Revisions to the Delaware Sediment & Stormwater Regulations

Training Session 3:

Plan Review Process

Delaware Sediment & Stormwater Regulations

Section 3.1

All projects requiring approval of a detailed Sediment and Stormwater Management Plan are subject to a ***three-step*** *approval process.*

Delaware

Sediment and Stormwater Program

Technical Document

Article 3.

Plan Review

And Approval

Step 1:
Project Application Meeting

Office Use Only
Date Received:_____
Submittal Complete: Yes / No Reviewer Initials:_____
Meeting date/time:_____
DelDOT Attendance Required? Yes / No

Stormwater Assessment Study (SAS) Checklist

Project Name:_____

Owner/Developer Name:_____

Contact Person:_____

Owner/Developer Phone:_____

Owner/Developer e-mail:_____

Consultant Name:_____

Contact Person:_____

Consultant Phone:_____

Consultant e-mail:_____

This checklist is for guidance only. The Delegated Agency reserves the right to request additional information during the review process as it deems necessary. Compliance with the checklist in no way is meant to relieve the design professional of his/her professional responsibilities.

03/2013 3.02.1.1-1

- Consultant uses Stormwater Assessment Study (SAS) Checklist Items to compile report

Step 1:
Project Application Meeting

B. On-Line Background Information

Items shall be arranged in the following order:

- ☐ Location map
- ☐ Most recent aerial photography of the site with parcel boundary and tax map ID number.

  DEN link: http://maps.dnrec.delaware.gov/navmap/
- ☐ 2007 Land Use/Land Cover

  DE Geospatial Data Excehange link: https://dataexchange.gis.delaware.gov/
- ☐ Wellhead Protection Areas

  DEN link: http://maps.dnrec.delaware.gov/navmap/
- ☐ Recharge Area Mapping

  DEN link: http://maps.dnrec.delaware.gov/navmap/
- ☐ FEMA Floodplain Map

  DEN link: http://maps.dnrec.delaware.gov/navmap/
- ☐ StreamStats map showing limit of downstream analysis. (The downstream analysis point will be located at the point in the watershed where the site area comprises less than 10% of the watershed area.)

  StreamStats link: http://water.usgs.gov/osw/streamstats/delaware.html
- ☐ StreamStats Basin Characteristics Report

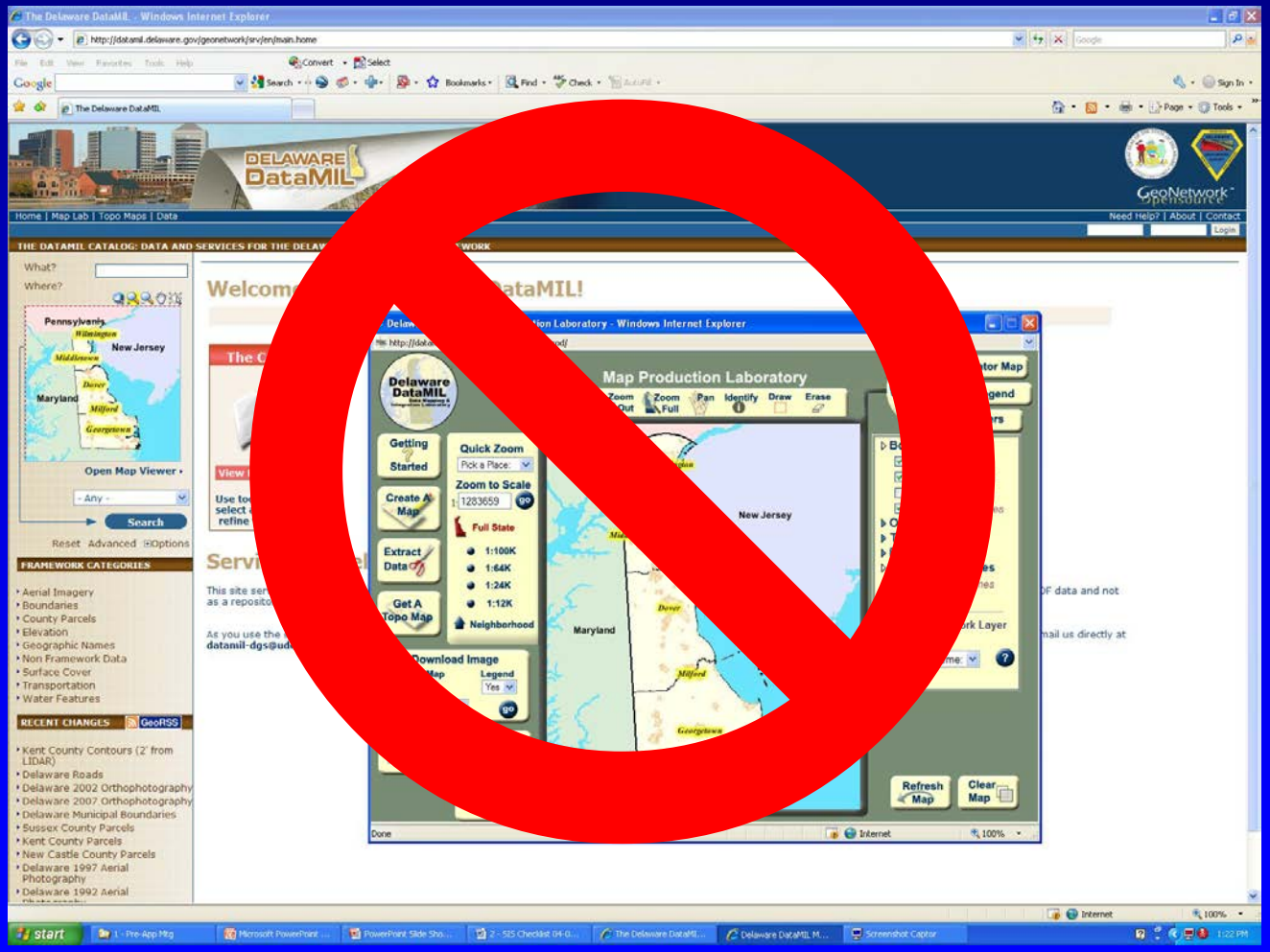
  StreamStats link: http://water.usgs.gov/osw/streamstats/delaware.html
- ☐ If DelDOT conveyance will be used to discharge stormwater from proposed development, submit DelDOT Road Plans for background information.

  DelDOT Archive link: http://www.deldot.gov/information/pubs_forms/archived_plans/index.shtml

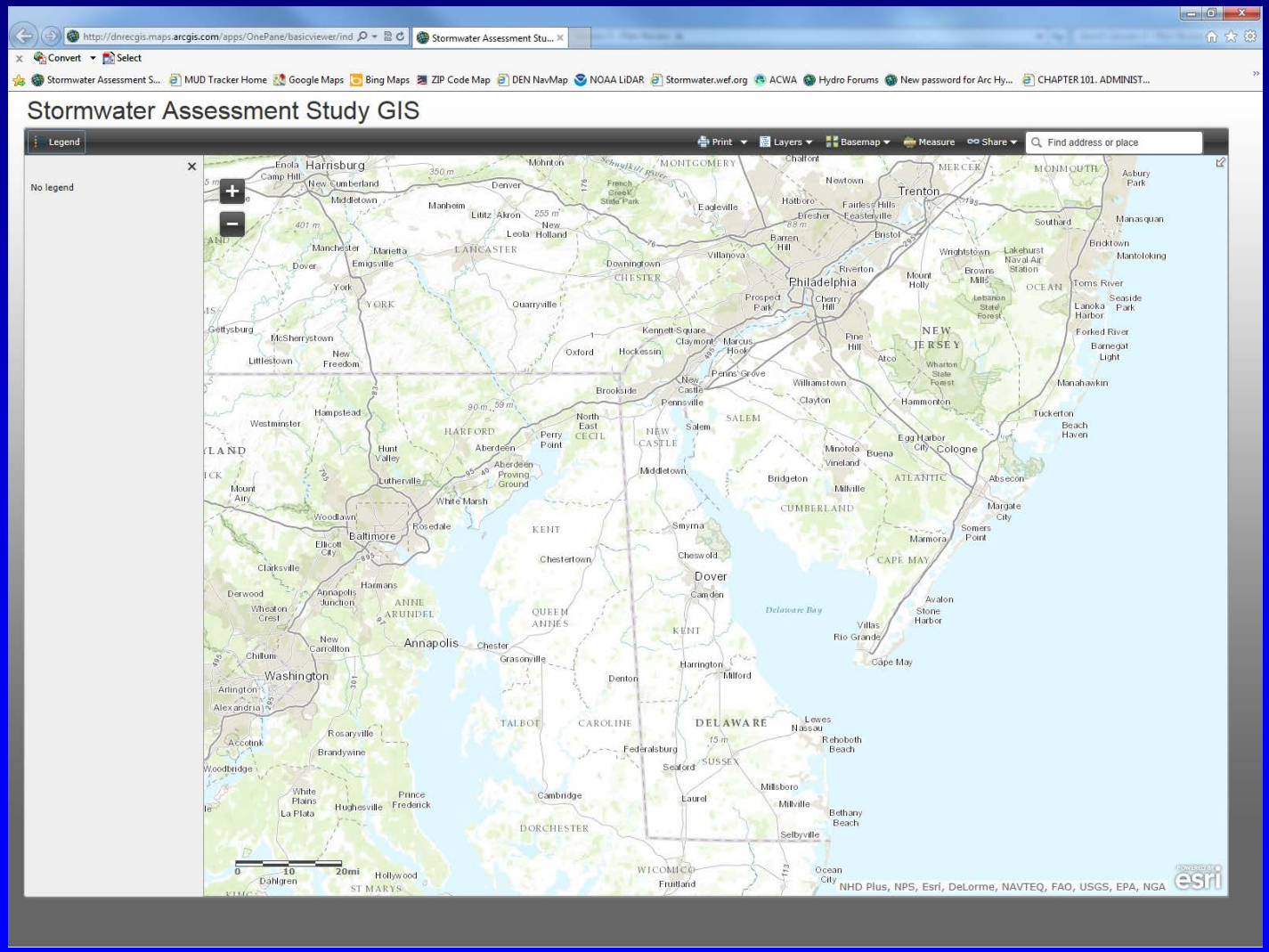
This checklist is for guidance only. The Delegated Agency reserves the right to request additional information during the review process as it deems necessary. Compliance with the checklist in no way is meant to relieve the design professional of his/her professional responsibilities.

- Consultant uses Stormwater Assessment Study (SAS) Checklist Items to compile report

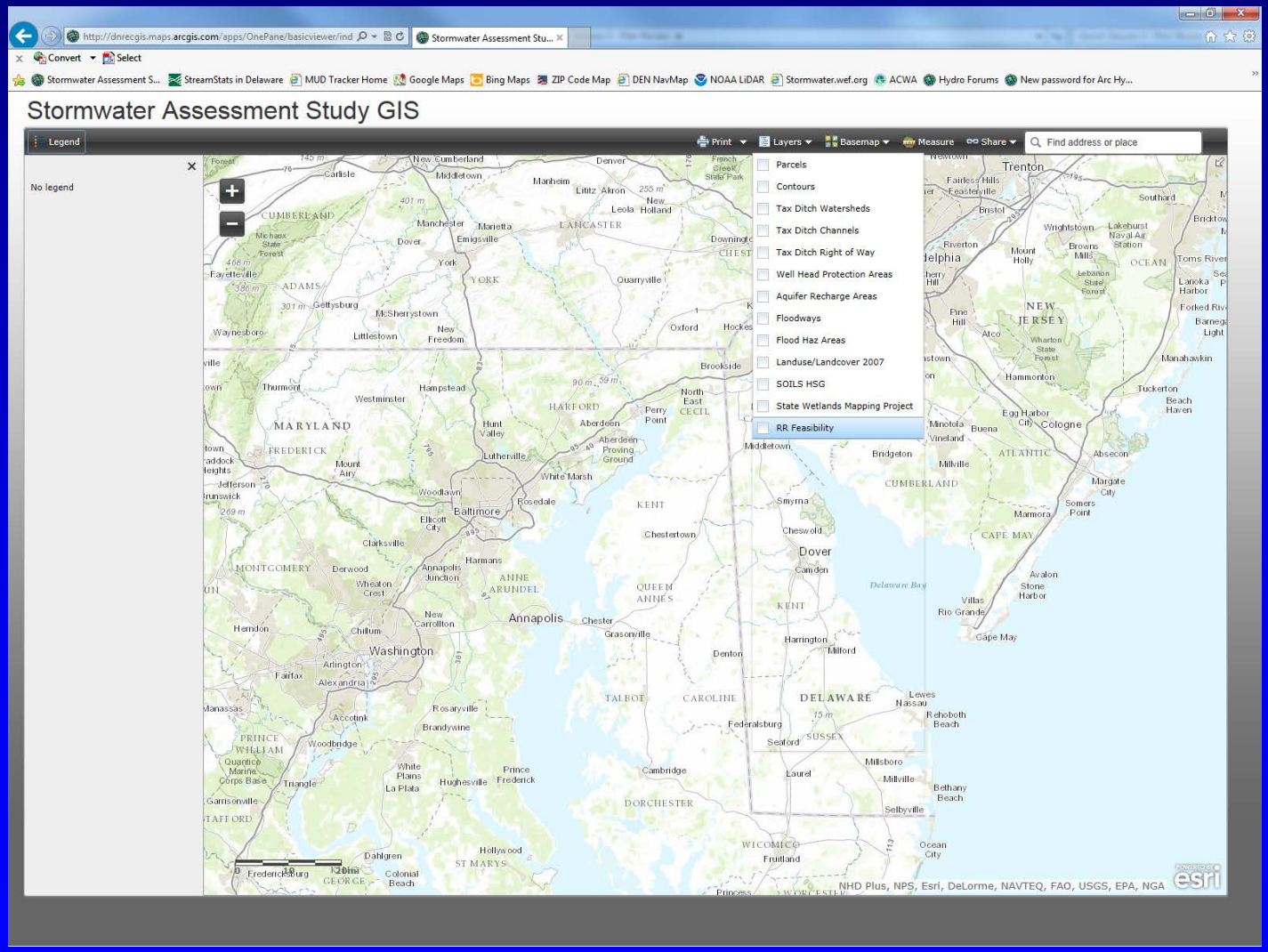
Tools for Preparing SAS: Delaware DataMIL



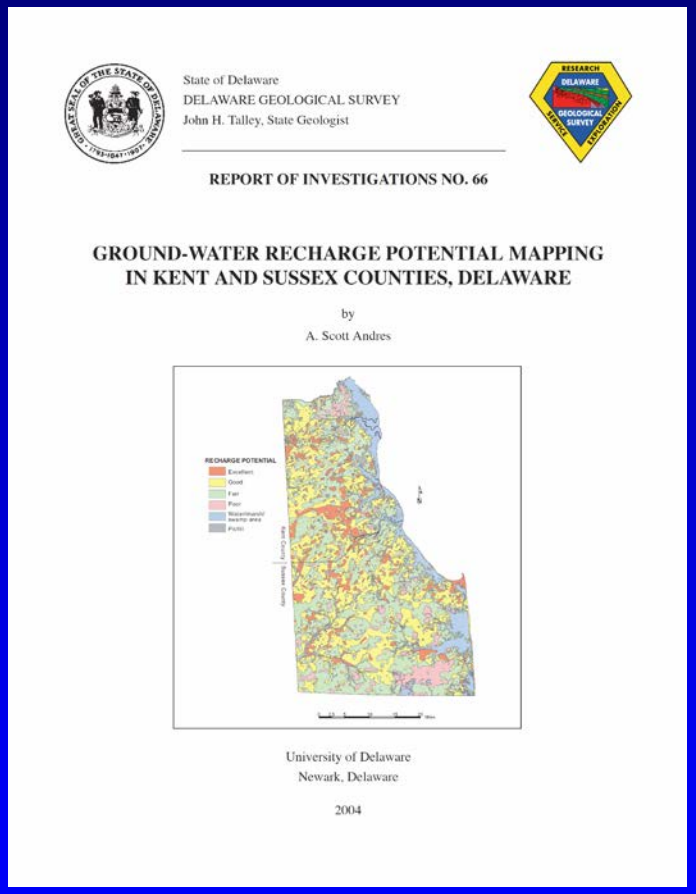
Tools for Preparing SAS: DNREC ArcGIS Online App



Tools for Preparing SAS: DNREC ArcGIS Online App



Runoff Reduction Feasibility Mapping



State of Delaware
DELAWARE GEOLOGICAL SURVEY
John H. Talley, State Geologist

REPORT OF INVESTIGATIONS NO. 66

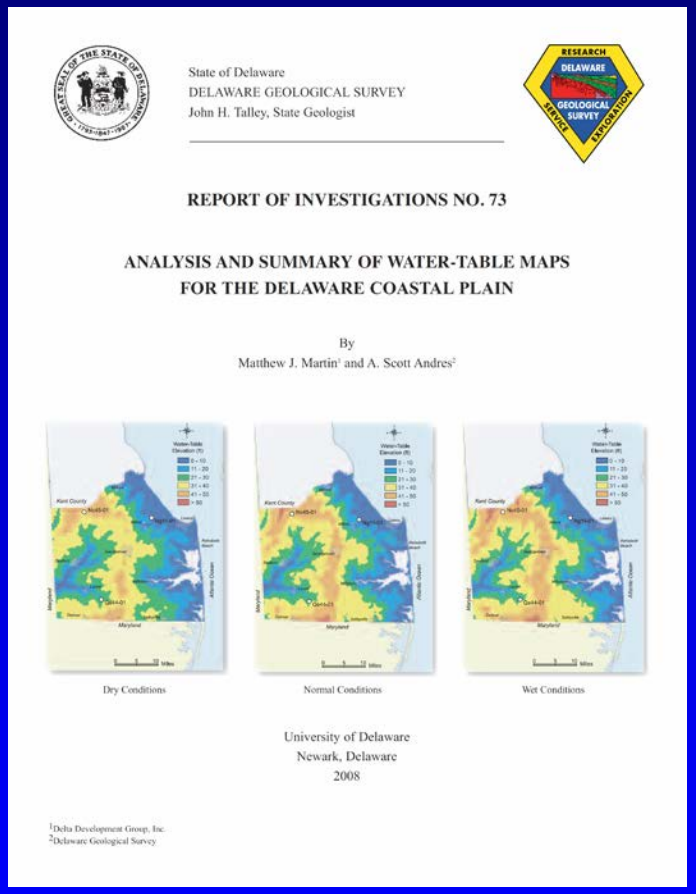
GROUND-WATER RECHARGE POTENTIAL MAPPING
IN KENT AND SUSSEX COUNTIES, DELAWARE

by
A. Scott Andres

University of Delaware
Newark, Delaware

2004

Delaware Geological Survey RI-66



State of Delaware
DELAWARE GEOLOGICAL SURVEY
John H. Talley, State Geologist

REPORT OF INVESTIGATIONS NO. 73

ANALYSIS AND SUMMARY OF WATER-TABLE MAPS
FOR THE DELAWARE COASTAL PLAIN

By
Matthew J. Martin[1] and A. Scott Andres[2]

Dry Conditions
Normal Conditions
Wet Conditions

University of Delaware
Newark, Delaware
2008

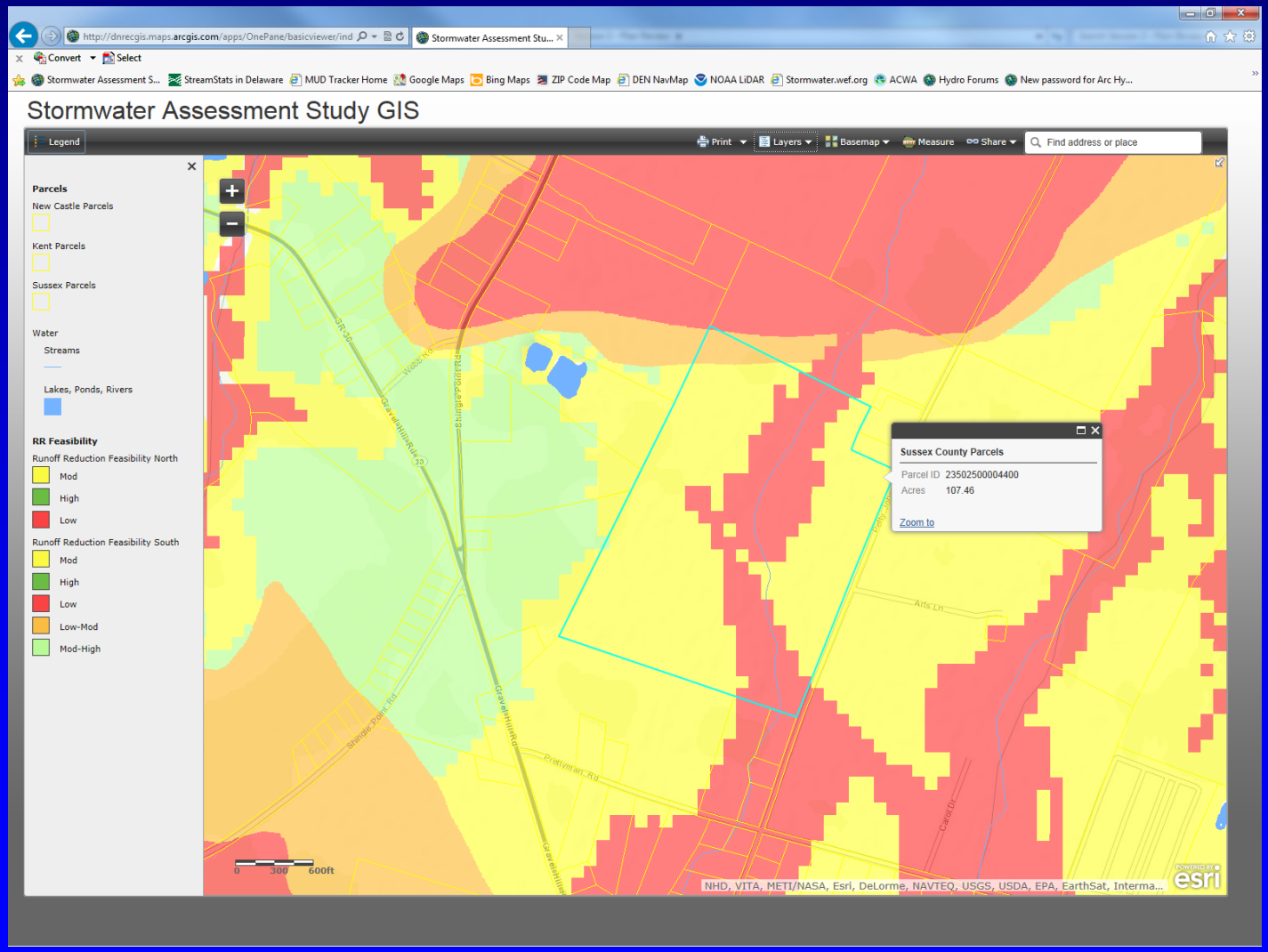
[1]Delta Development Group, Inc.
[2]Delaware Geological Survey

Delaware Geological Survey RI-73

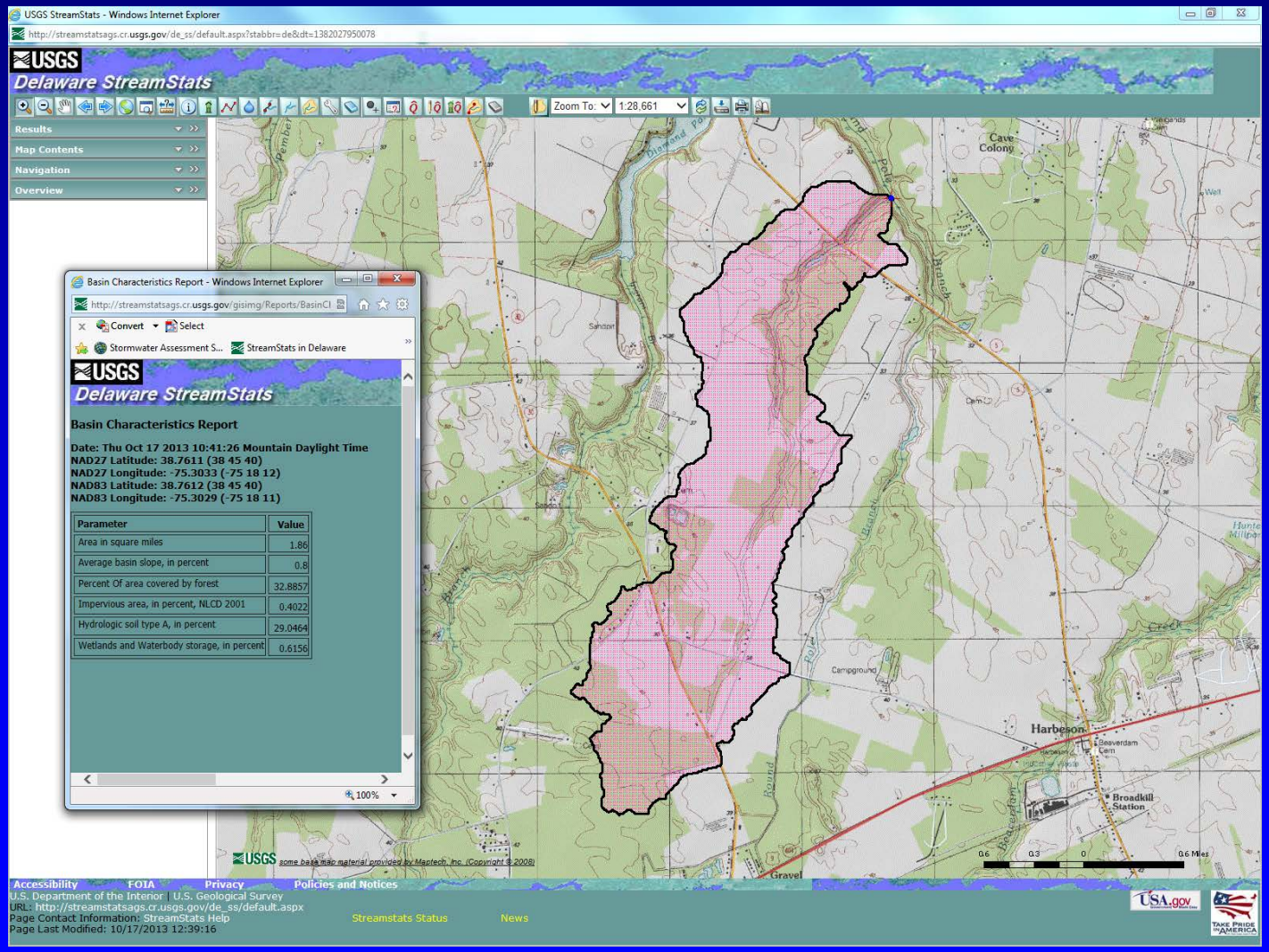
“Runoff Reduction Feasibility”

Wet Depth to WT	Recharge Class			
	Excellent	Good	Fair	Poor
0 - 3'	Low	Low	Low	Low
3' - 6'	Mod	Mod	Low-Mod	Low
>6'	High	Mod-High	Low-Mod	Low

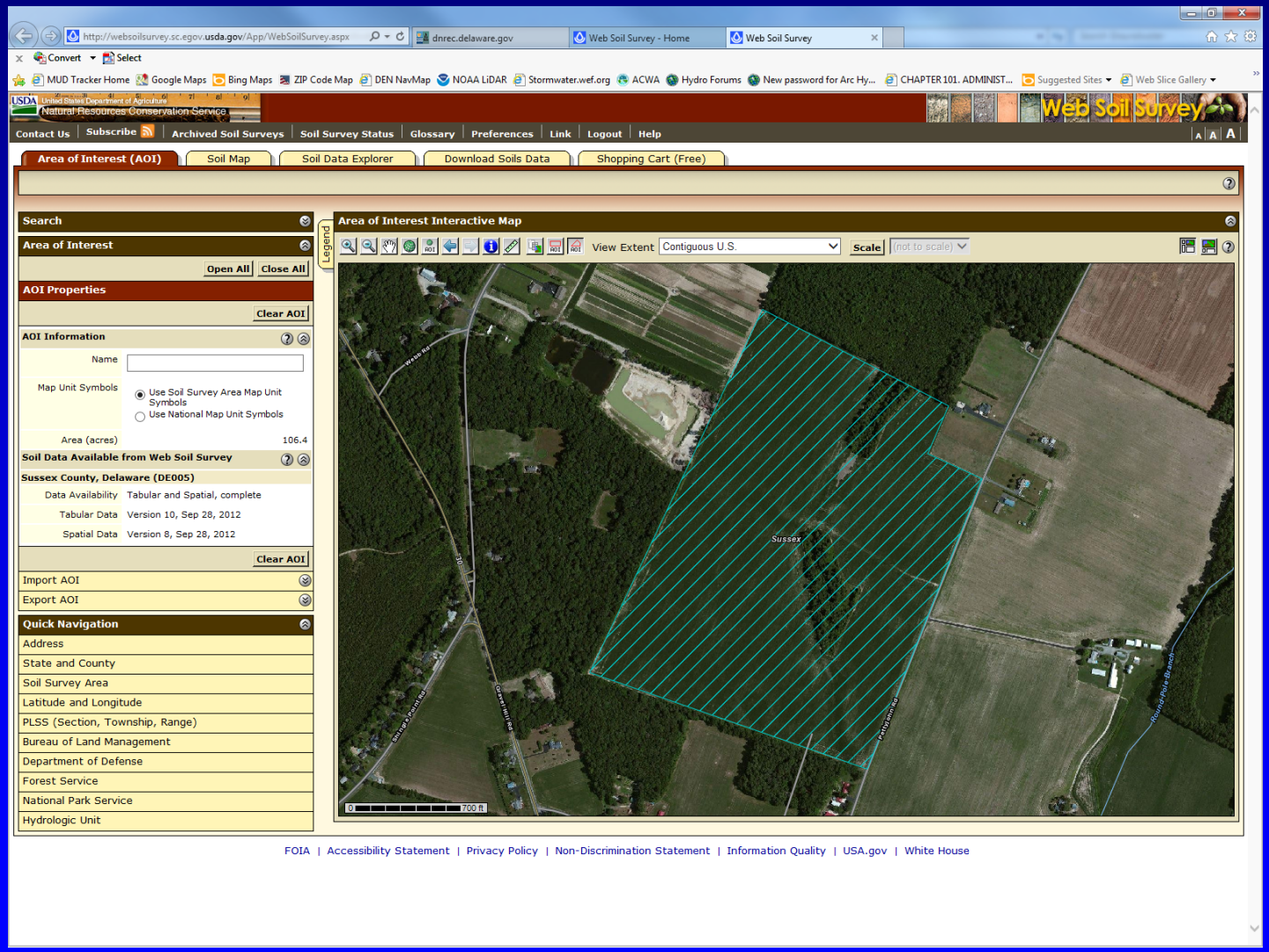
Example Runoff Reduction Feasibility Project Map



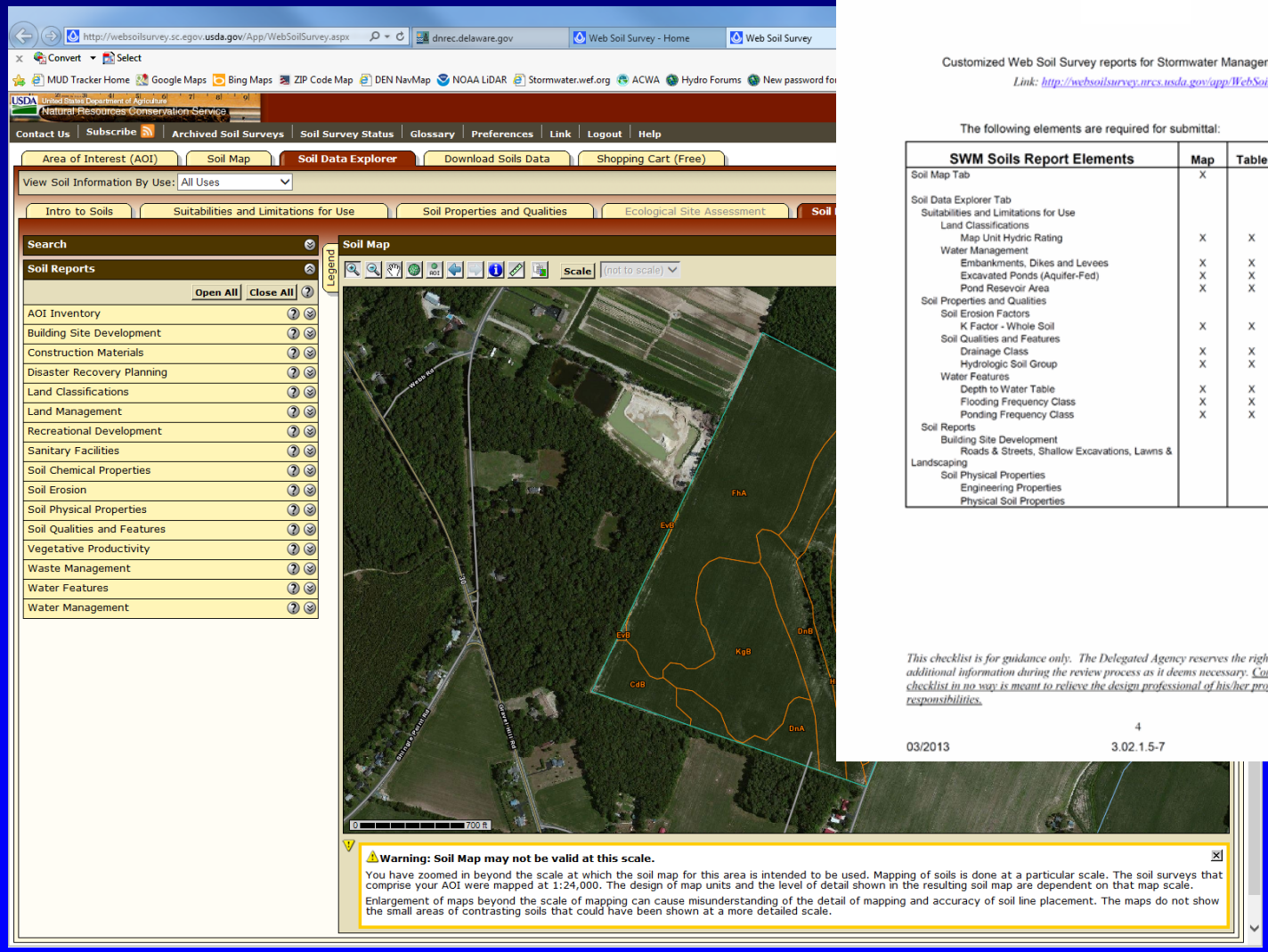
Tools for Preparing SAS: USGS Delaware StreamStats



Tools for Preparing SAS: NRCS Web Soil Survey (WSS)



Tools for Preparing SAS: NRCS Web Soil Survey (WSS)



Customized Web Soil Survey reports for Stormwater Management for total site.

Link: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

The following elements are required for submittal:

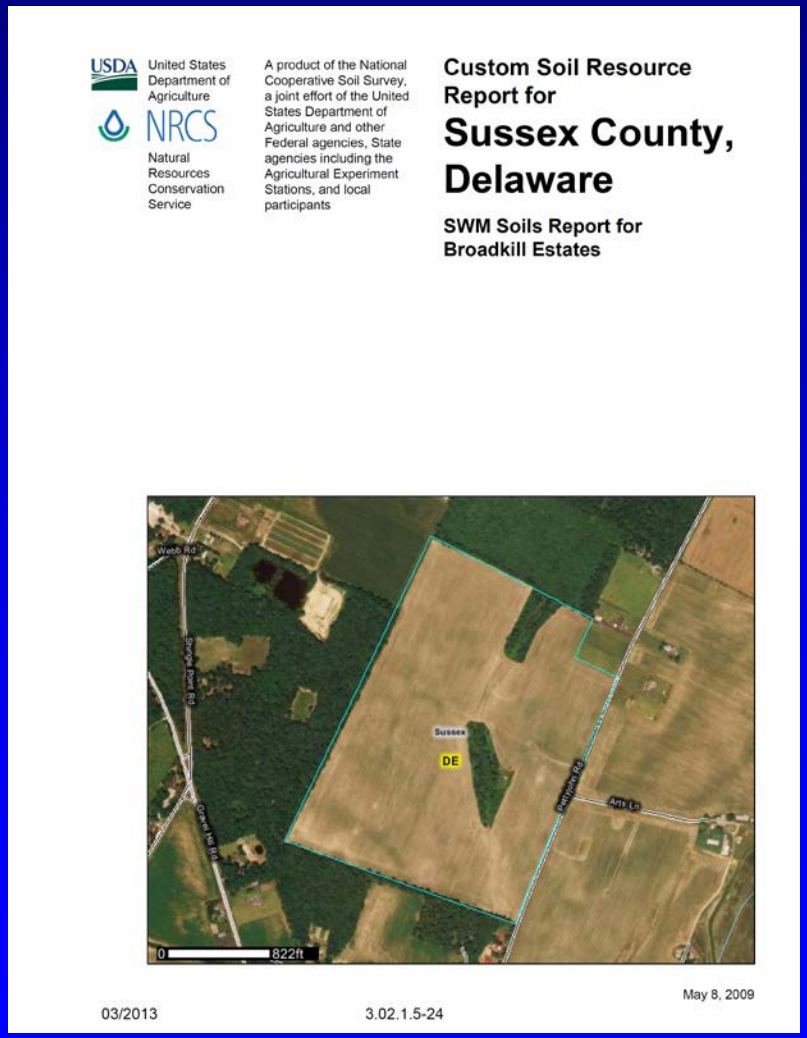
SWM Soils Report Elements	Map	Table	Desc.	Report
Soil Map Tab	X			
Soil Data Explorer Tab				
Suitabilities and Limitations for Use				
Land Classifications				
Map Unit Hydric Rating	X	X	X	
Water Management				
Embankments, Dikes and Levees	X	X	X	
Excavated Ponds (Aquifer-Fed)	X	X	X	
Pond Resevoir Area	X	X	X	
Soil Properties and Qualities				
Soil Erosion Factors				
K Factor - Whole Soil	X	X	X	
Soil Qualities and Features				
Drainage Class	X	X	X	
Hydrologic Soil Group	X	X	X	
Water Features				
Depth to Water Table	X	X	X	
Flooding Frequency Class	X	X	X	
Ponding Frequency Class	X	X	X	
Soil Reports				
Building Site Development				
Roads & Streets, Shallow Excavations, Lawns & Landscaping				X
Soil Physical Properties				
Engineering Properties				X
Physical Soil Properties				X

This checklist is for guidance only. The Delegated Agency reserves the right to request additional information during the review process as it deems necessary. Compliance with the checklist in no way is meant to relieve the design professional of his/her professional responsibilities.

4

03/2013 3.02.1.5-7

Tools for Preparing SAS: NRCS Web Soil Survey (WSS)



United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Sussex County, Delaware

SWM Soils Report for Broadkill Estates

May 8, 2009

03/2013

3.02.1.5-24

Step 1:
Project Application Meeting

Sediment & Stormwater
Project Application Package
for
Broadkill Estates
Sussex County, DE

GreenTech

Prepared by:
GreenTech Consulting, Inc.
Milton, DE

- Consultant uses Stormwater Assessment Study (SAS) Checklist Items to compile report
- SAS submitted to DA

Step 1:
Project Application Meeting

- Consultant uses Stormwater Assessment Study (SAS) Checklist Items to compile report
- SAS submitted to DA
- DA checks for completeness and schedules Project Application Meeting

Step 1:
Project Application Meeting

Sediment and Stormwater Program
Project Application Meeting
Discussion and Agreement Items

Project Name: _____
Meeting Date: _____

Discussion Items:

1. TMDL Watershed: _____
2. Groundwater Mapping
   a. Wellhead Protection Areas: **YES /NO**
   b. Depth to Water Table (Wet): _____
   c. Runoff Reduction Feasibility: _____
3. Watershed Master Plan
   a. Does this site fall within an area served by a watershed master plan? **YES / NO**
      - Appoquinimink WS
      - Murderkill WS
      - Upper Nanticoke WS
      - Other: _____
   b. What special design criteria are set for this project based upon its location in a watershed having a master plan?
4. The site contains tax ditches: **YES / NO**

Tax Ditch Name	Right-of-way Information

   a. Is there a proposal for changing tax ditch watershed boundaries? **YES / NO**
   b. The tax ditch requires a court order change (COC) for development to occur as planned? **YES / NO**
   c. Additional information regarding court order change:

03/2013 3.02.1.2-1

- Consultant uses Stormwater Assessment Study (SAS) Checklist Items to compile report
- SAS submitted to DA
- DA checks for completeness and schedules Project Application Meeting
- Consultant and Agency Staff Conduct Project Application Meeting Based On Discussion and Agreement Items

Step 1:
Project Application Meeting

Stormwater Assessment Report

Project:_____

Owner/Developer: _____

Consultant:_____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☐	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☐	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☐	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

03/2013 3.02.1.3-1

- Consultant uses Stormwater Assessment Study (SAS) Checklist Items to compile report
- SAS submitted to DA
- DA checks for completeness and schedules Project Application Meeting
- Consultant and Agency Staff Conduct Project Application Meeting Based On Discussion and Agreement Items
- Project Application Meeting Concludes with Completion of Stormwater Assessment Report (SAR)

Step 1:
Project Application Meeting

Assessment Item	Rating Value: Number	Yes/No	Acres	%
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.				
1.1 Hydric Soils (ac)				
1.2 "Very limited" for embankments, dikes and levees (ac)				
1.3 "Very limited" for excavated ponds due to depth to water table (ac)				
1.4 "Very limited" for excavated ponds due to cutbanks cave (ac)				
1.5 "Very limited" for pond reservoir areas (ac)				
1.6 Soil "K-factor" > 0.30 (ac)				
1.7 Drainage class "Poorly drained" or "Very poorly drained" (ac)				
1.8 Hydrologic Soil Group "D" (ac)				
1.9 Depth to water table < 100 cm (ac)				
1.10 Flood frequency class "Frequent" or "Very frequent" (ac)				
1.11 Ponding frequency class "Frequent" (ac)				
1.12 "Very limited" for local roads and streets (ac)				
1.13 "Very limited" for shallow excavations (ac)				
1.14 "Very limited" for lawns and landscaping (ac)				
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.				
2.1 Existing wooded or meadow areas to be disturbed (ac)				
2.2 Proposed impervious area (ac)				
3. Water Quality - Pollutant loadings associated with proposed project could adversely affect adequate stormwater management.				
3.1 Site area with Runoff Reduction Feasibility rating of Low or Low-Mod				
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.				
4.1 Site area that drains to sump (ac)				
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.				
5.1 Discharge points with identified problems (no.)				
5.2 Site area that drains to discharge point with identified problem (ac)				
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.				
6.1 Off-site areas draining onto site (ac)				
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.				
7.1 Known historic drainage problems (no.)				
7.2 In-line structures between site and 10% analysis point (no.)				
7.3 Stream channel condition degraded (yes/no)				

Step 1:
Project Application Meeting

Assessment Item	*Rating Criteria*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management fo the proposed project.	<15% of developed portion of the site has soils with limitations to development (i.e. high water table, erosivity, excavations)	15% - 50% of developed portion of the site has soils with limitations to development (i.e. high water table, erosivity, excavations)	>50% of developed portion of the site has soils with limitations to development (i.e. high water table, erosivity, excavations)
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	<25% existing woods/meadow to be disturbed **OR** <25% proposed impervious area	25%-50% existing woods/meadow to be disturbed **OR** 25%-50% proposed impervious area	> 50% existing woods/meadow to be disturbed **OR** > 50% proposed impervious area
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	<15% of developed portion of the site has RR Feasibility rating of Low or Low-Mod	15% - 50% of developed portion of the site has RR Feasibility rating of Low or Low-Mod	>50% of developed portion of the site has RR Feasibility rating of Low or Low-Mod
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	0% of site area drains to sump areas	≤50% of site area drains to sump areas	>50% of site area drains to sump areas
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channe or other hydraulic limitations.	Zero (0) site discharge points with identified problems **OR** <10% of site area drains to a discharge point with an identified problem	At least one (1) site discharge point with an identified problem **OR** 10% - 50% of site area drains to a discharge point with an identified problem	Multiple (more than 1) discharge point with an identified problem **OR** >50% of site area drains to a discharge point with an identified problem **OR** Lack of easements and/or alteration of drainage patterns could raise potential "right-to-discharge" issues.
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	<25% offsite area relative to site area draining onto site	25% - 50% offsite area relative to site area draining onto site	>50% offsite area relative to site area draining onto site
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	Zero (0) known historic drainage problems **OR** Zero (0) in-line structures prior to the 10% analysis point	At least one (1) known historic drainage problem **OR** At least one (1) in-line structure prior to the 10% analysis point	Multiple (more than 1) known historic drainage problems **OR** Multiple (more than 1) in-line structures prior to the 10% analysis point **OR** Stream channel condition degraded due to vegetation, slope, erosion, etc.

Step 1:
Project Application Meeting

Stormwater Assessment Report

Project: Broadkill Estates

Owner/Developer: I. M. Developer

Consultant: GreenTech Consulting, Inc.

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Quality - Pollutant loadings associated with proposed project could adversely affect adequate stormwater management.	☑	☐	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☑	☐	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☑	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☑	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)

Reporting Agency: Delegated Agency

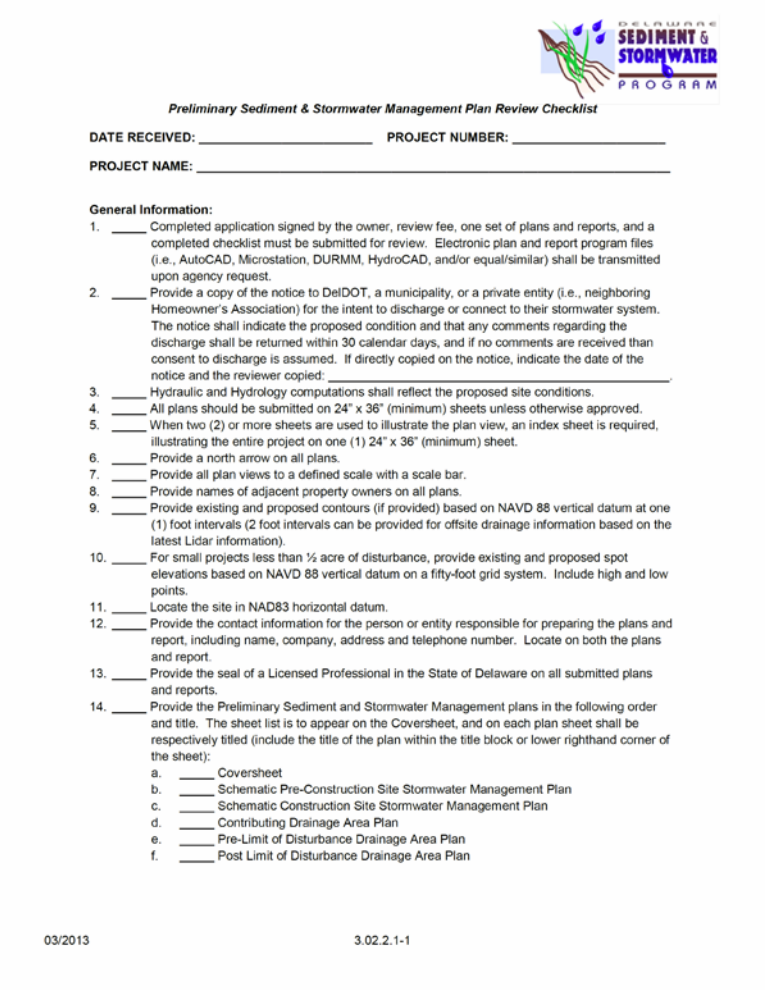
Contact Person: P. M. Won

Date of Pre-Application Meeting: mm-dd-yyyy

03/2013 3.02.1.5-121

- Consultant uses Stormwater Assessment Study (SAS) Checklist Items to compile report
- SAS submitted to DA
- DA checks for completeness and schedules Project Application Meeting
- Consultant and Agency Staff Conduct Project Application Meeting Based On Discussion and Agreement Items
- Project Application Meeting Concludes with Completion of Stormwater Assessment Report (SAR)
- Delegated Agency Forwards SAR to Appropriate Land Use Authority

Step 2:
Preliminary Sediment & SW Plan



DELAWARE SEDIMENT & STORMWATER PROGRAM

Preliminary Sediment & Stormwater Management Plan Review Checklist

DATE RECEIVED: _____ **PROJECT NUMBER:** _____

PROJECT NAME: _____

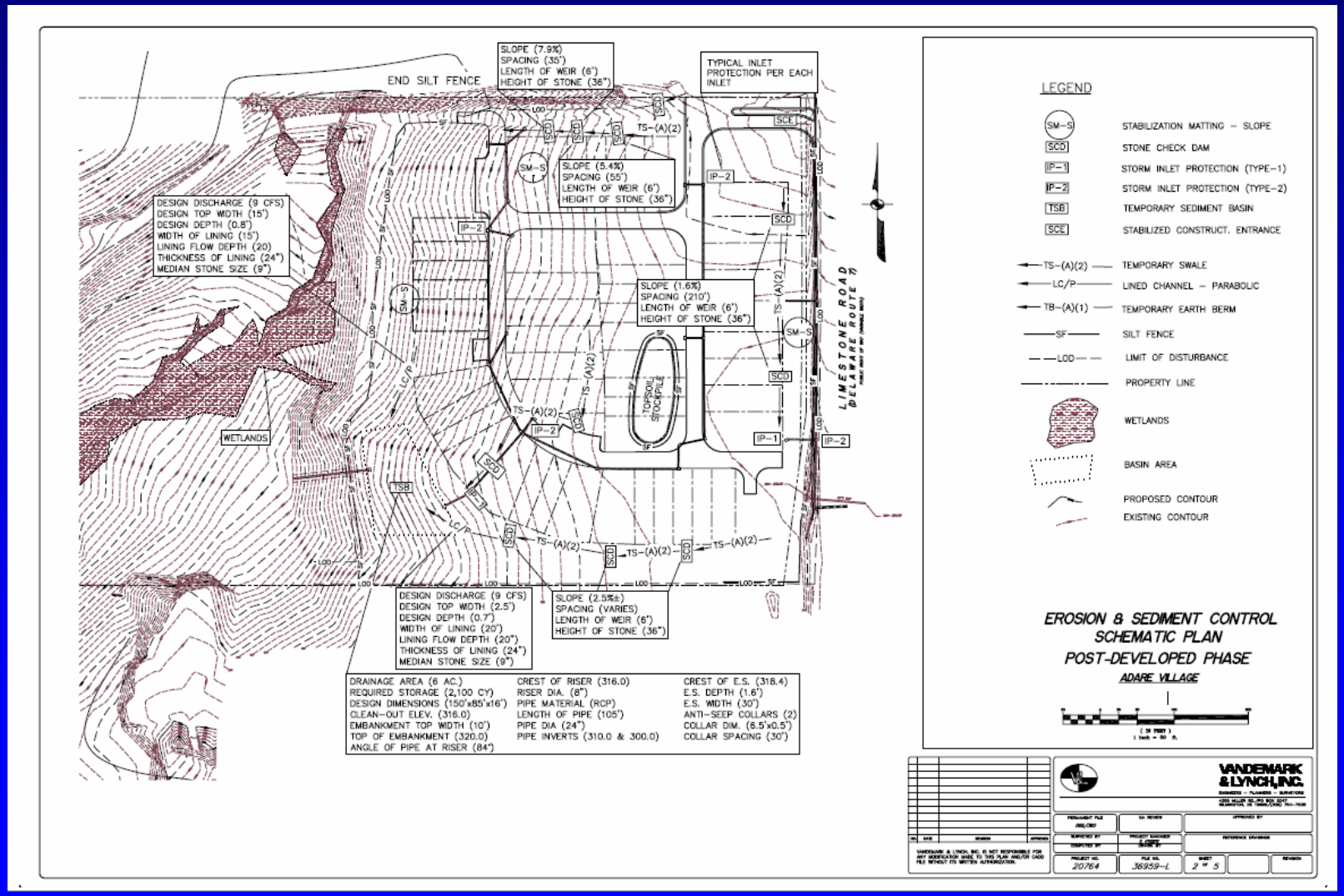
General Information:

1. _____ Completed application signed by the owner, review fee, one set of plans and reports, and a completed checklist must be submitted for review. Electronic plan and report program files (i.e., AutoCAD, Microstation, DURMM, HydroCAD, and/or equal/similar) shall be transmitted upon agency request.
2. _____ Provide a copy of the notice to DelDOT, a municipality, or a private entity (i.e., neighboring Homeowner's Association) for the intent to discharge or connect to their stormwater system. The notice shall indicate the proposed condition and that any comments regarding the discharge shall be returned within 30 calendar days, and if no comments are received than consent to discharge is assumed. If directly copied on the notice, indicate the date of the notice and the reviewer copied: _____.
3. _____ Hydraulic and Hydrology computations shall reflect the proposed site conditions.
4. _____ All plans should be submitted on 24" x 36" (minimum) sheets unless otherwise approved.
5. _____ When two (2) or more sheets are used to illustrate the plan view, an index sheet is required, illustrating the entire project on one (1) 24" x 36" (minimum) sheet.
6. _____ Provide a north arrow on all plans.
7. _____ Provide all plan views to a defined scale with a scale bar.
8. _____ Provide names of adjacent property owners on all plans.
9. _____ Provide existing and proposed contours (if provided) based on NAVD 88 vertical datum at one (1) foot intervals (2 foot intervals can be provided for offsite drainage information based on the latest Lidar information).
10. _____ For small projects less than ½ acre of disturbance, provide existing and proposed spot elevations based on NAVD 88 vertical datum on a fifty-foot grid system. Include high and low points.
11. _____ Locate the site in NAD83 horizontal datum.
12. _____ Provide the contact information for the person or entity responsible for preparing the plans and report, including name, company, address and telephone number. Locate on both the plans and report.
13. _____ Provide the seal of a Licensed Professional in the State of Delaware on all submitted plans and reports.
14. _____ Provide the Preliminary Sediment and Stormwater Management plans in the following order and title. The sheet list is to appear on the Coversheet, and on each plan sheet shall be respectively titled (include the title of the plan within the title block or lower righthand corner of the sheet):
    a. _____ Coversheet
    b. _____ Schematic Pre-Construction Site Stormwater Management Plan
    c. _____ Schematic Construction Site Stormwater Management Plan
    d. _____ Contributing Drainage Area Plan
    e. _____ Pre-Limit of Disturbance Drainage Area Plan
    f. _____ Post Limit of Disturbance Drainage Area Plan

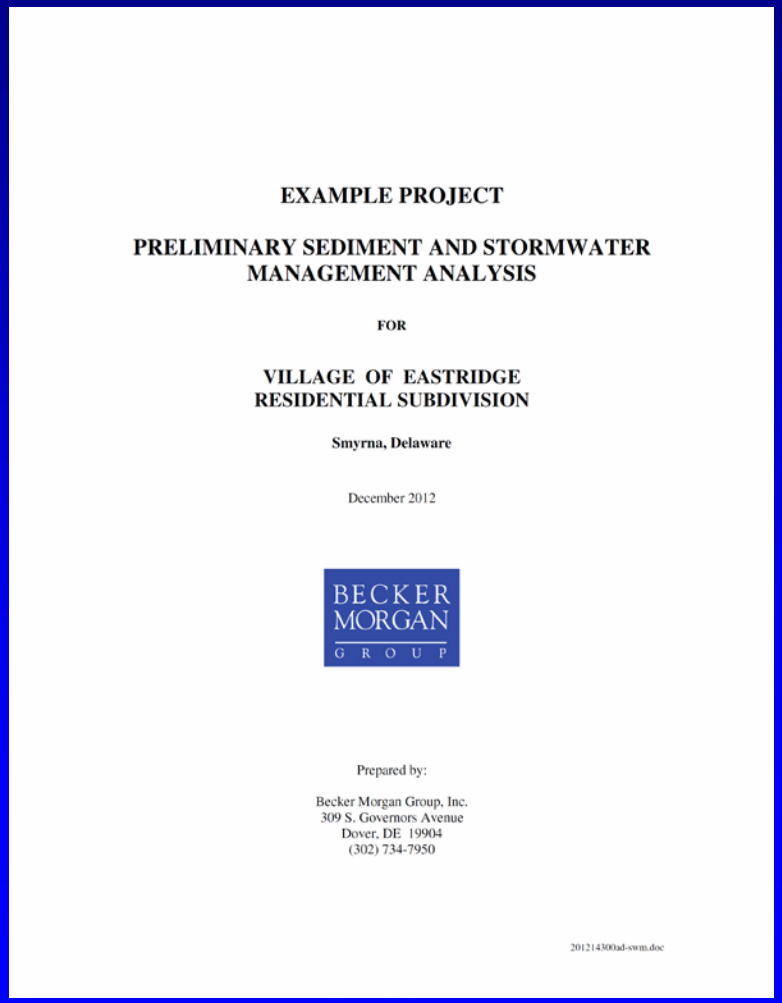
03/2013 3.02.2.1-1

- Consultant uses Checklist to prepare the Preliminary Sediment & SW Plan
  - Schematic Construction Site Stormwater Management Plan

Step 2:
Preliminary Sediment & SW Plan



Step 2:
Preliminary Sediment & SW Plan



EXAMPLE PROJECT

PRELIMINARY SEDIMENT AND STORMWATER MANAGEMENT ANALYSIS

FOR

VILLAGE OF EASTRIDGE RESIDENTIAL SUBDIVISION

Smyrna, Delaware

December 2012

BECKER MORGAN GROUP

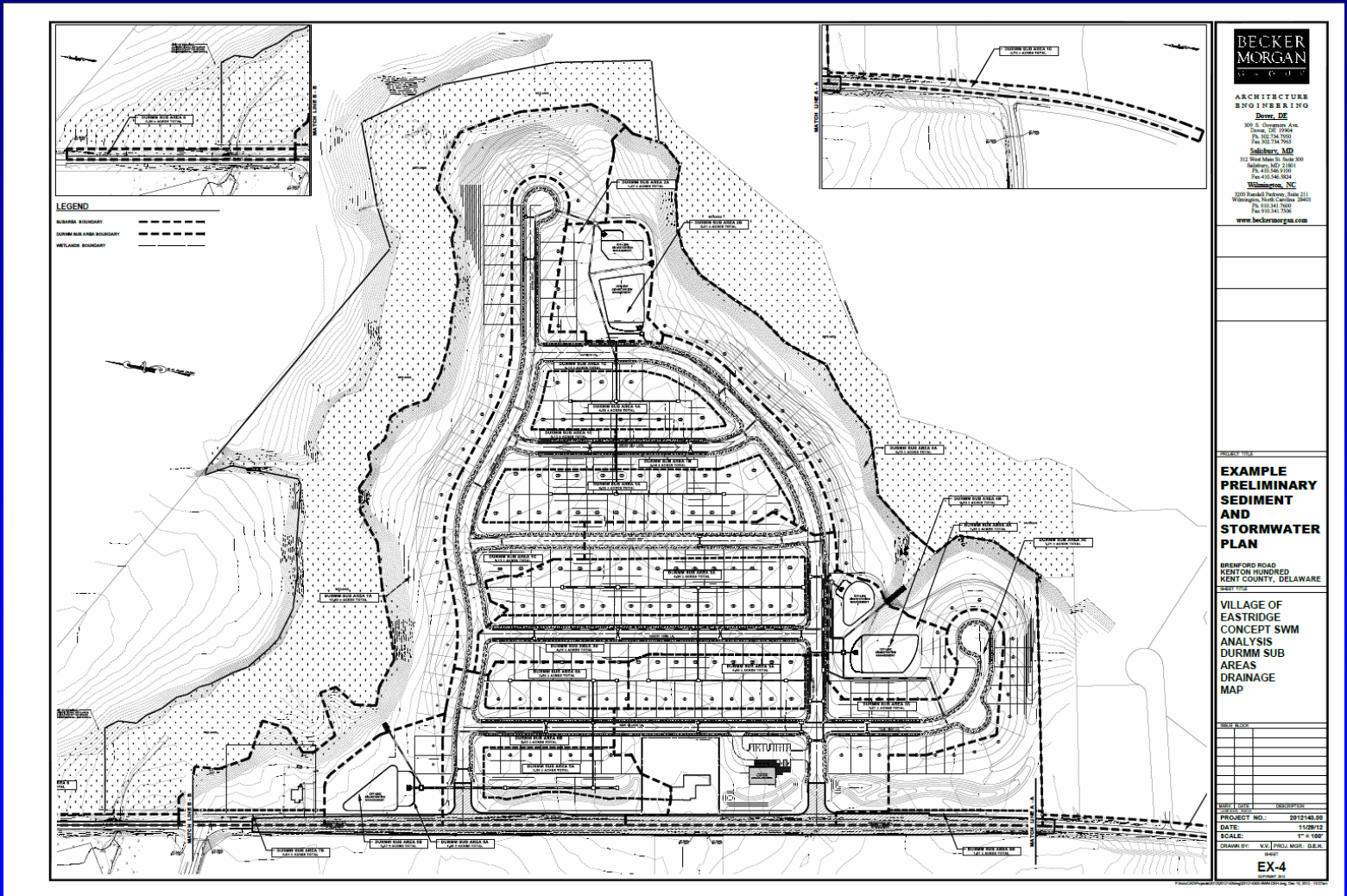
Prepared by:

Becker Morgan Group, Inc.
309 S. Governors Avenue
Dover, DE 19904
(302) 734-7950

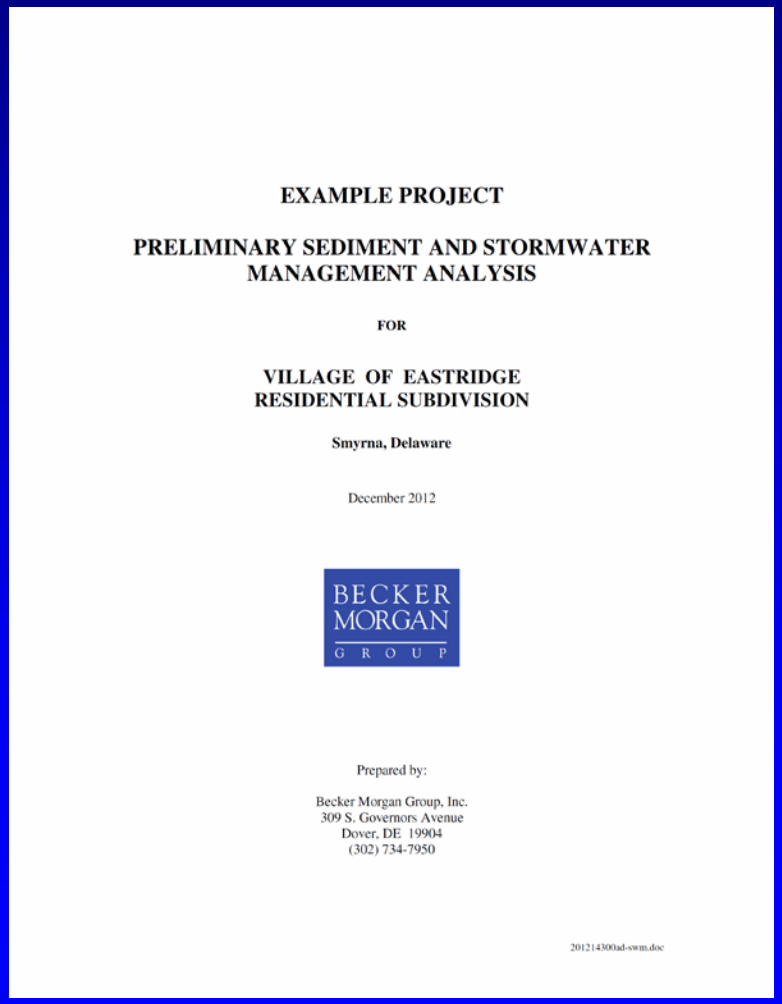
201214300ad-swm.doc

- Consultant uses Checklist to prepare the Preliminary Sediment & SW Plan
  - Schematic Construction Site Stormwater Management Plan
  - Stormwater Management Report w/Drainage Area Plans

Step 2:
Preliminary Sediment & SW Plan



Step 2:
Preliminary Sediment & SW Plan



EXAMPLE PROJECT

PRELIMINARY SEDIMENT AND STORMWATER MANAGEMENT ANALYSIS

FOR

VILLAGE OF EASTRIDGE RESIDENTIAL SUBDIVISION

Smyrna, Delaware

December 2012

BECKER MORGAN GROUP

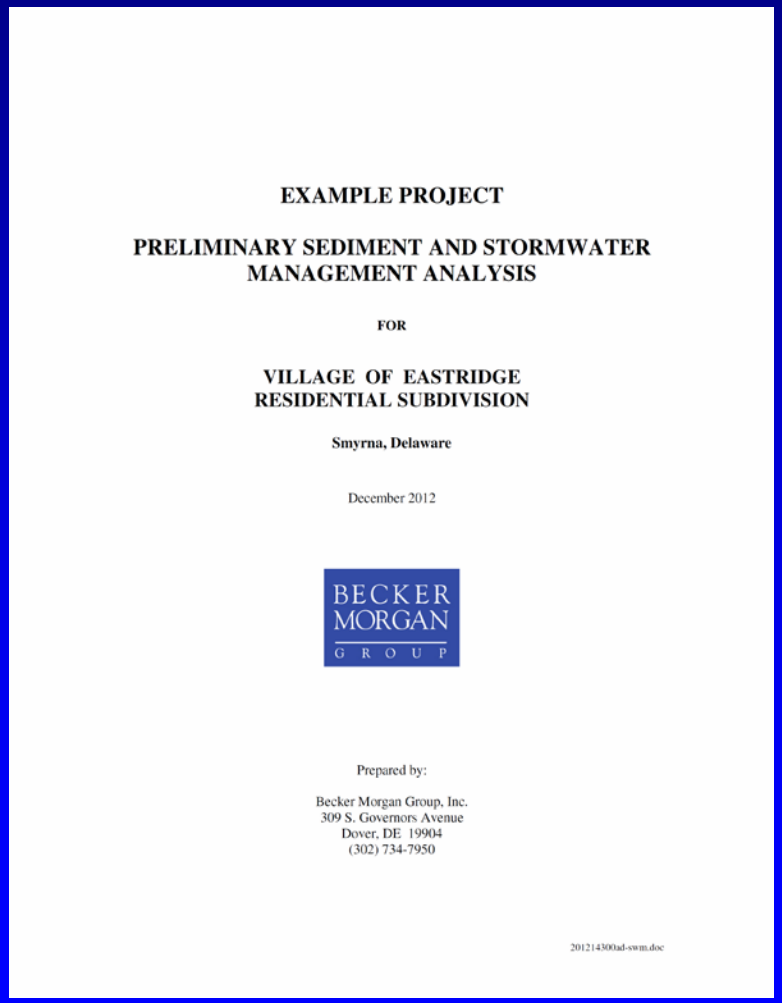
Prepared by:

Becker Morgan Group, Inc.
309 S. Governors Avenue
Dover, DE 19904
(302) 734-7950

201214300ad-swm.doc

- Preliminary SWM Design
  - DURMM v.2 comps for Resource Protection Event (RPv)
  - Hydrologic analysis for Conveyance Event (Cv)
  - Hydrologic analysis for Flooding Event (Fv)

Step 2:
Preliminary Sediment & SW Plan



EXAMPLE PROJECT

PRELIMINARY SEDIMENT AND STORMWATER MANAGEMENT ANALYSIS

FOR

VILLAGE OF EASTRIDGE RESIDENTIAL SUBDIVISION

Smyrna, Delaware

December 2012

BECKER MORGAN GROUP

Prepared by:

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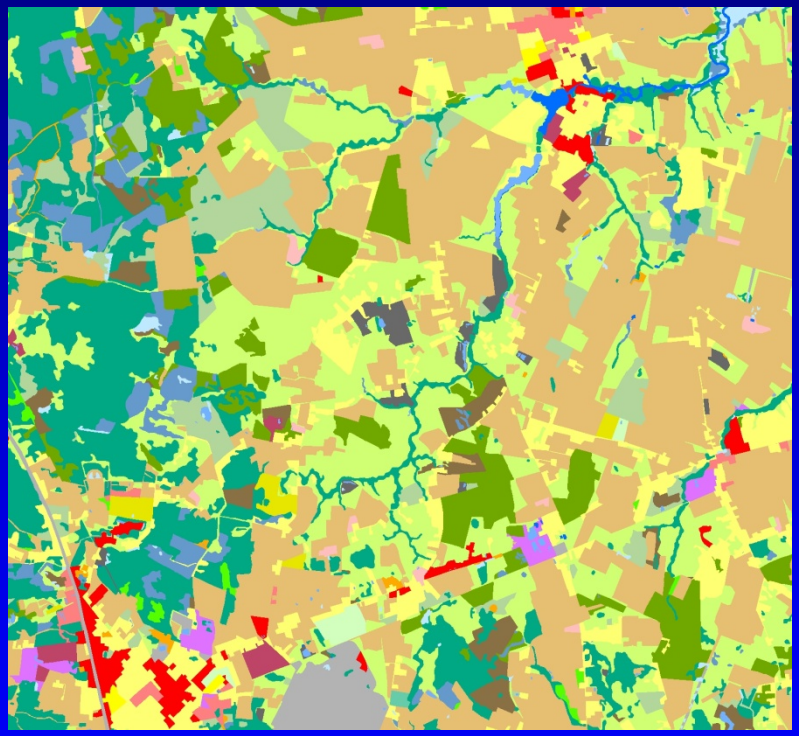
201214300ad-swm.doc

- Preliminary SWM Design
  - DURMM v.2 comps for Resource Protection Event (RPv)
  - Hydrologic analysis for Conveyance Event (Cv)
  - Hydrologic analysis for Flooding Event (Fv)

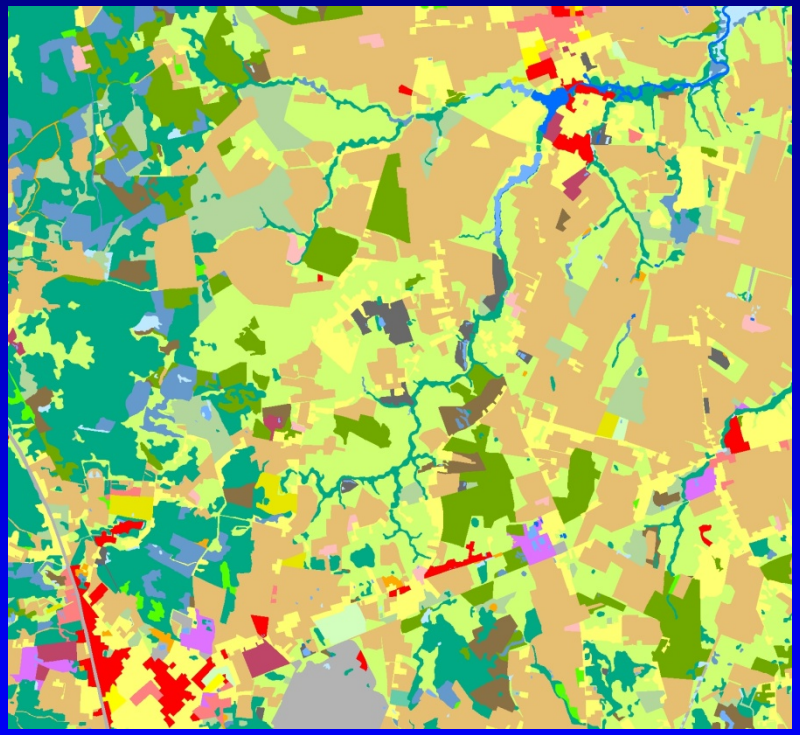
Options for Cv & Fv Compliance

- Option 1
  - Standards-based
    - Unit Discharge (cfs/ac)
  - Only projects that receive all minor ratings on the SAR qualify for the Unit Discharge option

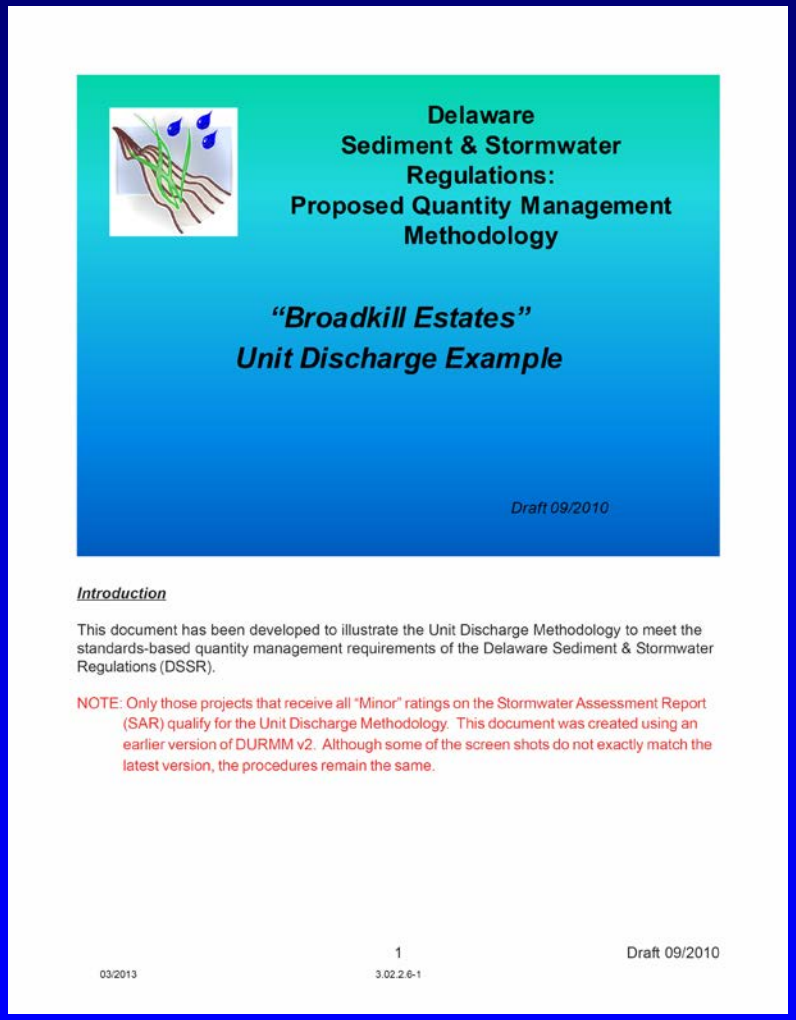


Options for Cv & Fv Compliance

- Option 1
  - Standards-based
    - Unit Discharge
      - Based on 2007 LULC
      - Non-Woodland/Non-Meadow
        - » 10-YR: 0.75 cfs/ac
        - » 100-YR: 2.25 cfs/ac
      - Woodland/Meadow
        - » 10-YR: 0.375 cfs/ac
        - » 100-YR: 1.25 cfs/ac
      - HSG-A Woods
        - » 10-YR: 0 cfs/ac
        - » 100-YR: 0.25 cfs/ac



Unit Discharge Example



Delaware
Sediment & Stormwater
Regulations:
Proposed Quantity Management
Methodology

"Broadkill Estates"
Unit Discharge Example

Draft 09/2010

Introduction

This document has been developed to illustrate the Unit Discharge Methodology to meet the standards-based quantity management requirements of the Delaware Sediment & Stormwater Regulations (DSSR).

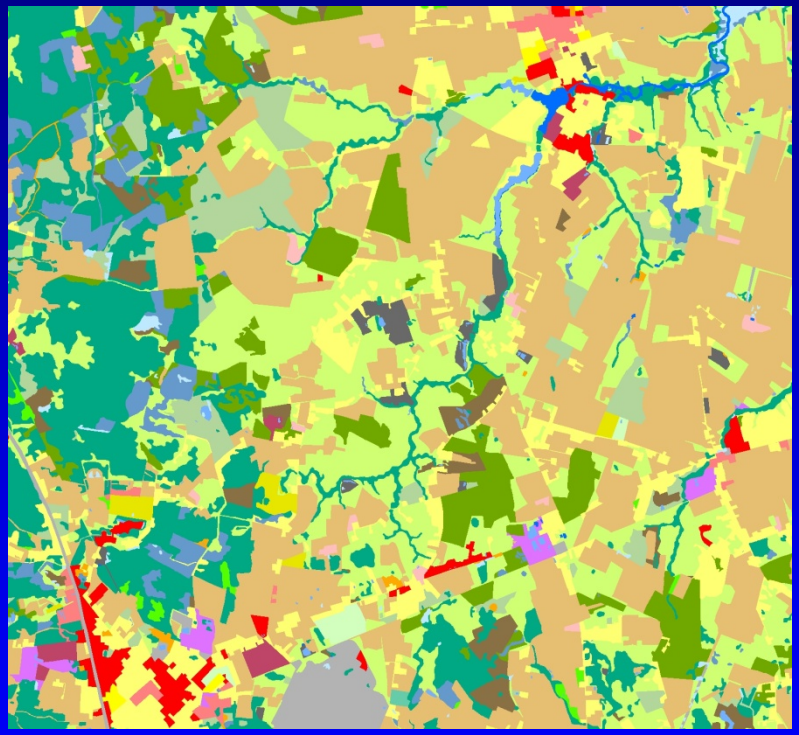
NOTE: Only those projects that receive all "Minor" ratings on the Stormwater Assessment Report (SAR) qualify for the Unit Discharge Methodology. This document was created using an earlier version of DURMM v2. Although some of the screen shots do not exactly match the latest version, the procedures remain the same.

1 Draft 09/2010
03/2013 3.02.2.6-1

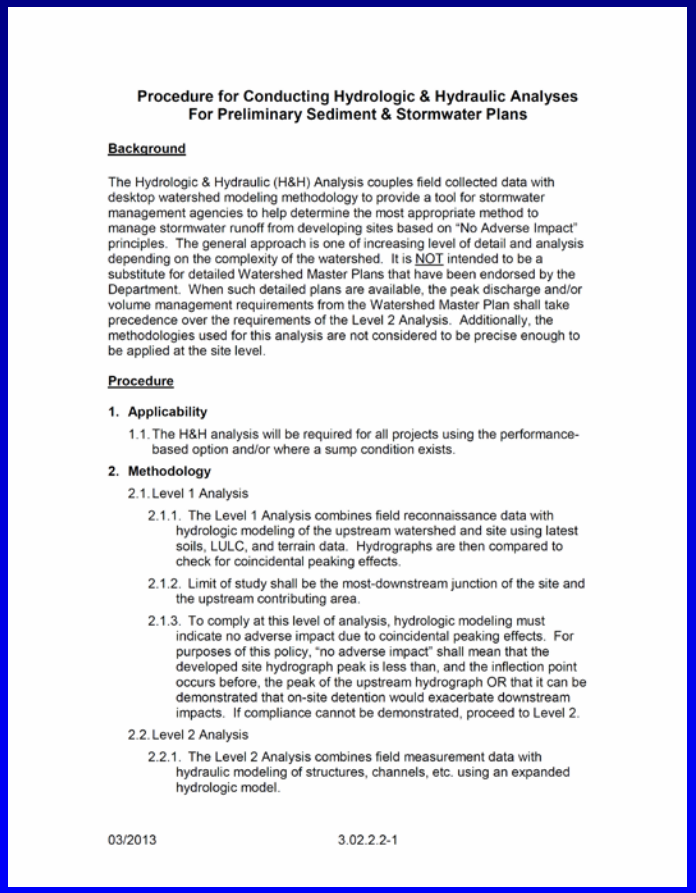
Article 3.02.2.6, Technical Document

Options for Cv & Fv Compliance

- Option 1
  - Standards-based
    - Unit Discharge (cfs/ac)
- Option 2
  - Performance-based
  - Criteria based on:
    - hydrograph timing
    - channel stability
    - system capacity
  - H&H analysis required
    - 3 levels of increasing detail



Procedure for H&H Analysis



Procedure for Conducting Hydrologic & Hydraulic Analyses For Preliminary Sediment & Stormwater Plans

Background

The Hydrologic & Hydraulic (H&H) Analysis couples field collected data with desktop watershed modeling methodology to provide a tool for stormwater management agencies to help determine the most appropriate method to manage stormwater runoff from developing sites based on "No Adverse Impact" principles. The general approach is one of increasing level of detail and analysis depending on the complexity of the watershed. It is NOT intended to be a substitute for detailed Watershed Master Plans that have been endorsed by the Department. When such detailed plans are available, the peak discharge and/or volume management requirements from the Watershed Master Plan shall take precedence over the requirements of the Level 2 Analysis. Additionally, the methodologies used for this analysis are not considered to be precise enough to be applied at the site level.

Procedure

1. **Applicability**
   1.1. The H&H analysis will be required for all projects using the performance-based option and/or where a sump condition exists.
2. **Methodology**
   2.1. Level 1 Analysis
      2.1.1. The Level 1 Analysis combines field reconnaissance data with hydrologic modeling of the upstream watershed and site using latest soils, LULC, and terrain data. Hydrographs are then compared to check for coincidental peaking effects.
      2.1.2. Limit of study shall be the most-downstream junction of the site and the upstream contributing area.
      2.1.3. To comply at this level of analysis, hydrologic modeling must indicate no adverse impact due to coincidental peaking effects. For purposes of this policy, "no adverse impact" shall mean that the developed site hydrograph peak is less than, and the inflection point occurs before, the peak of the upstream hydrograph OR that it can be demonstrated that on-site detention would exacerbate downstream impacts. If compliance cannot be demonstrated, proceed to Level 2.
   2.2. Level 2 Analysis
      2.2.1. The Level 2 Analysis combines field measurement data with hydraulic modeling of structures, channels, etc. using an expanded hydrologic model.

03/2013 3.02.2.2-1

- 3 Increasing Levels of Detail
  - Level 1: Peak comparison

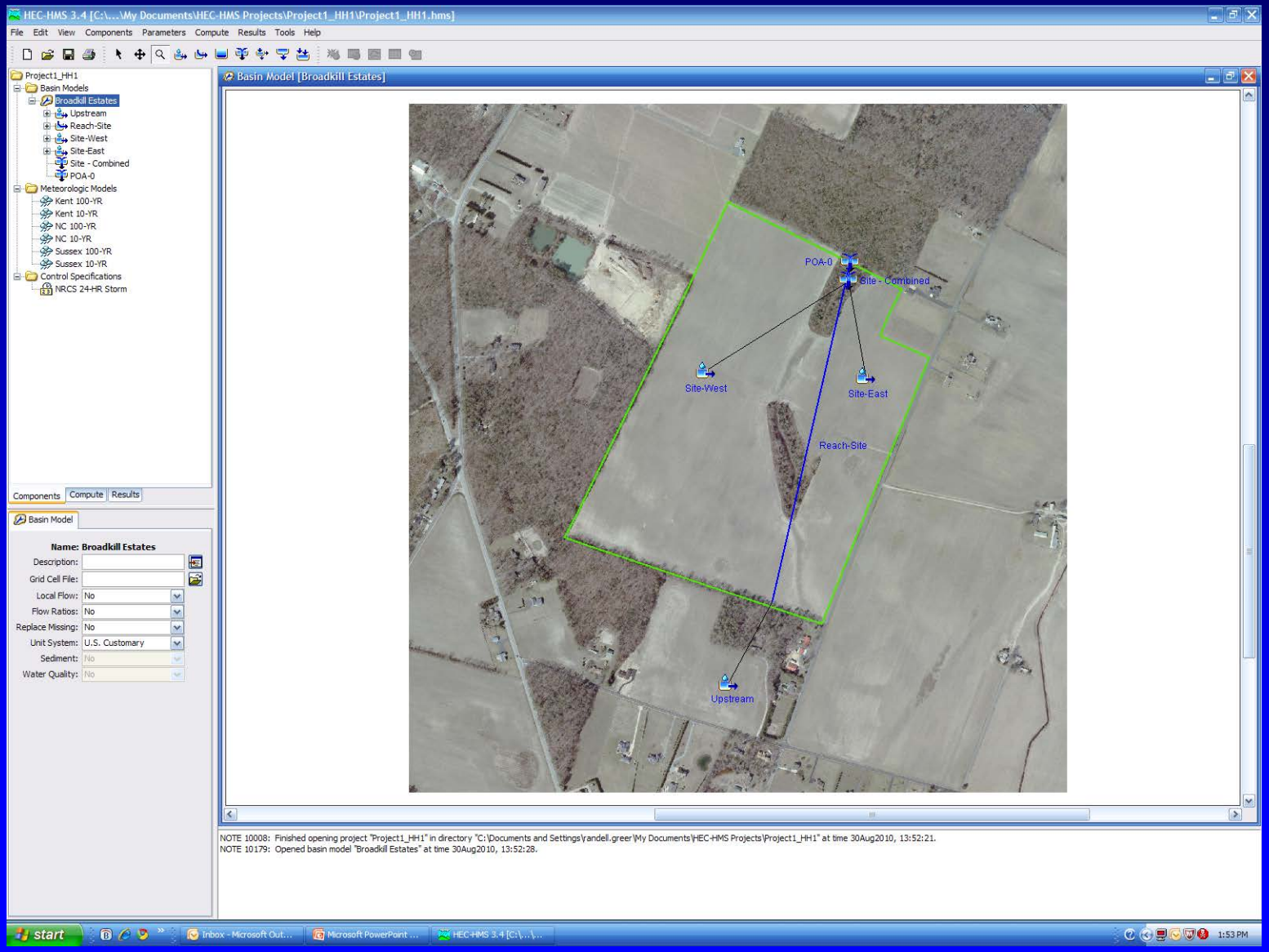
Article 3.02.2.2, Technical Document

Example: Level 1 H&H Analysis

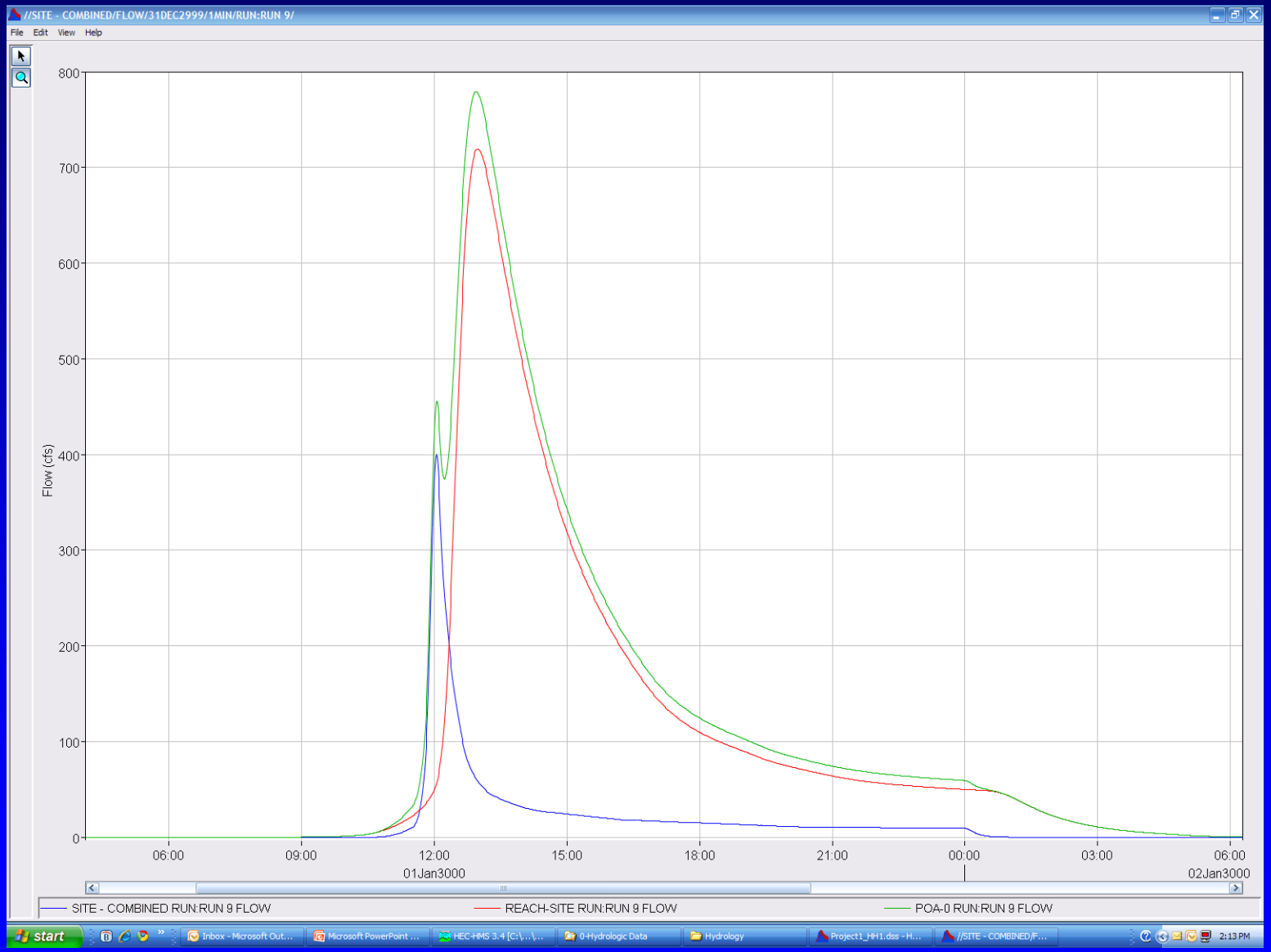
Procedure for Conducting Hydrologic & Hydraulic Analyses for Preliminary Sediment & Stormwater Plans, Sect. 2.1.3:

To comply at this level of analysis, hydrologic modeling must indicate no adverse impact due to coincidental peaking effects.

HEC-HMS Hydrologic Model



Example: Level 1 H&H Analysis

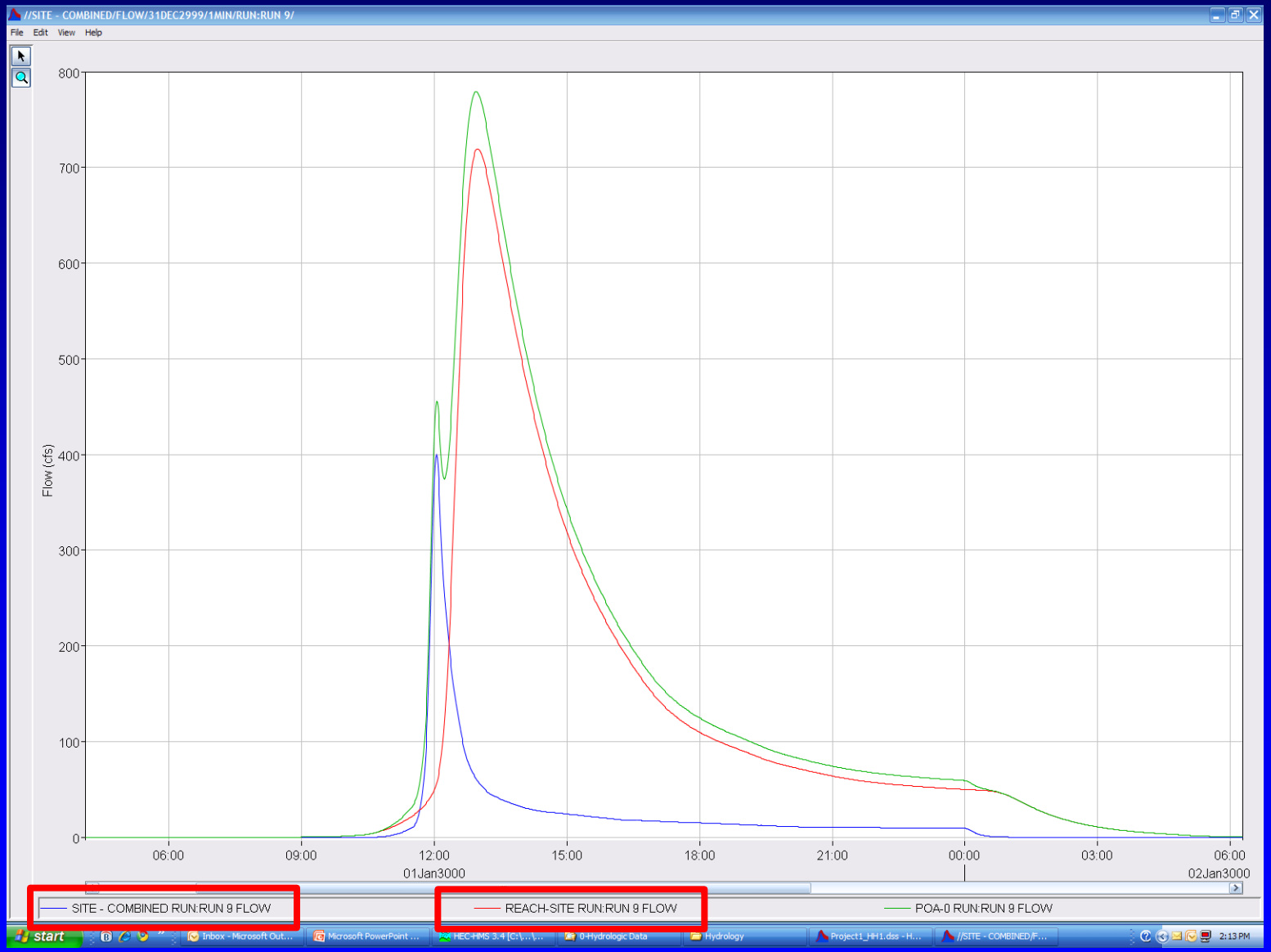


Example: Level 1 H&H Analysis

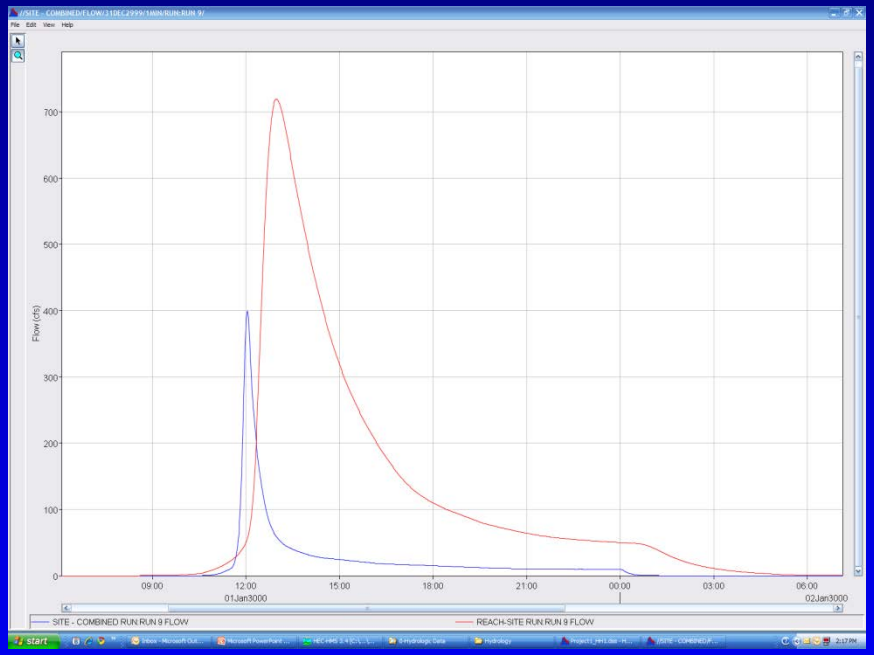
Procedure for Conducting Hydrologic & Hydraulic Analyses for Preliminary Sediment & Stormwater Plans, Sect. 2.1.3:

To comply at this level of analysis, hydrologic modeling must indicate no adverse impact due to coincidental peaking effects. For purposes of this policy, **"no adverse impact" shall mean that the developed site hydrograph peak is less than, and the inflection point occurs before, the peak of the upstream hydrograph** OR that it can be demonstrated that on-site detention would exacerbate downstream impacts.

Example: Level 1 H&H Analysis



Example: Level 1 H&H Analysis



✓ Developed site hydrograph peak less than peak of upstream hydrograph

AND…

? Developed site hydrograph inflection point occurs before peak of the upstream hydrograph

Significance of the Inflection Point

The dimensionless curvilinear unit hydrograph (fig. 16–1) has 37.5 percent of the total volume in the rising side, which is represented by one unit of time and one unit of discharge. This dimensionless unit hydrograph also can be represented by an equivalent triangular hydrograph having the same units of time and discharge, thus having the same percent of volume in the rising side of the triangle (fig. 16A–1). This allows the base of the triangle to be solved in relation to the time to peak using the geometry of triangles. Solving for the base length of the triangle, if one unit of time T_p equals 0.375 per cent of volume:

$$T_b = \frac{1.00}{.375} = 2.67 \text{ units of time}$$

$$T_r = T_b - T_p = 1.67 \text{ units of time or } 1.67\ T_p$$

where:

T_b = time from beginning to end of the triangular hydrograph

T_r = time from the peak to the end of the triangular hydrograph

T_p = time from the beginning of the triangular hydrograph to its peak

These relationships are useful in developing the peak rate equation for use with the dimensionless unit hydrograph.

Peak rate equation

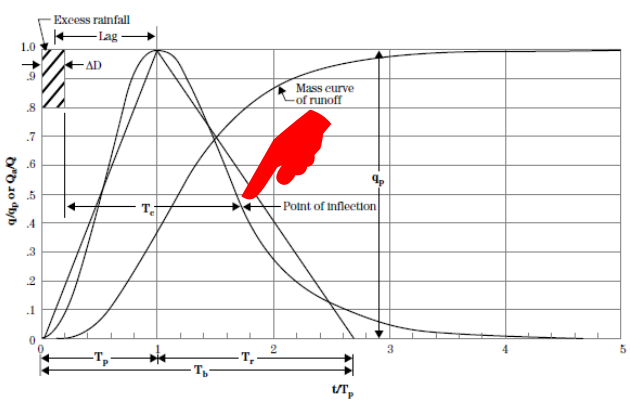
From figure 16A–1 the total volume under the triangular unit hydrograph is:

$$Q = \frac{q_p T_p}{2} + \frac{q_p T_r}{2} = \frac{q_p}{2}(T_p + T_r) \qquad [16A–1]$$

With Q in inches and T in hours, solve for peak rate q_p in inches per hour:

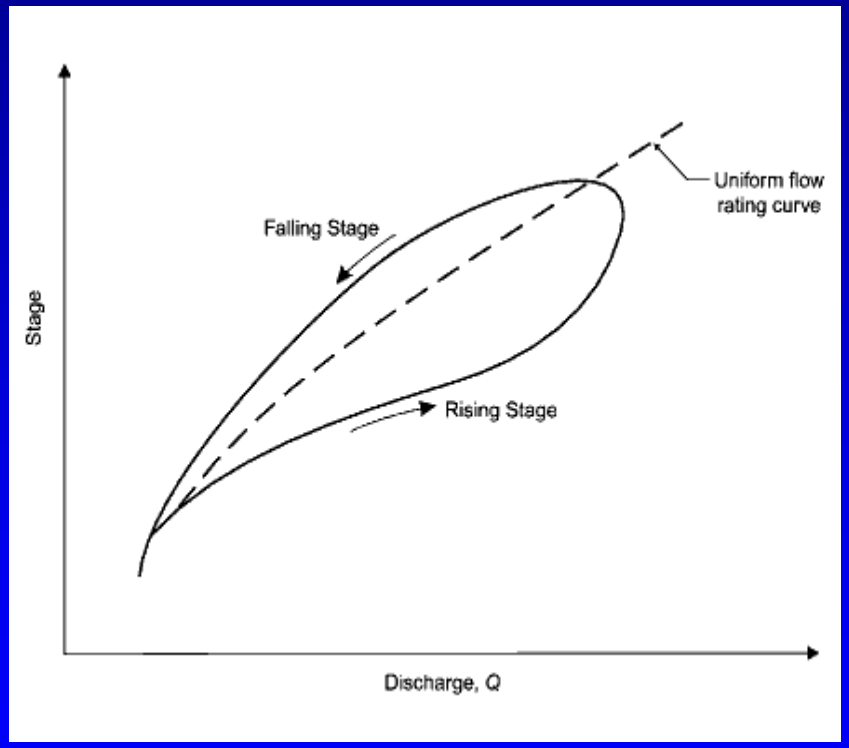
$$q_p = \frac{2Q}{T_p + T_r} \qquad [16A–2]$$

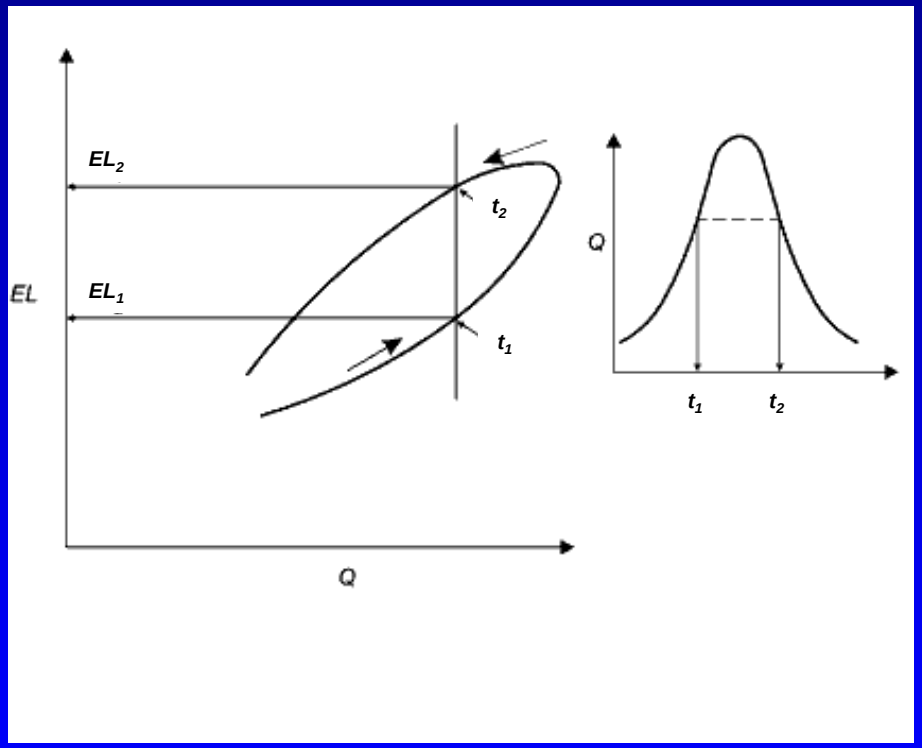
Figure 16A–1 Dimensionless curvilinear unit hydrograph and equivalent triangular hydrograph



- Volume @ T_p
  - Std. UH: 37.5%
  - DMV UH: 22%
- Volume @ T_{inf}
  - Std. UH: ~79%
  - DMV UH: ~63%

River Hydraulics: Hysteresis Effect (a.k.a., “Looped Rating Curve”)





NRCS Hydrograph Theory

Appendix 16A — Elements of a Unit Hydrograph

The dimensionless curvilinear unit hydrograph (fig. 16–1) has 37.5 percent of the total volume in the rising side, which is represented by one unit of time and one unit of discharge. This dimensionless unit hydrograph also can be represented by an equivalent triangular hydrograph having the same units of time and discharge, thus having the same percent of volume in the rising side of the triangle (fig. 16A–1). This allows the base of the triangle to be solved in relation to the time to peak using the geometry of triangles. Solving for the base length of the triangle, if one unit of time T_p equals 0.375 per cent of volume:

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These relationships are useful in developing the peak rate equation for use with the dimensionless unit hydrograph.

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From figure 16A–1 the total volume under the triangular unit hydrograph is:

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With Q in inches and T in hours, solve for peak rate q_p in inches per hour:

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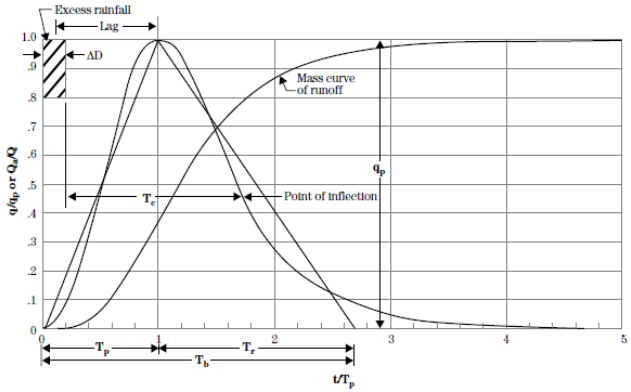
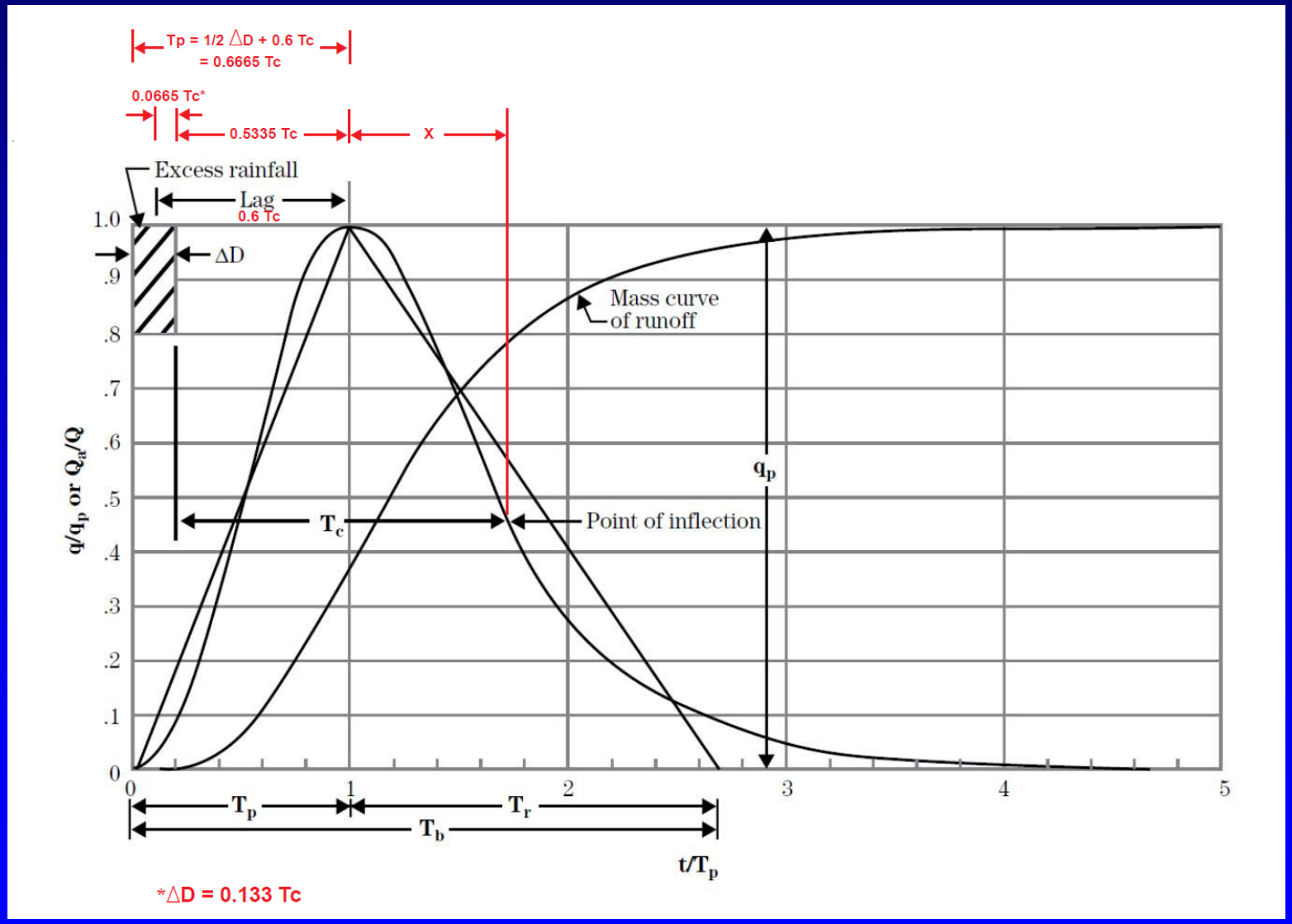
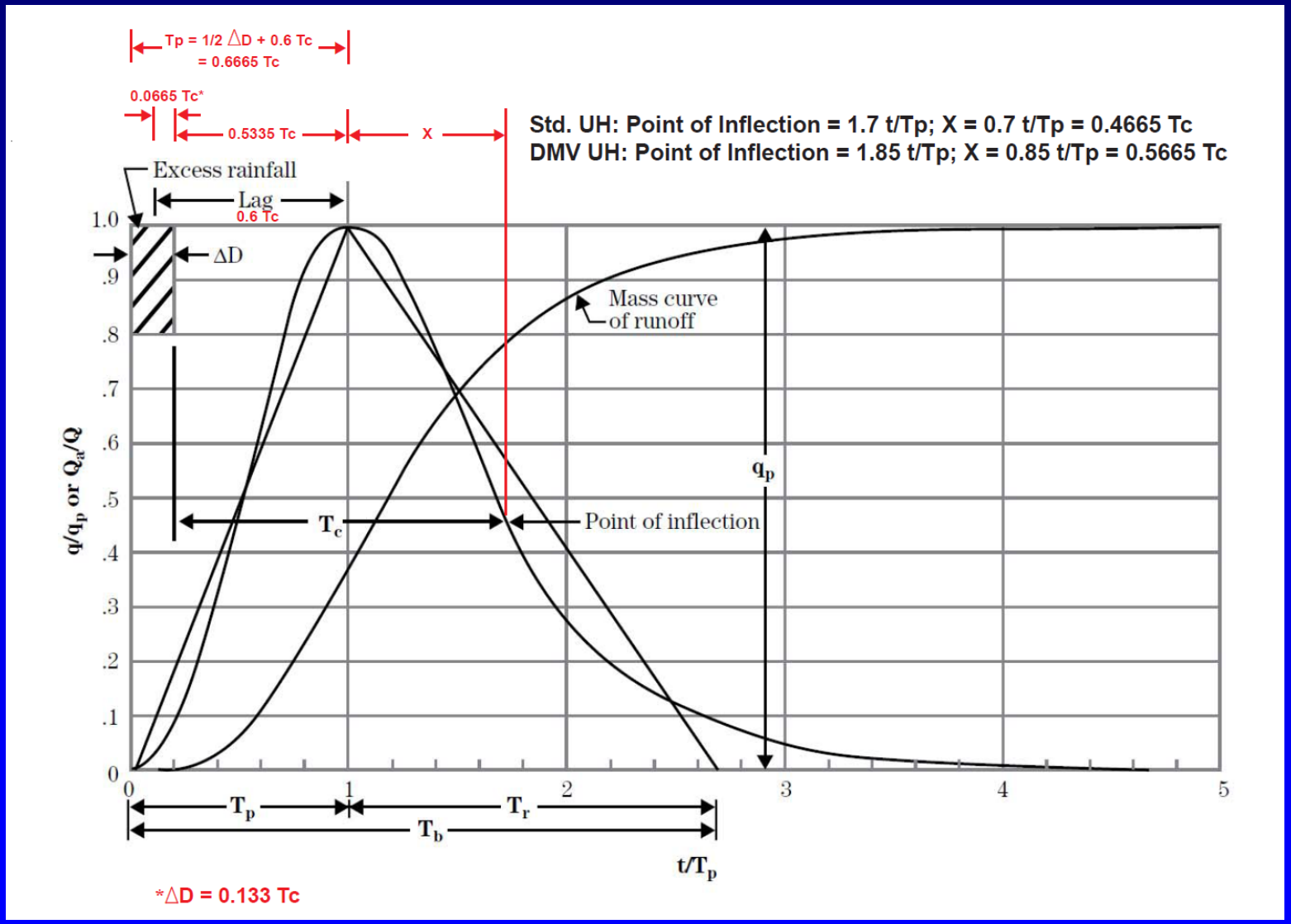


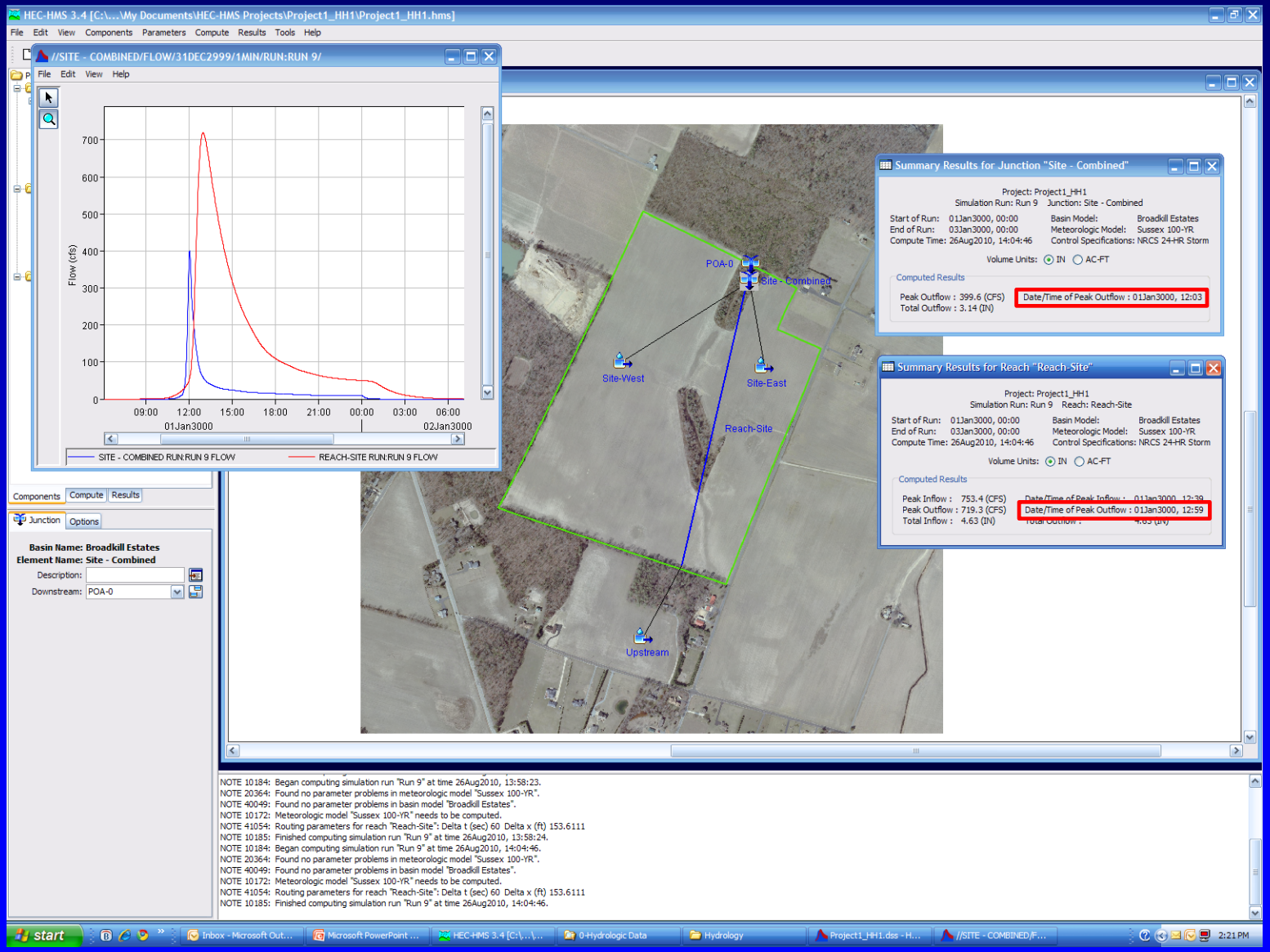
NRCS Hydrograph Theory



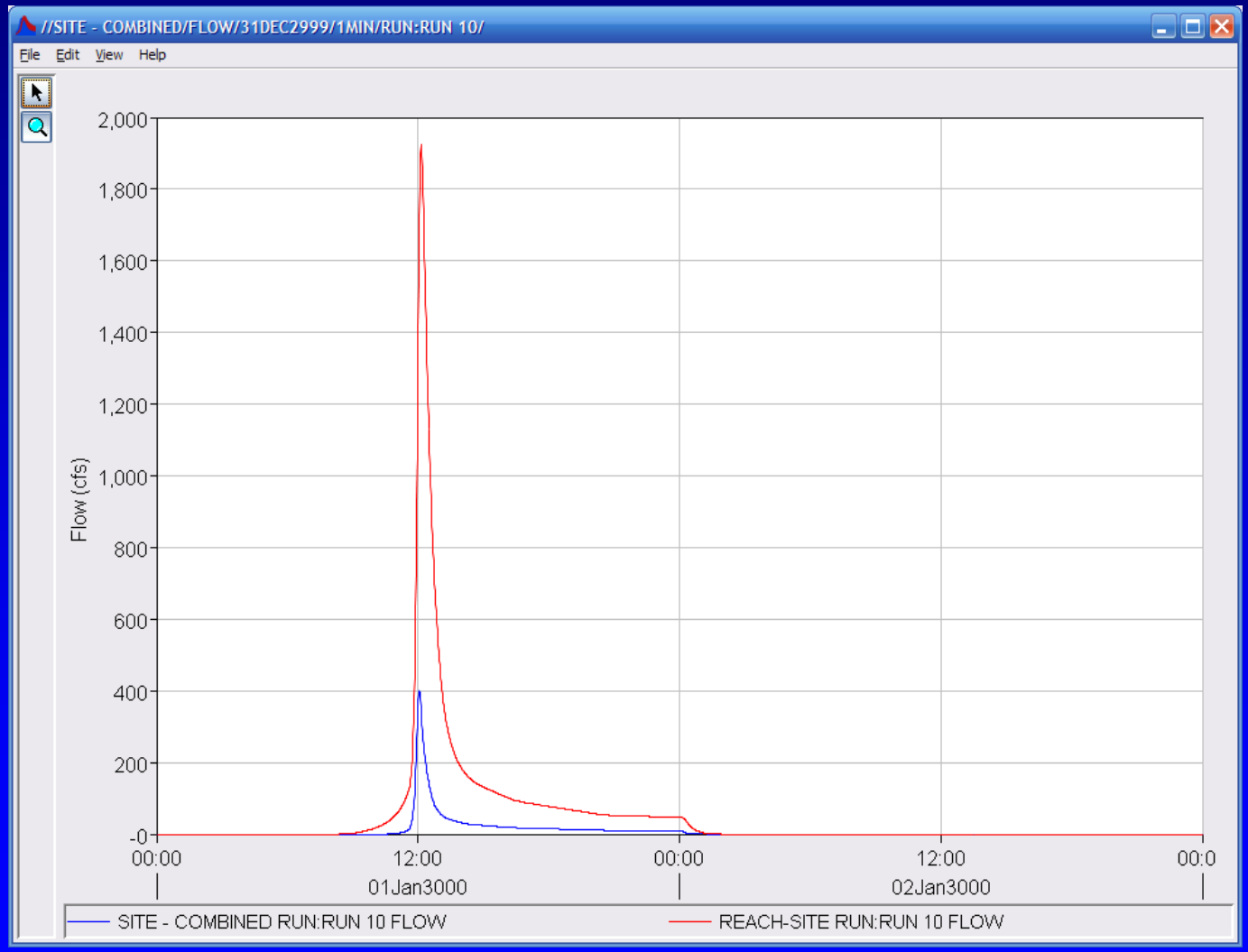
NRCS Hydrograph Theory



HEC-HMS Hydrologic Model



Level 1 H&H Analysis : What if Can't Show Compliance?



H&H Analysis Procedure

Procedure for Conducting Hydrologic & Hydraulic Analyses For Preliminary Sediment & Stormwater Plans

Background

The Hydrologic & Hydraulic (H&H) Analysis couples field collected data with desktop watershed modeling methodology to provide a tool for stormwater management agencies to help determine the most appropriate method to manage stormwater runoff from developing sites based on "No Adverse Impact" principles. The general approach is one of increasing level of detail and analysis depending on the complexity of the watershed. It is NOT intended to be a substitute for detailed Watershed Master Plans that have been endorsed by the Department. When such detailed plans are available, the peak discharge and/or volume management requirements from the Watershed Master Plan shall take precedence over the requirements of the Level 2 Analysis. Additionally, the methodologies used for this analysis are not considered to be precise enough to be applied at the site level.

Procedure

1. Applicability

1.1. The H&H analysis will be required for all projects using the performance-based option and/or where a sump condition exists.

2. Methodology

2.1. Level 1 Analysis

2.1.1. The Level 1 Analysis combines field reconnaissance data with hydrologic modeling of the upstream watershed and site using latest soils, LULC, and terrain data. Hydrographs are then compared to check for coincidental peaking effects.

2.1.2. Limit of study shall be the most-downstream junction of the site and the upstream contributing area.

2.1.3. To comply at this level of analysis, hydrologic modeling must indicate no adverse impact due to coincidental peaking effects. For purposes of this policy, "no adverse impact" shall mean that the developed site hydrograph peak is less than, and the inflection point occurs before, the peak of the upstream hydrograph OR that it can be demonstrated that on-site detention would exacerbate downstream impacts. If compliance cannot be demonstrated, proceed to Level 2.

2.2. Level 2 Analysis

2.2.1. The Level 2 Analysis combines field measurement data with hydraulic modeling of structures, channels, etc. using an expanded hydrologic model.

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- Section 2.1.3

  … If compliance cannot be demonstrated, proceed to Level 2.

Article 3.02.2.2, Technical Document

H&H Analysis

Procedure for Conducting Hydrologic & Hydraulic Analyses For Preliminary Sediment & Stormwater Plans

Background

The Hydrologic & Hydraulic (H&H) Analysis couples field collected data with desktop watershed modeling methodology to provide a tool for stormwater management agencies to help determine the most appropriate method to manage stormwater runoff from developing sites based on "No Adverse Impact" principles. The general approach is one of increasing level of detail and analysis depending on the complexity of the watershed. It is NOT intended to be a substitute for detailed Watershed Master Plans that have been endorsed by the Department. When such detailed plans are available, the peak discharge and/or volume management requirements from the Watershed Master Plan shall take precedence over the requirements of the Level 2 Analysis. Additionally, the methodologies used for this analysis are not considered to be precise enough to be applied at the site level.

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- 3 Increasing Levels of Detail
  - Level 1: Peak comparison
  - Level 2:
    - Pre vs. Post comparison (peak rate and volume); or
    - Steady flow WS analysis

Article 3.02.2.2, Technical Document

Level 2 H&H Analysis

Procedure for Conducting Hydrologic & Hydraulic Analyses for Preliminary Sediment & Stormwater Plans, Sect. 2.2.2:

Limit of the study shall be the point downstream where the site is 10% of the total contributing drainage area. Points of Analysis (POAs) shall be established at the site boundary and all hydraulic structures within the study reach. In cases where there are no hydraulic structures within the study reach, representative section(s) based on LiDAR data shall be used; locations to be determined at the Project Application Meeting.

Level 2 H&H Analysis

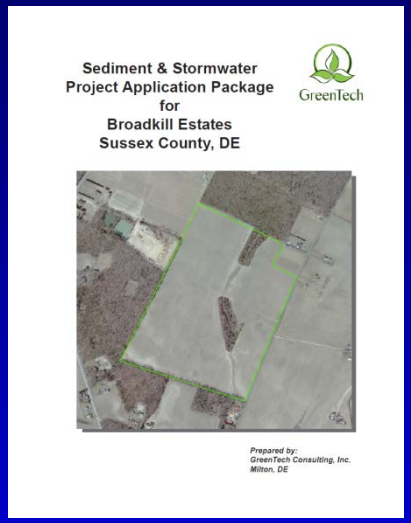


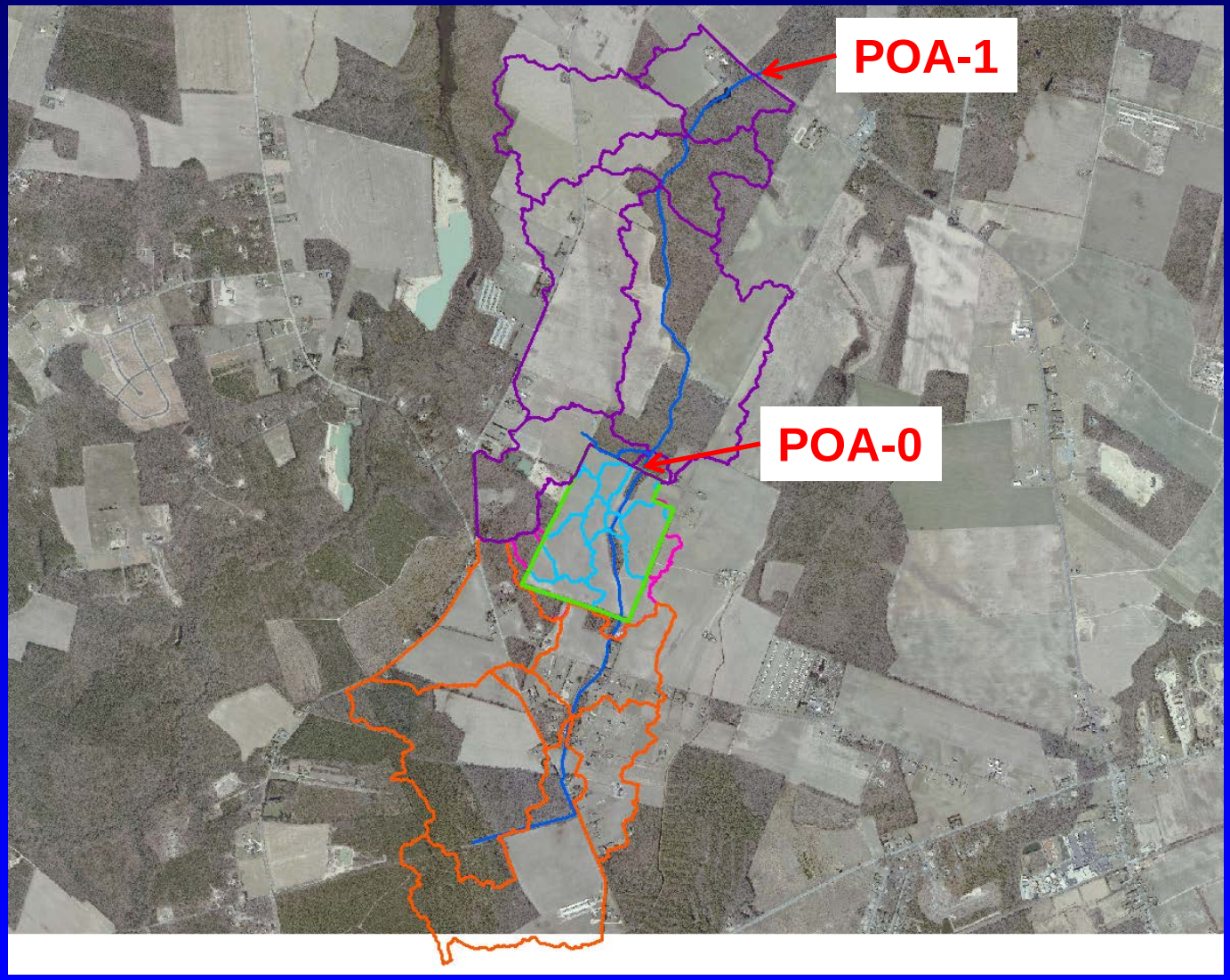
Fig. 1 Broadkill Estates – Points of Analysis (POAs)

Example: Level 2 H&H Analysis

Procedure for Conducting Hydrologic & Hydraulic Analyses for Preliminary Sediment & Stormwater Plans, Sect. 2.2.3:

To comply at this level of analysis, steady flow hydraulic modeling must indicate no adverse impacts to headwater, water surface elevations and/or areas of inundation at designated POAs. For purposes of this policy, **"no adverse impact" shall mean less than 0.05' increase in water surface elevations in channels and/or in headwater at hydraulic structures for all points of analysis**. In addition, the area of inundation shall not encroach upon buildings or similar structures previously not impacted.

Example: Level 2 H&H Analysis

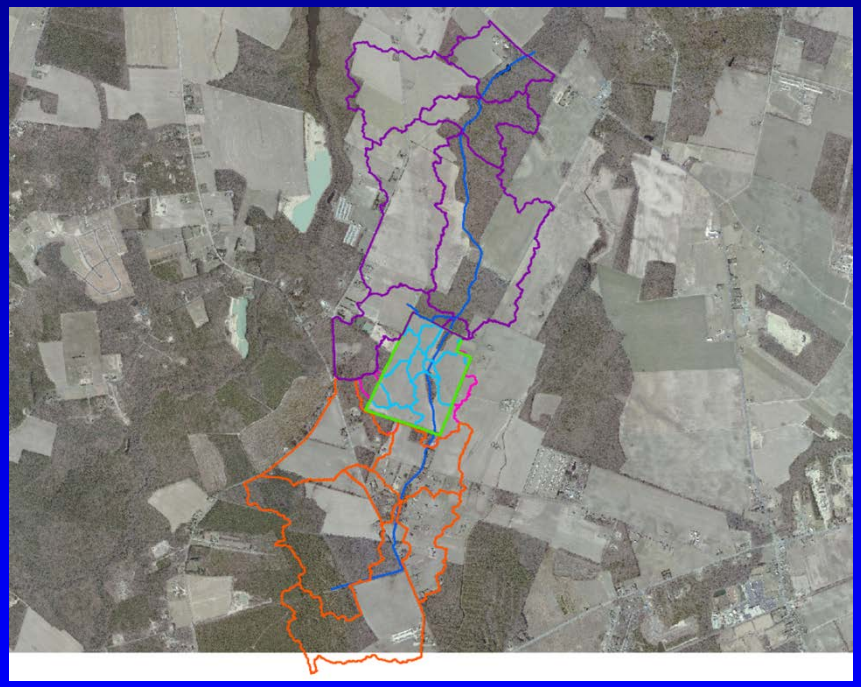


Example: Level 2 H&H Analysis

"The following procedure is based on what is considered the minimum requirements for the Level 2 H&H Analysis, which involves determining the water surface elevation for the pre-developed and post-developed conditions at the point of discharge from the site. The hydraulic model consists of three (3) cross sections. The middle cross section is established immediately downstream from the site discharge point. A minimum of one cross section upstream and one cross section downstream must be used to ensure the model will yield reasonable results. It may be necessary to analyze additional sections downstream to the "10% Rule" POA based on current Departmental guidance and/or policy."

Ref: "Workflow for Performing Level 2 H&H Analysis", DNREC (draft)

Level 2 H&H Analysis



- Hydrologic Model
  - Upstream
  - +Downstream
  - Site
    - Pre-Developed
    - Post-Developed
- Hydraulic Model
  - Steady flow
  - Peak discharge

Level 2 H&H Analysis: HecRAS Profile Output Table

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: Plan 01 River: Round Pole Trib Reach: Site

Reload Data

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Site	8200	PF 1	2152.00	27.70	35.00		35.08	0.001286	2.30	942.20	265.84	0.20
Site	8200	PF 2	2278.00	27.70	35.12		35.20	0.001307	2.37	975.44	277.56	0.20
Site	7775	PF 1	2152.00	26.80	34.66		34.71	0.000591	1.75	1240.21	282.91	0.14
Site	7775	PF 2	2278.00	26.80	34.78		34.83	0.000615	1.81	1272.51	291.01	0.14
Site	7350	PF 1	2233.00	27.40	34.18	31.09	34.28	0.002001	2.57	880.42	279.79	0.24
Site	7350	PF 2	2345.00	27.40	34.28	31.17	34.38	0.002004	2.62	909.23	284.86	0.24

Total flow in cross section.

H&H Analysis Procedure

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Procedure

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2. **Methodology**
   2.1. Level 1 Analysis
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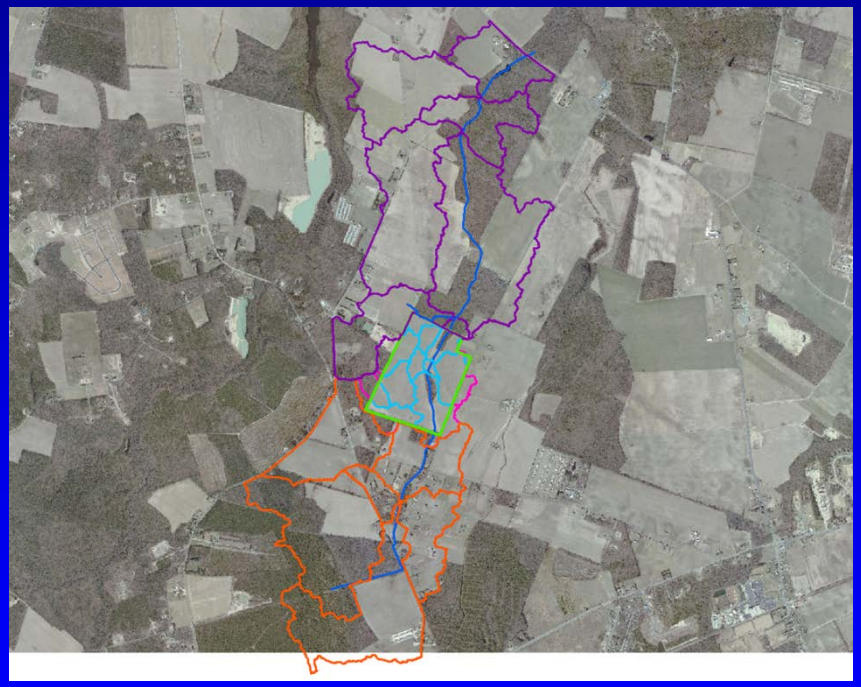
- Section 2.2.3.2

… If impacts are uncertain, proceed to Level 3.

Article 3.02.2.2, Technical Document

Level 3 H&H Analysis



- Hydrologic Model
  - Upstream
  - Downstream
  - Site
    - Pre-Developed
    - Post-Developed
- Hydraulic Model
  - **Unsteady flow**
  - **Hydrograph**

H&H Analysis Procedure

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2. **Methodology**
   2.1. Level 1 Analysis
      2.1.1. The Level 1 Analysis combines field reconnaissance data with hydrologic modeling of the upstream watershed and site using latest soils, LULC, and terrain data. Hydrographs are then compared to check for coincidental peaking effects.
      2.1.2. Limit of study shall be the most-downstream junction of the site and the upstream contributing area.
      2.1.3. To comply at this level of analysis, hydrologic modeling must indicate no adverse impact due to coincidental peaking effects. For purposes of this policy, "no adverse impact" shall mean that the developed site hydrograph peak is less than, and the inflection point occurs before, the peak of the upstream hydrograph OR that it can be demonstrated that on-site detention would exacerbate downstream impacts. If compliance cannot be demonstrated, proceed to Level 2.
   2.2. Level 2 Analysis
      2.2.1. The Level 2 Analysis combines field measurement data with hydraulic modeling of structures, channels, etc. using an expanded hydrologic model.

03/2013 3.02.2.2-1

- Section 2.3.3

… If the "no adverse impact" condition **can not be met, a remedy must be provided** in accordance with Section 3 of this policy.

Article 3.02.2.2, Technical Document

H&H Analysis Procedure

Procedure for Conducting Hydrologic & Hydraulic Analyses For Preliminary Sediment & Stormwater Plans

Background

The Hydrologic & Hydraulic (H&H) Analysis couples field collected data with desktop watershed modeling methodology to provide a tool for stormwater management agencies to help determine the most appropriate method to manage stormwater runoff from developing sites based on "No Adverse Impact" principles. The general approach is one of increasing level of detail and analysis depending on the complexity of the watershed. It is NOT intended to be a substitute for detailed Watershed Master Plans that have been endorsed by the Department. When such detailed plans are available, the peak discharge and/or volume management requirements from the Watershed Master Plan shall take precedence over the requirements of the Level 2 Analysis. Additionally, the methodologies used for this analysis are not considered to be precise enough to be applied at the site level.

Procedure

1. **Applicability**
   1.1. The H&H analysis will be required for all projects using the performance-based option and/or where a sump condition exists.
2. **Methodology**
   2.1. Level 1 Analysis
      2.1.1. The Level 1 Analysis combines field reconnaissance data with hydrologic modeling of the upstream watershed and site using latest soils, LULC, and terrain data. Hydrographs are then compared to check for coincidental peaking effects.
      2.1.2. Limit of study shall be the most-downstream junction of the site and the upstream contributing area.
      2.1.3. To comply at this level of analysis, hydrologic modeling must indicate no adverse impact due to coincidental peaking effects. For purposes of this policy, "no adverse impact" shall mean that the developed site hydrograph peak is less than, and the inflection point occurs before, the peak of the upstream hydrograph OR that it can be demonstrated that on-site detention would exacerbate downstream impacts. If compliance cannot be demonstrated, proceed to Level 2.
   2.2. Level 2 Analysis
      2.2.1. The Level 2 Analysis combines field measurement data with hydraulic modeling of structures, channels, etc. using an expanded hydrologic model.

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Article 3.02.2.2, Technical Document

- Section 3. Remedy
  - 3.1 Option 1: Modify detention design so that the downstream condition meets the "no adverse impact" as defined in Section 2 of this policy.
  - 3.2 Option 2: Improve existing downstream conveyance system so that the downstream condition meets the "no adverse impact" defined above.

H&H Analysis Procedure

Procedure for Conducting Hydrologic & Hydraulic Analyses For Preliminary Sediment & Stormwater Plans

Background

The Hydrologic & Hydraulic (H&H) Analysis couples field collected data with desktop watershed modeling methodology to provide a tool for stormwater management agencies to help determine the most appropriate method to manage stormwater runoff from developing sites based on "No Adverse Impact" principles. The general approach is one of increasing level of detail and analysis depending on the complexity of the watershed. It is NOT intended to be a substitute for detailed Watershed Master Plans that have been endorsed by the Department. When such detailed plans are available, the peak discharge and/or volume management requirements from the Watershed Master Plan shall take precedence over the requirements of the Level 2 Analysis. Additionally, the methodologies used for this analysis are not considered to be precise enough to be applied at the site level.

Procedure

1. **Applicability**
   1.1. The H&H analysis will be required for all projects using the performance-based option and/or where a sump condition exists.
2. **Methodology**
   2.1. Level 1 Analysis
      2.1.1. The Level 1 Analysis combines field reconnaissance data with hydrologic modeling of the upstream watershed and site using latest soils, LULC, and terrain data. Hydrographs are then compared to check for coincidental peaking effects.
      2.1.2. Limit of study shall be the most-downstream junction of the site and the upstream contributing area.
      2.1.3. To comply at this level of analysis, hydrologic modeling must indicate no adverse impact due to coincidental peaking effects. For purposes of this policy, "no adverse impact" shall mean that the developed site hydrograph peak is less than, and the inflection point occurs before, the peak of the upstream hydrograph OR that it can be demonstrated that on-site detention would exacerbate downstream impacts. If compliance cannot be demonstrated, proceed to Level 2.
   2.2. Level 2 Analysis
      2.2.1. The Level 2 Analysis combines field measurement data with hydraulic modeling of structures, channels, etc. using an expanded hydrologic model.

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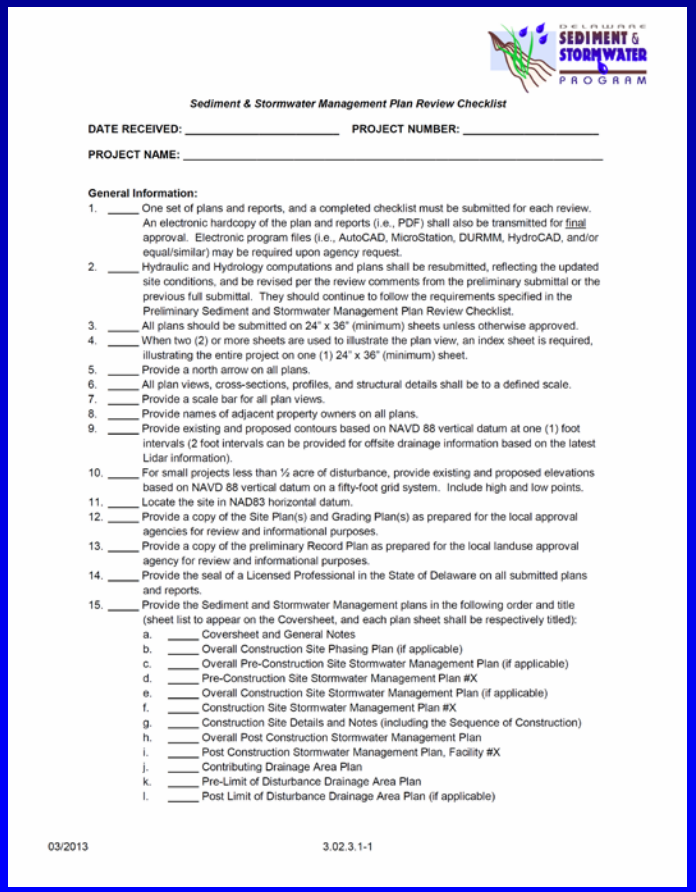
- NOTE:
  - The methodology is based on increasing level of detail, which presumably equates to increasing costs
  - **HOWEVER, there is no requirement to follow the methodology in strict order**

Article 3.02.2.2, Technical Document

Step 3:
Sediment & SWM Plan



DELAWARE SEDIMENT & STORMWATER PROGRAM

Sediment & Stormwater Management Plan Review Checklist

DATE RECEIVED: _____ **PROJECT NUMBER:** _____

PROJECT NAME: _____

General Information:

1. _____ One set of plans and reports, and a completed checklist must be submitted for each review. An electronic hardcopy of the plan and reports (i.e., PDF) shall also be transmitted for final approval. Electronic program files (i.e., AutoCAD, MicroStation, DURMM, HydroCAD, and/or equal/similar) may be required upon agency request.
2. _____ Hydraulic and Hydrology computations and plans shall be resubmitted, reflecting the updated site conditions, and be revised per the review comments from the preliminary submittal or the previous full submittal. They should continue to follow the requirements specified in the Preliminary Sediment and Stormwater Management Plan Review Checklist.
3. _____ All plans should be submitted on 24" x 36" (minimum) sheets unless otherwise approved.
4. _____ When two (2) or more sheets are used to illustrate the plan view, an index sheet is required, illustrating the entire project on one (1) 24" x 36" (minimum) sheet.
5. _____ Provide a north arrow on all plans.
6. _____ All plan views, cross-sections, profiles, and structural details shall be to a defined scale.
7. _____ Provide a scale bar for all plan views.
8. _____ Provide names of adjacent property owners on all plans.
9. _____ Provide existing and proposed contours based on NAVD 88 vertical datum at one (1) foot intervals (2 foot intervals can be provided for offsite drainage information based on the latest Lidar information).
10. _____ For small projects less than ½ acre of disturbance, provide existing and proposed elevations based on NAVD 88 vertical datum on a fifty-foot grid system. Include high and low points.
11. _____ Locate the site in NAD83 horizontal datum.
12. _____ Provide a copy of the Site Plan(s) and Grading Plan(s) as prepared for the local approval agencies for review and informational purposes.
13. _____ Provide a copy of the preliminary Record Plan as prepared for the local landuse approval agency for review and informational purposes.
14. _____ Provide the seal of a Licensed Professional in the State of Delaware on all submitted plans and reports.
15. _____ Provide the Sediment and Stormwater Management plans in the following order and title (sheet list to appear on the Coversheet, and each plan sheet shall be respectively titled):
    a. _____ Coversheet and General Notes
    b. _____ Overall Construction Site Phasing Plan (if applicable)
    c. _____ Overall Pre-Construction Site Stormwater Management Plan (if applicable)
    d. _____ Pre-Construction Site Stormwater Management Plan #X
    e. _____ Overall Construction Site Stormwater Management Plan (if applicable)
    f. _____ Construction Site Stormwater Management Plan #X
    g. _____ Construction Site Details and Notes (including the Sequence of Construction)
    h. _____ Overall Post Construction Stormwater Management Plan
    i. _____ Post Construction Stormwater Management Plan, Facility #X
    j. _____ Contributing Drainage Area Plan
    k. _____ Pre-Limit of Disturbance Drainage Area Plan
    l. _____ Post Limit of Disturbance Drainage Area Plan (if applicable)

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- Final Stormwater Management Report
- Consultant uses Checklist to prepare the Sediment & SWM Plan
  - Final construction plans
  - Details for all ESC/SWM practices
  - **Should be capable of acting as a stand-alone plan!!!**

Step 3:
Sediment & SWM Plan

Project Name

Sediment and Stormwater Management Plans

XXXX Hundred
XXXX Watershed
Tax Parcel[s]: XXXX
[City/Town of XXXX,] XXXX County, Delaware

PROJECT NOTES:

1. PARCEL DATA:
   TAX MAP #:
   PLUS #: (if applicable)
   DNREC SEDIMENT AND STORMWATER PROGRAM # (OR RELEVANT DELEGATED AGENCY) :
   ADDRESS (OR DISTANCE TO NEAREST INTERSECTING STREET) :
   LATITUDE/LONGITUDE:
   EXISTING SITE AREA:
   PROPOSED SITE AREA:
   EXISTING WETLAND AREA:
   PROPOSED CONDITION:
   PROPOSED DISCHARGE LOCATION(S):
   PROPOSED LIMIT OF DISTURBANCE PER DISCHARGE LOCATION:
2. OWNER DATA:
   OWNER'S NAME, TITLE
   COMPANY/LLC
   STREET ADDRESS
   TOWN, STATE, ZIP CODE
   PHONE #
   FAX #
3. LAND DEVELOPER DATA:
   DEVELOPER'S NAME, TITLE
   COMPANY/LLC
   STREET ADDRESS
   TOWN, STATE, ZIP CODE
   PHONE #
   FAX #
4. DESIGNER DATA:
   DESIGNER'S NAME, TITLE
   COMPANY/LLC
   STREET ADDRESS
   TOWN, STATE, ZIP CODE
   PHONE #
   FAX #
5. REVIEW AGENCY DATA:
   REVIEWER'S NAME, TITLE
   AGENCY NAME
   STREET ADDRESS
   TOWN, STATE, ZIP CODE
   PHONE #
   FAX #

SEDIMENT AND STORMWATER CONSTRUCTION NOTES:

1. THE DNREC SEDIMENT AND STORMWATER MANAGEMENT PROGRAM MUST BE NOTIFIED IN WRITING FIVE (5) DAYS PRIOR TO COMMENCING WITH CONSTRUCTION. FAILURE TO DO SO CONSTITUTES A VIOLATION OF THE APPROVED SEDIMENT AND STORMWATER MANAGEMENT PLAN.
2. REVIEW AND OR APPROVAL OF THE SEDIMENT AND STORMWATER MANAGEMENT PLAN SHALL NOT RELIEVE THE CONTRACTOR FROM HIS OR HER RESPONSIBILITIES FOR COMPLIANCE WITH THE REQUIREMENTS OF THE SEDIMENT AND STORMWATER REGULATIONS, NOR SHALL IT RELIEVE THE CONTRACTOR FROM ERRORS OR OMISSIONS IN THE APPROVED PLAN.
3. IF THE APPROVED PLAN NEEDS TO BE MODIFIED, ADDITIONAL SEDIMENT AND STORMWATER CONTROL MEASURES MAY BE REQUIRED AS DEEMED NECESSARY BY DNREC.
4. FOLLOWING SOIL DISTURBANCE OR REDISTURBANCE, PERMANENT OR TEMPORARY STABILIZATION SHALL BE COMPLETED FOR ALL PERIMETER SEDIMENT CONTROLS, SOIL STOCKPILES, AND ALL OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE WITHIN 14 CALENDAR DAYS UNLESS MORE RESTRICTIVE FEDERAL REQUIREMENTS APPLY.
5. ALL EROSION AND SEDIMENT CONTROL PRACTICES SHALL COMPLY WITH THE DELAWARE EROSION AND SEDIMENT CONTROL HANDBOOK, LATEST EDITION.
6. AT ANY TIME A DEWATERING OPERATION IS USED, IT SHALL BE PREVIOUSLY APPROVED BY THE AGENCY CONSTRUCTION SITE REVIEWER FOR A NON-EROSIVE POINT OF DISCHARGE, AND A DEWATERING PERMIT SHALL BE APPROVED BY THE DNREC WELL PERMITTING BRANCH.
7. APPROVED PLANS REMAIN VALID FOR 3 YEARS FROM THE DATE OF APPROVAL.
8. POST CONSTRUCTION VERIFICATION DRAWINGS ARE TO BE SUBMITTED TO THE DISTRICT WITHIN 60-DAYS OF STORMWATER MANAGEMENT FACILITY COMPLETION.
9. APPROVAL OF A SEDIMENT AND STORMWATER PLAN DOES NOT GRANT OR IMPLY A RIGHT TO DISCHARGE STORMWATER RUNOFF. THE OWNER/DEVELOPER IS RESPONSIBLE FOR ACQUIRING ANY AND ALL AGREEMENTS, EASEMENTS, ETC., NECESSARY TO COMPLY WITH STATE DRAINAGE AND OTHER APPLICABLE LAWS.
10. THE NOTICE OF INTENT FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER A NPDES GENERAL PERMIT FOR THIS PROJECT IS #_____. AT ANY TIME THE OWNERSHIP FOR THIS PROJECT CHANGES, A TRANSFER OF AUTHORIZATION OR A CO-PERMITTEE APPLICATION MUST BE SUBMITTED TO DNREC. THE PERMITTEE OF RECORD SHALL NOT BE RELIEVED OF THEIR RESPONSIBILITIES UNTIL A NOTICE OF TERMINATION HAS BEEN PROCESSED BY DNREC.
11. THE OWNER SHALL BE FAMILIAR WITH AND COMPLY WITH ALL ASPECTS OF THE NPDES CONSTRUCTION GENERAL PERMIT ASSOCIATED WITH THE PROJECT, INCLUDING, BUT NOT LIMITED TO, PERFORMING WEEKLY SITE INSPECTIONS DURING CONSTRUCTION AND AFTER RAIN EVENTS, AND MAINTAINING WRITTEN LOGS OF THESE INSPECTIONS.
12. BEFORE ANY EARTHWORK OR EXCAVATION TAKES PLACE, THE CONTRACTOR SHALL CALL MISS UTILITY AT 811 OR 1.800.282.8555 AT LEAST 48 HOURS PRIOR TO CONSTRUCTION, TO HAVE ALL EXISTING UTILITIES MARKED ONSITE.
13. THE CONTRACTOR SHALL AT ALL TIMES PROTECT AGAINST SEDIMENT OF DEBRIS LADEN RUNOFF OR WIND FROM LEAVING THE SIDE. PERIMETER CONTROLS SHALL BE CHECKED DAILY AND ADJUSTED AND/OR REPAIRED TO FULLY CONTAIN AND CONTROL SEDIMENT FROM LEAVING THE SITE. ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN IT HAS REACHED HALF OF THE EFFECTIVE CAPACITY OF THE CONTROL. IN ADDITION, THE CONTRACTOR MAY NEED TO ADJUST OR ALTER MEASURES IN TIMES OF ADVERSE WEATHER CONDITIONS, OR AS DIRECTED BY THE AGENCY SITE REVIEWER.
14. BEST AVAILABLE TECHNOLOGY (BAT) SHALL BE EMPLOYED TO MANAGE TURBID DISCHARGES IN ACCORDANCE WITH REQUIREMENTS OF 7. DEL. C. CH 60, *REGULATIONS GOVERNING THE CONTROL OF WATER POLLUTION* , SECTION 9.1.02, KNOWN AS SPECIAL CONDITIONS FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES AND DEPARTMENT POLICIES, PROCEDURES, AND GUIDANCE.
15. DOCUMENTATION OF SOIL TESTING AND MATERIALS USED FOR TEMPORARY OR PERMANENT STABILIZATION INCLUDING BUT NOT LIMITED TO SOIL TEST RESULTS, SEED TAGS, SOIL AMENDMENT TAGS, ETC, SHALL BE PROVIDED TO THE DEPARTMENT OR DELEGATED AGENCY TO VERIFY THAT THE PERMANENT OR TEMPORARY STABILIZATION HAS BEEN COMPLETED IN ACCORDANCE WITH THE APPROVED PLAN AND THE STANDARDS AND SPECIFICATIONS OF THE *DELAWARE EROSION AND SEDIMENT CONTROL HANDBOOK*, LATEST EDITION. THE DEPARTMENT OF THE DELEGATED AGENCY SHALL HAVE THE DISCRETION TO REQUIRE ADDITIONAL SOIL TESTING AND REAPPLICATION OF PERMANENT OR TEMPORARY STABILIZATION IN ACCORDANCE WITH THE SPECIFICATION PROVIDED WITHIN THE *DELAWARE EROSION AND SEDIMENT CONTROL HANDBOOK*, LATEST EDITION.

Example Legend
Property Line
Adjacent Property Line
Benchmark Symbol
Lot Line/Right-of-Way
Easement Line (Utility, Drainage, Stormwater, Access, etc)
Buffer Line (Wetland, Wellhead Protection, etc)
Contours
Wetland Line
Treeline
Soils Divide Line
Drainage Divide Line
Time of Concentration Path
Utility Lines and Symbols (Storm Pipe, Catchbasin, Water Main, Fire Hydrant, etc)
Soil Type Abbreviation Legend

Note:
1. *The above list is not exhaustive and should be adapted for each site.*
2. *The features should be distinguished as existing or proposed.*
3. *A legend for all Construction Site Stormwater Controls symbols and lines shall appear on the Construction Site Stormwater Management Plan(s).*

SHEET INDEX:

1. COVERSHEET AND GENERAL NOTES
2. OVERALL CONSTRUCTION SITE PHASING PLAN
3. OVERALL PRE-CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
4. PRE-CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN 1
5. PRE-CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN 2
6. OVERALL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
7. CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN 1
8. CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN 2
9. CONSTRUCTION SITE DETAILS AND NOTES
10. OVERALL POST CONSTRUCTION STORMWATER MANAGEMENT PLAN
11. POST CONSTRUCTION STORMWATER MANAGEMENT PLAN - FACILITY #1
12. POST CONSTRUCTION STORMWATER MANAGEMENT PLAN - FACILITY #2
13. CONTRIBUTING DRAINAGE AREA PLAN
14. PRE-LIMIT OF DISTURBANCE DRAINAGE AREA PLAN
15. POST LIMIT OF DISTURBANCE DRAINAGE AREA PLAN

OWNER'S CERTIFICATION:

"I, THE UNDERSIGNED, CERTIFY THAT ALL LAND CLEARING, CONSTRUCTION AND DEVELOPMENT SHALL BE DONE PURSUANT TO THE APPROVED PLAN AND THAT RESPONSIBLE PERSONNEL (I.E., BLUE CARD HOLDER) INVOLVED IN THE LAND DISTURBANCE WILL HAVE A CERTIFICATION OF TRAINING PRIOR TO INITIATION OF THE PROJECT, AT A DNREC SPONSORED OR APPROVED TRAINING COURSE FOR THE CONTROL OF EROSION AND SEDIMENT DURING CONSTRUCTION. IN ADDITION, I GRANT THE DNREC SEDIMENT AND STORMWATER PROGRAM AND/OR THE RELEVANT DELEGATED AGENCY THE RIGHT TO CONDUCT ON-SITE REVIEWS, AND I UNDERSTAND MY RESPONSIBILITIES UNDER THE NPDES CONSTRUCTION GENERAL PERMIT, AS REFERENCED ON THIS COVERSHEET."

OWNER'S NAME, TITLE — DATE
COMPANY/LLC
STREET ADDRESS
TOWN, STATE, ZIP CODE
PHONE #
FAX #

WETLAND CERTIFICATION:

THIS PROPERTY, TAX MAP #xxxx, HAS BEEN EXAMINED BY [COMPANY NAME] FOR THE PRESENCE OF WATERS OF THE UNITED STATES, INCLUDING WETLANDS (SECTION 404 AND SECTION 10), STATE SUBAQUEOUS LANDS AND STATE REGULATED WETLANDS AS ESTABLISHED BY THE REVIEWING AGENCIES IN THE FORM OF MANUALS, POLICIES AND PROCEDURES IN PLACE AT THE TIME THAT THE INVESTIGATION WAS CONDUCTED. THE WETLAND INFORMATION CONTAINED IN THIS PLAN SET IS IN ACCORDANCE WITH THIS CRITERIA [or, THERE WERE NO WETLANDS FOUND WITHIN THE SUBJECT PROPERTY]. PER STATE JD #xxxx AND/OR ARMY CORPS JD #xxxx [as applicable].

WETLAND DELINEATOR'S NAME, TITLE — DATE
COMPANY/LLC
STREET ADDRESS
TOWN, STATE, ZIP CODE
PHONE #
FAX #

SITE DESIGNER CERTIFICATION:

I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED UNDER MY SUPERVISION AND TO THE BEST OF MY KNOWLEDGE COMPLIES WITH THE APPLICABLE STATE AND LOCAL REGULATIONS AND ORDINANCES.

SITE DESIGNER'S NAME, TITLE — DATE
COMPANY/LLC
STREET ADDRESS
TOWN, STATE, ZIP CODE
PHONE #
FAX #

2"x3" Clear Area for Sediment and Stormwater Approval Stamp

LOCATION MAP
1" = 1/2 mile
4" min.
6" min.

REVISIONS

REVISION	DATE	DESCRIPTION

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL
Division of Soil and Water Conservation
Drainage Program
Dover Office: 89 Kings Highway, Dover DE 19901 — Phone: (302) 739-4651, Fax: (302) 739-6724
Georgetown Office: 2320 South DuPont Hwy, Georgetown DE 19947 — Phone: (302) 856-4561, Fax: (302) 855-1799

[Seal]

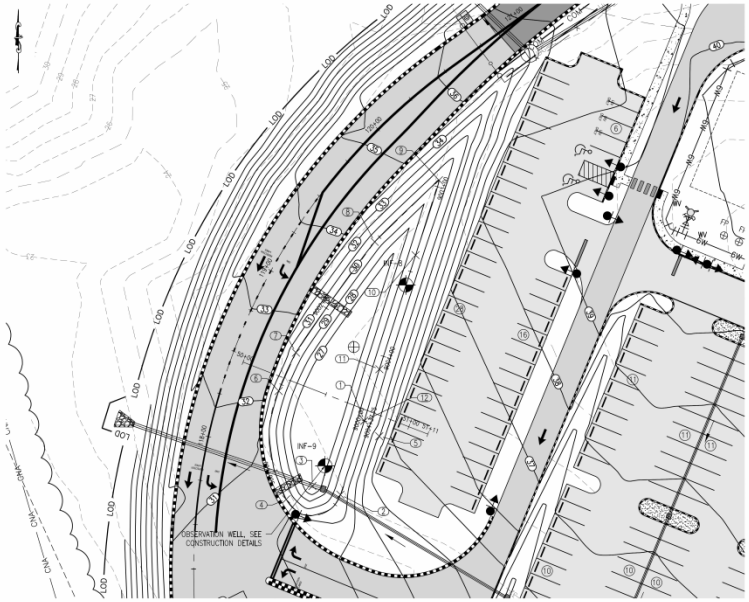
Designer's Name
License #XXXXX

COVER SHEET & GENERAL NOTES
PROJECT NAME
SEDIMENT AND STORMWATER MANAGEMENT PLANS
XXXX Hundred
XXXX Watershed
Tax Parcel[s]: XXXX
[City/Town of XXXX,] XXXX County, Delaware

Scale:	As Shown
Designed:	XXX
Drawn:	XXX
Checked:	XXX
Approved:	XXX

Sheet No. 1 / X

Step 3:
Sediment & SWM Plan + O&M Plan



BIORETENTION FACILITY
SCALE: 1" = 20'

SEQUENCE OF CONSTRUCTION FOR BIORETENTION AREA

1. STAKE OUT FACILITY LOCATION. PROHIBIT VEHICULAR/EQUIPMENT ACCESS AT FACILITY LOCATION TO PREVENT COMPACTION OF EXISTING SOILS.
2. EXCAVATE FROM THE SIDES OF THE FACILITY SO AS NOT TO COMPACT EXISTING SOIL TO ELEVATION 27.00. INSTALL OUTLET STRUCTURE AND OUTFALL PIPE. INSTALL SKIMMER DEWATERING DEVICE.
3. AFTER ALL UPSTREAM AREAS ARE PERMANENTLY STABILIZED CONVERT SEDIMENT BASIN TO BIORETETION FACILITY.
4. HAVE ALL MATERIALS ON-SITE TO CONVERT SEDIMENT BASIN TO FINAL BIORETENTION FACILITY.
5. EXCAVATE FROM THE SIDES OF THE FACILITY SO AS NOT TO COMPACT EXISTING SOIL. ONLY EXCAVATE THE PORTION OF THE FACILITY THAT MAY BE BACKFILLED WITH BIORETENTION MEDIA IN THE SAME DAY. TOPSOIL AND SEED SIDE SLOPES.
6. PLACE BIORETENTION SOIL MEDIA IN ACCORDANCE WITH CURRENT DNREC POLICY AND IN LIFTS OF ONE FOOT. SPREAD OUT SOIL MEDIA USING AN EXCAVATOR FROM THE SIDE OF THE EXCAVATION TO MINIMIZE COMPACTION. MEDIA IS TO BE EQUAL PARTS SAND, SPHAGNUM PEAT MOSS AND MULCH.
7. ALLOW SOIL MEDIA TO SETTLE FOR AT LEAST ONE STORM EVENT BEFORE THE FINAL LIFT IS ADDED.
8. PLANT VEGETATION SPECIFIED IN THE LANDSCAPING PLAN FOR BIORETENTION AREA.
9. INSTALL MULCHING AS NECESSARY AND AS SHOWN ON PLANS.
10. AN ASBUILT PLAN (AND ALL APPLICABLE SUPPLEMENTARY DOCUMENTATION) SHALL BE SUBMITTED AFTER FINAL COMPLETION OF THE BIORETENTION SYSTEM.

BIORETENTION FACILITY SPECIFICATIONS

FILTER MEDIUM

1. FILTER MEDIUM FOR THE BIORETENTION BASIN SHALL BE IN ACCORDANCE WITH DNREC SPECIFICATIONS AND AS SPECIFIED IN THE DESIGN DETAILS ON THE PLANS. THE MEDIUM SHALL BE A UNIFORM MIX, FREE OF STONES, STUMPS, ROOTS OR OTHER SIMILAR OBJECTS LARGER THAN TWO INCHES. NO OTHER MATERIALS OR SUBSTANCES SHALL BE MIXED OR DUMPED WITHIN THE BIORETENETION AREA THAT MAY BE HARMFUL OR PROVE A HINDRANCE TO MAINTENANCE OPERATIONS. THE FILTER MEDIUM SHALL BE FREE OF BERMUDA GRASS, QUACKGRASS, JOHNSON GRASS, MUGWORT, NUTSEDGE, POISON IVY, CANADIAN THISTLE, TEARTHUMB OR OTHER NOXIOUS WEEDS.
2. FILTER MEDIUM SHALL BE 2 FEET IN DEPTH.
3. FILTER MEDIUM PLANTING SOIL SHALL BE A UNIFORM MIX OF EQUAL PARTS BY VOLUME OF THE FOLLOWING:

   CLEAN CONCRETE SAND
   PEAT MOSS
   TRIPLE SHREDDED HARDWOOD MULCH

4. THIS MIXTURE SHALL BE SUPPLIED ONLY BY SUPPLIERS APPROVED BY DNREC. CONTACT THE DNREC FOR A LIST OF THE APPROVED SUPPLIERS.
5. MULCH SHALL BE TRIPLE SHREDDED HARDWOOD MULCH ONLY. MULCH SHALL BE WELL AGED (STOCKPILED FROM 6 TO 12 MONTHS), UNIFORM IN COLOR AND FREE OR FOREIGN MATERIAL.
6. MULCH SHALL BE 2" TO 3" THICK.
7. SAND SHALL MEET AASHTO M-6 OR ASTM C-33 WITH GRAIN SIZE OF 0.02"-0.04".

BIORETENTION FACILITY MAINTENANCE AND INSPECTION

INSPECTION: SEMI-ANNUAL (SPRING AND FALL) & AFTER STORM EVENTS OF 2 INCHES OR MORE.

TRASH AND DEBRIS: REMOVE TRASH AND DEBRIS ON A REGULAR BASIS. IT IS ESPECIALLY IMPORTANT TO REMOVE DEBRIS FROM ALL INLETS AND OUTFALL STRUCTURES.

SOIL: SOIL SHOULD BE TESTED ANNUALLY TO ENSURE PROPER PH AND FERTILITY INCLUDING: ORGANIC MATTER, MAGNESIUM (MG), PHOSPHORUS (P_2O_5), NITROGEN (N), POTASSIUM (K2O), AND SOLUBLE SALTS. IF REQUIRED, FERTILIZER SHOULD ONLY BE APPLIED IN THE FALL.

EROSION: IF BARE SOIL EXISTS ON SIDE SLOPES, RESEED AND/OR REPLANT AS REQUIRED BASE UPON INSPECTION FINDINGS. STABILIZE APPLICABLE ERODED AREAS WITH ROLLED EROSION CONTROL PRODUCTS OR TURF REINFORCEMENT MATS AS REQUIRED. IT IS RECOMMENDED TO USE BIODEGRADABLE PRODUCTS IN AID OF MOWING MAINTENANCE AND DETER WILDLIFE ENTANGLEMENT.

MOWING: MOW AROUND FACILITY WEEKLY DURING PEAK GROWING SEASON. MOW 10-FOOT WIDE ACCESS PATH TO ALL INLET AND OUTLET STRUCTURES, ALSO MOWING AROUND THESE STRUCTURES REGULARLY. USE MULCHING MOWER TO ENSURE THAT NUTRIENTS ARE RECYCLED. FOR WARM SEASON GRASSES, THE PREVIOUS SEASONS STALKS SHOULD BE CUT DOWN TO 8-12 INCHES IN EARLY SPRING, BEFORE NEW SEASONS GROWTH EMERGES.

MULCH: ADD DOUBLE OR TRIPLE-SHREDDED HARDWOOD MULCH, AS NEEDED, TO MAINTAIN 3 INCH DEPTH FOR FACILITIES WITH MULCH TOPDRESSING.

SPECIAL CONSIDERATIONS:

BIORETENTION FACILITIES ARE DESIGNED TO INFILTRATE WATER AND REMOVE POLLUTANTS FROM STORMWATER. DO NOT COMPACT FACILITY IN ANY WAY. THIS INCLUDES THE USE OF HEAVY EQUIPMENT OR MACHINERY. COMPACTION MAY LEAD TO SYSTEM FAILURE.

HIRE A PROFESSIONAL:

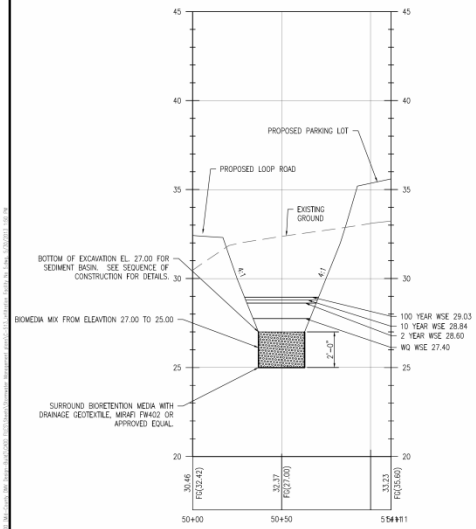
IF FACILITY DOES NOT DRAIN WITHIN 48 HOURS; REMOVAL OF ACCUMULATED SEDIMENT AS NEEDED; REPLACEMENT OF BIOSOIL MIX (EVERY 15-20 YEARS); REPAIR OF SEVERE EROSION; VEGETATION CONTROL (CHEMICAL APPLICATION) IF LICENSING REQUIRED BY DE DEPARTMENT OF AGRICULTURE.

INFILTRATION TRENCH DESIGN SUMMARY				
DESIGN STORM	FACILITY INFLOW	FACILITY DISCHARGE	WATER SURFACE ELEVATION	STORAGE VOLUME (AC-FT)
WATER QUALITY 2.0"	1.92	0.00	27.40	0.071
2 - YEAR	4.19	0.03	28.60	0.176
10 - YEAR	7.40	5.39	28.84	0.200
100 - YEAR	13.88	13.35	29.03	0.221

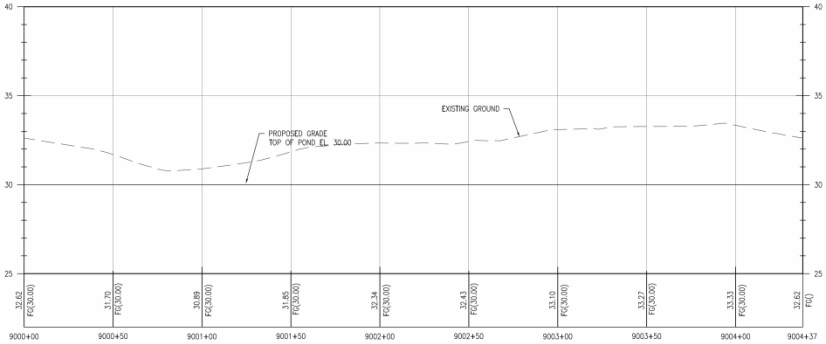
TOTAL IMPERVIOUS AREA TREATED BY FACILITY = 1.276 ACRES
DESIGN INFILTRATION RATE = 2.04 IN/HR

INFILTRATION FACILITY NO. 3 TOP OF BANK LAYOUT				
POINT NO.	NORTHING	EASTING	STATION	ELEVATION
1	573409.6637	587699.8086	POB 9000+00.00	30.00
2	573368.1382	587686.3744	PC 9000+43.64	30.00
3	573372.9611	587670.5950	RADIUS = 16.50'	
4	573365.5144	587655.8710	PT 9000+82.86	30.00
5	573400.9837	587708.2231	RADIUS = 62.00'	
6	573426.4104	587651.6769	PT 9001+46.14	30.00

INFILTRATION FACILITY NO. 3 TOP OF BANK LAYOUT				
POINT NO.	NORTHING	EASTING	STATION	ELEVATION
7	573447.9483	587661.3617	PI 9001+69.76	30.00
8	573510.1800	587705.6452	PI 9002+46.15	30.00
9	573544.8273	587741.7759	PI 9002+96.21	30.00
10	573502.7269	587728.6084	PI 9003+40.32	30.00
11	573438.6382	587708.2730	PI 9004+07.56	30.00
12	573409.6637	587699.8086	POE 9004+37.75	30.00



BIORETENTION TYPICAL SECTION
HOTIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 3'



BIORETENTION TOP OF POND
HOTIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 3'

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CENTURY ENGINEERING
CONSULTING ENGINEERS ■ SURVEYORS
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WEBSITE: www.centuryeng.com
EMAIL: dei@centuryeng.com

REVISIONS

DESCRIPTION	DATE

PROJECT
DESIGN-BUILD PROJECT
FOR
MID-COUNTY DMV FACILITY
STATE CONTRACT T201259401 FEDERAL CONTRACT CMAQ-2012001
RED LION HUNDRED, NEW CASTLE COUNTY, DELAWARE

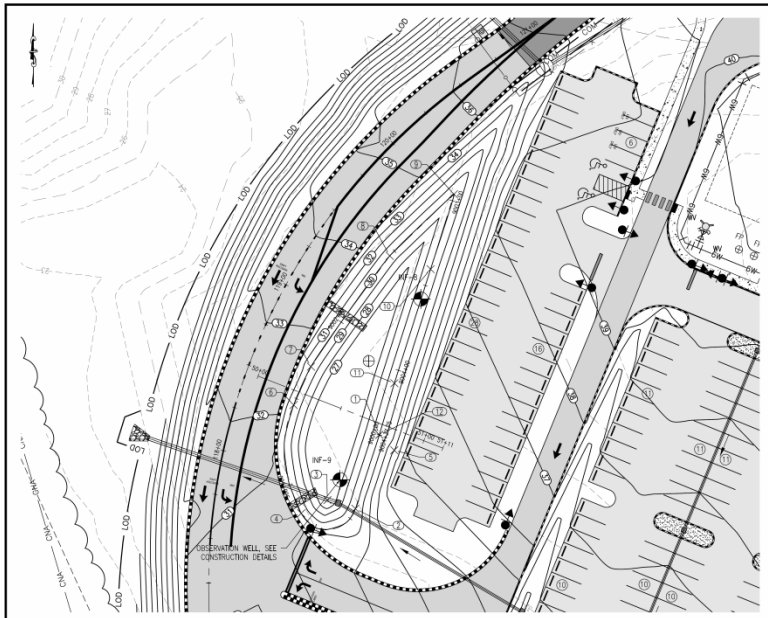
SHEET TITLE
BIORETENTION FACILITY

100% SUBMISSION PLANS
MAY 2013

DRAWN	CHK'D/DESIGNER
DLD	SLR
SCALE	SHEET NO.
AS NOTED	C-515
PROJECT NO. 125015.00	

Operation & Maintenance (O&M) Plan

- The O&M Plan is submitted with the initial Sediment and Stormwater Plan for review
- At the completion of construction, the O&M Plan is re-submitted for approval to ensure that any changes throughout construction have been included
- The stormwater facility's Post-Construction Verification Plan becomes part of the O&M Plan
  - There should be one stormwater facility per sheet in the O&M Plan
  - The "as-built" information should be contained on the same page as the SW facility O&M notes
- The O&M Plan is extracted from the Sediment and Stormwater Plan and it stands alone as a Plan that does not expire



BIORETENTION FACILITY
SCALE: 1" = 20'

SEQUENCE OF CONSTRUCTION FOR BIORETENTION AREA

1. STAKE OUT FACILITY LOCATION. PROHIBIT VEHICULAR/EQUIPMENT ACCESS AT FACILITY LOCATION TO PREVENT COMPACTION OF EXISTING SOILS.
2. EXCAVATE FROM THE SIDES OF THE FACILITY SO AS NOT TO COMPACT EXISTING SOIL TO ELEVATION 27.00. INSTALL OUTLET STRUCTURE AND OUTFALL PIPE. INSTALL SKIMMER DEWATERING DEVICE.
3. AFTER ALL UPSTREAM AREAS ARE PERMANENTLY STABILIZED CONVERT SEDIMENT BASIN TO BIORETETION FACILITY.
4. HAVE ALL MATERIALS ON-SITE TO CONVERT SEDIMENT BASIN TO FINAL BIORETENTION FACILITY.
5. EXCAVATE FROM THE SIDES OF THE FACILITY SO AS NOT TO COMPACT EXISTING SOIL. ONLY EXCAVATE THE PORTION OF THE FACILITY THAT MAY BE BACKFILLED WITH BIORETENTION MEDIA IN THE SAME DAY. TOPSOIL AND SEED SIDE SLOPES.
6. PLACE BIORETENTION SOIL MEDIA IN ACCORDANCE WITH CURRENT DNREC POLICY AND IN LIFTS OF ONE FOOT. SPREAD OUT SOIL MEDIA USING AN EXCAVATOR FROM THE SIDE OF THE EXCAVATION TO MINIMIZE COMPACTION. MEDIA IS TO BE EQUAL PARTS SAND, SPHAGNUM PEAT MOSS AND MULCH.
7. ALLOW SOIL MEDIA TO SETTLE FOR AT LEAST ONE STORM EVENT BEFORE THE FINAL LIFT IS ADDED.
8. PLANT VEGETATION SPECIFIED IN THE LANDSCAPING PLAN FOR BIORETENTION AREA.
9. INSTALL MULCHING AS NECESSARY AND AS SHOWN ON PLANS.
10. AN ASBUILT PLAN (AND ALL APPLICABLE SUPPLEMENTARY DOCUMENTATION) SHALL BE SUBMITTED AFTER FINAL COMPLETION OF THE BIORETENTION SYSTEM.

BIORETENTION FACILITY SPECIFICATIONS

FILTER MEDIUM

1. FILTER MEDIUM FOR THE BIORETENTION BASIN SHALL BE IN ACCORDANCE WITH DNREC SPECIFICATIONS AND AS SPECIFIED IN THE DESIGN DETAILS ON THE PLANS. THE MEDIUM SHALL BE A UNIFORM MIX, FREE OF STONES, STUMPS, ROOTS OR OTHER SIMILAR OBJECTS LARGER THAN TWO INCHES. NO OTHER MATERIALS OR SUBSTANCES SHALL BE MIXED OR DUMPED WITHIN THE BIORETENETION AREA THAT MAY BE HARMFUL OR PROVE A HINDRANCE TO MAINTENANCE OPERATIONS. THE FILTER MEDIUM SHALL BE FREE OF BERMUDA GRASS, QUACKGRASS, JOHNSON GRASS, MUCWORT, NUTSEDGE, POISON IVY, CANADIAN THISTLE, TEARTHUMB OR OTHER NOXIOUS WEEDS.
2. FILTER MEDIUM SHALL BE 2 FEET IN DEPTH.
3. FILTER MEDIUM PLANTING SOIL SHALL BE A UNIFORM MIX OF EQUAL PARTS BY VOLUME OF THE FOLLOWING:

   CLEAN CONCRETE SAND
   PEAT MOSS
   TRIPLE SHREDDED HARDWOOD MULCH

4. THIS MIXTURE SHALL BE SUPPLIED ONLY BY SUPPLIERS APPROVED BY DNREC. CONTACT THE DNREC FOR A LIST OF THE APPROVED SUPPLIERS.
5. MULCH SHALL BE TRIPLE SHREDDED HARDWOOD MULCH ONLY. MULCH SHALL BE WELL AGED (STOCKPILED FROM 6 TO 12 MONTHS), UNIFORM IN COLOR AND FREE OR FOREIGN MATERIAL.
6. MULCH SHALL BE 2" TO 3" THICK.
7. SAND SHALL MEET AASHTO M-6 OR ASTM C-33 WITH GRAIN SIZE OF 0.02"-0.04".

BIORETENTION FACILITY MAINTENANCE AND INSPECTION

INSPECTION: SEMI-ANNUAL (SPRING AND FALL) & AFTER STORM EVENTS OF 2 INCHES OR MORE.

TRASH AND DEBRIS: REMOVE TRASH AND DEBRIS ON A REGULAR BASIS. IT IS ESPECIALLY IMPORTANT TO REMOVE DEBRIS FROM ALL INLETS AND OUTFALL STRUCTURES.

SOIL: SOIL SHOULD BE TESTED ANNUALLY TO ENSURE PROPER PH AND FERTILITY INCLUDING: ORGANIC MATTER, MAGNESIUM (MG), PHOSPHORUS (P_2O_5), NITROGEN (N), POTASSIUM (K2O), AND SOLUBLE SALTS. IF REQUIRED, FERTILIZER SHOULD ONLY BE APPLIED IN THE FALL.

EROSION: IF BARE SOIL EXISTS ON SIDE SLOPES, RESEED AND/OR REPLANT AS REQUIRED BASE UPON INSPECTION FINDINGS. STABILIZE APPLICABLE ERODED AREAS WITH ROLLED EROSION CONTROL PRODUCTS OR TURF REINFORCEMENT MATS AS REQUIRED. IT IS RECOMMENDED TO USE BIODEGRADABLE PRODUCTS IN AID OF MOWING MAINTENANCE AND DETER WILDLIFE ENTANGLEMENT.

MOWING: MOW AROUND FACILITY WEEKLY DURING PEAK GROWING SEASON. MOW 10-FOOT WIDE ACCESS PATH TO ALL INLET AND OUTLET STRUCTURES, ALSO MOWING AROUND THESE STRUCTURES REGULARLY. USE MULCHING MOWER TO ENSURE THAT NUTRIENTS ARE RECYCLED. FOR WARM SEASON GRASSES, THE PREVIOUS SEASONS STALKS SHOULD BE CUT DOWN TO 8-12 INCHES IN EARLY SPRING, BEFORE NEW SEASONS GROWTH EMERGES.

MULCH: ADD DOUBLE OR TRIPLE-SHREDDED HARDWOOD MULCH, AS NEEDED, TO MAINTAIN 3 INCH DEPTH FOR FACILITIES WITH MULCH TOPDRESSING.

SPECIAL CONSIDERATIONS:

BIORETENTION FACILITIES ARE DESIGNED TO INFILTRATE WATER AND REMOVE POLLUTANTS FROM STORMWATER. DO NOT COMPACT FACILITY IN ANY WAY. THIS INCLUDES THE USE OF HEAVY EQUIPMENT OR MACHINERY. COMPACTION MAY LEAD TO SYSTEM FAILURE.

HIRE A PROFESSIONAL:

IF FACILITY DOES NOT DRAIN WITHIN 48 HOURS; REMOVAL OF ACCUMULATED SEDIMENT AS NEEDED; REPLACEMENT OF BIOSOIL MIX (EVERY 15-20 YEARS); REPAIR OF SEVERE EROSION; VEGETATION CONTROL (CHEMICAL APPLICATION) IF LICENSING REQUIRED BY DE DEPARTMENT OF AGRICULTURE.

INFILTRATION TRENCH DESIGN SUMMARY				
DESIGN STORM	FACILITY INFLOW	FACILITY DISCHARGE	WATER SURFACE ELEVATION	STORAGE VOLUME (AC-FT)
WATER QUALITY 2.0"	1.92	0.00	27.40	0.071
2 - YEAR	4.19	0.03	28.60	0.176
10 - YEAR	7.40	5.39	28.84	0.200
100 - YEAR	13.88	13.35	29.03	0.221

TOTAL IMPERVIOUS AREA TREATED BY FACILITY = 1.276 ACRES
DESIGN INFILTRATION RATE = 2.04 IN/HR

INFILTRATION FACILITY NO. 3 TOP OF BANK LAYOUT				
POINT NO.	NORTHING	EASTING	STATION	ELEVATION
1	573409.6637	587699.8086	POB 9000+00.00	30.00
2	573368.1382	587686.3744	PC 9000+43.64	30.00
3	573372.9611	587670.5950	RADIUS = 16.50'	
4	573365.5144	587655.8710	PT 9000+82.86	30.00
5	573400.9837	587708.2231	RADIUS = 62.00'	
6	573426.4104	587651.6769	PT 9001+46.14	30.00

INFILTRATION FACILITY NO. 3 TOP OF BANK LAYOUT				
POINT NO.	NORTHING	EASTING	STATION	ELEVATION
7	573447.9483	587661.3617	PI 9001+69.76	30.00
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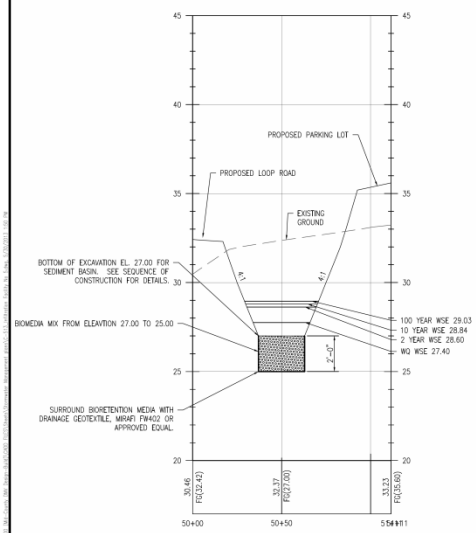
11	573438.6382	587708.2730	PI 9004+07.56	30.00
12	573409.6637	587699.8086	POE 9004+37.75	30.00

Post-Construction Verification Plan
+ Operation & Maintenance Plan



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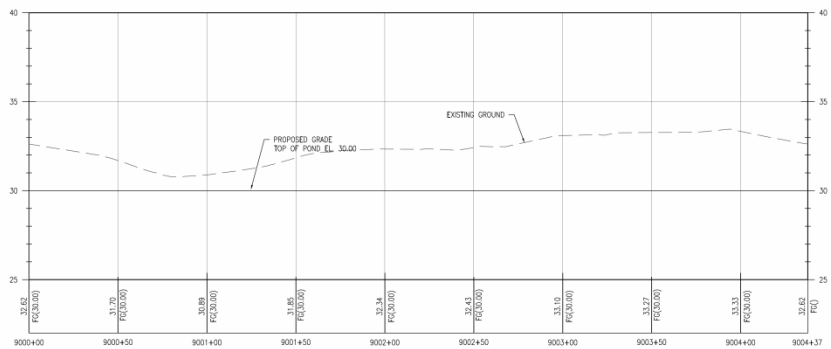

BIORETENTION TOP OF POND
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WEBSITE: www.centuryeng.com
EMAIL: dei@centuryeng.com

REVISIONS

DESCRIPTION	DATE

PROJECT
DESIGN-BUILD PROJECT
FOR
MID-COUNTY DMV FACILITY
STATE CONTRACT T201259401 FEDERAL CONTRACT CMAQ-2012001
RED LION HUNDRED, NEW CASTLE COUNTY, DELAWARE

SHEET TITLE
BIORETENTION FACILITY

100% SUBMISSION PLANS
MAY 2013

DRAWN	CHK'D/DESIGNER
DLD	SLR
SCALE	SHEET NO.
AS NOTED	C-515
PROJECT NO. 125015.00	

QUESTIONS?

Delaware

Sediment and Stormwater Program

Technical Document

Article 3.

Plan Review

And Approval

Revisions to the Delaware Sediment & Stormwater Regulations

Training Session 3: Stormwater Assessment Study & Stormwater Assessment Report

Example
Stormwater Assessment Study

Office Use Only
Date Received:_____
Submittal Complete: Yes / No Reviewer Initials:_____
Meeting date/time:_____
DelDOT Attendance Required? Yes / No

Stormwater Assessment Study (SAS) Checklist

Project Name:_____

Owner/Developer Name:_____

Contact Person:_____

Owner/Developer Phone:_____

Owner/Developer e-mail:_____

Consultant Name:_____

Contact Person:_____

Consultant Phone:_____

Consultant e-mail:_____

This checklist is for guidance only. The Delegated Agency reserves the right to request additional information during the review process as it deems necessary. Compliance with the checklist in no way is meant to relieve the design professional of his/her professional responsibilities.

03/2013 3.02.1.1-1

UPDATED

B. On-Line Background Information

Items shall be arranged in the fo

- ☐ Stormwater As sme dy GIS ng

  Pr out of the location m d for each layer represented:

  Parcel Boundary ng NHD s ns and water features

  ntours

  - ☐ ditch watershed
  - ☐ ditch locations
  - ☐ rights-of-way
  - ☐ Wellhead protection areas
  - ☐ Aquifer recharge areas
  - ☐ Floodways
  - ☐ Flood hazard areas
  - ☐ 2007 Land Use / Land Cover (LULC)
  - ☐ Hydrologic Soil Groups (HSG)
  - ☐ State Wetland Mapping Project (SWMP)
  - ☐ Runoff Reduction Feasibility *(NOTE: much of New Castle County is not mapped)*

SAS GIS Web application link:
http://dnrecgis.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=4e83b5da93834c669560faa8b338216f

- ☐ StreamStats map showing limit of downstream analysis. (The downstream analysis point will be located at the point in the watershed where the site area comprises less than 10% of the watershed area.)
  StreamStats link: *http://water.usgs.gov/osw/streamstats/delaware.html*

- ☐ StreamStats Basin Characteristics Report
  StreamStats link: *http://water.usgs.gov/osw/streamstats/delaware.html*

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DRAFT 01/2014 3.02.1.1-3

DRAFT

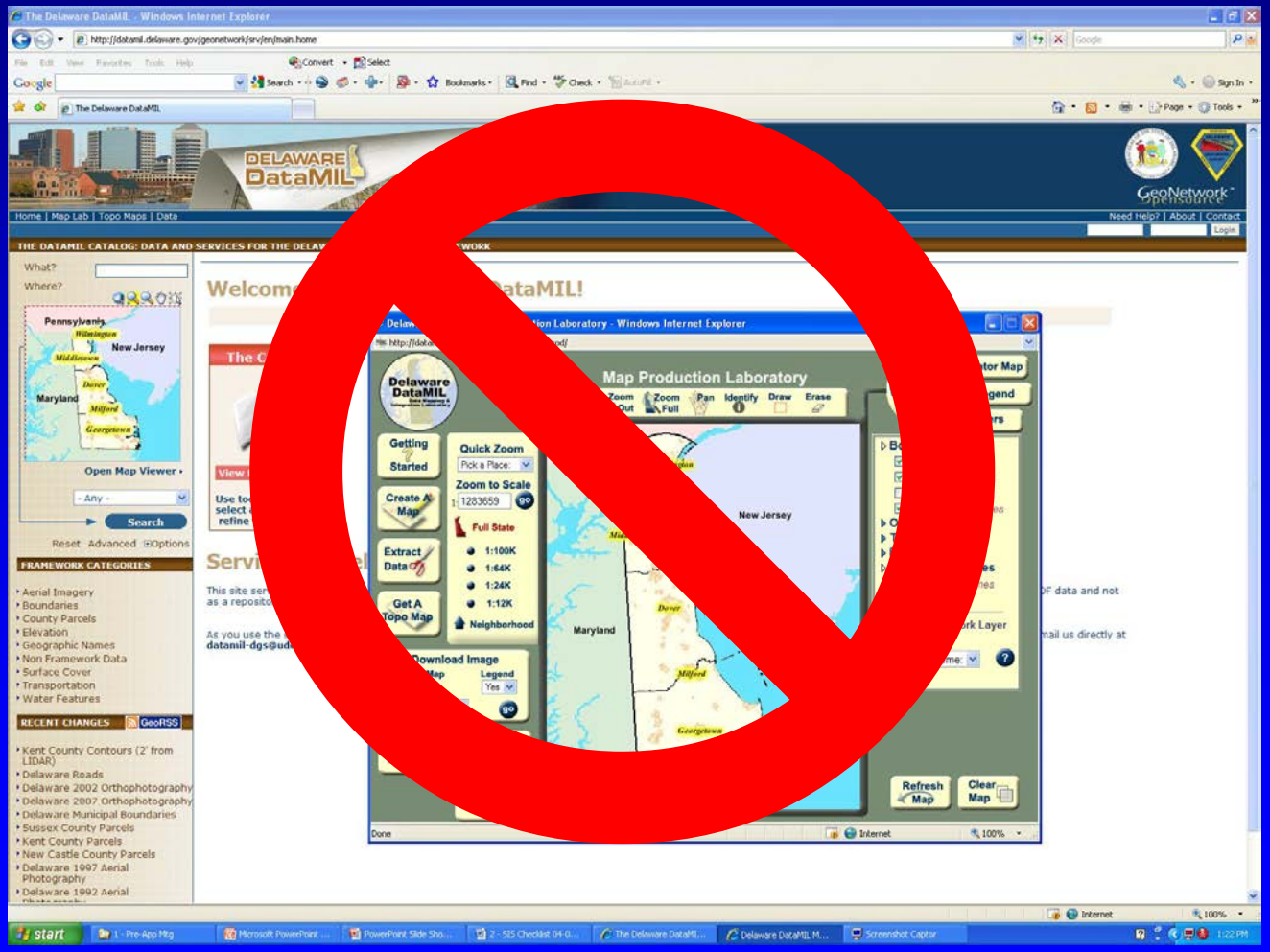
Stormwater Assessment Study

- Documents
  - Narrative of existing
    - Downstream
    - POA's
    - Photographs
  - Narrative of proposed
  - DelDOT Drainage Concerns

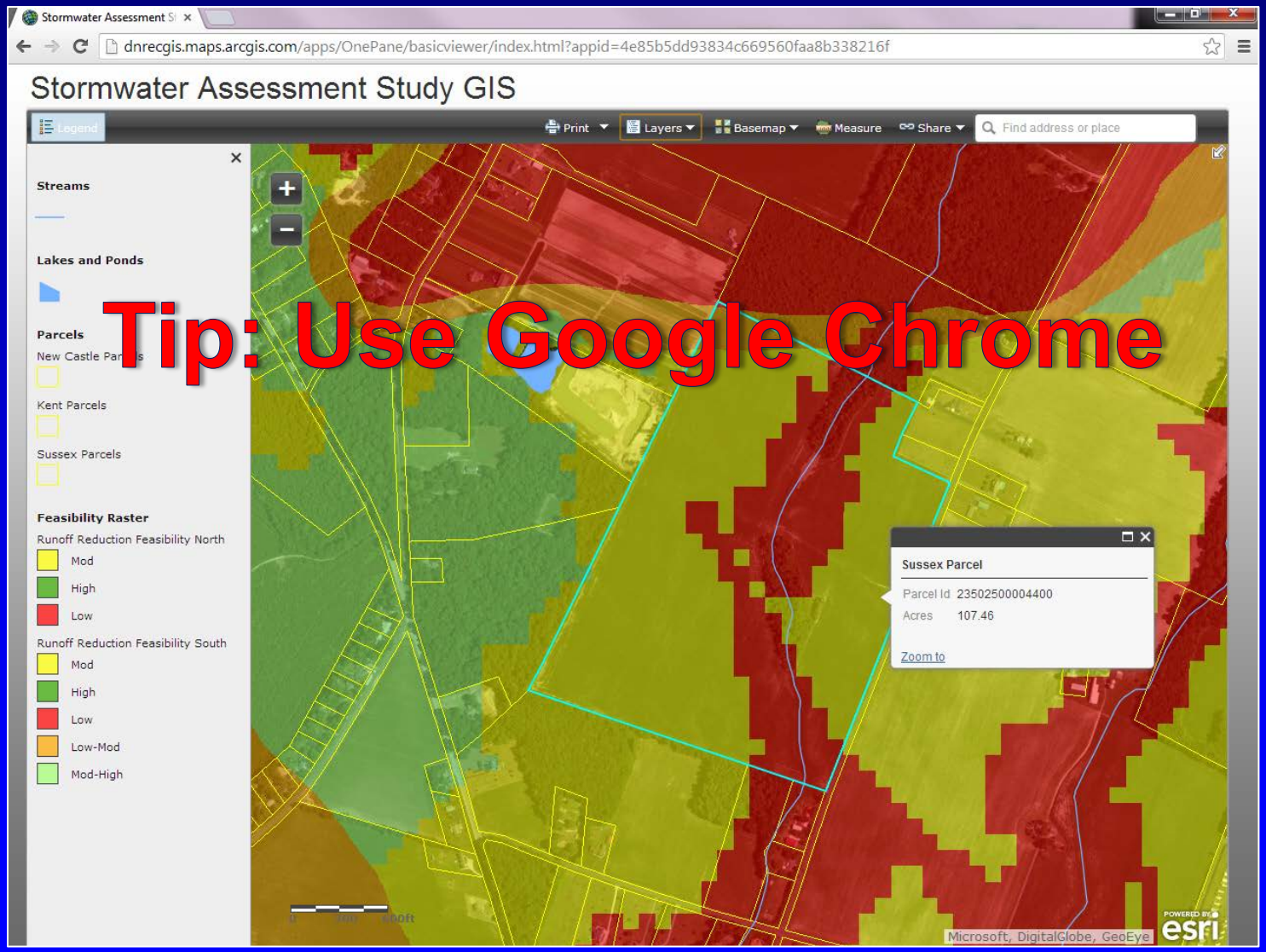
Online Background Information

- Stormwater Assessment Study GIS Mapping – each layer
- StreamStats Map
- StreamStats Basin Characteristics Report
- Customized Web Soil Survey
- DelDOT Road Plans

Tools for Preparing SAS: Delaware DataMIL



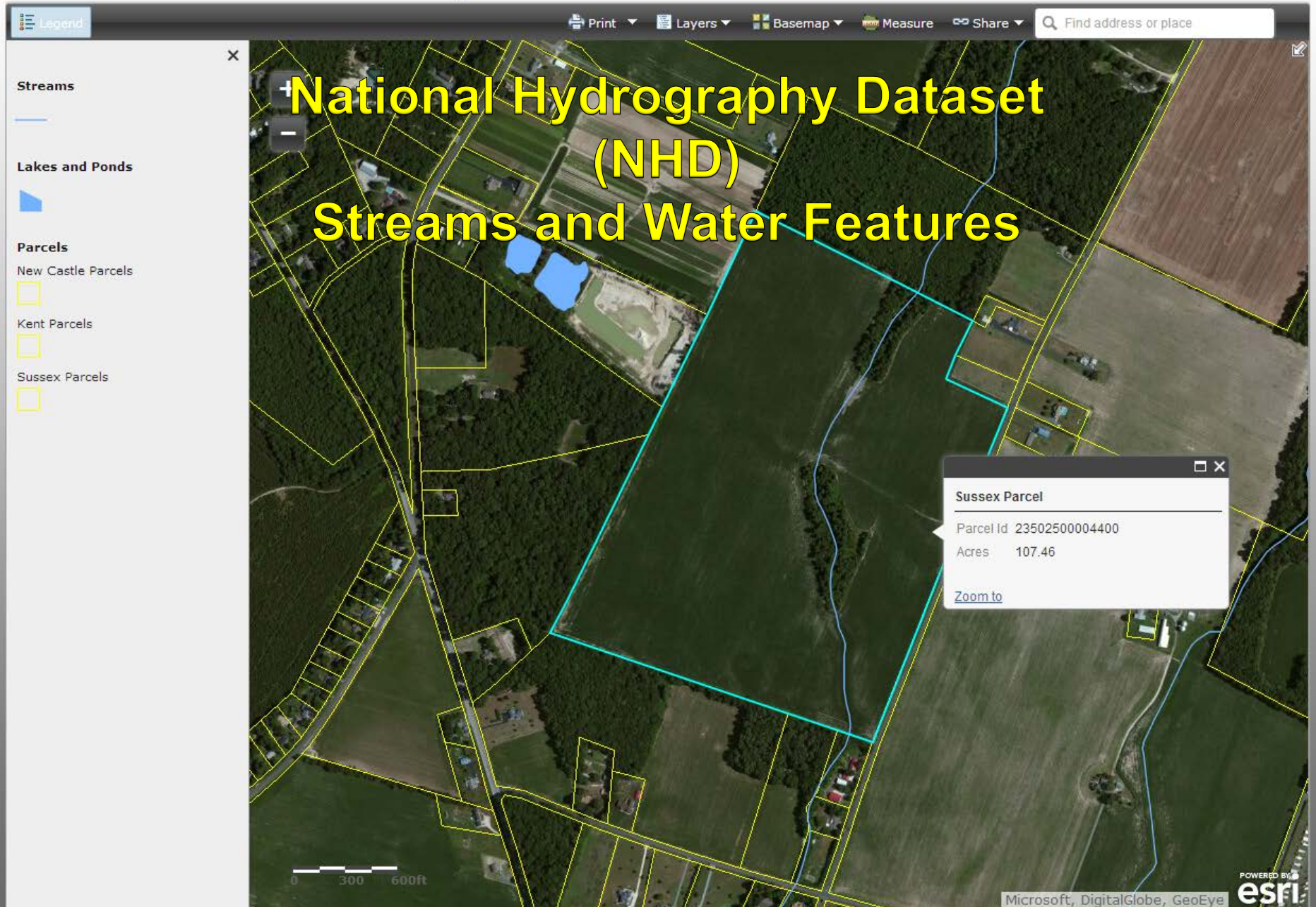
Tools for Preparing SAS: DNREC ArcGIS Online App



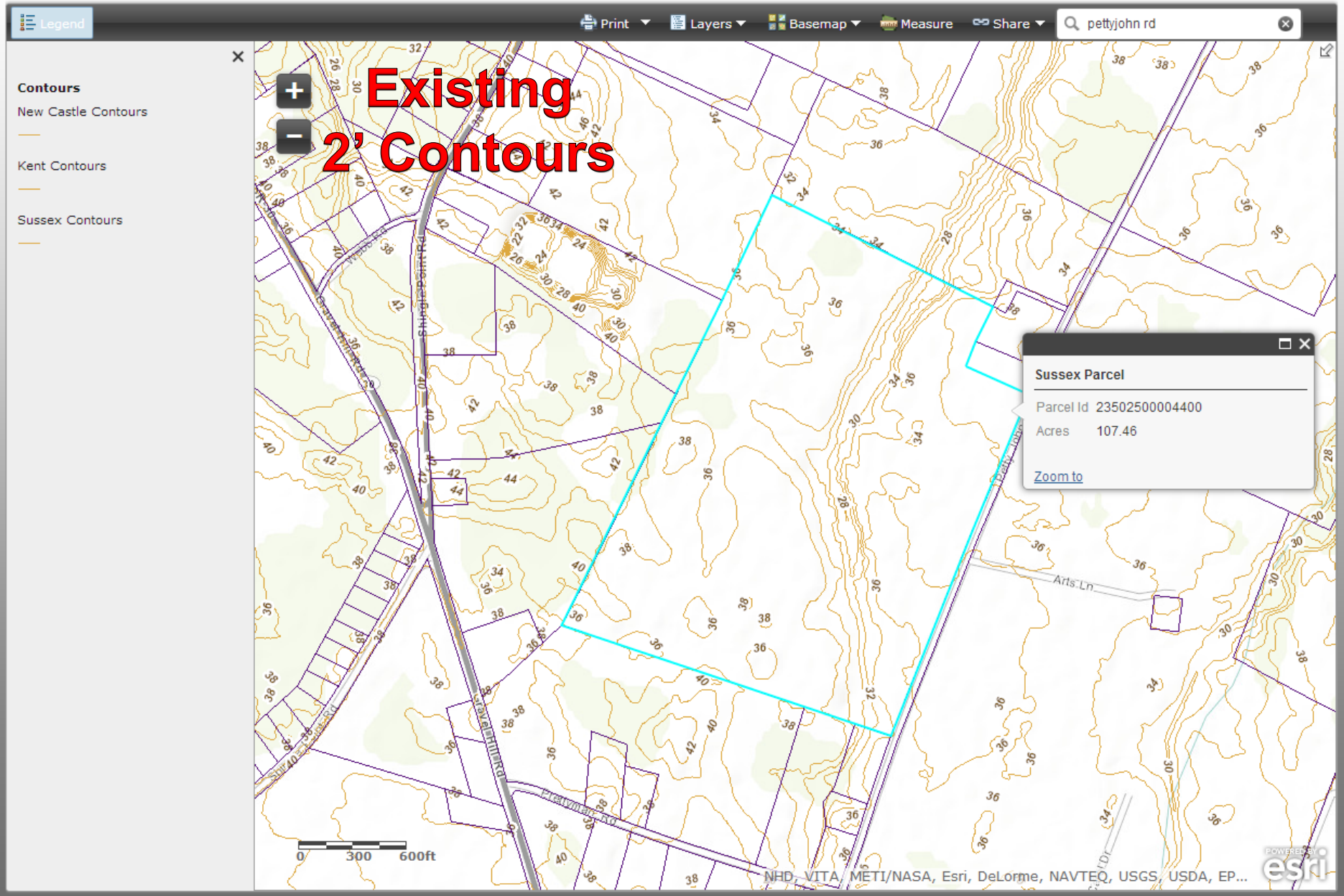
Tip: Use Google Chrome

Stormwater Assessment Study GIS

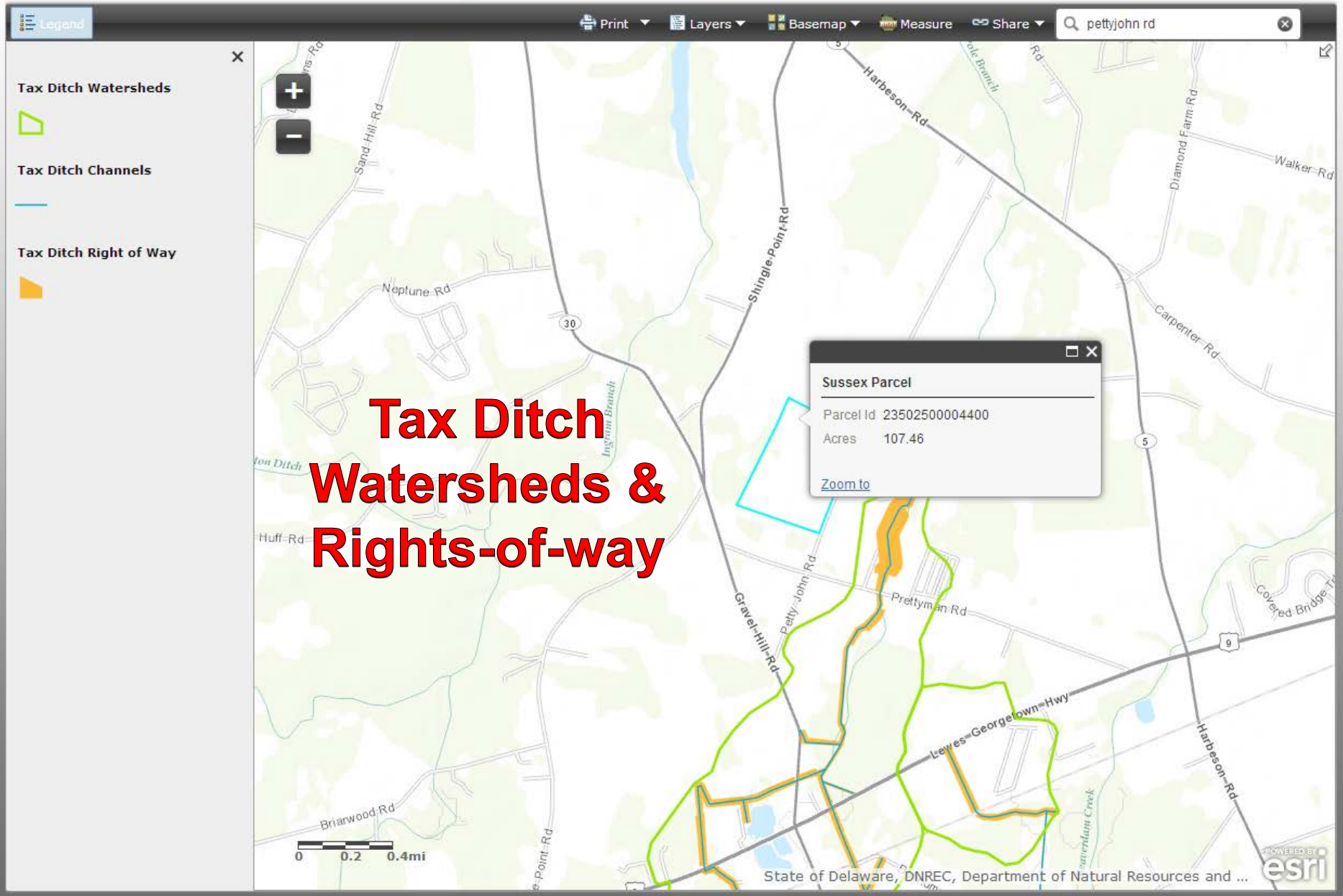
Stormwater Assessment Study GIS



Stormwater Assessment Study GIS



Stormwater Assessment Study GIS



Stormwater Assessment Study GIS

Stormwater Assessment S

dnrecgis.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=4e85b5dd93834c669560faa8b338216f

Stormwater Assessment Study GIS

Legend | Print | Layers | Basemap | Measure | Share | pettyjohn rd

Floodways

- FLOODWAY

Flood Haz Areas

- A
- AE
- AO
- VE
- X500

Sussex Parcel

Parcel Id 23502500004400

Acres 107.46

Zoom to

FEMA Floodplain Mapping

0 0.1 0.2mi

Microsoft, DigitalGlobe, GeoEye

POWERED BY esri

Stormwater Assessment St

dnrecgis.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=4e85b5dd93834c669560faa8b338216f

Stormwater Assessment Study GIS

Legend | Print | Layers | Basemap | Measure | Share | pettyjohn rd

2007 Land Use/ Land Cover

Landuse/Landcover 2007

- Non-tidal Emergent Wetland
- Single Family Dwellings
- Retail Sales/Wholesale/Professional Services
- Mixed Urban or Built-up Land
- Other Urban or Built-up Land
- Institutional/Governmental
- Cropland
- Confined Feeding Operations/Feedlots/Holding
- Deciduous Forest
- Evergreen Forest
- Man-made Reservoirs and Impoundments
- Non-tidal Forested Wetland
- Non-tidal Scrub/Shrub Wetland
- Transitional (incl. cleared, filled, and gra
- Mobile home Parks/Courts
- Extraction
- Idle Fields
- Mixed Forest
- Farmsteads and Farm Related Buildings
- Non-tidal Open Water
- Junk/Salvage Yards
- Truck Crops
- Recreational
- Shrub/Brush Rangeland

Sussex Parcel

Parcel Id 23502500004400

Acres 107.46

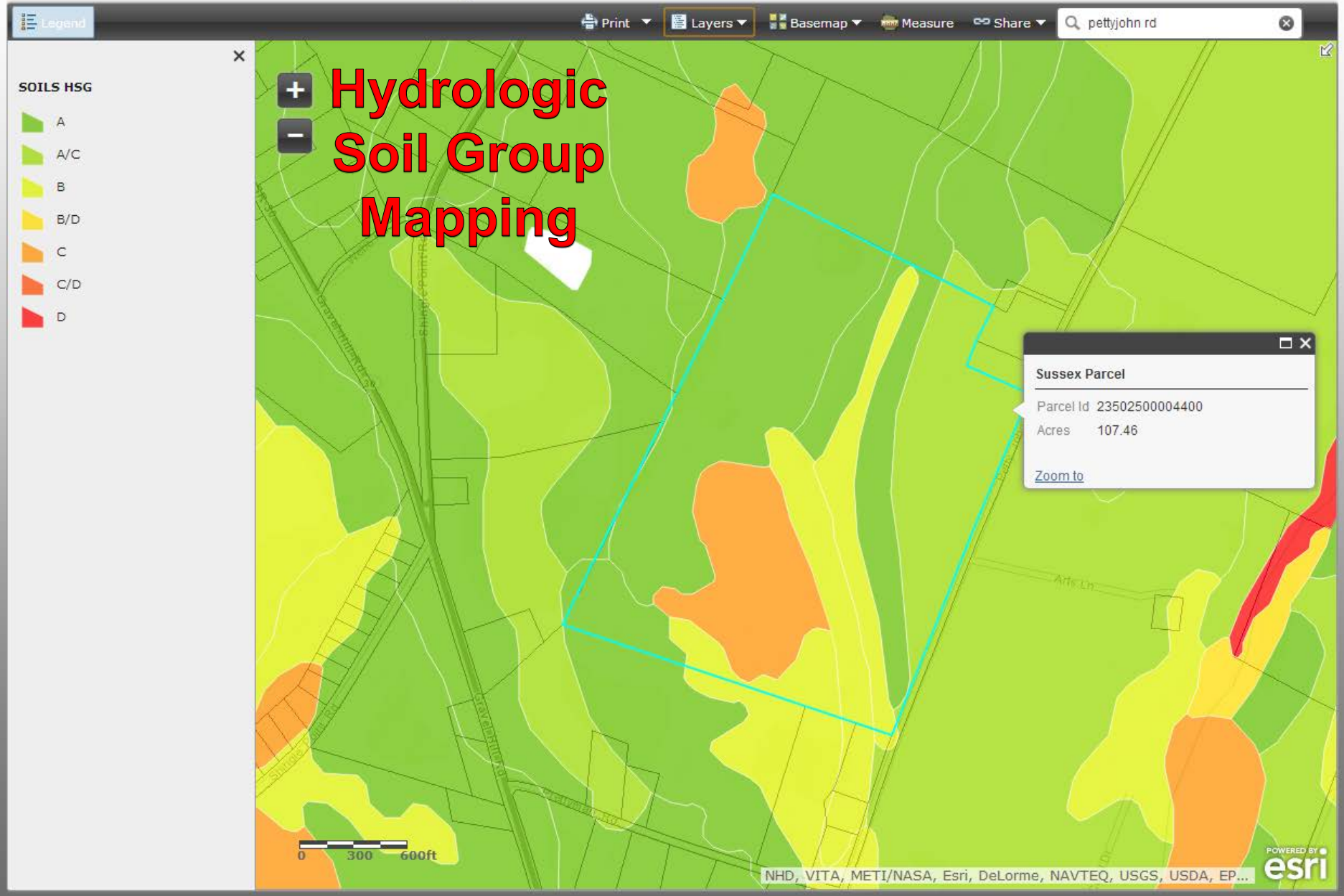
Zoom to

0 300 600ft

NHD, VITA, METI/NASA, Esri, DeLorme, NAVTEQ, USGS, USDA, EP...

POWERED BY esri

Stormwater Assessment Study GIS



Stormwater Assessment St

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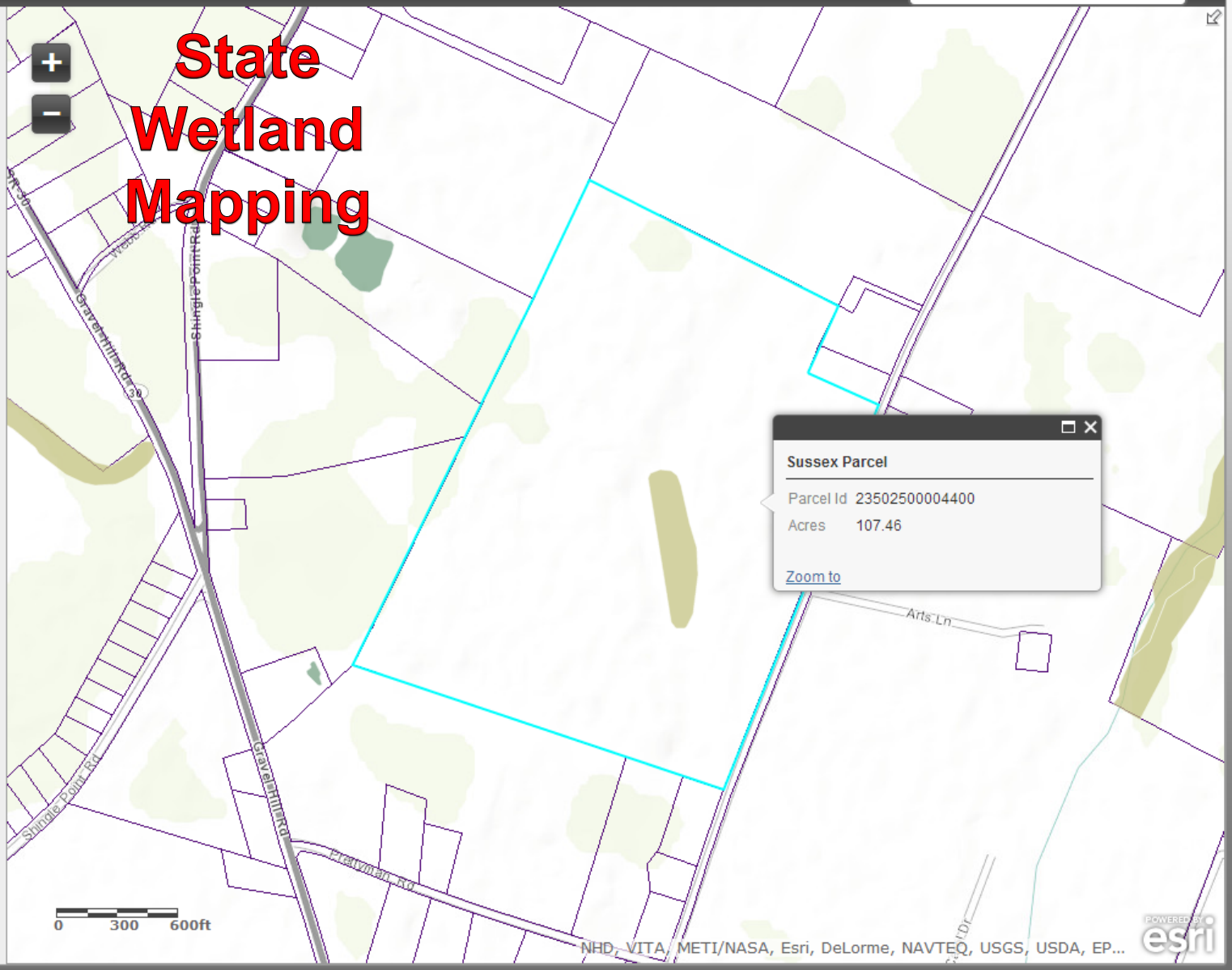
Stormwater Assessment Study GIS

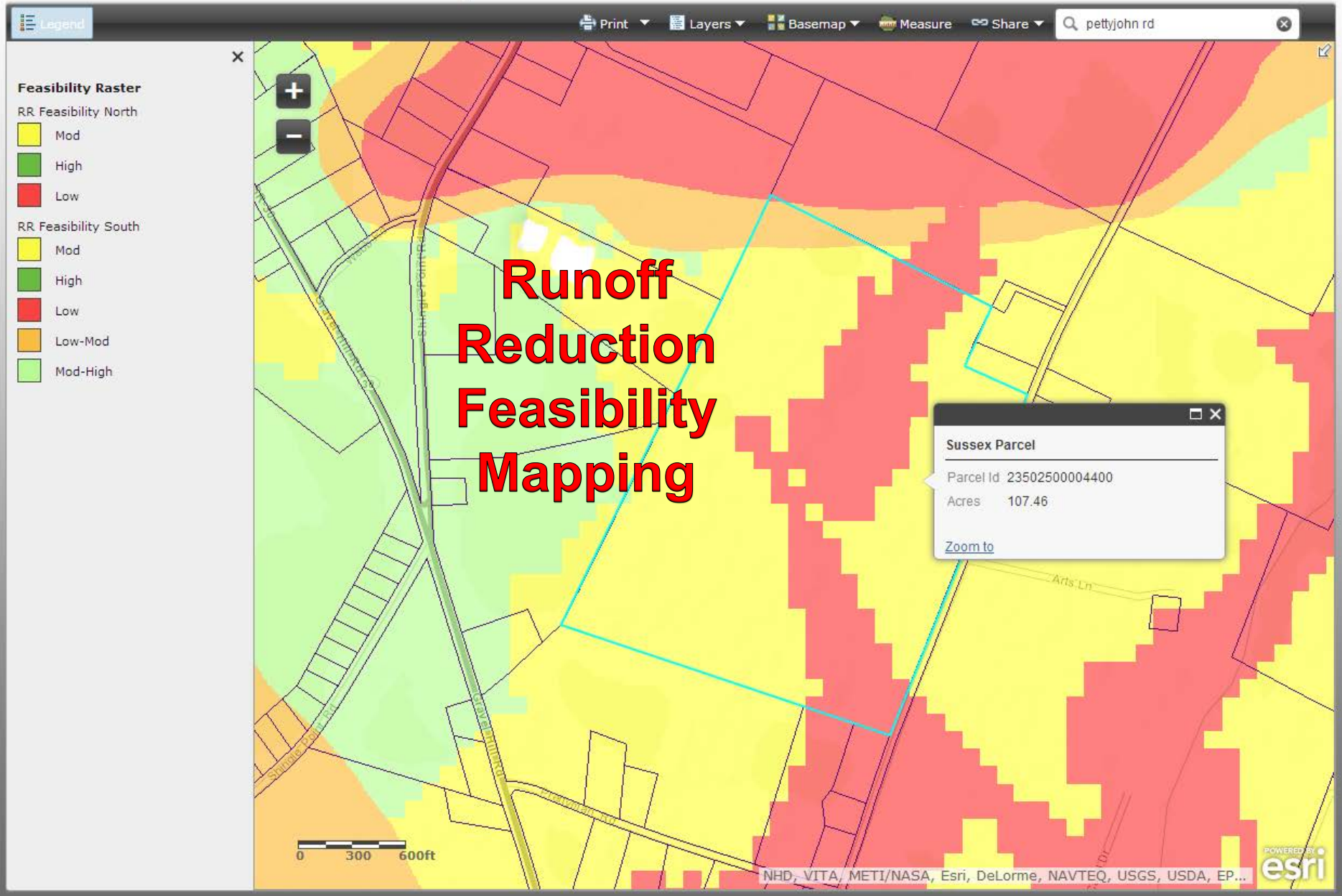
Legend | Print | Layers | Basemap | Measure | Share | pettyjohn rd

State Wetlands Mapping Project

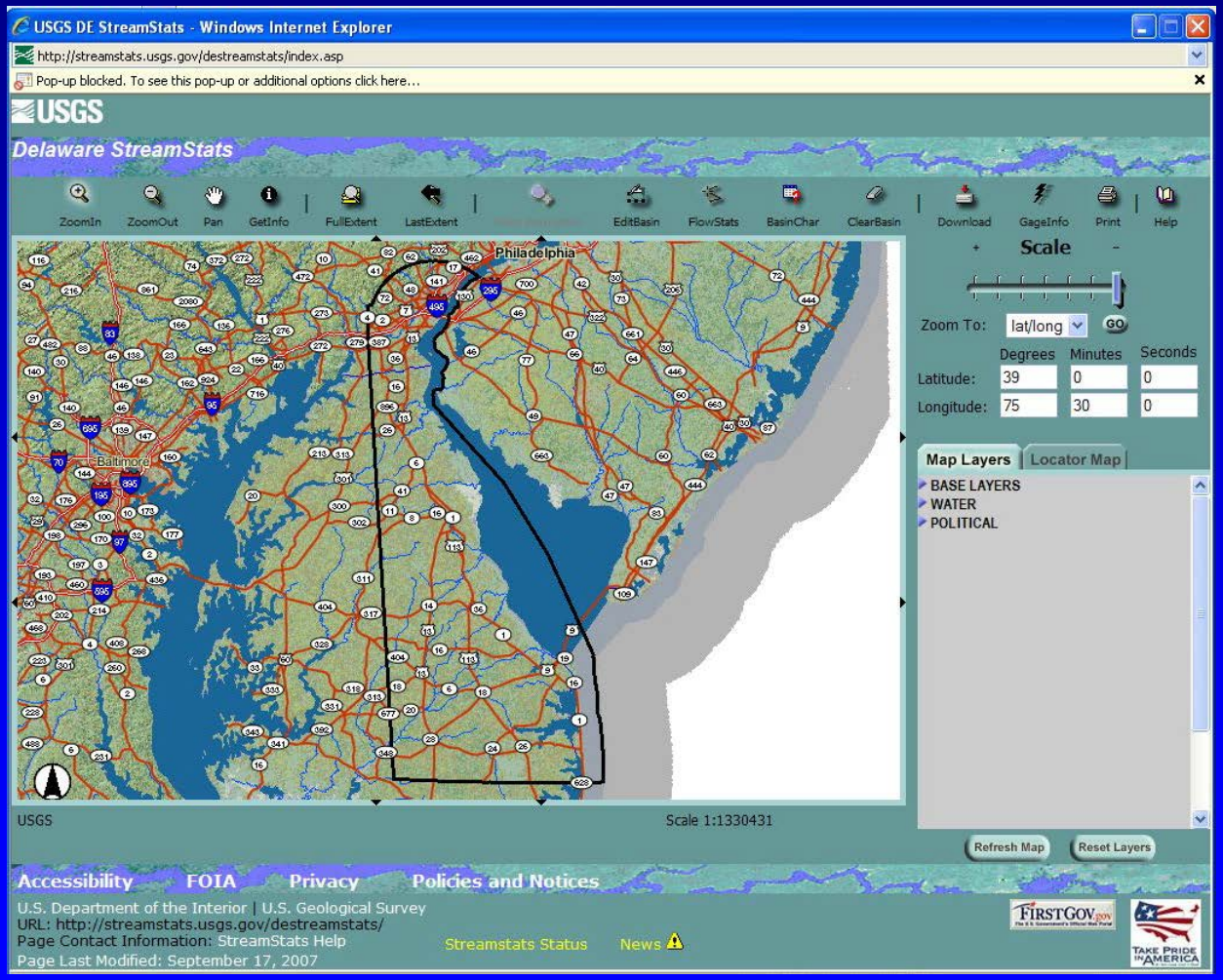
- Agriculture
- Estuarine Non-Vegetated
- Estuarine Vegetated
- Lacustrine
- Marine Non-vegetated
- Palustrine Emergent
- Palustrine Forested
- Palustrine Forested Deciduous
- Palustrine Forested Evergreen
- Palustrine Open Water/ Flats
- Palustrine Open Water/Flats
- Palustrine Scrub/Shrub
- Palustrine Scrub/shrub
- Palustrine Tidal Emergent
- Palustrine Tidal Forested
- Palustrine Tidal Forested
- Palustrine Tidal Scrub/Shrub
- Riverine Non-vegetated
- Riverine Vegetated
- <all other values>



Stormwater Assessment Study GIS



USGS StreamStats



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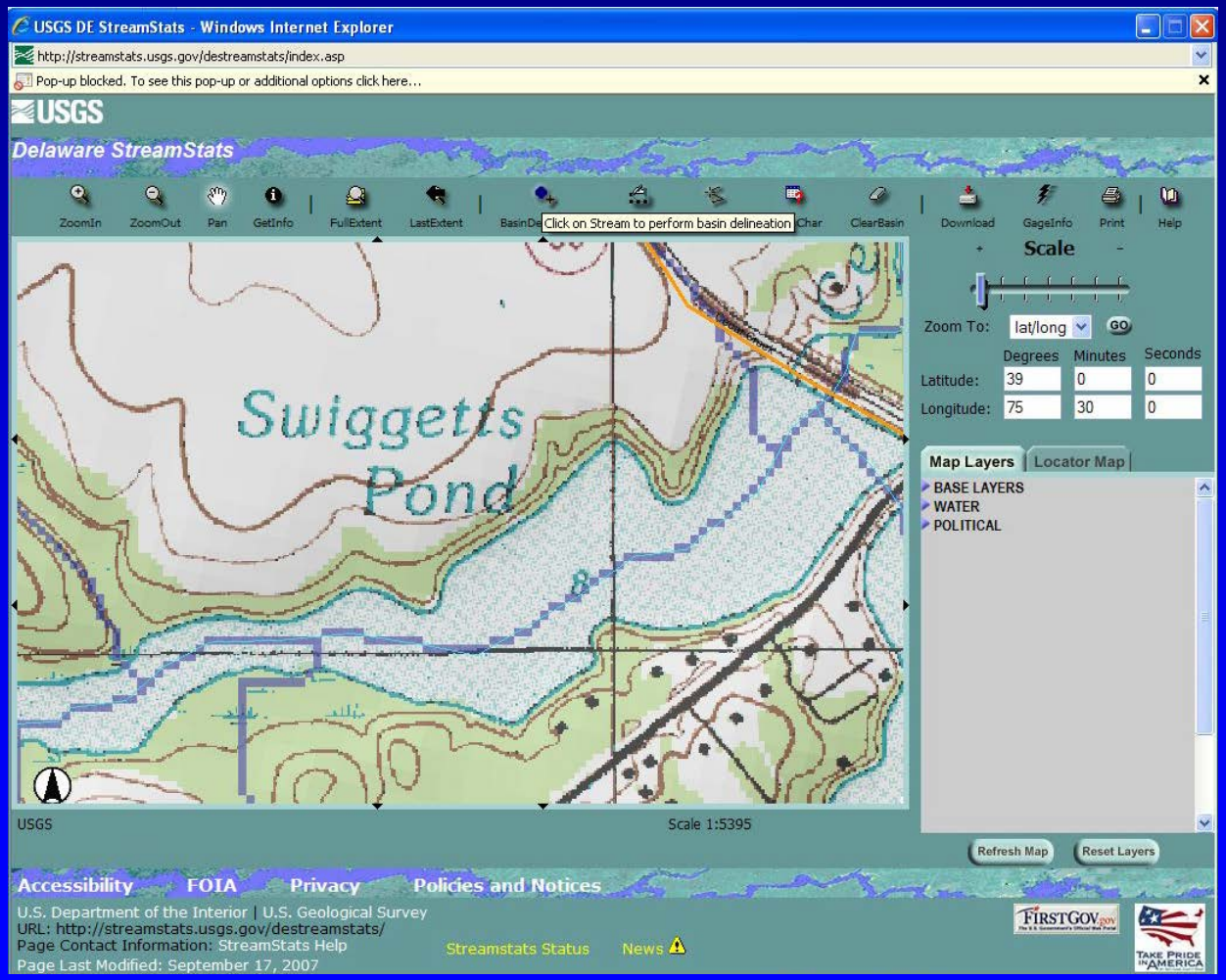

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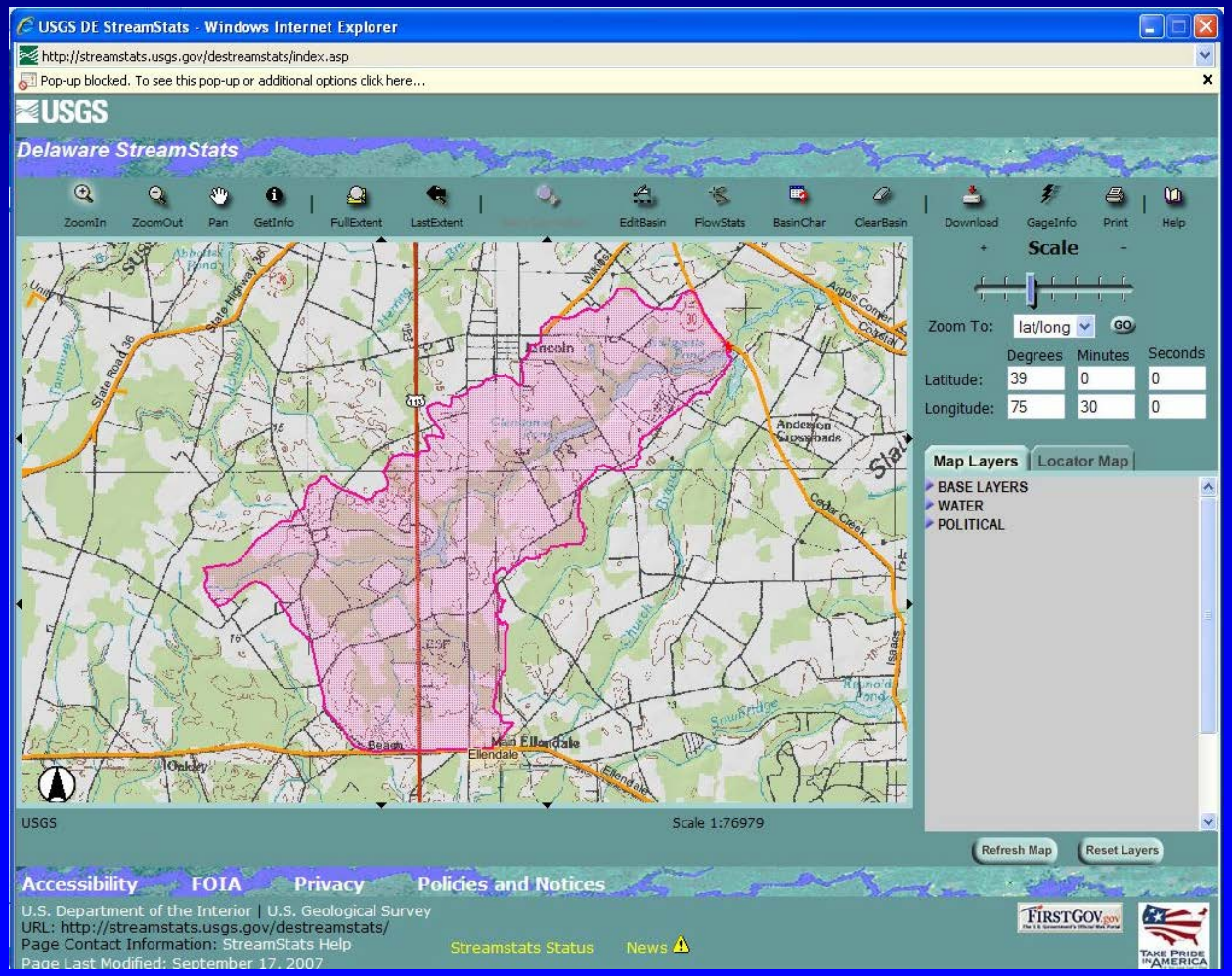

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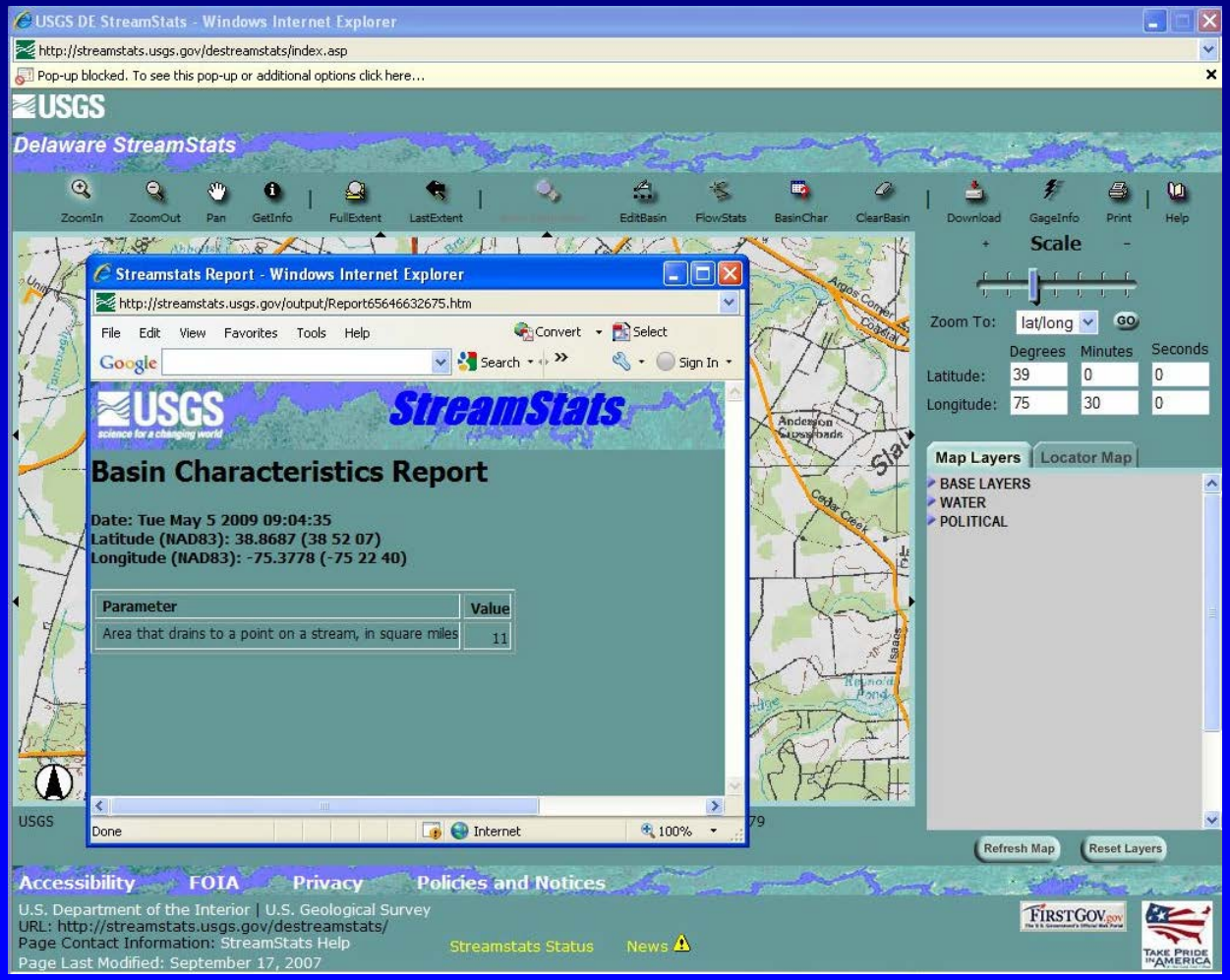
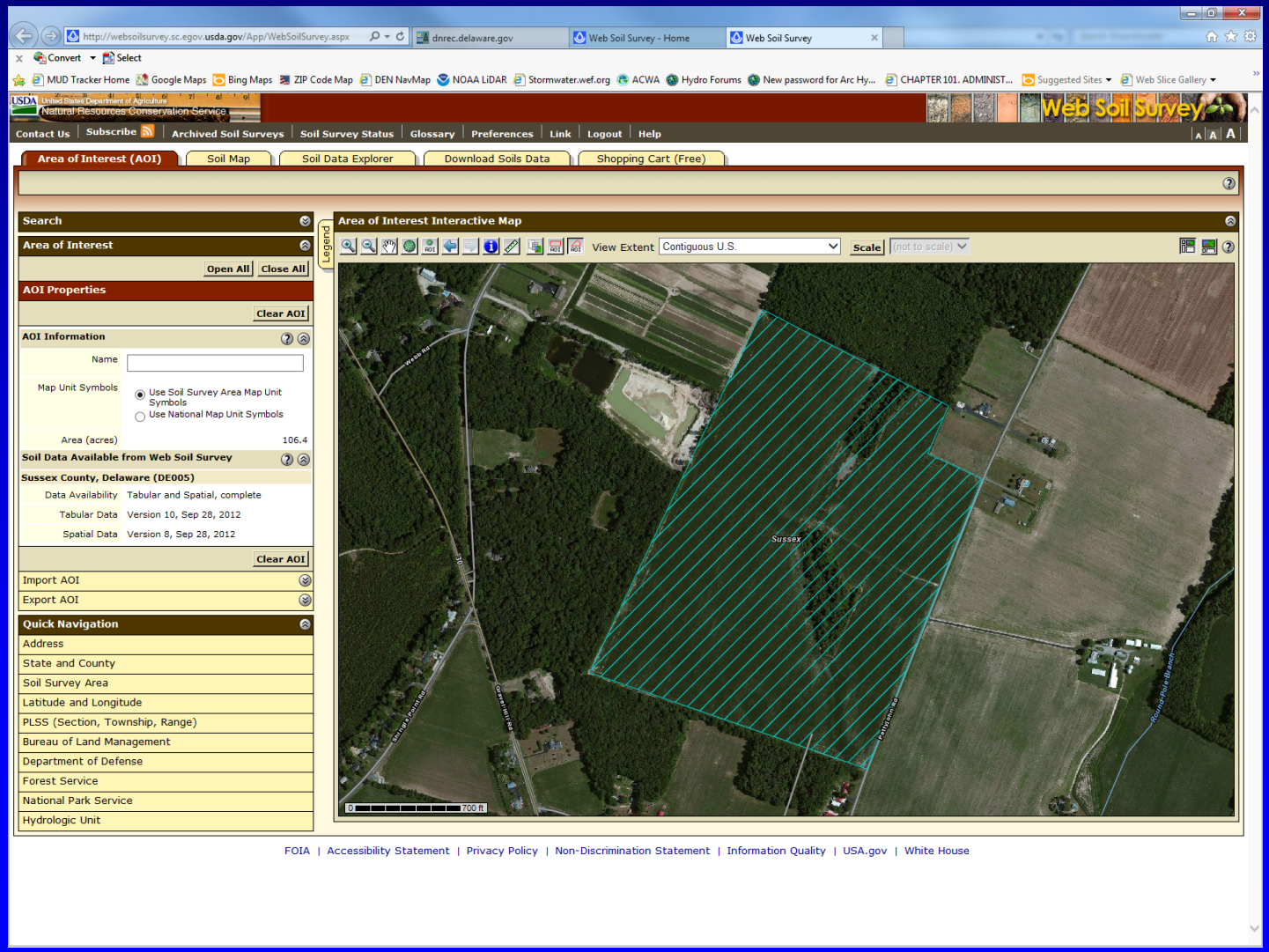


NRCS Web Soil Survey (WSS)



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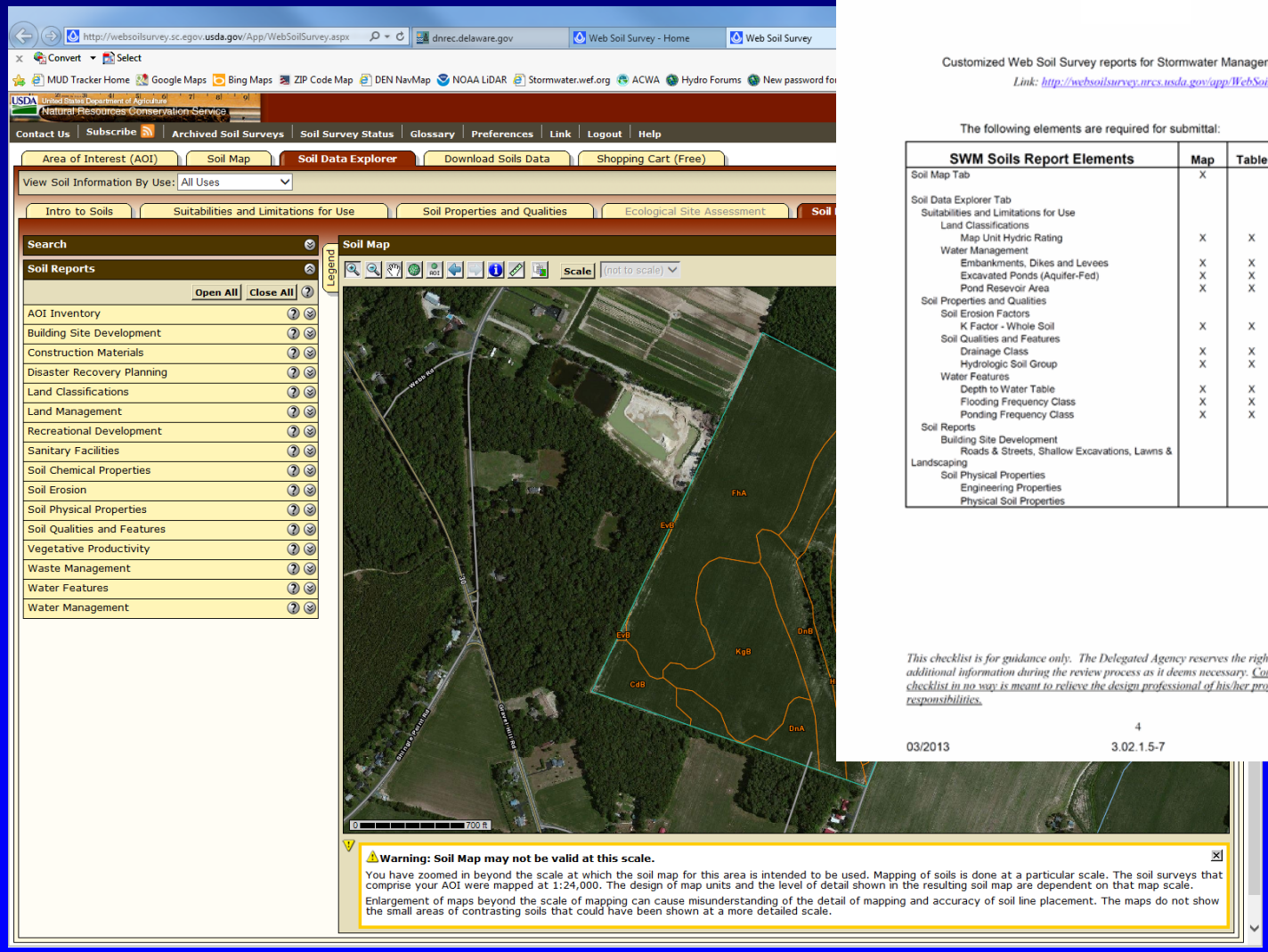


Customized Web Soil Survey reports for Stormwater Management for total site.

Link: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

The following elements are required for submittal:

SWM Soils Report Elements	Map	Table	Desc.	Report
Soil Map Tab	X			
Soil Data Explorer Tab				
Suitabilities and Limitations for Use				
Land Classifications				
Map Unit Hydric Rating	X	X	X	
Water Management				
Embankments, Dikes and Levees	X	X	X	
Excavated Ponds (Aquifer-Fed)	X	X	X	
Pond Resevoir Area	X	X	X	
Soil Properties and Qualities				
Soil Erosion Factors				
K Factor - Whole Soil	X	X	X	
Soil Qualities and Features				
Drainage Class	X	X	X	
Hydrologic Soil Group	X	X	X	
Water Features				
Depth to Water Table	X	X	X	
Flooding Frequency Class	X	X	X	
Ponding Frequency Class	X	X	X	
Soil Reports				
Building Site Development				
Roads & Streets, Shallow Excavations, Lawns & Landscaping				X
Soil Physical Properties				
Engineering Properties				X
Physical Soil Properties				X

This checklist is for guidance only. The Delegated Agency reserves the right to request additional information during the review process as it deems necessary. Compliance with the checklist in no way is meant to relieve the design professional of his/her professional responsibilities.

NRCS Web Soil Survey (WSS)

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Sussex County, Delaware

SWM Soils Report for Broadkill Estates

May 8, 2009

03/2013

3.02.1.5-24

Existing Hydrology Mapping

- Flow Paths
- On-site Subareas
- Off-Site Subareas
- Site points of analysis

SAS Submittal Requirements

- A. Documents
- B. Online Background Information
- C. Existing Hydrology Mapping
- D. Completed Stormwater Assessment Report (SAR)

Stormwater Assessment Report

Stormwater Assessment Report

Project:_____

Owner/Developer: _____

Consultant:_____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☐	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☐	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☐	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

03/2013 3.02.1.3-1

- Anticipated Engineering Effort
  - Minor
  - Moderate
  - Significant

Stormwater Assessment Report

Assessment Item	*Rating Criteria*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management fo the proposed project.	<15% of developed portion of the site has soils with limitations to development (i.e. high water table, erosivity, excavations)	15% - 50% of developed portion of the site has soils with limitations to development (i.e. high water erosivity, exca	>50% of the site has soils with l ns to deve t (i.e. high water e, erosivity, ations)
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	<25% existing woods/meadow to be disturbed OR <25% proposed imp ea	25%-50% w eadow disturb OR 25%-50% osed imper area	> existing wo eadow to be dis 50% osed impervious area
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	<15% of developed po of sibility ra f Lo ow-Mod	15% - 50% eveloped p the site ha Feasibility r f Lo ow-Mod	>50% of developed portion of the site has RR Feasibility rating of Low or Low-Mod
4. Sump Conditions - Existing topography of site create onal (closed 2' contours) where runoff lands to co sch	0% of site rains p areas	of site area drains to sump areas	>50% of site area drains to sump areas
5. Discharge Points - Areas where st ater ru aves th have limitations due to lo dient, back effec d chan or other hydraulic li ns.	Zero (0) charg points with hed problems OR <10% of site area drains to a discharge point with an identified problem	At least one (1) site discharge point with an identified problem OR 10% - 50% of site area drains to a discharge point with an identified problem	Multiple (more than 1) discharge point with an identified problem OR >50% of site area drains to a discharge point with an identified problem OR Lack of easements and/or alteration of drainage patterns could raise potential "right-to-discharge" issues.
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	<25% offsite area relative to site area draining onto site	25% - 50% offsite area relative to site area draining onto site	>50% offsite area relative to site area draining onto site
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	Zero (0) known historic drainage problems OR Zero (0) in-line structures prior to the 10% analysis point	At least one (1) known historic drainage problem OR At least one (1) in-line structure prior to the 10% analysis point	Multiple (more than 1) known historic drainage problems OR Multiple (more than 1) in-line structures prior to the 10% analysis point OR Stream channel condition degraded due to vegetation, slope, erosion, etc.

UPDATED

Stormwater Assessment Report

	Assessment Item	Rating Criteria		
		Minor	*Moderate*	*Significant*
1.	Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	<15% of developed portion of the site has soils with limitations to development (i.e. high water table, erosivity, excavations)	15% - 50% of developed portion of the site has soils with limitations to development (i.e. high water table, erosivity, excavations)	>50% of developed portion of the site has soils with limitations to development (i.e. high water table, erosivity, excavations)
2.	Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed	<25% existing woods/meadow to be disturbed	25%-50% existing woods/meadow to be disturbed	> 50% existing woods/meadow to be disturbed
		OR	**OR**	**OR**
		<25% proposed impervious area	25%-50% proposed impervious area	> 50% proposed impervious area
3.	Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	<15% of developed portion of the site has RR Feasibility rating of Low or Low-Mod	15% - 50% of developed portion of the site has RR Feasibility rating of Low or Low-Mod	>50% of developed portion of the site has RR Feasibility rating of Low or Low-Mod
		OR	**OR**	**OR**
		For areas not mapped for RR Feasibility, <15% of developed portion of site has water table <36" (90cm) or HSG "C" or "D" soils	For areas not mapped for RR Feasibility, 15% - 50% of developed portion of site has water table <36" (90cm) or HSG "C" or "D" soils	For areas not mapped for RR Feasibility, >50% of developed portion of site has water table <36" (90cm) or HSG "C" or "D" soils
4.	Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	0% of site area drains to sump areas	≤50% of site area drains to sump areas	>50% of site area drains to sump areas
5.	Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	Zero (0) site discharge points with identified problems	At least one (1) site discharge point with an identified problem	Multiple (more than 1) discharge point with an identified problem
			OR	**OR**
			< 50% of site area drains to a discharge point with an identified problem	>50% of site area drains to a discharge point with an identified problem
				OR
				Lack of easements and/or alteration of drainage patterns could raise potential "right-to-discharge" issues.
6.	Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the	<25% offsite area relative to site area draining onto site	25% - 50% offsite area relative to site area draining onto site	>50% offsite area relative to site area draining onto site
7.	Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from	Zero (0) known historic drainage problems	At least one (1) known historic drainage problem	Multiple (more than 1) known historic drainage problems
		AND	**OR**	**OR**
		Zero (0) in-line structures prior to the 10% analysis point	At least one (1) in-line structure prior to the 10% analysis point	Multiple (more than 1) in-line structures prior to the 10% analysis point
				OR
				Stream channel condition degraded due to vegetation, slope, erosion, etc.

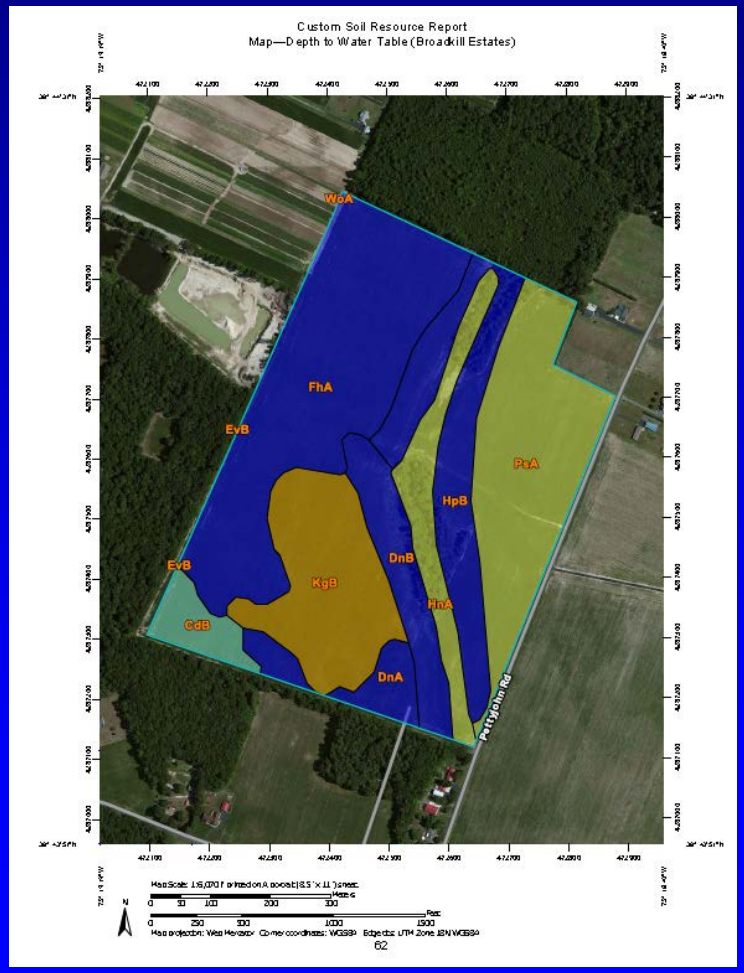
Stormwater Assessment Report

Assessment Item	Rating Value: Number	Yes/No	Acres	%
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.				
1.1 Hydric Soils (ac)				
1.2 "Very limited" for embankments, dikes and levees (ac)				
1.3 "Very limited" for excavated ponds due to depth to water table (ac)				
1.4 "Very limited" for excavated ponds due to cutbanks cave (ac)				
1.5 "Very limited" for pond reservoir areas (ac)				
1.6 Soil "K-factor" > 0.30 (ac)				
1.7 Drainage class "Poorly drained" or "Very poorly drained" (ac)				
1.8 Hydrologic Soil Group "D" (ac)				
1.9 Depth to water table < 100 cm (ac)				
1.10 Flood frequency class "Frequent" or "Very frequent" (ac)				
1.11 Ponding frequency class "Frequent" (ac)				
1.12 "Very limited" for local roads and streets (ac)				
1.13 "Very limited" for shallow excavations (ac)				
1.14 "Very limited" for lawns and landscaping (ac)				
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.				
2.1 Existing wooded or meadow areas to be disturbed (ac)				
2.2 Proposed impervious area (ac)				
3. Water Quality - Pollutant loadings associated with proposed project could adversely affect adequate stormwater management.				
3.1 Site area with Runoff Reduction Feasibility rating of Low or Low-Mod				
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.				
4.1 Site area that drains to sump (ac)				
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.				
5.1 Discharge points with identified problems (no.)				
5.2 Site area that drains to discharge point with identified problem (ac)				
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.				
6.1 Off-site areas draining onto site (ac)				
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.				
7.1 Known historic drainage problems (no.)				
7.2 In-line structures between site and 10% analysis point (no.)				
7.3 Stream channel condition degraded (yes/no)				

Soils

- Percentage of soils having limitations to development
  - Minor: <15%
  - Moderate: 15% - 50%
  - Significant: >50%

Broadkill Estates Soils



- Depth to water table mapping
- 30cm:
  - Klej-Galloway (KgB) = 15.6 ac
- 61cm:
  - Hammonton (HnA) = 7.5 ac
  - Pepperbox-Rosedale (PsA) = 20.9 ac

Broadkill Estates Soils

- From NRCS Web Soil Survey
  - Depth to water table < 100 cm
    - 44 ac
    - 41%
- Moderate Rating

Stormwater Assessment Report

Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☐	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☐	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☐	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

03/2013 3.02.1.3-1

- Soils - Moderate

Runoff Potential

Change in Land Cover (trees/meadow removed)

- Minor: <25%
- Moderate: 25% - 50%
- Significant: >50%

OR

Proposed Impervious Area

- Minor: <25%
- Moderate: 25% - 50%
- Significant: >50%

Broadkill Estates Runoff Potential

- Existing wooded/meadow areas to be disturbed = 0 acres
- Proposed Impervious area ~ 12 acres
  - ~12%
- Minor Rating

Stormwater Assessment Report

Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☐	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☐	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☐	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

03/2013 3.02.1.3-1

- Soils – Moderate
- Runoff Potential - Minor

Water Resource Protection

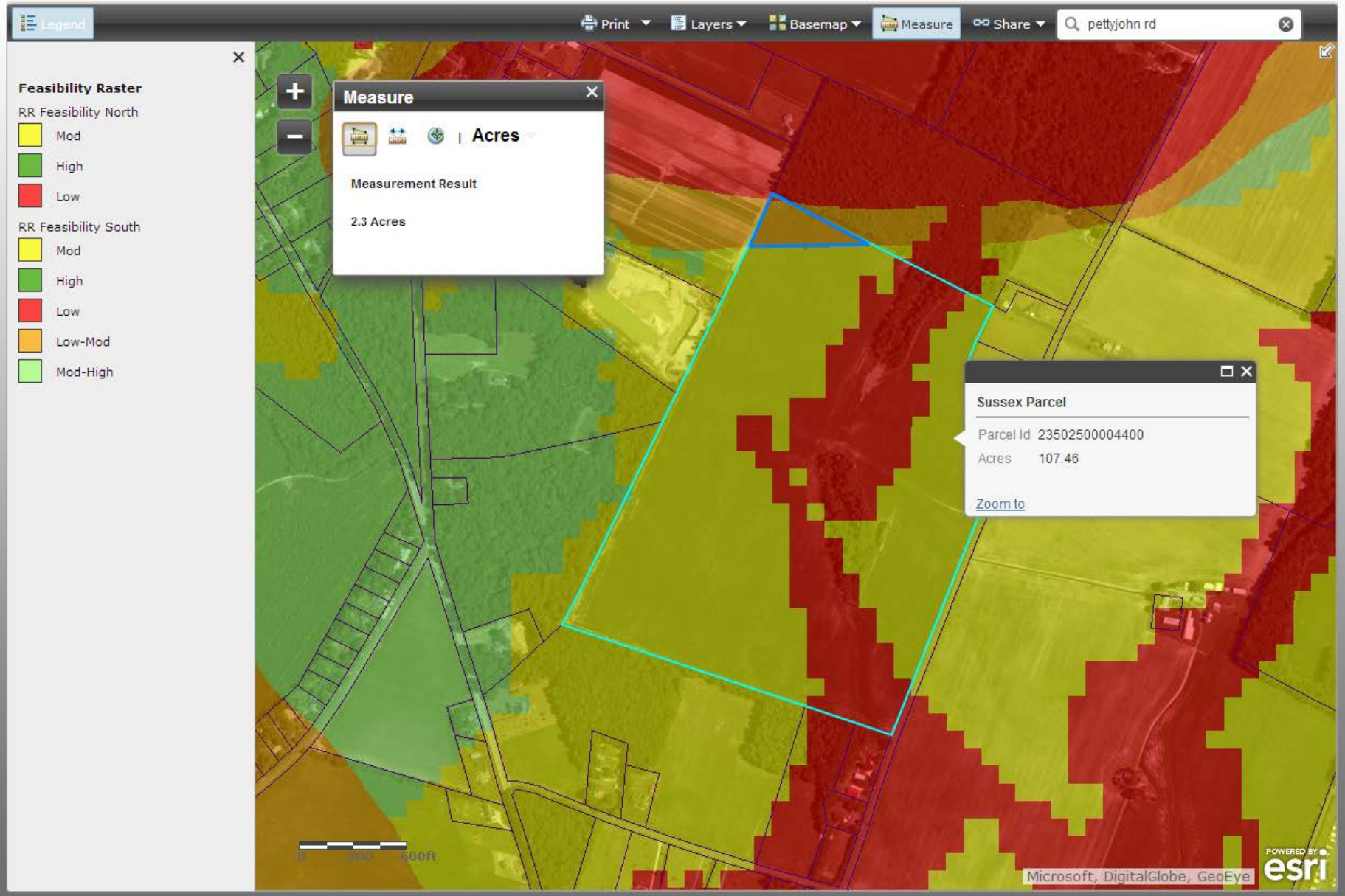
- Runoff Reduction Feasibility rating
  - Low or Low-Mod rating of developed area
  - Minor: <15%
  - Moderate: 15% - 50%
  - Significant: >50%

	Recharge Class			
Wet Depth to WT	Excellent	Good	Fair	Poor
0 - 3'	Low	Low	Low	Low
3' - 6'	Mod	Mod	Low-Mod	Low
>6'	High	Mod-High	Low-Mod	Low

www.dnrec.delaware.gov/ | www.dnrec.delaware.gov/ | Sediment & Stormwater | Stormwater Assessment St

dnrecgis.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=4e85b5dd93834c669560faa8b338216f

Stormwater Assessment Study GIS



Broadkill Estates
Water Resouce Protection

- Site area with Low RR Feasibility
  - 23.3 acres
- Site area with Low-Mod RR Feasibility
  - 2.3 acres
- Total = 25.6 acres or ~24%
- Moderate rating

Stormwater Assessment Report

Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☑	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☐	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☐	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

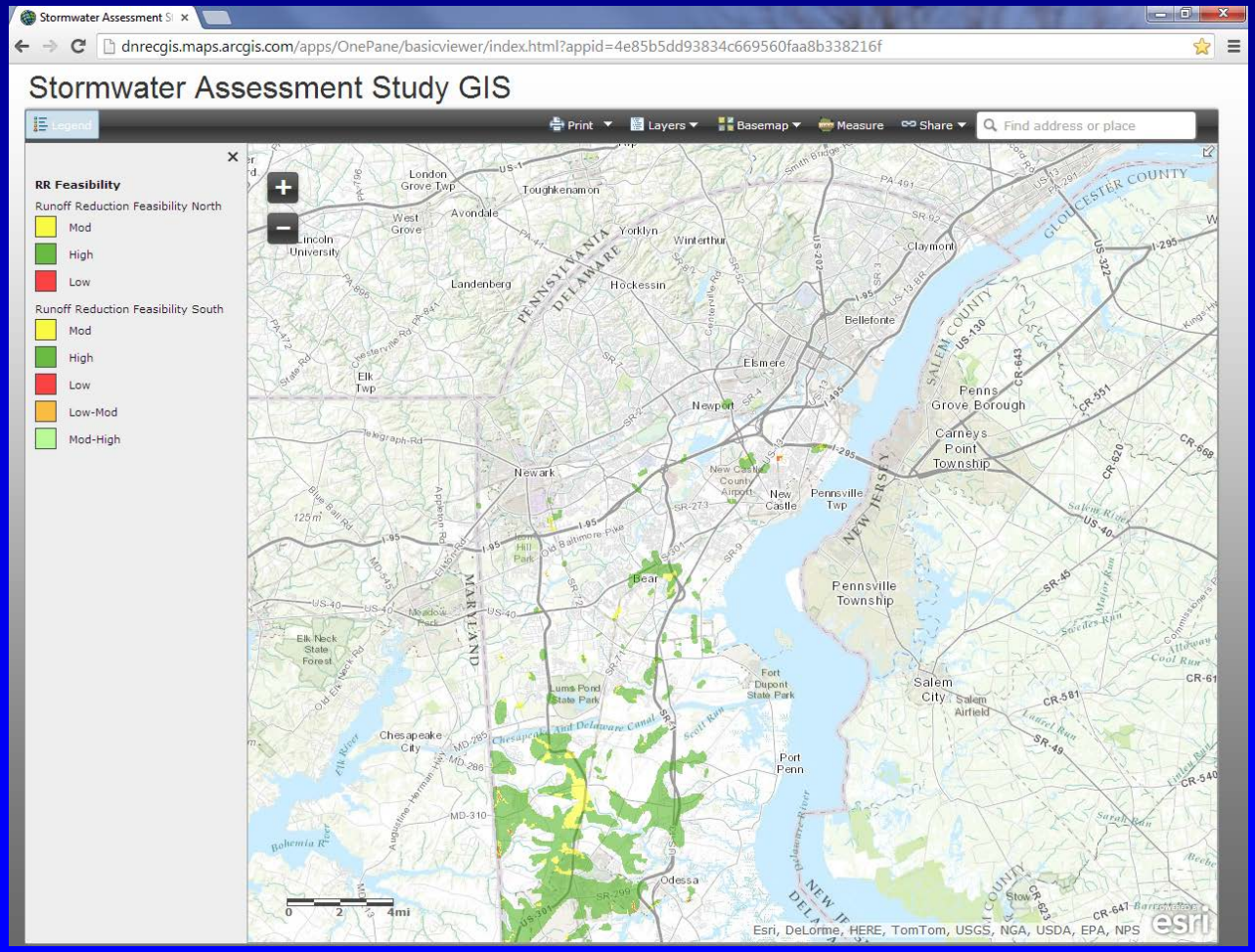
Contact Person: _____

Date of Project-Application Meeting: _____

03/2013 3.02.1.3-1

- Soils – Moderate
- Runoff Potential – Minor
- Water Resource Protection - Moderate

Water Resource Protection – New Castle County



Water Resource Protection – Areas Not Mapped in NCCounty

- Rating criteria for areas not mapped:
  - Water Table <36”, OR
  - HSG “C” or “D” soils

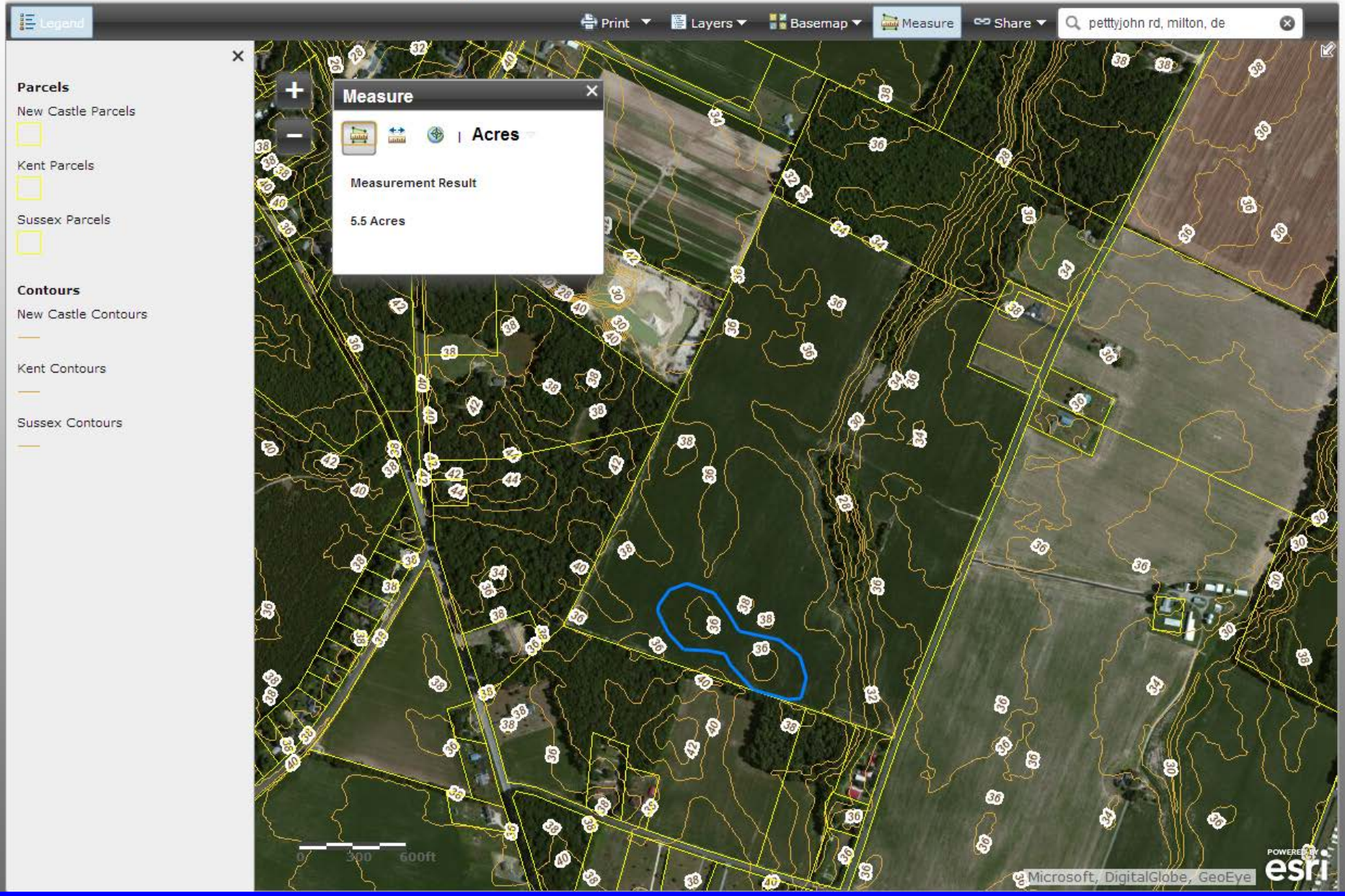
	Recharge Class			
Wet Depth to WT	Excellent	Good	Fair	Poor
0 - 3'	Low	Low	Low	Low
3' - 6'	Mod	Mod	Low-Mod	Low
>6'	High	Mod-High	Low-Mod	Low

- Minor: <15% site area
- Moderate: 15% - 50% site area
- Significant: >50% site area

Sump Conditions

- Closed 2’ contours
- Runoff collects without direct discharge
- Rating Criteria:
  - Minor: 0% site area drains to sumps
  - Moderate: <50% site area drains to sumps
  - Significant: >50% site area drains to sumps

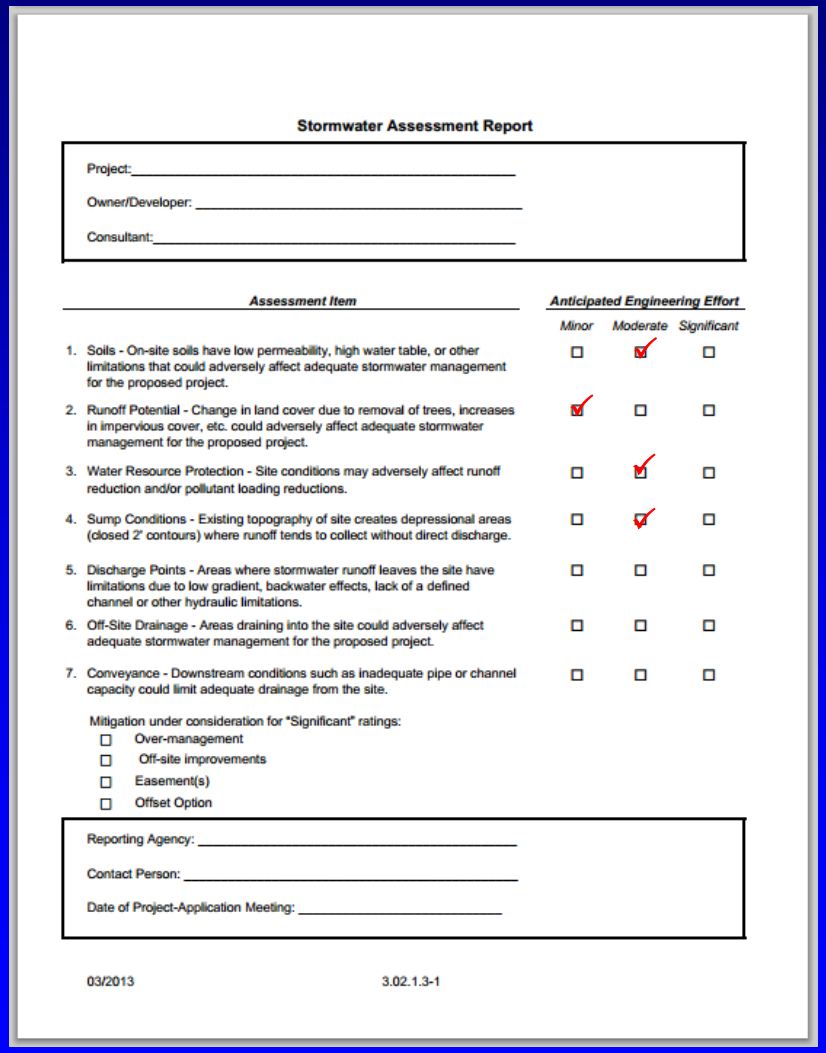
Stormwater Assessment Study GIS



Broadkill Estates Sump Conditions

- Approximately 7 acres
- 6.5%
- Moderate Rating

Stormwater Assessment Report



Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☑	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☑	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☐	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

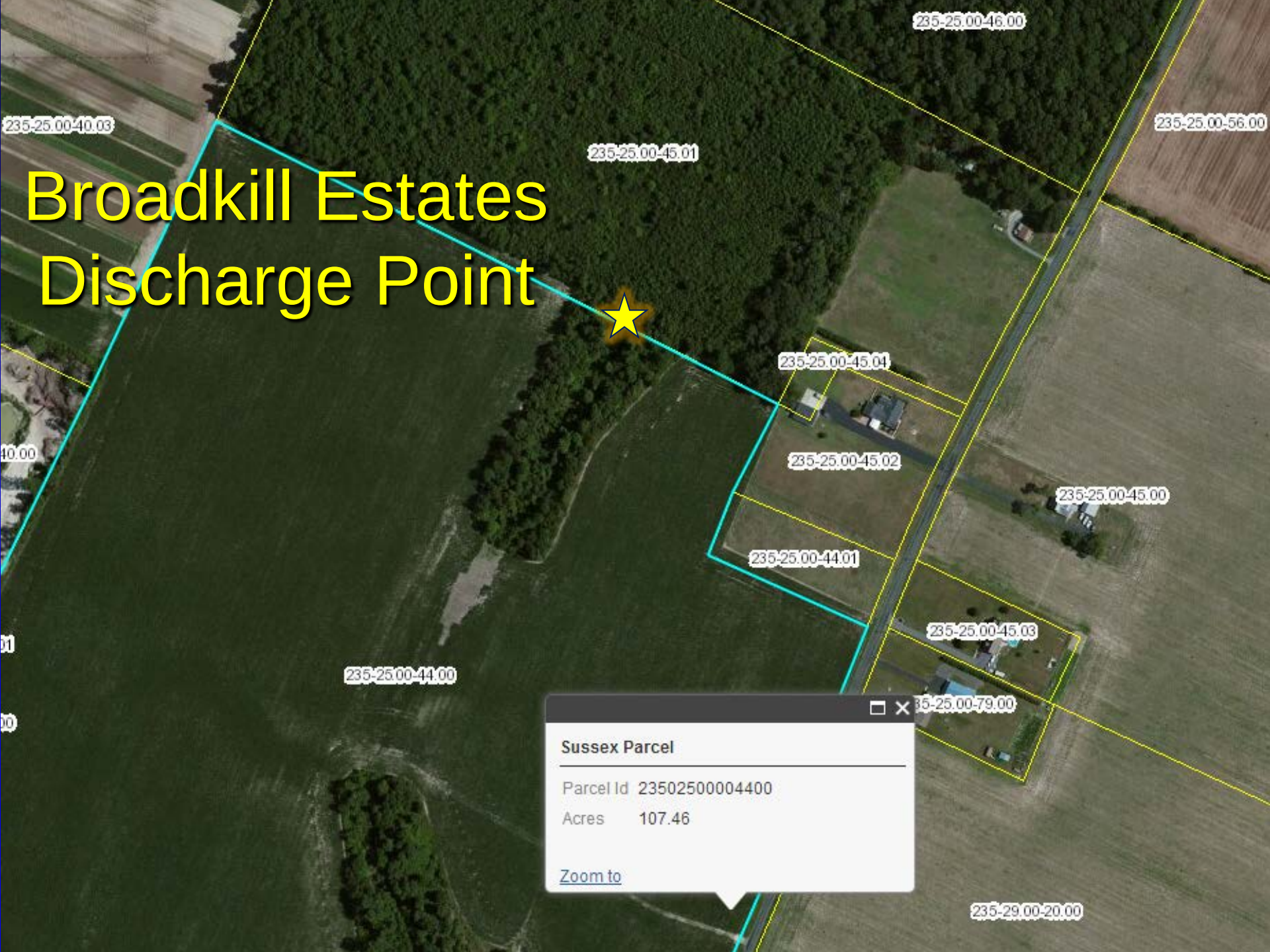
Date of Project-Application Meeting: _____

03/2013 3.02.1.3-1

- Soils – Moderate
- Runoff Potential – Minor
- Water Resource Protection – Moderate
- Sump Conditions - Moderate

Discharge Points

- Number of Discharge Points with problems
  - Minor: 0
  - Moderate: 1
  - Significant: >1
- Percentage of site area draining to problem discharge point
  - Minor: 0%
  - Moderate: <50%
  - Significant: >50%


Broadkill Estates
Discharge Point
235-25.00-46.00
235-25.00-40.03
235-25.00-56.00
235-25.00-45.01
235-25.00-45.04
235-25.00-45.02
235-25.00-45.00
235-25.00-44.01
235-25.00-45.03
235-25.00-44.00
Sussex Parcel
Parcel Id 23502500004400
Acres 107.46
Zoom to
235-29.00-20.00

Stormwater Assessment Report

Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☑	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☑	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☑	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☐	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

03/2013 3.02.1.3-1

- Soils – Moderate
- Runoff Potential – Minor
- Water Resource Protection – Moderate
- Sump Conditions – Moderate
- Discharge Points - Minor

Off-Site Drainage Areas

- Areas that could adversely affect stormwater management for project
- Offsite area relative to site area
  - Minor: <25%
  - Moderate: 25% - 50%
  - Significant: >50%

Stormwater Assessment Si

dnrecgis.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=4e85b5dd93834c669560faa8b338216f

Stormwater Assessment Study GIS

Legend | Print | Layers | Basemap | Measure | Share | petttyjohn rd, milton, de

Parcels

New Castle Parcels

Kent Parcels

Sussex Parcels

Contours

New Castle Contours

Kent Contours

Sussex Contours

Measure

Acres

Measurement Result

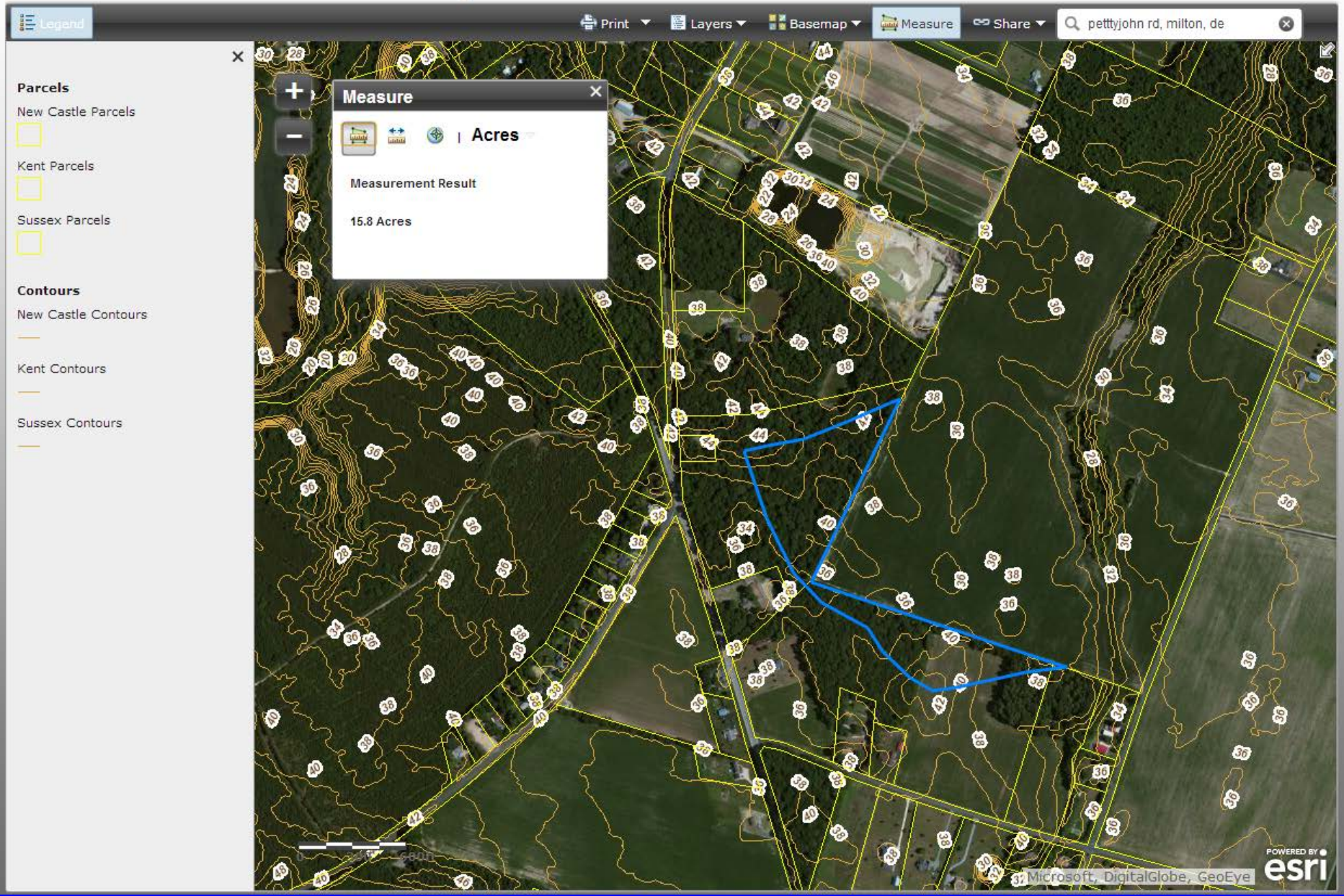
35.0 Acres

0 300 600ft

Microsoft, DigitalGlobe, GeoEye

POWERED BY esri

Stormwater Assessment Study GIS



Broadkill Estates
Off-Site Drainage

- Approximately 50.8 acres
  - Draining onto the site
  - Could be captured by onsite BMPs
- 47% offsite area relative to site area
- Moderate Rating

Stormwater Assessment Report

Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☑	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☑	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☑	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☐	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

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- Soils – Moderate
- Runoff Potential – Minor
- Water Resource Protection – Moderate
- Sump Conditions – Moderate
- Discharge Points – Minor
- Off-Site Drainage - Moderate

Conveyance

- Known historic drainage problems
  - Minor=0
  - Moderate=1
  - Significant>1
- In-line structures prior to analysis point
  - Minor=0
  - Moderate=1
  - Significant>1
- Degraded stream channel - Significant

Broadkill Estates Conveyance

- Historic Drainage Problems? NO
- In-line Structures? NO
- Degraded Stream Channel? NO
- Minor Rating

Stormwater Assessment Report

Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☑	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☑	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☑	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☑	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

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- Soils – Moderate
- Runoff Potential – Minor
- Water Resource Protection – Moderate
- Sump Conditions – Moderate
- Discharge Points – Minor
- Off-Site Drainage – Moderate
- Conveyance - Minor

SAS Submittal Requirements

- A. Documents
- B. Online Background Information
- C. Existing Hydrology Mapping
- D. Completed Stormwater Assessment Report (SAR)

Project Application Meeting

- Discussion Items
- Agreement Items
- Review Stormwater Assessment Report
- Sign minutes

Sediment and Stormwater Program
Project Application Meeting
Discussion and Agreement Items

Project Name: _____
Meeting Date: _____

Discussion Items:

1. TMDL Watershed: _____
2. Groundwater Mapping
   a. Wellhead Protection Areas: **YES /NO**
   b. Depth to Water Table (Wet): _____
   c. Runoff Reduction Feasibility: _____
3. Watershed Master Plan
   a. Does this site fall within an area served by a watershed master plan? **YES / NO**
      - Appoquinimink WS
      - Murderkill WS
      - Upper Nanticoke WS
      - Other: _____

   b. What special design criteria are set for this project based upon its location in a watershed having a master plan?

4. The site contains tax ditches: **YES / NO**

Tax Ditch Name	Right-of-way Information

   a. Is there a proposal for changing tax ditch watershed boundaries? **YES / NO**

   b. The tax ditch requires a court order change (COC) for development to occur as planned? **YES / NO**

   c. Additional information regarding court order change:

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Discussion Items

- TMDL Watershed
- Groundwater Mapping
- Watershed Master Plan
- Tax Ditches
- Proposed Grading
- Review area authority
  - Delegated Agency/DelDOT/DNREC
- Review Fees
- NOI & NOI Fees

Agreement Items

- Points of Analysis
- Existing Conditions Land Cover for Unit Discharge Approach
- Existing Drainage Features
- Runoff Reduction BMPs & RPv Compliance
- Cv and Fv Compliance

Mitigation for “Significant” Ratings

Stormwater Assessment Report

Project: _____

Owner/Developer: _____

Consultant: _____

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☑	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☑	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☑	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☑	☐	☐

Mitigation under consideration for *Significant* ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: _____

Contact Person: _____

Date of Project-Application Meeting: _____

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- Options:
  - Over-management
  - Off-site Improvements
  - Easement(s)
  - Offset Option
- Broadkill Estates
  - No “Significant”
  - Not Applicable

Complete SAR

Stormwater Assessment Report

Project: Broadkill Estates

Owner/Developer: I. M. A. Developer

Consultant: GreenTech Consultants

Assessment Item	*Anticipated Engineering Effort*		
	Minor	*Moderate*	*Significant*
1. Soils - On-site soils have low permeability, high water table, or other limitations that could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
2. Runoff Potential - Change in land cover due to removal of trees, increases in impervious cover, etc. could adversely affect adequate stormwater management for the proposed project.	☑	☐	☐
3. Water Resource Protection - Site conditions may adversely affect runoff reduction and/or pollutant loading reductions.	☐	☑	☐
4. Sump Conditions - Existing topography of site creates depressional areas (closed 2' contours) where runoff tends to collect without direct discharge.	☐	☑	☐
5. Discharge Points - Areas where stormwater runoff leaves the site have limitations due to low gradient, backwater effects, lack of a defined channel or other hydraulic limitations.	☑	☐	☐
6. Off-Site Drainage - Areas draining into the site could adversely affect adequate stormwater management for the proposed project.	☐	☑	☐
7. Conveyance - Downstream conditions such as inadequate pipe or channel capacity could limit adequate drainage from the site.	☑	☐	☐

Mitigation under consideration for "Significant" ratings:

- ☐ Over-management
- ☐ Off-site improvements
- ☐ Easement(s)
- ☐ Offset Option

Reporting Agency: DNREC Sediment & Stormwater Program

Contact Person: Elaine Webb

Date of Project-Application Meeting: 10/16/13

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- Forwarded to local approval agency
- Regs Sect 3.2.5

Questions?