STORMWATER MANAGEMENT REPORT

For a Proposed Repaving Project

Seastreak Ferry Terminal

Block 100, Lot 27
326 Shore Drive
Borough of Highlands
Monmouth County, New Jersey

Prepared for:

Highlands Landing Corporation

2 First Avenue
Atlantic Highlands, NJ 07716

Prepared by

One Industrial Way West
Building D, Suite H
Eatontown, NJ 07724

April 2025

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Prepared for

Highlands Landing Corporation
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Prepared By:

Najarian Associates, Inc.
One Industrial Way West
Eatontown, NJ 07724

Job Number: 8407

April 25, 2025

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New Jersey Professional Engineer Number 49075

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APPENDICES

1 INTRODUCTION

This report has been prepared to describe the stormwater drainage design for a proposed repaving project for Seastreak Ferry Terminal at 326 Shore Drive in the Highlands Borough. The purpose of this report is to demonstrate that the proposed improvements comply with the July 2023 NJDEP Stormwater Management Rules.

This report provides the calculations required to demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the current and projected two-, 10-, and 100-year storm events, as defined and determined pursuant to N.J.A.C. 7:8-5.7(c) and (d), respectively.

The site is mostly paved in the existing condition and the overall impervious coverage is being reduced in the proposed condition. Additionally, great care was taken to ensure the slopes of the pavement and pipes would result in a Time of Concentration (Tc) that matches the existing Tc time. Therefore, water quantity, water quality, and groundwater recharge requirements are satisfied just by the nature of the improvements and reduction in impervious. The intent of the design is to make the improvements necessary to the parking facilities on site and prove through hydrologic and hydraulic calculations that the proposed condition performs as good as or better than the existing condition.

1.1 Site Location and Existing Conditions

The Seastreak site is also known as Block 100, Lot 27 within Highlands Borough and is approximately 7.66 acres in size. The adjacent lots known as Block 100, Lots 27.04 and 27.05 are also owned by the applicant; however, there are no plans for development on those lots because they contain the actual ferry terminal and docks and there are no changes proposed to that existing use. Therefore, they are excluded from the application and this report.

The site is bounded by Shore Drive to the south, the Sandpiper condominiums to the southeast, the Sandy Hook Bay to the north, and existing Bayview condominiums to the

northwest. The site is located within NJ Watershed Management Area No 12, Monmouth within Water Region 3, Atlantic Coast. The Watershed is Raritan/ Sandy Hook Bay tributaries. The location of the site is shown on the maps included in Appendix A.

The site is currently utilized as a parking lot for the Seastreak ferry, with approximately 740 parking spaces based on ariel images. The parking spaces are on a mixture of gravel and asphalt. Throughout the parking area, there are ten inlets to collect runoff, eight of which drain towards Shore Drive and two of which drain towards Sandy Hook Bay.

The site slopes generally from north to south directing most of the rainwater runoff towards Shore Drive. The water then travels through the stormwater conveyance system beneath the Borough roadways and empties out into the Sandy Hook Bay. Any water that doesn't drain towards the road drains directly into the Sandy Hook Bay. The highest elevation, just over 11 feet (NAVD 88), is found in the north corner of the site, along the beach front and the Bayview condominiums. The lowest elevation, around 5.5 feet, is found in the middle of the existing gravel parking area near Shore Drive. The low points cause ponding to happen in multiple areas throughout the site during smaller storms.

2 EXISTING SITE CONDITIONS

The parking lot is not currently optimized for efficient circulation and maximum parking. The parking lot also experiences flooding at many of the existing parking spaces on the south side of the property. The main goals of the repaving project is to maximize parking spaces, provide efficient circulation, and to minimize the impact that flooding will have on the parking lot during smaller storm events.

The existing conditions are analyzed at two Points of Analysis based on the site topography and are described in detail below.

2.1 Point of Analysis 1

Point of Analysis 1 encompasses an area of 271,157 SF (6.22 acres), which constitutes most of the parking area on the site. 93.6% of this area is impervious made up of mostly asphalt, gravel and concrete. The drainage area generally

drains from north to south towards Shore Drive. There are eight inlets, most of which are concentrated along the front of the property. Of the eight inlets draining to the road, three have pipes that are back pitched, and one inlet is filled with debris. The existing inlets do not account for other low points on the property which results in localized ponding in those areas.

2.2 Point of Analysis 2

Point of Analysis 2 includes an area in the northeast of the property that connects to the pier for the ferry. The area is 0.25 AC and is entirely paved asphalt. The drainage area drains out to the Sandy Hook Bay through two inlets.

2.3 Summary of Existing Conditions

Existing site conditions were used to establish Curve Numbers (CN). The site soils are as discussed below (Table 4.1). In its existing state, the site is primarily asphalt, gravel and concrete and is used as a parking area for the ferry with small sheds and a building used for operations of the ferry and food trucks.

The existing peak flows for the 2-, 10-, and 100-year storms events for the site are given in Tables 2.4 and 2.5 for Points of Analysis 1 & 2. A plan entitled “Existing Drainage Area Plan” shows the existing drainage area, runoff curve numbers, and times of concentration and is included in Appendix F. Weighted curve number calculations and time of concentration calculations are provided in the HydroCAD analysis in Appendix "B".

Table 2.4 Existing Runoff Characteristics

Subbasin	Drainage Area (s.f.)	CN	tc (min)
EDA-1 Impervious	253,844	98	9.1
EDA-1 Pervious	17,313	39	9.1
POA-1	271,157	94	9.1
EDA-2 Impervious	11,012	98	2.1
POA-2	11,012	98	2.1

Table 2.5 - Existing Current Peak Flows (cfs)			
	Storm Event		
	2-Year	10-Year	100-Year
Analysis Point 1	12.49	19.51	33.37
Analysis Point 2	0.82	1.28	2.18

Table 2.6 - Existing Future Peak Flows (cfs)			
	Storm Event		
	2-Year	10-Year	100-Year
Analysis Point 1	14.92	23.06	41.53
Analysis Point 2	0.98	1.51	2.70

Table 2.7 - Proposed Current Peak Flows (cfs)			
	Storm Event		
	2-Year	10-Year	100-Year
Analysis Point 1	12.42	19.40	33.21
Analysis Point 2	0.82	1.28	2.18

Table 2.8 - Proposed Future Peak Flows (cfs)			
	Storm Event		
	2-Year	10-Year	100-Year
Analysis Point 1	14.84	22.93	41.36
Analysis Point 2	0.98	1.51	2.70

3 PROPOSED SITE CONDITIONS

The project proposes the disturbance of ±4.88 acres of the existing Seastreak Ferry parking lot, with ±2.78 acres to remain undisturbed or milled and overlayed.

The NJDEP BMP manual chapter 5 and NJAC 7:8 define the stormwater regulations to be used for the proposed site, which requires the demonstration through hydrologic and hydraulic analysis for stormwater leaving the site, post-construction runoff hydrographs for the current and projected 2-, 10-, and 100-year storm events, as defined and determined pursuant to N.J.A.C. 7:8-5.7(c) and NOAA Atlas 14, do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events.

The proposed improvements produce a decrease in impervious cover, resulting in an increase in infiltration while matching runoff times of concentration. The design for the proposed stormwater systems includes 15 new inlets and two existing inlets draining to the Sandy Hook Bay to remain for a total of 17 inlets and addresses the issues identified in the existing conveyance system in section 2 above. The specifics of the changes that are made regarding the new system are outlined in sections 3.1, 3.2 and 3.3 below.

3.1 Point of Analysis 1

The proposed improvements decrease the overall lot coverage from 83.5% to 82.0%. The reductions take place entirely within POA 1, mainly from the western edge of the property. The entirety of the stormwater conveyance improvements take place in Proposed Drainage Area 1 (PDA 1) including 15 new inlets, with pipe slopes ranging from 0.09% to 1.09%. The slopes for the stormwater pipes were calculated with the goal of keeping the time of concentration the same as the predevelopment time of concentration. By making the slopes consistent the proposed system fixes the back pitched pipe condition present in the existing condition and provides inlets at every low point across the drainage area.

3.2 Point of Analysis 2

There are no proposed changes to Tc or surface coverage in POA 2. The only improvements taking place are milling and overlaying of the existing pavement and

a new sidewalk in the same location as the old sidewalk that brings the pedestrian travel way into compliance with the latest ADA standards. The drainage pattern is to remain the same and will continue to drain water out towards the Sandy Hook Bay.

3.3 Summary of Proposed Conditions

The site will continue to drain from the north edge of the property to the south but will now include a series of high and low points with inlets at the designed low points. The lowest elevation on site is being raised to elevation 6.41 (up from approximately elevation 5.5 in the existing condition) with most of the elevation change happening in the front gravel parking area. The goal of the proposed grade change is to minimize the depth of flooding during smaller storm events.

A plan entitled “Proposed Drainage Area Plan” shows the proposed drainage areas, runoff curve numbers, and times of concentration; and is in Appendix F. Calculations for proposed times of concentration can be found in the proposed HydroCAD file in Appendix "C". A summary of the proposed runoff characteristics is shown below in table 3.1.

Table 3.1 Proposed Runoff Characteristics

Subbasin	Drainage Area (s.f.)	CN	tc (min)
PDA-1 Impervious	252,460	98	9.1
PDA-1 Pervious	18,697	39	9.1
POA-1	271,157	94	9.1
PDA-2 Impervious	11,012	98	2.1
POA-2	11,012	98	2.1

The peak flows corresponding to proposed conditions were then compared to the allowable values. The comparisons for each Analysis Point are given in Tables 3.4 and 3.5 below.

Table 3.2 - Proposed Current Peak Flows (cfs)			
	Storm Event		
	2-Year	10-Year	100-Year
Analysis Point 1	12.42	19.40	33.21
Analysis Point 2	0.82	1.28	2.18

Table 3.3 - Proposed Future Peak Flows (cfs)			
	Storm Event		
	2-Year	10-Year	100-Year
Analysis Point 1	14.84	22.93	41.36
Analysis Point 2	0.98	1.51	2.70

TABLE 3.4 Proposed Current Peak Flow Analysis				
POINT OF ANALYSIS 1				
STORM EVENT	EXISTING	PROPOSED	DELTA	COMPLIES
2-year	12.49	12.42	-0.07	YES
10-year	19.51	19.40	-0.11	YES
100-year	33.37	33.21	-0.16	YES
POINT OF ANALYSIS 2				
STORM EVENT	EXISTING	PROPOSED	DELTA	COMPLIES
2-year	0.82	0.82	0	YES
10-year	1.28	1.28	0	YES
100-year	2.18	2.18	0	YES

TABLE 3.5 Proposed Future Peak Flow Analysis				
POINT OF ANALYSIS 1				
STORM EVENT	EXISTING	PROPOSED	DELTA	COMPLIES
2-year	14.92	14.84	-0.08	YES
10-year	23.06	22.93	-0.13	YES
100-year	41.53	41.36	-0.17	YES
POINT OF ANALYSIS 2				
STORM EVENT	EXISTING	PROPOSED	DELTA	COMPLIES
2-year	0.98	0.98	0	YES
10-year	1.51	1.51	0	YES
100-year	2.70	2.70	0	YES

Examination of the results shows that the proposed peak flows are less in the proposed condition when compared to the peak condition. Closer examination of the hydrographs prove that the volume of stormwater runoff from the site is being reduced and that the post-construction runoff hydrographs for the current and projected 2-, 10-, and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events.

4 METHODOLOGY

The NJDEP stormwater runoff management (SWM) regulations at Section 7:8-5.6(b)1 requires the demonstration through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the current and projected 2, 10, and 100-year storm events, as defined and determined pursuant to N.J.A.C. 7:8-5.7(c) and (d), respectively, do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events.

The soil data for the site were determined from the NRCS web soil survey and from review of the existing site conditions. The soil on the site is shown in Appendix A. The soil as

mapped by the NRCS is entirely Urban land with 0 to 2 percent slopes. Table 4.1 presents the predominate soil type present on the site, as per the NRCS Websoils survey maps with corresponding hydrologic soil groups.

Table 4.1 Soil Properties – Portion of Site to be Developed

Symbol	Soil Name	Percent of Site	Hydrologic Soil Group
USKLEA	Urban land-Klej complex, 0 to 2 percent slopes	100%	A/D

In its existing state, the site is predominately asphalt, gravel and concrete that is being used as a parking area for the ferry and a smaller area of beach front which is all sand. There are also a few associated structures that are used for operations of the ferry and food trucks. The hydrologic soil group used in the models is A due to the high presence of sand across the site.

The time of concentration (Tc) is defined as the time required for runoff to travel from the most hydrologically distant point in the subbasin to the point at which the hydrographs are being computed. Times of concentration are calculated using the methods described in the TR-55, and are dependent upon surface type, flow length, and gradient of the flow path. The time of concentration for the proposed development was closely calculated to match that of the existing conditions. Specifically, pipe slopes were chosen in the design to ensure that the times of concentration were the same between the existing and proposed conditions to ensure compliance with Section 7:8-5.6(b)1.

The NOAA Atlas 14, 24hr, Storm Curve “D” Rainfall Distribution was used to describe the rainfall event for this analysis. The DelMarVa dimensionless unit hydrograph has been used to calculate design flood flow from the design storm. The total precipitation used for each of the storms analyzed was obtained from NOAA Atlas 14. The precipitation values were then multiplied by the adjustment factors show on Table 5-5 and 5-6 of the NJDEP BMP manual for the current storms and future storms, respectively. The adjusted precipitation values are in table 4.2 and 4.3 below:

Table 4.2 Frequency/Precipitation Relationship – Current Storms	
Storm Frequency (years)	24-hr Precipitation (inches)
Water Quality	1.25*
2	3.31
10	5.13
100	8.73

* 2-hr stormwater quality design storm

Table 4.3 Frequency/Precipitation Relationship – Future Storms	
Storm Frequency (years)	24-hr Precipitation (inches)
Water Quality	1.25*
2	3.94
10	6.05
100	10.79

* 2-hr stormwater quality design storm

4.1 Analysis of Water Quality Control Requirements

The NJDEP BMP manual also requires water quality control for stormwater discharge from new impervious surfaces. No new impervious surface is proposed. The improvements resulted in a decrease in impervious cover resulting in a decrease in peak flows and TSS rates when compared to the existing conditions. Therefore; additional water quality control is not required or proposed for the improvements.

5 GROUNDWATER RECHARGE

The NJDEP Stormwater Management Rules, Design and Performance Standards (NJAC 7:8, Subchapter 5) require that recharge be managed by either maintaining 100% of the existing average annual groundwater recharge or by infiltrating 100% of the proposed 2-year storm.

Impervious surface is being reduced in the proposed conditions. Therefore, an increase in recharge will naturally occur when compared to the existing condition. Attached in Appendix “D” are the groundwater recharge calculations demonstrating that groundwater recharge requirements are met.

6 STORMWATER DRAINAGE PIPING SYSTEM ANALYSIS

The design of the stormwater piping system was accomplished through the Natural Resources Conservation Service (NRCS) method. The method establishes a Curve Number (CN) for the site by evaluating the site’s drainage areas, soil types and land use. Drainage areas are established in the "Inlet Drainage Area Map in Appendix “F”. Soils types are listed in Table 4.1.

Appendix "C" contains the runoff coefficient calculations and the time of concentration calculations. The detailed drainage calculations and resulting pipe design are shown in Appendix "E". The locations of the piping system are shown on the plan entitled "Grading, Drainage, and Utility Plan," prepared by Najarian Associates, April 2025. The piping system was designed to reduce the impact that 2-year storm had on the site. Due to the site being near a tidal water body, the piping system has multiple areas on the site flooding above six inches. The proposed system continues to have inlets flooding as a result of the 2-year storm, with only one inlet flooding above six inches.

7 CONCLUSIONS

In conclusion, the improvements proposed will meet stormwater quantity, quality, and recharge requirements of the NJDEP as described in (N.J.A.C. 7:8-1.1 et. seq.) for a major development. Impervious coverage is being reduced, drainage patterns are remaining the same, and piping is being improved to reduce flooding to the site and surrounding infrastructure during smaller storms. ADA improvements have also been proposed to bring the site into compliance with the latest ADA guidelines.

R E F E R E N C E S

1. Brater, F.B. and H.W. King, Handbook of Hydraulics, McGraw-Hill Book Company, 1976.

2. New Jersey Department of Agriculture, Standards for Soil Erosion and Sediment Control in New Jersey, 2014 rev. 2017.

3. New Jersey Department of Environmental Protection (NJDEP), New Jersey Stormwater Best Management Practices Manual, 2004 and updated through 2021 Chapters; https://www.njstormwater.org/bmp_manual2.htm.

4. New Jersey Department of Environmental Protection (NJDEP), Technical Manual Flood Hazard Area Control Act Rules 7:13, 2018.

5. U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4 - Hydrology, August 1972.

6. U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release Number 55, January, 1986.

7. United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey. http://websoilsurvey.sc.egov.usda.gov/. Accessed May 2020

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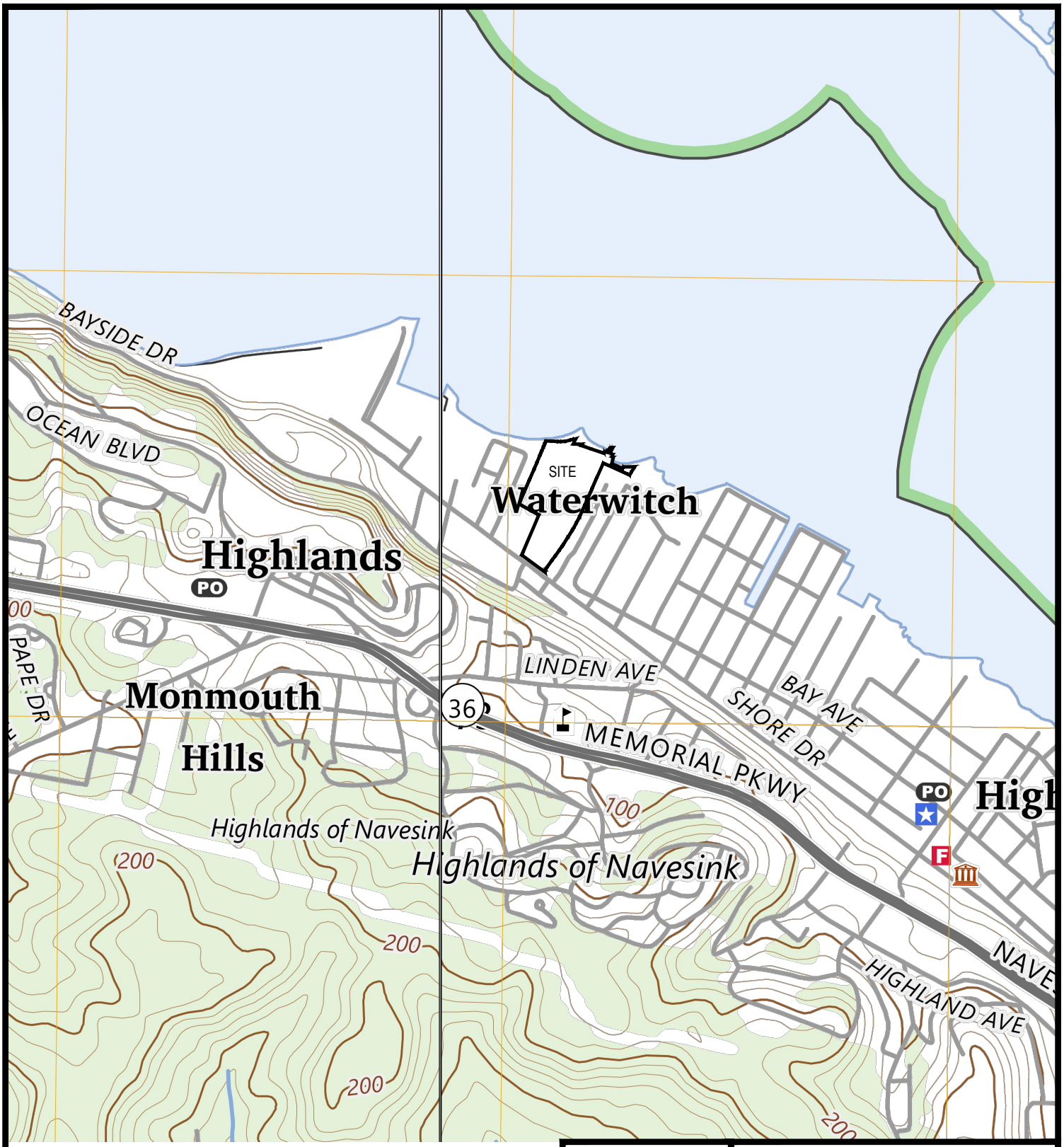
Appendix A

General Design Information



SOURCE:
USGS QUAD
SANDY HOOK EAST AND WEST

SITE LOCATION

BLOCK 100, LOT 27, TAX MAP 19
326 SHORE DRIVE, BOROUGH OF HIGHLANDS
MONMOUTH COUNTY, NJ

Najarian Associates
Professional Engineers, Land Surveyors & Planners • Scientists
One Industrial Way West, Eatontown, New Jersey 07724
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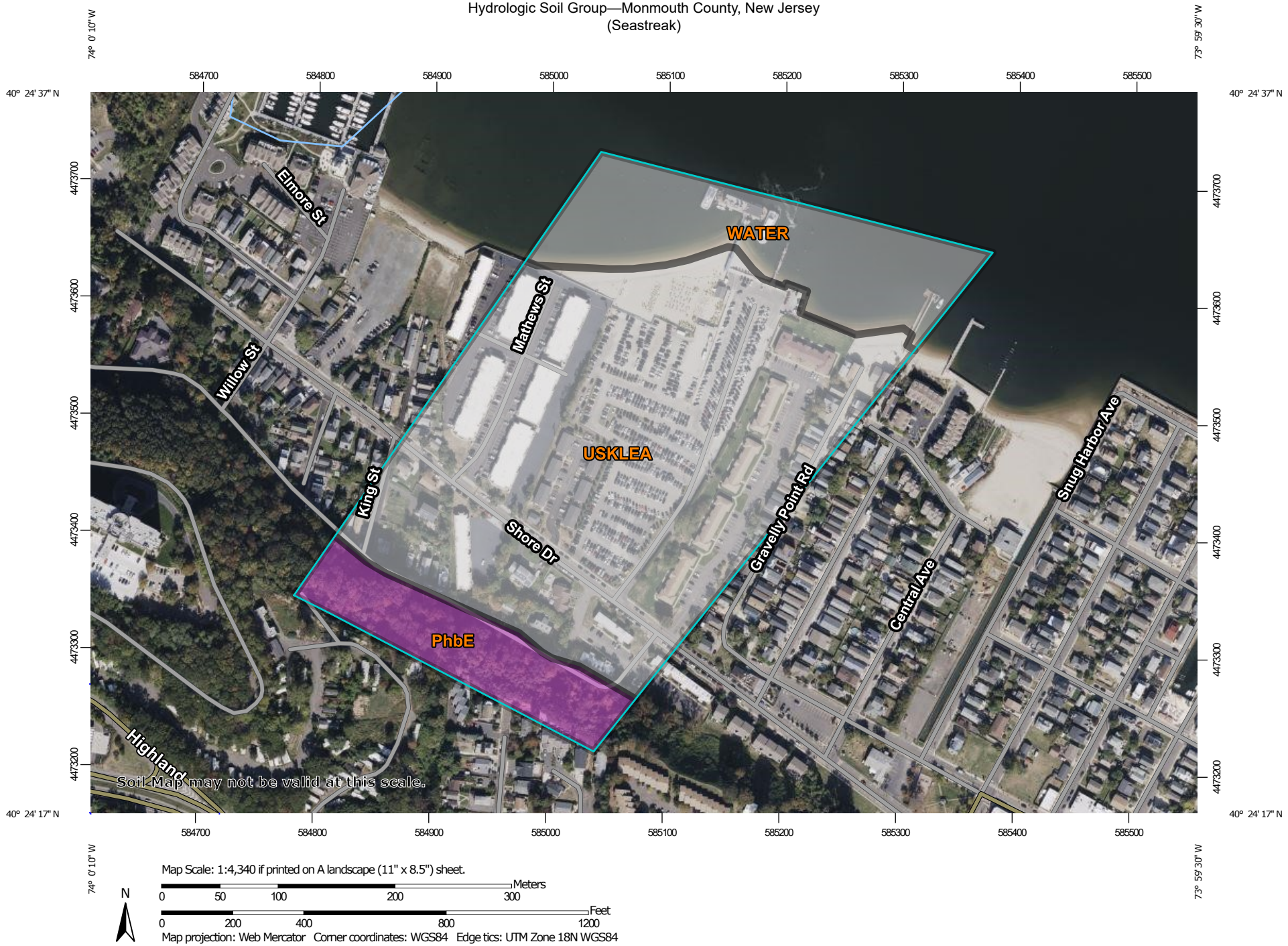
Certificate of Authorization Certificate # 24GA27993300

DRAWN	REVIEWED	SCALE	DATE	JOB NO.	SHEET NO.
ERI	BMT	1"=1000'	4-25-25	8407	1 OF 1

Hydrologic Soil Group—Monmouth County, New Jersey
(Seastreak)



Map Scale: 1:4,340 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

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 Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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: Monmouth County, New Jersey
Survey Area Data: Version 17, Aug 29, 2023

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

Date(s) aerial images were photographed: Oct 9, 2022—Oct 16, 2022

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
PhbE	Phalanx loamy sand, 10 to 25 percent slopes	A	4.1	10.8%
USKLEA	Urban land-Klej complex, 0 to 2 percent slopes		26.5	70.3%
WATER	Water		7.1	18.9%
Totals for Area of Interest			**37.8**	**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

NOAA Atlas 14, Volume 2, Version 3
Location name: Highlands, New Jersey, USA*
Latitude: 40.4087°, Longitude: -73.9965°
Elevation: 9 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.342** (0.311-0.378)	**0.409** (0.371-0.451)	**0.484** (0.438-0.535)	**0.540** (0.488-0.597)	**0.612** (0.550-0.676)	**0.663** (0.591-0.731)	**0.714** (0.633-0.790)	**0.761** (0.670-0.844)	**0.822** (0.714-0.917)	**0.869** (0.748-0.974)
10-min	**0.546** (0.495-0.602)	**0.654** (0.593-0.722)	**0.775** (0.702-0.857)	**0.864** (0.780-0.954)	**0.972** (0.872-1.07)	**1.05** (0.938-1.16)	**1.13** (1.00-1.25)	**1.20** (1.06-1.33)	**1.29** (1.12-1.44)	**1.36** (1.17-1.53)
15-min	**0.682** (0.619-0.752)	**0.820** (0.743-0.904)	**0.977** (0.885-1.08)	**1.09** (0.983-1.20)	**1.23** (1.10-1.36)	**1.33** (1.18-1.47)	**1.42** (1.26-1.58)	**1.51** (1.33-1.68)	**1.62** (1.41-1.81)	**1.70** (1.47-1.91)
30-min	**0.932** (0.846-1.03)	**1.13** (1.02-1.25)	**1.38** (1.25-1.53)	**1.57** (1.42-1.74)	**1.81** (1.63-2.00)	**1.99** (1.78-2.20)	**2.17** (1.93-2.40)	**2.35** (2.07-2.60)	**2.58** (2.24-2.88)	**2.75** (2.37-3.08)
60-min	**1.16** (1.05-1.28)	**1.42** (1.28-1.56)	**1.77** (1.61-1.96)	**2.05** (1.85-2.26)	**2.41** (2.16-2.66)	**2.69** (2.40-2.97)	**2.99** (2.65-3.30)	**3.28** (2.89-3.64)	**3.68** (3.20-4.11)	**4.00** (3.45-4.49)
2-hr	**1.44** (1.30-1.60)	**1.76** (1.59-1.95)	**2.22** (2.01-2.47)	**2.58** (2.32-2.86)	**3.08** (2.75-3.41)	**3.48** (3.10-3.86)	**3.90** (3.44-4.34)	**4.34** (3.80-4.84)	**4.96** (4.28-5.55)	**5.45** (4.66-6.14)
3-hr	**1.59** (1.44-1.77)	**1.94** (1.76-2.16)	**2.46** (2.23-2.74)	**2.86** (2.58-3.18)	**3.43** (3.07-3.81)	**3.90** (3.46-4.32)	**4.38** (3.86-4.86)	**4.89** (4.27-5.44)	**5.61** (4.83-6.27)	**6.19** (5.26-6.96)
6-hr	**2.03** (1.83-2.26)	**2.47** (2.23-2.74)	**3.11** (2.80-3.45)	**3.62** (3.26-4.01)	**4.36** (3.89-4.82)	**4.97** (4.40-5.50)	**5.62** (4.93-6.23)	**6.32** (5.48-7.01)	**7.31** (6.24-8.16)	**8.12** (6.86-9.11)
12-hr	**2.47** (2.24-2.74)	**3.00** (2.72-3.32)	**3.80** (3.43-4.20)	**4.46** (4.01-4.92)	**5.43** (4.84-5.98)	**6.26** (5.54-6.89)	**7.15** (6.25-7.88)	**8.12** (7.01-8.98)	**9.56** (8.10-10.6)	**10.8** (8.98-12.0)
24-hr	**2.73** (2.50-2.99)	**3.31** (3.03-3.63)	**4.26** (3.90-4.67)	**5.08** (4.63-5.55)	**6.30** (5.71-6.86)	**7.37** (6.62-8.00)	**8.56** (7.63-9.28)	**9.90** (8.73-10.7)	**11.9** (10.3-12.9)	**13.6** (11.7-14.8)
2-day	**3.27** (2.98-3.62)	**3.97** (3.62-4.39)	**5.09** (4.63-5.62)	**6.04** (5.47-6.66)	**7.46** (6.71-8.22)	**8.68** (7.76-9.56)	**10.0** (8.90-11.0)	**11.5** (10.1-12.7)	**13.8** (11.9-15.2)	**15.7** (13.4-17.4)
3-day	**3.46** (3.17-3.80)	**4.20** (3.84-4.61)	**5.36** (4.90-5.88)	**6.35** (5.79-6.96)	**7.81** (7.07-8.55)	**9.06** (8.15-9.91)	**10.4** (9.32-11.4)	**11.9** (10.6-13.1)	**14.2** (12.4-15.6)	**16.1** (13.9-17.8)
4-day	**3.65** (3.36-3.99)	**4.42** (4.07-4.83)	**5.64** (5.18-6.15)	**6.66** (6.10-7.25)	**8.16** (7.44-8.88)	**9.44** (8.55-10.3)	**10.8** (9.74-11.8)	**12.4** (11.0-13.5)	**14.7** (12.9-16.0)	**16.6** (14.4-18.2)
7-day	**4.22** (3.90-4.57)	**5.08** (4.70-5.50)	**6.37** (5.88-6.89)	**7.44** (6.87-8.04)	**9.00** (8.27-9.72)	**10.3** (9.42-11.1)	**11.7** (10.6-12.7)	**13.3** (11.9-14.4)	**15.5** (13.8-16.9)	**17.4** (15.3-19.0)
10-day	**4.74** (4.43-5.10)	**5.68** (5.30-6.10)	**7.02** (6.54-7.54)	**8.12** (7.55-8.72)	**9.70** (8.98-10.4)	**11.0** (10.1-11.8)	**12.4** (11.4-13.3)	**13.9** (12.6-15.0)	**16.1** (14.4-17.4)	**17.9** (15.9-19.4)
20-day	**6.39** (6.02-6.80)	**7.60** (7.15-8.08)	**9.11** (8.57-9.68)	**10.3** (9.69-11.0)	**12.0** (11.2-12.7)	**13.3** (12.4-14.1)	**14.6** (13.5-15.5)	**16.0** (14.7-17.0)	**17.8** (16.3-19.0)	**19.3** (17.5-20.6)
30-day	**7.95** (7.54-8.41)	**9.40** (8.91-9.94)	**11.1** (10.5-11.7)	**12.4** (11.7-13.1)	**14.1** (13.3-14.9)	**15.4** (14.5-16.3)	**16.7** (15.7-17.7)	**18.0** (16.8-19.1)	**19.7** (18.3-21.0)	**21.0** (19.4-22.4)
45-day	**10.1** (9.58-10.6)	**11.9** (11.3-12.5)	**13.8** (13.1-14.5)	**15.3** (14.5-16.0)	**17.1** (16.2-18.0)	**18.6** (17.5-19.6)	**20.0** (18.8-21.0)	**21.3** (20.0-22.5)	**23.0** (21.5-24.4)	**24.3** (22.5-25.8)
60-day	**12.1** (11.5-12.7)	**14.2** (13.5-14.9)	**16.3** (15.5-17.1)	**17.8** (16.9-18.7)	**19.8** (18.8-20.8)	**21.2** (20.1-22.3)	**22.6** (21.4-23.8)	**23.9** (22.6-25.2)	**25.5** (24.0-26.9)	**26.7** (25.0-28.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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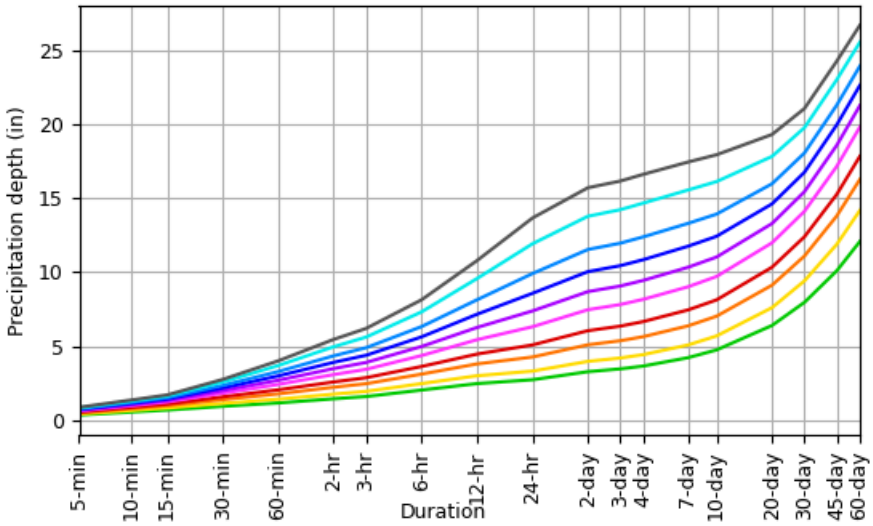
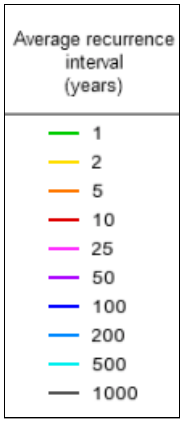
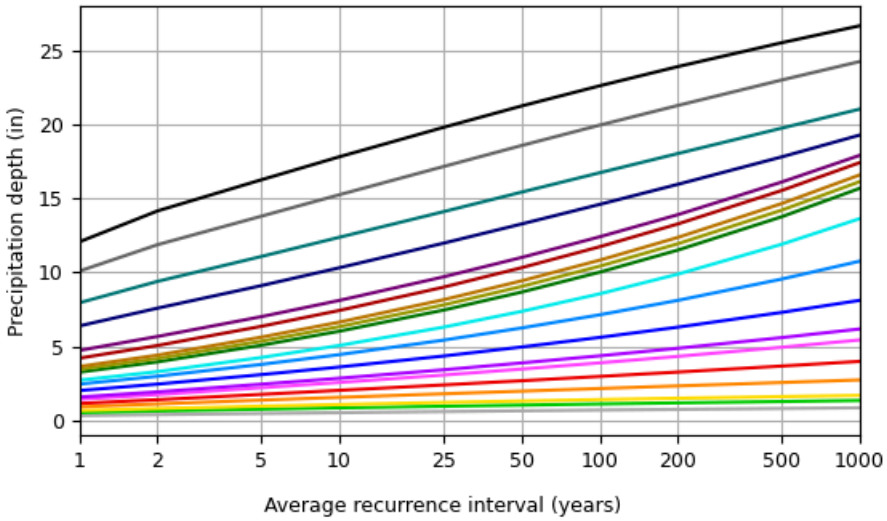
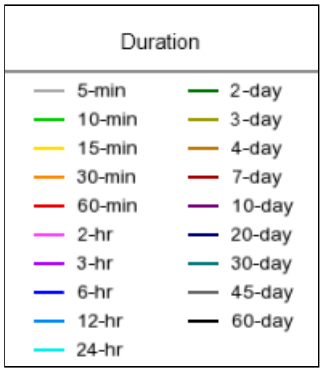
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 40.4087°, Longitude: -73.9965°









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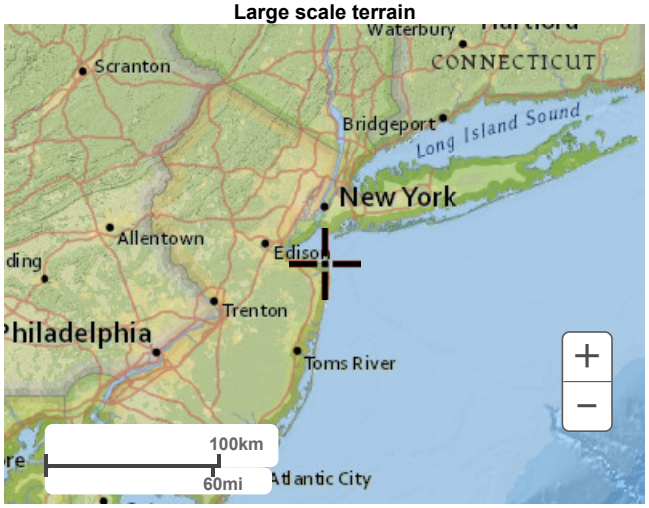
Maps & aerials

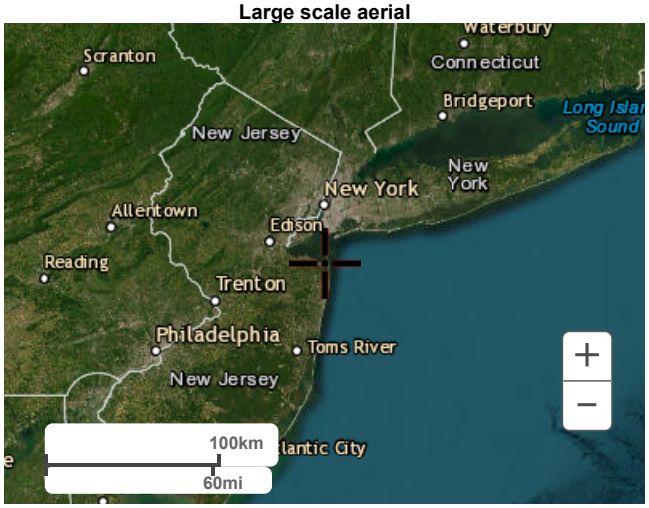
Small scale terrain

Large scale terrain



Large scale map

Large scale aerial



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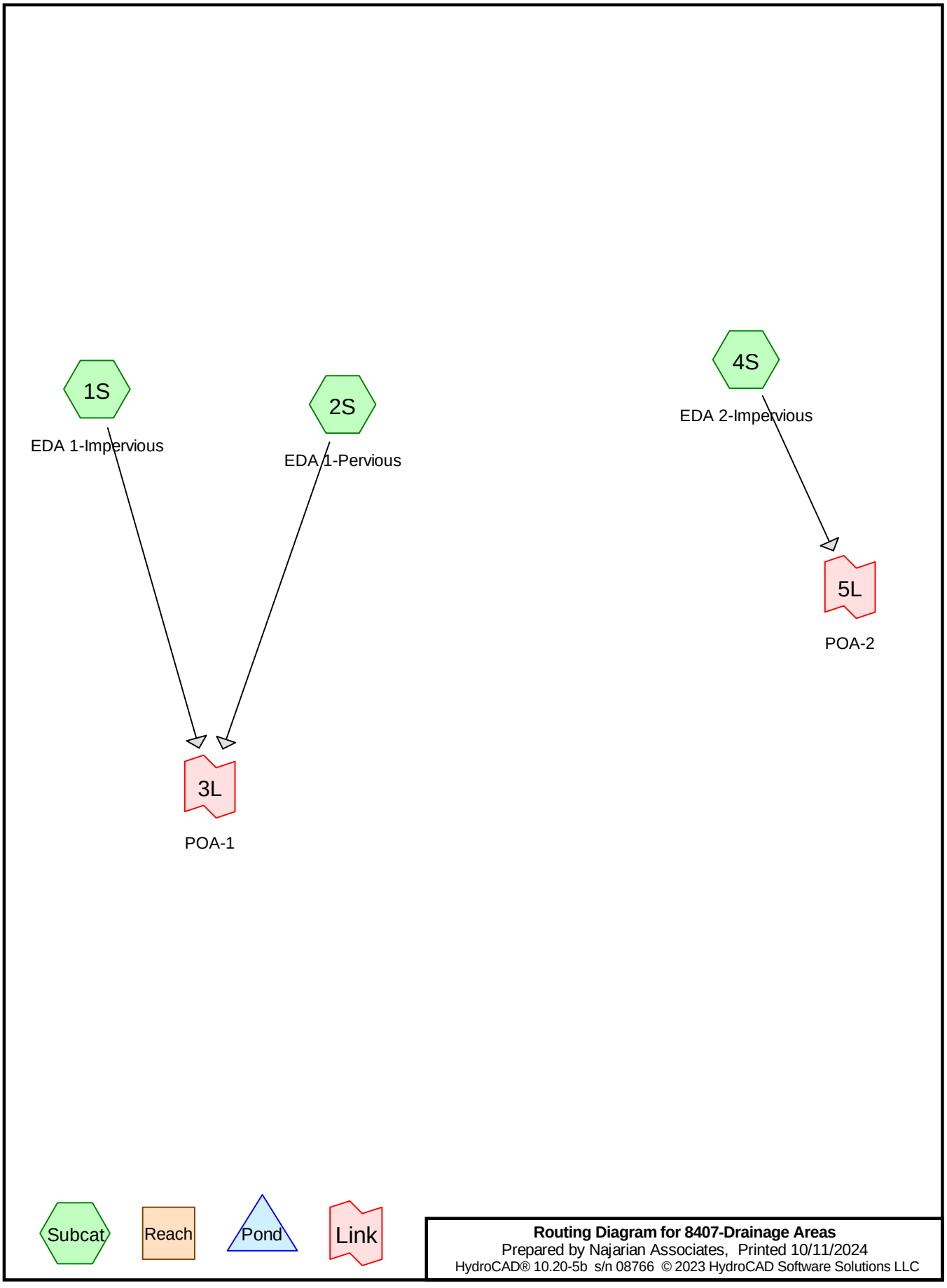
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix B

Existing HydroCAD Input and Output File



Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.397	39	>75% Grass cover, Good, HSG A (2S)
6.080	98	Paved parking, HSG A (1S, 4S)
6.478	**94**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.478	HSG A	1S, 2S, 4S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
6.478		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.397	0.000	0.000	0.000	0.000	0.397	>75% Grass cover, Good	2S
6.080	0.000	0.000	0.000	0.000	6.080	Paved parking	1S, 4S
6.478	**0.000**	**0.000**	**0.000**	**0.000**	**6.478**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1S	0.00	0.00	566.0	0.0016	0.013	0.0	12.0	0.0	
2	2S	0.00	0.00	566.0	0.0016	0.013	0.0	12.0	0.0	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EDA 1-Impervious Runoff Area=253,844 sf 100.00% Impervious Runoff Depth=10.55"
Flow Length=963' Tc=9.1 min CN=98 Runoff=41.21 cfs 5.123 af

Subcatchment 2S: EDA 1-Pervious Runoff Area=17,313 sf 0.00% Impervious Runoff Depth=2.52"
Flow Length=963' Tc=9.1 min CN=39 Runoff=0.66 cfs 0.083 af

Subcatchment 4S: EDA 2-Impervious Runoff Area=11,012 sf 100.00% Impervious Runoff Depth=10.55"
Flow Length=213' Tc=2.1 min CN=98 Runoff=2.70 cfs 0.222 af

Link 3L: POA-1 Inflow=41.53 cfs 5.206 af
Primary=41.53 cfs 5.206 af

Link 5L: POA-2 Inflow=2.70 cfs 0.222 af
Primary=2.70 cfs 0.222 af

Total Runoff Area = 6.478 ac Runoff Volume = 5.428 af Average Runoff Depth = 10.06"
6.14% Pervious = 0.397 ac 93.86% Impervious = 6.080 ac

Summary for Subcatchment 1S: EDA 1-Impervious

[47] Hint: Peak is 2892% of capacity of segment #3

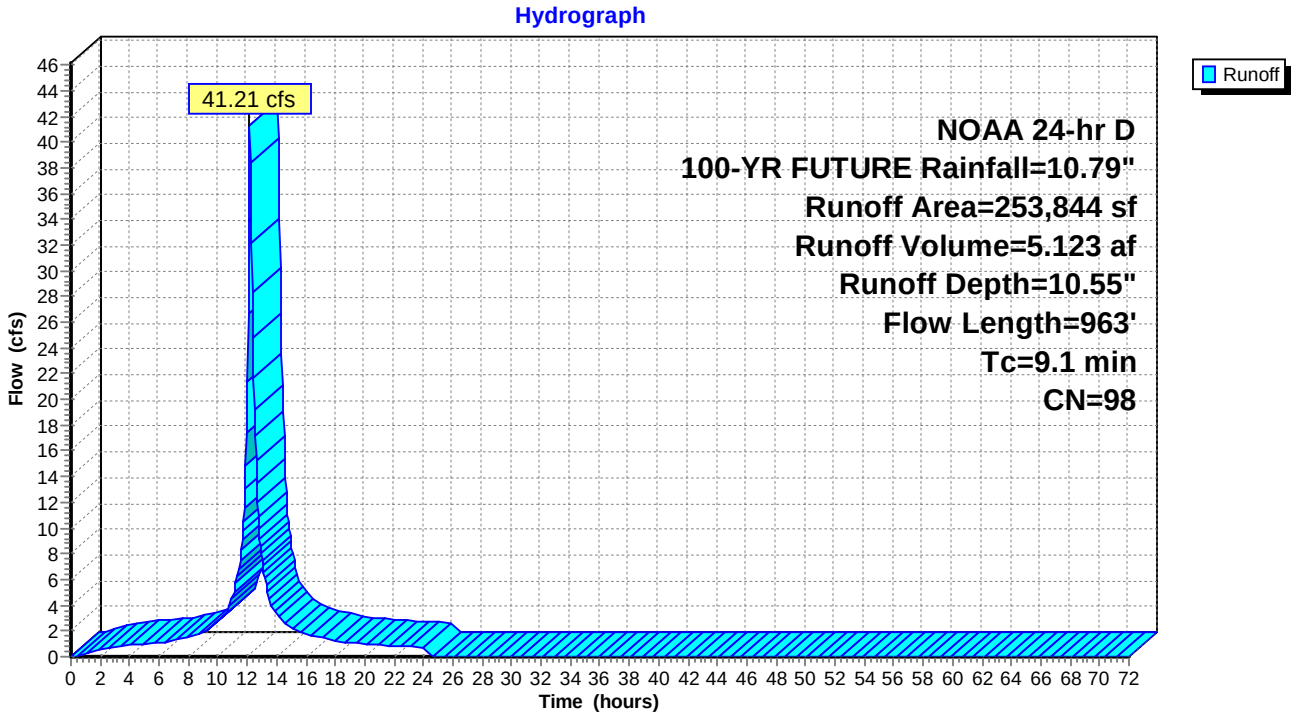
Runoff = 41.21 cfs @ 12.17 hrs, Volume= 5.123 af, Depth=10.55"
Routed to Link 3L : POA-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-YR FUTURE Rainfall=10.79"

Area (sf)	CN	Description
253,844	98	Paved parking, HSG A
253,844		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0092	1.12		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.94"
2.4	297	0.0103	2.06		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
5.2	566	0.0016	1.81	1.43	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
9.1	963	Total			

Subcatchment 1S: EDA 1-Impervious



Summary for Subcatchment 2S: EDA 1-Pervious

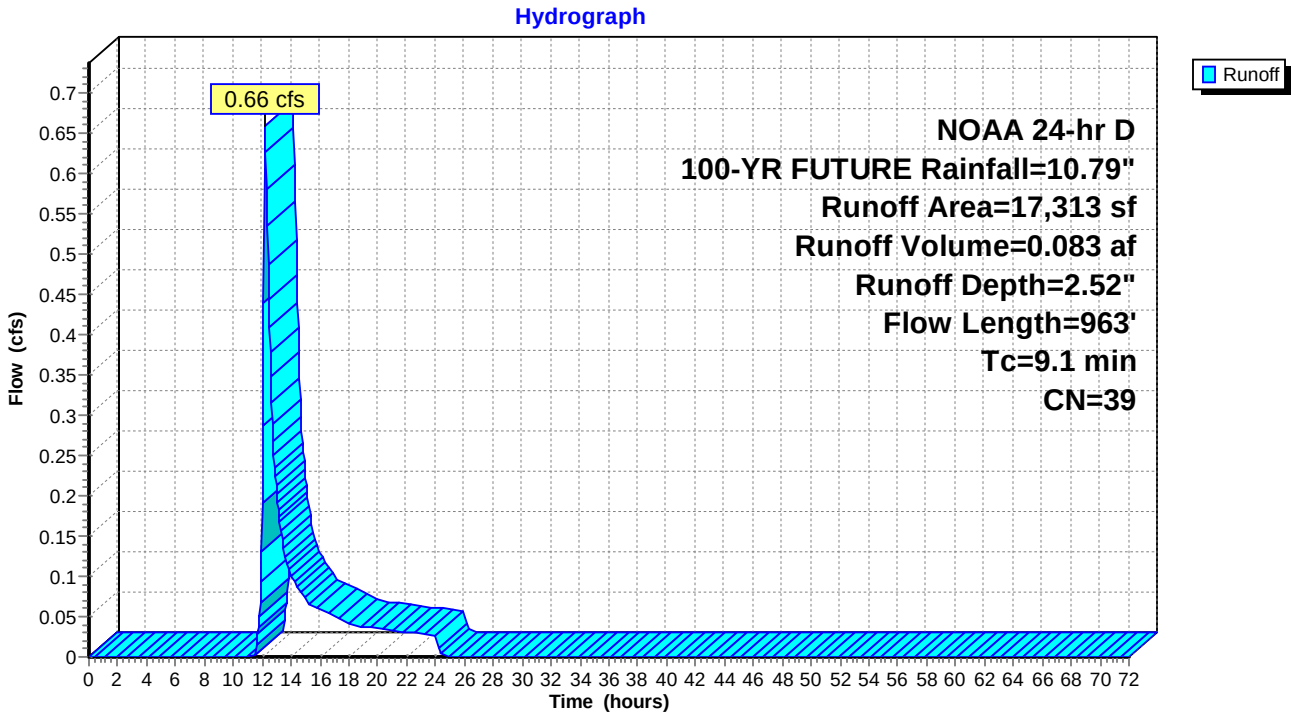
Runoff = 0.66 cfs @ 12.21 hrs, Volume= 0.083 af, Depth= 2.52"
Routed to Link 3L : POA-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-YR FUTURE Rainfall=10.79"

Area (sf)	CN	Description
17,313	39	>75% Grass cover, Good, HSG A
17,313		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0092	1.12		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.94"
2.4	297	0.0103	2.06		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
5.2	566	0.0016	1.81	1.43	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
9.1	963	Total			

Subcatchment 2S: EDA 1-Pervious



Summary for Subcatchment 4S: EDA 2-Impervious

[49] Hint: Tc<2dt may require smaller dt

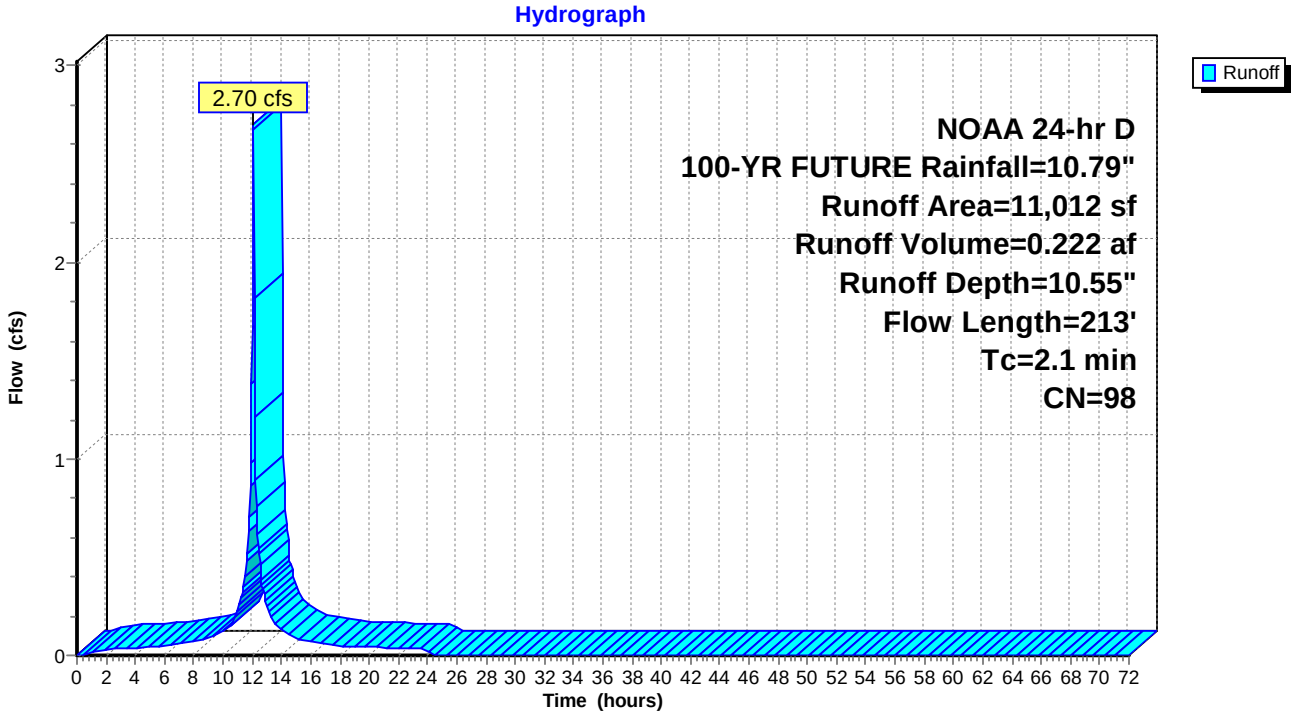
Runoff = 2.70 cfs @ 12.09 hrs, Volume= 0.222 af, Depth=10.55"
Routed to Link 5L : POA-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-YR FUTURE Rainfall=10.79"

Area (sf)	CN	Description
11,012	98	Paved parking, HSG A
11,012		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0227	1.61		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.94"
1.1	113	0.0077	1.78		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.1	213	Total			

Subcatchment 4S: EDA 2-Impervious

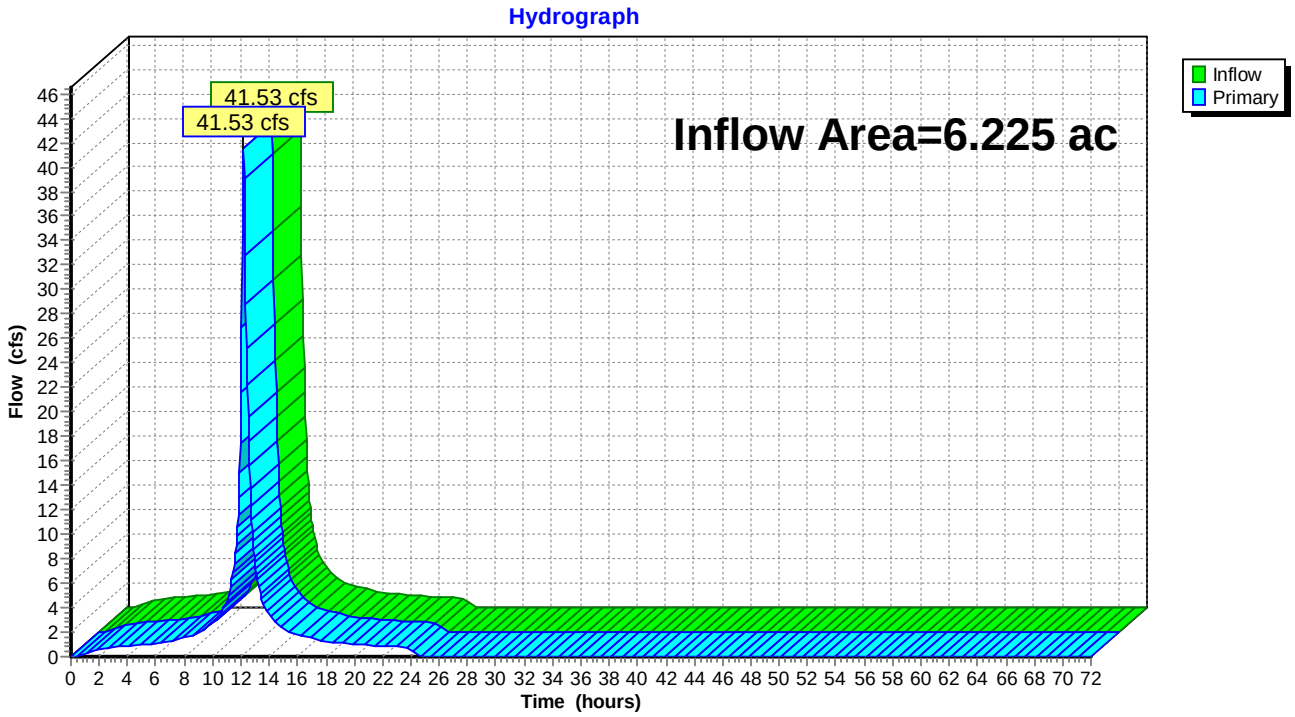


Summary for Link 3L: POA-1

Inflow Area = 6.225 ac, 93.62% Impervious, Inflow Depth = 10.04" for 100-YR FUTURE event
Inflow = 41.53 cfs @ 12.18 hrs, Volume= 5.206 af
Primary = 41.53 cfs @ 12.18 hrs, Volume= 5.206 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link 3L: POA-1

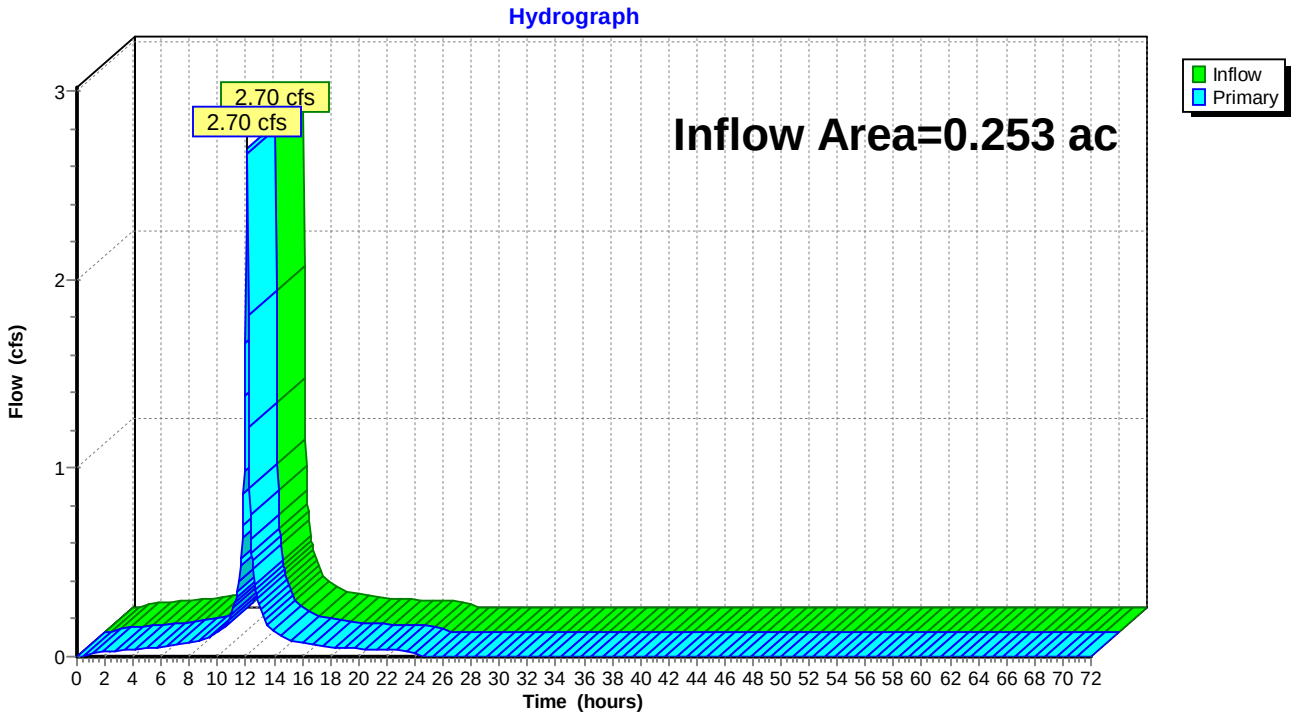


Summary for Link 5L: POA-2

Inflow Area = 0.253 ac,100.00% Impervious, Inflow Depth = 10.55" for 100-YR FUTURE event
Inflow = 2.70 cfs @ 12.09 hrs, Volume= 0.222 af
Primary = 2.70 cfs @ 12.09 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

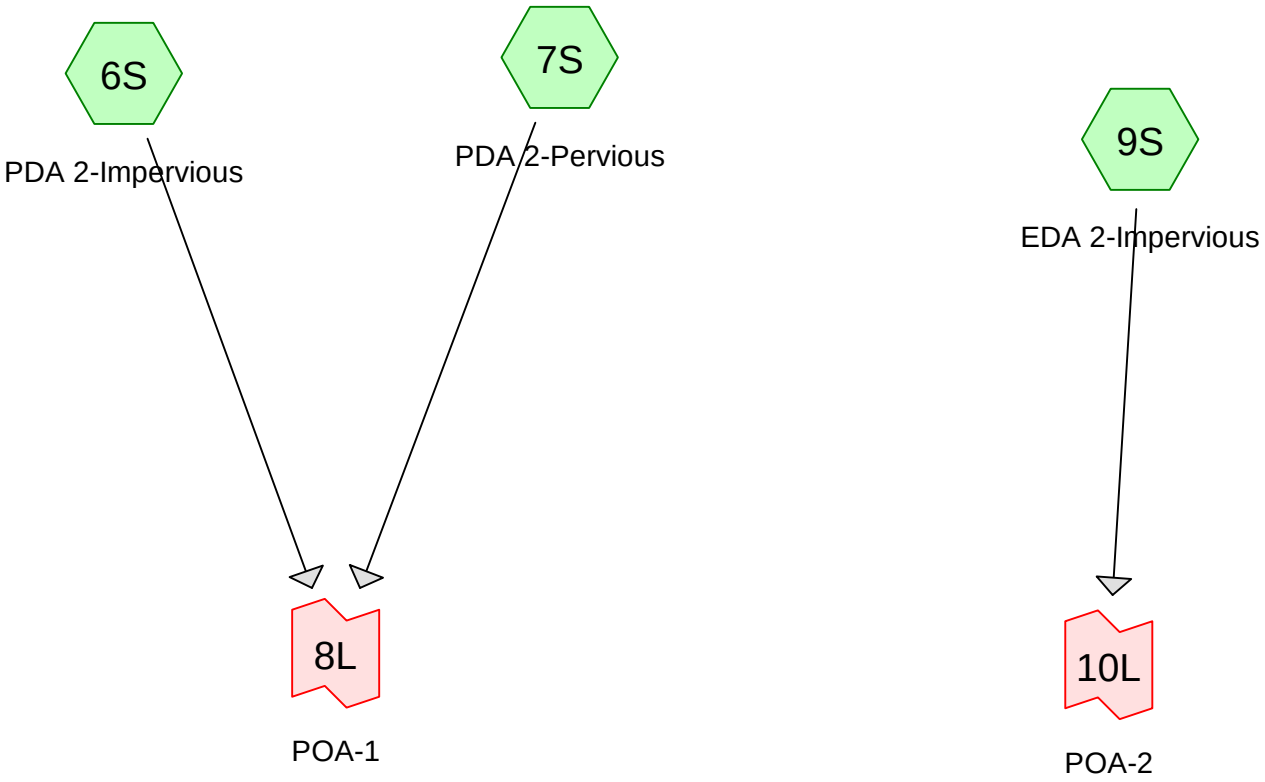
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link 5L: POA-2



Appendix C

Proposed HydroCAD Input and Output File



Subcat Reach Pond Link

Routing Diagram for 8407-Drainage Areas
Prepared by Najarian Associates, Printed 10/11/2024
HydroCAD® 10.20-5b s/n 08766 © 2023 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.429	39	>75% Grass cover, Good, HSG A (7S)
6.048	98	Paved parking, HSG A (6S, 9S)
6.478	**94**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.478	HSG A	6S, 7S, 9S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
6.478		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.429	0.000	0.000	0.000	0.000	0.429	>75% Grass cover, Good	7S
6.048	0.000	0.000	0.000	0.000	6.048	Paved parking	6S, 9S
6.478	**0.000**	**0.000**	**0.000**	**0.000**	**6.478**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	6S	0.00	0.00	553.0	0.0009	0.013	23.0	14.0	0.0	
2	7S	0.00	0.00	553.0	0.0009	0.013	23.0	14.0	0.0	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 6S: PDA 2-Impervious Runoff Area=252,460 sf 100.00% Impervious Runoff Depth=10.55"
Flow Length=948' Tc=9.1 min CN=98 Runoff=40.99 cfs 5.095 af

Subcatchment 7S: PDA 2-Pervious Runoff Area=18,697 sf 0.00% Impervious Runoff Depth=2.52"
Flow Length=948' Tc=9.1 min CN=39 Runoff=0.71 cfs 0.090 af

Subcatchment 9S: EDA 2-Impervious Runoff Area=11,012 sf 100.00% Impervious Runoff Depth=10.55"
Flow Length=213' Tc=2.1 min CN=98 Runoff=2.70 cfs 0.222 af

Link 8L: POA-1 Inflow=41.36 cfs 5.185 af
Primary=41.36 cfs 5.185 af

Link 10L: POA-2 Inflow=2.70 cfs 0.222 af
Primary=2.70 cfs 0.222 af

Total Runoff Area = 6.478 ac Runoff Volume = 5.407 af Average Runoff Depth = 10.02"
6.63% Pervious = 0.429 ac 93.37% Impervious = 6.048 ac

Summary for Subcatchment 6S: PDA 2-Impervious

[47] Hint: Peak is 1282% of capacity of segment #3

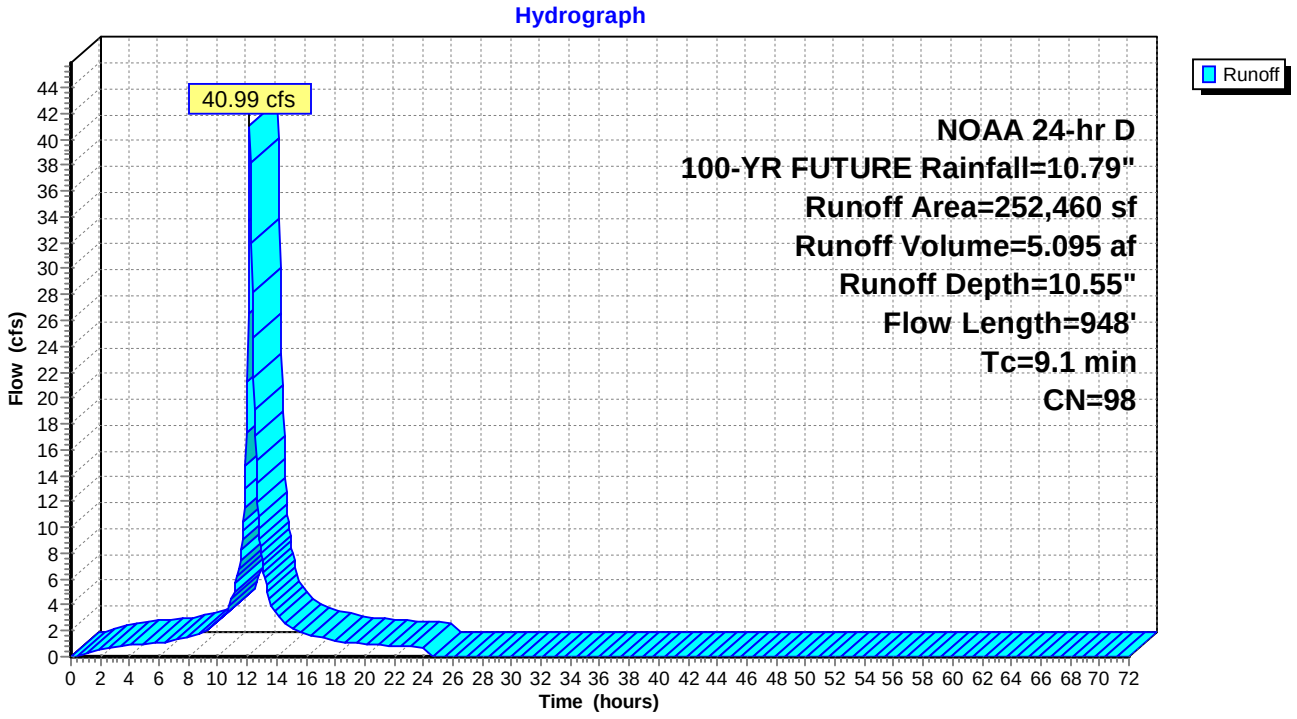
Runoff = 40.99 cfs @ 12.17 hrs, Volume= 5.095 af, Depth=10.55"
Routed to Link 8L : POA-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-YR FUTURE Rainfall=10.79"

Area (sf)	CN	Description
252,460	98	Paved parking, HSG A
252,460		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0104	1.18		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.94"
2.4	295	0.0103	2.06		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
5.3	553	0.0009	1.75	3.20	**Pipe Channel, RCP_Elliptical 23x14** 23.0" x 14.0", R=22.0" Elliptical Area= 1.8 sf Perim= 5.0' r= 0.36' n= 0.013
9.1	948	Total			

Subcatchment 6S: PDA 2-Impervious



Summary for Subcatchment 7S: PDA 2-Pervious

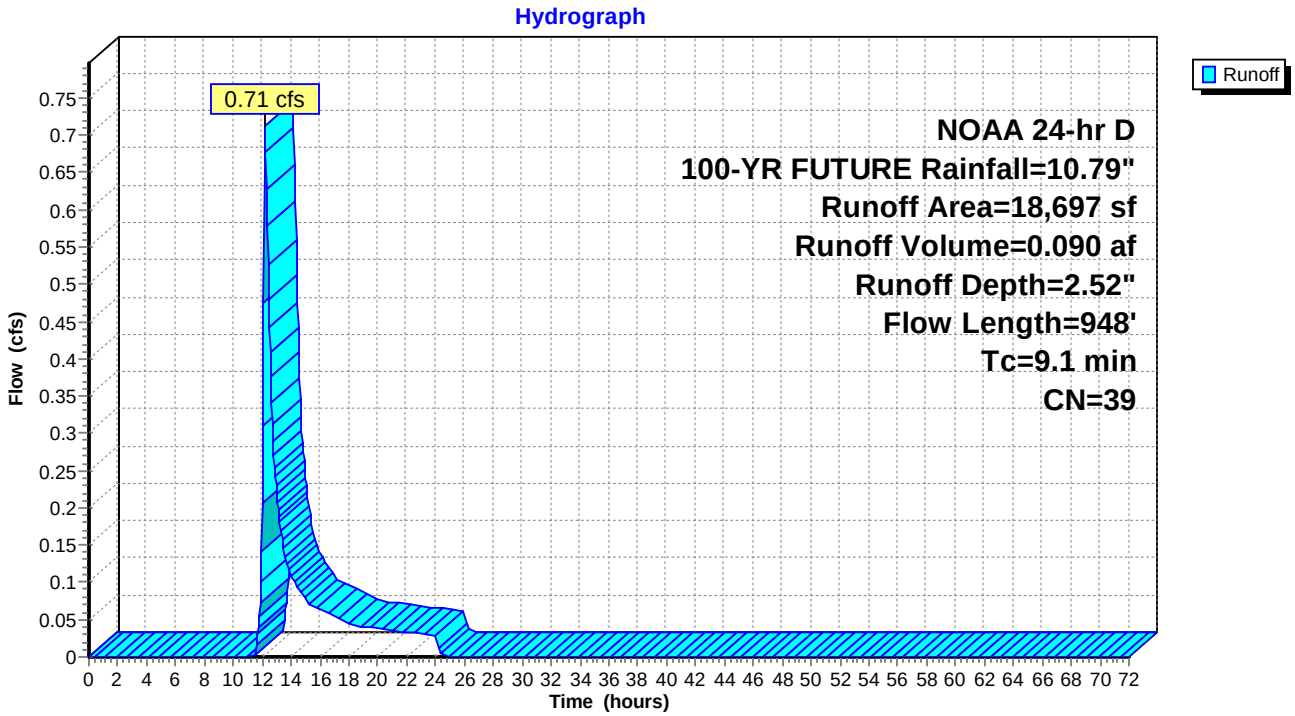
Runoff = 0.71 cfs @ 12.21 hrs, Volume= 0.090 af, Depth= 2.52"
Routed to Link 8L : POA-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-YR FUTURE Rainfall=10.79"

Area (sf)	CN	Description
18,697	39	>75% Grass cover, Good, HSG A
18,697		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0104	1.18		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.94"
2.4	295	0.0103	2.06		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
5.3	553	0.0009	1.75	3.20	**Pipe Channel, RCP_Elliptical 23x14** 23.0" x 14.0", R=22.0" Elliptical Area= 1.8 sf Perim= 5.0' r= 0.36' n= 0.013
9.1	948	Total			

Subcatchment 7S: PDA 2-Pervious



Summary for Subcatchment 9S: EDA 2-Impervious

[49] Hint: Tc<2dt may require smaller dt

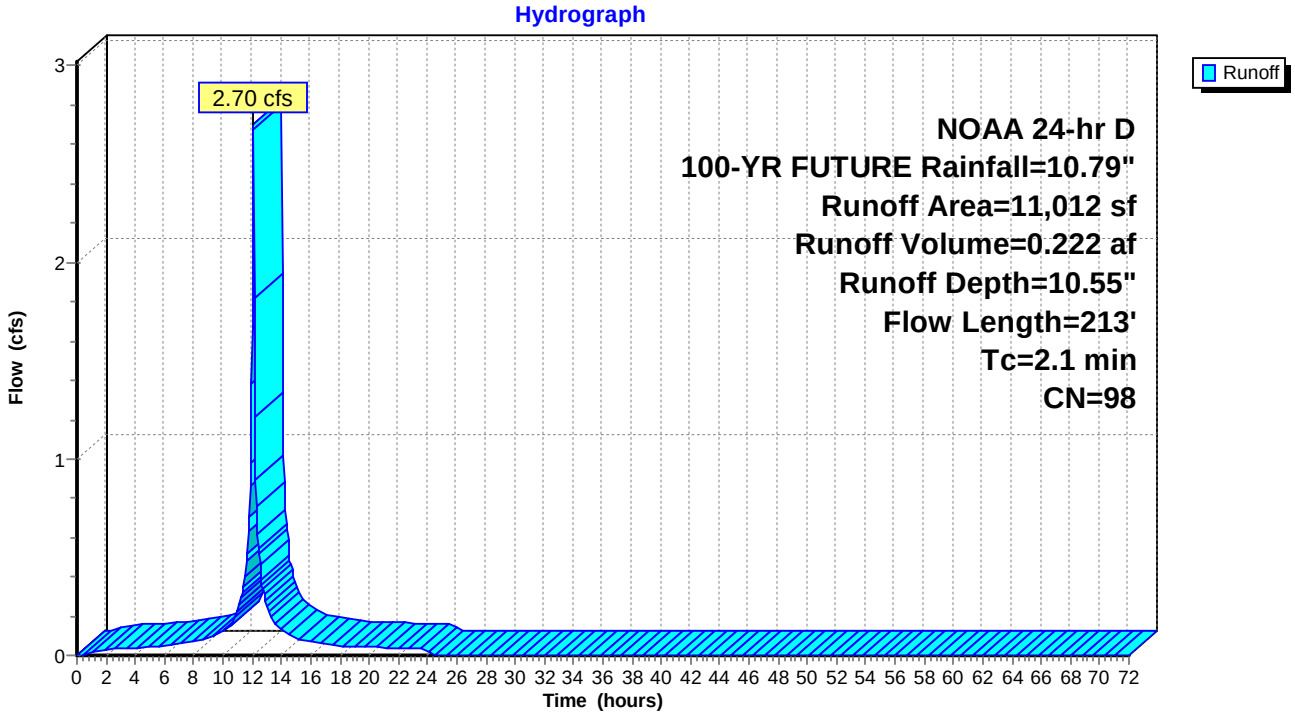
Runoff = 2.70 cfs @ 12.09 hrs, Volume= 0.222 af, Depth=10.55"
Routed to Link 10L : POA-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-YR FUTURE Rainfall=10.79"

Area (sf)	CN	Description
11,012	98	Paved parking, HSG A
11,012		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0227	1.61		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.94"
1.1	113	0.0077	1.78		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.1	213	Total			

Subcatchment 9S: EDA 2-Impervious

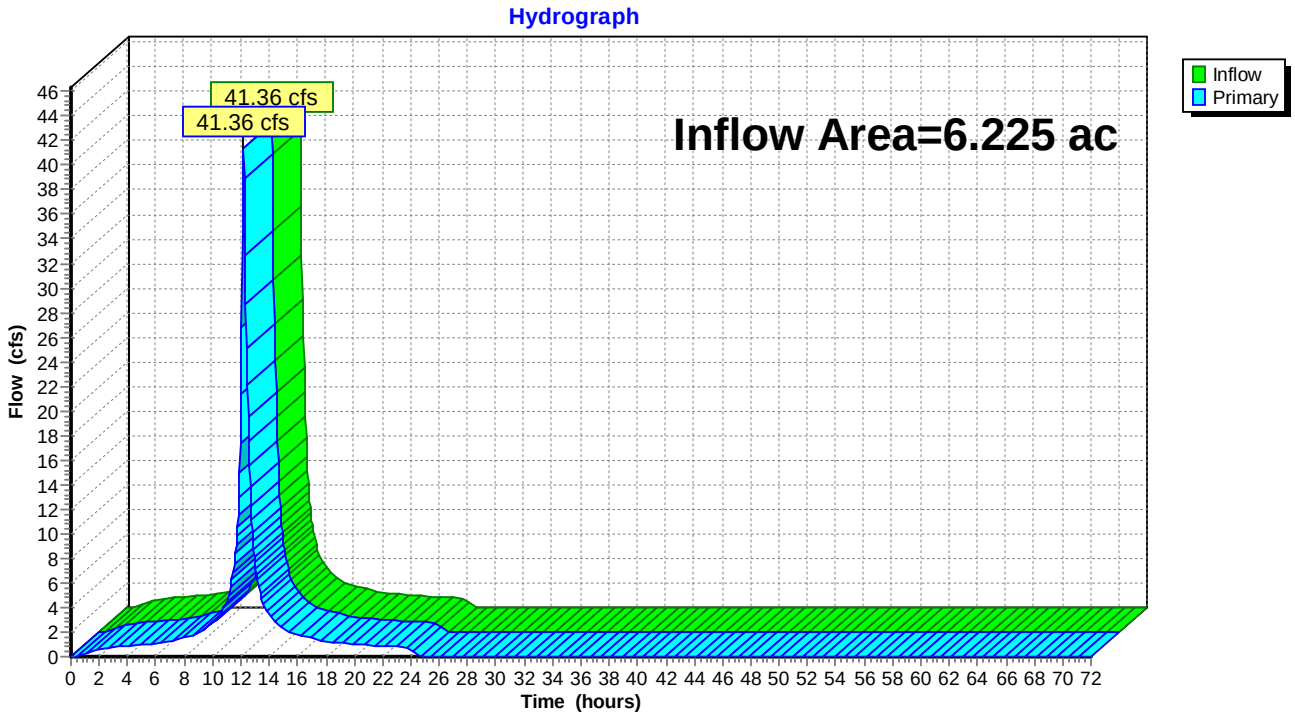


Summary for Link 8L: POA-1

Inflow Area = 6.225 ac, 93.10% Impervious, Inflow Depth = 10.00" for 100-YR FUTURE event
Inflow = 41.36 cfs @ 12.18 hrs, Volume= 5.185 af
Primary = 41.36 cfs @ 12.18 hrs, Volume= 5.185 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link 8L: POA-1

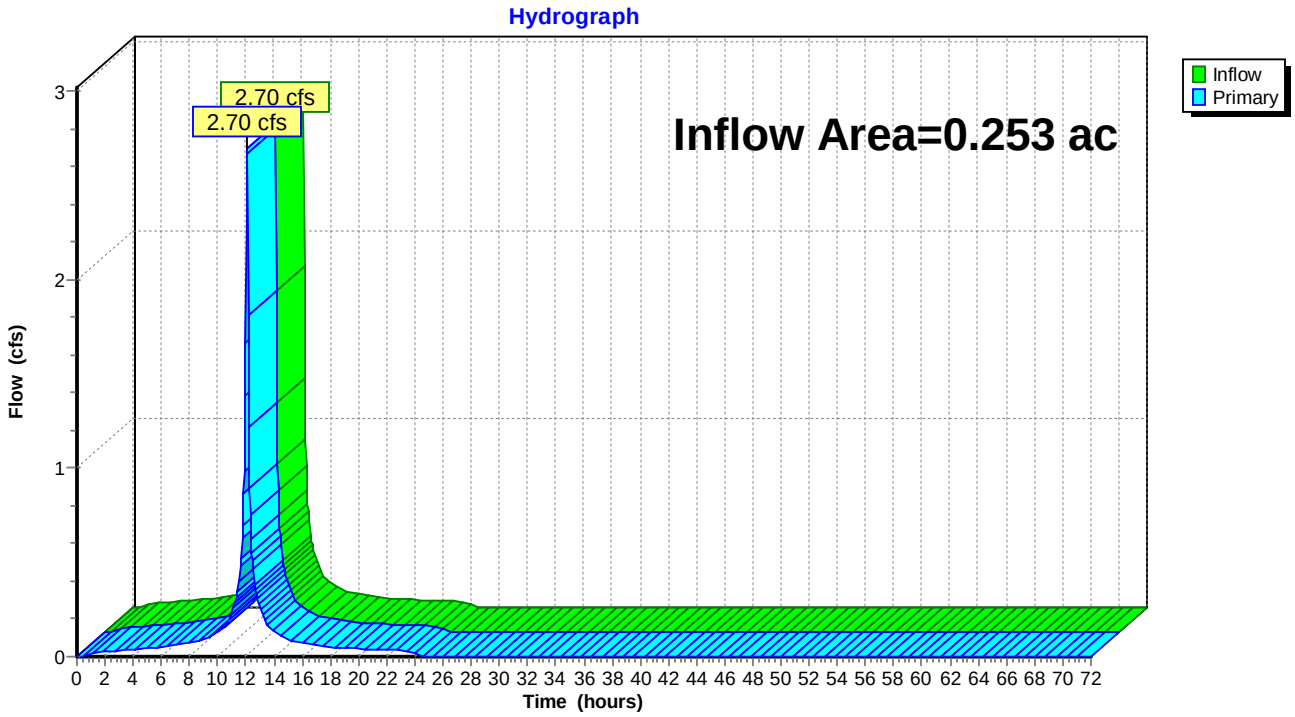


Summary for Link 10L: POA-2

Inflow Area = 0.253 ac,100.00% Impervious, Inflow Depth = 10.55" for 100-YR FUTURE event
Inflow = 2.70 cfs @ 12.09 hrs, Volume= 0.222 af
Primary = 2.70 cfs @ 12.09 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link 10L: POA-2



Appendix D

Groundwater Recharge Analysis

New Jersey Groundwater Recharge Spreadsheet Version 2.0 November 2003

Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓	Average Annual P (in)	Climatic Factor
MONMOUTH CO., HIGHLANDS BORO	47.4	1.55

Project Name:	**Seastreak Ferry**
Description:	**This is a test application**
Analysis Date:	**08/22/24**

Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	6.08	Impervious areas	Urban Land*	0.0	-
2	0.397	Meadow, Pasture, Grassland or range	Urban Land*	0.0	-
3	0				
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	6.5			Total Annual Recharge (in)	Total Annual Recharge (cu-ft)
				0.0	-

Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	6.049	Impervious areas	Urban Land*	0.0	-
2	0.429	adow, Pasture, Grassland or ra	Urban Land*	0.0	-
3	0				
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	6.5	Warning: make total area equal to Pre-Developed Condition		Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				0.0	-

Annual Recharge Requirements Calculation ↓

% of Pre-Developed Annual Recharge to Preserve =	100%	Total Impervious Area (sq.ft) 263,494
Post-Development Annual Recharge Deficit=	***0***	(cubic feet)

Recharge Efficiency Parameters Calculations (area averages)

RWC=	#N/A	(in)	DRWC= #N/A	(in)
ERWC =	#N/A	(in)	EDRWC= #N/A	(in)

Procedure to fill the Pre-Development and Post-Development Conditions Tables

For each land segment, first enter the area, then select TR-55 Land Cover, then select Soil. Start from the top of the table and proceed downward. Don't leave blank rows (with A=0) in between your segment entries. Rows with A=0 will not be displayed or used in calculations. For impervious areas outside of standard lots select "Impervious Areas" as the Land Cover. Soil type for impervious areas are only required if an infiltration facility will be built within these areas.

Appendix E

Drainage Piping System Analysis

SN	Element ID	Description	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width
					(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(inches)	(inches)
1	PIPE 124		64	64	71.31	3.75	0.00	3.69	0.00	0.06	0.0900	CIRCULAR	15.000	15.00
2	PIPE 101		64	Out-1PIPE 101	65.59	3.42	0.00	3.36	0.00	0.06	0.0900	Horizontal Ellipse	14.040	23.04
3	PIPE 102		64	64	82.69	3.55	0.00	3.45	0.03	0.11	0.1300	CIRCULAR	15.000	15.00
4	PIPE 103		64	64	100.11	3.68	0.00	3.55	0.00	0.13	0.1300	CIRCULAR	15.000	15.00
5	PIPE 104		64	64	99.31	3.81	0.00	3.68	0.00	0.13	0.1300	CIRCULAR	15.000	15.00
6	PIPE 104A		104A	64	57.94	3.89	0.00	3.81	0.00	0.08	0.1300	CIRCULAR	15.000	15.00
7	PIPE 105		64	64	100.31	3.94	0.00	3.81	0.00	0.13	0.1300	CIRCULAR	15.000	15.00
8	PIPE 106		64	64	99.79	4.07	0.00	3.94	0.00	0.13	0.1300	CIRCULAR	15.000	15.00
9	PIPE 107		64	64	184.23	6.08	0.00	4.07	0.00	2.01	1.0900	CIRCULAR	15.000	15.00
10	PIPE 120		64	64	99.81	3.51	0.00	3.42	0.00	0.09	0.0900	CIRCULAR	15.000	15.00
11	PIPE 122		64	64	100.18	3.60	0.00	3.51	0.00	0.09	0.0900	CIRCULAR	15.000	15.00
12	PIPE 123		64	64	100.14	3.69	0.00	3.60	0.00	0.09	0.0900	CIRCULAR	15.000	15.00
13	PIPE 125		64	64	56.54	3.74	0.00	3.69	0.00	0.05	0.0900	CIRCULAR	15.000	15.00
14	PIPE123A		123A	64	188.33	3.86	0.00	3.69	0.00	0.17	0.0900	CIRCULAR	15.000	15.00

Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	Lengthening Factor	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged (min)
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	0.93	0 12:12	2.13	0.56	2.89	0.32	0.39	0.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	4.96	0 11:59	4.03	0.27	4.72	1.05	1.00	79.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	2.94	0 12:04	3.66	0.38	2.89	1.02	1.00	37.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	3.04	0 12:05	3.53	0.47	2.89	1.05	1.00	31.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	3.07	0 12:30	3.32	0.50	2.89	1.06	1.00	24.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	0.25	0 12:12	1.46	0.66	2.89	0.09	0.20	0.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	3.06	0 12:22	3.20	0.52	2.89	1.06	1.00	14.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	1.25	0 12:12	2.30	0.72	2.89	0.43	0.46	0.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	1.25	0 12:12	4.27	0.72	6.75	0.19	0.29	0.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	2.96	0 11:59	3.77	0.44	2.89	1.03	1.00	72.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	3.05	0 12:01	3.69	0.45	2.89	1.06	1.00	62.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	3.09	0 12:55	3.27	0.51	2.89	1.07	1.00	53.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	0.52	0 12:12	1.80	0.52	2.89	0.18	0.29	0.00
0.0130	0.5000	0.5000	0.0000	0.00	NO	1.00	2.97	0 12:04	3.56	0.88	2.89	1.03	1.00	30.00

Max Flow Depth (ft)	Reported Condition
0.46	Calculated
1.17	SURCHARGED
1.25	SURCHARGED
1.25	SURCHARGED
1.25	SURCHARGED
0.23	Calculated
1.25	SURCHARGED
0.53	Calculated
0.35	Calculated
1.25	SURCHARGED
1.25	SURCHARGED
1.25	SURCHARGED
0.34	Calculated
1.25	SURCHARGED

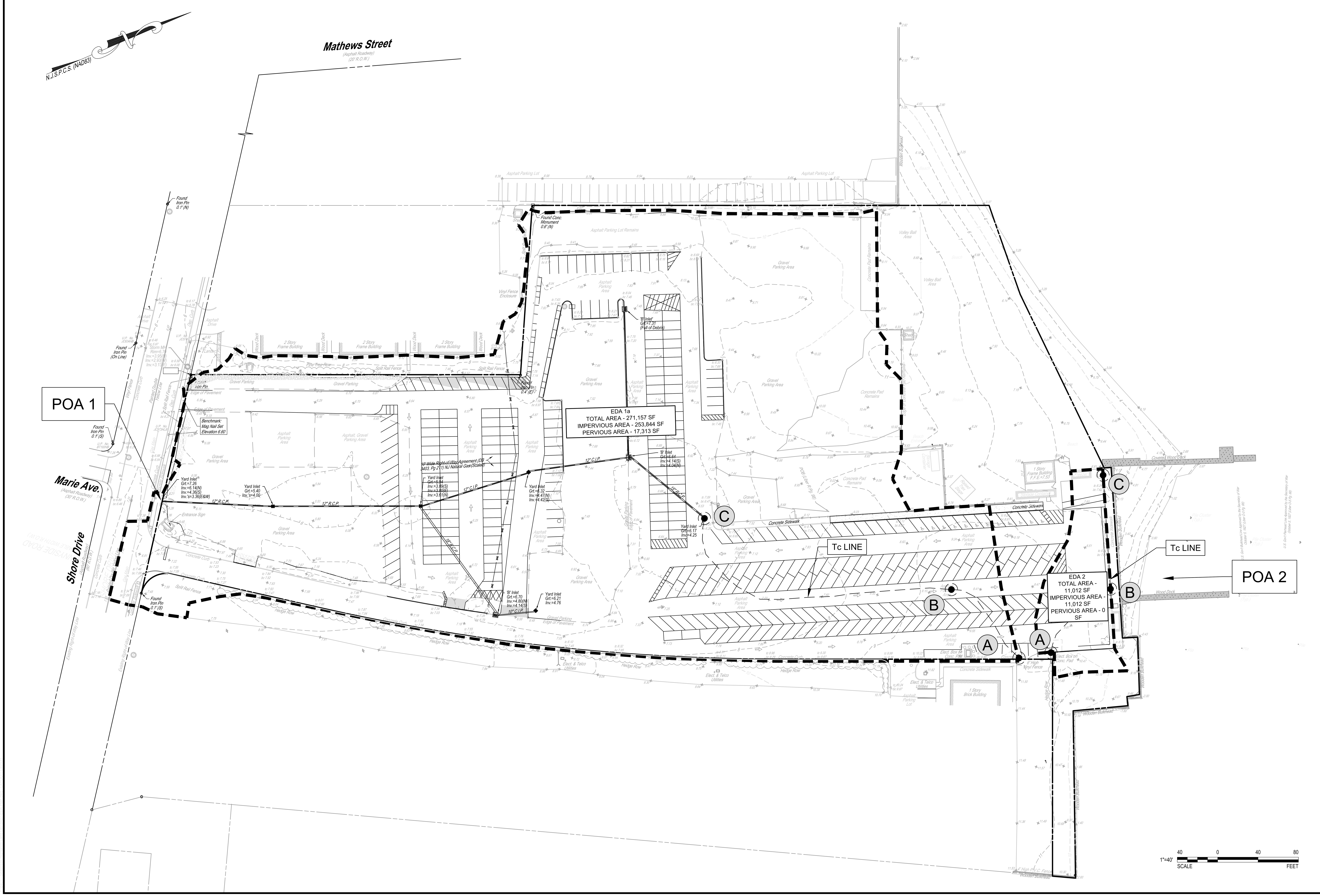
SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation (ft)	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)
1	Out-1PIPE 101	776433.48	-354069.18		3.36	FREE	NO		6.02	1.30	1.17	4.53

SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation	Ground/Rim (Max) Elevation	Ground/Rim (Max) Offset	Initial Water Elevation	Initial Water Depth	Surcharge Elevation	Surcharge Depth	Ponded Area	Minimum Pipe Cover	Peak Inflow
					(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft²)	(inches)	(cfs)
1	64	776498.78	-354075.33		3.42	6.50	3.08	3.42	0.00	6.50	0.00	3313.00	21.69	6.30
2	64	776498.55	-353992.64		3.55	6.50	2.95	3.55	0.00	6.50	0.00	3766.00	20.41	3.49
3	64	776598.66	-353992.88		3.68	6.51	2.82	3.68	0.00	6.51	0.00	4696.00	18.87	3.64
4	64	776697.88	-353997.11		3.81	6.50	2.69	3.81	0.00	6.50	0.00	5685.00	17.30	4.03
5	104A	776731.68	-353948.56		3.89	6.70	2.81	3.89	0.00	6.70	0.00	1695.00	18.75	0.25
6	64	776796.94	-354012.92		3.94	6.50	2.56	3.94	0.00	6.50	0.00	20777.00	15.72	4.51
7	64	776895.91	-354025.68		4.07	6.50	2.43	4.07	0.00	6.50	0.00	15298.00	14.16	1.25
8	64	777004.20	-353876.63		6.08	8.88	2.80	6.08	0.00	8.88	0.00	7872.00	18.61	1.26
9	64	776596.19	-354097.09		3.51	6.50	3.00	3.51	0.00	6.50	0.00	5097.00	20.95	3.69
10	64	776694.16	-354117.98		3.60	6.50	2.90	3.60	0.00	6.50	0.00	5457.00	19.84	3.75
11	64	776793.19	-354132.89		3.69	6.50	2.81	3.69	0.00	6.50	0.00	5178.00	18.76	5.16
12	123A	776976.57	-354090.05		3.86	6.25	2.39	3.86	0.00	6.25	0.00	38978.00	13.70	6.11
13	64	776850.19	-354175.75		3.75	6.55	2.80	3.75	0.00	6.55	0.00	5880.00	18.60	0.93
14	64	776764.20	-354181.44		3.74	6.77	3.03	3.74	0.00	6.77	0.00	3255.00	21.35	0.52

Peak Lateral Inflow (cfs)	Maximum HGL Elevation Attained (ft)	Maximum HGL Depth Attained (ft)	Maximum Surcharge Depth Attained (ft)	Minimum Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Maximum HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)
0.52	7.44	4.02	0.93	0.00	3.85	0.43	0 12:42	0 12:12	0.85	81.00
0.60	6.64	3.09	0.14	0.00	3.82	0.27	0 12:36	0 12:12	0.14	38.00
0.75	6.63	2.95	0.12	0.00	3.93	0.25	0 12:30	0 12:12	0.16	32.00
0.89	6.62	2.81	0.12	0.00	4.04	0.23	0 12:22	0 12:12	0.18	25.00
0.25	4.13	0.24	0.00	2.57	3.92	0.03	0 12:12	0 00:00	0.00	0.00
3.27	6.52	2.58	0.02	0.00	4.14	0.20	0 12:15	0 12:12	0.12	15.00
0.00	4.65	0.58	0.00	1.85	4.17	0.10	0 12:12	0 00:00	0.00	0.00
1.26	6.45	0.37	0.00	2.43	6.15	0.07	0 12:12	0 00:00	0.00	0.00
0.80	6.68	3.17	0.18	0.00	3.89	0.38	0 13:03	0 12:12	0.25	74.00
0.86	6.67	3.07	0.17	0.00	3.95	0.35	0 12:55	0 12:12	0.25	64.00
0.82	6.89	3.20	0.38	0.00	4.01	0.32	0 12:35	0 12:12	0.55	54.00
6.11	6.28	2.42	0.03	0.00	4.10	0.24	0 12:16	0 12:12	0.36	32.00
0.93	4.24	0.49	0.00	2.31	3.83	0.08	0 12:12	0 00:00	0.00	0.00
0.52	4.10	0.36	0.00	2.67	3.80	0.06	0 12:12	0 00:00	0.00	0.00

Appendix F

Drainage Maps



Professional Engineers, Land Surveyors & Planners • Scientists
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Certificate of Authorization Certificate # 24GA27993300

BRAD M. THOMPSON, P.E.
NJ PROFESSIONAL ENGINEER Lic. No. 49075

REVISIONS

NO.	DATE	DESCRIPTION

EXISTING DRAINAGE AREA PLAN
HIGHLANDS LANDING CORPORATION
BLOCK 100, LOT 27
TAX MAP SHEET NO. 19
BOROUGH OF HIGHLANDS
MONMOUTH COUNTY
NEW JERSEY

JOB NO. 8407	
FILE NAME 8407-EDA Plan.dwg	
DRAWN ERI	REVIEWED BMT
DATE 04/22/25	SCALE 1"=40'
SHEET NO. EDA OF 1	

N.J.S.P.C.S. (NAD83)

Mathews Street
(Asphalt Roadway)
(20' R.O.W.)

Marie Ave.
(Asphalt Roadway)
(50' R.O.W.)

Shore Drive

Block 100
Lot 30.02
Lands Now or Formerly of:
Bayview Condominiums
D.B. 4676, Pg. 343

Block 100
Lot 27.06
Lands Now or Formerly of:
Shore Landing L.L.C.
D.B. 5850, Pg. 476

Block 100
Lot 27.01
Lands Now or Formerly of:
Sandpiper Condominiums
D.B. 4884, Pg. 523

Block 100
Lot 27
Lands Now or Formerly of:
Highlands Landing Corporation
D.B. 5676, Pg. 868

Sandy Hook Bay

POA 1

POA 2

P.O.B.

N23° 16' 01"E 452.31'
(Deed: N23° 36' 58"E)

N62° 47' 19"W 162.02'
(Deed: N62° 36' 39"W)

N23° 16' 01"E 326.42'
(Deed: N23° 36' 58"E 326.43')

S86° 01' 46"E 93.39'
(Deed: S85° 48' 57"E)

N8° 27' 13"E 190.84'
(Deed: N8° 48' 02"E)

N63° 57' 49"W 221.74'
(Deed: N64° 36' 39"W)

S36° 02' 11"W 152.19'
(Deed: S36° 23' 00"W)

R=25.00', L=39.27'
ChB=S08° 57' 49"E
(Deed: S08° 37' 00"E)
ChL=35.36'

R=2050.00', L=456.88'
ChB=S29° 39' 06"W
(Deed: S29° 59' 55"W)
ChL=455.94'

N66° 43' 59"W 214.79'
(Deed: N66° 23' 19"W)

S67° 34' 14"E 165.68'
(Deed: S67° 13' 25"E)

S70° 32' 00"E 169.32'
(Deed: S70° 11' 11"E)

N18° 48' 12"E 6.90'
(Deed: N19° 09' 01"E)

N20° 28' 49"E 15.05'
(Deed: N20° 49' 39"E)

S68° 36' 03"E 56.79'
(Deed: S68° 15' 14"E)

S14° 12' 42"W 12.56'
(Deed: S14° 33' 31"W)

S72° 43' 21"E 9.14'
(Deed: S72° 22' 33"E)

S17° 58' 01"W 54.49'
(Deed: S18° 18' 50"W)

S23° 16' 01"W 270.72'
(Deed: S23° 36' 50"W)

S28° 15' 14"W 22.89'

PDA 1
TOTAL AREA - 271,157 SF
IMPERVIOUS AREA - 252,460 SF
PERVIOUS AREA - 18,697 SF

PDA 2
TOTAL AREA - 11,012 SF
IMPERVIOUS AREA - 11,012 SF
PERVIOUS AREA - 0 SF

Tc LINE

Tc LINE

MHWA LINE

1"=40'
40 0 40 80
SCALE FEET

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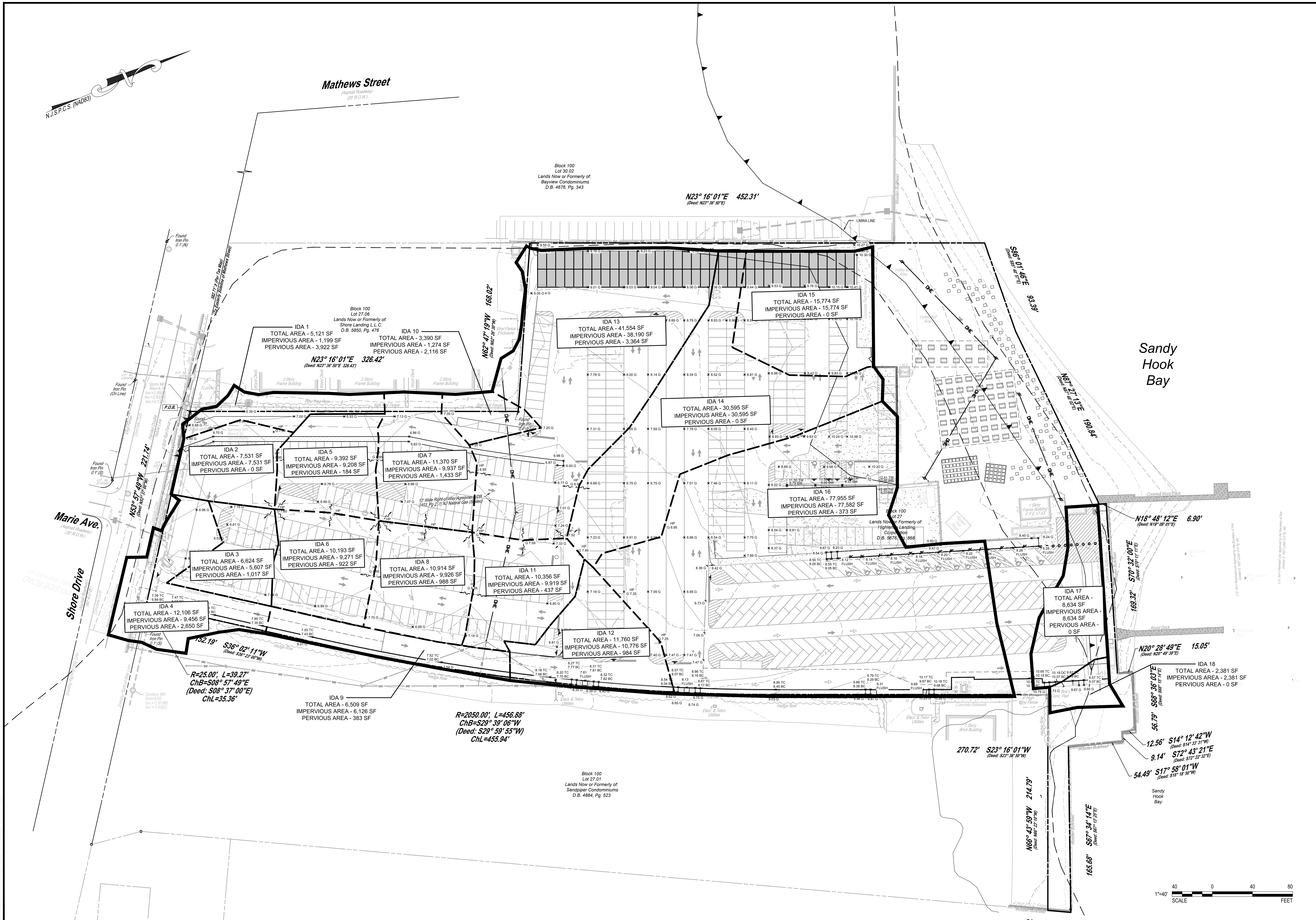
BRAD M. THOMPSON, P.E.
NJ PROFESSIONAL ENGINEER, Lic. No. 49775

REVISIONS

NO.	DESCRIPTION	DATE

PROPOSED DRAINAGE AREA PLAN
HIGHLANDS LANDING CORPORATION
BLACK 100, LOT 27
TAX MAP SHEET NO. 19
BOROUGH OF HIGHLANDS
MONMOUTH COUNTY
NEW JERSEY

JOB NO. 8407
FILE NAME 8407-PDA Plan.dwg
DRAWN ERI
REVIEWED BMT
DATE 04/22/25
SCALE 1"=40'
SHEET NO. PDA
OF 1



Najarian Associates

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Certificate of Authorization Certificate # 24GA27993300

BRAD M. THOMPSON, P.E.
NJ PROFESSIONAL ENGINEER Lic. No. 49075

REVISIONS

NO.	DATE	DESCRIPTION

INLET DRAINAGE AREA PLAN

HIGHLANDS LANDING CORPORATION
BLACK 100, LOT 27
TAX MAP SHEET NO. 19
BOROUGH OF HIGHLANDS
MONMOUTH COUNTY
NEW JERSEY

JOB NO.	8407
FILE NAME	8407-IDA Plan.dwg
DRAWN: ERI	REVIEWED: BMT
DATE: 04/22/25	SCALE: 1"=40'
SHEET NO.	IDA
OF 1	