HAYES ENGINEERING, INC.

To: Richard L. Seegel
Chairman
Zoning Board of Appeals
525 Washington Street lower level
Wellesley, Ma 02482

J. Derenzo & Associates LLC
(#680 Worcester Rd. LLC.)
43 Charles Street
Needham, Ma. 02494
jd@jderenzoproperties.com
Tel 781-449-0300

From: William R. Bergeron, P.E.
Project Engineer

Date: October 19, 2018

Subject: #16 Stearns Road, Wellesley, Massachusetts Supplemental Information

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Dear Board Members,

Based upon comments received at the public hearing on September 25, 2018 along with supplemental information from a meeting with the Engineering Division and Fire Department on October 4, 2018 we offer the following supplemental information for your consideration.

1. Please find attached a revised set of Civil Plans dated October 19, 2018 showing adjustments to the plans. We have also added two new plans showing the 680 Worcester Street and 16 Stearns Road sites on and area wide plan as well as the two sites shown on and aerial plan.
2. We have included the requested shadow study for both site done by our Architect James Velleco.
3. The revised plan includes a reconfiguration of the parking layout in order to provide a space for delivery vehicles.
4. The meeting with Charles DiGiandomenico Fire Prevention-Deputy Chief on October 4, 2018 confirmed that the original findings outlined in a letter dated January 18, 2018 were still valid. (January 18, 2018 attached)
5. The plan has been adjusted to enhance supplemental snow storage.
6. The Engineering Division requested clarification for a portion of the subsurface management area (SMA) and soils data for the proposed subsurface drainage. Based upon their concerns we have relocated all the SMA to the westerly portion of the site where we have more soils data. We have also provided supplemental groundwater mounding calculations to support the design in conformance with the Stormwater Management Standards. The plan has been revised to show open grate inspection covers and for the low lawn area and the walls and grading plan has been adjusted to

accommodate the new design. Revised hydraulic calculations indicate that there is no overflow condition for the 100 year design storm.

We look forward to discussing this supplemental information at the next scheduled public hearing.

William R Bergeron, P.E.

William R. Bergeron, P.E.
Project Engineer
Hayes Engineering, Inc.

cc
J. Derenzo Properties, LLC (#680 Worcester St. LLC)
43 Charles Street
Needham, Ma. 02494

GENERAL NOTES:

1. VERTICAL DATUM IS NAVD88
2. PROPERTY LINE INFORMATION DEPICTED ON THIS PLAN TAKEN FROM TOWN OF WELLESLEY LEVEL 3 ASSESSORS MAPPING AS AVAILABLE ON THE DATE OF PLAN PREPARATION BY THE MASSACHUSETTS BUREAU OF GEOGRAPHIC INFORMATION (MASSGIS) AND IS NOT THE RESULT OF AN ACTUAL FIELD SURVEY BY HAYES ENGINEERING, INC.
3. TOPOGRAPHIC INFORMATION DEPICTED ON THIS PLAN EXTRACTED FROM AVAILABLE MASSGIS LIDAR TERRAIN DATA PROVIDED BY THE MASSACHUSETTS BUREAU OF GEOGRAPHIC INFORMATION (MASSGIS) AND IS NOT THE RESULT OF AN ACTUAL FIELD SURVEY BY HAYES ENGINEERING, INC.
4. BUILDING LOCATIONS DEPICTED ON THIS PLAN TAKEN FROM MASSGIS 2-D LIDAR BUILDING LOCATIONS AND ARE NOT THE RESULT OF AN ACTUAL FIELD SURVEY BY HAYES ENGINEERING, INC.
5. PLAN CONTENTS ARE THE RESULT OF A COMPILATION OF THE ABOVE REFERENCED SOURCES AND VARIOUS RECORD AND NON-RECORD INFORMATION.
6. THE PURPOSE OF THIS PLAN IS TO DEPICT THE SITE IN A GENERAL NATURE WITHIN THE CONTEXT OF THE ABUTTING TOPOGRAPHIC FEATURES. THIS PLAN IS NOT TO BE CONSIDERED CONSTRUCTION DOCUMENTS.

Prepared For:

Owner / Applicant
Jay Derenzo
43 Charles Street
Needham, MA 02494

Prepared By:

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Wakefield, MA 01880
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Design By: WRB
Drawn By: AMC
Checked By: AMC
Project File: WEL
Comp. No: WEL11

- ☐ Issued For Permit
- ☐ Issued For Review
- ☐ Issued For Bid
- ☐ Issued For Construction
- ☐ Not For Construction

No	Revision	Date
1		
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Scale: 1"=40'
0' 20' 40' 80'

Date: October 10, 2018

Drawing Title:

CONTEXT MAP
STEARNS ROAD AND
WORCESTER ROAD
WELLESLEY, MASS.

Seal:

Drawing No.:

C1

SHEET 1 OF 1

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GENERAL NOTES:

1. VERTICAL DATUM IS NAVD88
2. PROPERTY LINE INFORMATION DEPICTED ON THIS PLAN TAKEN FROM TOWN OF WELLESLEY LEVEL 3 ASSESSORS MAPPING AS AVAILABLE ON THE DATE OF PLAN PREPARATION BY THE MASSACHUSETTS BUREAU OF GEOGRAPHIC INFORMATION (MASSGIS) AND IS NOT THE RESULT OF AN ACTUAL FIELD SURVEY BY HAYES ENGINEERING, INC.
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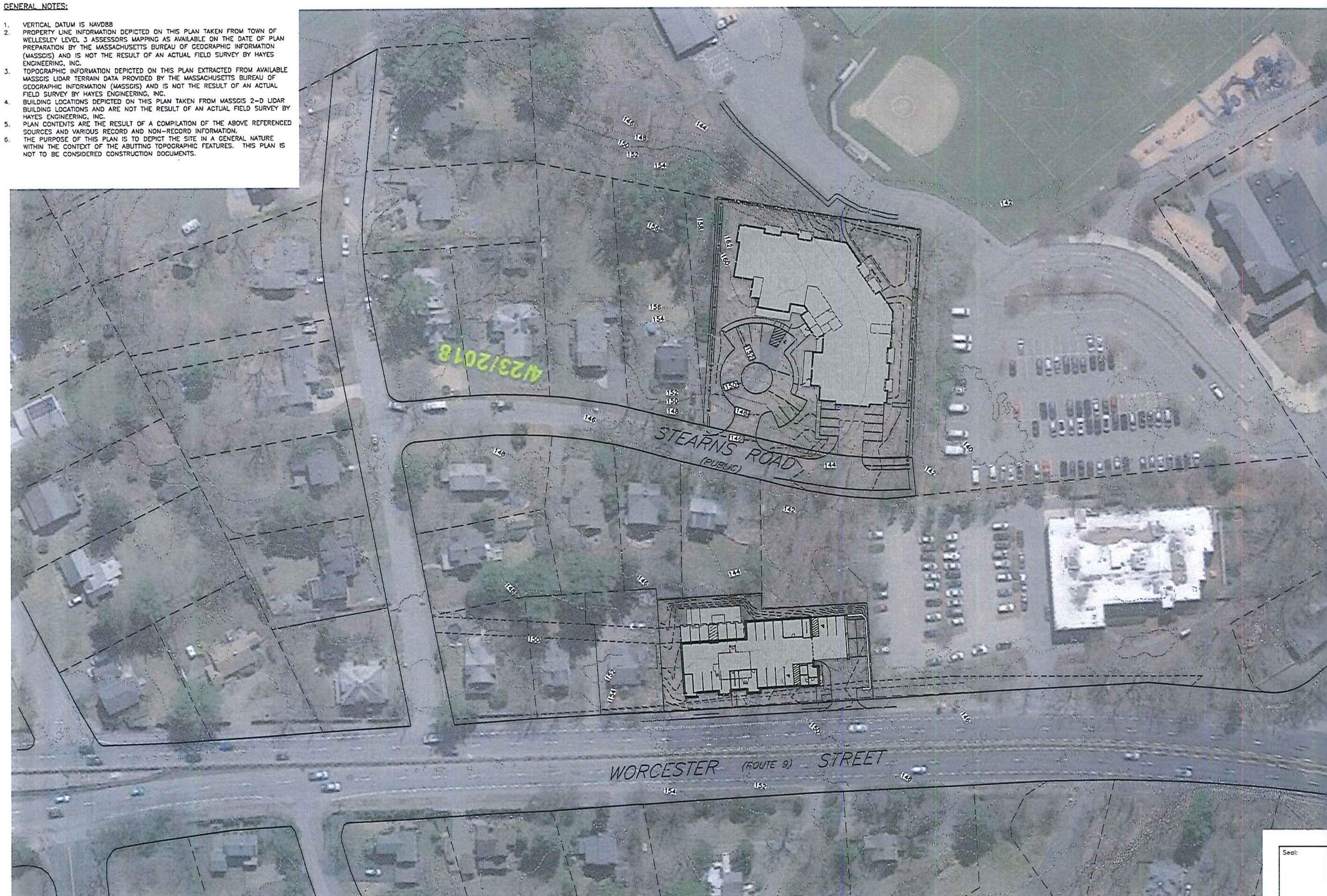

Prepared For:

Owner / Applicant
Joy Derenzo
43 Charles Street
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Scale: 1"=40'

0' 20' 40' 80'

Date: October 10, 2018

Drawing Title:

CONTEXT MAP
STEARNS ROAD AND
WORCESTER ROAD
WELLESLEY, MASS.

Seal:

Drawing No.: C1

SHEET 1 OF 1

N:\wel11\d-locus.dwg, 10/22/2018 3:12:35 PM, TC

6:40 AM

NOON

5:00 PM

16 STEARNS ROAD AND 680 WORCESTER STREET

SHADOW STUDY DIAGRAM
SUMMER SOLSTICE
JUNE 21

8 AM

NOON

3:30 PM

16 STEARNS ROAD AND 680 WORCESTER STREET

SHADOW STUDY DIAGRAM
AUTUMNAL EQUINOX (SPRING SIMILAR)
SEPTEMBER 22

9:10 AM

NOON

2:10 PM

16 STEARNS ROAD AND 680 WORCESTER STREET

SHADOW STUDY DIAGRAM
WINTER SOLITICE
DECEMBER 22

HAYES ENGINEERING, INC.

Memorandum

To:	Charles DiGiandomenico Fire Prevention-Deputy Chief Wellesley Fire Department 457 Worcester Street Wellesley, Massachusetts 02481	**JOB #:**	WEL-0012
From:	William R. Bergeron, P.E.	**Date:**	January18, 2018
Subject:	Project Information 16 Stearns Road		

Charles I would like to thank you for meeting with us yesterday to go over the proposed new project to be located at 16 Stearns Road in Wellesley Massachusetts. The purpose of the meeting was to provide you with additional information and plans that have evolved based upon concerns raised by the Town on the preliminary conceptual submittal to the Massachusetts Housing Authority.

As I explained yesterday the submittal to Massachusetts Housing is not expected to be a final design but more of a concept for them to determine if the project meets the community needs. It is not intended to be a final design that the community has to approve. As with all our projects we try to accommodate the technical requirements to the extent that the law allows by having meetings with the various Town Departments to determine specific areas of concern. Based upon the items outlined in the letter from the Selectmen to MassHousing dated October 6, 2017 the Fire Department pointed out several concerns. We have now had an opportunity to adjust the plans to address them as we talked about yesterday.

1. The plan has been modified to effectively reduce the height by two floors (approximately 23 feet shorter) as well as reducing the number of units from 36 to 24 units. The footprint of the building has also been reduced to provide more than 20 feet to all the side yards as well as adjusting the grades to be more accessible should the need arise.

2. I provided you copies of the modified plans showing the ability of the SU-30 vehicle to access and turn around on the site at the proposed circular driveway to the main building entrance as well as providing a second means of access at the garage driveway entrance which also has been equipped with a Tee easement to allow municipal vehicles to turn around at the end of the road. The tower truck will have access to the front driveway and will have sufficient space to turnaround at the Tee end of the road. As pointed out there is also good access from the Sprague Field fire access road on the back side of the site. We understand that this side of the site may be congested during functions at the field however the location where access adjacent to the building is provided in marked as a no parking tow zone so if enforcement is maintained the access

will also be maintained during an emergency. We have also designed an emergency access point from the school department property to the end of Stearns Road for additional potential access in case of emergency conditions. It is my understanding that the provisions of 18.2.3.4.1.1 of the adopted Mass NFPA can allow widths as little as ten feet for one way operations as we have here. We understand that you may want the width of the access to be increased when the plans are reviewed further by your department and the width can be adjusted if needed. I have attached the turning movements for the tower truck as requested.

3. The potential for looping the existing water main were also discussed. There is a hydrant adjacent to the school parking lot approximately 150+/- feet from the garage driveway that could provide a source of water from a different water connection.

4. There may be an opportunity to actually connect the end of Stearns Road to the existing hydrant water line adjacent to the school parking lot to eliminate the dead end water condition. This would enhance water flows and improve water quality by eliminating the existing dead end water main condition for both lines.

5. The building will have a fire sprinkler system. The actual design will depend on the fire flow conditions. I know you indicated that in your experience that flows and pressure have not been an issue for this area in the past but the options for this area discussed can only enhance the conditions.

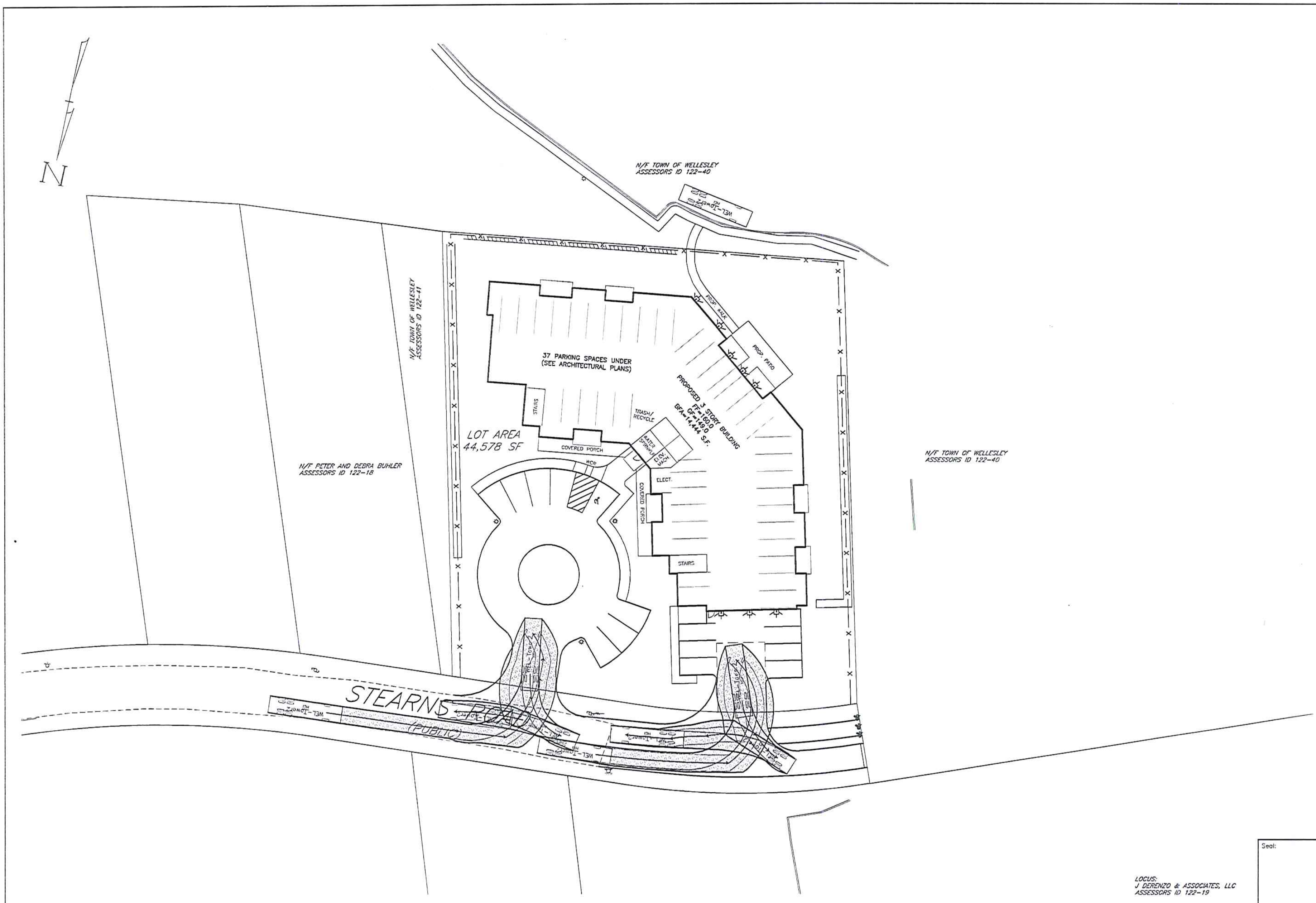
6. The existing hydrant in front of the structure provides a locations for the fire connections as well as having the other alternatives noted above. This will allow access for the Fire Department with the ability to have access to all points of the building in less than the 250 foot requirement outlined in 18.2.3.2.2 of the adopted Mass NFPA requirements.

7. Prior discussions about this area indicate that the expected response time to the site would be very quick since it is very close and off the main street where the fire station is located.

I believe that the results of the meeting were that your previous concerns had been addressed. We understand that when the actual building permit design is performed that all the formal fire engineering requirements will be reviewed. We look forward to working with you and the Wellesley Fire Department on this project.

Please feel free to call if you have any questions or concerns regarding this matter.
Thanks

William R. Bergeron, P.E.
Project Engineer
Hayes Engineering, Inc.



Prepared For:

Applicant
16 Stearns Road LLC
Joy Derenzo
43 Charles Street
Needham, MA 02494

Prepared By:

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Design By: WRB
Drawn By: EBL
Checked By: WRD
Project File: WEL-0012
Comp. No: WEL11

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Scale: 1"=20'
0' 10' 20' 40'

Date: January 12, 2018

Drawing Title:

FIRE VEHICLE ACCESS PLAN
#16 STEARNS ROAD
WELLESLEY, MASS.

Seal:

Drawing No.:

C6

SHEET 6 OF 10

SUPPLEMENTAL DRAINAGE INFORMATION

16 Stearns Road, Wellesley, Massachusetts

October 23, 2018

Hayes Engineering, Inc
603 Salem Street
Wakefield, MA 01880
Tel: (781) 246-2800
Fax: (781) 246-7596
Nantucket, MA 02554
Tel: (508) 228-7909

Memorandum

Refer to File No. **WEL-0012**

TO: Town of Wellesley Zoning Board of Appeals

FROM: William R. Bergeron, PE

DATE: October 22, 2018

SUBJECT: Groundwater Mounding Calculations
16 Stearns Road
Wellesley, MA

Cc:

COMMONWEALTH OF MASSACHUSETTS
William R. Bergeron
CIVIL
No. 29464
REGISTERED PROFESSIONAL ENGINEER

William R. Bergeron PE
10/23/2018

In accordance with Volume 3, Chapter 1 of the Massachusetts DEP Stormwater Standards a mounding analysis was conducted for the proposed subsurface infiltration system (PSIS) at the above referenced project. Mounding analysis is required for exfiltration systems that have less than four (4) feet separation to seasonal high groundwater *and* proposed to attenuate the peak discharge from a 10-year of higher 24-hour storm event. The mounding analysis must demonstrate:

1. the *Required Recharge Volume* is fully dewatered within 72-hours; and
2. the groundwater mound that forms under the recharge system will not break out above the land within the 72-hour period.

The accompanying groundwater mounding calculations were performed using Glover's Solution for the Hantush Method and modelled with the HANTUSH software package developed by GeoHydroCycle, Inc. The following model parameters were used in the analysis:

- Application Rate – The application rate is equivalent to the total 100-year storm infiltration volume (13,081 cf) divided by the surface area of the infiltration system (2,184 sf) over the duration of the design storm (1 day) or 6 feet per day;

- Duration of Application – The duration of application is 24-hours, equivalent to the duration of the design storm event;

- Total Simulation Time – The total simulation time is 72-hours, the period of analysis;

- Fillable Porosity – The fillable porosity is the specific yield of an aquifer. The attached graph from Walton's *Analytical Groundwater Modeling* indicates an average porosity in fine sands of 0.40;

- Hydraulic Conductivity – The hydraulic conductivity of fine sand was estimated to be 50 feet per day using the estimated range of rates for silty sand and clean sand on the accompanying Anderson & Woessner graph indicating Ranges of Hydraulic Conductivity for Unconsolidated Materials;

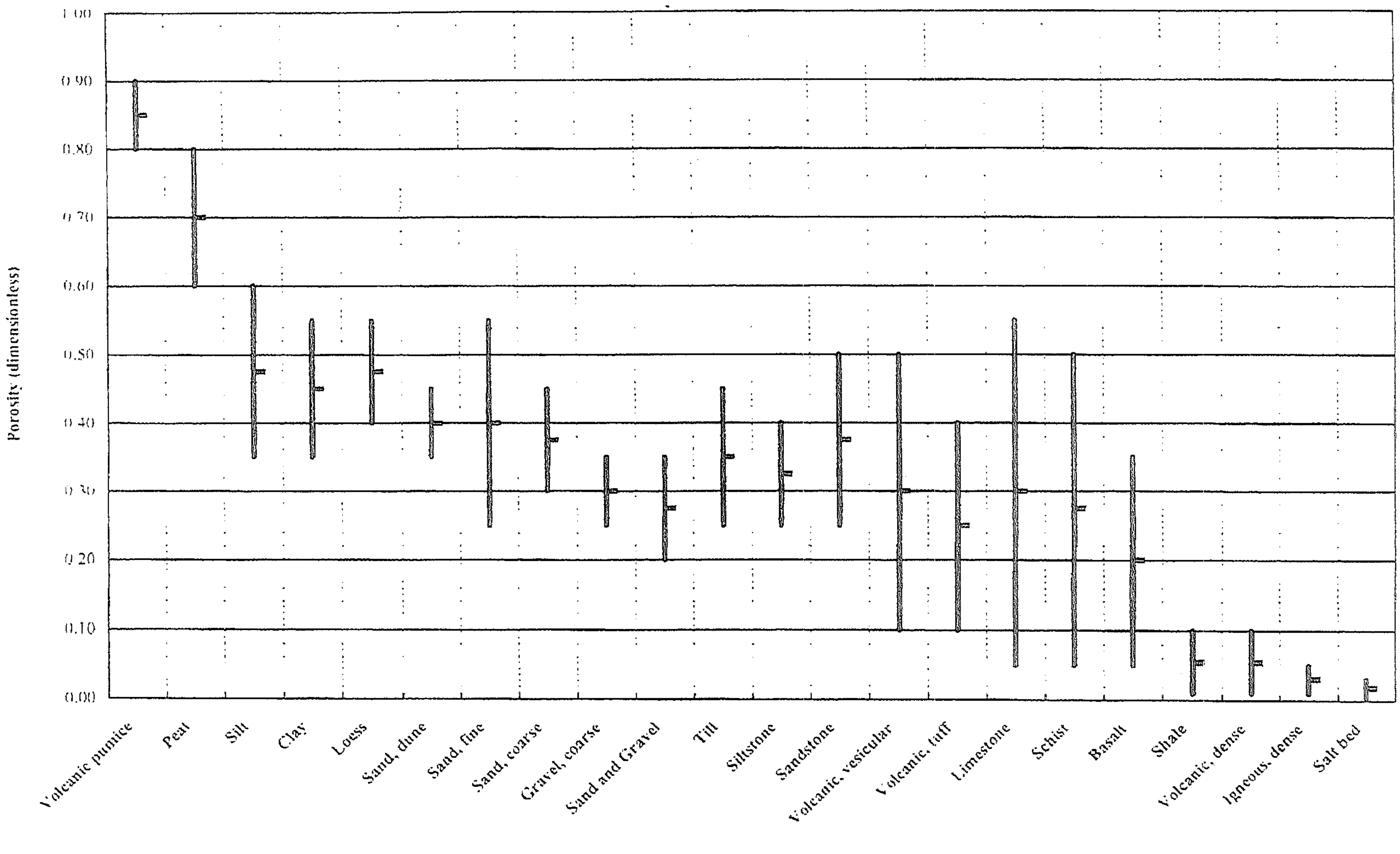
- Initial Saturated Thickness – The initial saturated thickness of the aquifer is the difference between the seasonal high water table elevation and bedrock. The average saturated thickens for those test holes having seasonal high water table indicators (redoximorphic features) used for analysis was 2.03 feet;

- Length and width of application area were generated by using a rectangle having equivalent length and surface area as the irregularly shaped PSIS. The equivalent system for the model was 191.6-feet in length by 12.5-feet in width;

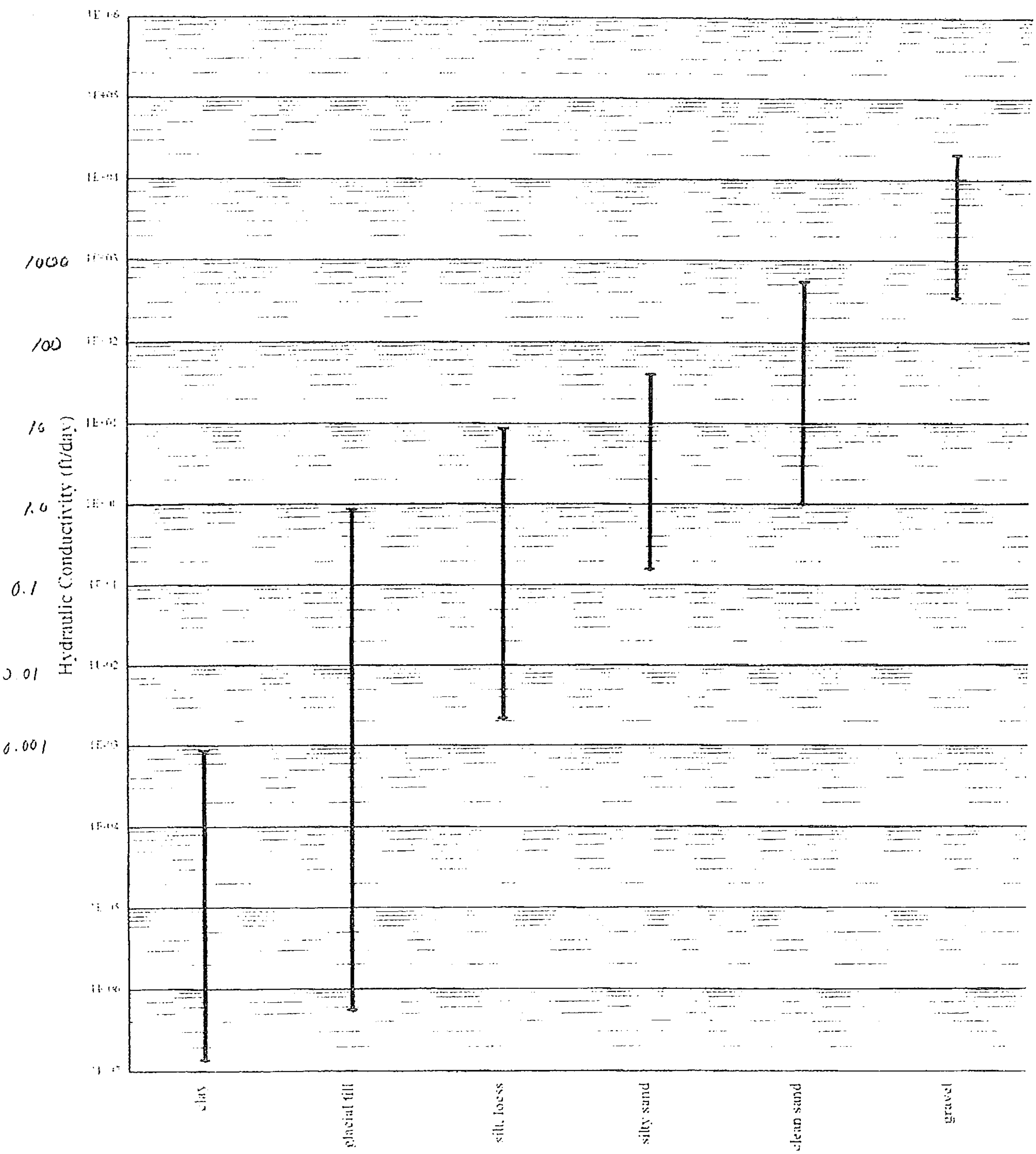
The resultant groundwater mound peaked at 5.53 feet above the average, estimated seasonal high water table elevation in the system (ESHWT=140.94) to an elevation of 146.47 feet. The bottom of the stone below the infiltration system is proposed at elevation 144.50 and the top of stone above the infiltration system is proposed at elevation 148.04. The finished grade over the system is proposed to be at elevation 149.5. The groundwater elevation does not break out above the land in accordance with Volume 3, Chapter 1 of the Stormwater Standards. Additionally the ground water recedes to an elevation of 2.08 feet above the ESHWT elevation, or elevation 143.02, indicating the proposed infiltration system is fully dewatered within 72-hours (bottom of stone elevation = 144.50).

Porosity

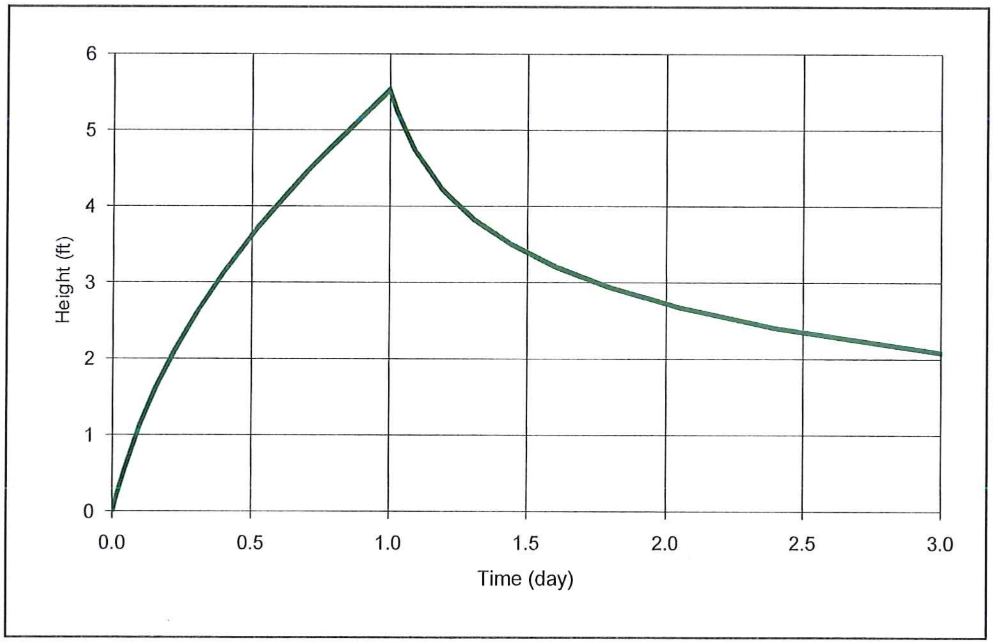
Walton, William C., 1989, Analytical Groundwater Modeling, p. 141.



Ranges of Hydraulic Conductivity - Unconsolidated Materials
Anderson & Woessner, 1992 p. 40



Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Hayes Engineering, Inc.

PROJECT: WEL-0012: 16 Stearns Road

ANALYST: AMC

DATE: 10/22/2018 TIME: 2:10:38 PM

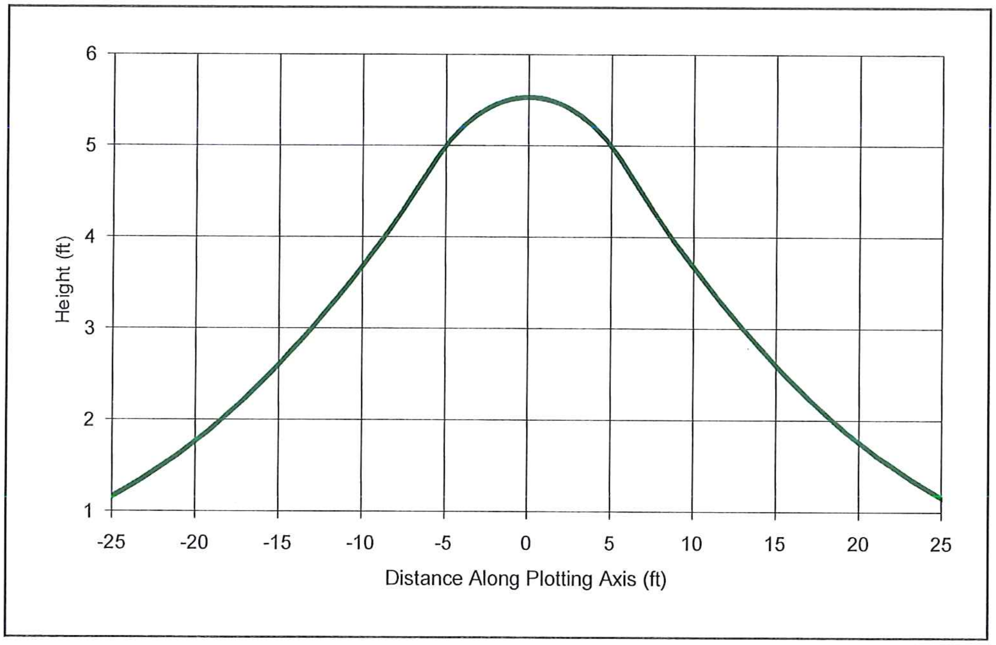
INPUT PARAMETERS

Application rate: 6 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.4
Hydraulic conductivity: 50 ft/day
Initial saturated thickness: 2.03 ft
Length of application area: 191.6 ft
Width of application area: 12.5 ft
No constant head boundary used
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 14370 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.2
0	0.6
0.1	1.13
0.2	1.63
0.2	2.11
0.3	2.6
0.4	3.13
0.5	3.73
0.7	4.46
1	5.53
1	5.25
1.1	4.74
1.2	4.22
1.3	3.83
1.4	3.5
1.6	3.21
1.8	2.94
2	2.68
2.4	2.41
3	2.08

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Hayes Engineering, Inc.

PROJECT: WEL-0012: 16 Stearns Road

ANALYST: AMC

DATE: 10/22/2018 TIME: 2:11:32 PM

INPUT PARAMETERS

Application rate: 6 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.4
Hydraulic conductivity: 50 ft/day
Initial saturated thickness: 2.03 ft
Length of application area: 191.6 ft
Width of application area: 12.5 ft
No constant head boundary used
Plotting axis from Y-Axis: 90 degrees
Edge of recharge area:
positive X: 6.2 ft
positive Y: 0 ft
Total volume applied: 14370 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-25	0	-25	1.16
-21	0	-21	1.62
-17	0	-17	2.23
-13.1	0	-13	2.99
-9.9	0	-10	3.69
-7.5	0	-8	4.3
-5.5	0	-6	4.86
-3.9	0	-4	5.22
-2.4	0	-2	5.42
-1.5	0	-1	5.49
-0.8	0	-1	5.52
0	0	0	5.53
0.8	0	1	5.52
1.5	0	1	5.49
2.4	0	2	5.42
3.9	0	4	5.22
5.5	0	6	4.86
7.5	0	8	4.3
9.9	0	10	3.69
13.1	0	13	2.99
17	0	17	2.23
21	0	21	1.62
25	0	25	1.16

#16 Stearns Road
Wellesley, MA
Runoff Sumary

COMMONWEALTH OF MASSACHUSETTS
William R. Bergeron
CIVIL
No. 29464
REGISTERED PROFESSIONAL ENGINEER
William R. Bergeron P.E.
10/23/2018

South

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	0.00	0.00	0.00	0	0	0
10 Year	0.00	0.00	0.00	10	0	-10
25 Year	0.00	0.00	0.00	35	0	-35
100 Year	0.01	0.00	-0.01	92	0	-92

East

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	0.00	0.00	0.00	0	0	0
10 Year	0.00	0.00	0.00	11	0	-11
25 Year	0.00	0.00	0.00	37	0	-37
100 Year	0.01	0.00	0.00	95	0	-95

To Stearns

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	0.00	0.00	0.00	30	40	10
10 Year	0.05	0.04	-0.01	805	388	-417
25 Year	0.16	0.09	-0.07	1577	690	-887
100 Year	0.42	0.20	-0.22	2968	1212	-1756

Total

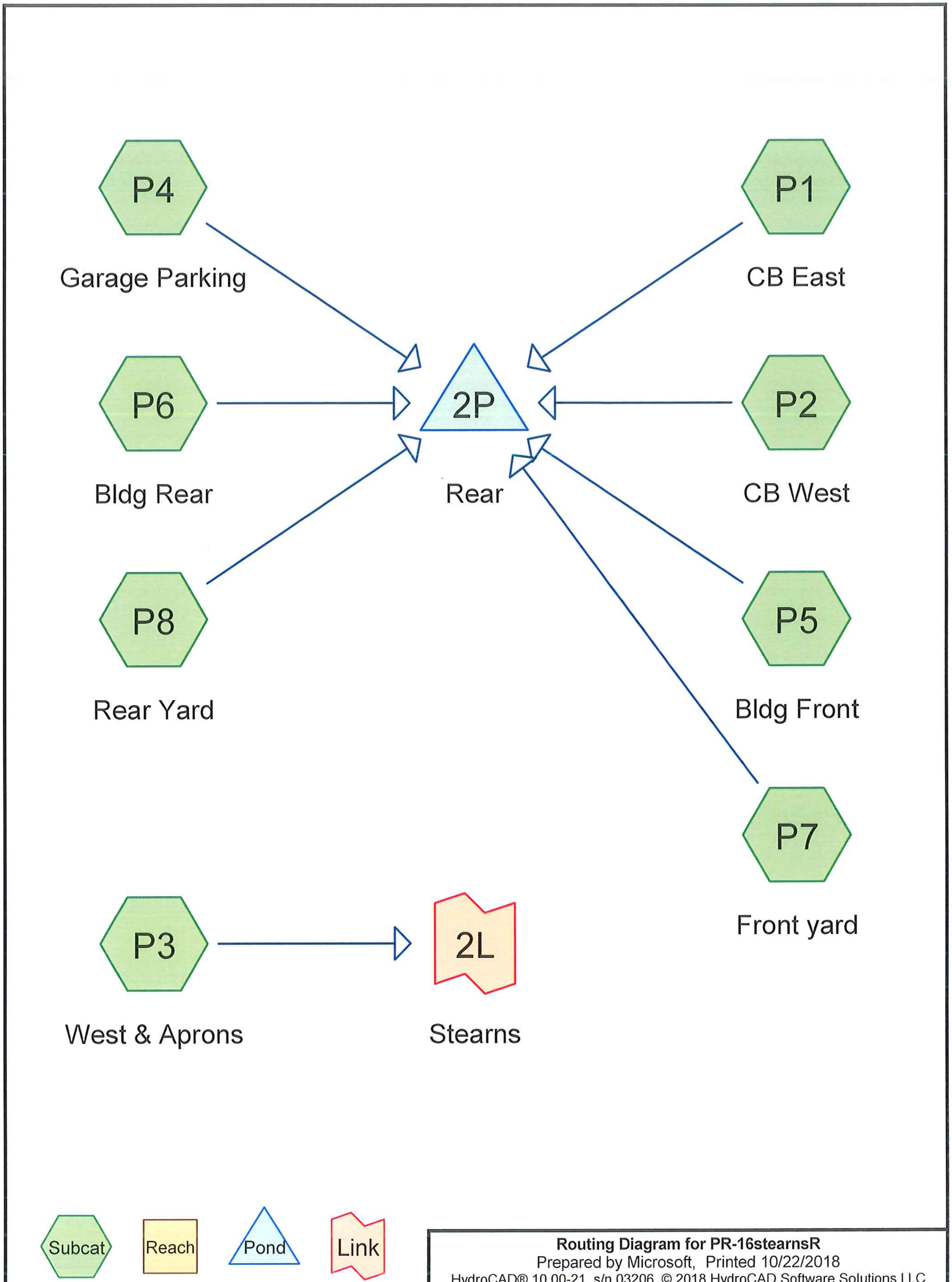
Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	0.00	0.00	0.00	30	40	10
10 Year	0.05	0.04	-0.01	825	388	-437
25 Year	0.16	0.09	-0.07	1649	690	-959
100 Year	0.44	0.20	-0.24	3155	1212	-1943

#16 Stearns Road
Wellesley, MA
BMP Peak Elevations

BMP 2P

Storm	Peak Elevation
2 Year	145.24
10 Year	146.00
25 Year	146.50
100 Year	147.42

10/22/2018



Routing Diagram for PR-16stearnsR
Prepared by Microsoft, Printed 10/22/2018
HydroCAD® 10.00-21 s/n 03206 © 2018 HydroCAD Software Solutions LLC

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: CB East Runoff Area=8,671 sf 49.86% Impervious Runoff Depth=0.68"
Tc=6.0 min CN=68 Runoff=0.13 cfs 491 cf

Subcatchment P2: CB West Runoff Area=2,318 sf 87.58% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=91 Runoff=0.13 cfs 418 cf

Subcatchment P3: West & Aprons Runoff Area=14,392 sf 12.79% Impervious Runoff Depth=0.03"
Flow Length=360' Tc=15.3 min CN=45 Runoff=0.00 cfs 40 cf

Subcatchment P4: Garage Parking Runoff Area=2,853 sf 92.99% Impervious Runoff Depth=2.45"
Tc=6.0 min CN=94 Runoff=0.18 cfs 582 cf

Subcatchment P5: Bldg Front Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.50 cfs 1,771 cf

Subcatchment P6: Bldg Rear Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.50 cfs 1,771 cf

Subcatchment P7: Front yard Runoff Area=1,933 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment P8: Rear Yard Runoff Area=5,903 sf 16.77% Impervious Runoff Depth=0.09"
Tc=6.0 min CN=49 Runoff=0.00 cfs 45 cf

Pond 2P: Rear Peak Elev=145.24' Storage=851 cf Inflow=1.43 cfs 5,077 cf
Outflow=0.42 cfs 5,077 cf

Link 2L: Stearns Inflow=0.00 cfs 40 cf
Primary=0.00 cfs 40 cf

Total Runoff Area = 50,890 sf Runoff Volume = 5,117 cf Average Runoff Depth = 1.21"
47.62% Pervious = 24,233 sf 52.38% Impervious = 26,657 sf

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: CB East Runoff Area=8,671 sf 49.86% Impervious Runoff Depth=1.60"
Tc=6.0 min CN=68 Runoff=0.35 cfs 1,156 cf

Subcatchment P2: CB West Runoff Area=2,318 sf 87.58% Impervious Runoff Depth=3.59"
Tc=6.0 min CN=91 Runoff=0.21 cfs 694 cf

Subcatchment P3: West & Aprons Runoff Area=14,392 sf 12.79% Impervious Runoff Depth=0.32"
Flow Length=360' Tc=15.3 min CN=45 Runoff=0.04 cfs 388 cf

Subcatchment P4: Garage Parking Runoff Area=2,853 sf 92.99% Impervious Runoff Depth=3.91"
Tc=6.0 min CN=94 Runoff=0.27 cfs 930 cf

Subcatchment P5: Bldg Front Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=0.75 cfs 2,695 cf

Subcatchment P6: Bldg Rear Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=0.75 cfs 2,695 cf

Subcatchment P7: Front yard Runoff Area=1,933 sf 0.00% Impervious Runoff Depth=0.13"
Tc=6.0 min CN=39 Runoff=0.00 cfs 20 cf

Subcatchment P8: Rear Yard Runoff Area=5,903 sf 16.77% Impervious Runoff Depth=0.49"
Tc=6.0 min CN=49 Runoff=0.04 cfs 241 cf

Pond 2P: Rear Peak Elev=146.00' Storage=2,120 cf Inflow=2.36 cfs 8,432 cf
Outflow=0.42 cfs 8,432 cf

Link 2L: Stearns Inflow=0.04 cfs 388 cf
Primary=0.04 cfs 388 cf

Total Runoff Area = 50,890 sf Runoff Volume = 8,820 cf Average Runoff Depth = 2.08"
47.62% Pervious = 24,233 sf 52.38% Impervious = 26,657 sf

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: CB East Runoff Area=8,671 sf 49.86% Impervious Runoff Depth=2.17"
Tc=6.0 min CN=68 Runoff=0.49 cfs 1,568 cf

Subcatchment P2: CB West Runoff Area=2,318 sf 87.58% Impervious Runoff Depth=4.37"
Tc=6.0 min CN=91 Runoff=0.25 cfs 844 cf

Subcatchment P3: West & Aprons Runoff Area=14,392 sf 12.79% Impervious Runoff Depth=0.58"
Flow Length=360' Tc=15.3 min CN=45 Runoff=0.09 cfs 690 cf

Subcatchment P4: Garage Parking Runoff Area=2,853 sf 92.99% Impervious Runoff Depth=4.70"
Tc=6.0 min CN=94 Runoff=0.33 cfs 1,118 cf

Subcatchment P5: Bldg Front Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=0.88 cfs 3,188 cf

Subcatchment P6: Bldg Rear Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=0.88 cfs 3,188 cf

Subcatchment P7: Front yard Runoff Area=1,933 sf 0.00% Impervious Runoff Depth=0.29"
Tc=6.0 min CN=39 Runoff=0.00 cfs 46 cf

Subcatchment P8: Rear Yard Runoff Area=5,903 sf 16.77% Impervious Runoff Depth=0.80"
Tc=6.0 min CN=49 Runoff=0.08 cfs 395 cf

Pond 2P: Rear Peak Elev=146.50' Storage=2,914 cf Inflow=2.90 cfs 10,347 cf
Outflow=0.42 cfs 10,347 cf

Link 2L: Stearns Inflow=0.09 cfs 690 cf
Primary=0.09 cfs 690 cf

Total Runoff Area = 50,890 sf Runoff Volume = 11,037 cf Average Runoff Depth = 2.60"
47.62% Pervious = 24,233 sf 52.38% Impervious = 26,657 sf

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: CB East	Runoff Area=8,671 sf 49.86% Impervious Runoff Depth=3.01" Tc=6.0 min CN=68 Runoff=0.69 cfs 2,175 cf
Subcatchment P2: CB West	Runoff Area=2,318 sf 87.58% Impervious Runoff Depth=5.45" Tc=6.0 min CN=91 Runoff=0.31 cfs 1,052 cf
Subcatchment P3: West & Aprons	Runoff Area=14,392 sf 12.79% Impervious Runoff Depth=1.01" Flow Length=360' Tc=15.3 min CN=45 Runoff=0.20 cfs 1,212 cf
Subcatchment P4: Garage Parking	Runoff Area=2,853 sf 92.99% Impervious Runoff Depth=5.79" Tc=6.0 min CN=94 Runoff=0.40 cfs 1,377 cf
Subcatchment P5: Bldg Front	Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=6.26" Tc=6.0 min CN=98 Runoff=1.06 cfs 3,866 cf
Subcatchment P6: Bldg Rear	Runoff Area=7,410 sf 100.00% Impervious Runoff Depth=6.26" Tc=6.0 min CN=98 Runoff=1.06 cfs 3,866 cf
Subcatchment P7: Front yard	Runoff Area=1,933 sf 0.00% Impervious Runoff Depth=0.60" Tc=6.0 min CN=39 Runoff=0.01 cfs 96 cf
Subcatchment P8: Rear Yard	Runoff Area=5,903 sf 16.77% Impervious Runoff Depth=1.32" Tc=6.0 min CN=49 Runoff=0.17 cfs 648 cf
Pond 2P: Rear	Peak Elev=147.42' Storage=4,127 cf Inflow=3.68 cfs 13,081 cf Outflow=0.42 cfs 13,081 cf
Link 2L: Stearns	Inflow=0.20 cfs 1,212 cf Primary=0.20 cfs 1,212 cf

Total Runoff Area = 50,890 sf Runoff Volume = 14,293 cf Average Runoff Depth = 3.37"
47.62% Pervious = 24,233 sf 52.38% Impervious = 26,657 sf

Pond 2P: Rear - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

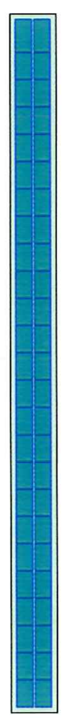
25 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 176.50' Row Length +18.0" End Stone x 2 = 179.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 18.0" Side Stone x 2 = 12.17' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

50 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 2 Rows = 2,630.2 cf Chamber Storage

7,734.7 cf Field - 2,630.2 cf Chambers = 5,104.5 cf Stone x 40.0% Voids = 2,041.8 cf Stone Storage

Chamber Storage + Stone Storage = 4,672.0 cf = 0.107 af
Overall Storage Efficiency = 60.4%
Overall System Size = 179.50' x 12.17' x 3.54'

50 Chambers
286.5 cy Field
189.1 cy Stone



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Water Quality Flow Calculation Worksheet

Refer to File No. **WEL-0012**

For First ½-inch of Runoff WQV:

Impervious Surfaces to Vortsentry:

Catchment	Time of Conc. (hours)	Impervious Area (acres)	Impervious Area (sq. mi.)
P1	0.10	0.099	
P2	0.10	0.047	
P4	0.10	0.061	
Σ		0.207	0.000323438

Time of Concentration:

Longest Catchment Tc: 0.10

q_u from Figure 2, attached: 752 csm/in

Water Quality Flow (WQF):

$$Q_{1.0} = (q_u)(A)(WQV)$$

Where:

$Q_{0.5}$ = peak flow rate associated with the first ½-inch of runoff;

q_u = the unit peak discharge, in cubic feet per second per square mile per inch;

A = impervious surface in drainage area, in square miles;

WQV = water quality volume, in inches (0.5 inches)

$$Q_{0.5} = \left(752\frac{csm}{in}\right)(0.000323438\ sq.\ mi.)(0.5")$$

$$Q_{0.5} = 0.12\ cfs$$

Proprietary Separator Selection:

The VortSentry HS36 will provide a presumptive removal rate of 80% for water quality flows through 0.55 cfs. See Massachusetts sizing table below:

VortSentry HS Model	Swirl Chamber Diameter (ft)	Typical Depth Below Invert (ft)	Treatment Capacity (cfs)[1]	Max. Inlet/Outlet Pipe Diameter (in)	Maximum Sediment Storage Capacity (CF)
VortSentry HS36*	3	5.6	0.55	18	39
w/ 1' added sump	3	6.6	0.55	18	47
w/ 2' added sump	3	7.6	0.55	18	54
w/ 3' added sump	3	8.6	0.55	18	61
w/ 4' added sump	3	9.6	0.55	18	68
w/ 5' added sump	3	10.6	0.55	18	75
VortSentry HS48**	4	6.8	1.2	24	85
w/ 1' added sump	4	7.8	1.2	24	97
w/ 2' added sump	4	8.8	1.2	24	110
w/ 3' added sump	4	9.8	1.2	24	123
w/ 4' added sump	4	10.8	1.2	24	135
VortSentry HS60***	5	8.0	2.2	30	156
w/ 1' added sump	5	9.0	2.2	30	176
w/ 2' added sump	5	10.0	2.2	30	196
w/ 3' added sump	5	11.0	2.2	30	215

*maintenance recommended when sediment reaches a height of 3'-7" below water surface elevation in sump.
**maintenance recommended when sediment reaches a height of 4'-9" below water surface elevation in sump.
***maintenance recommended when sediment reaches a height of 6.0' below water surface elevation in sump.
1. Design Flow Rate is based on 80% removal of particle size distribution with an average particle size of 240 micron. This flow also represents the maximum flow prior to which bypass occurs.

Notes:
Systems can be sized based on a water quality flow (e.g. 1 inch storm) or on a net annual basis depending on the local regulatory requirement.
When sizing based on a water quality storm, the required flow to be treated should be equal or less than the listed water quality flow for the selected system. Systems sized based on a water quality storm are generally more conservatively sized.
Additional particle size distributions are available for sizing purposes upon request.
Depth below invert is measured to the inside bottom of the system. This depth can be adjusted to meet specific storage or maintenance requirements.
Contact our support staff for the most cost effective sizing for your area.

The StormCeptor STC 900 will provide a presumptive removal rate of 77% for water quality flows through 0.89 cfs. See Massachusetts sizing table below:

Massachusetts – Water Quality (Q) Flow Rate

Stormceptor STC Model	Inside Diameter	Typical Depth Below Inlet Pipe Invert [1]	Water Quality Flow Rate Q [2]	Peak Conveyance Flow Rate [3]	Hydrocarbon Capacity [4]	Maximum Sediment Capacity [4]
	(ft)	(in)	(cfs)	(cfs)	(Gallons)	(ft³)
STC 450i	4	68	0.40	5.5	86	46
STC 900	6	63	0.89	22	251	89
STC 2400	8	104	1.58	22	840	205
STC 4800	10	140	2.47	22	909	543
STC 7200	12	148	3.56	22	1,059	839
STC 11000	2 x 10	142	4.94	48	2,792	1,086
STC 16000	2 x 12	148	7.12	48	3,055	1,677

[1] Depth Below Pipe Inlet Invert to the Bottom of Base Slab, and Maximum Sediment Capacity can vary to accommodate specific site designs and pollutant loads. Depths can vary to accommodate special designs or site conditions. Contact your local representative for assistance.
[2] Water Quality Flow Rate (Q) is based on 80% annual average TSS removal of the OK110 particle size distribution.
[3] Peak Conveyance Flow Rate is based upon ideal velocity of 3 feet per second and outlet pipe diameters of 18-inch, 36-inch, and 54-inch diameters.
[4] Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

Figure 2: For First ½-inch of Runoff, Table of qu values for Ia/P Curve = 0.0.058, listed by tc, for Type III Storm Distribution

Tc (Hours)	qu (csm/in)
0.01	821
0.03	821
0.05	813
0.067	794
0.083	773
0.1	752
0.116	733
0.133	713
0.15	694
0.167	677
0.183	662
0.2	646
0.217	632
0.233	619
0.25	606
0.3	572
0.333	552
0.35	542
0.4	516
0.416	508
0.5	472
0.583	443
0.6	437
0.667	417
0.7	408
0.8	383
0.9	361
1	342
1.1	325
1.2	311
1.3	297
1.4	285
1.5	274
1.6	264
1.7	254

Tc (Hours)	qu (csm/in)
1.8	246
1.9	238
2	230
2.1	223
2.2	217
2.3	211
2.4	205
2.5	200
2.6	194
2.7	190
2.8	185
2.9	181
3	176
3.1	173
3.2	169
3.3	165
3.4	162
3.5	158
3.6	155
3.7	152
3.8	149
3.9	147
4	144
4.1	141
4.2	139
4.3	136
4.4	134
4.5	132
4.6	130
4.7	128
4.8	126
4.9	124
5	122
5.1	120
5.2	118

Tc (Hours)	qu (csm/in)
5.3	116
5.4	115
5.5	113
5.6	112
5.7	110
5.8	109
5.9	107
6	106
6.1	104
6.2	103
6.3	102
6.4	100
6.5	99
6.6	98
6.7	97
6.8	96
6.9	94
7	93
7.1	92
7.2	91
7.3	90
7.4	89
7.5	88
7.6	87
7.7	86
7.8	85
7.9	84
8	84
8.1	83
8.2	82
8.3	81
8.4	80
8.5	79
8.6	79
8.7	78

Tc (Hours)	qu (csm/in)
8.8	77
8.9	76
9	76
9.1	75
9.2	74
9.3	74
9.4	73
9.5	72
9.6	72
9.7	71
9.8	70
9.9	70
10	69