

FRIEZE CRAMER ROSEN & HUBER LLP
C O U N S E L L O R S A T L A W

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EVANS HUBER
781-943-4043
EH@I28LAW.COM

January 14, 2021

By Electronic Mail and Hand Delivery

Planning Board
Town of Needham
500 Dedham Avenue
Needham, Massachusetts 02492

Re: North Hill Needham, Inc.
865 Central Avenue, Needham, MA 02492
Application for Further Site Plan Review and Special Permit

Dear Planning Board Members:

Pursuant to Chapter 40A of the Massachusetts General Laws, the Needham Zoning By-Law, the Needham Planning Board Rules, and Section 4.2 of Site Plan Special Permit Amendment No. 91-3 dated July 8, 2014, I hereby submit applications for Further Site Plan Review and Special Permits on behalf of my client, North Hill Needham, Inc., of which this letter is a part. The Board will recall that on September 8, 2011, it issued a Major Project Site Plan Review Permit (the “Original Decision”) that permitted certain renovations and expansions to the North Hill campus. Certain components of the Petitioner’s Master Plan were deferred until Town Meeting approved an amendment to the Zoning By-Law on November 7, 2011. On March 19, 2013, the Board issued a Site Plan Special Permit Amendment approving the balance of the components of the work. Thereafter, certain amendments were approved by decisions of this Board dated July 8, 2014, and August 11, 2015, respectively. In addition, certain changes were approved by memo dated August 25, 2016 pursuant to the Planning Board’s insignificant modifications policy.

The work approved by the Original Decision and the various amendments comprise the “Project.”¹ The current application addresses certain minor modifications that the Applicant wishes to make to the Project, including the following:

- (a) Widening the existing fire lane to 20 feet;

¹ Reference is made to Site Plan Special Permit No. 91-3 dated May 28, 1991 and amendments thereto dated July 1, 1997, October 7, 1997, August 10, 1999, September 8, 2011, March 20, 2012, July 10, 2012, September 28, 2012, March 19, 2013, July 8, 2014, August 11, 2015, and August 25, 2016, respectively.

Planning Board
January 14, 2021
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- (b) Creation of 75 new parking spaces adjacent to the widened fire lane;
- (c) Associated sitework, such as adding handrails to the existing walkway adjacent to Building G, and reconstructing a portion of the existing walkway adjacent to Building I; and
- (d) Landscaping;

all as more particularly shown on the Plans filed with the Application.

A list of the proposed changes to the Approved Plans is included in the Vanasse Hangen Brustlin, Inc. ("VHB") memorandum dated January 4, 2021, and filed with the Board as part of this application.

As the Planning Board is aware, North Hill has expanded and modernized its facility over the past several years, much of it pursuant to the Planning Board special permit/site plan review process. There presently exists a 12-foot wide fire lane that parallels the rear of the main building. During the construction process a number of residents and staff parked adjacent to the fire lane. Since in many instances those parking spaces were closer to residents' units or staff offices than the parking areas that were formerly utilized, a number of residents and staff continued to park adjacent to the fire lane. In addition to the benefit that proximity of spaces brings, particularly to many senior citizens who have some difficulty walking longer distances (much of it outside), many of our residents find comfort in being able to see their motor vehicle from their unit, or at least know that they are closer to their vehicles.

As a response to these concerns, as well as the desire of North Hill to widen the fire lane to 20 feet in accordance with updated fire regulations, (for increased safety) North Hill is proposing to construct 75 new parking spaces along a portion of the fire lane, as more particularly shown on the plans filed with the application. The proposed new parking area has been designed to comply with the parking area design criteria set forth in Section 5.1.3 of the Zoning By-law.

The Petitioner notes that while the existing Decision provides that at the conclusion of the Project the number of parking spaces will be 512, the Project, as proposed by this Application for an amendment, will increase the total number of parking spaces at the conclusion of the Project to 587 parking spaces.² All of the additional spaces will be compliant with the requirements of the Zoning By-Law. The only spaces not compliant in all respects with the provisions of Section 5.1.3 are the six existing spaces located along the southeasterly corner of the existing Farley Building. Waivers have been previously granted by the Board for those spaces in prior decisions. Moreover, the requirements of Section 5.1.3(n) (Bicycle Racks) has been waived.

² A Parking Summary Chart is included in Sheet C-3 of the VHB drawings filed herewith. In order to minimize the changes between the current, revised drawings and the previously submitted and approved drawings, a chart using the same rows and columns as were on the prior drawings is included, with the increased number of parking spaces "bubbled." The planned 75 new spaces are part of the numbers that appear in the final column of the revised chart.

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The Applicant certifies pursuant to the Zoning By-Law, Section 4.4 that the project can be constructed and/or that the proposed uses thereof can be commenced without need for the issuance of any variance from any provisions of the Zoning By-Law by the Zoning Board of Appeals.

The zoning relief required for the modifications to the Project is the following:

1. Special Permit for Further Site Plan Review of a Major Project, pursuant to Zoning By-Law Section 7.4, Article 2 of the Planning Board Rules and Section 4.2 of Special Permit No. 91-3, dated July 8, 2014.
2. Special Permit pursuant to Sections 5.1.1.5 and 5.1.1.7 of the Zoning By-Law to waive strict adherence to the off-street parking requirements of Section 5.1.3 of the Zoning By-Law, if applicable. As described above, the total number of parking spaces after completion of the Project will increase from 512 to 587. A waiver is requested from Section 5.1.3(n)(Bicycle Racks) because no bicycle racks are provided. Parking Waivers have already been granted with respect to the necessity of providing bicycle racks, but the petitioner requests the relief again if the Board determines that the provisions of section 5.1.1.7 are applicable. In addition, a waiver is requested from the requirements of Section 5.1.3(f) (Parking Space Size) with respect to the six existing spaces located along the southeasterly corner of the existing Farley building. The spaces are non-compliant in that they are of varying lengths (between 14-16 feet). A parking waiver has already been granted with respect to these parking spaces, but the Petitioner requests this relief again, if the Board determines that the provisions of Section 5.1.1.7 are applicable. (With respect to said parking waivers granted in prior decisions, see, for example, sections 1.9 and 1.24, and the relief granting clause of the March 19, 2013 decision, and sections 1.7 and 1.25, and the relief granting section of the July 8, 2014 decision).

These Applications for Site Plan Review and Special Permits include the following documents:

1. Application for Further Site Plan Review and Special Permits.
2. Site, Architectural and Landscape Plans entitled "North Hill Life Care Facility, 865 Central Avenue, Needham, Massachusetts 02492" (dated, or last rev. date, 12/23/20).
3. Summary of changes from approved plans prepared by by Vanasse Hangen Brustlin, Inc., 101 Walnut Street, Watertown, Massachusetts 02471-9151 dated January 4, 2021.
4. Supplemental Stormwater Memo prepared by Vanasse Hangen Brustlin, Inc., 101 Walnut Street, Watertown, Massachusetts 02471-9151 dated December 23, 2020.
5. Check payable to the Town of Needham in the amount of \$1000.00 representing the filing fee for Major Site Plan Review.

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Pursuant to the Board's Covid-19 procedures, these documents are being submitted electronically; additionally two (2) hard copies of the application (1 with original signatures) and all supporting materials, including wet-stamped plans, are being mailed to the Planning Department along with the application fee; and, lastly, one hard copy of (a) the Application for Further Site Plan Review and Special Permits, (b) this letter, (c) the VHB memorandum, and (d) all the plans (no smaller than 11 x 17), is being mailed to each Board member, and to Lee Newman.

The Applicant notes that the existing cooling tower shown on the plans for purposes of illustration is in need of replacement and the proposed location of the cooling tower (also shown on the plans) is slightly different from the current location. The replacement of the existing cooling tower is part of a continuous process of maintenance, repair, and replacement of elements of a large facility such as North Hill, and Applicant requests that the Board make a determination that said cooling tower replacement is not part of the site plan review process and will be permitted and overseen, as required, by the Building Department. Since the cooling tower is in the same location as the other work proposed herein, it is much more efficient to do both projects at the same time.

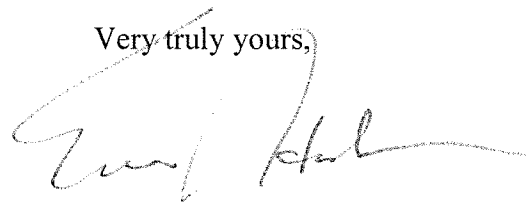
The Applicant hereby requests, pursuant to Zoning By-Law Section 7.4.4, that the Planning Board waive the submission by Applicant of any of the required information not submitted herewith.

The Applicant has previously submitted a copy of these plans to the Design Review Board ("DRB"). The Applicant met with the Design Review Board on January 11, 2021, at which time the DRB approved these plans.

I would appreciate your scheduling this matter for hearing at the Board's February 16, 2021 meeting.

Thank you for your cooperation.

Very truly yours,

A handwritten signature in dark ink, appearing to read 'Evans Huber', written over a horizontal line.

Evans Huber

Enclosures
cc: Roy A Cramer, Esq.

**TOWN OF NEEDHAM
MASSACHUSETTS**

PLANNING BOARD

500 Dedham Ave
Needham, MA 02192
781-455-7550
January 13, 2021

**APPLICATION FOR FURTHER SITE PLAN REVIEW
AND SPECIAL PERMITS**

Project Determination:

☒

Major Project

☐

Minor Project

This application must be completed, signed, and submitted with the filing fee by the applicant or his representative in accordance with the Planning Board's Rules as adopted under its jurisdiction as a Special Permit Granting Authority. Section 7.4 of the by-laws.

Location of Property: 865 Central Avenue, Needham, MA 02492

Name of Applicant: North Hill Needham, Inc.

Address: 865 Central Avenue, Needham, MA 02492 Tel.#: 781 433 6204

Applicant is Owner

☐

Tenant

☒

Property Owner's Name: Babson College

Address: 1 College Drive, Babson Park, MA 02152 Tel.#: 781 235 1200

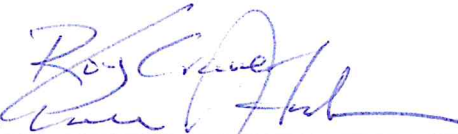
Characteristics of Property: Lot Area: 59.54 acres Present Use: Senior Living Apartments and nursing home

Map #: 309 Parcel #: 25 Zoning District: A-2 and SRA

Description of Project for Site Plan Review under Section 7.4. of the Zoning By-law:

See Exhibit A attached hereto.

Signature of Applicant (or his representative)



Roy A. Cramer, Esq.
Evans Huber, Esq.

Address if not Applicant

Frieze Cramer Rosen & Huber LLP
60 Walnut Street, Wellesley, MA 02481
Tel. # 781 943 4030

Owner's permission if other than applicant BABSON COLLEGE

By: _____

SUMMARY OF PLANNING BOARD ACTION

Received by Planning Board _____ Date _____

Hearing Date _____

Decision Required by _____ (date)
(90 days after hearing for special permit)

Parties in Interest Notified
of Public Hearing _____ (date)

Granted _____ (date)

Decision and Notices of the
Decision sent _____ (date)

Denied _____ (date)

Withdrawn _____ (date)

Fee Paid _____
Fee Waived _____

NOTE: Reports on Minor Projects must be issued within 35 days of filing date.

Exhibit A
Application for Further Site Plan Review
North Hill Needham, Inc.
Property at 865 Central Avenue, Needham, MA

Description of Project for Further Site Plan Review Under Section 7.4 of the Zoning By-Law

Reference is made to Site Plan Special Permit No. 91-3 dated May 28, 1991 and amendments thereto dated July 1, 1997, October 7, 1997, August 10, 1999, September 8, 2011, March 20, 2012, July 10, 2012, September 28, 2012, March 19, 2013, July 8, 2014, and August 11, 2015, respectively. In addition, certain changes were approved by memo dated August 25, 2016 pursuant to the Planning Board's insignificant modifications policy.

The Applicant proposes to construct 75 new parking spaces along a portion of the existing fire lane, widen the fire lane, and undertake associated sitework and landscaping, all as more particularly shown on the plans filed herewith.

Applicant seeks further site plan review pursuant to Section 7.4 of the Bylaw, and a Special Permit waiving strict compliance with the requirements of Sections 5.1.1.5, 5.1.1.7, and 5.1.3 of the Bylaw.



Memorandum

To: Roy A. Cramer
Frieze Cramer Rosen & Huber, LLP
60 Walnut Street
Wellesley, MA 02481

Date: January 4, 2021

Project #: 11369.01

From: Dan Keches, P.E.
Justin Mosca, P.E.

Re: North Hill Life Care Facility -
Plan Changes for Site Plan Special Permit Modification

The following is a list of changes to the North Hill Life Care Facility permitting plans of record that have been made to date subsequent to the latest SUP approval. All revisions are clouded and numbered on the plans according to the following line items:

#1: Added "Bayview Road" improvements (reconstruction/widening of existing fire lane)

- Civil Changes
 - Widening of fire lane to current code requirements
 - 75 parking space addition
 - Cooling tower and access path relocation
 - Adjacent slope regrading
 - Retaining walls, reconstruction and addition
 - Granite curb and guard rail addition
 - Signage additions
 - Bioretention basins and connections to existing closed-drainage addition
 - Cooling tower sanitary sewer connection addition
- Landscape Architecture Changes
 - Bioretention basin planting addition
 - Concrete steps reconstruction
 - Handrail additions
- Electrical Changes
 - Site lighting replacement
 - Cooling tower maintenance lighting addition
 - Associated electrical connections, handholes, and routing

101 Walnut Street
PO Box 9151
Watertown, MA 02472-4026
P 617.924.1770

Site Plans

Issued for: **Permitting**

Date Issued: June 17, 2011

Revised: 7/28/11, 12/3/12, 4/1/13, 5/28/14, 7/8/14, 7/30/15, 8/9/16, 1/4/21

Sheet Index

Number	Drawing Title	Latest Issue
C1	Legend and General Notes	6/17/2011
* C2	Key Plan	1/4/2021
* C3	Overall Site Master Plan	1/4/2021
* C3.1	Phasing Site Plan	1/4/2021
C4.1.1	Permitting Layout and Materials Plan	5/28/2014
+ C4.1.2	Bayview Road Layout and Materials Plan	1/4/2021
C4.2.1	Permitting Layout and Materials Plan	12/3/2012
+ C4.2.2	Bayview Road Layout and Materials Plan	1/4/2021
C4.3.1	Permitting Layout and Materials Plan	7/14/2016
+ C4.3.2	Bayview Road Layout and Materials Plan	1/4/2021
C4.4.1	Permitting Layout and Materials Plan	7/30/2014
C4.5.1	Permitting Layout and Materials Plan	12/3/2012
C5.1.1	Permitting Grading and Drainage Plan	5/28/2014
+ C5.1.2	Bayview Road Grading and Drainage Plan	1/4/2021
C5.2.1	Permitting Grading and Drainage Plan	12/3/2012
+ C5.2.2	Bayview Road Grading and Drainage Plan	1/4/2021
C5.3.1	Permitting Grading and Drainage Plan	8/9/2016
+ C5.3.2	Bayview Road Grading and Drainage Plan	1/4/2021
C5.4.1	Permitting Grading and Drainage Plan	7/30/2014
C5.5.1	Permitting Grading and Drainage Plan	5/28/2014
C6.1.1	Permitting Utilities Plan	5/28/2014
+ C6.1.2	Bayview Road Utilities Plan	1/4/2021
C6.2.1	Permitting Utilities Plan	12/3/2012
+ C6.2.2	Bayview Road Utilities Plan	1/4/2021
C6.3.1	Permitting Utilities Plan	8/9/2016
+ C6.3.2	Bayview Road Utilities Plan	1/4/2021
C6.4.1	Permitting Utilities Plan	7/30/2014
C6.5.1	Permitting Utilities Plan	5/28/2014
* C7	Emergency Vehicle Access Plan	1/4/2021
C8.1	Site Details	12/3/2012
C8.2	Site Details	7/14/2016
C8.3	Site Details	8/9/2016
C8.4	Site Details	5/28/2014
+ C8.5	Bayview Road Site Details	1/4/2021

Reference Drawings

Number	Drawing Title	Latest Issue
SV-1-5	Existing Conditions Plan of Land	6/17/2011
L1	Key Plan	7/30/2014
L2.1	Materials Plan	12/3/2012
L2.2	Materials Plan	12/3/2012
L2.3	Materials Plan	7/30/2014
L2.3.1	Materials and Grading Plan (New IL)	7/14/2016
L2.4	Materials Plan	10/15/2014
L3.1	Planting and Irrigation	12/3/2012
L3.2	Planting and Irrigation	12/3/2012
L3.3	Planting and Irrigation	7/30/2014
L3.3.1	Planting Plan (New IL)	7/14/2016
L3.4	Planting and Irrigation	7/30/2014
L3.5	Main Entry Modifications	12/3/2012
L3.6	Main Entry Modifications	12/3/2012
+ L3.7	Bayview Road Stairway & Path Improvements	1/4/2021
+ L3.8	Bayview Road Bioretention Basin Planting Plans	1/4/2021
L4.1	Site Details	12/3/2012
L4.2	Site Details	12/3/2012
L4.3	Site Details	12/3/2012
L4.4	Site Details	12/3/2012

Reference Drawings (continued)

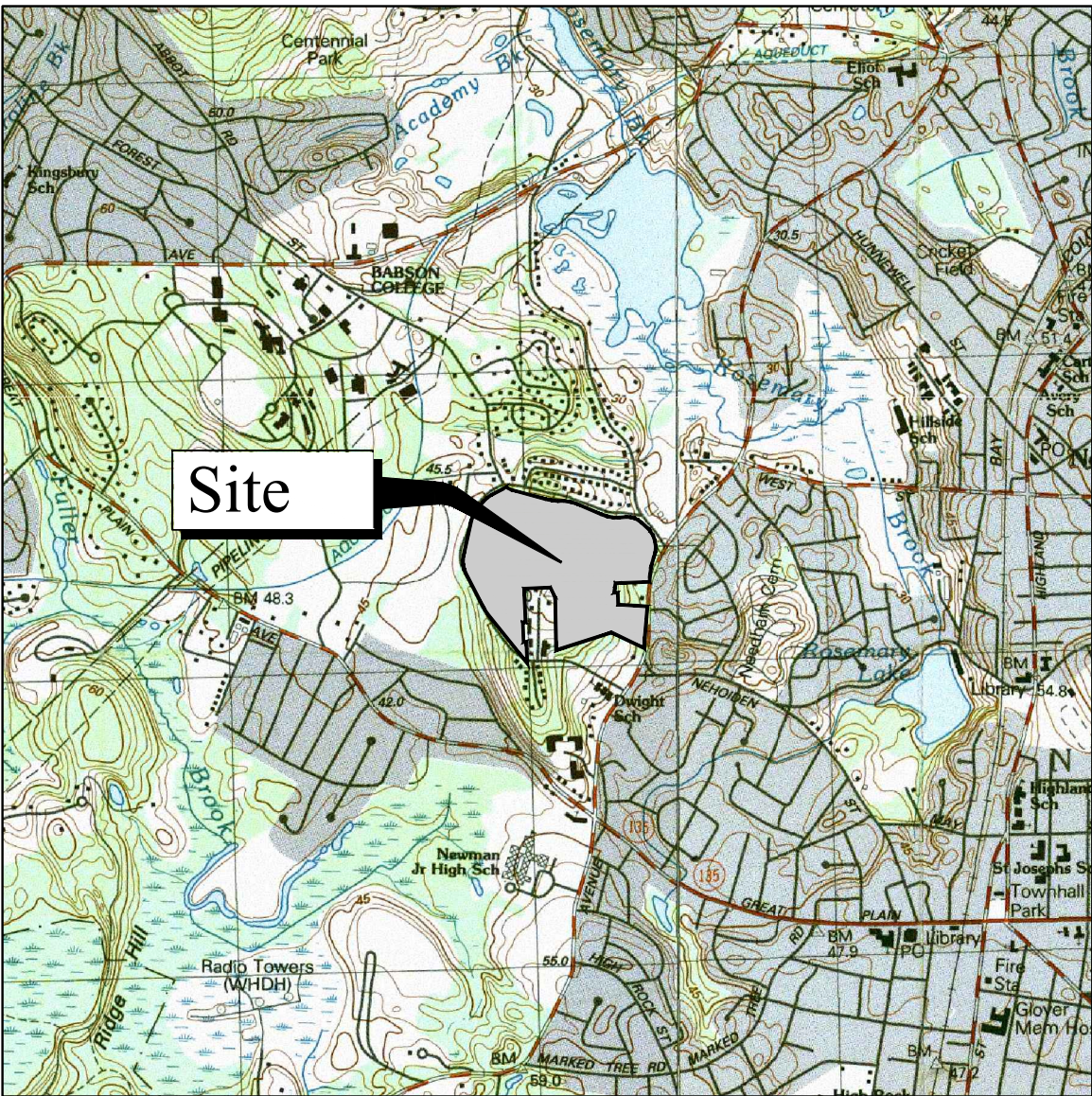
Number	Drawing Title	Latest Issue
L4.5	Site Details	12/3/2012
L4.6	Site Details	12/3/2012
PH1.01	Photometric Lighting Plan	5/28/2014
+ PH1.02	Bayview Road Lighting Photometric Plan	1/4/2021
ES1.01A	Site Distribution Plan - Part "A"	7/12/2012
ES1.01B	Site Distribution Plan - Part "B"	7/12/2012
+ ES1.02	Bayview Road Site Distribution Plan	1/4/2021
A-1	Entry Addition (IL Commons)	6/6/2011
A-2	Canyon Addition (IL Commons)	6/6/2011
A-3	Green House Addition & Repurposing Facade (IL Commons)	12/3/2012
A-4	C & E Wing Entry Elevation	5/11/2012
A-5	Lower Floor (IL Commons)	6/17/2011
A-6	First Floor (IL Commons)	6/17/2011
A-7	Second Floor (IL Commons)	6/17/2011
A-8	Third Floor (IL Commons)	6/17/2011
A-9	Fourth Floor (IL Commons)	6/17/2011
A-10	Fifth Floor (IL Commons)	6/17/2011
A-11.1	Level 1 Floor Plan (New IL)	5/28/2014
A-12.1	Level 2 Floor Plan (New IL)	5/28/2014
A-13.1	Level 3 Floor Plan (New IL)	5/28/2014
A-14.1	Level 4 Floor Plan (New IL)	5/28/2014
A-15.1	Level 5 Floor Plan (New IL)	5/28/2014
A-16.1	Exterior Elevations (New IL)	5/28/2014
A-17	Plan & Elevations (Maintenance Building)	12/3/2012
A-18	Level One Floor Plan (SNF)	12/3/2012
A-19	Level Two Floor Plan (SNF)	12/3/2012
A-20	Level Three Floor Plan (SNF)	12/3/2012
A-21	Level Four Floor Plan (SNF)	12/3/2012
A-22	Exterior Elevations (SNF)	5/8/2014
A-23	Level Three Floor Plan (EIL)	12/3/2012
A-24	Level Four Floor Plan (EIL)	12/3/2012
A-25	Exterior Elevations (EIL)	12/3/2012
A26	Floor and Roof Plan (Farley)	12/3/2012
A27	Exterior Elevations (Farley)	12/3/2012
A-5	Lower Floor (Commons Interior Phasing)	6/27/2011
A-6	First Floor (Commons Interior Phasing)	6/27/2011
A-7	Second Floor (Commons Interior Phasing)	6/27/2011
A-8	Third Floor (Commons Interior Phasing)	6/27/2011
A-9	Fourth Floor (Commons Interior Phasing)	6/27/2011
A-10	Fifth Floor (Commons Interior Phasing)	6/27/2011
A1.05	Sitework and Canopy Detail	10/5/2011
9 Sheets	6'-0" x 8'-0" Aluminum Building	2/29/2012 (Unchanged, Not Submitted)

NOTE:

- * DENOTES PLAN REVISED IN PLANSET
- + DENOTES PLAN ADDED TO PLANSET

North Hill Life Care Facility

865 Central Avenue
Needham, Massachusetts 02492



Site Location Map



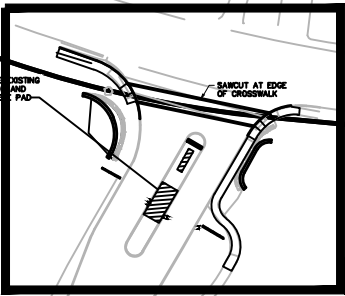
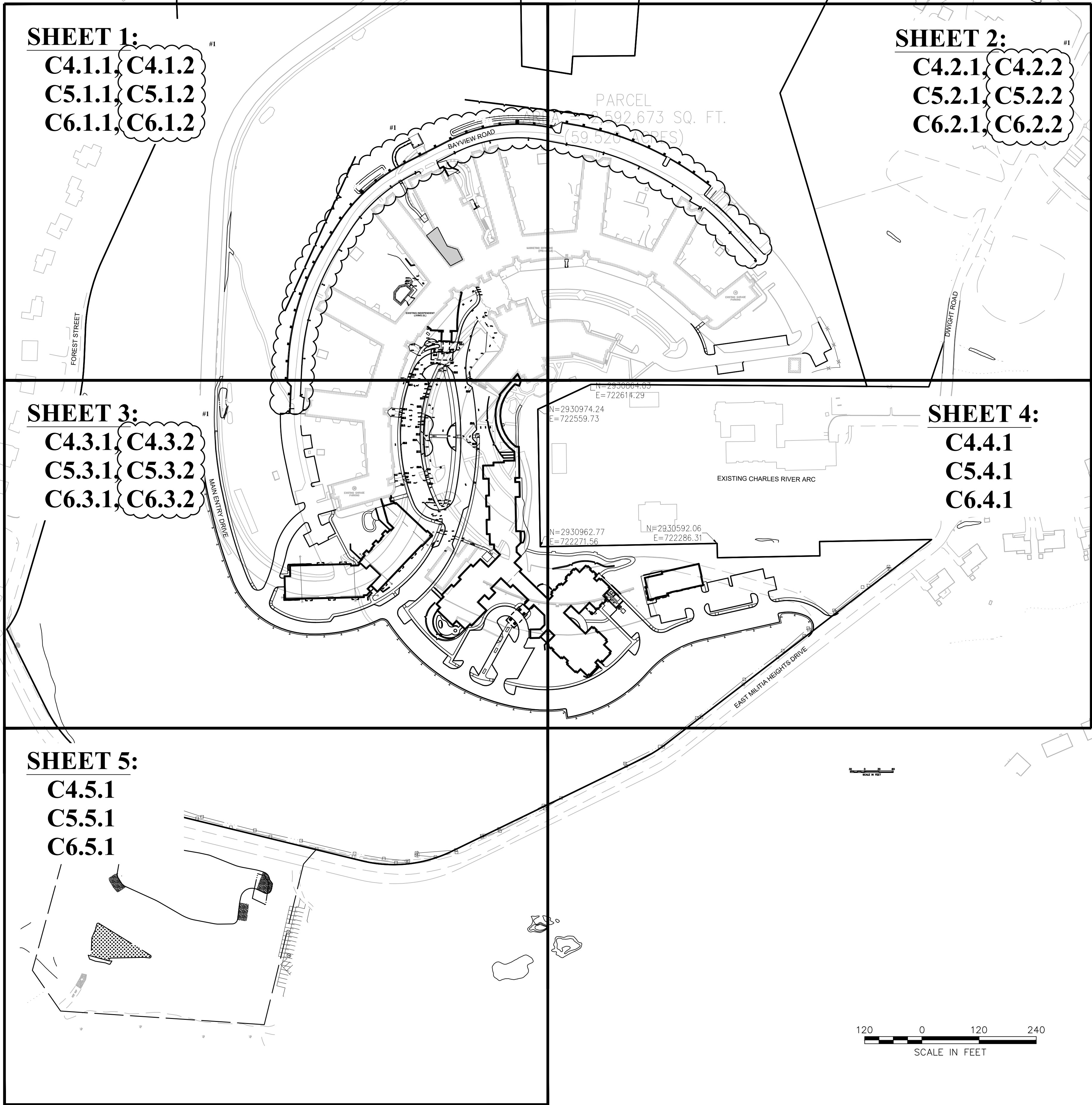
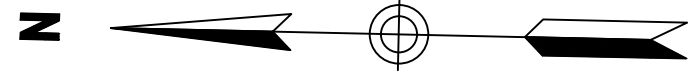
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services

101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617.924.1770 • FAX 617.924.2286



Applicant:
North Hill Needham, Inc.
865 Central Avenue
Needham, MA 02492

VHB Project No. 11369.00
865 Central Avenue, Needham, MA
Issued for: Permitting - 1/4/21



Inset 1A:
C4.1.1
C5.1.1
C6.1.1

SHEET 1:
C4.1.1, C4.1.2
C5.1.1, C5.1.2
C6.1.1, C6.1.2

SHEET 2:
C4.2.1, C4.2.2
C5.2.1, C5.2.2
C6.2.1, C6.2.2

SHEET 3:
C4.3.1, C4.3.2
C5.3.1, C5.3.2
C6.3.1, C6.3.2

SHEET 4:
C4.4.1
C5.4.1
C6.4.1

SHEET 5:
C4.5.1
C5.5.1
C6.5.1

Bayview Road Improvements Project Team:

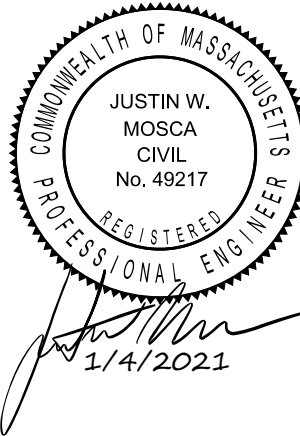
Landscape Architect
Hammer + Walsh Design Inc 617.439.0125
Electrical
Bard, Rao & Athanas Consulting, Inc. 617.254.0016

New 45 IL Residences Project Team:

Architect
DiMella Shaffer 617.426.5004
Structural
L.A. Fuess Partners, Inc. 617.948.5700
MEP/Code
R.W. Sullivan Engineering 617.523.8227
Landscape Architect
Hammer + Walsh Design Inc 617.439.0125
Interiors
Wellesley Design Consultants, Inc. 978.965.8185

Commons / SNF / EIL / Maint. Bldg. Project Team:

Architect
JSA 603.436.2551
Structural
Engineers Design Group 781.396.9007
Mechanical/Plumbing/Fire
R.W. Sullivan Engineering 617.523.8227
Electrical
VAD, Inc. 781.255.9754
Landscape Architect
Copley Wolff Design Group 617.654.9000
Interiors
Wellesley Design Consultants, Inc. 978.965.8185
Food Service and Laundry
Crabtree McGrath Associates 978.352.8500



1/4/21	Bayview Road Improvements
7/14/16	Permitting Modifications
5/28/14	Permitting Modifications
12/3/12	Permitting Modifications
7/28/11	Parking Revisions

Revisions:

Scale: 1" = 120'
Date: June 17, 2011
Drawn By: **Checked By:** **Reviewed By:**

North Hill
Life Care Facility
865 Central Avenue
Needham, MA 02492

Permitting
Not Issued for Construction

Key Plan

C2

Zoning Summary Chart

Zoning District(S):	Apartment A-2				
Overlay District(S):	N/A				
Zoning Regulation Requirements	Required	Provided			
		New Independent Living	Maintenance Building	Enhanced Independent Living	Skilled Nursing Facility
MINIMUM LOT AREA	43,560 SF	2,592,674± SF (59.5± ACRES)			
FRONTAGE	150 FT	>> 150 FT			
FRONT YARD SETBACK	40 FT	515 FT	216 FT	406 FT	205 FT
SIDE YARD SETBACK	40 FT	492 FT	41 FT	41 FT	41 FT
REAR YARD SETBACK	40 FT	226 FT	41 FT	41 FT	41 FT
MAXIMUM FLOOR AREA RATIO	0.30	0.29			
MAXIMUM BUILDING HEIGHT	3 STORIES/40 FT*	3 STORIES/<40 FT**	1 STORY/20 FT	2 STORIES/29 FT	3-4 STORIES/47 FT**
MINIMUM PARKING AREA LANDSCAPING PERCENTAGE	10%	>> 10%			
MINIMUM INTERIOR PARKING AREA LANDSCAPING PERCENTAGE	2.5%	>> 2.5%			

* 4 STORIES/50-FT. IF UTILIZED AS A CONVALESCENT OR NURSING HOME W/ RESTRICTIONS, PER SECTION 4.3.1 OF THE ZONING BY-LAW
** SNF BUILDING HEIGHT (46.9') = ROOF ELEVATION (271.7') - AVERAGE ADJOINING GRADE (224.8)
*** REFER TO ARCHITECTURAL PLANS

Parking Summary Chart

Description	Size		Spaces		
	Required	Provided	Existing	Required	Provided
PROPOSED RELOCATED STANDARD 90° SPACES (SITE)	9 x 18.5	9 x 18.5	--	--	276
PROPOSED RELOCATED STANDARD PARALLEL SPACES (SITE)	9 x 22	9 x 22	--	--	64
PROPOSED RELOCATED STANDARD ACCESSIBLE SPACES (SITE)	8 x 18*	9 x 18.5	--	--	4
PROPOSED RELOCATED VAN ACCESSIBLE SPACES (SITE)	8 x 18*	9 x 18.5	--	--	5
PROPOSED RELOCATED GARAGE SPACES**			--	--	49
TOTAL PROPOSED RELOCATED SPACES					398
TOTAL SPACES			478***	478***	587****
LOADING BAYS			N/A	N/A	2

* ADA/AAB REQUIREMENTS
** PROPOSED RELOCATED GARAGE SPACES INCLUDE 2 STANDARD ACCESSIBLE SPACES
*** INCLUDES 6 EXISTING NON-CONFORMING SPACES
**** PER SPECIAL PERMIT
***** TOTAL SPACES INCLUDES 189 EXISTING SPACES WHICH ARE TO REMAIN, 6 OF WHICH ARE NON-CONFORMING SPACES, 12 OF WHICH ARE ACCESSIBLE SPACES AND 80 OF WHICH ARE EXISTING GARAGE PARKING SPACES, AND 398 PROPOSED/RELOCATED SPACES

Key Plan

(P) - EXISTING PARKING SPACES TO REMAIN (189 TOTAL)
(P) - PROPOSED PARKING SPACES (398 TOTAL) #1
- AREA OF GREENROOF (SEE ARCHITECTURAL PLANS)

Notes

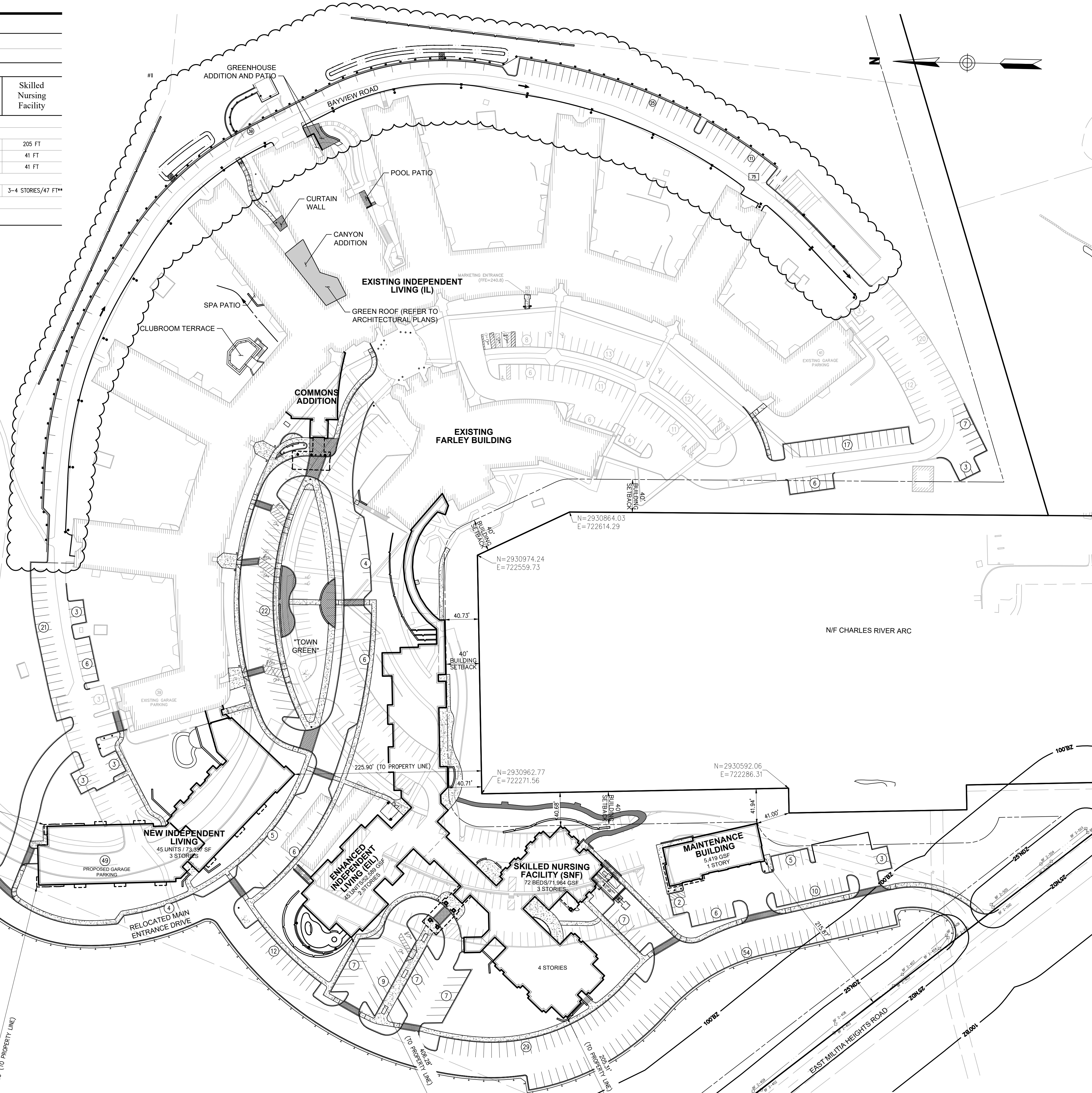
1. PARKING AREAS WILL COMPLY WITH ALL PARKING PLAN AND DESIGN REQUIREMENTS SET FORTH IN SECTION 5.1.3 OF THE NEEDHAM ZONING BYLAWS EXCEPT THAT A WAIVER IS REQUESTED FROM THE PROVISIONS OF SECTION 5.1.3(g) ("PARKING LOT ILLUMINATION"), SO THAT EACH PARKING AREA SHALL PROVIDE AN AVERAGE ILLUMINATION LEVEL OF AT LEAST ONE FOOTCANDLE.

Sign Summary

M.U.T.C.D.	Specification		Desc.
Number	Width	Height	
R1-1	30"	30"	
R6-1R	12"	18"	
R6-1L	12"	18"	
R5-1	30"	30"	
R7-1	12"	18"	
R7-8 (REVISED)	12"	18"	
R7-8A	12"	6"	

Sign Summary

M.U.T.C.D.	Specification		Desc.
Number	Width	Height	
SP-1	12"	18"	CAUTION WATCH FOR EXISTING VEHICLES
SP-2	12"	18"	NO LOADING OR DELIVERIES



Civil:



101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770

North Hill

877.736.4371

Bayview Road Improvements Project Team:

Landscape Architect
Hammer + Walsh Design Inc 617.439.0125

Electrical
Bard, Rao & Athanas Consulting, Inc. 617.254.0016

New 45 IL Residences Project Team:

Architect
DiMella Shaffer 617.426.5004

Structural
L.A. Fuess Partners, Inc. 617.948.5700

MEP/Code
R.W. Sullivan Engineering 617.523.8227

Landscape Architect
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Interiors
Wellesley Design Consultants, Inc. 978.965.8185

Commons / SNF / EIL / Maint. Bldg. Project Team:

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JSA 603.436.2551

Structural
Engineers Design Group 781.396.9007

Mechanical/Plumbing/Fire
R.W. Sullivan Engineering 617.523.8227

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Food Service and Laundry
Crabtree McGrath Associates 978.352.8500



1/4/21 Bayview Road Improvements
7/14/16 Permitting Modifications
5/28/14 Permitting Modifications
12/3/12 Permitting Modifications
7/28/11 Parking Revisions

Revisions:

Scale: 1" = 60'
Date: June 17, 2011

Drawn By: **Checked By:** **Reviewed By:**

North Hill Life Care Facility

865 Central Avenue
Needham, MA 02492

Permitting

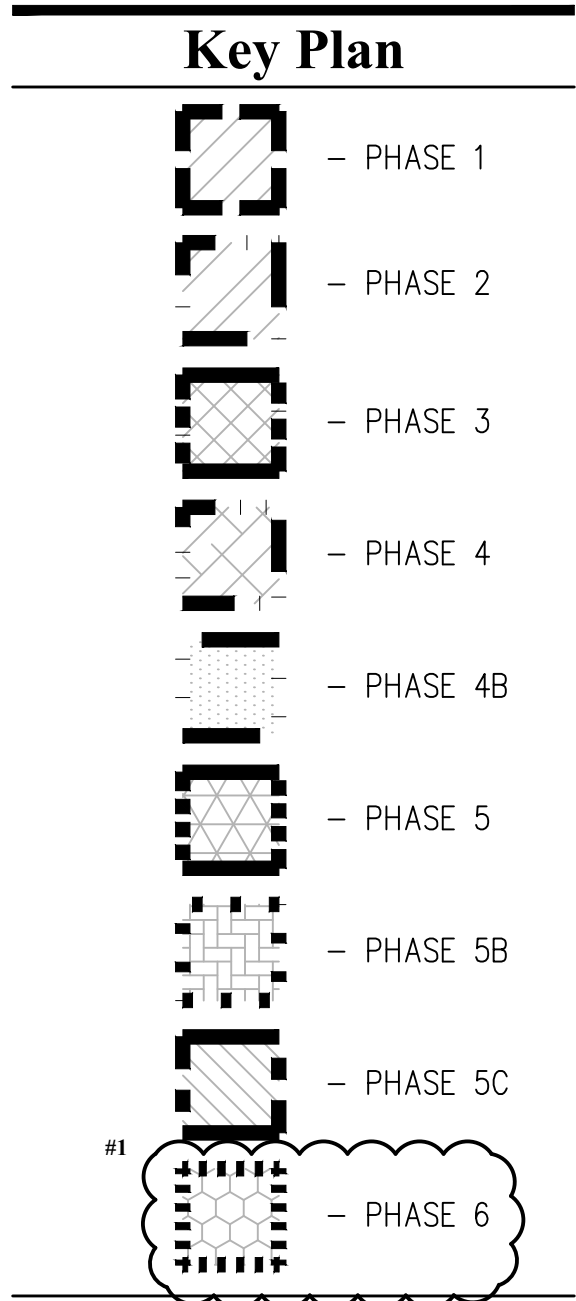
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Overall Site Master Plan

C3

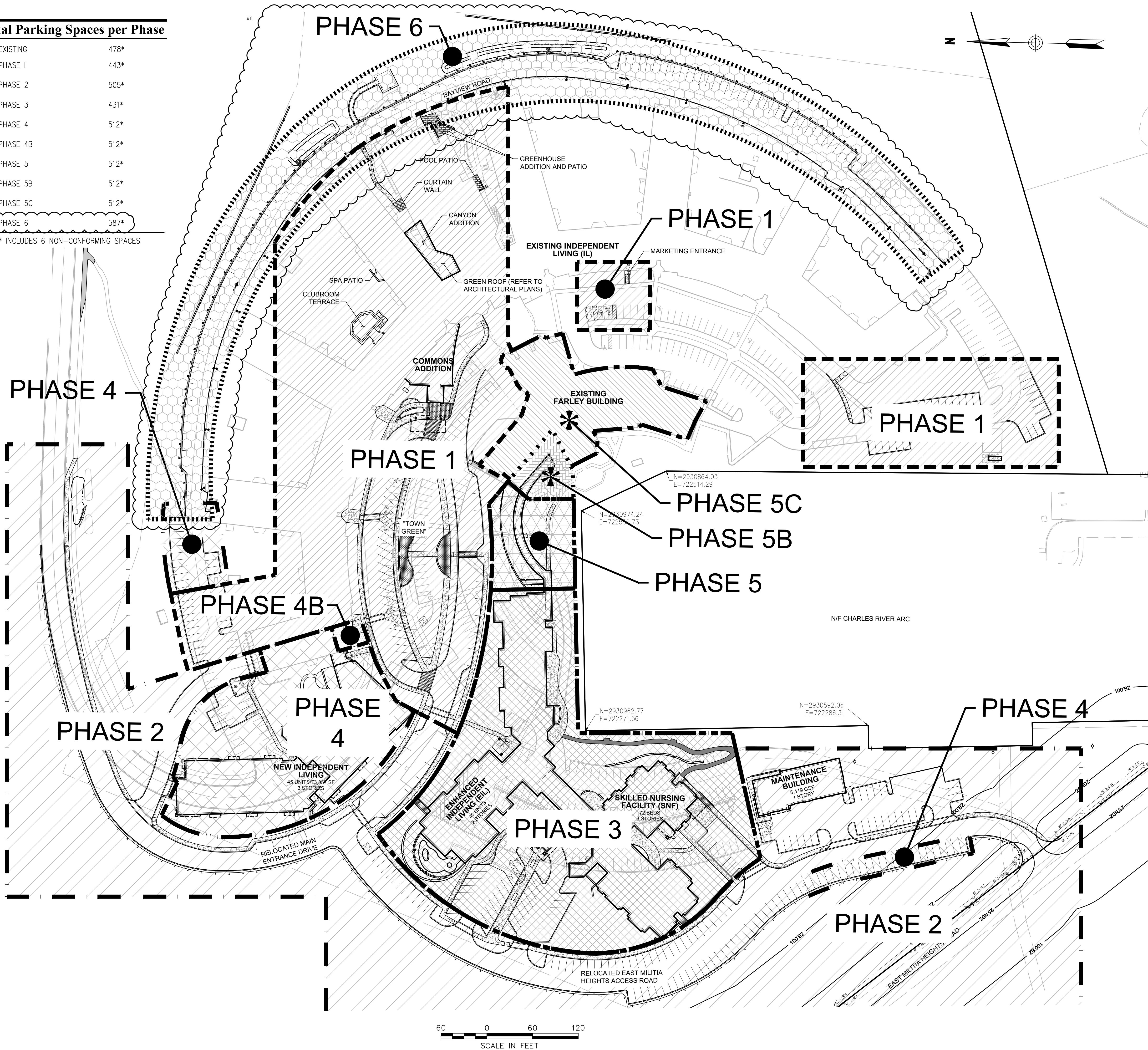
\\vhb\proj\Wat-LD\11369_04\cad\ld\Plans\11369_04-PHASING.dwg

8/19/2020 2:07:42 PM



Total Parking Spaces per Phase		
EXISTING	478*	
PHASE 1	443*	
PHASE 2	505*	
PHASE 3	431*	
PHASE 4	512*	
PHASE 4B	512*	
PHASE 5	512*	
PHASE 5B	512*	
PHASE 5C	512*	
PHASE 6	587*	

* INCLUDES 6 NON-CONFORMING SPACES



vhb
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Food Service and Laundry Crabtree McGrath Associates	978.352.8500



1/4/21	Bayview Road Improvements
7/14/16	Permitting Modifications
7/8/14	Permitting Modifications
5/28/14	Permitting Modifications
12/3/12	Permitting Modifications
7/28/11	Parking Revisions

Revisions:

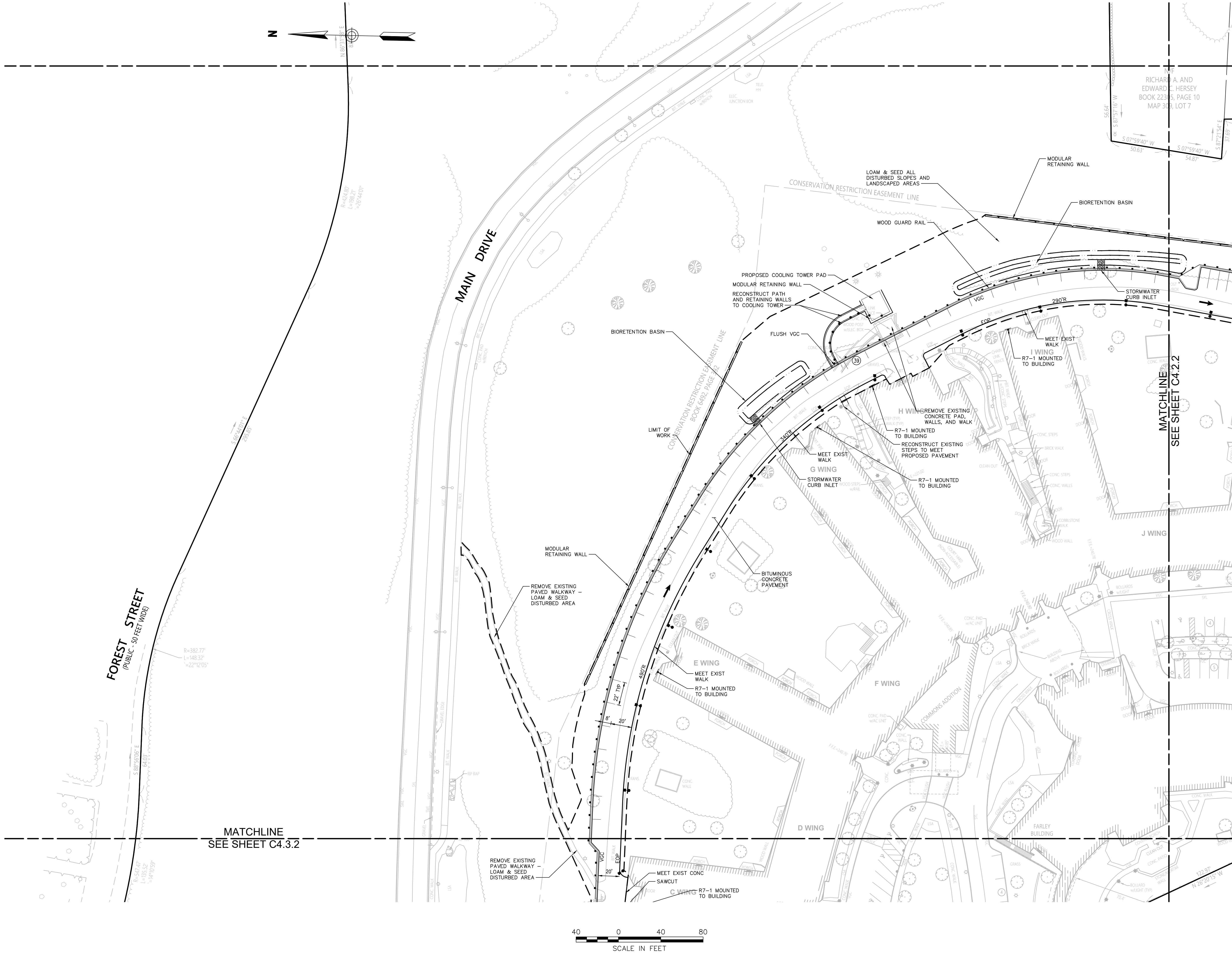
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Drawn By:	Checked By: Reviewed By:

**North Hill
Life Care Facility**
865 Central Avenue
Needham, MA 02492

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Phasing Site Plan

C3.1



Civil: **vhb**
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Site Key



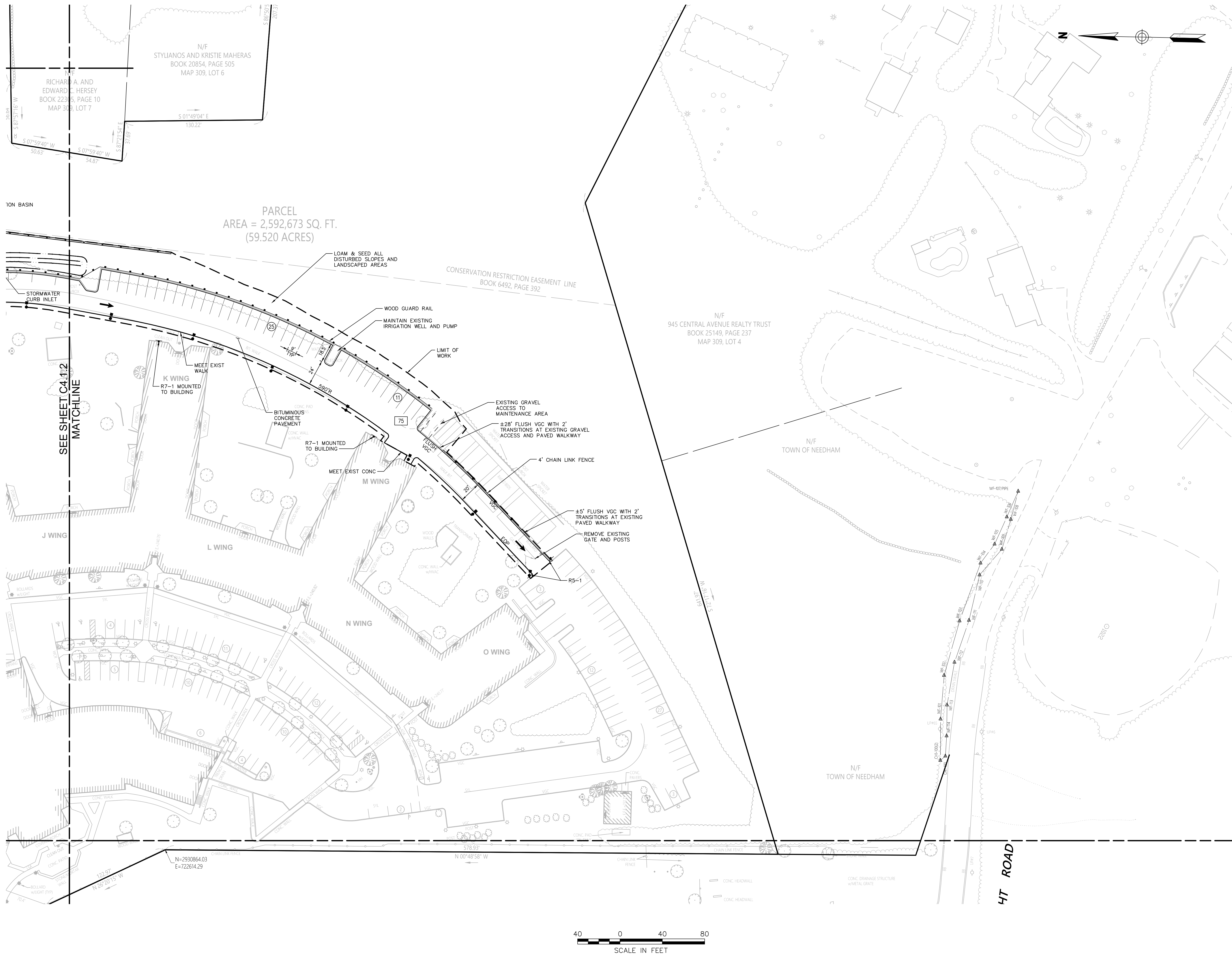
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Date: January 4, 2021
Drawn By: **Checked By:** **Reviewed By:**

North Hill
Life Care Facility
865 Central Avenue
Needham, MA 02492

Permitting
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Bayview Road
Layout & Materials Plan

#1 **C4.1.2**



Bayview Road Improvements Project Team:

Landscape Architect Hammer + Walsh Design Inc	617.439.0125
Electrical Bard, Rao & Athanas Consulting, Inc.	617.254.0016

New 45 IL Residences Project Team:

Architect DiMella Shaffer	617.426.5004
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MEP/Code R.W. Sullivan Engineering	617.523.8227
Landscape Architect Hammer + Walsh Design Inc	617.439.0125
Interiors Wellesley Design Consultants, Inc.	978.965.8185

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Food Service and Laundry Crabtree McGrath Associates	978.352.8500



Site Key



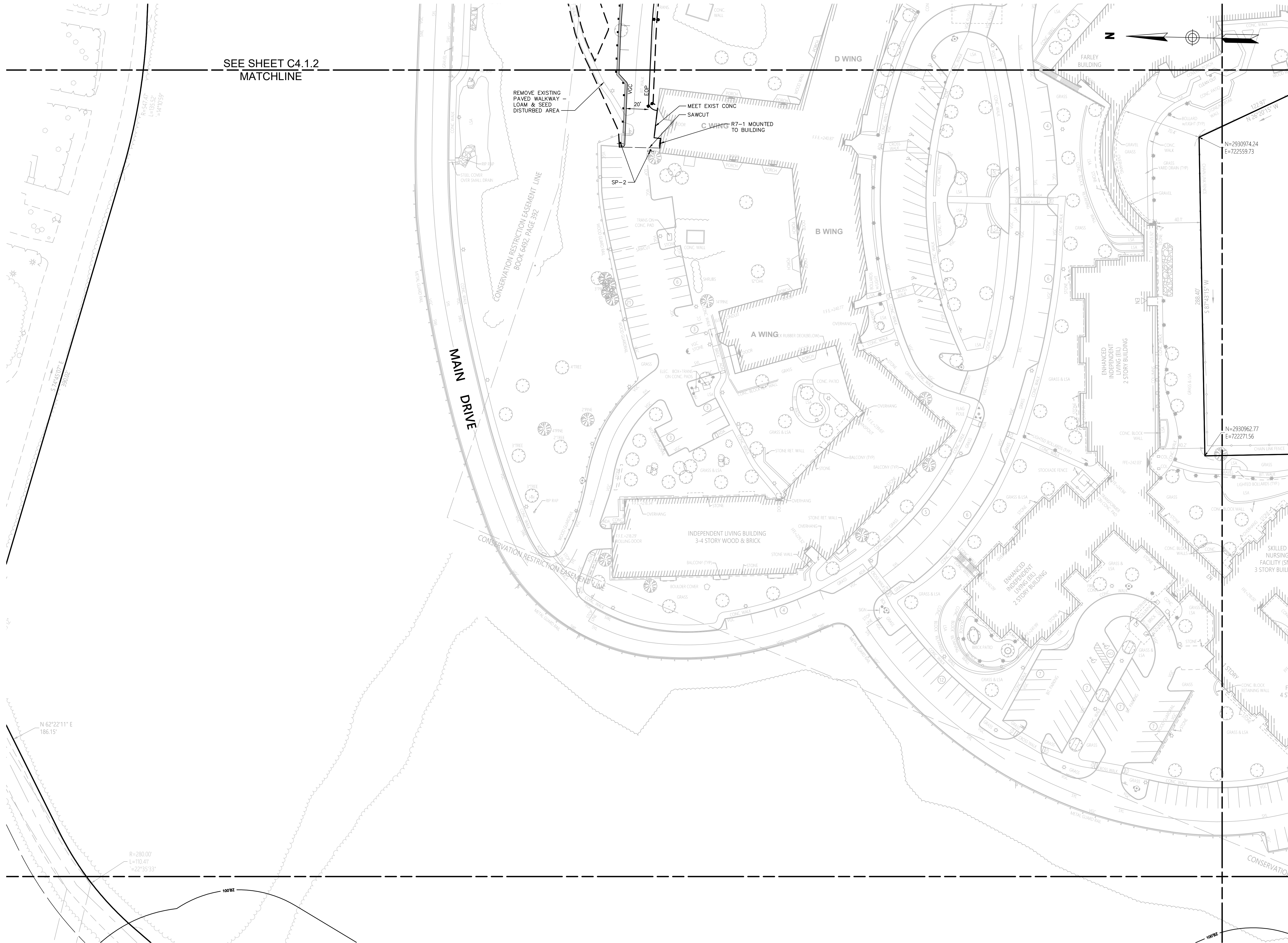
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Drawn By:	Checked By:	Reviewed By:	

**North Hill
Life Care Facility**
865 Central Avenue
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Bayview Road
Layout & Materials Plan

C4.2.2



Civil: 
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Bayview Road Improvements Project Team:

Landscape Architect
Hammer + Walsh Design Inc 617.439.0125
Electrical
Bard, Rao & Athanas Consulting, Inc. 617.254.0016

New 45 IL Residences Project Team:

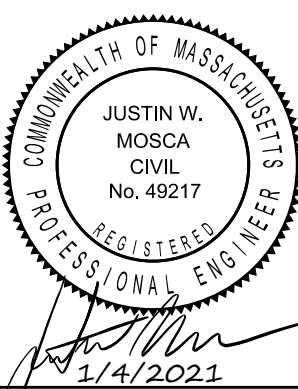
Architect
DiMella Shaffer 617.426.5004
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Food Service and Laundry
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Site Key



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Life Care Facility**

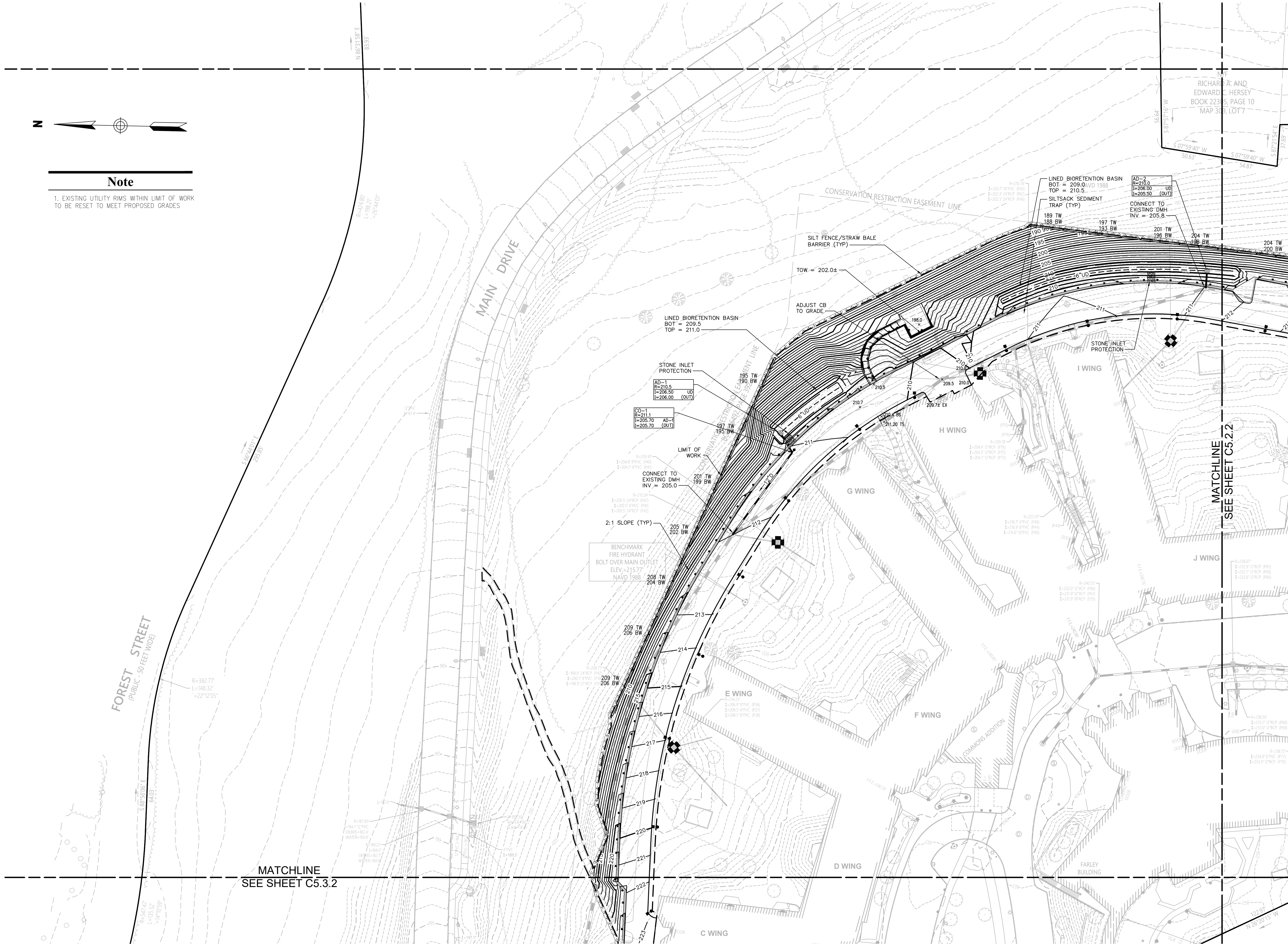
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Bayview Road
Layout & Materials Plan

#1 **C4.3.2**



Civil:

101 Walnut Street
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New 45 IL Residences Project Team:

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Crabtree McGrath Associates 978.352.8500

Site Key

Revisions:

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Date: January 4, 2021

Drawn By: **Checked By:** **Reviewed By:**

North Hill
Life Care Facility

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Bayview Road
Grading & Drainage Plan

C5.1.2



Civil: **vhb**
101 Walnut Street
PO Box 9151
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North Hill 877.736.4371

Bayview Road Improvements Project Team:

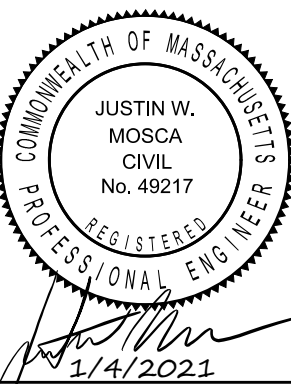
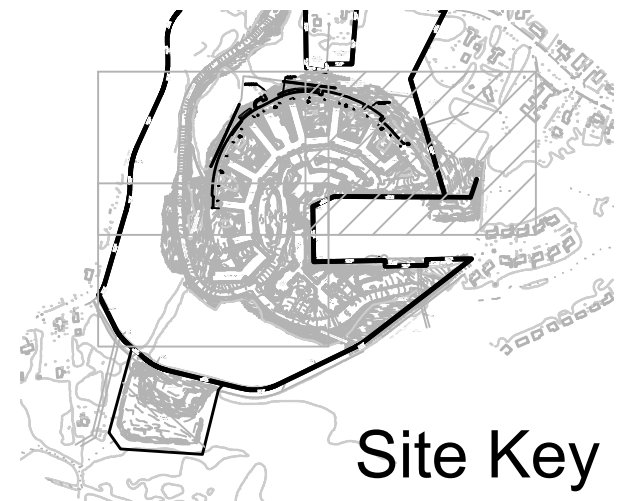
Landscape Architect
Hammer + Walsh Design Inc 617.439.0125
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New 45 IL Residences Project Team:

Architect
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Food Service and Laundry
Crabtree McGrath Associates 978.352.8500



Revisions:
Scale: 1" = 40'
Date: January 4, 2021
Drawn By: **Checked By:** **Reviewed By:**

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Life Care Facility
865 Central Avenue
Needham, MA 02492

Permitting
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Bayview Road
Grading & Drainage Plan

#1 **C5.2.2**



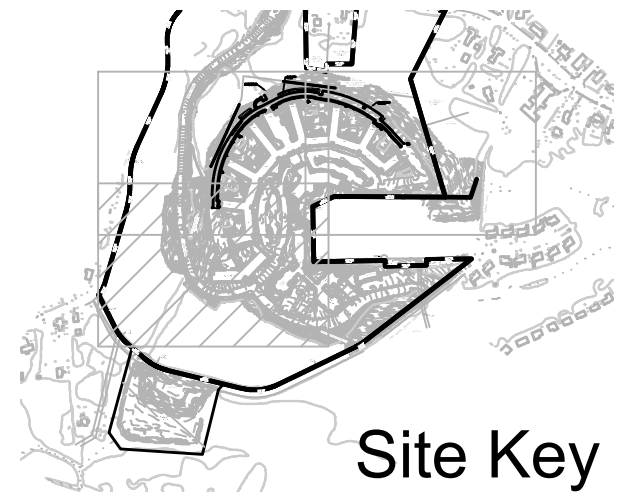
Civil: 
101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770

North  Hill 877.736.4371

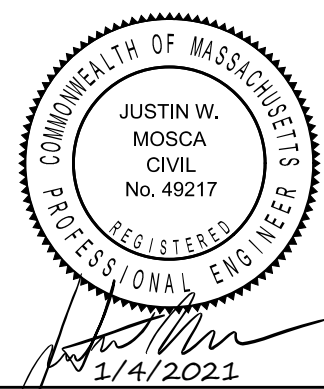
Bayview Road Improvements Project Team:
Landscape Architect
Hammer + Walsh Design Inc 617.439.0125
Electrical
Bard, Rao & Athanas Consulting, Inc. 617.254.0016

New 45 IL Residences Project Team:
Architect
DiMella Shaffer 617.426.5004
Structural
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Commons / SNF / EIL / Maint. Bldg. Project Team:
Architect
JSA 603.436.2551
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R.W. Sullivan Engineering 617.523.8227
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Copley Wolff Design Group 617.654.9000
Interiors
Wellesley Design Consultants, Inc. 978.965.8185
Food Service and Laundry
Crabtree McGrath Associates 978.352.8500



Site Key



Revisions:
Scale: 1" = 40'
Date: January 4, 2021
Drawn By: **Checked By:** **Reviewed By:**

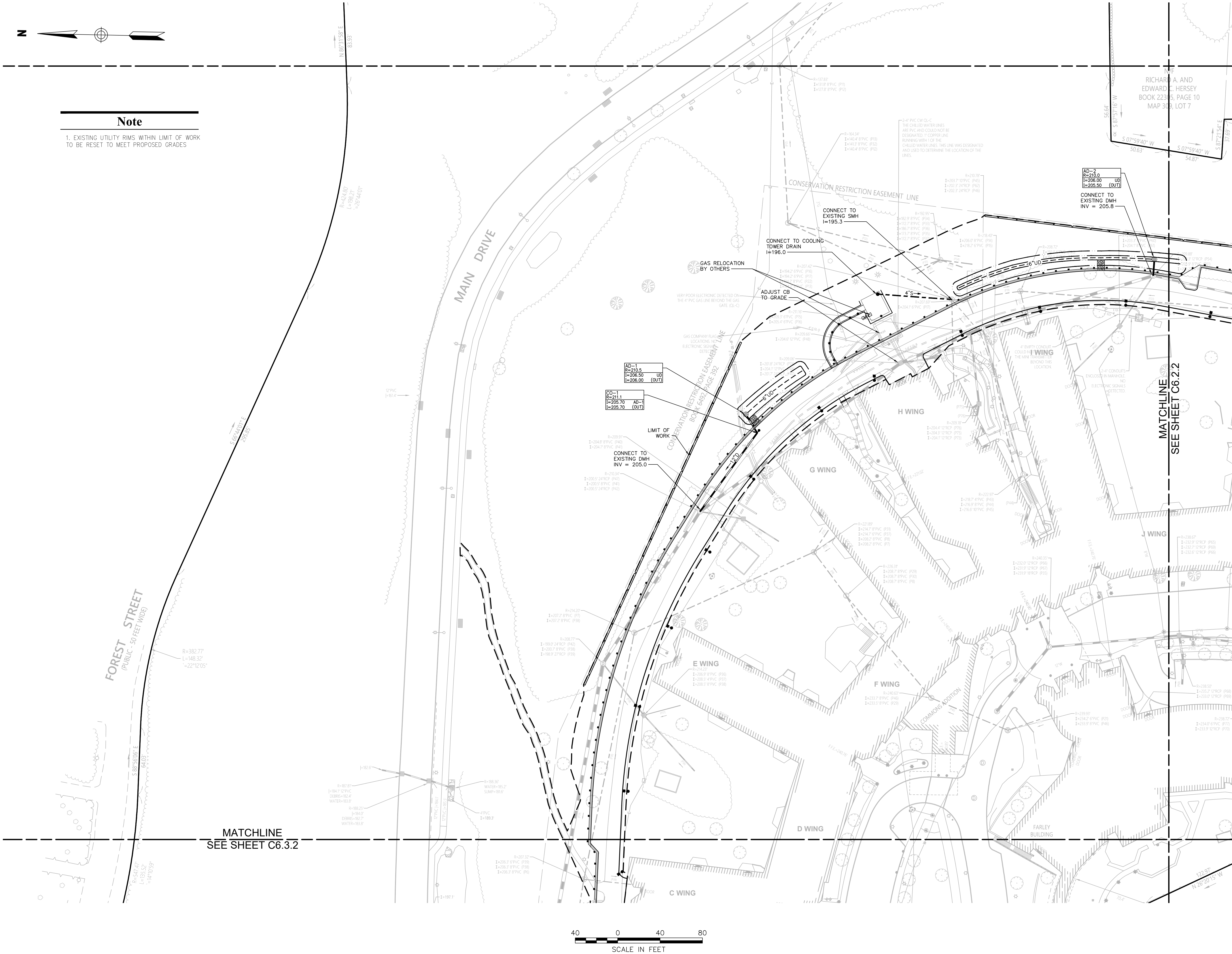
North Hill
Life Care Facility
865 Central Avenue
Needham, MA 02492

Permitting
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Bayview Road
Grading & Drainage Plan

#1 **C5.3.2**





Note

1. EXISTING UTILITY RIMS WITHIN LIMIT OF WORK TO BE RESET TO MEET PROPOSED GRADES



Civil:

101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770



877.736.4371

Bayview Road Improvements Project Team:

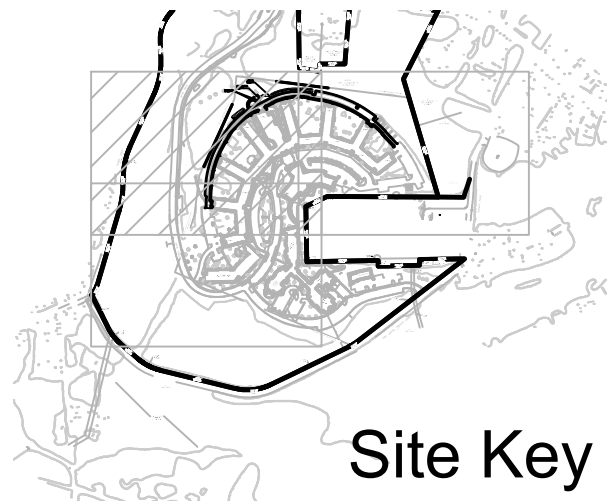
Landscape Architect Hammer + Walsh Design Inc	617.439.0125
Electrical Bard, Rao & Athanas Consulting, Inc.	617.254.0016

New 45 IL Residences Project Team:

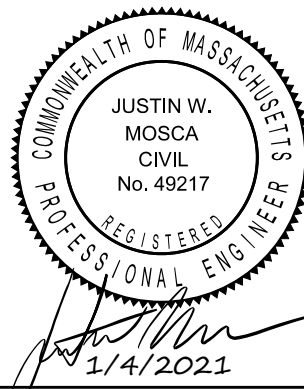
Architect DiMella Shaffer	617.426.5004
Structural L.A. Fuess Partners, Inc.	617.948.5700
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Site Key



Revisions:			
Scale: 1" = 40'	Date: January 4, 2021		
Drawn By:	Checked By:	Reviewed By:	

North Hill
Life Care Facility

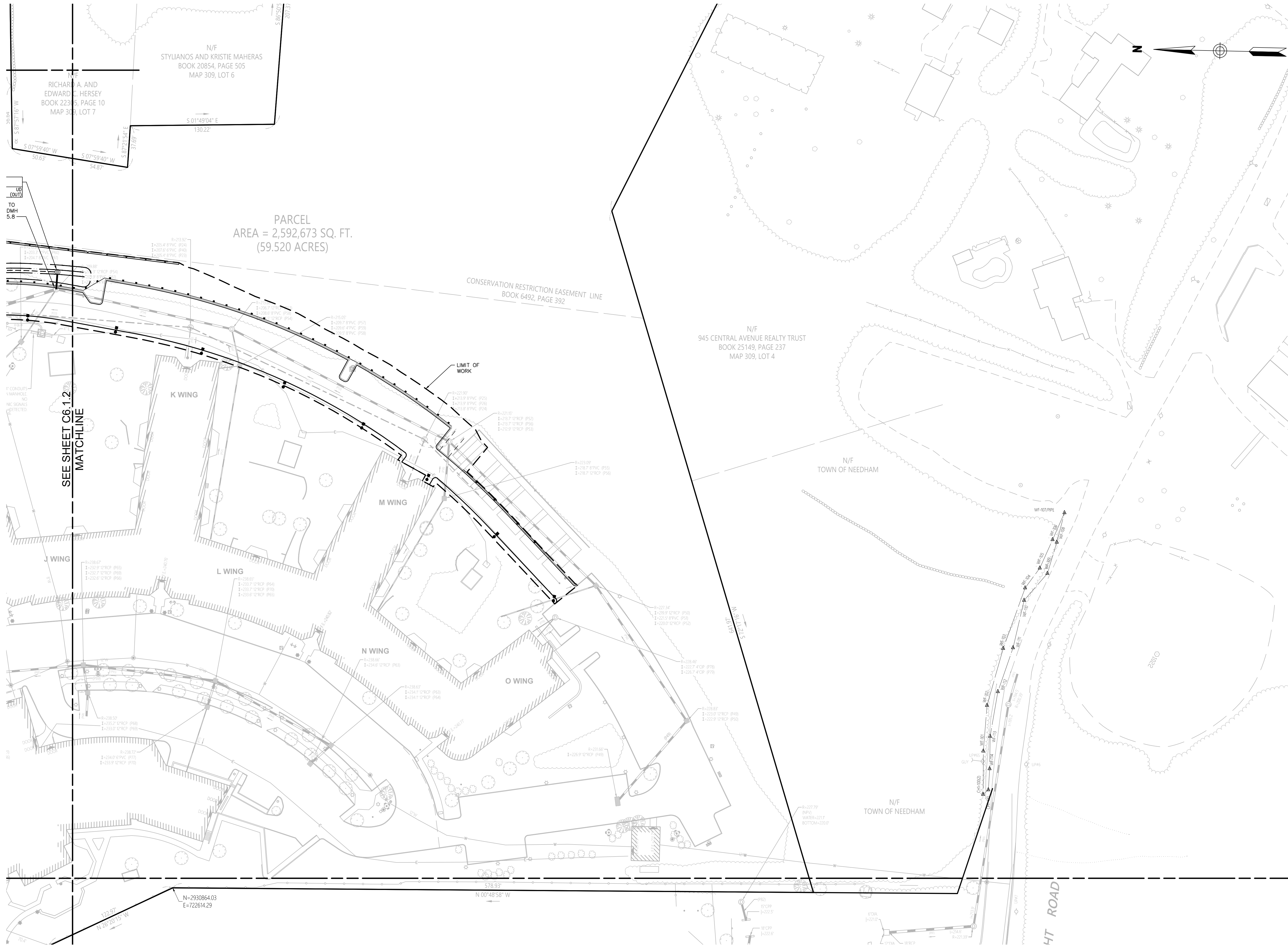
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Bayview Road
Utilities Plan

#1

C6.1.2



Civil:

vhb

101 Walnut Street
PO Box 9151
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Bayview Road Improvements Project Team:

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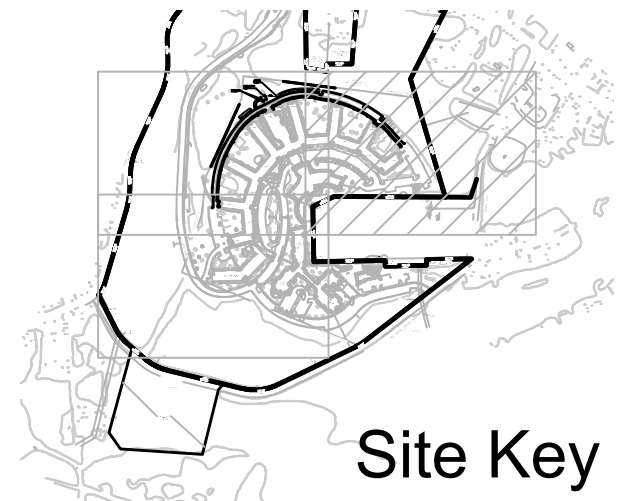
Mechanical/Plumbing/Fire
R.W. Sullivan Engineering 617.523.8227

Electrical
VAD, Inc. 781.255.9754

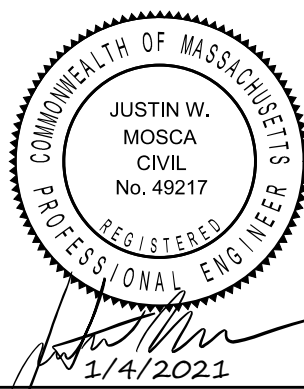
Landscape Architect
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Food Service and Laundry
Crabtree McGrath Associates 978.352.8500



Site Key



Revisions:

Scale: 1" = 40'

Date: January 4, 2021

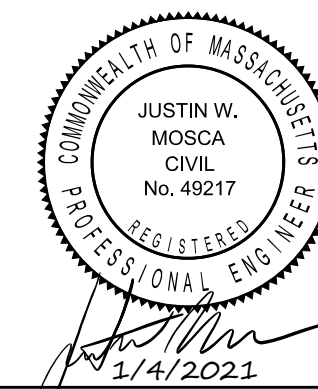
Drawn By: **Checked By:** **Reviewed By:**

North Hill
Life Care Facility
865 Central Avenue
Needham, MA 02492

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Bayview Road
Utilities Plan

C6.2.2

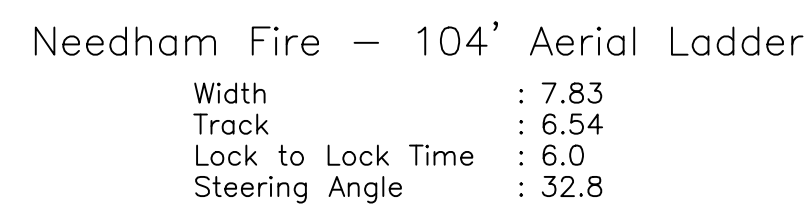


**North Hill
Life Care Facility**
865 Central Avenue
Needham, MA 02492

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Bayview Road
Utilities Plan

#1 C6.3.2

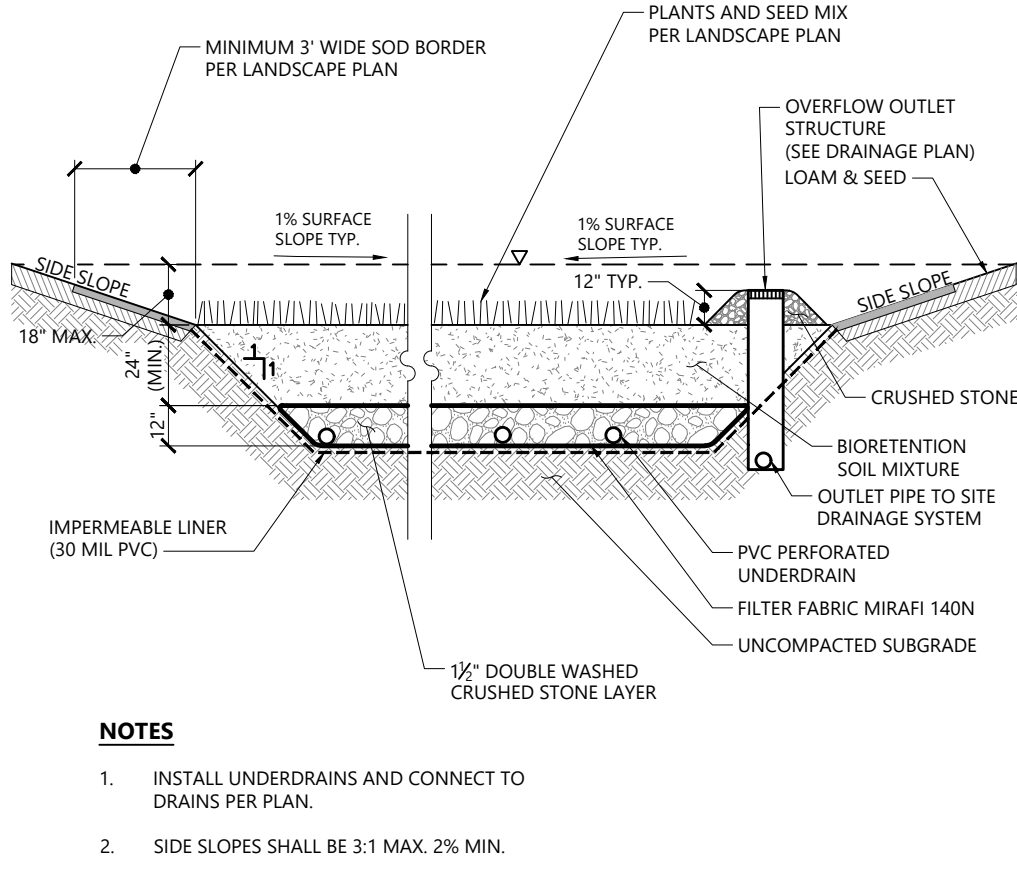


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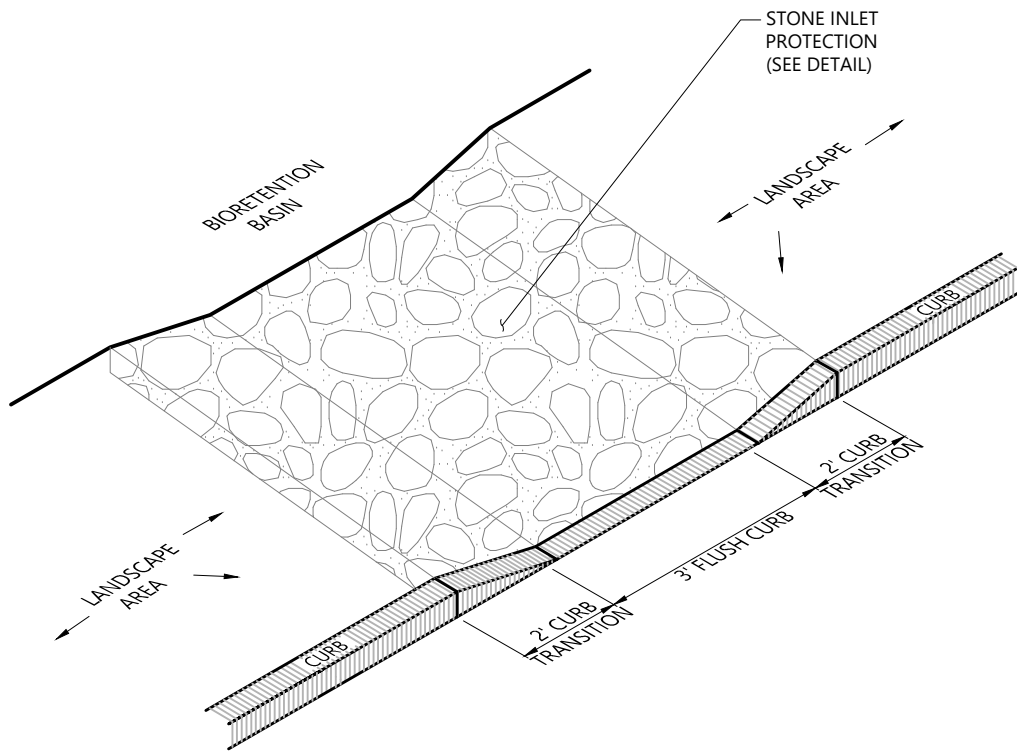
Permitting
Not Issued for Construction

Emergency Vehicle
Access Plan

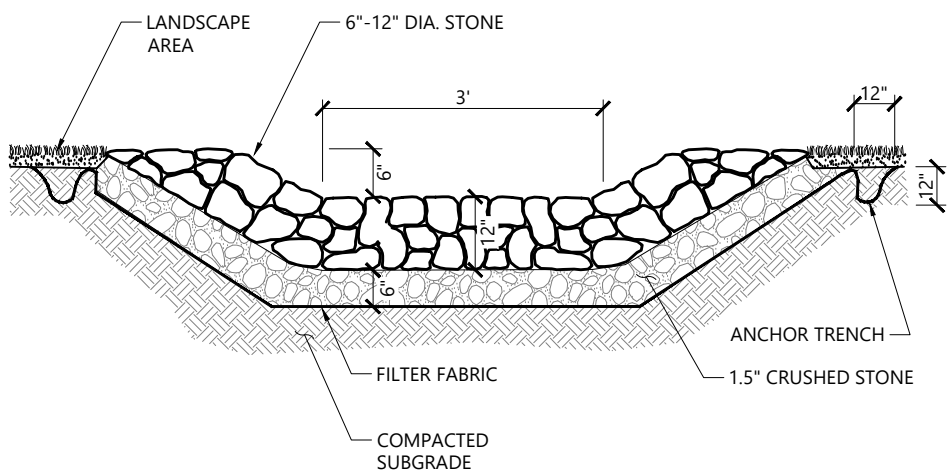
C7



Bioretention Basin 3/20
N.T.S. Source: VHB REV LD_199



Stormwater Curb Inlet 1/16
N.T.S. Source: VHB REV LD_512



Stone Inlet Protection 1/16
N.T.S. Source: VHB REV LD_170

Civil:



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North Hill

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Bayview Road Improvements Project Team:		
Landscape Architect		
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Electrical		
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New 45 IL Residences Project Team:		
Architect		
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Structural		
L.A. Fuess Partners, Inc.	617.948.5700	
MEP/Code		
R.W. Sullivan Engineering	617.523.8227	
Landscape Architect		
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Interiors		
Wellesley Design Consultants, Inc.	978.965.8185	

Commons / SNF / EIL / Maint. Bldg. Project Team:		
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Structural		
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Mechanical/Plumbing/Fire		
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Interiors		
Wellesley Design Consultants, Inc.	978.965.8185	
Food Service and Laundry		
Crabtree McGrath Associates	978.352.8500	

Revisions:

Scale: NTS

Date: January 4, 2021

Drawn By:

Checked By:

Reviewed By:

COMMONWEALTH OF MASSACHUSETTS

JUSTIN W. MOSCA

CIVIL

No. 49217

REGISTERED PROFESSIONAL ENGINEER



1/4/2021

North Hill

Life Care Facility

865 Central Avenue
Needham, MA 02492

Permitting

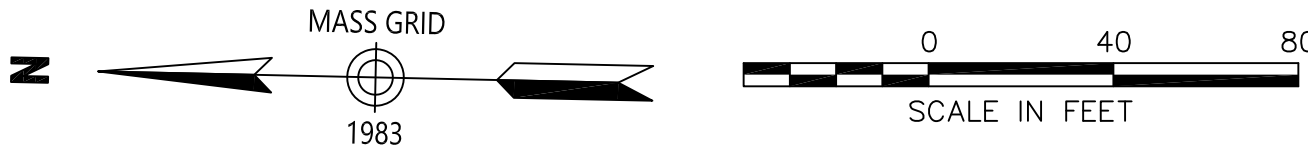
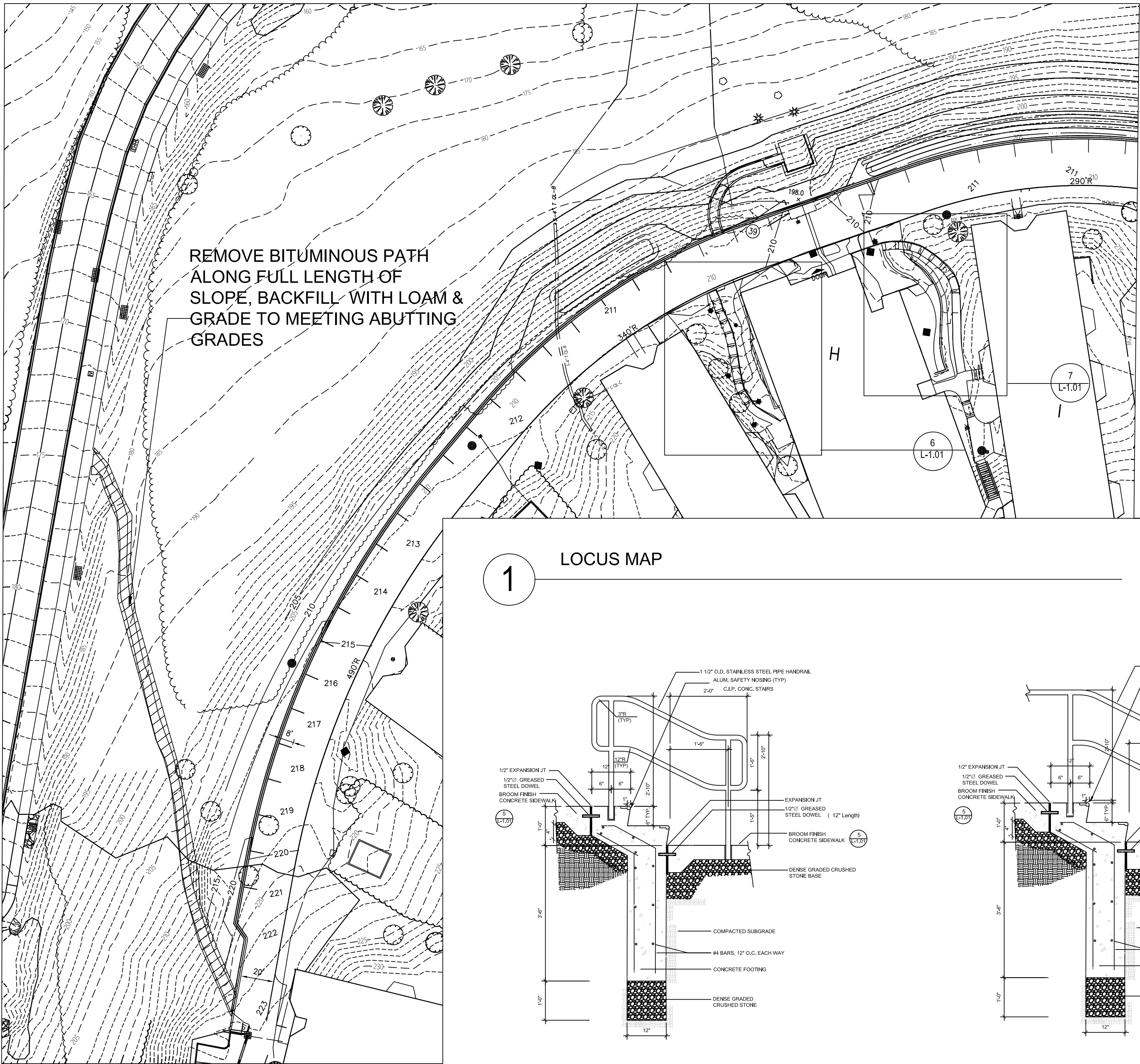
Not Issued for Construction

Bayview Road

Site Details

#1

C8.5



GENERAL NOTES

Concrete Paving Notes:

- Concrete shall be 4,000 psi compressive strength, 5-7% air entrained.
- Extend the depth of the concrete slab to accommodate handrail post footings as detailed.
- Expansion joints shall be spaced a maximum of 25' O.C. and shall be radial to the curves of the walk.
- Install steel dowels at all expansion joints to prevent differential settling between pours. Provide 3 dowels per expansion joint.
- Tool joints shall be equidistantly spaced between tool joints, between 5' and 6' O.C., typ.
- Finish shall be a medium broom finish swept perpendicular to the direction of the walkway.

Handrail notes:

- Handrails shall be Grade 304 stainless steel pipe, 1 1/2" O.D., as detailed.
- For both existing and new concrete walkways, core holes in the concrete as detailed.
- Place handrails in center of coring and support in a plumb position.
- Fill voids with exterior grade non-shrink grout such as Super Por-Rok.
- Maintain plumb support until grout has cured.
- Remove excess grout from the base of each post.

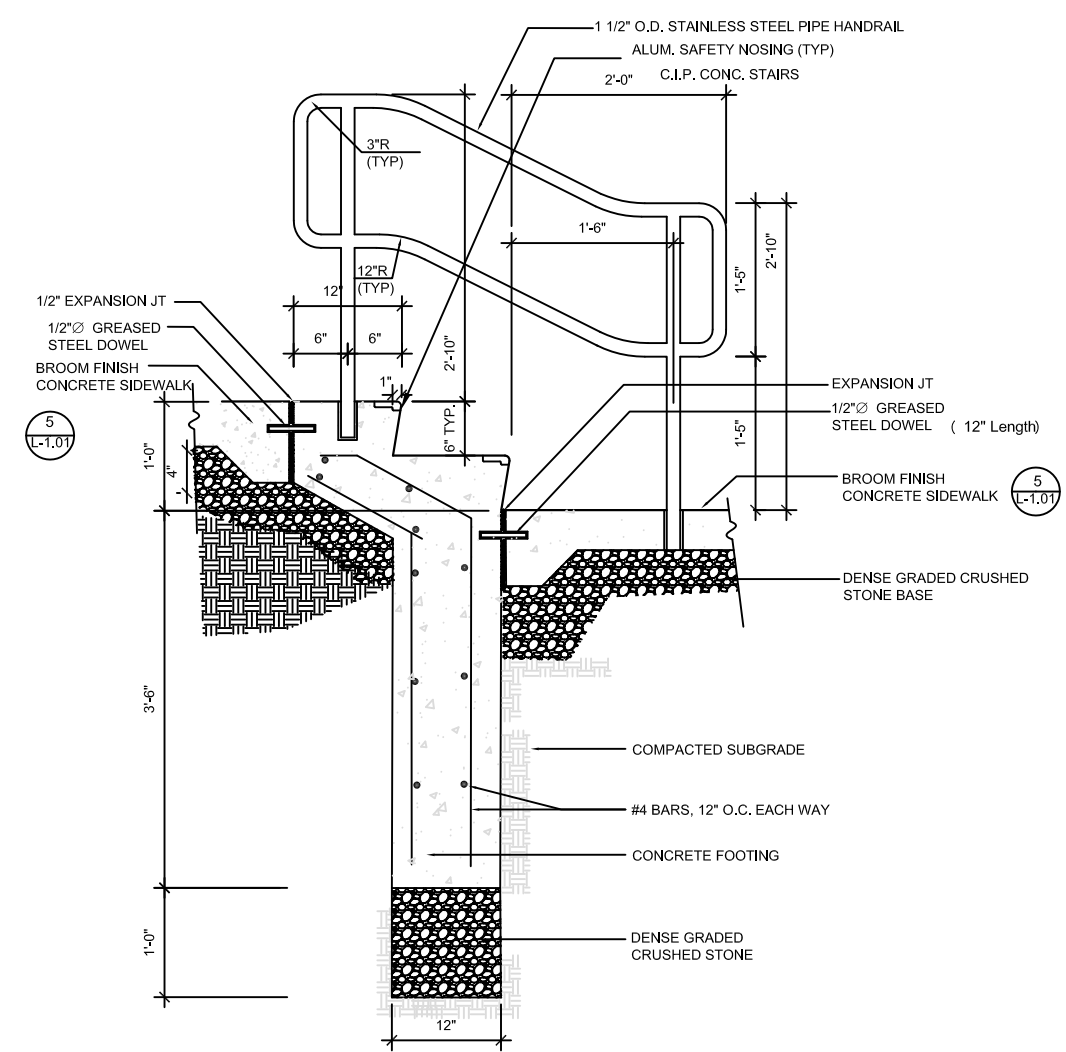
Sodding notes:

- Prior to topsoiling, the existing finish grade shall be cultivated to a depth of 6" to 8"
- Topsoil for sod shall have a pH of between 5.8 and 7.0 and shall contain not less than 4% nor more than 20% organic matter. Topsoil shall be provided to a depth of 6".
- Sod shall be provided by a recognized supplier/distributor and shall be machine cut at a uniform thickness of 1 1/2" (1 1/4" - 1 3/4") at the time of cutting.
- Immediately before sod is installed, the ground shall be scarified, harrowed, raked and broomed until the surface is smooth, friable, and of uniformly fine texture.
- Soil moistening: After all grading has been completed, the soil shall be irrigated 12-24 hours prior to laying the sod. Sod should not be laid on soil that is dry and powdery.
- Starter strip: The first row of sod shall be laid in a straight line, with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to ensure that the sod is not stretched or overlapped and that all joints are butted tightly to prevent voids that would cause drying of the roots.

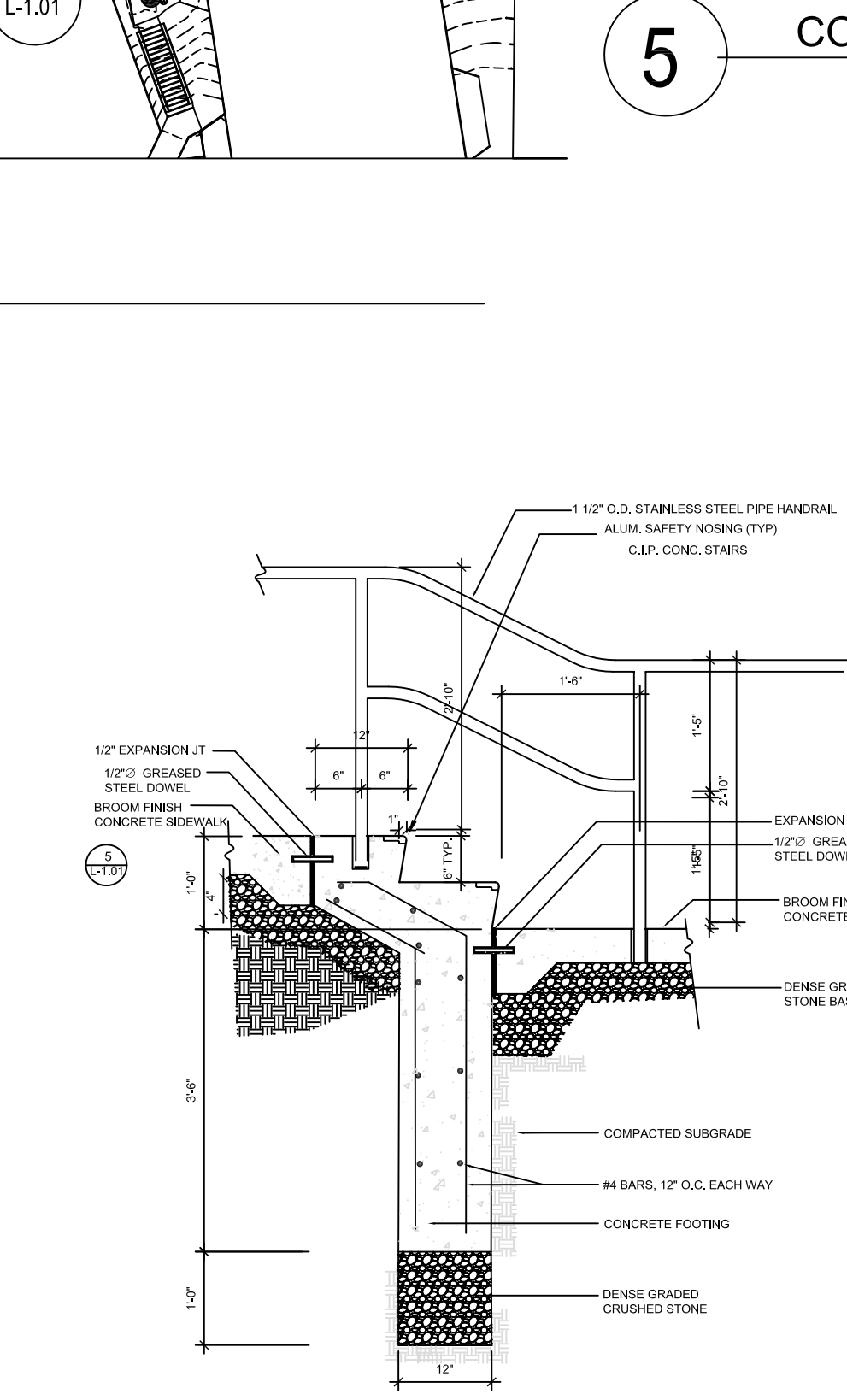
Planting notes:

- In the event of a discrepancy between the planting plan and the plant list, the planting plan shall take precedence.
- In the event of a discrepancy on the planting plan between the number of circles representing plants and the number of plants identified in a plant call-out, the number of circles on the plan shall take precedence.
- Substitutions: In the event the specified species cannot be found prior to the required planting schedule, substitutions shall be allowed, provided they are reviewed and approved by the Landscape Architect prior to purchase, and can be provided in the specified size (one gallon) and quantities.

1 LOCUS MAP

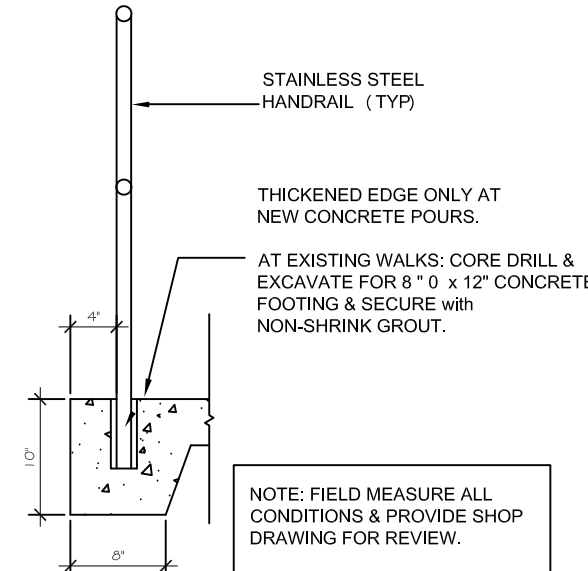


2 STAND ALONE HANDRAIL

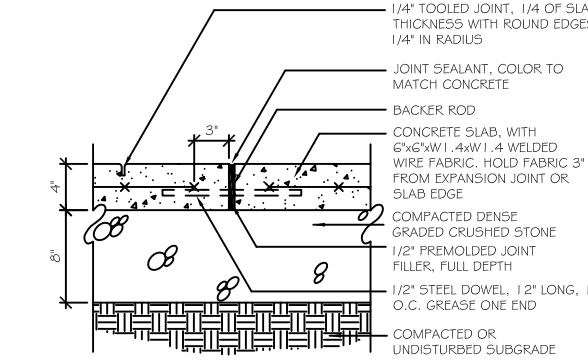


3 CONTINUOUS HANDRAIL

4 POST OFFSET AT CONCRETE EDGE

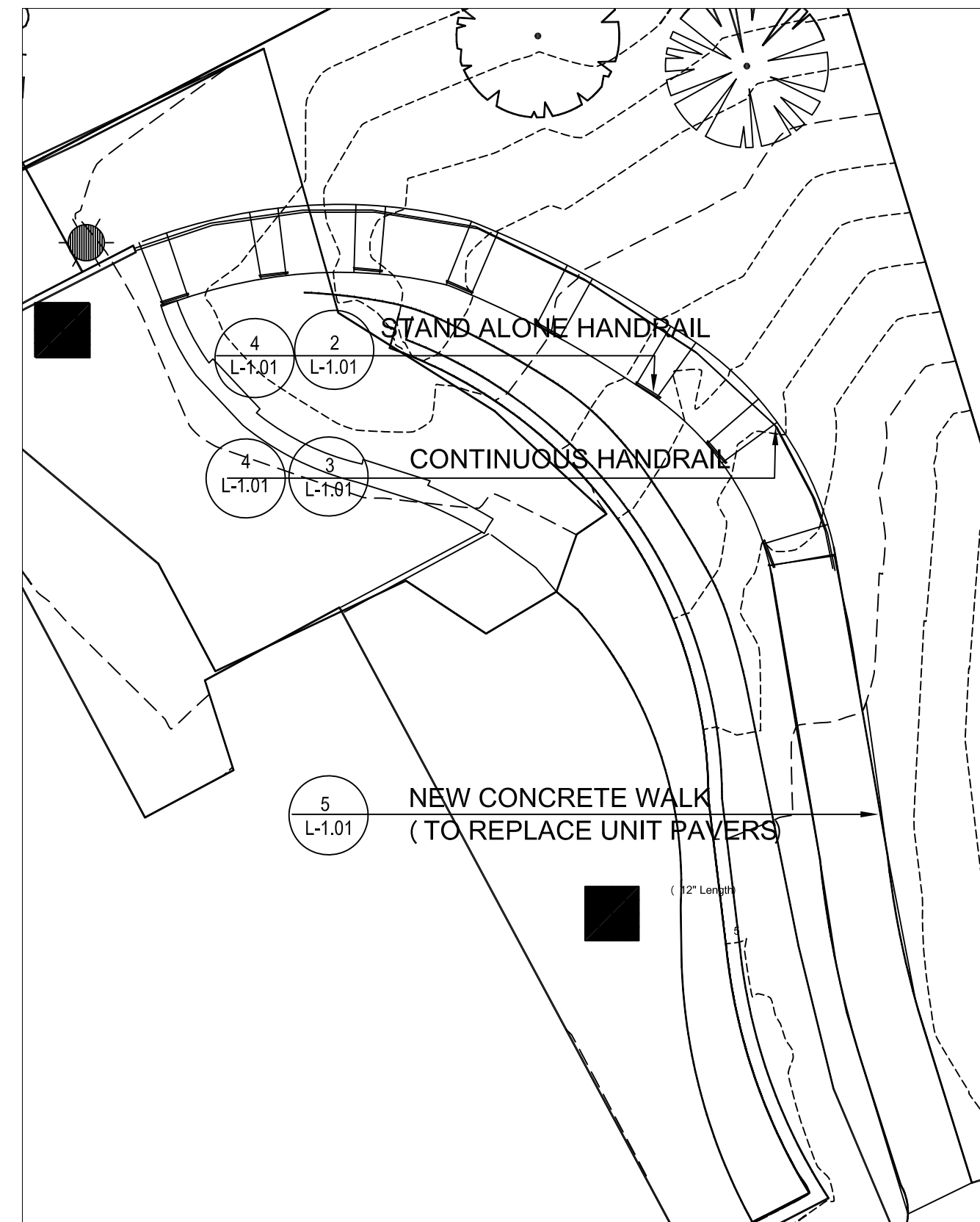
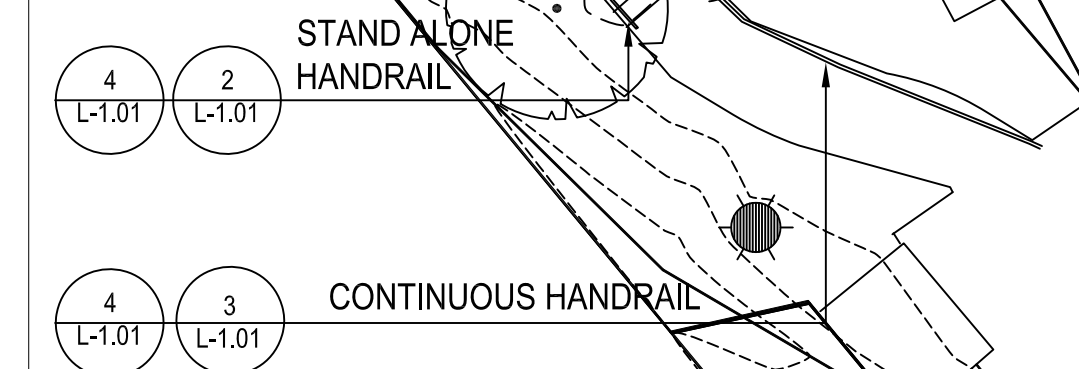


5 CONCRETE WALK



NOTES:
1. CONTROL JOINTS EVERY 25' UNLESS OTHERWISE SHOWN ON PLAN.
2. EXPANSION JOINTS EVERY 30' UNLESS OTHERWISE SHOWN ON PLAN.
3. WHERE NEW CONCRETE MEETS EXISTING CONCRETE, CORE DRILL EXISTING CONCRETE TO RECEIVE STEEL DOWEL.

6 EXISTING WALKWAY NORTH OF BLDG "H"

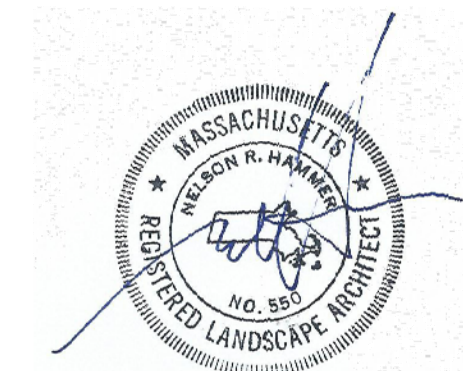


7 REBUILT WALKWAY SOUTH OF BLDG "H"

Civil: **vhb**
101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770

North Hill 877.736.4371

Bayview Road Improvements Project Team:
Electrical
Bard, Rao & Athanas Consulting, Inc. 617.254.0016
Landscape Architect
Hammer + Walsh
Design Inc.
24 Farnsworth Street, 4th Floor
Boston, MA 02210
(617) 439-0125
www.hammerwalsh.com



Revisions:
Scale: Date: **January 4, 2021**
Drawn By: Checked By: Reviewed By:

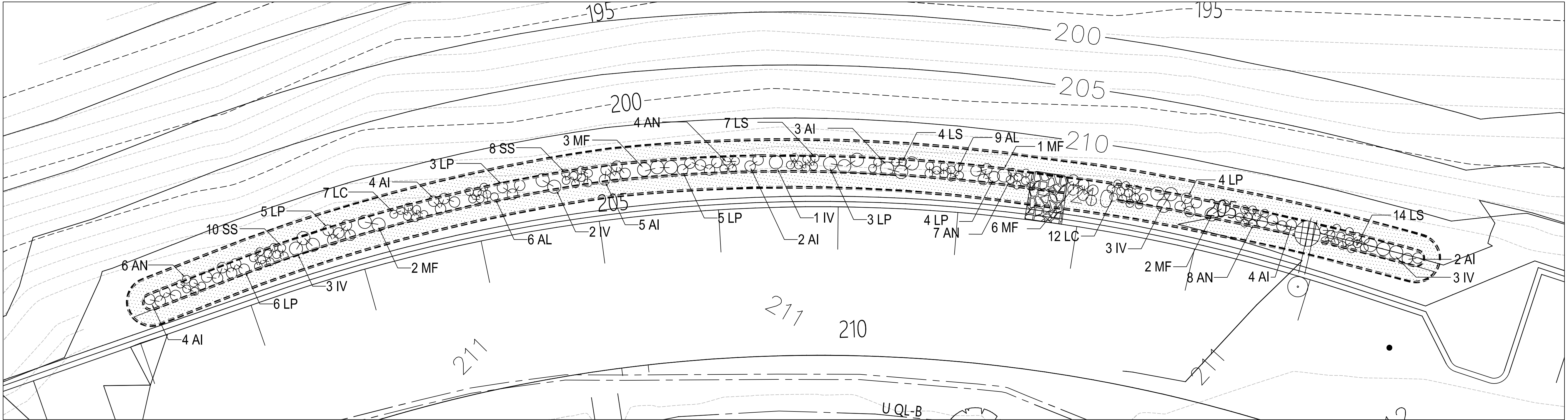
North Hill
Life Care Facility
865 Central Avenue
Needham, MA 02492

Permitting
Not Issued For Construction

Bayview Road
Stairway & Path Improvements

#1
L 3.7

D:\2 SHARED DRIVE (TS5200DS64-2)\ACTIVE PROJECTS\NORTH HILL- BAY VIEW ROAD\DRAWINGS\CURRENT\1 3.8 12-31-20.dwg

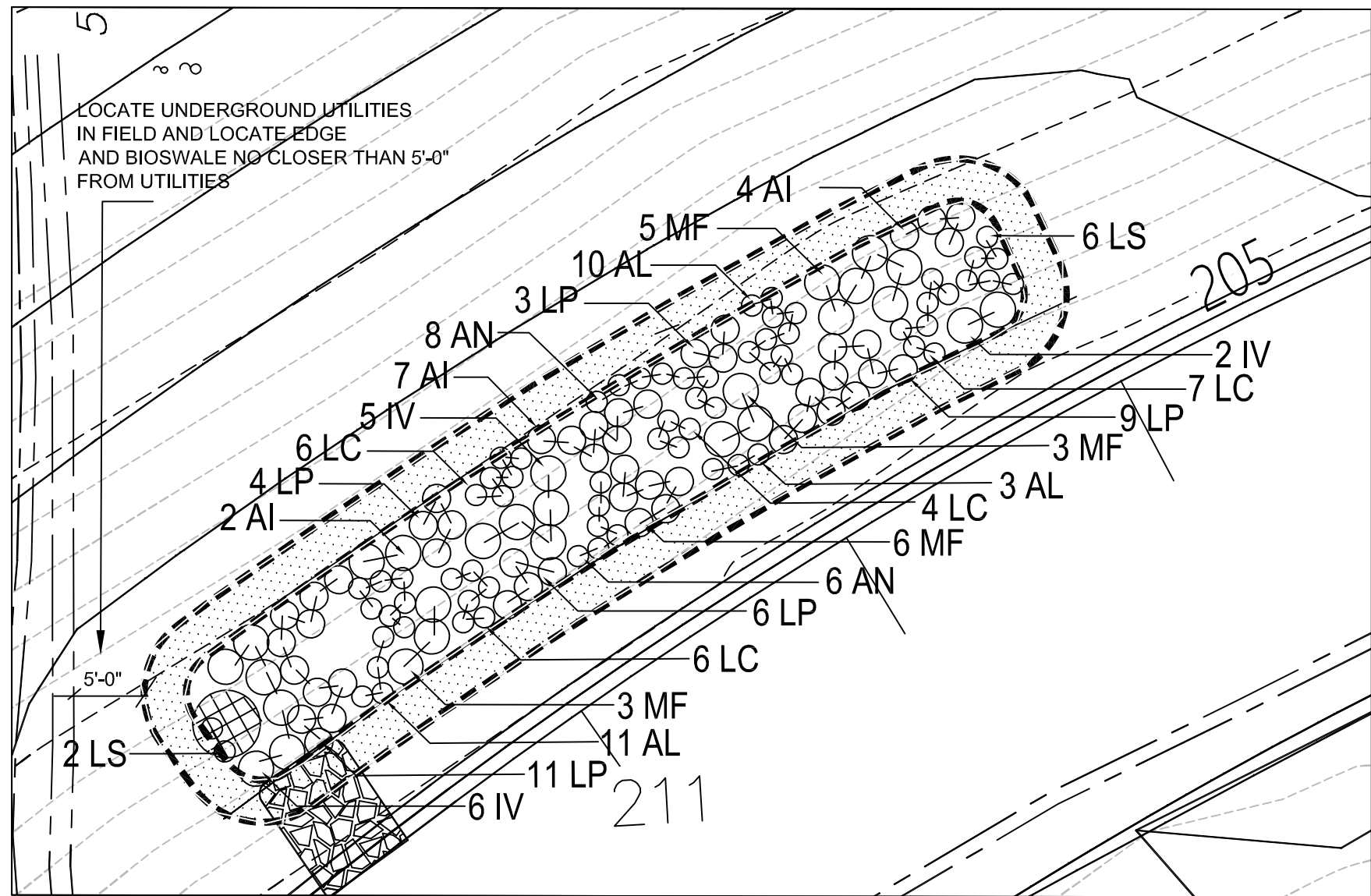


1 SOUTH BIOSWALE

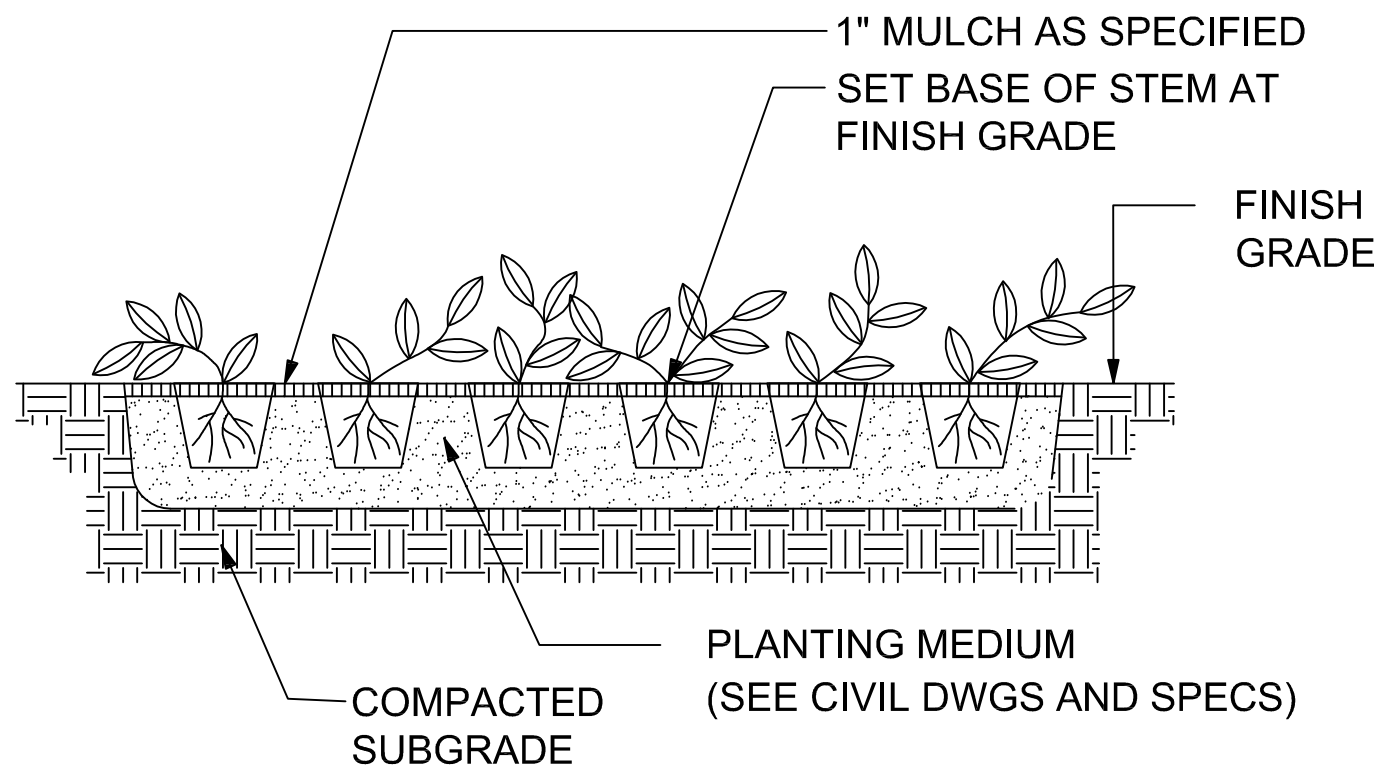
NORTH HILL RETIREMENT COMMUNITY
BAY VIEW ROAD IMPROVEMENTS

BIOSWALE PLANT LIST

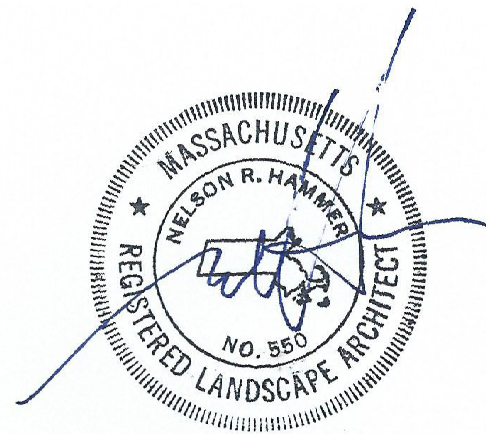
QUANTITIES			KEY	BOTANICAL NAME	COMMON NAME	MATURE		
NORTH	SOUTH	TOTAL				HEIGHT	SPACING	SIZE
13	20	33	AI	Asclepias incarnata	Swamp Milkweed	36"-48"	24"	4" PLUGS
24	19	43	AL	Aster laevis	Bluebird	36"-48"	18"	4" PLUGS
14	25	39	AN	Aster novae-angliae	New England Aster	up to 48"	18"	4" PLUGS
13	26	39	IV	Iris versicolor	Blue Flag Iris	24"-36"	30"	4" PLUGS
28	58	86	LP	Liatris spicata	Blazing Star	up to 24"	24"	4" PLUGS
23	42	65	LC	Lobelia cardinalis	Cardinal Flower	12"-72"	18"	4" PLUGS
6	29	35	LS	Lobelia siphilitica	Great Blue Lobelia	24"-36"	18"	4" PLUGS
17	31	48	MF	Monarda fistulosa	Wild Bergamot	48"-50"	30"	4" PLUGS
	18	18	SS	Schizyachyrium scoparium	Little Bluestem	24"-48"	18"	4" PLUGS



2 NORTH BIOSWALE



3 PLANTING DETAIL



Revisions:
Scale: Date: **January 4, 2021**
Drawn By: Checked By: Reviewed By:

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865 Central Avenue
Needham, MA 02492

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Bayview Road
Bioretention Basin Planting Plans

#1
L 3.8

8/19/2020 2:07:42 PM

K:\Jobs\3029900.D5\ELEC\05-Lighting Plan.dwg

8/19/2020 2:07:42 PM



Calculation Summary	
Label	Units
Red	2 Fc
Green	1 Fc
Blue	0.5 Fc
Light Blue	0.1 Fc

Calculation Summary						
Label	Units	Avg	Max	Min	Avg/Min	Max/Min
Path	Fc	0.58	1	0.3	1.93	3.33
Street	Fc	1.08	1.9	0.2	5.40	9.50
Equipment Bay	Fc	5.87	10.5	2.2	2.67	4.77

Civil:

vhb

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North Hill

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Bayview Road Improvements Project Team:

Landscape Architect
Hammer + Walsh Design Inc

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Electrical
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617.254.0016

Revisions:

Scale:	Date:	
	January 04, 2021	
Drawn By:	Checked By:	Reviewed By:

North Hill
Life Care Facility
865 Central Avenue
Needham, MA 02492

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Bayview Road
Lighting Photometric Plan

#1
PH1.02

LIGHTING FIXTURE SCHEDULE							
TYPE	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	LAMP DATA			NOTES
				NB	WATTS	TYPE	
P1	POLE	BEACON	URB-CAP-21-24L-55-4K7-UNV-2-PCU	1	27	LED	UNV
S1	STEP LIGHT	KIM LIGHTING	EL807/3L3KUV	1	3.6	LED	UNV
W1	WALLPACK	BEACON	TRV-3-241-27-4K7-4V-UNV-MDB-PCU-BLT	1	27	LED	UNV
B1	BOLLARD	BEACON	BRP42-AC-24N8-55-3K-UNV-INDS-AB-CES-BLT	1	55	LED	UNV REPLACE EXISTING WALKWAY BOLLARDS

ABBREVIATIONS (LIGHTING PLANS)

CU	COPPER
DCR	DEPARTMENT OF CONSERVATION AND RECREATION
FC	FOOTCANDLES
HH	HANDHOLE
LED	LIGHT EMITTING DIODE
LM	LUMEN
MH	MOUNTING HEIGHT
PB	PULLBOX
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
RMC	RIGID METAL CONDUIT
RMCPV	RIGID METAL CONDUIT, PVC COATED

LINE LEGENDS

UES	UNDERGROUND ELECTRICAL SERVICE FEEDER, ONE (1) 3" RIGID STEEL CONDUIT (120/240V, SINGLE PHASE)
	UNDERGROUND ELECTRICAL CONDUIT, ONE (1) 2" PVC SCH 80, UON, WIRING AS INDICATED.
	SURFACE MOUNTED ELECTRICAL CONDUIT, 3/4" PV COATED RIGID STEEL WITH 2#10 AWG, 1#10 AWG GROUND. CONDUCTORS SHALL BE TYPE XHHW-2 WITH XLP JACKET.
HH	LIGHTING HANDHOLE
	LED WALLPACK FIXTURE WITH FACTORY BACKBOX, BLACK.
	LED STEP LIGHT FIXTURE WITH FACTORY BACKBOX, BLACK.
	JUNCTION BOX, NEMA 3R GALVANIZED STEEL, WITH THREADED, SEALED HUBS.
	DISCONNECT SWITCH, NEMA 3R GALVANIZED STEEL, WITH THREADED, SEALED HUBS.
TC	TIME CLOCK WITH CONTACTORS

ABBREVIATIONS

ETR	EXISTING TO REMAIN
ETD	EXISTING TO BE DEMOLISHED
ETRL	EXISTING TO BE RELOCATED
ENL	EXISTING NEW LOCATION

Civil:



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Electrical
Bard, Rao & Athanas Consulting, Inc. 617.254.0016



GENERAL NOTES

1. REFER TO LEGEND SHEET E-000 FOR LEGEND, SYMBOLS, AND NOTES

KEY NOTES

- 1 PROVIDE EMPTY BACK BOX AND 1" CONDUIT FOR WANDERGUARD SYSTEM FURNISHED BY VENDOR AND PER MANUFACTURER'S DRAWINGS
- 2 FEED (2) EXTERIOR LIGHTING CIRCUITS BACK TO EXISTING PANEL LL VIA HANDHOLE
- 3 COORDINATE STEP LIGHT MOUNTING WITH APPROVED WALL MANUFACTURER

Revisions:

Scale: **Date:**
January 04, 2021
Drawn By: **Checked By:** **Reviewed By:**

North Hill
Life Care Facility

865 Central Avenue
Needham, MA 02492

Permitting
Not Issued for Construction

Bayview Road
Site Distribution Plan

#1

ES1.02



Memorandum

To: Roy A. Cramer
Frieze Cramer Rosen & Huber, LLP
60 Walnut Street
Wellesley, MA 02481

Date: January 4, 2021

Project #: 11369.04

From: Dan Keches, P.E.
Justin Mosca, P.E.

Re: North Hill Life Care Facility -
Bayview Road Stormwater Revisions

Project Description

Vanasse Hangen Brustlin, Inc. (VHB) has prepared this memorandum as a supplement to the June 2011 Stormwater Report for the master plan and associated improvements at the North Hill campus (Project) at 865 Central Avenue, Needham, MA (Site), as amended through the Project's Certificate of Compliance issued September 19, 2017, which documents the existing and proposed drainage conditions associated with the redevelopment.

The Project has been under construction since 2011. During this time, the constructed phases of the Project have remained consistent with the June 2011 overall program and design intent. The changes described herein consist of a new phase of work which includes improvement of Bayview Road, an existing fire access lane around the rear (north and east sides) of the existing Independent Living Building (IL Building). Work proposed under this new phase of the Project includes reconstructing the fire lane to a 20-foot width around the entire IL Building for improved emergency vehicle access, adding 75 parking spaces on the outside of the fire lane, and constructing stormwater management features, ancillary area lighting and landscape improvements. An existing cooling tower will also be replaced, including associated utility routing. This memorandum is intended to give an accounting of those changes from a stormwater perspective and to demonstrate that they do not negatively impact the Project's stormwater management system. The associated improvements are detailed on the project plans dated January 4, 2021.

Existing Conditions

Through the various phases of site development and associated design changes during that time, the Stormwater Management Report has undergone several updates since 2011. As such, the term "existing conditions" can vary in meaning depending on the point in time being referenced. For the purposes of this memorandum, the following terminology will be used to clearly identify design reference points:

- "Pre-Project Existing Condition(s)": Refers to the onsite conditions existing at the time of the original Stormwater Management Report dated June 2011. This is the primary point of comparison for peak rate and volumes to off-site areas.
- "Previously Approved Condition(s)": Refers to the onsite conditions as they exist at the time of this filing, through all phases of installed improvements to date. Comparison against this point in time is a relative reference to what was previously approved under the Project's Special Permit and environmental filings.
- "Currently Proposed Condition(s)": Refers to the future site conditions following installation of the improvements proposed under this revision to the Special Permit plans.

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Memorandum

Under both Pre-Project Existing Conditions and Previously Approved Conditions, the area of proposed work consists of a 12-foot wide paved drive and gravel shoulder extending from "C" to "O" Wings of the existing IL Building. Stormwater runoff from the driveway and shoulder flows overland down primarily vegetated slopes to the North and East towards the Main Entry Drive and Central Avenue. Any runoff that makes it beyond the vegetated slope is ultimately collected in the closed-drainage networks along those roadways. Runoff from this area is not collected in the Site's closed-drainage system and is not tributary to the East Militia Height Drive Basin (DP-1). As this portion of the Site is located beyond the limits of work completed under previous phases of site improvements, it was not included in the original stormwater model or analysis. Accordingly, it has now been added to the stormwater model as Subcatchment 30. A new Design Point 3 (DP-3) has also been added for the offsite closed-drainage networks in Central Avenue to which this area is eventually tributary. Refer to the enclosed, Figure 2 for updated drainage areas for the Pre-Project Existing Conditions.

Proposed Conditions

In the Currently Proposed Condition, the majority of the existing access drive in the area of work will be replaced with a 20-foot wide paved driveway conforming to access requirements for fire lanes, and paved parallel parking will be added to the outer perimeter. For the remaining portion of the drive at the east end, the driveway width will be increased to 24 feet to accommodate "head in" parking where adjacent topography allows. Curbing will be provided along the outer edge of the new pavement to route stormwater from the reconstructed drive into the onsite stormwater management system and prevent runoff down the adjacent slopes. Stormwater will flow overland to one of two proposed lined, filtering bioretention basins located on the outside of the new driveway near "G" and "I" Wings of the IL Building. Outlets from these basins will connect back to the existing closed-drainage system within Bayview Road, ultimately routing this stormwater to the existing stormwater infiltration/detention basin at East Militia Heights Drive and DP-1. Refer to the enclosed, updated Figure 3 for Currently Proposed Conditions drainage areas.

Stormwater Management

Hydrologic Analysis

As proposed, the Bayview Road improvements divert stormwater from the newly added Design Point 3 under the Pre-Project Existing Conditions to Design Point 1 under the Currently Proposed Conditions. As such, they represent an increase in tributary area and stormwater runoff routed to the existing East Militia basin and Design Point 1 compared to the Previously Approved Condition; however, the improvements will result in no net increase in the rate of stormwater runoff as compared to the Pre-Project Existing Conditions outlined in the original Stormwater Report. The proposed changes will result in a net increase in impervious area over the Previously Approved Condition of approximately 24,500 square feet (sf), which represents approximately 1.6% of the tributary area to DP-1.

The following tables present a summary of the stormwater characteristics and analysis of the Pre-Project Existing Conditions, the Previously Approved Conditions, and the Currently Proposed Conditions for comparison. Refer to Attachment 2 for full hydrologic calculations. These tables are a modification to those originally presented in the



Memorandum

Stormwater Report and subsequent amendments referenced above and, as such, only include information applicable to the proposed modification that has been added or revised. As a conservative approach, the volumes of the newly proposed bioretention basins have not been included in the hydrologic model as detention, since the proposed bioretention basins have been sized for water quality (refer to "Water Quality" section herein) and are anticipated to have negligible impacts on runoff rates and volumes, which are managed in the downstream East Militia Basin.

As shown in the Table 3 updated values, while the proposed Bayview Road improvements result in a slight increase from some of the Previously Approved Conditions peak runoff rates, they maintain peak runoff at or below the Pre-Project Existing Conditions rates. Please refer to the Project's Stormwater Report for the hydrologic analysis of areas unaffected by the currently proposed modifications.

Table 2 Updated Values
Pre-Project Existing Conditions Hydrologic Data (EX-30)

Drainage Area	Discharge Location	Design Point	Area (acres)	Curve Number	Time of Concentration (min)
EX-30 (added)	Central Ave. Drainage	3	3.8	78	5.0

Table 3 Updated Values
Proposed Conditions Hydrologic Data (PR-14 and PR-30)

Drainage Area	Discharge Location	Design Point	Area (acres)	Curve Number	Time of Concentration (min)
PR-14 (updated)	E. Militia Basin	1	1.1	96	6.5
PR-30 (added)	Central Ave Drainage	3	2.7	76	5.0

Table 4 Updated Values
Peak Discharge Rates (cubic feet per second) (DP-1 and DP-3)

Design Point	2-year	10-year	25-year	100-year
<u>Design Point 1: East Militia Basin</u>				
Pre-Project Existing Conditions	1.9	3.1	6.1	8.4
Previously Approved Conditions	1.8	2.2	5.3	8.4
Currently Proposed Conditions	1.8	2.6	6.1	8.2
<u>Design Point 3: Central Ave. Drainage</u>				
Pre-Project Existing Conditions	5.7	11.2	14.4	19.1
Previously Approved Conditions	-	-	-	-
Currently Proposed Conditions	3.6	7.4	9.6	12.9



Memorandum

Infiltration

The newly proposed Bayview Road phase of the Project represents a net increase in impervious cover over the Previously Approved Condition. Test borings were performed in coordination with the Project's geotechnical engineer to determine soil conditions and feasibility for infiltration to meet both MassDEP's required recharge volume and the Town of Needham's Stormwater Bylaw. Those requirements are 0.25 inches over the impervious area (for hydraulic soil group C soils) and 1.0 inches over the impervious area, respectively.

Existing soils consist of glacial till material comprised of 30-40% silt and clay. According to the Geotechnical Engineer's findings, "The natural glacial till soil deposits at the site are typically dense to very dense and contain high percentages of silt and clay sized particles. As a result, these soils are considered poorly drained and typically have very slow hydraulic conductivity rates." These findings are consistent with soils exposed and observed elsewhere onsite, where stormwater facilities constructed in previous phases of the Project have been found to retain stormwater for extended periods and drawdown very slowly, if at all. Although gradation suggests HSG "B" soils, stormwater infiltration is not anticipated to be feasible in the area of proposed work for Bayview Road due to the highly dense existing soil conditions. Accordingly, infiltration measures are not proposed. Bioretention basins have been designed with impermeable liners and underdrains to collect treated stormwater and route it to the closed-drainage system, thereby protecting adjacent slopes from lateral breakout due to poor soil conditions underlying the basins. Refer to Attachment 3 for the results of the onsite subsurface soil investigation effort.

Water Quality

The proposed Bayview Road phase of the Project will improve the water quality of stormwater runoff within the work area. Under Pre-Project Existing Conditions and the Previously Approved Conditions, stormwater runoff from the paved driveway flows untreated to the north and east, down the adjacent slope, and is collected in the closed-drainage system along the Main Entry Driveway/Central Avenue. Under the proposed condition, vertical curbing will be provided along the outer edge of the expanded driveway/parking, allowing stormwater runoff to be collected and routed to one of two new filtering bioretention basins. These basins have been designed to provide improved water quality by removing Total Suspended Solids (TSS) and Total Phosphorus through organic media and filtration. Due to poor underlying soils and proximity to the adjacent slope, the basins will be provided with an impermeable liner and underdrain system. Treated stormwater will be collected in the underdrains and routed to the existing closed drainage system following treatment. The proposed bioretention basin soil profile, combined with a pretreatment inlet filter strip, provides 90% TSS removal in accordance with MassDEP methodology. The proposed basin volumes provide treatment of a volume exceeding the required half-inch of runoff over the tributary impervious area per MassDEP requirements for TSS. Refer to Attachment 4 for TSS removal calculations.

The project site is located within the watershed of the Charles River, which is regulated under Total Maximum Daily Loads (TMDLs) for Nutrients and Pathogens. Under the Town of Needham's MS4 requirements and associated local regulations, the Project is required to remove 55% of the annual phosphorous load from the current area of proposed work. The proposed bioretention basins have been sized to treat a volume equal to 0.62 inches over the proposed impervious area within the limit of work (See Attachment 5), which in turn provides 65% removal of Total Phosphorus



Memorandum

in accordance with the US EPA Stormwater Best Management Practices Analysis (Attachment 6). This removal meets the requirements of the EPA's TMDL for high-density residential land use, as well as the Town of Needham's stormwater bylaw and associated phosphorous removal target.

Regarding pathogens, the main source of degradation to nearby waterways are sanitary sewers (illicit connections, combined sewer overflows, and aging infrastructure) and stormwater runoff. There are no known illicit sanitary connections to North Hill's stormwater management system. Furthermore, North Hill has an existing animal waste policy in place to control waste from any pets on campus, which helps to reduce pathogens entering the storm system. Per US EPA guidance for mitigation measured to address pathogen pollution in surface waters, bioretention basins provide good mitigation of pathogens in stormwater. The proposed bioretention basins will provide pathogen removal within the tributary area of Bayview Road.

Summary

The currently proposed "Bayview Road" phase of the Project will provide stormwater improvements compared to both the Pre-Project Existing Condition and the Previously Approved Condition. Stormwater runoff from the paved area of the fire lane that previously flowed untreated toward Central Avenue will now be collected in an onsite stormwater management system designed to provide greater than the requisite water quality through the use of bioretention basins providing removal of suspended solids, phosphorus, and pathogens. While total impervious area is expected to increase over the Previously Approved Condition, post-construction peak runoff rates will continue to be managed in the East Militia Basin and will be maintained at or below the Pre-Project Existing Condition. Subsurface soil conditions have been studied in detail, and infiltration has been deemed not feasible due to dense glacial till soils. The proposed improvements have otherwise been designed to meet all applicable design criteria of both state and local stormwater regulations. As such, the Project will result in a net benefit to onsite stormwater management and water quality.



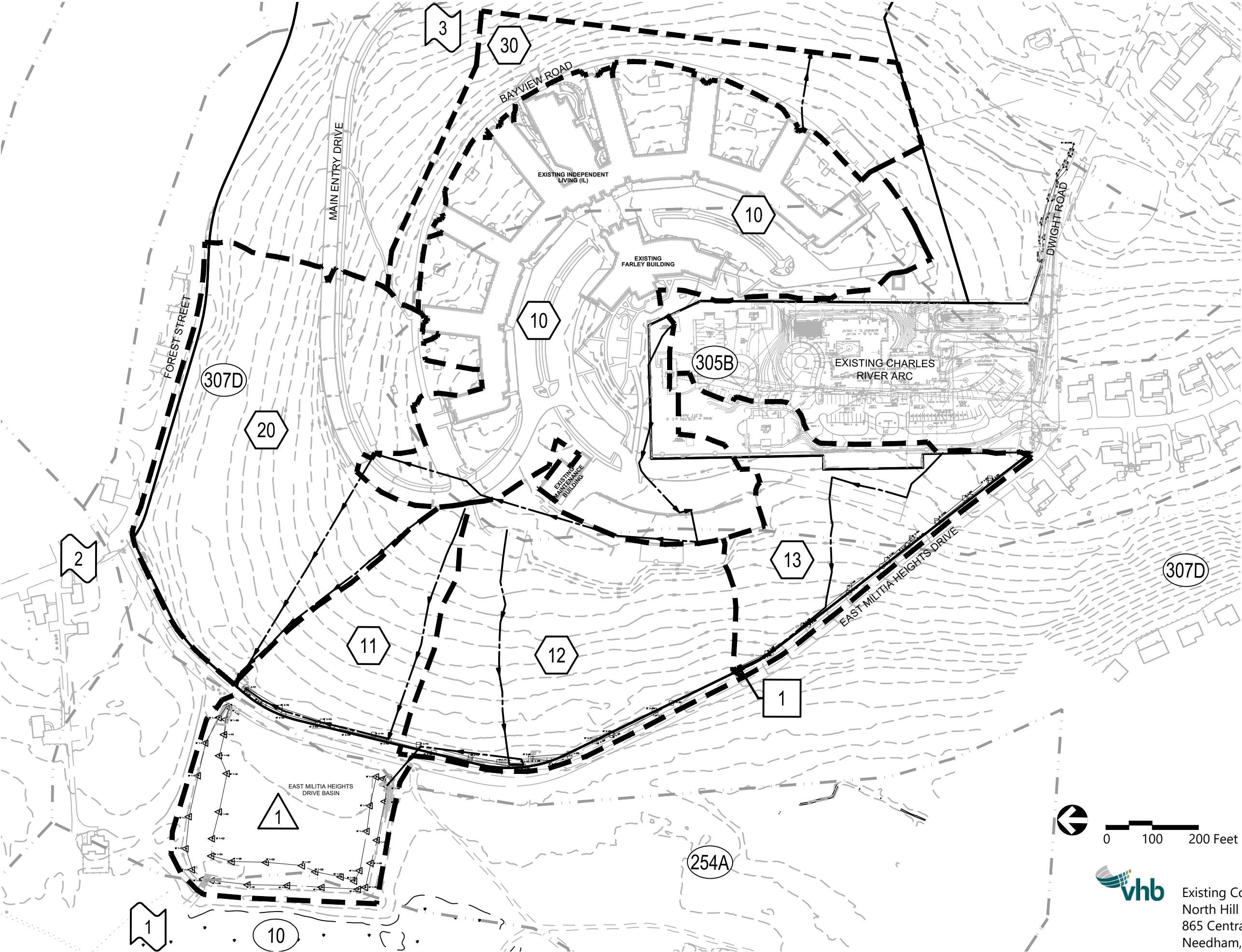
Memorandum

Attachments

1. Updated Stormwater Report Figures
 - a. Figure 2 – Existing Conditions Drainage Areas
 - b. Figure 3 – Proposed Conditions Drainage Areas
2. Updated Hydrologic Analyses
 - a. Existing Conditions Hydrologic Analysis
 - b. Proposed Conditions Hydrologic Analysis
3. Soil Boring Logs
4. TSS Removal Calculations
5. Water Quality Volume Calculations
6. US EPA BMP Performance Analysis – Bioretention



Attachment 1 – Updated Stormwater Report Figures



LEGEND

1

SUBCATCHMENT DRAINAGE AREA DESIGNATION

1

POND

1

DESIGN POINT

1

REACH

DRAINAGE AREA BOUNDARY

TIME OF CONCENTRATION FLOW LINE

SOIL TYPE BOUNDARY

2-101 2-102

WETLAND BOUNDARY

NRCS SOIL CLASSIFICATIONS (HSG)

307D

PAXTON FINE SANDY LOAM (HSG C)

305B

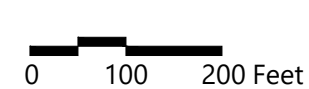
PAXTON FINE SANDY LOAM (HSG C)

254A

MERRIMAC FINE SANDY LOAM (HSG A)

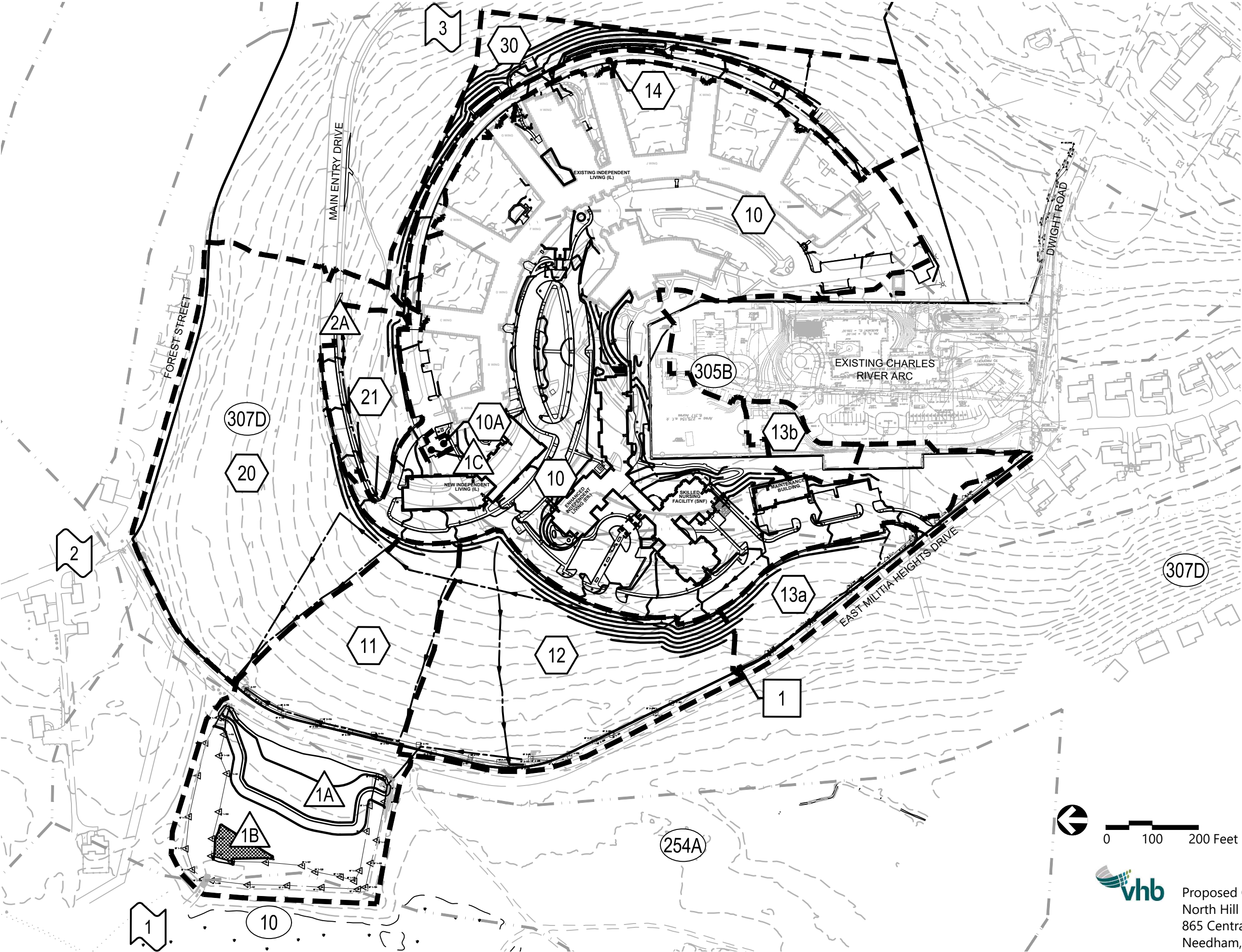
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SCARBORO AND BIRDSALL SOILS (HSG D)



Existing Conditions Drainage Areas
North Hill Life Care Facility
865 Central Avenue
Needham, Massachusetts

Figure 2
June 2011
Rev Dec 2020



LEGEND

1

SUBCATCHMENT DRAINAGE AREA DESIGNATION

1

POND

1

DESIGN POINT

1

REACH

DRAINAGE AREA BOUNDARY

TIME OF CONCENTRATION FLOW LINE

SOIL TYPE BOUNDARY

WETLAND BOUNDARY

NRCS SOIL CLASSIFICATIONS (HSG)

307D

PAXTON FINE SANDY LOAM (HSG C)

305B

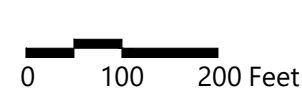
PAXTON FINE SANDY LOAM (HSG C)

254A

MERRIMAC FINE SANDY LOAM (HSG A)

10

SCARBORO AND BIRDSALL SOILS (HSG D)

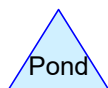
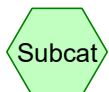
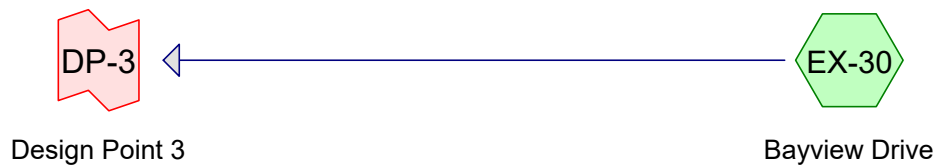
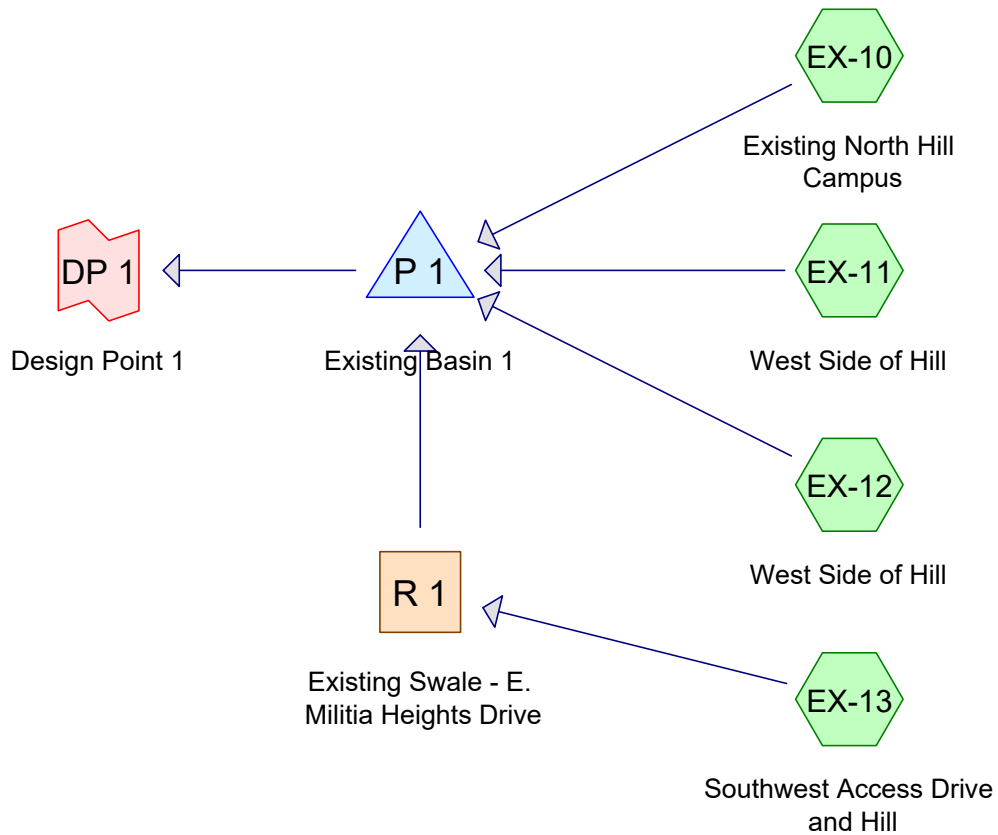


Proposed Conditions Drainage Areas
North Hill Life Care Facility
865 Central Avenue
Needham, Massachusetts

Figure 3
June 2011
Rev Dec 2020



Attachment 2 – Updated Hydrologic Analyses



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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.062	49	50-75% Grass cover, Fair, HSG A (EX-11)
11.559	79	50-75% Grass cover, Fair, HSG C (EX-10, EX-11, EX-12, EX-13, EX-20, EX-30)
0.370	84	50-75% Grass cover, Fair, HSG D (EX-11)
11.316	98	Impervious (EX-10, EX-11, EX-12, EX-13, EX-20, EX-30)
0.185	36	Woods, Fair, HSG A (EX-11)
21.293	73	Woods, Fair, HSG C (EX-10, EX-11, EX-12, EX-13, EX-20, EX-30)
47.784	79	TOTAL AREA

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Type III 24-hr 2 year Rainfall=3.20"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-10: Existing North Hill Runoff Area=699,160 sf 59.28% Impervious Runoff Depth=2.17"
Flow Length=1,860' Tc=15.8 min CN=90 Runoff=30.0 cfs 2.901 af

SubcatchmentEX-11: West Side of Hill Runoff Area=300,305 sf 2.40% Impervious Runoff Depth=0.52"
Flow Length=850' Tc=13.1 min CN=63 Runoff=2.3 cfs 0.298 af

SubcatchmentEX-12: West Side of Hill Runoff Area=311,390 sf 2.71% Impervious Runoff Depth=1.09"
Flow Length=875' Tc=11.2 min CN=75 Runoff=7.3 cfs 0.652 af

SubcatchmentEX-13: Southwest Access Runoff Area=198,695 sf 12.31% Impervious Runoff Depth=1.21"
Flow Length=810' Tc=14.2 min CN=77 Runoff=4.8 cfs 0.461 af

SubcatchmentEX-20: Northwest Portion Runoff Area=408,120 sf 4.33% Impervious Runoff Depth=1.15"
Flow Length=525' Slope=0.1100 '/' Tc=11.0 min CN=76 Runoff=10.3 cfs 0.899 af

SubcatchmentEX-30: Bayview Drive Runoff Area=163,800 sf 12.61% Impervious Runoff Depth=1.27"
Flow Length=169' Tc=5.0 min CN=78 Runoff=5.7 cfs 0.399 af

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=4.8 cfs 0.461 af
Outflow=4.8 cfs 0.461 af

Pond P 1: Existing Basin 1 Peak Elev=149.17' Storage=121,584 cf Inflow=44.2 cfs 4.311 af
Outflow=1.9 cfs 4.224 af

Link DP 1: Design Point 1 Inflow=1.9 cfs 4.224 af
Primary=1.9 cfs 4.224 af

Link DP 2: Design Point 2 Inflow=10.3 cfs 0.899 af
Primary=10.3 cfs 0.899 af

Link DP-3: Design Point 3 Inflow=5.7 cfs 0.399 af
Primary=5.7 cfs 0.399 af

Total Runoff Area = 47.784 ac Runoff Volume = 5.610 af Average Runoff Depth = 1.41"
76.32% Pervious = 36.468 ac 23.68% Impervious = 11.316 ac

Summary for Subcatchment EX-10: Existing North Hill Campus

Runoff = 30.0 cfs @ 12.21 hrs, Volume= 2.901 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
414,480	98	Impervious
61,415	73	Woods, Fair, HSG C
223,265	79	50-75% Grass cover, Fair, HSG C
699,160	90	Weighted Average
284,680		40.72% Pervious Area
414,480		59.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
2.8	205	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.4	50	0.0800	1.98		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.5	130	0.0380	3.96		Shallow Concentrated Flow, Pavement Paved Kv= 20.3 fps
0.8	240	0.0110	4.76	3.74	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
1.4	350	0.0050	4.20	7.43	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, straight & clean
0.2	210	0.0400	14.40	45.24	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, straight & clean
0.4	570	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	1,860	Total			

Summary for Subcatchment EX-11: West Side of Hill

Runoff = 2.3 cfs @ 12.23 hrs, Volume= 0.298 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

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Type III 24-hr 2 year Rainfall=3.20"

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Area (sf)	CN	Description
7,215	98	Impervious
8,040	36	Woods, Fair, HSG A
124,230	73	Woods, Fair, HSG C
133,360	49	50-75% Grass cover, Fair, HSG A
11,360	79	50-75% Grass cover, Fair, HSG C
16,100	84	50-75% Grass cover, Fair, HSG D
300,305	63	Weighted Average
293,090		97.60% Pervious Area
7,215		2.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	30	0.1000	2.21		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
3.8	440	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.3	330	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
13.1	850	Total			

Summary for Subcatchment EX-12: West Side of Hill

Runoff = 7.3 cfs @ 12.16 hrs, Volume= 0.652 af, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
* 8,445	98	Impervious
221,385	73	Woods, Fair, HSG C
81,560	79	50-75% Grass cover, Fair, HSG C
311,390	75	Weighted Average
302,945		97.29% Pervious Area
8,445		2.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
4.3	465	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.0	330	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
11.2	875	Total			

Summary for Subcatchment EX-13: Southwest Access Drive and Hill

Runoff = 4.8 cfs @ 12.20 hrs, Volume= 0.461 af, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description
*	24,450	98	Impervious
	131,500	73	Woods, Fair, HSG C
	42,745	79	50-75% Grass cover, Fair, HSG C
	198,695	77	Weighted Average
	174,245		87.69% Pervious Area
	24,450		12.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	45	0.0780	1.40		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.2	30	0.2000	2.24		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.7	165	0.0120	1.64		Shallow Concentrated Flow, Access Drive Swale Grassed Waterway Kv= 15.0 fps
0.1	45	0.0670	11.74	9.22	Pipe Channel, Culvert below Access Drive 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
2.4	235	0.1110	1.67		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.8	240	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
14.2	810	Total			

Summary for Subcatchment EX-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 10.3 cfs @ 12.16 hrs, Volume= 0.899 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description
*	17,670	98	Impervious
	290,810	73	Woods, Fair, HSG C
	99,640	79	50-75% Grass cover, Fair, HSG C
	408,120	76	Weighted Average
	390,450		95.67% Pervious Area
	17,670		4.33% Impervious Area

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Type III 24-hr 2 year Rainfall=3.20"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
4.8	475	0.1100	1.66		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
11.0	525	Total			

Summary for Subcatchment EX-30: Bayview Drive

Runoff = 5.7 cfs @ 12.08 hrs, Volume= 0.399 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
20,650	98	Impervious
98,200	73	Woods, Fair, HSG C
44,950	79	50-75% Grass cover, Fair, HSG C
163,800	78	Weighted Average
143,150		87.39% Pervious Area
20,650		12.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	32	0.0410	4.11		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
0.3	33	0.0910	2.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.9	104	0.1440	1.90		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	169	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.561 ac, 12.31% Impervious, Inflow Depth = 1.21" for 2 year event
 Inflow = 4.8 cfs @ 12.20 hrs, Volume= 0.461 af
 Outflow = 4.8 cfs @ 12.20 hrs, Volume= 0.461 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1: Existing Basin 1

[44] Hint: Outlet device #2 is below defined storage

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Type III 24-hr 2 year Rainfall=3.20"

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Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth = 1.49" for 2 year event
 Inflow = 44.2 cfs @ 12.20 hrs, Volume= 4.311 af
 Outflow = 1.9 cfs @ 16.70 hrs, Volume= 4.224 af, Atten= 96%, Lag= 269.8 min
 Primary = 1.9 cfs @ 16.70 hrs, Volume= 4.224 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 149.17' @ 16.70 hrs Surf.Area= 74,192 sf Storage= 121,584 cf

Plug-Flow detention time= 720.8 min calculated for 4.223 af (98% of inflow)
 Center-of-Mass det. time= 709.0 min (1,543.5 - 834.5)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	702,453 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
145.00	2,525	0	0
146.00	9,550	6,038	6,038
147.00	21,235	15,393	21,430
148.00	42,190	31,713	53,143
149.00	69,605	55,898	109,040
150.00	95,895	82,750	191,790
151.00	120,320	108,108	299,898
152.00	132,780	126,550	426,448
153.00	138,220	135,500	561,948
154.00	142,790	140,505	702,453

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.9 cfs @ 16.70 hrs HW=149.17' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 1.9 cfs of 6.9 cfs potential flow)
 2=Low Flow Orifice (Orifice Controls 0.2 cfs @ 10.09 fps)
 3=Orifice (Orifice Controls 1.7 cfs @ 8.61 fps)
 4=Weir/Orifice (Controls 0.0 cfs)
 5=Orifice (Controls 0.0 cfs)
 6=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Link DP 1: Design Point 1

Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth > 1.46" for 2 year event
Inflow = 1.9 cfs @ 16.70 hrs, Volume= 4.224 af
Primary = 1.9 cfs @ 16.70 hrs, Volume= 4.224 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

Inflow Area = 9.369 ac, 4.33% Impervious, Inflow Depth = 1.15" for 2 year event
Inflow = 10.3 cfs @ 12.16 hrs, Volume= 0.899 af
Primary = 10.3 cfs @ 12.16 hrs, Volume= 0.899 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Design Point 3

Inflow Area = 3.760 ac, 12.61% Impervious, Inflow Depth = 1.27" for 2 year event
Inflow = 5.7 cfs @ 12.08 hrs, Volume= 0.399 af
Primary = 5.7 cfs @ 12.08 hrs, Volume= 0.399 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-10: Existing North Hill Runoff Area=699,160 sf 59.28% Impervious Runoff Depth=3.59"
Flow Length=1,860' Tc=15.8 min CN=90 Runoff=48.8 cfs 4.799 af

SubcatchmentEX-11: West Side of Hill Runoff Area=300,305 sf 2.40% Impervious Runoff Depth=1.32"
Flow Length=850' Tc=13.1 min CN=63 Runoff=7.7 cfs 0.760 af

SubcatchmentEX-12: West Side of Hill Runoff Area=311,390 sf 2.71% Impervious Runoff Depth=2.21"
Flow Length=875' Tc=11.2 min CN=75 Runoff=15.5 cfs 1.316 af

SubcatchmentEX-13: Southwest Access Runoff Area=198,695 sf 12.31% Impervious Runoff Depth=2.37"
Flow Length=810' Tc=14.2 min CN=77 Runoff=9.8 cfs 0.902 af

SubcatchmentEX-20: Northwest Portion Runoff Area=408,120 sf 4.33% Impervious Runoff Depth=2.29"
Flow Length=525' Slope=0.1100 '/' Tc=11.0 min CN=76 Runoff=21.2 cfs 1.788 af

SubcatchmentEX-30: Bayview Drive Runoff Area=163,800 sf 12.61% Impervious Runoff Depth=2.46"
Flow Length=169' Tc=5.0 min CN=78 Runoff=11.2 cfs 0.771 af

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=9.8 cfs 0.902 af
Outflow=9.8 cfs 0.902 af

Pond P 1: Existing Basin 1 Peak Elev=150.43' Storage=235,783 cf Inflow=80.8 cfs 7.776 af
Outflow=3.1 cfs 6.600 af

Link DP 1: Design Point 1 Inflow=3.1 cfs 6.600 af
Primary=3.1 cfs 6.600 af

Link DP 2: Design Point 2 Inflow=21.2 cfs 1.788 af
Primary=21.2 cfs 1.788 af

Link DP-3: Design Point 3 Inflow=11.2 cfs 0.771 af
Primary=11.2 cfs 0.771 af

Total Runoff Area = 47.784 ac Runoff Volume = 10.335 af Average Runoff Depth = 2.60"
76.32% Pervious = 36.468 ac 23.68% Impervious = 11.316 ac

Summary for Subcatchment EX-10: Existing North Hill Campus

Runoff = 48.8 cfs @ 12.21 hrs, Volume= 4.799 af, Depth= 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
414,480	98	Impervious
61,415	73	Woods, Fair, HSG C
223,265	79	50-75% Grass cover, Fair, HSG C
699,160	90	Weighted Average
284,680		40.72% Pervious Area
414,480		59.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
2.8	205	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.4	50	0.0800	1.98		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.5	130	0.0380	3.96		Shallow Concentrated Flow, Pavement Paved Kv= 20.3 fps
0.8	240	0.0110	4.76	3.74	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
1.4	350	0.0050	4.20	7.43	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, straight & clean
0.2	210	0.0400	14.40	45.24	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, straight & clean
0.4	570	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	1,860	Total			

Summary for Subcatchment EX-11: West Side of Hill

Runoff = 7.7 cfs @ 12.20 hrs, Volume= 0.760 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

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Type III 24-hr 10 year Rainfall=4.70"

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Area (sf)	CN	Description
7,215	98	Impervious
8,040	36	Woods, Fair, HSG A
124,230	73	Woods, Fair, HSG C
133,360	49	50-75% Grass cover, Fair, HSG A
11,360	79	50-75% Grass cover, Fair, HSG C
16,100	84	50-75% Grass cover, Fair, HSG D
300,305	63	Weighted Average
293,090		97.60% Pervious Area
7,215		2.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	30	0.1000	2.21		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
3.8	440	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.3	330	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
13.1	850	Total			

Summary for Subcatchment EX-12: West Side of Hill

Runoff = 15.5 cfs @ 12.16 hrs, Volume= 1.316 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
* 8,445	98	Impervious
221,385	73	Woods, Fair, HSG C
81,560	79	50-75% Grass cover, Fair, HSG C
311,390	75	Weighted Average
302,945		97.29% Pervious Area
8,445		2.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
4.3	465	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.0	330	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
11.2	875	Total			

Summary for Subcatchment EX-13: Southwest Access Drive and Hill

Runoff = 9.8 cfs @ 12.20 hrs, Volume= 0.902 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

	Area (sf)	CN	Description
*	24,450	98	Impervious
	131,500	73	Woods, Fair, HSG C
	42,745	79	50-75% Grass cover, Fair, HSG C
	198,695	77	Weighted Average
	174,245		87.69% Pervious Area
	24,450		12.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	45	0.0780	1.40		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.2	30	0.2000	2.24		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.7	165	0.0120	1.64		Shallow Concentrated Flow, Access Drive Swale Grassed Waterway Kv= 15.0 fps
0.1	45	0.0670	11.74	9.22	Pipe Channel, Culvert below Access Drive 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
2.4	235	0.1110	1.67		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.8	240	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
14.2	810	Total			

Summary for Subcatchment EX-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 21.2 cfs @ 12.16 hrs, Volume= 1.788 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

	Area (sf)	CN	Description
*	17,670	98	Impervious
	290,810	73	Woods, Fair, HSG C
	99,640	79	50-75% Grass cover, Fair, HSG C
	408,120	76	Weighted Average
	390,450		95.67% Pervious Area
	17,670		4.33% Impervious Area

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Type III 24-hr 10 year Rainfall=4.70"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
4.8	475	0.1100	1.66		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
11.0	525	Total			

Summary for Subcatchment EX-30: Bayview Drive

Runoff = 11.2 cfs @ 12.08 hrs, Volume= 0.771 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
20,650	98	Impervious
98,200	73	Woods, Fair, HSG C
44,950	79	50-75% Grass cover, Fair, HSG C
163,800	78	Weighted Average
143,150		87.39% Pervious Area
20,650		12.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	32	0.0410	4.11		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
0.3	33	0.0910	2.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.9	104	0.1440	1.90		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	169	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.561 ac, 12.31% Impervious, Inflow Depth = 2.37" for 10 year event
 Inflow = 9.8 cfs @ 12.20 hrs, Volume= 0.902 af
 Outflow = 9.8 cfs @ 12.20 hrs, Volume= 0.902 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1: Existing Basin 1

[44] Hint: Outlet device #2 is below defined storage

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Type III 24-hr 10 year Rainfall=4.70"

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Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth = 2.69" for 10 year event
 Inflow = 80.8 cfs @ 12.20 hrs, Volume= 7.776 af
 Outflow = 3.1 cfs @ 16.74 hrs, Volume= 6.600 af, Atten= 96%, Lag= 272.9 min
 Primary = 3.1 cfs @ 16.74 hrs, Volume= 6.600 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 150.43' @ 16.74 hrs Surf.Area= 106,512 sf Storage= 235,783 cf

Plug-Flow detention time= 904.1 min calculated for 6.600 af (85% of inflow)
 Center-of-Mass det. time= 838.4 min (1,659.0 - 820.6)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	702,453 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
145.00	2,525	0	0
146.00	9,550	6,038	6,038
147.00	21,235	15,393	21,430
148.00	42,190	31,713	53,143
149.00	69,605	55,898	109,040
150.00	95,895	82,750	191,790
151.00	120,320	108,108	299,898
152.00	132,780	126,550	426,448
153.00	138,220	135,500	561,948
154.00	142,790	140,505	702,453

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=3.1 cfs @ 16.74 hrs HW=150.43' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 3.1 cfs of 7.8 cfs potential flow)
 2=Low Flow Orifice (Orifice Controls 0.2 cfs @ 11.45 fps)
 3=Orifice (Orifice Controls 2.0 cfs @ 10.16 fps)
 4=Weir/Orifice (Orifice Controls 0.9 cfs @ 1.45 fps)
 5=Orifice (Controls 0.0 cfs)
 6=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Link DP 1: Design Point 1

Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth > 2.29" for 10 year event
Inflow = 3.1 cfs @ 16.74 hrs, Volume= 6.600 af
Primary = 3.1 cfs @ 16.74 hrs, Volume= 6.600 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

Inflow Area = 9.369 ac, 4.33% Impervious, Inflow Depth = 2.29" for 10 year event
Inflow = 21.2 cfs @ 12.16 hrs, Volume= 1.788 af
Primary = 21.2 cfs @ 12.16 hrs, Volume= 1.788 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Design Point 3

Inflow Area = 3.760 ac, 12.61% Impervious, Inflow Depth = 2.46" for 10 year event
Inflow = 11.2 cfs @ 12.08 hrs, Volume= 0.771 af
Primary = 11.2 cfs @ 12.08 hrs, Volume= 0.771 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-10: Existing North Hill Runoff Area=699,160 sf 59.28% Impervious Runoff Depth=4.36"
Flow Length=1,860' Tc=15.8 min CN=90 Runoff=58.8 cfs 5.832 af

SubcatchmentEX-11: West Side of Hill Runoff Area=300,305 sf 2.40% Impervious Runoff Depth=1.83"
Flow Length=850' Tc=13.1 min CN=63 Runoff=11.2 cfs 1.054 af

SubcatchmentEX-12: West Side of Hill Runoff Area=311,390 sf 2.71% Impervious Runoff Depth=2.86"
Flow Length=875' Tc=11.2 min CN=75 Runoff=20.2 cfs 1.704 af

SubcatchmentEX-13: Southwest Access Runoff Area=198,695 sf 12.31% Impervious Runoff Depth=3.05"
Flow Length=810' Tc=14.2 min CN=77 Runoff=12.6 cfs 1.158 af

SubcatchmentEX-20: Northwest Portion Runoff Area=408,120 sf 4.33% Impervious Runoff Depth=2.95"
Flow Length=525' Slope=0.1100 '/' Tc=11.0 min CN=76 Runoff=27.5 cfs 2.306 af

SubcatchmentEX-30: Bayview Drive Runoff Area=163,800 sf 12.61% Impervious Runoff Depth=3.14"
Flow Length=169' Tc=5.0 min CN=78 Runoff=14.4 cfs 0.984 af

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=12.6 cfs 1.158 af
Outflow=12.6 cfs 1.158 af

Pond P 1: Existing Basin 1 Peak Elev=150.77' Storage=272,377 cf Inflow=101.4 cfs 9.748 af
Outflow=6.1 cfs 8.401 af

Link DP 1: Design Point 1 Inflow=6.1 cfs 8.401 af
Primary=6.1 cfs 8.401 af

Link DP 2: Design Point 2 Inflow=27.5 cfs 2.306 af
Primary=27.5 cfs 2.306 af

Link DP-3: Design Point 3 Inflow=14.4 cfs 0.984 af
Primary=14.4 cfs 0.984 af

Total Runoff Area = 47.784 ac Runoff Volume = 13.037 af Average Runoff Depth = 3.27"
76.32% Pervious = 36.468 ac 23.68% Impervious = 11.316 ac

Summary for Subcatchment EX-10: Existing North Hill Campus

Runoff = 58.8 cfs @ 12.20 hrs, Volume= 5.832 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (sf)	CN	Description
414,480	98	Impervious
61,415	73	Woods, Fair, HSG C
223,265	79	50-75% Grass cover, Fair, HSG C
699,160	90	Weighted Average
284,680		40.72% Pervious Area
414,480		59.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
2.8	205	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.4	50	0.0800	1.98		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.5	130	0.0380	3.96		Shallow Concentrated Flow, Pavement Paved Kv= 20.3 fps
0.8	240	0.0110	4.76	3.74	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
1.4	350	0.0050	4.20	7.43	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, straight & clean
0.2	210	0.0400	14.40	45.24	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, straight & clean
0.4	570	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	1,860	Total			

Summary for Subcatchment EX-11: West Side of Hill

Runoff = 11.2 cfs @ 12.19 hrs, Volume= 1.054 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

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Type III 24-hr 25 year Rainfall=5.50"

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Area (sf)	CN	Description
7,215	98	Impervious
8,040	36	Woods, Fair, HSG A
124,230	73	Woods, Fair, HSG C
133,360	49	50-75% Grass cover, Fair, HSG A
11,360	79	50-75% Grass cover, Fair, HSG C
16,100	84	50-75% Grass cover, Fair, HSG D
300,305	63	Weighted Average
293,090		97.60% Pervious Area
7,215		2.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	30	0.1000	2.21		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
3.8	440	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.3	330	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
13.1	850	Total			

Summary for Subcatchment EX-12: West Side of Hill

Runoff = 20.2 cfs @ 12.16 hrs, Volume= 1.704 af, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (sf)	CN	Description
* 8,445	98	Impervious
221,385	73	Woods, Fair, HSG C
81,560	79	50-75% Grass cover, Fair, HSG C
311,390	75	Weighted Average
302,945		97.29% Pervious Area
8,445		2.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
4.3	465	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.0	330	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
11.2	875	Total			

Summary for Subcatchment EX-13: Southwest Access Drive and Hill

Runoff = 12.6 cfs @ 12.20 hrs, Volume= 1.158 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

	Area (sf)	CN	Description
*	24,450	98	Impervious
	131,500	73	Woods, Fair, HSG C
	42,745	79	50-75% Grass cover, Fair, HSG C
	198,695	77	Weighted Average
	174,245		87.69% Pervious Area
	24,450		12.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	45	0.0780	1.40		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.2	30	0.2000	2.24		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.7	165	0.0120	1.64		Shallow Concentrated Flow, Access Drive Swale Grassed Waterway Kv= 15.0 fps
0.1	45	0.0670	11.74	9.22	Pipe Channel, Culvert below Access Drive 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
2.4	235	0.1110	1.67		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.8	240	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
14.2	810	Total			

Summary for Subcatchment EX-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 27.5 cfs @ 12.16 hrs, Volume= 2.306 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

	Area (sf)	CN	Description
*	17,670	98	Impervious
	290,810	73	Woods, Fair, HSG C
	99,640	79	50-75% Grass cover, Fair, HSG C
	408,120	76	Weighted Average
	390,450		95.67% Pervious Area
	17,670		4.33% Impervious Area

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Type III 24-hr 25 year Rainfall=5.50"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
4.8	475	0.1100	1.66		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
11.0	525	Total			

Summary for Subcatchment EX-30: Bayview Drive

Runoff = 14.4 cfs @ 12.07 hrs, Volume= 0.984 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (sf)	CN	Description
20,650	98	Impervious
98,200	73	Woods, Fair, HSG C
44,950	79	50-75% Grass cover, Fair, HSG C
163,800	78	Weighted Average
143,150		87.39% Pervious Area
20,650		12.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	32	0.0410	4.11		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
0.3	33	0.0910	2.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.9	104	0.1440	1.90		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	169	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.561 ac, 12.31% Impervious, Inflow Depth = 3.05" for 25 year event
 Inflow = 12.6 cfs @ 12.20 hrs, Volume= 1.158 af
 Outflow = 12.6 cfs @ 12.20 hrs, Volume= 1.158 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1: Existing Basin 1

[44] Hint: Outlet device #2 is below defined storage

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Type III 24-hr 25 year Rainfall=5.50"

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Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth = 3.38" for 25 year event
 Inflow = 101.4 cfs @ 12.20 hrs, Volume= 9.748 af
 Outflow = 6.1 cfs @ 15.19 hrs, Volume= 8.401 af, Atten= 94%, Lag= 179.6 min
 Primary = 6.1 cfs @ 15.19 hrs, Volume= 8.401 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 150.77' @ 15.19 hrs Surf.Area= 114,597 sf Storage= 272,377 cf

Plug-Flow detention time= 772.5 min calculated for 8.400 af (86% of inflow)
 Center-of-Mass det. time= 711.0 min (1,526.3 - 815.3)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	702,453 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
145.00	2,525	0	0
146.00	9,550	6,038	6,038
147.00	21,235	15,393	21,430
148.00	42,190	31,713	53,143
149.00	69,605	55,898	109,040
150.00	95,895	82,750	191,790
151.00	120,320	108,108	299,898
152.00	132,780	126,550	426,448
153.00	138,220	135,500	561,948
154.00	142,790	140,505	702,453

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=6.1 cfs @ 15.19 hrs HW=150.77' TW=0.00' (Dynamic Tailwater)

1=Culvert (Passes 6.1 cfs of 8.0 cfs potential flow)
 2=Low Flow Orifice (Orifice Controls 0.3 cfs @ 11.78 fps)
 3=Orifice (Orifice Controls 2.1 cfs @ 10.53 fps)
 4=Weir/Orifice (Orifice Controls 3.8 cfs @ 2.35 fps)
 5=Orifice (Controls 0.0 cfs)
 6=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Link DP 1: Design Point 1

Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth > 2.91" for 25 year event
Inflow = 6.1 cfs @ 15.19 hrs, Volume= 8.401 af
Primary = 6.1 cfs @ 15.19 hrs, Volume= 8.401 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

Inflow Area = 9.369 ac, 4.33% Impervious, Inflow Depth = 2.95" for 25 year event
Inflow = 27.5 cfs @ 12.16 hrs, Volume= 2.306 af
Primary = 27.5 cfs @ 12.16 hrs, Volume= 2.306 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Design Point 3

Inflow Area = 3.760 ac, 12.61% Impervious, Inflow Depth = 3.14" for 25 year event
Inflow = 14.4 cfs @ 12.07 hrs, Volume= 0.984 af
Primary = 14.4 cfs @ 12.07 hrs, Volume= 0.984 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Type III 24-hr 100 year Rainfall=6.70"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-10: Existing North Hill Runoff Area=699,160 sf 59.28% Impervious Runoff Depth=5.53"
Flow Length=1,860' Tc=15.8 min CN=90 Runoff=73.6 cfs 7.396 af

SubcatchmentEX-11: West Side of Hill Runoff Area=300,305 sf 2.40% Impervious Runoff Depth=2.68"
Flow Length=850' Tc=13.1 min CN=63 Runoff=16.8 cfs 1.539 af

SubcatchmentEX-12: West Side of Hill Runoff Area=311,390 sf 2.71% Impervious Runoff Depth=3.89"
Flow Length=875' Tc=11.2 min CN=75 Runoff=27.4 cfs 2.315 af

SubcatchmentEX-13: Southwest Access Runoff Area=198,695 sf 12.31% Impervious Runoff Depth=4.10"
Flow Length=810' Tc=14.2 min CN=77 Runoff=16.9 cfs 1.557 af

SubcatchmentEX-20: Northwest Portion Runoff Area=408,120 sf 4.33% Impervious Runoff Depth=3.99"
Flow Length=525' Slope=0.1100 '/' Tc=11.0 min CN=76 Runoff=37.1 cfs 3.116 af

SubcatchmentEX-30: Bayview Drive Runoff Area=163,800 sf 12.61% Impervious Runoff Depth=4.20"
Flow Length=169' Tc=5.0 min CN=78 Runoff=19.1 cfs 1.317 af

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=16.9 cfs 1.557 af
Outflow=16.9 cfs 1.557 af

Pond P 1: Existing Basin 1 Peak Elev=151.36' Storage=344,420 cf Inflow=132.9 cfs 12.807 af
Outflow=8.4 cfs 11.270 af

Link DP 1: Design Point 1 Inflow=8.4 cfs 11.270 af
Primary=8.4 cfs 11.270 af

Link DP 2: Design Point 2 Inflow=37.1 cfs 3.116 af
Primary=37.1 cfs 3.116 af

Link DP-3: Design Point 3 Inflow=19.1 cfs 1.317 af
Primary=19.1 cfs 1.317 af

Total Runoff Area = 47.784 ac Runoff Volume = 17.241 af Average Runoff Depth = 4.33"
76.32% Pervious = 36.468 ac 23.68% Impervious = 11.316 ac

Summary for Subcatchment EX-10: Existing North Hill Campus

Runoff = 73.6 cfs @ 12.20 hrs, Volume= 7.396 af, Depth= 5.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (sf)	CN	Description
414,480	98	Impervious
61,415	73	Woods, Fair, HSG C
223,265	79	50-75% Grass cover, Fair, HSG C
699,160	90	Weighted Average
284,680		40.72% Pervious Area
414,480		59.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
2.8	205	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.4	50	0.0800	1.98		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.5	130	0.0380	3.96		Shallow Concentrated Flow, Pavement Paved Kv= 20.3 fps
0.8	240	0.0110	4.76	3.74	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
1.4	350	0.0050	4.20	7.43	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, straight & clean
0.2	210	0.0400	14.40	45.24	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, straight & clean
0.4	570	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	1,860	Total			

Summary for Subcatchment EX-11: West Side of Hill

Runoff = 16.8 cfs @ 12.19 hrs, Volume= 1.539 af, Depth= 2.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

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Type III 24-hr 100 year Rainfall=6.70"

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Area (sf)	CN	Description
7,215	98	Impervious
8,040	36	Woods, Fair, HSG A
124,230	73	Woods, Fair, HSG C
133,360	49	50-75% Grass cover, Fair, HSG A
11,360	79	50-75% Grass cover, Fair, HSG C
16,100	84	50-75% Grass cover, Fair, HSG D
300,305	63	Weighted Average
293,090		97.60% Pervious Area
7,215		2.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	30	0.1000	2.21		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
3.8	440	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.3	330	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
13.1	850	Total			

Summary for Subcatchment EX-12: West Side of Hill

Runoff = 27.4 cfs @ 12.16 hrs, Volume= 2.315 af, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (sf)	CN	Description
* 8,445	98	Impervious
221,385	73	Woods, Fair, HSG C
81,560	79	50-75% Grass cover, Fair, HSG C
311,390	75	Weighted Average
302,945		97.29% Pervious Area
8,445		2.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
4.3	465	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.0	330	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
11.2	875	Total			

Summary for Subcatchment EX-13: Southwest Access Drive and Hill

Runoff = 16.9 cfs @ 12.19 hrs, Volume= 1.557 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

	Area (sf)	CN	Description
*	24,450	98	Impervious
	131,500	73	Woods, Fair, HSG C
	42,745	79	50-75% Grass cover, Fair, HSG C
	198,695	77	Weighted Average
	174,245		87.69% Pervious Area
	24,450		12.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	45	0.0780	1.40		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.2	30	0.2000	2.24		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.7	165	0.0120	1.64		Shallow Concentrated Flow, Access Drive Swale Grassed Waterway Kv= 15.0 fps
0.1	45	0.0670	11.74	9.22	Pipe Channel, Culvert below Access Drive 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
2.4	235	0.1110	1.67		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.8	240	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
14.2	810	Total			

Summary for Subcatchment EX-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 37.1 cfs @ 12.15 hrs, Volume= 3.116 af, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

	Area (sf)	CN	Description
*	17,670	98	Impervious
	290,810	73	Woods, Fair, HSG C
	99,640	79	50-75% Grass cover, Fair, HSG C
	408,120	76	Weighted Average
	390,450		95.67% Pervious Area
	17,670		4.33% Impervious Area

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Type III 24-hr 100 year Rainfall=6.70"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
4.8	475	0.1100	1.66		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
11.0	525	Total			

Summary for Subcatchment EX-30: Bayview Drive

Runoff = 19.1 cfs @ 12.07 hrs, Volume= 1.317 af, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (sf)	CN	Description
20,650	98	Impervious
98,200	73	Woods, Fair, HSG C
44,950	79	50-75% Grass cover, Fair, HSG C
163,800	78	Weighted Average
143,150		87.39% Pervious Area
20,650		12.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	32	0.0410	4.11		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
0.3	33	0.0910	2.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.9	104	0.1440	1.90		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	169	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.561 ac, 12.31% Impervious, Inflow Depth = 4.10" for 100 year event
 Inflow = 16.9 cfs @ 12.19 hrs, Volume= 1.557 af
 Outflow = 16.9 cfs @ 12.19 hrs, Volume= 1.557 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1: Existing Basin 1

[44] Hint: Outlet device #2 is below defined storage

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Type III 24-hr 100 year Rainfall=6.70"

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Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth = 4.43" for 100 year event
 Inflow = 132.9 cfs @ 12.19 hrs, Volume= 12.807 af
 Outflow = 8.4 cfs @ 14.89 hrs, Volume= 11.270 af, Atten= 94%, Lag= 161.8 min
 Primary = 8.4 cfs @ 14.89 hrs, Volume= 11.270 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 151.36' @ 14.89 hrs Surf.Area= 124,846 sf Storage= 344,420 cf

Plug-Flow detention time= 657.2 min calculated for 11.268 af (88% of inflow)
 Center-of-Mass det. time= 601.6 min (1,410.4 - 808.8)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	702,453 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
145.00	2,525	0	0
146.00	9,550	6,038	6,038
147.00	21,235	15,393	21,430
148.00	42,190	31,713	53,143
149.00	69,605	55,898	109,040
150.00	95,895	82,750	191,790
151.00	120,320	108,108	299,898
152.00	132,780	126,550	426,448
153.00	138,220	135,500	561,948
154.00	142,790	140,505	702,453

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=8.4 cfs @ 14.89 hrs HW=151.36' TW=0.00' (Dynamic Tailwater)

1=Culvert (Barrel Controls 8.4 cfs @ 10.72 fps)
 2=Low Flow Orifice (Passes < 0.3 cfs potential flow)
 3=Orifice (Passes < 2.2 cfs potential flow)
 4=Weir/Orifice (Passes < 11.1 cfs potential flow)
 5=Orifice (Passes < 1.7 cfs potential flow)
 6=Broad-Crested Rectangular Weir (Controls 0.0 cfs)

Summary for Link DP 1: Design Point 1

Inflow Area = 34.654 ac, 30.11% Impervious, Inflow Depth > 3.90" for 100 year event
Inflow = 8.4 cfs @ 14.89 hrs, Volume= 11.270 af
Primary = 8.4 cfs @ 14.89 hrs, Volume= 11.270 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

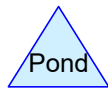
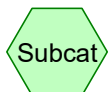
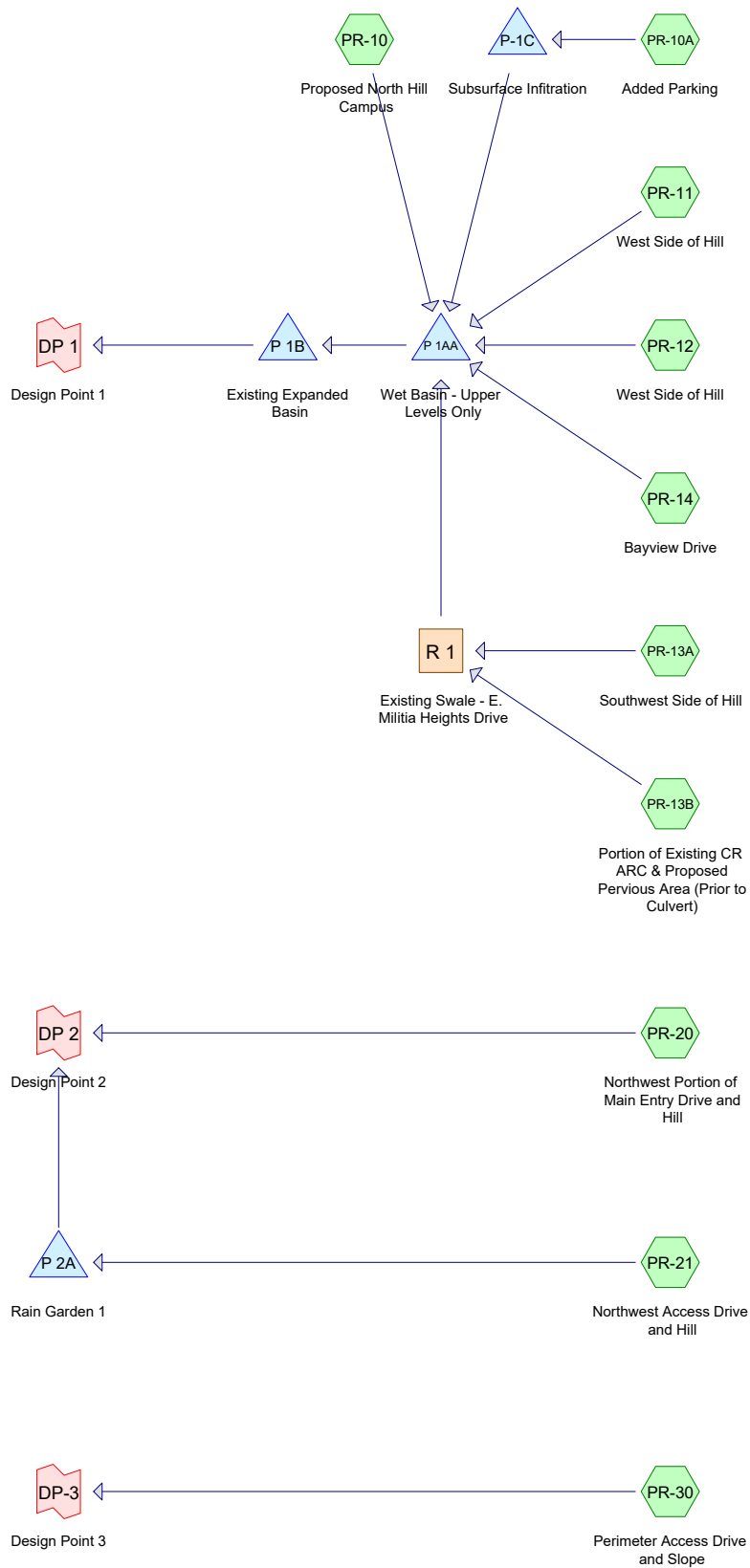
Inflow Area = 9.369 ac, 4.33% Impervious, Inflow Depth = 3.99" for 100 year event
Inflow = 37.1 cfs @ 12.15 hrs, Volume= 3.116 af
Primary = 37.1 cfs @ 12.15 hrs, Volume= 3.116 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Design Point 3

Inflow Area = 3.760 ac, 12.61% Impervious, Inflow Depth = 4.20" for 100 year event
Inflow = 19.1 cfs @ 12.07 hrs, Volume= 1.317 af
Primary = 19.1 cfs @ 12.07 hrs, Volume= 1.317 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
503,994	79	50-75% Grass cover, Fair, HSG C (PR-10, PR-11, PR-12, PR-13A, PR-13B, PR-14, PR-20, PR-21, PR-30)
141,619	30	Brush, Good, HSG A (PR-11)
7,201	65	Brush, Good, HSG C (PR-11)
16,102	73	Brush, Good, HSG D (PR-11)
611,287	98	Impervious (PR-10, PR-10A, PR-11, PR-12, PR-13A, PR-13B, PR-14, PR-20, PR-21, PR-30)
801,298	73	Woods, Fair, HSG C (PR-10, PR-11, PR-12, PR-13A, PR-13B, PR-20, PR-21, PR-30)
2,081,501	79	TOTAL AREA

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-10: Proposed North Runoff Area=917,489 sf 56.53% Impervious Runoff Depth=2.08"
Flow Length=2,324' Tc=15.8 min CN=89 Runoff=37.9 cfs 159,149 cf

SubcatchmentPR-10A: Added Parking Runoff Area=2,400 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.2 cfs 593 cf

SubcatchmentPR-11: West Side of Hill Runoff Area=292,366 sf 2.47% Impervious Runoff Depth=0.20"
Flow Length=805' Tc=12.9 min CN=53 Runoff=0.4 cfs 4,815 cf

SubcatchmentPR-12: West Side of Hill Runoff Area=222,032 sf 3.42% Impervious Runoff Depth=1.09"
Flow Length=870' Tc=10.8 min CN=75 Runoff=5.3 cfs 20,241 cf

SubcatchmentPR-13A: Southwest Side of Runoff Area=68,701 sf 11.70% Impervious Runoff Depth=1.21"
Flow Length=515' Tc=8.4 min CN=77 Runoff=2.0 cfs 6,938 cf

SubcatchmentPR-13B: Portion of Existing Runoff Area=25,070 sf 25.21% Impervious Runoff Depth=1.47"
Tc=5.0 min CN=81 Runoff=1.0 cfs 3,069 cf

SubcatchmentPR-14: Bayview Drive Runoff Area=47,450 sf 91.46% Impervious Runoff Depth=2.75"
Flow Length=2,236' Tc=6.5 min CN=96 Runoff=3.2 cfs 10,871 cf

SubcatchmentPR-20: Northwest Portion Runoff Area=327,503 sf 1.84% Impervious Runoff Depth=1.04"
Flow Length=450' Slope=0.1100 '/' Tc=10.2 min CN=74 Runoff=7.5 cfs 28,317 cf

SubcatchmentPR-21: Northwest Access Runoff Area=62,140 sf 15.82% Impervious Runoff Depth=1.47"
Flow Length=370' Tc=5.3 min CN=81 Runoff=2.5 cfs 7,607 cf

SubcatchmentPR-30: Perimeter Access Runoff Area=116,350 sf 1.55% Impervious Runoff Depth=1.15"
Flow Length=101' Tc=5.0 min CN=76 Runoff=3.6 cfs 11,170 cf

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=2.9 cfs 10,007 cf
Outflow=2.9 cfs 10,007 cf

Pond P 1AA: Wet Basin - Upper Levels Peak Elev=152.71' Storage=75,581 cf Inflow=47.0 cfs 205,337 cf
Outflow=22.5 cfs 205,339 cf

Pond P 1B: Existing Expanded Basin Peak Elev=148.88' Storage=102,138 cf Inflow=22.5 cfs 205,339 cf
Outflow=1.8 cfs 197,436 cf

Pond P 2A: Rain Garden 1 Peak Elev=194.25' Storage=614 cf Inflow=2.5 cfs 7,607 cf
Outflow=2.5 cfs 7,172 cf

Pond P-1C: Subsurface Infiltration Peak Elev=223.93' Storage=344 cf Inflow=0.2 cfs 593 cf
Discarded=0.0 cfs 0 cf Primary=0.1 cfs 254 cf Outflow=0.1 cfs 254 cf

Link DP 1: Design Point 1 Inflow=1.8 cfs 197,436 cf
Primary=1.8 cfs 197,436 cf

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Link DP 2: Design Point 2

Inflow=9.6 cfs 35,489 cf

Primary=9.6 cfs 35,489 cf

Link DP-3: Design Point 3

Inflow=3.6 cfs 11,170 cf

Primary=3.6 cfs 11,170 cf

Total Runoff Area = 2,081,501 sf Runoff Volume = 252,770 cf Average Runoff Depth = 1.46"
70.63% Pervious = 1,470,214 sf 29.37% Impervious = 611,287 sf

Summary for Subcatchment PR-10: Proposed North Hill Campus

Runoff = 37.9 cfs @ 12.21 hrs, Volume= 159,149 cf, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description
*	518,662	98	Impervious
	93,214	73	Woods, Fair, HSG C
	305,613	79	50-75% Grass cover, Fair, HSG C
	917,489	89	Weighted Average
	398,827		43.47% Pervious Area
	518,662		56.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.7	125	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.1	15	0.3300	4.02		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.7	456	0.0500	10.14	7.97	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
0.3	132	0.0150	7.28	12.87	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
2.1	928	0.0100	7.20	22.62	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.4	483	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	2,324	Total			

Summary for Subcatchment PR-10A: Added Parking

Runoff = 0.2 cfs @ 12.07 hrs, Volume= 593 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

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Type III 24-hr 2 year Rainfall=3.20"

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	Area (sf)	CN	Description
*	2,400	98	Impervious
	2,400		100.00% Impervious Area

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

Summary for Subcatchment PR-11: West Side of Hill

Runoff = 0.4 cfs @ 12.49 hrs, Volume= 4,815 cf, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description
	7,216	98	Impervious
	8,259	30	Brush, Good, HSG A
	111,905	73	Woods, Fair, HSG C
*	133,360	30	Brush, Good, HSG A
	8,323	79	50-75% Grass cover, Fair, HSG C
	16,102	73	Brush, Good, HSG D
	7,201	65	Brush, Good, HSG C
	292,366	53	Weighted Average
	285,150		97.53% Pervious Area
	7,216		2.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.5	400	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.6	355	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
12.9	805	Total			

Summary for Subcatchment PR-12: West Side of Hill

Runoff = 5.3 cfs @ 12.16 hrs, Volume= 20,241 cf, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

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Type III 24-hr 2 year Rainfall=3.20"

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Area (sf)	CN	Description
* 7,600	98	Impervious
190,538	73	Woods, Fair, HSG C
23,894	79	50-75% Grass cover, Fair, HSG C
222,032	75	Weighted Average
214,432		96.58% Pervious Area
7,600		3.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	15	0.0200	0.12		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
0.9	15	0.1750	0.28		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
2.5	20	0.1750	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	430	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.1	360	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
10.8	870	Total			

Summary for Subcatchment PR-13A: Southwest Side of Hill

Runoff = 2.0 cfs @ 12.13 hrs, Volume= 6,938 cf, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
* 8,039	98	Impervious
48,481	73	Woods, Fair, HSG C
12,181	79	50-75% Grass cover, Fair, HSG C
68,701	77	Weighted Average
60,662		88.30% Pervious Area
8,039		11.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	20	0.0250	0.13		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
3.8	30	0.1400	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	85	0.1400	1.87		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	380	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
8.4	515	Total			

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Type III 24-hr 2 year Rainfall=3.20"

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Summary for Subcatchment PR-13B: Portion of Existing CR ARC & Proposed Pervious Area (Prior to Cu

Runoff = 1.0 cfs @ 12.08 hrs, Volume= 3,069 cf, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description
*	6,320	98	Impervious
	9,870	73	Woods, Fair, HSG C
	8,880	79	50-75% Grass cover, Fair, HSG C
	25,070	81	Weighted Average
	18,750		74.79% Pervious Area
	6,320		25.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum Tc

Summary for Subcatchment PR-14: Bayview Drive

Runoff = 3.2 cfs @ 12.09 hrs, Volume= 10,871 cf, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

	Area (sf)	CN	Description
	43,400	98	Impervious
	0	73	Woods, Fair, HSG C
	4,050	79	50-75% Grass cover, Fair, HSG C
	47,450	96	Weighted Average
	4,050		8.54% Pervious Area
	43,400		91.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	32	0.0220	1.14		Sheet Flow, Paved Smooth surfaces n= 0.011 P2= 3.20"
2.7	573	0.0300	3.52		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
2.8	1,000	0.0070	6.02	18.93	Pipe Channel, RCP_Round 24" 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.4	571	0.0790	21.89	87.05	Pipe Channel, RCP_Round 27" 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013
0.1	60	0.0150	11.56	81.69	Pipe Channel, RCP_Round 36" 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
6.5	2,236	Total			

Summary for Subcatchment PR-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 7.5 cfs @ 12.15 hrs, Volume= 28,317 cf, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
* 6,020	98	Impervious
275,940	73	Woods, Fair, HSG C
45,543	79	50-75% Grass cover, Fair, HSG C
327,503	74	Weighted Average
321,483		98.16% Pervious Area
6,020		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods
					Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	400	0.1100	1.66		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
10.2	450	Total			

Summary for Subcatchment PR-21: Northwest Access Drive and Hill

Runoff = 2.5 cfs @ 12.08 hrs, Volume= 7,607 cf, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
* 9,830	98	Impervious
10,850	73	Woods, Fair, HSG C
41,460	79	50-75% Grass cover, Fair, HSG C
62,140	81	Weighted Average
52,310		84.18% Pervious Area
9,830		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0588	0.23		Sheet Flow, Grass
					Grass: Short n= 0.150 P2= 3.20"
1.6	320	0.0500	3.35		Shallow Concentrated Flow, Swale
					Grassed Waterway Kv= 15.0 fps
5.3	370	Total			

Summary for Subcatchment PR-30: Perimeter Access Drive and Slope

Runoff = 3.6 cfs @ 12.08 hrs, Volume= 11,170 cf, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (sf)	CN	Description
1,800	98	Impervious
60,500	73	Woods, Fair, HSG C
54,050	79	50-75% Grass cover, Fair, HSG C
116,350	76	Weighted Average
114,550		98.45% Pervious Area
1,800		1.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.3440	4.11		Shallow Concentrated Flow, Grass
					Short Grass Pasture Kv= 7.0 fps
0.7	85	0.1530	1.96		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
0.8	101	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 93,771 sf, 15.31% Impervious, Inflow Depth = 1.28" for 2 year event
Inflow = 2.9 cfs @ 12.11 hrs, Volume= 10,007 cf
Outflow = 2.9 cfs @ 12.11 hrs, Volume= 10,007 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1AA: Wet Basin - Upper Levels Only

[44] Hint: Outlet device #3 is below defined storage

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 1.56" for 2 year event
Inflow = 47.0 cfs @ 12.20 hrs, Volume= 205,337 cf
Outflow = 22.5 cfs @ 12.52 hrs, Volume= 205,339 cf, Atten= 52%, Lag= 19.5 min
Primary = 22.5 cfs @ 12.52 hrs, Volume= 205,339 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 152.71' @ 12.52 hrs Surf.Area= 31,230 sf Storage= 75,581 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 204.8 min (1,032.1 - 827.3)

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Volume	Invert	Avail.Storage	Storage Description
#1	149.70'	101,744 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.70	20,236	0	0
150.00	20,347	6,087	6,087
151.00	24,116	22,232	28,319
152.00	28,073	26,095	54,413
153.00	32,496	30,285	84,698
153.50	35,688	17,046	101,744

Device	Routing	Invert	Outlet Devices
#1	Primary	152.25'	20.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#2	Primary	152.59'	24.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#3	Primary	149.50'	8.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=22.5 cfs @ 12.52 hrs HW=152.71' TW=146.99' (Dynamic Tailwater)

- 1=Broad-Crested Rectangular Weir (Weir Controls 16.8 cfs @ 1.81 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 2.7 cfs @ 0.91 fps)
- 3=Orifice/Grate (Orifice Controls 3.0 cfs @ 8.63 fps)

Summary for Pond P 1B: Existing Expanded Basin

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 1.56" for 2 year event
 Inflow = 22.5 cfs @ 12.52 hrs, Volume= 205,339 cf
 Outflow = 1.8 cfs @ 25.03 hrs, Volume= 197,436 cf, Atten= 92%, Lag= 750.7 min
 Primary = 1.8 cfs @ 25.03 hrs, Volume= 197,436 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 148.88' @ 25.03 hrs Surf.Area= 62,722 sf Storage= 102,138 cf

Plug-Flow detention time= 671.9 min calculated for 197,395 cf (96% of inflow)
 Center-of-Mass det. time= 645.4 min (1,677.5 - 1,032.1)

Volume	Invert	Avail.Storage	Storage Description
#1	144.50'	527,911 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
144.50	0	0	0
145.00	2,609	652	652
146.00	10,587	6,598	7,250
147.00	22,591	16,589	23,839
148.00	41,981	32,286	56,125
149.00	65,579	53,780	109,905
150.00	76,289	70,934	180,839
151.00	81,609	78,949	259,788
152.00	86,811	84,210	343,998
153.00	92,120	89,466	433,464
154.00	96,775	94,448	527,911

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.014, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Weir - Rip Rap Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.8 cfs @ 25.03 hrs HW=148.88' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 1.8 cfs of 6.4 cfs potential flow)
 2=Low Flow Orifice (Orifice Controls 0.2 cfs @ 9.74 fps)
 3=Orifice (Orifice Controls 1.6 cfs @ 8.20 fps)
 4=Weir/Orifice (Controls 0.0 cfs)
 5=Orifice (Controls 0.0 cfs)
 6=Weir - Rip Rap Spillway (Controls 0.0 cfs)

Summary for Pond P 2A: Rain Garden 1

Inflow Area = 62,140 sf, 15.82% Impervious, Inflow Depth = 1.47" for 2 year event
 Inflow = 2.5 cfs @ 12.08 hrs, Volume= 7,607 cf
 Outflow = 2.5 cfs @ 12.10 hrs, Volume= 7,172 cf, Atten= 2%, Lag= 0.8 min
 Primary = 2.5 cfs @ 12.10 hrs, Volume= 7,172 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 194.25' @ 12.10 hrs Surf.Area= 748 sf Storage= 614 cf

Plug-Flow detention time= 44.1 min calculated for 7,172 cf (94% of inflow)
 Center-of-Mass det. time= 13.5 min (852.4 - 838.9)

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Volume	Invert	Avail.Storage	Storage Description
#1	193.25'	1,258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.25	490	0	0
194.00	670	435	435
194.50	825	374	809
195.00	970	449	1,258

Device	Routing	Invert	Outlet Devices
#1	Primary	194.00'	8.0' long x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=2.5 cfs @ 12.10 hrs HW=194.25' TW=0.00' (Dynamic Tailwater)

↑**1=Broad-Crested Rectangular Weir**(Weir Controls 2.5 cfs @ 1.22 fps)

Summary for Pond P-1C: Subsurface Infiltration

Inflow Area = 2,400 sf, 100.00% Impervious, Inflow Depth = 2.97" for 2 year event
 Inflow = 0.2 cfs @ 12.07 hrs, Volume= 593 cf
 Outflow = 0.1 cfs @ 12.24 hrs, Volume= 254 cf, Atten= 58%, Lag= 10.2 min
 Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
 Primary = 0.1 cfs @ 12.24 hrs, Volume= 254 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 223.93' @ 12.24 hrs Surf.Area= 243 sf Storage= 344 cf

Flood Elev= 227.10' Surf.Area= 243 sf Storage= 384 cf

Plug-Flow detention time= 299.4 min calculated for 254 cf (43% of inflow)

Center-of-Mass det. time= 158.9 min (914.4 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	221.00'	237 cf	6.83'W x 33.68'L x 2.83'H Field A
			652 cf Overall - 59 cf Embedded = 593 cf x 40.0% Voids
#2A	222.00'	59 cf	ADS_StormTech SC-310 +Cap x 4 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	220.10'	88 cf	4.00'D x 7.00'H Catch Basin
		384 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	220.10'	0.170 in/hr Exfiltration X 0.00 over Surface area Conductivity to Groundwater Elevation = 216.00' Phase-In= 0.10'
#2	Primary	223.80'	12.0" Round Culvert L= 15.0' RCP, square edge headwall, Ke= 0.500

Inlet / Outlet Invert= 223.80' / 222.90' S= 0.0600 '/' Cc= 0.900
n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=220.10' (Free Discharge)

↑**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.24 hrs HW=223.93' TW=152.00' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 0.1 cfs @ 1.23 fps)

Summary for Link DP 1: Design Point 1

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth > 1.50" for 2 year event
Inflow = 1.8 cfs @ 25.03 hrs, Volume= 197,436 cf
Primary = 1.8 cfs @ 25.03 hrs, Volume= 197,436 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

Inflow Area = 389,643 sf, 4.07% Impervious, Inflow Depth = 1.09" for 2 year event
Inflow = 9.6 cfs @ 12.14 hrs, Volume= 35,489 cf
Primary = 9.6 cfs @ 12.14 hrs, Volume= 35,489 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Design Point 3

Inflow Area = 116,350 sf, 1.55% Impervious, Inflow Depth = 1.15" for 2 year event
Inflow = 3.6 cfs @ 12.08 hrs, Volume= 11,170 cf
Primary = 3.6 cfs @ 12.08 hrs, Volume= 11,170 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-10: Proposed North Runoff Area=917,489 sf 56.53% Impervious Runoff Depth=3.49"
Flow Length=2,324' Tc=15.8 min CN=89 Runoff=62.5 cfs 266,483 cf

SubcatchmentPR-10A: Added Parking Runoff Area=2,400 sf 100.00% Impervious Runoff Depth=4.46"
Tc=5.0 min CN=98 Runoff=0.3 cfs 893 cf

SubcatchmentPR-11: West Side of Hill Runoff Area=292,366 sf 2.47% Impervious Runoff Depth=0.73"
Flow Length=805' Tc=12.9 min CN=53 Runoff=3.1 cfs 17,691 cf

SubcatchmentPR-12: West Side of Hill Runoff Area=222,032 sf 3.42% Impervious Runoff Depth=2.21"
Flow Length=870' Tc=10.8 min CN=75 Runoff=11.2 cfs 40,859 cf

SubcatchmentPR-13A: Southwest Side of Runoff Area=68,701 sf 11.70% Impervious Runoff Depth=2.37"
Flow Length=515' Tc=8.4 min CN=77 Runoff=4.0 cfs 13,592 cf

SubcatchmentPR-13B: Portion of Existing Runoff Area=25,070 sf 25.21% Impervious Runoff Depth=2.72"
Tc=5.0 min CN=81 Runoff=1.9 cfs 5,686 cf

SubcatchmentPR-14: Bayview Drive Runoff Area=47,450 sf 91.46% Impervious Runoff Depth=4.23"
Flow Length=2,236' Tc=6.5 min CN=96 Runoff=4.8 cfs 16,744 cf

SubcatchmentPR-20: Northwest Portion Runoff Area=327,503 sf 1.84% Impervious Runoff Depth=2.13"
Flow Length=450' Slope=0.1100 '/' Tc=10.2 min CN=74 Runoff=16.1 cfs 58,060 cf

SubcatchmentPR-21: Northwest Access Runoff Area=62,140 sf 15.82% Impervious Runoff Depth=2.72"
Flow Length=370' Tc=5.3 min CN=81 Runoff=4.7 cfs 14,095 cf

SubcatchmentPR-30: Perimeter Access Runoff Area=116,350 sf 1.55% Impervious Runoff Depth=2.29"
Flow Length=101' Tc=5.0 min CN=76 Runoff=7.4 cfs 22,209 cf

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=5.7 cfs 19,278 cf
Outflow=5.7 cfs 19,278 cf

Pond P 1AA: Wet Basin - Upper Levels Peak Elev=153.13' Storage=88,991 cf Inflow=83.0 cfs 361,608 cf
Outflow=72.8 cfs 361,610 cf

Pond P 1B: Existing Expanded Basin Peak Elev=150.34' Storage=207,119 cf Inflow=72.8 cfs 361,610 cf
Outflow=2.6 cfs 282,332 cf

Pond P 2A: Rain Garden 1 Peak Elev=194.37' Storage=708 cf Inflow=4.7 cfs 14,095 cf
Outflow=4.6 cfs 13,660 cf

Pond P-1C: Subsurface Infiltration Peak Elev=224.05' Storage=346 cf Inflow=0.3 cfs 893 cf
Discarded=0.0 cfs 0 cf Primary=0.3 cfs 553 cf Outflow=0.3 cfs 553 cf

Link DP 1: Design Point 1 Inflow=2.6 cfs 282,332 cf
Primary=2.6 cfs 282,332 cf

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Link DP 2: Design Point 2

Inflow=20.0 cfs 71,720 cf

Primary=20.0 cfs 71,720 cf

Link DP-3: Design Point 3

Inflow=7.4 cfs 22,209 cf

Primary=7.4 cfs 22,209 cf

Total Runoff Area = 2,081,501 sf Runoff Volume = 456,311 cf Average Runoff Depth = 2.63"
70.63% Pervious = 1,470,214 sf 29.37% Impervious = 611,287 sf

Summary for Subcatchment PR-10: Proposed North Hill Campus

Runoff = 62.5 cfs @ 12.21 hrs, Volume= 266,483 cf, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

	Area (sf)	CN	Description
*	518,662	98	Impervious
	93,214	73	Woods, Fair, HSG C
	305,613	79	50-75% Grass cover, Fair, HSG C
	917,489	89	Weighted Average
	398,827		43.47% Pervious Area
	518,662		56.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.7	125	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.1	15	0.3300	4.02		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.7	456	0.0500	10.14	7.97	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
0.3	132	0.0150	7.28	12.87	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
2.1	928	0.0100	7.20	22.62	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.4	483	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	2,324	Total			

Summary for Subcatchment PR-10A: Added Parking

Runoff = 0.3 cfs @ 12.07 hrs, Volume= 893 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

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Type III 24-hr 10 year Rainfall=4.70"

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	Area (sf)	CN	Description
*	2,400	98	Impervious
	2,400		100.00% Impervious Area

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

Summary for Subcatchment PR-11: West Side of Hill

Runoff = 3.1 cfs @ 12.23 hrs, Volume= 17,691 cf, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

	Area (sf)	CN	Description
	7,216	98	Impervious
	8,259	30	Brush, Good, HSG A
	111,905	73	Woods, Fair, HSG C
*	133,360	30	Brush, Good, HSG A
	8,323	79	50-75% Grass cover, Fair, HSG C
	16,102	73	Brush, Good, HSG D
	7,201	65	Brush, Good, HSG C
	292,366	53	Weighted Average
	285,150		97.53% Pervious Area
	7,216		2.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.5	400	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.6	355	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
12.9	805	Total			

Summary for Subcatchment PR-12: West Side of Hill

Runoff = 11.2 cfs @ 12.15 hrs, Volume= 40,859 cf, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

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Type III 24-hr 10 year Rainfall=4.70"

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Area (sf)	CN	Description
* 7,600	98	Impervious
190,538	73	Woods, Fair, HSG C
23,894	79	50-75% Grass cover, Fair, HSG C
222,032	75	Weighted Average
214,432		96.58% Pervious Area
7,600		3.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	15	0.0200	0.12		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
0.9	15	0.1750	0.28		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
2.5	20	0.1750	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	430	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.1	360	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
10.8	870	Total			

Summary for Subcatchment PR-13A: Southwest Side of Hill

Runoff = 4.0 cfs @ 12.12 hrs, Volume= 13,592 cf, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
* 8,039	98	Impervious
48,481	73	Woods, Fair, HSG C
12,181	79	50-75% Grass cover, Fair, HSG C
68,701	77	Weighted Average
60,662		88.30% Pervious Area
8,039		11.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	20	0.0250	0.13		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
3.8	30	0.1400	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	85	0.1400	1.87		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	380	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
8.4	515	Total			

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Type III 24-hr 10 year Rainfall=4.70"

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Summary for Subcatchment PR-13B: Portion of Existing CR ARC & Proposed Pervious Area (Prior to Cu

Runoff = 1.9 cfs @ 12.07 hrs, Volume= 5,686 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

	Area (sf)	CN	Description
*	6,320	98	Impervious
	9,870	73	Woods, Fair, HSG C
	8,880	79	50-75% Grass cover, Fair, HSG C
	25,070	81	Weighted Average
	18,750		74.79% Pervious Area
	6,320		25.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum Tc

Summary for Subcatchment PR-14: Bayview Drive

Runoff = 4.8 cfs @ 12.09 hrs, Volume= 16,744 cf, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

	Area (sf)	CN	Description
	43,400	98	Impervious
	0	73	Woods, Fair, HSG C
	4,050	79	50-75% Grass cover, Fair, HSG C
	47,450	96	Weighted Average
	4,050		8.54% Pervious Area
	43,400		91.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	32	0.0220	1.14		Sheet Flow, Paved Smooth surfaces n= 0.011 P2= 3.20"
2.7	573	0.0300	3.52		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
2.8	1,000	0.0070	6.02	18.93	Pipe Channel, RCP_Round 24" 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.4	571	0.0790	21.89	87.05	Pipe Channel, RCP_Round 27" 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013
0.1	60	0.0150	11.56	81.69	Pipe Channel, RCP_Round 36" 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
6.5	2,236	Total			

Summary for Subcatchment PR-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 16.1 cfs @ 12.14 hrs, Volume= 58,060 cf, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
* 6,020	98	Impervious
275,940	73	Woods, Fair, HSG C
45,543	79	50-75% Grass cover, Fair, HSG C
327,503	74	Weighted Average
321,483		98.16% Pervious Area
6,020		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods
					Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	400	0.1100	1.66		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
10.2	450	Total			

Summary for Subcatchment PR-21: Northwest Access Drive and Hill

Runoff = 4.7 cfs @ 12.08 hrs, Volume= 14,095 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
* 9,830	98	Impervious
10,850	73	Woods, Fair, HSG C
41,460	79	50-75% Grass cover, Fair, HSG C
62,140	81	Weighted Average
52,310		84.18% Pervious Area
9,830		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0588	0.23		Sheet Flow, Grass
					Grass: Short n= 0.150 P2= 3.20"
1.6	320	0.0500	3.35		Shallow Concentrated Flow, Swale
					Grassed Waterway Kv= 15.0 fps
5.3	370	Total			

Summary for Subcatchment PR-30: Perimeter Access Drive and Slope

Runoff = 7.4 cfs @ 12.08 hrs, Volume= 22,209 cf, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 year Rainfall=4.70"

Area (sf)	CN	Description
1,800	98	Impervious
60,500	73	Woods, Fair, HSG C
54,050	79	50-75% Grass cover, Fair, HSG C
116,350	76	Weighted Average
114,550		98.45% Pervious Area
1,800		1.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.3440	4.11		Shallow Concentrated Flow, Grass
					Short Grass Pasture Kv= 7.0 fps
0.7	85	0.1530	1.96		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
0.8	101	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 93,771 sf, 15.31% Impervious, Inflow Depth = 2.47" for 10 year event
Inflow = 5.7 cfs @ 12.10 hrs, Volume= 19,278 cf
Outflow = 5.7 cfs @ 12.10 hrs, Volume= 19,278 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1AA: Wet Basin - Upper Levels Only

[44] Hint: Outlet device #3 is below defined storage

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 2.75" for 10 year event
Inflow = 83.0 cfs @ 12.20 hrs, Volume= 361,608 cf
Outflow = 72.8 cfs @ 12.28 hrs, Volume= 361,610 cf, Atten= 12%, Lag= 5.3 min
Primary = 72.8 cfs @ 12.28 hrs, Volume= 361,610 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 153.13' @ 12.28 hrs Surf.Area= 33,329 sf Storage= 88,991 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 173.3 min (987.9 - 814.6)

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Volume	Invert	Avail.Storage	Storage Description
#1	149.70'	101,744 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.70	20,236	0	0
150.00	20,347	6,087	6,087
151.00	24,116	22,232	28,319
152.00	28,073	26,095	54,413
153.00	32,496	30,285	84,698
153.50	35,688	17,046	101,744

Device	Routing	Invert	Outlet Devices
#1	Primary	152.25'	20.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#2	Primary	152.59'	24.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#3	Primary	149.50'	8.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=72.8 cfs @ 12.28 hrs HW=153.13' TW=147.84' (Dynamic Tailwater)

- 1=Broad-Crested Rectangular Weir (Weir Controls 44.0 cfs @ 2.50 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 25.5 cfs @ 1.97 fps)
- 3=Orifice/Grate (Orifice Controls 3.2 cfs @ 9.17 fps)

Summary for Pond P 1B: Existing Expanded Basin

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 2.75" for 10 year event
 Inflow = 72.8 cfs @ 12.28 hrs, Volume= 361,610 cf
 Outflow = 2.6 cfs @ 18.21 hrs, Volume= 282,332 cf, Atten= 96%, Lag= 355.8 min
 Primary = 2.6 cfs @ 18.21 hrs, Volume= 282,332 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 150.34' @ 18.21 hrs Surf.Area= 78,100 sf Storage= 207,119 cf

Plug-Flow detention time= 906.2 min calculated for 282,332 cf (78% of inflow)
 Center-of-Mass det. time= 737.0 min (1,725.0 - 987.9)

Volume	Invert	Avail.Storage	Storage Description
#1	144.50'	527,911 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

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Type III 24-hr 10 year Rainfall=4.70"

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
144.50	0	0	0
145.00	2,609	652	652
146.00	10,587	6,598	7,250
147.00	22,591	16,589	23,839
148.00	41,981	32,286	56,125
149.00	65,579	53,780	109,905
150.00	76,289	70,934	180,839
151.00	81,609	78,949	259,788
152.00	86,811	84,210	343,998
153.00	92,120	89,466	433,464
154.00	96,775	94,448	527,911

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.014, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Weir - Rip Rap Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.6 cfs @ 18.21 hrs HW=150.34' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 2.6 cfs of 7.4 cfs potential flow)
 2=Low Flow Orifice (Orifice Controls 0.2 cfs @ 11.35 fps)
 3=Orifice (Orifice Controls 2.0 cfs @ 10.05 fps)
 4=Weir/Orifice (Orifice Controls 0.4 cfs @ 1.07 fps)
 5=Orifice (Controls 0.0 cfs)
 6=Weir - Rip Rap Spillway (Controls 0.0 cfs)

Summary for Pond P 2A: Rain Garden 1

Inflow Area = 62,140 sf, 15.82% Impervious, Inflow Depth = 2.72" for 10 year event
 Inflow = 4.7 cfs @ 12.08 hrs, Volume= 14,095 cf
 Outflow = 4.6 cfs @ 12.09 hrs, Volume= 13,660 cf, Atten= 1%, Lag= 0.7 min
 Primary = 4.6 cfs @ 12.09 hrs, Volume= 13,660 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 194.37' @ 12.09 hrs Surf.Area= 786 sf Storage= 708 cf

Plug-Flow detention time= 27.7 min calculated for 13,657 cf (97% of inflow)
 Center-of-Mass det. time= 9.9 min (831.0 - 821.1)

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Volume	Invert	Avail.Storage	Storage Description
#1	193.25'	1,258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.25	490	0	0
194.00	670	435	435
194.50	825	374	809
195.00	970	449	1,258

Device	Routing	Invert	Outlet Devices
#1	Primary	194.00'	8.0' long x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=4.6 cfs @ 12.09 hrs HW=194.37' TW=0.00' (Dynamic Tailwater)↑**1=Broad-Crested Rectangular Weir**(Weir Controls 4.6 cfs @ 1.54 fps)**Summary for Pond P-1C: Subsurface Infiltration**

Inflow Area = 2,400 sf, 100.00% Impervious, Inflow Depth = 4.46" for 10 year event
 Inflow = 0.3 cfs @ 12.07 hrs, Volume= 893 cf
 Outflow = 0.3 cfs @ 12.07 hrs, Volume= 553 cf, Atten= 0%, Lag= 0.1 min
 Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
 Primary = 0.3 cfs @ 12.07 hrs, Volume= 553 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 224.05' @ 12.07 hrs Surf.Area= 243 sf Storage= 346 cf

Flood Elev= 227.10' Surf.Area= 243 sf Storage= 384 cf

Plug-Flow detention time= 210.7 min calculated for 553 cf (62% of inflow)

Center-of-Mass det. time= 103.6 min (851.8 - 748.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	221.00'	237 cf	6.83'W x 33.68'L x 2.83'H Field A 652 cf Overall - 59 cf Embedded = 593 cf x 40.0% Voids
#2A	222.00'	59 cf	ADS_StormTech SC-310 +Cap x 4 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	220.10'	88 cf	4.00'D x 7.00'H Catch Basin
		384 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	220.10'	0.170 in/hr Exfiltration X 0.00 over Surface area Conductivity to Groundwater Elevation = 216.00' Phase-In= 0.10'
#2	Primary	223.80'	12.0" Round Culvert L= 15.0' RCP, square edge headwall, Ke= 0.500

Inlet / Outlet Invert= 223.80' / 222.90' S= 0.0600 '/' Cc= 0.900
n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=220.10' (Free Discharge)

↑**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.07 hrs HW=224.05' TW=152.36' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 0.3 cfs @ 1.70 fps)

Summary for Link DP 1: Design Point 1

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth > 2.15" for 10 year event
Inflow = 2.6 cfs @ 18.21 hrs, Volume= 282,332 cf
Primary = 2.6 cfs @ 18.21 hrs, Volume= 282,332 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

Inflow Area = 389,643 sf, 4.07% Impervious, Inflow Depth = 2.21" for 10 year event
Inflow = 20.0 cfs @ 12.13 hrs, Volume= 71,720 cf
Primary = 20.0 cfs @ 12.13 hrs, Volume= 71,720 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Design Point 3

Inflow Area = 116,350 sf, 1.55% Impervious, Inflow Depth = 2.29" for 10 year event
Inflow = 7.4 cfs @ 12.08 hrs, Volume= 22,209 cf
Primary = 7.4 cfs @ 12.08 hrs, Volume= 22,209 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-10: Proposed North Runoff Area=917,489 sf 56.53% Impervious Runoff Depth=4.25"
Flow Length=2,324' Tc=15.8 min CN=89 Runoff=75.6 cfs 325,118 cf

SubcatchmentPR-10A: Added Parking Runoff Area=2,400 sf 100.00% Impervious Runoff Depth=5.26"
Tc=5.0 min CN=98 Runoff=0.3 cfs 1,052 cf

SubcatchmentPR-11: West Side of Hill Runoff Area=292,366 sf 2.47% Impervious Runoff Depth=1.10"
Flow Length=805' Tc=12.9 min CN=53 Runoff=5.5 cfs 26,863 cf

SubcatchmentPR-12: West Side of Hill Runoff Area=222,032 sf 3.42% Impervious Runoff Depth=2.86"
Flow Length=870' Tc=10.8 min CN=75 Runoff=14.5 cfs 52,928 cf

SubcatchmentPR-13A: Southwest Side of Runoff Area=68,701 sf 11.70% Impervious Runoff Depth=3.05"
Flow Length=515' Tc=8.4 min CN=77 Runoff=5.2 cfs 17,441 cf

SubcatchmentPR-13B: Portion of Existing Runoff Area=25,070 sf 25.21% Impervious Runoff Depth=3.43"
Tc=5.0 min CN=81 Runoff=2.4 cfs 7,168 cf

SubcatchmentPR-14: Bayview Drive Runoff Area=47,450 sf 91.46% Impervious Runoff Depth=5.03"
Flow Length=2,236' Tc=6.5 min CN=96 Runoff=5.7 cfs 19,889 cf

SubcatchmentPR-20: Northwest Portion Runoff Area=327,503 sf 1.84% Impervious Runoff Depth=2.77"
Flow Length=450' Slope=0.1100 '/' Tc=10.2 min CN=74 Runoff=21.1 cfs 75,576 cf

SubcatchmentPR-21: Northwest Access Runoff Area=62,140 sf 15.82% Impervious Runoff Depth=3.43"
Flow Length=370' Tc=5.3 min CN=81 Runoff=5.9 cfs 17,767 cf

SubcatchmentPR-30: Perimeter Access Runoff Area=116,350 sf 1.55% Impervious Runoff Depth=2.95"
Flow Length=101' Tc=5.0 min CN=76 Runoff=9.6 cfs 28,632 cf

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=7.3 cfs 24,609 cf
Outflow=7.3 cfs 24,609 cf

Pond P 1AA: Wet Basin - Upper Levels Peak Elev=153.28' Storage=94,084 cf Inflow=103.4 cfs 450,119 cf
Outflow=96.0 cfs 450,121 cf

Pond P 1B: Existing Expanded Basin Peak Elev=150.77' Storage=241,012 cf Inflow=96.0 cfs 450,121 cf
Outflow=6.1 cfs 364,023 cf

Pond P 2A: Rain Garden 1 Peak Elev=194.43' Storage=753 cf Inflow=5.9 cfs 17,767 cf
Outflow=5.8 cfs 17,332 cf

Pond P-1C: Subsurface Infiltration Peak Elev=224.07' Storage=346 cf Inflow=0.3 cfs 1,052 cf
Discarded=0.0 cfs 0 cf Primary=0.3 cfs 713 cf Outflow=0.3 cfs 713 cf

Link DP 1: Design Point 1 Inflow=6.1 cfs 364,023 cf
Primary=6.1 cfs 364,023 cf

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Type III 24-hr 25 year Rainfall=5.50"

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Link DP 2: Design Point 2

Inflow=26.1 cfs 92,908 cf

Primary=26.1 cfs 92,908 cf

Link DP-3: Design Point 3

Inflow=9.6 cfs 28,632 cf

Primary=9.6 cfs 28,632 cf

Total Runoff Area = 2,081,501 sf Runoff Volume = 572,434 cf Average Runoff Depth = 3.30"
70.63% Pervious = 1,470,214 sf 29.37% Impervious = 611,287 sf

Summary for Subcatchment PR-10: Proposed North Hill Campus

Runoff = 75.6 cfs @ 12.21 hrs, Volume= 325,118 cf, Depth= 4.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

	Area (sf)	CN	Description
*	518,662	98	Impervious
	93,214	73	Woods, Fair, HSG C
	305,613	79	50-75% Grass cover, Fair, HSG C
	917,489	89	Weighted Average
	398,827		43.47% Pervious Area
	518,662		56.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.7	125	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.1	15	0.3300	4.02		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.7	456	0.0500	10.14	7.97	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
0.3	132	0.0150	7.28	12.87	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
2.1	928	0.0100	7.20	22.62	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.4	483	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	2,324	Total			

Summary for Subcatchment PR-10A: Added Parking

Runoff = 0.3 cfs @ 12.07 hrs, Volume= 1,052 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

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Type III 24-hr 25 year Rainfall=5.50"

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	Area (sf)	CN	Description
*	2,400	98	Impervious
	2,400		100.00% Impervious Area

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

Summary for Subcatchment PR-11: West Side of Hill

Runoff = 5.5 cfs @ 12.21 hrs, Volume= 26,863 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

	Area (sf)	CN	Description
	7,216	98	Impervious
	8,259	30	Brush, Good, HSG A
	111,905	73	Woods, Fair, HSG C
*	133,360	30	Brush, Good, HSG A
	8,323	79	50-75% Grass cover, Fair, HSG C
	16,102	73	Brush, Good, HSG D
	7,201	65	Brush, Good, HSG C
	292,366	53	Weighted Average
	285,150		97.53% Pervious Area
	7,216		2.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.5	400	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.6	355	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
12.9	805	Total			

Summary for Subcatchment PR-12: West Side of Hill

Runoff = 14.5 cfs @ 12.15 hrs, Volume= 52,928 cf, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

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Type III 24-hr 25 year Rainfall=5.50"

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Area (sf)	CN	Description
* 7,600	98	Impervious
190,538	73	Woods, Fair, HSG C
23,894	79	50-75% Grass cover, Fair, HSG C
222,032	75	Weighted Average
214,432		96.58% Pervious Area
7,600		3.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	15	0.0200	0.12		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
0.9	15	0.1750	0.28		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
2.5	20	0.1750	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	430	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.1	360	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
10.8	870	Total			

Summary for Subcatchment PR-13A: Southwest Side of Hill

Runoff = 5.2 cfs @ 12.12 hrs, Volume= 17,441 cf, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (sf)	CN	Description
* 8,039	98	Impervious
48,481	73	Woods, Fair, HSG C
12,181	79	50-75% Grass cover, Fair, HSG C
68,701	77	Weighted Average
60,662		88.30% Pervious Area
8,039		11.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	20	0.0250	0.13		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
3.8	30	0.1400	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	85	0.1400	1.87		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	380	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
8.4	515	Total			

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Type III 24-hr 25 year Rainfall=5.50"

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Summary for Subcatchment PR-13B: Portion of Existing CR ARC & Proposed Pervious Area (Prior to Cu

Runoff = 2.4 cfs @ 12.07 hrs, Volume= 7,168 cf, Depth= 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

	Area (sf)	CN	Description
*	6,320	98	Impervious
	9,870	73	Woods, Fair, HSG C
	8,880	79	50-75% Grass cover, Fair, HSG C
	25,070	81	Weighted Average
	18,750		74.79% Pervious Area
	6,320		25.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum Tc

Summary for Subcatchment PR-14: Bayview Drive

Runoff = 5.7 cfs @ 12.09 hrs, Volume= 19,889 cf, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

	Area (sf)	CN	Description
	43,400	98	Impervious
	0	73	Woods, Fair, HSG C
	4,050	79	50-75% Grass cover, Fair, HSG C
	47,450	96	Weighted Average
	4,050		8.54% Pervious Area
	43,400		91.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	32	0.0220	1.14		Sheet Flow, Paved Smooth surfaces n= 0.011 P2= 3.20"
2.7	573	0.0300	3.52		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
2.8	1,000	0.0070	6.02	18.93	Pipe Channel, RCP_Round 24" 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.4	571	0.0790	21.89	87.05	Pipe Channel, RCP_Round 27" 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013
0.1	60	0.0150	11.56	81.69	Pipe Channel, RCP_Round 36" 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
6.5	2,236	Total			

Summary for Subcatchment PR-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 21.1 cfs @ 12.14 hrs, Volume= 75,576 cf, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (sf)	CN	Description
* 6,020	98	Impervious
275,940	73	Woods, Fair, HSG C
45,543	79	50-75% Grass cover, Fair, HSG C
327,503	74	Weighted Average
321,483		98.16% Pervious Area
6,020		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods
					Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	400	0.1100	1.66		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
10.2	450	Total			

Summary for Subcatchment PR-21: Northwest Access Drive and Hill

Runoff = 5.9 cfs @ 12.08 hrs, Volume= 17,767 cf, Depth= 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (sf)	CN	Description
* 9,830	98	Impervious
10,850	73	Woods, Fair, HSG C
41,460	79	50-75% Grass cover, Fair, HSG C
62,140	81	Weighted Average
52,310		84.18% Pervious Area
9,830		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0588	0.23		Sheet Flow, Grass
					Grass: Short n= 0.150 P2= 3.20"
1.6	320	0.0500	3.35		Shallow Concentrated Flow, Swale
					Grassed Waterway Kv= 15.0 fps
5.3	370	Total			

Summary for Subcatchment PR-30: Perimeter Access Drive and Slope

Runoff = 9.6 cfs @ 12.08 hrs, Volume= 28,632 cf, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 year Rainfall=5.50"

Area (sf)	CN	Description
1,800	98	Impervious
60,500	73	Woods, Fair, HSG C
54,050	79	50-75% Grass cover, Fair, HSG C
116,350	76	Weighted Average
114,550		98.45% Pervious Area
1,800		1.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.3440	4.11		Shallow Concentrated Flow, Grass
					Short Grass Pasture Kv= 7.0 fps
0.7	85	0.1530	1.96		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
0.8	101	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 93,771 sf, 15.31% Impervious, Inflow Depth = 3.15" for 25 year event
Inflow = 7.3 cfs @ 12.10 hrs, Volume= 24,609 cf
Outflow = 7.3 cfs @ 12.10 hrs, Volume= 24,609 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1AA: Wet Basin - Upper Levels Only

[44] Hint: Outlet device #3 is below defined storage

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 3.43" for 25 year event
Inflow = 103.4 cfs @ 12.19 hrs, Volume= 450,119 cf
Outflow = 96.0 cfs @ 12.25 hrs, Volume= 450,121 cf, Atten= 7%, Lag= 3.8 min
Primary = 96.0 cfs @ 12.25 hrs, Volume= 450,121 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 153.28' @ 12.25 hrs Surf.Area= 34,290 sf Storage= 94,084 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 152.7 min (962.4 - 809.7)

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Type III 24-hr 25 year Rainfall=5.50"

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Volume	Invert	Avail.Storage	Storage Description
#1	149.70'	101,744 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.70	20,236	0	0
150.00	20,347	6,087	6,087
151.00	24,116	22,232	28,319
152.00	28,073	26,095	54,413
153.00	32,496	30,285	84,698
153.50	35,688	17,046	101,744

Device	Routing	Invert	Outlet Devices
#1	Primary	152.25'	20.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#2	Primary	152.59'	24.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#3	Primary	149.50'	8.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=96.0 cfs @ 12.25 hrs HW=153.28' TW=148.39' (Dynamic Tailwater)

- 1=Broad-Crested Rectangular Weir (Weir Controls 55.7 cfs @ 2.70 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 37.0 cfs @ 2.23 fps)
- 3=Orifice/Grate (Orifice Controls 3.3 cfs @ 9.36 fps)

Summary for Pond P 1B: Existing Expanded Basin

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 3.43" for 25 year event
 Inflow = 96.0 cfs @ 12.25 hrs, Volume= 450,121 cf
 Outflow = 6.1 cfs @ 15.51 hrs, Volume= 364,023 cf, Atten= 94%, Lag= 195.5 min
 Primary = 6.1 cfs @ 15.51 hrs, Volume= 364,023 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 150.77' @ 15.51 hrs Surf.Area= 80,376 sf Storage= 241,012 cf

Plug-Flow detention time= 764.8 min calculated for 364,023 cf (81% of inflow)
 Center-of-Mass det. time= 611.3 min (1,573.7 - 962.4)

Volume	Invert	Avail.Storage	Storage Description
#1	144.50'	527,911 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

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Type III 24-hr 25 year Rainfall=5.50"

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
144.50	0	0	0
145.00	2,609	652	652
146.00	10,587	6,598	7,250
147.00	22,591	16,589	23,839
148.00	41,981	32,286	56,125
149.00	65,579	53,780	109,905
150.00	76,289	70,934	180,839
151.00	81,609	78,949	259,788
152.00	86,811	84,210	343,998
153.00	92,120	89,466	433,464
154.00	96,775	94,448	527,911

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.014, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Weir - Rip Rap Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=6.1 cfs @ 15.51 hrs HW=150.77' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 6.1 cfs of 7.7 cfs potential flow)
 2=Low Flow Orifice (Orifice Controls 0.3 cfs @ 11.78 fps)
 3=Orifice (Orifice Controls 2.1 cfs @ 10.54 fps)
 4=Weir/Orifice (Orifice Controls 3.8 cfs @ 2.35 fps)
 5=Orifice (Controls 0.0 cfs)
 6=Weir - Rip Rap Spillway (Controls 0.0 cfs)

Summary for Pond P 2A: Rain Garden 1

Inflow Area = 62,140 sf, 15.82% Impervious, Inflow Depth = 3.43" for 25 year event
 Inflow = 5.9 cfs @ 12.08 hrs, Volume= 17,767 cf
 Outflow = 5.8 cfs @ 12.09 hrs, Volume= 17,332 cf, Atten= 1%, Lag= 0.6 min
 Primary = 5.8 cfs @ 12.09 hrs, Volume= 17,332 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 194.43' @ 12.09 hrs Surf.Area= 804 sf Storage= 753 cf

Plug-Flow detention time= 23.4 min calculated for 17,332 cf (98% of inflow)
 Center-of-Mass det. time= 8.9 min (823.3 - 814.4)

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Type III 24-hr 25 year Rainfall=5.50"

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Volume	Invert	Avail.Storage	Storage Description
#1	193.25'	1,258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.25	490	0	0
194.00	670	435	435
194.50	825	374	809
195.00	970	449	1,258

Device	Routing	Invert	Outlet Devices
#1	Primary	194.00'	8.0' long x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=5.8 cfs @ 12.09 hrs HW=194.43' TW=0.00' (Dynamic Tailwater)

↑**1=Broad-Crested Rectangular Weir**(Weir Controls 5.8 cfs @ 1.68 fps)

Summary for Pond P-1C: Subsurface Infiltration

Inflow Area = 2,400 sf, 100.00% Impervious, Inflow Depth = 5.26" for 25 year event
 Inflow = 0.3 cfs @ 12.07 hrs, Volume= 1,052 cf
 Outflow = 0.3 cfs @ 12.07 hrs, Volume= 713 cf, Atten= 0%, Lag= 0.1 min
 Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
 Primary = 0.3 cfs @ 12.07 hrs, Volume= 713 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 224.07' @ 12.07 hrs Surf.Area= 243 sf Storage= 346 cf

Flood Elev= 227.10' Surf.Area= 243 sf Storage= 384 cf

Plug-Flow detention time= 192.0 min calculated for 713 cf (68% of inflow)

Center-of-Mass det. time= 93.2 min (838.7 - 745.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	221.00'	237 cf	6.83'W x 33.68'L x 2.83'H Field A
			652 cf Overall - 59 cf Embedded = 593 cf x 40.0% Voids
#2A	222.00'	59 cf	ADS_StormTech SC-310 +Cap x 4 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	220.10'	88 cf	4.00'D x 7.00'H Catch Basin
		384 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	220.10'	0.170 in/hr Exfiltration X 0.00 over Surface area Conductivity to Groundwater Elevation = 216.00' Phase-In= 0.10'
#2	Primary	223.80'	12.0" Round Culvert L= 15.0' RCP, square edge headwall, Ke= 0.500

Inlet / Outlet Invert= 223.80' / 222.90' S= 0.0600 '/' Cc= 0.900
n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=220.10' (Free Discharge)

↑**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.07 hrs HW=224.07' TW=152.87' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 0.3 cfs @ 1.78 fps)

Summary for Link DP 1: Design Point 1

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth > 2.77" for 25 year event
Inflow = 6.1 cfs @ 15.51 hrs, Volume= 364,023 cf
Primary = 6.1 cfs @ 15.51 hrs, Volume= 364,023 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

Inflow Area = 389,643 sf, 4.07% Impervious, Inflow Depth = 2.86" for 25 year event
Inflow = 26.1 cfs @ 12.13 hrs, Volume= 92,908 cf
Primary = 26.1 cfs @ 12.13 hrs, Volume= 92,908 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Design Point 3

Inflow Area = 116,350 sf, 1.55% Impervious, Inflow Depth = 2.95" for 25 year event
Inflow = 9.6 cfs @ 12.08 hrs, Volume= 28,632 cf
Primary = 9.6 cfs @ 12.08 hrs, Volume= 28,632 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

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Type III 24-hr 100 year Rainfall=6.70"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-10: Proposed North Runoff Area=917,489 sf 56.53% Impervious Runoff Depth=5.42"
Flow Length=2,324' Tc=15.8 min CN=89 Runoff=95.2 cfs 414,058 cf

SubcatchmentPR-10A: Added Parking Runoff Area=2,400 sf 100.00% Impervious Runoff Depth=6.46"
Tc=5.0 min CN=98 Runoff=0.4 cfs 1,292 cf

SubcatchmentPR-11: West Side of Hill Runoff Area=292,366 sf 2.47% Impervious Runoff Depth=1.76"
Flow Length=805' Tc=12.9 min CN=53 Runoff=9.9 cfs 42,865 cf

SubcatchmentPR-12: West Side of Hill Runoff Area=222,032 sf 3.42% Impervious Runoff Depth=3.89"
Flow Length=870' Tc=10.8 min CN=75 Runoff=19.8 cfs 71,906 cf

SubcatchmentPR-13A: Southwest Side of Runoff Area=68,701 sf 11.70% Impervious Runoff Depth=4.10"
Flow Length=515' Tc=8.4 min CN=77 Runoff=7.0 cfs 23,457 cf

SubcatchmentPR-13B: Portion of Existing Runoff Area=25,070 sf 25.21% Impervious Runoff Depth=4.53"
Tc=5.0 min CN=81 Runoff=3.1 cfs 9,457 cf

SubcatchmentPR-14: Bayview Drive Runoff Area=47,450 sf 91.46% Impervious Runoff Depth=6.22"
Flow Length=2,236' Tc=6.5 min CN=96 Runoff=7.0 cfs 24,613 cf

SubcatchmentPR-20: Northwest Portion Runoff Area=327,503 sf 1.84% Impervious Runoff Depth=3.78"
Flow Length=450' Slope=0.1100 '/' Tc=10.2 min CN=74 Runoff=29.0 cfs 103,211 cf

SubcatchmentPR-21: Northwest Access Runoff Area=62,140 sf 15.82% Impervious Runoff Depth=4.53"
Flow Length=370' Tc=5.3 min CN=81 Runoff=7.7 cfs 23,441 cf

SubcatchmentPR-30: Perimeter Access Runoff Area=116,350 sf 1.55% Impervious Runoff Depth=3.99"
Flow Length=101' Tc=5.0 min CN=76 Runoff=12.9 cfs 38,700 cf

Reach R 1: Existing Swale - E. Militia Heights Drive Inflow=9.8 cfs 32,914 cf
Outflow=9.8 cfs 32,914 cf

Pond P 1AA: Wet Basin - Upper Levels Peak Elev=153.46' Storage=100,492 cf Inflow=134.7 cfs 587,308 cf
Outflow=127.2 cfs 587,311 cf

Pond P 1B: Existing Expanded Basin Peak Elev=151.63' Storage=312,462 cf Inflow=127.2 cfs 587,311 cf
Outflow=8.2 cfs 495,217 cf

Pond P 2A: Rain Garden 1 Peak Elev=194.51' Storage=816 cf Inflow=7.7 cfs 23,441 cf
Outflow=7.6 cfs 23,006 cf

Pond P-1C: Subsurface Infiltration Peak Elev=224.10' Storage=347 cf Inflow=0.4 cfs 1,292 cf
Discarded=0.0 cfs 0 cf Primary=0.4 cfs 953 cf Outflow=0.4 cfs 953 cf

Link DP 1: Design Point 1 Inflow=8.2 cfs 495,217 cf
Primary=8.2 cfs 495,217 cf

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Link DP 2: Design Point 2

Inflow=35.4 cfs 126,217 cf

Primary=35.4 cfs 126,217 cf

Link DP-3: Design Point 3

Inflow=12.9 cfs 38,700 cf

Primary=12.9 cfs 38,700 cf

Total Runoff Area = 2,081,501 sf Runoff Volume = 753,000 cf Average Runoff Depth = 4.34"
70.63% Pervious = 1,470,214 sf 29.37% Impervious = 611,287 sf

Summary for Subcatchment PR-10: Proposed North Hill Campus

Runoff = 95.2 cfs @ 12.20 hrs, Volume= 414,058 cf, Depth= 5.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

	Area (sf)	CN	Description
*	518,662	98	Impervious
	93,214	73	Woods, Fair, HSG C
	305,613	79	50-75% Grass cover, Fair, HSG C
	917,489	89	Weighted Average
	398,827		43.47% Pervious Area
	518,662		56.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	20	0.0250	0.06		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	30	0.2500	0.17		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.9	55	0.0200	0.99		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.7	125	0.0590	1.21		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.1	15	0.3300	4.02		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, Grass Short Grass Pasture Kv= 7.0 fps
0.7	456	0.0500	10.14	7.97	Pipe Channel, Drain Network 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
0.3	132	0.0150	7.28	12.87	Pipe Channel, Drain Network 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
2.1	928	0.0100	7.20	22.62	Pipe Channel, Drain Network 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.4	483	0.0800	22.03	87.60	Pipe Channel, Drain Network 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013 Concrete pipe, bends & connections
15.8	2,324	Total			

Summary for Subcatchment PR-10A: Added Parking

Runoff = 0.4 cfs @ 12.07 hrs, Volume= 1,292 cf, Depth= 6.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

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Type III 24-hr 100 year Rainfall=6.70"

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	Area (sf)	CN	Description
*	2,400	98	Impervious
	2,400		100.00% Impervious Area

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

Summary for Subcatchment PR-11: West Side of Hill

Runoff = 9.9 cfs @ 12.20 hrs, Volume= 42,865 cf, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

	Area (sf)	CN	Description
	7,216	98	Impervious
	8,259	30	Brush, Good, HSG A
	111,905	73	Woods, Fair, HSG C
*	133,360	30	Brush, Good, HSG A
	8,323	79	50-75% Grass cover, Fair, HSG C
	16,102	73	Brush, Good, HSG D
	7,201	65	Brush, Good, HSG C
	292,366	53	Weighted Average
	285,150		97.53% Pervious Area
	7,216		2.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1300	0.14		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.5	400	0.1480	1.92		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
3.6	355	0.0120	1.64		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
12.9	805	Total			

Summary for Subcatchment PR-12: West Side of Hill

Runoff = 19.8 cfs @ 12.15 hrs, Volume= 71,906 cf, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

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Type III 24-hr 100 year Rainfall=6.70"

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Area (sf)	CN	Description
* 7,600	98	Impervious
190,538	73	Woods, Fair, HSG C
23,894	79	50-75% Grass cover, Fair, HSG C
222,032	75	Weighted Average
214,432		96.58% Pervious Area
7,600		3.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	15	0.0200	0.12		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
0.9	15	0.1750	0.28		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
2.5	20	0.1750	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	430	0.1330	1.82		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
0.3	30	0.0100	1.50		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
1.1	360	0.0080	5.58	17.54	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Corrugated PE, smooth interior
10.8	870	Total			

Summary for Subcatchment PR-13A: Southwest Side of Hill

Runoff = 7.0 cfs @ 12.12 hrs, Volume= 23,457 cf, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (sf)	CN	Description
* 8,039	98	Impervious
48,481	73	Woods, Fair, HSG C
12,181	79	50-75% Grass cover, Fair, HSG C
68,701	77	Weighted Average
60,662		88.30% Pervious Area
8,039		11.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	20	0.0250	0.13		Sheet Flow, Grass Grass: Short n= 0.150 P2= 3.20"
3.8	30	0.1400	0.13		Sheet Flow, Woods Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	85	0.1400	1.87		Shallow Concentrated Flow, Woods Woodland Kv= 5.0 fps
1.3	380	0.1040	4.84		Shallow Concentrated Flow, E. Militia - Swale Grassed Waterway Kv= 15.0 fps
8.4	515	Total			

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Type III 24-hr 100 year Rainfall=6.70"

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Summary for Subcatchment PR-13B: Portion of Existing CR ARC & Proposed Pervious Area (Prior to Cu

Runoff = 3.1 cfs @ 12.07 hrs, Volume= 9,457 cf, Depth= 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

	Area (sf)	CN	Description
*	6,320	98	Impervious
	9,870	73	Woods, Fair, HSG C
	8,880	79	50-75% Grass cover, Fair, HSG C
	25,070	81	Weighted Average
	18,750		74.79% Pervious Area
	6,320		25.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum Tc

Summary for Subcatchment PR-14: Bayview Drive

Runoff = 7.0 cfs @ 12.09 hrs, Volume= 24,613 cf, Depth= 6.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

	Area (sf)	CN	Description
	43,400	98	Impervious
	0	73	Woods, Fair, HSG C
	4,050	79	50-75% Grass cover, Fair, HSG C
	47,450	96	Weighted Average
	4,050		8.54% Pervious Area
	43,400		91.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	32	0.0220	1.14		Sheet Flow, Paved Smooth surfaces n= 0.011 P2= 3.20"
2.7	573	0.0300	3.52		Shallow Concentrated Flow, Paved Paved Kv= 20.3 fps
2.8	1,000	0.0070	6.02	18.93	Pipe Channel, RCP_Round 24" 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.4	571	0.0790	21.89	87.05	Pipe Channel, RCP_Round 27" 27.0" Round Area= 4.0 sf Perim= 7.1' r= 0.56' n= 0.013
0.1	60	0.0150	11.56	81.69	Pipe Channel, RCP_Round 36" 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013
6.5	2,236	Total			

Summary for Subcatchment PR-20: Northwest Portion of Main Entry Drive and Hill

Runoff = 29.0 cfs @ 12.14 hrs, Volume= 103,211 cf, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (sf)	CN	Description
* 6,020	98	Impervious
275,940	73	Woods, Fair, HSG C
45,543	79	50-75% Grass cover, Fair, HSG C
327,503	74	Weighted Average
321,483		98.16% Pervious Area
6,020		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.1100	0.13		Sheet Flow, Woods
					Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	400	0.1100	1.66		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
10.2	450	Total			

Summary for Subcatchment PR-21: Northwest Access Drive and Hill

Runoff = 7.7 cfs @ 12.08 hrs, Volume= 23,441 cf, Depth= 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (sf)	CN	Description
* 9,830	98	Impervious
10,850	73	Woods, Fair, HSG C
41,460	79	50-75% Grass cover, Fair, HSG C
62,140	81	Weighted Average
52,310		84.18% Pervious Area
9,830		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0588	0.23		Sheet Flow, Grass
					Grass: Short n= 0.150 P2= 3.20"
1.6	320	0.0500	3.35		Shallow Concentrated Flow, Swale
					Grassed Waterway Kv= 15.0 fps
5.3	370	Total			

Summary for Subcatchment PR-30: Perimeter Access Drive and Slope

Runoff = 12.9 cfs @ 12.07 hrs, Volume= 38,700 cf, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 year Rainfall=6.70"

Area (sf)	CN	Description
1,800	98	Impervious
60,500	73	Woods, Fair, HSG C
54,050	79	50-75% Grass cover, Fair, HSG C
116,350	76	Weighted Average
114,550		98.45% Pervious Area
1,800		1.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	16	0.3440	4.11		Shallow Concentrated Flow, Grass
					Short Grass Pasture Kv= 7.0 fps
0.7	85	0.1530	1.96		Shallow Concentrated Flow, Woods
					Woodland Kv= 5.0 fps
0.8	101	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach R 1: Existing Swale - E. Militia Heights Drive

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 93,771 sf, 15.31% Impervious, Inflow Depth = 4.21" for 100 year event
Inflow = 9.8 cfs @ 12.10 hrs, Volume= 32,914 cf
Outflow = 9.8 cfs @ 12.10 hrs, Volume= 32,914 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond P 1AA: Wet Basin - Upper Levels Only

[44] Hint: Outlet device #3 is below defined storage

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 4.47" for 100 year event
Inflow = 134.7 cfs @ 12.19 hrs, Volume= 587,308 cf
Outflow = 127.2 cfs @ 12.24 hrs, Volume= 587,311 cf, Atten= 6%, Lag= 3.4 min
Primary = 127.2 cfs @ 12.24 hrs, Volume= 587,311 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 153.46' @ 12.24 hrs Surf.Area= 35,463 sf Storage= 100,492 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 128.1 min (931.8 - 803.7)

11369.04-NorthHill_HydroCAD-PR

Type III 24-hr 100 year Rainfall=6.70"

Prepared by VHB

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Volume	Invert	Avail.Storage	Storage Description
#1	149.70'	101,744 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.70	20,236	0	0
150.00	20,347	6,087	6,087
151.00	24,116	22,232	28,319
152.00	28,073	26,095	54,413
153.00	32,496	30,285	84,698
153.50	35,688	17,046	101,744

Device	Routing	Invert	Outlet Devices
#1	Primary	152.25'	20.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#2	Primary	152.59'	24.0' long x 12.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.58 2.63 2.70 2.67 2.66 2.67 2.66 2.63
#3	Primary	149.50'	8.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=127.1 cfs @ 12.24 hrs HW=153.46' TW=149.19' (Dynamic Tailwater)

1=Broad-Crested Rectangular Weir (Weir Controls 71.5 cfs @ 2.94 fps)

2=Broad-Crested Rectangular Weir (Weir Controls 52.3 cfs @ 2.49 fps)

3=Orifice/Grate (Orifice Controls 3.3 cfs @ 9.59 fps)

Summary for Pond P 1B: Existing Expanded Basin

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth = 4.47" for 100 year event
 Inflow = 127.2 cfs @ 12.24 hrs, Volume= 587,311 cf
 Outflow = 8.2 cfs @ 15.28 hrs, Volume= 495,217 cf, Atten= 94%, Lag= 182.4 min
 Primary = 8.2 cfs @ 15.28 hrs, Volume= 495,217 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 151.63' @ 15.28 hrs Surf.Area= 84,900 sf Storage= 312,462 cf

Plug-Flow detention time= 639.9 min calculated for 495,114 cf (84% of inflow)

Center-of-Mass det. time= 510.8 min (1,442.6 - 931.8)

Volume	Invert	Avail.Storage	Storage Description
#1	144.50'	527,911 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

11369.04-NorthHill_HydroCAD-PR

Type III 24-hr 100 year Rainfall=6.70"

Prepared by VHB

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Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
144.50	0	0	0
145.00	2,609	652	652
146.00	10,587	6,598	7,250
147.00	22,591	16,589	23,839
148.00	41,981	32,286	56,125
149.00	65,579	53,780	109,905
150.00	76,289	70,934	180,839
151.00	81,609	78,949	259,788
152.00	86,811	84,210	343,998
153.00	92,120	89,466	433,464
154.00	96,775	94,448	527,911

Device	Routing	Invert	Outlet Devices
#1	Primary	143.90'	12.0" Round Culvert L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.90' / 143.76' S= 0.0020 ' S= 0.0020 ' Cc= 0.900 n= 0.014, Flow Area= 0.79 sf
#2	Device 1	144.70'	2.0" Vert. Low Flow Orifice C= 0.600
#3	Device 1	145.73'	6.0" Vert. Orifice C= 0.600
#4	Device 1	150.23'	36.0" W x 12.0" H Vert. Weir/Orifice C= 0.600
#5	Device 1	151.24'	36.0" x 36.0" Horiz. Orifice C= 0.600 Limited to weir flow at low heads
#6	Primary	153.00'	13.0' long x 20.0' breadth Weir - Rip Rap Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=8.2 cfs @ 15.28 hrs HW=151.63' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Barrel Controls 8.2 cfs @ 10.46 fps)
- 2=Low Flow Orifice (Passes < 0.3 cfs potential flow)
- 3=Orifice (Passes < 2.2 cfs potential flow)
- 4=Weir/Orifice (Passes < 13.5 cfs potential flow)
- 5=Orifice (Passes < 9.7 cfs potential flow)
- 6=Weir - Rip Rap Spillway (Controls 0.0 cfs)

Summary for Pond P 2A: Rain Garden 1

Inflow Area = 62,140 sf, 15.82% Impervious, Inflow Depth = 4.53" for 100 year event
 Inflow = 7.7 cfs @ 12.08 hrs, Volume= 23,441 cf
 Outflow = 7.6 cfs @ 12.09 hrs, Volume= 23,006 cf, Atten= 1%, Lag= 0.6 min
 Primary = 7.6 cfs @ 12.09 hrs, Volume= 23,006 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 194.51' @ 12.09 hrs Surf.Area= 828 sf Storage= 816 cf

Plug-Flow detention time= 19.0 min calculated for 23,001 cf (98% of inflow)
 Center-of-Mass det. time= 7.8 min (814.4 - 806.6)

11369.04-NorthHill_HydroCAD-PR

Type III 24-hr 100 year Rainfall=6.70"

Prepared by VHB

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Volume	Invert	Avail.Storage	Storage Description
#1	193.25'	1,258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
193.25	490	0	0
194.00	670	435	435
194.50	825	374	809
195.00	970	449	1,258

Device	Routing	Invert	Outlet Devices
#1	Primary	194.00'	8.0' long x 4.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=7.6 cfs @ 12.09 hrs HW=194.51' TW=0.00' (Dynamic Tailwater)↑**1=Broad-Crested Rectangular Weir**(Weir Controls 7.6 cfs @ 1.87 fps)**Summary for Pond P-1C: Subsurface Infiltration**

Inflow Area = 2,400 sf, 100.00% Impervious, Inflow Depth = 6.46" for 100 year event
 Inflow = 0.4 cfs @ 12.07 hrs, Volume= 1,292 cf
 Outflow = 0.4 cfs @ 12.07 hrs, Volume= 953 cf, Atten= 0%, Lag= 0.1 min
 Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
 Primary = 0.4 cfs @ 12.07 hrs, Volume= 953 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 224.10' @ 12.07 hrs Surf.Area= 243 sf Storage= 347 cf

Flood Elev= 227.10' Surf.Area= 243 sf Storage= 384 cf

Plug-Flow detention time= 173.3 min calculated for 952 cf (74% of inflow)

Center-of-Mass det. time= 83.6 min (826.2 - 742.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	221.00'	237 cf	6.83'W x 33.68'L x 2.83'H Field A 652 cf Overall - 59 cf Embedded = 593 cf x 40.0% Voids
#2A	222.00'	59 cf	ADS_StormTech SC-310 +Cap x 4 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
#3	220.10'	88 cf	4.00'D x 7.00'H Catch Basin
		384 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	220.10'	0.170 in/hr Exfiltration X 0.00 over Surface area Conductivity to Groundwater Elevation = 216.00' Phase-In= 0.10'
#2	Primary	223.80'	12.0" Round Culvert L= 15.0' RCP, square edge headwall, Ke= 0.500

Inlet / Outlet Invert= 223.80' / 222.90' S= 0.0600 '/' Cc= 0.900
n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=220.10' (Free Discharge)

↑**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.4 cfs @ 12.07 hrs HW=224.10' TW=153.13' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 0.4 cfs @ 1.87 fps)

Summary for Link DP 1: Design Point 1

Inflow Area = 1,575,508 sf, 37.68% Impervious, Inflow Depth > 3.77" for 100 year event
Inflow = 8.2 cfs @ 15.28 hrs, Volume= 495,217 cf
Primary = 8.2 cfs @ 15.28 hrs, Volume= 495,217 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link DP 2: Design Point 2

Inflow Area = 389,643 sf, 4.07% Impervious, Inflow Depth = 3.89" for 100 year event
Inflow = 35.4 cfs @ 12.13 hrs, Volume= 126,217 cf
Primary = 35.4 cfs @ 12.13 hrs, Volume= 126,217 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

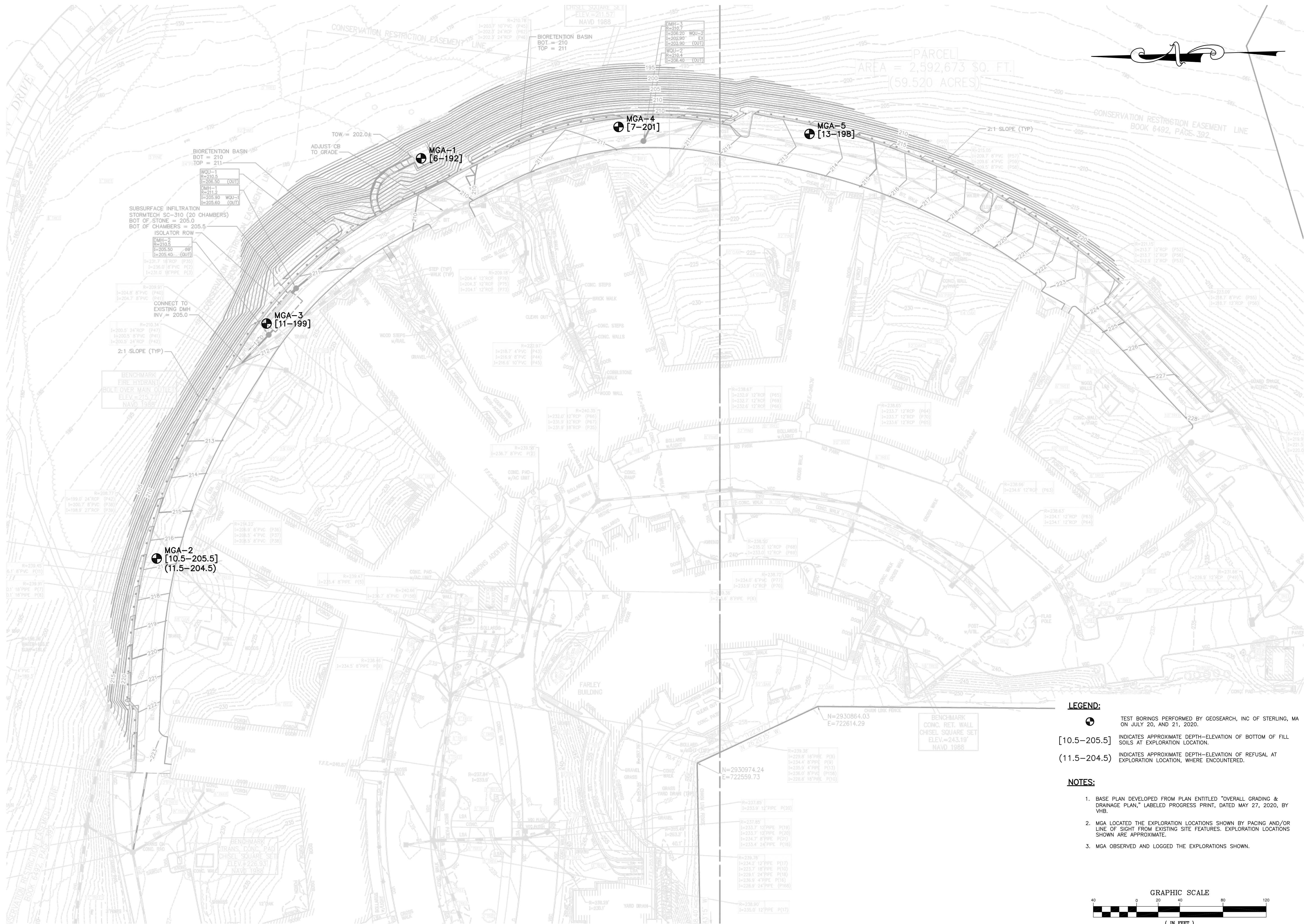
Summary for Link DP-3: Design Point 3

Inflow Area = 116,350 sf, 1.55% Impervious, Inflow Depth = 3.99" for 100 year event
Inflow = 12.9 cfs @ 12.07 hrs, Volume= 38,700 cf
Primary = 12.9 cfs @ 12.07 hrs, Volume= 38,700 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



Attachment 3 – Soil Boring Logs

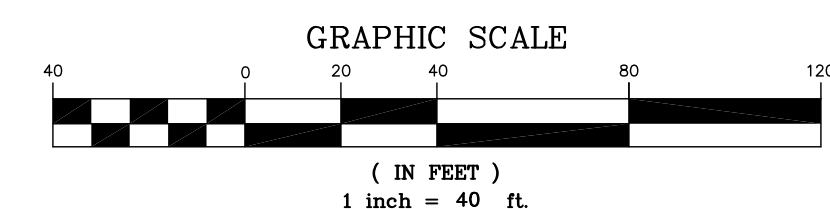


LEGEND:

- TEST BORINGS PERFORMED BY GEOSearch, INC. OF STERLING, MA ON JULY 20, AND 21, 2020.
- [10.5-205.5] INDICATES APPROXIMATE DEPTH-ELEVATION OF BOTTOM OF FILL SOILS AT EXPLORATION LOCATION.
- (11.5-204.5) INDICATES APPROXIMATE DEPTH-ELEVATION OF REFUSAL AT EXPLORATION LOCATION, WHERE ENCOUNTERED.

NOTES:

- BASE PLAN DEVELOPED FROM PLAN ENTITLED "OVERALL GRADING & DRAINAGE PLAN," LABELED PROGRESS PRINT, DATED MAY 27, 2020, BY VHB.
- MGA LOCATED THE EXPLORATION LOCATIONS SHOWN BY PACING AND/OR LINE OF SIGHT FROM EXISTING SITE FEATURES. EXPLORATION LOCATIONS SHOWN ARE APPROXIMATE.
- MGA OBSERVED AND LOGGED THE EXPLORATIONS SHOWN.



REVISIONS

DRAWN BY: RED

DESIGNED BY: RED

CHECKED BY: SLH

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EXPLORATION LOCATION PLAN

NORTH HILL EXPANSION

865 CENTRAL AVENUE, NEEDHAM, MASSACHUSETTS

SEPTEMBER 2020

SCALE: 1" = 40'

JOB No. G0809

FIG No. 2

SHEET 1 OF 1



McCardle Gannon
Associates, Inc.

TEST BORING LOG

BORING MGA-1

PROJECT: North Hill Expansion, 865 Central Avenue, Needham, MA

CLIENT: North Hill, CCRC

CONTRACTOR: Geosearch

MGA NO. : G0809
SHEET NO. : 1 of 1
LOCATION N : See Plan

E :
ELEVATION : 198'±

DATE START : 7/20/20

END : 7/20/20

DRILLER : Ken Bylund

ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HSA	Split Spoon	----
7/20/20	3:15pm	NE (4)	17.5	17.5	Size I.D.	4-1/4"	1-3/8"	----
					Hammer Wt.	----	140#	----
					Hammer Fall	----	30"	----

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			3	S-1	0.0	16	197.5	Dark brown, fine to medium SAND, some Silt, little Roots/Organic Matter. -FOREST MAT/TOPSOIL FILL- Dense, brown, fine to coarse SAND and SILT, little (+) fine to coarse Gravel. Very dense, brown to dark gray, fine to coarse SAND, some Silt, little (+) fine to coarse Gravel, trace (-) Roots. -FILL- Brown, fine to coarse SAND, some Silt, little (+) fine to coarse Gravel.
			15		2.0		0.5	
			19					
			12					
			15	S-2	2.0	14		Olive-brown, fine to coarse SAND, some Silt, some (-) fine to coarse Gravel. Dense, olive-brown, fine to coarse SAND and SILT, trace (+) fine Gravel.
			30		4.0			
			29					
			22					
4			7	S-3	5.0	6	192.0	Very dense, olive-brown, fine to coarse SAND, some Silt, some (-) fine to coarse Gravel. -GLACIAL TILL- Dense, olive-brown to gray, fine to coarse SAND, some Silt, some (-) fine to coarse Gravel. [Drive box broke on drill rig while attempting to auger to 20 feet. Boring terminated at 17.5 feet] BOTTOM OF BORING AT 17.5 FEET.
			15		6.0		6.0	
			22	S-3A	6.0	12		
			35		7.0			
			20	S-4	7.0	20		
			22		9.0			
			22					
			21					
			18	S-5	10.0	16		
			39		12.0			
			37					
			27					
12			15	S-6	15.0	20		
			15		17.0			
			21					
			28					
16							180.5	
							17.5	
20								

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION	SUMMARY
0 - 4	Very Loose	0 - 2	Very Soft	- S - Split Spoon	Station: Rock: Samples:
4 - 10	Loose	2 - 4	Soft	- T - Thin Wall Tube	
10 - 30	Medium Dense	4 - 8	Medium Stiff	- U - Undisturbed Piston	BORING MGA-1
30 - 50	Dense	8 - 15	Stiff	- C - Diamond Core	
50 +	Very Dense	15 - 30	Very Stiff	- B - Bulk/Grab Sample	
		30+	Hard		



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TEST BORING LOG

BORING MGA-2

PROJECT: North Hill Expansion, 865 Central Avenue, Needham, MA

CLIENT: North Hill, CCRC

CONTRACTOR: Geosearch

MGA NO. : G0809
SHEET NO. : 1 of 1
LOCATION N : See Plan

E :
ELEVATION : 216'±

DATE START : 7/20/20

END : 7/20/20

DRILLER : Ken Bylund

ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HSA	Split Spoon	----
7/20/20	10:00am	NE (4)	11.5	11.5	Size I.D.	4-1/4"	1-3/8"	----
					Hammer Wt.	----	140#	----
					Hammer Fall	----	30"	----

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			19	S-1	0.0	20		Dense, brown, fine to coarse SAND, some fine to coarse Gravel, little Silt.
			22		2.0			
			18					
			32					
			48	S-2	2.0	24		Very dense, olive-brown, fine to coarse SAND, some Silt, little fine Gravel.
			64		4.0			
4			61					-FILL-
			58					
			4	S-3	5.0	12		Loose, olive-brown, fine to coarse SAND and SILT, trace fine Gravel.
			3		7.0			
			2					
			3					
			2	S-4	7.0	6		Very loose to loose, olive-brown, fine to coarse SAND and SILT, trace fine Gravel.
8			3		9.0			
			1					
			2					
			9	S-5	10.0	6	205.5	Olive-brown, fine to coarse SAND and SILT, little (-) fine Gravel, trace (-) Roots.
			13	S-5A	10.5	8	10.5	
			50/22"		10.5		204.5	Olive-brown, fine to coarse SAND, some (+) Silt, little (+) fine to coarse Gravel.
12					11.2		11.5	-GLACIAL TILL- AUGUER REFUSAL AT 11.5 FEET.
16								
20								

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION	SUMMARY
0 - 4	Very Loose	0 - 2	Very Soft		Station:
4 - 10	Loose	2 - 4	Soft		Rock:
10 - 30	Medium Dense	4 - 8	Medium Stiff		Samples:
30 - 50	Dense	8 - 15	Stiff		BORING MGA-2
50 +	Very Dense	15 - 30	Very Stiff		
		30+	Hard		



**McCardle Gannon
Associates, Inc.**

TEST BORING LOG

BORING MGA-3

PROJECT: North Hill Expansion, 865 Central Avenue, Needham, MA

CLIENT: North Hill, CCRC

CONTRACTOR: Geosearch

MGA NO. : G0809

SHEET NO. : 1 of 1

LOCATION N : See Plan

E :

ELEVATION : 210'±

DATE START : 7/20/20

END : 7/20/20

DRILLER : Ken Bylund

ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HSA	Split Spoon	----
7/20/20	12:30pm	NE (4)	20	22	Size I.D.	4-1/4"	1-3/8"	----
					Hammer Wt.	----	140#	----
					Hammer Fall	----	30"	----

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recov- ery (in)	Elev- ation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			13 8 11 21	S-1	0.0 2.0	12	199.0	Medium dense, brown to black, fine to coarse SAND, some fine to coarse Gravel, little (+) Silt, trace (-) Roots.
			24 24 29 17	S-2	2.0 4.0	6	11.0	Very dense, brown, fine to coarse GRAVEL, little fine to coarse Sand, little Silt.
4			6 21 16 29	S-3	5.0 7.0	16		-FILL- Dense, olive-brown, fine to coarse SAND, some Silt, some fine to coarse Gravel.
			35 27 21 17	S-4	7.0 9.0	14		Dense, olive-brown, fine to coarse SAND, some Silt, some (-) fine to coarse Gravel.
8			15 8	S-5	10.0 11.0	12		Gray-brown, fine to coarse SAND, some (+) Silt, some (-) fine to coarse Gravel, trace (-) Roots.
			27 34	S-5A	11.0 12.0	12		Olive-brown, fine to coarse SAND, some Silt, some (-) fine to coarse Gravel.
12			29 33 47 36	S-6	12.0 14.0	20		Very dense, olive-brown, fine to coarse SAND, some (+) Silt, little (-) fine Gravel.
			25 28 114 63	S-7	15.0 17.0	18		Very dense, olive-brown, fine to coarse SAND and SILT, some fine to coarse Gravel.
16								-GLACIAL TILL-
			24 28 34 42	S-8	20.0 22.0	24		Very dense, olive-brown, fine to coarse SAND, some (+) fine to coarse Gravel, some Silt.
20							188.0	
							22.0	BOTTOM OF BORING AT 22 FEET.

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION	SUMMARY
0 - 4	Very Loose	0 - 2	Very Soft	- S - Split Spoon	Station: Rock: Samples:
4 - 10	Loose	2 - 4	Soft	- T - Thin Wall Tube	
10 - 30	Medium Dense	4 - 8	Medium Stiff	- U - Undisturbed Piston	BORING MGA-3
30 - 50	Dense	8 - 15	Stiff	- C - Diamond Core	
50 +	Very Dense	15 - 30	Very Stiff	- B - Bulk/Grab Sample	
		30+	Hard		



McCardle Gannon
Associates, Inc.

TEST BORING LOG

BORING MGA-4

PROJECT: North Hill Expansion, 865 Central Avenue, Needham, MA

CLIENT: North Hill, CCRC

CONTRACTOR: Geosearch

MGA NO. : G0809

SHEET NO. : 1 of 2

LOCATION N : See Plan

E :

ELEVATION : 208'±

DATE START : 7/21/20

END : 7/21/20

DRILLER : Ken Bylund

ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HSA	Split Spoon	----
7/21/20	10:00am	NE (4)	25	25.3	Size I.D.	4-1/4"	1-3/8"	----
					Hammer Wt.	----	140#	----
					Hammer Fall	----	30"	----

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			11	S-1	0.0	20	201.0 7.0	Medium dense, dark brown to brown, fine to coarse SAND, some fine to coarse Gravel, little Silt.
			12		2.0			
			9					
			3					
			7	S-2	2.0	16		Dense, dark brown, fine to coarse SAND and fine to coarse GRAVEL, little (+) Silt.
			12		4.0			
			22					
			21					-FILL-
4								
			8	S-3	5.0	12		Dense, brown, fine to coarse SAND, some Silt, little (+) fine Gravel.
			8		7.0			
			36					
			40					
			28	S-4	7.0	16		Medium dense to dense, gray-brown, fine to coarse SAND, some Silt, some (-) fine to coarse Gravel, trace (-) Roots.
8			13		9.0			
			17					
			16					
			21	S-5	10.0	14		Very dense, olive-brown, fine to coarse SAND, some (+) fine to coarse Gravel, some (-) Silt.
			28		12.0			
			25					
			27					-GLACIAL TILL-
12								
			17	S-6	15.0	24		Dense, olive-brown, fine to coarse SAND, some (+) fine to coarse Gravel, some (-) Silt.
			25		17.0			
			23					
			33					
			31	S-7	20.0	22		Very dense, olive-brown, fine to coarse SAND, some fine to coarse Gravel, some (-) Silt.
20			33		22.0			
			41					
			47					
								[Difficult augering from 20-25± feet]

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION	SUMMARY
0 - 4	Very Loose	0 - 2	Very Soft		Station:
4 - 10	Loose	2 - 4	Soft		Rock:
10 - 30	Medium Dense	4 - 8	Medium Stiff		Samples:
30 - 50	Dense	8 - 15	Stiff		BORING MGA-4
50 +	Very Dense	15 - 30	Very Stiff		
		30+	Hard		

PROJECT: North Hill Expansion, 865 Central Avenue, Needham, MA

CLIENT: North Hill, CCRC

MGA NO. : G0809

SHEET NO. : 2 of 2

Depth in Feet		Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/Depth (ft)	FIELD CLASSIFICATION AND REMARKS
24									-GLACIAL TILL- Olive-brown, fine to coarse SAND, some Silt, little (+) fine to coarse Gravel. BOTTOM OF BORING AT 25.3 FEET.
			50/4"	S-8	25.0 25.3	4	182.7 25.3		
28									
32									
36									
40									
44									
48									

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION	SUMMARY
0 - 4	Very Loose	0 - 2	Very Soft	- S - Split Spoon - T - Thin Wall Tube - U - Undisturbed Piston - C - Diamond Core - B - Bulk/Grab Sample	Station:
4 - 10	Loose	2 - 4	Soft		Rock:
10 - 30	Medium Dense	4 - 8	Medium Stiff		Samples:
30 - 50	Dense	8 - 15	Stiff		BORING MGA-4
50 +	Very Dense	15 - 30	Very Stiff		
		30+	Hard		



**McCardle Gannon
Associates, Inc.**

TEST BORING LOG

BORING MGA-5

PROJECT: North Hill Expansion, 865 Central Avenue, Needham, MA

CLIENT: North Hill, CCRC

CONTRACTOR: Geosearch

MGA NO. : G0809

SHEET NO. : 1 of 2

LOCATION N : See Plan

E :

ELEVATION : 211'±

DATE START : 7/21/20

END : 7/21/20

DRILLER : Ken Bylund

ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HSA	Split Spoon	----
7/21/20	12:30pm	NE (4)	25	27	Size I.D.	4-1/4"	1-3/8"	----
					Hammer Wt.	----	140#	----
					Hammer Fall	----	30"	----

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recov- ery (in)	Elev- ation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			11 18 5 5	S-1	0.0 2.0	12	198.0 13.0	Medium dense, dark brown, fine to coarse SAND, some fine to coarse Gravel, little Silt.
			8 8 7 6	S-2	2.0 4.0	16		Medium dense, brown, fine to coarse SAND, some Silt, little fine to coarse Gravel.
4								-FILL-
			4 3 3 2	S-3	5.0 7.0	18		Loose, dark brown, fine to coarse SAND and SILT, little (-) Roots/Organic Matter, trace (-) fine Gravel.
8			2 2 5 8	S-4	7.0 9.0	10		Loose, dark brown, fine to coarse SAND, some Silt, little fine to coarse Gravel, trace (-) Roots.
			4 6 8 7	S-5	10.0 12.0	13		Medium dense, brown, fine to coarse SAND, some fine to coarse Gravel, some Silt, trace (-) Roots.
12			6 8	S-6	12.0 13.0	6		Brown, fine to coarse SAND, some fine to coarse Gravel, some Silt.
			10 12	S-6A	13.0 14.0	12		Gray, fine to coarse SAND, some Silt, some fine to coarse Gravel.
16			12 12 15 26	S-7	15.0 17.0	12		Medium dense, gray, fine to coarse SAND, some (+) fine to coarse Gravel, some (-) Silt.
								-GLACIAL TILL-
20			16 75 50/0"	S-8	20.0 21.0	6		Very dense, gray, fine to coarse GRAVEL, some fine to coarse SAND, little (+) Silt.
								[Difficult augering from 20-25± feet]

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION	SUMMARY
0 - 4	Very Loose	0 - 2	Very Soft	- S - Split Spoon	Station: Rock: Samples:
4 - 10	Loose	2 - 4	Soft	- T - Thin Wall Tube	
10 - 30	Medium Dense	4 - 8	Medium Stiff	- U - Undisturbed Piston	BORING MGA-5
30 - 50	Dense	8 - 15	Stiff	- C - Diamond Core	
50 +	Very Dense	15 - 30 30+	Very Stiff Hard	- B - Bulk/Grab Sample	

PROJECT: North Hill Expansion, 865 Central Avenue, Needham, MA

CLIENT: North Hill, CCRC

MGA NO. : G0809

SHEET NO. : 2 of 2

FIELD CLASSIFICATION AND REMARKS							
24							-GLACIAL TILL-
			51	S-9	25.0	16	Very dense, gray, fien to coarse SAND, some fine to coarse Gravel, some Silt.
			62		27.0		
			68				
			84				
28							184.0
							27.0
							BOTTOM OF BORING AT 27 FEET.
32							
36							
40							
44							
48							

KEY TO SYMBOLS

Symbol Description

Strata symbols



Forest Mat/Topsoil Fill



Fill



Glacial Till

Soil Samplers



Split Spoon

Notes:

1. Geosearch, Inc. of Sterling, Massachusetts performed the test borings on July 20 and 21, 2020 using all-terrain vehicle (ATV) (MGA-1 through MGA-3) and truck mounted (MGA-4 and MGA-5) drill rigs equipped with a 140-pound automatic hammer.
2. Test boring elevations were estimated from ground surface contours on shown on a plan entitled "Overall Grading & Drainage Plan", dated May 20, 2019 by VHB. Elevations should be considered approximate.
3. MGA observed and logged the test borings.
4. NE = Not Encountered



Attachment 4 – TSS Removal Calculations



VHB, Inc..
101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
(617) 924-1770

TSS Removal Calculation Worksheet

Project Name: **North Hill**
Project Number: **11369.04**
Location: **Needham, MA**
Discharge Point: **DP-1**
Drainage Area(s): **14**

Sheet: **1 of 1**
Date: **September 2020**
Computed by: **DMK**
Checked by: **JWM**

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D E)
Bioretention Area	90%	1.00	0.90	0.10

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.

** Equals remaining load from previous BMP (E)

**Treatment Train
TSS Removal =**

90%



Attachment 5 – Water Quality Volume Calculations



Water Quality Volume Calculations

Project Name: North Hill
Project Location: Needham, MA
Proj. No.: 11369.04
Date: September 2020
Calculated by: DMK
Checked by: JWM

Bioretention Basin #1

Water Quality Storm Runoff Depth (inches) = **0.62**
Total Impervious Area (sq.ft.) = **16,550**

Required*:

Runoff Depth to be Treated (in.) Required
Volume (cu.ft.)
0.62 **855**

Provided:

Elevation	Area (s.f.)	Cumulative Volume (cu.ft.)
209.5	700	0
210.5	1200	950

* Per US EPA Stormwater Best Management Practices Analysis for 65% Phosphorus Removal

Bioretention Basin #2

Water Quality Storm Runoff Depth (inches) = **0.62**
Total Impervious Area (sq.ft.) = **26,850**

Required*:

Runoff Depth to
be Treated (in.) Required
Volume (cu.ft.)
0.62 **1387**

Provided:

Elevation	Area (s.f.)	Cumulative Volume (cu.ft.)
210	850	0
211	2200	1525

* Per US EPA Stormwater Best Management Practices Analysis for 65% Phosphorus Removal



Attachment 6 – EPA Bioretention Performance Analysis

BMP Performance Curve: Bioretention

BMP Performance Table

BMP Name: Bioretention

Land Use	Pollutant	Depth of Runoff Treated (inches) *							
		0.1	0.2	0.4	0.6	0.8	1.0	1.5	2.0
Commercial	TSS	44%	69%	91%	97%	98%	99%	100%	100%
	TP	19%	33%	53%	64%	71%	76%	84%	89%
	Zn	68%	88%	95%	96%	96%	97%	98%	99%
Industrial	TSS	45%	70%	91%	97%	98%	99%	100%	100%
	TP	20%	34%	53%	64%	71%	76%	84%	89%
	Zn	46%	72%	94%	96%	96%	96%	98%	99%
High-Density Residential	TSS	46%	70%	92%	97%	99%	99%	100%	100%
	TP	19%	34%	53%	64%	71%	76%	84%	89%
	Zn	53%	79%	95%	96%	96%	97%	98%	99%
Medium-Density Residential	TSS	54%	78%	94%	98%	99%	99%	100%	100%
	TP	20%	34%	53%	63%	70%	75%	83%	88%
	Zn	23%	41%	68%	83%	92%	95%	97%	97%
Low-Density Residential	TSS	52%	73%	91%	96%	98%	99%	99%	100%
	TP	21%	35%	52%	62%	68%	73%	81%	86%
	Zn	17%	33%	59%	76%	88%	93%	97%	97%

* 0.62 inches treated = 65% removal efficiency

Annual Pollutant Loading Rates

Land use	Pollutant load (lbs/acre-year)		
	TSS	TP	Zn
Commercial	1117.77	1.66	2.33
Industrial	745.22	1.43	0.45
High-Density Residential	465.08	1.10	0.79
Medium-Density Residential	274.63	0.55	0.11
Low-Density Residential	72.11	0.042	0.043