PRELIMINARY
SEDIMENT AND STORMWATER REPORT

DNREC EXAMPLE PLAN

INSTITUTIONAL SITE

APPOQUINIMINK HUNDRED, NEW CASTLE COUNTY,
DELAWARE

Prepared for:
DNREC, Division of Watershed Stewardship
Sediment and Stormwater Program
89 Kings Highway
Dover, DE 19901

Prepared by:
LandmarkJCM
100 W. Commons Blvd., Suite 300
New Castle, DE 19720

Civil Engineer Date

Preliminary Sediment & Stormwater Management Plan Review Checklist

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

PROJECT NAME: Example Plan - Residential Site

General Information:

1. X 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. N/A 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. X Hydraulic and Hydrology computations shall reflect the proposed site conditions.
4. X All plans should be submitted on 24" x 36" (minimum) sheets unless otherwise approved.
5. X 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. X Provide a north arrow on all plans.
7. X Provide all plan views to a defined scale with a scale bar.
8. X Provide names of adjacent property owners on all plans.
9. X 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. N/A 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. X Locate the site in NAD83 horizontal datum.
12. X 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. X Provide the seal of a Licensed Professional in the State of Delaware on all submitted plans and reports.
14. X 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. X Coversheet
    b. N/A Schematic Pre-Construction Site Stormwater Management Plan
    c. N/A Schematic Construction Site Stormwater Management Plan
    d. X Contributing Drainage Area Plan
    e. N/A Pre-Limit of Disturbance Drainage Area Plan
    f. X Post Limit of Disturbance Drainage Area Plan

Coversheet:

15. _X_ Project Header (to duplicate in the title block on each sheet):
    a. _X_ Project Name (and Phase, if applicable).
    b. _X_ Title of Plan Set: Preliminary Sediment and Stormwater Management Plans
    c. _X_ Project Location (including watershed, hundred, town, county, etc., as applicable).
    d. _X_ Project tax map identification number(s).
16. _X_ Legend indicating plan symbols and lines, including but not limited to, soils, drainage area information, grading and site information.
17. _X_ Provide a vicinity map with a scale either at 1" = ½ mile or 1" = 1 mile, depending on project size, and indicate the site boundary within the map. The map shall be no smaller than 4"x4" in size.
18. _X_ Project Notes:
    a. Parcel Data:
        i. _X_ Tax Map Number(s)
        ii. _X_ PLUS Number (if applicable)
        iii. _X_ DNREC Sediment and Stormwater Program [or relevant Delegated Agency] Number
        iv. _X_ Site Address (or Nearest Intersecting Street and Distance between)
        v. _X_ Latitude and Longitude State Plane coordinates, with approximate geographical location (ie, Benchmark #1, Northeast Site Corner, etc). Provide in degree decimal format.
        vi. _X_ Existing Site Area
        vii. _X_ Proposed Site Area
        viii. _X_ Existing Wetland Area
        ix. _____ Proposed Discharge Location(s)
        x. _____ Proposed Total Limit of Disturbance per Discharge Location
    b. Contact Data:
        i. Owner's Name, Title: _X_ Owner _X_ Land Developer _X_ Designer
        ii. Company/LLC: _X_ Owner _X_ Land Developer _X_ Designer
        iii. Full Street Address: _X_ Owner _X_ Land Developer _X_ Designer
        iv. Phone Number: _X_ Owner _X_ Land Developer _X_ Designer
        v. Fax Number: _X_ Owner _X_ Land Developer _X_ Designer
19. _X_ Include a Site Designer Certification that states "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." <u>This shall be signed in ink or an original reproducible.</u>
20. _X_ Provide a list of all sheets and their corresponding sheet number for all Preliminary Sediment and Stormwater Management Plans.

Schematic Construction Site Stormwater Management Plans:

The purpose of the Schematic Construction Site Stormwater Management Plan is to provide a preliminary design of the site's phasing in relation to the site's existing conditions and it's construction and stormwater facility locations. It will eventually be further developed into the Pre-Construction and Construction Site Stormwater Management Plan for the full plan submittal.

21. N/A Schematic Pre-Construction Site Stormwater Management Plan (if required, as determined at the SAS review meeting):
    a. _____ Include the entire site boundary in an existing conditions plan view (i.e., site boundary, existing contours, wetlands, treelines, existing structures/utilities to remain or to be removed, etc).
    b. _____ Indicate the approximate limit of disturbance per phase of construction. Provide a legend indicating the total disturbed acreage per limit of construction.
    c. _____ Indicate the location of all perimeter controls, stockpile locations, sediment trapping facilities, and other construction stormwater management controls needed for demolition and bulk grading (i.e., silt fence, stabilized construction entrances, temporary swales, sediment basins, etc).
    d. _____ Proposed contours are not required.
    e. _____ Provide a legend indicating the lines and symbols used to define the site and construction stormwater controls.
22. N/A Schematic Construction Site Stormwater Management Plan:
    a. _____ Include the entire site boundary in an existing conditions plan view (i.e., site boundary, existing contours, wetlands, treelines, existing structures to remain, etc).
    b. _____ Include a preliminary site plan view overlaid with the existing conditions. Include all lot and/or building outlines; right-of-ways and/or paved areas (whichever is less constrictive); and proposed stormwater locations including facilities, structures and pipes.
    c. _____ Indicate the approximate limit of disturbance per phase of construction. Provide a legend indicating the total disturbed acreage per limit of construction.
    d. _____ Indicate the location of all construction site stormwater controls, including perimeter controls, sediment controls, water controls, and pollution prevention controls. (i.e., silt fence, stabilized construction entrances, temporary swales, sediment basins, etc).
    e. _____ Proposed contours are not required, but should be included when available. If not flow arrows showing the drainage intent can suffice.
    f. _____ Provide a legend indicating the lines and symbols used to define the site and construction stormwater controls.

Drainage Area Plans:

The drainage area plans shall provide a graphic portrayal of the information that is contained with the DURMM worksheets. Any additional hydraulic or hydrologic computations that are required to show compliance with the *Delaware Sediment and Stormwater Regulations* may require additional drainage area or watershed plans (i.e., to satisfy the Cv and Fv requirements). These plans are not prescribed below, but shall follow similar guidelines, clearly indicate the parameters used within the calculations, and be contained within the plan Sediment and Stormwater Management Plan set.

23. _X_ Contributing Drainage Area Plan
    a. _X_ Provide a plan correlating to the Contributing Area RCN worksheet (post development model for the entire drainage area) for each subarea (subareas may be combined onto the same sheet, so long as they are clearly distinguishable).
    b. _X_ Provide soils mapping on the plan, using the latest NRCS soil information, with a general description of each soil.
    c. _X_ Indicate the LOD and the OLOD contributing areas, separated per their respective land cover and soil type classification. Provide the area of each designation.
    d. _X_ Provide a legend indicating the various landuse covers (a hatch shall be provided for each type of landuse).
    e. _X_ Provide a summary table indicating the sub-areas and their respective point of analysis, total area, and RCN.
    f. _N/A_ Show the Tc path for the area outside the LOD as used in the OLOD worksheet.
    g. _X_ Show the Tc path for any other areas that require further analysis using other H&H software.
24. _N/A_ Pre-Limit of Disturbance Drainage Area Plan
    a. _____ Provide a plan correlating to the Pre LOD information requested in the LOD worksheet (location of woods and meadow condition within the LOD per sub-area prior to disturbance) for each subarea (subareas may be combined onto the same sheet, so long as they are clearly distinguishable).
    b. _____ Provide soils mapping on the plan, using the latest NRCS soil information, with a general description of each soil.
    c. _____ Indicate the areas of woods and/or meadow condition per soil type classification. Provide the area of each designation.
    d. _____ Provide a legend indicating the various landuse covers (a hatch shall be provided for each type of landuse).
    e. _____ Provide a summary table indicating the sub-areas and their respective point of analysis, total area, and RCN.
25. _X_ Post Limit of Disturbance Drainage Area Plan
    a. _X_ Provide a plan correlating to the Post LOD information requested in the LOD worksheet (location of all impervious areas). This should only be done if the LOD and OLOD cannot be shown on the Contributing Area Plan due to sizing.
    b. _X_ Provide soils mapping on plan, using the latest NRCS soil information, with a general description of each soil.
    c. _X_ Indicate the impervious area with the subarea. Provide the area of each designation.
    d. _X_ Provide a legend indicating the various landuse covers (a hatch shall be provided for each type of landuse).
    e. _X_ Provide a summary table indicating the sub-areas and their respective point of analysis, total area, and RCN.

Stormwater Management Report:

26. __X__ Provide information in the report in the following order:
    - a. __X__ Coverpage
    - b. __X__ Table of Contents
    - c. __X__ Site Narrative:
        - a. __X__ Introduction
        - b. __X__ Existing Conditions describing the drainage patterns, landuse(s), and existing features. Include 2007 site aerial, photos of site conditions and at all discharge locations.
        - c. __X__ Existing Soils description per the NRCS Web Soil Survey including the hydrologic soil group; and soil testing results from on-site soil testing.
        - d. __X__ Post Development Conditions, including summary of the proposed development, the proposed drainage system, indication of why the standards or performance approach was utilized, methods for RPv, Cv, and Fv compliance, requests for waivers and/or offsets, etc.
        - e. _____ Construction Site Conditions, describing methods to prevent sediment and pollution discharge and illicit transportation.
        - f. __X__ Conclusion
    - d. __X__ DURMM computations
    - e. __N/A__ Additional hydraulic and hydrologic computations, such as pond and discharge pipe/swale routings.
    - f. __N/A__ Supplementary Construction Site computations (i.e., temporary sediment basin design worksheet, anti-seep collar sizing, forebay sizing, etc).
    - g. __N/A__ Soil report(s) including boring locations and log reports.
    - h. __X__ Appendix containing any supplemental information (information previously included within the Stormwater Assessment Study report does not need to be duplicated).
27. __X__ Provide drainage calculations for the RPv, Cv, and Fv events using the latest DURMM model and other approved H&H software as required.
28. __X__ All inputted data must be supported by surveys, Lidar information, photos, aerials, maps, etc. and shall be referenced in the report and/or drainage area plans. Information previously included within the Stormwater Assessment Study submittal is acceptable and does not need to be duplicated.
29. __N/A__ All hydrologic computations shall be accomplished using the most recent version of USDA, Soil Conservation Service TR-20 or TR-55. The storm duration for computational purposes shall be the 24-hour rainfall event. For projects south of the Chesapeake and Delaware (C&D) Canal, the Delmarva Unit Hydrograph shall be used.
30. __X__ The pre-development condition shall be based off of the 2007 aerial photography provided by the State of Delaware, through the Delaware DataMIL and online GIS mapping. This may not directly correlate to current site conditions if the landuse has changed; however, the 2007 landuse shall be used regardless if more or less conservative than the current landuse.
31. __N/A__ The pre-development peak discharge rate shall be computed assuming that all land uses in the site to be developed are in good hydrologic conditions.

Contents

1.0 INTRODUCTION

Landmark/JCM was retained by the Appoquinimink School District to prepare construction plans for a school campus for a portion of Tax Parcel 14-007.00-028 located off of Old State Road in Odessa, Delaware. The design was completed and approved under the current regulations. This site has been chosen as the Institutional Site example to be analyzed under the proposed regulations for illustrative purposes. This report will provide the required elements of the new DNREC Preliminary Sediment and Stormwater Management Plan Checklist and will provide discussion and comparison of the original site design with the results obtained from the DURMM v2 analysis. In the interest of simplicity, only a portion of the overall site has been included in this example report, including a selection of best management practices.

2.0 EXISTING CONDITIONS

Landmark/JCM prepared this stormwater report for the proposed construction of a school campus plan for the Appoquinimink School District on a portion of Tax Parcel 14-007.00-028 located off of Old State Road in Odessa, Delaware.

2.1 Physical Location

The property is located within a developing area and the Appoquinimink School District is rapidly expanding. The site is located west of Old State Road. The school site is surrounded on three sides by the Appoquinimink Creek. The Appoquin Farms subdivision lies to the north of the parcel and the Spring Creek subdivision lies to the south of the parcel. The remaining portion of Tax Parcel 14-007.00-028 lies across Old State Road and will continue to be farmed during the near future.

2.2 Topography

The site has a general high point approximately 1,700 feet off Old State Road and centrally located within the site. There is generally 48 feet of fall from the site to three sides containing the Appoquinimink Creek. A small portion of the site drains toward Old State Road and along the roadway in a ditch.

2.3 Soils and Geology

The site soils are mapped as follows:
(Ba)Broadkill-Appoquinimink complex, very frequently flooded, tidal, HSG 'D';
(DoB) Downer sandy loam, 2 to 5 percent slopes, HSG 'B';
(FgA) Fallsington loam, 0 to 2 percent slopes, HSG 'D';
(KhC) Keyport sandy loam, 5 to 10 percent slopes, moderately well drained, HSG 'C';
(KmE) Keyport loam, 10 to 25 percent slopes, HSG 'C';
(KpA) Keyport silt loam, 0 to 2 percent slopes, moderately well drained, HSG 'C';
(KpB) Keyport silt loam, 2 to 5 percent slopes, moderately well drained, HSG 'C';
(LhA) Lenni silt loam, 0 to 2 percent slopes, poorly drained, HSG 'D';
(Lk) Lenape mucky peat, very frequently flooded, tidal, HSG 'D';
(Ln) Lenape-Nanticoke complex, very frequently flooded, tidal, HSG 'D';
(LO) Longmarsh and Indiantown soils, frequently flooded, HSG 'D';
(ReA) Reybold silt loam, 0 to 2 percent slopes, well drained, HSG 'B';
(ReB) Reybold silt loam, 2 to 5 percent slopes, well drained, HSG 'B';
(ReC) Reybold silt loam, 5 to 10 percent slopes, well drained, HSG 'B';
(SaC) Sassafras sandy loam, 5 to 10 percent slopes, well drained, HSG 'B';
(WoA) Woodstown loam, 0 to 2 percent slopes, HSG 'C';
(Za) Zekiah sandy loam, frequently flooded, HSG 'D'

A Subsurface Exploration was performed in May 2010. Test pits and soil borings have been performed within the proposed location of potential bioretention and infiltration areas to

evaluate subsurface soil conditions and to determine the depth to the seasonal high water table. Infiltration testing was also performed to evaluate the soils' engineering and hydraulic properties. The elevation of the seasonal high water table was determined to be approximately EL 20 to 25 feet below grade. Field tested infiltration rates were also determined to range from 2 to 10 inches per hour. Soil borings were also performed in the locations of the proposed buildings. Several test pits were located around the site to determine possible areas to achieve acceptable infiltration rates. It was determined that while some areas across the site contained soils that represented Hydrologic Soil Group A and achieved field tested infiltration, much of the area contains underlying soils that more accurately represent Hydrologic Soil Group D with lower field tested infiltration rates. Typical infiltration rates for the soils observed at the site were 0.02 to 0.09 in/hr. It is typically recommended that infiltration practices be proposed for soils with an infiltration rate of 0.5 in/hr or greater. Based on the long-term infiltration rates it was recommended that stormwater infiltration practices not be considered for stormwater quality management practices. This project proposes the use of bioretention facilities with underdrains to manage stormwater quality runoff along with grassed filter strips and bioswales.

2.4 Surface Water

Surface water is currently not managed by any practice. Surface water is generally concentrated within the farm field as furrows or rows are planted as demonstrated by the TR-55 classification for straight row crops with crop residue and good condition. The fields are tilled right up to the existing wood line where runoff is shallow concentrated through the existing underbrush and tree canopy. There are existing drainage cuts and ditches within the tree canopy that channelize the runoff to the Appoquinimink Creek.

The proposed construction intends to provide for the implementation of Green Technology Best Management Practices to mitigate the construction of impervious areas. There will be bioretention basins filter strips and bioswales placed in or near parking lot groupings and at the edges of parking areas and roadways.

2.5 100-Year Floodplain

This site is mapped within a "Zone A" area of 100-year flooding in accordance with the Flood Insurance Rate Map Number 10003C0310-G and 10003C0320-G dated January 17, 2007. Zone A has no elevation data attributed to it. DNREC is currently working with URS to establish limits of updated flooding within this area. Landmark/JCM obtained current hydrodynamic modeling of the Delaware Bay and Estuaries performed by the U.S.A.C.O.E. establishing the 100-year flooding limits of the Appoquinimink River to be elevation 8.73, NAVD. For ease of mapping, Landmark/JCM has mapped the 100-year flood limit as contour elevation 9.0, NAVD. A LOMR has been submitted to FEMA and approved based on updated topography information. The remaining portions of the site are located in Zone X and are described as areas determined to be outside the 0.2% annual chance floodplain.

The main school structures are proposed to be between elevation 44 and elevation 50 with the outer loop road to have an approximate minimum elevation 26.0.

3.0 ENVIRONMENTAL CONSIDERATIONS

3.1 Wetlands

According to the Statewide Wetlands Mapping Project (SWMP) mapping, tidally influenced estuarine emergent wetlands (E2EM1N) circumscribe much of the parcel's boundary. Additionally, palustrine freshwater tidal (PSS1 & PFO1R) and non-tidal (PF01A7 & PUBFx) wetlands are found in the headwater reaches and immediately drain into the estuarine wetlands.

This site was evaluated in April and May 2010 in accordance with the procedures set forth in the 1987 Corps of Engineers Wetland Delineation Manual (Technical Report Y-87-1), and subsequent public notices, to identify the presence of jurisdictional wetlands and wetlands were found to exist on the site. See Wetland Report dated May 2010 by Landmark/JCM.

3.2 Streams

This project is bordered on three (3) sides by the Appoquinimink Creek, which is tidal in this area. This project proposes compliance with the Delaware Sediment and Stormwater Regulations, Sections 5.3.3.2 and 5.4.3.2. Provisions will be made or exist for a nonerosive conveyance system to tidewater by either a closed drainage system or by open channel flow that has adequate capacity and stability for the conveyance event (Cv) and the flooding event (Fv).

3.3 Existing Erosion

The upper reach of the existing drainage way to the south west of the project has experienced head cut erosion. The peripheral areas of the Appoquinimink Creek are well vegetated and stabilized. There are isolated areas where sediment is conveyed from the farm field and lies around the bottom of the slopes. This project proposes to direct temporary erosion control measures to by-pass the area of existing erosion. No erosion is anticipated due to the final grading operations of the site. Development includes measures to reduce the overall area draining through the head cut erosion and erosion control measures at all outfall points.

4.0 RESOURCE PROTECTION EVENT

The runoff from all areas disturbed by the proposed development will be managed for resource protection event runoff reduction and water quality by Best Management Practices (BMP's) such as bioretention facilities, biofiltration swales, and vegetated filter strips. These facilities will capture the storm runoff, reduce the resource protection event volume and reduce pollutant loading. As previously stated, only a portion of the overall site has been included in the analysis with DURMM v2. The BMP's that have been evaluated are discussed below. The data that was used in the DURMM v2 spreadsheets is summarized in the following tables. Please refer to the Pre-LOD and Post-LOD Worksheets for delineation of these areas.

PRE-LOD DATA SUMMARY TABLE

BMP	TOTAL AREA (AC.)	HSG B			HSG C			HSG D		
		TOTAL	PRE IMPERV	WOODS/ MDW	TOTAL	PRE IMPERV	WOODS /MDW	TOTAL	PRE IMPERV	WOODS /MDW
FS 3+BS 1	4.37	1.84	--	--	.41	--	--	2.12	--	--
FS 5	0.50	0.50	--	--	--	--	--	--	--	--
BS 2	2.65	1.92	--	--	0.73	--	--	--	--	--
BIO 1	1.12	0.81	--	--	0.23	--	--	0.08	--	--
BS 4	2.43	1.74	--	--	0.69	--	--	--	--	--
FS 9	0.77	--	--	--	0.77	--	--	--	--	--
BS 5	1.12	--	--	--	1.12	--	--	--	--	--

POST-LOD DATA SUMMARY TABLE

BMP	TOTAL AREA (AC.)	HSG B			HSG C			HSG D		
		TOTAL	POST IMPERV	GRASS, GOOD	TOTAL	POST IMPERV	GRASS, GOOD	TOTAL	POST IMPERV	GRASS, GOOD
FS 3+BS 1	4.37*	1.84	1.05	0.79	.41	0.11	0.30	2.12	0.19	1.93
FS5	0.50	0.50	0.30	0.20	--	--	--	--	--	--
BS 2	2.65	1.92	0.76	1.16	0.73	0.23	0.50	--	--	--
BIO 1	1.12	0.81	0.65	0.16	0.23	0.12	0.11	0.08	0.05	0.03
BS 4	2.43	1.74	0.30	1.44	0.69	0.10	0.59	--	--	--
FS 9	0.77	--	--	--	0.77	--	--	--	--	--
BS 5	1.12	--	--	--	1.12	--	--	--	--	--

*Not including OLOD area

4.1 Bioretention Area 1

The drainage area for Bioretention Area 1 is labeled BIO 1. This area includes B, C and D soils with a predeveloped cover of row crop and a postdeveloped cover of parking lot and minor lawn area.

The in-situ soils do not offer any significant infiltration capabilities as outlined in the attached geotechnical report. An underdrain is provided due to low infiltration potential. The surface area of the bioretention bed is 2,536 sf. The storage volume available up to 6" above the surface of the biomedia is 5,937 cf. as currently designed. As currently designed, Bioretention Area 1 does not provide the required RPv runoff reduction and has a shortfall of 0.46 in. The facility (with the underdrain) would need to be expanded to provide 9,710 cf of storage volume to meet the RPv runoff reduction requirements. Alternately, if infiltration were possible, the facility would already meet the RPv runoff reduction requirement with 0.27 in. to spare.

BIORETENTION AREA 1: ALTERNATIVES COMPARISON

Area: 1.12 ac. RCN: 89.88
RPv: 1.94 in. Req'd RPv: 1.19 in. (reduction of 0.75 in.)

	Original Design	Expanded	Orig. w/ infiltration
Volume provided*	5937 cf	9710 cf	5937 cf
Retention Reduction Allowance	50%	50%	100%
Retention Reduction Volume (a.f.)	0.07	0.11	0.14
Adjusted CN after reduction	76.45	65.65	57.91
RPv Runoff Reduction	0.73	1.20	1.46
RPv volume after reduction (in.)	1.21	0.75	0.48
Shortfall or Surplus (in.)	-0.46	+0.01	+0.27
Shortfall (c.f.)	1682	n/a	n/a

*Volume @ 6" above biomedia

4.2 Bioswale 1 and Filter Strip 3

The drainage area for Filter Strip 3 (FS 3) is a portion of the drainage area for Bioswale 1 (BS 1). This area includes B, C, and D soils with a predeveloped cover of row crop and postdeveloped cover of the rear bus parking lot, a small portion of roof, lawn area and partial sports field area. An offsite area is included as draining to Bioswale 1 as area outside the limit of disturbance (OLOD) with a cover of 0.5-acre residential with both B and D soils. A large percentage of the impervious runoff flows through FS 3 prior to BS 1 so they have been treated as two practices in sequence for the same drainage area. FS 3 alone is not sufficient to reduce the RPv volume but, in sequence with BS 1, the runoff reduction requirement is met with a surplus of 0.33 in.

4.3 Bioswale 2 and Filter Strip 5

The drainage area for Bioswale 2 and Filter Strip 5 includes B and C soils with a predeveloped cover of row crop and postdeveloped cover of parking area, roof runoff, sidewalk, a portion of the entrance drive and lawn area. The drainage area for Filter Strip 5 is a portion of the drainage area for Bioswale 2. This area is made up of parking and sidewalk. However, FS 5 is only a small portion of the total area so it has been run separately and then entered in as an upstream area. BS 2, as designed, does not meet the runoff reduction requirement, with a shortfall of 0.05 in. This result is based on 75% A/B soils. If the swale were located in 100% A/B soils, it would meet the runoff reduction requirement. Alternately, if the swale were converted to a bioretention area with an underdrain, it would also meet the runoff reduction requirement. Looking at the grading and the pipe invert, this is possible and, although a more expensive practice, it could be done without changing the site layout.

4.4 Bioswale 4

The drainage area for Biofiltration Swale 4 includes B and C soils with a predeveloped cover of row crop. Postdeveloped cover consists of lawn area and part of the exterior loop road in front of the Early Childhood Center. The road drainage enters BS 4 by curb cuts along the road. The runoff reduction requirement is met with a surplus of 0.17 in.

4.5 Bioswale 5 and Filter Strip 9

The drainage area for Bioswale 5 and Filter Strip 9 is predominantly C soils with a predeveloped cover of row crop and postdeveloped cover of outdoor classroom and sidewalks, a portion of the entrance drive and lawn area. The drainage area for Filter Strip 9 is a portion of the drainage area for Bioswale 5. FS 9 treats the outdoor theater. However, FS 9 is only a small portion of the total area so it has been run separately and then entered in as an upstream area. BS 5, as designed, does not meet the runoff reduction requirement, with a shortfall of 0.04 in. This result is based on 0% A/B soils. If the swale were located in only 20% A/B soils, it would meet the runoff reduction requirement.

5.0 CONVEYANCE AND FLOODING EVENTS

This project proposes compliance with the Delaware Sediment and Stormwater Regulations Sections 5.3.3.2 and 5.4.3.2. Provision will be made or exists for a non-erosive conveyance system to tidewater by either a closed drainage system or by open channel flow that has adequate capacity and stability for the conveyance event (Cv) and the flooding event (Fv).

Cv AND Fv SUMMARY TABLE

	Conveyance Event (Cv)				Flooding Event (Fv)			
PRACTICE	RCN	Cv Volume (in)	Reduced Volume (in)	% Reduction	RCN	Fv Volume (in)	Reduced Volume (in)	% Reduction
BS 1 + FS 3	76.46	2.59	2.41	7%	78.06	5.45	5.40	1%
BS 2 + FS 5	75.94	2.49	2.37	5%	76.94	5.32	5.27	1%
BIO 1	74.06	3.67	2.21	40%	77.48	6.79	5.33	22%
BS 4	68.99	1.91	1.81	5%	69.86	4.49	4.45	1%
BS 5 + FS 9	79.89	2.85	2.71	5%	80.97	5.80	5.74	1%

6.0 HYDROLOGIC COMPUTATIONS

Any hydrologic computations that might be required (not applicable in this case) shall be accomplished using HydroCAD software based on TR-55 and TR-20. The storm duration for computational purposes shall be the 24-hour rainfall event. For projects south of the Chesapeake and Delaware (C&D) Canal, the Delmarva Unit Hydrograph shall be used.

7.0 CONSTRUCTION SITE CONDITIONS

The site construction for building the Elementary School and Early Childhood Center is proposed to take place in one phase. Total site disturbance is proposed to be 68.7 acres. The subject parcel is 272.20 acres with 107.70 acres of protected resources. The disturbance is proposed to be broken up to limit the maximum disturbance to approximately 20 acres. The Pre-bulk erosion control will be broken up into several phases. In designing the erosion and sediment controls for this project, site construction will need to be broken up into four (4) manageable disturbance areas.

8.0 CONCLUSIONS

The Summary Tables provided (see Tables 1, 2, and 3) account for the runoff reduction for the overall contributing area analyzed. All five subareas considered in this report with the eight practices have been included. Table 1 represents the original design. Table 2 represents the original design with an expanded BIO 1. Table 3 represents the same with BIO 1 assuming infiltration capability. Table 1 shows reveals that the original design just misses meeting the requirements by a shortfall of -0.03 in. with an offset volume of 2,041 cf. Table 2 shows the runoff reduction goal met by a margin of +0.44 in. Table 3 shows the runoff reduction goal met by a margin of +0.70 in. It is clear that the original design done in accordance with the current regulations comes very close to meeting the proposed DURMM v2 criteria and with some minor modifications, the DURMM v2 requirements can be met with relatively minor impact to the site design. It is also clear that locating practices in A/B soils and taking advantage of any available infiltration yields the most effective design of BMP's.

DURMM v2: INSTITUTIONAL SITE
SUMMARY TABLE 1

Summary Table for Sub-Areas Draining to a Common Point of Interest (POI)[1]									
Ref. #	Sub-Area ID[2]	Contributing Area (ac)	RPv Runoff Reduction Shortfall(+) or Credit(-) (in.)[3]	Adjusted RPv CN after all reductions[4]	Cv RCN for H&H Modeling[4]	Fv RCN for H&H Modeling[4]	TN Pollutant Load (lb/yr)	TP Pollutant Load (lb/yr)	TSS Pollutant Load (lb/yr)
1	BS 1 + FS 3	10.15	-0.33	66.66	76.46	78.06	6.50	0.88	195.00
2	BS 2 + FS 5	3.15	0.03	65.25	75.94	76.94	4.07	0.55	122.00
3	BIO 1	1.12	0.46	76.45	74.06	77.48	7.78	1.05	233.00
4	BS 4	2.43	-0.17	60.71	68.99	69.86	3.16	0.43	95.00
5	BS 5 + FS 9	1.89	0.04	75.04	79.89	80.97	6.64	0.90	199.00
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
Totals to Common POI		18.74 ac	0.03 in.	67.08	75.61	77.07	28.15 lb/yr	3.81 lb/yr	844.00 lb/yr
RPv Runoff Reduction Goal Met?			NO						
	If Not, Total Offset Volume Required		2,041 cu. ft.						

Notes:

1. As long as the site lies within the same watershed, all sub-areas within the site can be tallied to reflect global site conditions; or, the summary table can be used to show conditions to a specific POI.
2. Only the furtherst downstream sub-area information should be entered for a series of sub-areas that drain directly into each other.
3. A RPv runoff reduction shortfall should be entered as a positive number, as it is the runoff volume still needed to be reduced. A RPv credit should be entered as a negative number, as it indicates the additional volume that was reduced past the requirement.

DURMM v2: INSTITUTIONAL SITE
SUMMARY TABLE 2

Summary Table for Sub-Areas Draining to a Common Point of Interest (POI)[1]									
Ref. #	Sub-Area ID[2]	Contributing Area (ac)	RPv Runoff Reduction Shortfall(+) or Credit(-) (in.)[3]	Adjusted RPv CN after all reductions[4]	Cv RCN for H&H Modeling[4]	Fv RCN for H&H Modeling[4]	TN Pollutant Load (lb/yr)	TP Pollutant Load (lb/yr)	TSS Pollutant Load (lb/yr)
1	BS 1 + F5 3	10.15	-0.33	66.66	76.46	78.06	6.50	0.88	195.00
2	BS 2 + F5 5	3.15	0.03	65.25	75.94	76.94	4.07	0.55	122.00
3	BIO 1-EXP	1.12	-0.01	65.65	61.48	69.46	4.99	0.84	144.00
4	BS 4	2.43	-0.17	60.71	68.99	69.86	3.16	0.43	95.00
5	B5 5 + F59	1.89	0.04	75.04	79.89	80.97	6.64	0.90	199.00
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
Totals to Common POI		18.74 ac	-0.44 in.	66.44	74.85	76.59	25.36 lb/yr	3.60 lb/yr	755.00 lb/yr
RPv Runoff Reduction Goal Met?			YES						
If Not, Total Offset Volume Required			N/A						

Notes:

1. As long as the site lies within the same watershed, all sub-areas within the site can be tallied to reflect global site conditions; or, the summary table can be used to show conditions to a specific POI.
2. Only the furtherst downstream sub-area information should be entered for a series of sub-areas that drain directly into each other.
3. A RPv runoff reduction shortfall should be entered as a positive number, as it is the runoff volume still needed to be reduced. A RPv credit should be entered as a negative number, as it indicates the additional volume that was reduced past the requirement.

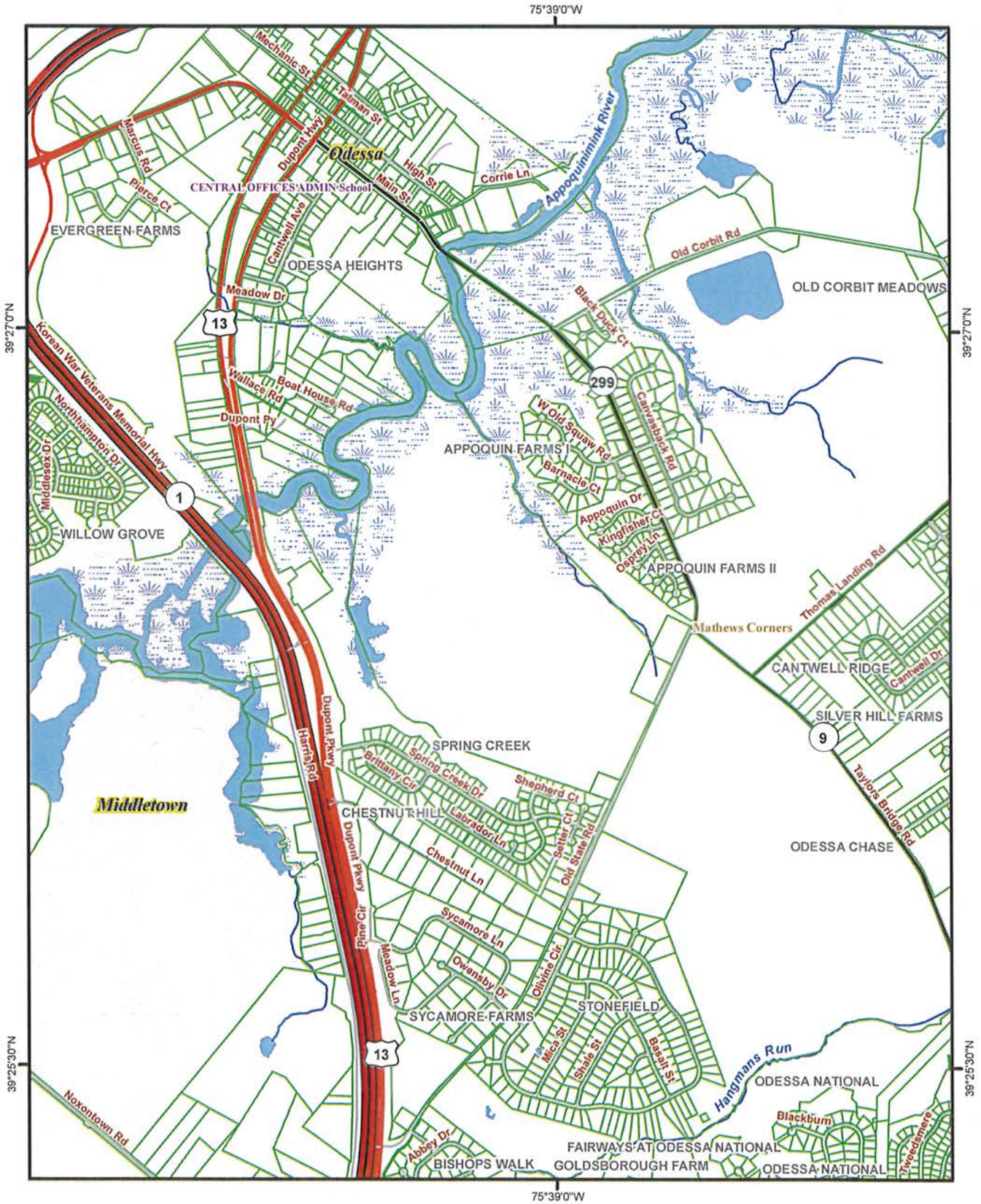
DURMM v2: INSTITUTIONAL SITE
SUMMARY TABLE 3

Summary Table for Sub-Areas Draining to a Common Point of Interest (POI)[1]									
Ref. #	Sub-Area ID[2]	Contributing Area (ac)	RPv Runoff Reduction Shortfall(+) or Credit(-) (in.)[3]	Adjusted RPv CN after all reductions[4]	Cv RCN for H&H Modeling[4]	Fv RCN for H&H Modeling[4]	TN Pollutant Load (lb/yr)	TP Pollutant Load (lb/yr)	TSS Pollutant Load (lb/yr)
1	BS 1 + FS 3	10.15	-0.33	66.66	76.46	78.06	6.50	0.88	195.00
2	BS 2 + FS 5	3.15	0.03	65.25	75.94	76.94	4.07	0.55	122.00
3	BIO 1-INF	1.12	-0.27	59.91	74.06	77.48	3.08	0.42	93.00
4	BS 4	2.43	-0.17	60.71	68.99	69.86	3.16	0.43	95.00
5	BS 5 + FS 9	1.89	0.04	75.04	79.89	80.97	6.64	0.90	199.00
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
Totals to Common POI		18.74 ac	-0.70 in.	66.09	75.61	77.07	23.45 lb/yr	3.18 lb/yr	704.00 lb/yr
RPv Runoff Reduction Goal Met?			YES						
If Not, Total Offset Volume Required			N/A						

Notes:

1. As long as the site lies within the same watershed, all sub-areas within the site can be tallied to reflect global site conditions; or, the summary table can be used to show conditions to a specific POI.
2. Only the furtherst downstream sub-area information should be entered for a series of sub-areas that drain directly into each other.
3. A RPv runoff reduction shortfall should be entered as a positive number, as it is the runoff volume still needed to be reduced. A RPv credit should be entered as a negative number, as it indicates the additional volume that was reduced past the requirement.

State of Delaware



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Kilometers

0 550 1100 2200
Feet

Data on map are based on Delaware framework data layers. The Delaware DataMIL is maintained by the Delaware Geological Survey (DGS) and served via the Delaware Department of Technology and Information (DTI) internet.

Magnetic Declination
Approx. 11 mils

DataMIL Mini Map

Effective April 2016

State of Delaware

Scale 1:40,185

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Kilometers

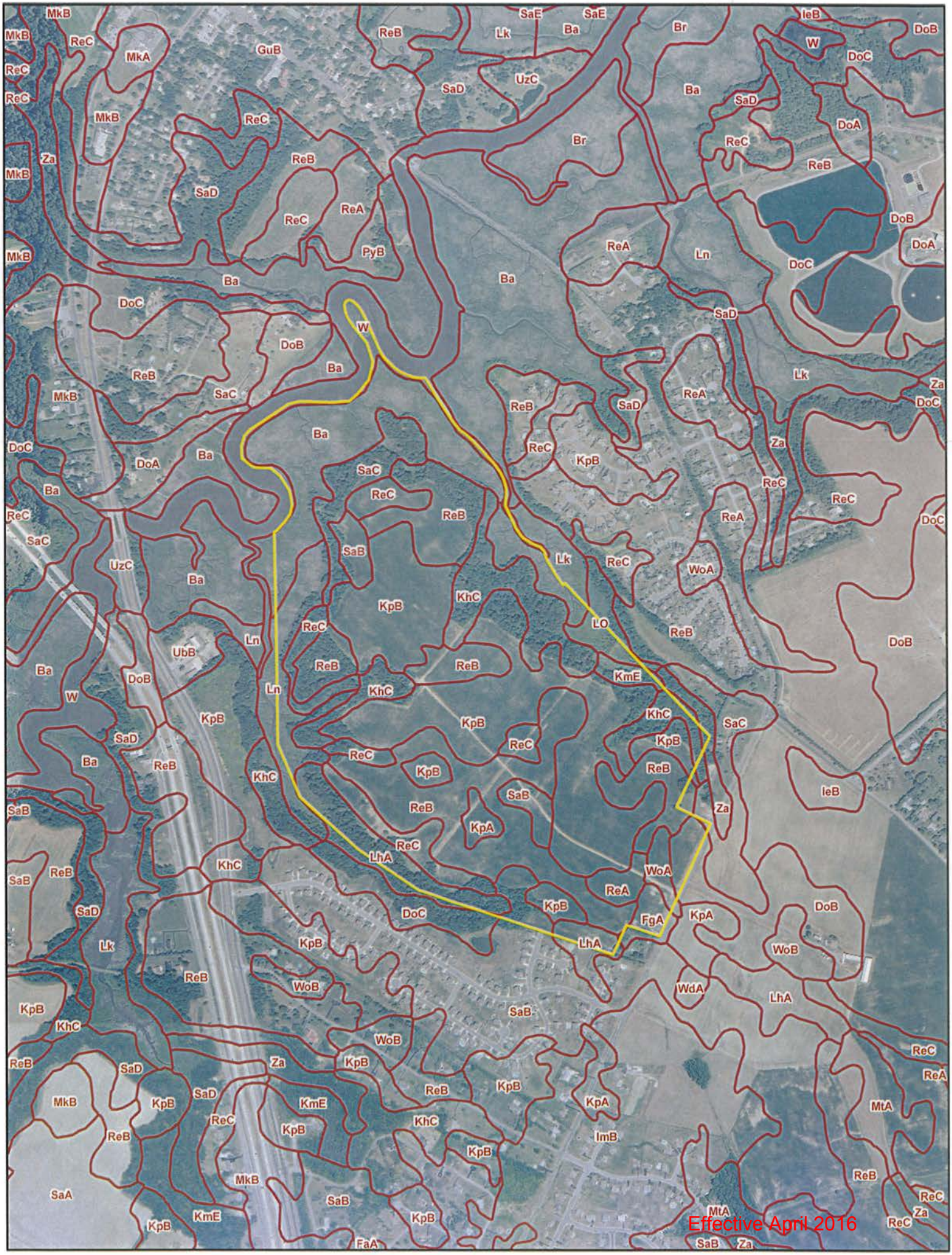
0 1100 2200 4400
Feet

Data on map are based on Delaware framework data layers. The Delaware DataMIL is maintained by the Delaware Geological Survey (DGS) and served via the Delaware Department of Technology and Information (DTI) internet.

Magnetic Declination
Approx. 11 mils

DataMIL Mini Map

Effective April 2016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W
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ReA
Za
PyB
Ln
KpB
KhC
LO
KmE
WoA
UbB
DoB
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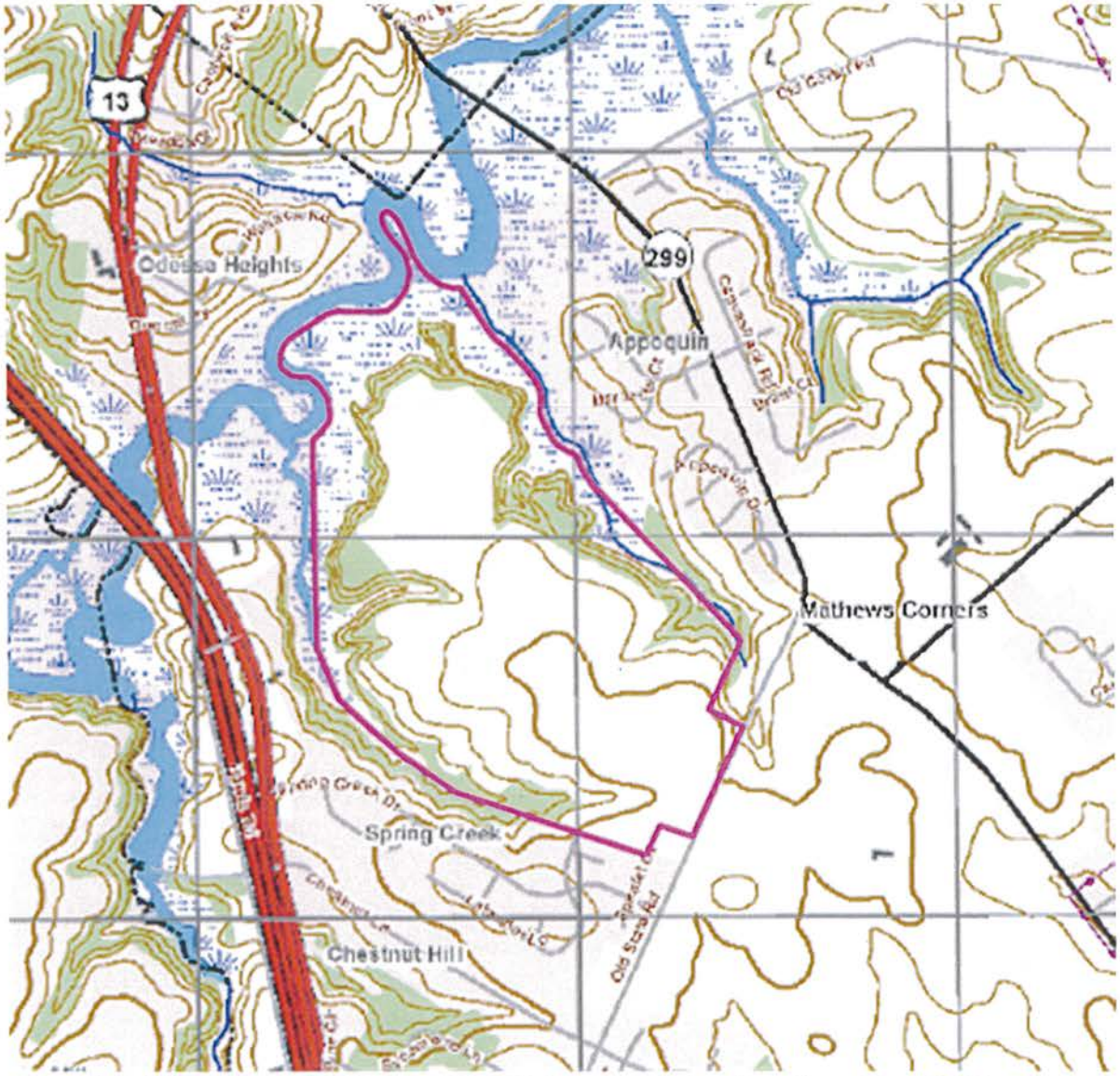
Effective April 2016



Middletown 7.5 Minute USGS Topographic Map from DataMIL
(not to scale, for reference only)

State of Delaware

Scale 1:10,044

0 0.03 0.06 0.075 0.15
Kilometers

0 270 540 1080
Feet

Magnetic Declination
Approx. 11 mils

DataMIL Mini Map

Data on map are based on Delaware framework data layers. The Delaware DataMIL is maintained by the Delaware Geological Survey (DGS) and served via the Delaware Department of Technology and Information (DTI) internet.

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 4
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39	1.44	61	0.59	74		80
Impervious Areas										
	Paved parking lots, roofs, driveways			98	0.3	98	0.1	98		98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0		1.74		0.69		0	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	2.43
Weighted Runoff Curve Number (RCN)	70

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 4
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)		1.74	0.69	
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***		0.3	0.1	0.05
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	17%	14%	0%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	67.38	77.48	0.00
2.2 RPv per HSG (in.)	0.00	0.81	1.26	0.00
2.3 Target Runoff per HSG (in.)	0.00	0.58	1.10	0.00
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.75	0.75	0.00
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	2.25	2.25	0.00

2.6 Subarea LOD (ac)	2.43
2.7 Subarea Weighted RCN	70.25
2.8 Subarea Weighted RPv (in.)	0.94
2.9 Subarea Weighted Target Runoff (in.)	0.73

RPv Target Runoff (in.)	
Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID				
3.2 Upstream LOD Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	2.43
4.2 Weighted RCN	70.25
4.3 Weighted RPv (in.)	0.94
4.4 Weighted Target Runoff (in.)	0.73
4.5 Estimated Annual Runoff (in.)	11.62
4.6 Req'd Runoff Reduction within LOD (in.)	0.21
4.7 Req'd Runoff Reduction within LOD (%)	22%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 4
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

	DMV	
3.1 Unit Hydrograph Type		
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

STD Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1		0.10	2.55323	-0.61512	-0.16403	
2		0.30	2.46532	-0.62257	-0.11657	
3		0.35	2.41896	-0.61594	-0.08820	
4		0.40	2.36409	-0.59857	-0.05621	
5		0.45	2.29238	-0.57005	-0.02281	
6		0.50	2.20282	-0.51599	-0.01259	log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A	#N/A

DMV Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1		0.10	2.33733	-0.68709	-0.10847	
2		0.30	2.22599	-0.68545	-0.03220	
3		0.35	2.17707	-0.66476	-0.00830	
4		0.40	2.12341	-0.63854	0.01624	
5		0.45	2.06447	-0.59720	0.02867	
6		0.50	1.99673	-0.53417	0.03114	log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A	#N/A

UH STD	curve number	Ia (in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

Effective April 2016

PROJECT: INSTITUTIONAL
DRAINAGE SUBAREA ID: BS 4
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Bioswale	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	2.43		2.43		2.43		2.43		2.43	
1.2 *Reserved*										
1.3 Initial RCN	70.25									
1.4 RPv for Contributing Area (in.)	0.94									
1.5 Req'd RPv Reduction for Contributing Area (in.)	0.21									
1.6 Req'd RPv Reduction for Contributing Area (%)	22%									
1.7 RPv allowable discharge rate (cfs)	0.10									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0									
2.2 Retention reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	0.94		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	70.48		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	70.25		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	11.62		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	60%									
3.4 Annual runoff reduction allowance (%)	40%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	6.97		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	60.71		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.37		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	0.57		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	0.37		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	39%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	60.71		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	70.42		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	OK		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	N/A		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	N/A		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	N/A		N/A		N/A		N/A		N/A	

DURMM BMP Name

--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**BS 4**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Bioswale			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	2.43																			
1.2 Initial RCN	70																			
1.3 Annual runoff volume (in.)	11.62																			
1.4 Annual runoff volume (liters)	2.90E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		5.81E+06	7.84E+05	1.74E+08																
2.4 Stormwater Load (lb/ac/yr)		5.27	0.71	158		3.16	0.43	95		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	40%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		40%	40%	40%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		3.16	0.43	95		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		OK	OK	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		0.00	0.00	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		0%	0%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		0.57	0.57	0.57		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.00	0.00	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 4
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioswale**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	2.43		2.43		2.43		2.43		2.43	
1.2 Initial RCN	70.25									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	1.91									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Cv allowable discharge rate (cfs)	1.82									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	1.91		1.81		#N/A		#N/A		#N/A	
2.5 CN*	70.25		68.99		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	5%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	1.81		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	68.99		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.10		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	1.81		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	5%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	68.99		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 4
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioswale**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	2.43		2.43		2.43		2.43		2.43	
1.2 Initial RCN	70.25									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	4.49									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Fv allowable discharge rate (cfs)	5.47									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	4.49		4.45		#N/A		#N/A		#N/A	
2.5 CN*	70.25		69.86		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	1%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	4.45		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	69.86		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.04		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	4.45		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	1%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	69.86		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 4
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	2.43				
C.A. RCN	70				
Subarea LOD (ac.)	2.43				
Upstream Subarea ID	0	0	0	0	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	2.43				
Combined RCN with Upstream Areas (ac.)	70.25				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Bioswale	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	0.94				
Req'd RPv Reduction for Contributing Area (in.)	0.21				
Req'd RPv Reduction for Contributing Area (%)	22%				
C.A. allowable discharge rate (cfs)	0.10				
Unmanaged Polluant load, TN (lbs/ac/yr)	5.27				
Unmanaged Polluant load, TP (lbs/ac/yr)	0.71				
Unmanaged Polluant load, TSS (lbs/ac/yr)	158				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	0.57	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.37	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	39%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	OK	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	3.16	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.43	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	95	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	N/A	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	1.91				
Stds-based allowable discharge (cfs)	1.82				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	1.81	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	4.49				
Stds-based allowable discharge (cfs)	5.47				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	4.45	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	2.43
C.A. RCN	70
LOD Area (ac.)	2.43
Weighted Target Runoff (in.)	0.73
Adjusted CN after all reductions	60.71
Adjusted RPv (in.)	0.57
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	68.99
Flooding Event, Fv	8	69.86

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 2 + FS 5
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39	1.16	61	0.5	74		80
Impervious Areas										
	Paved parking lots, roofs, driveways			98	0.76	98	0.23	98		98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0		1.92		0.73		0	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1	FS 5	0.5	83
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	**3.15**
Weighted Runoff Curve Number (RCN)	**78**

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 2 + FS 5
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)		1.92	0.73	
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***		0.76	0.23	
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	40%	32%	0%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	75.65	81.56	0.00
2.2 RPv per HSG (in.)	0.00	1.17	1.47	0.00
2.3 Target Runoff per HSG (in.)	0.00	0.58	1.10	0.00
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.75	0.75	0.00
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	2.25	2.25	0.00

2.6 Subarea LOD (ac)	2.65
2.7 Subarea Weighted RCN	77.28
2.8 Subarea Weighted RPv (in.)	1.25
2.9 Subarea Weighted Target Runoff (in.)	0.73

RPv Target Runoff (in.)	
Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID	FS 5			
3.2 Upstream LOD Area (ac)	0.50			
3.3 Target Runoff for Upstream Area (in.)	0.58			
3.4 Adjusted CN after all reductions	78.06			
3.5 Adjusted RPv (in.)	1.29			
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	3.15
4.2 Weighted RCN	77.40
4.3 Weighted RPv (in.)	1.26
4.4 Weighted Target Runoff (in.)	0.70
4.5 Estimated Annual Runoff (in.)	16.32
4.6 Req'd Runoff Reduction within LOD (in.)	0.56
4.7 Req'd Runoff Reduction within LOD (%)	44%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 2 + FS 5
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	3.15
1.2 C.A. RCN	78
1.3 LOD Area (ac)	2.65
1.4 LOD RCN	77
1.5 Outside LOD Area (ac)	0.5
1.6 Outside LOD RCN	83

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13

2yr 24hr rain event 3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	DMV	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	0.41	0.41
3.5 Ia/P ratio	0.09	0.05
3.6 Unit Peak Discharge, qu (csm/in)	#NUM!	#NUM!
3.7 Runoff (in.)	2.99	5.98
3.8 Peak Discharge, qp (cfs)	#NUM!	#NUM!
3.9 Equiv. unit peak discharge (cfs/ac)	#NUM!	#NUM!

STD Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P	C0	C1	C2	
1	0.10	2.55323	-0.61512	-0.16403	
2	0.30	2.46532	-0.62257	-0.11657	
3	0.35	2.41896	-0.61594	-0.08820	
4	0.40	2.36409	-0.59857	-0.05621	
5	0.45	2.29238	-0.57005	-0.02281	
6	0.50	2.20282	-0.51599	-0.01259	log(qu)
10-YR	0.09	2.55164	-0.61014	-0.16796	#NUM!
100-YR	0.05	2.54582	-0.59301	-0.17227	#NUM!

DMV Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P	C0	C1	C2	
1	0.10	2.33733	-0.68709	-0.10847	
2	0.30	2.22599	-0.68545	-0.03220	
3	0.35	2.17707	-0.66476	-0.00830	
4	0.40	2.12341	-0.63854	0.01624	
5	0.45	2.06447	-0.59720	0.02867	
6	0.50	1.99673	-0.53417	0.03114	log(qu)
10-YR	0.09	2.341355	-0.68644	-0.11089	#NUM!
100-YR	0.05	2.347804	-0.68571	-0.11486	#NUM!

UH STD	curve number	Ia (in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

PROJECT: INSTITUTIONAL

DRAINAGE SUBAREA ID: BS 2 + FS 5

LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Bioswale	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	3.15		3.15		3.15		3.15		3.15	
1.2 *Reserved*										
1.3 Initial RCN	77.40									
1.4 RPv for Contributing Area (in.)	1.26									
1.5 Req'd RPv Reduction for Contributing Area (in.)	0.56									
1.6 Req'd RPv Reduction for Contributing Area (%)	44%									
1.7 RPv allowable discharge rate (cfs)	0.17									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0									
2.2 Retention reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	1.26		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	77.46		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	77.40		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	16.32		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	75%									
3.4 Annual runoff reduction allowance (%)	44%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	9.18		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	65.67		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.51		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	0.75		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	0.51		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	41%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	65.67		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	74.52		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	No		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	0.05		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	165		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	520		N/A		N/A		N/A		N/A	

DURMM BMP Name

--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**BS 2 + FS 5**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Bioswale			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	3.15																			
1.2 Initial RCN	77																			
1.3 Annual runoff volume (in.)	16.32																			
1.4 Annual runoff volume (liters)	5.28E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		1.06E+07	1.43E+06	3.17E+08																
2.4 Stormwater Load (lb/ac/yr)		7.40	1.00	222		4.16	0.56	125		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	44%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		44%	44%	44%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		4.16	0.56	125		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		OK	OK	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		0.00	0.00	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		0%	0%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		0.75	0.75	0.75		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.00	0.00	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 2 + FS 5
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioswale**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	3.15		3.15		3.15		3.15		3.15	
1.2 Initial RCN	77.40									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	2.49									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	#NUM!									
1.7 Cv allowable discharge rate (cfs)	#NUM!									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	2.49		2.37		#N/A		#N/A		#N/A	
2.5 CN*	77.40		75.94		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	5%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	2.37		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	75.94		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.12		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.37		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	5%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	75.94		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 2 + FS 5
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioswale**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	3.15		3.15		3.15		3.15		3.15	
1.2 Initial RCN	77.40									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	5.32									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	#NUM!									
1.7 Fv allowable discharge rate (cfs)	#NUM!									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	5.32		5.27		#N/A		#N/A		#N/A	
2.5 CN*	77.40		76.94		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	1%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	5.27		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	76.94		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.05		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	5.27		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	1%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	76.94		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 2 + FS 5
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	3.15				
C.A. RCN	78				
Subarea LOD (ac.)	2.65				
Upstream Subarea ID	FS 5	0	0	0	
Upstream Subarea LOD (ac.)	0.50	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	3.15				
Combined RCN with Upstream Areas (ac.)	77.40				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Bioswale	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.26				
Req'd RPv Reduction for Contributing Area (in.)	0.56				
Req'd RPv Reduction for Contributing Area (%)	44%				
C.A. allowable discharge rate (cfs)	0.17				
Unmanaged Polluant load, TN (lbs/ac/yr)	7.40				
Unmanaged Polluant load, TP (lbs/ac/yr)	1.00				
Unmanaged Polluant load, TSS (lbs/ac/yr)	222				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	0.75	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.51	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	41%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	No	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	4.16	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.56	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	125	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	520	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	2.49				
Stds-based allowable discharge (cfs)	#NUM!				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	2.37	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	5.32				
Stds-based allowable discharge (cfs)	#NUM!				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	5.27	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	3.15
C.A. RCN	78
LOD Area (ac.)	3.15
Weighted Target Runoff (in.)	0.70
Adjusted CN after all reductions	65.67
Adjusted RPv (in.)	0.75
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	75.94
Flooding Event, Fv	8	76.94

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 1 + FS 3
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39	0.79	61	0.3	74	1.93	80
Impervious Areas										
	Paved parking lots, roofs, driveways			98	1.05	98	0.11	98	0.19	98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54	5.37	70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										

Subarea Contributing Area per Soil Type (ac)	0	7.21	0.41	2.12

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	9.74
Weighted Runoff Curve Number (RCN)	75

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 1 + FS 3
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)		1.84	0.41	2.12
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***		1.05	0.11	0.19
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	57%	27%	9%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	82.11	80.44	81.61
2.2 RPv per HSG (in.)	0.00	1.50	1.41	1.47
2.3 Target Runoff per HSG (in.)	0.00	0.58	1.10	1.39
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.75	0.75	0.75
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	2.25	2.25	2.25

2.6 Subarea LOD (ac)	4.37
2.7 Subarea Weighted RCN	81.71
2.8 Subarea Weighted RPv (in.)	1.48
2.9 Subarea Weighted Target Runoff (in.)	1.02

RPv Target Runoff (in.)	
Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID				
3.2 Upstream LOD Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	4.37
4.2 Weighted RCN	81.71
4.3 Weighted RPv (in.)	1.48
4.4 Weighted Target Runoff (in.)	1.02
4.5 Estimated Annual Runoff (in.)	19.73
4.6 Req'd Runoff Reduction within LOD (in.)	0.45
4.7 Req'd Runoff Reduction within LOD (%)	31%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 1 + FS 3
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	9.74
1.2 C.A. RCN	75
1.3 LOD Area (ac)	4.37
1.4 LOD RCN	82
1.5 Outside LOD Area (ac)	5.37
1.6 Outside LOD RCN	70

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet	100	0.02	f	0.24	N/A	0.23
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated	200	0.02	u	N/A	2.3	0.02
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.26 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	DMV	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	0.857	0.857
3.5 Ia/P ratio	0.18	0.11
3.6 Unit Peak Discharge, qu (csm/in)	482	504
3.7 Runoff (in.)	1.89	4.46
3.8 Peak Discharge, qp (cfs)	7.64	18.88
3.9 Equiv. unit peak discharge (cfs/ac)	1.42	3.52

STD Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P	C0	C1	C2	
1	0.10	2.55323	-0.61512	-0.16403	
2	0.30	2.46532	-0.62257	-0.11657	
3	0.35	2.41896	-0.61594	-0.08820	
4	0.40	2.36409	-0.59857	-0.05621	
5	0.45	2.29238	-0.57005	-0.02281	
6	0.50	2.20282	-0.51599	-0.01259	log(qu)
10-YR	0.18	2.54103	-0.62695	-0.14904	2.857893277
100-YR	0.11	2.55263	-0.61716	-0.16449	2.85841817

DMV Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P	C0	C1	C2	
1	0.10	2.33733	-0.68709	-0.10847	
2	0.30	2.22599	-0.68545	-0.03220	
3	0.35	2.17707	-0.66476	-0.00830	
4	0.40	2.12341	-0.63854	0.01624	
5	0.45	2.06447	-0.59720	0.02867	
6	0.50	1.99673	-0.53417	0.03114	log(qu)
10-YR	0.18	2.306786	-0.69212	-0.08747	2.683187918
100-YR	0.11	2.33552	-0.6876	-0.10714	2.702479828

UH STD	curve number	Ia (in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

PROJECT: INSTITUTIONAL
DRAINAGE SUBAREA ID: BS 1 + FS 3
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Filter strip	Type	Bioswale	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	9.74		9.74		9.74		9.74		9.74	
1.2 *Reserved*										
1.3 Initial RCN	75.26									
1.4 RPv for Contributing Area (in.)	1.15									
1.5 Req'd RPv Reduction for Contributing Area (in.)	0.20									
1.6 Req'd RPv Reduction for Contributing Area (%)	18%									
1.7 RPv allowable discharge rate (cfs)	0.27									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0		0							
2.2 Retention reduction allowance (%)	0%		0%		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.00		0.00		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.00		0.00		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	1.15		1.00		N/A		N/A		N/A	
2.6 Adjusted CN*	75.26		71.84		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	75.26		71.84		N/A		N/A		N/A	
3.2 Annual runoff (in.)	14.79		12.57		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	0%		25%							
3.4 Annual runoff reduction allowance (%)	15%		31%		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	12.57		8.64		N/A		N/A		N/A	
3.6 Adjusted ACN	71.84		64.55		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.15		0.45		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	1.00		0.71		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	0.15		0.45		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	13%		39%		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	71.84		64.55		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	79.47		73.60		N/A		N/A		N/A	
4.6 Req'd reduction met?	No		OK		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	0.05		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	178		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	1738		N/A		N/A		N/A		N/A	

DURMM BMP Name

--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**BS 1 + FS 3**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Filter strip			Type:	Bioswale			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	9.74																			
1.2 Initial RCN	75																			
1.3 Annual runoff volume (in.)	14.79																			
1.4 Annual runoff volume (liters)	1.48E+07																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		2.96E+07	4.00E+06	8.88E+08																
2.4 Stormwater Load (lb/ac/yr)		6.70	0.91	201		5.70	0.77	171		3.92	0.53	118		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	15%				31%				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		15%	15%	15%		31%	31%	31%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		5.70	0.77	171		3.92	0.53	118		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		OK	OK	OK		OK	OK	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		0.00	0.00	0		0.00	0.00	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		0%	0%	0%		0%	0%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		1.00	1.00	1.00		0.71	0.71	0.71		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.00	0.00	0.00		0.00	0.00	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		0	0	0		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		0	0	0		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 1 + FS 3
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Filter strip**	**Type:**	**Bioswale**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	9.74		9.74		9.74		9.74		9.74	
1.2 Initial RCN	75.26									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	2.31									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	1.42									
1.7 Cv allowable discharge rate (cfs)	10.92									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	2.31		2.26		2.15		#N/A		#N/A	
2.5 CN*	75.26		74.70		73.31		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	2%		5%		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	2.26		2.15		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	74.70		73.31		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.05		0.16		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.26		2.15		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	2%		7%		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	74.70		73.31		#N/A		#N/A		#N/A	

PROJECT: INSTITUTIONAL

DRAINAGE SUBAREA ID: BS 1 + FS 3

LOCATION (County): New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	Filter strip	Type:	Bioswale	Type:	--	Type:	--	Type:	--
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	9.74		9.74		9.74		9.74		9.74	
1.2 Initial RCN	75.26									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	5.07									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	3.52									
1.7 Fv allowable discharge rate (cfs)	28.71									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	5.07		5.07		5.02		#N/A		#N/A	
2.5 CN*	75.26		75.26		74.82		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		1%		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	5.07		5.02		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	75.26		74.82		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		0.05		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	5.07		5.02		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	0%		1%		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	75.26		74.82		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 1 + FS 3
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	9.74				
C.A. RCN	75				
Subarea LOD (ac.)	4.37				
Upstream Subarea ID	0	0	0	0	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	4.37				
Combined RCN with Upstream Areas (ac.)	81.71				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Filter strip	Bioswale	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.15				
Req'd RPv Reduction for Contributing Area (in.)	0.20				
Req'd RPv Reduction for Contributing Area (%)	18%				
C.A. allowable discharge rate (cfs)	0.27				
Unmanaged Polluant load, TN (lbs/ac/yr)	6.70				
Unmanaged Polluant load, TP (lbs/ac/yr)	0.91				
Unmanaged Polluant load, TSS (lbs/ac/yr)	201				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	1.00	0.71	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.15	0.45	N/A	N/A	N/A
Total RPv runoff reduction (%)	13%	0.39	N/A	N/A	N/A
Req'd runoff reduction met?	No	OK	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	5.70	3.92	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.77	0.53	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	171	118	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	1738	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	2.31				
Stds-based allowable discharge (cfs)	10.92				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	2.26	2.15	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	5.07				
Stds-based allowable discharge (cfs)	28.71				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	5.07	5.02	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	9.74
C.A. RCN	75
LOD Area (ac.)	4.37
Weighted Target Runoff (in.)	1.02
Adjusted CN after all reductions	64.55
Adjusted RPv (in.)	0.71
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	73.31
Flooding Event, Fv	8	74.82

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39	0.16	61	0.11	74	0.03	80
Impervious Areas										
	Paved parking lots, roofs, driveways			98	0.65	98	0.12	98	0.05	98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0		0.81		0.23		0.08	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	**1.12**
Weighted Runoff Curve Number (RCN)	**90**

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)		0.81	0.23	0.08
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***		0.65	0.12	0.05
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	80%	52%	63%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	90.69	86.52	91.25
2.2 RPv per HSG (in.)	0.00	1.99	1.74	2.02
2.3 Target Runoff per HSG (in.)	0.00	0.58	1.10	1.39
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.75	0.75	0.75
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	2.25	2.25	2.25

2.6 Subarea LOD (ac)	1.12
2.7 Subarea Weighted RCN	89.88
2.8 Subarea Weighted RPv (in.)	1.94
2.9 Subarea Weighted Target Runoff (in.)	0.75

RPv Target Runoff (in.)

Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID				
3.2 Upstream LOD Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	1.12
4.2 Weighted RCN	89.88
4.3 Weighted RPv (in.)	1.94
4.4 Weighted Target Runoff (in.)	0.75
4.5 Estimated Annual Runoff (in.)	27.53
4.6 Req'd Runoff Reduction within LOD (in.)	1.19
4.7 Req'd Runoff Reduction within LOD (%)	62%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

	DMV	
3.1 Unit Hydrograph Type		
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

STD Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1		0.10	2.55323	-0.61512	-0.16403	
2		0.30	2.46532	-0.62257	-0.11657	
3		0.35	2.41896	-0.61594	-0.08820	
4		0.40	2.36409	-0.59857	-0.05621	
5		0.45	2.29238	-0.57005	-0.02281	
6		0.50	2.20282	-0.51599	-0.01259	log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A	#N/A

DMV Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1		0.10	2.33733	-0.68709	-0.10847	
2		0.30	2.22599	-0.68545	-0.03220	
3		0.35	2.17707	-0.66476	-0.00830	
4		0.40	2.12341	-0.63854	0.01624	
5		0.45	2.06447	-0.59720	0.02867	
6		0.50	1.99673	-0.53417	0.03114	log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A	#N/A

UH	curve number	Ia (in)
STD		
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

PROJECT: INSTITUTIONAL
DRAINAGE SUBAREA ID: BIO 1
LOCATION (County): New Castle
RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Bioretention w/underdrain	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 *Reserved*										
1.3 Initial RCN	89.88									
1.4 RPv for Contributing Area (in.)	1.94									
1.5 Req'd RPv Reduction for Contributing Area (in.)	1.19									
1.6 Req'd RPv Reduction for Contributing Area (%)	62%									
1.7 RPv allowable discharge rate (cfs)	0.09									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	5937									
2.2 Retention reduction allowance (%)	50%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.07		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.73		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	1.21		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	76.45		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	89.88		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	27.53		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	60%									
3.4 Annual runoff reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	27.53		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	89.87		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.00		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	1.21		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	0.73		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	38%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	76.45		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	83.01		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	No		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	0.46		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	1682		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	1883		N/A		N/A		N/A		N/A	

DURMM BMP Name
--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**BIO 1**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Bioretention w/underdrain			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	1.12																			
1.2 Initial RCN	90																			
1.3 Annual runoff volume (in.)	27.53																			
1.4 Annual runoff volume (liters)	3.17E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		6.34E+06	8.56E+05	1.90E+08																
2.4 Stormwater Load (lb/ac/yr)		12.48	1.68	374		7.78	1.05	233		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	38%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		38%	38%	38%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		7.78	1.05	233		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		No	No	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		1.38	0.22	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		18%	21%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		1.21	1.21	1.21		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.21	0.25	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		778	920	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		871	1030	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioretention w/underdrain**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 Initial RCN	89.88									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	3.67									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Cv allowable discharge rate (cfs)	0.84									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	5937.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.14		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	1.46		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	2.21		2.21		#N/A		#N/A		#N/A	
2.5 CN*	74.06		74.06		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	3.67		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	89.88		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.21		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	40%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	74.06		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioretention w/underdrain**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 Initial RCN	89.88									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	6.79									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Fv allowable discharge rate (cfs)	2.52									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	5937.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.14		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	1.46		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	5.33		5.33		#N/A		#N/A		#N/A	
2.5 CN*	77.48		77.48		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	6.79		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	89.88		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	5.33		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	22%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	77.48		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	1.12				
C.A. RCN	90				
Subarea LOD (ac.)	1.12				
Upstream Subarea ID	0	0	0	0	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	1.12				
Combined RCN with Upstream Areas (ac.)	89.88				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Bioretention w/underdrain	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.94				
Req'd RPv Reduction for Contributing Area (in.)	1.19				
Req'd RPv Reduction for Contributing Area (%)	62%				
C.A. allowable discharge rate (cfs)	0.09				
Unmanaged Polluant load, TN (lbs/ac/yr)	12.48				
Unmanaged Polluant load, TP (lbs/ac/yr)	1.68				
Unmanaged Polluant load, TSS (lbs/ac/yr)	374				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	1.21	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.73	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	38%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	No	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	7.78	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	1.05	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	233	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	1883	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	3.67				
Stds-based allowable discharge (cfs)	0.84				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	2.21	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	6.79				
Stds-based allowable discharge (cfs)	2.52				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	5.33	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	1.12
C.A. RCN	90
LOD Area (ac.)	1.12
Weighted Target Runoff (in.)	0.75
Adjusted CN after all reductions	76.45
Adjusted RPv (in.)	1.21
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	74.06
Flooding Event, Fv	8	77.48

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-INFILTRATION
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39	0.16	61	0.11	74	0.03	80
Impervious Areas										
	Paved parking lots, roofs, driveways			98	0.65	98	0.12	98	0.05	98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0		0.81		0.23		0.08	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	1.12
Weighted Runoff Curve Number (RCN)	90

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-INFILTRATION
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)		0.81	0.23	0.08
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***		0.65	0.12	0.05
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	80%	52%	63%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	90.69	86.52	91.25
2.2 RPv per HSG (in.)	0.00	1.99	1.74	2.02
2.3 Target Runoff per HSG (in.)	0.00	0.58	1.10	1.39
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.75	0.75	0.75
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	2.25	2.25	2.25

2.6 Subarea LOD (ac)	1.12
2.7 Subarea Weighted RCN	89.88
2.8 Subarea Weighted RPv (in.)	1.94
2.9 Subarea Weighted Target Runoff (in.)	0.75

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID				
3.2 Upstream LOD Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	1.12
4.2 Weighted RCN	89.88
4.3 Weighted RPv (in.)	1.94
4.4 Weighted Target Runoff (in.)	0.75
4.5 Estimated Annual Runoff (in.)	27.53
4.6 Req'd Runoff Reduction within LOD (in.)	1.19
4.7 Req'd Runoff Reduction within LOD (%)	62%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

RPv Target Runoff (in.)

Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-INFILTRATION
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

	DMV	
3.1 Unit Hydrograph Type		
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

STD Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1		0.10	2.55323	-0.61512	-0.16403	
2		0.30	2.46532	-0.62257	-0.11657	
3		0.35	2.41896	-0.61594	-0.08820	
4		0.40	2.36409	-0.59857	-0.05621	
5		0.45	2.29238	-0.57005	-0.02281	
6		0.50	2.20282	-0.51599	-0.01259	log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A	#N/A

DMV Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1		0.10	2.33733	-0.68709	-0.10847	
2		0.30	2.22599	-0.68545	-0.03220	
3		0.35	2.17707	-0.66476	-0.00830	
4		0.40	2.12341	-0.63854	0.01624	
5		0.45	2.06447	-0.59720	0.02867	
6		0.50	1.99673	-0.53417	0.03114	log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A	#N/A

UH STD	curve number	Ia (in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

PROJECT: INSTITUTIONAL

DRAINAGE SUBAREA ID: BIO 1-INFILTRATION

LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Infiltration w/sand or vegetation	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 *Reserved*										
1.3 Initial RCN	89.88									
1.4 RPv for Contributing Area (in.)	1.94									
1.5 Req'd RPv Reduction for Contributing Area (in.)	1.19									
1.6 Req'd RPv Reduction for Contributing Area (%)	62%									
1.7 RPv allowable discharge rate (cfs)	0.09									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	5937									
2.2 Retention reduction allowance (%)	100%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.14		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	1.46		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	0.48		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	57.91		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	89.88		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	27.53		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	60%									
3.4 Annual runoff reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	27.53		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	89.87		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.00		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	0.48		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	1.46		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	75%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	57.91		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	68.03		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	OK		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	N/A		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	N/A		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	N/A		N/A		N/A		N/A		N/A	

DURMM BMP Name

--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**BIO 1-INFILTRATION**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Infiltration w/sand or vegetation			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	1.12																			
1.2 Initial RCN	90																			
1.3 Annual runoff volume (in.)	27.53																			
1.4 Annual runoff volume (liters)	3.17E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		6.34E+06	8.56E+05	1.90E+08																
2.4 Stormwater Load (lb/ac/yr)		12.48	1.68	374		3.08	0.42	93		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	75%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		75%	75%	75%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		3.08	0.42	93		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		OK	OK	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		0.00	0.00	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		0%	0%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		0.48	0.48	0.48		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.00	0.00	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		0	0	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-INFILTRATION
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Infiltration w/sand or vegetation**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 Initial RCN	89.88									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	3.67									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Cv allowable discharge rate (cfs)	0.84									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	5937.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.14		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	1.46		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	2.21		2.21		#N/A		#N/A		#N/A	
2.5 CN*	74.06		74.06		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	3.67		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	89.88		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.21		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	40%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	74.06		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-INFILTRATION
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	Infiltration w/sand or vegetation	Type:	--	Type:	--	Type:	--	Type:	--
Step 1 - Calculate Initial Fv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 Initial RCN	89.88									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	6.79									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Fv allowable discharge rate (cfs)	2.52									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	5937.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.14		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	1.46		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	5.33		5.33		#N/A		#N/A		#N/A	
2.5 CN*	77.48		77.48		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	6.79		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	89.88		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	5.33		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	22%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	77.48		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-INFILTRATION
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	1.12				
C.A. RCN	90				
Subarea LOD (ac.)	1.12				
Upstream Subarea ID	0	0	0	0	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	1.12				
Combined RCN with Upstream Areas (ac.)	89.88				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Infiltration w/sand or vegetation	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.94				
Req'd RPv Reduction for Contributing Area (in.)	1.19				
Req'd RPv Reduction for Contributing Area (%)	62%				
C.A. allowable discharge rate (cfs)	0.09				
Unmanaged Polluant load, TN (lbs/ac/yr)	12.48				
Unmanaged Polluant load, TP (lbs/ac/yr)	1.68				
Unmanaged Polluant load, TSS (lbs/ac/yr)	374				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	0.48	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	1.46	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	75%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	OK	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	3.08	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.42	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	93	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	N/A	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	3.67				
Stds-based allowable discharge (cfs)	0.84				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	2.21	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	6.79				
Stds-based allowable discharge (cfs)	2.52				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	5.33	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	1.12
C.A. RCN	90
LOD Area (ac.)	1.12
Weighted Target Runoff (in.)	0.75
Adjusted CN after all reductions	57.91
Adjusted RPv (in.)	0.48
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	74.06
Flooding Event, Fv	8	77.48

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-EXPANDED
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39	0.16	61	0.11	74	0.03	80
Impervious Areas										
	Paved parking lots, roofs, driveways			98	0.65	98	0.12	98	0.05	98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0		0.81		0.23		0.08	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	1.12
Weighted Runoff Curve Number (RCN)	90

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-EXPANDED
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)		0.81	0.23	0.08
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***		0.65	0.12	0.05
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	80%	52%	63%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	90.69	86.52	91.25
2.2 RPv per HSG (in.)	0.00	1.99	1.74	2.02
2.3 Target Runoff per HSG (in.)	0.00	0.58	1.10	1.39
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.75	0.75	0.75
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	2.25	2.25	2.25

2.6 Subarea LOD (ac)	1.12
2.7 Subarea Weighted RCN	89.88
2.8 Subarea Weighted RPv (in.)	1.94
2.9 Subarea Weighted Target Runoff (in.)	0.75

RPv Target Runoff (in.)	
Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID				
3.2 Upstream LOD Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	1.12
4.2 Weighted RCN	89.88
4.3 Weighted RPv (in.)	1.94
4.4 Weighted Target Runoff (in.)	0.75
4.5 Estimated Annual Runoff (in.)	27.53
4.6 Req'd Runoff Reduction within LOD (in.)	1.19
4.7 Req'd Runoff Reduction within LOD (%)	62%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-EXPANDED
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

	DMV	
3.1 Unit Hydrograph Type		
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

STD Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P		C0	C1	C2	
1		0.10	2.55323	-0.61512	-0.16403
2		0.30	2.46532	-0.62257	-0.11657
3		0.35	2.41896	-0.61594	-0.08820
4		0.40	2.36409	-0.59857	-0.05621
5		0.45	2.29238	-0.57005	-0.02281
6		0.50	2.20282	-0.51599	-0.01259 log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A #N/A
100-YR	#N/A		#N/A	#N/A	#N/A #N/A

DMV Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P		C0	C1	C2	
1		0.10	2.33733	-0.68709	-0.10847
2		0.30	2.22599	-0.68545	-0.03220
3		0.35	2.17707	-0.66476	-0.00830
4		0.40	2.12341	-0.63854	0.01624
5		0.45	2.06447	-0.59720	0.02867
6		0.50	1.99673	-0.53417	0.03114 log(qu)
10-YR	#N/A		#N/A	#N/A	#N/A #N/A
100-YR	#N/A		#N/A	#N/A	#N/A #N/A

UH	curve	Ia
STD	number	(in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

PROJECT: INSTITUTIONAL
DRAINAGE SUBAREA ID: BIO 1-EXPANDED
LOCATION (County): New Castle
RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Bioretention w/underdrain	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 *Reserved*										
1.3 Initial RCN	89.88									
1.4 RPv for Contributing Area (in.)	1.94									
1.5 Req'd RPv Reduction for Contributing Area (in.)	1.19									
1.6 Req'd RPv Reduction for Contributing Area (%)	62%									
1.7 RPv allowable discharge rate (cfs)	0.09									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	9710									
2.2 Retention reduction allowance (%)	50%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.11		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	1.19		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	0.75		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	65.65		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	89.88		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	27.53		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	60%									
3.4 Annual runoff reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	27.53		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	89.87		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.00		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	0.75		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	1.20		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	62%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	65.65		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	74.48		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	OK		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	N/A		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	N/A		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	N/A		N/A		N/A		N/A		N/A	

DURMM BMP Name
--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**BIO 1-EXPANDED**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Bioretention w/underdrain			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	1.12																			
1.2 Initial RCN	90																			
1.3 Annual runoff volume (in.)	27.53																			
1.4 Annual runoff volume (liters)	3.17E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		6.34E+06	8.56E+05	1.90E+08																
2.4 Stormwater Load (lb/ac/yr)		12.48	1.68	374		4.99	0.84	144		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	62%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		60%	50%	62%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		4.99	0.84	144		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		OK	No	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		0.00	0.01	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		0%	1%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		0.75	0.75	0.75		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.00	0.01	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		0	40	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		0	44	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-EXPANDED
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioretention w/underdrain**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 Initial RCN	89.88									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	3.67									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Cv allowable discharge rate (cfs)	0.84									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	9710.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.22		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	2.39		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	1.28		1.28		#N/A		#N/A		#N/A	
2.5 CN*	61.48		61.48		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	3.67		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	89.88		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	1.28		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	65%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	61.48		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-EXPANDED
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioretention w/underdrain**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	1.12		1.12		1.12		1.12		1.12	
1.2 Initial RCN	89.88									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	6.79									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Fv allowable discharge rate (cfs)	2.52									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	9710.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.22		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	2.39		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	4.40		4.40		#N/A		#N/A		#N/A	
2.5 CN*	69.46		69.46		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	6.79		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	89.88		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	4.40		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	35%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	69.46		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BIO 1-EXPANDED
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	1.12				
C.A. RCN	90				
Subarea LOD (ac.)	1.12				
Upstream Subarea ID	0	0	0	0	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	1.12				
Combined RCN with Upstream Areas (ac.)	89.88				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Bioretention w/underdrain	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.94				
Req'd RPv Reduction for Contributing Area (in.)	1.19				
Req'd RPv Reduction for Contributing Area (%)	62%				
C.A. allowable discharge rate (cfs)	0.09				
Unmanaged Polluant load, TN (lbs/ac/yr)	12.48				
Unmanaged Polluant load, TP (lbs/ac/yr)	1.68				
Unmanaged Polluant load, TSS (lbs/ac/yr)	374				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	0.75	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	1.20	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	62%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	OK	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	4.99	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.84	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	144	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	N/A	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	3.67				
Stds-based allowable discharge (cfs)	0.84				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	1.28	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	6.79				
Stds-based allowable discharge (cfs)	2.52				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	4.40	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	1.12
C.A. RCN	90
LOD Area (ac.)	1.12
Weighted Target Runoff (in.)	0.75
Adjusted CN after all reductions	65.65
Adjusted RPv (in.)	0.75
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	61.48
Flooding Event, Fv	8	69.46

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 5 + FS 9
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39		61	0.52	74		80
Impervious Areas										
	Paved parking lots, roofs, driveways			98		98	0.6	98		98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0		0		1.12		0	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1	FS 9	0.77	77
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	**1.89**
Weighted Runoff Curve Number (RCN)	**83**

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 5 + FS 9
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)			1.12	
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***			0.6	0.05
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	0%	54%	0%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	0.00	86.86	0.00
2.2 RPv per HSG (in.)	0.00	0.00	1.76	0.00
2.3 Target Runoff per HSG (in.)	0.00	0.00	1.10	0.00
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.00	0.75	0.00
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.00	2.25	0.00

2.6 Subarea LOD (ac)	1.12
2.7 Subarea Weighted RCN	86.86
2.8 Subarea Weighted RPv (in.)	1.76
2.9 Subarea Weighted Target Runoff (in.)	1.10

RPv Target Runoff (in.)	
Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID	FS 9			
3.2 Upstream LOD Area (ac)	0.77			
3.3 Target Runoff for Upstream Area (in.)	1.10			
3.4 Adjusted CN after all reductions	73.62			
3.5 Adjusted RPv (in.)	1.24			
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	1.89
4.2 Weighted RCN	81.46
4.3 Weighted RPv (in.)	1.55
4.4 Weighted Target Runoff (in.)	1.10
4.5 Estimated Annual Runoff (in.)	19.52
4.6 Req'd Runoff Reduction within LOD (in.)	0.45
4.7 Req'd Runoff Reduction within LOD (%)	29%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 5 + FS 9
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	1.89
1.2 C.A. RCN	83
1.3 LOD Area (ac)	1.12
1.4 LOD RCN	87
1.5 Outside LOD Area (ac)	0.77
1.6 Outside LOD RCN	77

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	DMV	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	0.632	0.632
3.5 Ia/P ratio	0.13	0.08
3.6 Unit Peak Discharge, qu (csm/in)	#NUM!	#NUM!
3.7 Runoff (in.)	2.46	5.27
3.8 Peak Discharge, qp (cfs)	#NUM!	#NUM!
3.9 Equiv. unit peak discharge (cfs/ac)	#NUM!	#NUM!

STD Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P	C0	C1	C2	
1	0.10	2.55323	-0.61512	-0.16403	
2	0.30	2.46532	-0.62257	-0.11657	
3	0.35	2.41896	-0.61594	-0.08820	
4	0.40	2.36409	-0.59857	-0.05621	
5	0.45	2.29238	-0.57005	-0.02281	
6	0.50	2.20282	-0.51599	-0.01259	log(qu)
10-YR	0.13	2.55122	-0.62240	-0.15987	#NUM!
100-YR	0.08	2.55095	-0.60754	-0.16888	#NUM!

DMV Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P	C0	C1	C2	
1	0.10	2.33733	-0.68709	-0.10847	
2	0.30	2.22599	-0.68545	-0.03220	
3	0.35	2.17707	-0.66476	-0.00830	
4	0.40	2.12341	-0.63854	0.01624	
5	0.45	2.06447	-0.59720	0.02867	
6	0.50	1.99673	-0.53417	0.03114	log(qu)
10-YR	0.13	2.327295	-0.68923	-0.10165	#NUM!
100-YR	0.08	2.342822	-0.68619	-0.11181	#NUM!

UH STD	curve number	Ia (in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

Effective April 2016

PROJECT: INSTITUTIONAL
DRAINAGE SUBAREA ID: BS 5 + FS 9
LOCATION (County): New Castle
RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Bioswale	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	1.89		1.89		1.89		1.89		1.89	
1.2 *Reserved*										
1.3 Initial RCN	81.46									
1.4 RPv for Contributing Area (in.)	1.55									
1.5 Req'd RPv Reduction for Contributing Area (in.)	0.45									
1.6 Req'd RPv Reduction for Contributing Area (%)	29%									
1.7 RPv allowable discharge rate (cfs)	0.12									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0									
2.2 Retention reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	1.55		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	83.06		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	81.46		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	19.52		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	0%									
3.4 Annual runoff reduction allowance (%)	25%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	14.64		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	75.04		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.40		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	1.14		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	0.40		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	26%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	75.04		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	81.95		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	No		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	0.04		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	159		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	300		N/A		N/A		N/A		N/A	

DURMM BMP Name

--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**BS 5 + FS 9**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Bioswale			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	1.89																			
1.2 Initial RCN	81																			
1.3 Annual runoff volume (in.)	19.52																			
1.4 Annual runoff volume (liters)	3.79E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		7.58E+06	1.02E+06	2.28E+08																
2.4 Stormwater Load (lb/ac/yr)		8.85	1.19	265		6.64	0.90	199		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	25%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		25%	25%	25%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		6.64	0.90	199		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		No	No	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		0.24	0.07	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		4%	7%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		1.14	1.14	1.14		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.04	0.08	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		148	305	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		279	577	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 5 + FS 9
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioswale**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	1.89		1.89		1.89		1.89		1.89	
1.2 Initial RCN	81.46									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	2.85									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	#NUM!									
1.7 Cv allowable discharge rate (cfs)	#NUM!									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	2.85		2.71		#N/A		#N/A		#N/A	
2.5 CN*	81.46		79.89		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	5%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	2.71		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	79.89		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.14		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.71		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	5%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	79.89		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 5 + FS 9
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Bioswale**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	1.89		1.89		1.89		1.89		1.89	
1.2 Initial RCN	81.46									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	5.80									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	#NUM!									
1.7 Fv allowable discharge rate (cfs)	#NUM!									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	5.80		5.74		#N/A		#N/A		#N/A	
2.5 CN*	81.46		80.97		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	1%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	5.74		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	80.97		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.06		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	5.74		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	1%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	80.97		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	BS 5 + FS 9
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	1.89				
C.A. RCN	83				
Subarea LOD (ac.)	1.12				
Upstream Subarea ID	FS 9	0	0	0	
Upstream Subarea LOD (ac.)	0.77	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	1.89				
Combined RCN with Upstream Areas (ac.)	81.46				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Bioswale	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.55				
Req'd RPv Reduction for Contributing Area (in.)	0.45				
Req'd RPv Reduction for Contributing Area (%)	29%				
C.A. allowable discharge rate (cfs)	0.12				
Unmanaged Polluant load, TN (lbs/ac/yr)	8.85				
Unmanaged Polluant load, TP (lbs/ac/yr)	1.19				
Unmanaged Polluant load, TSS (lbs/ac/yr)	265				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	1.14	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.40	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	26%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	No	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	6.64	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.90	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	199	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	300	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	2.85				
Stds-based allowable discharge (cfs)	#NUM!				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	2.71	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	5.80				
Stds-based allowable discharge (cfs)	#NUM!				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	5.74	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	1.89
C.A. RCN	83
LOD Area (ac.)	1.89
Weighted Target Runoff (in.)	1.10
Adjusted CN after all reductions	75.04
Adjusted RPv (in.)	1.14
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	79.89
Flooding Event, Fv	8	80.97

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 5
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39	0.2	61		74		80
Impervious Areas										
	Paved parking lots, roofs, driveways			98	0.3	98		98		98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0		0.5		0		0	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	**0.5**
Weighted Runoff Curve Number (RCN)	**83**

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 5
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)		0.5		
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***		0.3		
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	60%	0%	0%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	83.20	0.00	0.00
2.2 RPv per HSG (in.)	0.00	1.56	0.00	0.00
2.3 Target Runoff per HSG (in.)	0.00	0.58	0.00	0.00
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.75	0.00	0.00
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	2.25	0.00	0.00

2.6 Subarea LOD (ac)	0.50
2.7 Subarea Weighted RCN	83.20
2.8 Subarea Weighted RPv (in.)	1.56
2.9 Subarea Weighted Target Runoff (in.)	0.58

RPv Target Runoff (in.)

Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID				
3.2 Upstream LOD Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	0.50
4.2 Weighted RCN	83.20
4.3 Weighted RPv (in.)	1.56
4.4 Weighted Target Runoff (in.)	0.58
4.5 Estimated Annual Runoff (in.)	21.01
4.6 Req'd Runoff Reduction within LOD (in.)	0.97
4.7 Req'd Runoff Reduction within LOD (%)	63%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 5
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

	DMV	
3.1 Unit Hydrograph Type		
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

STD Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P		C0	C1	C2	
1		0.10	2.55323	-0.61512	-0.16403
2		0.30	2.46532	-0.62257	-0.11657
3		0.35	2.41896	-0.61594	-0.08820
4		0.40	2.36409	-0.59857	-0.05621
5		0.45	2.29238	-0.57005	-0.02281
6		0.50	2.20282	-0.51599	-0.01259
10-YR	#N/A		#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A

log(qu)
#N/A
#N/A

DMV Unit Peak Discharge Coefficient Table - Type II Storm

Ia/P		C0	C1	C2	
1		0.10	2.33733	-0.68709	-0.10847
2		0.30	2.22599	-0.68545	-0.03220
3		0.35	2.17707	-0.66476	-0.00830
4		0.40	2.12341	-0.63854	0.01624
5		0.45	2.06447	-0.59720	0.02867
6		0.50	1.99673	-0.53417	0.03114
10-YR	#N/A		#N/A	#N/A	#N/A
100-YR	#N/A		#N/A	#N/A	#N/A

log(qu)
#N/A
#N/A

UH	curve	Ia
STD	number	(in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

PROJECT: INSTITUTIONAL
DRAINAGE SUBAREA ID: FS 5
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Filter strip	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	0.50		0.50		0.50		0.50		0.50	
1.2 *Reserved*										
1.3 Initial RCN	83.20									
1.4 RPv for Contributing Area (in.)	1.56									
1.5 Req'd RPv Reduction for Contributing Area (in.)	0.97									
1.6 Req'd RPv Reduction for Contributing Area (%)	63%									
1.7 RPv allowable discharge rate (cfs)	0.03									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)										
2.2 Retention reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	1.56		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	83.20		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	83.20		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	21.01		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	100%									
3.4 Annual runoff reduction allowance (%)	20%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	16.81		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	78.06		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.27		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	1.29		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	0.27		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	17%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	78.06		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	84.25		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	No		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	0.71		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	2568		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	1284		N/A		N/A		N/A		N/A	

DURMM BMP Name

--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**FS 5**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Filter strip			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	0.50																			
1.2 Initial RCN	83																			
1.3 Annual runoff volume (in.)	21.01																			
1.4 Annual runoff volume (liters)	1.08E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		2.16E+06	2.92E+05	6.48E+07																
2.4 Stormwater Load (lb/ac/yr)		9.53	1.29	286		7.62	1.03	229		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	20%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		20%	20%	20%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		7.62	1.03	229		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		No	No	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		1.22	0.20	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		16%	19%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		1.29	1.29	1.29		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.21	0.25	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		750	905	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		375	452	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 5
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Filter strip**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	0.50		0.50		0.50		0.50		0.50	
1.2 Initial RCN	83.20									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	3.01									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Cv allowable discharge rate (cfs)	0.38									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	3.01		2.95		#N/A		#N/A		#N/A	
2.5 CN*	83.20		82.56		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	2%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	2.95		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	82.56		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.06		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.95		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	2%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	82.56		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 5
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Filter strip**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	0.50		0.50		0.50		0.50		0.50	
1.2 Initial RCN	83.20									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	6.00									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Fv allowable discharge rate (cfs)	1.13									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	6.00		6.00		#N/A		#N/A		#N/A	
2.5 CN*	83.20		83.20		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	6.00		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	83.20		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	6.00		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	0%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	83.20		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 5
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	0.5				
C.A. RCN	83				
Subarea LOD (ac.)	0.5				
Upstream Subarea ID	0	0	0	0	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	0.50				
Combined RCN with Upstream Areas (ac.)	83.20				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Filter strip	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.56				
Req'd RPv Reduction for Contributing Area (in.)	0.97				
Req'd RPv Reduction for Contributing Area (%)	63%				
C.A. allowable discharge rate (cfs)	0.03				
Unmanaged Polluant load, TN (lbs/ac/yr)	9.53				
Unmanaged Polluant load, TP (lbs/ac/yr)	1.29				
Unmanaged Polluant load, TSS (lbs/ac/yr)	286				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	1.29	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.27	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	17%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	No	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	7.62	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	1.03	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	229	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	1284	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	3.01				
Stds-based allowable discharge (cfs)	0.38				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	2.95	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	6.00				
Stds-based allowable discharge (cfs)	1.13				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	6.00	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	0.50
C.A. RCN	83
LOD Area (ac.)	0.50
Weighted Target Runoff (in.)	0.58
Adjusted CN after all reductions	78.06
Adjusted RPv (in.)	1.29
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	82.56
Flooding Event, Fv	8	83.20

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 9
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
	Pasture, grassland or range	poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
	Meadow -cont. grass (non grazed)	----		30		58		71		78
	Brush - brush, weed, grass mix	poor		48		67		77		83
		fair		35		56		70		77
		good		30		48		65		73
	Woods - grass combination	poor		57		73		82		86
		fair		43		65		76		82
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39		61	0.67	74		80
Impervious Areas										
	Paved parking lots, roofs, driveways			98		98	0.1	98		98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
	Subarea Contributing Area per Soil Type (ac)		0		0		0.77		0	

UPSTREAM CONTRIBUTING AREAS

	Subarea ID	Acres	RCN
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area (ac)	0.77
Weighted Runoff Curve Number (RCN)	77

County

Kent
New Castle
Sussex

Unit Hydrograph

DMV
STD

Effective April 2016

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 9
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)			0.77	
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***			0.1	0.05
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	0%	13%	0%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	0.00	0.00	77.12	0.00
2.2 RPv per HSG (in.)	0.00	0.00	1.24	0.00
2.3 Target Runoff per HSG (in.)	0.00	0.00	1.10	0.00
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.00	0.75	0.00
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.00	2.25	0.00

2.6 Subarea LOD (ac)	0.77
2.7 Subarea Weighted RCN	77.12
2.8 Subarea Weighted RPv (in.)	1.24
2.9 Subarea Weighted Target Runoff (in.)	1.10

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Subarea ID				
3.2 Upstream LOD Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	0.77
4.2 Weighted RCN	77.12
4.3 Weighted RPv (in.)	1.24
4.4 Weighted Target Runoff (in.)	1.10
4.5 Estimated Annual Runoff (in.)	16.11
4.6 Req'd Runoff Reduction within LOD (in.)	0.14
4.7 Req'd Runoff Reduction within LOD (%)	11%

Step 5 - Cv Unit Discharge	
5. LOD Allowable Unit Discharge (cfs/ac)	0.75

Step 6 - Fv Unit Discharge	
6. LOD Allowable Unit Discharge (cfs/ac)	2.25

RPv Target Runoff (in.)

Soil	Woods
HSG A	0.00
HSG B	0.12
HSG C	0.55
HSG D	0.87

Cv/Fv Unit Discharge

Woodland/Meadow (HSG A)
10-YR: 0 cfs/ac
100-YR: 0.25 cfs/ac

Woodland/Meadow (HSG B,C,D)
10-YR: 0.375 cfs/ac
100-YR: 1.25 cfs/ac

Non-Woodland/Non-Meadow
10-YR: 0.75 cfs/ac
100-YR: 2.25 cfs/ac

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 9
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Rainfall per County (in.)

County	10-YR	100-YR
Kent	5.2	8.9
New Castle	4.8	8.0
Sussex	5.3	9.2

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc) 0.00 hrs

Sheet Flow Surface Code & Type		Manning's "n"
a	Smooth Surface	0.01
b	fallow (no residue)	0.05
c	cultivated < 20% Res.	0.06
d	cultivated > 20% Res.	0.17
e	grass - range, short	0.15
f	grass, dense	0.24
g	grass, bermuda	0.41
h	woods, light	0.40
i	woods, dense	0.80
j	range, natural	0.13
	2yr 24hr rain event	3.3

Sheet Flow Surface Codes

a Smooth Surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

	DMV	
3.1 Unit Hydrograph Type		
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

STD Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1	0.10	2.55323	-0.61512	-0.16403	
2	0.30	2.46532	-0.62257	-0.11657	
3	0.35	2.41896	-0.61594	-0.08820	
4	0.40	2.36409	-0.59857	-0.05621	
5	0.45	2.29238	-0.57005	-0.02281	
6	0.50	2.20282	-0.51599	-0.01259	log(qu)
10-YR	#N/A	#N/A	#N/A	#N/A	#N/A
100-YR	#N/A	#N/A	#N/A	#N/A	#N/A

DMV Unit Peak Discharge Coefficient Table - Type II Storm

	Ia/P	C0	C1	C2	
1	0.10	2.33733	-0.68709	-0.10847	
2	0.30	2.22599	-0.68545	-0.03220	
3	0.35	2.17707	-0.66476	-0.00830	
4	0.40	2.12341	-0.63854	0.01624	
5	0.45	2.06447	-0.59720	0.02867	
6	0.50	1.99673	-0.53417	0.03114	log(qu)
10-YR	#N/A	#N/A	#N/A	#N/A	#N/A
100-YR	#N/A	#N/A	#N/A	#N/A	#N/A

UH STD	curve number	Ia (in)
DMV	30	4.667
	31	4.452
	32	4.250
	33	4.061
	34	3.882
	35	3.714
	36	3.556
	37	3.405
	38	3.263
	39	3.128
	40	3.000
	41	2.878
	42	2.762
	43	2.651
	44	2.545
	45	2.444
	46	2.348
	47	2.255
	48	2.167
	49	2.082
	50	2.000
	51	1.922
	52	1.846
	53	1.774
	54	1.704
	55	1.636
	56	1.571
	57	1.509
	58	1.448
	59	1.390
	60	1.333
	61	1.279
	62	1.226
	63	1.175
	64	1.125
	65	1.077
	66	1.030
	67	0.985
	68	0.941
	69	0.899
	70	0.857
	71	0.817
	72	0.778
	73	0.740
	74	0.703
	75	0.667
	76	0.632
	77	0.597
	78	0.564
	79	0.532
	80	0.500
	81	0.469
	82	0.439
	83	0.410
	84	0.381
	85	0.353
	86	0.326
	87	0.299
	88	0.273
	89	0.247
	90	0.222
	91	0.198
	92	0.174
	93	0.151
	94	0.128
	95	0.105
	96	0.083
	97	0.062
	98	0.041

PROJECT: INSTITUTIONAL
DRAINAGE SUBAREA ID: FS 9
LOCATION (County): New Castle
RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	Filter strip	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	Data		Data		Data		Data		Data	
1.1 Total contributing area to BMP (ac)	0.77		0.77		0.77		0.77		0.77	
1.2 *Reserved*										
1.3 Initial RCN	77.12									
1.4 RPv for Contributing Area (in.)	1.24									
1.5 Req'd RPv Reduction for Contributing Area (in.)	0.14									
1.6 Req'd RPv Reduction for Contributing Area (%)	11%									
1.7 RPv allowable discharge rate (cfs)	0.04									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0									
2.2 Retention reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	1.24		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	77.12		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	77.12		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	16.11		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	0%									
3.4 Annual runoff reduction allowance (%)	15%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	13.69		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	73.62		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.16		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv runoff volume after all reductions (in.)	1.08		N/A		N/A		N/A		N/A	
4.2 Total RPv runoff reduction (in.)	0.16		N/A		N/A		N/A		N/A	
4.3 Total RPv runoff reduction (%)	13%		N/A		N/A		N/A		N/A	
4.4 Adjusted CN after all reductions	73.62		N/A		N/A		N/A		N/A	
4.5 Equivalent TR-55 RCN for H&H modeling	80.86		N/A		N/A		N/A		N/A	
4.6 Req'd reduction met?	OK		N/A		N/A		N/A		N/A	
Step 5 - Determine Runoff Reduction Offset										
5.1 Runoff Reduction Shortfall (in.)	N/A		N/A		N/A		N/A		N/A	
5.2 Runoff Reduction Shortfall (cu.ft./ac)	N/A		N/A		N/A		N/A		N/A	
5.3 Total Offset Volume (cu.ft.)	N/A		N/A		N/A		N/A		N/A	

DURMM BMP Name

--
Infiltration w/sand or vegetation
Infiltration w/o sand or vegetation
Bioretention w/underdrain
Permeable pave w/sand or vegetation
Permeable pave w/o sand or vegetation
Vegetated roof
Rainwater harvesting
Impervious disconnection
Bioswale
Vegetated open channel
Filter strip
Riparian forest buffer
Urban tree planting
Soil amendment
Sheetflow to turf open space
Sheetflow to forest open space
Wet swale
Ephemeral wetland
--
Dry ED basin
Dry detention pond
Hydrodynamic structure
Urban filtering practice
Wet pond
Constructed wetland
--
Nutrient management
Street sweeping
--
Urban stream restoration

Effective April 2016

PROJECT:	**INSTITUTIONAL**
DRAINAGE SUBAREA ID:	**FS 9**
LANDUSE TYPE:	**Institutional**
TMDL WATERSHED:	**Appoquinimink River**

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	Filter strip			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	0.77																			
1.2 Initial RCN	77																			
1.3 Annual runoff volume (in.)	16.11																			
1.4 Annual runoff volume (liters)	1.28E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.00	0.27	60																
2.2 Load (mg/yr)		2.55E+06	3.44E+05	7.65E+07																
2.4 Stormwater Load (lb/ac/yr)		7.30	0.99	219		6.21	0.84	186		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 3 - Adjust for Runoff Reduction																				
3.1 BMP Runoff Reduction (%)	15%				N/A				N/A				N/A				N/A			
3.2 BMP Removal Efficiency (%)		15%	15%	15%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
3.3 Adjusted load (lb/ac/yr)		6.21	0.84	186		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
Step 4 - Calculate Pollutant Reduction																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A		6.40	0.83	N/A
4.2 Reduction met?		OK	No	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK		#N/A	#N/A	OK
Step 5 - Determine TMDL Offset																				
5.1 TMDL Shortfall (lb/ac/yr)		0.00	0.01	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0		#N/A	#N/A	0
5.2 TMDL Shortfall (%)		0%	1%	0%		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.3 Residual RPv Volume (in)		1.08	1.08	1.08		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
5.4 Req'd Additional RR to meet TMDL (in)*		0.00	0.01	0.00		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.5 Req'd Additional RR to meet TMDL (cu.ft./ac)		0	37	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A
5.6 Total Offset Volume (cu.ft.)		0	29	0		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A		#N/A	#N/A	#N/A

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 9
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Filter strip**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	0.77		0.77		0.77		0.77		0.77	
1.2 Initial RCN	77.12									
1.3 **10-YR** Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	2.47									
1.5 LOD allowable unit discharge (cfs/ac)	0.75									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Cv allowable discharge rate (cfs)	0.58									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	2.47		2.42		#N/A		#N/A		#N/A	
2.5 CN*	77.12		76.54		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	2%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	2.42		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	76.54		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.05		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.42		#N/A		#N/A		#N/A		#N/A	
4.2 Total Cv runoff reduction (%)	2%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	76.54		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 9
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**Filter strip**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	0.77		0.77		0.77		0.77		0.77	
1.2 Initial RCN	77.12									
1.3 **100-YR** Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	5.29									
1.5 LOD allowable unit discharge (cfs/ac)	2.25									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Fv allowable discharge rate (cfs)	1.73									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		0.00		0.00		0.00		0.00	
2.2 Storage volume (ac-ft)	0.00		0.00		0.00		0.00		0.00	
2.3 Storage volume (in.)	0.00		0.00		0.00		0.00		0.00	
2.4 Runoff volume after reduction (in.)	5.29		5.29		#N/A		#N/A		#N/A	
2.5 CN*	77.12		77.12		#N/A		#N/A		#N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		#N/A		#N/A		#N/A		#N/A	
3.2 Annual runoff after reduction (in.)	5.29		#N/A		#N/A		#N/A		#N/A	
3.3 Adjusted ACN	77.12		#N/A		#N/A		#N/A		#N/A	
3.4 Event-based runoff reduction (in.)	0.00		#N/A		#N/A		#N/A		#N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	5.29		#N/A		#N/A		#N/A		#N/A	
4.2 Total Fv runoff reduction (%)	0%		#N/A		#N/A		#N/A		#N/A	
4.3 Adjusted RCN for H&H modeling	77.12		#N/A		#N/A		#N/A		#N/A	

PROJECT:	INSTITUTIONAL
DRAINAGE SUBAREA ID:	FS 9
TMDL Watershed:	Appoquinimink River

DURMM OUTPUT WORKSHEET

Site Data DURMM v2.beta.110802

Contributing Area to BMPs (ac.)	0.77				
C.A. RCN	77				
Subarea LOD (ac.)	0.77				
Upstream Subarea ID	0	0	0	0	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	0.77				
Combined RCN with Upstream Areas (ac.)	77.12				
TMDL-TN (lb/ac/yr)	6.40				
TMDL-TP (lb/ac/yr)	0.83				
TMDL-TSS (lb/ac/yr)	N/A				

BMP Selection	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	Filter strip	--	--	--	--

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.24				
Req'd RPv Reduction for Contributing Area (in.)	0.14				
Req'd RPv Reduction for Contributing Area (%)	11%				
C.A. allowable discharge rate (cfs)	0.04				
Unmanaged Polluant load, TN (lbs/ac/yr)	7.30				
Unmanaged Polluant load, TP (lbs/ac/yr)	0.99				
Unmanaged Polluant load, TSS (lbs/ac/yr)	219				

BMP Runoff Reduction Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
RPv runoff volume after all reductions (in.)	1.08	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.16	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	13%	N/A	N/A	N/A	N/A
Req'd runoff reduction met?	OK	N/A	N/A	N/A	N/A
BMP TMDL Performance					
Adjusted pollutant load, TN (lb/ac/yr)	6.21	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.84	#N/A	#N/A	#N/A	#N/A
Adjusted pollutant load, TSS (lb/ac/yr)	186	#N/A	#N/A	#N/A	#N/A
Offsets Requirements					
RPv Offset (cu. ft.)	N/A	N/A	N/A	N/A	N/A

Conveyance Event (Cv)

Cv runoff volume (in.)	2.47				
Stds-based allowable discharge (cfs)	0.58				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Cv runoff volume after all reductions (in.)	2.42	#N/A	#N/A	#N/A	#N/A

Flooding Event (Fv)

Fv runoff volume (in.)	5.29				
Stds-based allowable discharge (cfs)	1.73				

BMP Performance	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Fv runoff volume after all reductions (in.)	5.29	#N/A	#N/A	#N/A	#N/A

Adjusted Subarea Data for Downstream DURMM Modeling

Contributing Area (ac.)	0.77
C.A. RCN	77
LOD Area (ac.)	0.77
Weighted Target Runoff (in.)	1.10
Adjusted CN after all reductions	73.62
Adjusted RPv (in.)	1.08
Adjusted Cv (in.)	
Adjusted Fv (in.)	

Adjusted Subarea Data for H&H Modeling	Rain (in.)	RCN
Resource Protection Event, RPv	2.7	N/A
Conveyance Event, Cv	4.8	76.54
Flooding Event, Fv	8	77.12

Effective April 2016

DUFFIELD ASSOCIATES

INFILTRATION EVALUATION

APPOQUINIMINK SCHOOL DISTRICT
PROPOSED ODESSA CAMPUS – PHASE I
ODESSA, DELAWARE

July 2010

Prepared for:

Appoquinimink School District
118 South Sixth Street
Odessa, Delaware 19730

Prepared by:

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Senior Geotechnical Engineer

Project No. 3975.GC

I. INTRODUCTION

The following report summarizes Duffield Associates, Inc.'s (Duffield Associates) field infiltration testing program performed within the proposed Appoquinimink School District campus located off of Old State Road in Odessa, Delaware. Included in this report is a summary of the data obtained in the field and laboratory testing programs. These services were provided in general accordance with our agreement, dated May 7, 2010, authorized to proceed by Appoquinimink School District on May 12, 2010.

To assist with this evaluation, the project civil engineer (Landmark Engineering) has provided Duffield Associates with a site plan showing the preliminary site layout, conceptual site grading, and existing topography in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg," dated May 17, 2010.

Based on the information provided, we understand that it is proposed to construct a school campus on an approximately 270-acre, agricultural-use parcel located west of Old State Road in Odessa, Delaware, as shown on the enclosed site location sketch. The purpose of this project was to evaluate the field infiltration rates at several of the proposed stormwater management features proposed as part of the Phase I development. Infiltration practices and best management practices (BMPs) are being considered for stormwater management in lieu of conventional stormwater management basins.

In addition to this infiltration evaluation, Duffield Associates also performed a geotechnical evaluation at the site. This evaluation has been summarized in a separate report.

II. FIELD EVALUATION AND LABORATORY TESTING

On June 8 through 15, 2010, a total of fifteen (15) backhoe-excavated test pits, designated as IT-1 through IT-13 and TP-1 and TP-2, were excavated at the site. The test pits, extending to depths ranging from approximately 7.5 to 12 feet below the existing ground surface, were performed at the site by Feldmann Brothers, Inc. of Newark, Delaware, as a subcontractor to Duffield Associates. The approximate locations of test pits are indicated on the enclosed Infiltration Test Location Sketch. The test pit locations were estimated by Duffield Associates' representative, utilizing existing site features for reference, as well as a handheld GPS unit.

Duffield Associates' representative was present to review the performance of the test pits. Test pit logs, which describe the conditions observed during the field exploration program, are enclosed. At completion of the test pit excavations and subsequent infiltration testing, the test pits were backfilled with the excavated material and leveled off with the surrounding grades. No additional compactive effort or site restoration was performed. Further restoration of the test pit locations was beyond the scope of services performed for this evaluation.

In 13 of the test pits (test pit Nos. IT-1 through IT-13), infiltration testing was performed at depths ranging from approximately 5 to 9 feet below the existing ground surface, corresponding to elevations of approximately 35.0 to 46.8 feet, project datum. The existing ground surface elevation at each location was estimated from the existing site survey provided. At these depths, single-ring infiltrometer tests were performed in each test pit, in general accordance with ASTM D 5126-90 "Comparison of Field Methods for Determining Hydraulic Conductivity in the Vadose Zone." At completion of the testing, the test pits were extended up to an additional 6 feet to evaluate the consistency and relative saturation of the soils at the tested location.

Following completion of the field program, soil samples were returned to Duffield Associates' laboratory for testing of selected samples. The laboratory testing program for this portion of the evaluation included the determination of natural water content (ASTM D 2216) and the determination of percent finer than a No. 270 sieve [silt/clay content in accordance with the United States Department of Agriculture (USDA) classification system] for thirteen (13) soil samples; one (1) sample from each of the infiltration test locations. The results of these laboratory tests are included on the test pit logs included with this report.

III. SUBSURFACE CONDITIONS

A review of the New Castle County Soil Survey indicates that the shallow subsurface soils in the general area of the proposed construction consists of those soils identified as predominantly of the Keyport Series and, to a lesser extent, the Matapeake Series. The United States Department of Agriculture (USDA) soil descriptions for the Keyport Series are generally shallow clay soils and the description for the Matapeake Series are generally silt loam and silty clay loam soils overlaying very fine to fine sandy loam. These conditions were generally consistent with the shallow soil conditions encountered during the field program.

In general, the site soils consisted of a surface layer of topsoil overlying low plasticity silts and clays interlayered in areas with silty and clayey sands and gravels. Beneath these layers, a stratum of soft consistency, high plasticity clays and silts were observed in all the test pits conducted at the project site.

Groundwater (not attributable to the infiltration testing) was observed in three (3) of the test pits (IT-6, TP-1, and TP-2) at depths ranging from approximately 6.8 to 10.8 feet below the existing ground surface, corresponding to an elevation range of approximately 38 to 41.2 feet, project datum. The groundwater was observed to be seeping through fissures in the high plasticity clay soils and, likely, represents perched water conditions, rather than a true representation of depth to the static groundwater table. Groundwater (not attributable to the infiltration testing) was not observed in any of the other test pits performed during this evaluation, some of which were extended to depths of up to 12 feet below grade. Groundwater was encountered in five (5) of the test borings performed as part of the concurrent geotechnical evaluation, at depths ranging from 10 to 18.5 feet below the existing ground surface corresponding to an elevation range of approximately 9.5 to 42 feet, project datum; however, no groundwater was encountered in a majority of test borings terminated at or below these elevations.

IV. INFILTRATION TEST RESULTS

The infiltration tests were performed in apparent natural, undisturbed site soils. The table below summarizes the results of the infiltration testing.

TEST LOCATION	APPROX. ELEVATION OF TEST (FT.)	APPROX. DEPTH OF TEST (FT. BELOW EX. GRADE)	USDA DESCRIPTION	USCS DESCRIPTION	HYDROLOGIC SOIL GROUP	AVERAGE FIELD INFILTRATION RATE (IN/HR)
IT-1	46.5±	5.5	Loamy Sand	Fine to medium SAND, little to some silt, little fine to coarse gravel, trace coarse sand	A*	1.8
IT-2	46.8±	5.2	Loamy Sand	Fine to medium SAND, little silt, trace coarse sand, trace gravel	A*	8.3
IT-3	45.0±	5.0	Clay	CLAY, some silt, trace fine sand	D	2.8
IT-4	41.8±	5.2	Clay	CLAY, trace fine sand	D	1.7
IT-5	44.0±	7	Clay	CLAY, trace fine sand	D	8.9
IT-6	43.5±	7.5	Clay	CLAY, trace fine sand	D	0.6
IT-7	41.4±	5.6	Clay	CLAY, trace fine sand	D	0.2
IT-8	35.0±	5	Clay Loam	CLAY, little very fine sand	D	1.9
IT-9	36.0±	5	Silty Clay	Silty CLAY, trace fine sand	D	0.2
IT-10	37.0±	5	Clay	Silty CLAY, little fine sand	D	7.8
IT-11	35.7±	5.3	Silty Clay Loam	SILT/CLAY trace fine sand	D	2.0
IT-12	39.0±	9	Loamy Sand	Fine SAND, some gravel, some silty clay layers, trace cobbles	A *	0.5
IT-13	43.6±	5.4	Clay Loam	Silty CLAY, and fine sand, trace gravel	D	0.6

* Note: In tests IT-1, IT-2, and IT-12 where the infiltration test was performed in Hydrologic Group A soils, Group D soils were encountered within 3 feet below the infiltration test depth.

V. CONCLUSIONS AND DESIGN RECOMMENDATIONS

Based on the data obtained during our field and laboratory testing programs and subsequent analysis, the following conclusions and design recommendations are presented.

1. **Design for Stormwater Infiltration.** The field infiltration test results tabulated above are generally much higher than is typically expected in fine-grained, Hydrologic Soil Group D soils. During the test borings and infiltration tests conducted at the site, oxidized fissures and a blocky soil structure were observed in the high plasticity clay stratum. The oxidization along the fissures indicates water transport "around" the soil rather than through the soil in a homogenous way as would be expected in other high infiltration rate soils such as sands. Water can generally be expected to move more quickly through these fissures as the clay layer dries due to the shrinkage of the individual soil "blocks." While the water infiltrated during the field testing appeared to be accessing these fissures, it can be expected that with heavy construction equipment, and the smearing and cutting action of excavation for the construction of the stormwater management features, these fissures would be sealed in the upper portions of the soil, thus reducing the infiltration rate in the soil from that observed during the recent testing. In addition, the presence of an infiltration stormwater feature at the site would tend to concentrate and prolong the presence of water in the soil layer. With this increased exposure to water, the clay "blocks" can be expected to swell as the moisture content increases during these wet periods, which would likely reduce the width of the existing fissures and likely reduce the infiltration rate.

   Where relatively sandy layers were observed at the site, such as in IT-1, IT-2, and IT-12, they were underlain by the high plasticity clay stratum described above. Delaware Sediment & Stormwater Regulations (2005) recommend a minimum separation of 3 feet between the bottom of an infiltration feature and the seasonal high water table (SHWT) or a limiting soil layer such as Hydrologic Soil Group D soils. Even where thicker layers of sands were observed, the underlying clays may decrease the effective infiltration rate as water pools or mounds over the clay layer.

   Therefore, for features where infiltration of stormwater is proposed, it is our recommendation that typical published infiltration rates for the Hydrological Soil Group D soils be used for design. Typical infiltration rates for the soils observed at the site are summarized below.

USDA DESCRIPTION	HYDROLOGIC SOIL GROUP	MINIMUM INFILTRATION RATE (IN/HR)
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Silty Clay	D	0.04
Clay	D	0.02

   It is typically recommended that infiltration practices only be utilized in soil textures with an infiltration rate of 0.5 inches per hour or greater. **Based on the long-term infiltration rates anticipated at this site typical to the soil textural classifications, it is recommended that stormwater infiltration practices <u>not</u> be considered in the Phase I area of the site.** It is

possible that infiltration practices could be feasible in areas not investigated during this Phase I evaluation.

At this time, it is our understanding that the majority of the stormwater management practices at the site are to consist of BMPs, such as infiltration basins, rain gardens, and bioswales, where infiltration is promoted. It is recommended that the design of these systems include underdrains to reduce long-term ponding of water following rain events, based on the anticipated low, long-term infiltration capacity of the site soils.

2. **Suitability of On-Site Soils for Pond Construction.** Based on the test pits performed as part of this evaluation, as well as the test borings performed as part of the concurrent geotechnical evaluation, it appears as though some surficial fine-grained soils and the high plasticity clays found beneath the surficial strata observed on site are generally considered suitable for the construction of a low permeability cutoff trench or core trench in accordance with the Pond Code, or for the construction of a pond liner, if necessary, for a wet pond. Therefore, significant importing of fill soils or geosynthetic clay liners should not be required for construction of stormwater management features should a stormwater management basin be considered for the site.

   Should pond embankments be required, they should be designed and constructed in accordance with the U.S. Soil Conservation Service (SCS) Small Pond Code 378 as amended by the State of Delaware. Pond Code 378 requires that an embankment pond be constructed with a cutoff trench and embankment core consisting of relatively impermeable material [Unified Soil Classification System (USCS) GC, SC, CH, or CL materials] placed in controlled lifts and compacted to 95% of the maximum dry density as determined by a Standard Proctor (ASTM D 698).

This report has been prepared according to generally accepted soil engineering standards and is based on the conditions observed during the test pit exploration. It should be noted that, although soil quality has been inferred from the interpolation of the test pit data, subsurface conditions between the test pits are, in fact, unknown. These recommendations may require modifications based on the final design of stormwater features at the site. Should any conditions encountered differ from those described in this report, this office should be notified immediately in order to review and possibly modify these recommendations. The costs for the construction review are not part of our existing agreement. This report applies solely to the size, type, and location of the project described herein. In the event that changes are proposed, Duffield Associates will not consider this report valid unless the changes have been reviewed and the recommendations of this report modified and reapproved in writing.

WORD\3975GC.0710-APPOQUINIMINKODESSAINFL.RPT

DUFFIELD ASSOCIATES

SITE LOCATION SKETCH

Effective April 2016

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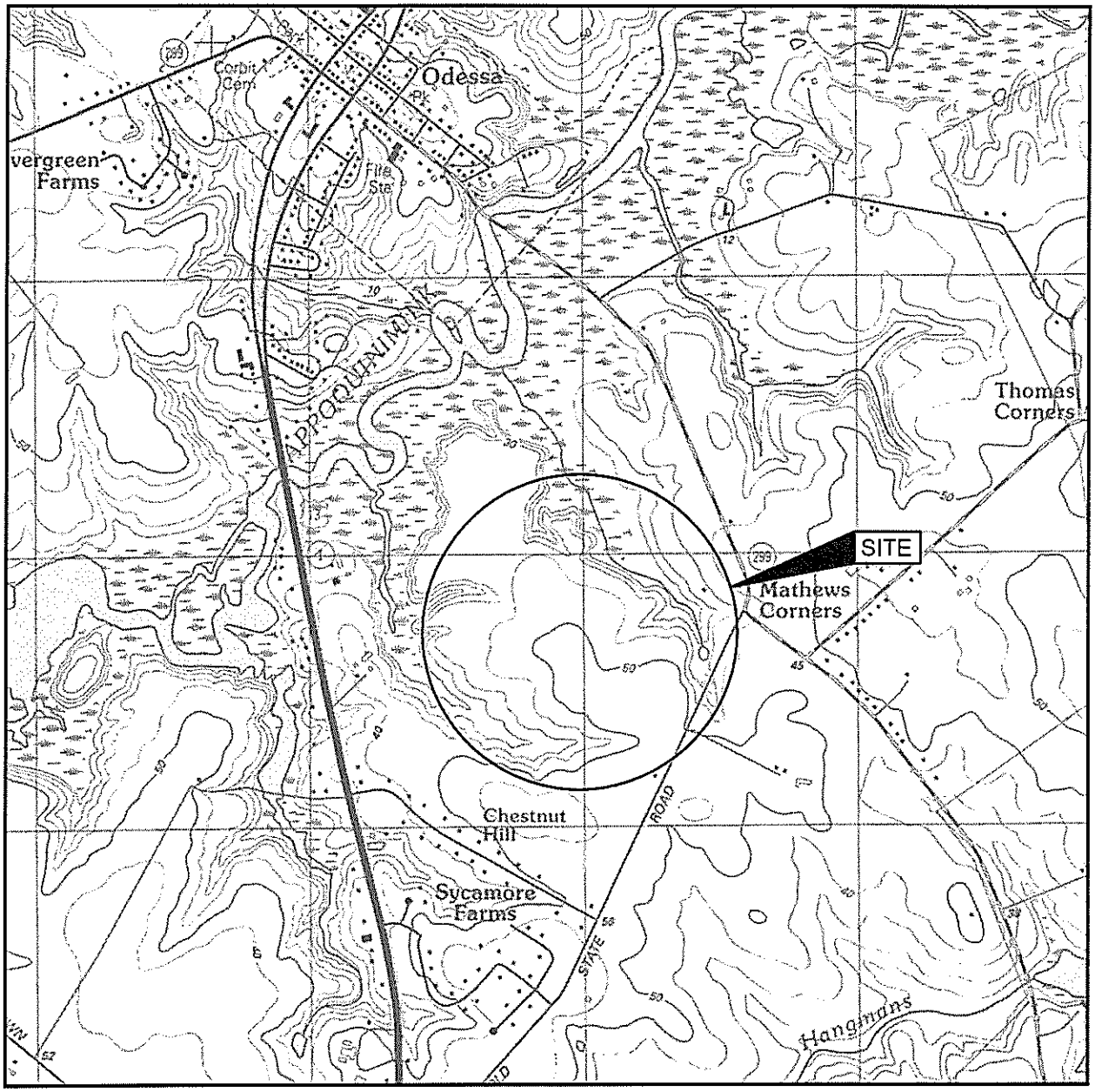

NOTE:
THIS SITE LOCATION SKETCH IS ADAPTED FROM THE U.S.G.S. TOPOGRAPHIC MAP, 7.5 MINUTE SERIES, FOR MIDDLETOWN AND TAYLORS BRIDGE, DELAWARE-NEW JERSEY 1993.

DATE: 6 JULY 2010	SITE LOCATION SKETCH	DESIGNED BY: BJD	DUFFIELD ASSOCIATES Consultants in the Geosciences 5400 LIMESTONE ROAD WILMINGTON, DE 19808-1232 TEL: (302)239-6634 FAX: (302)239-8485 OFFICES IN PHILADELPHIA, PA GEORGETOWN, DE AND STONE HARBOR, NJ
SCALE: 1"=2000'	**APPOQUINIMINK SCHOOL DISTRICT PROPOSED ODESSA CAMPUS**	DRAWN BY: MCM	
PROJECT NO. 3975.GC		CHECKED BY: SJY	
SHEET: FIGURE 1	ODESSA ~ NEW CASTLE COUNTY ~ DELAWARE	FILE: B-3975GC-01	

DUFFIELD ASSOCIATES

INFILTRATION TEST LOCATION SKETCH

Effective April 2016

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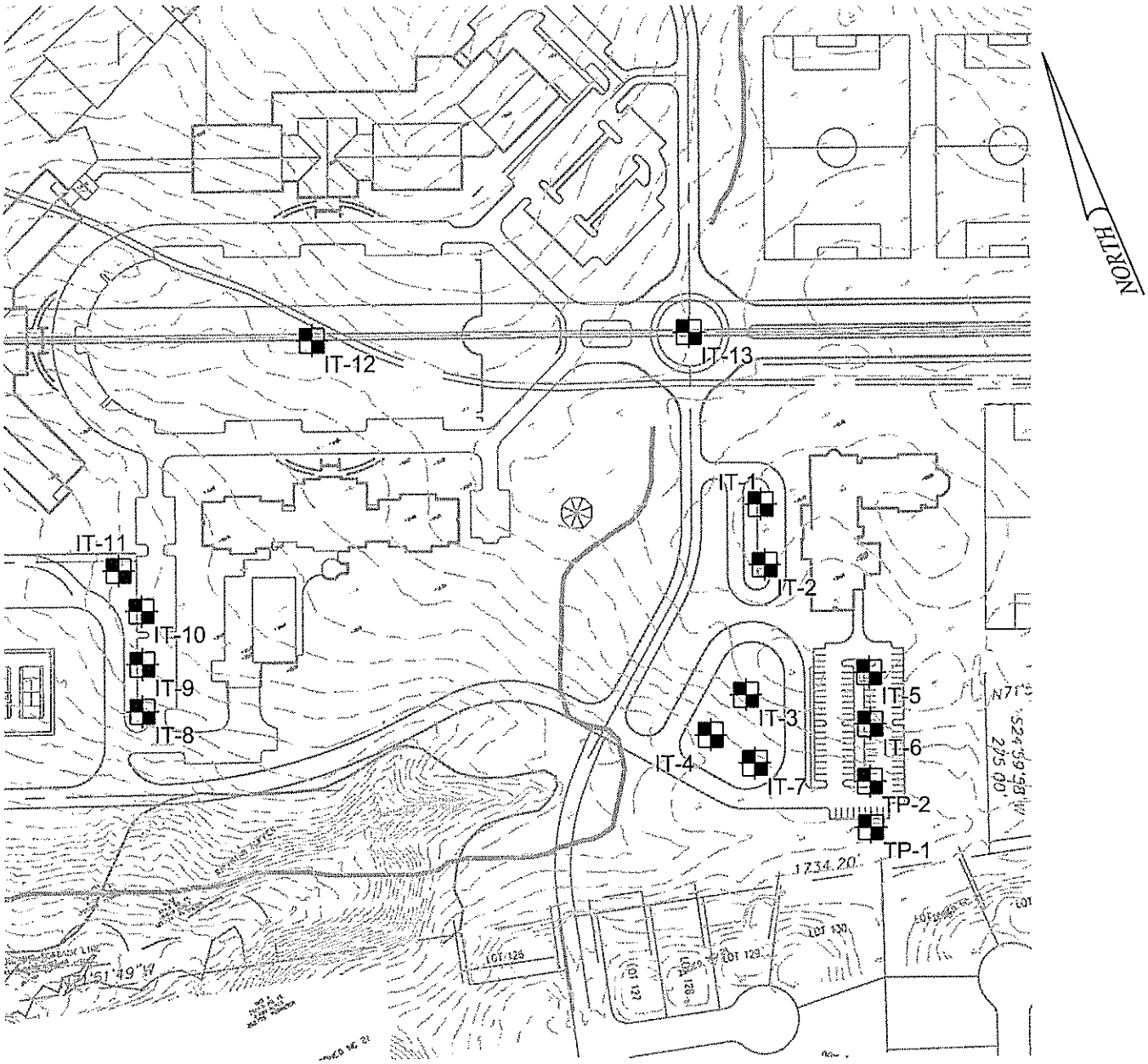

TP-1 - APPROXIMATE INFILTRATION TEST PIT LOCATION

NOTE:
THIS SKETCH IS ADAPTED FROM A DRAWING TITLED "ACAD-ACAD-DUFFIELD-LAYOUT," PREPARED BY LANDMARK ENGINEERING AND DATED MAY 17, 2010.

DATE: 6 JULY 2010	INFILTRATION TEST LOCATION SKETCH	DESIGNED BY: BJD	DUFFIELD ASSOCIATES Consultants in the Geosciences 5400 LIMESTONE ROAD WILMINGTON, DE 19808-1232 TEL: (302)239-6634 FAX (302)239-8485 OFFICES IN PHILADELPHIA, PA GEORGETOWN, DE AND STONE HARBOR, NJ
SCALE: 1"=250'	APPOQUINIMINK SCHOOL DISTRICT PROPOSED ODESSA CAMPUS	DRAWN BY: MCM	
PROJECT NO. 3975.GC		CHECKED BY: SBZ	
SHEET: FIGURE 2	ODESSA ~ NEW CASTLE COUNTY ~ DELAWARE	FILE: A-3975GC-03	

TEST PIT LOGS (15)

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 10, 2010
LOGGED BY:	MPN - TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-1	0 – 0.7	TOPSOIL/ rootmat (brown silt, some fine to medium sand, trace clay, little organics, trace fine gravel, damp)
Elev. ±52 feet	0.7 – 1.7 Sample No. 1	Reddish brown, reddish yellow fine to medium SAND, some silty clay, trace fine gravel (faintly mottled, stiff, damp) USCS: SC
	1.7 – 4 Sample No. 2	Gray, reddish brown CLAY, some silt, trace fine sand (visible iron staining, trace organics, trace mica, blocky, stiff, dry to damp) USCS: CL
	4 – 5.8 Sample No. 3 @ 4 – 5.5 Sample No. 4 @ 5.5 – 5.8	Reddish brown, reddish yellow fine to medium SAND, little to some silt, little fine to coarse gravel, trace coarse sand (trace to little iron staining, damp) • Moisture: 13.5% • Percent passing No. 270 Sieve: 16.8% • USDA: Loamy Sand • USCS: SM
	5.8 – 7.6 Sample No. 5 @ 6.5	Dark orange-brown, brown, dark red-brown fine to coarse SAND, little gravel, trace cobbles, little silt (moist) USCS: SM
	7.6 – --- Sample No. 6 @ 9	Orange-brown, red-brown, light blue-gray, mottled CLAY, trace fine sand (moist, blocky) USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 9.5 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 9.5 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5.5 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
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TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 10, 2010
LOGGED BY:	MPN - TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-2	0 – 0.6	TOPSOIL/ rootmat (brown silt, little fine to medium sand, trace clay, trace organics (damp)
Elev. ±52 feet	0.6 – 2.5 Sample No. 1	Reddish brown, brown, light gray SILT/CLAY, some fine sand (trace iron staining, faint to distinct mottles, grain size increasing with depth) USCS: ML
	2.5 – 5 Sample No. 2	Reddish brown, reddish yellow fine to medium SAND, little to some silt, little to some coarse gravel to cobbles (damp, purple clay balls around gravel, visible iron staining) USCS: SM
	5 – 6 Sample No. 3 @ 5 – 5.2 Sample No. 4 @ 5.2 – 5.7	Yellow-brown, orange-brown, red-brown fine to medium SAND, little silt, trace coarse sand, trace gravel (moist) • Moisture: 10.7% • Percent passing No. 270 Sieve: 13.1% • USDA: Loamy Sand • USCS: SM
	6 – 7	Dark red-brown, brown fine to coarse SAND, little gravel, trace to little silt, trace cobbles (wet) USCS: SM
	7 – --- Sample No. 5 @ 8	Light blue-gray, orange-brown, mottled CLAY, trace fine sand (moist) USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 9.5 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 9.5 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5.2 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

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TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 8, 2010
LOGGED BY:	MPN		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-3	0 – 0.5	TOPSOIL/ rootmat (brown, light brown fine to medium sand, some silt, trace clay, trace mica, damp)
Elev. ±50 feet	0.5 – 4 Sample No. 1	Light brown, reddish brown fine to medium SAND, and coarse to very coarse rounded gravel, and 3-5" cobbles, some silt (silt increasing with depth, gravel and sand cemented together. USCS: SM
	4 – --- Sample No. 2 @ 4-5	Light gray, reddish brown, prominently mottled CLAY, some silt, trace fine sand (soft, damp, no mottling and gray below 6 feet) • Moisture: 31.2% • Percent passing No. 270 Sieve: 94.3% • USDA: Clay • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 8.5 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 8.5 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

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TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 14, 2010
LOGGED BY:	TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-4	0 – 0.9	TOPSOIL
Elev. ±47 feet	0.9 – 2.3 Sample No. 1 @ 1.5	Gray-brown, yellow-brown, brown clayey SILT, little to some fine to medium sand, trace coarse sand and gravel (moist) USCS: ML
	2.3 – --- Sample No. 2 @ 5.2 Sample No. 3 @ 5.3 - 5.5 Sample No. 4 @ 9	Light blue-gray, orange-brown, mottled CLAY, trace fine sand (moist, blocky) • Moisture: 32.3% • Percent passing No. 270 Sieve: 95.0% • USDA: Clay • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 9.5 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 9.5 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5.2 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 8, 2010
LOGGED BY:	MPN		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-5	0 – 1.3	TOPSOIL/ rootmat (brown, light brown silt, trace fine sand, trace clay, trace mica, trace fine rounded gravel, dry to damp)
Elev. ±51 feet	1.3 – 2 Sample No. 1	Light brown, yellow-brown, reddish brown SILT, little clay, trace fine sand (distinct reddish mottles, stiff, dry to damp) USCS: ML
	2 – 4.5 Sample No. 2	Gray, reddish brown CLAY, some silt, trace to little fine sand, trace iron concretions, trace gravel (prominent mottling, red-brown iron staining veins, stiff, dry-damp) USCS: CL
	4.5 – 11 Sample No. 3 @ 4.5 - 7	Gray, reddish brown CLAY, trace fine sand (more gray with depth, soft, damp) • Moisture: 32.8% • Percent passing No. 270 Sieve: 95.6% • USDA: Clay • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 11 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 11 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 7 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

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TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 11, 2010
LOGGED BY:	TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-6	0 – 0.9	TOPSOIL
Elev. ±51 feet	0.9 – 3.2 Sample No. 1 @ 2	Brown, gray-brown fine to medium SAND, little silt, trace gravel, trace cobbles, trace coarse sand (moist) USCS: SM
	3.2 – 5 Sample No. 2 @ 4	Light brown, yellow-brown, orange-brown fine to medium SAND, little to trace silt (moist) USCS: SM
	5 – 6.5 Sample No. 3 @ 6	Orange-brown, dark red-brown, brown, yellow-brown fine to coarse SAND, little to some gravel, trace cobbles, trace to little silt (moist) USCS: SM
	6.5 – --- Sample No. 4 @ 7.5 Sample No. 5 @ 7.6 – 7.8 Sample No. 6 @ 11.5	Light gray, orange-brown, mottled CLAY, trace fine sand (purplish gray with depth, moist, blocky) • Moisture: 45.6% • Percent passing No. 270 Sieve: 96.3% • USDA: Clay • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 11.8 feet below the existing ground surface (b.e.g.s.)
(4) Slight groundwater seepage was observed in the test pit below a depth of 10.8 ft b.e.g.s. 2 hours after completion of excavation.
(5) Single ring infiltration test performed at approximately 7.5 feet b.e.g.s.
(6) Water level at 11.2 feet b.e.g.s., bottom of excavation at 11.5 feet b.e.g.s. 3 hours after completion of excavation.
(7) Test pit backfilled with excavated soils upon completion.

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Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 14, 2010
LOGGED BY:	TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-7	0 – 0.8	TOPSOIL
Elev. ±47 feet	0.8 – 4.5 Sample No. 1 @ 3	Gray-brown, orange-brown, brown, gray, slightly mottled silty CLAY, trace to little fine to medium sand, trace gravel, trace cobbles (moist) USCS: CL
	4.5 – --- Sample No. 2 @ 5.6 Sample No. 3 @ 5.7 – 5.9 Sample No. 4 @ 10	Light blue-gray, orange-brown, slightly mottled CLAY, trace fine sand (trace cobbles, trace gravel near top of layer, moist, blocky) • Moisture: 38.5% • Percent passing No. 270 Sieve: 99.8% • USDA: Clay • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 10 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 10 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5.6 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 8, 2010
LOGGED BY:	MPN		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-8	0 – 1	TOPSOIL/ rootmat (Light brown silt, trace fine sand, trace clay (dry, strongly mottled)
Elev. ±40 feet	1 – 2 Sample No. 1	Reddish brown SILT/CLAY, some fine to medium sand, trace fine gravel (damp, stiff consistency, very strongly mottled) USCS: CL
	2 – 3 Sample No. 2	Reddish brown, brown fine to medium SAND, and very coarse gravel, some silt (cemented matrix, dry) USCS: SM
	3 – --- Sample No. 3	Reddish brown CLAY, little very fine sand (soft consistency, damp, distinct gray mottles) • Moisture: 32.1% • Percent passing No. 270 Sieve: 87.4% • USDA: Clay Loam • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 8 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 8 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

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TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 11, 2010
LOGGED BY:	TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-9	0 – 0.9	TOPSOIL
Elev. ±41 feet	0.9 – 3.9 Sample No. 1 @ 2 - 3	Brown, light brown, slightly mottled silty CLAY, little fine to medium sand, trace gravel (moist) USCS: CL
	3.9 – --- Sample No. 2 @ 5 Sample No. 3 @ 5.2 – 5.4 Sample No. 4 @ 9	Light gray, brown, orange-brown, slightly mottled silty CLAY, trace fine sand (moist, blocky, becoming purplish gray with depth) • Moisture: 45.7% • Percent passing No. 270 Sieve: 97.6% • USDA: Silty Clay • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 10.3 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 10.3 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 11, 2010
LOGGED BY:	TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-10	0 – 0.9	TOPSOIL
Elev. ±42 feet	0.9 – 3.5 Sample No. 1 @ 2.5	Brown, gray-brown, yellow-brown fine to medium SAND, and silty clay, trace to little gravel, trace coarse sand, trace roots (moist) USCS: SC
	– Sample No. 2 @ 5 Sample No. 3 @ 5.2 – 5.5 Sample No. 4 @ 8.5	Yellow-brown, gray-brown, light gray, mottled silty CLAY, little fine sand (moist, blocky, becoming purplish gray, less sandy, less mottled with depth) • Moisture: 45.9% • Percent passing No. 270 Sieve: 83.2% • USDA: Clay • USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 9.5 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 9.5 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 8, 2010
LOGGED BY:	MPN		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-11	0 – 1	TOPSOIL (Brown, light brown fine to medium sand, little to some silt, trace organics, damp)
Elev. ±41 feet	1 – 4 Sample No. 1 @ 1 – 2.5 Sample No. 2 @ 2.5 – 3 Sample No. 3 @ 3 – 4	Reddish brown, reddish yellow fine to medium SAND, little to some silt/clay, trace mica (damp, varicolored cobbles and cemented soil at bottom of layer) USCS: SM
	4 – --- Sample No. 4 @ 4 – 5.3	Reddish brown SILT/CLAY trace fine sand (faint gray mottles, damp, soft, becoming gray and wet below 7.5 feet) • Moisture: 29.4% • Percent passing No. 270 Sieve: 96.5% • USDA: Silty Clay Loam • USCS: MH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 8 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 8 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5.3 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
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TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 10, 2010
LOGGED BY:	MPN - TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-12	0 – 1	TOPSOIL/ rootmat (Brown silt, trace to little fine to medium sand, trace clay, trace organics, damp)
Elev. ±48 feet	1 – 3	Reddish brown SILT/CLAY, trace to little fine sand (faintly mottled, damp, stiff consistency) USCS: CL
	3 – 6.5 Sample No. 1	Reddish brown-gray, reddish yellow fine to medium SAND, little to some silt/clay, trace to little iron stone staining, trace fine gravel (semi cemented, stiff consistency, damp to dry, increasing fines with depth) USCS: SC
	6.5 – 10 Sample No. 2 Sample No. 3 @ 9 – 9.4	Brown, reddish brown-gray fine SAND, some gravel, some silty clay layers, trace cobbles (damp to wet below test) • Moisture: 12.2% • Percent passing No. 270 Sieve: 21.2% • USDA: Loamy Sand • USCS: SM
	10 – 12 Sample No. 4 @ 11	Orange-brown, light blue-gray silty CLAY, trace fine sand (moist, mottled) USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 12 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 12 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 9 feet b.e.g.s.
(6) Electric cable/conduit and masonry block found approximately 4 feet b.e.g.s.
(7) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 10, 2010
LOGGED BY:	MPN - TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
IT-13	0 – 1	TOPSOIL/ rootmat (brown, light brown silt, some fine to medium sand, trace clay, trace organics, damp)
Elev. ±49 feet	1 – 2.6 Sample No. 1	Reddish brown, brown, reddish yellow fine to medium SAND, some silt/clay, trace gravel (medium stiff consistency, damp, faint mottles) USCS: SC
	2.6 – 3.9 Sample No. 2	Reddish-brown, gray SILT/CLAY, little fine to medium sand trace gravel, trace organics (stiff consistency, dry to damp, prominent mottling, significant iron staining, blocky) USCS: CL
	3.9 – 6 Sample No. 3 @ 3.9 – 5.4 Sample No. 4 @ 5.4 – 5.6	Light gray, reddish brown silty CLAY, and fine sand, trace gravel (less mottled, dry to damp, very stiff consistency) • Moisture: 18.5% • Percent passing No. 270 Sieve: 66.3% • USDA: Clay Loam • USCS: CL
	6 – --- Sample No. 5 @ 8	Light gray silty CLAY, trace fine sand (moist, iron stained layer at 6 feet) USCS: CH

NOTES:
(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 10.5 feet below the existing ground surface (b.e.g.s.)
(4) No groundwater seepage was observed in the test pit to a depth of 10.5 ft b.e.g.s..
(5) Single ring infiltration test performed at approximately 5.4 feet b.e.g.s.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 11, 2010
LOGGED BY:	TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
TP-1	0 – 0.5	TOPSOIL
Elev. ±47 feet	0.5 – 3.2 Sample No. 1 @ 2	Gray, red-brown, light blue-gray, mottled CLAY, trace fine to medium sand (moist, blocky) USCS: CL
	3.2 – 5.5 Sample No. 2 @ 3.5 Sample No. 3 @ 5.5	Gray, orange-brown, red-brown GRAVEL and medium to coarse SAND, little fine sand, little silt (moist) USCS: GM
	5.5 – --- Sample No. 4 @ 6 Sample No. 5 @ 11	Gray, orange-brown, slightly mottled CLAY, trace fine sand (moist, below 9' water visible in natural "fractures") USCS: CH

NOTES:

(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 12 feet below the existing ground surface (b.e.g.s.)
(4) Slight groundwater seepage was observed in the test pit below a depth of 9 ft b.e.g.s. 20 minutes after completion of excavation.
(5) Water level at 11.5 feet, bottom of excavation at 12 feet 1 hour after completion of excavation.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT:	Proposed Odessa School Campus	PROJECT NO.:	3975.GC
CLIENT:	Appoquinimink School District	DATE:	June 11, 2010
LOGGED BY:	TRA		

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
TP-2	0 – 0.8	TOPSOIL
Elev. ±48 feet	0.8 – 5 Sample No. 1 @ 3'	Brown, orange-brown, gray-brown, slightly mottled silty CLAY, little fine to medium sand, trace gravel, trace cobbles (mosit) USCS: CL
	5 – --- Sample No. 2 @ 7.5'	Orange-brown, gray-brown, mottled CLAY, trace fine sand (moist) USCS: CH

NOTES:

(1) Test pit excavated by Feldmann Brothers' personnel utilizing a rubber tired backhoe.
(2) Ground surface elevation data based on topographic information provided to Duffield Associates by Landmark Engineering in an electronic file titled "ACAD-ACAD-Duffield-layout.dwg".
(3) Test pit terminated approximately 7.5 feet below the existing ground surface (b.e.g.s.)
(4) Slight groundwater seepage was observed in the test pit below a depth of 6.8 ft b.e.g.s. at completion of excavation.
(5) Water level at 7 feet b.e.g.s. bottom of excavation at 7.5 feet b.e.g.s. 2 hours after completion of excavation.
(6) Test pit backfilled with excavated soils upon completion.

DUFFIELD ASSOCIATES

GENERAL NOTES

Effective April 2016

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DUFFIELD ASSOCIATES

GENERAL NOTES

DUFFIELD ASSOCIATES uses the following definitions and terminology to classify and correlate the field and laboratory samples.

VISUAL UNIFIED CLASSIFICATIONS: The soil samples are described by color, major constituent, modifiers (by percentage), and density (or consistency). Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a No. 200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a No. 200 sieve; they are described as: clays or clayey silts if they are cohesive and silts if they are noncohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

The Unified Soil Classification symbols are:

COARSE GRAINED SOILS

GW - Well graded gravels
GP - Poorly graded gravels
GM - Silty gravels
GC - Clayey gravels
SW - Well graded sands
SP - Poorly graded sands
SM - Silty sands
SC - Clayey sands

FINE GRAINED SOILS

ML - Silts of low plasticity
CL - Clays of low to medium plasticity
OL - Organic silt clays of low plasticity
MH - Silts of high plasticity
CH - Clays of high plasticity
OH - Organic silt clays of high plasticity
PT - Peat and highly organic soils

SIZE DESCRIPTION

F - Fine
M - Medium
C - Coarse
G - Gravel

MODIFIERS (PERCENTAGE)

Tr -	Trace	1 - 10%
Ltl -	Little	11 - 20%
Some		21 - 35%
& -	And	36 - 50%

COLOR

Or - Orange
Yel - Yellow
Br - Brown
Blk - Black
Gr - Gray
R - Red
Vc - Varicolored
Dk - Dark
Lt - Light

DENSITY: COARSE GRAINED SOILS

Very loose	4 blows/ft or less
Loose	5 to 10 blows/ft
Medium	11 to 30 blows/ft
Dense	31 to 50 blows/ft
Very Dense	51 blows/ft or more

CONSISTENCY: FINE GRAINED SOILS

Very soft	2 blows/ft or less
Soft	3 to 4 blows/ft
Medium	5 to 8 blows/ft
Stiff	9 to 15 blows/ft
Very stiff	16 to 30 blows/ft
Hard	31 blows/ft or more

NOTE: The Standard Penetration Test "N" value is the number of blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

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Smith Property
Wetland Investigation Report

Smith Property

Wetland Investigation Report

Prepared at the Request of:
Appoquinimink School District
118 South 6th Street
Odessa, Delaware 19730

Prepared for Review by:

United States Army Corps of Engineers
Philadelphia District
Wanamaker Building
Penn Square East
Philadelphia, Pennsylvania 19107

New Castle County
Department of Land Use
87 Reads Way
New Castle, Delaware 19720

State of Delaware
Division of Water Resources
Wetlands Section
89 Kings Highway
Dover, Delaware 19901

Prepared:
May 2010

TABLE OF CONTENTS

Appendices

Summary

This document presents the findings from the wetland field investigation completed for the Smith Property (Tax Parcel No. 14-007.00-028) located near Odessa in New Castle County, Delaware. This report is suitable for a submittal to local agencies. All information contained within this report has been field collected and summarized by Landmark/JCM, Inc. Formal surveyed field delineations were performed within the property boundaries of the subject parcel as identified by Landmark/JCM, Inc., both in the field and on provided site drawings titled "Exploratory Major Land Development Plan" dated June 23, 2010. The delineated features on the plan are based on Landmark/JCM's experience and best professional judgment. Any disturbance of these areas may be subject to U.S. Army Corps of Engineers (USACE) or New Castle County regulations.

The field delineation was performed within the approximate boundaries of the subject property as shown on Figures 1 and 2. The property consisted primarily of active agricultural areas with forest cover in the northern, western, and southern portions.

The investigation concluded that two unnamed relatively permanent waterways with abutting non-tidal forested and emergent wetlands were situated along the northeastern and southwestern property boundaries. These RPW's drain into tidal portions of Appoquinimink River bordering the northern property boundary. The Appoquinimink River drains off-site northeasterly into Delaware River, a traditional navigable waterway (TNW). The USACE asserts jurisdiction over non-navigable tributaries of TNW that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally. The USACE also asserts jurisdiction over wetlands that directly abut such tributaries.

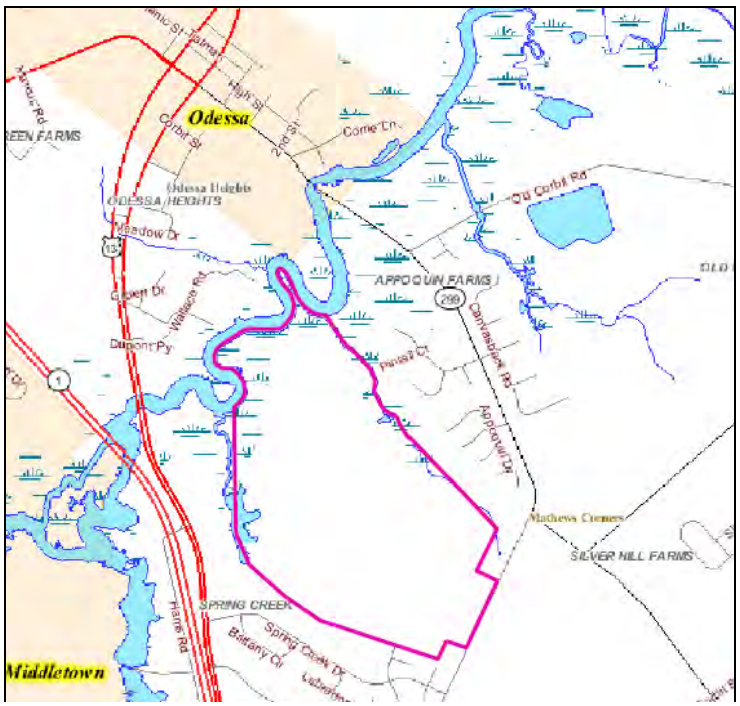

Figure 1. Site Location Map (not to scale, for reference only)

Figure 2. 2009 Aerial Photograph (not to scale, for reference only)

Delineation History

The field delineation was performed by this firm in April 2010 with data collection in May 2010 to accurately define the limits of waters and/or wetlands for jurisdictional and permitting purposes within the parcel. The field delineations have been completed, and the lines have been surveyed and plotted for final verification.

Methods

This investigation used the techniques for Routine Determinations described in the 1987 USACE Wetland Delineation Manual (Y-87-1) and Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region. The field interpretations follow the definitions listed in the Public Notices from the Army Corp of Engineers, dates September 26, 1990, October 4, 1990, September 4, 1991, and December 2, 2008.

Delineation Criteria

The following criteria were used to delineate the natural resources described in this report. For the purpose of Section 404 of the Clean Water Act regulation, the term "waters of the United States" includes open water and wetlands (see Glossary for complete definitions). For the purpose of this report and common usage, "waters of the U.S." refers to regulated open water areas and wetlands refers to vegetated areas that meet the wetland criteria as defined below.

Waters of the United States

In order for an area to be classified as regulated waters of the U.S., the feature must be consistent with the definitions as listed in 33 CFR (Code of Federal Regulations) Section 328.3 and the current guidance (see Glossary). Delineation criteria for open water areas are typically the ordinary high water mark (OHWM).

Non-tidal and Tidal Vegetated Wetlands

In order for an area to be classified as wetlands under USACE methods, it must display: 1. Hydric Soils, 2. Hydrophytic Vegetation and 3. Indicators of Wetland Hydrology. The methodology for determining the dominant vegetation on the site was a hybridization of the methods described in the 1987 Manual and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region, as described below.

The diagnostic environmental characteristics of wetlands in accordance Part II, Number 26 b.(1), (2) and (3); and Number 26 c. are listed below:

1. Vegetation: The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions (as described below). Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions.

Vegetation has been classified by the U.S. Fish and Wildlife Service according to the following categories:

Obligate Wetland Plants (OBL): Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions.

Facultative Wetland Plants (FACW): Plants that occur usually (estimated probability >67% to 99%) in wetlands.

Facultative Plants (FAC): Plants with a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and uplands (non wetlands).

Facultative Upland Plants (FACU): Plants that occur sometimes (estimated probability 1% to <33%) in wetlands.

Not Listed (NL or UPL): Plants that occur rarely (estimated probability <1%) in wetlands.

2. Soil: Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions. A complete description of hydric soils can be found in the Supplement. Common hydric soil indicators include:

Organic Soil: A soil that is more than 50% organic material (peats and mucks).

Sulfidic Material: A soil that emits the odor of rotten eggs produced by sulfides formed in a reducing environment of saturated soils.

Aquic or Peraquic Moisture Regime: A soil that is permanently flooded and/or saturated close to the surface and is devoid of oxygen.

Soil Colors: Gleyed (Gray) soils and/or soils with low matrix chroma and bright mottles in the top 10-12 inches. A chroma of #2 in mottled soils or #1 in unmottled soils is considered hydric. (Colors are as defined in Munsell Color Book 1975).

Soil on Hydric Soils List: A soil that matches the profile description for a soil type defined as hydric by the National Technical Committee on Hydric Soils (NTCHS).

Iron and/or Manganese Concretions: Segregated oxides of iron or manganese are found close to the surface (within 7.5 cm).

3. Hydrology: The area is inundated either permanently or periodically at mean water depths of less than or equal to 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.

Except in certain situations, evidence of a minimum of one positive wetland indicator from each parameter (vegetation, soils and hydrology) must be found in order to make a positive wetland determination.

Wetland hydrology may be indicated by drift lines, sediment deposition, watermarks, recorded well or stream gage data, visual observations, blackened leaves, or oxidized root channels with living roots.

The general guidance utilized at this time is that water must be within one foot of the surface consecutively greater than 5% of the growing season or more than 12 consecutive days during the growing season.

Data Collection

Waters and/or wetland parameters or lack of waters and/or wetland parameters observed throughout the site were recorded in standard field note books. Representative wetland and upland borings were recorded at or near the wetland or waters boundary as well as any representative areas of disagreement between this delineation and the United States Fish and Wildlife Service, National Wetlands Inventory (NWI) map or where deemed appropriate.

The soils exposed at each sample boring were observed using a hand soil auger. Borings were made to a depth of 18 inches when possible. Soil texture information follows the United States Department of Agriculture (USDA) classification system.

The plants recorded at each sample station follow the nomenclature of Fernald (1950) and Kartesz and Kartesz (1981) and the PLANTS Database (USDA 2007).

Hydrological indicators follow the descriptions of the 1987 Wetland Delineation Manual and Interim Regional Supplement to the Corps of Engineers Wetland delineation Manual: Atlantic and Gulf Coastal Plain Region. Wetland hydrology indicator nomenclature uses the system developed by

Cowardin, et al. (1981) and the U.S. Fish and Wildlife Service National Wetland Inventory mapping program.

Data Sheets

The field analysis provided ample opportunity to express the typical conditions found in the field which determined where to place the waters and/or wetland flags as well as to document any conditions found in areas of disagreement between the delineation and the NWI or SWMP designations. Conditions along the lines were characterized by representative samples which recorded the vegetation, apparent hydrology, and existing soil conditions. These samples were documented on the Routine Wetland Delineation Data Forms from the 1987 USACE Wetlands Delineation Manual, which are attached in the Appendix. Sample locations were estimated on the plans based on their relative location to physical features and surveyed flags.

Jurisdiction

USACE and EPA

Section 10 Waters of the U.S. (Navigable Waters) and Tidal Wetlands

Section 10 of the Rivers and Harbors Act (RHA) of 1899 gives the Environmental Protection Agency (EPA) and USACE (the agencies) jurisdiction over traditional navigable waters (TNW). Section 10 Waters (including wetlands) includes tidal open waters and wetlands to the mean high tide mark and non-tidal navigable waters and wetlands to the ordinary high water mark (OHWM). The USACE maintains a list TNWs. These waterways include tidal and certain non-tidal waters.

Section 404 Waters of the U.S. including Vegetated Wetlands

Waters of the United States including tidal and non-tidal vegetated wetlands are regulated by the USACE under Section 404 of the Clean Water Act. Section 404 waters (including wetlands) includes tidal open waters to the high tide line, non-tidal navigable waters to the OHWM, non-navigable open water to the OHWM, and all wetlands to the wetland/upland boundary. In order to be jurisdictional, non-wetland waters of the United States (typically referred to as just waters of the U.S.) must be consistent with the definitions listed in 33 CFR (Code of Federal Regulations) Section 328.3 and the current guidance. Non-tidal wetlands must display the three criteria (hydric soils, hydrophytic vegetation, and wetland hydrology) in order to be jurisdictional.

In accordance with guidance, the agencies will assert jurisdiction over the following waters and wetlands:

- Traditional Navigable Waters
- Wetlands adjacent to TNWs
- Non-navigable tributaries of TNWs that are relatively permanent (relative permanent waters - RPW) where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g. typically three months.)
- Wetlands that directly abut such tributaries

The agencies will decide jurisdiction over the following waters based on a fact-specific analysis to determine whether they have a significant nexus (see Glossary) with a TNW:

- Non-navigable tributaries that are not relatively permanent

- Wetlands adjacent to non-navigable tributaries that are not relatively permanent
- Wetlands adjacent to but that do not directly abut a relatively permanent non-navigable tributary
- In addition, an USACE policy decision has been made to collect information relevant to a significant nexus evaluation for all "intermittent" non-navigable tributaries and their adjacent wetlands (i.e., even if the tributary's flow may be relatively permanent, but is not perennial).

The agencies generally will **not** assert jurisdiction over the following features:

- Swales or erosional features (e.g., gullies, small washes characterized by low volume, infrequent, or short duration flow)
- Ditches (including roadside ditches) excavated wholly in and draining only uplands and that do not carry a relatively permanent flow of water

The agencies will apply the significant nexus standard as follows:

- A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by all wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of downstream TNWs.
- Significant nexus includes consideration of hydrologic and ecologic factors (see Glossary)

Geographically isolated wetlands which do not have a significant nexus connection to interstate commerce are not jurisdictional. The USACE District office evaluates if these wetlands are isolated under the CWA if submitted for a JD. USACE and EPA headquarters must concur with an isolated wetlands evaluation for a non-jurisdictional determination.

State of Delaware

State Subaqueous Lands

The State of Delaware regulates all perennial and intermittent watercourses as State Subaqueous Lands. Subaqueous Lands are water conveyances with defined banks and channels permanently or seasonally supported by groundwater, spring seeps, or surface waters in addition to precipitation and surface water runoff from storm events. Ephemeral streams are not typically considered Subaqueous Lands as they rely only on surface water runoff from storm events and are otherwise dry. A determination of the limits of regulated Subaqueous Lands is usually done on a case-by-case basis by the Delaware Department of Natural Resources and Environmental Control (DNREC). If Subaqueous Lands are determined to be present on the property, they will most likely be found to coincide with waters of the United States.

Tidal Wetlands

The State of Delaware regulates those tidal wetlands indicated on the Delaware Tidal Wetland maps in accordance with the Delaware Wetlands Title 7, Part VII, Chapter 66.
These areas include tidal waters and adjacent areas "whose surface is at or below an elevation of 2 feet above local mean high water, and upon which may grow or is capable of growing" typical tidal water hydrophytes.

New Castle County

Perennial and Intermittent Streams

The Unified Development Code (UDC) for New Castle County, Delaware requires a 100-foot riparian buffer on either side of all perennial and intermittent streams, plus land adjacent to identifiable stream channels that drain greater than 10 acres.

Non-Tidal Vegetated Wetlands

The UDC for New Castle County, Delaware provides protection for 100% of federally regulated and non-federally regulated wetlands, and requires the addition of a 50-foot buffer around all non-tidal wetlands greater than 20,000 ft^2 in area. A USACE permit or a variance from New Castle County allows for the waiver of this protection. If a wetland is classified as a Piedmont stream valley wetland, the entire wetland area plus an additional 50 feet of adjacent land is required as a riparian buffer.

Tidal Wetlands

The UDC for New Castle County, Delaware requires a 100-foot buffer on all tidal wetlands within the County.

Results

General Site Description

A background review was performed in the office prior to the commencement of site work. The results of this background review are described below.

Location

The field delineation was performed within the boundaries of the subject property located at Latitude 39°-26'-20" North and Longitude 75°-39'-08" West in New Castle County, Delaware. The property is bordered to the northeast by Appoquinimink Farms subdivision, the northwest and west by Appoquinimink River, the east by Old State Road, and the south by Chestnut Hill subdivision (see Figures 1 and 2).

Soils

The USDA Web Soil Survey document indicated the site is underlain with Broadkill-Appoquinimink complex (Ba), Fallsington loam (FgA), Keyport sandy loam (KhC), Keyport loam (KmE), Keyport silt loam (Kpa and KpB), Lenni silt loam (LhA), Lenape mucky peat (Lk), Lenape-Nanticoke complex (Ln), Longmarsh and Indiantown soils (Lo), Reybold silt loam (ReA, ReB, and ReC), and Sassafras sandy loam (SaB and SaC), Woodstown loam (WoA), and Zekiah sandy loam (Za) (Figure 3). The Fallsington and Lenni series consist of poorly drained soils that occur on uplands. The Keyport and Woodstown series consists of deep, moderately well-drained soils that occupy uplands of the Coastal Plain. The Broadkill-Appoquinimink, Lenape, Longmarsh, and Zekiah series consist of soils that are frequently flooded. The Reybold and Sassafras series consist of deep, well-drained soils

on uplands. Of these soils listed, the Broadkill-Appoquinimink, Fallsington, Lenni, Lenape, Lenape-Nanticoke, Longmarsh and Indiantown, and Zekiah series are considered hydric by the Natural Technical Committee on Hydric Soils.

The Soil Survey does not indicate any drainage patterns associated with the subject property.

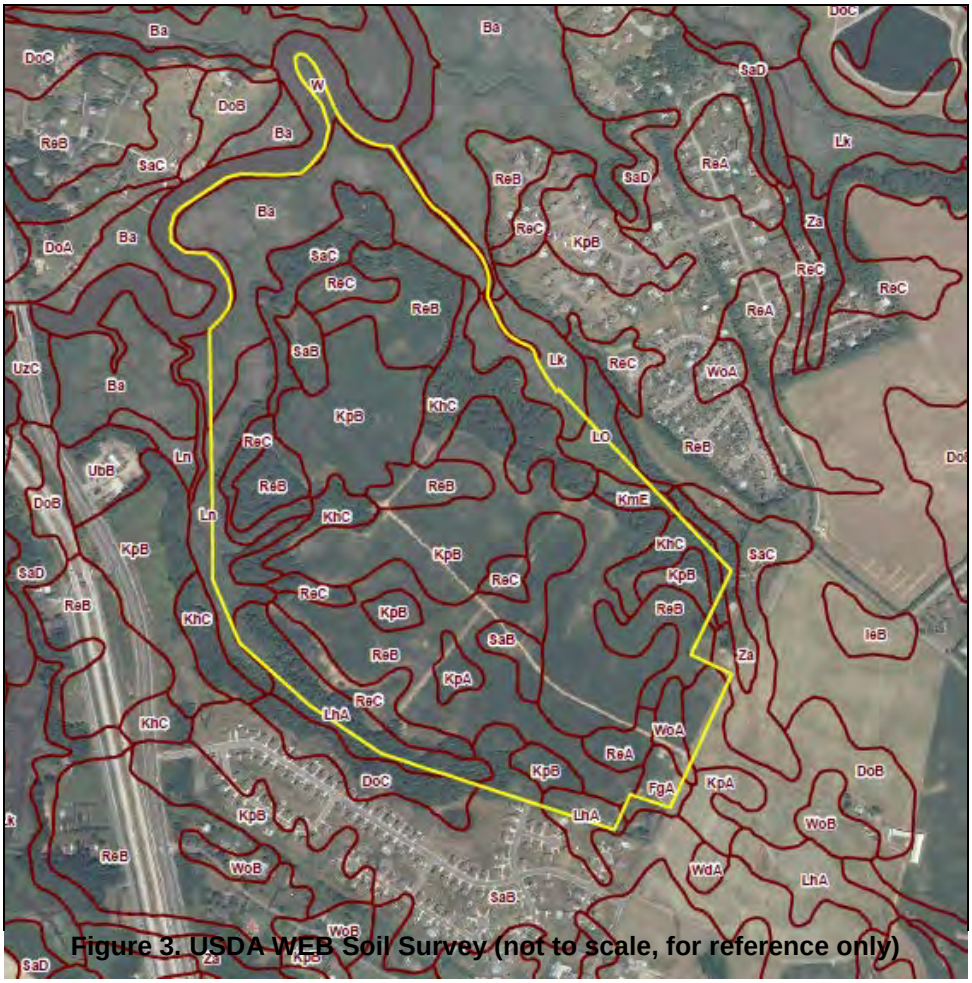

Figure 3. USDA WEB Soil Survey (not to scale, for reference only)

Mapped Hydrology and Topography

The subject property drains steeply both north and south into unnamed "blue-line" drainages located along the northeastern and southwestern property boundaries. These features drain northerly into Appoquinimink River, a tributary to Delaware River and traditional navigable waterway. Site hydrology appears to be influenced mainly by sheet flow runoff from uplands within the property. Site elevations range from 50' above sea level (asl) in the south to 5' asl in the north according to the Middletown 7.5 Minute USGS Quadrangle (Figure 4).

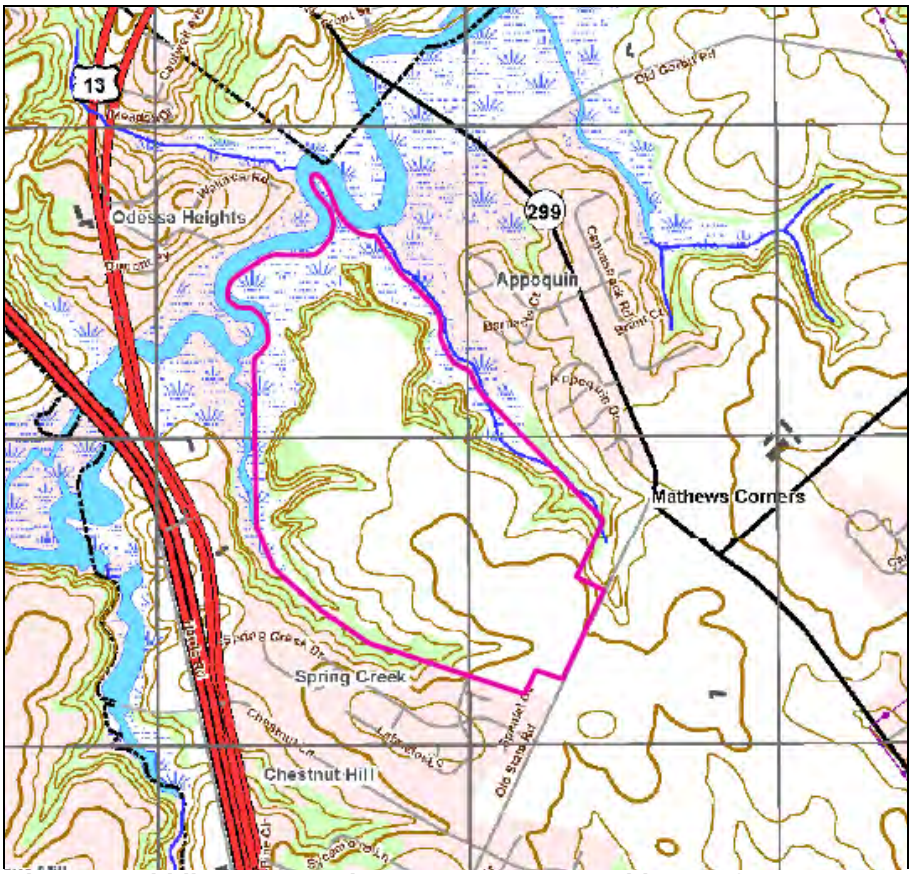

Figure 4. Middletown 7.5 Minute USGS Topographic Map from DataMIL (not to scale, for reference only)

Mapped Wetlands

National Wetland Inventory Mapping

The U.S. Fish and Wildlife Service National Wetland Inventory (NWI) map depicted eustarine emergent wetlands (E2EM1P) along the northern boundary of the property associated with Appoquinimink River. Palustrine forested and emergent wetlands (PFO1R and PEM1E), and eustarine emergent (E2EM1/5P6) are shown along the western and southern property boundaries. Eustarine emergent and open water wetlands(E2EM1P and E1OWL), palustrine forested (PFO1R), and a riverine stream (R3OWH) are shown along the northeastern property boundary (Figure 5).

Figure 5. National Wetlands Inventory Map
(not to scale, for reference only)

Statewide Wetland Mapping Program

The Statewide Wetland Mapping Program (SWMP) map (Figure 6) indicated eustarine emergent wetlands (E2EM1N) in the northern, northeastern, and western portions of the property. Palustrine scrub-shrub wetlands (PSS1R and PSS1/EM1R), palustrine forested wetlands (PFO1R and PFO1A7) are shown in the northeastern portion of the property. Along the western and southern boundary palustrine scrub-shrub wetlands (PSS1R) and palustrine forested wetlands (PFO1A7) are shown. The digital map does not indicate linear features.

Figure 6. Digital Statewide Wetland Map (not to scale, for reference only)

Field Delineation Specifics

Upland Land Use and Land Cover Types

- Cropland – The north-central, south-central and eastern portions of the property were in active agricultural production. At the time of the survey corn stubble was present in the fields. Other herbaceous plants observed included Lambs Quarter, Canada Thistle, and Ground Ivy.

View looking south across agricultural field in the southeastern portion of the property.

View looking east across agricultural field from the central portion of the property.

Looking south across agricultural field from the central portion of the property.

Active agricultural field in the northern portion of the property.

- Woodlands– The northern, western, and southern portions of the property consisted of deciduous forest cover. Common species included White Oak, Northern Red Oak, Black Oak, Chestnut Oak, Mockernut Hickory, and American Beech. Shrub/herbaceous species included Northern Arrowwood, Spicebush, Mountain Laurel, Black Gum, Red Maple, Lowbush Blueberry, May Apple, False Solomon's Seal, and Common Greenbrier.

Upland forest cover in the western portion of the subject property.

Typical forest cover in the northeastern portion of the property.

Upland forest cover in the northwestern portion of the subject property.

Typical forest cover in the western portion of the property.

- Hedgerow– A narrow hedgerow was observed in the northeastern portion of the property. Common species within this area included Black Cherry, Sassafras, Black Gum, Smooth Sumac, Multiflora Rose, Poison Ivy, and Japanese Honeysuckle.

View looking south toward hedgerow in the northeastern portion of the subject property.

Line Specifications

The waters/ wetland lines were placed within the property boundaries as estimated during fieldwork based on physical features. All water and/or wetland features found within this area were flagged with vinyl, pink ribbon with black "WETLAND DELINEATION" letters. Two lines were marked with alpha numeric designators with letters representing the lines and numbers representing the positions along each line. These lines were subsequently surveyed and plotted by Landmark/JCM, Inc. Common vegetation observed within the wetlands is described below within the appropriate wetland classification section.

Line A began in the north-central portion of the property delineating tidal marsh associated with Appoquinimink River. Line A continued southwesterly then easterly demarcating non-tidal palustrine forested wetlands, scrub-shrub wetlands and intermittent waters of the U.S. Line A ended at the southern property boundary and consisted of 232 flags.

Standing water within tidal marsh in the northern portion of the property delineated by Line A.

View looking west across tidal marsh in the northwestern portion of the property.

Non-tidal wetland delineated by Line A in the western portion of the property.

Non-tidal forested wetland located in the west-central portion of the property.

Waters of the U.S. located in the south-central portion of the property.

Non-tidal forested/scrub-shrub wetland area in the southwestern portion of the property.

Line B began opposite of Line A in the north-central portion of the property and traveled northeasterly demarcating emergent tidal wetlands associated with Appoquinimink River. Line B turned east and then southeast delineating palustrine forested wetlands associated with the unnamed RPW along the northeastern property boundary. Line B ended at the eastern property boundary and consisted of 264 flags.

Non-tidal scrub-shrub wetland delineated by Line B in the north-central portion of the property.

View looking north across tidal marsh delineated by Line B in the northern portion of the property.

View looking west across tidal marsh located in the northern portion of the property.

Tidal marsh wetland delineated by Line B.

Waters of the United States (open water)

Appoquinimink River along the northern property boundary and the two RPW's located along the northeastern and southwestern property boundaries qualify as waters of the U.S. and therefore be considered jurisdictional by the USACE. These RPW's were not delineated separately in the field and are located within the delineated wetland boundary.

State Subaqueous Lands

Appoquinimink River along the northern property boundary and the two RPW's located along the northeastern and southwestern property boundaries that were classified as waters of the U.S. would also qualify as State Subaqueous Lands. The State determines the boundaries of their jurisdiction on a case-by-case basis.

Non-tidal Vegetated Wetlands

Non-tidal scrub-shrub and forested wetlands were observed in the eastern, northeastern, western, and southern portions of the property. Common vegetation consisted of Red Maple, Black Gum, Winterberry, Sweet Pepperbush, Narrow-leaf Cattail, Skunk Cabbage, Spotted Touch-Me-Not, Northern Arrowwood, and Common Greenbrier.

Section 10 Waters

Navigable waters applicable to Section 10 regulation were located in the northern portion of subject property associated with Appoquinimink River.

Tidal Wetlands

Tidal wetlands were encountered in the northern, north-central, and southwestern portions of the subject property associated with Appoquinimink River. Common emergent vegetation observed included Narrow-leaf Cattail, Pickerelweed, Yellow Flag, Swamp Dock, Sweet Bay Magnolia, Common Reed, Reed Canary Grass, Silky Dogwood, Salt Meadow Grass, Water Purslane, and Black Gum.

Comparison to Mapped Wetlands

The National Wetland Inventory Map and State Wetland Mapping Program accurately depicted the majority of the wetland resources within the subject property boundaries. However, NWI misidentified a small isolated area in the southeastern corner as a palustrine emergent wetland (PEM1E). This area was in active agricultural production and did not meet any of the three wetland criteria.

Conclusions

The waters and/ or wetlands delineated within the property boundaries were flagged in April 2010. Two lines were used to demarcate the delineated wetland boundaries for review by the USACE and fourteen data samples were collected to support the delineation.

The investigation concluded that two unnamed relatively permanent waterways with abutting non-tidal forested, scrub-shrub, and emergent wetlands were situated along the northeastern and southwestern property boundaries. These RPW's drain into tidal portions of Appoquinimink River bordering the northern property boundary. The Appoquinimink River drains off-site northeasterly into Delaware River, a traditional navigable waterway (TNW). The USACE asserts jurisdiction over non-navigable tributaries of TNW that are relatively permanent where the tributaries typically flow

year-round or have continuous flow at least seasonally. The USACE also asserts jurisdiction over wetlands that directly abut such tributaries.

Waters of the United States were limited to the Appoquinimink River and the two unnamed RPW's located along the northeastern and southwestern property boundaries.

The areas identified as Waters of the U.S. may qualify as Subaqueous Lands regulated by the State of Delaware. The State determines the boundaries of their jurisdiction on a case-by-case basis.

Tidal wetlands were present in the northern, southwestern, and north-central portions of the property associated with Appoquinimink River.

The sole purpose of this delineation is to identify the limits of waters of the United States including wetlands, Tidal Waters, Navigable Waters, and Subaqueous Lands and to document the site conditions. This report contains the information necessary to accompany the JD information sheets when submitting to the USACE with a jurisdictional determination request, if necessary.

Notes

The USACE regulates the placement of structures and fill in Section 10 Waters and the placement of fill and/or dredge material into waters of the U.S. including wetlands. The placement of fill and/or dredged material has been widely interpreted by the Courts. Please consult our office prior to any work in wetlands. No work of this nature should be performed without a JD and/or a permit from the USACE.

The State of Delaware regulates activities in Subaqueous Lands as well as State mapped tidal wetlands. No work in those areas should be performed without a permit from the State.

New Castle County regulates the disturbance of wetlands, including non-jurisdictional, isolated wetlands and associated buffers. No work should be performed in these areas without approval from the County.

This study has been performed utilizing best professional judgment based on the conditions at the time of the investigation. The investigator is not responsible for changed conditions, either man made or natural, which change the wetland boundaries.

References

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Glossary

Waters of the U.S. *As defined by 33 CFR Part 328, Section 328.3.*

a. Waters of the United States

1. All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
2. All interstate waters including interstate wetlands;
3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use degradation or destruction of which could affect interstate or foreign commerce including any such waters;
    a. Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
    b. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
    c. Which are used or could be used for industrial purposes by industries in interstate commerce;
4. All impoundments of waters otherwise defined as waters of the United States under the definition;
5. Tributaries of waters identified in paragraphs (a) (1)-(4) of this section;
6. The territorial seas;
7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) (1)-(6) of this section.
   Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 123.11(m) which also meet the criteria of this definition) are not waters of the United States.
8. Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with the EPA.

b. The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

c. The term "adjacent" means bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent wetlands."

d. The term "high tide line" means the line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

e. The term "ordinary high water mark" means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

f. The term "tidal waters" means those waters that rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by hydrologic, wind, or other effects.

Guidelines and Public Notices periodically released by the EPA and USACE refine and interpret these definitions.

Navigable Waters of the U.S. *As defined by 33 CFR Part 328, Section 329.4*

Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity.

Tabulated lists of final determinations of navigability are to be maintained in each district office, and be updated as necessitated by court decisions, jurisdictional inquiries, or other changed conditions.

Traditional Navigable Water (TNW) *Per US Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook, dated May 30, 2007*

Traditional navigable water currently used or that have been used in the past, or may be susceptible to use, in interstate or foreign commerce, including but not limited to tidal waters. Such waters are those referred to in as “navigable-in-fact”.

Non-navigable Tributaries of TNWs with Relatively Permanent Flow (RPF)

The guidance describes the second category – non-navigable tributaries with relatively permanent flow as waters, e.g. streams, that typically flow year-round or that have continuous flow at least seasonally (typically three months) excluding ephemeral tributaries and intermittent streams.

Significant Nexus Determination

The significant nexus evaluation will combine, for analytical purposes, the tributary, and all of its adjacent wetlands, whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. A significant nexus analysis will assess the flow characteristics and functions of the relevant reach of the tributary, in combination with functions collectively performed by all wetlands (if present) adjacent to the tributary, to determine if they have more than an insubstantial or speculative effect on the chemical, physical, and biological integrity of TNWs.

Consideration will be given to the distance between the tributary and the TNW. The tributary will not be so remote as to make the effect on the TNW speculative or insubstantial. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW).

Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of a significant nexus.

Hydrologic factors will be considered, such as:

- volume, duration, and frequency of flow, including consideration of certain physical characteristics of the tributary
- proximity to the traditional navigable water
- size of the watershed
- average annual rainfall
- average annual winter snow pack

Ecologic factors will be considered, such as:

- the ability of the tributary and its adjacent wetlands (if any) to carry pollutants and flood waters to traditional navigable waters
- the ability of the tributary and its adjacent wetlands (if any) to provide aquatic habitat that supports biota of a traditional navigable water
- the ability for adjacent wetlands to trap and filter pollutants or store flood waters
- the ability to maintain water quality

Certain geographical features (e.g., ditches, canals) that transport relatively permanent (continuous at least seasonally) flow directly or indirectly into TNWs or between two (or more) waters of the U.S., including wetlands, are jurisdictional waters regulated under the CWA.

Certain geographic features (e.g., swales, ditches, pipes) may contribute to a surface hydrologic connection where the features:

- replace or relocate a water of the U.S., or
- connect a water of the U.S. to another water of the U.S., or
- provide relatively permanent flow to a water of the U.S.

Certain geographic features generally are not jurisdictional waters:

- swales, erosional features (e.g. gullies) and small washes characterized by low volume, infrequent, and short duration flow
- ditches (including roadside ditches) excavated wholly in and draining only uplands and that do not carry a relatively permanent flow of water
- uplands transporting over land flow generated from precipitation (i.e., rain events and snowmelt)

APPLICATION NO. ##########(S)
PRELIMINARY SEDIMENT AND STORMWATER PLAN
INSTITUTIONAL PLAN
APPOQUINIMINK HUNDRED - NEW CASTLE COUNTY
DELAWARE

1. TAX PARCEL NUMBER: 14.007–00.028

2. SOURCE OF TITLE: PART OF DEED RECORD 1160, PAGE 388 AND DEED RECORD C. VOLUME 93, PAGE 157.

3. GROSS AREA: 272.20 +/– ACRES

4. EXISTING ZONING: S – SUBURBAN

   BULK AREA RESTRICTIONS

STREET YARD SETBACK:	40'
SIDE YARD:	25'
REAR YARD:	40'
LOT AREA:	1 ACRE
BUILDING HEIGHT:	45'
PARKING SETBACK (STREET/OTHER):	20'/10'

5. TOPOGRAPHIC SURVEY: A TOPOGRAPHIC SURVEY VIA AERIAL AND GROUND SURVEYS WAS COMPLETED BY VANDEMARK & LYNCH, INC. IN MAY 2010.

A. DATUM: NAVD 1988

   BENCHMARK: CHISEL CUT ON TOP NORTH END OF HEADWALL ON WEST SIDE OF OLD STATE ROAD APPROXIMATELY 48± FEET IN A NORTHWESTERLY DIRECTION FROM UTILITY POLE NO 45814/32181.

   ELEVATION: 30.91 FEET

B. PERIMETER MONUMENTATION:

   EXISTING (0)

   PROPOSED (0)

   BASED ON THIS TOPOGRAPHY, THIS SITE CONTAINS PRECAUTIONARY AND PROHIBITIVE STEEP SLOPES DISTRICTS WHICH ARE SHOWN ON THE PLAN. THERE ARE 0.4122 AC. OF PRECAUTIONARY SLOPES AND 0.2887 AC. OF PROHIBITIVE SLOPES ON THE SITE. THIS PLAN PROPOSES NO DISTURBANCE OF EITHER STEEP SLOPE AREA.

6. WATER SUPPLY: ARTESIAN WATER
   WATER SUPPLY IS SUBJECT TO THE APPROVAL OF THE DELAWARE STATE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL AND THE DELAWARE DEPARTMENT OF PUBLIC HEALTH.

7. SANITARY SEWER: GRAVITY

   SEWERAGE IS SUBJECT TO THE APPROVAL OF THE NEW CASTLE COUNTY DEPARTMENT OF SPECIAL SERVICES. AT THE TIME OF APPROVAL OF THIS PLAN, SEWER CAPACITY EXISTED TO ACCOMMODATE THE ANTICIPATED FLOWS GENERATED BY THIS ADDITIONAL DEVELOPMENT. NEW CASTLE COUNTY HAS COMMITTED TO PROVIDE SEWER IN ACCORDANCE WITH THE LAND DEVELOPMENT IMPROVEMENT AGREEMENT FOR THIS DEVELOPMENT. THE OWNER OF THIS PROPERTY, HIS SUCCESSOR OR ASSIGNS, SHALL BE RESPONSIBLE FOR EXTENDING SEWER SERVICE TO EACH LOT SHOWN ON OR CREATED BY THIS PLAN. ESTIMATED SEWAGE FLOW GENERATION FOR THIS PROJECT:
   KINDERGARTEN CENTER: 330 STUDENTS X 7.5 G + 50 STAFF X 12.5 G = 3,100 GPD
   ELEMENTARY SCHOOL: 840 STUDENTS X 7.5 G + 80 STAFF X 12.5 G = 7,300 GPD
   MIDDLE SCHOOL: 1,000 STUDENTS X 7.5 G + 90 STAFF X 12.5 G = 8,625 GPD
   HIGH SCHOOL: 1,600 STUDENTS X 7.5 G + 110 STAFF X 12.5 G = 13,375 GPD
   ART BUILDING: 1,200 SEATS X 1G/2.5 SEATS = 480 GPD

   TOTAL ESTIMATED FLOW: 32,880 GPD

8. PRIVATE WELLS AND SEPTIC SYSTEMS THAT EXIST WITHIN THIS DEVELOPMENT WILL BE ABANDONED IN ACCORDANCE WITH THE CURRENT STATE OF DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL REGULATIONS.

9. DEBRIS DISPOSAL: NO DEBRIS WILL BE BURIED OR DISPOSED OF ON THIS SITE.

10. WATER RESOURCE PROTECTION: NO PORTION OF THIS PROPERTY IS LOCATED WITHIN A WATER RESOURCE PROTECTION AREA (WRPA). SEE WRPA MAP FOR NEW CASTLE COUNTY, DE, SHEET 3 OF 3 DATED 1987, REVISED 1993, MAY 2001 AND FEB 2006.

11. A 100–YEAR FLOOD PLAIN EXISTS ON THIS PARCEL, IN ACCORDANCE WITH FLOOD INSURANCE RATE MAPS, 10003O0310G & 10003O0320G PANELS 310 & 320 OF 450, DATED JANUARY 17, 2007. THE SITE LIES WITHIN THE 100 YEAR FLOOD PLAIN LINE SHOWN IN ACCORDANCE WITH THE RESULTS OF A DYNAMIC WATER MODEL AT THE DELAWARE RIVER AND ESTUARY AS PREPARED BY THE U.S.A.C.O.E. ACCORDINGLY, IT IS ANTICIPATED THAT THE TRUE 100 YEAR FLOOD PLAIN AT THE SITE IS 8.73 NAVD. FOR CLARITY, REPRESENTATION OF THE 100 YEAR FLOOD PLAIN WILL BE SHOWN AT ELEVATION 9.0. THE APPOQUINIMINK SCHOOL DISTRICT WILL APPLY TO FEMA FOR A LOMR BASED ON IMPROVED TOPOGRAPHIC INFORMATION AND RESULTS OF THE STUDY BY THE U.S.A.C.O.E.

12. CRITICAL NATURAL AREAS: THE STATE INVENTORY OF CRITICAL NATURAL AREAS HAS BEEN EXAMINED AND THE CNA FOUND TO EXIST ON THE SITE IS SHOWN ON THIS PLAN. THERE ARE 9.6441 AC. OF YOUNG FOREST AND 2.9928 AC. OF MATURE FOREST. PER THIS PLAN, A YOUNG FOREST DISTURBANCE OF 0.6456 AC. AND A MATURE FOREST DISTURBANCE OF 0.0202 AC. IS PROPOSED.

13. WETLANDS: THIS SITE WAS EVALUATED IN ACCORDANCE WITH THE PROCEDURES SET FORTH IN THE 1987 CORPS OF ENGINEERS WETLAND DELINEATION MANUAL (TECHNICAL REPORT Y–87–1), AND SUBSEQUENT PUBLIC NOTICES, TO IDENTIFY THE PRESENCE OF JURISDICTIONAL WETLANDS, AND THE WETLANDS FOUND TO EXIST ON THE SITE, TOTALING IN AREA 62.0981 ACRES OF LAND, ARE SHOWN ON THIS PLAN. SEE WETLAND REPORT PREPARED BY LANDMARK/JCM DATED MAY, 2010. FOR A METES AND BOUNDS DESCRIPTION OF THESE WETLANDS. NO WETLAND DISTURBANCE IS PROPOSED BY THIS PLAN.

14. TREE PRESERVATION: THE DEVELOPER SHALL PRESERVE ALL TREES ON THIS SITE EXCEPT WHERE NECESSARY TO CONSTRUCT BUILDINGS, ACCESSWAYS, AND UTILITIES, AND WHERE SELECTIVE THINNING OF EXISTING VEGETATION IS APPROVED. EXISTING PLANT MATERIALS DESIGNATED TO REMAIN ON THIS PLAN, OR THE LANDSCAPE PLAN, SHALL BE PRESERVED AND PROPERLY PROTECTED DURING CONSTRUCTION. IN THE CASE OF UTILITY RIGHTS–OF–WAY AND EASEMENTS, ANY DISTURBED AREAS SHALL BE REPLANTED SO AS TO ACHIEVE A RECURRENCE OF NATURAL VEGETATIVE COVER.

15. CONSERVATION EASEMENT: ANY AREA DESIGNATED FOR PROTECTION AS A NATURAL RESOURCE PURSUANT TO CHAPTER 40, ARTICLE 10 OF THE NEW CASTLE COUNTY UNIFIED DEVELOPMENT CODE IS HEREBY PROTECTED BY A CONSERVATION EASEMENT THAT SHALL RUN IN PERPETUITY FOR THE BENEFIT OF NEW CASTLE COUNTY. ANY AREA ON THIS PLAN DELINEATED AS A CONSERVATION EASEMENT SHALL REMAIN IN ITS NATURAL STATE.

16. LAND DEVELOPMENT DATA:

EXISTING BUILDING AREA: (0 SF)	0 ACRES	= 0%
EXISTING PAVED AREA:	0 ACRES	= 0%
EXISTING STORMWATER MANAGEMENT (SWM) AREA:	0 ACRES	= 0%
PROPOSED BUILDING AREA: (466,943 SF)	10.72 ACRES	= 3.94%
PROPOSED PAVED AREA:	33.71 ACRES	= 12.38%
PROPOSED SWM AREA:	4.24 ACRES	= 1.56%
PROPOSED LANDSCAPE SURFACE AREA:	223.53 ACRES	= 82.12%
TOTAL	272.20 ACRES	= 100%

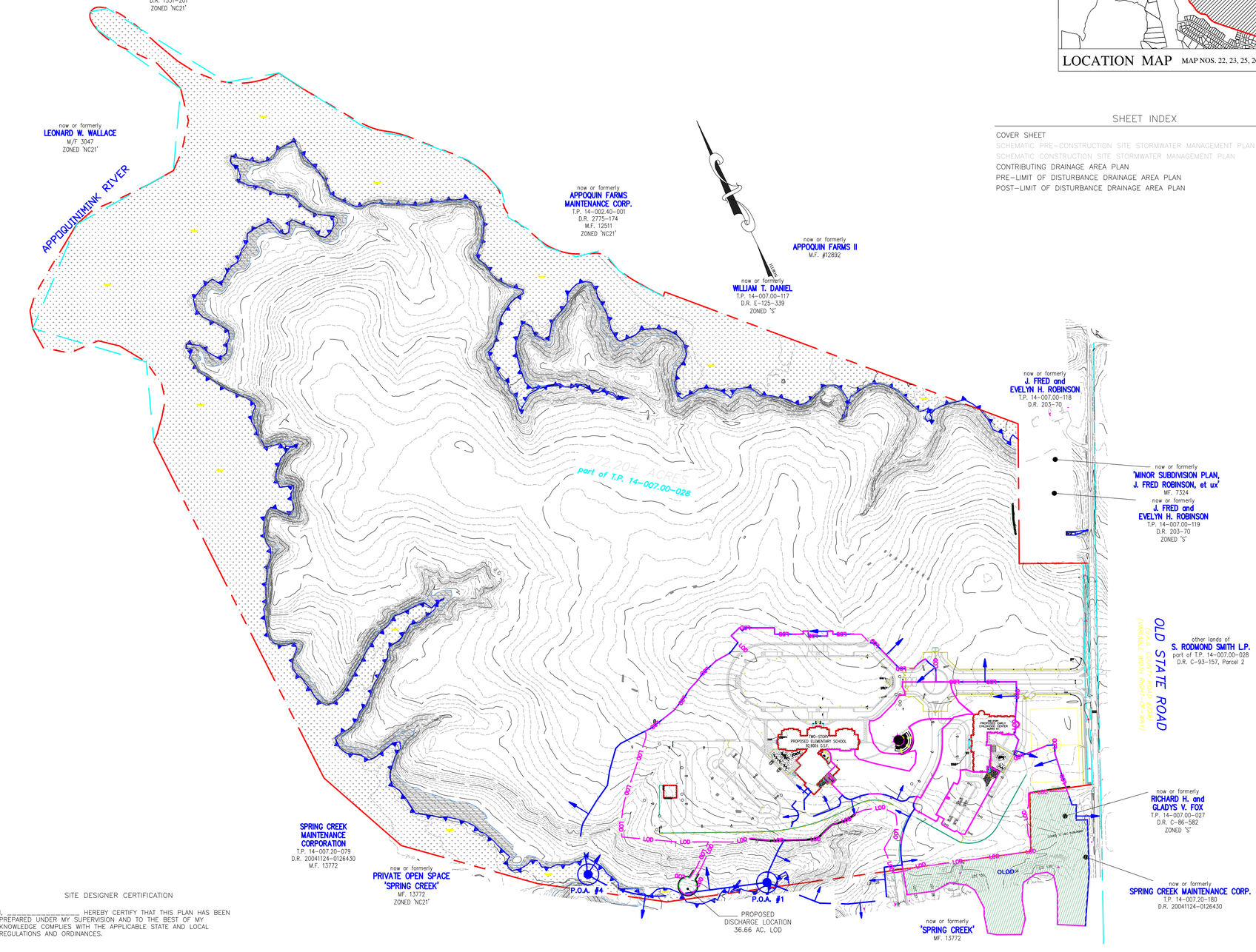
LEGEND

- WETLANDS DELINEATION LINE
- PROPOSED DRAINAGE BOUNDARY (PDB)
- LOD — LIMITS OF DISTURBANCE
- BMP DRAINAGE AREA
- OLOD–1/2 AC. RESIDENTIAL

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.

SIGNATURE _____ DATE _____



PLAN INDEX
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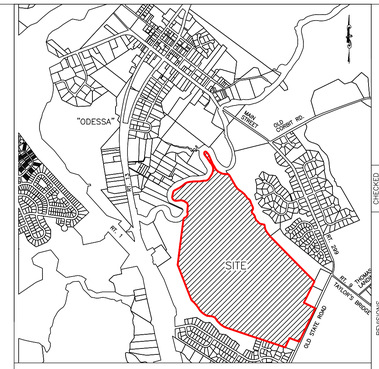


LOCATION MAP MAP NOS. 22, 23, 25, 26 1"=2000'

SHEET INDEX

CHECKED BY:

REVISIONS

APPLICATION NO. ##########(S)
COVER SHEET
FOR
INSTITUTIONAL PLAN
APPOQUINIMINK HUNDRED – NEW CASTLE COUNTY, DELAWARE

OWNER/DEVELOPER NAME
COMPANY / LLC
FULL STREET ADDRESS
PHONE #
FAX #

NEW CASTLE, DE (302) 323-9377
DOVER, DE (302) 734-9597
GEORGETOWN, DE (302) 854-9138
WAYNE, PA (610) 687-1976
HAVRE DE GRACE, MD (410) 939-2144

LandmarkJCM
Science and Engineering
100 WEST COMMONS BOULEVARD, SUITE 301
NEW CASTLE, DELAWARE 19720
PHONE: (302) 323-9377 • FAX: (302) 323-9463
INFO@LANDMARKJCM.COM • WWW.LANDMARKJCM.COM

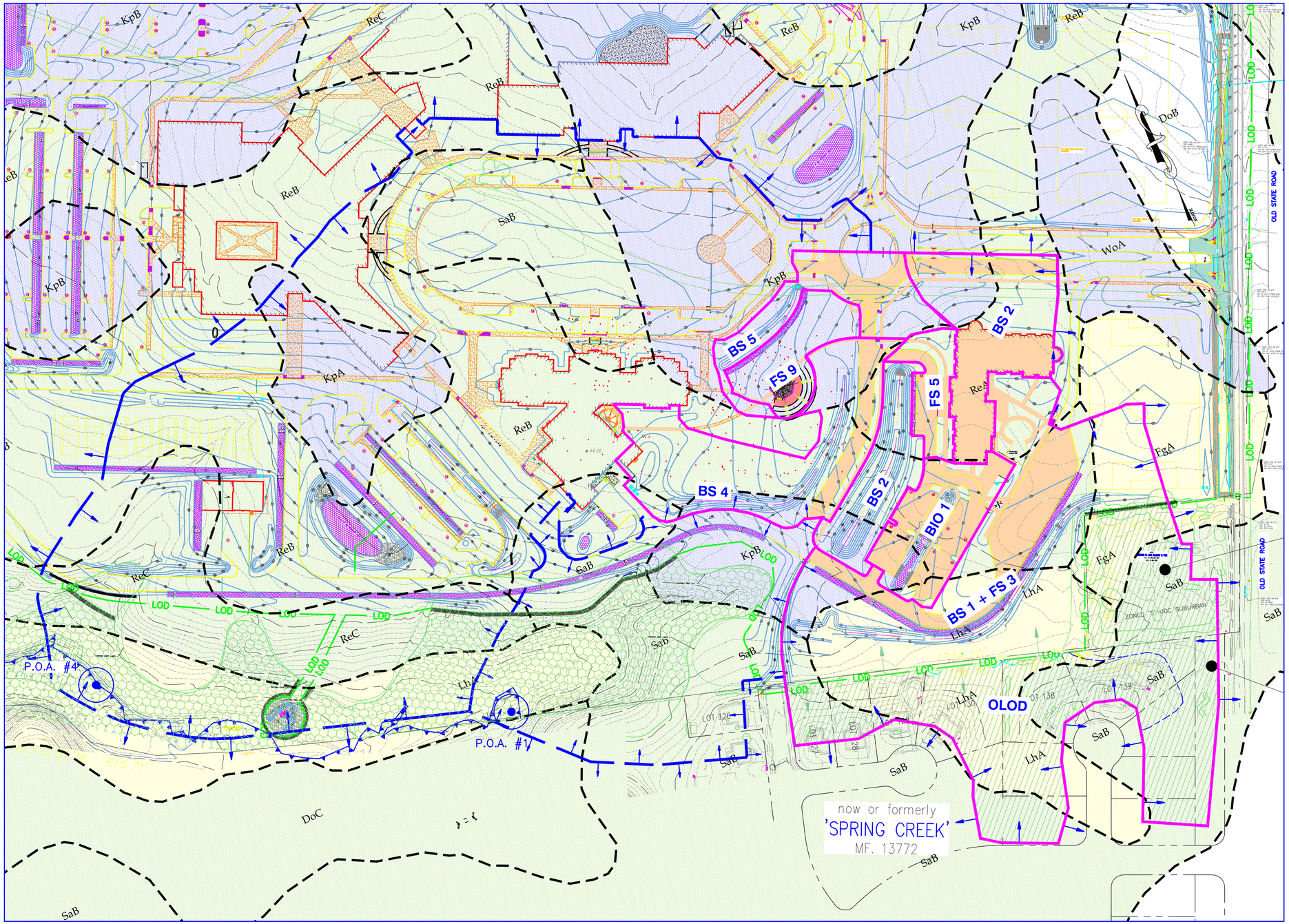
DRAWN BY:	ASR	SCALE:	1"=250'
DESIGNED BY:	LEI/JCM	DATE:	7–28–11
CHECKED BY:	ASR	LAST MODIFIED	8/25/11
COMM. NO.	C2378	FILE NO.	XXX
DRAWING NAME:	COVER SHEET.DWG	SHEET NO.	01 OF 06

C-001

THIS DRAWING AND THE DESIGN SHOWN ARE THE PROPERTY OF LANDMARK/JCM ENGINEERING. IT IS CONFIDENTIAL AND SHALL NOT BE COPIED WITHOUT WRITTEN PERMISSION.

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY.

ALL CONSTRUCTION MUST BE DONE IN CONFORMANCE WITH OSHA CONSTRUCTION SAFETY AND HEALTH ACT OF 1970 AND THE RULES AND REGULATIONS THERETO APPURTENANT



POST-LOD DATA SUMMARY TABLE

BMP	TOTAL AREA (AC.)	HSG B			HSG C			HSG D		
		TOTAL	IMPERV	GRASS, GOOD	TOTAL	IMPERV	GRASS, GOOD	TOTAL	IMPERV	GRASS, GOOD
FS 1+BS 1	4.37	1.84	1.05	0.79	.41	0.11	0.30	2.12	0.19	1.93
FS 5	0.50	0.50	0.30	0.20	--	--	--	--	--	--
BS 2	2.65	1.92	0.76	1.16	0.73	0.23	0.50	--	--	--
BIO 1	1.12	0.81	0.65	0.16	0.23	0.12	0.11	0.08	0.05	0.03
BS 4	2.43	1.74	0.30	1.44	0.69	0.10	0.59	--	--	--
FS 9	0.77	--	--	--	0.77	--	--	--	--	--
BS 3	1.12	--	--	--	1.12	--	--	--	--	--

SITE SOILS:
FgA: Fallsington loam, 0 to 2 percent slopes, HSG D
KpB: Keyport silt loam, 2 to 5 percent slopes, HSG C
LhA: Lenni silt loam, 0 to 2 percent slopes, HSG D
ReA: Reybold silt loam, 0 to 2 percent slopes, HSG B
ReB: Reybold silt loam, 2 to 5 percent slopes, HSG B
SaB: Sassafras sandy loam, 5 to 10 percent slopes, HSG B

LEGEND

- PROP. DRAINAGE BOUNDARY
- BMP DRAINAGE AREA
- HSG B
- HSG C
- HSG D
- OLOD-1/2 AC. RESIDENTIAL
- IMPERVIOUS
- TIME OF CONCENTRATION

APPLICATION NO. ########(S)
CONTRIBUTING DRAINAGE AREA PLAN
FOR

INSTITUTIONAL PLAN

APPOQUINIMINK HUNDRED – NEW CASTLE COUNTY, DELAWARE

OWNER/DEVELOPER
OWNER'S/DEVELOPER'S NAME
COMPANY/LLC
FULL STREET ADDRESS
PHONE #
FAX #

REVISIONS

CHECKED BY:

NEW CASTLE, DE (302) 323-9377
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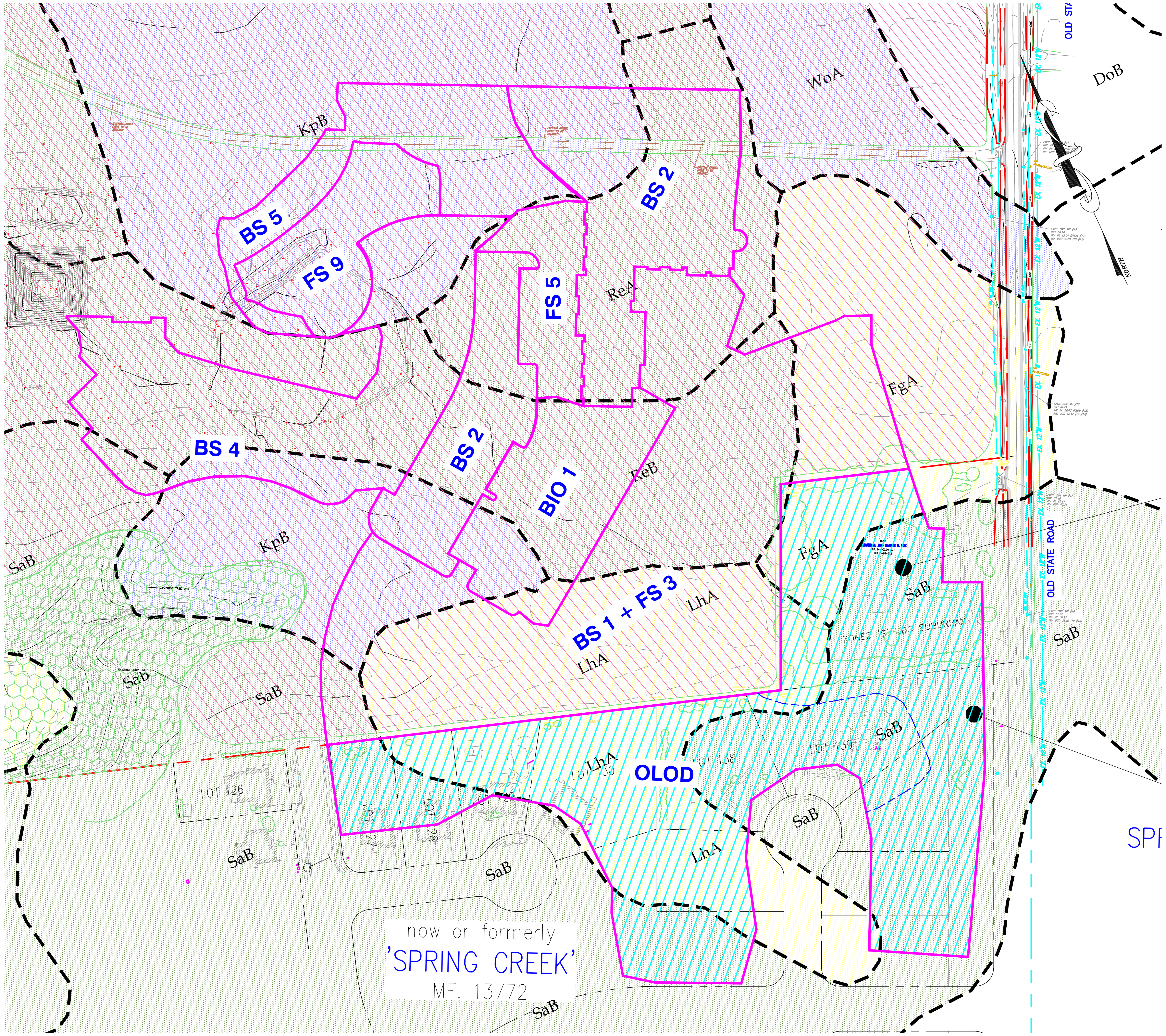
0 50 100 200 GRAPHIC SCALE

THIS DRAWING DOES NOT INCLUDE NECESSARY CONSTRUCTION SAFETY MEASURES.
ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL APPLICABLE RULES AND REGULATIONS THERETO APPURTENANT

DRAWN BY:	ASR	SCALE:	1"=100'
DESIGNED BY:	LE/JCM	DATE:	7-28-11
CHECKED BY:	ASR	LAST MODIFIED	8/31/11
COMM. NO.	C2378	FILE NO.	XXX
DRAWING NAME:		POST LOD.DWG	

C-004 SHEET NO. 01 OF 06

Effective April 2016



LEGEND

- BMP DRAINAGE AREA
- HSG B
- HSG C
- HSG D
- OLOD-1/2 AC. RESIDENTIAL
- ROW CROP
- WOODS
- TIME OF CONCENTRATION

PRE-LOD DATA SUMMARY TABLE

BMP	TOTAL AREA (AC.)	HSG B			HSG C			HSG D		
		TOTAL	IMPERV	WOODS/ MDW	TOTAL	IMPERV	WOODS /MDW	TOTAL	IMPERV	WOODS /MDW
FS 3+BS 1	4.37	1.84	--	--	.41	--	--	2.12	--	--
FS 5	0.50	0.50	--	--	--	--	--	--	--	--
BS 2	2.65	1.92	--	--	0.73	--	--	--	--	--
BIO 1	1.12	0.81	--	--	0.23	--	--	0.08	--	--
BS 4	2.43	1.74	--	--	0.69	--	--	--	--	--
FS 9	0.77	--	--	--	0.77	--	--	--	--	--
BS 5	1.12	--	--	--	1.12	--	--	--	--	--

SITE SOILS:
FgA: Fallsington loam, 0 to 2 percent slopes, HSG D
KpB: Keyport silt loam, 2 to 5 percent slopes, HSG C
LhA: Lenni silt loam, 0 to 2 percent slopes, HSG D
ReA: Reybold silt loam, 0 to 2 percent slopes, HSG B
ReB: Reybold silt loam, 2 to 5 percent slopes, HSG B
SaB: Sassafras sandy loam, 5 to 10 percent slopes, HSG B

REVISIONS | CHECKED BY

APPLICATION NO. #########(S)

PRE LIMIT OF DISTURBANCE DRAINAGE AREA PLAN

INSTITUTIONAL PLAN

APPOQUINIMINK HUNDRED – NEW CASTLE COUNTY, DELAWARE

OWNER/DEVELOPER
OWNER/DEVELOPER NAME
COMPANY/LLC
FULL STREET ADDRESS
PHONE #
FAX #

LandmarkJCM Science and Engineering
100 WEST COMMONS BOULEVARD, SUITE 301
NEW CASTLE, DELAWARE 19720
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WAYNE, PA (610) 687-1976
HAVRE DE GRACE, MD (410) 939-2144

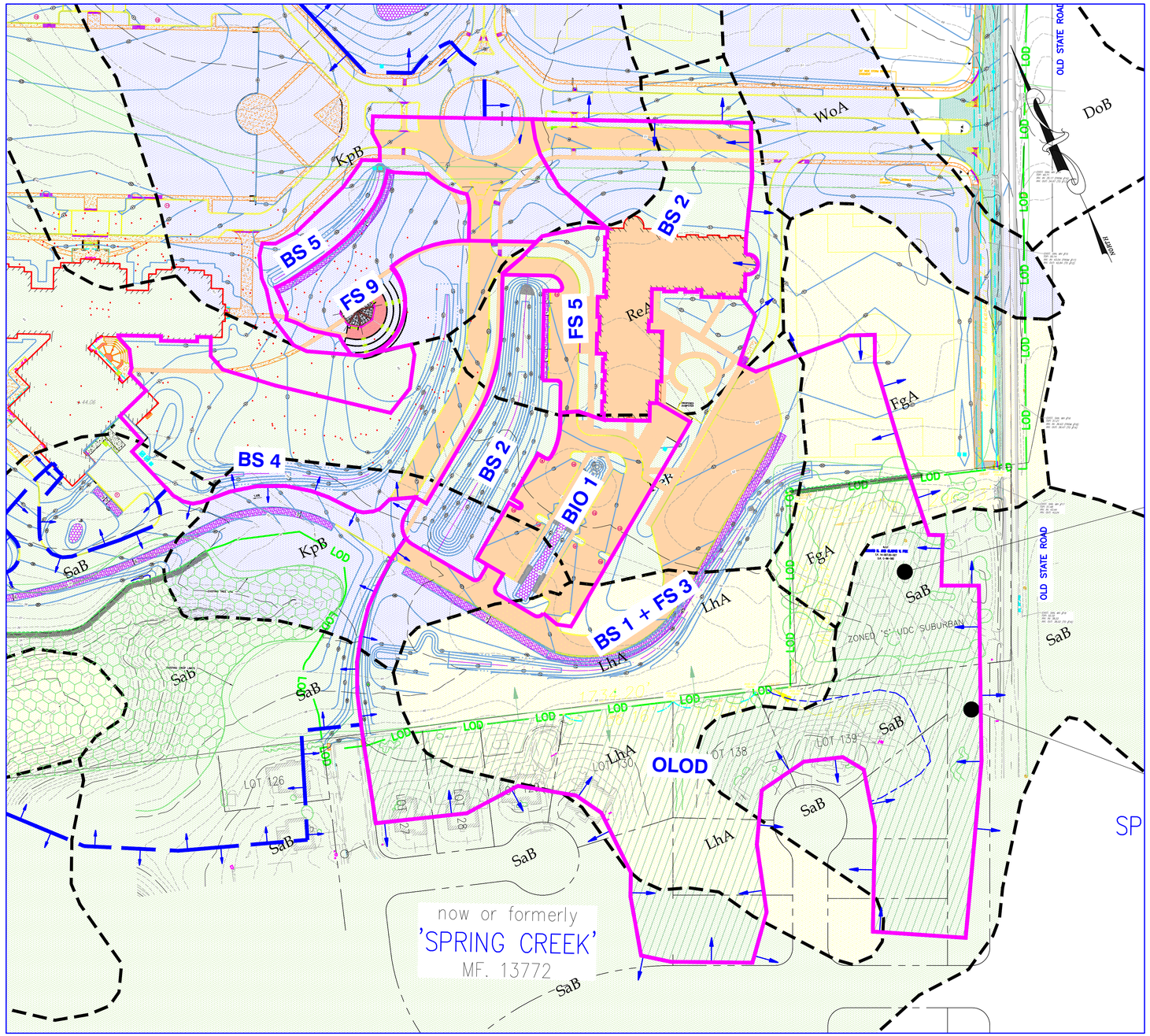
0 40 80 160
GRAPHIC SCALE

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY.

ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970 AND THE RULES AND REGULATIONS THERETO APPURTENANT

DRAWN BY: ASR	SCALE: 1"=80'
DESIGNED BY: LEI/JCM	DATE: 7-28-11
CHECKED BY: ASR	LAST MODIFIED 8/30/11
COMM. NO. C2378	FILE NO. XXX
DRAWING NAME: PRE-LOD.DWG	
C-005	SHEET NO. 05 OF 06

Effective April 2016



LEGEND

- PROP. DRAINAGE BOUNDARY
- IMPERVIOUS
- BMP DRAINAGE AREA
- HSG B
- HSG C
- HSG D
- OLOD-1/2 AC. RESIDENTIAL
- WOODS
- TIME OF CONCENTRATION

POST-LOD DATA SUMMARY TABLE

BMP	TOTAL AREA (AC.)	HSG B			HSG C			HSG D		
		TOTAL	IMPERV	GRASS, GOOD	TOTAL	IMPERV	GRASS, GOOD	TOTAL	IMPERV	GRASS, GOOD
FS 3+BS 1	4.37	1.84	1.05	0.79	.41	0.11	0.30	2.12	0.19	1.93
FS 5	0.50	0.50	0.30	0.20	--	--	--	--	--	--
BS 2	2.65	1.92	0.76	1.16	0.73	0.23	0.50	--	--	--
BIO 1	1.12	0.81	0.65	0.16	0.23	0.12	0.11	0.08	0.05	0.03
BS 4	2.43	1.74	0.30	1.44	0.69	0.10	0.59	--	--	--
FS 9	0.77	--	--	--	0.77	--	--	--	--	--
BS 5	1.12	--	--	--	1.12	--	--	--	--	--

SITE SOILS:
FgA: Fallsington loam, 0 to 2 percent slopes, HSG D
KpB: Keyport silt loam, 2 to 5 percent slopes, HSG C
LhA: Lenni silt loam, 0 to 2 percent slopes, HSG D
ReA: Reybold silt loam, 0 to 2 percent slopes, HSG B
ReB: Reybold silt loam, 2 to 5 percent slopes, HSG B
SaB: Sassafras sandy loam, 5 to 10 percent slopes, HSG B

APPLICATION NO. ########(S)
POST LIMIT OF DISTURBANCE DRAINAGE AREA PLAN

INSTITUTIONAL PLAN

APPOQUINIMINK HUNDRED NEW CASTLE COUNTY, DELAWARE

OWNER/DEVELOPER NAME
COMPANY/LLC
FULL STREET ADDRESS
PHONE #
FAX #

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GRAPHIC SCALE 0

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DRAWN BY:	ASR	SCALE:	1" = 80'
DESIGNED BY:	LEV/JCM	DATE:	7-28-11
CHECKED BY:	ASR	LAST MODIFIED	8/31/11
CONM. NO.	C2378	FILE NO.	XXX
DRAWING NAME:	POST LOD.DWG	SHEET NO.	06 OF 06

C-006

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