

STORMWATER MANAGEMENT ANALYSIS FOR

**21-27 HANCOCK STREET,
NEWBURYPORT, MA**

Prepared for:

Jay Caswell
Caswell Development
24 Graf Road
Newburyport, MA

Prepared by:

Design Consultants, Inc.
120 Middlesex Avenue, Suite 20
Somerville, Massachusetts 02145

**Project No. 2020-087
February, 2021**





TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 EXISTING CONDITION	1
2.1 FEMA Flood Insurance Rate Map	1
2.2 Soils	1
3.0 PROPOSED CONDITION	1
4.0 HYDROLOGIC MODEL	2
Table 4.1: Hydrological Calculation Summary	2
5.0 CONCLUSION	2

APPENDICES

Appendix A	Site Plans
Appendix B	Existing & Proposed Drainage Areas
Appendix C	FEMA Flood Insurance Rate Map
Appendix D	Soils Information
Appendix E	Existing & Proposed Hydrology
Appendix F	Operation & Maintenance Plan

1.0 INTRODUCTION

Caswell Development is proposing to redevelop the site located at 21 and 27 Hancock Street, Newburyport, MA with the construction of two 2-family townhomes. The following report addresses the hydrologic calculations and stormwater management design proposed at the site.

2.0 EXISTING CONDITION

The limit of work for the project is the parcels of land shown in the Town of Newburyport's Assessor's Database as Map 25, Parcels 42 and 43. These two parcels are identified as 27 Hancock Street and 21-25 Hancock Street, with Leavitt Court, currently a "paper street" running between the two parcels and currently providing access to the single-family home located at 27 Hancock Street. The 21-25 Hancock Street parcel is approximately 16,228 SF of area and the 27 Hancock Street parcel is approximately 16,400 SF. Therefore the total area of the two parcels is 0.49 acres (32,628 SF). The total subject site, including the Leavitt Court area is 0.85 acres (36,954 SF).

The 27 Hancock Street parcel currently consists of a single-family home surrounded by a paved driveway, lawn area, landscaping and some wooded area. The 21-25 Hancock Street parcel currently consists of a large automobile garage with three garage bays, also with paved driveway access, some surrounding lawn area and plenty of surrounding wooded area in the rear. The existing site is 39.8% impervious, with approximately 14,710 SF of impervious area.

The existing site has no larger stormwater system. The topography across the site slopes downgrade, from Hancock Street to the abutting properties to the north, from approximately El. 34 to El. 28.50. Under these existing conditions, the site has a single design discharge point. All stormwater from the site drains across the property via sheet flow to the northeast abutting properties.

2.1 FEMA Flood Insurance Rate Map

According to the FEMA Flood Insurance Rate Map Number 25009C0136G, with an effective date of July 16, 2014, the site is located within a Zone X, which is "areas determined to be outside the 0.2% annual chance floodplain." (See Appendix C: FEMA Flood Insurance Rate Map)

2.2 Soils

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the soils across the entire site is classified as Merrimac Fine Sandy Loam, 0 to 3 percent slopes. This soil classification is recognized as part of Hydrologic Soil Group A, which was used for the purposes of hydrologic calculations across the entire site. (See Appendix D: Soils Information)

3.0 PROPOSED CONDITION

The project proposes the redevelopment of the site at 21-27 Hancock Street with the construction of two 2-family townhomes, each with driveway access from either directly off Hancock Street or from Leavitt Court, which is proposed to be constructed as a paved 20' wide roadway. The proposed site will include 7,820 SF of roof area, along with 6,253 SF of paved area that includes both the proposed driveways and the new road area. The rest of the site will consist entirely of landscaping/lawn or wooded area.

The proposed site is 38.8% impervious, with approximately 14,524 SF of total impervious area. This is a net decrease of 186 SF in impervious area from the existing to the proposed conditions. This net decrease is sufficient enough to allow for the decrease in off-site flow rates and volumes for the 2-year, 10-year, 25-year and 100-year storms with no additional stormwater improvements on-site. Therefore, meeting Standard 2 of the Massachusetts Stormwater Handbook. See below for Table 4.1 Hydrological Calculation Summary addressing the off-site runoffs and volumes for all appropriate storms. (See Appendix B: Site Plans)(See Appendix F: Existing and Proposed Drainage Areas)

As discussed above, this site design will result in a decrease in off-site flow rates and volumes for the 2-year, 10-year, 25-year and 100-year storm due to the decrease in impervious area from the existing to the proposed conditions. The proposed design will still direct roof runoff via downspouts to Cultec infiltration chambers set below ground, however they have not been accounted for in the hydrological summary.

4.0 HYDROLOGIC MODEL

The hydrologic model was developed in HydroCAD, a computer program based on USDA's Technical Release TR-55, Urban Hydrology for Small Watersheds. Both existing and proposed conditions are modeled for the 2-year, 10-year, 25-year, and 100-year 24-hour storm events. HydroCAD allows for variable rainfall intensity throughout the storm duration, peaking near the middle of the Type III, 24-hour storm. The drainage area's time of concentration (t_c) is assumed to be six minutes for this site, which is the minimum recommended by TR-55. Complete calculations, performed using the HydroCAD software, are included in the appendix.

Table 4.1: Hydrological Calculation Summary

Description	Existing Conditions		Proposed Conditions	
Drainage Area	36,953 +/- Square Feet		36,953 +/- Square Feet	
Storm Event (Year)	Offsite Peak Runoff (CFS)	Offsite Runoff Volume (CF)	Offsite Peak Runoff (CFS)	Offsite Runoff Volume (CF)
2	0.39	1,353	0.34	1,246
10	1.48	3,930	1.39	3,732
25	2.54	6,481	2.43	6,222
100	5.05	12,663	4.90	12,299

5.0 CONCLUSION

Based on DCI's analysis of the existing and proposed conditions, the proposed site conditions meet the stormwater management criteria set. Design point runoff volumes have been decreased for the 2-year, 10-year, 25-year and 100-year storm events. Peak flow rates are decreased for the 2-year and 10-year, 25-year and 100-year storm event. DCI concludes that the proposed redevelopment at 21-27 Hancock Street, Newburyport, MA adheres to all applicable stormwater management policies.

Appendix A

SITE PLANS

N/F
H 50 NOMINEE TRUST
MAP 25 LOT 8
BOOK 15177 PAGE 582
FOR REGISTRY OF DEEDS USE ONLY

NORTH



DCI
Design Consultants Inc.
Somerville - Quincy - Newburyport
www.dci-ma.com

DEVELOPER:
CASWELL DEVELOPMENT
24 GRAF ROAD
NEWBURYPORT MA

ARCHITECT:
GRAF ARCHITECTS
2 LIBERTY STREET
NEWBURYPORT MA

SURVEYOR:
WINTER GEC
44 MERRIMAC ST. UNIT 312
NEWBURYPORT, MA

PROJECT TEAM

21-27 HANCOCK
NEWBURYPORT, MA.

PROJECT INFO

REV	DESCRIPTION	DATE

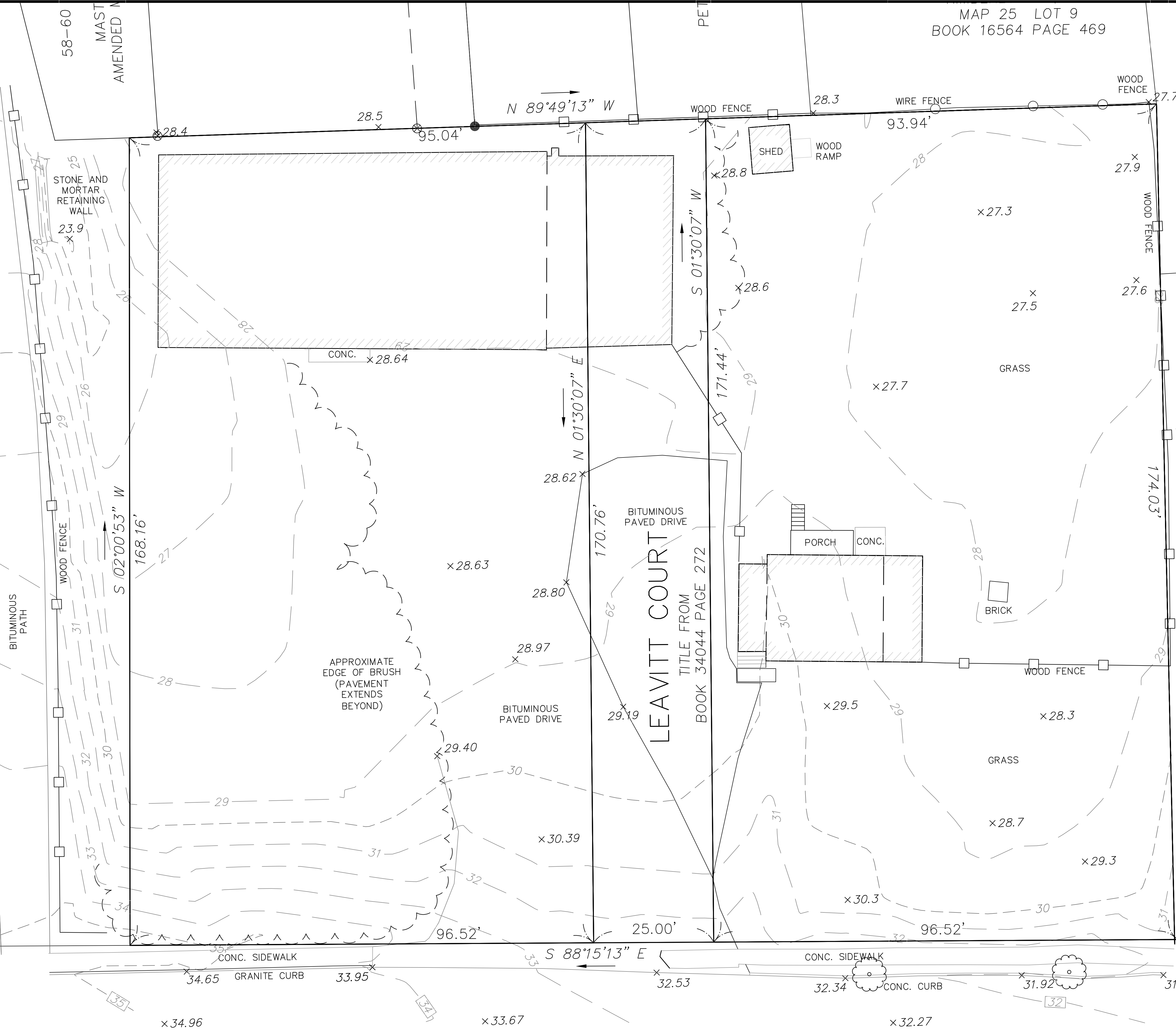
STAMP:

**EXISTING
CONDITION
PLAN**

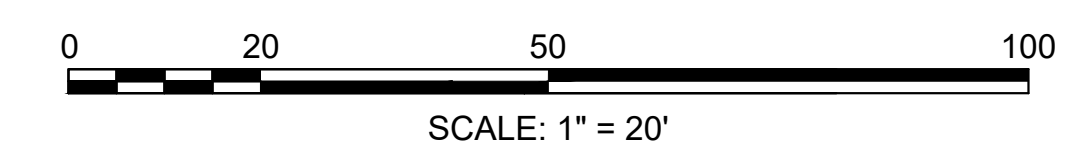
SHEET NAME:
V102

SHT NO:
DR BY: GS
CHK BY: SS
PROJ NO: 20-087
DATE: 02/05/2021
SCALE: 1"=10'

"CLIPPER CITY RAIL TRAIL"
N/F
CITY OF NEWBURYPORT
BOOK 25956 PAGE 191



(S)
RIM: 34.5
INV: 27.2





"CLIPPER CITY RAIL TRAIL"
N/F
CITY OF NEWBURYPORT
BOOK 25956 PAGE 191

BITUMINOUS PATH

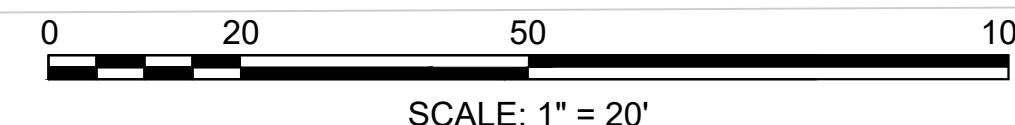
S 102°00'53" W
168.16'

58-60 PU
N
MASTER
AMENDED MAP

RIM: 34.5
INV: 27.2

STA 100+00.00
DESIGN SPEED = 20 mi/h

HANCOCK STREET



DCI
Design Consultants Inc.
Somerville - Quincy - Newburyport
www.dci-ma.com

DEVELOPER:
CASWELL DEVELOPMENT
24 GRAF ROAD
NEWBURYPORT MA

ARCHITECT:
GRAF ARCHITECTS
2 LIBERTY STREET
NEWBURYPORT MA

SURVEYOR
WINTER GEC
44 MERRIMAC ST. UNIT 312
NEWBURYPORT, MA

PROJECT TEAM

FOR REGISTRY OF DEEDS USE ONLY

21-27 HANCOCK
NEWBURYPORT, MA.

PROJECT INFO

REV	DESCRIPTION	DATE

STAMP:

GRADING & DRAINAGE PLAN

SHEET NAME:
C102

SHT NO:
DR BY: GS
CHK BY: SS
PROJ NO: 20-087
DATE: 02/05/2021
SCALE: 1"=10'

N/F
PHYLLIS RYAN
MAP 25 LOT 44
BOOK 33816 PAGE 418

ROBERT W. JORGENSEN &
KIMBERLY A. QUINT
MAP 25 LOT 9
BOOK 16564 PAGE 469



Appendix B

**EXISTING & PROPOSED
DRAINAGE AREAS**



Somerville - Quincy - Newburyport
www.dci-ma.com

DEVELOPER:
CASWELL DEVELOPMENT
24 GRAF ROAD
NEWBURYPORT MA

ARCHITECT:
GRAF ARCHITECTS
2 LIBERTY STREET
NEWBURYPORT MA

SURVEYOR
WINTER GEC
44 MERRIMAC ST. UNIT 312
NEWBURYPORT, MA

PROJECT TEAM

21-27 HANCOCK
NEWBURYPORT, MA.

PROJECT INFO

REV	DESCRIPTION	DATE

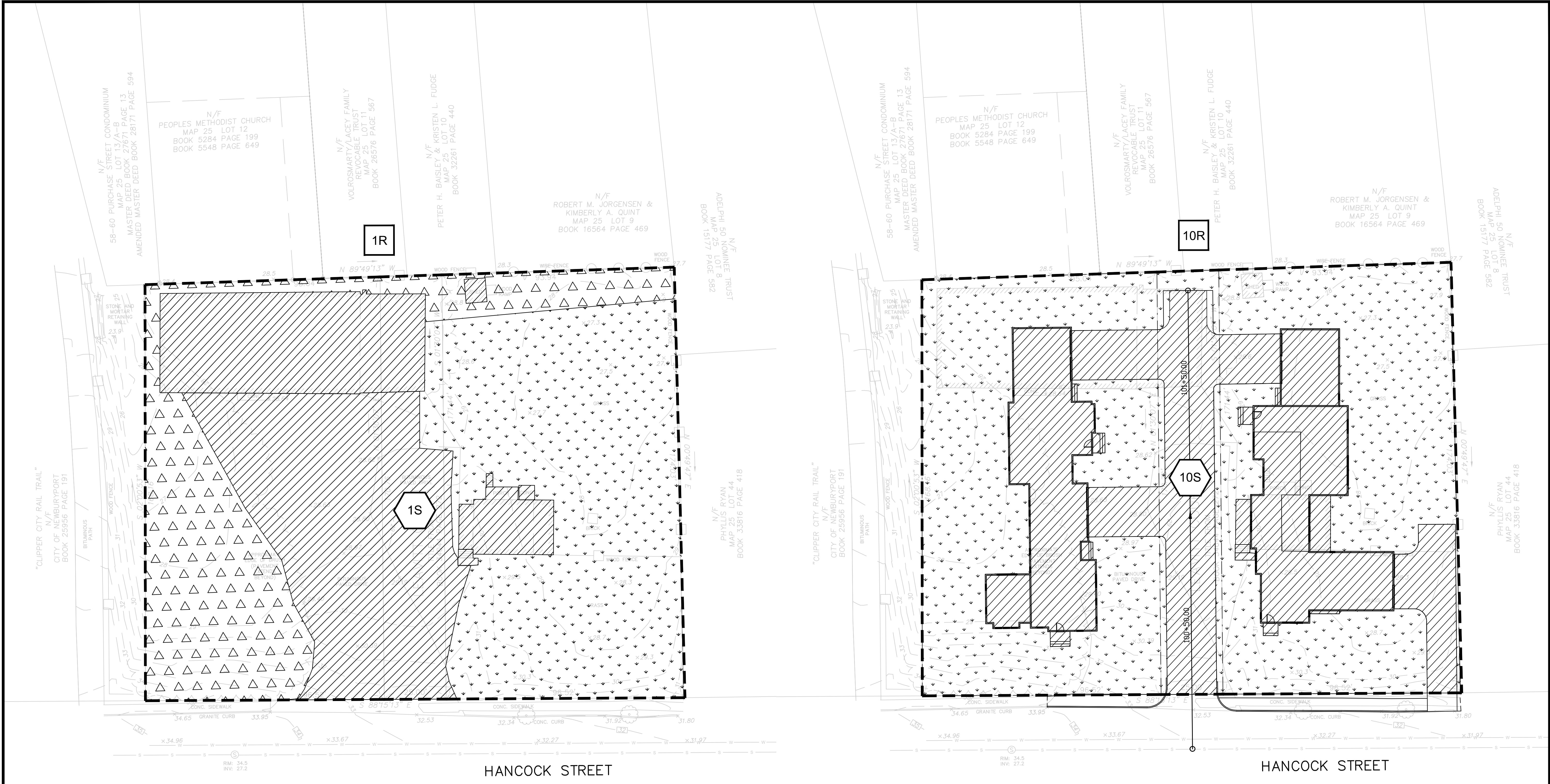
REV DESCRIPTION DATE

STAMP:

DRAINAGE AREA PLAN

SHEET NAME:
C401

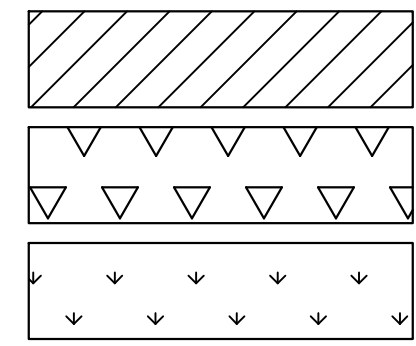
SHT NO:
DR BY: MCH
CHK BY: SBS
PROJ NO: 20-067
DATE: 12/9/2020
SCALE: 1"=20'



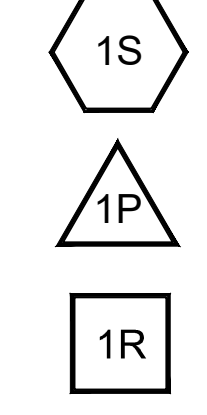
EXISTING

PROPOSED

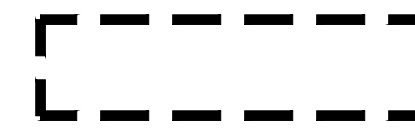
LEGEND



IMPERVIOUS AREA
WOODED AREA
LANDSCAPE



SUBCATCHMENT
POND
DESIGN POINT



DRAINAGE AREA

P:\2020 Projects\2020-087 Leavitt Ct Newburyport\Drainage\20-087 DR.dwg

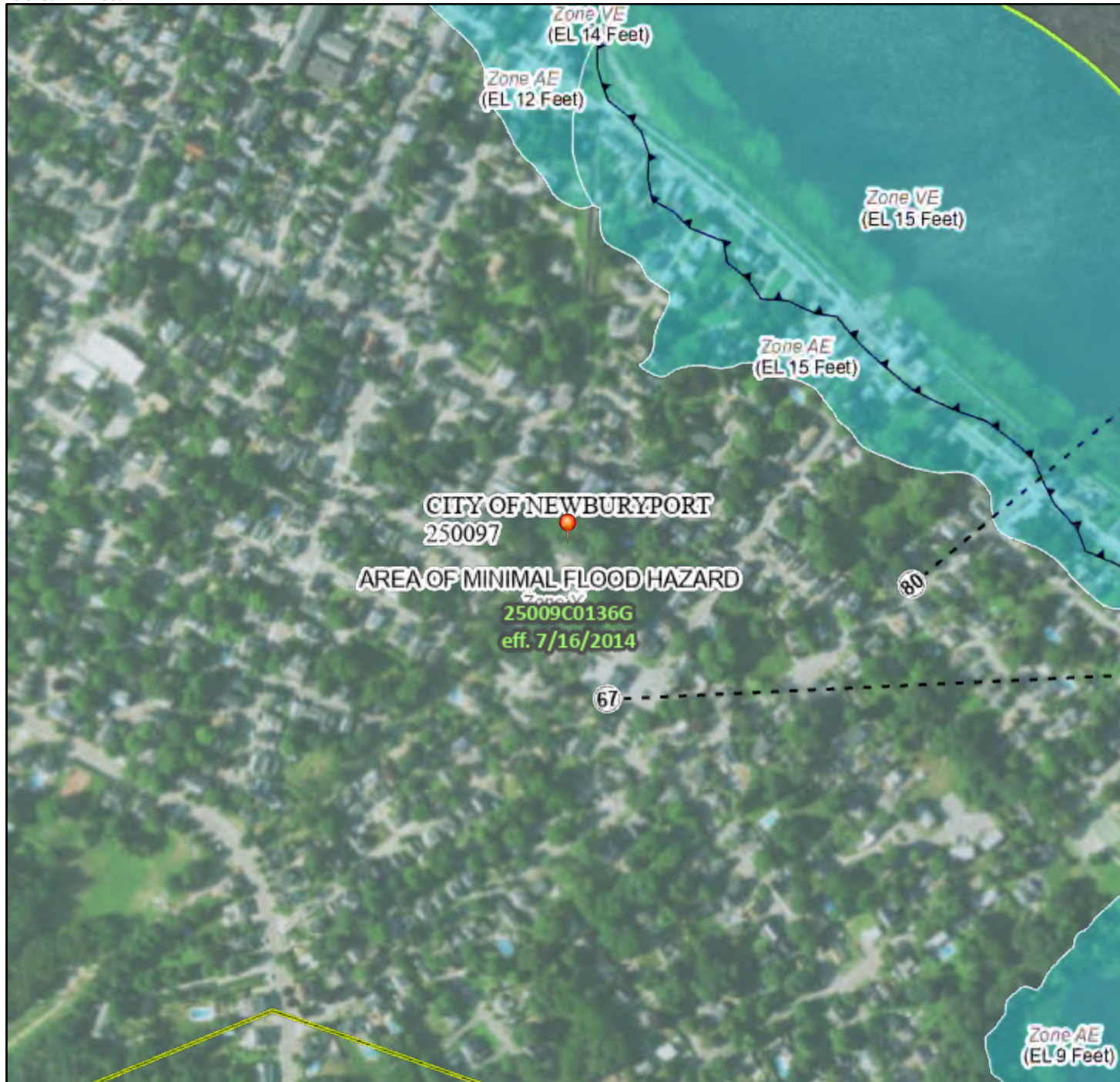
Appendix C

**FEMA FLOOD INSURANCE
RATE MAP**

National Flood Hazard Layer FIRMMette



70°51'56"W 42°48'30"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance
		17.5 Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **1/29/2021 at 2:47 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

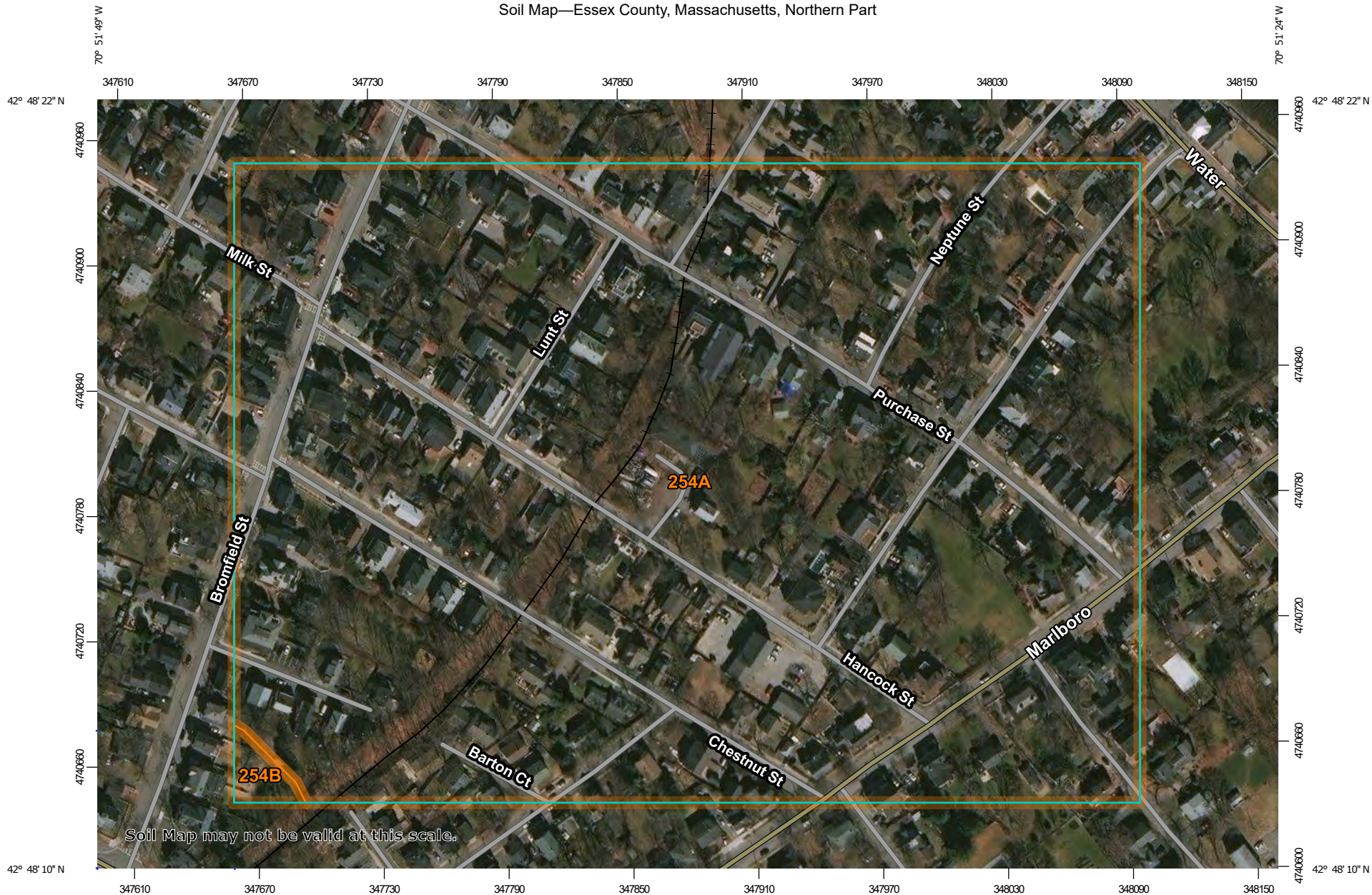
0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

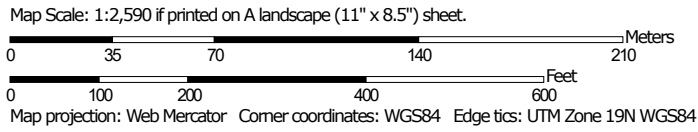
Appendix D

SOILS INFORMATION

Soil Map—Essex County, Massachusetts, Northern Part



Soil Map may not be valid at this scale.




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 1:15,800.

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: Essex County, Massachusetts, Northern Part

Survey Area Data: Version 16, Jun 9, 2020

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

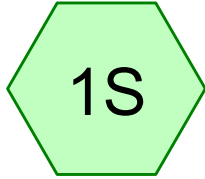
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

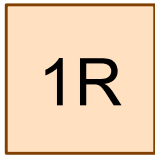
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	32.9	99.4%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	0.2	0.6%
Totals for Area of Interest		33.1	100.0%

Appendix E

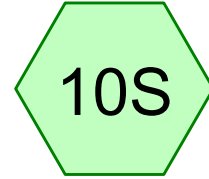
**EXISTING AND PROPOSED
HYDROLOGY**



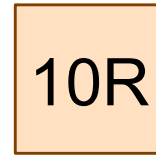
ENTIRE SITE



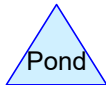
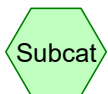
OFFSITE



ENTIRE SITE



OFFSITE



20-087 DR

Prepared by Design Consultants, Inc.

HydroCAD® 10.00-20 s/n 08381 © 2017 HydroCAD Software Solutions LLC

Printed 2/17/2021

Page 2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
36,475	39	>75% Grass cover, Good, HSG A (1S, 10S)
15,918	98	Paved parking, HSG A (1S, 10S)
13,313	98	Roofs, HSG A (1S, 10S)
8,194	43	Woods/grass comb., Fair, HSG A (1S)

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
73,900	HSG A	1S, 10S
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	

20-087 DR

Prepared by Design Consultants, Inc.

HydroCAD® 10.00-20 s/n 08381 © 2017 HydroCAD Software Solutions LLC

Printed 2/17/2021

Page 4

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
36,475	0	0	0	0	36,475	>75% Grass cover, Good
15,918	0	0	0	0	15,918	Paved parking
13,313	0	0	0	0	13,313	Roofs
8,194	0	0	0	0	8,194	Woods/grass comb., Fair

20-087 DR

Type III 24-hr 2-Year Rainfall=3.15"

Prepared by Design Consultants, Inc.

Printed 2/17/2021

HydroCAD® 10.00-20 s/n 08381 © 2017 HydroCAD Software Solutions LLC

Page 5

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: ENTIRE SITE

Runoff Area=36,948 sf 39.80% Impervious Runoff Depth>0.44"
Tc=0.0 min CN=63 Runoff=0.39 cfs 1,353 cf

Subcatchment 10S: ENTIRE SITE

Runoff Area=36,952 sf 39.31% Impervious Runoff Depth>0.40"
Tc=0.0 min CN=62 Runoff=0.34 cfs 1,246 cf

Reach 1R: OFFSITE

Inflow=0.39 cfs 1,353 cf
Outflow=0.39 cfs 1,353 cf

Reach 10R: OFFSITE

Inflow=0.34 cfs 1,246 cf
Outflow=0.34 cfs 1,246 cf

Summary for Subcatchment 1S: ENTIRE SITE

Runoff = 0.39 cfs @ 12.03 hrs, Volume= 1,353 cf, Depth> 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
9,402	98	Paved parking, HSG A
5,305	98	Roofs, HSG A
8,194	43	Woods/grass comb., Fair, HSG A
14,047	39	>75% Grass cover, Good, HSG A
36,948	63	Weighted Average
22,241		60.20% Pervious Area
14,707		39.80% Impervious Area

Summary for Subcatchment 10S: ENTIRE SITE

Runoff = 0.34 cfs @ 12.03 hrs, Volume= 1,246 cf, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
6,516	98	Paved parking, HSG A
22,428	39	>75% Grass cover, Good, HSG A
8,008	98	Roofs, HSG A
36,952	62	Weighted Average
22,428		60.69% Pervious Area
14,524		39.31% Impervious Area

Summary for Reach 1R: OFFSITE

Inflow Area = 36,948 sf, 39.80% Impervious, Inflow Depth > 0.44" for 2-Year event
Inflow = 0.39 cfs @ 12.03 hrs, Volume= 1,353 cf
Outflow = 0.39 cfs @ 12.03 hrs, Volume= 1,353 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 10R: OFFSITE

Inflow Area = 36,952 sf, 39.31% Impervious, Inflow Depth > 0.40" for 2-Year event
Inflow = 0.34 cfs @ 12.03 hrs, Volume= 1,246 cf
Outflow = 0.34 cfs @ 12.03 hrs, Volume= 1,246 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

20-087 DR

Type III 24-hr 10-Year Rainfall=4.83"

Prepared by Design Consultants, Inc.

Printed 2/17/2021

HydroCAD® 10.00-20 s/n 08381 © 2017 HydroCAD Software Solutions LLC

Page 7

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: ENTIRE SITE

Runoff Area=36,948 sf 39.80% Impervious Runoff Depth>1.28"
Tc=0.0 min CN=63 Runoff=1.48 cfs 3,930 cf

Subcatchment 10S: ENTIRE SITE

Runoff Area=36,952 sf 39.31% Impervious Runoff Depth>1.21"
Tc=0.0 min CN=62 Runoff=1.39 cfs 3,732 cf

Reach 1R: OFFSITE

Inflow=1.48 cfs 3,930 cf
Outflow=1.48 cfs 3,930 cf

Reach 10R: OFFSITE

Inflow=1.39 cfs 3,732 cf
Outflow=1.39 cfs 3,732 cf

Summary for Subcatchment 1S: ENTIRE SITE

Runoff = 1.48 cfs @ 12.01 hrs, Volume= 3,930 cf, Depth> 1.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
9,402	98	Paved parking, HSG A
5,305	98	Roofs, HSG A
8,194	43	Woods/grass comb., Fair, HSG A
14,047	39	>75% Grass cover, Good, HSG A
36,948	63	Weighted Average
22,241		60.20% Pervious Area
14,707		39.80% Impervious Area

Summary for Subcatchment 10S: ENTIRE SITE

Runoff = 1.39 cfs @ 12.01 hrs, Volume= 3,732 cf, Depth> 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
6,516	98	Paved parking, HSG A
22,428	39	>75% Grass cover, Good, HSG A
8,008	98	Roofs, HSG A
36,952	62	Weighted Average
22,428		60.69% Pervious Area
14,524		39.31% Impervious Area

Summary for Reach 1R: OFFSITE

Inflow Area = 36,948 sf, 39.80% Impervious, Inflow Depth > 1.28" for 10-Year event
Inflow = 1.48 cfs @ 12.01 hrs, Volume= 3,930 cf
Outflow = 1.48 cfs @ 12.01 hrs, Volume= 3,930 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 10R: OFFSITE

Inflow Area = 36,952 sf, 39.31% Impervious, Inflow Depth > 1.21" for 10-Year event
Inflow = 1.39 cfs @ 12.01 hrs, Volume= 3,732 cf
Outflow = 1.39 cfs @ 12.01 hrs, Volume= 3,732 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: ENTIRE SITE Runoff Area=36,948 sf 39.80% Impervious Runoff Depth>2.10"
Tc=0.0 min CN=63 Runoff=2.54 cfs 6,481 cf

Subcatchment 10S: ENTIRE SITE Runoff Area=36,952 sf 39.31% Impervious Runoff Depth>2.02"
Tc=0.0 min CN=62 Runoff=2.43 cfs 6,222 cf

Reach 1R: OFFSITE Inflow=2.54 cfs 6,481 cf
Outflow=2.54 cfs 6,481 cf

Reach 10R: OFFSITE Inflow=2.43 cfs 6,222 cf
Outflow=2.43 cfs 6,222 cf

Summary for Subcatchment 1S: ENTIRE SITE

Runoff = 2.54 cfs @ 12.01 hrs, Volume= 6,481 cf, Depth> 2.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
9,402	98	Paved parking, HSG A
5,305	98	Roofs, HSG A
8,194	43	Woods/grass comb., Fair, HSG A
14,047	39	>75% Grass cover, Good, HSG A
36,948	63	Weighted Average
22,241		60.20% Pervious Area
14,707		39.80% Impervious Area

Summary for Subcatchment 10S: ENTIRE SITE

Runoff = 2.43 cfs @ 12.01 hrs, Volume= 6,222 cf, Depth> 2.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
6,516	98	Paved parking, HSG A
22,428	39	>75% Grass cover, Good, HSG A
8,008	98	Roofs, HSG A
36,952	62	Weighted Average
22,428		60.69% Pervious Area
14,524		39.31% Impervious Area

Summary for Reach 1R: OFFSITE

Inflow Area = 36,948 sf, 39.80% Impervious, Inflow Depth > 2.10" for 25-Year event
Inflow = 2.54 cfs @ 12.01 hrs, Volume= 6,481 cf
Outflow = 2.54 cfs @ 12.01 hrs, Volume= 6,481 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 10R: OFFSITE

Inflow Area = 36,952 sf, 39.31% Impervious, Inflow Depth > 2.02" for 25-Year event
Inflow = 2.43 cfs @ 12.01 hrs, Volume= 6,222 cf
Outflow = 2.43 cfs @ 12.01 hrs, Volume= 6,222 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: ENTIRE SITE

Runoff Area=36,948 sf 39.80% Impervious Runoff Depth>4.11"
Tc=0.0 min CN=63 Runoff=5.05 cfs 12,663 cf

Subcatchment 10S: ENTIRE SITE

Runoff Area=36,952 sf 39.31% Impervious Runoff Depth>3.99"
Tc=0.0 min CN=62 Runoff=4.90 cfs 12,299 cf

Reach 1R: OFFSITE

Inflow=5.05 cfs 12,663 cf
Outflow=5.05 cfs 12,663 cf

Reach 10R: OFFSITE

Inflow=4.90 cfs 12,299 cf
Outflow=4.90 cfs 12,299 cf

Summary for Subcatchment 1S: ENTIRE SITE

Runoff = 5.05 cfs @ 12.00 hrs, Volume= 12,663 cf, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
9,402	98	Paved parking, HSG A
5,305	98	Roofs, HSG A
8,194	43	Woods/grass comb., Fair, HSG A
14,047	39	>75% Grass cover, Good, HSG A
36,948	63	Weighted Average
22,241		60.20% Pervious Area
14,707		39.80% Impervious Area

Summary for Subcatchment 10S: ENTIRE SITE

Runoff = 4.90 cfs @ 12.01 hrs, Volume= 12,299 cf, Depth> 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
6,516	98	Paved parking, HSG A
22,428	39	>75% Grass cover, Good, HSG A
8,008	98	Roofs, HSG A
36,952	62	Weighted Average
22,428		60.69% Pervious Area
14,524		39.31% Impervious Area

Summary for Reach 1R: OFFSITE

Inflow Area = 36,948 sf, 39.80% Impervious, Inflow Depth > 4.11" for 100-Year event
Inflow = 5.05 cfs @ 12.00 hrs, Volume= 12,663 cf
Outflow = 5.05 cfs @ 12.00 hrs, Volume= 12,663 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 10R: OFFSITE

Inflow Area = 36,952 sf, 39.31% Impervious, Inflow Depth > 3.99" for 100-Year event
Inflow = 4.90 cfs @ 12.01 hrs, Volume= 12,299 cf
Outflow = 4.90 cfs @ 12.01 hrs, Volume= 12,299 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Appendix F

**OPERATION & MAINTENANCE
PLAN**

Operation & Maintenance Plan (Permanent BMPs)

FOR

**21-27 Hancock Street,
Newburyport, MA**

Date: February, 2021

Owner/Operator: Jay Caswell
Caswell Development
24 Graf Road
Newburyport, MA

Inspection and Maintenance Schedule

Facility personnel will inspect the stormwater management system on a routine basis not less than once per month for the first six (6) months of operation and annually thereafter. The estimated cost for this inspection and maintenance schedule is \$1,200/yr. Refer to project design and as-built plans for stormwater systems and landscaped area locations. Inspection and maintenance shall be performed as follows:

1. Landscaped Areas:

Landscaped areas shall be inspected and maintained on a regular basis. Areas that may be subject to erosion will be stabilized and reseeded immediately. Inspect soil and repair eroded areas monthly. Re-plant void areas as needed. Remove litter and debris monthly. Remove and replace dead vegetation twice per year in spring and fall. Replace soil media if ponding is witnessed more than 48 hours after rainfall event.

2. Roof Drains:

Inspections: The downspout inlets on the roof of the building will need periodic maintenance to ensure proper function. The required interval for this maintenance will vary by season; however, downspout inlets should be inspected for debris before the rainy season. When trees and other deciduous vegetation shed leaves that drop into the gutters, this will inhibit the flow of water and possibly clog downspouts. The leaves and/or debris must be removed in order for the system to work as designed.

Maintenance: Debris, such as leaves and trash, shall be removed by hand. Sediments shall be swept and collected or vacuumed.

3. Infiltration Chambers:

Inspections: During first year visually inspect after each major storm (>1.5") and again 72 hours later to verify exfiltration is occurring as designed. Note if water remains in basin after 72 hours. After first year visually inspect twice per year. Infiltration Systems shall be inspected for accumulation of silt, sediment, standing water, or debris on an annual basis. Debris and sediment shall be removed. Inspect overflow outlet of chambers and level spreader at gravel basin. Basin should be inspected for excessive erosion or any additional necessary changes. Down gradient of gravel basin and level spreader should also be inspected for excess erosion.

Inspection & Maintenance procedure is as follows: The inspection port is a 24" manhole cover with a frame. Removing the manhole cover will provide access to the Chamber below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment, if any, in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream structure. CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.

Inspection & Maintenance of Chamber Outfall and Level Spreader: When infiltration chambers are inspected, the chambers outfall and level spreader should be inspected for evidence of any standing water, debris or accumulation of sediment. The area around the level spreader and outfall should additionally be inspected for excessive erosion or scouring that could indicate any need for changes.

Stormwater System Inspection Report

General Information			
Location: 21-27 Hancock Street, Newburyport			
Date of Inspection		Start/End Time	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Purpose of Inspection			
Weather Information			
Has it rained since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Weather at time of this inspection?			

Site-Specific Stormwater Devices: (See above for inspection frequency)

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
1		<input type="checkbox"/> Yes <input type="checkbox"/> No		
2		<input type="checkbox"/> Yes <input type="checkbox"/> No		
3		<input type="checkbox"/> Yes <input type="checkbox"/> No		
4		<input type="checkbox"/> Yes <input type="checkbox"/> No		
5		<input type="checkbox"/> Yes <input type="checkbox"/> No		
6		<input type="checkbox"/> Yes <input type="checkbox"/> No		
7		<input type="checkbox"/> Yes <input type="checkbox"/> No		
8		<input type="checkbox"/> Yes <input type="checkbox"/> No		

Overall Site Issues

	Description		Corrective Action	Date for Corrective Action/Responsible Person
1	Are all slopes properly stabilized?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
2	Are natural resource areas (e.g., streams, wetlands, etc.) being subjected to erosion?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
3	Are discharge points free of sediment deposits?	<input type="checkbox"/> Yes <input type="checkbox"/> No		

Certification Statement:

“I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

Print name:

Signature:

Date: