Stormwater Division

MEMORANDUM

DATE: July 28, 2014
TO: Michael J. Gillis, Virginia Correctional Enterprises Document Management Services
FROM: Jacob Smith, Stormwater Intern
PO: 110426
RE: Files Approved for Scanning

NAME PDF/SCANNED FILE:	**STONEHOUSE AMENITY H**		
BMP ID OR GEN FILE NUMBER:	WC111-113	**OWNER NAME:**	GC STONEHOUSE GREENLAND SUB LLC
PIN:	0540100015	**SITE ADDRESS:**	N/A
		LEGAL DESCRIPTION:	TRACT 1

MAINTENANCE AGREEMENT IN FILE:	**YES**	**BOOK/PAGE OR DOCUMENT NO.:**	080027247	**OTHER DESCRIPTION:**	N/A

BOX NO.:	2	**COMMENTS:**	DECLARATION INSPECTION MAINTENANCE

Development Management
101-A Mounts Bay Road
P.O. Box 8784
Williamsburg, VA 23187-8784
P: 757-253-6671
F. 757-253-6822
devman@james-city.va.us

jamescitycountyva.gov

Building Safety and Permits
757-253-6620

Engineering and Resource Protection
757-253-6670

Planning
757-253-6685

Zoning Enforcement
757-253-6671

May 20, 2013

GC Stonehouse Greenland Sub LLC
Stonehouse Amenity H
4011 West Chase Blvd, Suite 175
Raleigh, NC. 27607

Re: Stonehouse Amenity H
County Plan No. SP-008-09
County BMP ID Code: WC111, WC112 and WC113

Dear Applicant/owner:

The Engineering and Resource Protection Division has received a record drawing (asbuilt) and construction certification for the stormwater management facility and associated conveyance system components for the above referenced project. The record drawing provides as-built information for the bioretention basin, infiltration basin, and swale located on the site. Record Drawings (as-built) and construction certifications are required for the entirety of the stormwater conveyance and attenuation system which includes any stormwater management/BMP(s) and the associated conveyance system(s). Certifying to the construction of these systems and components indicates that all items were constructed in accordance with the associated plans and specifications. Record drawings and construction certifications must meet established program requirements of both the county engineering and resource protection and stormwater divisions.

Based on our review of the project, record drawing submittal, and concurrent field inspection as performed on April 1, 2013, the following items must be addressed prior to the release of surety and for our division to proceed with the closing out of the project:

Record Drawing:

1. The asbuilt information for the storm was provided on the sheet C3.0 (sheet 1 of 2). To avoid confusion in the documents, please review the application and correct the references as needed. For example, the reference provided on sheet 5.0 and on the left side of the detail for BMP #1 refers to sheet C6.0 which is not contained in the record drawing set. Please inspect the remainder of the documents to ensure all call outs are appropriate.

2. Add the approved maintenance plan from Sheet C5.1 of the approved plan to the record drawing plan set.

3. If possible add the following County identifiers to the lower right hand corner of the record drawing: County Plan Number SP-008-09 and BMP ID Codes: WC111 (BMP #1), WC112 (BMP #2) and WC113 (BMP #3).

Construction - Related Items:

4. Erosion gullies are present in the wet swale and need to be repaired and stabilized prior to the resubmittal of these record drawings.

5. Active erosion gullies and scours present at the enhanced outfall area associated with structure FES-1 (as indicated on the record drawings) must be repaired with compacted material, reseeded, and mulched or matted for stability. regrade side and armor

6. Clear and remove all vegetation, brush, debris, and sediment within 10 feet of the principal flow control (riser) structures and clean all weirs and orifices. Flow into the riser for the infiltration basin and bioretention shall not be obstructed by vegetation.

7. There is substantial erosion and subsidence through and around the planting beds as located within the bioretention area along the south side of the facility. While the record drawings appear to indicate these slopes match the 3:1 (H:V) as indicated in the approved plan set, it appears that the combination of the slopes and plantings has resulted in the sloughing of the material and the conditions need to be rectified more so than just the replacement per plan as these are the conditions that have generated this comment. Redesign of this area may be necessary in order for it to function as originally intended. move plants to other side

8. A large washout area has formed on the southern side of the bioretention facility, adjacent to the light pole nearest the clubhouse. It appears to be the result of the rip rap armoring which conveys drainage to the bioretention area from the parking lot which has contributed the undermining of the parking lot and exposure of the irrigation line in this area. This issue needs to be restored and properly compacted and stabilized in its entirety prior to the resubmittal of these record drawings. concrete lip

9. A sinkhole appears to have formed immediately adjacent to MH-1 and downslope of the bioretention area. Explore the area to determine the cause and repair as needed.

Once this work has been completed, and prior to resubmitting the record drawing information for review and approval, please contact our office so that staff may reinspect the facility. Should it be confirmed by staff that to all items have been satisfactorily completed, a final submittal of the record drawing information will be requested on CD or DVD containing full sized pdf's of the record drawings and other relative information. Once all required information has been provided, staff will then proceed with final release of the surety and/or closing out the project.

Should you have any comments or questions, please contact me at your convenience at 757-253-6702 or via email at William.cain@jamescitycountyva.gov.

Sincerely,

William Cain, P.E, CFM
Chief Civil Engineer
Engineering and Resource Protection

cc: Ed Tang – WSP-Sells - via email
Camille Kattan – GET Solutions - via fax
Jordan Anglin - Henderson General Contractors- via email
Tina Creech - JCC ERP DIV inspector – via email

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Environmental Division

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James City County, Virginia
Stormwater Division

Stormwater Facilities - BMP and Conveyance Systems
Record Drawing and Construction Certification Forms

Note: In accordance with the requirements of the Chesapeake Bay Preservation Ordinance, Chapter 23, Section 23-10(4), BMPs shall be designed and constructed in accordance with the manual entitled* James City County Guidelines for Design and Construction of Stormwater Management BMPs. *The Subdivision Ordinance, Chapter 19-62, the Zoning Ordinance, Chapter 24-159, and approved construction 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, written construction certification is required by a Professional Engineer who inspected the structure during its construction. Currently there are over 20 water quality type BMPs accepted by the County.

Section 1 - Site Information:

Project Name: Stonehouse Amenity H

Structure/BMP Name: BMP#1, BMP#2, and BMP#3 (WC111, WC112, WC113)

Project Location: Six Mt. Zion Road

BMP Location: Parking, Playground, and Open Play Area

County Plan No.: SP - 0008 - 2009

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

Tax Map/Parcel No.: 05401000015

BMP ID Code (if known): D-1, C-2, E-1 (WC111, WC112, WC113)

Zoning District: PUD-R

Land Use: Recreation

Site Area (sf or acres): 10.59 Acres

Brief Description of Stormwater Management/BMP Facility: Sheetflow across parking lot to BMP#1 (Biorention), sheetflow from slope and playground to BMP#2 (inflitration), and sheetflow across open play area to BMP#3 (swale). Combined discharge with stilling basin at wetland/stream feature.

Nearest Visible Landmark to SWM/BMP Facility: _____

Nearest Vertical Ground Control (if known):

☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☐ Other

Station Number or Name: Monument #334

Datum or Reference Elevation: NGVD29 and NAD83

Control Description: _____

Control Location from Subject Facility: _____

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: August 2009

Facility Monitored by County Representative during Construction: ☒ Yes ☐ No ☐ Unknown

Name of Site Work Contractor Who Constructed Facility: Henderson General Contractors

Name of Professional Firm Who Routinely Monitored Construction: Williamsburg Environmental Group

Date of Completion for SWM/BMP Facility: May 26, 2010

Date of Record Drawing/Construction Certification Submittal: May 27, 2010

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

Section 3 - Owner / Designer / Contractor Information:

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

Name: GS Stonehouse Greenland Sub LLC

Mailing Address: 4011 West Chase Blvd, Ste 175, Raleigh, NC 27607

Business Phone: 919-832-9998 Fax: 919-832-9896

Contact Person: Tom Page Title: Vice President

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

Firm Name: WSP SELLS

Mailing Address: 15401 Weston Parkway, Ste 100, Cary, NC 27513

Business Phone: 919-678-0035 Fax: 919-676-0206

Responsible Plan Preparer: Craig M. Duerr, PE

Title: Project Manager

Plan Name: Stonehoue Amenity H

Firm's Project No. 08-4046 Plan Date: 07/17/09

Sheet No. Applicable to SWM/BMP Facility: C3.0/ C5.0/ C5.1/ ____ / ____

Stormwater Facility Contractor: *(Note: Site Work Contractor directly responsible for construction of the Stormwater facilities.)*

Name: Henderson General Contractors

Mailing Address: 5806 Mooretown Road, Williamsburg, VA 23188

Business Phone: 757-565-1090 Fax: 757-564-9120

Contact Person: Rob Haven

Site Foreman/Supervisor: Project Manager

Specialty Subcontractors & Purpose (for BMP Construction Only): ____

Section 4 - Professional Certifications:

Certifying Professionals: *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 stormwater facilities for the project including all BMP and conveyance systems. A Registered Professional Engineer is responsible for the inspection, monitoring and certification of all stormwater facilities – BMP and conveyance systems during their construction.*

Record Drawing and Construction Certifications for Stormwater Facilities - BMP and Conveyance Systems

Record Drawing Certification

Firm Name: WSP SELLS
Mailing Address: 15401 Weston Parkway
Cary, NC 27513
Business Phone: 919-678-0035
Fax: 919-676-0206

Name: Alan Nash, LS
Title: Survey Manager

Signature: Alan Nash
Date: 6/22/10

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
6/22/10
ALAN W. NASH
LIC. NO. 002709
LAND SURVEYOR

(Seal)
Virginia Registered Professional Engineer or Certified Land Surveyor

Construction Certification

Firm Name: GET Solutions
Mailing Address: 1592 Penniman Rd, Ste E
Williamsburg, VA 23185
Business Phone: 757-564-6452
Fax: 757-564-6453

Name: CAMILLE A. KATTAN
Title: PRINCIPLE ENGINEER

Signature: Camille A. Kattan
Date: 11/7/12

I hereby certify to the best of my knowledge and belief that these Stormwater Facilities were monitored and constructed in accordance with the provisions of the approved construction plans and specifications except as specifically noted.

COMMONWEALTH OF VIRGINIA
CAMILLE A. KATTAN
Lic. No. 018045
11/7/12
PROFESSIONAL ENGINEER

(Seal)
Virginia Registered Professional Engineer

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

☒ Preconstruction Meeting - Provides an opportunity to review stormwater facilities construction, maintenance and operation plans, and address any questions regarding construction and/or monitoring of the structure. The certifying professionals, geotechnical engineer, Owner/Applicant, Contractor and County representative(s) are required to attend the preconstruction meeting. Advance notice to the Stormwater Division is required. Usually, this requirement can be met simultaneously with Erosion and Sediment Control preconstruction meeting held for the project.

☒ A fully completed ***Stormwater Facilities – BMP and Conveyance Systems, 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 stormwater facilities including all BMPs and conveyance systems.

☒ Construction Certification. Construction of Stormwater 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 construction plans and specifications, and standard accepted construction practice and shall submit a written certification and/or drawings to the Stormwater Division as required. Soil and compaction test reports, concrete test reports, inspection reports, logs and other required construction material or installation documentation shall be required by the Stormwater Division to substantiate the certification. 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 with notification to the Stormwater Division.

☒ Record Drawing and Construction Certifications are required within **thirty (30) days** of the completion of any Stormwater Facility - BMP or conveyance system. Submittals must be reviewed and accepted by James City County Stormwater Division prior to final inspection, acceptance, surety release or issuance of a Certificate of Occupancy.

Dual Purpose Facilities - Completion of construction also includes any interim stage for Stormwater BMP facilities which serve a dual purpose as temporary sediment basins during construction and as permanent stormwater BMP facilities following completion of development and stabilization. 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 Stormwater 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 Stormwater 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 facilities construction plan including applicable plan views, profiles, sections, details, maintenance plans, etc. as related to the subject Stormwater 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 surety or a Certificate of Occupancy, 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 Stormwater 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 Stormwater Division staff at the time of final submission.

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

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

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

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

XX 3. All plan sheets labeled with "RECORD DRAWING" in large text in lower right hand corner. Include approved County Plan Number and BMP ID Code if known.

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

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

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

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

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

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

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

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

XX 6. Cross-section of the embankment through the principal spillway or outlet barrel. Must extend at least 100 ft. downstream of the pipe outlet or to recorded site property line, whichever is closer. Proper correlation is required between principal spillway (control structure) crest, emergency spillway crest, orifice and weirs and the top of the dam or

facility. All elevations and dimensions must reasonably match the design plan or be sequentially relative to each other and the facility must reflect the required design storage volume(s) and/or design depth.

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.

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

XX 9. Primary control structure (riser) diameter or dimensions, height, type of material and base size. Indicate provisions for access that are present such as steps, ladders, etc.

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

XX 11. Type and size of anti-vortex and trash rack device. Height, diameter, dimensions, bar spacings (if applicable) and elevations relative to the principal spillway crest. Indicate if lockable hatch is present or not.

XX 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.**

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

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

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

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

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

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

N/A 19. Fencing location and type, if applicable to facility.

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

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

XX 22. Any other information formally requested by the Stormwater Division specific to the constructed Stormwater BMP facility.

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

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

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

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

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

N/A 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.

N/A 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.

N/A 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).

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

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

N/A A10. Low flow orifice has a non-clogging mechanism.

N/A A11. A pond drain pipe with valve was provided.

N/A 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.

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

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

N/A B1. Same requirements as Group A Wet Ponds.

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

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

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

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

_____ B6. No more than one-half (2) of the wetland surface area is planted.

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

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

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

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

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

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

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

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

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

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

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

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

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

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

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

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

XX C13. Observation well provided. Clean-outs provided for underdrains

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

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

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

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

XX D2. Sediment pretreatment devices provided.

XX 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.

XX 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.

N/A 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.
BMP#1 was converted from a sedimetn basin

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

N/A D7. Filtering system is off-line from storm drainage conveyance system.

XX 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.

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

XX 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.

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

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

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

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
AS-BUILT PLAN CHECKLIST

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

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

N/A F1. All requirements of Section II, Minimum Standards, apply to Group F facilities.

_____F2. Basin bottom has positive slope and drainage from all basin inflow points to the riser (or outflow) location.

_____F3. Timber wall BMP used in intermittent stream only. (ie. Prohibited in perennial streams.)

_____F4. Forebay provided approximately 20 ft. upstream of the facility. Forebays generally 4 to 6 feet in depth.

_____F5. A reverse slope pipe, vertical stand pipe or mini-barrel and riser was provided to prevent clogging.

_____F6. Principal spillway and outlet barrel provided consisting of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

_____F7. Mini-barrel and riser, if used, contains a removable trash rack to reduce clogging.

_____F8. Low flow orifice, if used, has a minimum diameter of three (3) inches or two (2) inches if internal orifice control was utilized and a small, cage type external trash rack.

_____F9. Timbers properly reinforced or concrete footing provided if soil conditions were prohibitive.

_____F10. Timber wall cross members extended to a minimum depth of two (2) feet below ground elevation.

_____F11. Protection against erosion and scour from the low flow orifice and weir-flow trajectory provided.

_____F12. Stilling basin or standard outlet protection provided at principal spillway outlet.

_____F13. Adequate, direct access provided to the facility. Access corridor to facility is at least ten (10) feet wide, slope is less than twenty (20) percent and appropriate stabilization provided for equipment and vehicle use. Access extends to forebay, standpipe and timber wall, as applicable.

_____F14. No visual signs of undercutting of timber walls or clogging of the low orifice were present.

_____F15. No visual signs of erosion or channel degradation immediately downstream of facility.

_____F16. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

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

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

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

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

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

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

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

STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM
RECORD DRAWING CHECKLIST

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

X. Storm Drainage Systems, closed and open

(Includes all stormwater drainage conveyance systems such as onsite or offsite storm drains, open channels, inlets, manholes, junctions, outlet protections, deflectors, etc. The intent of this portion of the certification is toensure the drainage conveyance facilities are constructed in accordance with the construction plans and specifications so that they convey the desing flow levels and don not require excessive maintenance.)

XX SD1. All requirements of Section II, Minimum Standards, apply to Storm Conveyance systems.

XX SD2. Horizontal location of all pipes, structures and channels relative to the approved plan.

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

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

N/A SD5. Channel cross-section and invert elevations at 100 foot intervals. Channel liners as specified on the construction plans.

XX SD6. Class, length, width and depth of riprap and outlet protections or dimensions of special energy dissipation structures.

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

N/A O1. All requirements of Section II, Minimum Standards, apply to this section.

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

TRANSMITTAL SHEET

ENGINEERING & RESOURCE PROTECTION → STORMWATER

Project: **Stonehouse Amenity H**

County Plan No.: **SP-008-09**

Assigned BMP No: WC111, WC112, WC113

BMP Type: **Bioretention, Infiltration, WetSwale/Outfall** comments

Information Enclosed:

X Computations

X Other:

Name: **Tina Creech**

Date: **6/12/14**

Signature: Tina Creech

James City County Environmental Division
Stormwater Management / BMP Inspection Report
Subsurface - Detention and Infiltration Facilities

County BMP ID Code (if known): WC113

Name of Facility: Stonehouse Avenue H BMP No.: 3 Date: 4/1/13 / Reinspect 6/21/14 @ 9:00

Location: Six Mount Zion Road

Name of Owner: GC Stonehouse Greenland Sub LLC

Name of Inspector: William Cain & Tina Creech

Type of Facility: Wet Swale-detention enhanced outfall

Weather Conditions: Cloudy Type: ☑ Final Inspection ☐ County BMP Inspection Program ☐ Owners Inspection

If an inspection item is not applicable, mark NA, otherwise mark the appropriate column.

O.K. - The item checked is in adequate condition and the maintenance program is currently satisfactory. No action required.
Routine - The item checked requires attention, but does not present an immediate threat to the function/integrity of the BMP.
Urgent - The item checked requires immediate attention to keep the BMP operational and prevent damage to the facility.

Provide an explanation and details in the comment column, if routine or urgent are marked.

Facility Item	O.K.	Routine	Urgent	Comments
Accessibility:				
Roads				
Parking Areas				
Gates				
Locks				
Safety Fencing				
Access Points:				
Trap Doors				
Manholes/ Vaults				
Grates				
Observ Wells				
Pretreatment Devices: ☐ **Inlet** ☐ **Sump** ☐ **Forebay** ☐ **Other**				
Sediment				
Trash & Debris				
Structure				
Other				

Facility Item	O.K.	Routine	Urgent	Comments
Primary Storage/ Infiltration Area Structure (Pipe, Stone, etc):				
Trash & Debris				
Sediment				
Ponding / Drawdown				
Cracks				
Joints				
Seams				
Coating				
Aesthetics				
Other				
Inlet Structure # 1 (Describe Location): Wet Swale				
Condition of Structure				
Erosion	✓	✓		Rill erosion needs to be repaired
Trash and Debris				
Sediment	✓	✓		
Aesthetics	Repaired upon 5/21/14 reinspection			
Other				
Inlet Structure # 2 (Describe Location):				
Condition of Structure				
Erosion				
Trash and Debris				
Sediment				
Aesthetics				
Other				
Inlet Structure # 3 (Describe Location):				
Condition of Structure				
Erosion				
Trash and Debris				
Sediment				
Aesthetics				
Other				
Outlet - Principal Overflow or Bypass Structure (Describe Location): NW of Site				
Condition of Structure				
Erosion	✓	Repaired 5/21/14	✓	end of outlet pipe needs to be repaired. Rill erosion beneath Matting.
Trash and Debris				
Sediment	✓		✓	
Other				

Facility Item	O.K.	Routine	Urgent	Comments
Nusiance Type Conditions:				
Mosquito Breeding	✓			
Animals, Rodents	✓			
Graffiti	✓			
Other	✓			
Perimeter (Contributing Drainage Area) Conditions:				
Stabilization	✓			
Vegetation Condition	✓			
Trash and Debris	✓			
Aesthetics	✓			
Other				

Remarks:

Overall Environmental Division Internal Rating: 3

Signature: Lina Creech **Date:** 4/1/13

Title: Env. Insp

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James City County Environmental Division
Stormwater Management / BMP Inspection Report
Subsurface - Detention and Infiltration Facilities

County BMP ID Code (if known): WC112

Name of Facility: Stonehouse Amenity H BMP No.: 2 Date: 4/1/13 / 5/21/14 reinspect

Location: Six Mount Zion Road

Name of Owner: GC Stonehouse Greenland Sub LLC

Name of Inspector: ~~William~~ Maggie Cain & Tina Creech

Type of Facility: Infiltration trench

Weather Conditions: Cloudy Type: ☑ Final Inspection ☐ County BMP Inspection Program ☐ Owners Inspection

If an inspection item is not applicable, mark NA, otherwise mark the appropriate column.

O.K. - The item checked is in adequate condition and the maintenance program is currently satisfactory. No action required.
Routine - The item checked requires attention, but does not present an immediate threat to the function/integrity of the BMP.
Urgent - The item checked requires immediate attention to keep the BMP operational and prevent damage to the facility.

Provide an explanation and details in the comment column, if routine or urgent are marked.

Facility Item	O.K.	Routine	Urgent	Comments
Accessibility:				
Roads	✓			
Parking Areas	✓			
Gates				
Locks				
Safety Fencing				
Access Points:				
Trap Doors				
Manholes/ Vaults				
Grates	✓			
Observ Wells	✓			
Pretreatment Devices: ☐ **Inlet** ☐ **Sump** ☐ **Forebay** ☐ **Other**				
Sediment	✓			
Trash & Debris	✓			
Structure	✓			
Other				

Facility Item	O.K.	Routine	Urgent	Comments
Primary Storage/ Infiltration Area Structure (Pipe, Stone, etc):				
Trash & Debris	✓			
Sediment	✓			
Ponding / Drawdown	✓			
Cracks	✓			
Joints	✓			
Seams	✓			
Coating	✓			
Aesthetics	✓			10' around structure
Other				cat-tails removed.
Inlet Structure # 1 (Describe Location):				
Condition of Structure				
Erosion				
Trash and Debris				
Sediment				
Aesthetics				
Other				
Inlet Structure # 2 (Describe Location):				
Condition of Structure				
Erosion				
Trash and Debris				
Sediment				
Aesthetics				
Other				
Inlet Structure # 3 (Describe Location):				
Condition of Structure				
Erosion				
Trash and Debris				
Sediment				
Aesthetics				
Other				
Outlet - Principal Overflow or Bypass Structure (Describe Location):				
Condition of Structure				
Erosion				
Trash and Debris				
Sediment				
Other				

Facility Item	O.K.	Routine	Urgent	Comments
Nusiance Type Conditions:				
Mosquito Breeding	✓			
Animals, Rodents	✓			
Graffiti	✓			
Other				
Perimeter (Contributing Drainage Area) Conditions:				
Stabilization	✓			(2 areas repaired)
Vegetation Condition	✓			
Trash and Debris	✓			
Aesthetics	✓			
Other				

Remarks:

Overall Environmental Division Internal Rating: 3

Signature: Jira Creech

Date: 4/1/13 / 5/21/14 Reinspection w/ Maggie

Title: Env Insp

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James City County Environmental Division
Stormwater Management / BMP Inspection Report
Bioretention Facilities

County BMP ID Code (if known): WC111

Name of Facility: Stonehouse Amenity II BMP No.: 1 Date: 4/1/13 Reinspect 5/21/14

Location: Six Mount Zion Road

Name of Owner: CC Stonehouse Greenland Sub LLC

Name of Inspector: William Cain & Tina Creech

Type of Facility: Bioretention

Weather Conditions: Cloudy Type: ☑ Final Inspection ☐ County BMP Inspection Program ☐ Owner Inspection

If an inspection item is not applicable, mark NA, otherwise mark the appropriate column.

O.K. - The item checked is in adequate condition and the maintenance program is currently satisfactory. No action required.
Routine - The item checked requires attention, but does not present an immediate threat to the function/integrity of the BMP.
Urgent - The item checked requires immediate attention to keep the BMP operational and prevent damage to the facility.

Provide an explanation and details in the comment column, if routine or urgent are marked.

Facility Item	O.K.	Routine	Urgent	Comments
Accessibility:				
Roads	✓			
Parking Areas	✓			light pole repaired 5/21/14
Gates				
Locks				
Safety Fencing				
Observation Wells/Areas:				
Trap Doors				
Manhole Covers				
Grates	✓			
Steps	✓			
Pretreatment Devices: ☐ Inlet ☐ Sump ☐ Forebay ☐ Other				
Sediment	✓			
Trash & Debris	✓			
Structure	✓			
Other				
Inflow Structure (Describe Type/Location):				

Facility Item	O.K.	Routine	Urgent	Comments
Condition	✓			
Erosion	✓			
Trash and Debris	✓			
Sediment	✓			
Aesthetics	✓			
Other				
Primary Infiltration (Bioretention Cell) Area:				
Specialty Landscaping	✓ 5/21/14		✓	*5/21/14 - repaired - moved to Major erosion around landscaping rear
Mulch Layer	✓			Matting installed
Planting Soil/Sand	✓			
Subgrade Soil	✓			
Aggregate	✓			Removed cattails 10'
Underdrain	✓			around structure
Sediment	✓			
Aesthetics				
Overflow or Bypass Control Structure (Describe Type/Location): MH-1				
Condition	✓		✓	Sinkhole at structure. ✓ repaired 5/21/14
Erosion	✓			
Trash & Debris	✓			
Sediment	✓			
Other				
Outlet Structure (Describe Type/Location):				
Condition	✓			
Erosion	✓			
Trash & Debris	✓			
Sediment	✓			
Other				
Contributing Drainage Area/Perimeter Conditions:				
Land Use	✓			
Stabilization	✓			
Trash & Debris	✓			
Pollutant Hazard	✓			
Other	✓ 5/21/14		✓	✓ Repaired 5/21/14 large sinkhole at edge of bio/sidewalk

Facility Item	O.K.	Routine	Urgent	Comments

Sketch and/or Remarks:

Overall Environmental Division Internal Rating: 4

Signature: Tina Creech **Date:** 4/1/13 / 5/21/14 reinspect (Final w/ Bruce)

Title: Env Insp.

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COPY

COUNTY OF JAMES CITY, VIRGINIA

DECLARATION OF COVENANTS
INSPECTION/MAINTENANCE OF DRAINAGE SYSTEM

THIS DECLARATION, made this 16th day of July, 2009, between G.S. Stonehouse Green Land Sub LLC, and all successors in interest, ("COVENANTOR(S)"), owner(s) of the following property:

Parcel Identification Number: 0540100015
Legal Description: Tract 1 GS Stonehouse Green Land Sub LLC
Project or Subdivision Name: Stonehouse Amenity H
Document No. 080027247
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.

Instrument # 090021483
Recorded on July 29, 2009

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

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

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

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

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

COVENANTOR(S) Thom D. Page

TOM PAGE
Print Name

V.P. - G.S. VIRGINIA
Title

ACKNOWLEDGMENT

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

I hereby certify that on this 16 day of July, 2009, before the subscribed, a Notary Public for the Commonwealth of Virginia, personally appeared Tom Page and did acknowledge the foregoing instrument to be his/her Act.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 16 day of July, 2009.

[SEAL] Dana M Tillson
Notary Public

Notary Registration Number:

My Commission expires:

DANA M. TILLSON
Notary Public
Commonwealth of Virginia
7265579
My Commission Expires Oct 31, 2013

Approved as to form:

Asst. County Attorney

This Declaration of Covenants prepared by:

Name:

Print Name: Jordan Anglin

Title: Project Engineer

Address: 5806 Mooretown Road
Williamsburg VA 23188

Phone Number: 757-879-2394

(drainage1.pre)

WORKSHEET FOR BMP POINT SYSTEM

computation wrong.

LAND AREA SUMMARY: Stonehouse - AMENITY H

A. STRUCTURAL BMP POINT ALLOCATION

BMP	BMP POINTS		FRACTION OF SITE SERVED BY BMP (Acre)		WEIGHTED BMP POINTS
Infiltration Basin (1.0 in / imp ac) (Playground)	10	x	0.75 %	=	0.97
Bioretention (1/2 parking and drive)	10	x	1.00 %	=	1.29
Bioretention (Building + 1/2 parking and drive)	10	x	1.50	=	1.94
Bioretention (Supplemental parking)	10	x	1.00	=	1.29
Wet Swale (Play Area #1 and Pool)	4	x	1.00	=	0.52
Wet Swale (Play Area #2)	4	x	1.00	=	0.52
			TOTAL WEIGHTED STRUCTURAL BMP POINTS:		**6.52**

5.29

B. NATURAL OPEN SPACE CREDIT

NON-STRUCTUAL BMP	FRACTION OF SITE		NATURAL OPEN SPACE CREDIT		POINTS FOR NATURAL OPEN SPACE
RPA BUFFER & WETLANDS	3.00	x	(0.10 PER 1%)	=	2.79
OTHER DUNOS	0.00	x	(0.10 PER 1%)	=	0.00
STORMWATER DUNOS	0.00	x	(0.15 PER 1%)	=	0.00
ADJACENT DUNOS (Adjacent to Play Area)	1.00	x	(0.15 PER 1%)	=	1.40
			TOTAL NATURAL OPEN SPACE CREDIT:		**4.19**

Shows where areas are located.

C. TOTAL WEIGHTED POINTS

6.52	+	4.19	=	10.70
STRUCTURAL BMP POINTS		NATURAL OPEN SPACE POINTS		TOTAL

- What is Site Area?
- Stream Channel Protection?

Can not put LID for SSC and then get the 10 point for the same structure

POOR QUALITY

ORIGINAL(S) FOLLOW

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VCE DOCUMENT CONVERSION CENTER

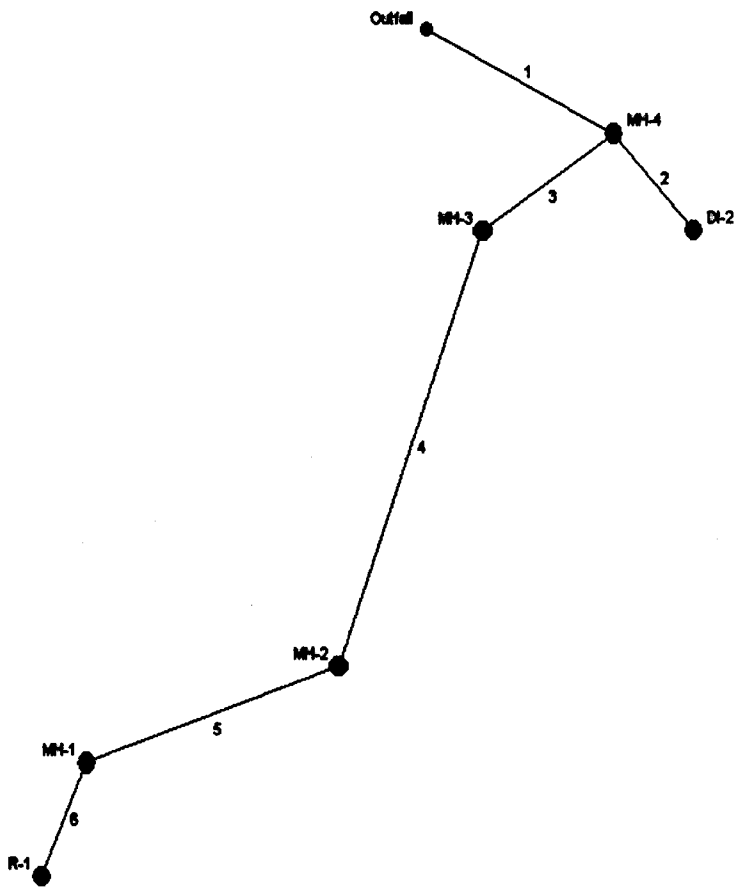
STORM DRAIN OUTFALL
HYDRAULIC GRADE LINE CALCULATIONS
Revised 7/17/09

COMMONWEALTH OF VIRGINIA
CRAIG MICHAEL DUERR
No. 045357
PROFESSIONAL ENGINEER

7/17/09

RECEIVED
JUL 2009
Planning Department

Hydraflow Plan View

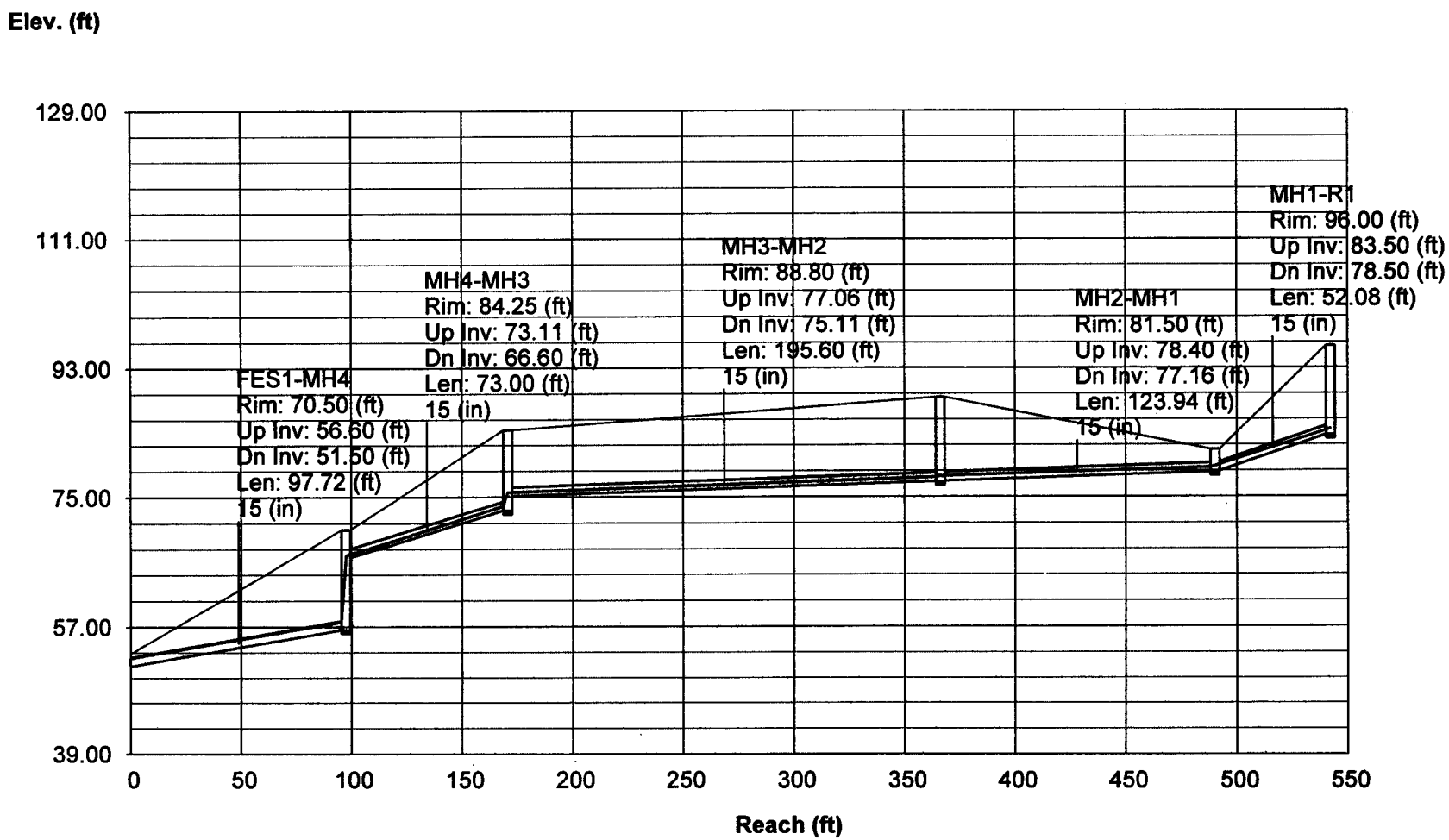


Project file: storm design 2.stm	No. Lines: 6	07-17-2009

Hydraflow Storm Sewers 2003

Storm Sewer Profile

Proj. file: storm design 2.stm



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	97.7	27.1	MH	0.36	0.10	0.50	5.0	51.50	5.22	56.60	15	Cir	0.013	1.00	70.50	FES1-MH4
2	1	55.0	20.7	MH	2.53	0.70	0.50	5.0	66.60	7.09	70.50	15	Cir	0.013	1.00	83.00	MH4-DI2
3	1	73.0	119.0	MH	0.00	0.00	0.00	0.0	66.60	8.92	73.11	15	Cir	0.013	0.75	84.25	MH4-MH3
4	3	195.6	-35.7	MH	0.00	0.00	0.00	0.0	75.11	1.00	77.06	15	Cir	0.013	0.75	88.80	MH3-MH2
5	4	123.9	50.7	MH	0.00	0.00	0.00	0.0	77.16	1.00	78.40	15	Cir	0.013	0.75	81.50	MH2-MH1
6	5	52.1	-47.2	MH	2.37	0.00	0.00	0.0	78.50	9.60	83.50	15	Cir	0.013	1.00	96.00	MH1-R1

Project File: storm design 2.stm | Number of lines: 6 | Date: 07-17-2009

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	FES1-MH4	8.09	15 c	97.7	51.50	56.60	5.219	52.62	57.72	0.75	End
2	MH4-DI2	5.03	15 c	55.0	66.60	70.50	7.091	67.06	71.40	0.44	1
3	MH4-MH3	2.37	15 c	73.0	66.60	73.11	8.918	66.90	73.73	0.18	1
4	MH3-MH2	2.37	15 c	195.6	75.11	77.06	0.997	75.63	77.68	0.18	3
5	MH2-MH1	2.37	15 c	123.9	77.16	78.40	1.000	77.86	79.02	0.18	4
6	MH1-R1	2.37	15 c	52.1	78.50	83.50	9.601	79.20	84.12	0.24	5

Project File: storm design 2.stm | Number of lines: 6 | Run Date: 07-17-2009

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

Storm Sewer Tabulation

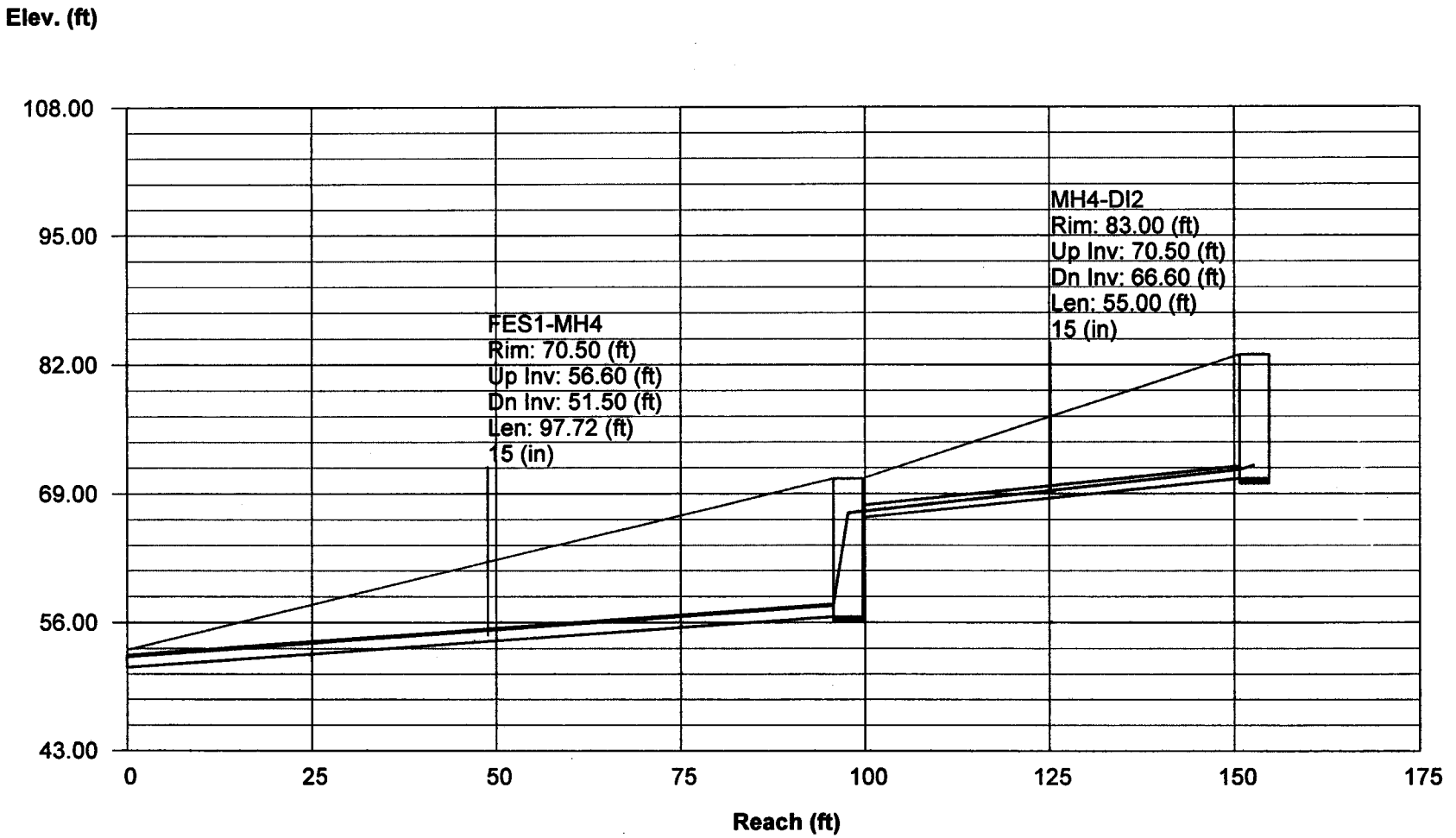
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	97.7	0.10	0.80	0.50	0.05	0.40	5.0	5.2	7.1	8.09	14.75	6.97	15	5.22	56.60	51.50	57.72	52.62	70.50	53.26	FES1-MH4
2	1	55.0	0.70	0.70	0.50	0.35	0.35	5.0	5.0	7.1	5.03	17.20	8.73	15	7.09	70.50	66.60	71.40	67.06	83.00	70.50	MH4-DI2
3	1	73.0	0.00	0.00	0.00	0.00	0.00	0.0	3.2	0.0	2.37	19.28	7.25	15	8.92	73.11	66.60	73.73	66.90	84.25	70.50	MH4-MH3
4	3	195.6	0.00	0.00	0.00	0.00	0.00	0.0	1.5	0.0	2.37	6.45	4.39	15	1.00	77.06	75.11	77.68	75.63	88.80	84.25	MH3-MH2
5	4	123.9	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	2.37	6.46	3.65	15	1.00	78.40	77.16	79.02	77.86	81.50	88.80	MH2-MH1
6	5	52.1	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.37	20.01	3.65	15	9.60	83.50	78.50	84.12	79.20	96.00	81.50	MH1-R1

Project File: storm design 2.stm | Number of lines: 6 | Run Date: 07-17-2009

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

Storm Sewer Profile

Proj. file: storm design 2.stm



RECEIVED
JUL - 9 2009
ENVIRONMENTAL
DESIGN

TRANSMITTAL

DATE: **July 8, 2009**

TO: Environmental

FROM: Kate Sipes, Senior Planner

SUBJECT: **SP-0008-2009, Stonehouse Amenity H**

ITEMS ATTACHED:

- Site Plan
- Comment response letter
- Storm Drain Outfall Hydraulic Grade Line Calculations

ACTION: Please review and return comments by **July 23, 2009.**

Please upload any comments issued for this application to CaseTrak.

Plan is approved, conditioned upon addressing comment from Division email dated July 16, 2009 (Storm outfall #1 profile. A Land-Disturbing Permit & Siltation Agreement, with surety, are required for this project. Applicable stormwater facility inspection fees apply to the project. The provisions of approved Chesapeake Bay Exception CBE-09-086 apply to the project.

07-21-09

Scott ✓ 07/15/2009

Approved under condition standing in the e-mail ~~attachment~~ attached.

Thanks

Zu

✓ 7.9.09

Zu - No further comments mike.

Zuzanna Lesniak

From: Zuzanna Lesniak
Sent: Thursday, July 16, 2009 2:27 PM
To: 'craig.duerr@wspsells.com'; Kate Sipes
Cc: William Cain
Subject: Stonehouse Amenity H
Attachments: image001.jpg

Craig,

I reviewed your application and the majority of comments have been addressed, except comment # 2. The profile for storm outfall # 1 as shown on sheet C6.0 is still showing a pipe slope between MH3 and MH 4 as 9.04% not 8.9%. Per our phone conversation on July 16, 2009 we agreed to make that minor correction on the final set of plans so Environmental Division can approve the plan and issue Land Disturbing Permit.

With kindness regards
Zuzanna Lesniak

Civil Engineer
Environmental Division
101 Mounts Bay Rd, P.O. Box 8784
Williamsburg, VA 23187-8784

phone: 757-259-4161
Fax: 757-259-4032

zlesniak@james-city.va.us

www.jccegov.com

WSP · SELLS MEMORANDUM

15401 Weston Pkwy, Ste 100, Cary NC 27513
Phone: (919) 678-0035
Fax: (919) 678-0206

To: Kathryn Sipes, JCC Planning

From: Craig Duerr, WSP SELLS

Date: June 29, 2009

Re: Amenity H Site Plan
Response to 3rd Plan Review Comments
Stonehouse, James City County, VA
Case #C-083-08 / SP-0008-2009

Following are replies in ***bold italics*** to staff comments received on the Site Plan for Amenity H. Applicable revisions will be incorporated into the site plan re-submittal.

Planning (refer to Comments dated June 19, 2009)

The site plan has been granted preliminary approval effective June 19, 2009 subject to the following conditions:

1. Please include the height of the light poles in the lighting details and refer to Section 24-57(c) of the Zoning Ordinance for other requirements, including acceptable luminary designs. Fixture F-5 (Colonial Fixture) does not appear to meet the ordinance requirements.

Sheet LP-1 has been revised.

Proffer Administrator (refer to memorandum dated April 20, 2009):

No further comments. Pease refer to Z-0004-2007 for all proffers associated with this case.

Comment noted.

Landscape (refer to memorandum dated April 27, 2009):

The plan complies with all James City County landscape ordinance requirements and is approved as submitted.

Comment noted.

JCSA (refer to e-mail dated June 22, 2009)

General

1. Sign and date all certifications.

Comment noted.

2. The plat may need to be revised by the developer if during construction an easement location changes or during review of the record drawings problems or discrepancies are found.

Comment noted.

Response to 3rd Plan Review Comments
Amenity H - Stonehouse

June 29, 2009

Environmental (refer to Memorandum dated May 15, 2009)

General:

1. Response to the previous comment # 1 is noted. Please provide paper copy with the next submittal.

A paper copy of the Report of Subsurface Investigation and Geotechnical Engineering Services prepared by GET Solutions dated April 7, 2009 has been included with the re-submittal to assist staff with verification of the BMP design.

Stormwater Management / Drainage:

2. **Previous comment # 12 was not completely addressed.** In the Storm Sewer Summary Report and Storm Inventory Report as submitted, some information included in the report was not consistent with the information on the plan. On the plan slope for the pipe 3 is listed as 8.9% when in the calculation 9.042%. Also on the plan slope for pipe 2 is shown as 7.10 when in calculations 9.709%. Please correct.

Sheet C6.0 has been revised to correct the pipe slope from MH-3 to MH-4. Revised hydraulic gradeline calculations for the BMP outfalls have been included with these responses to comments to correct the pipe length and slope from DI-2 to MH-4 due to the previous shift in the location of the combined swale outfall structure shown on the plans.

3. Dissimilar Materials. Provide information in the plan set as to the method of connection to be made between the concrete riser and the PVC under drain. It is recommended that a 'Kor-n-Seal' boot or equivalent be used to provide a flexible and water tight connection.

Sheet C5.1 specified "Kor-n-Seal" for riser structure on BMP#1. Notes have been added on Sheets C5.0 and C6.0 to specify a "Kor-n'Seal" boot or equivalent for PVC connections to concrete drainage structures. A note has also been added to Sheets C5.0 and C6.0 to specify non-shrink grout at manhole openings and gaskets and fittings in accordance with ASTM F477 and ASTM D3212 for water and soil tight HDPE connections to concrete drainage structures.

4. Please make sure that all pipe connections and changes of directions of the pipe are equipped with clean outs or manholes.

Sheet C3.0 has been revised to avoid clean-out for runs from AD-6 to DI-1, AD-2 to YI-8, YI-4 to YI-6, and AD-10 to YI-6 and add clean-outs at changes in direction for runs from YI-2 to YI-2, YI-8 to DI-1, AD-8 to AD-7, and at BMP#2 and the pool dewatering outlet.

5. It is strongly recommended that all steep slopes be stabilized with ES-3 matting to aid in the establishment of vegetative cover and to prevent erosion. Installation should be in accordance with STD. & Spec. 3.35 Mulching, STD. & Spec. 3.36 Soil Stabilization & Matting. It was discussed in the previous meetings that GreenArmor was intended to be used on this site. If this is still the intention, provide specification for installations of that measure.

Sheets C4.0 and C4.1 have been revised to specify EC-2 matting or equivalent for fill slopes up to 3:1 and cut slopes up to 2:1 and specify EC-3 (TRM) matting for fill slopes up to 2:1 and within drainage channels. Sheet C4.3 has been added to include specifications for Flexterra FGM as an alternate for EC-2 and GreenArmor Enkamat 7010as an alternate to EC-3 (TRM including reference to the VESCH standards 3.35 and 3.36. In addition, a typical detail for installation of Flexterra FGM has been added to Sheet C4.3.

6. Provide a note or ASTM Specifications in the plan concerning standard practice for underground installation of HDPE pipe for gravity-flow applications. Please reference ASTM D2321-05.

A note has been added to Sheets C3.0, C5.0, and C6.0 to specify that HDPE pipe shall be installed in accordance with ASTM D2321-05.

VDOT (refer to Memorandum dated June 9, 2009)

The Residency has completed its review of the revised subject site plan dated 6/1/2009. It appears that all previous comments have been adequately addressed, and all applicable standards and specifications have been met as acknowledged by the Professional Engineer who sealed the plans. Approval of the plans is recommended.

A VDOT Land Use Permit will be required prior to commencing construction within state right of way.

Comment noted.

Fire Department (refer to memorandum dated April 24, 2009):

Approved as a site plan only.

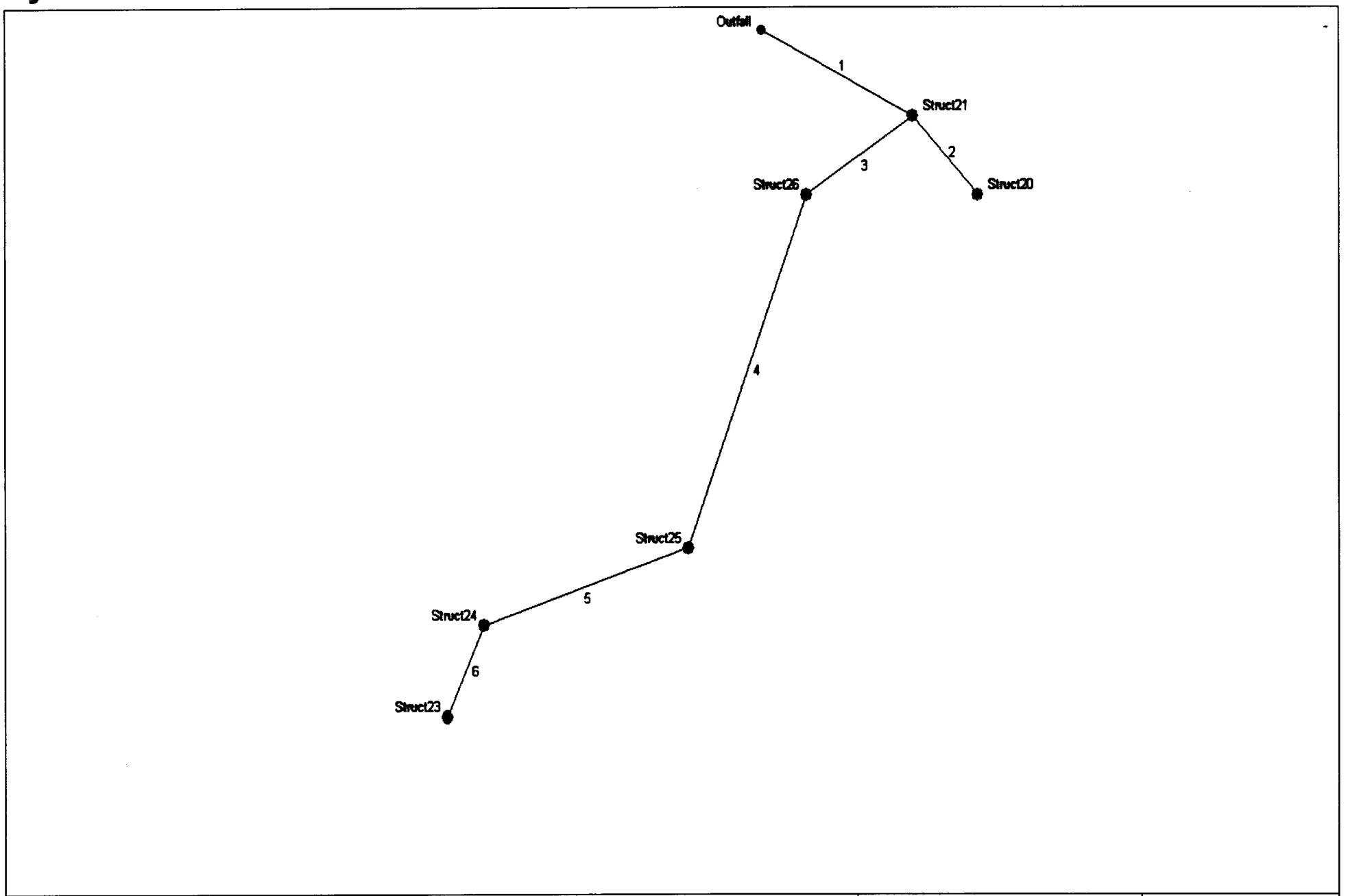
Comment noted.

STORM DRAIN OUTFALL
HYDRAULIC GRADE LINE CALCULATIONS
Revised 6/29/09

COMMONWEALTH OF VIRGINIA
CRAIG MICHAEL DUERR
No. 045397
6/29/09
PROFESSIONAL ENGINEER

SP-8-09

Hydraflow Plan View



Project file: storm design 2.stm	No. Lines: 6	07-02-2009

Hydraflow Storm Sewers 2003

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	97.7	27.1	MH	0.36	0.10	0.50	5.0	51.50	5.22	56.60	15	Cir	0.013	1.00	71.68	Pipe21
2	1	55.0	20.7	MH	2.53	0.70	0.50	5.0	66.60	7.09	70.50	15	Cir	0.013	1.00	83.00	Pipe20
3	1	73.0	119.0	MH	0.00	0.00	0.00	0.0	66.60	8.92	73.11	15	Cir	0.013	0.75	84.25	Pipe26
4	3	195.6	-35.7	MH	0.00	0.00	0.00	0.0	75.11	1.00	77.06	15	Cir	0.013	0.75	88.80	Pipe25
5	4	123.9	50.7	MH	0.00	0.00	0.00	0.0	77.16	1.00	78.40	15	Cir	0.013	0.75	81.50	Pipe24
6	5	52.1	-47.2	MH	2.37	0.00	0.00	0.0	78.50	9.60	83.50	15	Cir	0.013	1.00	95.00	Pipe23

not address

Project File: storm design 2.stm | Number of lines: 6 | Date: 07-02-2009

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	Pipe21	8.09	15 c	97.7	51.50	56.60	5.219	52.62	57.72	0.75	End
2	Pipe20	5.03	15 c	55.0	66.60	70.50	7.091	67.06	71.40	0.44	1
3	Pipe26	2.37	15 c	73.0	66.60	73.11	8.918	66.90	73.73	0.18	1
4	Pipe25	2.37	15 c	195.6	75.11	77.06	0.997	75.63	77.68	0.18	3
5	Pipe24	2.37	15 c	123.9	77.16	78.40	1.000	77.86	79.02	0.18	4
6	Pipe23	2.37	15 c	52.1	78.50	83.50	9.601	79.20	84.12	0.24	5

Project File: storm design 2.stm | Number of lines: 6 | Run Date: 07-02-2009

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

Storm Sewer Tabulation

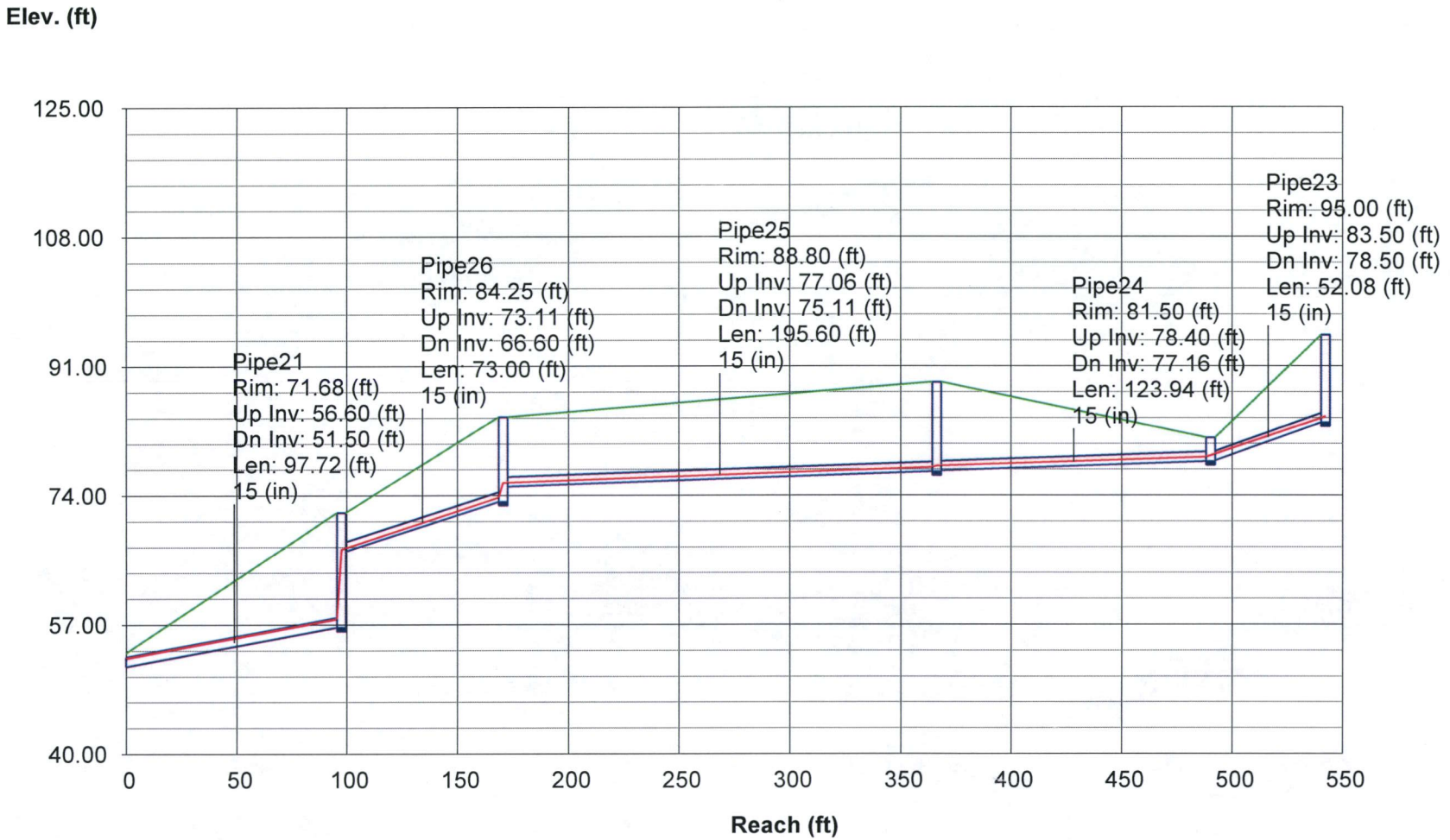
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	97.7	0.10	0.80	0.50	0.05	0.40	5.0	5.2	7.1	8.09	14.75	6.97	15	5.22	56.60	51.50	57.72	52.62	71.68	53.26	Pipe21
2	1	55.0	0.70	0.70	0.50	0.35	0.35	5.0	5.0	7.1	5.03	17.20	8.73	15	7.09	70.50	66.60	71.40	67.06	83.00	71.68	Pipe20
3	1	73.0	0.00	0.00	0.00	0.00	0.00	0.0	3.2	0.0	2.37	19.28	7.25	15	8.92	73.11	66.60	73.73	66.90	84.25	71.68	Pipe26
4	3	195.6	0.00	0.00	0.00	0.00	0.00	0.0	1.5	0.0	2.37	6.45	4.39	15	1.00	77.06	75.11	77.68	75.63	88.80	84.25	Pipe25
5	4	123.9	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	2.37	6.46	3.65	15	1.00	78.40	77.16	79.02	77.86	81.50	88.80	Pipe24
6	5	52.1	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.37	20.01	3.65	15	9.60	83.50	78.50	84.12	79.20	95.00	81.50	Pipe23

Project File: storm design 2.stm | Number of lines: 6 | Run Date: 07-02-2009

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

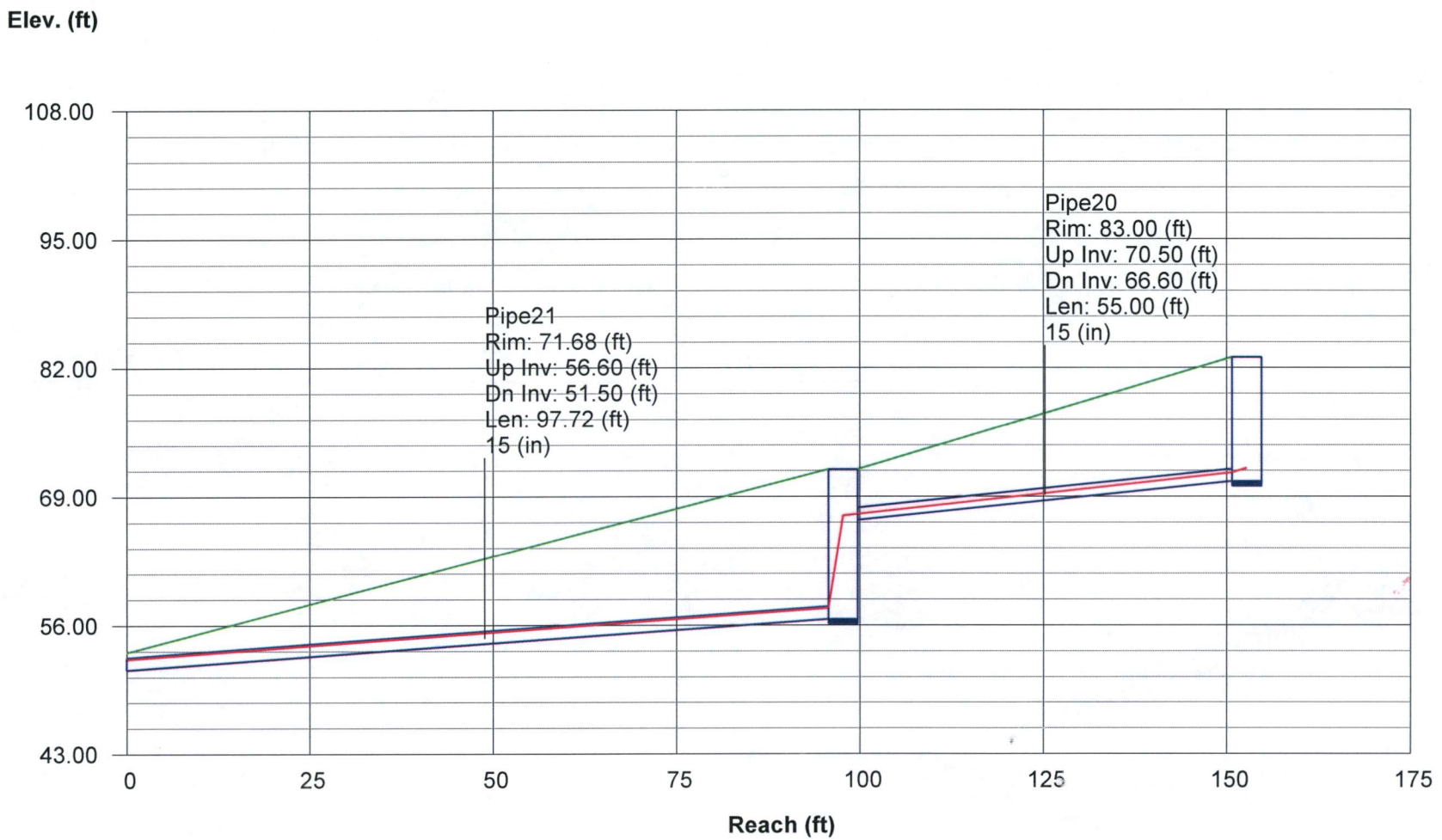
Storm Sewer Profile

Proj. file: storm design 2.stm



Storm Sewer Profile

Proj. file: storm design 2.stm



STONEHOUSE
Amenity H

James City County, Virginia

Stormwater Management and Drainage Design Report

Date: January 22, 2009
April 9, 2009 (Revised)
June 1, 2009 (Revised)

SP-8-09
BMPs
WC 111
WC112
WC113

COMMONWEALTH OF VIRGINIA
DONALD ALLEN SEVER
Lic. No. 43575
6/1/09
PROFESSIONAL ENGINEER

Prepared by:

WSP · SELLS

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(919) 678-0035
(919) 678-0206 (Fax)

Donald Sever, PE

SELLS Project Number 08-4046

STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT

Stonehouse – Amenity H

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- Pre- and Post-Development Drainage Areas and Peak Flow Calculations
- Impervious Area Calculations
- BMP #1: Bioretention Area Design Worksheet and Calculations
- BMP #2: Infiltration Trench Design Worksheet
- BMP #3: Combined Swale Outfall Calculations
- Storm Drain Outfall Hydraulic Grade Line Calculations
- Sediment Traps Calculations
- Stilling Basin Calculations

RECEIVED JUN 2009 Planning Department

Stormwater Management Plan – Stonehouse Amenity H

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 with 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: Amenity H is proposed to be a community center that will include construction of a 4,700 square foot community building, 4,500 square foot swimming pool, 20' x 20' wading pool, 30,000 square foot open lawn area, and outdoor seating area. Two access points will be provided off Six Mt. Zion Road for the main parking lot for the community building and swimming pool and a supplemental parking lot for the play areas. Better site design will help enhance natural views, while preserving the natural integrity of this site, as well as surrounding sites. Approx. 6.18 acres of land disturbance activity is proposed for this development.

- Existing Site Conditions: Amenity H is a 10.59 acre, densely vegetated, undeveloped tract with tree cover dominating the entire site. Approx. 3.30 acres of RPA are located along the western portion of the site. Within the center of the RPA are stream and wetland features, which naturally disperse water flow off-site to the north. No regulated floodplains exist on-site.

- Adjacent and Off-Site Areas: Amenity H is located at the northwest quadrant of the Fieldstone Parkway and Six Mt. Zion Road intersection. To the west is an undisturbed natural open space area of Tract 12, which is a proposed single family community. To the north is the remaining undeveloped portion of Tract 3 which is future planned residential development. To the east across Six Mt. Zion Road is an undeveloped parcel which is a future tennis and softball complex. To the south across Fieldstone Parkway is Tract 10B, which is a future planned commercial development.

- Soils Description: The James City County soils survey indicates that Craven Fine Sandy Loam with 2% 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 RPA. 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 the Craven-Uchee Complex on the east side of Six Mt. Zion Road and Johnston Complex with the RPA.

- Critical Areas: Amenity H includes area of potentially erosive soils. Special consideration has been given to provide enhanced outlet protection measures including extending BMP outfalls to the wetlands with rip rap stilling basins at the discharge point. Some steep slopes impacts (approx. 0.25 acres) are proposed associated with BMP construction and open play area grading. Some impacts to the RPA buffer (approx. 0.05 acres) are proposed associated with BMP outlets. Refer to Sheet C1.0 - Environmental Inventory Plan for additional information.

<u>Compliance with 10-Point System</u>

The stormwater management plan utilizes several BMPs as follows:

- <u>BMP#1</u> – Proposed bioretention area (10-pt) for treatment of approx. 2.24 acres from the parking lot, driveway, and a portion of the building and conveyance to manhole MH-4 with a combined storm drain outfall to Stilling Basin #1 and wetlands;

WC#1

WC#2

- <u>BMP#2</u> – Proposed infiltration basin (10-pt) for treatment of approx. 0.44 acres from the playground, sidewalk, and upland areas and conveyance in series to Wet Swale BMP#3A (50% credit of 4-pt) and combined swale outfall with BMP#3B.

WC#3

- <u>BMP#3</u> – Proposed wet swales (4-pt) for treatment of approx. 2.30 acres from the open play area, pool deck, and a portion of the building and conveyance to manhole MH-4 with a combined storm drain outfall to Stilling Basin #1 and wetlands.

Please note, a future bioretention area (BMP#4) will be constructed with future improvements to Six Mt. Zion Road for treatment of approx. 1.00 acres from the future supplemental parking lot a as illustrated on the Conceptual Stormwater Management Plan. The wet swales have been designed to convey the future outfall from BMP#4 in series (50% credit). In the interim, the area will remain undisturbed and be considered an area that treats stormwater runoff from the site for the purpose of complying with the County's requirements.

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

- <u>Resource Protection Area (RPA)</u> – Approx. 3.25 acres (excluding 0.05 acres of impact) of wetlands, streams, and buffers exist at the east end of the site.
- <u>Undisturbed Natural Open Space</u> – Approx. 0.40-acres of the site adjacent to the RPA buffer shall remain undisturbed.

Please note, approx. 1.06 acres of the site between the open play area and Six Mt. Zion Road is proposed to remain natural, to the extent practicable, however, this tree save area has not been taken into consideration for compliance with the County's 10-Point System. Refer to the "Worksheet for BMP Point System" and "Stormwater Management / BMP Facility Calculations" in the Appendices for more information.

Storm Drainage System

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 driveway and parking area 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 on the storm drain outfall.

Erosion & Sediment Control

Two (2) temporary sediment traps are proposed for initial Phase 1 activities 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.

An additional sediment trap (to be converted to BMP#1 after final stabilizaiton) is proposed for Phase 2 activities. In addition, improvements to the receiving channel at the combined storm drain outfall from BMP#1 and the wet swales with a rip rap stilling basin is proposed to provide enhance outlet protection. Refer to the plans for design specifications of erosion and sediment control devices including sediment traps, diversions, swales, dissipaters, and stilling basin.

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 a bioretention area and an infiltration trench to promote infiltration is proposed in areas where available soils mapping indicate HSG type B soils may be present. Please note, field geotechnical investigations have confirmed infiltration rates of greater than 0.52 in/hr.

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.*

The bioretention area (BMP#1) is proposed adjacent to the parking lot to provide enhanced water quality performance and has been designed to provide adequate detention for larger storm events. In addition, the infiltration trench (BMP#2) is proposed under the playground area with an overflow to the wet swales (BMP#3). Use of Filterra-type systems 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 may consider low impact walking trails within RPA buffer areas and an elevated boardwark crossing of the wetland/stream for connectivity to the existing Stonehouse Glen development with posted informational signs. Compliance with this consideration to post informational signs and limit development will be considered in the final design.

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.*

After review of this design consideration, the plan reflects avoidance of significant stream and RPA crossings with the exception of a possible elevated boardwalk crossing for a low impact walking trail.

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.*

Some steep slopes will be impacted associated with construction of the BMPs. 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.*

Conveyance of drainage for the proposed play areas shall be mimic existing sheet flow conditions. Lot-to-lot drainage is not applicable for the site.

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:

An initial version of the Stormwater Management Inventory System has been submitted to the County for compliance with this proffer.

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 and approval 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 = 6.18 acres

Measures = 3 unit measures from SSCP Menu (Class 3 for 1-10 acres)

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 = ½ unit

Proposed Measures:

SSCP#20: Enhanced Outlet Protection = 1 unit

Rip rap stilling basin will be provided at the combined storm drain outfall from BMP#1 and proposed wet swales 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 3:1 slopes. EC-3 non-degradable matting will be applied to 2:1 slopes associated with the proposed BMPs.

SSCP#28: Enhanced Channel Stabilization = 1 unit

EC-3 non-degradable matting applied to proposed drainage channels.

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 or obstructions 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 of the inspections 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,

PRE- VS. POST-DEVELOPMENT DRAINAGE AREAS AND PEAK FLOW RATE CALCULATIONS

WORKSHEET AND EXHIBIT FOR 10-POINT SYSTEM

PROJECT NAME:	**STONEHOUSE AMENITY H**		
WSP SELLS PROJECT #	08-4046		
DESIGNED BY:	AHH	DATE:	01/22/09
REVIEWED BY:	CMD	DATE:	04/09/09
REVISED BY:	CMD	DATE:	06/01/09

WORKSHEET FOR BMP POINT SYSTEM

IDENTIFICATION	ACRES		
TOTAL AREA	10.59		
RPA BUFFER & WETLANDS (Less Impacts)	3.25	30.7%	OF TOTAL AREA
STORMWATER DUNOS (Future BMP#4)	1.06	10.0%	OF TOTAL AREA
ADJACENT DUNOS (Adjacent to Play Areas)	0.40	3.8%	OF TOTAL AREA
OTHER DUNOS	0.00	0.0%	OF TOTAL AREA
NET AREA (DENOMINATOR)	5.88	55.5%	OF TOTAL AREA
STRUCTURAL SITE AREA (NUMERATOR)	1.30	22.1%	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	/	7.34	0.00
Wet Pond	8	x	0.00	/	7.34	0.00
Wet ED Pond	10	x	0.00	/	7.34	0.00
Shallow Marsh	6	x	0.00	/	7.34	0.00
ED Shallow Wetland	6	x	0.00	/	7.34	0.00
Pond/Wetland System	10	x	0.00	/	7.34	0.00
Pocket Wetland	6	x	0.00	/	7.34	0.00
Infiltration Trench (0.5"/imp ac)	8	x	0.00	/	7.34	0.00
Infiltration Trench (1"/imp ac)	10	x	0.00	/	7.34	0.00
Infiltration Basin (0.5"/imp ac)	8	x	0.00	/	7.34	0.00
Infiltration Basin (1"/imp ac) (BMP#2: Playground) WC112	10	x	0.44	/	7.34	0.60
Bioretention (BMP#1: Parking, Drive, 1/2 Building) WC111	10	x	2.24	/	7.34	3.05
Bioretention (BMP#4: Future parking)	10	x	0.00	/	7.34	0.00
Surface Sand Filter	8	x	0.00	/	7.34	0.00
Underground Sand Filter	8	x	0.00	/	7.34	0.00
Perimeter Sand Filter	8	x	0.00	/	7.34	0.00
Organic Sand Filter	8	x	0.00	/	7.34	0.00
Pocket Sand Filter	6	x	0.00	/	7.34	0.00
Wet Swale (BMP#3: In series with BMP#2) WC112	2	x	0.44	/	7.34	0.12
Wet Swale (BMP#3: Open Play, 1/2 Building, Pool) WC113	4	x	2.30	/	7.34	1.25
Dry Swale	10	x	0.00	/	7.34	0.00
Biofilters	4	x	0.00	/	7.34	0.00
Timber Walls	4	x	0.00	/	7.34	0.00
Dry ED *(w/forebay)*	4	x	0.00	/	7.34	0.00
Offsite Credits*	6	x	0.00	/	7.34	0.00
			TOTAL WEIGHTED STRUCTURAL BMP POINTS:			**5.02**

** 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	1.06	/	10.59	x	(0.15 PER 1%)	1.50
Adjacent to a wetland, mature forest, or RPA	0.40	/	10.59	x	(0.15 PER 1%)	0.57
All other open space (less 0.05 acres of impact)	3.25	/	10.59	x	(0.10 PER 1%)	3.07
			TOTAL NATURAL OPEN SPACE CREDIT:			**5.14**

C. TOTAL WEIGHTED POINTS

5.02	+	**5.14**	**10.16**
STRUCTURAL BMP POINTS		**NATURAL OPEN SPACE POINTS**	**TOTAL**

POOR QUALITY

ORIGINAL(S) FOLLOW

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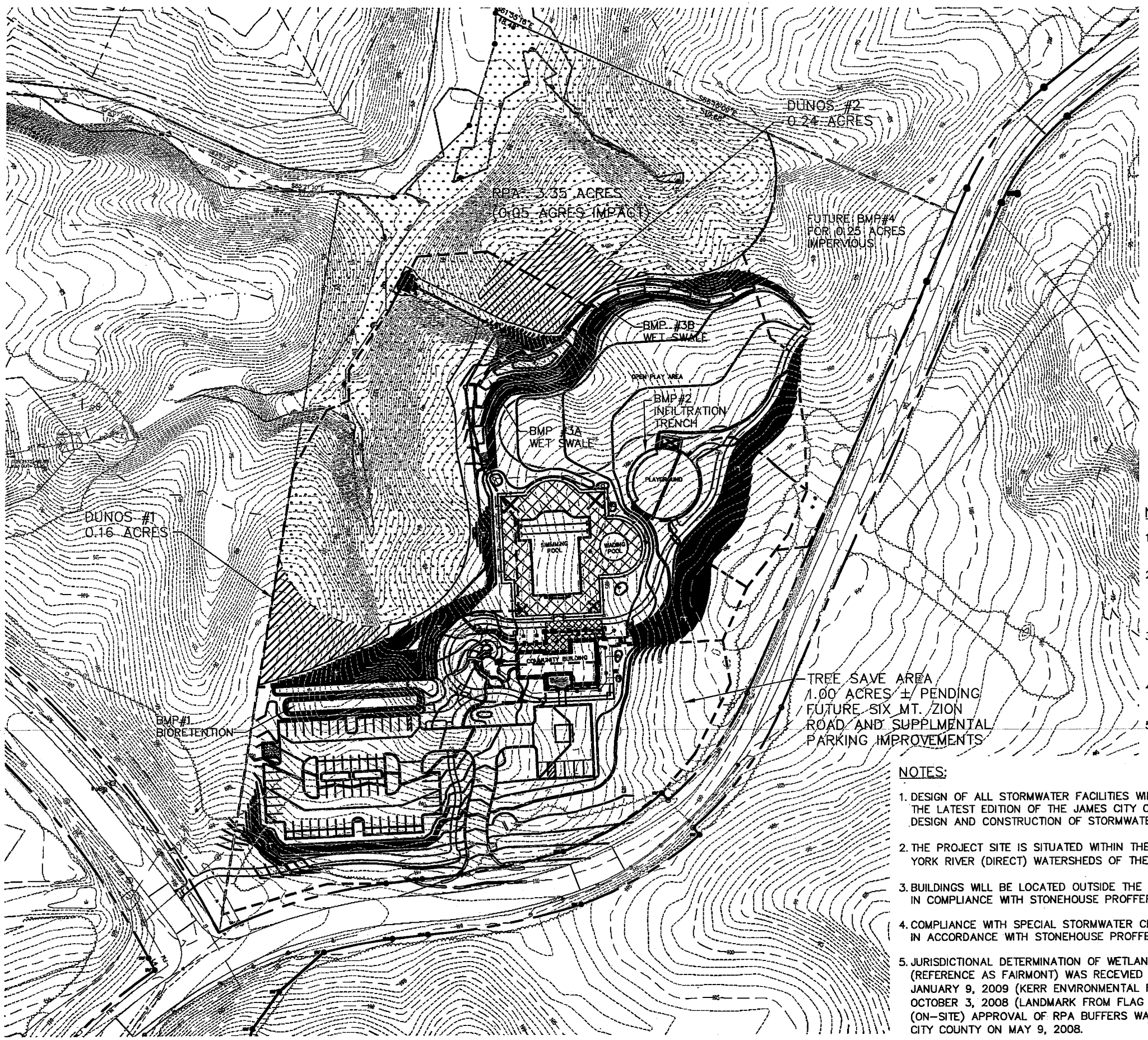

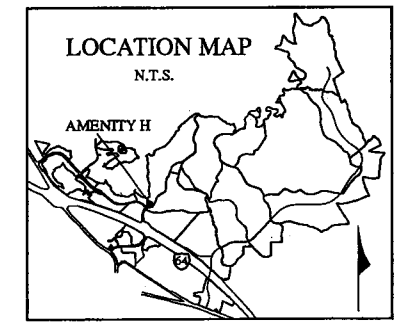

MANAGEMENT AREA ANALYSIS	
SUBSHED	AREA (AC)
DRAINAGE AREA #1 (BMP#1)	1.99
DRAINAGE AREA #2 (BMP#2)	0.44
DRAINAGE AREA #3 (BMP#3A & 3B)	2.68
DRAINAGE AREAS #4 (FUTURE BMP #4)	1.04
RESOURCE PROTECTION AREAS	3.35
ADJACENT NATURAL AREAS #1 AND #2	0.40
OTHER ON-SITE DRAINAGE AREAS TO RPA AND/OR SIX MT. ZION ROAD	0.69
TOTAL	10.59

SUMMARY OF STORMWATER/BMP FACILITIES				
BMP #	BMP TYPE	CONT DA (AC)	% IMPERVIOUS	IMPERVIOUS AREA (AC)
1	BIORETENTION	2.24	36%	0.81
2	INFILTRATION TRENCH	0.44	7%	0.03
3	WET SWALES	2.30	16%	0.36
4	FUTURE BIORETENTION	1.06	24%	0.25

NOTES:

1. RUNOFF COEFFICIENTS FOR IMPERVIOUS AND PERVIOUS AREAS ARE C=0.95 AND C=0.30.
2. DRAINAGE AREAS #2 AND #3 WILL CONVEY IN SERIES TO BMP#3. FUTURE DRAINAGE AREA #4 FOR FUTURE PARKING WILL CONVEY TO FUTURE BMP#4 IN SERIES WITH BMP#3.
3. OTHER ON-SITE DRAINAGE AREAS INCLUDE RUN-OFF TO SIX MT. ZION ROAD AND SHEETFLOW INTO THE RPA.
4. RESTORATION OF TWO (2) EXISTING HEADCUTS IS PROPOSED FOR RPA MITIGATION.
5. CONSERVATION EASEMENT (3.71 ACRES) INCLUDES RPA (LESS 0.05 ACRES IMPACT) AND ADJACENT NATURAL AREAS (0.40 ACRES).

NOTES:

1. DESIGN OF ALL STORMWATER FACILITIES WILL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE JAMES CITY COUNTY GUIDELINES FOR DESIGN AND CONSTRUCTION OF STORMWATER MANAGEMENT BMPS.
2. THE PROJECT SITE IS SITUATED WITHIN THE WARE CREEK AND/OR YORK RIVER (DIRECT) WATERSHEDS OF THE COUNTY.
3. BUILDINGS WILL BE LOCATED OUTSIDE THE 25' RPA BUILDING SETBACK IN COMPLIANCE WITH STONEHOUSE PROFFER 10.5.
4. COMPLIANCE WITH SPECIAL STORMWATER CRITERIA SHALL BE PROVIDED IN ACCORDANCE WITH STONEHOUSE PROFFER 10.1.
5. JURISDICTIONAL DETERMINATION OF WETLAND DELINEATIONS (REFERENCE AS FAIRMONT) WAS RECEIVED FROM THE USACE ON JANUARY 9, 2009 (KERR ENVIRONMENTAL FROM FLAG #WF-12) AND OCTOBER 3, 2008 (LANDMARK FROM FLAG #2425). CONDITIONAL (ON-SITE) APPROVAL OF RPA BUFFERS WAS RECEIVED FROM JAMES CITY COUNTY ON MAY 9, 2008.

NORTH

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

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PRELIMINARY NOT RELEASED FOR CONSTRUCTION

STONEHOUSE
AMENITY H
JAMES CITY COUNTY, VA

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

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REVISIONS

PROJECT #: 09-4046 DATE: 01/23/09
DRAWN BY: MB CHECKED BY: CD

TITLE
STORMWATER / BMP DRAINAGE AREAS

SHEET
EXHIBIT 1

PRE- VS. POST-DEVELOPMENT PEAK FLOW RATE CALCULATIONS FOR 2-YEAR AND 25-YEAR STORM

DESIGN WORKSHEET - PRE VS. POST ANALYSIS

WSP · SELLS

Project Name: STONEHOUSE AMENITY H
Designed by: DF Date: 5/27/09
Checked by: CD Date: 6/1/09

PRE-DEVELOPMENT

Drainage Basin #	Drainage Area (ac)	Flow Length (ft)	Average Slope (ft/ft)	Time of Concentration (min)	I (2) (in/hr)	I (10) (in/hr)	C-value	Q(2) (cfs)	Q(10) (cfs)
1	4.64	693	0.079	3.18	6.04	7.63	0.30	8.40	10.62
2	2.15	485	0.136	1.97	6.42	8.03	0.30	4.14	5.18
Point of Analysis	**6.79**							**12.55**	**15.80**

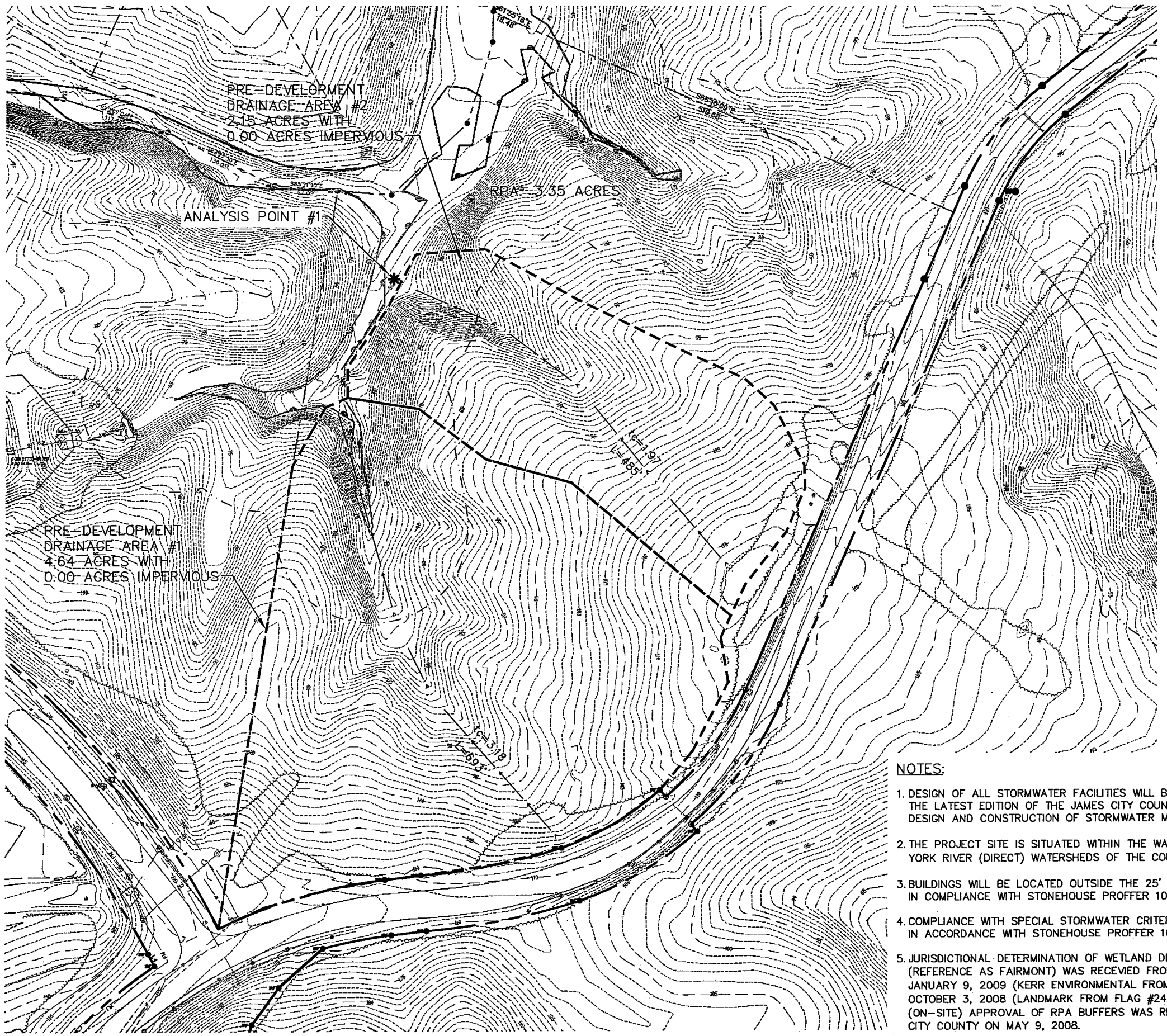
POST DEVELOPMENT

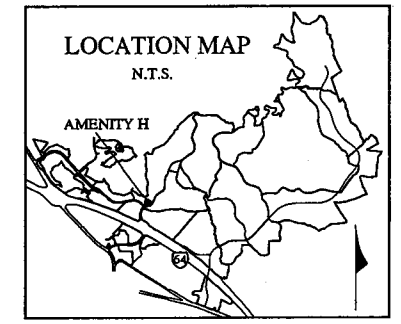
Drainage Basin #	Drainage Area (ac)	Flow Length (ft)	Average Slope (ft/ft)	Time of Concentration (min)	I (2) (in/hr)	I (10) (in/hr)	C-value	Q(2) (cfs)	Q(10) (cfs)	Treatment Type
1	2.24	See Hydraflow Results						1.17	3.62	BMP#1 - Bioretention
2	0.44	208	0.123	5.00	5.54	7.10	0.30	0.73	0.94	BMP#2 - Infiltration
3	2.30	See Hydraflow Results						4.59	6.21	BMP#3 - Wet Swales
4	2.08	422	0.057	2.47	6.26	7.86	0.30	3.90	4.90	Natural Open Space/RPA
Point of Analyis	**7.06**							**10.40**	**15.67**	

IDF Equation: **a/(Tc+b)**

Richmond Regression Constants

R	a	b
2	122.47	17.10
10	185.51	21.13





PRE-DEVELOPMENT DRAINAGE AREAS	
SUBSHED	AREA (AC)
DRAINAGE AREA #1	4.64
DRAINAGE AREA #2	2.15
POINT OF ANALYSIS	6.79

NOTES:

1. RUNOFF COEFFICIENTS FOR UNDEVELOPED AREAS ARE AN AVERAGE OF WOODLAND C=0.25 AND OPEN SPACE, C=0.35.
2. DRAINAGE AREAS #1 AND #2 WILL CONVEY VIA SHEETFLOW TO EXISTING NATURAL CHANNELS.
3. OTHER ON-SITE DRAINAGE AREAS NOT INCLUDED IN PRE- VERSUS POST-DEVELOPMENT ANALYSIS FOR 2-YEAR AND 10-YEAR STORMS.
4. TIME OF CONCENTRATIONS BASED ON KIRPACH EQUATION.
5. RAINFALL INTENSITY BASED ON IDF EQUATION USING RICHMOND REGRESSION CONSTANTS.

NOTES:

1. DESIGN OF ALL STORMWATER FACILITIES WILL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE JAMES CITY COUNTY GUIDELINES FOR DESIGN AND CONSTRUCTION OF STORMWATER MANAGEMENT BMPS.
2. THE PROJECT SITE IS SITUATED WITHIN THE WARE CREEK AND/OR YORK RIVER (DIRECT) WATERSHEDS OF THE COUNTY.
3. BUILDINGS WILL BE LOCATED OUTSIDE THE 25' RPA BUILDING SETBACK IN COMPLIANCE WITH STONEHOUSE PROFFER 10.5.
4. COMPLIANCE WITH SPECIAL STORMWATER CRITERIA SHALL BE PROVIDED IN ACCORDANCE WITH STONEHOUSE PROFFER 10.1.
5. JURISDICTIONAL DETERMINATION OF WETLAND DELINEATIONS (REFERENCE AS FAIRMONT) WAS RECEVIED FROM THE USACE ON JANUARY 9, 2009 (KERR ENVIRONMENTAL FROM FLAG #WF-12) AND OCTOBER 3, 2008 (LANDMARK FROM FLAG #2425). CONDITIONAL (ON-SITE) APPROVAL OF RPA BUFFERS WAS RECEIVED FROM JAMES CITY COUNTY ON MAY 9, 2008.

NORTH

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

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PRELIMINARY NOT RELEASED FOR CONSTRUCTION

STONEHOUSE
AMENITY H
JAMES CITY COUNTY, VA

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

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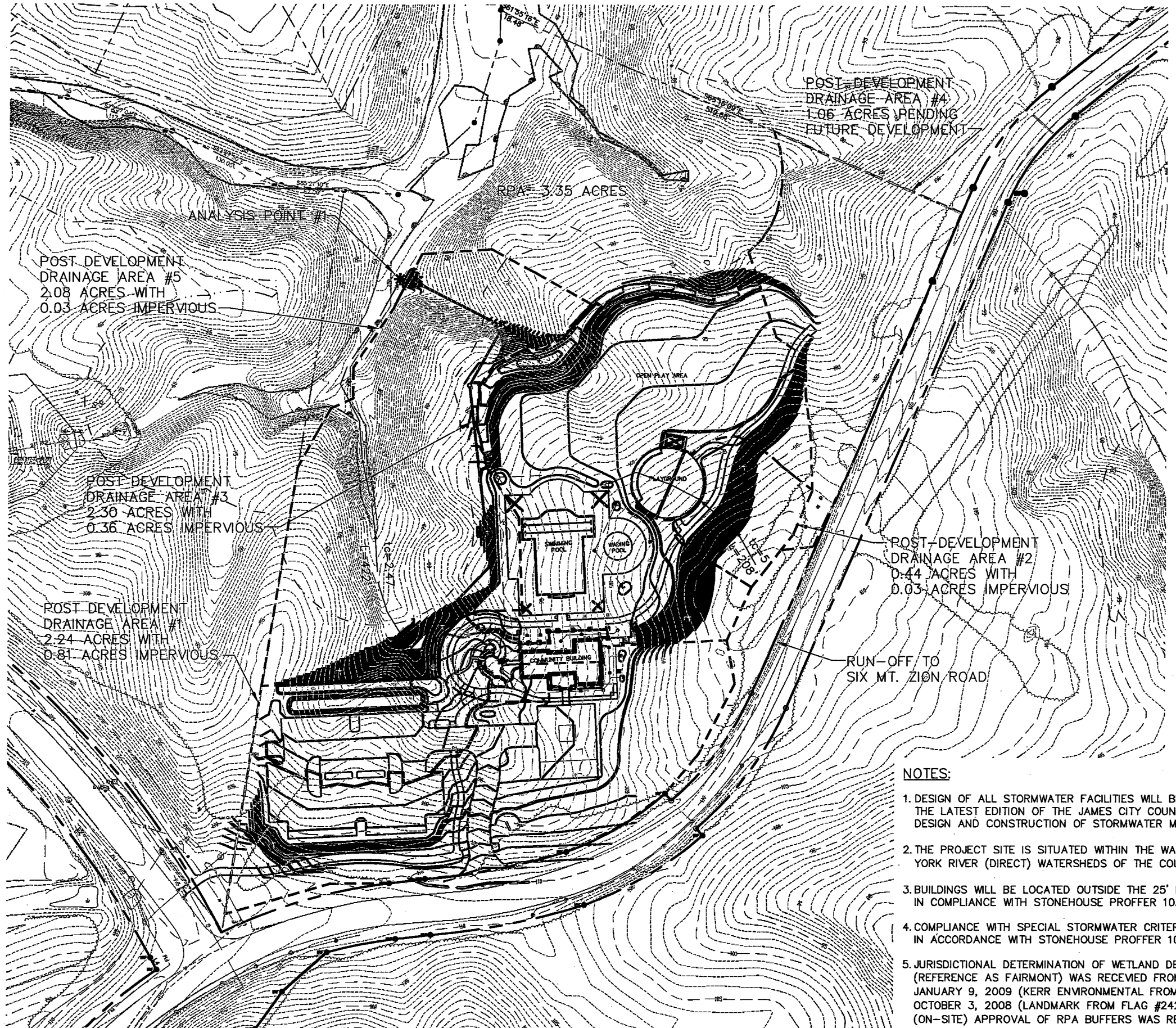
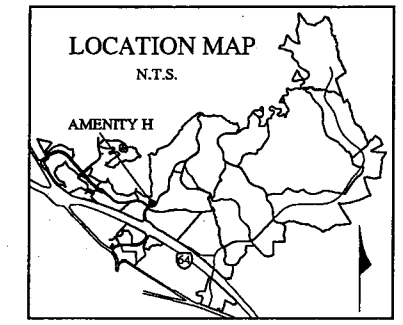
REVISIONS

PROJECT #: 08-4046 DATE: 01/2009
DRAWN BY: MB CHECKED BY: CD

TITLE
PRE DEVELOPMENT DRAINAGE AREAS

SHEET
EXHIBIT 2





POST-DEVELOPMENT DRAINAGE AREAS	
SUBSHED	AREA (AC)
DRAINAGE AREA #1 (BMP#1)	2.24
DRAINAGE AREA #2 (BMP#2)	0.44
DRAINAGE AREA #3 (BMP#3A & 3B)	2.30
DRAINAGE AREAS #4 (FUTURE BMP #4)	1.06
DRAINAGE AREA #5 (INCLUDE IN POA#1)	2.08
OTHER ON-SITE DRAINAGE AREAS TO RPA AND/OR SIX MT. ZION ROAD	2.50
TOTAL	10.59

NOTES:

1. RUNOFF COEFFICIENTS FOR IMPERVIOUS AND PERVIOUS AREAS ARE C=0.95 AND C=0.30, RESPECTIVELY.
2. DRAINAGE AREAS #2 AND #3 WILL CONVEY IN SERIES TO BMP#3. FUTURE DRAINAGE AREA #4 FOR FUTURE PARKING WILL CONVEY TO FUTURE BMP#4 IN SERIES WITH BMP#3.
3. OTHER ON-SITE DRAINAGE AREAS INCLUDE RUN-OFF TO SIX MT. ZION ROAD AND SHEETFLOW INTO THE RPA.
4. REFER TO HYDRAFLOW CALCULATIONS FOR POST-DEVELOPMENT FLOW RATES FOR 2-YEAR AND 10-YEAR STROM FOR OUTFALL FROM BMP#1 AND BMP#3
5. TIME OF CONCENTERATION FOR BMP#2 ASSUMES CONSERVATIVE 5-MINUTES FOR INFILTATION AND 6-INCH MAXIMUM PONDING DEPTH.
6. POINT OF ANALYSIS FOR PRE- VERSUS POST-DEVELOPMENT 2-YEAR AND 25-YEAR STORM EVENTS INCLUDES 7.06 ACRES FOR DRAINAGE AREAS 1-4.

NOTES:

1. DESIGN OF ALL STORMWATER FACILITIES WILL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE JAMES CITY COUNTY GUIDELINES FOR DESIGN AND CONSTRUCTION OF STORMWATER MANAGEMENT BMPS.
2. THE PROJECT SITE IS SITUATED WITHIN THE WARE CREEK AND/OR YORK RIVER (DIRECT) WATERSHEDS OF THE COUNTY.
3. BUILDINGS WILL BE LOCATED OUTSIDE THE 25' RPA BUILDING SETBACK IN COMPLIANCE WITH STONEHOUSE PROFFER 10.5.
4. COMPLIANCE WITH SPECIAL STORMWATER CRITERIA SHALL BE PROVIDED IN ACCORDANCE WITH STONEHOUSE PROFFER 10.1.
5. JURISDICTIONAL DETERMINATION OF WETLAND DELINEATIONS (REFERENCE AS FAIRMONT) WAS RECEIVED FROM THE USACE ON JANUARY 9, 2009 (KERR ENVIRONMENTAL FROM FLAG #WF-12) AND OCTOBER 3, 2008 (LANDMARK FROM FLAG #2425). CONDITIONAL (ON-SITE) APPROVAL OF RPA BUFFERS WAS RECEIVED FROM JAMES CITY COUNTY ON MAY 9, 2008.

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REVISIONS

PROJECT #: 08-4046 DATE: 01/22/09
DRAWN BY: MB CHECKED BY: CD

TITLE
POST DEVELOPMENT
DRAINAGE AREAS

SHEET
EXHIBIT 3

IMPERVIOUS AREA CALCULATIONS

IMPERVIOUS AREA CALCULATIONS

WSP • SELLS

Project Name:	STONEHOUSE AMENITY H		
Designed by:	IN	Date:	1/22/09
Checked by:	CD	Date:	6/1/09

BMP#1: Bioretention

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Building				1,500	0.03
Parking/Driveway				30,000	0.69
Hardscape/Sidewalk				4,000	0.09
				Total Impervious Area:	**0.81**
				Total Drainage Area:	**2.24**
				Total Percent Impervious:	**36.4%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.71
Forested:	0.25		0.71
Impervious Surfaces:	0.95		0.81
		Weighted "C" value:	**0.54**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.71
Forested:	77		0.71
Impervious Surfaces:	98		0.81
		Weighted "CN" value:	**86**

BMP#2: Infiltration

Description	Quantity	Unit	Per Unit	Impervious Area (SF)	Area (ac)
Building				-	0.00
Parking/Driveway				-	0.00
Hardscape/Sidewalk				1,500	0.03
				Total Impervious Area:	**0.03**
				Total Drainage Area:	**0.44**
				Total Percent Impervious:	**7.8%**

Weighted "C" Value

	C		Area (ac)
Grass, Open Space:	0.35		0.20
Forested:	0.25		0.20
Impervious Surfaces:	0.95		0.03
		Weighted "C" value:	**0.35**

Weighted CN Value (HSG C)

	CN		Area (ac)
Grass, Open Space, good condition:	80		0.20
Forested:	77		0.20
Impervious Surfaces:	98		0.03
		Weighted "CN" value:	**80**

PROJECT NAME: **STONEHOUSE AMENITY H**

WSP SELLS PROJECT #	08-4046		
DESIGNED BY:	AHH	DATE:	01/22/09
REVIEWED BY:	CMD	DATE:	04/09/09
REVISED BY:	CMD	DATE:	06/01/09

WORKSHEET FOR BMP POINT SYSTEM

IDENTIFICATION	ACRES	
TOTAL AREA	10.59	
RPA BUFFER & WETLANDS	3.30	31.2% OF TOTAL AREA
STORMWATER DUNOS (Future BMP#4)	1.04	9.8% OF TOTAL AREA
ADJACENT DUNOS (Adjacent to Play Areas)	0.40	3.8% OF TOTAL AREA
OTHER DUNOS	0.00	0.0% OF TOTAL AREA
NET AREA (DENOMINATOR)	5.85	55.2% OF TOTAL AREA
STRUCTURAL SITE AREA (NUMERATOR)	1.29	22.1% 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	/	7.29	0.00
Wet Pond	8	x	0.00	/	7.29	0.00
Wet ED Pond	10	x	0.00	/	7.29	0.00
Shallow Marsh	6	x	0.00	/	7.29	0.00
ED Shallow Wetland	6	x	0.00	/	7.29	0.00
Pond/Wetland System	10	x	0.00	/	7.29	0.00
Pocket Wetland	6	x	0.00	/	7.29	0.00
Infiltration Trench (0.5"/imp ac)	8	x	0.00	/	7.29	0.00
Infiltration Trench (1"/imp ac)	10	x	0.00	/	7.29	0.00
Infiltration Basin (0.5"/imp ac)	8	x	0.00	/	7.29	0.00
Infiltration Basin (1"/imp ac) (BMP#2: Playground)	10	x	0.44	/	7.29	0.60
Bioretention (BMP#1: Parking lot & driveway)	10	x	2.24	/	7.29	3.07
Bioretention (BMP#4: Future parking)	10	x	0.00	/	7.29	0.00
Surface Sand Filter	8	x	0.00	/	7.29	0.00
Underground Sand Filter	8	x	0.00	/	7.29	0.00
Perimeter Sand Filter	8	x	0.00	/	7.29	0.00
Organic Sand Filter	8	x	0.00	/	7.29	0.00
Pocket Sand Filter	6	x	0.00	/	7.29	0.00
Wet Swale (BMP#3: In series with BMP#2)	2	x	0.44	/	7.29	0.12
Wet Swale (BMP#3: Open play, building & pool)	4	x	2.30	/	7.29	1.26
Dry Swale	10	x	0.00	/	7.29	0.00
Biofilters	4	x	0.00	/	7.29	0.00
Timber Walls	4	x	0.00	/	7.29	0.00
Dry ED *(w/forebay)*	4	x	0.00	/	7.29	0.00
Offsite Credits*	6	x	0.00	/	7.29	0.00
	TOTAL WEIGHTED STRUCTURAL BMP POINTS:					**5.05**

** 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	1.04	/	10.59	x (0.15 PER 1%)	1.47
Adjacent to a wetland, mature forest, or RPA	0.40	/	10.59	x (0.15 PER 1%)	0.57
All other open space (less impacts)	3.30	/	10.59	x (0.10 PER 1%)	3.12
				TOTAL NATURAL OPEN SPACE CREDIT:	**5.16**

C. TOTAL WEIGHTED POINTS

5.05	+	5.16	10.21
STRUCTURAL BMP POINTS		NATURAL OPEN SPACE POINTS	TOTAL

BMP #1 - BIORETENTION AREA
DESIGN WORKSHEET AND CALCULATIONS

DESIGN WORKSHEET - BMP#1

WSP · SELLS

Project Name:	STONEHOUSE AMENITY H		
Designed by:	IN	Date:	1/22/09
Checked by:	CD	Date:	6/1/09

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 = 36% % Impervious Area of Site

A = 2.24 Drainage Area (Acres)

Rv = 0.053

WQv = Water Quality Volume = 0.010 Acre-Feet

433 Cubic Feet

Bioretention Surface Area

Design Criteria: Minimum 5% of Impervious Area

Impervious Area = 0.81 Acres

35,500 SF

Minimum Surface Area = 1,775 SF required

Actual Surface Area = 1,820 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 = 1,820 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 = 0.118 cubic feet per second (cfs)

DESIGN WORKSHEET - BMP#1

WSP • SELLS

Project Name:	STONEHOUSE AMENITY H		
Designed by:	IN	Date:	1/22/09
Checked by:	CD	Date:	6/1/09

Time to Drawdown Water through Bioretention Media

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

A =	**1,820**	Bioretention Surface Area (SF)
X =	**2.5**	Depth to Lower (ft)
n =	**0.45**	Porosity of Bioretention Media

Volume = **2,048** Cubic Feet

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

4.8 Hours

Check: **OK**

Underdrains

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

Factor of Safety (range between 2 and 10) **5**

Design Flow **0.42** 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)*

5.74 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

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Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	Mod. Rational	------	4.92	6.12	------	------	7.81	9.22	------	11.05	BMP#1
2	Reservoir	1	0.58	1.17	------	------	3.62	5.69	------	8.03	BMP#1 Route

Proj. file: BMP#1.gpw

Tuesday, Jun 2 2009, 11:05 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	4.92	1	5	2,216	----	----	----	BMP#1
2	Reservoir	0.58	1	11	936	1	95.86	1,937	BMP#1 Route

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

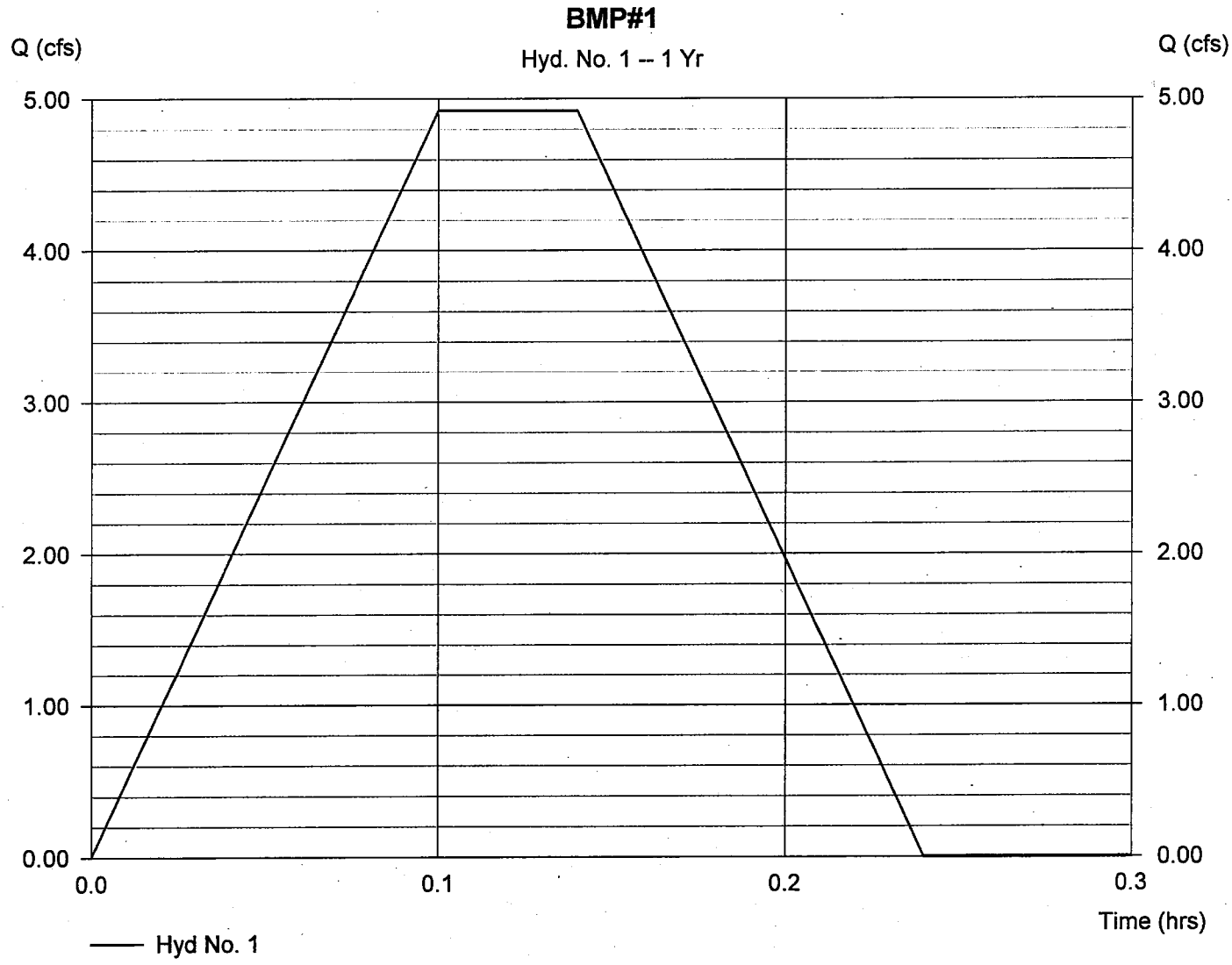
Tuesday, Jun 2 2009, 11:5 AM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 4.92 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 2.240 ac	Runoff coeff.	= 0.54
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,216 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

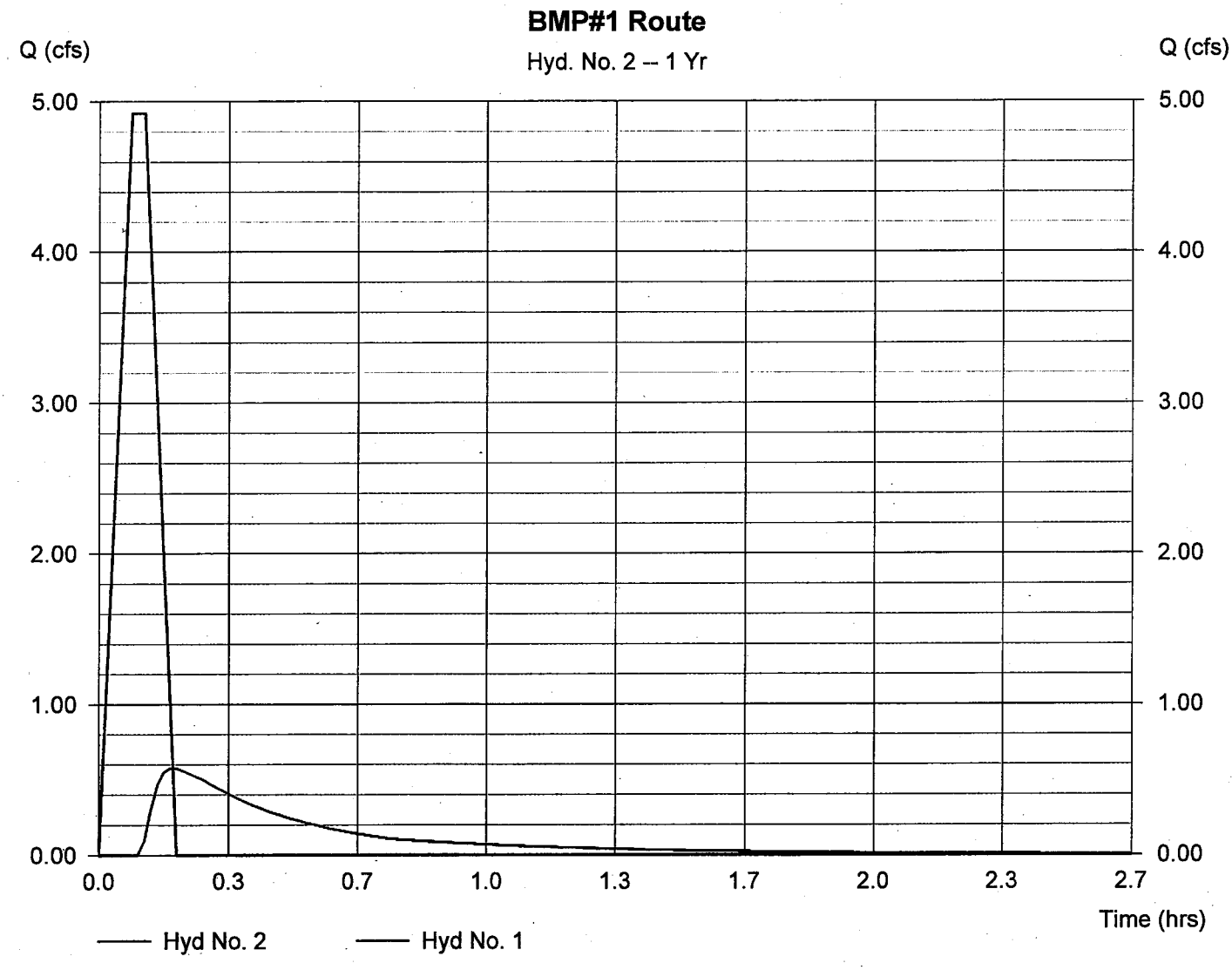
Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.58 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 95.86 ft
Reservoir name	= BMP#1	Max. Storage	= 1,937 cuft

Storage Indication method used.

Hydrograph Volume = 936 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
1.50	96.50	3,282	1,501	3,760

Culvert / Orifice Structures

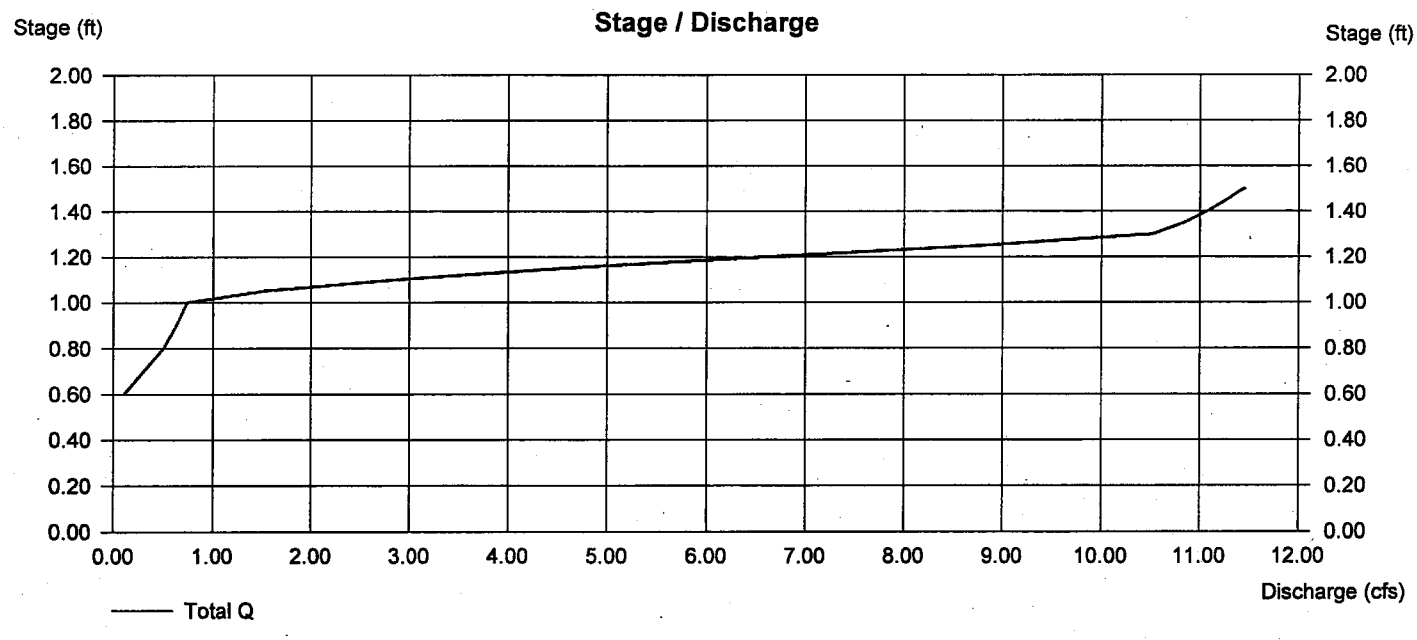
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 83.50	95.50	0.00	0.00
Length (ft)	= 150.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.



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	6.12	1	5	2,754	—	—	—	BMP#1
2	Reservoir	1.17	1	11	1,438	1	96.03	2,341	BMP#1 Route

BMP#1.gpw	Return Period: 2 Year	Tuesday, Jun 2 2009, 11:05 AM

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

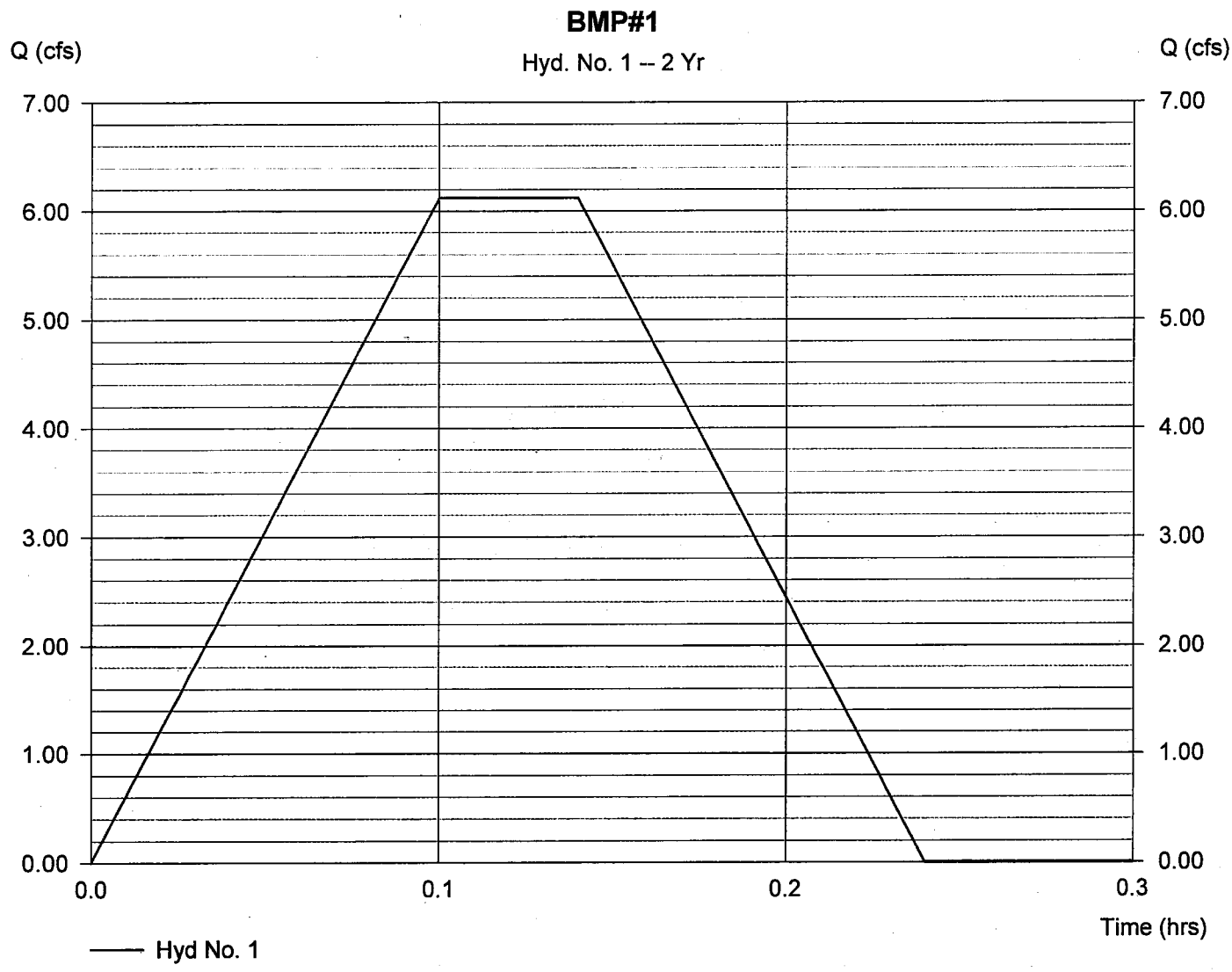
Tuesday, Jun 2 2009, 11:5 AM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 6.12 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 2.240 ac	Runoff coeff.	= 0.54
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,754 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

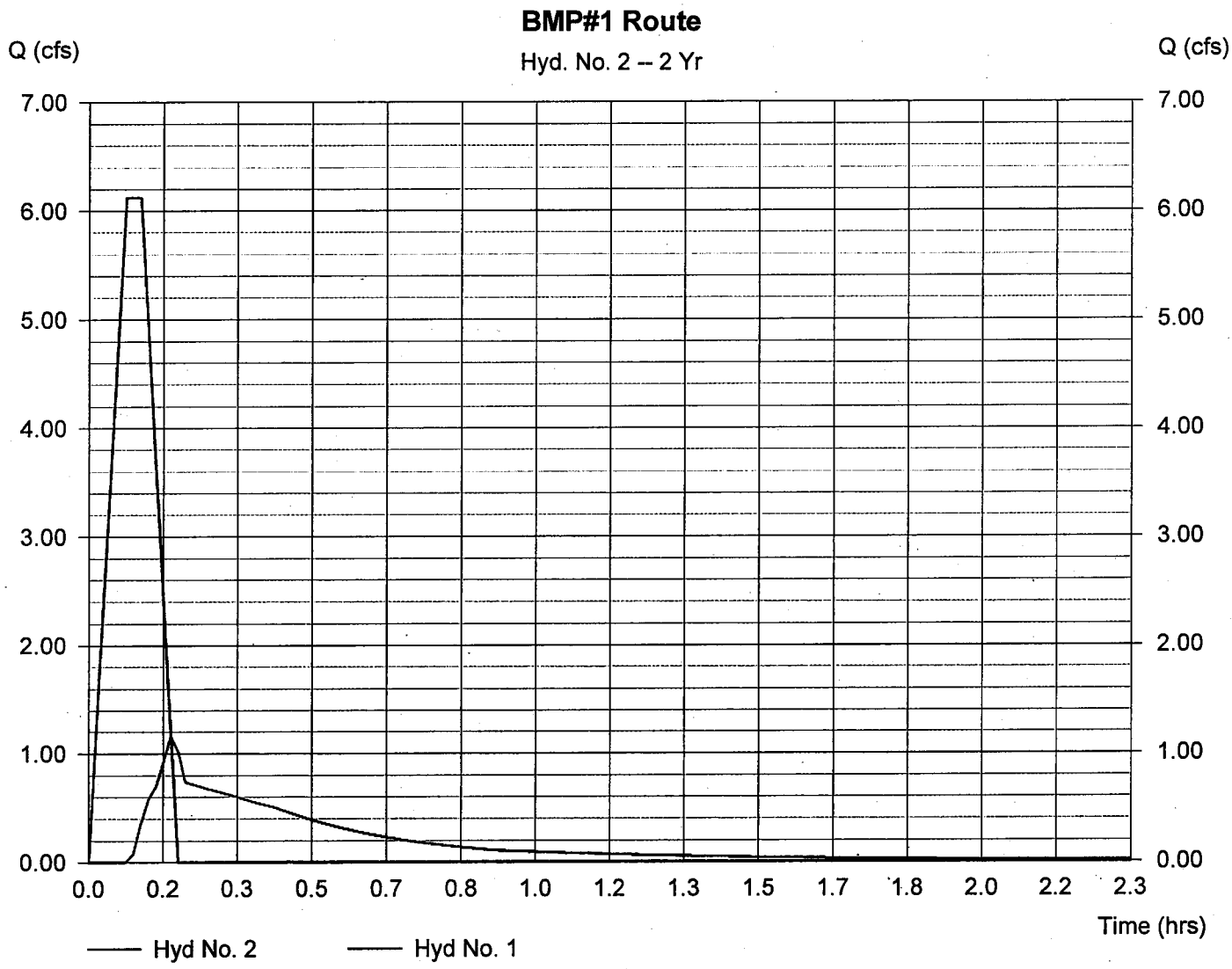
Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 1.17 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 96.03 ft
Reservoir name	= BMP#1	Max. Storage	= 2,341 cuft

Storage Indication method used.

Hydrograph Volume = 1,438 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
1.50	96.50	3,282	1,501	3,760

Culvert / Orifice Structures

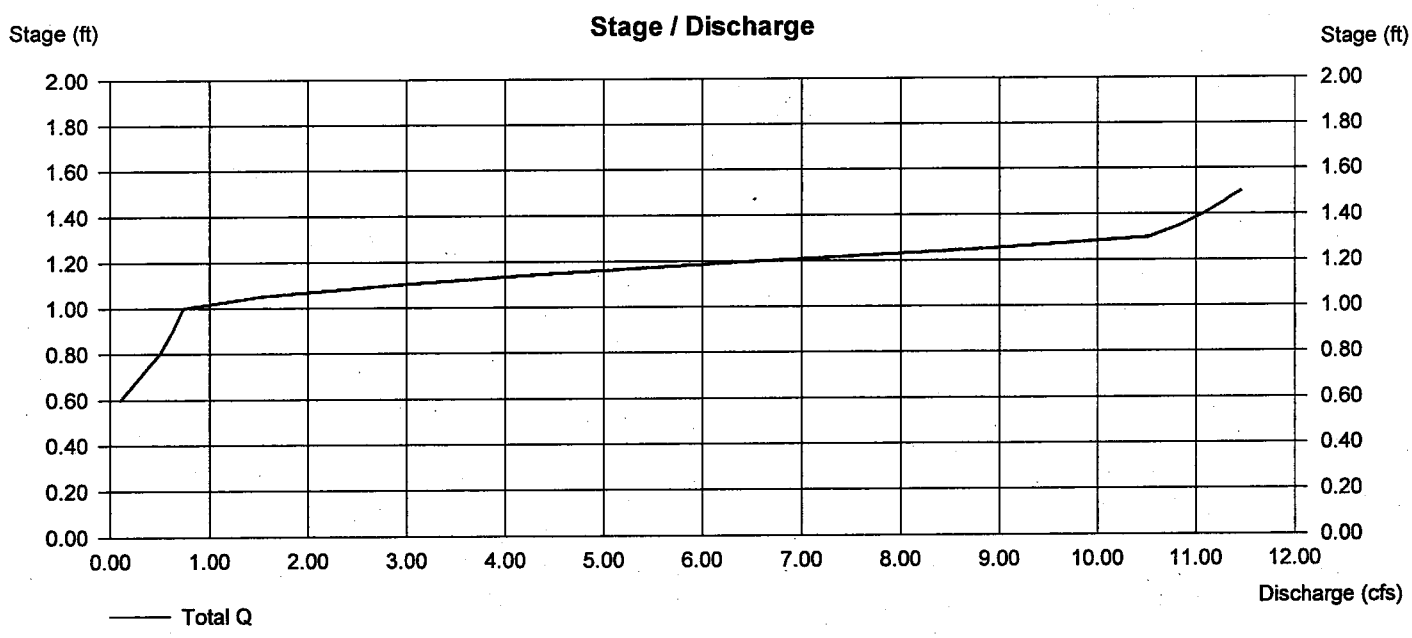
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 83.50	95.50	0.00	0.00
Length (ft)	= 150.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.



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	7.81	1	5	3,514	—	—	—	BMP#1
2	Reservoir	3.62	1	10	2,148	1	96.12	2,626	BMP#1 Route

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

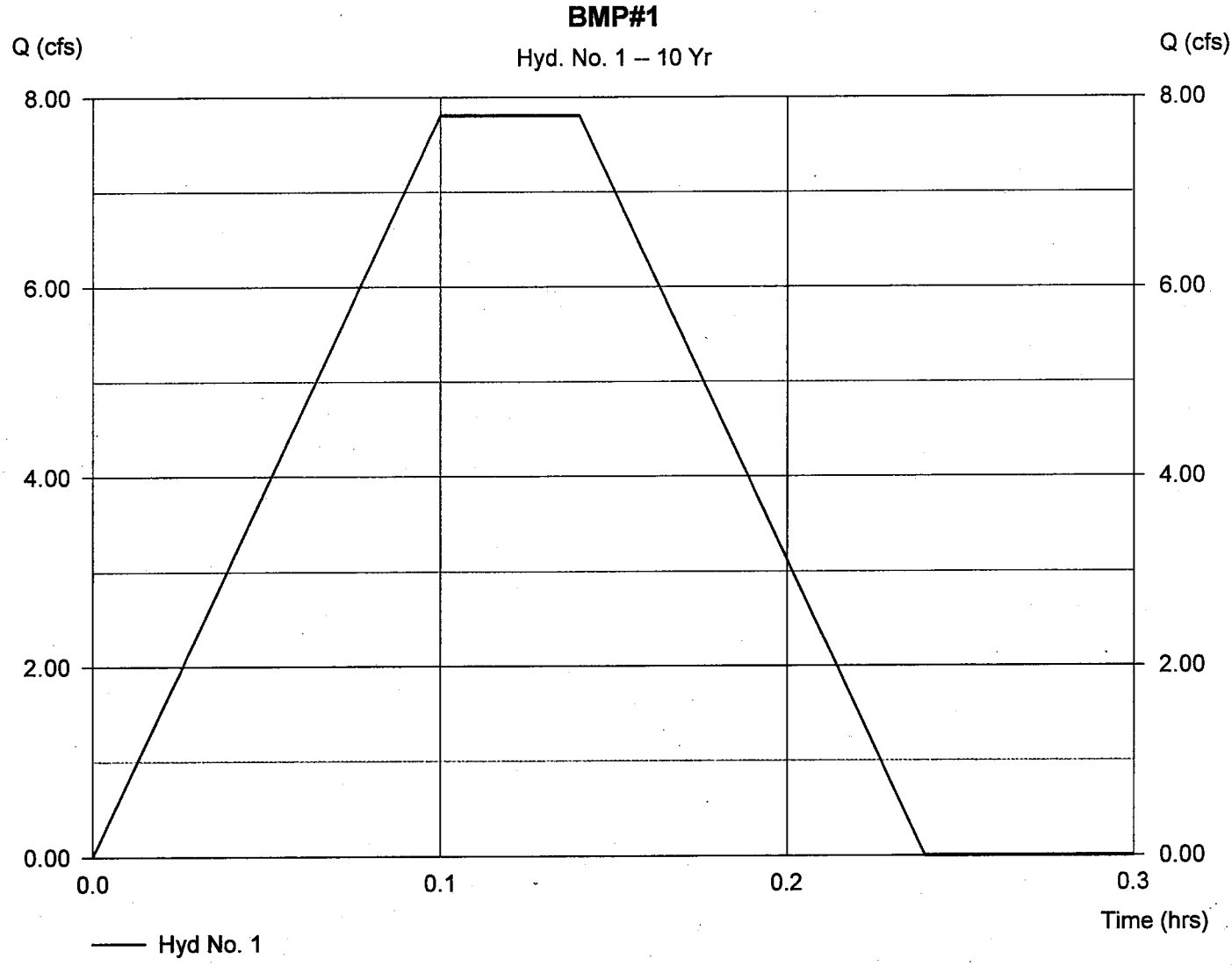
Tuesday, Jun 2 2009, 11:5 AM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 7.81 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 2.240 ac	Runoff coeff.	= 0.54
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,514 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

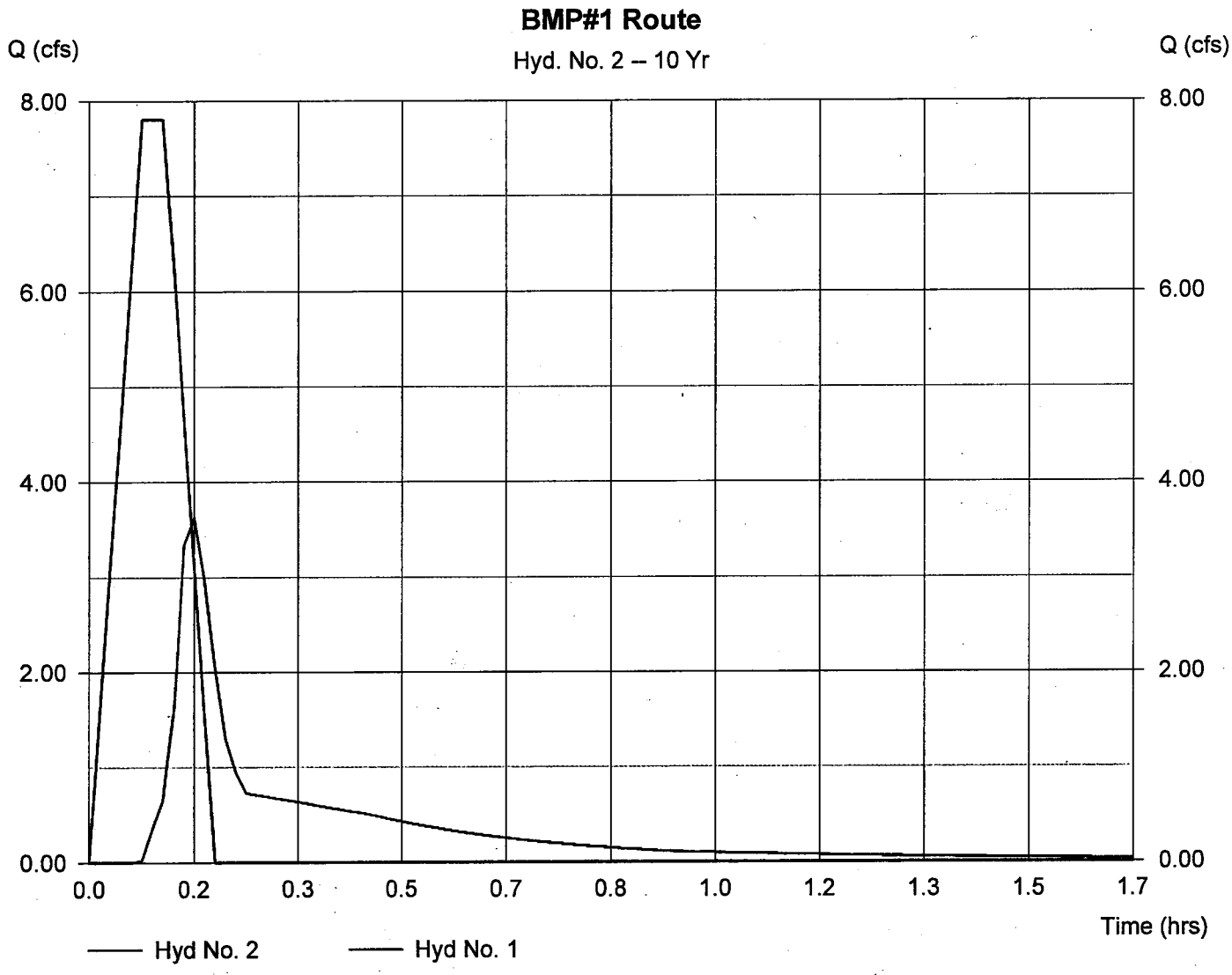
Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 3.62 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 96.12 ft
Reservoir name	= BMP#1	Max. Storage	= 2,626 cuft

Storage Indication method used.

Hydrograph Volume = 2,148 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
1.50	96.50	3,282	1,501	3,760

Culvert / Orifice Structures

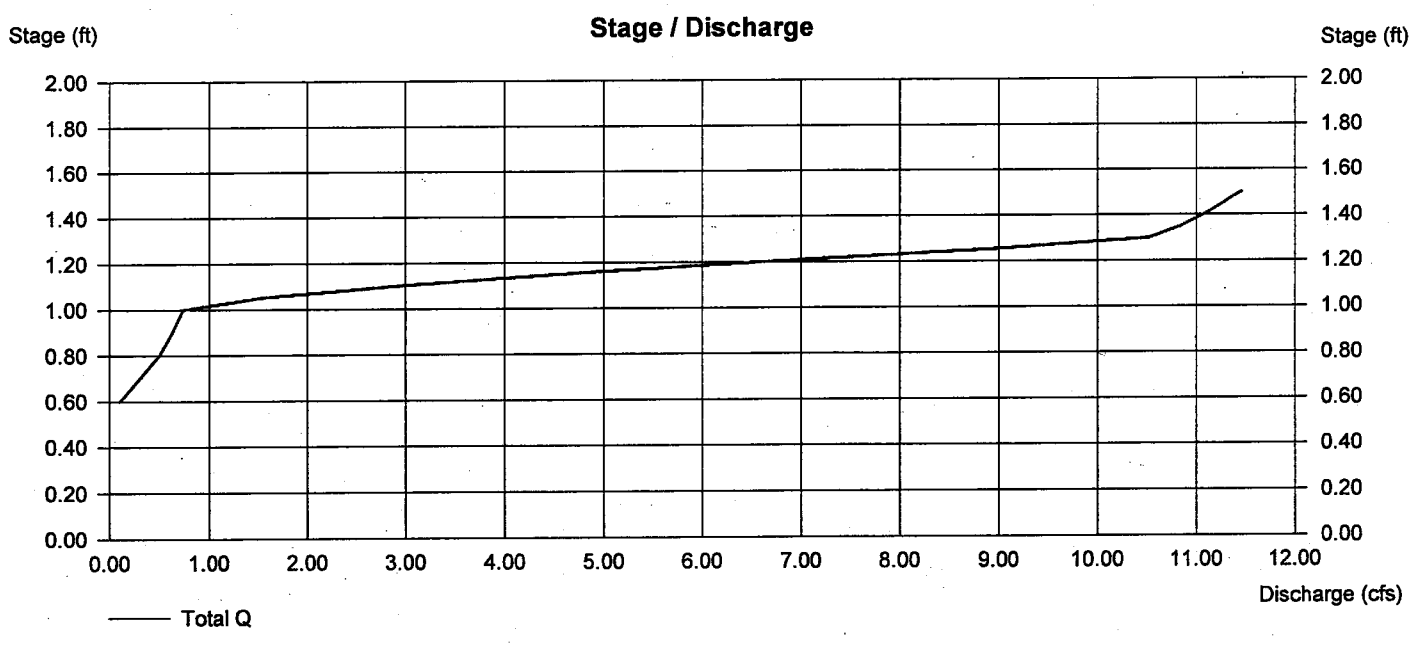
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 83.50	95.50	0.00	0.00
Length (ft)	= 150.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.



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	9.22	1	5	4,149	---	------	------	BMP#1
2	Reservoir	5.69	1	9	2,741	1	96.18	2,792	BMP#1 Route

BMP#1.gpw	Return Period: 25 Year	Tuesday, Jun 2 2009, 11:05 AM

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

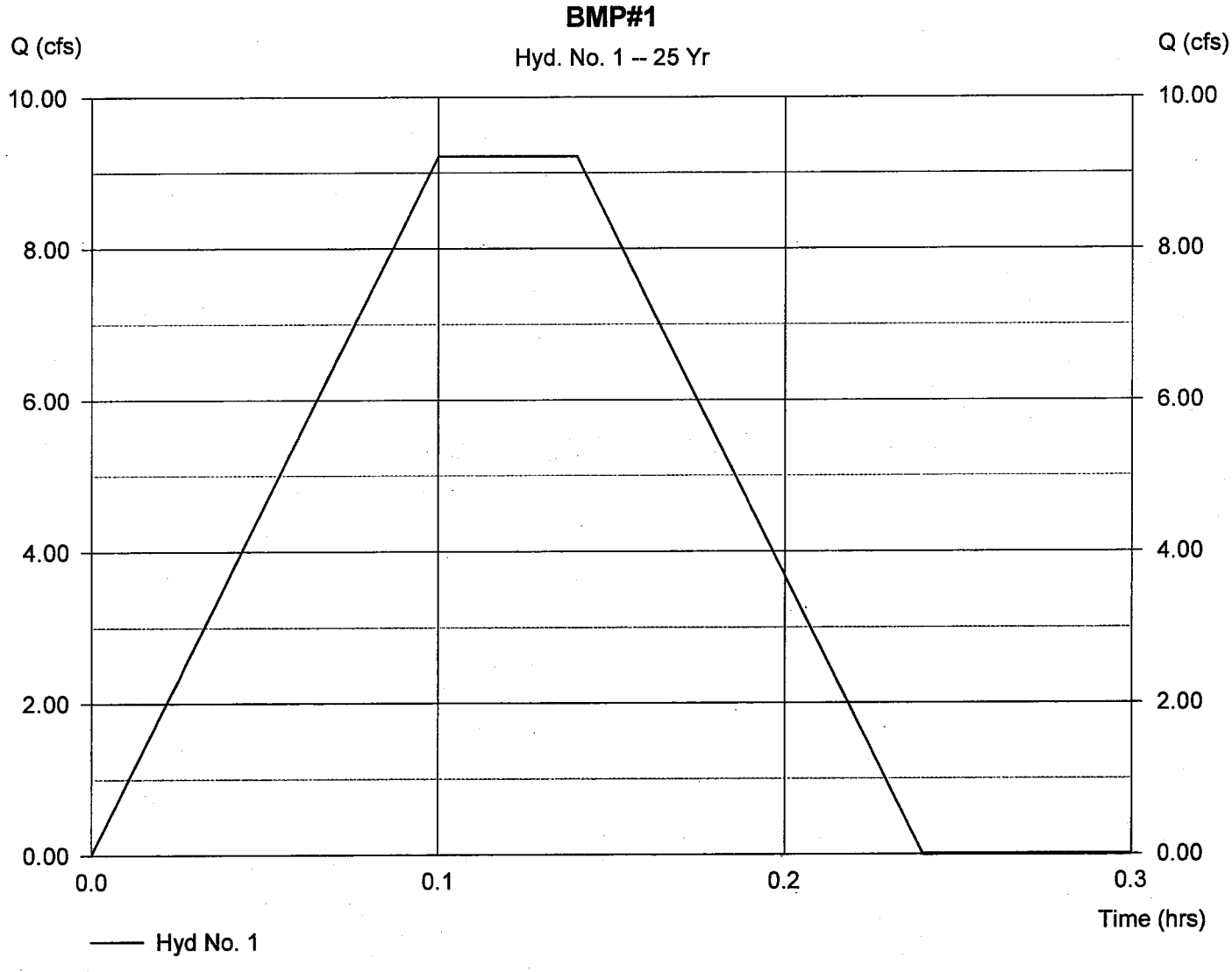
Tuesday, Jun 2 2009, 11:5 AM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 9.22 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 2.240 ac	Runoff coeff.	= 0.54
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,149 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

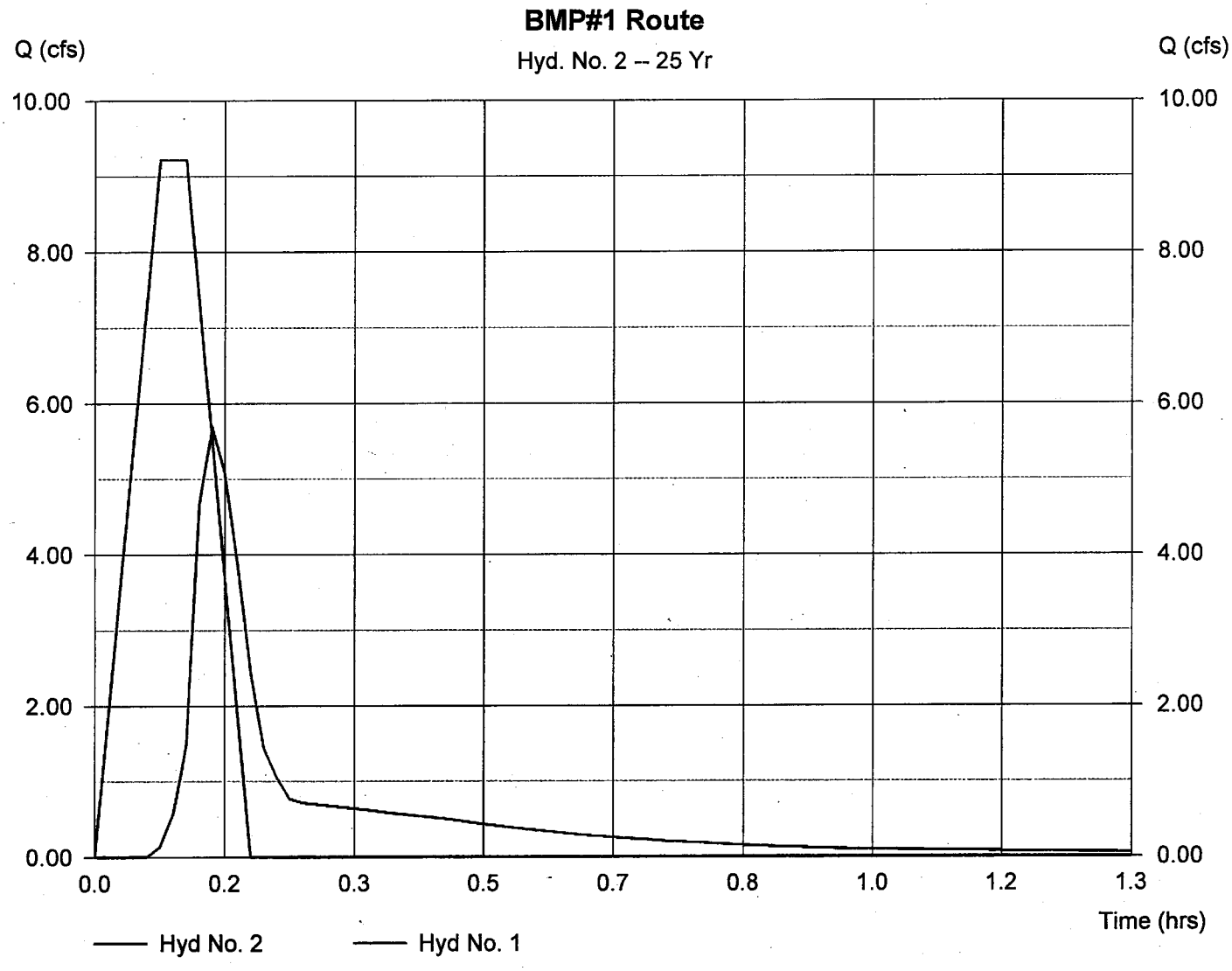
Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 5.69 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 96.18 ft
Reservoir name	= BMP#1	Max. Storage	= 2,792 cuft

Storage Indication method used.

Hydrograph Volume = 2,741 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
1.50	96.50	3,282	1,501	3,760

Culvert / Orifice Structures

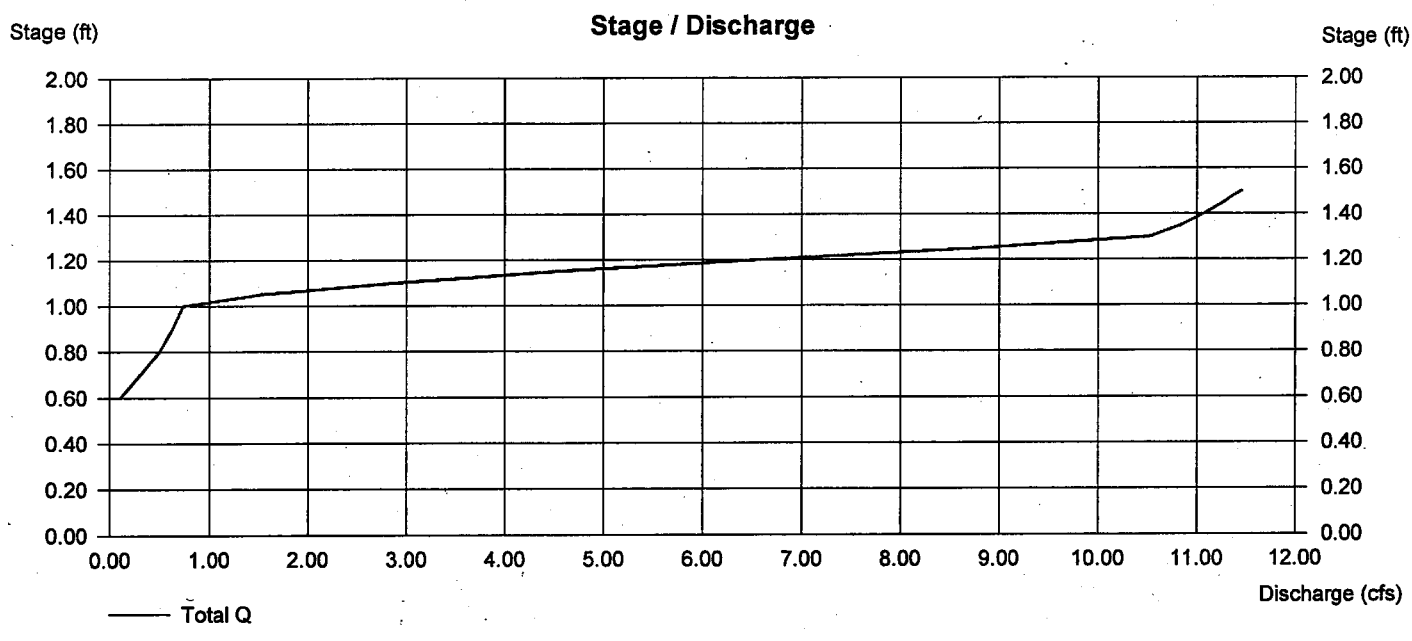
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 83.50	95.50	0.00	0.00
Length (ft)	= 150.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.



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	11.05	1	5	4,971	---	---	---	BMP#1
2	Reservoir	8.03	1	8	3,508	1	96.23	2,955	BMP#1 Route

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

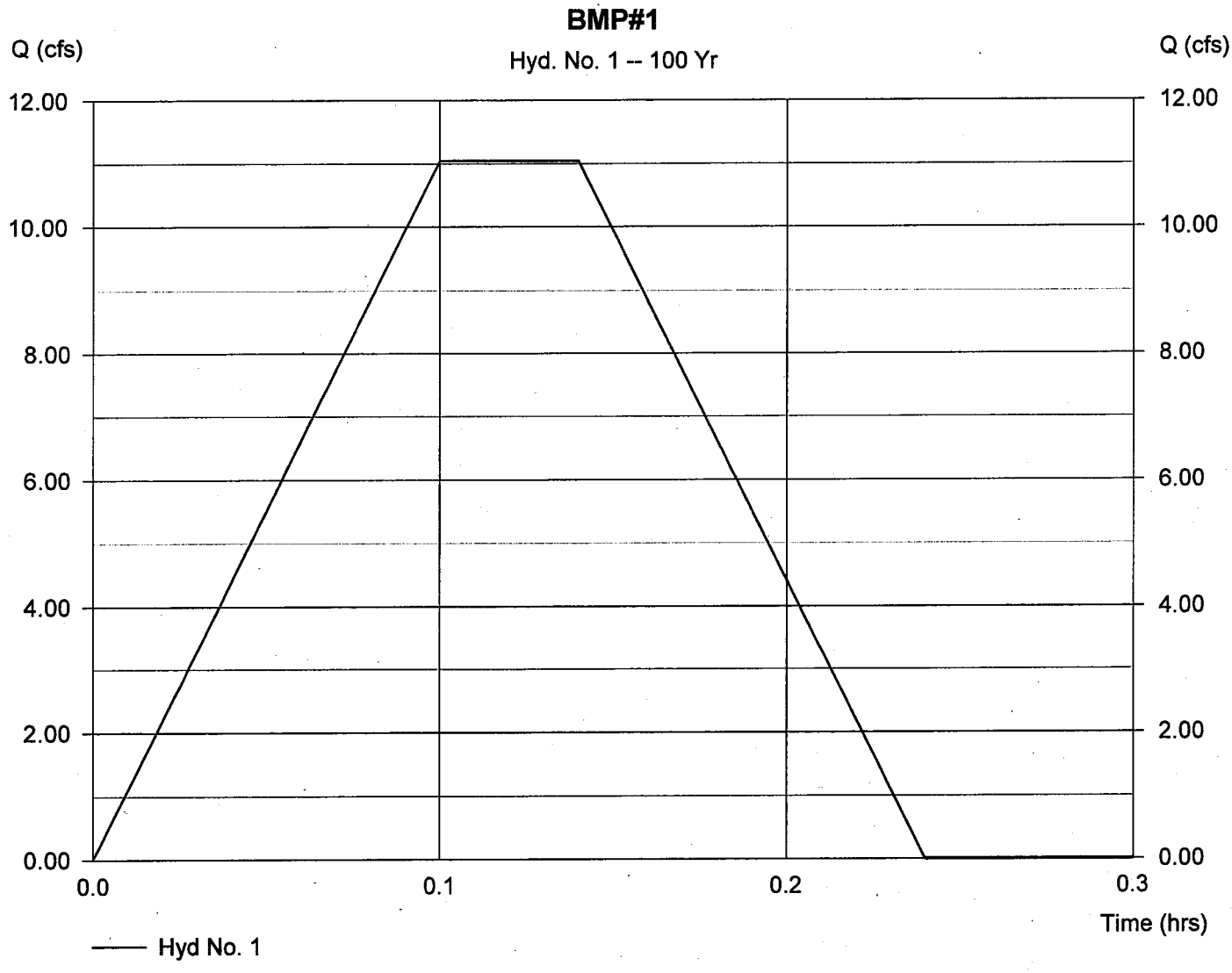
Tuesday, Jun 2 2009, 11:5 AM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 11.05 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 2.240 ac	Runoff coeff.	= 0.54
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,971 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:5 AM

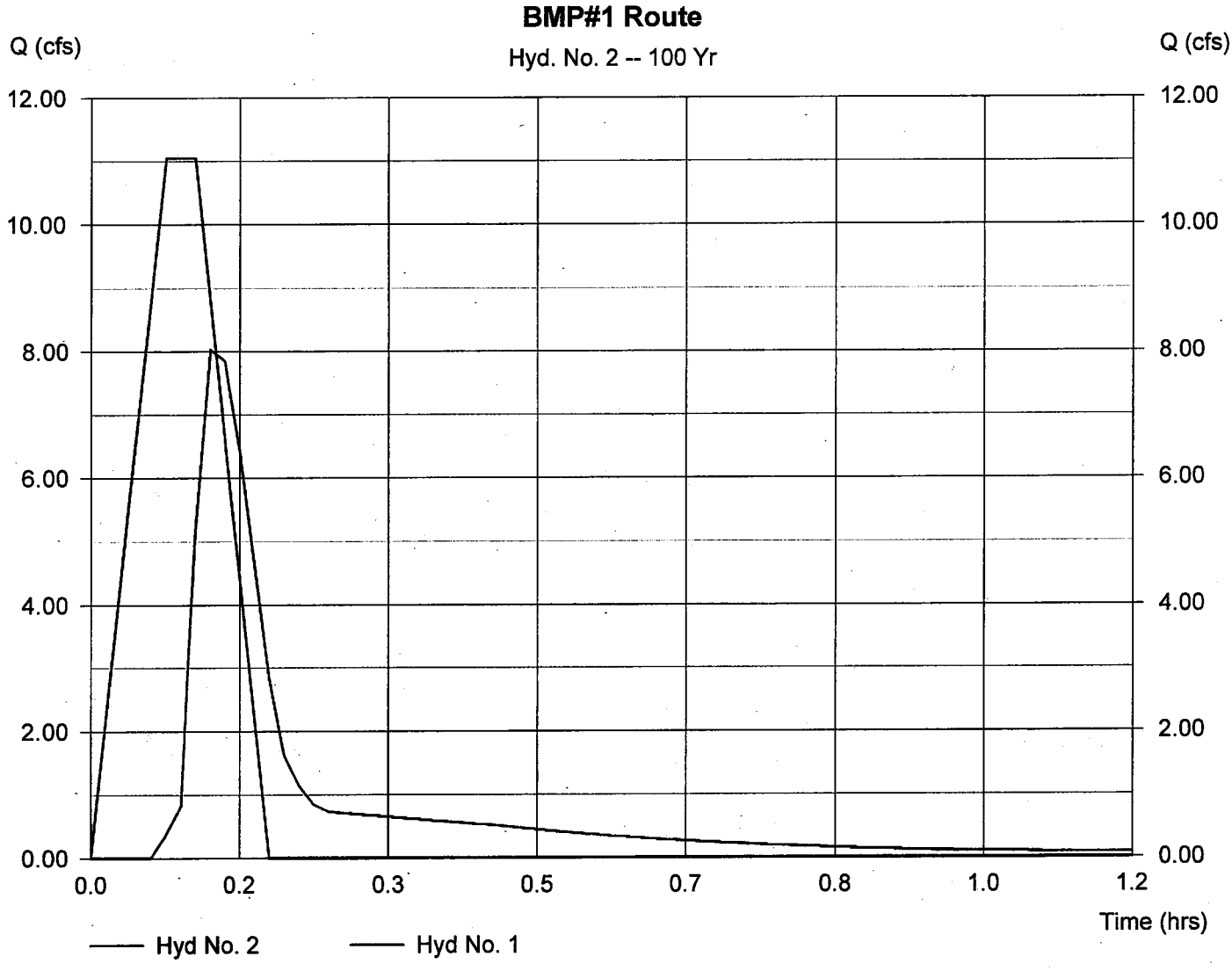
Hyd. No. 2

BMP#1 Route

Hydrograph type	=	Reservoir	Peak discharge	=	8.03 cfs
Storm frequency	=	100 yrs	Time interval	=	1 min
Inflow hyd. No.	=	1	Max. Elevation	=	96.23 ft
Reservoir name	=	BMP#1	Max. Storage	=	2,955 cuft

Storage Indication method used.

Hydrograph Volume = 3,508 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Jun 2 2009, 11:5 AM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
1.50	96.50	3,282	1,501	3,760

Culvert / Orifice Structures

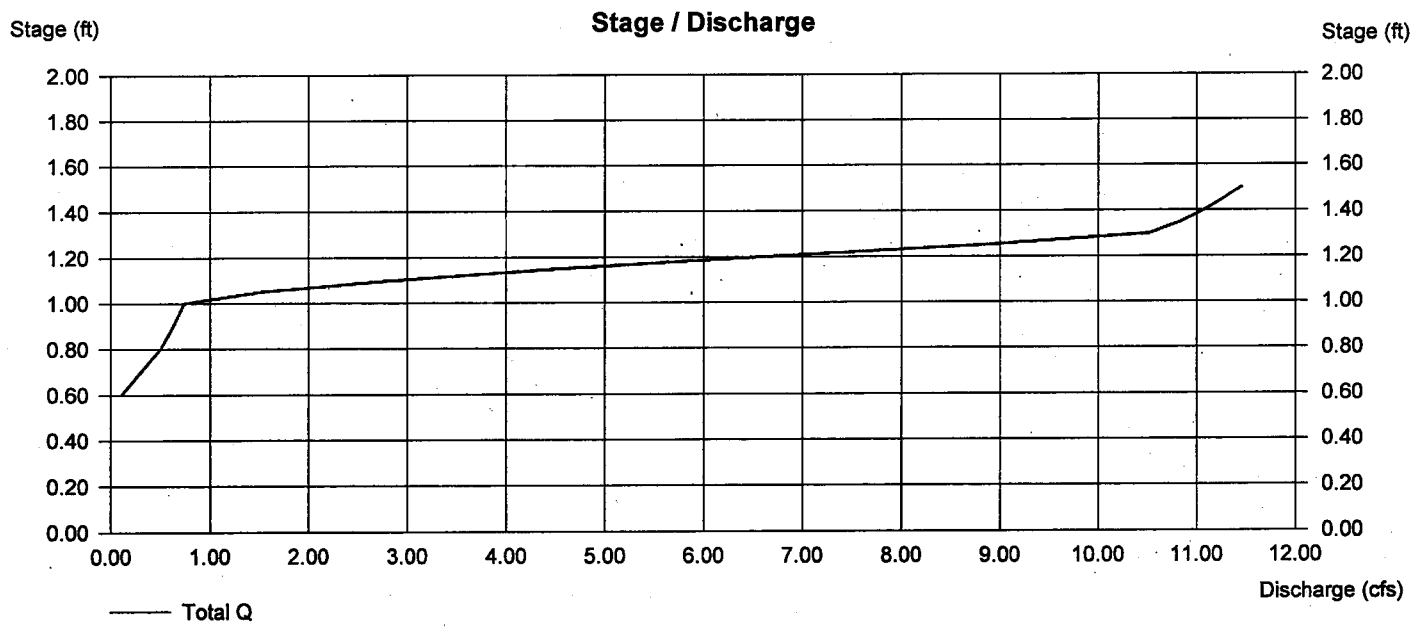
	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 83.50	95.50	0.00	0.00
Length (ft)	= 150.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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 #2 - INFILTRATION TRENCH DESIGN WORKSHEET

WC 112

DESIGN WORKSHEET - INFILTRATION

WSP · SELLS

Project Name:	STONEHOUSE AMENITY H		
Designed by:	IN	Date:	1/22/09
Checked by:	CD	Date:	4/7/09

Water Quality Volume

Simplified Method: $WQv = (R_D)(R_V)(A) / 12$

R_D = 1 Design Storm Rainfall Depth (inches)

R_V = Runoff Coefficient (Runoff/Rainfall)

$R_V = 0.05 + 0.009(I)$

I =	7.83	% Impervious Area of Site
A =	0.44	Drainage Area (Acres)
Rv =	0.120	

WQv = Water Quality Volume = 0.004 Acre-Feet 192 Cubic Feet

Maximum Infiltration Trench Ponding Depth

$f_d = 0.5 \times f$ $d_{max} = (f_d)(T_{max})$

f =	2.00	Permeability Coefficient of Infiltration Trench Media (ft/hour)
f_d =	1.00	Design Infiltration Rate of Infiltration Media (ft/hour)
T_{max} =	0.5	Maximum Allowable Drain Time (hours)
d_{max} =	0.5	Maximum Ponding Depth (feet)

Minimum Infiltration Trench Surface Area

$SA_{min} = WQv / (fd)(Tmax)$

SA_{min} =	385	SF required for 6" Maximum Ponding Depth
Actual Surface Area =	412	SF provided

Actual Ponding Depth = 0.50 feet 6.00 inches

Infiltration Rates

Darcy's Equation for Water Draw Through Rate: $Q = (.0000232)(K)(A)(H/L)$

K =	2.00	Infiltration Rate of Infiltration Basin Media (ft/day)
A =	412	Infiltration Trench Surface Area (sf)
H =	0.50	Height of Water above Drainage Zone (ft)
L =	3.0	Thickness of Media Bed (ft)

Q = Rate of Draw through Infiltration Media = 0.003 cubic feet per second (cfs)

DESIGN WORKSHEET - INFILTRATION

WSP · SELLS

Project Name:	STONEHOUSE AMENITY H		
Designed by:	IN	Date:	1/22/09
Checked by:	CD	Date:	4/7/09

Time to Drawdown Water through Infiltration Trench

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

A =	412	Infiltration Trench Surface Area (SF)
X =	3.5	Depth to Lower (ft)
n =	0.35	Porosity of Infiltration Media

Volume = 505 Cubic Feet

Time (T) = V / Q = 158,405 Seconds

44.0 Hours

Check: **OK**

Underdrains

Minimum Flow: *Q = 2.3E-5 * K * A* 0.02 cfs

Factor of Safety (range between 2 and 10) 5

Design Flow: 0.09 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)*

3.29 inches *calculations assume n=0.011*

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

Equivalent Pipe Diameters

D= (in)	No. of 4" diam	D= (in)	No of 6" diam
5.13	2	7.84	2
5.95	3	9.11	3
6.66	4	10.13	4
7.22	5		
7.75	6		
8.2	7		

Note: A minimum of 2 underdrains recommended

BMP #3 – COMBINED WET SWALE OUTFALL CALCULATIONS

WC 113

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Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	Mod. Rational	------	4.35	5.41	------	------	6.90	8.14	------	9.76	BMP#3 Swale
2	Reservoir	1	3.14	4.59	------	------	6.21	7.80	------	9.54	BMP#3 Swale 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	4.35	1	5	1,958	---	-----	-----	BMP#3 Swale
2	Reservoir	3.14	1	8	1,376	1	83.12	1,125	BMP#3 Swale 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	5.41	1	5	2,433	---	-----	-----	BMP#3 Swale
2	Reservoir	4.59	1	8	1,819	1	83.17	1,211	BMP#3 Swale Route

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

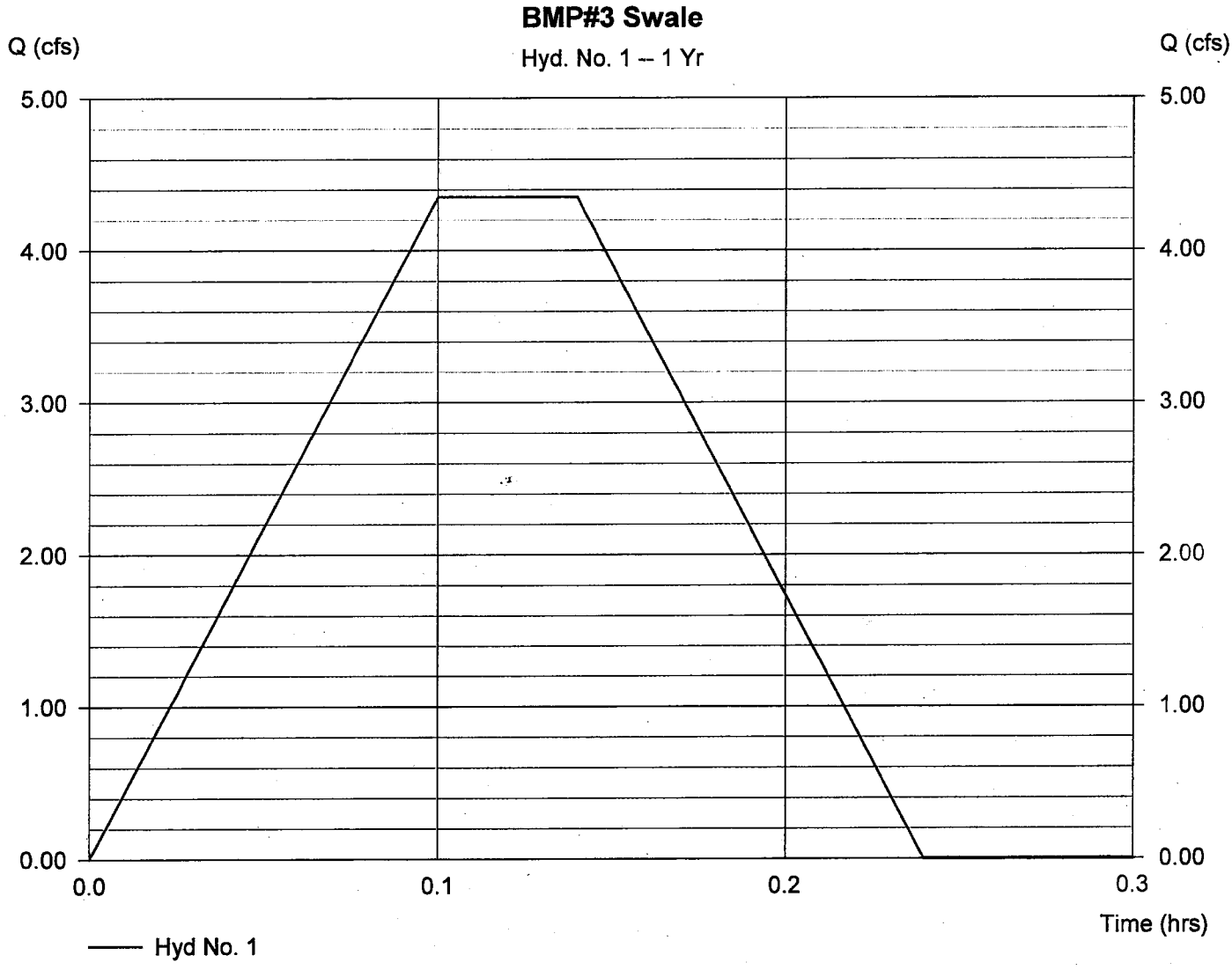
Tuesday, Jun 2 2009, 11:18 AM

Hyd. No. 1

BMP#3 Swale

Hydrograph type	= Mod. Rational	Peak discharge	= 4.35 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 2.740 ac	Runoff coeff.	= 0.39
Intensity	= 4.071 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 1,958 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:18 AM

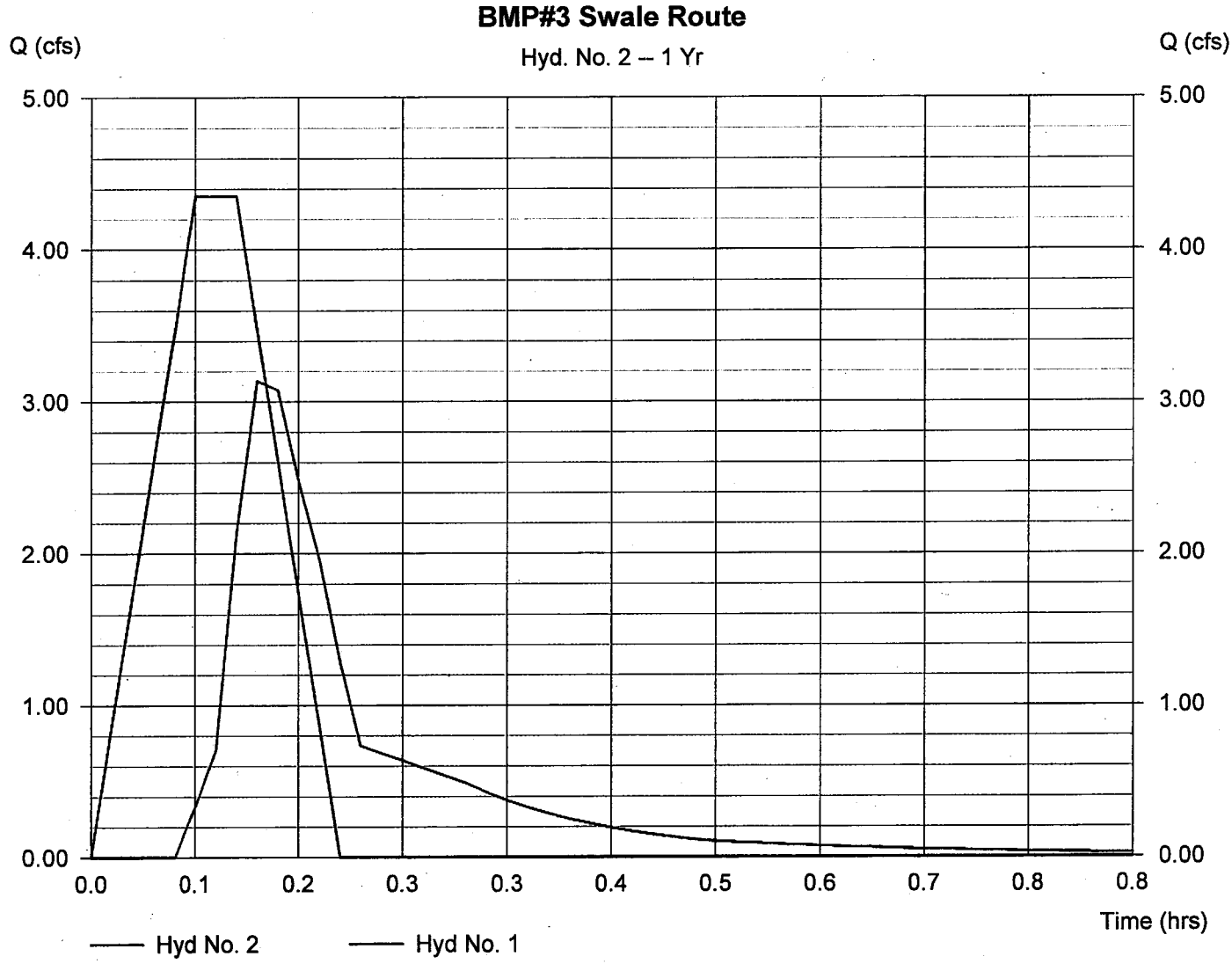
Hyd. No. 2

BMP#3 Swale Route

Hydrograph type	= Reservoir	Peak discharge	= 3.14 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 83.12 ft
Reservoir name	= BMP#3 Swale	Max. Storage	= 1,125 cuft

Storage Indication method used.

Hydrograph Volume = 1,376 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

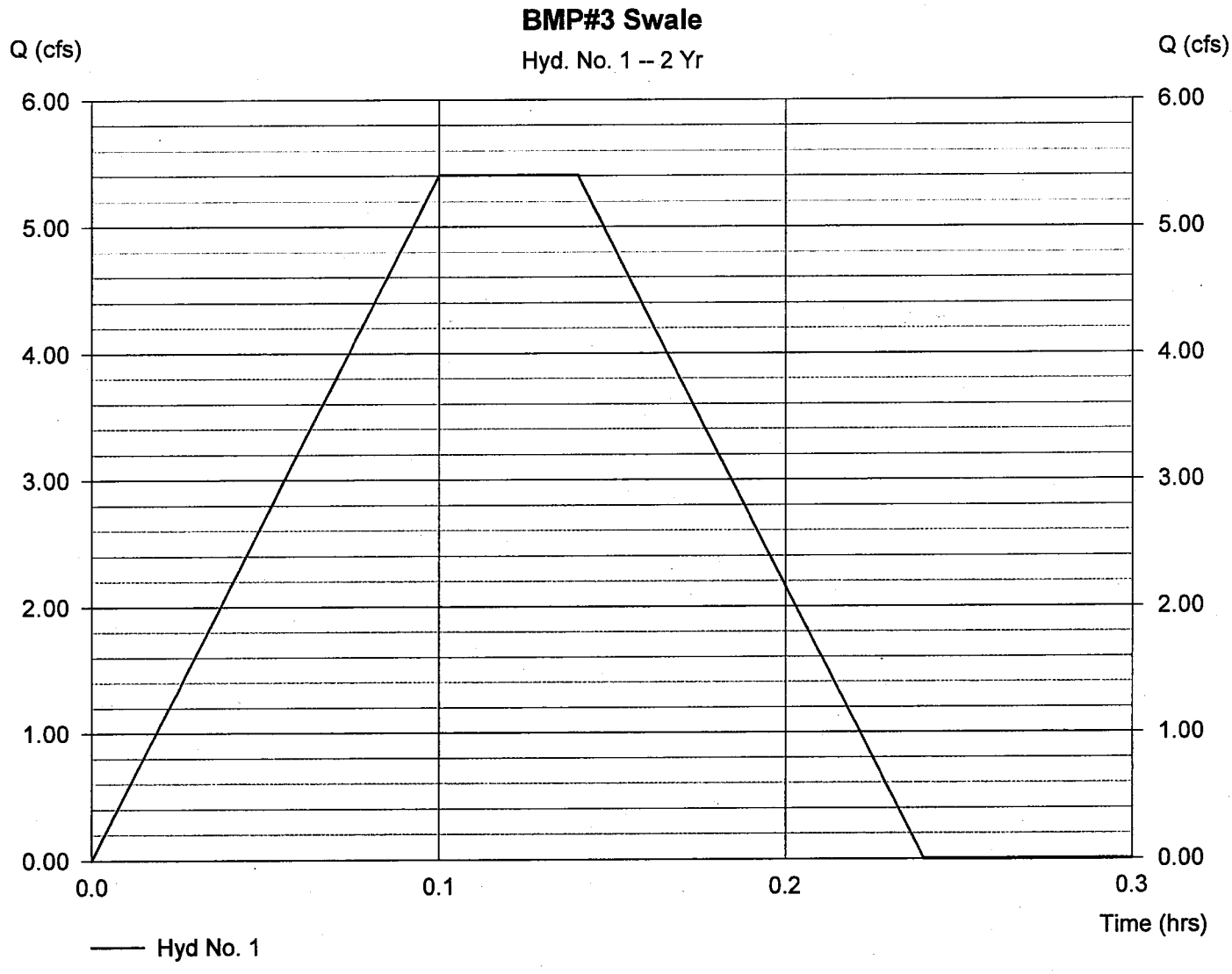
Tuesday, Jun 2 2009, 11:18 AM

Hyd. No. 1

BMP#3 Swale

Hydrograph type	= Mod. Rational	Peak discharge	= 5.41 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 2.740 ac	Runoff coeff.	= 0.39
Intensity	= 5.059 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,433 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:18 AM

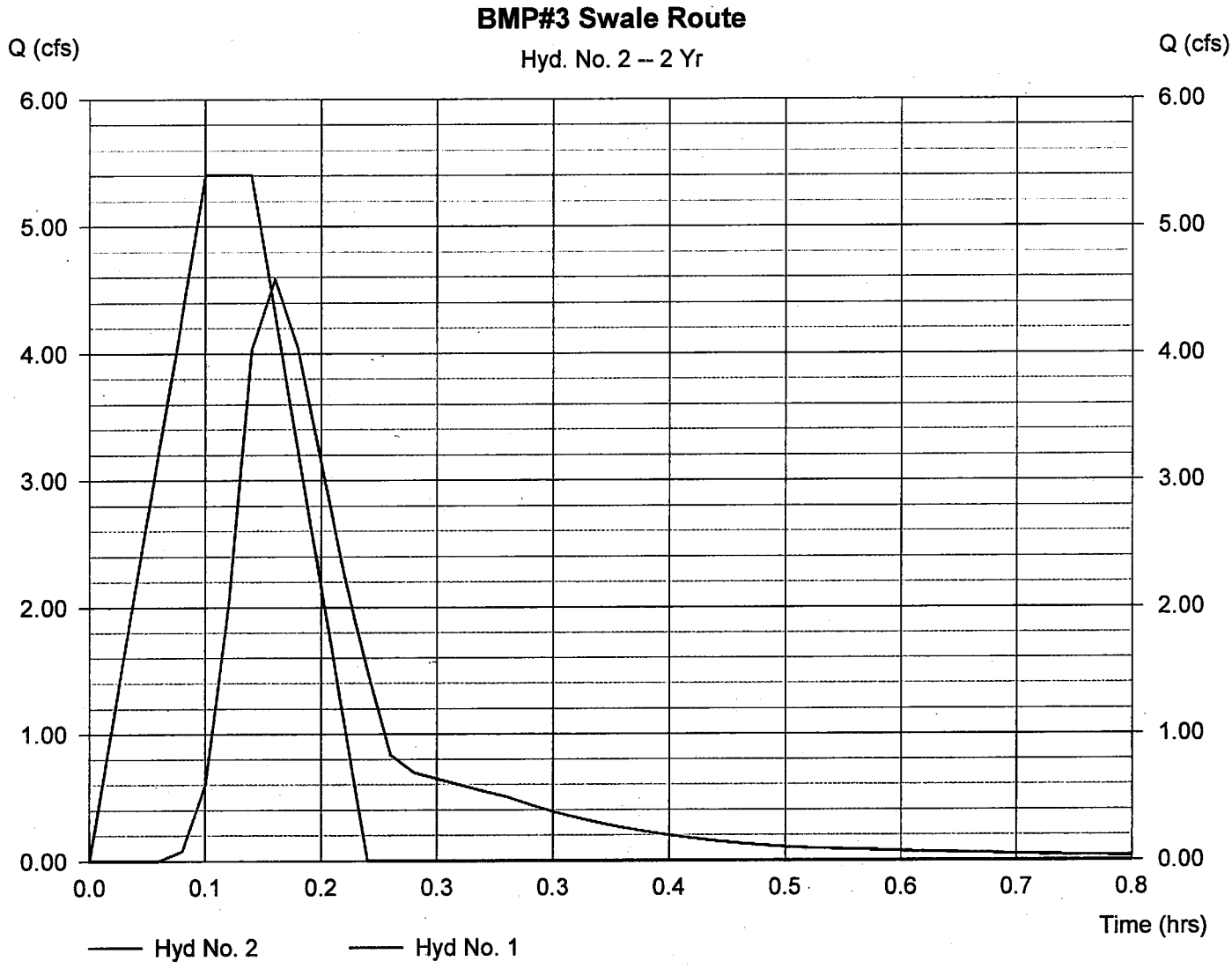
Hyd. No. 2

BMP#3 Swale Route

Hydrograph type	= Reservoir	Peak discharge	= 4.59 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 83.17 ft
Reservoir name	= BMP#3 Swale	Max. Storage	= 1,211 cuft

Storage Indication method used.

Hydrograph Volume = 1,819 cuft



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	6.90	1	5	3,104	---	-----	-----	BMP#3 Swale
2	Reservoir	6.21	1	8	2,446	1	83.21	1,300	BMP#3 Swale Route

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

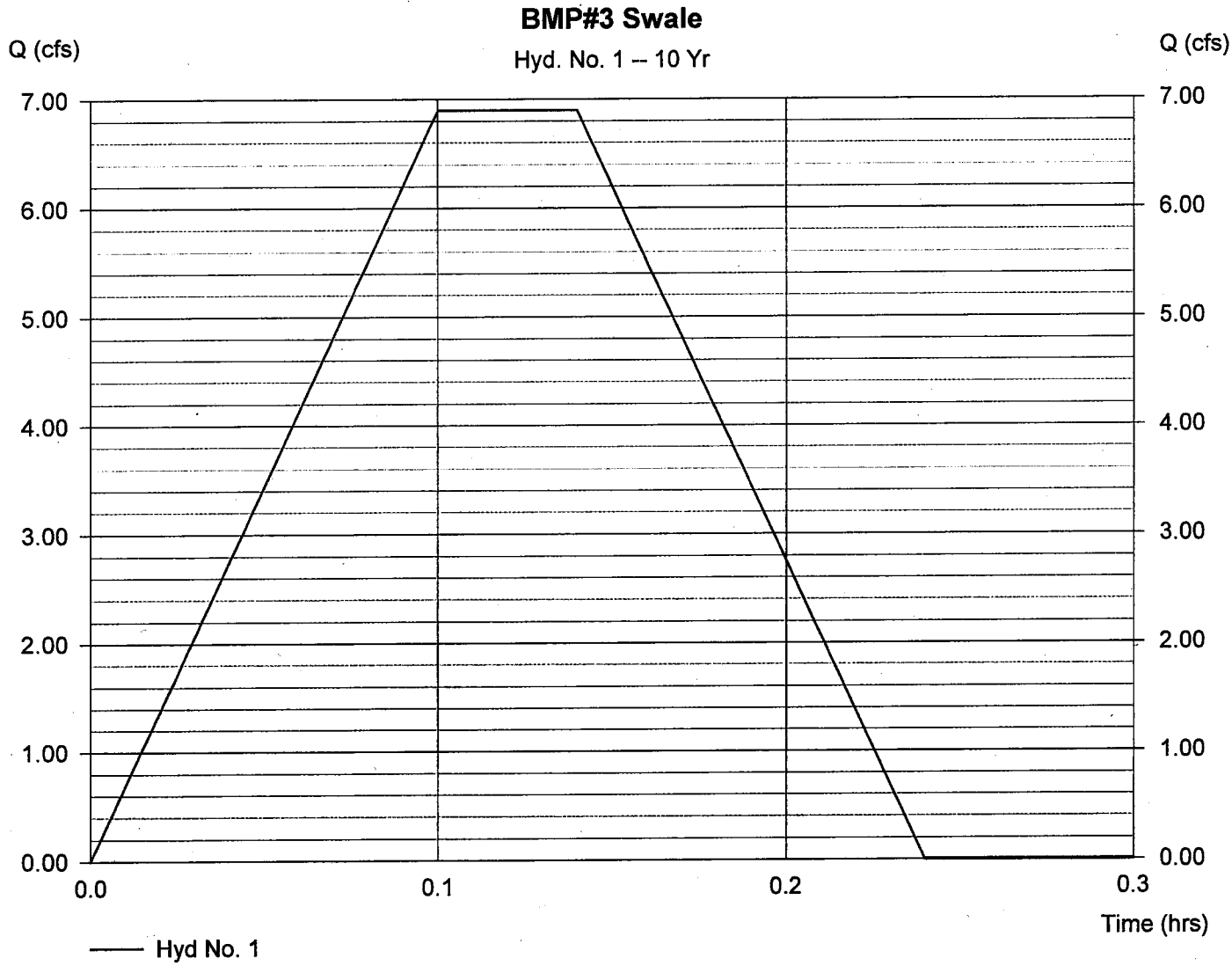
Tuesday, Jun 2 2009, 11:18 AM

Hyd. No. 1

BMP#3 Swale

Hydrograph type	= Mod. Rational	Peak discharge	= 6.90 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 2.740 ac	Runoff coeff.	= 0.39
Intensity	= 6.456 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,104 cuft



Hydrograph Plot

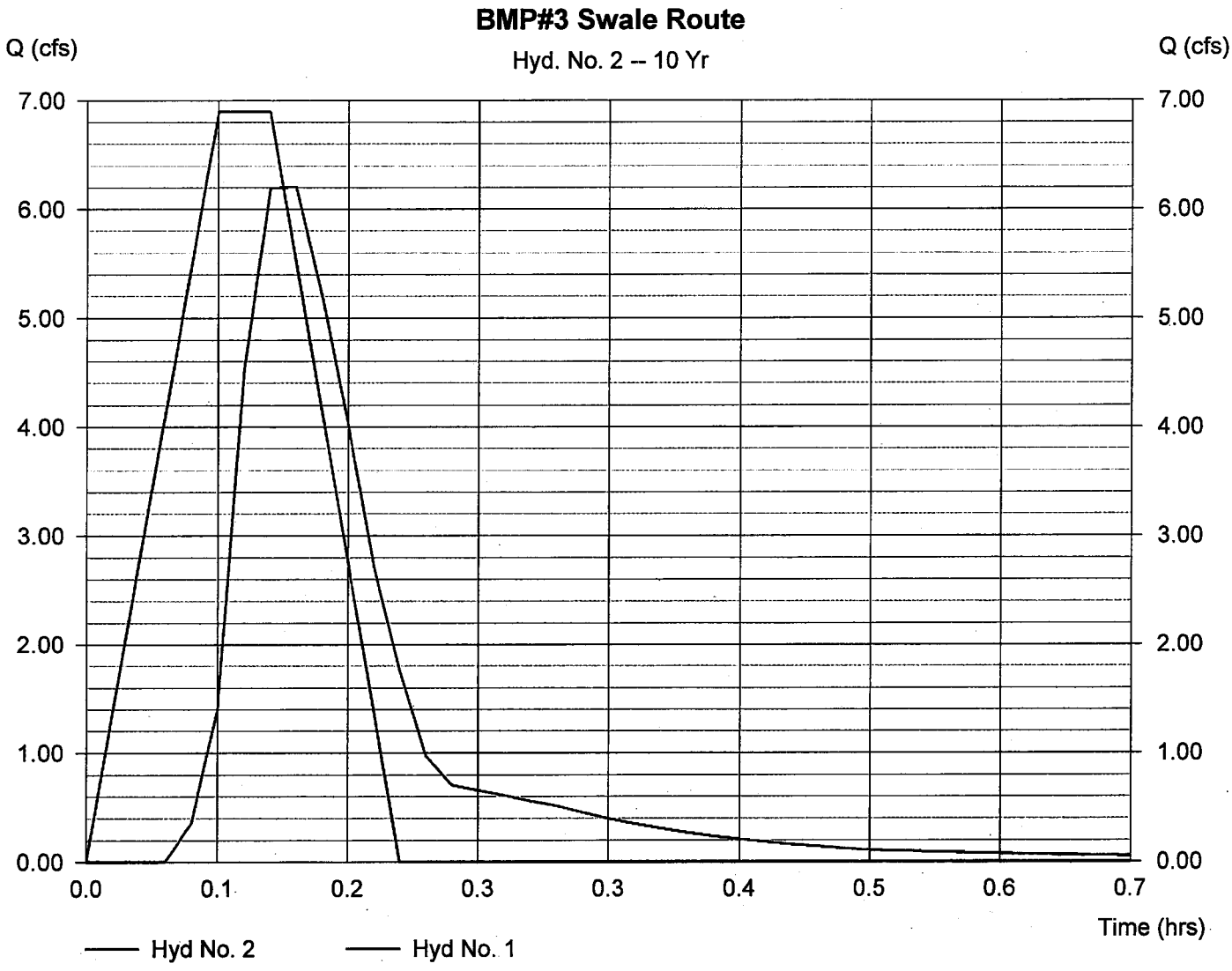
Hydraflow Hydrographs by Intelisolve | Tuesday, Jun 2 2009, 11:18 AM

Hyd. No. 2

BMP#3 Swale Route

Hydrograph type	= Reservoir	Peak discharge	= 6.21 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1'	Max. Elevation	= 83.21 ft
Reservoir name	= BMP#3 Swale	Max. Storage	= 1,300 cuft

Storage Indication method used. | Hydrograph Volume = 2,446 cuft



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	8.14	1	5	3,665	---	----	-----	BMP#3 Swale
2	Reservoir	7.80	1	7	2,970	1	83.25	1,373	BMP#3 Swale Route

BMP#3 Swales.gpw | Return Period: 25 Year | Tuesday, Jun 2 2009, 11:18 AM

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

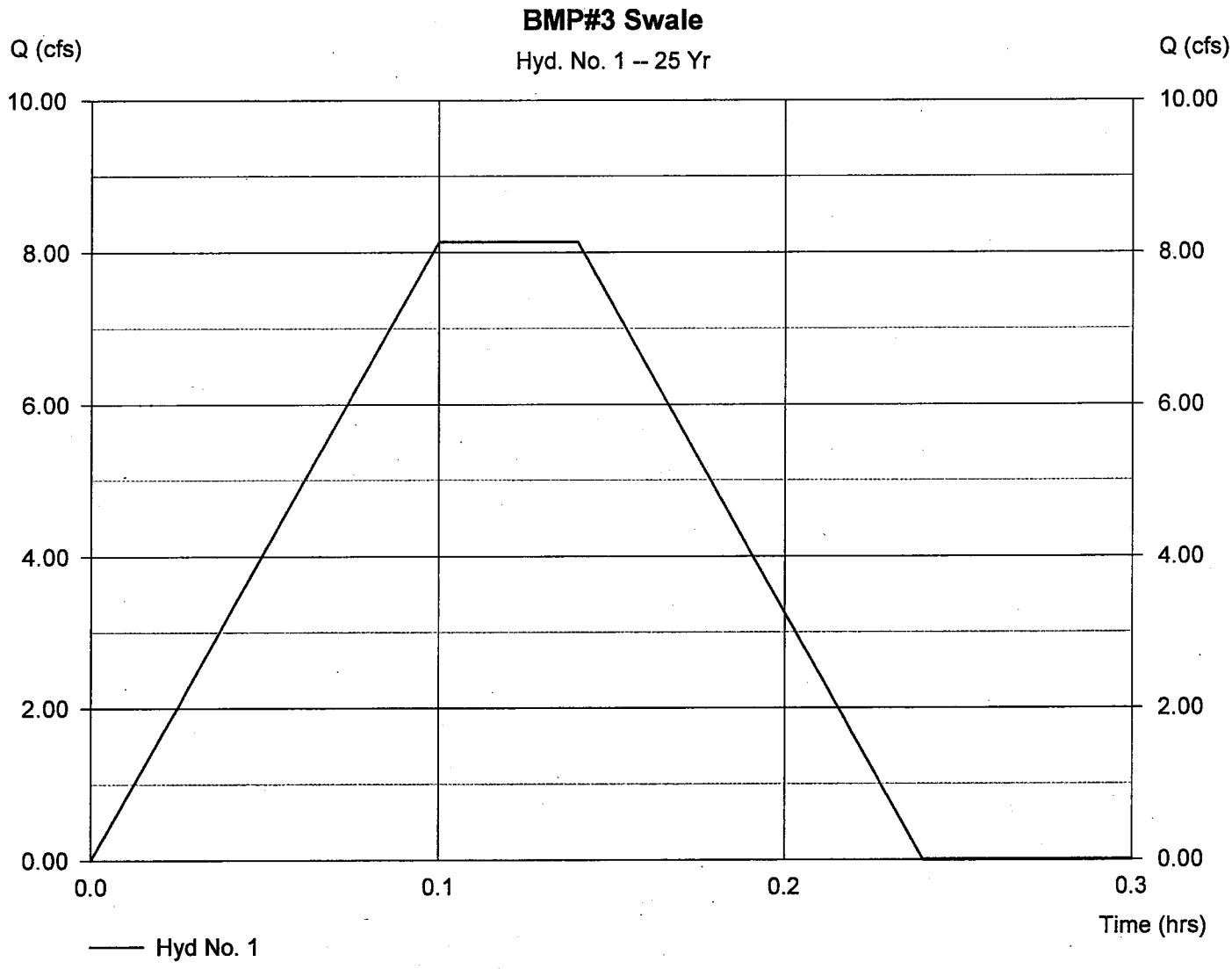
Tuesday, Jun 2 2009, 11:18 AM

Hyd. No. 1

BMP#3 Swale

Hydrograph type	= Mod. Rational	Peak discharge	= 8.14 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 2.740 ac	Runoff coeff.	= 0.39
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,665 cuft



Hydrograph Plot

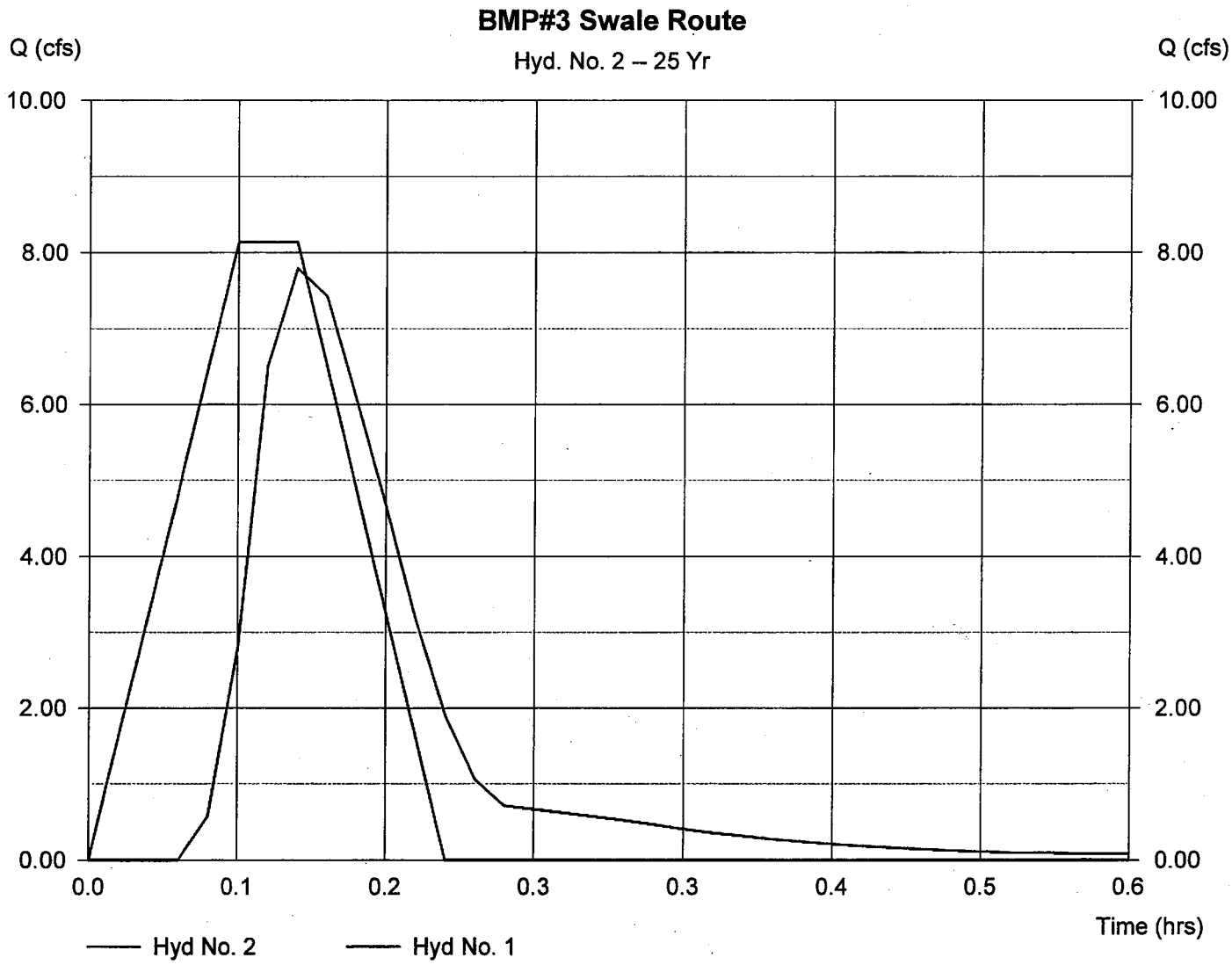
Hydraflow Hydrographs by Intelisolve | Tuesday, Jun 2 2009, 11:18 AM

Hyd. No. 2

BMP#3 Swale Route

Hydrograph type	= Reservoir	Peak discharge	= 7.80 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 83.25 ft
Reservoir name	= BMP#3 Swale	Max. Storage	= 1,373 cuft

Storage Indication method used. | Hydrograph Volume = 2,970 cuft



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	9.76	1	5	4,392	---	-----	-----	BMP#3 Swale
2	Reservoir	9.54	1	7	3,648	1	83.30	1,454	BMP#3 Swale Route

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

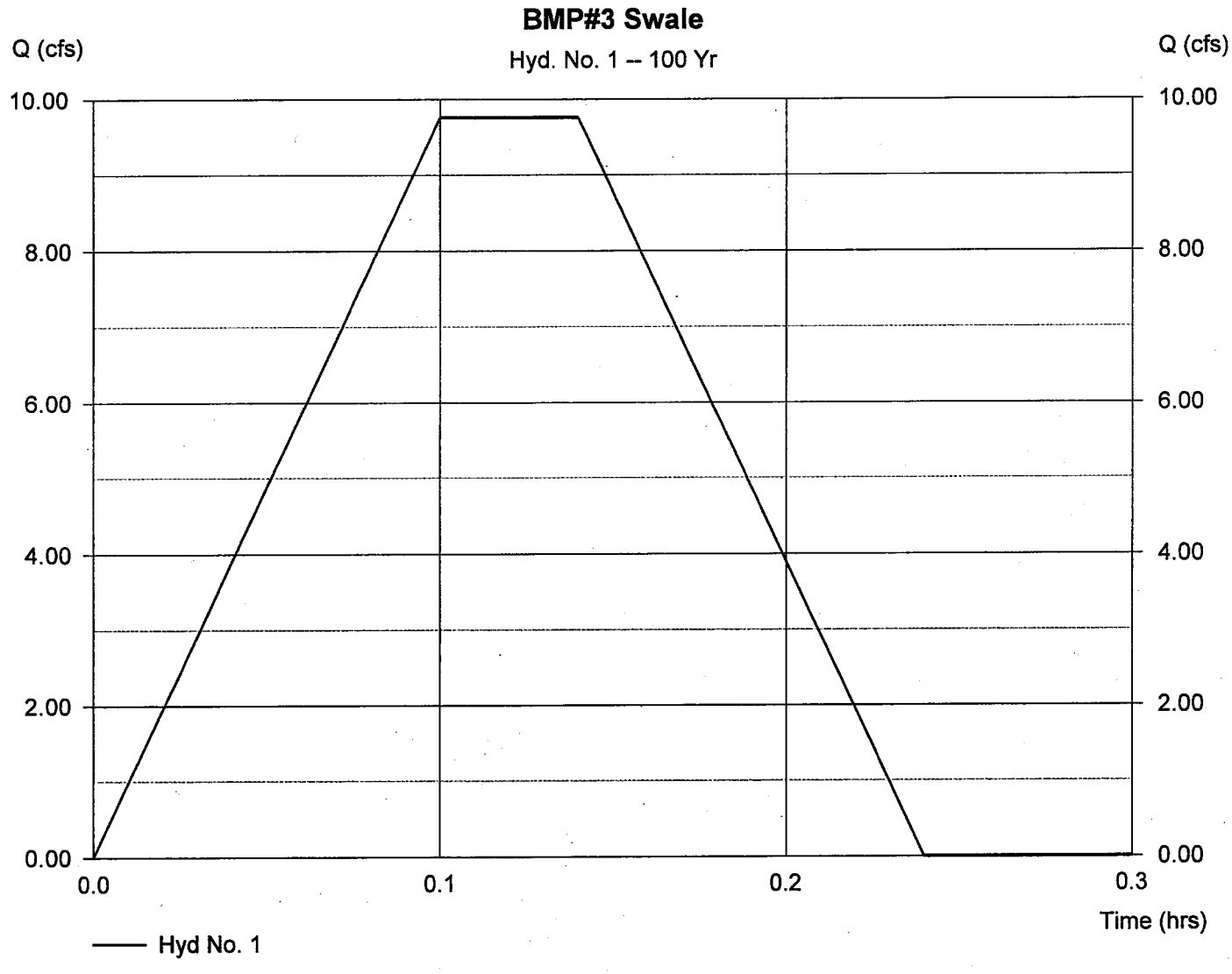
Tuesday, Jun 2 2009, 11:18 AM

Hyd. No. 1

BMP#3 Swale

Hydrograph type	= Mod. Rational	Peak discharge	= 9.76 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 2.740 ac	Runoff coeff.	= 0.39
Intensity	= 9.132 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,392 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 11:18 AM

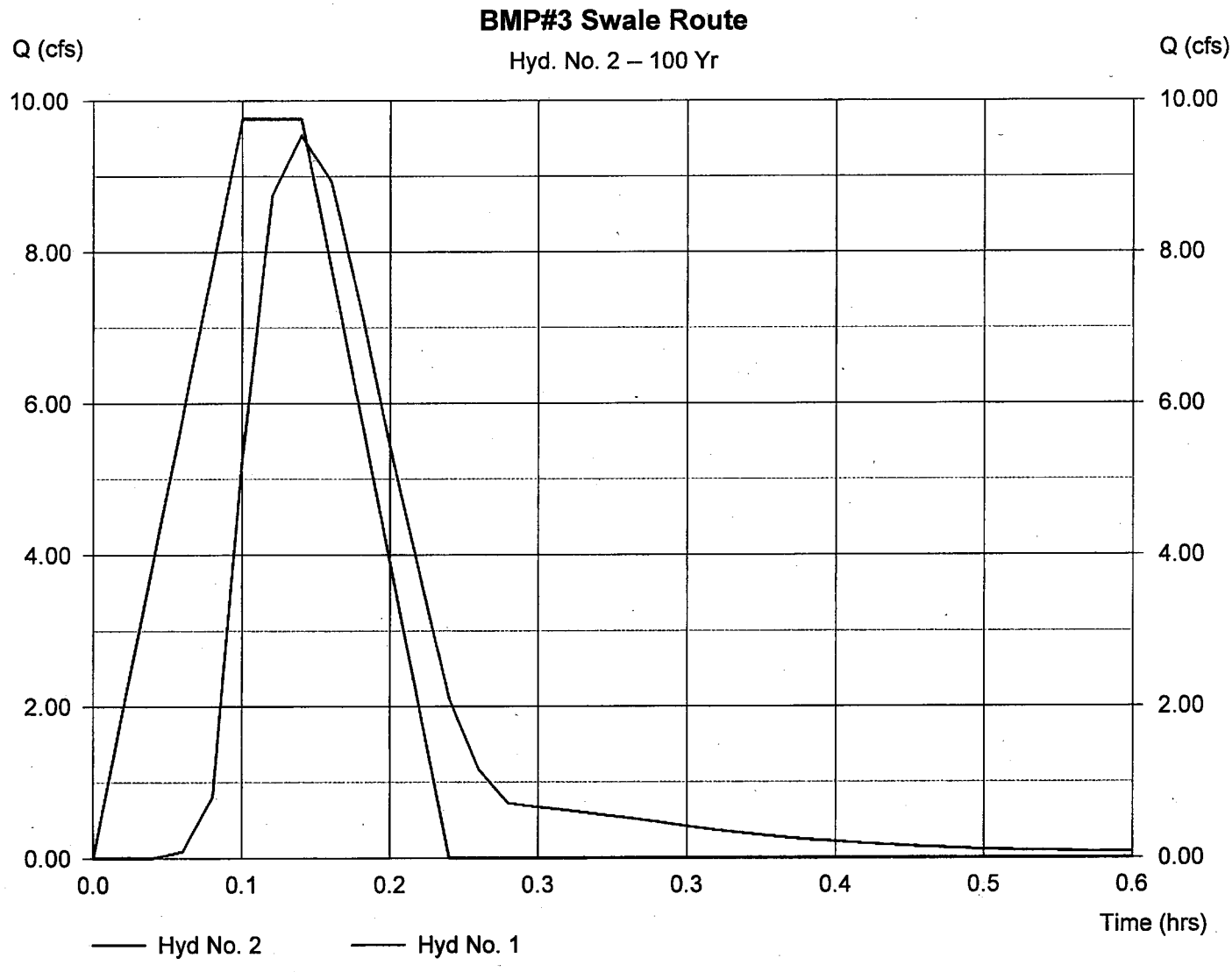
Hyd. No. 2

BMP#3 Swale Route

Hydrograph type	= Reservoir	Peak discharge	= 9.54 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 83.30 ft
Reservoir name	= BMP#3 Swale	Max. Storage	= 1,454 cuft

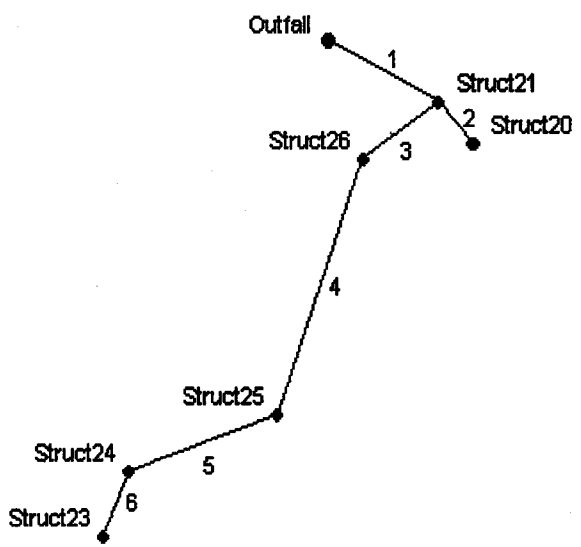
Storage Indication method used.

Hydrograph Volume = 3,648 cuft



STORM DRAIN OUTFALL
HYDRAULIC GRADE LINE CALCULATIONS

Hydraflow Plan View



Project file: storm design 2.stm	No. Lines: 6	06-02-2009

Hydraflow Storm Sewers 2003

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	97.7	27.1	MH	0.36	0.10	0.50	5.0	51.50	5.22	56.60	15	Cir	0.013	1.00	71.68	Pipe21
2	1	40.2	20.7	MH	2.53	0.70	0.50	5.0	66.60	9.71	70.50	15	Cir	0.013	1.00	83.00	Pipe20
3	1	72.0	119.0	MH	0.00	0.00	0.00	0.0	66.60	9.04	73.11	15	Cir	0.013	0.75	84.25	Pipe26
4	3	195.6	-35.7	MH	0.00	0.00	0.00	0.0	75.11	1.00	77.06	15	Cir	0.013	0.75	88.80	Pipe25
5	4	123.9	50.7	MH	0.00	0.00	0.00	0.0	77.16	1.00	78.40	15	Cir	0.013	0.75	81.50	Pipe24
6	5	52.1	-47.2	MH	2.37	0.00	0.00	0.0	78.50	9.60	83.50	15	Cir	0.013	1.00	95.00	Pipe23

7.10 %

8.97 %

Project File: storm design 2.stm | Number of lines: 6 | Date: 06-02-2009

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	Pipe21	8.09	15 c	97.7	51.50	56.60	5.219 7.10%	52.62	57.72	0.76	End
2	Pipe20	5.03	15 c	40.2	66.60	70.50	9.709 8.99%	67.03	71.60	0.30	1
3	Pipe26	2.37	15 c	72.0	66.60	73.11	9.042	66.90	73.73	0.18	1
4	Pipe25	2.37	15 c	195.6	75.11	77.06	0.997	75.63	77.68	0.18	3
5	Pipe24	2.37	15 c	123.9	77.16	78.40	1.000	77.86	79.02	0.18	4
6	Pipe23	2.37	15 c	52.1	78.50	83.50	9.601	79.20	84.12	0.24	5

Project File: storm design 2.stm | Number of lines: 6 | Run Date: 06-02-2009

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

Storm Sewer Tabulation

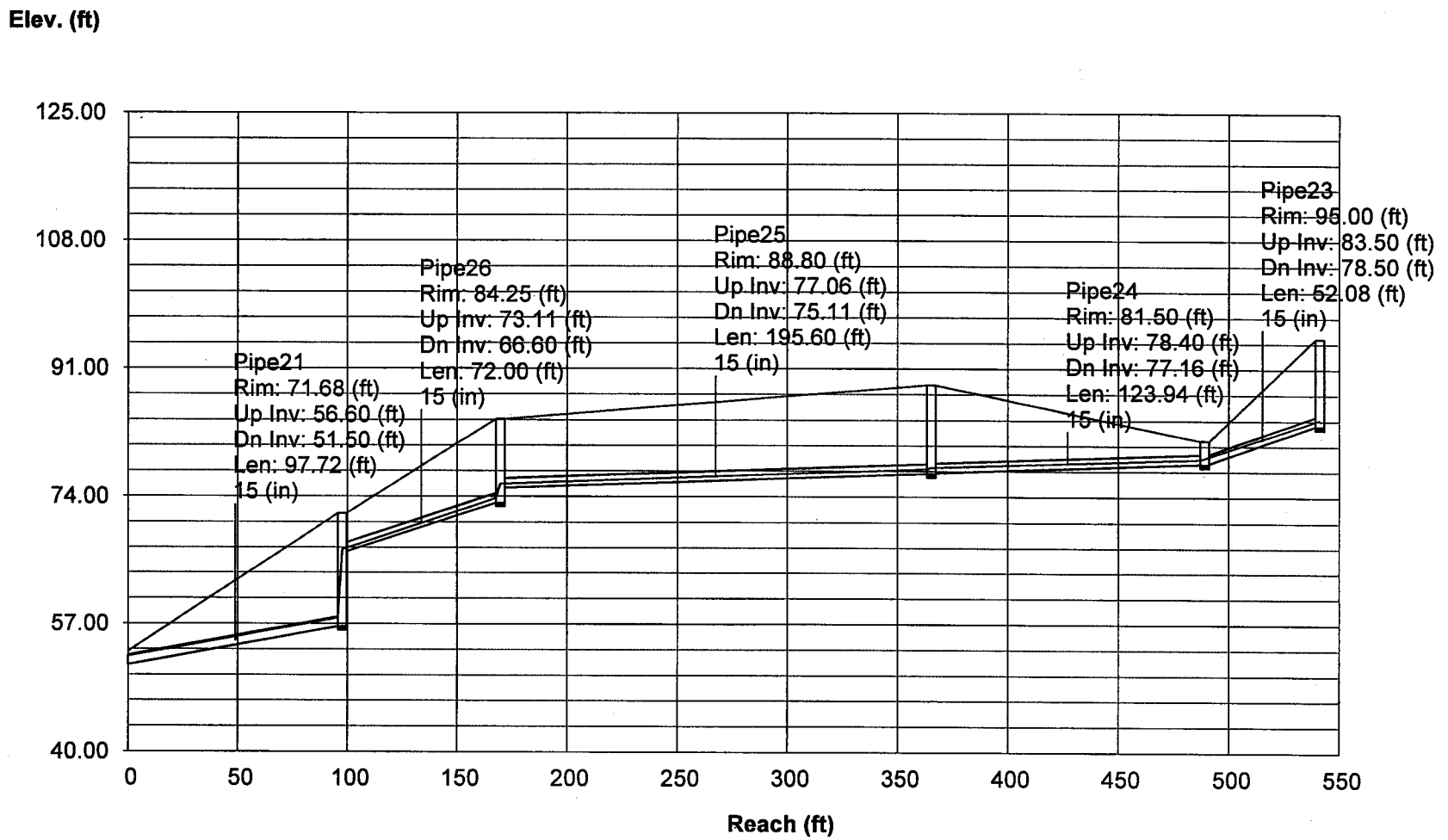
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	97.7	0.10	0.80	0.50	0.05	0.40	5.0	5.2	7.1	8.09	14.75	6.97	15	5.22	56.60	51.50	57.72	52.62	71.68	53.26	Pipe21
2	1	40.2	0.70	0.70	0.50	0.35	0.35	5.0	5.0	7.1	5.03	20.12	8.96	15	9.71	70.50	66.60	71.60	67.03	83.00	71.68	Pipe20
3	1	72.0	0.00	0.00	0.00	0.00	0.00	0.0	3.2	0.0	2.37	19.42	7.32	15	9.04	73.11	66.60	73.73	66.90	84.25	71.68	Pipe26
4	3	195.6	0.00	0.00	0.00	0.00	0.00	0.0	1.5	0.0	2.37	6.45	4.39	15	1.00	77.06	75.11	77.68	75.63	88.80	84.25	Pipe25
5	4	123.9	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	2.37	6.46	3.65	15	1.00	78.40	77.16	79.02	77.86	81.50	88.80	Pipe24
6	5	52.1	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.37	20.01	3.65	15	9.60	83.50	78.50	84.12	79.20	95.00	81.50	Pipe23

Project File: storm design 2.stm | Number of lines: 6 | Run Date: 06-02-2009

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

Storm Sewer Profile

Proj. file: storm design 2.stm



SEDIMENT TRAP CALCULATIONS

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Hydrograph No. 6, Reservoir, ST-3 ROUTE 10

Pond Report 11

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	Mod. Rational	------	2.73	3.29	------	3.94	4.38	5.24	5.70	6.36	ST-1
2	Mod. Rational	------	2.84	3.52	------	4.09	4.50	5.31	5.73	6.36	ST-2
3	Mod. Rational	------	2.84	3.52	------	4.09	4.50	5.31	5.73	6.36	ST-3
4	Reservoir	1	0.00	0.00	------	0.00	0.00	0.00	0.00	0.00	ST-1 ROUTE
5	Reservoir	2	0.00	0.00	------	0.00	0.00	0.00	0.00	0.00	ST-2 ROUTE
6	Reservoir	3	0.00	0.00	------	0.00	0.00	0.00	0.00	0.00	ST-3 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	5.24	1	10	4,718	---	-----	-----	ST-1
2	Mod. Rational	5.31	1	5	2,389	---	-----	-----	ST-2
3	Mod. Rational	5.31	1	5	2,389	---	-----	-----	ST-3
4	Reservoir	0.00	1	0	0	1	83.82	4,718	ST-1 ROUTE
5	Reservoir	0.00	1	0	0	2	80.74	2,230	ST-2 ROUTE
6	Reservoir	0.00	1	0	0	3	95.21	2,230	ST-3 ROUTE

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

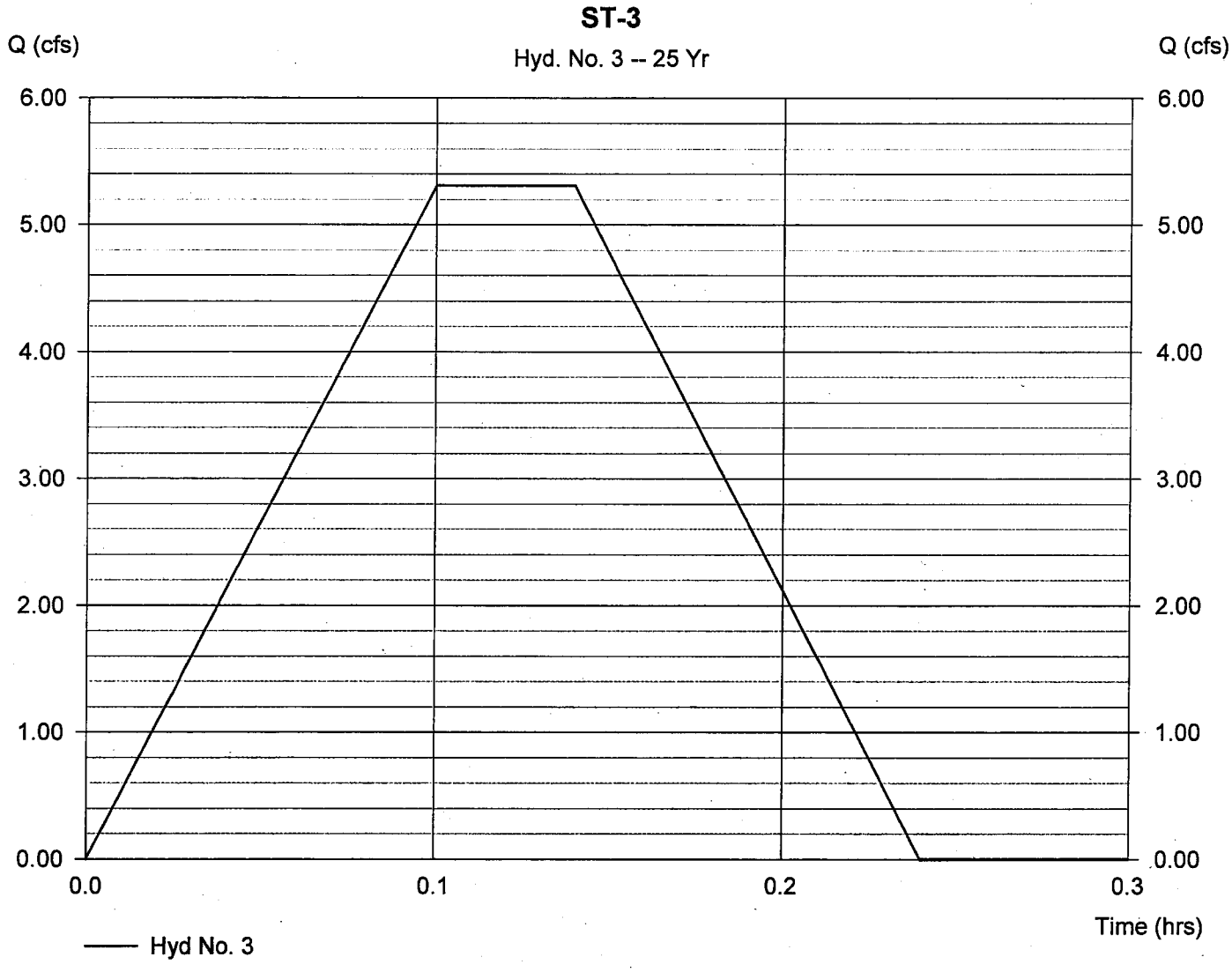
Tuesday, Jun 2 2009, 2:43 PM

Hyd. No. 3

ST-3

Hydrograph type	= Mod. Rational	Peak discharge	= 5.31 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.990 ac	Runoff coeff.	= 0.35
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,389 cuft



Hydrograph Plot

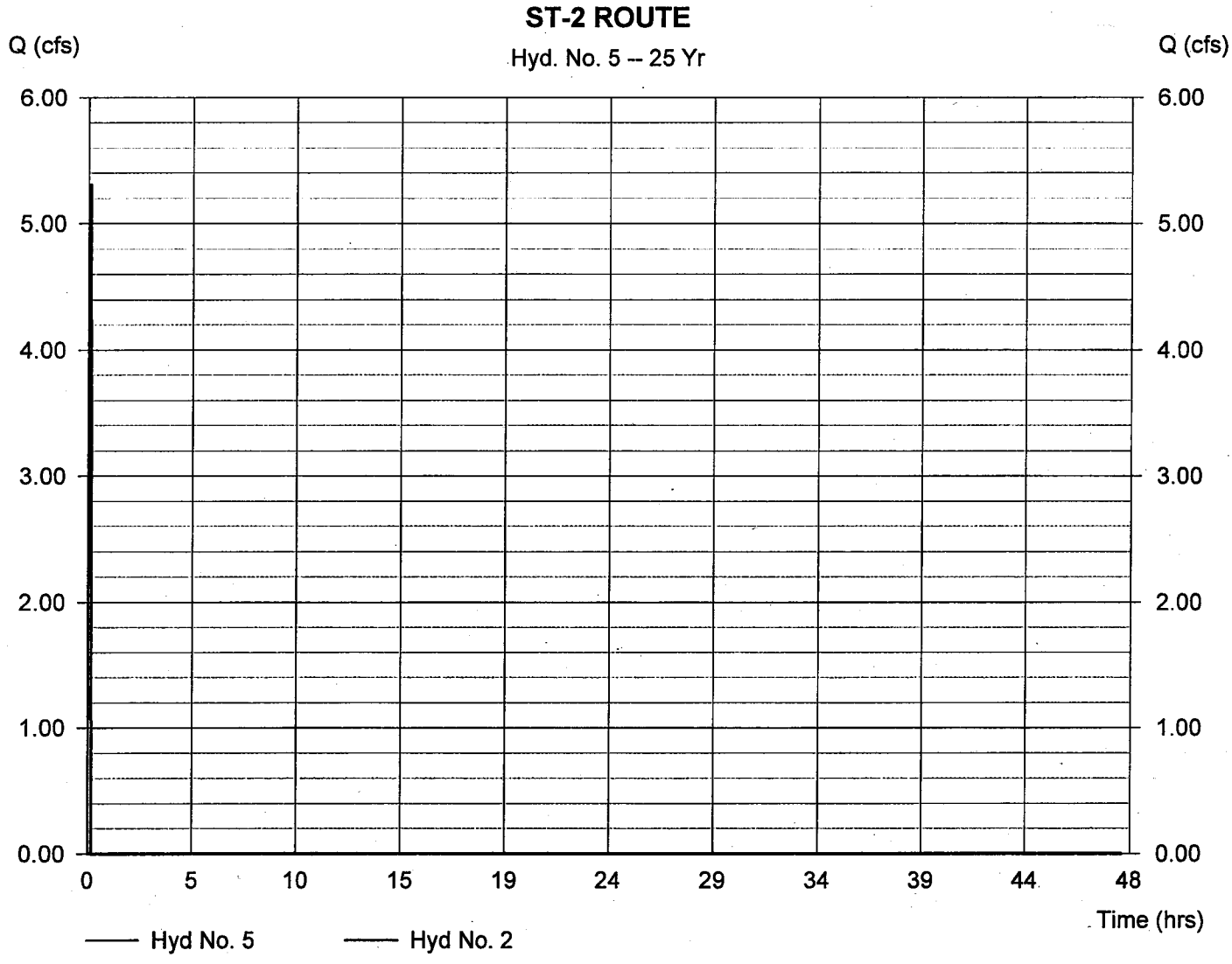
Hydraflow Hydrographs by Intelisolve | Tuesday, Jun 2 2009, 2:43 PM

Hyd. No. 5

ST-2 ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 80.74 ft
Reservoir name	= ST-2	Max. Storage	= 2,230 cuft

Storage Indication method used. | Hydrograph Volume = 0 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Tuesday, Jun 2 2009, 2:43 PM

Pond No. 2 - ST-2

Pond Data

Bottom LxW = 32.0 x 16.0 ft Side slope = 2.0:1 Bottom elev. = 78.00 ft Depth = 6.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	78.00	512	0	0
0.30	78.30	571	162	162
0.60	78.60	633	181	343
0.90	78.90	698	200	542
1.20	79.20	765	219	762
1.50	79.50	836	240	1,002
1.80	79.80	909	262	1,264
2.10	80.10	986	284	1,548
2.40	80.40	1,065	308	1,855
2.70	80.70	1,147	332	2,187
3.00	81.00	1,232	357	2,544
3.30	81.30	1,320	383	2,927
3.60	81.60	1,411	409	3,336
3.90	81.90	1,504	437	3,773
4.20	82.20	1,601	466	4,239
4.50	82.50	1,700	495	4,734
4.80	82.80	1,802	525	5,259
5.10	83.10	1,907	556	5,816
5.40	83.40	2,015	588	6,404
5.70	83.70	2,126	621	7,025
6.00	84.00	2,240	655	7,680

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

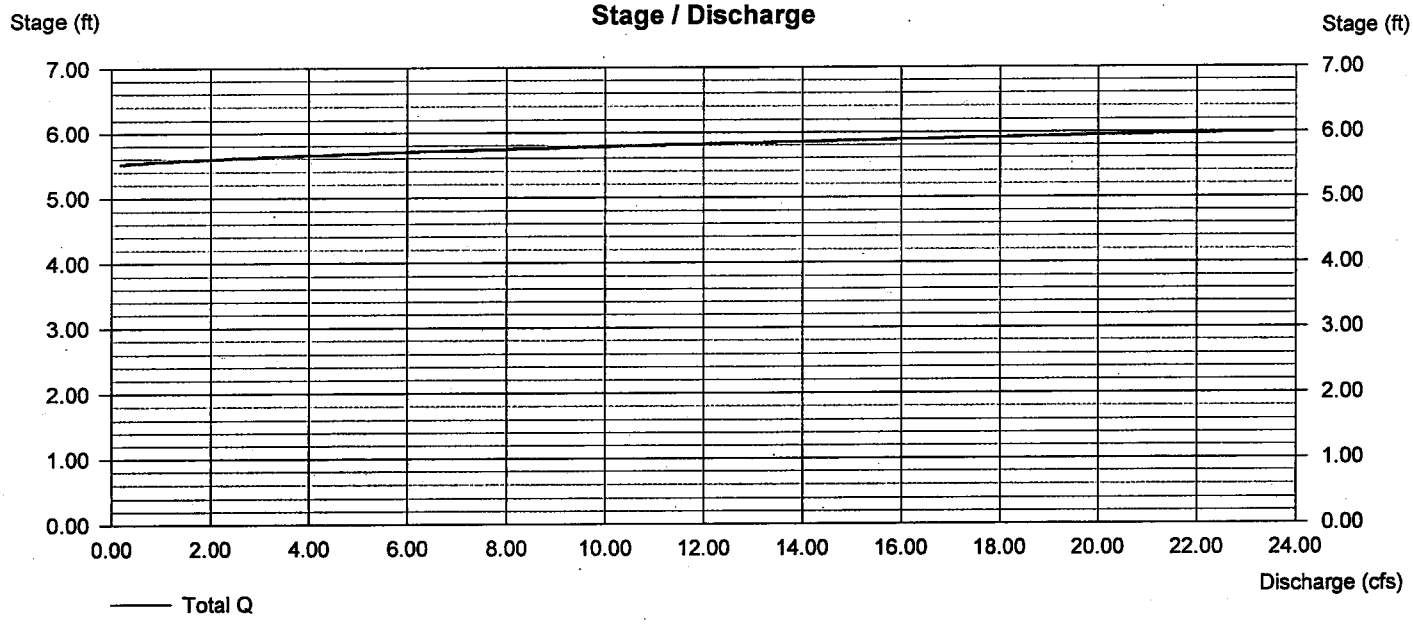
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 83.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

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

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

Stage / Discharge



Hydrograph Plot

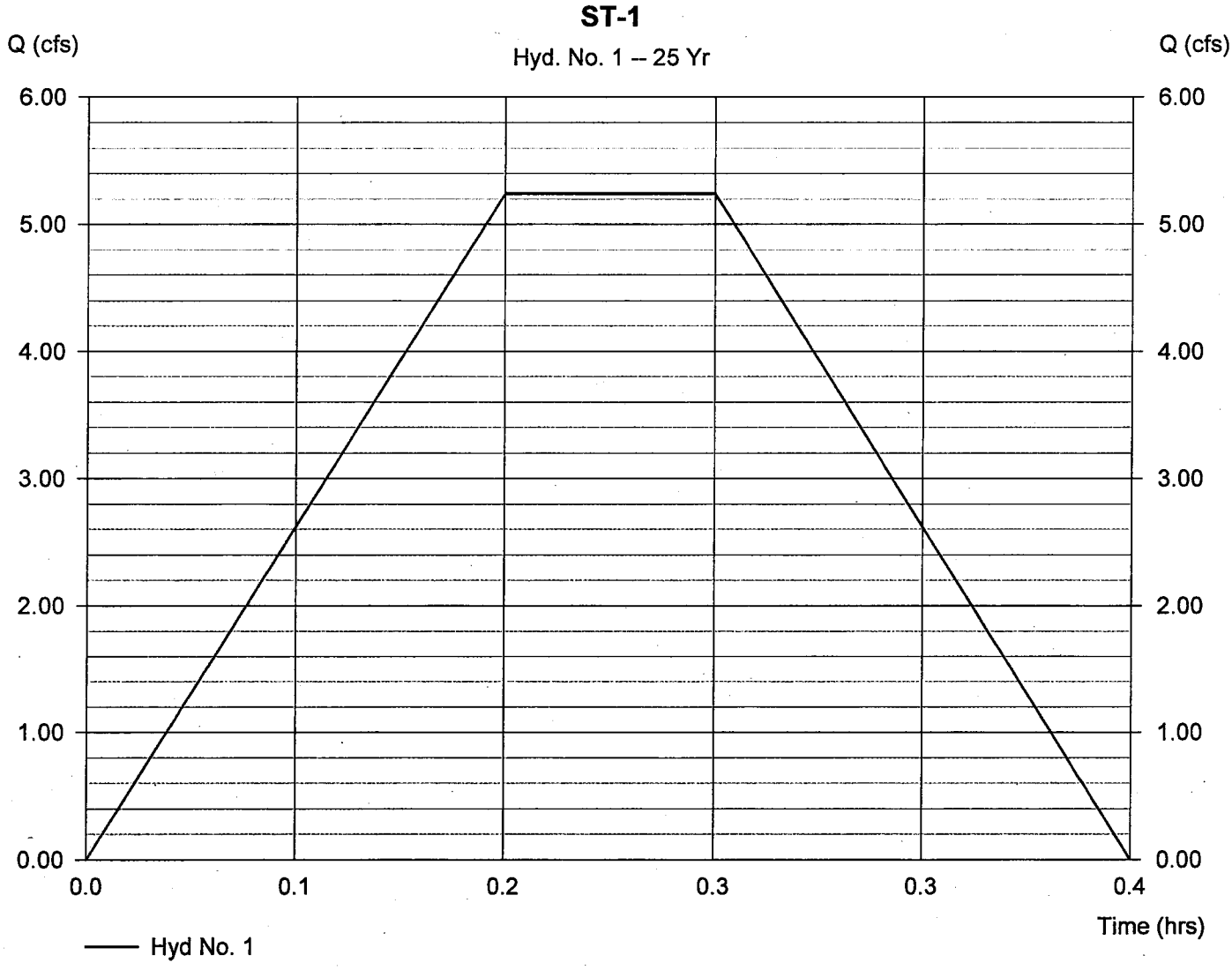
Hydraflow Hydrographs by Intelisolve | Tuesday, Jun 2 2009, 2:43 PM

Hyd. No. 1

ST-1

Hydrograph type	= Mod. Rational	Peak discharge	= 5.24 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 2.480 ac	Runoff coeff.	= 0.35
Intensity	= 6.040 in/hr	Tc by User	= 10.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,718 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

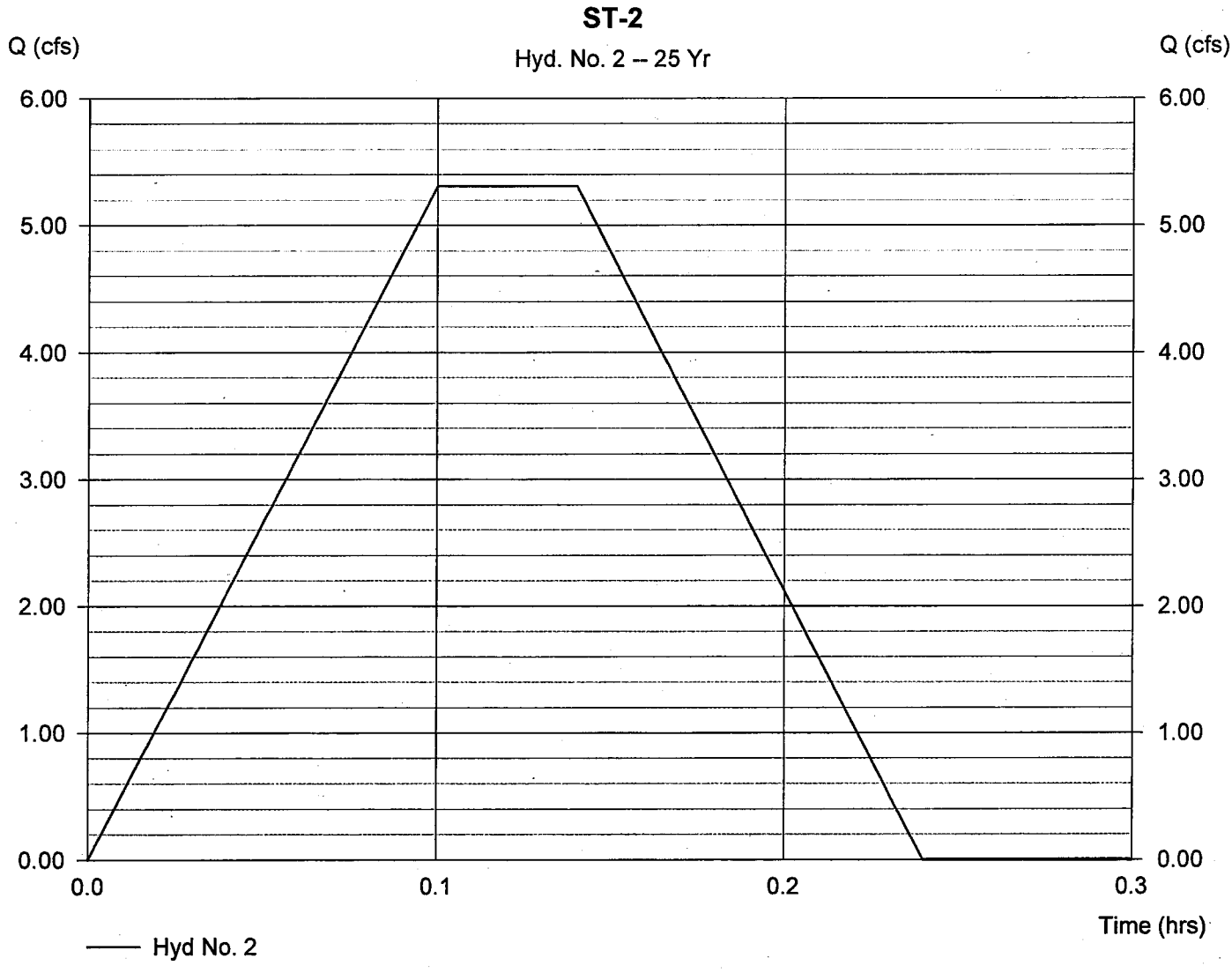
Tuesday, Jun 2 2009, 2:43 PM

Hyd. No. 2

ST-2

Hydrograph type	= Mod. Rational	Peak discharge	= 5.31 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.990 ac	Runoff coeff.	= 0.35
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,389 cuft



Hydrograph Plot

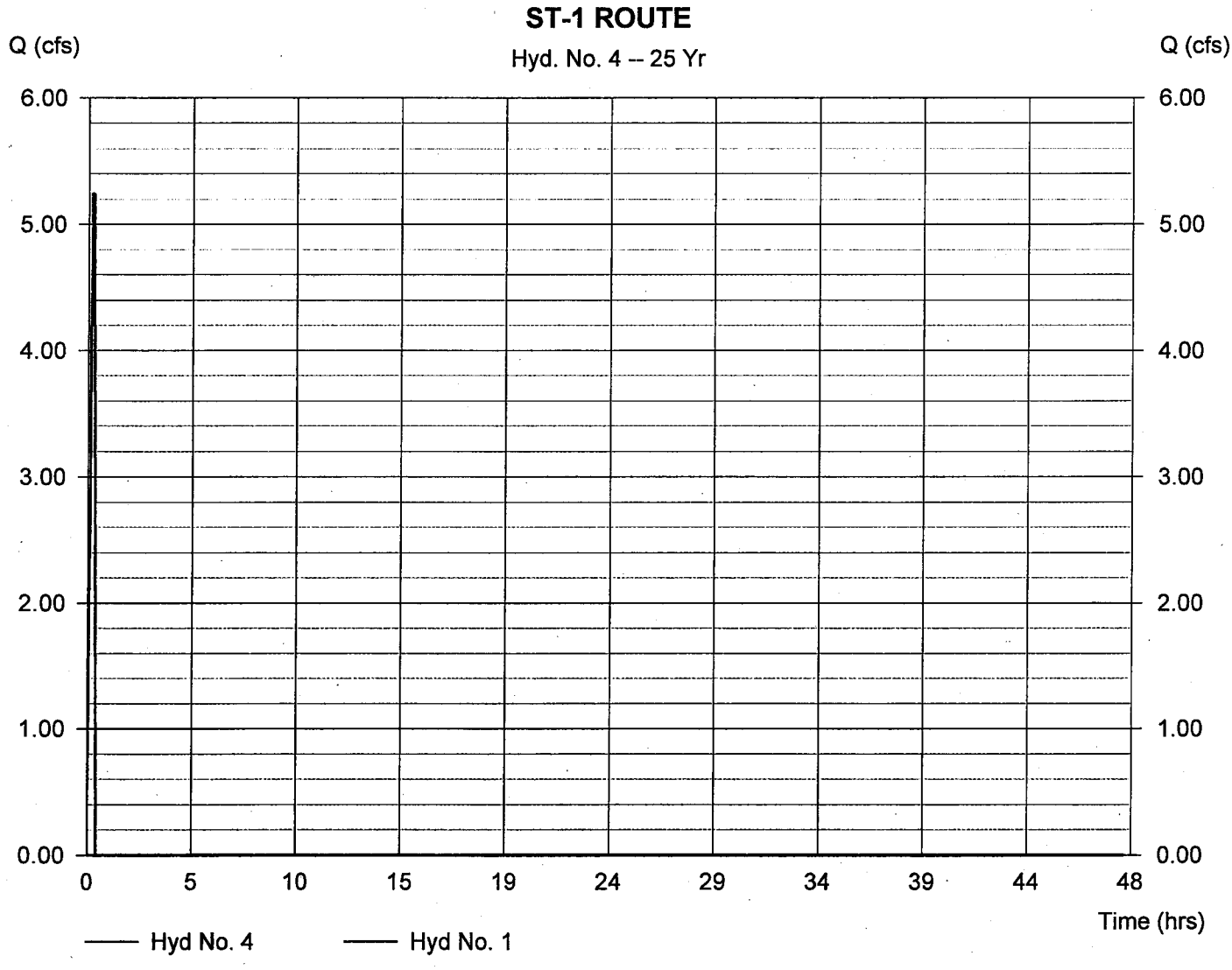
Hydraflow Hydrographs by Intelisolve — Tuesday, Jun 2 2009, 2:43 PM

Hyd. No. 4

ST-1 ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 83.82 ft
Reservoir name	= ST-1	Max. Storage	= 4,718 cuft

Storage Indication method used. — Hydrograph Volume = 0 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Jun 2 2009, 2:43 PM

Pond No. 1 - ST-1

Pond Data

Bottom LxW = 38.0 x 19.0 ft Side slope = 2.0:1 Bottom elev. = 80.00 ft Depth = 6.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	80.00	722	0	0
0.30	80.30	792	227	227
0.60	80.60	865	248	475
0.90	80.90	940	271	746
1.20	81.20	1,019	294	1,040
1.50	81.50	1,100	318	1,358
1.80	81.80	1,184	343	1,700
2.10	82.10	1,271	368	2,068
2.40	82.40	1,361	395	2,463
2.70	82.70	1,454	422	2,885
3.00	83.00	1,550	451	3,336
3.30	83.30	1,649	480	3,816
3.60	83.60	1,750	510	4,325
3.90	83.90	1,855	541	4,866
4.20	84.20	1,962	572	5,438
4.50	84.50	2,072	605	6,043
4.80	84.80	2,185	638	6,682
5.10	85.10	2,301	673	7,355
5.40	85.40	2,420	708	8,063
5.70	85.70	2,541	744	8,807
6.00	86.00	2,666	781	9,588

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

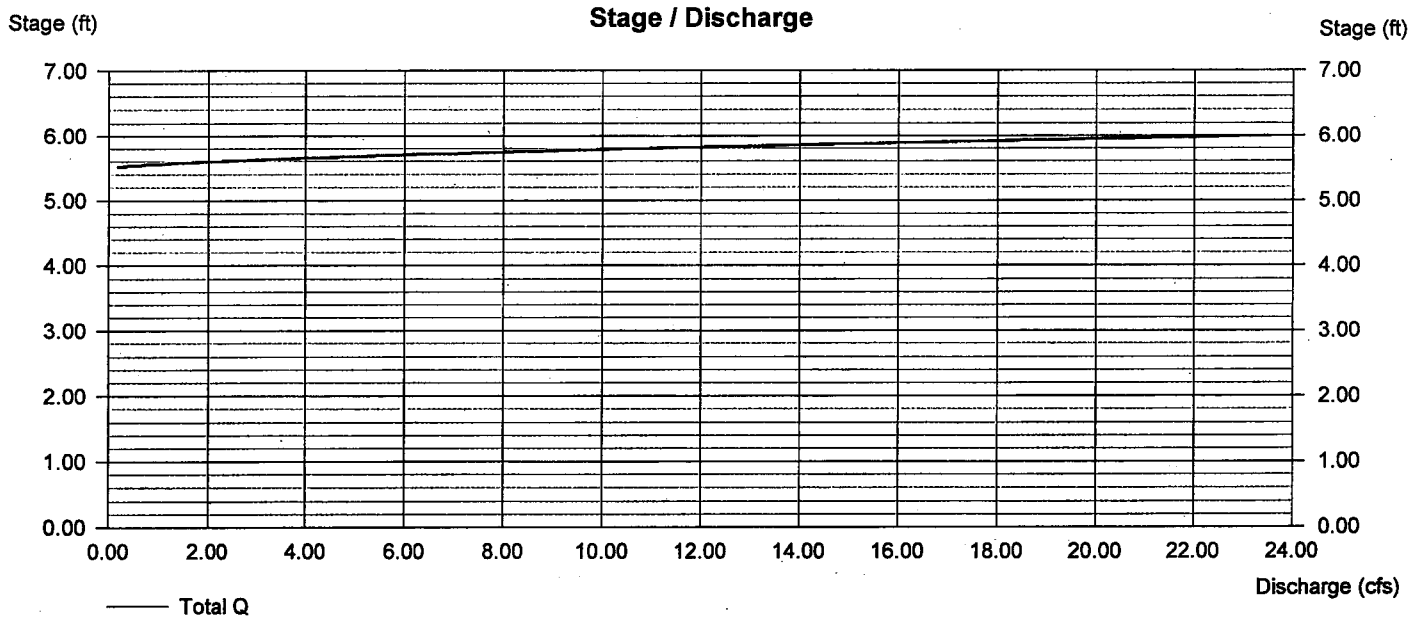
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 85.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

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

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

Stage / Discharge



Hydrograph Plot

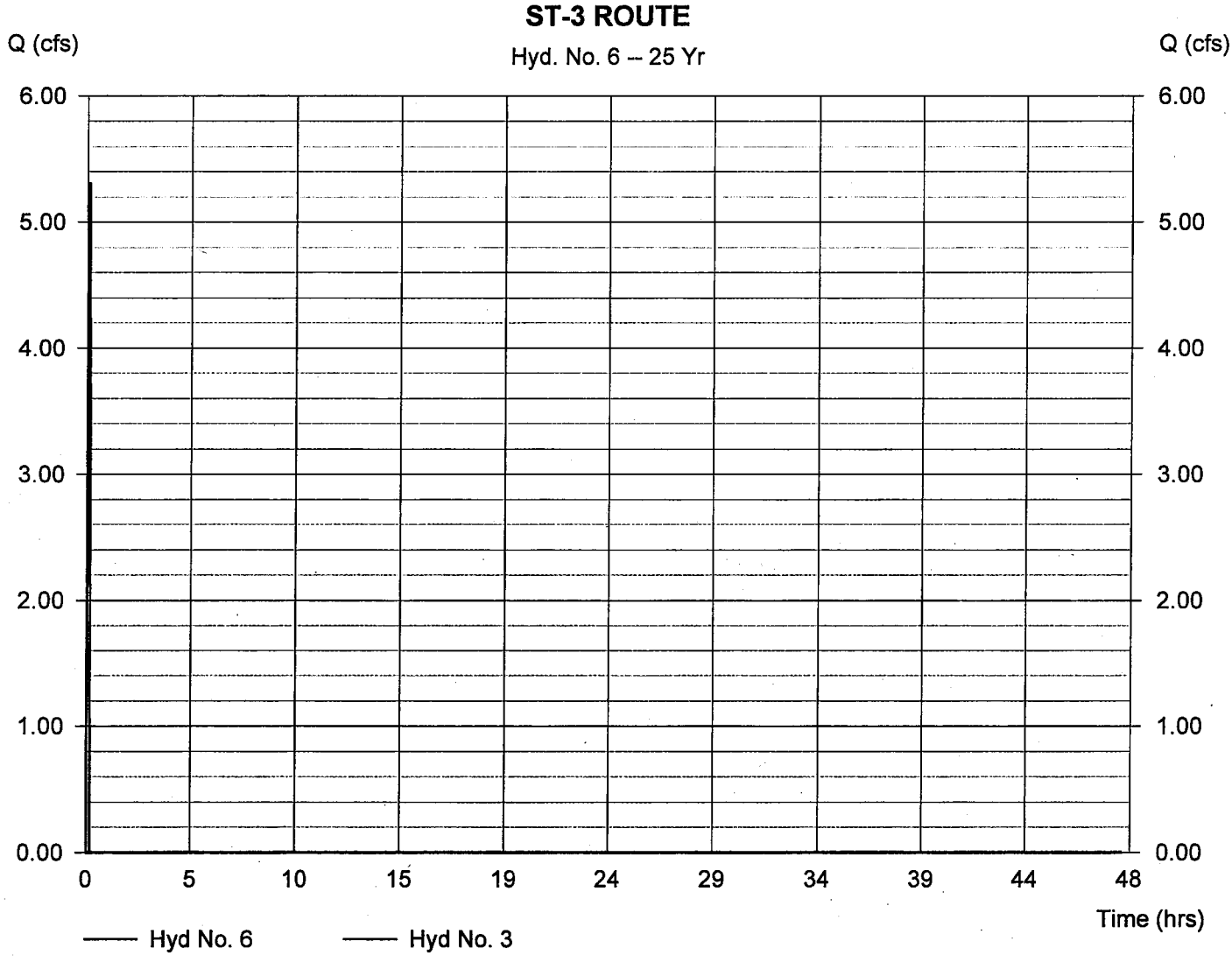
Hydraflow Hydrographs by Intelisolve | Tuesday, Jun 2 2009, 2:43 PM

Hyd. No. 6

ST-3 ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 95.21 ft
Reservoir name	= ST-3	Max. Storage	= 2,230 cuft

Storage Indication method used. | Hydrograph Volume = 0 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve — Tuesday, Jun 2 2009, 2:43 PM

Pond No. 3 - ST-3

Pond Data

Bottom LxW = 110.0 x 8.0 ft Side slope = 2.0:1 Bottom elev. = 93.50 ft Depth = 4.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	93.50	880	0	0
0.20	93.70	975	185	185
0.40	93.90	1,071	205	390
0.60	94.10	1,169	224	614
0.80	94.30	1,268	244	858
1.00	94.50	1,368	264	1,121
1.20	94.70	1,469	284	1,405
1.40	94.90	1,572	304	1,709
1.60	95.10	1,676	325	2,034
1.80	95.30	1,781	346	2,380
2.00	95.50	1,888	367	2,747
2.20	95.70	1,996	388	3,135
2.40	95.90	2,105	410	3,545
2.60	96.10	2,215	432	3,977
2.80	96.30	2,327	454	4,431
3.00	96.50	2,440	477	4,908
3.20	96.70	2,554	499	5,407
3.40	96.90	2,670	522	5,930
3.60	97.10	2,787	546	6,475
3.80	97.30	2,905	569	7,044
4.00	97.50	3,024	593	7,637

Culvert / Orifice Structures

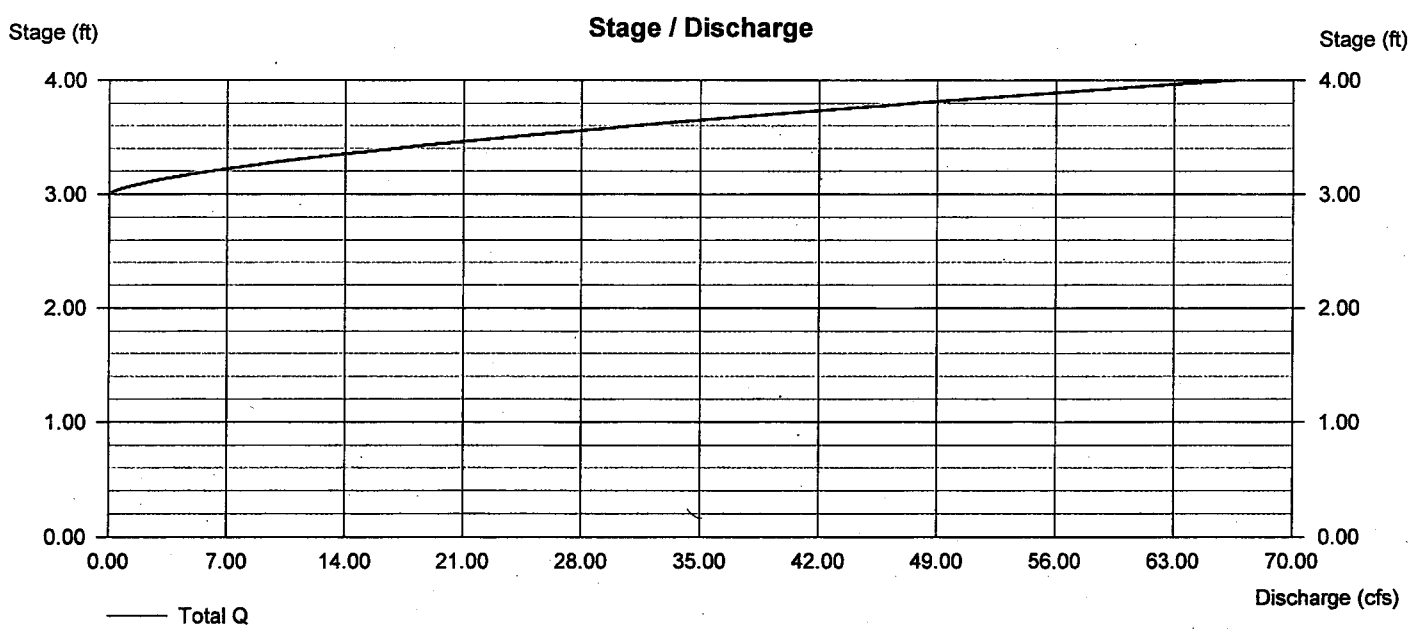
	[A]	[B]	[C]	[D]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 96.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

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

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



STILLING BASIN CALCULATIONS

DESIGN WORKSHEET - STILLING BASIN #1

WSP · SELLS

Project Name: STONEHOUSE AMENITY H

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

Variables:

Design Flow =	Q100	=	9.22	CFS
Barrel Diameter =	D	=	1.25	Feet
Depth of basin =	hs	=	0.83	
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	=	5.28		
	TW/D	=	0.16		
From Fig III-10	Yo/D	=	0.88		
	Yo	=	1.1	Feet	
	TW/Yo	=	0.18	< 0.75	Check
Use Yo/D as d/D from Table III-2 and insert the value for AVD^2		=	0.73		
	A	=	1.14	Sq. Feet	
	Vo	=	8.06		

Step 2	Ye	=	0.76
Step 3	Fr	=	1.63

Step 4 50 for Rip Rap	d50	=	0.3	Feet	
	d50/Ye	=	0.40		
Froude Number		=	1.63		
From Figure XI-2	hs/Ye	=	1.1		
	hs	=	0.83		
2 <	hs/d50	=	2.77	< 4	Check

Step 5

Length of Pool =	LS	=	8.32	Feet, or	3.8	Feet,	Whichever is Greater
Overall Length =	LB	=	12.48	Feet, or	5	Feet,	Whichever is Greater

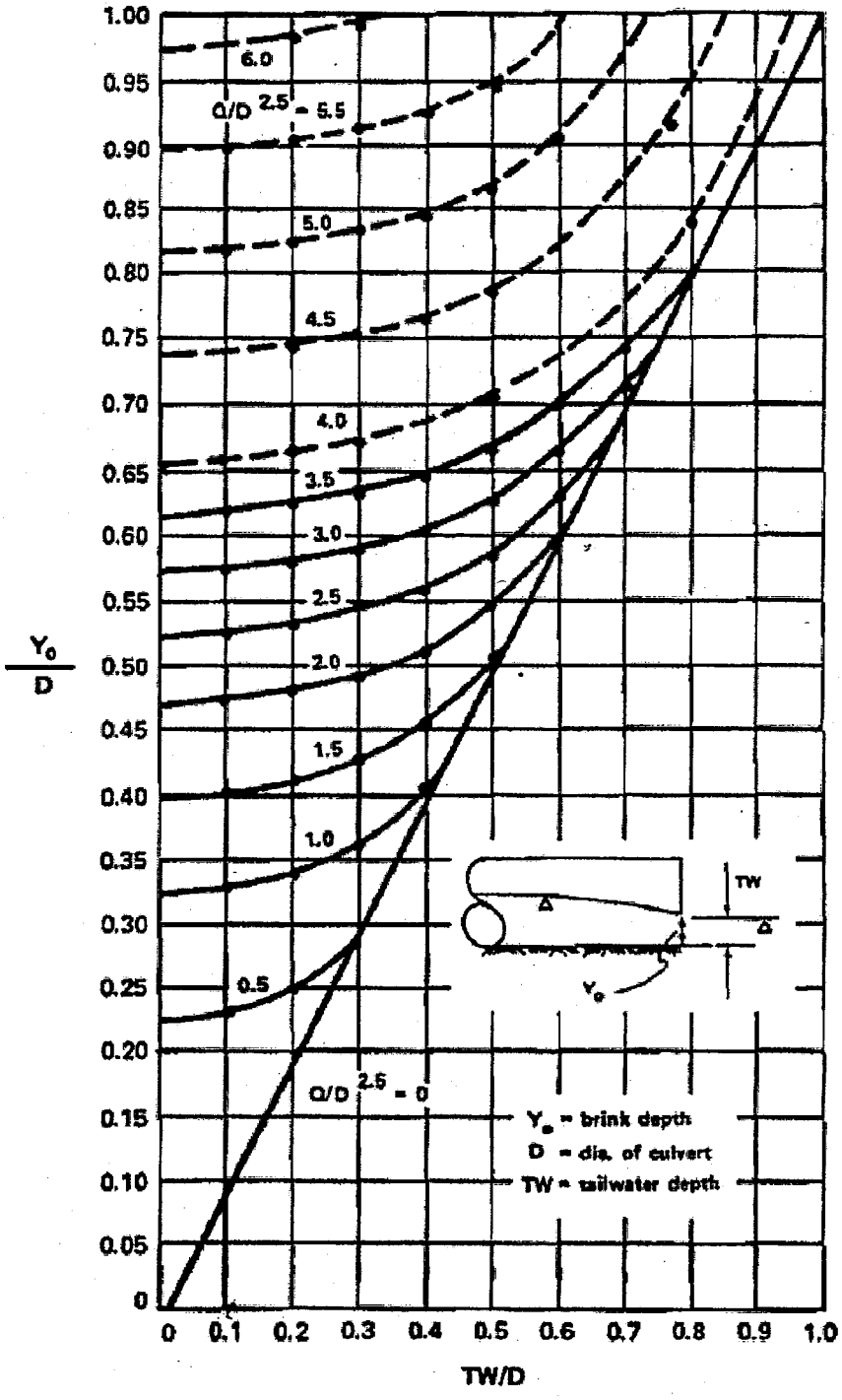


Figure III-10 Dimensionless Rating Curve for the Outlets of Circular Culverts on Horizontal and Mild Slopes from Reference III-2

DESIGN WORKSHEET - STILLING BASIN #1

WSP · SELLS

Project Name: STONEHOUSE AMENITY H

Designed by: DF Date: 4/21/09
Checked by: CD Date: 4/21/09

Variables:

Design Flow =	Q100	=	9.22	CFS
Barrel Diameter =	D	=	1.25	Feet
Depth of basin =	hs	=	0.83	
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	=	5.28	
	TW/D	=	0.16	
From Fig. III-10	Yo/D	=	0.88	
	Yo	=	1.1	Feet
	TW/Yo	=	0.18	< 0.75
Use Yo/D as d/D from Table III-2 and insert the value for **A/D^2**		=	0.73	
	A	=	1.14	Sq. Feet
	Vo	=	8.06	

Step 2	Ye	=	0.76	

Step 3	Fr	=	1.63	

Step 4 50 for Rip Rap	d50	=	0.3	Feet
	d50/Ye	=	0.40	
Froude Number		=	1.63	
From Figure XI-2,	hs/Ye	=	1.1	
	hs	=	0.83	
2 <	hs/d50	=	2.77	< 4

Step 5

Length of Pool =	LS	=	8.32	Feet, or	3.8	Feet, Whichever is Greater
Overall Length =	LB	=	12.48	Feet, or	5	Feet, Whichever is Greater

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Check

POOR QUALITY

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Note changes and open the possibilities for new comments.

Insert information from pr

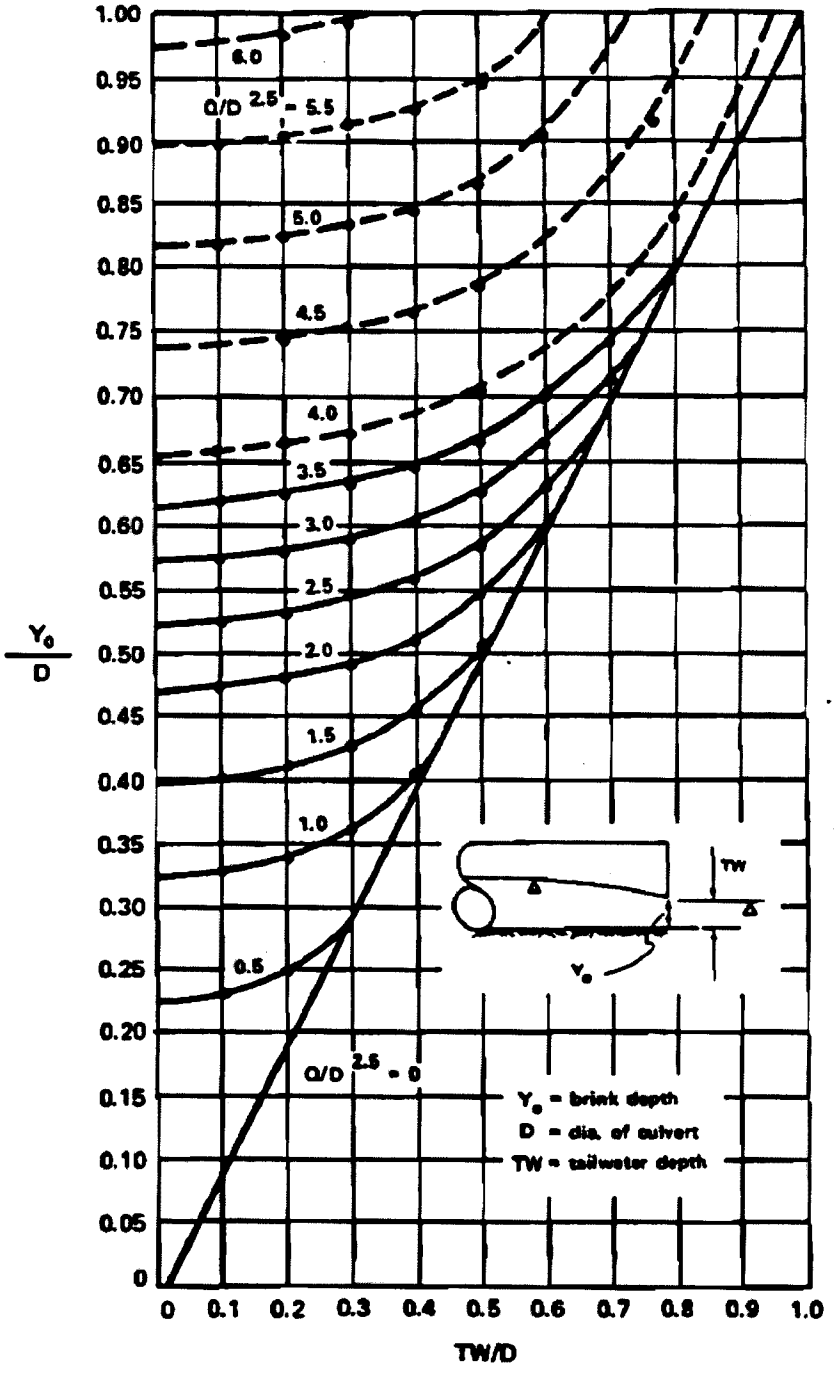

Figure III-10 Dimensionless Rating Curve for the Outlets of Circular Culverts on Horizontal and Mild Slopes from Reference III-2

- need special storm water conveyance . . .
  proper 10.1
  ~~Pro~~ Submit prove for
  1-year 24 h

- maintenance on Plan 896-4975

- outfall perpendicular to channel
  not good

B92 0351

- no need sizing for ST.
- pre development at FES#1
  compare to post development
ST - wet and dry storage

- If no elimination they need to prove that will hold channel
- If underdrain Bioretention can have 1' of ponding
- drainage area maps for ~~adequ~~ channel calc.
- BMP #1 need underdrain because of ST

$\frac{43560}{12} = 3630 cf$

$43560 \times 1/12$

$\frac{2906}{}$

17. Record drawings prepared in accordance with the JCSA Standards and Specifications must be submitted to JCSA and approved prior to JCSA's acceptance of the proposed water and sewer facilities.

Comment noted.

18. Add the following note to the drawings: "Only JCSA personnel are authorized to operate valves on the existing JCSA water main".

The above note is included as part of JCSA General Notes on Sheet C0.1. However, note to be added as part of the General Utility Notes on Sheet C6.0.

19. The Applicant shall be responsible for developing water conservation standards to be submitted to and approved by the James City Service Authority and subsequently for enforcing these standards. The standards shall address such water conservation measures as limitations on the installation and use of approved landscaping design and materials to promote water conservation and minimize the use of public water resources. Because the Guidelines refer to landscaping, irrigation and plant material, the James City Service Authority (JCSA) shall approve the standards prior to final plan approval. Please contact Mrs. Beth Davis, JCSA Environmental Education Coordinator at (757) 253-6859, as early in the landscape design process as possible.

A DRAFT Water Conservation Agreement was included with the initial submittal, however, no comments were received.

20. All proposed JCSA Utility Easements shall be 20' minimum width, including those provided around fire hydrants.

Comment noted.

<u>Environmental (refer to Memorandum dated February 12, 2009)</u>

General:

1. A Land-Disturbing Permit and Siltation Agreement, with surety, are required for this project.

Comment noted.

2. A stormwater facilities inspection fee is required prior to issuance of a Land-Disturbing Permit. Contact the Stormwater Division at 259-1460 for additional information.

Comment noted.

3. A Standard Inspection / Maintenance agreement is required to be executed with the County due to the proposed stormwater conveyance systems and Stormwater Management/BMP facilities associated with this project.

Comment noted.

4. Offsite Work. Provide evidence of permission to occupy or disturb the offsite adjacent tract from the parcel owner.

GS Stonehouse is the land owner for the off-site adjacent tract.

5. Miss Utility. Provide standard notes requiring contact of Miss Utility prior to any utility or site work excavations.

Sheet C0.1 includes a General Utility Note for the Contractor to contact Miss Utility.

6. A Geotechnical Report, prepared by a professional engineer, is required to be submitted for the BMP design prior to issuance of a Land-Disturbing permit for the project.

GET has completed the field work and testing for the subsurface investigation. A report from GET will be submitted to the County under separate cover.

7. Record Drawing and Construction Certification. The stormwater management/BMP facility as proposed for this project will require submission, review and approval of a record drawing (asbuilt) and construction certification prior to release of the posted bond/surety. Provide notes on the plan accordingly to ensure this activity is adequately coordinated and performed before, during and following construction in accordance with current County guidelines.

Comment noted.

8. VSMP. Construction activity for the site will exceed 2,500 square feet. Therefore, it is the owner's responsibility to register for coverage under the General Permit for Discharge of Stormwater from Construction Activities, in accordance with current requirements of the Virginia Department of Conservation and Recreation and the Virginia Stormwater Management Program. Visit http://www.dcr.virginia.gov/sw/vsmp.htm or contact the DCR Central Office at 804-371-7330 for additional information.

Comment noted.

9. VDOT. It appears a VDOT CE-7 (temporary construction entrance permit) will be required. Contact the Williamsburg Residency, Permits and Subdivisions at 757-253-4832 for further information.

Comment noted.

10. Plan Number. Please reference the assigned County plan number on all subsequent submissions.

The County Plan Number SP-0008-2009 will be added to the Cover Sheet.

11. A conservation easement / Natural Open Space Easement plat and a Deed of Easement must be reviewed, approved, and recorded prior to the issuance of a land disturbing permit. Please include the RPA in this easement.

Comment noted.

12. Please provide a digital file (.dxf) of the property line, surveyed wetlands line and Resource Protection Area line so that the County's RPA GIS layer can be brought up-to-date in this area. Submit via e-mail to Mr. Michael Woolson at mwoolson@james-city.va.us.

Kerr Environmental (Kerr) shall submit a digital file of the surveyed wetland line and RPA buffer line the County. Communications with the County's Mike Woolson are ongoing with Kerr to amend the previous buffer determination dated May 9, 2008 due to the compilation of the wetland delineations from Landmark (Flag #2425) and Kerr (Flag #WFSM-12).

Chesapeake Bay Preservation:

13. Environmental Inventory. Although an environmental inventory plan sheet was provided in the plan set, please quantify all impacts (acres, square feet, linear feet, etc.), as applicable.

No impacts to wetlands are anticipated for this project. Sheet C1.0 identifies the proposed RPA impacts associated with BMP outfalls and steep slope impacts associated with BMP and open play area grading.

14. Steep Slope Areas. Section 23-5 of the Chesapeake Bay Preservation Ordinance does not allow land-disturbing activities to be performed on slopes 25 percent or greater. It appears that steep slope areas are impacted; therefore, a request for a waiver or exception is required, in writing.

Comment noted.

15. RPA Signs. Include provisions on the plan for installation of signs identifying the landward limit of the RPA or conservation easement (whichever is more restrictive). Refer to Section 23-7(c) of the Chapter 23 Chesapeake Bay Preservation ordinance.

RPA signs will be added.

16. Water Quality Impact Assessment. A WQIA may be required once all stormwater outfalls are discharged to an adequate channel. Refer to Sections 23-7(b) and 23-11 of the Chesapeake Bay Preservation ordinance.

A Minor Water Quality Impact Assessment will be included with the re-submittal.

Erosion & Sediment Control Plan:

17. Soils Data. The listed erodibility factors for soils 10B, 10C, and 11C are incorrectly listed and should have a range from 0.32 to 0.37, per page 132 of the Soil Survey of James City and York Counties and the City of Williamsburg Virginia, 1985.

Erodibility factors will be corrected.

18. Existing Conditions Notes: Please provide all dates in notes number 4 and 5 as presented on plan sheet C0.1.

Dates will be provided for the USACE verification of the wetland delineations and the County's verification of the RPA buffers.

19. Temporary Stockpile Areas. The location of the stockpile area, as shown on the Erosion Control Plan – Phase 2, seems to be in the way of major earthwork operations. A different location may be more beneficial, even if offsite.

The construction sequence for Phase 1 will be revised to clarify that initial top soil stripping and earthwork operations will be required in the vicinity of proposed temporary stockpile area for future use to establish turf for the open play area.

20. Limits of Work. Adjust the limits of work to include the BMP outfalls, once they are directed to an adequate channel. Ensure that all applicable revisions are made to the Environmental Inventory once alterations have been made.

BMP outfalls will be extended to the wetlands and adequate channels.

21. Tree Protection. Include tree protection around the entire area to be protected at the southwestern corner of the site, near the intersection of Fieldstone Parkway and Six Mount Zion Road.

Tree protection fence will be added along the northwestern portion of the site between Six Mt. Zion Road and the grading for the open play area.

22. Phase 1 Erosion Control Plan. The following comments pertain to the Phase 1 Erosion Control Plan, as presented:

a. Provide a construction entrance.

A construction entrance will be added.

b. Provide elevations and grading for sediment trap #3.

Sediment trap #3 has been deleted.

c. Adjust (move) sediment traps 1 and 2 so that the outfalls of the structures are located where the outfall of the temporary slope drains are located. Further, upsize these two traps into basins, so that they will have a more useful project lifespan. They can be gradually filled in as the slopes in these areas are brought to final grade. Provide all pertinent calculations. Provide baffles, if necessary.

As discussed in the February 23, 2009 plan review meeting, drainage areas for the traps are less than 3-acres. Given these temporary devices will be removed, construction of basins is not warranted. However, the proposed BMP outfalls will be constructed as part of the Phase 1 erosion control sequence for the temporary slope drain connections. Calculations will be provided to confirm adequate capacity for the 2-year and 25-year storm events.

23. Sequence of Construction. Provide a sequence of construction outlining installation of erosion and sediment control measures for the project and associated site and utility work. Include perimeter areas required for installation of erosion and sediment control and utility connections. It is important to clarify what steps occur when, as basically the entire western and northern half of the project is in fill and the entire eastern half is in cut.

Construction sequencing for Phases 1 and 2 operations are provided on Sheets C4.0 and C4.1.

24. Rock Check Dams. Provide rock check dams at sufficient foot intervals (100 ft. suggested) in the diversions leading to the sediment traps/basins.

Rock check dams will be provided at approximately 100-foot intervals for diversions.

25. Additional Erosion Control Plan comments may be generated in the future once basins are provided for.

Comment noted.

Stormwater Management / Drainage:

26. Drainage. Drainage easements of adequate width are necessary to ensure offsite drainage can be maintained through the proposed onsite storm drainage system or for on-site drainage

to convey through off-site systems or channels. Refer to Item 7 of the *James City County Stormwater Conveyance Systems General Design and Construction Guidelines.*

Comment noted.

27. BMP/Water Quality Points. The standard worksheet for the BMP Point System as provided shows a fraction of the site as an acre value. Please provide proper information consistent with the procedure of the calculation of the BMP points. A fraction of the site should be shown as a percentage value of the proposed development. Please submit proper information with the next submittal.

The worksheet will be corrected. .

28. Please make sure that Structure Number column in Drainage Structure Table (on sheet C3.0) is consistence with the marking of that structures on the plan.

The Drainage Structure Numbers will be corrected.

29. Pipes. Provide information about the pipe size, type, length and slope on the plan. Also for the outfall pipe of BMP #2 consider the use of a manhole structure as a stilling well immediately up stream of the system outfall to slow down the discharge into stilling basin.

The Drainage Piping Table on Sheet C3.0 provides the required information for clarity. Drop manholes will be used for the BMP outfalls to reduce velocities.

30. Based on high erodibility of soils in the Stonehouse district, all stilling basins and associated outfalls will have to be relocated to the edge of the wetlands. This will require waiver/exception to the RPA.

Stilling basins will be relocated to the wetlands subject to the County's administrative approval of a waiver/exception for the RPA buffer impacts associated with the BMP outfalls.

31. Stilling basins. With the next submittal provide all proper information concerning calculation and detail drawing for each of the stilling basins.

Calculations will be provided based on the County's sample worksheet.

32. Details. Provide detail for BMP#4 and swales.

A detail for BMP#2 (previously BMP#4) is provided on Sheet C5.1. A detail for the proposed wet swales (BMP#3) is provided on Sheet C4.1.

33. Swales. Configuration of the swale B and C need to be reworked. Consider joining swales together and wrapping them around the slope, place riser structure in the mid section of the swale with outfall pipe discharging to the define channel.

An inlet at the joining of the swales will be added to connect to the outfall pipe.

34. Drainage Map. Provide a drainage map showing proposed drainage sub areas with more visible delineation of drainage areas. Include the size of each drainage area as well as applicable runoff coefficients, times of concentration and applicable offsite service area.

Revisions to the drainage map included in the Stormwater Management & Drainage Design Report will be provided.

35. Channel Adequacy. There are approximately 2 areas associated with this development plan which discharge into existing natural drainage channels from storm drain pipe in an uncontrolled manner. Submit adequacy analyses for all design and existing receiving natural and man-made drainage channels in accordance with VESCH, MS-19 procedure to verify that those channels are adequate for velocity and capacity using the 2-year design storm event and man-made channels are adequate for velocity based on the 2-year event and for capacity based on the 10-year event. Evaluate natural channels based on permissible velocities using existing soil or existing cover conditions.

Adequacy calculations are not required for the outfall from BMP #1. Adequacy calculations wil be provided for the outfall from the swales.

36. Bioretention Areas. The following comments pertain to the information provided in the submittal package and related to the propose Bioretention facilities:

    a. With the next submittal provide landscaping plan for bio-retention basins.

Landscape Development Plans with BMP plantings for the bioretention basin (BMP#1) will be provided with the re-submittal.

    b. Provide a soil specification on plan sheet C5.1 consistent with the requirements contained in the Virginia Stormwater Management Handbook.

    Typical soil specifications are provided on the Landscape Development Plans. In addition to revising the filter media depth from 3-feet to 2.5 feet, the Bioretention Cross Section Notes on Sheet C5.1 will be revised to reflect the requirements contained in the Virginia Stormwater Management Handbook.

    c. Ensure that a proper interlocking mulch specification is included with the next submittal.

    As discussed in the February 23, 2009 plan review meeting, use of a herbaceous layer or ground cover (70 to 80% coverage) will be specified rather than interlocking mulch.

37. Additional Stormwater Management comments may be generated in the future one all proper information will be submitted.

Comment noted.

<u>Fire Department (refer to Comments dated February 4, 2009)</u>

1. The proposed fire hydrant is shown installed on a 6-inch water main. JCSA and JCC Fire Department standards require fire hydrants to be supplied by a minimum 8-inch water main.

The water main will be increased to 8-inches.

<u>VDOT (refer to Memorandum dated February 11, 2009)</u>

1. Are the drainage structures shown within the right of way on Sheet C6.0 a part of this plan or installed as part of the roadway plans? The following items are related to the drainage structures that need to be addressed.

As discussed in the February 23, 2009 plan review meeting, improvements to Six Mt. Zion Road will be constructed at a later date.

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JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

EROSION AND SEDIMENT CONTROL PLAN CHECKLIST

I. *GENERAL:*

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

II. *SITE PLAN:*

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

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

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

III. *NARRATIVE:*

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

Yes No N/A

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

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

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

IV. *CALCULATIONS:*

Yes No N/A

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

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

JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST

I. *GENERAL:*

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

Yes No N/A

☒ ☐ ☐ *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins.

☒ ☐ ☐ *STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations.

☒ ☐ ☐ *TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided.

☒ ☐ ☐ *MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities.

☒ ☐ ☐ *STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information.

☒ ☐ ☐ *PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.)

- ☒ ☐ ☐ North arrow and plan legend.
- ☒ ☐ ☐ Property lines.
- ☒ ☐ ☐ Adjacent property information.
- ☒ ☐ ☐ Existing site features and existing impervious cover areas.
- ☒ ☐ ☐ Impervious cover tabulations.
- ☒ ☐ ☐ Existing drainage facilities (natural or manmade).
- ☒ ☐ ☐ Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.).
- ☒ ☐ ☐ Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography.
- ☒ ☐ ☐ Existing and proposed easement locations.

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

II. *STORMWATER CONVEYANCE SYSTEMS:*

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

Yes No N/A

☒ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

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

III. *STORMWATER MANAGEMENT / BMP FACILITIES:*

Yes No N/A

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

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

☒ ☐ ☐ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

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

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

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

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

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

Yes No N/A

☐ ☐ ☒ *CORE TRENCH*

- ☐ ☐ ☒ Material (per plan or Geotechnical Report).
- ☐ ☐ ☒ Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
- ☐ ☐ ☒ Side slopes (1:1 maximum steepness)
- ☐ ☐ ☒ Depth (4' minimum or greater as dictated by Geotechnical Report).

☒ ☐ ☐ *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*

- ☒ ☐ ☐ Durable, watertight, resistant material (concrete preferred).
- ☒ ☐ ☐ Riser diameter is at least 1.25 times larger than barrel diameter.
- ☒ ☐ ☐ All pertinent dimensions and elevations shown.
- ☒ ☐ ☐ Control orifice or weir dimensions and elevations shown.
- ☒ ☐ ☐ Trash rack - removable - for each release.
- ☒ ☐ ☐ Anti-vortex device, baffle or plate.
- ☒ ☐ ☐ Riser base structure with dimensions and embedment specifications (concrete preferred).
- ☐ ☐ ☒ Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
- ☒ ☐ ☐ Low flow orifice with trash rack device.

☒ ☐ ☐ *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*

- ☒ ☐ ☐ Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
- ☒ ☐ ☐ Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
- ☒ ☐ ☐ Pipe inverts, length, size, class and slope shown.
- ☒ ☐ ☐ Flared end section or endwall provided on barrel outlet.

☒ ☐ ☐ *SEEPAGE CONTROL* - Phreatic line shown (4:1 slope measured from intersection of embankment and principal spillway design high water).

☒ ☐ ☐ *ANTI-SEEP COLLARS*

- ☒ ☐ ☐ Anti-seep collar, concrete preferred.
- ☒ ☐ ☐ Size - 15 percent increase in length of saturation using outside pipe diameter.
- ☒ ☐ ☐ Spacing and location on barrel (located at least 2 feet from a pipe joint).

☐ ☐ ☒ *FILTER DIAPHRAGMS* -Design based on latest NRCS design methods and certified by a professional engineer.

Yes No N/A

☒ ☐ ☐ *ELEVATION AND DIMENSIONAL DESIGN DATA*

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

☒ ☐ ☐ *CROSS SECTION THROUGH FACILITY*

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

☐ ☒ ☐ *EMERGENCY SPILLWAY PROFILE*

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

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

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

IV. *OUTLET PROTECTIONS:*

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

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

Plan Preparer: _____

Date: _____

SWMProg/BMP/Checklist/ChkList

5/5/09

Zv. Additional comments
in SP-008-09.1

Mike.

TRANSMITTAL

RECEIVED
APR 23 2009
ENVIRONMENTAL DIVISION

DATE: **April 23, 2009**

TO: JCSA
Environmental

FROM: Sarah Propst, Planner

SUBJECT: **SP-0008-2009, Stonehouse Amenity H**

ITEMS ATTACHED:

- Site Plan with new pages C1.0, 3.0, 4.0, 4.1, 5.0, and 6.0
- Revised Minor Water Quality Impact Assessment (Environmental)
- Revised Design Worksheet – Stilling Basin #1 (Environmental)

ACTION: Please review and return comments by **May 7, 2009.**

Please upload any comments issued for this application to CaseTrak.

STONEHOUSE
Amenity H

James City County, Virginia

Stormwater Management and Drainage Design Report

Date: April 9, 2009

RECEIVED
APR 2009
Planning Department

COMMONWEALTH OF VIRGINIA
DONALD ALLEN SEVER
Lic. No. 43575
PROFESSIONAL ENGINEER

4/9/9

Prepared by:

WSP · SELLS

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Donald Sever, PE

SELLS Project Number 08-4046

STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT

Stonehouse – Amenity H

TABLE OF CONTENTS

Stormwater Management Narrative

Compliance with 10-Point System

Strom Drainage System

Erosion and Sediment Control

Significant Design Considerations

Special Stormwater Criteria Compliance

BMP Operation & Maintenance Plan

APPENDICES

- Worksheet for BMP Point System
- BMP Drainage Area Exhibit
- Sediment Traps Calculations
- Storm Drainage System Calculations
- Bioretention Area #1 Calculations
- Infiltration Trench #2 Design Worksheet
- Stilling Basin Design Calculations
- Channel Adequacy Calculations

Stormwater Management Plan – Stonehouse Amenity H

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 with 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: Amenity H is proposed to be a community center that will include construction of a 4,700 square foot community building, 4,500 square foot swimming pool, 20' x 20' wading pool, 30,000 square foot open lawn area, and outdoor seating area. Two access points will be provided off Six Mt. Zion Road for the main parking lot for the community building and swimming pool and a supplemental parking lot for the play areas. Better site design will help enhance natural views, while preserving the natural integrity of this site, as well as surrounding sites. Approx. 5.4 acres of land disturbance activity is proposed for this development.

- Existing Site Conditions: Amenity H is a 10.57 acre, densely vegetated, undeveloped tract with tree cover dominating the entire site. Approx. 3.28 acres of RPA are located along the western portion of the site. Within the center of the RPA are stream and wetland features, which naturally disperse water flow off-site to the north. No floodplains exist on-site.

- Adjacent and Off-Site Areas: Amenity H is located at the northwest quadrant of the Fieldstone Parkway and Six Mt. Zion Road intersection. To the west is an undisturbed natural open space area of Tract 12, which is a proposed single family community. To the north is the remaining undeveloped portion of Tract 3 which is future planned residential development. To the east across Six Mt. Zion Road is an undeveloped parcel which is a future tennis and softball complex. To the south across Fieldstone Parkway is Tract 10B, which is a future planned commercial development.

- Soils Description: The James City County soils survey indicates that Craven Fine Sandy Loam with 2% 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 RPA. 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 the Craven-Uchee Complex on the east side of Six Mt. Zion Road and Johnston Complex with the RPA.

- Critical Areas: Amenity H includes area of potentially erosive soils. Special consideration has been given to provide enhanced outlet protection measures including extending BMP outfalls to the wetlands and stilling basins with rip rap at the outlets beyond the required limits of the dissipater pads. Some steep slopes impacts are proposed associated with BMP construction and some impacts to the RPA buffer are proposed associated with BMP outlets. Refer to the "Environmental Inventory Map" for additional information.

Compliance with 10-Point System

The stormwater management plan utilizes several BMPs as follows:

- BMP#1 – Proposed bioretention area (10-pt) for treatment of approx. 1.99 acres from the parking lot and driveway and conveyance to the Stilling Basin #1 and wetlands;
- BMP#2 – Proposed infiltration basin (10-pt) for treatment of approx. 0.43 acres from the playground, sidewalk, and upland areas to convey in series to a wet swale (50% credit).
- BMP#3 – Proposed wet swales (4-pt) for treatment of approx. 2.70 acres from the open play, building, and pool deck areas and conveyance to Stilling Basin #2 and wetlands.

Please note, a future bioretention area (BMP#4) will be constructed with future improvements to Six Mt. Zion Road for treatment of approx. 0.86 acres from the future supplemental parking lot. The wet swales have been designed to convey the future outfall from BMP#4 in series (50% credit). In the interim, the area will remain undisturbed and be considered an area that treats stormwater runoff from the site for the purpose of complying with the County's requirements.

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

- Resource Protection Area (RPA) – Approx. 3.28 acres of wetlands, streams, and buffers exist at the east end of the site.
- Undisturbed Natural Open Space – Conservation easements are proposed for approx. 0.43-acres of the site adjacent to the RPA buffer.
- Tree Save Area – Approx. 1.00 acres of the site along Six Mt. Zion Road is proposed to remain natural, where practicable.

Refer to the "Worksheet for BMP Point System" and "Stormwater Management / BMP Facility Calculations" in the Appendices for more information.

Storm Drainage System

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.

Erosion & Sediment Control

Two (2) temporary sediment traps are proposed for initial Phase 1 activities 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.

An additional sediment trap (to be converted to BMP#1 after final stabilizaiton) is proposed for Phase 2 activities. In addition, improvements to the receiving channels at the outfalls of proposed BMPs #1 and 3 with stilling basins are proposed to provide enhance outlet protection. Refer to the plans for design specifications of erosion and sediment control devices including sediment basins, swales, and rip rap 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 a bioretention area and an infiltration trench to promote infiltration is proposed in areas where available soils mapping indicate HSG type B soils may be present. Please note, field geotechnical investigations have confirmed infiltration rates of greater than 0.52 in/hr.

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.*

The bioretention area (BMP#1) is proposed adjacent to the parking lot to provide enhanced water quality performance and has been designed to provide adequate detention for larger storm events. In addition, the infiltration trench (BMP#2) is proposed under the playground area with an overflow to the wet swales (BMP#3). Use of Filterra-type systems 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 may consider low impact walking trails within RPA buffer areas and an elevated boardwark crossing of the wetland/stream for connectivity to the existing Stonehouse Glen development with posted informational signs. Compliance with this consideration to post informational signs and limit development will be considered in the final design.

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.*

After review of this design consideration, the plan reflects avoidance of significant stream and RPA crossings with the exception of a possible elevated boardwalk crossing for a low impact walking trail.

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.*

Some steep slopes will be impacted associated with construction of the BMPs. 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.*

Conveyance of drainage for the proposed play areas shall be mimic existing sheet flow conditions. Lot-to-lot drainage is not applicable for the site.

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:

An initial version of the Stormwater Management Inventory System has been submitted to the County for compliance with this proffer.

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 and approval 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:

Do not have yet

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 = 6.23 acres

Measures = 3 unit measures from SSCP Menu (Class 3 for 1-10 acres)

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 = ½ unit

Proposed Measures:

SSCP#20: Enhanced Outlet Protection = 1 unit

Rip rap stilling basin will be provided at the outfall of BMPs #1 and #3 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 3:1 slopes. EC-3 non-degradable matting will be applied to 2:1 slopes associated with the proposed BMPs.

SSCP#28: Enhanced Channel Stabilization = 1 unit

EC-3 non-degradable matting applied to proposed drainage channels.

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 or obstructions 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 of the inspections 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,

WORKSHEET FOR 10-POINT SYSTEM

PROJECT NAME:	STONEHOUSE		
CHS PROJECT#:	08-4046		
DESIGNED BY:	AHH	DATE:	10/30/08
REVIEWED BY:	CMD	DATE:	01/22/09

WORKSHEET FOR BMP POINT SYSTEM

LAND AREA SUMMARY: Tract Amenity H

IDENTIFICATION	ACRES	
TOTAL AREA	10.96	
RPA BUFFER & WETLANDS	3.47	31.7% OF TOTAL AREA
STORMWATER DUNOS (Future BMP#4)	0.86	7.8% OF TOTAL AREA
ADJACENT DUNOS (Adjacent to Play Areas)	0.49	4.5% OF TOTAL AREA
OTHER DUNOS	0.00	0.0% OF TOTAL AREA
NET AREA (DENOMINATOR)	6.14	56.0% OF TOTAL AREA
STRUCTURAL SITE AREA (NUMERATOR)	1.50	24.4% 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	/	7.49	0.00
Wet Pond	8	x	0.00	/	7.49	0.00
Wet ED Pond	10	x	0.00	/	7.49	0.00
Shallow Marsh	6	x	0.00	/	7.49	0.00
ED Shallow Wetland	6	x	0.00	/	7.49	0.00
Pond/Wetland System	10	x	0.00	/	7.49	0.00
Pocket Wetland	6	x	0.00	/	7.49	0.00
Infiltration Trench (0.5"/imp ac)	8	x	0.00	/	7.49	0.00
Infiltration Trench (1"/imp ac)	10	x	0.00	/	7.49	0.00
Infiltration Basin (0.5"/imp ac)	8	x	0.00	/	7.49	0.00
Infiltration Basin (1"/imp ac) (BMP#3: Playground)	10	x	0.46	/	7.49	0.61
Bioretention (BMP#1: 1/2 parking & drive)	10	x	0.99	/	7.49	1.32
Bioretention (BMP#2: Drop-off, 1/2 parking & drive)	10	x	1.17	/	7.49	1.56
Bioretention (BMP#4: Future parking)	10	x	0.00	/	7.49	0.00
Surface Sand Filter	8	x	0.00	/	7.49	0.00
Underground Sand Filter	8	x	0.00	/	7.49	0.00
Perimeter Sand Filter	8	x	0.00	/	7.49	0.00
Organic Sand Filter	8	x	0.00	/	7.49	0.00
Pocket Sand Filter	6	x	0.00	/	7.49	0.00
Wet Swale (Play areas and BMP#3 in series)	2	x	0.46	/	7.49	0.12
Wet Swale (Play areas and building & pool areas)	4	x	2.62	/	7.49	1.40
Dry Swale	10	x	0.00	/	7.49	0.00
Biofilters	4	x	0.00	/	7.49	0.00
Timber Walls	4	x	0.00	/	7.49	0.00
Dry ED *(w/forebay)*	4	x	0.00	/	7.49	0.00
Offsite Credits*	6	x	0.00	/	7.49	0.00
	TOTAL WEIGHTED STRUCTURAL BMP POINTS:					**5.01**

** 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	0.86	/	10.96	x	(0.15 PER 1%)	1.18
Adjacent to a wetland, mature forest, or RPA	0.49	/	10.96	x	(0.15 PER 1%)	0.67
All other open space	3.47	/	10.96	x	(0.10 PER 1%)	3.17
	TOTAL NATURAL OPEN SPACE CREDIT:					**5.02**

C. TOTAL WEIGHTED POINTS

5.01	+	5.02	10.03
STRUCTURAL BMP POINTS		NATURAL OPEN SPACE POINTS	TOTAL

PROJECT NAME:	**STONEHOUSE**		
CHS PROJECT#:	08-4046		
DESIGNED BY:	AHH	DATE:	10/30/08
REVIEWED BY:	CMD	DATE:	01/22/09

WORKSHEET FOR BMP POINT SYSTEM

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STRUCTURAL SITE AREA (NUMERATOR)	1.50	*24.4%* OF NET AREA

A. STRUCTURAL BMP POINT ALLOCATION

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Small Wet Pond	6	x	0.00	/	7.49	0.00
Wet Pond	8	x	0.00	/	7.49	0.00
Wet ED Pond	10	x	0.00	/	7.49	0.00
Shallow Marsh	6	x	0.00	/	7.49	0.00
ED Shallow Wetland	6	x	0.00	/	7.49	0.00
Pond/Wetland System	10	x	0.00	/	7.49	0.00
Pocket Wetland	6	x	0.00	/	7.49	0.00
Infiltration Trench (0.5"/imp ac)	8	x	0.00	/	7.49	0.00
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Timber Walls	4	x	0.00	/	7.49	0.00
Dry ED *(w/forebay)*	4	x	0.00	/	7.49	0.00
Offsite Credits*	6	x	0.00	/	7.49	0.00
			TOTAL WEIGHTED STRUCTURAL BMP POINTS:			**5.01**

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

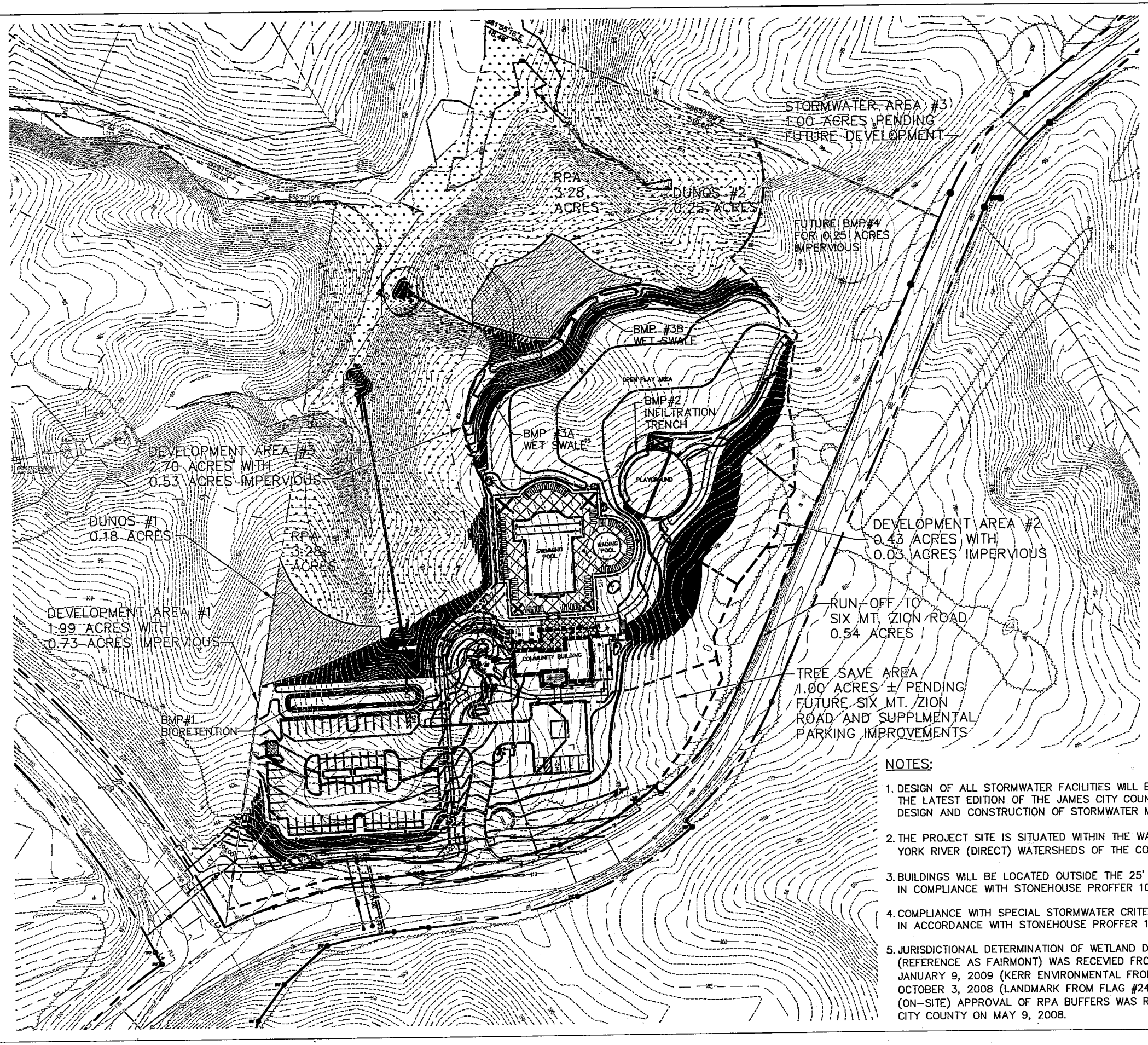
B. NATURAL OPEN SPACE CREDIT

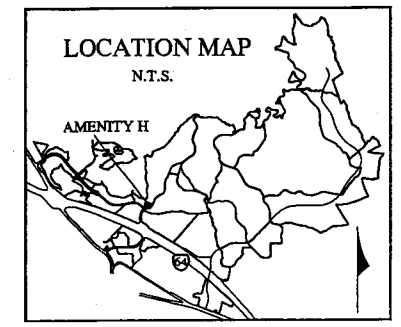
OPEN SPACE CONSERVATION EASEMENTS	FRACTION OF SITE TO OPEN SPACE			NATURAL OPEN SPACE CREDIT	POINTS FOR NATURAL OPEN SPACE
Accepts and treats stormwater runoff from the development site per design specification	where? 0.86	/	10.96	x (0.15 PER 1%)	1.18
Adjacent to a wetland, mature forest, or RPA	where? 0.49	/	10.96	x (0.15 PER 1%)	0.67
All other open space	3.47	/	10.96	x (0.10 PER 1%)	3.17
			TOTAL NATURAL OPEN SPACE CREDIT:		**5.02**

C. TOTAL WEIGHTED POINTS

5.01	+	**5.02**	**10.03**
STRUCTURAL BMP POINTS		**NATURAL OPEN SPACE POINTS**	**TOTAL**

DRAINAGE AREA EXHIBIT





MANAGEMENT AREA ANALYSIS	
SUBSHED	AREA (AC)
DA#1 (BMP#1)	1.99
DA#2 (BMP#2)	0.43
DA#3 (BMP#3A & 3B)	2.70
FUTRURE DA#4 (STORMWATER AREA #3)	1.00
RPA	3.28
OTHER (DUNOS #1 AND #2 AND ADJACENT RPA AREAS)	0.63
OFF-SITE RUN-OFF TO SIX MT. ZION ROAD	0.54
TOTAL	10.57

SUMMARY OF STORMWATER/BMP FACILITIES				
BMP #	BMP TYPE	CONT DA (AC)	% IMPERVIOUS	IMPERVIOUS AREA (AC)
1	BIORETENTION	1.99	37%	0.73
2	INFILTRATION TRENCH	0.43	7%	0.03
3	WET SWALES	2.70	20%	0.53
4	FUTURE BIORETENTION	1.00	25%	0.25

NOTES:

1. RUNOFF COEFFICIENTS FOR IMPERVIOUS AND PERVIOUS AREAS ARE C=0.95 AND C=0.35, RESPECTIVELY.
2. SUB DRAINAGE AREAS #2 AND #3 WILL CONVEY IN SERIES TO BMP#3. FUTURE SUB DRAINAGE AREA #4 FOR FUTURE PARKING WILL CONVEY TO FUTURE BMP#4 IN SERIES WITH BMP#3B.
3. OTHER ON-SITE DRAINAGE AREAS INCLUDE RUN-OFF TO SIX MT. ZION ROAD AND SHEETFLOW INTO THE RPA.
4. RESTORATION OF EXISTING DENUDED AREAS ALONG SIX MT. ZION ROAD IS PROPOSED FOR RPA MITIGATION.

NOTES:

1. DESIGN OF ALL STORMWATER FACILITIES WILL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE JAMES CITY COUNTY GUIDELINES FOR DESIGN AND CONSTRUCTION OF STORMWATER MANAGEMENT BMPS.
2. THE PROJECT SITE IS SITUATED WITHIN THE WARE CREEK AND/OR YORK RIVER (DIRECT) WATERSHEDS OF THE COUNTY.
3. BUILDINGS WILL BE LOCATED OUTSIDE THE 25' RPA BUILDING SETBACK IN COMPLIANCE WITH STONEHOUSE PROFFER 10.5.
4. COMPLIANCE WITH SPECIAL STORMWATER CRITERIA SHALL BE PROVIDED IN ACCORDANCE WITH STONEHOUSE PROFFER 10.1.
5. JURISDICTIONAL DETERMINATION OF WETLAND DELINEATIONS (REFERENCE AS FAIRMONT) WAS RECEVIED FROM THE USACE ON JANUARY 9, 2009 (KERR ENVIRONMENTAL FROM FLAG #WF-12) AND OCTOBER 3, 2008 (LANDMARK FROM FLAG #2425). CONDITIONAL (ON-SITE) APPROVAL OF RPA BUFFERS WAS RECEIVED FROM JAMES CITY COUNTY ON MAY 9, 2008.

NORTH

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

WSP • SELLS
Transportation & Infrastructure
15401 Weston Parkway Suite 100 • Cary, NC 27513 • 919.678.0035
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PRELIMINARY NOT RELEASED FOR CONSTRUCTION

STONEHOUSE AMENITY H

JAMES CITY COUNTY, VA

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

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REVISIONS

PROJECT #: 08-4046 DATE: 01/23/09

DRAWN BY: MB CHECKED BY: CD

TITLE
STORMWATER / BMP DRAINAGE AREAS

SHEET
EXHIBIT 1

SEDIMENT TRAP CALCULATIONS

DESIGN WORKSHEET - SEDIMENT TRAPS

WSP · SELLS

Project Name: STONEHOUSE AMENITY H
Designed by: IN Date: 1/22/09
Checked by: CD Date: 4/7/09

PHASE 1 EROSION & SEDIMENT CONTROL

ID#	Drainage Area (AC)	Volume Required (CF)	Mininum Wet Storage (CF)	Wet Depth (FT)	Bottom Width (FT)	Bottom Length (FT)	Wet Storage Provided (CF)	Bottom Elev (FT)	Top Elev (FT)	25-Year Storm Elev (FT)
ST-1	2.48	8,988	4,494	4.0	18	36	4,832	80.00	86.00	84.96
ST-2	1.99	7,184	3,592	4.0	16	32	4,096	78.00	84.00	80.54

WHERE DO I GET THIS?

WHERE IS THE DRY STORAGE?

NOTES:
1. VOLUME REQUIRED BASED ON 134 CY PER ACRE OF DRAINAGE AREA.
1. REFER TO STORMWAER MANAGEMENT & DRAINAGE REPORT FOR 25-YEAR STORM CALCULATIONS.

PHASE 2 EROSION & SEDIMENT CONTROL

ID#	Drainage Area (AC)	Volume Required (CF)	Mininum Wet Storage (CF)	Wet Depth (FT)	Bottom Width (FT)	Bottom Length (FT)	Wet Storage Provided (CF)	Bottom Elev (FT)	Top Elev (FT)	25-Year Storm Elev (FT)
ST-3	1.99	7,200	3,600	3	8	110	4,980	92.50	97.00	94.21

NOTES:
1. ST-3 SHALL BE CONVERTED TO BMP#1 AFTER FINAL STABILIZAITON

Table of Contents

25 - Year

Summary Report 1
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Pond Report 6
Hydrograph No. 5, Reservoir, ST-2 ROUTE 7
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Hydrograph No. 6, Reservoir, ST-3 ROUTE 9
Pond Report 10

STORM DRAINAGE SYSTEM CALCULATIONS

Hydraulic Grade Line Calculations

Inlet 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	5.24	1	10	4,718	---	----	-----	ST-1
2	Mod. Rational	5.31	1	5	2,389	---	----	-----	ST-2
3	Mod. Rational	5.31	1	5	2,389	---	----	-----	ST-3
4	Reservoir	0.00	1	0	0	1	84.96	4,718	ST-1 ROUTE
5	Reservoir	0.00	1	0	0	2	80.54	2,230	ST-2 ROUTE
6	Reservoir	0.00	1	0	0	3	94.21	2,230	ST-3 ROUTE

SEDIMENT TRAPS

Sediment Basins.gpw	Return Period: 25 Year	Thursday, Apr 9 2009, 12:25 PM

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

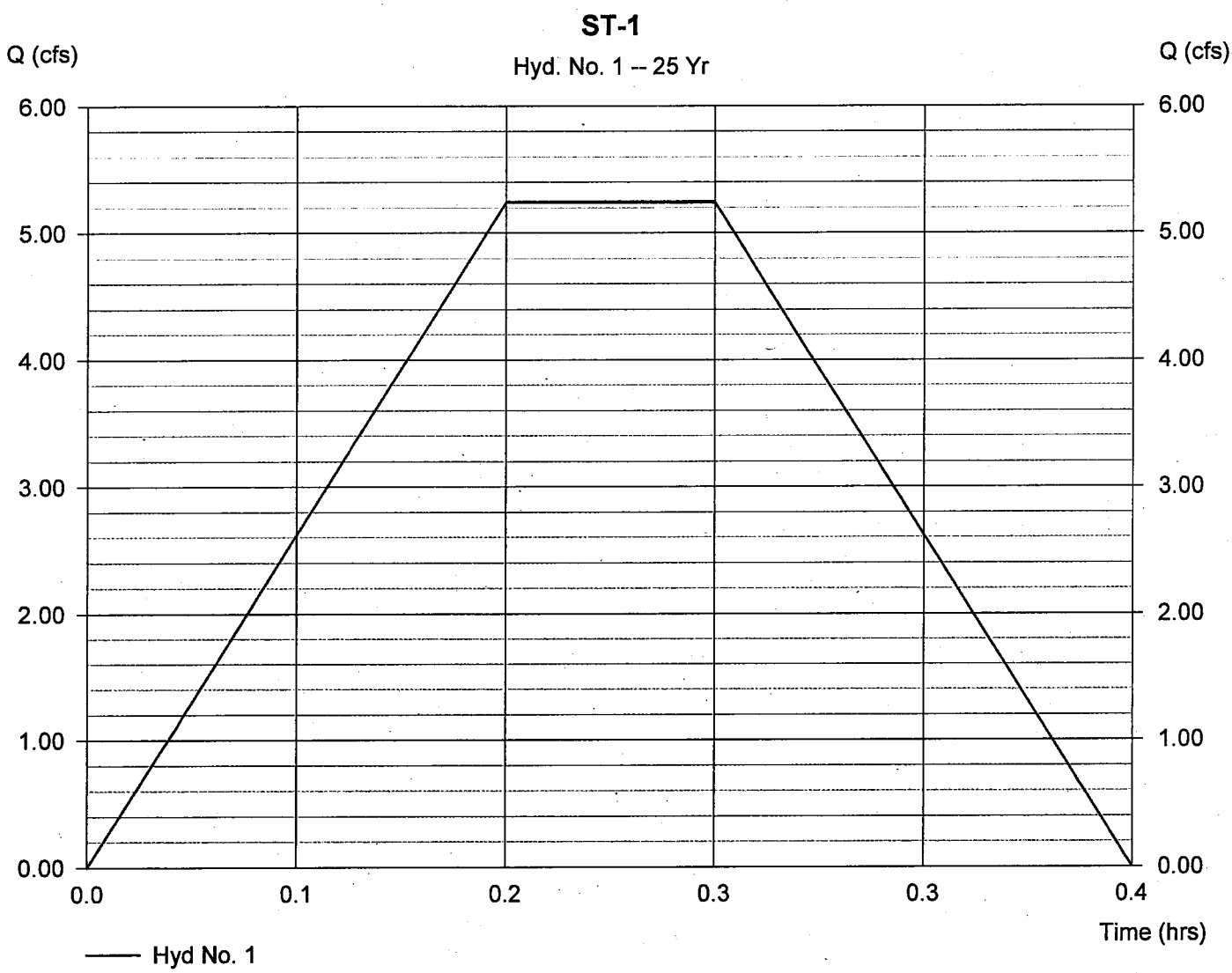
Thursday, Apr 9 2009, 12:25 PM

Hyd. No. 1

ST-1

Hydrograph type	= Mod. Rational	Peak discharge	= 5.24 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 2.480 ac	Runoff coeff.	= 0.35
Intensity	= 6.040 in/hr	Tc by User	= 10.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,718 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

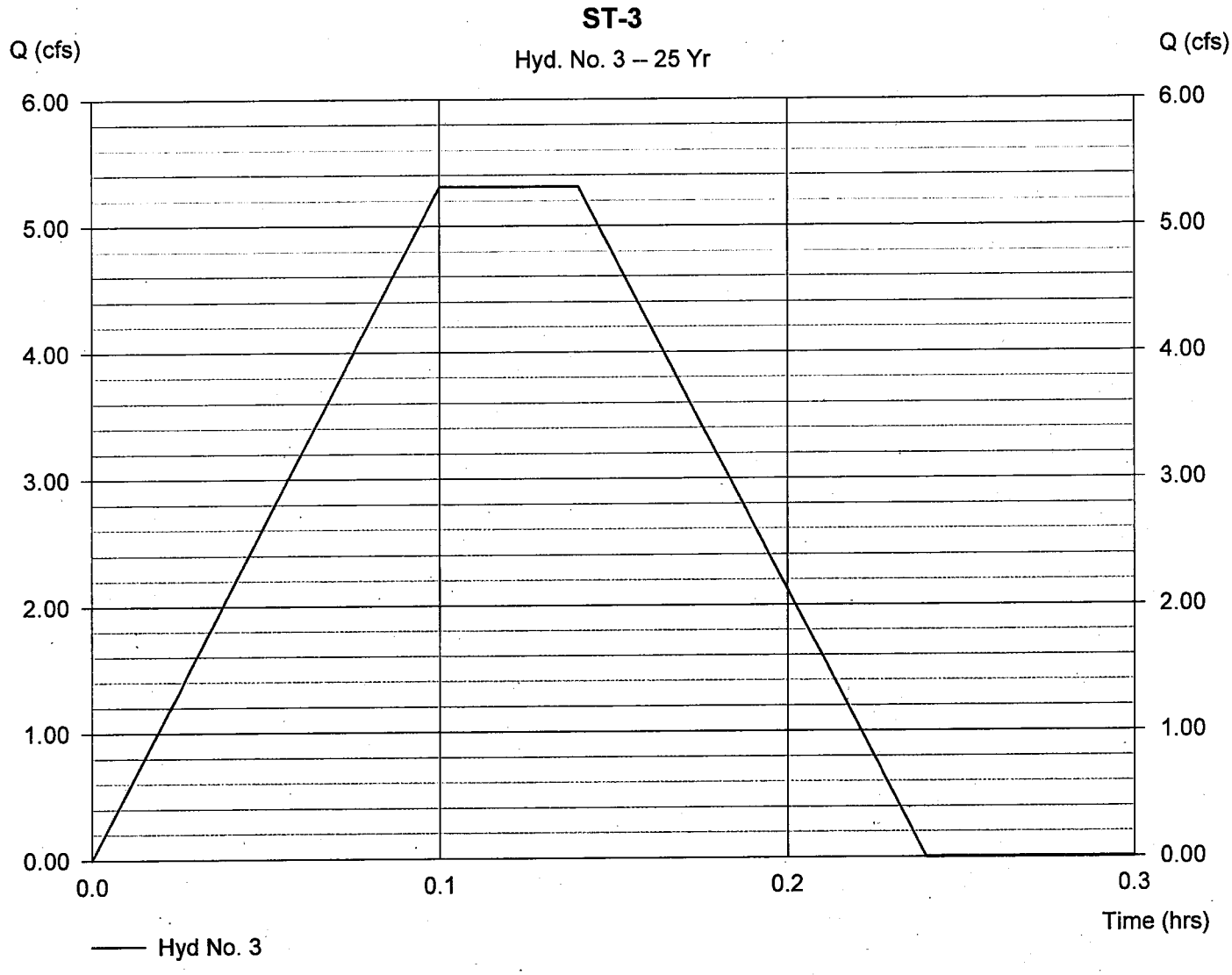
Thursday, Apr 9 2009, 12:25 PM

Hyd. No. 3

ST-3

Hydrograph type	= Mod. Rational	Peak discharge	= 5.31 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.990 ac	Runoff coeff.	= 0.35
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,389 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

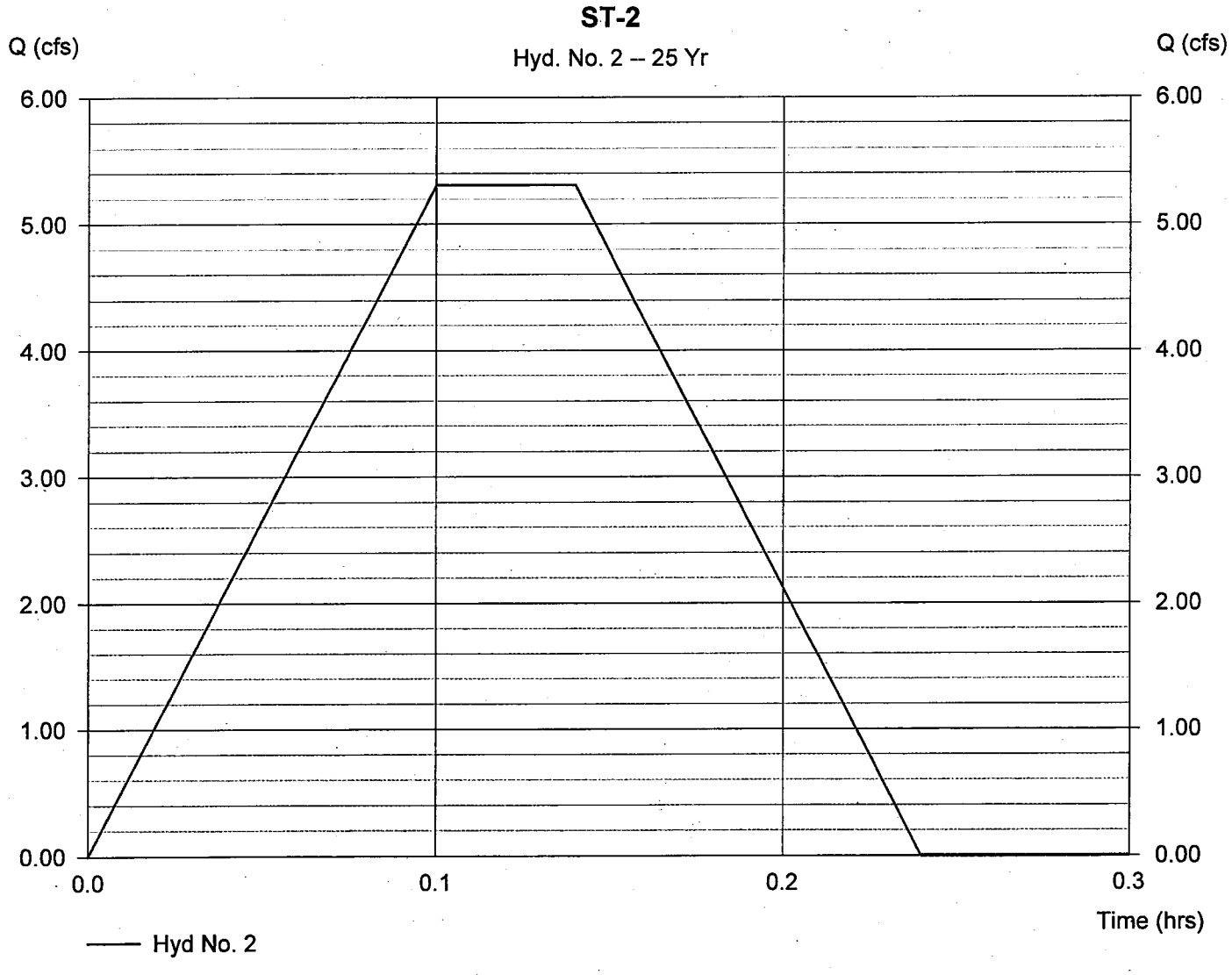
Thursday, Apr 9 2009, 12:25 PM

Hyd. No. 2

ST-2

Hydrograph type	= Mod. Rational	Peak discharge	= 5.31 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 1.990 ac	Runoff coeff.	= 0.35
Intensity	= 7.622 in/hr	Tc by User	= 5.00 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,389 cuft



Hydrograph Plot

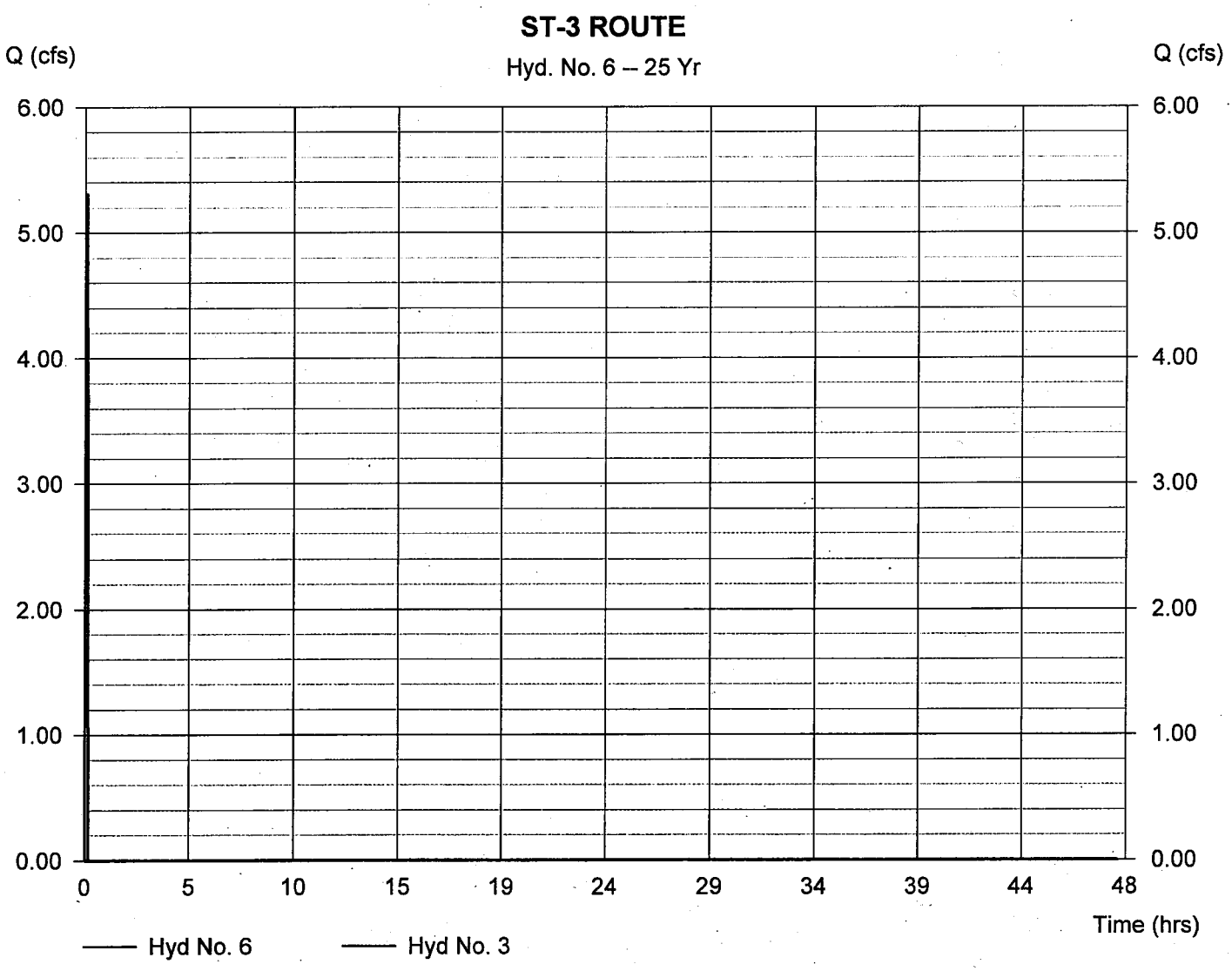
Hydraflow Hydrographs by Intelisolve | Thursday, Apr 9 2009, 12:25 PM

Hyd. No. 6

ST-3 ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 94.21 ft
Reservoir name	= ST-3	Max. Storage	= 2,230 cuft

Storage Indication method used. | Hydrograph Volume = 0 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve — Thursday, Apr 9 2009, 12:25 PM

Pond No. 3 - ST-3

Pond Data

Bottom LxW = 110.0 x 8.0 ft Side slope = 2.0:1 Bottom elev. = 92.50 ft Depth = 4.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	92.50	880	0	0
0.23	92.73	987	210	210
0.45	92.95	1,096	234	444
0.68	93.18	1,206	259	703
0.90	93.40	1,318	284	987
1.13	93.63	1,431	309	1,296
1.35	93.85	1,546	335	1,631
1.58	94.08	1,663	361	1,992
1.80	94.30	1,781	387	2,380
2.03	94.53	1,901	414	2,794
2.25	94.75	2,023	441	3,235
2.48	94.98	2,146	469	3,705
2.70	95.20	2,271	497	4,201
2.93	95.43	2,397	525	4,727
3.15	95.65	2,526	554	5,280
3.38	95.88	2,655	583	5,863
3.60	96.10	2,787	612	6,475
3.82	96.33	2,919	642	7,117
4.05	96.55	3,054	672	7,789
4.27	96.78	3,190	702	8,492
4.50	97.00	3,328	733	9,225

Culvert / Orifice Structures

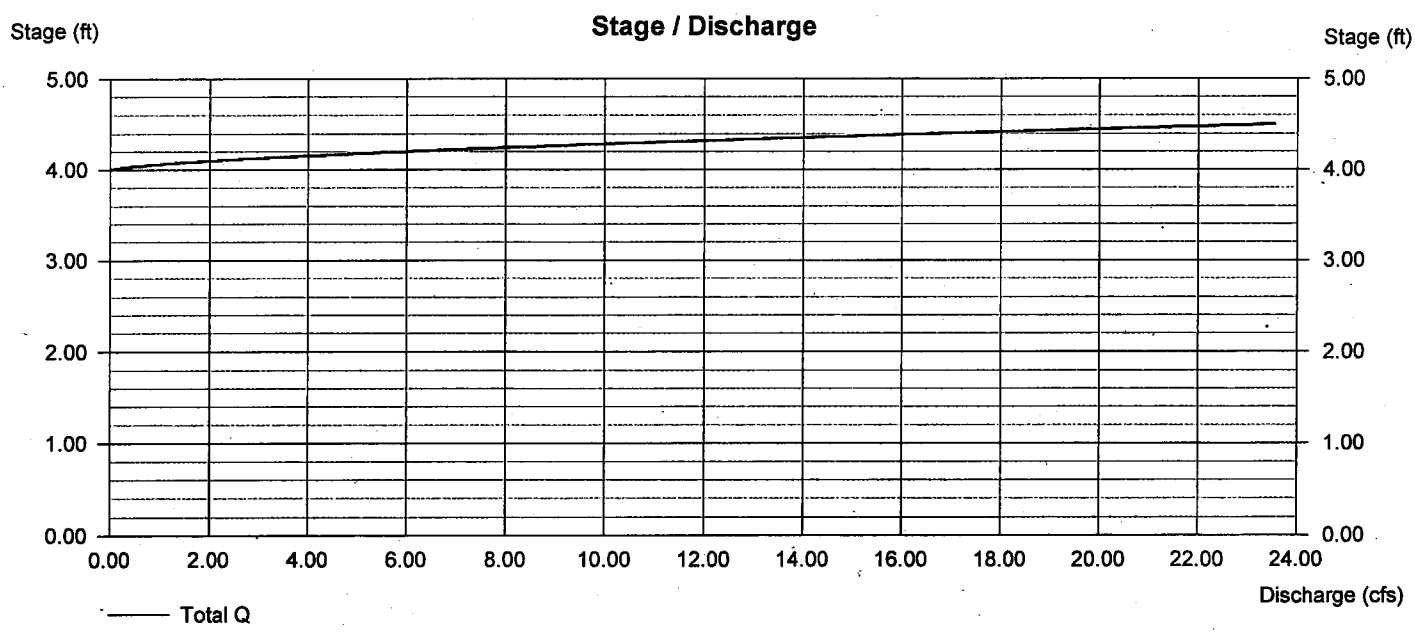
	[A]	[B]	[C]	[D]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 96.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

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

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



Hydrograph Plot

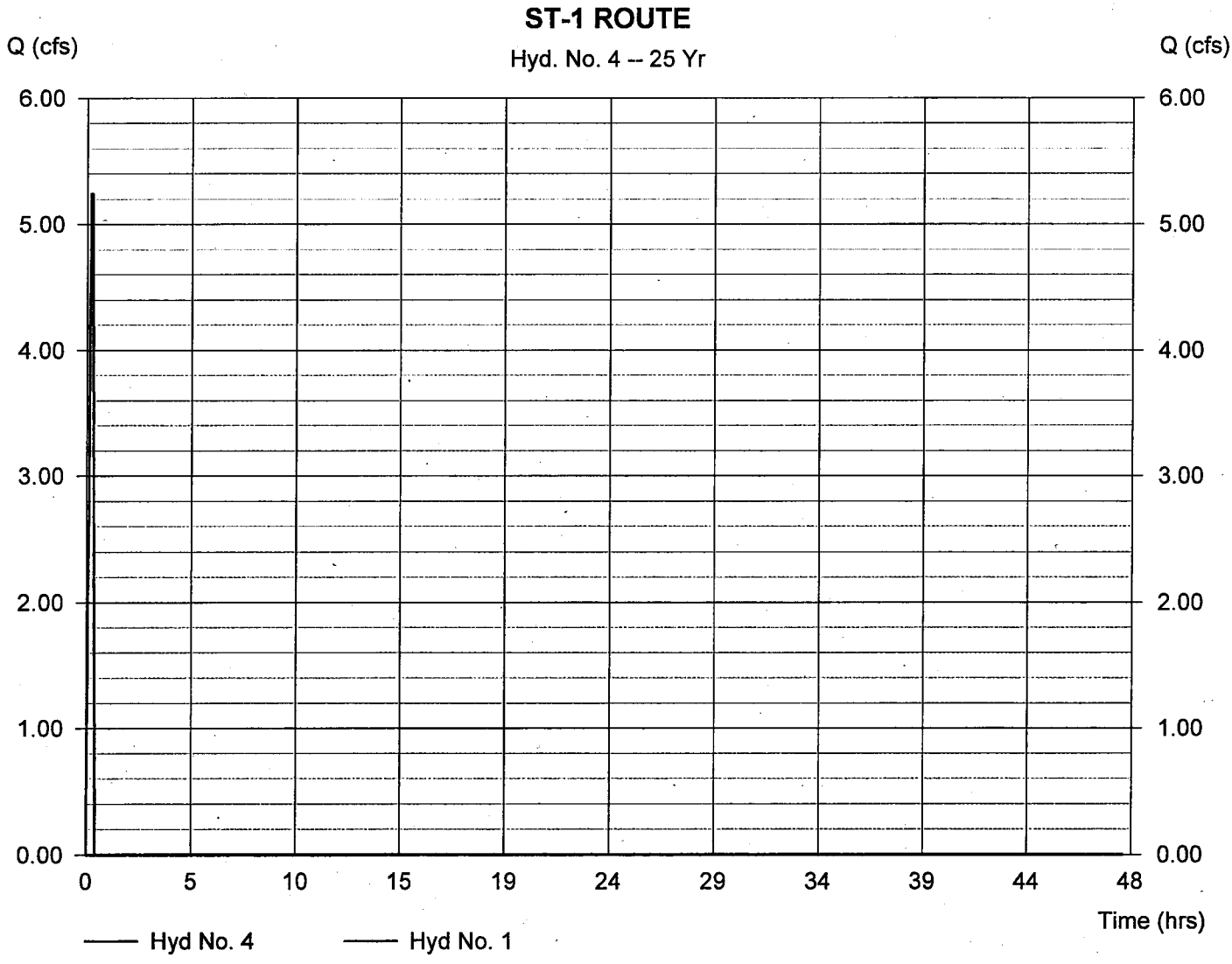
Hydraflow Hydrographs by Intelisolve | Thursday, Apr 9 2009, 12:25 PM

Hyd. No. 4

ST-1 ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Max. Elevation	= 84.96 ft
Reservoir name	= ST-1	Max. Storage	= 4,718 cuft

Storage Indication method used. | Hydrograph Volume = 0 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve — Thursday, Apr 9 2009, 12:25 PM

Pond No. 1 - ST-1

Pond Data

Bottom LxW = 32.0 x 12.0 ft Side slope = 2.0:1 Bottom elev. = 80.00 ft Depth = 6.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	80.00	384	0	0
0.30	80.30	438	123	123
0.60	80.60	495	140	263
0.90	80.90	555	158	421
1.20	81.20	618	176	597
1.50	81.50	684	195	792
1.80	81.80	753	215	1,007
2.10	82.10	824	236	1,244
2.40	82.40	899	258	1,502
2.70	82.70	976	281	1,783
3.00	83.00	1,056	305	2,088
3.30	83.30	1,139	329	2,417
3.60	83.60	1,225	355	2,772
3.90	83.90	1,314	381	3,152
4.20	84.20	1,405	408	3,560
4.50	84.50	1,500	436	3,996
4.80	84.80	1,597	465	4,461
5.10	85.10	1,698	494	4,955
5.40	85.40	1,801	525	5,479
5.70	85.70	1,907	556	6,036
6.00	86.00	2,016	588	6,624

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

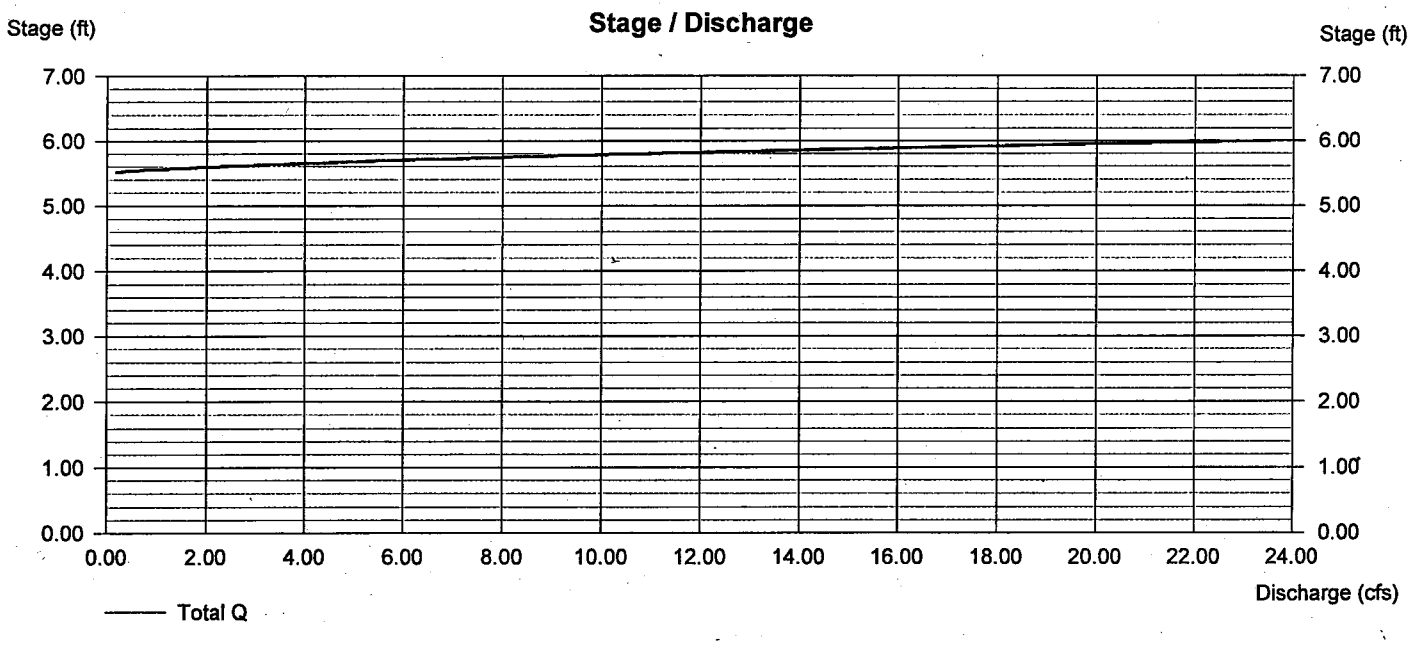
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 85.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

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

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

Stage / Discharge



Hydrograph Plot

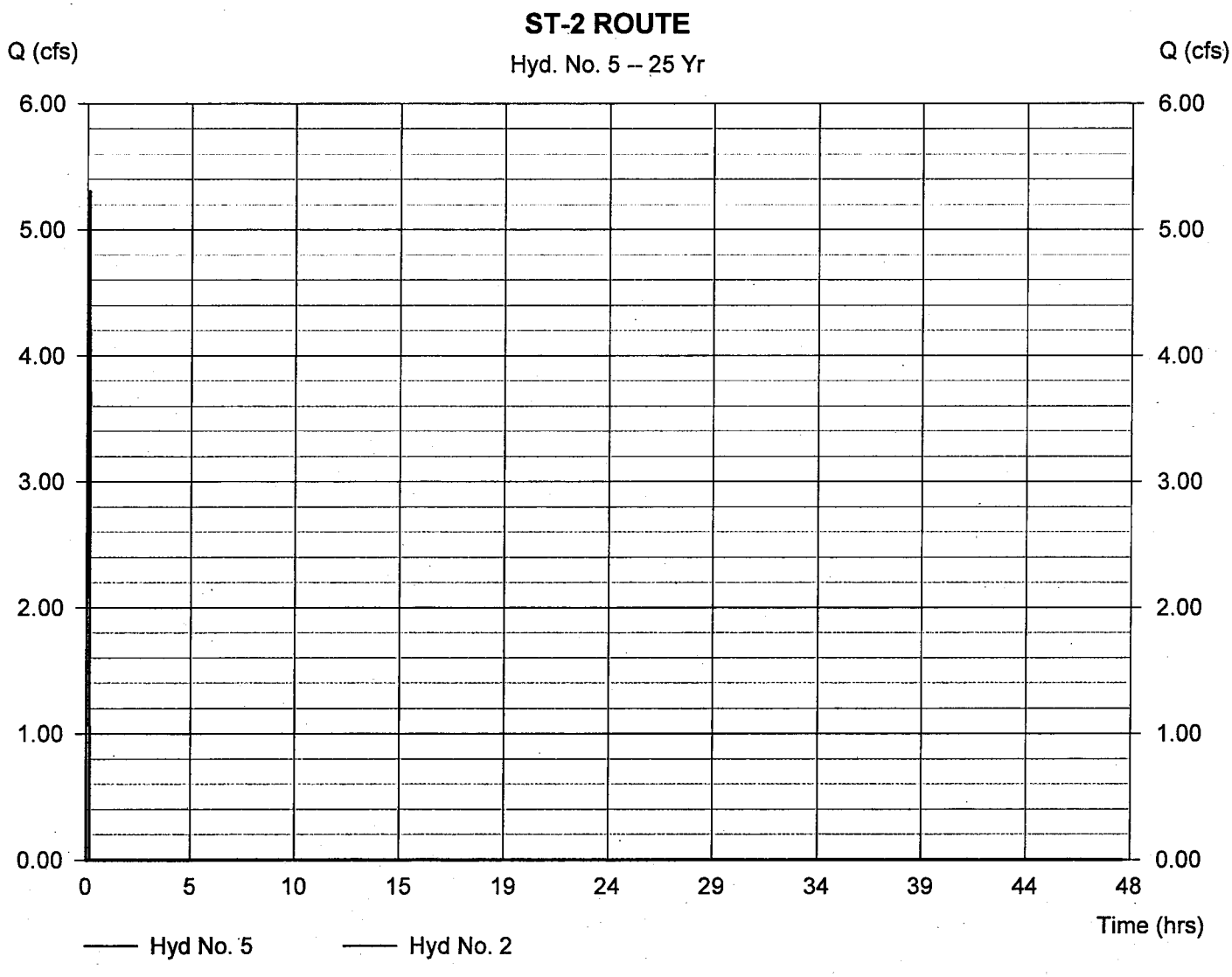
Hydraflow Hydrographs by Intelisolve | Thursday, Apr 9 2009, 12:25 PM

Hyd. No. 5

ST-2 ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 0.00 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 2	Max. Elevation	= 80.54 ft
Reservoir name	= ST-2	Max. Storage	= 2,230 cuft

Storage Indication method used. | Hydrograph Volume = 0 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve — Thursday, Apr 9 2009, 12:25 PM

Pond No. 2 - ST-2

Pond Data

Bottom LxW = 36.0 x 16.0 ft Side slope = 2.0:1 Bottom elev. = 78.00 ft Depth = 6.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	78.00	576	0	0
0.30	78.30	640	182	182
0.60	78.60	707	202	384
0.90	78.90	776	222	607
1.20	79.20	849	244	850
1.50	79.50	924	266	1,116
1.80	79.80	1,002	289	1,405
2.10	80.10	1,083	313	1,718
2.40	80.40	1,167	338	2,055
2.70	80.70	1,254	363	2,418
3.00	81.00	1,344	390	2,808
3.30	81.30	1,437	417	3,225
3.60	81.60	1,532	445	3,670
3.90	81.90	1,631	474	4,145
4.20	82.20	1,732	504	4,649
4.50	82.50	1,836	535	5,184
4.80	82.80	1,943	567	5,751
5.10	83.10	2,053	599	6,350
5.40	83.40	2,166	633	6,983
5.70	83.70	2,281	667	7,650
6.00	84.00	2,400	702	8,352

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

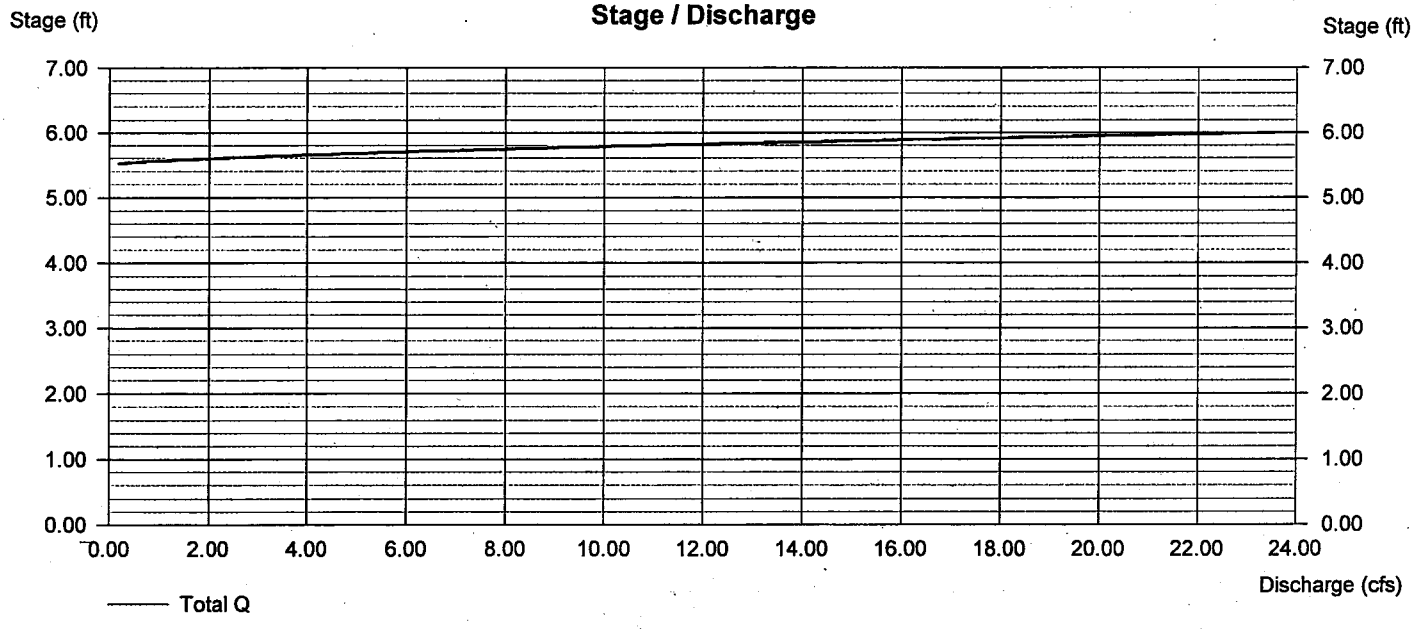
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 83.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

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

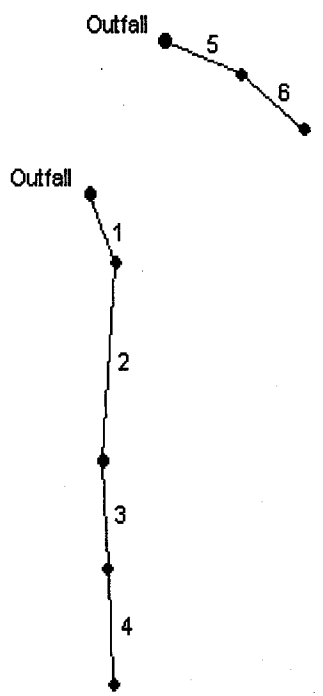
Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Discharge



PIPE COMPUTATIONS

Hydraflow Plan View



Project file: Storm design.stm	No. Lines: 6	03-26-2009

Hydraflow Storm Sewers 2003

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	52.8	67.8	MH	0.00	0.10	0.50	5.0	58.50	1.00	59.03	18	Cir	0.013	0.45	65.00	FES#1-MH#1
2	1	141.7	26.7	MH	0.00	0.10	0.50	5.0	59.03	4.92	66.00	18	Cir	0.013	0.15	69.50	MH#1-MH#1A
3	2	78.0	-7.4	MH	0.00	0.10	0.80	5.0	66.00	8.97	73.00	18	Cir	0.013	0.15	95.50	MH#1A-R2
4	3	81.8	0.1	MH	0.00	0.10	0.80	5.0	90.50	1.83	92.00	15	Cir	0.013	1.00	97.00	R2-R1
5	End	59.2	24.2	MH	0.00	0.10	0.50	5.0	56.16	0.51	56.46	15	Cir	0.013	0.45	65.00	FES#2-MH#2
6	5	67.0	12.3	MH	0.00	0.70	0.50	5.0	61.75	9.71	68.25	15	Cir	0.013	1.00	82.50	MH#2-MH#2A

Project File: Storm design.stm | Number of lines: 6 | Date: 03-26-2009

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	52.8	0.10	0.40	0.50	0.05	0.26	5.0	10.8	8.1	2.10	10.52	3.55	18	1.00	59.03	58.50	59.58	59.05	65.00	58.50	FES#1-MH#1
2	1	141.7	0.10	0.30	0.50	0.05	0.21	5.0	8.7	8.6	1.81	23.29	2.94	18	4.92	66.00	59.03	66.51	59.67	69.50	65.00	MH#1-MH#1A
3	2	78.0	0.10	0.20	0.80	0.08	0.16	5.0	7.2	9.0	1.44	31.45	2.84	18	8.97	73.00	66.00	73.46	66.54	95.50	69.50	MH#1A-R2
4	3	81.8	0.10	0.10	0.80	0.08	0.08	5.0	5.0	9.7	0.78	8.75	3.54	15	1.83	92.00	90.50	92.35	90.75	97.00	95.50	R2-R1
5	End	59.2	0.10	0.80	0.50	0.05	0.40	5.0	5.4	9.6	3.83	4.60	4.34	15	0.51	56.46	56.16	57.38	56.94	65.00	56.25	FES#2-MH#2
6	5	67.0	0.70	0.70	0.50	0.35	0.35	5.0	5.0	9.7	3.40	20.12	8.30	15	9.71	68.25	61.75	68.99	62.10	82.50	65.00	MH#2-MH#2A

Project File: Storm design.stm | Number of lines: 6 | Run Date: 03-26-2009

NOTES: Intensity = 157.18 / (Inlet time + 19.60) ^ 0.87; Return period = 100 Yrs.

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#1-MH#1	2.10	18 c	52.8	58.50	59.03	1.004	59.05	59.58	0.09	End
2	MH#1-MH#1A	1.81	18 c	141.7	59.03	66.00	4.920	59.67	66.51	0.03	1
3	MH#1A-R2	1.44	18 c	78.0	66.00	73.00	8.971	66.54	73.46	0.02	2
4	R2-R1	0.78	15 c	81.8	90.50	92.00	1.835	90.75	92.35	0.12	3
5	FES#2-MH#2	3.83	15 c	59.2	56.16	56.46	0.507	56.94	57.38	0.11	End
6	MH#2-MH#2A	3.40	15 c	67.0	61.75	68.25	9.707	62.10	68.99	0.32	5

Project File: Storm design.stm | Number of lines: 6 | Run Date: 03-26-2009

NOTES: c = circular; e = elliptical; b = box; Return period = 100 Yrs.; * Indicates surcharge condition.

Hydraulic Grade Line Computations

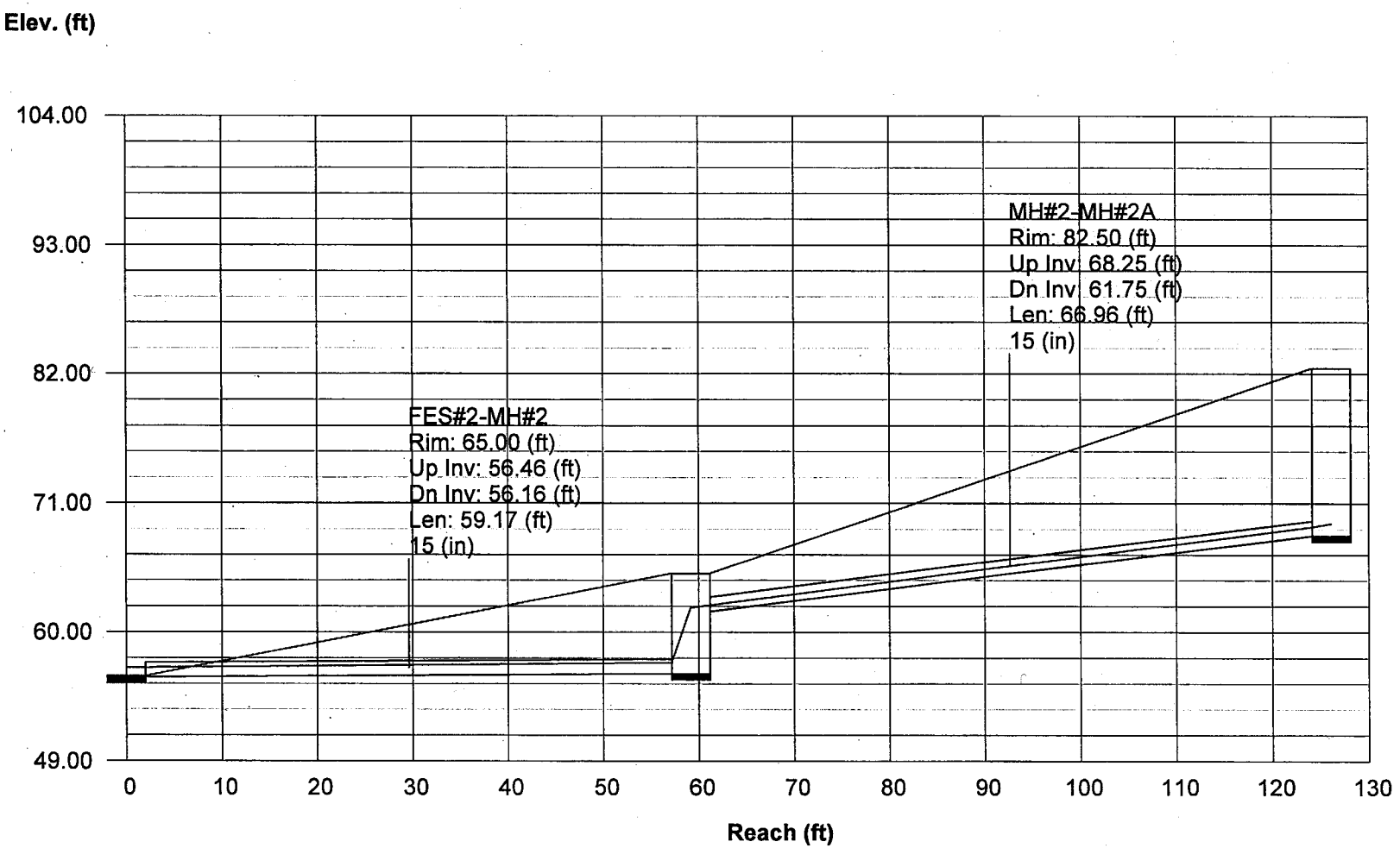
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(In)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	18	2.10	58.50	59.05	0.55	0.59	3.55	0.20	59.25	0.476	52.8	59.03	59.58	0.55**	0.59	3.55	0.20	59.78	0.476	0.476	n/a	0.45	0.09
2	18	1.81	59.03	59.67	0.64	0.72	2.51	0.10	59.77	0.205	142	66.00	66.51	0.51**	0.53	3.38	0.18	66.69	0.467	0.336	n/a	0.15	0.03
3	18	1.44	66.00	66.54	0.54	0.57	2.52	0.10	66.64	0.246	78.0	73.00	73.46	0.46**	0.46	3.15	0.15	73.61	0.458	0.352	n/a	0.15	0.02
4	15	0.78	90.50	90.75	0.25*	0.18	4.35	0.29	91.05	1.776	81.8	92.00	92.35	0.35**	0.28	2.73	0.12	92.47	0.479	1.127	n/a	1.00	0.12
5	15	3.83	56.16	56.94	0.78*	0.81	4.73	0.35	57.29	0.684	59.2	56.46	57.38	0.92	0.97	3.95	0.24	57.62	0.440	0.562	0.332	0.45	0.11
6	15	3.40	61.75	62.10	0.35*	0.28	12.09	2.27	64.37	9.468	67.0	68.25	68.99	0.74**	0.75	4.51	0.32	69.30	0.646	5.057	n/a	1.00	0.32

Project File: Storm design.stm | Number of lines: 6 | Run Date: 03-26-2009

NOTES: * Normal depth assumed., ** Critical depth assumed.

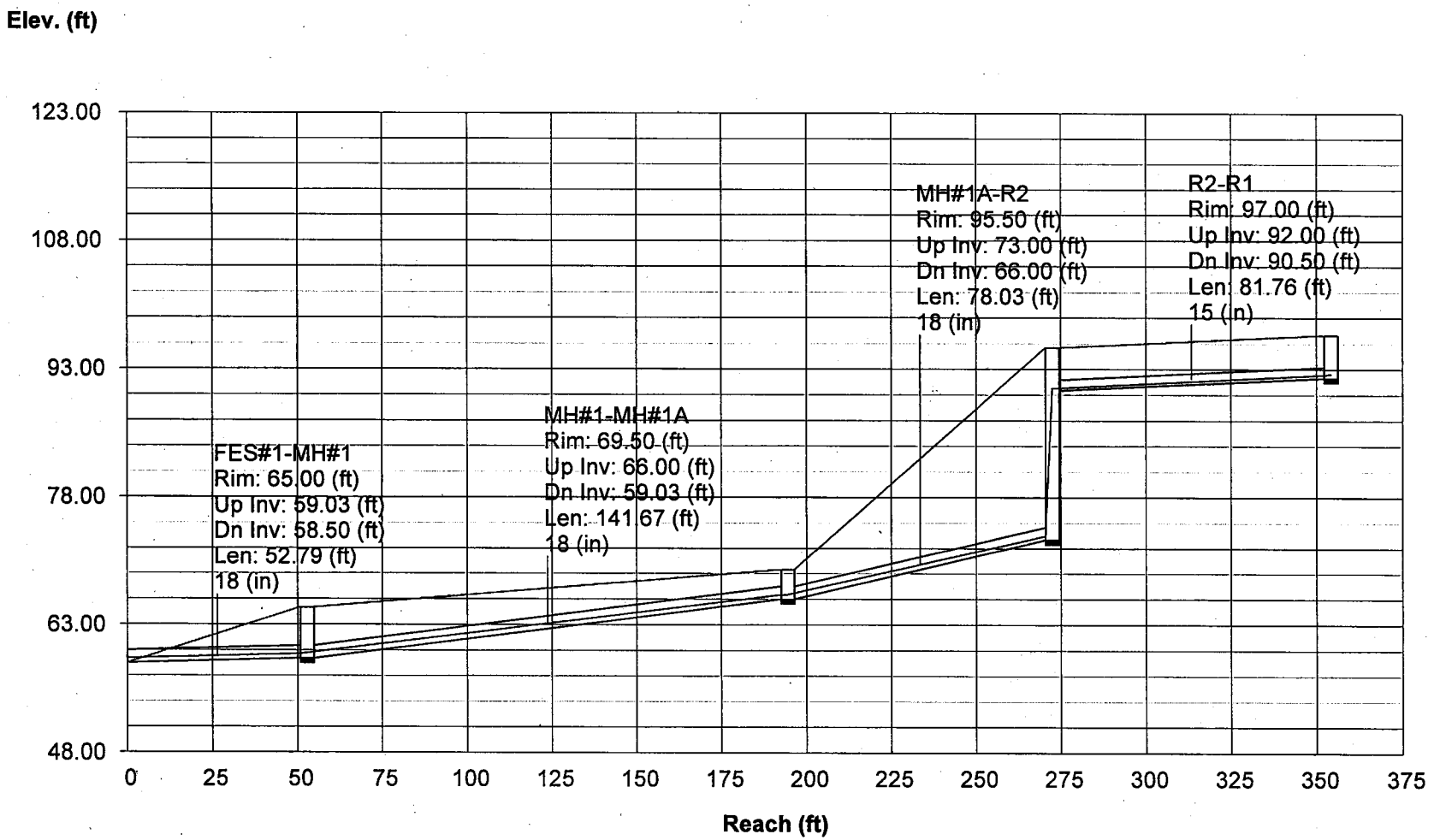
Storm Sewer Profile

Proj. file: Storm design.stm



Storm Sewer Profile

Proj. file: Storm design.stm



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	64.8	67.8	MH	0.00	0.10	0.50	5.0	58.50	8.18	63.80	18	Cir	0.013	0.45	65.00	FES#1-MH#1
2	1	111.7	26.7	MH	0.00	0.10	0.50	5.0	64.00	1.61	65.80	18	Cir	0.013	0.15	69.50	MH#1-MH#1A
3	2	78.0	-7.4	MH	0.00	0.10	0.80	5.0	66.00	9.48	73.40	18	Cir	0.013	0.15	95.50	MH#1A-R2
4	3	81.8	0.1	MH	0.00	0.10	0.80	5.0	90.90	1.83	92.40	15	Cir	0.013	1.00	97.00	R2-R1
5	End	59.2	24.2	MH	0.00	0.10	0.50	5.0	56.16	1.00	56.75	15	Cir	0.013	0.45	65.00	FES#2-MH#2
6	5	67.0	12.3	MH	0.00	0.70	0.50	5.0	61.75	9.71	68.25	15	Cir	0.013	1.00	82.50	MH#2-MH#2A

Project File: Storm design.stm | Number of lines: 6 | Date: 03-30-2009

Storm Sewer Tabulation

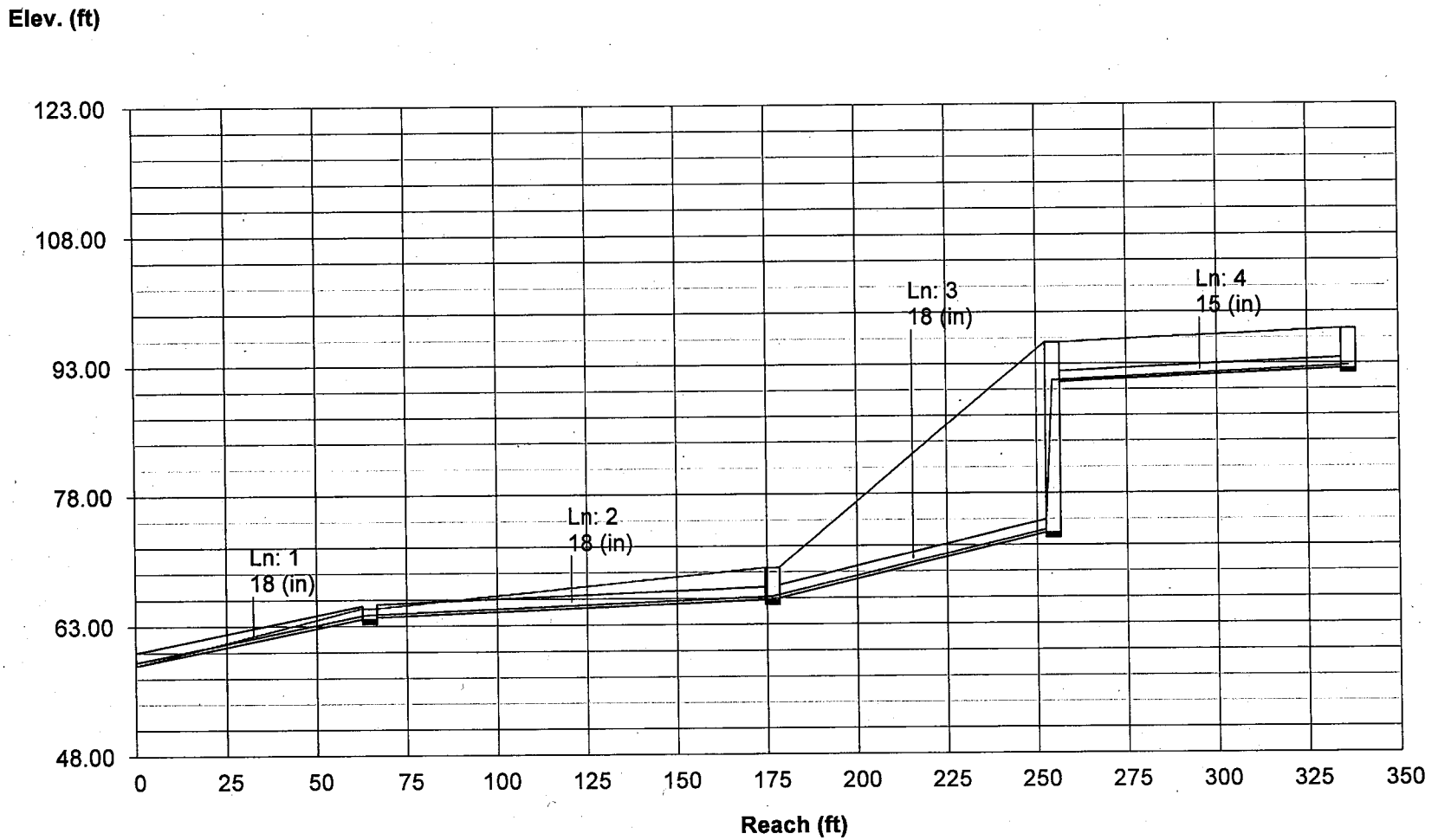
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	64.8	0.10	0.40	0.50	0.05	0.26	5.0	10.3	8.2	2.13	30.03	3.57	18	8.18	63.80	58.50	64.36	59.06	65.00	58.50	FES#1-MH#1
2	1	111.7	0.10	0.30	0.50	0.05	0.21	5.0	8.7	8.6	1.81	13.33	3.75	18	1.61	65.80	64.00	66.31	64.45	69.50	65.00	MH#1-MH#1A
3	2	78.0	0.10	0.20	0.80	0.08	0.16	5.0	7.2	9.0	1.44	32.34	3.98	18	9.48	73.40	66.00	73.86	66.34	95.50	69.50	MH#1A-R2
4	3	81.8	0.10	0.10	0.80	0.08	0.08	5.0	5.0	9.7	0.78	8.75	3.54	15	1.83	92.40	90.90	92.75	91.15	97.00	95.50	R2-R1
5	End	59.2	0.10	0.80	0.50	0.05	0.40	5.0	5.4	9.6	3.83	6.45	4.73	15	1.00	56.75	56.16	57.53	56.94	65.00	56.25	FES#2-MH#2
6	5	67.0	0.70	0.70	0.50	0.35	0.35	5.0	5.0	9.7	3.40	20.12	8.30	15	9.71	68.25	61.75	68.99	62.10	82.50	65.00	MH#2-MH#2A

Project File: Storm design.stm | Number of lines: 6 | Run Date: 03-30-2009

NOTES: Intensity = 157.18 / (Inlet time + 19.60) ^ 0.87; Return period = 100 Yrs.

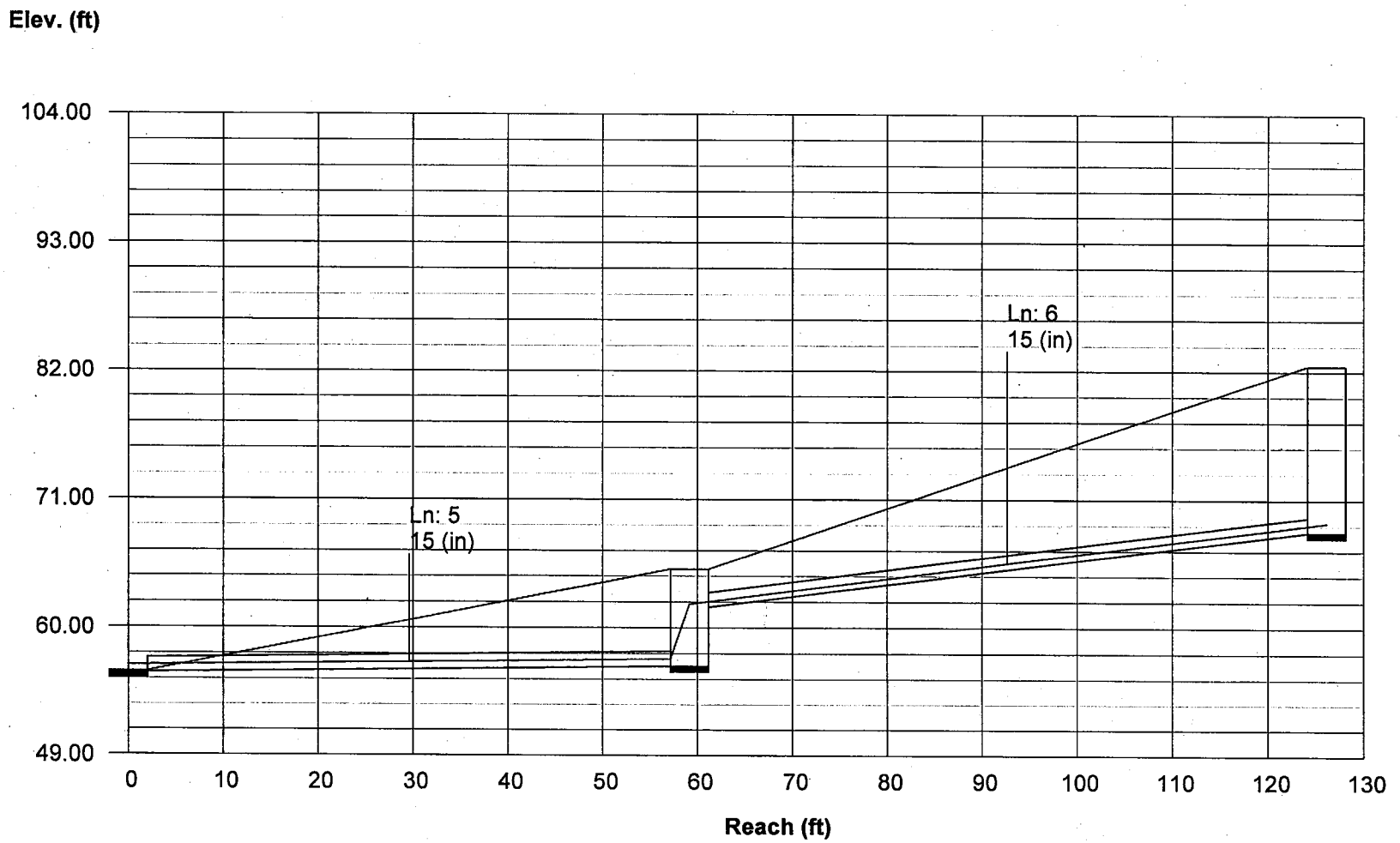
Storm Sewer Profile

Proj. file: Storm design.stm



Storm Sewer Profile

Proj. file: Storm design.stm



BIORETENTION AREA #1
CALCULATIONS

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WHERE IS POND #2?

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 4.62 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Drainage area	= 2.0 ac → 1.99 acre	Runoff coeff.	= 0.57
Intensity	= 4.071 in/hr	Tc by User	= 5 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

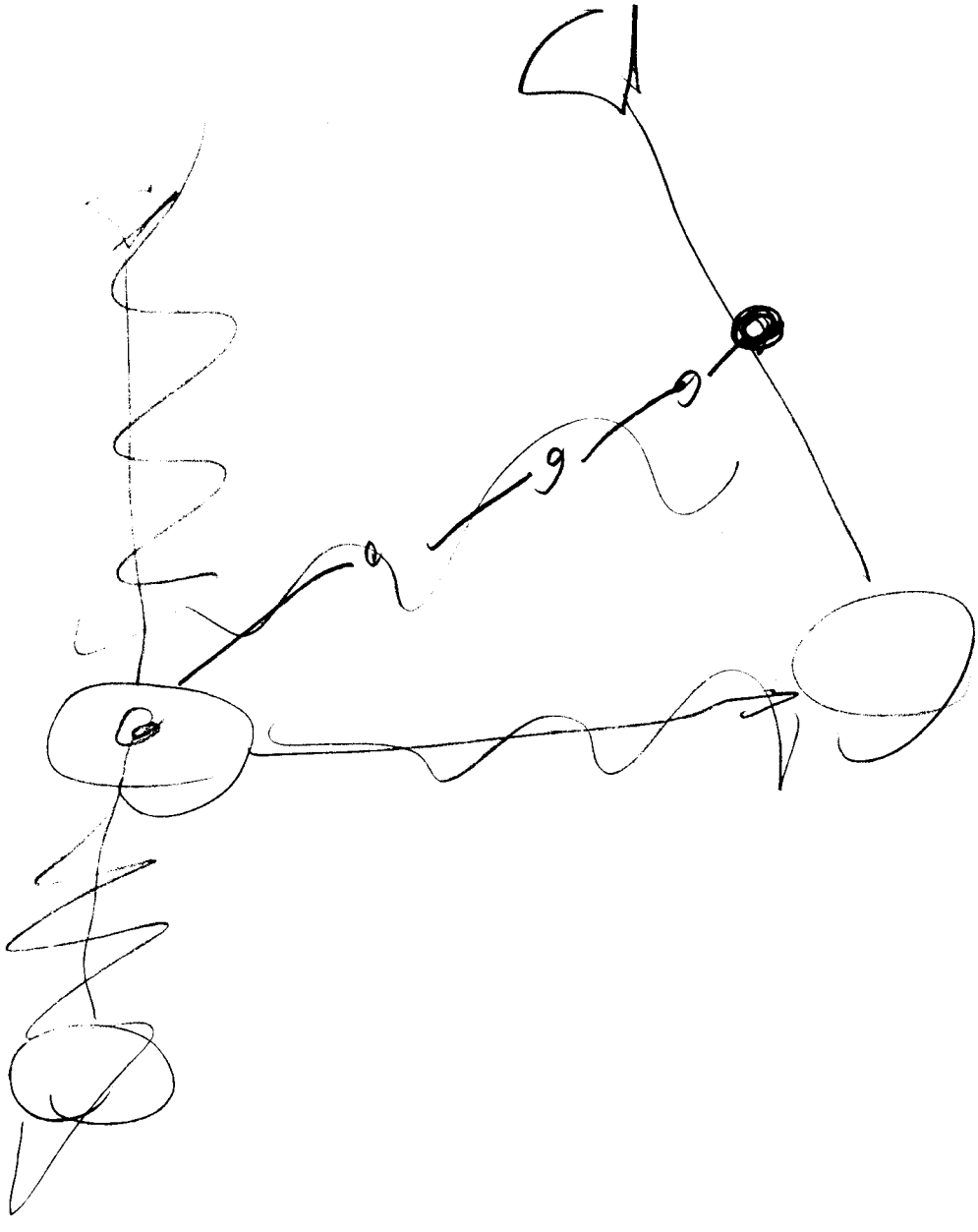
Hydrograph Volume = 2,078 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time (hrs	Outflow cfs)
0.02	0.92
0.10	4.62 <<
0.18	0.92

...End



#12

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.52 cfs
Storm frequency	= 1 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Reservoir name	= BMP#1
Max. Elevation	= 95.81 ft	Max. Storage	= 1,829 cuft

Storage Indication method used.

Outflow hydrograph volume = 808 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.17	1.85	95.79	7.98	0.48	-----	-----	-----	-----	-----	-----	-----	0.48
0.25	0.00	95.77	7.98	0.44	-----	-----	-----	-----	-----	-----	-----	0.44
0.33	0.00	95.72	7.98	0.34	-----	-----	-----	-----	-----	-----	-----	0.34
0.42	0.00	95.68	7.98	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
0.50	0.00	95.65	7.98	0.20	-----	-----	-----	-----	-----	-----	-----	0.20
0.58	0.00	95.62	7.98	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
0.67	0.00	95.61	7.98	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
0.75	0.00	95.59	7.98	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
0.83	0.00	95.58	7.98	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
0.92	0.00	95.57	7.98	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
1.00	0.00	95.56	7.98	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
1.08	0.00	95.55	7.98	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
1.17	0.00	95.54	7.98	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
1.25	0.00	95.54	7.98	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
1.33	0.00	95.53	7.98	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
1.42	0.00	95.53	7.98	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
1.50	0.00	95.53	7.98	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
1.58	0.00	95.52	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
1.67	0.00	95.52	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
1.75	0.00	95.52	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
1.83	0.00	95.51	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
1.92	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.00	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.08	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.17	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.25	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.33	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.42	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01

...End

Hydrograph Report

Hydraflow Hydrographs by Intelisolve — Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 5.74 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 2.0 ac	Runoff coeff.	= 0.57
Intensity	= 5.059 in/hr	Tc by User	= 5 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 2,582 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time (hrs	Outflow cfs)
0.02	1.15
0.10	5.74
0.18	1.15

...End

WHERE IS VOLUME OF RUNOFF?

BED?

WHERE'S HYDROGRAPH?

$Q_{max} = 5.74$ cfs $\cdot T_c \cdot F$ (TIME OF STORM) = VOLUME OF RUNOFF

ROUTED

MAY DEV

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 7.32 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 2.0 ac	Runoff coeff.	= 0.57
Intensity	= 6.456 in/hr	Tc by User	= 5 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,295 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)
0.02	1.46
0.10	7.32 <<
0.18	1.46

...End

Pond Report

Hydraflow Hydrographs by Intelisolve — Thursday, Apr 9 2009, 12:55 PM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	~~96.00~~	~~2,721~~	~~2,259~~	~~2,259~~ 2686.20
~~2.00~~	~~97.00~~	~~1,675~~	~~2,198~~	~~4,457~~

Culvert / Orifice Structures

riser dewatering orifice

	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 92.00	95.50	0.00	0.00
Length (ft)	= 150.00	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

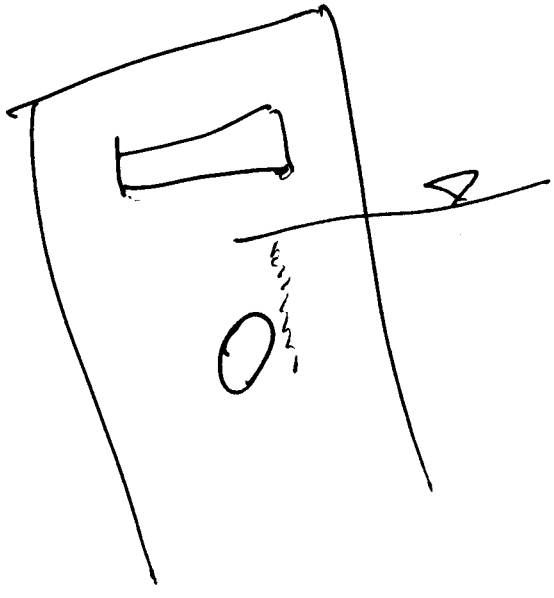
	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.56	0.00	0.00	0.00
Crest El. (ft)	= 96.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

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

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	95.00	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	226	95.10	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.20	452	95.20	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.30	678	95.30	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.40	904	95.40	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.50	1,130	95.50	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.60	1,355	95.60	7.98	0.11	---	---	0.00	---	---	---	---	0.11
0.70	1,581	95.70	7.98	0.30	---	---	0.00	---	---	---	---	0.30
0.80	1,807	95.80	7.98	0.50	---	---	0.00	---	---	---	---	0.50
0.90	2,033	95.90	7.98	0.63	---	---	0.00	---	---	---	---	0.63
1.00	2,259	96.00	7.98	0.74	---	---	0.00	---	---	---	---	0.74
1.10	2,479	96.10	7.98	0.83	---	---	0.69	---	---	---	---	1.52
1.20	2,699	96.20	7.98	0.91	---	---	1.95	---	---	---	---	2.87
1.30	2,918	96.30	7.98	0.99	---	---	3.59	---	---	---	---	4.58
1.40	3,138	96.40	7.98	1.06	---	---	5.53	---	---	---	---	6.59
1.50	3,358	96.50	7.98	1.13	---	---	7.72	---	---	---	---	8.85
1.60	3,578	96.60	9.34	1.19	---	---	9.33	---	---	---	---	10.52
1.70	3,798	96.70	9.60	1.25	---	---	9.60	---	---	---	---	10.84
1.80	4,017	96.80	9.78	1.30	---	---	9.78	---	---	---	---	11.08
1.90	4,237	96.90	9.92	1.36	---	---	9.92	---	---	---	---	11.28
2.00	4,457	97.00	10.05	1.41	---	---	10.04	---	---	---	---	11.46



Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 0.72 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Reservoir name	= BMP#1
Max. Elevation	= 95.99 ft	Max. Storage	= 2,225 cuft

Storage Indication method used.

Outflow hydrograph volume = 1,278 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.17	2.30	95.96	7.98	0.69	-----	-----	-----	-----	-----	-----	-----	0.69
0.25	0.00	95.93	7.98	0.66	-----	-----	-----	-----	-----	-----	-----	0.66
0.33	0.00	95.85	7.98	0.56	-----	-----	-----	-----	-----	-----	-----	0.56
0.42	0.00	95.78	7.98	0.46	-----	-----	-----	-----	-----	-----	-----	0.46
0.50	0.00	95.72	7.98	0.35	-----	-----	-----	-----	-----	-----	-----	0.35
0.58	0.00	95.68	7.98	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
0.67	0.00	95.65	7.98	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
0.75	0.00	95.63	7.98	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
0.83	0.00	95.61	7.98	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
0.92	0.00	95.59	7.98	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.00	0.00	95.58	7.98	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.08	0.00	95.57	7.98	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.17	0.00	95.56	7.98	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
1.25	0.00	95.55	7.98	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
1.33	0.00	95.55	7.98	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
1.42	0.00	95.54	7.98	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
1.50	0.00	95.53	7.98	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
1.58	0.00	95.53	7.98	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
1.67	0.00	95.53	7.98	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
1.75	0.00	95.52	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
1.83	0.00	95.52	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
1.92	0.00	95.52	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
2.00	0.00	95.51	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
2.08	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.17	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.25	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.33	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
2.42	0.00	95.51	7.98	0.01	-----	-----	-----	-----	-----	-----	-----	0.01

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START HERE?

...End

Pond Report

Hydraflow Hydrographs by Intelisolve — Thursday, Apr 9 2009, 12:55 PM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
2.00	97.00	1,675	2,198	4,457

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 92.00	95.50	0.00	0.00
Length (ft)	= 150.00	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)	= 6.56	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	95.00	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	226	95.10	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.20	452	95.20	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.30	678	95.30	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.40	904	95.40	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.50	1,130	95.50	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.60	1,355	95.60	7.98	0.11	---	---	0.00	---	---	---	---	0.11
0.70	1,581	95.70	7.98	0.30	---	---	0.00	---	---	---	---	0.30
0.80	1,807	95.80	7.98	0.50	---	---	0.00	---	---	---	---	0.50
0.90	2,033	95.90	7.98	0.63	---	---	0.00	---	---	---	---	0.63
1.00	2,259	96.00	7.98	0.74	---	---	0.00	---	---	---	---	0.74
1.10	2,479	96.10	7.98	0.83	---	---	0.69	---	---	---	---	1.52
1.20	2,699	96.20	7.98	0.91	---	---	1.95	---	---	---	---	2.87
1.30	2,918	96.30	7.98	0.99	---	---	3.59	---	---	---	---	4.58
1.40	3,138	96.40	7.98	1.06	---	---	5.53	---	---	---	---	6.59
1.50	3,358	96.50	7.98	1.13	---	---	7.72	---	---	---	---	8.85
1.60	3,578	96.60	9.34	1.19	---	---	9.33	---	---	---	---	10.52
1.70	3,798	96.70	9.60	1.25	---	---	9.60	---	---	---	---	10.84
1.80	4,017	96.80	9.78	1.30	---	---	9.78	---	---	---	---	11.08
1.90	4,237	96.90	9.92	1.36	---	---	9.92	---	---	---	---	11.28
2.00	4,457	97.00	10.05	1.41	---	---	10.04	---	---	---	---	11.46

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 2.37 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Reservoir name	= BMP#1
Max. Elevation	= 96.16 ft	Max. Storage	= 2,618 cuft

Storage Indication method used.

Outflow hydrograph volume = 1,944 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.17	2.93	96.16 <<	7.98	0.88	-----	-----	1.49	-----	-----	-----	-----	2.37 <<
0.25	0.00	96.02	7.98	0.75	-----	-----	0.13	-----	-----	-----	-----	0.88
0.33	0.00	95.92	7.98	0.66	-----	-----	-----	-----	-----	-----	-----	0.66
0.42	0.00	95.84	7.98	0.56	-----	-----	-----	-----	-----	-----	-----	0.56
0.50	0.00	95.77	7.98	0.45	-----	-----	-----	-----	-----	-----	-----	0.45
0.58	0.00	95.72	7.98	0.35	-----	-----	-----	-----	-----	-----	-----	0.35
0.67	0.00	95.68	7.98	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
0.75	0.00	95.65	7.98	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
0.83	0.00	95.63	7.98	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
0.92	0.00	95.61	7.98	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
1.00	0.00	95.59	7.98	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.08	0.00	95.58	7.98	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.17	0.00	95.57	7.98	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.25	0.00	95.56	7.98	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
1.33	0.00	95.55	7.98	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
1.42	0.00	95.55	7.98	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
1.50	0.00	95.54	7.98	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
1.58	0.00	95.53	7.98	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
1.67	0.00	95.53	7.98	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
1.75	0.00	95.53	7.98	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
1.83	0.00	95.52	7.98	0.02	-----	-----	-----	-----	-----	-----	-----	0.02

...End

Pond Report

Hydraflow Hydrographs by Intelisolve — Thursday, Apr 9 2009, 12:55 PM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
2.00	97.00	1,675	2,198	4,457

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 92.00	95.50	0.00	0.00
Length (ft)	= 150.00	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)	= 6.56	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	95.00	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	226	95.10	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.20	452	95.20	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.30	678	95.30	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.40	904	95.40	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.50	1,130	95.50	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.60	1,355	95.60	7.98	0.11	---	---	0.00	---	---	---	---	0.11
0.70	1,581	95.70	7.98	0.30	---	---	0.00	---	---	---	---	0.30
0.80	1,807	95.80	7.98	0.50	---	---	0.00	---	---	---	---	0.50
0.90	2,033	95.90	7.98	0.63	---	---	0.00	---	---	---	---	0.63
1.00	2,259	96.00	7.98	0.74	---	---	0.00	---	---	---	---	0.74
1.10	2,479	96.10	7.98	0.83	---	---	0.69	---	---	---	---	1.52
1.20	2,699	96.20	7.98	0.91	---	---	1.95	---	---	---	---	2.87
1.30	2,918	96.30	7.98	0.99	---	---	3.59	---	---	---	---	4.58
1.40	3,138	96.40	7.98	1.06	---	---	5.53	---	---	---	---	6.59
1.50	3,358	96.50	7.98	1.13	---	---	7.72	---	---	---	---	8.85
1.60	3,578	96.60	9.34	1.19	---	---	9.33	---	---	---	---	10.52
1.70	3,798	96.70	9.60	1.25	---	---	9.60	---	---	---	---	10.84
1.80	4,017	96.80	9.78	1.30	---	---	9.78	---	---	---	---	11.08
1.90	4,237	96.90	9.92	1.36	---	---	9.92	---	---	---	---	11.28
2.00	4,457	97.00	10.05	1.41	---	---	10.04	---	---	---	---	11.46

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 8.65 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Drainage area	= 2.0 ac	Runoff coeff.	= 0.57
Intensity	= 7.622 in/hr	Tc by User	= 5 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 3,890 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)
0.02	1.73
0.10	8.65 <<
0.18	1.73

...End

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 3.99 cfs
Storm frequency	= 25 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Reservoir name	= BMP#1
Max. Elevation	= 96.27 ft	Max. Storage	= 2,843 cuft

Storage Indication method used.

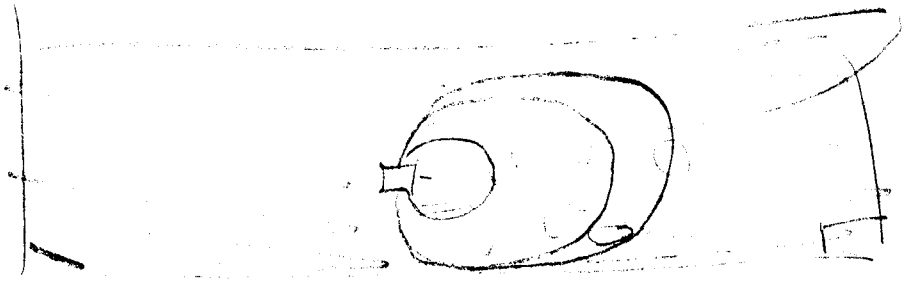
Outflow hydrograph volume = 2,499 cuft

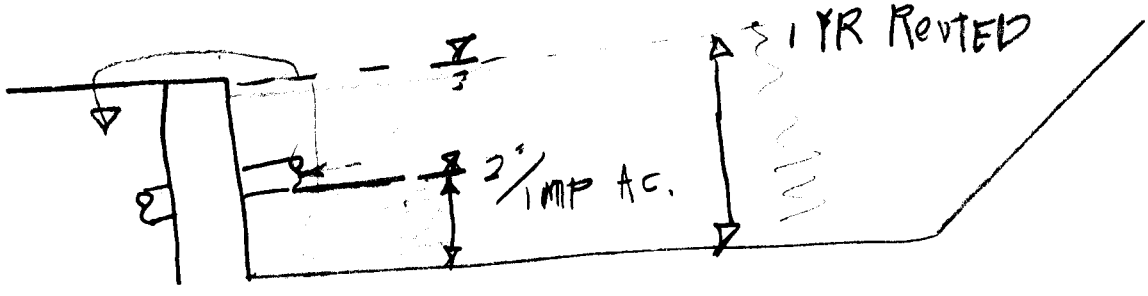
(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.08	8.65 <<	95.57	7.98	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.17	3.46	96.27 <<	7.98	0.96	-----	-----	3.03	-----	-----	-----	-----	3.99 <<
0.25	0.00	96.04	7.98	0.78	-----	-----	0.29	-----	-----	-----	-----	1.07
0.33	0.00	95.94	7.98	0.67	-----	-----	-----	-----	-----	-----	-----	0.67
0.42	0.00	95.86	7.98	0.57	-----	-----	-----	-----	-----	-----	-----	0.57
0.50	0.00	95.79	7.98	0.48	-----	-----	-----	-----	-----	-----	-----	0.48
0.58	0.00	95.73	7.98	0.36	-----	-----	-----	-----	-----	-----	-----	0.36
0.67	0.00	95.69	7.98	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
0.75	0.00	95.65	7.98	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
0.83	0.00	95.63	7.98	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
0.92	0.00	95.61	7.98	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
1.00	0.00	95.60	7.98	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.08	0.00	95.58	7.98	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.17	0.00	95.57	7.98	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.25	0.00	95.56	7.98	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
1.33	0.00	95.55	7.98	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
1.42	0.00	95.55	7.98	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
1.50	0.00	95.54	7.98	0.04	-----	-----	-----	-----	-----	-----	-----	0.04

...End

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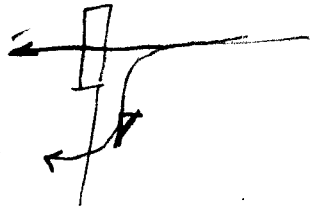


Pond Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
2.00	97.00	1,675	2,198	4,457

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 92.00	95.50	0.00	0.00
Length (ft)	= 150.00	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)	= 6.56	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	95.00	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	226	95.10	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.20	452	95.20	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.30	678	95.30	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.40	904	95.40	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.50	1,130	95.50	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.60	1,355	95.60	7.98	0.11	---	---	0.00	---	---	---	---	0.11
0.70	1,581	95.70	7.98	0.30	---	---	0.00	---	---	---	---	0.30
0.80	1,807	95.80	7.98	0.50	---	---	0.00	---	---	---	---	0.50
0.90	2,033	95.90	7.98	0.63	---	---	0.00	---	---	---	---	0.63
1.00	2,259	96.00	7.98	0.74	---	---	0.00	---	---	---	---	0.74
1.10	2,479	96.10	7.98	0.83	---	---	0.69	---	---	---	---	1.52
1.20	2,699	96.20	7.98	0.91	---	---	1.95	---	---	---	---	2.87
1.30	2,918	96.30	7.98	0.99	---	---	3.59	---	---	---	---	4.58
1.40	3,138	96.40	7.98	1.06	---	---	5.53	---	---	---	---	6.59
1.50	3,358	96.50	7.98	1.13	---	---	7.72	---	---	---	---	8.85
1.60	3,578	96.60	9.34	1.19	---	---	9.33	---	---	---	---	10.52
1.70	3,798	96.70	9.60	1.25	---	---	9.60	---	---	---	---	10.84
1.80	4,017	96.80	9.78	1.30	---	---	9.78	---	---	---	---	11.08
1.90	4,237	96.90	9.92	1.36	---	---	9.92	---	---	---	---	11.28
2.00	4,457	97.00	10.05	1.41	---	---	10.04	---	---	---	---	11.46

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 1

BMP#1

Hydrograph type	= Mod. Rational	Peak discharge	= 10.36 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 2.0 ac	Runoff coeff.	= 0.57
Intensity	= 9.132 in/hr	Tc by User	= 5 min
IDF Curve	= VIRGINIA FHA.IDF	Storm duration	= 1.5 x Tc

Hydrograph Volume = 4,662 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)
0.02	2.07
0.10	10.36 <<
0.18	2.07

...End

Hydrograph Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Hyd. No. 2

BMP#1 Route

Hydrograph type	= Reservoir	Peak discharge	= 6.08 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 1	Reservoir name	= BMP#1
Max. Elevation	= 96.37 ft	Max. Storage	= 3,082 cuft

Storage Indication method used.

Outflow hydrograph volume = 3,219 cuft

(Printed values >= 1% of Qp. Print interval = 5)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.08	10.36 <<	95.68	7.98	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
0.17	4.14	96.36	7.98	1.03	-----	-----	4.66	-----	-----	-----	-----	5.69
0.25	0.00	96.06	7.98	0.79	-----	-----	0.42	-----	-----	-----	-----	1.21
0.33	0.00	95.95	7.98	0.68	-----	-----	-----	-----	-----	-----	-----	0.68
0.42	0.00	95.86	7.98	0.59	-----	-----	-----	-----	-----	-----	-----	0.59
0.50	0.00	95.79	7.98	0.49	-----	-----	-----	-----	-----	-----	-----	0.49
0.58	0.00	95.74	7.98	0.38	-----	-----	-----	-----	-----	-----	-----	0.38
0.67	0.00	95.69	7.98	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
0.75	0.00	95.66	7.98	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
0.83	0.00	95.63	7.98	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
0.92	0.00	95.61	7.98	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
1.00	0.00	95.60	7.98	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.08	0.00	95.58	7.98	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.17	0.00	95.57	7.98	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.25	0.00	95.56	7.98	0.07	-----	-----	-----	-----	-----	-----	-----	0.07

...End

Pond Report

Hydraflow Hydrographs by Intelisolve

Thursday, Apr 9 2009, 12:55 PM

Pond No. 1 - BMP#1

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	95.00	1,797	0	0
1.00	96.00	2,721	2,259	2,259
2.00	97.00	1,675	2,198	4,457

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 15.00	3.00	0.00	0.00
Span (in)	= 15.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 92.00	95.50	0.00	0.00
Length (ft)	= 150.00	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)	= 6.56	0.00	0.00	0.00
Crest El. (ft)	= 96.00	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.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	95.00	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	226	95.10	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.20	452	95.20	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.30	678	95.30	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.40	904	95.40	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.50	1,130	95.50	7.98	0.00	---	---	0.00	---	---	---	---	0.00
0.60	1,355	95.60	7.98	0.11	---	---	0.00	---	---	---	---	0.11
0.70	1,581	95.70	7.98	0.30	---	---	0.00	---	---	---	---	0.30
0.80	1,807	95.80	7.98	0.50	---	---	0.00	---	---	---	---	0.50
0.90	2,033	95.90	7.98	0.63	---	---	0.00	---	---	---	---	0.63
1.00	2,259	96.00	7.98	0.74	---	---	0.00	---	---	---	---	0.74
1.10	2,479	96.10	7.98	0.83	---	---	0.69	---	---	---	---	1.52
1.20	2,699	96.20	7.98	0.91	---	---	1.95	---	---	---	---	2.87
1.30	2,918	96.30	7.98	0.99	---	---	3.59	---	---	---	---	4.58
1.40	3,138	96.40	7.98	1.06	---	---	5.53	---	---	---	---	6.59
1.50	3,358	96.50	7.98	1.13	---	---	7.72	---	---	---	---	8.85
1.60	3,578	96.60	9.34	1.19	---	---	9.33	---	---	---	---	10.52
1.70	3,798	96.70	9.60	1.25	---	---	9.60	---	---	---	---	10.84
1.80	4,017	96.80	9.78	1.30	---	---	9.78	---	---	---	---	11.08
1.90	4,237	96.90	9.92	1.36	---	---	9.92	---	---	---	---	11.28
2.00	4,457	97.00	10.05	1.41	---	---	10.04	---	---	---	---	11.46

INFILTRATION TRENCH #2
DESIGN WORKSHEET

INFILTRATION BASIN DESIGN WORKSHEET

Water Quality Volume

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

R_D = Design Storm Rainfall Depth (inches)

R_D = 1 First 1" run-off for water quality

R_V = runoff coefficient (Runoff/Rainfall)

$R_V = 0.05 + 0.009(I)$

I = 35.21 % Impervious Area of Site

A = 0.71 Drainage Area (Acres)

Rv = 0.367

WQv = Water Quality Volume = 0.022 Acre-Feet

946 Cubic Feet

Maximum Infiltration Basin Ponding Depth

$f_d = 0.5 \times f$

d_{max} $(f_d)(T_{max})$

f = 0.17 Permeability Coefficient of Infiltration Basin Media (ft/hour)

f_d = 0.08 Design Infiltration Rate of Infiltration Basin Media (ft/hour)

T_{max} = 48 Maximum Allowable Drain Time (hours)

2.00 Maximum Allowable Drain Time (days)

d_{max} = 2 Maximum Ponding Depth (feet)

Minimum Infiltration Basin Surface Area

$SA_{min} = \frac{(WQv)}{(f_d)(T_{max})}$

SA_{min} = 236 SF required for 2' Maximum Ponding Depth

Actual Surface Area = 7,850 SF provided

Formulating Pre- & Post- Development Hydrographs

Utilize small watershed method & center-weighted storm (Malcom)

Return Period	2 *year*	(24-hour storm event)
I =	5.73 *in/hr*	(precipitation frequency) [5 min TOC used]
C-pre =	0.30	(standard Rational C for wooded area)
C-post =	0.51	(standard Rational C for residential development)
A =	0.71 *acre*	
A =	30,928 *sf*	

Q* = (P - 0.2S)^2 / (P + 0.8S) = Runoff Depth

Q-pre =	1.2 *cfs*		Q*-pre =	2.96 *in*
Q-post =	2.1 *cfs*		Q*-post =	3.74 *in*
Vol-pre =	7,627 *cf*			
Vol-post =	9,638 *cf*			
T-pre =	75 *min*		S-pre =	3.51
T-post =	56 *min*		S-post =	2.20

S = 1000/CN - 10 = inches of potential maximum retention after rainfall

Time Step 2 *min*

Time *min*	Q- pre *cfs*	Q-post *cfs*
0	0.00	0.00
2	0.00	0.01
4	0.01	0.03
6	0.02	0.06
8	0.03	0.10
10	0.05	0.16
12	0.08	0.23
14	0.10	0.31
16	0.13	0.40
18	0.17	0.49
20	0.20	0.60
22	0.24	0.71
24	0.28	0.82
26	0.33	0.94
28	0.37	1.05
30	0.42	1.17
32	0.47	1.29
34	0.52	1.40
36	0.57	1.51
38	0.62	1.61
40	0.68	1.70
42	0.73	1.79
44	0.78	1.87
46	0.82	1.93
48	0.87	1.99
50	0.92	2.03
52	0.96	2.06
54	1.00	2.08
56	1.04	2.08
58	1.07	2.07
60	1.10	2.05
62	1.13	2.01
64	1.16	1.96
66	1.18	1.90
68	1.19	1.83
70	1.21	1.75

Pre Development CN values for "C" type soils

	Acres	CN	Composite CN
Impervious Area	0.00	98	0.00
Pervious Area	0.71	74	74.00
		Total	74.00
		Use	74

Post Development CN values for "C" type soils

	Acres	CN	Composite CN
Impervious Area	0.25	98	34.51
Pervious Area	0.46	74	47.94
		Total	82.45
		Use	82

Pre Development C values for "C" type soils

	Acres	C	Composite C
Impervious Area	0.00	0.9	0.00
Pervious Area	0.71	0.3	0.30
		Total	0.30

Post Development C values for "C" type soils

	Acres	C	Composite C
Impervious Area	0.25	0.9	0.32
Pervious Area	0.46	0.3	0.19
		Total	0.51

Time of Concentration (Kirpich Tc Equation)

Predevelopment

L	100 *ft*	(Length of Overland Flow)
S	0.05 *ft/ft*	(average overland slope)
tc	0.86 *min*	bare soil
tc	1.71 *min*	grassed

Post Development

L	150 *ft*	(Length of Overland Flow)
S	0.1 *ft/ft*	(average overland slope)
tc	0.90 *min*	bare soil
tc	1.79 *min*	grassed

Note: Compare this to a 5 minute minimum.

72	1.22	1.67
74	1.22	1.60
76	1.22	1.52
78	1.22	1.46
80	1.21	1.39
82	1.19	1.33
84	1.18	1.26
86	1.16	1.21
88	1.13	1.15
90	1.10	1.10
92	1.07	1.05
94	1.04	1.00
96	1.00	0.96
98	0.97	0.91
100	0.93	0.87
102	0.90	0.83
104	0.87	0.79
106	0.84	0.76
108	0.81	0.72
110	0.79	0.69
112	0.76	0.66
114	0.73	0.63
116	0.71	0.60
118	0.68	0.57
120	0.66	0.54
122	0.64	0.52
124	0.62	0.50
126	0.60	0.47
128	0.57	0.45
130	0.56	0.43
132	0.54	0.41
134	0.52	0.39
136	0.50	0.37
138	0.48	0.36
140	0.47	0.34
142	0.45	0.33
144	0.44	0.31
146	0.42	0.30
148	0.41	0.28
150	0.39	0.27
152	0.38	0.26
154	0.37	0.25
156	0.35	0.23
158	0.34	0.22
160	0.33	0.21
162	0.32	0.20
164	0.31	0.19
166	0.30	0.19
168	0.29	0.18
170	0.28	0.17
172	0.27	0.16
174	0.26	0.15
176	0.25	0.15
178	0.24	0.14
180	0.23	0.13

STILLING BASIN CALCULATIONS

Stilling Basin 1

Fill in

check Points

Use Attached Charts

This procedure is only valid for circular culverts.

Variables:

Design Flow =	Q100	=	2.1	CFS
Barrel Diameter =	D	=	1.5	Feet
Depth of basin =	hs	=	0.45	
Width of basin =	W	=	D = 1.5	
Tailwater Depth =	TW	=	0.25	feet

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

Step 1	Q/D^2.5	=	0.76		
	TW/D	=	0.17		
From Fig. III-10	Yo/D	=	0.28		
	Yo	=	0.42	Feet	
	TW/Yo	=	0.60	< 0.75	Check
From Table III-2, use Yo/D as d/D and insert the value for A/D^2 into this cell		=	0.18		
	A	=	0.41	Sq. Feet	
	Vo	=	5.19		

Step 2	Ye	=	0.45	
Step 3	Fr	=	1.36	
Step 4 Pick a d50 for Rip Rap	d50	=	0.15	Feet
	d50/Ye	=	0.33	
Froude Number		=	1.36	
From Figure XI-2,	hs/Ye	=	1	
	hs	=	0.45	
2 <	hs/d50	=	3.00	< 4 Check

Step 5

Length of Pool =	LS	=	4.50	Feet,	or	4.5	Feet, Whichever is Greater
Overall Length =	LB	=	6.75	Feet,	or	6	Feet, Whichever is Greater

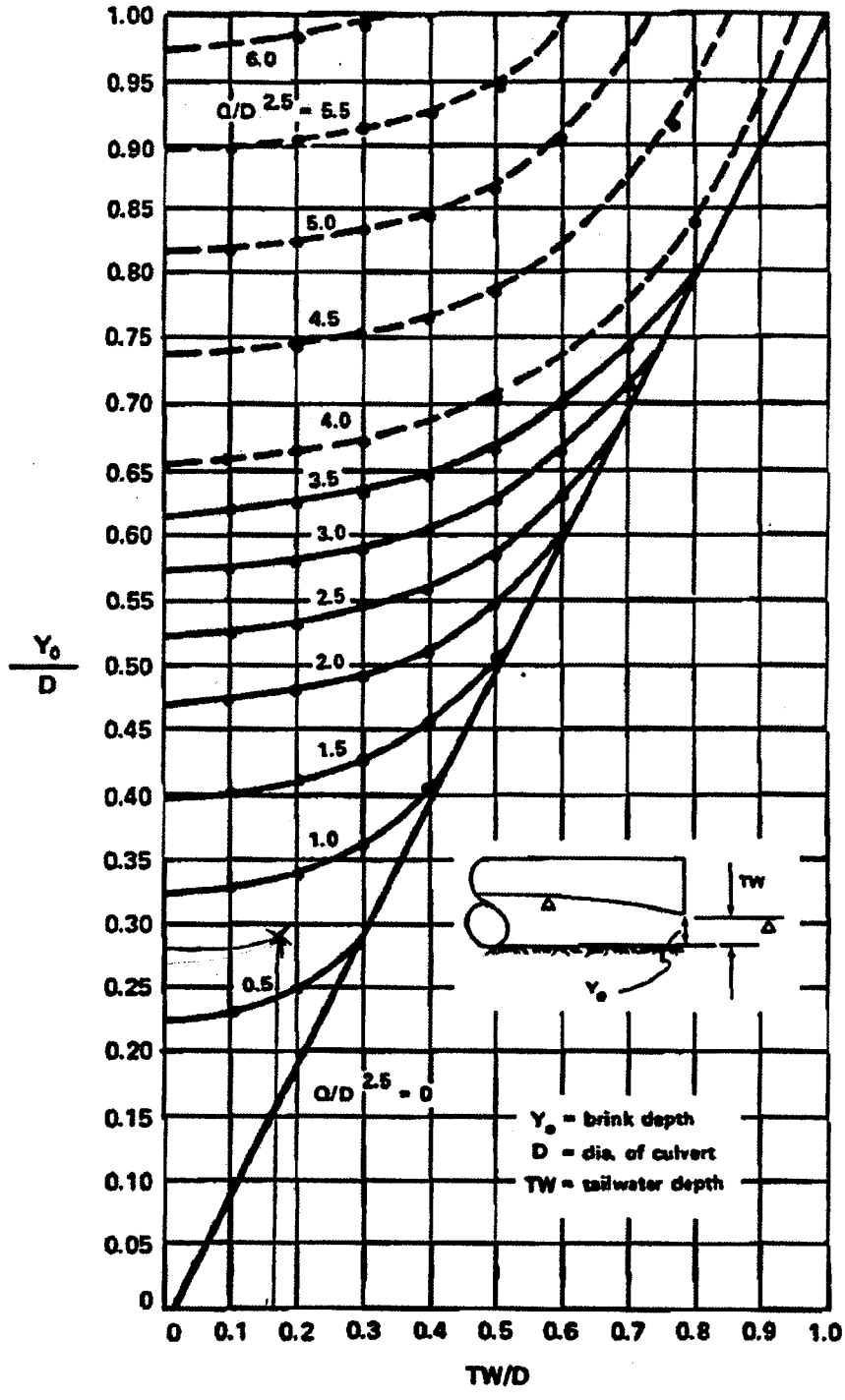


Figure III-10 Dimensionless Rating Curve for the Outlets of Circular Culverts on Horizontal and Mild Slopes from Reference III-2

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	0.00031	10.57	0.52	0.4127	0.2562	0.247	1.415
0.03	0.0069	0.0197	0.00074	8.58	0.53	0.4227	0.2592	0.255	1.388
0.04	0.0105	0.0262	0.00138	7.38	0.54	0.4327	0.2621	0.263	1.362
0.05	0.0147	0.0325	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	0.0668	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	1.105
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	0.3008	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	0.1516	0.0686	2.49	0.76	0.6406	0.3024	0.429	0.891
0.27	0.1711	0.1566	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	0.6656	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	0.1756	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	0.1088	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	1.96	0.86	0.7186	0.3026	0.481	0.720
0.37	0.2642	0.2020	0.1351	1.91	0.87	0.7254	0.3018	0.485	0.703
0.38	0.2738	0.2062	0.1420	1.87	0.88	0.7320	0.3007	0.488	0.687
0.39	0.2836	0.2102	0.1490	1.83	0.89	0.7384	0.2996	0.491	0.670
0.40	0.2934	0.2142	0.1561	1.79	0.90	0.7445	0.2980	0.494	0.654
0.41	0.3032	0.2182	0.1633	1.76	0.91	0.7504	0.2963	0.496	0.637
0.42	0.3130	0.2220	0.1706	1.72	0.92	0.7560	0.2944	0.497	0.621
0.43	0.3229	0.2258	0.1779	1.69	0.93	0.7612	0.2921	0.498	0.604
0.44	0.3328	0.2295	0.1854	1.65	0.94	0.7662	0.2895	0.498	0.588
0.45	0.3428	0.2331	0.1929	1.62	0.95	0.7707	0.2865	0.498	0.571
0.46	0.3527	0.2366	0.201	1.59	0.96	0.7749	0.2829	0.496	0.553
0.47	0.3627	0.2401	0.209	1.56	0.97	0.7785	0.2787	0.494	0.536
0.48	0.3727	0.2436	0.216	1.53	0.98	0.7817	0.2736	0.489	0.517
0.49	0.3827	0.2468	0.224	1.50	0.99	0.7841	0.2666	0.483	0.498
0.50	0.3927	0.2500	0.232	1.47	1.00	0.7854	0.2500	0.463	0.463

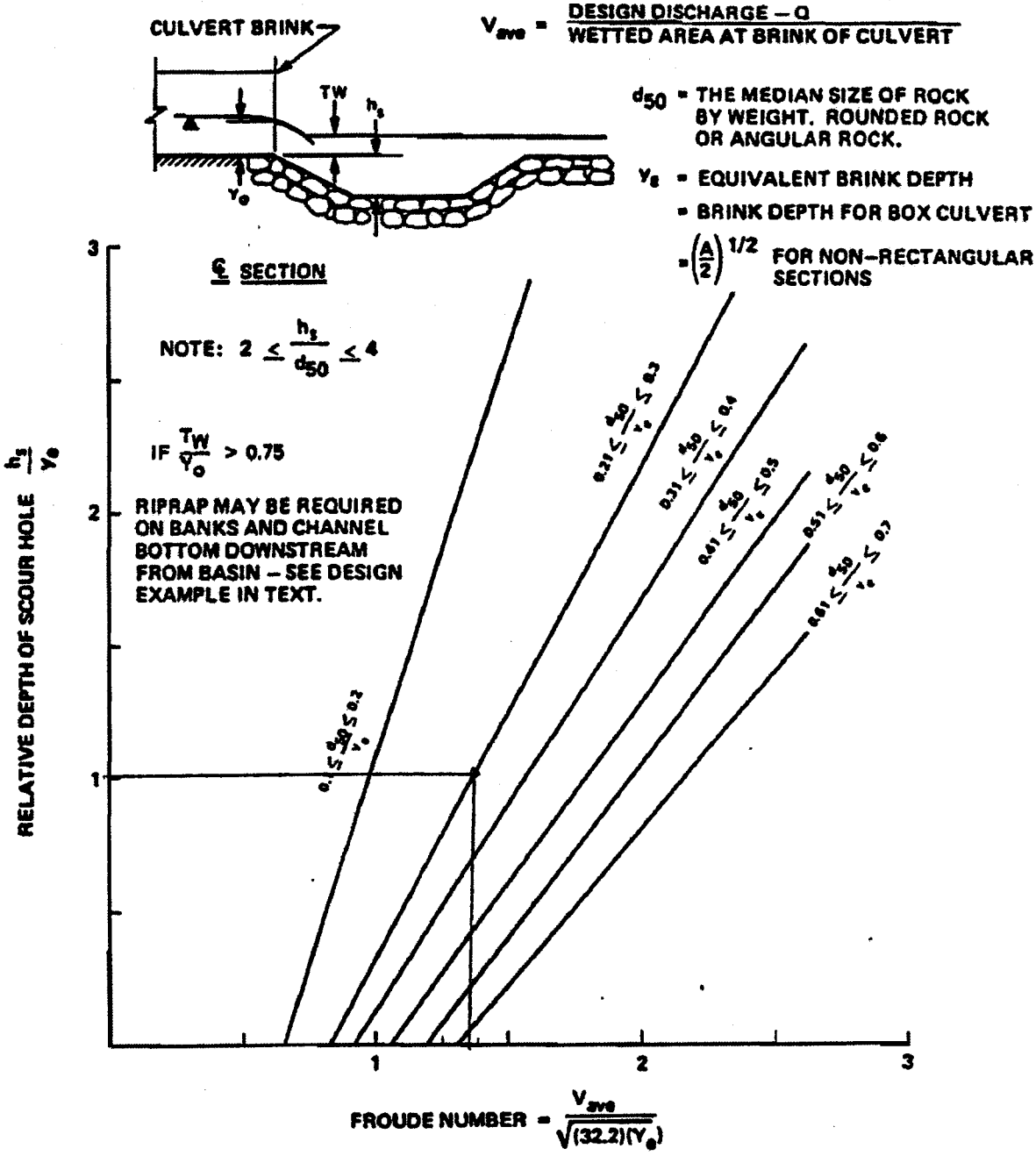
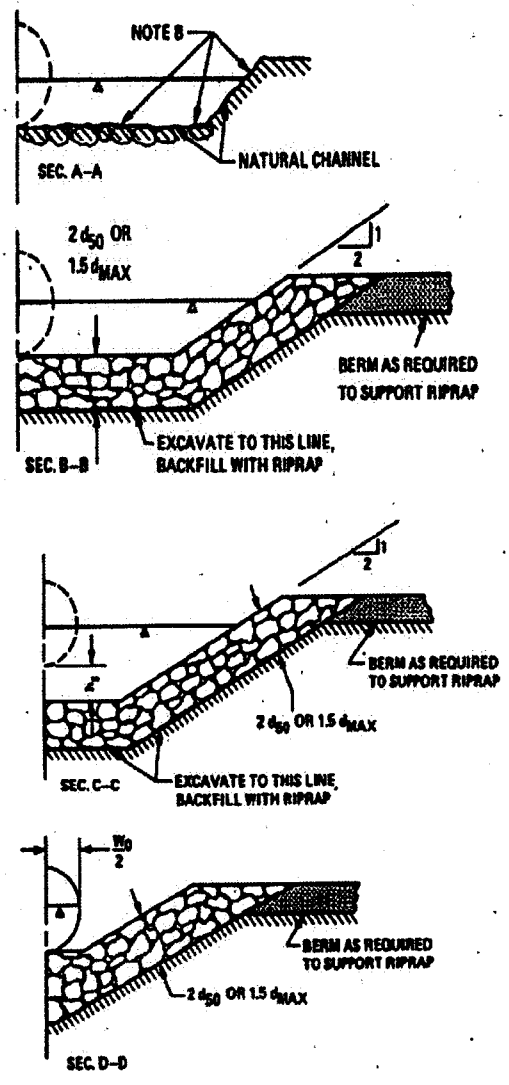
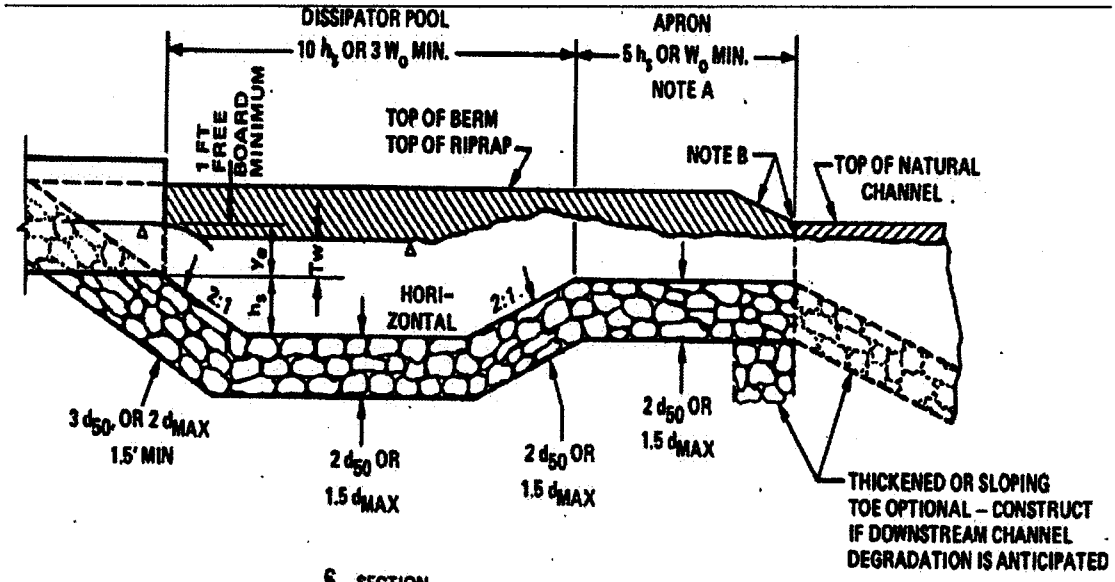
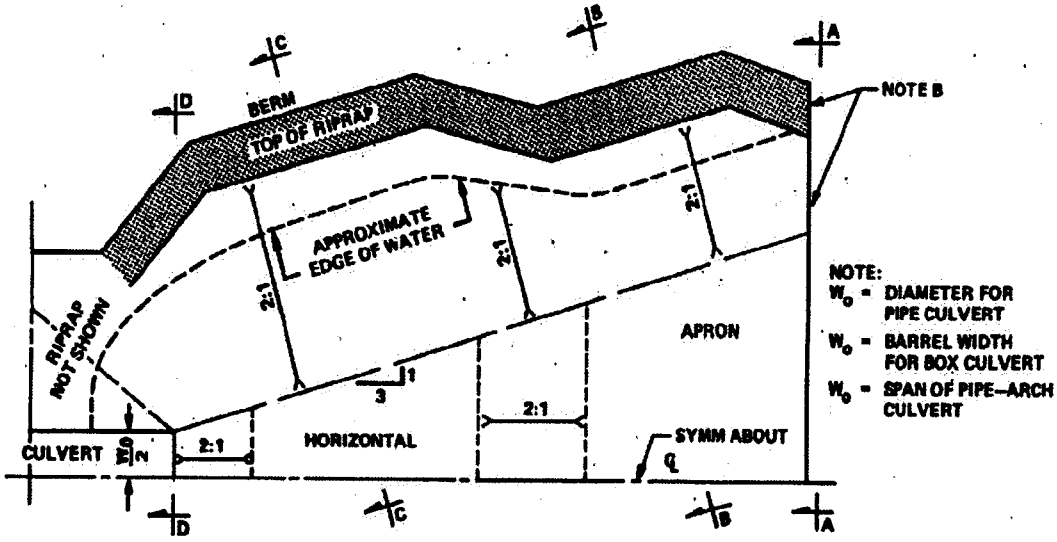


FIGURE X1–2. RELATIVE DEPTH OF SCOUR HOLE VERSUS FROUDE NUMBER AT BRINK OF CULVERT WITH RELATIVE SIZE OF RIPRAP AS A THIRD VARIABLE


NOTE 8
NATURAL CHANNEL
SEC. A-A
2 d_{50} OR
1.5 d_{MAX}
1
2
BERM AS REQUIRED
TO SUPPORT RIPRAP
EXCAVATE TO THIS LINE,
BACKFILL WITH RIPRAP
SEC. B-B
1
2
BERM AS REQUIRED
TO SUPPORT RIPRAP
2 d_{50} OR 1.5 d_{MAX}
EXCAVATE TO THIS LINE,
BACKFILL WITH RIPRAP
SEC. C-C
$\frac{W_0}{2}$
BERM AS REQUIRED
TO SUPPORT RIPRAP
2 d_{50} OR 1.5 d_{MAX}
SEC. D-D



℄ SECTION



HALF PLAN

Stilling Basin 2

Fill in

check Points

Use Attached Charts

This procedure is only valid for circular culverts.

Variables:

Design Flow =	Q100	=	3.83	CFS
Barrel Diameter =	D	=	1.25	Feet
Depth of basin =	hs	=	0.54	
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.

Step 1	Q/D^2.5	=	2.19		
	TW/D	=	0.32		
From Fig. III-10	Yo/D	=	0.48		
	Yo	=	0.600	Feet	
	TW/Yo	=	0.67	< 0.75	Check
From Table III-2, use Yo/D as d/D and insert the value for A/D^2 into this cell		=	0.37		
	A	=	0.58	Sq. Feet	
	Vo	=	6.58		

Step 2	Ye	=	0.54	
Step 3	Fr	=	1.58	
Step 4 Pick a d50 for Rip Rap	d50	=	0.2	Feet
	d50/Ye	=	0.37	
Froude Number		=	1.58	
From Figure XI-2,	hs/Ye	=	1	
	hs	=	0.54	
2 <	hs/d50	=	2.70	< 4 Check

Step 5

Length of Pool =	LS	=	5.40	Feet, or	3.8	Feet,	Whichever is Greater
Overall Length =	LB	=	8.09	Feet, or	5	Feet,	Whichever is Greater

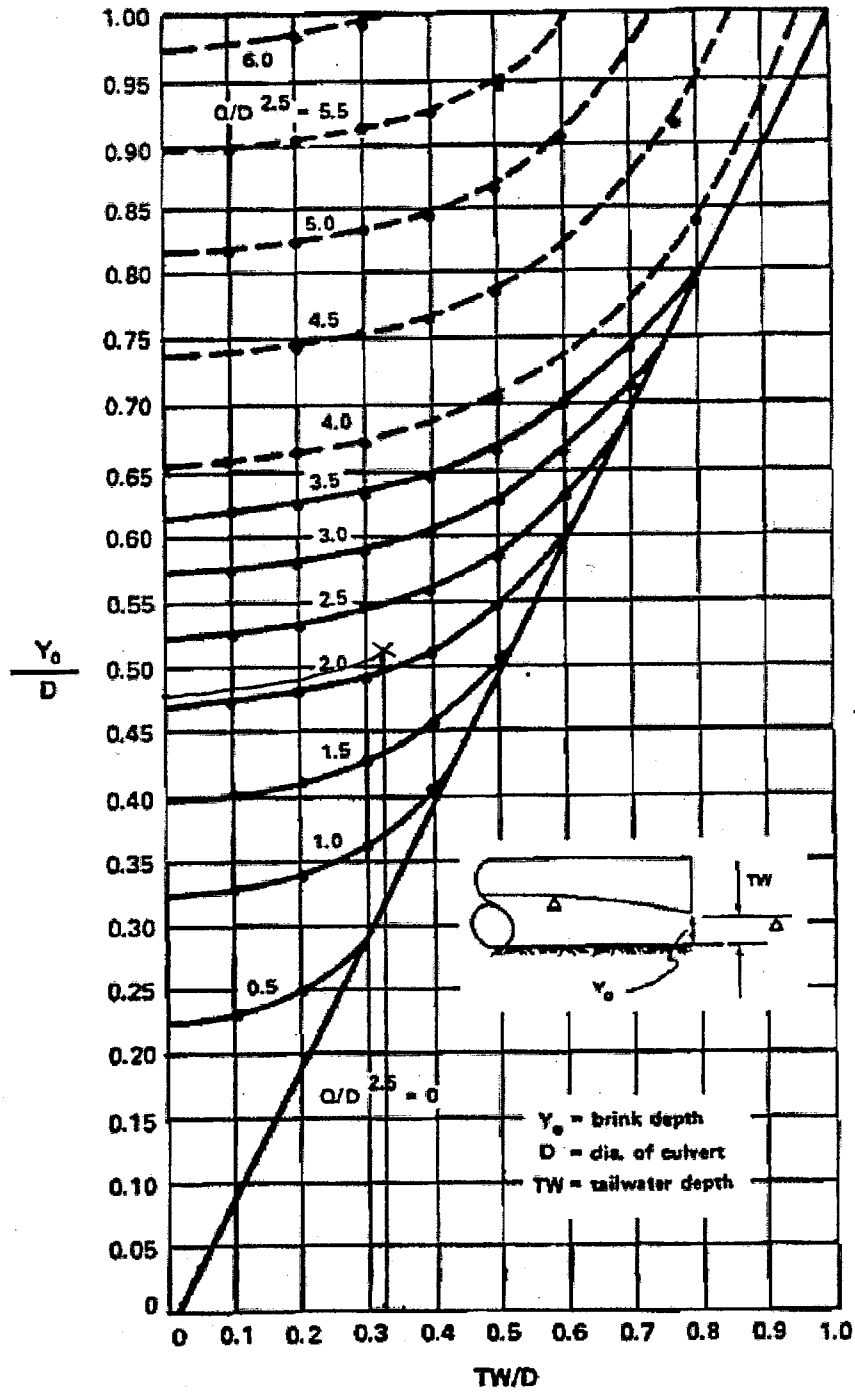


Figure III-10 Dimensionless Rating Curve for the Outlets of Circular Culverts on Horizontal and Mild Slopes from Reference III-2

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	0.00031	10.57	0.52	0.4127	0.2562	0.247	1.415
0.03	0.0069	0.0197	0.00074	8.56	0.53	0.4227	0.2592	0.255	1.388
0.04	0.0105	0.0262	0.00138	7.38	0.54	0.4327	0.2621	0.263	1.362
0.05	0.0147	0.0325	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	0.0668	0.0871	0.01952	3.69	0.64	0.5308	0.2862	0.343	1.126
0.15	0.0739	0.0929	0.0226	3.54	0.65	0.5404	0.2882	0.350	1.105
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	0.0366	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	0.3008	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	0.1516	0.0686	2.49	0.76	0.6405	0.3024	0.429	0.891
0.27	0.1711	0.1566	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	0.3026	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	0.2296	0.1854	1.655	0.94	0.7662	0.2895	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	0.2735	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

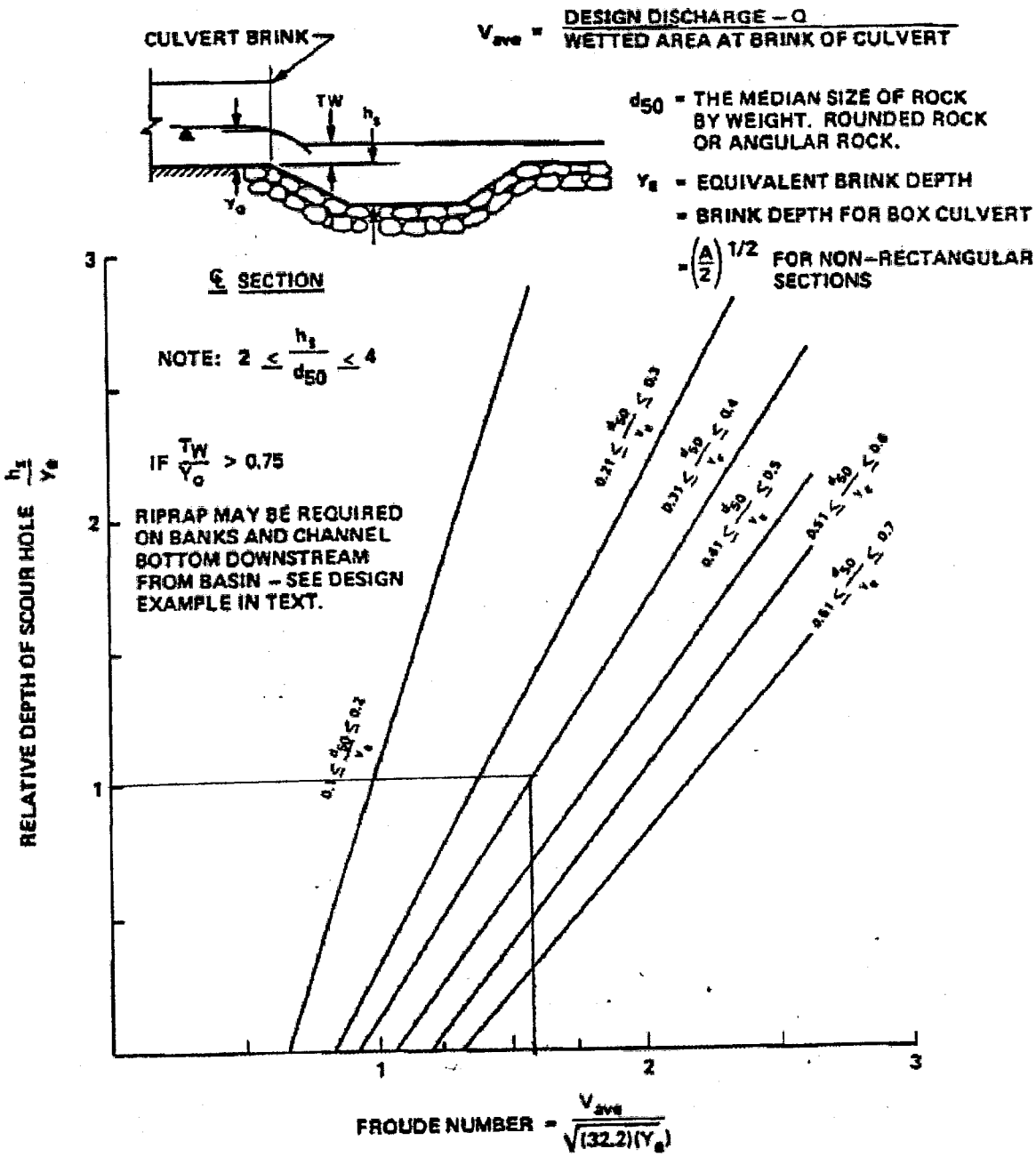
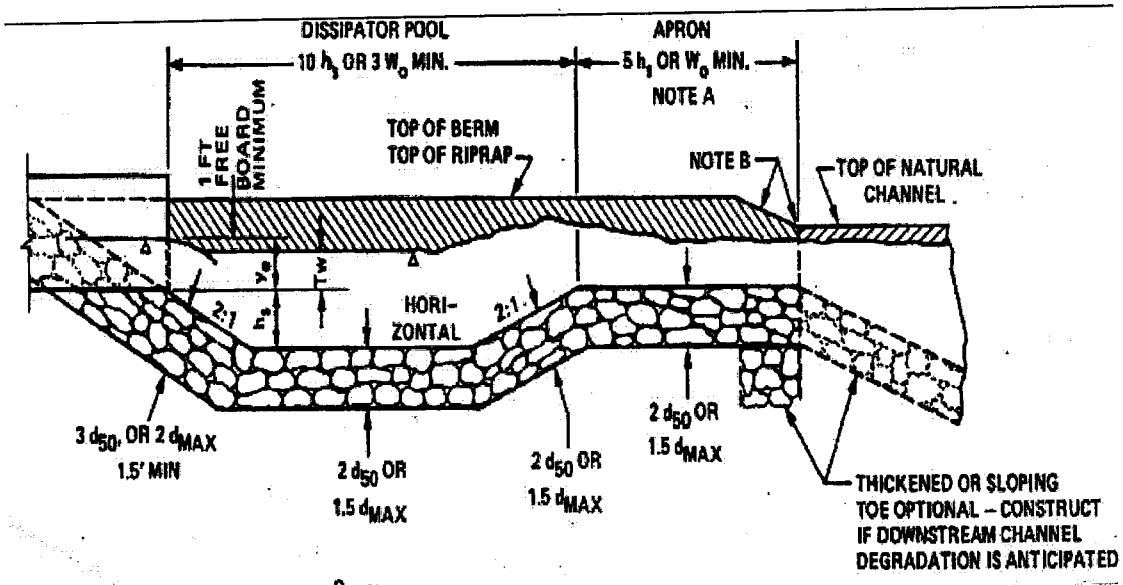


FIGURE X1–2. RELATIVE DEPTH OF SCOUR HOLE VERSUS FROUDE NUMBER AT BRINK OF CULVERT WITH RELATIVE SIZE OF RIPRAP AS A THIRD VARIABLE



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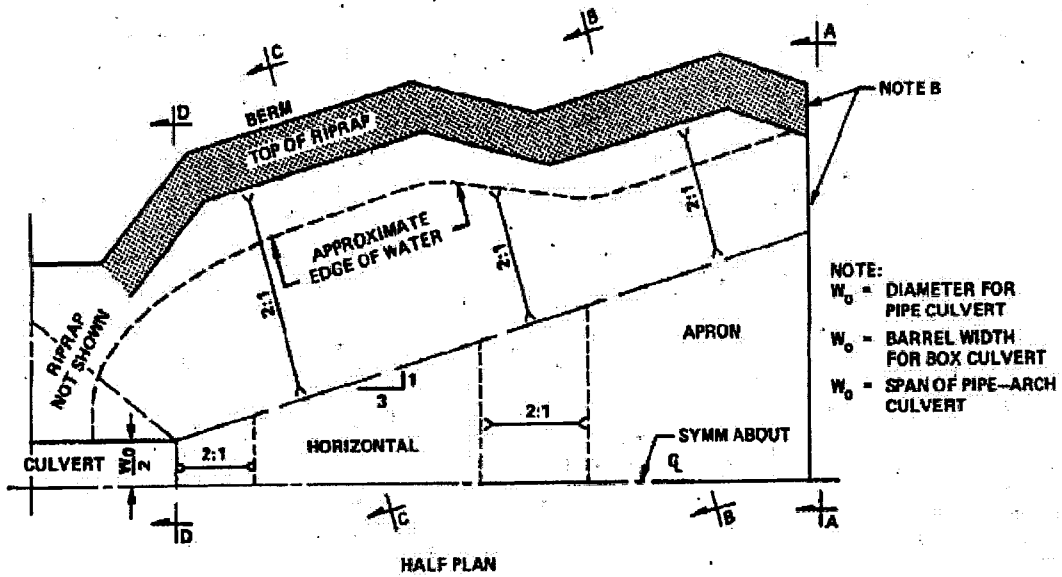
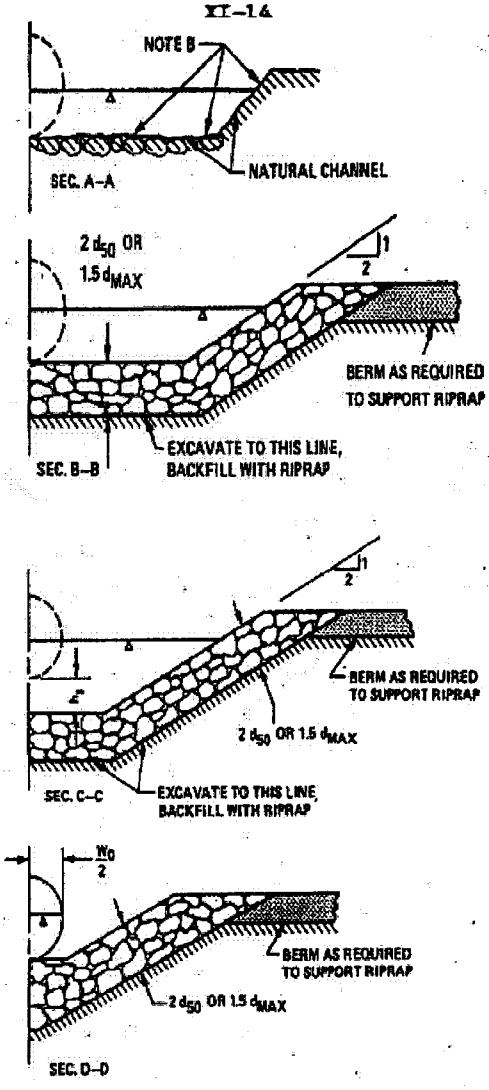
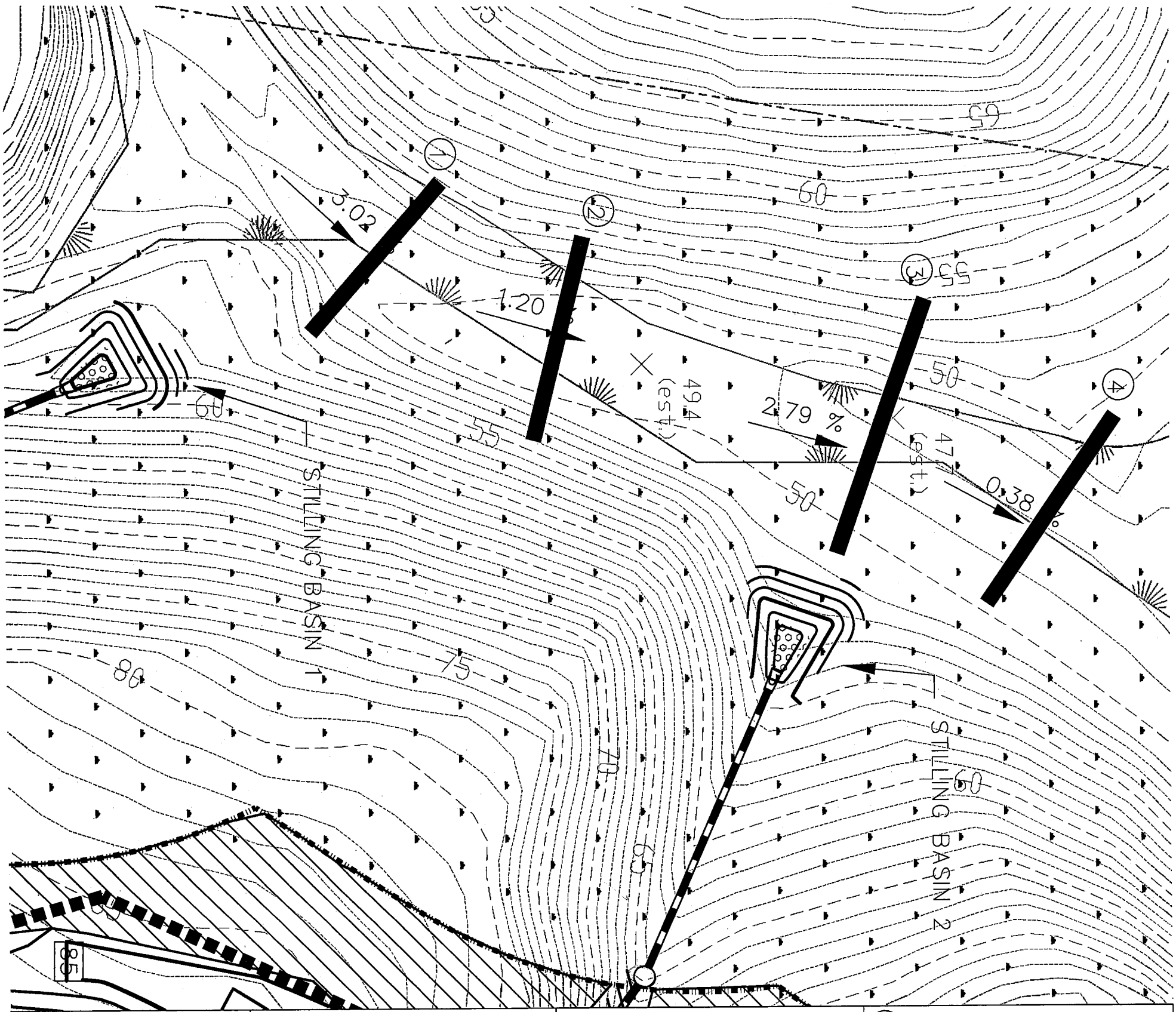
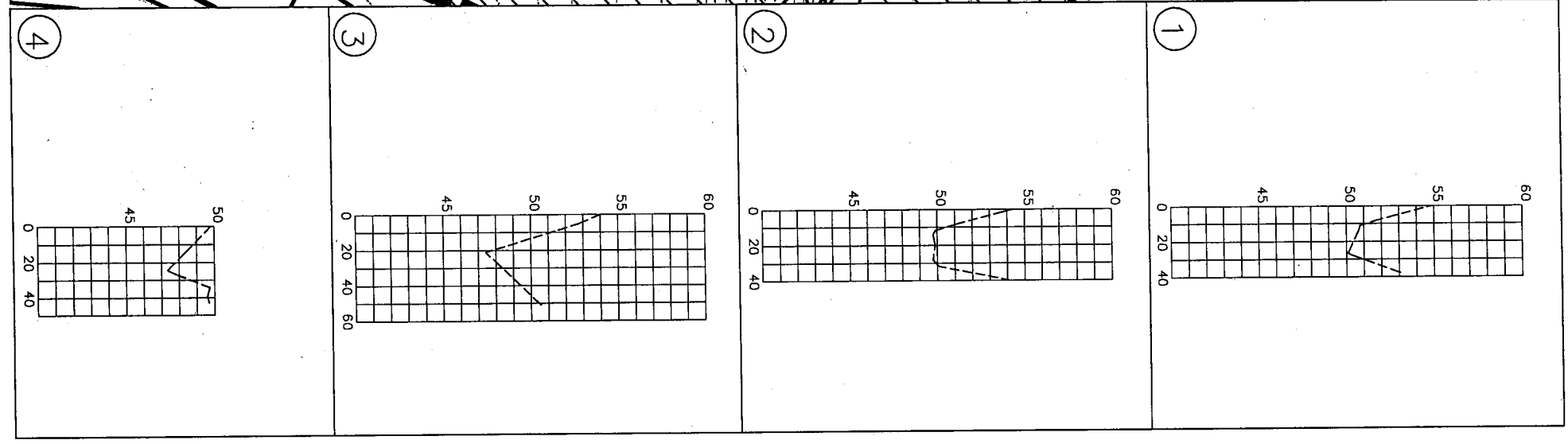


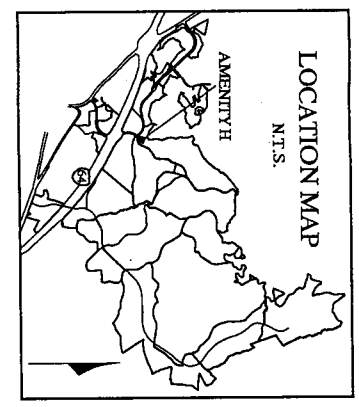
HALF PLAN


NOTE B
NATURAL CHANNEL
SEC. A-A
2 d_{50} OR
1.5 d_{MAX}
1
2
BERM AS REQUIRED
TO SUPPORT RIPRAP
EXCAVATE TO THIS LINE,
BACKFILL WITH RIPRAP
SEC. B-B
1
2
BERM AS REQUIRED
TO SUPPORT RIPRAP
2 d_{50} OR 1.5 d_{MAX}
EXCAVATE TO THIS LINE,
BACKFILL WITH RIPRAP
SEC. C-C
$\frac{W_0}{2}$
BERM AS REQUIRED
TO SUPPORT RIPRAP
2 d_{50} OR 1.5 d_{MAX}
SEC. D-D

CHANNEL ADEQUACY CALCULATIONS







NOTE: SECTIONS WERE EXTRACTED FROM ACTUAL FIELD TOPO BY WSP SELLS.

NORTH

0 5 10 20
(IN FEET)
1 INCH = 10 FEET

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REVISIONS

PROJECT #: 08-0006 DATE: 01/22/09
DRAWN BY: MB CHECKED BY: CD

TITLE
CHANNEL ADEQUACY EXHIBIT

SHEET
EXHIBIT 2

STONEHOUSE AMENITY H

JAMES CITY COUNTY, VA

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

PRELIMINARY NOT RELEASED FOR CONSTRUCTION

WSP · SELLS
Transportation & Infrastructure
15401 Weston Parkway Suite 100 ▪ Cary, NC 27513 ▪ 919.678.0035
www.wspsells.com

Channel Adequacy from Stilling Basin 1 - Section 1

Project Description	Amenity H		
Friction Method	Manning Formula		
Solve For	Normal Depth		

0.035 max

Input Data

Roughness Coefficient	0.100	
Channel Slope	0.03020	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.50	ft/ft (H:V)
Bottom Width	18.00	ft
Discharge	1.03	ft^3/s

Results

Normal Depth	0.10	ft
Flow Area	1.85	ft^2
Wetted Perimeter	18.69	ft
Top Width	18.66	ft
Critical Depth	0.05	ft
Critical Slope	0.40599	ft/ft
Velocity	0.56	ft/s
Velocity Head	0.00	ft
Specific Energy	0.11	ft
Froude Number	0.31	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.10	ft
Critical Depth	0.05	ft
Channel Slope	0.03020	ft/ft
Critical Slope	0.40599	ft/ft

Channel Adequacy for Stilling Basin 1 - Section 2

Project Description	Amenity H		
Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient	0.100	
Channel Slope	0.01200	ft/ft
Left Side Slope	1.70	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	9.30	ft
Discharge	1.05	ft^3/s

Results

Normal Depth	0.20	ft
Flow Area	2.06	ft^2
Wetted Perimeter	11.66	ft
Top Width	11.60	ft
Critical Depth	0.07	ft
Critical Slope	0.35591	ft/ft
Velocity	0.51	ft/s
Velocity Head	0.00	ft
Specific Energy	0.20	ft
Froude Number	0.21	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.20	ft
Critical Depth	0.07	ft
Channel Slope	0.01200	ft/ft
Critical Slope	0.35591	ft/ft

Channel Adequacy for Stilling Basin 2 - Section 1

Project Description	Amenity H		
Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient	0.100	
Channel Slope	0.02790	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	9.50	ft/ft (H:V)
Discharge	2.23	ft^3/s

Results

Normal Depth		0.58	ft
Flow Area		2.08	ft^2
Wetted Perimeter		7.34	ft
Top Width		7.21	ft
Critical Depth		0.38	ft
Critical Slope		0.25932	ft/ft
Velocity		1.07	ft/s
Velocity Head		0.02	ft
Specific Energy		0.59	ft
Froude Number		0.35	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.58	ft
Critical Depth	0.38	ft
Channel Slope	0.02790	ft/ft
Critical Slope	0.25932	ft/ft

Channel Adequacy for Stilling Basin 2 - Section 2

Project Description	Amenity H		
Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient	0.100	→ 0.035
Channel Slope	0.00380	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Discharge	2.23	ft^3/s

Results

Section 4

Normal Depth	0.80	ft
Flow Area	4.51	ft^2
Wetted Perimeter	11.38	ft
Top Width	11.24	ft
Critical Depth	0.36	ft
Critical Slope	0.26162	ft/ft
Velocity	0.49	ft/s
Velocity Head	0.00	ft
Specific Energy	0.81	ft
Froude Number	0.14	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.80	ft
Critical Depth	0.36	ft
Channel Slope	0.00380	ft/ft
Critical Slope	0.26162	ft/ft

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

Project Name: Stonehouse Amenity H
County Plan No. (List any amendments): SP-008-09
Stormwater Management Facility Type: #1 Bioretention #2 Infiltration #3 Swale
BMP Phase #: ☐ I ☐ II ☑ III

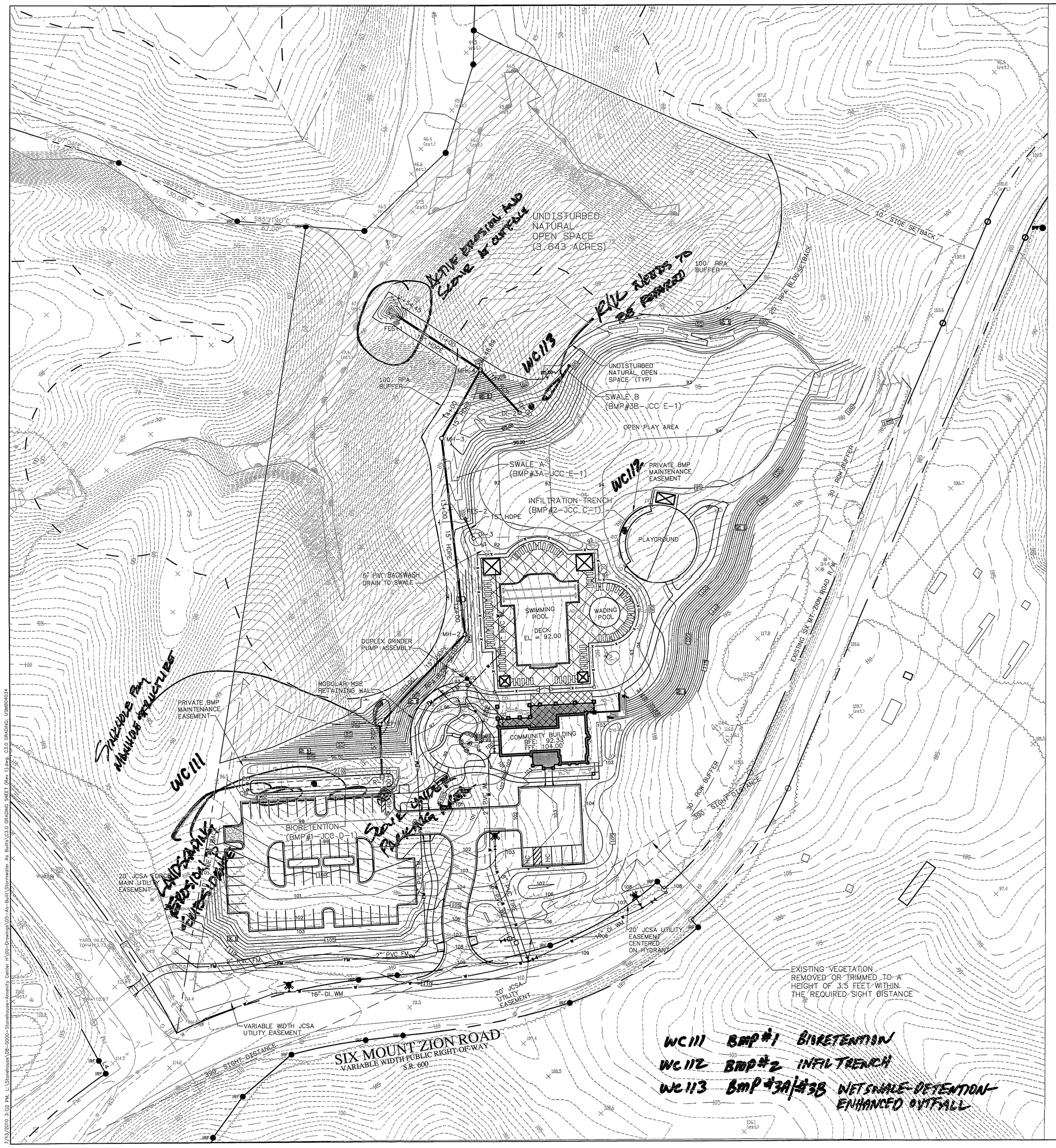
- ☑ Information Package Submittal Date: 11/14/12
- ☐ Completeness Check:
  - ☑ Record Drawing — Date/By: 6/22/10 WSP Sells / Alan Nash
  - ☑ Construction Certification — Date/By: 11/7/12 GET / Camille Kattan
  - ☑ RD/CC Standard Forms — (Ensure that all forms for the BMP type are included)
  - ☑ Insp/Maint Agreement — # / Date: 7/16/09
  - ☑ BMP Maintenance Plan — Location: C5.1
  - ☐ Special Considerations:
- ☑ Standard E&SC Notes on Approved Plan Requiring RD/CC or County comment in plan review
  Location (sheet #): C.4.2
- ☐ **County BMP ID Code #:** WC111, WC112, WC113
- ☑ 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: 4/1/13 / 5/21/14
- ☑ Record Drawing (RD) Review — Date: 4/1/13 5/21/14
- ☑ Construction Certification (CC) Review — Date: 4/1/13 5/21/14
- ☑ Actions:
  - ☐ No comments.
  - ☑ Comments. Letter Forwarded. — Date:
  - ☐ Record Drawing (RD)
  - ☐ Construction Certification (CC)
  - ☑ Construction-Related (CR)
  - ☑ Site Issues (SI)
  - ☐ Other :
- ☐ Resubmittal (# and date):
- ☑ Re-inspection (if necessary): 5/21/14 Complete
- ☑ 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. → unable to provide CD/mylar (2012)
- ☑ Complete "As-built Tracking Log".
- ☐ Last check of BMP Access Database (County BMP Inventory).
- ☐ Add BMP to JCC Hydrology & Hydraulic database (optional).
- ☐ Add BMP to Municipal BMP list (if a County-owned facility)
- ☐ Add BMP to PRIDE BMP ratings database.

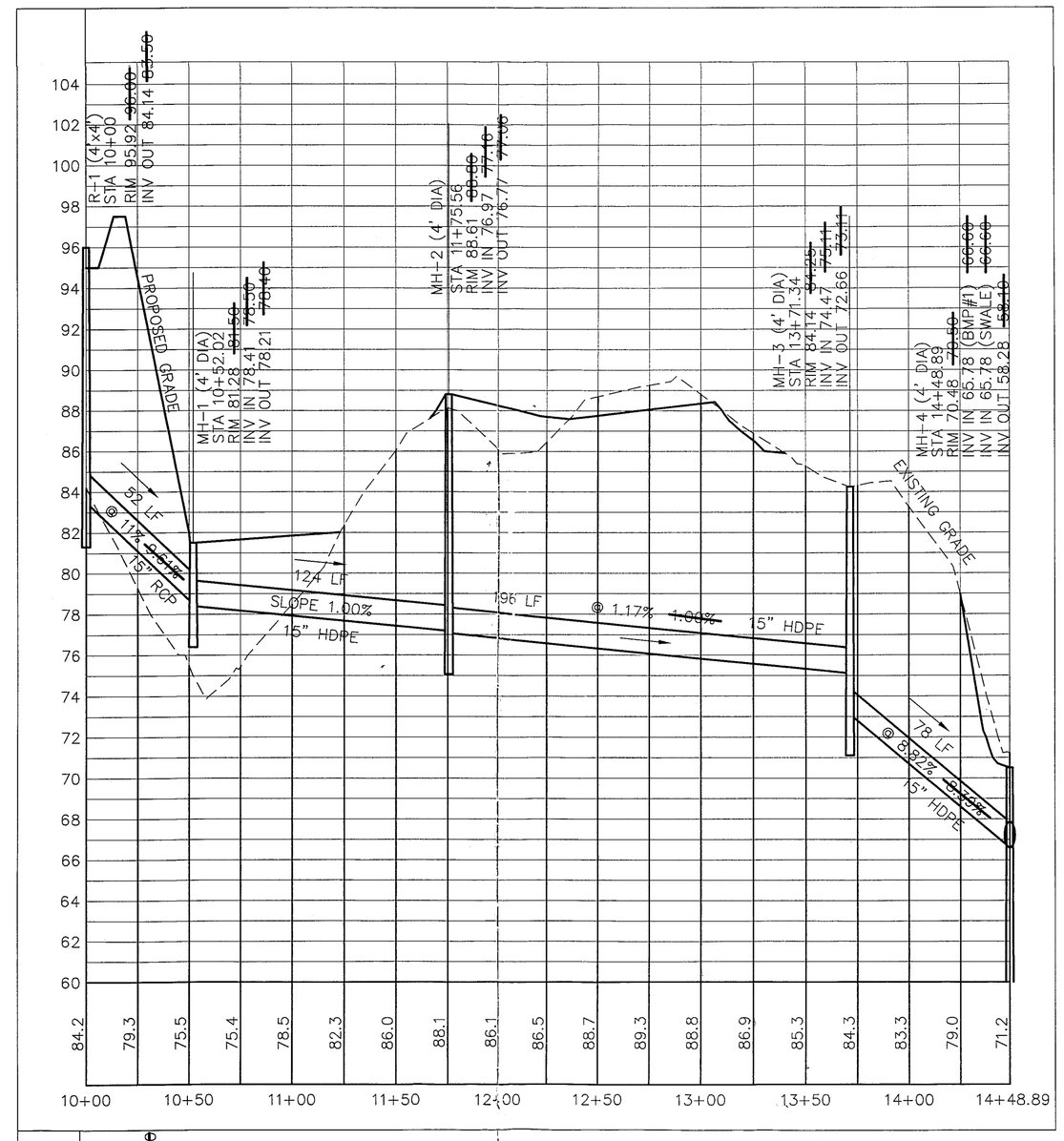
Final Sign-Off

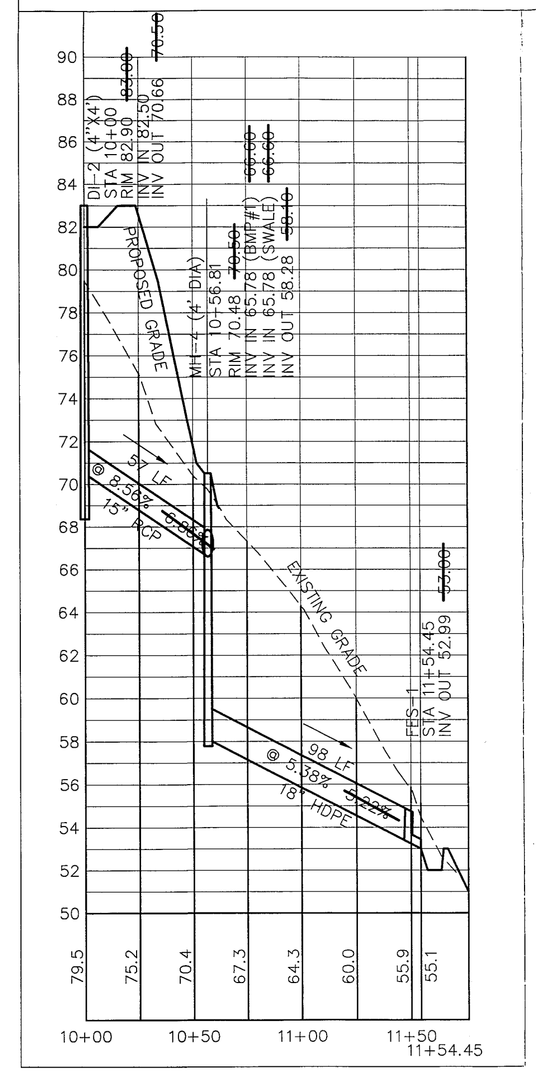
Inspector: Tina Crepelli — Date: 6/12/14

Chief Engineer: [signature] — Date: 06/16/14

*** See separate checklist, if needed.







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 PREVISIONS OF THE APPROVED CONSTRUCTION PLANS AND SPECIFICATIONS EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA
CRAIG MICHAEL DUERR
No. 045357
PROFESSIONAL ENGINEER
7/13/10

(SEAL)
VIRGINIA REGISTERED PROFESSIONAL ENGINEER OR CERTIFIED LAND SURVEYOR

NOTE:
1. MAX. 2% SLOPE IN ALL DIRECTIONS FOR HANDICAP SPACES (TYP).
2. ALL SIDE SLOPES SHALL BE GRADED AT 3:1 OR GREATER UNLESS OTHERWISE NOTED ON PLANS.
3. MINIMUM 2% SLOPES IN OPEN PLAY AREA AND 1% IN PARKING LOT. MAXIMUM SLOPE IN PARKING LOT 3% AND 8% FOR DRIVEWAYS.
4. REFER TO BUILDING PLANS FOR DETAILS ON ROOF DRAINS.
5. REFER TO HARDSCAPE PLANS FOR SPOT ELEVATIONS BETWEEN BUILDING AND POOL

NOTE:
1. ALL PVC PIPES TO BE PRESSURE RATED.
2. ALL HDPE PIPES SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321-05.

LEGEND:
BFE: BASEMENT FLOOR ELEVATION / BUILDING LOWER LEVEL
FFE: FINISHED FLOOR ELEVATION / BUILDING UPPER LEVEL
TW: TOP OF WALL ELEVATION
BW: BOTTOM OF WALL ELEVATION
EW: END WALL ELEVATION

NORTH

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

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AS BUILT
RECORD DRAWING

STONEHOUSE AMENITY H

JAMES CITY COUNTY, VA

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

Environmental Division
NOV 14 2012
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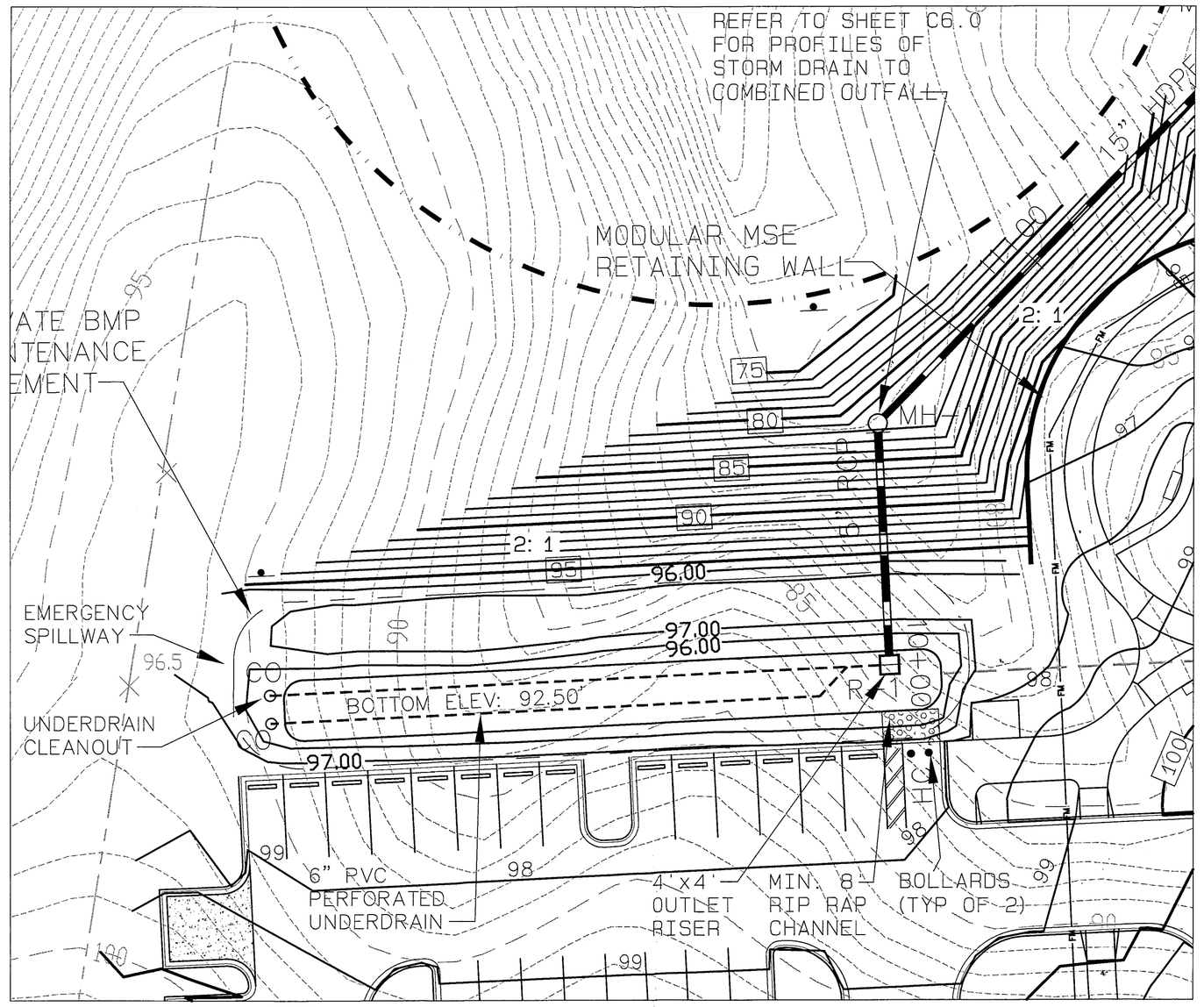
REVISIONS

1	AS BUILTS 07/13/2010

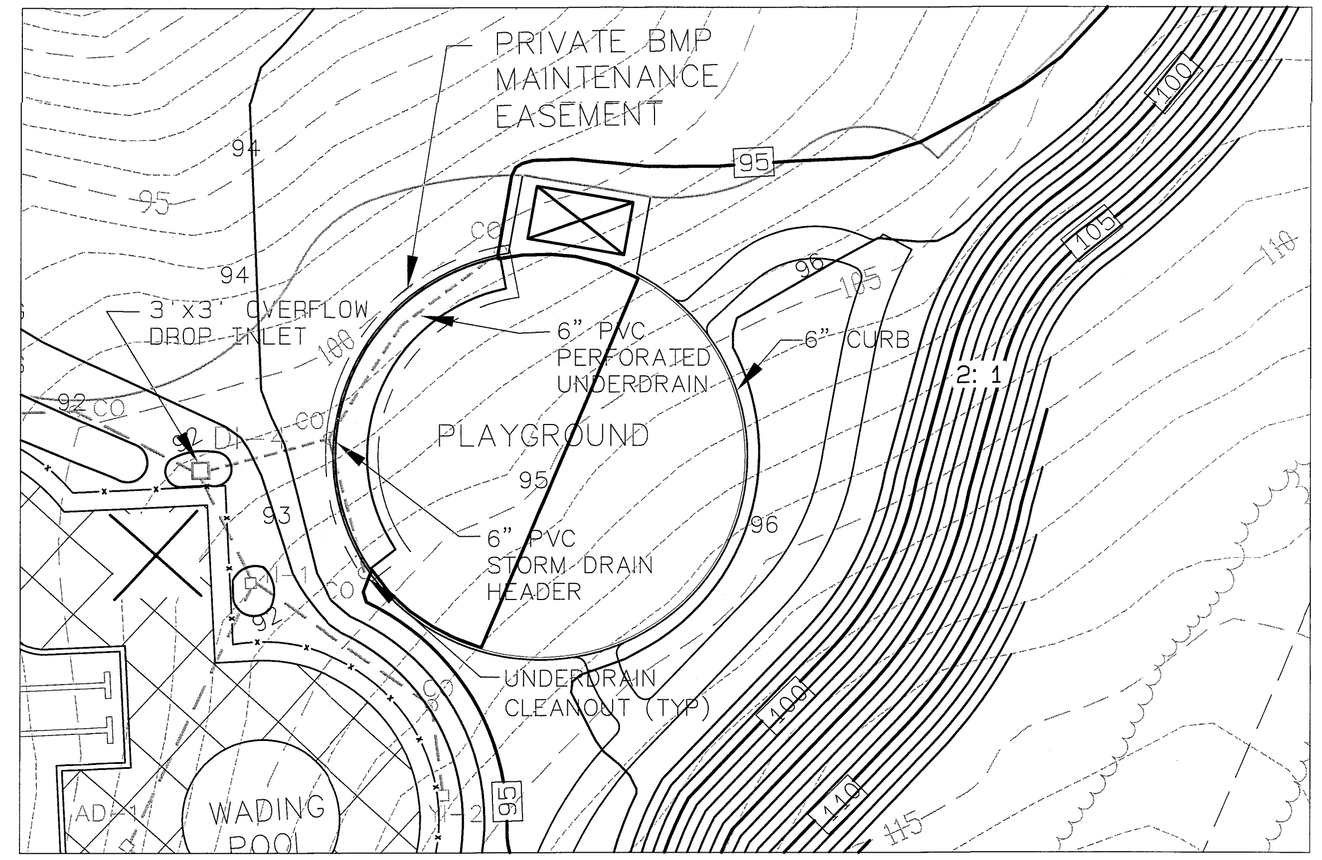
PROJECT #: 08-4046 DATE: 01/22/09
DRAWN BY: MB CHECKED BY: CD

TITLE
GRADING AND DRAINAGE PLAN

SHEET
C3.0



BMP#1: BIORETENTION AREA PLAN



BMP#2: INFLITRATION TRENCH PLAN

NOTES:

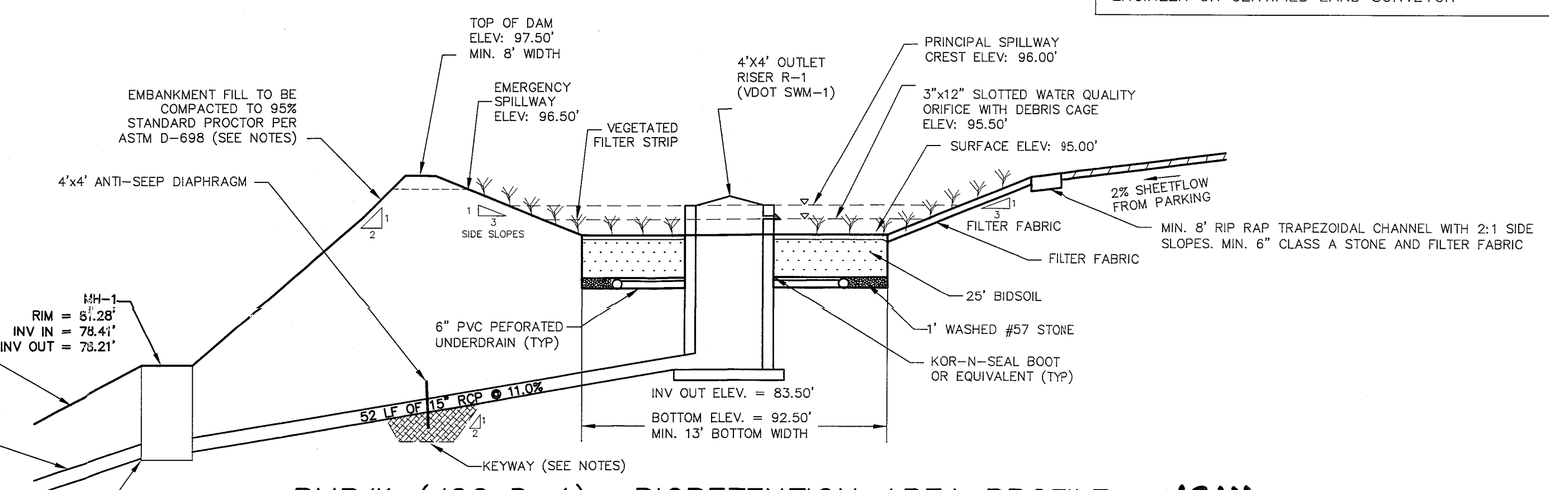
1. SEDIMENT TRAP SHALL BE CLEANED OUT AND VEGETATIVE COVER ESTABLISHED PRIOR TO USE AS A BIORETENTION BMP#1 FACILIY.
2. *ALL STORM DRAIN PIPES IN AND OUT OF THE BMP FACILITIES SHALL* BE CLASS III RCP MEETING ASTM STANDARD C76 WITH O RING JOINTS. THE JOINTS SHALL BE WRAPPED WITH NON-WOVEN FELT FABRIC EXTENDING 6-8 INCHES ON EITHER SIDE OF THE JOINT.
3. 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.
4. EXCAVATE EXISTING ALLUVIAL SOILS TO FIRM SOIL (+ OR - 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.
5. ALL PVC PIPE SHALL BE PRESSURE RATED.
6. ALL HDPE PIPE SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D-2321-05.
7. 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.

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 PREVISIONS OF THE APPROVED CONSTRUCTION PLANS AND SPECIFICATIONS EXCEPT AS SPECIFICALLY NOTED.

COMMONWEALTH OF VIRGINIA — CRAIG MICHAEL DUERR — No. 045357 — PROFESSIONAL ENGINEER — 7/13/10

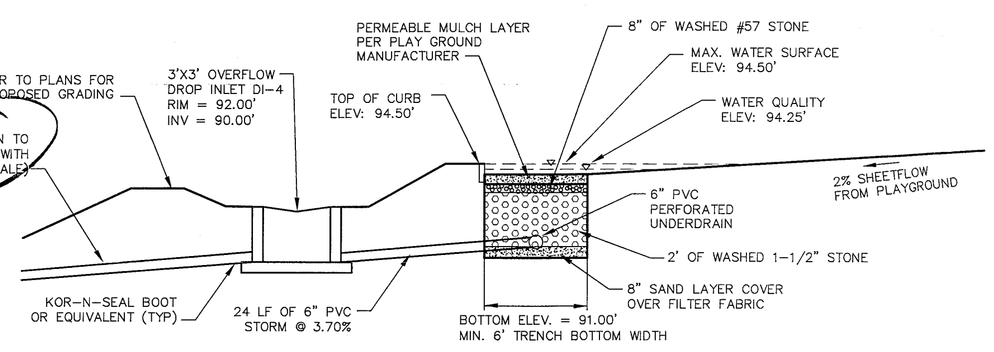
(SEAL)

VIRGINIA REGISTERED PROFESSIONAL ENGINEER OR CERTIFIED LAND SURVEYOR



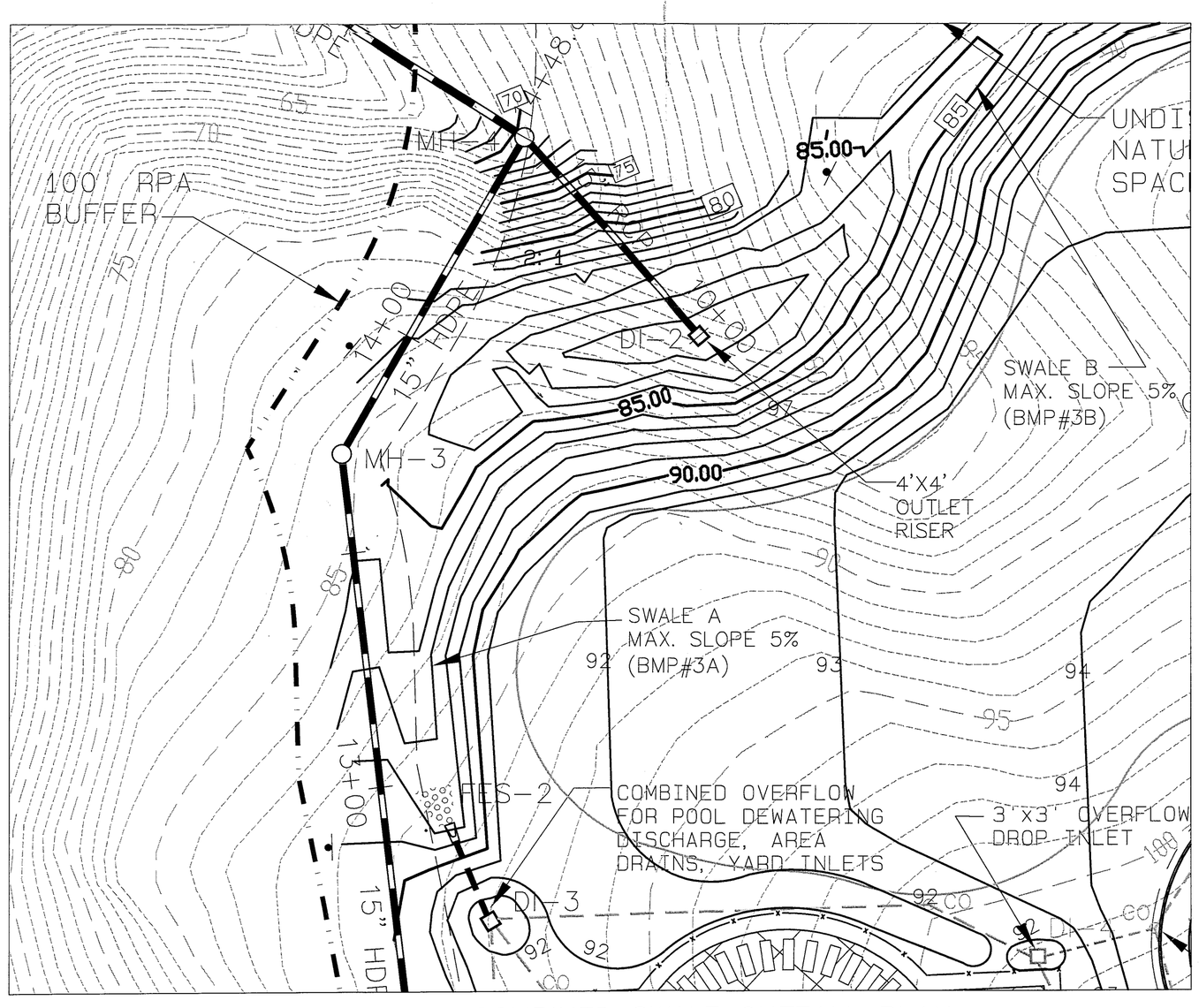
BMP#1 (JCC D-1)- BIORETENTION AREA PROFILE WC111

NTS

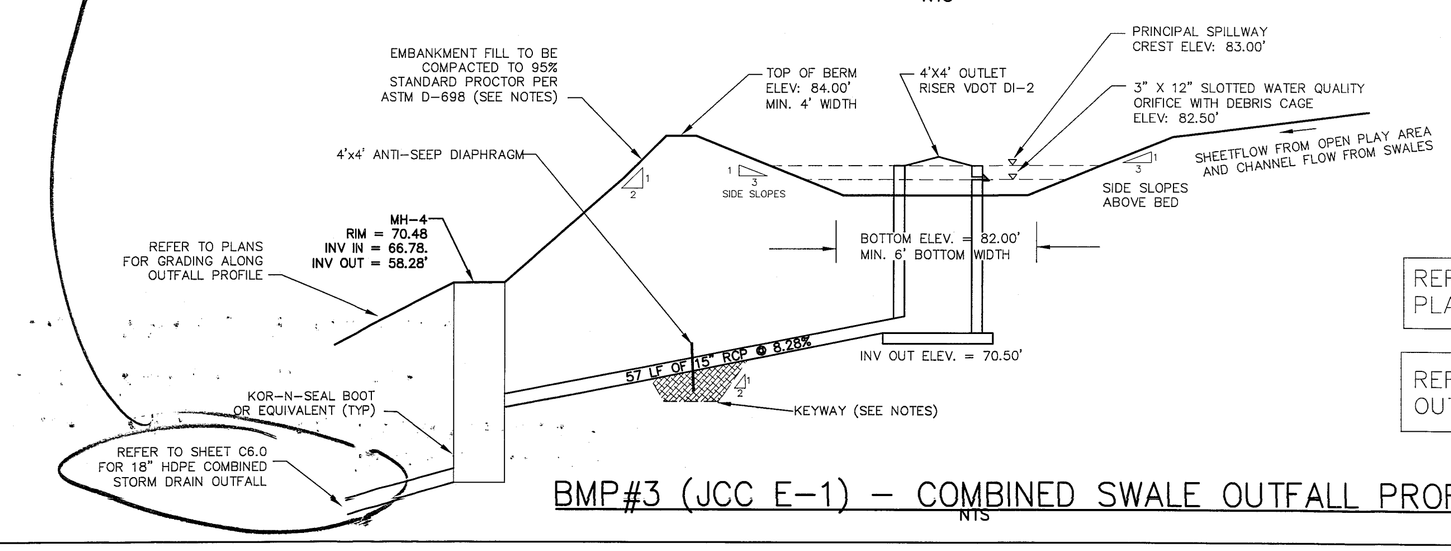


BMP#2 (JCC C-1) - INFILTRATION TRENCH PROFILE WC112

NTS



BMP#3: COMBINED SWALE OUTFALL PLAN



BMP#3 (JCC E-1) - COMBINED SWALE OUTFALL PROFILE WC113

NTS

NORTH

0 10 20 40

(IN FEET)
1 INCH = 20 FEET

REFER TO LANSCAPE DEVELOPMENT PLANS FOR BMP PLANTING SCHEDULE.

REFER TO SHEET C3.0 FOR BMP OUTFALL PROFILES.

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4011 WESTCHASE BLVD, SUITE 175
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REVISIONS	
1	AS BUILTS 07/13/2010

PROJECT #: 08-4046 DATE: 01/22/09

DRAWN BY: IN CHECKED BY: CD

TITLE
BMP PLANS AND PROFILES

SHEET
C5.0

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7/13/2010 3:03 PM, L:\Stonehouse\08-2000-Stonehouse-Amenity Center M\05-As-Built\Stormwater As Built\C5.0 STORM AND BMPs SHEETS.DWG, C5.0 BMP1-2, LDAMDA034