# STORMWATER MANAGEMENT, GROUNDWATER RECHARGE AND WATER QUALITY ANALYSIS

*For*

**Surfside Crossing**
**Proposed Multi-Family Mixed Use Building**

**1102 9th Ave**
**Block 405, Lot 5-7**
**Neptune Township**
**Monmouth County, NJ**

**Prepared by:**

DYNAMIC ENGINEERING

**826 Newtown Yardley Road Suite 201**
**Newtown, PA 18940**
**(267) 685-0276**

**Steven R. Cattani, PE, CME, CFM**
**NJ Professional Engineer License #40014**

**REV 2 – April 2023**
**DEC# 2241-99-002**

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# I. SITE DESCRIPTION

The project site consists of Block 405, Lots 5-7, located at the intersection of 9th Ave, Memorial Drive, and 8th Ave. in Neptune Township, Monmouth County, New Jersey. Currently, the site is mostly open with wooded areas towards the central portion of the combined lots. In addition, the site currently has two single-family homes located of existing lot 7. The subject site is 79,034 square feet (1.81 acres). The site is bordered to the north by 9th Ave; to the east Memorial Drive; to the south 8th Ave, and the west by residential uses. The project consists of developing the parcel with a proposed multi-family mixed use building totaling 120,000 square feet over multiple floors. The building includes 53 residential units, and 7,181 SF of retail with one hundred and thirty (119) total passenger surface vehicle parking spaces, driveways, landscaping and other related site improvements.

The existing conditions of the tract have been verified by the Alta/ NSPS Land Title Survey, prepared by Dynamic Survey, LLC, dated 3/30/2022.

# II. DESIGN OVERVIEW

This report has been prepared to define and analyze the stormwater drainage conditions that would occur as a result of the development of Block 405, Lots 5-7 in Neptune Township, Monmouth County, New Jersey. The project includes new stormwater management facilities to address applicable aspects of Neptune Township Stormwater Management rules and NJAC 7:8.

Based upon the fact that the proposed improvements will result in more than one (1) acre of land disturbance and increase the amount or impervious coverage by more than 0.25 acres, this project is classified as a “major development”; and therefore, has been designed to meet the stormwater runoff quantity, quality and groundwater recharge standards, set forth by Neptune Township Land Use Ordinance and NJAC 7:8. Accordingly, the following items are addressed within this report:

- Erosion control, groundwater recharge and runoff quantity standards (7:8-5.4)
- Stormwater runoff quality standards (7:8-5.5)
- Calculation of stormwater runoff and groundwater recharge (7:8-5.6)
- Standards for structural stormwater management measures (7:8-5.7)

The scope of the report includes the proposed multi-family dwelling, basins, driveways, parking areas, landscaping and other related site improvements as shown on the engineering drawings. The proposed overall site plan contains 74.3% impervious lot coverage. The storm systems on site have been designed using this coverage.

A hydrological evaluation is provided for the NJDEP Water Quality, 2, 10, 25, and 100-year storm events utilizing the Urban Hydrology for Small Watersheds TR55 method.

NJAC 7:8-5.4(a)3 states the stormwater quantity impacts can be calculating to meet one the of the following below:

*i. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the 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;*

*ii. 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 two, 10 and 100-year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;*

*iii. Design stormwater management measures so that the post-construction peak runoff rates for the two, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed.*

Per the above requirements, runoff from the site will comply with the flow reductions indicated under iii as follows:

| | |
|---|---|
| 2-year: | 50% reduction |
| 10-year: | 25% reduction |
| 100-year: | 20% reduction |

This facility will comply with the Stormwater Management Best Management Practices.

It is important to note that the aforementioned flow reduction requirements are only required to be applied to onsite drainage areas within the limit of disturbance to satisfy Neptune Township and NJDEP flow reduction requirements. Therefore, the proposed development satisfies the flow reduction requirements by applying the peak rate reduction requirements only to the onsite areas that are proposed to be disturbed, all remaining undisturbed areas on site will continue to discharge under their existing condition.

## III. EXISTING DRAINAGE CONDITIONS

The tract has been evaluated with the following drainage sub-watershed areas as depicted on the Existing Conditions Drainage Area Map that can be found in the appendix of this report.

Existing Drainage Area 1: This study area is comprised of mostly grassed areas with portions of the existing asphalt driveways and single-family home. It is analyzed as an area to be disturbed as a result of the proposed development. The stormwater runoff currently flows from the eastern portion of the site to the western end of the property towards the existing 'B' inlet located on 8th Avenue, also known as POA 2.

Existing Drainage Area 2: This study area is comprised of mostly grassed and wooded areas with a portion of the existing asphalt driveways and single-family homes. It is analyzed as an area to be disturbed as a result of the proposed development. The stormwater runoff currently flows from the eastern portion of the site to the western end of the property towards the existing low point located offsite at the rear of the adjacent lot 4. From this low point, runoff flows toward the existing 'B' inlet located on 9th Avenue, also known as POA 1.

Existing Drainage Area 3: This study area is comprised of mostly grassed and wooded areas. It is analyzed as an area to be disturbed as a result of the proposed development. The stormwater runoff currently flows from the eastern portion of the site to the western end of the property towards the existing 'B' inlet located on 9th Avenue, also known as POA 1.

Existing Bypass to Memorial Drive: This study area is comprised of mostly grassed areas. It is analyzed as an area to be minimally disturbed as a result of the proposed development. The stormwater runoff currently flows from the southern portion of the site to the northeastern side of the property towards the existing 'B' inlet located on Memorial Drive, also known as POA 3.

Based on the Monmouth County soils survey information, the soil types native to the site include:

| MONMOUTH COUNTY SOIL SURVEY INFORMATION | | | | |
|---|---|---|---|---|
| SOIL TYPE (SYMBOL) | SOIL TYPE (NAME) | HYDROLOGIC SOIL GROUP | DEFAULT SOIL TYPE (NAME) | DEFAULT HYDROLOGIC SOIL GROUP |
| UR | Urban Lands | N/A | Fort Mott | A |

Per the NJ Stormwater BMP Manual Chapter 12 Soil Testing Criteria, sites that do not have a Hydrologic Soil Group can be defined as Fort Mott, HSG A, as the site is within the Coastal Plain. The soil investigation completed by Dynamic Earth, LLC, confirms the site should be examined using HSG A by completing five (5) permeability tests that show permeability rates consistent with HSG type A soils. The soil borings and soil profile pits generally encountered deep fill material and loose natural soils near the proposed building footprint. Topsoil was encountered between approximately five inches and ten inches of topsoil at the surface. Beneath the surficial cover, existing fill materials were encountered that generally consisted of sand, loamy sand, sandy loam, and clay with variable amounts of gravel and debris. The debris encountered included brick, metal, pvc, glass, seashells, concrete, and asphalt. The existing fill materials were encountered to depths ranging between approximately 2.5 feet and 5.5 feet below the ground surface; corresponding to elevations ranging between 12.2 feet and 7.6 feet. Beneath the existing fill materials, natural soils were encountered that generally consisted of sand, sandy loam, loam sandy clay loam, silty clay loam, clay loam, silty clay, and clay with variable amounts of gravel. The natural soils were encountered to termination and refusal depths ranging between approximately 10 feet and 12.4 feet below the ground surface; corresponding to elevations ranging between 4.5 feet and 0.7 feet. The refusal encountered was due to continuous wet cave-in of coarse-grained materials.

Indicators of seasonal high groundwater (based on soil mottling and/or direct groundwater observations during the wet season) were encountered at depths ranging between approximately 2.5 feet and 4.6 feet below the ground surface; corresponding to elevations ranging between 12.2 feet and 8.8 feet. Groundwater was encountered at depths ranging between approximately five feet and seven feet below the ground surface; corresponding to elevations ranging between 10.5 feet and 7.5 feet. Groundwater levels are expected to fluctuate seasonally and following significant periods of precipitation. A summary of seasonal high groundwater levels encountered and permeability samples collected is presented in the chart below:

<table>
<tr><th colspan="7">Seasonal High Groundwater and Permeability Test Summary</th></tr>
<tr><th rowspan="2">Location</th><th rowspan="2">Surface Elevation (ft)</th><th colspan="2">Estimated Seasonal High Groundwater</th><th rowspan="2">Sample Depth (Inches)</th><th colspan="2">Permeability Results (inches/hour)</th></tr>
<tr><th>Depth (ft)</th><th>Elevation (ft)</th><th>Replicate A</th><th>Replicate B</th></tr>
<tr><td rowspan="2">SPP-1</td><td rowspan="2">14.7</td><td rowspan="2">2.5</td><td rowspan="2">12.2</td><td>18</td><td colspan="2" rowspan="4">Not Tested</td></tr>
<tr><td>40</td></tr>
<tr><td rowspan="2">SPP-2</td><td rowspan="2">13.4</td><td rowspan="2">4.6</td><td rowspan="2">8.8</td><td>44</td></tr>
<tr><td>78</td></tr>
<tr><td rowspan="3">SPP-3</td><td rowspan="3">13.1</td><td rowspan="3">3.3</td><td rowspan="3">9.8</td><td>24</td><td>8.9</td><td>7.5</td></tr>
<tr><td>45</td><td colspan="2" rowspan="2">Not Tested</td></tr>
<tr><td>70</td></tr>
<tr><td rowspan="3">SPP-4</td><td rowspan="3">13.1</td><td rowspan="3">3.0</td><td rowspan="3">10.1</td><td>24</td><td>6.5</td><td>13.8</td></tr>
<tr><td>42</td><td colspan="2" rowspan="2">Not Tested</td></tr>
<tr><td>100</td></tr>
<tr><td>SPP-5</td><td>13.9</td><td>4.0</td><td>9.9</td><td>24</td><td>12.5</td><td>6.6</td></tr>
<tr><td rowspan="2">SPP-6</td><td rowspan="2">13.2</td><td rowspan="2">3.8</td><td rowspan="2">9.4</td><td>32</td><td>>20</td><td>>20</td></tr>
<tr><td>50</td><td colspan="2">Not Tested</td></tr>
<tr><td rowspan="2">SPP-7</td><td rowspan="2">14.5</td><td rowspan="2">4.2</td><td rowspan="2">10.3</td><td>30</td><td>14.4</td><td>18.7</td></tr>
<tr><td>50</td><td colspan="2" rowspan="4">Not Tested</td></tr>
<tr><td rowspan="2">SPP-8</td><td rowspan="2">13.3</td><td rowspan="2">3.9</td><td rowspan="2">9.4</td><td>36</td></tr>
<tr><td>60</td></tr>
<tr><td>SPP-9</td><td>12.9</td><td>4.0</td><td>8.9</td><td>36</td></tr>
</table>

Based on the laboratory testing completed and the subsurface conditions encountered at soil profile pit excavations, the soils encountered are generally consistent with a hydraulic soil group (HSG) A.

## IV. PROPOSED DRAINAGE CONDITIONS

The tract has been evaluated with the following drainage sub-watershed areas as depicted on the Contributory Drainage Area Map that can be found in the appendix of this report. Each sub-watershed area has been calculated as a separate point of analysis.

Proposed Drainage Area 1: This portion of the site consists of parking lot runoff. Stormwater runoff from this area flows through multiple curb cuts to the proposed above ground recharge area. Stormwater in this area is designed to infiltrate up to and including the 100-yr storm.

Proposed Study Area 2: This portion of the site mainly consists of the building roof runoff with some runoff from the proposed parking lot. Stormwater runoff from this area is collected by a series of roof leaders which flows to the proposed above ground small-scale infiltration basin 2. Stormwater discharged from basin 2 flows through the outlet control structure to the subsurface small-scale infiltration basin 3.

Proposed Study Area 3: This portion of the site consists of the majority of the impervious surfaces on the site including the porous pavement, asphalt, and portions of the landscaped areas. Runoff from this drainage area sheet flows to the proposed porous pavement and then to the subsurface small-scale infiltration basin 3. Stormwater discharged from basin 3, flows through the outlet control structure to the existing 'B' inlet on 9$^{th}$ Avenue, also known as POA 1.

Proposed Bypass 8$^{th}$ Ave: This portion of the site consists of a minimal portion of the asphalt driveway and adjacent grassed areas. Runoff from this area flows undetained to the existing 'B' inlet on 8$^{th}$ Avenue, also known as POA 2.

Proposed Bypass 9$^{th}$ Ave: This portion of the site consists of a minimal portion of the asphalt driveway and adjacent grassed areas. Runoff from this area flows undetained to the existing 'B' inlet on 9$^{th}$ Avenue, also known as POA 1.

Proposed Bypass Memorial Drive: This portion of the site consists of a minimal portion of the concrete sidewalk and adjacent grassed areas. This area is essentially unchanged from its existing condition. Runoff from this area flows undetained to the existing 'B' inlet on Memorial Drive also known as POA 3.

## V. NON-STRUCTURAL STORMWATER MANAGEMENT STRATEGIES

The proposed project has been designed to the maximum extent practicable by incorporating the nonstructural stormwater management strategies set forth in NJAC 7:8-5.3 as follows:

1. **Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment lost:** The proposed impervious surface is minimized wherever possible under the proposed condition; therefore, increasing the water quality benefits on the site. By implementation of the porous pavement and infiltration basins, the proposed development meets the water quality requirements set forth by NJAC 7:8.
2. **Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces:** The impervious surfaces have been minimized wherever possible. Impervious surfaces have been diverted to multiple structural BMPs capable of providing water quality treatment.
3. **Maximize the protection of natural drainage features and vegetation:** In the proposed condition, there is an increase in impervious coverage. A Landscaping Plan has been prepared to compensate for the loss of existing vegetation due to the development.
4. **Minimize the decrease in the "time of concentration" from pre-construction to post-construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed:** The decrease in the time of concentration has been minimized by maintaining existing overland flow slopes to the maximum extent practical.
5. **Minimize land disturbance including clearing and grading:** Land disturbance has been minimized where feasible. The site disturbance is limited to the development area.
6. **Minimize soil compaction:** Soil compaction will be minimized in the basins and proposed lawn and landscape areas.
7. **Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides:** The project proposes low-maintenance trees, shrubs, and ground cover on the site. Refer to the Landscape Plan for plant information.
8. **Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas:** Due to the site constraints, it is not feasible to design a vegetated open-channel conveyance system on this project.
9. **Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimizes the release of those pollutants into stormwater runoff:** The proposed small-scale infiltration basins provide 80% TSS removal. In addition, the porous pavement will provide 80% TSS removal prior to discharging to basin 3. Basin 3 will provide additional water quality measures due to infiltration.

## VI. DESIGN METHODOLOGY

The intention of the proposed stormwater management facilities for this project is to comply with applicable required measures from Neptune Township Land Use Ordinance and NJAC 7:8. In order to prepare the stormwater calculations for the subject project, an investigation of the property and topography was performed. An on-site review of the tract was performed by Dynamic Engineering Consultants, PC, verifying the existing site conditions and land cover characteristics. Dynamic Survey was contracted to prepare the ALTA/NSPS Land Title Survey for the existing site.

Based on our review of the existing site conditions and the Topographic Survey, the Drainage Area Maps for the existing and proposed site conditions as defined within this report were established. A grading plan was developed for the proposed site improvements with consideration to the existing drainage patterns. The plan was then designed to ensure runoff from the proposed development could be directed to stormwater management facilities to the maximum extent practicable in order to address the applicable sections of Neptune Township Stormwater Management rules and NJAC 7:8.

The above ground small-scale infiltration basin will temporarily store stormwater runoff from the site. An outlet control structure for basin 2 has been implemented to release stormwater runoff at a controlled rate to satisfy the stormwater quantity requirements, the parking lot recharge area is designed to infiltrate up to and including the 100-yr storm. Overflow from the above ground basin 2 is routed via the emergency spillway to the existing downstream stormwater management facilities. The above ground infiltration basins have been designed to meet the requirements set forth by NJAC 7:8.

The porous pavement drains to a subsurface small-scale infiltration basin that temporarily stores and attenuates stormwater runoff from the site. An outlet control structure has been implemented to release stormwater runoff at a controlled rate to satisfy the stormwater quantity requirements. The subsurface small-scale infiltration basin has been designed to meet the recharge requirements set forth by NJAC 7:8.

According to the NJAC 7:8-5.5(a), a TSS removal rate of 80% is required for stormwater runoff generated from vehicular pavement areas as a result of a major development. By the use of small-scale infiltration basins, and porous pavement, the proposed site meets the 80% TSS removal.

## VII. STORMWATER MANAGEMENT BASIN DESIGN AND RUNOFF QUANTITY STANDARDS

In order to meet the stormwater runoff quantity and water quality requirements set forth in NJAC 7:8, the site design incorporates porous pavement, a subsurface small-scale infiltration basin, and one (1) above ground small-scale infiltration basin, and one (1) recharge area. Runoff from a portion of the roof area flows through a series of roof leaders to the above ground small-scale infiltration basin 2. Discharge from basin 2 flows through the stormwater conveyance systems to the subsurface small-scale infiltration basin 3. Additional runoff to basin 3 flows over land by sheet flow to the pervious paving areas, filters through the pervious paving and is then collected by the subsurface small-scale infiltration basin 3. Outflow from basins 2 and 3 is combined and routed to the existing 'B' inlet on 9th Avenue, also known as POA 1.

Minimal areas adjacent to each road frontage will have runoff that is undetained to each POA. It is important to note that the impervious surfaces that bypass to each POA are less in the proposed condition as compared to existing. An outline of the Drainage Areas is located in the Runoff Curve Number (CN) Calculations Existing & Proposed in the appendix of the report.

A summary of the pre and post development flows are shown in the charts below:

**Pre-development and Post Development Peak Runoff Results**

| PRE VS. POST SUMMARY CHART (FLOW TO POA 1) | | | | | | |
|---|---|---|---|---|---|---|
| **DESIGN STORM** | **EXISTING DISTURBED AREA (CFS)** | **HYDRO-GRAPH #** | **RUNOFF RATE REDUCTION OF DISTURBED AREA** | **MAXIMUM TOTAL ALLOWABLE RUNOFF RATE (CFS)** | **PROPOSED RUNOFF RATE (CFS)** | **HYDRO-GRAPH #** |
| 2 Year | 0.17 | 18 | 50% | 0.09 | 0.09 | 22 |
| 10 Year | 0.27 | 18 | 25% | 0.20 | 0.13 | 22 |
| 100 Year | 1.58 | 18 | 20% | 1.26 | 0.43 | 22 |

| PRE VS. POST SUMMARY CHART (FLOW TO POA 2) | | | | | | |
|---|---|---|---|---|---|---|
| **DESIGN STORM** | **EXISTING DISTURBED AREA (CFS)** | **HYDRO-GRAPH #** | **RUNOFF RATE REDUCTION OF DISTURBED AREA** | **MAXIMUM TOTAL ALLOWABLE RUNOFF RATE (CFS)** | **PROPOSED RUNOFF RATE (CFS)** | **HYDRO-GRAPH #** |
| 2 Year | 0.10 | 10 | 50% | 0.05 | 0.05 | 33 |
| 10 Year | 0.16 | 10 | 25% | 0.12 | 0.09 | 33 |
| 100 Year | 0.31 | 10 | 20% | 0.25 | 0.21 | 33 |

## VIII. GROUNDWATER RECHARGE & WATER QUALITY

As required by NJAC 7:8-5.5, a TSS removal rate of 80% is required for stormwater generated by the water quality design storm as a result of a major development. The design for the subject development meets the obligation for TSS removal by utilizing porous pavement, one (1) subsurface infiltration basin, and two (2) above ground infiltration basins.

Nine (9) test pits have been conducted for the four (4) BMP's on site; however, only eight (8) pits will be used in design of the BMP's. SPP-2 and -3 were used in designing the parking lot recharge area, which has a bottom area of 355 SF. SPP-6 and -7 were used in designing Basin 2, which has a basin bottom area of 678 SF. SPP-2, -3, and -9 were used in designing Basin 3 which has an area of 11,044 SF. Lastly, the pervious pavement was designed using SPP-8 and -3, which has an area of 6,450 SF. See soil pit testing results in Section III of this report for further information.

**Recharge:** The Post-Development Annual Recharge Deficit has been calculated using the New Jersey Groundwater Recharge Spreadsheet. Per the NJGRS Spreadsheet and soils investigation, the site development does not result in a recharge deficit. Refer to the NJ Groundwater Recharge Spreadsheet in the Appendix of this report.

**Water Quality**: The stormwater management design for the project satisfies the requirements set forth in NJAC 7:8-5.5(a) by utilizing pervious paving and small-scale infiltration basins. The pervious pavement will provide the minimum TSS removal rate of 80%. Per NJDEP BMP Manual Chapter 9.6, pervious pavement provides an 80% TSS removal. The project meets the contributory drainage area requirement of 3:1 (drainage area to area of pervious pavement), with a maximum slope of less than 5%. For both of the above ground small-scale infiltration basins (#4 & #2), the runoff for the water quality storm is infiltrated. Additionally, the stormwater will be evacuated from the infiltration basins within 72 hours. As a result, the water quality requirements of the Neptune Township Land Development Ordinance and NJAC 7:8 are met.

## IX. STABILITY ANALYSIS

Per the NJ Soil Erosion Standards, Section 21, "Standard for Off-Site Stability," compliance has been met for the site. The conditions of the NJ SESC Standards Section 21-1 have been satisfied using the point of discharge method with a well-defined channel.

a. **Retain pre-developed runoff characteristics. Do not increase the rate of runoff from development.** Discharge rates from the proposed stormwater improvements are below the flow rates in the existing conditions; therefore method 'b' below will be used.
b. **Analyze the waterway or channel for stability under the planned rate of discharge using the Standard for Grassed Waterways or Standard for Chanel Stabilization, as appropriate.** Peak flows from the 2- and 10-year storms shall be analyzed. The 2- and 10-year storms have existing peak flowrates of 0.17 cfs and 0.27 cfs, respectively. The proposed conditions, during the stability analysis, meets the requirements set forth in the Standard for Channel Stabilization by not exceeding the maximum flow rates for the existing 12" pipe at POA 1. A summary of the flow rates are shown in the chart below:

| PRE VS. POST SUMMARY CHART (STUDY POINT – STABILITY) | | | |
|---|---|---|---|
| Design Storm | Existing Runoff Rate (CFS) | Proposed Runoff Rate (CFS) | Proposed Pipe Velocity (fps) |
| 2 Year | 0.17 | 0.40 | 4.0 |
| 10 Year | 0.27 | 1.27 | 5.5 |

c. **Modify the waterway or channel to a stable design condition.** The combined flows to the existing stormwater facilities show that the proposed flow rates are in a stable condition as the discharge rate is lower than the maximum allowable flow rate in the existing 12" pipe.

## X. CONCLUSION

The proposed overall development has been designed with provisions for the safe and efficient control of stormwater runoff in a manner that will not adversely impact the existing drainage patterns, adjacent roadways, or adjacent parcels. The 80% TSS removal obligations set forth by NJAC 7:8 have been satisfied by utilizing two (2) infiltration basins, recharge area, and pervious pavement. Recharge requirements are met utilizing the subsurface small-scale infiltration basin.

With this stated, it is evident that the proposed development will not have a negative impact on the existing drainage pattern, water quality, or groundwater recharge on site or within the vicinity of the subject parcel.

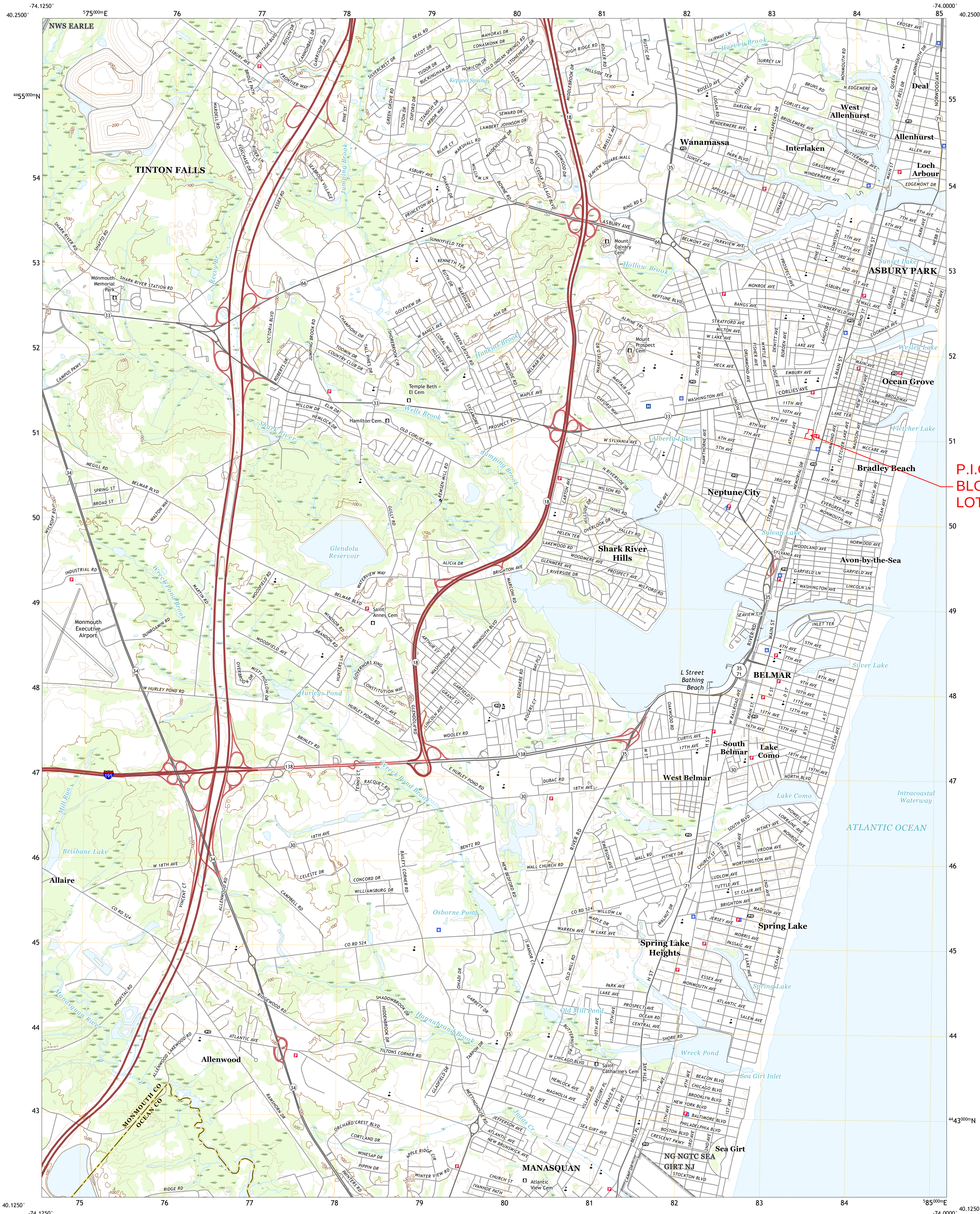
# APPENDIX

# USGS MAP

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

ASBURY PARK QUADRANGLE
NEW JERSEY
7.5-MINUTE SERIES




P.I.Q.
BLOCK: 405
LOTS: 5, 6, & 7

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18T
This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery ........ NAIP, July 2015 - September 2015
Roads ........ U.S. Census Bureau, 2016
Names ........ GNIS, 1979 - 2019
Hydrography ........ National Hydrography Dataset, 2002 - 2009
Contours ........ National Elevation Dataset, 2012
Boundaries ........ Multiple sources; see metadata file 2017 - 2018
Wetlands ........ FWS National Wetlands Inventory 2007 - 2008

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.18

QUADRANGLE LOCATION

ADJOINING QUADRANGLES
1 Marlboro
2 Long Branch West
3 Long Branch East
4 Farmingdale
5 Asbury Park OE E
6 Lakewood
7 Point Pleasant

ROAD CLASSIFICATION
Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

ASBURY PARK, NJ
2019

NSN. 7643016382338
NGA REF NO. USGSX24K39787

# NRCS SOILS MAPS

United States Department of Agriculture

Natural Resources Conservation Service

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

# Custom Soil Resource Report for Monmouth County, New Jersey


April 4, 2022

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

# Contents

# How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil





scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.



# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map






## 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: Monmouth County, New Jersey
Survey Area Data: Version 15, Aug 31, 2021

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

Date(s) aerial images were photographed: Sep 25, 2020—Oct 15, 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 |
|---|---|---|---|
| UR | Urban land | 2.5 | 100.0% |
| **Totals for Area of Interest** | | **2.5** | **100.0%** |

## Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.





An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## Monmouth County, New Jersey

### UR—Urban land

**Map Unit Setting**

*National map unit symbol:* 4j92
*Elevation:* 0 to 170 feet
*Mean annual precipitation:* 30 to 64 inches
*Mean annual air temperature:* 46 to 79 degrees F
*Frost-free period:* 131 to 178 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Urban land:* 95 percent
*Minor components:* 5 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Urban Land**

**Setting**

*Parent material:* Surface covered by pavement, concrete, buildings, and other structures underlain by disturbed and natural soil material

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 8s
*Hydric soil rating:* Unranked

**Minor Components**

**Udorthents**

*Percent of map unit:* 5 percent
*Landform:* Low hills
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No



# References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

# RUNOFF CURVE NUMBER (CN) CALCULATIONS-EXISTING

# EXISTING DRAINAGE AREA SUMMARY AND AVERAGE CURVE NUMBER(CN) CALCULATIONS

| | | | |
|---|---|---|---|
| Project: | Surfside Crossing Multi-Family Development | Computed By: | SMM |
| Job #: | 2241-99-002 | Checked By: | SRC |
| Location: | Memorial Drive & 8th Ave, Neptune, Nj | Date: | 6/14/2022 |

| Drainage Area | Impervious Area (acre) | Impervious Area (sf) | Curve Number (CN) Used | HSG A - Open Space Area (acre) | HSG A - Open Space Area (sf) | Curve Number (CN) Used | HSG A - Wooded Area (acre) | HSG A - Wooded Area (sf) | Curve Number (CN) Used | Avg. Perv. Curve Number | Total Pervious Area (acres) | Total Area (acres) | TC (Min.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DA 1 - 8TH AVE | 0.04 | 1,631 | 98 | 0.04 | 1,655 | 39 | 0.01 | 463 | 30 | 37 | 0.05 | 0.09 | 10 |
| DA 2 - LOW POINT | 0.08 | 3,695 | 98 | 0.58 | 25,241 | 39 | 0.28 | 12,397 | 30 | 36 | 0.86 | 0.95 | 12 |
| DA 3 - 9TH AVE | 0.00 | - | 98 | 0.62 | 26,997 | 39 | 0.13 | 5,783 | 30 | 37 | 0.75 | 0.75 | 10 |
| BYPASS - MEMORIAL | 0.00 | - | 98 | 0.03 | 1,176 | 39 | 0.00 | - | 30 | 39 | 0.03 | 0.03 | 10 |
| **Total** | **0.12** | **5326.00** | | **1.26** | **55069.00** | | **0.43** | **18643.00** | | | **1.67** | **1.81** | |

| | | | | | |
|---|---|---|---|---|---|
| Per County Soil Survey - | Soil Abbr | HSG | A | Soil | Fort mott |

| Description | Runoff Curve Number (CN) (HSG A) | Runoff Curve Number (CN) (HSG B) | Runoff Curve Number (CN) (HSG C) | Runoff Curve Number (CN) (HSG D) |
|---|---|---|---|---|
| Impervious Surface | 98 | 98 | 98 | 98 |
| Open Space (lawn) (good) | 39 | 61 | 74 | 80 |
| Woods (good) | 30 | 55 | 70 | 77 |

# RUNOFF CURVE NUMBER (CN) CALCULATIONS-
# PROPOSED

DYNAMIC ENGINEERING

# Proposed Drainage Area Summary and Average Curve Number(CN) Calculations

| | | | |
|---|---|---|---|
| Project: | Surfside Crossing Multi-Family Development | Computed By: | SMM |
| Job #: | 2241-99-002 | Checked By: | SRC |
| Location: | Memorial Drive & 8th Ave, Neptune, NJ | Date: | 6/14/2022 |
| | | Last Revised: | 4/5/2023 |

| Drainage Area | Impervious Area (acre) | Impervious Area (sf) | Curve Number (CN) Used | HSG A - Open Space Area (acre) | HSG A - Open Space Area (sf) | Curve Number (CN) Used | Avg. Perv. Curve Number | Total Pervious Area (acres) | Total Area (acres) | TC (Min.) |
|---|---|---|---|---|---|---|---|---|---|---|
| DA 1 - BASIN 4 | 0.06 | 2,690 | 98 | 0.05 | 2,032 | 39 | 39 | 0.05 | 0.11 | 6 |
| DA 2 - BASIN 2 | 0.52 | 22,640 | 98 | 0.07 | 2,866 | 39 | 39 | 0.07 | 0.59 | 6 |
| DA 3 - BASIN 3 | 0.79 | 34,241 | 98 | 0.09 | 3,921 | 39 | 39 | 0.09 | 0.88 | 6 |
| BYPASS MEMORIAL | 0.012 | 502 | 98 | 0.05 | 2,178 | 39 | 39 | 0.05 | 0.06 | 6 |
| BYPASS 9TH AVE | 0.03 | 1,243 | 98 | 0.09 | 3,714 | 39 | 39 | 0.09 | 0.11 | 6 |
| BYPASS 8TH AVE | 0.02 | 841 | 98 | 0.05 | 2,067 | 39 | 39 | 0.05 | 0.07 | 6 |
| **Total** | **1.43** | **62157.00** | | **0.39** | **16778.00** | | | **0.39** | **1.81** | |

| | | | | | |
|---|---|---|---|---|---|
| Per County Soil Survey - | Soil Abbr | HSG | A | Soil | Fort Mott |

| Description | Runoff Curve Number (CN) (HSG A) | Runoff Curve Number (CN) (HSG B) | Runoff Curve Number (CN) (HSG C) | Runoff Curve Number (CN) (HSG D) |
|---|---|---|---|---|
| Impervious Surface | 98 | 98 | 98 | 98 |
| Open Space (lawn) (good) | 39 | 61 | 74 | 80 |
| Woods (good) | 30 | 55 | 70 | 77 |

# EXISTING TIME OF CONCENTRATION (Tc) CALCULATIONS

DYNAMIC ENGINEERING
1904 Main Street, Lake Como, NJ 07719
(732) 974-0198

Date: 6/14/2022
Project: SURFSIDE CROSSING
Project No: 2241-99-002

Calculated By: SMM
Checked By: SRC

## Worksheet 3: Time of Concentration ($T_c$) Calculations

**Land Condition:** Existing
**Drainage Area:** DA - 1

• ***Sheet Flow*:**

| | AB | | | |
|---|---|---|---|---|
| 1. Surface Description | Range (natural) | | | |
| 2. Manning's Roughness Coefficient, *n* | 0.13 | | | |
| 3. Flow Length, *L* { total $L \le 100$ ft } | 100.0 ft | | | |
| 4. Two-Year 24-hour Rainfall, $p_2$ for . . . Monmouth County | 3.38 in | 3.38 in | 3.38 in | |
| 5. Land Slope, *s* (ft/ft) | 0.016 ft/ft | | | |
| 6. Travel Time, $T_t = \dfrac{0.007\,(n\,L)^{0.8}}{p_2^{\,0.5}\,s^{0.4}}$ | 0.155 hr + | 0.000 hr + | 0.000 hr = | 0.155 hr |

• ***Shallow Concentrated Flow*:**

| | BC | CD | DE | |
|---|---|---|---|---|
| 7. Surface Description | Unpaved | Paved | Unpaved | |
| 8. Flow Length, *L* | 12.0 ft | 15.6 ft | 37.0 ft | |
| 9. Watercourse Slope, *s* | 0.014 ft/ft | 0.014 ft/ft | 0.014 ft/ft | |
| 10. Average velocity, *V* { see Figure 3.1 } | 1.91 ft/s | 2.41 ft/s | 1.91 ft/s | |
| 11. Travel Time, $T_t = \dfrac{L}{3600\,V}$ | 0.002 hr + | 0.002 hr + | 0.005 hr = | 0.009 hr |

• ***Channel Flow*:**

| | | | | |
|---|---|---|---|---|
| 12. Pipe Diameter, *D* | | | | |
| 13. Cross-Sectional Flow Area, *A* | | | | |
| 14. Wetted Perimeter, $p_w$ | | | | |
| 15. Hydraulic Radius, $r = A / p_w$ | | | | |
| 16. Channel Slope, *s* | | | | |
| 17. Pipe Material | | | | |
| 18. Manning's Roughness Coefficient, *n* | | | | |
| 19. Velocity, $V = \dfrac{1.49\,r^{2/3}\,s^{1/2}}{n}$ | | | | |
| 20. Flow Length, *L* | | | | |
| 21. Travel Time, $T_t = \dfrac{L}{3600\,V}$ | 0.000 hr + | 0.000 hr + | 0.000 hr = | 0.000 hr |
| 22. Watershed or subarea Time of Concentration, $T_c$ { add $T_t$ in steps 6, 11 and 21 } | | | | 0.164 hr |
| | | | | **9.8 min** |

DYNAMIC ENGINEERING
1904 Main Street, Lake Como, NJ 07719
(732) 974-0198

Date: 6/14/2022
Project: SURFSIDE CROSSING
Project No: 2241-99-002

Calculated By: SMM
Checked By: SRC

## Worksheet 3: Time of Concentration ($T_c$) Calculations

**Land Condition:** Existing
**Drainage Area:** DA - 2

### • Sheet Flow:

| | | | | | |
|---|---|---|---|---|---|
| | AB | | | | |
| 1. Surface Description | Range (natural) | | | | |
| 2. Manning's Roughness Coefficient, $n$ | 0.13 | | | | |
| 3. Flow Length, $L$ { total $L \leq 100$ ft } | 100.0 ft | | | | |
| 4. Two-Year 24-hour Rainfall, $p_2$ for . . . Monmouth County | 3.38 in | 3.38 in | 3.38 in | | |
| 5. Land Slope, $s$ (ft/ft) | 0.020 ft/ft | | | | |
| 6. Travel Time, $T_t = \frac{0.007\,(n\;L)^{0.8}}{p_2^{\;0.5}\; s^{\;0.4}}$ | 0.142 hr | + 0.000 hr | + 0.000 hr | = | 0.142 hr |

### • Shallow Concentrated Flow:

| | | | | | |
|---|---|---|---|---|---|
| | BC | | | | |
| 7. Surface Description | Unpaved | | | | |
| 8. Flow Length, $L$ | 290.0 ft | | | | |
| 9. Watercourse Slope, $s$ | 0.013 ft/ft | | | | |
| 10. Average velocity, $V$ { see Figure 3.1) | 1.83 ft/s | | | | |
| 11. Travel Time, $T_t = \frac{L}{3600\,V}$ | 0.044 hr | + 0.000 hr | + 0.000 hr | = | 0.044 hr |

### • Channel Flow:

| | | | | | |
|---|---|---|---|---|---|
| 12. Pipe Diameter, $D$ | | | | | |
| 13. Cross-Sectional Flow Area, $A$ | | | | | |
| 14. Wetted Perimeter, $p_w$ | | | | | |
| 15. Hydraulic Radius, $r = A\ /\ p_w$ | | | | | |
| 16. Channel Slope, $s$ | | | | | |
| 17. Pipe Material | | | | | |
| 18. Manning's Roughness Coefficient, $n$ | | | | | |
| 19. Velocity, $V = \frac{1.49\; r^{2/3}\; s^{1/2}}{n}$ | | | | | |
| 20. Flow Length, $L$ | | | | | |
| 21. Travel Time, $T_t = \frac{L}{3600\,V}$ | 0.000 hr | + 0.000 hr | + 0.000 hr | = | 0.000 hr |

22. Watershed or subarea Time of Concentration, $T_c$ { add $T_t$ in steps 6, 11 and 21 } . . . 0.186 hr

**11.1 min**

DYNAMIC ENGINEERING
1904 Main Street, Lake Como, NJ 07719
(732) 974-0198

| | |
|---|---|
| Date: | 6/14/2022 |
| Project: | SURFSIDE CROSSING |
| Project No: | 2241-99-002 |
| Calculated By: | SMM |
| Checked By: | SRC |

## Worksheet 3: Time of Concentration ($T_c$) Calculations

**Land Condition:** Existing
**Drainage Area:** DA - 3

**• *Sheet Flow*:**

| | | | | | |
|---|---|---|---|---|---|
| | AB | | | | |
| 1. Surface Description | Range (natural) | | | | |
| 2. Manning's Roughness Coefficient, *n* | 0.13 | | | | |
| 3. Flow Length, *L* { *total L ≤ 100 ft* } | 100.0 ft | | | | |
| 4. Two-Year 24-hour Rainfall, $p_2$ for Monmouth County | 3.38 in | 3.38 in | 3.38 in | | |
| 5. Land Slope, *s (ft/ft)* | 0.025 ft/ft | | | | |
| 6. Travel Time, $T_t = \frac{0.007\,(n\,L)^{0.8}}{p_2^{\,0.5}\; s^{0.4}}$ | 0.130 hr | + 0.000 hr | + 0.000 hr | = | 0.130 hr |

**• *Shallow Concentrated Flow*:**

| | | | | | |
|---|---|---|---|---|---|
| | BC | | | | |
| 7. Surface Description | Unpaved | | | | |
| 8. Flow Length, *L* | 233.0 ft | | | | |
| 9. Watercourse Slope, *s* | 0.009 ft/ft | | | | |
| 10. Average velocity, *V* { *see Figure 3.1)* | 1.56 ft/s | | | | |
| 11. Travel Time, $T_t = \frac{L}{3600\,V}$ | 0.041 hr | + 0.000 hr | + 0.000 hr | = | 0.041 hr |

**• *Channel Flow*:**

| | | | | | |
|---|---|---|---|---|---|
| 12. Pipe Diameter, *D* | | | | | |
| 13. Cross-Sectional Flow Area, *A* | | | | | |
| 14. Wetted Perimeter, $p_w$ | | | | | |
| 15. Hydraulic Radius, $r = A\,/\,p_w$ | | | | | |
| 16. Channel Slope, *s* | | | | | |
| 17. Pipe Material | | | | | |
| 18. Manning's Roughness Coefficient, *n* | | | | | |
| 19. Velocity, $V = \frac{1.49\; r^{2/3}\; s^{1/2}}{n}$ | | | | | |
| 20. Flow Length, *L* | | | | | |
| 21. Travel Time, $T_t = \frac{L}{3600\,V}$ | 0.000 hr | + 0.000 hr | + 0.000 hr | = | 0.000 hr |

22. Watershed or subarea Time of Concentration, $T_c$ { *add $T_t$ in steps 6, 11 and 21* } . . . 0.171 hr

**10.3 min**

# HYDROGRAPH SUMMARY REPORTS –
# EXISTING & PROPOSED
# WQ, 2 YR., 10 YR., 25 YR. & 100 YR.