STORMWATER REPORT

Hudson Engineering, LLC.

25 West 8th Street, Ste. B
Bayonne, NJ, 07002
O: (201) 589-0906
www.hudsoneng.com
info@hudsoneng.com

Project: 80-84 E 25th St. Stormwater Evaluation

Project #: KAW01P002

Subject: Stormwater Management Report

Date: 11/8/2024

Prepared by: Jordan Cecinini, PE

NJ License #: 24GE05496800

1 Introduction

Hudson Engineering, LLC (HE) was engaged by Kawalek+Kawalek Architects, LLC to prepare a stormwater management system in accordance with the Bayonne Stormwater Control Ordinance for improvements at 80-84 E 25th St, Bayonne, NJ 07002 (Block:442 Lot:14).

The existing site consists of a 1-story brick and masonry structure built up to 3 of the 4 property lines. Along the adjacent structure on 86 E 25th St. there is a concrete walkway running the full length of 80-84 E 25th St. The lot is 6,578 square feet (SF) with the coverage breakdown shown in Table 1-1.

Table 1-1: Existing Lot Coverage

Coverage	Area (SF)
Building Coverage	6,282
Impervious Coverage	296
Total Impervious (Building + Impervious)	*6,578*
Pervious Coverage (Lawn Areas)	0

The proposed improvements include the demolition of the existing brick and masonry structure and the development of a four-story residential building. On each side of the structure, a concrete walkway is being installed. A maintained lawn will be installed at the rear of the property. The proposed lot coverage is described in Table 1-2.

Table 1-2: Proposed Lot Coverage

Coverage	Area (SF)
Building Coverage	5,424
Impervious Coverage	424
Total Impervious (Building + Impervious)	*5,848*
Pervious Coverage (Lawn/Landscaping Areas)	730

As shown in Table 1-1 and Table 1-2, the Project will result in a decrease in impervious coverage of 730 SF. Bayonne's definition of a "major development" is listed as either;

1. The disturbance of one or more acres of land since February 2, 2004.
2. The creation of ¼ acre or more of regulated impervious surface since February 2, 2004.
3. The creation of ¼ acre or more of regulated motor vehicle surface since March 2, 2021.
4. A combination of items 2 and 3 that totals an area of ¼ acre or more.

As such, this Project is not defined as a Major Development and adheres to Section 30-4 Subsection r of the Bayonne Stormwater Ordinance.

2 Stormwater Management Design

Per the City of Bayonne Ordinance – Section 30-4 subsection r "Stormwater Runoff Quantity Standards" designates the minimum design and performance standards to control stormwater runoff quantity impacts. Per item 2(a) of subsection r, it is required that "through hydrologic and hydraulic analysis that the stormwater leaving the site, post-construction runoff hydrographs for the two-, ten- and hundred-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events."

Using a hydrology and hydraulic modeling system, HydroCAD, using the SCS TR-20 practices, the existing and proposed site were simulated under the two- (2), ten-(10), and one hundred-(100) year storm events for Hudson County.

See Table 2-1 for the Stormwater Runoff Rate evaluation and Table 2-2 for the Stormwater Runoff Volume evaluation.

Table 2-1: Stormwater Runoff Rate

Storm Event	Existing Runoff Rate (CFS)	Proposed Runoff Rate (CFS)	Peak Runoff Difference (CFS)
2-Year	0.63	0.54	-0.09
10-Year	1.01	0.93	-0.08
100-Year	1.76	1.69	-0.07

Table 2-2: Stormwater Runoff Volume

Storm Event	Existing Runoff Volume (CF)	Proposed Runoff Volume (CF)	Runoff Volume Difference (CF)
2-Year	1,687	1,295	-392
10-Year	2,622	2,193	-429
100-Year	4,424	3,964	-460

The proposed improvements overall reduce the amount of impervious surface, therefore reducing the rate and total runoff from the property.

2.1 Stormwater Drainage Design

Per the City of Bayonne Stormwater Ordinance stated above, the improvements on site meet the minimum design and performance standards, therefore, no stormwater management system is required to be constructed on site.

3 Compliance with Chapter 30, Section 9, Subsection C

3.1 Subsection C Part 2: Environmental Site Analysis

Refer to Appendix C.

3.2 Subsection C Part 3: Project Description and Site Plan

Refer to Site Plans and Details (sheet A.002).

3.3 Subsection C Part 4: Land Use Planning and Source Control Plan

Refer to Site Plans and Details (sheet A.002) and see Section 2 of this report.

3.4 Subsection C Part 5: Stormwater Management Facilities Map

Refer to Site Plans and Details (sheet A.002).

3.5 Subsection C Part 6: Calculations

Refer to Appendix A and B.

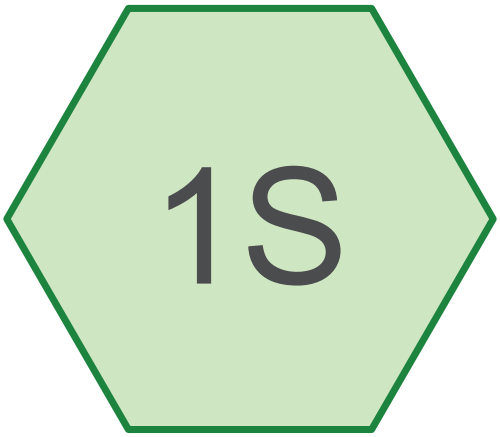
3.6 Subsection C Part 7: Maintenance and Repair Plan

No stormwater management facility required. No Maintenance and Repair Plan required.

3.7 Calculations Demonstrating Compliance with Retention Standard

Refer to Section 2 of this Report and Appendix A and B.

A. HydroCAD Existing Design Report



Existing Plot

Subcat Reach Pond Link

Routing Diagram for 2E 80-84 E 25 Existing

Prepared by HydroCAD SAMPLER 1-800-927-7246 www.hydrocad.net, Printed 11/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type II 24-hr		Default	24.00	1	3.31	2

Summary for Subcatchment 1S: Existing Plot

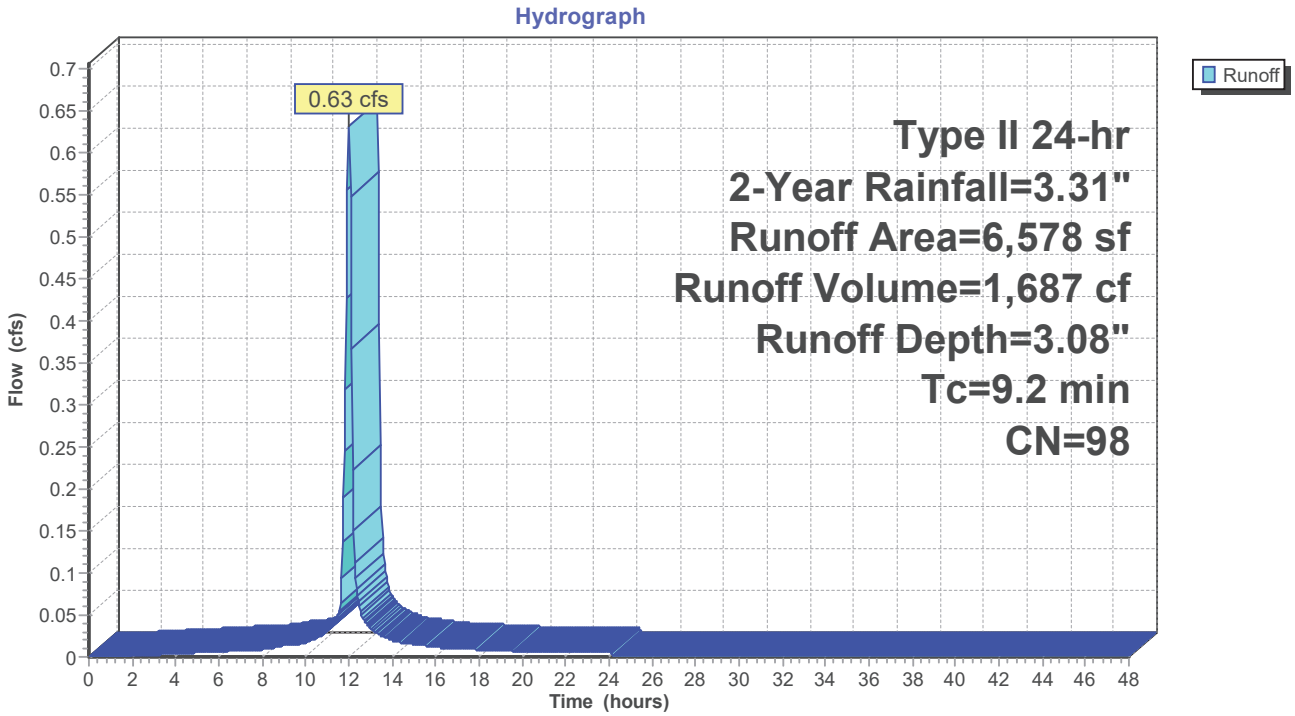
Runoff = 0.63 cfs @ 12.00 hrs, Volume= 1,687 cf, Depth= 3.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.31"

	Area (sf)	CN	Description
*	6,282	98	Roofs, HSG A Building Coverage
*	296	98	Sidewalks and Curbs
	6,578	98	Weighted Average
	6,578		100.00% Impervious Area

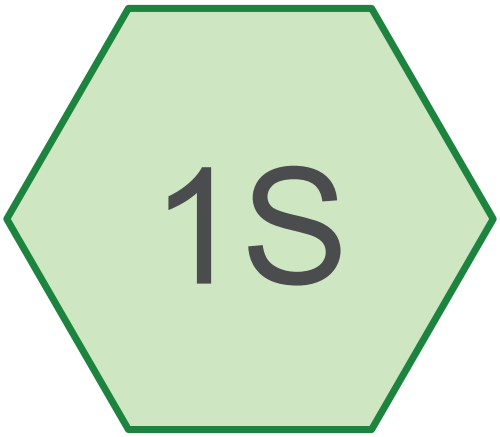
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2					**Direct Entry, 2 Year Tc**

Subcatchment 1S: Existing Plot



Hydrograph for Subcatchment 1S: Existing Plot

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	47.00	3.31	3.08	0.00
1.00	0.03	0.00	0.00	48.00	3.31	3.08	0.00
2.00	0.07	0.00	0.00				
3.00	0.11	0.02	0.00				
4.00	0.16	0.04	0.00				
5.00	0.21	0.08	0.01				
6.00	0.26	0.12	0.01				
7.00	0.33	0.17	0.01				
8.00	0.40	0.23	0.01				
9.00	0.49	0.31	0.01				
10.00	0.60	0.41	0.02				
11.00	0.78	0.58	0.03				
12.00	2.19	1.97	**0.63**				
13.00	2.56	2.33	0.03				
14.00	2.71	2.48	0.02				
15.00	2.83	2.59	0.02				
16.00	2.91	2.68	0.01				
17.00	2.98	2.75	0.01				
18.00	3.05	2.82	0.01				
19.00	3.10	2.87	0.01				
20.00	3.15	2.92	0.01				
21.00	3.19	2.96	0.01				
22.00	3.23	3.00	0.01				
23.00	3.27	3.04	0.01				
24.00	**3.31**	**3.08**	0.01				
25.00	3.31	3.08	0.00				
26.00	3.31	3.08	0.00				
27.00	3.31	3.08	0.00				
28.00	3.31	3.08	0.00				
29.00	3.31	3.08	0.00				
30.00	3.31	3.08	0.00				
31.00	3.31	3.08	0.00				
32.00	3.31	3.08	0.00				
33.00	3.31	3.08	0.00				
34.00	3.31	3.08	0.00				
35.00	3.31	3.08	0.00				
36.00	3.31	3.08	0.00				
37.00	3.31	3.08	0.00				
38.00	3.31	3.08	0.00				
39.00	3.31	3.08	0.00				
40.00	3.31	3.08	0.00				
41.00	3.31	3.08	0.00				
42.00	3.31	3.08	0.00				
43.00	3.31	3.08	0.00				
44.00	3.31	3.08	0.00				
45.00	3.31	3.08	0.00				
46.00	3.31	3.08	0.00				



Existing Plot

Subcat Reach Pond Link

Routing Diagram for 10E 80-84 E 25 Existing

Prepared by HydroCAD SAMPLER 1-800-927-7246 www.hydrocad.net, Printed 11/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	10-Year	Type II 24-hr		Default	24.00	1	5.02	2

Summary for Subcatchment 1S: Existing Plot

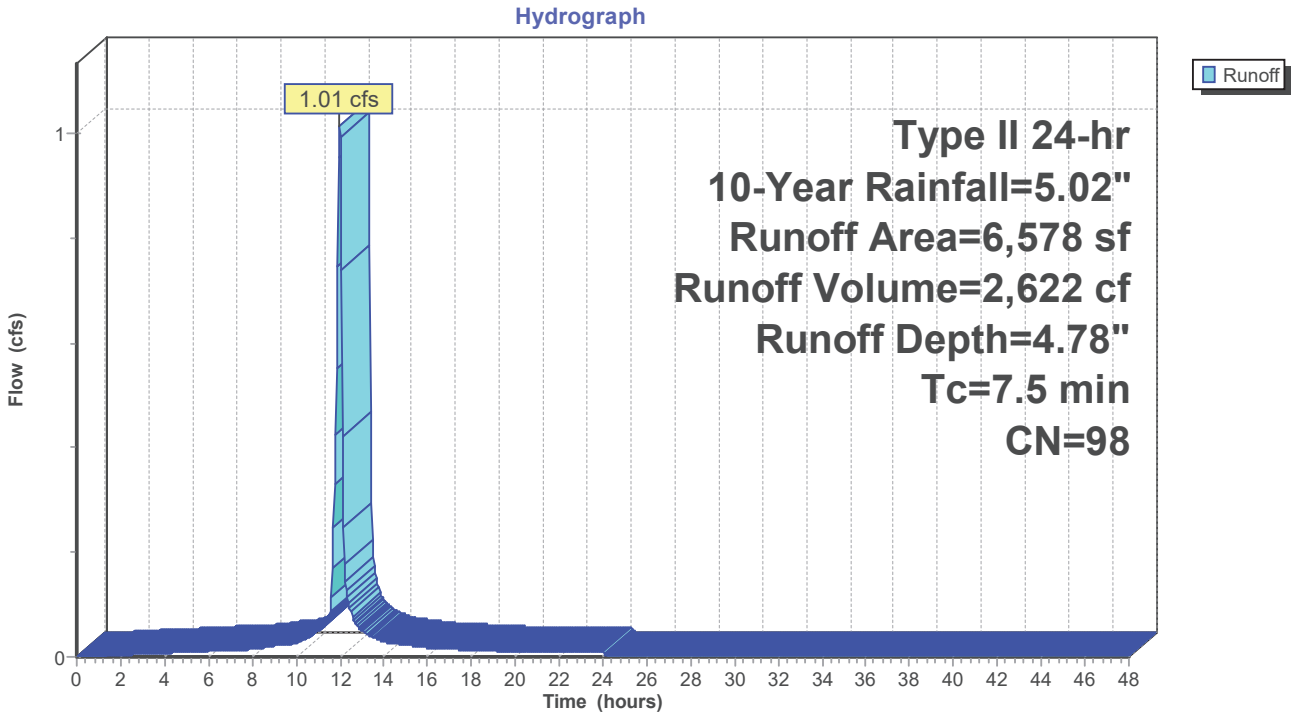
Runoff = 1.01 cfs @ 11.98 hrs, Volume= 2,622 cf, Depth= 4.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.02"

	Area (sf)	CN	Description
*	6,282	98	Roofs, HSG A Building Coverage
*	296	98	Sidewalks and Curbs
	6,578	98	Weighted Average
	6,578		100.00% Impervious Area

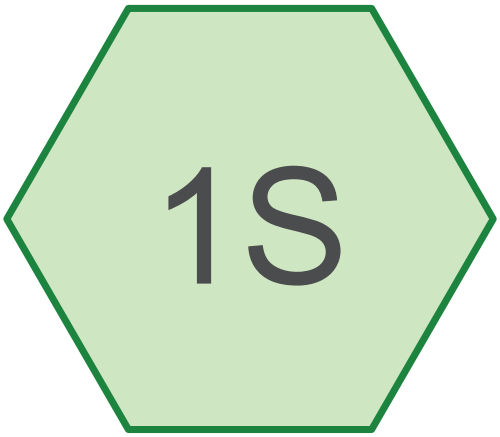
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5					**Direct Entry, 10 Year Tc**

Subcatchment 1S: Existing Plot



Hydrograph for Subcatchment 1S: Existing Plot

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.05	0.00	0.00
2.00	0.11	0.02	0.00
3.00	0.17	0.05	0.01
4.00	0.24	0.10	0.01
5.00	0.32	0.16	0.01
6.00	0.40	0.23	0.01
7.00	0.50	0.32	0.01
8.00	0.60	0.41	0.02
9.00	0.74	0.54	0.02
10.00	0.91	0.70	0.03
11.00	1.18	0.97	0.05
12.00	3.33	3.10	**0.99**
13.00	3.88	3.64	0.05
14.00	4.12	3.88	0.03
15.00	4.28	4.05	0.02
16.00	4.42	4.18	0.02
17.00	4.53	4.29	0.02
18.00	4.62	4.39	0.01
19.00	4.71	4.47	0.01
20.00	4.78	4.54	0.01
21.00	4.84	4.61	0.01
22.00	4.90	4.67	0.01
23.00	4.96	4.73	0.01
24.00	**5.02**	**4.78**	0.01
25.00	5.02	4.78	0.00
26.00	5.02	4.78	0.00
27.00	5.02	4.78	0.00
28.00	5.02	4.78	0.00
29.00	5.02	4.78	0.00
30.00	5.02	4.78	0.00
31.00	5.02	4.78	0.00
32.00	5.02	4.78	0.00
33.00	5.02	4.78	0.00
34.00	5.02	4.78	0.00
35.00	5.02	4.78	0.00
36.00	5.02	4.78	0.00
37.00	5.02	4.78	0.00
38.00	5.02	4.78	0.00
39.00	5.02	4.78	0.00
40.00	5.02	4.78	0.00
41.00	5.02	4.78	0.00
42.00	5.02	4.78	0.00
43.00	5.02	4.78	0.00
44.00	5.02	4.78	0.00
45.00	5.02	4.78	0.00
46.00	5.02	4.78	0.00
47.00	5.02	4.78	0.00
48.00	5.02	4.78	0.00



Existing Plot

Subcat Reach Pond Link

Routing Diagram for 100E 80-84 E 25 Existing

Prepared by HydroCAD SAMPLER 1-800-927-7246 www.hydrocad.net, Printed 11/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	100-Year	Type II 24-hr		Default	24.00	1	8.31	2

Summary for Subcatchment 1S: Existing Plot

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

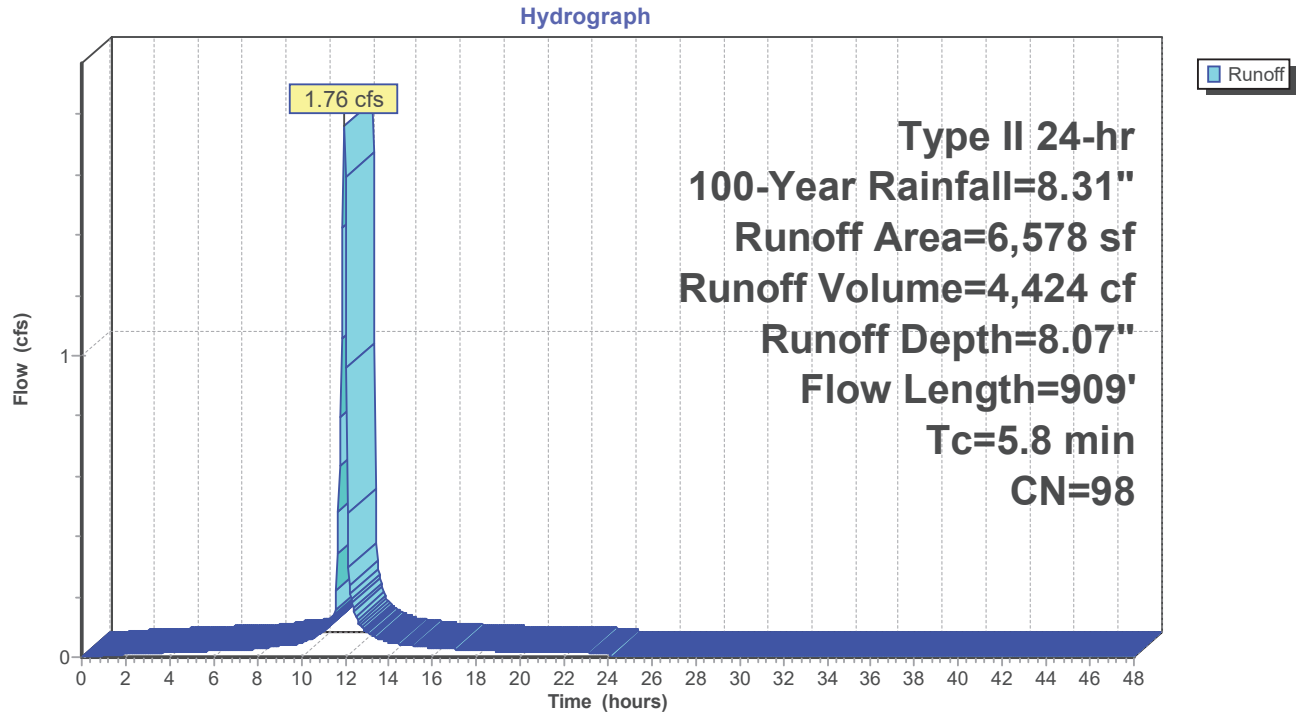
Runoff = 1.76 cfs @ 11.96 hrs, Volume= 4,424 cf, Depth= 8.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=8.31"

	Area (sf)	CN	Description
*	6,282	98	Roofs, HSG A Building Coverage
*	296	98	Sidewalks and Curbs
	6,578	98	Weighted Average
	6,578		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	909		2.61		**Direct Entry, 100 Year Tc**

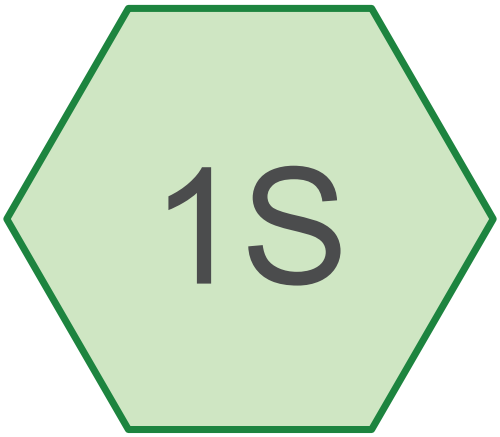
Subcatchment 1S: Existing Plot



Hydrograph for Subcatchment 1S: Existing Plot

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.01	0.00
2.00	0.18	0.06	0.01
3.00	0.29	0.13	0.01
4.00	0.40	0.23	0.02
5.00	0.52	0.34	0.02
6.00	0.66	0.47	0.02
7.00	0.82	0.62	0.02
8.00	1.00	0.79	0.03
9.00	1.22	1.01	0.04
10.00	1.50	1.28	0.05
11.00	1.95	1.73	**0.09**
12.00	5.51	5.27	**1.59**
13.00	6.42	6.18	0.08
14.00	6.81	6.58	0.05
15.00	7.09	6.85	0.04
16.00	7.31	7.07	0.03
17.00	7.49	7.25	0.03
18.00	7.65	7.41	0.02
19.00	7.79	7.55	0.02
20.00	7.91	7.67	0.02
21.00	8.02	7.78	0.02
22.00	8.12	7.88	0.02
23.00	8.22	7.98	0.01
24.00	**8.31**	**8.07**	0.01
25.00	8.31	8.07	0.00
26.00	8.31	8.07	0.00
27.00	8.31	8.07	0.00
28.00	8.31	8.07	0.00
29.00	8.31	8.07	0.00
30.00	8.31	8.07	0.00
31.00	8.31	8.07	0.00
32.00	8.31	8.07	0.00
33.00	8.31	8.07	0.00
34.00	8.31	8.07	0.00
35.00	8.31	8.07	0.00
36.00	8.31	8.07	0.00
37.00	8.31	8.07	0.00
38.00	8.31	8.07	0.00
39.00	8.31	8.07	0.00
40.00	8.31	8.07	0.00
41.00	8.31	8.07	0.00
42.00	8.31	8.07	0.00
43.00	8.31	8.07	0.00
44.00	8.31	8.07	0.00
45.00	8.31	8.07	0.00
46.00	8.31	8.07	0.00
47.00	8.31	8.07	0.00
48.00	8.31	8.07	0.00

B. HydroCAD Proposed Design Report



Proposed Plot

Subcat Reach Pond Link

Routing Diagram for 2P 80-84 E 25 Proposed

Prepared by HydroCAD SAMPLER 1-800-927-7246 www.hydrocad.net, Printed 11/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type II 24-hr		Default	24.00	1	3.31	2

Summary for Subcatchment 1S: Proposed Plot

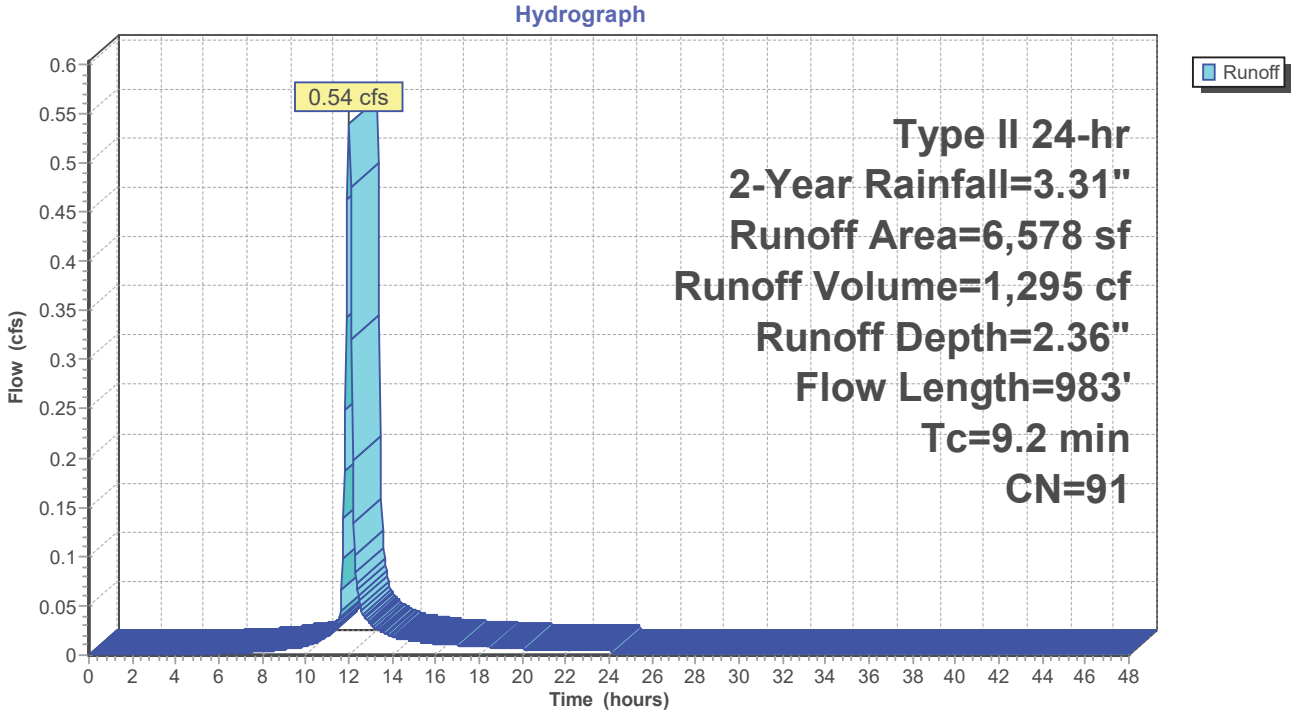
Runoff = 0.54 cfs @ 12.00 hrs, Volume= 1,295 cf, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.31"

	Area (sf)	CN	Description
*	5,424	98	Roofs, HSG A Building Coverage
*	424	98	Sidewalks and Curbs
	730	39	>75% Grass cover, Good, HSG A
	6,578	91	Weighted Average
	730		11.10% Pervious Area
	5,848		88.90% Impervious Area

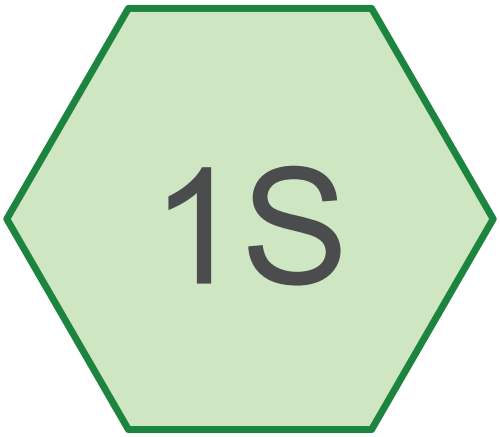
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	983		1.78		**Direct Entry, 2 Year Tc**

Subcatchment 1S: Proposed Plot



Hydrograph for Subcatchment 1S: Proposed Plot

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.03	0.00	0.00
2.00	0.07	0.00	0.00
3.00	0.11	0.00	0.00
4.00	0.16	0.00	0.00
5.00	0.21	0.00	0.00
6.00	0.26	0.00	0.00
7.00	0.33	0.02	0.00
8.00	0.40	0.03	0.00
9.00	0.49	0.07	0.01
10.00	0.60	0.12	0.01
11.00	0.78	0.21	0.02
12.00	2.19	1.34	**0.54**
13.00	2.56	1.66	0.03
14.00	2.71	1.81	0.02
15.00	2.83	1.91	0.01
16.00	2.91	1.99	0.01
17.00	2.98	2.06	0.01
18.00	3.05	2.12	0.01
19.00	3.10	2.17	0.01
20.00	3.15	2.21	0.01
21.00	3.19	2.25	0.01
22.00	3.23	2.29	0.01
23.00	3.27	2.33	0.01
24.00	**3.31**	**2.36**	0.01
25.00	3.31	2.36	0.00
26.00	3.31	2.36	0.00
27.00	3.31	2.36	0.00
28.00	3.31	2.36	0.00
29.00	3.31	2.36	0.00
30.00	3.31	2.36	0.00
31.00	3.31	2.36	0.00
32.00	3.31	2.36	0.00
33.00	3.31	2.36	0.00
34.00	3.31	2.36	0.00
35.00	3.31	2.36	0.00
36.00	3.31	2.36	0.00
37.00	3.31	2.36	0.00
38.00	3.31	2.36	0.00
39.00	3.31	2.36	0.00
40.00	3.31	2.36	0.00
41.00	3.31	2.36	0.00
42.00	3.31	2.36	0.00
43.00	3.31	2.36	0.00
44.00	3.31	2.36	0.00
45.00	3.31	2.36	0.00
46.00	3.31	2.36	0.00
47.00	3.31	2.36	0.00
48.00	3.31	2.36	0.00



Proposed Plot

Subcat Reach Pond Link

Routing Diagram for 10P 80-84 E 25 10Y Proposed

Prepared by HydroCAD SAMPLER 1-800-927-7246 www.hydrocad.net, Printed 11/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	10-Year	Type II 24-hr		Default	24.00	1	5.02	2

Summary for Subcatchment 1S: Proposed Plot

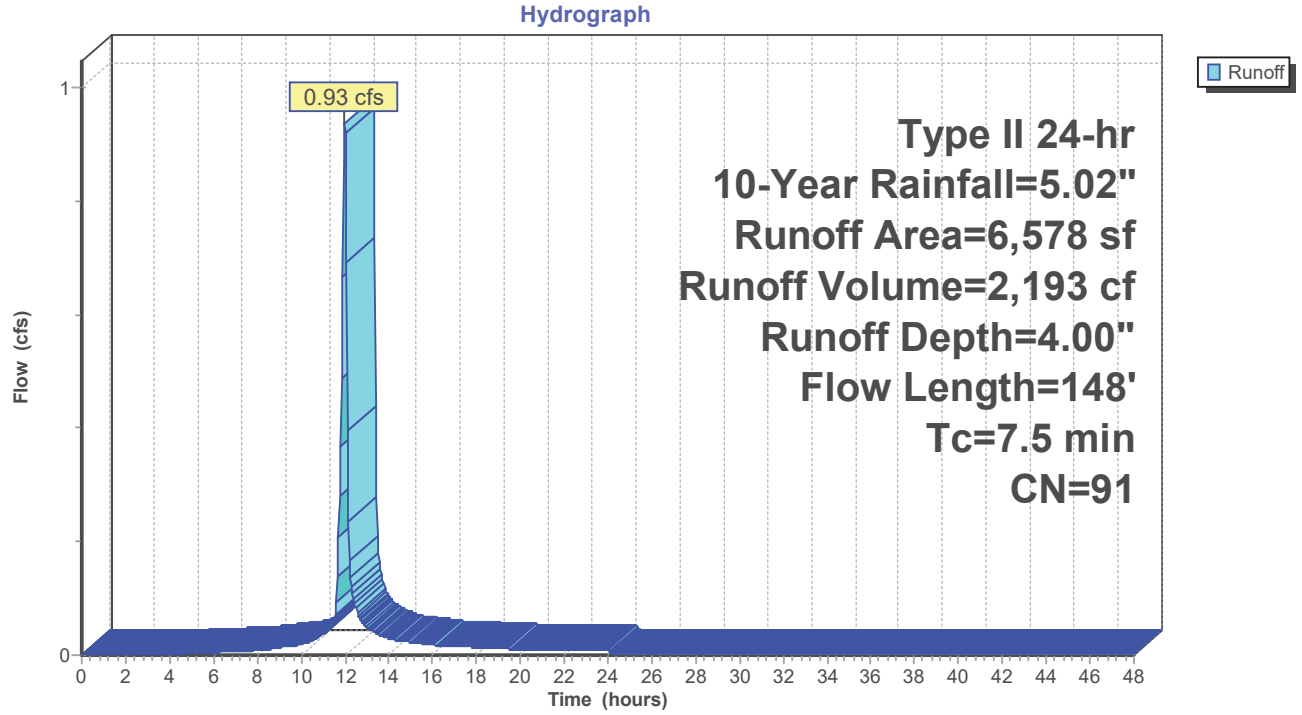
Runoff = 0.93 cfs @ 11.98 hrs, Volume= 2,193 cf, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.02"

	Area (sf)	CN	Description
*	5,424	98	Roofs, HSG A Building Coverage
*	424	98	Sidewalks and Curbs
	730	39	>75% Grass cover, Good, HSG A
	6,578	91	Weighted Average
	730		11.10% Pervious Area
	5,848		88.90% Impervious Area

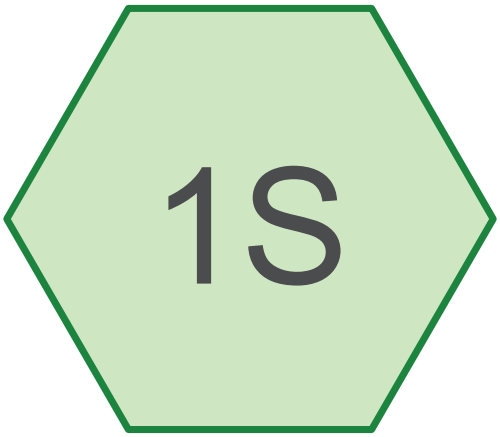
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	148		0.33		**Direct Entry, 10 Year Tc**

Subcatchment 1S: Proposed Plot



Hydrograph for Subcatchment 1S: Proposed Plot

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.05	0.00	0.00
2.00	0.11	0.00	0.00
3.00	0.17	0.00	0.00
4.00	0.24	0.00	0.00
5.00	0.32	0.01	0.00
6.00	0.40	0.03	0.00
7.00	0.50	0.07	0.01
8.00	0.60	0.12	0.01
9.00	0.74	0.19	0.01
10.00	0.91	0.30	0.02
11.00	1.18	0.49	0.04
12.00	3.33	2.38	**0.92**
13.00	3.88	2.90	0.05
14.00	4.12	3.13	0.03
15.00	4.28	3.29	0.02
16.00	4.42	3.42	0.02
17.00	4.53	3.52	0.02
18.00	4.62	3.62	0.01
19.00	4.71	3.70	0.01
20.00	4.78	3.77	0.01
21.00	4.84	3.83	0.01
22.00	4.90	3.89	0.01
23.00	4.96	3.95	0.01
24.00	**5.02**	**4.00**	0.01
25.00	5.02	4.00	0.00
26.00	5.02	4.00	0.00
27.00	5.02	4.00	0.00
28.00	5.02	4.00	0.00
29.00	5.02	4.00	0.00
30.00	5.02	4.00	0.00
31.00	5.02	4.00	0.00
32.00	5.02	4.00	0.00
33.00	5.02	4.00	0.00
34.00	5.02	4.00	0.00
35.00	5.02	4.00	0.00
36.00	5.02	4.00	0.00
37.00	5.02	4.00	0.00
38.00	5.02	4.00	0.00
39.00	5.02	4.00	0.00
40.00	5.02	4.00	0.00
41.00	5.02	4.00	0.00
42.00	5.02	4.00	0.00
43.00	5.02	4.00	0.00
44.00	5.02	4.00	0.00
45.00	5.02	4.00	0.00
46.00	5.02	4.00	0.00
47.00	5.02	4.00	0.00
48.00	5.02	4.00	0.00



Proposed Plot

Subcat Reach Pond Link

Routing Diagram for 100P 80-84 E 25 100Y Proposed

Prepared by HydroCAD SAMPLER 1-800-927-7246 www.hydrocad.net, Printed 11/5/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	100-Year	Type II 24-hr		Default	24.00	1	8.31	2

Summary for Subcatchment 1S: Proposed Plot

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

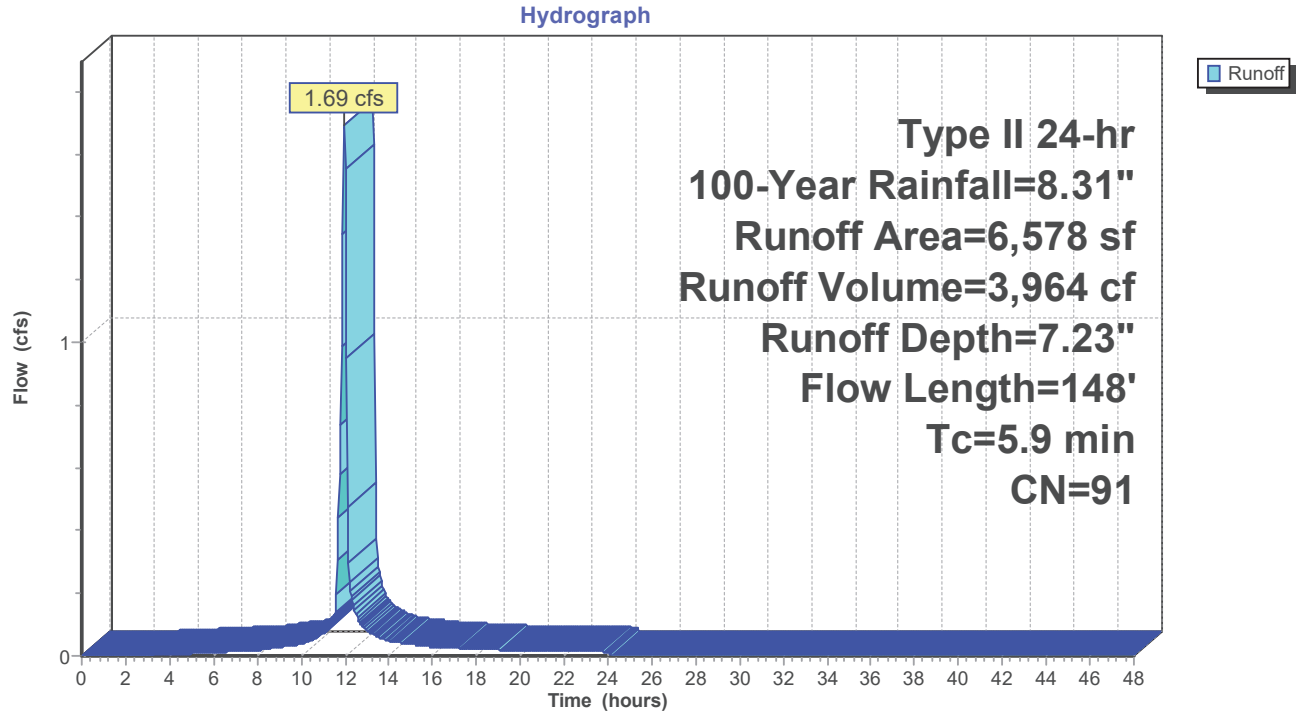
Runoff = 1.69 cfs @ 11.96 hrs, Volume= 3,964 cf, Depth= 7.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=8.31"

	Area (sf)	CN	Description
*	5,424	98	Roofs, HSG A Building Coverage
*	424	98	Sidewalks and Curbs
	730	39	>75% Grass cover, Good, HSG A
	6,578	91	Weighted Average
	730		11.10% Pervious Area
	5,848		88.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	148		0.42		**Direct Entry, 100 Year Tc**

Subcatchment 1S: Proposed Plot



Hydrograph for Subcatchment 1S: Proposed Plot

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	47.00	8.31	7.23	0.00
1.00	0.09	0.00	0.00	48.00	8.31	7.23	0.00
2.00	0.18	0.00	0.00				
3.00	0.29	0.01	0.00				
4.00	0.40	0.03	0.01				
5.00	0.52	0.08	0.01				
6.00	0.66	0.15	0.01				
7.00	0.82	0.24	0.02				
8.00	1.00	0.36	0.02				
9.00	1.22	0.52	0.03				
10.00	1.50	0.74	0.04				
11.00	1.95	1.12	**0.07**				
12.00	5.51	4.48	**1.55**				
13.00	6.42	5.36	0.08				
14.00	6.81	5.76	0.05				
15.00	7.09	6.03	0.04				
16.00	7.31	6.25	0.03				
17.00	7.49	6.42	0.03				
18.00	7.65	6.58	0.02				
19.00	7.79	6.72	0.02				
20.00	7.91	6.84	0.02				
21.00	8.02	6.94	0.02				
22.00	8.12	7.04	0.02				
23.00	8.22	7.14	0.01				
24.00	**8.31**	**7.23**	0.01				
25.00	8.31	7.23	0.00				
26.00	8.31	7.23	0.00				
27.00	8.31	7.23	0.00				
28.00	8.31	7.23	0.00				
29.00	8.31	7.23	0.00				
30.00	8.31	7.23	0.00				
31.00	8.31	7.23	0.00				
32.00	8.31	7.23	0.00				
33.00	8.31	7.23	0.00				
34.00	8.31	7.23	0.00				
35.00	8.31	7.23	0.00				
36.00	8.31	7.23	0.00				
37.00	8.31	7.23	0.00				
38.00	8.31	7.23	0.00				
39.00	8.31	7.23	0.00				
40.00	8.31	7.23	0.00				
41.00	8.31	7.23	0.00				
42.00	8.31	7.23	0.00				
43.00	8.31	7.23	0.00				
44.00	8.31	7.23	0.00				
45.00	8.31	7.23	0.00				
46.00	8.31	7.23	0.00				

C. USDA Soil Resource Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Hudson County, New Jersey

November 5, 2024

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

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

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.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,080 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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: Hudson County, New Jersey
Survey Area Data: Version 14, Sep 3, 2024

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
URTILB	Urban land, till substratum, 0 to 8 percent slopes	2.3	100.0%
Totals for Area of Interest		**2.3**	**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.

Hudson County, New Jersey

URTILB—Urban land, till substratum, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2qjwr
Elevation: 0 to 520 feet
Mean annual precipitation: 30 to 56 inches
Mean annual air temperature: 47 to 63 degrees F
Frost-free period: 179 to 217 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land, till substratum: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land, Till Substratum

Setting

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Asphalt over human-transported material

Typical profile

M - 0 to 15 inches: material
2^C - 15 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

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

Minor Components

Greenbelt

Percent of map unit: 10 percent
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, base slope, crest, talf
Down-slope shape: Convex, linear
Across-slope shape: Convex, 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

D. Time of Concentration Existing Calculation

$R_i := 1\ ft$ Rise

$R_n := 100\ ft$ Run

$P := 3.31\ in$ 2 year, 24-hour rainfaill, in, see Table 5-1

$n := 0.011$ Manning's Roughness Coefficients for Sheet Flow see Figure 5-12

$S_L := \frac{R_i}{R_n} = 1\ \%$ Slope in feet

Time of Concentration using Velocity Method

$$L := \frac{\left(100 \cdot \sqrt{S_L}\right) ft}{n} = 909.0909\ ft$$ Sheet Flow Length

$$T_t := \frac{\left(0.007 \cdot \left(n \cdot \frac{L}{ft}\right)^{0.8}\right) hr}{\left(\frac{P}{in}\right)^{0.5} \cdot \left(S_L\right)^{0.4}} = 0.1532\ hr$$ Travel Time

$T_t = 9.1904\ min$

$T_c := T_t$ Time of Concentration

Table 5-1: County-Specific, New Jersey 24-Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

Figure 5-12: Manning's Roughness Coefficients for Sheet Flow

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n [1/]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [2/]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3/]	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Figure 5-13: Velocity Versus Slope for Shallow Concentrated Flow From NEH, Part 630, Chapter 15

Figure 15–4 Velocity versus slope for shallow concentrated flow

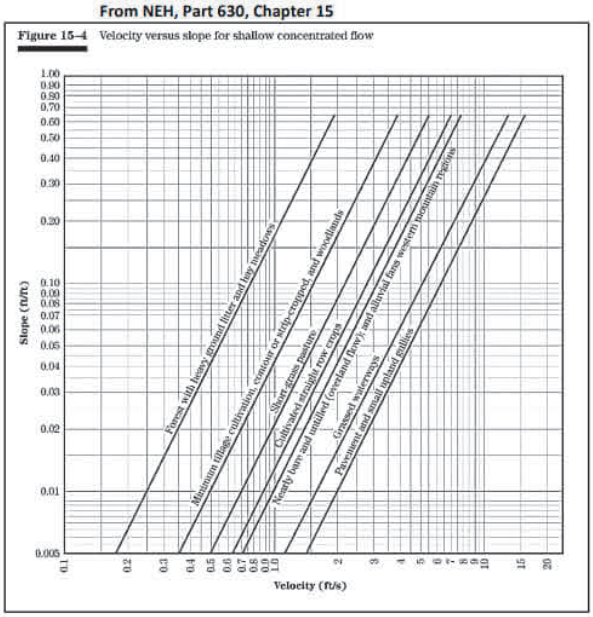


Table 9–5 Runoff curve numbers for urban areas [1/]

Cover description cover type and hydrologic condition	Average percent impervious area [2/]	-- CN for hydrologic soil group -- A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

1/ Average runoff condition, and $I_a = 0.2S$.
2/ The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.
3/ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space type.
4/ Composite CNs for natural desert landscaping should be computed using figures 9–3 or 9–4 based on the impervious area percentage (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

$R_i := 1\ ft$ Rise

$R_n := 100\ ft$ Run

$P := 5.02\ in$ 10 year, 24-hour rainfaill, in, see Table 5-1

$n := 0.011$ Manning's Roughness Coefficients for Sheet Flow see Figure 5-12

$S_L := \frac{R_i}{R_n} = 1\ \%$ Slope in feet

Time of Concentration using Velocity Method

$$L := \frac{\left(100 \cdot \sqrt{S_L}\right) ft}{n} = 909.0909\ ft$$ Sheet Flow Length

$$T_t := \frac{\left(0.007 \cdot \left(n \cdot \frac{L}{ft}\right)^{0.8}\right) hr}{\left(\frac{P}{in}\right)^{0.5} \cdot \left(S_L\right)^{0.4}} = 0.1244\ hr$$ Travel Time

$T_t = 7.4627\ min$

$T_c := T_t$ Time of Concentration

Table 5-1: County-Specific, New Jersey 24-Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

Figure 5-12: Manning's Roughness Coefficients for Sheet Flow

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n 1/
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses 2/	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: 3/	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Figure 5-13: Velocity Versus Slope for Shallow Concentrated Flow From NEH, Part 630, Chapter 15

Figure 15–4 Velocity versus slope for shallow concentrated flow

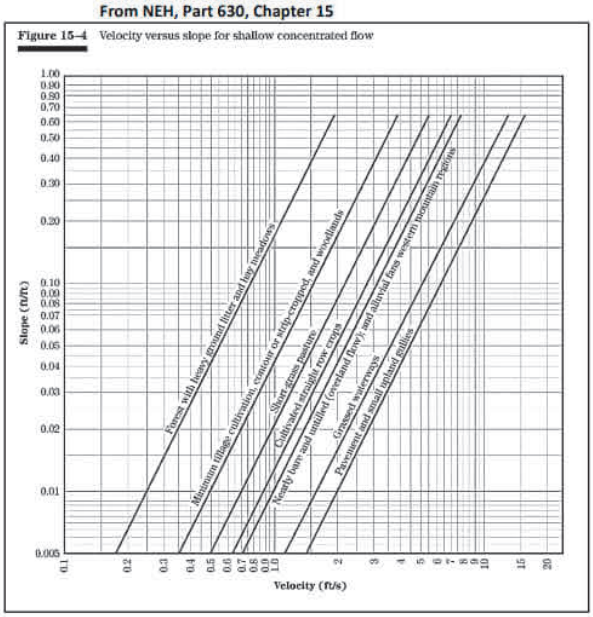


Table 9–5 Runoff curve numbers for urban areas 1/

Cover description cover type and hydrologic condition	Average percent impervious area 2/	-- CN for hydrologic soil group -- A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) 3/					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) 4/		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

1/ Average runoff condition, and $I_a = 0.2S$.
2/ The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.
3/ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space type.
4/ Composite CNs for natural desert landscaping should be computed using figures 9–3 or 9–4 based on the impervious area percentage (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

$R_i := 1\ ft$ Rise

$R_n := 100\ ft$ Run

$P := 8.31\ in$ 100 year, 24-hour rainfaill, in, see Table 5-1

$n := 0.011$ Manning's Roughness Coefficients for Sheet Flow see Figure 5-12

$S_L := \frac{R_i}{R_n} = 1\ \%$ Slope in feet

Time of Concentration using Velocity Method

$$L := \frac{\left(100 \cdot \sqrt{S_L}\right) ft}{n} = 909.0909\ ft$$ Sheet Flow Length

$$T_t := \frac{\left(0.007 \cdot \left(n \cdot \frac{L}{ft}\right)^{0.8}\right) hr}{\left(\frac{P}{in}\right)^{0.5} \cdot \left(S_L\right)^{0.4}} = 0.0967\ hr$$ Travel Time

$T_t = 5.8003\ min$

$T_c := T_t$ Time of Concentration

Table 5-1: County-Specific, New Jersey 24-Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

Figure 5-12: Manning's Roughness Coefficients for Sheet Flow

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n [1]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Figure 5-13: Velocity Versus Slope for Shallow Concentrated Flow From NEH, Part 630, Chapter 15

Figure 15–4 Velocity versus slope for shallow concentrated flow

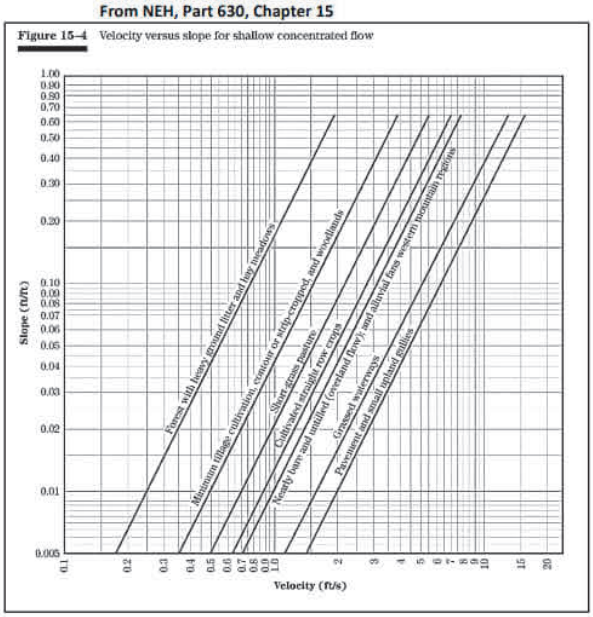


Table 9–5 Runoff curve numbers for urban areas [1]

Cover description cover type and hydrologic condition	Average percent impervious area [2]	-- CN for hydrologic soil group -- A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

1/ Average runoff condition, and $I_a = 0.2S$.
2/ The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.
3/ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space type.
4/ Composite CNs for natural desert landscaping should be computed using figures 9–3 or 9–4 based on the impervious area percentage (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

E. Time of Concentration Proposed Calculation

$P := 3.31\ in$ 2 year, 24-hour rainfall, in, see Table 5-1

$L_1 := 34\ ft$ Lenght of Surface One $\quad E_1 := 1.29\ ft$ Elevation One

$L_2 := 42\ ft$ Length of Surface Two $\quad E_2 := 0.40\ ft$ Elevation Two

$n_1 := 0.15$ Manning's Roughness Coefficients for Sheet Flow. See Figure 5-12

$n_2 := 0.011$ Manning's Roughness Coefficients for Sheet Flow. See Figure 5-12

$R_i := (E_1 - E_2) = 0.89\ ft$ Rise

$R_n := (L_1 + L_2) = 76\ ft$ Run

$$n_a := \frac{((n_1 \cdot L_1) + (n_2 \cdot L_2))}{R_n} = 0.0732$$ Average Roughness Coefficient

$$S_L := \frac{R_i}{R_n} = 1.1711\ \%$$ Slope in feet

Time of Concentration using Velocity Method

$$L := \frac{\left(100 \cdot \sqrt{S_L}\right)\ ft}{n_a} = 147.8668\ ft$$ Sheet Flow Length

$$T_t := \frac{\left(0.007 \cdot \left(n_a \cdot \frac{L}{ft}\right)^{0.8}\right)\ hr}{\left(\frac{P}{in}\right)^{0.5} \cdot (S_L)^{0.4}}$$

$T_t = 9.1904\ min$

$T_c := T_t$ Time of Concentration

Figure 5-13: Velocity Versus Slope for Shallow Concentrated Flow From NEH, Part 630, Chapter 15

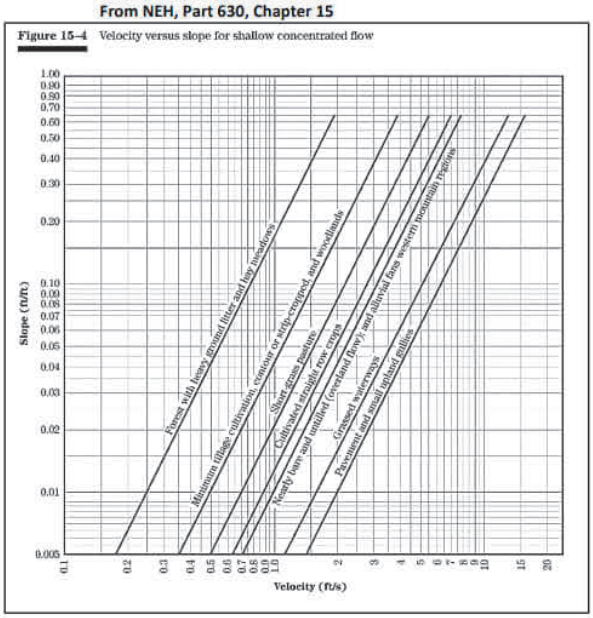


Figure 5-12: Manning's Roughness Coefficients for Sheet Flow

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n [1]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Table 5-1: County-Specific, New Jersey 24-Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

Table 9-5 Runoff curve numbers for urban areas [1]

Cover description cover type and hydrologic condition	Average percent impervious area [2]	-- CN for hydrologic soil group -- A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

1/ Average runoff condition, and $I_a = 0.2S$.
2/ The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.
3/ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space type.
4/ Composite CNs for natural desert landscaping should be computed using figures 9-3 or 9-4 based on the impervious area percentage (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

$P := 5.02\ in$ 10 year, 24-hour rainfall, in, see Table 5-1

$L_1 := 34\ ft$ Lenght of Surface One $E_1 := 1.29\ ft$ Elevation One

$L_2 := 42\ ft$ Length of Surface Two $E_2 := 0.40\ ft$ Elevation Two

$n_1 := 0.15$ Manning's Roughness Coefficients for Sheet Flow. See Figure 5-12

$n_2 := 0.011$ Manning's Roughness Coefficients for Sheet Flow. See Figure 5-12

$R_i := (E_1 - E_2) = 0.89\ ft$ Rise

$R_n := (L_1 + L_2) = 76\ ft$ Run

$$n_a := \frac{((n_1 \cdot L_1) + (n_2 \cdot L_2))}{R_n} = 0.0732$$ Average Roughness Coefficient

$$S_L := \frac{R_i}{R_n} = 1.1711\ \%$$ Slope in feet

Time of Concentration using Velocity Method

$$L := \frac{\left(100 \cdot \sqrt{S_L}\right)\ ft}{n_a} = 147.8668\ ft$$ Sheet Flow Length

$$T_t := \frac{\left(0.007 \cdot \left(n_a \cdot \frac{L}{ft}\right)^{0.8}\right)\ hr}{\left(\frac{P}{in}\right)^{0.5} \cdot (S_L)^{0.4}} = 0.1244\ hr$$ Travel Time

$T_t = 7.4627\ min$

$T_c := T_t$ Time of Concentration

Table 5-1: County-Specific, New Jersey 24-Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

Figure 5-12: Manning's Roughness Coefficients for Sheet Flow

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n [1]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Figure 5-13: Velocity Versus Slope for Shallow Concentrated Flow From NEH, Part 630, Chapter 15

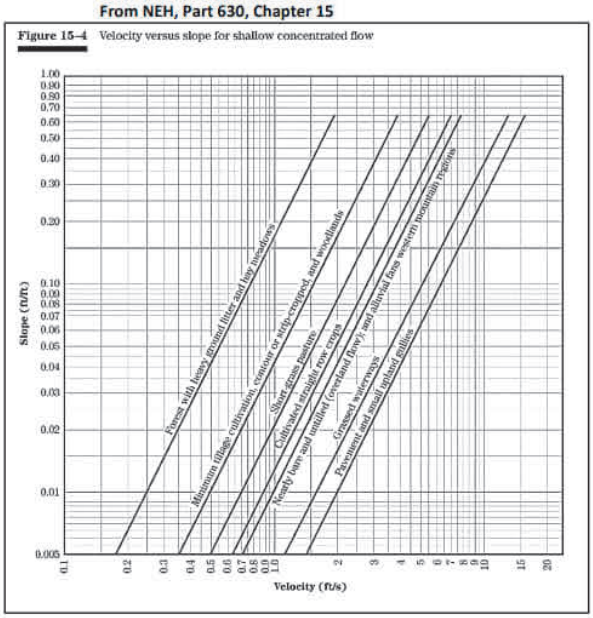


Table 9-5 Runoff curve numbers for urban areas [1]

Cover description cover type and hydrologic condition	Average percent impervious area [2]	-- CN for hydrologic soil group -- A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

1/ Average runoff condition, and $I_a = 0.2S$.
2/ The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.
3/ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space type.
4/ Composite CNs for natural desert landscaping should be computed using figures 9–3 or 9–4 based on the impervious area percentage (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

$P := 8.31\ in$ 100 year, 24-hour rainfall, in, see Table 5-1

$L_1 := 34\ ft$ Lenght of Surface One $E_1 := 1.29\ ft$ Elevation One

$L_2 := 42\ ft$ Length of Surface Two $E_2 := 0.40\ ft$ Elevation Two

$n_1 := 0.15$ Manning's Roughness Coefficients for Sheet Flow. See Figure 5-12

$n_2 := 0.011$ Manning's Roughness Coefficients for Sheet Flow. See Figure 5-12

$R_i := (E_1 - E_2) = 0.89\ ft$ Rise

$R_n := (L_1 + L_2) = 76\ ft$ Run

$$n_a := \frac{((n_1 \cdot L_1) + (n_2 \cdot L_2))}{R_n} = 0.0732$$ Average Roughness Coefficient

$$S_L := \frac{R_i}{R_n} = 1.1711\ \%$$ Slope in feet

Time of Concentration using Velocity Method

$$L := \frac{\left(100 \cdot \sqrt{S_L}\right)\ ft}{n_a} = 147.8668\ ft$$ Sheet Flow Length

$$T_t := \frac{\left(0.007 \cdot \left(n_a \cdot \frac{L}{ft}\right)^{0.8}\right)\ hr}{\left(\frac{P}{in}\right)^{0.5} \cdot (S_L)^{0.4}} = 0.0967\ hr$$ Travel Time

$T_t = 5.8003\ min$

$T_c := T_t$ Time of Concentration

Table 5-1: County-Specific, New Jersey 24-Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

Figure 5-12: Manning's Roughness Coefficients for Sheet Flow

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n [1]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Figure 5-13: Velocity Versus Slope for Shallow Concentrated Flow From NEH, Part 630, Chapter 15

Figure 15–4 Velocity versus slope for shallow concentrated flow

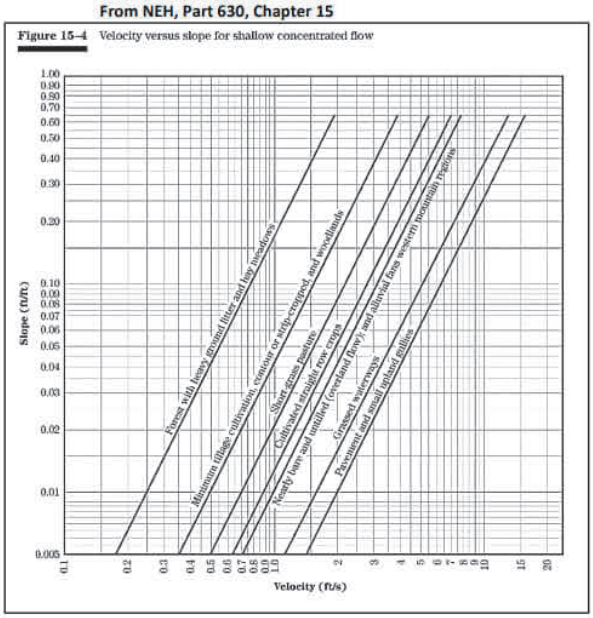


Table 9–5 Runoff curve numbers for urban areas [1]

Cover description cover type and hydrologic condition	Average percent impervious area [2]	CN for hydrologic soil group A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

1/ Average runoff condition, and $I_a = 0.2S$.
2/ The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.
3/ CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space type.
4/ Composite CNs for natural desert landscaping should be computed using figures 9–3 or 9–4 based on the impervious area percentage (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.