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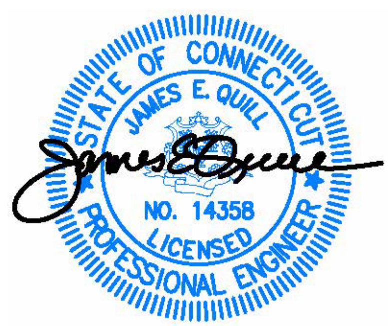
Information prepared for:

WESTERN GROUP, LLC

#245 Route 32
Montville, CT
&
Town of Montville
Department of Public Works / Engineering Department

Project Name: Wilton's Way Proposed Residential Development



STORMWATER STUDY

Documentation

Dated: January 25, 2022

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OWNER/APPLICANT: WESTERN GROUP, LLC
PROJECT LOCATION: WILTONS WAY #245 Route 32,
Montville, Connecticut

DRAINAGE STUDY

INTRODUCTION

The purpose of this study is to outline the storm water analysis for the proposed development at #245 Norwich-New London Road Town of Montville, Route 32 Uncasville, CT. The storm water management plan is based on a hydrologic analysis of pre-development and post-development conditions using a Type III-24 Hour, for 25 –year frequency storms. The peak flow rate and the increase in runoff for up to the 100-year storm frequency is being compared in this study. The hydrological analysis is conducted within the area of the property as bounded by the property lines shown on the plan only.

245 Route 32 Associates is proposing to construct two multi-level residential condominium buildings, basements, new driveways and miscellaneous landscaping at 245 Norwich-New London Road, Route 32 Montville, CT. The proposed development is located on the east side of State Route 32 travelling northbound. Refer to the plan titled "Residential Development" dated January 4, 2022, prepared for Western Group, LLC prepared by Fuller Engineering & Land Surveying, LLC for the extent of the proposed development.

The proposed development will increase the amount of impervious area on the site, and will therefore increase the runoff rain water leaving the site. The analysis did not consider back-to-back storms.

PRE-DEVELOPMENT CONDITIONS

The site considered in this study is the entire area of the property which is located in the C-1 District, which is a Commercial Zone, although the proposed development will be strictly residential use.. The total area (79,607 s.f.) (1.828 acre) currently is composed of mainly pervious surfaces will little impervious land surfaces..

The runoff from this area sheet flows towards the East at the low point on the property (considered as POC "A") (outfall 1L in Hydrocad). The peak flow towards POC "A" for a Type III-24 Hour, for 25 –year frequency storms is 2.66 cfs.

PROPOSED POST-DEVELOPMENT CONDITIONS

The proposed developments on said parcel with area of (79,607 s.f.) will be two (2) multi story residential condominium buildings, common drive and independent driveway/parking and miscellaneous landscaping. The proposed development will increase the impervious surface by 29,165 s.f. within the watershed encompassing POC "A". Stormwater runoff from the proposed building and basement driveway will be directed to the inlet structure which is connected to 60 units 4' x 8' x 4' Concrete Galleys in 2 groups, first set of 28 embedded in 58' x 18.6' x 5.17' gravel bed, and a second set of 32 embedded in 66' x 18.6' x 5.17' gravel bed to help treat water quality and attenuate the storm water runoff going to the control structure at the back of the retaining wall before discharging to 12" RCP flared end to the Rip-Rap Plunge Poo/ moving towards POC "A" (outfall 1L in Hydrocad). Storm water runoff from the driveways and common drive will sheet flow into common drive catch basin distributing the stormwater along the edge of the common drive in a storm sewer system. Roof drains will be directly connected underground to the concrete galley system. The overflow of the concrete galley system will be directed to a control structure which will discharge the water into a energy dissipating rip-rap plunge pool. The peak flow towards POC "A" for a Type III-24 Hour, for 25 –year frequency storm, post development is 1.94 cfs. which is less than the pre development conditions.

DESIGN METHODOLOGY

The site consists of a Hydrological Soil Group (HSG) rating C (refer to Appendix B) which is used in the analysis. The following CN values are used; (a) 98 for impervious surfaces; (b) 81 for HSG C , 30% imp. 1/3 acre residential; (c) 65 for HSG C, 50-75% grass cover,good condition.

HydroCAD Version 10.0 was utilized to evaluate the runoff volume and peak discharge rates of the pre and post-development conditions. The design storm frequencies considered are the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year storm frequencies. They were used in the analysis with the following 24-hour rainfall total; 2-year, 3.46 inches; 5-year, 4.36 in.; 10-year, 5.12 inches; 25-year, 6.15 inches;50-year, 6.93 inches; and 100-year, 7.75 inches. The peak flow towards the rip-rap pool at the wooded border is less than the pre-development runoff peak flows as shown in Table 1.

TABLE 1 – Peak Flows in cfs/Volume in C.F.

STORM EVENT	LINK/POC	FLOW/VOLUME	EXISTING	PROPOSED	Δ	Δ (%)
2 Year Storm	LINK 1 (A)	q (ft^3/s)	0.5	0.25	-0.25	-50.0
		v (ft^3)	3386	1193	-2193	-64.8
5 Year Storm	LINK 1 (A)	q (ft^3/s)	1.1	0.48	-0.62	-56.4
		v (ft^3)	6228	2370	-3858	-61.9
10 Year Storm	LINK 1 (A)	q (ft^3/s)	1.72	0.81	-0.91	-52.9
		v (ft^3)	9045	5364	-3681	-40.7
25 Year Storm	LINK 1 (A)	q (ft^3/s)	2.66	1.94	-0.72	-27.1
		v (ft^3)	13330	9858	-3472	-26.0
50 Year Storm	LINK 1 (A)	q (ft^3/s)	3.44	3.36	-0.08	-2.3
		v (ft^3)	16857	13514	-3343	-19.8
100 Year Storm	LINK 1 (A)	q (ft^3/s)	4.29	4.07	-0.22	-5.1
		v (ft^3)	20774	17547	-3227	-15.5

Based on the tabulated results above, the peak flows and the run off volume of the post-development condition are less than the pre-development conditions.

SOIL EROSION AND SEDIMENTATION CONTROL

For temporary condition or during construction a silt fence shall be provided along the property lines. Anti-tracking aprons shall be provided at all access routes from the site to the public road. All planting areas shall be protected with slope stabilization measures.

For permanent condition, all embankments, after being stabilized, shall be sodded. Newly planted areas shall be covered with straw or erosion control blankets.

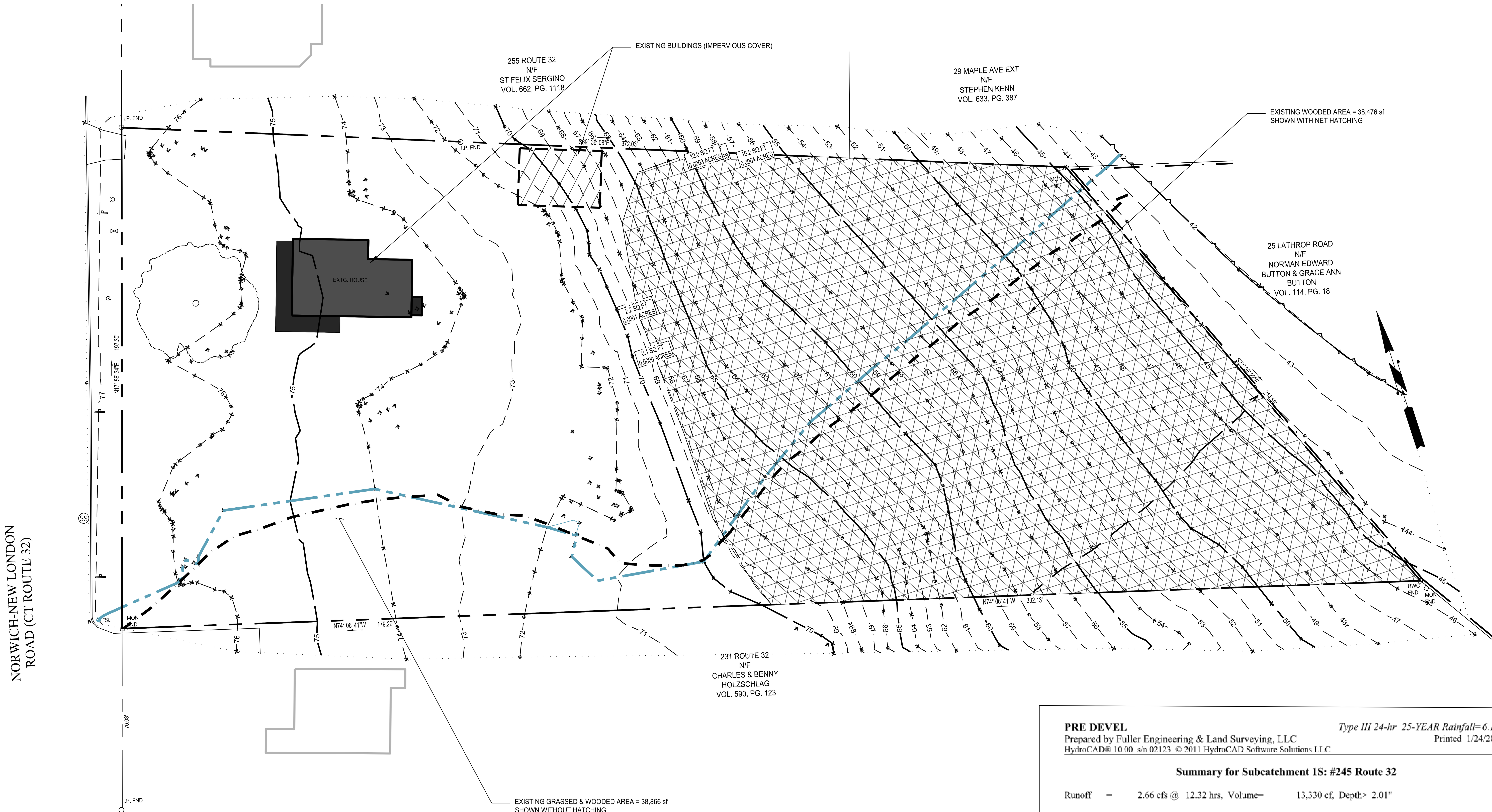
CONCLUSION

The proposed development will increase the impervious coverage on the site thus increase the volume and peak flow rate of runoff generated during a storm event. However, to address the water quality volume and peak flow issues, a subsurface detention/retention system will be installed to treat and attenuate the storm water runoff. The proposed development will not increase the peak flow rate to the POC.

Since the proposed development incorporates pre-treatment and attenuation of runoff to the maximum extent practical, if the proposed development is constructed as depicted on the proposed development plans, then there will be no adverse impacts to adjoining properties and/or street drainage.

EXHIBITS “A” AND “B”

WATERSHED MAPS
FOR
EXISTING & PROPOSED CONDITIONS



PRE DEVEL *Type III 24-hr 25-YEAR Rainfall=6.15"*
Prepared by Fuller Engineering & Land Surveying, LLC Printed 1/24/2022
HydroCAD® 10.00 s/n 02123 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: #245 Route 32

Runoff = 2.66 cfs @ 12.32 hrs, Volume= 13,330 cf, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEAR Rainfall=6.15"

Area (sf)	CN	Description
1,661	98	Roofs, HSG B
22	98	Unconnected pavement, HSG B
580	98	Unconnected roofs, HSG D
38,476	58	Woods/grass comb., Good, HSG B
38,866	61	>75% Grass cover, Good, HSG B
79,605	61	Weighted Average, UI Adjusted CN = 60
77,342		97.16% Pervious Area
2,263		2.84% Impervious Area
602		26.60% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	480	0.0695	0.71		**Lag/CN Method, Overland Flow**
10.3	100	0.1160	0.16		**Sheet Flow, Thru the Woods** Woods: Light underbrush n= 0.400 P2= 3.40"
21.6	580	Total			

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APPROVED BY THE MONTVILLE PLANNING AND ZONING COMMISSION

CHAIRMAN DATE

STATE OF CONNECTICUT JAMES E. QUILL NO. 14358 LICENSED PROFESSIONAL ENGINEER

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WILTON'S WAY
22 UNIT CONDOMINIUM DEVELOPMENT
245 NORWICH-NEW LONDON ROAD (RT 32)
MONTVILLE, CONNECTICUT
PREPARED FOR
WESTERN GROUP, LLC

Job Number: FE22-1700

Job Start Date: 1/4/22

Submission 01/25/22

Drawn By: D.R.R. Checked By: J.E.Q.

Sheet Title: DRAINAGE AREA MAP - EXISTING CONDITIONS

Scale: 1" = 20'

Sheet Number: DA-EX

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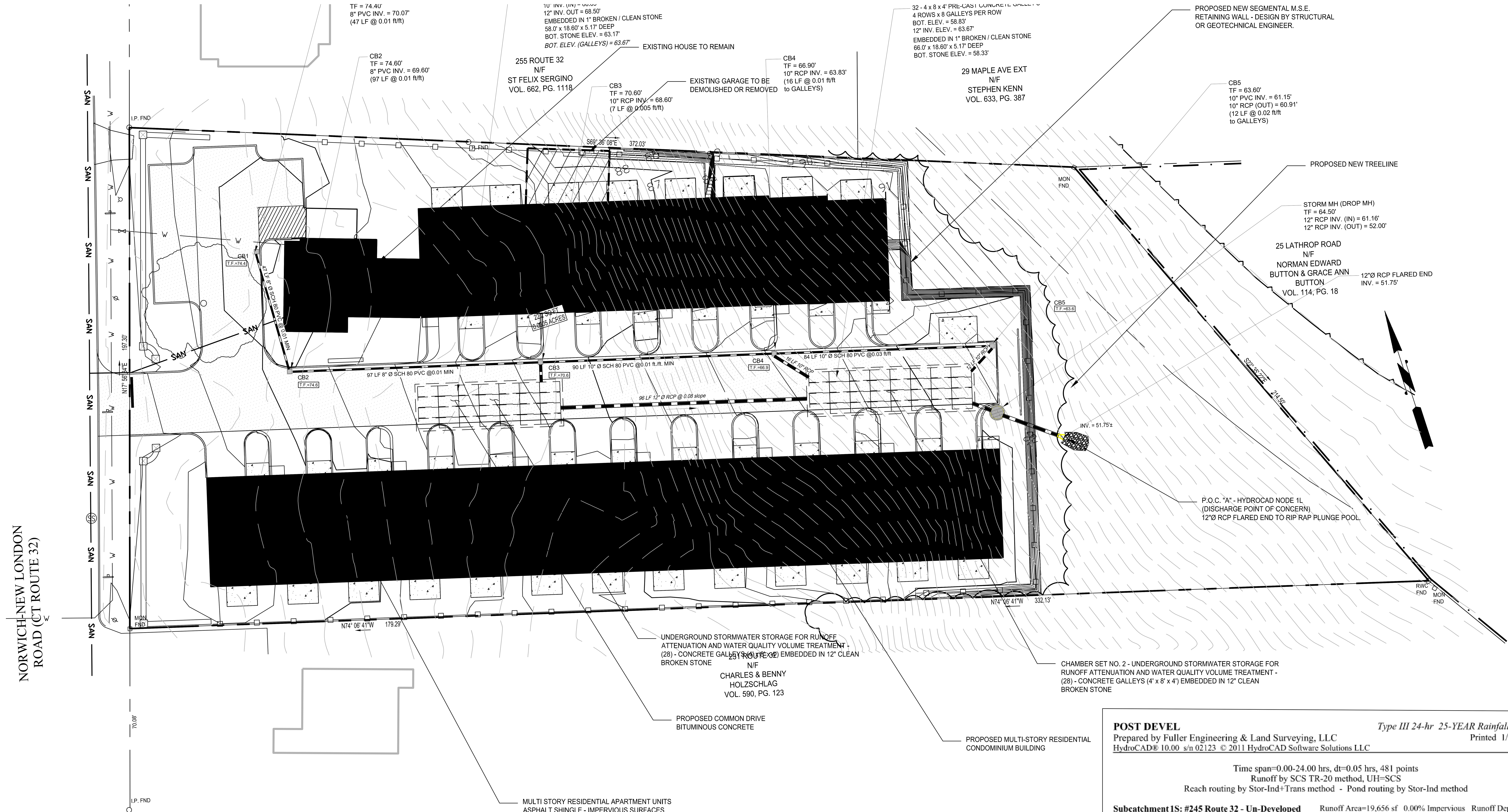

POST DEVEL *Type III 24-hr 25-YEAR Rainfall=6.15"*
Prepared by Fuller Engineering & Land Surveying, LLC — Printed 1/24/2022
HydroCAD® 10.00 s/n 02123 © 2011 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: #245 Route 32 - Un-Developed Runoff Area=19,656 sf 0.00% Impervious Runoff Depth>2.45"
Flow Length=120' Slope=0.1080 '/' Tc=12.7 min CN=65 Runoff=1.01 cfs 4,020 cf

Subcatchment 2S: NEW CONDO'S & Runoff Area=32,401 sf 74.30% Impervious Runoff Depth>5.18"
Flow Length=668' Slope=0.0750 '/' Tc=40.8 min CN=92 Runoff=2.10 cfs 13,998 cf

Subcatchment 3S: Urban Commercial wth Open Runoff Area=27,548 sf 0.00% Impervious Runoff Depth>2.81"
Tc=29.3 min CN=69 Runoff=1.19 cfs 6,455 cf

Reach 1R: CONTROL STRUCTURE Avg. Flow Depth=0.01' Max Vel=154.72 fps Inflow=1.76 cfs 5,838 cf
n=0.013 L=5.0' S=1.8320 '/' Capacity=3,515.86 cfs Outflow=1.76 cfs 5,838 cf

Reach 2R: Rip Rap Pool Avg. Flow Depth=0.44' Max Vel=2.45 fps Inflow=1.76 cfs 5,838 cf
n=0.040 L=10.0' S=0.0250 '/' Capacity=130.02 cfs Outflow=1.76 cfs 5,838 cf

Pond 1P: 60 CONCRETE GALLEY'S Peak Elev=62.39' Storage=6,666 cf Inflow=3.23 cfs 20,453 cf
Discarded=0.22 cfs 12,033 cf Primary=1.76 cfs 5,838 cf Outflow=1.99 cfs 17,871 cf

Link 1L: POC "A" DRAIN INLET AT S.E. END OF PARCEL Inflow=1.94 cfs 9,858 cf
Primary=1.94 cfs 9,858 cf

Total Runoff Area = 79,605 sf Runoff Volume = 24,473 cf Average Runoff Depth = 3.69"
69.76% Pervious = 55,533 sf 30.24% Impervious = 24,072 sf

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APPROVED BY THE MONTVILLE PLANNING AND ZONING COMMISSION

CHAIRMAN DATE

STATE OF CONNECTICUT JAMES E. QUILL NO. 14358 LICENSED PROFESSIONAL ENGINEER

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WILTON'S WAY
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Job Number: FE22-1700

Job Start Date: 1/4/22

Submission 01/25/22

Drawn By: D.R.R. Checked By: J.E.Q.

Sheet Title: DRAINAGE AREA MAP - PROPOSED CONDITIONS

Scale: 1" = 20'

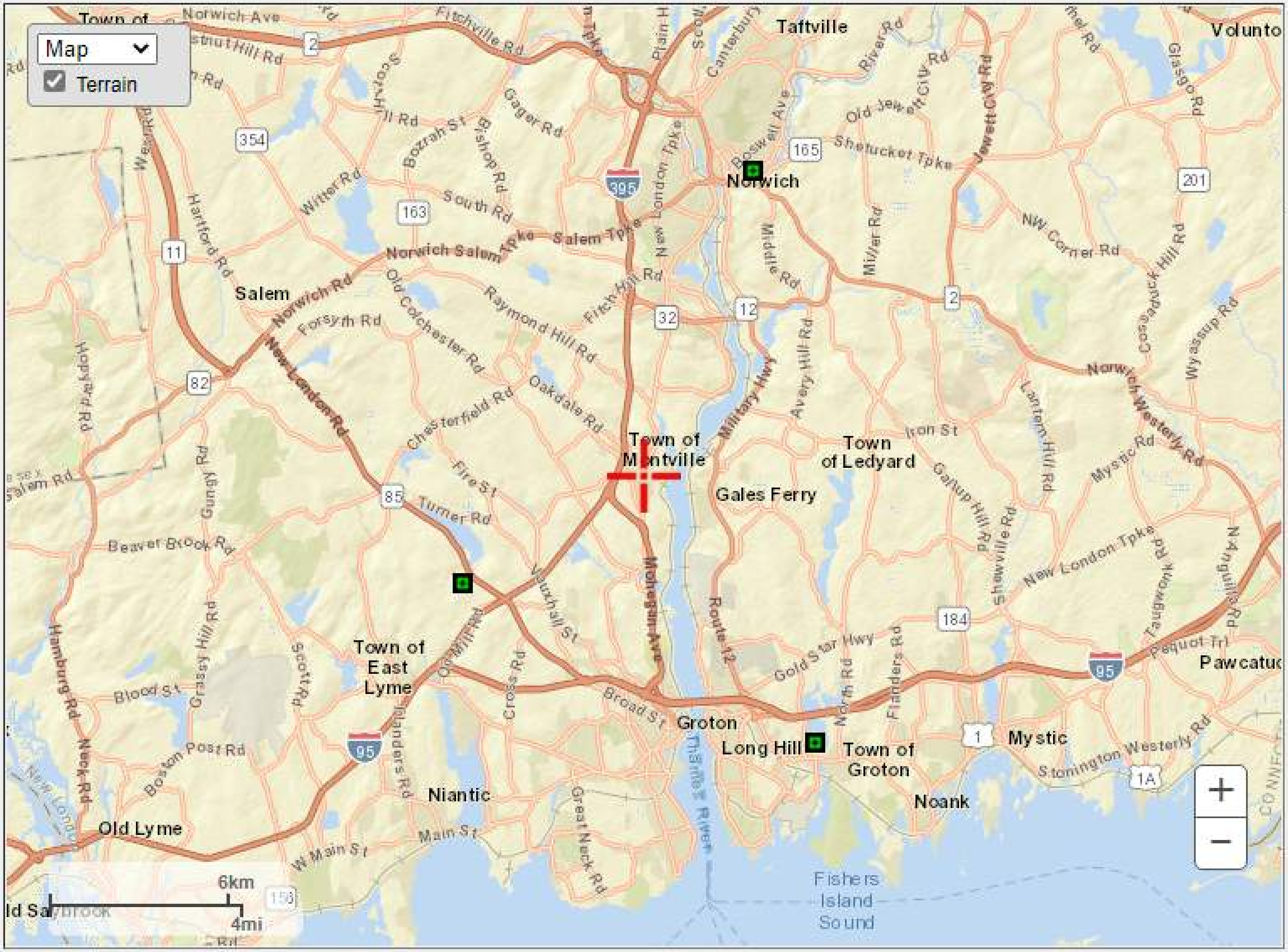
Sheet Number: DA-PRO

APPENDIX "A"

MONTVILLE PRECIPITATION FREQUENCY (PF) RAINFALL DATA

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CT

#245 Norwich New London Road (CT State RTE. 32) Montville, CT



a) Select location

Move crosshair or double click

b) Click on station icon

Show stations on map

Location information:

Name: Uncasville, Connecticut, USA*

Latitude: 41.4331°

Longitude: -72.1092°

Elevation: 67.49 ft **

* Source: ESRI Maps

** Source: USGS

NOAA Atlas 14, Volume 10, Version 3
Location name: Uncasville, Connecticut, USA*
Latitude: 41.4331°, Longitude: -72.1092°
Elevation: 67.49 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.340** (0.266-0.427)	**0.406** (0.317-0.510)	**0.514** (0.400-0.648)	**0.604** (0.467-0.763)	**0.727** (0.545-0.952)	**0.820** (0.601-1.09)	**0.918** (0.654-1.26)	**1.03** (0.693-1.43)	**1.19** (0.770-1.70)	**1.32** (0.835-1.91)
10-min	**0.482** (0.377-0.605)	**0.576** (0.449-0.723)	**0.729** (0.567-0.918)	**0.856** (0.662-1.08)	**1.03** (0.772-1.35)	**1.16** (0.853-1.55)	**1.30** (0.926-1.78)	**1.46** (0.982-2.02)	**1.68** (1.09-2.40)	**1.87** (1.18-2.71)
15-min	**0.567** (0.443-0.712)	**0.677** (0.529-0.851)	**0.857** (0.667-1.08)	**1.01** (0.779-1.27)	**1.21** (0.908-1.59)	**1.37** (1.00-1.82)	**1.53** (1.09-2.10)	**1.71** (1.16-2.38)	**1.98** (1.28-2.83)	**2.20** (1.39-3.19)
30-min	**0.803** (0.627-1.01)	**0.958** (0.747-1.20)	**1.21** (0.942-1.53)	**1.42** (1.10-1.80)	**1.71** (1.28-2.24)	**1.93** (1.41-2.57)	**2.16** (1.54-2.96)	**2.42** (1.63-3.36)	**2.79** (1.81-3.99)	**3.10** (1.96-4.50)
60-min	**1.04** (0.811-1.30)	**1.24** (0.966-1.56)	**1.57** (1.22-1.97)	**1.84** (1.42-2.32)	**2.21** (1.66-2.89)	**2.49** (1.83-3.32)	**2.79** (1.99-3.82)	**3.12** (2.10-4.34)	**3.61** (2.34-5.15)	**4.01** (2.53-5.81)
2-hr	**1.36** (1.08-1.70)	**1.63** (1.28-2.03)	**2.05** (1.61-2.57)	**2.41** (1.88-3.02)	**2.90** (2.19-3.77)	**3.26** (2.41-4.31)	**3.65** (2.62-4.97)	**4.10** (2.78-5.65)	**4.75** (3.09-6.72)	**5.28** (3.36-7.59)
3-hr	**1.58** (1.25-1.96)	**1.89** (1.49-2.34)	**2.38** (1.88-2.96)	**2.79** (2.19-3.48)	**3.35** (2.54-4.34)	**3.78** (2.81-4.97)	**4.22** (3.05-5.73)	**4.74** (3.22-6.50)	**5.49** (3.59-7.74)	**6.12** (3.90-8.75)
6-hr	**2.01** (1.60-2.47)	**2.39** (1.90-2.94)	**3.00** (2.39-3.70)	**3.51** (2.78-4.35)	**4.22** (3.22-5.41)	**4.75** (3.55-6.19)	**5.30** (3.85-7.13)	**5.95** (4.07-8.08)	**6.89** (4.52-9.61)	**7.67** (4.91-10.9)
12-hr	**2.48** (2.00-3.02)	**2.94** (2.36-3.59)	**3.69** (2.96-4.52)	**4.31** (3.44-5.30)	**5.17** (3.98-6.58)	**5.81** (4.38-7.52)	**6.49** (4.74-8.65)	**7.28** (5.00-9.80)	**8.42** (5.55-11.6)	**9.37** (6.02-13.2)
24-hr	**2.90** (2.36-3.51)	**3.46** (2.80-4.18)	**4.36** (3.53-5.30)	**5.12** (4.11-6.24)	**6.15** (4.77-7.77)	**6.93** (5.26-8.89)	**7.75** (5.71-10.3)	**8.71** (6.02-11.6)	**10.1** (6.71-13.9)	**11.3** (7.31-15.7)
2-day	**3.25** (2.66-3.89)	**3.91** (3.20-4.69)	**4.99** (4.06-6.00)	**5.88** (4.77-7.11)	**7.12** (5.57-8.92)	**8.03** (6.15-10.3)	**9.02** (6.71-11.9)	**10.2** (7.09-13.5)	**12.0** (7.97-16.3)	**13.5** (8.75-18.6)
3-day	**3.52** (2.90-4.20)	**4.23** (3.48-5.06)	**5.40** (4.43-6.47)	**6.37** (5.19-7.66)	**7.70** (6.06-9.62)	**8.69** (6.69-11.0)	**9.76** (7.29-12.8)	**11.0** (7.70-14.5)	**13.0** (8.66-17.5)	**14.6** (9.51-20.0)
4-day	**3.78** (3.12-4.50)	**4.53** (3.74-5.39)	**5.75** (4.73-6.87)	**6.77** (5.53-8.12)	**8.17** (6.45-10.2)	**9.21** (7.11-11.7)	**10.3** (7.73-13.5)	**11.7** (8.15-15.3)	**13.7** (9.16-18.4)	**15.4** (10.0-21.0)
7-day	**4.50** (3.75-5.33)	**5.32** (4.43-6.30)	**6.66** (5.52-7.90)	**7.77** (6.40-9.26)	**9.30** (7.38-11.5)	**10.4** (8.10-13.1)	**11.7** (8.75-15.1)	**13.1** (9.20-17.0)	**15.2** (10.2-20.3)	**17.0** (11.1-23.1)
10-day	**5.22** (4.37-6.15)	**6.08** (5.08-7.16)	**7.48** (6.22-8.83)	**8.64** (7.14-10.2)	**10.2** (8.16-12.5)	**11.4** (8.90-14.2)	**12.7** (9.55-16.3)	**14.2** (9.99-18.4)	**16.3** (11.0-21.6)	**18.0** (11.8-24.3)
20-day	**7.42** (6.26-8.66)	**8.33** (7.03-9.74)	**9.83** (8.25-11.5)	**11.1** (9.23-13.0)	**12.8** (10.2-15.4)	**14.1** (11.0-17.2)	**15.4** (11.5-19.3)	**16.8** (11.9-21.5)	**18.7** (12.7-24.6)	**20.1** (13.3-26.9)
30-day	**9.25** (7.85-10.7)	**10.2** (8.65-11.9)	**11.8** (9.92-13.7)	**13.0** (10.9-15.3)	**14.8** (11.9-17.7)	**16.2** (12.7-19.6)	**17.5** (13.1-21.7)	**18.9** (13.5-24.0)	**20.5** (14.0-26.8)	**21.7** (14.4-28.9)
45-day	**11.5** (9.82-13.3)	**12.5** (10.7-14.5)	**14.1** (12.0-16.4)	**15.5** (13.1-18.0)	**17.4** (14.0-20.7)	**18.9** (14.8-22.7)	**20.3** (15.2-24.8)	**21.5** (15.4-27.2)	**23.0** (15.7-29.9)	**24.0** (15.9-31.7)
60-day	**13.4** (11.5-15.4)	**14.4** (12.3-16.6)	**16.2** (13.8-18.7)	**17.6** (14.9-20.4)	**19.6** (15.8-23.1)	**21.1** (16.6-25.3)	**22.6** (16.9-27.5)	**23.8** (17.1-30.0)	**25.2** (17.3-32.6)	**26.1** (17.4-34.3)

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

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

Please refer to NOAA Atlas 14 document for more information.

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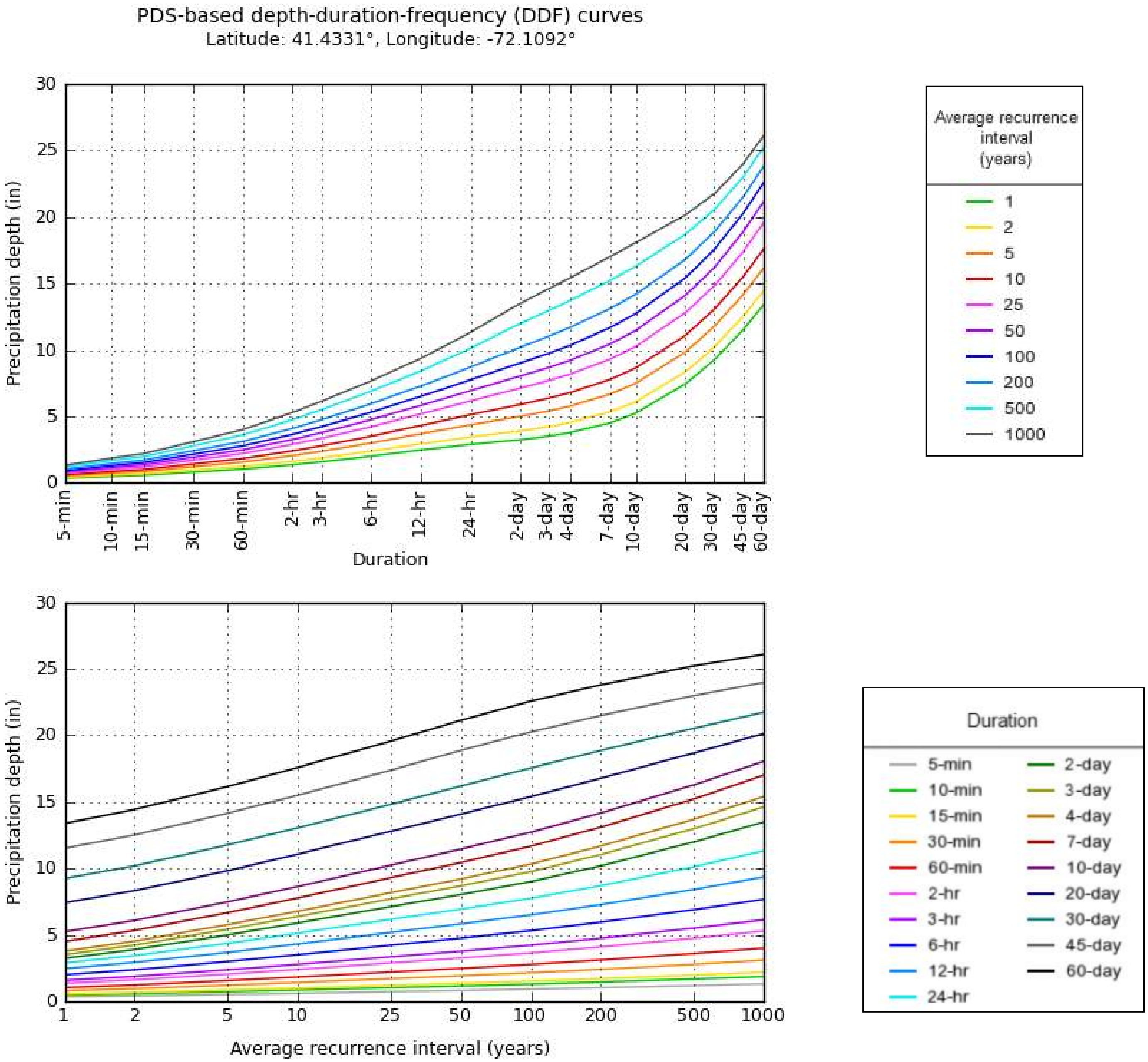
PF graphical



NOAA Atlas 14, Volume 10, Version 3

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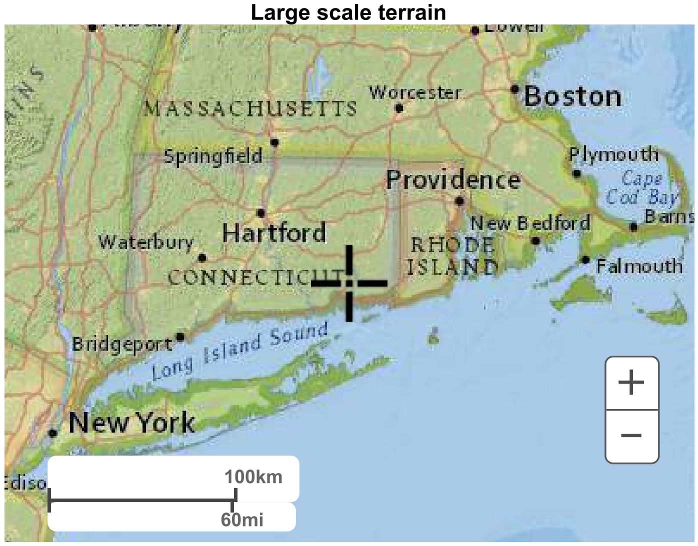
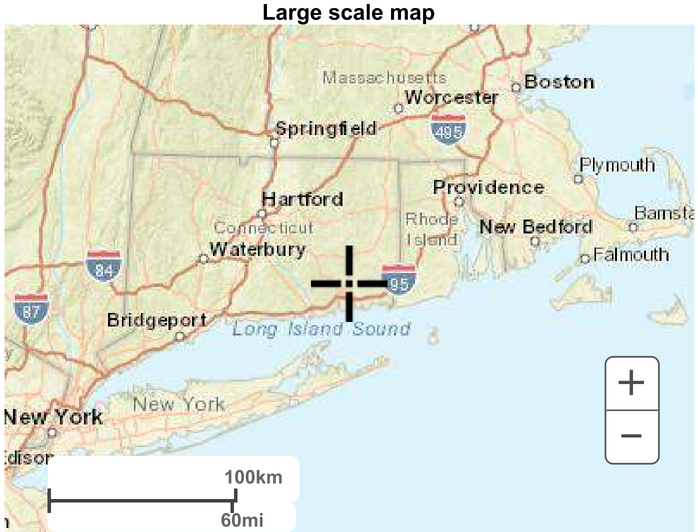
Maps & aerials

Small scale terrain

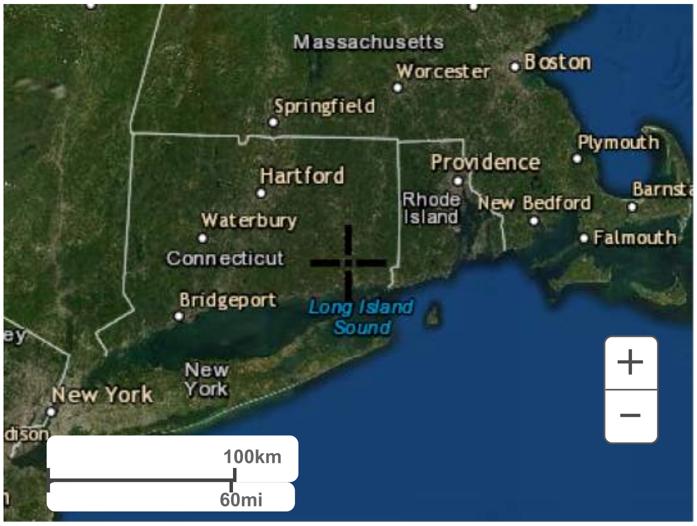
Large scale terrain



Large scale map



Large scale aerial



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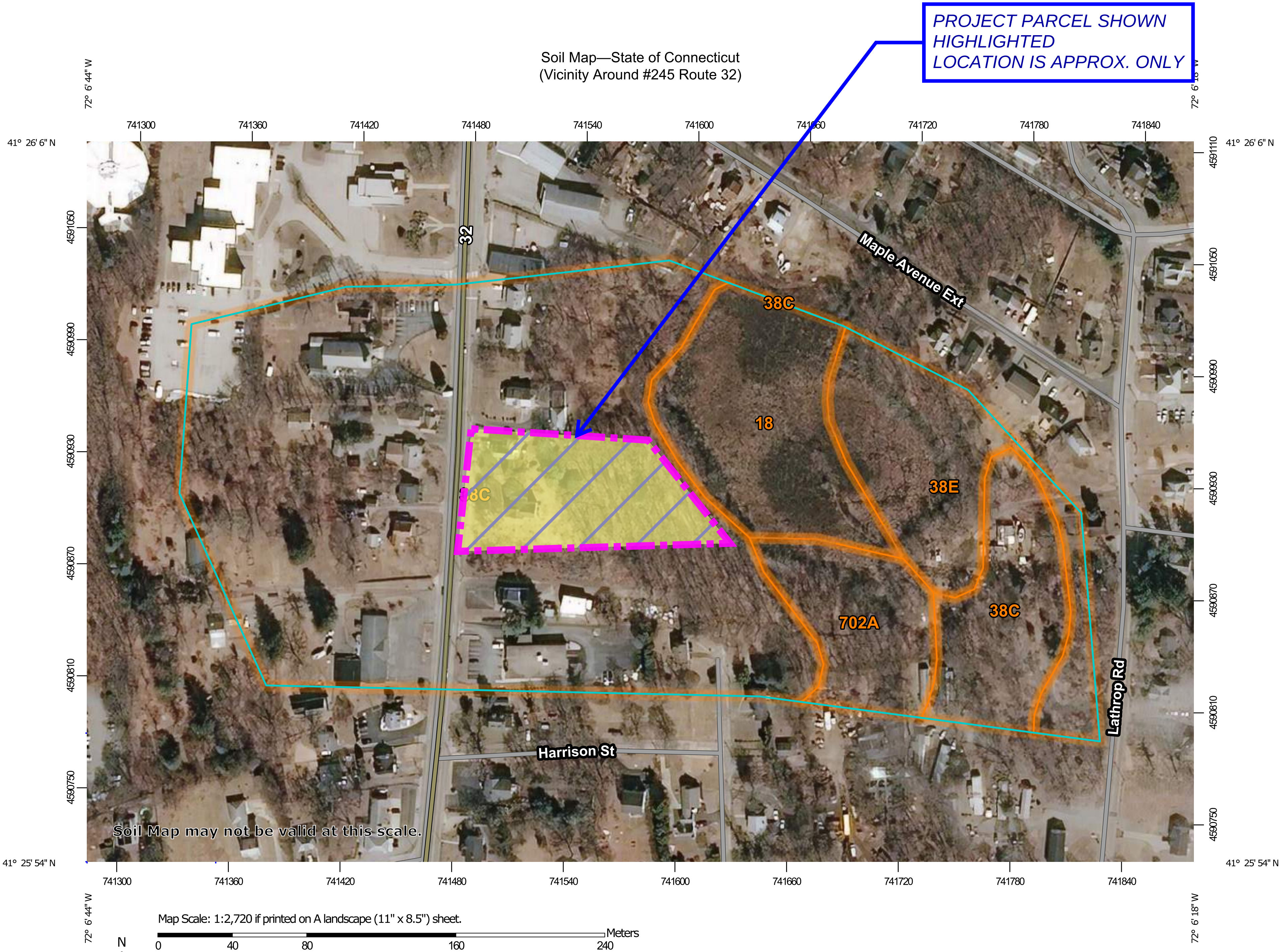
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

APPENDIX “B”

NRCS SOIL MAP AND HYDROLOGIC SOIL GROUP RATINGS

Soil Map—State of Connecticut
(Vicinity Around #245 Route 32)



Map Scale: 1:2,720 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

N

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

United States Department of Agriculture

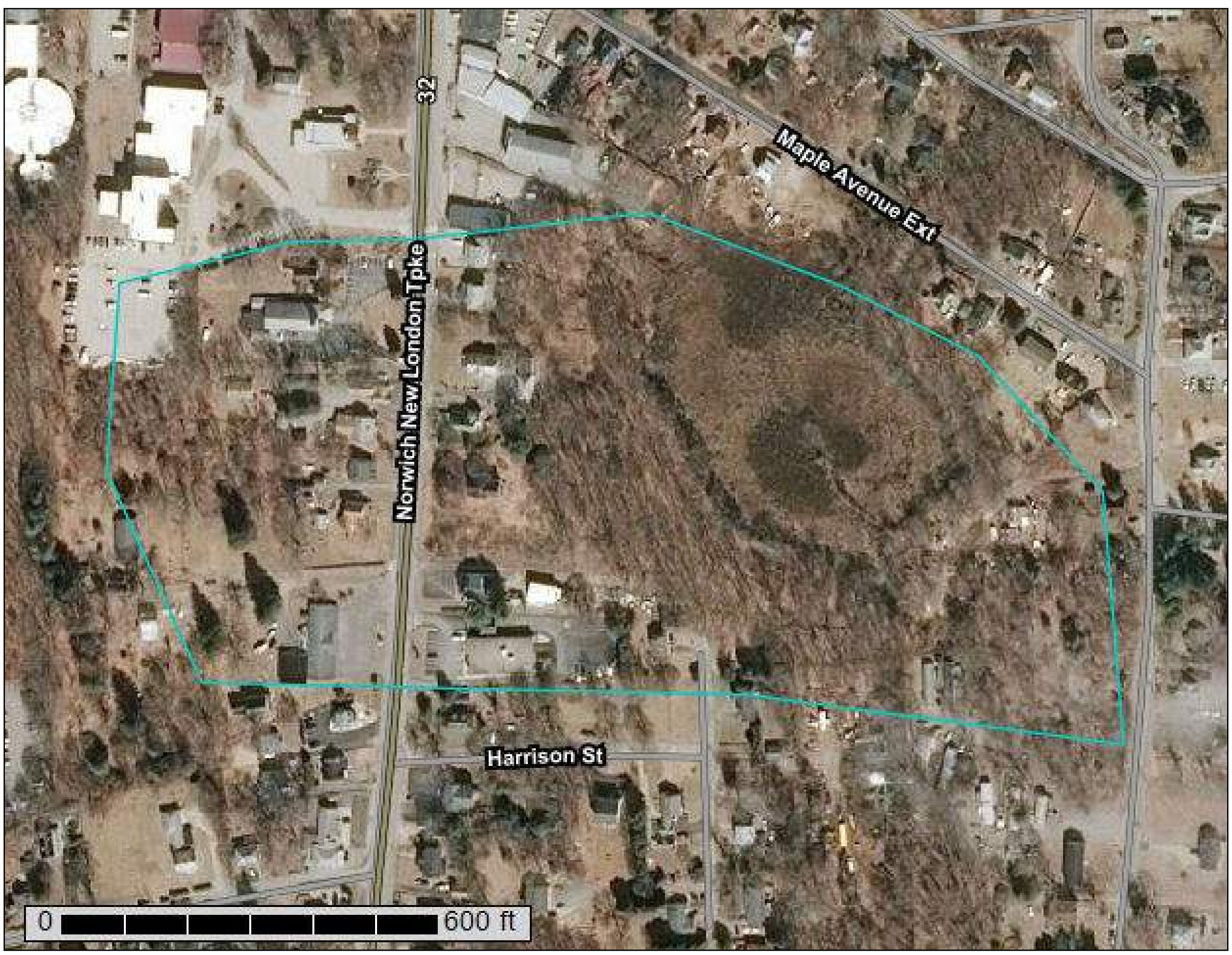
NRCS

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

State of Connecticut



January 24, 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.

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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 (#245 Norwich - New London Road Route 32 Montville, CT)

Map Scale: 1:2,720 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

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: State of Connecticut
Survey Area Data: Version 21, Sep 7, 2021

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

Date(s) aerial images were photographed: Mar 20, 2019—Mar 27, 2019

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 (#245 Norwich - New London Road Route 32 Montville, CT)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
18	Catden and Freetown soils, 0 to 2 percent slopes	2.8	11.7%
38C	Hinckley loamy sand, 3 to 15 percent slopes	17.0	70.7%
38E	Hinckley loamy sand, 15 to 45 percent slopes	2.7	11.1%
702A	Tisbury silt loam, 0 to 3 percent slopes	1.6	6.5%
Totals for Area of Interest		**24.0**	**100.0%**

Map Unit Descriptions (#245 Norwich - New London Road Route 32 Montville, CT)

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.

State of Connecticut

18—Catden and Freetown soils, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2t2r2
Elevation: 0 to 1,390 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Catden and similar soils: 45 percent
Freetown and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Catden

Setting

Landform: Depressions, kettles, marshes, swamps, depressions, bogs, fens, depressions
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed herbaceous organic material and/or highly decomposed woody organic material

Typical profile

Oa1 - 0 to 2 inches: muck
Oa2 - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: NoneRare
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very high (about 26.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY042NY - Semi-Rich Organic Wetlands
Hydric soil rating: Yes

Description of Freetown

Setting

Landform: Depressions, marshes, depressions, bogs, swamps, kettles
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: NoneRare
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 26.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Natchaug

Percent of map unit: 7 percent
Landform: Depressions, depressions, depressions
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 6 percent
Landform: Drainageways, depressions
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Timakwa

Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

Hydric soil rating: Yes

Scarboro

Percent of map unit: 2 percent
Landform: Depressions, drainageways, outwash deltas, outwash terraces
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave, linear
Hydric soil rating: Yes

38C—Hinckley loamy sand, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svmb
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser, tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Kames, outwash plains, outwash terraces, moraines, eskers
Landform position (two-dimensional): Summit, shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser, tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Agawam

Percent of map unit: 3 percent
Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, toeslope, footslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser, tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent

Landform: Outwash deltas, moraines, outwash plains, kame terraces, outwash terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

38E—Hinckley loamy sand, 15 to 45 percent slopes

Map Unit Setting

National map unit symbol: 2svmj
Elevation: 0 to 1,280 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Eskers, kames, outwash deltas, outwash terraces, moraines, outwash plains, kame terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 15 to 45 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 5 percent
Landform: Eskers, kames, moraines, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Agawam

Percent of map unit: 3 percent
Landform: Eskers, kame terraces, outwash deltas, outwash terraces, moraines, kames, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent
Landform: Kames, eskers, outwash deltas, outwash plains, kame terraces, outwash terraces, moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave

Hydric soil rating: No

702A—Tisbury silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2y07g
Elevation: 0 to 1,260 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Tisbury and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tisbury

Setting

Landform: Outwash terraces, deltas, outwash plains, valley trains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-silty eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite, schist, and/or gneiss

Typical profile

Ap - 0 to 8 inches: silt loam
Bw1 - 8 to 18 inches: silt loam
Bw2 - 18 to 26 inches: silt loam
2C - 26 to 65 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 24 to 36 inches to strongly contrasting textural stratification
Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Ecological site: F144AY026CT - Moist Silty Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Agawam

Percent of map unit: 5 percent
Landform: Kame terraces, outwash plains, outwash terraces, moraines, kames
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ninigret

Percent of map unit: 3 percent
Landform: Kame terraces, outwash plains, moraines, kames, outwash terraces
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, concave
Hydric soil rating: No

Raypol

Percent of map unit: 2 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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APPENDIX “C”

RETENTION SYSTEM STRUCTURE RATING TABLE’S

Stage-Area-Storage for Pond 1P: 60 CONCRETE GALLEY'S

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
58.33	**2,269**	0	59.39	2,269	1,428
58.35	2,269	18	59.41	2,269	1,464
58.37	2,269	36	59.43	2,269	1,499
58.39	2,269	54	59.45	2,269	1,534
58.41	2,269	73	59.47	2,269	1,569
58.43	2,269	91	59.49	2,269	1,605
58.45	2,269	109	59.51	2,269	1,640
58.47	2,269	127	59.53	2,269	1,675
58.49	2,269	145	59.55	2,269	1,711
58.51	2,269	163	59.57	2,269	1,746
58.53	2,269	182	59.59	2,269	1,781
58.55	2,269	200	59.61	2,269	1,816
58.57	2,269	218	59.63	2,269	1,852
58.59	2,269	236	59.65	2,269	1,887
58.61	2,269	254	59.67	2,269	1,922
58.63	2,269	272	59.69	2,269	1,957
58.65	2,269	290	59.71	2,269	1,992
58.67	2,269	309	59.73	2,269	2,028
58.69	2,269	327	59.75	2,269	2,063
58.71	2,269	345	59.77	2,269	2,098
58.73	2,269	363	59.79	2,269	2,133
58.75	2,269	381	59.81	2,269	2,168
58.77	2,269	399	59.83	2,269	2,204
58.79	2,269	418	59.85	2,269	2,239
58.81	2,269	436	59.87	2,269	2,274
58.83	2,269	454	59.89	2,269	2,309
58.85	2,269	488	59.91	2,269	2,344
58.87	2,269	522	59.93	2,269	2,380
58.89	2,269	556	59.95	2,269	2,415
58.91	2,269	590	59.97	2,269	2,450
58.93	2,269	624	59.99	2,269	2,485
58.95	2,269	658	60.01	2,269	2,520
58.97	2,269	692	60.03	2,269	2,555
58.99	2,269	726	60.05	2,269	2,590
59.01	2,269	760	60.07	2,269	2,625
59.03	2,269	794	60.09	2,269	2,661
59.05	2,269	829	60.11	2,269	2,696
59.07	2,269	863	60.13	2,269	2,731
59.09	2,269	898	60.15	2,269	2,766
59.11	2,269	933	60.17	2,269	2,801
59.13	2,269	969	60.19	2,269	2,836
59.15	2,269	1,004	60.21	2,269	2,871
59.17	2,269	1,039	60.23	2,269	2,906
59.19	2,269	1,075	60.25	2,269	2,941
59.21	2,269	1,110	60.27	2,269	2,976
59.23	2,269	1,146	60.29	2,269	3,011
59.25	2,269	1,181	60.31	2,269	3,046
59.27	2,269	1,216	60.33	2,269	3,082
59.29	2,269	1,252	60.35	2,269	3,117
59.31	2,269	1,287	60.37	2,269	3,152
59.33	2,269	1,322	60.39	2,269	3,187
59.35	2,269	1,358	60.41	2,269	3,222
59.37	2,269	1,393	60.43	2,269	3,257

Stage-Area-Storage for Pond 1P: 60 CONCRETE GALLEY'S (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
60.45	2,269	3,292	61.51	2,269	5,139
60.47	2,269	3,327	61.53	2,269	5,174
60.49	2,269	3,362	61.55	2,269	5,209
60.51	2,269	3,397	61.57	2,269	5,243
60.53	2,269	3,432	61.59	2,269	5,278
60.55	2,269	3,467	61.61	2,269	5,313
60.57	2,269	3,502	61.63	2,269	5,347
60.59	2,269	3,537	61.65	2,269	5,382
60.61	2,269	3,572	61.67	2,269	5,417
60.63	2,269	3,607	61.69	2,269	5,451
60.65	2,269	3,642	61.71	2,269	5,486
60.67	2,269	3,676	61.73	2,269	5,521
60.69	2,269	3,711	61.75	2,269	5,555
60.71	2,269	3,746	61.77	2,269	5,590
60.73	2,269	3,781	61.79	2,269	5,625
60.75	2,269	3,816	61.81	2,269	5,659
60.77	2,269	3,851	61.83	2,269	5,694
60.79	2,269	3,886	61.85	2,269	5,728
60.81	2,269	3,921	61.87	2,269	5,763
60.83	2,269	3,956	61.89	2,269	5,798
60.85	2,269	3,991	61.91	2,269	5,832
60.87	2,269	4,026	61.93	2,269	5,867
60.89	2,269	4,061	61.95	2,269	5,901
60.91	2,269	4,095	61.97	2,269	5,936
60.93	2,269	4,130	61.99	2,269	5,971
60.95	2,269	4,165	62.01	2,269	6,005
60.97	2,269	4,200	62.03	2,269	6,040
60.99	2,269	4,235	62.05	2,269	6,074
61.01	2,269	4,270	62.07	2,269	6,109
61.03	2,269	4,305	62.09	2,269	6,143
61.05	2,269	4,339	62.11	2,269	6,178
61.07	2,269	4,374	62.13	2,269	6,212
61.09	2,269	4,409	62.15	2,269	6,247
61.11	2,269	4,444	62.17	2,269	6,282
61.13	2,269	4,479	62.19	2,269	6,316
61.15	2,269	4,514	62.21	2,269	6,351
61.17	2,269	4,548	62.23	2,269	6,385
61.19	2,269	4,583	62.25	2,269	6,420
61.21	2,269	4,618	62.27	2,269	6,454
61.23	2,269	4,653	62.29	2,269	6,489
61.25	2,269	4,688	62.31	2,269	6,523
61.27	2,269	4,722	62.33	2,269	6,558
61.29	2,269	4,757	62.35	2,269	6,592
61.31	2,269	4,792	62.37	2,269	6,626
61.33	2,269	4,827	62.39	2,269	6,661
61.35	2,269	4,861	62.41	2,269	6,695
61.37	2,269	4,896	62.43	2,269	6,699
61.39	2,269	4,931	62.45	2,269	6,703
61.41	2,269	4,966	62.47	2,269	6,707
61.43	2,269	5,000	62.49	2,269	6,711
61.45	2,269	5,035	62.51	2,269	6,715
61.47	2,269	5,070	62.53	2,269	6,719
61.49	2,269	5,105	62.55	2,269	6,723

Stage-Area-Storage for Pond 1P: 60 CONCRETE GALLEY'S (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
62.57	2,269	6,727
62.59	2,269	6,731
62.61	2,269	6,735
62.63	2,269	6,739
62.65	2,269	6,743
62.67	2,269	6,747
62.69	2,269	6,751
62.71	2,269	6,755
62.73	2,269	6,759
62.75	2,269	6,763
62.77	2,269	6,767
62.79	2,269	6,771
62.81	2,269	6,775
62.83	2,269	6,779
62.85	2,269	6,797
62.87	2,269	6,815
62.89	2,269	6,833
62.91	2,269	6,852
62.93	2,269	6,870
62.95	2,269	6,888
62.97	2,269	6,906
62.99	2,269	6,924
63.01	2,269	6,942
63.03	2,269	6,961
63.05	2,269	6,979
63.07	2,269	6,997
63.09	2,269	7,015
63.11	2,269	7,033
63.13	2,269	7,051
63.15	2,269	7,069
63.17	2,269	7,088
63.19	2,269	7,106
63.21	2,269	7,124
63.23	2,269	7,142
63.25	2,269	7,160
63.27	2,269	7,178
63.29	2,269	7,197
63.31	2,269	7,215
63.33	2,269	7,233
63.35	2,269	7,251
63.37	2,269	7,269
63.39	2,269	7,287
63.41	2,269	7,305
63.43	2,269	7,324
63.45	2,269	7,342
63.47	2,269	7,360
63.49	2,269	**7,378**

APPENDIX “D”

WATER QUALITY VOLUME CALCULATION

Fuller Engineering & Land Surveying, LLC
525 John Street • Second Floor
Bridgeport, CT 06604
(203) 333-9465 (203) 336-1769 FAX

Project: **#245 Norwich New London Rd. CT Route 32**
MONTVILLE, CT

Date: **1/24/22**

Water Quality Volume Calc
Connecticut Stormwater Quality Manual Methodology

Completed By: **SDU**

Drainage Area: **SITE**

Checked By:

Step 1: Calculate Water Quality Volume, (WQv)

WQv = (1" x R x A) / 12

Where:
R = RvI * %I + RvT * %T + RvF * %F
RvI = Runoff Coefficient for Impervious Cover (SEE MANUAL TABLE 5.5)
%I = Percent of Site in Impervious Cover (Fraction)
RvT = Runoff Coefficient for Lawn
%T = Percent of Site in Lawn (Fraction)
RvF = Runoff Coefficient for Forest Cover
%F = Percent of Site in Forest (Fraction)
A = Tributary Drainage Area (Acre)
WQv = Required Water Quality Volume
P = 2 Year Frequency Storm (3.4)

Design Parameters									Water Quality Volume
P (in)	A (SF)	RvI	%I	RvT	%T	RvF	%F	R	(Cu. Ft.)
1.0	79,605.00	0.95	0.40	0.08	0.35	0.05	0.247	0.41584	**2758.58**

Volume Required to Store On-Site for Cleaning: **2,759 CU. FT.**

Inundated Volume provided by the subsurface systems is > 7,000 Cu. Ft.

Vol. provided by the subsurface sys. with inv. set at 61.67' (60 count) = 5,417 Cu. Ft.

Therefore the WQV is Satisfied

APPENDIX “E”

RUNOFF VOLUME REDUCTION CALCULATION

Fuller Engineering & Land Surveying, LLC
525 John Street • Second Floor
Bridgeport, CT 06604
(203) 333-9465 (203) 336-1769 FAX

Project: **#245 Norwich New London Rd. CT Route 32**
MONTVILLE, CT

Date: **1/22/22**

Runoff Volume Reduction Calc
Connecticut Stormwater Quality Manual Methodology

Completed By: **SDU**

Drainage Area: **Site**

Checked By:

Step 2: Calculate Runoff Volume Reduction, (RRV)

$$RRV = V_{post}\ (2yr) - V_{pre}\ (2yr)$$

Where: V_{post} (2yr) = Total Runoff Volume of Post-Construction Site Condition (2 yr, 24 hour storm)
V_{pre} (2yr) = Total Runoff Volume of Pre-Construction Site Condition (2 yr, 24 hour storm)

Design Parameters		Runoff Reduction Volume
Vpost (2yr)	**Vpre (2yr)**	**(Cu. Ft.)**
10278.00	3386.00	**6892.00**

Runoff will be infiltrated in proposed underground retention system.

V_{pre} (2yr) = Total Runoff Volume of Pre-Construction Site Condition (2 yr, 24 hour storm) =3,386.0 CF

V_{post} (2yr) = Total Runoff Volume of Post-Construction Site Condition (2 yr, 24 hour storm)(No BMP) =10,278.0 CF

RRV = V_{post} (2yr) - V_{pre} (2yr) = 6,892.0 CF

RSV = Proposed Retention Storage Volume * (Total Allowable for system) = 7,378 CF

* Refer to Appendix "C" for Retention Strorage Volume Calculations.

V_{post_BMP} = Total Runoff Volume of Post-Construction with BMP's (2 yr, 24 hour storm)

V_{post_BMP} =V_{post} (2yr) - RSV =10,278 - 7,378 = 2,900 CF

$V_{post\_BMP} < V_{pre}$ (2yr) **Therefore the Runoff Volume Reduction Standard is met.**

APPENDIX “f”

GROUND WATER RECHARGE VOLUME CALCULATION

Fuller Engineering & Land Surveying, LLC
525 John Street • Second Floor
Bridgeport, CT 06604
(203) 333-9465 (203) 336-1769 FAX

Project: **#245 Norwich New London Rd. CT Route 32**
MONTVILLE, CT

Date: **1/24/22**

Ground Water Recharge Volume Calculations
Connecticut Stormwater Quality Manual Methodology

Completed By: **SDU**

Drainage Area: **Urban Area (69.8% of Area)**

Checked By:

Calculate Ground Water Recharge, (GWR)

GRV = F x I

Where: GRV = Groundwater Recharge Volume (cubic-ft)
F = Target Depth Factor associated with Hydrologic Soil Group (inches)
I = Impervious Area on the Post-Development Site (sq. ft)

	Design Parameters		Groundwater Recharge Volume
	Target Depth Factor	Impervious Area	
HSG C	0.25	24,072	**501.50**

Ground Water Recharge Volume: **501.5 CU. FT.**

Total Retention Storage Volume provided by 60 Concrete Galley with gravel bed is 5,417 Cu. Ft.

Total Retention Storage Volume > Groundwater Recharge Volume, therefore Standard is met

APPENDIX “G”

TSS (TOTAL SUSPENDED SOLIDS)
REMOVAL CALCULATION

TSS Removal Calculation Worksheet

Location: 28 CONCRETE GALLEYS

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
DEEP SUMP CATCH BASIN	25%	1.00	0.25	0.75
SUBSURFACE STRUCTURE	90%	0.75	0.68	0.08
		0.08	0.00	0.08
		0.08	0.00	0.08
		0.08	0.00	0.08

Total TSS Removal = 93%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 245 ROUTE 32
Prepared By: SDU
Date: 1/24/2022

*Equals remaining load from previous BMP (E) which enters the BMP

TSS Removal Calculation Worksheet

Location: 32 CONCRETE GALLEYS

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
SUBSURFACE STRUCTURE	90%	0.08	0.07	0.01
DEEP SUMP CATCH BASIN	25%	0.01	0.00	0.01
		0.01	0.00	0.01
		0.01	0.00	0.01
		0.01	0.00	0.01

Total TSS Removal = 99%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 245 ROUTE 32
Prepared By: SDU
Date: 1/24/2022

*Equals remaining load from previous BMP (E) which enters the BMP

APPENDIX "H"

INFILTRATION SYSTEM DRAWDOWN CALCULATION

FULLER ENGINEERING & LAND SURVEYING, LLC
525 John Street • Second Floor
Bridgeport, CT 06604
(203) 333-9465 (203) 336-1769 FAX

DRAWDOWN CALCULATIONS:

245 NORWICH-NEW LONDON ROAD
STATE ROUTE 32
MONTVILLE, CT

(60) - 4' x 8' x 4' High CONCRETE GALLEY DETENTION/RETENTION SYSTEM

The storage capacity of this retention system is 5,417 cf.
Refer to Appendix "C" for a structure rating table of the system.

$$\text{Time} = \frac{DV}{K \times A}$$

SOIL CONDUCTIVITY
RATE = 20 MIN PER IN
3 IN PER HR
SAFETY FACTOR OF 2
RATE = 1.5 IN PER HR

DV =	DESIGN VOLUME	5,417	cf
K=	INFILTRATION RATE	1.5	in/hr (rate based on Soil Class)
A=	BOTTOM AREA	907.68	sf surface area x porosity of stone (122 x 18.6 x 0.4)

$$\text{Time} = \frac{5417}{(1.5)x(907.7)(1/12)}$$

Time = 47.7 hrs

The proposed Concrete Galley System volume will drawdown within 48 Hours.

DRAWDOWN CALCULATION BASED ON THE FOLLOWING:

(Using a conservative Percolation Rate of 20 min./in & Test Pit Data By Others):

TEST HOLE DATA
PERFORMED 9/30/14, BY P. LAFAYETTE, P.E.

TH-1
0-12" TOPSOIL
12-47" TAN FINE-MED. SAND W/SOME SILT
47-130" MED.-COARSE SAND AND STONES

NO MOTTLING, NO WATER, NO LEDGE

TH-2
0-6" TOPSOIL
6-40" TAN FINE-MED. SAND W/SOME SILT
40-128" MED.-COARSE SAND AND STONES

NO MOTTLING, NO WATER, NO LEDGE

TH-3
0-4" TOPSOIL
4-32" ORANGE FINE SAND W/SOME SILT & S
32-125" MED.-COARSE SAND AND STONES

NO MOTTLING, NO WATER, NO LEDGE

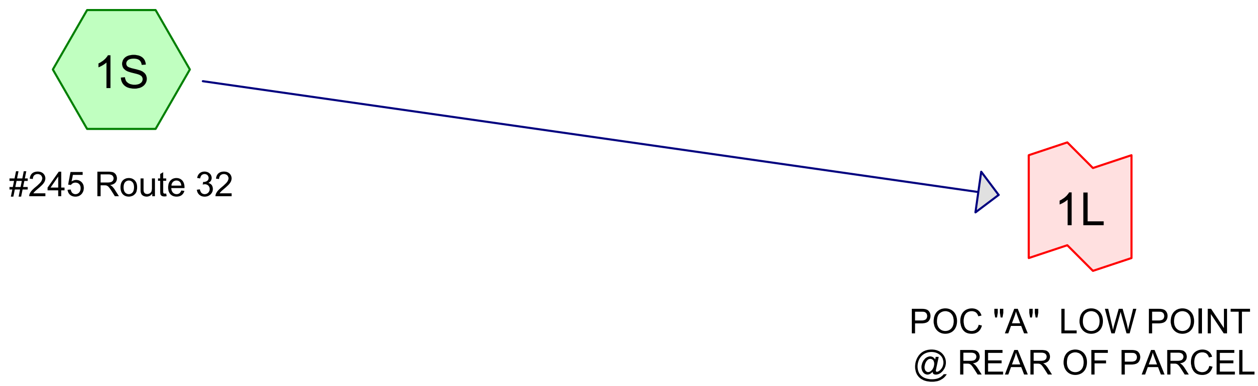
TH-2
0-10" TOPSOIL
10-52" ORANGE FINE SAND W/SOME SILT & S
52-136" MED.-COARSE SAND AND STONES

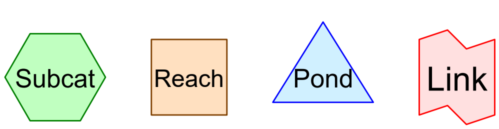
NO MOTTLING, NO WATER, NO LEDGE

NOTE: SOIL TESTING DATA PROVIDED BY OTHERS. DEVELOPMENT SOLUTIONS, LLC GRADING, DRAINAGE & UTILITY PLAN - COMMERCIAL/RESIDENTIAL COMPLEX NORWICH-NEW LONDON ROAD (ROUTE 32) MONTVILLE, CONNECTICUT. PREPARED FOR TOMASHE LLC 19 TULSA COURT MONMOUTH JUNCTION, NJ 08852. DATED SEPTEMBER 19, 2014, SCALE: 1" = 20', DRAWING NO. DS - 14 - 545.

APPENDIX “J”

HYDROCAD ANALYSIS 25-Year Storm Frequency
EXISTING CONDITIONS





Routing Diagram for PRE DEVEL
Prepared by Fuller Engineering & Land Surveying, LLC, Printed 1/24/2022
HydroCAD® 10.00 s/n 02123 © 2011 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
38,476	58	Woods/grass comb., Good, HSG B (1S)
38,866	61	>75% Grass cover, Good, HSG B (1S)
1,661	98	Roofs, HSG B (1S)
22	98	Unconnected pavement, HSG B (1S)
580	98	Unconnected roofs, HSG D (1S)
79,605	**61**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
79,025	HSG B	1S
0	HSG C	
580	HSG D	1S
0	Other	
79,605		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	38,866	0	0	0	38,866	>75% Grass cover, Good	1S
0	22	0	0	0	22	Unconnected pavement	1S
0	1,661	0	0	0	1,661	Roofs	1S
0	0	0	580	0	580	Unconnected roofs	1S
0	38,476	0	0	0	38,476	Woods/grass comb., Good	1S
0	**79,025**	**0**	**580**	**0**	**79,605**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: #245 Route 32 Runoff Area=79,605 sf 2.84% Impervious Runoff Depth>2.01"
Flow Length=580' Tc=21.6 min UI Adjusted CN=60 Runoff=2.66 cfs 13,330 cf

Link 1L: POC "A" LOW POINT @ REAR OF PARCEL Inflow=2.66 cfs 13,330 cf
Primary=2.66 cfs 13,330 cf

Total Runoff Area = 79,605 sf Runoff Volume = 13,330 cf Average Runoff Depth = 2.01"
97.16% Pervious = 77,342 sf 2.84% Impervious = 2,263 sf

Summary for Subcatchment 1S: #245 Route 32

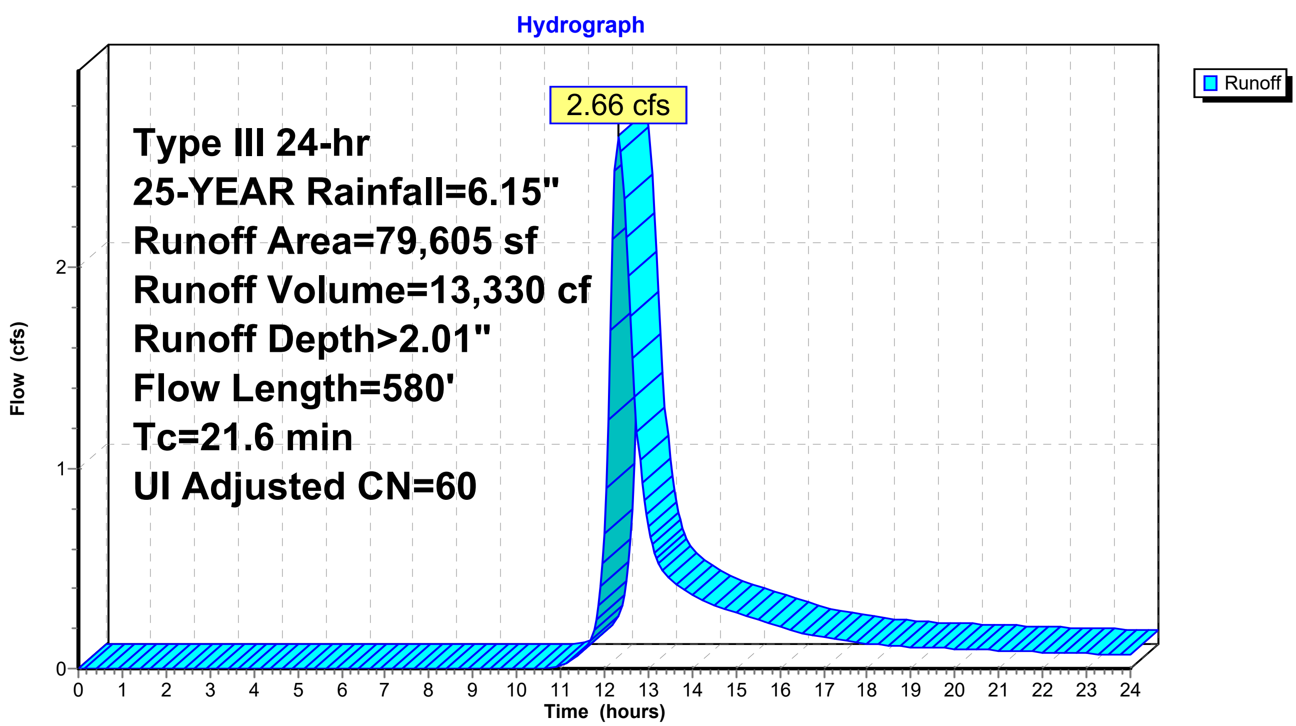
Runoff = 2.66 cfs @ 12.32 hrs, Volume= 13,330 cf, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEAR Rainfall=6.15"

Area (sf)	CN	Description
1,661	98	Roofs, HSG B
22	98	Unconnected pavement, HSG B
580	98	Unconnected roofs, HSG D
38,476	58	Woods/grass comb., Good, HSG B
38,866	61	>75% Grass cover, Good, HSG B
79,605	61	Weighted Average, UI Adjusted CN = 60
77,342		97.16% Pervious Area
2,263		2.84% Impervious Area
602		26.60% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	480	0.0695	0.71		**Lag/CN Method, Overland Flow**
10.3	100	0.1160	0.16		**Sheet Flow, Thru the Woods** Woods: Light underbrush n= 0.400 P2= 3.40"
21.6	580	Total			

Subcatchment 1S: #245 Route 32



Hydrograph for Subcatchment 1S: #245 Route 32

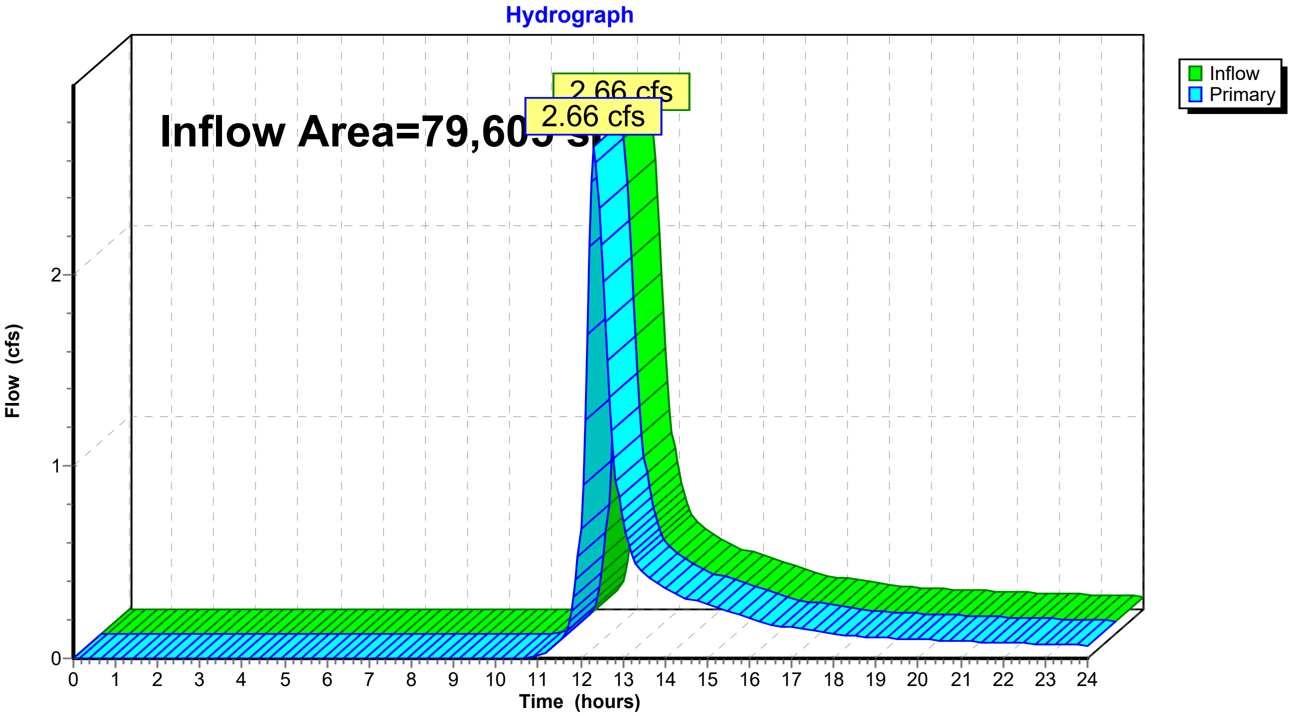
Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.02	0.00	0.00
0.50	0.03	0.00	0.00
0.75	0.05	0.00	0.00
1.00	0.06	0.00	0.00
1.25	0.08	0.00	0.00
1.50	0.09	0.00	0.00
1.75	0.11	0.00	0.00
2.00	0.12	0.00	0.00
2.25	0.14	0.00	0.00
2.50	0.15	0.00	0.00
2.75	0.17	0.00	0.00
3.00	0.19	0.00	0.00
3.25	0.21	0.00	0.00
3.50	0.23	0.00	0.00
3.75	0.24	0.00	0.00
4.00	0.26	0.00	0.00
4.25	0.28	0.00	0.00
4.50	0.31	0.00	0.00
4.75	0.33	0.00	0.00
5.00	0.35	0.00	0.00
5.25	0.37	0.00	0.00
5.50	0.39	0.00	0.00
5.75	0.42	0.00	0.00
6.00	0.44	0.00	0.00
6.25	0.47	0.00	0.00
6.50	0.50	0.00	0.00
6.75	0.53	0.00	0.00
7.00	0.56	0.00	0.00
7.25	0.59	0.00	0.00
7.50	0.62	0.00	0.00
7.75	0.66	0.00	0.00
8.00	0.70	0.00	0.00
8.25	0.74	0.00	0.00
8.50	0.79	0.00	0.00
8.75	0.84	0.00	0.00
9.00	0.90	0.00	0.00
9.25	0.96	0.00	0.00
9.50	1.02	0.00	0.00
9.75	1.09	0.00	0.00
10.00	1.16	0.00	0.00
10.25	1.24	0.00	0.00
10.50	1.33	0.00	0.00
10.75	1.43	0.00	0.00
11.00	1.54	0.01	0.02
11.25	1.67	0.02	0.04
11.50	1.83	0.03	0.09
11.75	2.18	0.10	0.19
12.00	3.07	0.36	0.68
12.25	3.97	0.74	**2.48**
12.50	4.32	0.92	**2.15**
12.75	4.48	1.01	1.18
13.00	4.61	1.08	0.71
13.25	4.72	1.14	0.52
13.50	4.82	1.20	0.44
13.75	4.91	1.25	0.40
14.00	4.99	1.29	0.37
14.25	5.06	1.34	0.34
14.50	5.13	1.38	0.31
14.75	5.19	1.42	0.30
15.00	5.25	1.45	0.28
15.25	5.31	1.49	0.26
15.50	5.36	1.52	0.24
15.75	5.41	1.54	0.23
16.00	5.45	1.57	0.21
16.25	5.49	1.60	0.19
16.50	5.53	1.62	0.18
16.75	5.56	1.64	0.17
17.00	5.59	1.66	0.16
17.25	5.62	1.68	0.15
17.50	5.65	1.70	0.14
17.75	5.68	1.72	0.14
18.00	5.71	1.73	0.13
18.25	5.73	1.75	0.12
18.50	5.76	1.76	0.11
18.75	5.78	1.78	0.11
19.00	5.80	1.79	0.11
19.25	5.82	1.81	0.11
19.50	5.84	1.82	0.10
19.75	5.87	1.83	0.10
20.00	5.89	1.85	0.10
20.25	5.91	1.86	0.10
20.50	5.92	1.87	0.09
20.75	5.94	1.88	0.09
21.00	5.96	1.90	0.09
21.25	5.98	1.91	0.09
21.50	6.00	1.92	0.09
21.75	6.01	1.93	0.08
22.00	6.03	1.94	0.08
22.25	6.05	1.95	0.08
22.50	6.06	1.96	0.08
22.75	6.08	1.97	0.08
23.00	6.09	1.98	0.07
23.25	6.11	1.99	0.07
23.50	6.12	2.00	0.07
23.75	6.14	2.01	0.07
24.00	**6.15**	**2.02**	0.07

Summary for Link 1L: POC "A" LOW POINT @ REAR OF PARCEL

Inflow Area = 79,605 sf, 2.84% Impervious, Inflow Depth > 2.01" for 25-YEAR event
Inflow = 2.66 cfs @ 12.32 hrs, Volume= 13,330 cf
Primary = 2.66 cfs @ 12.32 hrs, Volume= 13,330 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: POC "A" LOW POINT @ REAR OF PARCEL

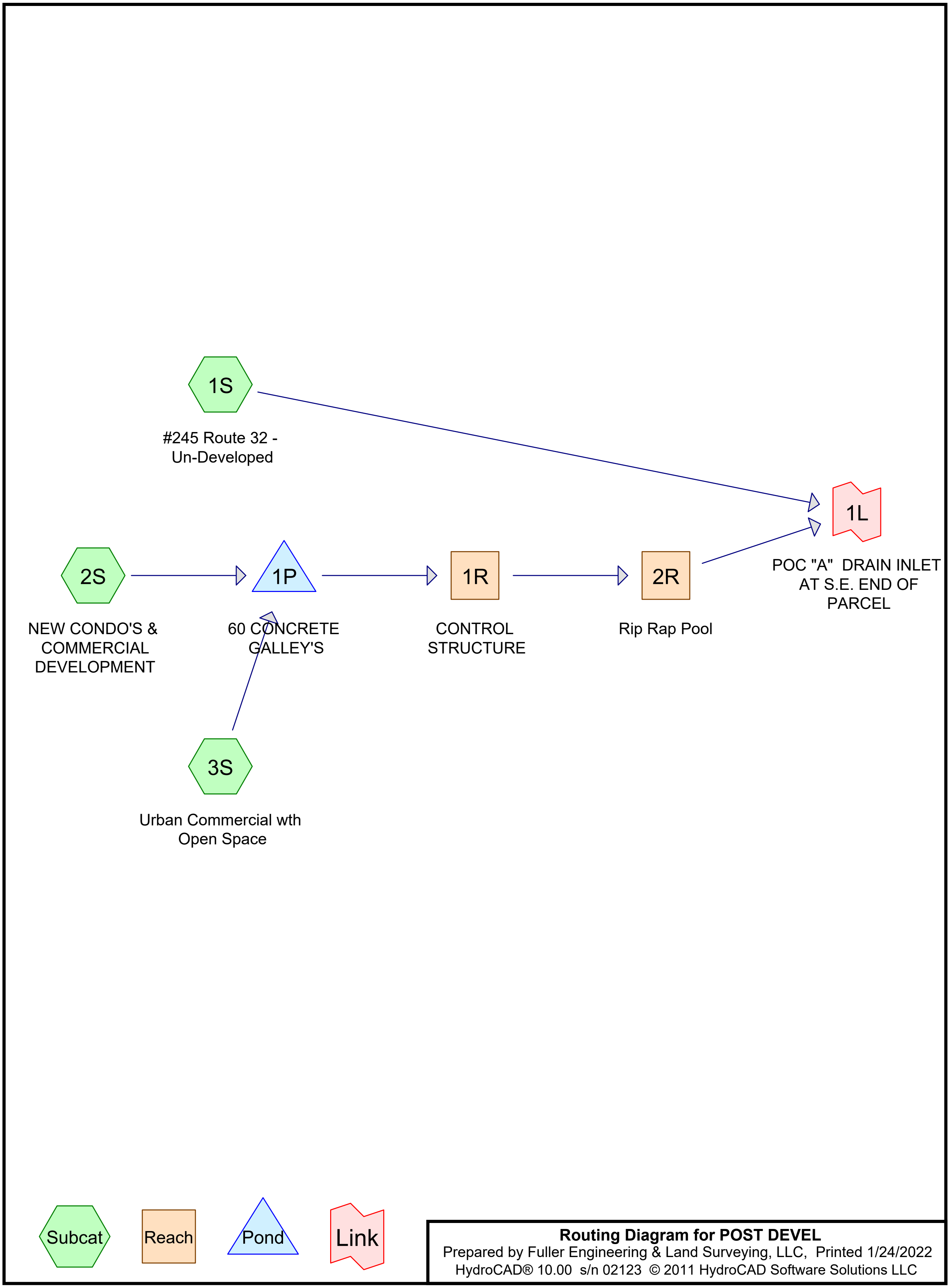


Hydrograph for Link 1L: POC "A" LOW POINT @ REAR OF PARCEL

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00
0.25	0.00	0.00	0.00
0.50	0.00	0.00	0.00
0.75	0.00	0.00	0.00
1.00	0.00	0.00	0.00
1.25	0.00	0.00	0.00
1.50	0.00	0.00	0.00
1.75	0.00	0.00	0.00
2.00	0.00	0.00	0.00
2.25	0.00	0.00	0.00
2.50	0.00	0.00	0.00
2.75	0.00	0.00	0.00
3.00	0.00	0.00	0.00
3.25	0.00	0.00	0.00
3.50	0.00	0.00	0.00
3.75	0.00	0.00	0.00
4.00	0.00	0.00	0.00
4.25	0.00	0.00	0.00
4.50	0.00	0.00	0.00
4.75	0.00	0.00	0.00
5.00	0.00	0.00	0.00
5.25	0.00	0.00	0.00
5.50	0.00	0.00	0.00
5.75	0.00	0.00	0.00
6.00	0.00	0.00	0.00
6.25	0.00	0.00	0.00
6.50	0.00	0.00	0.00
6.75	0.00	0.00	0.00
7.00	0.00	0.00	0.00
7.25	0.00	0.00	0.00
7.50	0.00	0.00	0.00
7.75	0.00	0.00	0.00
8.00	0.00	0.00	0.00
8.25	0.00	0.00	0.00
8.50	0.00	0.00	0.00
8.75	0.00	0.00	0.00
9.00	0.00	0.00	0.00
9.25	0.00	0.00	0.00
9.50	0.00	0.00	0.00
9.75	0.00	0.00	0.00
10.00	0.00	0.00	0.00
10.25	0.00	0.00	0.00
10.50	0.00	0.00	0.00
10.75	0.00	0.00	0.00
11.00	0.02	0.00	0.02
11.25	0.04	0.00	0.04
11.50	0.09	0.00	0.09
11.75	0.19	0.00	0.19
12.00	0.68	0.00	0.68
12.25	**2.48**	0.00	**2.48**
12.50	**2.15**	0.00	**2.15**
12.75	1.18	0.00	1.18
13.00	0.71	0.00	0.71
13.25	0.52	0.00	0.52
13.50	0.44	0.00	0.44
13.75	0.40	0.00	0.40
14.00	0.37	0.00	0.37
14.25	0.34	0.00	0.34
14.50	0.31	0.00	0.31
14.75	0.30	0.00	0.30
15.00	0.28	0.00	0.28
15.25	0.26	0.00	0.26
15.50	0.24	0.00	0.24
15.75	0.23	0.00	0.23
16.00	0.21	0.00	0.21
16.25	0.19	0.00	0.19
16.50	0.18	0.00	0.18
16.75	0.17	0.00	0.17
17.00	0.16	0.00	0.16
17.25	0.15	0.00	0.15
17.50	0.14	0.00	0.14
17.75	0.14	0.00	0.14
18.00	0.13	0.00	0.13
18.25	0.12	0.00	0.12
18.50	0.11	0.00	0.11
18.75	0.11	0.00	0.11
19.00	0.11	0.00	0.11
19.25	0.11	0.00	0.11
19.50	0.10	0.00	0.10
19.75	0.10	0.00	0.10
20.00	0.10	0.00	0.10
20.25	0.10	0.00	0.10
20.50	0.09	0.00	0.09
20.75	0.09	0.00	0.09
21.00	0.09	0.00	0.09
21.25	0.09	0.00	0.09
21.50	0.09	0.00	0.09
21.75	0.08	0.00	0.08
22.00	0.08	0.00	0.08
22.25	0.08	0.00	0.08
22.50	0.08	0.00	0.08
22.75	0.08	0.00	0.08
23.00	0.07	0.00	0.07
23.25	0.07	0.00	0.07
23.50	0.07	0.00	0.07
23.75	0.07	0.00	0.07
24.00	0.07	0.00	0.07

APPENDIX "K"

HYDROCAD ANALYSIS 25-Year Storm Frequency
PROPOSED CONDITIONS


1S
#245 Route 32 -
Un-Developed
2S
NEW CONDO'S &
COMMERCIAL
DEVELOPMENT
1P
60 CONCRETE
GALLEY'S
1R
CONTROL
STRUCTURE
2R
Rip Rap Pool
1L
POC "A" DRAIN INLET
AT S.E. END OF
PARCEL
3S
Urban Commercial wth
Open Space
Subcat
Reach
Pond
Link
Routing Diagram for POST DEVEL
Prepared by Fuller Engineering & Land Surveying, LLC, Printed 1/24/2022
HydroCAD® 10.00 s/n 02123 © 2011 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
19,656	65	Brush, Good, HSG C (1S)
27,548	69	50-75% Grass cover, Fair, HSG B (3S)
11,898	81	1/3 acre lots, 30% imp, HSG C (2S)
20,503	98	Roofs, HSG B (2S)
79,605	**77**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
48,051	HSG B	2S, 3S
31,554	HSG C	1S, 2S
0	HSG D	
0	Other	
79,605		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	27,548	0	0	0	27,548	50-75% Grass cover, Fair	3S
0	20,503	0	0	0	20,503	Roofs	2S
0	0	11,898	0	0	11,898	1/3 acre lots, 30% imp	2S
0	0	19,656	0	0	19,656	Brush, Good	1S
0	**48,051**	**31,554**	**0**	**0**	**79,605**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: #245 Route 32 - Un-Developed Runoff Area=19,656 sf 0.00% Impervious Runoff Depth>2.45"
Flow Length=120' Slope=0.1080 '/' Tc=12.7 min CN=65 Runoff=1.01 cfs 4,020 cf

Subcatchment 2S: NEW CONDO'S & Runoff Area=32,401 sf 74.30% Impervious Runoff Depth>5.18"
Flow Length=668' Slope=0.0750 '/' Tc=40.8 min CN=92 Runoff=2.10 cfs 13,998 cf

Subcatchment 3S: Urban Commercial wth Open Runoff Area=27,548 sf 0.00% Impervious Runoff Depth>2.81"
Tc=29.3 min CN=69 Runoff=1.19 cfs 6,455 cf

Reach 1R: CONTROL STRUCTURE Avg. Flow Depth=0.01' Max Vel=154.72 fps Inflow=1.76 cfs 5,838 cf
n=0.013 L=5.0' S=1.8320 '/' Capacity=3,515.86 cfs Outflow=1.76 cfs 5,838 cf

Reach 2R: Rip Rap Pool Avg. Flow Depth=0.44' Max Vel=2.45 fps Inflow=1.76 cfs 5,838 cf
n=0.040 L=10.0' S=0.0250 '/' Capacity=130.02 cfs Outflow=1.76 cfs 5,838 cf

Pond 1P: 60 CONCRETE GALLEY'S Peak Elev=62.39' Storage=6,666 cf Inflow=3.23 cfs 20,453 cf
Discarded=0.22 cfs 12,033 cf Primary=1.76 cfs 5,838 cf Outflow=1.99 cfs 17,871 cf

Link 1L: POC "A" DRAIN INLET AT S.E. END OF PARCEL Inflow=1.94 cfs 9,858 cf
Primary=1.94 cfs 9,858 cf

Total Runoff Area = 79,605 sf Runoff Volume = 24,473 cf Average Runoff Depth = 3.69"
69.76% Pervious = 55,533 sf 30.24% Impervious = 24,072 sf

Summary for Subcatchment 1S: #245 Route 32 - Un-Developed

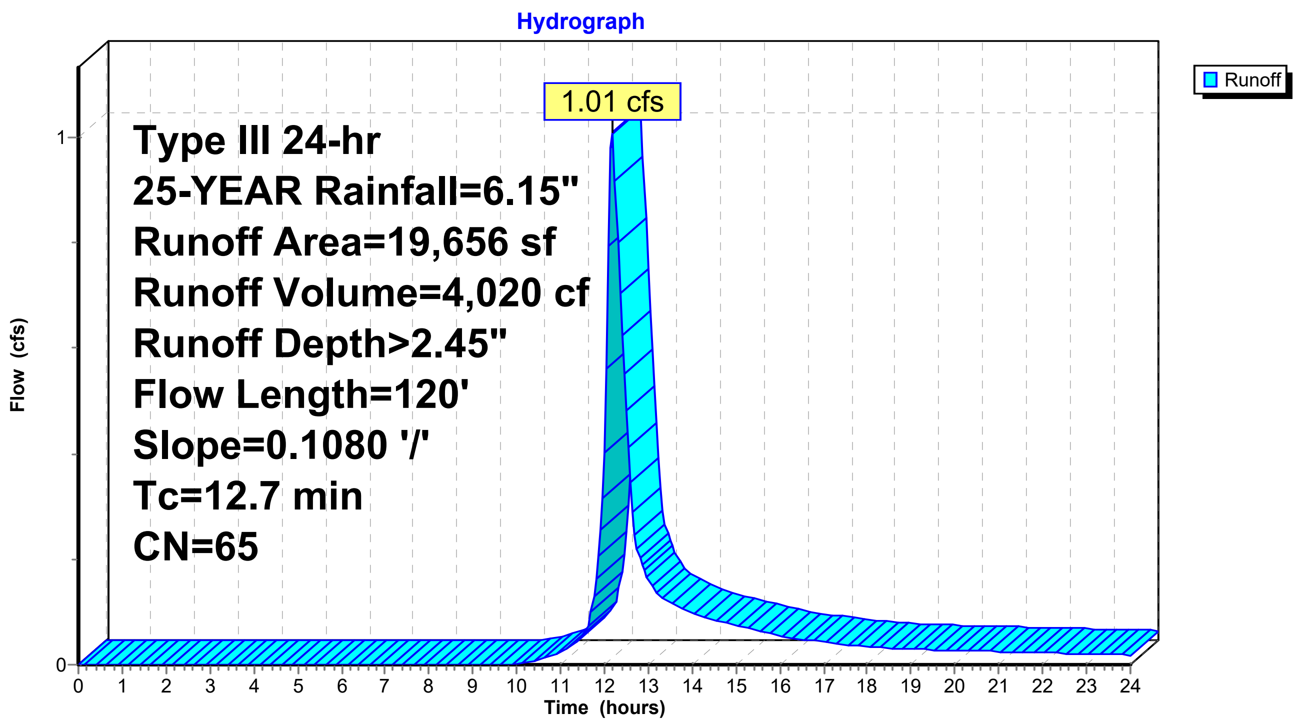
Runoff = 1.01 cfs @ 12.19 hrs, Volume= 4,020 cf, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEAR Rainfall=6.15"

Area (sf)	CN	Description
19,656	65	Brush, Good, HSG C
19,656		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	120	0.1080	0.74		**Lag/CN Method, Overland Flow**
10.0					**Direct Entry, HydroStatic Seepage from Wall**
12.7	120	Total			

Subcatchment 1S: #245 Route 32 - Un-Developed



Hydrograph for Subcatchment 1S: #245 Route 32 - Un-Developed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.02	0.00	0.00
0.50	0.03	0.00	0.00
0.75	0.05	0.00	0.00
1.00	0.06	0.00	0.00
1.25	0.08	0.00	0.00
1.50	0.09	0.00	0.00
1.75	0.11	0.00	0.00
2.00	0.12	0.00	0.00
2.25	0.14	0.00	0.00
2.50	0.15	0.00	0.00
2.75	0.17	0.00	0.00
3.00	0.19	0.00	0.00
3.25	0.21	0.00	0.00
3.50	0.23	0.00	0.00
3.75	0.24	0.00	0.00
4.00	0.26	0.00	0.00
4.25	0.28	0.00	0.00
4.50	0.31	0.00	0.00
4.75	0.33	0.00	0.00
5.00	0.35	0.00	0.00
5.25	0.37	0.00	0.00
5.50	0.39	0.00	0.00
5.75	0.42	0.00	0.00
6.00	0.44	0.00	0.00
6.25	0.47	0.00	0.00
6.50	0.50	0.00	0.00
6.75	0.53	0.00	0.00
7.00	0.56	0.00	0.00
7.25	0.59	0.00	0.00
7.50	0.62	0.00	0.00
7.75	0.66	0.00	0.00
8.00	0.70	0.00	0.00
8.25	0.74	0.00	0.00
8.50	0.79	0.00	0.00
8.75	0.84	0.00	0.00
9.00	0.90	0.00	0.00
9.25	0.96	0.00	0.00
9.50	1.02	0.00	0.00
9.75	1.09	0.00	0.00
10.00	1.16	0.00	0.00
10.25	1.24	0.00	0.01
10.50	1.33	0.01	0.01
10.75	1.43	0.02	0.02
11.00	1.54	0.04	0.02
11.25	1.67	0.06	0.04
11.50	1.83	0.09	0.06
11.75	2.18	0.19	0.13
12.00	3.07	0.54	**0.40**
12.25	3.97	1.01	**0.92**
12.50	4.32	1.22	0.48
12.75	4.48	1.32	0.22
13.00	4.61	1.40	0.16
13.25	4.72	1.47	0.13
13.50	4.82	1.53	0.12
13.75	4.91	1.59	0.11
14.00	4.99	1.65	0.10
14.25	5.06	1.69	0.09
14.50	5.13	1.74	0.09
14.75	5.19	1.78	0.08
15.00	5.25	1.82	0.08
15.25	5.31	1.86	0.07
15.50	5.36	1.90	0.07
15.75	5.41	1.93	0.06
16.00	5.45	1.96	0.05
16.25	5.49	1.99	0.05
16.50	5.53	2.01	0.05
16.75	5.56	2.04	0.05
17.00	5.59	2.06	0.04
17.25	5.62	2.08	0.04
17.50	5.65	2.10	0.04
17.75	5.68	2.12	0.04
18.00	5.71	2.14	0.03
18.25	5.73	2.16	0.03
18.50	5.76	2.17	0.03
18.75	5.78	2.19	0.03
19.00	5.80	2.21	0.03
19.25	5.82	2.22	0.03
19.50	5.84	2.24	0.03
19.75	5.87	2.25	0.03
20.00	5.89	2.27	0.03
20.25	5.91	2.28	0.03
20.50	5.92	2.30	0.03
20.75	5.94	2.31	0.03
21.00	5.96	2.32	0.02
21.25	5.98	2.34	0.02
21.50	6.00	2.35	0.02
21.75	6.01	2.36	0.02
22.00	6.03	2.37	0.02
22.25	6.05	2.39	0.02
22.50	6.06	2.40	0.02
22.75	6.08	2.41	0.02
23.00	6.09	2.42	0.02
23.25	6.11	2.43	0.02
23.50	6.12	2.44	0.02
23.75	6.14	2.45	0.02
24.00	**6.15**	**2.46**	0.02

Summary for Subcatchment 2S: NEW CONDO'S & COMMERCIAL DEVELOPMENT

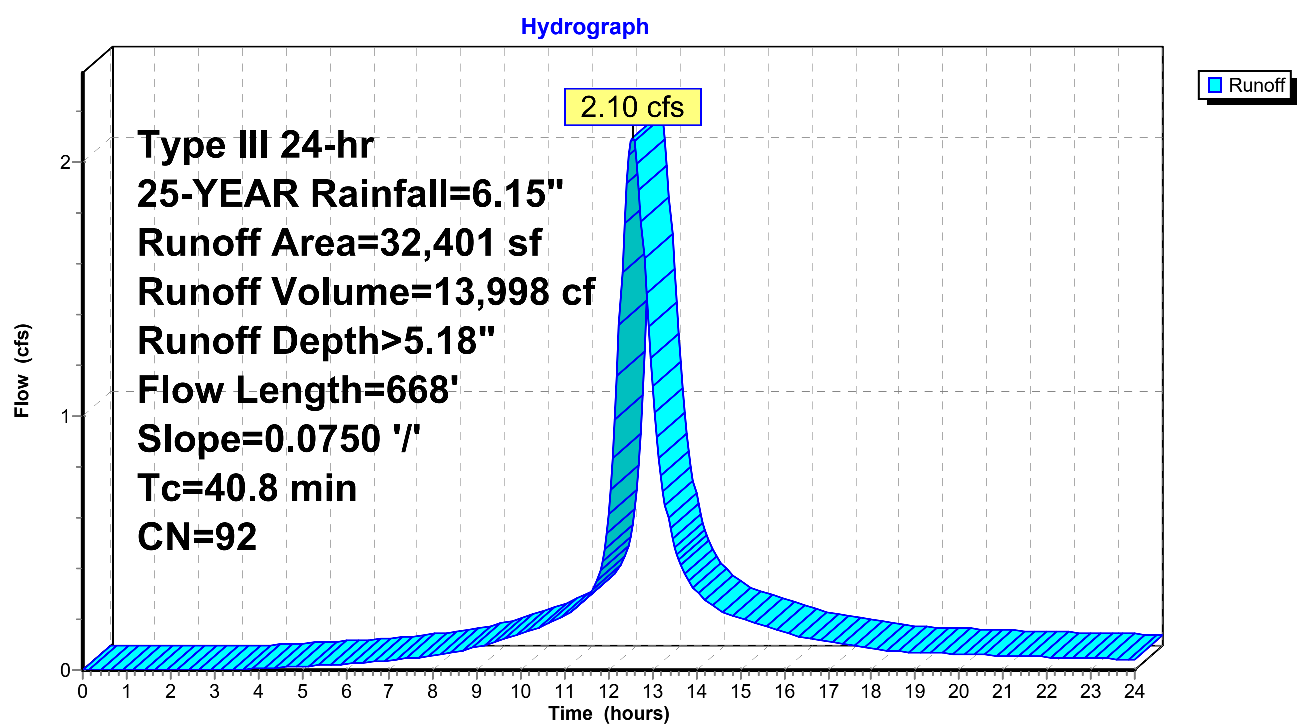
Runoff = 2.10 cfs @ 12.54 hrs, Volume= 13,998 cf, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEAR Rainfall=6.15"

Area (sf)	CN	Description
20,503	98	Roofs, HSG B
11,898	81	1/3 acre lots, 30% imp, HSG C
32,401	92	Weighted Average
8,329		25.70% Pervious Area
24,072		74.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.0					**Direct Entry, DIRECT**
0.6	456		12.69		**Lake or Reservoir, DETENTION** Mean Depth= 5.00'
10.2	212	0.0750	0.35		**Sheet Flow, OverLand Flow** Grass: Short n= 0.150 P2= 3.40"
40.8	668	Total			

Subcatchment 2S: NEW CONDO'S & COMMERCIAL DEVELOPMENT



Hydrograph for Subcatchment 2S: NEW CONDO'S & COMMERCIAL DEVELOPMENT

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.02	0.00	0.00
0.50	0.03	0.00	0.00
0.75	0.05	0.00	0.00
1.00	0.06	0.00	0.00
1.25	0.08	0.00	0.00
1.50	0.09	0.00	0.00
1.75	0.11	0.00	0.00
2.00	0.12	0.00	0.00
2.25	0.14	0.00	0.00
2.50	0.15	0.00	0.00
2.75	0.17	0.00	0.00
3.00	0.19	0.00	0.00
3.25	0.21	0.00	0.00
3.50	0.23	0.00	0.00
3.75	0.24	0.01	0.00
4.00	0.26	0.01	0.01
4.25	0.28	0.01	0.01
4.50	0.31	0.02	0.01
4.75	0.33	0.02	0.01
5.00	0.35	0.03	0.01
5.25	0.37	0.04	0.02
5.50	0.39	0.04	0.02
5.75	0.42	0.05	0.02
6.00	0.44	0.06	0.02
6.25	0.47	0.07	0.03
6.50	0.50	0.09	0.03
6.75	0.53	0.10	0.03
7.00	0.56	0.12	0.04
7.25	0.59	0.13	0.04
7.50	0.62	0.15	0.05
7.75	0.66	0.18	0.05
8.00	0.70	0.20	0.06
8.25	0.74	0.23	0.06
8.50	0.79	0.26	0.07
8.75	0.84	0.29	0.08
9.00	0.90	0.33	0.09
9.25	0.96	0.37	0.10
9.50	1.02	0.42	0.12
9.75	1.09	0.47	0.13
10.00	1.16	0.53	0.14
10.25	1.24	0.59	0.16
10.50	1.33	0.66	0.17
10.75	1.43	0.74	0.19
11.00	1.54	0.83	0.22
11.25	1.67	0.94	0.24
11.50	1.83	1.09	0.29
11.75	2.18	1.40	0.36
12.00	3.07	2.23	0.61
12.25	3.97	3.08	1.36
12.50	4.32	3.42	**2.09**
12.75	4.48	3.59	**1.76**
13.00	4.61	3.71	1.11
13.25	4.72	3.82	0.70
13.50	4.82	3.91	0.49
13.75	4.91	4.00	0.37
14.00	4.99	4.08	0.31
14.25	5.06	4.15	0.27
14.50	5.13	4.22	0.24
14.75	5.19	4.28	0.22
15.00	5.25	4.34	0.20
15.25	5.31	4.39	0.19
15.50	5.36	4.44	0.18
15.75	5.41	4.49	0.16
16.00	5.45	4.53	0.15
16.25	5.49	4.57	0.14
16.50	5.53	4.60	0.13
16.75	5.56	4.64	0.12
17.00	5.59	4.67	0.11
17.25	5.62	4.70	0.10
17.50	5.65	4.73	0.10
17.75	5.68	4.76	0.09
18.00	5.71	4.78	0.09
18.25	5.73	4.81	0.08
18.50	5.76	4.83	0.08
18.75	5.78	4.85	0.07
19.00	5.80	4.87	0.07
19.25	5.82	4.90	0.07
19.50	5.84	4.92	0.07
19.75	5.87	4.94	0.06
20.00	5.89	4.96	0.06
20.25	5.91	4.98	0.06
20.50	5.92	5.00	0.06
20.75	5.94	5.01	0.06
21.00	5.96	5.03	0.06
21.25	5.98	5.05	0.06
21.50	6.00	5.07	0.05
21.75	6.01	5.08	0.05
22.00	6.03	5.10	0.05
22.25	6.05	5.12	0.05
22.50	6.06	5.13	0.05
22.75	6.08	5.15	0.05
23.00	6.09	5.16	0.05
23.25	6.11	5.18	0.05
23.50	6.12	5.19	0.04
23.75	6.14	5.20	0.04
24.00	**6.15**	**5.22**	0.04

Summary for Subcatchment 3S: Urban Commercial wth Open Space

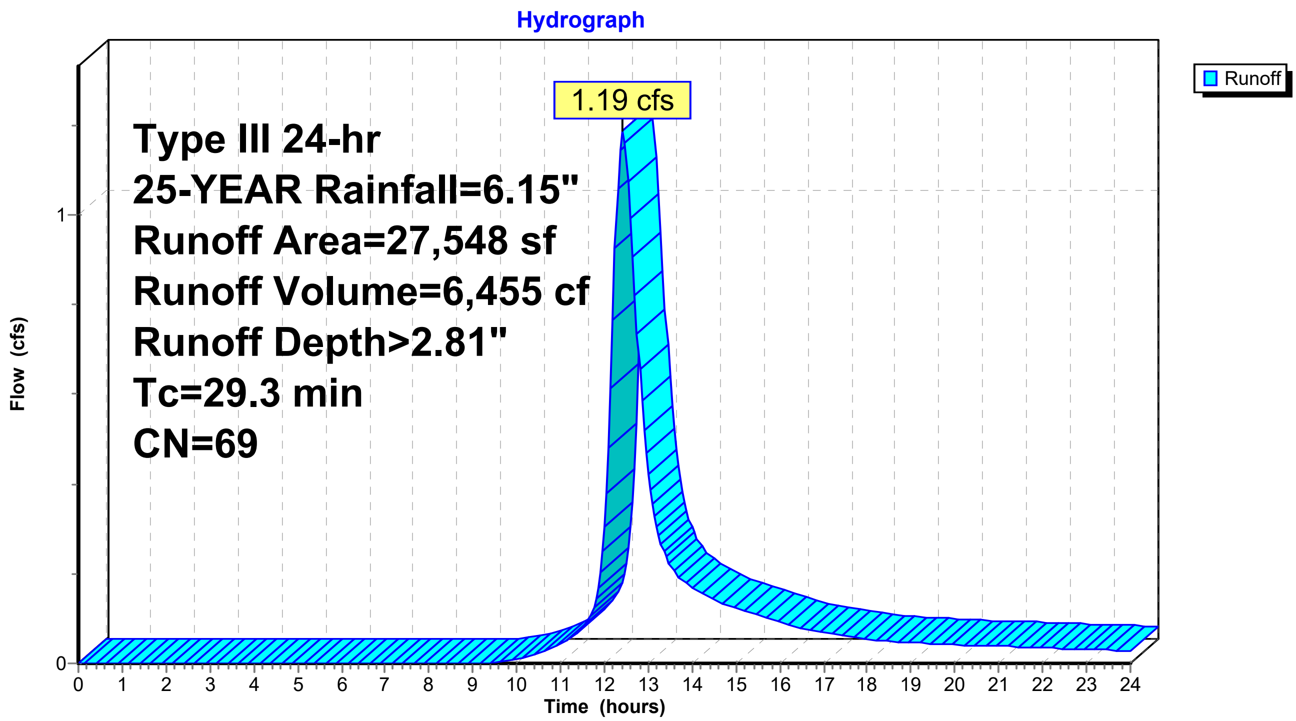
Runoff = 1.19 cfs @ 12.42 hrs, Volume= 6,455 cf, Depth> 2.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEAR Rainfall=6.15"

Area (sf)	CN	Description
27,548	69	50-75% Grass cover, Fair, HSG B
27,548		100.00% Pervious Area

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

Subcatchment 3S: Urban Commercial wth Open Space



Hydrograph for Subcatchment 3S: Urban Commercial wth Open Space

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.02	0.00	0.00
0.50	0.03	0.00	0.00
0.75	0.05	0.00	0.00
1.00	0.06	0.00	0.00
1.25	0.08	0.00	0.00
1.50	0.09	0.00	0.00
1.75	0.11	0.00	0.00
2.00	0.12	0.00	0.00
2.25	0.14	0.00	0.00
2.50	0.15	0.00	0.00
2.75	0.17	0.00	0.00
3.00	0.19	0.00	0.00
3.25	0.21	0.00	0.00
3.50	0.23	0.00	0.00
3.75	0.24	0.00	0.00
4.00	0.26	0.00	0.00
4.25	0.28	0.00	0.00
4.50	0.31	0.00	0.00
4.75	0.33	0.00	0.00
5.00	0.35	0.00	0.00
5.25	0.37	0.00	0.00
5.50	0.39	0.00	0.00
5.75	0.42	0.00	0.00
6.00	0.44	0.00	0.00
6.25	0.47	0.00	0.00
6.50	0.50	0.00	0.00
6.75	0.53	0.00	0.00
7.00	0.56	0.00	0.00
7.25	0.59	0.00	0.00
7.50	0.62	0.00	0.00
7.75	0.66	0.00	0.00
8.00	0.70	0.00	0.00
8.25	0.74	0.00	0.00
8.50	0.79	0.00	0.00
8.75	0.84	0.00	0.00
9.00	0.90	0.00	0.00
9.25	0.96	0.00	0.00
9.50	1.02	0.00	0.00
9.75	1.09	0.01	0.01
10.00	1.16	0.01	0.01
10.25	1.24	0.02	0.02
10.50	1.33	0.04	0.02
10.75	1.43	0.06	0.03
11.00	1.54	0.08	0.04
11.25	1.67	0.11	0.06
11.50	1.83	0.16	0.08
11.75	2.18	0.29	0.12
12.00	3.07	0.71	0.30
12.25	3.97	1.24	**0.92**
12.50	4.32	1.48	**1.14**
12.75	4.48	1.59	0.73
13.00	4.61	1.68	0.42
13.25	4.72	1.76	0.28
13.50	4.82	1.83	0.22
13.75	4.91	1.89	0.19
14.00	4.99	1.95	0.17
14.25	5.06	2.00	0.15
14.50	5.13	2.05	0.14
14.75	5.19	2.10	0.13
15.00	5.25	2.14	0.12
15.25	5.31	2.18	0.12
15.50	5.36	2.22	0.11
15.75	5.41	2.26	0.10
16.00	5.45	2.29	0.09
16.25	5.49	2.32	0.08
16.50	5.53	2.35	0.08
16.75	5.56	2.37	0.07
17.00	5.59	2.40	0.07
17.25	5.62	2.42	0.07
17.50	5.65	2.45	0.06
17.75	5.68	2.47	0.06
18.00	5.71	2.49	0.05
18.25	5.73	2.50	0.05
18.50	5.76	2.52	0.05
18.75	5.78	2.54	0.05
19.00	5.80	2.56	0.05
19.25	5.82	2.58	0.04
19.50	5.84	2.59	0.04
19.75	5.87	2.61	0.04
20.00	5.89	2.62	0.04
20.25	5.91	2.64	0.04
20.50	5.92	2.65	0.04
20.75	5.94	2.67	0.04
21.00	5.96	2.68	0.04
21.25	5.98	2.70	0.04
21.50	6.00	2.71	0.04
21.75	6.01	2.72	0.04
22.00	6.03	2.74	0.03
22.25	6.05	2.75	0.03
22.50	6.06	2.76	0.03
22.75	6.08	2.77	0.03
23.00	6.09	2.79	0.03
23.25	6.11	2.80	0.03
23.50	6.12	2.81	0.03
23.75	6.14	2.82	0.03
24.00	**6.15**	**2.83**	0.03

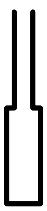
Summary for Reach 1R: CONTROL STRUCTURE

Inflow Area = 59,949 sf, 40.15% Impervious, Inflow Depth = 1.17" for 25-YEAR event
Inflow = 1.76 cfs @ 12.87 hrs, Volume= 5,838 cf
Outflow = 1.76 cfs @ 12.87 hrs, Volume= 5,838 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 154.72 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 154.72 fps, Avg. Travel Time= 0.0 min

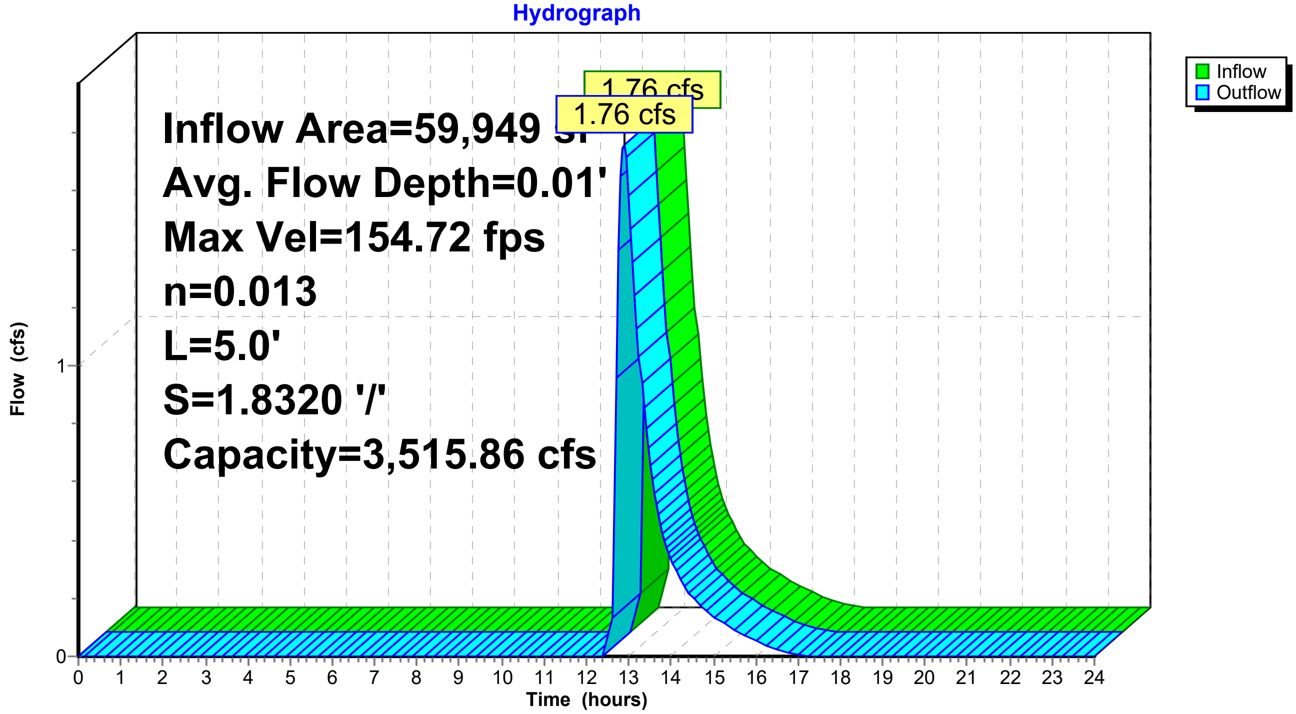
Peak Storage= 0 cf @ 12.87 hrs
Average Depth at Peak Storage= 0.01'
Bank-Full Depth= 12.00' Flow Area= 19.6 sf, Capacity= 3,515.86 cfs

Custom stage-perimeter table, n= 0.013 Concrete pipe, bends & connections
100 Intermediate values determined by Multi-point interpolation
Length= 5.0' Slope= 1.8320 '/'
Inlet Invert= 61.16', Outlet Invert= 52.00'

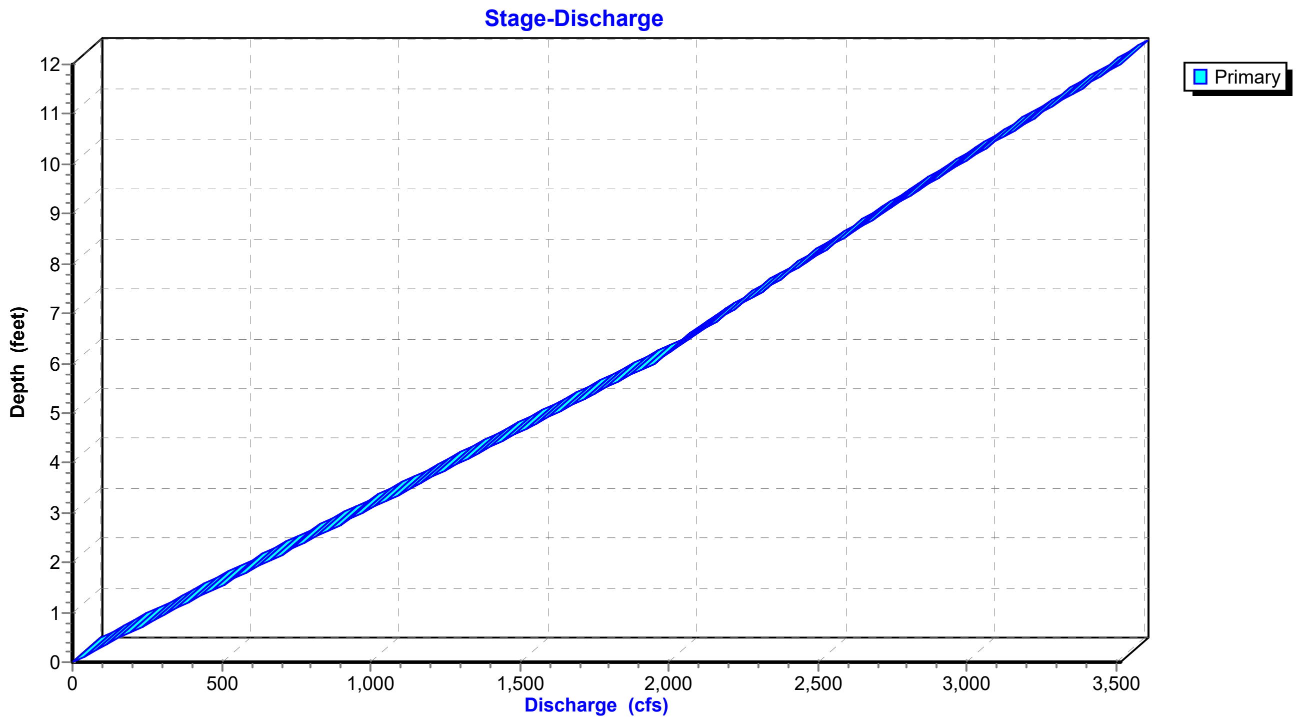


Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
6.00	12.6	12.6	63	1,949.43
12.00	19.6	15.7	98	3,515.86

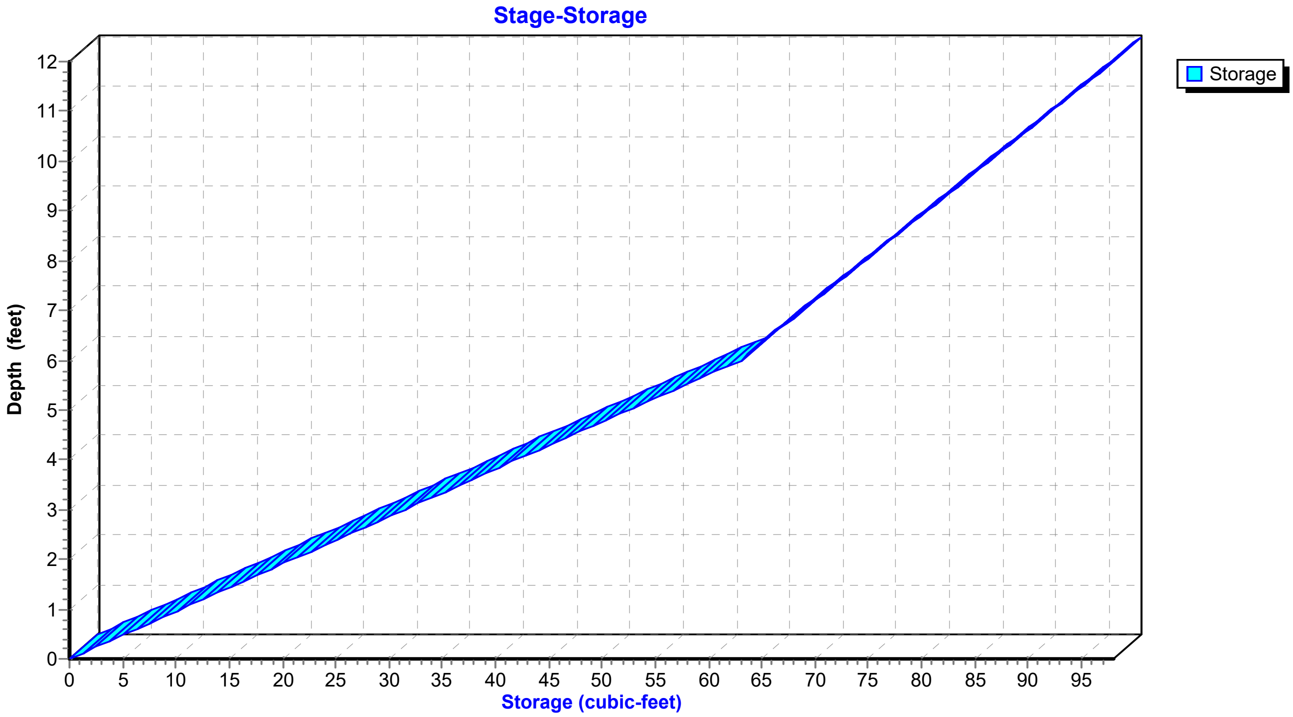
Reach 1R: CONTROL STRUCTURE



Reach 1R: CONTROL STRUCTURE



Reach 1R: CONTROL STRUCTURE



Hydrograph for Reach 1R: CONTROL STRUCTURE

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	61.16	0.00
0.50	0.00	0	61.16	0.00
1.00	0.00	0	61.16	0.00
1.50	0.00	0	61.16	0.00
2.00	0.00	0	61.16	0.00
2.50	0.00	0	61.16	0.00
3.00	0.00	0	61.16	0.00
3.50	0.00	0	61.16	0.00
4.00	0.00	0	61.16	0.00
4.50	0.00	0	61.16	0.00
5.00	0.00	0	61.16	0.00
5.50	0.00	0	61.16	0.00
6.00	0.00	0	61.16	0.00
6.50	0.00	0	61.16	0.00
7.00	0.00	0	61.16	0.00
7.50	0.00	0	61.16	0.00
8.00	0.00	0	61.16	0.00
8.50	0.00	0	61.16	0.00
9.00	0.00	0	61.16	0.00
9.50	0.00	0	61.16	0.00
10.00	0.00	0	61.16	0.00
10.50	0.00	0	61.16	0.00
11.00	0.00	0	61.16	0.00
11.50	0.00	0	61.16	0.00
12.00	0.00	0	61.16	0.00
12.50	**0.00**	**0**	**61.16**	**0.00**
13.00	**1.59**	**0**	**61.16**	**1.59**
13.50	0.66	0	61.16	0.66
14.00	0.34	0	61.16	0.34
14.50	0.21	0	61.16	0.21
15.00	0.14	0	61.16	0.14
15.50	0.09	0	61.16	0.09
16.00	0.06	0	61.16	0.06
16.50	0.02	0	61.16	0.02
17.00	0.00	0	61.16	0.00
17.50	0.00	0	61.16	0.00
18.00	0.00	0	61.16	0.00
18.50	0.00	0	61.16	0.00
19.00	0.00	0	61.16	0.00
19.50	0.00	0	61.16	0.00
20.00	0.00	0	61.16	0.00
20.50	0.00	0	61.16	0.00
21.00	0.00	0	61.16	0.00
21.50	0.00	0	61.16	0.00
22.00	0.00	0	61.16	0.00
22.50	0.00	0	61.16	0.00
23.00	0.00	0	61.16	0.00
23.50	0.00	0	61.16	0.00
24.00	0.00	0	61.16	0.00

Stage-Discharge for Reach 1R: CONTROL STRUCTURE

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
61.16	0.00	0.00
61.31	154.72	48.74
61.46	154.72	97.47
61.61	154.72	146.21
61.76	154.72	194.94
61.91	154.72	243.68
62.06	154.72	292.42
62.21	154.72	341.15
62.36	154.72	389.89
62.51	154.72	438.62
62.66	154.72	487.36
62.81	154.72	536.09
62.96	154.72	584.83
63.11	154.72	633.57
63.26	154.72	682.30
63.41	154.72	731.04
63.56	154.72	779.77
63.71	154.72	828.51
63.86	154.72	877.25
64.01	154.72	925.98
64.16	154.72	974.72
64.31	154.72	1,023.45
64.46	154.72	1,072.19
64.61	154.72	1,120.93
64.76	154.72	1,169.66
64.91	154.72	1,218.40
65.06	154.72	1,267.13
65.21	154.72	1,315.87
65.36	154.72	1,364.60
65.51	154.72	1,413.34
65.66	154.72	1,462.08
65.81	154.72	1,510.81
65.96	154.72	1,559.55
66.11	154.72	1,608.28
66.26	154.72	1,657.02
66.41	154.72	1,705.76
66.56	154.72	1,754.49
66.71	154.72	1,803.23
66.86	154.72	1,851.96
67.01	154.72	1,900.70
67.16	154.72	1,949.43
67.31	155.51	1,986.64
67.46	156.29	2,023.96
67.61	157.06	2,061.41
67.76	157.82	2,098.97
67.91	158.56	2,136.67
68.06	159.30	2,174.48
68.21	160.03	2,212.40
68.36	160.74	2,250.42
68.51	161.45	2,288.57
68.66	162.15	2,326.83
68.81	162.83	2,365.18

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
68.96	163.51	2,403.64
69.11	164.18	2,442.20
69.26	164.84	2,480.87
69.41	165.49	2,519.63
69.56	166.14	2,558.48
69.71	166.77	2,597.44
69.86	167.39	2,636.48
70.01	168.01	2,675.62
70.16	168.62	2,714.84
70.31	169.23	2,754.15
70.46	169.82	2,793.55
70.61	170.41	2,833.04
70.76	170.99	2,872.60
70.91	171.56	2,912.25
71.06	172.13	2,951.98
71.21	172.69	2,991.79
71.36	173.24	3,031.67
71.51	173.78	3,071.63
71.66	174.32	3,111.67
71.81	174.86	3,151.77
71.96	175.38	3,191.95
72.11	175.90	3,232.21
72.26	176.42	3,272.53
72.41	176.92	3,312.92
72.56	177.43	3,353.37
72.71	177.92	3,393.90
72.86	178.41	3,434.50
73.01	178.90	3,475.15
73.16	**179.38**	**3,515.86**

Stage-Area-Storage for Reach 1R: CONTROL STRUCTURE

Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)	Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)
61.16	0.0	0	68.96	14.7	74
61.31	0.3	2	69.11	14.9	74
61.46	0.6	3	69.26	15.1	75
61.61	0.9	5	69.41	15.2	76
61.76	1.3	6	69.56	15.4	77
61.91	1.6	8	69.71	15.6	78
62.06	1.9	9	69.86	15.8	79
62.21	2.2	11	70.01	15.9	80
62.36	2.5	13	70.16	16.1	81
62.51	2.8	14	70.31	16.3	81
62.66	3.1	16	70.46	16.4	82
62.81	3.5	17	70.61	16.6	83
62.96	3.8	19	70.76	16.8	84
63.11	4.1	20	70.91	17.0	85
63.26	4.4	22	71.06	17.2	86
63.41	4.7	24	71.21	17.3	87
63.56	5.0	25	71.36	17.5	88
63.71	5.4	27	71.51	17.7	88
63.86	5.7	28	71.66	17.9	89
64.01	6.0	30	71.81	18.0	90
64.16	6.3	32	71.96	18.2	91
64.31	6.6	33	72.11	18.4	92
64.46	6.9	35	72.26	18.6	93
64.61	7.2	36	72.41	18.7	94
64.76	7.6	38	72.56	18.9	95
64.91	7.9	39	72.71	19.1	95
65.06	8.2	41	72.86	19.3	96
65.21	8.5	43	73.01	19.4	97
65.36	8.8	44	73.16	**19.6**	**98**
65.51	9.1	46			
65.66	9.4	47			
65.81	9.8	49			
65.96	10.1	50			
66.11	10.4	52			
66.26	10.7	54			
66.41	11.0	55			
66.56	11.3	57			
66.71	11.7	58			
66.86	12.0	60			
67.01	12.3	61			
67.16	12.6	63			
67.31	12.8	64			
67.46	12.9	65			
67.61	13.1	66			
67.76	13.3	67			
67.91	13.5	67			
68.06	13.7	68			
68.21	13.8	69			
68.36	14.0	70			
68.51	14.2	71			
68.66	14.3	72			
68.81	14.5	73			

Summary for Reach 2R: Rip Rap Pool

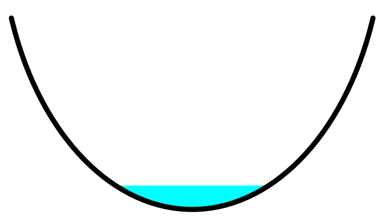
[62] Hint: Exceeded Reach 1R OUTLET depth by 0.43' @ 12.90 hrs

Inflow Area = 59,949 sf, 40.15% Impervious, Inflow Depth = 1.17" for 25-YEAR event
Inflow = 1.76 cfs @ 12.87 hrs, Volume= 5,838 cf
Outflow = 1.76 cfs @ 12.88 hrs, Volume= 5,838 cf, Atten= 0%, Lag= 0.5 min

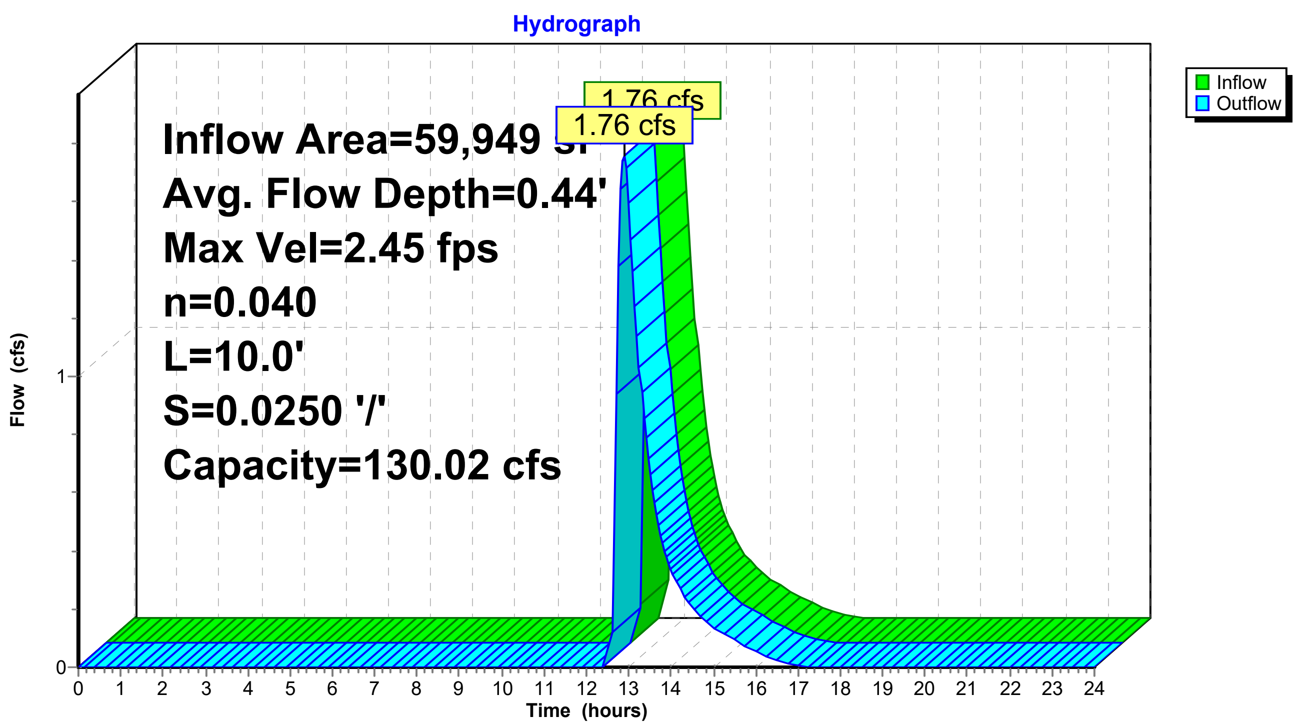
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.45 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.25 fps, Avg. Travel Time= 0.1 min

Peak Storage= 7 cf @ 12.88 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 3.50' Flow Area= 16.3 sf, Capacity= 130.02 cfs

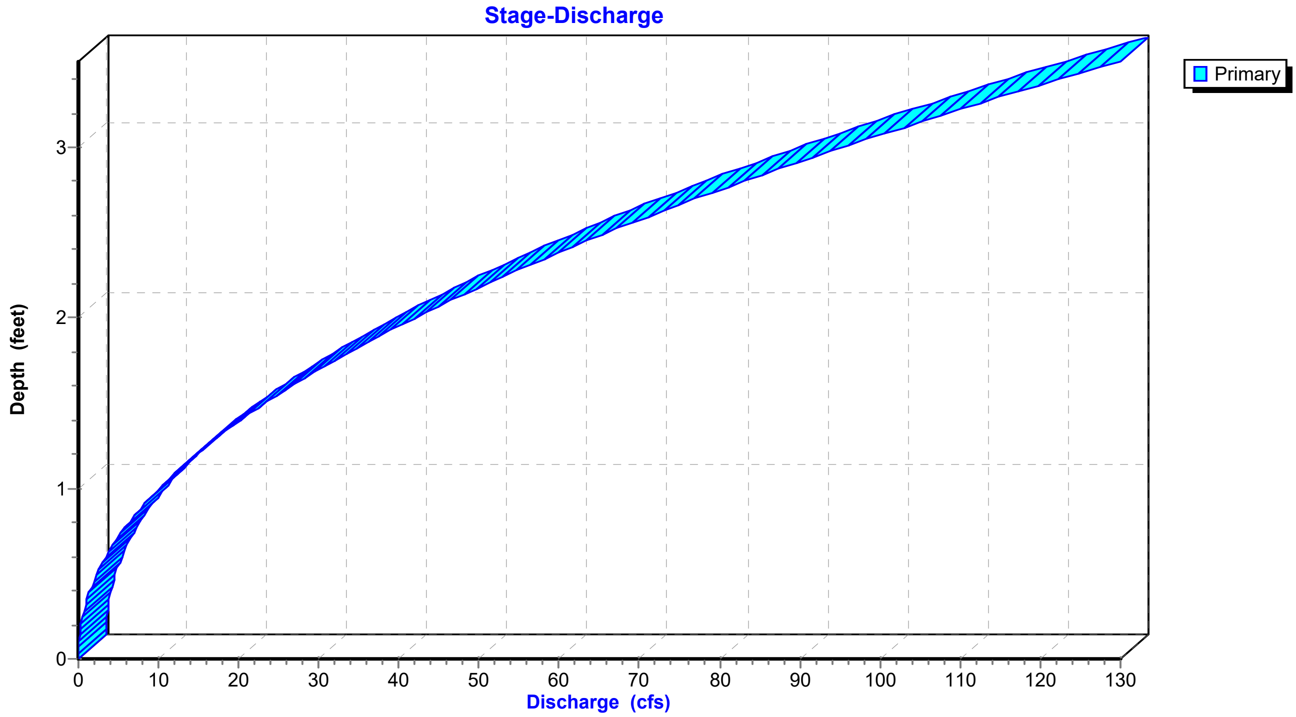
7.00' x 3.50' deep Parabolic Channel, n= 0.040 Earth, cobble bottom, clean sides
Length= 10.0' Slope= 0.0250 '/'
Inlet Invert= 52.00', Outlet Invert= 51.75'



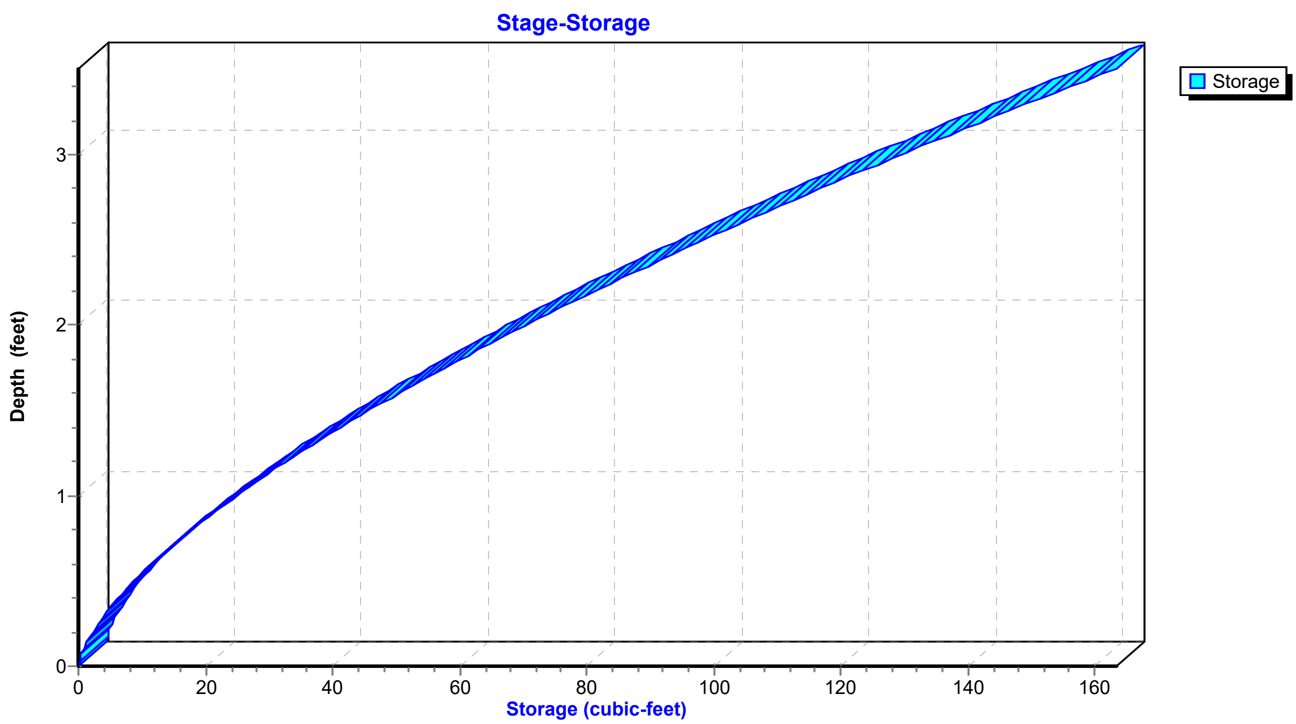
Reach 2R: Rip Rap Pool



Reach 2R: Rip Rap Pool



Reach 2R: Rip Rap Pool



Hydrograph for Reach 2R: Rip Rap Pool

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	52.00	0.00
0.50	0.00	0	52.00	0.00
1.00	0.00	0	52.00	0.00
1.50	0.00	0	52.00	0.00
2.00	0.00	0	52.00	0.00
2.50	0.00	0	52.00	0.00
3.00	0.00	0	52.00	0.00
3.50	0.00	0	52.00	0.00
4.00	0.00	0	52.00	0.00
4.50	0.00	0	52.00	0.00
5.00	0.00	0	52.00	0.00
5.50	0.00	0	52.00	0.00
6.00	0.00	0	52.00	0.00
6.50	0.00	0	52.00	0.00
7.00	0.00	0	52.00	0.00
7.50	0.00	0	52.00	0.00
8.00	0.00	0	52.00	0.00
8.50	0.00	0	52.00	0.00
9.00	0.00	0	52.00	0.00
9.50	0.00	0	52.00	0.00
10.00	0.00	0	52.00	0.00
10.50	0.00	0	52.00	0.00
11.00	0.00	0	52.00	0.00
11.50	0.00	0	52.00	0.00
12.00	0.00	0	52.00	0.00
12.50	**0.00**	**0**	**52.00**	**0.00**
13.00	**1.59**	**7**	**52.42**	**1.60**
13.50	0.66	4	52.28	0.66
14.00	0.34	2	52.20	0.34
14.50	0.21	2	52.16	0.21
15.00	0.14	1	52.13	0.14
15.50	0.09	1	52.11	0.09
16.00	0.06	1	52.08	0.06
16.50	0.02	0	52.05	0.02
17.00	0.00	0	52.02	0.00
17.50	0.00	0	52.00	0.00
18.00	0.00	0	52.00	0.00
18.50	0.00	0	52.00	0.00
19.00	0.00	0	52.00	0.00
19.50	0.00	0	52.00	0.00
20.00	0.00	0	52.00	0.00
20.50	0.00	0	52.00	0.00
21.00	0.00	0	52.00	0.00
21.50	0.00	0	52.00	0.00
22.00	0.00	0	52.00	0.00
22.50	0.00	0	52.00	0.00
23.00	0.00	0	52.00	0.00
23.50	0.00	0	52.00	0.00
24.00	0.00	0	52.00	0.00

Stage-Discharge for Reach 2R: Rip Rap Pool

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
52.00	0.00	0.00	54.60	6.85	71.61
52.05	0.60	0.02	54.65	6.91	74.41
52.10	0.95	0.08	54.70	6.98	77.27
52.15	1.24	0.18	54.75	7.05	80.18
52.20	1.50	0.34	54.80	7.11	83.14
52.25	1.73	0.54	54.85	7.18	86.15
52.30	1.94	0.80	54.90	7.24	89.22
52.35	2.14	1.10	54.95	7.31	92.34
52.40	2.32	1.47	55.00	7.37	95.51
52.45	2.50	1.88	55.05	7.43	98.73
52.50	2.67	2.36	55.10	7.49	102.00
52.55	2.83	2.88	55.15	7.55	105.32
52.60	2.98	3.46	55.20	7.61	108.70
52.65	3.13	4.10	55.25	7.67	112.12
52.70	3.28	4.79	55.30	7.73	115.60
52.75	3.41	5.53	55.35	7.79	119.13
52.80	3.55	6.33	55.40	7.85	122.71
52.85	3.68	7.19	55.45	7.90	126.34
52.90	3.80	8.10	55.50	**7.96**	**130.02**
52.95	3.93	9.07			
53.00	4.04	10.09			
53.05	4.16	11.17			
53.10	4.27	12.30			
53.15	4.39	13.49			
53.20	4.49	14.74			
53.25	4.60	16.03			
53.30	4.70	17.39			
53.35	4.80	18.80			
53.40	4.90	20.26			
53.45	5.00	21.78			
53.50	5.10	23.35			
53.55	5.19	24.98			
53.60	5.28	26.66			
53.65	5.37	28.40			
53.70	5.46	30.19			
53.75	5.55	32.03			
53.80	5.63	33.94			
53.85	5.72	35.89			
53.90	5.80	37.90			
53.95	5.88	39.96			
54.00	5.96	42.07			
54.05	6.04	44.24			
54.10	6.12	46.46			
54.15	6.20	48.74			
54.20	6.27	51.07			
54.25	6.35	53.45			
54.30	6.42	55.89			
54.35	6.50	58.37			
54.40	6.57	60.92			
54.45	6.64	63.51			
54.50	6.71	66.16			
54.55	6.78	68.86			

Stage-Area-Storage for Reach 2R: Rip Rap Pool

Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)	Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)
52.00	0.0	0	54.60	10.5	105
52.05	0.0	0	54.65	10.8	108
52.10	0.1	1	54.70	11.1	111
52.15	0.1	1	54.75	11.4	114
52.20	0.2	2	54.80	11.7	117
52.25	0.3	3	54.85	12.0	120
52.30	0.4	4	54.90	12.3	123
52.35	0.5	5	54.95	12.6	126
52.40	0.6	6	55.00	13.0	130
52.45	0.8	8	55.05	13.3	133
52.50	0.9	9	55.10	13.6	136
52.55	1.0	10	55.15	13.9	139
52.60	1.2	12	55.20	14.3	143
52.65	1.3	13	55.25	14.6	146
52.70	1.5	15	55.30	15.0	150
52.75	1.6	16	55.35	15.3	153
52.80	1.8	18	55.40	15.6	156
52.85	2.0	20	55.45	16.0	160
52.90	2.1	21	55.50	**16.3**	**163**
52.95	2.3	23			
53.00	2.5	25			
53.05	2.7	27			
53.10	2.9	29			
53.15	3.1	31			
53.20	3.3	33			
53.25	3.5	35			
53.30	3.7	37			
53.35	3.9	39			
53.40	4.1	41			
53.45	4.4	44			
53.50	4.6	46			
53.55	4.8	48			
53.60	5.0	50			
53.65	5.3	53			
53.70	5.5	55			
53.75	5.8	58			
53.80	6.0	60			
53.85	6.3	63			
53.90	6.5	65			
53.95	6.8	68			
54.00	7.1	71			
54.05	7.3	73			
54.10	7.6	76			
54.15	7.9	79			
54.20	8.1	81			
54.25	8.4	84			
54.30	8.7	87			
54.35	9.0	90			
54.40	9.3	93			
54.45	9.6	96			
54.50	9.9	99			
54.55	10.2	102			

Summary for Pond 1P: 60 CONCRETE GALLEY'S

Inflow Area = 59,949 sf, 40.15% Impervious, Inflow Depth > 4.09" for 25-YEAR event
Inflow = 3.23 cfs @ 12.49 hrs, Volume= 20,453 cf
Outflow = 1.99 cfs @ 12.87 hrs, Volume= 17,871 cf, Atten= 38%, Lag= 23.2 min
Discarded = 0.22 cfs @ 12.87 hrs, Volume= 12,033 cf
Primary = 1.76 cfs @ 12.87 hrs, Volume= 5,838 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 62.39' @ 12.87 hrs Surf.Area= 2,269 sf Storage= 6,666 cf

Plug-Flow detention time= 157.9 min calculated for 17,834 cf (87% of inflow)
Center-of-Mass det. time= 102.7 min (923.8 - 821.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	58.33'	1,770 cf	**18.60'W x 122.00'L x 5.17'H Field A** 11,724 cf Overall - 7,298 cf Embedded = 4,426 cf x 40.0% Voids
#2A	58.83'	5,614 cf	**Galley 4x8x4** x 60 Inside #1 Inside= 42.0"W x 43.0"H => 12.47 sf x 7.50'L = 93.6 cf Outside= 52.8"W x 48.0"H => 15.20 sf x 8.00'L = 121.6 cf
		7,384 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	61.67'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	58.33'	**4.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.22 cfs @ 12.87 hrs HW=62.39' (Free Discharge)
└─**2=Exfiltration** (Controls 0.22 cfs)

Primary OutFlow Max=1.75 cfs @ 12.87 hrs HW=62.39' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 1.75 cfs @ 2.89 fps)

Pond 1P: 60 CONCRETE GALLEY'S - Chamber Wizard Field A

Chamber Model = Galley 4x8x4
Inside= 42.0"W x 43.0"H => 12.47 sf x 7.50'L = 93.6 cf
Outside= 52.8"W x 48.0"H => 15.20 sf x 8.00'L = 121.6 cf

52.8" Wide = 52.8" C-C Row Spacing

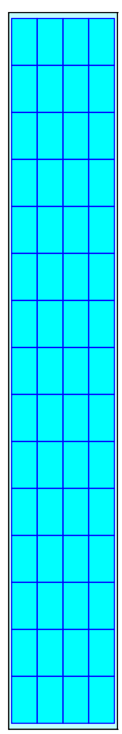
15 Chambers/Row x 8.00' Long = 120.00' Row Length +12.0" End Stone x 2 = 122.00' Base Length
4 Rows x 52.8" Wide + 6.0" Side Stone x 2 = 18.60' Base Width
6.0" Base + 48.0" Chamber Height + 8.0" Cover = 5.17' Field Height

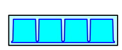
60 Chambers x 93.6 cf = 5,613.7 cf Chamber Storage
60 Chambers x 121.6 cf = 7,298.2 cf Displacement

11,724.2 cf Field - 7,298.2 cf Chambers = 4,426.0 cf Stone x 40.0% Voids = 1,770.4 cf Stone Storage

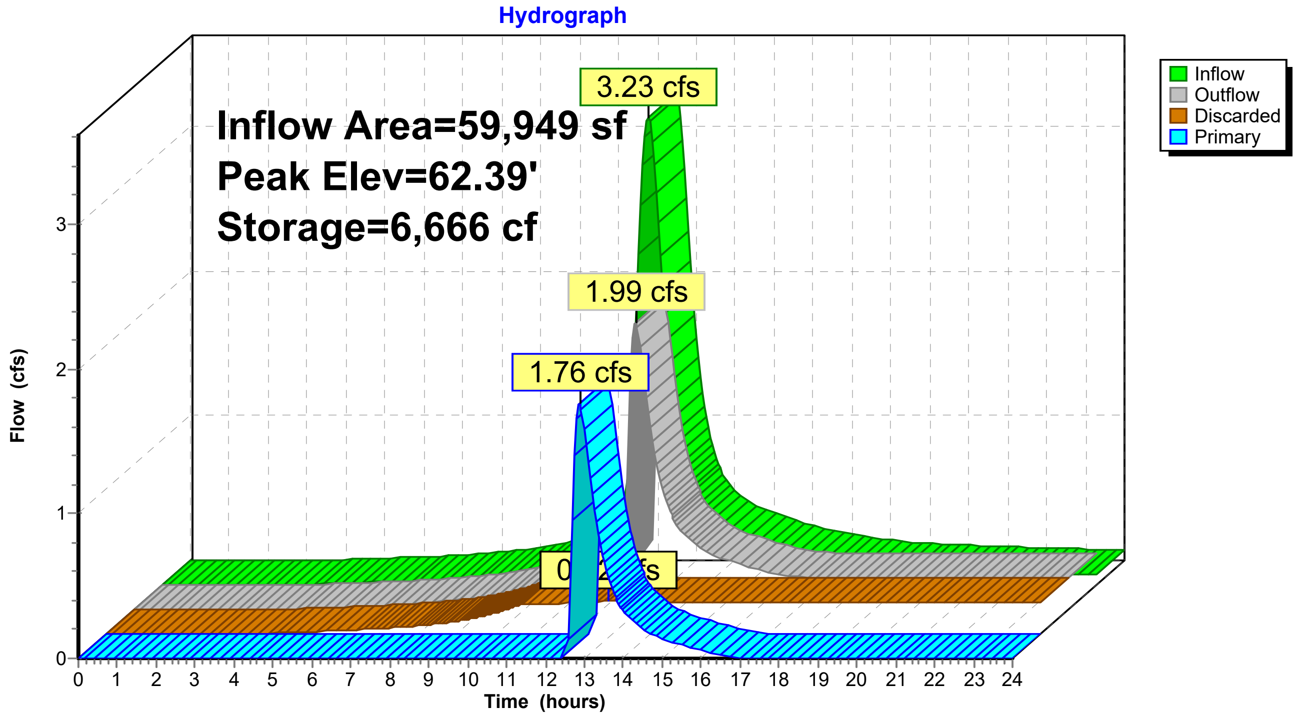
Stone + Chamber Storage = 7,384.2 cf = 0.170 af
Overall Storage Efficiency = 63.0%

60 Chambers
434.2 cy Field
163.9 cy Stone

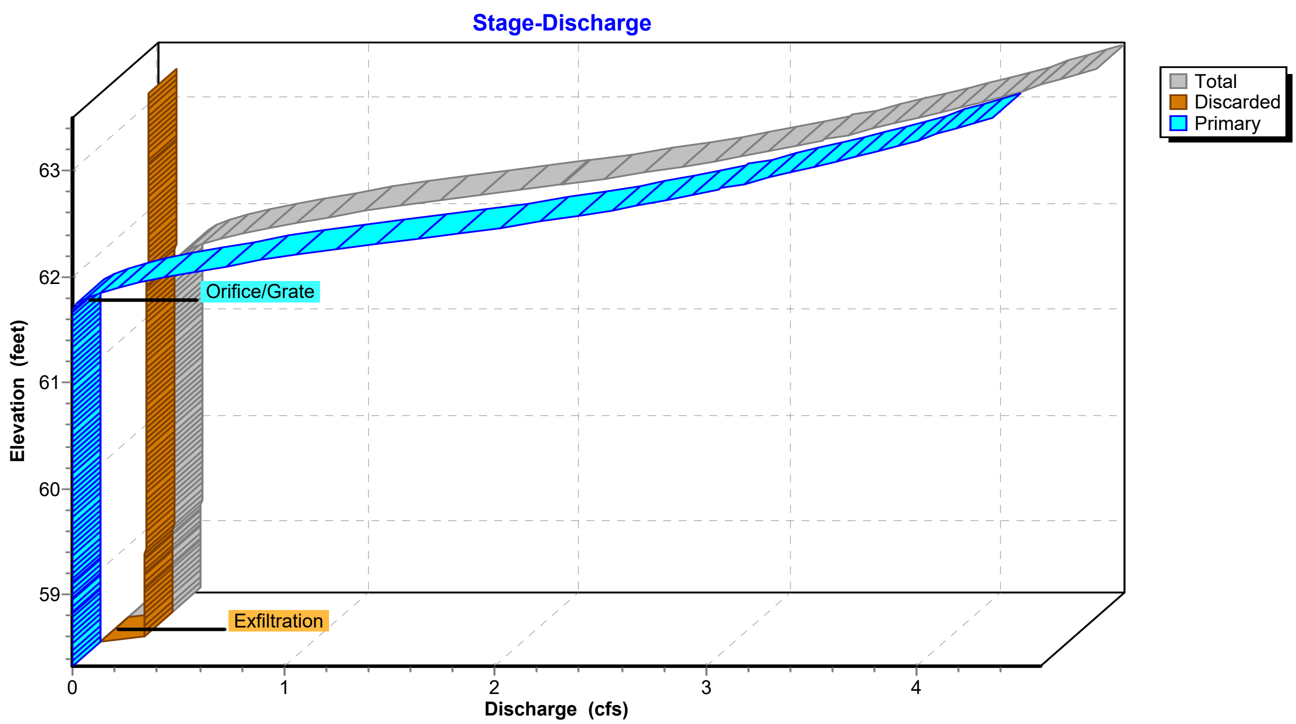




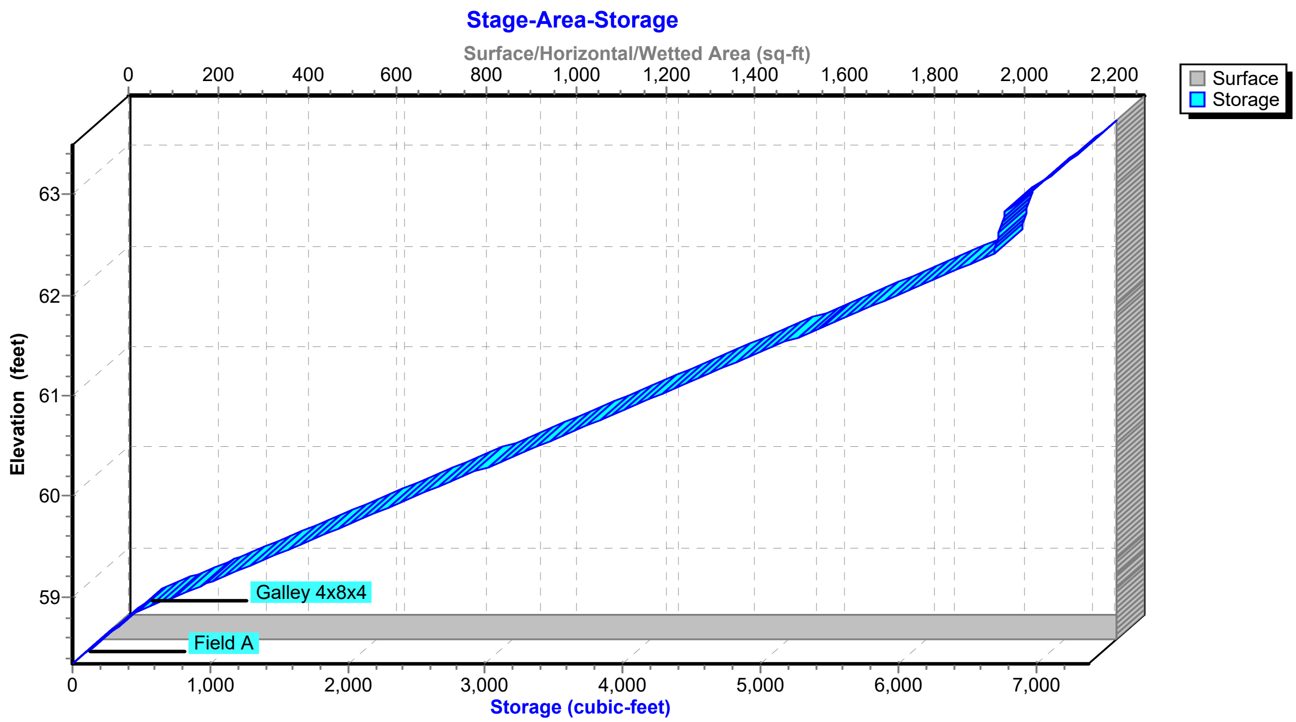
Pond 1P: 60 CONCRETE GALLEY'S



Pond 1P: 60 CONCRETE GALLEY'S



Pond 1P: 60 CONCRETE GALLEY'S



Hydrograph for Pond 1P: 60 CONCRETE GALLEY'S

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	58.33	0.00	0.00	0.00
0.50	0.00	0	58.33	0.00	0.00	0.00
1.00	0.00	0	58.33	0.00	0.00	0.00
1.50	0.00	0	58.33	0.00	0.00	0.00
2.00	0.00	0	58.33	0.00	0.00	0.00
2.50	0.00	0	58.33	0.00	0.00	0.00
3.00	0.00	0	58.33	0.00	0.00	0.00
3.50	0.00	0	58.33	0.00	0.00	0.00
4.00	0.01	1	58.33	0.00	0.00	0.00
4.50	0.01	2	58.33	0.01	0.01	0.00
5.00	0.01	3	58.33	0.01	0.01	0.00
5.50	0.02	4	58.33	0.02	0.02	0.00
6.00	0.02	5	58.34	0.02	0.02	0.00
6.50	0.03	6	58.34	0.03	0.03	0.00
7.00	0.04	8	58.34	0.04	0.04	0.00
7.50	0.05	10	58.34	0.05	0.05	0.00
8.00	0.06	13	58.34	0.06	0.06	0.00
8.50	0.07	16	58.35	0.07	0.07	0.00
9.00	0.09	20	58.35	0.09	0.09	0.00
9.50	0.12	25	58.36	0.11	0.11	0.00
10.00	0.15	33	58.37	0.15	0.15	0.00
10.50	0.19	42	58.38	0.19	0.19	0.00
11.00	0.26	78	58.42	0.21	0.21	0.00
11.50	0.36	247	58.60	0.21	0.21	0.00
12.00	0.92	834	59.05	0.21	0.21	0.00
12.50	**3.23**	**4,427**	**61.10**	**0.22**	**0.22**	**0.00**
13.00	1.54	**6,588**	**62.35**	**1.81**	**0.22**	**1.59**
13.50	0.70	6,125	62.08	0.88	0.22	0.66
14.00	0.48	5,909	61.95	0.56	0.22	0.34
14.50	0.38	5,798	61.89	0.43	0.22	0.21
15.00	0.33	5,725	61.85	0.36	0.22	0.14
15.50	0.28	5,667	61.81	0.32	0.22	0.09
16.00	0.24	5,608	61.78	0.28	0.22	0.06
16.50	0.20	5,537	61.74	0.24	0.22	0.02
17.00	0.18	5,457	61.69	0.23	0.22	0.00
17.50	0.16	5,361	61.64	0.22	0.22	0.00
18.00	0.14	5,233	61.56	0.22	0.22	0.00
18.50	0.12	5,073	61.47	0.22	0.22	0.00
19.00	0.12	4,891	61.37	0.22	0.22	0.00
19.50	0.11	4,697	61.26	0.22	0.22	0.00
20.00	0.10	4,493	61.14	0.22	0.22	0.00
20.50	0.10	4,281	61.02	0.22	0.22	0.00
21.00	0.09	4,060	60.89	0.22	0.22	0.00
21.50	0.09	3,833	60.76	0.22	0.22	0.00
22.00	0.09	3,599	60.63	0.22	0.22	0.00
22.50	0.08	3,358	60.49	0.22	0.22	0.00
23.00	0.08	3,110	60.35	0.22	0.22	0.00
23.50	0.07	2,856	60.20	0.22	0.22	0.00
24.00	0.07	2,595	60.05	0.22	0.22	0.00

Stage-Discharge for Pond 1P: 60 CONCRETE GALLEY'S

Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)
58.33	0.00	0.00	0.00
58.43	0.21	0.21	0.00
58.53	0.21	0.21	0.00
58.63	0.21	0.21	0.00
58.73	0.21	0.21	0.00
58.83	0.21	0.21	0.00
58.93	0.21	0.21	0.00
59.03	0.21	0.21	0.00
59.13	0.21	0.21	0.00
59.23	0.21	0.21	0.00
59.33	0.21	0.21	0.00
59.43	0.21	0.21	0.00
59.53	0.21	0.21	0.00
59.63	0.21	0.21	0.00
59.73	0.22	0.22	0.00
59.83	0.22	0.22	0.00
59.93	0.22	0.22	0.00
60.03	0.22	0.22	0.00
60.13	0.22	0.22	0.00
60.23	0.22	0.22	0.00
60.33	0.22	0.22	0.00
60.43	0.22	0.22	0.00
60.53	0.22	0.22	0.00
60.63	0.22	0.22	0.00
60.73	0.22	0.22	0.00
60.83	0.22	0.22	0.00
60.93	0.22	0.22	0.00
61.03	0.22	0.22	0.00
61.13	0.22	0.22	0.00
61.23	0.22	0.22	0.00
61.33	0.22	0.22	0.00
61.43	0.22	0.22	0.00
61.53	0.22	0.22	0.00
61.63	0.22	0.22	0.00
61.73	0.24	0.22	0.02
61.83	0.33	0.22	0.11
61.93	0.50	0.22	0.28
62.03	0.74	0.22	0.52
62.13	1.04	0.22	0.81
62.23	1.38	0.22	1.15
62.33	1.75	0.22	1.52
62.43	2.13	0.22	1.90
62.53	2.49	0.23	2.27
62.63	2.81	0.23	2.58
62.73	3.06	0.23	2.83
62.83	3.30	0.23	3.07
62.93	3.52	0.23	3.30
63.03	3.73	0.23	3.51
63.13	3.93	0.23	3.71
63.23	4.12	0.23	3.89
63.33	4.30	0.23	4.07
63.43	**4.47**	**0.23**	**4.24**

Stage-Area-Storage for Pond 1P: 60 CONCRETE GALLEY'S

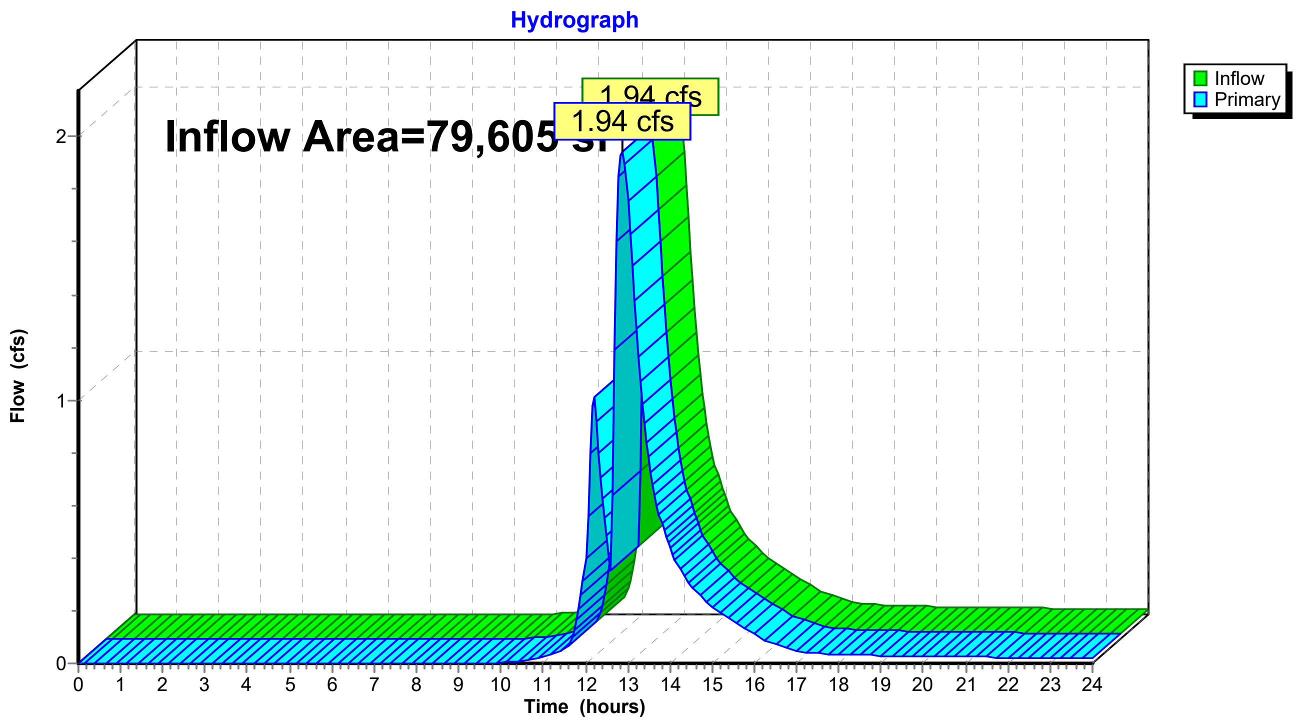
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
58.33	**2,269**	0
58.43	2,269	91
58.53	2,269	182
58.63	2,269	272
58.73	2,269	363
58.83	2,269	454
58.93	2,269	624
59.03	2,269	794
59.13	2,269	969
59.23	2,269	1,146
59.33	2,269	1,322
59.43	2,269	1,499
59.53	2,269	1,675
59.63	2,269	1,852
59.73	2,269	2,028
59.83	2,269	2,204
59.93	2,269	2,380
60.03	2,269	2,555
60.13	2,269	2,731
60.23	2,269	2,906
60.33	2,269	3,082
60.43	2,269	3,257
60.53	2,269	3,432
60.63	2,269	3,607
60.73	2,269	3,781
60.83	2,269	3,956
60.93	2,269	4,130
61.03	2,269	4,305
61.13	2,269	4,479
61.23	2,269	4,653
61.33	2,269	4,827
61.43	2,269	5,000
61.53	2,269	5,174
61.63	2,269	5,347
61.73	2,269	5,521
61.83	2,269	5,694
61.93	2,269	5,867
62.03	2,269	6,040
62.13	2,269	6,212
62.23	2,269	6,385
62.33	2,269	6,558
62.43	2,269	6,699
62.53	2,269	6,719
62.63	2,269	6,739
62.73	2,269	6,759
62.83	2,269	6,779
62.93	2,269	6,870
63.03	2,269	6,961
63.13	2,269	7,051
63.23	2,269	7,142
63.33	2,269	7,233
63.43	2,269	**7,324**

Summary for Link 1L: POC "A" DRAIN INLET AT S.E. END OF PARCEL

Inflow Area =	79,605 sf, 30.24% Impervious,	Inflow Depth > 1.49"	for 25-YEAR event
Inflow =	1.94 cfs @ 12.88 hrs, Volume=	9,858 cf	
Primary =	1.94 cfs @ 12.88 hrs, Volume=	9,858 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: POC "A" DRAIN INLET AT S.E. END OF PARCEL



Hydrograph for Link 1L: POC "A" DRAIN INLET AT S.E. END OF PARCEL

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00
0.25	0.00	0.00	0.00
0.50	0.00	0.00	0.00
0.75	0.00	0.00	0.00
1.00	0.00	0.00	0.00
1.25	0.00	0.00	0.00
1.50	0.00	0.00	0.00
1.75	0.00	0.00	0.00
2.00	0.00	0.00	0.00
2.25	0.00	0.00	0.00
2.50	0.00	0.00	0.00
2.75	0.00	0.00	0.00
3.00	0.00	0.00	0.00
3.25	0.00	0.00	0.00
3.50	0.00	0.00	0.00
3.75	0.00	0.00	0.00
4.00	0.00	0.00	0.00
4.25	0.00	0.00	0.00
4.50	0.00	0.00	0.00
4.75	0.00	0.00	0.00
5.00	0.00	0.00	0.00
5.25	0.00	0.00	0.00
5.50	0.00	0.00	0.00
5.75	0.00	0.00	0.00
6.00	0.00	0.00	0.00
6.25	0.00	0.00	0.00
6.50	0.00	0.00	0.00
6.75	0.00	0.00	0.00
7.00	0.00	0.00	0.00
7.25	0.00	0.00	0.00
7.50	0.00	0.00	0.00
7.75	0.00	0.00	0.00
8.00	0.00	0.00	0.00
8.25	0.00	0.00	0.00
8.50	0.00	0.00	0.00
8.75	0.00	0.00	0.00
9.00	0.00	0.00	0.00
9.25	0.00	0.00	0.00
9.50	0.00	0.00	0.00
9.75	0.00	0.00	0.00
10.00	0.00	0.00	0.00
10.25	0.01	0.00	0.01
10.50	0.01	0.00	0.01
10.75	0.02	0.00	0.02
11.00	0.02	0.00	0.02
11.25	0.04	0.00	0.04
11.50	0.06	0.00	0.06
11.75	0.13	0.00	0.13
12.00	0.40	0.00	0.40
12.25	0.92	0.00	0.92
12.50	0.48	0.00	0.48
12.75	**1.60**	0.00	**1.60**
13.00	**1.76**	0.00	**1.76**
13.25	1.16	0.00	1.16
13.50	0.78	0.00	0.78
13.75	0.56	0.00	0.56
14.00	0.44	0.00	0.44
14.25	0.35	0.00	0.35
14.50	0.29	0.00	0.29
14.75	0.25	0.00	0.25
15.00	0.21	0.00	0.21
15.25	0.19	0.00	0.19
15.50	0.16	0.00	0.16
15.75	0.13	0.00	0.13
16.00	0.11	0.00	0.11
16.25	0.09	0.00	0.09
16.50	0.07	0.00	0.07
16.75	0.06	0.00	0.06
17.00	0.05	0.00	0.05
17.25	0.04	0.00	0.04
17.50	0.04	0.00	0.04
17.75	0.04	0.00	0.04
18.00	0.03	0.00	0.03
18.25	0.03	0.00	0.03
18.50	0.03	0.00	0.03
18.75	0.03	0.00	0.03
19.00	0.03	0.00	0.03
19.25	0.03	0.00	0.03
19.50	0.03	0.00	0.03
19.75	0.03	0.00	0.03
20.00	0.03	0.00	0.03
20.25	0.03	0.00	0.03
20.50	0.03	0.00	0.03
20.75	0.03	0.00	0.03
21.00	0.02	0.00	0.02
21.25	0.02	0.00	0.02
21.50	0.02	0.00	0.02
21.75	0.02	0.00	0.02
22.00	0.02	0.00	0.02
22.25	0.02	0.00	0.02
22.50	0.02	0.00	0.02
22.75	0.02	0.00	0.02
23.00	0.02	0.00	0.02
23.25	0.02	0.00	0.02
23.50	0.02	0.00	0.02
23.75	0.02	0.00	0.02
24.00	0.02	0.00	0.02

APPENDIX "L"

RIP-RAP OUTLET PROTECTION

CALCULATION

Fuller Engineering & Land Surveying
525 John Street • Second Floor
Bridgeport, CT 06604
(203) 333-9465 (203) 336-1769 FAX

Project:	**245 NORWICH NEW LONDON ROAD MONTVILLE, CT**		
		Date:	**1/24/22**
	Rip - Rap Outlet Protection Calculation		
		Complete d By:	**SDU**
Drainage Area:	**(1P) 60 4x8 CONCRETE GALLEYS**	**Checked By:**	

Ref. Section 7.3 CONNDOT Drainage Manual.

L_a = Length of Apron (Type A Riprap Apron - Minimum Tailwater Condition TW < 0.5 Rp

$$L_a = \frac{1.80\ (Q - 5)}{Sp^{1.5}}$$

where:

La = length of apron, m (ft)
S_p = inside diameter for circular sections or maximum inside pipe span for noncircular sections, (ft) = 12" (1.0 ft)
Q = pipe (design) discharge, (cfs) = 1.94 cfs
TW = tailwater depth, (ft) = 0 (free discharge)
R_p = maximum inside pipe rise, (ft) = 1.0'
Note: S_p = R_p = inside diameter for circular sections

S_p =	1	ft
Q =	1.94	cfs
TW =	0	ft
L_a =	1.03	ft

Width:

Type A Riprap Apron (Minimum Tailwater Condition)

$W_1 = 3S_p$ (min.) 3 ft

$W_2 = 3s_p + 0.7L_a$ for TW < 0.5 R_p 3.72 ft

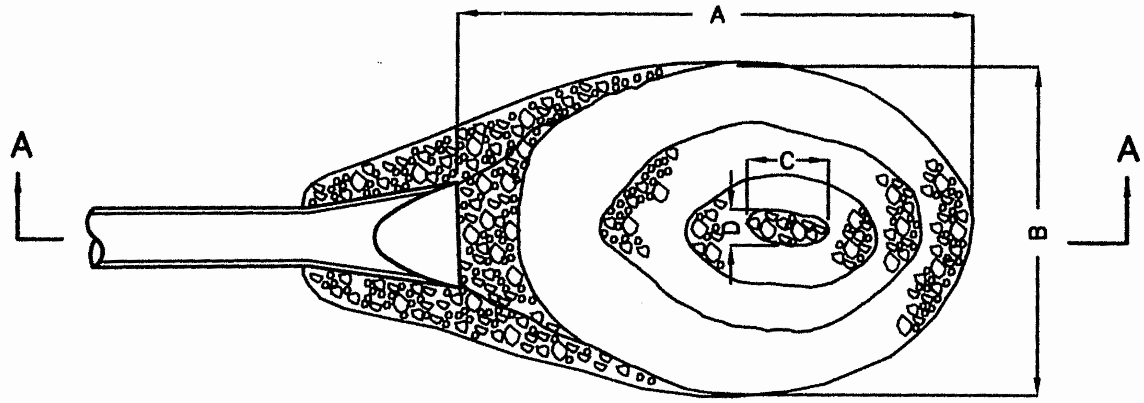
where:
W_1 = width of apron at pipe outlet or upstream apron limit
W_2 = width of apron at terminus or downstream apron limit

Therefore a Type A Riprap apron with dimensions as follows is required:

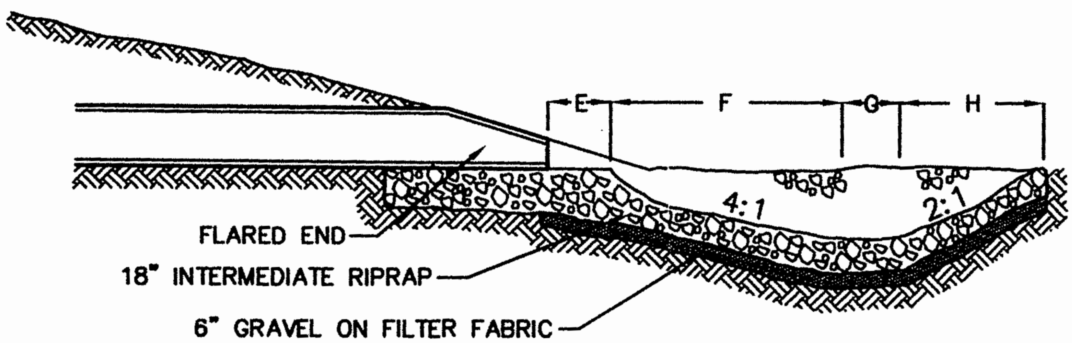
3 ft W + 4 ft W x 4 ft L

Provided is a Pre-formed Scour Hole with dimensions as follows:

7.0 ft W x 10.0 ft L x 1.5 ft D > the required apron therefore ***OK***



PLAN



SECTION A-A

RIPRAP PLUNGE POOL

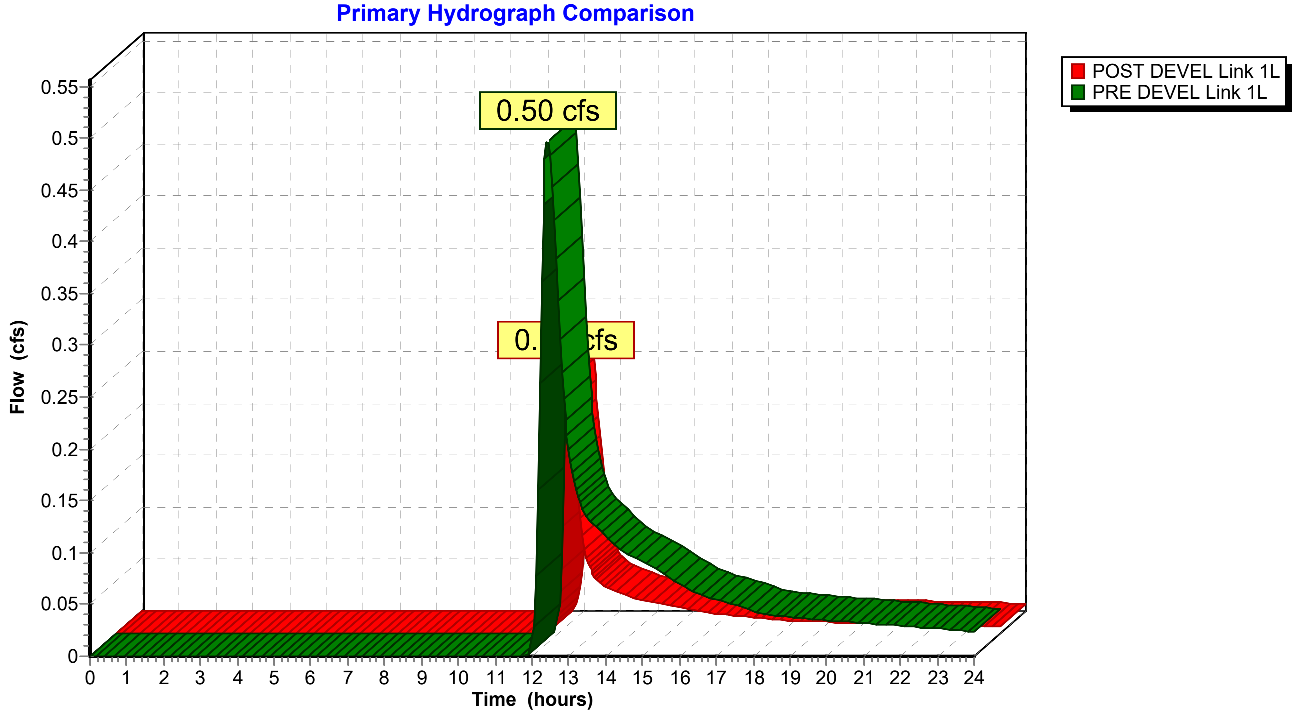
PIPE SIZE	A	B	C	D	E	F	G	H	WT. RIPRAP TONS
12"&15"	10'	7'	1'-6"	1'	1'	4'-6"	1'-6"	3'	6
18"	12'	8'	2'	1'	1'	5'	2'	4'	8
21"	15'	9'	2'-6"	1'-6"	1'	7'	2'-6"	4'-6"	12
24"	17'	10'	2'-6"	1'-6"	1'	8'	2'-6"	5'-6"	15
30"	20'	13'	3'	2'	2'	9'	3'	6'	22
36"	24'	16'	3'-6"	2'	2'	9'-6"	3'-6"	7'	33

APPENDIX "M"

HYDROCAD – OTHER STORM FREQUENCY SUMMARIES
2, 5, 10, 50, & 100 YEAR STORMS

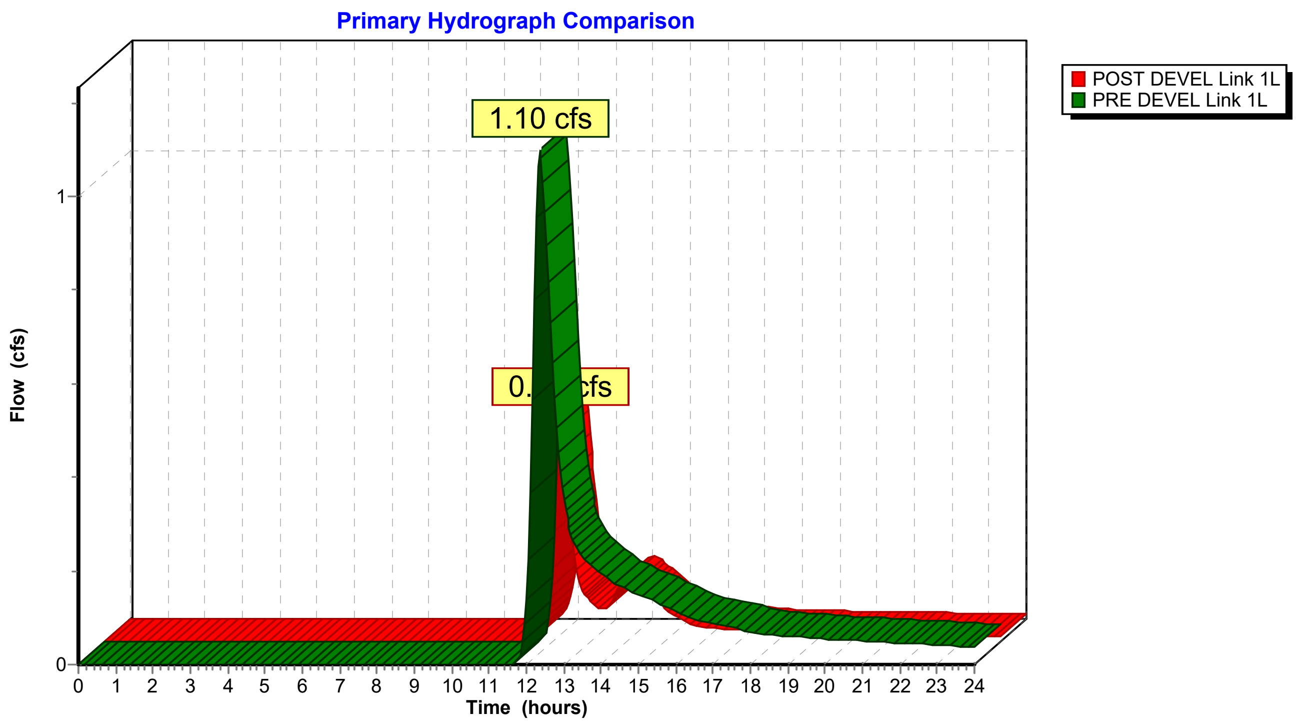
Comparison Report

Node	Inflow (cfs)	Primary (cfs)
POST DEVEL Link 1L	0.25	0.25
PRE DEVEL Link 1L	**0.50**	**0.50**



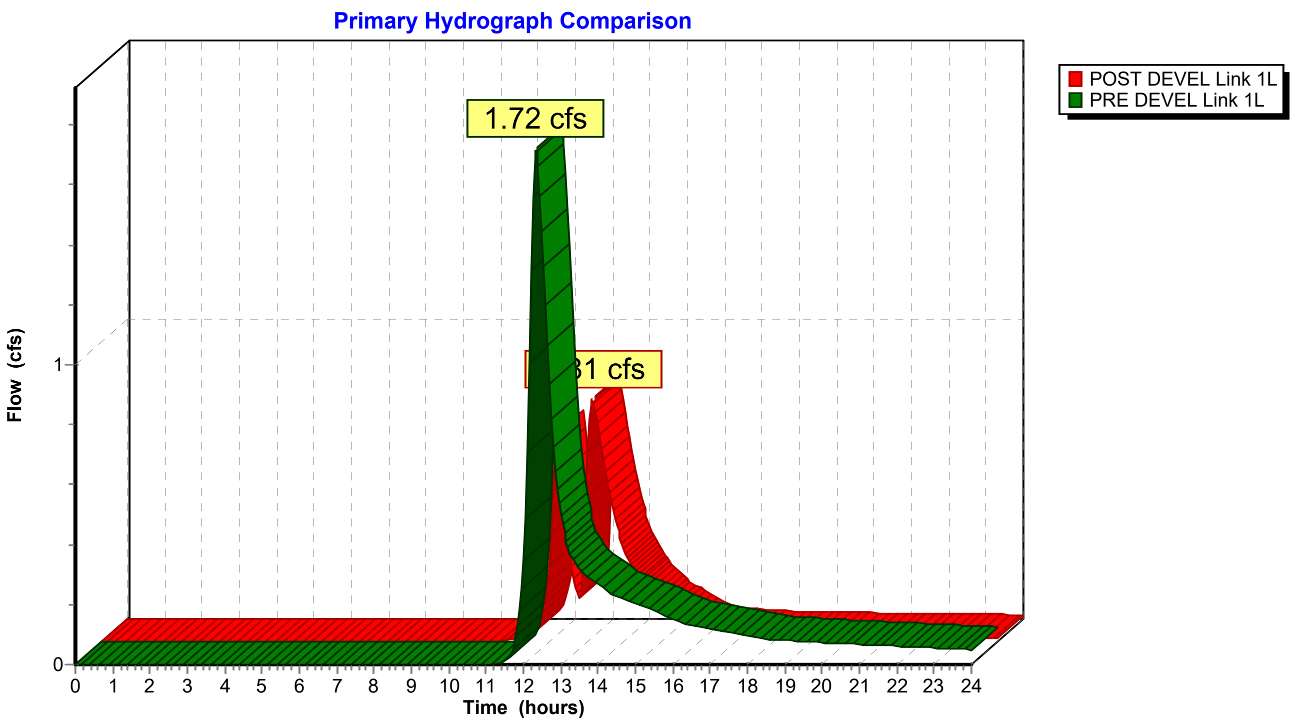
Comparison Report

Node	Inflow (cfs)	Primary (cfs)
POST DEVEL Link 1L	0.48	0.48
PRE DEVEL Link 1L	**1.10**	**1.10**



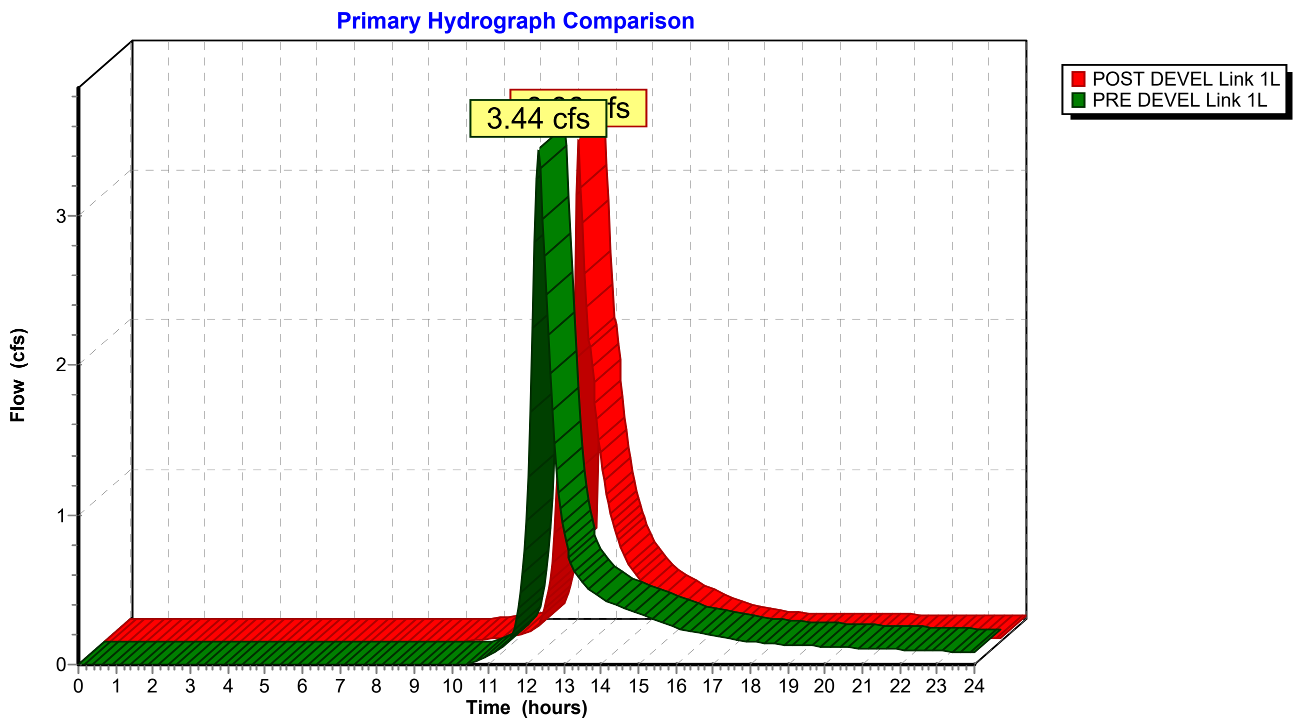
Comparison Report

Node	Inflow (cfs)	Primary (cfs)
POST DEVEL Link 1L	0.81	0.81
PRE DEVEL Link 1L	**1.72**	**1.72**



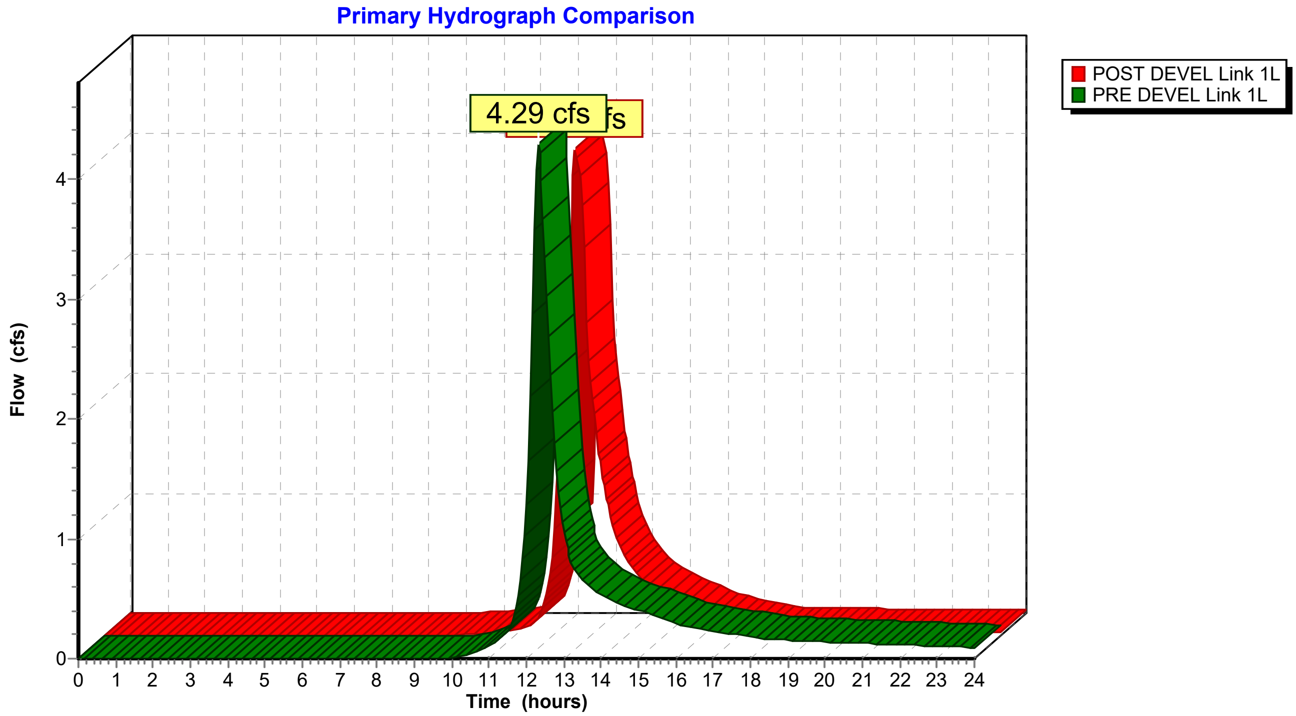
Comparison Report

Node	Inflow (cfs)	Primary (cfs)
POST DEVEL Link 1L	3.36	3.36
PRE DEVEL Link 1L	**3.44**	**3.44**



Comparison Report

Node	Inflow (cfs)	Primary (cfs)
POST DEVEL Link 1L	4.07	4.07
PRE DEVEL Link 1L	**4.29**	**4.29**



SANITARY SEWER REPORT SECTION

PLUS MISCELLANEOUS INFORMATIONAL MAPS

FULLER ENGINEERING AND LAND SURVEYING, LLC
525 John Street – Second Floor – Bridgeport, CT 06604

Phone: (203) 333-9465 Fax: (203) 336-1769

PROJECT: RESIDENTIAL DEVELOPMENT @ #245 ROUTE 32
LOCATION: 245 NORWICH-NEW LONDON ROAD (ROUTE 32)
CLIENT: WESTERN GROUP, LLC

SUMMATION OF PROPOSED SEWAGE FLOW:

	QTY (unit or sqft)	GPD/UNIT	TOTAL GPD	
STUDIO	0	200	-	
1 BEDROOM	0	200	-	
2 BEDROOM	0	300	-	
3 BEDROOM	22	400	8,800.00	
			-	
TOTAL	**22**		**8,800.00**	**GPD**
	7.48 GAL	1 CF	1,176.47	CF/day
	1 day	24 hour	49.01960784	CF/HR
	1 hour	3600 sec	0.013616558	CFS
	MGD=	0.00880	MGD*4=	0.0352
INCLUDE PEAKING FACTOR OF 4			0.054466231	CFS

where:
GPD = Gallons per Day
MGD = Millions Gallons per Day

Note: ***The Existing house is to remain unchanged with 3 Bedrooms in addition to 21 residential apartment units each with 3 bedrooms.***

FULLER ENGINEERING AND LAND SURVEYING, LLC
525 John Street – Second Floor – Bridgeport, CT 06604

Phone: (203) 333-9465 Fax: (203) 336-1769

CONVEYANCE CALCULATIONS:

PROJECT: RESIDENTIAL DEVELOPMENT @ #245 ROUTE 32
LOCATION: 245 NORWICH-NEW LONDON ROAD (ROUTE 32) MONTVILLE, CT
CLIENT: WESTERN GROUP, LLC

PIPE: Existing 8" Sanitary Sewer in Town Road
Pipe Diameter: **8** inches
MANNINGS EQUATION

$$R = \frac{A}{P_W}$$ **0.166667**

Where	R:	Hydraulic radius (ft)	
	A:	Cross-sectional area (ft^2)	0.349066
	P_W:	Wetted Perimeter (ft)	2.094395

$$V = \frac{k R^{2/3} S^{1/2}}{n}$$ **2.452942**

Where	V:	Mean Velocity (ft/s)	
	k:	1.49 for U.S. customary units, or 1.0 for S.I. units	
	n:	Manning's roughness value	0.012
	R:	Hydraulic Radius (ft)	0.166667
	S:	friction Slope (ft/ft)	0.004255

$$Q = VA$$ **0.856238** cfs

Where	Q:	Flow Rate(cfs)
	V:	Average velocity (ft/s)

The Q for the proposed buildings plus storm infiltration
going in to the system is 0.054 cfs which is less than the calculated Q; therefore OK
The Existing 8" Lateral at 0.0043 slope is adequate.

Notes:

1. Storm runoff infiltration is considered at part of the safety factor.
2. Sewer system from development will be a force main system. Each building complex is to have a separate Grinder Pump System as Mfg. by e-ONE Sewer Systems.

Table 1 – Average Daily Flow on Specific Developments

TYPE OF DEVELOPMENT	UNIT	ADF (GPD/UNIT)
Auditorium	Seat	5
Automobile parking	1000 Gross square feet	25
Automobile repair garage	1000 Gross square feet	100
Bar	Seat	20
Bar: Public Areas & Tables	15 Gross square feet	20
Barber Shop	1000 Gross square feet	50
Beauty Salon	1000 Gross square feet	200
Carwash	Square feet inside	240
Church	Seat	5
Community center	Occupant	5
Country Club	Member	20
Factories (Exclusive of industrial waste)	Employee/shift	25
Factories (add for showers)	Employee/shift	+10
Gymnasium	1000 Gross square feet	300
Hospital – Convalescent/Rest Homes	Bed	150
Hospital	Bed	250
Jail	Inmate	85
Laboratory - commercial	1000 Gross square feet	300
Laundromat	Washer	400
Library / Museum	1000 Gross square feet	25
Manufacturing - industry	1000 Gross square feet	100
Medical building	1000 Gross square feet	300
Motel/Hotel	Room	100
Motel/Hotel (with cooking facilities)	Room	150
Office building	1000 Gross square feet	200
Residential –		
– single family dwelling, Townhouses	Dwelling unit	400
– bachelor/single, artist dwelling	Dwelling unit	100
– 1 Bedroom apartment or condo	Dwelling unit	200
– 2 Bedroom apartment or condo	Dwelling unit	300
– 3 Bedroom apartment of condo	Dwelling unit	400
– boarding house	Bed	85
– mobile home	Unit	200
– guest house with kitchen	Dwelling unit	300
Restaurant – fixed seat	Seat	50 or
Restaurant (dining area)	15 Gross square feet	50
Restaurant – Bakery, Doughnut Shop, take out	1000 Gross square feet	300
School – day care center	Child	10
School – elementary / junior high	Student	10
School – high school	Student	15
School - kindergarten	35 Gross square feet	10
Stadium/Theater – fixed seat	Seat	5
Stores, Shopping Centers, and Malls	1000 Gross square feet	100
University or College	Student	20
University Dormitory	Student	100
Veterinarian	1000 Gross square feet	300
Warehouse	1000 Gross square feet	25

Table 1 Notes:
Gross square feet: area included within the exterior of the surrounding walls of a building excluding courts.
Example Calculation - Assume a 10,000 sq. ft. office building is proposed. The estimated average daily flow is calculated as 10,000 sq. ft. x 200 gpd/1000 sq. ft. = 2000 gpd.

Table 2 – Average Flow Rate based on Land Use and Area Density

LAND USE / AREA DENSITY	UNIT	ADF (GPD/UNIT)
Low Density Residential (Single Family) (10 people / acre)	acre	1,000
Medium Density (Multi-Family) Residential (12 to 15 people / acre)	acre	1,200 – 1,500
High Density (Multi-Family) Residential (20 to 75 people / acre)	acre	2,000 – 7,500
Office & Institutional	acre	5,000
Commercial & Light Industrial	acre	5,000
Industrial	acre	10,000

The design Flow shall be calculated as follows:

Design Flow = Average Daily Flow x Peaking Factor

where:

Design Flow = Flow used to design a sanitary sewer facility, gpd.

Average Daily Flow = Estimated average daily flow, gpd.

Peaking Factor = Ratio of peak hourly flow to average daily flow. A peaking factor of four (4) shall be used for all calculations unless directed otherwise by the Authority.

Note:
All developments with proposed ADF above 2,000 gpd are required to evaluate the capacity of the existing sanitary sewer system.

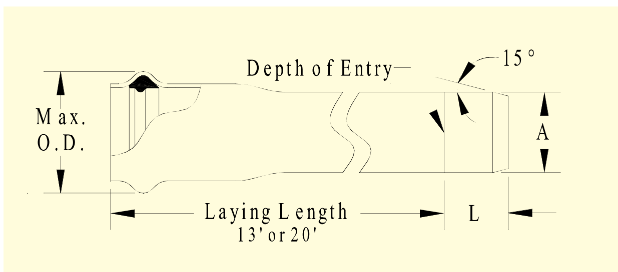
NATIONAL PIPE & PLASTICS, INC. **EVER-GREEN®**

PVC SEWER & STORM DRAINAGE PIPE

Scope: This submittal designates the general requirements for **Unplasticized Polyvinyl Chloride (PVC) Plastic PSM Sewer Pipe from compound with a cell classification 12454, as defined in ASTM Standard D-1784.**

Pipe: Pipe in trade size diameter of 4” through 15” shall meet the requirements of the latest ASTM D-3034 Standard. Pipe in trade sizes diameter of 18” and above shall meet the requirements of the latest ASTM Standard F-679. The above pipe shall conform to the requirements of CSA B-182.2. If integral gasketed bell ends are provided on the pipe, the pipe joint must meet the requirements of ASTM Standard D-3212, and the sealing gasket must conform to the requirements of ASTM Standard F-477 for sizes 4”-15”. The D-3034 normal pipe length will be 13’+/-1” laying length, (BNQ: 13’1½” min.) with other lengths available upon request. Pipe in trade size diameters of 4 and 6 inch are available with solvent-weld bells.

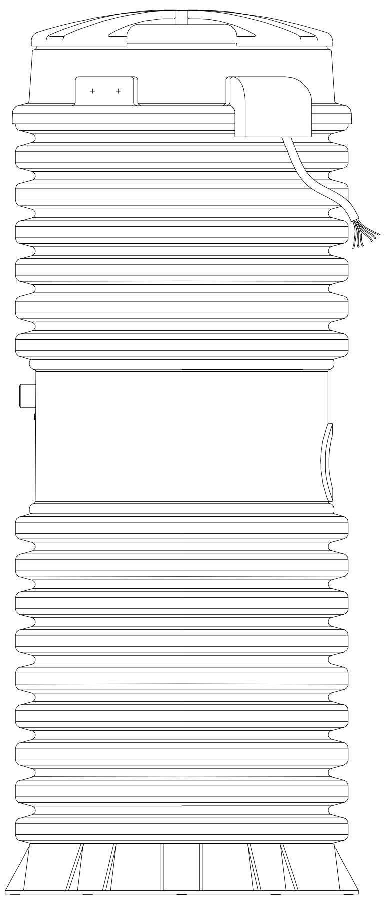
Fittings: Fittings shall conform to ASTM D-3034 & F-679 & CSA B-182.2.



Pipe Dimensions

ASTM D-3034			Minimum Wall Thickness					“L” Dimension Reference
Nominal Size	**Metric (m.m)**	**Average O.D.**	**SDR-41**	**SDR-35**	**SDR-26**	**SDR-23.5**	**Max. Bell OD**	**Max.**
4”	100	4.215	----	0.120	0.162	0.178	5.050	3.500
6”	150	6.275	0.153	0.180	0.241	0.265	7.305	4.375
8”	200	8.400	0.205	0.240	0.323	----	9.605	4.375
10”	250	10.500	0.256	0.300	0.404	----	12.030	6.125
12”	300	12.500	0.305	0.360	0.481	----	14.100	6.000
15”	375	15.300	0.375	0.437	0.588	----	17.200	6.375
Min. Pipe Stiffness @ 5% Deflection			28 psi	46 psi	115 psi	153 psi		
ASTM F-679			*T-1 Min. (SDR-35)		*T-1 Min. (SDR-26)	**T-2 Min (SDR-35)		
18”	450	18.701	0.536		0.719	0.499	20.690	9.125
21”	500	22.047	0.632		0.847	0.588	24.260	10.125
24”	600	24.803	0.711		0.953	0.661	27.290	11.125
Min. Pipe Stiffness @ 5% Deflection			46 psi		115 psi	46 psi		

*T-1 Is for material with a minimum cell classification of 12454B (400,000 psi min. modulus).
**T-2 Is for material with a minimum cell classification of 12364C (500,000 psi min. modulus).
This information is for reference only and is not manufactured by National Pipe & Plastics, Inc.



Low Pressure Sewer Systems Using Environment One Grinder Pumps

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Introduction

E/One low pressure sewer (LPS) systems offer the designer new freedom in solving many problem situations that have defied reasonably economical solutions using the conventional approach.

Each LPS system design should be considered on the basis of its own unique circumstances. On such a basis, a sound choice between gravity and low pressure systems can be made.

General criteria aid the engineer in making a preliminary choice between several alternative systems: entirely low pressure, entirely gravity, entirely vacuum or a combination of systems. These criteria are presented and are intended to serve as a general guide. The final decision and design are the responsibility of the project consulting engineer, whose knowledge of local conditions, including construction costs, regulatory requirements and the client's particular needs, become vital to the preparation of the final designs and specifications.

Advantages of LPS Systems

LPS systems have low initial (front end) cost compared to gravity systems, which have nearly all the total investment allocated in the first stage. With the LPS system, grinder pump costs are incurred only as construction progresses. These costs will be deferred for many years in certain types of development programs.

An LPS system is not subject to infiltration from ground water or from surface storm water entering through leaking pipe joints and manholes. With zero infiltration, treatment plants need not be sized to handle the peak flow rates caused by infiltration. Treatment efficiencies can be more consistent, and treatment plant operating costs decrease.

An LPS system may become the critical factor in determining whether "marginal" land can be economically developed. Many attractive sites have been considered unsuitable for development because of the excessive costs typically associated with conventional sewer systems — sites with hilly terrain, land with negligible slope, high water tables, poor percolation characteristics, rock, seasonal occupancy or low population density.

Many communities are planning to convert from septic tanks to central sewage collection and treatment systems to minimize health hazards and/or environmental deterioration. The major reduction in cost and the simplicity of installation of an LPS system have strong appeal for such community improvement programs. Small-diameter pipe pressure mains can be laid along existing roadways with minimum disruption to streets, sidewalks, lawns, driveways and underground utilities. Surface restoration costs are similarly minimized. Sewage delivered to the treatment plant (because it contains no infiltration) is more uniform in "strength," the volume is smaller, and peaks are greatly reduced.

Description and Operation

Grinder pumps of approved design accomplish all pumping and sewage-grinding processes for small-diameter LPS systems.

The system consists of conventional drain, waste and vent (DWV) piping within the residence connected to the grinder pump inlet. The grinder pump may be installed above or below grade, indoors or outdoors. Depending on flow factors and model used, it may serve one or more residences, or several families in the case of apartment buildings.

Grinder pumps discharge a finely ground slurry into small–diameter pressure piping. In a completely pressurized collection system, all the piping downstream from the grinder pump (including laterals and mains) will normally be under low pressure. Pipe sizes will start at 1 1/4 inches for house connections (compared to 4 or 6 inches in gravity systems) and will be proportionally smaller than the equivalent gravity pipeline throughout the system. All pipes are arranged as zone networks without loops.

Depending on topography, size of the system and planned rate of buildout, appurtenances may include valve boxes, flushing arrangements, air release valves at significant high points, check valves and full-ported stops at the junction of each house connection with the low pressure sewer main.

Pump Operation

Low pressure sewer systems have become feasible with the availability of the Environment One grinder pump, the reliability of which has been proven in almost 40 years of service. The grinder pump station provides adequate holding capacity, reliable grinding and pressure transport of a fine slurry to an existing gravity sewer, pump station or directly to a wastewater treatment plant.

In operation, the grinder pump station will handle sewage and many items that should not, but often do, appear in domestic wastewater. For example, plastic, wood, rubber and light metal objects can be routinely handled without jamming the grinder or clogging the pump or piping system. The grinder pump will discharge this slurry at a maximum rate of 15 gpm or 11 gpm at a pressure of 40 psig. Transporting sewage several thousand feet to a discharge point at a higher elevation is possible as long as the sum of the static and friction losses does not exceed design limits of 185 feet TDH (80 psig).

The grinder pump is actuated when the depth of the sewage in the tank reaches a predetermined “turn-on” level, and pumping continues until the “turn off” level is reached. The pump’s running time is short, power consumption is low, and long pump life is ensured. The unit is protected against backflow from discharge lines by an integral check valve. Several grinder pump station models are available to satisfy various total and peak demand conditions.

Pump Type

The semi-positive displacement pump in the grinder pump station has a nearly vertical H-Q curve. This is the best type of pump for successful parallel operation of many pumps into a system of common low pressure mains. Since each pump will be located at a different point along common low pressure mains and at various elevations, each pump should operate in an efficient and predictable manner, whether one pump or numerous pumps are operating at a given moment; the pumps in such a system do not have a single fixed “operating point,” but must operate consistently over a wide range of heads that are continually, and often rapidly, changing.

The Environment One grinder pump has the capability of operating above the LPS system design criteria of 80 psig, or 185 feet (Figure 1). Based on the maximum daily number of pumps operating simultaneously (Table 3) versus the number of pumps connected to the system at the design pressure of 185 feet, the capability to operate significantly above the system’s design pressure is mandatory in order for the system to operate properly during the approximately bimonthly peaks when the “absolute maximum” numbers of pumps are operating. This feature also ensures that pumping will continue under those conditions when higher–than–normal pressure occurs in the pipeline.

System designs with calculated heads approaching the upper limits of recommended heads should be reviewed by Environment One application specialists. Contact your local Environment One Regional Sales Office or authorized distributor for a no-cost, computerized review of your design.

Occasionally during “normal” operation, there will be short periods when higher-than-design pressures will be experienced. These can result from a variety of causes including solids buildup (obstructions) or air bubbles.

Deposits of solids or air accumulation will be purged from the line since the pump continues to produce an essentially constant flow, even though the cross section of the pipeline has temporarily been reduced. Higher velocities through the reduced cross section will provide the scouring action needed to correct such conditions as soon as they start to appear.

These higher–than–expected pressure conditions are transitory occurrences. The only requirement is that no damage be done to the pumping equipment, pipelines or appurtenances during these occasional short periods. Environment One grinder pumps are driven by motors rated for continuous operation at 104 F/40 C above ambient temperature. They can operate at 50 percent above rated pressure for at least 5 minutes without excessive temperature rise. Based on the Albany, New York, demonstration project[4], for this type of overload to last even as long as one minute would be rare.

Motor Selection

A grinder pump station is an electromechanical system that depends on electric power for its operating, control and alarm functions. The design and selection of Environment One’s pump, motor, grinder and level–sensing controls were accomplished by optimizing the wastewater transport function of the unit within the necessary constraints for unattended, trouble–free operation in a residential environment.

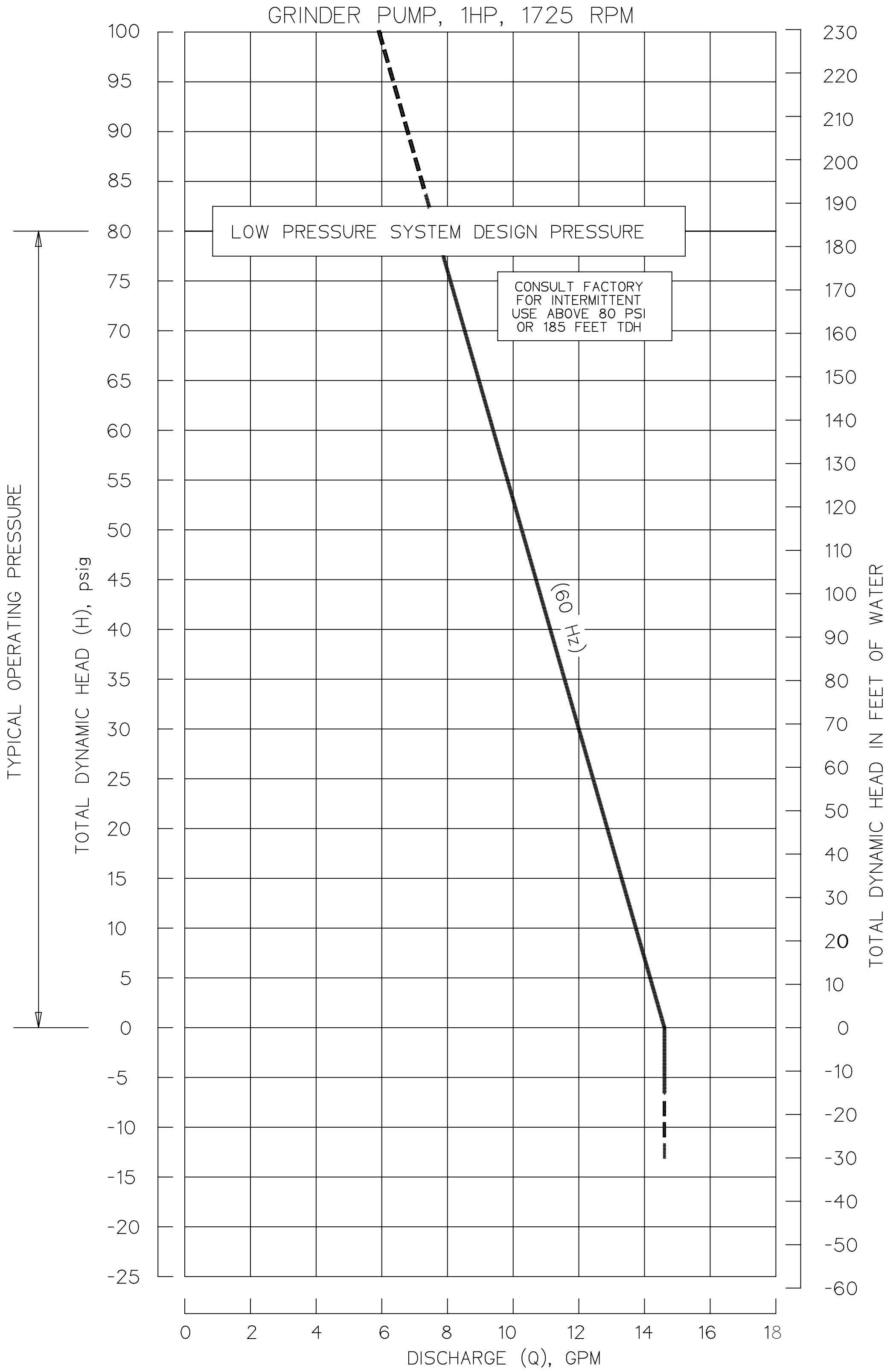
A single grinder pump core is common to all models of Environment One grinder pumps (models DH071, DH151, DH152, DH272 and DH502). This central core contains all of the working and control elements of the unit and is powered by a 1 hp, 240v (or 120v), 1,725 rpm capacitor start, thermally protected induction motor. Each of these motor features was carefully considered in the design of the grinder pump station.

The pump should be considered as a residential appliance. For this reason, performing the grinding and pumping functions using no more than 1 hp to permit occasional use at 120v in older homes not wired for 240v is desirable. In order to achieve the high heads desired and provide constant flow at varying heads, the 1-hp motor is coupled to a pump of semi-positive displacement design (Figure 1).

At a rating of 1 hp and 1,725 rpm, the Environment One grinder pump develops more than 8.4 foot-pounds of torque. Motors used to drive centrifugal pumps are often rated at 2.0 hp at 3,450 rpm and may produce less torque. When handling residential sewage, grinding torque may be demanded during any portion of the starting or running cycle. When the pump stops (controlled by level) in the midst of grinding hard objects (e.g. tongue depressors, plastic items, etc.), it must, upon restarting, be able to provide sufficient torque to the grinder to overcome the resistance of any object remaining from the previous cycle.

Figure 1

Grinder Pump Performance Characteristics



Power Outages

Environment One grinder pump stations have adequate excess holding capacity to provide wastewater storage during most electrical power outages (Figure 2). This excess holding capacity is shown on curve A. Data from the Federal Power Commission on national electrical power outages is plotted as a cumulative distribution function (curve B). Note that only volume above the normal “turn-on” level was counted as available storage. The average flow of 1.54 gallons/hour/person is based on the actual measured flow over a one-year period at the Albany Demonstration Project[4].

The local electrical power utility should be contacted to obtain a history on the power interruptions of the feeder(s) scheduled to serve the low pressure sewer site. From this data, curve B should be replotted to reflect local conditions. In those rare local areas where the frequency and/or the duration of outages exceed 7.5 hours, the use of Model DH151, with its greater holding capacity than that of the DH071, could be considered.

When power has been restored after a power outage, it is likely that nearly all the pumps in the system will try to operate simultaneously. Under these conditions, the dynamic head loss component of the total head will rise significantly. A number of pumps in the system would see a total back pressure high enough to cause the thermal overload protectors to automatically trip in a few minutes. Operation under conditions that could cause damage to the pumps or the system would be avoided. While these pumps are offline, other pumps in the system would be able to empty their tanks. After one to two minutes, the group that tripped off on thermal overload would cool and restart. The system back pressure would have been reduced and the group would be able to pump down normally. This process repeats itself automatically under the influence of each unit’s own thermal protector, reliably restoring the system to normal operation.

Power Consumption

Monthly power consumption of a residential grinder pump station is substantially less than that of other major appliances. The power consumption will vary based on the system operating parameters. The monthly cost can be approximated using the following equation and operating data:

$$\frac{{}^{*}\text{ Watts} \times \text{GPD} \times \text{Days/Mo}}{{}^{**}\text{ GPM} \times 60\text{ min} \times 1000} = \text{kwhr per month}$$

Discharge Pressure (PSI)	0	25	60	80
* Watts	690	770	1100	1400
** Flow (GPM)	15	12.4	9.3	7.7

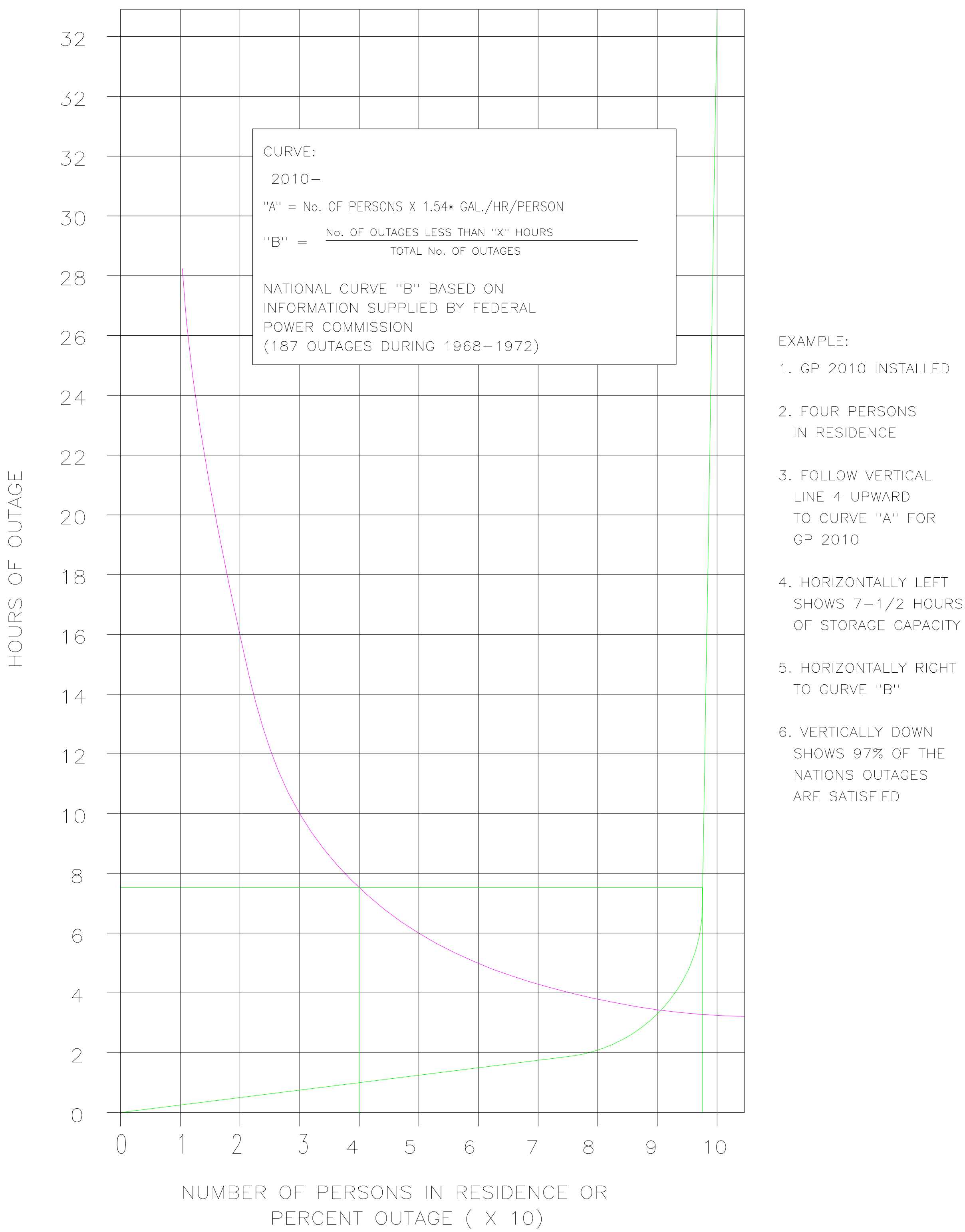
As an example of the calculation for a typical single-family home using 250 GPD, pumping at 25 psi is:

$$\frac{770\text{ W} \times 250\text{ GPD} \times 30\text{ Days}}{12.4\text{ GPM} \times 60\text{ min} \times 1000} = 7.76\text{ kwhr per month}$$

Then, multiply the kilowatt hours by the current cost of electricity and you will have an approximate monthly cost of running the unit.

Figure 2

Relationship of GP Storage Capacity to Power Outage Experience



LPS System Design

Once the initial analysis of a project has confirmed the feasibility of using the low-pressure approach, the completion of a preliminary system design is straightforward. This is primarily a result of two characteristics of E/One's semi-positive displacement pump: near-constant flow over the entire range of operating pressures and the ability of the pump to handle transient overpressures.

The balance of this section outlines a systematic approach to LPS system design, leading from pump model and pipe selection to a detailed zone and system analysis.

Information Required

The information that should be assembled prior to initiation of the LPS system design includes:

- Topography map
- Soil conditions
- Climatic conditions (frost depth, low temperature and duration)
- Water table
- Applicable codes
- Discharge location
- Lot layout (with structures shown, if available)
- Total number of lots
- Dwelling type(s)
- Use and flow factors (seasonal occupancy or year-round, appliances, water supply sources)
- Area development sequence and timetable

Grinder Pump Station Size Selection

Use this table to select grinder pump models for the types of occupancy to be served.

Model	Recommended Flow (gpd)	Adequate for Managing …
DH071	up to 700	Flow from one average single-family home, and up to two average, single-family homes where codes allow and with consent of the factory.
DH151	up to 1,500	Flow from up to two average single-family homes, and up to six average, single-family homes where codes allow and with consent of the factory.
DH152	up to 3,000	Flow from up to four average single-family homes, and up to 12 average, single-family homes with consent of the factory.
DH272	up to 5,000	Flow from up to six average single-family homes, and up to 20 average, single-family homes with consent of the factory.
DH502	up to 6,000	Flow from up to nine average single-family homes,

and up to 24 average, single-family homes with consent of the factory.

Considerations include:

- Wetwell and discharge piping must be protected from freezing
- Model and basin size must be appropriate for incoming flows, including peak flows
- Appropriate alarm device must be used
- Suitable location

Daily flows above those recommended may exceed the tank's peak flow holding capacity and/or shorten the interval between pump overhauls. The company should be consulted if higher inflows are expected.

The final selection will have to be determined by the engineer on the basis of actual measurements or best estimates of the expected sewage flow.

Grinder Pump Placement

The most economical location for installation of the grinder pump station is in the basement of the building it will serve. However, due consideration must be given when choosing an indoor location. If there is a risk of damage to items located in the basement level, other provisions should be made during basement installation or an outdoor unit should be considered.

Considerations such as ownership of the pumps by a municipality or private organization and/or the need for outdoor accessibility frequently dictate outdoor, in-ground installations. For outdoor installations, all GP models are available with high density polyethylene (HDPE) integral accessways ranging in height up to 10 feet. By keeping the unit as close as possible to the building, the lengths of gravity sewer and wiring will be minimized, keeping installation costs lower while reducing the chances of infiltration in the gravity flow section.

AC power from the building being served should be used for the grinder pump. Separate power sources add to installation and O&M costs, decrease overall reliability and frequently represent an aesthetic issue.

When two dwellings are to be served by a single unit, the station is usually placed in a position requiring the shortest gravity drains from each home. With multi-family buildings, more than one grinder pump may be required.

Pipe Selection

The final determination of the type of pipe to be used is the responsibility of the consulting engineer. In addition, the requirements of local codes, soil, terrain, water and weather conditions that prevail will guide this decision.

Although pipe fabricated from any approved material may be used, most LPS systems have been built with PVC and HDPE pipe. Continuous coils of small-diameter, HDPE pipe can be installed with automatic trenching machines and horizontal drilling machines to sewer areas at lower cost.

Table 1 **PIPE WATER CAPACITY** *Gallons/100 feet of Pipe Length*			
Nominal Pipe Size (in.)	Sch 40 PVC	SDR 21 PVC	SDR 11 HDPE
1 1/4	7.8	9.2	7.4
1 1/2	10.6	12.1	9.9
2	17.4	18.8	15.4
2 1/2	23.9	27.6	—
3	38.4	40.9	33.5
4	66.1	67.5	55.3
5	103.7	103.1	84.5
6	150.0	146.0	119.9
8	260.0	249.0	203.2

Table 2 **PVC PIPE COMPARISONS** *Nominal Pipe Size = 2 in.*		
Parameter	**Sch 40**	**SDR 21**
Wall Thickness, in.	0.154	0.113
Inside Diameter, in.	2.067	2.149
50 gpm Friction Loss, ft/100 ft	4.16	3.44

Table 1 compares the water capacity of two types of PVC pipe commonly used: SDR-21 and Sch 40, and one type of HDPE, SDR-11. All three have adequate pressure ratings for low pressure sewer service.

Although both types of PVC pipes are suitable, the three parameters compared in Table 2 illustrate why SDR-21 is suggested as a good compromise between capacity, strength, friction loss characteristics and cost.

System Layout

A preliminary sketch of the entire pressure sewer system should be prepared (Figure 3). Pump models should be selected and their location (elevation) should be noted. The location and direction of flow of each lateral, zone and main, and the point of discharge should be shown.

The system should be designed to give the shortest runs and the fewest abrupt changes in direction. “Loops” in the system must be avoided as they lead to unpredictable and uneven distribution of flow.

Although not shown in Figure 3, the elevation of the shutoff valve of the lowest-lying pump in each zone should be recorded and used in the final determination of static head loss. Since Environment One grinder pumps are semi-positive displacement and relatively insensitive to changes in head, precisely surveyed profiles are unnecessary.

Air/vacuum valves, air release valves and combination air valves serve to prevent the concentration of air at high points within a system. This is accomplished by exhausting large quantities of air as the system is filled and also by releasing pockets of air as they accumulate while the system is in operation and under pressure. Air/vacuum valves and combination air valves also serve to prevent a potentially destructive vacuum from forming.

Air/vacuum valves should be installed at all system high points and significant changes in grade. Combination air valves should be installed at those high points where air pockets can form. Air release valves should be installed at intervals of 2,000 to 2,500 feet on all long horizontal runs that lack a clearly defined high point.

Air relief valves should be installed at the beginning of each downward leg in the system that exhibits a 30-foot or more drop. Trapped pockets of air in the system not only add static head, but also increase friction losses by reducing the cross sectional area available for flow. Air will accumulate in downhill runs preceded by an uphill run.

Long ascending or descending lines require air and vacuum or dual-function valves placed at approximately 2000-foot intervals. Long horizontal runs require dual function valves placed at approximately 2000-foot intervals.

Pressure air release valves allow air and/or gas to continuously and automatically released from a pressurized liquid system. If air or gas pockets collect at the high points in a pumped system, then those pressurized air pockets can begin to displace usable pipe cross section. As the cross section of the pipe artificially decreases, the pump sees this situation as increased resistance to its ability to force the liquid through the pipe.

Air relief valves at high points may be necessary, depending on total system head, flow velocity and the particular profile. The engineer should consult Environment One in cases where trapped air is considered a potential problem.

Cleanout and flushing stations should be incorporated into the pipe layout. In general, cleanouts should be installed at the terminal end of each main, every 1,000 to 1,500 feet on straight runs of pipe, and whenever two or more mains come together and feed into another main.

Zone Designations

The LPS system illustrated in Figure 3 contains 72 pumps and is divided into 14 individually numbered zones. Division into zones facilitates final selection of pipe sizes, which are appropriate in relation to the requirements that flow velocity in the system is adequate and that both static and dynamic head losses are within design criteria. Assignment of individual zones follows from the relationship between the accumulating total number of pumps in a system to the predicted number that will periodically operate simultaneously (Table 3).

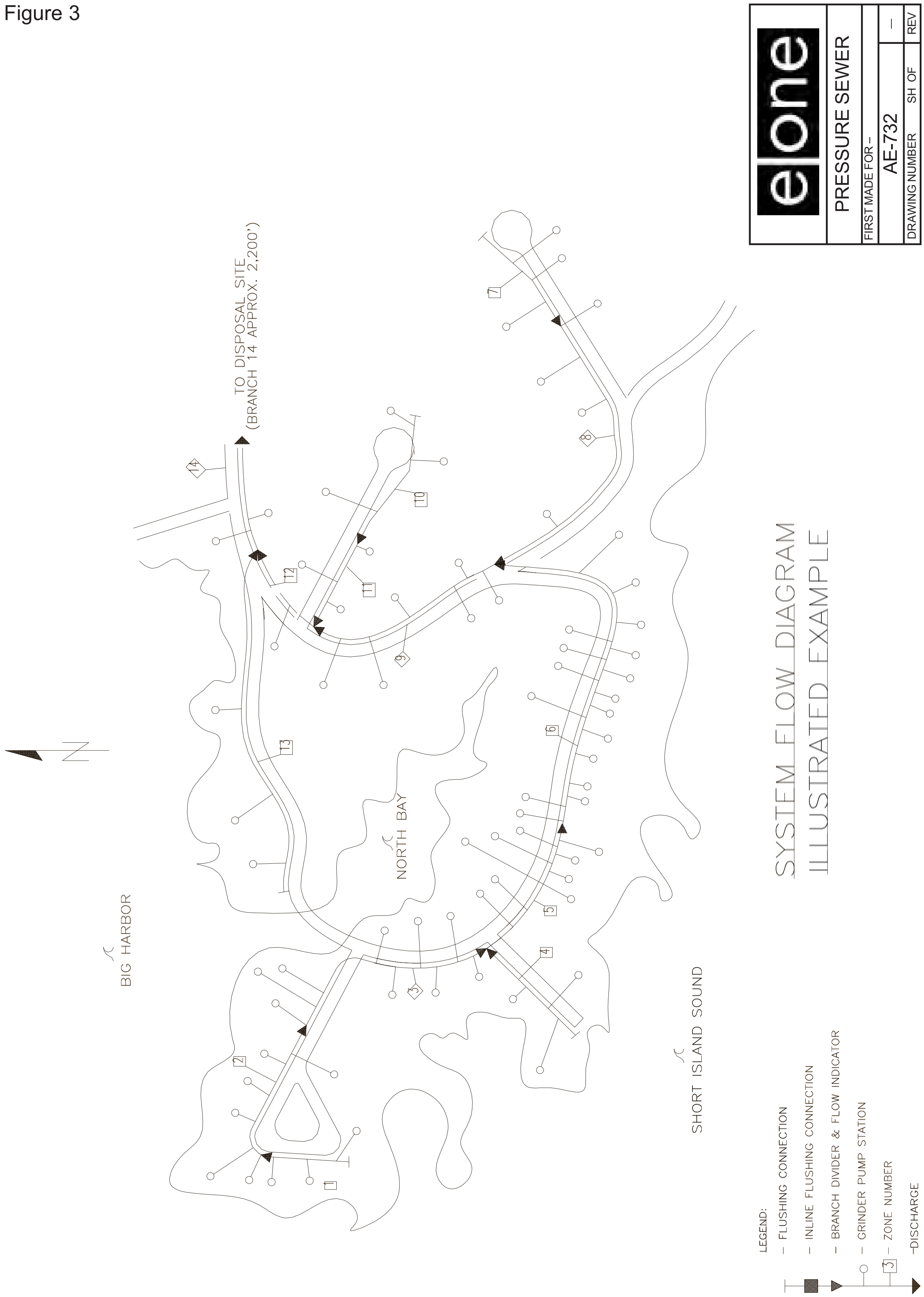
Table 4 was initially developed after careful analysis of more than 58,000 pump events in a 307-day period during the Albany project (4). It was extended for larger systems by application of probability theory. The validity of this table has since been confirmed by actual operating experience with thousands of large and small LPS systems during a 34-year period.

Using Figure 3, the actual exercise of assigning zones is largely mechanical. The single pump farthest from the discharge point in any main or lateral constitutes a zone. This and downstream pumps along the main are accumulated until their aggregate number is sufficient to increase the number of pumps in simultaneous operations by one, i.e., until the predicted maximum flow increases by 11 gpm.

Figure 3 shows that zones 1, 2 and 3 end when the number of pumps connected total 3, 6 and 9, and the number of pumps in daily simultaneous operation are 2, 3 and 4, respectively.

Any place where two or more sections of main join, or where the outfall is reached, also determines the end of a zone. This design rule takes precedence over the procedure stated above, as seen in

Figure 3


PRESSURE SEWER
FIRST MADE FOR –
AE-732
DRAWING NUMBER
SH OF
REV
TO DISPOSAL SITE
(BRANCH 14 APPROX. 2,200')
SYSTEM FLOW DIAGRAM
ILLUSTRATED EXAMPLE
NORTH BAY
BIG HARBOR
SHORT ISLAND SOUND
N
LEGEND:
– FLUSHING CONNECTION
– INLINE FLUSHING CONNECTION
– BRANCH DIVIDER & FLOW INDICATOR
– GRINDER PUMP STATION
3 – ZONE NUMBER
–DISCHARGE

zones 3, 4, 6, 8, 9, 11, 12, 13 and 14.

Completion of Pipe Schedule and Zone Analysis

The data recorded on the System Flow Diagram (Figure 3) is then transferred to Table 4.

Table 4 Column No.	Designation
1	Zone Number
2	Connects to Zone
3	Number of Pumps in Zone
4	Accumulated Pumps in Zone
11	Length of Main this Zone in Feet

Column 4 is completed by referring to Table 3, where the maximum number of pumps in simultaneous operation is given as a function of the number of pumps upstream from the end of the particular zone. The output of each zone will vary slightly with head requirements, but under typical conditions, the flow is approximately 11 gpm. Calculate the maximum anticipated flow for each zone by multiplying the number of simultaneous operations in Column 7 by 11 gpm and record the results in Column 8.

To complete columns 9, 10, 12 and 13, refer to Flow Velocity and Friction Head Loss table for the type of pipe selected — in this case, Table 5 for SDR-21. It will be seen that the engineer will frequently be presented with more than one option when selecting pipe size. Sometimes a compromise in pipe size will be required to meet present needs as well as planned future development. As a general rule, pipe sizes should be selected to minimize friction losses while keeping velocity near or above 2 feet per second.

For example, Zone 1 has a maximum of two pumps running (Column 7). Table 5 offers a choice of 1.25-inch, 1.5-inch or 2-inch pipe. 1.5-inch pipe is selected since flow velocity equals

Table 3
MAXIMUM NUMBER OF GRINDER PUMP CORES OPERATING DAILY

Number of Grinder Pump Cores Connected	Maximum Daily Number of Grinder Pump Cores Operating Simultaneously
1	1
2–3	2
4–9	3
10–18	4
19–30	5
31–50	6
51–80	7
81–113	8
114–146	9
147–179	10
180–212	11
213–245	12
246–278	13
279–311	14
312–344	15
345–377	16
378–410	17
411–443	18
444–476	19
477–509	20
510–542	21
543–575	22
576–608	23
609–641	24
642–674	25
675–707	26
708–740	27
741–773	28
774–806	29
807–839	30
840–872	31
873–905	32
906–938	33
939–971	34
972–1,004	35

BY: DATE:

PIPE: SDR 21 PVC

PREPARED FOR:

PRELIMINARY LOW-PRESSURE SEWER SYSTEM PIPE SCHEDULE AND ZONE ANALYSIS OF:

Illustrated Example
Table 4

Environment/One
CORPORATION

AE
SHEET NO. OF REV

1 ZONE NO.	2 CONN. TO ZONE	3 NO. PUMPS IN ZONE	4 ACCUM. PUMPS IN ZONE	5 GAL/DAY PER CORE	6 MAX. FLOW PER CORE	7 MAX. SIM OPS	8 MAX. FLOW (gpm)	9 PIPE SIZE (in)	10 MAX. VELOCITY (FPS)	11 LENGTH OF MAIN THIS ZONE	12 FRICTION LOSS FACTOR (ft/100 ft)	13 FRICTION LOSS THIS ZONE	14 ACCUM. FRICTION LOSS (ft)	15 MAX. MAIN ELEV.	16 MIN. PUMP ELEV.	17 STATIC HEAD (ft)	18 TOTAL DYNAMIC HEAD (ft)
1	2	3	3	200	11	2	22	1.5	3.04	205	2.15	4.41	73.41	40	10	30	103.41
2	3	6	9	200	11	3	33	2.0	2.92	380	1.54	5.86	69.00	40	10	30	99.00
3	5	9	18	200	11	4	44	2.0	3.89	630	2.63	16.56	63.14	40	5	35	98.14
4	5	3	3	200	11	2	22	1.5	3.04	310	2.15	8.46	53.25	40	5	35	88.25
5	6	9	30	200	11	5	55	3.0	2.24	800	0.60	4.83	46.58	40	5	35	81.58
6	9	17	47	200	11	6	66	3.0	2.69	1,000	0.85	8.46	41.75	40	5	35	76.75
7	8	3	3	200	11	2	22	1.5	3.04	175	2.15	3.77	49.56	40	5	35	84.56
8	9	4	7	200	11	3	33	2.0	2.92	810	1.54	12.50	45.80	40	30	10	55.80
9	12	6	60	200	11	7	77	3.0	3.14	520	1.12	5.85	33.30	40	10	30	63.30
10	11	3	3	200	11	2	22	1.5	3.04	230	2.15	4.95	37.03	40	10	30	67.03
11	12	3	6	200	11	3	33	2.0	2.92	300	1.54	4.63	32.08	40	10	30	62.08
12	14	1	67	200	11	7	77	3.0	3.14	240	1.12	2.70	27.45	40	10	30	57.45
13	14	3	3	200	11	2	22	1.5	3.04	985	2.15	21.19	45.94	40	5	35	80.94
14	14	2	72	200	11	7	77	3.0	3.14	2,200	1.12	24.75	24.75	40	30	10	34.75

3.04 ft/sec and friction loss equals 2.15 ft/100 ft. Since the zone is 205 feet in length (Column 11), the total friction loss (Column 13) is:

HF = (2.15 ft/100 ft)(205 ft) = 4.41 ft

For Zone 14, with 72 upstream pumps, it is seen that a maximum of seven pumps can be running simultaneously. Table 5 provides options of:

3-inch pipe: V = 3.14 ft/sec; HF = 1.12 ft/100 ft

or

4-inch pipe: V = 1.90 ft/sec; HF = 0.33 ft/100 ft

The smaller-diameter 3-inch pipe is selected because of the increased velocities, especially with the TDH below 185 feet. A choice of 3-inch pipe would lead to a friction loss in this zone of:

HF = (1.12 ft/100 ft) (2200 ft) = 24.75 ft

Accumulated friction loss (Column 14) for each zone is next determined by adding the friction loss for each zone from the system outfall (Zone 14) to the zone in question. Thus, from Figure 3 it is seen that the accumulated friction loss for Zone 1 is:

Zone Number	Friction Loss (ft)
14	24.75
12	2.70
9	5.85
6	8.46
5	4.83
3	16.56
2	5.86
1	4.41

73.41 ft = Accumulated friction loss, Zone 1

The same summation is completed for each zone.

To complete the hydraulic analysis, refer to the drawing contours and record in Column 15 the maximum line elevation between the point of discharge and the zone under consideration. In Column 16, record the elevation of the lowest pump in the zone. Subtract the values in Column 16 from those in Column 15 and record only positive elevation differentials in Column 17. Add the values in Column 14 to those in Column 17 and record the total in Column 18 to show the maximum combination of friction and static head a pump will experience at any given point in the system.

Review

The accumulated data in Table 4 should finally be reviewed for conformity with the criteria of flow velocity greater than or equal to 2.0 ft/sec and total design head less than or equal to 185 feet. If the system pressure exceeds 92 feet, the number of cores operating will remain the same and the flow from each pump will be reduced from 11 gpm to 9 gpm.

Data should be reviewed to determine whether system improvements could result from construction modifications. As an example, deeper burial of pipe in one or two critical high-elevation zones might bring the entire system into compliance with design criteria. Environment One should be consulted in marginal cases and/or concerning:

- Odor control issues
- Frost protection issues
- Excessive static head conditions
- Excessive total dynamic head conditions
- Unusual applications

Table 5
SDR 21 PVC PIPE
Flow Velocity and Friction Head Loss *vs* Pumps in Simultaneous Operation (C = 150)

	1 1/4 in.		1 1/2 in.		2 in.		2 1/2 in.		3 in.		4 in.		5 in.		6 in.		8 in.		
N	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**N**
1	1.99	**1.15**	1.52	**0.60**															**1**
2	3.99	**4.16**	3.04	**2.15**	1.95	**0.73**													**2**
3	5.98	**8.82**	4.56	**4.56**	2.92	**1.54**	1.99	**0.61**											**3**
4	7.97	**15.02**	6.08	**7.77**	3.89	**2.63**	2.66	**1.04**	1.79	**0.40**									**4**
5					4.87	**3.97**	3.32	**1.57**	2.24	**0.60**									**5**
6					5.84	**5.57**	3.99	**2.20**	2.69	**0.85**									**6**
7					6.81	**7.41**	4.65	**2.93**	3.14	**1.12**	1.90	**0.33**							**7**
8							5.32	**3.75**	3.59	**1.44**	2.17	**0.42**							**8**
9							5.98	**4.66**	4.04	**1.79**	2.44	**0.53**							**9**
10							6.64	**5.67**	4.49	**2.18**	2.71	**0.64**							**10**
11									4.93	**2.60**	2.98	**0.76**	1.95	**0.27**					**11**
12									5.38	**3.05**	3.25	**0.90**	2.13	**0.32**					**12**
13									5.83	**3.54**	3.52	**1.04**	2.31	**0.37**					**13**
14									6.28	**4.06**	3.80	**1.19**	2.48	**0.43**					**14**
15											4.07	**1.36**	2.66	**0.48**	1.88	**0.21**			**15**
16											4.34	**1.53**	2.84	**0.55**	2.00	**0.23**			**16**
17											4.61	**1.71**	3.02	**0.61**	2.13	**0.26**			**17**
18											4.88	**1.90**	3.19	**0.68**	2.25	**0.29**			**18**
19											5.15	**2.10**	3.37	**0.75**	2.38	**0.32**			**19**
20											5.42	**2.31**	3.55	**0.82**	2.50	**0.35**			**20**
21											5.69	**2.53**	3.73	**0.90**	2.63	**0.39**			**21**
22											5.96	**2.76**	3.90	**0.98**	2.75	**0.42**			**22**
23											6.24	**2.99**	4.08	**1.07**	2.88	**0.46**			**23**
24													4.26	**1.16**	3.00	**0.49**			**24**
25													4.44	**1.25**	3.13	**0.53**			**25**
26													4.61	**1.34**	3.25	**0.57**			**26**
27													4.79	**1.44**	3.38	**0.61**	1.99	**0.17**	**27**
28													4.97	**1.54**	3.50	**0.66**	2.07	**0.18**	**28**
29													5.15	**1.64**	3.63	**0.70**	2.14	**0.19**	**29**
30													5.32	**1.75**	3.75	**0.75**	2.21	**0.21**	**30**
31													5.50	**1.86**	3.88	**0.79**	2.29	**0.22**	**31**
32													5.68	**1.97**	4.01	**0.84**	2.36	**0.23**	**32**
33													5.86	**2.08**	4.13	**0.89**	2.44	**0.25**	**33**
34													6.03	**2.20**	4.26	**0.94**	2.51	**0.26**	**34**
35													6.21	**2.32**	4.38	**0.99**	2.58	**0.28**	**35**
36															4.51	**1.05**	2.66	**0.29**	**36**
37															4.63	**1.10**	2.73	**0.30**	**37**
38															4.76	**1.16**	2.81	**0.32**	**38**
39															4.88	**1.21**	2.88	**0.34**	**39**
40															5.01	**1.27**	2.95	**0.35**	**40**
41															5.13	**1.33**	3.03	**0.37**	**41**
42															5.26	**1.39**	3.10	**0.39**	**42**
43															5.38	**1.45**	3.17	**0.40**	**43**
44															5.51	**1.52**	3.25	**0.42**	**44**
45															5.63	**1.58**	3.32	**0.44**	**45**
46															5.76	**1.65**	3.40	**0.46**	**46**
47															5.88	**1.72**	3.47	**0.47**	**47**
48															6.01	**1.78**	3.54	**0.49**	**48**
49															6.13	**1.85**	3.62	**0.51**	**49**
50															6.26	**1.92**	3.69	**0.53**	**50**

Head Loss Calculations
From Modified Hazen - Williams Formula

$$H_F = .2083 \left[\left(\frac{100}{C}\right)^{1.852} \times \frac{q^{1.852}}{d^{4.8655}} \right]$$

$$V = .3208 \frac{q}{A}$$

$$A = \frac{d^2\pi}{4}$$ = cross-sectional flow, sq. in.

C = 150
q = flow in gallons per minute
d = I.D. of pipe in inches =
[average O.D. - (2 x min. wall thickness]

N = Number of pumps operating at 11 gpm
V = Flow velocity in ft/sec
H_F = Friction head loss in ft/100 ft of pipe

Table 6
SCHEDULE 40 PVC PIPE

Flow Velocity and Friction Head Loss *vs* Pumps in Simultaneous Operation (C = 150)

	1 1/4 in.		1 1/2 in.		2 in.		2 1/2 in.		3 in.		4 in.		5 in.		6 in.		8 in.		
N	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**V**	**H_F**	**N**
1	2.36	**1.74**	1.73	**0.82**	1.05	**0.24**													**1**
2	4.72	**6.28**	3.47	**2.97**	2.10	**0.88**	1.47	**0.37**											**2**
3	7.08	**13.31**	5.20	**6.29**	3.15	**1.86**	2.21	**0.79**											**3**
4			6.93	**10.71**	4.21	**3.18**	2.95	**1.34**	1.91	**0.46**									**4**
5					5.26	**4.80**	3.68	**2.02**	2.39	**0.70**									**5**
6					6.31	**6.73**	4.42	**2.83**	2.87	**0.99**									**6**
7							5.16	**3.77**	3.34	**1.31**	1.94	**0.35**							**7**
8							5.89	**4.83**	3.82	**1.68**	2.22	**0.45**							**8**
9							6.63	**6.01**	4.30	**2.09**	2.49	**0.56**							**9**
10									4.78	**2.54**	2.77	**0.68**							**10**
11									5.25	**3.03**	3.05	**0.81**	1.94	**0.27**					**11**
12									5.73	**3.56**	3.33	**0.95**	2.12	**0.32**					**12**
13									6.21	**4.13**	3.60	**1.10**	2.29	**0.37**					**13**
14											3.88	**1.26**	2.47	**0.42**					**14**
15											4.16	**1.43**	2.65	**0.48**					**15**
16											4.44	**1.62**	2.82	**0.54**	1.95	**0.22**			**16**
17											4.71	**1.81**	3.00	**0.60**	2.08	**0.25**			**17**
18											4.99	**2.01**	3.17	**0.67**	2.20	**0.27**			**18**
19											5.27	**2.22**	3.35	**0.74**	2.32	**0.30**			**19**
20											5.54	**2.44**	3.53	**0.81**	2.44	**0.33**			**20**
21											5.82	**2.67**	3.70	**0.89**	2.56	**0.36**			**21**
22											6.10	**2.91**	3.88	**0.97**	2.69	**0.40**			**22**
23													4.06	**1.05**	2.81	**0.43**			**23**
24													4.23	**1.14**	2.93	**0.47**			**24**
25													4.41	**1.23**	3.05	**0.50**			**25**
26													4.59	**1.32**	3.17	**0.54**			**26**
27													4.76	**1.42**	3.30	**0.58**			**27**
28													4.94	**1.52**	3.42	**0.62**	1.98	**0.16**	**28**
29													5.11	**1.62**	3.54	**0.66**	2.05	**0.17**	**29**
30													5.29	**1.72**	3.66	**0.70**	2.12	**0.19**	**30**
31													5.47	**1.83**	3.79	**0.75**	2.19	**0.20**	**31**
32													5.64	**1.94**	3.91	**0.79**	2.26	**0.21**	**32**
33													5.82	**2.06**	4.03	**0.84**	2.33	**0.22**	**33**
34													6.00	**2.17**	4.15	**0.89**	2.40	**0.23**	**34**
35													6.17	**2.29**	4.27	**0.94**	2.47	**0.25**	**35**
36															4.40	**0.99**	2.54	**0.26**	**36**
37															4.52	**1.04**	2.61	**0.27**	**37**
38															4.64	**1.09**	2.68	**0.29**	**38**
39															4.76	**1.15**	2.75	**0.30**	**39**
40															4.88	**1.20**	2.82	**0.32**	**40**
41															5.01	**1.26**	2.89	**0.33**	**41**
42															5.13	**1.31**	2.96	**0.35**	**42**
43															5.25	**1.37**	3.03	**0.36**	**43**
44															5.37	**1.43**	3.11	**0.38**	**44**
45															5.49	**1.49**	3.18	**0.39**	**45**
46															5.62	**1.56**	3.25	**0.41**	**46**
47															5.74	**1.62**	3.32	**0.43**	**47**
48															5.86	**1.68**	3.39	**0.44**	**48**
49															5.98	**1.75**	3.46	**0.46**	**49**
50															6.11	**1.81**	3.53	**0.48**	**50**

Head Loss Calculations
From Modified Hazen - Williams Formula

$$H_F = .2083 \left[\left(\frac{100}{C}\right)^{1.852} \times \frac{q^{1.852}}{d^{4.8655}} \right]$$

$$V = .3208 \frac{q}{A}$$

$$A = \frac{d^2\pi}{4} = \text{cross-sectional flow, sq. in.}$$

C = 150
q = flow in gallons per minute
d = I.D. of pipe in inches =
[average O.D. - (2 x min. wall thickness]

N = Number of pumps operating at 11 gpm
V = Flow velocity in ft/sec
H_F = Friction head loss in ft/100 ft of pipe

Table 7
SDR 11 HDPE PIPE

Flow Velocity and Friction Head Loss *vs* Pumps in Simultaneous Operation (C = 155)

	1 1/4 in.		1 1/2 in.		2 in.		3 in.		4 in.		5 in.		6 in.		8 in.		
N	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	V	H_F	N
1	2.47	**1.84**	1.86	**0.92**													1
2	4.95	**6.63**	3.72	**3.32**	2.38	**1.12**											2
3	7.42	**14.04**	5.58	**7.03**	3.57	**2.37**	1.64	**0.36**									3
4			7.44	**11.98**	4.76	**4.04**	2.19	**0.61**									4
5					5.95	**6.11**	2.74	**0.92**									5
6					7.14	**8.56**	3.29	**1.30**	1.99	**0.38**							6
7							3.83	**1.72**	2.32	**0.51**							7
8							4.38	**2.21**	2.65	**0.65**							8
9							4.93	**2.75**	2.98	**0.81**	1.95	**0.29**					9
10							5.48	**3.34**	3.31	**0.98**	2.17	**0.35**					10
11							6.03	**3.98**	3.65	**1.17**	2.39	**0.42**					11
12									3.98	**1.38**	2.60	**0.49**					12
13									4.31	**1.60**	2.82	**0.57**	1.99	**0.24**			13
14									4.64	**1.83**	3.04	**0.65**	2.14	**0.28**			14
15									4.97	**2.08**	3.25	**0.74**	2.29	**0.32**			15
16									5.30	**2.35**	3.47	**0.84**	2.45	**0.36**			16
17									5.63	**2.63**	3.69	**0.94**	2.60	**0.40**			17
18									5.97	**2.92**	3.90	**1.04**	2.75	**0.44**			18
19									6.30	**3.23**	4.12	**1.15**	2.90	**0.49**			19
20											4.34	**1.27**	3.06	**0.54**			20
21											4.56	**1.39**	3.21	**0.59**			21
22											4.77	**1.51**	3.36	**0.64**	1.98	**0.18**	22
23											4.99	**1.64**	3.52	**0.70**	2.08	**0.19**	23
24											5.21	**1.77**	3.67	**0.76**	2.17	**0.21**	24
25											5.42	**1.91**	3.82	**0.82**	2.26	**0.23**	25
26											5.64	**2.06**	3.98	**0.88**	2.35	**0.24**	26
27											5.86	**2.21**	4.13	**0.94**	2.44	**0.26**	27
28											6.07	**2.36**	4.28	**1.01**	2.53	**0.28**	28
29													4.43	**1.08**	2.62	**0.30**	29
30													4.59	**1.15**	2.71	**0.32**	30
31													4.74	**1.22**	2.80	**0.34**	31
32													4.89	**1.29**	2.89	**0.36**	32
33													5.05	**1.37**	2.98	**0.38**	33
34													5.20	**1.44**	3.07	**0.40**	34
35													5.35	**1.52**	3.16	**0.42**	35
36													5.50	**1.60**	3.25	**0.44**	36
37													5.66	**1.69**	3.34	**0.47**	37
38													5.81	**1.77**	3.43	**0.49**	38
39													5.96	**1.86**	3.52	**0.52**	39
40													6.12	**1.95**	3.61	**0.54**	40
41															3.70	**0.57**	41
42															3.79	**0.59**	42
43															3.88	**0.62**	43
44															3.97	**0.65**	44
45															4.06	**0.67**	45
46															4.15	**0.70**	46
47															4.24	**0.73**	47
48															4.33	**0.76**	48
49															4.42	**0.79**	49
50															4.51	**0.82**	50

Head Loss Calculations
From Modified Hazen - Williams Formula

$$H_F = .2083 \left[\left(\frac{100}{C}\right)^{1.852} \times \frac{q^{1.852}}{d^{4.8655}} \right]$$

$$V = .3208 \frac{q}{A}$$

$$A = \frac{d^2\pi}{4}$$ = cross-sectional flow, sq. in.

C = 150

q = flow in gallons per minute

d = I.D. of pipe in inches =
[average O.D. - (2 x min. wall thickness)]

N = Number of pumps operating at 11 gpm

V = Flow velocity in ft/sec

H_F = Friction head loss in ft/100 ft of pipe

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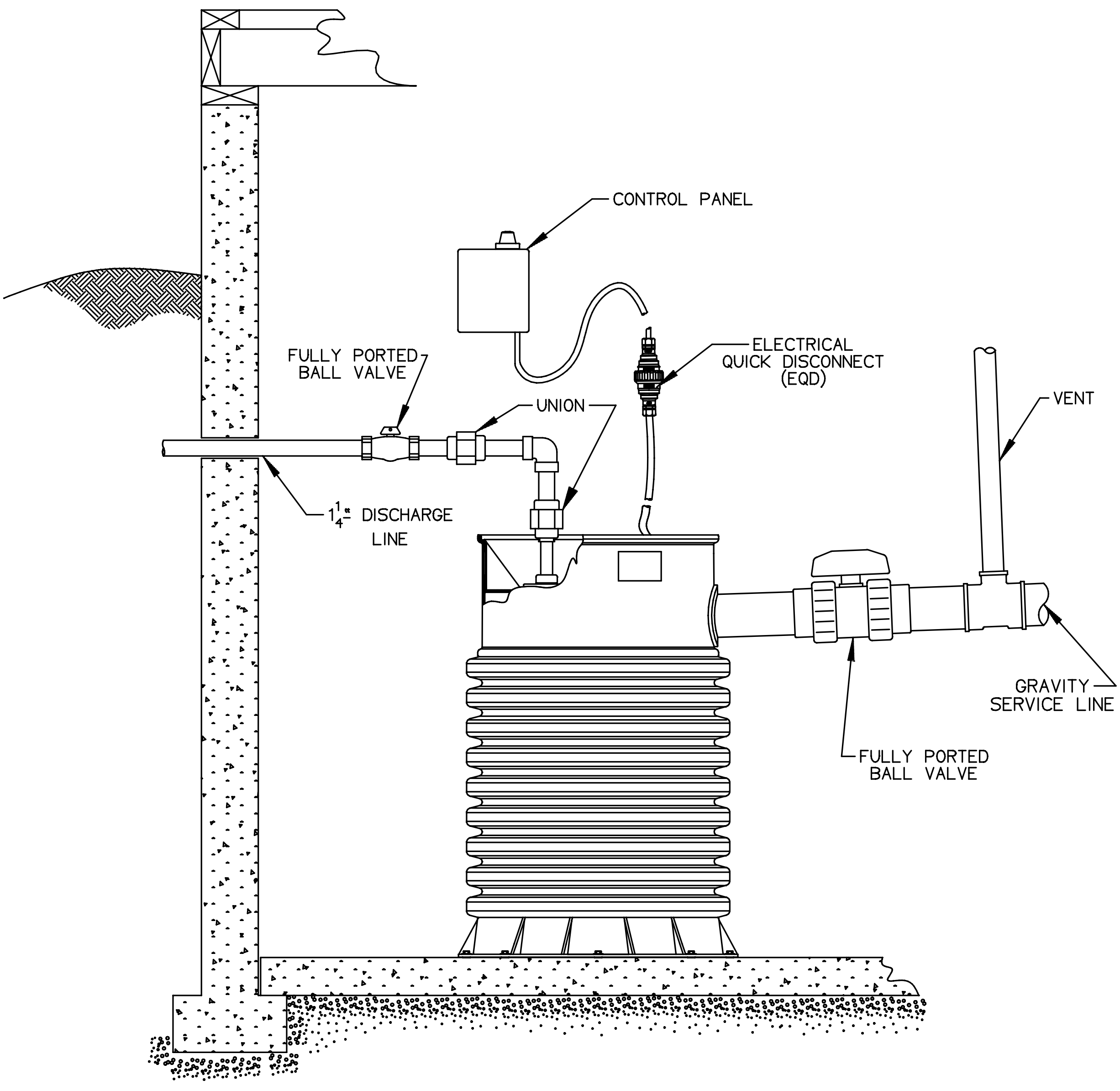
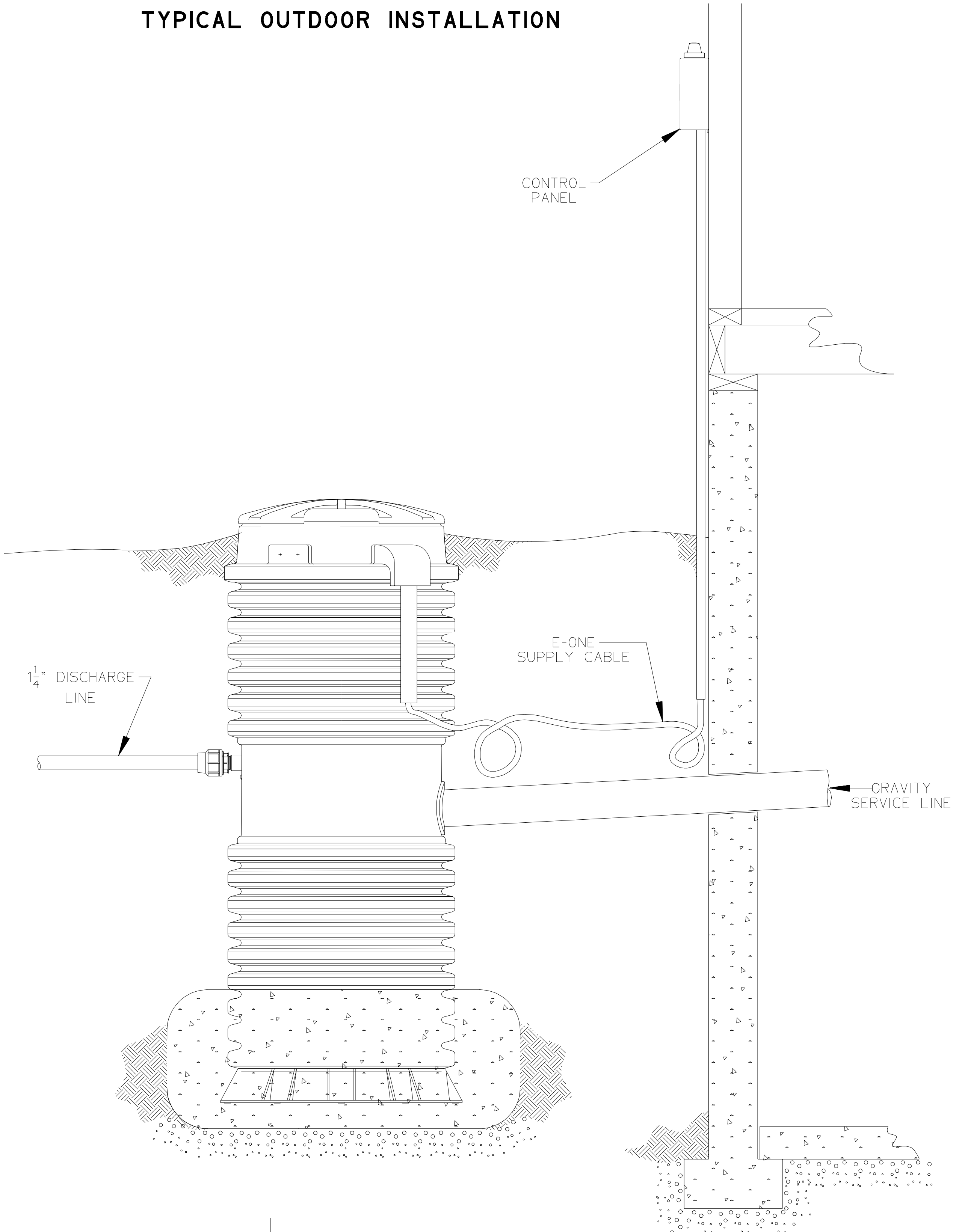
TYPICAL INDOOR INSTALLATION



TYPICAL OUTDOOR INSTALLATION



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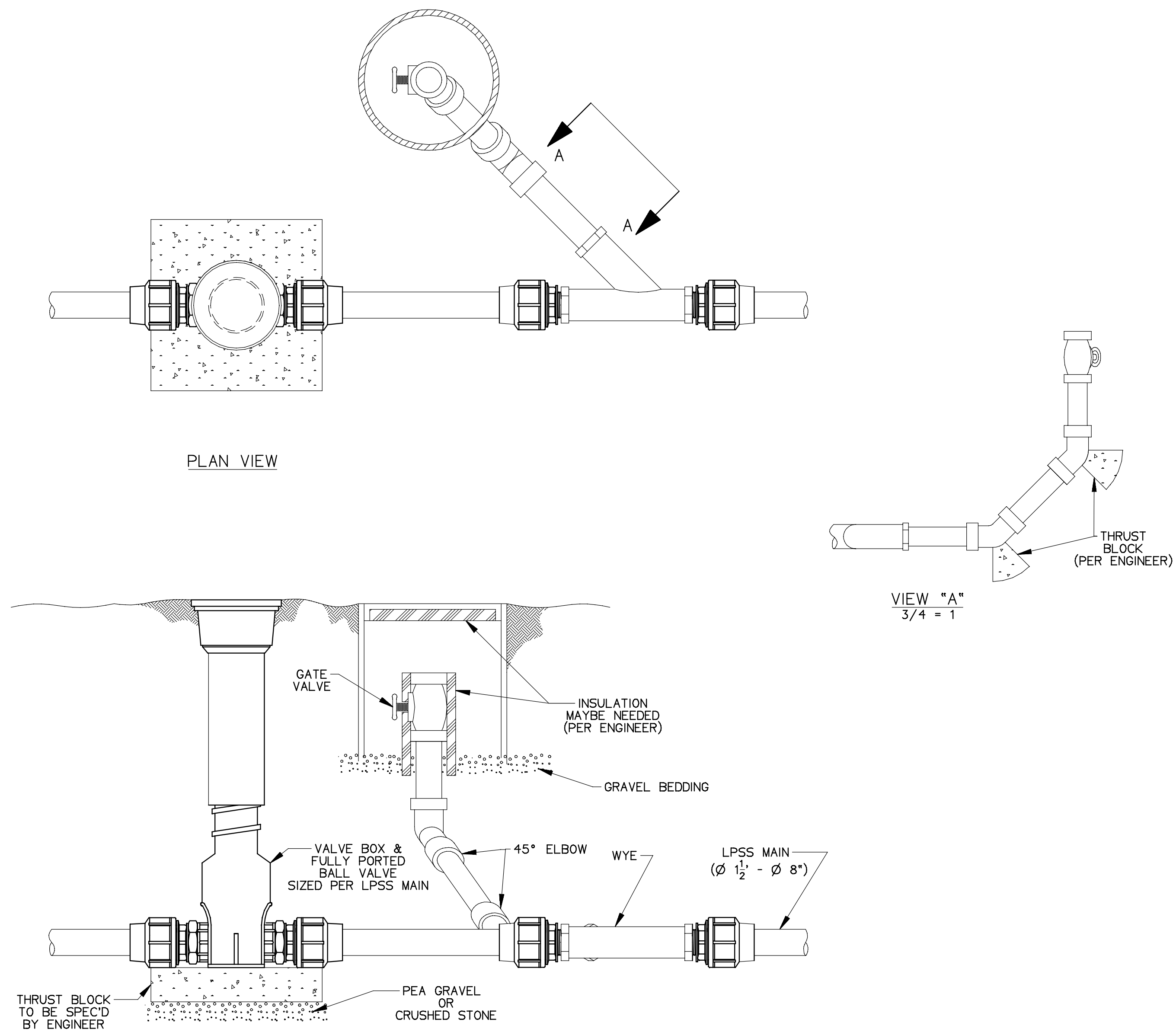
LM000112 REV. A



TYPICAL FLUSHING CONNECTION ON LPSS MAIN

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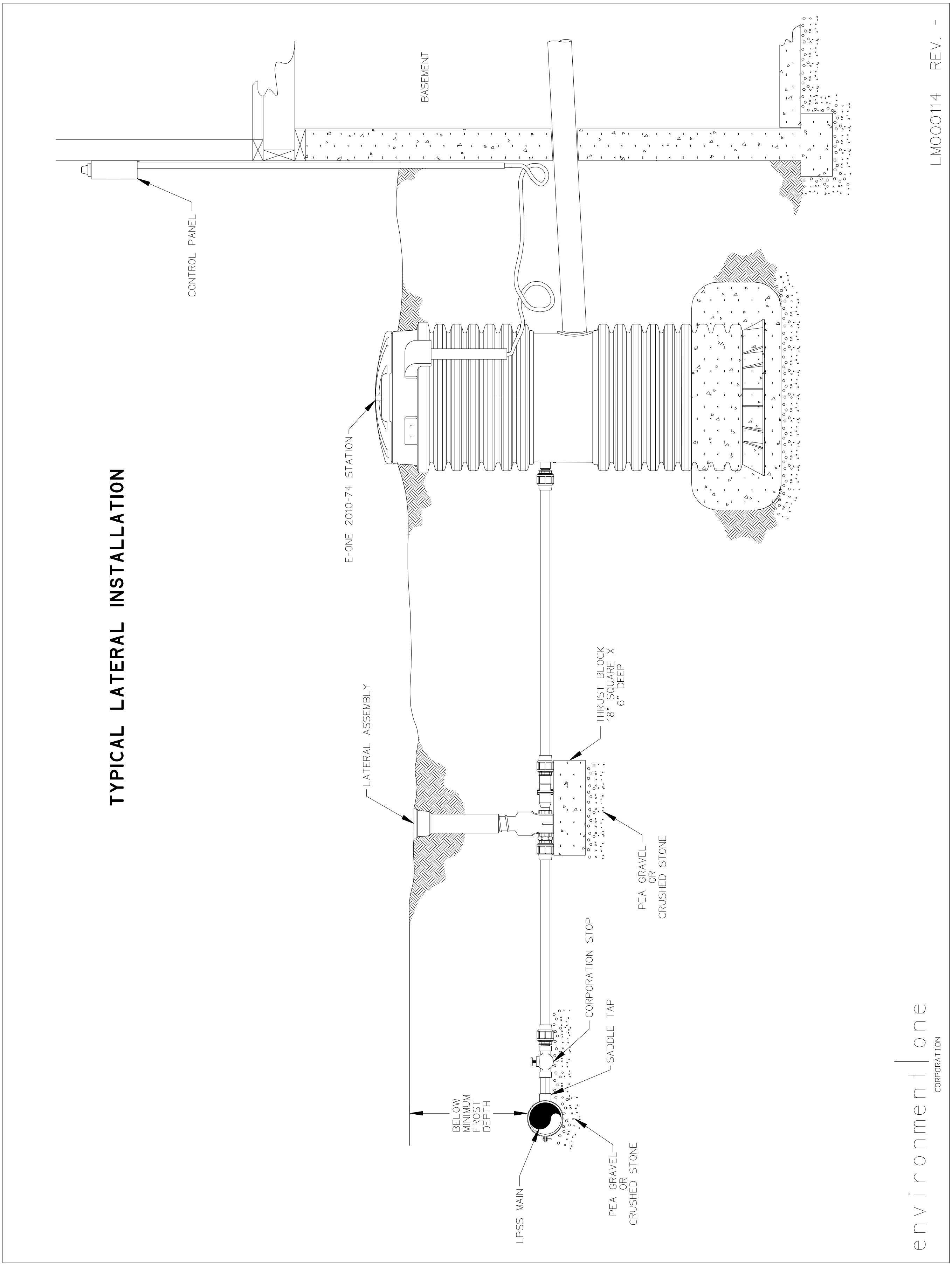
LM000113 REV. A


TYPICAL LATERAL INSTALLATION
BASEMENT
CONTROL PANEL
E-ONE 2010-74 STATION
LATERAL ASSEMBLY
THRUST BLOCK
18" SQUARE X
6" DEEP
PEA GRAVEL
OR
CRUSHED STONE
CORPORATION STOP
SADDLE TAP
BELOW
MINIMUM
FROST
DEPTH
LPSS MAIN
PEA GRAVEL
OR
CRUSHED STONE
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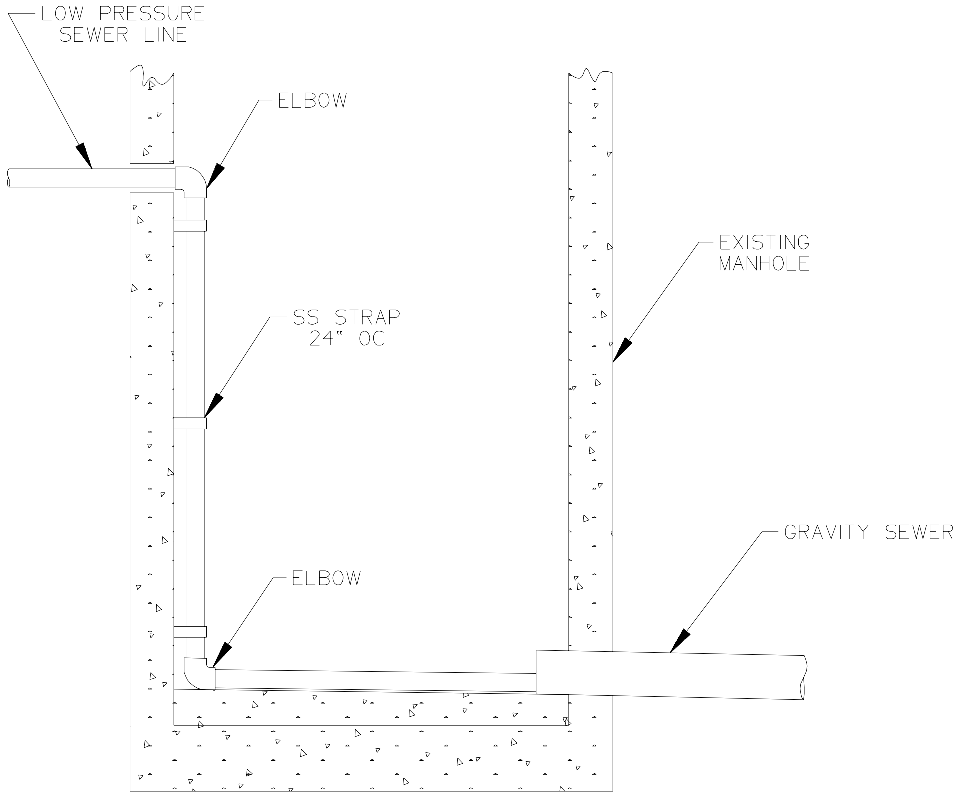
LM000114 REV. -

TYPICAL DROP CONNECTION
LPSS IN EXISTING MANHOLE



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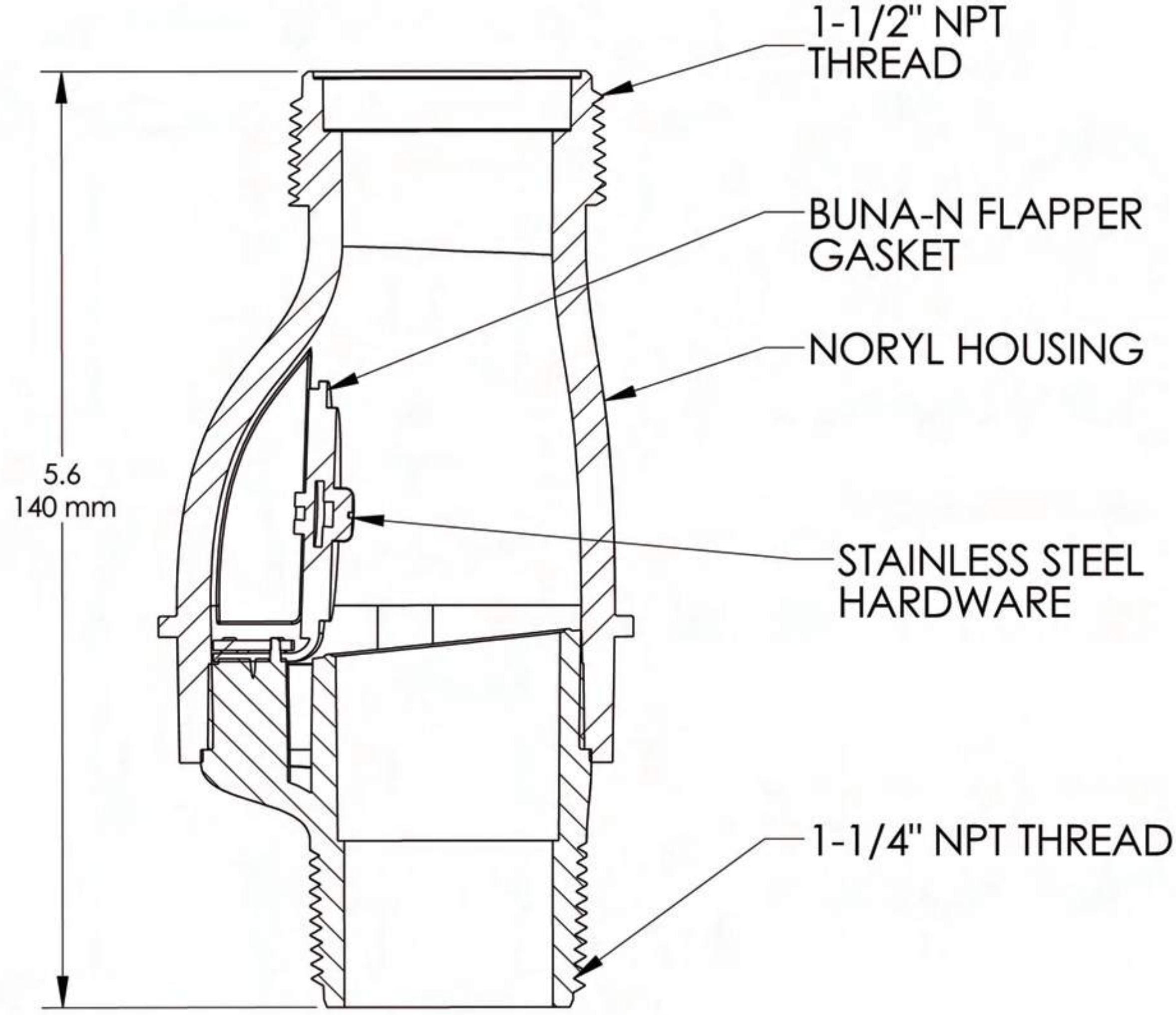
LM000115 REV. -



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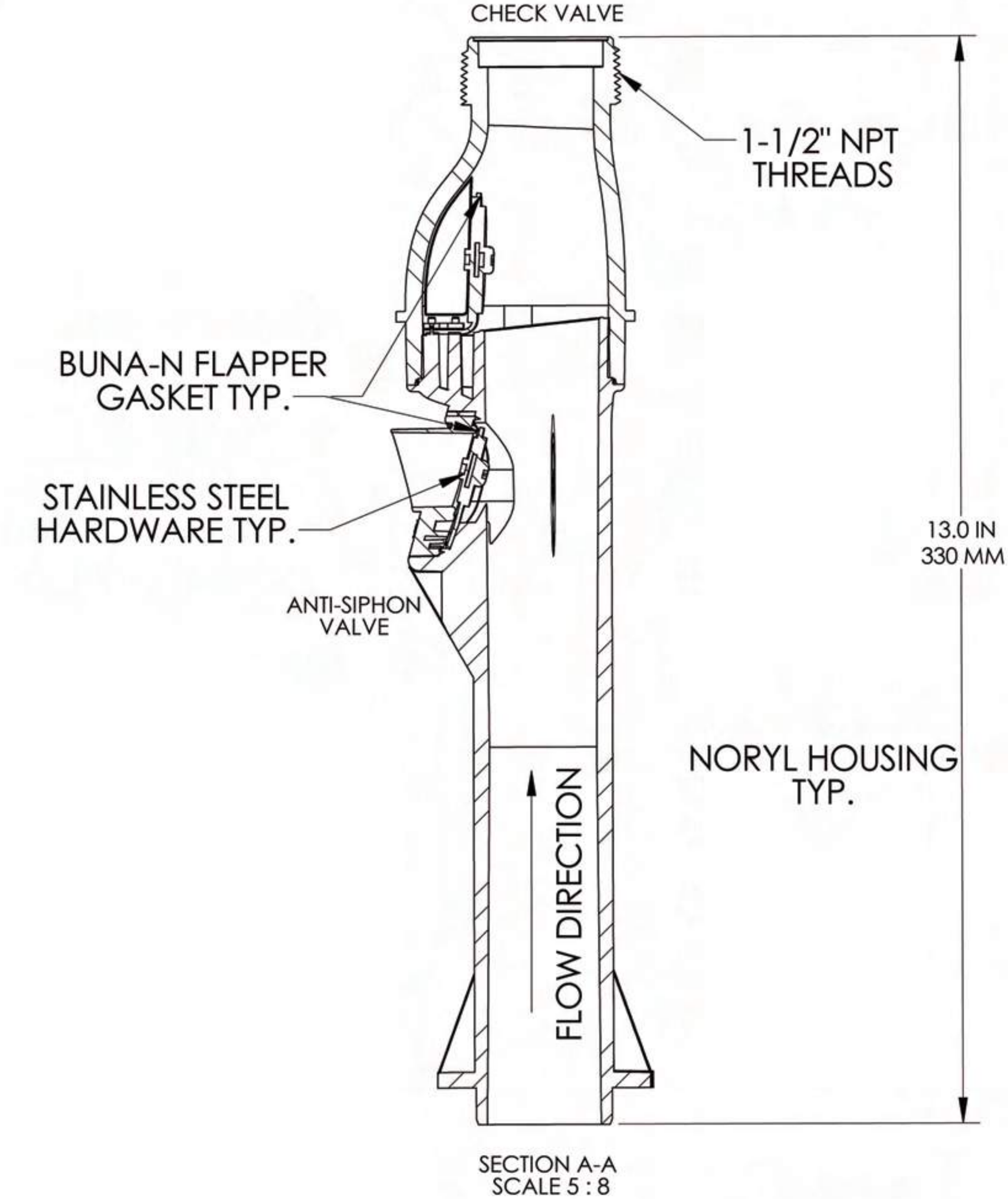
ENVIRONMENT ONE CORPORATION

REDUNDANT CHECK VALVE

ENG MODEL: US Assembly K7	SERVICE #:
DRAWING NUMBER	SH 1 OF 1



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ENVIRONMENT ONE CORPORATION

ANTI-SIPHON CHECK VALVE

SERVICE #:

DRAWING NUMBER

SH 1 OF 1

Manufacturer Evaluation List

General Requirements for Low Pressure Sewer Systems

Service and Maintenance Check List

- Local fast-response service and maintenance organization has been designated
- Manufacturers of all equipment specified for the system have supplied all installation details
- Warranties for all equipment specified for the system have been evaluated
- Fast replacement parts availability for all equipment in the system has been ensured by each equipment manufacturer
- User instructions have been supplied to homeowners

Grinder Pump

- Designated for the specific purpose of grinding and pumping domestic wastewater
- Suitable for parallel operation in a system containing thousands of pumps connected to a common discharge line
- Has a history of reliable operation
- Compatible with existing power sources and provides economical operation
- Simple to service and troubleshoot, easily accessible for removal of grinder pump core; designed with simple wiring and controls; easily disassembled and reassembled
- Warranty covering parts and labor for a reasonable length of time
- Supported by a thoroughly detailed installation manual, service manual and facilities for service training

Certifications

- Canadian Standards Association
- Underwriters Laboratories, Inc.
- National Sanitation Foundation

Required Features

- Non-clogging pump
- Non-jamming grinder
- Anti-siphon valve integral with grinder pump
- All valves of non-clogging design: integral check valve, anti-siphon valve and redundant check valve
- High-level warning alarm

Motor

- Low rpm (1,725)
- Overload protection, built-in, automatic reset
- High torque, low starting current

Tank

- Self scouring
- Completely sealed
- Non-corroding material

Level Sensing Control

- Non-fouling type
- No moving parts in contact with sewage

Motor Controls

- Completely protected
- Simple to service or replace
- UL-listed alarm panel

A Precision Castparts Company

Environment One Corporation
2773 Balltown Road
Niskayuna, New York USA 12309–1090

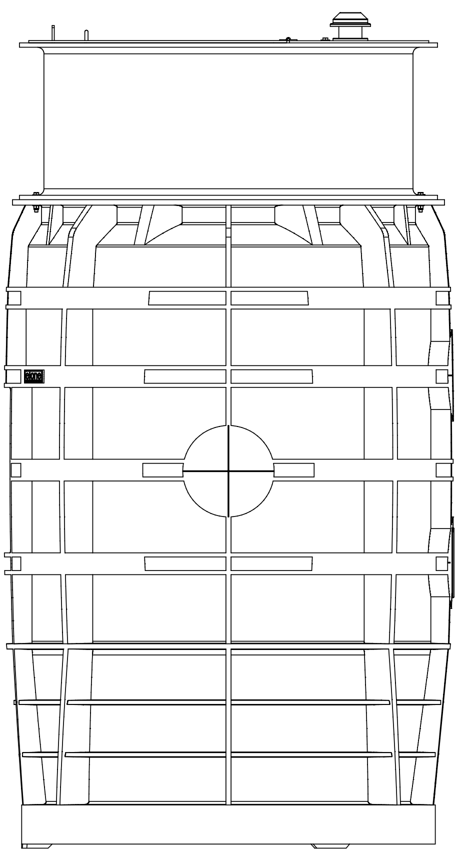
Voice: (01) 518.346.6161
Fax: 518.346.6188

www.eone.com

LM000353 Rev. A
060208

E/ONE EXTREME SERIES

WH483/WR483



General Features

The model WH483 or WR483 grinder pump station is a complete unit that includes: three grinder pumps, check valve, polyethylene tank, controls, and alarm panel. Designed for higher flow applications where local codes dictate higher storage requirements. The lower portion of the tank has a smaller diameter, tapered down to a dish-shaped bottom. The large tank access opening easily accommodates installation of the grinder pumps and equipment.

- Rated for flows of 5000 gpd (18,927 lpd)
- 486 gallons (1840 liters) of capacity
- Standard outdoor heights range from 75 inches to 122 inches

The WH483 is the “hardwired,” or “wired,” model where a cable connects the motor controls to the level controls through watertight penetrations.

The WR483 is the “radio frequency identification” (RFID), or “wireless,” model that uses wireless technology to communicate between the level controls and the motor controls.

Operational Information

Motor

1 hp, 1,725 rpm, high torque, capacitor start, thermally protected, 120/240V, 60 Hz, 1 phase

Inlet Connections

4-inch inlet grommet standard for DWV pipe. Other inlet configurations available from the factory.

Discharge Connections

Pump discharge terminates in 1.25-inch NPT female thread. Can easily be adapted to 1.25-inch PVC pipe or any other material required by local codes.

Discharge

15 gpm at 0 psig (0.95 lps at 0 m)
11 gpm at 40 psig (0.69 lps at 28 m)
7.8 gpm at 80 psig (0.49 lps at 56 m)

Accessories

E/One requires that the Uni-Lateral, E/One’s own stainless steel check valve, be installed between the grinder pump station and the street main for added protection against backflow.

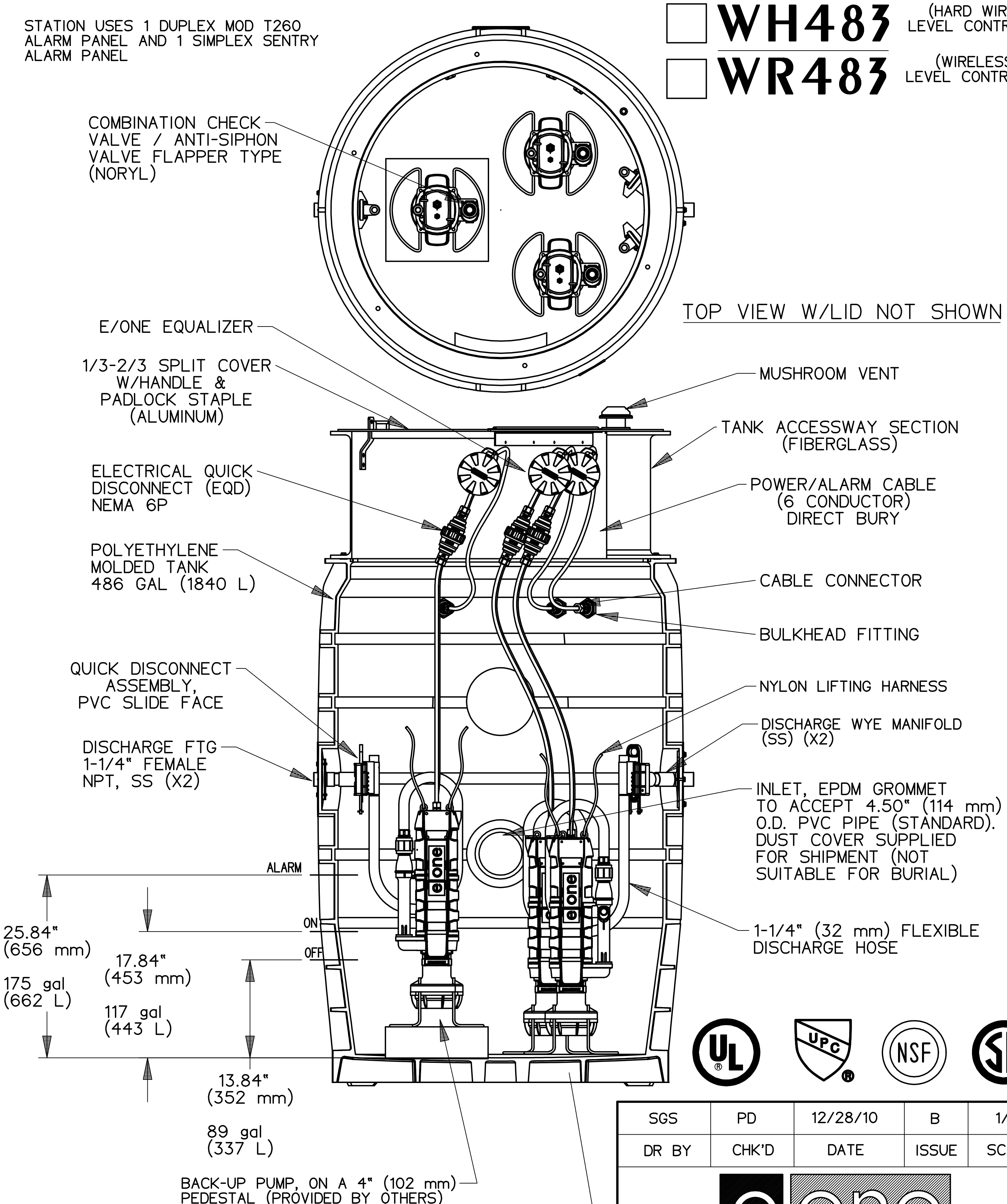
Alarm panels are available with a variety of options, from basic monitoring to advanced notice of service requirements.

The Remote Sentry is ideal for installations where the alarm panel may be hidden from view.

STATION USES 1 DUPLEX MOD T260 ALARM PANEL AND 1 SIMPLEX SENTRY ALARM PANEL

☐ **WH483** (HARD WIRED LEVEL CONTROLS)

☐ **WR483** (WIRELESS LEVEL CONTROLS)



CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

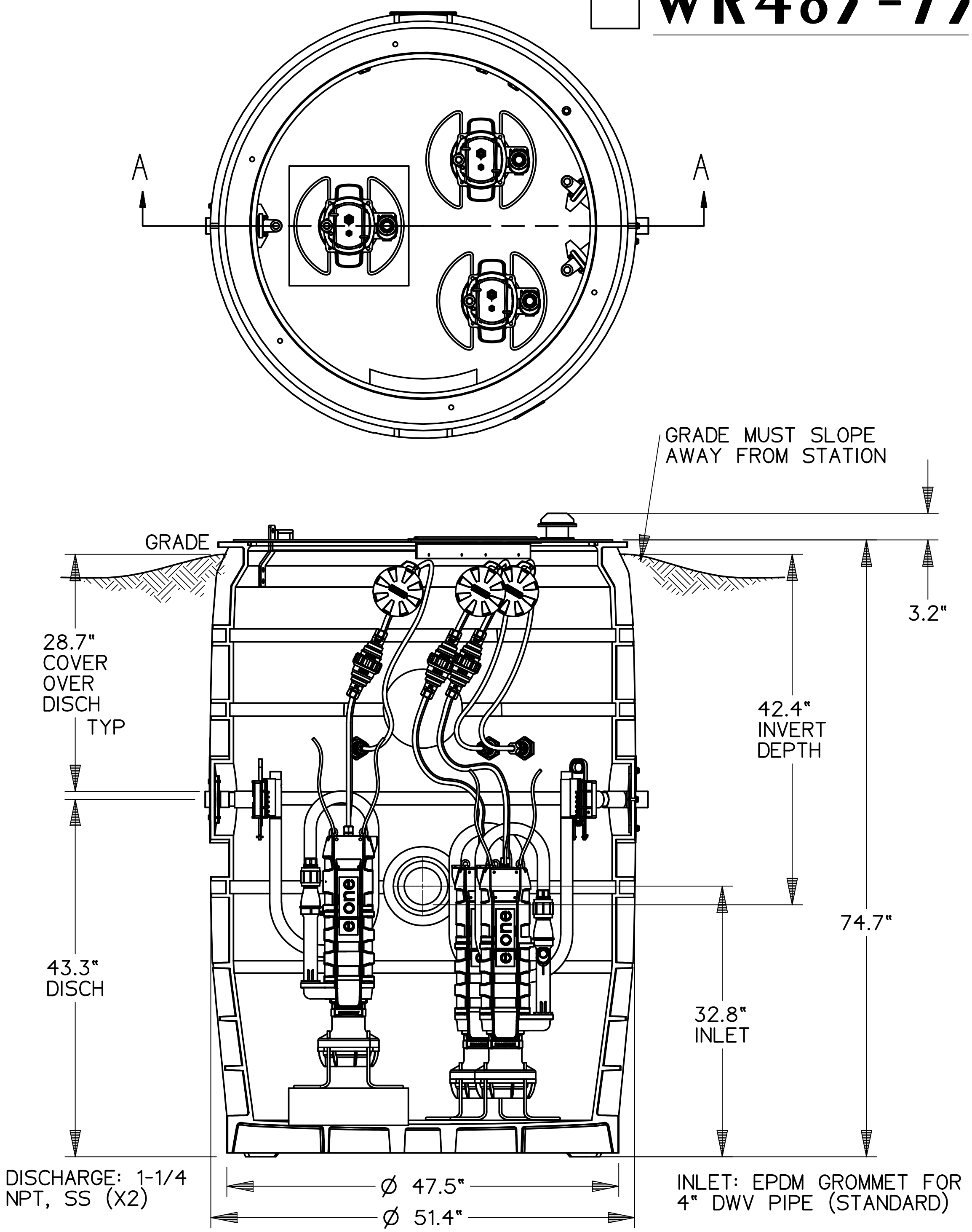
SGS	PD	12/28/10	B	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

e one SEWER SYSTEMS

MODEL WH483 / WR483
DETAIL SHEET, TRIPLEX

NA0214P02

WH483-75 (HARD WIRED LEVEL CONTROLS)
WR483-75 (WIRELESS LEVEL CONTROLS)



CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

SGS	PD	06/24/10	A	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

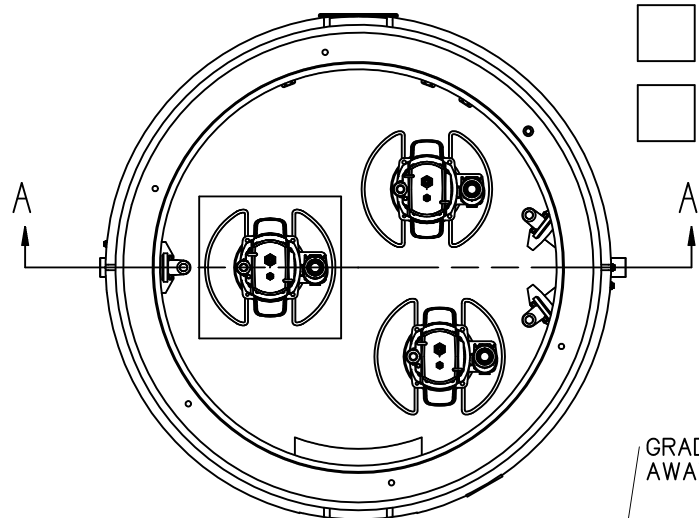
eone SEWER SYSTEMS

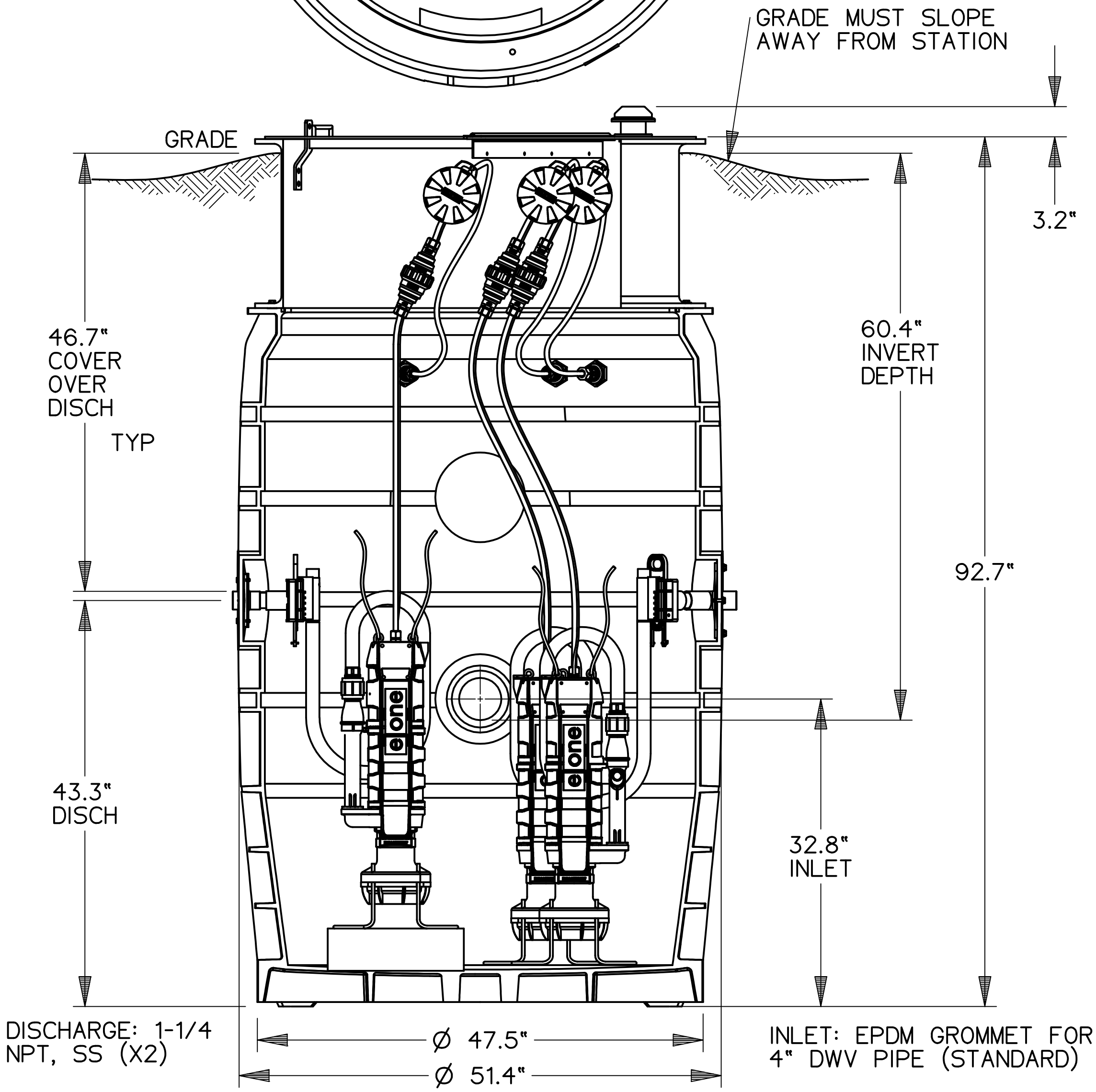
MODEL WH483-75 / WR483-75

NA0214P03

☐ **WH483-92** (HARD WIRED LEVEL CONTROLS)

☐ **WR483-92** (WIRELESS LEVEL CONTROLS)





CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

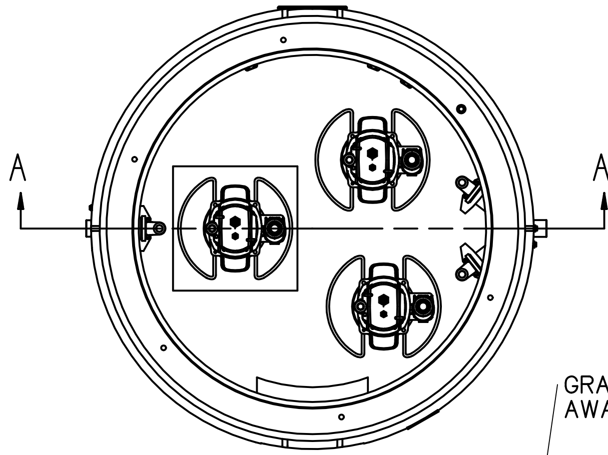
SGS	PD	02/10/11	A	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

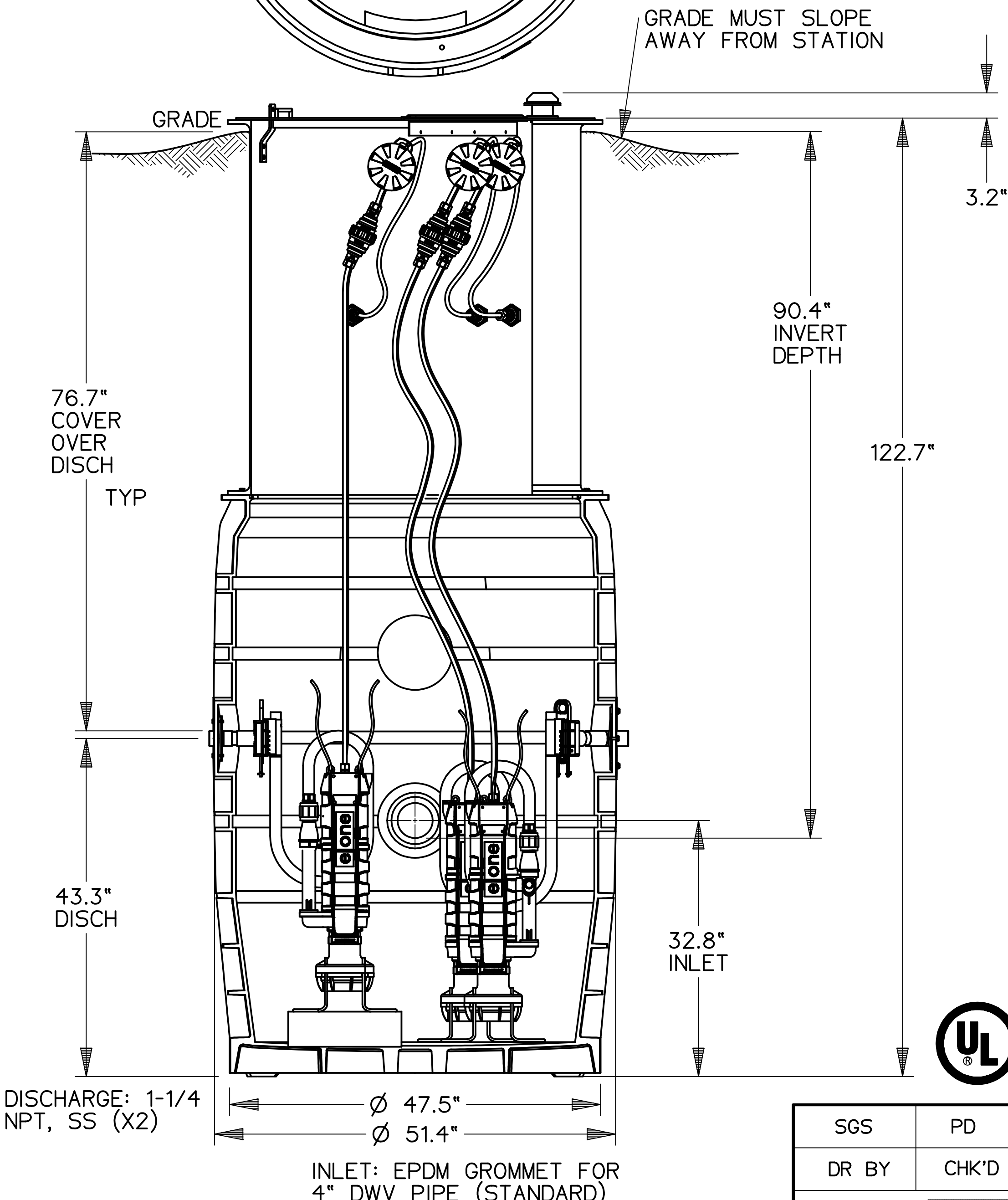
eone SEWER SYSTEMS

MODEL WH483-92 / WR483-92

NA0214P04

WH483-122 (HARD WIRED LEVEL CONTROLS)
WR483-122 (WIRELESS LEVEL CONTROLS)





CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

SGS	PD	02/10/11	A	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

e one SEWER SYSTEMS

MODEL WH483-122 / WR483-122

NA0214P05

EXHIBIT “C”

CT ECO – Environmental Conditions Online

Erosion Susceptibility Map

CT ECO CT Environmental Conditions Online

EROSION SUSCEPTIBILITY - #245 ROUTE 32 MONTVILLE, CT

Legend

Basin Line
- Major Basin
- Regional Basin
- Subregional Basin
- Local Basin
- Basin Reach

Erosion Susceptibility
- Most Susceptable to Erosion
- Highly Susceptable to Erosion
- Surficial Materials Susceptable to E
- Soils Susceptable to Erosion

Geographic Names7

Geographic Place 3

Airport
- Airport
- Heliport

Railroad

Streets
- Interstate Highway
- US Highway
- State Highway
- Primary limited-access
- Ramp
- Street
- Ferry crossing

County Line

Notes

0.1 | 0 | 0.07 | 0.1 Miles

This map is intended for general planning, management, education, and research purposes only. Data shown on this map may not be complete or current. The data shown may have been compiled at different times and at different map scales, which may not match the scale at which the data is shown on this map.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

EXHIBIT "D"

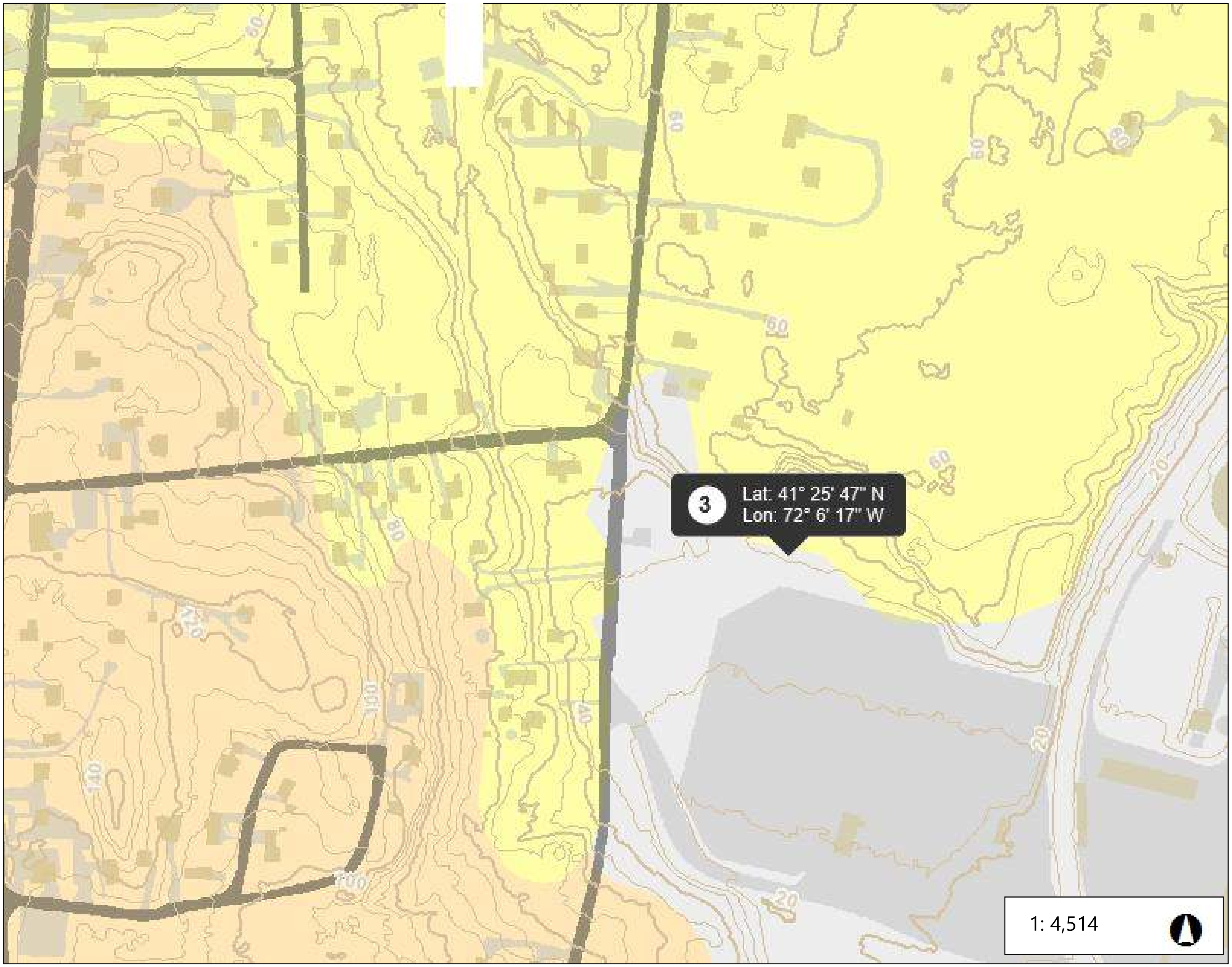
CT ECO – Environmental Conditions Online

Soil Parent Material Map

(Probable Underlying Soil Type)

CT Environmental Conditions Online

SOIL PARENT MATERIAL - #245 ROUTE 32 MONTVILLE, CT



Legend

Impervious Cover 2012

- Not Impervious
- Buildings
- Roads
- Other Impervious

Soil Parent Material

- Moderate to Bedrock
- Moderate - Shallow to Bedrock
- Shallow to Bedrock
- Glaciofluvial - Shallow to Bedrock
- Glaciofluvial
- Melt-out Till
- Melt-out Till - Moderate to Bedrock
- Melt-out Till - Shallow to Bedrock
- Deep Organic - Inland
- Shallow Organic - Inland
- Deep Organic - Tidal
- Shallow Organic - Tidal
- Alluvial/Floodplain
- Glaciolacustrine
- Lodgement Till
- Urban Influenced

Geographic Names7

Geographic Place 3

Airport

- Airport

Notes

0.1 0 0.07 0.1 Miles

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THIS MAP IS NOT TO BE USED FOR NAVIGATION

EXHIBIT "E"

FEMA – Federal Emergency Management Agency

FIRM – Insurance Rate Map

1DWLRQDO)ORRG+D]DUG/D\HU)5,50HWWH

FEMA