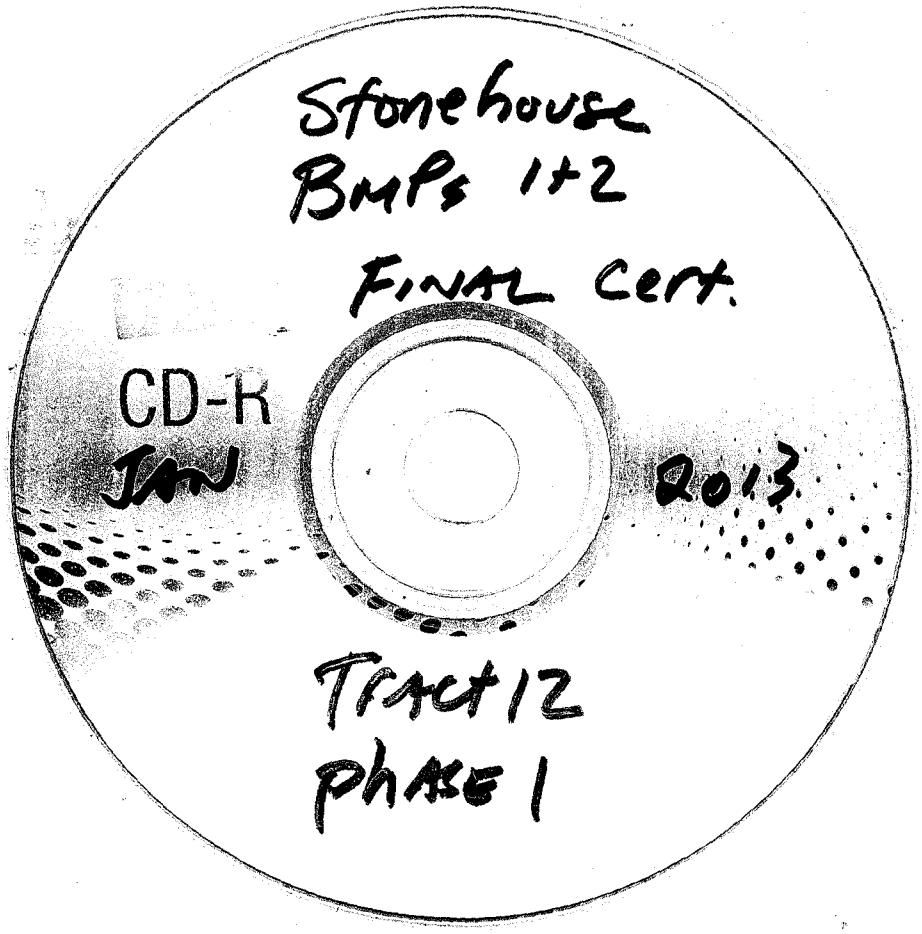
Stonehouse
BMPs 1+2
FINAL Cert.
CD-R
JAN
2013
TRACT 12
PHASE 1

WC107 & WC108

Prepared By and Return to: JCC Attorney's Office
101-C Mount's Bay Road
Williamsburg, VA 23185
(757) 253-6612

COUNTY OF JAMES CITY, VIRGINIA

DECLARATION OF COVENANTS
INSPECTION/MAINTENANCE OF DRAINAGE SYSTEM

Please type or print legibly in black ink. Covenantor(s) should submit this form to the JCC Environmental Division, 101-E Mounts Bay Road, Williamsburg, VA 23185.

THIS DECLARATION OF COVENANTS, made this 1st day of February, 20 11, between GS Stonehouse Green Land Sub, LLC, and all successors in interest, ("COVENANTOR(S)"), owner(s) of the following property:

Parcel Identification Number: 0540100014, 0530100021, and 0530100022
Legal Description: Residual Parcels R-1 12.8822 AC, R-2 44.38 AC, and R-3 5.29 AC of Stonehouse Glen, Sections 1 & 2
Project or Subdivision Name: Stonehouse Tract 12
Document/Instrument No. 060027006 or Deed Book _____, Page No. _____,
and the County of James City, Virginia ("COUNTY.")

WITNESSETH:

I (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 COVENANTOR(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, monitoring, 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 the 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 assess 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.

Instrument # 110006284

Recorded on March 11, 2011

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) has executed this DECLARATION OF COVENANTS as of the date first above written.

COVENANTOR(S)

David L Guy
Signature

DAVID L. GUY DEVELOPMENT MANAGER
Print Name and Title

ACKNOWLEDGMENT

COMMONWEALTH OF VIRGINIA
CITY/COUNTY OF James City, to wit:

I hereby certify that on this 1st day of February, 2011, before the subscribed, a Notary Public for the Commonwealth of Virginia, personally appeared David L. Guy and did acknowledge the foregoing instrument to be his/her Act.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 1st day of February, 2011.

KATHERINE C. HOLDEN COMMONWEALTH OF VIRGINIA NOTARY PUBLIC [SEAL]

Katherine C. Holden
Notary Public

Notary Registration Number: 197414
My Commission expires: 7/31/13

Approved as to form:

County Attorney

This Declaration of Covenants prepared by:

Signature: Print Name and Title: Katherine Holden, Proj. Administrator

Address: 129 Industrial Boulevard, Toano, VA 23168

Phone Number: 757-565-2885

Drainage1_pre_doc
(Revised 9-5-08)

TRANSMITTAL SHEET

ENGINEERING & RESOURCE PROTECTION → STORMWATER

Project: STONEHOUSE TRACT 12 PHASE 1

County Plan No. S-048-09

Assigned BMP No.: WC107, WC108

BMP Type: BIO-RETENTION ; WET ED BASIN

Information Enclosed:

- ☑ Record Drawings (Asbuilts)
- ☑ Construction Certification
- ☑ Computations
- ☐ Other :

Name: MIKE MAJDCSIK

Date: 1/23/13

Signature: [signature]

WSP · SELLS

15401 Weston Parkway, Suite 100
Cary, NC 27513
T: 919.678.0035
F: 919.678.0206
www.wspsells.com

LETTER OF TRANSMITTAL

DATE	October 12, 2012	
JOB NO.	08-4040	PROPOSAL NO.
ATTN:		
RE:	Stonehouse – Tract 12	
	As builts Phase 1	
	Case # S-0048-2009	

Environmental Division
OCT 15 2012

TO: Bill Cain, P.E.
James City County Engineering & Resource Protection
101-E Mounts Bay Road
Williamsburg, VA 23187-8784

WE ARE SENDING YOU [X] Attached [ ] Via FedEx [ ] Via Mail the following items:

RECEIVED

[ ] Shop Drawings [ ] Prints [ ] Plans [ ] Samples [ ] Specifications
[ ] Copy of Letter [ ] Change Order
[ ] Photographs [ ] Control Photographs [ ] Contact Prints [ ] Manuscripts [ ] Diskettes
[ ] Diapositives [X] See Below

COPIES	DATE	NO.	DESCRIPTION
1			Stonehouse – Tract 12 Phase 1 BMP Record Drawings (Review set)
1			BMP Certification and Record Drawing Checklist for BMP 1
1			BMP Certification and Record Drawing Checklist for BMP 2
1			Photo log
1			Copies of Geotech reports during construction

THESE ARE TRANSMITTED as checked below:

[ ] For approval
[ ] For your use
[ ] As requested
[X] For review and comment
[ ] Control survey required
[ ] See below remarks

[ ] Approved as submitted
[ ] Approved as noted
[ ] Return for corrections
[ ] For your records
[ ] Analytical aerial triangulation required
[ ] For review and comment

[ ] Resubmit _____ copies for approval
[ ] Submit _____ copies for distribution
[ ] Return corrected prints

[ ] FOR BIDS DUE _____ 20 ____ [ ] PRINTS RETURNED AFTER LOAN TO US

REMARKS

Bill,

Per our meeting last week, please find enclosed the above items for you to make your final inspection for the 2 BMPs in phase 1 of Tract 12. Once everything is finalized please let me know of any comments and we can finalize record drawings and send up electronic and mylar copies for your files.

COPY TO: Mike Etchemendy – Stonehouse Green
Mike Nice – George Nice & Sons

SIGNED: Ed Tang, PE

Ed Tang

000351

00076

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Form ID No. 0215

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Company WSP/SELLS

Address 15401 WESTON PKWY STE 100 Dept./Floor/Suite/Room

City CARY State NC ZIP 27513-8637

2 Your Internal Billing Reference 08 4040

3 To

Recipient's Name Bill Cain, PE Phone 757 253-6702

Company James City County Engineering + Resource Protection

Address 101-E Mounts Bay Road

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HOLD Saturday FedEx location address REQUIRED. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations. ☐

Address

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City Williamsburg State VA ZIP 23187

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8003 4696 4214

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2 or 3 Business Days

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- ☐ FedEx 2Day — Second business afternoon.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☐ FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

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☐ Indirect Signature — If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only. *Fee applies.*

Does this shipment contain dangerous goods? One box must be checked.

☒ No ☐ Yes As per attached Shipper's Declaration. ☐ Yes Shipper's Declaration not required. ☐ Dry Ice Dry Ice, 9, UN 1845 ____ x ____ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box. ☐ Cargo Aircraft Only

7 Payment *Bill to:*

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☒ Sender Acct. No. in Section 1 will be billed. ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

[redacted]

Total Packages 1 Total Weight 2 lbs. Credit Card Auth.

†Our liability is limited to $100 unless you declare a higher value. See the current FedEx Service Guide for details.

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Environmental Division

OCT 15 2012

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 - TRACT 12 (PHASE 1)
Structure/BMP Name: BMP 2
Project Location: LYTHAM CT.
BMP Location: COMMON OPEN SPACE 4
County Plan No.: S - 0048 - 2009

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

Tax Map/Parcel No.: 0540700001B
BMP ID Code (if known): 2
Zoning District:: PUD-R
Land Use: RESIDENTIAL
Site Area (sf or acres): 1.72 AC (DRAINAGE AREA)

Brief Description of Stormwater Management/BMP Facility:

BIO RETENTION POND (WET ED W/FOREBAY) K/C 108

Nearest Visible Landmark to SWM/BMP Facility: FIELDSTONE PKWY + STONEHOUSE GLEN

Nearest Vertical Ground Control (if known):
☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☒ Other NGVD 27
Station Number or Name: TOANO 2
Datum or Reference Elevation: NAD83/86, NGVD 27, EL 108.14
Control Description: CONCRETE MONUMENT
Control Location from Subject Facility: INTX RTE 60 + RTE 30

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: MAY 2011
Facility Monitored by County Representative during Construction: ☒ Yes ☐ No ☐ Unknown
Name of Site Work Contractor Who Constructed Facility: GEORGE NICE + SONS
Name of Professional Firm Who Routinely Monitored Construction: GET SOLUTIONS | FERR ENVIRONMENTAL | WSP SELLS
Date of Completion for SWM/BMP Facility: AUG. 2012
Date of Record Drawing/Construction Certification Submittal: _____

(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: G.S. STONEHOUSE GREEN LAND SUB LLC.
Mailing Address: 11950 DEMOCRACY DR
RESTON, VA 20190
Business Phone: 703-437-8800 Fax: _____
Contact Person: MIKE ETCHEMENDY Title: DEV. MGR

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: WSP SELLS
Mailing Address: 15401 WESTON PKWY
CARY NC 27513
Business Phone: 919-678.0035
Fax: 919.678.0206
Responsible Plan Preparer: CRAIG DUERR, PE
Title: PROJ. MGR
Plan Name: STONEHOUSE TRACT 12
Firm's Project No. 08-4051
Plan Date: AUG. 18, 2010
Sheet No.'s Applicable to SWM/BMP Facility: C4.3 / C5.1 / ____ / ____ / ____

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

Name: GEORGE NICE + SONS
Mailing Address: 129 INDUSTRIAL BLVD
TOANO VA 23168
Business Phone: 757-565-2885
Fax: 757-565-1526
Contact Person: MIKE NICE, P.E.
Site Foreman/Supervisor: "
Specialty Subcontractors & Purpose (for BMP Construction Only):

NONE

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: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC 27513
Business Phone: 919 678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
PROFESSIONAL ENGINEER

_____ (Seal)

Virginia Registered Professional Engineer or Certified Land Surveyor

Construction Certification

Firm Name: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC 27513
Business Phone: 919-678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
PROFESSIONAL ENGINEER

_____ (Seal)

Virginia Registered Professional Engineer

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

mike N. date?

- ☐ 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.)*

✓ 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.

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

✓ 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).

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

✓ 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.)*

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

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

✓ 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.

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

✓ 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.

✓ 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.

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

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

✓ 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.

✓ 10. Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.

✓ 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.**

✓ 14. Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.

✓ 15. Outlet barrel diameter, length, slope, type and thickness class of material and type of flared end sections, headwall or endwall.

✓ 16. Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.

✓ 17. BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.

✓ 18. Maintenance plan taken from approved design plan transposed onto record drawing set.

NA 19. Fencing location and type, if applicable to facility.

✓ 20. BMP vicinity properly cleaned of stockpiles and construction debris.

✓ 21. No visual signs of erosion or channel degradation immediately downstream of facility.

✓ 22. Any other information formally requested by the Environmental Division specific to the constructed SWM/BMP facility.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

BMP #2

(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)*

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

✓ D2. Sediment pretreatment devices provided.

✓ 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.

✓ 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.

✓ 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. (was cleaned out)

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

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

✓ D8. Overflow outlet has adequate erosion protection.

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

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

✓ 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.

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

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

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

Environmental Division

OCT 15 2012

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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.)

Section 1 - Site Information:

Project Name: STONEHOUSE - TRACT 12 (PHASE 1)
Structure/BMP Name: BMP 1
Project Location: LYTHAM CT (BEHIND LOTS 47-48)
BMP Location: " "
County Plan No.: S - 0048 - 2009

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

Tax Map/Parcel No.: 0540700001A
BMP ID Code (if known): 1
Zoning District:: PUD-R
Land Use: RESIDENTIAL
Site Area (sf or acres): 1.91 AC (DRAINAGE AREA)

Brief Description of Stormwater Management/BMP Facility:

WET EXTENDED DETENTION POND

Nearest Visible Landmark to SWM/BMP Facility: FIELDSTONE PKWY + STONEHOUSE GLEN

Nearest Vertical Ground Control (if known):
☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☒ Other NGVD27
Station Number or Name: TOANO 2
Datum or Reference Elevation: NAD 83 / 86, NGVD 27, EL 188.14
Control Description: CONCRETE MONUMENT
Control Location from Subject Facility: INTX RTE 60, RTE 30

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: MAY 2011
Facility Monitored by County Representative during Construction: ☒ Yes ☐ No ☐ Unknown
Name of Site Work Contractor Who Constructed Facility: GEORGE NICE + SONS
Name of Professional Firm Who Routinely Monitored Construction: GET SOLUTIONS | KERR ENVIRONMENTAL | WSP SELLS
Date of Completion for SWM/BMP Facility: AUG. 2012
Date of Record Drawing/Construction Certification Submittal: _____

(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: G.S. STONEHOUSE GREEN LAND SUB LLC.
Mailing Address: 11950 DEMOCRACY DR
RESTON, VA 20190
Business Phone: 703-437-8800 Fax: _____
Contact Person: MIKE ETCHEMENDY Title: DEV. MGR

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: WSP SELLS
Mailing Address: 15401 WESTON PKWY
CARY NC 27513
Business Phone: 919-678-0035
Fax: 919-678-0206
Responsible Plan Preparer: CRAIG DUERR, P.E
Title: PROJECT MGR.
Plan Name: STONEHOUSE TRACT 12
Firm's Project No. 08-4051
Plan Date: AUG 18, 2010
Sheet No.'s Applicable to SWM/BMP Facility: C4.3 / C5.0 / C6.0 / ____ / ____

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

Name: GEORGE NICE + SONS
Mailing Address: 129 INDUSTRIAL BLVD.
TOANO, VA 23168
Business Phone: 757-565-2885
Fax: 757-565-1526
Contact Person: MIKE NICE, P.E.
Site Foreman/Supervisor: "
Specialty Subcontractors & Purpose (for BMP Construction Only):

NONE

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: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC, 27513
Business Phone: 919 678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
PROFESSIONAL ENGINEER

_____ (Seal)

Virginia Registered Professional Engineer or Certified Land Surveyor

Construction Certification

Firm Name: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC 27513
Business Phone: 919 678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
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.)*

✓ 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.

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

✓ 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).

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

✓ 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.)*

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

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

✓ 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.

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

✓ 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.

✓ 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.

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

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

✓ 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.

✓ 10. Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.

✓ 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.

✓ 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.**

✓ 13. Top of impervious core embankment, core trench limits and elevation of cut-off trench bottom. **May need to obtain this information during construction.**

✓ 14. Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.

✓ 15. Outlet barrel diameter, length, slope, type and thickness class of material and type of flared end sections, headwall or endwall.

✓ 16. Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.

____ 17. BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.

✓ 18. Maintenance plan taken from approved design plan transposed onto record drawing set.

NA 19. Fencing location and type, if applicable to facility.

✓ 20. BMP vicinity properly cleaned of stockpiles and construction debris.

✓ 21. No visual signs of erosion or channel degradation immediately downstream of facility.

✓ 22. Any other information formally requested by the Environmental Division specific to the constructed SWM/BMP facility.

BMP #1

(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.)*

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

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

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

✓ 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.

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

N/A 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.

✓ 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).

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

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

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

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

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

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

James City County Engineering and Resource Protection Division
Stormwater Management/BMP Record Drawing and Construction Certification Review Tracking Form

Project Name: STONEHOUSE TRACK 12, PHASE 1
County Plan No. (List any amendments): S-048-09
Stormwater Management Facility Type: WET EXTENDED DETENTION, BIORETENTION
BMP Phase #: ☐ I ☐ II ☑ III

- ☒ Information Package Submittal Date: OCTOBER 15, 2012
- ☒ Completeness Check:
  - ☒ Record Drawing Date/By: 10/15/12 WAC
  - ☒ Construction Certification Date/By: 10/15/12 WAC
  - ☒ RD/CC Standard Forms (Ensure that all forms for the BMP type are included)
  - ☒ Insp/Maint Agreement ● # / Date: 10/12/12
  - ☒ BMP Maintenance Plan ● Location: C5.3 (SEE AS-BUILT)
  - ☒ Special Considerations: N/A
- ☒ Standard E&SC Notes on Approved Plan Requiring RD/CC or County comment in plan review Location (sheet #): ● C3.1
- ☒ **County BMP ID Code #:** WC 108 (WET ED), WC 107 (BIO)
- ☑ Log into Division's "As-Built Tracking Log"
- ☑ Obtain basic site information (GPIN, Owner, Address, etc.)
- ☑ Log into Access Database (BMP ID #, Plan No., GPIN, Project Name, etc.)
- ☑ Copy from Active Project File (correspondence, H&H, design computations, etc.).
- ☑ Create As-Built File using Project File information (File label, folder, copy plan/details/design information, etc.).
- ☑ Inspector Review of RD/CC (consult with Chief Engineer prior to completion of comments).
- ☑ Record Drawing Review against Approved Plan prior to Field Inspection.
- ☑ Final Site Inspection (FI) Performed Date: 10/18/12 WAC/MM
- ☑ Record Drawing (RD) Review Date: 10/15/12 WAC
- ☑ Construction Certification (CC) Review Date: 10/15/12 WAC
- ☑ Actions:
  - ☐ No comments.
  - ☑ Comments. Letter Forwarded. Date: 10/12 WAC
  - ☑ Record Drawing (RD)
  - ☑ Construction Certification (CC)
  - ☑ Construction-Related (CR)
  - ☐ Site Issues (SI)
  - ☐ Other :
- ☑ Resubmittal (# and date): 01/13 WAC - ALL ITEMS ADDRESSED
- ☑ Re-inspection (if necessary): 01/13 WAC - ALL ITEMS ADDRESSED
- ☑ Drainage System Information Acceptable (RD/CC/System Info). Ok for bond release.
- ☑ Complete "Surety Request Form".
- ☑ Final Inspection of active file copying any relevant information to "As-Built" file.
- ☑ On County BMP Inventory (Phase I, II or III).
- ☑ Copy Final Inspection Report into County BMP Inspection Program file.
- ☑ Provide Digital Photographs of BMP and save into County BMP Inventory.
- ☑ Request mylar/reproducible from As-Built plan preparer.
- ☑ Complete "As-built Tracking Log".
- ☑ Last check of BMP Access Database (County BMP Inventory).
- ☑ Add BMP to JCC Hydrology & Hydraulic database (optional). N/A
- ☑ Add BMP to Municipal BMP list (if a County-owned facility) N/A
- ☑ Add BMP to PRIDE BMP ratings database. N/A

Final Sign-Off

Inspector: [signature] Date: 1/23/13

Chief Engineer: [signature] Date: 1/23/13

*** See separate checklist, if needed.

115 PLANTATION
ROAD

STONEHOUSE
Tract 12

James City County, Virginia

Stormwater Management and Drainage Design Report

Date: August 17, 2009
March 17, 2010 (REVISED)

Environmental Division
MAR 22 2010
RECEIVED

COMMONWEALTH OF VIRGINIA
CRAIG MICHAEL DUERR
No. 046357
PROFESSIONAL ENGINEER
3/17/10

Prepared by:

WSP • SELLS

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Cary, North Carolina 27513
(919) 678-0035
(919) 678-0206 (Fax)

Craig M. Duerr, PE

SELLS Project Number 08-4051

STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT

Stonehouse – Tract 12

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Stormwater Management Plan – Stonehouse Tract 12

A Conceptual Tract Stormwater Management Plan was previously submitted to satisfy Proffer 10.2 of the approved rezoning for the Stonehouse PUD (designated on the January 2008 Stonehouse Master Plan). This report provides updates and design criteria based on the construction drawings prepared for the proposed subdivision.

Background information relating to the development of a site-wide stormwater management concept plan has been previously provided to James City County (JCC) as part of the January 2008 Rezoning and Master Plan Application for Stonehouse. Sections 6 and 7 include the Analysis of Environmental Impacts – Environmental Inventory, and the Stonehouse PUD Analysis of Stormwater Management, respectively.

Stormwater Narrative

Plans for proposed structural Best Management Practices (BMPs) are included with the subdivision submittal. A wetland/ stream delineation, topographic survey, and geotechnical investigation have been incorporated as part of the construction drawings. Pre-submittal meetings with the JCC Environmental Division and site visits have created a cooperative design and review process. The "Erosion and Sediment Control Plan" and "Stormwater Management Design Plan" checklists are included in the submittal.

In evaluating stormwater management solutions for the site, unique characteristics were considered such as avoidance of Chesapeake Bay Preservation Area (CBPA) Resource Protection Areas (RPA), non-RPA wetlands, and other environmentally sensitive areas that permitting and cost alone might render impractical and improbable. Preliminary observations and mapping identify the following to be considered in stormwater management planning:

- Project Description: Tract 12 is proposed to be a single family development comprising 57 homes adjacent to the existing Stonehouse Glen development. Two access points from Fieldstone Parkway and one access point from Stonehouse Glen are proposed to create connectivity to public streets and individual driveways within each section of the site. Approx. 11.77 acres of land disturbance activity is proposed for this phase of infrastructure development.

- Existing Site Conditions: Tract 12 is currently a 62.49-acre, densely vegetated, undeveloped tract with a vast amount of tree cover dominating the entire site. Approx. 21.43 acres of wetlands, streams, and RPA buffer exist along the north, west, and east ends of the site including 2 features that extend into the site and separate the parcel into 3 development areas. No regulatory floodplains exist on-site. Two existing dry ponds (BMP#3A and BMP#3D) and one stormwater outfall structure are located on-site for runoff from Fieldstone Parkway. A multi-purpose pedestrian path exists to the south along Fieldstone Parkway.

- Adjacent and Off-Site Areas: Tract 12 is located north of Fieldstone Parkway. To the east are Amenity H and Six Mt. Zion Road (Route 600). To the west is an existing JCSA water storage facility and Land Bay 8, which is a proposed townhouse community. To the north is the existing Stonehouse Glen single family residential development. To the south across Fieldstone Parkway is Tracts 10A and 10B, which are undeveloped, moderately vegetated areas for

future commercial development. Off-site improvements for landscaping along Fieldstone Parkway and extension of a gravity sewer outfall with an aerial crossing of the stream feature to an existing pump station are also proposed.

- Soils Description: The James City County soils survey indicates that Craven-Uchee Complex soils with 6% to 10% slopes are the primary soils within the development areas. These soils are moderately well drained and are classified as hydrologic soil group "C" with moderate shrink/swell potential, high erodibility potential, slow permeability, and seasonal high water table of 30 inches. Emporia Complex soils with 25% to 50% slopes are the other primary soils that exist on site within the predominantly undeveloped areas. These soils are well drained and are classified as hydrologic soil group "C" with moderate shrink/swell potential, high erodibility potential, slow permeability, and depth to seasonal high water table of 45 inches. Other small areas of the site include Craven, Emporia, Norfolk, and Slagle fine sandy loam along Fieldstone Parkway.

- Critical Areas: Tract 12 includes area of potentially erosive soils. Special consideration has been given to provide enhanced outlet protection measures including stilling basins at outfalls and rip rap beyond the required limits of the dissipater pads. Some impacts to the RPA buffer are proposed associated with BMP and gravity sewer outfalls. Special consideration has been given to the proposed off-site gravity sewer outfall routing to avoid steep slopes on the east bank of the existing stream and wetland feature. Refer to Sheet C1.0 - Environmental Inventory Plan for additional information.

Compliance with 10-Point System

The stormwater management plan utilizes several BMPs including proposed wet extended detention ponds and bioretention devices within coving areas, as wells as several existing grass swales and existing dry extended detention basins as follows:

- BMP#1 – Proposed wet extended detention pond (10-pt) for treatment of approx. 1.91 acres from Lots 45-49, a portion of the proposed subdivision street, and overflow from BMP#2;
- BMP#2 – Proposed bioretention area (10-pt) for treatment of approx. 1.72 acres from Lots 39-45 and a portion of the proposed subdivision street to convey to BMP#1 in series (50% credit);
- BMP #3A – Existing dry extended detention basin (4-pt) for treatment of approx. 2.18 acres from Lots 38, 43-46 and off-site run-off from Fieldstone Parkway;
- BMP #3B – Existing dry extended detention basin (4-pt) for treatment of approx. 1.07 acres from Lots 49-51 and run-off from Stonehouse Glen (off-site excluded from BMP 10-Point System calculations); ;
- BMP #3C – Existing dry extended detention basin (4-pt) for treatment of approx. 1.14 acres from Lots 39-43 and run-off from Stonehouse Glen (off-site excluded from BMP 10-Point System calculations); ;
- BMP #3D – Existing dry extended detention basin(4-pt) for treatment of approx. 0.56 acres from the undeveloped portion of the site and run-off from Fieldstone Parkway (off-site excluded from BMP 10-Point System calculations);

- BMP#4 – Proposed wet extended detention pond (10-pt) for treatment of approx. 2.51 acres from Lots 20-24, Lots 31-32, a portion of the proposed subdivision street, and overflow from BMPs #5 and #6;
- BMP#5 – Proposed bioretention area (10-pt) for treatment of approx. 1.89 acres from Lot 19, Lots 36-37, and a portion of the proposed subdivision street to convey to BMP#4 in series (50% credit);
- BMP#6 – Proposed bioretention area (10-pt) for treatment of approx. 1.27 acres from Lots 25-30, a portion of the proposed subdivision street to convey to BMP#4 in series (50% credit);
- BMP#7 – Proposed wet extended detention pond (10-pt) for treatment of approx. 2.36 acres from Lots 1-3, Lots 14-18, and a portion of the proposed subdivision street;
- BMP#8 – Proposed wet extended detention pond (10-pt) for treatment of approx. 1.46 acres from Lots 5-8, a portion of the proposed subdivision street, and overflow from BMP#9; and,
- BMP#9 – Proposed bioretention area (10-pt) for treatment of approx. 1.21 acres from Lot 4, Lots 7-11, and a portion of the proposed subdivision street to convey to BMP#8 in series (50% credit).

Based on site topographic constraints, runoff from the rear of Lots 7-18, 26-31, 32-34, and 52-57 will sheetflow into the 25' RPA Building Setback and 100' RPA buffer without structural BMPs. Refer to the "Worksheet for BMP Point System" and "Stormwater Management / BMP Facility Calculations" in the Appendices for more information.

Other contributing elements of the 10-point system include the following:

- Resource Protection Area (RPA) – Approx. 21.43 acres of wetlands, streams, and 100' RPA buffers exist to the west of Bird Swamp, to the north at the rear of lots and between developed portions of the site, and to the east of Stonehouse Glen. Approx. 0.88 acres of disturbed areas for existing BMPs and approx. 0.32 acres of impacts for the proposed gravity sewer and BMP storm drain outfalls are excluded from the 10-point system calculations.
- Undisturbed Natural Open Space – Approx. 31.49 acres of conservation easements are proposed including the above RPA less impacts and disturbed areas for areas adjacent to RPA. In addition, approx. 7.04 acres of common open space is proposed for stormwater management facilities and the right-of-way buffers. Other stormwater management elements excluded from the 10-point system calculations include the following:
- Grass Swales – Improvements to existing natural channels and grass swales are proposed to convey approx. 1.50 acres of run-off (rather than closed pipe systems) from Lots 46-47 to BMP#1, Lot 38 and Lots 43-35 to existing BMP#3A, Lots 49-51 to existing BMP#3B, and Lots 35-37 to BMP#5.
- RPA Mitigation - Approx. 5.97-acres of common area open space along Fieldstone Parkway and surrounding the existing BMPs will be improved with landscaping to stabilized denuded areas adjacent to the RPA.

Based on site inspections and review of original design plans prepared by Landmark Design Group, the post development drainage areas contributing to the existing BMPs is consistent with the pre-development drainage areas. As such, use of these stormwater management facilities should be acceptable. Applicable soil erosion and sediment control measures will be installed during construction. In addition, improvements to the forebay for existing BMP#3A have been identified on the plans.

Storm Drainage and Erosion Control

The proposed storm drainage system includes catch basins, yard inlets, and reinforced concrete piping designed to carry the 10-year storm in accordance with applicable JCC guidelines. The design of the closed storm drain systems associated with the collection of runoff from roadways and other impervious surfaces has been minimized, where applicable, in accordance with Better Site Design guidelines. Refer to the plans and "Storm Drainage System Calculations" in the Appendices for more detailed information.

Several temporary sediment basins and traps (to be converted to BMPs) are proposed to provide erosion and sediment control. Other proposed devices include temporary diversions and slope drains, inlet protection, silt fencing, stormwater conveyance channels, and rip rap basins. All measures have been designed in accordance with the VADCR Erosion and Sediment Control Manual in order to convey and treat sediment laden runoff during the construction. Construction sequences to identify the appropriate process for conversion of devices and a maintenance plan to outline inspection frequency and maintenance requirements have been prepared.

In addition, improvements to the receiving channels at the storm drain outfalls from BMPs #1, #4, #7, and #8 are proposed to provide enhance outlet protection. Refer to the plans for design specifications of erosion and sediment control devices including sediment basins, swales, matting, and rip rap stilling basins.

Significant Design Considerations Checklist

Based on review of previous submittals, discussions with JCC Environmental Division, meetings with Stonehouse HOA, and review of applicable guidelines, the following design considerations and lessons learned will be applied to stormwater management:

1. *The 1-year, 24-hour channel protection volume will be detained entirely within the upstream stormwater devices and released over 24 hours. As a result, all sections of the downstream channels will be protected from erosion. James City County requires 24-hour attenuation of the volume of runoff generated from the 1-year storm. Using the Kerplunk method, basins will be designed to contain the resulting volume then will be dewatered. If it takes 24 hours, but less than 48, design will be acceptable.*

Compliance with this consideration is reflected in the BMP design.

2. *Stormwater outfalls as they relate to channel adequacy or the existence of a channel will be addressed. In order to reduce the risk of scour and ensuing head cuts outfalls will be field verified using field run survey below outfalls to confirm the existence of a natural channel meeting the definitions contained in the Virginia Erosion and Sediment Control Handbook and the Virginia Stormwater Management Handbook.*

Compliance with this consideration is reflected in BMP design.

3. *The issue of nutrient loading, with specific interest given to phosphorous and nitrogen, is accounted for in the 10-point requirement computation. Removal rates, efficiencies, and target pollutants were accounted for when considering the type of basins to include in the James City County Guidelines for Design and Construction of Stormwater Management BMPs. A nutrient management program will be implemented as required.*

Compliance with this consideration will be included through compliance with Stonehouse Proffer 10.9 and development of a Nutrient Management Program.

4. *In accordance with Appendix F of the James City County Guidelines for Design and Construction of Stormwater Management BMPs, the proposed marina will be considered a stormwater hotspot. Certain types of BMPs will not be allowed at this location. During review of specific site plans, additional areas of interest will be identified for the County to verify the existence of any hotspots for which special stormwater management needs apply.*

This site is not related to the proposed marina. The County has not identified any portion of this site as an area of interest for hotspot consideration.

5. *Within the 10-point requirement, point values are small for open space and areas used for stormwater management points must be dedicated, by easement, to James City County and be in a natural undisturbed state. There cannot be any overlying easements (drainage, utility, access, etc.).*

Compliance with this consideration is reflected in the BMP design.

6. *Infiltration systems will be utilized in areas where soil conditions allow for proper design and the discharge passes through some sort of a treatment device for quality purposes. CONTECH-type systems in combination with a filter device or natural sand filter are preferred. The main issues here are that the soils in certain places in the Stonehouse area are vertical and highly erosive. These systems will be proposed away from the steeper slopes (to prevent sloughing) in combination with geotechnical advice. Areas of Hydrologic Soil Group A&B will be targeted throughout the site and evaluated to determine if infiltration is appropriate. Use of infiltration will be contingent upon approval by the James City County Environmental Division.*

Use of bioretention areas to promote infiltration is proposed in areas where available soils mapping indicate HSG type B soils may be present and field geotechnical investigations have confirmed infiltration rates of greater than 0.52 in/hr. Dry swales are located at the rear of lots where longitudal slopes are less than 5% to capture runoff associated with lot-to-lot drainage. Bioretention areas are located in cul-de-sacs and coving areas.

7. *Depressed vegetated open space within traffic islands and medians and the use of more "coving" in place of cul de sacs will be used to promote the application of a Filterra-type system to provide quality treatment for small (less than 0.5 acre) areas within neighborhoods. This form of bioretention provides good water quality performance and is considered easier to maintain than similar systems designed and constructed in the field. There is no benefit in terms of attenuation, and additional BMPs will be necessary to achieve stormwater management goals. This will be applied within disconnected section of roadway at the interior extents of residential development. Traditional cul-de-sac design will be used in areas where limitations of space or other design constraints do not allow coving.*

Bioretention areas are proposed for several depressed vegetated open space areas within proposed cul-de-sacs and coving areas to provide enhanced water quality performance. Larger storm events will by-pass bioretention areas and be conveyed to proposed wet ponds to provide adequate detention. Use of a Filterra-type system was cost prohibitive for this development.

8. *Portions of the site are within the detailed and approximate flood hazard areas identified on the Flood Insurance Rate Map issued by the Federal Emergency Management Agency (FEMA). Where required by the County floodplain overlay district in the zoning ordinance and by FEMA as part of the National Flood Insurance Program Regulations, flood studies will be developed to evaluate impacts on base flood elevations and delineations. This will include the appropriate actions from a processing perspective in the event a conditional letter of map revision or letter of map revision is required to reflect impacts. Specifically, detailed hydraulic analyses of stream crossings will be provided to document sizing procedures.*

This site is shown on FIRM number 51095C0045C, dated September 28, 2007. The nearest downstream regulatory Special Flood Hazard Area is the Zone A along Bird Swamp. It is expected there will be no contributing impacts to water quantity on that Zone A.

9. *The non-binding illustrative plan identifies amenities. These amenities provide for low impact recreational and historical uses. For amenities located within wetlands, RPA and/or RPA buffer areas, development beyond the establishment of walking trails and posting of informational signs will be limited. For water amenities, there is the potential for canoe style boat launches. If proposed, appropriate permitting procedures will be followed. For sections of recreational trails passing through wetlands, elevated boardwalk sections will be used to minimize impacts. At this time, the exact use of each identified amenity has not been established. Preliminary uses are listed in the table on the illustrative plan.*

This site does not include any amenity features.

10. *Crossings as proposed between Tracts 1 and 4 and 7 and 8 may be very difficult from a permitting perspective. It is understood that permitting of wetland and RPA road crossings will not be easy and that design and cost considerations should take into account stringent requirements for minimizing and mitigating impacts to wetlands and RPAs.*

There are two areas of RPA that essentially cut the site in thirds. Original plans called for a single linear road network across the entire site parallel to fieldstone Parkway. After review of this design consideration, the plan have been revised to reflect avoidance of significant stream and RPA crossings.

11. *At this time there is no information about existing farm ponds within the development area. Consideration will be given to using these if appropriate but based on the historical uses of the land it is not expected any farm ponds will be sited in locations of stormwater management interest.*

There are no farm ponds on this site.

12. *Structural BMP point credit associated with Richardson Mill Pond (County BMP ID Code: WC059) from contributing areas associated with this land plan will not be allowed beyond the natural topographical divide at Six Mount Zion Road (State Route 600). One of the project goals is to provide both water quantity and quality treatment within the development areas draining to Richardson Mill Pond in order to avoid utilizing the pond as a BMP.*

The plan proposes to meet all requirements for quality and quantity control on site and not to utilize Richardson Mill Pond for water quality.

13. *Steep slope areas have been identified based on County GIS data and protection and avoidance of steep slopes, consistent with Section 23-5 of the County's Chesapeake Bay Preservation ordinance, will be a priority within the project area. This information will be field verified throughout the project as field surveys advance through tract by tract. Additionally, the information will be used to establish lot layout to avoid environmentally sensitive areas and take the responsibility of avoidance from individual builders/contractors.*

No steep slopes will be impacted for this development based on review of the field topographic survey with the exception of areas required for the BMPs and

gravity sewer outfall. Further, the application of Proffer 10.5 providing an addition 25' building setback from the RPA buffer, along with our general approach of using an extended RPA buffer to support required open space, contribute to this mitigation.

14. *Uncontrolled drainage not conveyed to a stormwater management/BMP facility will be subject to the provisions of Minimum Standard #19 of the Virginia Erosion and Sediment Control regulations. Such discharges will outfall into an adequate, well-defined bed and natural bank receiving natural or man-made systems. If systems are not adequate other measures will be required. These might include flow reduction, channel improvements, detention, and/or a combination as necessary. Lot to lot drainage will be handled in design of grading plans and the responsibility of designing and constructing these drainage systems will not placed on builders. This includes the design of any conveyance outfalls.*

Compliance with this consideration is reflected in the grading plans. Drainage easements have been provided to convey lot-to-lot drainage to the swales. Runoff from the rear of some of the lots will sheet flow to dedicated undisturbed open space conservation easements and the RPA.

15. *For the use of regional ponds as BMPs, it is understood that permitting with the state agencies and obtaining approval from the local board is a very timely process and there are no guarantees. It is not likely that the stormwater management plan will include the identification of a regional BMP within the proposed development area.*

No regional BMPs are proposed for this development.

16. *Reduction in disturbance of Hydrologic Soil Group (HSG) A&B soils areas and/or utilization of HSG A&B soil areas for infiltration purposes will be examined closely during master stormwater management plan, concept plan and plan of development submittals. Special Stormwater Criteria (SSC) in James City County will be used as a reference in preparing plans that address impacts to HSG A&B soils. Specifically, Table SSC-2 will be used to evaluate practices that result in unit measures to offset impacts. Areas of HSG A&B soils have been identified based on GIS data. These areas will be further investigated and delineated as development moves forward. There are no watershed management plans approved by James City County for the Ware Creek (Richardson Mill Pond), Ware Creek, or York River (direct) watersheds. Therefore, the Stonehouse site does not meet the requirements of SSC Type 1. The December 14, 2004 SSC document will be used as a reference in preparing plans that address impacts to HSG A&B soils. Specifically, at the site and subdivision plan stage development activities and proposed impacts to RPAs will be identified and a determination will be approved by James City County in terms of the application of SSC through the variance process (Type 2).*

Compliance with this consideration has been included through compliance with Stonehouse Proffer 10.1.

Additionally, through the Rezoning of this property, a series of Proffers was developed that relate to environmental considerations as follows:

10.1: Special Stormwater Criteria Compliance:

Compliance with this proffer is explained in detail later in this plan.

10.2: Conceptual Tract Master Stormwater Management Plans:

Compliance with this proffer has been previously satisfied.

10.3: Stormwater Management Inventory System:

Compliance with this proffer is ongoing. A beta version has been submitted to the County for review.

10.4: Easement Granting:

Areas for easement dedication have been identified on the plans.

10.5: RPA Building Setback:

RBP Building Setbacks have been identified on the plans.

10.6: LID Education Center:

Compliance with this proffer is not related to development of this site.

10.7: Cistern:

Compliance with this proffer is not related to development of this site.

10.8: Natural Resource Policy:

A Natural Resource Inventory has been submitted to the County for review. Approval is required prior to land disturbance for compliance with this proffer.

10.9: Nutrient Management Plan:

A Nutrient Management Plan shall be submitted to the County for review and approval prior to issuance of building permits for more than 25% of the units for compliance with this proffer.

10.10: LEED Certification for Amenity Center:

Compliance with this proffer is not related to development of this site.

10.11: Water Quality Monitoring:

Compliance with this proffer has been achieved through a one-time monetary contribution from the Developer to the County.

Special Stormwater Criteria Compliance Checklist

Stonehouse Proffer 10.1 states that the Property shall be subject to the County's Special Stormwater Criteria (SSC) as a SSC Type 1 as if the Ware Creek Watershed was subject to a management plan adopted by the Board of Supervisors so long as the SSC continue to be applicable to the Powhatan and Yarmouth Creek Watersheds or are generally applicable in the County. If the County repeals its SSC program, the Owner shall no longer be bound by this Proffer. The County acknowledges and agrees to SSC Units for the following:

1. Stormwater Management Inventory System identified as Proffer 10.3 qualifies for 1 SSC Unit per Tract under SSCP#22
2. Additional 25 foot building setback from RPA identified as Proffer 10.5 qualifies for 1 SSC Unit per Tract under SSCP#23
3. Provision of as-built drawings for the entire storm drainage system, included in Proffer 10.1, qualifies for ½ SSC Unit per Tract under SSCP#39

The following process, based on the SSC document dated December 14, 2004, is applied to confirm compliance with SSC through the conceptual site planning and stormwater management for development plans:

1. Step 1 is to identify the status of any existing Watershed Management Plan (WMP) including the proposed development area. Stonehouse is within the Ware Creek Watershed. Although there is not an approved WMP for this watershed the site is treated as SSC Type 1 as defined by Proffer 10.1.
2. Step 2 is to identify Variance Determination. This does not apply.
3. Step 3 is to compile an inventory of soils. Mapping has been prepared and submitted to James City County as part of the Environmental Inventory in support of the Rezoning Application. Additionally, soils information has been provided by James City County.
4. Step 4 is to determine extent of HSG A and B soils within the limits of disturbance. Although the SSC document only states that HSG A and B soils are of concern, it is understood that the County prefers HSG 11C soils to be considered highly erodable. Mapping in support of this Plan provides a qualifier in advance of geotechnical investigation concerning the appropriateness of proposing infiltration in concept. Limits of disturbance and impacts to existing HSG A and B (and 11C) soils will be clearly defined in advance of site plan submittal. Based on a review of the mapping there is a substantial amount of these soils within the site.
5. Step 5 is to evaluate option to save all HSG A and B (and 11C) soils. This will not apply to this site.
6. Step 6 is to apply SSC Measures.

Following this procedure, Table SSC-1 is used to determine required number of unit measures.

Proposed Disturbed Area = 11.77 acres (approx. 20 acres at build-out of project)

Measures = 5 unit measures based on SSC Class 4 Designation for 10-50 acres of disturbed area

Table SSC-2 is used to determine action plan to comply.

Proffered Measures:

SSCP#22 = 1 unit

SSCP#23 = 1 unit

SSCP#39 = ½ unit

TOTAL = 2 ½ units

Remaining Require Measures = 2.5 units

Proposed Measures:

SSCP#20: Enhanced Outlet Protection = 1 unit

Rip rap stilling basins will be provided at the outfall of each proposed wet pond BMPs to mitigate against conditions witnessed at other existing BMPs in the County related to location and design of outfalls.

SSCP#25: Enhanced Slope Stabilization = 1 unit

EC-2 matting will be applied to fill slopes up to 3:1 and cut slopes up to 2:1 slopes. EC-3 matting (TRM) will be applied to fill slopes up to 2:1 associated with the proposed BMPs.

SSCP#28: Enhanced Channel Stabilization = 1 unit

EC-3 matting (TRM) applied to proposed drainage channels. All matting shall be non-degradable.

BMP Operation and Maintenance Plan

Proper maintenance of stormwater management BMP facilities is encouraged to prevent the introduction of debris and sediment into the facility, spillway(s), and downstream waterways. Following installation of the facility and establishment of vegetation in disturbed areas, inspection for sediment buildups will be performed at least quarterly. It is anticipated that under normal conditions, sediment removal from the facility will be required once every 10 years. If other construction or related activities are performed on upslope parcels, adequate protection should be provided and inspections performed at least once weekly of these newly disturbed areas as well as inspections for accumulated sediments at the BMP facility.

A designated representative of the owner will inspect the BMP structure after each significant rain event or the following working day if a weekend or holiday occurs. A significant rainfall event 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. Appropriate action, performed at the cost of the owner, will be taken to ensure appropriate maintenance keys to locked access points shall be made available to James City County personnel upon request.

Inspection and maintenance of the facility will consist of the following additional measures:

1. The inspection for sediment buildup will be performed by visual inspection and a physical determination of sediment depth within the storage area. Sediment removal is required using a rubber-wheeled backhoe. At the same time, or at least once per year, the riser bottom and outlet pipe shall be cleaned of accumulated sediments. Dispose of sediments removed from the facility at an acceptable disposal area. Sediment shall not be allowed to accumulate in depths greater than 1-foot. No sediment shall be allowed to accumulate to prevent the proper function of any pipe or culvert.
2. Perform maintenance mowing of grassed areas atleast twice each year. Grasses such as tall fescue should be mowed in early summer after emergence of the heads on cool season grasses and in late fall to prevent seeds of annual weeds from maturing. Mowing of legumes can be less frequent. Trees and shrubs should not be permitted to grow on any part of the graded embankment.
3. Perform soil sampling on stabilized BMP soil areas once every 4 years. Soil sampling and testing should be performed by a qualified independent testing laboratory. Apply additional lime and fertilizer in accordance with test recommendations.
4. If vegetation covers less than 40% of soil surfaces in stabilized BMP areas, lime, fertilize, and seed in accordance with recommendations for new seedlings, as listed in dam construction notes. If vegetation covers more than 40% but less than 70% of soil surfaces, lime, fertilize, and overseed in accordance with current seedling recommendations.
5. Perform quarterly inspections of the release structures, riser section, and crest of spillway for the observance of collected debris. Immediately remove any debris to maintain.

6. Perform yearly structural inspections of the facility for damage. Structural inspection shall be performed on the concrete riser, anti-vortex device, trash rack, orifice/weir(s), outlet barrel, and embankment. If damage is evident, further investigation by a professional engineer may be required to assess the continued integrity of the structure.
7. Perform quarterly inspections of the graded side slopes of the BMP facility for signs of animal/rodent borrows or slope erosion. Immediately perform necessary repairs, refilling or reseeding as appropriate.
8. The owner or designated representative shall keep reasonable, accurate written records of inspections performed on the structure. Records shall document routine maintenance and/or repairs performed. Copies shall be provided to the County upon request.
9. The facility shall not be modified in any way without prior consent/approval of the County,

EXHIBITS

10-POINT SYSTEM WORKSHEET

PRE- AND POST-DEVELOPMENT DRAINAGE AREAS

IMPERVIOUS AREA CALCULATIONS

POINTS

PROJECT NAME:	**STONEHOUSE**		
WSP SELLS PROJECT #	08-4051		
DESIGNED BY:	AHH	DATE:	03/26/08
REVIEWED BY:	CMD	DATE:	08/17/09

WORKSHEET FOR BMP POINT SYSTEM

LAND AREA SUMMARY: **Tract 12**

IDENTIFICATION	**ACRES**		
TOTAL AREA	62.49		
RPA BUFFER & WETLANDS *(Less 1.20 acres of impact)*	20.23	32.4%	OF TOTAL AREA
STORMWATER DUNOS *(Adjacent to Lots 5, 10,and BMPs)*	2.06	3.3%	OF TOTAL AREA
ADJACENT DUNOS *(Parcels to East & West)*	9.20	14.7%	OF TOTAL AREA
OTHER OPEN SPACE *(R/W Buffer and BMPs)*	5.97	9.6%	OF TOTAL AREA
NET AREA (DENOMINATOR)	31.00	49.6%	OF TOTAL AREA
STRUCTURAL SITE AREA (NUMERATOR)	9.80	*31.6%*	OF NET AREA

A. STRUCTURAL BMP POINT ALLOCATION

BMP	**BMP POINTS**		**FRACTION OF SITE SERVED BY BMP**			**WEIGHTED BMP POINTS**
Small Wet Pond	6	x	0.00	/	42.26	0.00
Wet Pond	8	x	0.00	/	42.26	0.00
ED Wet Pond *(BMP#1: Lots 46-49 + BMP#2)*	10	x	3.63	/	42.26	0.86
ED Wet Pond *(BMP#4: Road, Lots 20-24/32-32, BMPs)*	10	x	5.69	/	42.26	1.35
ED Wet Pond *(BMP#7: Road, Lots 1-3, 14-18)*	10	x	2.36	/	42.26	0.56
ED Wet Pond *(BMP#8: Road, Lots 5-8, BMP#9)*	10	x	2.54	/	42.26	0.60
Wet ED Pond	10	x	0.00	/	42.26	0.00
Shallow Marsh	6	x	0.00	/	42.26	0.00
ED Shallow Wetland	6	x	0.00	/	42.26	0.00
Pond/Wetland System	10	x	0.00	/	42.26	0.00
Pocket Wetland	6	x	0.00	/	42.26	0.00
Infiltration Trench (0.5 in / imp ac)	8	x	0.00	/	42.26	0.00
Infiltration Trench (1.0 in / imp ac)	10	x	0.00	/	42.26	0.00
Infiltration Basin (0.5 in / imp ac)	8	x	0.00	/	42.26	0.00
Infiltration Basin (1.0 in / imp ac)	10	x	0.00	/	42.26	0.00
Bioretention *(BMP#2: Road + Lots 39-44) (50% credit)*	5	x	1.72	/	42.26	0.20
Bioretention *(BMP#5: Loop + Lots 19, 36-37) (50% credit)*	5	x	1.91	/	42.26	0.23
Bioretention *(BMP#6: Loop + Lots 25-30) (50% credit)*	5	x	1.27	/	42.26	0.15
Bioretention *(BMP#9: Loop + Lots 4, 7-13) (50% credit)*	5	x	1.21	/	42.26	0.14
Surface Sand Filter	8	x	0.00	/	42.26	0.00
Underground Sand Filter	8	x	0.00	/	42.26	0.00
Perimeter Sand Filter	8	x	0.00	/	42.26	0.00
Organic Sand Filter	8	x	0.00	/	42.26	0.00
Pocket Sand Filter	6	x	0.00	/	42.26	0.00
Wet Swale *(Lots 38, 44, 45, 50, and 51 to existing BMPs)*	2	x	1.50	/	42.26	0.00
Dry Swale	10	x	0.00	/	42.26	0.00
Biofilters	4	x	0.00	/	42.26	0.00
Timber Walls	4	x	0.00	/	42.26	0.00
Dry ED with forebay *(Existing BMP#3A for Lots 38, 44-55)*	4	x	2.18	/	42.26	0.21
Offsite Credits* *(Existing BMP#3B for Lots 50-51)*	4	x	1.07	/	42.26	0.10
Offsite Credits* *(Existing BMP#3C for Lots 41-42, 52-56)*	4	x	1.14	/	42.26	0.11
Offsite Credits* *(Existing BMP#3D)*	4	x	0.56	/	42.26	0.05
			TOTAL WEIGHTED STRUCTURAL BMP POINTS:			**4.56**

** Note: RPA's, wetlands, steep slopes, and other areas already protected under other regulations are not eligible for this credit.*

B. NATURAL OPEN SPACE CREDIT

OPEN SPACE CONSERVATION EASEMENTS	**FRACTION OF SITE TO OPEN SPACE**				**NATURAL OPEN SPACE CREDIT**	**POINTS FOR NATURAL OPEN SPACE**
Accepts and treats stormwater runoff from the development site per design specification	2.06	/	62.49	x	(0.15 PER 1%)	0.49
Adjacent to a wetland, mature forest, or RPA	9.20	/	62.49	x	(0.15 PER 1%)	2.21
All other open space (RPA excluding disturbed common areas and proposed development impacts)	20.23	/	62.49	x	(0.10 PER 1%)	3.24
			TOTAL NATURAL OPEN SPACE CREDIT:			**5.94**

C. TOTAL WEIGHTED POINTS

4.56	+	**5.94**	**10.50**
STRUCTURAL BMP POINTS		**NATURAL OPEN SPACE POINTS**	**TOTAL**

WORKSHEET FOR BMP POINT SYSTEM

LAND AREA SUMMARY: **Tract 12**

A. STRUCTURAL BMP POINT ALLOCATION

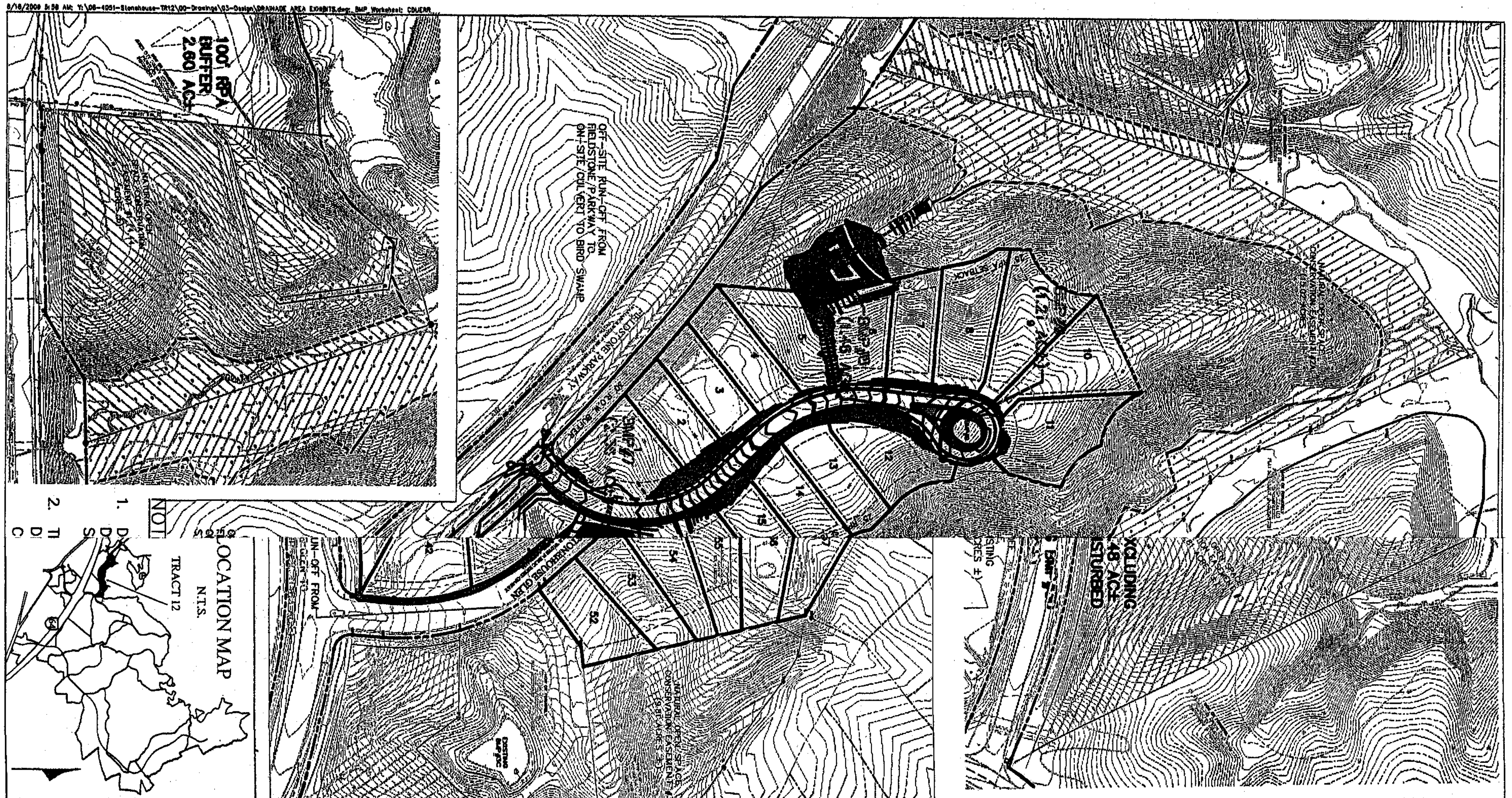
BMP	BMP POINTS		FRACTION OF SITE SERVED BY BMP		WEIGHTED BMP POINTS
ED Wet Pond (BMP#1: Lots 46-49 + BMP#2)	10	x	3.63	=	0.86
ED Wet Pond (BMP#4: Road, Lots 20-24/32-32, BMPs)	10	x	5.69	=	1.35
ED Wet Pond (BMP#7: Road, Lots 1-3, 14-18)	10	x	2.36	=	0.56
ED Wet Pond (BMP#8: Road, Lots 5-8, BMP#9)	10	x	2.54	=	0.60
Bioretention (BMP#2: Road + Lots 39-44) (50% credit)	5	x	1.72	=	0.20
Bioretention (BMP#5: Loop + Lots 19, 36-37) (50% credit)	5	x	1.91	=	0.23
Bioretention (BMP#6: Loop + Lots 25-30) (50% credit)	5	x	1.27	=	0.15
Bioretention (BMP#9: Loop + Lots 4, 7-13) (50% credit)	5	x	1.21	=	0.14
Wet Swale (Lots 38, 44, 45, 50, and 51 to existing BMPs)	2	x	1.50	=	0.00
Dry ED with forebay (Existing BMP#3A for Lots 38, 44-55)	4	x	2.18	=	0.21
Offsite Credits* (Existing BMP#3B for Lots 50-51)	4	x	1.07	=	0.10
Offsite Credits* (Existing BMP#3C for Lots 41-42, 52-56)	4	x	1.14	=	0.11
Offsite Credits* (Existing BMP#3D)	4	x	0.56	=	0.05
			TOTAL WEIGHTED STRUCTURAL BMP POINTS:		**4.56**

B. NATURAL OPEN SPACE CREDIT

NON-STRUCTUAL BMP	FRACTION OF SITE		NATURAL OPEN SPACE CREDIT		POINTS FOR NATURAL OPEN SPACE
STORMWATER DUNOS (Adjacent to Lots 5, 10,and BMPs)	0.03	x	(0.15 PER 1%)	=	0.49
ADJACENT DUNOS (Parcels to East & West)	0.15	x	(0.15 PER 1%)	=	2.21
RPA BUFFER & WETLANDS (Less 1.20 acres of impact)	0.32	x	(0.10 PER 1%)	=	3.24
			TOTAL NATURAL OPEN SPACE CREDIT:		**5.94**

C. TOTAL WEIGHTED POINTS

4.56	+	5.94	=	10.50
STRUCTURAL BMP POINTS		NATURAL OPEN SPACE POINTS		TOTAL



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REVISIONS

TITLE
STORMWATER/BMP
10-POINT SYSTEM

SHEET
EXHIBIT 1

TRACT 12
STONEHOUSE
JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

PRELIMINARY NOT RELEASED FOR CONSTRUCTION

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15401 Weston Parkway Suite 100 • Cary, NC 27513 • 919.678.0035
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REVISIONS

PROJECT #: 08-4051 DATE: 08/27/09

DRAWN BY: MB CHECKED BY: CD

TITLE
DRAINAGE AREAS
PRE DEVELOPMENT

SHEET
EXHIBIT 2

TRACT 12
STONEHOUSE
JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

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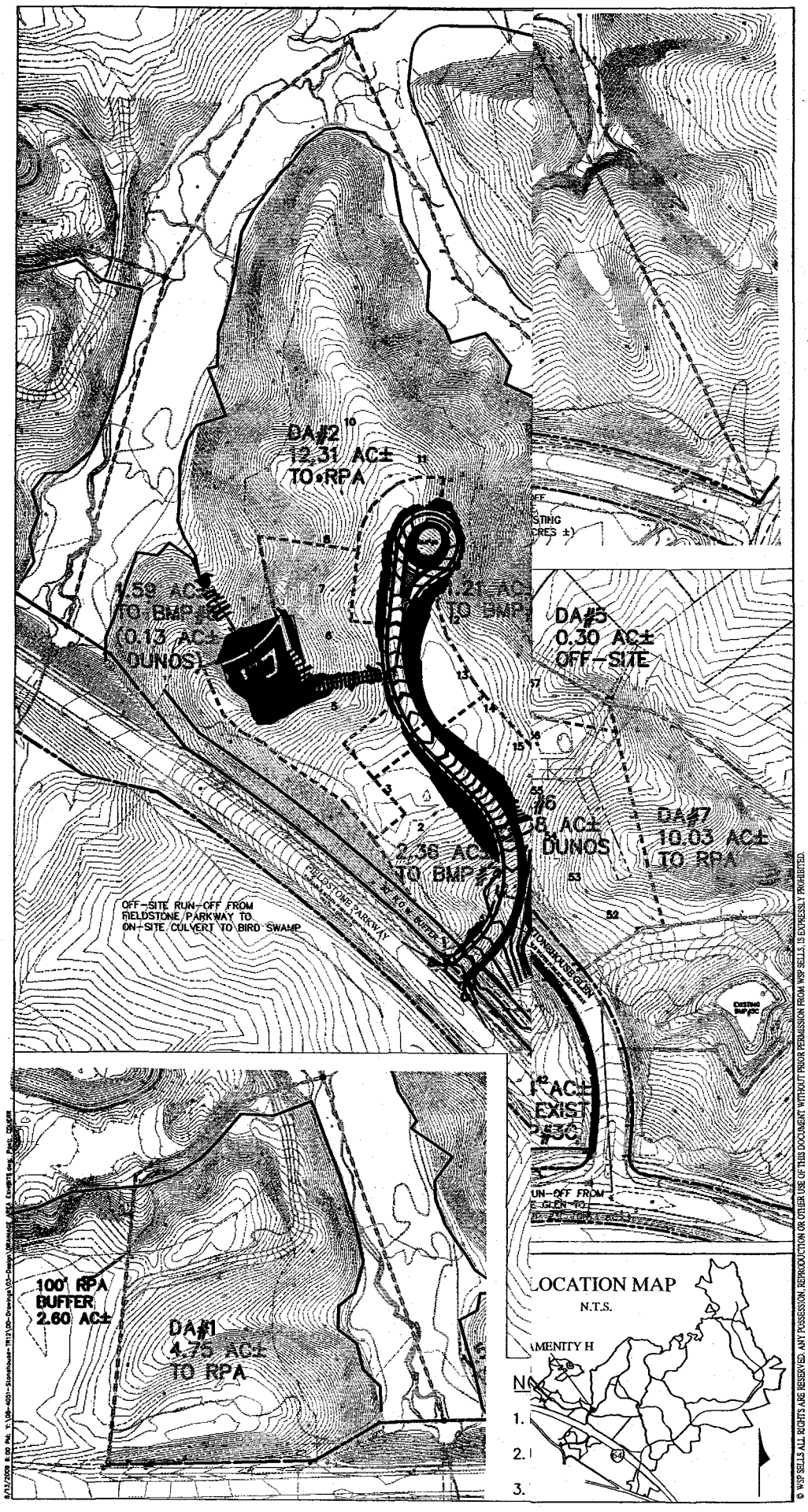

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TRACT 12
STONEHOUSE

JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC

4011 WESTCHASE BLVD, SUITE 175

RALEIGH, NC 27607

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REVISIONS

PROJECT #: 08-4051 DATE: 08/11/09

DRAWN BY: MB CHECKED BY: CD

TITLE

DRAINAGE AREAS
POST DEVELOPMENT

SHEET

EXHIBIT 3

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#1: Wet Pond

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	4.5	EA	5,000	22,500	0.52
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**0.52**
				Total Drainage Area:	**1.91**
				Total Percent Impervious:	**27.0%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.70
Forested:	0.25		0.70
Impervious Surfaces:	0.95		0.52
		Weighted "C" value:	**0.48**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.70
Forested:	77		0.70
Impervious Surfaces:	98		0.52
		Weighted "CN" value:	**56**

BMP#2: Bioretention

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	2.5	EA	5,000	12,500	0.29
Roadway				16,500	0.38
Sidewalk				2,000	0.05
				Total Impervious Area:	**0.71**
				Total Drainage Area:	**1.72**
				Total Percent Impervious:	**41.4%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.50
Forested:	0.25		0.50
Impervious Surfaces:	0.95		0.71
		Weighted "C" value:	**0.57**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.50
Forested:	77		0.50
Impervious Surfaces:	98		0.71
		Weighted "CN" value:	**64**

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#3A: Existing Dry ED Basin (Fieldstone Parkway)

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	2	EA	5,000	10,000	0.23
Roadway				30,800	0.71
Sidewalk	-	LF		8,800	0.20
				Total Impervious Area:	**1.14**
				Total Drainage Area:	**2.50**
				Total Percent Impervious:	**45.5%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.68
Forested:	0.25		0.68
Impervious Surfaces:	0.95		1.14
		Weighted "C" value:	**0.60**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.68
Forested:	77		0.68
Impervious Surfaces:	98		1.14
		Weighted "CN" value:	**66**

BMP#3B: Existing Dry ED Basin (Stonehouse Glen Development)

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	2	EA	5,000	10,000	0.23
Roadway				16,500	0.38
Sidewalk				-	0.00
				Total Impervious Area:	**0.61**
				Total Drainage Area:	**1.07**
				Total Percent Impervious:	**56.9%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.23
Forested:	0.25		0.23
Impervious Surfaces:	0.95		0.61
		Weighted "C" value:	**0.67**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.23
Forested:	77		0.23
Impervious Surfaces:	98		0.61
		Weighted "CN" value:	**73**

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#3C: Existing Dry ED Basin (Stonehouse Glen)

Description	Quantity	Unit	Impervious Per Unit	Area (SF)	Area (ac)
Lots	2	EA	5,000	10,000	0.23
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**0.23**
				Total Drainage Area:	**1.14**
				Total Percent Impervious:	**20.1%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.46
Forested:	0.25		0.46
Impervious Surfaces:	0.95		0.23
		Weighted "C" value:	**0.43**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.46
Forested:	77		0.46
Impervious Surfaces:	98		0.23
		Weighted "CN" value:	**52**

BMP#3D: Existing Dry ED Basin (Fieldstone Parkway)

Description	Quantity	Unit	Impervious Per Unit	Area (SF)	Area (ac)
Lots	0	EA	5,000	-	0.00
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**0.00**
				Total Drainage Area:	**0.94**
				Total Percent Impervious:	**0.0%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.47
Forested:	0.25		0.47
Impervious Surfaces:	0.95		0.00
		Weighted "C" value:	**0.30**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.47
Forested:	77		0.47
Impervious Surfaces:	98		0.00
		Weighted "CN" value:	**40**

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#4: Wet Pond

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	5.5	EA	5,000	27,500	0.63
Roadway				12,000	0.28
Sidewalk				2,000	0.05
				Total Impervious Area:	**0.95**
				Total Drainage Area:	**2.51**
				Total Percent Impervious:	**38.0%**

Weighted "C" Value

	C	Area (ac)
Grass, Open Space:	0.35	0.78
Forested:	0.25	0.78
Impervious Surfaces:	0.95	0.95
	Weighted "C" value:	**0.55**

Weighted CN Value (HSG C)

	CN	Area (ac)
Grass, Open Space, good condition:	80	0.78
Forested:	77	0.78
Impervious Surfaces:	98	0.95
	Weighted "CN" value:	**62**

BMP#5: Bioretention

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	3.5	EA	5,000	17,500	0.40
Roadway				16,000	0.37
Sidewalk				1,000	0.02
				Total Impervious Area:	**0.79**
				Total Drainage Area:	**1.91**
				Total Percent Impervious:	**41.5%**

Weighted "C" Value

	C	Area (ac)
Grass, Open Space:	0.35	0.56
Forested:	0.25	0.56
Impervious Surfaces:	0.95	0.79
	Weighted "C" value:	**0.57**

Weighted CN Value (HSG C)

	CN	Area (ac)
Grass, Open Space, good condition:	80	0.56
Forested:	77	0.56
Impervious Surfaces:	98	0.79
	Weighted "CN" value:	**64**

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#6: Bioretention

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	2.5	EA	5,000	12,500	0.29
Roadway				10,000	0.23
Sidewalk				-	0.00
				Total Impervious Area:	**0.52**
				Total Drainage Area:	**1.27**
				Total Percent Impervious:	**40.7%**

Weighted "C" Value

	C	Area (ac)
Grass, Open Space:	0.35	0.38
Forested:	0.25	0.38
Impervious Surfaces:	0.95	0.52
	Weighted "C" value:	**0.56**

Weighted CN Value (HSG C)

	CN	Area (ac)
Grass, Open Space, good condition:	80	0.38
Forested:	77	0.38
Impervious Surfaces:	98	0.52
	Weighted "CN" value:	**64**

BMP#7: Wet Pond

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	5	EA	5,000	25,000	0.57
Roadway				12,000	0.28
Sidewalk				2,500	0.06
				Total Impervious Area:	**0.91**
				Total Drainage Area:	**2.36**
				Total Percent Impervious:	**38.4%**

Weighted "C" Value

	C	Area (ac)
Grass, Open Space:	0.35	0.73
Forested:	0.25	0.73
Impervious Surfaces:	0.95	0.91
	Weighted "C" value:	**0.55**

Weighted CN Value (HSG C)

	CN	Area (ac)
Grass, Open Space, good condition:	80	0.73
Forested:	77	0.73
Impervious Surfaces:	98	0.91
	Weighted "CN" value:	**62**

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#8: Wet Pond

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	5	EA	5,000	25,000	0.57
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**0.57**
				Total Drainage Area:	**1.64**
				Total Percent Impervious:	**35.0%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.53
Forested:	0.25		0.53
Impervious Surfaces:	0.95		0.57
		Weighted "C" value:	**0.53**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.53
Forested:	77		0.53
Impervious Surfaces:	98		0.57
		Weighted "CN" value:	**60**

BMP#9: Bioretention

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	1	EA	5,000	5,000	0.11
Roadway				11,000	0.25
Sidewalk				1,000	0.02
				Total Impervious Area:	**0.39**
				Total Drainage Area:	**1.21**
				Total Percent Impervious:	**32.3%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.41
Forested:	0.25		0.41
Impervious Surfaces:	0.95		0.39
		Weighted "C" value:	**0.51**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.41
Forested:	77		0.41
Impervious Surfaces:	98		0.39
		Weighted "CN" value:	**59**

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

Sheetflow into RPA and DUNOS

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	21.5	EA	5,000	107,500	2.47
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**2.47**
				Total Drainage Area:	**43.25**
				Total Percent Impervious:	**5.7%**

Weighted "C" Value

	C	Area (ac)
Grass, Open Space:	0.35	30.59
Forested:	0.25	10.20
Impervious Surfaces:	0.95	2.47
	Weighted "C" value:	**0.36**

Weighted CN Value (HSG C)

	CN	Area (ac)
Grass, Open Space, good condition:	80	30.59
Forested:	77	10.20
Impervious Surfaces:	98	2.47
	Weighted "CN" value:	**62**

TOTAL IMPERVIOUS AREA	**9.80**	**Acres**
TOTAL DRAINAGE AREA	**62.49**	**Acres**
TOTAL PERCENT IMPERVIOUS	**15.7%**	

DESIGN WORKSHEET - IMPERVIOUS AREAS

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Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

Sheetflow into RPA and DUNOS

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	21.5	EA	5,000	107,500	2.47
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**2.47**
				Total Drainage Area:	**43.25**
				Total Percent Impervious:	**5.7%**

Weighted "C" Value

	C	Area (ac)
Grass, Open Space:	0.35	30.59
Forested:	0.25	10.20
Impervious Surfaces:	0.95	2.47
	Weighted "C" value:	**0.36**

Weighted CN Value (HSG C)

	CN	Area (ac)
Grass, Open Space, good condition:	80	30.59
Forested:	77	10.20
Impervious Surfaces:	98	2.47
	Weighted "CN" value:	**62**

TOTAL IMPERVIOUS AREA	**9.80**	**Acres**
TOTAL DRAINAGE AREA	**62.49**	**Acres**
TOTAL PERCENT IMPERVIOUS	**15.7%**	

BMP#1: WET EXTENDED DETETION POND
DESIGN WORKSHEET & CALCULATIONS

Hydrograph Plot

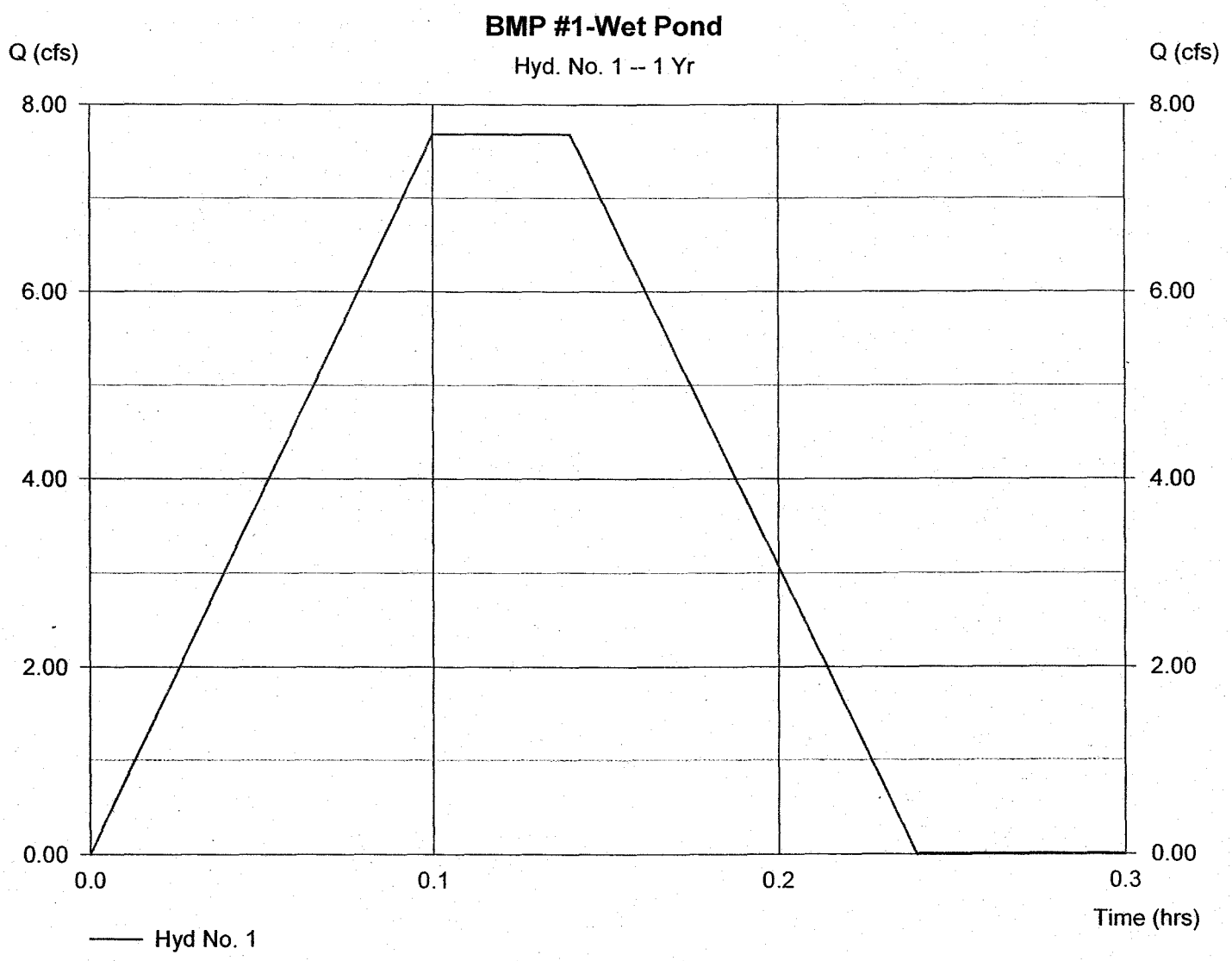
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 10:25 AM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 7.68 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 3.630 ac	Runoff coeff.	= 0.52
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,458 cuft



Hydrograph Plot

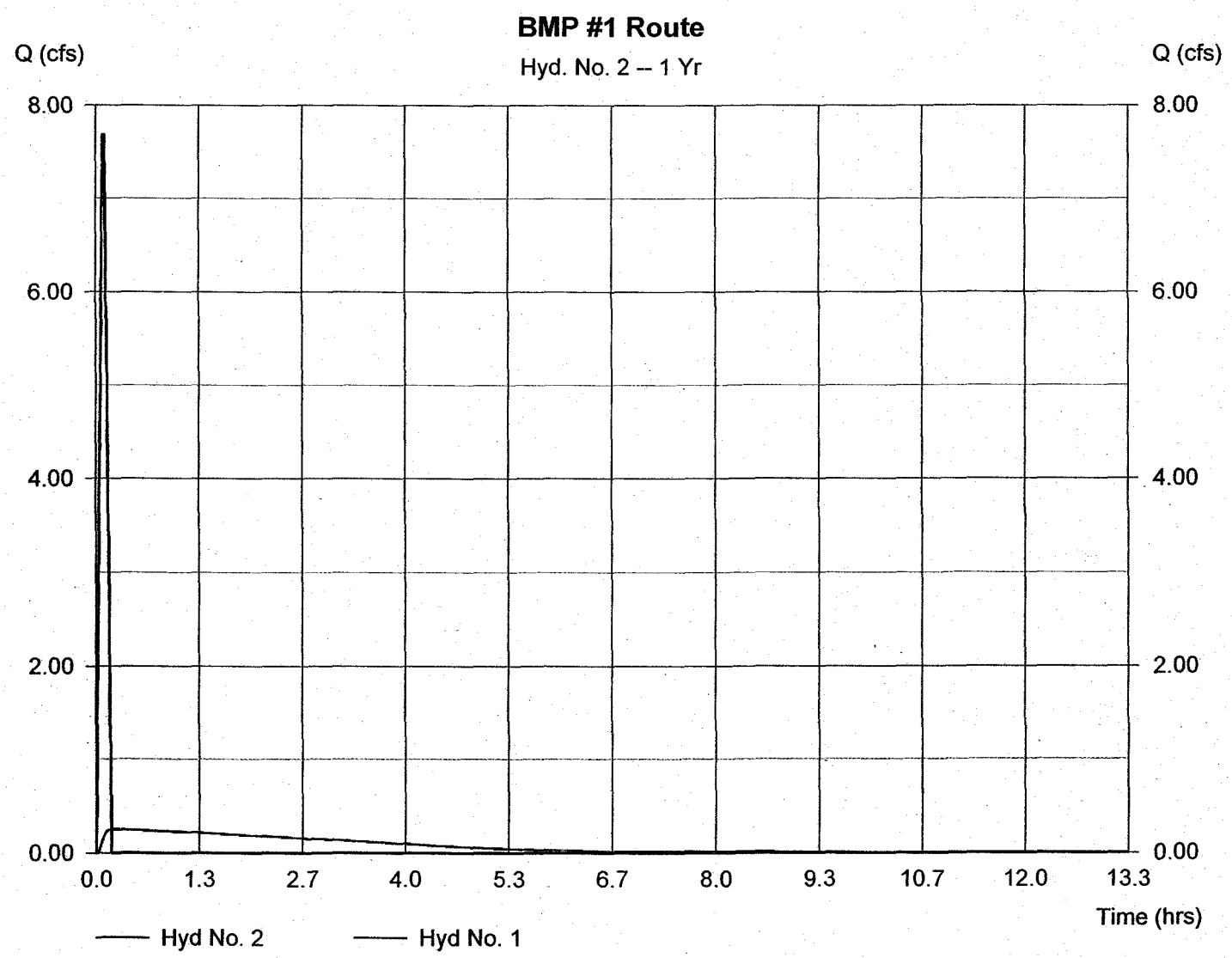
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 1:51 PM

Hyd. No. 2

BMP #1 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.25 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 86.24 ft
Reservoir name	= BMP #1-Wet Pond	Max. Storage	= 3,120 cuft

Storage Indication method used. | Hydrograph Volume = 3,216 cuft



Hydrograph Plot

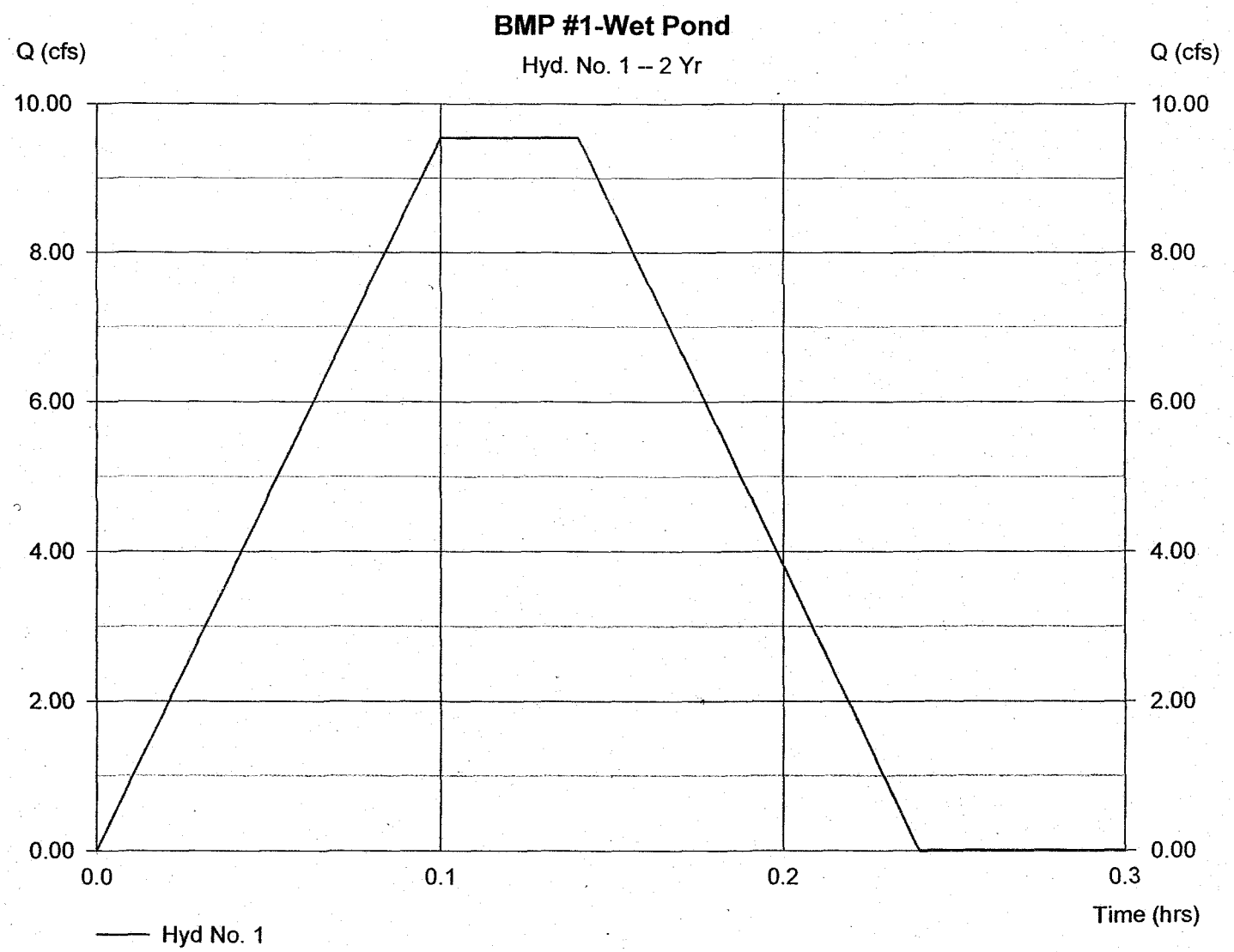
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 10:25 AM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 9.55 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 3.630 ac	Runoff coeff.	= 0.52
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,297 cuft



Hydrograph Plot

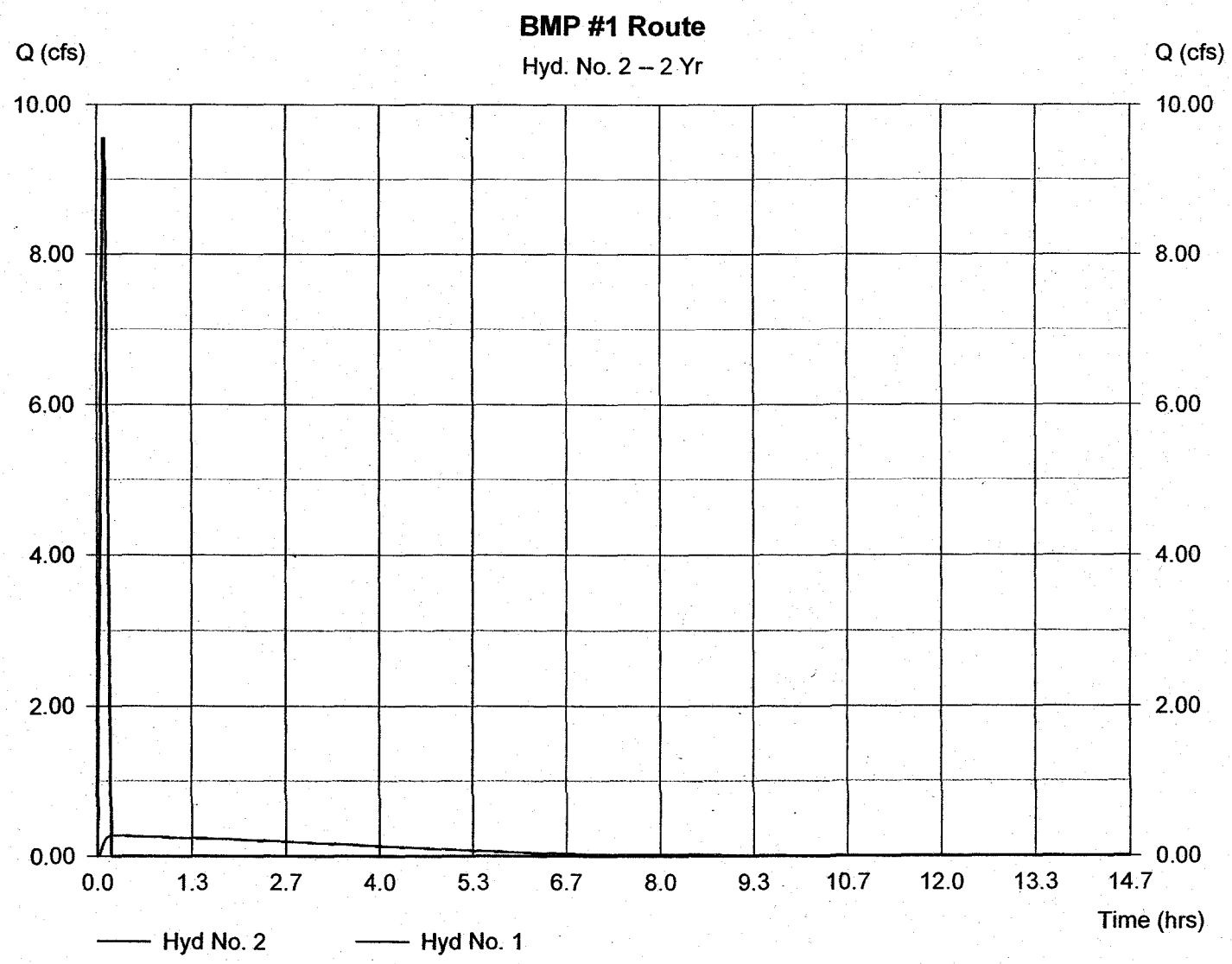
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 1:51 PM

Hyd. No. 2

BMP #1 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.27 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 86.47 ft
Reservoir name	= BMP #1-Wet Pond	Max. Storage	= 3,890 cuft

Storage Indication method used. | Hydrograph Volume = 3,999 cuft



Hydrograph Plot

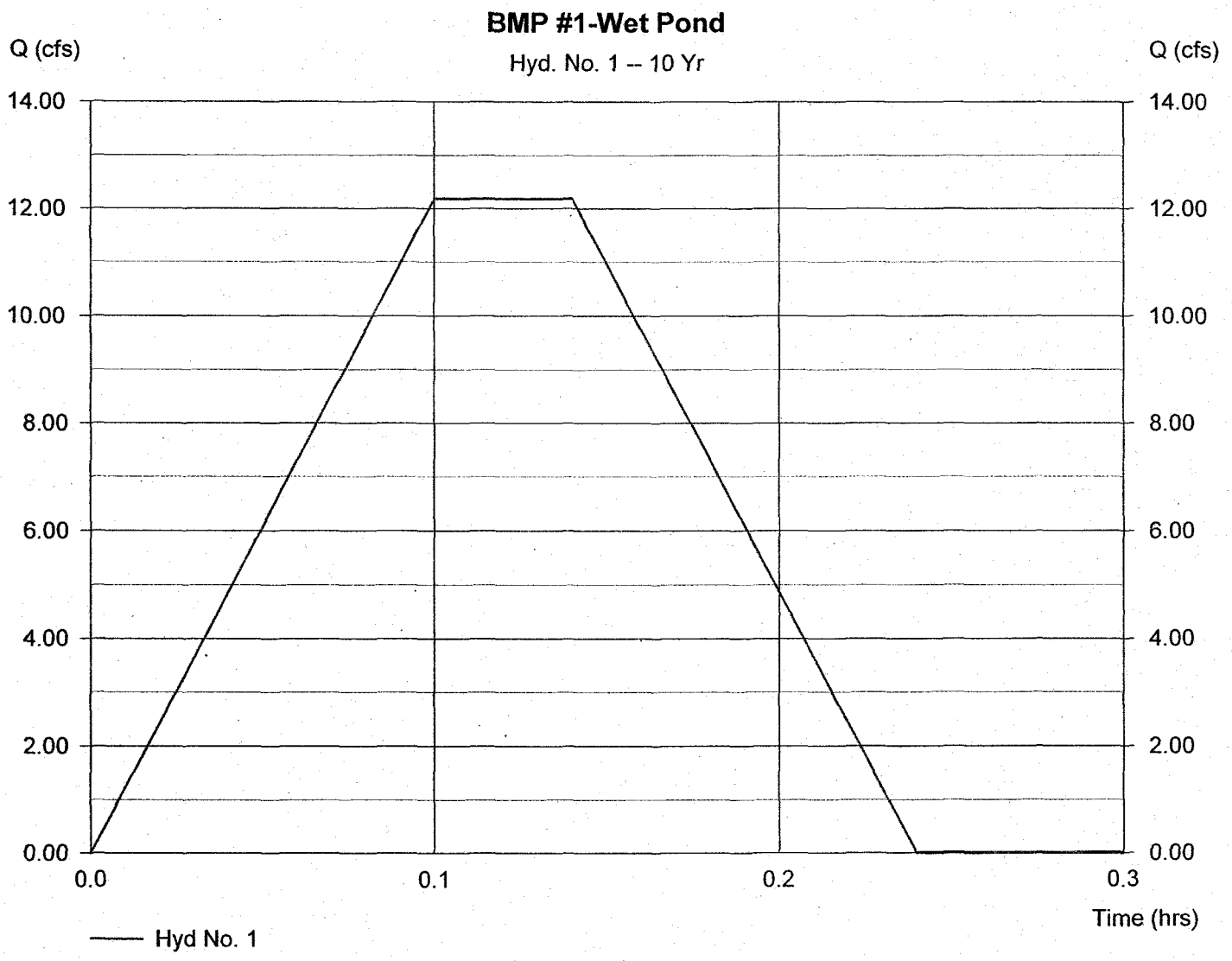
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 10:25 AM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 12.19 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 3.630 ac	Runoff coeff.	= 0.52
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 5,484 cuft



Hydrograph Plot

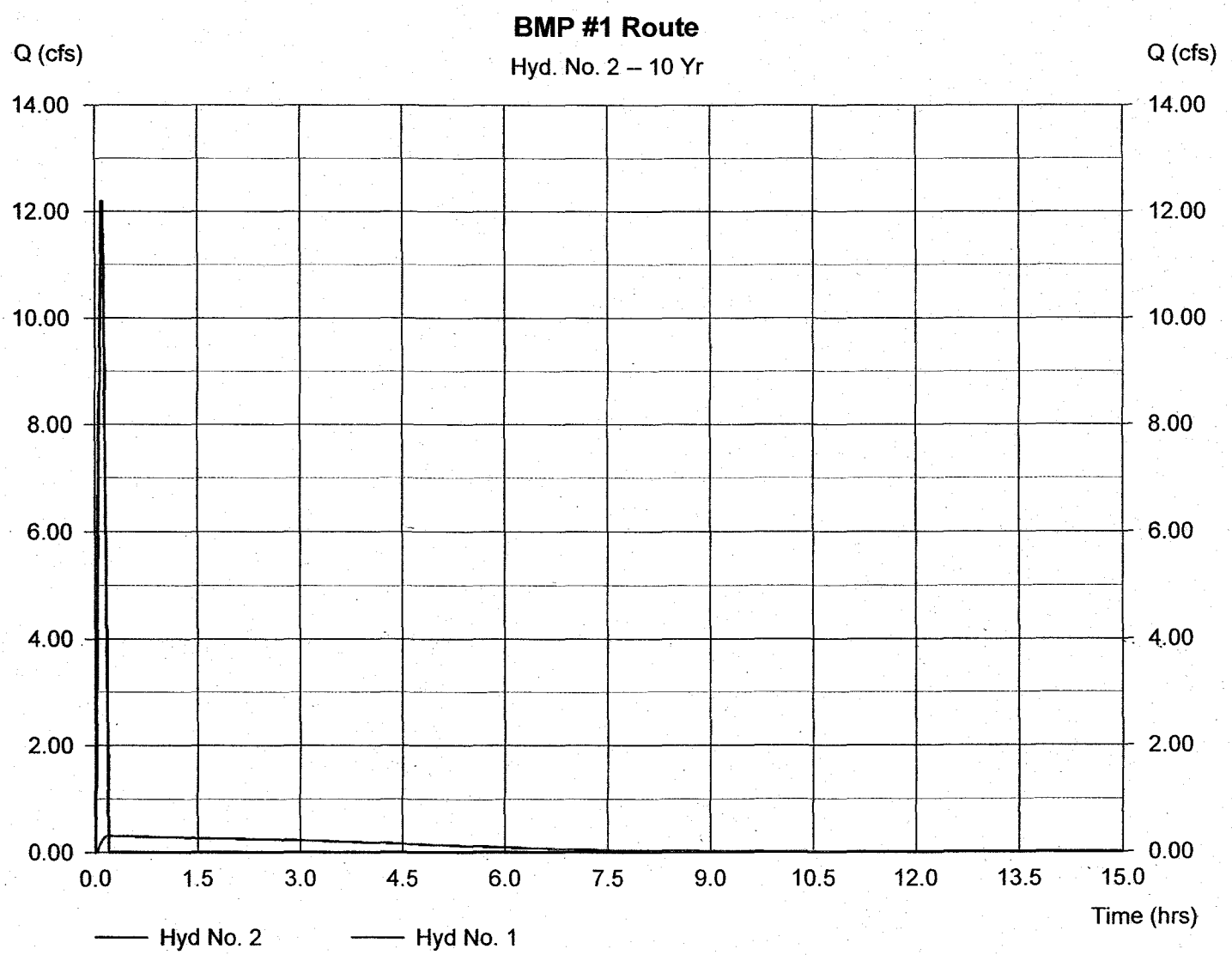
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 1:51 PM

Hyd. No. 2

BMP #1 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.30 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 86.78 ft
Reservoir name	= BMP #1-Wet Pond	Max. Storage	= 4,982 cuft

Storage Indication method used. | Hydrograph Volume = 5,107 cuft



Hydrograph Plot

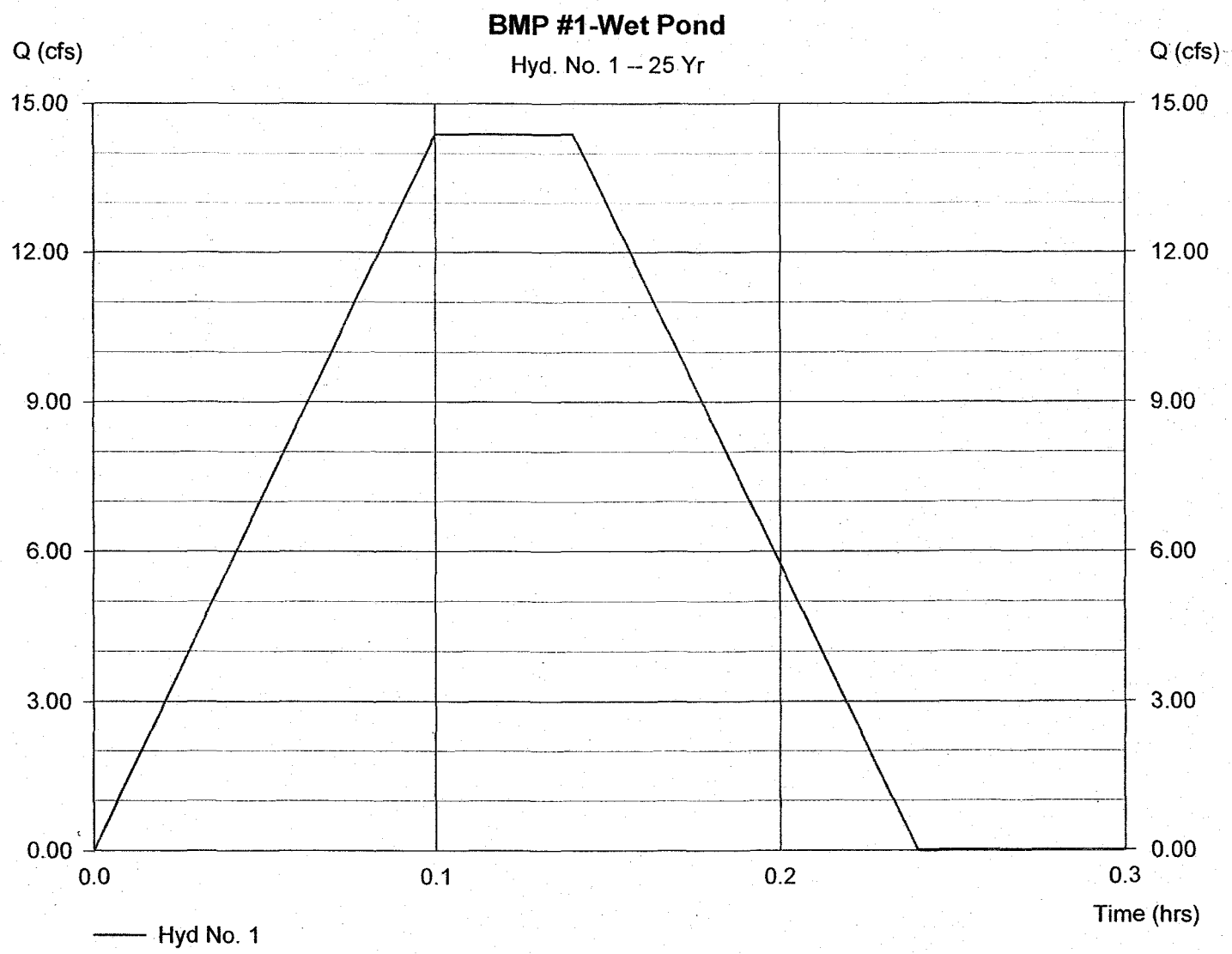
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 10:25 AM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 14.39 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 3.630 ac	Runoff coeff.	= 0.52
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 6,474 cuft



Hydrograph Plot

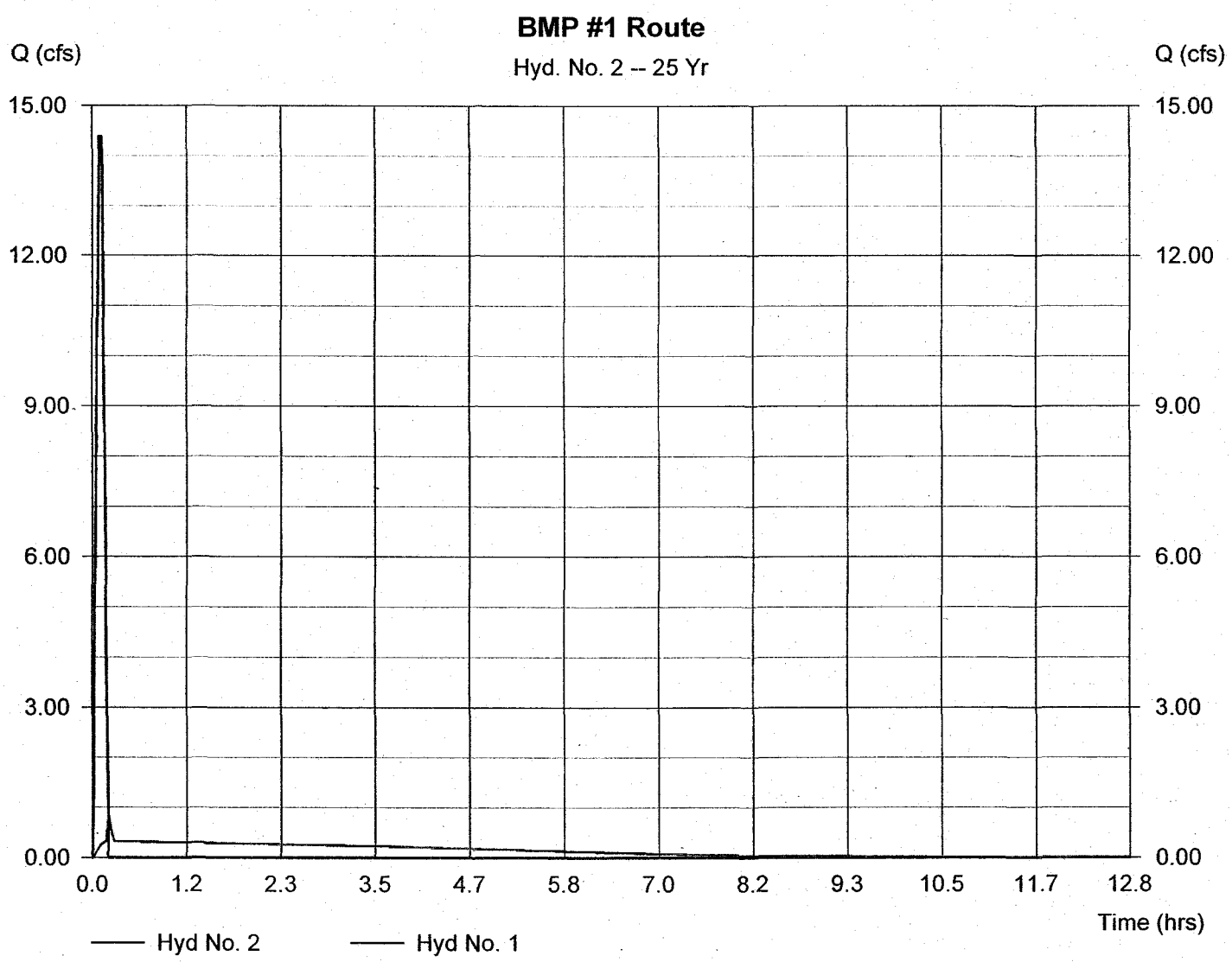
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 10:25 AM

Hyd. No. 2

BMP #1 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.83 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 87.03 ft
Reservoir name	= BMP #1-Wet Pond	Max. Storage	= 5,859 cuft

Storage Indication method used. | Hydrograph Volume = 6,031 cuft



Hydrograph Plot

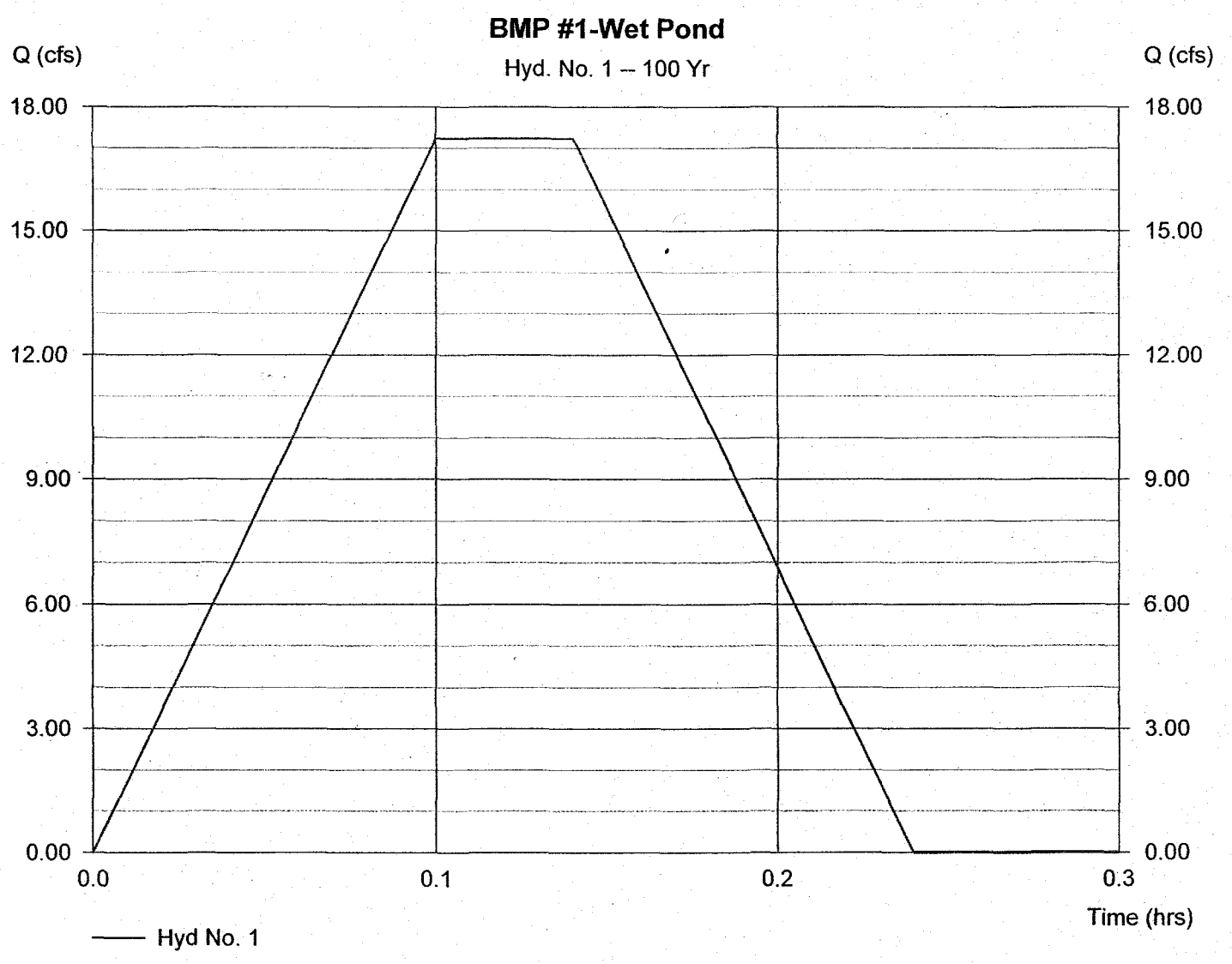
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 10:25 AM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 17.24 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 3.630 ac	Runoff coeff.	= 0.52
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 7,757 cuft



Hydrograph Plot

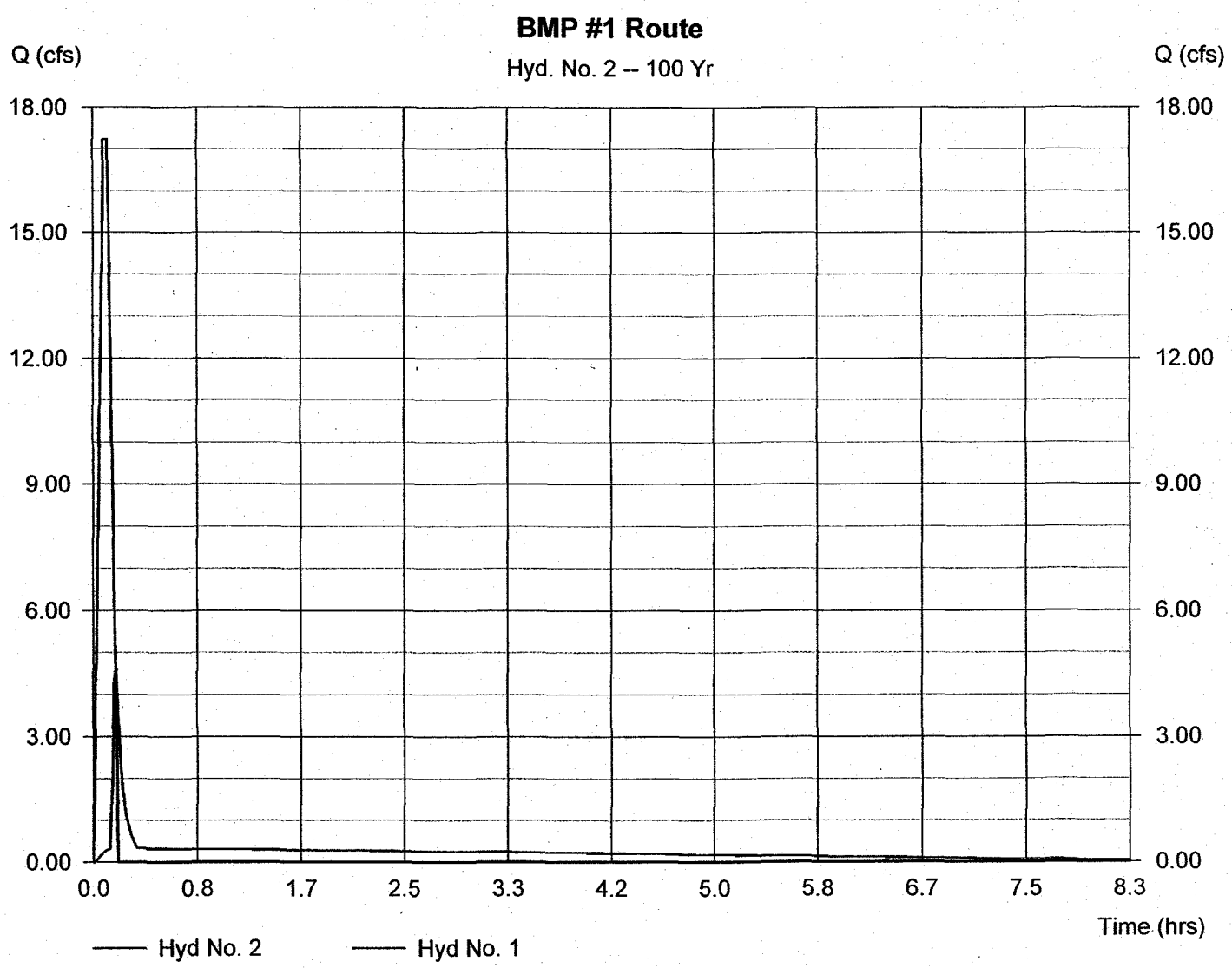
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 1:51 PM

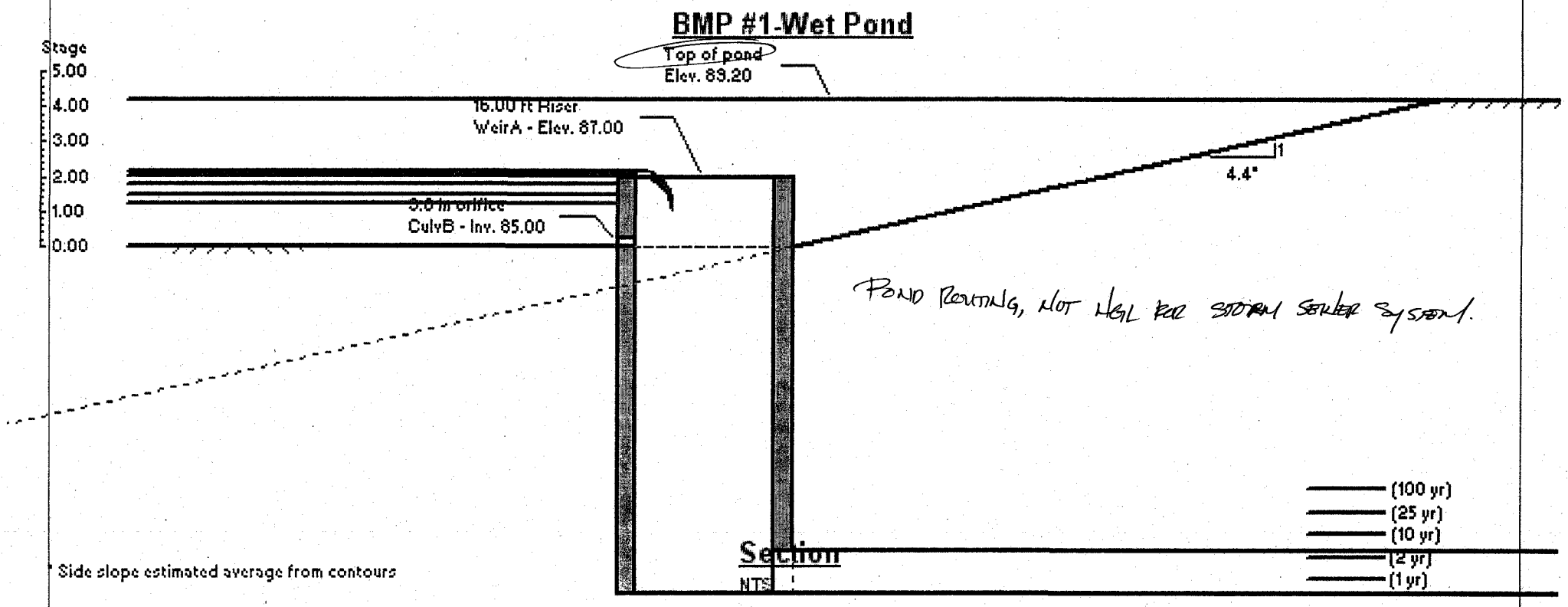
Hyd. No. 2

BMP #1 Route

Hydrograph type	= Reservoir	Peak discharge	= 4.61 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 87.18 ft
Reservoir name	= BMP #1-Wet Pond	Max. Storage	= 6,531 cuft

Storage Indication method used. | Hydrograph Volume = 7,229 cuft





Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: Wet Pond #1.gpw	Wednesday, Nov 18 2009, 10:27 AM

CMP #1 WET POND
CONFIGURATION

Pond Report

Hydraflow Hydrographs by Intelisolve — Wednesday, Nov 18 2009, 10:27 AM

Pond No. 1 - BMP #1-Wet Pond

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	85.00	1,600	0	0
1.00	86.00	2,971	2,286	2,286
2.00	87.00	3,916	3,444	5,729
3.00	88.00	4,808	4,362	10,091
4.00	89.00	5,971	5,390	15,481
4.20	89.20	6,200	1,217	16,698

Culvert / Orifice Structures

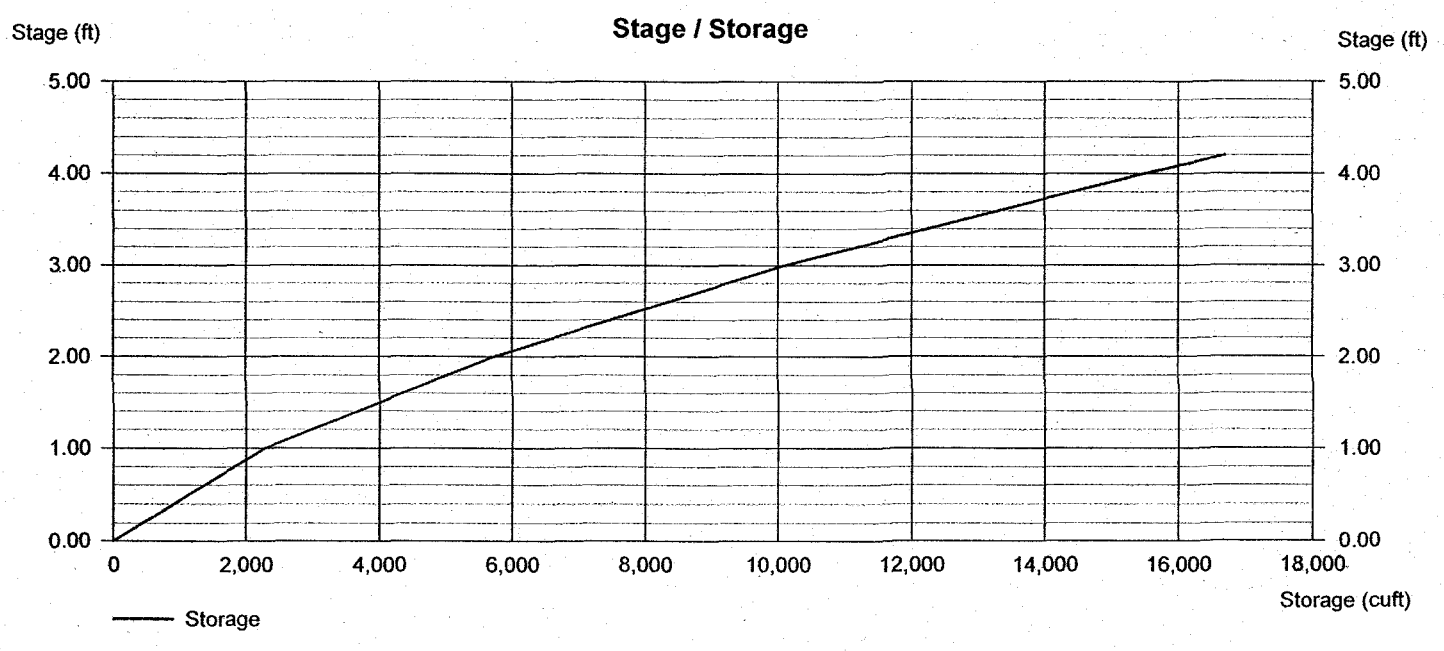
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 75.00	85.00	0.00	0.00
Length (ft)	= 43.00	0.00	0.00	0.00
Slope (%)	= 8.94	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 87.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	—	—	—
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



BMP#2: BIORETENTION
DESIGN WORKSHEET & CALCULATIONS

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

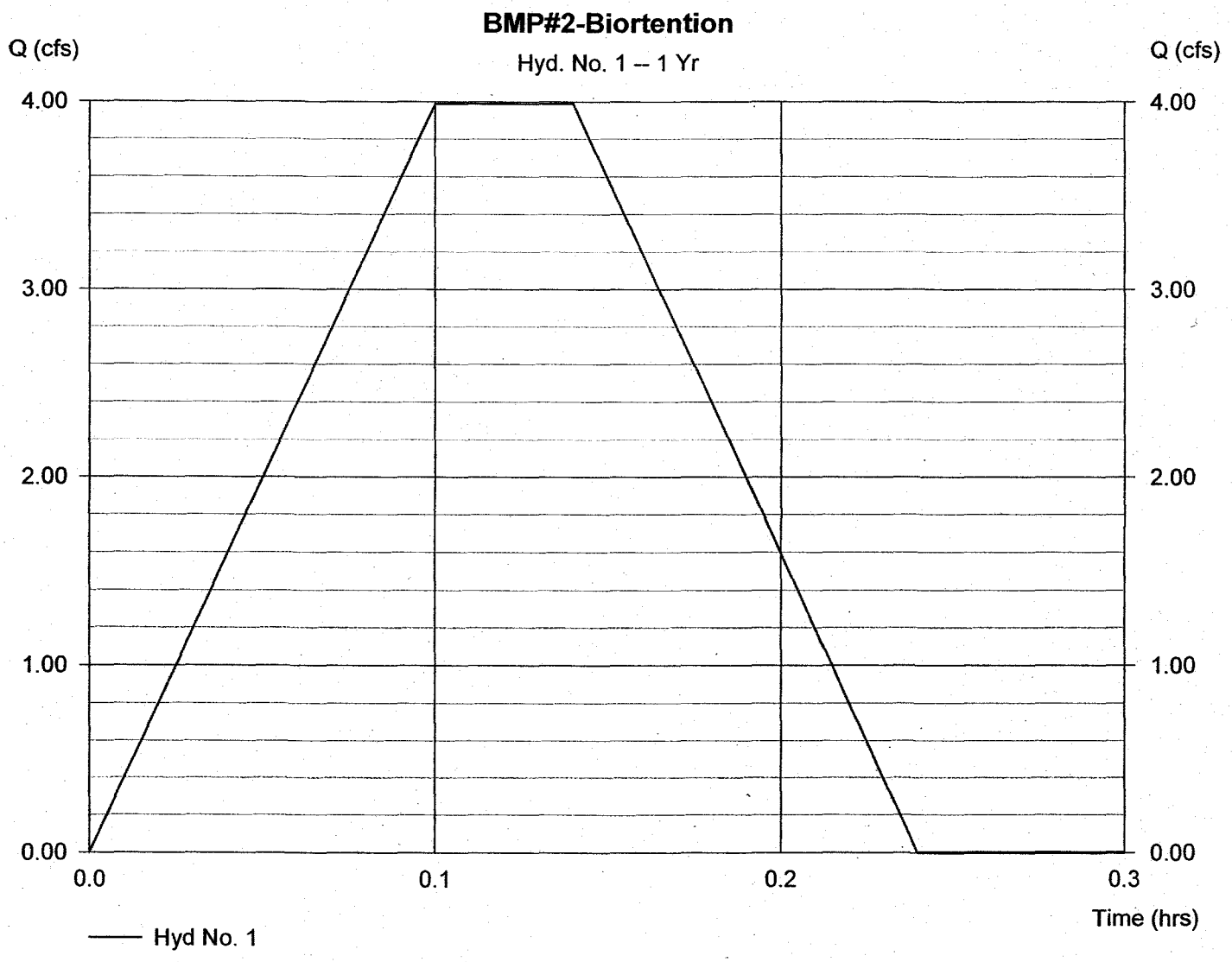
Friday, Aug 14 2009, 11:12 AM

Hyd. No. 1

BMP#2-Biortention

Hydrograph type	= Mod. Rational	Peak discharge	= 3.99 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,796 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Aug 14 2009, 11:12 AM

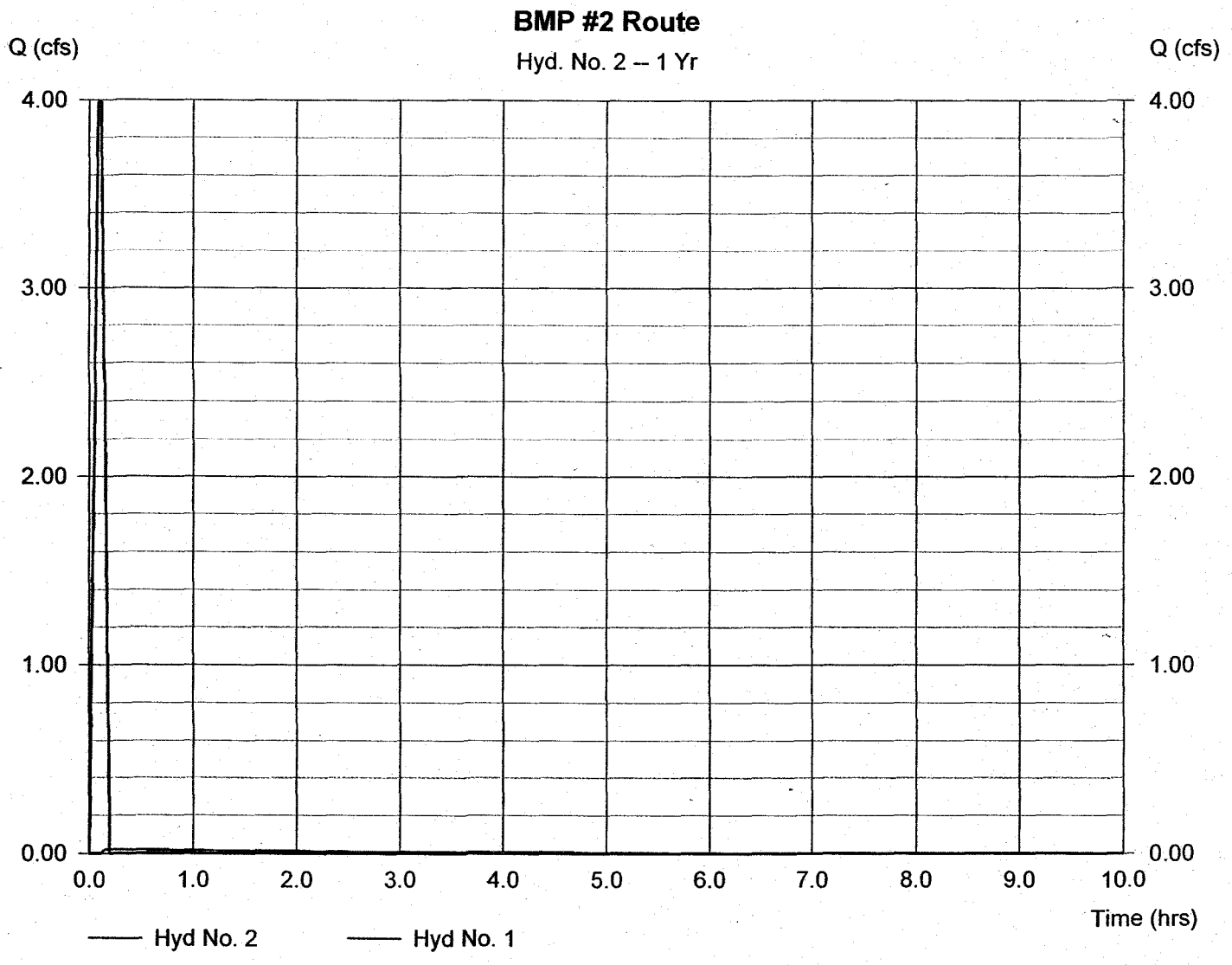
Hyd. No. 2

BMP #2 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.02 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 100.61 ft
Reservoir name	= BMP#2-Bioretention	Max. Storage	= 1,326 cuft

Storage Indication method used.

Hydrograph Volume = 223 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

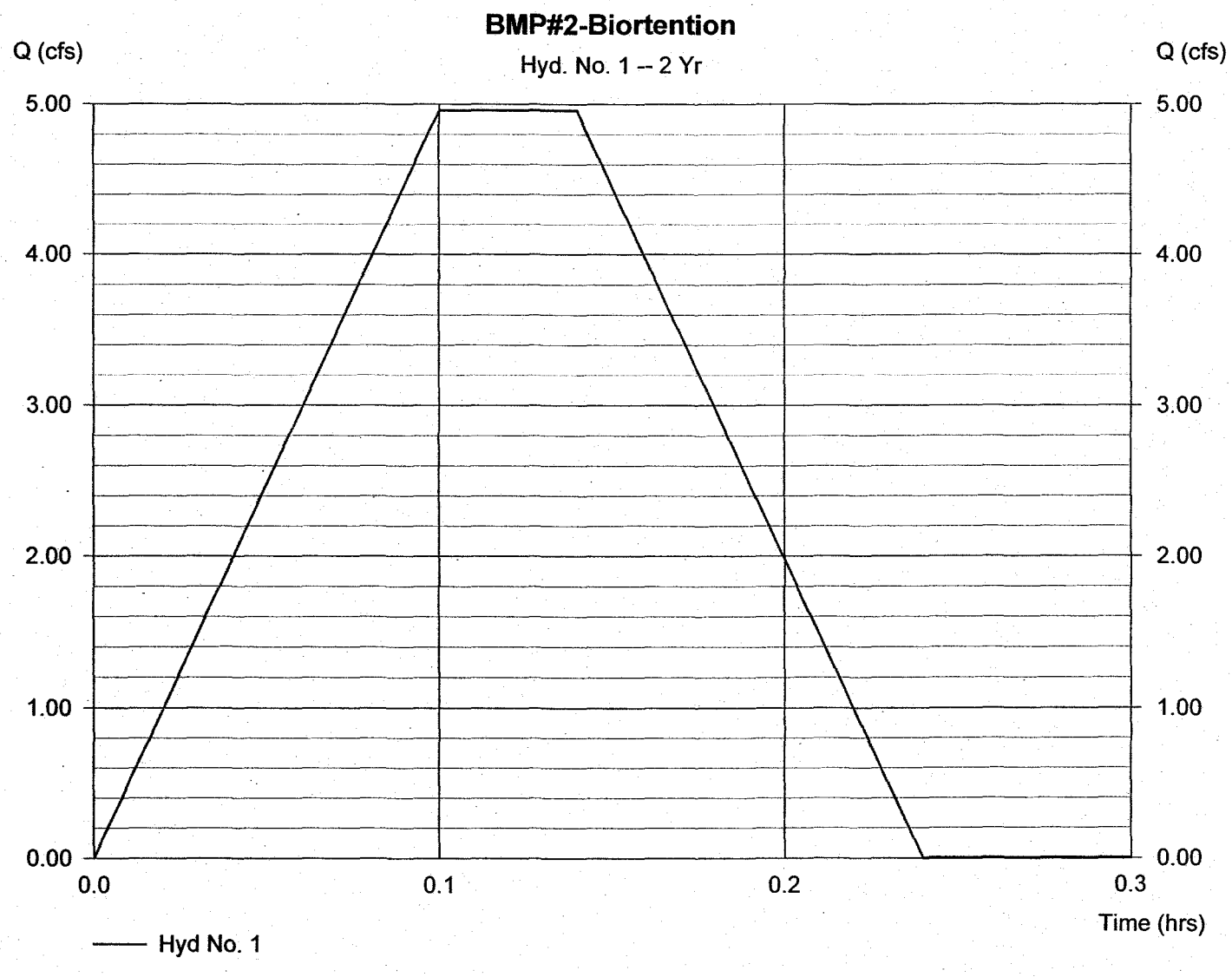
Friday, Aug 14 2009, 11:12 AM

Hyd. No. 1

BMP#2-Biortention

Hydrograph type	= Mod. Rational	Peak discharge	= 4.96 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,232 cuft



Hydrograph Plot

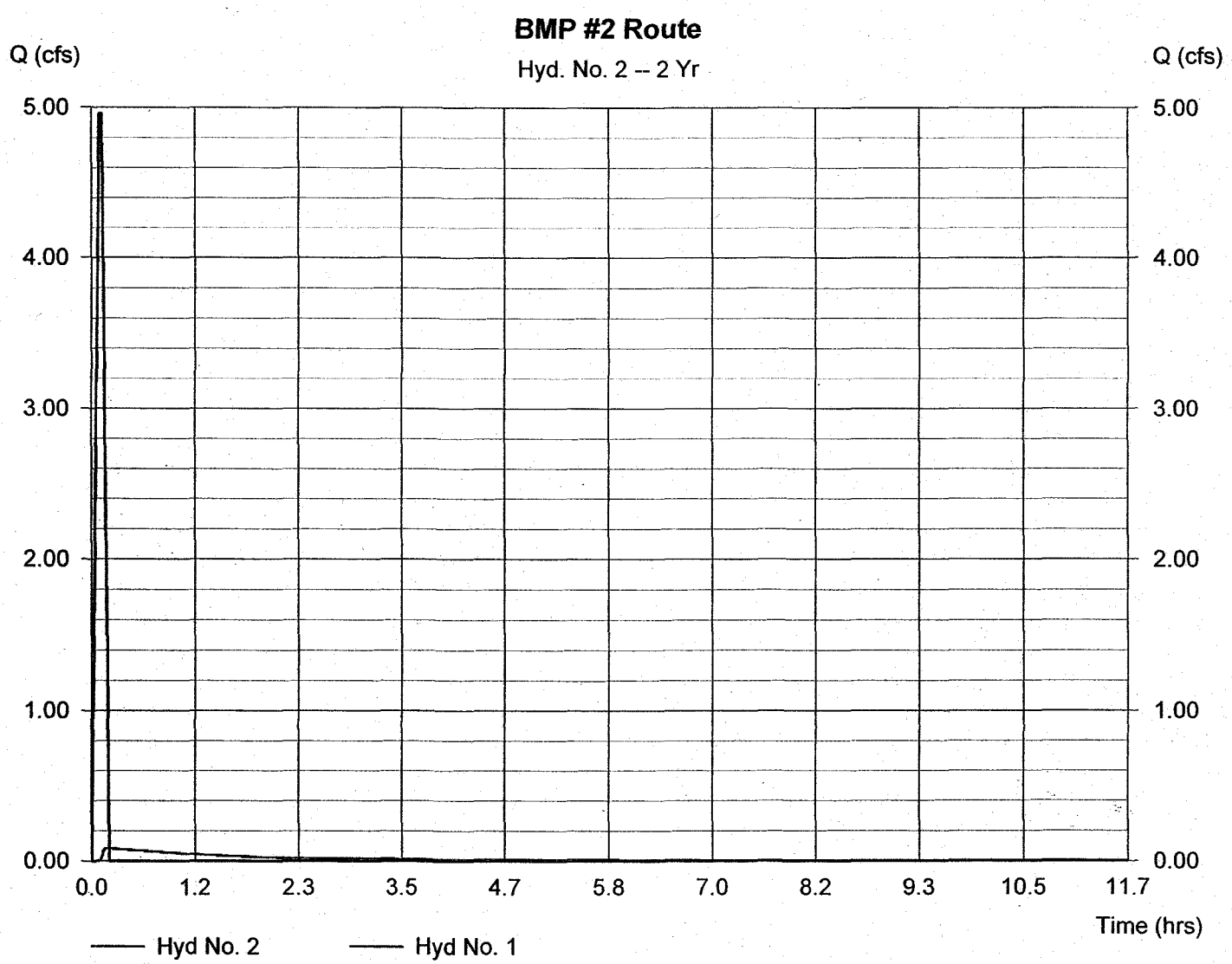
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 11:12 AM

Hyd. No. 2

BMP #2 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.09 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 100.76 ft
Reservoir name	= BMP#2-Bioretention	Max. Storage	= 1,670 cuft

Storage Indication method used. | Hydrograph Volume = 578 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

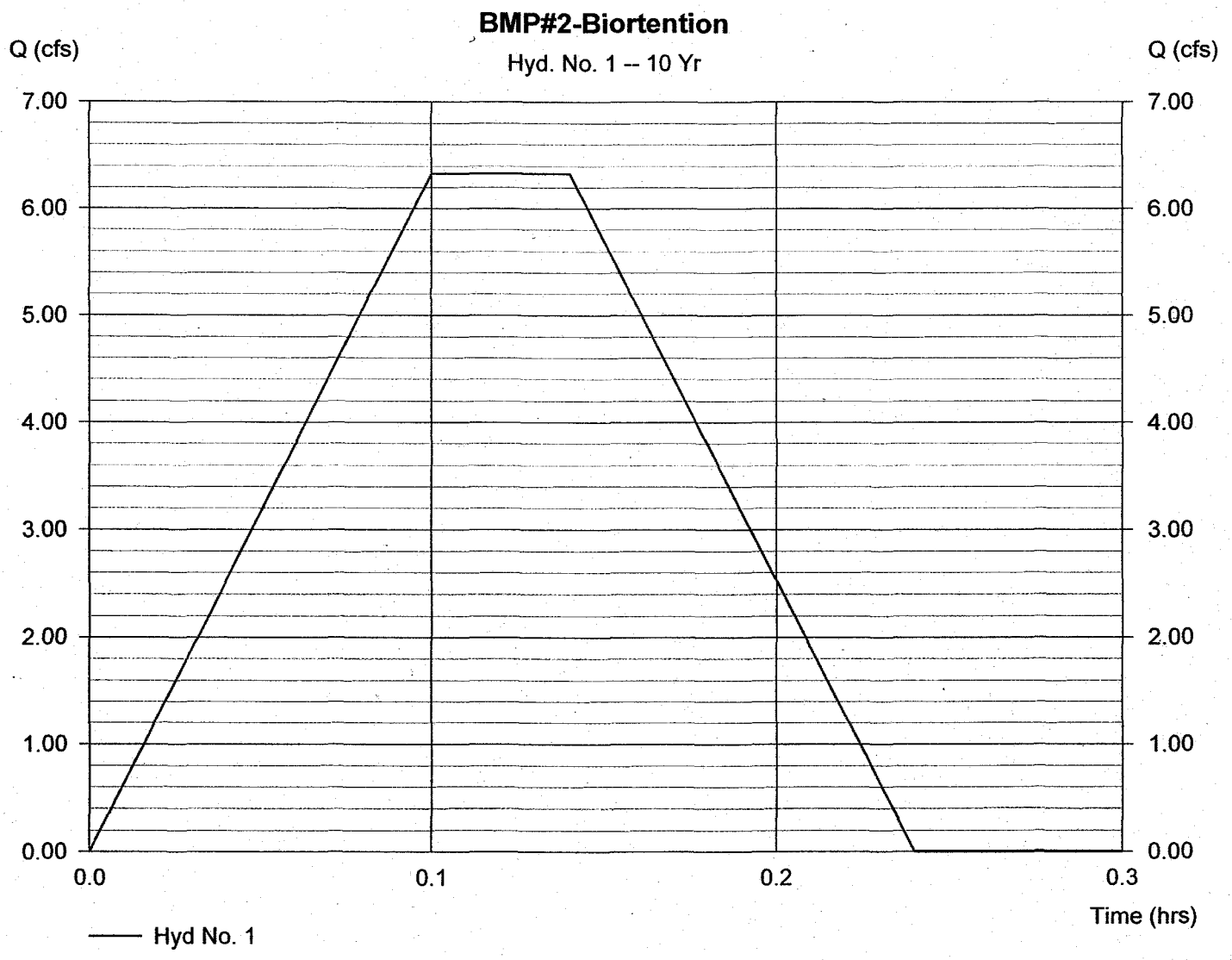
Friday, Aug 14 2009, 11:12 AM

Hyd. No. 1

BMP#2-Biortention

Hydrograph type	= Mod. Rational	Peak discharge	= 6.33 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,848 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Aug 14 2009, 11:12 AM

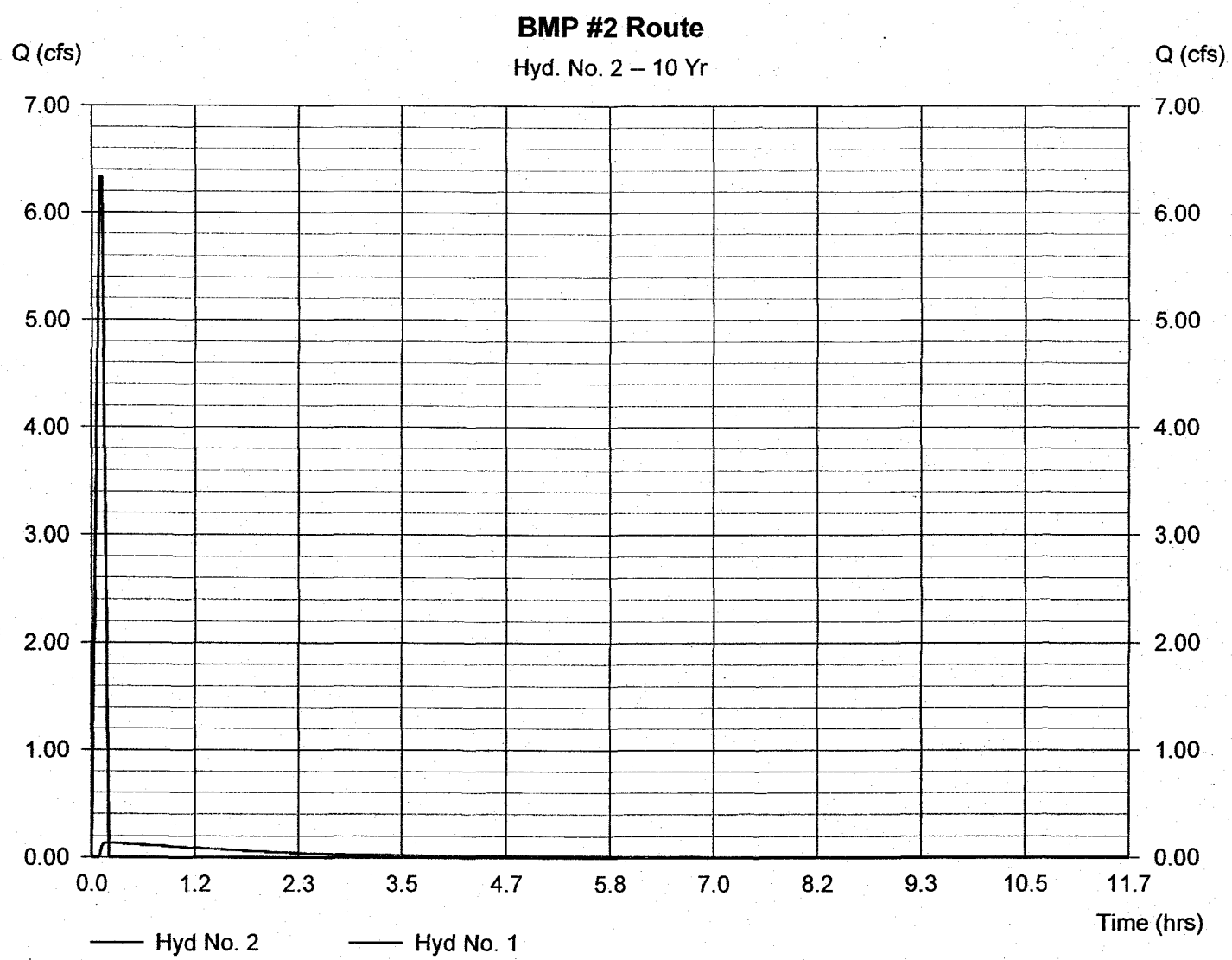
Hyd. No. 2

BMP #2 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.13 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 100.95 ft
Reservoir name	= BMP#2-Bioretention	Max. Storage	= 2,072 cuft

Storage Indication method used.

Hydrograph Volume = 993 cuft



Hydrograph Plot

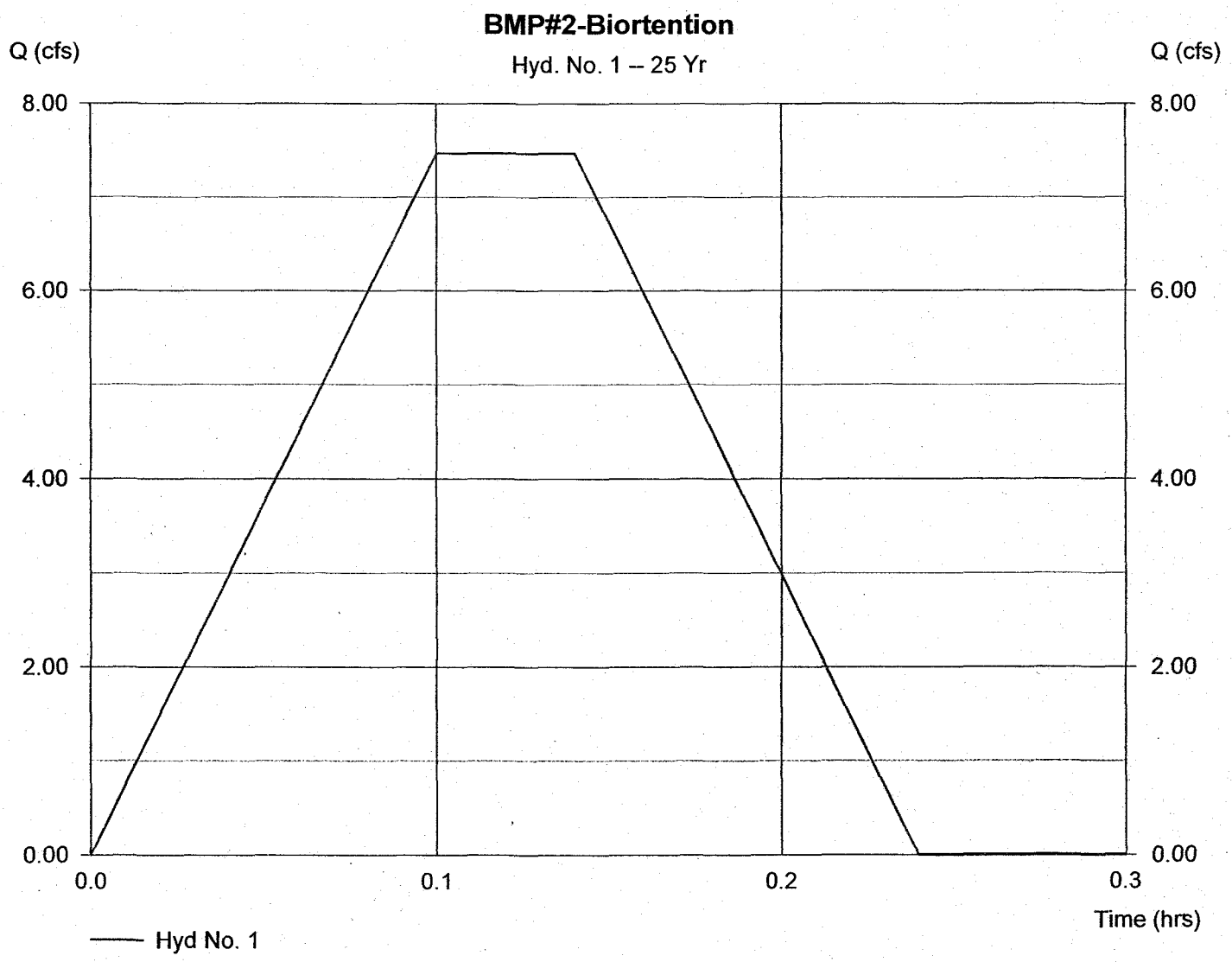
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 9:45 AM

Hyd. No. 1

BMP#2-Biortention

Hydrograph type	= Mod. Rational	Peak discharge	= 7.47 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,363 cuft



Hydrograph Plot

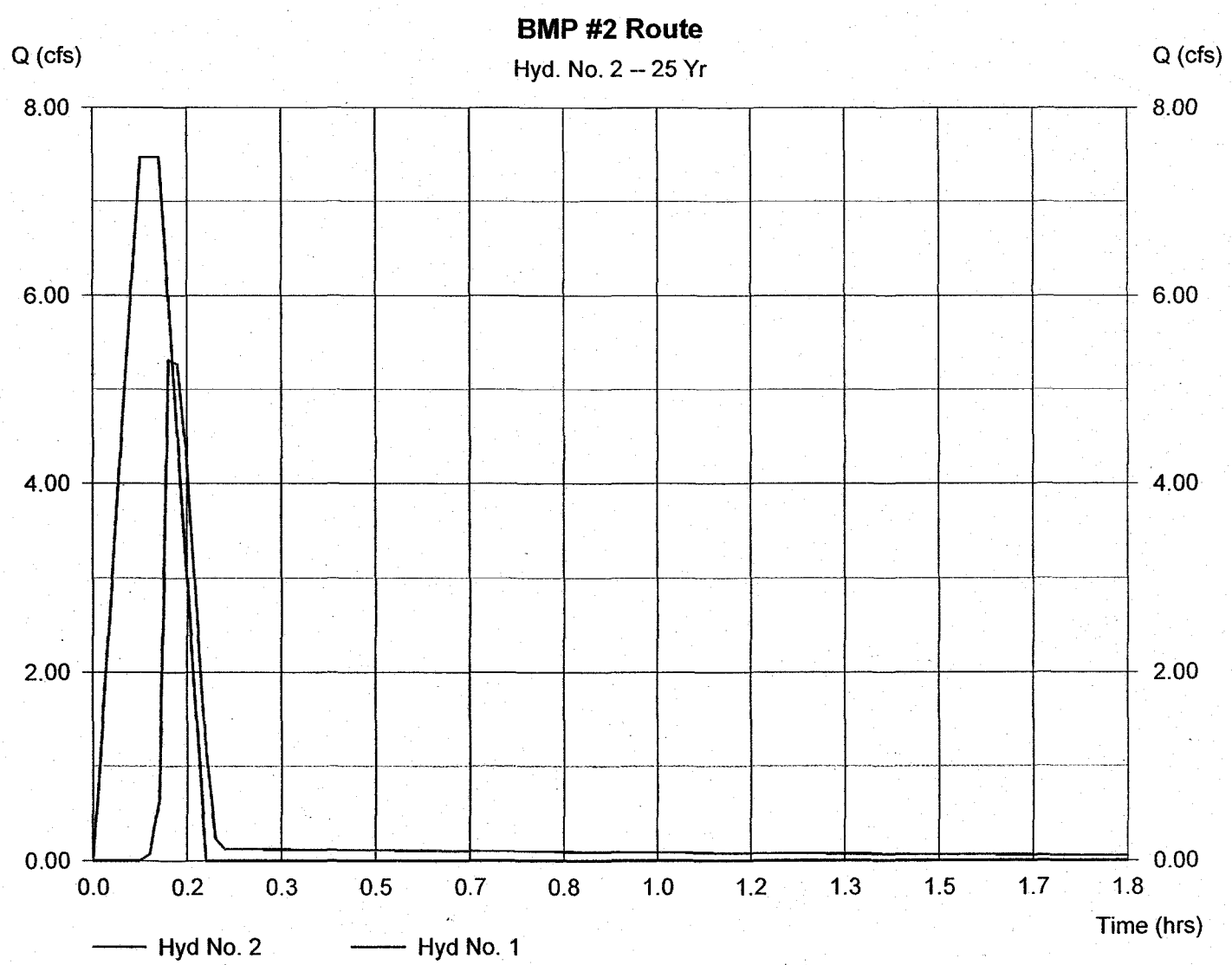
Hydraflow Hydrographs by Intelisolve | Wednesday, Nov 18 2009, 9:45 AM

Hyd. No. 2

BMP #2 Route

Hydrograph type	= Reservoir	Peak discharge	= 5.31 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 101.01 ft
Reservoir name	= BMP#2-Bioretention	Max. Storage	= 2,219 cuft

Storage Indication method used. | Hydrograph Volume = 2,033 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

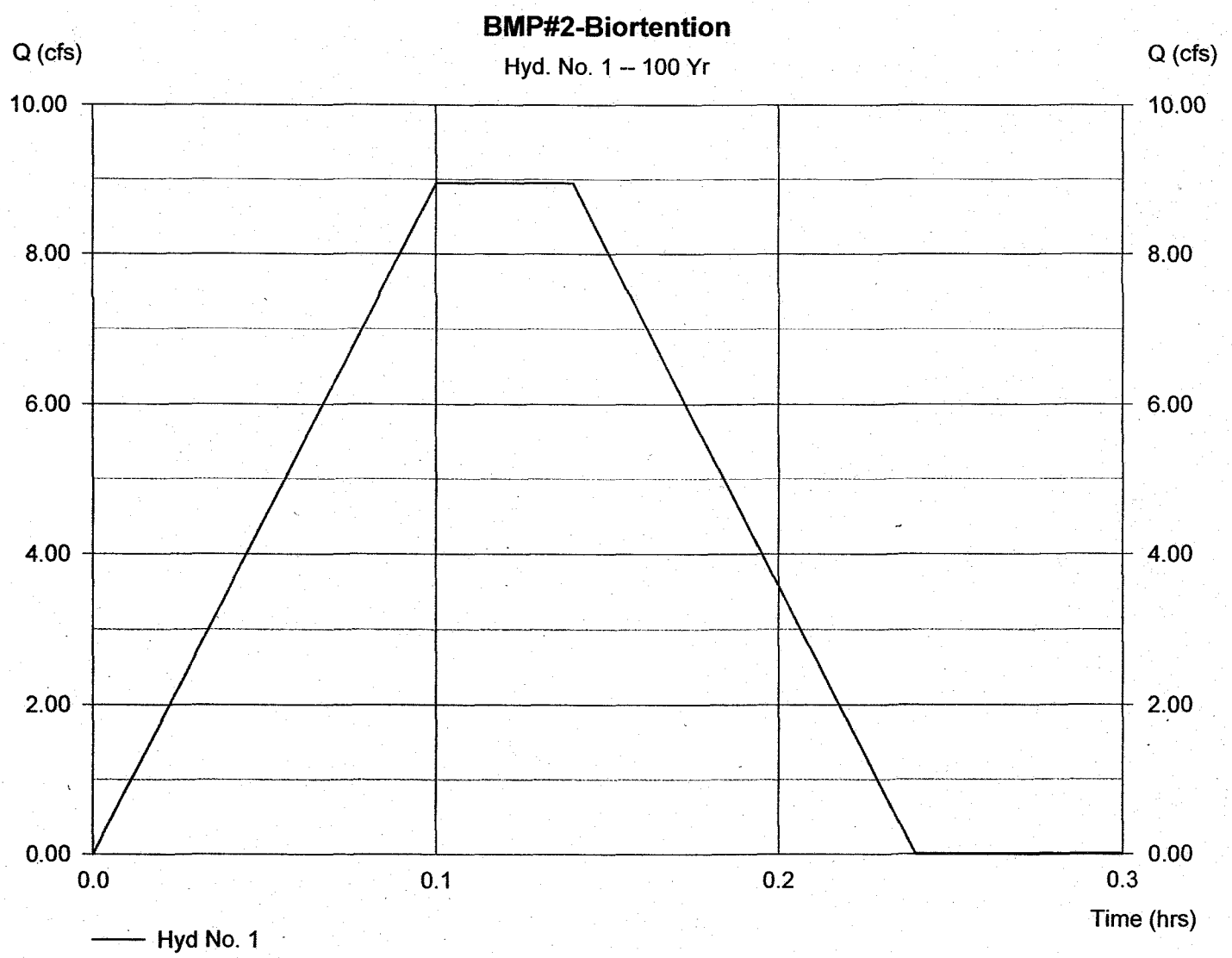
Friday, Aug 14 2009, 11:12 AM

Hyd. No. 1

BMP#2-Biortention

Hydrograph type	= Mod. Rational	Peak discharge	= 8.95 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,029 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Aug 14 2009, 11:12 AM

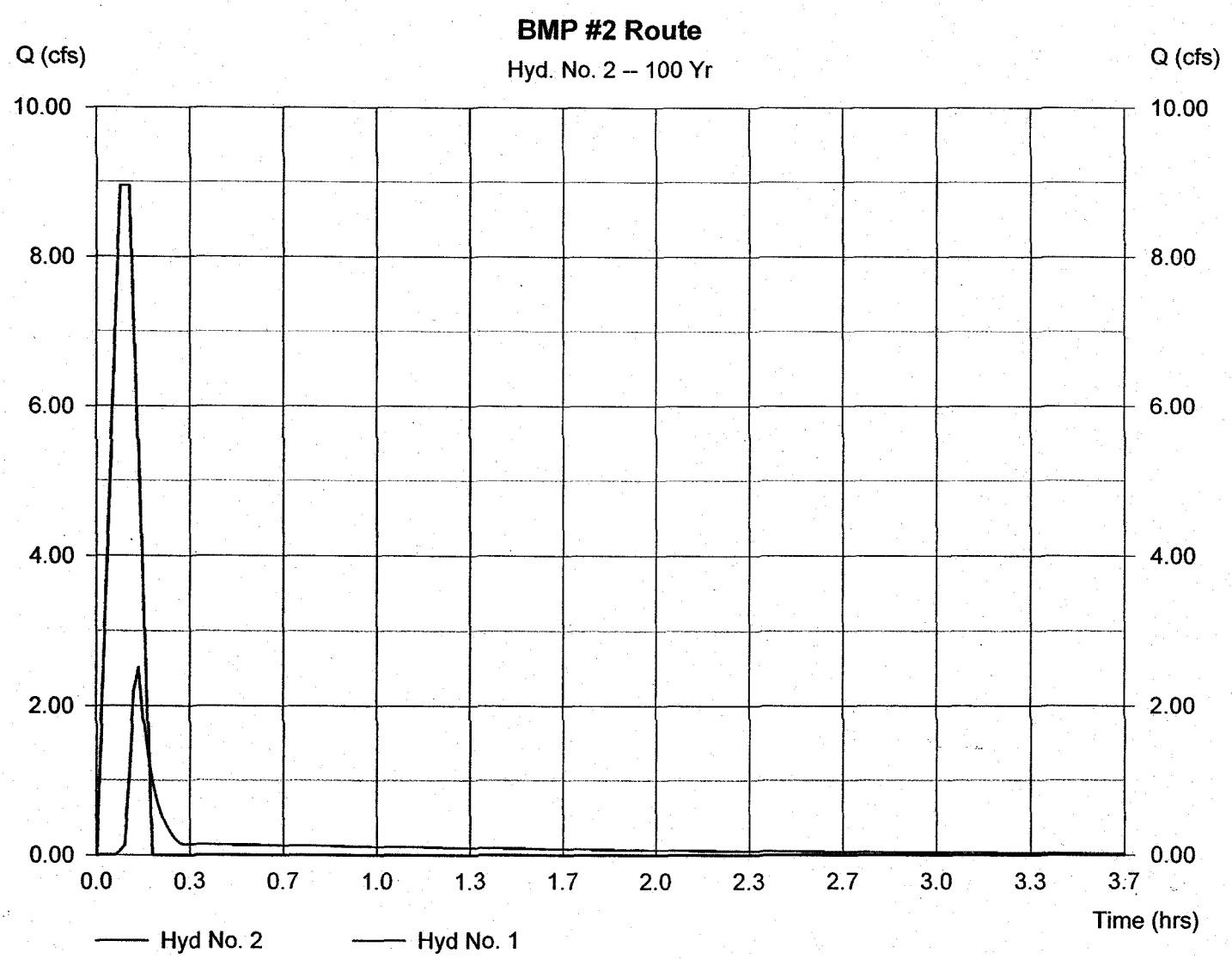
Hyd. No. 2

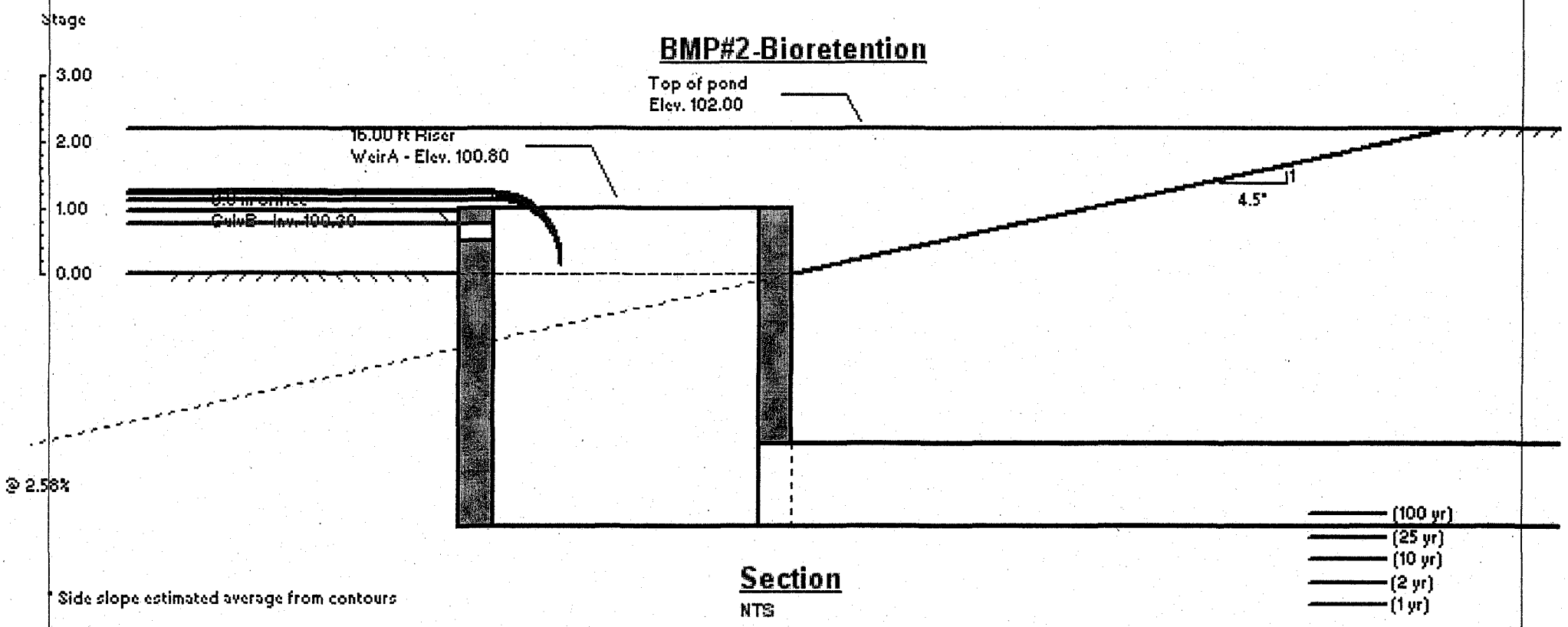
BMP #2 Route

Hydrograph type	= Reservoir	Peak discharge	= 2.52 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 101.12 ft
Reservoir name	= BMP#2-Bioretention	Max. Storage	= 2,591 cuft

Storage Indication method used.

Hydrograph Volume = 1,823 cuft





Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: Bioretention #2.gpw	Wednesday, Nov 18 2009, 9:54 AM

BMP #2 BIORET.
COMPGULATION

Pond Report

Hydraflow Hydrographs by Intelisolve

Wednesday, Nov 18 2009, 9:53 AM

Pond No. 1 - BMP#2-Bioretention

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	99.80	1,877	0	0
1.00	101.00	2,501	2,189	2,189
2.20	102.00	4,103	3,962	6,151

Culvert / Orifice Structures

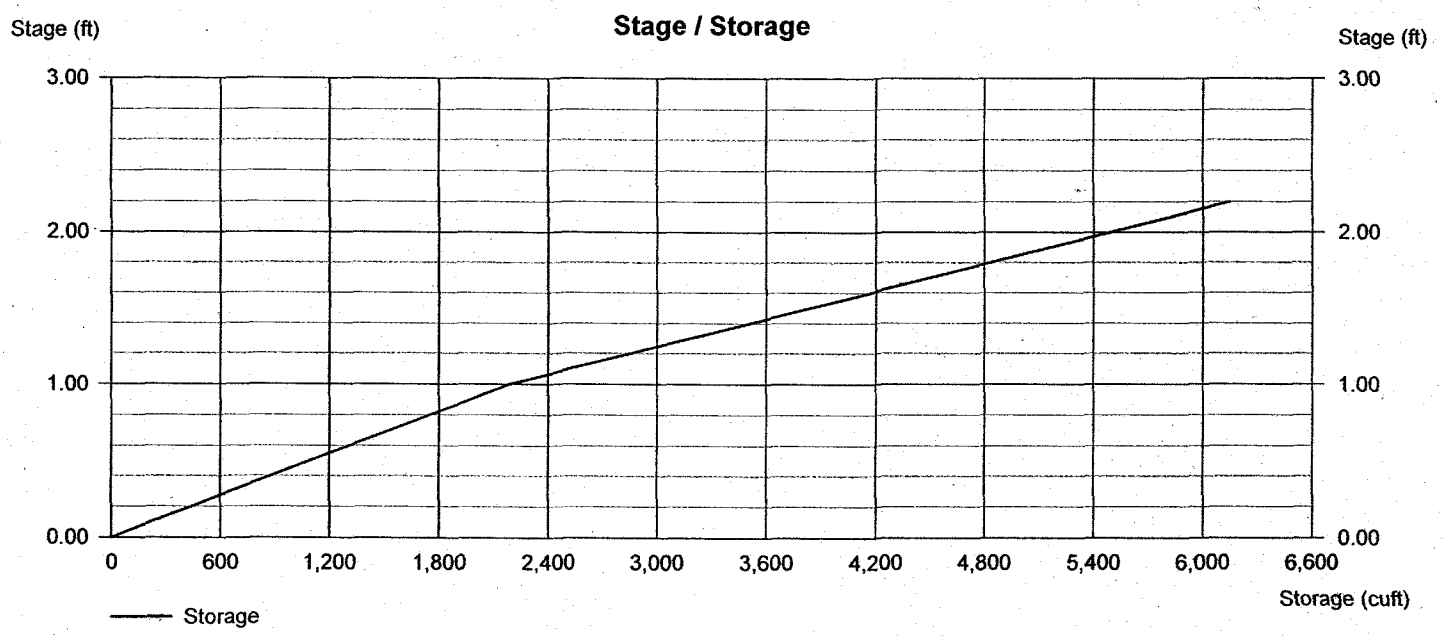
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 96.00	100.30	0.00	0.00
Length (ft)	= 208.00	0.00	0.00	0.00
Slope (%)	= 2.58	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 100.80	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#3A: Existing Dry ED Basin (Fieldstone Parkway)

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	2	EA	5,000	10,000	0.23
Roadway				30,800	0.71
Sidewalk	-	LF		8,800	0.20
				Total Impervious Area:	**1.14**
				Total Drainage Area:	**2.50**
				Total Percent Impervious:	**45.5%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.68
Forested:	0.25		0.68
Impervious Surfaces:	0.95		1.14
		Weighted "C" value:	**0.60**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.68
Forested:	77		0.68
Impervious Surfaces:	98		1.14
		Weighted "CN" value:	**66**

BMP#3B: Existing Dry ED Basin (Stonehouse Glen Development)

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Lots	2	EA	5,000	10,000	0.23
Roadway				16,500	0.38
Sidewalk				-	0.00
				Total Impervious Area:	**0.61**
				Total Drainage Area:	**1.07**
				Total Percent Impervious:	**56.9%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.23
Forested:	0.25		0.23
Impervious Surfaces:	0.95		0.61
		Weighted "C" value:	**0.67**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.23
Forested:	77		0.23
Impervious Surfaces:	98		0.61
		Weighted "CN" value:	**73**

DESIGN WORKSHEET - IMPERVIOUS AREAS

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	08/17/09

BMP#3C: Existing Dry ED Basin (Stonehouse Glen)

Description	Quantity	Unit	Impervious Per Unit	Area (SF)	Area (ac)
Lots	2	EA	5,000	10,000	0.23
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**0.23**
				Total Drainage Area:	**1.14**
				Total Percent Impervious:	**20.1%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.46
Forested:	0.25		0.46
Impervious Surfaces:	0.95		0.23
		Weighted "C" value:	**0.43**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.46
Forested:	77		0.46
Impervious Surfaces:	98		0.23
		Weighted "CN" value:	**52**

BMP#3D: Existing Dry ED Basin (Fieldstone Parkway)

Description	Quantity	Unit	Impervious Per Unit	Area (SF)	Area (ac)
Lots	0	EA	5,000	-	0.00
Roadway				-	0.00
Sidewalk				-	0.00
				Total Impervious Area:	**0.00**
				Total Drainage Area:	**0.94**
				Total Percent Impervious:	**0.0%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.47
Forested:	0.25		0.47
Impervious Surfaces:	0.95		0.00
		Weighted "C" value:	**0.30**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.47
Forested:	77		0.47
Impervious Surfaces:	98		0.00
		Weighted "CN" value:	**40**

BMP#4: WET EXTENDED DETETION POND
DESIGN WORKSHEET & CALCULATIONS

Hydrograph Plot

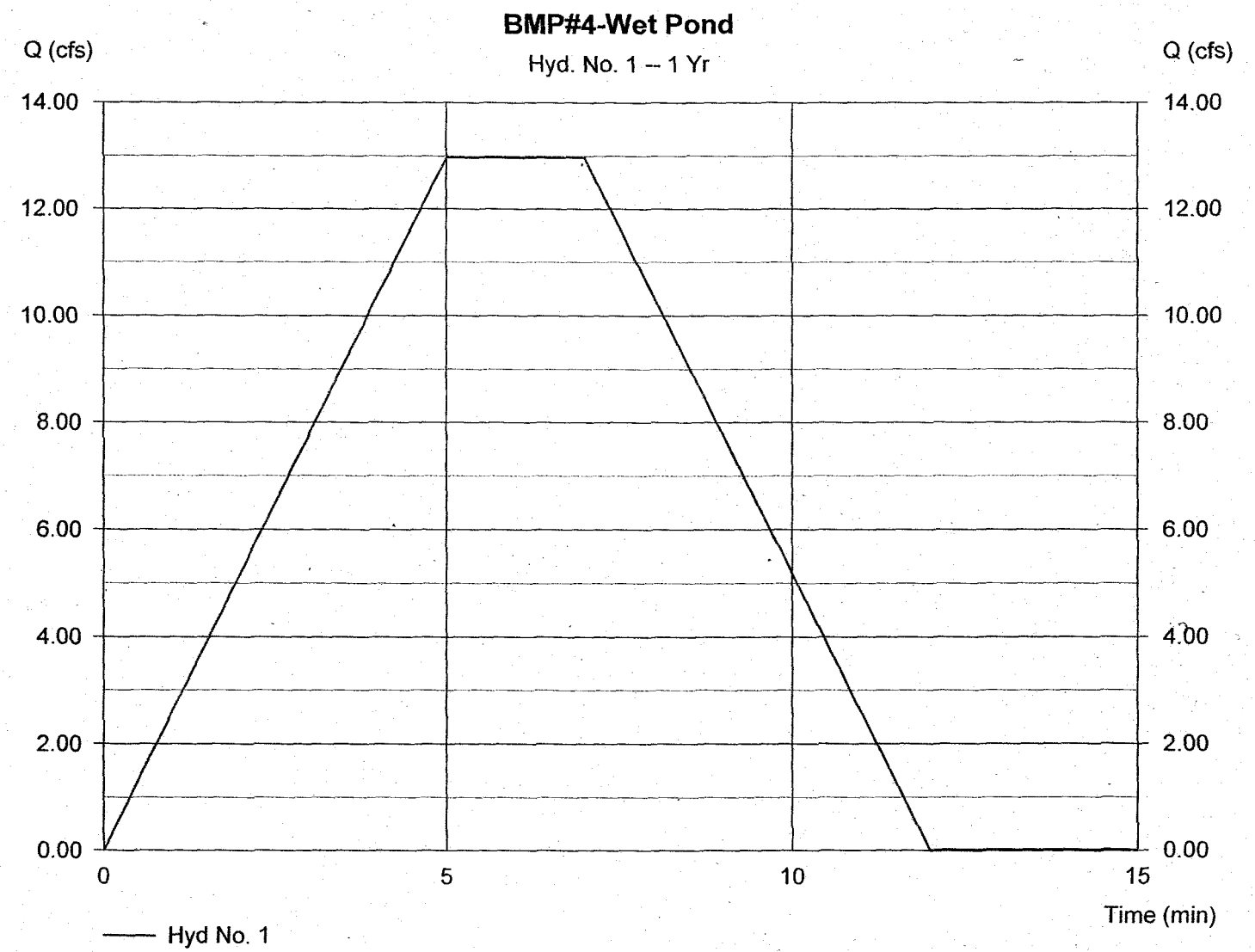
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:16 AM

Hyd. No. 1

BMP#4-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 12.97 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 5.690 ac	Runoff coeff.	= 0.56
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 5,837 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:29 AM

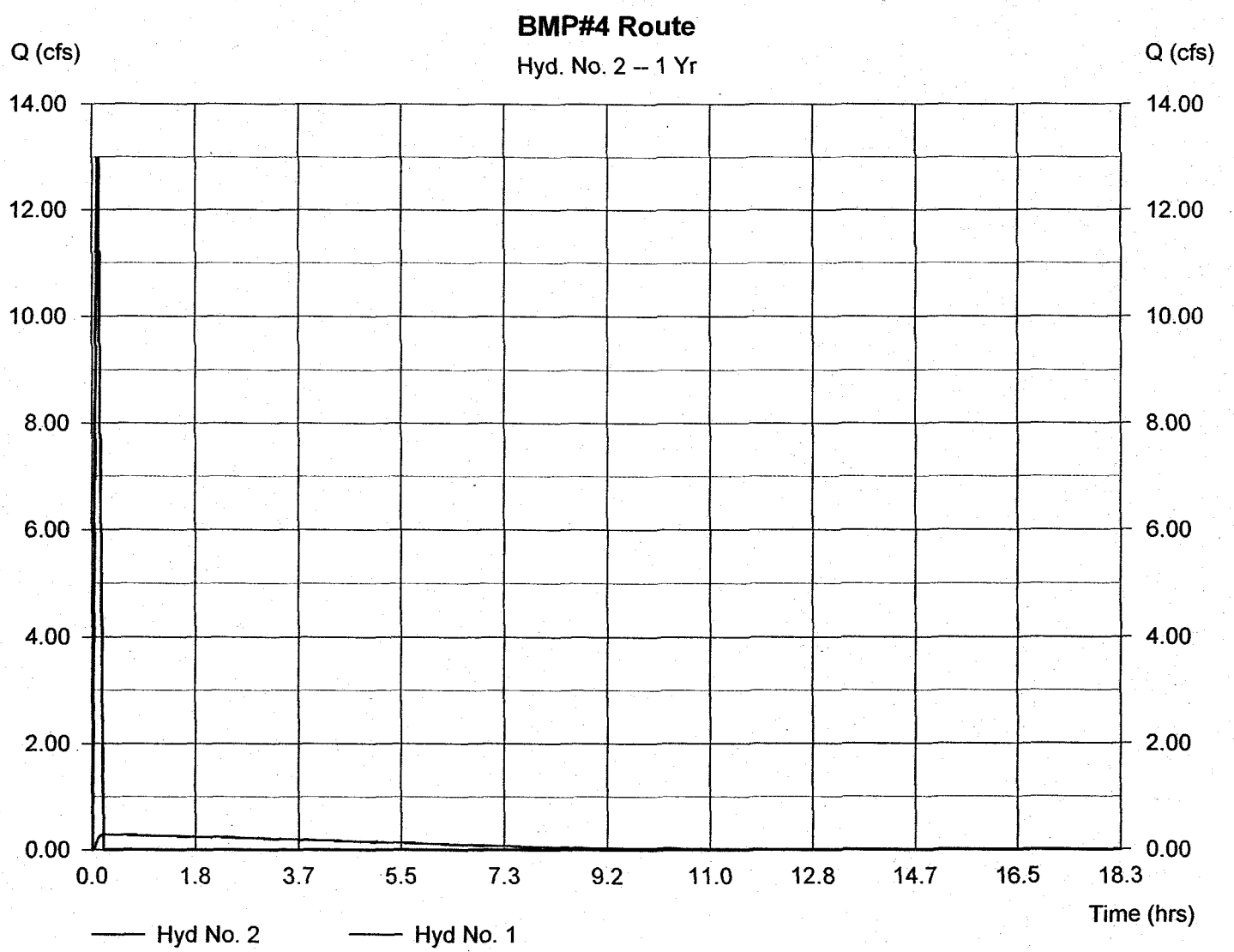
Hyd. No. 2

BMP#4 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.28 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 75.55 ft
Reservoir name	= BMP#4-Wet Pond	Max. Storage	= 5,325 cuft

Storage Indication method used.

Hydrograph Volume = 5,432 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

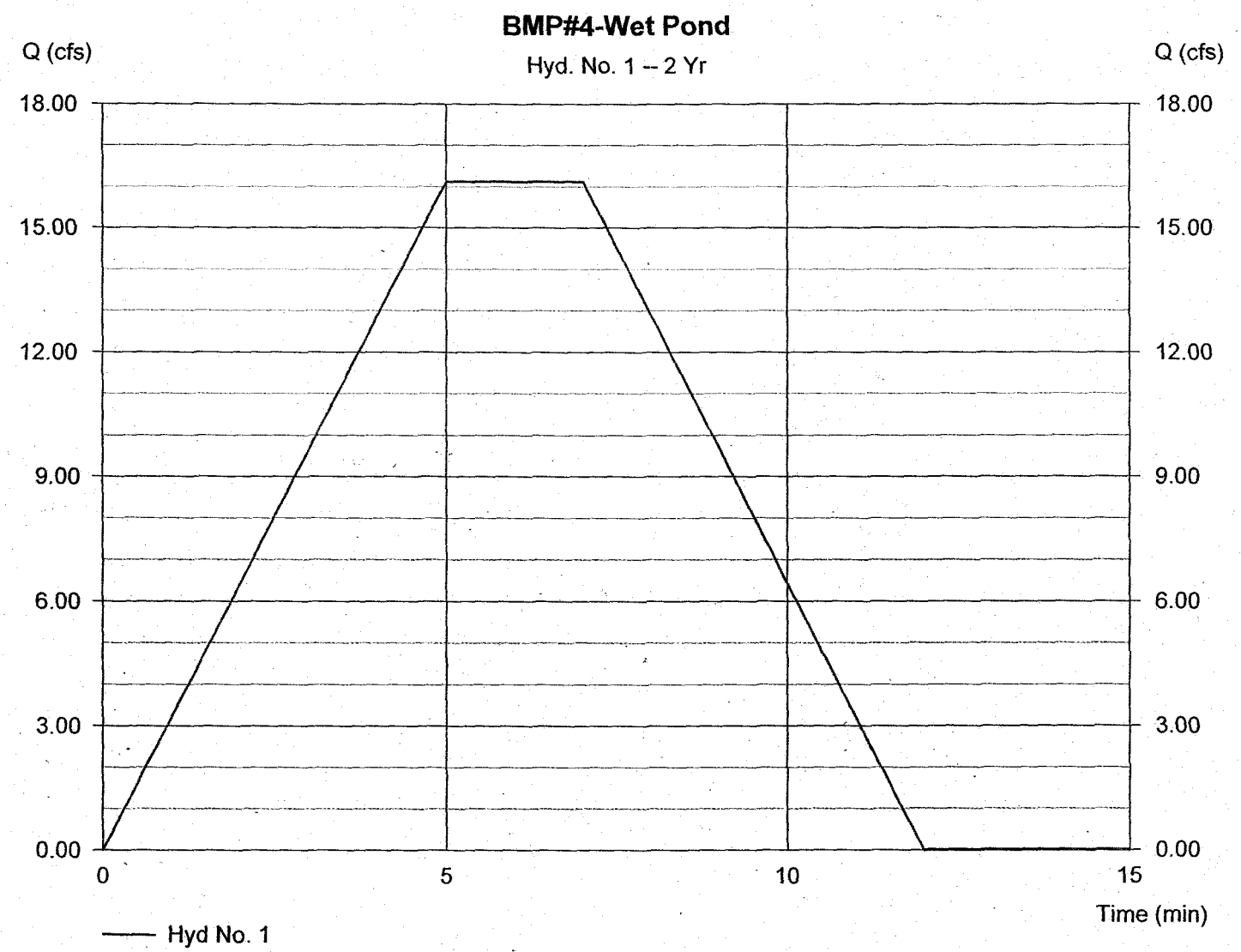
Thursday, Mar 18 2010, 8:16 AM

Hyd. No. 1

BMP#4-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 16.12 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 5.690 ac	Runoff coeff.	= 0.56
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 7,254 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:29 AM

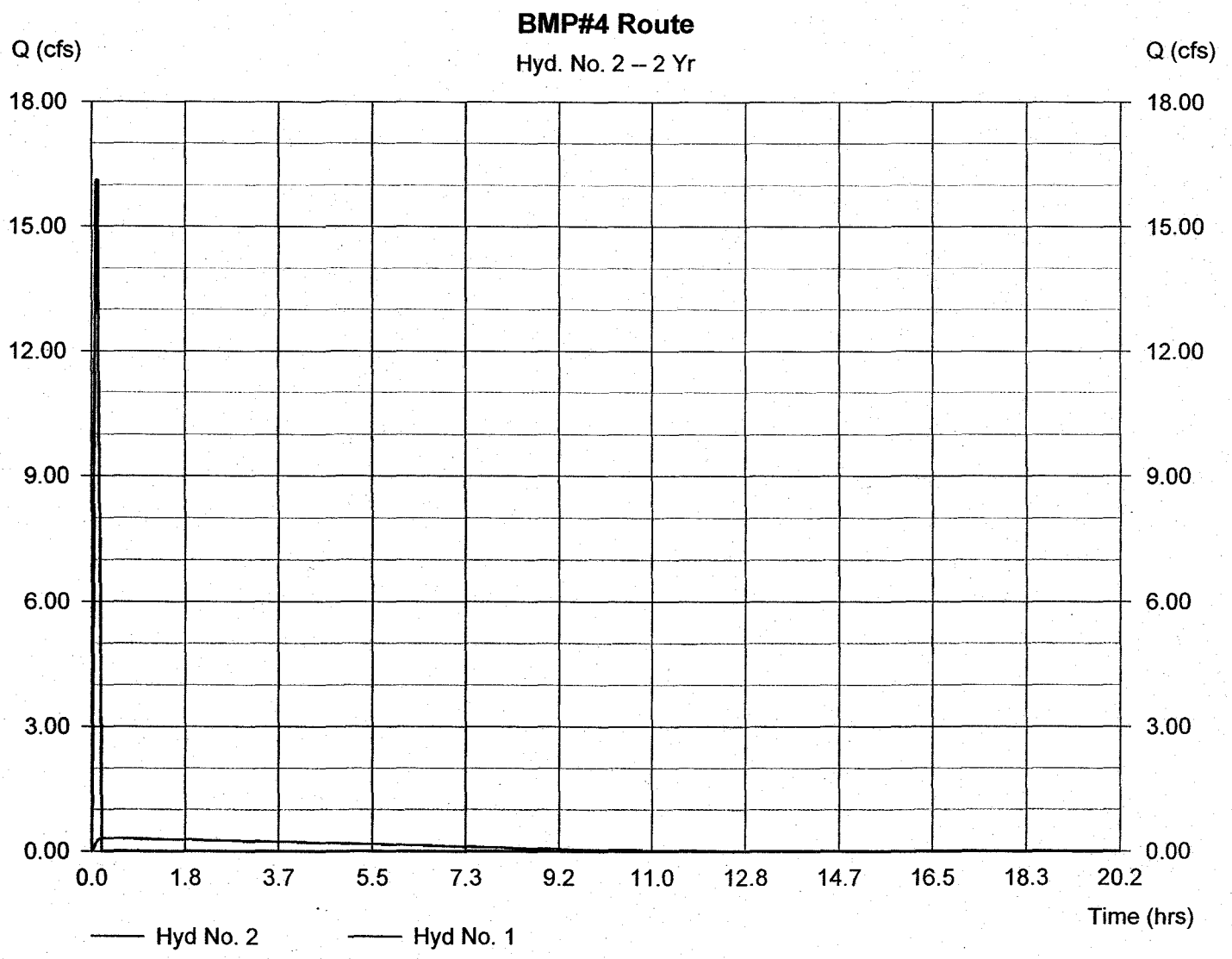
Hyd. No. 2

BMP#4 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.31 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 75.87 ft
Reservoir name	= BMP#4-Wet Pond	Max. Storage	= 6,632 cuft

Storage Indication method used.

Hydrograph Volume = 6,754 cuft



Hydrograph Plot

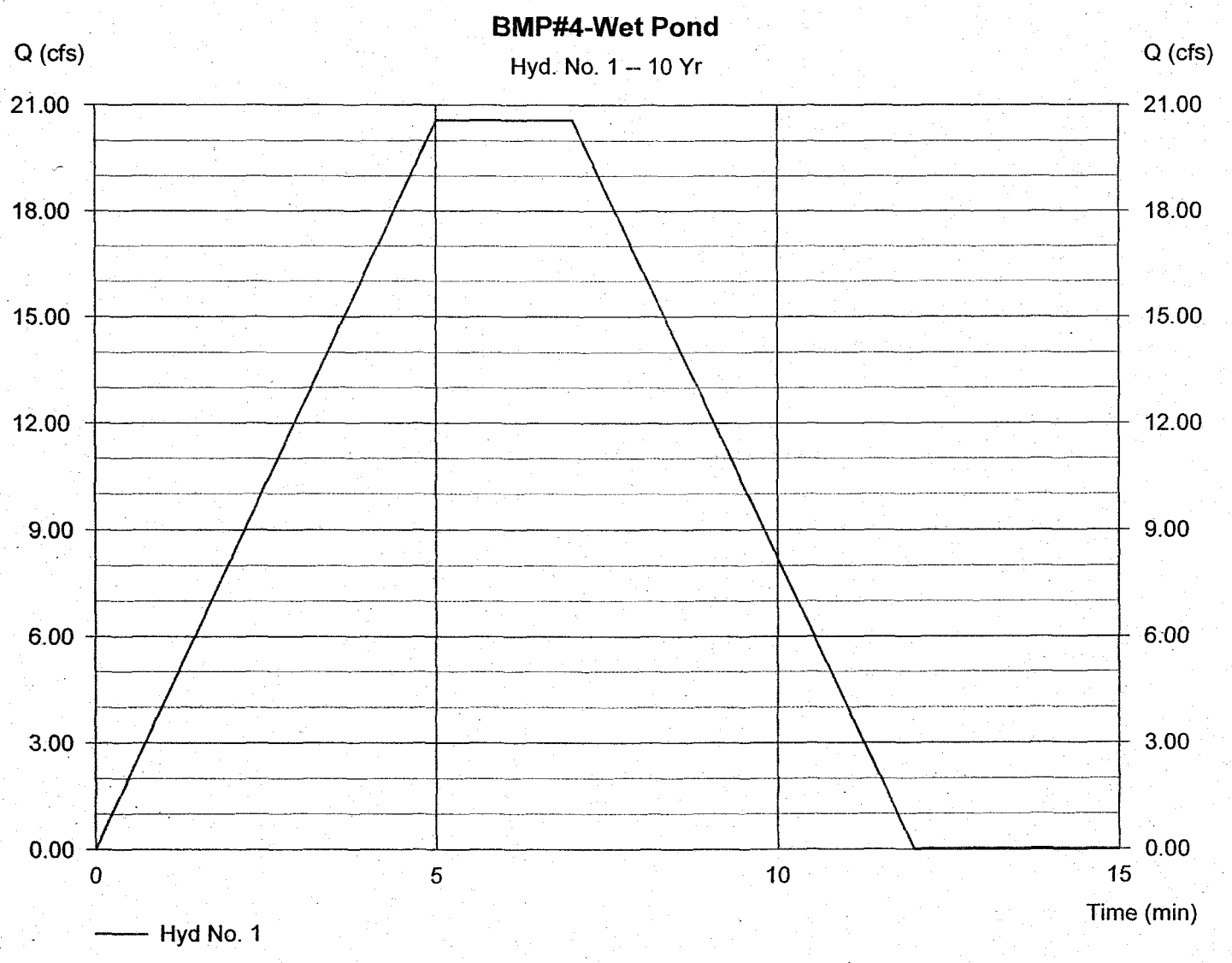
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:16 AM

Hyd. No. 1

BMP#4-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 20.57 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 5.690 ac	Runoff coeff.	= 0.56
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 9,257 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:29 AM

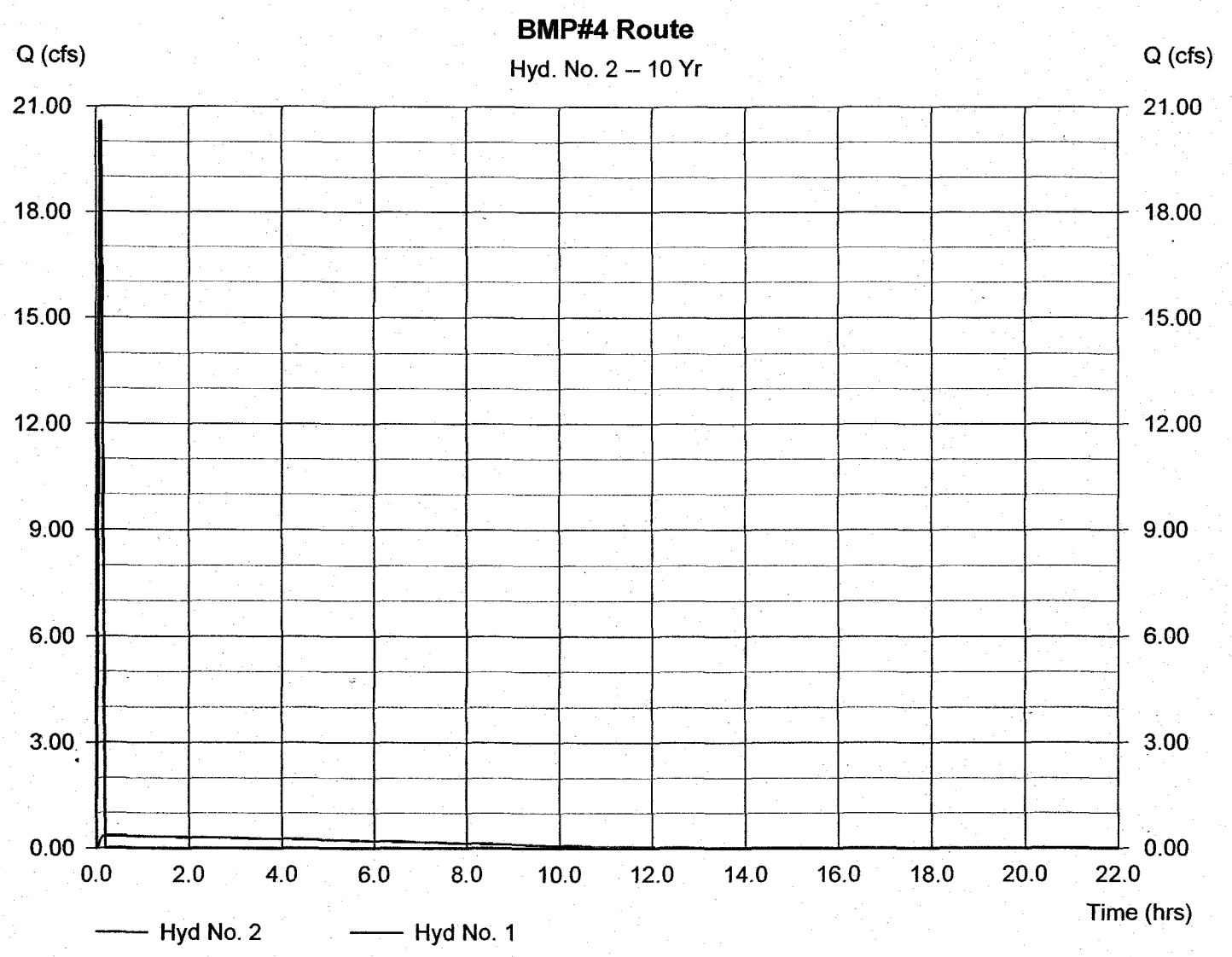
Hyd. No. 2

BMP#4 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.35 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 76.27 ft
Reservoir name	= BMP#4-Wet Pond	Max. Storage	= 8,484 cuft

Storage Indication method used.

Hydrograph Volume = 8,624 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

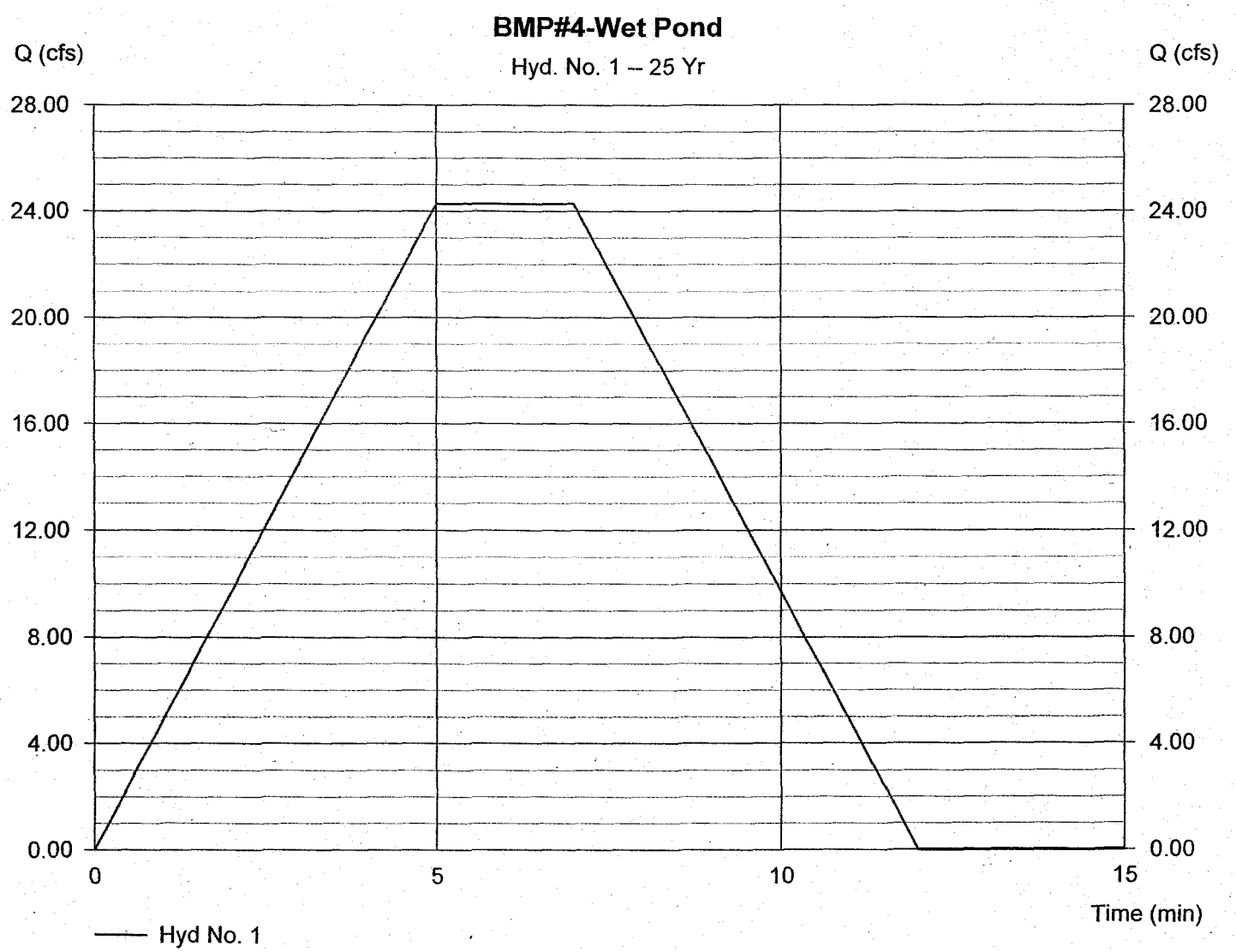
Thursday, Mar 18 2010, 8:16 AM

Hyd. No. 1

BMP#4-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 24.29 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 5.690 ac	Runoff coeff.	= 0.56
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 10,929 cuft



Hydrograph Plot

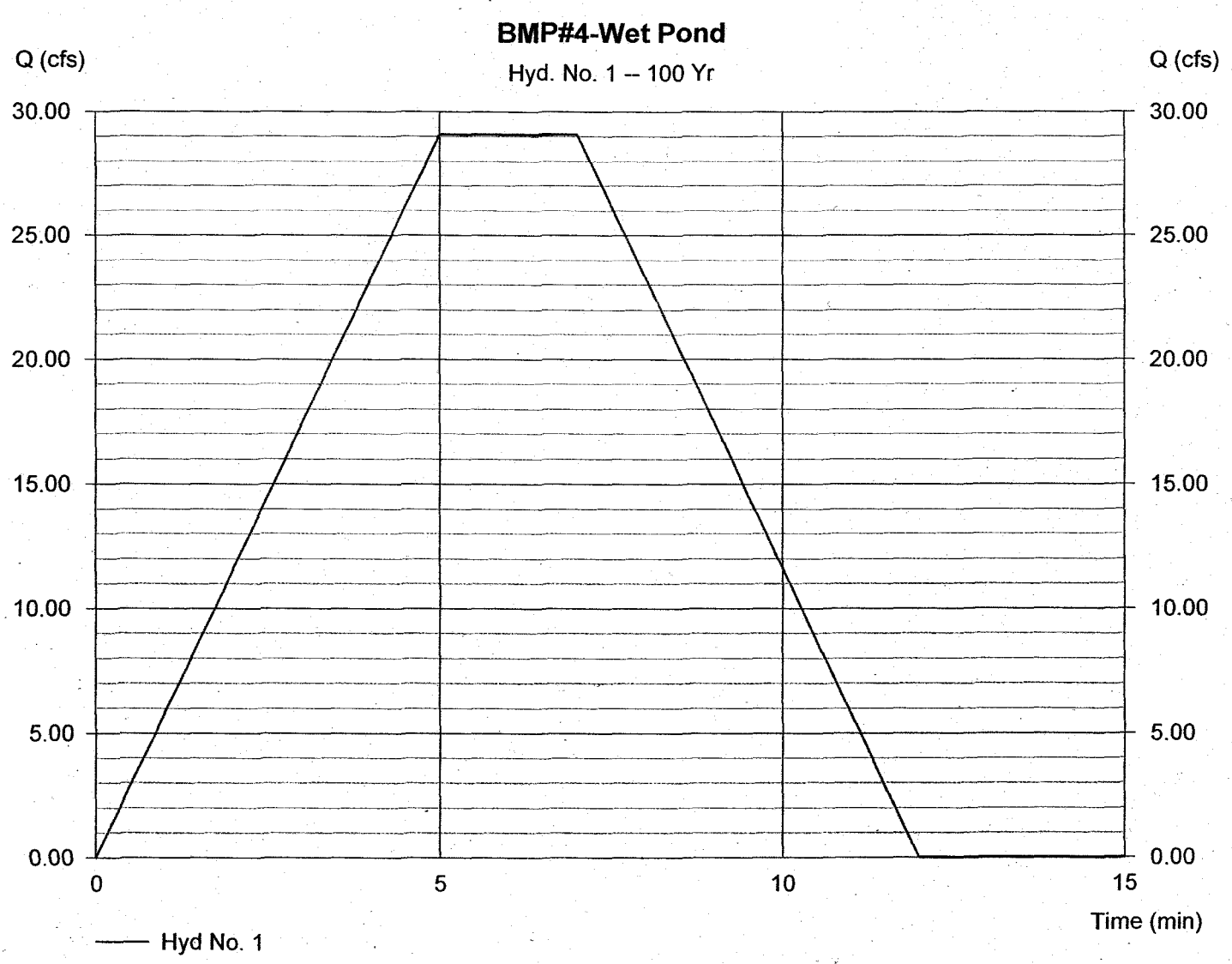
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:28 AM

Hyd. No. 1

BMP#4-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 29.10 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 5.690 ac	Runoff coeff.	= 0.56
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 13,095 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:29 AM

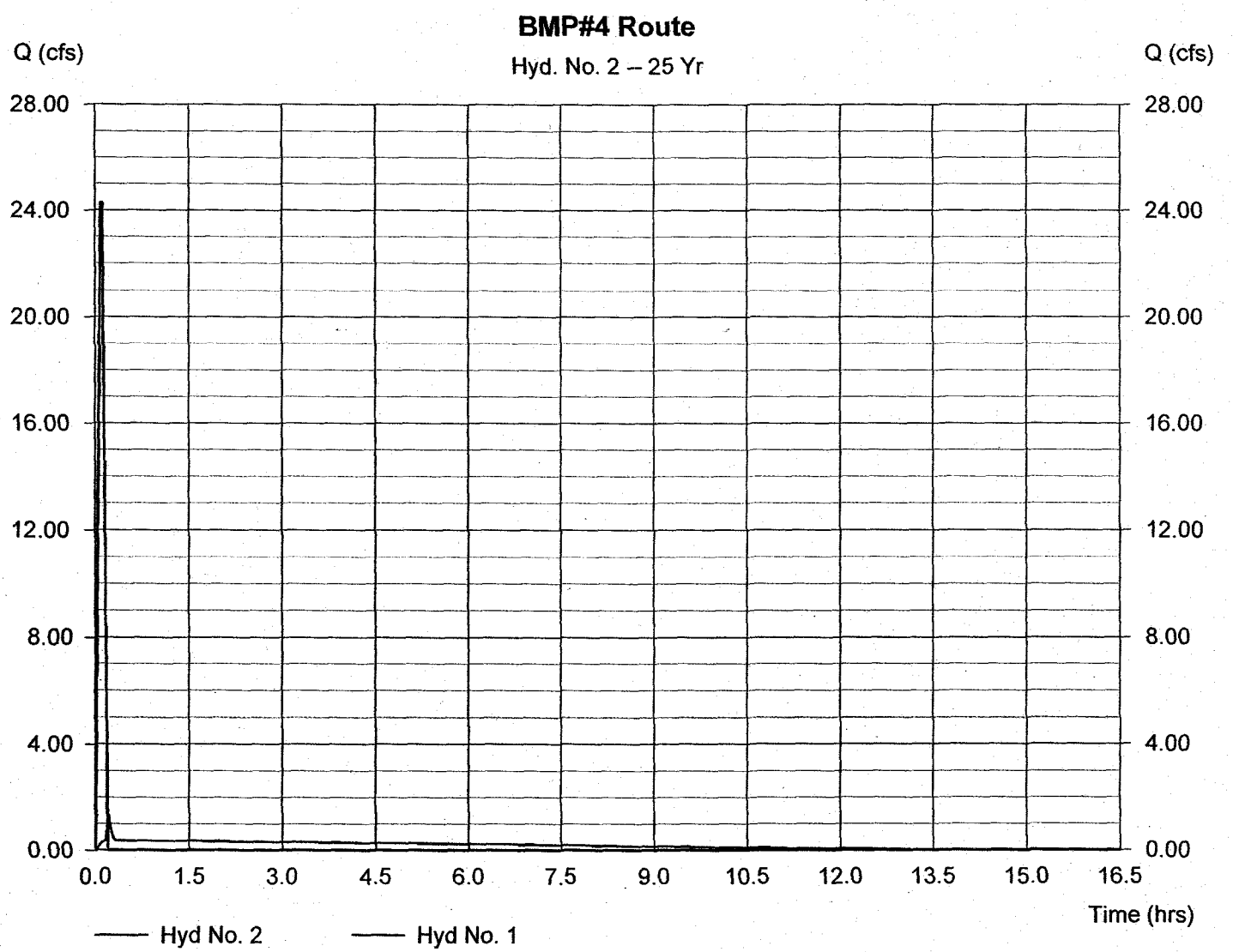
Hyd. No. 2

BMP#4 Route

Hydrograph type	= Reservoir	Peak discharge	= 1.34 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 76.56 ft
Reservoir name	= BMP#4-Wet Pond	Max. Storage	= 9,959 cuft

Storage Indication method used.

Hydrograph Volume = 10,185 cuft



Hydrograph Plot

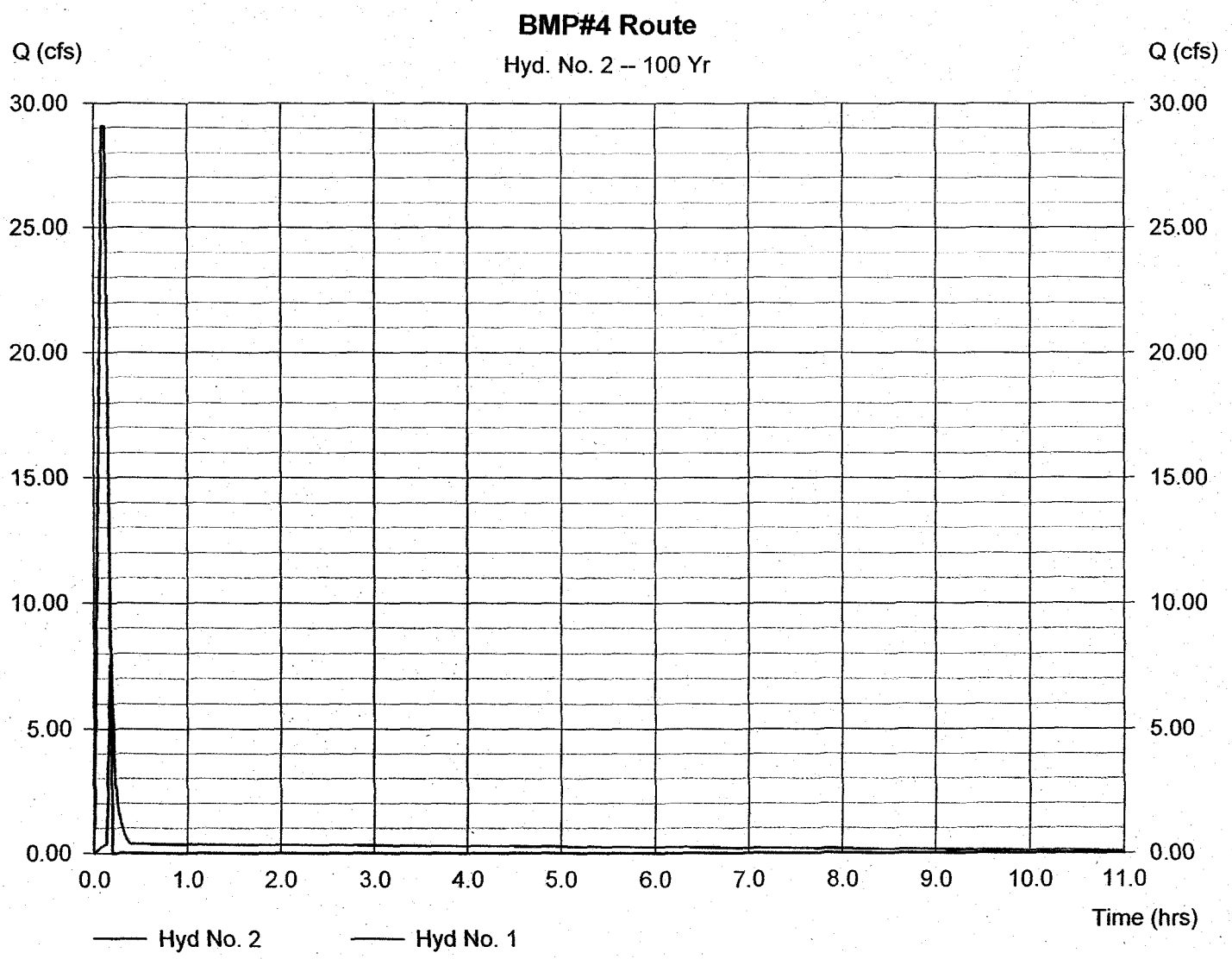
Hydraflow Hydrographs by Intelisolve — Tuesday, Nov 17 2009, 3:47 PM

Hyd. No. 2

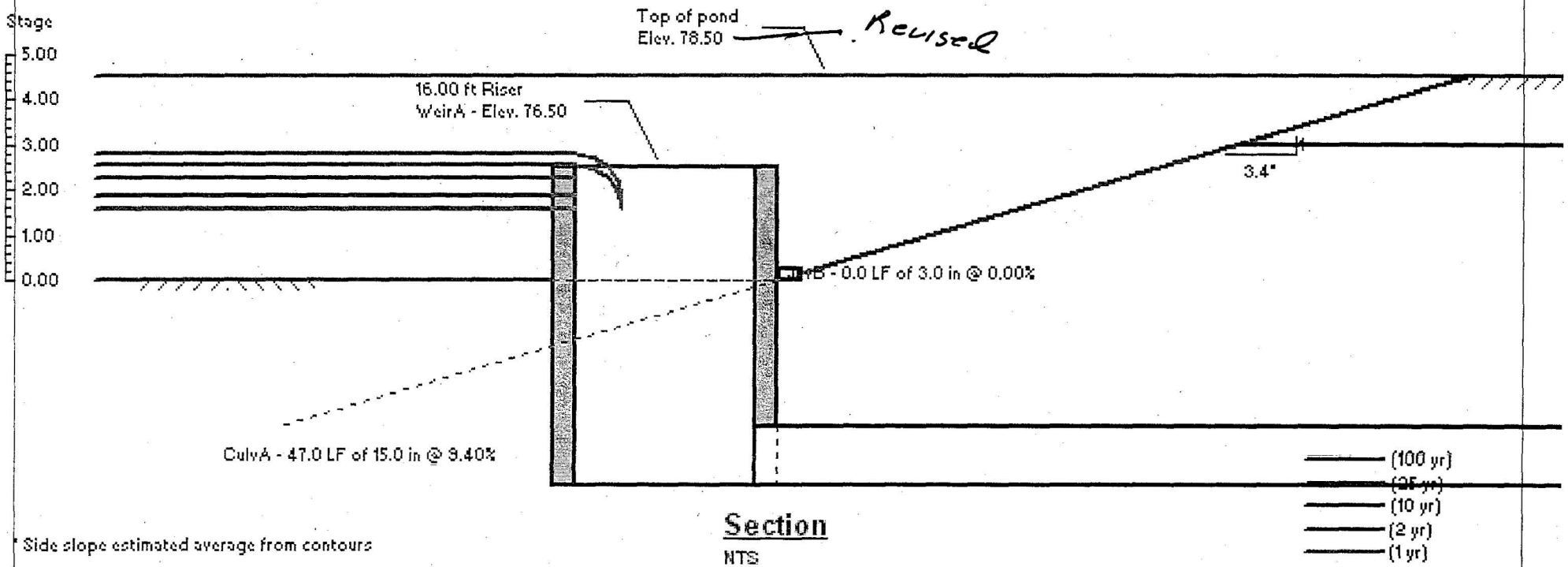
BMP#4 Route

Hydrograph type	= Reservoir	Peak discharge	= 7.97 cfs
Storm frequency	= 100 yrs ←	Time interval	= 1 min pam7850
Inflow hyd. No.	= 1	Max. Elevation	= 76.77 ft
Reservoir name	= BMP#4-Wet Pond	Max. Storage	= 11,037 cuft

Storage Indication method used. — Hydrograph Volume = 12,206 cuft



BMP#4-Wet Pond



Section

NTS

* Side slope estimated average from contours

Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: Wet Pond #4.gpw	Tuesday, Nov 17 2009, 3:47 PM

Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Nov 17 2009, 3:48 PM

Pond No. 1 - BMP#4-Wet Pond

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	74.00	2,628	0	0
1.00	75.00	3,537	3,083	3,083
2.00	76.00	4,585	4,061	7,144
3.00	77.00	5,518	5,052	12,195
4.00	78.00	6,456	5,987	18,182
4.50	78.50	6,925	3,345	21,527

Culvert / Orifice Structures

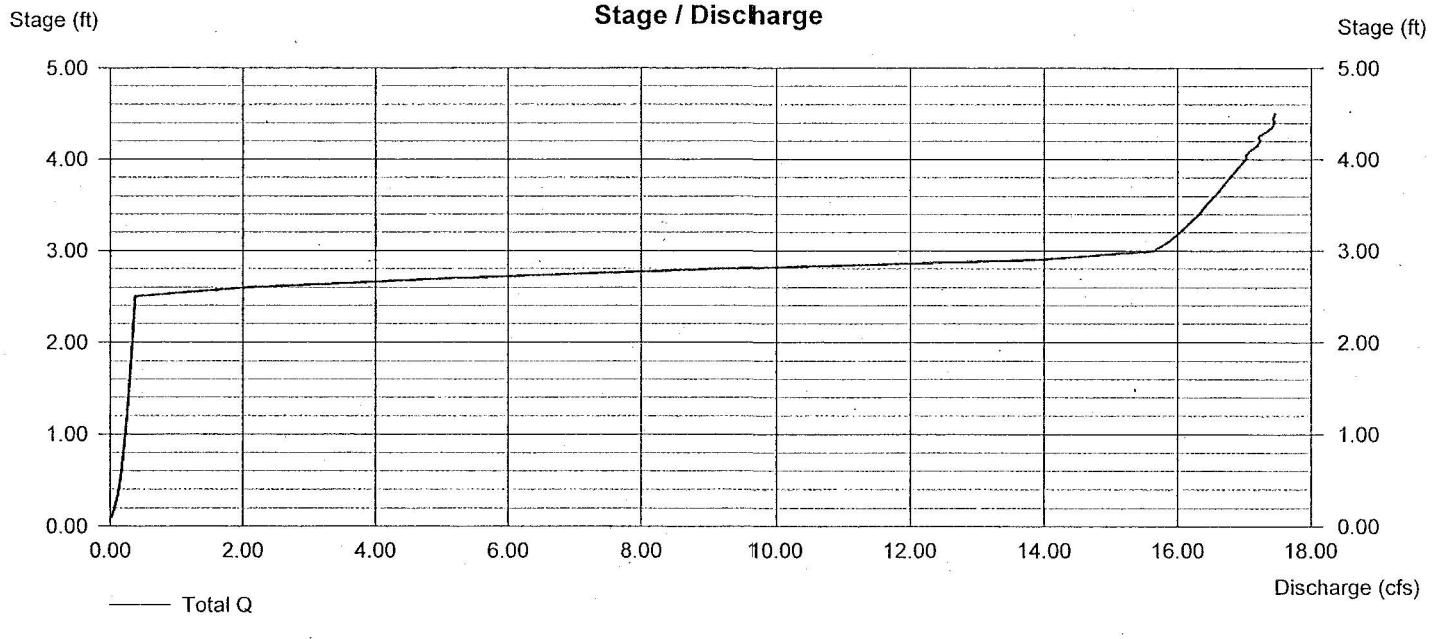
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 69.50	74.00	0.00	0.00
Length (ft)	= 47.00	0.00	0.00	0.00
Slope (%)	= 9.40	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 76.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Pond Report

Hydraflow Hydrographs by Intelisolve

Tuesday, Nov 17 2009, 3:49 PM

Pond No. 1 - BMP#4-Wet Pond

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	74.00	2,628	0	0
1.00	75.00	3,537	3,083	3,083
2.00	76.00	4,585	4,061	7,144
3.00	77.00	5,518	5,052	12,195
4.00	78.00	6,456	5,987	18,182
4.50	78.50	6,925	3,345	21,527

Culvert / Orifice Structures

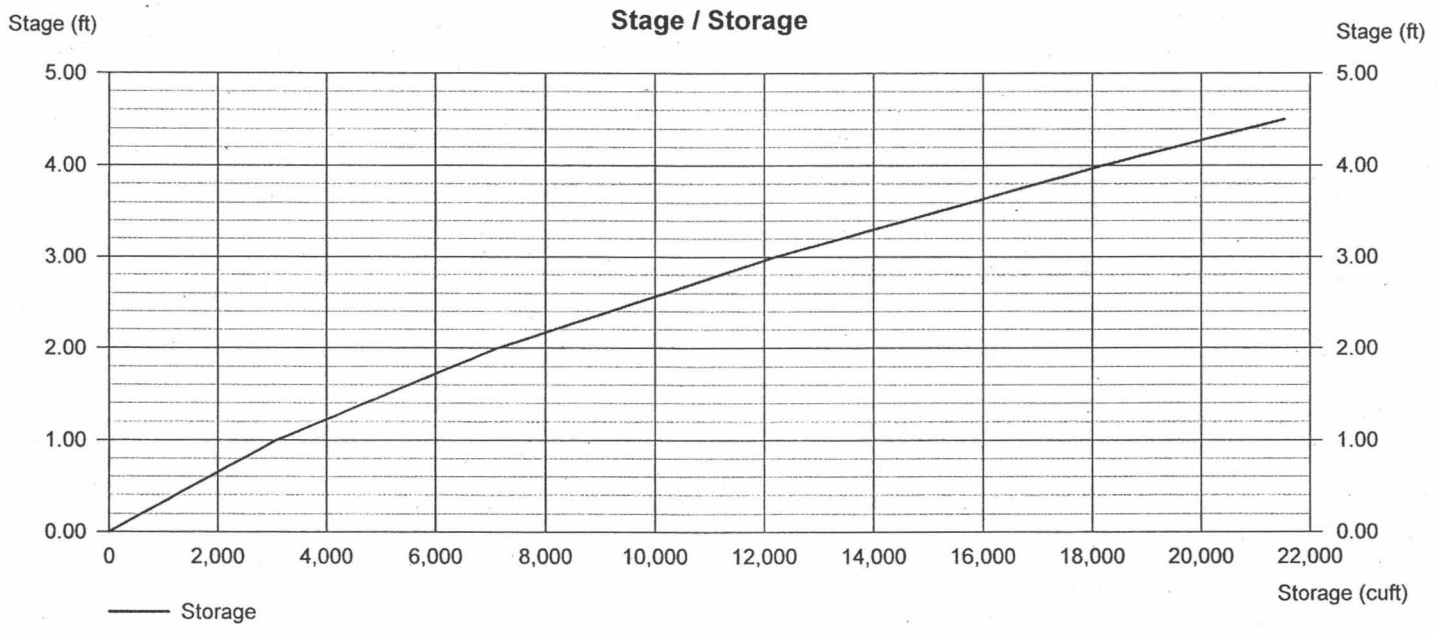
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 69.50	74.00	0.00	0.00
Length (ft)	= 47.00	0.00	0.00	0.00
Slope (%)	= 9.40	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 76.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



BMP#5: BIORETENTION
DESIGN WORKSHEET & CALCULATIONS

DESIGN WORKSHEET - BMP #5

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	8/17/09

Water Quality Volume

Simplified Method:

$$WQv = \frac{(R_D)(R_V)(A)}{12}$$

R_D = 1 Design Storm Rainfall Depth (inches)

R_V = Runoff coefficient (Runoff/Rainfall)

$R_V = 0.05 + 0.009(I)$

I = 41% % Impervious Area of Site

A = 1.91 Drainage Area (Acres)

Rv = 0.054

WQv = Water Quality Volume =		
	0.009	Acre-Feet
	373	Cubic Feet

Bioretention Surface Area

Design Criteria: Minimum 5% of Impervious Area

Impervious Area =		
	0.79	Acres
	34,500	SF

Minimum Surface Area =	1,725	SF required
Actual Surface Area =	1,730	SF provided

Bioretention Infiltration Rates

Darcy's Equation for Bioretention Water Draw Through Rate:

$Q = (.0000232)(K)(A)(H/L)$

K =	2.0	Hydraulic Conductivity of filter media/soil mixture (ft/day)
A =	1,730	Bioretention Surface Area (sf)
H =	3.5	Height of Water above Drainage Zone (ft)
L =	2.5	Thickness of Soil Bed (ft)

Q = Rate of Draw through Bioretention Soil =	0.112	cubic feet per second (cfs)

Time to Drawdown Water through Bioretention Media

Volume (V) = (A) (X) (n)

A =	1,730	Bioretention Surface Area (SF)
X =	2.5	Depth to Lower (ft)
n =	0.45	Porosity

Volume = 1,946 Cubic Feet

Time (T) = V / Q = 17,318 Seconds

4.8 Hours okay

Underdrains

Minimum Flow *equation: Q = 2.3E-5 * K * A* 0.08 cfs

Factor of Safety (range between 2 and 10) 5

Design Flow 0.40 cfs

Manning's Roughness Coefficient

0.011 smooth wall

0.015 corrugated wall **Use n =** 0.011

Internal Slope (recommended minimum 0.5%) 0.5 **%**

Pipe(s) Diameter(s) *equation: D = 16 * (Q * n * s^0.5)^(3/8)*

5.64 inches *calculations assume n=0.011*

# of 4" underdrains: 3 # of 6" underdrains: 2

Equivalent Pipe Diameters

D= (in)	No. of 4" diamet
5.13	2
5.95	3
6.66	4
7.22	5
7.75	6
8.2	7

D= (in)	No of 6" diameter
7.84	2
9.11	3
10.13	4

Note: A minimum of 2 underdrains recommended

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

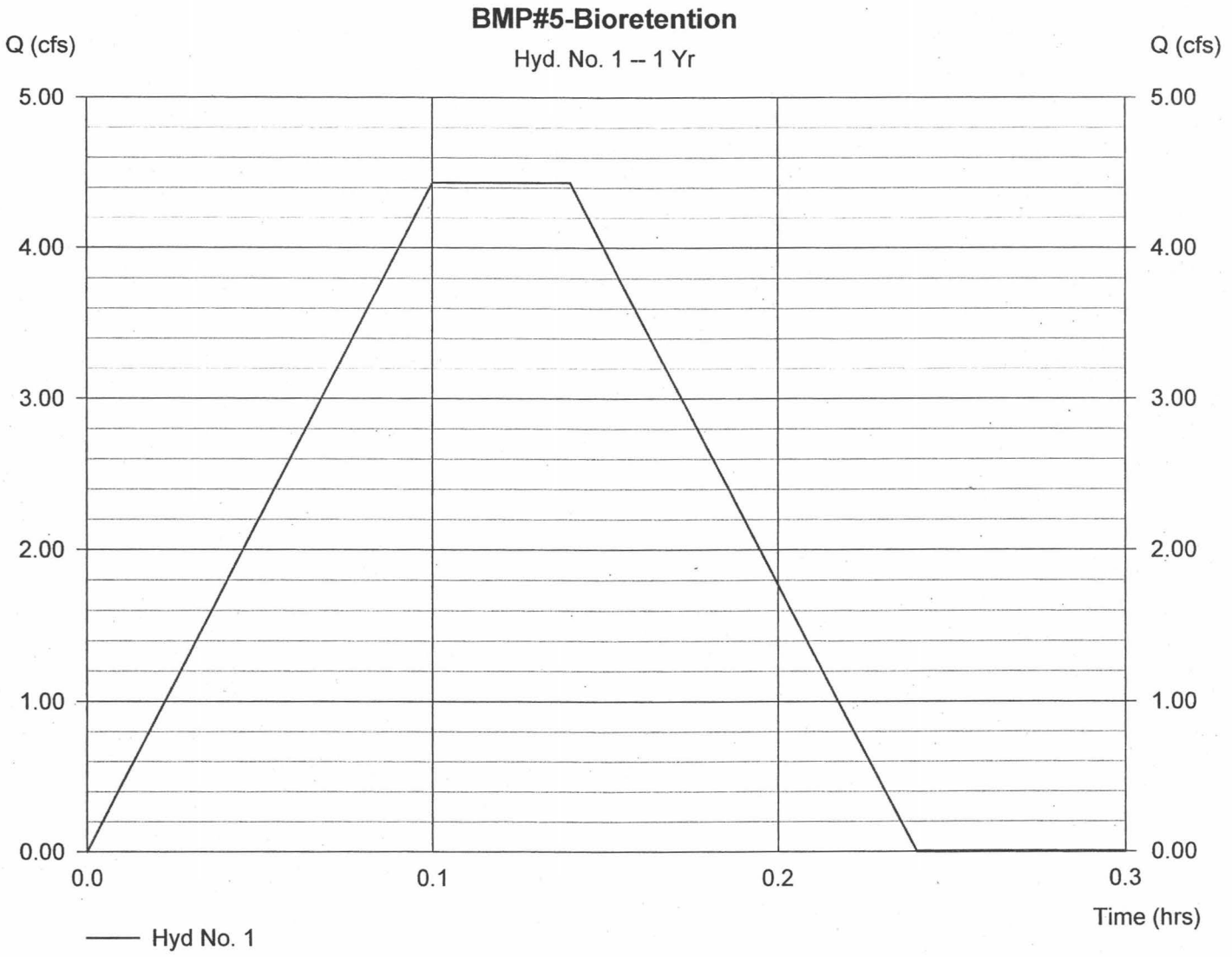
Friday, Aug 14 2009, 11:14 AM

Hyd. No. 1

BMP#5-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 4.43 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.57
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,994 cuft



Hydrograph Plot

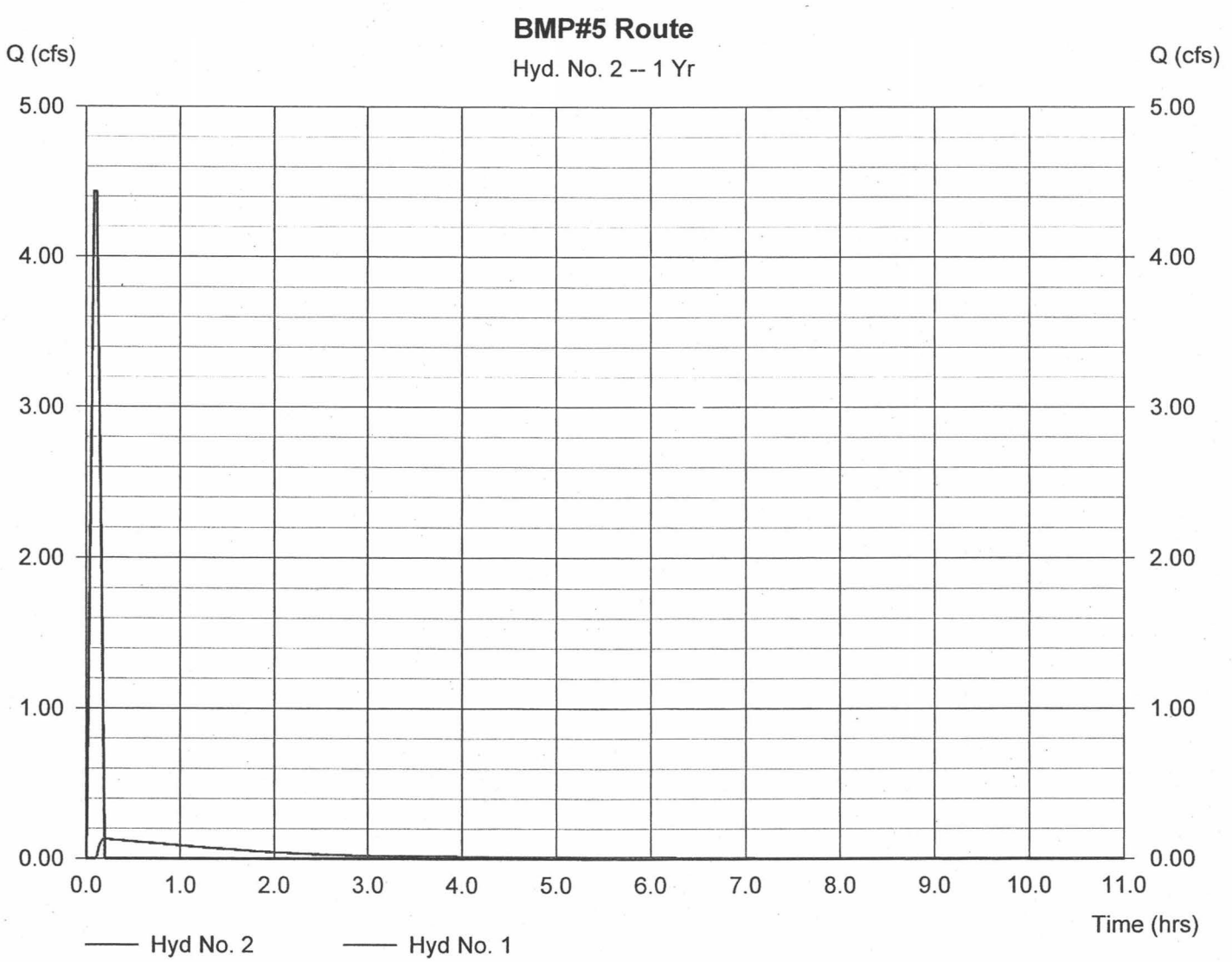
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 11:14 AM

Hyd. No. 2

BMP#5 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.13 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 88.92 ft
Reservoir name	= BMP#5-Bioretention	Max. Storage	= 1,831 cuft

Storage Indication method used. | Hydrograph Volume = 860 cuft



Hydrograph Plot

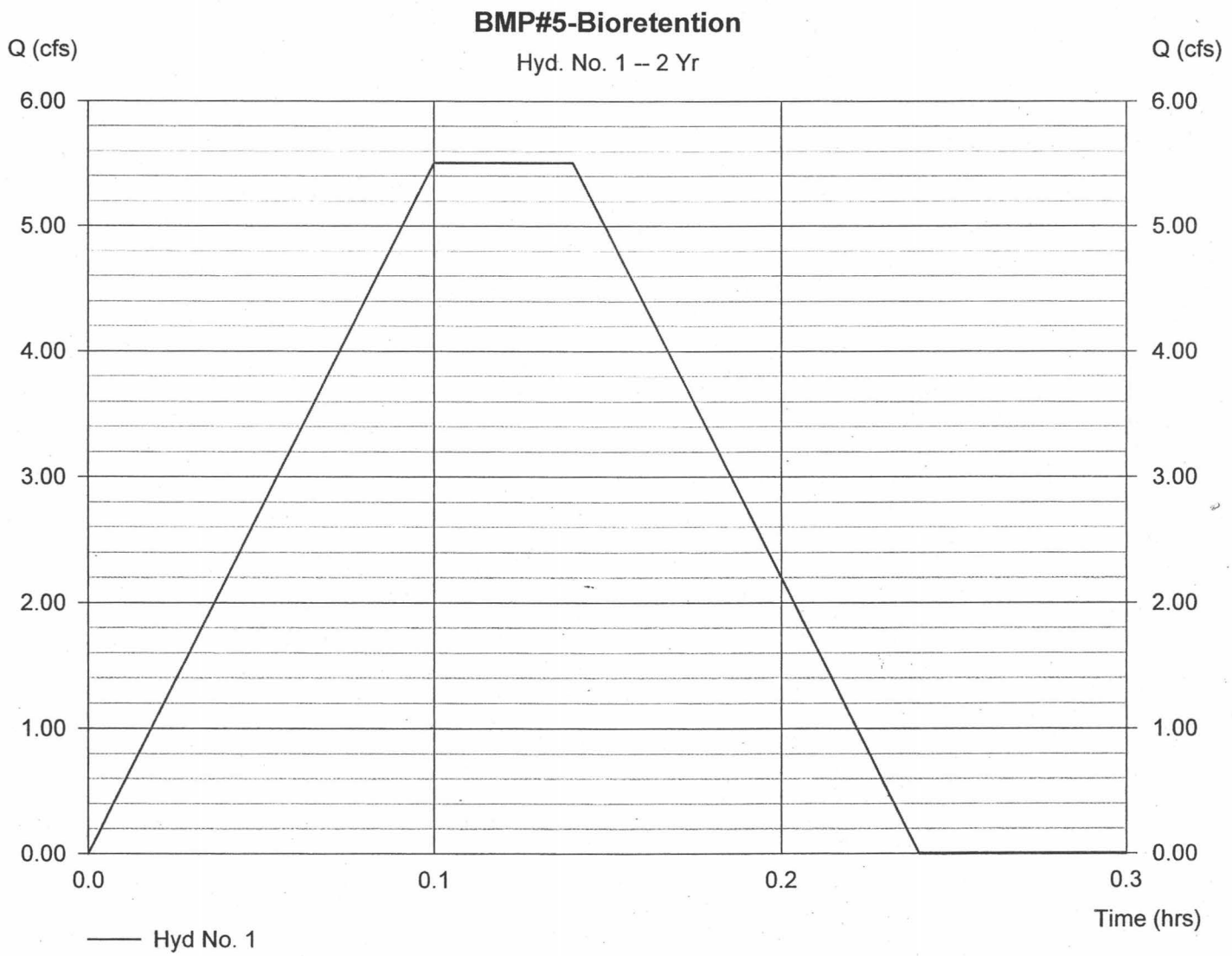
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 11:14 AM

Hyd. No. 1

BMP#5-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 5.51 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.57
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,478 cuft



Hydrograph Plot

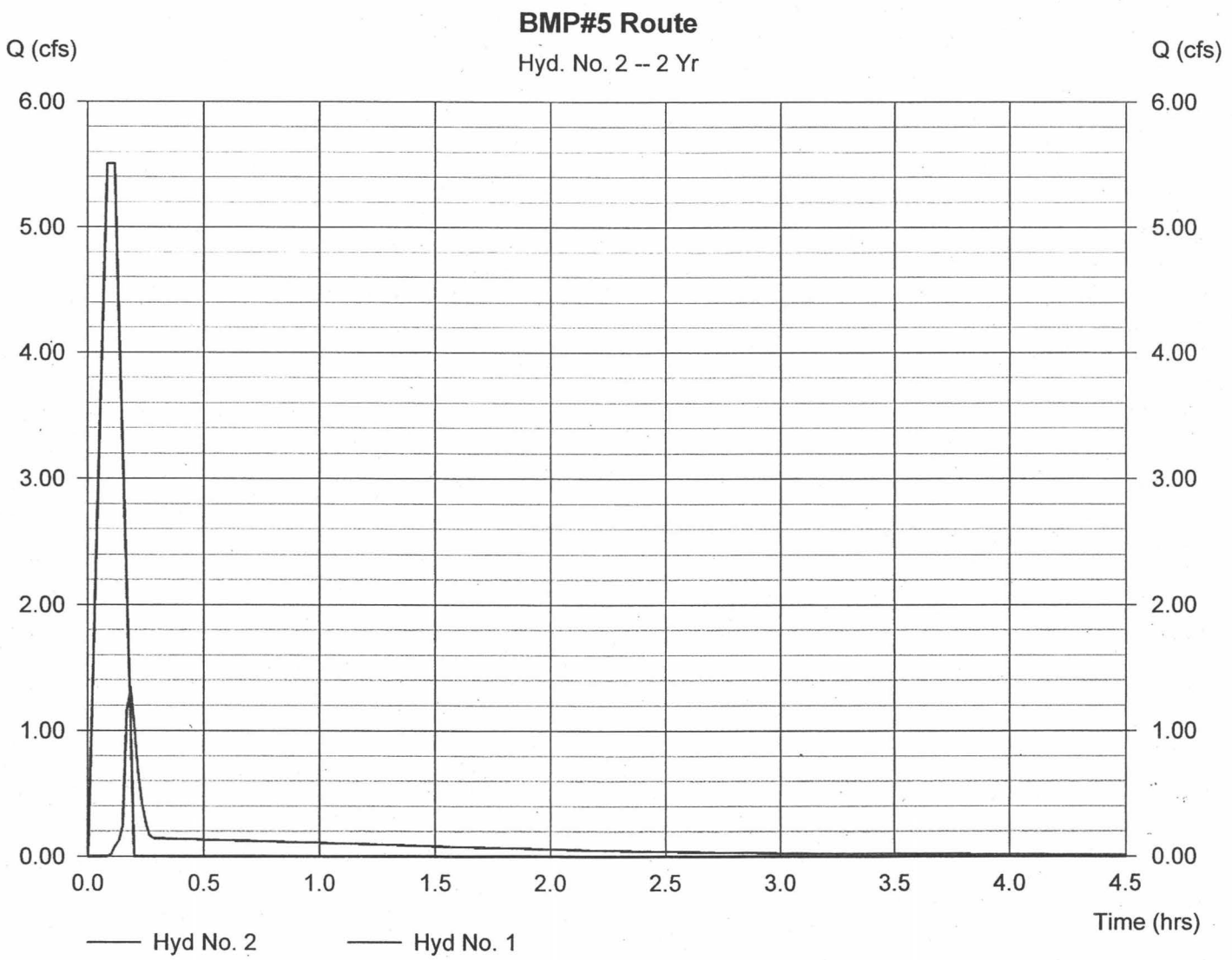
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 11:14 AM

Hyd. No. 2

BMP#5 Route

Hydrograph type	= Reservoir	Peak discharge	= 1.34 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 89.07 ft
Reservoir name	= BMP#5-Bioretention	Max. Storage	= 2,142 cuft

Storage Indication method used. | Hydrograph Volume = 1,312 cuft



Hydrograph Plot

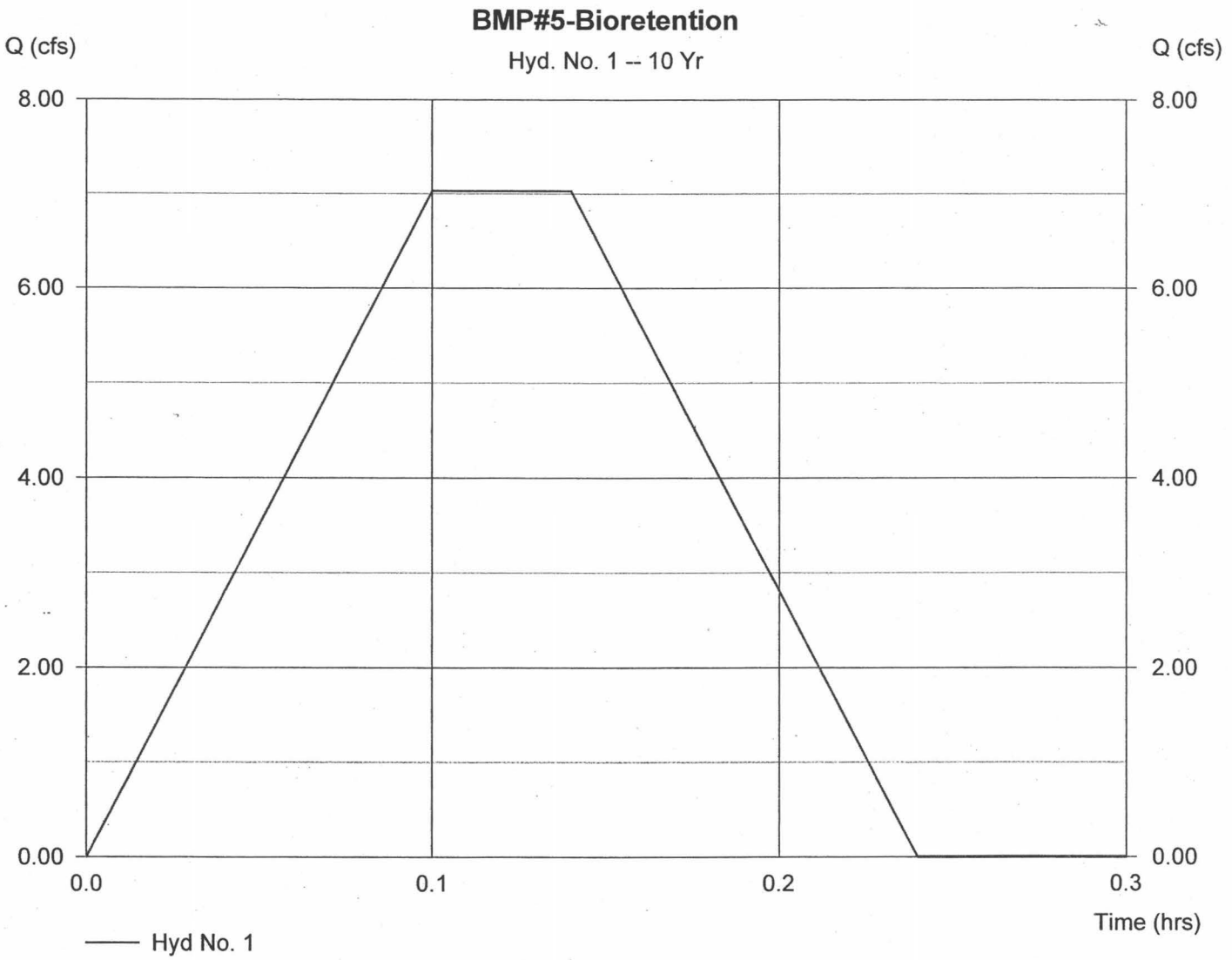
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 11:14 AM

Hyd. No. 1

BMP#5-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 7.03 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.57
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,163 cuft



Hydrograph Plot

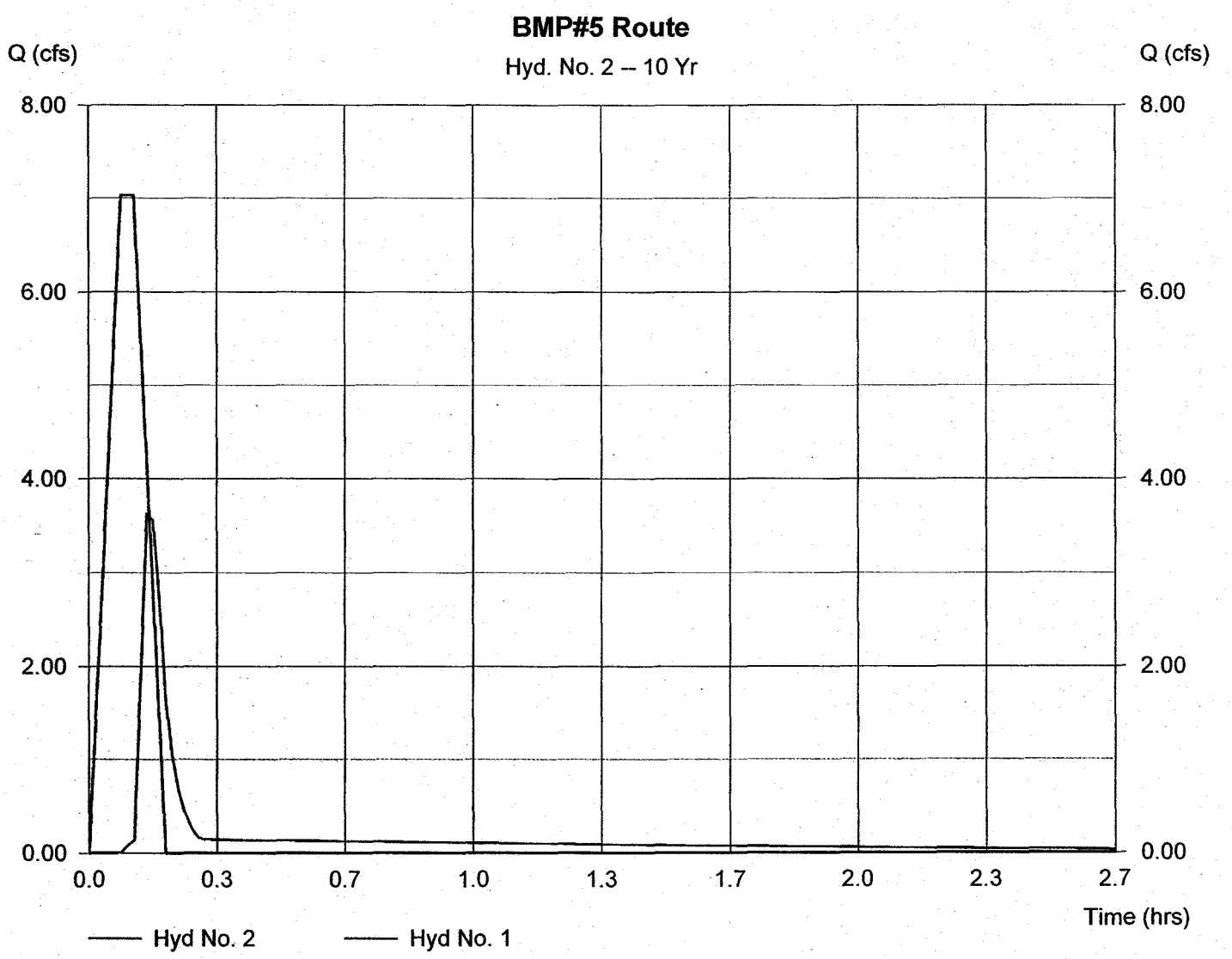
Hydraflow Hydrographs by Intelisolve | Friday, Aug 14 2009, 11:14 AM

Hyd. No. 2

BMP#5 Route

Hydrograph type	= Reservoir	Peak discharge	= 3.62 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 89.16 ft
Reservoir name	= BMP#5-Bioretention	Max. Storage	= 2,340 cuft

Storage Indication method used. | Hydrograph Volume = 1,951 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

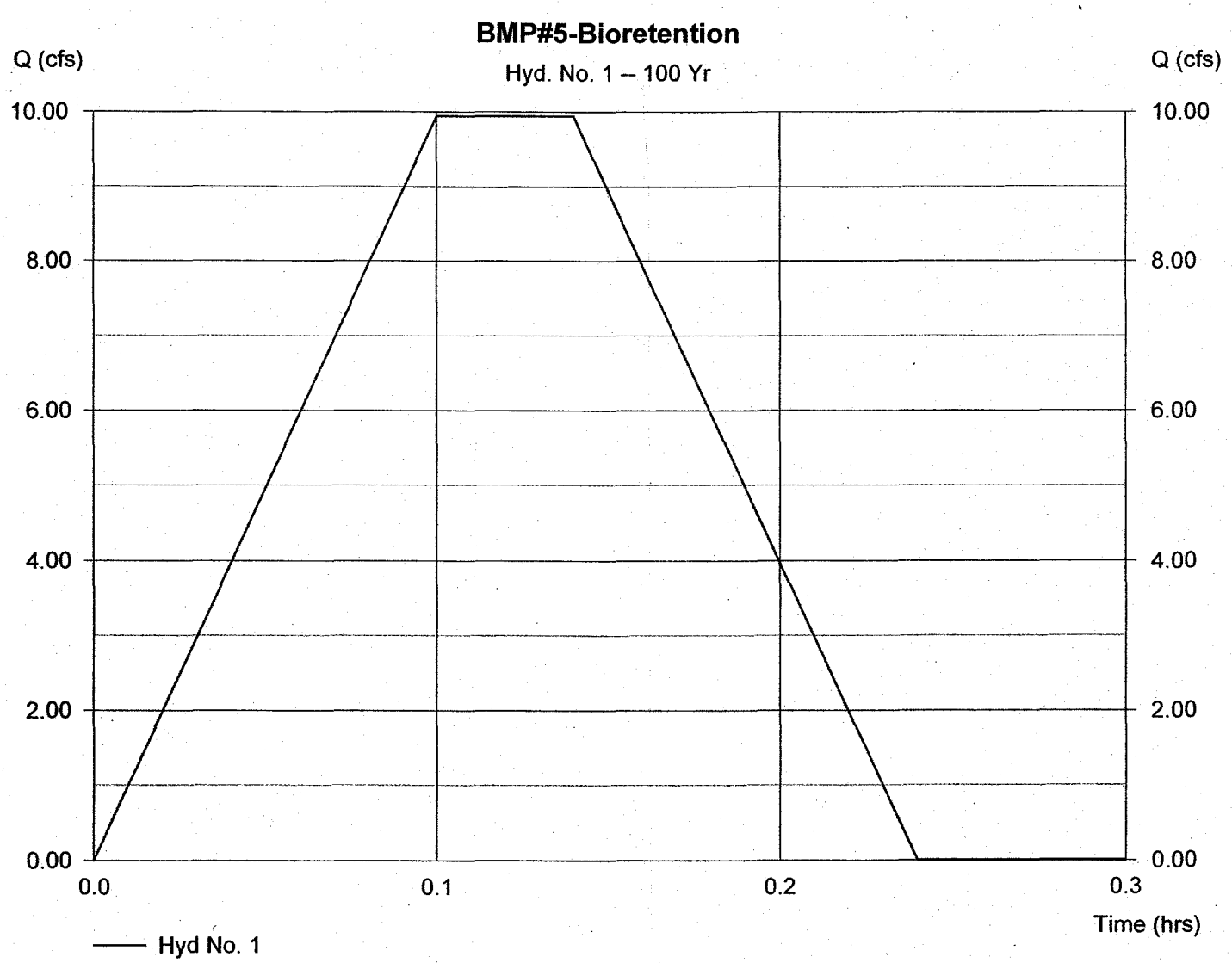
Friday, Aug 14 2009, 11:14 AM

Hyd. No. 1

BMP#5-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 9.94 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.57
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,474 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Aug 14 2009, 11:14 AM

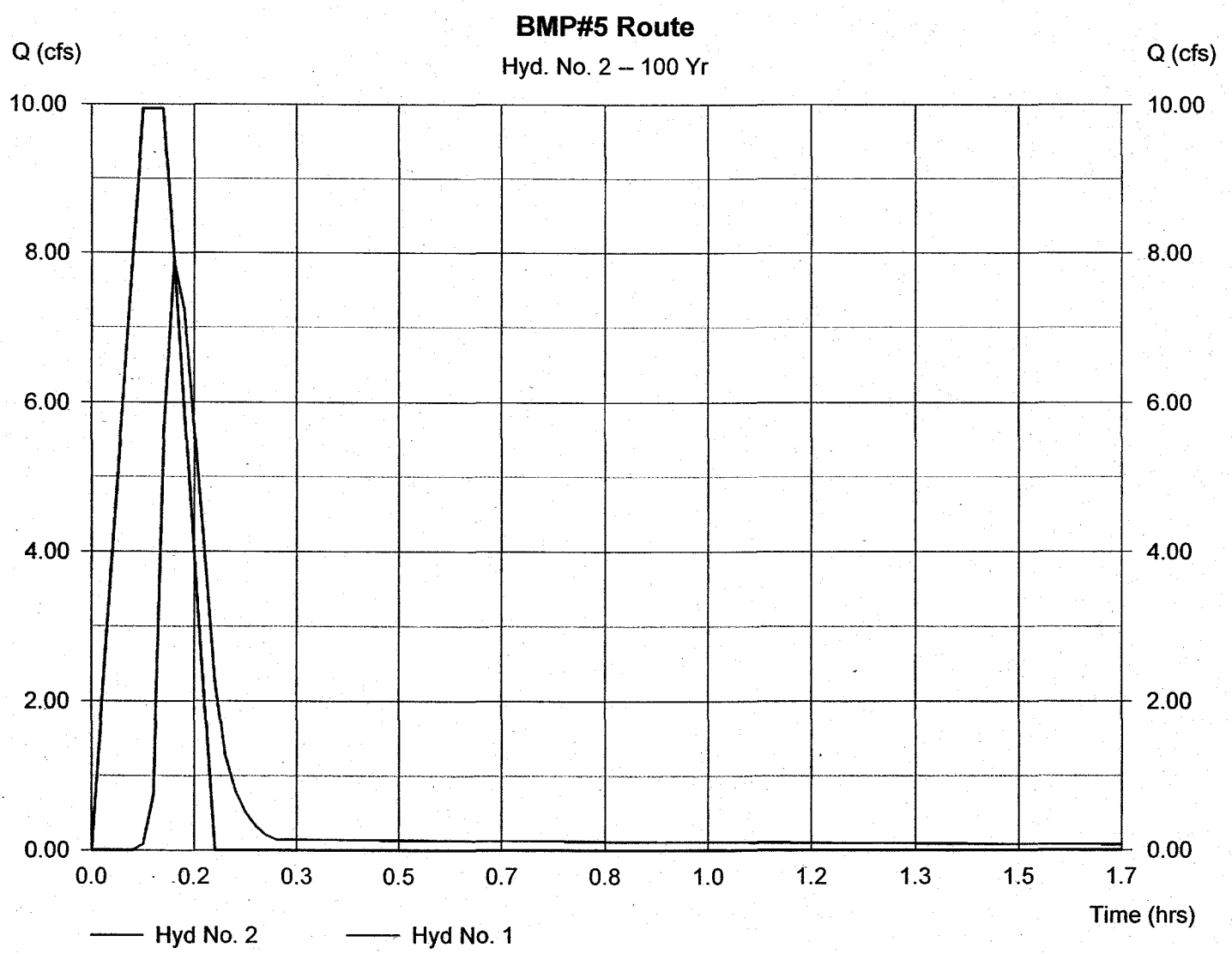
Hyd. No. 2

BMP#5 Route

Hydrograph type	= Reservoir	Peak discharge	= 7.89 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 89.27 ft
Reservoir name	= BMP#5-Bioretention	Max. Storage	= 2,604 cuft

Storage Indication method used.

Hydrograph Volume = 3,175 cuft



BMP#6: BIORETENTION
DESIGN WORKSHEET & CALCULATIONS

DESIGN WORKSHEET - BMP #6

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	8/17/09

Water Quality Volume

Simplified Method:

$$WQv = \frac{(R_D)(R_V)(A)}{12}$$

R_D = 1 Design Storm Rainfall Depth (inches)

R_V = Runoff coefficient (Runoff/Rainfall)

$R_V = 0.05 + 0.009(I)$

I = 41% % Impervious Area of Site

A = 1.27 Drainage Area (Acres)

Rv = 0.054

WQv = Water Quality Volume = 0.006 Acre-Feet; 247 Cubic Feet

Bioretention Surface Area

Design Criteria: Minimum 5% of Impervious Area

Impervious Area = 0.52 Acres; 22,500 SF

Minimum Surface Area = 1,125 SF required

Actual Surface Area = 1,407 SF provided

Bioretention Infiltration Rates

Darcy's Equation for Bioretention Water Draw Through Rate:

Q = (.0000232) (K) (A) (H/L)

K = 2.0 Hydraulic Conductivity of filter media/soil mixture (ft/day)

A = 1,407 Bioretention Surface Area (sf)

H = 3.5 Height of Water above Drainage Zone (ft)

L = 2.5 Thickness of Soil Bed (ft)

Q = Rate of Draw through Bioretention Soil = 0.091 **cubic feet per second (cfs)**

Time to Drawdown Water through Bioretention Media

Volume (V) = (A) (X) (n)

A =	1,407	Bioretention Surface Area (SF)
X =	2.5	Depth to Lower (ft)
n =	0.45	Porosity

Volume = 1,583 Cubic Feet

Time (T) = V / Q = 17,318 Seconds

4.8 Hours okay

Underdrains

Minimum Flow *equation: Q = 2.3E-5 * K * A* 0.06 cfs

Factor of Safety (range between 2 and 10) 5

Design Flow 0.32 cfs

Manning's Roughness Coefficient

0.011 smooth wall

0.015 corrugated wall **Use n =** 0.011

Internal Slope (recommended minimum 0.5%) 0.5 **%**

Pipe(s) Diameter(s) *equation: D = 16 * (Q * n * s^0.5)^(3/8)*

5.22 inches *calculations assume n=0.011*

# of 4" underdrains: 3 # of 6" underdrains: 2

Equivalent Pipe Diameters

D= (in)	No. of 4" diamet
5.13	2
5.95	3
6.66	4
7.22	5
7.75	6
8.2	7

D= (in)	No of 6" diameter
7.84	2
9.11	3
10.13	4

Note: A minimum of 2 underdrains recommended

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

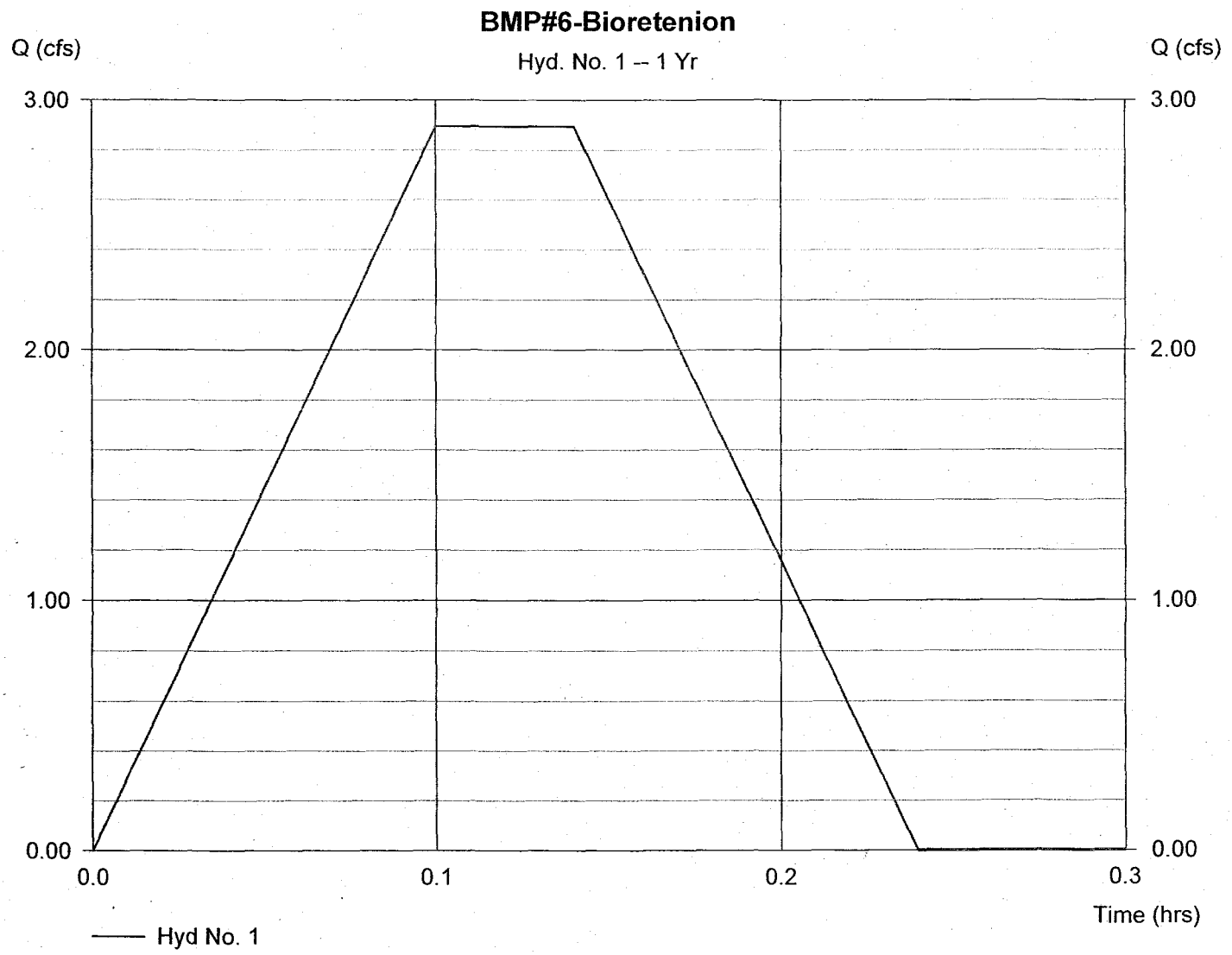
Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 1

BMP#6-Bioretenion

Hydrograph type	= Mod. Rational	Peak discharge	= 2.90 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.270 ac	Runoff coeff.	= 0.56
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,303 cuft



Hydrograph Plot

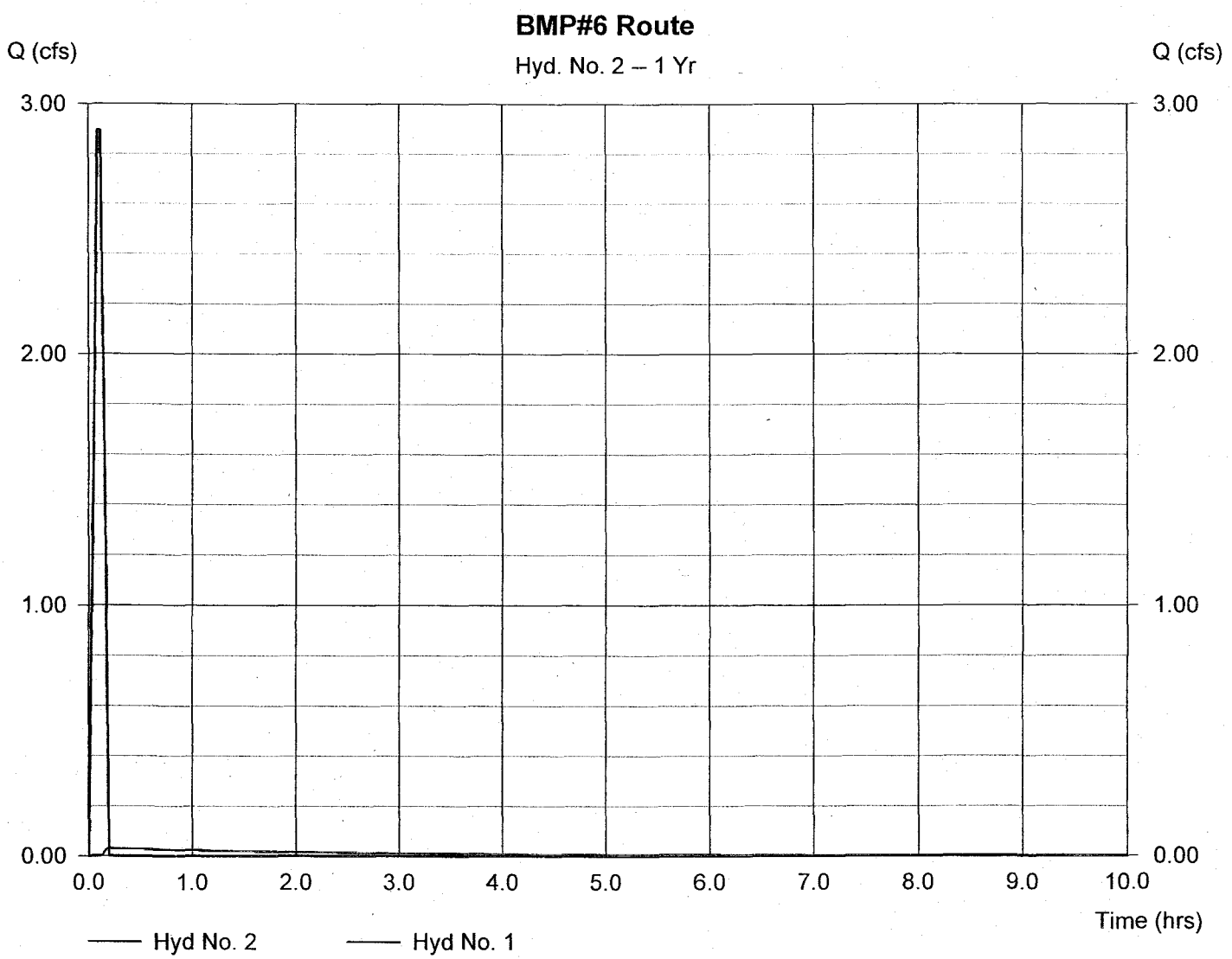
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 2

BMP#6 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.03 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 82.39 ft
Reservoir name	= BMP#6-Bioretention	Max. Storage	= 1,211 cuft

Storage Indication method used. | Hydrograph Volume = 300 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

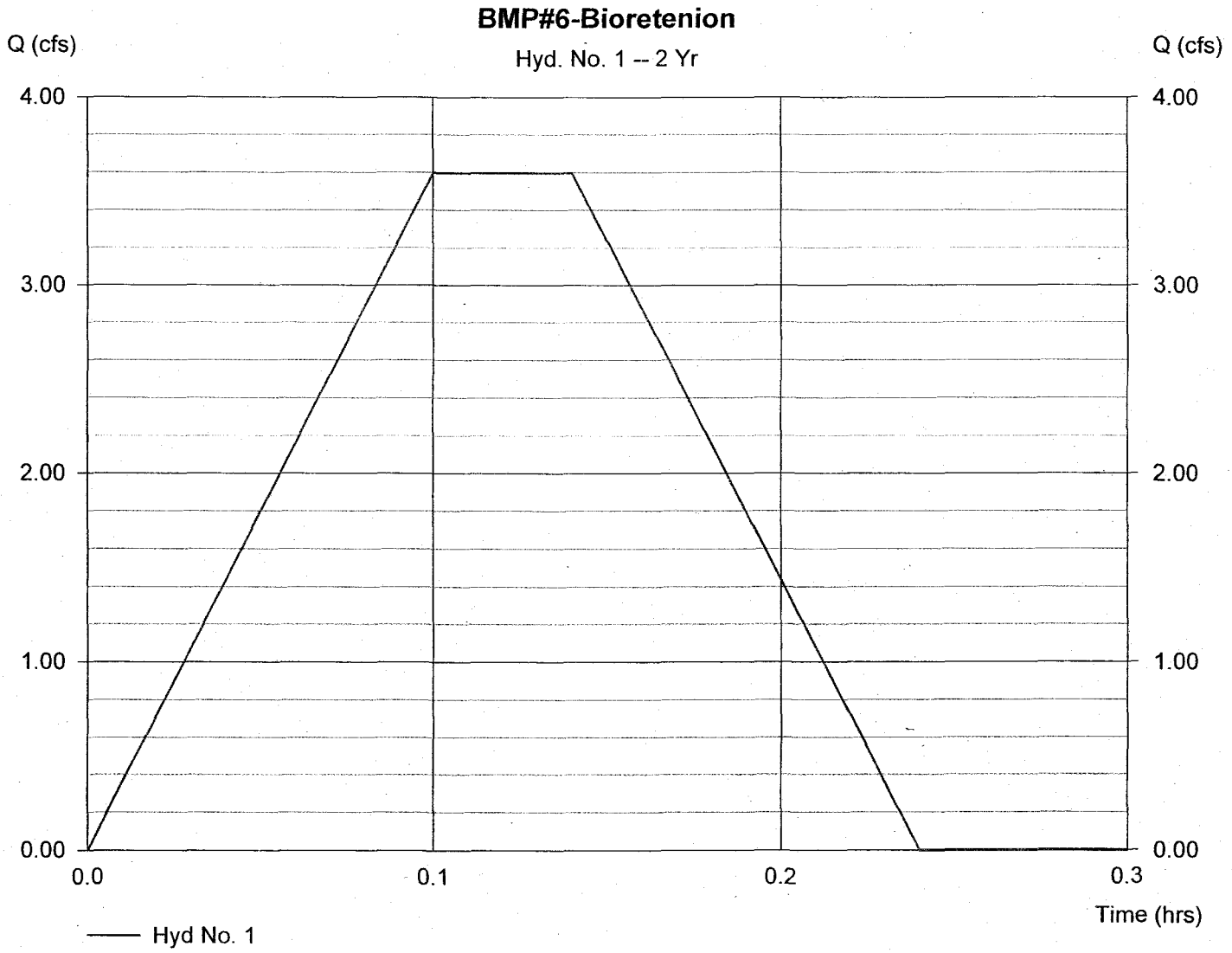
Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 1

BMP#6-Bioretenion

Hydrograph type	= Mod. Rational	Peak discharge	= 3.60 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 1.270 ac	Runoff coeff.	= 0.56
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,619 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Nov 17 2009, 3:22 PM

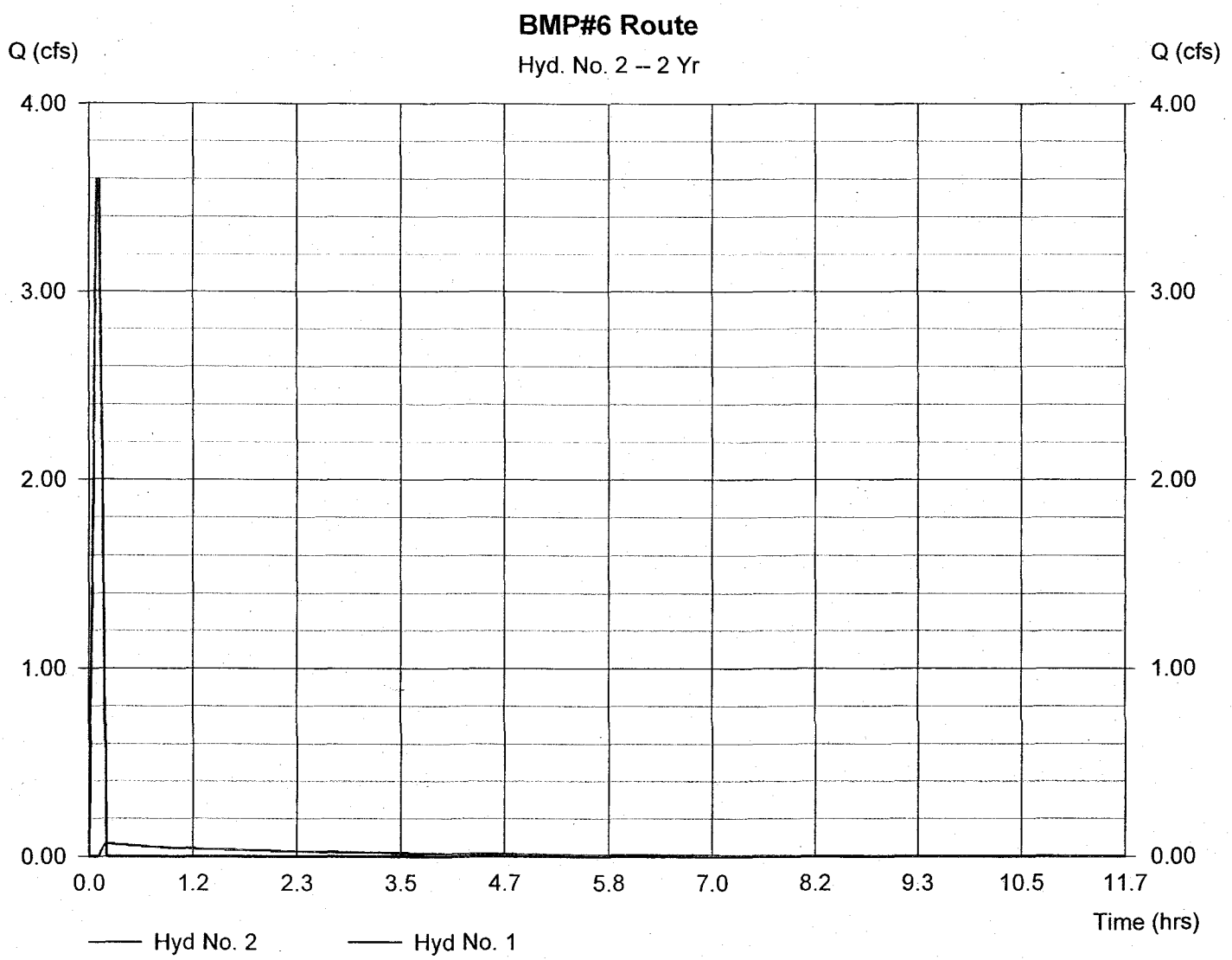
Hyd. No. 2

BMP#6 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.07 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 82.53 ft
Reservoir name	= BMP#6-Bioretention	Max. Storage	= 1,497 cuft

Storage Indication method used.

Hydrograph Volume = 595 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

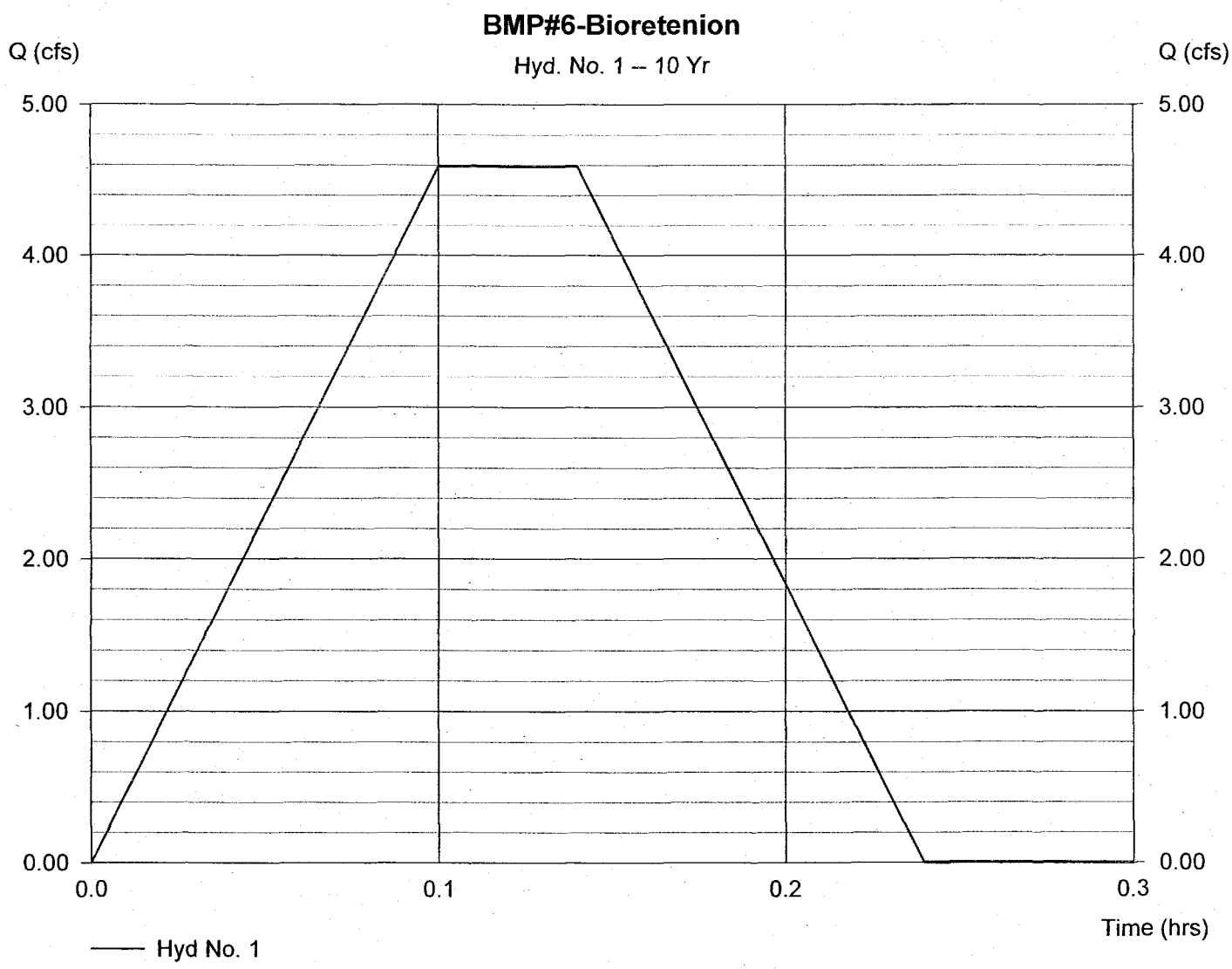
Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 1

BMP#6-Bioretenion

Hydrograph type	= Mod. Rational	Peak discharge	= 4.59 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 1.270 ac	Runoff coeff.	= 0.56
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,066 cuft



Hydrograph Plot

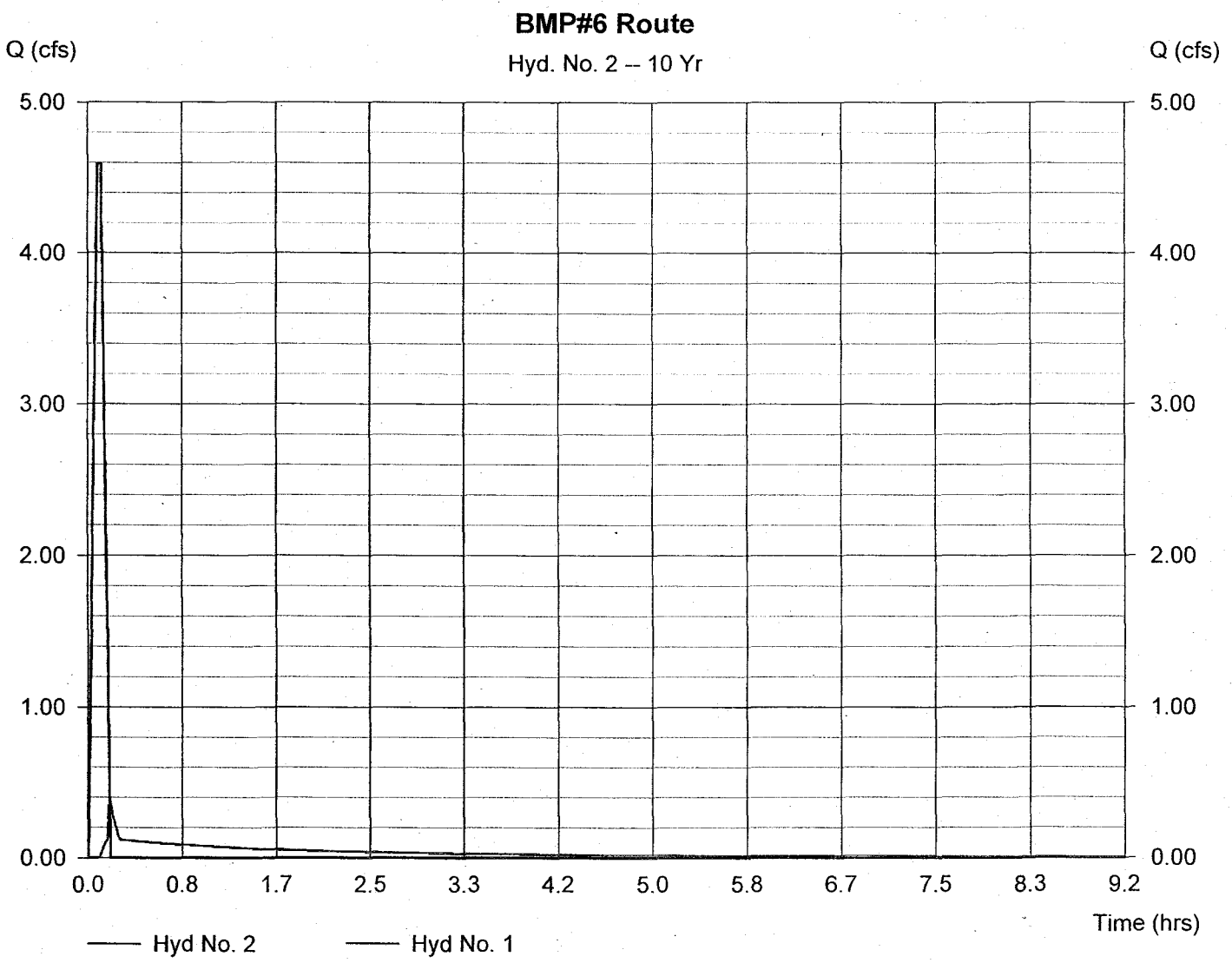
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 2

BMP#6 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.37 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 82.71 ft
Reservoir name	= BMP#6-Bioretention	Max. Storage	= 1,877 cuft

Storage Indication method used. | Hydrograph Volume = 1,013 cuft



Hydrograph Plot

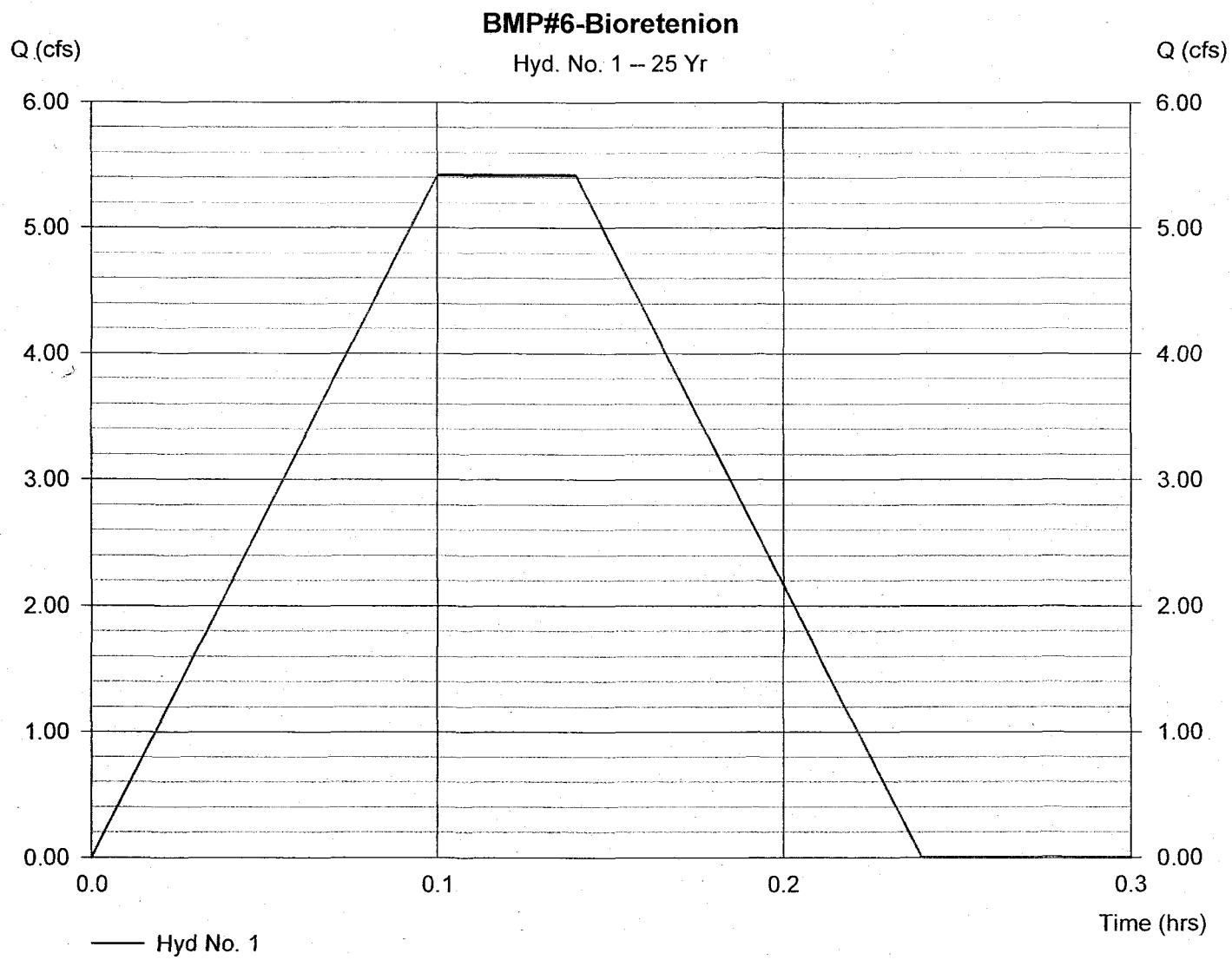
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 1

BMP#6-Bioretenion

Hydrograph type	= Mod. Rational	Peak discharge	= 5.42 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.270 ac	Runoff coeff.	= 0.56
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,439 cuft



Hydrograph Plot

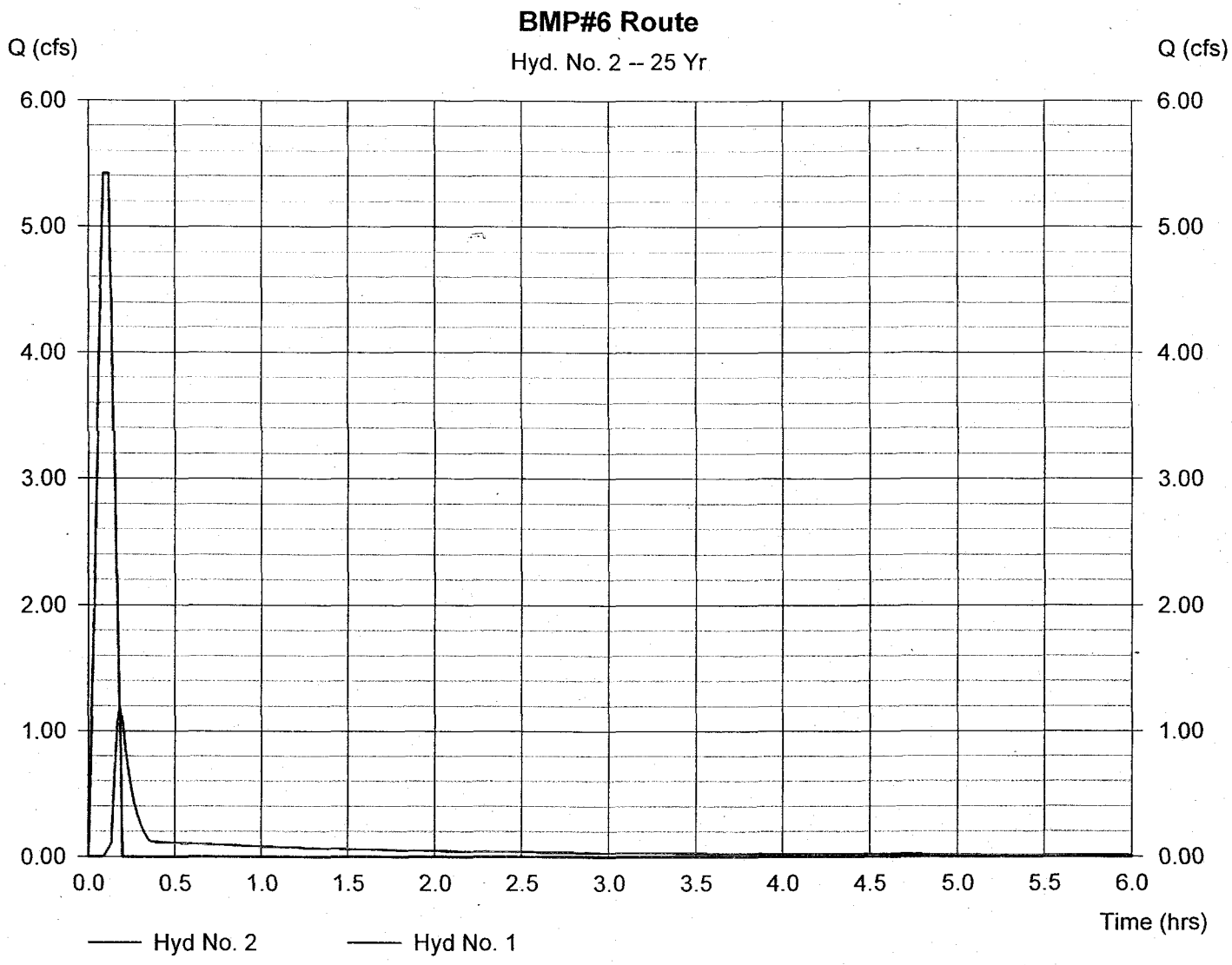
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 2

BMP#6 Route

Hydrograph type	= Reservoir	Peak discharge	= 1.19 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 82.82 ft
Reservoir name	= BMP#6-Bioretention	Max. Storage	= 2,093 cuft

Storage Indication method used. | Hydrograph Volume = 1,361 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

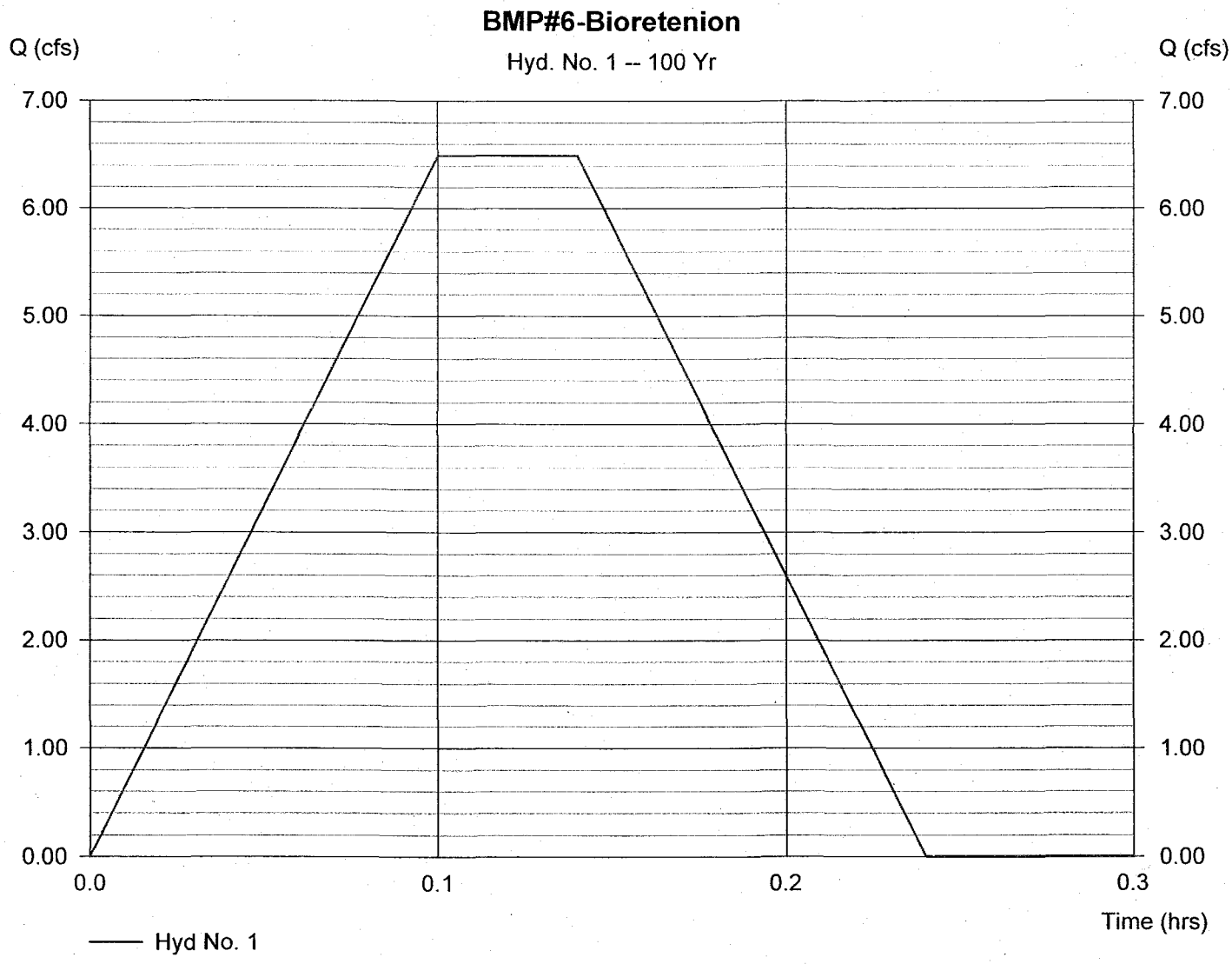
Tuesday, Nov 17 2009, 3:22 PM

Hyd. No. 1

BMP#6-Bioretenion

Hydrograph type	= Mod. Rational	Peak discharge	= 6.50 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.270 ac	Runoff coeff.	= 0.56
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,923 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 17 2009, 3:22 PM

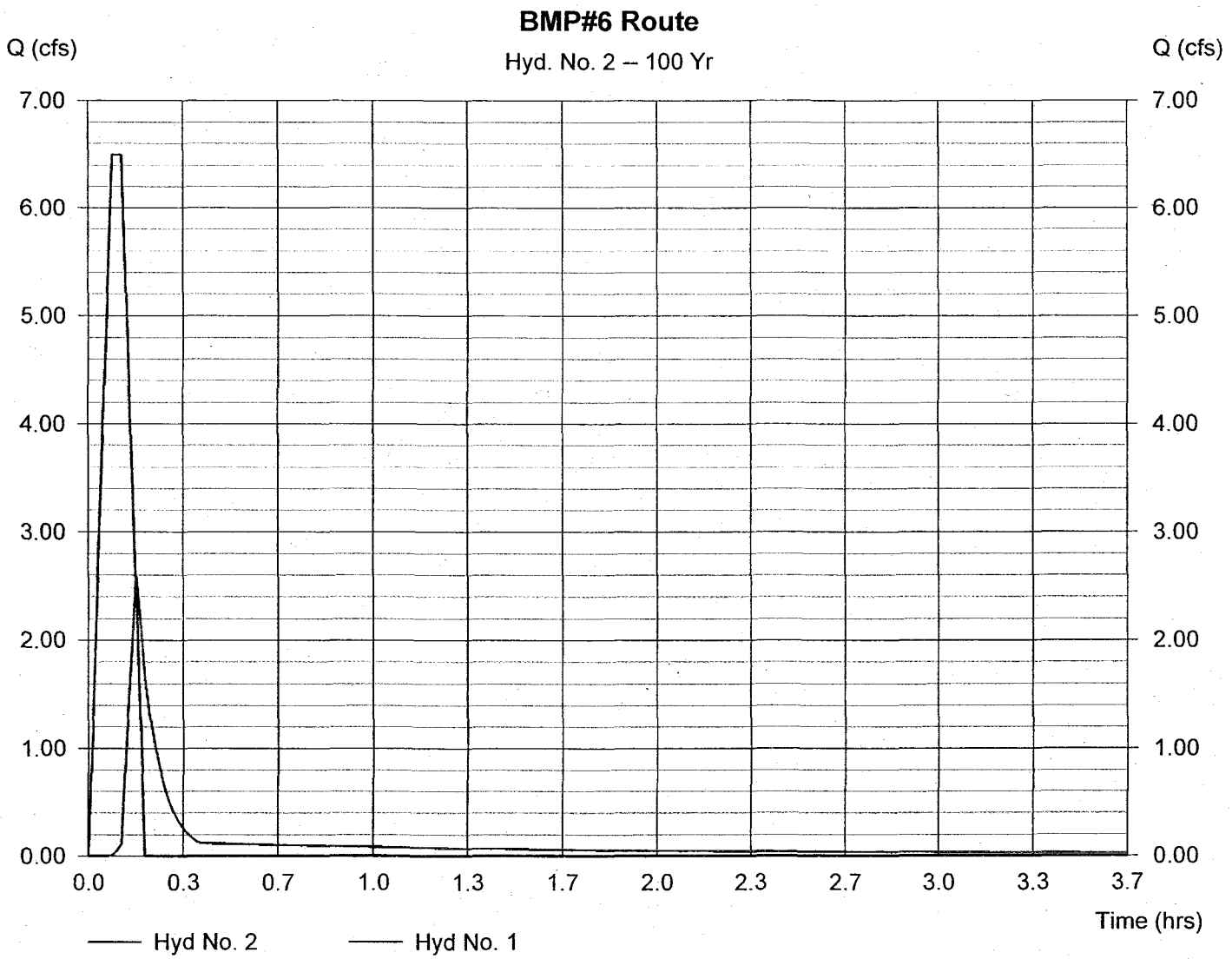
Hyd. No. 2

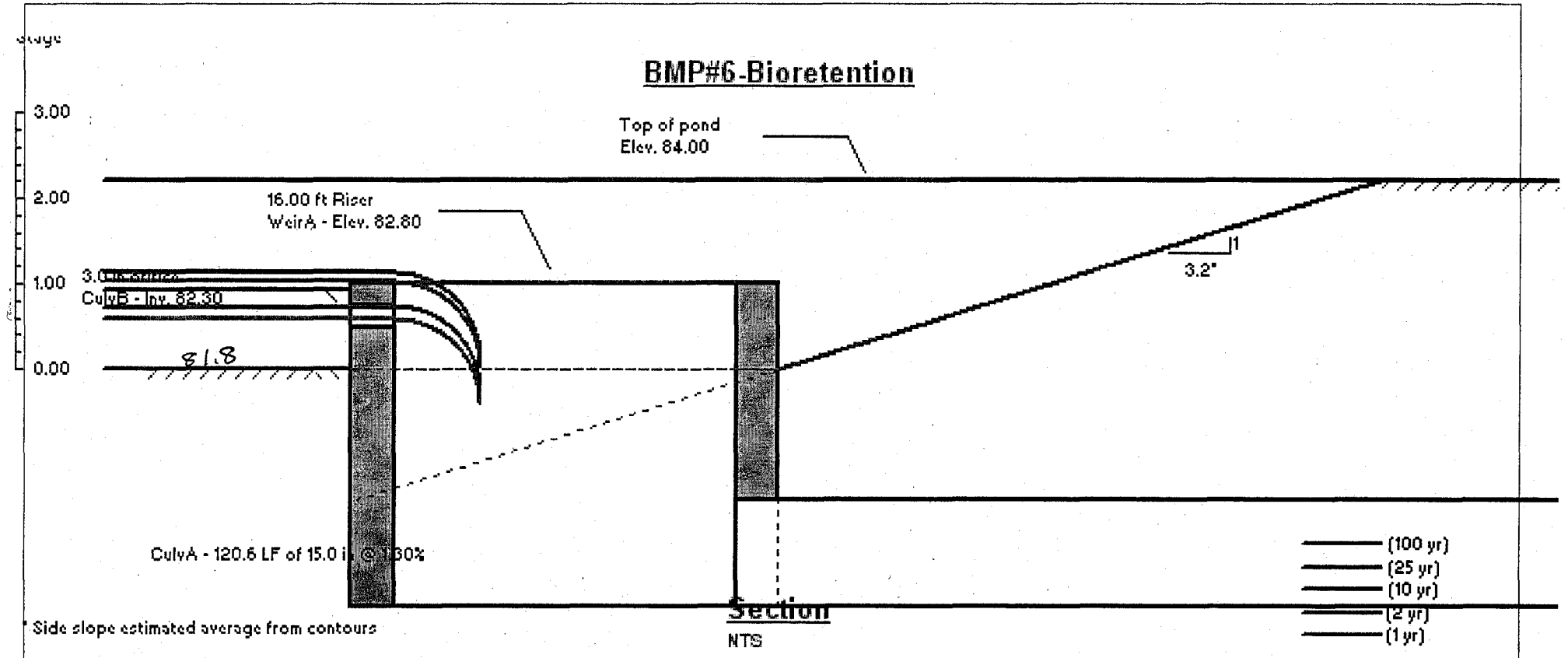
BMP#6 Route

Hydrograph type	=	Reservoir	Peak discharge	=	2.65 cfs
Storm frequency	=	100 yrs	Time interval	=	1 min
Inflow hyd. No.	=	1	Max. Elevation	=	82.92 ft
Reservoir name	=	BMP#6-Bioretention	Max. Storage	=	2,311 cuft

Dam 84.00

Storage Indication method used. | Hydrograph Volume = 1,812 cuft





Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: Bioretention #6.gpw	Tuesday, Nov 17 2009, 3:23 PM

Pond Report

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:30 AM

Pond No. 1 - BMP#6-Bioretention

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	83.00	1,407	0	0
1.00	84.00	1,941	1,674	1,674
2.00	85.00	2,931	2,436	4,110

Culvert / Orifice Structures

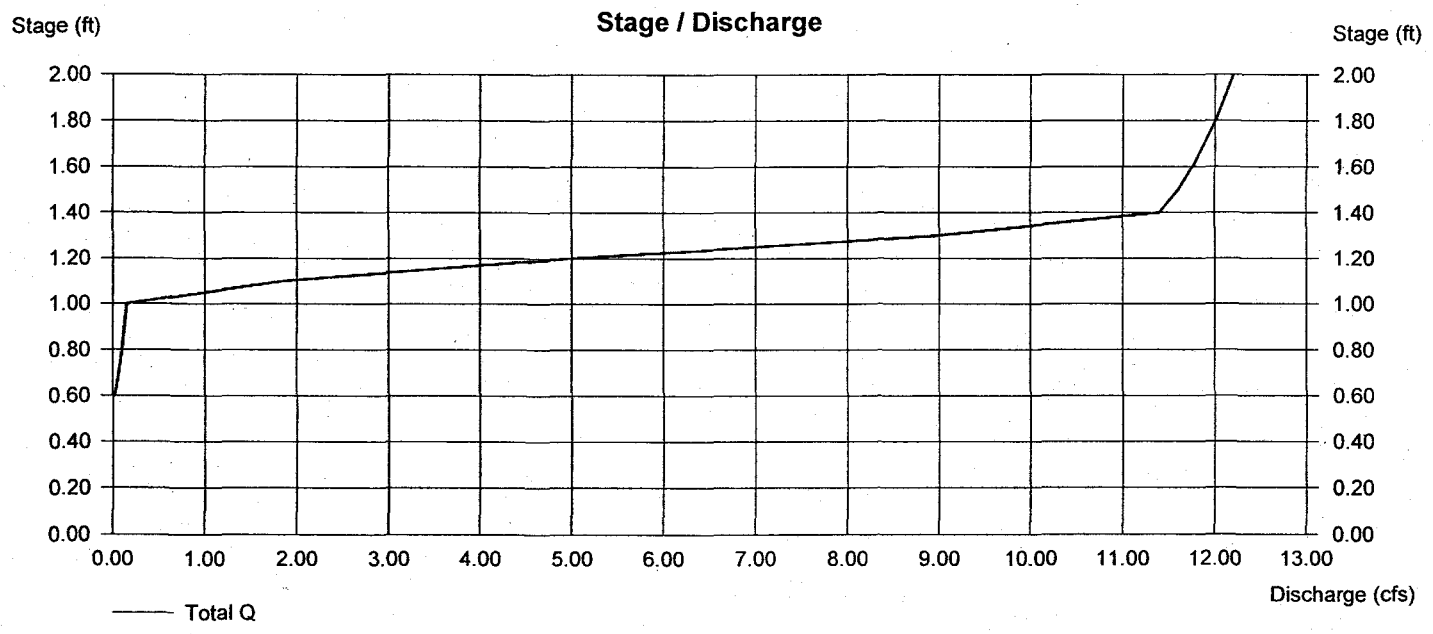
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 79.00	83.50	0.00	0.00
Length (ft)	= 120.55	0.00	0.00	0.00
Slope (%)	= 1.30	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 84.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



BMP#7: WET EXTENDED DETETION POND

DESIGN WORKSHEET & CALCULATIONS

Hydrograph Plot

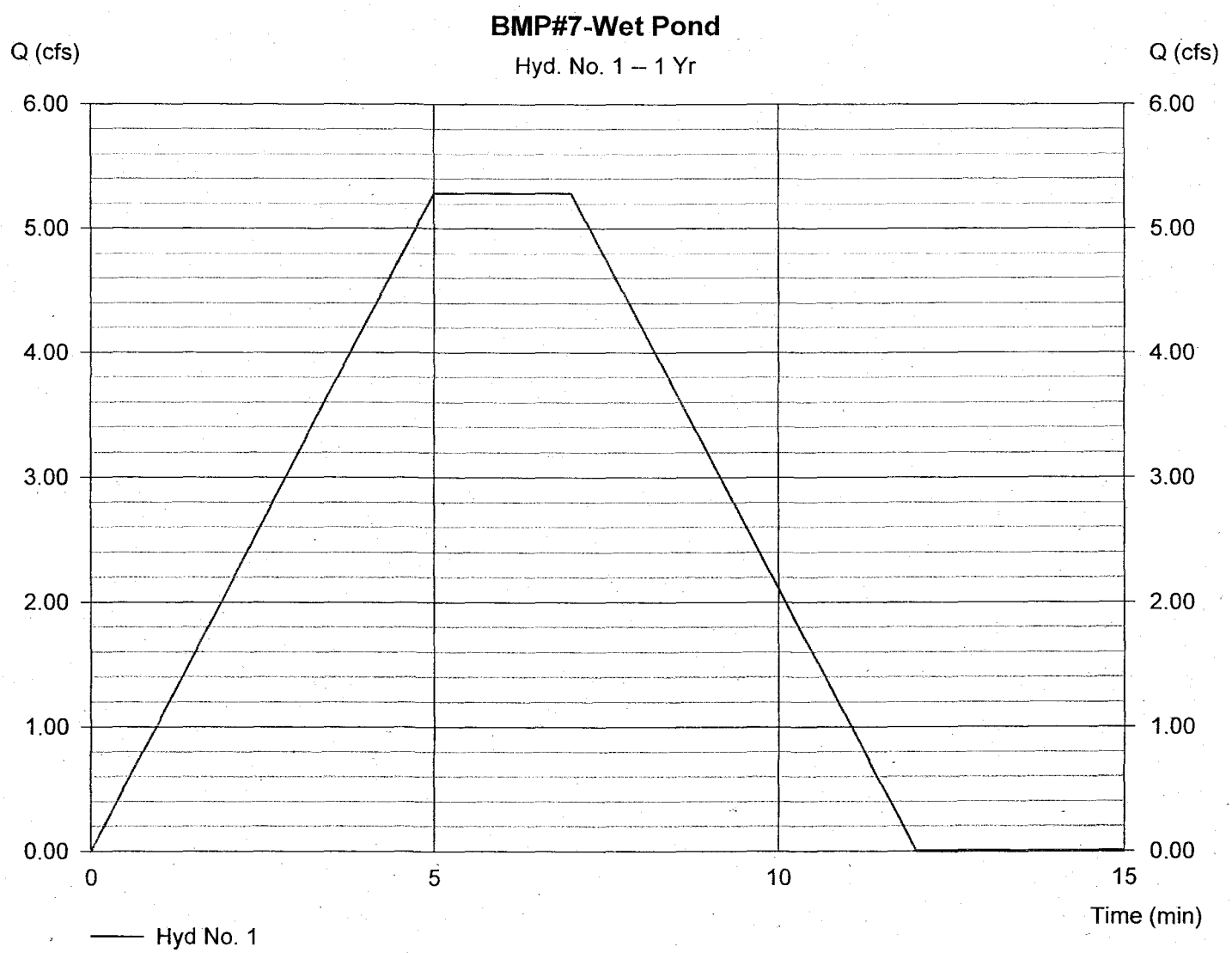
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:20 AM

Hyd. No. 1

BMP#7-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 5.28 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 2.360 ac	Runoff coeff.	= 0.55
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,378 cuft



Hydrograph Plot

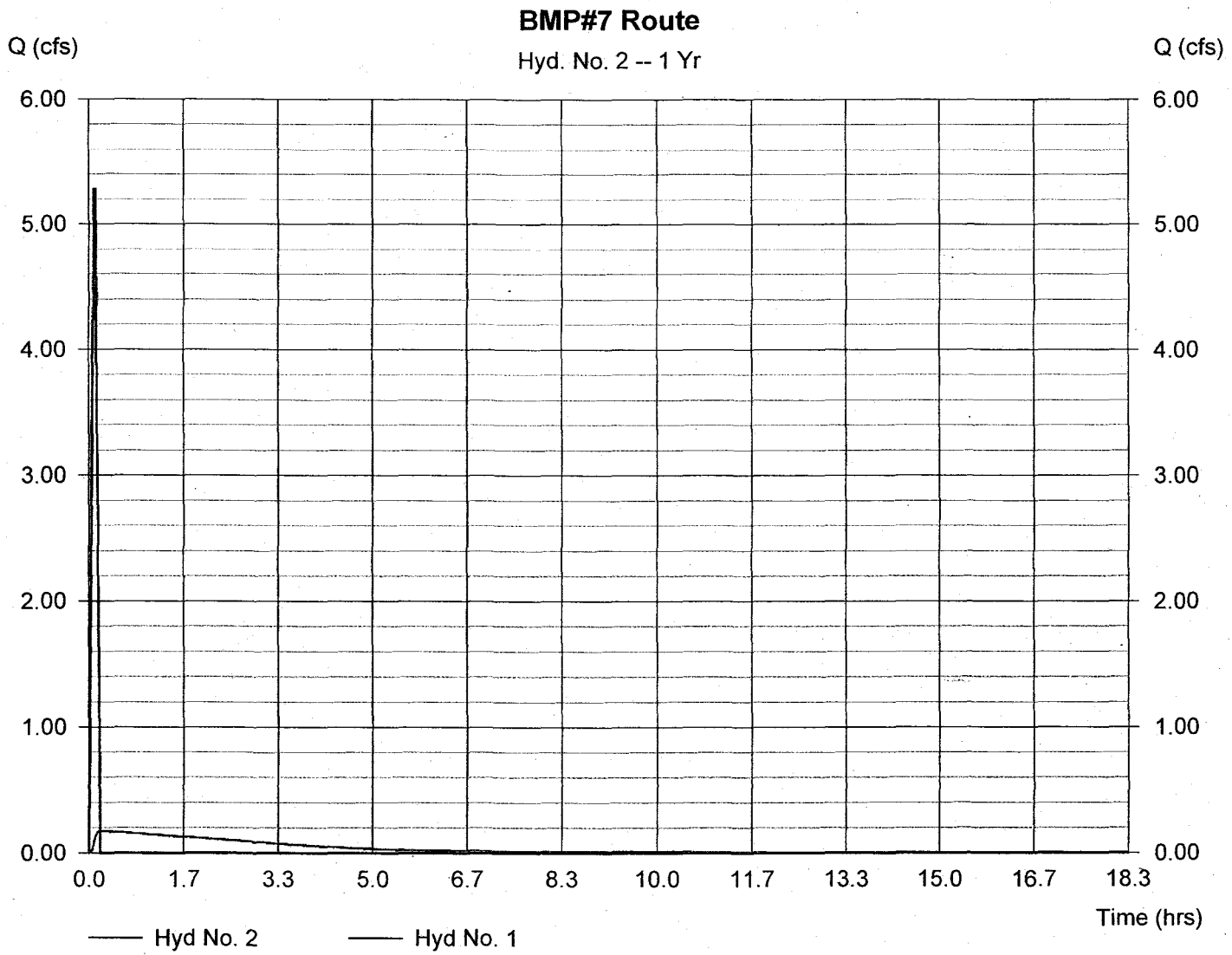
Hydraflow Hydrographs by Intelisolve | Saturday, Aug 15 2009, 10:43 AM

Hyd. No. 2

BMP#7 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.18 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 74.68 ft
Reservoir name	= BMP#7-Wet Pond	Max. Storage	= 2,151 cuft

Storage Indication method used. | Hydrograph Volume = 2,203 cuft



Hydrograph Plot

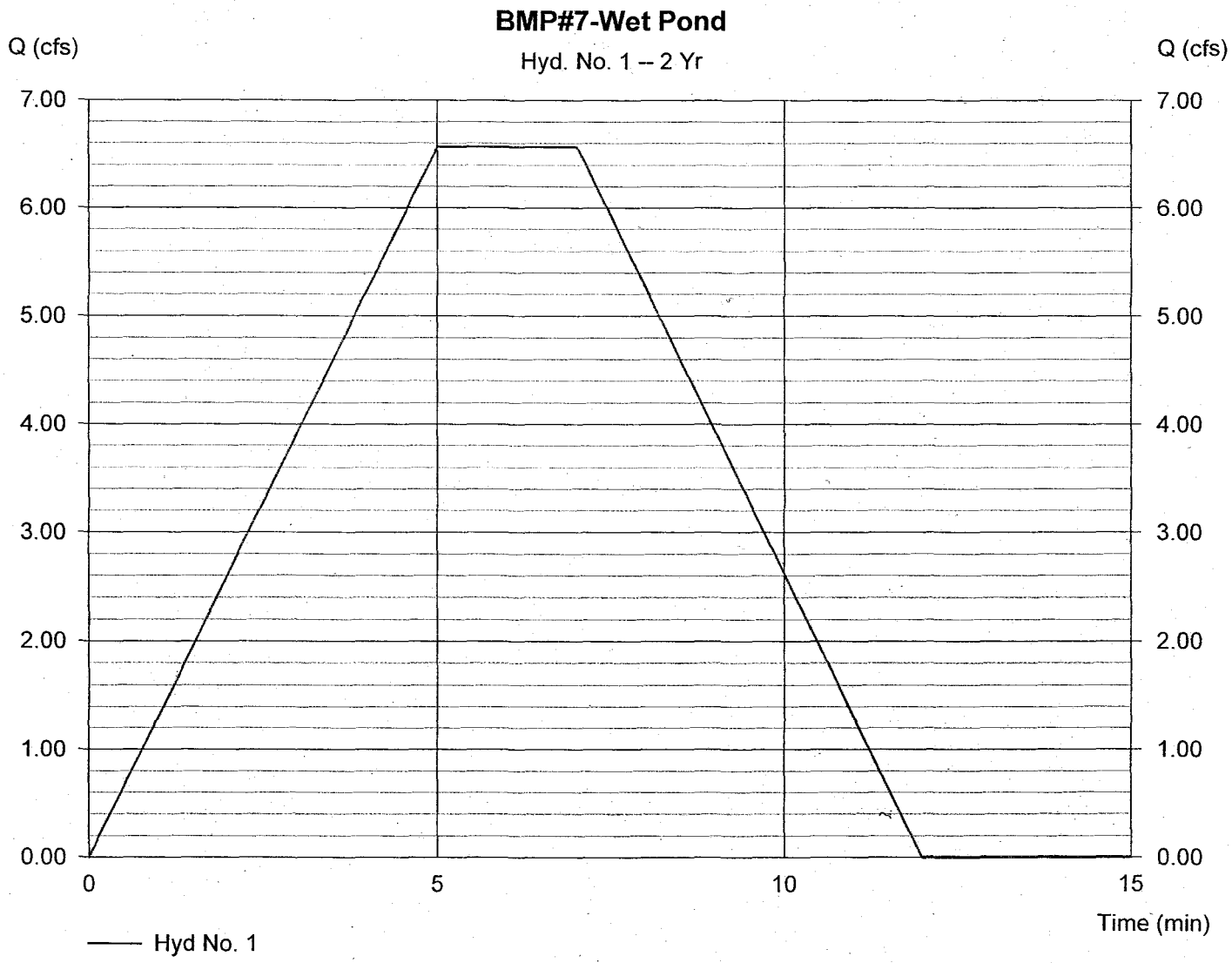
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:20 AM

Hyd. No. 1

BMP#7-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 6.57 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 2.360 ac	Runoff coeff.	= 0.55
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,955 cuft



Hydrograph Plot

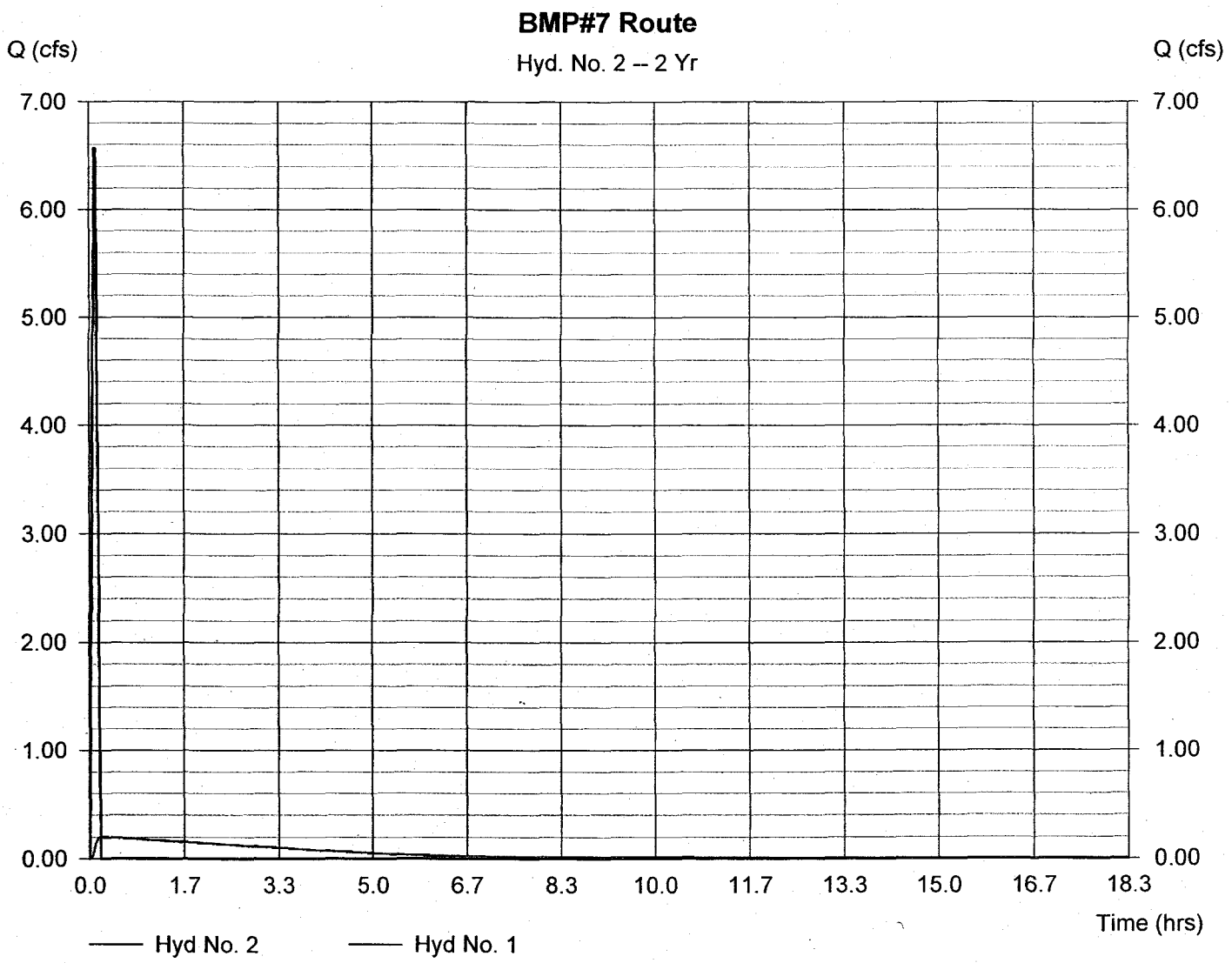
Hydraflow Hydrographs by Intelisolve | Saturday, Aug 15 2009, 10:43 AM

Hyd. No. 2

BMP#7 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.20 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 74.84 ft
Reservoir name	= BMP#7-Wet Pond	Max. Storage	= 2,678 cuft

Storage Indication method used. | Hydrograph Volume = 2,742 cuft



Hydrograph Plot

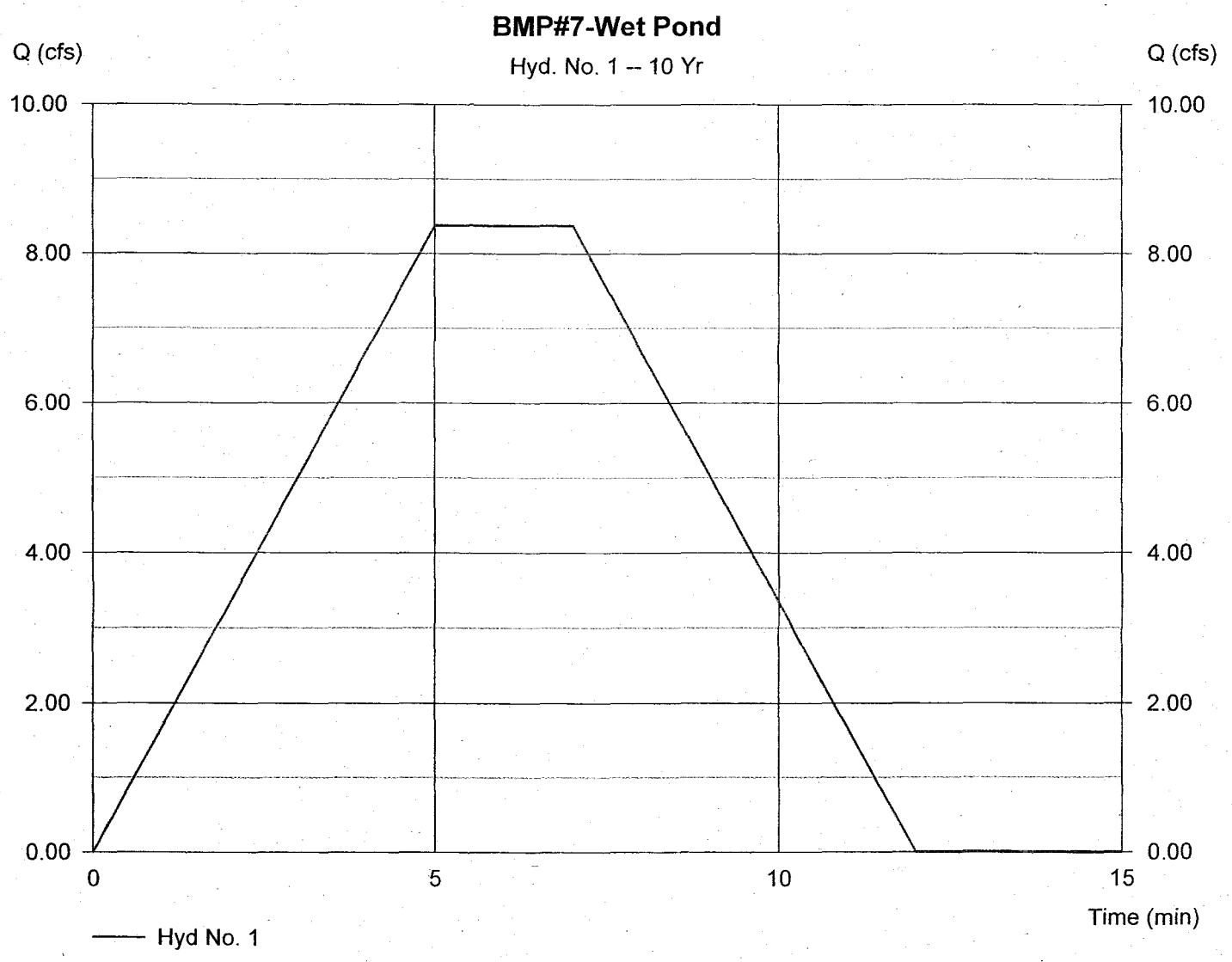
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:20 AM

Hyd. No. 1

BMP#7-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 8.38 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 2.360 ac	Runoff coeff.	= 0.55
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,771 cuft



Hydrograph Plot

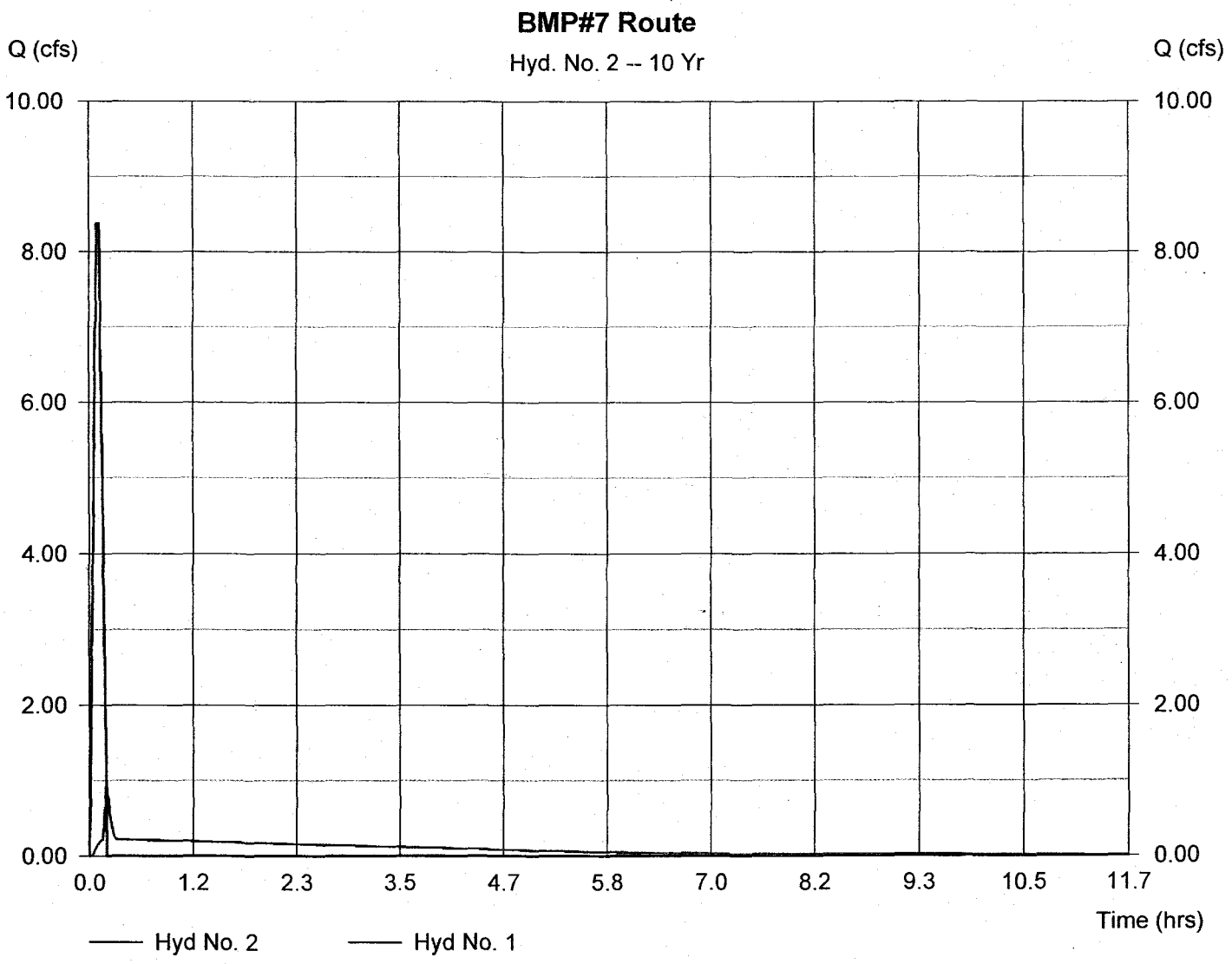
Hydraflow Hydrographs by Intelisolve | Saturday, Aug 15 2009, 10:43 AM

Hyd. No. 2

BMP#7 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.92 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 75.04 ft
Reservoir name	= BMP#7-Wet Pond	Max. Storage	= 3,353 cuft

Storage Indication method used. | Hydrograph Volume = 3,503 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

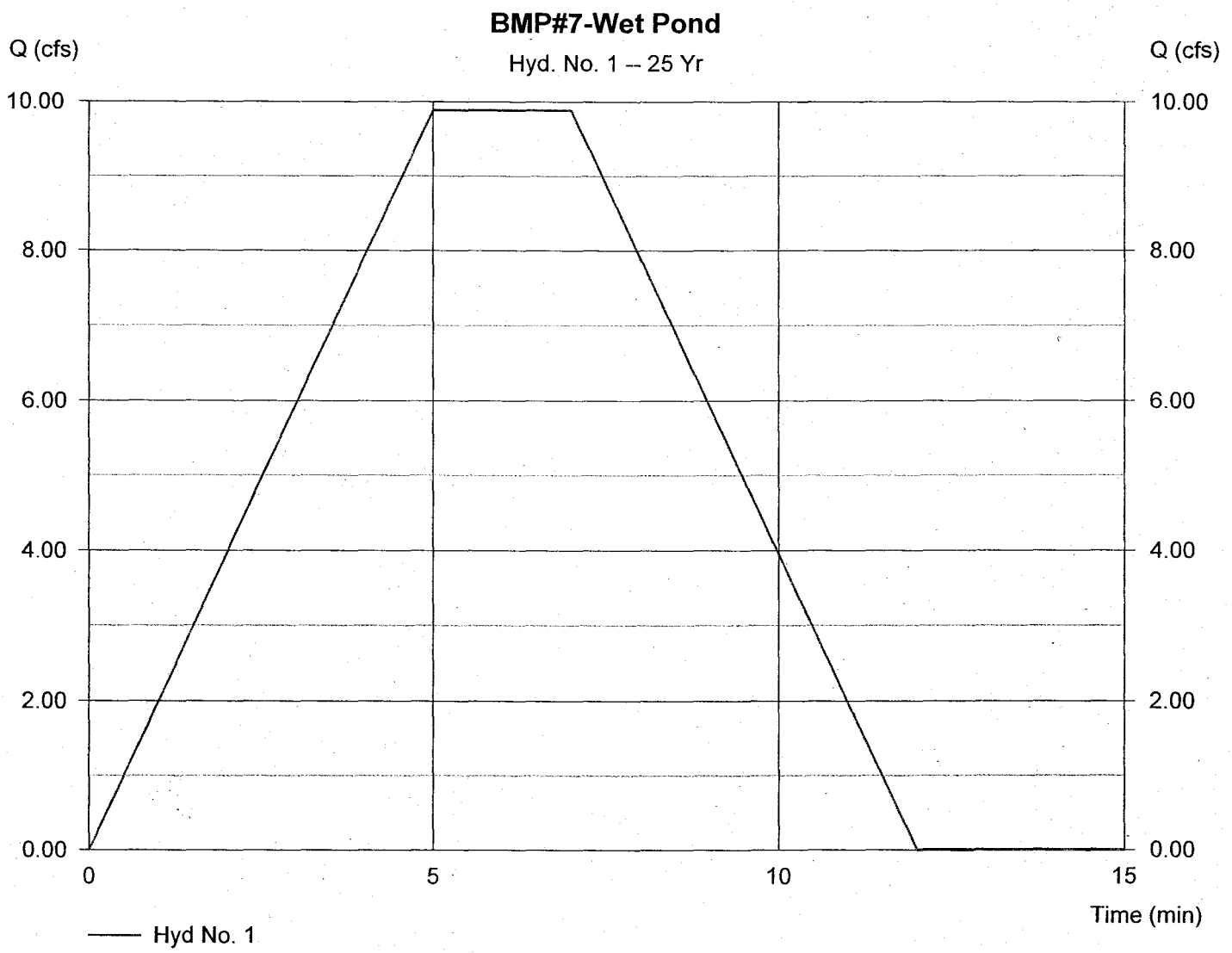
Thursday, Mar 18 2010, 8:20 AM

Hyd. No. 1

BMP#7-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 9.89 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 2.360 ac	Runoff coeff.	= 0.55
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,452 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:43 AM

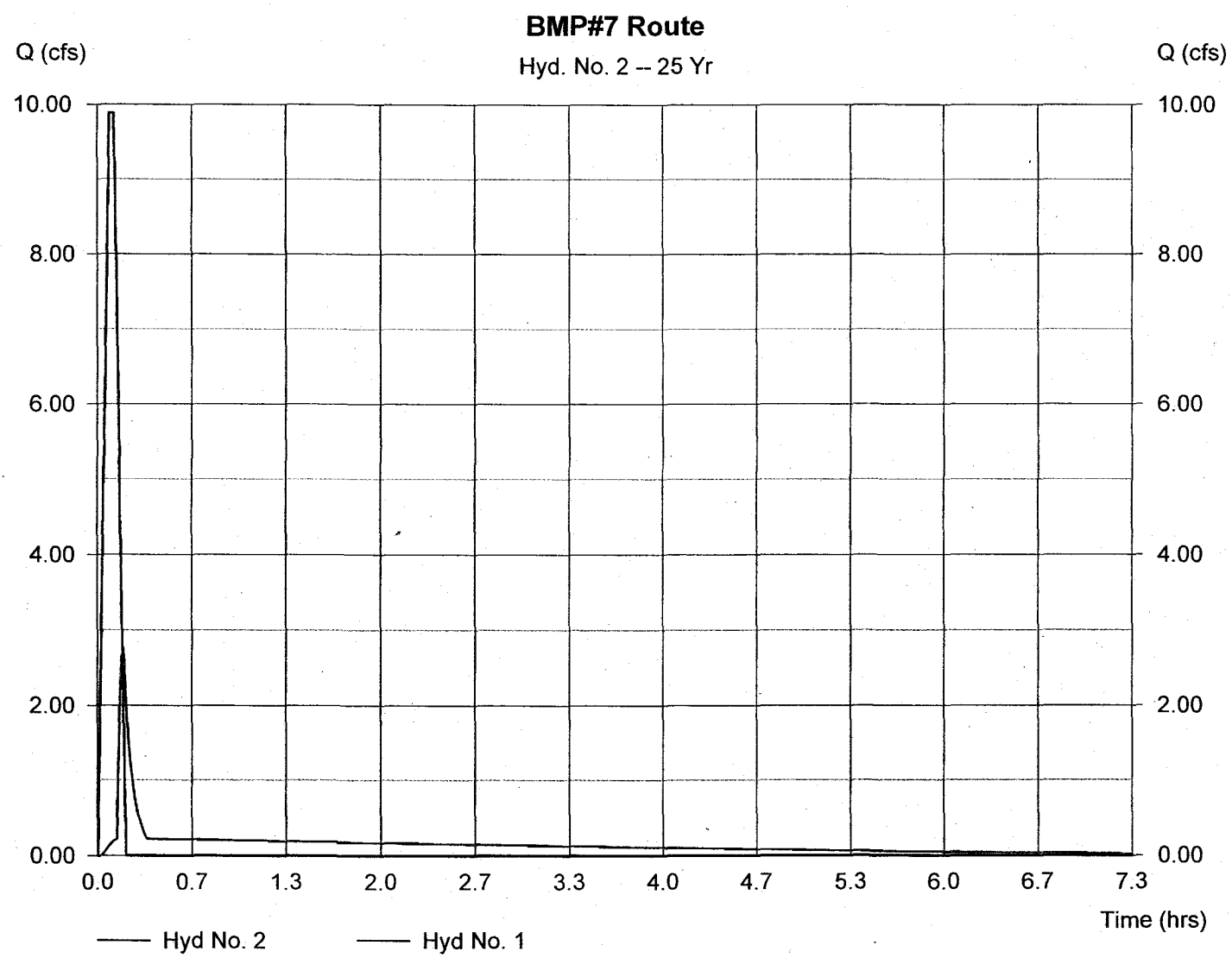
Hyd. No. 2

BMP#7 Route

Hydrograph type	= Reservoir	Peak discharge	= 2.76 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 75.13 ft
Reservoir name	= BMP#7-Wet Pond	Max. Storage	= 3,705 cuft

Storage Indication method used.

Hydrograph Volume = 4,139 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Thursday, Mar 18 2010, 8:22 AM

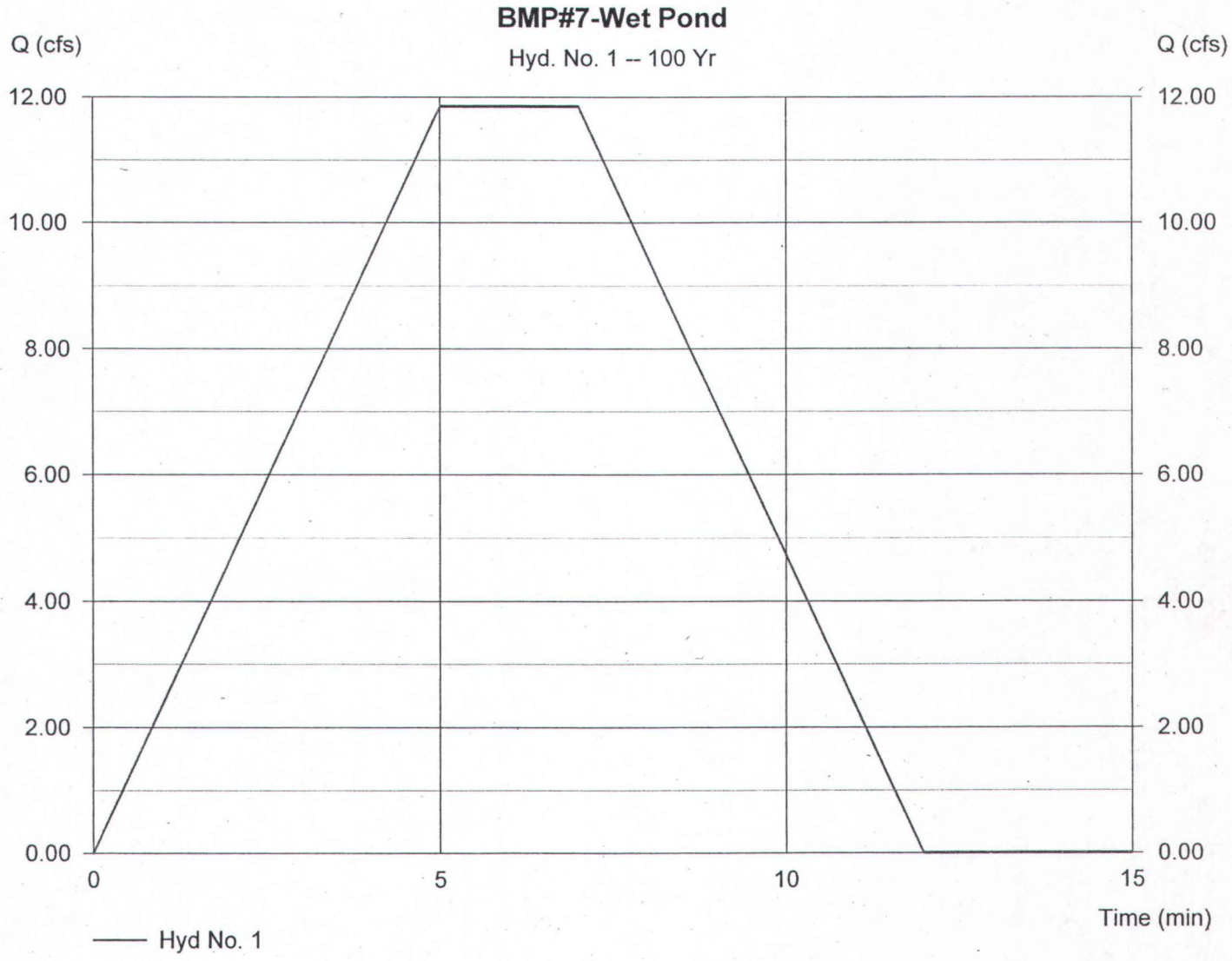
Hyd. No. 1

BMP#7-Wet Pond

NOT ROUTED

Hydrograph type	= Mod. Rational	Peak discharge	= 11.85 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 2.360 ac	Runoff coeff.	= 0.55
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 5,334 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:43 AM

Hyd. No. 2

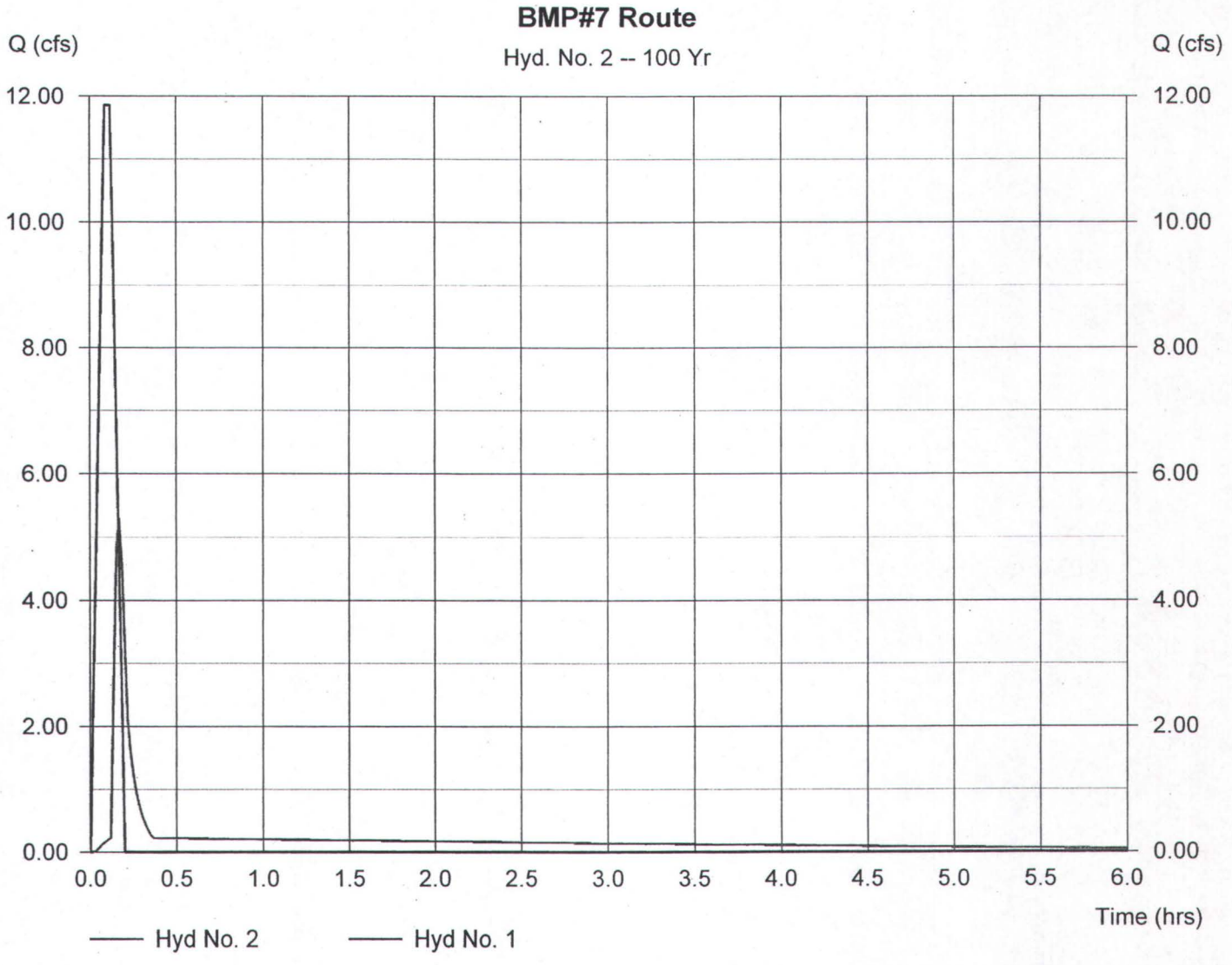
BMP#7 Route

ROUTED! ✓

Hydrograph type	= Reservoir	Peak discharge	= 5.29 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 75.21 ft
Reservoir name	= BMP#7-Wet Pond	Max. Storage	= 4,031 cuft

Storage Indication method used.

Hydrograph Volume = 4,963 cuft



BMP # 7 SETUP

Pond Report

Hydraflow Hydrographs by Intelisolve — Saturday, Aug 15 2009, 10:43 AM

Pond No. 1 - BMP#7-Wet Pond

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	74.00	2,716	0	0
1.00	75.00	3,654	3,185	3,185
2.00	76.00	4,521	4,088	7,273
3.00	77.00	5,342	4,932	12,204
4.00	78.00	6,226	5,784	17,988

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 68.50	74.00	0.00	0.00
Length (ft)	= 40.00	0.00	0.00	0.00
Slope (%)	= 8.75	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	10.00	0.00	0.00
Crest El. (ft)	= 75.00	77.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	Rect	---	---
Multi-Stage	= Yes	No	No	No

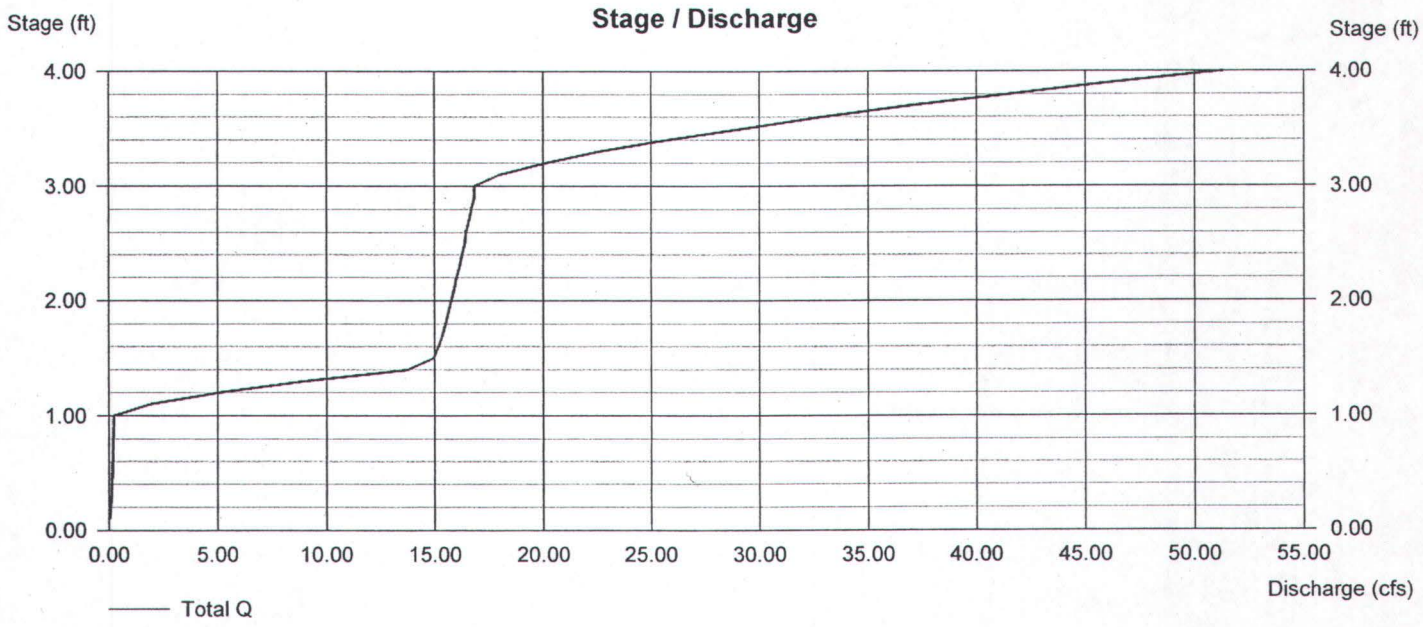
78.00 BY PLAN

1.8' FREEBOARD

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

NO ES BY PLAN
ES NOT USED IN ROUTING



BMP#8: WET EXTENDED DETETION POND

DESIGN WORKSHEET & CALCULATIONS

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

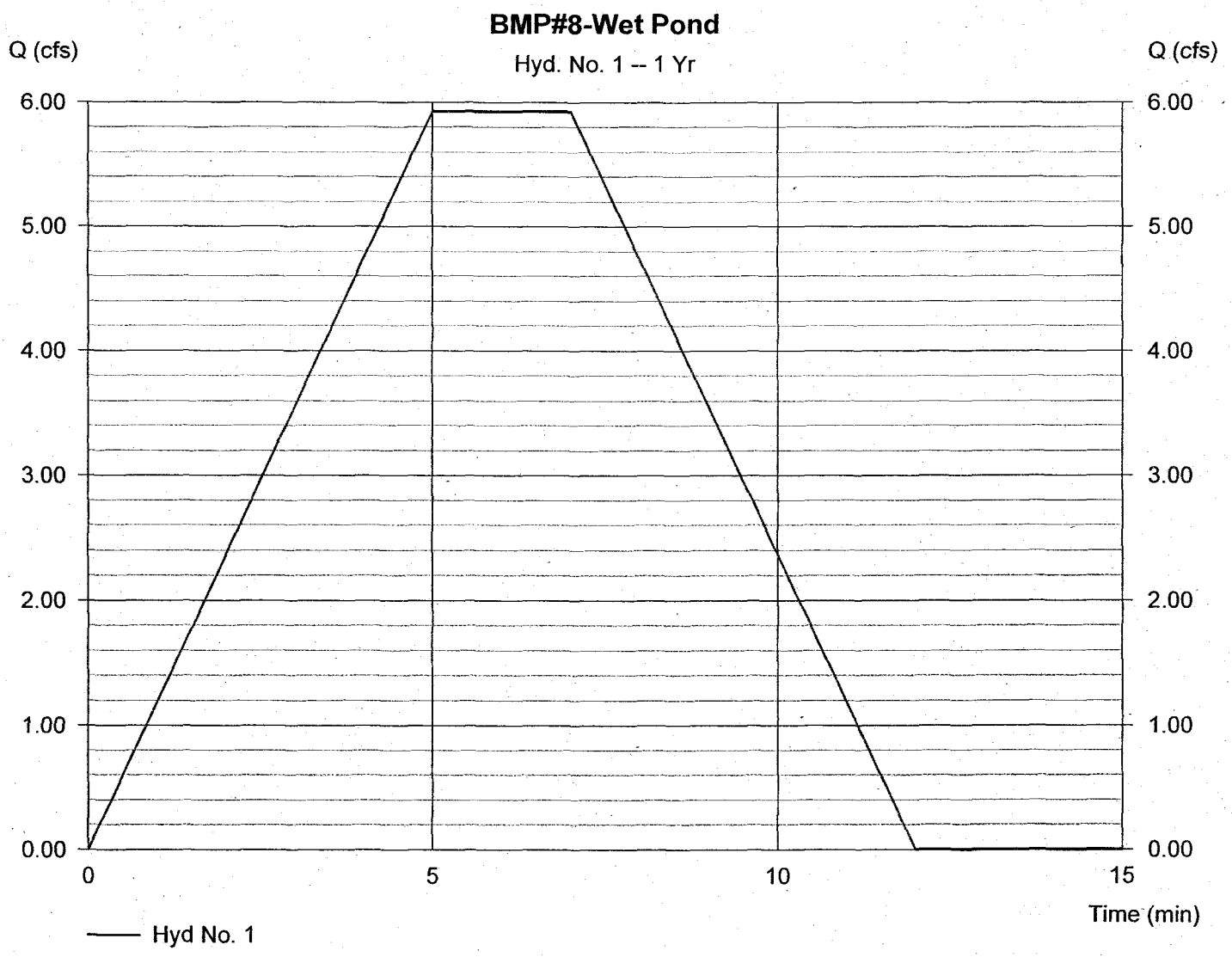
Thursday, Mar 18 2010, 8:23 AM

Hyd. No. 1

BMP#8-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 5.93 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 2.800 ac	Runoff coeff.	= 0.52
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,667 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:51 AM

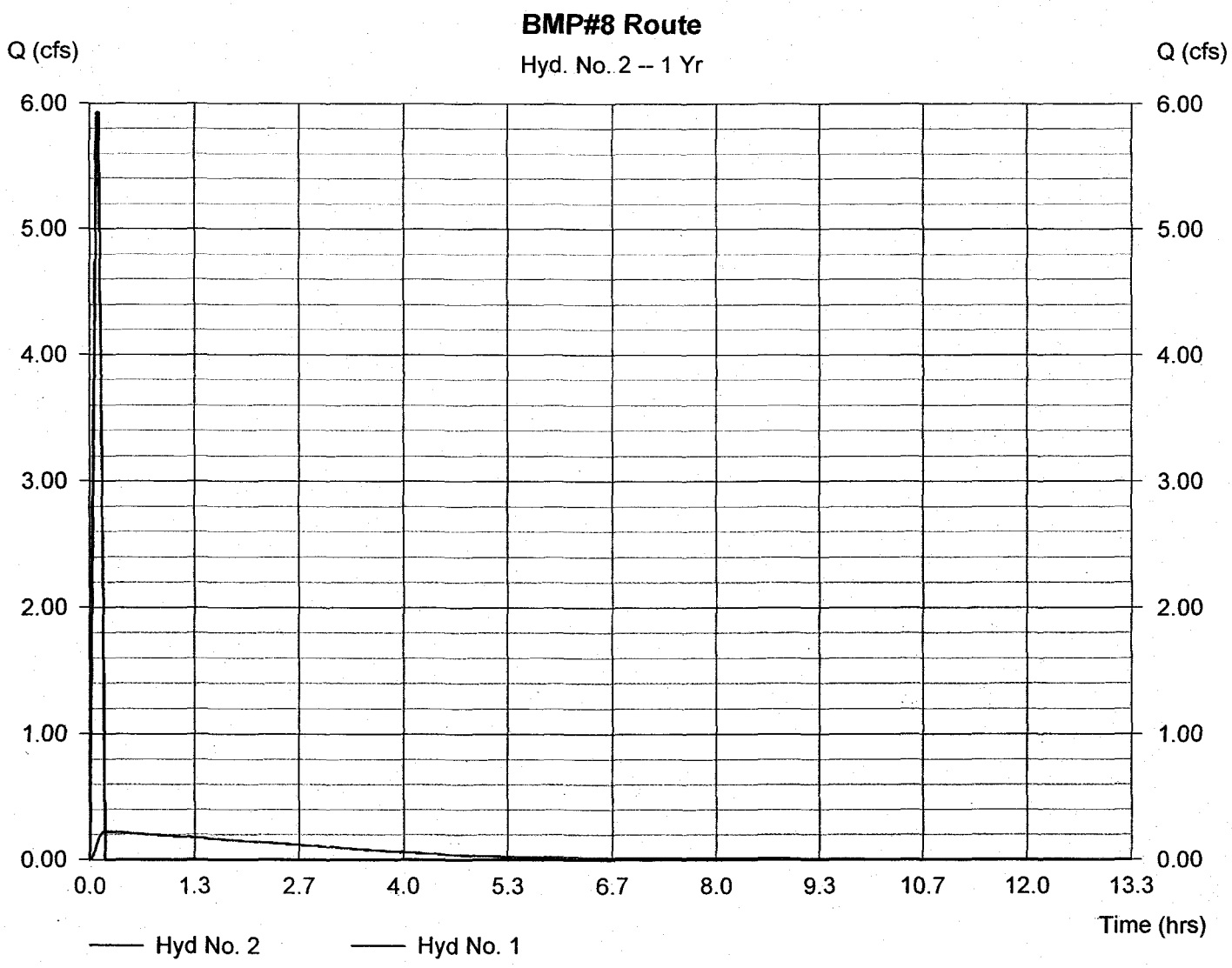
Hyd. No. 2

BMP#8 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.22 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 67.02 ft
Reservoir name	= BMP#8-Wet Pond	Max. Storage	= 2,398 cuft

Storage Indication method used.

Hydrograph Volume = 2,478 cuft



Hydrograph Plot

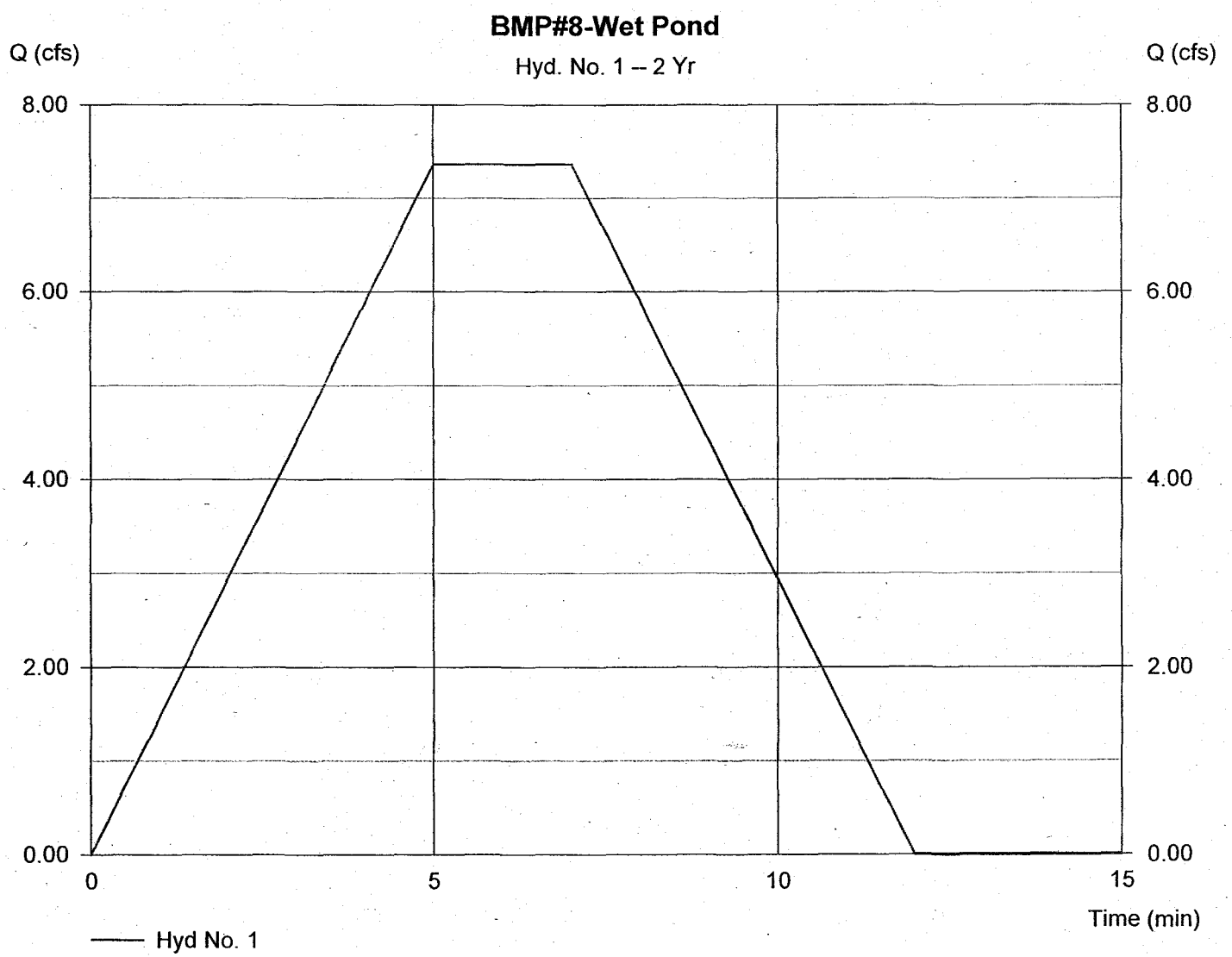
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:23 AM

Hyd. No. 1

BMP#8-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 7.37 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 2.800 ac	Runoff coeff.	= 0.52
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,314 cuft



Hydrograph Plot

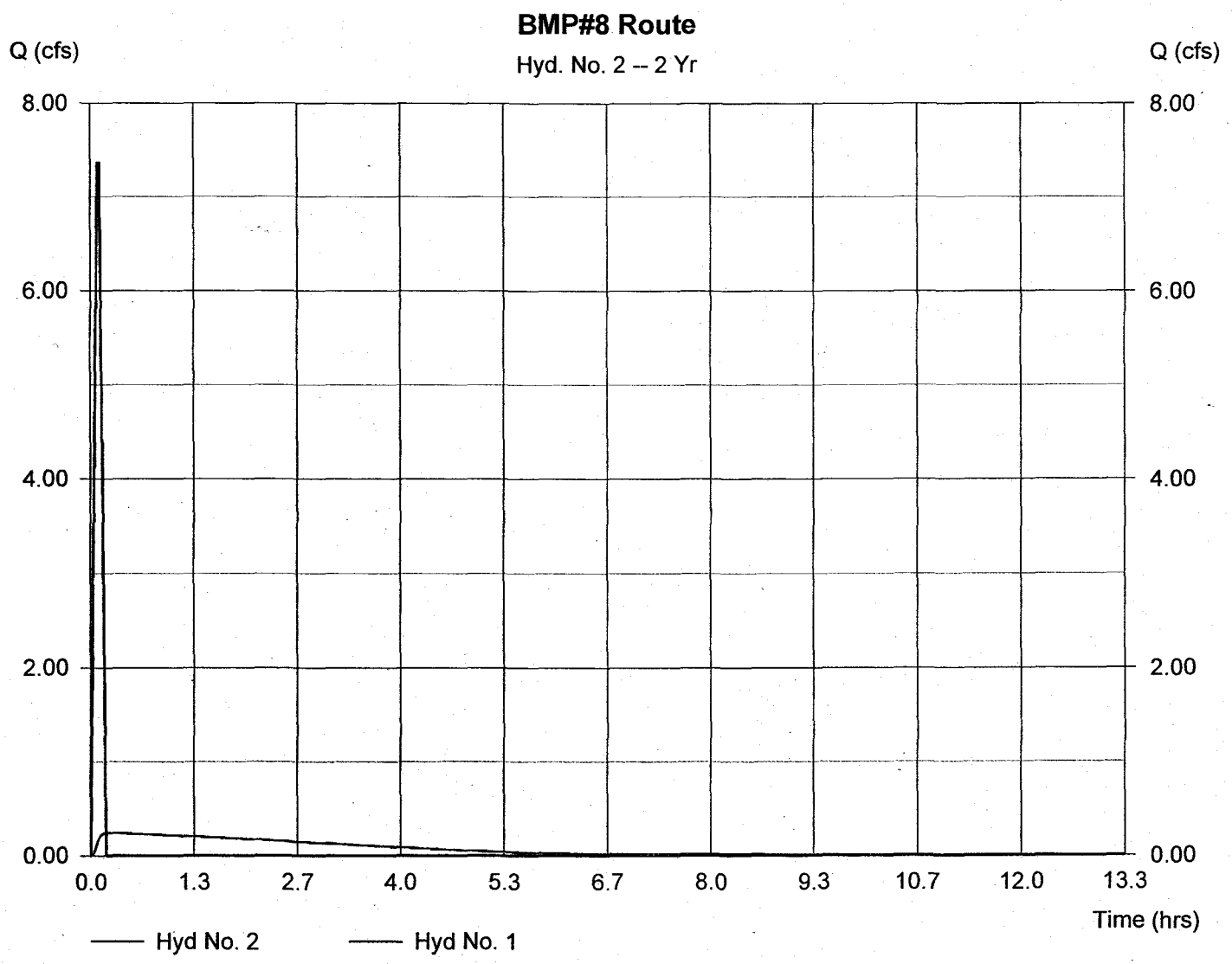
Hydraflow Hydrographs by Intelisolve — Saturday, Aug 15 2009, 10:51 AM

Hyd. No. 2

BMP#8 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.25 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 67.21 ft
Reservoir name	= BMP#8-Wet Pond	Max. Storage	= 2,989 cuft

Storage Indication method used. — Hydrograph Volume = 3,082 cuft



Hydrograph Plot

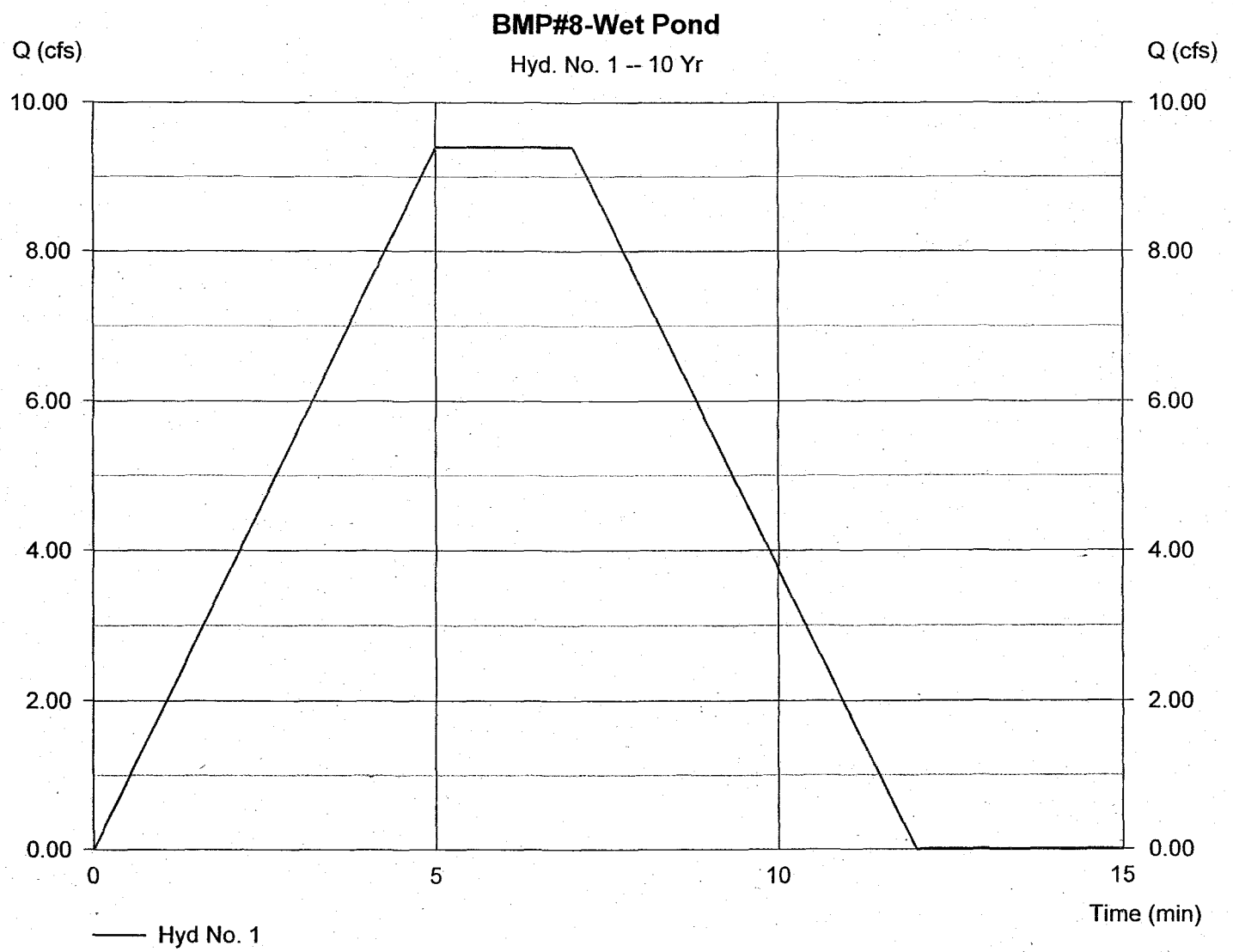
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:23 AM

Hyd. No. 1

BMP#8-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 9.40 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 2.800 ac	Runoff coeff.	= 0.52
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,230 cuft



Hydrograph Plot

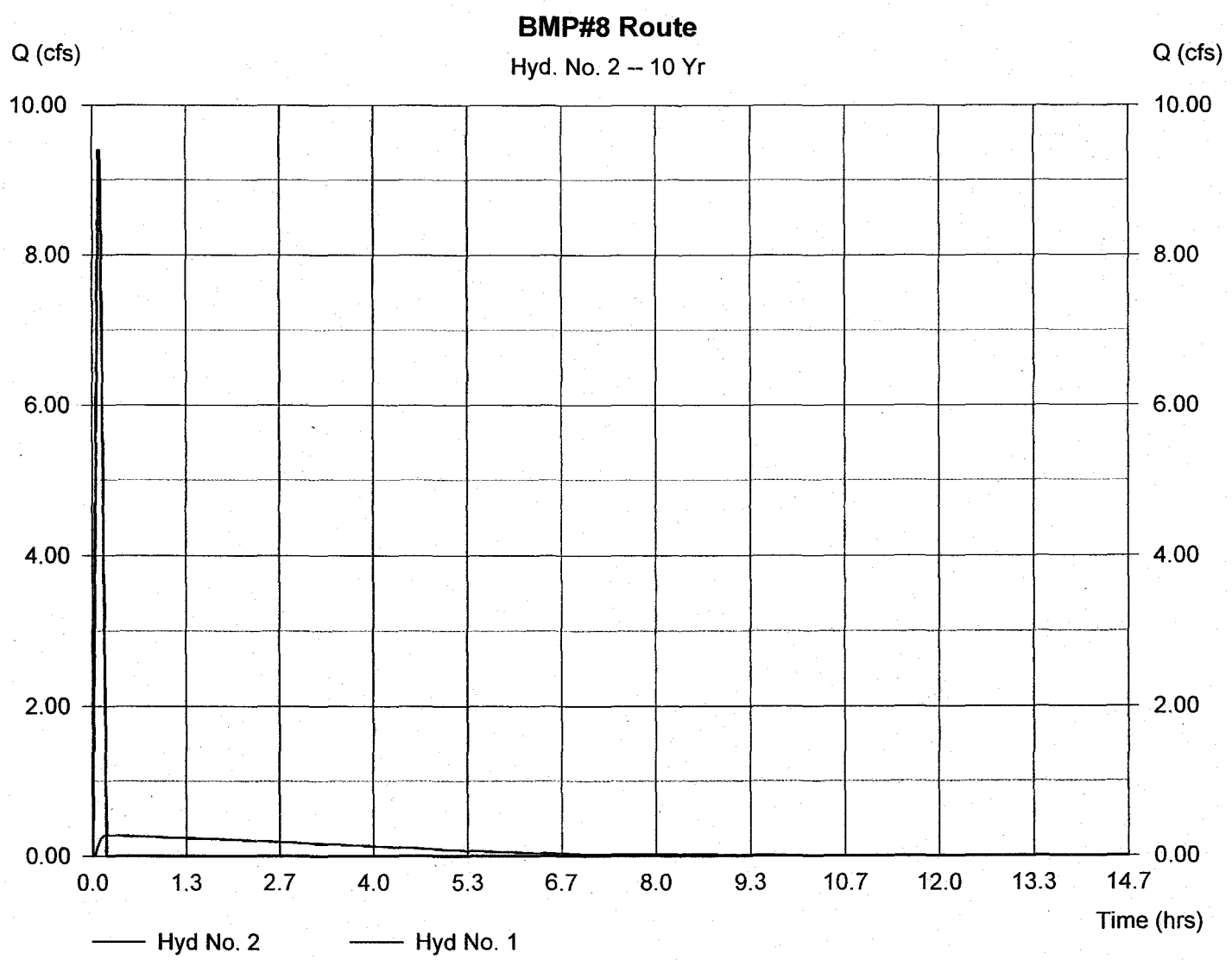
Hydraflow Hydrographs by Intelisolve | Saturday, Aug 15 2009, 10:51 AM

Hyd. No. 2

BMP#8 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.28 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 67.49 ft
Reservoir name	= BMP#8-Wet Pond	Max. Storage	= 3,828 cuft

Storage Indication method used. | Hydrograph Volume = 3,936 cuft



Hydrograph Plot

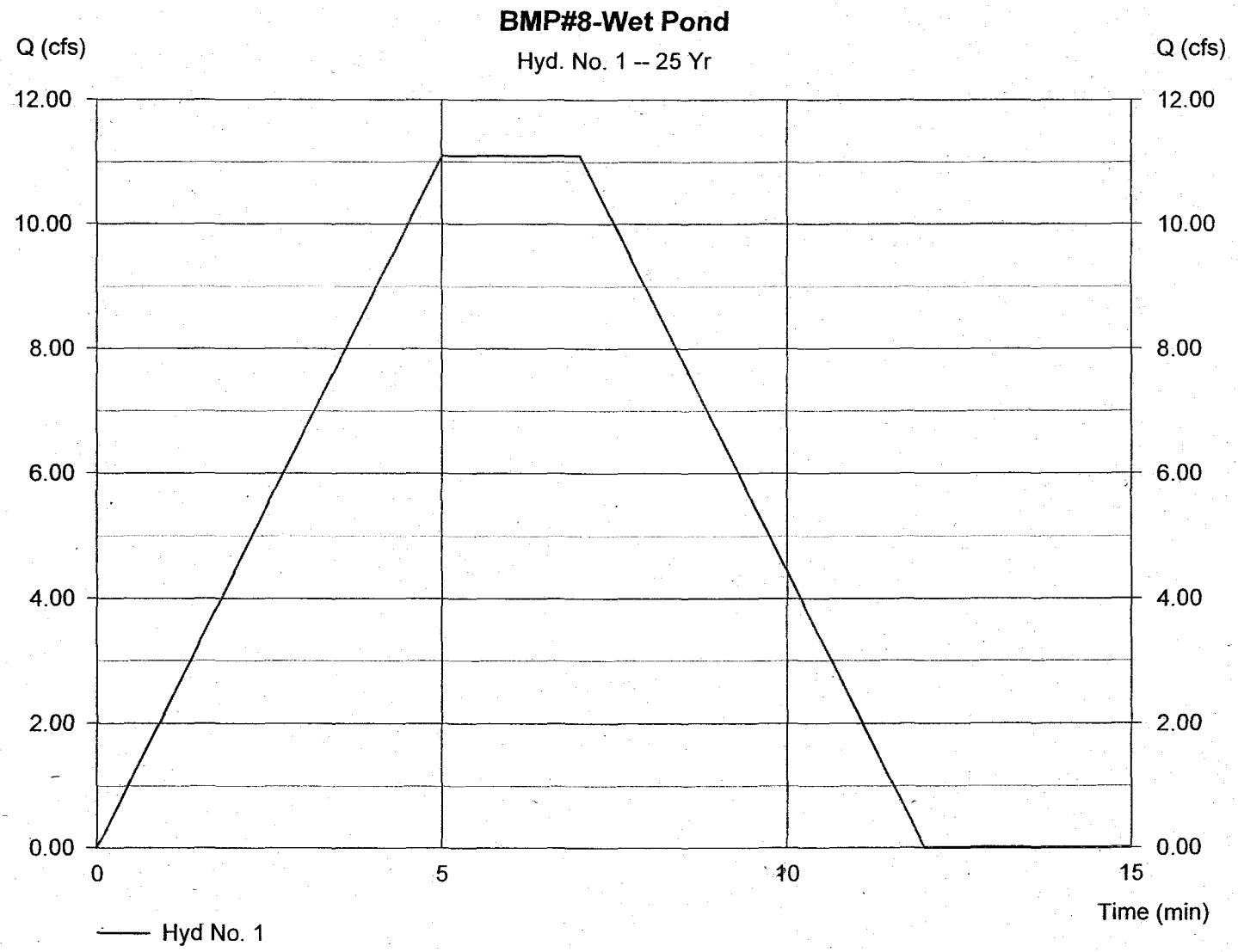
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:23 AM

Hyd. No. 1

BMP#8-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 11.10 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 2.800 ac	Runoff coeff.	= 0.52
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,994 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:51 AM

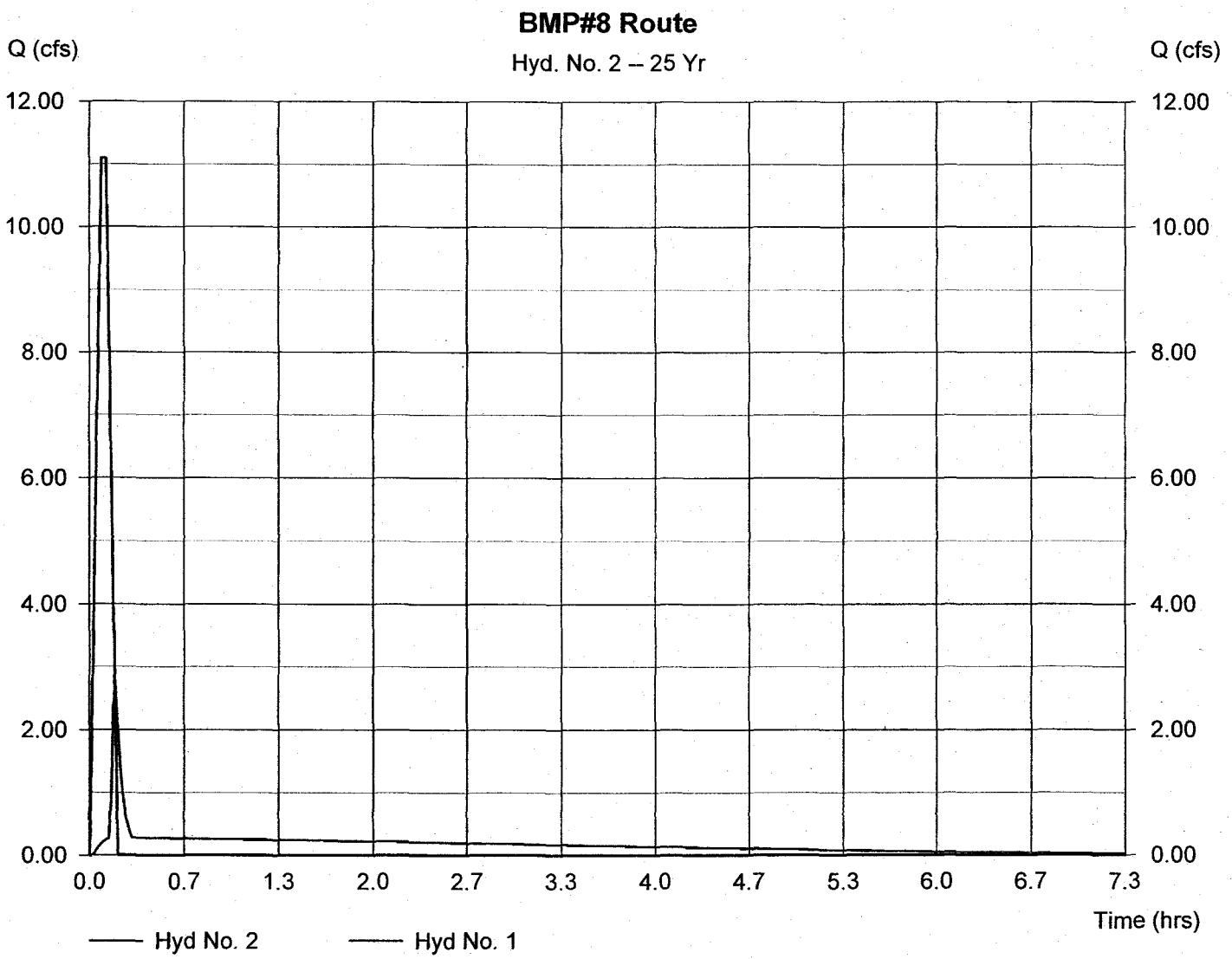
Hyd. No. 2

BMP#8 Route

Hydrograph type	= Reservoir	Peak discharge	= 2.77 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 67.63 ft
Reservoir name	= BMP#8-Wet Pond	Max. Storage	= 4,254 cuft

Storage Indication method used.

Hydrograph Volume = 4,649 cuft



Hydrograph Plot

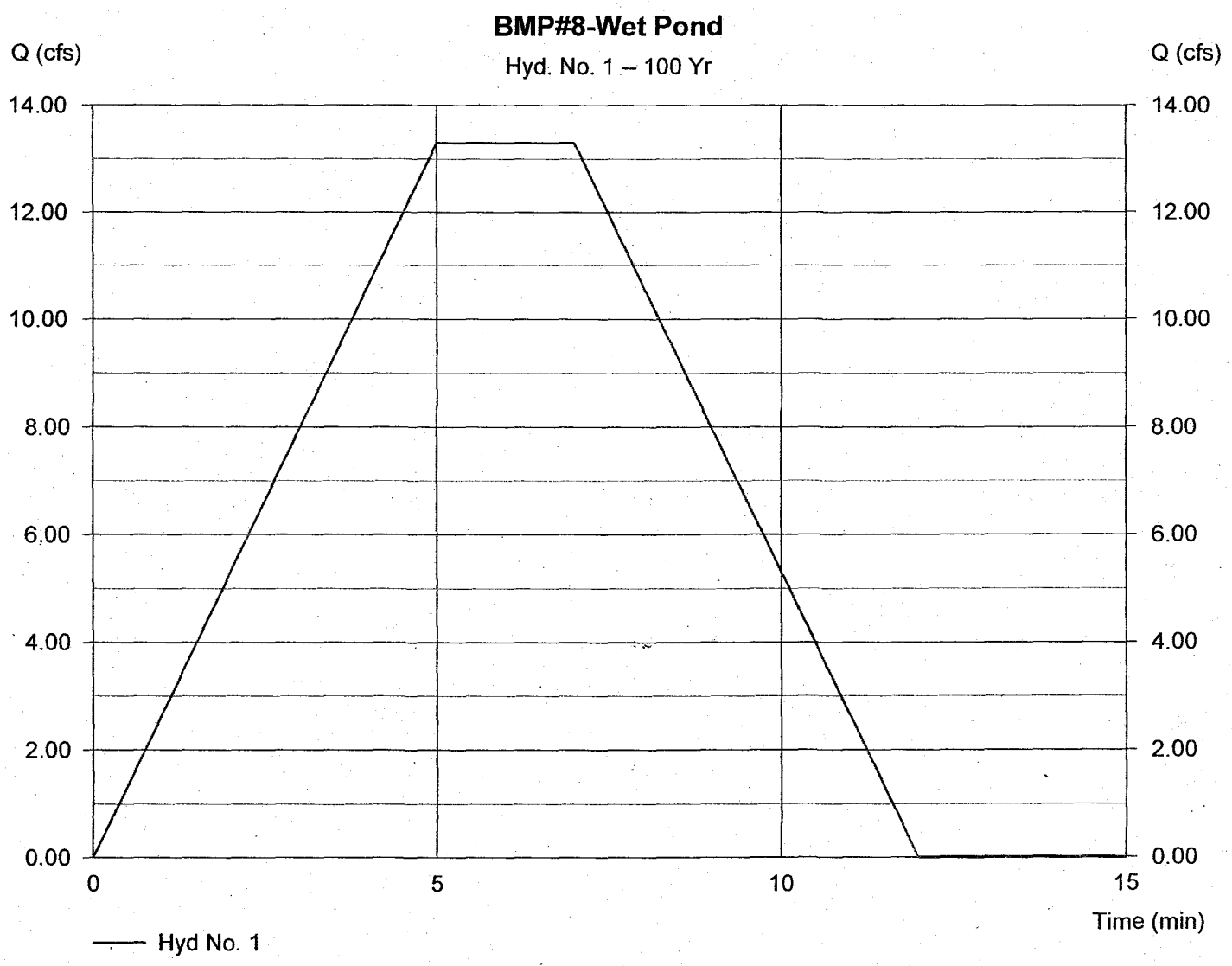
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:23 AM

Hyd. No. 1

BMP#8-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 13.30 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 2.800 ac	Runoff coeff.	= 0.52
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 5,984 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:51 AM

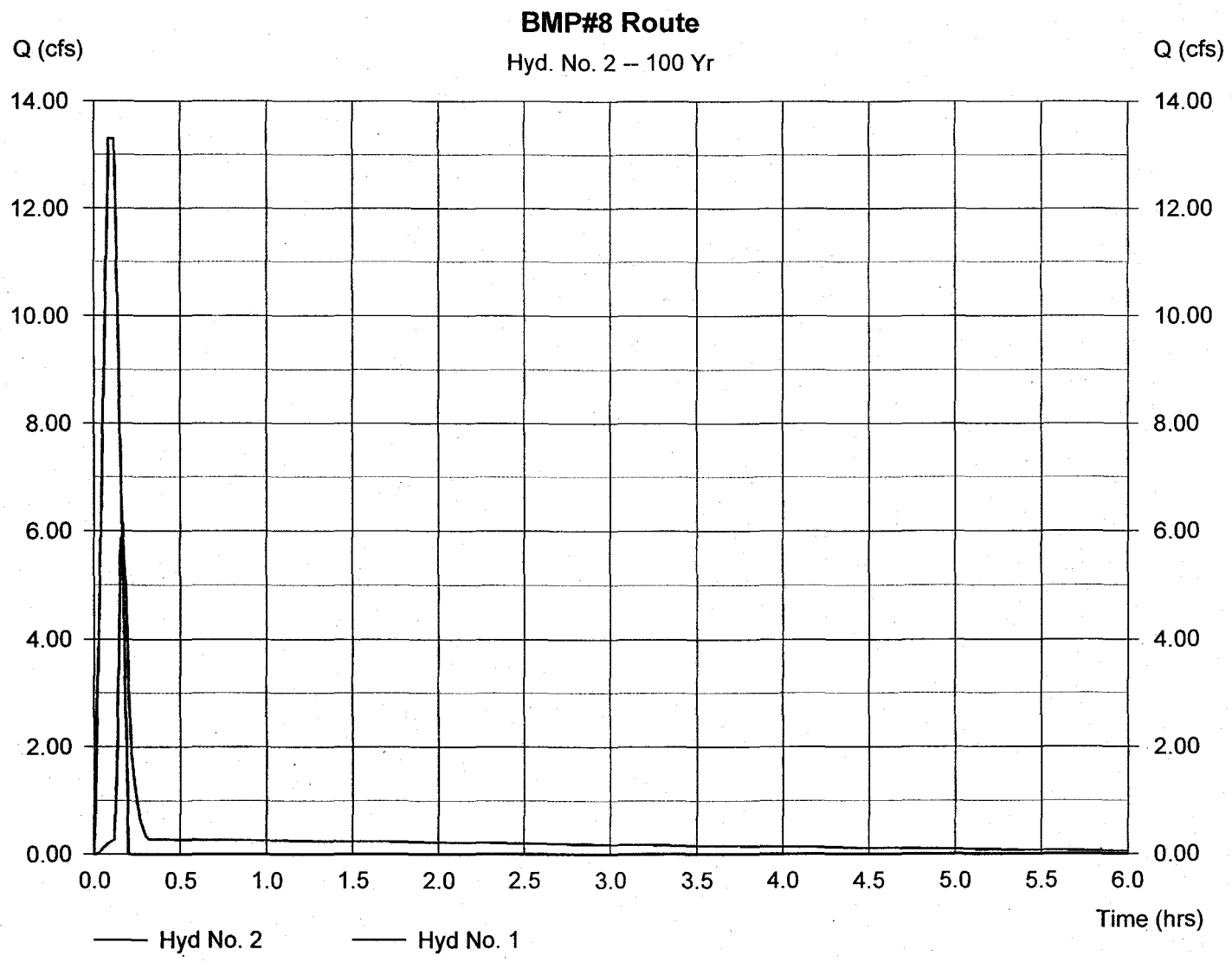
Hyd. No. 2

BMP#8 Route

Hydrograph type	= Reservoir	Peak discharge	= 6.15 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 67.73 ft
Reservoir name	= BMP#8-Wet Pond	Max. Storage	= 4,565 cuft

Storage Indication method used.

Hydrograph Volume = 5,573 cuft



BAIT #8 SET-UP

Pond Report

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 10:51 AM

Pond No. 1 - BMP#8-Wet Pond

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	66.00	1,933	0	0
1.00	67.00	2,722	2,328	2,328
2.00	68.00	3,432	3,077	5,405
3.00	69.00	4,230	3,831	9,236
4.00	70.00	5,097	4,664	13,899

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 58.00	66.00	0.00	0.00
Length (ft)	= 53.00	0.00	0.00	0.00
Slope (%)	= 8.60	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 67.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	—	—	—
Multi-Stage	= Yes	No	No	No

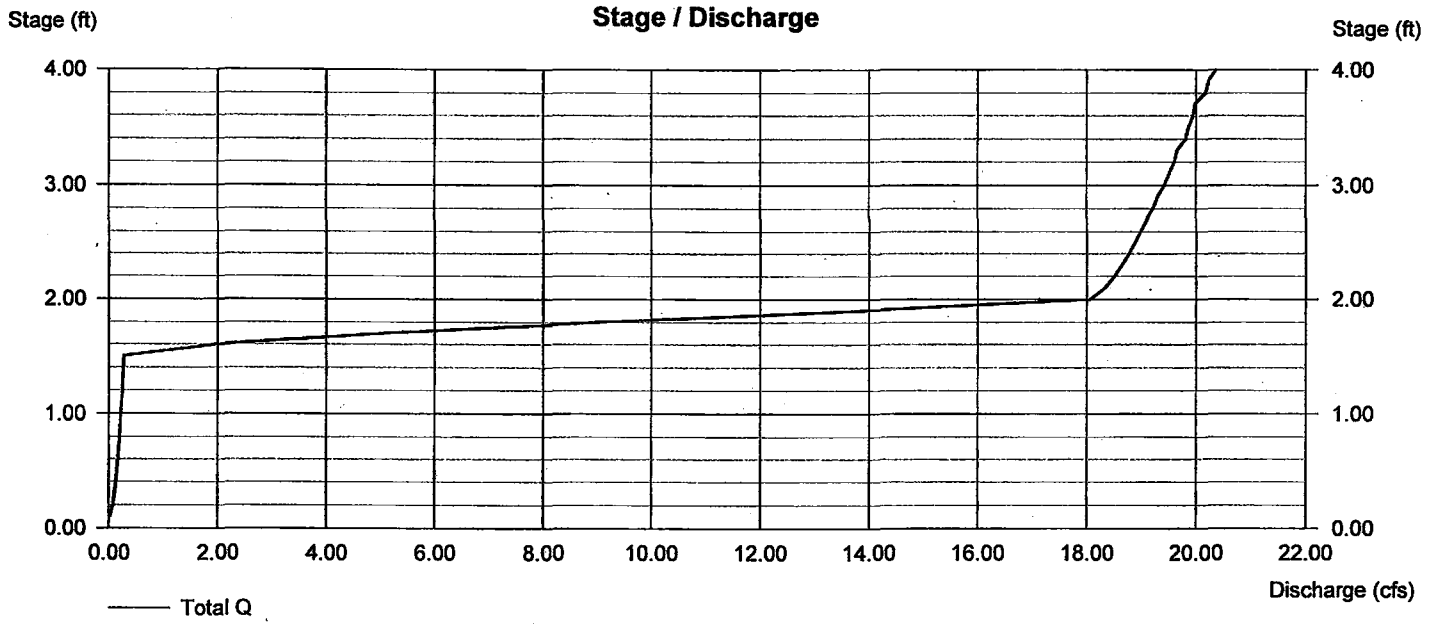
Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

see Formula + HGL

T.4 E12'

Stage / Discharge



BMP#9: BIORETENTION
DESIGN WORKSHEET & CALCULATIONS

DESIGN WORKSHEET - BMP #9

WSP · SELLS

Project Name:	Stonehouse Tract 12	Designed By:	IN
Project Number:	08-4051	Checked By:	CMD
		Date:	8/17/09

Water Quality Volume

Simplified Method:

$$WQv = \frac{(R_D)(R_V)(A)}{12}$$

R_D = 1 Design Storm Rainfall Depth (inches)

R_V = Runoff coefficient (Runoff/Rainfall)

$R_V = 0.05 + 0.009(I)$

I = 32% % Impervious Area of Site

A = 1.21 Drainage Area (Acres)

Rv = 0.053

WQv = Water Quality Volume = 0.005 Acre-Feet; 232 Cubic Feet

Bioretention Surface Area

Design Criteria: Minimum 5% of Impervious Area

Impervious Area = 0.39 Acres; 17,000 SF

Minimum Surface Area = 850 SF required

Actual Surface Area = 1,590 SF provided

Bioretention Infiltration Rates

Darcy's Equation for Bioretention Water Draw Through Rate:

Q = (.0000232) (K) (A) (H/L)

K = 2.0 Hydraulic Conductivity of filter media/soil mixture (ft/day)

A = 1,590 Bioretention Surface Area (sf)

H = 3.5 Height of Water above Drainage Zone (ft)

L = 2.5 Thickness of Soil Bed (ft)

Q = Rate of Draw through Bioretention Soil = 0.103 **cubic feet per second (cfs)**

Time to Drawdown Water through Bioretention Media

Volume (V) = (A) (X) (n)

A =	1,590	Bioretention Surface Area (SF)
X =	2.5	Depth to Lower (ft)
n =	0.45	Porosity
Volume =	1,789	Cubic Feet
Time (T) = V / Q =	17,318	Seconds
	4.8	Hours

okay

Underdrains

Minimum Flow *equation: Q = 2.3E-5 * K * A* 0.07 cfs

Factor of Safety (range between 2 and 10) 5

Design Flow 0.37 cfs

Manning's Roughness Coefficient

0.011 smooth wall

0.015 corrugated wall **Use n =** 0.011

Internal Slope (recommended minimum 0.5%) 0.5 **%**

Pipe(s) Diameter(s) *equation: D = 16 * (Q * n * s^0.5)^(3/8)*

5.46 inches *calculations assume n=0.011*

# of 4" underdrains: 3 # of 6" underdrains: 2

Equivalent Pipe Diameters

D= (in)	No. of 4" diamet
5.13	2
5.95	3
6.66	4
7.22	5
7.75	6
8.2	7

D= (in)	No of 6" diameter
7.84	2
9.11	3
10.13	4

Note: A minimum of 2 underdrains recommended

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

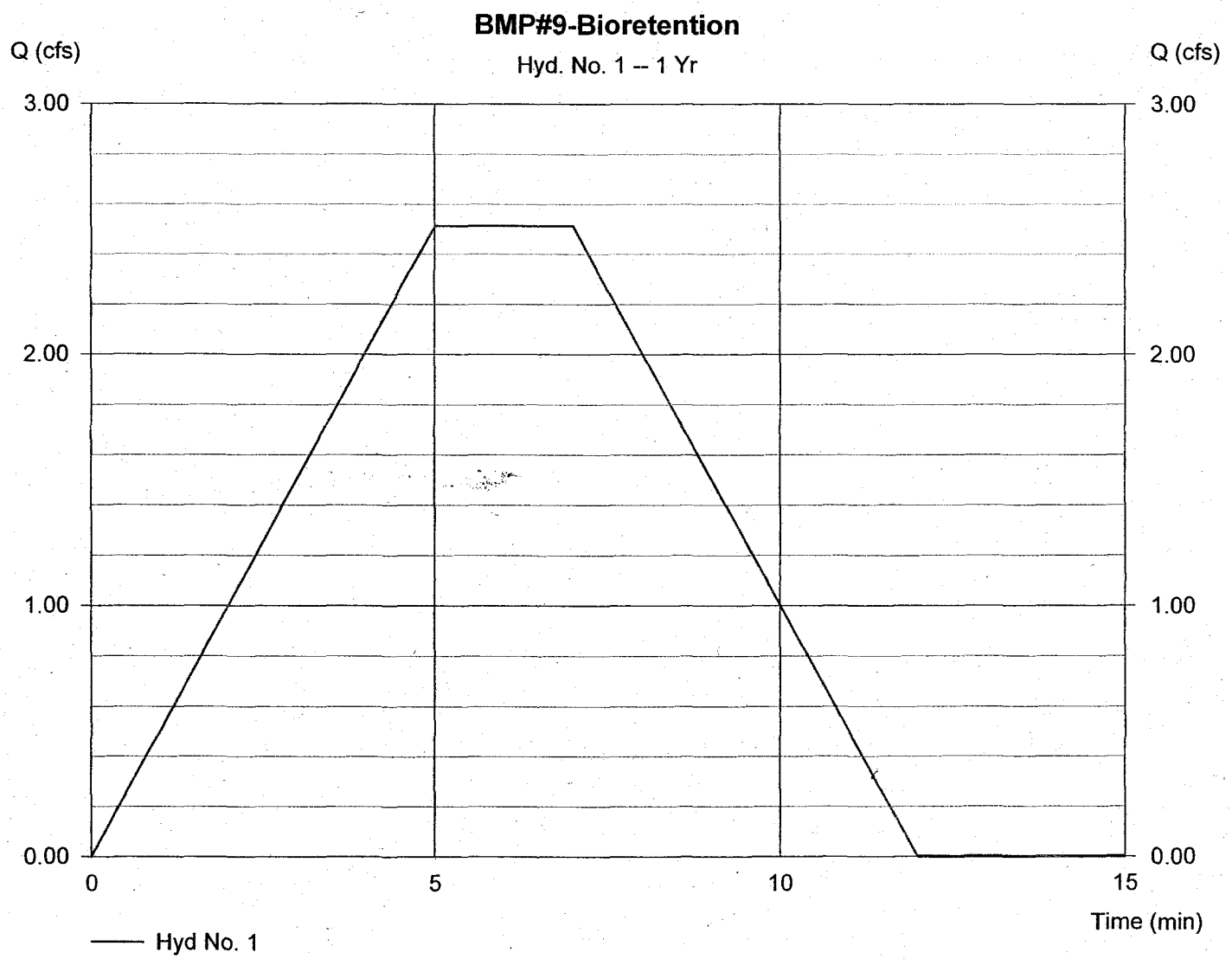
Thursday, Mar 18 2010, 8:25 AM

Hyd. No. 1

BMP#9-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 2.51 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.210 ac	Runoff coeff.	= 0.51
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,130 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 11:4 AM

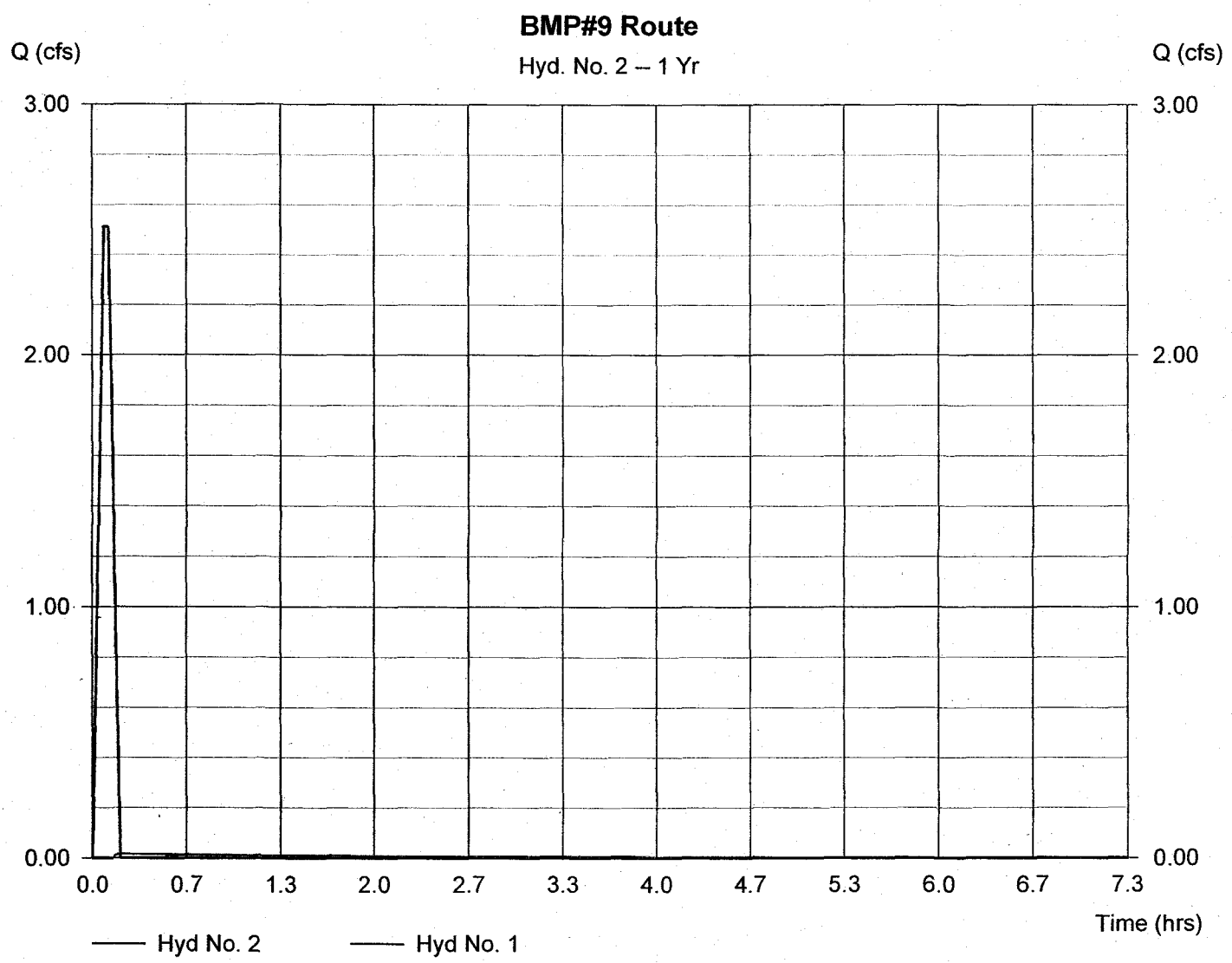
Hyd. No. 2

BMP#9 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.02 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 85.58 ft
Reservoir name	= BMP#9-Bioretention	Max. Storage	= 1,053 cuft

Storage Indication method used.

Hydrograph Volume = 136 cuft



Hydrograph Plot

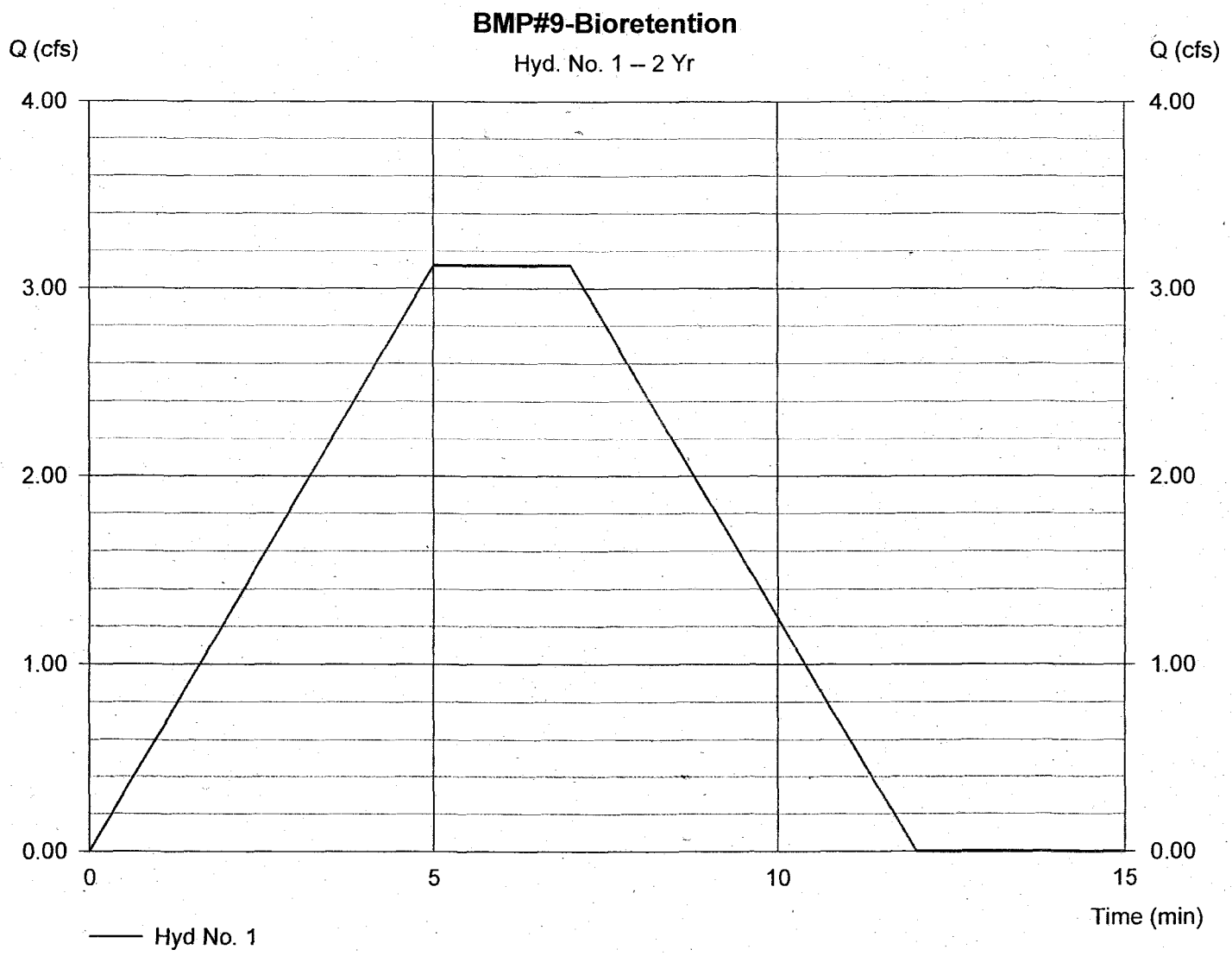
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:25 AM

Hyd. No. 1

BMP#9-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 3.12 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 1.210 ac	Runoff coeff.	= 0.51
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,405 cuft



Hydrograph Plot

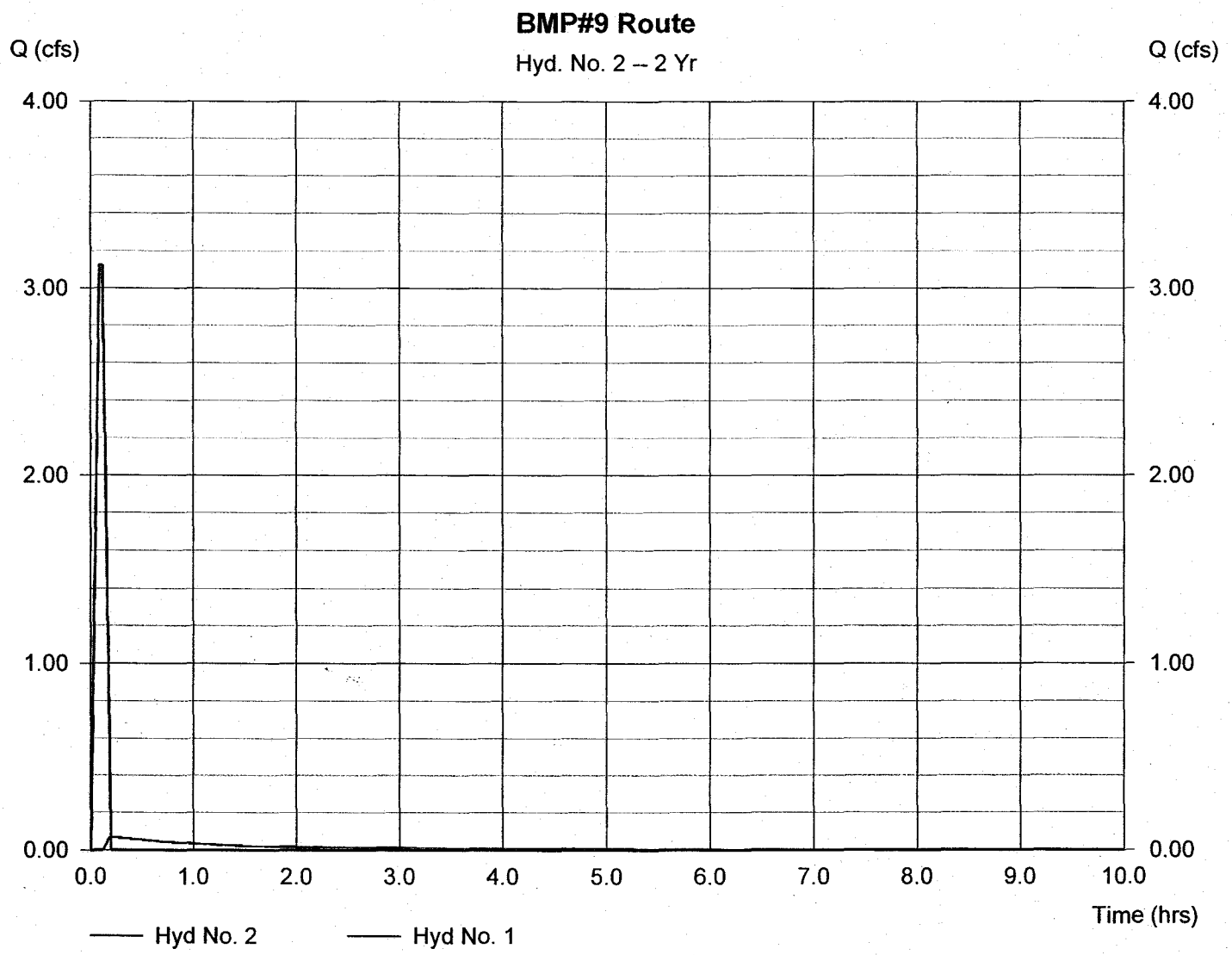
Hydraflow Hydrographs by Intelisolve | Saturday, Aug 15 2009, 11:4 AM

Hyd. No. 2

BMP#9 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.07 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 85.71 ft
Reservoir name	= BMP#9-Bioretention	Max. Storage	= 1,299 cuft

Storage Indication method used. | Hydrograph Volume = 392 cuft



Hydrograph Plot

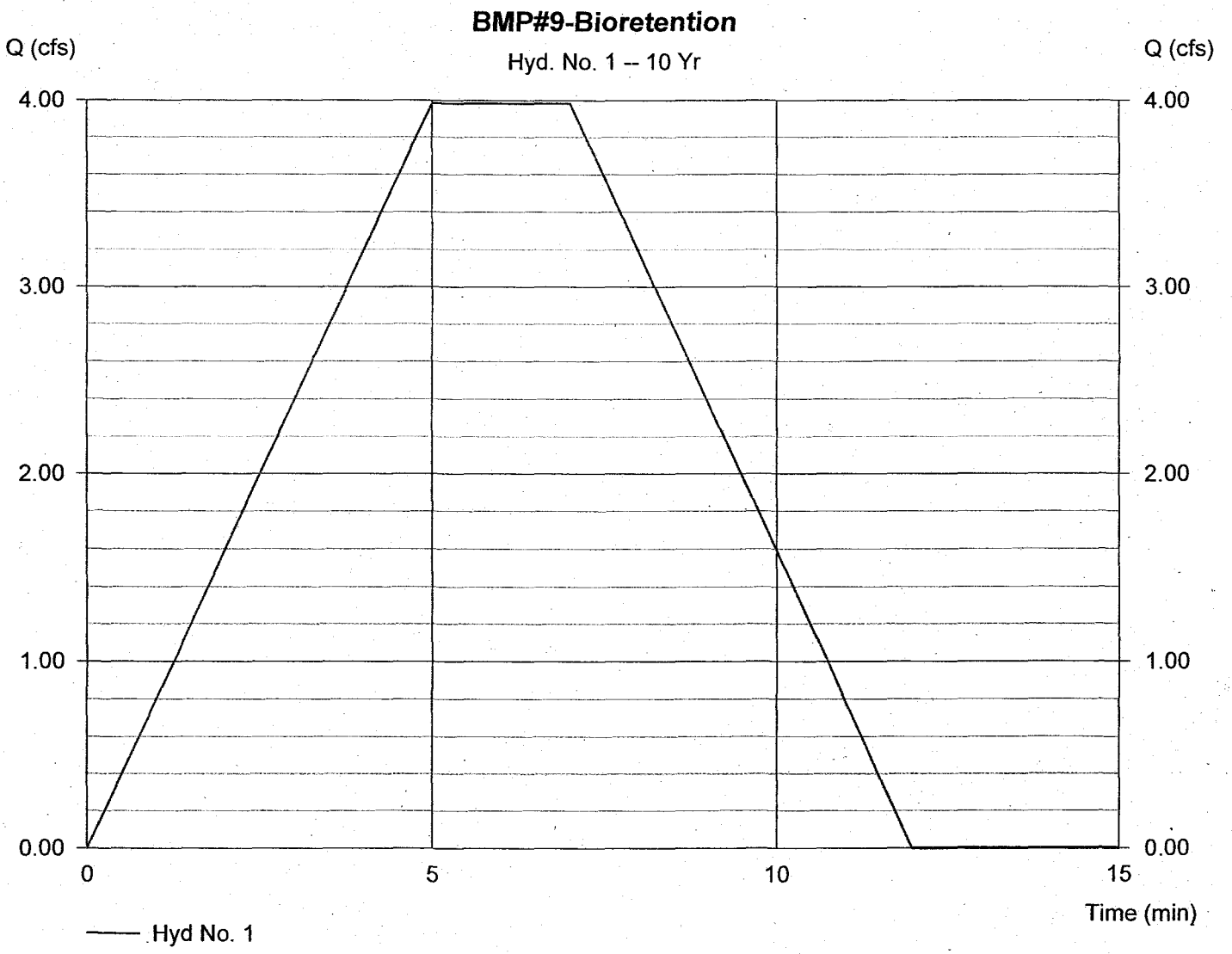
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:25 AM

Hyd. No. 1

BMP#9-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 3.98 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 1.210 ac	Runoff coeff.	= 0.51
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,793 cuft



Hydrograph Plot

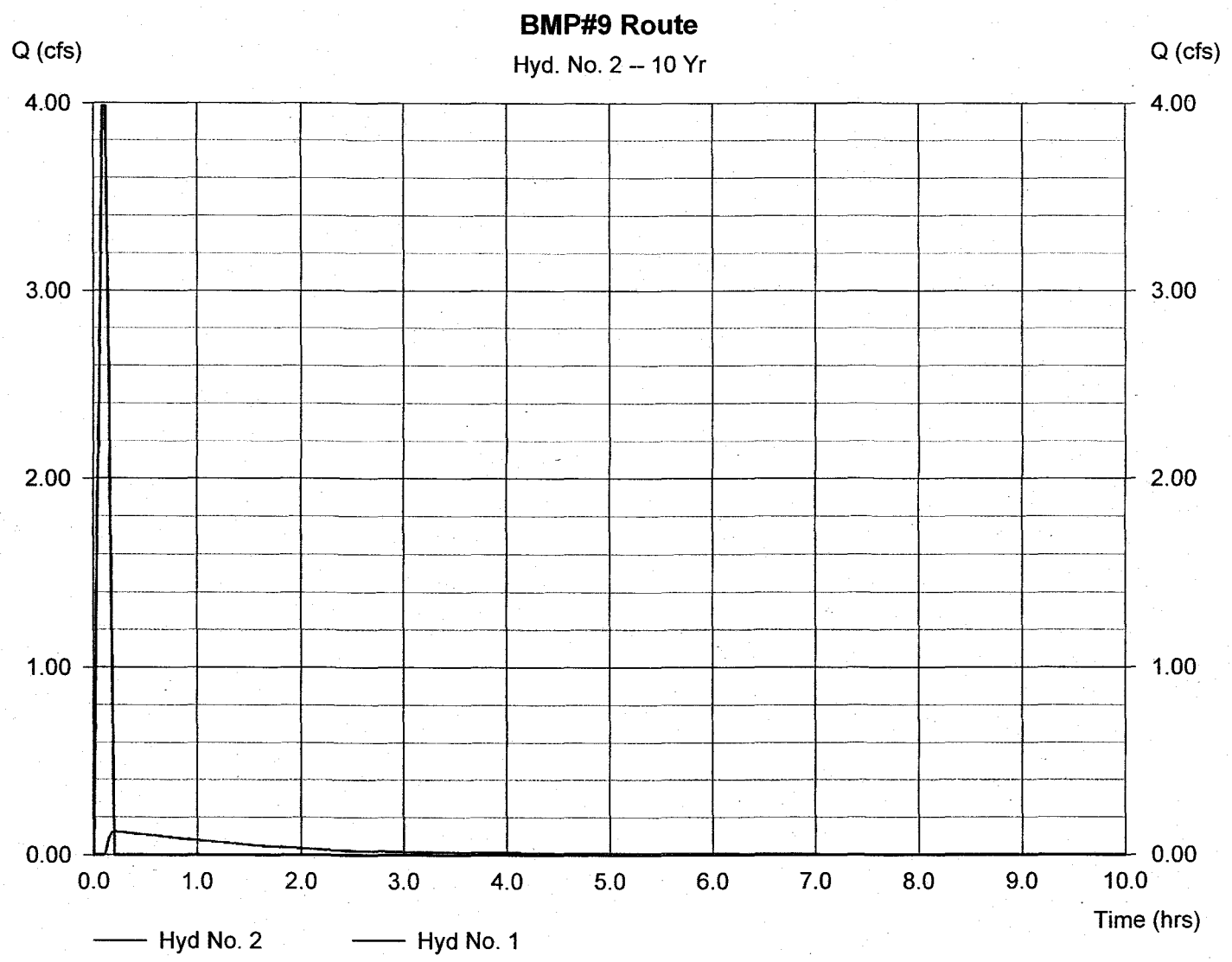
Hydraflow Hydrographs by Intelisolve | Saturday, Aug 15 2009, 11:4 AM

Hyd. No. 2

BMP#9 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.12 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 85.90 ft
Reservoir name	= BMP#9-Bioretention	Max. Storage	= 1,644 cuft

Storage Indication method used. | Hydrograph Volume = 755 cuft



Hydrograph Plot

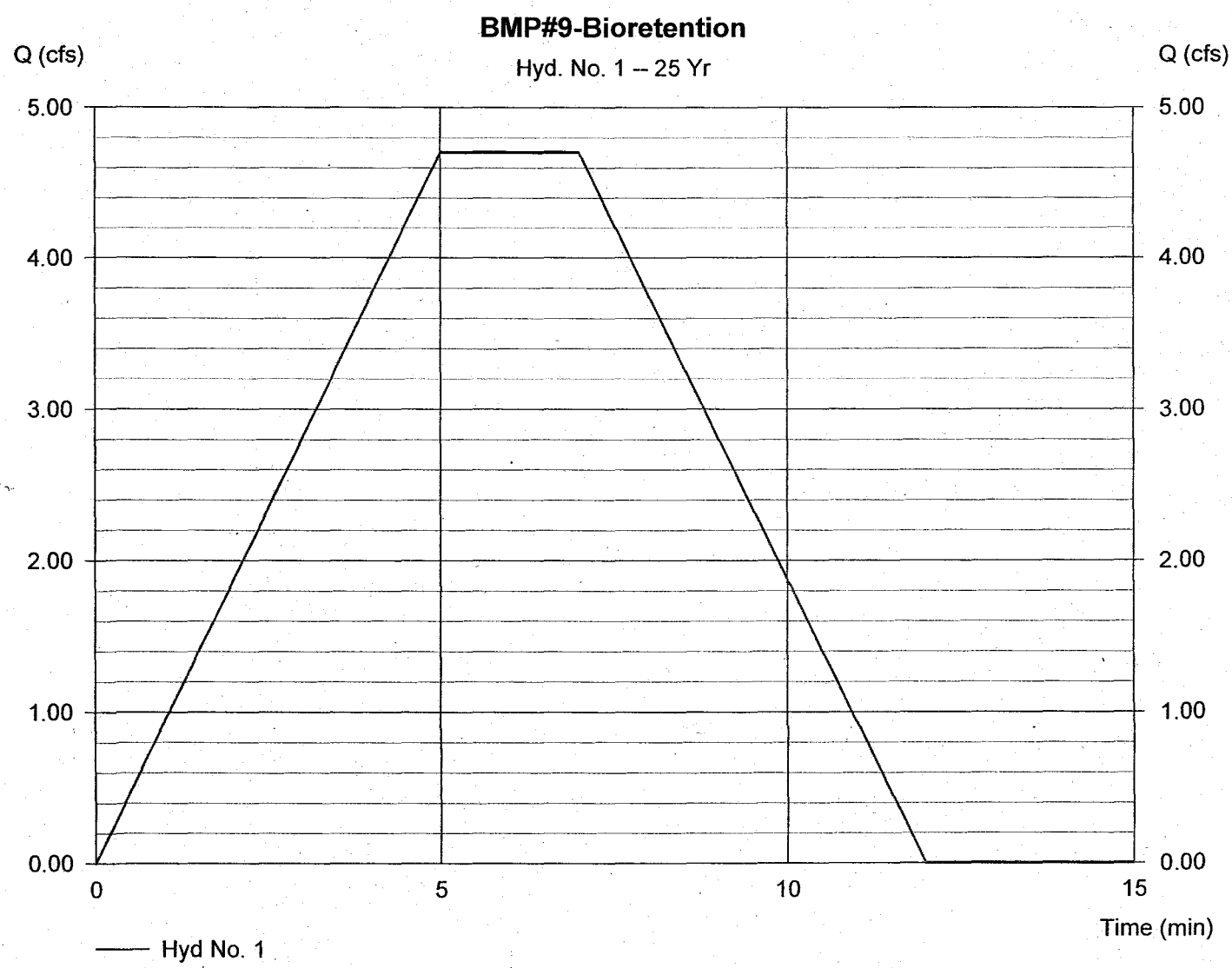
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:25 AM

Hyd. No. 1

BMP#9-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 4.70 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.210 ac	Runoff coeff.	= 0.51
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,117 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Saturday, Aug 15 2009, 11:4 AM

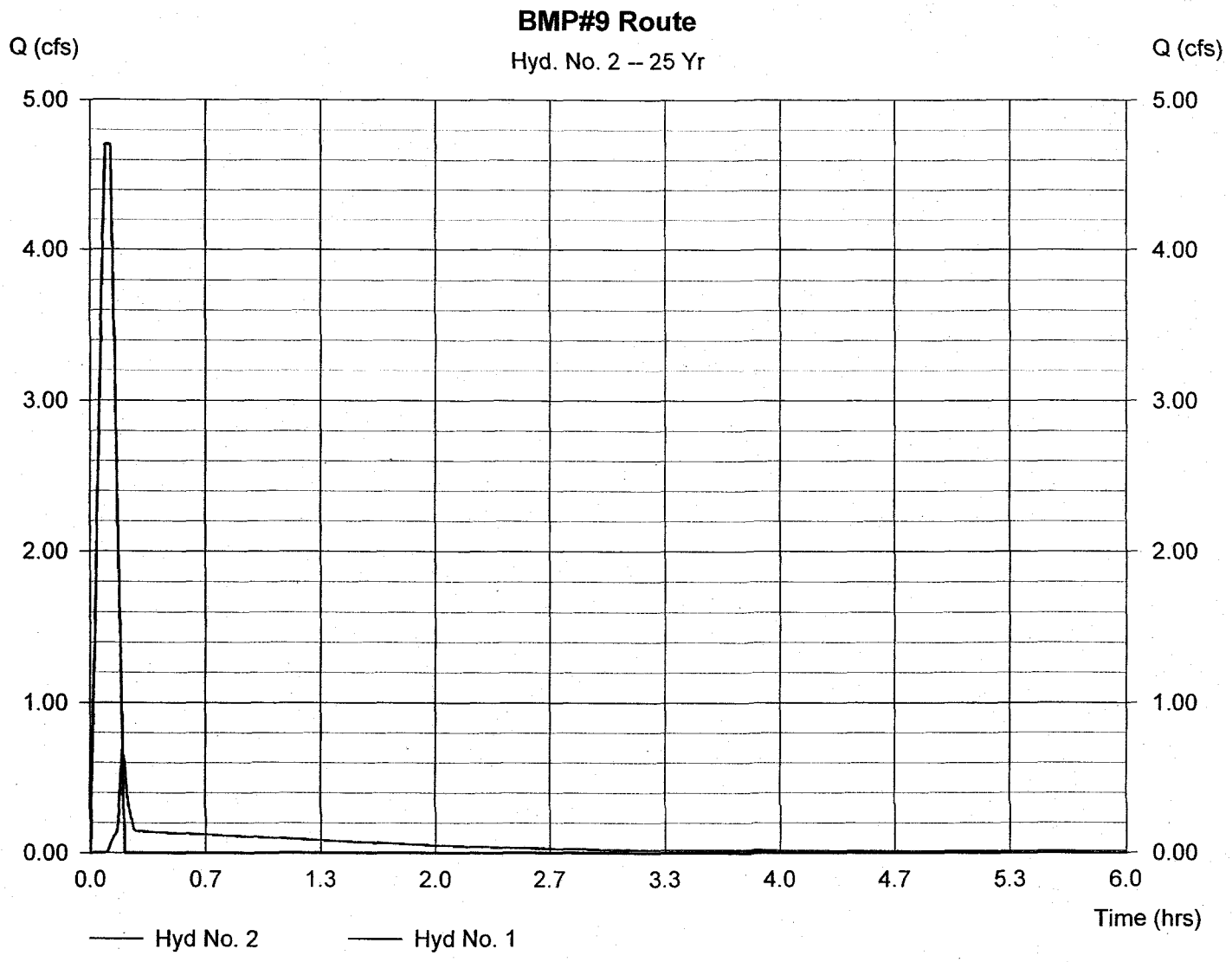
Hyd. No. 2

BMP#9 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.69 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 86.03 ft
Reservoir name	= BMP#9-Bioretention	Max. Storage	= 1,892 cuft

Storage Indication method used.

Hydrograph Volume = 1,057 cuft



Hydrograph Plot

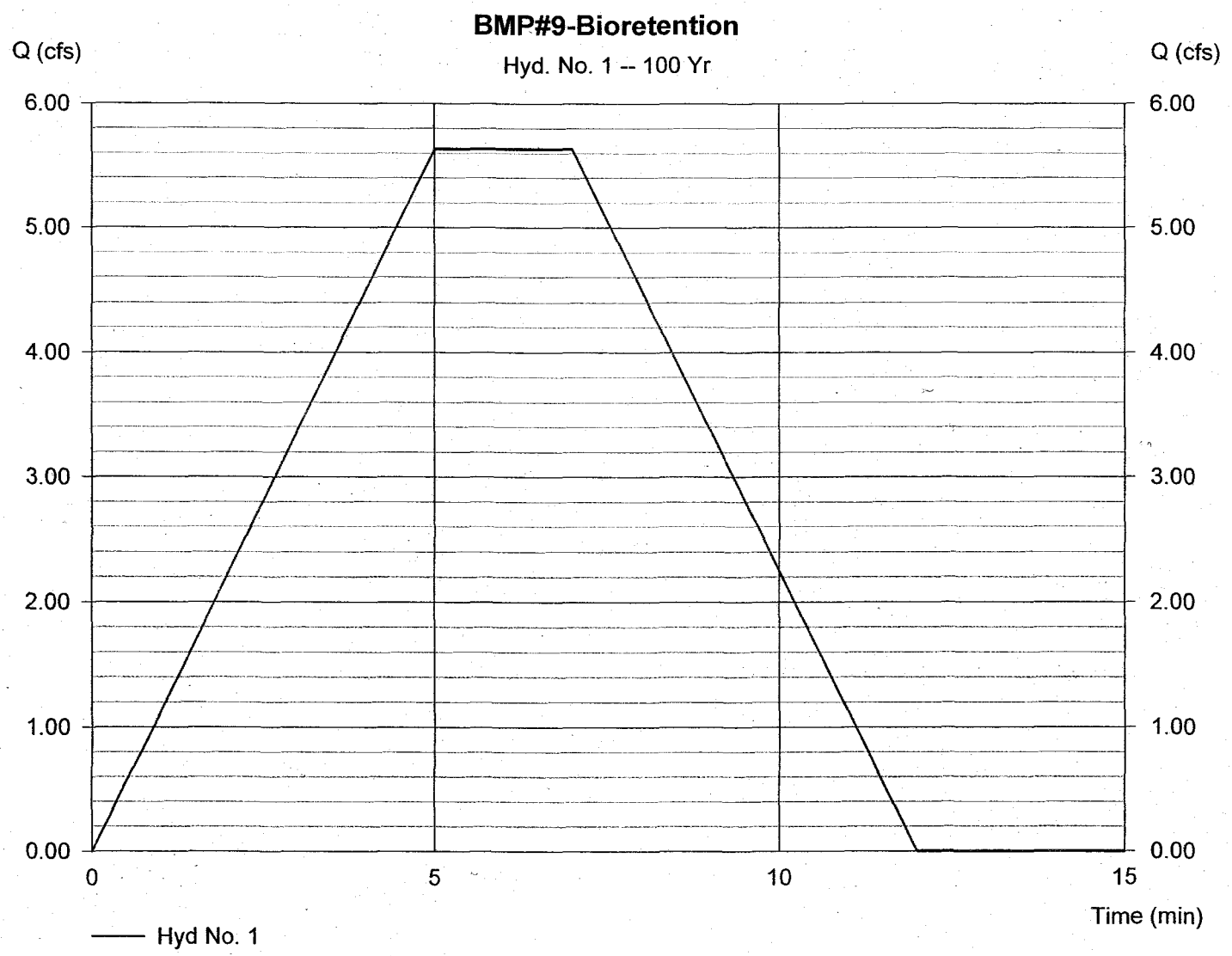
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:31 AM

Hyd. No. 1

BMP#9-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 5.64 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.210 ac	Runoff coeff.	= 0.51
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,536 cuft



Hydrograph Plot

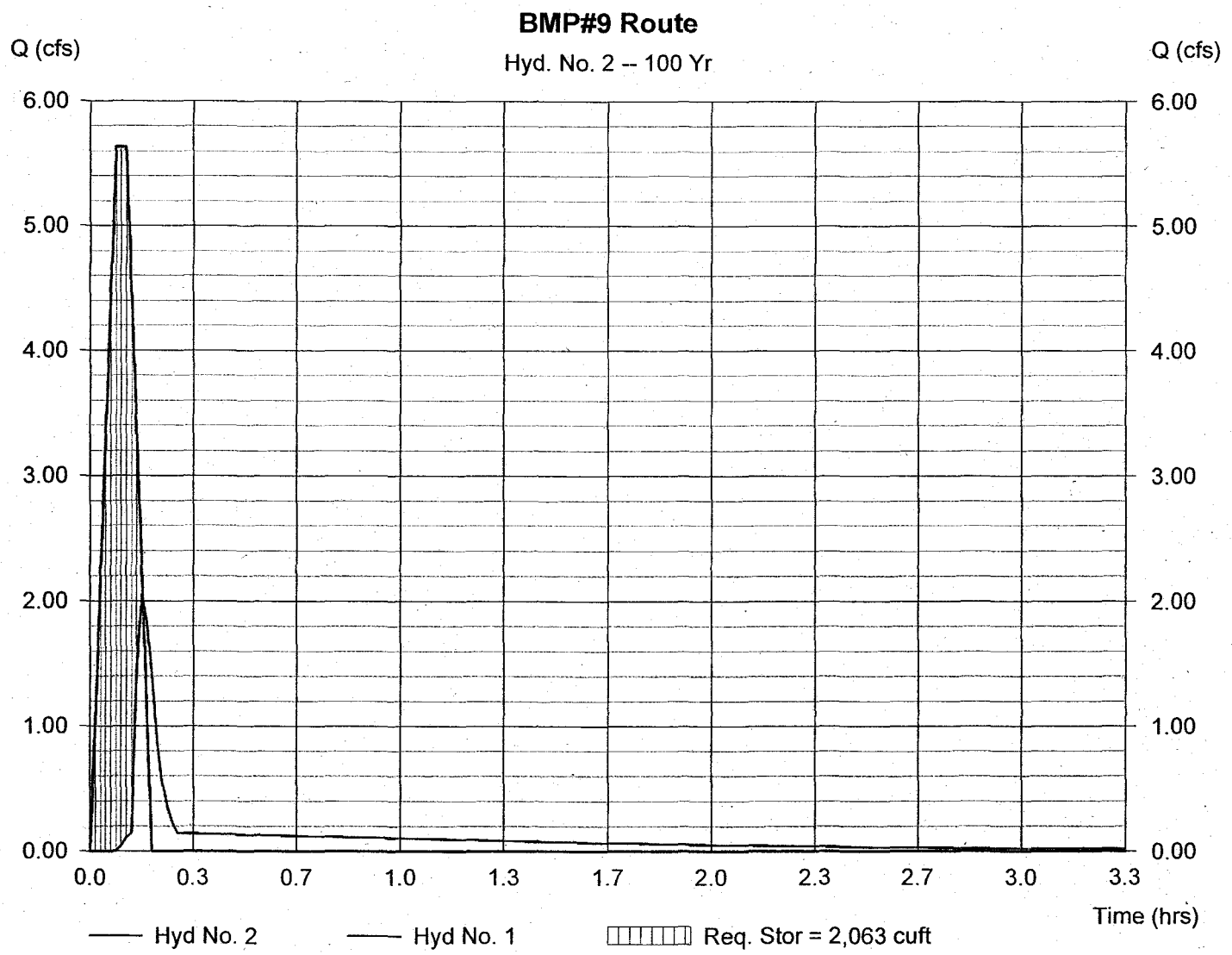
Hydraflow Hydrographs by Intelisolve | Thursday, Mar 18 2010, 8:31 AM

Hyd. No. 2

BMP#9 Route

Hydrograph type	= Reservoir	Peak discharge	= 2.05 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 86.11 ft
Reservoir name	= BMP#9-Bioretention	Max. Storage	= 2,063 cuft

Storage Indication method used. | Hydrograph Volume = 1,448 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve — Saturday, Aug 15 2009, 11:4 AM

Pond No. 1 - BMP#9-Bioretention

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	85.00	1,590	0	0
1.00	86.00	2,048	1,819	1,819
2.00	87.00	2,536	2,292	4,111

Culvert / Orifice Structures

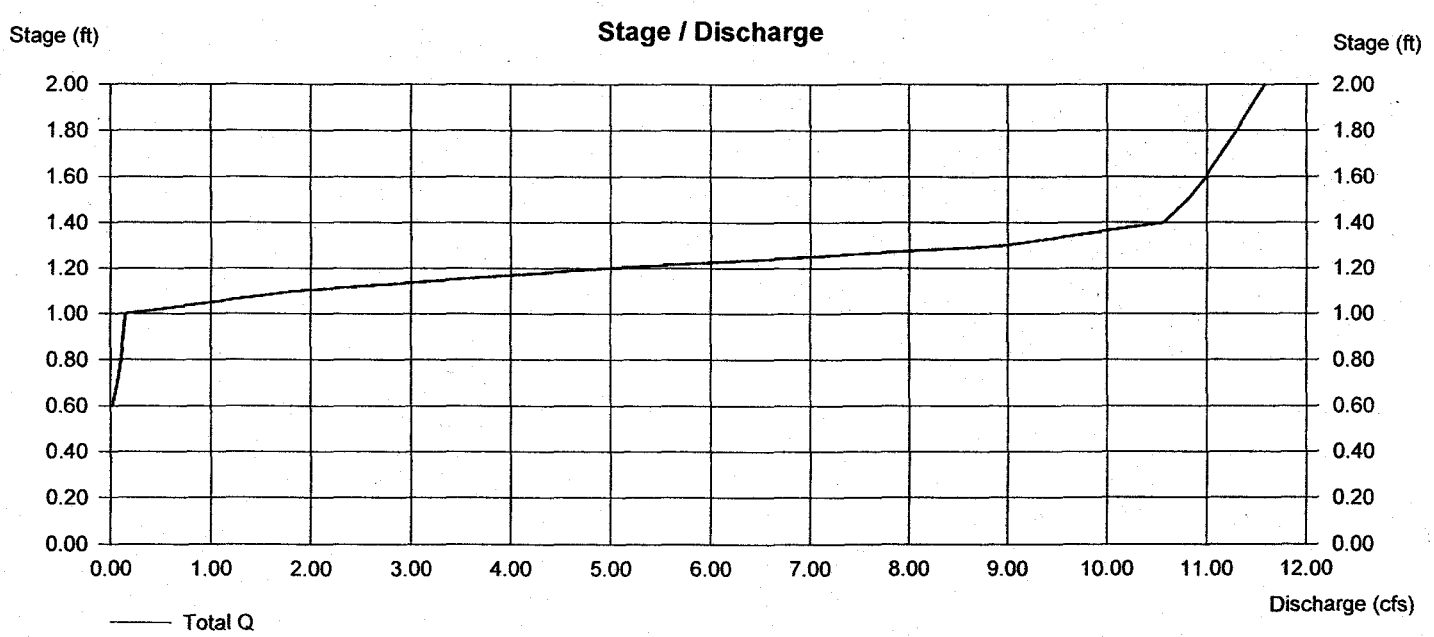
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 82.00	85.50	0.00	0.00
Length (ft)	= 86.50	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 86.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

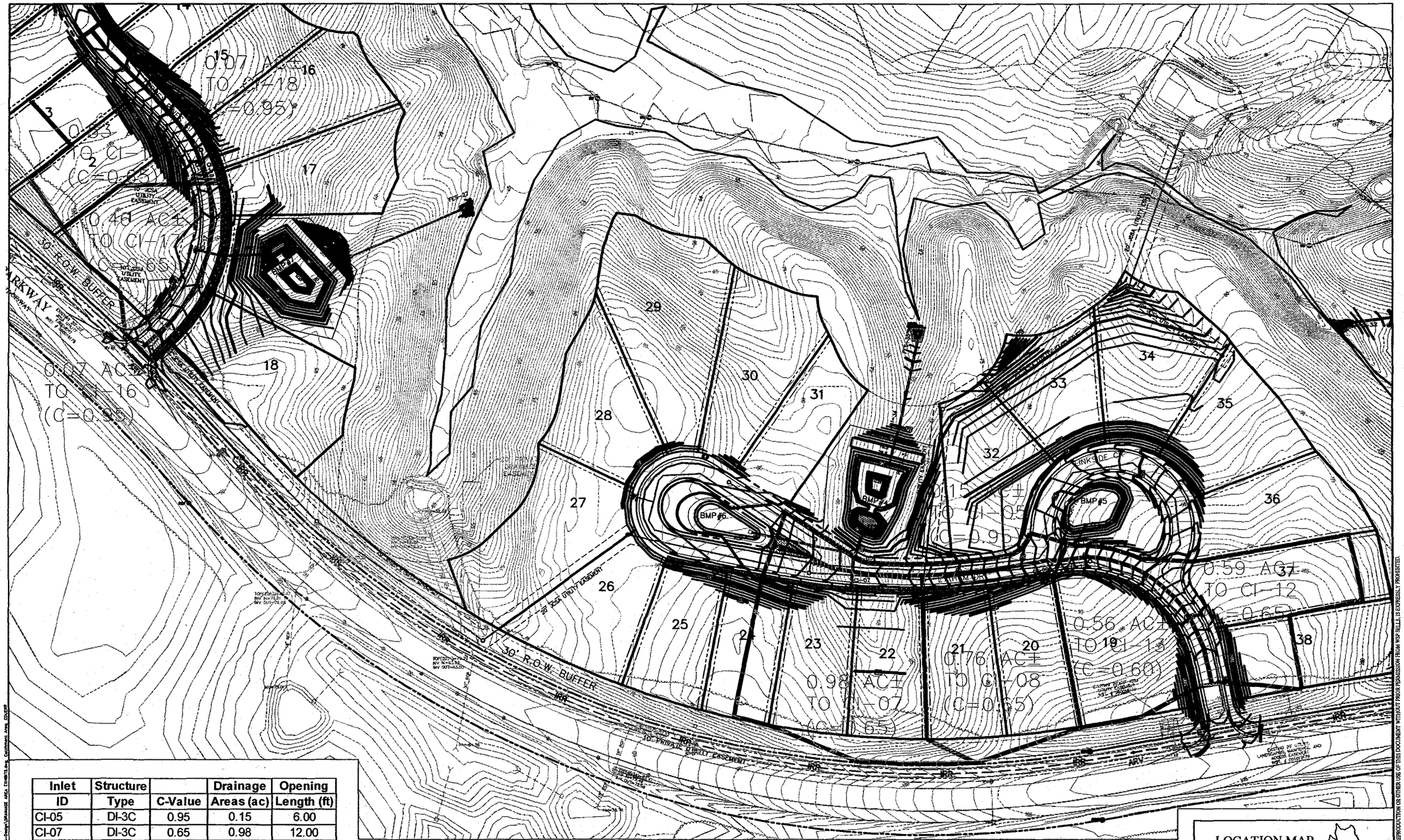


STORM DRAINAGE SYSTEM

CATCHMENT AREA EXHIBIT

HYDRAULIC GRADE LINE CALCULATIONS

INLET CALCULATIONS



Inlet ID	Structure Type	C-Value	Drainage Areas (ac)	Opening Length (ft)
CI-05	DI-3C	0.95	0.15	6.00
CI-07	DI-3C	0.65	0.98	12.00
CI-08	DI-3B	0.65	0.76	8.00
CI-09	DI-3A	0.65	0.00	2.50
CI-12	DI-3B	0.65	0.56	6.00
CI-13	DI-3B	0.65	0.59	6.00
CI-16	DI-3C	0.95	0.07	6.00
CI-17	DI-3C	0.65	0.46	6.00
CI-18	DI-3B	0.95	0.07	6.00
CI-19	DI-3B	0.65	0.53	6.00

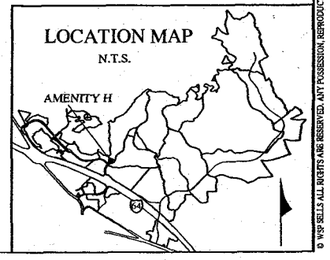
NOTES:

1. RUNOFF COEFFICIENTS FROM LOTS AND ROADWAY ARE AN AVERAGE OF IMPERVIOUS, C=0.95 AND OPEN SPACE, C=0.35.
2. RUN-OFF TO BMP#2, BMP#5, BMP#6, AND BMP#9 WILL CONVEY VIA SHEETFLOW FROM ROADWAYS.
3. CURB INLET OPENINGS BASED ON VDOT STANDARRDS. REFER TO INLET CALCULATONS FOR SPREAD VALUES.
4. REFER TO HYDRAULIC GRADE LINE CALCULATIONS FOR STORM DRAINS AND BMP OUTFALLS.

NORTH

0 25 50 100
(IN FEET)
1 INCH = 50 FEET

LOCATION MAP
N.T.S.



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TRACT 12
STONEHOUSE
JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

REVISIONS

PROJECT #: 08-4051 DATE: 08/17/09

DRAWN BY: MB CATCHMENT

TITLE
CATCHMENT AREAS

SHEET
EXHIBIT 4

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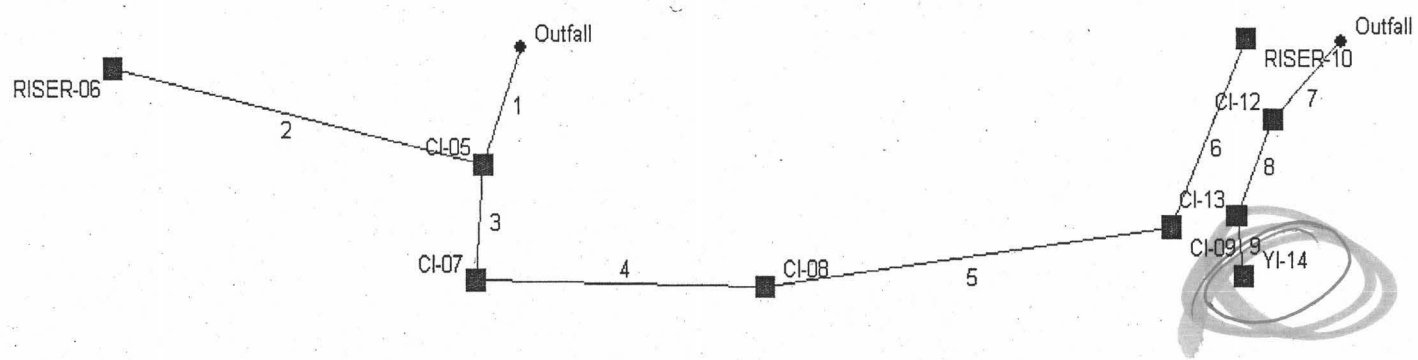
Hydraflow Plan View

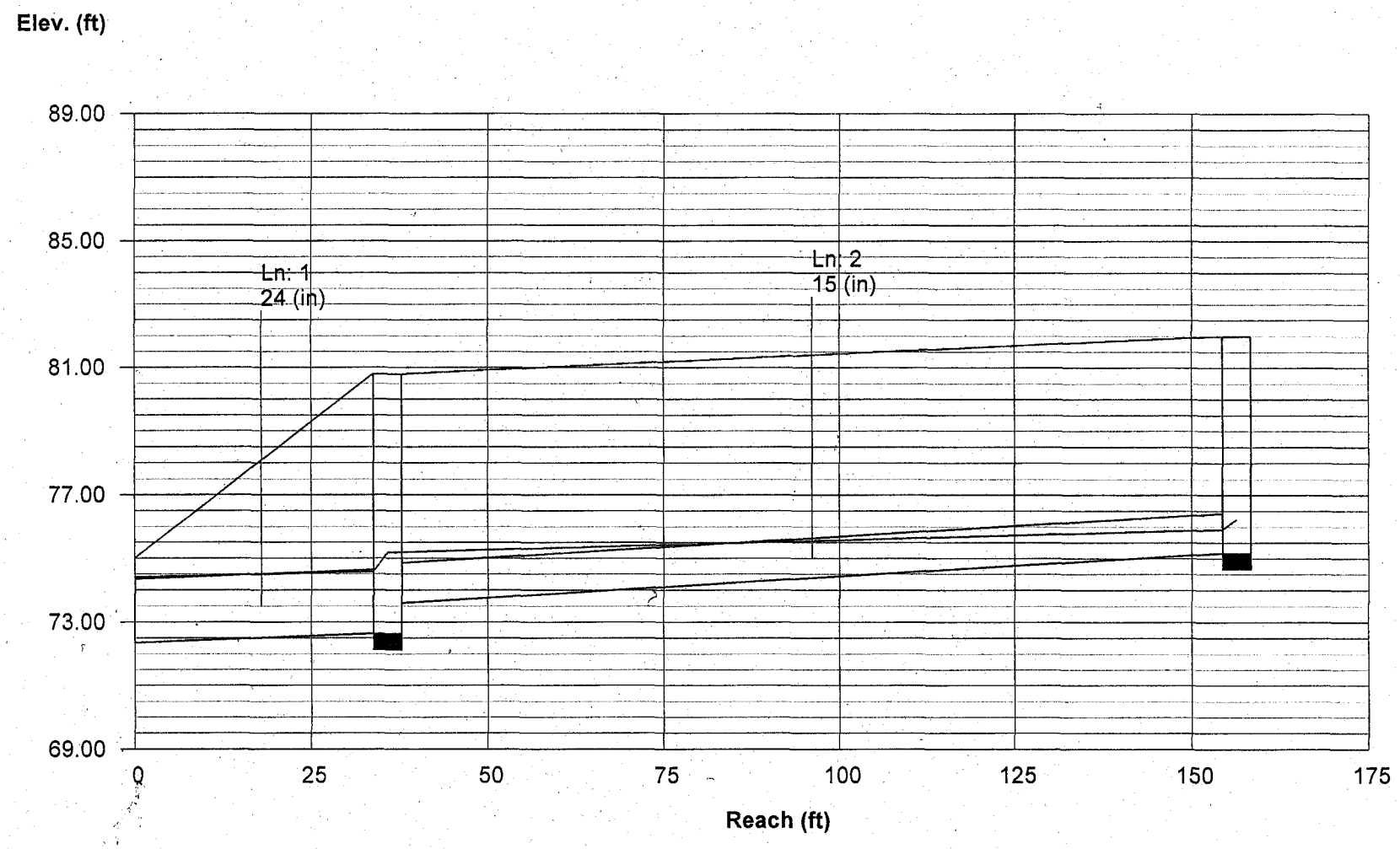


Project file: BMP-04-AND-05.stm	No. Lines: 9	03-18-2010

Hydraflow Storm Sewers 2003

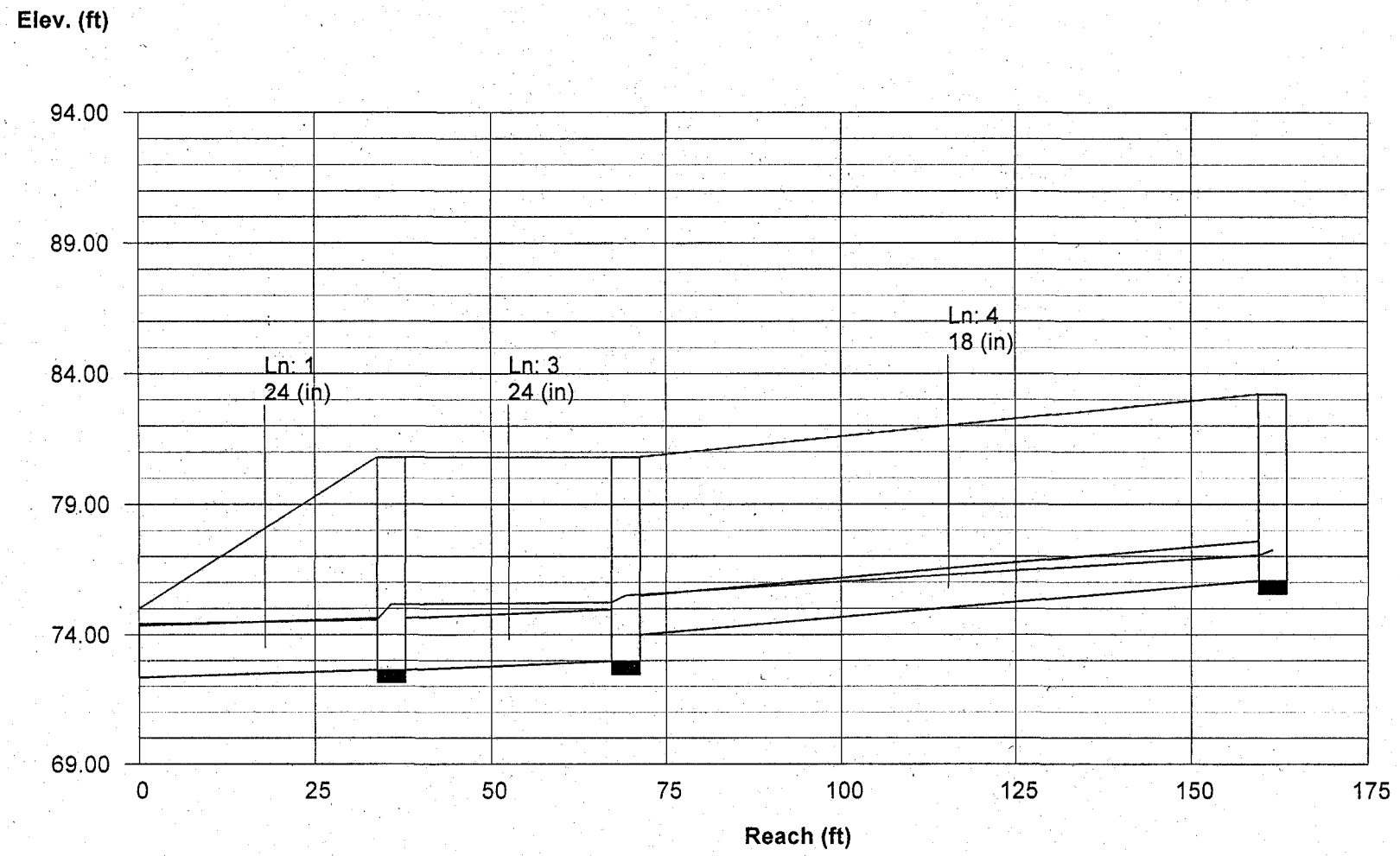
Storm Sewer Profile

Proj. file: BMP-04-AND-05.stm



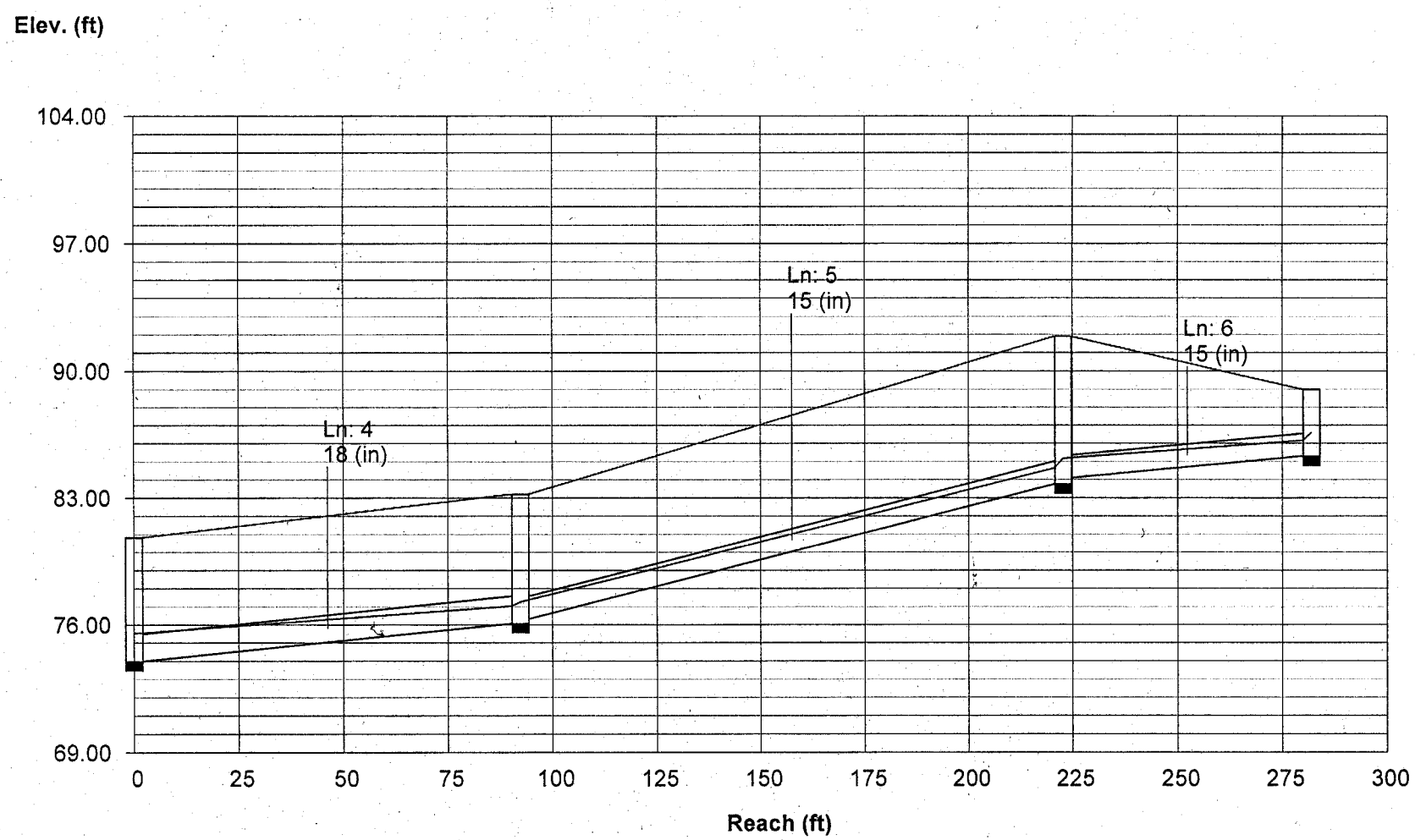
Storm Sewer Profile

Proj. file: BMP-04-AND-05.stm



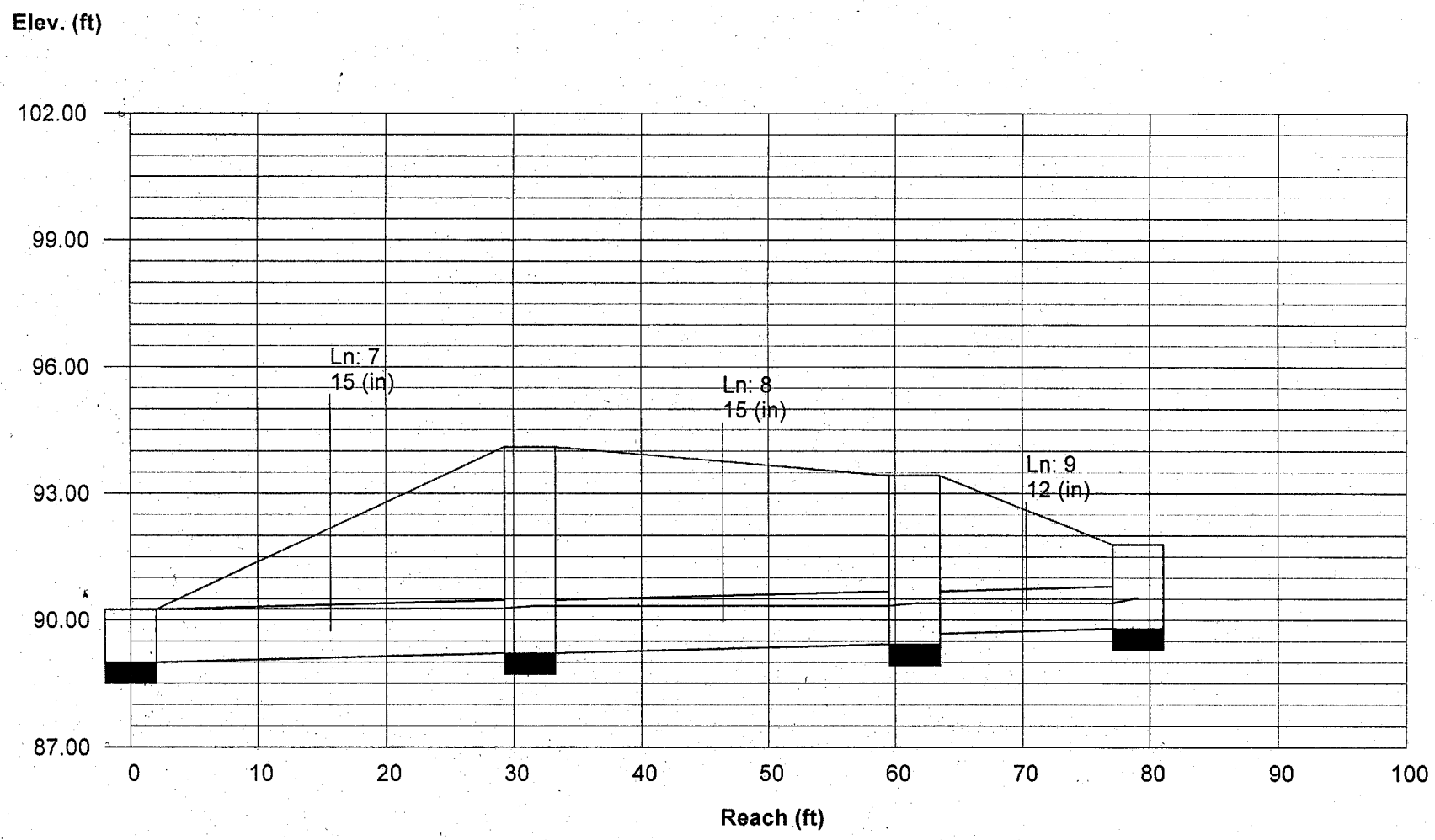
Storm Sewer Profile

Proj. file: BMP-04-AND-05.stm



Storm Sewer Profile

Proj. file: BMP-04-AND-05.stm



Storm Sewer 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	FES-04-CI-05	15.86	24 c	35.8	72.35	72.64	0.810	74.41	74.57	0.61	End
2	CI-05-RISER-06	3.43	15 c	120.6	73.60 74.89	75.17 76.46	1.302	75.18	75.91	0.32	1
3	CI-05-CI-07	10.68	24 c	33.4	72.64	72.97	0.988	75.18*	75.25*	0.27	1
4	CI-07-CI-08	6.27	18 c	92.3	74.00	76.08	2.254	75.52	77.04	0.22	3
5	CI-08-CI-09	4.78	15 c	130.4	76.33	83.76	5.697	77.25	84.64	0.53	4
6	CI-09-RISER-10	4.77	15 c	59.2	84.11	85.30	2.010	85.16	86.17	0.42	5
7	FES-11-CI-12	2.36	15 c	31.3	89.00 88.00	89.22 88.22	0.703	90.25	90.28	0.05	End
8	CI-12-CI-13	2.19	15 c	30.2	89.22	89.43	0.695	90.33	90.34	0.06	7
9	CI-13-YI-14	1.41	12 c	17.6	89.68	89.80	0.683	90.40	90.40	0.13	8

If remove

fes-A to fes B missing

Project File: BMP-04-AND-05.stm | Number of lines: 9 | Run Date: 03-18-2010

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

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	35.8	0.47	4.43	0.66	0.31	2.45	5.0	7.4	6.5	15.86	20.35	5.08	24	0.81	72.64	72.35	74.57	74.41	80.80	75.00	FES-04-CI-05
2	1	120.6	0.77	0.77	0.65	0.50	0.50	6.0	6.0	6.8	3.43	7.37	3.66	15	1.30	75.17	73.60	75.91	75.18	82.00	80.80	CI-05-RISER-06
3	1	33.4	1.36	3.19	0.51	0.69	1.64	5.0	7.3	6.5	10.68	22.48	3.40	24	0.99	72.97	72.64	75.25	75.18	80.82	80.80	CI-05-CI-07
4	3	92.3	0.37	1.83	0.65	0.24	0.95	5.0	6.8	6.6	6.27	15.76	4.41	18	2.25	76.08	74.00	77.04	75.52	83.21	80.82	CI-07-CI-08
5	4	130.4	0.01	1.46	0.95	0.01	0.71	5.0	6.3	6.8	4.78	15.41	5.07	15	5.70	83.76	76.33	84.64	77.25	91.92	83.21	CI-08-CI-09
6	5	59.2	1.45	1.45	0.48	0.70	0.70	6.0	6.0	6.8	4.77	9.15	4.76	15	2.01	85.30	84.11	86.17	85.16	89.00	91.92	CI-09-RISER-10
7	End	31.3	0.03	0.61	0.95	0.03	0.34	5.0	5.4	7.0	2.36	5.42	3.92	15	0.70	89.22	89.00	89.84	89.61	94.10	90.25	FES-11-CI-12
8	7	30.2	0.13	0.58	0.85	0.11	0.31	5.0	5.2	7.1	2.19	5.38	3.25	15	0.69	89.43	89.22	90.02	90.00	93.43	94.10	CI-12-CI-13
9	8	17.6	0.45	0.45	0.44	0.20	0.20	5.0	5.0	7.1	1.41	2.94	3.56	12	0.68	89.80	89.68	90.31	90.18	91.80	93.43	CI-13-YI-14

Project File: BMP-04-AND-05.stm | Number of lines: 9 | Run Date: 03-18-2010

NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

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	35.8	109.7	Curb	0.00	0.47	0.66	5.0	72.35	0.81	72.64	24	Cir	0.013	1.50	80.80	FES-04-CI-05
2	1	120.6	83.6	Grate	0.00	0.77	0.65	6.0	73.60	1.30	75.17	15	Cir	0.013	1.00	82.00	CI-05-RISER-06
3	1	33.4	-14.9	Curb	0.00	1.36	0.51	5.0	72.64	0.99	72.97	24	Cir	0.013	1.50	80.82	CI-05-CI-07
4	3	92.3	-93.7	Curb	0.00	0.37	0.65	5.0	74.00	2.25	76.08	18	Cir	0.013	0.50	83.21	CI-07-CI-08
5	4	130.4	-8.6	Curb	0.00	0.01	0.95	5.0	76.33	5.70	83.76	15	Cir	0.013	1.25	91.92	CI-08-CI-09
6	5	59.2	-58.6	Grate	0.00	1.45	0.48	6.0	84.11	2.01	85.30	15	Cir	0.013	1.00	89.00	CI-09-RISER-10
7	End	31.3	133.9	Curb	0.00	0.03	0.95	5.0	89.00	0.70	89.22	15	Cir	0.013	0.70	94.10	FES-11-CI-12
8	7	30.2	-21.4	Curb	0.00	0.13	0.85	5.0	89.22	0.69	89.43	15	Cir	0.013	0.70	93.43	CI-12-CI-13
9	8	17.6	-29.5	Grate	0.00	0.45	0.44	5.0	89.68	0.68	89.80	12	Cir	0.013	1.00	91.80	CI-13-YI-14

Project File: BMP-04-AND-05.stm | Number of lines: 9 | Date: 03-18-2010

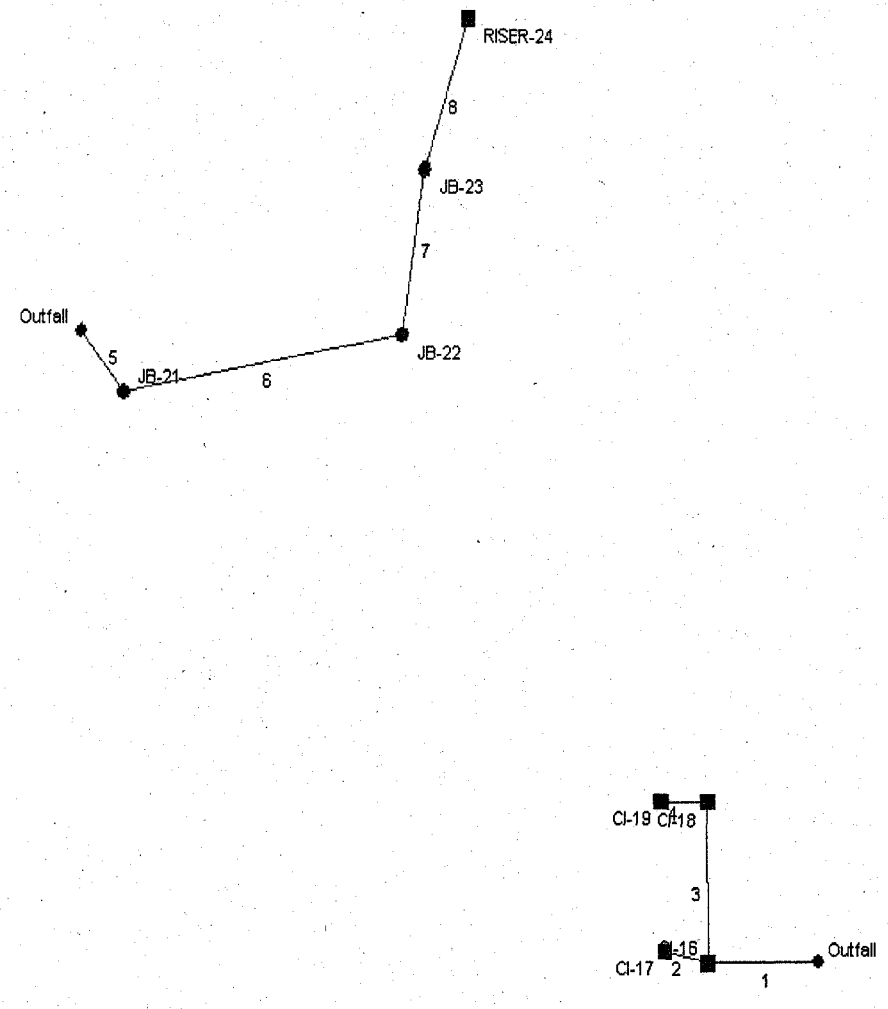
Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	depth (ft)	spread (ft)	depth (ft)	spread (ft)	Dep (in)	
1	CI-05	2.21	0.00	2.21	0.00	Curb	5.5	6.00	0.00	0.00	0.00	Sag	2.50	0.050	0.020	0.000	0.28	10.08	0.40	10.08	2.40	Off
2	RISER-06	3.43	0.00	3.43	0.00	Grate	0.0	0.00	3.10	3.00	2.00	Sag	2.50	0.050	0.020	0.000	0.17	4.92	0.30	4.92	2.40	Off
3	CI-07	4.95	0.49	5.44	0.00	Curb	5.5	12.00	0.00	0.00	0.00	Sag	2.50	0.050	0.020	0.000	0.35	13.61	0.47	13.61	2.40	Off
4	CI-08	1.72	0.14	1.36	0.49	Curb	5.5	8.00	0.00	0.00	0.00	0.053	2.50	0.050	0.020	0.013	0.18	5.25	0.23	2.26	2.40	3
5	CI-09	0.07	0.21	0.15	0.14	Curb	5.5	2.50	0.00	0.00	0.00	0.070	2.50	0.050	0.020	0.013	0.09	1.80	0.11	1.06	2.40	4
6	RISER-10	4.77	0.09	4.85	0.00	Grate	0.0	0.00	3.10	3.00	2.00	Sag	2.50	0.050	0.020	0.000	0.25	8.82	0.38	8.82	2.40	Off
7	CI-12	0.20	0.00	0.12	0.09	Curb	5.5	2.50	0.00	0.00	0.00	0.070	2.50	0.050	0.020	0.013	0.08	1.60	0.09	0.94	2.40	6
8	CI-13	0.79	0.00	0.57	0.21	Curb	5.5	6.00	0.00	0.00	0.00	0.070	2.50	0.050	0.020	0.013	0.12	2.40	0.16	1.56	2.40	5
9	YI-14	1.41	0.00	1.41	0.00	Grate	0.0	0.00	3.10	3.00	2.00	Sag	2.50	0.050	0.020	0.000	0.04	0.81	0.17	1.65	2.40	Off

Project File: BMP-04-AND-05.stm | I-D-F File: ChesterfieldCoefficients.IDF | Number of lines: 9 | Run Date: 03-18-2010

NOTES: Inlet N-Values = 0.016 ; Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraflow Plan View

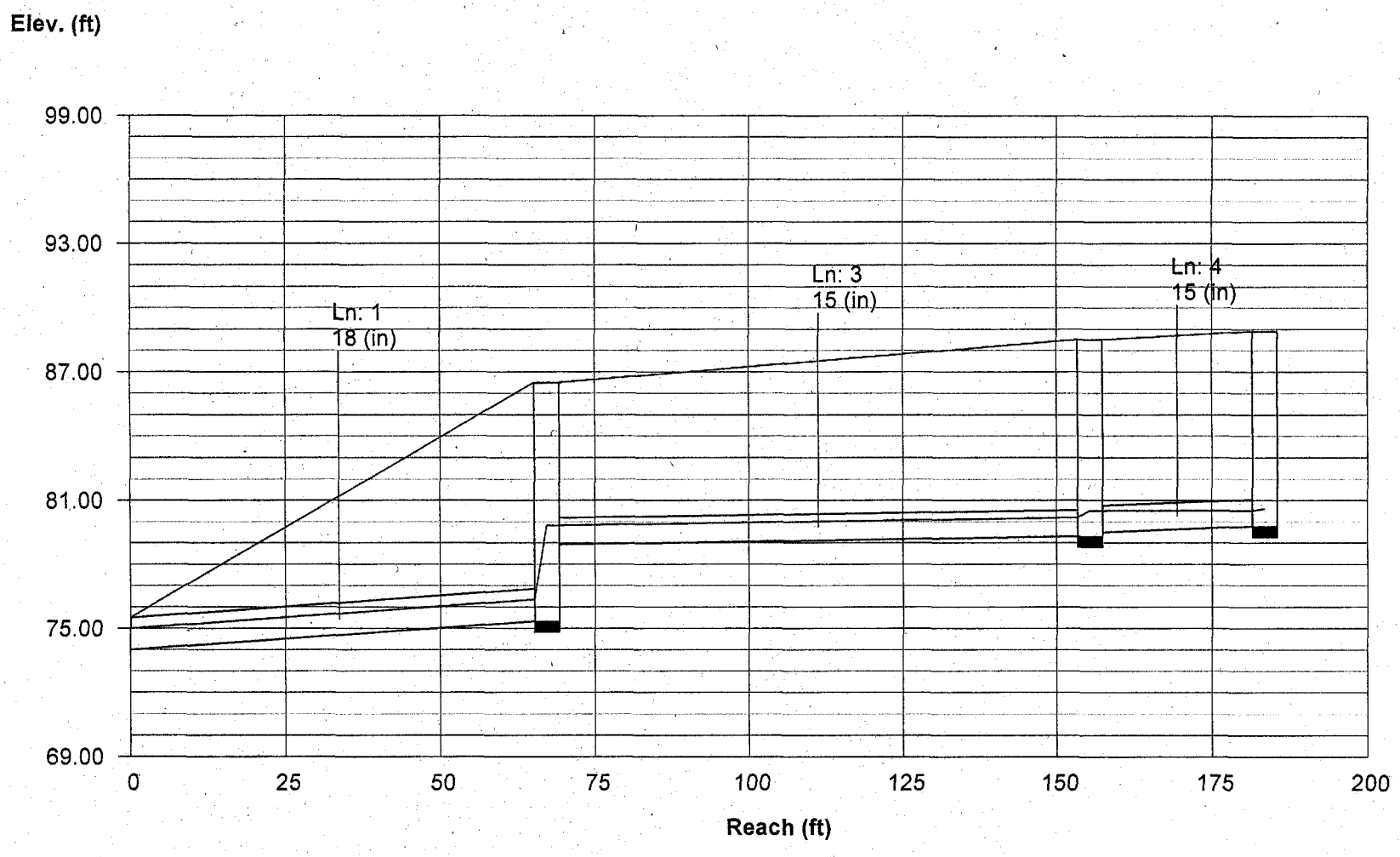


Project file: BMP-07-AND-08.stm	No. Lines: 8	03-18-2010

Hydraflow Storm Sewers 2003

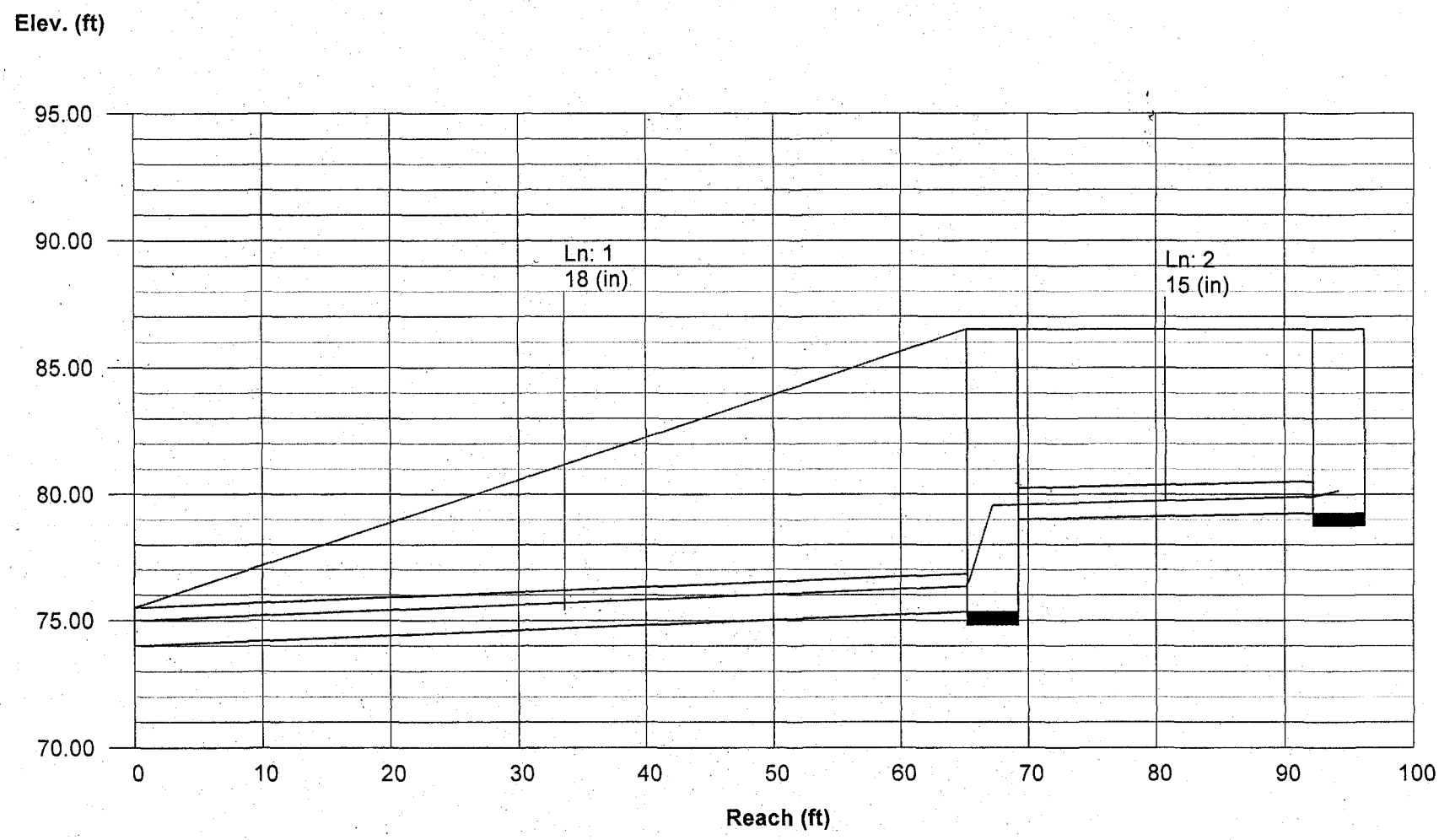
Storm Sewer Profile

Proj. file: BMP-07-AND-08.stm



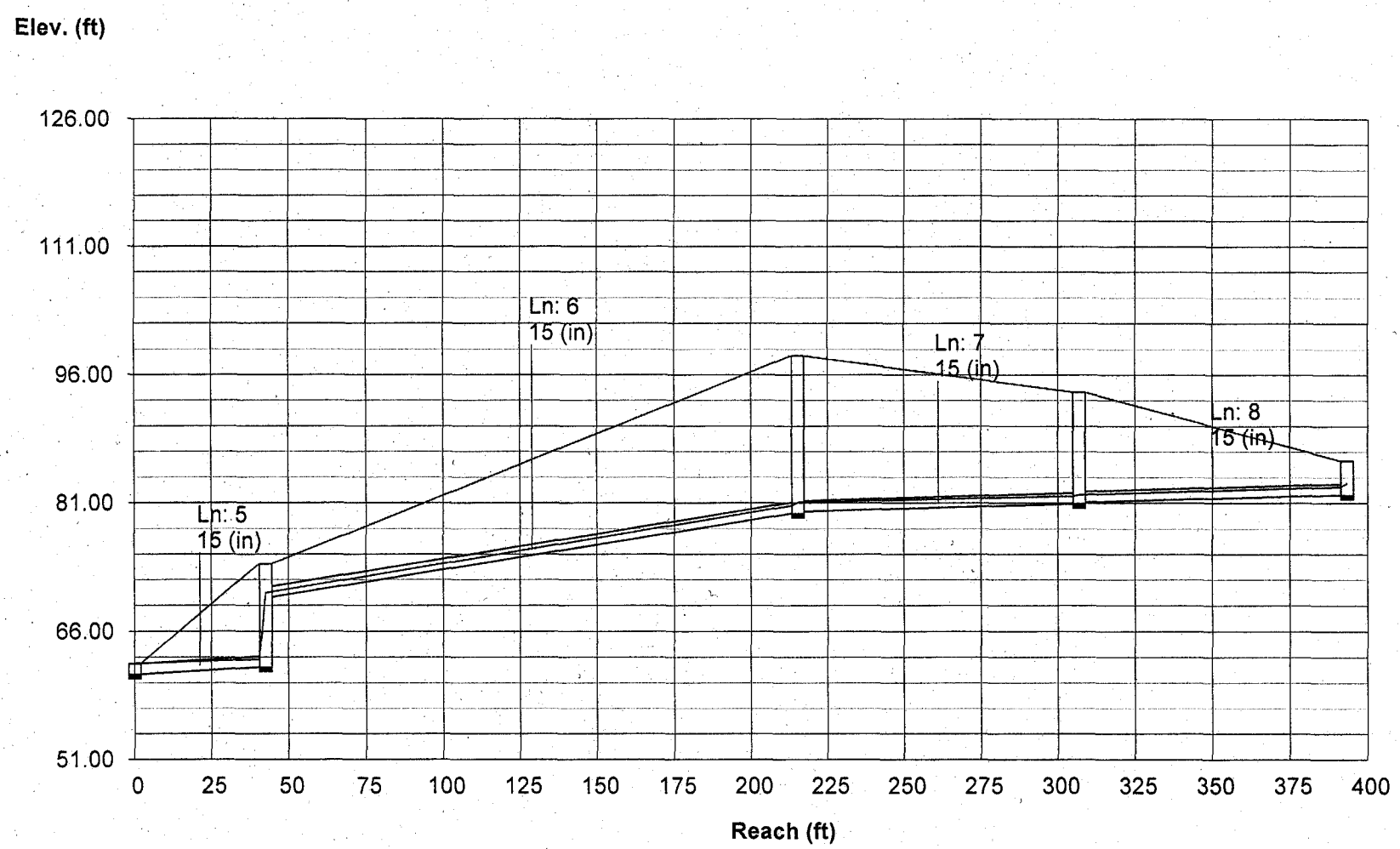
Storm Sewer Profile

Proj. file: BMP-07-AND-08.stm



Storm Sewer Profile

Proj. file: BMP-07-AND-08.stm



Storm Sewer 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	FES-15-CI-16	6.92	18 c	67.2	74.00	75.34	1.994	75.00	76.34	0.71	End
2	CI-16-CI-17	2.55	15 c	27.0	79.00	79.26	0.963	79.55	79.90	0.25	1
3	CI-16-CI-18	3.58	15 c	88.2	78.93	79.31	0.431	79.81	80.19	0.35	1
4	CI-18-CI-19	1.77	15 c	28.1	79.51	79.79	0.998	80.54	80.53	0.08	3
5	FES-20-JB-21	4.76	15 c	42.6	61.00	61.85	1.996	62.25	62.72	0.36	End
6	JB-21-JB-22	4.89	15 c	172.7	70.00	79.80	5.675	70.49	80.69	0.37	5
7	JB-22-JB-23	4.97	15 c	91.6	80.00	80.92	1.005	81.05	81.81	0.07	6
8	JB-23-RISER-24	5.04	15 c	86.5	81.12	81.98	0.994	81.95	82.88	0.44	7

Project File: BMP-07-AND-08.stm | Number of lines: 8 | Run Date: 03-18-2010

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

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	67.2	0.15	1.56	0.91	0.14	1.00	5.0	5.8	6.9	6.92	14.83	5.50	18	1.99	75.34	74.00	76.34	75.00	86.50	75.50	FES-15-CI-16
2	1	27.0	0.65	0.65	0.55	0.36	0.36	5.0	5.0	7.1	2.55	6.34	4.44	15	0.96	79.26	79.00	79.90	79.55	86.50	86.50	CI-16-CI-17
3	1	88.2	0.39	0.76	0.67	0.26	0.51	5.0	5.3	7.0	3.58	4.24	3.87	15	0.43	79.31	78.93	80.19	79.81	88.52	86.50	CI-16-CI-18
4	3	28.1	0.37	0.37	0.67	0.25	0.25	5.0	5.0	7.1	1.77	6.45	1.98	15	1.00	79.79	79.51	80.53	80.54	88.91	88.52	CI-18-CI-19
5	End	42.6	0.00	1.15	0.00	0.00	0.74	5.0	7.5	6.5	4.76	9.12	4.54	15	2.00	61.85	61.00	62.72	62.25	73.89	62.25	FES-20-JB-21
6	5	172.7	0.00	1.15	0.00	0.00	0.74	5.0	6.7	6.6	4.89	15.38	8.19	15	5.67	79.80	70.00	80.69	70.49	98.25	73.89	JB-21-JB-22
7	6	91.6	0.00	1.15	0.00	0.00	0.74	5.0	6.4	6.8	4.97	6.47	4.91	15	1.00	80.92	80.00	81.81	81.05	94.01	98.25	JB-22-JB-23
8	7	86.5	1.15	1.15	0.64	0.74	0.74	6.0	6.0	6.8	5.04	6.44	5.57	15	0.99	81.98	81.12	82.88	81.95	86.00	94.01	JB-23-RISER-24

Project File: BMP-07-AND-08.stm | Number of lines: 8 | Run Date: 03-18-2010

NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

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	67.2	179.5	Curb	0.00	0.15	0.91	5.0	74.00	1.99	75.34	18	Cir	0.013	1.50	86.50	FES-15-CI-16
2	1	27.0	13.8	Curb	0.00	0.65	0.55	5.0	79.00	0.96	79.26	15	Cir	0.013	1.00	86.50	CI-16-CI-17
3	1	88.2	90.3	Curb	0.00	0.39	0.67	5.0	78.93	0.43	79.31	15	Cir	0.013	1.50	88.52	CI-16-CI-18
4	3	28.1	-88.9	Curb	0.00	0.37	0.67	5.0	79.51	1.00	79.79	15	Cir	0.013	1.00	88.91	CI-18-CI-19
5	End	42.6	52.4	MH	0.00	0.00	0.00	5.0	61.00	2.00	61.85	15	Cir	0.013	0.85	73.89	FES-20-JB-21
6	5	172.7	-62.8	MH	0.00	0.00	0.00	5.0	70.00	5.67	79.80	15	Cir	0.013	0.85	98.25	JB-21-JB-22
7	6	91.6	-71.3	MH	0.00	0.00	0.00	5.0	80.00	1.00	80.92	15	Cir	0.013	0.15	94.01	JB-22-JB-23
8	7	86.5	9.4	Grate	0.00	1.15	0.64	6.0	81.12	0.99	81.98	15	Cir	0.013	1.00	86.00	JB-23-RISER-24

Project File: BMP-07-AND-08.stm | Number of lines: 8 | Date: 03-18-2010

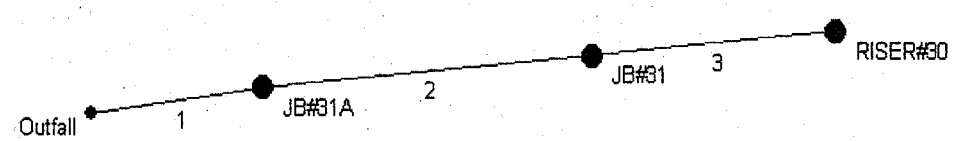
Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	depth (ft)	spread (ft)	depth (ft)	spread (ft)	Dep (in)	
1	CI-16	0.97	0.75	1.73	0.00	Curb	5.0	2.50	0.00	0.00	0.00	Sag	2.50	0.050	0.020	0.000	0.30	11.21	0.42	11.21	2.40	Off
2	CI-17	2.55	0.72	3.27	0.00	Curb	5.0	6.00	0.00	0.00	0.00	Sag	2.50	0.050	0.020	0.000	0.34	13.09	0.46	13.09	2.40	Off
3	CI-18	1.86	0.00	1.11	0.75	Curb	5.0	6.00	0.00	0.00	0.00	0.051	2.50	0.050	0.020	0.013	0.18	5.25	0.23	2.28	2.40	1
4	CI-19	1.77	0.00	1.05	0.72	Curb	5.0	6.00	0.00	0.00	0.00	0.055	2.50	0.050	0.020	0.013	0.17	4.75	0.22	2.20	2.40	2
5	JB-21	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
6	JB-22	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
7	JB-23	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
8	RISER-24	5.04	0.00	5.04	0.00	Grate	0.0	0.00	3.10	2.50	2.50	Sag	2.00	0.100	0.030	0.000	0.37	7.62	0.37	7.62	0.00	Off

Project File: BMP-07-AND-08.stm | I-D-F File: ChesterfieldCoefficients.IDF | Number of lines: 8 | Run Date: 03-18-2010

NOTES: Inlet N-Values = 0.016 ; Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraflow Plan View



Project file: BMP#1 OUTFALL.stm	No. Lines: 3	11-17-2009

Hydraflow Storm Sewers 2003

Bmp # 1 outfall 100-yr HGL

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	34.0	0.00	0.00	0.00	0.00	0.00	5.0	5.3	0.0	5.00	6.46	4.32	15	1.00	64.34	64.00	65.38	65.25	70.40	65.25	FES#30 - JB#31
2	1	64.9	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	5.00	15.81	8.34	15	6.00	69.89	66.00	70.78	66.49	76.00	70.40	JB#31A - JB#31
3	2	47.9	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.00	19.36	9.27	15	8.99	75.81	71.50	76.70	71.93	87.00	76.00	RISER30-JB#31

Project File: BMP#1 OUTFALL.stm | Number of lines: 3 | Run Date: 11-17-2009

NOTES: Intensity = 221.97 / (Inlet time + 21.25) ^ 0.95; Return period = 100 Yrs.

Storm Sewer Tabulation

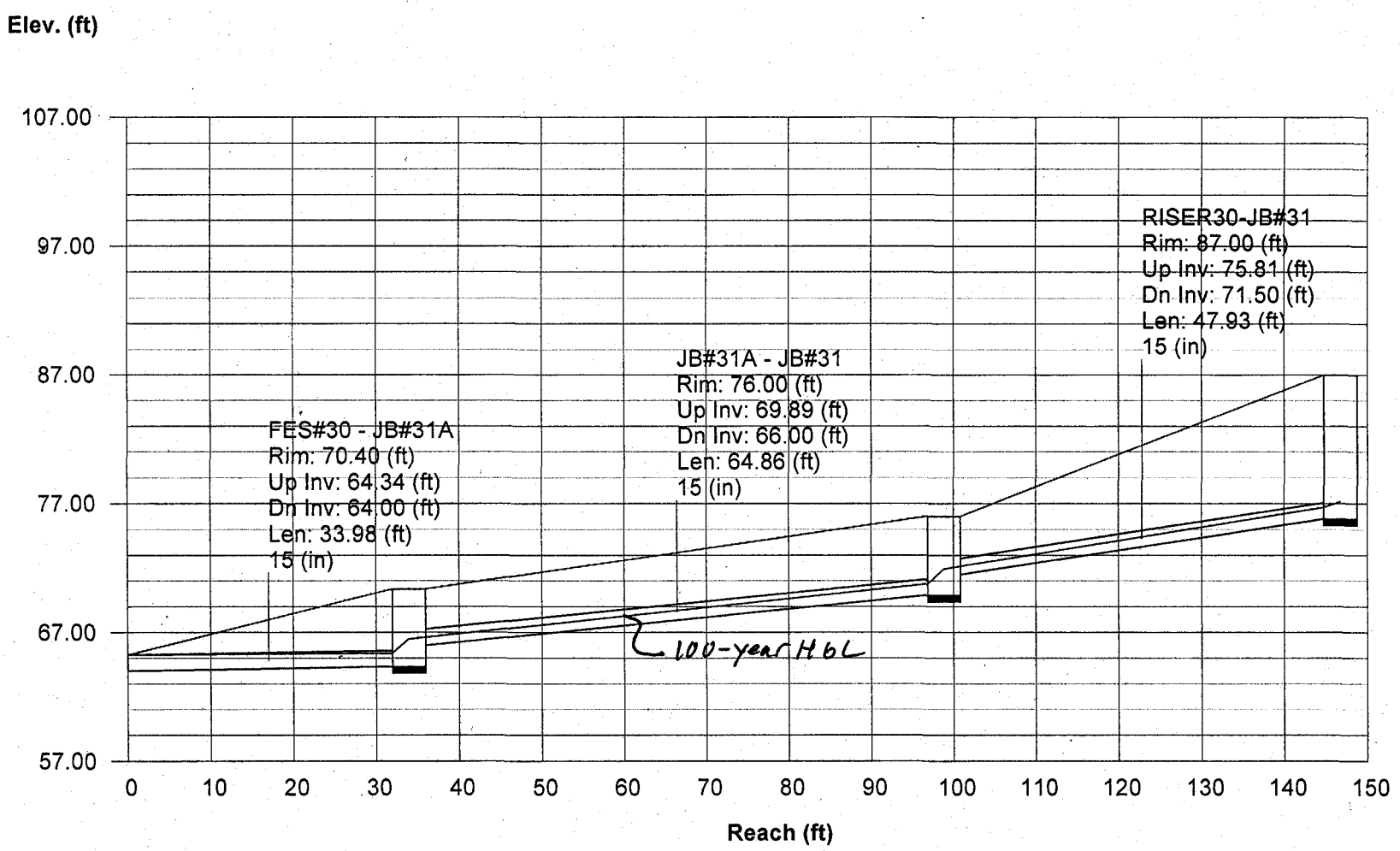
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	34.0	0.00	0.00	0.00	0.00	0.00	5.0	5.3	0.0	5.00	6.46	4.32	15	1.00	64.34	64.00	65.38	65.25	70.40	65.25	FES#30 - JB#31
2	1	64.9	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	5.00	15.81	8.34	15	6.00	69.89	66.00	70.78	66.49	76.00	70.40	JB#31A - JB#31
3	2	47.9	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.00	19.36	9.27	15	8.99	75.81	71.50	76.70	71.93	87.00	76.00	RISER30-JB#31

Project File: BMP#1 OUTFALL.stm | Number of lines: 3 | Run Date: 11-17-2009

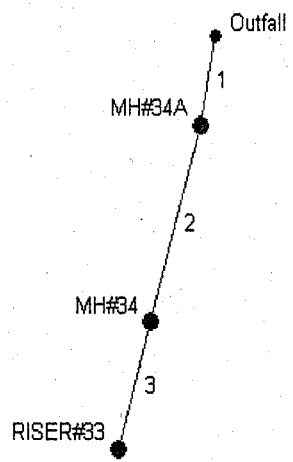
NOTES: Intensity = 221.97 / (Inlet time + 21.25) ^ 0.95; Return period = 100 Yrs.

Storm Sewer Profile

Proj. file: BMP#1 OUTFALL.stm



Hydraflow Plan View



Project file: BMP#4 OUTFALL.stm	No. Lines: 3	11-17-2009

Hydraflow Storm Sewers 2003

BMP 4 outfall 100-yr HGL

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	31.9	101.0	MH	0.00	0.00	0.00	0.0	61.00	1.00	61.32	18	Cir	0.013	0.15	67.18	FES#35 -MH#34A
2	1	72.9	5.1	MH	0.00	0.00	0.00	0.0	62.50	3.00	64.69	15	Cir	0.013	0.15	69.00	MH#34 - MH#34A
3	2	46.6	0.0	MH	8.00	0.00	0.00	0.0	65.50	5.11	67.88	15	Cir	0.013	1.00	76.50	RISER#33 - MH#34

Project File: BMP#4 OUTFALL.stm | Number of lines: 3 | Date: 11-17-2009

Storm Sewer Tabulation

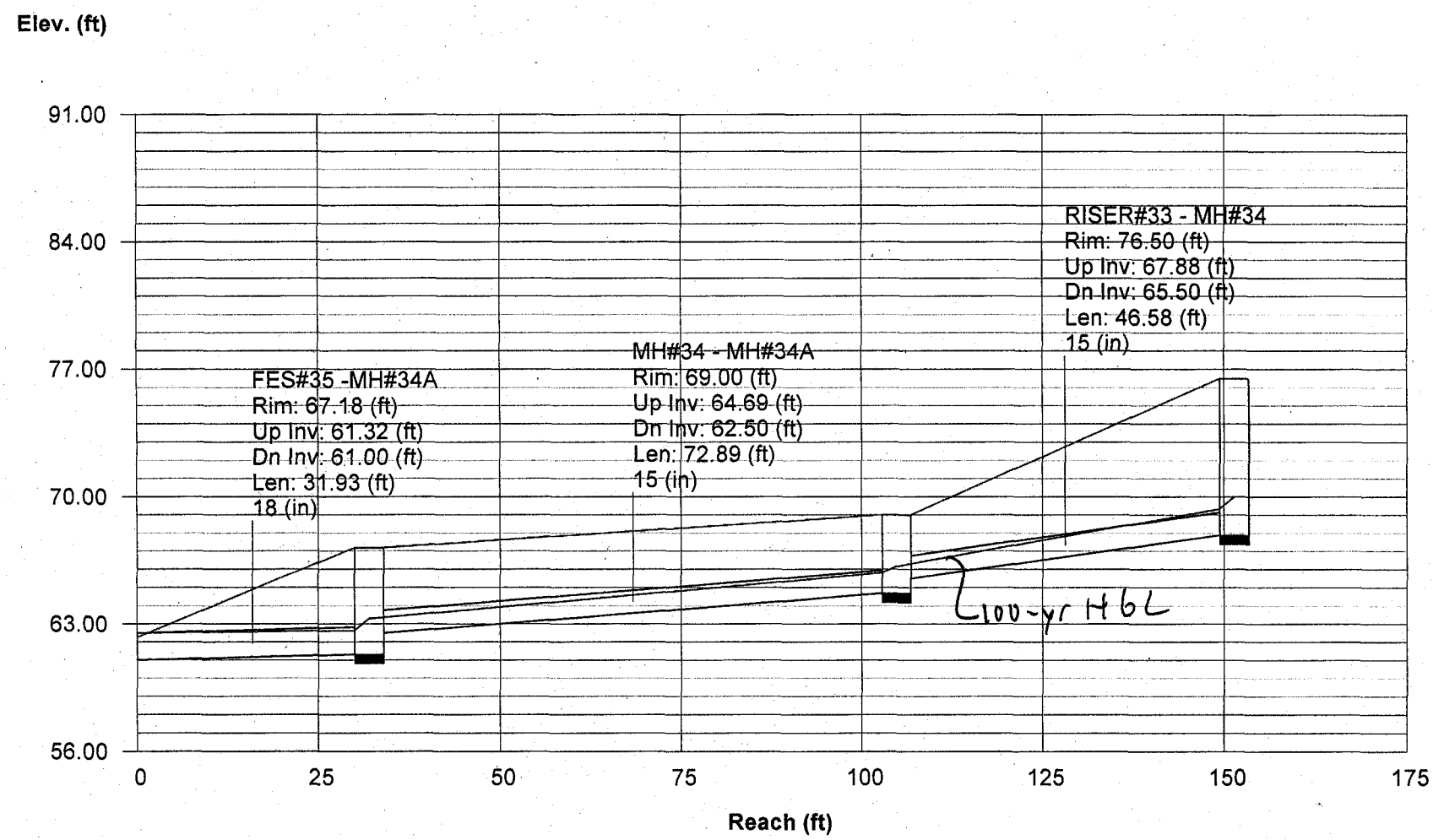
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	31.9	0.00	0.00	0.00	0.00	0.00	0.0	0.3	0.0	8.00	10.51	4.72	18	1.00	61.32	61.00	62.62	62.50	67.18	62.25	FES#35 -MH#34
2	1	72.9	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	8.00	11.19	8.41	15	3.00	64.69	62.50	65.81	63.28	69.00	67.18	MH#34 - MH#34
3	2	46.6	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	8.00	14.60	9.32	15	5.11	67.88	65.50	69.32	66.16	76.50	69.00	RISER#33 - MH#

Project File: BMP#4 OUTFALL.stm | Number of lines: 3 | Run Date: 11-17-2009

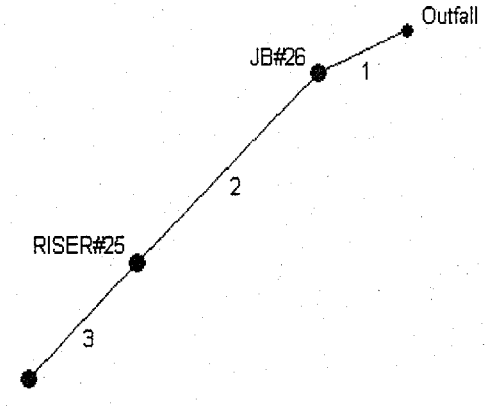
NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

Storm Sewer Profile

Proj. file: BMP#4 OUTFALL.stm



Hydraflow Plan View



Project file: BMP#7 OUTFALL.stm	No. Lines: 3	11-17-2009

Hydraflow Storm Sewers 2003

Bmp7 outfall 100-yr HGL

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	38.2	156.4	MH	0.00	0.00	0.00	0.0	49.00	1.00	49.38	15	Cir	0.013	0.45	69.00	FES#27 - MH#26A
2	1	97.3	-19.9	MH	0.00	0.00	0.00	0.0	51.38	10.00	61.11	15	Cir	0.013	0.15	75.00	MH#26 - MH#25A
3	2	59.6	0.0	MH	6.00	0.00	0.00	0.0	63.11	9.04	68.50	15	Cir	0.013	1.00	0.00	RISER25-MH26

Project File: BMP#7 OUTFALL.stm | Number of lines: 3 | Date: 11-17-2009

Storm Sewer Tabulation

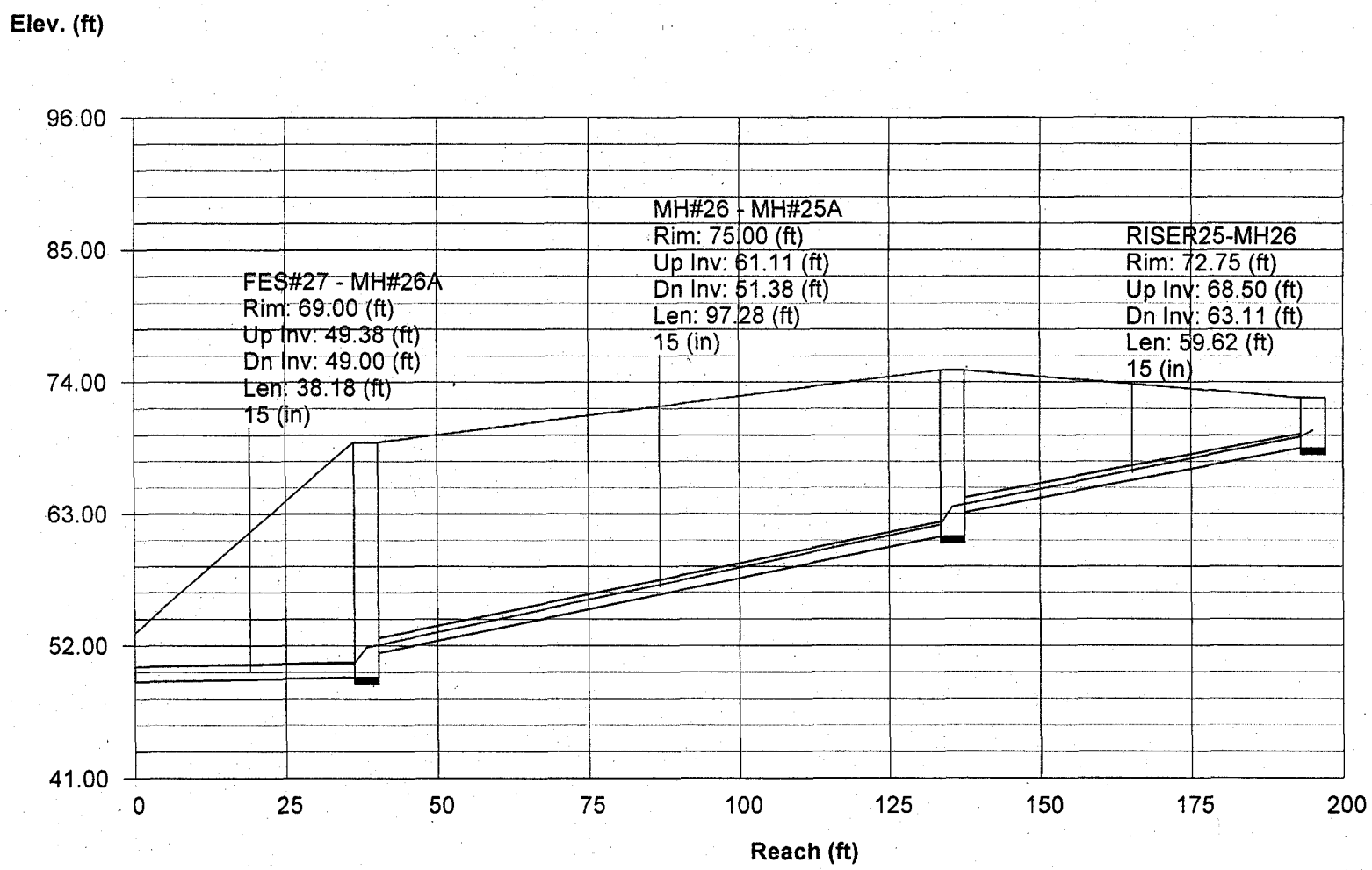
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	38.2	0.00	0.00	0.00	0.00	0.00	0.0	0.5	0.0	6.00	6.44	4.99	15	1.00	49.38	49.00	50.53	50.25	69.00	53.00	FES#27 - MH#26
2	1	97.3	0.00	0.00	0.00	0.00	0.00	0.0	0.2	0.0	6.00	20.42	10.08	15	10.00	61.11	51.38	62.09	51.85	75.00	69.00	MH#26 - MH#25
3	2	59.6	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	6.00	19.42	9.84	15	9.04	68.50	63.11	69.48	63.59	0.00	75.00	RISER25-MH26

Project File: BMP#7 OUTFALL.stm | Number of lines: 3 | Run Date: 11-17-2009

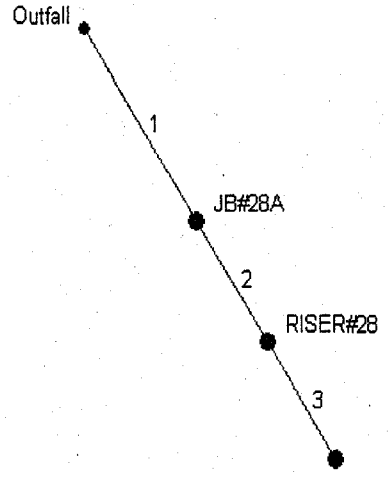
NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

Storm Sewer Profile

Proj. file: BMP#7 OUTFALL.stm



Hydraflow Plan View



Project file: BMP#8 OUTFALL.stm	No. Lines: 3	11-18-2009

Hydraflow Storm Sewers 2003

Bmp 8 outfall 100-yr HGL

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	21.2	56.9	MH	0.00	0.00	0.00	5.0	43.50	0.99	43.71	18	Cir	0.013	0.15	48.32	FES29 - JB#28B
2	1	59.7	-0.1	MH	0.00	0.00	0.00	5.0	45.37	8.01	50.15	15	Cir	0.013	0.15	56.50	JB#28A - JB#28B
3	2	51.0	0.0	MH	6.15	0.00	0.00	0.0	53.00	9.80	58.00	15	Cir	0.013	1.00	67.50	RISER#28-JB-28A

Project File: BMP#8 OUTFALL.stm | Number of lines: 3 | Date: 11-18-2009

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	21.2	0.00	0.00	0.00	0.00	0.00	5.0	5.2	0.0	6.15	10.45	4.44	18	0.99	43.71	43.50	44.70	44.75	48.32	44.75	FES29 - JB#28
2	1	59.7	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	6.15	18.28	9.64	15	8.01	50.15	45.37	51.14	45.87	56.50	48.32	JB#28A - JB#2
3	2	51.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	6.15	20.22	10.11	15	9.80	58.00	53.00	58.99	53.48	67.50	56.50	RISER#28-JB-

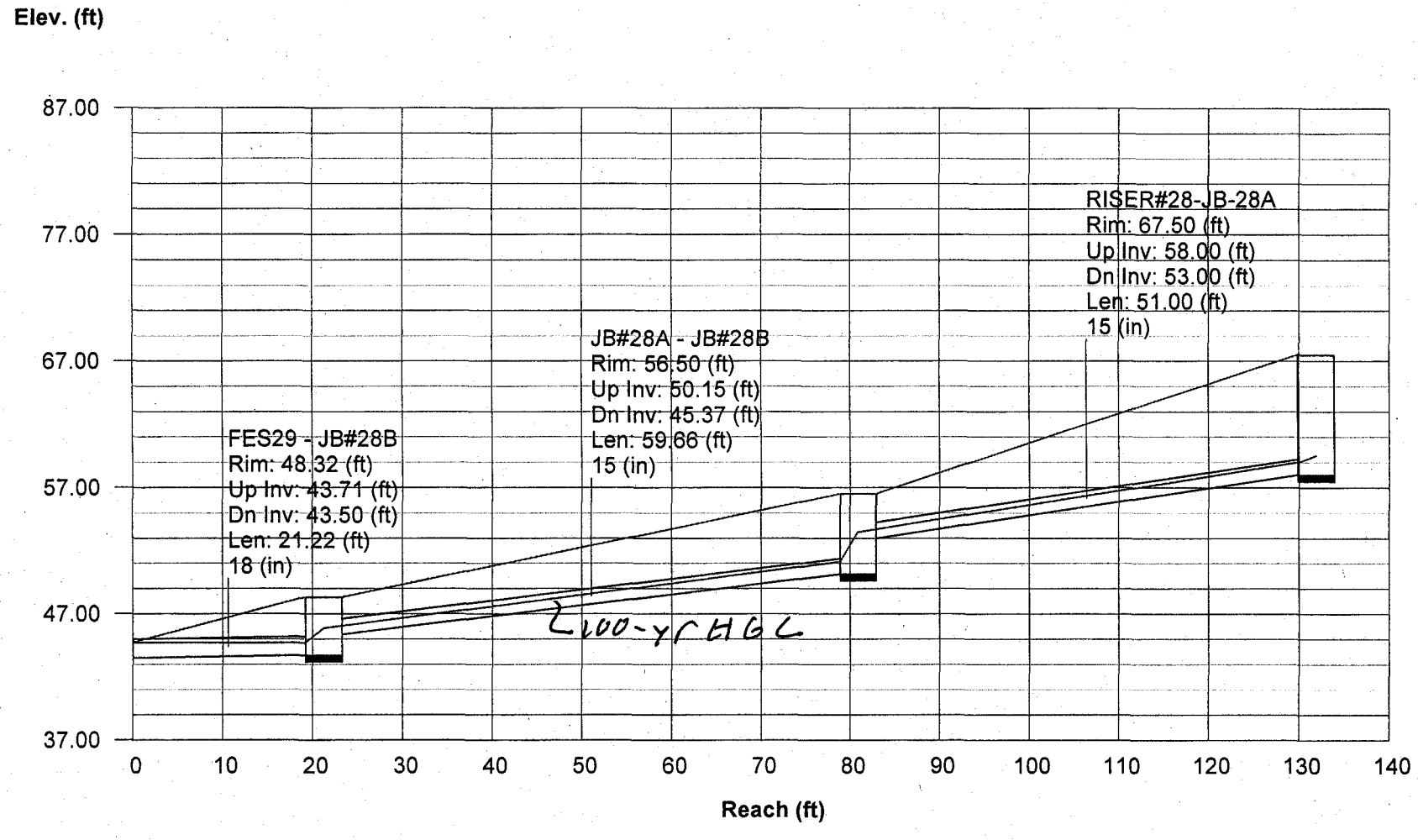
Project File: BMP#8 OUTFALL.stm | Number of lines: 3 | Run Date: 11-18-2009

NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

BMP#8 HGL

Storm Sewer Profile

Proj. file: BMP#8 OUTFALL.stm



EROSION & SEDIMENT CONTROL

SEDIMENT BASIN CALCULATIONS

STILLING BASIN CALCULATIONS

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	13.67	1	5	6,153	---	-----	-----	SB#1
2	Reservoir	0.17	1	12	1,709	1	85.62	5,709	SB#1 Route

SB#1.gpw | Return Period: 25 Year | Friday, Aug 14 2009, 11:09 AM

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	18.12	1	5	8,152	---	-----	-----	SB#2
2	Reservoir	0.23	1	10	3,412	1	75.07	5,907	SB#2 Route

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	7.00	1	5	3,149	---	-----	-----	SB#3
2	Reservoir	0.21	1	12	2,923	1	74.90	2,855	SB#3 Route

SB#3.gpw | Return Period: 25 Year | Friday, Aug 14 2009, 11:10 AM

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	7.77	1	5	3,496	---	-----	-----	SB#4
2	Reservoir	0.02	1	12	183	1	66.11	3,261	SB#4 Route

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	7.47	1	5	3,363	—	-----	-----	ST#1
2	Reservoir	0.00	1	0	0	1	100.32	2,460	ST#1 Route

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	8.44	1	5	3,800	—	—	—	ST#2
2	Reservoir	0.03	1	12	191	1	88.62	3,544	ST#2 Route

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	4.65	1	5	2,091	---	-----	-----	ST#3
2	Reservoir	0.00	1	0	0	1	83.34	1,951	St#3 Route

ST#3.gpw	Return Period: 25 Year	Friday, Aug 14 2009, 11:10 AM

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Mod. Rational	4.43	1	5	1,992	---	-----	-----	ST#4
2	Reservoir	0.00	1	0	0	1	84.90	1,859	ST#4 Route

ST#4.gpw	Return Period: 25 Year	Friday, Aug 14 2009, 11:10 AM

DESIGN WORKSHEET - STILLING BASIN #1

FES-2 from BMP#1 Outfall

WSP · SELLS

Project Name: STONEHOUSE TRACT 12

Designed by: DF Date: 6/1/09
Checked by: CD Date: 8/17/09

Variables:

Design Flow =	Q100	=	4.61	CFS
Barrel Diameter =	D	=	1.25	Feet
Depth of basin =	hs	=	0.41	
Width of basin =	W	=	D = 1.25	
Tailwater Depth =	TW	=	0.2	feet

Designer Input: This is an iterative procedure. The outcome of the following equations must fall within the given tolerences.

Fill in Values
Check Points
Refer to [illegible] charts

This procedure is only valid for circular culverts.

Step 1	Q/D^2.5	=	2.64		
	TW/D	=	0.16		
From Fig [illegible]	Yo/D	=	0.55		
	Yo	=	0.6875	Feet	
	TW/Yo	=	0.29	< 0.75	Check
Use Yo/D as d/D from Table II-2 and insert the value for A/D^2		=	0.44		
	A	=	0.69	Sq. Feet	
	Vo	=	6.67		

Step 2	Ye	=	0.59	

Step 3	Fr	=	1.53	

Step 4 50 for Rip Rap	d50	=	0.3	Feet	
	d50/Ye	=	0.51		
Froude Number		=	1.53		
From Figure XI-2	hs/Ye	=	0.7		
	hs	=	0.41		
2 <	hs/d50	=	1.37	< 4	Check

Step 5

Length of Pool =	LS	=	4.12 Feet, or 3.8 Feet, Whichever is Greater	
Overall Length =	LB	=	6.17 Feet, or 5 Feet, Whichever is Greater	

DESIGN WORKSHEET - STILLING BASIN #2

FES-3 from BMP#4 Outfall

WSP · SELLS

Project Name:	STONEHOUSE TRACT 12		
Designed by:	DF	Date:	6/1/09
Checked by:	CD	Date:	8/17/09

Variables:

Design Flow =	Q100	=	7.97	CFS
Barrel Diameter =	D	=	1.25	Feet
Depth of basin =	hs	=	0.81	
Width of basin =	W	=	D = 1.25	
Tailwater Depth =	TW	=	0.2	feet

Designer Input: This is an iterative procedure. The outcome of the following equations must fall within the given tolerences.

Fill in Values
Check Points
Refer to Attached Charts

This procedure is only valid for circular culverts.

Step 1	Q/D^2.5	=	4.56		
	TW/D	=	0.16		
From Fig. III-10	Yo/D	=	0.76		
	Yo	=	0.95	Feet	
	TW/Yo	=	0.21	< 0.75	Check
Use Yo/D as d/D from Table III-2 and insert the value for A/D^2		=	0.64		
	A	=	1.00	Sq. Feet	
	Vo	=	7.96		

Step 2	Ye	=	0.71

Step 3	Fr	=	1.67

Step 4 50 for Rip Rap	d50	=	0.3	Feet
	d50/Ye	=	0.42	
Froude Number		=	1.67	
From Figure XI-2	hs/Ye	=	1.15	
	hs	=	0.81	
2 <	hs/d50	=	2.71	< 4 Check

Step 5

Length of Pool =	LS	=	8.13	Feet, or	3.8	Feet, Whichever is Greater
Overall Length =	LB	=	12.20	Feet, or	5	Feet, Whichever is Greater

DESIGN WORKSHEET - STILLING BASIN #3

FES-4 from BMP#7 Outfall

WSP · SELLS

Project Name:	STONEHOUSE TRACT 12		
Designed by:	DF	Date:	6/1/09
Checked by:	CD	Date:	8/17/09

Variables:

Design Flow =	Q100	=	5.29	CFS
Barrel Diameter =	D	=	1.5	Feet
Depth of basin =	hs	=	0.86	
Width of basin =	W	=	D = 1.5	
Tailwater Depth =	TW	=	0.2	feet

Designer Input: This is an iterative procedure. The outcome of the following equations must fall within the given tolerences.

Fill in Values

Check Points

Repeat to Alter Input Values

This procedure is only valid for circular culverts.

Step 1	Q/D^2.5	=	1.92		
	TW/D	=	0.13		
From Fig. III-10	Yo/D	=	0.47		
	Yo	=	0.705	Feet	
	TW/Yo	=	0.28	< 0.75	Check
Use Yo/D as d/D from Table III-2 and insert the value for A/D^2		=	0.36		
	A	=	0.82	Sq. Feet	
	Vo	=	6.48		

Step 2	Ye	=	0.64	
Step 3	Fr	=	1.43	
Step 4	Pick a d50 for Rip Rap	d50	=	0.3 Feet
		d50/Ye	=	0.47
	Froude Number		=	1.43
	From Figure XI-2	hs/Ye	=	1.35
		hs	=	0.86
	2 <	hs/d50	=	2.87 < 4 Check

Step 5

Length of Pool =	LS	=	8.62 Feet, or 4.5 Feet, Whichever is Greater	
Overall Length =	LB	=	12.94 Feet, or 6 Feet, Whichever is Greater	

DESIGN WORKSHEET - STILLING BASIN #4

FES-5 from BMP#8 Outfall

WSP · SELLS

Project Name:	STONEHOUSE TRACT 12		
Designed by:	DF	Date:	6/1/09
Checked by:	CD	Date:	8/17/09

Variables:

Design Flow =	Q100	=	6.15	CFS
Barrel Diameter =	D	=	1.25	Feet
Depth of basin =	hs	=	0.84	
Width of basin =	W	=	D = 1.25	
Tailwater Depth =	TW	=	0.4	feet

Designer Input: This is an iterative procedure. The outcome of the following equations must fall within the given tolerences.

Fill in Values
Check Points
Refer to Attached Plans

This procedure is only valid for circular culverts.

Step 1	Q/D^2.5	=	3.52		
	TW/D	=	0.32		
From Fig. II-10	Yo/D	=	0.6		
	Yo	=	0.750	Feet	
	TW/Yo	=	0.53	< 0.75	Check
Use Yo/D as d/D from Table II-2 and insert the value for A/D^2		=	0.49		
	A	=	0.77	Sq. Feet	
	Vo	=	8.00		

Step 2	Ye	=	0.62

Step 3	Fr	=	1.79

Step 4	Pick a d50 for Rip Rap	d50	=	0.3	Feet
		d50/Ye	=	0.48	
	Froude Number		=	1.79	
	From Figure XI-2	hs/Ye	=	1.35	
		hs	=	0.84	
	2 <	hs/d50	=	2.79	< 4 Check

Step 5

Length of Pool =	LS	=	8.37	Feet, or	3.8	Feet, Whichever is Greater
Overall Length =	LB	=	12.55	Feet, or	5	Feet, Whichever is Greater

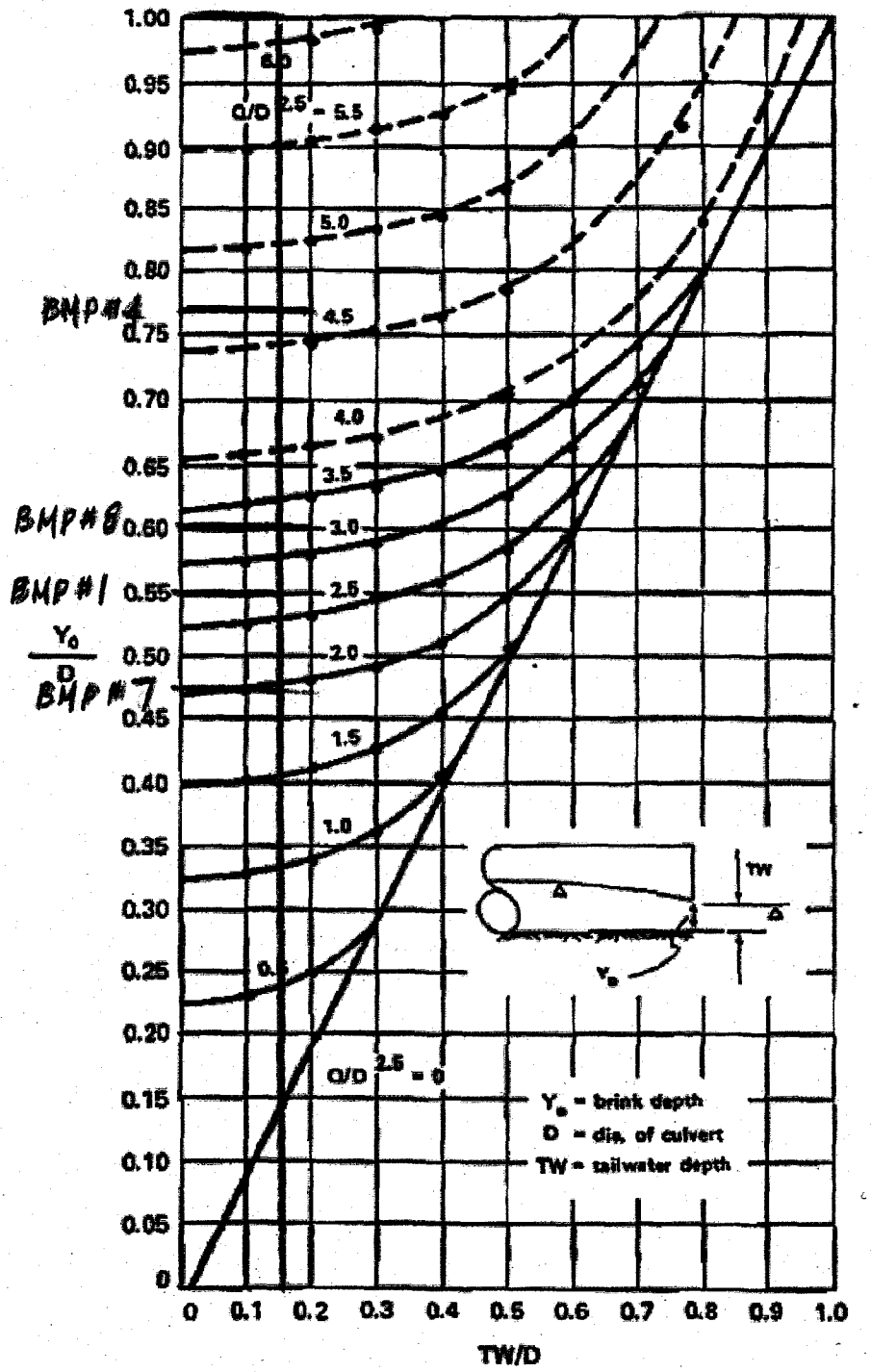


Figure III-10 Dimensionless Rating Curve for the Outlets of Circular Culverts on Horizontal and Mild Slopes from Reference III-2

Table III-2.—*Uniform flow in circular sections flowing partly full.* From Reference III-3.

d = depth of flow
D = diameter of pipe
A = area of flow
R = hydraulic radius

Q = discharge in cubic feet per second by Manning's formula
n = Manning's coefficient
S = slope of the channel bottom and of the water surface

$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{R}{D}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qn}{d^{8/3}S^{1/2}}$	$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{R}{D}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qn}{d^{8/3}S^{1/2}}$
0.01	0.0013	0.0066	0.00007	15.04	0.51	0.4027	0.2531	0.239	1.442
0.02	0.0037	0.0132	0.00021	10.57	0.52	0.4127	0.2562	0.247	1.418
0.03	0.0069	0.0197	0.00014	8.56	0.53	0.4227	0.2592	0.256	1.388
0.04	0.0105	0.0262	0.00128	7.38	0.54	0.4327	0.2621	0.263	1.362
0.05	0.0147	0.0326	0.00222	6.55	0.55	0.4426	0.2649	0.271	1.336
0.06	0.0192	0.0389	0.00328	5.95	0.56	0.4526	0.2676	0.279	1.311
0.07	0.0242	0.0451	0.00455	5.47	0.57	0.4625	0.2703	0.287	1.286
0.08	0.0294	0.0513	0.00604	5.09	0.58	0.4724	0.2728	0.295	1.262
0.09	0.0350	0.0575	0.00775	4.76	0.59	0.4822	0.2753	0.303	1.238
0.10	0.0409	0.0635	0.00967	4.49	0.60	0.4920	0.2776	0.311	1.215
0.11	0.0470	0.0695	0.01181	4.25	0.61	0.5018	0.2799	0.319	1.192
0.12	0.0534	0.0755	0.01417	4.04	0.62	0.5115	0.2821	0.327	1.170
0.13	0.0600	0.0813	0.01674	3.86	0.63	0.5212	0.2842	0.335	1.148
0.14	0.0669	0.0871	0.01952	3.69	0.64	0.5308	0.2862	0.343	1.126
0.15	0.0739	0.0929	0.0225	3.54	0.65	0.5404	0.2882	0.350	1.106
0.16	0.0811	0.0985	0.0257	3.41	0.66	0.5499	0.2900	0.358	1.084
0.17	0.0885	0.1042	0.0291	3.28	0.67	0.5594	0.2917	0.366	1.064
0.18	0.0961	0.1097	0.0327	3.17	0.68	0.5687	0.2933	0.373	1.044
0.19	0.1039	0.1152	0.0365	3.06	0.69	0.5780	0.2948	0.380	1.024
0.20	0.1118	0.1206	0.0406	2.96	0.70	0.5872	0.2962	0.388	1.004
0.21	0.1199	0.1259	0.0448	2.87	0.71	0.5964	0.2975	0.395	0.985
0.22	0.1281	0.1312	0.0492	2.79	0.72	0.6054	0.2987	0.402	0.966
0.23	0.1365	0.1364	0.0537	2.71	0.73	0.6143	0.2998	0.409	0.947
0.24	0.1449	0.1416	0.0585	2.63	0.74	0.6231	0.3006	0.416	0.928
0.25	0.1535	0.1466	0.0634	2.56	0.75	0.6319	0.3017	0.422	0.910
0.26	0.1623	0.1518	0.0686	2.49	0.76	0.6405	0.3024	0.429	0.891
0.27	0.1711	0.1568	0.0739	2.42	0.77	0.6489	0.3031	0.435	0.873
0.28	0.1800	0.1614	0.0793	2.36	0.78	0.6573	0.3036	0.441	0.856
0.29	0.1890	0.1662	0.0849	2.30	0.79	0.6655	0.3039	0.447	0.838
0.30	0.1982	0.1709	0.0907	2.25	0.80	0.6736	0.3042	0.453	0.821
0.31	0.2074	0.1755	0.0966	2.20	0.81	0.6815	0.3043	0.458	0.804
0.32	0.2167	0.1802	0.1027	2.14	0.82	0.6893	0.3043	0.463	0.787
0.33	0.2260	0.1847	0.1089	2.09	0.83	0.6969	0.3041	0.468	0.770
0.34	0.2355	0.1891	0.1153	2.05	0.84	0.7043	0.3038	0.473	0.753
0.35	0.2450	0.1935	0.1218	2.00	0.85	0.7115	0.3033	0.477	0.736
0.36	0.2546	0.1978	0.1284	1.956	0.86	0.7186	0.3028	0.481	0.720
0.37	0.2642	0.2020	0.1351	1.915	0.87	0.7254	0.3018	0.485	0.703
0.38	0.2739	0.2062	0.1420	1.875	0.88	0.7320	0.3007	0.488	0.687
0.39	0.2836	0.2102	0.1490	1.836	0.89	0.7384	0.2995	0.491	0.670
0.40	0.2934	0.2142	0.1561	1.797	0.90	0.7445	0.2980	0.494	0.654
0.41	0.3032	0.2182	0.1633	1.760	0.91	0.7504	0.2963	0.496	0.637
0.42	0.3130	0.2220	0.1706	1.724	0.92	0.7560	0.2944	0.497	0.621
0.43	0.3229	0.2258	0.1779	1.689	0.93	0.7612	0.2921	0.498	0.604
0.44	0.3328	0.2295	0.1854	1.655	0.94	0.7662	0.2896	0.498	0.588
0.45	0.3428	0.2331	0.1929	1.622	0.95	0.7707	0.2865	0.498	0.571
0.46	0.3527	0.2366	0.201	1.590	0.96	0.7749	0.2829	0.496	0.553
0.47	0.3627	0.2401	0.208	1.559	0.97	0.7785	0.2787	0.494	0.536
0.48	0.3727	0.2435	0.216	1.530	0.98	0.7817	0.2736	0.489	0.517
0.49	0.3827	0.2468	0.224	1.500	0.99	0.7841	0.2666	0.483	0.498
0.50	0.3927	0.2500	0.232	1.471	1.00	0.7854	0.2500	0.463	0.463

BMP#1

BMP#2

BMP#4

BMP#7

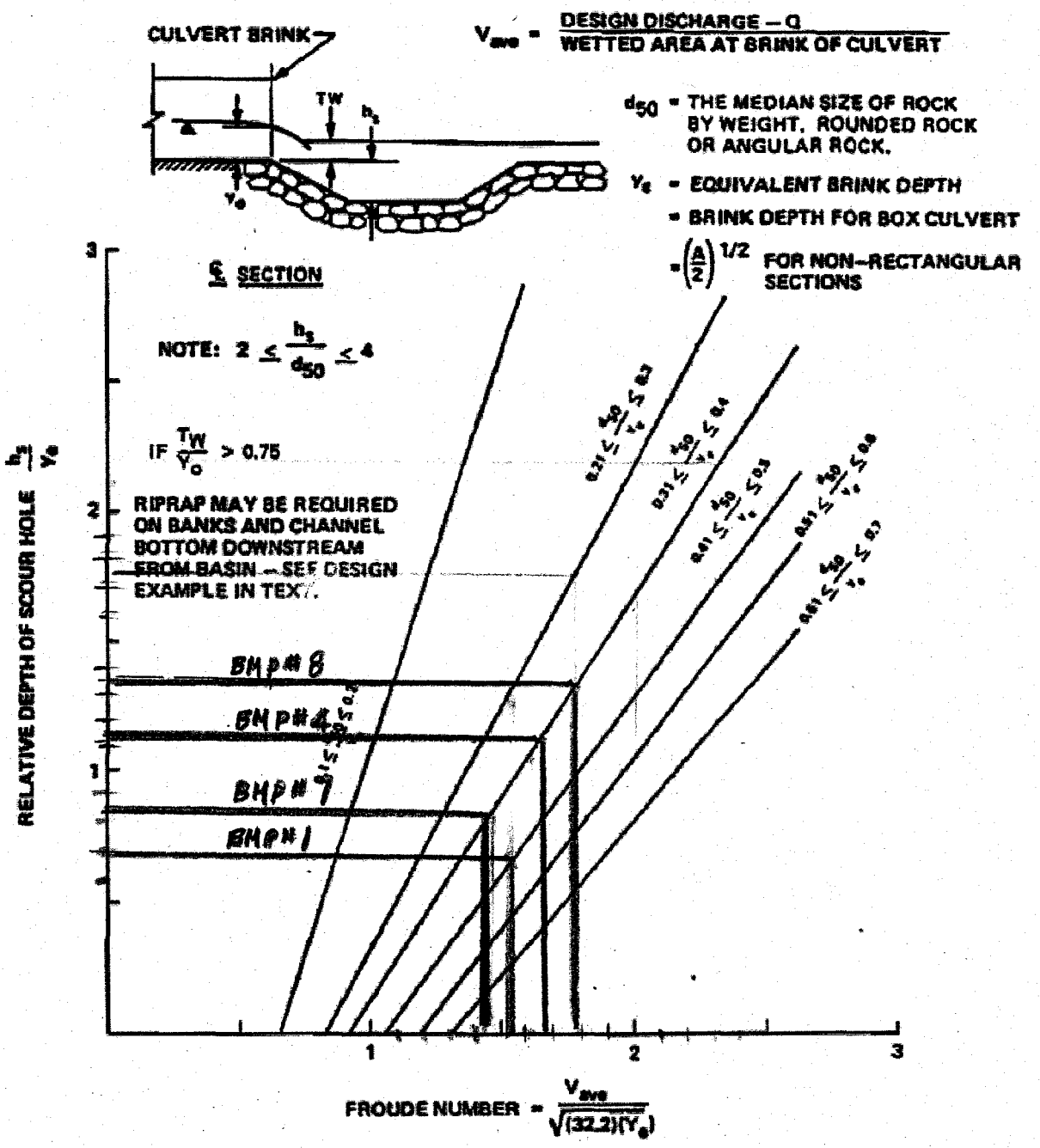


FIGURE XI-2. RELATIVE DEPTH OF SCOUR HOLE VERSUS FROUDE NUMBER AT BRINK OF CULVERT WITH RELATIVE SIZE OF RIPRAP AS A THIRD VARIABLE

DOWN STREAM CHANNEL ADEQUACY

APPENDIX 19.A

Manning's Roughness Coefficient,[a] n
(design use)

channel material	n^b
plastic (PVC and ABS)	0.009
clean, uncoated cast iron	0.013–0.015
clean, coated cast iron	0.012–0.014
dirty, tuberculated cast iron	0.015–0.035
riveted steel	0.015–0.017
lock-bar and welded steel pipe	0.012–0.013
galvanized iron	0.015–0.017
brass and glass	0.009–0.013
wood stave	
small diameter	0.011–0.012
large diameter	0.012–0.013
concrete	
average value used	0.013
typical commercial, ball and spigot rubber gasketed end connections	
– full (pressurized and wet)	0.010
– partially full	0.0085
with rough joints	0.016–0.017
dry mix, rough forms	0.015–0.016
wet mix, steel forms	0.012–0.014
very smooth, finished	0.011–0.012
vitrified sewer	0.013–0.015
common-clay drainage tile	0.012–0.014
asbestos	0.011
planed timber (flume)	0.012 (0.010–0.014)
canvas	0.012
unplaned timber (flume)	0.013 (0.011–0.015)
brick	0.016
rubble masonry	0.017
smooth earth	0.018
firm gravel	0.023
corrugated metal pipe (CMP)	0.024 (see App. 17.F)
natural channels, good condition	0.025
rip rap	0.035
natural channels with stones and weeds	0.035 ←
very poor natural channels	0.060

[a]Compiled from various sources.
[b]Values outside these ranges have been observed, but these values are typical.

Support Material

STONEHOUSE
Tract 12

James City County, Virginia

Water Quality Impact Assessment

Chesapeake Bay Board Case #CBE-10-018
James City County Case #S-0048-2009

Date: August 17, 2009
March 17, 2010 (REVISED)

Prepared by:

WSP • SELLS

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COMMONWEALTH OF VIRGINIA
CRAIG MICHAEL DUERR
No. 045157
PROFESSIONAL ENGINEER
3/17/10

Craig M. Duerr, PE

WSP SELLS Project Number 08-4051

Water Quality Impact Assessment Summary – Stonehouse Tract 12

Three locations of the existing receiving stream channel were analyzed both from the existing condition and proposed condition to determine that the post development condition did not increase the flows and velocities of the existing stream channel.

To calculate the pre and post development condition a Hydraflow Hydrograph Model was created for each. The post development model as combined with the Hydrograph models of the proposed modeled stormwater devices.

A summary of the results is below and no increase in stream flow and velocity was determined.

Section 1

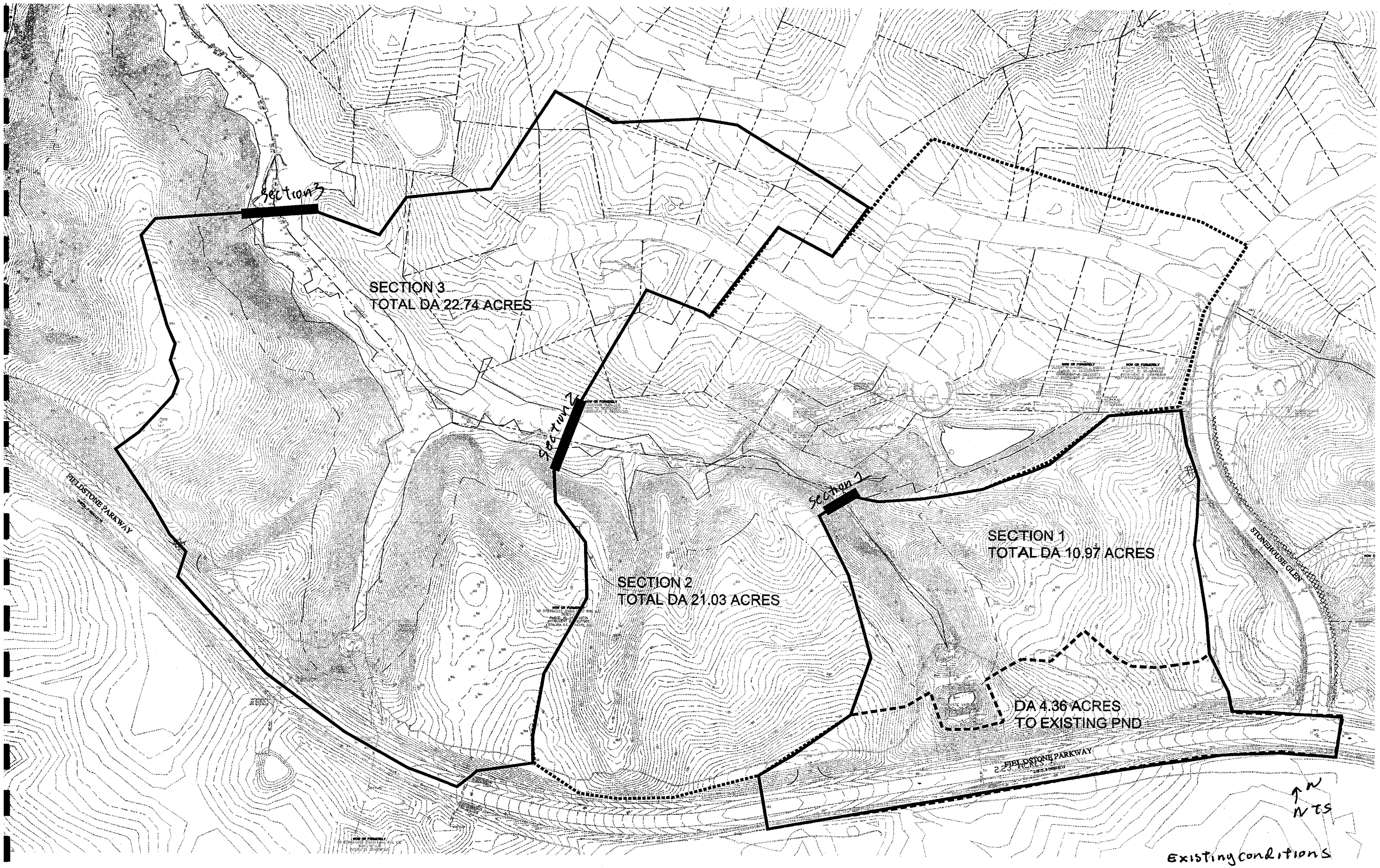
	Pre Development	Post Development
2-year	10.3 cfs, 2.4 ft/s	8.9 cfs, 2.2 ft/s
10-year	14.7 cfs, 2.7 ft/s	12.0 cfs, 2.5 ft/s

Section 2

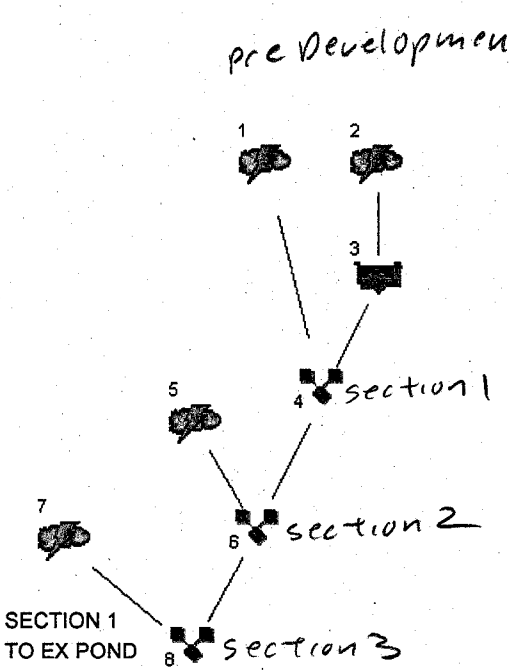
	Pre Development	Post Development
2-year	37.5 cfs, 2.1 ft/s	29.7 cfs, 1.9 ft/s
10-year	51.3 cfs, 2.3 ft/s	40.0 cfs, 2.1 ft/s

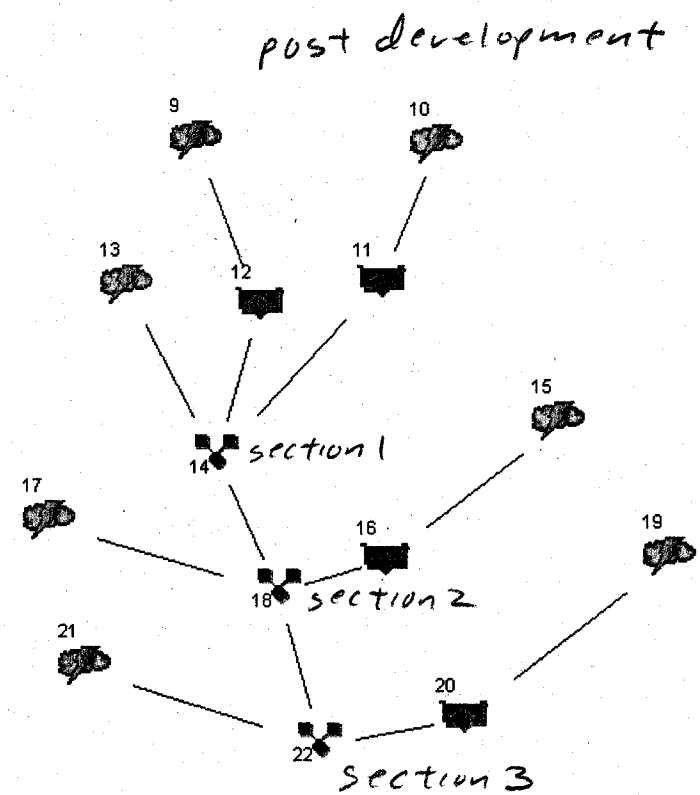
Section 3

	Pre Development	Post Development
2-year	69.3 cfs, 2.7 ft/s	56.0 cfs, 2.4 ft/s
10-year	94.5 cfs, 2.8 ft/s	76.0 cfs, 2.6 ft/s



Existing conditions





Legend

Hyd.	Origin	Description
1	Mod. Rational	PRE DEVELOPMENT SECTION 1
2	Mod. Rational	PRE DEVELOPMENT TO EX POND
3	Reservoir	PRE DEV. EX PND
4	Combine	SECT 1 PRE DEV
5	Mod. Rational	pre development sectin 2
6	Combine	pre dev section 2
7	Mod. Rational	pre dev section 3
8	Combine	pre dev section 3
9	Mod. Rational	BMP1 DA
10	Mod. Rational	EX POND POST DEVEL
11	Reservoir	POST DEVEL. EX POND
12	Reservoir	BMP 1 ROUTING
13	Mod. Rational	POST DEVEL WITH LOT AREA
14	Combine	SECTION 1 POST DEVELOPMENT
15	Mod. Rational	BMP 4 POST DEVEL
16	Reservoir	BMP 4 ROUTING
17	Mod. Rational	POST DEVEL W LOT AREA
18	Combine	SECTION 2 POST DEVEL
19	Mod. Rational	BMP7 POST DEV
20	Reservoir	BMP 7 ROUTING
21	Mod. Rational	POST DEVEL W LOT AREA
22	Combine	SECTION 3 POST DEVEL

Hydrograph Plot

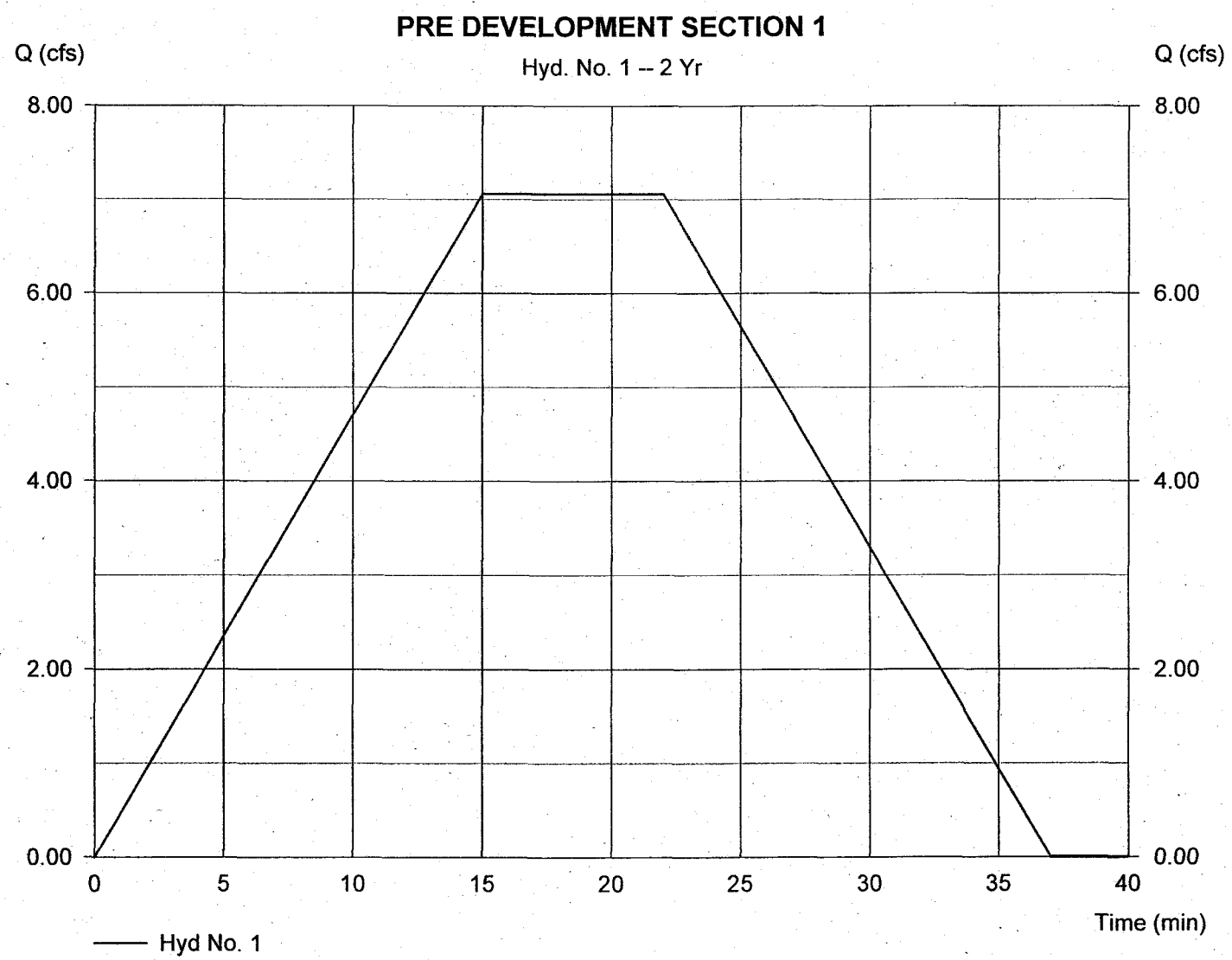
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 1

PRE DEVELOPMENT SECTION 1

Hydrograph type	= Mod. Rational	Peak discharge	= 7.06 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 6.600 ac	Runoff coeff.	= 0.35
Intensity	= 3.056 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 9,531 cuft



Hydrograph Plot

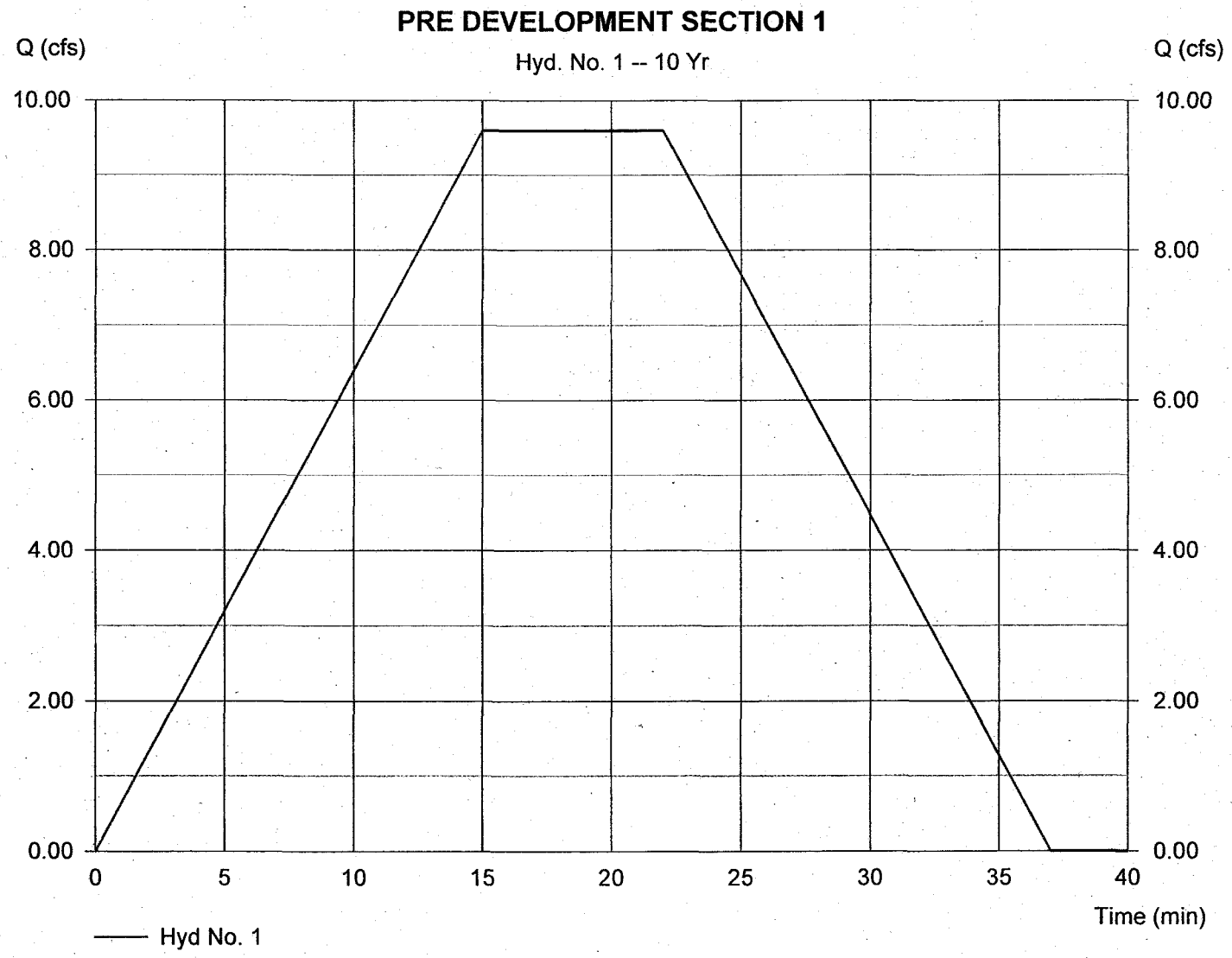
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 1

PRE DEVELOPMENT SECTION 1

Hydrograph type	= Mod. Rational	Peak discharge	= 9.60 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 6.600 ac	Runoff coeff.	= 0.35
Intensity	= 4.155 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 12,958 cuft



Hydrograph Plot

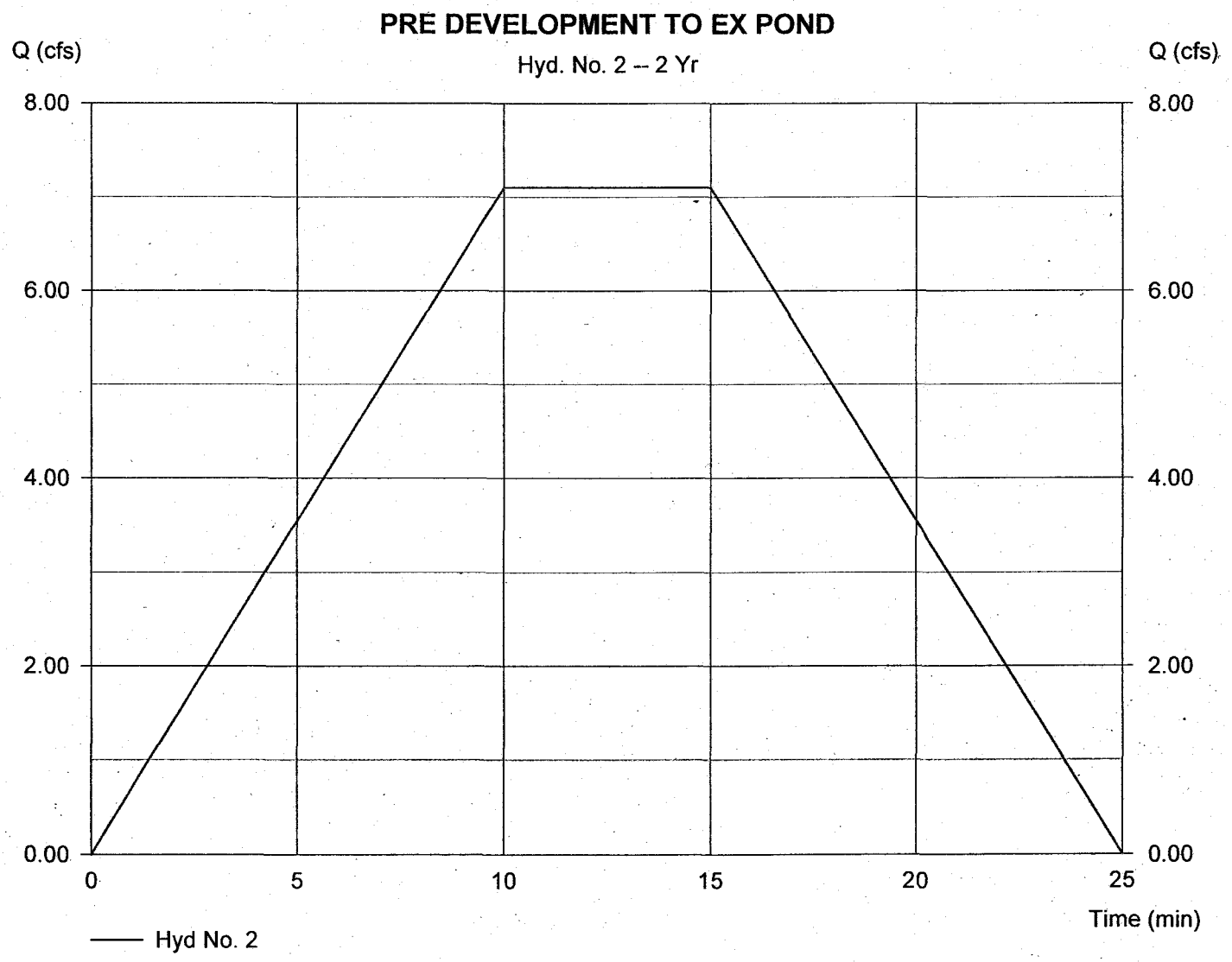
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 2

PRE DEVELOPMENT TO EX POND

Hydrograph type	= Mod. Rational	Peak discharge	= 7.10 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 4.360 ac	Runoff coeff.	= 0.43
Intensity	= 3.788 in/hr	Tc by User	= 10.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 6,392 cuft



Hydrograph Plot

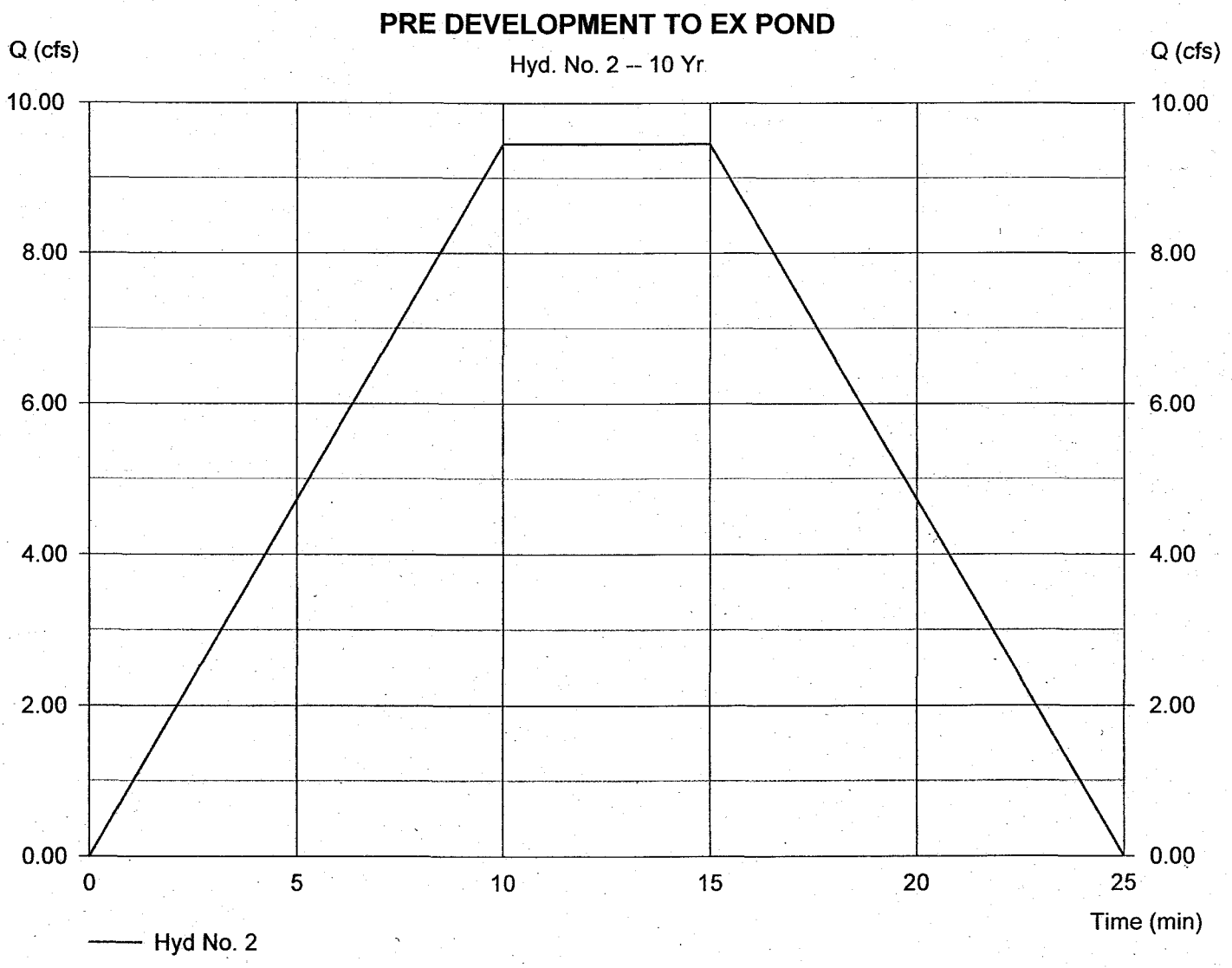
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 2

PRE DEVELOPMENT TO EX POND

Hydrograph type	= Mod. Rational	Peak discharge	= 9.45 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 4.360 ac	Runoff coeff.	= 0.43
Intensity	= 5.043 in/hr	Tc by User	= 10.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 8,509 cuft



Hydrograph Plot

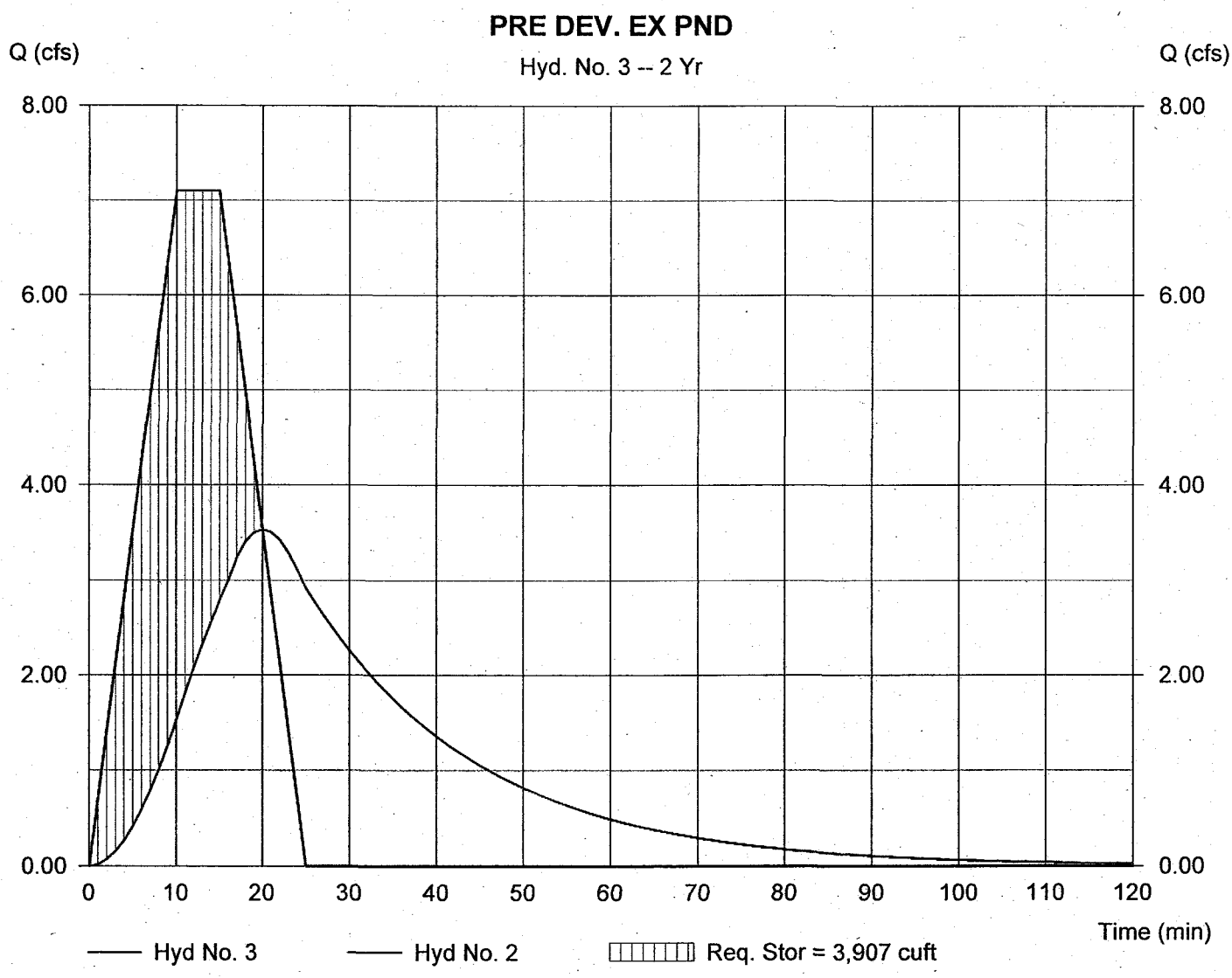
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 3

PRE DEV. EX PND

Hydrograph type	= Reservoir	Peak discharge	= 3.53 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 73.89 ft
Reservoir name	= EXISTING BMP	Max. Storage	= 3,907 cuft

Storage Indication method used. | Hydrograph Volume = 6,391 cuft



Hydrograph Plot

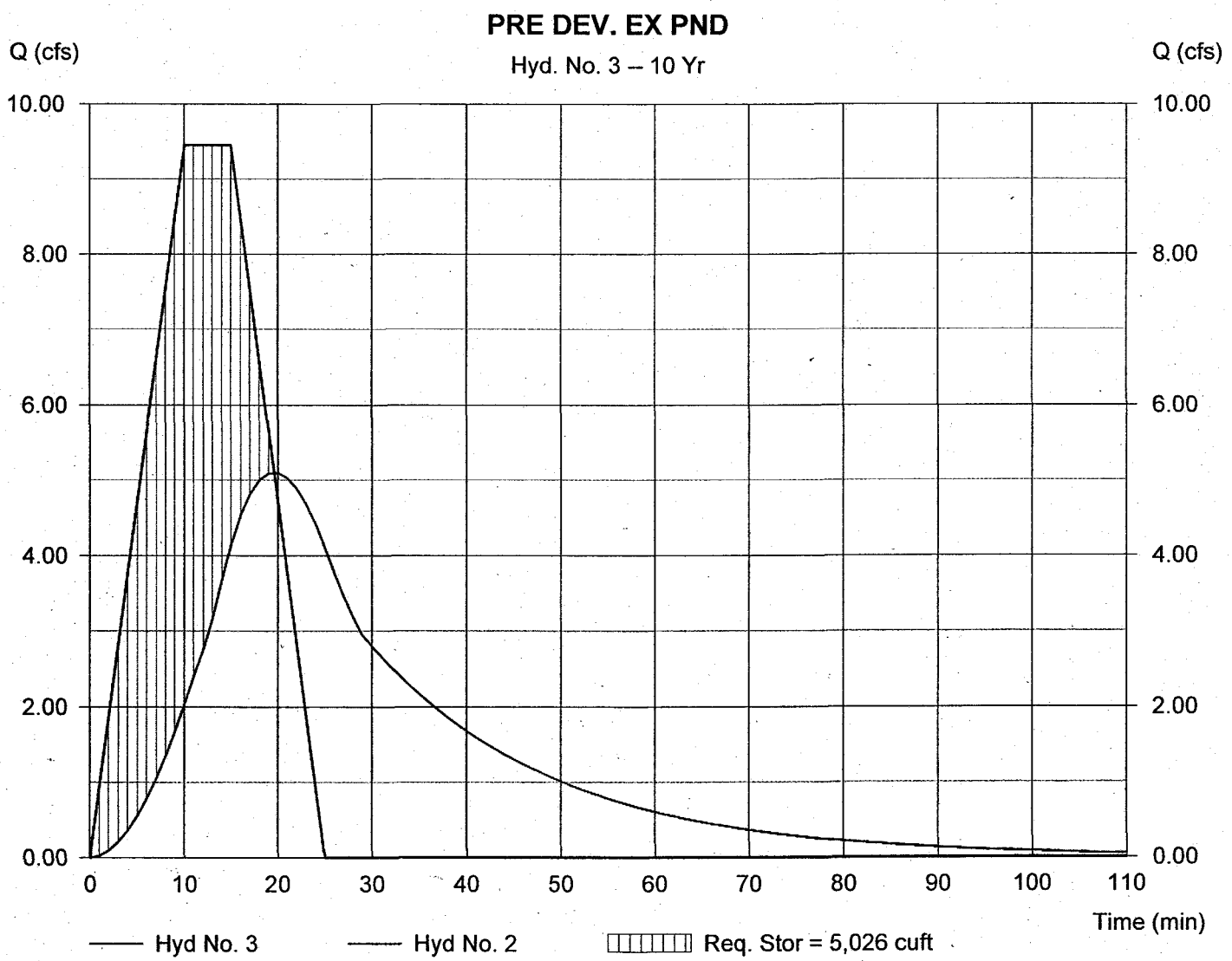
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 3

PRE DEV. EX PND

Hydrograph type	= Reservoir	Peak discharge	= 5.10 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 74.15 ft
Reservoir name	= EXISTING BMP	Max. Storage	= 5,026 cuft

Storage Indication method used. | Hydrograph Volume = 8,508 cuft



Hydrograph Plot

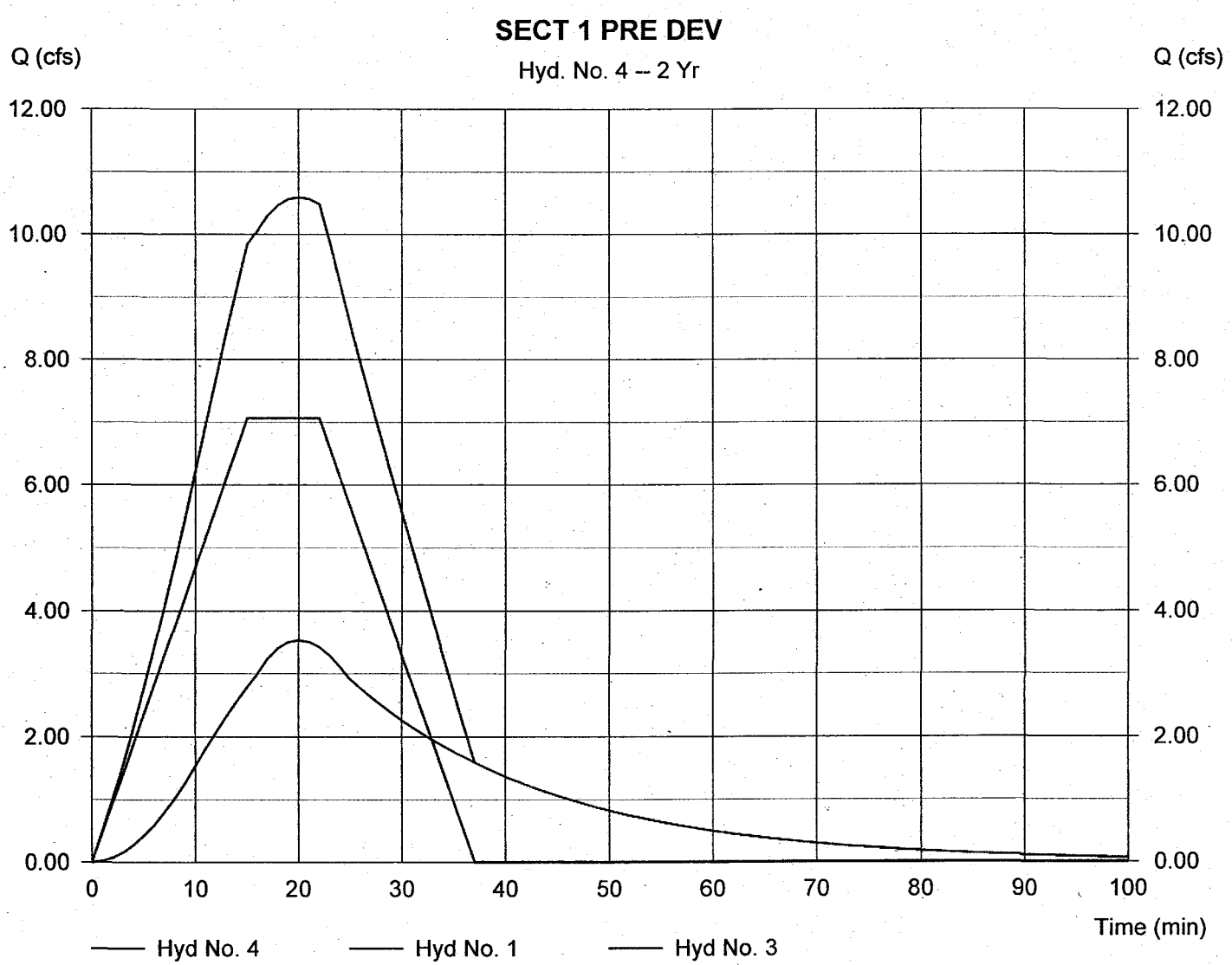
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 4

SECT 1 PRE DEV

Hydrograph type	= Combine	Peak discharge	= 10.59 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyds.	= 1, 3		

Hydrograph Volume = 15,710 cuft



Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	16	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2	% (maximum slope typical)	
Depth	0.267	ft	
n	0.035		

Numbers

flow area	4.4	ft^2
Slope Length	0.60	ft
wetted perimeter	17.2	ft
Hydraulic Radius	0.26	ft

Velocity/Flow

Velocity(v)=	2.4	ft/s
Flow (Q)=	10.7	ft^3/s

2-yr pre development section 2

Shear Stress

	62.4 pcf	Unit weight of water
	0.02 ft/ft	Channel Gradient
	0.267 ft	Depth of Channel
T	**0.33 psf**	**Shear Stress**

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

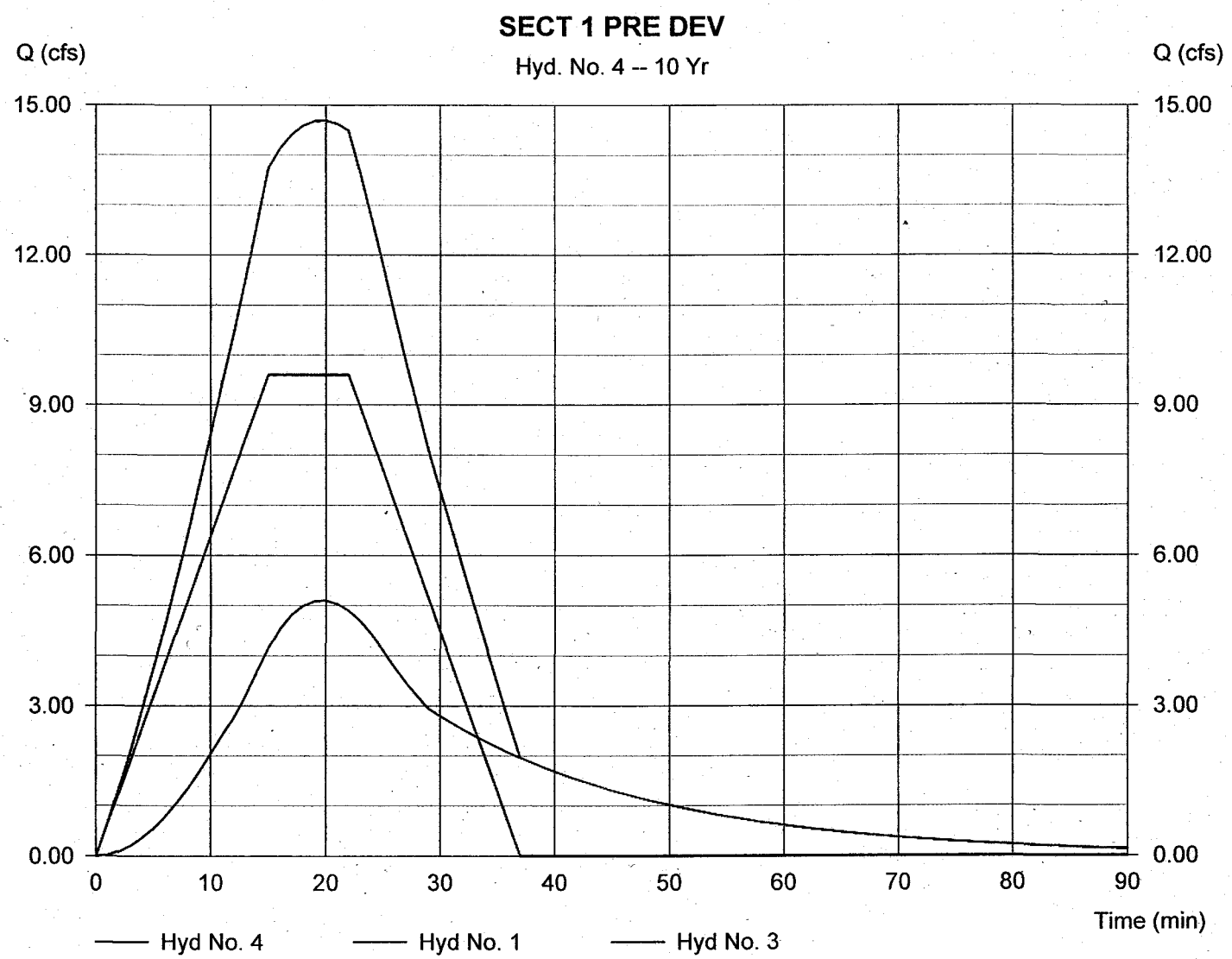
Hyd. No. 4

SECT 1 PRE DEV

Hydrograph type = Combine
Storm frequency = 10 yrs
Inflow hyds. = 1, 3

Peak discharge = 14.70 cfs
Time interval = 1 min

Hydrograph Volume = 21,179 cuft



Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	16	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2	% (maximum slope typical)	
Depth	0.321	ft	
n	0.035		

Numbers

flow area	5.3	ft^2
Slope Length	0.72	ft
wetted perimeter	17.4	ft
Hydraulic Radius	0.31	ft

Velocity/Flow

Velocity(v)=	2.7	ft/s	
Flow (Q)=	14.6	ft^3/s	10-yr pre development section 7

Shear Stress

	62.4	pcf	Unit weight of water
	0.02	ft/ft	Channel Gradient
	0.321	ft	Depth of Channel
T	**0.40**	**psf**	**Shear Stress**

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

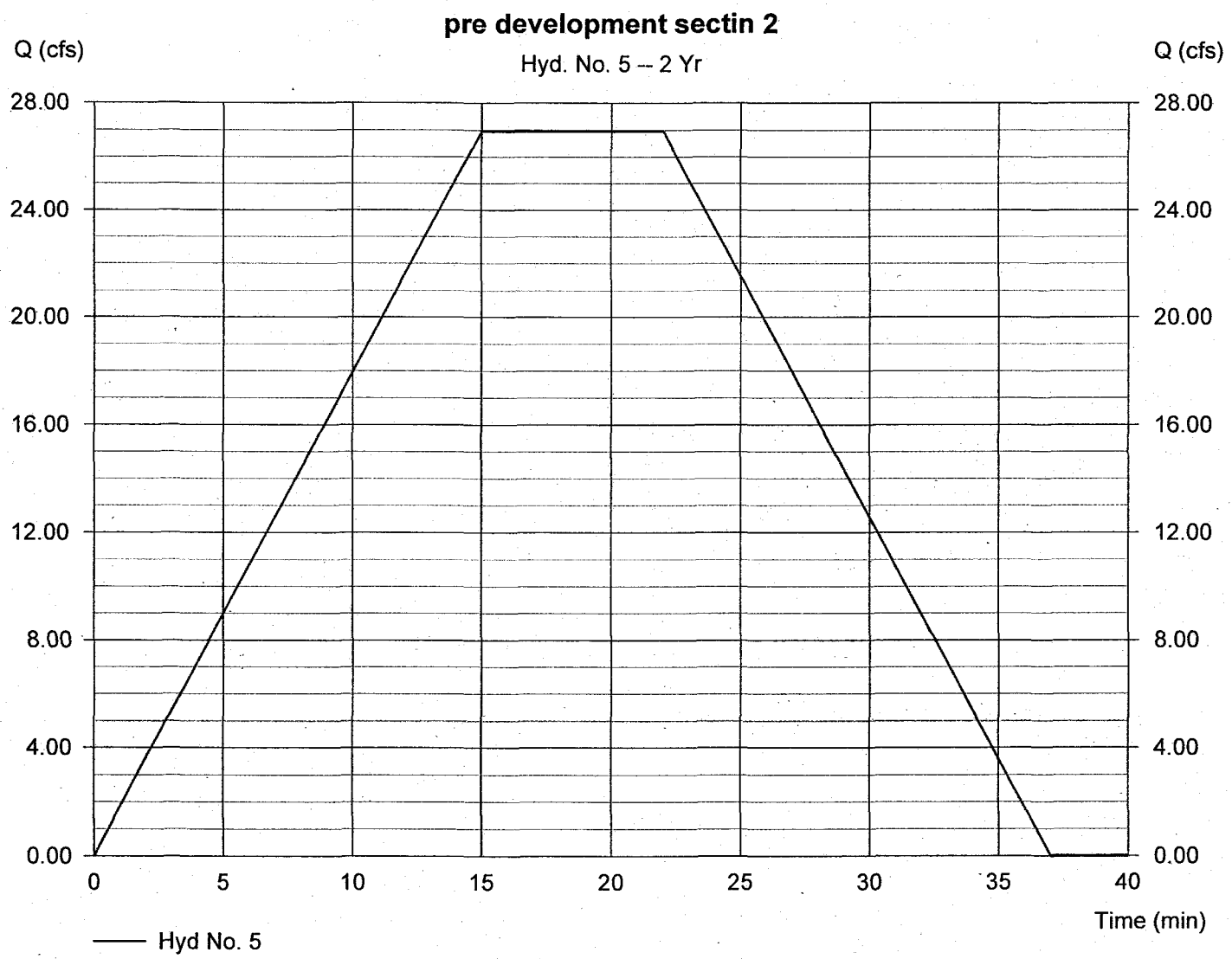
Friday, Nov 20 2009, 3:30 PM

Hyd. No. 5

pre development sectin 2

Hydrograph type	= Mod. Rational	Peak discharge	= 26.96 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 21.000 ac	Runoff coeff.	= 0.42
Intensity	= 3.056 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 36,392 cuft



Hydrograph Plot

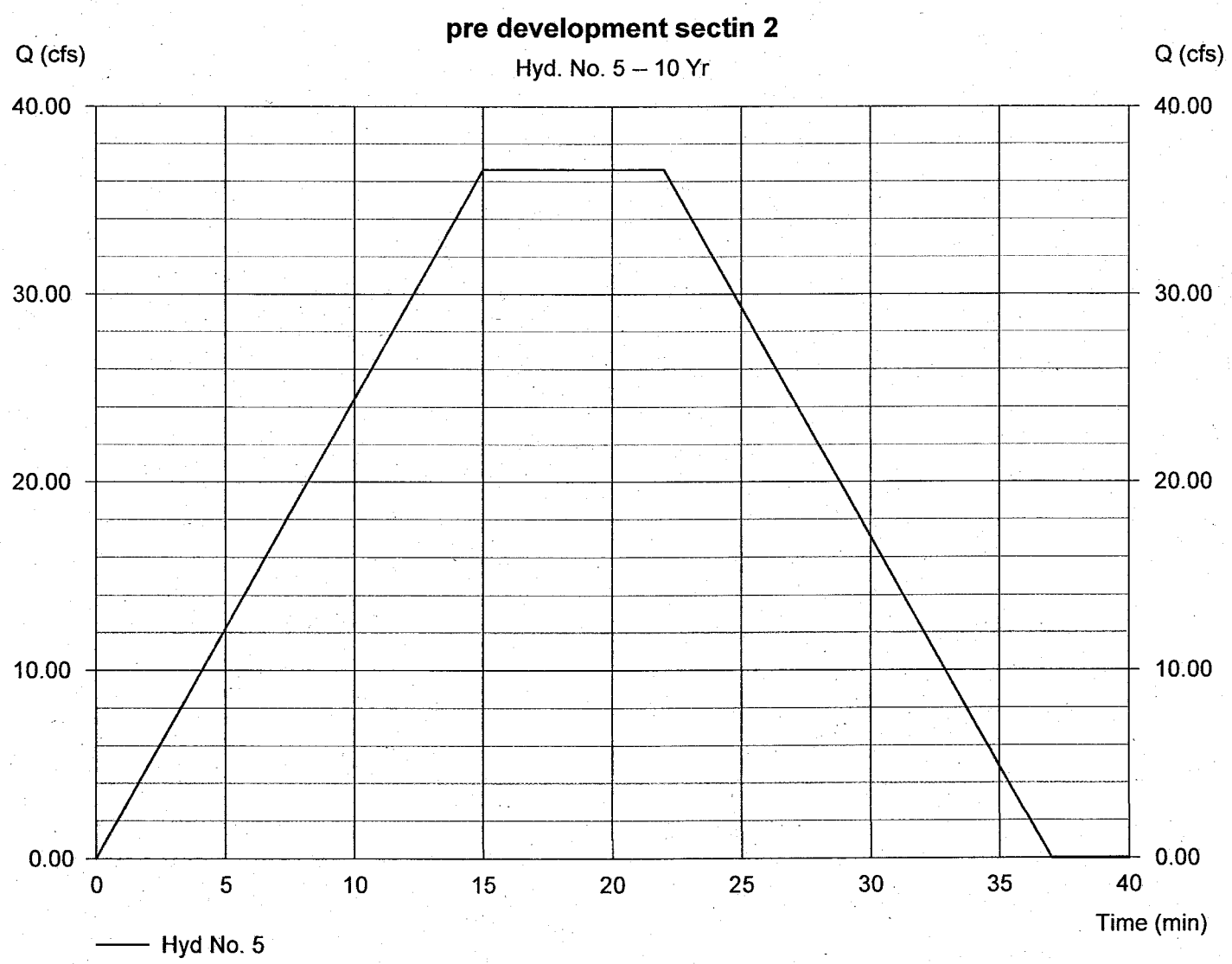
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:30 PM

Hyd. No. 5

pre development sectin 2

Hydrograph type	= Mod. Rational	Peak discharge	= 36.65 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 21.000 ac	Runoff coeff.	= 0.42
Intensity	= 4.155 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 49,478 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

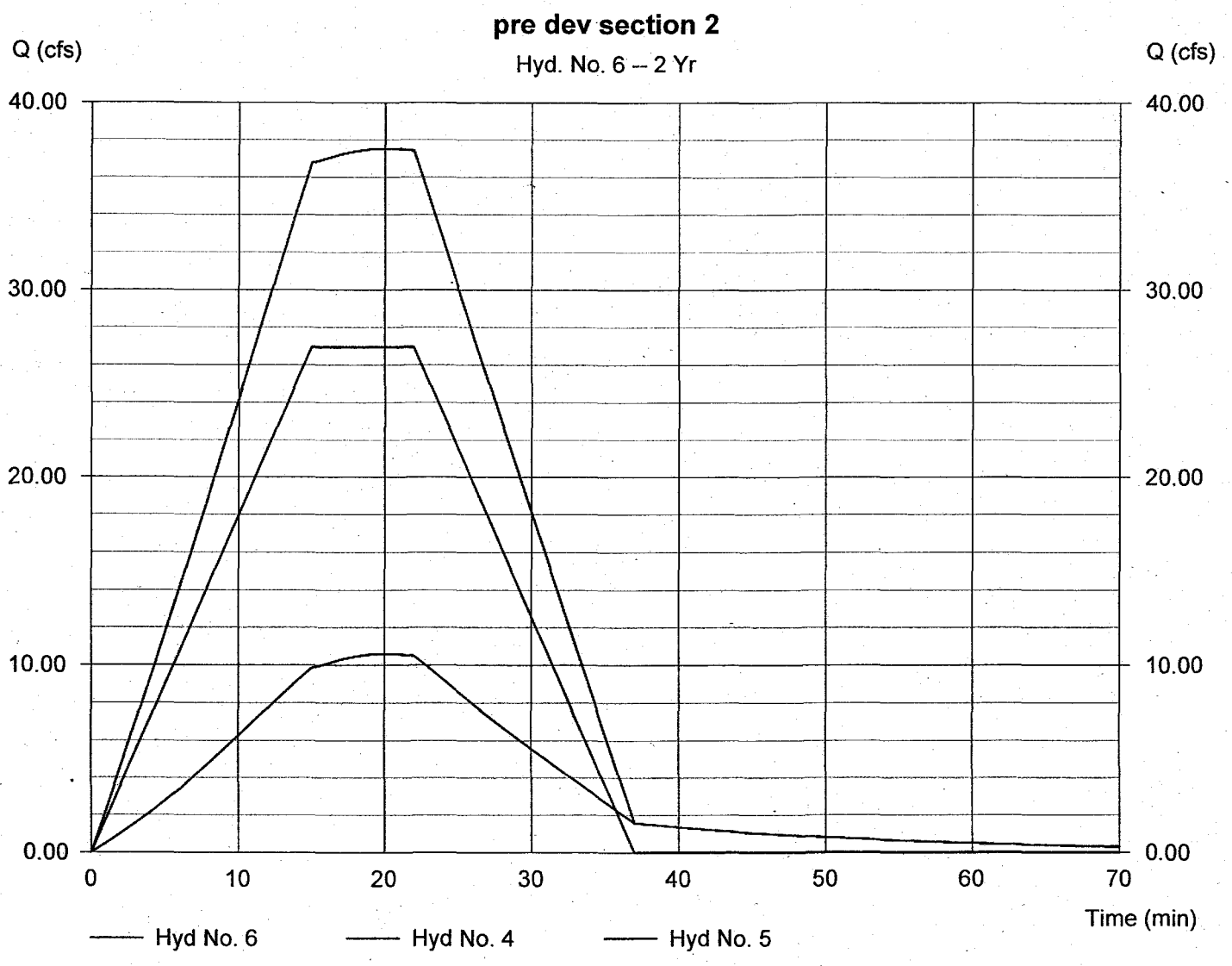
Friday, Nov 20 2009, 3:31 PM

Hyd. No. 6

pre dev section 2

Hydrograph type	= Combine	Peak discharge	= 37.55 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyds.	= 4, 5		

Hydrograph Volume = 51,293 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

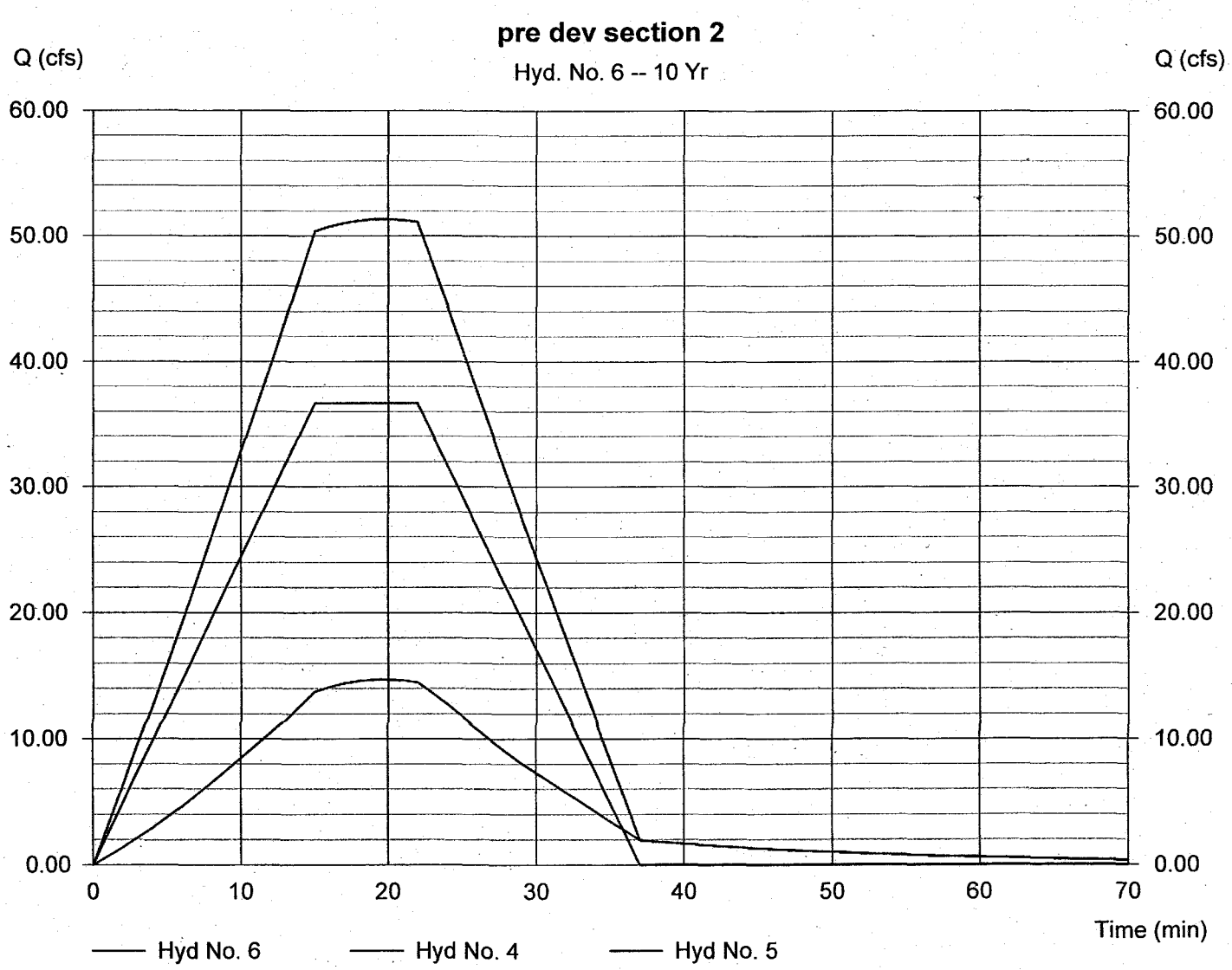
Friday, Nov 20 2009, 3:31 PM

Hyd. No. 6

pre dev section 2

Hydrograph type	= Combine	Peak discharge	= 51.35 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyds.	= 4, 5		

Hydrograph Volume = 69,557 cuft



Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	97	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2	% (maximum slope typical)	
Depth	0.233	ft	
n	0.035		

Numbers

flow area	22.7	ft^2
Slope Length	0.52	ft
wetted perimeter	98.0	ft
Hydraulic Radius	0.23	ft

Velocity/Flow

Velocity(v)=	2.3	ft/s	
Flow (Q)=	51.4	ft^3/s	10-yr predevelopment Section 2

Shear Stress

62.4	pcf	Unit weight of water
0.02	ft/ft	Channel Gradient
0.233	ft	Depth of Channel
T	**0.29 psf**	**Shear Stress**

Hydrograph Plot

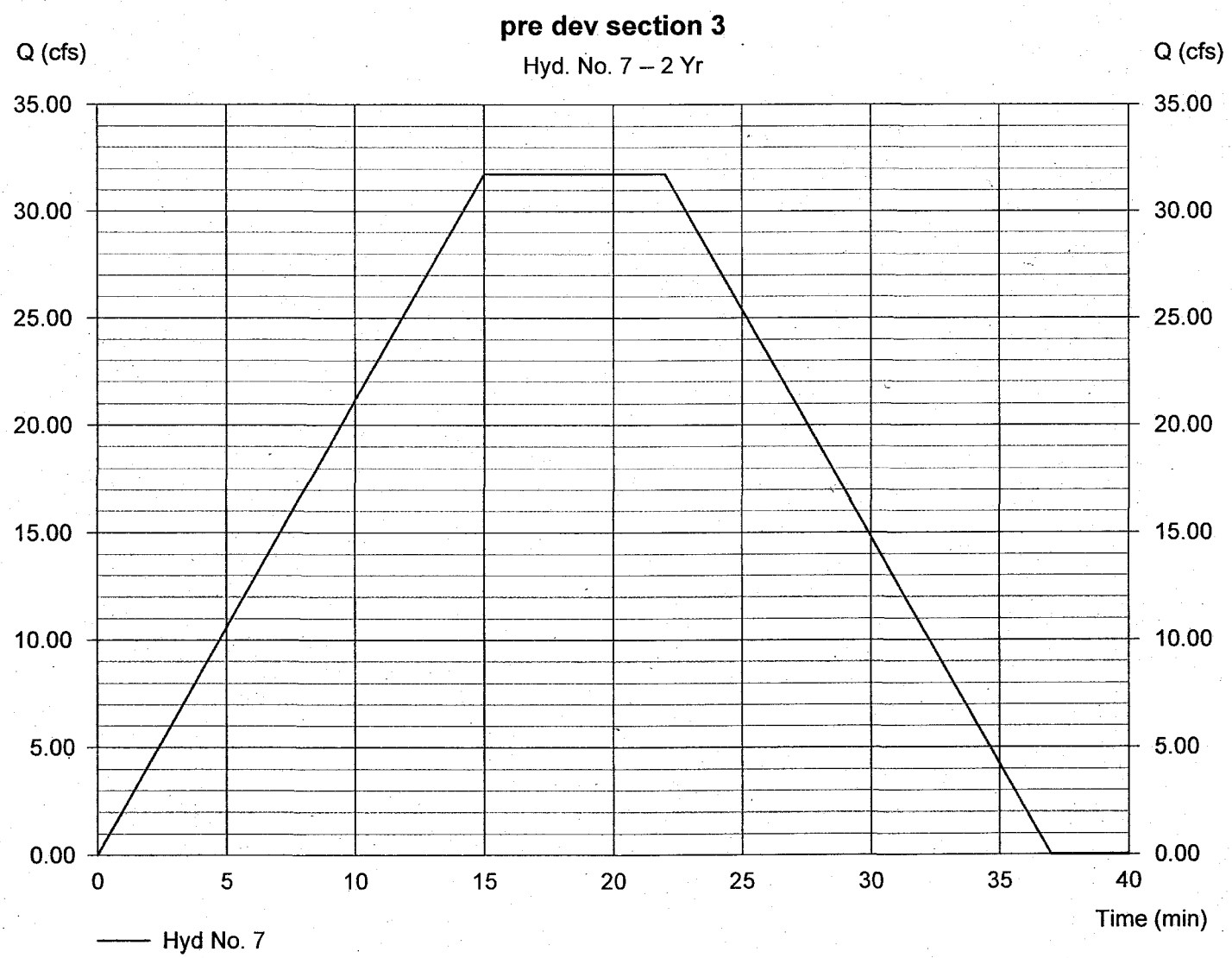
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:31 PM

Hyd. No. 7

pre dev section 3

Hydrograph type	= Mod. Rational	Peak discharge	= 31.76 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 24.740 ac	Runoff coeff.	= 0.42
Intensity	= 3.056 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 42,873 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

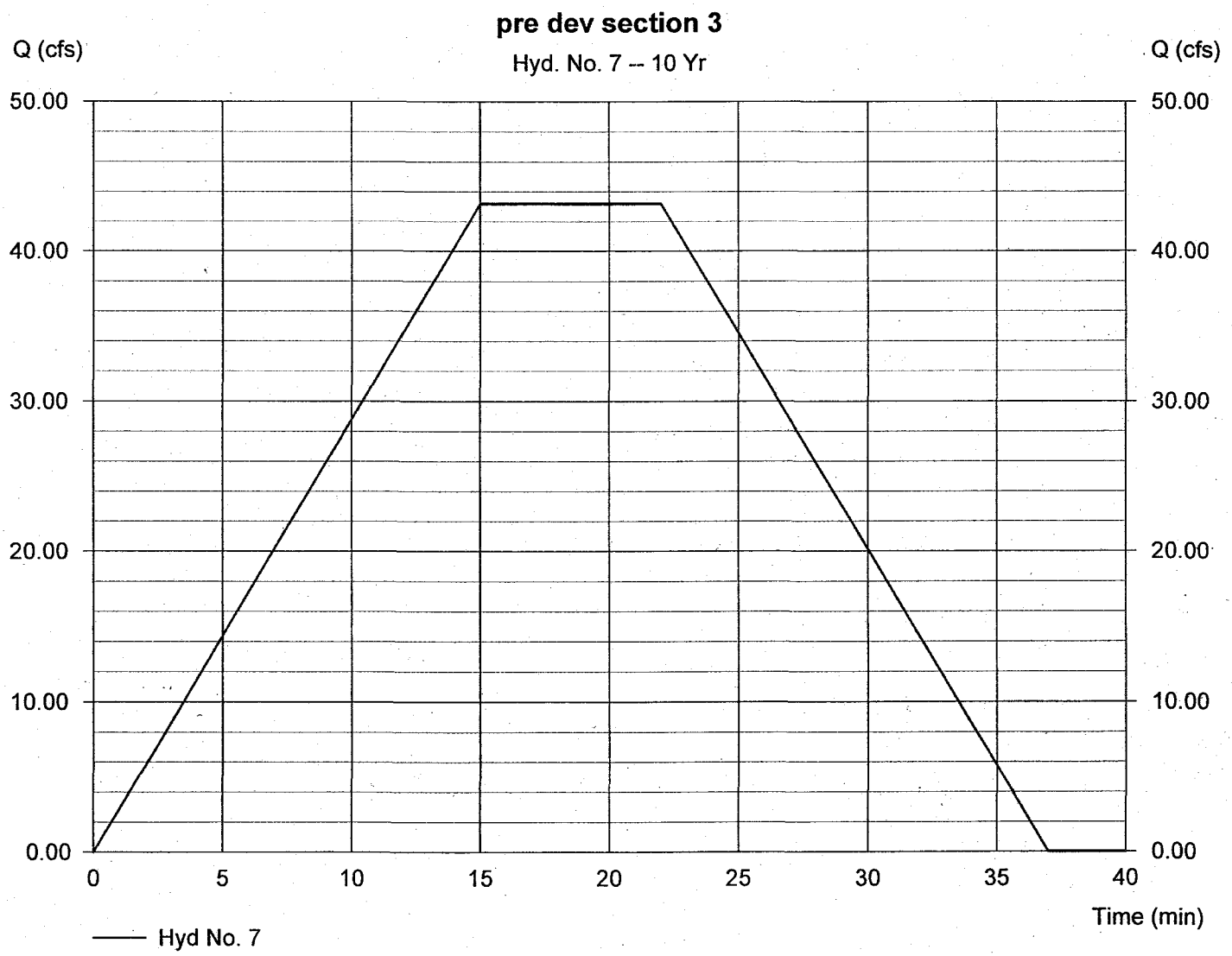
Friday, Nov 20 2009, 3:31 PM

Hyd. No. 7

pre dev section 3

Hydrograph type	= Mod. Rational	Peak discharge	= 43.18 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 24.740 ac	Runoff coeff.	= 0.42
Intensity	= 4.155 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 58,290 cuft



Hydrograph Plot

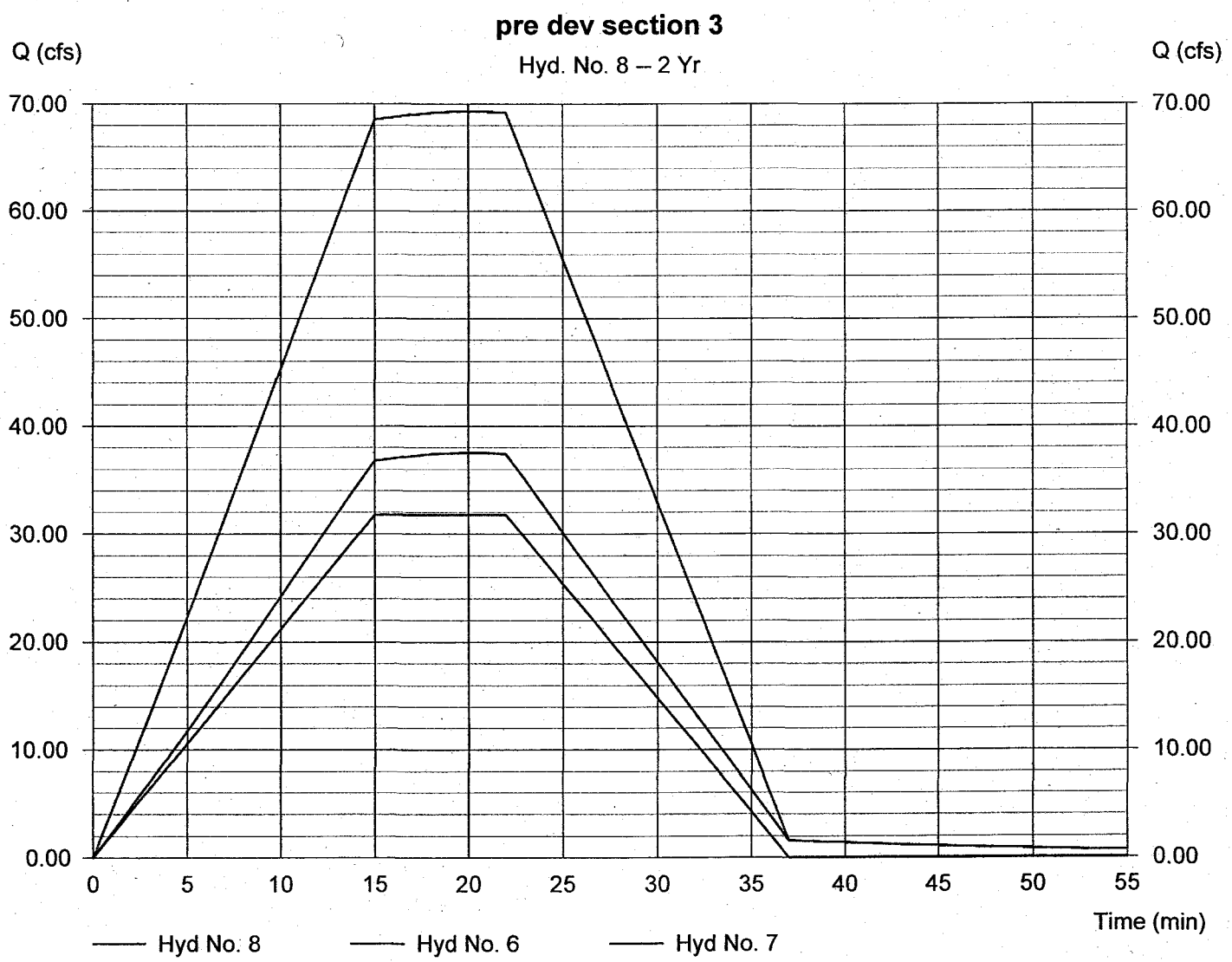
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:31 PM

Hyd. No. 8

pre dev section 3

Hydrograph type	= Combine	Peak discharge	= 69.31 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyds.	= 6, 7		

Hydrograph Volume = 93,213 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

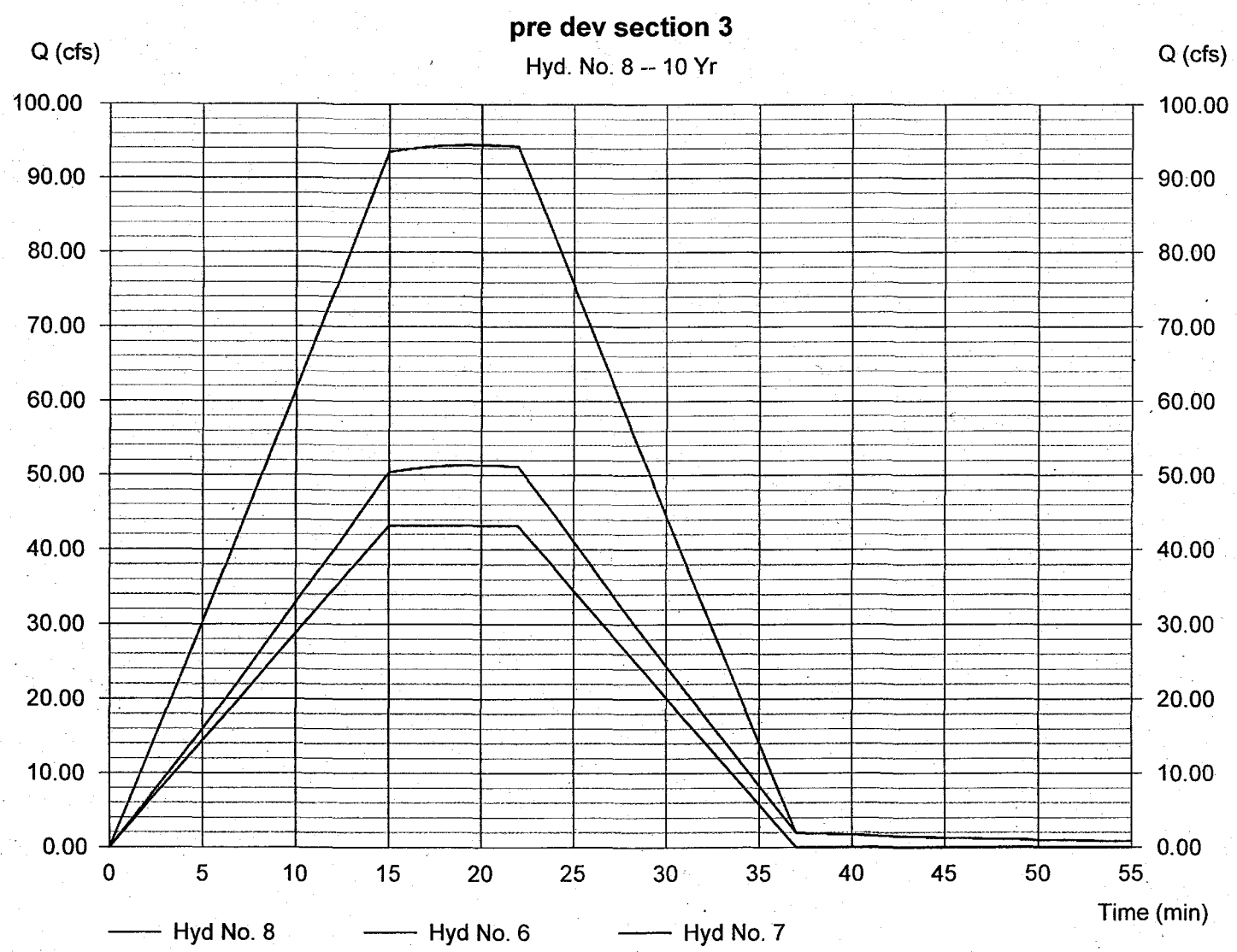
Friday, Nov 20 2009, 3:31 PM

Hyd. No. 8

pre dev section 3

Hydrograph type	= Combine	Peak discharge	= 94.52 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyds.	= 6, 7		

Hydrograph Volume = 126,551 cuft



Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	105	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2.5	% (maximum slope typical)	
Depth	0.25	ft	
n	0.035		

Numbers

flow area	26.4	ft^2
Slope Length	0.56	ft
wetted perimeter	106.1	ft
Hydraulic Radius	0.25	ft

Velocity/Flow

Velocity(v)=	2.7	ft/s
Flow (Q)=	70.0	ft^3/s

2 yr predevelopment section 3

Shear Stress

62.4	pcf	Unit weight of water
0.025	ft/ft	Channel Gradient
0.25	ft	Depth of Channel
T **0.39**	**psf**	**Shear Stress**

Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	105	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2	% (maximum slope typical)	
Depth	0.32	ft	
n	0.035		

Numbers

flow area	33.8	ft^2
Slope Length	0.72	ft
wetted perimeter	106.4	ft
Hydraulic Radius	0.32	ft

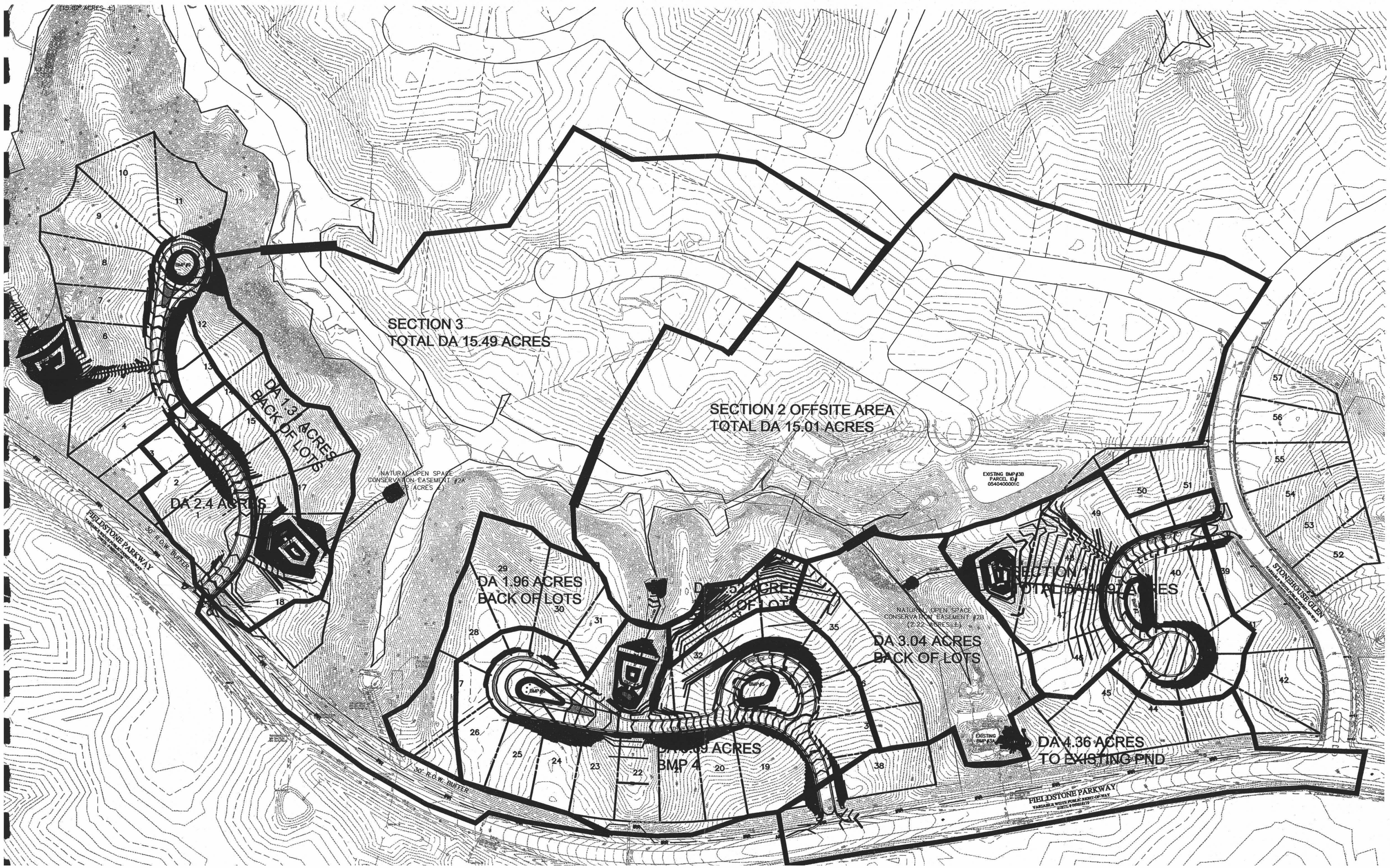
Velocity/Flow

Velocity(v)=	2.8	ft/s
Flow (Q)=	94.5	ft^3/s

2yr predevelopment section 3

Shear Stress

62.4	pcf	Unit weight of water
0.02	ft/ft	Channel Gradient
0.32	ft	Depth of Channel
T **0.40**	**psf**	**Shear Stress**


SECTION 3
TOTAL DA 15.49 ACRES
SECTION 2 OFFSITE AREA
TOTAL DA 15.01 ACRES
DA 1.31 ACRES
BACK OF LOTS
DA 2.4 ACRES
NATURAL OPEN SPACE
CONSERVATION EASEMENT #2A
(2.92 ACRES ±)
EXISTING BMP #3B
PARCEL ID # 0540400001C
DA 1.96 ACRES
BACK OF LOTS
DA 3.04 ACRES
BACK OF LOTS
NATURAL OPEN SPACE
CONSERVATION EASEMENT #2B
(2.22 ACRES ±)
BMP 4
DA 4.36 ACRES
TO EXISTING POND
EXISTING BMP #3A
FIELDSTONE PARKWAY
30' R.O.W. BUFFER
STONEHOUSE GLEN

Hydrograph Plot

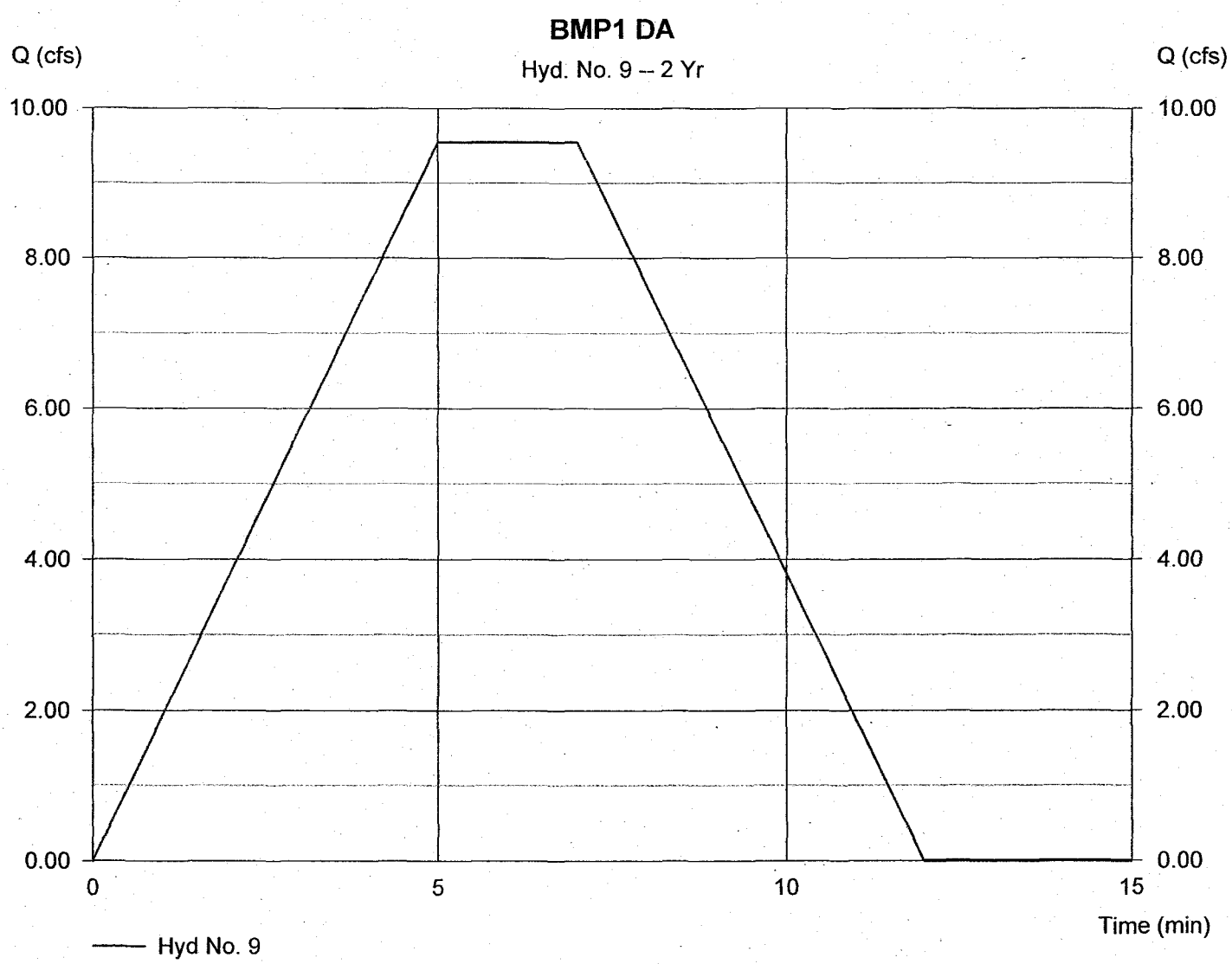
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:33 PM

Hyd. No. 9

BMP1 DA

Hydrograph type	= Mod. Rational	Peak discharge	= 9.55 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 3.630 ac	Runoff coeff.	= 0.52
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,297 cuft



Hydrograph Plot

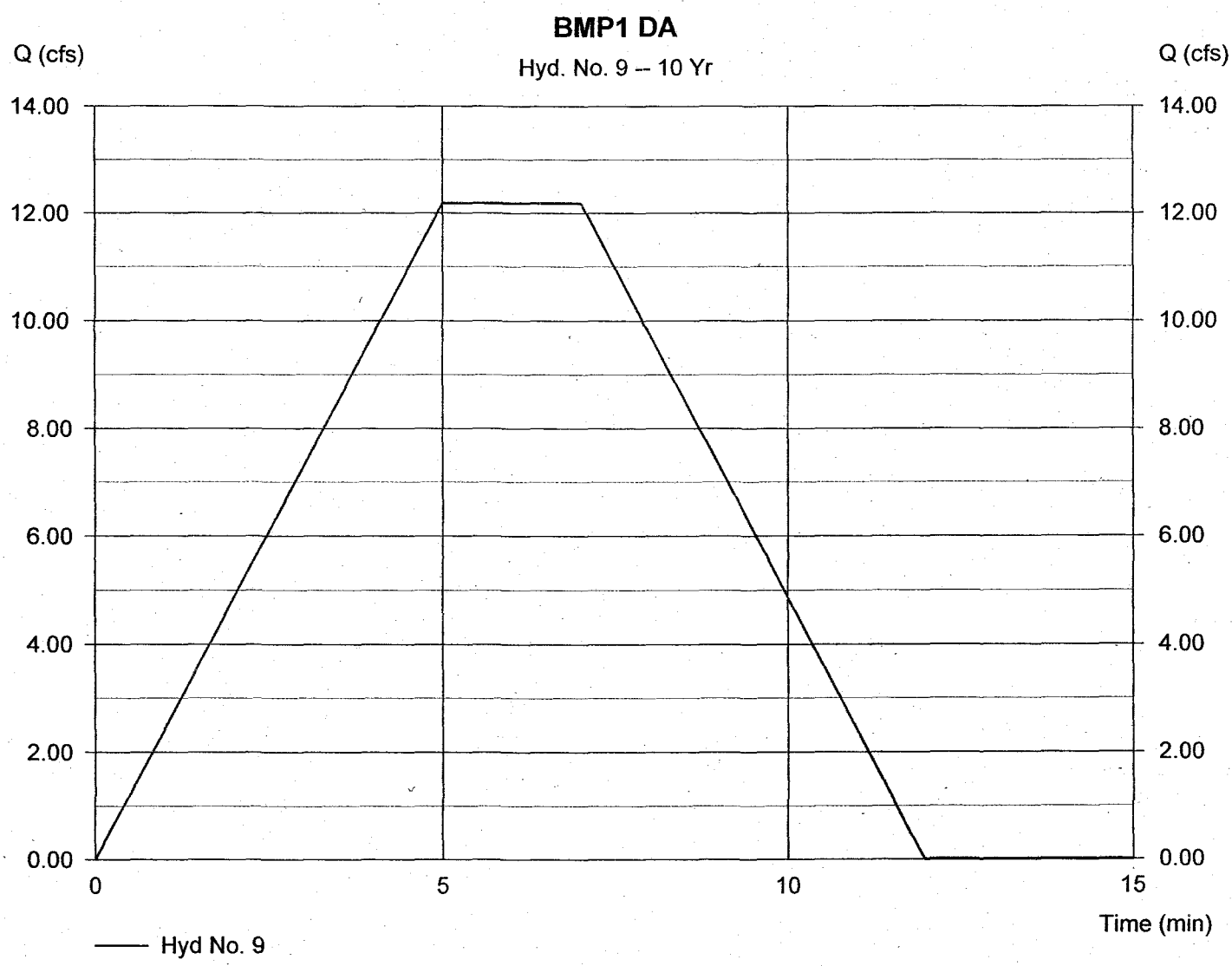
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:33 PM

Hyd. No. 9

BMP1 DA

Hydrograph type	= Mod. Rational	Peak discharge	= 12.19 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 3.630 ac	Runoff coeff.	= 0.52
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 5,484 cuft



Hydrograph Plot

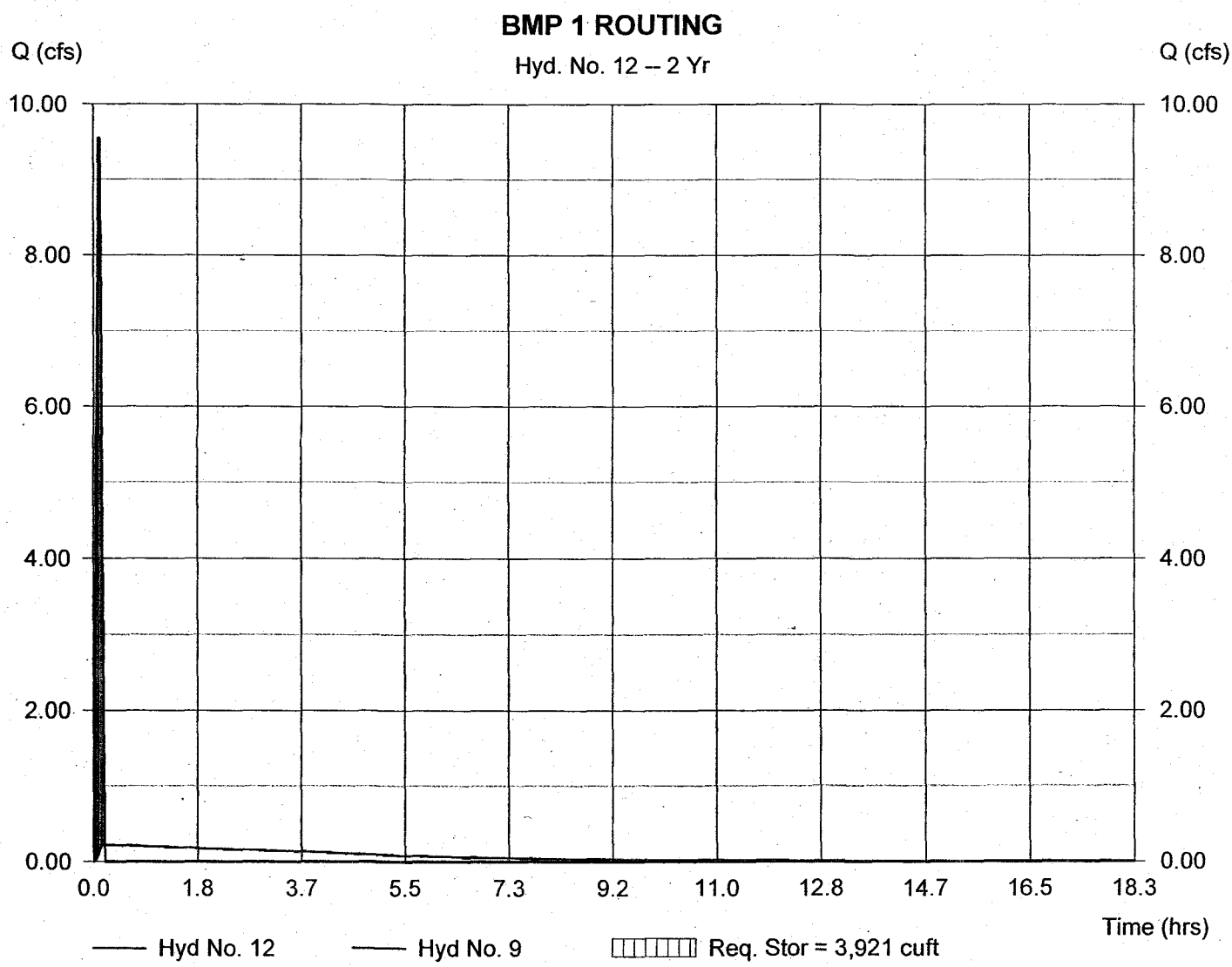
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 12

BMP 1 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.22 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 9	Max. Elevation	= 86.01 ft
Reservoir name	= BMP1	Max. Storage	= 3,921 cuft

Storage Indication method used. | Hydrograph Volume = 3,998 cuft



Hydrograph Plot

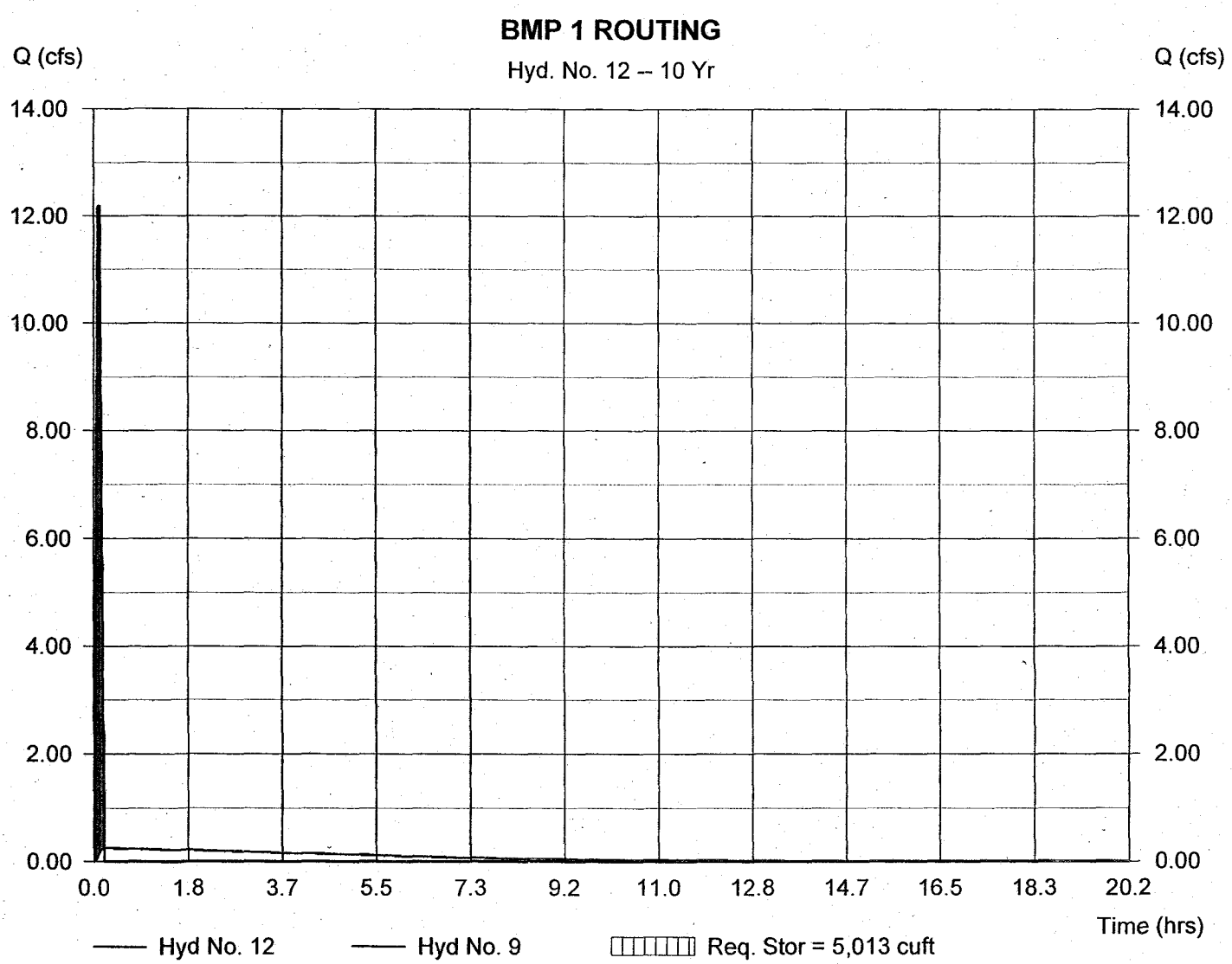
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 12

BMP 1 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.25 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 9	Max. Elevation	= 86.29 ft
Reservoir name	= BMP1	Max. Storage	= 5,013 cuft

Storage Indication method used. | Hydrograph Volume = 5,105 cuft



Hydrograph Plot

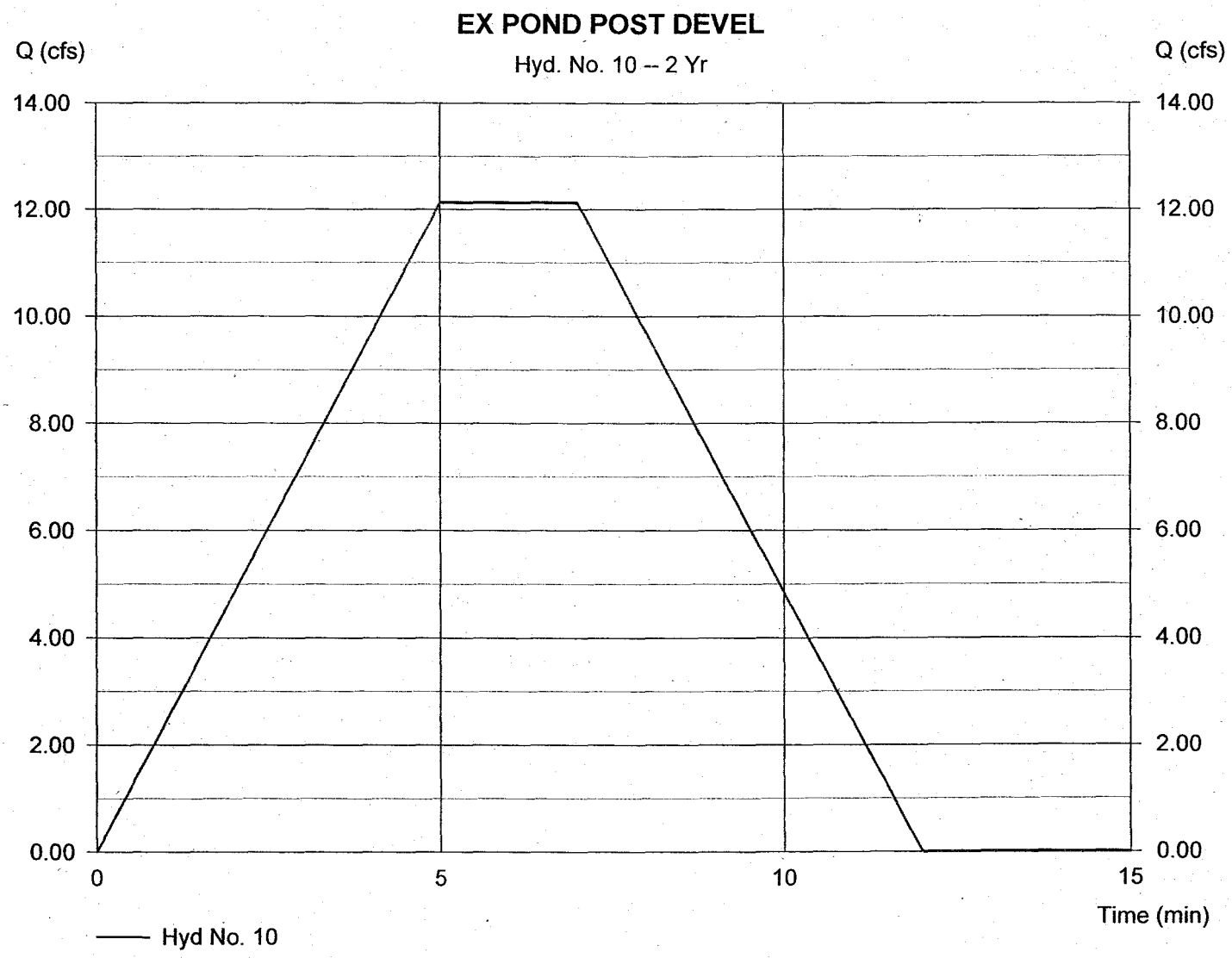
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 10

EX POND POST DEVEL

Hydrograph type	= Mod. Rational	Peak discharge	= 12.13 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 4.360 ac	Runoff coeff.	= 0.55
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 5,459 cuft



Hydrograph Plot

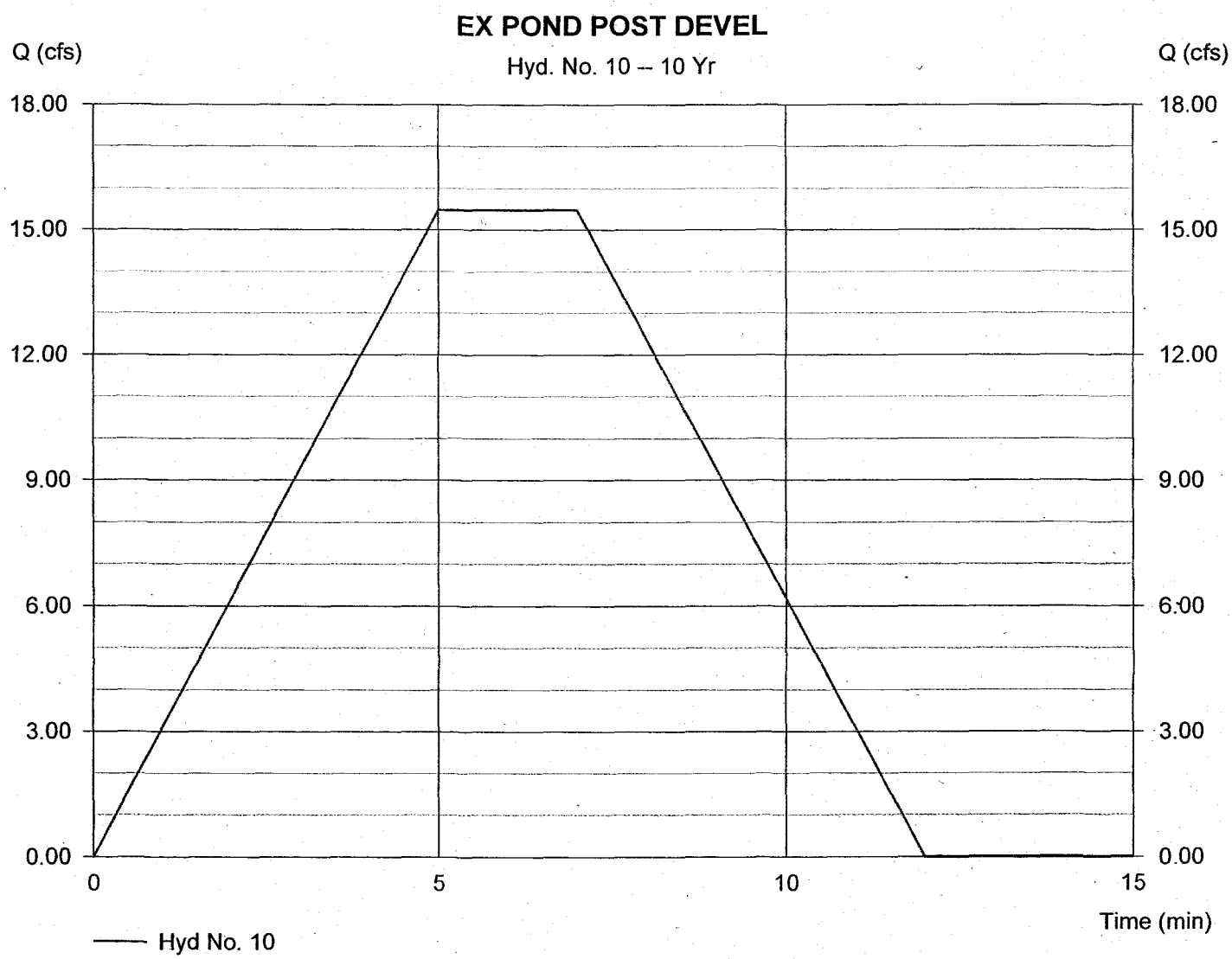
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 10

EX POND POST DEVEL

Hydrograph type	= Mod. Rational	Peak discharge	= 15.48 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 4.360 ac	Runoff coeff.	= 0.55
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 6,967 cuft



Hydrograph Plot

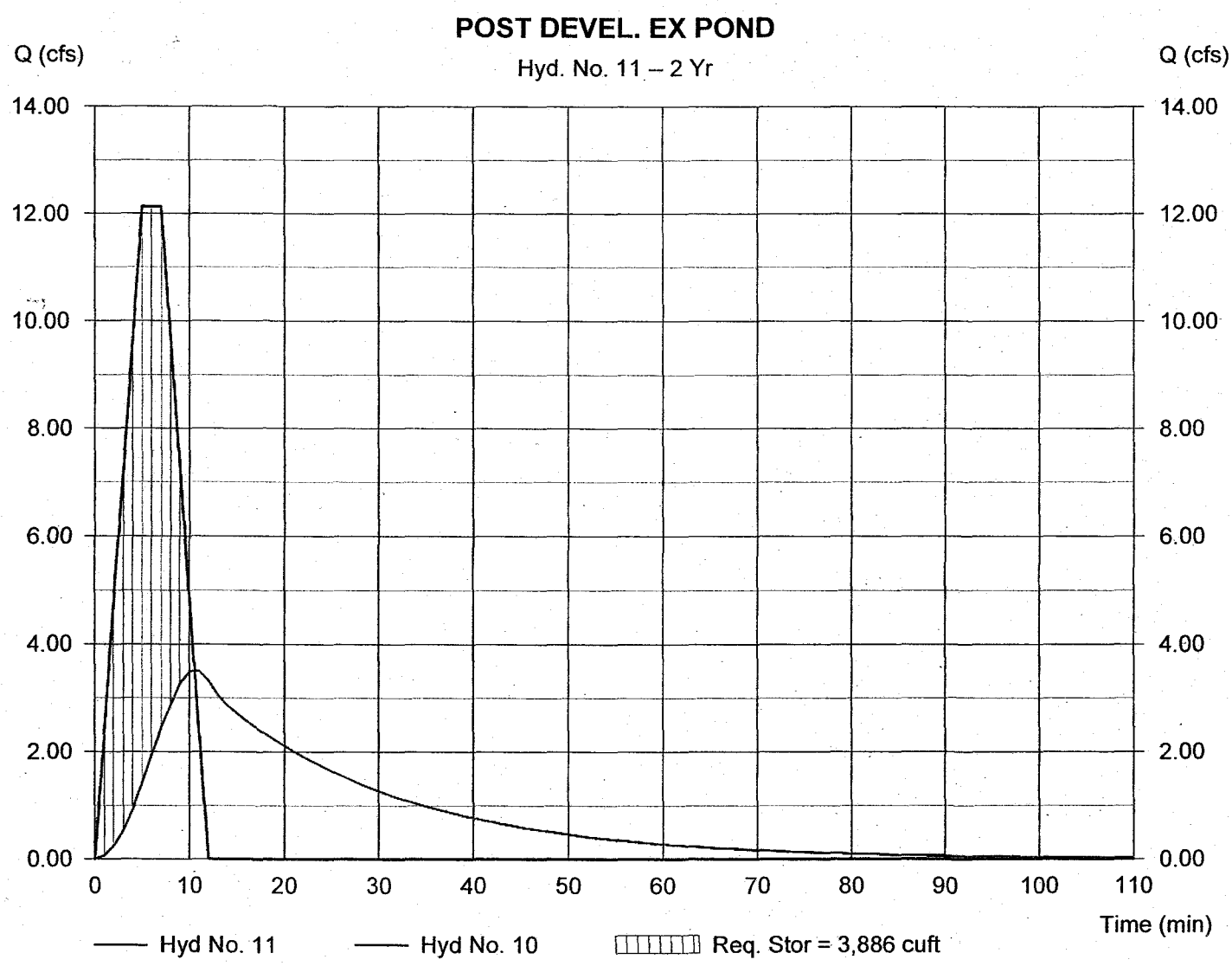
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 11

POST DEVEL. EX POND

Hydrograph type	= Reservoir	Peak discharge	= 3.50 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 10	Max. Elevation	= 73.89 ft
Reservoir name	= EXISTING BMP	Max. Storage	= 3,886 cuft

Storage Indication method used. | Hydrograph Volume = 5,094 cuft



Hydrograph Plot

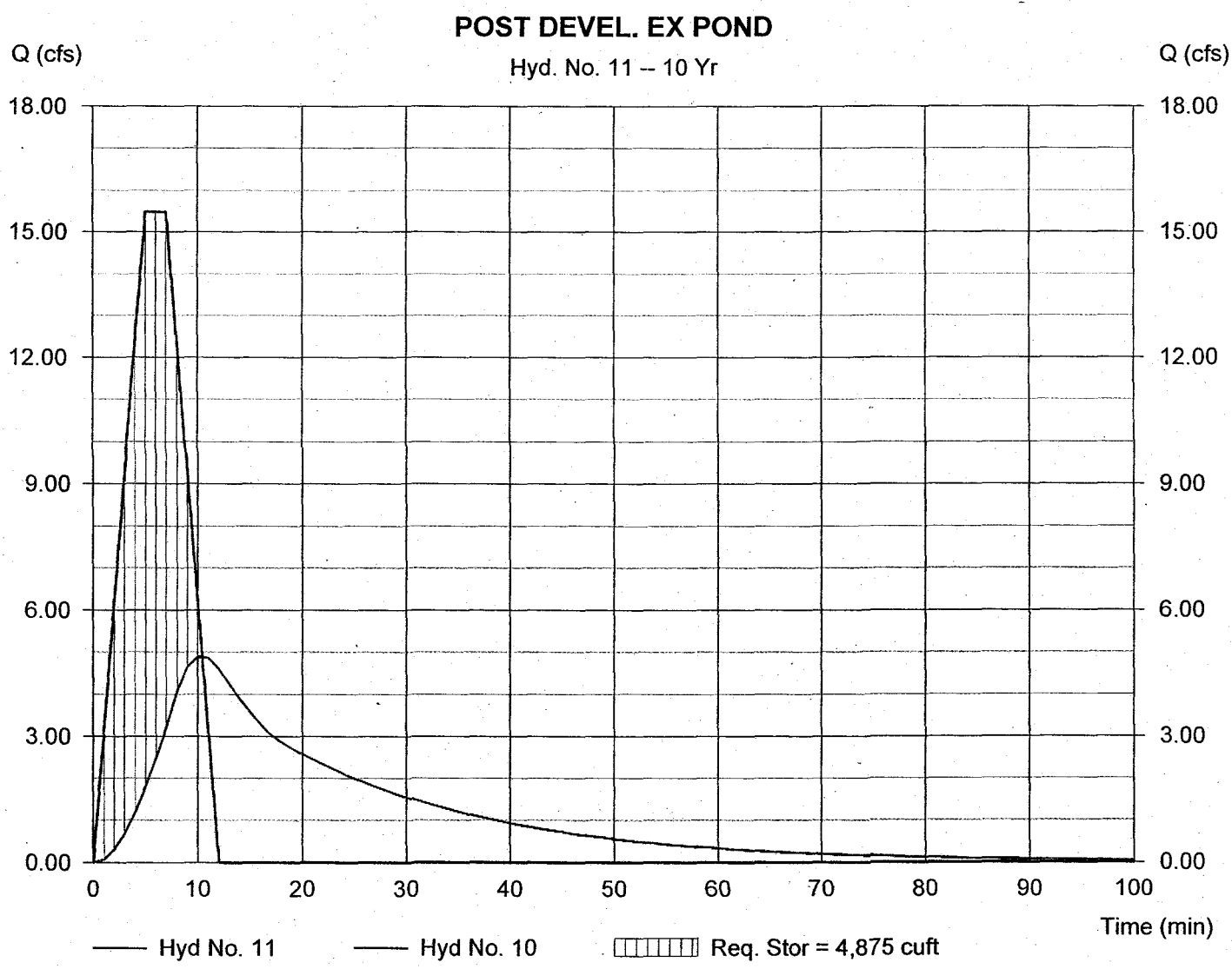
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 11

POST DEVEL. EX POND

Hydrograph type	= Reservoir	Peak discharge	= 4.89 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 10	Max. Elevation	= 74.12 ft
Reservoir name	= EXISTING BMP	Max. Storage	= 4,875 cuft

Storage Indication method used. | Hydrograph Volume = 6,501 cuft



Hydrograph Plot

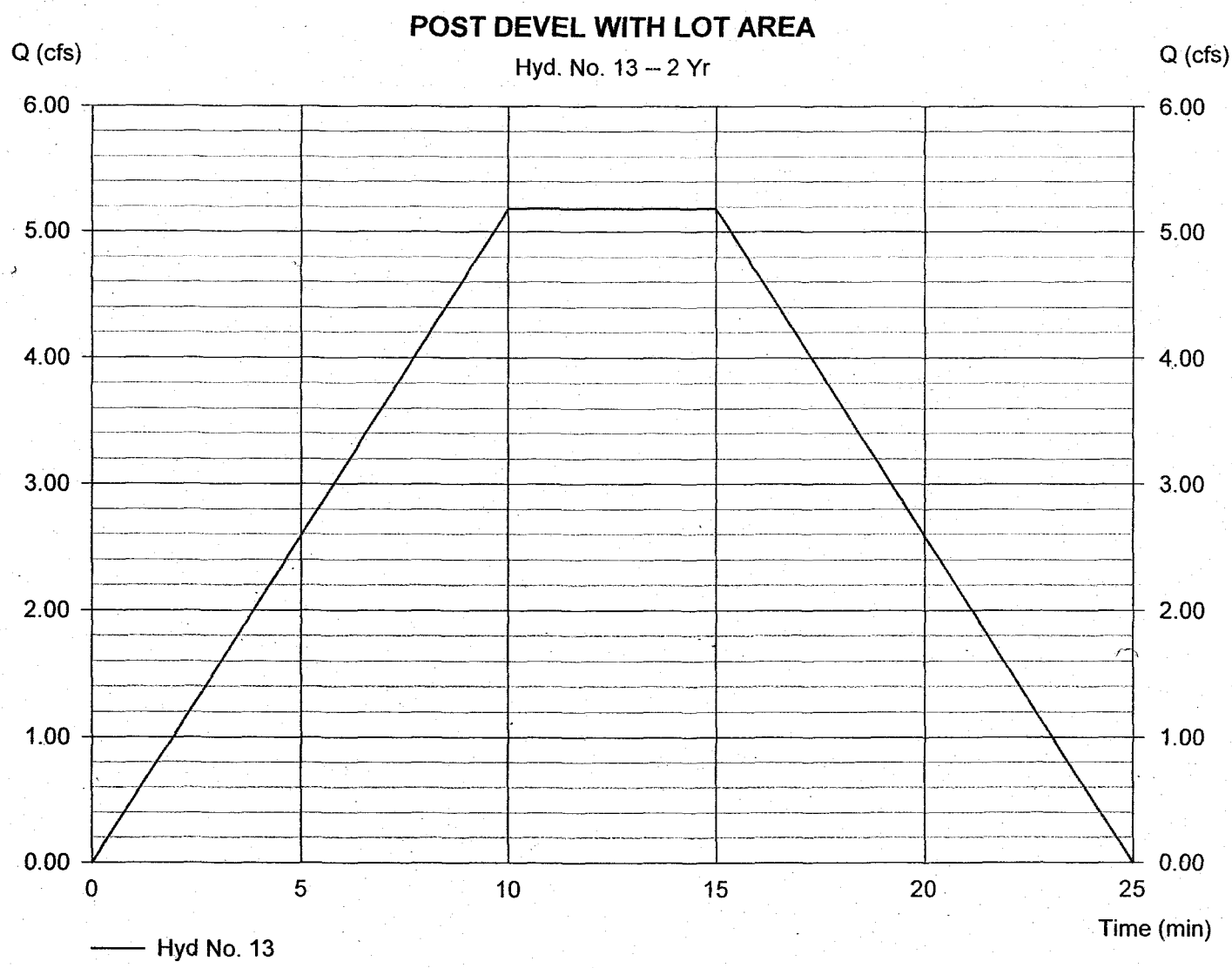
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 13

POST DEVEL WITH LOT AREA

Hydrograph type	= Mod. Rational	Peak discharge	= 5.18 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 3.040 ac	Runoff coeff.	= 0.45
Intensity	= 3.788 in/hr	Tc by User	= 10.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,664 cuft



Hydrograph Plot

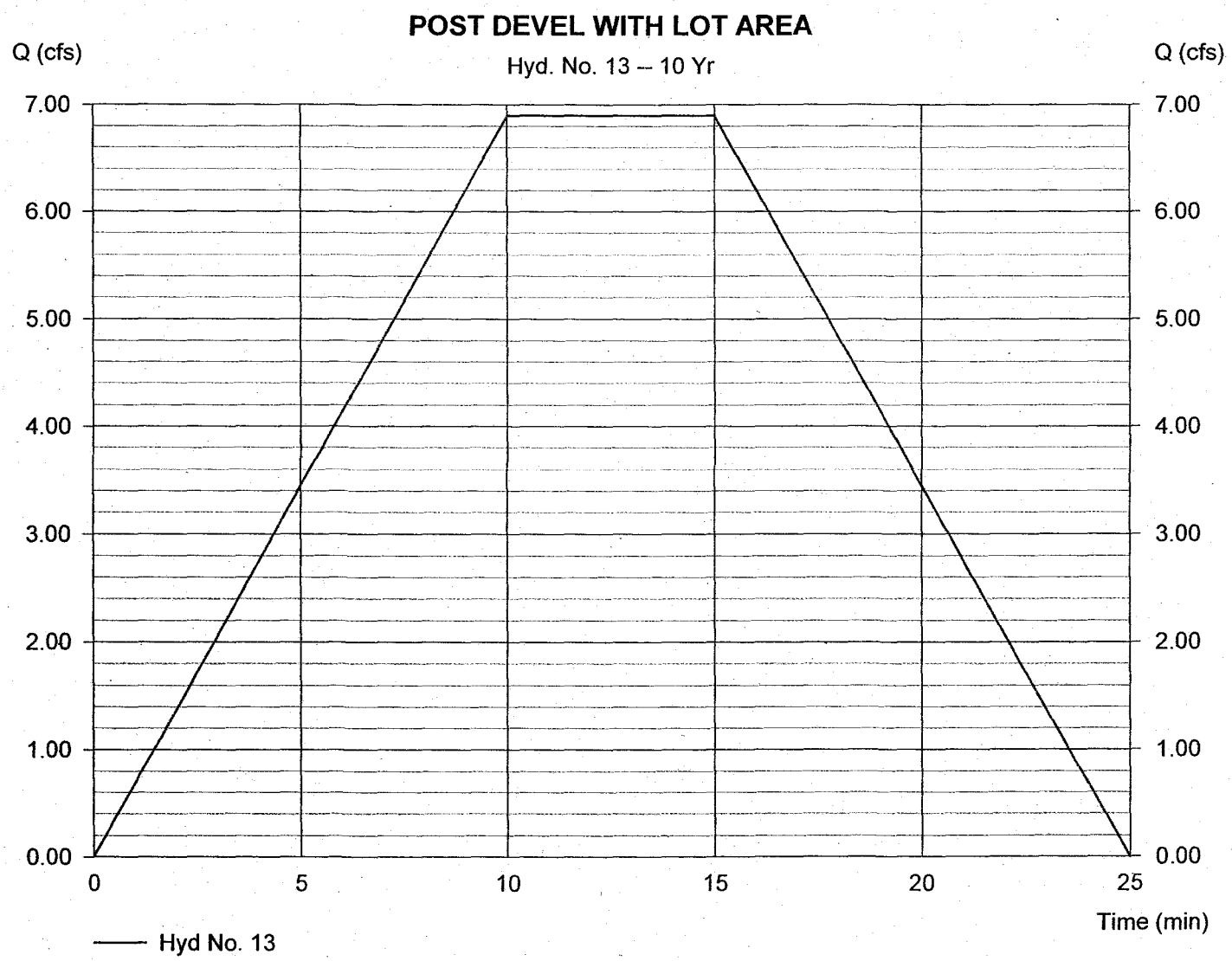
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 13

POST DEVEL WITH LOT AREA

Hydrograph type	= Mod. Rational	Peak discharge	= 6.90 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 3.040 ac	Runoff coeff.	= 0.45
Intensity	= 5.043 in/hr	Tc by User	= 10.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 6,209 cuft



Hydrograph Plot

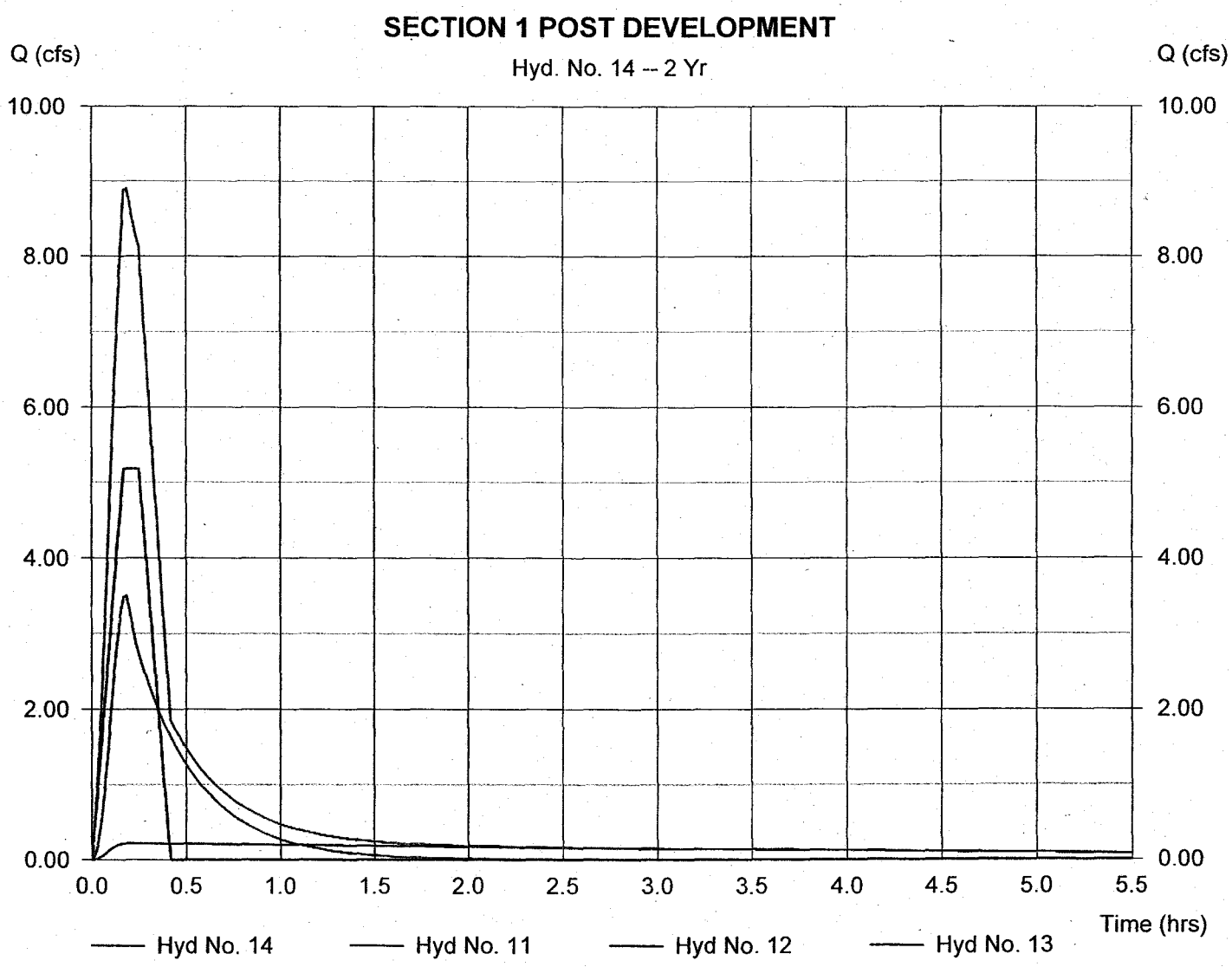
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:34 PM

Hyd. No. 14

SECTION 1 POST DEVELOPMENT

Hydrograph type	= Combine	Peak discharge	= 8.91 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyds.	= 11, 12, 13		

Hydrograph Volume = 13,756 cuft



Hydrograph Plot

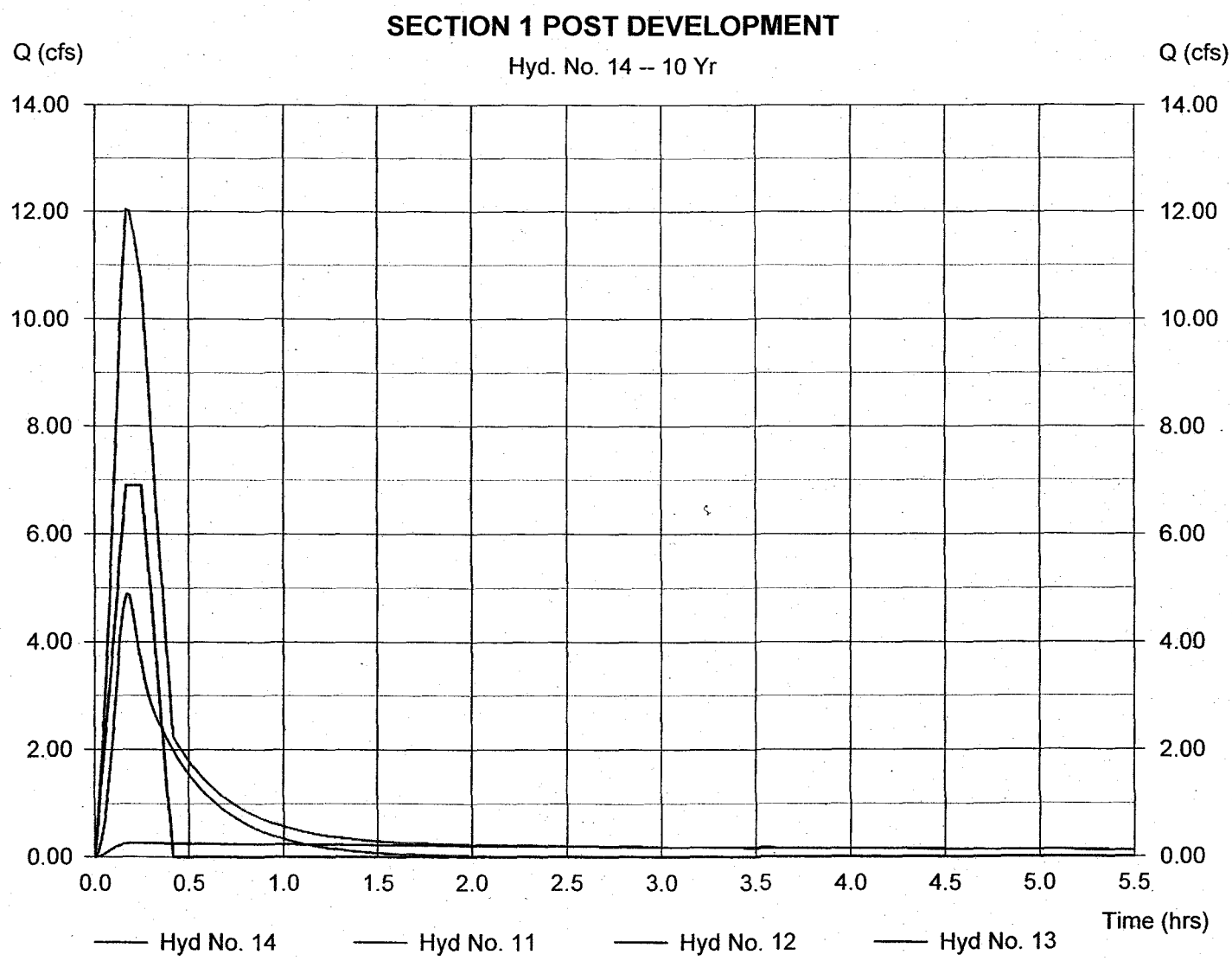
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:35 PM

Hyd. No. 14

SECTION 1 POST DEVELOPMENT

Hydrograph type	= Combine	Peak discharge	= 12.03 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyds.	= 11, 12, 13		

Hydrograph Volume = 17,815 cuft



Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	16	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2	% (maximum slope typical)	
Depth	0.234	ft	
n	0.035		

Numbers

flow area	3.9	ft^2
Slope Length	0.52	ft
wetted perimeter	17.0	ft
Hydraulic Radius	0.23	ft

Velocity/Flow

Velocity(v)=	2.2	ft/s	Below erosive velocity
Flow (Q)=	8.6	ft^3/s	2-year post Dev Section 1

Shear Stress

	62.4	pcf	Unit weight of water
	0.02	ft/ft	Channel Gradient
	0.234	ft	Depth of Channel
T	**0.29**	**psf**	**Shear Stress**

Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	97	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2.5	% (maximum slope typical)	
Depth	0.18	ft	
n	0.035		

Numbers

flow area	17.5	ft^2
Slope Length	0.40	ft
wetted perimeter	97.8	ft
Hydraulic Radius	0.18	ft

Velocity/Flow

Velocity(v)=	2.1	ft/s	
Flow (Q)=	37.4	ft^3/s	2-year predevelopment section 2

Shear Stress

	62.4 pcf	Unit weight of water
	0.025 ft/ft	Channel Gradient
	0.18 ft	Depth of Channel
T	**0.28 psf**	**Shear Stress**

Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	16	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2	% (maximum slope typical)	
Depth	0.288	ft	-sufficient capacity
n	0.035		

Numbers

flow area	4.8	ft^2
Slope Length	0.64	ft
wetted perimeter	17.3	ft
Hydraulic Radius	0.28	ft

Velocity/Flow

Velocity(v)=	2.5	ft/s	
Flow (Q)=	12.1	ft^3/s	10-year post development Section 2

Shear Stress

	62.4	pcf	Unit weight of water
	0.02	ft/ft	Channel Gradient
	0.288	ft	Depth of Channel
T	**0.36**	**psf**	**Shear Stress**

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

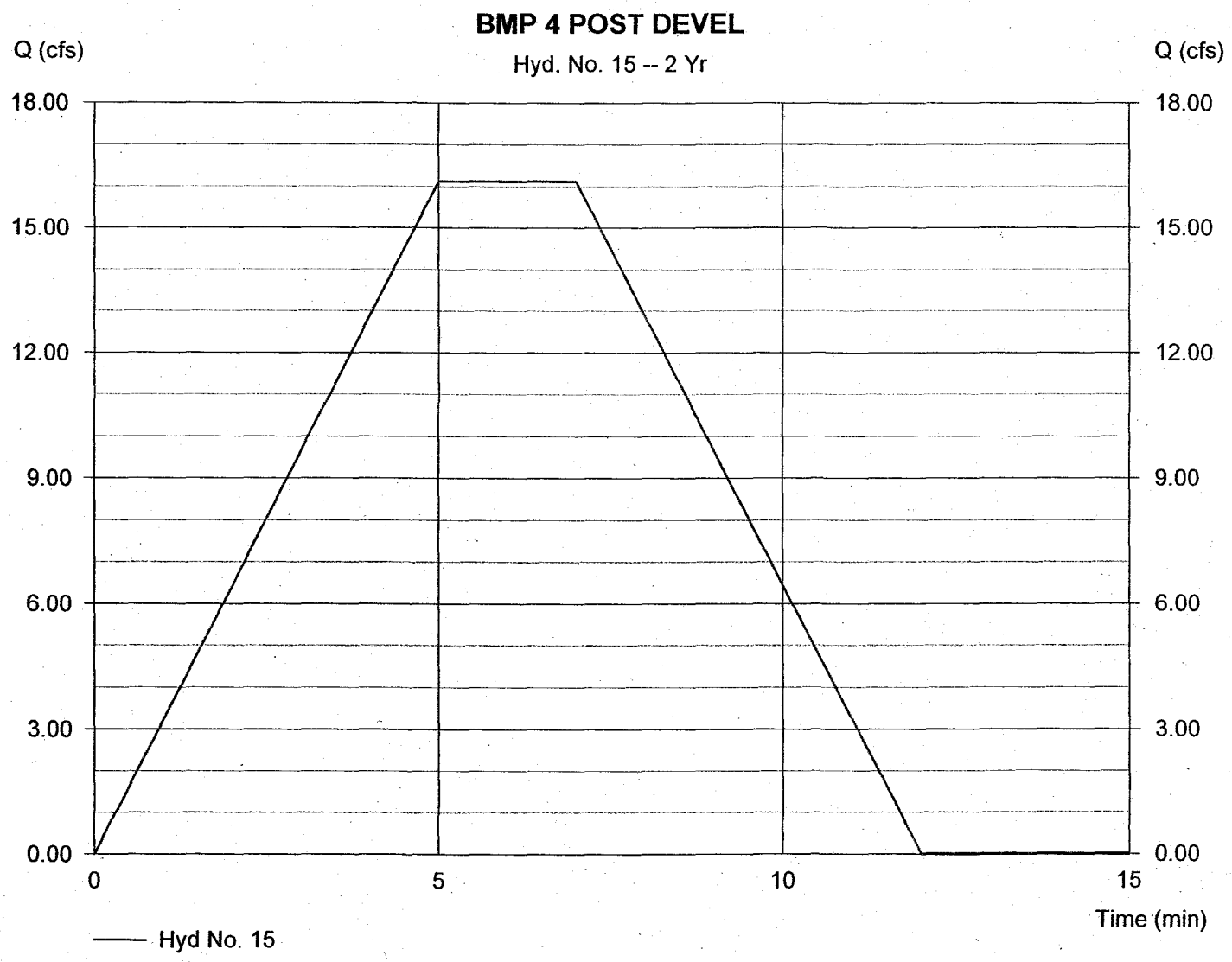
Friday, Nov 20 2009, 3:36 PM

Hyd. No. 15

BMP 4 POST DEVEL

Hydrograph type	= Mod. Rational	Peak discharge	= 16.12 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 5.690 ac	Runoff coeff.	= 0.56
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 7,254 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

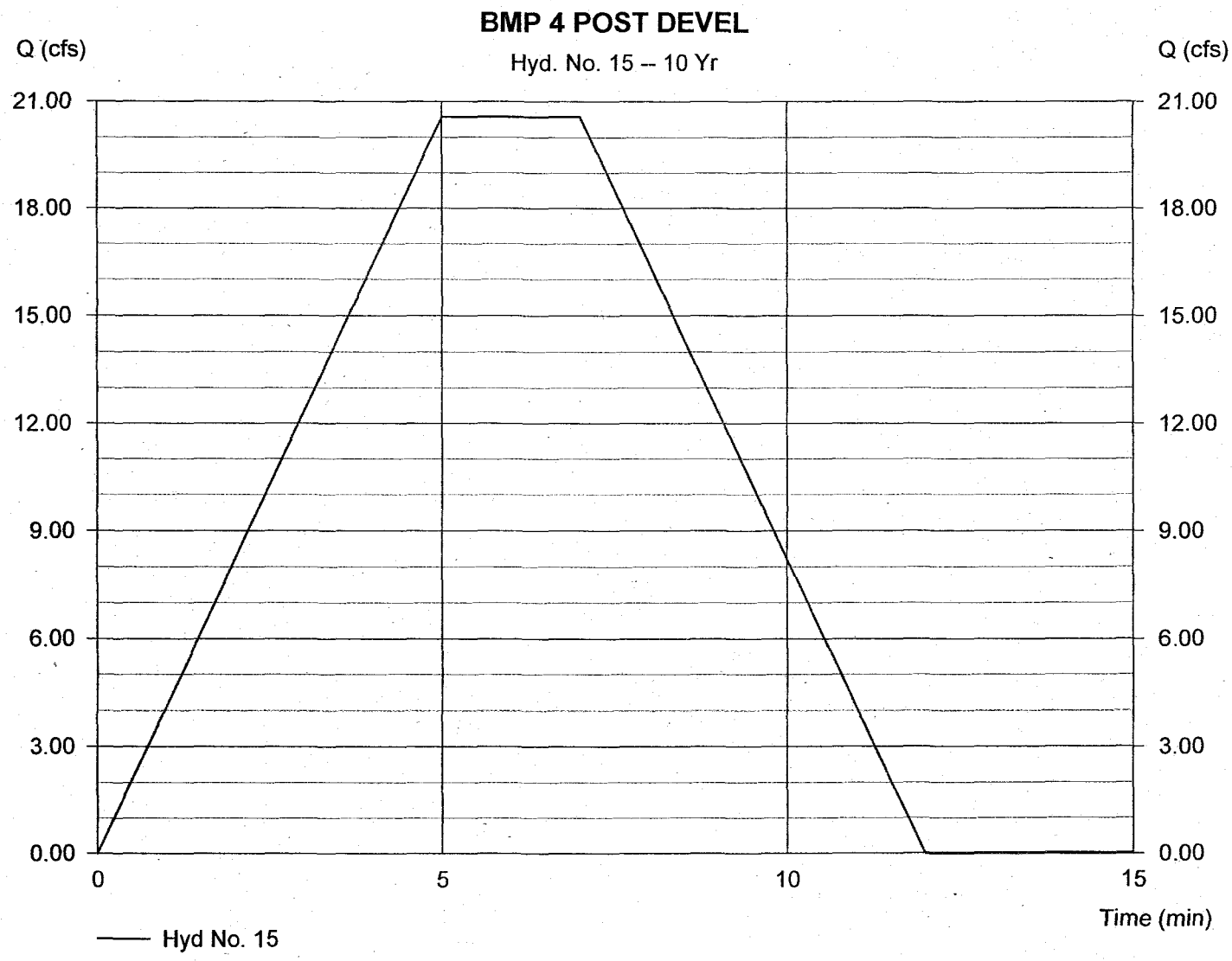
Friday, Nov 20 2009, 3:36 PM

Hyd. No. 15

BMP 4 POST DEVEL

Hydrograph type	= Mod. Rational	Peak discharge	= 20.57 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 5.690 ac	Runoff coeff.	= 0.56
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 9,257 cuft



Hydrograph Plot

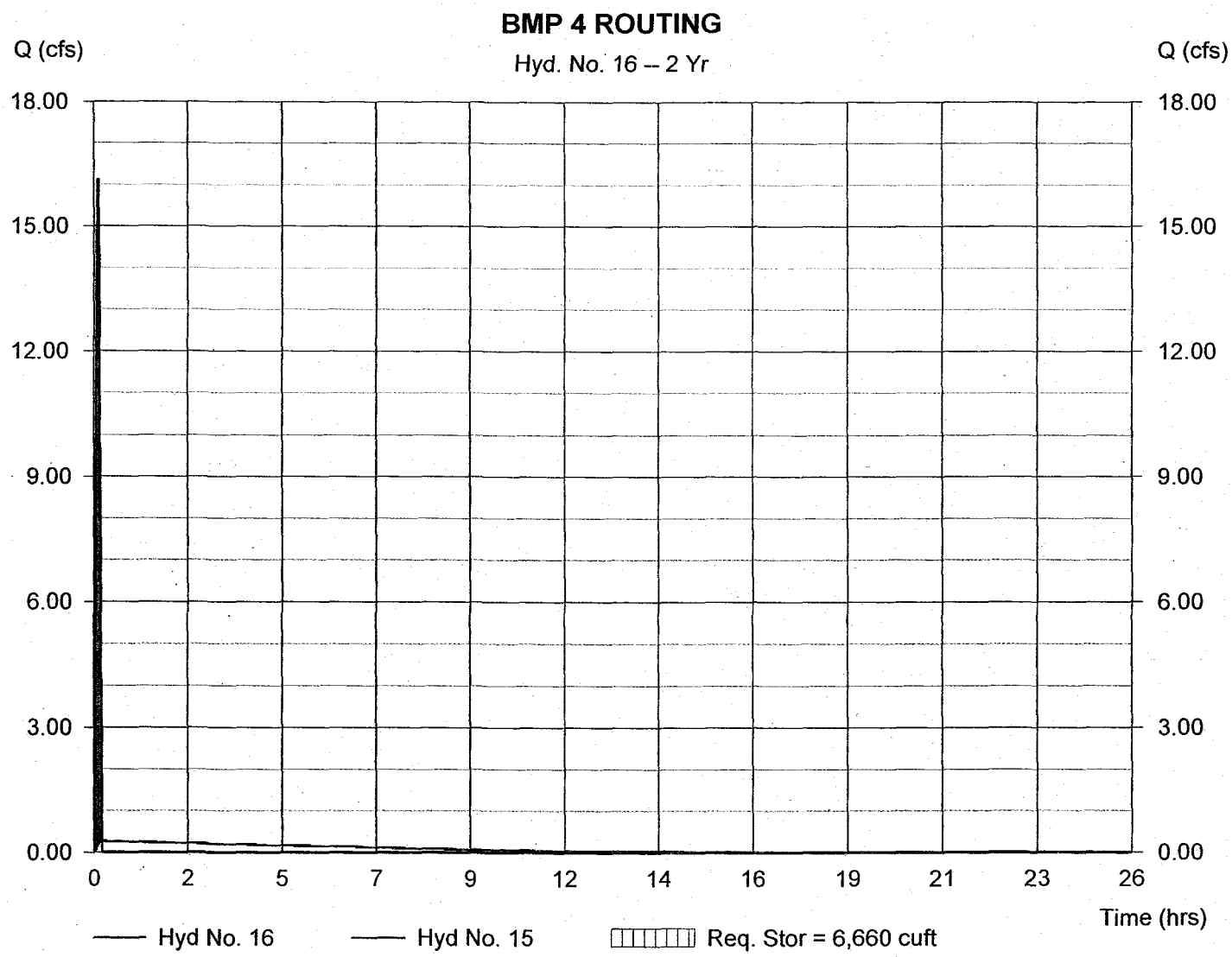
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:36 PM

Hyd. No. 16

BMP 4 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.27 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 15	Max. Elevation	= 75.39 ft
Reservoir name	= BMP4	Max. Storage	= 6,660 cuft

Storage Indication method used. | Hydrograph Volume = 6,754 cuft



Hydrograph Plot

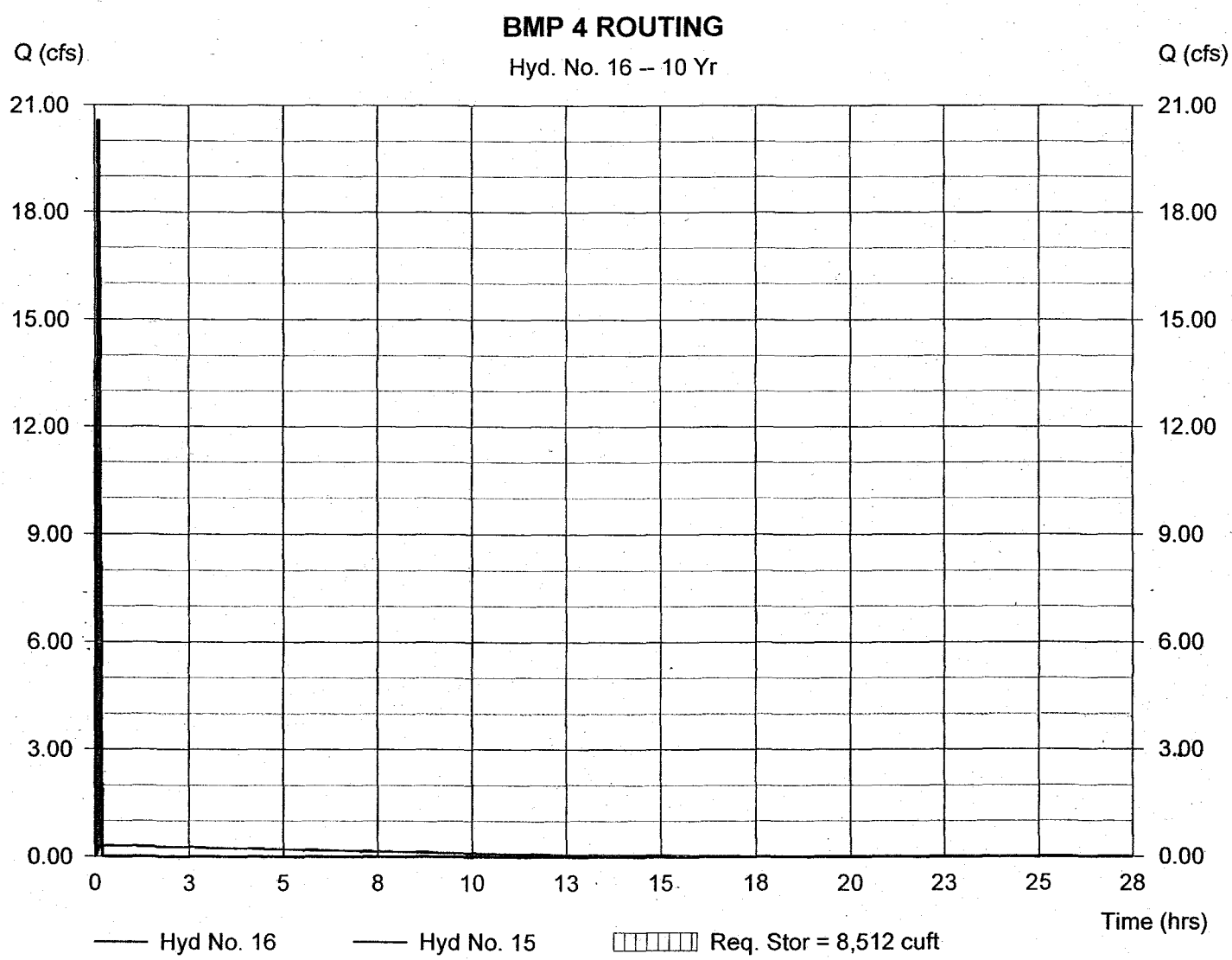
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:36 PM

Hyd. No. 16

BMP 4 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.30 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 15	Max. Elevation	= 75.78 ft
Reservoir name	= BMP4	Max. Storage	= 8,512 cuft

Storage Indication method used. | Hydrograph Volume = 8,624 cuft



Hydrograph Plot

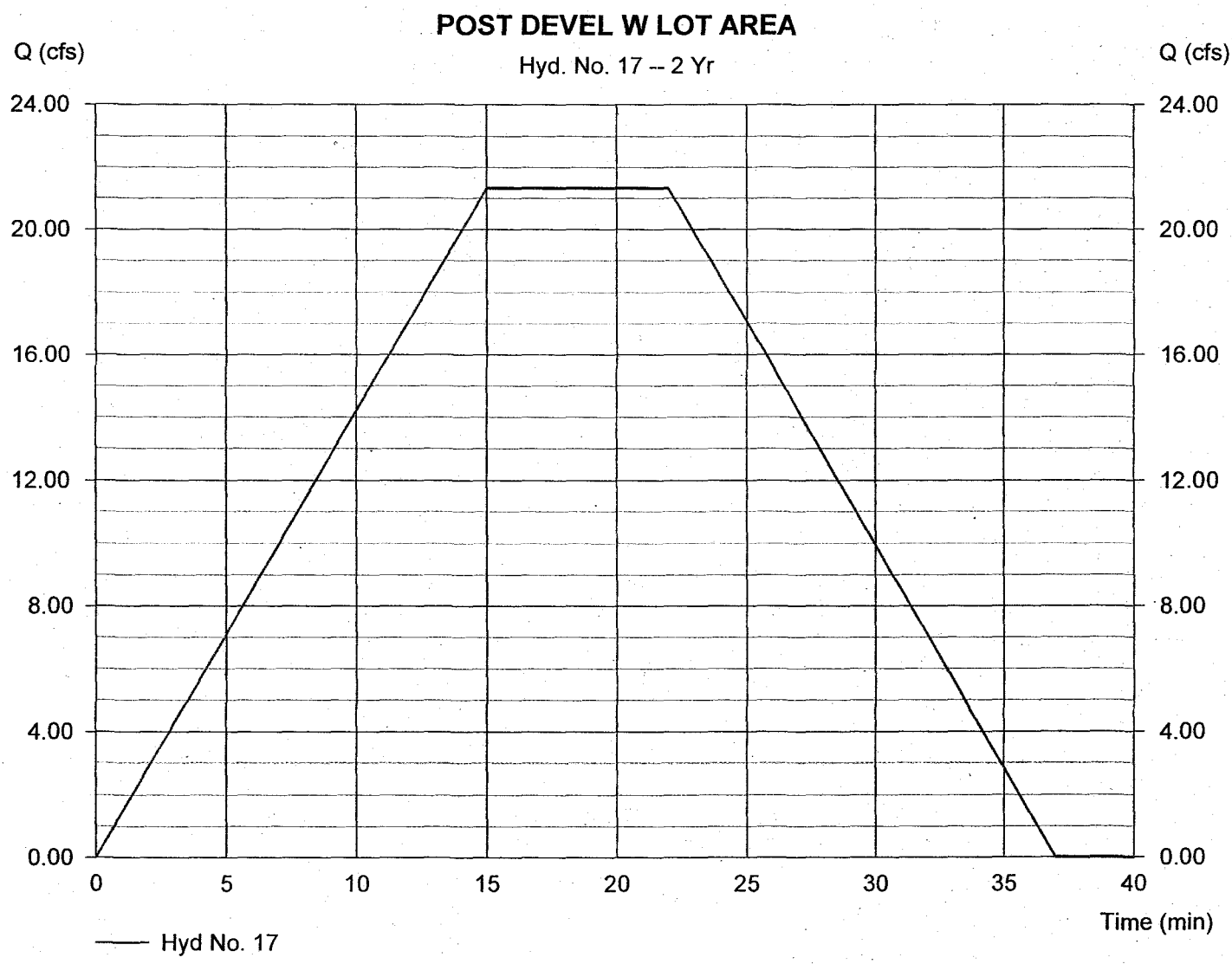
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:36 PM

Hyd. No. 17

POST DEVEL W LOT AREA

Hydrograph type	= Mod. Rational	Peak discharge	= 21.33 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 15.510 ac	Runoff coeff.	= 0.45
Intensity	= 3.056 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 28,798 cuft



Hydrograph Plot

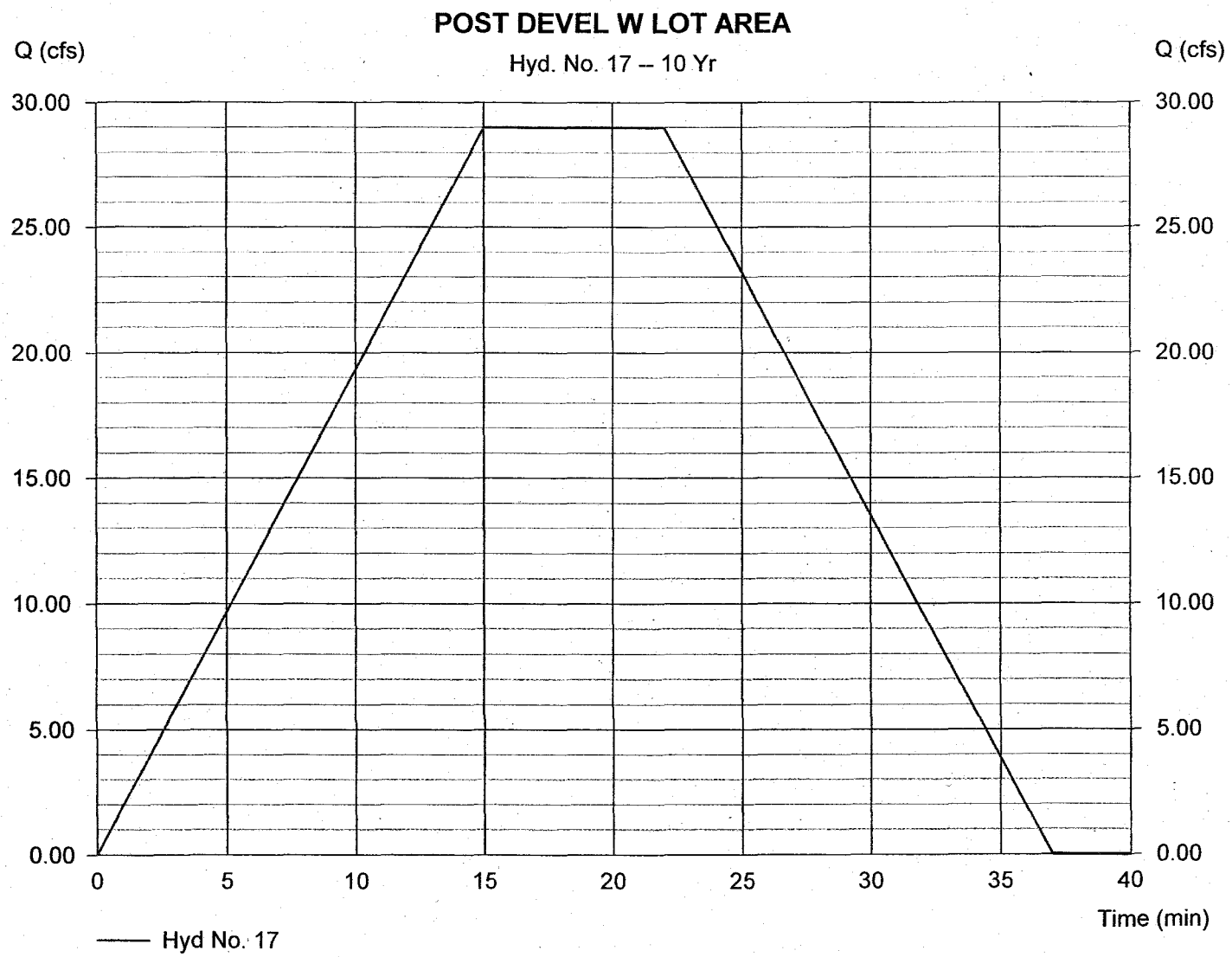
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:36 PM

Hyd. No. 17

POST DEVEL W LOT AREA

Hydrograph type	= Mod. Rational	Peak discharge	= 29.00 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 15.510 ac	Runoff coeff.	= 0.45
Intensity	= 4.155 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 39,153 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:36 PM

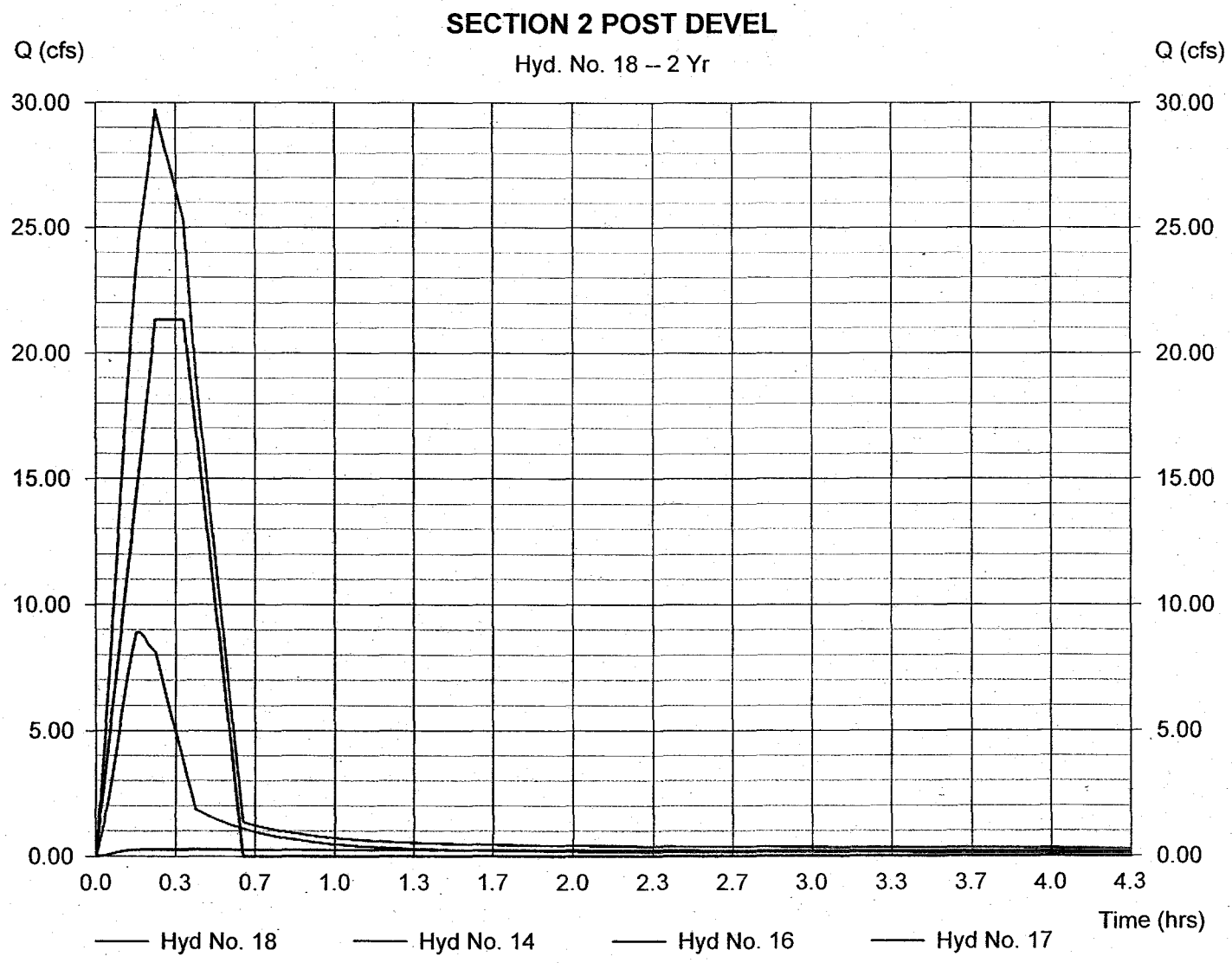
Hyd. No. 18

SECTION 2 POST DEVEL

Hydrograph type = Combine
Storm frequency = 2 yrs
Inflow hyds. = 14, 16, 17

Peak discharge = 29.72 cfs
Time interval = 1 min

Hydrograph Volume = 48,668 cuft



Hydrograph Plot

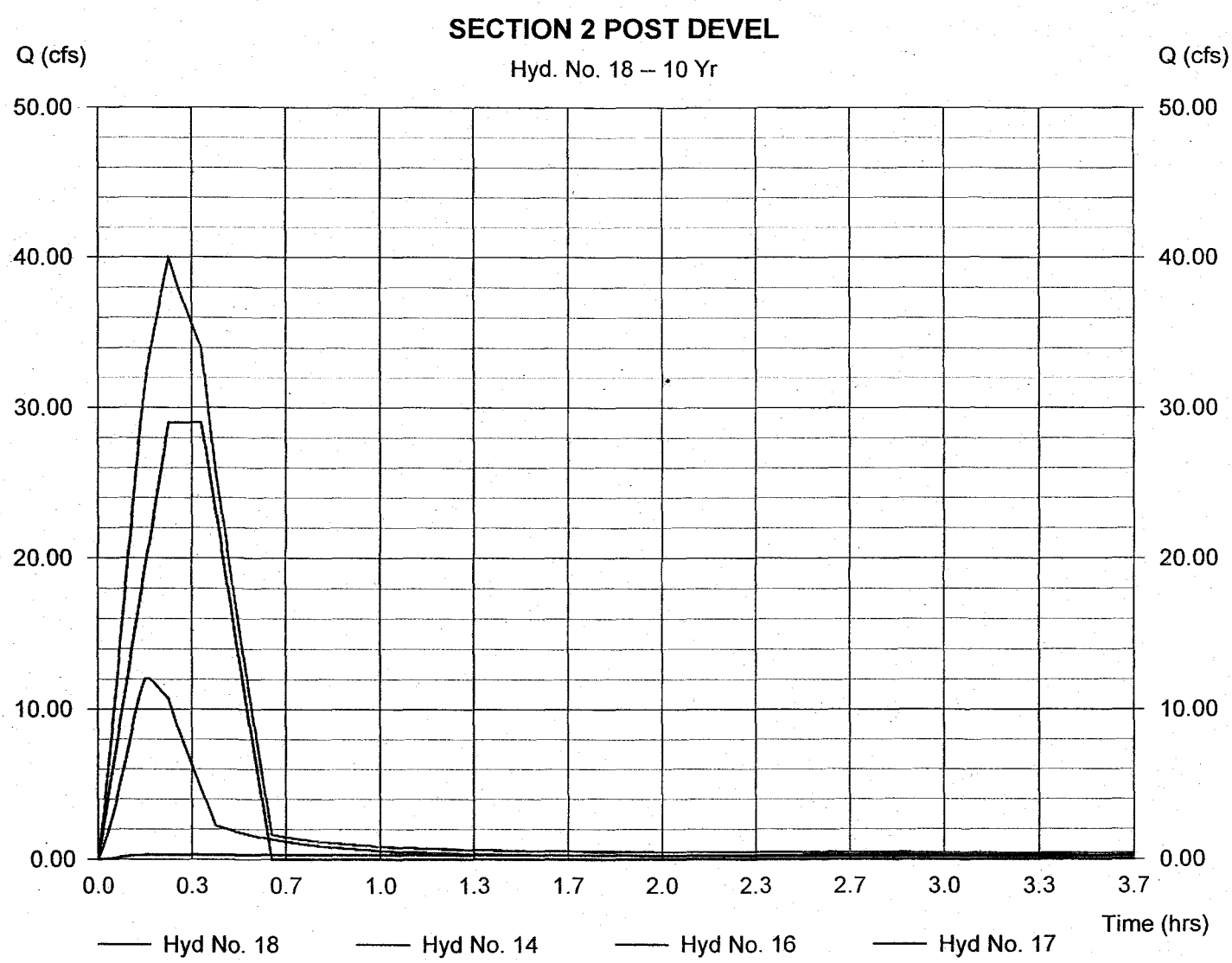
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:37 PM

Hyd. No. 18

SECTION 2 POST DEVEL

Hydrograph type	= Combine	Peak discharge	= 40.03 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyds.	= 14, 16, 17		

Hydrograph Volume = 64,722 cuft



Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	97	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2.5	% (maximum slope typical)	
Depth	0.157	ft	
n	0.035		

Numbers

flow area	15.3	ft^2
Slope Length	0.35	ft
wetted perimeter	97.7	ft
Hydraulic Radius	0.16	ft

Velocity/Flow

Velocity(v)=	1.9	ft/s	Below erosive velocity
Flow (Q)=	29.8	ft^3/s	2-year post Development section 2

Shear Stress

62.4	pcf	Unit weight of water
0.025	ft/ft	Channel Gradient
0.157	ft	Depth of Channel
T **0.24**	**psf**	**Shear Stress**

Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	97 ft	Mannings Equation
Side Slope	2 ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2 % (maximum slope typical)	
Depth	0.202 ft	sufficient capacity
n	0.035	

Numbers

flow area	19.7 ft^2
Slope Length	0.45 ft
wetted perimeter	97.9 ft
Hydraulic Radius	0.20 ft

Velocity/Flow

Velocity(v)=	2.1 ft/s	
Flow (Q)=	40.5 ft^3/s	~~10-year~~ 10-year post development section 2

Shear Stress

	62.4 pcf	Unit weight of water
	0.02 ft/ft	Channel Gradient
	0.202 ft	Depth of Channel
T	**0.25 psf**	**Shear Stress**

Hydrograph Plot

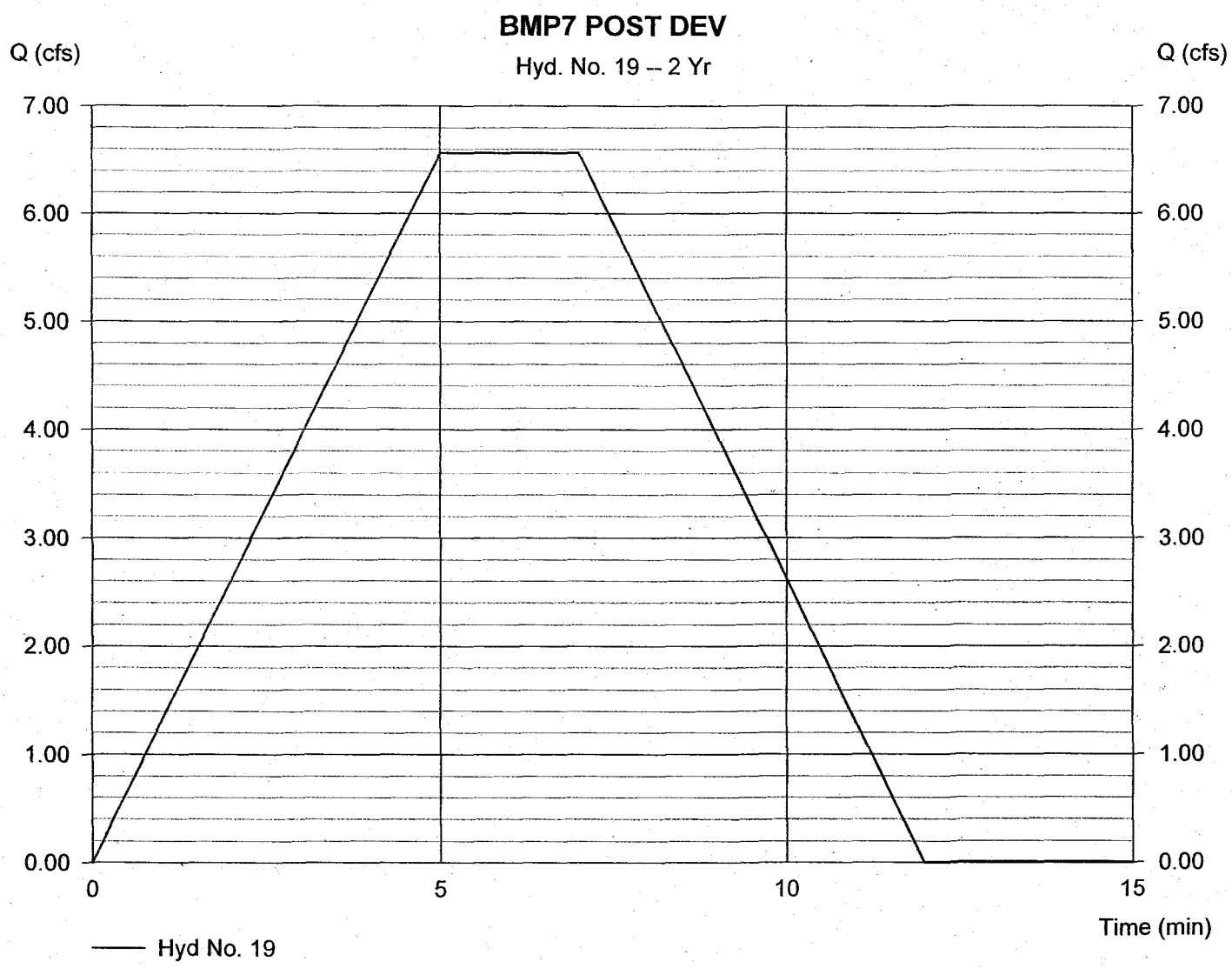
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:37 PM

Hyd. No. 19

BMP7 POST DEV

Hydrograph type	= Mod. Rational	Peak discharge	= 6.57 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 2.360 ac	Runoff coeff.	= 0.55
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,955 cuft



Hydrograph Plot

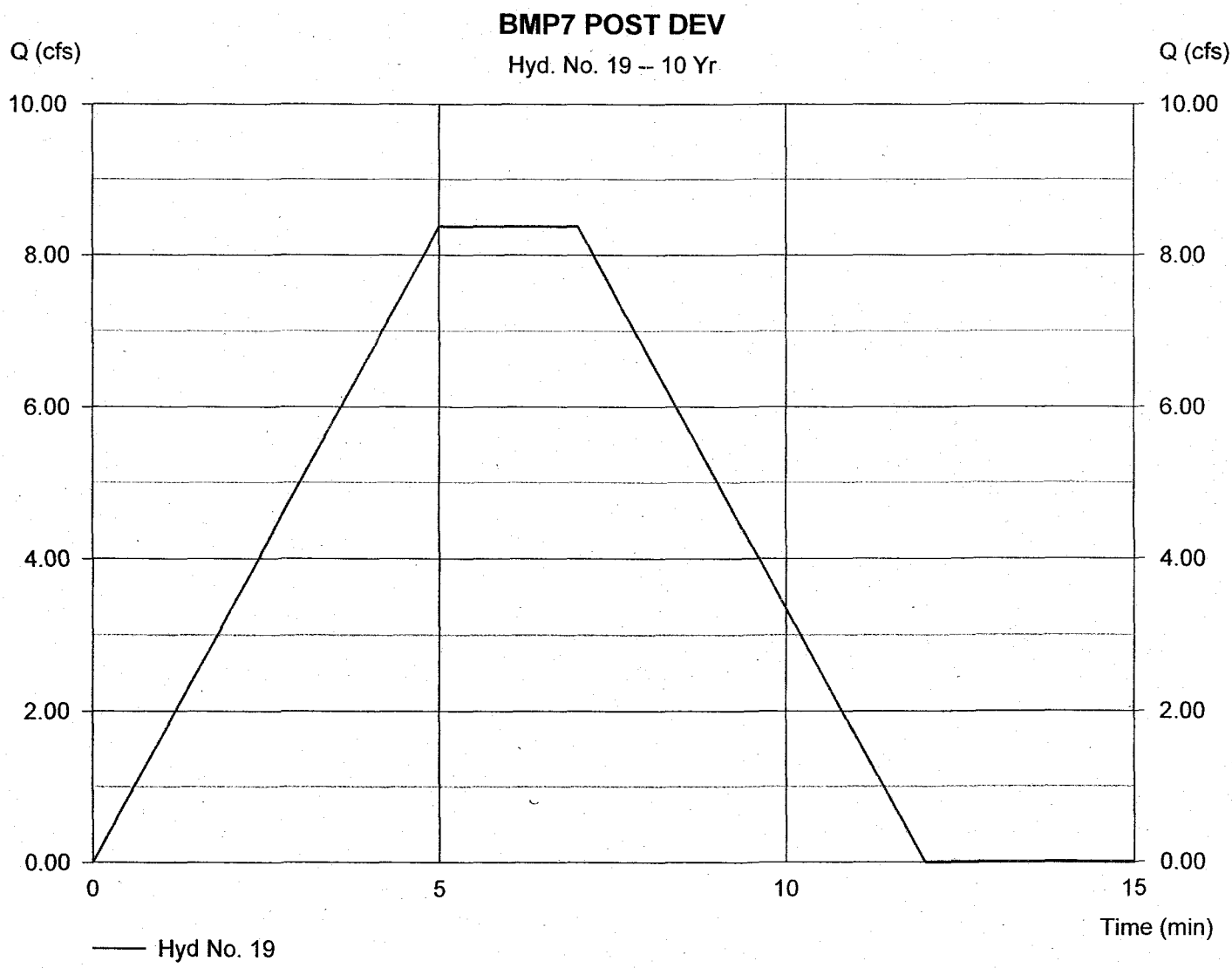
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:37 PM

Hyd. No. 19

BMP7 POST DEV

Hydrograph type	= Mod. Rational	Peak discharge	= 8.38 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 2.360 ac	Runoff coeff.	= 0.55
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,771 cuft



Hydrograph Plot

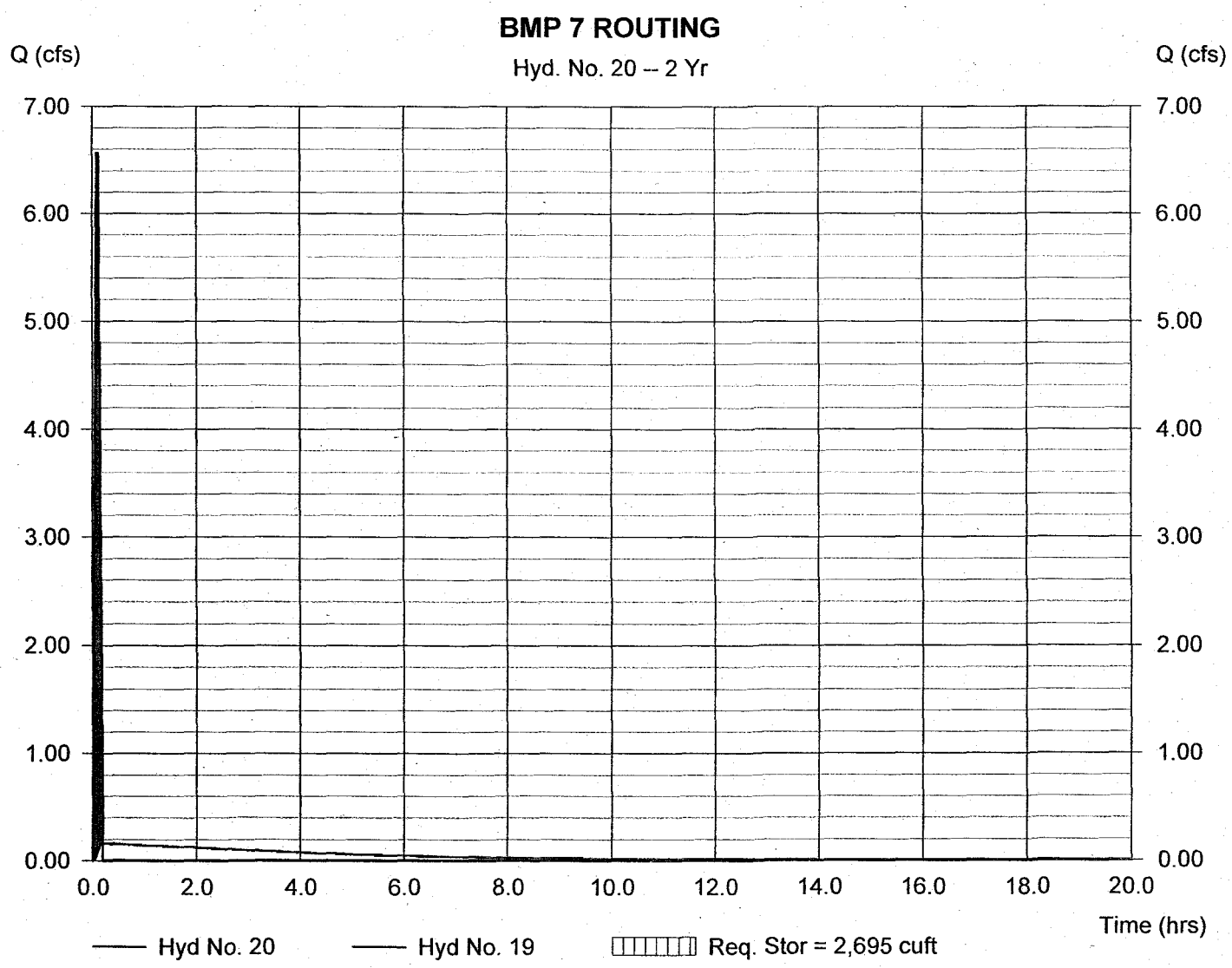
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:37 PM

Hyd. No. 20

BMP 7 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.16 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 19	Max. Elevation	= 74.60 ft
Reservoir name	= BMP7	Max. Storage	= 2,695 cuft

Storage Indication method used. | Hydrograph Volume = 2,743 cuft



Hydrograph Plot

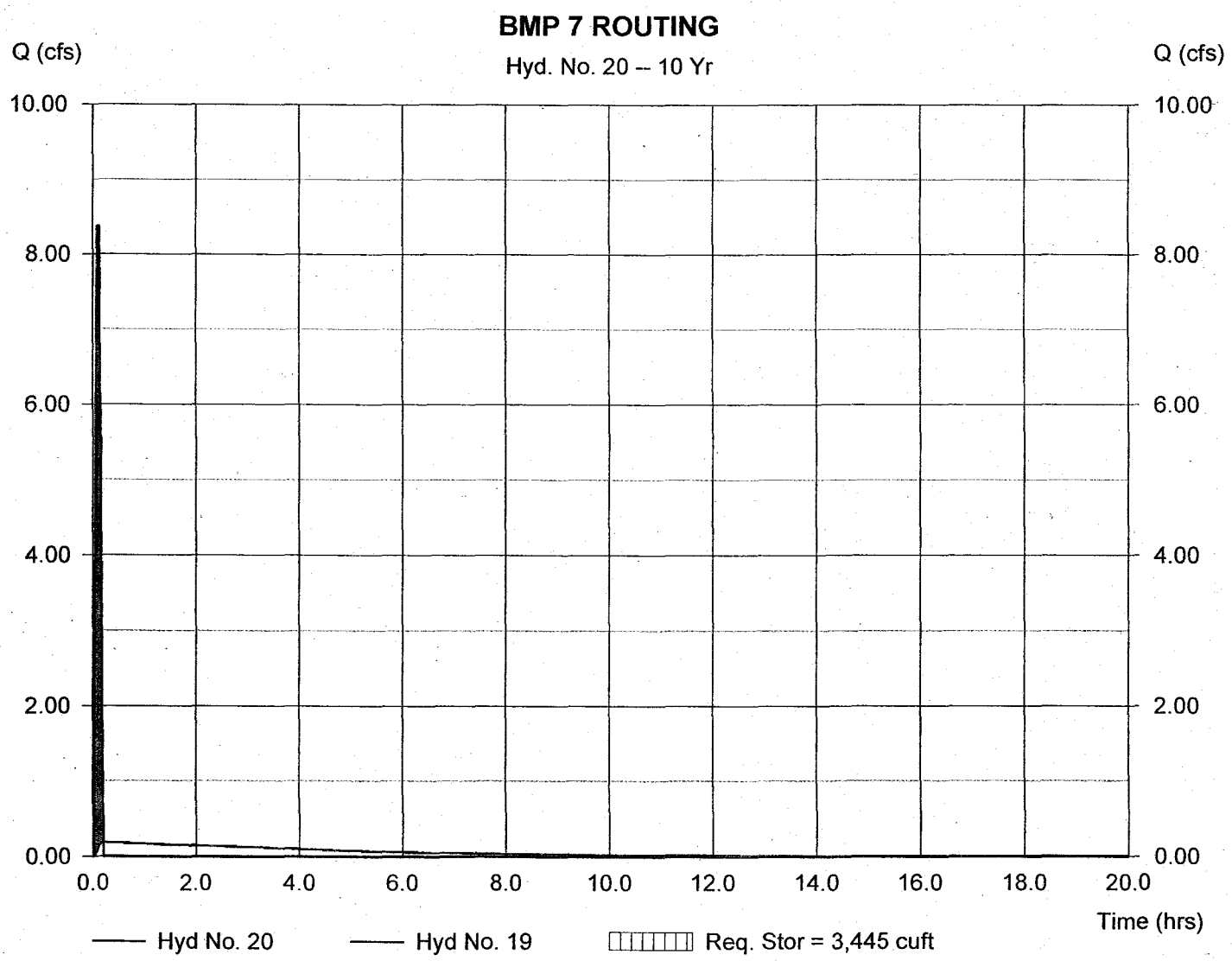
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:37 PM

Hyd. No. 20

BMP 7 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.19 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 19	Max. Elevation	= 74.77 ft
Reservoir name	= BMP7	Max. Storage	= 3,445 cuft

Storage Indication method used. | Hydrograph Volume = 3,505 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

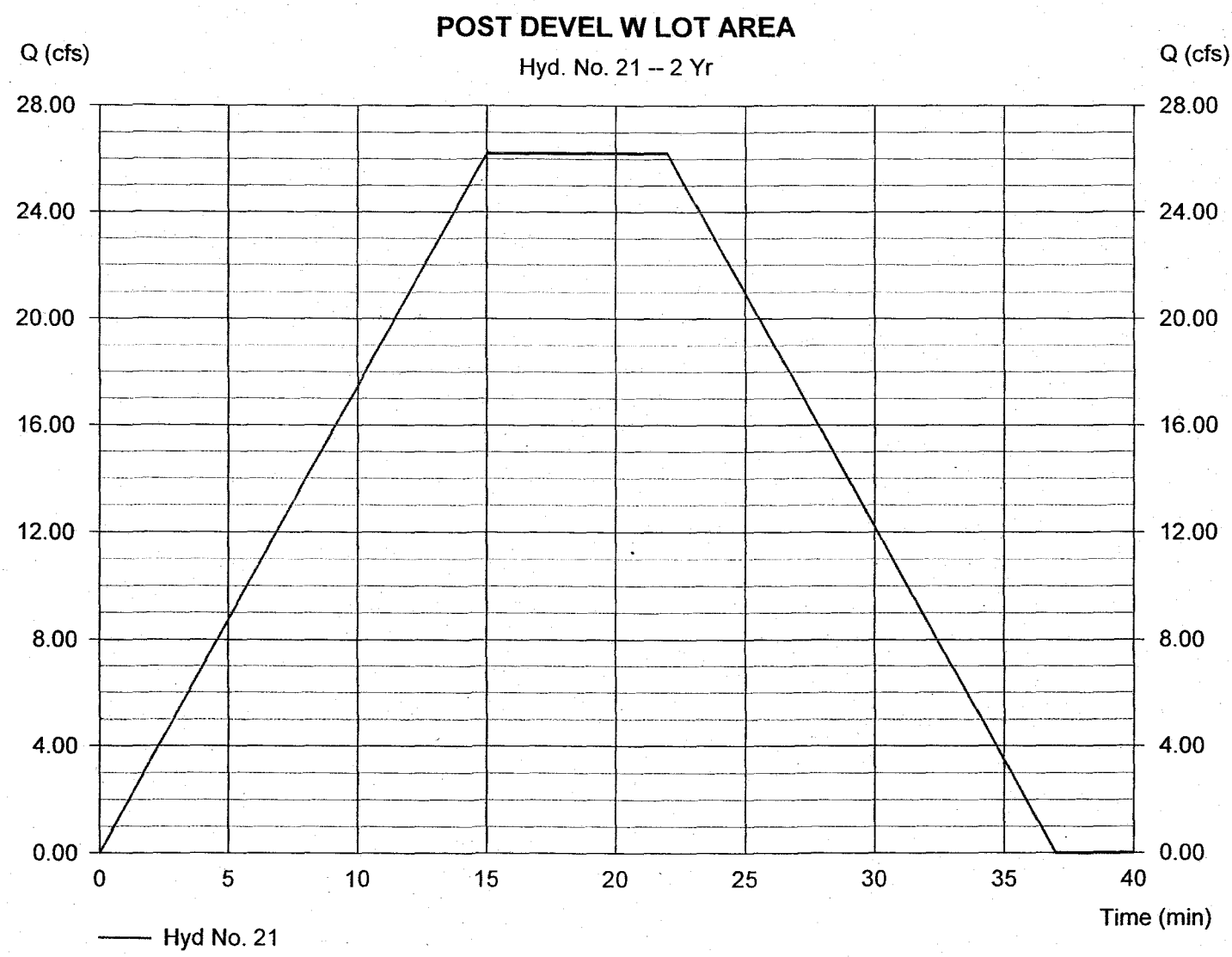
Friday, Nov 20 2009, 3:38 PM

Hyd. No. 21

POST DEVEL W LOT AREA

Hydrograph type	= Mod. Rational	Peak discharge	= 26.21 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 19.060 ac	Runoff coeff.	= 0.45
Intensity	= 3.056 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 35,389 cuft



Hydrograph Plot

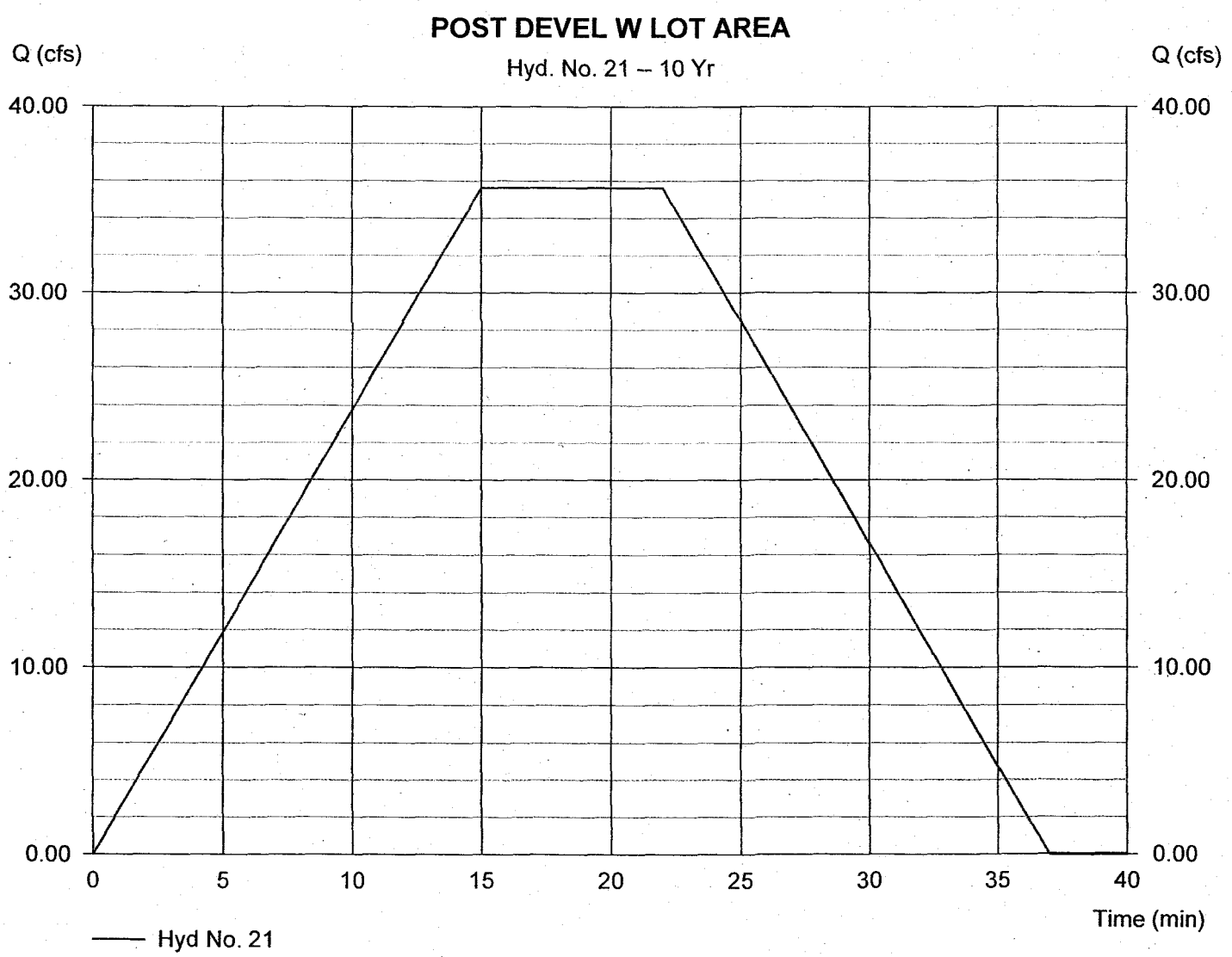
Hydraflow Hydrographs by Intelisolve | Friday, Nov 20 2009, 3:38 PM

Hyd. No. 21

POST DEVEL W LOT AREA

Hydrograph type	= Mod. Rational	Peak discharge	= 35.64 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 19.060 ac	Runoff coeff.	= 0.45
Intensity	= 4.155 in/hr	Tc by User	= 15.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 48,115 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

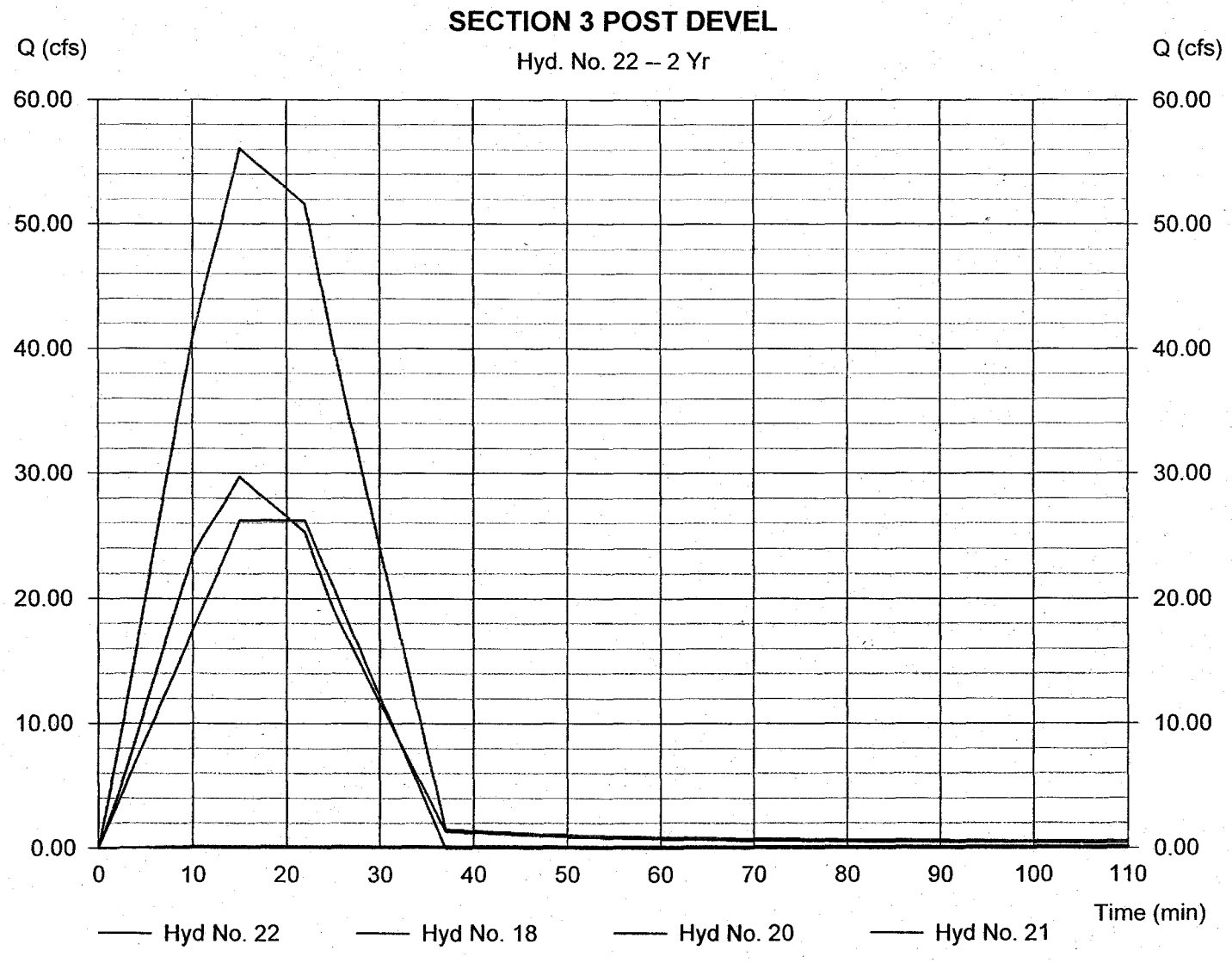
Friday, Nov 20 2009, 3:38 PM

Hyd. No. 22

SECTION 3 POST DEVEL

Hydrograph type	= Combine	Peak discharge	= 56.09 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyds.	= 18, 20, 21		

Hydrograph Volume = 86,013 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

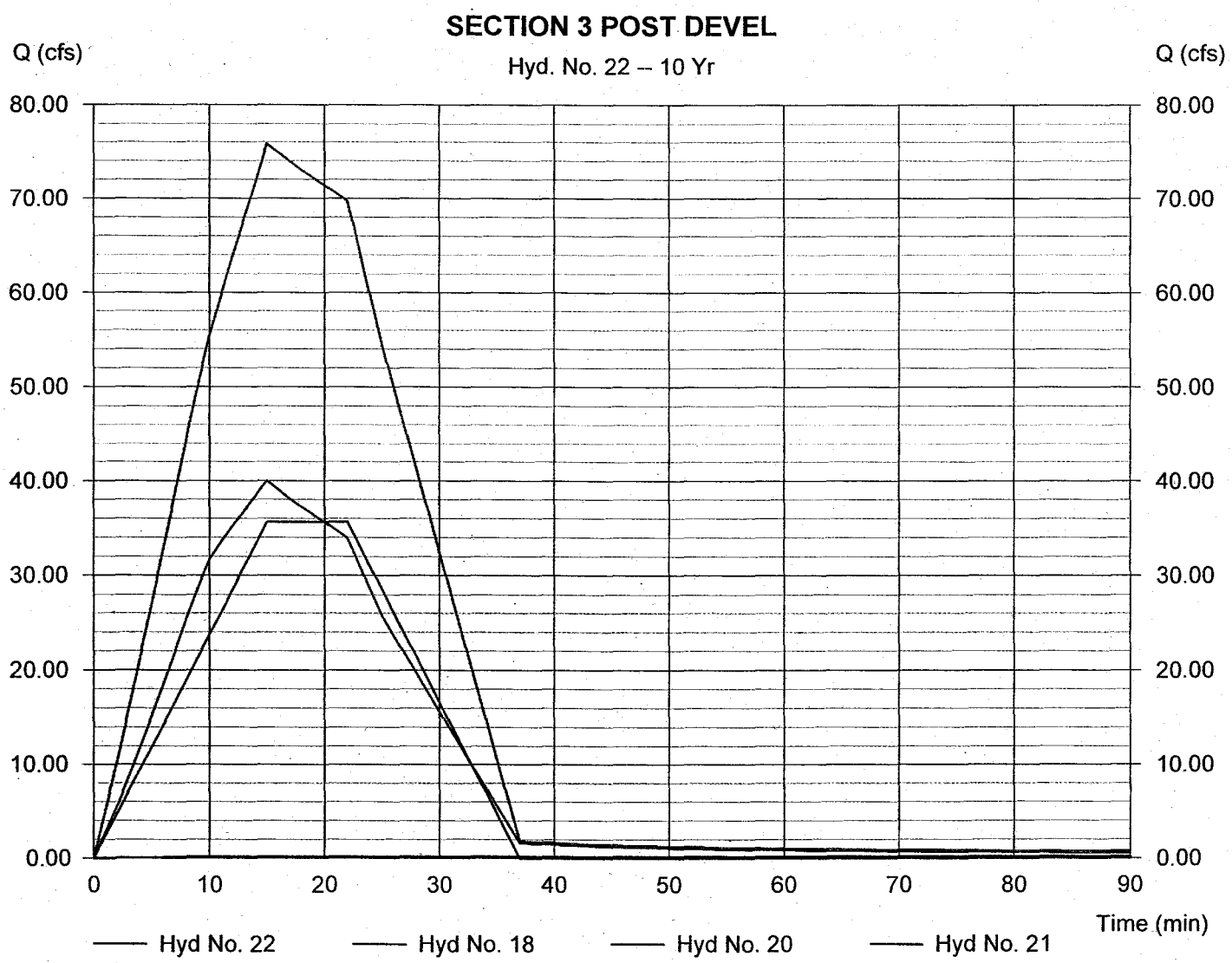
Friday, Nov 20 2009, 3:38 PM

Hyd. No. 22

SECTION 3 POST DEVEL

Hydrograph type	= Combine	Peak discharge	= 75.86 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyds.	= 18, 20, 21		

Hydrograph Volume = 115,273 cuft



Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	105	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2.5	% (maximum slope typical)	
Depth	0.22	ft	
n	0.035		

Numbers

flow area	23.2	ft^2
Slope Length	0.49	ft
wetted perimeter	106.0	ft
Hydraulic Radius	0.22	ft

Velocity/Flow

Velocity(v)=	2.4	ft/s	Belowe Erosive velocity
Flow (Q)=	56.5	ft^3/s	2-year post dev section 3

Shear Stress

	62.4	pcf	Unit weight of water
	0.025	ft/ft	Channel Gradient
	0.22	ft	Depth of Channel
T	**0.34**	**psf**	**Shear Stress**

Project	Stonehouse TR 12
Date	11/20/2009
Designer	SSL

Trapezoidal Channel Calculations (Open Channel Flow)

Channel Crossection Data

Bottom Width	105	ft	Mannings Equation
Side Slope	2	ft/ft	$Q=1.49/n(R^{2/3})(S^{1/2})A$
channel slope	2	% (maximum slope typical)	
Depth	0.281	ft	sufficient capacity
n	0.035		

Numbers

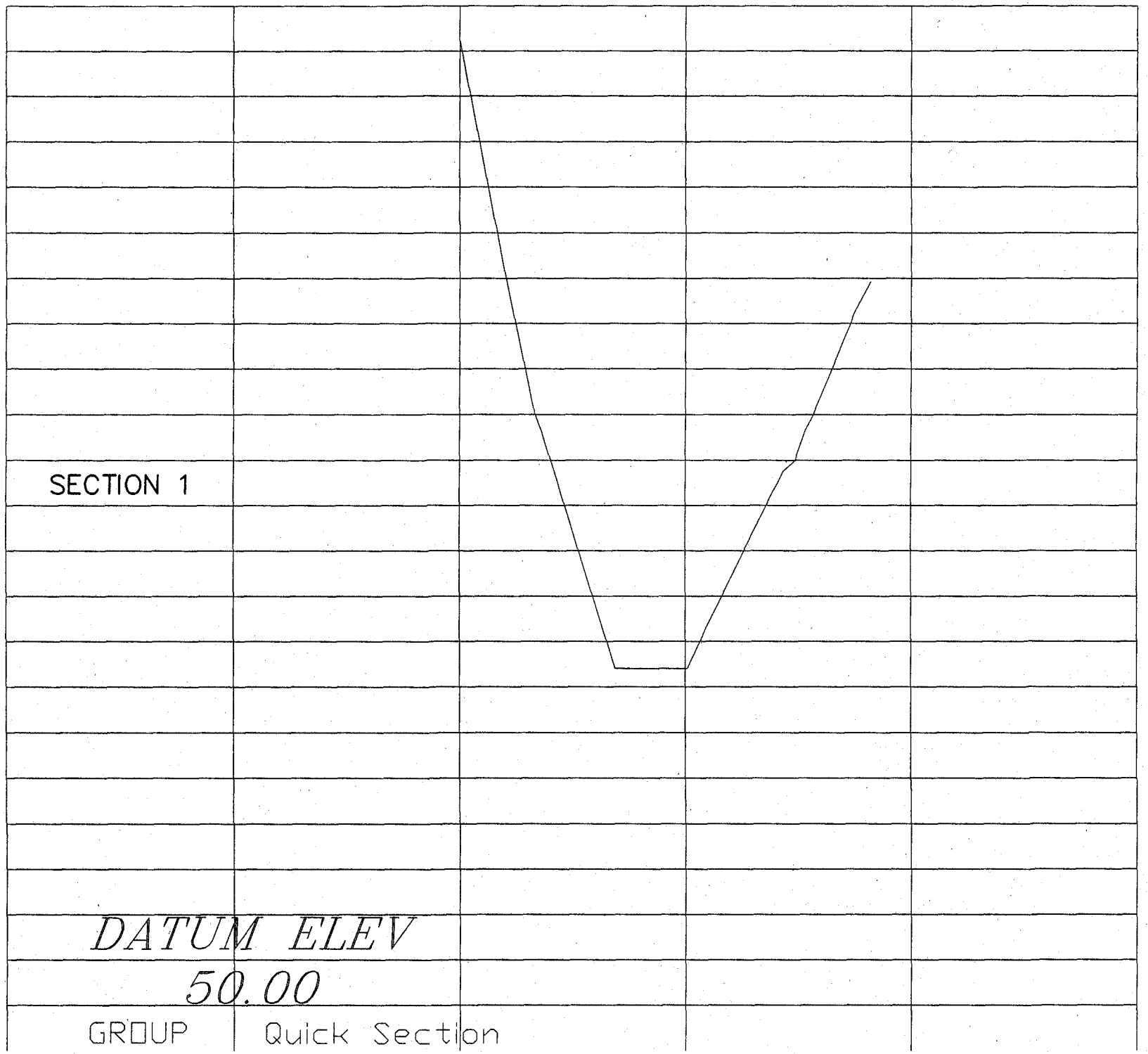
flow area	29.7	ft^2
Slope Length	0.63	ft
wetted perimeter	106.3	ft
Hydraulic Radius	0.28	ft

Velocity/Flow

Velocity(v)=	2.6	ft/s	
Flow (Q)=	76.0	ft^3/s	10-year post development section 3

Shear Stress

	62.4	pcf	Unit weight of water
	0.02	ft/ft	Channel Gradient
	0.281	ft	Depth of Channel
T	**0.35**	**psf**	**Shear Stress**



Pre Development
2-year 10.6 cfs
D=0.267ft, V=2.4 ft/s
10-year 14.7 cfs
D= 0.321 ft, V= 2.7 ft/s

Post Development
2yr 8.9 cfs
D=0.234 ft, V=2.2 ft/s
10yr 12.0 cfs
D=0.29 ft, V=2.5 ft/s

1" = 3' ↑
1" = 30' →

Pre Development

2yr 37.55cfs
D=0.18ft, V=2.1ft/s

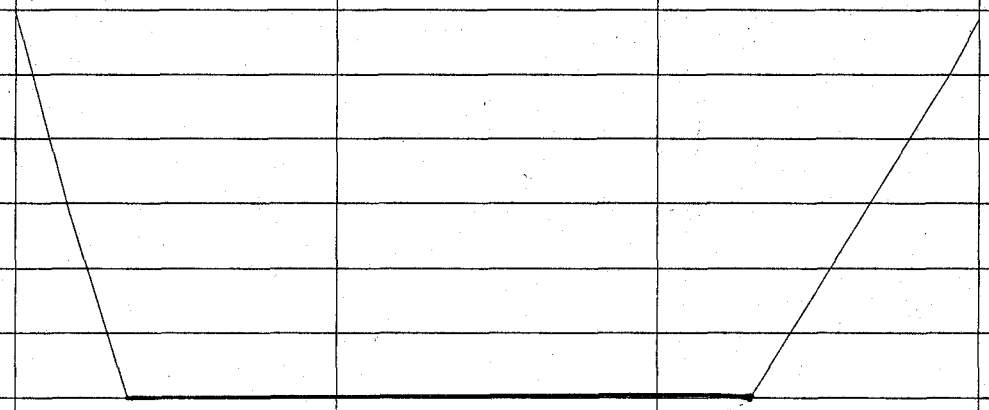
10yr 51.35cfs
D=0.233ft, V=2.3ft/s

Post Development

2yr 29.7cfs
D=0.157ft, V=1.9ft/s

10yr 40.0cfs
D=0.202ft, V=2.1ft/s

SECTION 2



DATUM ELEV
40.00

1"=3' ↑
1"=30' →

GROUP Quick Section

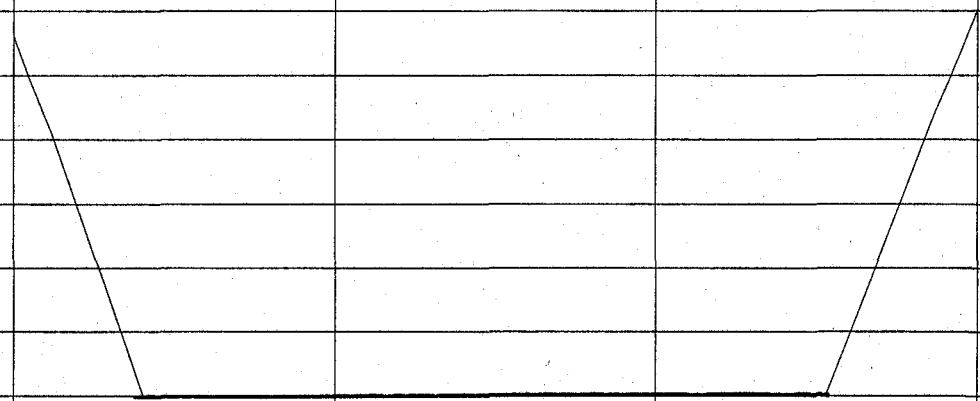
Predevelopment
2yr 69.31cfs
D=0.25ft, V=2.7ft/s

10yr 94.5cfs
D=0.32ft, V=2.8ft/s

post Development
2yr 56.0cfs
D=0.22ft, V=2.4ft/s

10yr 76.0cfs
D=0.28ft, V=2.6ft/s

SECTION 3



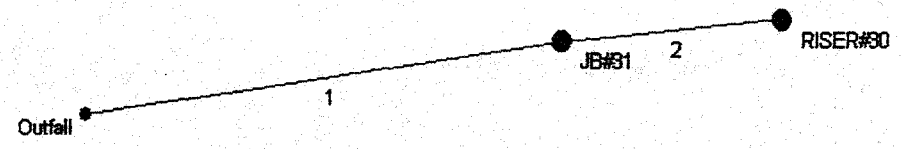
DATUM ELEV
30.00

GROUP Quick Section

1"=3'↑
1"=30'→

Stonehouse
Landbay 12

Hydraflow Plan View

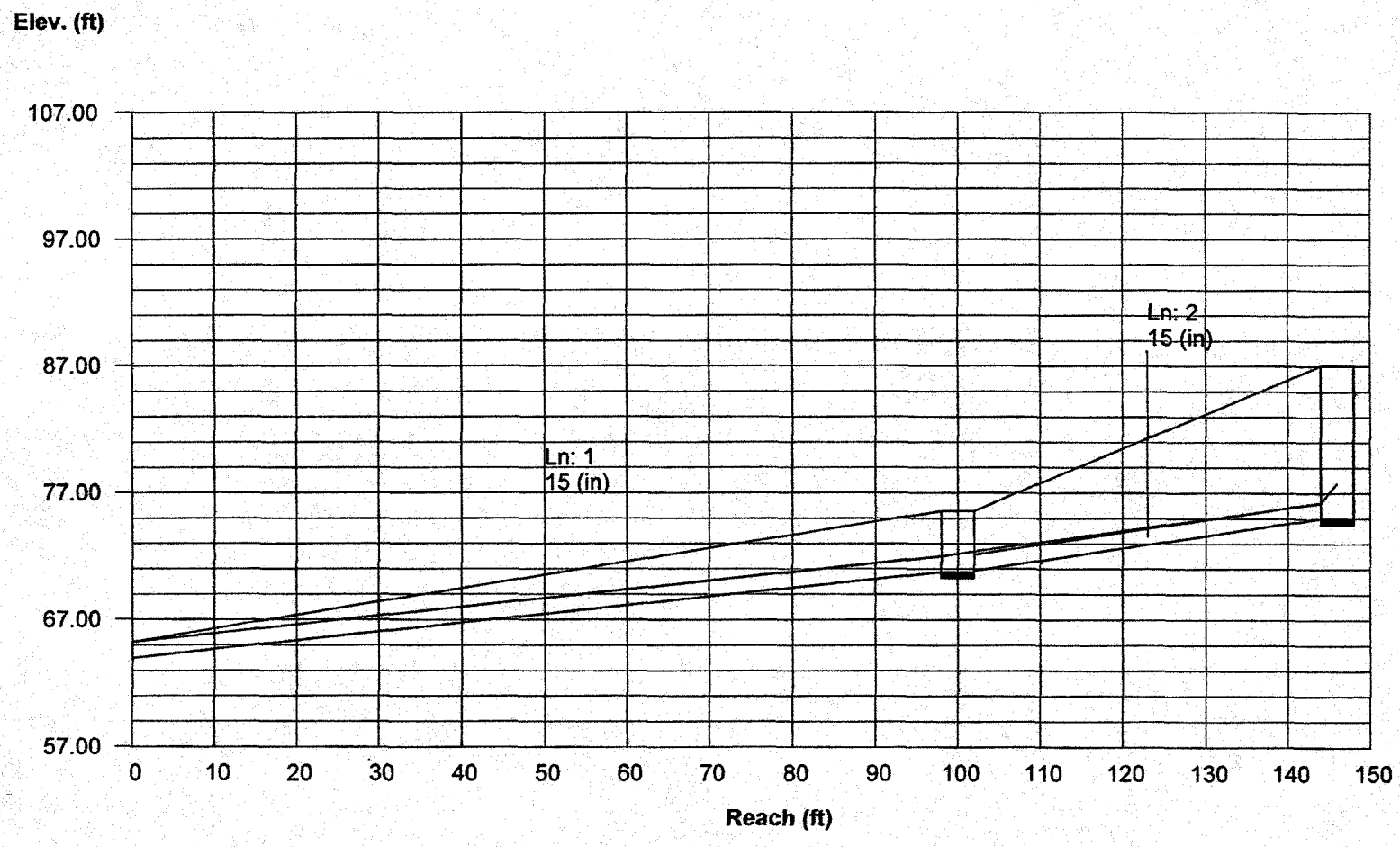


Project file: BMP#1 OUTFALL.stm	No. Lines: 2	08-18-2009

Hydraflow Storm Sewers 2003

Storm Sewer Profile

Proj. file: BMP#1 OUTFALL.stm



Storm Sewer 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	FES#32 - JB#31	12.19	15 c	100.0	64.00	70.76	6.760	65.25	71.98	0.23	End
2	JB#31 - RISER#30	12.19	15 c	46.0	70.86	75.00	9.000	72.21	76.22	1.55	1

Project File: BMP#1 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * indicates surcharge condition.

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	100.0	0.00	0.00	0.00	0.00	0.00	5.0	5.1	0.0	12.19	16.79	5.03 9.97	15	6.76	70.76	OUTFALL 64.00	71.98	65.25	75.57	65.25	FES#32 - JB#31
2	1	46.0	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	12.19	19.37	9.97	15	9.00	75.00	70.86	76.22	72.21	87.00	75.57	JB#31 - RISER#3

the inflow for BMP need to be utilizing for 10 year storm from the riser to the outfall need 100 year storm

USING MANNING'S EQUATION FOR THIS SYSTEM UNDER Q=12.19 CFS, THE VELOCITY AT OUTFALL SHOULD BE @ 5.03 FPS. TYPICALLY OTHER PROJECTS FROM OTHER FIRMS SUBMITTED AS BEING VERY LOW, NOT IDEAL. IF NEED TO RUN THIS SOFTWARE

Project File: BMP#1 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

Hydraflow Storm Sewers 2003

need to be done for 100 year

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	depth (ft)	spread (ft)	depth (ft)	spread (ft)	Dep (in)	
1	JB#31	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
2	RISER#30	12.19*	0.00	0.00	12.19	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off

Project File: BMP#1 OUTFALL.stm | I-D-F File: VIRGINIA FHA.IDF | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Inlet N-Values = 0.016 ; Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs. ; * Indicates Known Q added

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	15	12.19	64.00	65.25	1.25	1.23	9.94	1.53	66.78	3.565	100	70.76	71.98	1.22**	1.22	10.00	1.55	73.53	3.166	3.366	n/a	0.15	0.23
2	15	12.19	70.86	72.21	1.25	1.23	9.94	1.53	73.75	3.565	46.0	75.00	76.22	1.22**	1.22	10.00	1.55	77.77	3.166	3.366	n/a	1.00	1.55

10 YEAR ?

Project File: BMP#1 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: * Normal depth assumed., ** Critical depth assumed.

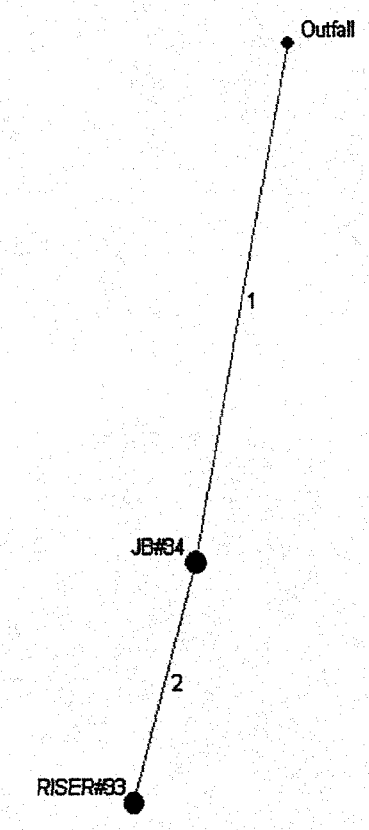
REPORT

Line No.	Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)
1	FES#32 - JB#31	100.00	15	6.76
2	JB#31 - RISER#30	46.00	15	9.00

Project File: BMP#1 OUTFALL.stm | Number of lines: 2 | Date: 08-18-2009

NOTES: ** At critical depth

Hydraflow Plan View

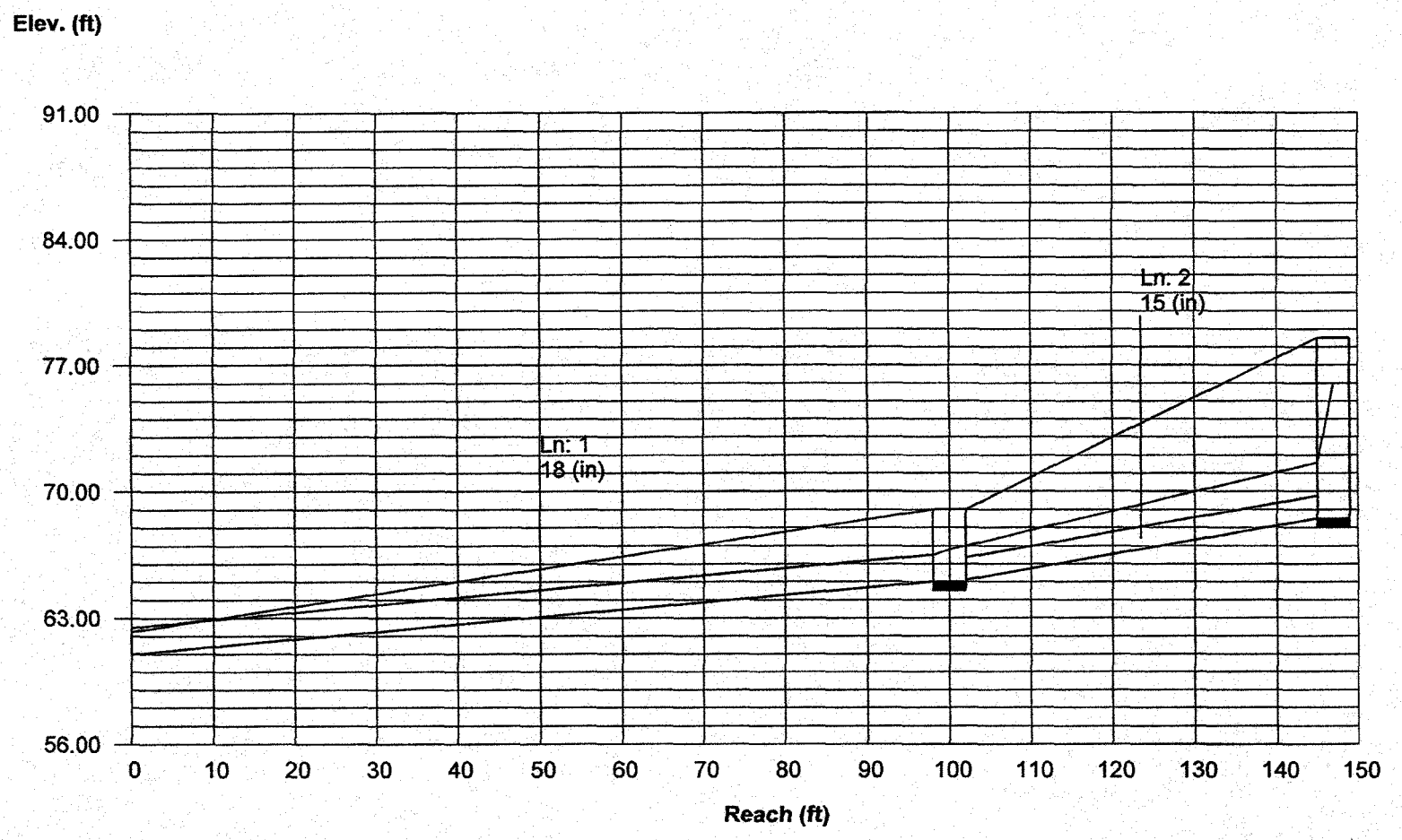


Project file: BMP#4 OUTFALL.stm	No. Lines: 2	08-18-2009

Hydraflow Storm Sewers 2003

Storm Sewer Profile

Proj. file: BMP#4 OUTFALL.stm



Storm Sewer 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	FES#35 - JB#34	20.57	18 c	100.0	61.00	65.00	4.000	62.50	66.47	0.32	End
2	JB#34 - RISER#33	20.57	15 c	47.0	65.10	68.50	7.234	66.79*	71.56*	4.37	1

Project File: BMP#4 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs. * Indicates surcharge condition.

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	100.0	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	20.57	21.00	11.67	18	4.00	65.00	61.00	66.47	62.50	69.00	62.25	FES#35 - JB#34
2	1	47.0	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	20.57	17.37	16.76	15	7.23	68.50	65.10	71.56	66.79	78.50	69.00	JB#34 - RISER#3

Project File: BMP#4 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	depth (ft)	spread (ft)	depth (ft)	spread (ft)	Dep (in)	
1	JB#34	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
2	RISER#33	20.57*	0.00	0.00	20.57	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off

Project File: BMP#4 OUTFALL.stm | I-D-F File: VIRGINIA FHA.IDF | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Inlet N-Values = 0.016 ; Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs. ; * Indicates Known Q added

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	18	20.57	61.00	62.50	1.50	1.77	11.64	2.11	64.61	3.839	100	65.00	66.47	1.47**	1.76	11.69	2.13	68.60	3.444	3.641	n/a	0.15	0.32
2	15	20.57	65.10	66.79	1.25	1.23	16.77	4.37	71.16	10.152	47.0	68.50	71.56	1.25	1.23	16.76	4.37	75.93	10.148	10.150	4.770	1.00	4.37

Project File: BMP#4 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: * Normal depth assumed., ** Critical depth assumed.

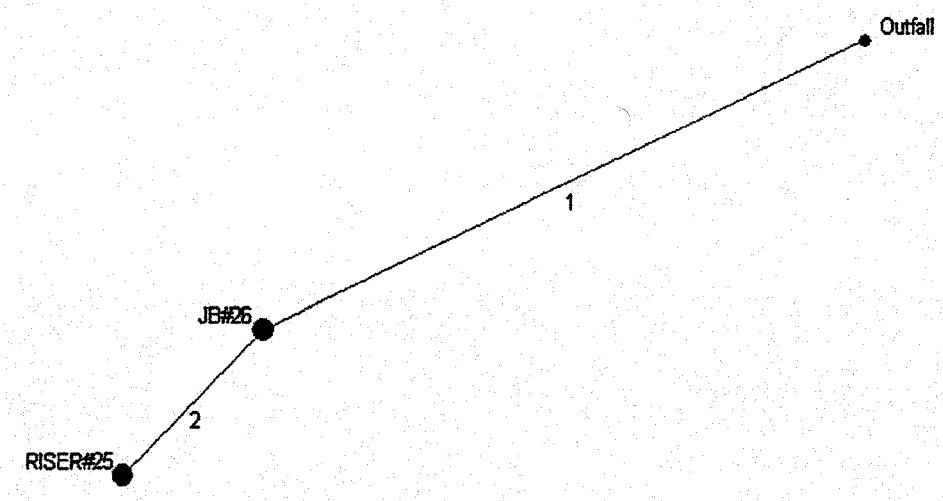
REPORT

Line No.	Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)
1	FES#35 - JB#34	100.00	18	4.00
2	JB#34 - RISER#33	47.00	15	7.23

Project File: BMP#4 OUTFALL.stm | Number of lines: 2 | Date: 08-18-2009

NOTES: ** At critical depth

Hydraflow Plan View

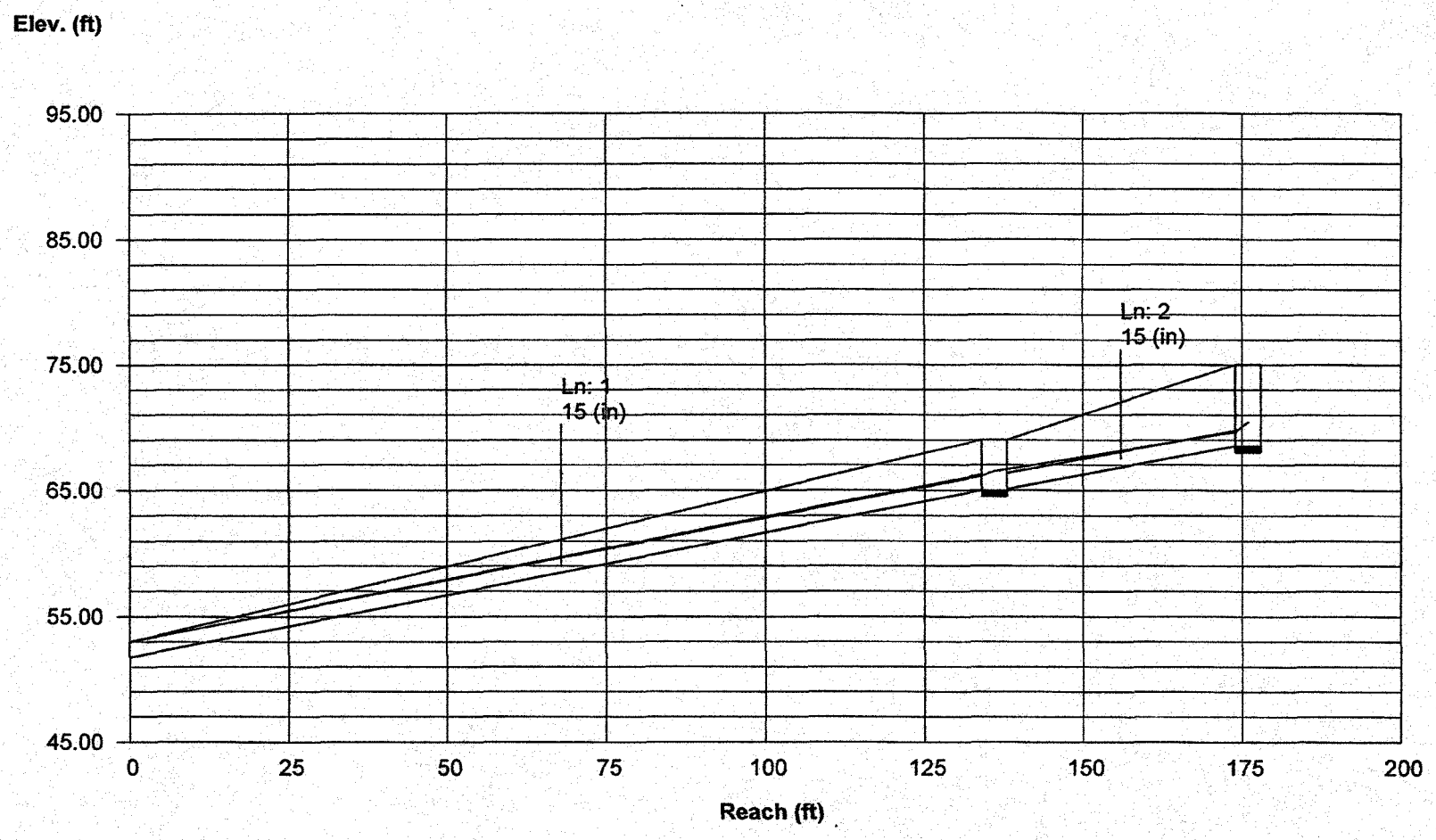


Project file: BMP#7 OUTFALL.stm	No. Lines: 2	08-18-2009

Hydraflow Storm Sewers 2003

Storm Sewer Profile

Proj. file: BMP#7 OUTFALL.stm



Hydraflow Storm Sewers 2003

Storm Sewer 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	FES#27 - JB#26	8.38	15 c	136.0	51.75	65.00	9.743	53.00	66.13	0.36	End
2	JB#26 - RISER#25	8.38	15 c	40.0	65.10	68.50	8.500	66.49	69.63	0.80	1

Project File: BMP#7 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

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	136.0	0.00	0.00	0.00	0.00	0.00	5.0	5.1	0.0	8.38	20.16	7.00	15	9.74	65.00	51.75	66.13	53.00	69.00	53.00	FES#27 - JB#26
2	1	40.0	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	8.38	18.83	7.00	15	8.50	68.50	65.10	69.63	66.49	75.00	69.00	JB#26 - RISER#2

Project File: BMP#7 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	depth (ft)	spread (ft)	depth (ft)	spread (ft)	Dep (in)	
1	JB#26	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
2	RISER#25	8.38*	0.00	0.00	8.38	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off

Project File: BMP#7 OUTFALL.stm | I-D-F File: VIRGINIA FHA.IDF | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Inlet N-Values = 0.016 ; Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs. ; * Indicates Known Q added

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	15	8.38	51.75	53.00	1.25	1.23	6.83	0.73	53.73	1.685	136	65.00	66.13	1.13**	1.17	7.17	0.80	66.93	1.474	1.580	n/a	0.45	0.36
2	15	8.38	65.10	66.49	1.25	1.23	6.83	0.73	67.22	1.685	40.0	68.50	69.63	1.13**	1.17	7.17	0.80	70.43	1.474	1.580	n/a	1.00	0.80

Project File: BMP#7 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: * Normal depth assumed., ** Critical depth assumed.

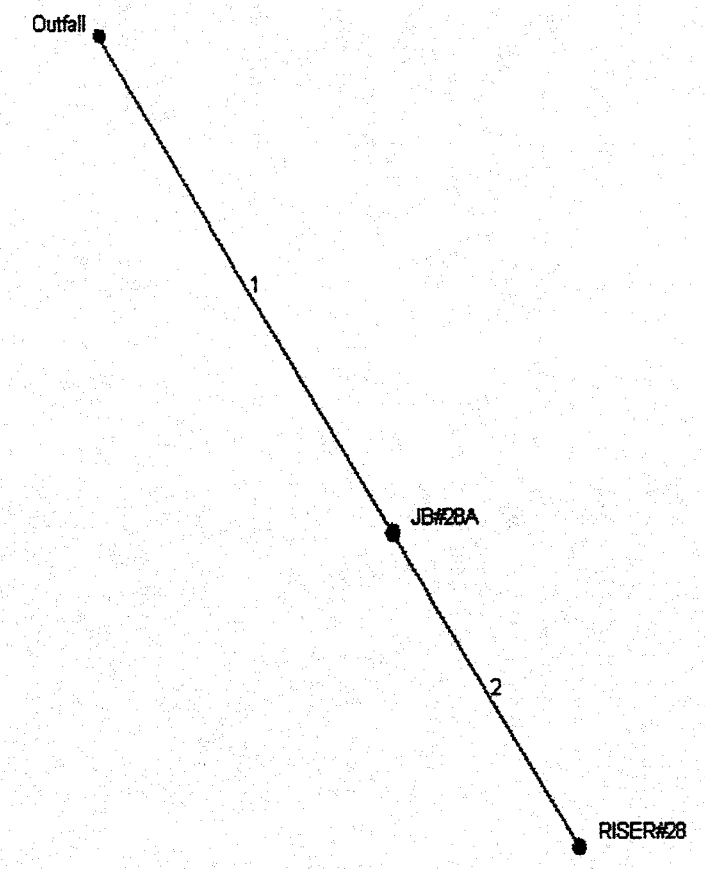
REPORT

Line No.	Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)
1	FES#27 - JB#26	136.00	15	9.74
2	JB#26 - RISER#25	40.00	15	8.50

Project File: BMP#7 OUTFALL.stm | Number of lines: 2 | Date: 08-18-2009

NOTES: ** At critical depth

Hydraflow Plan View

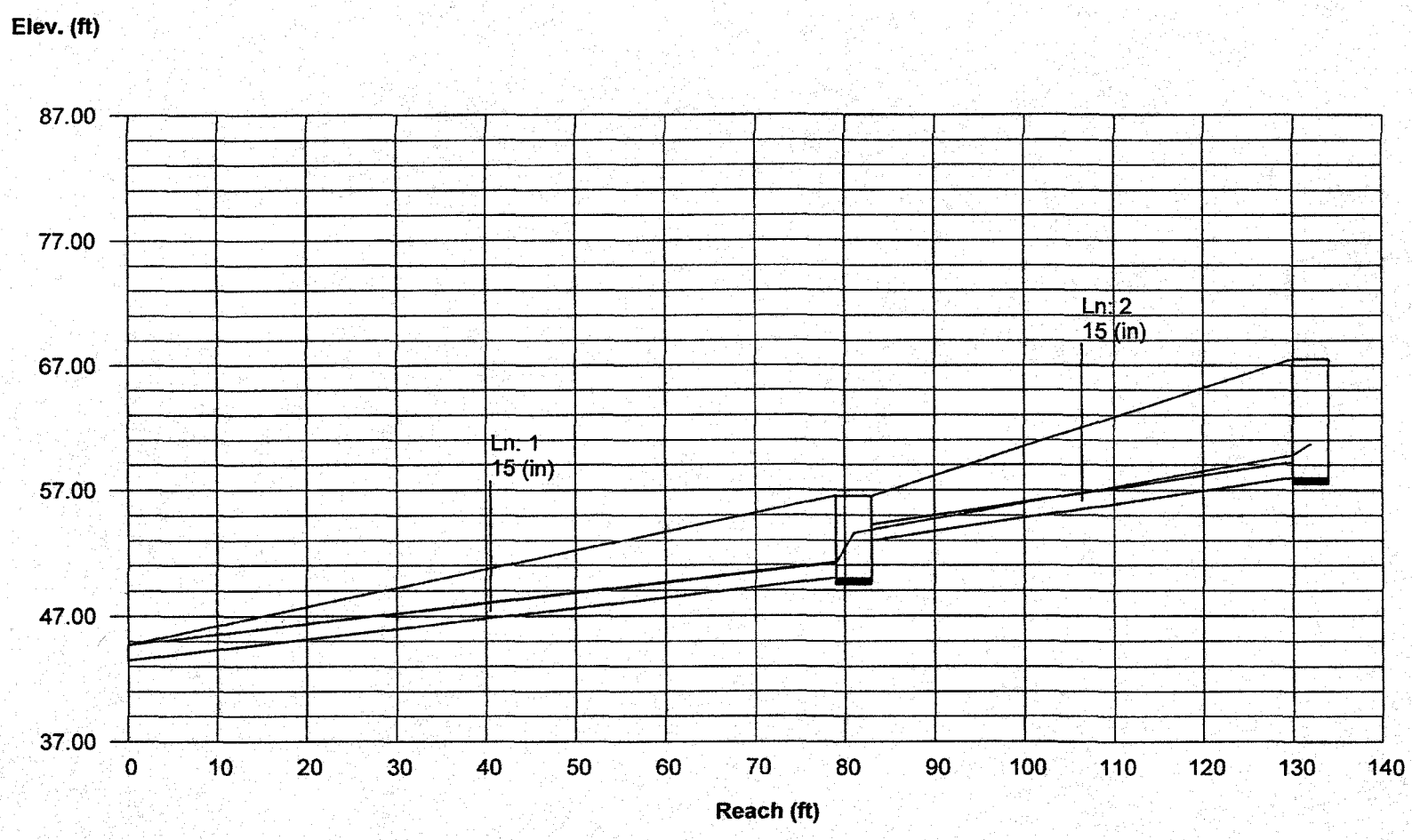


Project file: BMP#8 OUTFALL.stm	No. Lines: 2	08-18-2009

Hydraflow Storm Sewers 2003

Storm Sewer Profile

Proj. file: BMP#8 OUTFALL.stm



Hydraflow Storm Sewers 2003

Storm Sewer 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	FES29 - JB#28A	9.40	15 c	81.0	43.50	50.00	8.025	44.75	51.17	0.14	End
2	JB#28A - RISER#2	9.40	15 c	51.0	53.00	58.00	9.804	53.60*	59.78*	0.91	1

Project File: BMP#8 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

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	81.0	0.00	0.00	0.00	0.00	0.00	5.0	5.1	0.0	9.40	18.29	7.77	15	8.02	50.00	43.50	51.17	44.75	56.50	44.75	FES29 - JB#28A
2	1	51.0	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	9.40	20.22	11.91	15	9.80	58.00	53.00	59.78	53.60	67.50	56.50	JB#28A - RISER

Project File: BMP#8 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	depth (ft)	spread (ft)	depth (ft)	spread (ft)	Dep (in)	
1	JB#28A	0.00	9.40	0.00	9.40	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
2	RISER#28	9.40*	0.00	0.00	9.40	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	1

Project File: BMP#8 OUTFALL.stm | I-D-F File: VIRGINIA FHA.IDF | Number of lines: 2 | Run Date: 08-18-2009

NOTES: Inlet N-Values = 0.016 ; Intensity = 111.70 / (Inlet time + 16.25) ^ 0.90; Return period = 10 Yrs. ; * Indicates Known Q added

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	15	9.40	43.50	44.75	1.25	1.23	7.66	0.91	45.66	2.120	81.0	50.00	51.17	1.17**	1.19	7.87	0.96	52.13	1.831	1.976	n/a	0.15	0.14
2	15	9.40	53.00	53.60	0.60*	0.58	16.16	4.06	57.66	9.776	51.0	58.00	59.78	1.25	1.23	7.66	0.91	60.69	2.119	5.948	3.033	1.00	0.91

Project File: BMP#8 OUTFALL.stm | Number of lines: 2 | Run Date: 08-18-2009

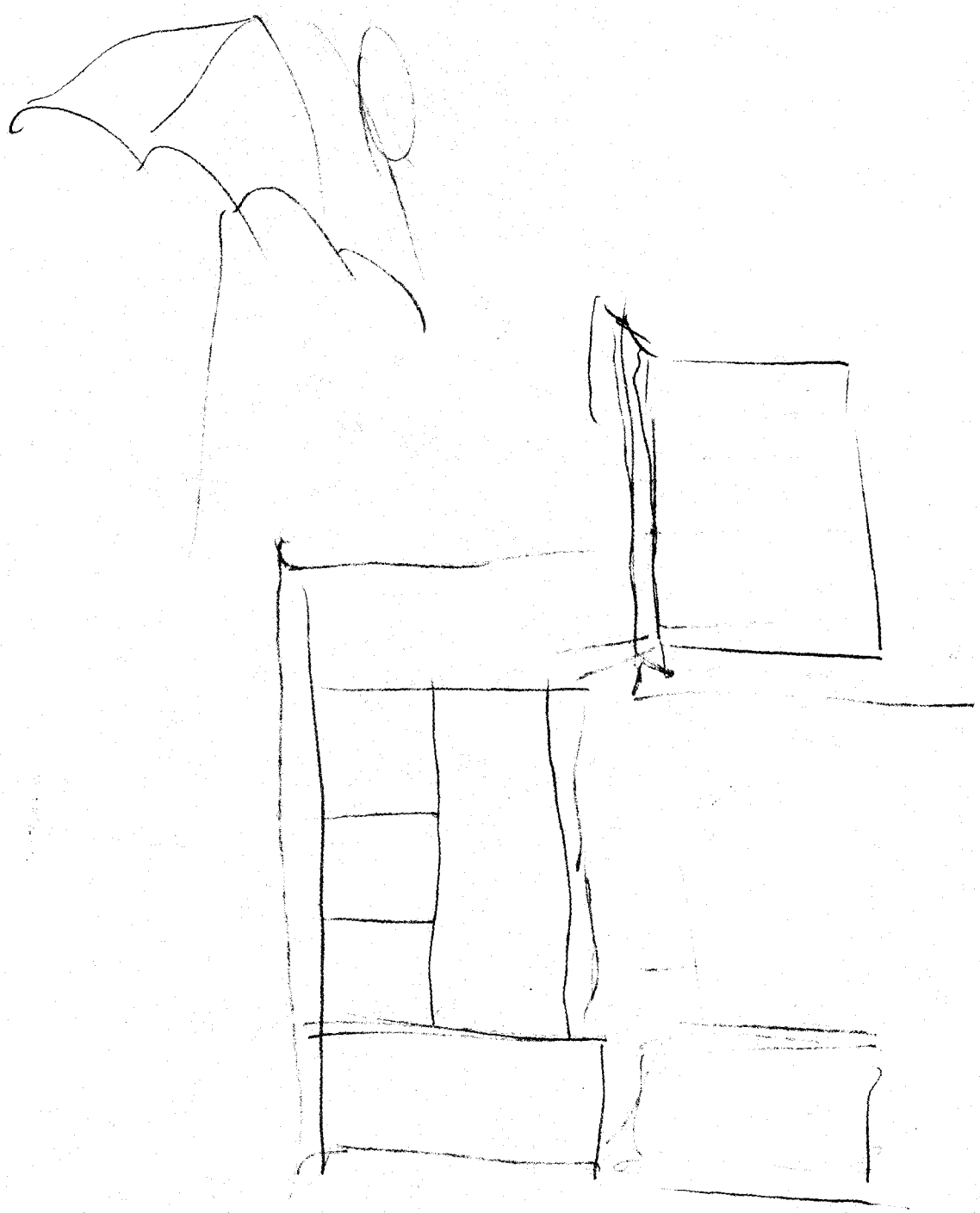
NOTES: * Normal depth assumed., ** Critical depth assumed.

REPORT

Line No.	Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)
1	FES29 - JB#28A	81.00	15	8.02
2	JB#28A - RISER#28	51.00	15	9.80

Project File: BMP#8 OUTFALL.stm | Number of lines: 2 | Date: 08-18-2009

NOTES: ** At critical depth



STONEHOUSE TRACT 12
PHASE 1

Environmental Division
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Site Inspection Photos

Taken Date: October 5, 2012

Prepared by:

WSP · SELLS

15401 Weston Parkway
Suite 100
Cary, North Carolina 27513
(919) 678-0035
(919) 678-0206 (Fax)

CHS Project Number 08-4040

BMP 2- LOOKING AT STABILIZED AREAS ON LYTHAM CT.

BMP 2 – BIO RETENTION AREA LOOKING AT PLANTINGS

BMP 2 – RISER STRUCTURE

BMP 2 – LOOKING FROM RISER TO THE SOUTH

BMP 2 – CLOSE UP OF RISER WITH SLOTS

BMP 2- TYPICAL CLEAN OUT. THESE HDPE CLEANOUTS WERE REPLACED ON 10/9/12 WITH THREADED PLUGS THAT ARE VISIBLE FROM THE ROAD (SEE UPDATED PICTURES IN THIS LOG)

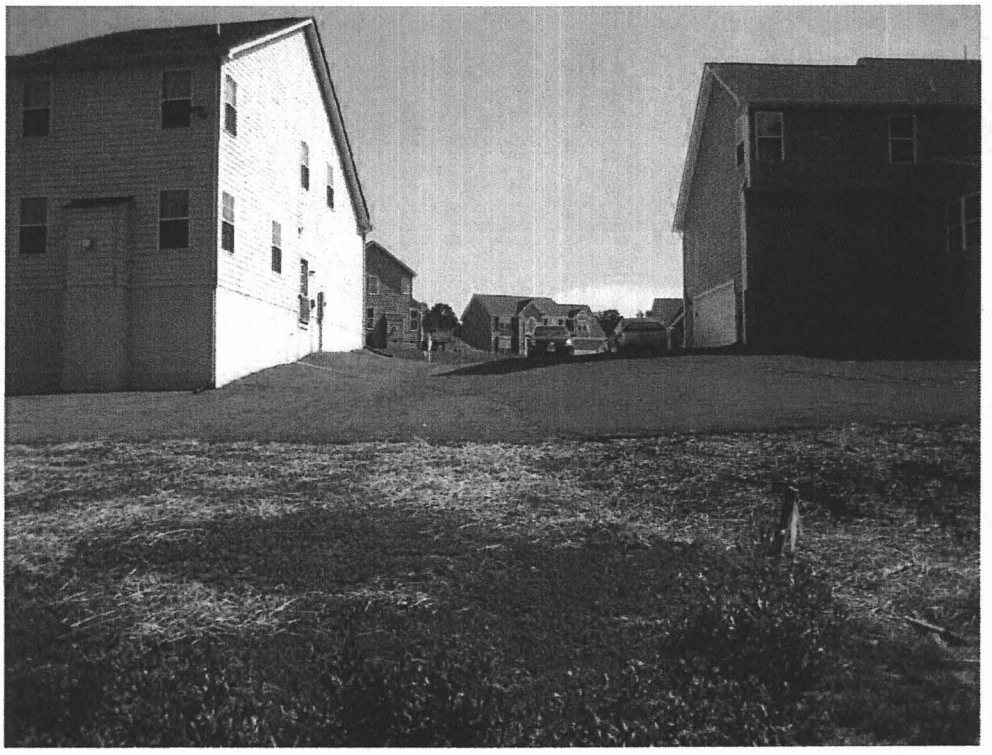
BMP 1 – ACCESS EASEMENT BETWEEN LOTS 47-48

BMP 1 – EXTENDED WET POND LOOKING AT RISER AND MAIN POOL

BMP 1 – LOOKING AT VEGETATION ON NORTHSIDE OF BMP

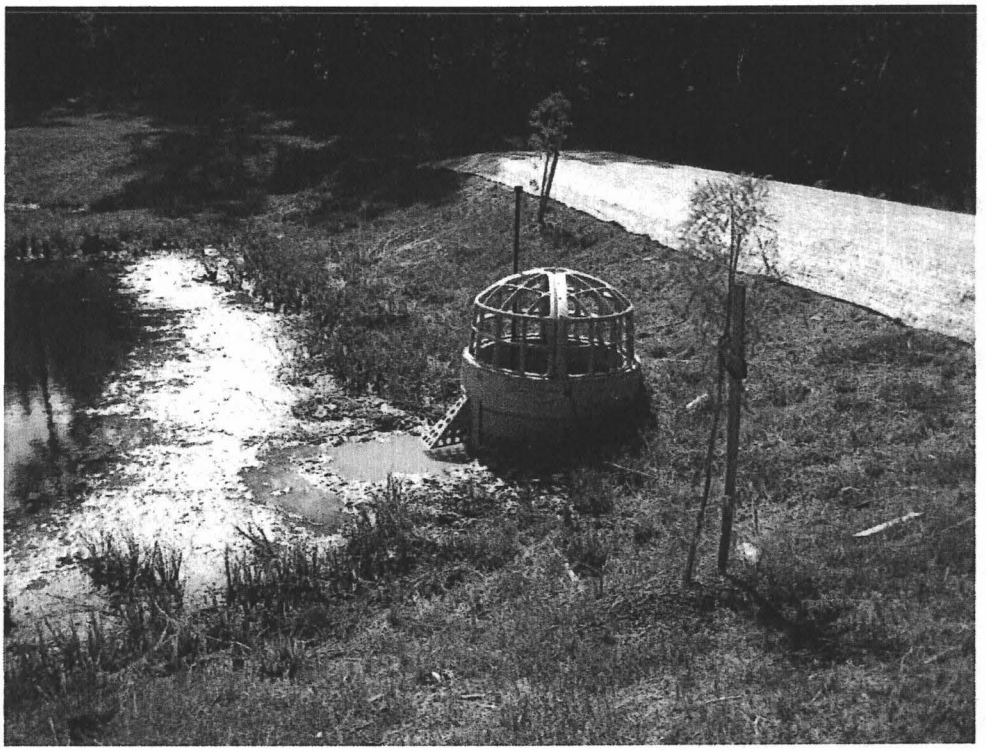
BMP 1 – LOOKING AT FOREBAY ON RIGHT SIDE

BMP 1- LOOKING AT SECOND FOREBAY ON LEFT SIDE, CATTAILS TO BE REMOVED BY CONTRACTOR



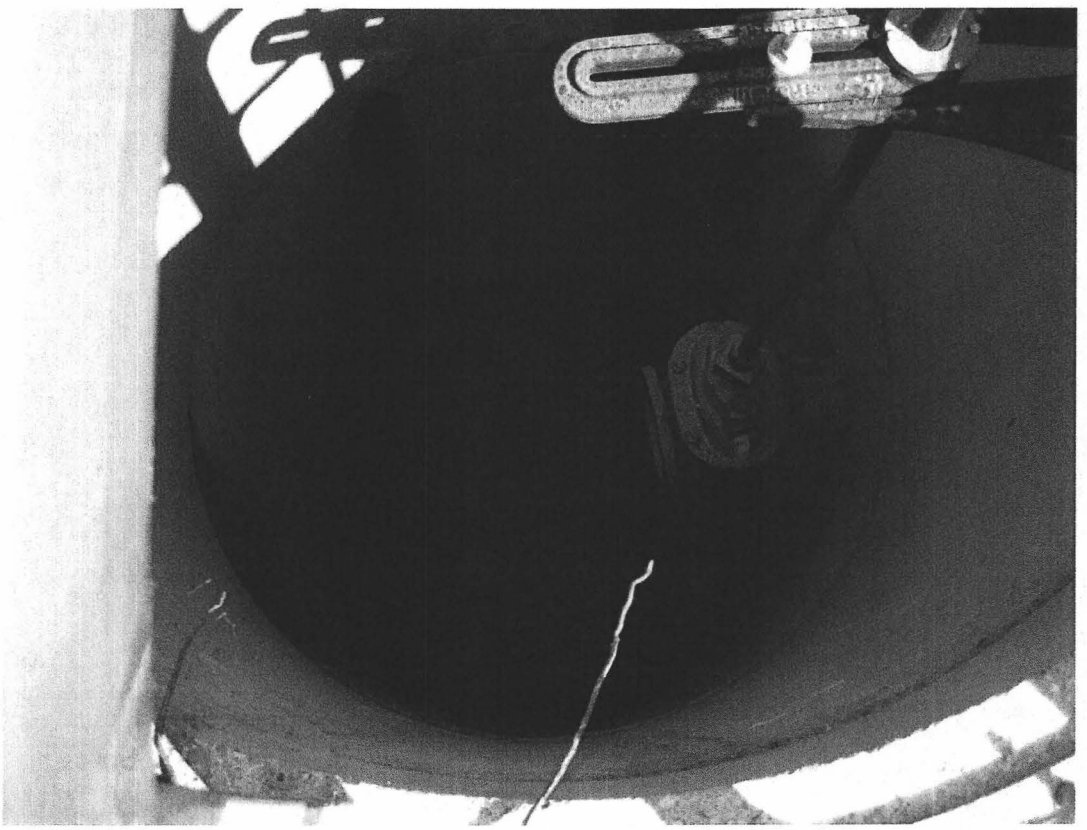
BMP 1 – LOOKING FROM BMP BETWEEN LOTS 47-48 FOR ACCESS

BMP 1 – TOP OF DAM JUST REGRADED AND STABILIZED WITH MAT AND SEED



BMP 1 – RISER STRUCTURE

BMP 1 – LOOKING DOWNSTREAM FROM DAM INTO OUTFALL INTO RPA

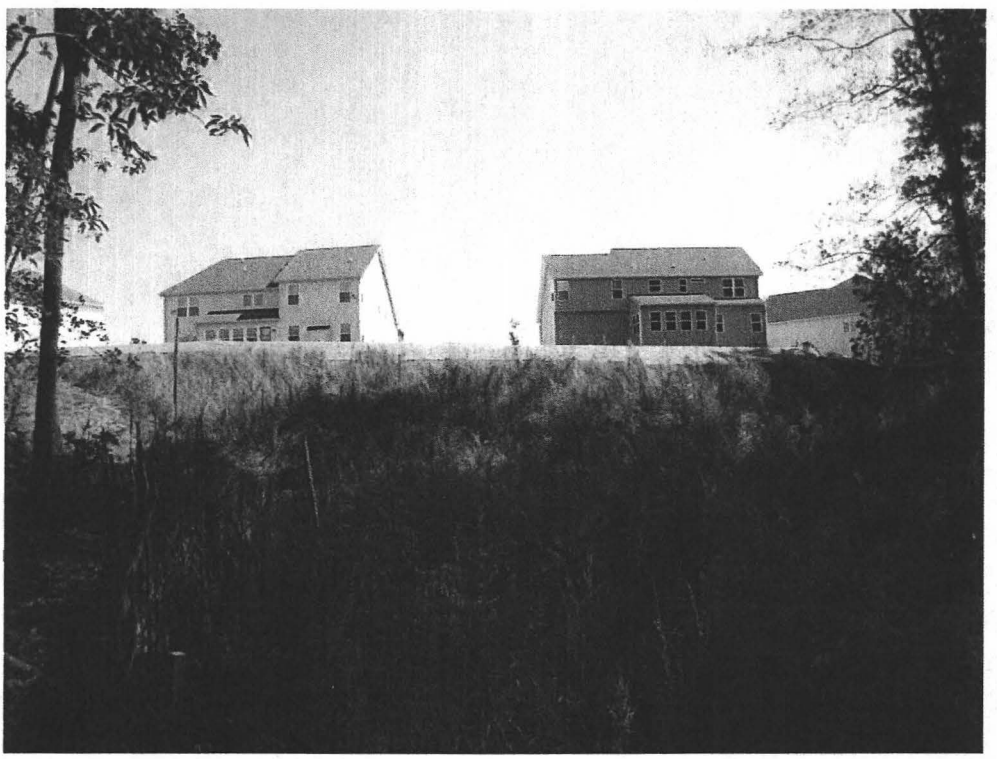


BMP 1 – RISER STRUCTURE LOOKING INSIDE, GATE VALVE SHOWN

BMP 1 – 3" RISER ORIFICE FROM INSIDE

BMP 1 – RISER ORIFICE WITH TRASH SKIMMER OUTSIDE

BMP 1 – STILLING BASIN AT DOWNSTREAM END WITH FES 32



BMP 1 – LOOKING AT DAM FROM THE OUTFALL AREA DOWNSTREAM

BMP 1 – RISER TRASH RACK MADE BY STORMRAX

BMP 2- CLEANOUTS HAVE BEEN CORRECTED WITH THREADED PLUGS

TAKEN 10-9-12

BMP 2 – BIORETENTION AFTER RAINFALL 10-9-12, CLEANOUTS CLEARLY VISIBLE

A&L Eastern Laboratories

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6446

www.aleastern.com

Submitted By: MICHELLE BROADY

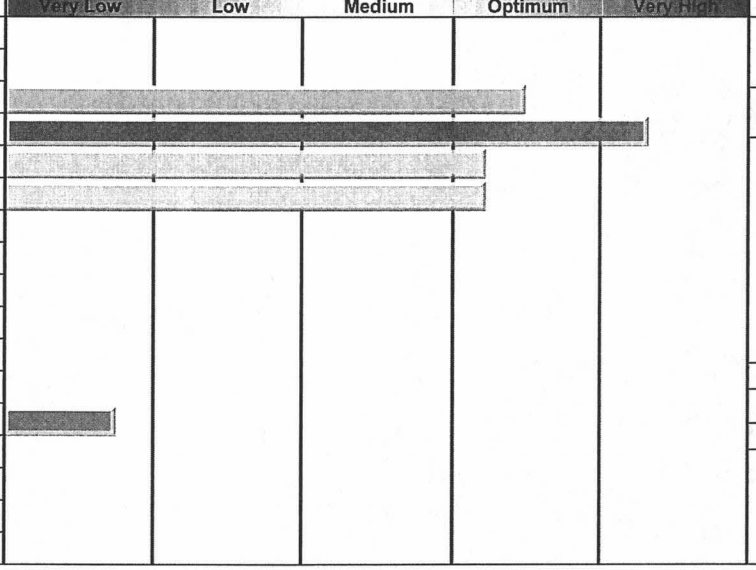
SOIL ANALYSIS

Client :	Grower :	
WALTRIP RECYCLING INC 11 MARCLAY ROAD WILLIAMSBURG VA 23185	NEW TOWN	Report No: 12-181-0540 Cust No: 01749 Date Printed: 07/05/2012 Date Received : 06/29/2012 PO: Page : 1 of 1

Lab Number : 07730 **Field Id :** **Sample Id :** NEW LAWN

Test	Method	Results
Soil pH	1:1	6.9
Buffer pH		6.92
Phosphorus (P)	M3	78 ppm
Potassium (K)	M3	231 ppm
Calcium (Ca)	M3	1361 ppm
Magnesium (Mg)	M3	183 ppm
Sulfur (S)		
Boron (B)		
Copper (Cu)		
Iron (Fe)		
Manganese (Mn)		
Zinc (Zn)		
Sodium (Na)	M3	28 ppm
Soluble Salts		0.24 mmhos/cm
Organic Matter	WB	3.5 % ENR 107
Nitrate Nitrogen		

SOIL TEST RATINGS



Calculated Cation Exchange Capacity	
9.2 meq/100g	
Calculated Cation Saturation	
%K	6.4
%Ca	74.0
%Mg	16.6
%H	1.4
Hmeq	0.1
%Na	1.3
K : Mg Ratio	
0.39	
Ca : Mg Ratio	
4.46	

Additional results to follow

SOIL FERTILITY GUIDELINES

Crop : Bio-Retention **Yield Goal :** 0 **Rec Units:** LB/1000 SF

(lbs)	LIME	(tons)	N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe
0			3.0	0.5	0	0						

Crop : **Rec Units:**

Comments :

Bio-Retention

· All recommended fertilizers are on actual elemental basis. To convert to product basis, divide the recommended quantity in the first page by the percentage of the active ingredient then multiply by 100.

· Phosphate is more efficient if applied near the plant, apply all phosphate beside the row. Broadcast N and/or K2O then mix into the soil. If there is no fertilizer meets the ratio, you can use single element fertilizer such as Urea, Triplesuper Phosphate and Muriate of Potash to achieve the requirements. Consult the enclosed instruction sheet on lime and fertilizer application.

· For more in depth explanation, go to our website www.al-labs-eastern.com and select the "Lawn and Garden" tab at the top of home page. At the bottom of the "Lawn and Garden" page, you find information explaining a soil test report and fertilizer recommendations. http://al-labs-eastern.com/forms/LawnGardenSoilTestExplained.pdf

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M3 - Mehlich 3 WB - Walkley Black Color 1:1 - Water pH

Report Number
12-181-0540 **Page:** 1 of 1

Account Number
01749

Send To : WALTRIP RECYCLING INC
11 MARCLAY ROAD
WILLIAMSBURG , VA 23185

Client : NEW TOWN

A&L Eastern Laboratories, Inc.

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6446

www.aleastern.com

Submitted By : MICHELLE BROADY
Purchase Order :
Report Date : 7/5/2012
Date Received : 6/29/2012

REPORT OF ANALYSIS

Lab No	Sample ID Sample Date and Time	Glass Shards > 4mm	Metal Fragments > 4mm	Organic Matter (LOI)	Plastic Film	Plastic Fragments (>4mm)
		TMECC 07.06.A		SOIL LOI 440	TMECC 07.06.A	
				%		
07730	NEW LAWN	< 1	< 1	4.20	< 1	< 1

Method Reference:
Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, p. 1004-1005
Recommended Chemical Soil Test Procedures for the North Central Region. NCR Research Pub. No. 221 Revised.
Test Methods for the Examination of Composting and Compost, US Composting Council, 1997

Pauric McGroary

Pauric McGroary

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Sample results are reported 'as received' and are not moisture corrected unless noted

GET Solutions, Inc.
Geotechnical • Environmental • Testing

G E T Solutions, Inc.
1592-E Penniman Road
Williamsburg, Virginia 23185
Tel: (757) 564-6452
Fax:(757) 564-6453

FIELD REPORT No. 19
Page 1 of 1

Project No: **WM11-128T**
Permit No:
Permit Date:

Project Name:
Tract 12 - Phase 1 Stonehouse Development

Location:
James City County, Virginia

Client:
George Nice & Sons, Inc.

General Contractor:
George Nice & Sons, Inc.

Day/Date:
Thurs-Sat/21-23 June 12

Weather/Temp:
Sunny/80-90's

Scope of Services:
Bioretention Installation Observations

Deficiency Observed ☐ No Deficiency Observed ☐

As requested, **G E T** representatives visited the project site between the dates of June 21 and June 23, 2012, in order to inspect the on-going construction of Bioretention Facility BMP #2. During our site visits, the subgrade soils within the basin were observed to had been properly de-mucked of all loose sediment. Once approved the contractor proceeded with installing the underdrain system, which consisted of perforated pipe, VDOT #57 stone, and a layer of filter fabric beneath and above the layer of VDOT #57 stone and then installing the subsequest biosoil. Based on our field observations, Bioretention Facility BMP #2 was constructed in general accordance with the approved project plans.

By:
A. Libby/J. Wheeler
G E T Solutions. Inc.

Distribution:
mnice@gniceandsons.com

Reviewed by:

J. Wheeler
G E T Solutions, Inc.

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Geotechnical - Environmental - Testing

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FIELD REPORT No. 1

Project No: **WM11-128T**
Permit No:
Permit Date:

Project Name:
Tract 12 - Phase 1 Stonehouse Development

Location:
James City County, Virginia

Client:
George Nice & Sons, Inc.

General Contractor:
George Nice & Sons, Inc.

Day/Date:
Thurs/12 May 11

Weather/Temp:
Sunny/70's

Scope of Services:
BMP Inspection

Deficiency Observed ☐ No Deficiency Observed ☐

As requested, a **G E T** representative visited the project site in order to observe the footprint of the embankment dam for BMP #1 prior to keyway excavation and subsequent fill placement. The contractor had previously stripped the topsoil from the observed area. Based on our field observations, the observed embankment dam footprint was considered suitable for keyway excavation and embankment dam fill. The keyway should be a minimum of 8 feet wide and 4 feet deep.

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FIELD REPORT No. 2
Page 1 of 1

Project No: **WM11-128T**
Permit No:
Permit Date:

Project Name:
Tract 12 - Phase 1 Stonehouse Development

Location:
James City County, Virginia

Client:
George Nice & Sons, Inc.

General Contractor:
George Nice & Sons, Inc.

Day/Date:
Fri/13 May 11

Weather/Temp:
Cloudy/60's

Scope of Services:
BMP #1 - Key Way Inspection

Deficiency Observed ☐ No Deficiency Observed ☐

As requested, a **G E T** representative visited the project site in order to observe the key way excavation. The contractor had properly excavated the recommended 8-foot wide and 4-foot deep key way. Based on our field observations, the observed key way excavation was considered suitable for fill placement.

By:
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COMPACTION TEST REPORT (No. 1) - Sheet 1 of 2

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/13/11
Project Location:	James City County, Virginia	Technician:	A. Libby
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Cloudy/Rain Temp. (°F) 60's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 - Key Way Backfill for Dam

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	16.3	106.6	123.9	4	95	97	X		3' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
2	18.8	104.1	123.7	4	95	95	X		2' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
3	16.0	104.4	121.1	4	95	95	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
4	18.9	105.0	124.8	4	95	95	X		Subgrade	See Attached Sketch (Page 2 of 2, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill within Keyway	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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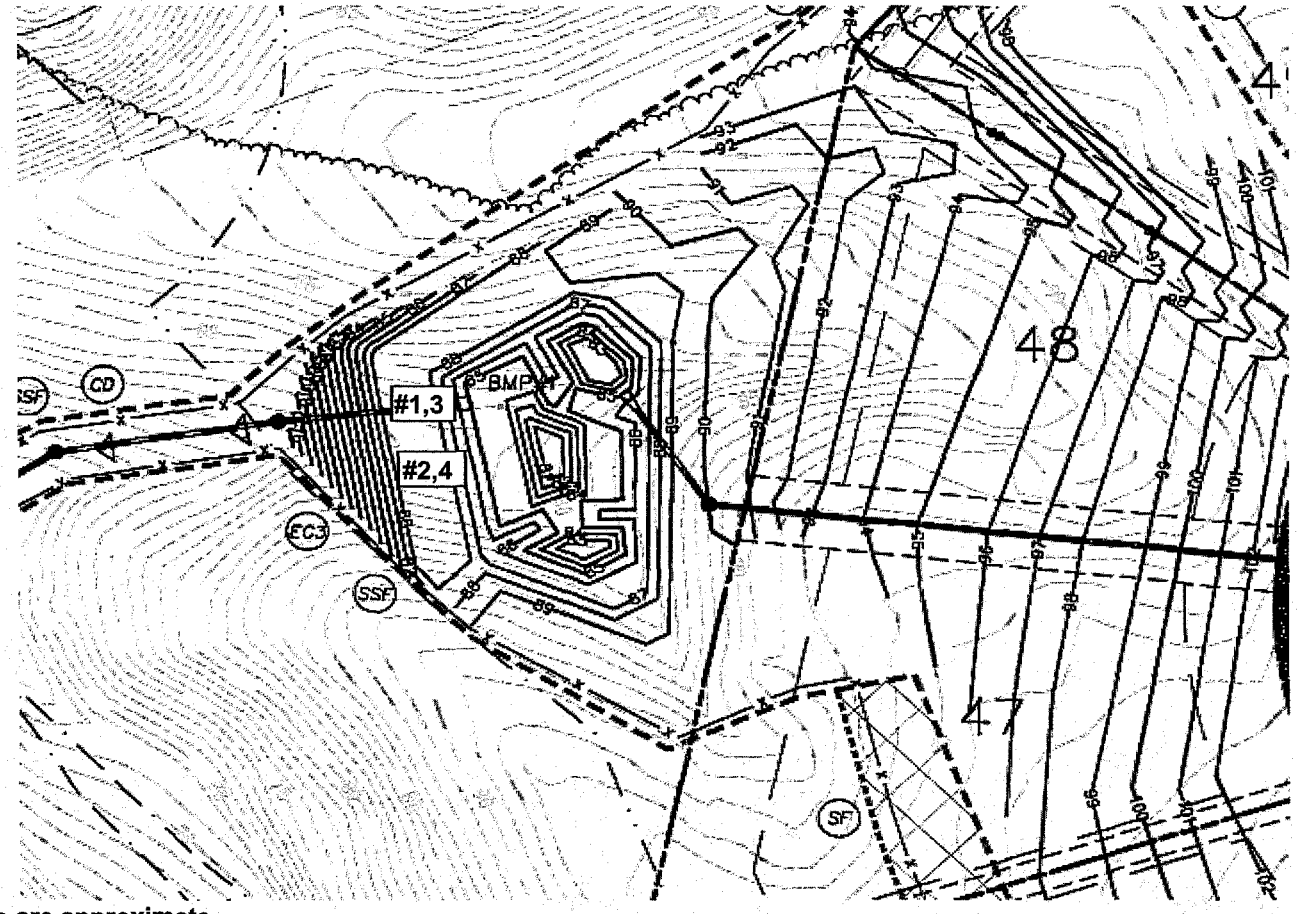
COMPACTION TEST REPORT (No. 1) - Sheet 2 of 2

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	**Tract 12 - Phase 1 Stonehouse Development**		
	James City County, Virginia	**SCALE:**	**NTS**
PROJECT NO:	**WM11-128T**	**DATE:**	**5/13/2011**
CLIENT:	**George Nice & Sons, Inc.**	**PLOT BY:**	**AL**

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COMPACTION TEST REPORT (No. 2) - Sheet 1 of 2

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	A. Dudley
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Emabnkment Dam Fill - BMP #1

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	19.7	104.5	125.1	4	95	95	X		Elev. 75'	See Attached Sketch (Page 2 of 2, Figure 1)
2	18.3	107.1	126.7	4	95	97	X		Elev. 76'	See Attached Sketch (Page 2 of 2, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy Lean CLAY (CL)
Test Conducted on:	Embankment Dam Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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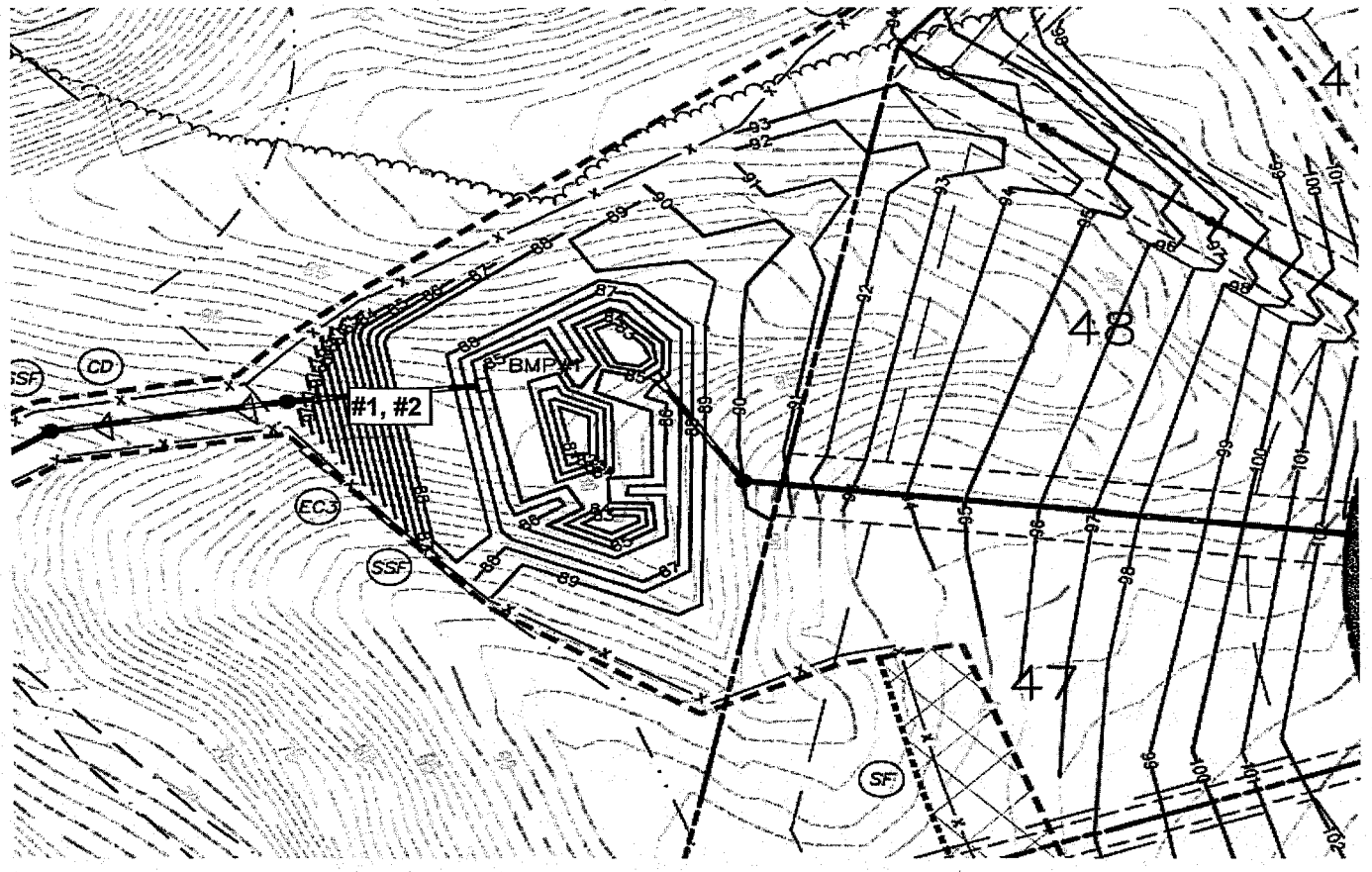
COMPACTION TEST REPORT (No. 2) - Sheet 2 of 2

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/14/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	AD

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COMPACTION TEST REPORT (No. 3) - Sheet 1 of 4

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	R. Tweedy
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Embankment Dam Fill for BMP #1 & Lot #48

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	18.5	100.3	118.9	4	95	90	X		Elev. 77.0'	See Attached Sketch (Page 4 of 4, Figure 1)
2	18.9	104.8	124.6	4	95	94	X		Elev. 78.0'	See Attached Sketch (Page 4 of 4, Figure 1)
3	19.4	102.0	121.9	4	95	92	X		Elev. 79.0'	See Attached Sketch (Page 4 of 4, Figure 1)
4	18.1	108.7	128.3	4	95	98	X		Elev. 80.0'	See Attached Sketch (Page 4 of 4, Figure 1)
5	17.8	103.3	121.6	4	95	93	X		Elev. 83.0'	See Attached Sketch (Page 4 of 4, Figure 1)
6	16.8	107.4	125.5	4	95	97	X		Elev. 84.6'	See Attached Sketch (Page 4 of 4, Figure 1)
7	10.1	110.7	123.9	3	95	98	X		Elev. 83.5'	See Attached Sketch (Page 4 of 4, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	3 4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	6, 12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Keyway	Max. Dry Density (pcf):	113.5 111.0
		Optimum Moisture (%):	14.5% 16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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COMPACTION TEST REPORT (No. 3) - Sheet 2 of 4

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	R. Tweedy
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 and Lot #48 Fill

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
8	10.1	112.4	123.8	3	95	99	X		Elev. 83.5'	See Attached Sketch (Page 4 of 4, Figure 1)
9	10.2	114.0	125.7	3	95	100	X		Elev. 80.9'	See Attached Sketch (Page 4 of 4, Figure 1)
10	17.5	108.1	121.2	4	95	97	X		Elev. 83.5'	See Attached Sketch (Page 4 of 4, Figure 1)
11	16.8	106.1	124.0	4	95	96	X		Elev. 80.9'	See Attached Sketch (Page 4 of 4, Figure 1)
12	18.0	102.6	121.0	4	95	92	X		Elev. 82.0'	See Attached Sketch (Page 4 of 4, Figure 1)
13	11.8	107.0	119.5	4	95	96	X		Elev. 83.0'	See Attached Sketch (Page 4 of 4, Figure 1)
14	15.6	104.1	120.3	4	95	94	X		Elev. 84.0'	See Attached Sketch (Page 4 of 4, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	3 4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	BMP and Lot Fill	Max. Dry Density (pcf):	113.5 111.0
		Optimum Moisture (%):	14.5% 16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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COMPACTION TEST REPORT (No. 3) - Sheet 3 of 4

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	R. Tweedy
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 and Lot #48 Fill

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
15	13.8	108.6	123.6	4	95	98	X		Elev. 81.9'	See Attached Sketch (Page 4 of 4, Figure 1)
16	15.3	107.2	123.6	4	95	97	X		Elev. 86.4'	See Attached Sketch (Page 4 of 4, Figure 1)
17	13.9	105.0	119.6	4	95	95	X		Elev. 84.0'	See Attached Sketch (Page 4 of 4, Figure 1)
18	17.4	111.1	124.9	4	95	100	X		Elev. 82.8'	See Attached Sketch (Page 4 of 4, Figure 1)
19	14.2	108.0	123.3	4	95	97	X		Elev. 86.4'	See Attached Sketch (Page 4 of 4, Figure 1)
20	16.5	106.8	124.3	4	95	96	X		Elev. 84.0'	See Attached Sketch (Page 4 of 4, Figure 1)
21	15.8	108.9	126.2	1	95	98	X		Elev. 82.5'	See Attached Sketch (Page 4 of 4, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	BMP and Lot Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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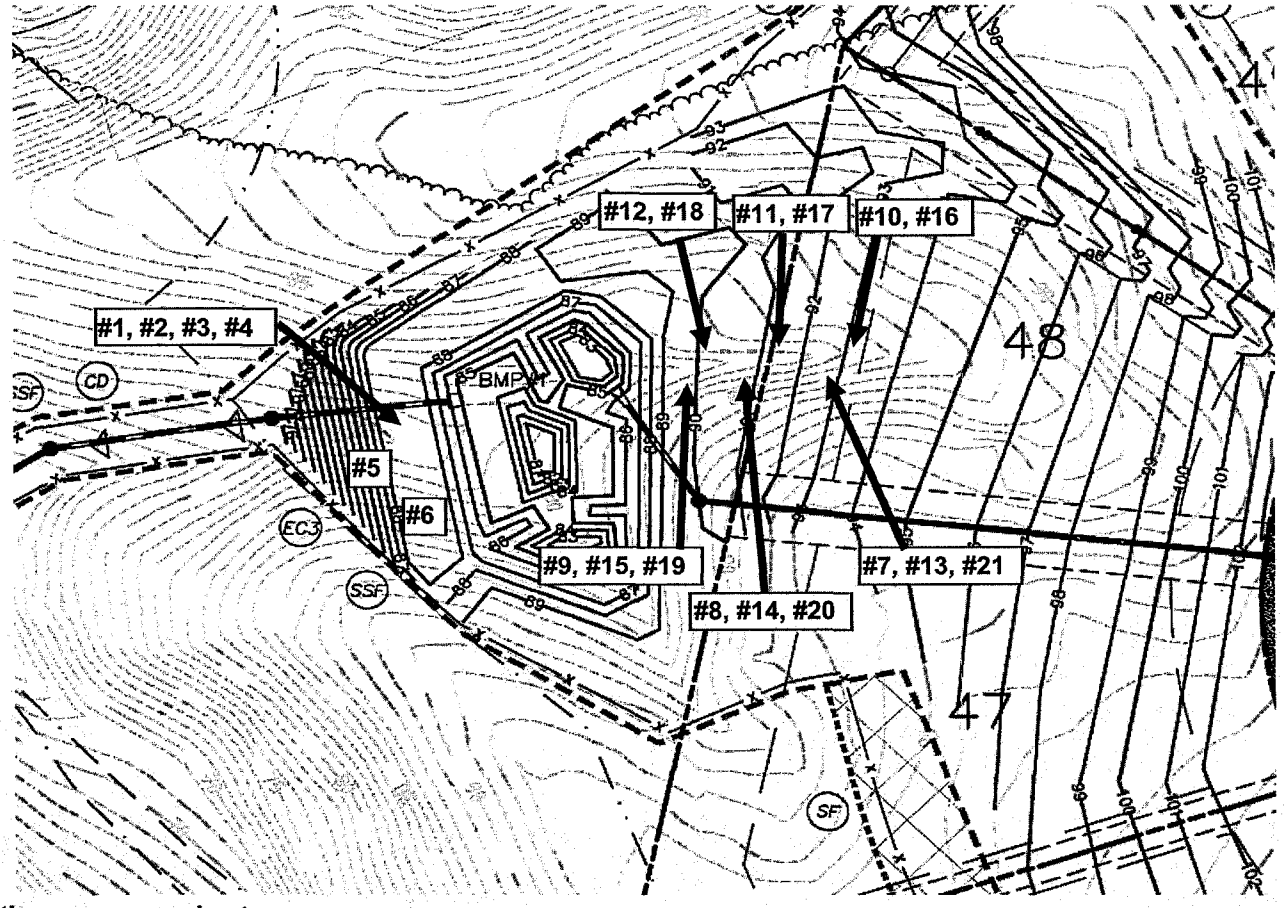
COMPACTION TEST REPORT (No. 3) - Sheet 4 of 4

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/14/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	RT

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COMPACTION TEST REPORT (No. 4) - Sheet 1 of 2

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/24/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Embankment Dam Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	18.7	105.1	124.8	4	95	96	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
2	18.0	104.4	123.1	4	95	95	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
3	16.2	105.3	122.3	4	95	96	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
4	17.8	106.6	125.6	4	95	97	X		Subgrade	See Attached Sketch (Page 2 of 2, Figure 1)
5	19.5	105.5	126.1	4	95	96	X		Subgrade	See Attached Sketch (Page 2 of 2, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Outfall Pipe	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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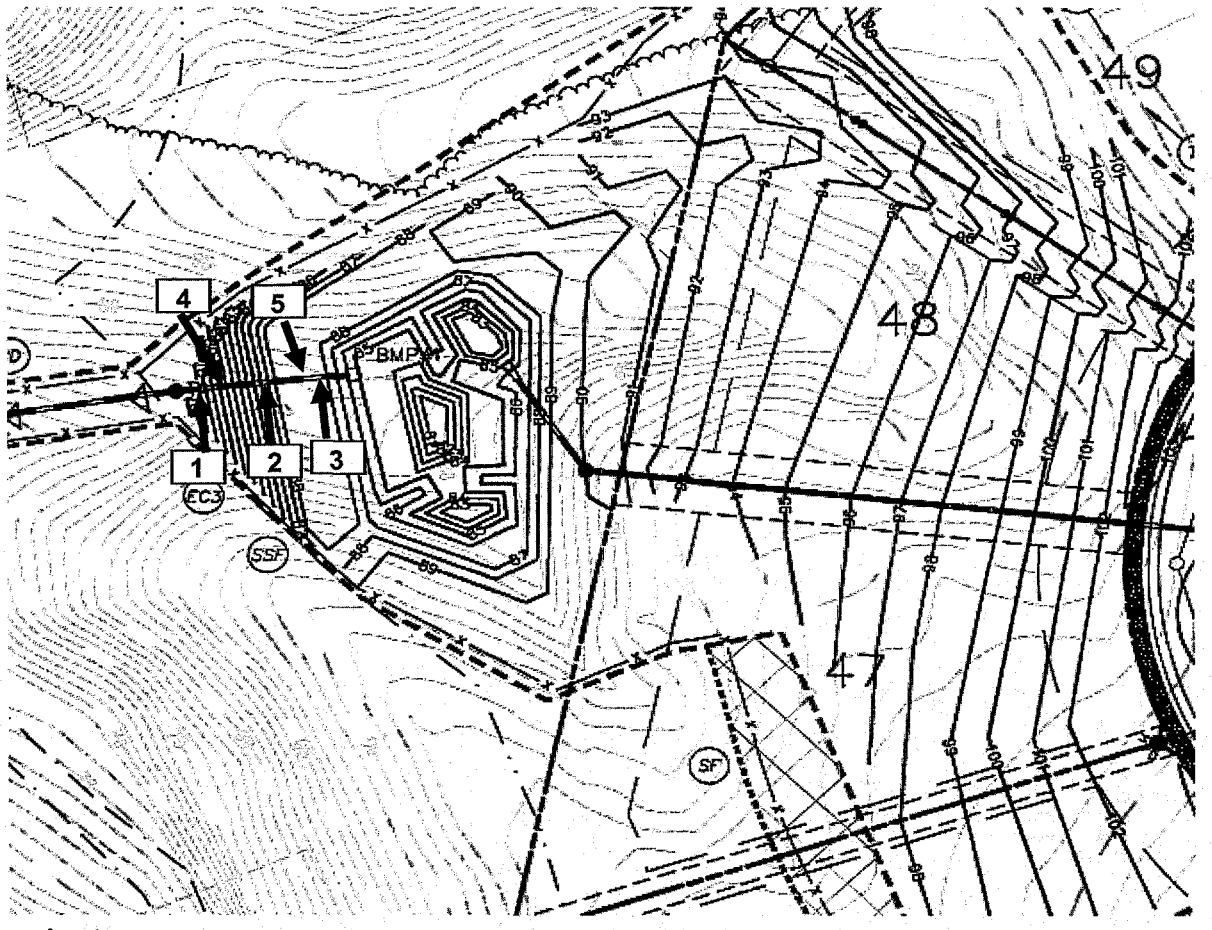
COMPACTION TEST REPORT (No. 4) - Sheet 2 of 2

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/24/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	DM

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COMPACTION TEST REPORT (No. 5) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/25/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Embankment Dam & Sediment Trap

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	18.7	105.7	125.5	4	95	96	X		Elev. 73.8'	See Attached Sketch (Page 3 of 3, Figure 1)
2	14.7	109.3	125.4	4	95	99	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
3	16.6	104.7	122.1	4	95	95	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
4	17.1	106.0	124.1	4	95	96	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
5	17.0	105.0	122.9	4	95	95	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
6	15.6	105.1	121.5	4	95	96	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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COMPACTION TEST REPORT (No. 5) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/25/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 - Embankment Dam

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
7	15.8	107.8	124.8	4	95	98	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)
8	19.4	104.5	124.8	4	95	95	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)
9	16.7	106.3	124.0	4	95	97	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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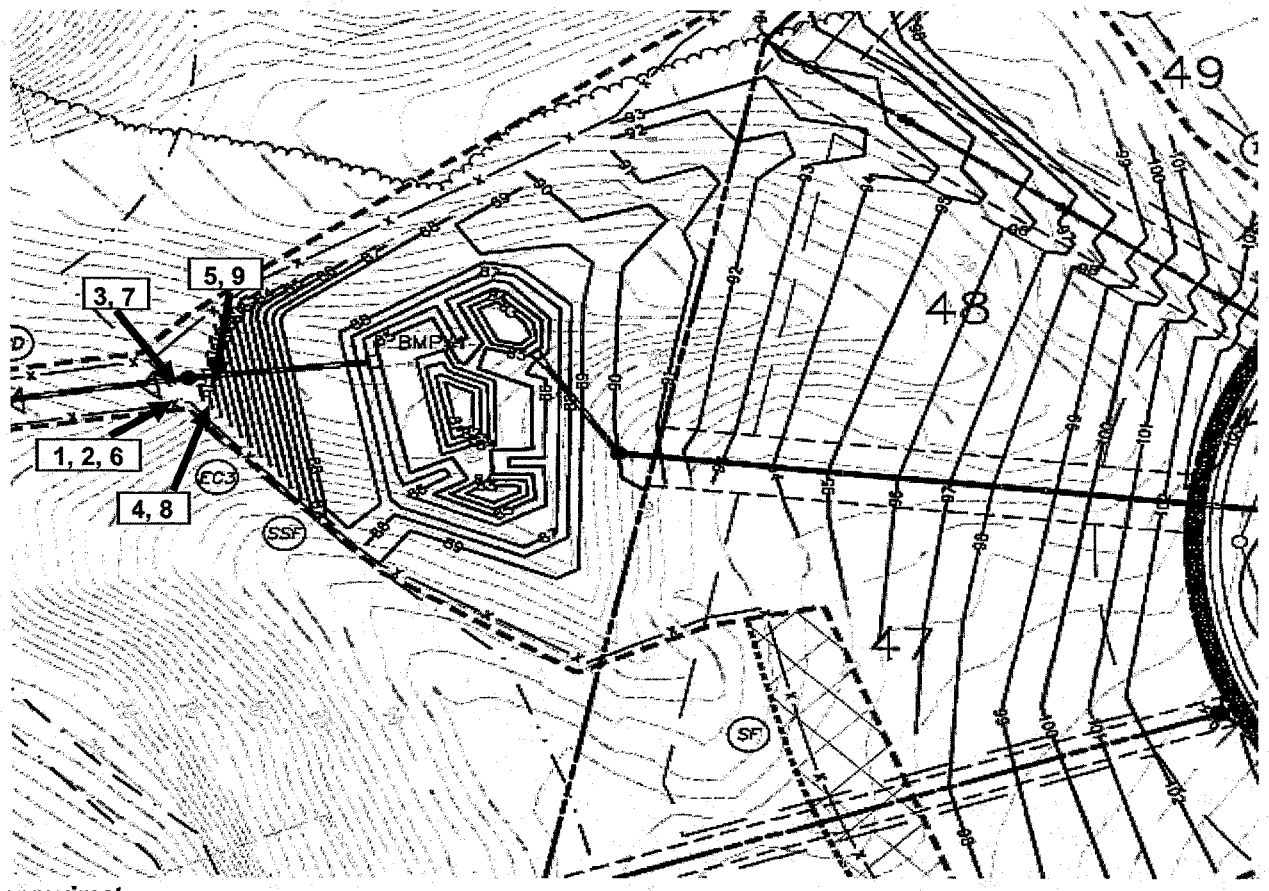
COMPACTION TEST REPORT (No. 5) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	**Tract 12 - Phase 1 Stonehouse Development James City County, Virginia**	**SCALE:**	**NTS**
PROJECT NO:	**WM11-128T**	**DATE:**	**5/25/2011**
CLIENT:	**George Nice & Sons, Inc.**	**PLOT BY:**	**JW**

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COMPACTION TEST REPORT (No. 6) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/26/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	17.6	104.2	122.5	4	95	95	X		Elev. 81'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
2	18.4	104.1	123.3	4	95	95	X		Elev. 81'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
3	17.2	108.8	127.6	4	95	99	X		Elev. 81'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
4	17.4	108.2	127.0	4	95	98	X		Elev. 81'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
5	13.4	108.5	123.0	4	95	99	X		Elev. 82'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
6	17.5	109.6	123.3	4	95	100	X		Elev. 82'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
7	15.8	107.5	124.5	4	95	98	X		Elev. 82'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
8	17.6	105.2	123.7	4	95	96	X		Elev. 82'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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COMPACTION TEST REPORT (No. 6) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/26/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
9	18.4	105.5	124.9	4	95	96	X		Elev. 83'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
10	18.7	105.6	125.4	4	95	96	X		Elev. 83'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
11	18.7	104.2	123.7	4	95	95	X		Elev. 83'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
12	15.3	107.6	124.1	4	95	98	X		Elev. 83'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
13	18.5	104.4	123.6	4	95	95	X		Elev. 84'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
14	17.2	105.7	123.9	4	95	96	X		Elev. 84'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
15	18.3	104.7	123.8	4	95	95	X		Elev. 84'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
16	18.9	106.0	126.0	4	95	96	X		Elev. 84'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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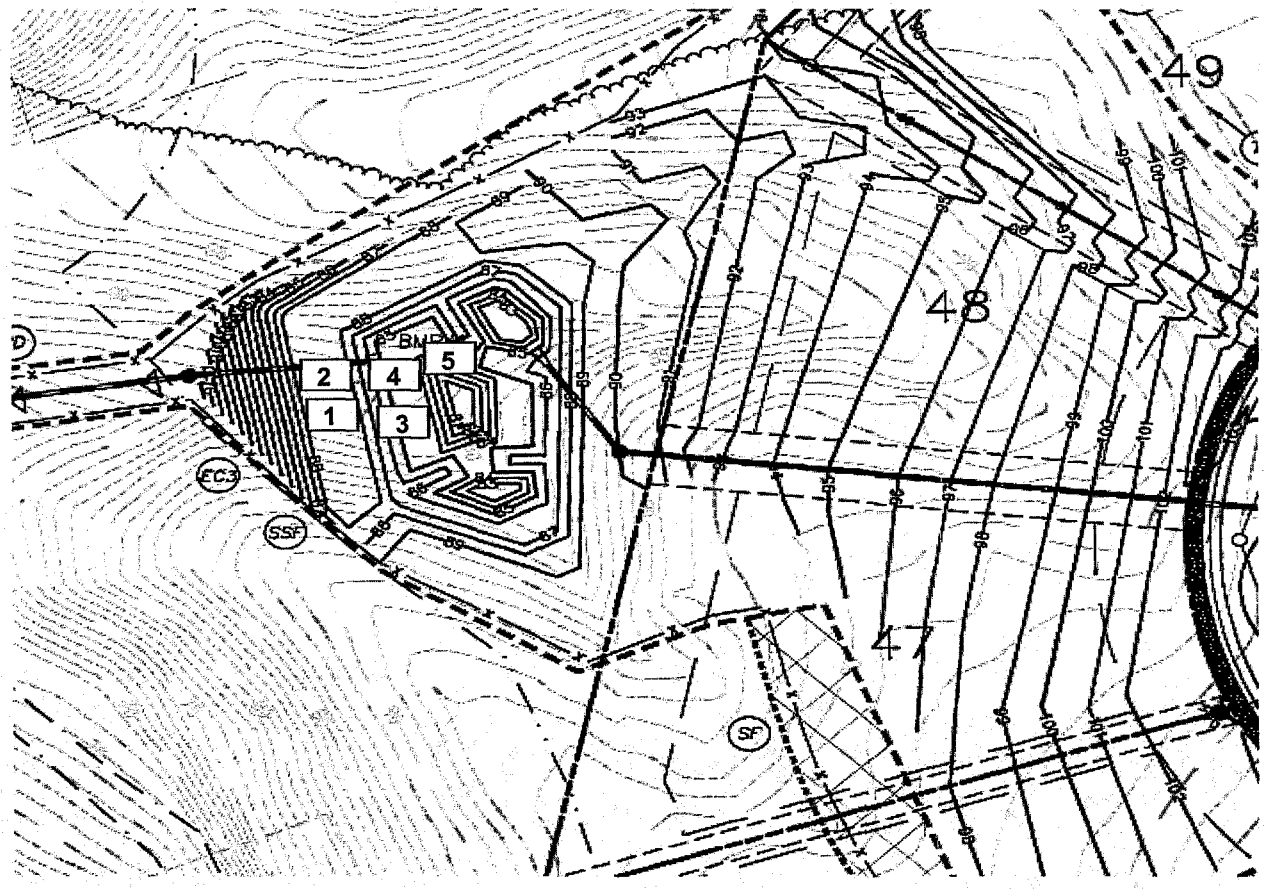
COMPACTION TEST REPORT (No. 6) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	**Tract 12 - Phase 1 Stonehouse Development James City County, Virginia**	**SCALE:**	**NTS**
PROJECT NO:	**WM11-128T**	**DATE:**	**5/26/2011**
CLIENT:	**George Nice & Sons, Inc.**	**PLOT BY:**	**DM**

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COMPACTION TEST REPORT (No. 7) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/27/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	17.7	106.6	125.4	4	95	97	X		Elev. 86'	Location #5 - See Attached Sketch (Page 3 of 3, Figure 1)
2	18.4	106.4	126.0	4	95	97	X		Elev. 86'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
3	17.4	108.0	126.7	4	95	98	X		Elev. 86'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
4	17.8	105.6	124.4	4	95	96	X		Elev. 86'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
5	16.5	108.9	126.9	4	95	99	X		Elev. 87'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
6	16.8	106.8	124.7	4	95	97	X		Elev. 87'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
7	17.2	104.8	122.8	4	95	95	X		Elev. 87'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
8	16.8	105.2	123.0	4	95	96	X		Elev. 87'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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COMPACTION TEST REPORT (No. 7) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/27/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
9	19.4	106.3	126.9	4	95	97	X		Elev. 88'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
10	19.1	106.5	126.9	4	95	97	X		Elev. 88'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
11	17.9	106.7	125.8	4	95	97	X		Elev. 88'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
12	14.0	105.4	125.5	4	95	96	X		Elev. 88'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
13	15.6	108.0	124.9	4	95	98	X		Elev. 88'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
14	17.2	105.9	124.0	4	95	96	X		Elev. 88'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
15	13.4	108.9	123.4	4	95	99	X		Elev. 88'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
16	13.5	107.8	122.3	4	95	98	X		Elev. 88'	Location #5 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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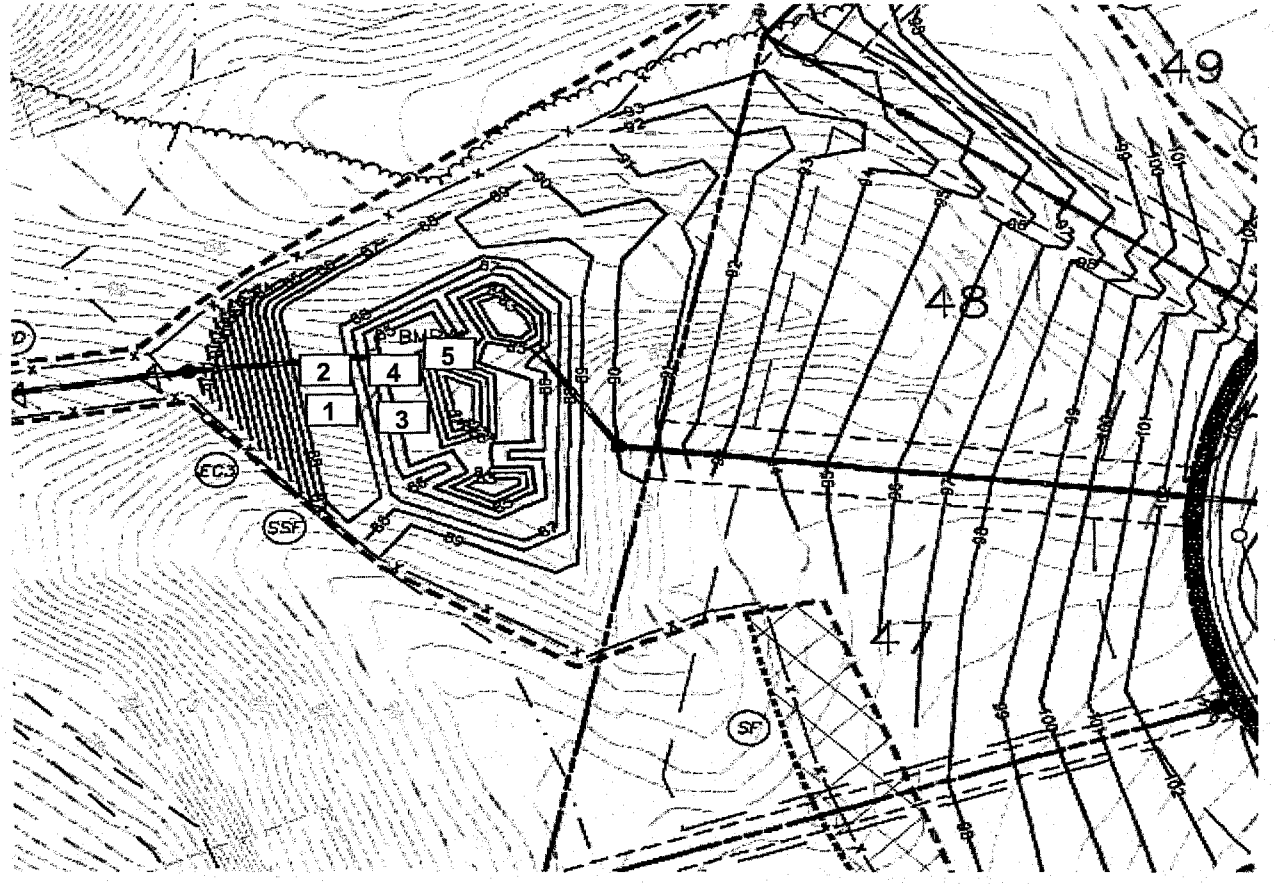
COMPACTION TEST REPORT (No. 7) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/27/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	DM

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COMPACTION TEST REPORT (No. 8) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/31/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #2 to BMP #1

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	14.4	104.3	119.3	4	95	95	X		3' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
2	14.6	104.5	119.8	4	95	95	X		3' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
3	15.4	105.5	121.8	4	95	96	X		2' BFG	See Attached Sketch (Page 3 of 3, Figure 1)
4	15.3	108.5	125.2	4	95	99	X		2' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
5	16.7	108.0	126.0	4	95	98	X		1' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
6	17.9	105.4	124.3	4	95	96	X		1' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
7	16.5	108.1	126.0	4	95	98	X		Subgrade	See Attached Sketch (Page 3 of 3, Figure 1)
8	18.0	104.2	122.9	4	95	95	X		1' BSG	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Sewer	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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COMPACTION TEST REPORT (No. 8) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/31/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #2 to BMP #1

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
9	18.4	104.2	123.4	4	95	95	X		2' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
10	17.9	107.4	126.7	4	95	98	X		3' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
11	17.2	105.5	123.7	4	95	96	X		4' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
12	16.4	106.5	124.0	4	95	97	X		5' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
13	15.4	104.6	120.0	4	95	95	X		Subgrade	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Drain	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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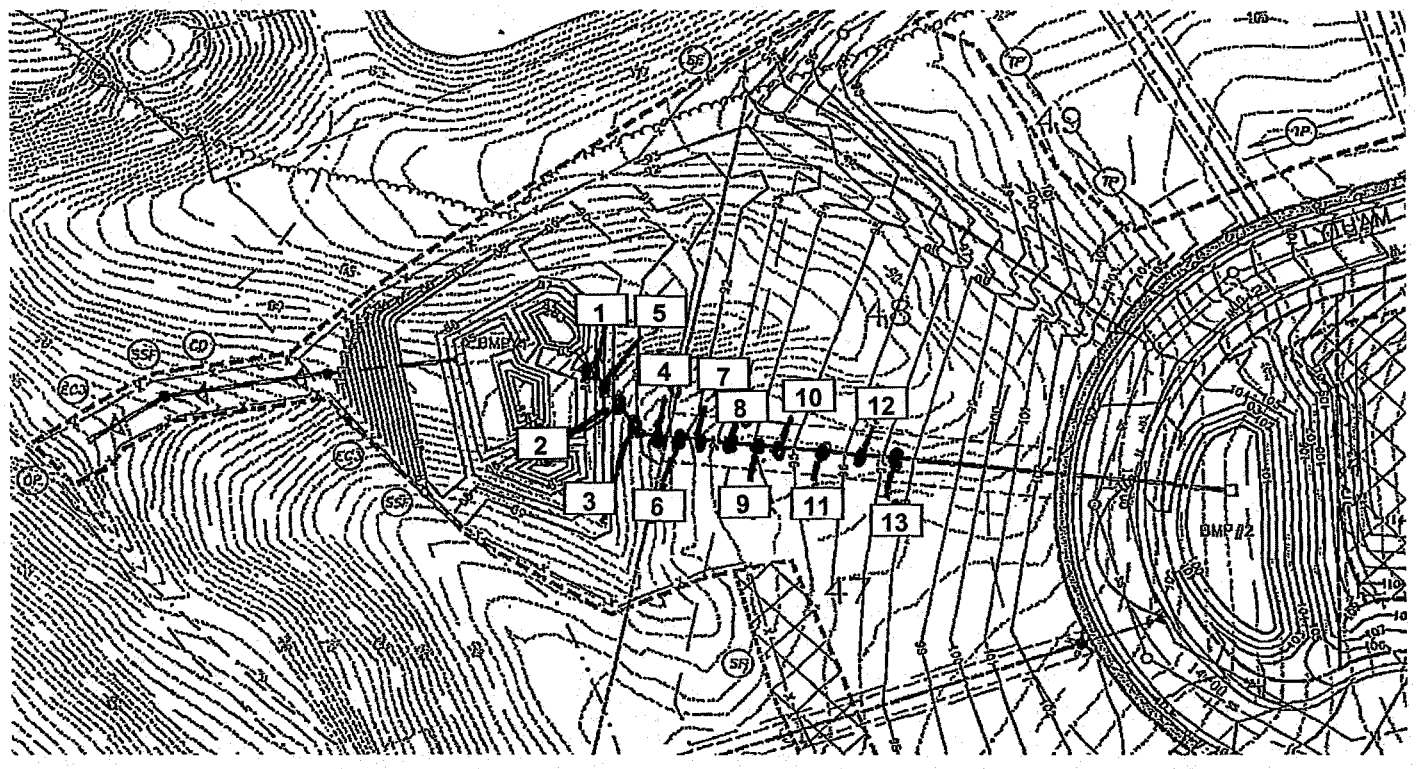
COMPACTION TEST REPORT (No. 8) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	**Tract 12 - Phase 1 Stonehouse Development James City County, Virginia**	**SCALE:**	**NTS**
PROJECT NO:	**WM11-128T**	**DATE:**	**5/27/2011**
CLIENT:	**George Nice & Sons, Inc.**	**PLOT BY:**	**DM**

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COMPACTION TEST REPORT (No. 9) - Sheet 1 of 5

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	6/1/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #1to BMP #2

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	17.6	108.6	127.8	4	85	99	X		5' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
2	18.6	108.3	128.4	4	85	98	X		5' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
3	18.6	105.7	125.4	4	85	96	X		4' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
4	17.2	105.9	124.1	4	85	96	X		4' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
5	17.5	109.6	128.1	4	85	100	X		3' BSG	See Attached Sketch (Page 3 of 5, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Drain	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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COMPACTION TEST REPORT (No. 9) - Sheet 2 of 5

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	6/1/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #1to BMP #2

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
6	18.6	107.6	127.7	4	85	98	X		3' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
7	16.9	110.6	129.6	4	85	100	X		2' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
8	16.7	107.6	125.5	4	85	98	X		2' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
9	19.2	104.9	125.1	4	85	95	X		1' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
10	15.7	109.4	126.6	4	85	99	X		Subgrade	See Attached Sketch (Page 3 of 5, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Drain	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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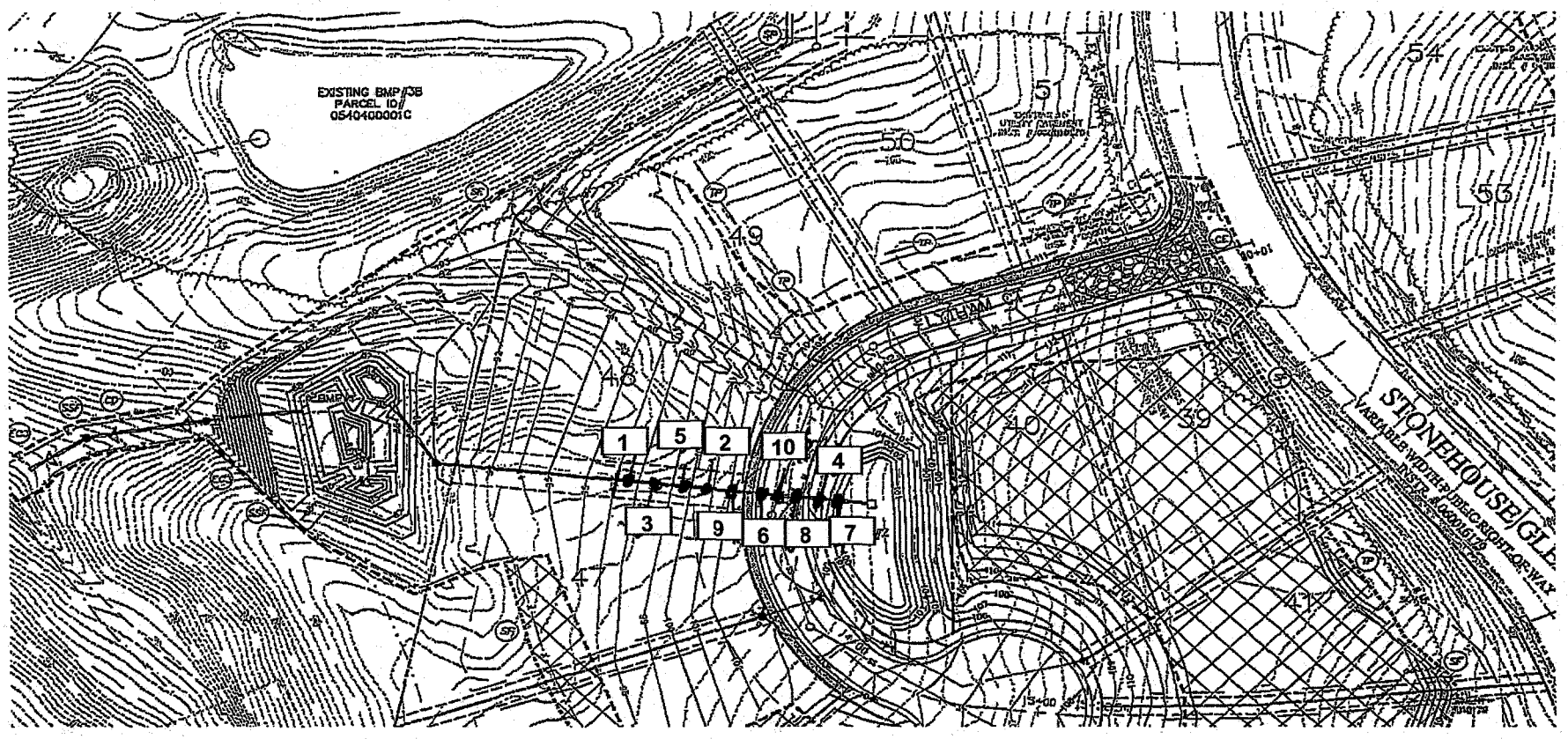
COMPACTION TEST REPORT (No. 9) - Sheet 3 of 5

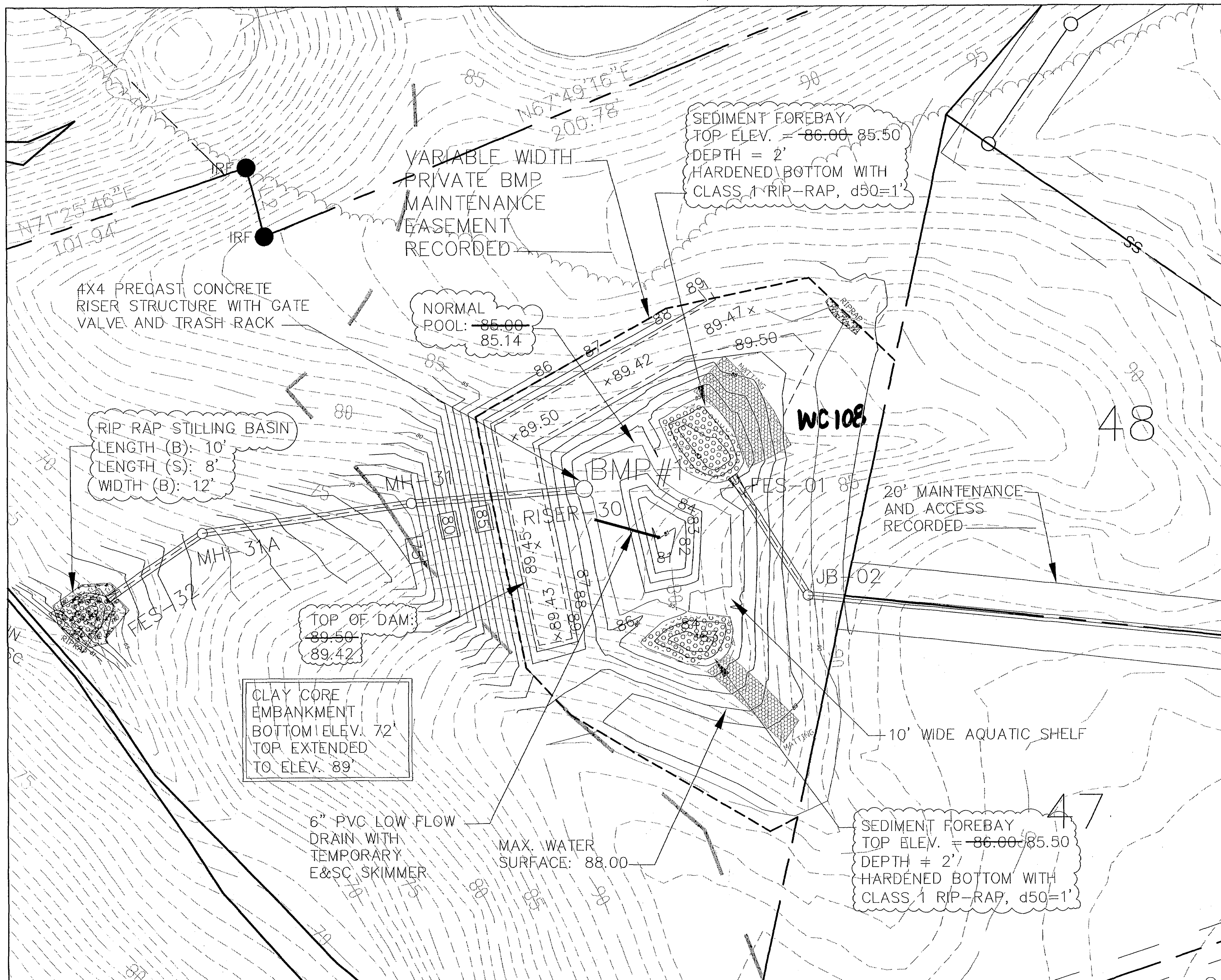
Figure 1



Locations are approximate

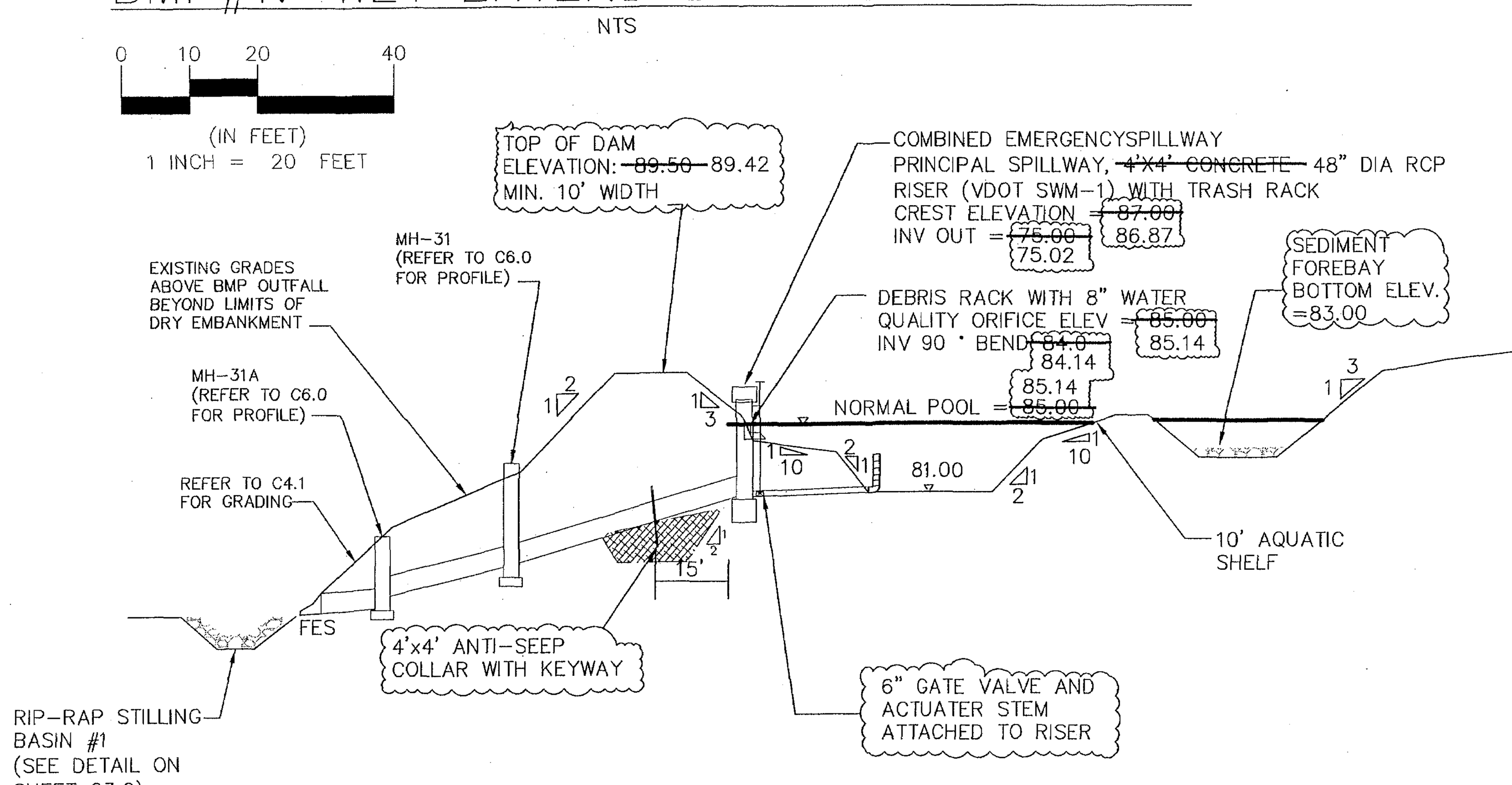
LOCATION SKETCH

PROJECT:	**Tract 12 - Phase 1 Stonehouse Development James City County, Virginia**	**SCALE:**	**NTS**
PROJECT NO:	**WM11-128T**	**DATE:**	**6/1/2011**
CLIENT:	**George Nice & Sons, Inc.**	**PLOT BY:**	**JW**



BMP#1: WET EXTENDED DETENTION POND

NTS



100 YEAR ELEVATION = 87.18
10 YEAR ELEVATION = 86.78
2 YEAR ELEVATION = 86.47
1 YEAR ELEVATION = 86.24

NOTE: THE RISER STRUCTURE SHALL BE PROVIDED WITH KOR-N-SEAL (OR EQUIVALENT BOOTS) FOR DISSIMILAR PIPE MATERIALS.

REFER TO SHEETS C8.1 FOR DETAILS AND C6.0 FOR OUTFALL PROFILES.

REFER TO LANDSCAPE DEVELOPMENT PLANS FOR BMP PLANTINGS.

RECORD DRAWINGS SEQUENCE TO CONVERT BASIN TO WET POND

1. LARGE RECORD DRAWINGS EQUIPMENT SHALL BE PROHIBITED IN VICINITY OF RISER STRUCTURE AND DAM TO NOT THREATEN STRUCTURAL INTEGRITY.
2. AFTER FINAL STABILIZATION, DEWATER THE WET STORAGE AREA FOLLOWING THE METHODS OUTLINED IN THE VESCH, 1992 EDITION.
3. REMOVE SEDIMENT AND OTHER DEBRIS TO A CONTAINED SPOIL AREA AND PROPERLY DISPOSED IN ACCORDANCE WITH APPLICABLE REGULATIONS.
4. PROVIDE TOPSOIL FOR ADEQUATE SHELF TO PROMOTE FINAL STABILIZATION.
5. MODIFY THE RISER STRUCTURE AS SHOWN ON THE PLANS AND CONTACT THE ENGINEER AND COUNTY FOR A FINAL INSPECTION.
6. AFTER INSPECTION, INSTALL LANDSCAPING AND STABILIZATION AS SHOWN ON THE PLANS IN ACCORDANCE WITH VESCH, 1992 EDITION AND MINIMUM STANDARD 3.05 OF THE VSWM, 1999 EDITION.

NOTES:

1. ALL RCP SHALL BE CLASS III MEETING ASTM STANDARD C76 WITH O RING JOINTS. JOINTS SHALL BE WRAPPED WITH NON-WOVEN FELT FABRIC EXTENDING 6-8 INCHES ON EITHER SIDE OF THE JOINT.
2. DAM EMBANKMENTS SHALL HAVE 95% COMPACTION WITH MOISTURE CONTENT WITHIN 2% OF THE OPTIMUM AND CERTIFIED BY GEOTECHNICAL ENGINEER. GEOTECHNICAL ENGINEER TO APPROVE FILL MATERIAL AND INSPECT COMPACTION IN 1' LIFTS.
3. EXCAVATE EXISTING ALLUVIAL SOILS TO FIRM SOIL (+/- 5') FOR DAM EMBANKMENTS. KEYWAY SHALL BE 8' WIDE AT BOTTOM WITH 2:1 SIDESLOPES TO THE ELEVATION OF THE BARREL ASSEMBLY. BACKFILL WITH SUITABLE MATERIAL, APPROVED BY GEOTECHNICAL ENGINEER, IN 1' LIFTS. COMPACT TO STANDARD PROCTOR ASTM D-698.
4. ALL PVC PIPE SHALL BE PRESSURE RATED. ALL HDPE PIPE SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321-05.
5. GASKETS (ASTM F477) AND FITTINGS (ASTM D3212) SHALL BE USED FOR SOIL AND WATER TIGHT HDPE CONNECTIONS TO CONCRETE STRUCTURES. NON-SHRINK GROUT SHALL BE USED AROUND MANHOLE OPENING.
6. VDOT IS NOT RESPONSIBLE FOR THE MAINTENANCE OF THE BMP'S OR THEIR OUTFALL STRUCTURES, AND SHALL BE SAVED HARMLESS FROM ANY DAMAGES.

STORMWATER BMP FACILITY MAINTENANCE PLAN

PROPER MAINTENANCE OF THIS FACILITY IS ENCOURAGED TO PREVENT THE INTRODUCTION OF DEBRIS AND SEDIMENT INTO THE FACILITY, SPILLWAY(S), AND DOWNSTREAM WATERWAYS. FOLLOWING INSTALLATION OF THE FACILITY AND ESTABLISHMENT OF VEGETATION IN DISTURBED AREAS, INSPECTION FOR SEDIMENT BUILDUPS WILL BE PERFORMED AT LEAST QUARTERLY. IT IS ANTICIPATED THAT UNDER NORMAL CONDITIONS, SEDIMENT REMOVAL FROM THE FACILITY WILL BE RQEUIRED ONCE EVERY 10 YEARS. IF OTHER CONS TRUCTION OR RELATED ACTIVITIES ARE PERFORMED ON UPSLOPE PARCELS, ADEQUATE PROTECTION SHOULD BE PROVIDED AND INSPECTIONS PERFORMED ATLEAST ONCE WEEKLY OF THESE NEWLY DISTURBED AREAS AS WELL AS INPSECTIONS FOR ACCUMULATED SEDIMENTS AT THE BMP FACILITY.

A DESIGNATED REPRESENTATIVE OF THE OWNER WILL INSPECT THE BMP STRUCTURE AFTER EACH SIGNIFICANT RAIN EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL EVENT 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. APPROPRIATE ACTION, PERFORMED AT THE COST OF THE OWNER, WILL BE TAKEN TO ENSURE APPROPRIATE MAINTENANCE KEYS TO LOCKED ACCESS POINTS SHALL BE MADE AVAILABLE TO COUNTY PERSONNEL UPON REQUEST.

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

1. THE INSPECTION FOR SEDIMENT BUILD-UP WILL BE PERFORMED BY VISUAL INSPECTION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN THE STORAGE AREA. SEDIMENT REMOVAL IS REQURIED USING A RUBBER WHEELED BACKHOE. AT THE SAME TIME, OR ATLEAST ONCE PER YEAR, THE RISER BOTTOM AND OUTLET PIPE SHALL BE CLEANED OF ACCUMULATED SEDIMENTS. DISPOSE OF SEDIMENTS REMOVED FRO M THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA. SEDIMENT SHALL NOT BE ALLOWED TO ACCUMULATE IN DEPTHS GREATER THAN 1-FOOT. NO SEDIMENT SHALL BE ALLOWED TO ACCUMULATE TO PREVENT THE PROPER FUNCTION OF ANY PIPE OR CULVERT.
2. PERFORM MAINTENANCE MOWING OF GRAS SED AREAS AT LEAST TWICE EACH YEAR. GRASSES SUCH AS TALL FESCUE SHOULD BE MOWED IN EARLY SUMMER AFTER EMERGENCE OF THE HEADS ON COOL SEASON GRASSES AND IN LATE FALL TO PREVENT SEEDS OF ANNUAL WEEDS FROM MATURING. MOWING OF LEGUMES CAN BE LESS FREQUENT. TREES AND SHRUBS SHOULD NOT BE PERMITTED TO GROW ON ANY PART OF THE GRADED EMBANKMENT.
3. PERFORM SOIL SAMPLING ON STABILIZED BMP SOIL AREAS ONCE EVERY 4 YEARS. SOIL SAMPLING AND TESTING SHOULD BE PEFORMED BY A QUALIFIED INDEPENDENT TESTING LABORATORY. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.
4. IF VEGETATION COVERS LESS THAN 40% OF SOIL SURFACES IN STABILIZE BMP AREAS, LIME, FERTILIZE, AND SEED IN ACCORDANCE WITH RECOMMENDATIONS FOR DAM CONSRUCTION. IF VEGETATION COVERS NEW SEEDLINGS, AS LISTED ON NOTES, MORE THAN 40% BUT LESS THAN 70% OF SOIL SURFACES, LIME, FERTILIZE, AND OVERSEED IN ACCORDANCE WITH CURRENT SEEDLING RECOMMENDATIONS.
5. PERFORM QUARTERLY INSPECTIONS OF THE RELEASE STRUCTURES, RISER SECTION, AND CREST OF SPILLW AY FOR THE OBSERVANCE OF COLLECTED DEBRIS. IMMEDIATELY REMOVE ANY DEBRIS TO MAINTAIN.
6. PERFORM YEARLY STRUCTURAL INSPECTIONS OF THE FACILITY FOR DAMAGE. STRUCTURAL INSPECTION SHALL BE PERFORMED ON THE CONCRETE RISER, ANTI-VORTEX DEVICE, TRASH RACK, ORIFICE / WIER(S), OUTLET BARREL, AND EMBANKMENT. IF DAMAGE IS EVIDENT, FURTHER INVESTIGATION BY A PROFESSIONAL ENGINEER MAY BE REQUIRED TO ASSESS THE CONTINUED INTEGRITY OF THE STRUCTURE.
7. PERFORM QUARTERLY INSPECTIONS OF THE GRADED SIDE SLOPES OF THE BMP FACILITY FOR SIGNS OF ANIMAL/RODENT BORROWS OR SLOPE EROSION. IMMEDIATELY PERFORM NECESSARY REPAIRS, REFILLING OR RESEEDING AS APPROPRIATE.
8. THE OWNER OR DESIGNATED REPRESENTATIVE SHALL KEEP REASONABLE, ACCURATE WRITTEN RECORDS OF INSPECTIONS PERFORMED ON THE STRUCTURE. RECORDS SHALL DOCUMENT ROUTINE MAINTENANCE AND/OR REPAIRS PERFORMED. COPIES SHALL BE PROVIDED TO THE COUNTY UPON REQUEST.
9. THE FACILITY SHALL NOT BE MODIFIED IN ANY WAY WITHOUT PRIOR CONSENT/APPROVAL OF THE COUNTY.

MAINTENANCE/INSPECTION GUIDELINES

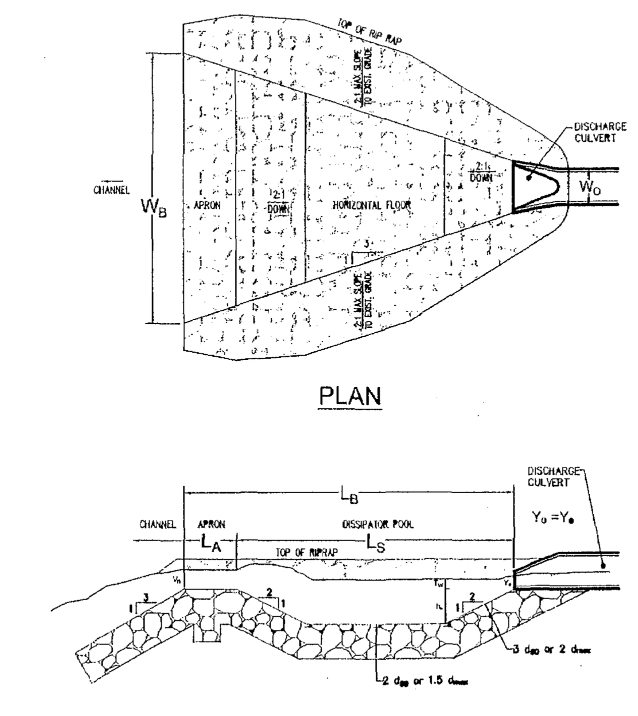
A schedule of recommended maintenance for bioretention areas with general guidance regarding methods, frequency, and time of year for maintenance is as follows:

Description	Method	Frequency	Time of the year
SOIL			
Inspect and Repair Erosion	Visual	Monthly	Monthly
ORGANIC LAYER			
Remulch any void areas	By hand	Whenever needed	Whenever needed
Remove previous mulch layer before applying new layer (optional)	By hand	Once every two to three years	Spring
Any additional mulch added (optional)	By hand	Once a year	Spring
PLANTS			
Removal and replacement of all dead and diseased vegetation considered beyond treatment	See planting specifications	Twice a year	3/15 to 4/30 and 10/1 to11/30
Treat all diseased trees and shrubs	Mechanical or by hand	N/A	Depends on insect or disease infestation
Watering of plant material shall take place at the end of each day for 14 consecutive days after planting has been completed	By hand	Immediately after completion of project	N/A
Replace stakes after one year	By hand	Once a year	Only remove stakes in the spring
Replace any deficient stakes or wires	By hand	N/A	Whenever needed
Check for accumulated sediments	Visual	Monthly	Monthly

THE RECORD DRAWING INFORMATION IS REFLECTIVE OF ASBUILT INFORMATION BY GEORGE NICE SONS DATED (07/13/2012) FOR THE GRADING AND WSPSELLS SURVEYING FOR THE BMP STRUCTURES.

NORTH

0 10 20 40
(IN FEET)
1 INCH = 20 FEET



RIP RAP STILLING BASIN DETAIL

N.T.S

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 PREVIOUS APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA
S. SHAYNE LEATHERS
Lic. No. 050365
PROFESSIONAL ENGINEER

(SEAL)

VIRGINIA REGISTERED PROFESSIONAL ENGINEER OR CERTIFIED LAND SURVEYOR

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RECORD DRAWING

PROJECT # S-0048-2009

WSP · SELLS
Transportation & Infrastructure
15401 Weston Parkway Suite 100 • Cary, NC 27513 • 919.678.0035
www.wspsells.com

PRELIMINARY RECORD DRAWINGS

TRACT 12 STONEHOUSE

JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

Environmental Division
OCT 15 2012
RECEIVED

REVISIONS	
1	RECORD DRAWING 10-10-12

PROJECT #: 08-4051 DATE: 08/17/09
DRAWN BY: MB CHECKED BY: CD

TITLE

BMP#1 AND 4 DETAILS (WET PONDS)

SHEET

C5.0

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10/12/2012 11:09 AM; L:\Stonehouse\08-4051-Stonehouse-TR12\00-Drawings\05-As-Built\PHASE 1\C5 BMP DETAILS.DWG; C5.0-BMP#1-4; USMB04034

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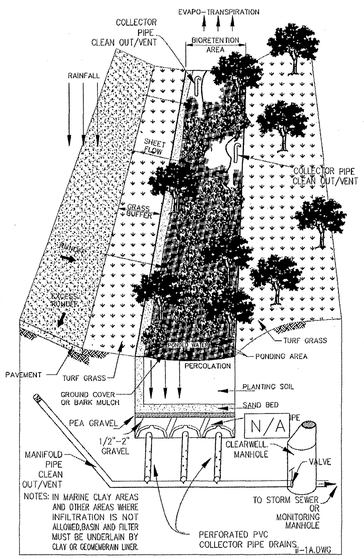
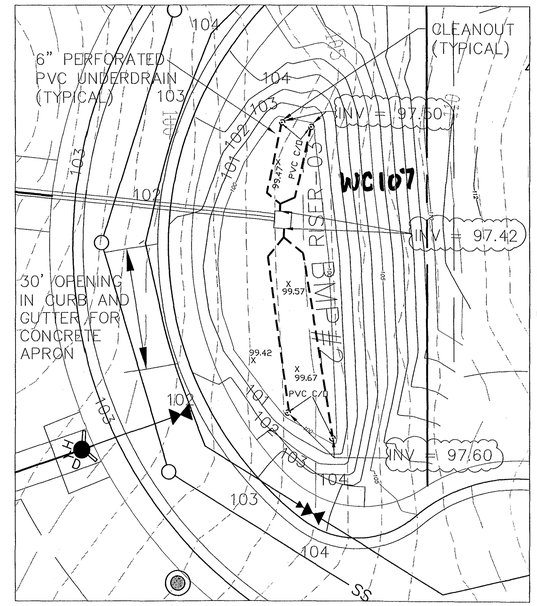
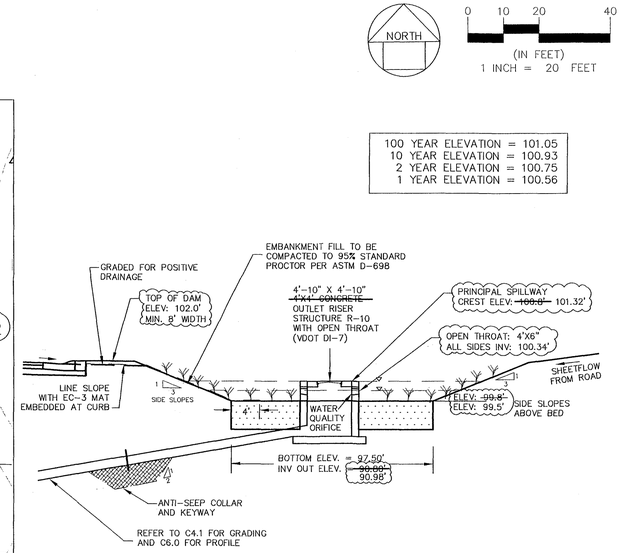




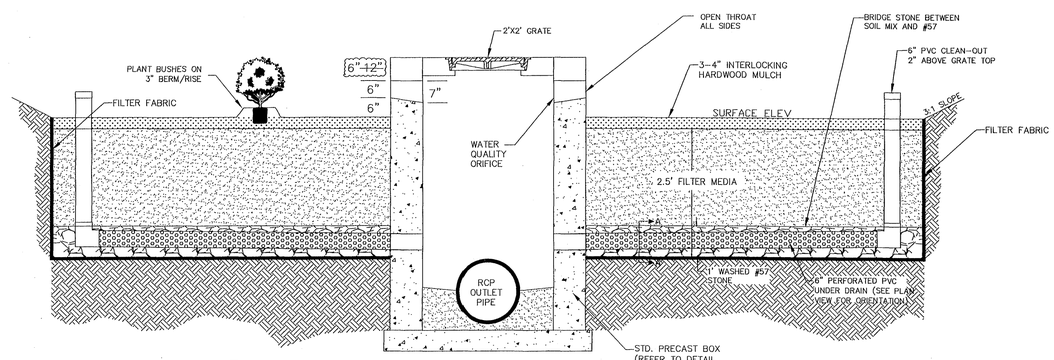
BMP#2: BIORETENTION PLAN



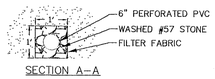
BMP#2 – PROFILE

NTS

REFER TO LANSCAPE DEVELOPMENT PLANS FOR BMP PLANTING SCHEDULE.



NOTE: THE RISER STRUCTURE SHALL BE PROVIDED WITH KOR–N–SEAL (OR EQUIVALENT BOOTS) FOR DISSIMILAR PIPE MATERIALS.



SECTION A–A

TYPICAL BIORETENTION CROSS–SECTION DETAIL

1. ALL SEDIMENT AND EROSION PRACTICES SHALL BE IN PLACE AND THE SLOPES DRAINING TO THE BIORETENTION AREA SHALL BE STABILIZED BEFORE RECORD DRAWINGS BEGINS.
2. FILTER MEDIA MIXTURE SHALL CONSIST OF THE FOLLOWING OR EQUIVALENT SUBJECT TO COUNTY REVIEW AND APPROVAL:

– 50% SAND
– 30% LEAF COMPOST (FULLY COMPOSTED, NOT PARTIALLY ROTTED LEAVES)
– 20% TOPSOIL

CONTRACTOR SHALL PROVIDE MIX TO ENGINEER PRIOR TO INSTALLATION.

3. IF MULCH USED, MATERIAL SHALL BE INTERLOCKING SHREDDED HARDWOOD OR SHREDDED WOOD CHIPS OR OTHER SIMILAR PRODUCT AND MUST BE WELL AGED, UNIFORM IN COLOR, AND FREE OF FOREIGN MATERIAL INCLUDING PLANT MATERIAL. THE MULCH LAYER SHALL BE UNIFORMLY APPLIED APPROXIMATELY 3 TO 4 INCHES IN DEPTHS.
4. TOPSOIL SHALL BE SANDY LOAM OR LOAMY SAND WITH NO MORE THAN 5% CLAY, FREE OF STONES, STUMPS, ROOTS, OR SIMILAR OBJECTS GREATER THAN 1–INCH, OR ANY OTHER MATERIAL OR SUBSTANCE WHICH MAY BE HARMFUL TO PLANT GROWTH OR A HINDRANCE TO MAINTENANCE.
5. TOPSOIL SHALL MEET THE FOLLOWING CRITERI

–	PH RANGE:	5.0 – 7.0
–	ORGANIC MATTER:	GREATER THAN 1.5%
–	MAGNESIUM (MG):	100+ UNITS
–	PHOSPHORUS (P2O5):	150+ UNITS
–	POTASSIUM (K2O):	120+ UNITS
–	SOLUBLE SALTS:	NOT TO EXCEED 900 PPM (SOIL) OR 3,000 PPM (ORGANIC MIX)

THE CONTRACTOR SHALL PROVIDE THE FOLLOWING SOIL TESTS FROM A QUALIFIED PROFESSIONAL.

– PH, ORGANIC MATTER: 1 TEST PER BIORETENTION AREA
– MAGNESIUM, PHOSPHORUS, POTASSIUM, SOLUBLE SALTS: 1 TEST PER 500 CUBIC YARDS
– GRAIN SIZE ANALYSIS: 1 TEST PER BIORETENTION AREA"

6. SOIL SHALL BE PLACED IN LIFTS LESS THAN 18 INCHES AND LIGHTLY COMPACTED (MINIMAL COMPACTIVE EFFORT) BY TAMPING OR ROLLING WITH HAND–OPERATED LANDSCAPE ROLLER.
7. PLANTING SOIL MIXTURE SHALL HAVE A P INDEX OF 10 – 25 AND HYDRAULIC CONDUCTIVITY = 2.0 – 4.0 IN/HR

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COMMONWEALTH OF VIRGINIA
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RECORD DRAWING

PROJECT # S–0048–2009

WSP • SELLS
Transportation & Infrastructure
15401 Weston Parkway Suite 100 • Cary, NC 27513 • 919.678.0035
www.wspsells.com

PRELIMINARY RECORD DRAWINGS

TRACT 12
STONEHOUSE
JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

REVISIONS

1	RECORD DRAWING 10–10–12

PROJECT #: 08-4051 DATE: 08/17/09
DRAWN BY: MB CHECKED BY: CD

TITLE
BMP #2, 5, 6, AND 9 DETAILS (BIORETENTION)

SHEET
C5.1

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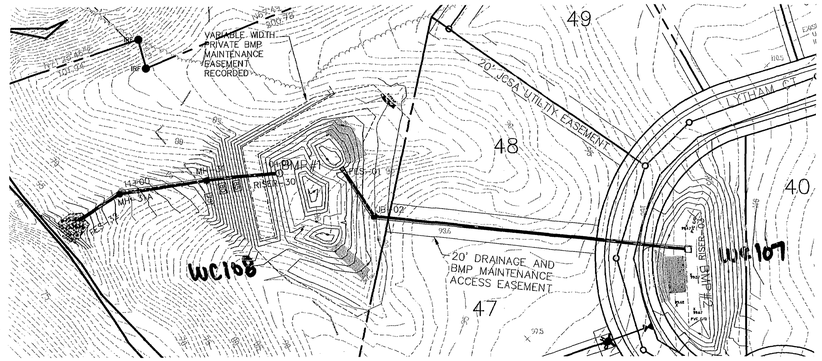
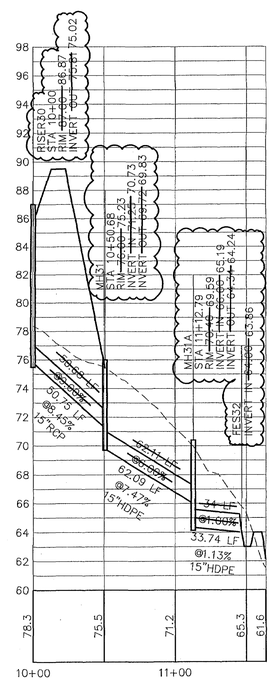
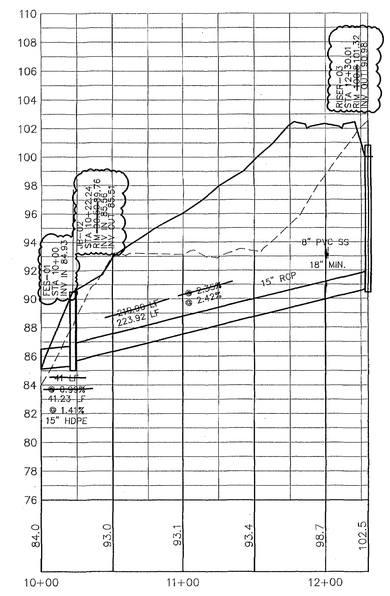
10/12/2012 11:09 AM, L:\Stonehouse\08-4051-Stonehouse-TR12\05-Drawings\05-As-Built\PHASE 1\C5 BMP DETAILS.DWG, C5.1-BMP2-5-6-9, USMBN4034



BMP #1 PLAN
1" = 20'



BMP #1 OUTFALL PROFILE
1"=5' (HORZ) / 1"=5' (VERT)



PROFILE TO BMP #1
1"=5' (HORZ) / 1"=5' (VERT)

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(IN FEET)
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PRELIMINARY RECORD DRAWINGS

TRACT 12 STONEHOUSE

JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

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REVISIONS

1	RECORD DRAWING - 10/10/2012

PROJECT #: 08-4051 DATE: 08/17/09
DRAWN BY: MB CHECKED BY: CD

TITLE
STORM PROFILES

SHEET
C6.0

10/10/2012 10:12 File: L:\Stonehouse\08-4051-Stonehouse-TR12\08-Drawings\05-As-Built\PHASE 1\C6 STORM PROFILES.DWG, C6.0-Storm Profiles, USMB04534

STONEHOUSE Tract 12

James City County, Virginia

ASBUILT Stormwater Management and Drainage Design Report-BMP 1 & 2

Date: November 15, 2012

Prepared by:

WSP · SELLS

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Suite 100
Cary, North Carolina 27513
(919) 678-0035
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COMMONWEALTH OF VIRGINIA
S. SHAYNE LEATHERS
Lic. No. 050365
11/29/12
PROFESSIONAL ENGINEER

S. Shayne Leathers, PE

SELLS Project Number 08-4051

Table of Contents

BMP#2 Asbuilt Water Quality Volume Verification
Asbuilt Verification BMP#2 Routing
Asbuilt Verification BMP#1 Combined Routing with BMP#2
Asbuilt Verification BMP#1 SCS Combined Routing to confirm 24 hour detention of the 1 year, 24 hour storm event for stream channel protection design criteria

Flow summary @ FES32

	event	design	AsBuilt (combined route)
Rational	1-yr	0.25 cfs	0.18 cfs
	2-yr	0.27 cfs	
	10-yr	0.30 cfs	0.25 cfs
	25-yr	0.83 cfs	0.27 cfs
	100-yr	4.61 cfs	0.69 cfs
SCS	1-yr 24hr	—	3.12 cfs

BMP#2 Asbuilt Water Quality Volume Verification

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Comp. By ..... Date ..... Project ..... Sheet No. ..... of .....
Chkd. By ..... Date ..... Subject ..... Job No. .....

water quality verification

Bmp 2

$T_V = \frac{P}{12}(R_{V1}(\%I))SA$

$P = 1$ inch
$R_{V1} = 0.95$
$\%I = 0.41$
$SA = 1.72$ ac

$T_V = \frac{1}{12}[(0.95)(0.41)](1.72)$

$= 0.056$ ac-ft $= 2,432$ cuft $= T_V$ (Bmp 2)

Bmp 1

$T_V = \frac{P}{12}(R_{V1}(\%I))SA$

$P = 1$ inch
$R_{V1} = 0.95$
$\%I = 0.27$
$SA = 1.91$ ac

$T_V = \frac{1}{12}(0.95(0.27)(1.91) = 0.041$ ac-ft $= 1,778$ cuft $=$ T_V (Bmp 2)

T_V (total) $= 2,342 + 1,778 = \underline{4,120 \text{ cuft} = T_V \text{ (total)}}$

Bmp 2 constructed volume
91.5' ± 1852 sf (BTm)
100.35 ± 2,358 sf (weir)

$\forall_{Bmp2} = \frac{(2358 + 1852)}{2}(100.35 - 91.5) =$

$\forall_{Bmp2} = 1,789$ cuft

Bmp 1 constructed volume
4125 sf (Riser Rim)
2103 sf (NP)

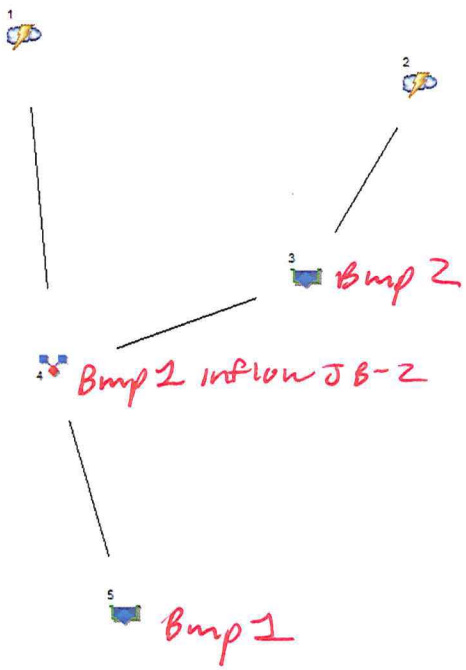
$\forall_{Bmp1} = \frac{4125 - 2103}{2}(2) = 6,228$ cuft

Provide $\forall$

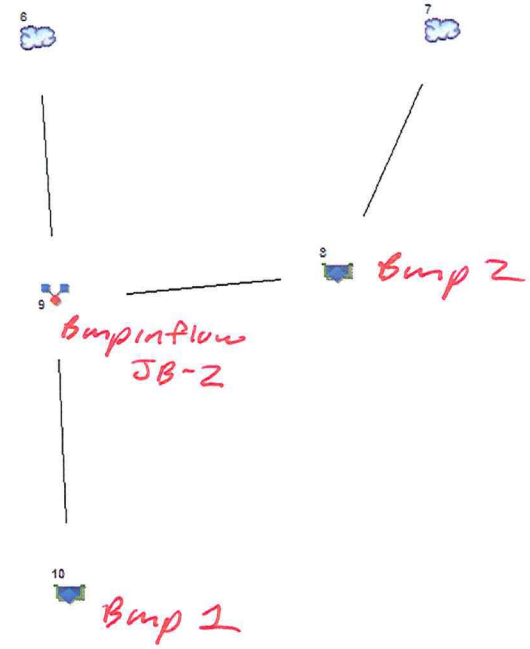
6,228
+ 1,789
8,017 cuft > 4,120 cuft

Asbuilt Verification BMP#1 Combined Routing with BMP#2

Rational model



SCS model -24-hour



Legend

Hyd.	Origin	Description
1	Mod. Rational	BMP #1-Wet Pond
2	Mod. Rational	BMP#2-Bioretention
3	Reservoir	BMP#2 Routing
4	Combine	BMP#1 Inflow
5	Reservoir	BMP#1 Routing
6	SCS Runoff	BMP#1 Wetpond SCS
7	SCS Runoff	BMP#2 Biorention SCS
8	Reservoir	BMP#2 SCS Routing
9	Combine	BMP#1 Inflow SCS
10	Reservoir	BMP#1 SCS Routing

Hydrograph Plot

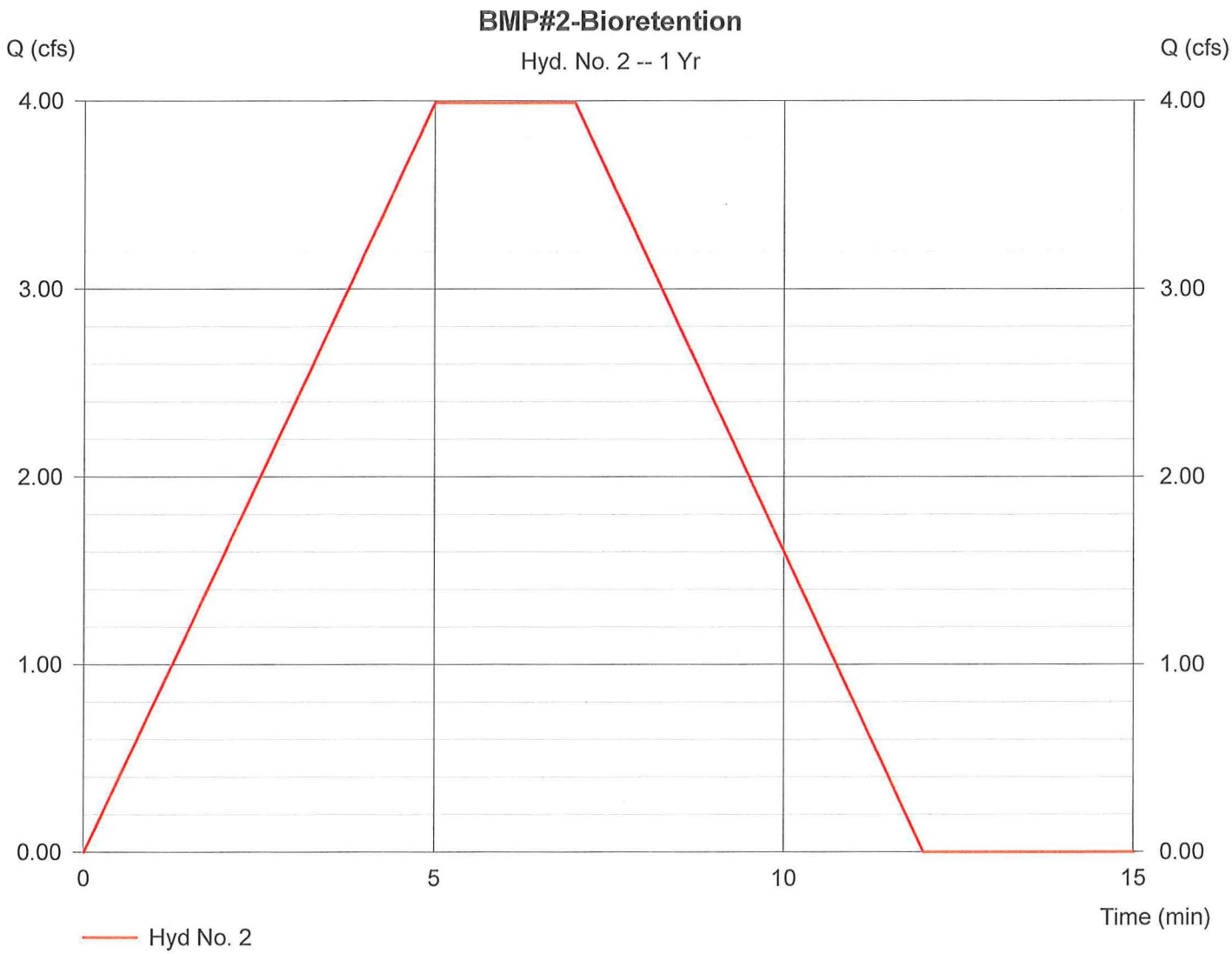
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 2

BMP#2-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 3.99 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,796 cuft



Hydrograph Plot

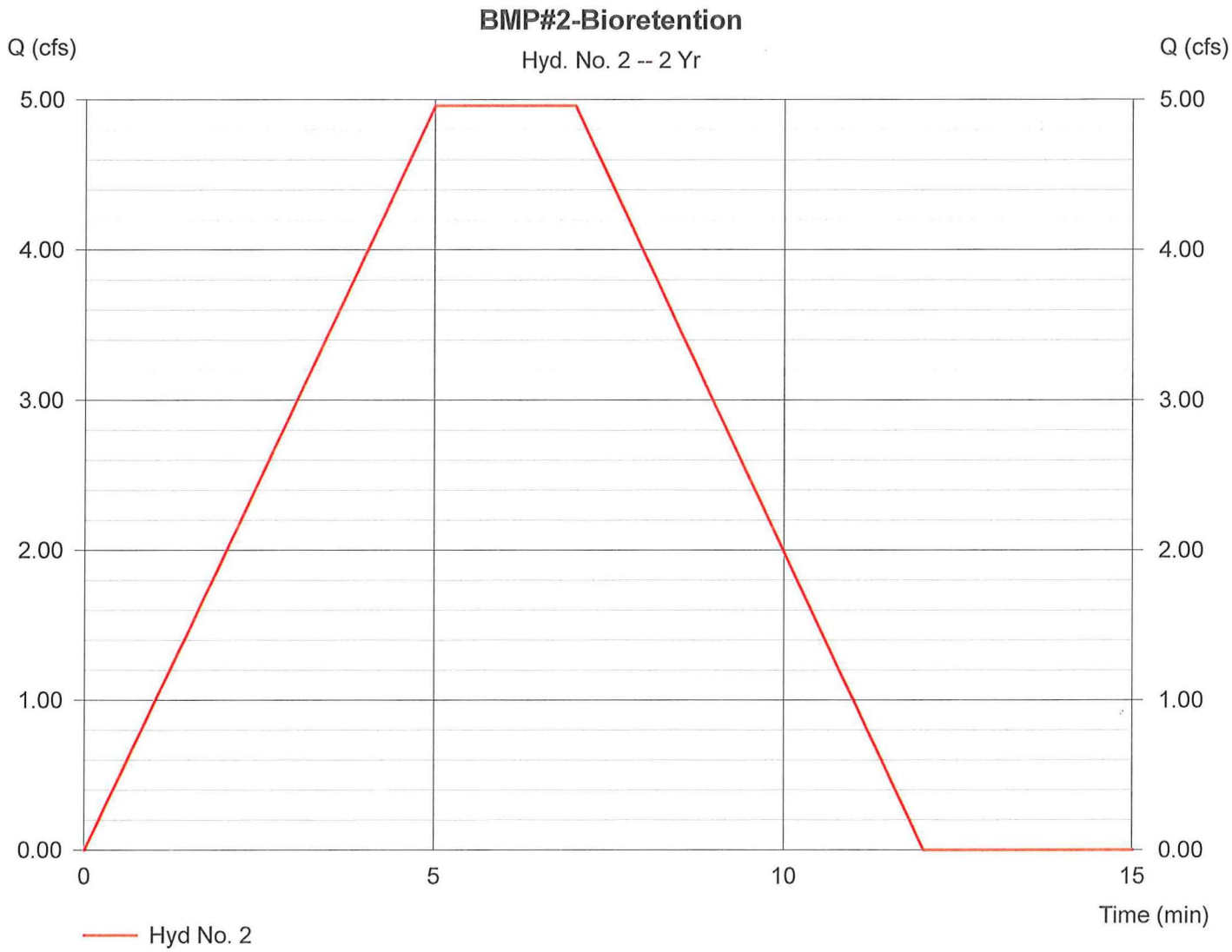
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 2

BMP#2-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 4.96 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,232 cuft



Hydrograph Plot

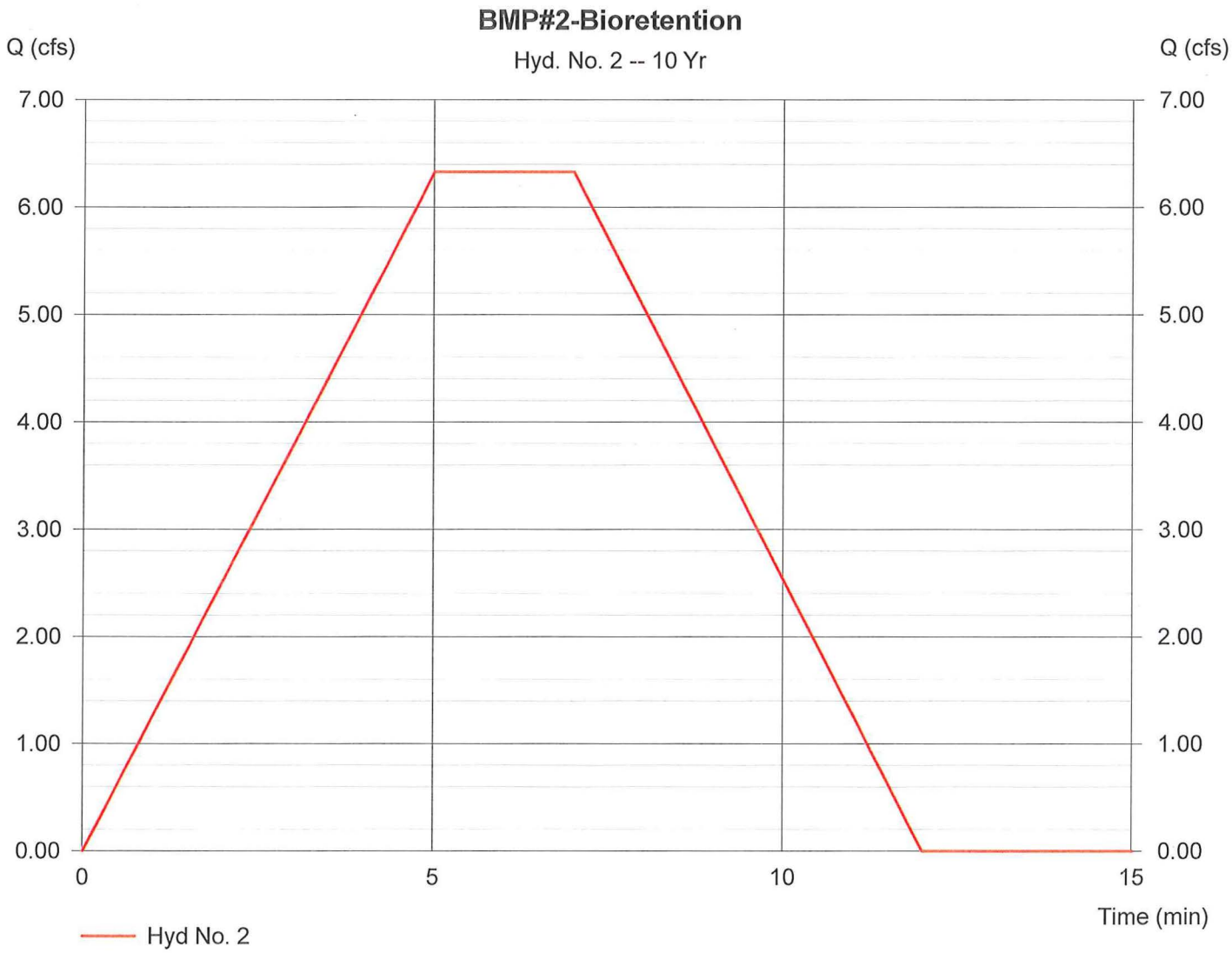
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 2

BMP#2-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 6.33 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,848 cuft



Hydrograph Plot

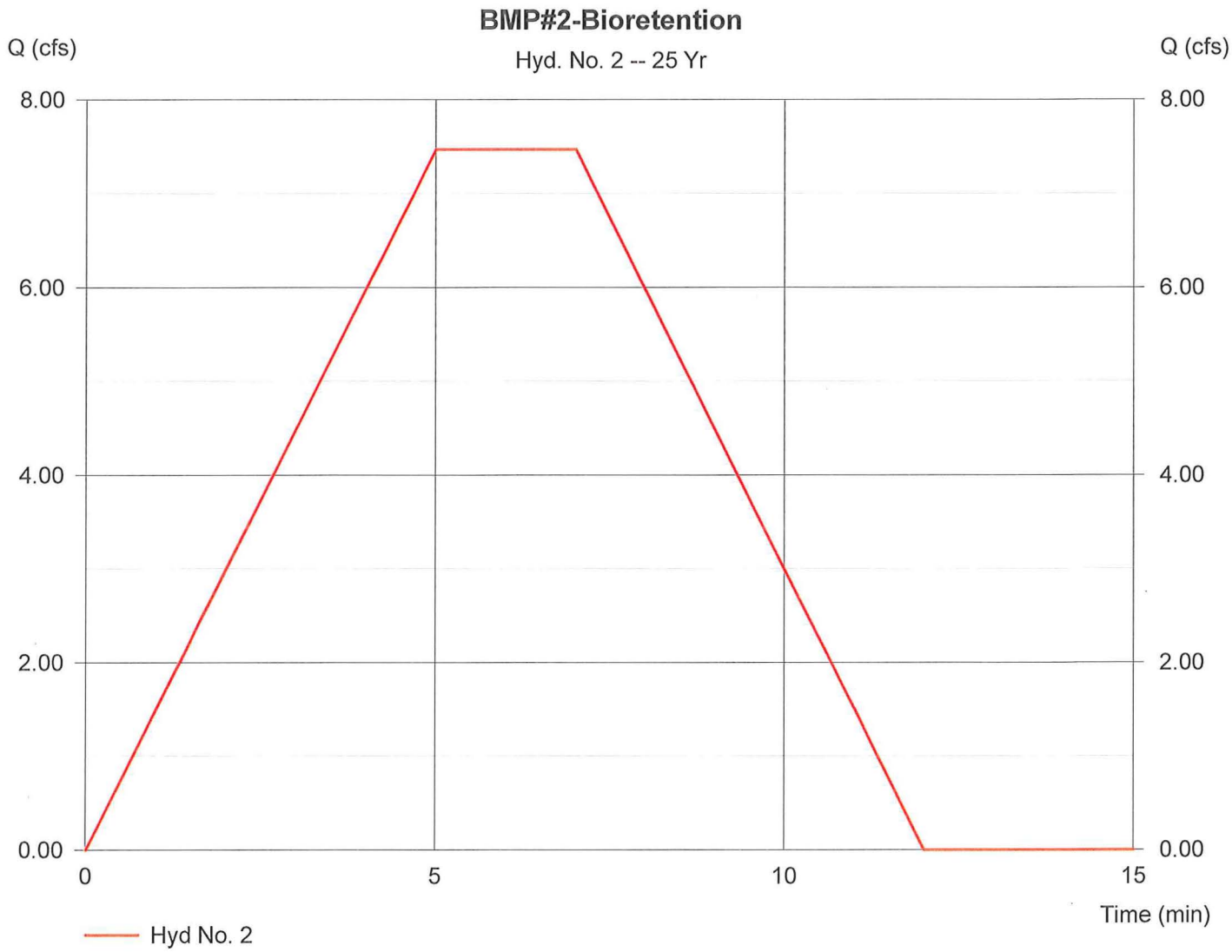
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 2

BMP#2-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 7.47 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,363 cuft



Hydrograph Plot

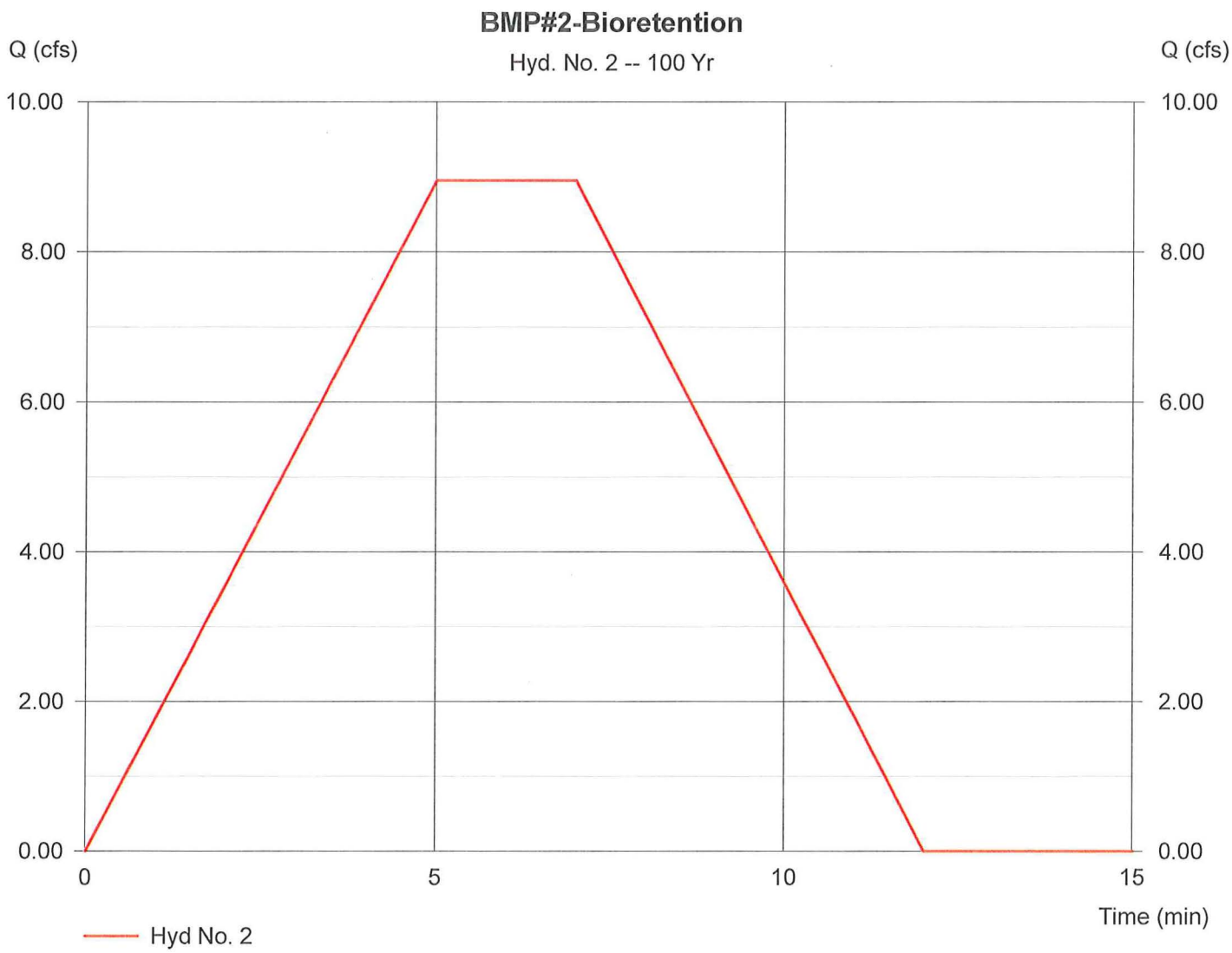
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 2

BMP#2-Bioretention

Hydrograph type	= Mod. Rational	Peak discharge	= 8.95 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Runoff coeff.	= 0.57
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,029 cuft



Hydrograph Plot

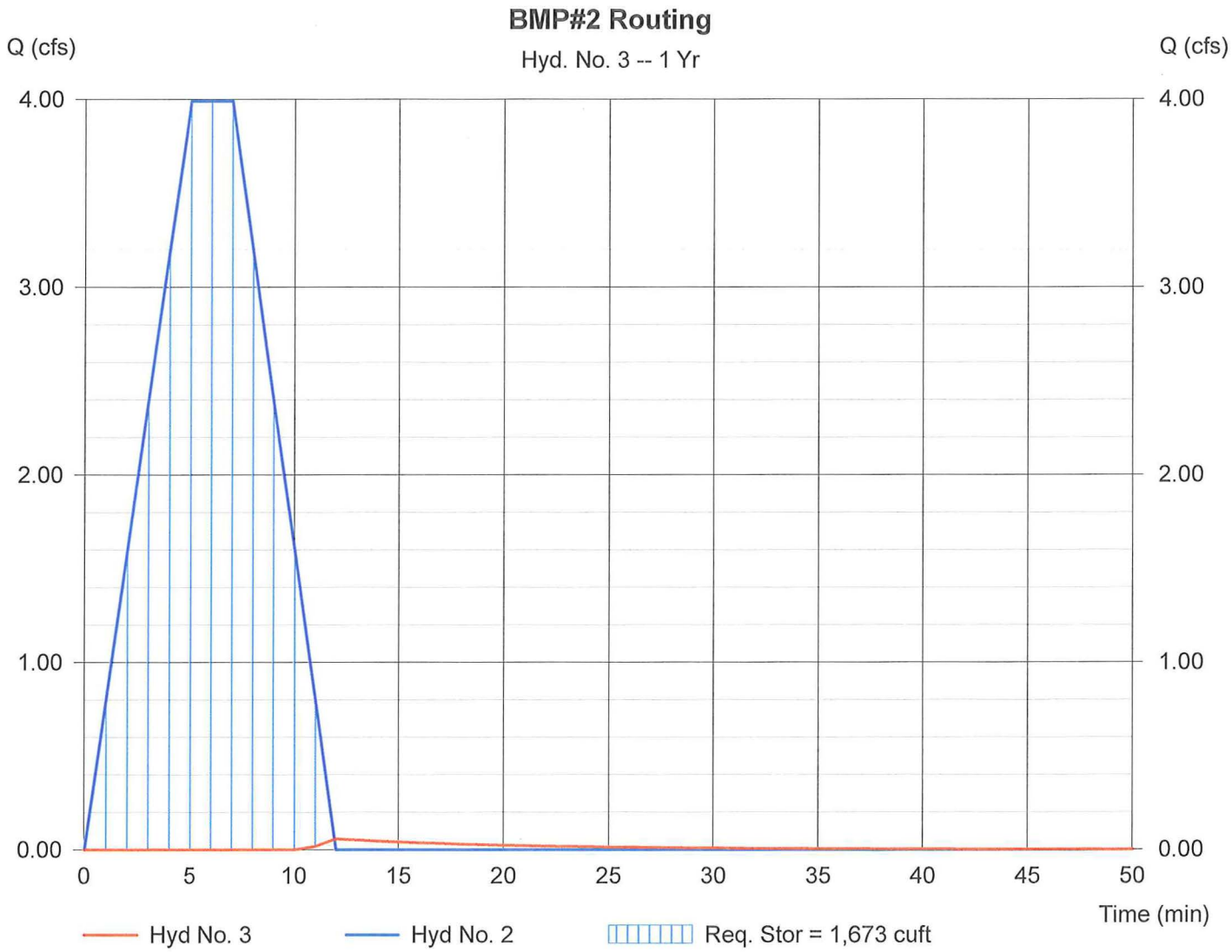
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 3

BMP#2 Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.06 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 100.26 ft
Reservoir name	= BMP#2 Biorention ab	Max. Storage	= 1,673 cuft

Storage Indication method used. | Hydrograph Volume = 34 cuft



Hydrograph Plot

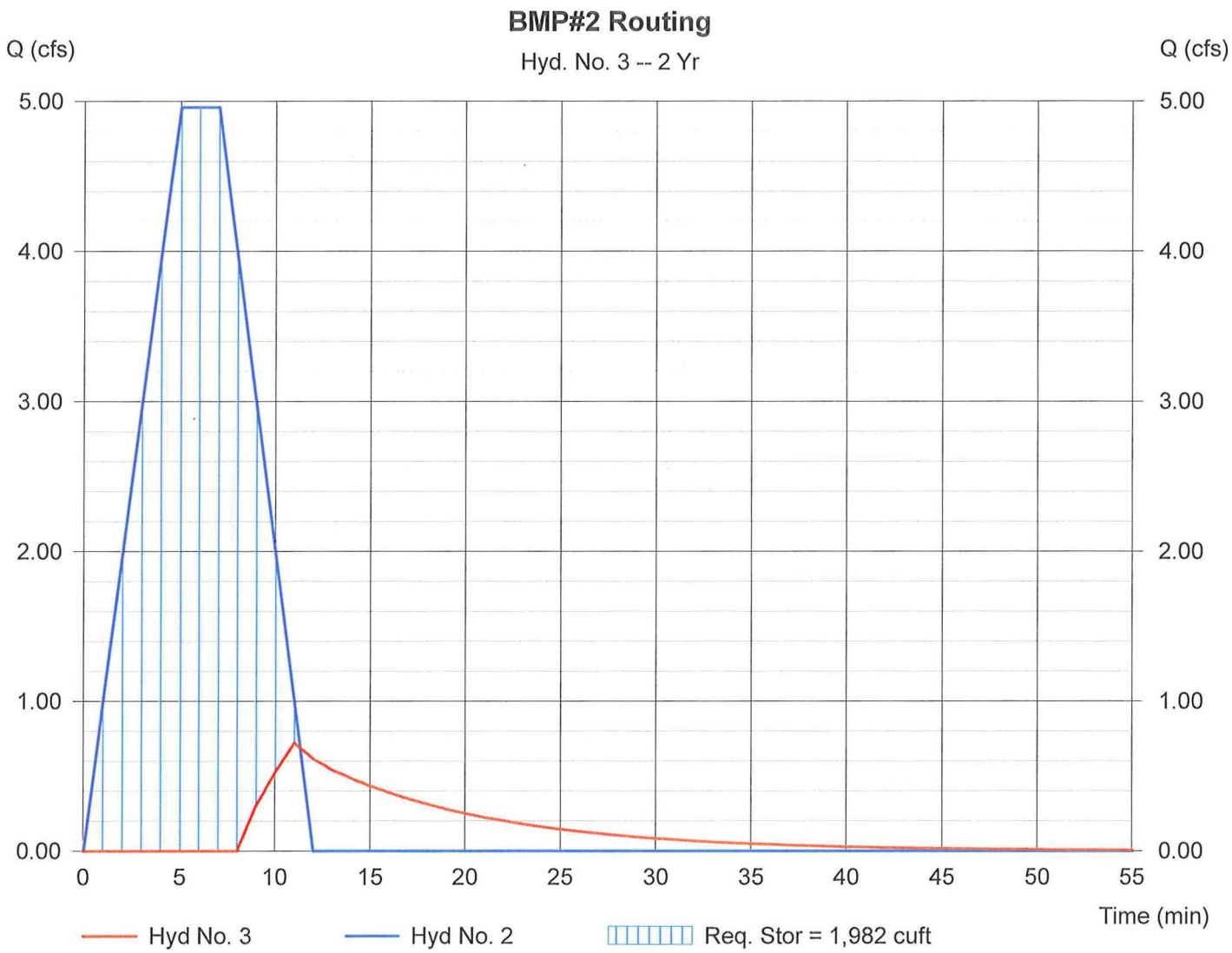
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 3

BMP#2 Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.72 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 100.41 ft
Reservoir name	= BMP#2 Biorention ab	Max. Storage	= 1,982 cuft

Storage Indication method used. | Hydrograph Volume = 441 cuft



Hydrograph Plot

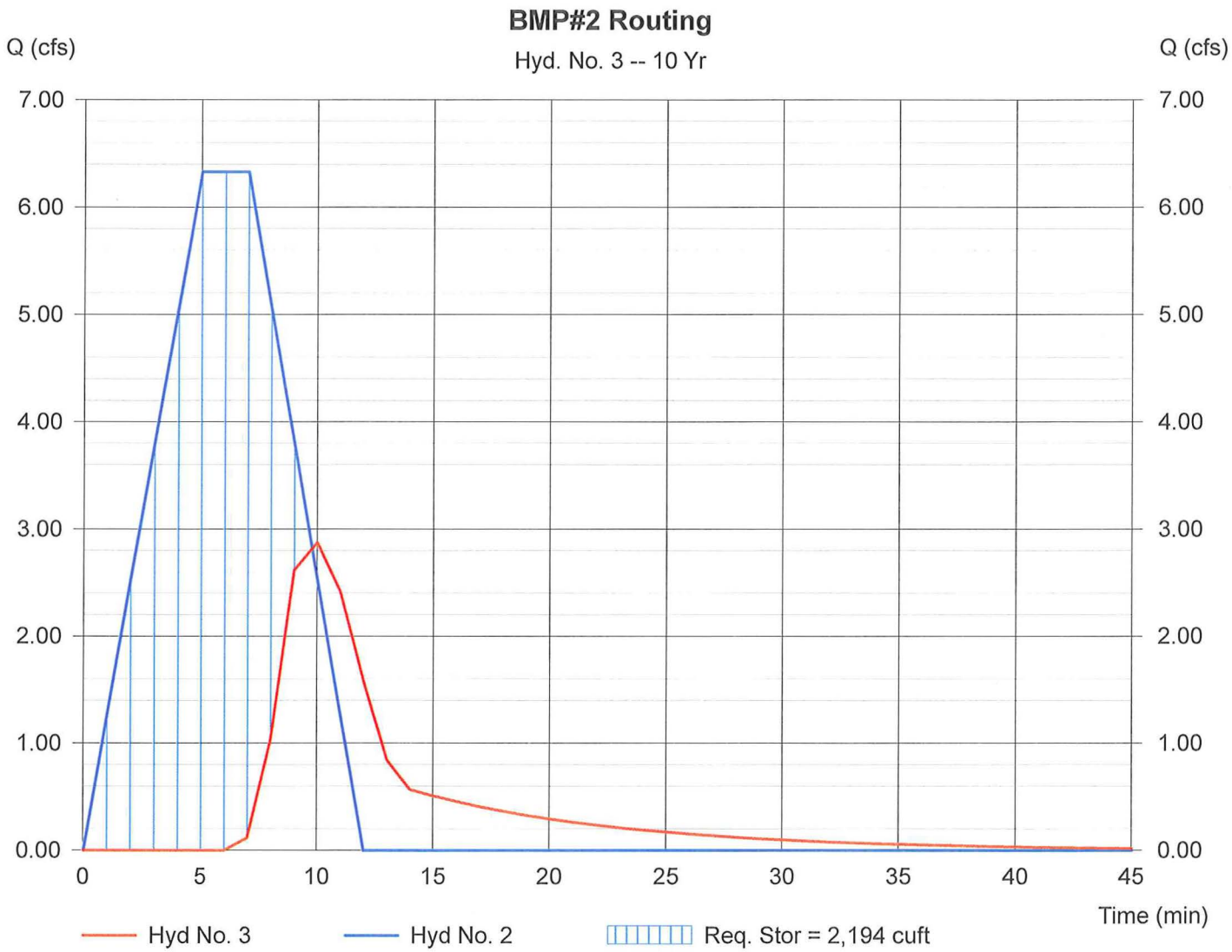
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 3

BMP#2 Routing

Hydrograph type	= Reservoir	Peak discharge	= 2.87 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 100.50 ft
Reservoir name	= BMP#2 Biorention ab	Max. Storage	= 2,194 cuft

Storage Indication method used. | Hydrograph Volume = 1,016 cuft



Hydrograph Plot

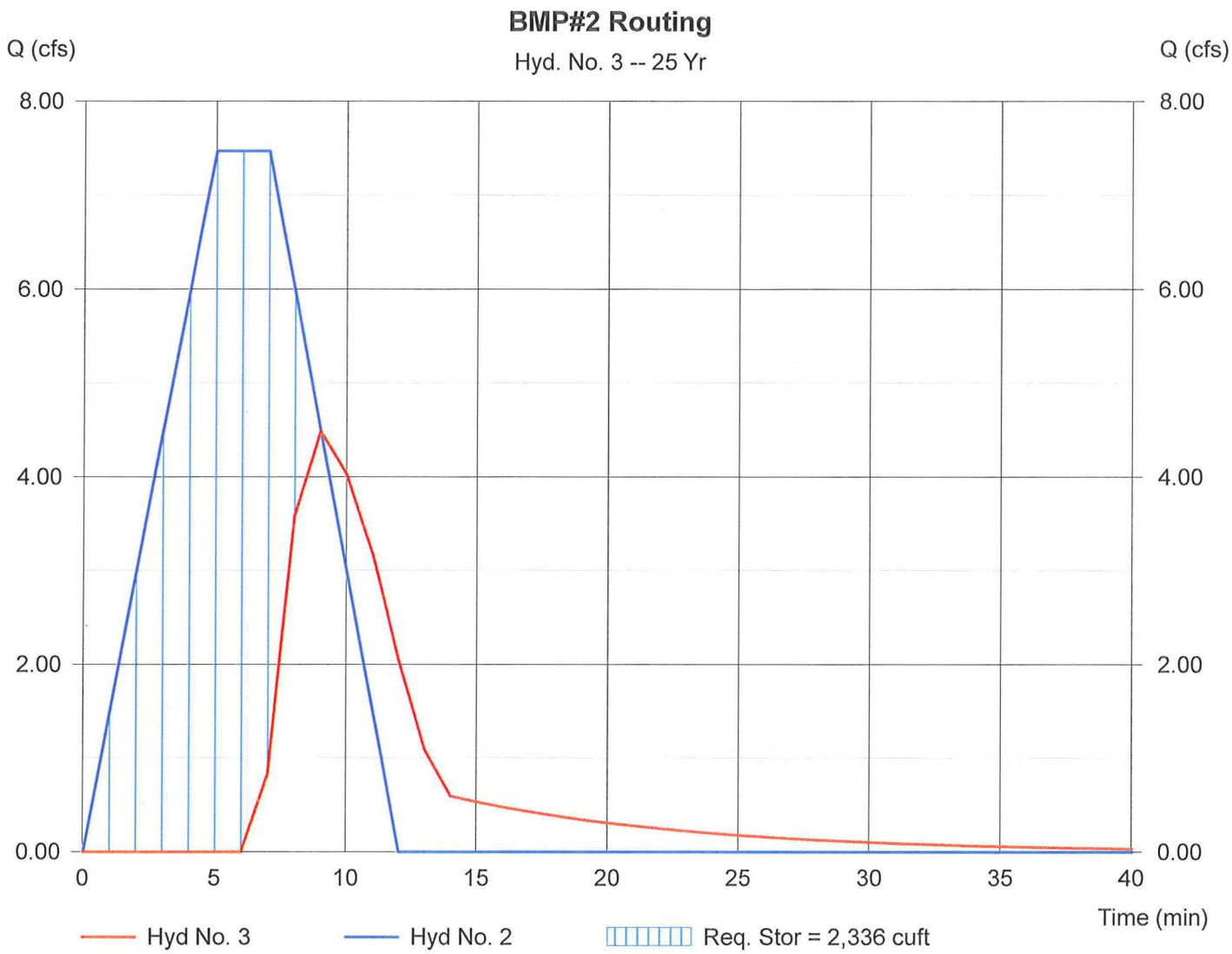
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 3

BMP#2 Routing

Hydrograph type	= Reservoir	Peak discharge	= 4.49 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 100.57 ft
Reservoir name	= BMP#2 Biorention ab	Max. Storage	= 2,336 cuft

Storage Indication method used. | Hydrograph Volume = 1,496 cuft



Hydrograph Plot

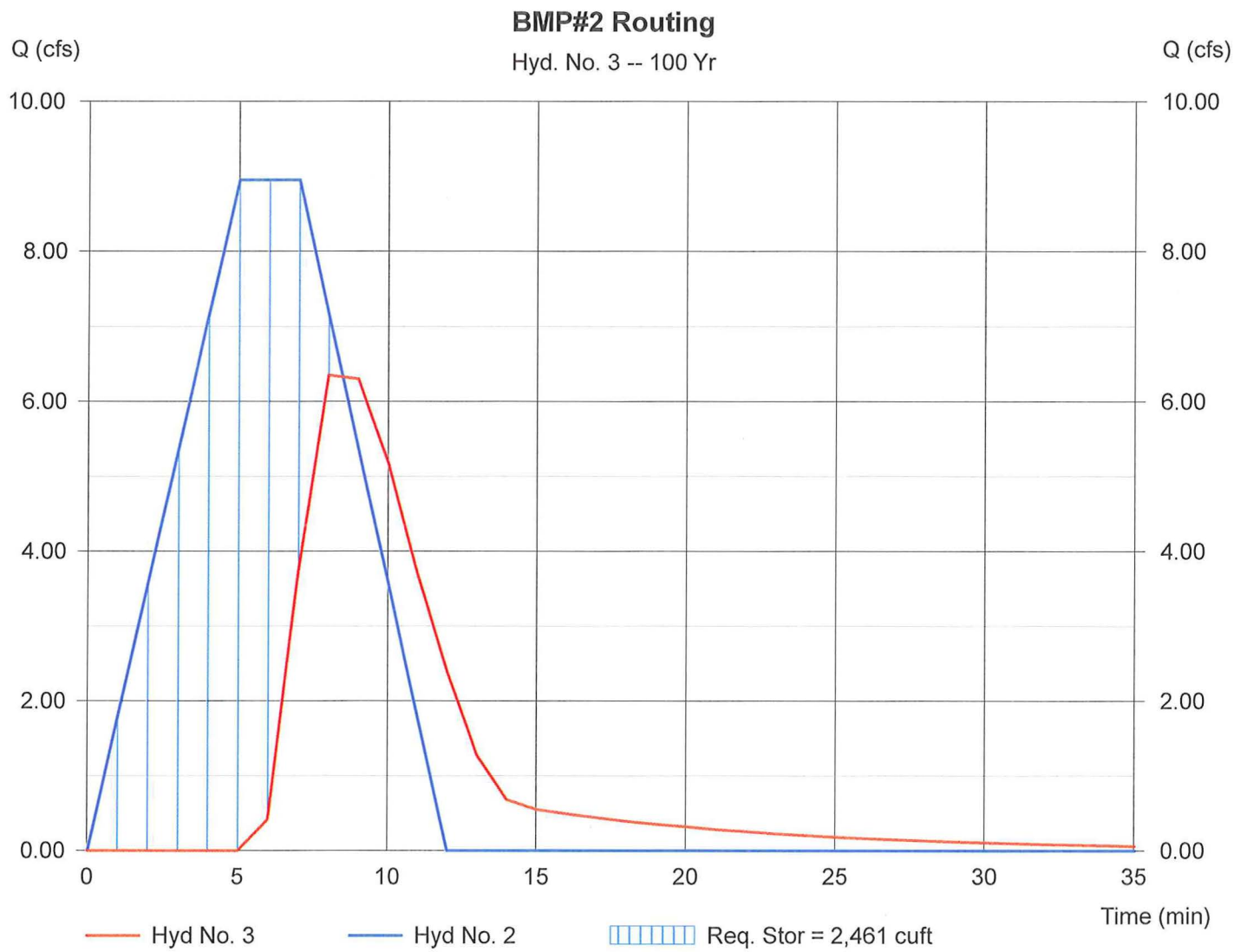
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:8 PM

Hyd. No. 3

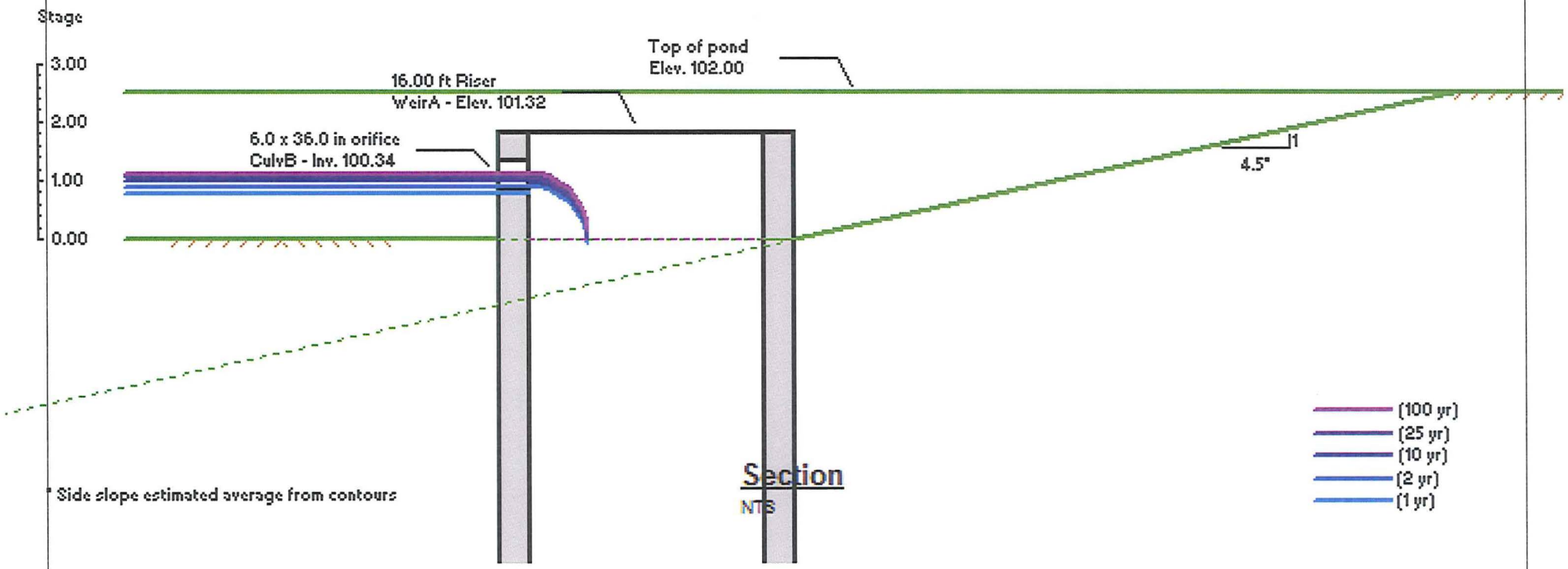
BMP#2 Routing

Hydrograph type	= Reservoir	Peak discharge	= 6.35 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 100.62 ft
Reservoir name	= BMP#2 Biorention ab	Max. Storage	= 2,461 cuft

Storage Indication method used. | Hydrograph Volume = 2,118 cuft



BMP#2 Biorention ab



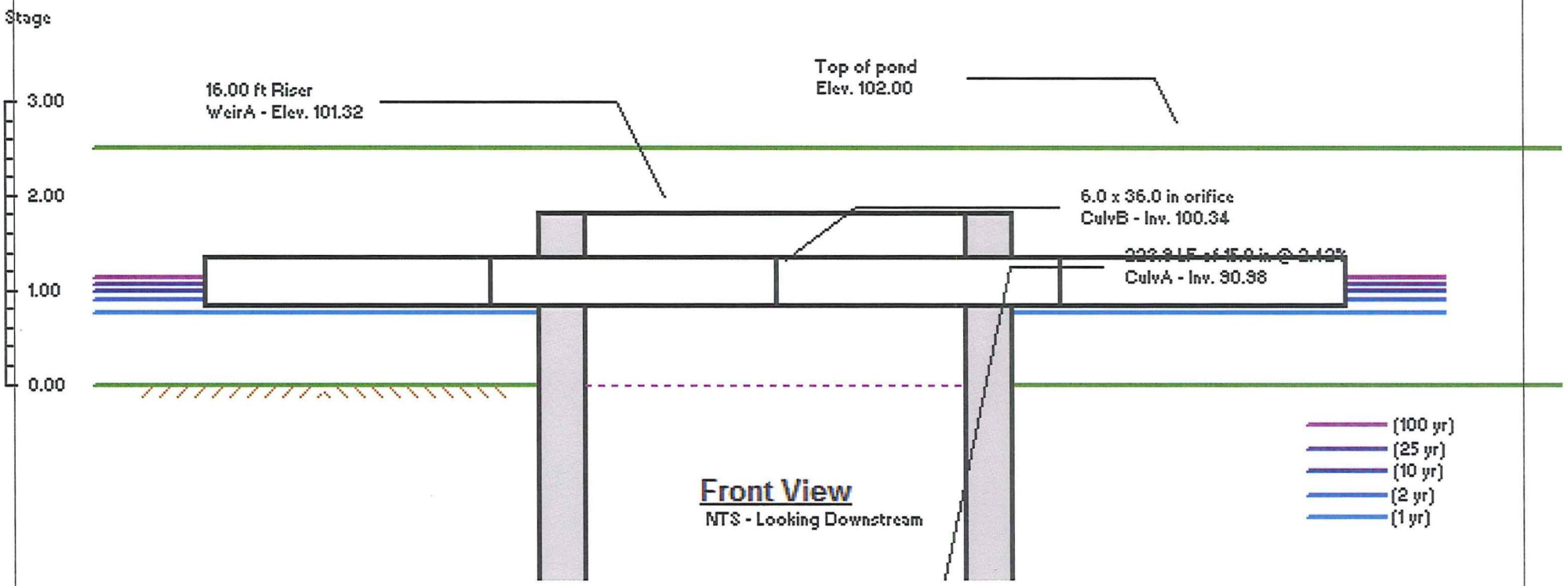
Section

NTS

Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: bmp 1 2 ssl asbuilt.gpw	Tuesday, Nov 13 2012, 2:08 PM

BMP#2 Biorention ab



Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: bmp 1 2 ssl asbuilt.gpw	Tuesday, Nov 13 2012, 2:08 PM

Hydrograph Plot

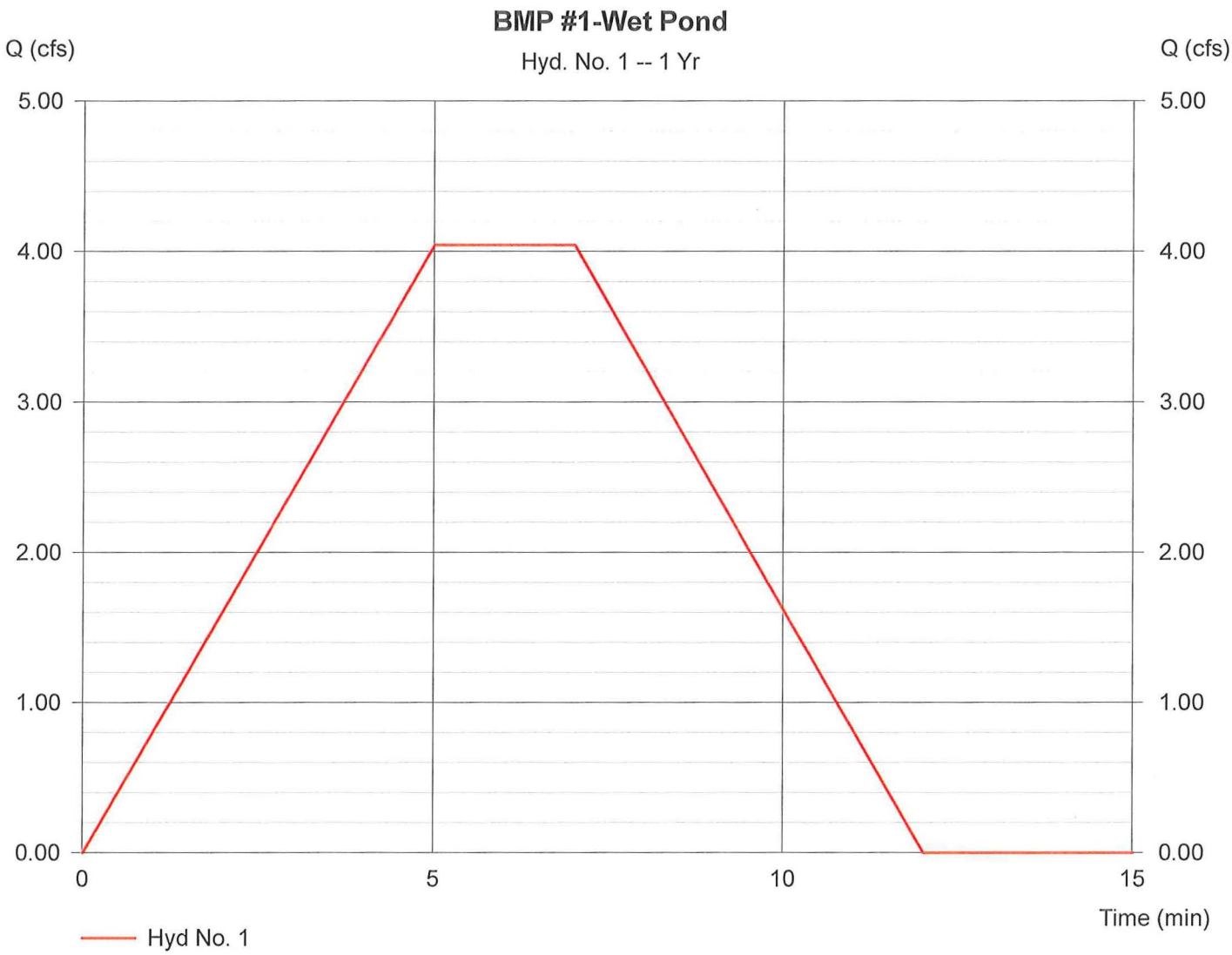
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:6 PM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 4.04 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.52
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,819 cuft



Hydrograph Plot

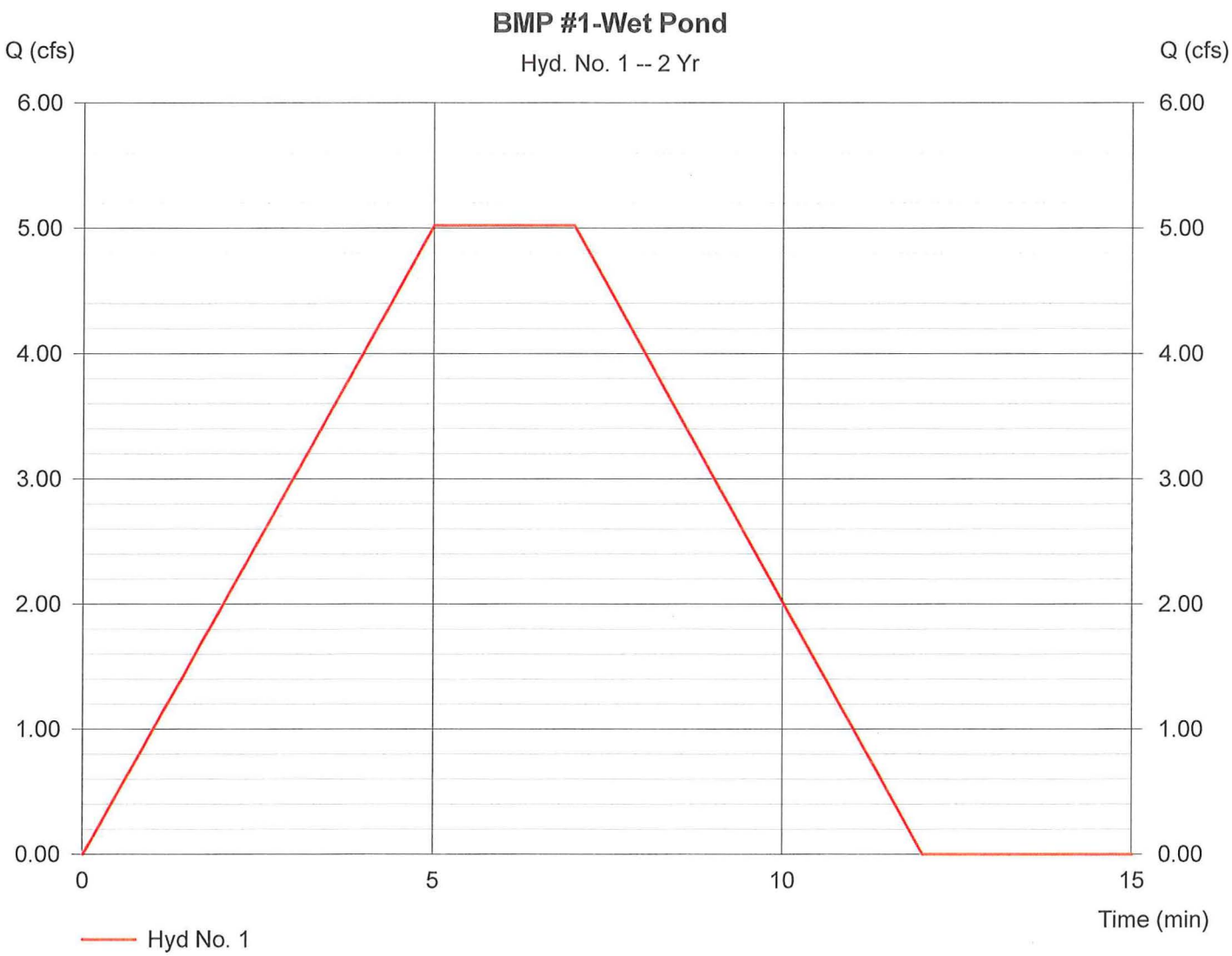
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:6 PM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 5.02 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.52
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,261 cuft



Hydrograph Plot

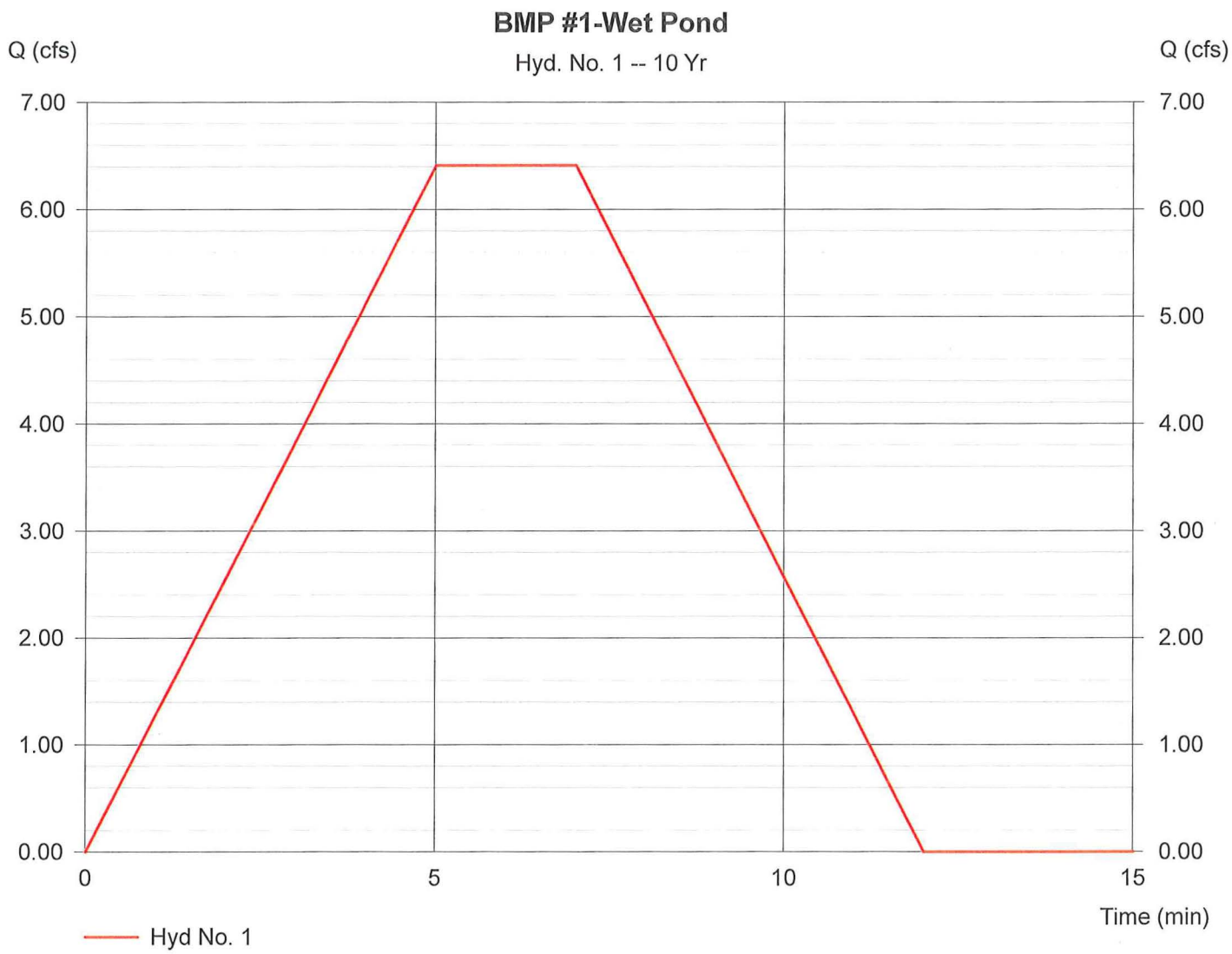
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:6 PM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 6.41 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.52
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,885 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

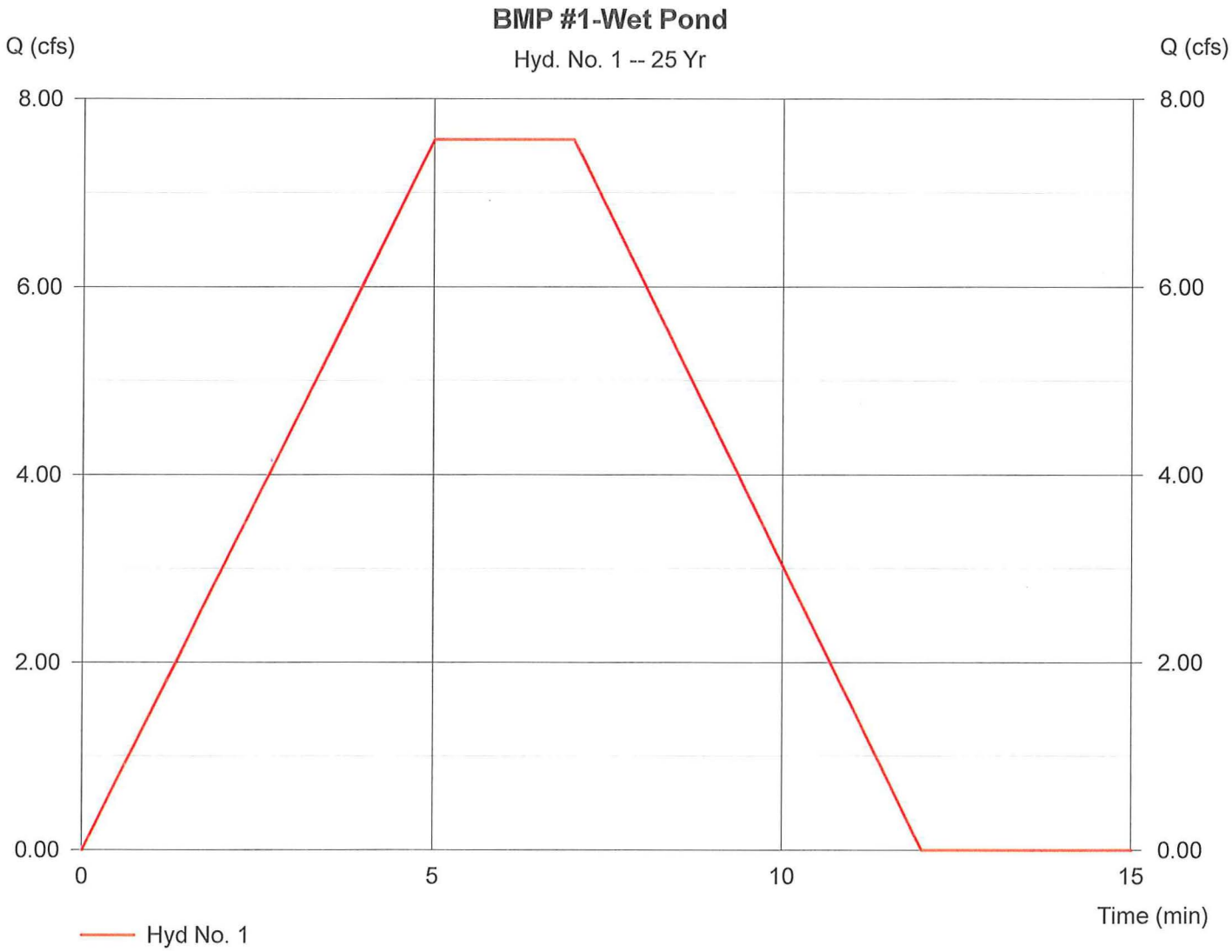
Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 7.57 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.52
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,407 cuft



Hydrograph Plot

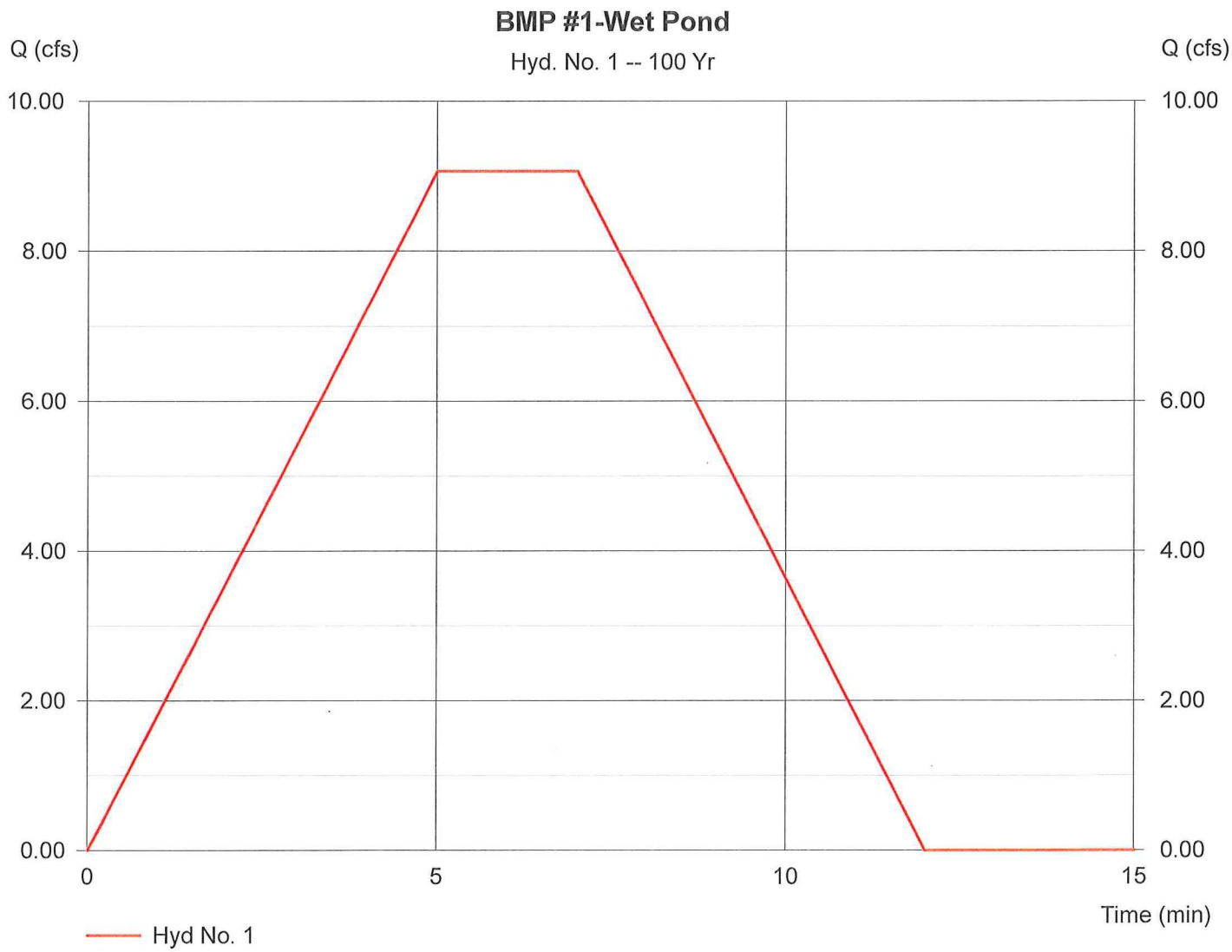
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:7 PM

Hyd. No. 1

BMP #1-Wet Pond

Hydrograph type	= Mod. Rational	Peak discharge	= 9.07 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Runoff coeff.	= 0.52
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,082 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

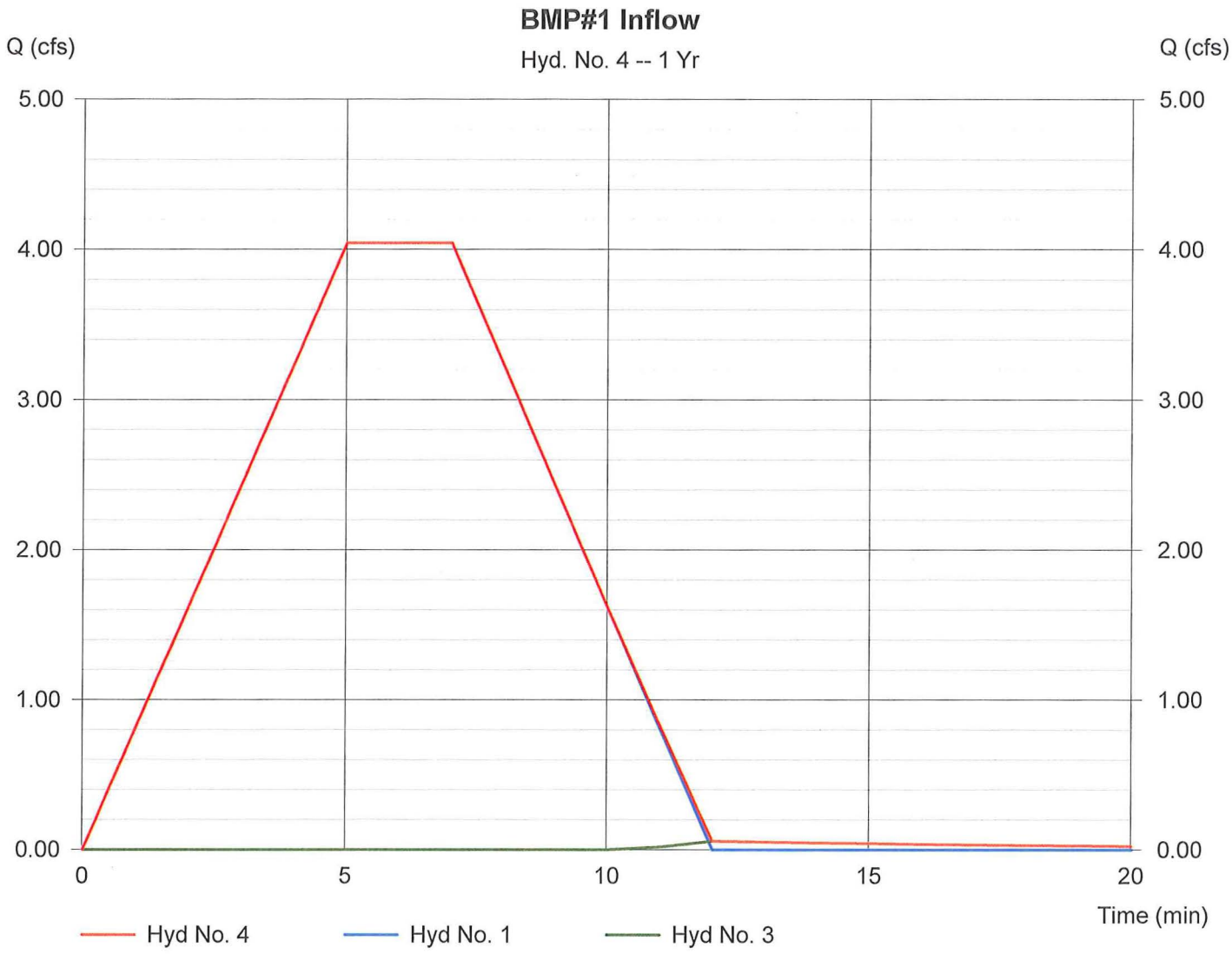
Tuesday, Nov 13 2012, 2:8 PM

Hyd. No. 4

BMP#1 Inflow

Hydrograph type	= Combine	Peak discharge	= 4.04 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyds.	= 1, 3		

Hydrograph Volume = 1,732 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

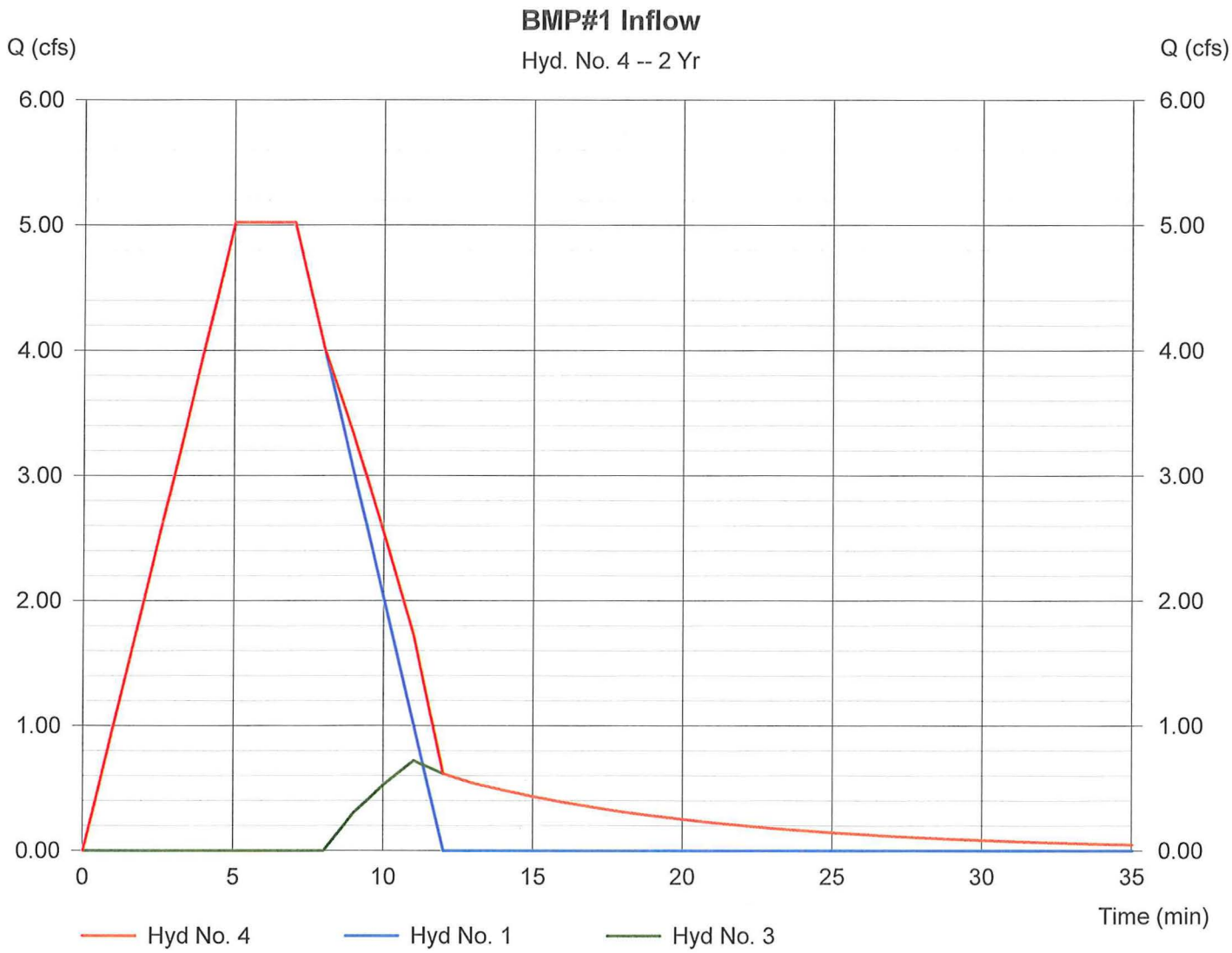
Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 4

BMP#1 Inflow

Hydrograph type	= Combine	Peak discharge	= 5.02 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyds.	= 1, 3		

Hydrograph Volume = 2,551 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

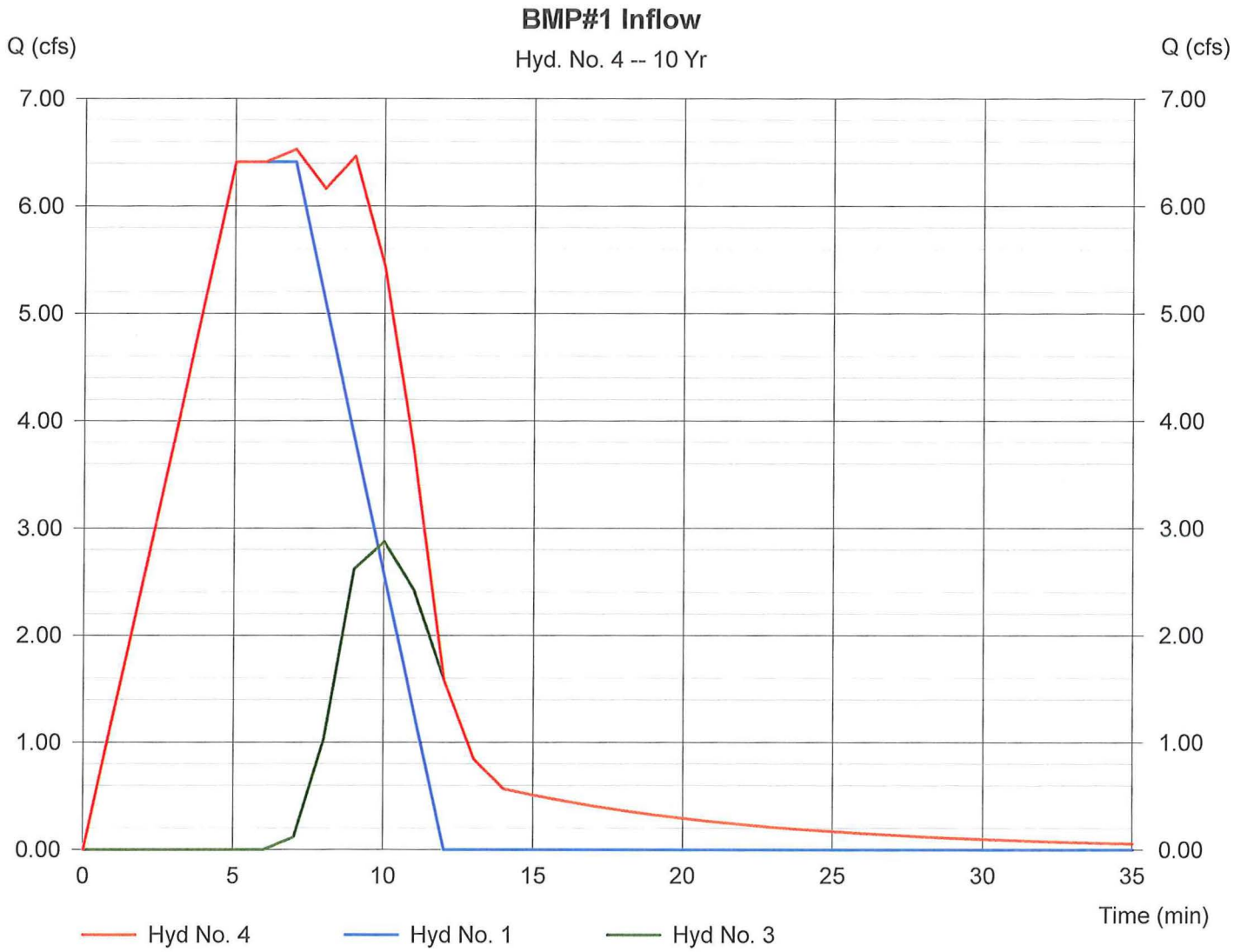
Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 4

BMP#1 Inflow

Hydrograph type	= Combine	Peak discharge	= 6.53 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyds.	= 1, 3		

Hydrograph Volume = 3,709 cuft



Hydrograph Plot

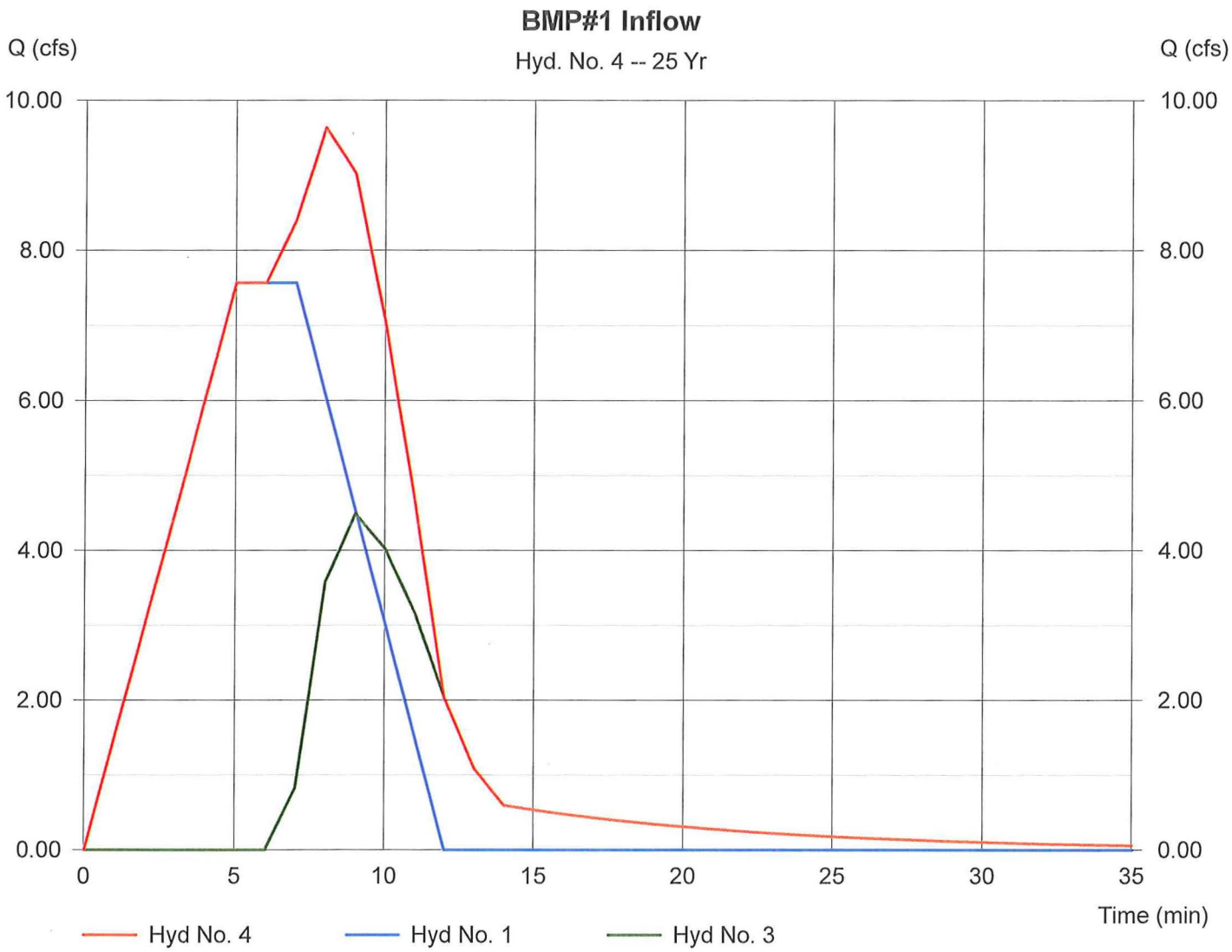
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 4

BMP#1 Inflow

Hydrograph type	= Combine	Peak discharge	= 9.64 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyds.	= 1, 3		

Hydrograph Volume = 4,676 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

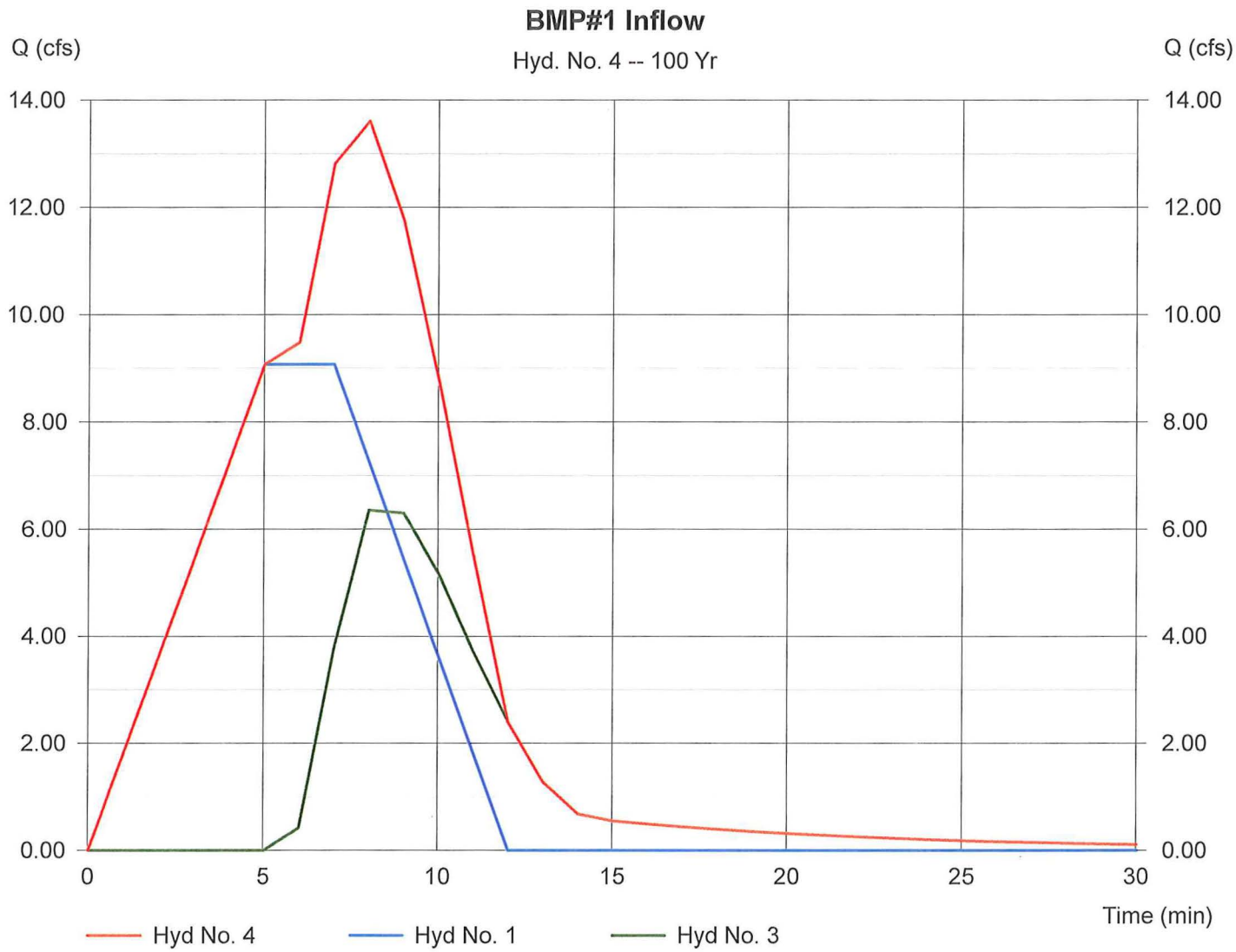
Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 4

BMP#1 Inflow

Hydrograph type	= Combine	Peak discharge	= 13.61 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyds.	= 1, 3		

Hydrograph Volume = 5,928 cuft



Hydrograph Plot

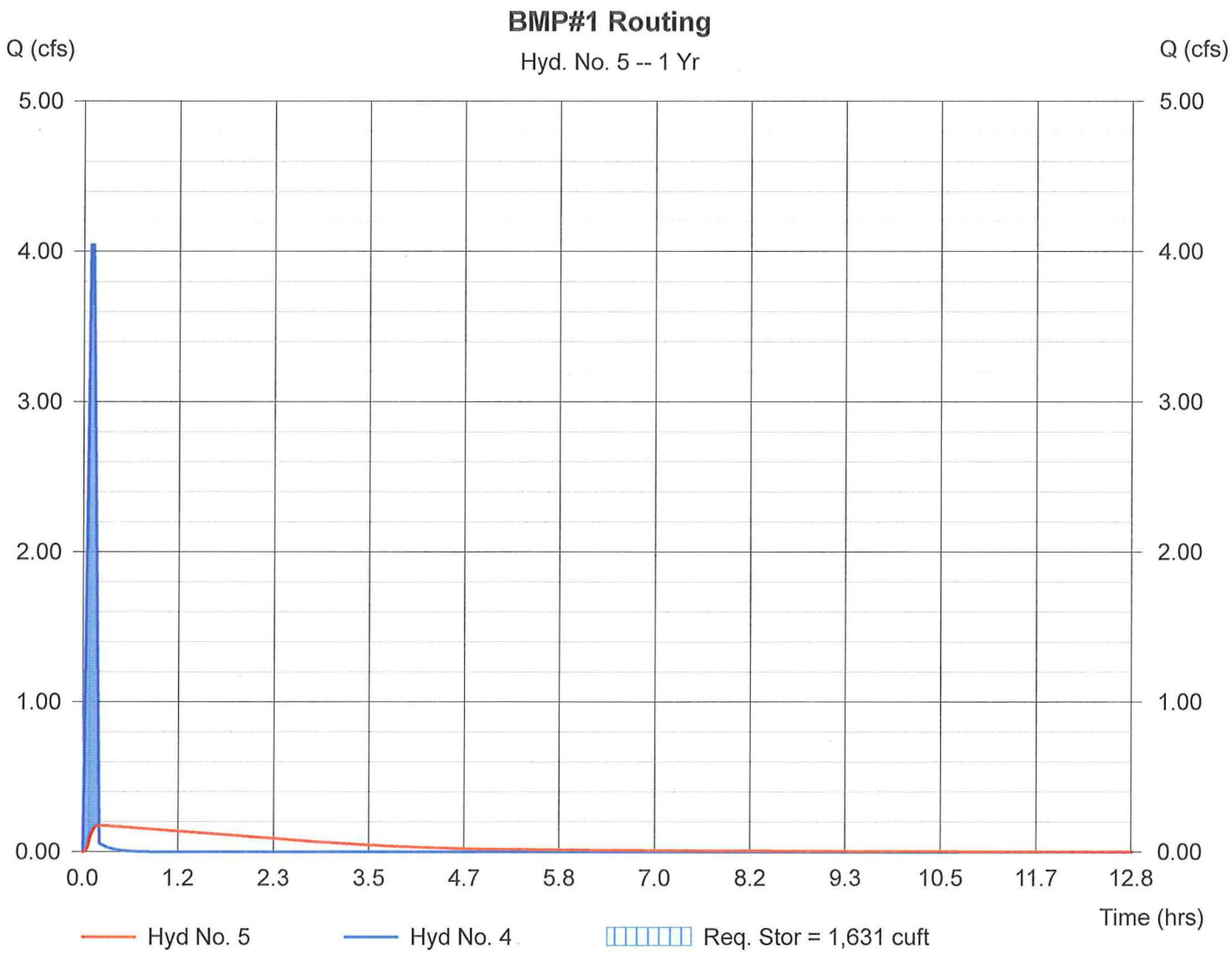
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 5

BMP#1 Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.18 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 4	Max. Elevation	= 85.82 ft
Reservoir name	= BMP #1-Wet Pond ab	Max. Storage	= 1,631 cuft

Storage Indication method used. | Hydrograph Volume = 1,721 cuft



Hydrograph Plot

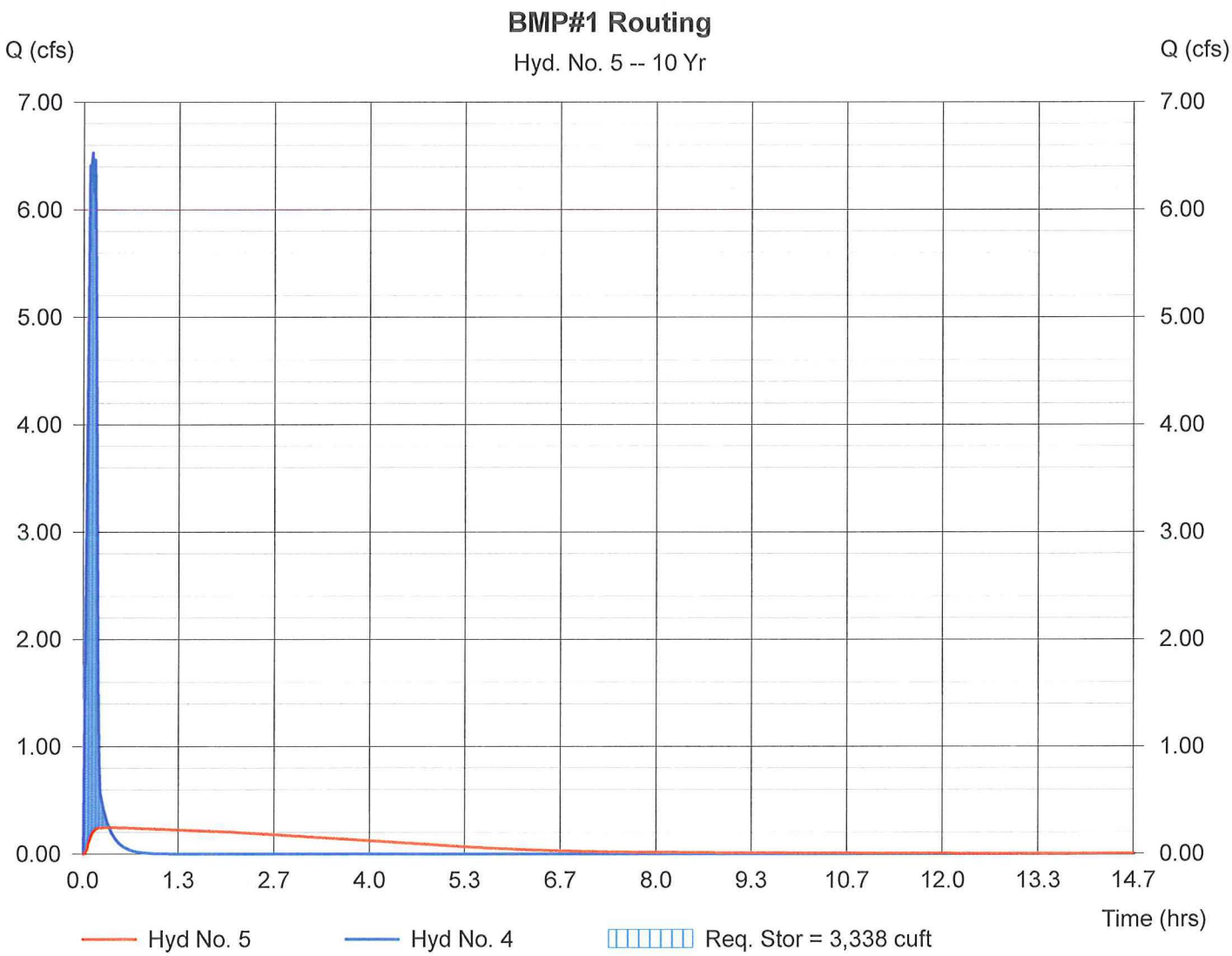
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 5

BMP#1 Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.25 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 4	Max. Elevation	= 86.35 ft
Reservoir name	= BMP #1-Wet Pond ab	Max. Storage	= 3,338 cuft

Storage Indication method used. | Hydrograph Volume = 3,698 cuft



Hydrograph Plot

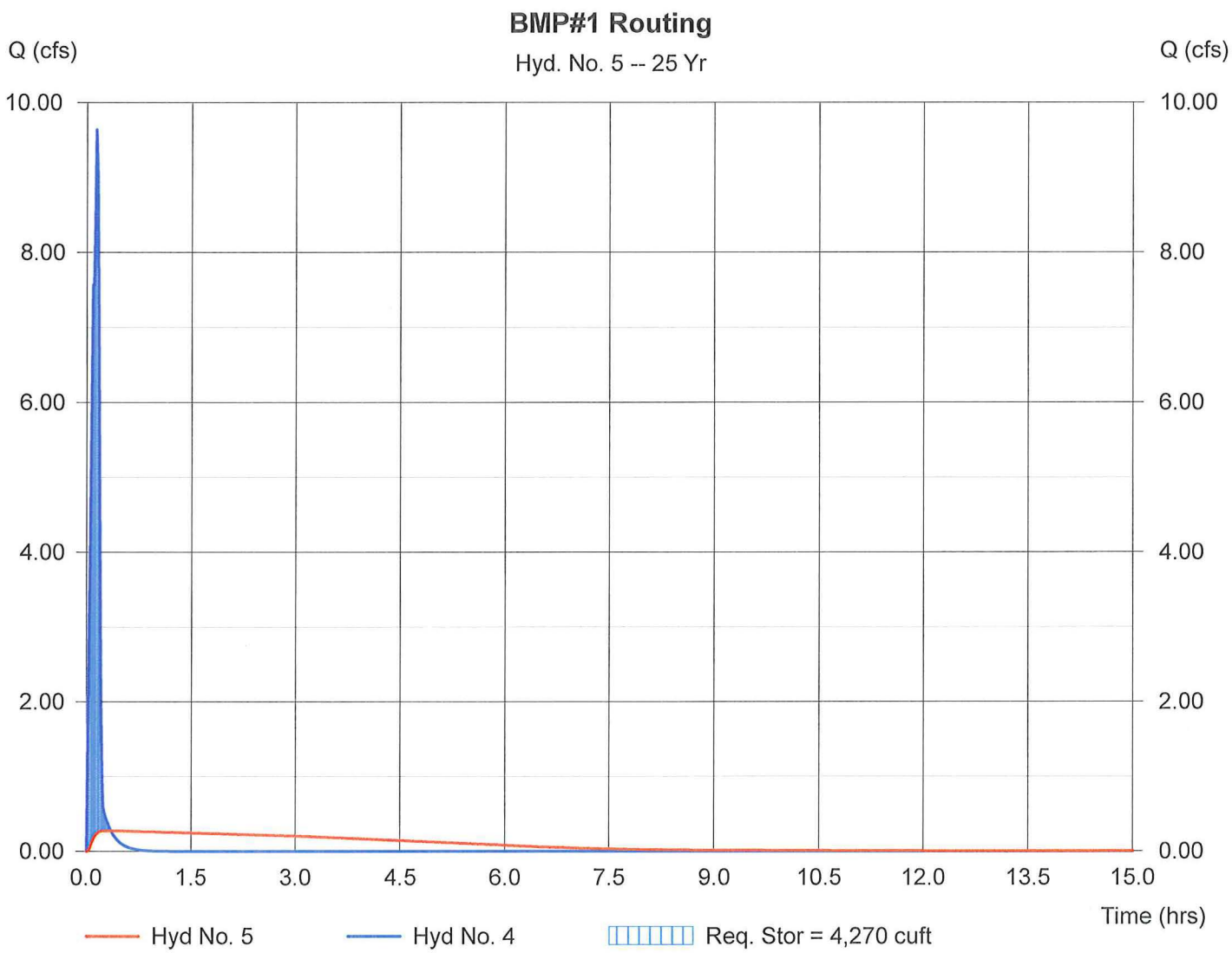
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 5

BMP#1 Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.27 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 4	Max. Elevation	= 86.60 ft
Reservoir name	= BMP #1-Wet Pond ab	Max. Storage	= 4,270 cuft

Storage Indication method used. | Hydrograph Volume = 4,664 cuft



Hydrograph Plot

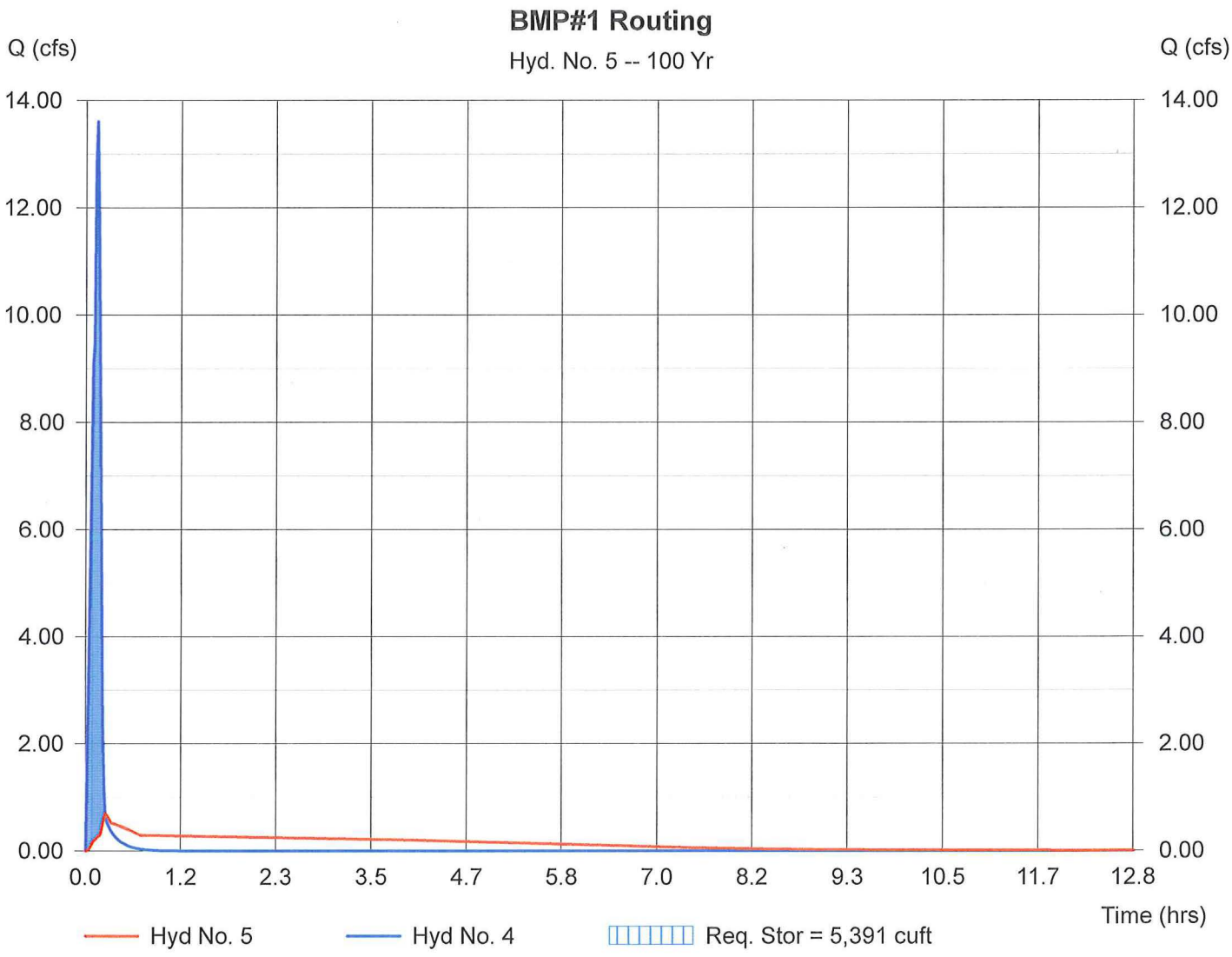
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:9 PM

Hyd. No. 5

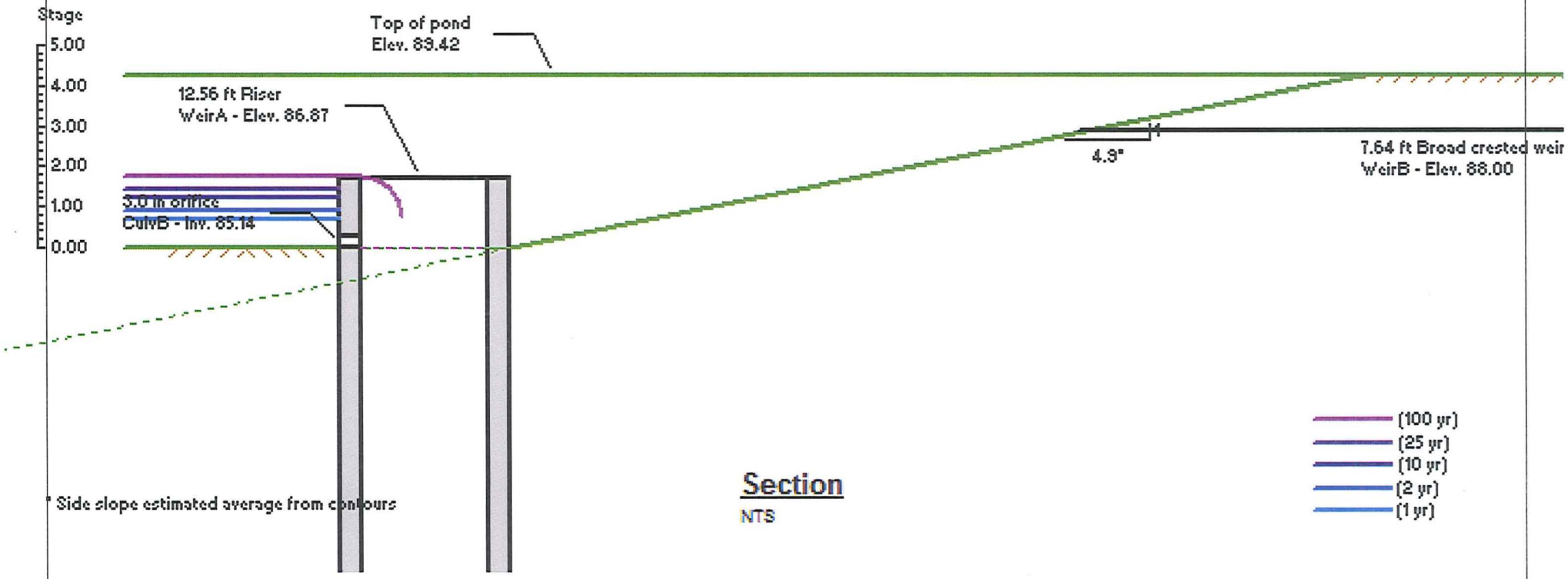
BMP#1 Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.69 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 4	Max. Elevation	= 86.91 ft
Reservoir name	= BMP #1-Wet Pond ab	Max. Storage	= 5,391 cuft

Storage Indication method used. | Hydrograph Volume = 5,916 cuft



BMP #1-Wet Pond ab



Section

NTS

Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: bmp 1 2 ssl asbuilt.gpw	Tuesday, Nov 13 2012, 2:10 PM

Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Nov 13 2012, 2:14 PM

Pond No. 1 - BMP #1-Wet Pond ab

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	85.15	1,696	0	0
0.85	86.00	3,175	2,070	2,070
1.85	87.00	4,125	3,650	5,720
2.85	88.00	5,095	4,610	10,330
3.85	89.00	6,193	5,644	15,974
4.27	89.42	6,872	2,744	18,718

Culvert / Orifice Structures

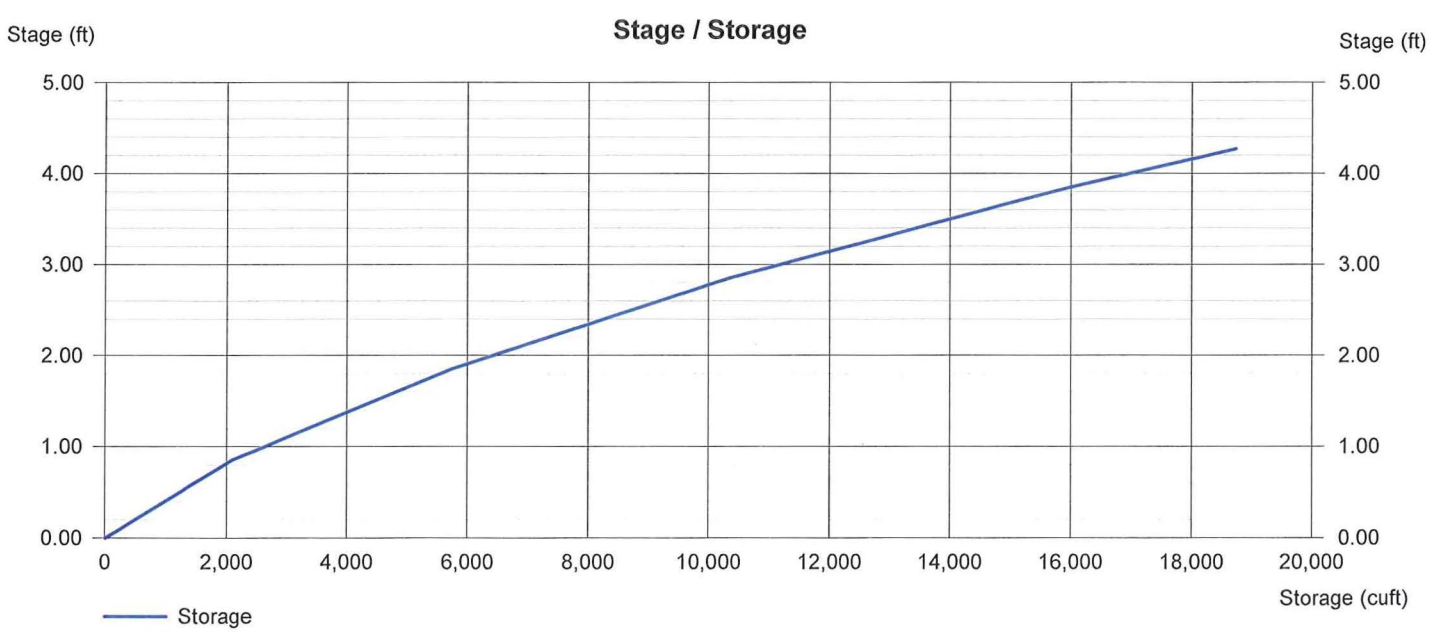
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 75.00	85.14	0.00	0.00
Length (ft)	= 43.00	0.00	0.00	0.00
Slope (%)	= 8.94	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.56	7.64	0.00	0.00
Crest El. (ft)	= 86.87	88.00	0.00	0.00
Weir Coeff.	= 3.33	2.60	0.00	0.00
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Nov 13 2012, 2:14 PM

Pond No. 1 - BMP #1-Wet Pond ab

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	85.15	1,696	0	0
0.85	86.00	3,175	2,070	2,070
1.85	87.00	4,125	3,650	5,720
2.85	88.00	5,095	4,610	10,330
3.85	89.00	6,193	5,644	15,974
4.27	89.42	6,872	2,744	18,718

Culvert / Orifice Structures

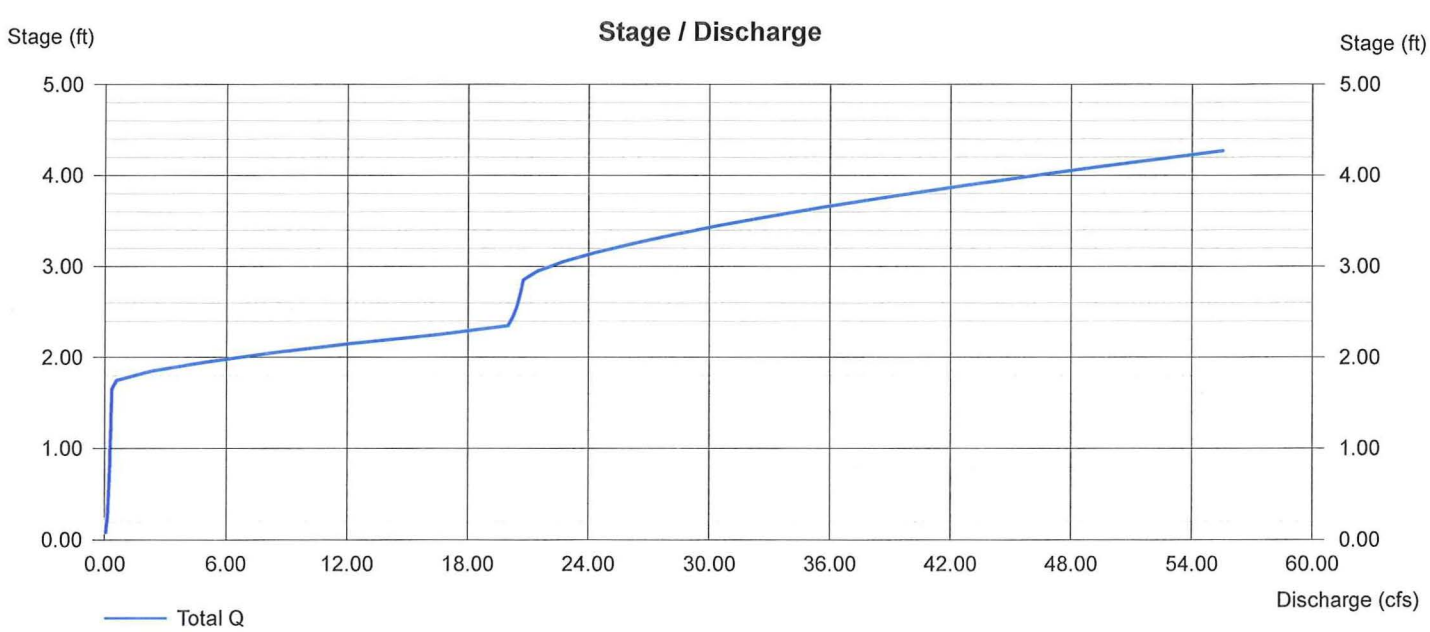
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 75.00	85.14	0.00	0.00
Length (ft)	= 43.00	0.00	0.00	0.00
Slope (%)	= 8.94	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.56	7.64	0.00	0.00
Crest El. (ft)	= 86.87	88.00	0.00	0.00
Weir Coeff.	= 3.33	2.60	0.00	0.00
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) **Tailwater Elev. =** 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Nov 13 2012, 2:14 PM

Pond No. 2 - BMP#2 Biorention ab

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	99.50	1,877	0	0
1.50	101.00	2,501	3,284	3,284
2.50	102.00	4,103	3,302	6,586

Culvert / Orifice Structures

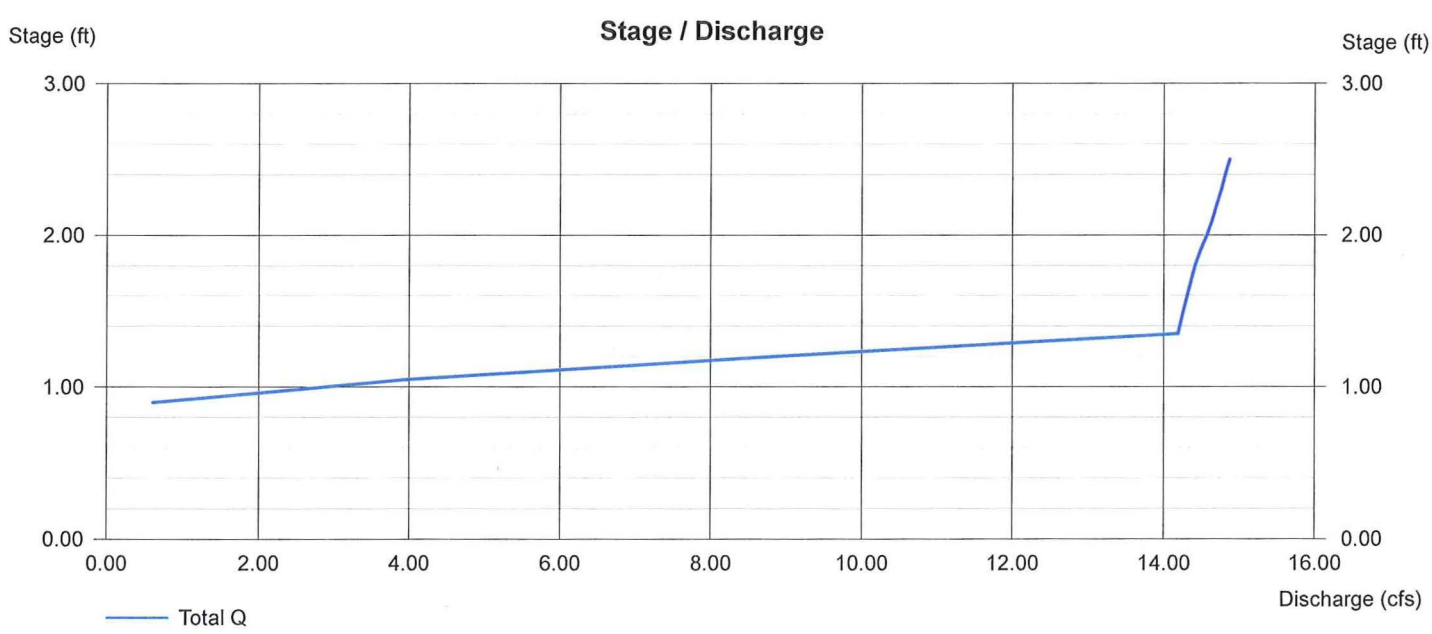
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	6.00	0.00	0.00
Span (in)	= 15.00	36.00	0.00	0.00
No. Barrels	= 1	4	0	0
Invert El. (ft)	= 90.98	100.34	0.00	0.00
Length (ft)	= 223.92	0.00	0.00	0.00
Slope (%)	= 2.42	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 101.32	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Nov 13 2012, 2:15 PM

Pond No. 2 - BMP#2 Biorention ab

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	99.50	1,877	0	0
1.50	101.00	2,501	3,284	3,284
2.50	102.00	4,103	3,302	6,586

Culvert / Orifice Structures

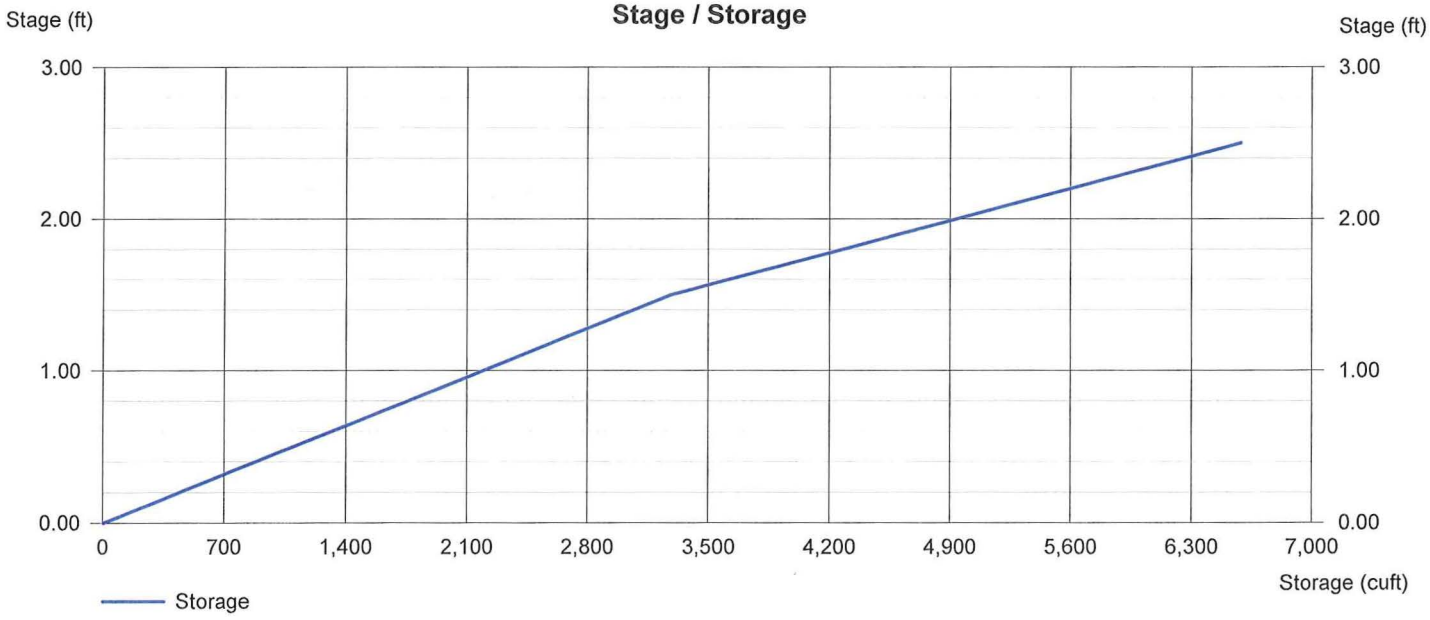
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	6.00	0.00	0.00
Span (in)	= 15.00	36.00	0.00	0.00
No. Barrels	= 1	4	0	0
Invert El. (ft)	= 90.98	100.34	0.00	0.00
Length (ft)	= 223.92	0.00	0.00	0.00
Slope (%)	= 2.42	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 101.32	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Asbuilt Verification BMP#1 SCS Combined Routing to confirm 24 hour detention of the 1 year, 24 hour storm event for stream channel protection design criteria

Table 2-2.
Values of SCS CN and Rational C for various cover conditions
(Based upon SCS,1986)

Cover Description	SCS Curve Number				Rational C				Percent Impervious
	HSG A	HSG B	HSG C	HSG D	HSG A	HSG B	HSG C	HSG D	
Fully developed urban areas									
Open space									
Poor condition (<50% grass)	68	79	86	89	0.36	0.58	0.72	0.78	
Fair condition (50 -75% grass)	49	69	79	84	0.15	0.38	0.58	0.68	
Good condition (>50% grass)	39	61	74	80	0.15	0.22	0.48	0.60	
Impervious areas									
Pavement, roofs	98	98	98	98	0.96	0.96	0.96	0.96	
Gravel	76	85	89	91	0.52	0.70	0.78	0.82	
Dirt	72	82	87	89	0.44	0.64	0.74	0.78	
Urban districts									
Commercial and business	89	92	94	95	0.78	0.84	0.88	0.90	85
Industrial	81	88	91	93	0.62	0.76	0.82	0.86	72
Residential areas (by lot size)									
1/8 acre (town houses, condos)	77	85	90	92	0.54	0.70	0.80	0.84	65
1/4 acre	61	75	83	87	0.22	0.50	0.66	0.74	38
1/3 acre	57	72	81	86	0.15	0.44	0.62	0.72	30
1/2 acre	54	70	80	85	0.15	0.40	0.60	0.70	25
1 acre	51	68	79	84	0.15	0.36	0.58	0.68	20
2 acres	46	65	77	82	0.15	0.30	0.54	0.64	12
Agricultural areas									
Pasture, grassland									
Poor	68	79	86	89	0.36	0.58	0.72	0.78	
Fair	49	69	79	84	0.15	0.38	0.58	0.68	
Good	39	61	74	80	0.15	0.22	0.48	0.60	
Meadow (mowed)	30	58	71	78	0.15	0.16	0.42	0.56	
Brush					0.15	0.15	0.15	0.15	
Poor	48	67	77	83	0.15	0.34	0.54	0.66	
Fair	35	56	70	77	0.15	0.15	0.40	0.54	
Good	30	48	65	73	0.15	0.15	0.30	0.46	
Woods and grass (orchard)									
Poor	57	73	82	86	0.15	0.46	0.64	0.72	
Fair	43	65	76	82	0.15	0.30	0.52	0.64	
Good	32	58	72	79	0.15	0.16	0.44	0.58	
Woods									
Poor	45	66	77	83	0.15	0.32	0.54	0.66	
Fair	36	60	73	79	0.15	0.20	0.46	0.58	
Good	30	55	70	77	0.15	0.15	0.40	0.54	
Row crops, straight, good	67	78	85	89	0.34	0.56	0.70	0.78	
Row crops, contoured, good	65	75	82	86	0.30	0.50	0.64	0.72	
Small grain, good	63	75	83	87	0.26	0.50	0.66	0.74	
Farmsteads	59	74	82	86	0.18	0.48	0.64	0.72	

In the table values of Rational C were computed from $C = 0.020\ CN - 1.0$

Hydrograph Plot

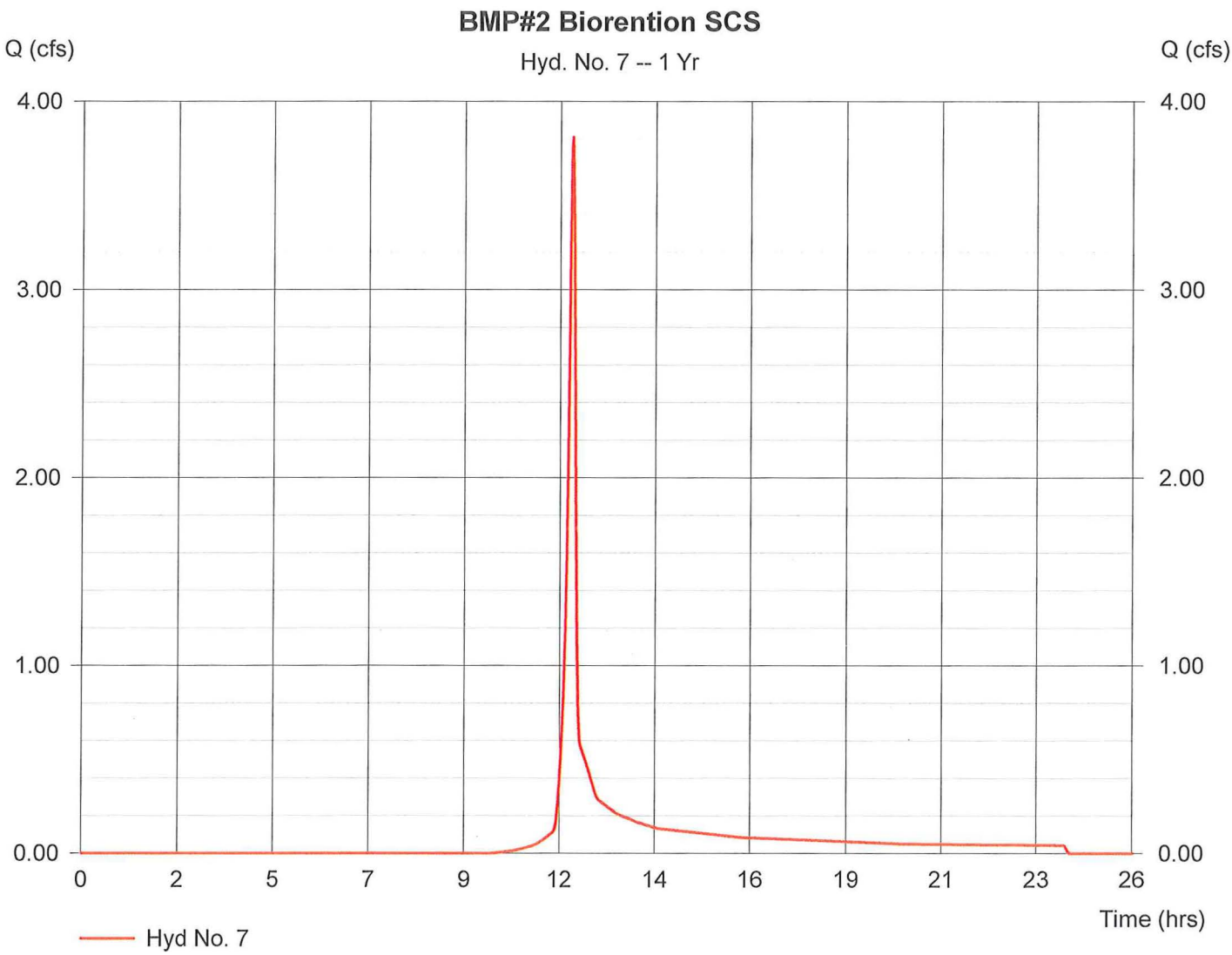
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:16 PM

Hyd. No. 7

BMP#2 Biorention SCS

Hydrograph type	= SCS Runoff	Peak discharge	= 3.81 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.720 ac	Curve number	= 79
Basin Slope	= 6.0 %	Hydraulic length	= 350 ft
Tc method	= USER	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 7,652 cuft



Hydrograph Plot

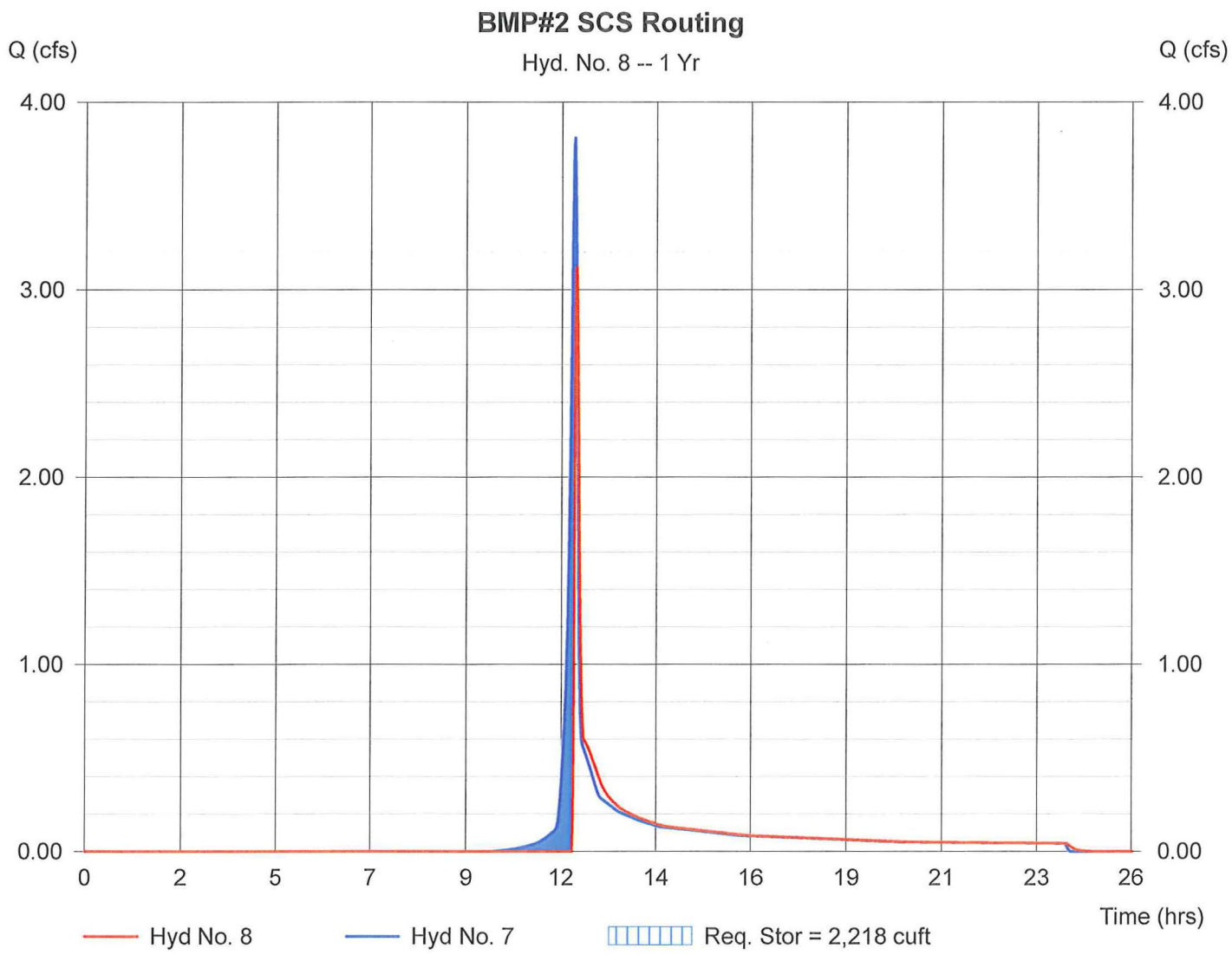
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:51 PM

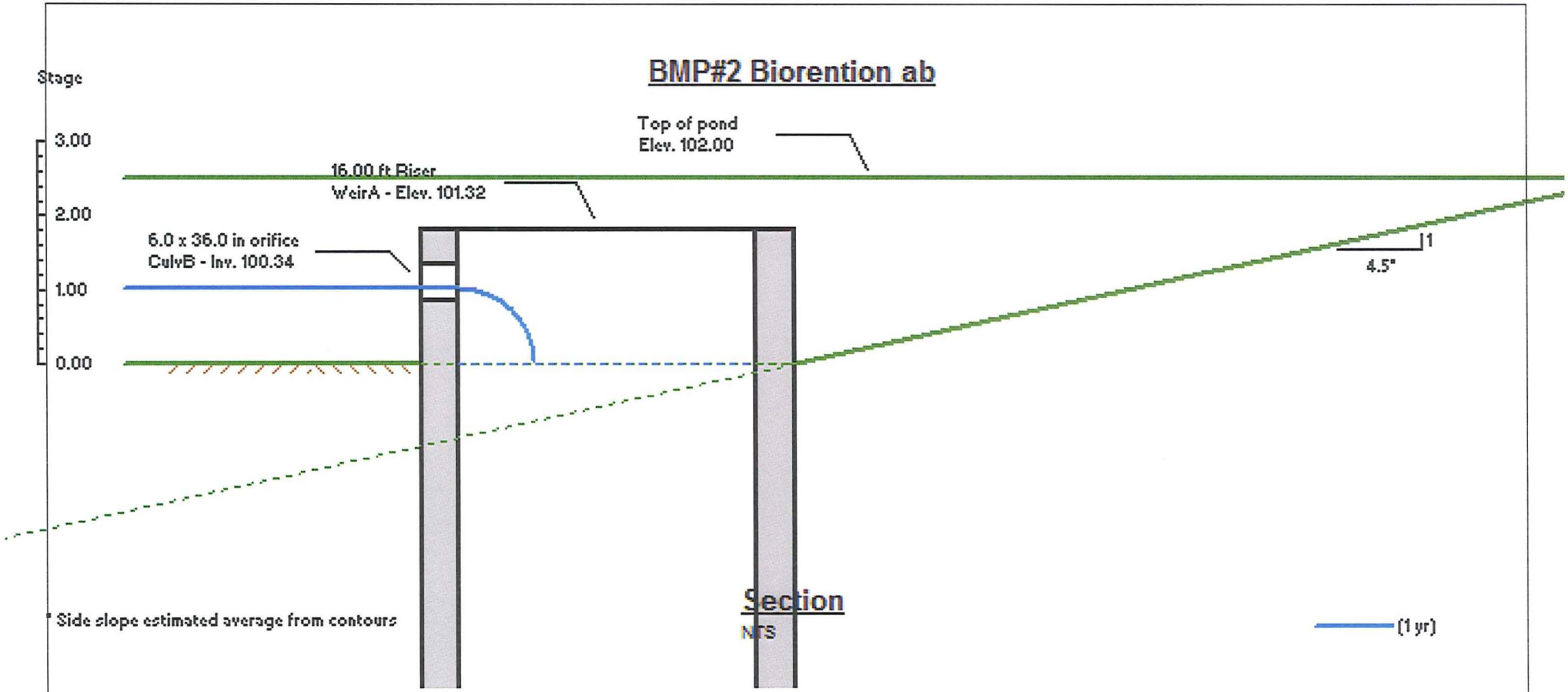
Hyd. No. 8

BMP#2 SCS Routing

Hydrograph type	= Reservoir	Peak discharge	= 3.12 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 7	Max. Elevation	= 100.51 ft
Reservoir name	= BMP#2 Biorention ab	Max. Storage	= 2,218 cuft

Storage Indication method used. | Hydrograph Volume = 6,010 cuft

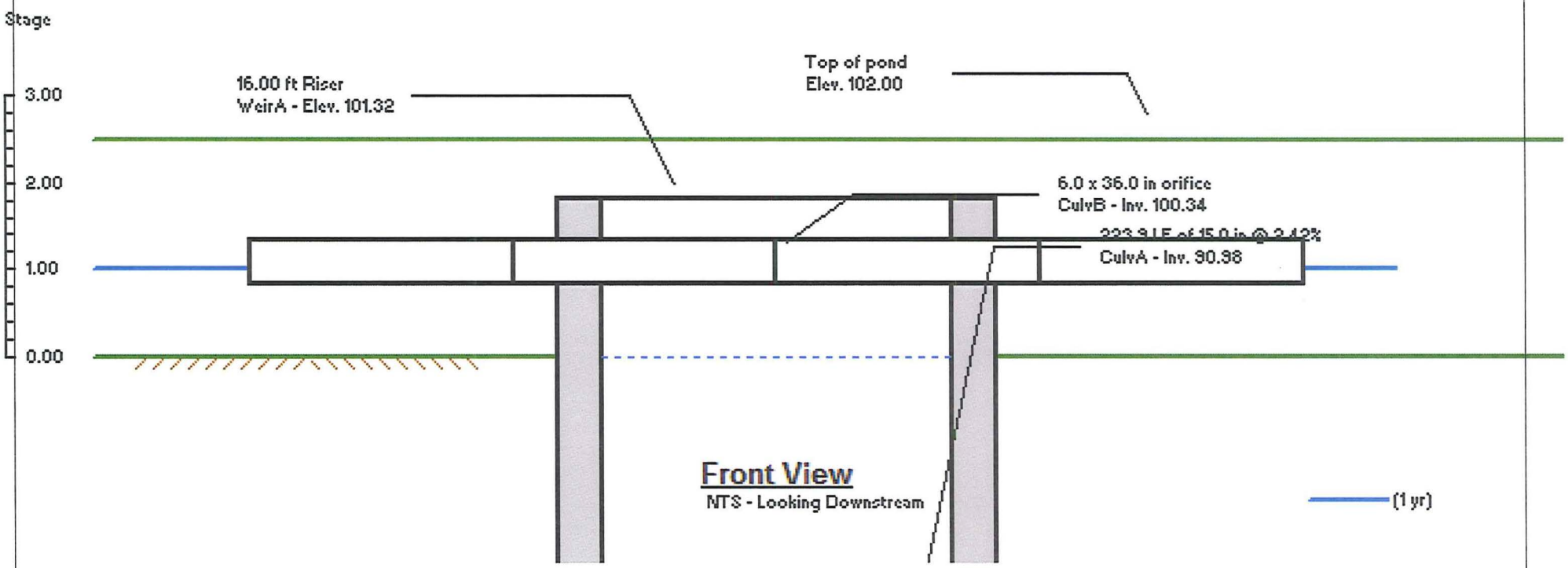




Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: bmp 1 2 ssl asbuilt.gpw	Tuesday, Nov 13 2012, 2:16 PM

BMP#2 Biorention ab



Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: bmp 1 2 ssl asbuilt.gpw	Tuesday, Nov 13 2012, 2:17 PM

Hydrograph Plot

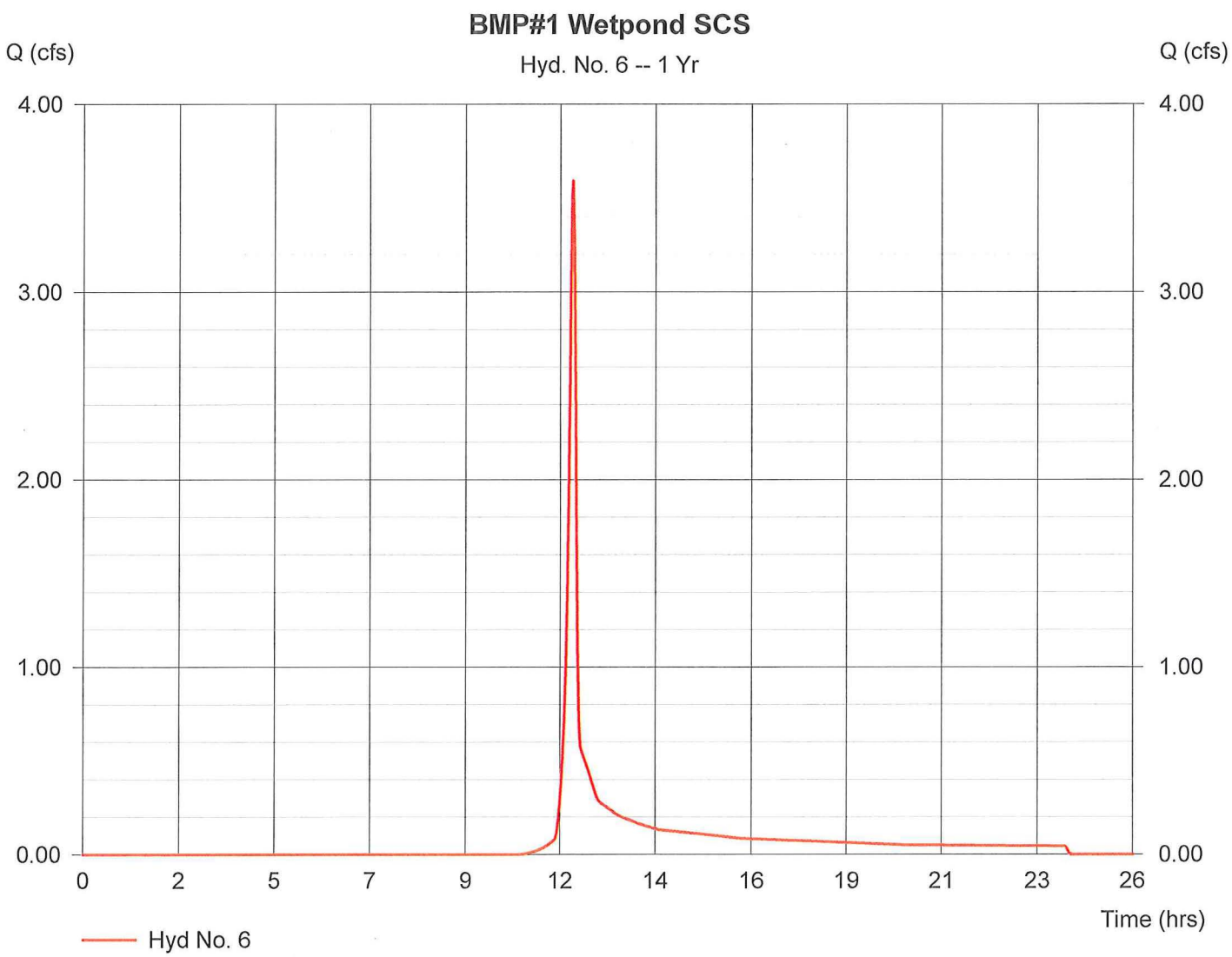
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:17 PM

Hyd. No. 6

BMP#1 Wetpond SCS

Hydrograph type	= SCS Runoff	Peak discharge	= 3.59 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 1.910 ac	Curve number	= 76
Basin Slope	= 6.0 %	Hydraulic length	= 550 ft
Tc method	= USER	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 7,257 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

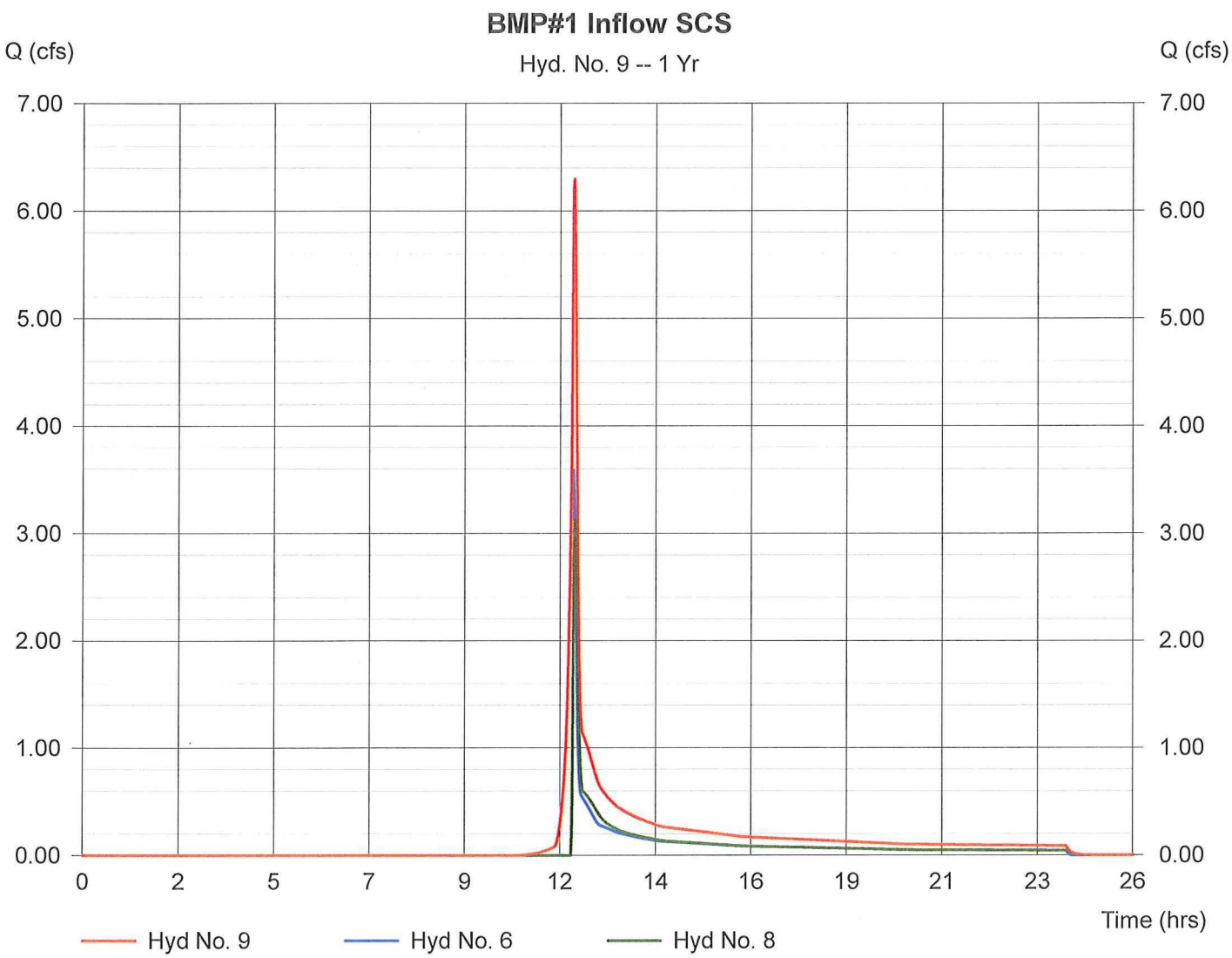
Tuesday, Nov 13 2012, 2:17 PM

Hyd. No. 9

BMP#1 Inflow SCS

Hydrograph type	= Combine	Peak discharge	= 6.30 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyds.	= 6, 8		

Hydrograph Volume = 13,267 cuft



Hydrograph Plot

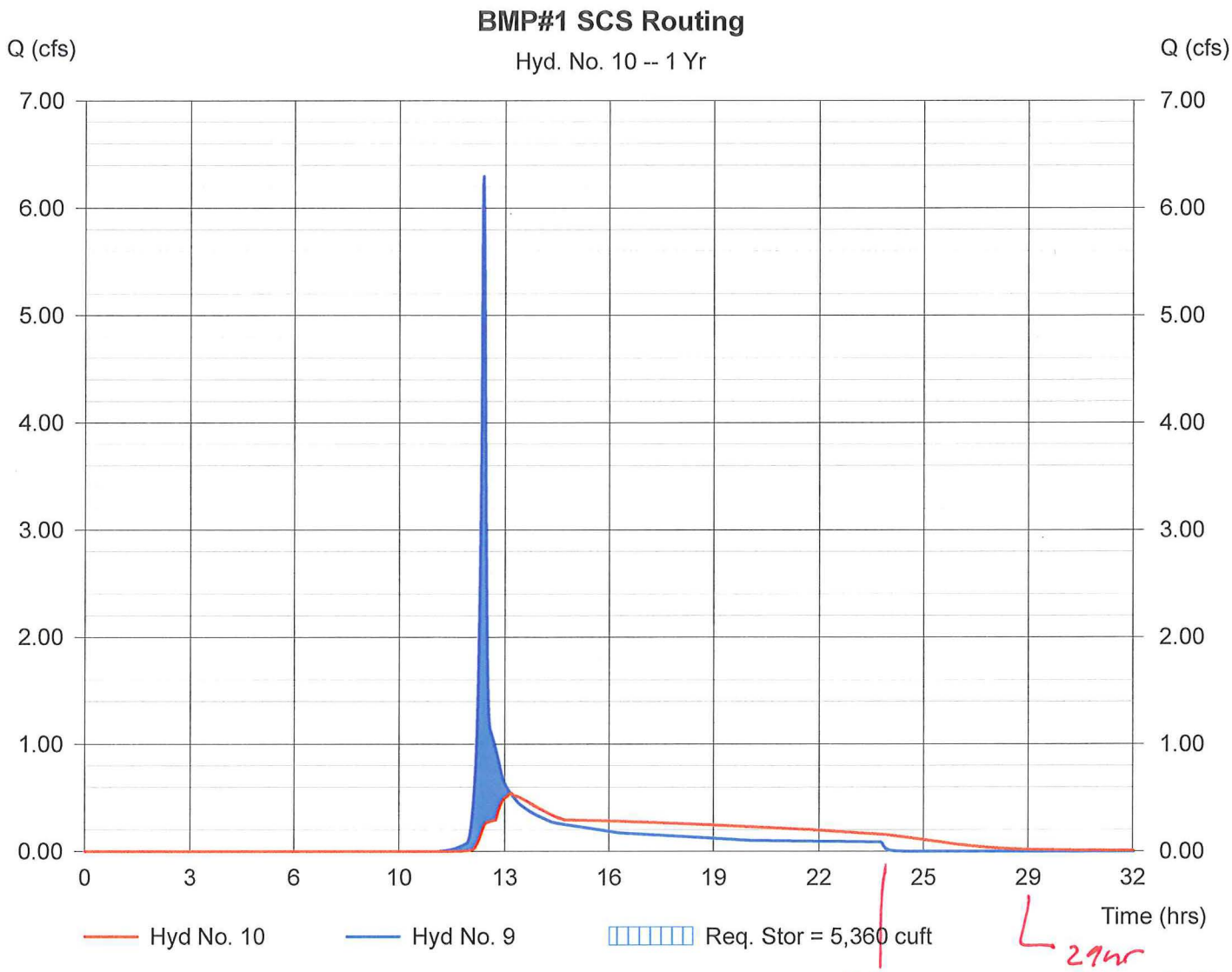
Hydraflow Hydrographs by Intelisolve | Tuesday, Nov 13 2012, 2:18 PM

Hyd. No. 10

BMP#1 SCS Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.54 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 9	Max. Elevation	= 86.90 ft
Reservoir name	= BMP #1-Wet Pond ab	Max. Storage	= 5,360 cuft

Storage Indication method used. | Hydrograph Volume = 13,256 cuft

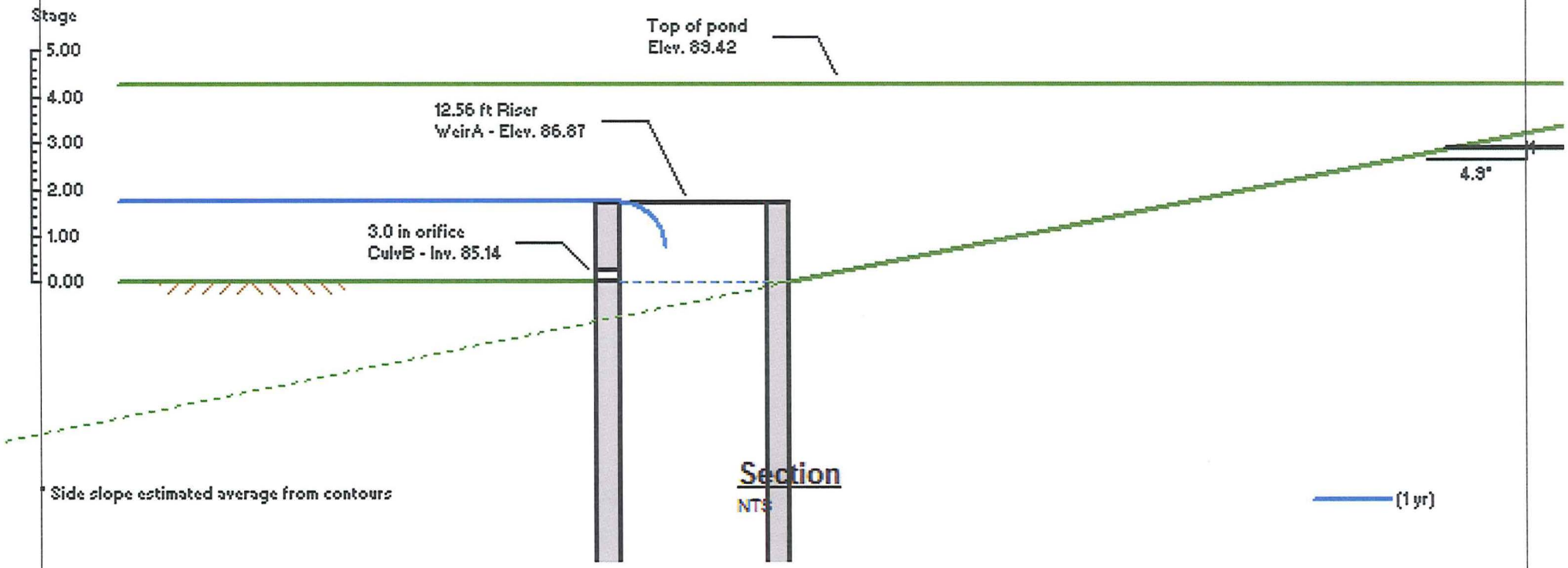


24hr flow 0.16cfs

29hr flow 0.01cfs

29 hr > 24hr detention for 1yr 24hr storm

BMP #1-Wet Pond ab



Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: bmp 1 2 ssl asbuilt.gpw	Tuesday, Nov 13 2012, 2:18 PM

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 · TRACT 12 (PHASE 1)
Structure/BMP Name: BMP 1
Project Location: LYTHAM CT (BEHIND LOTS 47-48)
BMP Location: " "
County Plan No.: S - 0048 - 2009

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

Tax Map/Parcel No.: 0540700001A
BMP ID Code (if known): 1 (WC-108)
Zoning District:: PUD-R
Land Use: RESIDENTIAL
Site Area (sf or acres): 1.91 AC (DRAINAGE AREA)

Brief Description of Stormwater Management/BMP Facility:

WET EXTENDED DETENTION POND

Nearest Visible Landmark to SWM/BMP Facility: FIELDSTONE PKWY + STONEHOUSE GLEN

Nearest Vertical Ground Control (if known):
☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☒ Other NGVD27
Station Number or Name: TOAN02
Datum or Reference Elevation: NAD 83 /86 , NGVD 27 , EL 188.14
Control Description: CONCRETE MONUMENT
Control Location from Subject Facility: INTX RTE 60, RTE 30

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: MAY 2011
Facility Monitored by County Representative during Construction: ☒ Yes ☐ No ☐ Unknown
Name of Site Work Contractor Who Constructed Facility: GEORGE NICE + SONS
Name of Professional Firm Who Routinely Monitored Construction: GET SOLUTIONS / KERR ENVIRONMENTAL / WSP SELLS
Date of Completion for SWM/BMP Facility: AUG. 2012
Date of Record Drawing/Construction Certification Submittal: _____

(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: G.S. STONEHOUSE GREEN LAND SUB LLC.
Mailing Address: 11950 DEMOCRACY DR
RESTON, VA 20190
Business Phone: 703-437-8800 Fax: _____
Contact Person: MIKE ETCHEMENDY Title: DEV. MGR

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: WSP SELLS
Mailing Address: 15401 WESTON PKWY
CARY NC 27513
Business Phone: 919-678-0035
Fax: 919-678-0206
Responsible Plan Preparer: CRAIG DUERR, P.E
Title: PROJECT MGR.
Plan Name: STONEHOUSE TRACT 12
Firm's Project No. 08-4051
Plan Date: AUG 18, 2010
Sheet No.'s Applicable to SWM/BMP Facility: C4.3 / C5.0 / C6.0 / ____ / ____

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

Name: GEORGE NICE + SONS
Mailing Address: 129 INDUSTRIAL BLVD.
TOANO, VA 23168
Business Phone: 757-565-2885
Fax: 757-565-1526
Contact Person: MIKE NICE, P.E.
Site Foreman/Supervisor: "
Specialty Subcontractors & Purpose (for BMP Construction Only):

NONE

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: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC 27513
Business Phone: 919 678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
1/4/2013
PROFESSIONAL ENGINEER

(Seal)

Virginia Registered Professional Engineer or Certified Land Surveyor

Construction Certification

Firm Name: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC 27513
Business Phone: 919-678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
1/4/2013
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.)*

✓ 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.

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

✓ 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).

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

✓ 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.)*

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

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

✓ 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.

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

✓ 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.

✓ 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.

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

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

✓ 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.

✓ 10. Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.

✓ 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.

✓ 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.**

✓ 13. Top of impervious core embankment, core trench limits and elevation of cut-off trench bottom. **May need to obtain this information during construction.**

✓ 14. Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.

✓ 15. Outlet barrel diameter, length, slope, type and thickness class of material and type of flared end sections, headwall or endwall.

✓ 16. Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.

____ 17. BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.

✓ 18. Maintenance plan taken from approved design plan transposed onto record drawing set.

NA 19. Fencing location and type, if applicable to facility.

✓ 20. BMP vicinity properly cleaned of stockpiles and construction debris.

✓ 21. No visual signs of erosion or channel degradation immediately downstream of facility.

✓ 22. Any other information formally requested by the Environmental Division specific to the constructed SWM/BMP facility.

BMP #1

(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.)*

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

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

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

✓ 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.

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

N/A 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.

✓ 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).

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

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

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

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

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

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

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 - TRACT 12 (PHASE 1)
Structure/BMP Name: BMP 2
Project Location: LYTHAM CT.
BMP Location: COMMON OPEN SPACE 4
County Plan No.: S - 0048 - 2009

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

Tax Map/Parcel No.: 05407 00001B
BMP ID Code (if known): 2 WC107
Zoning District:: PUD-R
Land Use: RESIDENTIAL
Site Area (sf or acres): 1.72 AC. (DRAINAGE AREA)

Brief Description of Stormwater Management/BMP Facility:

BIORETENTION POND

Nearest Visible Landmark to SWM/BMP Facility: FIELDSTONE PKWY + STONEHOUSE GLEN

Nearest Vertical Ground Control (if known):
☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☒ Other NGVD 27
Station Number or Name: TOANO 2
Datum or Reference Elevation: NAD83/86, NGVD27, EL 108.14
Control Description: CONCRETE MONUMENT
Control Location from Subject Facility: INTX RTE 60 + RTE 30

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: MAY 2011
Facility Monitored by County Representative during Construction: ☒ Yes ☐ No ☐ Unknown
Name of Site Work Contractor Who Constructed Facility: GEORGE NICE & SONS
Name of Professional Firm Who Routinely Monitored Construction: GET SOLUTIONS | KERR ENVIRONMENTAL / WSP SELLS
Date of Completion for SWM/BMP Facility: AUG. 2012
Date of Record Drawing/Construction Certification Submittal: _____

(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: G.S. STONEHOUSE GREEN LAND SUB LLC.
Mailing Address: 11950 DEMOCRACY DR
RESTON, VA 20190
Business Phone: 703-437-8800 Fax: _____
Contact Person: MIKE ETCHEMENDY Title: DEV. MGR

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: WSP SELLS
Mailing Address: 15401 WESTON PKWY
CARY NC 27513
Business Phone: 919-678.0035
Fax: 919-678.0206
Responsible Plan Preparer: CRAIG DUERR, PE
Title: PROJ. MGR
Plan Name: STONEHOUSE TRACT 12
Firm's Project No. 08-4051
Plan Date: AUG. 18, 2010
Sheet No.'s Applicable to SWM/BMP Facility: C4.3 / C5.1 / ____ / ____ / ____

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

Name: GEORGE NICE + SONS
Mailing Address: 129 INDUSTRIAL BLVD
TOANO VA 23168
Business Phone: 757-565-2885
Fax: 757-565-1526
Contact Person: MIKE NICE, P.E.
Site Foreman/Supervisor: "
Specialty Subcontractors & Purpose (for BMP Construction Only):

NONE

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: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC 27513
Business Phone: 919 678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
1/4/2013
PROFESSIONAL ENGINEER

(Seal)

Virginia Registered Professional Engineer or Certified Land Surveyor

Construction Certification

Firm Name: WSP Sells
Mailing Address: 15401 Weston Parkway Suite 100, Cary, NC 27513
Business Phone: 919-678 0035
Fax: 919 678 0206

Name: S. Shayne Leathers
Title: Senior Engineer

Signature:
Date: 10/12/12

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
S. SHAYNE LEATHERS
Lic. No. 050365
1/4/2013
PROFESSIONAL ENGINEER

(Seal)

Virginia Registered Professional Engineer

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

Mike N. date?

☐ 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.)*

✓ 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.

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

✓ 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).

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

✓ 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.)*

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

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

✓ 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.

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

✓ 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.

✓ 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.

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

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

✓ 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.

✓ 10. Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.

✓ 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.**

✓ 14. Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.

✓ 15. Outlet barrel diameter, length, slope, type and thickness class of material and type of flared end sections, headwall or endwall.

✓ 16. Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.

✓ 17. BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.

✓ 18. Maintenance plan taken from approved design plan transposed onto record drawing set.

NA 19. Fencing location and type, if applicable to facility.

✓ 20. BMP vicinity properly cleaned of stockpiles and construction debris.

✓ 21. No visual signs of erosion or channel degradation immediately downstream of facility.

✓ 22. Any other information formally requested by the Environmental Division specific to the constructed SWM/BMP facility.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

BMP #2

(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)*

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

✓ D2. Sediment pretreatment devices provided.

✓ 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.

✓ 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.

✓ 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. (was cleaned out)

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

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

✓ D8. Overflow outlet has adequate erosion protection.

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

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

✓ 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.

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

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

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

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www.aleastern.com

Submitted By: MICHELLE BROADY

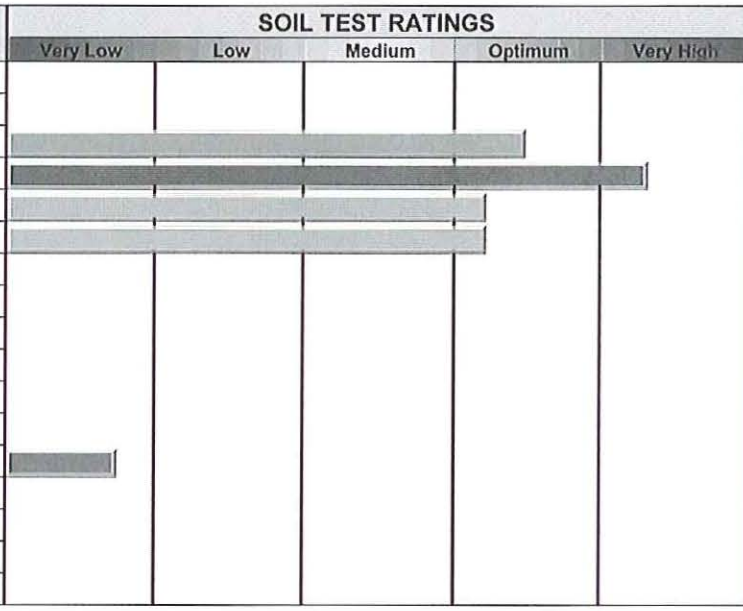
SOIL ANALYSIS

Client :	Grower :	
WALTRIP RECYCLING INC 11 MARCLAY ROAD WILLIAMSBURG VA 23185	NEW TOWN	Report No: 12-181-0540 Cust No: 01749 Date Printed: 07/05/2012 Date Received : 06/29/2012 PO: Page : 1 of 1

Lab Number : 07730 **Field Id :** **Sample Id :** NEW LAWN

Test	Method	Results
Soil pH	1:1	6.9
Buffer pH		6.92
Phosphorus (P)	M3	78 ppm
Potassium (K)	M3	231 ppm
Calcium (Ca)	M3	1361 ppm
Magnesium (Mg)	M3	183 ppm
Sulfur (S)		
Boron (B)		
Copper (Cu)		
Iron (Fe)		
Manganese (Mn)		
Zinc (Zn)		
Sodium (Na)	M3	28 ppm
Soluble Salts		0.24 mmhos/cm
Organic Matter	WB	3.5 % ENR 107
Nitrate Nitrogen		

SOIL TEST RATINGS



Calculated Cation Exchange Capacity

9.2 meq/100g

Calculated Cation Saturation

%K	6.4
%Ca	74.0
%Mg	16.6
%H	1.4
Hmeq	0.1
%Na	1.3

K : Mg Ratio

0.39

Ca : Mg Ratio

4.46

Additional results to follow

SOIL FERTILITY GUIDELINES

Crop : Bio-Retention **Yield Goal :** 0 **Rec Units:** LB/1000 SF

(lbs) LIME	(tons)	N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe
0		3.0	0.5	0	0						

Crop : **Rec Units:**

Comments :

Bio-Retention

· All recommended fertilizers are on actual elemental basis. To convert to product basis, divide the recommended quantity in the first page by the percentage of the active ingredient then multiply by 100.

· Phosphate is more efficient if applied near the plant, apply all phosphate beside the row. Broadcast N and/or K2O then mix into the soil. If there is no fertilizer meets the ratio, you can use single element fertilizer such as Urea, Triplesuper Phosphate and Muriate of Potash to achieve the requirements. Consult the enclosed instruction sheet on lime and fertilizer application.

· For more in depth explanation, go to our website www.al-labs-eastern.com and select the "Lawn and Garden" tab at the top of home page. At the bottom of the "Lawn and Garden" page, you find information explaining a soil test report and fertilizer recommendations. http://al-labs-eastern.com/forms/LawnGardenSoilTestExplained.pdf

M3 - Mehlich 3 WB - Walkley Black Color 1:1 - Water pH
Analysis prepared by: A&L Eastern Laboratories, Inc.

Report Number
12-181-0540 **Page:** 1 of 1

Account Number
01749

Send To : WALTRIP RECYCLING INC
11 MARCLAY ROAD
WILLIAMSBURG , VA 23185

Client : NEW TOWN

A&L Eastern Laboratories, Inc.

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6446

www.aleastern.com

Submitted By : MICHELLE BROADY
Purchase Order :
Report Date : 7/5/2012
Date Received : 6/29/2012

REPORT OF ANALYSIS

Lab No	Sample ID Sample Date and Time	Glass Shards > 4mm	Metal Fragments > 4mm	Organic Matter (LOI)	Plastic Film	Plastic Fragments (>4mm)
		TMECC 07.06.A		SOIL LOI 440	TMECC 07.06.A	
				%		
07730	NEW LAWN	< 1	< 1	4.20	< 1	< 1

Method Reference:
Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, p. 1004-1005
Recommended Chemical Soil Test Procedures for the North Central Region. NCR Research Pub. No. 221 Revised.
Test Methods for the Examination of Composting and Compost, US Composting Council, 1997

Pauric McGroary

Pauric McGroary

Sample results are reported 'as received' and are not moisture corrected unless noted

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FIELD REPORT No. 19

Project No: **WM11-128T**
Permit No:
Permit Date:

Project Name:
Tract 12 - Phase 1 Stonehouse Development

Location:
James City County, Virginia

Client:
George Nice & Sons, Inc.

General Contractor:
George Nice & Sons, Inc.

Day/Date:
Thurs-Sat/21-23 June 12

Weather/Temp:
Sunny/80-90's

Scope of Services:
Bioretention Installation Observations

Deficiency Observed ☐ No Deficiency Observed ☒

As requested, **G E T** representatives visited the project site between the dates of June 21 and June 23, 2012, in order to inspect the on-going construction of Bioretention Facility BMP #2. During our site visits, the subgrade soils within the basin were observed to had been properly de-mucked of all loose sediment. Once approved the contractor proceeded with installing the underdrain system, which consisted of perforated pipe, VDOT #57 stone, and a layer of filter fabric beneath and above the layer of VDOT #57 stone and then installing the subsequest biosoil. Based on our field observations, Bioretention Facility BMP #2 was constructed in general accordance with the approved project plans.

By:
A. Libby/J. Wheeler
G E T Solutions. Inc.

Distribution:
mnice@gniceandsons.com

Reviewed by:

J. Wheeler
G E T Solutions, Inc.

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FIELD REPORT No. 1

Project No: **WM11-128T**
Permit No:
Permit Date:

Project Name:
Tract 12 - Phase 1 Stonehouse Development

Location:
James City County, Virginia

Client:
George Nice & Sons, Inc.

General Contractor:
George Nice & Sons, Inc.

Day/Date:
Thurs/12 May 11

Weather/Temp:
Sunny/70's

Scope of Services:
BMP Inspection

Deficiency Observed ☐ No Deficiency Observed ☒

As requested, a **G E T** representative visited the project site in order to observe the footprint of the embankment dam for BMP #1 prior to keyway excavation and subsequent fill placement. The contractor had previously stripped the topsoil from the observed area. Based on our field observations, the observed embankment dam footprint was considered suitable for keyway excavation and embankment dam fill. The keyway should be a minimum of 8 feet wide and 4 feet deep.

Distribution:
mnice@gniceandsons.com

Reviewed by:

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FIELD REPORT No. 2
Page 1 of 1

Project No: **WM11-128T**
Permit No:
Permit Date:

Project Name:
Tract 12 - Phase 1 Stonehouse Development

Location:
James City County, Virginia

Client:
George Nice & Sons, Inc.

General Contractor:
George Nice & Sons, Inc.

Day/Date:
Fri/13 May 11

Weather/Temp:
Cloudy/60's

Scope of Services:
BMP #1 - Key Way Inspection

Deficiency Observed ☐ No Deficiency Observed ☒

As requested, a **G E T** representative visited the project site in order to observe the key way excavation. The contractor had properly excavated the recommended 8-foot wide and 4-foot deep key way. Based on our field observations, the observed key way excavation was considered suitable for fill placement.

By:
A. Libby
G E T Solutions, Inc.

Distribution:
mnice@gniceandsons.com

Reviewed by:

J. Wheeler
G E T Solutions, Inc.

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COMPACTION TEST REPORT (No. 1) - Sheet 1 of 2

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/13/11
Project Location:	James City County, Virginia	Technician:	A. Libby
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Cloudy/Rain Temp. (˚F) 60's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 - Key Way Backfill for Dam

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	16.3	106.6	123.9	4	95	97	X		3' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
2	18.8	104.1	123.7	4	95	95	X		2' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
3	16.0	104.4	121.1	4	95	95	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
4	18.9	105.0	124.8	4	95	95	X		Subgrade	See Attached Sketch (Page 2 of 2, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill within Keyway	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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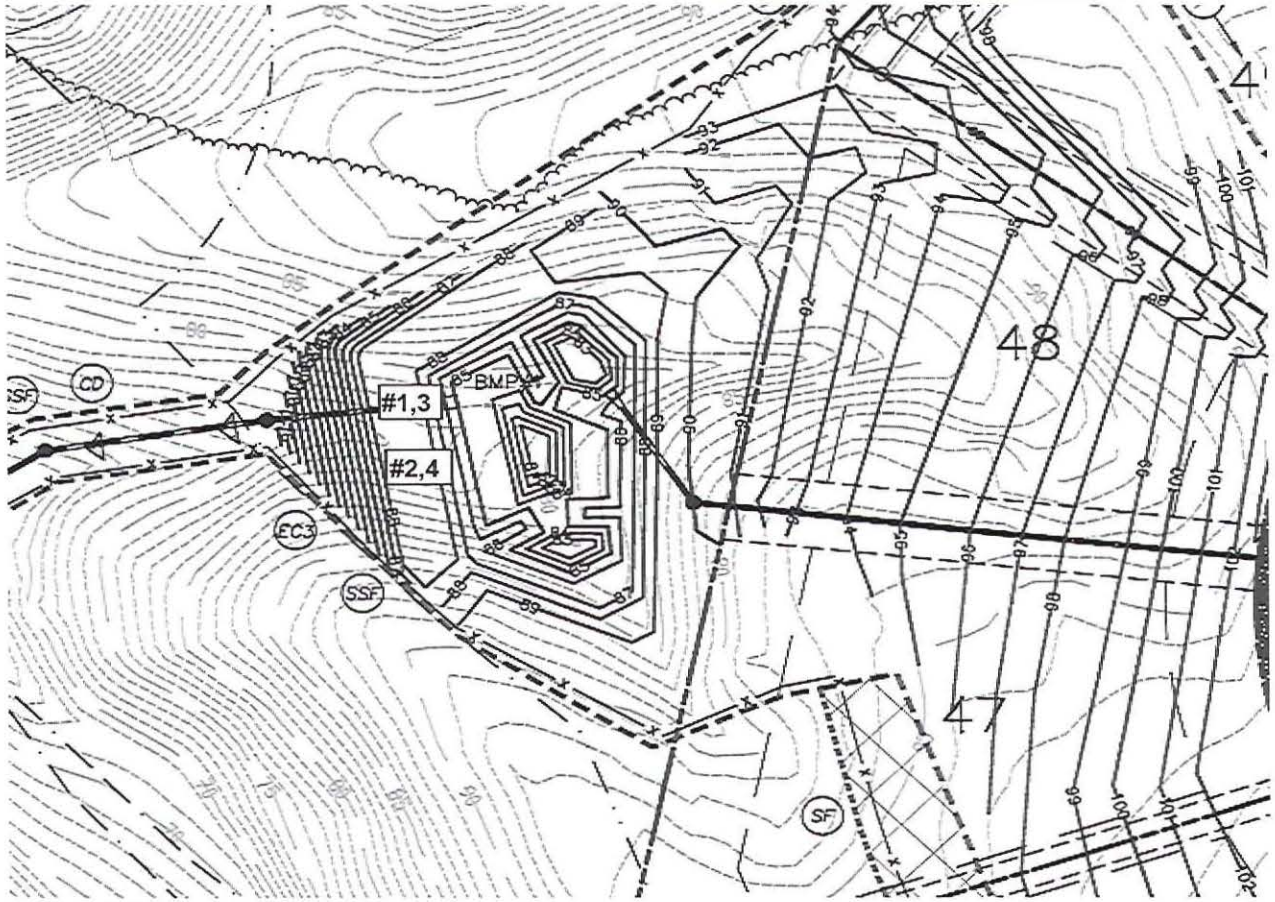
COMPACTION TEST REPORT (No. 1) - Sheet 2 of 2

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/13/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	AL

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COMPACTION TEST REPORT (No. 2) - Sheet 1 of 2

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	A. Dudley
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Emabnkment Dam Fill - BMP #1

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	19.7	104.5	125.1	4	95	95	X		Elev. 75'	See Attached Sketch (Page 2 of 2, Figure 1)
2	18.3	107.1	126.7	4	95	97	X		Elev. 76'	See Attached Sketch (Page 2 of 2, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy Lean CLAY (CL)
Test Conducted on:	Embankment Dam Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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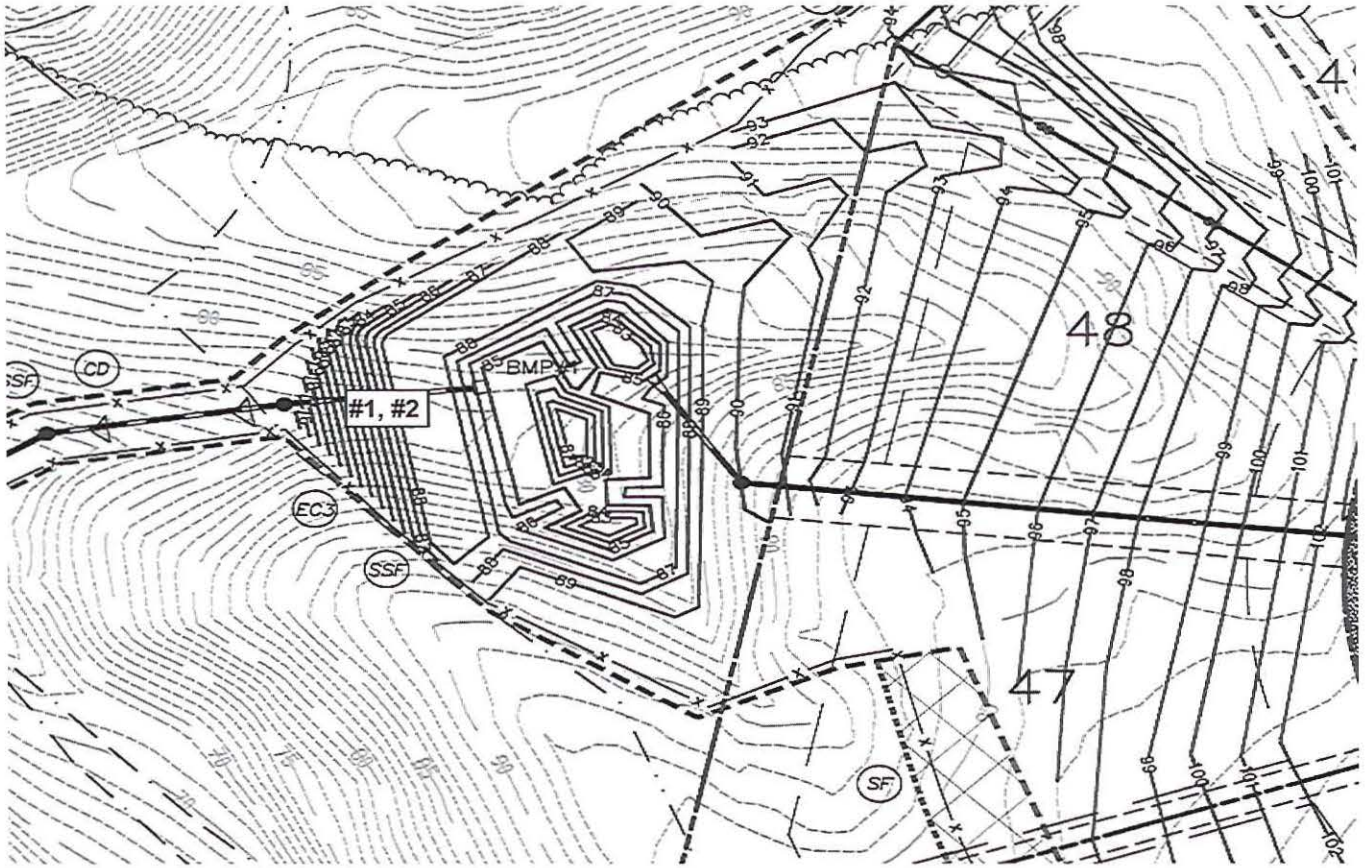
COMPACTION TEST REPORT (No. 2) - Sheet 2 of 2

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/14/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	AD

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COMPACTION TEST REPORT (No. 3) - Sheet 1 of 4

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	R. Tweedy
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Embankment Dam Fill for BMP #1 & Lot #48

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	18.5	100.3	118.9	4	95	90	X		Elev. 77.0'	See Attached Sketch (Page 4 of 4, Figure 1)
2	18.9	104.8	124.6	4	95	94	X		Elev. 78.0'	See Attached Sketch (Page 4 of 4, Figure 1)
3	19.4	102.0	121.9	4	95	92	X		Elev. 79.0'	See Attached Sketch (Page 4 of 4, Figure 1)
4	18.1	108.7	128.3	4	95	98	X		Elev. 80.0'	See Attached Sketch (Page 4 of 4, Figure 1)
5	17.8	103.3	121.6	4	95	93	X		Elev. 83.0'	See Attached Sketch (Page 4 of 4, Figure 1)
6	16.8	107.4	125.5	4	95	97	X		Elev. 84.6'	See Attached Sketch (Page 4 of 4, Figure 1)
7	10.1	110.7	123.9	3	95	98	X		Elev. 83.5'	See Attached Sketch (Page 4 of 4, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	3	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698	
Testing Depth:	6, 12 inches	Material Description:	Sandy, Lean CLAY (CL)	
Test Conducted on:	Backfill over Keyway	Max. Dry Density (pcf):	113.5	111.0
		Optimum Moisture (%):	14.5%	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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COMPACTION TEST REPORT (No. 3) - Sheet 2 of 4

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	R. Tweedy
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 and Lot #48 Fill

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
8	10.1	112.4	123.8	3	95	99	X		Elev. 83.5'	See Attached Sketch (Page 4 of 4, Figure 1)
9	10.2	114.0	125.7	3	95	100	X		Elev. 80.9'	See Attached Sketch (Page 4 of 4, Figure 1)
10	17.5	108.1	121.2	4	95	97	X		Elev. 83.5'	See Attached Sketch (Page 4 of 4, Figure 1)
11	16.8	106.1	124.0	4	95	96	X		Elev. 80.9'	See Attached Sketch (Page 4 of 4, Figure 1)
12	18.0	102.6	121.0	4	95	92	X		Elev. 82.0'	See Attached Sketch (Page 4 of 4, Figure 1)
13	11.8	107.0	119.5	4	95	96	X		Elev. 83.0'	See Attached Sketch (Page 4 of 4, Figure 1)
14	15.6	104.1	120.3	4	95	94	X		Elev. 84.0'	See Attached Sketch (Page 4 of 4, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	3	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698	
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)	
Test Conducted on:	BMP and Lot Fill	Max. Dry Density (pcf):	113.5	111.0
		Optimum Moisture (%):	14.5%	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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COMPACTION TEST REPORT (No. 3) - Sheet 3 of 4

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/14/11
Project Location:	James City County, Virginia	Technician:	R. Tweedy
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 and Lot #48 Fill

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
15	13.8	108.6	123.6	4	95	98	X		Elev. 81.9'	See Attached Sketch (Page 4 of 4, Figure 1)
16	15.3	107.2	123.6	4	95	97	X		Elev. 86.4'	See Attached Sketch (Page 4 of 4, Figure 1)
17	13.9	105.0	119.6	4	95	95	X		Elev. 84.0'	See Attached Sketch (Page 4 of 4, Figure 1)
18	17.4	111.1	124.9	4	95	100	X		Elev. 82.8'	See Attached Sketch (Page 4 of 4, Figure 1)
19	14.2	108.0	123.3	4	95	97	X		Elev. 86.4'	See Attached Sketch (Page 4 of 4, Figure 1)
20	16.5	106.8	124.3	4	95	96	X		Elev. 84.0'	See Attached Sketch (Page 4 of 4, Figure 1)
21	15.8	108.9	126.2	1	95	98	X		Elev. 82.5'	See Attached Sketch (Page 4 of 4, Figure 1)

Compaction Equipment Used:	Sheeps Foot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	BMP and Lot Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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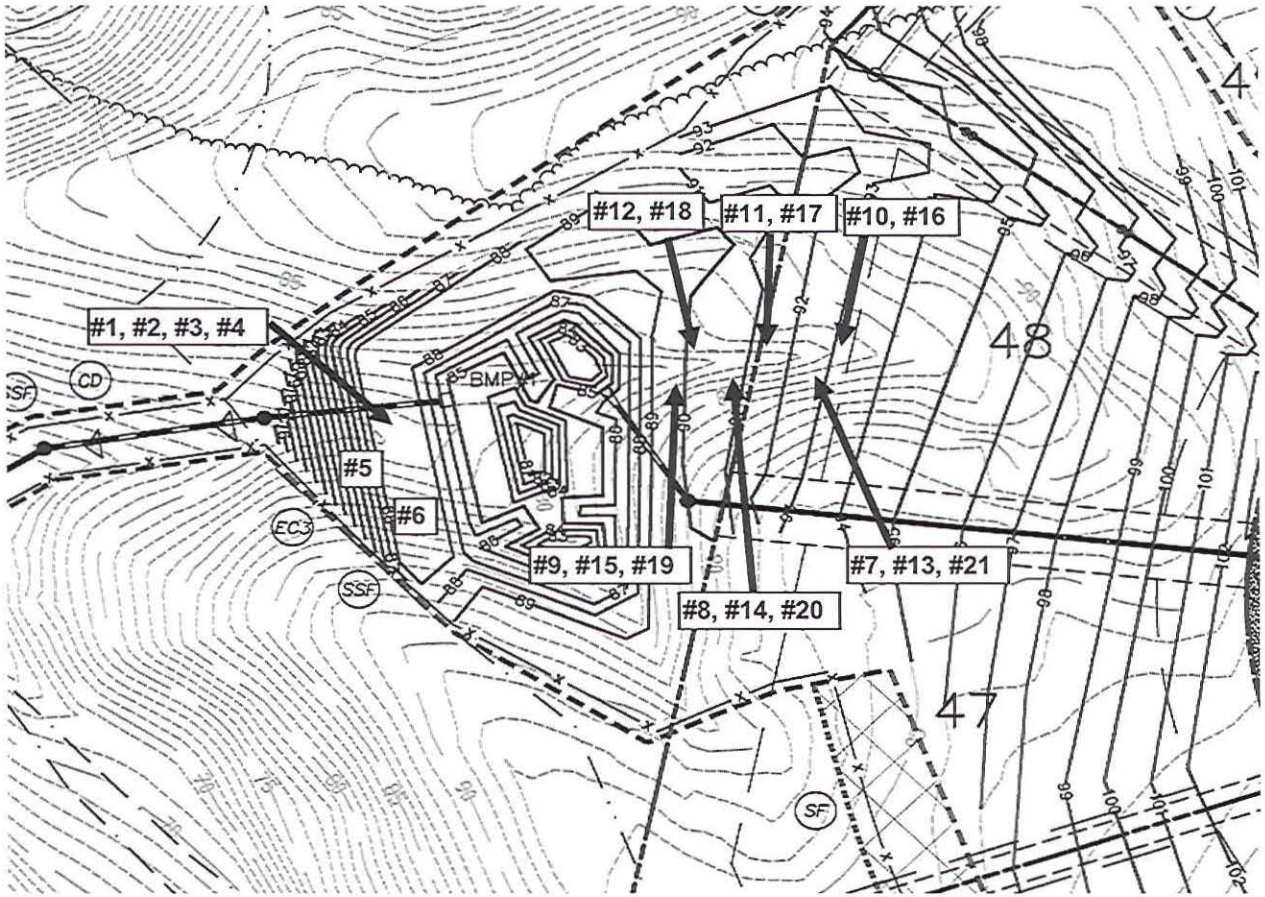
COMPACTION TEST REPORT (No. 3) - Sheet 4 of 4

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/14/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	RT

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COMPACTION TEST REPORT (No. 4) - Sheet 1 of 2

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/24/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Embankment Dam Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	18.7	105.1	124.8	4	95	96	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
2	18.0	104.4	123.1	4	95	95	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
3	16.2	105.3	122.3	4	95	96	X		1' BSG	See Attached Sketch (Page 2 of 2, Figure 1)
4	17.8	106.6	125.6	4	95	97	X		Subgrade	See Attached Sketch (Page 2 of 2, Figure 1)
5	19.5	105.5	126.1	4	95	96	X		Subgrade	See Attached Sketch (Page 2 of 2, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Outfall Pipe	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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COMPACTION TEST REPORT (No. 4) - Sheet 2 of 2

Figure 1

Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/24/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	DM

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COMPACTION TEST REPORT (No. 5) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/25/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Embankment Dam & Sediment Trap

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	18.7	105.7	125.5	4	95	96	X		Elev. 73.8'	See Attached Sketch (Page 3 of 3, Figure 1)
2	14.7	109.3	125.4	4	95	99	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
3	16.6	104.7	122.1	4	95	95	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
4	17.1	106.0	124.1	4	95	96	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
5	17.0	105.0	122.9	4	95	95	X		Elev. 76.4'	See Attached Sketch (Page 3 of 3, Figure 1)
6	15.6	105.1	121.5	4	95	96	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

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COMPACTION TEST REPORT (No. 5) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/25/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 - Embankment Dam

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
7	15.8	107.8	124.8	4	95	98	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)
8	19.4	104.5	124.8	4	95	95	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)
9	16.7	106.3	124.0	4	95	97	X		Elev. 77.6'	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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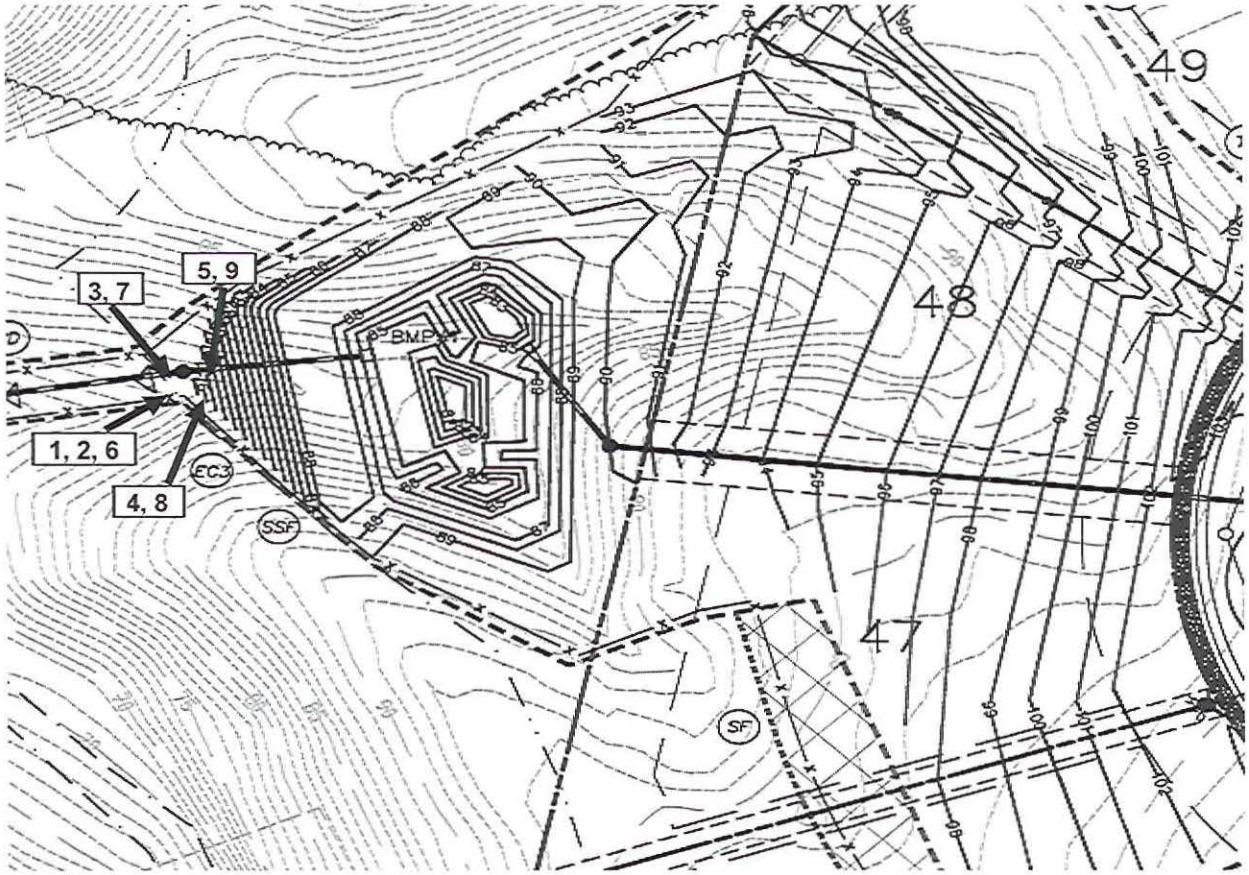
COMPACTION TEST REPORT (No. 5) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/25/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	JW

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COMPACTION TEST REPORT (No. 6) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/26/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	17.6	104.2	122.5	4	95	95	X		Elev. 81'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
2	18.4	104.1	123.3	4	95	95	X		Elev. 81'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
3	17.2	108.8	127.6	4	95	99	X		Elev. 81'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
4	17.4	108.2	127.0	4	95	98	X		Elev. 81'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
5	13.4	108.5	123.0	4	95	99	X		Elev. 82'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
6	17.5	109.6	123.3	4	95	100	X		Elev. 82'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
7	15.8	107.5	124.5	4	95	98	X		Elev. 82'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
8	17.6	105.2	123.7	4	95	96	X		Elev. 82'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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COMPACTION TEST REPORT (No. 6) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/26/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (˚F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
9	18.4	105.5	124.9	4	95	96	X		Elev. 83'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
10	18.7	105.6	125.4	4	95	96	X		Elev. 83'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
11	18.7	104.2	123.7	4	95	95	X		Elev. 83'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
12	15.3	107.6	124.1	4	95	98	X		Elev. 83'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
13	18.5	104.4	123.6	4	95	95	X		Elev. 84'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
14	17.2	105.7	123.9	4	95	96	X		Elev. 84'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
15	18.3	104.7	123.8	4	95	95	X		Elev. 84'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
16	18.9	106.0	126.0	4	95	96	X		Elev. 84'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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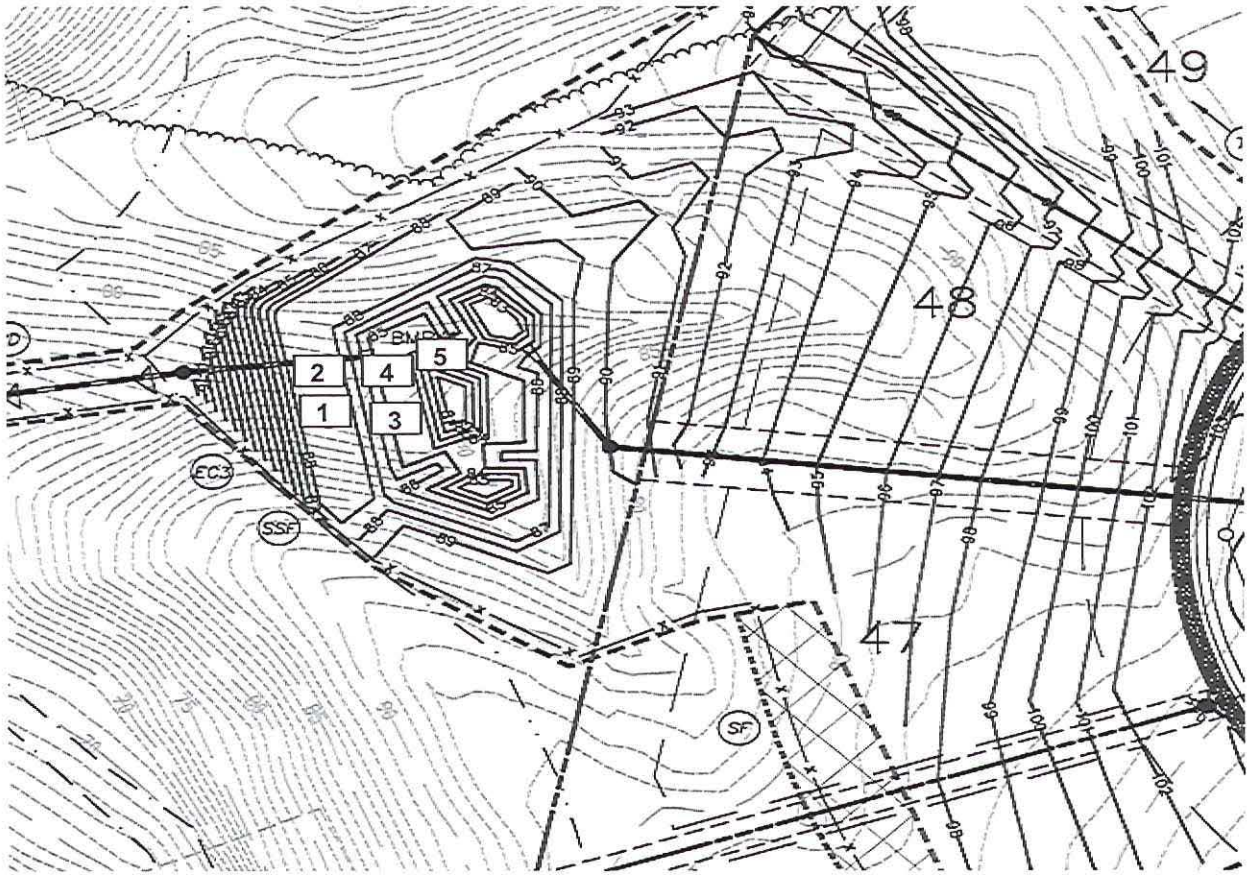
COMPACTION TEST REPORT (No. 6) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/26/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	DM

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COMPACTION TEST REPORT (No. 7) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/27/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	17.7	106.6	125.4	4	95	97	X		Elev. 86'	Location #5 - See Attached Sketch (Page 3 of 3, Figure 1)
2	18.4	106.4	126.0	4	95	97	X		Elev. 86'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
3	17.4	108.0	126.7	4	95	98	X		Elev. 86'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
4	17.8	105.6	124.4	4	95	96	X		Elev. 86'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
5	16.5	108.9	126.9	4	95	99	X		Elev. 87'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
6	16.8	106.8	124.7	4	95	97	X		Elev. 87'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
7	17.2	104.8	122.8	4	95	95	X		Elev. 87'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
8	16.8	105.2	123.0	4	95	96	X		Elev. 87'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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COMPACTION TEST REPORT (No. 7) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/27/11
Project Location:	James City County, Virginia	Technician:	D. Mitchell
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	BMP #1 Area

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
9	19.4	106.3	126.9	4	95	97	X		Elev. 88'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
10	19.1	106.5	126.9	4	95	97	X		Elev. 88'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
11	17.9	106.7	125.8	4	95	97	X		Elev. 88'	Location #1 - See Attached Sketch (Page 3 of 3, Figure 1)
12	14.0	105.4	125.5	4	95	96	X		Elev. 88'	Location #2 - See Attached Sketch (Page 3 of 3, Figure 1)
13	15.6	108.0	124.9	4	95	98	X		Elev. 88'	Location #3 - See Attached Sketch (Page 3 of 3, Figure 1)
14	17.2	105.9	124.0	4	95	96	X		Elev. 88'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
15	13.4	108.9	123.4	4	95	99	X		Elev. 88'	Location #4 - See Attached Sketch (Page 3 of 3, Figure 1)
16	13.5	107.8	122.3	4	95	98	X		Elev. 88'	Location #5 - See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Sheepsfoot Roller	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Embankment Dam & BMP Area Fill	Max. Dry Density (pcf):	110.0
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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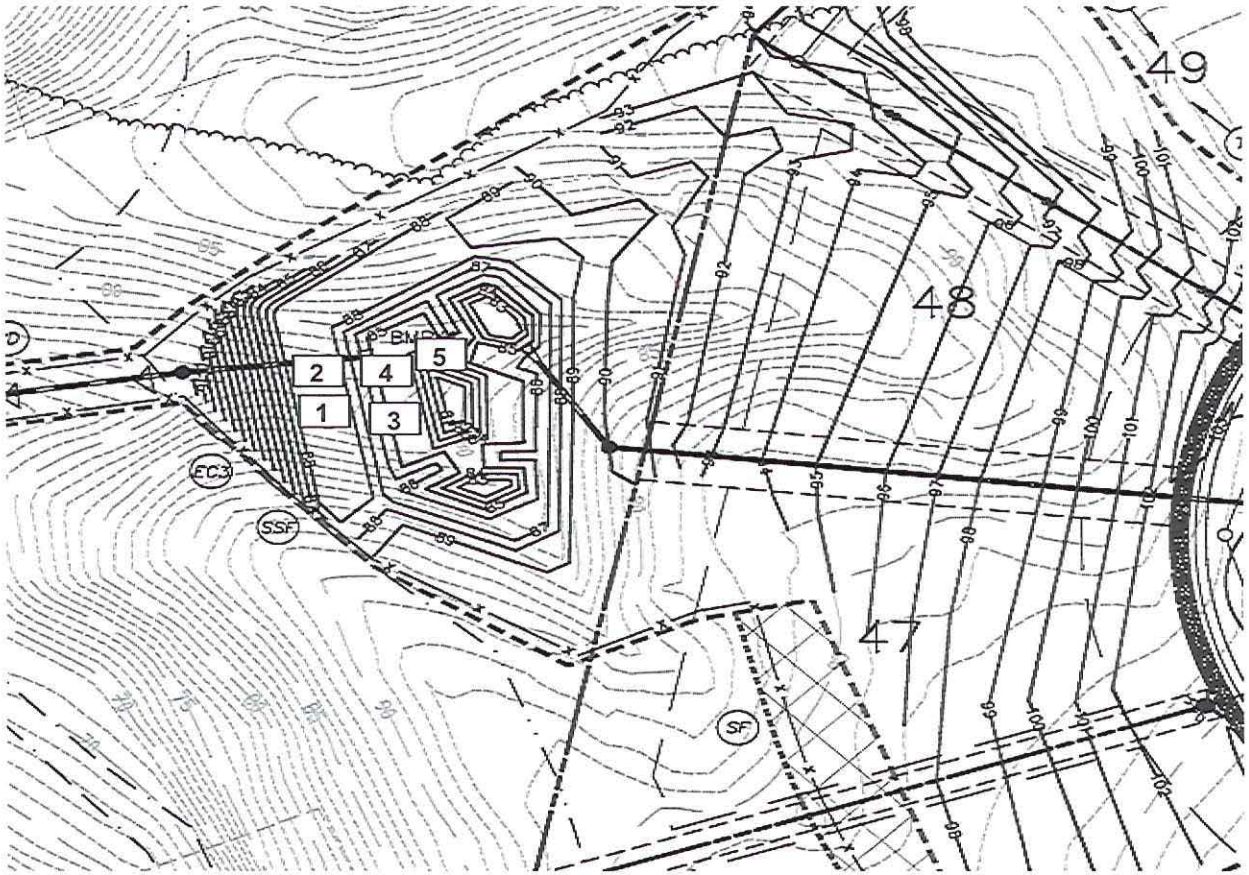
COMPACTION TEST REPORT (No. 7) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/27/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	DM

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COMPACTION TEST REPORT (No. 8) - Sheet 1 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/31/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #2 to BMP #1

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	14.4	104.3	119.3	4	95	95	X		3' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
2	14.6	104.5	119.8	4	95	95	X		3' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
3	15.4	105.5	121.8	4	95	96	X		2' BFG	See Attached Sketch (Page 3 of 3, Figure 1)
4	15.3	108.5	125.2	4	95	99	X		2' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
5	16.7	108.0	126.0	4	95	98	X		1' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
6	17.9	105.4	124.3	4	95	96	X		1' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
7	16.5	108.1	126.0	4	95	98	X		Subgrade	See Attached Sketch (Page 3 of 3, Figure 1)
8	18.0	104.2	122.9	4	95	95	X		1' BSG	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Sewer	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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COMPACTION TEST REPORT (No. 8) - Sheet 2 of 3

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	5/31/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 80's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #2 to BMP #1

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
9	18.4	104.2	123.4	4	95	95	X		2' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
10	17.9	107.4	126.7	4	95	98	X		3' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
11	17.2	105.5	123.7	4	95	96	X		4' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
12	16.4	106.5	124.0	4	95	97	X		5' BSG	See Attached Sketch (Page 3 of 3, Figure 1)
13	15.4	104.6	120.0	4	95	95	X		Subgrade	See Attached Sketch (Page 3 of 3, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Drain	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

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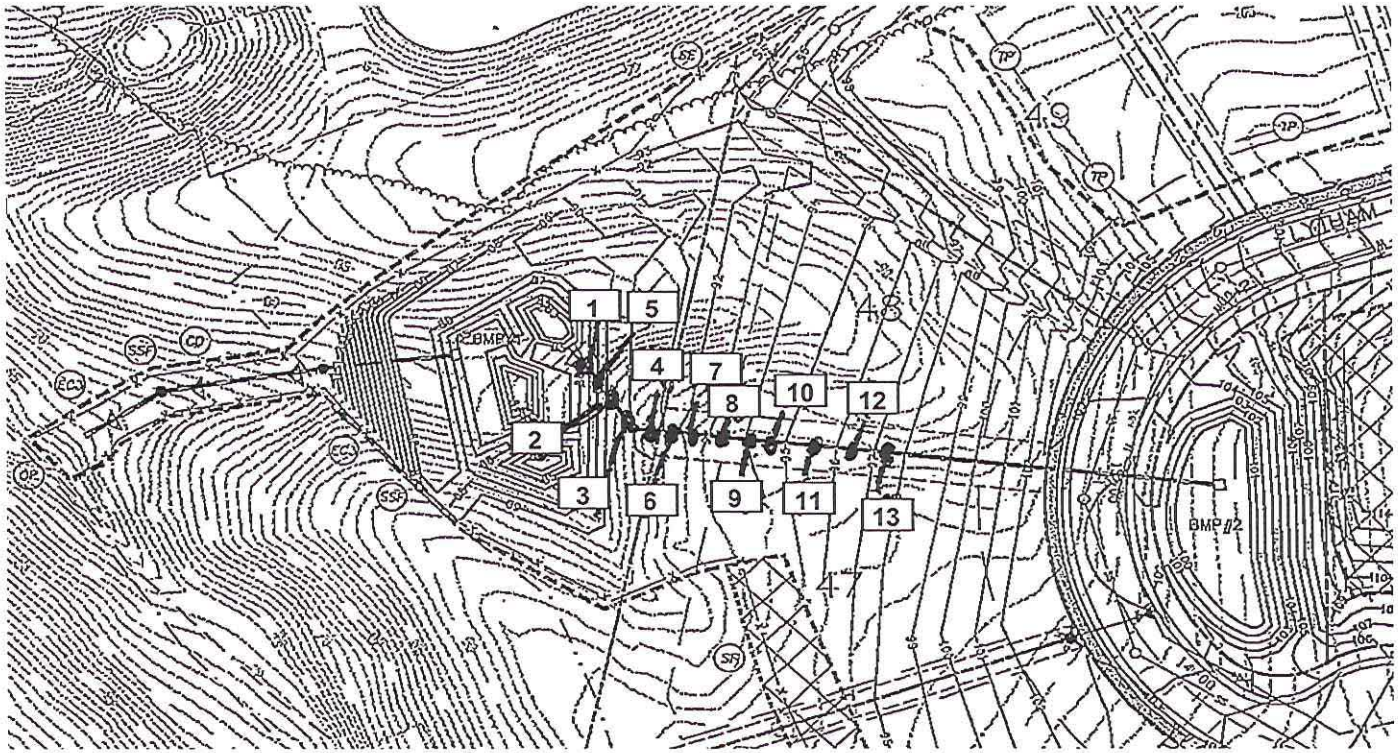
COMPACTION TEST REPORT (No. 8) - Sheet 3 of 3

Figure 1



Locations are approximate

LOCATION SKETCH

PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	5/27/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	DM

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COMPACTION TEST REPORT (No. 9) - Sheet 1 of 5

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	6/1/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #1to BMP #2

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
1	17.6	108.6	127.8	4	85	99	X		5' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
2	18.6	108.3	128.4	4	85	98	X		5' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
3	18.6	105.7	125.4	4	85	96	X		4' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
4	17.2	105.9	124.1	4	85	96	X		4' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
5	17.5	109.6	128.1	4	85	100	X		3' BSG	See Attached Sketch (Page 3 of 5, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Drain	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

J. Wheeler
G E T Solutions, Inc.

GET Solutions, Inc.
Geotechnical • Environmental • Testing
G E T Solutions, Inc.
1592-E Penniman Road
Williamsburg, Virginia 23185
Tel: (757) 564-6452
Fax:(757) 564-6453

COMPACTION TEST REPORT (No. 9) - Sheet 2 of 5

Project:	Tract 12 - Phase 1 Stonehouse Development	Date:	6/1/11
Project Location:	James City County, Virginia	Technician:	J. Wagner
Client:	George Nice & Sons, Inc.	Job Number:	WM11-128T
General Contractor:	George Nice & Sons, Inc.	Weather:	Sunny Temp. (°F) 90's
Grading Contractor:	George Nice & Sons, Inc.	General Test Location:	Storm Drain from BMP #1to BMP #2

Test Number	Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Proctor Number	% Proctor		Pass	Fail	Test Elevation*	Test Location (Grid, Coordinates, Roadway Station, etc.)
					Spec	Actual				
6	18.6	107.6	127.7	4	85	98	X		3' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
7	16.9	110.6	129.6	4	85	100	X		2' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
8	16.7	107.6	125.5	4	85	98	X		2' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
9	19.2	104.9	125.1	4	85	95	X		1' BSG	See Attached Sketch (Page 3 of 5, Figure 1)
10	15.7	109.4	126.6	4	85	99	X		Subgrade	See Attached Sketch (Page 3 of 5, Figure 1)

Compaction Equipment Used:	Trench Roller/Sheepsfoot	Proctor Number:	4
Field Testing Procedure:	ASTM D698	Proctor Type:	ASTM D698
Testing Depth:	12 inches	Material Description:	Sandy, Lean CLAY (CL)
Test Conducted on:	Backfill over Storm Drain	Max. Dry Density (pcf):	110.1
		Optimum Moisture (%):	16.3%

Remarks:

Test locations and test elevations are approximate and are established in the field by the GET Solutions, Inc. technician.

* Note: BFF = Below Finish Floor, BFG = Below Finish Grade, FG = Finished Grade, BSG = Below Subgrade

Reviewed By:

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Williamsburg, Virginia 23185
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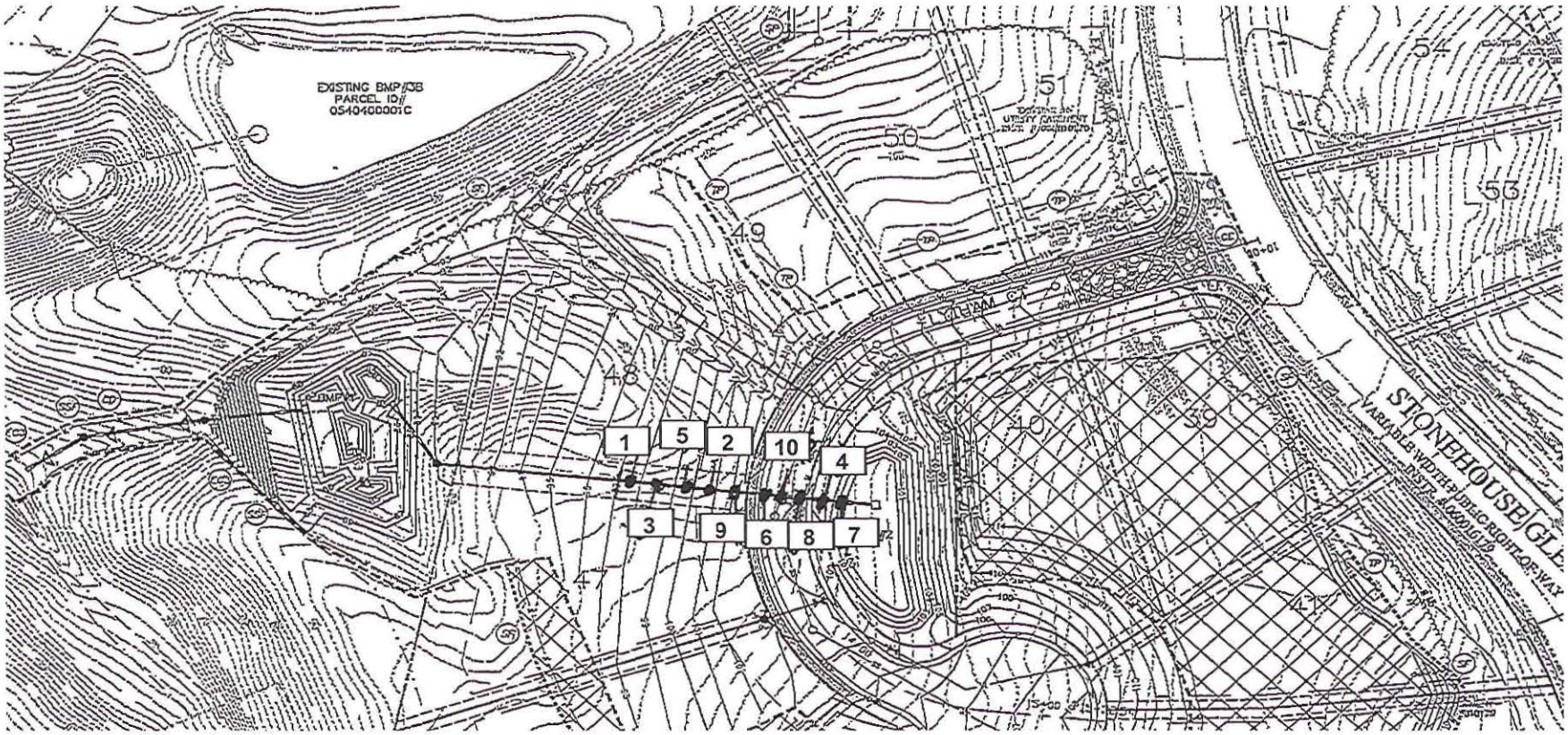
COMPACTION TEST REPORT (No. 9) - Sheet 3 of 5

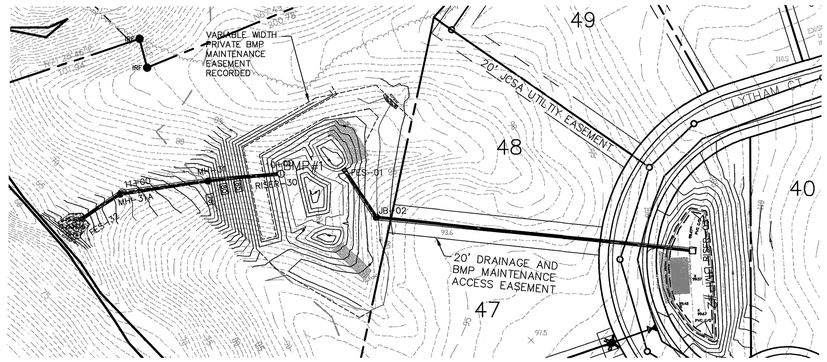
Figure 1



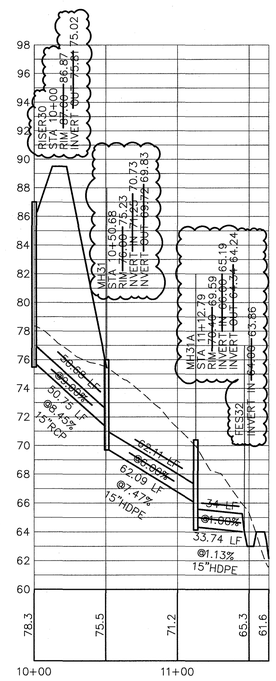
Locations are approximate

LOCATION SKETCH

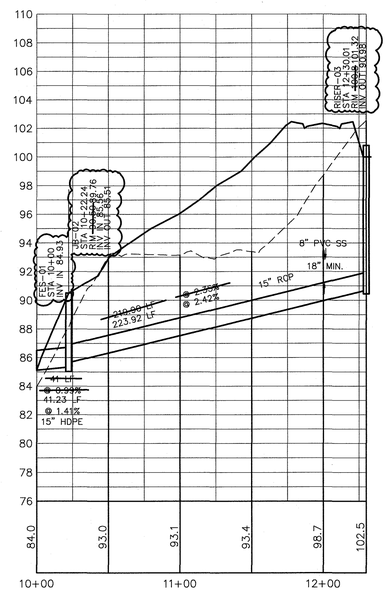
PROJECT:	Tract 12 - Phase 1 Stonehouse Development James City County, Virginia	SCALE:	NTS
PROJECT NO:	WM11-128T	DATE:	6/1/2011
CLIENT:	George Nice & Sons, Inc.	PLOT BY:	JW



BMP #1 PLAN
1" = 20'



BMP #1 OUTFALL PROFILE
1"=5' (HORZ) / 1"=5' (VERT)



PROFILE TO BMP #1
1"=5' (HORZ) / 1"=5' (VERT)

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 PREVIOUS APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA
S. SHAYNE LEATHERS
Lic. No. 050365
11/9/13
PROFESSIONAL ENGINEER

(SEAL)
VIRGINIA REGISTERED PROFESSIONAL ENGINEER OR CERTIFIED LAND SURVEYOR

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITION OF THE STORMWATER FACILITIES. THE FACILITIES APPEAR TO CONFORM TO THE PROVISIONS OF THE APPROVED CONSTRUCTION PLANS AND SPECIFICATIONS EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA
S. SHAYNE LEATHERS
Lic. No. 050365
11/9/13
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THE RECORD DRAWING INFORMATION IS REFLECTIVE OF ASBUILT INFORMATION BY GEORGE NICE SONS DATED (07/13/2012) FOR THE GRADING AND WSPSELLS SURVEYING FOR THE BMP STRUCTURES.

GENERAL NOTES FOR HDPE PIPE:

1. ALL HDPE PIPE SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321-05.
2. GASKETS AND FITTINGS IN ACCORDANCE WITH ASTM F477 AND ASTM D3212 SHALL BE USED FOR SOIL AND WATER TIGHT HDPE CONNECTIONS TO CONCRETE STRUCTURES. NON-SHRINK GROUT SHALL BE USED AROUND MANHOLE OPENING.

GENERAL NOTES FOR PVC PIPE:

1. ALL PVC PIPE SHALL BE PRESSURE RATED.
2. RISER STRUCTURES SHALL BE PROVIDED WITH KOR-N-SEAL OR EQUIVALENT BOOT CONNECTION FOR DISSIMILAR PIPE MATERIALS.

NORTH

0 25 50 100
(IN FEET)
1 INCH = 50 FEET

RECORD DRAWING

PROJECT # S-0048-2009

WSP • SELLS
Transportation & Infrastructure
15401 Weston Parkway Suite 100 • Cary, NC 27513 • 919.678.0035
www.wspsells.com

RECORD DRAWINGS

TRACT 12 STONEHOUSE

JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

REVISIONS

1	RECORD DRAWING – 10/10/2012

PROJECT #: 08-4051 DATE: 08/17/09
DRAWN BY: MB CHECKED BY: CD
TITLE
STORM PROFILES
SHEET
C6.0

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1/4/2013 9:21 AM L:\Stonehouse\08-4051-Stonehouse-TR12\06-Drawing\05-As-Built\PHASE 1\C6 STORM PROFILES.DWG, C6.0-Storm Profiles, USQ.04142

STORMWATER BMP FACILITY MAINTENANCE PLAN

PROPER MAINTENANCE OF THIS FACILITY IS ENCOURAGED TO PREVENT THE INTRODUCTION OF DEBRIS AND SEDIMENT INTO THE FACILITY, SPILLWAY(S), AND DOWNSTREAM WATERWAYS. FOLLOWING INSTALLATION OF THE FACILITY AND ESTABLISHMENT OF VEGETATION IN DISTURBED AREAS, INSPECTION FOR SEDIMENT BUILDUPS WILL BE PERFORMED AT LEAST QUARTERLY. IT IS ANTICIPATED THAT UNDER NORMAL CONDITIONS, SEDIMENT REMOVAL FROM THE FACILITY WILL BE RQEUIRED ONCE EVERY 10 YEARS. IF OTHER CONS TRUCTION OR RELATED ACTIVITIES ARE PERFORMED ON UPSLOPE PARCELS, ADEQUATE PROTECTION SHOULD BE PROVIDED AND INSPECTIONS PERFORMED ATLEAST ONCE WEEKLY OF THESE NEWLY DISTURBED AREAS AS WELL AS INPSECTIONS FOR ACCUMULATED SEDIMENTS AT THE BMP FACILITY.

A DESIGNATED REPRESENTATIVE OF THE OWNER WILL INSPECT THE BMP STRUCTURE AFTER EACH SIGNIFICANT RAIN EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL EVENT 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. APPROPRIATE ACTION, PERFORMED AT THE COST OF THE OWNER, WILL BE TAKEN TO ENSURE APPROPRIATE MAINTENANCE KEYS TO LOCKED ACCESS POINTS SHALL BE MADE AVAILABLE TO COUNTY PERSONNEL UPON REQUEST.

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

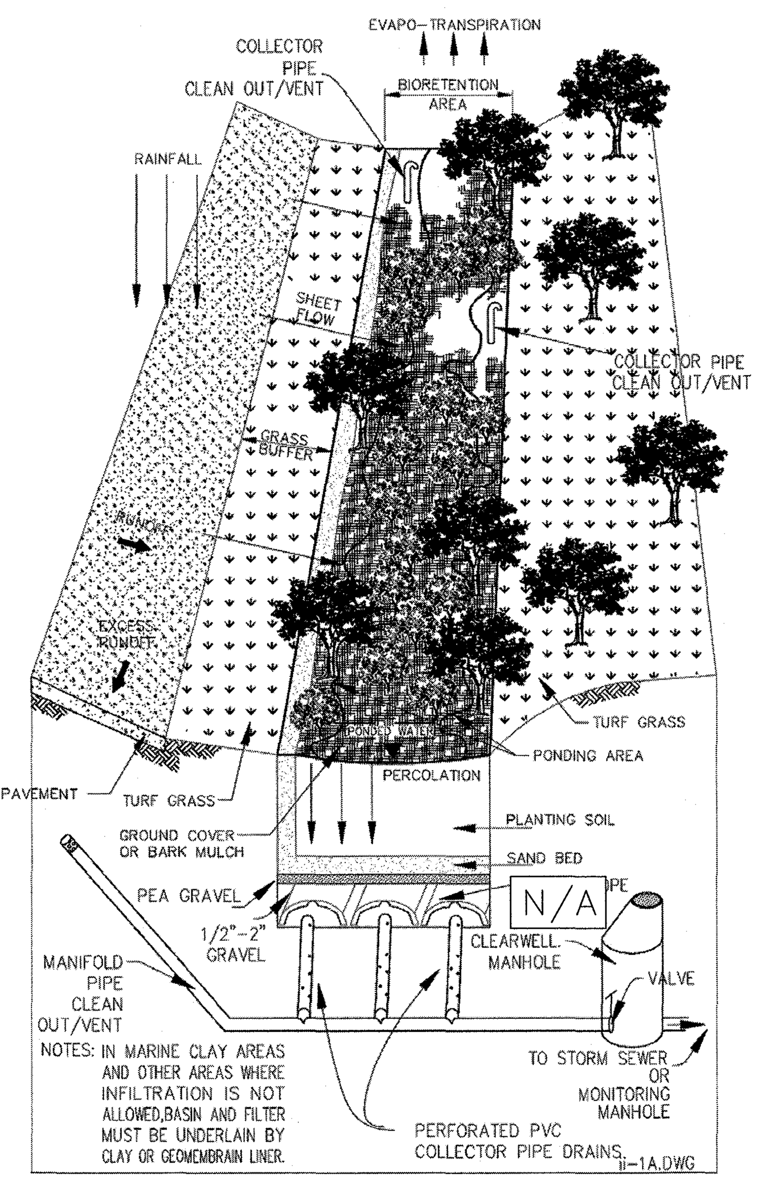
1. THE INSPECTION FOR SEDIMENT BUILD–UP WILL BE PERFORMED BY VISUAL INSPECTION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN THE STORAGE AREA. SEDIMENT REMOVAL IS REQURIED USING A RUBBER WHEELED BACKHOE. AT THE SAME TIME, OR ATLEAST ONCE PER YEAR, THE RISER BOTTOM AND OUTLET PIPE SHALL BE CLEANED OF ACCUMULATED SEDIMENTS. DISPOSE OF SEDIMENTS REMOVED FRO M THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA. SEDIMENT SHALL NOT BE ALLOWED TO ACCUMULATE IN DEPTHS GREATER THAN 1–FOOT. NO SEDIMENT SHALL BE ALLOWED TO ACCUMULATE TO PREVENT THE PROPER FUNCTION OF ANY PIPE OR CULVERT.
2. PERFORM MAINTENANCE MOWING OF GRAS SED AREAS AT LEAST TWICE EACH YEAR. GRASSES SUCH AS TALL FESCUE SHOULD BE MOWED IN EARLY SUMMER AFTER EMERGENCE OF THE HEADS ON COOL SEASON GRASSES AND IN LATE FALL TO PREVENT SEEDS OF ANNUAL WEEDS FROM MATURING. MOWING OF LEGUMES CAN BE LESS FREQUENT. TREES AND SHRUBS SHOULD NOT BE PERMITTED TO GROW ON ANY PART OF THE GRADED EMBANKMENT.
3. PERFORM SOIL SAMPLING ON STABILIZED BMP SOIL AREAS ONCE EVERY 4 YEARS. SOIL SAMPLING AND TESTING SHOULD BE PEFORMED BY A QUALIFIED INDEPENDENT TESTING LABORATORY. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.
4. IF VEGETATION COVERS LESS THAN 40% OF SOIL SURFACES IN STABILIZE BMP AREAS, LIME, FERTILIZE, AND SEED IN ACCORDANCE WITH RECOMMENDATIONS FOR DAM CONSRUCTION. IF VEGETATION COVERS NEW SEEDLINGS, AS LISTED ON NOTES, MORE THAN 40% BUT LESS THAN 70% OF SOIL SURFACES, LIME, FERTILIZE, AND OVERSEED IN ACCORDANCE WITH CURRENT SEEDLING RECOMMENDATIONS.
5. PERFORM QUARTERLY INSPECTIONS OF THE RELEASE STRUCTURES, RISER SECTION, AND CREST OF SPILLW AY FOR THE OBSERVANCE OF COLLECTED DEBRIS. IMMEDIATELY REMOVE ANY DEBRIS TO MAINTAIN.
6. PERFORM YEARLY STRUCTURAL INSPECTIONS OF THE FACILITY FOR DAMAGE. STRUCTURAL INSPECTION SHALL BE PERFORMED ON THE CONCRETE RISER, ANTI–VORTEX DEVICE, TRASH RACK, ORIFICE / WIER(S), OUTLET BARREL, AND EMBANKMENT. IF DAMAGE IS EVIDENT, FURTHER INVESTIGATION BY A PROFESSIONAL ENGINEER MAY BE REQUIRED TO ASSESS THE CONTINUED INTEGRITY OF THE STRUCTURE.
7. PERFORM QUARTERLY INSPECTIONS OF THE GRADED SIDE SLOPES OF THE BMP FACILITY FOR SIGNS OF ANIMAL/RODENT BORROWS OR SLOPE EROSION. IMMEDIATELY PERFORM NECESSARY REPAIRS, REFILLING OR RESEEDING AS APPROPRIATE.
8. THE OWNER OR DESIGNATED REPRESENTATIVE SHALL KEEP REASONABLE, ACCURATE WRITTEN RECORDS OF INSPECTIONS PERFORMED ON THE STRUCTURE. RECORDS SHALL DOCUMENT ROUTINE MAINTENANCE AND/OR REPAIRS PERFORMED. COPIES SHALL BE PROVIDED TO THE COUNTY UPON REQUEST.
9. THE FACILITY SHALL NOT BE MODIFIED IN ANY WAY WITHOUT PRIOR CONSENT/APPROVAL OF THE COUNTY.

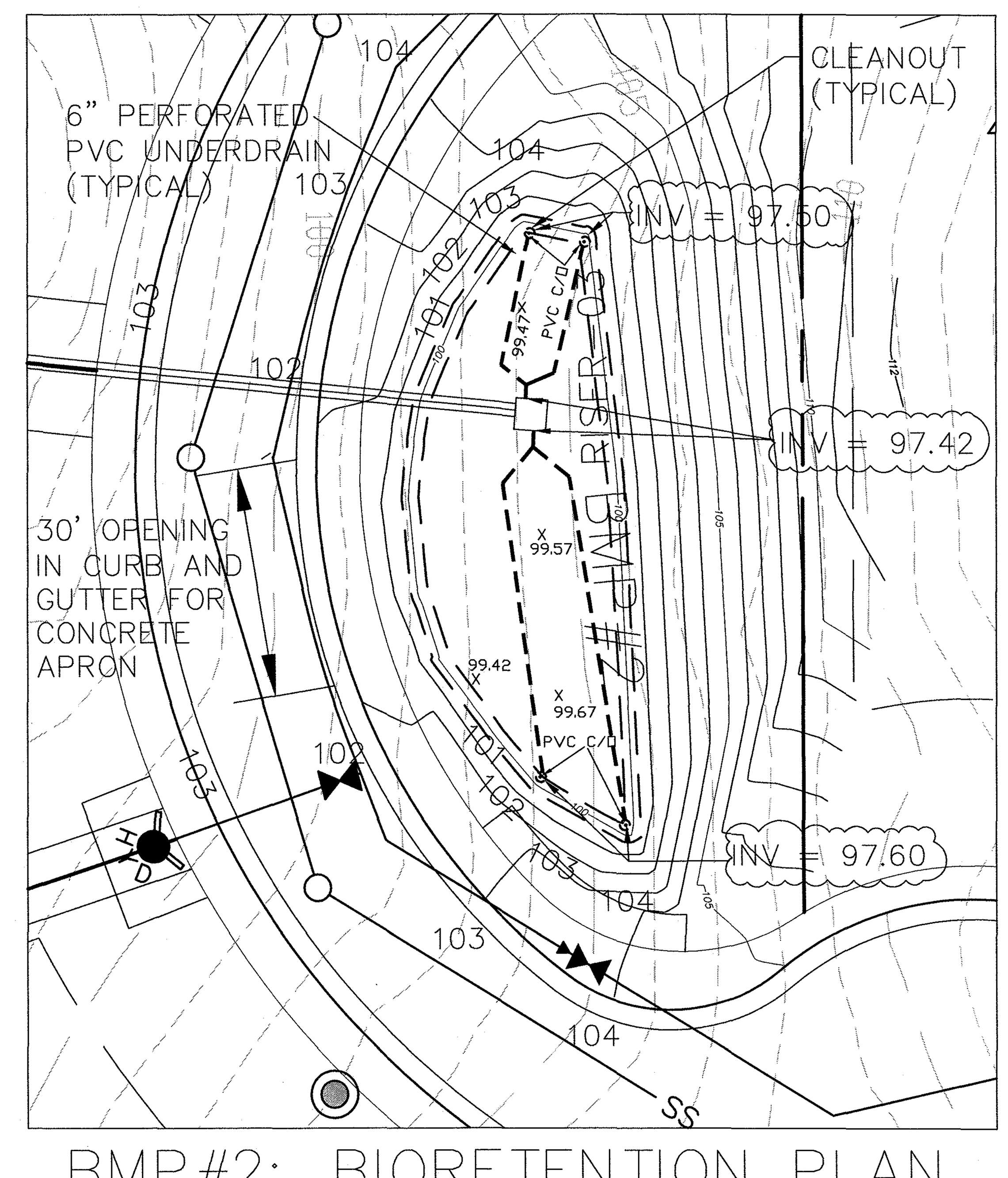
MAINTENANCE/INSPECTION GUIDELINES

A schedule of recommended maintenance for bioretention areas with general guidance regarding methods, frequency, and time of year for maintenance is as follows:

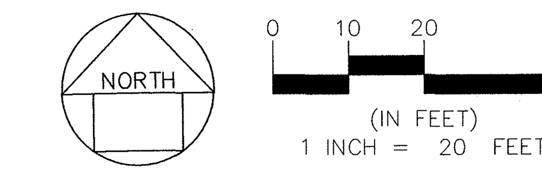
Description	Method	Frequency	Time of the year
SOIL			
Inspect and Repair Erosion	Visual	Monthly	Monthly
ORGANIC LAYER			
Remulch any void areas	By hand	Whenever needed	Whenever needed
Remove previous mulch layer before applying new layer (optional)	By hand	Once every two to three years	Spring
Any additional mulch added (optional)	By hand	Once a year	Spring
PLANTS			
Removal and replacement of all dead and diseased vegetation considered beyond treatment	See planting specifications	Twice a year	3/15 to 4/30 and 10/1 to11/30
Treat all diseased trees and shrubs	Mechanical or by hand	N/A	Depends on insect or disease infestation
Watering of plant material shall take place at the end of each day for 14 consecutive days after planting has been completed	By hand	Immediately after completion of project	N/A
Replace stakes after one year	By hand	Once a year	Only remove stakes in the spring
Replace any deficient stakes or wires	By hand	N/A	Whenever needed
Check for accumulated sediments	Visual	Monthly	Monthly

1/4/2013 9:17 AM; L:\Stonehouse\08-4051-Stonehouse-TR12\00-Drawings\05-As-Built\PHASE 1\C5 BMP DETAILS.DWG; C5.1-BMP2-5-6-9; USSL04142

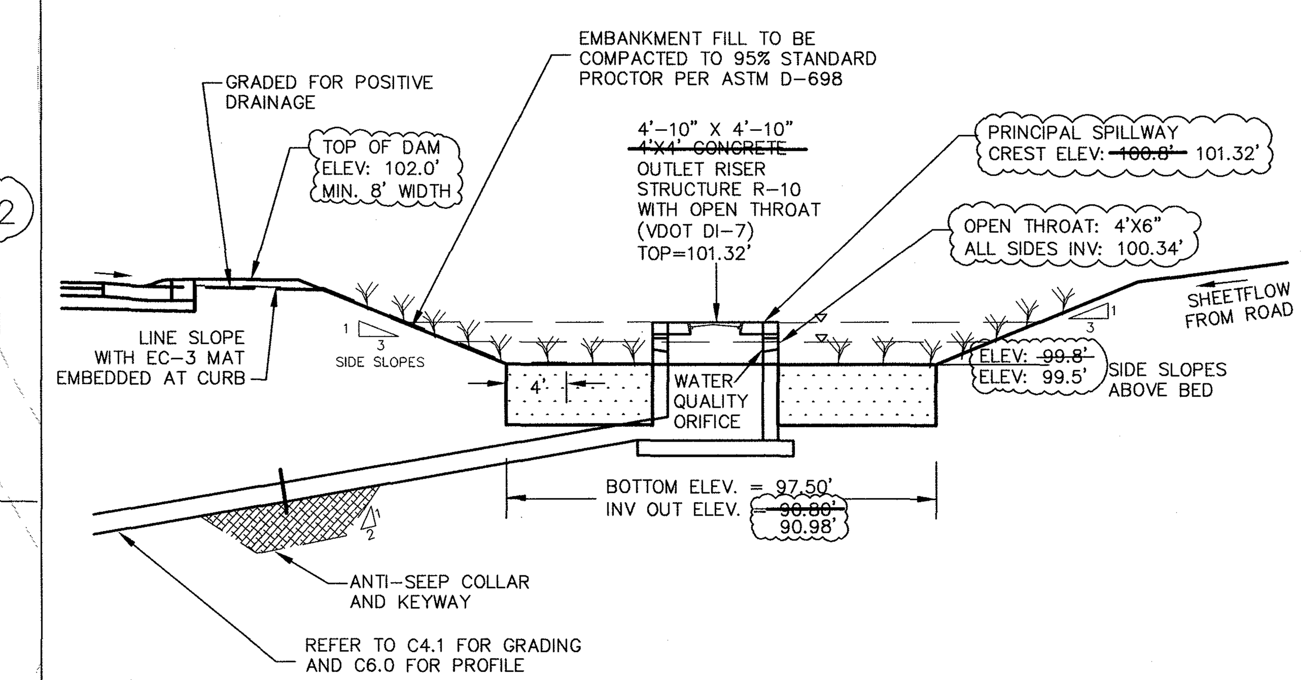




BMP#2: BIORETENTION PLAN



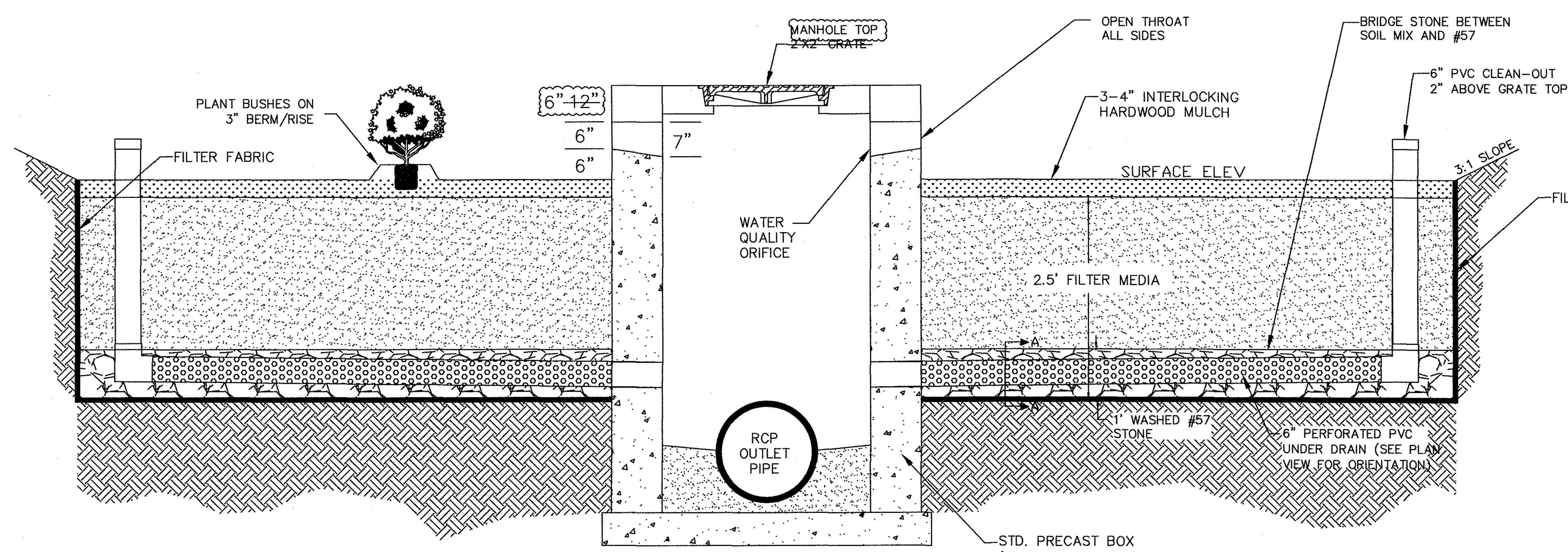
100 YEAR ELEVATION = ~~101.05~~	100.62'
10 YEAR ELEVATION = ~~100.93~~	100.50'
2 YEAR ELEVATION = ~~100.75~~	100.41'
1 YEAR ELEVATION = ~~100.56~~	100.26'



BMP#2 – PROFILE

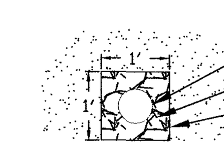
NTS

REFER TO LANSCAPE DEVELOPMENT PLANS FOR BMP PLANTING SCHEDULE.



NOTE: THE RISER STRUCTURE SHALL BE PROVIDED WITH KOR–N–SEAL (OR EQUIVALENT BOOTS) FOR DISSIMILAR PIPE MATERIALS.

TYPICAL BIORETENTION CROSS–SECTION DETAIL



SECTION A–A

1. ALL SEDIMENT AND EROSION PRACTICES SHALL BE IN PLACE AND THE SLOPES DRAINING TO THE BIORETENTION AREA SHALL BE STABILIZED BEFORE RECORD DRAWINGS BEGINS.
2. FILTER MEDIA MIXTURE SHALL CONSIST OF THE FOLLOWING OR EQUIVALENT SUBJECT TO COUNTY REVIEW AND APPROVAL:

– 50% SAND
– 30% LEAF COMPOST (FULLY COMPOSTED, NOT PARTIALLY ROTTED LEAVES)
– 20% TOPSOIL

CONTRACTOR SHALL PROVIDE MIX TO ENGINEER PRIOR TO INSTALLATION.

3. IF MULCH USED, MATERIAL SHALL BE INTERLOCKING SHREDDED HARDWOOD OR SHREDDED WOOD CHIPS OR OTHER SIMILAR PRODUCT AND MUST BE WELL AGED, UNIFORM IN COLOR, AND FREE OF FOREIGN MATERIAL INCLUDING PLANT MATERIAL. THE MULCH LAYER SHALL BE UNIFORMLY APPLIED APPROXIMATELY 3 TO 4 INCHES IN DEPTHS.
4. TOPSOIL SHALL BE SANDY LOAM OR LOAMY SAND WITH NO MORE THAN 5% CLAY, FREE OF STONES, STUMPS, ROOTS, OR SIMILAR OBJECTS GREATER THAN 1–INCH, OR ANY OTHER MATERIAL OR SUBSTANCE WHICH MAY BE HARMFUL TO PLANT GROWTH OR A HINDRANCE TO MAINTENANCE.
5. TOPSOIL SHALL MEET THE FOLLOWING CRITERI

– PH RANGE:	5.0 – 7.0
– ORGANIC MATTER:	GREATER THAN 1.5%
– MAGNESIUM (MG):	100+ UNITS
– PHOSPHORUS (P205):	150+ UNITS
– POTASSIUM (K20):	120+ UNITS
– SOLUBLE SALTS:	NOT TO EXCEED 900 PPM (SOIL) OR 3,000 PPM (ORGANIC MIX)

THE CONTRACTOR SHALL PROVIDE THE FOLLOWING SOIL TESTS FROM A QUALIFIED PROFESSIONAL.

– PH, ORGANIC MATTER: 1 TEST PER BIORETENTION AREA
– MAGNESIUM, PHOSPHORUS, POTASSIUM, SOLUBLE SALTS: 1 TEST PER 500 CUBIC YARDS
– GRAIN SIZE ANALYSIS: 1 TEST PER BIORETENTION AREA"

6. SOIL SHALL BE PLACED IN LIFTS LESS THAN 18 INCHES AND LIGHTLY COMPACTED (MINIMAL COMPACTIVE EFFORT) BY TAMPING OR ROLLING WITH HAND–OPERATED LANDSCAPE ROLLER.
7. PLANTING SOIL MIXTURE SHALL HAVE A P INDEX OF 10 – 25 AND HYDRAULIC CONDUCTIVITY = 2.0 – 4.0 IN/HR

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 PREVIOUS APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA
S. SHAYNE LEATHERS
Lic. No. 050365
1/4/13
PROFESSIONAL ENGINEER

(SEAL)
VIRGINIA REGISTERED PROFESSIONAL ENGINEER OR CERTIFIED LAND SURVEYOR

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RECORD DRAWING

PROJECT # S–0048–2009

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RECORD DRAWINGS

TRACT 12 STONEHOUSE

JAMES CITY COUNTY, VA

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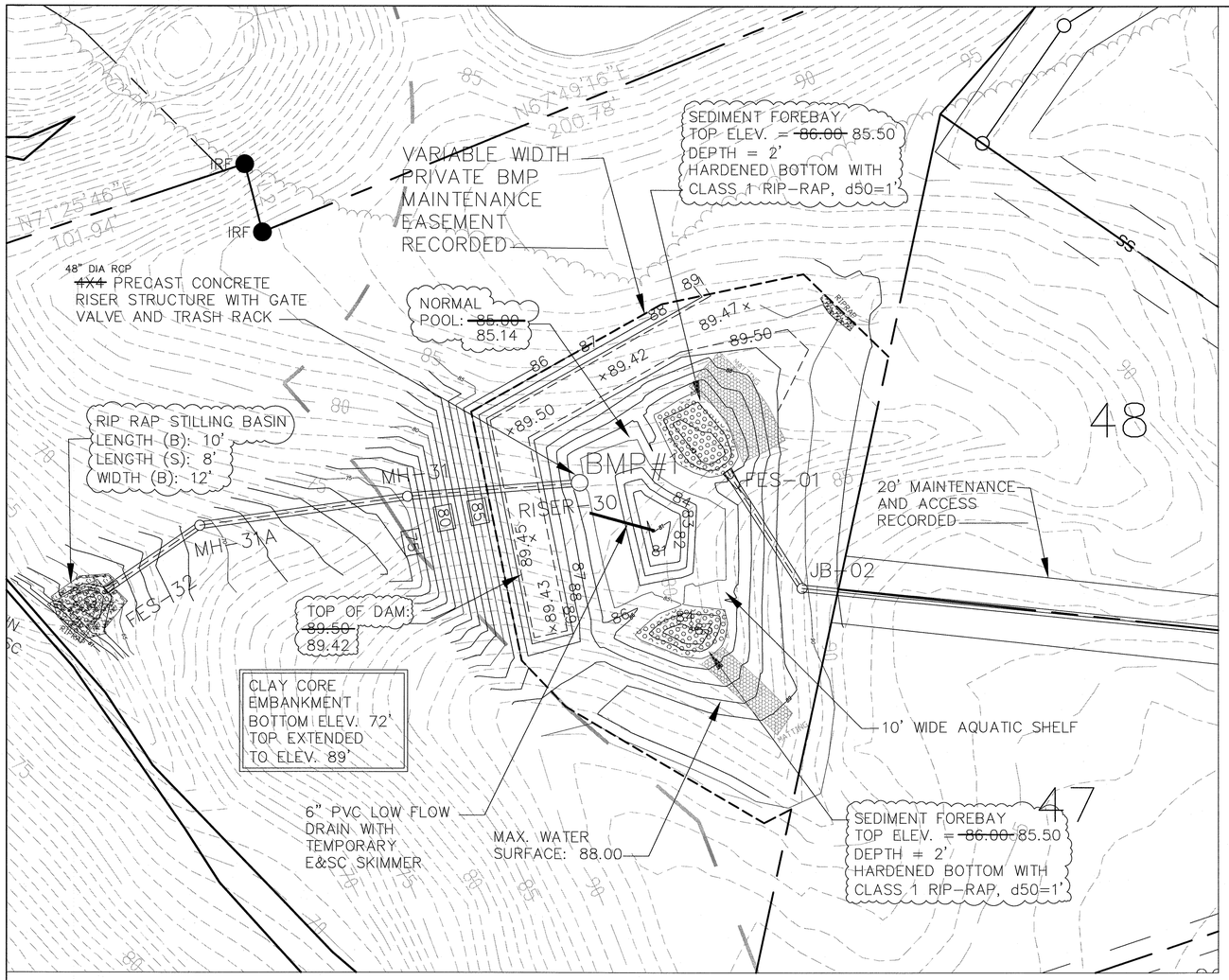
REVISIONS	
1	RECORD DRAWING 10–10–12

PROJECT #: 08-4051 DATE: 08/17/09
DRAWN BY: MB CHECKED BY: CD

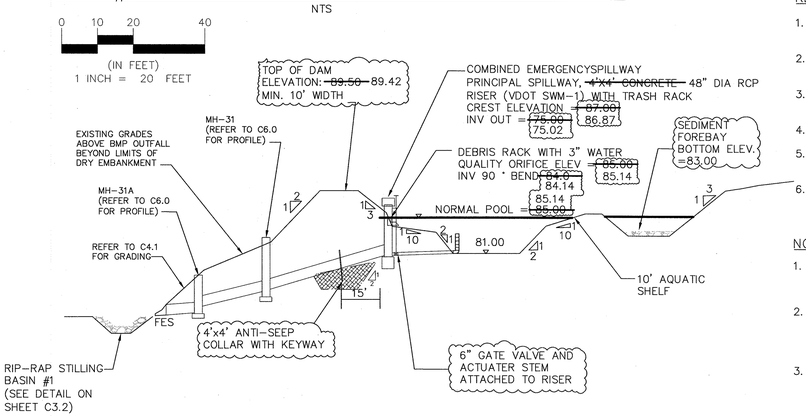
TITLE
BMP #2, ~~5, 6, AND 9~~ DETAILS (BIORETENTION)

SHEET
C5.1



BMP#1: WET EXTENDED DETENTION POND

NTS



100 YEAR ELEVATION	= ~~87.10~~	86.91'
10 YEAR ELEVATION	= ~~86.78~~	86.35'
2 YEAR ELEVATION	= ~~86.47~~	86.05'
1 YEAR ELEVATION	= ~~86.24~~	85.82'

NOTE: THE RISER STRUCTURE SHALL BE PROVIDED WITH KOR-N-SEAL (OR EQUIVALENT BOOTS) FOR DISSIMILAR PIPE MATERIALS.

REFER TO SHEETS C8.1 FOR DETAILS AND C6.0 FOR OUTFALL PROFILES.

REFER TO LANDSCAPE DEVELOPMENT PLANS FOR BMP PLANTINGS.

RECORD DRAWINGS SEQUENCE TO CONVERT BASIN TO WET POND

1. LARGE RECORD DRAWINGS EQUIPMENT SHALL BE PROHIBITED IN VICINITY OF RISER STRUCTURE AND DAM TO NOT THREATEN STRUCTURAL INTEGRITY.
2. AFTER FINAL STABILIZATION, DEWATER THE WET STORAGE AREA FOLLOWING THE METHODS OUTLINED IN THE VESCH, 1992 EDITION.
3. REMOVE SEDIMENT AND OTHER DEBRIS TO A CONTAINED SPOIL AREA AND PROPERLY DISPOSED IN ACCORDANCE WITH APPLICABLE REGULATIONS.
4. PROVIDE TOPSOIL FOR ADEQUATE SHELF TO PROMOTE FINAL STABILIZATION.
5. MODIFY THE RISER STRUCTURE AS SHOWN ON THE PLANS AND CONTACT THE ENGINEER AND COUNTY FOR A FINAL INSPECTION.
6. AFTER INSPECTION, INSTALL LANDSCAPING AND STABILIZATION AS SHOWN ON THE PLANS IN ACCORDANCE WITH VESCH, 1992 EDITION AND MINIMUM STANDARD 3.05 OF THE VSWM, 1999 EDITION.

NOTES:

1. ALL RCP SHALL BE CLASS III MEETING ASTM STANDARD C76 WITH O RING JOINTS. JOINTS SHALL BE WRAPPED WITH NON-WOVEN FELT FABRIC EXTENDING 6-8 INCHES ON EITHER SIDE OF THE JOINT.
2. DAM EMBANKMENTS SHALL HAVE 95% COMPACTION WITH MOISTURE CONTENT WITHIN 2% OF THE OPTIMUM AND CERTIFIED BY GEOTECHNICAL ENGINEER. GEOTECHNICAL ENGINEER TO APPROVE FILL MATERIAL AND INSPECT COMPACTION IN 1' LIFTS.
3. EXCAVATE EXISTING ALLUVIAL SOILS TO FIRM SOIL (+/- 5') FOR DAM EMBANKMENTS. KEYWAY SHALL BE 8' WIDE AT BOTTOM WITH 2:1 SIDESLOPES TO THE ELEVATION OF THE BARREL ASSEMBLY. BACKFILL WITH SUITABLE MATERIAL, APPROVED BY GEOTECHNICAL ENGINEER, IN 1' LIFTS. COMPACT TO STANDARD PROCTOR ASTM D-698.
4. ALL PVC PIPE SHALL BE PRESSURE RATED. ALL HDPE PIPE SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321-05.
5. GASKETS (ASTM F477) AND FITTINGS (ASTM D3212) SHALL BE USED FOR SOIL AND WATER TIGHT HDPE CONNECTIONS TO CONCRETE STRUCTURES. NON-SHRINK GROUT SHALL BE USED AROUND MANHOLE OPENING.
6. VDOT IS NOT RESPONSIBLE FOR THE MAINTENANCE OF THE BMP'S OR THEIR OUTFALL STRUCTURES, AND SHALL BE SAVED HARMLESS FROM ANY DAMAGES.

STORMWATER BMP FACILITY MAINTENANCE PLAN

PROPER MAINTENANCE OF THIS FACILITY IS ENCOURAGED TO PREVENT THE INTRODUCTION OF DEBRIS AND SEDIMENT INTO THE FACILITY, SPILLWAY(S), AND DOWNSTREAM WATERWAYS. FOLLOWING INSTALLATION OF THE FACILITY AND ESTABLISHMENT OF VEGETATION IN DISTURBED AREAS, INSPECTION FOR SEDIMENT BUILDUPS WILL BE PERFORMED AT LEAST QUARTERLY. IT IS ANTICIPATED THAT UNDER NORMAL CONDITIONS, SEDIMENT REMOVAL FROM THE FACILITY WILL BE RQEUIRED ONCE EVERY 10 YEARS. IF OTHER CONS TRUCTION OR RELATED ACTIVITIES ARE PERFORMED ON UPSLOPE PARCELS, ADEQUATE PROTECTION SHOULD BE PROVIDED AND INSPECTIONS PERFORMED ATLEAST ONCE WEEKLY OF THESE NEWLY DISTURBED AREAS AS WELL AS INPSECTIONS FOR ACCUMULATED SEDIMENTS AT THE BMP FACILITY.

A DESIGNATED REPRESENTATIVE OF THE OWNER WILL INSPECT THE BMP STRUCTURE AFTER EACH SIGNIFICANT RAIN EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL EVENT 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. APPROPRIATE ACTION, PERFORMED AT THE COST OF THE OWNER, WILL BE TAKEN TO ENSURE APPROPRIATE MAINTENANCE KEYS TO LOCKED ACCESS POINTS SHALL BE MADE AVAILABLE TO COUNTY PERSONNEL UPON REQUEST.

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

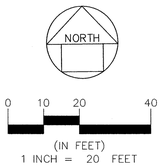
1. THE INSPECTION FOR SEDIMENT BUILD-UP WILL BE PERFORMED BY VISUAL INSPECTION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN THE STORAGE AREA. SEDIMENT REMOVAL IS REQURIED USING A RUBBER WHEELED BACKHOE. AT THE SAME TIME, OR ATLEAST ONCE PER YEAR, THE RISER BOTTOM AND OUTLET PIPE SHALL BE CLEANED OF ACCUMULATED SEDIMENTS. DISPOSE OF SEDIMENTS REMOVED FRO M THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA. SEDIMENT SHALL NOT BE ALLOWED TO ACCUMULATE IN DEPTHS GREATER THAN 1-FOOT. NO SEDIMENT SHALL BE ALLOWED TO ACCUMULATE TO PREVENT THE PROPER FUNCTION OF ANY PIPE OR CULVERT.
2. PERFORM MAINTENANCE MOWING OF GRAS SED AREAS AT LEAST TWICE EACH YEAR. GRASSES SUCH AS TALL FESCUE SHOULD BE MOWED IN EARLY SUMMER AFTER EMERGENCE OF THE HEADS ON COOL SEASON GRASSES AND IN LATE FALL TO PREVENT SEEDS OF ANNUAL WEEDS FROM MATURING. MOWING OF LEGUMES CAN BE LESS FREQUENT. TREES AND SHRUBS SHOULD NOT BE PERMITTED TO GROW ON ANY PART OF THE GRADED EMBANKMENT.
3. PERFORM SOIL SAMPLING ON STABILIZED BMP SOIL AREAS ONCE EVERY 4 YEARS. SOIL SAMPLING AND TESTING SHOULD BE PEFORMED BY A QUALIFIED INDEPENDENT TESTING LABORATORY. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.
4. IF VEGETATION COVERS LESS THAN 40% OF SOIL SURFACES IN STABILIZE BMP AREAS, LIME, FERTILIZE, AND SEED IN ACCORDANCE WITH RECOMMENDATIONS FOR DAM CONSRUCTION. IF VEGETATION COVERS NEW SEEDLINGS, AS LISTED ON NOTES, MORE THAN 40% BUT LESS THAN 70% OF SOIL SURFACES, LIME, FERTILIZE, AND OVERSEED IN ACCORDANCE WITH CURRENT SEEDLING RECOMMENDATIONS.
5. PERFORM QUARTERLY INSPECTIONS OF THE RELEASE STRUCTURES, RISER SECTION, AND CREST OF SPILLW AY FOR THE OBSERVANCE OF COLLECTED DEBRIS. IMMEDIATELY REMOVE ANY DEBRIS TO MAINTAIN.
6. PERFORM YEARLY STRUCTURAL INSPECTIONS OF THE FACILITY FOR DAMAGE. STRUCTURAL INSPECTION SHALL BE PERFORMED ON THE CONCRETE RISER, ANTI-VORTEX DEVICE, TRASH RACK, ORIFICE / WIER(S), OUTLET BARREL, AND EMBANKMENT. IF DAMAGE IS EVIDENT, FURTHER INVESTIGATION BY A PROFESSIONAL ENGINEER MAY BE REQUIRED TO ASSESS THE CONTINUED INTEGRITY OF THE STRUCTURE.
7. PERFORM QUARTERLY INSPECTIONS OF THE GRADED SIDE SLOPES OF THE BMP FACILITY FOR SIGNS OF ANIMAL/RODENT BORROWS OR SLOPE EROSION. IMMEDIATELY PERFORM NECESSARY REPAIRS, REFILLING OR RESEEDING AS APPROPRIATE.
8. THE OWNER OR DESIGNATED REPRESENTATIVE SHALL KEEP REASONABLE, ACCURATE WRITTEN RECORDS OF INSPECTIONS PERFORMED ON THE STRUCTURE. RECORDS SHALL DOCUMENT ROUTINE MAINTENANCE AND/OR REPAIRS PERFORMED. COPIES SHALL BE PROVIDED TO THE COUNTY UPON REQUEST.
9. THE FACILITY SHALL NOT BE MODIFIED IN ANY WAY WITHOUT PRIOR CONSENT/APPROVAL OF THE COUNTY.

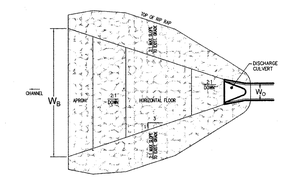
MAINTENANCE/INSPECTION GUIDELINES

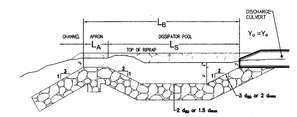
A schedule of recommended maintenance for bioretention areas with general guidance regarding methods, frequency, and time of year for maintenance is as follows:

Description	Method	Frequency	Time of the year
SOIL			
Inspect and Repair Erosion	Visual	Monthly	Monthly
ORGANIC LAYER			
Remulch any void areas	By hand	Whenever needed	Whenever needed
Remove previous mulch layer before applying new layer (optional)	By hand	Once every two to three years	Spring
Any additional mulch added (optional)	By hand	Once a year	Spring
PLANTS			
Removal and replacement of all dead and diseased vegetation considered beyond treatment	See planting specifications	Twice a year	3/15 to 4/30 and 10/1 to11/30
Treat all diseased trees and shrubs	Mechanical or by hand	N/A	Depends on insect or disease infestation
Watering of plant material shall take place at the end of each day for 14 consecutive days after planting has been completed	By hand	Immediately after completion of project	N/A
Replace stakes after one year	By hand	Once a year	Only remove stakes in the spring
Replace any deficient stakes or wires	By hand	N/A	Whenever needed
Check for accumulated sediments	Visual	Monthly	Monthly

THE RECORD DRAWING INFORMATION IS REFLECTIVE OF ASBUILT INFORMATION BY GEORGE NICE SONS DATED (07/13/2012) FOR THE GRADING AND WSPSELLS SURVEYING FOR THE BMP STRUCTURES.







RIP RAP STILLING BASIN DETAIL
N.T.S

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 PREVIOUS APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA
S. SHAYNE LEATHERS
Lic. No. 050365
1/4/13
PROFESSIONAL ENGINEER

(SEAL)
VIRGINIA REGISTERED PROFESSIONAL ENGINEER OR CERTIFIED LAND SURVEYOR

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITION OF THE STORMWATER FACILITIES. THE FACILITIES APPEAR TO CONFORM TO THE PROVISIONS OF THE APPROVED CONSTRUCTION PLANS AND SPECIFICATIONS EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA
S. SHAYNE LEATHERS
Lic. No. 050365
1/4/13
PROFESSIONAL ENGINEER

(SEAL)
VIRGINIA REGISTERED PROFESSIONAL ENGINEER OR CERTIFIED LAND SURVEYOR

RECORD DRAWING

PROJECT # S-0048-2009

WSP • SELLS
Transportation & Infrastructure
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RECORD DRAWINGS

TRACT 12 STONEHOUSE

JAMES CITY COUNTY, VA

GS STONEHOUSE GREENLAND SUB, LLC
4011 WESTCHASE BLVD, SUITE 175
RALEIGH, NC 27607

REVISIONS

1	RECORD DRAWING 10-10-12

PROJECT #: 08-4051 DATE: 08/17/09

DRAWN BY: MB CHECKED BY: CD

TITLE

BMP#1 ~~AND 4~~ DETAILS (WET PONDS)

SHEET

C5.0

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1/4/2013 9:16 AM L:\Stonehouse\08-4051-Stonehouse-TR12\00-Drawings\05-As-Built\PHASE 1\C5 BMP DETAILS.DWG, C5.0-BMP#1-4, USSD4142

STONEHOUSE TRACT 12
PHASE 1

Site Inspection Photos

Taken Date: October 5, 2012

Prepared by:

WSP · SELLS

15401 Weston Parkway
Suite 100
Cary, North Carolina 27513
(919) 678-0035
(919) 678-0206 (Fax)

CHS Project Number 08-4040

BMP 2- LOOKING AT STABILIZED AREAS ON LYTHAM CT.

BMP 2 – BIO RETENTION AREA LOOKING AT PLANTINGS

BMP 2 – RISER STRUCTURE

BMP 2 – LOOKING FROM RISER TO THE SOUTH

BMP 2 – CLOSE UP OF RISER WITH SLOTS

BMP 2- TYPICAL CLEAN OUT. THESE HDPE CLEANOUTS WERE REPLACED ON 10/9/12 WITH THREADED PLUGS THAT ARE VISIBLE FROM THE ROAD (SEE UPDATED PICTURES IN THIS LOG)

BMP 1 – ACCESS EASEMENT BETWEEN LOTS 47-48

BMP 1 – EXTENDED WET POND LOOKING AT RISER AND MAIN POOL

BMP 1 – LOOKING AT VEGETATION ON NORTHSIDE OF BMP

BMP 1 – LOOKING AT FOREBAY ON RIGHT SIDE

BMP 1- LOOKING AT SECOND FOREBAY ON LEFT SIDE, CATTAILS TO BE REMOVED BY CONTRACTOR

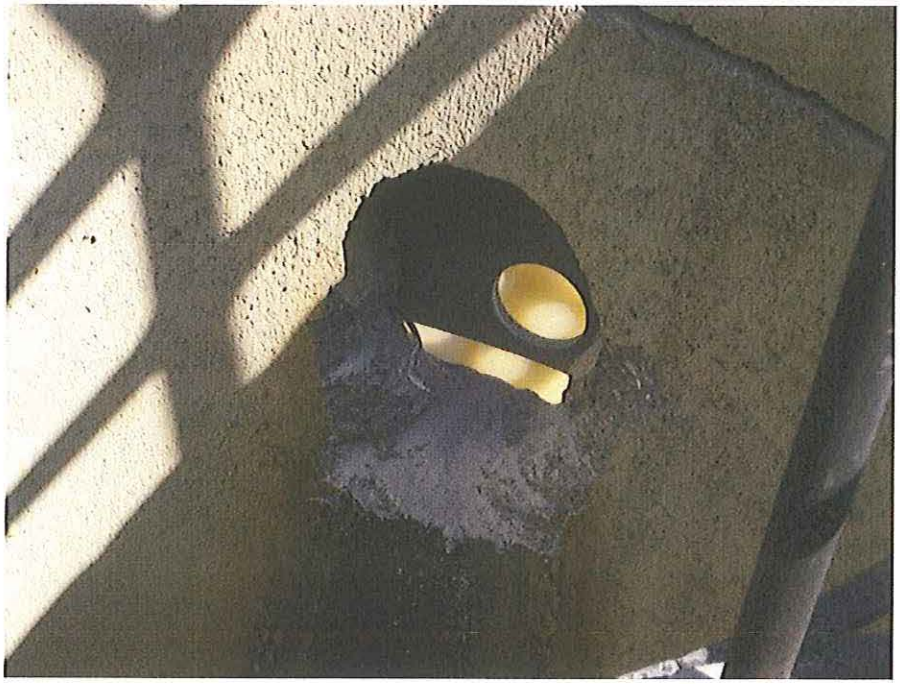
BMP 1 – LOOKING FROM BMP BETWEEN LOTS 47-48 FOR ACCESS

BMP 1 – TOP OF DAM JUST REGRADED AND STABILIZED WITH MAT AND SEED

BMP 1 – RISER STRUCTURE

BMP 1 – LOOKING DOWNSTREAM FROM DAM INTO OUTFALL INTO RPA

BMP 1 – RISER STRUCTURE LOOKING INSIDE, GATE VALVE SHOWN

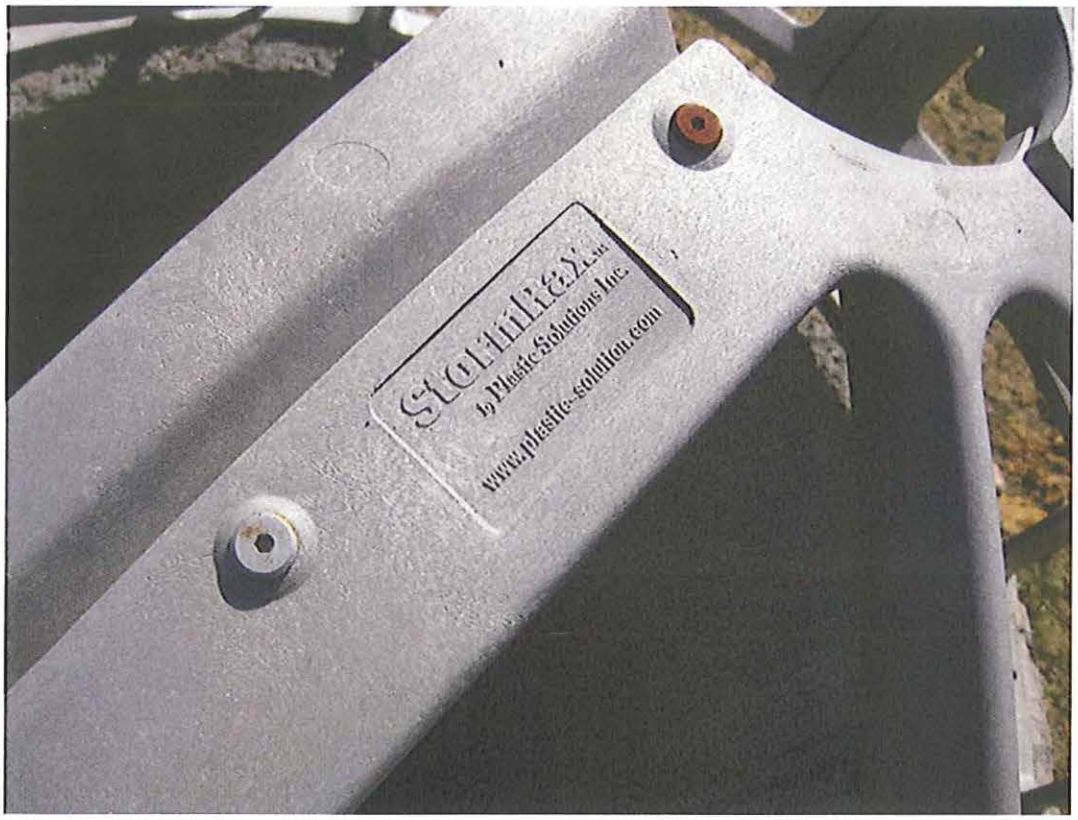


BMP 1 – 3" RISER ORIFICE FROM INSIDE

BMP 1 – RISER ORIFICE WITH TRASH SKIMMER OUTSIDE

BMP 1 – STILLING BASIN AT DOWNSTREAM END WITH FES 32

BMP 1 – LOOKING AT DAM FROM THE OUTFALL AREA DOWNSTREAM



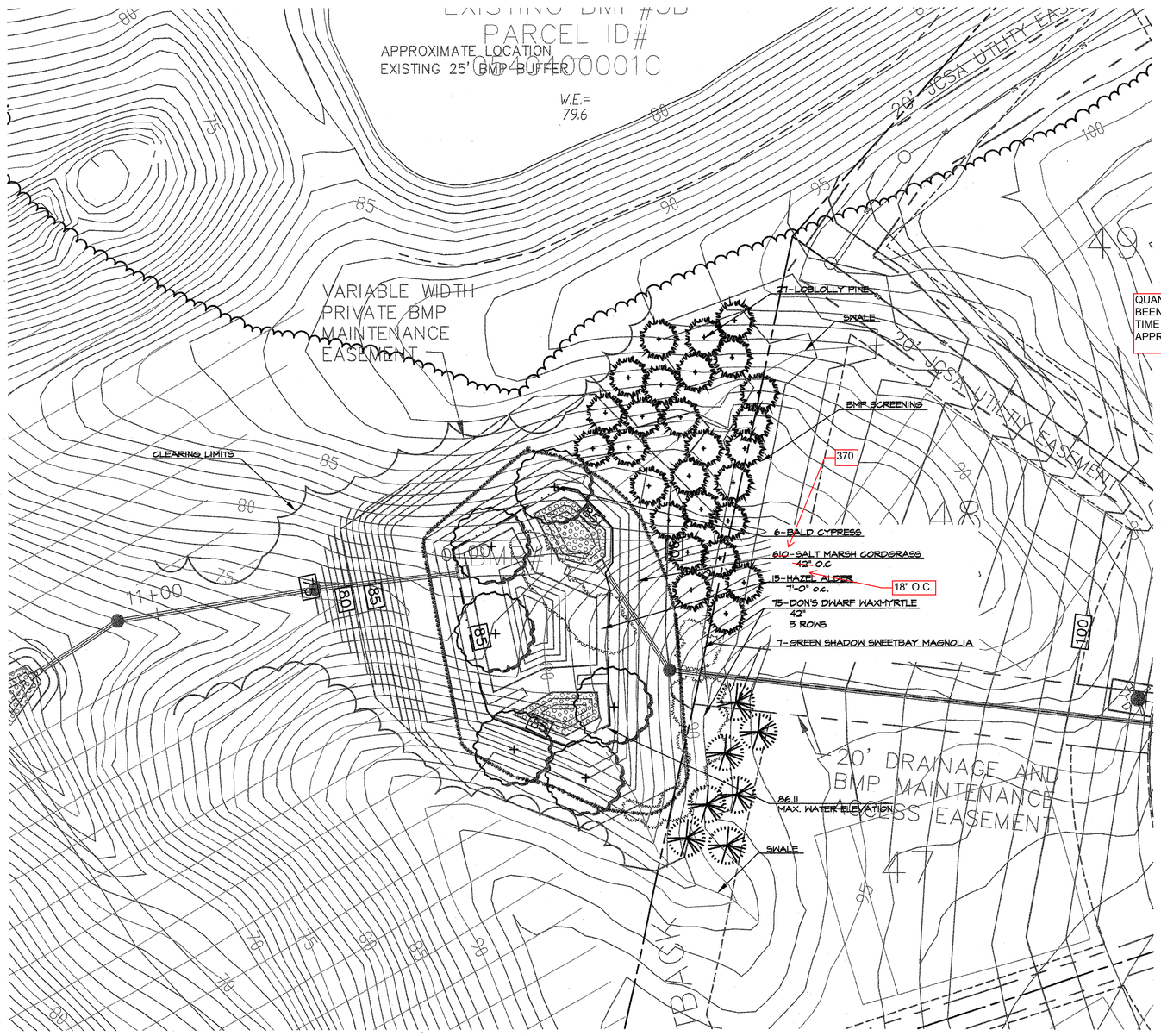
BMP 1 – RISER TRASH RACK MADE BY STORMRAX

BMP 2- CLEANOUTS HAVE BEEN CORRECTED WITH THREADED PLUGS

TAKEN 10-9-12

BMP 2 – BIORETENTION AFTER RAINFALL 10-9-12, CLEANOUTS CLEARLY VISIBLE

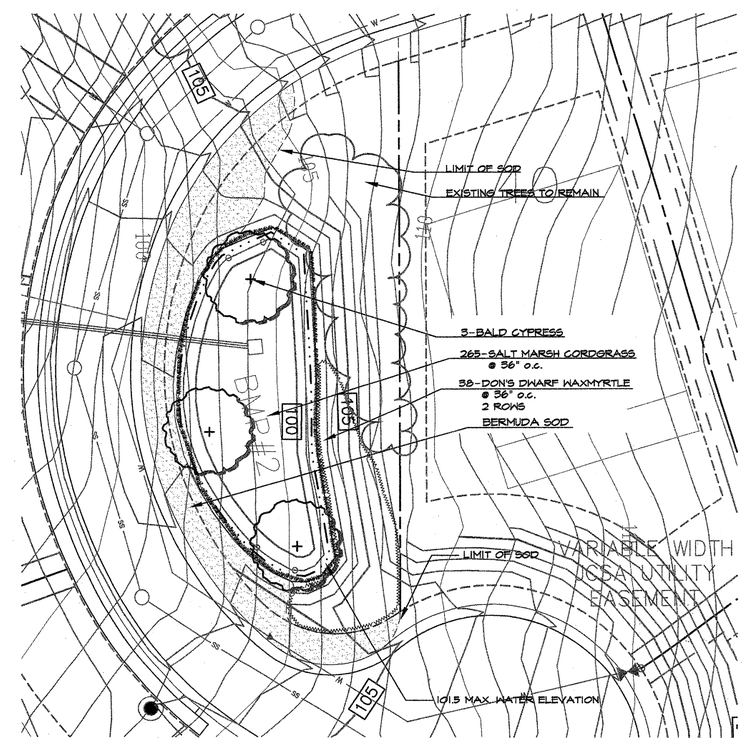
NOTE:
ALL DISTURBED AREAS IN BMP AREA NOT DELINEATED BY PLANTING BEDS ARE TO BE HYDROSEEDED WITH LOVEGRASS BY CONTRACTOR



A LS-7 BMP #1 PLANTING
SCALE:1"=20'-0"

QUANTITY OF CORDGRASS HAS BEEN REVISED AT AS BUILT TIME DUE TO TYPO ON THE APPROVED PLANS.

NOTE:
ALL DISTURBED AREAS IN BMP AREA NOT DELINEATED BY PLANTING BEDS ARE TO BE HYDROSEEDED WITH LOVEGRASS BY CONTRACTOR



B LS-7 BMP #2 PLANTING PLAN
SCALE:1"=20'-0"

0' 10' 20' 40' NORTH

COMMONWEALTH OF VIRGINIA
ROBERT S. RYAN
No. 660
4/26/10
REGISTERED LANDSCAPE ARCHITECT

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HGOR
PLANNERS LANDSCAPE ARCHITECTS

REVISIONS

NO.	DATE	ISSUE
1	11/30/09	PLAN REV
2	01/27/10	PLAN REV
3	03/04/10	PLAN REV
4	04/26/10	PLAN REV

Stonehouse-Tract 12

James City County, VA
GS Virginia
Raleigh, NC

TITLE
LANDSCAPE DEVELOPMENT PLAN

DATE	05/08/09
JOB NO.	08056
DWG FILE	08056LW40
DRAWN BY	MZ / CS
CHECKED	TS
SCALE	AS SHOWN
SHEET	LS -7

NOT RELEASED FOR CONSTRUCTION

Last modified on 04/26/10 by TODD
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