MidAtlantic
Engineering Partners

October 26, 2023 Project # 9SD-2101

STORMWATER MANAGEMENT REPORT
FOR
THE BATTERY

427 W. 7TH STREET
NEWCASTLE, NEW CASTLE COUNTY, DELEWARE

PREPARED BY:

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I. PROJECT DESCRIPTION

The project is located near the intersection of W. 7th Street and Washington Street in the City of New Castle, Delaware. The current property consists of 4.26 acres but only 3.09 acres are included within the proposed development. The existing parcel consists primarily of vacant imperious land and two buildings. The purpose of this project is to construct two (2) proposed buildings containing 152 apartment units as well as amenity, and retail spaces.

B. PRE-DEVELOPMENT ANALYSIS

The existing parcel consists primarily of vacant imperious land and two buildings, both of which will be demolished as part of the proposed improvements. The site is bordered to the north by W. 7th Street, to the east by a parking lot and autobody shop, and to the south and west by tidal wetlands of the Delaware River. There are no existing BMPs on site. A small area at the front of the site flows overland into W. 7th Street where it is collected by curb inlets. A slight ridge through the center of the site divides the east and west portions. Most of the eastern portion flows to an existing inlet within the asphalt parking area which also picks up runoff from the parking lot on the adjacent site. This existing inlet then discharges directly to the wetlands along the western edge of the site via an outfall. The southern and western portions flow uncontrolled overland to the same wetland area.

Point of Analysis #1 includes all the area flowing to the existing inlet on site and any area that flows directly to the wetland areas at the southern and western edges of the site. Point of Analysis #2 includes the small amount of area flowing into W. 7th Street. The downstream drainage area boundary was defined by the projects Limit of Disturbance (LOD) as the areas outside the LOD are predominantly protected wetland areas and will remain undisturbed from pre to post development conditions.

C. SOILS

The soils found on the site were delineated from the NRCS Web Soil Survey for New Castle County. The project site consists mostly of soils in Hydrologic Group (HSG) “D”. A small portion of the site includes HSG “C” soils and some Urban Land areas, however HSG “D” soils were used in all calculations to be conservative. Soil mapping with supplemental soil documentation is included in Appendix A of this report.

D. POST-DEVELOPMENT HYDROLOGY

The post-development site will utilize the same general analysis points as the pre-development site. However, point of analysis #1 has been shown near the southern edge of the proposed site but the discharge will reach the same portion of connected wetlands as in the pre-development conditions. 95% of the runoff from the proposed site will be collected by a series of inlets and treated via a vortex chamber filter before being discharged. A small portion of site frontage will flow overland into W. 7th Street collected via curb inlets. Point of analysis #3 includes a small portion of pervious area that will flow overland directly into the wetland area at the southern edge of the site. The proposed vortex filter has been designed to provide pre-treatment for all runoff being collected on site before it is discharged to the existing wetlands at POI #1 while also providing bypass for larger storm events. Design criteria and analysis have been provided in appendix F of this report.

Resource Protection Event (RPv)

DURMM v2 was used to determine compliance with the Resource Protection Event (RPv) as a result of the proposed project. The model shows that the proposed project does not comply with the RPv event; however, the proposed development presents a significant improvement over the current site conditions. The site consists of 1.87 acres of existing impervious area which is mostly paved. Currently, all impervious areas flows uncontrolled directly to the surrounding wetlands or directly into a single inlet on site which discharges into the channel adjacent to the site. It should be noted that much of the site contains poor (D) soils and does not have the potential of infiltration today. The project will also be bringing a large quantity of structural fill to raise the site above the floodplain.

As a result of the development the impervious surface will be increased by 0.52 acres but 54% will be made up of clean roof runoff. 95% of the proposed impervious area will be collected through a series of inlets and treated via a vortex chamber filter before being discharged from the site. The remaining 5% will flow overland into W. 7th Street.

Conveyance (Cv) and Flooding Event (Fv)

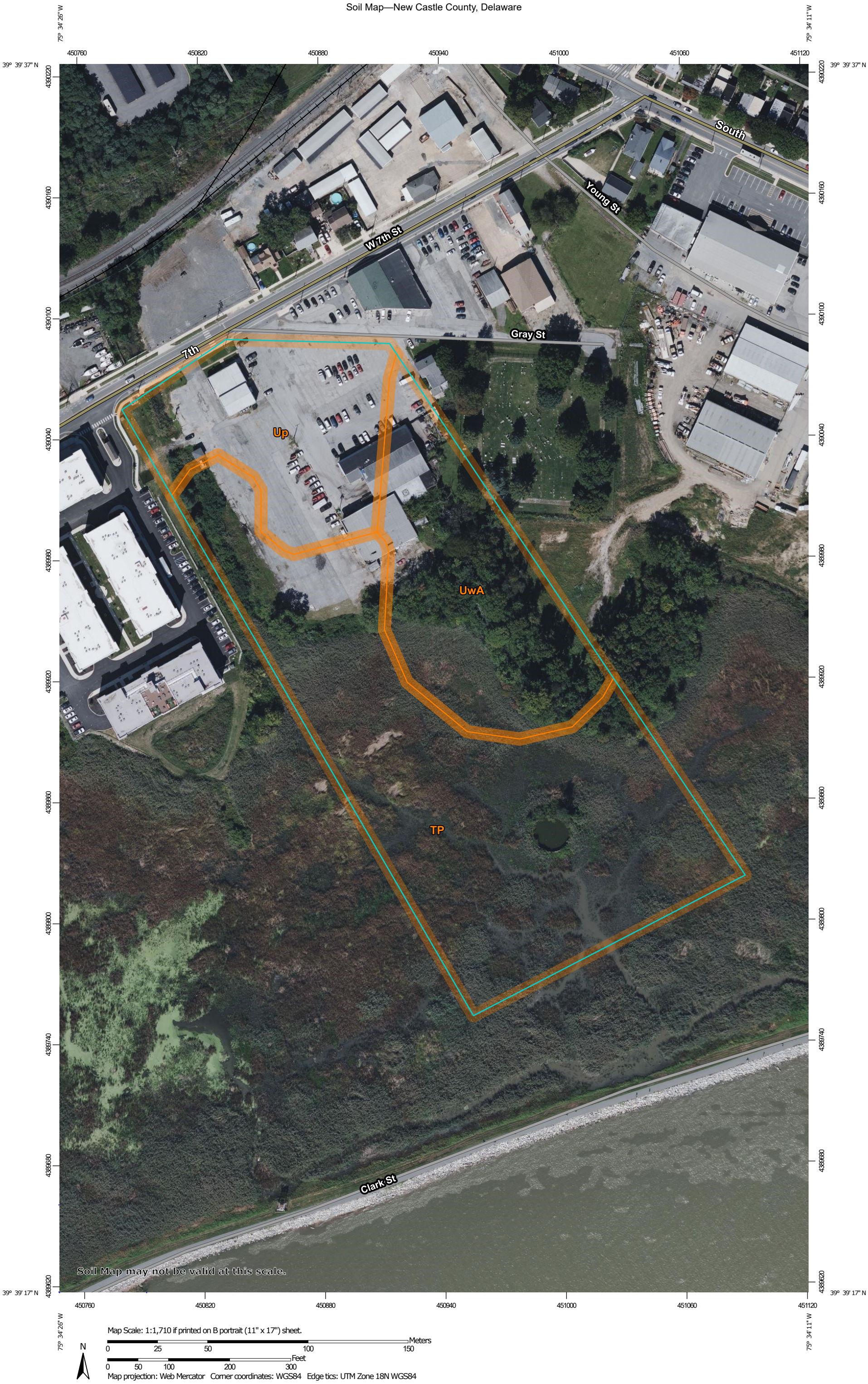
In accordance with the Deleware Sediment and Stormwater Regulations Section 5.3.3.2 and 5.4.3.2, the proposed site is exempt from stormwater quantity management for the Conveyance (Cv) and the Flooding (Fv) Events as the runoff discharge from the site is conveyed to tidal waters via a non-erosive conveyance channel with adequate capacity.

E. EROSION & SEDIMENT CONTROL

To accomplish these tasks, 12.385 total acres of on-site runoff is routed to four (4) small-scale infiltration basins and six (6) underground infiltration basins. The remaining 1.000 acres of on-site area is counted in the stormwater model as bypass. Runoff will be collected via overland flow, roof leaders, and a conventional piped stormwater collection system to direct the appropriate runoff to the corresponding basins. Both quality and quantity control are provided by the basins. The allowable peak runoff rates for the post-developed site were found by applying the required reductions to the pre-developed peak flows for the onsite disturbed areas. Runoff rates and vo

APPENDIX A

SOIL MAP



Map Scale: 1:1,710 if printed on B portrait (11" x 17") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: New Castle County, Delaware
Survey Area Data: Version 16, Aug 26, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 16, 2020—Sep 20, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
TP	Transquaking and Mispillion soils, very frequently flooded, tidal	6.7	56.3%
Up	Urban land	2.4	19.7%
UwA	Udorthents, wet substratum, 0 to 2 percent slopes	2.9	24.1%
Totals for Area of Interest		**12.0**	**100.0%**

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
TP	Transquaking and Mispillion soils, very frequently flooded, tidal	A/D	1.3	36.7%
Up	Urban land		1.8	52.3%
UwA	Udorthents, wet substratum, 0 to 2 percent slopes	C	0.4	10.9%
Totals for Area of Interest			**3.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

HYDROCAD CALCULATIONS (PRE-DEVELOMENT)

Subcat Reach Pond Link

Routing Diagram for Pre-Developement_9SD-2101

Prepared by {enter your company name here}, Printed 10/27/2023

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.501	80	>75% Grass cover, Good, HSG D (EDA-1, EDA-2)
1.564	98	Paved parking, HSG D (EDA-1, EDA-2)
0.306	98	Roofs, HSG D (EDA-1, EDA-2)
0.721	86	Woods/grass comb., Poor, HSG D (EDA-1)
3.093	**92**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.501	0.000	0.501	>75% Grass cover, Good	EDA-1, EDA-2
0.000	0.000	0.000	1.564	0.000	1.564	Paved parking	EDA-1, EDA-2
0.000	0.000	0.000	0.306	0.000	0.306	Roofs	EDA-1, EDA-2
0.000	0.000	0.000	0.721	0.000	0.721	Woods/grass comb., Poor	EDA-1
0.000	**0.000**	**0.000**	**3.093**	**0.000**	**3.093**	**TOTAL AREA**	

Summary for Subcatchment EDA-1: EDA-1

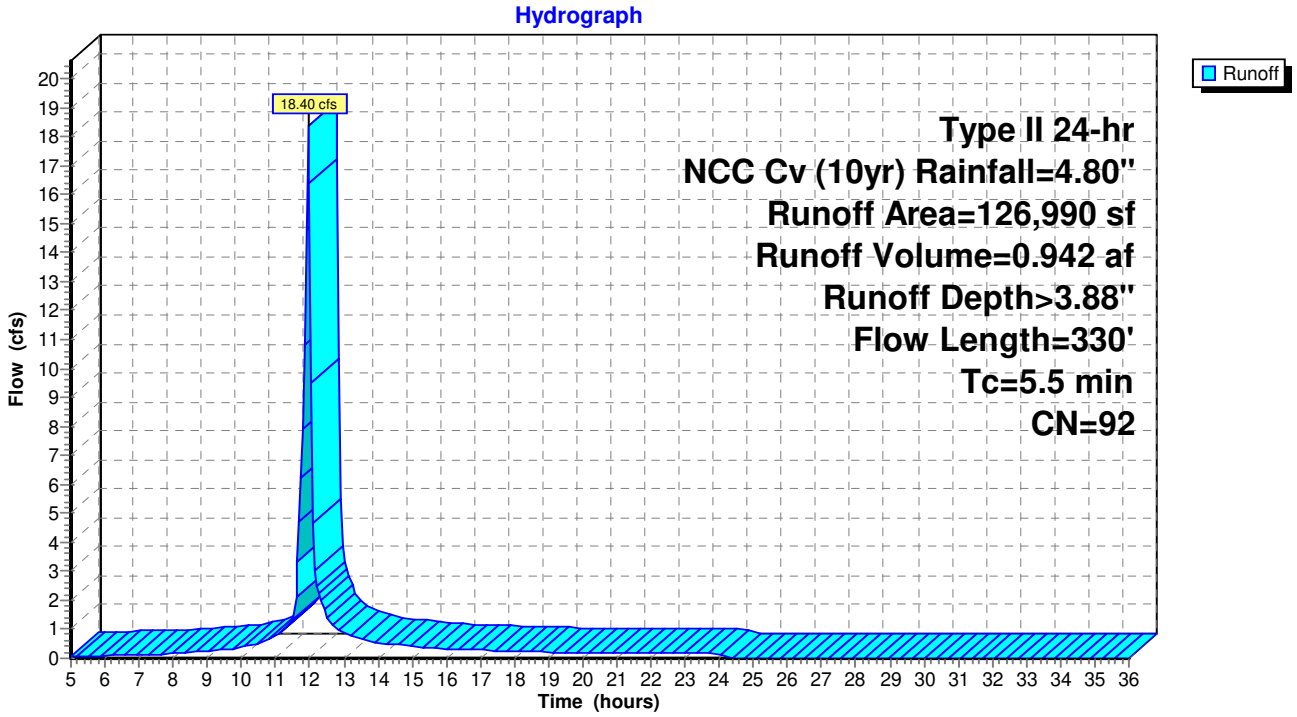
Runoff = 18.40 cfs @ 11.96 hrs, Volume= 0.942 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC Cv (10yr) Rainfall=4.80"

Area (sf)	CN	Description
64,688	98	Paved parking, HSG D
20,120	80	>75% Grass cover, Good, HSG D
10,765	98	Roofs, HSG D
31,417	86	Woods/grass comb., Poor, HSG D
126,990	92	Weighted Average
51,537		40.58% Pervious Area
75,453		59.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0080	0.95		**Sheet Flow, A1-A2** Smooth surfaces n= 0.011 P2= 3.20"
2.2	125	0.0190	0.96		**Shallow Concentrated Flow, A2-A3** Short Grass Pasture Kv= 7.0 fps
0.5	39	0.0040	1.28		**Shallow Concentrated Flow, A3-A4** Paved Kv= 20.3 fps
1.1	66	0.0220	1.04		**Shallow Concentrated Flow, A4-A5** Short Grass Pasture Kv= 7.0 fps
5.5	330	Total			

Subcatchment EDA-1: EDA-1



Summary for Subcatchment EDA-2: EDA-2

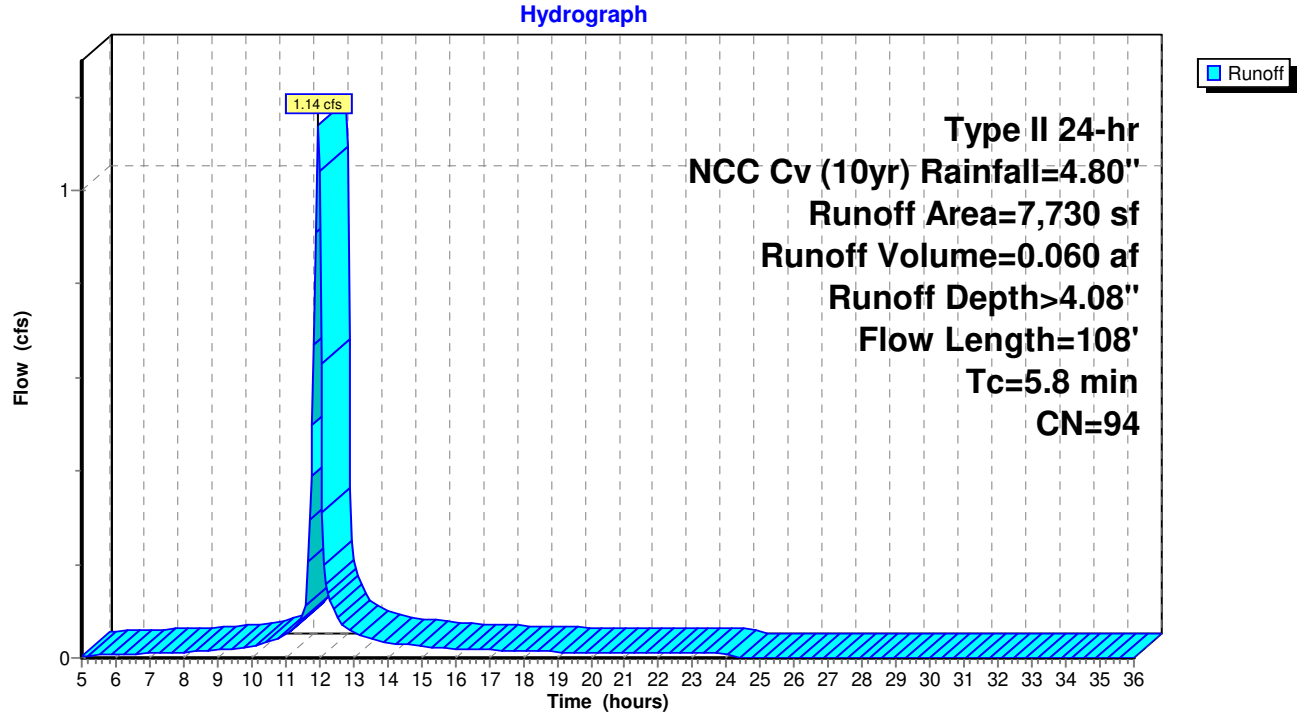
Runoff = 1.14 cfs @ 11.96 hrs, Volume= 0.060 af, Depth> 4.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC Cv (10yr) Rainfall=4.80"

Area (sf)	CN	Description
3,456	98	Paved parking, HSG D
1,696	80	>75% Grass cover, Good, HSG D
2,578	98	Roofs, HSG D
7,730	94	Weighted Average
1,696		21.94% Pervious Area
6,034		78.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	52	0.0050	0.69		**Sheet Flow, B1-B2** Smooth surfaces n= 0.011 P2= 3.20"
4.4	48	0.0340	0.18		**Sheet Flow, B2-B3** Grass: Short n= 0.150 P2= 3.20"
0.1	8	0.0070	1.70		**Shallow Concentrated Flow, B3-B4** Paved Kv= 20.3 fps
5.8	108	Total			

Subcatchment EDA-2: EDA-2



Summary for Subcatchment EDA-1: EDA-1

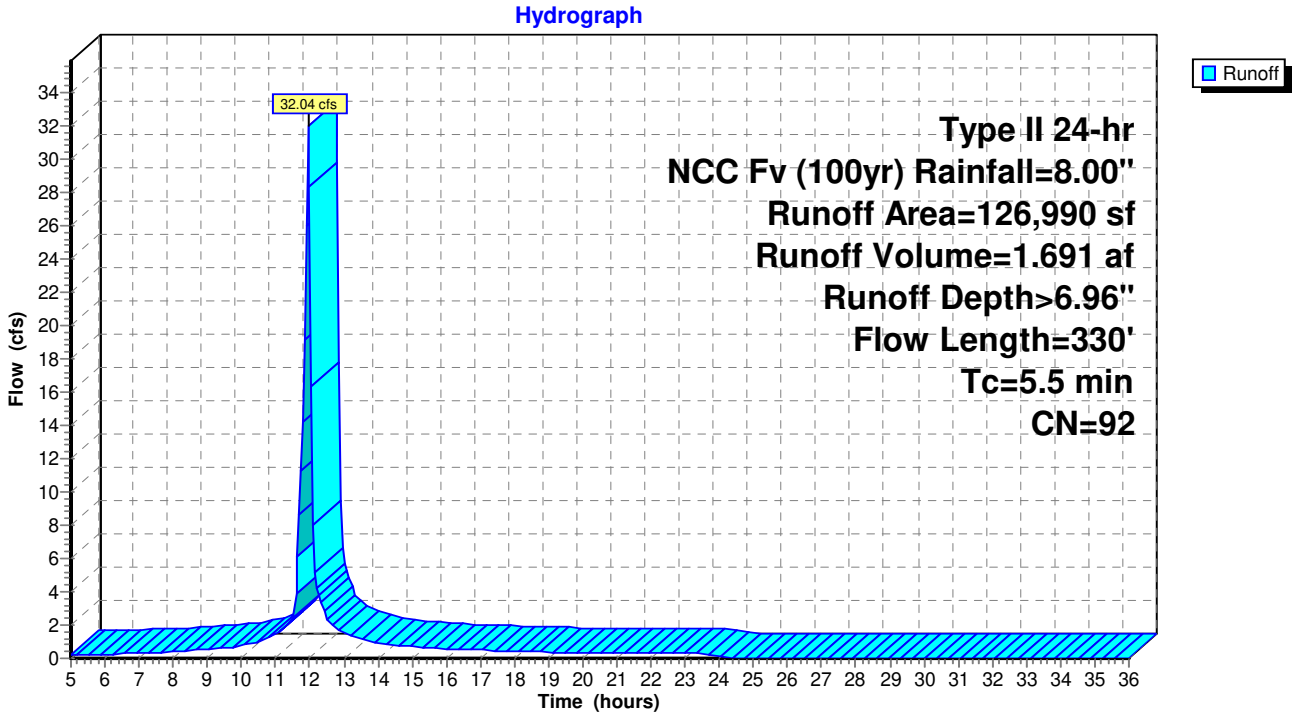
Runoff = 32.04 cfs @ 11.96 hrs, Volume= 1.691 af, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC Fv (100yr) Rainfall=8.00"

Area (sf)	CN	Description
64,688	98	Paved parking, HSG D
20,120	80	>75% Grass cover, Good, HSG D
10,765	98	Roofs, HSG D
31,417	86	Woods/grass comb., Poor, HSG D
126,990	92	Weighted Average
51,537		40.58% Pervious Area
75,453		59.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0080	0.95		**Sheet Flow, A1-A2** Smooth surfaces n= 0.011 P2= 3.20"
2.2	125	0.0190	0.96		**Shallow Concentrated Flow, A2-A3** Short Grass Pasture Kv= 7.0 fps
0.5	39	0.0040	1.28		**Shallow Concentrated Flow, A3-A4** Paved Kv= 20.3 fps
1.1	66	0.0220	1.04		**Shallow Concentrated Flow, A4-A5** Short Grass Pasture Kv= 7.0 fps
5.5	330	Total			

Subcatchment EDA-1: EDA-1



Summary for Subcatchment EDA-2: EDA-2

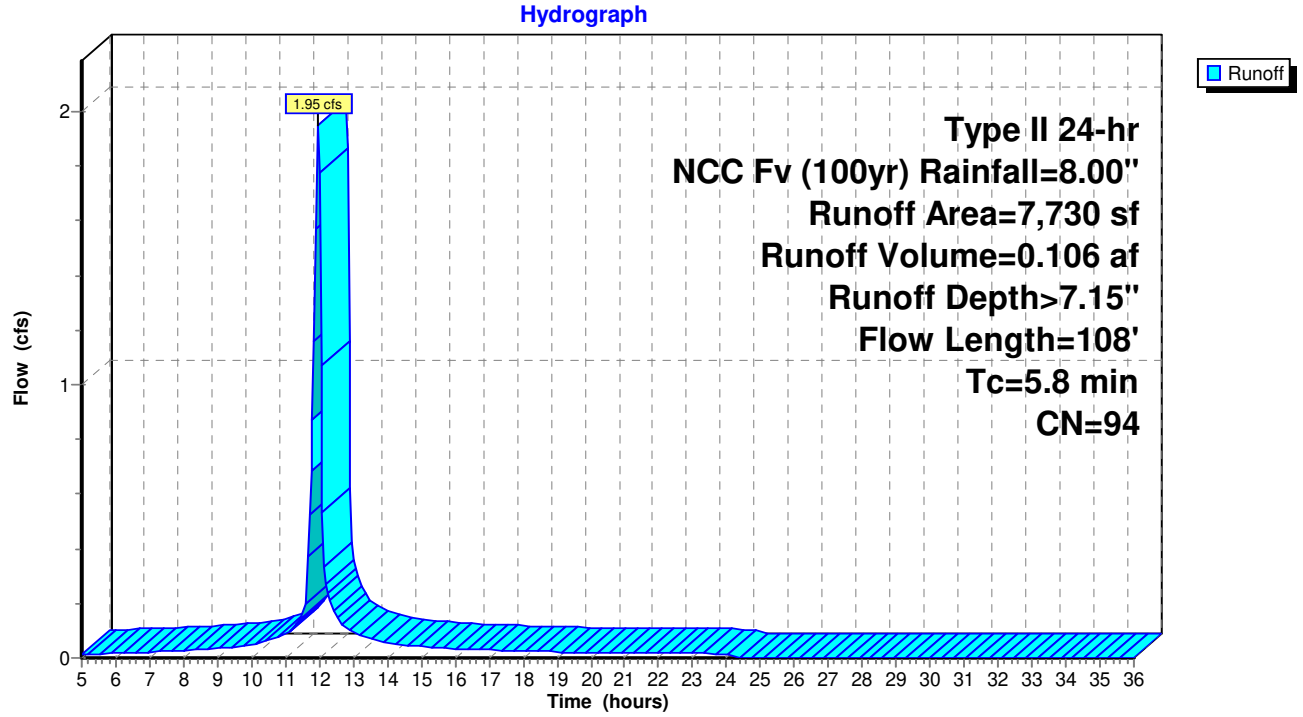
Runoff = 1.95 cfs @ 11.96 hrs, Volume= 0.106 af, Depth> 7.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC Fv (100yr) Rainfall=8.00"

Area (sf)	CN	Description
3,456	98	Paved parking, HSG D
1,696	80	>75% Grass cover, Good, HSG D
2,578	98	Roofs, HSG D
7,730	94	Weighted Average
1,696		21.94% Pervious Area
6,034		78.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	52	0.0050	0.69		**Sheet Flow, B1-B2** Smooth surfaces n= 0.011 P2= 3.20"
4.4	48	0.0340	0.18		**Sheet Flow, B2-B3** Grass: Short n= 0.150 P2= 3.20"
0.1	8	0.0070	1.70		**Shallow Concentrated Flow, B3-B4** Paved Kv= 20.3 fps
5.8	108	Total			

Subcatchment EDA-2: EDA-2



Summary for Subcatchment EDA-1: EDA-1

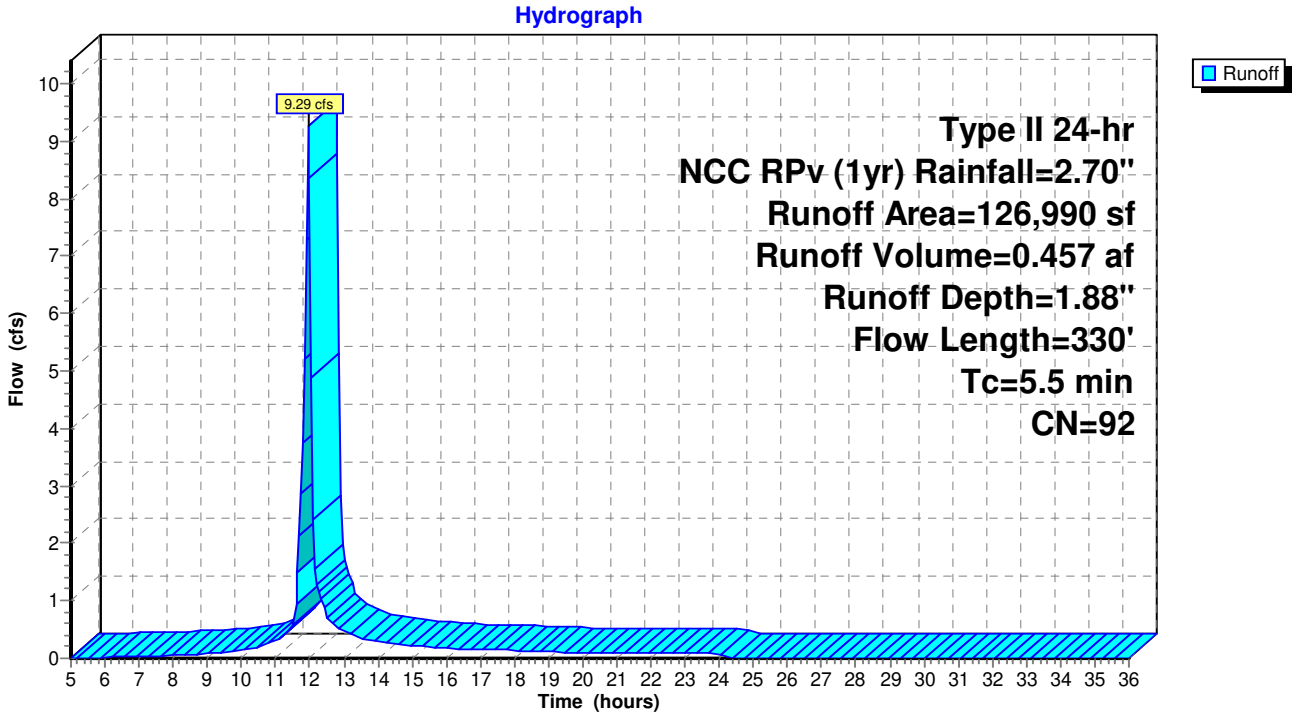
Runoff = 9.29 cfs @ 11.96 hrs, Volume= 0.457 af, Depth= 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC RPv (1yr) Rainfall=2.70"

Area (sf)	CN	Description
64,688	98	Paved parking, HSG D
20,120	80	>75% Grass cover, Good, HSG D
10,765	98	Roofs, HSG D
31,417	86	Woods/grass comb., Poor, HSG D
126,990	92	Weighted Average
51,537		40.58% Pervious Area
75,453		59.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0080	0.95		**Sheet Flow, A1-A2** Smooth surfaces n= 0.011 P2= 3.20"
2.2	125	0.0190	0.96		**Shallow Concentrated Flow, A2-A3** Short Grass Pasture Kv= 7.0 fps
0.5	39	0.0040	1.28		**Shallow Concentrated Flow, A3-A4** Paved Kv= 20.3 fps
1.1	66	0.0220	1.04		**Shallow Concentrated Flow, A4-A5** Short Grass Pasture Kv= 7.0 fps
5.5	330	Total			

Subcatchment EDA-1: EDA-1



Summary for Subcatchment EDA-2: EDA-2

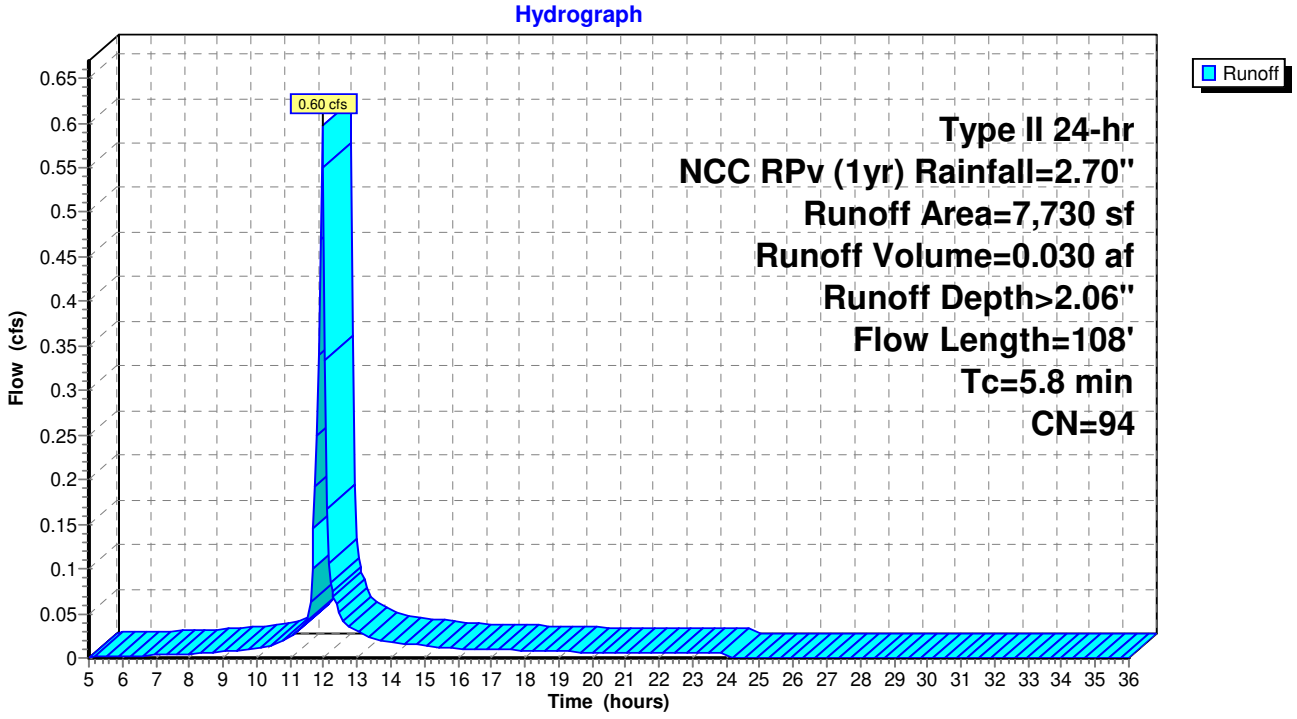
Runoff = 0.60 cfs @ 11.96 hrs, Volume= 0.030 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC RPv (1yr) Rainfall=2.70"

Area (sf)	CN	Description
3,456	98	Paved parking, HSG D
1,696	80	>75% Grass cover, Good, HSG D
2,578	98	Roofs, HSG D
7,730	94	Weighted Average
1,696		21.94% Pervious Area
6,034		78.06% Impervious Area

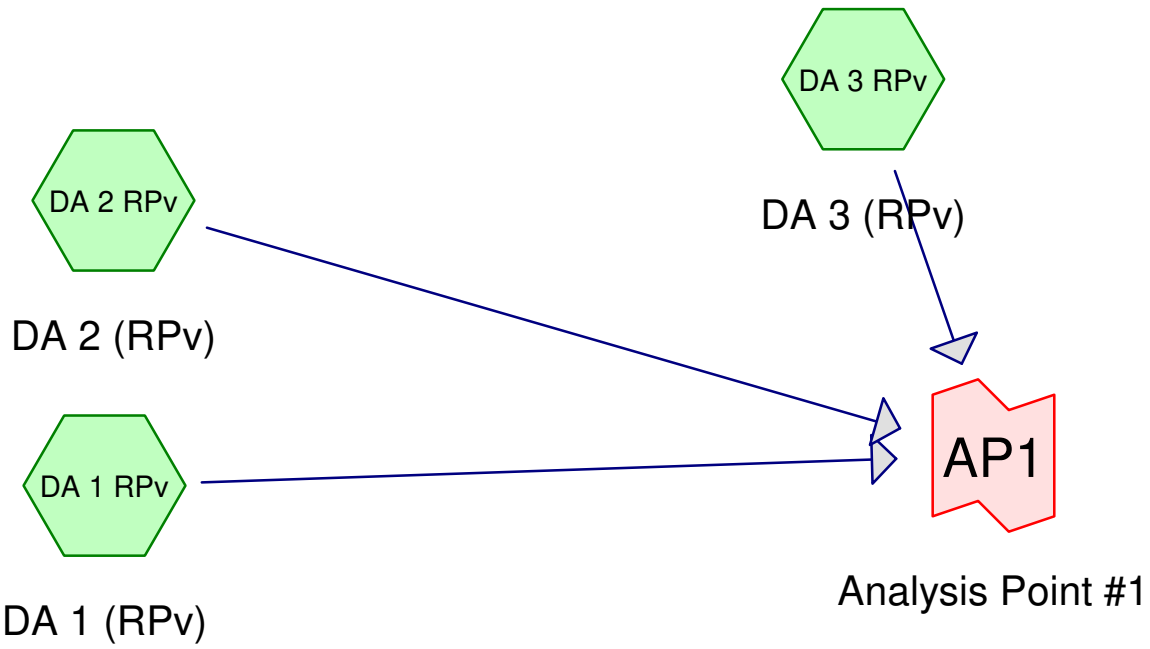
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	52	0.0050	0.69		**Sheet Flow, B1-B2** Smooth surfaces n= 0.011 P2= 3.20"
4.4	48	0.0340	0.18		**Sheet Flow, B2-B3** Grass: Short n= 0.150 P2= 3.20"
0.1	8	0.0070	1.70		**Shallow Concentrated Flow, B3-B4** Paved Kv= 20.3 fps
5.8	108	Total			

Subcatchment EDA-2: EDA-2



APPENDIX C

HYDROCAD CALCULATIONS (POST-DEVELOPMENT)



Subcat Reach Pond Link

Routing Diagram for Post-Developement RPv(1yr)_9SD-2101
Prepared by {enter your company name here}, Printed 10/27/2023
HydroCAD® 10.00-26 s/n 07360 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.698	80.00	>75% Grass cover, Good, HSG D (DA 1 RPv, DA 2 RPv, DA 3 RPv)
2.394	98.00	Paved parking, HSG D (DA 1 RPv, DA 2 RPv)
3.092	**93.94**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.698	0.000	0.698	>75% Grass cover, Good	DA 1 RPv, DA 2 RPv, DA 3 RPv
0.000	0.000	0.000	2.394	0.000	2.394	Paved parking	DA 1 RPv, DA 2 RPv
0.000	**0.000**	**0.000**	**3.092**	**0.000**	**3.092**	**TOTAL AREA**	

Summary for Subcatchment DA 1 RPv: DA 1 (RPv)

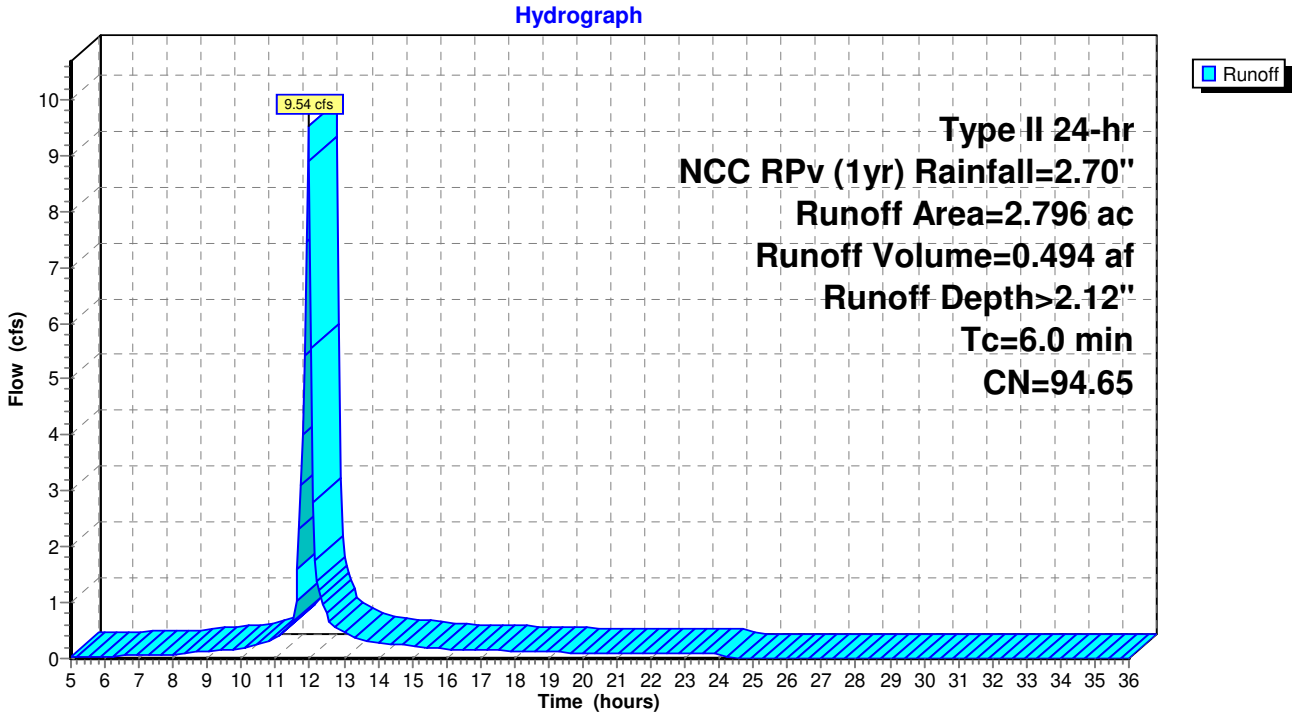
Runoff = 9.54 cfs @ 11.96 hrs, Volume= 0.494 af, Depth> 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC RPv (1yr) Rainfall=2.70"

Area (ac)	CN	Description
2.275	98.00	Paved parking, HSG D
0.521	80.00	>75% Grass cover, Good, HSG D
2.796	94.65	Weighted Average
0.521		18.63% Pervious Area
2.275		81.37% Impervious Area

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

Subcatchment DA 1 RPv: DA 1 (RPv)



Summary for Subcatchment DA 2 RPv: DA 2 (RPv)

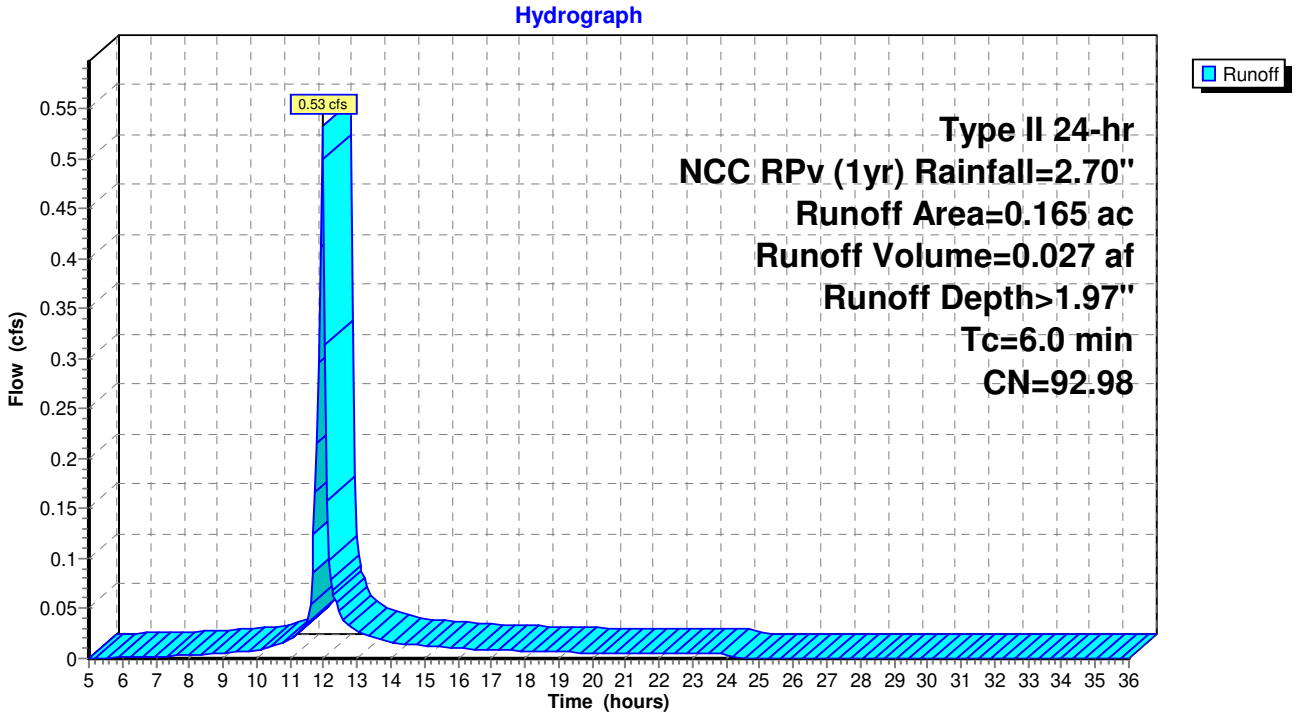
Runoff = 0.53 cfs @ 11.97 hrs, Volume= 0.027 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC RPv (1yr) Rainfall=2.70"

Area (ac)	CN	Description
0.119	98.00	Paved parking, HSG D
0.046	80.00	>75% Grass cover, Good, HSG D
0.165	92.98	Weighted Average
0.046		27.88% Pervious Area
0.119		72.12% Impervious Area

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

Subcatchment DA 2 RPv: DA 2 (RPv)



Summary for Subcatchment DA 3 RPv: DA 3 (RPv)

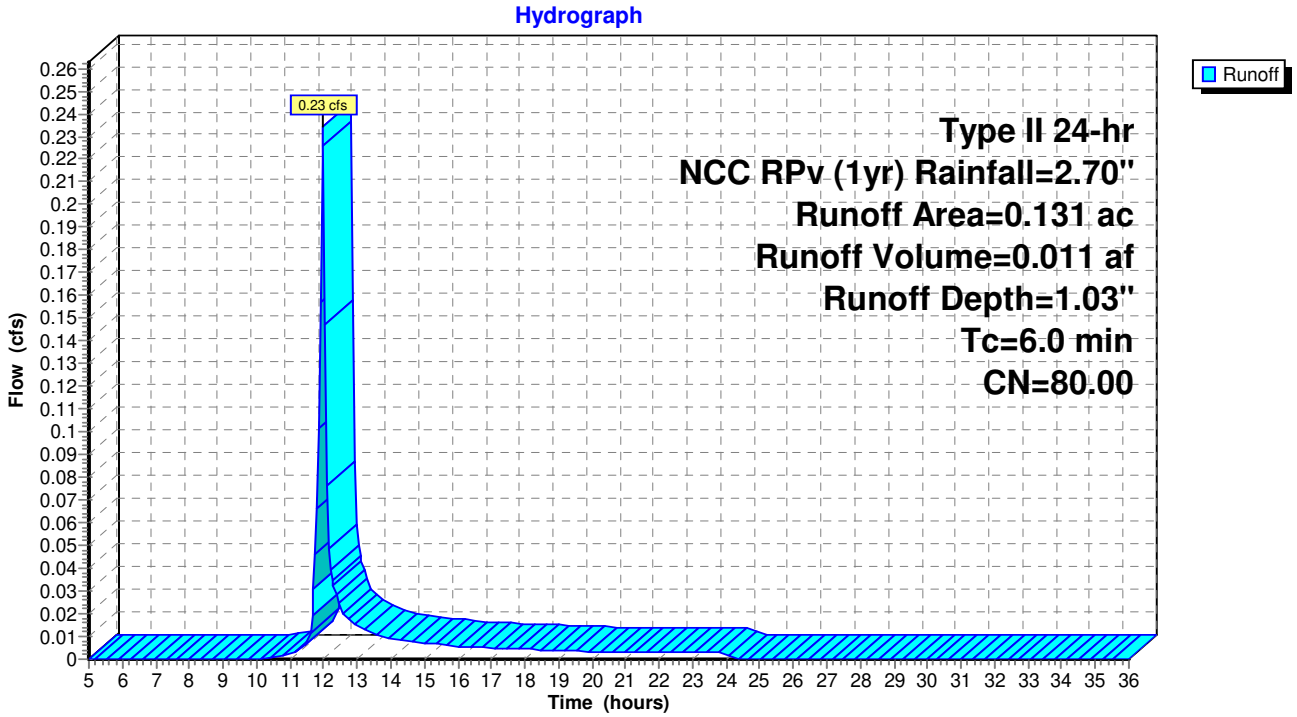
Runoff = 0.23 cfs @ 11.98 hrs, Volume= 0.011 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr NCC RPv (1yr) Rainfall=2.70"

Area (ac)	CN	Description
0.131	80.00	>75% Grass cover, Good, HSG D
0.131		100.00% Pervious Area

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

Subcatchment DA 3 RPv: DA 3 (RPv)

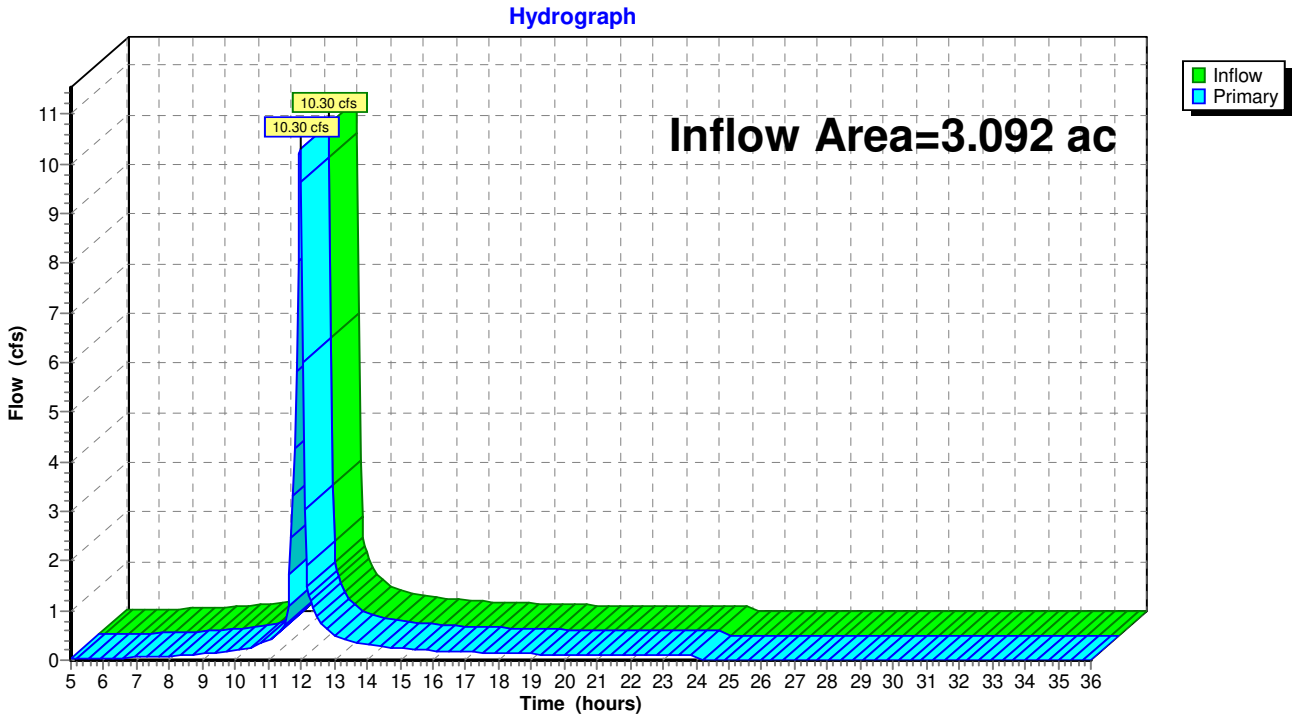


Summary for Link AP1: Analysis Point #1

Inflow Area = 3.092 ac, 77.43% Impervious, Inflow Depth > 2.06" for NCC RPv (1yr) event
Inflow = 10.30 cfs @ 11.96 hrs, Volume= 0.532 af
Primary = 10.30 cfs @ 11.96 hrs, Volume= 0.532 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link AP1: Analysis Point #1



APPENDIX D

DURMM CALCULATIONS

PROJECT:	The Battery			
DRAINAGE SUBAREA ID:	DA-1			
COUNTY:	New Castle	**UNIT HYDROGRAPH:**	STD	
TMDL Watershed:	Delaware River	**VERSION:**	**DURMM v2.51.220414_50% ReDev**	

DURMM OUTPUT WORKSHEET

Site Data

Contributing Area to BMPs (ac.)	2.79			
C.A. RCN	94.65			
Subarea LOD (ac.)	2.79			
Subarea RCN	94.65			
Upstream Subarea ID	N/A	N/A	N/A	N/A
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00
Combined LOD with Upstream Areas (ac.)	2.79			
Combined RCN with Upstream Areas (ac.)	94.65			
Watershed TMDL-TN (lb/ac/yr)	0.00			
Watershed TMDL-TP (lb/ac/yr)	0.00			
Watershed TMDL-TSS (lb/ac/yr)	0			

BMP Data

	BMP 1	**BMP 2**	**BMP 3**	**BMP 4**	**BMP 5**
	15-A Proprietary Practices	--	--	--	--
RPv runoff volume after all reductions (in.)	2.21	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	-0.01	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	0%	N/A	N/A	N/A	N/A
RPv Compliance Met Through Runoff Reduction?	NO	N/A	N/A	N/A	N/A
RPv Residual Volume (cu. ft.)	6,882	N/A	N/A	N/A	N/A
Adjusted pollutant load, TN (lb/ac/yr)	20.89	N/A	N/A	N/A	N/A
Adjusted pollutant load, TP (lb/ac/yr)	3.66	N/A	N/A	N/A	N/A
Adjusted pollutant load, TSS (lb/ac/yr)	671.52	N/A	N/A	N/A	N/A
Cv runoff volume after all reductions (in.)	4.18	N/A	N/A	N/A	N/A
Fv runoff volume after all reductions (in.)	7.36	N/A	N/A	N/A	N/A

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	2.20		
Annual Runoff for Contributing Area (in.)	32.99		
Req'd RPv to be Managed for Contributing Area (in.)	0.67		
Req'd RPv to be Managed for Contributing Area (%)	30%		
RPv Runoff Management Required (cu. Ft.)	6781		
RPv Runoff Management Provided (cu. Ft.)	-101		
RPv Residual Volume (cu.ft.)	6882	SHORTFALL	(Requires additional management or offset)
C.A. RPv avg. discharge rate (cfs)	0.04		
C.A. RPv max. discharge rate (cfs)	0.20		
TN Pollutant Load (lb/yr)	58.29		
TP Pollutant Load (lb/yr)	10.20		
TSS Pollutant Load (lb/yr)	1874		

Conveyance Event (Cv)

Cv runoff volume (in.)	4.18
Adjusted RCN for H&H Modeling (CN*)	94.65

Flooding Event (Fv)

Fv runoff volume (in.)	7.36
Equivalent RCN for H&H Modeling (CN*)	94.65

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	DA-1
Contributing Area (ac.)	2.79
Weighted Target Runoff (in.)	1.53
Adjusted CN after all reductions	94.59
Adjusted RPv (in.)	2.21
Adjusted Cv (in.)	4.18
Adjusted Fv (in.)	7.36

Adjusted Subarea Data for Nutrient Protocol Modeling

Contributing Area (ac.)	2.79
LOD Area (ac.)	2.79
TN Pollutant Load (lb/yr)	58.29
TP Pollutant Load (lb/yr)	10.20
TSS Pollutant Load (lb/yr)	1874
Percent Impervious Cover	81%

Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest

Subarea ID	DA-1		
Contributing Area (ac.)	2.79		
RPv Residual Volume (cu.ft.)	6882	SHORTFALL	(Requires additional management or offset)
Adjusted CN after all reductions	94.59		
Cv RCN for H&H Modeling	94.65		
Fv RCN for H&H Modeling	94.65		
TN Pollutant Load (lb/yr)	58.29		
TP Pollutant Load (lb/yr)	10.20		
TSS Pollutant Load (lb/yr)	1874		

PROJECT:	The Battery
DRAINAGE SUBAREA ID:	DA-1
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

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		74	0.52	80
Impervious Areas										
	Paved parking lots, roofs, driveways			98		98		98	2.27	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	2.79	
Subarea Contributing Area (ac)	2.79				
Subarea Weighted RCN	95				

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 w. Upstream Areas (ac)	2.79
Weighted Runoff Curve Number (RCN)	95

PROJECT:	The Battery
DRAINAGE SUBAREA ID:	DA-1
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

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)				2.79
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				1.05
1.3 Pre-Developed Impervious Within LOD (ac)				1.74
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***				2.27
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	0%	0%	81%

Step 2 - Subarea LOD Runoff Calculations

2.1 RCN per HSG	0.00	0.00	0.00	94.65
2.2 RPv per HSG (in.)	0.00	0.00	0.00	2.20
2.3 Target RCN per HSG	0.00	0.00	0.00	84.48
2.4 Target Runoff per HSG (in.)	0.00	0.00	0.00	1.53

2.5 Subarea LOD (ac)	2.79
2.6 Subarea Weighted RCN	94.65
2.7 Subarea Weighted RPv (in.)	2.20
2.8 Subarea Weighted Target Runoff (in.)	1.53

Step 3 - Upstream LOD Areas *(from previous DURMM Report as applicable)*

	Area 1	Area 2	Area 3	Area 4
3.1 Upstream Sub-Area ID				
3.2 Upstream Contributing 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)	2.79
4.2 Weighted RCN	94.65
4.3 Weighted RPv (in.)	2.20
4.4 Weighted Target Runoff (in.)	1.53
4.5 Estimated Annual Runoff (in.)	32.99
4.6 Req'd Runoff to be Managed within LOD (in.)	0.67
4.7 Req'd Runoff to be Managed within LOD (%)	30%

PROJECT: The Battery
DRAINAGE SUBAREA ID: DA-1
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	15-A Proprietary Practices	Type	--	Type	--	Type	--	Type	--
Step 1 - Calculate Initial RPv	**Data**									
1.1 Total contributing area to BMP (ac)	2.79									
1.2 Initial RCN	94.65									
1.3 RPv for Contributing Area (in.)	2.20									
1.4 Req'd RPv to be Managed for Contributing Area (in.)	0.67									
1.5 Req'd RPv to be Managed for Contributing Area (%)	30%									
Step 2 - Adjust for Retention Reduction										
2.1 Retention volume provided (cu. ft.)	6890									
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.)	2.20		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	94.59		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	94.65		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	32.99		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	0%		0%		0%		0%		0%	
3.4 Annual runoff reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	32.99		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	94.65		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	-0.01		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv Runoff Manangement Provided (cu. ft.)	-101		N/A		N/A		N/A		N/A	
4.2 RPv runoff volume after all reductions (in.)	2.21		N/A		N/A		N/A		N/A	
4.3 RPv runoff volume after all reductions (cu.ft.)	22,382		N/A		N/A		N/A		N/A	
4.4 Total RPv runoff reduction (in.)	-0.01		N/A		N/A		N/A		N/A	
4.5 Total RPv runoff reduction (%)	0%		N/A		N/A		N/A		N/A	
4.6 Adjusted CN after all reductions*	94.59		N/A		N/A		N/A		N/A	
4.7 Adjusted equivalent annual runoff (in.)	32.92		N/A		N/A		N/A		N/A	
4.8 RPv Compliance Met Through Runoff Reduction?	NO		N/A		N/A		N/A		N/A	
4.9 Runoff Reduction Credit, if Applicable (cu.ft)	N/A		N/A		N/A		N/A		N/A	
Step 5 - Determine Residual Volume to be Managed or Offset										
5.1 RPv Residual Volume (in.)	0.68		N/A		N/A		N/A		N/A	
5.2 RPv Residual Volume (cu.ft./ac)	2,467		N/A		N/A		N/A		N/A	
5.3 Residual Volume to be Managed or Offset (cu.ft.)	6,882		N/A		N/A		N/A		N/A	
5.4 RPv avg. discharge rate for 48-hr detention (cfs)	0.040		N/A		N/A		N/A		N/A	
5.5 RPv max. discharge rate for 48-hr detention (cfs)	0.199		N/A		N/A		N/A		N/A	

***NOTE: No additional runoff reduction credit can be taken for surface recharge practices once the "Adjusted CN after all reductions" (Step 4.6) reaches the equivalent CN for the native soil-cover condition of the BMP footprint itself (i.e. for Sheet Flow to Turf Filter Strip on B soils Step 4.6 cannot be below 61). If this occurs contact the DNREC – SSP for further guidance.**

PROJECT: The Battery
DRAINAGE SUBAREA ID: DA-1
TMDL WATERSHED: Delaware River

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	15-A Proprietary Practices			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)	2.79																			
1.2 Initial RCN	95																			
1.3 Annual runoff volume (in.)	32.99																			
1.4 Annual runoff volume (liters)	9.46E+06																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.80	0.49	90		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
2.2 Load (mg/yr)		2.65E+07	4.64E+06	8.52E+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
2.3 Stormwater Load (lb/ac/yr)		20.94	3.66	673		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 3 - Adjust for Pollutant Reduction																				
3.1 BMP annual runoff reduction (%)	0%				N/A				N/A				N/A				N/A			
3.2 Adjusted annual runoff volume (in)	32.92				N/A				N/A				N/A				N/A			
3.3 Adjusted annual runoff volume (liters)	9.44E+06				N/A				N/A				N/A				N/A			
3.4 Adjusted load from annual reductions (lb/ac/yr)		20.89	3.66	671.52		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
3.5 BMP removal efficiency (%)		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
3.6 BMP effluent concentration (mg/L)		2.80	0.49	90.00		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
3.7 Final Adjusted load (lb/ac/yr)		20.89	3.66	672		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 - Pollutant Reduction Met? ***(For Informational Purposes)***																				
4.1 TMDL (lb/ac/yr)		0.00	0.00	0																
4.2 Reduction met?		NO	NO	NO		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
4.3 Final Adjusted Load (lb/yr)		58.29	10.20	1874		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

APPENDIX F

VORTEX CHAMBER INFORMATION

Hydrodynamic Separation Product Calculator

The Battery - New Castle

Vortex Chamber #1

CDS 2020-5

Project Information					
Project Name	The Battery - New Castle			**Option #**	A
Country	UNITED_STATES	**State**	Pennsylvania	**City**	New Castle

Contact Information			
First Name	Tyler	**Last Name**	Wicker
Company	MidAtlantic	**Phone #**	609-541-7104
Email	Twicker@MidAtlanticEng.com		

Design Criteria					
Site Designation	Vortex Chamber #1			**Sizing Method**	Net Annual
Screening Required?	Yes	**Drainage Area (ac)**	2.34	**Peak Flow (cfs)**	25.00
Groundwater Depth (ft)	0 - 5	**Pipe Invert Depth (ft)**	0 - 5	**Bedrock Depth (ft)**	10 - 15
Multiple Inlets?	Yes	**Grate Inlet Required?**	Yes	**Pipe Size (in)**	24.00
Required Particle Size Distribution?	No	**90° between two inlets?**	No	**180° between inlet and outlet?**	No
Runoff Coefficient	0.98	**Rainfall Station**	143 - Philadelphia Airport, PA	**TC (Min)**	10

Treatment Selection					
Treatment Unit	CDS	**System Model**	2020-5		
Target Removal	80%	**Particle Size Distribution (PSD)**	125	**Predicted Net Annual Removal**	81.31%

CONTECH ENGINEERED SOLUTIONS

Hydrodynamic Separation Product Calculator

The Battery - New Castle

Vortex Chamber #1

CDS 2020-5

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD								
Rainfall Intensity[1] (in/hr)	% Rainfall Volume[1]	Cumulative Rainfall Volume	Rainfall Volume Treated	Total Flowrate (cfs)	Treated Flowrate (cfs)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.0200	9.51%	9.51%	9.51%	0.0459	0.0459	4.17%	100.00%	9.51%
0.0400	9.61%	19.12%	9.61%	0.0917	0.0917	8.34%	99.74%	9.59%
0.0600	8.61%	27.73%	8.61%	0.1376	0.1376	12.51%	98.91%	8.52%
0.0800	7.47%	35.20%	7.47%	0.1835	0.1835	16.68%	98.07%	7.33%
0.1000	8.58%	43.78%	8.58%	0.2293	0.2293	20.85%	97.24%	8.34%
0.1200	5.27%	49.05%	5.27%	0.2752	0.2752	25.02%	96.40%	5.08%
0.1400	5.04%	54.09%	5.04%	0.3210	0.3210	29.18%	95.57%	4.82%
0.1600	4.23%	58.32%	4.23%	0.3669	0.3669	33.35%	94.74%	4.01%
0.1800	4.03%	62.35%	4.03%	0.4128	0.4128	37.53%	93.90%	3.78%
0.2000	3.61%	65.96%	3.61%	0.4586	0.4586	41.69%	93.07%	3.36%
0.2500	5.82%	71.78%	5.82%	0.5733	0.5733	52.12%	90.98%	5.30%
0.3000	5.25%	77.03%	5.25%	0.6880	0.6880	62.55%	88.89%	4.67%
0.3500	3.63%	80.66%	3.63%	0.8026	0.8026	72.96%	86.81%	3.15%
0.4000	2.73%	83.39%	2.73%	0.9173	0.9173	83.39%	84.72%	2.31%
0.4500	2.06%	85.45%	2.06%	1.0319	1.0319	93.81%	82.64%	1.70%
0.5000	1.79%	87.24%	1.72%	1.1466	1.1000	100.00%	78.09%	1.40%
0.7500	4.98%	92.22%	3.19%	1.7199	1.1000	100.00%	52.06%	2.59%
1.0000	2.27%	94.49%	1.09%	2.2932	1.1000	100.00%	39.05%	0.89%
1.5000	5.07%	99.56%	1.62%	3.4398	1.1000	100.00%	26.03%	1.32%
2.0000	0.45%	100.01%	0.11%	4.5864	1.1000	100.00%	19.52%	0.09%
								87.76%
							Removal Efficiency Adjustment[2] =	6.45%
							Predicted % Annual Rainfall Treated =	86.73%
							Predicted Net Annual Load Removal Efficiency =	81.31%

1 - Based on 10 years of precipitation data from NCDC 6889, Philadelphia WSCMO AP, Philadelphia County, PA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

SECTION (_____)
STORM WATER TREATMENT DEVICE

1.0 GENERAL

1.1 This item shall govern the furnishing and installation of the CDS® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.

1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS® device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

1.4.1 Section 02240: Dewatering
1.4.2 Section 02260: Excavation Support and Protection
1.4.3 Section 02315: Excavation and Fill
1.4.4 Section 02340: Soil Stabilization

1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1.7 The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
- 2.1.4 Aggregates shall conform to ASTM C 33;
- 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

2.2 Internal Components and appurtenances shall conform to the following:

- 2.2.1 Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
- 2.2.2 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- 2.2.3 Fiberglass components shall conform to applicable sections of ASTM D-4097
- 2.2.4 Access system(s) conform to the following:
- 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

3.0 PERFORMANCE

3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load with a particle size distribution having a mean particle size (d_{50}) of 125 microns unless otherwise stated.

3.2 The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this

subsection under all flow conditions. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

3.3 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

3.4 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.

3.5 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.6 The SWTD shall have completed field tested following TARP Tier II protocol requirements

4.0 EXECUTION

4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.

4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

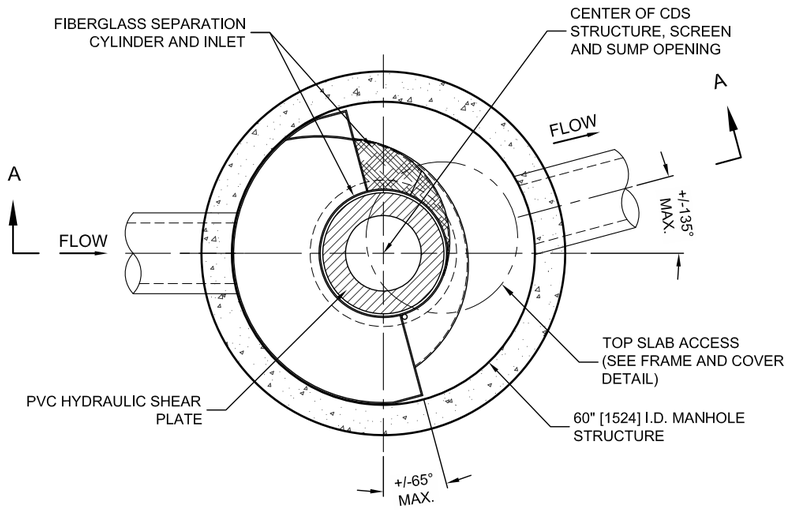
4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

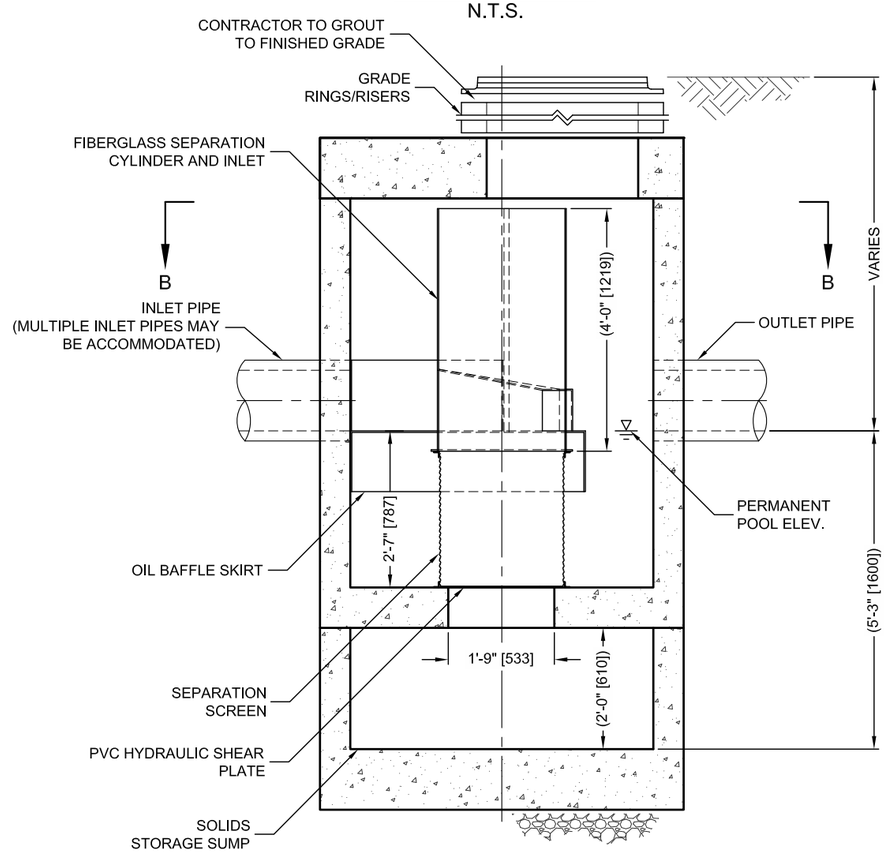
TABLE 1
Storm Water Treatment Device
Storage Capacities

CDS Model	Minimum Sump Storage Capacity $(yd^3)/(m^3)$	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-4	0.9(0.7)	61(232)
CDS2015-5	1.5(1.1)	83(313)
CDS2020-5	1.5(1.1)	99(376)
CDS2025-5	1.5(1.1)	116(439)
CDS3020-6	2.1 (1.6)	184(696)
CDS3025-6	2.1(1.6)	210(795)
CDS3030-6	2.1 (1.6)	236(895)
CDS3035-6	2.1 (1.6)	263(994)
CDS3535-7	2.9(2.2)	377(1426)
CDS4030-8	5.6(4.3)	426(1612)
CDS4040-8	5.6 (4.3)	520(1970)
CDS4045-8	5.6 (4.3)	568(2149)
CDS5640-10	8.7(6.7)	758(2869)
CDS5653-10	8.7(6.7)	965(3652)
CDS5668-10	8.7(6.7)	1172(4435)
CDS5678-10	8.7(6.7)	1309(4956)
CDS7070-DV	3.6(2.8)	914 (3459)
CDS10060-DV	5.0 (3.8)	792 (2997)
CDS10080-DV	5.0 (3.8)	1057 (4000)
CDS100100-DV	5.0 (3.8)	1320 (4996)

END OF SECTION



PLAN VIEW B-B
N.T.S.



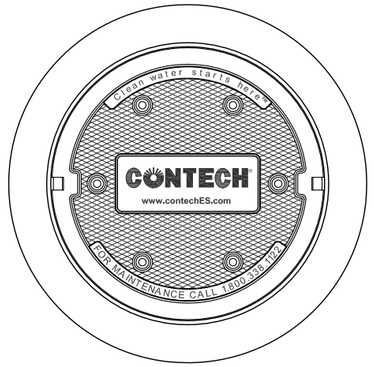
ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,782; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS2020-5-C DESIGN NOTES

THE STANDARD CDS2020-5-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (CFS OR L/s)	*
PEAK FLOW RATE (CFS OR L/s)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR 4700)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2020-5-C
INLINE CDS
STANDARD DETAIL

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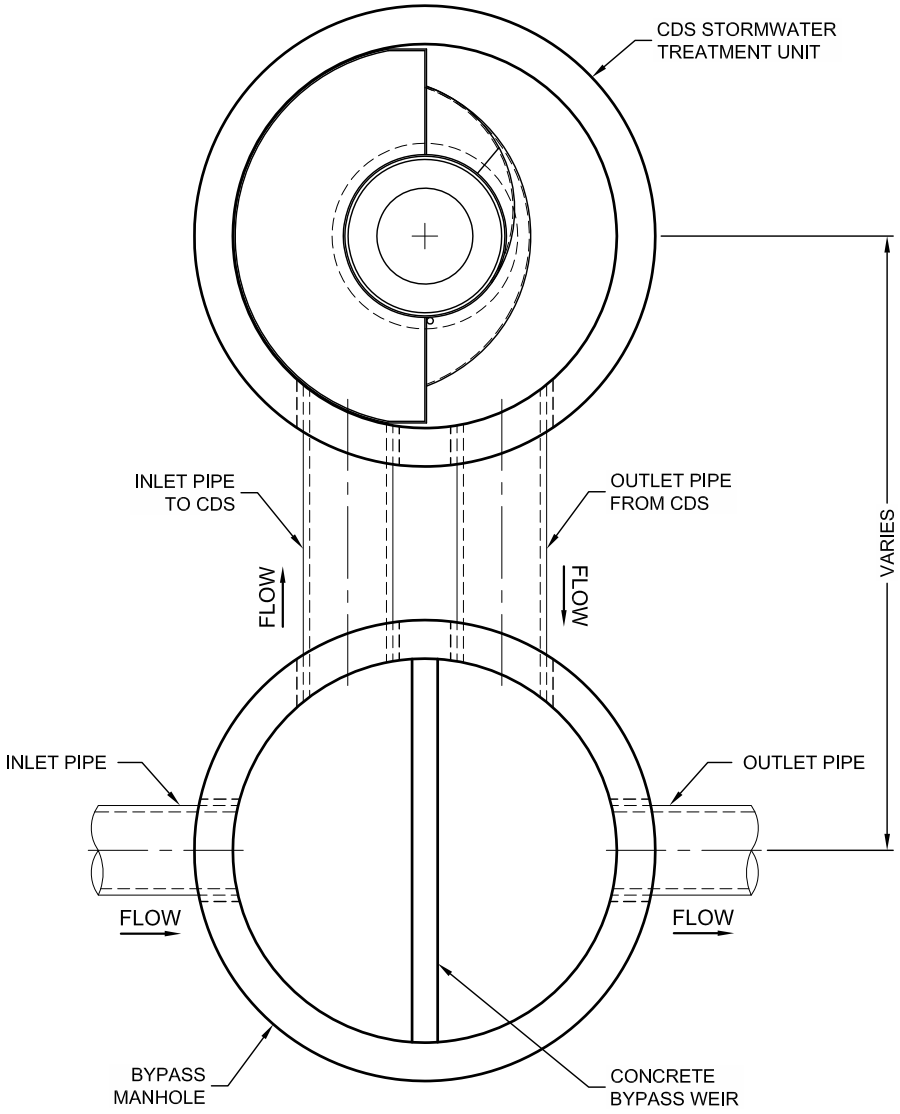

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CDS STORMWATER TREATMENT SYSTEM
TYPICAL OFFLINE LAYOUT
WITH BYPASS MANHOLE STRUCTURE

DATE:03/12/13	SCALE: NONE	PROJECT No.: N/A	SEQ. No.: N/A	DRAWN: N/A	CHECKED: N/A

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APPENDIX E

DRAINAGE AREA MAPS