

February 2, 2024
Updated March 7, 2024

To: Mr. Mark Oram
Sherborn BOH
19 Washington Street
Sherborn, MA 01770

Dear Mr. Oram:

Thank you for sending us your review comments. We have revised the plan to incorporate your comments and recommendations. To facilitate your review, we provided in the following a brief response point to point to your comments. Your comment is quoted first in *italics* and followed by our response in **red**.

Please be advised that the application and septic system design plan for 65 Farm, Road, Sherborn, MA, dated 11/30/2023, received by our office on 12/12/2023, and subsequently reviewed with the engineer and peer reviewer, have been found to be deficient based on the following deficiencies or missing information:

1. *The owner's name and address are not noted on the septic plan.*
Response: This information is listed as General Note #1.
2. *The well on the property next to the septic system on 55 Farm Road is not shown on the plot plan.*
Response: The well was shown on Sheet 2 but can now also be seen on Sheet 1. The distance from the well to the proposed SAS is 141.60-ft upgradient of the SAS.
3. *If variances are being requested from the Sherborn Board of Health regulations, these waivers are to be noted on the proposed plot plans that show the well and septic system.*
Response: Please note this application is for Title V approval only. The design meets all Title V requirements. To the extent waivers from local regulations are required, Fenix Partners Farm Road Development will seek them from the Sherborn ZBA as proscribed by MA Chapter 40B. As a practical matter, we expect to request a waiver for the 125 ft setback from BVW for the SAS location.
4. *Septic note#5 is to indicate the need to notify the Board of Health.*
Response: The notification to Board of Health is detailed in Design Construction Note #1.
5. *Each septic tank compartment capacity has not been shown.*
Response: The capacity of each compartment of the septic tank is added as requested on Sheet 7 of 10.
6. *There is no indication on the plan that the boundaries are legal boundaries.*
Response: The boundaries of the project site have been legally determined and recorded in the ANR Plan of Land by Samiotas Consultants, Inc. dated February 24, 2022. Note #10 is added to the general notes for such purpose.
7. *The water lines are not shown.*
Response: The water lines have been added to the site plan.
8. *The elevations are to be provided for all the soil testing, deepholes, and percolation testing.*
Response: The elevations are added to the soil profiles as requested. See Sheet 4 of 10.

9. *The estimated seasonal high groundwater is not provided at the septic tank and pump chamber locations.*
Response: The estimated high groundwater has been provided for all the tanks in the profile. See Sheet 7 of 10.
10. *The soil test logs on sheet 4 of 9 do not match the information collected by the Health Agent, see Note F [E] below.*
Response: See response to Note E below.
11. *A note shall be placed on the septic plans stating that all septic system covers, including the septic tank and sewer manholes covers that are raised to grade, are to be secured.*
Response: A callout note has been added as requested on Sheet 7 of 10.
12. *The percolation test inch drops for the last three inches are to be shown for the determination of the percolation rate.*
Response: A percolation summary table that shows the drops between the inches of 12 and 6 have been added to Sheet 4 of 10.
13. *Elevations for the deep holes are to be provided on the soil test logs, including the elevation for each soil horizon.*
Response: The information was provided in the soil report and have been added to the plan on Sheet 4 of 10.
14. *The elevations of the percolation test are not provided.*
Response: The elevations of the percolation tests were added to Sheet 4 of 10.
15. *On sheet 4 of 9, the soil test reports shall indicate if there was refusal at the base of the deep hole.*
Response: The soil logs are rechecked and ledge information were added to the soil logs on Sheet 4 of 10.

Additional Notes:

- a. *The septic plan has not been reviewed and approved by the Conservation Commission.*
Response: Approval of the Conservation Commission is not required by Title V. The septic system is located outside the 100' buffer zone, with modest grading to 86'. Filings with the Conservation Commission will occur after the issuance of a Comprehensive Permit by the Sherborn ZBA.
- b. *The well applications and fees have not been received.*
Response: The applicant is working with the Sherborn ZBA for permitting of wells as required by MA Chapter 40B. Distances from wells to septic are provided as required under Title V.
- c. *Deed recordings prohibiting the installation of garbage grinders are to be completed prior to the septic and well plan being released for construction.*
Response: The deed recording will be executed toward the final stage of the comprehensive permit.
- d. *The information for the mounding analysis and nitrogen loading analysis requested by the peer reviewer who also noted that there is to be a definitive statement that the abutters' wells are not being affected by this proposed septic system.*
Response: The information for groundwater mounding analysis and nitrogen loading has been provided in our hydrogeological evaluation report. Following our meeting with the Agent and the peer review hydrogeologist Peter Dillion. The updated groundwater mounding analysis and supporting data including soil texture laboratory report, and permeability analysis sheets are attached here for reference. The nitrogen budget

analysis result is also attached here for reference.

e. *The soil testing on sheet 4 of 9 does not match the Health Agent's soil testing logs. The engineer was sent these soil testing logs on 12/20/2023. On 1/11/2024, the engineer noted that he has not had the opportunity to review those soil testing logs.*

Response: We have rechecked our soil logs against the Agent's soil note and send out our notes back with comparison to the agent. Our field notes are attached to this letter for reference.

Feel free to contact us if you have any questions.

Sincerely,

Creative Land & Water Engineering, LLC

By



Desheng Wang
Desheng Wang, Ph.D., P.E., CWS, CSE

Francis Alves

Francis Alves, E.I.T., CSE
Civil/Environmental Engineer

Appendix Supplementary Data for Groundwater Mounding Analysis and Updated Groundwater Mounding Analysis

To address the peer review comments regarding the determination of the input parameters, specifically, the saturated soil (unconsolidated aquifer) depth and the hydraulic conductivity (permeability of the soils), we had a meeting on December 20, 2023 with Mr. Peter Dillon, a Hydrogeologist of Tetra Tech and Mr. Mark Oram of the Board of Health Agent.

1. We showed that the nearby well drill logs (49, 53 and 55 Farm Road) were carefully evaluated and found that the well at 53 Farm Road is consistent with the area of the proposed SAS. The saturated soil thickness of 14.5 ft will be used to update the groundwater mounding analysis. This number is very consistent with the deep hole soil testing data. Given that the mounding will spread hundreds of feet, the aquifer depth is conservatively quantified as further downstream the aquifer depth will be thicker. 49 Farm Road well has 25 ft soil over ledge and about 22 ft of saturated soil. See Table S1 for a summary of the well condition. The over 10 gpm yield in all three wells also indicated that the aquifer here is very consistently productive and permeable. The man-dug isolated wet pond on 65 Farm Road has a depth of 15 ft under normal high water, therefore the saturated soil aquifer depth will be at least 15 ft.

Table S1. Existing Well Data around the proposed SAS

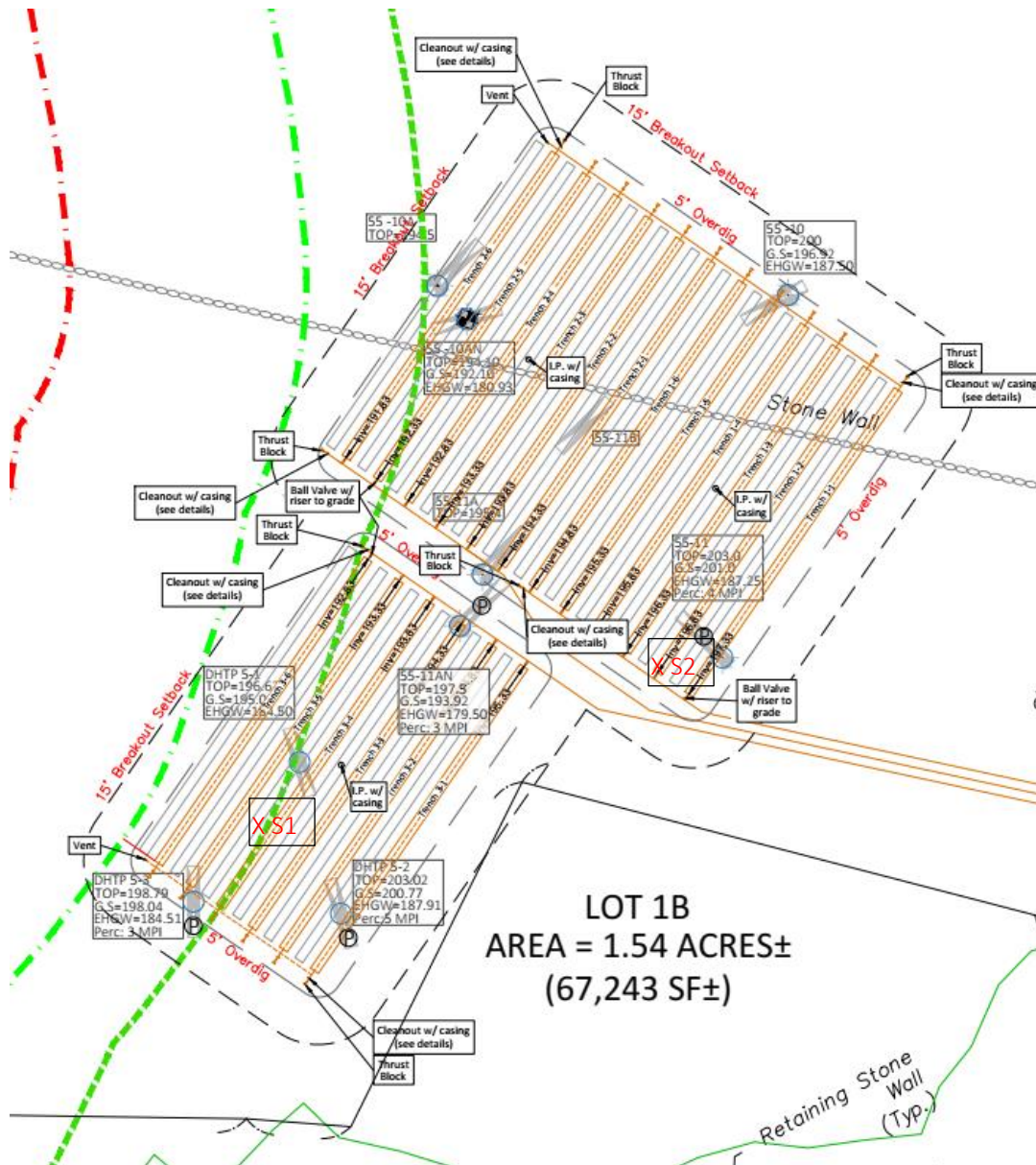
Location	Date drilled	Well depth, ft	Well Cap, gpm	Gravel depth, ft	Water depth, ft	GW correction, ft	unconsolidated Aq. Depth, ft	Note
49 Farm Rd*	10/25/2005	400	10	25	5	2	22	Similar el. with SAS on opposite of Wetland
53 Farm Rd	11/15/2021	300	11	18	5.5	2	14.5	Similar ele with SAS on the same side of wetland
55 Farm Rd	5/20/1980	520	10	17				30+ ft above SAS on the same side of wetland
64 Farm Rad	1980s			15			15	Man-made pond in 1980s

*Water level is estimated based on offsite observation and onsite soil testing, which could be higher.

2. We also showed that the hydraulic conductivity in documented literature for loamy sand condition is consistent with what we used. See attached extract from a book of soil and rock properties. Mr. Dillon recommended that we take two soil samples from the SAS area to do a grain size sieve analysis, which would accurately confirm the soil texture and provide data for permeability analysis. On January 3, 2024, we took two soil samples witnessed by Mr. Oram from the upper limit of the SAS and down gradient limit of SAS. The two samples together with four soil samples taken from the four proposed stormwater management basins were delivered to Yankee Engineering Testing for sieve analysis. The sieve analysis showed that the soil at the lower limit (S1) is coarse medium sand and the soil at the upper limit of the SAS (S2) is loamy sand. This is consistent with general geological observations, soil in upper hill tends to be well mixed siltier condition than the lower flattened area. And the site has a general deep groundwater condition is another collateral evidence of the well drained soil condition. Out of six soil samples, only one soil was tested sandy loam that is close to loamy sand in upper hill area for stormwater Basin A. Three of them are actually sand and two are loamy sand. See Tabe S2 for a summary and attached lab report for details. Based on the grain size distribution, we calculated the permeability of all six soil samples using two methods: Hazen and Kenny. The result is summarized in Table S3.

Table S2. Summary of soil texture analysis based on sieve analysis, 65 Farm Rd, Sherborn, MA

Soil Sample	Location	Sand, silt, and Clay compisition				Soil texture per USDA
		Sand % 0.05-2 mm	Silt % 0.002-0.05mm	Clay % <0.002mm	Total %	
S1	lower edge of SAS	92.53	5.6	1.87	100	medium sand
S2	upper edge of SAS	73.66	24.56	1.78	100	medium loamy sand
SA1	Stormwater Basin A	66.1	30.5	3.4	100	medium sand loam
SB-1	Stormwater Basin B-1	97.91	2.09	0	100	fine medium sand
SB-2	Stormwater Basin B-2	75.64	22.86	1.5	100	medium loamy sand
SC	Stormwater Basin C	91.46	6.71	1.83	100	medium sand



Location of soil samples in SAS area

Table S3. Summary of hydraulic conductivity (permeability) analysis

Soil Sample	Location	estimated K, ft/day	Average K, ft/day	Typical K for silt/sand*	Design K	Soil texture per USDA
S1	lower edge of SAS	29-850	439	153	24	medium sand
S2	upper edge of SAS	4.39-76	40	28		medium loamy sand
SA1	Stormwater Basin A	0.52-8.5	4.51	28		medium sand loam
SB-1	Stormwater Basin B-1	37.84-1437.17	737	153		fine medium sand
SB-2	Stormwater Basin B-2	7.80-76.54	42.17	28		medium loamy sand
SC	Stormwater Basin C	57.43-1028	543.21	153		medium sand

* Ameratunga, Jay, Sivakugan, N., and Das, B. M. Correlations of soil and rock properties in geotechnical engineering, Springer 2016.

A computer program using Hantush method is used to calculate the groundwater mounding from the proposed septic system. The parameters were determined by onsite soil testing as follows.

Sewage Discharge Rate = 8360 GPD

Hydraulic Conductivity = 24 ft/day. (see previous section)

Specific Yield = 0.26 (R. Brown Groundwater, Elsevier Applied Sci. Publishers LTD 1986)

Impervious Datum = 0-50 ft. BGS, conservative value 14.5 based on the well drilling data at 53 Farm road and check with 49 and 55 Farm road well drilling data. is used, See Table s1

Groundwater Table = 279.5 ft. medium value with Frimpter adjustment (soil evaluation, and monitoring)

Effective Leaching Area = 92 ft x 82 ft (L1-# and L2-#); 82 ft x 46 ft (L3-#)

Groundwater mounding time = 90 days –recommended by DEP guideline.

The calculated maximum groundwater mounding heights are 0.91 ft (L1 and L2), 0.81 ft (L3). These values are added to the adjusted groundwater table at each trench line conservatively to make sure the maximum mounded high ground water table would be at least 4 ft below the bottom of each trench. See Tables 9.1 and 9.2 for summary. The septic design plan has been updated with this new mounding analysis. The updated computer model output is attached for reference.

It can be seen that there will be at least 7.17 ft groundwater separation assuming the high groundwater is at the dry test pit bottom. It will be at least 8.29 ft if the water table is based on the observed water tables in the two wet wells.

Table 9.1 - Hydraulic profile design summary of SAS (Rev. 2/2/2024)

Line	Bottom Elev, ft	Dist to Ref well DHTP-11An, ft	EHGW with wet well, ft	Mound EHGW, ft	GW Sep, ft	EHGW with dry well, ft	Mound GW using dry tp, ft	GW Sep, ft
L 1-1	195.33	52.34	180.66	181.57	13.76	187.25	188.16	7.17
L1-2	194.83	50.565	180.62	181.53	13.30	186.68	187.59	7.24
L1-3	194.33	49.235	180.59	181.50	12.83	186.10	187.01	7.32
L1-4	193.83	47.98	180.56	181.47	12.36	185.53	186.44	7.39
L1-5	193.33	47.38	180.55	181.46	11.87	184.95	185.86	7.47
L1-6	192.83	89.75	181.49	182.40	10.43	184.38	185.29	7.54
L2-1	192.33	0	179.50	180.41	11.92	183.80	184.71	7.62
L2-2	191.83	0	179.50	180.41	11.42	183.23	184.14	7.69
L2-3	191.33	47.6	180.56	181.47	9.86	182.66	183.57	7.76
L2-4	190.83	48.2	180.57	181.48	9.35	182.08	182.99	7.84
L2-5	190.33	48.255	180.57	181.48	8.85	181.51	182.42	7.91
L2-6	189.83	51.105	180.63	181.54	8.29	180.93	181.84	7.99
L3-1	193.33	37	180.32	181.13	12.20	184.95	185.76	7.57
L3-2	192.83	35	180.28	181.09	11.74	184.38	185.19	7.64
L3-3	192.33	0	179.50	180.31	12.02	183.80	184.61	7.72
L3-4	191.83	33	180.23	181.04	10.79	183.23	184.04	7.79
L3-5	191.33	36	180.30	181.11	10.22	182.66	183.47	7.86
L3-6	190.83	41	180.41	181.22	9.61	182.08	182.89	7.94
Average					11.16			7.64
Minimum					8.29			7.17

Note: The combined max mounding height in L1 and L2 is 0.91 ft
The max mounding height in L3 is 0.81 ft

Table 9.2 - Summary of groundwater mounding analysis – SAS (Rev 2/2/2024)

Parameters	Leaching Field		Note
Recharge area	SAS 1+2	SAS3	All trenches are placed more than 8 ft above the estimated highgroundwater and not be impacted by groundwater mounding.
Dimension, Length, ft	92	82	
Dimension, Width, ft	82	46	
Area, sq. ft	7544.00	3772.00	
Recharge Vol. Cu ft (per day or event)	745.10	372.55	
Duration, day	90	90	
Recharge rate, cu ft/day/sq. ft	0.10	0.10	
Dewater time, day	90	90	
GW Separation, ft	8.49	12.58	
Distance to wetland, ft	125	125	
Maximum mounding height, ft	0.71	0.41	
Estimated effective Max MH, ft	0.91	0.81	
Impact mounding height by other systems, ft	0.2	0.4	
Combined Mound height, ft	0.91	0.81	
Bottom of Trench, ft	192.58	192.08	
Top of stones, ft			
EHGW, ft	184.09	179.5	
	average		
Bottom aquifer, ft	170	170	
Flood routing elev, ft	291.670	291.670	
Top of grade, ft	292.5	275.5	
Aquafer depth, ft	14.5	14.5	
Hydraulic Conductivity, ft/day	24.00	24.00	
Groundwater mound rage, ft	841	841	

Hazen Method

Input report:

Test pit:	S1-SAS	Soil:	Medium to Coarse sand
Shape factor:	0.011	D10 (cm):	0.00962 Better for range 0.01 to 0.03 cm
Void ratio (e):	0.51	D60 (cm):	0.5
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	51.98 Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.005

Output report:

	Hazen	Kenney**	
Permeability k (cm/s):	$Ch \cdot D_{10}^2$	$Ch \cdot D_{50}^2 \cdot 10^{-4} / 1.02$	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	93.21014	1	Average
	(range 100-150)	range 1-5	
Calculated permeability (cm/s):	0.008626 , or	0.25	
	0.00034 ft/sec	0.009843	5.09E-03 ft/s
	29.34 ft/day	850.39	439.87 ft/day
Rawls value	16.54	16.54	16.54 ft/day
Percolation rate:	3 mpi		

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Ref. 1. Hazen method

2. Kenney TC, Lau D, Ofoegbu GI (1984) Permeability of compacted granular materials, CanGeotech J 21 (4): 726-729

Hazen Method

Input report:

Test pit:	S2-SAS	Soil:	Medium loamy sand
Shape factor:	0.011	D10 (cm):	0.003 Better for range 0.01 to 0.03 cm
Void ratio (e):	0.6	D60 (cm):	0.36143
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	120.48 Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0015

Output report:

	Hanzen	Kenney**	
Permeability k (cm/s):	$Ch \cdot D_{10}^2$	$Ch \cdot D_{50}^2 \cdot 10^{-4} / 1.02$	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	143.2397	1	Average
	range (100-150)	range 1-5	
Calculated permeability (cm/s):	0.001289 , or	0.0225	
	5.08E-05 ft/sec	0.000886 ft/s	4.68E-04 ft/s
	4.39 ft/day	76.54 ft/day	40.46 ft/day
Rawls value	4.82	4.82	4.82 ft/day
Percolation rate	5 mpi		

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Hazen Method

Input report:

Test pit:	S-A1- Basin A1	Soil:	Medium sandy loam
Shape factor:	0.011	D10 (cm):	0.00116 Better for range 0.01 to 0.03 cm
Void ratio (e):	0.55	D60 (cm):	0.21529
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	185.59 Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0005

Output report:

	Hazen	Kenney**	
Permeability k (cm/s):	Ch*D10^2	Ch*D5^2*10^4/1.02	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	113.8901	1	Average
	range (100-150)	range 1-5	
Calculated permeability (cm/s):	0.000153 , or	0.0025	
	6.03E-06 ft/sec	9.84E-05 ft/s	5.22E-05 ft/s
	0.52 ft/day	8.50 ft/day	4.51 ft/day
Rawls value	2.04 ft/day	2.04 ft/day	2.04 ft/day

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Hazen Method

Input report:

Test pit:	SB2-Basin B2	Soil:	Medium loamy sand
Shape factor:	0.011	D10 (cm):	0.004 Better for range 0.01 to 0.03 cm
Void ratio (e):	0.6	D60 (cm):	0.615
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	153.75 Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0015

Output report:

	Hazen	Kenney**	
Permeability k (cm/s):	$Ch \cdot D_{10}^2$	$Ch \cdot D_{50}^2 \cdot 10^{-4/1.02}$	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	143.2397	1	Average
	range (100-150)	range 1-5	
Calculated permeability (cm/s):	0.002292 , or	0.0225	
	9.02E-05 ft/sec	0.000886 ft/s	4.88E-04 ft/s
	7.80 ft/day	76.54 ft/day	42.17 ft/day
Rawls value	4.82	4.82	4.82 ft/day
Percolation rate	<2	mpi	

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Hazen Method

Input report:

Test pit:	SB1-Basin B1	Soil:	Medium to Coarse sand
Shape factor:	0.011	D10 (cm):	0.00763 Better for range 0.01 to 0.03 cm
Void ratio (e):	0.67	D60 (cm):	0.02073
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	2.72 Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0065

Output report:

	Hazen	Kenney**	
Permeability k (cm/s):	$Ch \cdot D_{10}^2$	$Ch \cdot D_5^2 \cdot 10^4 / 1.02$	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	191.0898	1	Average
	(range 100-150)	range 1-5	
Calculated permeability (cm/s):	0.011125 , or	0.4225	
	0.000438 ft/sec	0.016634	8.54E-03 ft/s
	37.84 ft/day	1437.17	737.50 ft/day
Rawls value	16.54	16.54	16.54 ft/day

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Ref. 1. Hazen method

2. Kenney TC, Lau D, Ofoegbu GI (1984) Permeability of compacted granular materials, CanGeotech J 21 (4): 726-729

Hazen Method

Input report:

Test pit:	SC-Basin C	Soil:	Medium sand
Shape factor:	0.011	D10 (cm):	0.0094 Better for range 0.01 to 0.03 cm
Void ratio (e):	0.67	D60 (cm):	0.32736
Design temperature (C.degree):	20	Uniformity coef.(D60/D10):	34.83 Better for less or equal to 5
Gravity acceleration (cm/s^2):	981	D5(cm):	0.0055

Output report:

	Hazen	Kenney**	
Permeability k (cm/s):	$Ch \cdot D_{10}^2$	$Ch \cdot D_{50}^2 \cdot 10^{-4} / 1.02$	
Kinematic viscosity at 0 oC (cm^2/s):	0.01792		
Design kinematic viscosity (cm^2/s):	0.01017		
Coef Ch (1/s.cm):	191.0898	1	Average
	(range 100-150)	range 1-5	
Calculated permeability (cm/s):	0.016885 , or	0.3025	
	0.000665 ft/sec	0.011909	6.29E-03 ft/s
	57.43 ft/day	1028.98	543.21 ft/day
Rawls value	16.54	16.54	16.54 ft/day

Recommended Void Ratio for Sandy Soils

Soil	Void ratio
Sand, loose and uniform	0.85
Sand, dense and uniform	0.51
Sand, loose and mixed	0.67
Sand, dense and mixed	0.43
Loamy sand	0.6
Loamy sand, dense	0.4
Sandy loam	0.55
Sandy loam, dense	0.35

Ref. 1. Hazen method

2. Kenney TC, Lau D, Ofoegbu GI (1984) Permeability of compacted granular materials, CanGeotech J 21 (4): 726-729

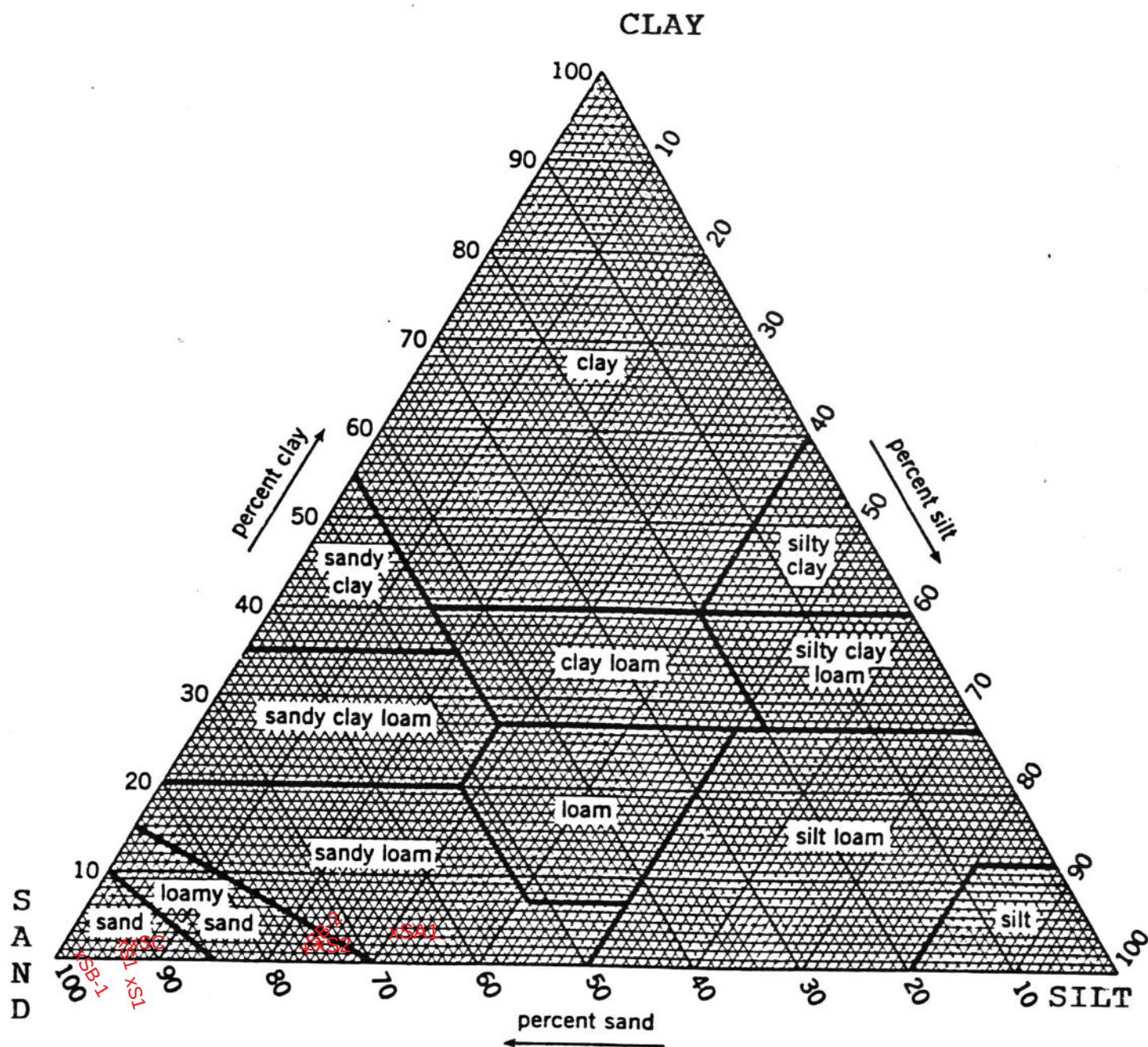
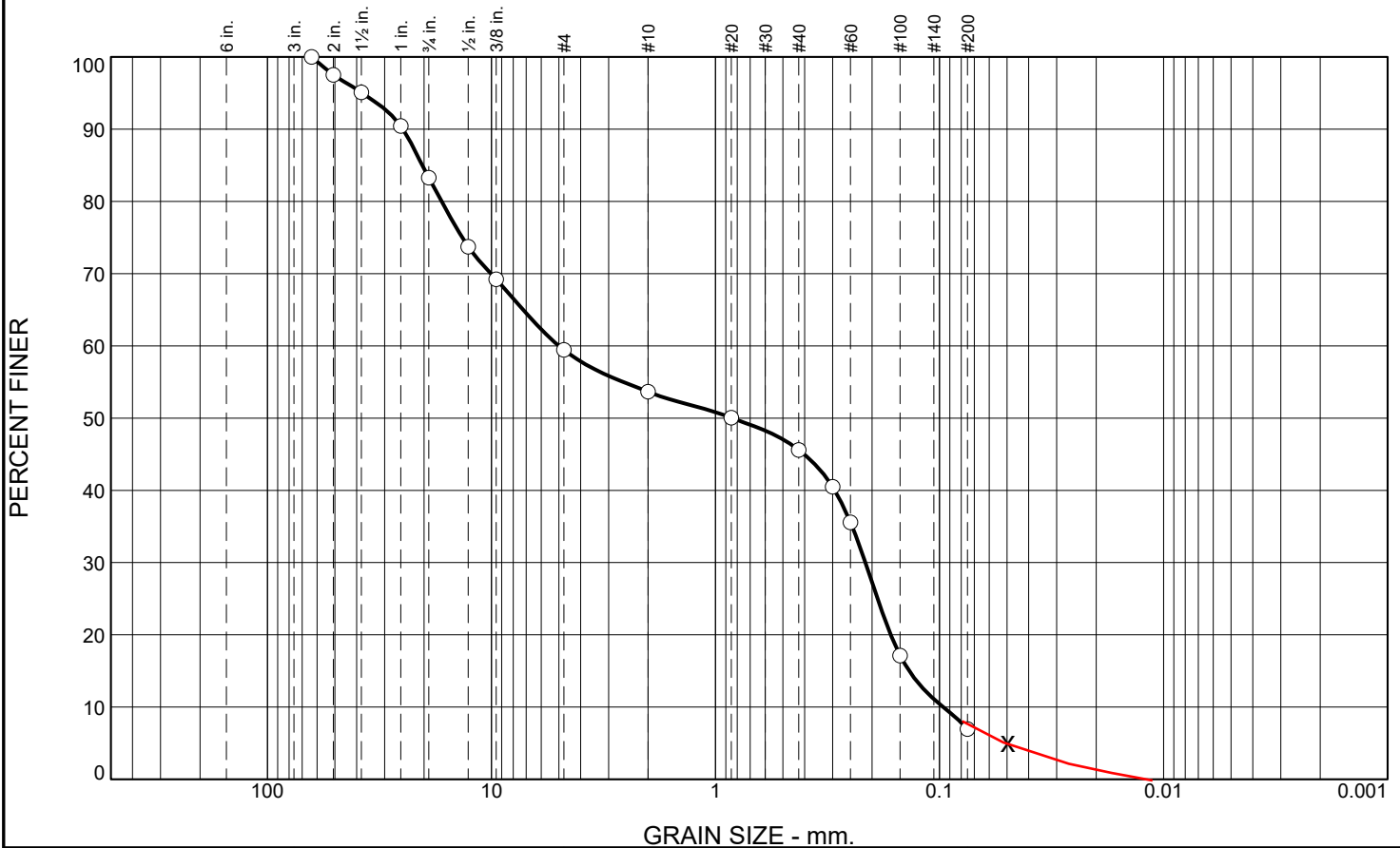


Figure 1: SOIL TEXTURAL TRIANGLE

Table Summary of soil texture analysis based on sieve analysis, 65 Farm Rd, Sherborn, MA

Soil Sample	Location	Sand, silt, and Clay composition				Soil texture per USDA
		Sand % 0.05-2 mm	Silt % 0.002-0.05mm	Clay % <0.002mm	Total %	
S1	lower edge of SAS	92.53	5.6	1.87	100	medium sand
S2	upper edge of SAS	73.66	24.56	1.78	100	medium loamy sand
SA1	Stormwater Basin A	66.1	30.5	3.4	100	medium sand loam
SB-1	Stormwater Basin B-1	97.91	2.09	0	100	fine medium sand
SB-2	Stormwater Basin B-2	75.64	22.86	1.5	100	medium loamy sand
SC	Stormwater Basin C	91.46	6.71	1.83	100	medium sand

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.7	23.9	5.8	8.0	38.6	7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2-1/2"	100.0		
2"	97.5		
1.5	95.1		
1	90.4		
.75	83.3		
.5	73.7		
3/8	69.2		
#4	59.4		
#10	53.6		
#20	50.0		
#40	45.6		
#50	40.5		
#60	35.6		
#100	17.1		
#200	7.0		

* (no specification provided)

Material Description

Brown 2.5" max f/m sand and gravel trace silt
USDA Class I Loamy Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D₈₅= 20.3667 D₆₀= 5.0006 D₅₀= 0.8422
D₃₀= 0.2143 D₁₅= 0.1366 D₁₀= 0.0962
C_u= 51.96 C_c= 0.10

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

Sample No.: L-33929
Location: S-1 Sample

Source of Sample: Farm Rd - Sherborn MA

Date: 1/9/24
Elev./Depth: submitted

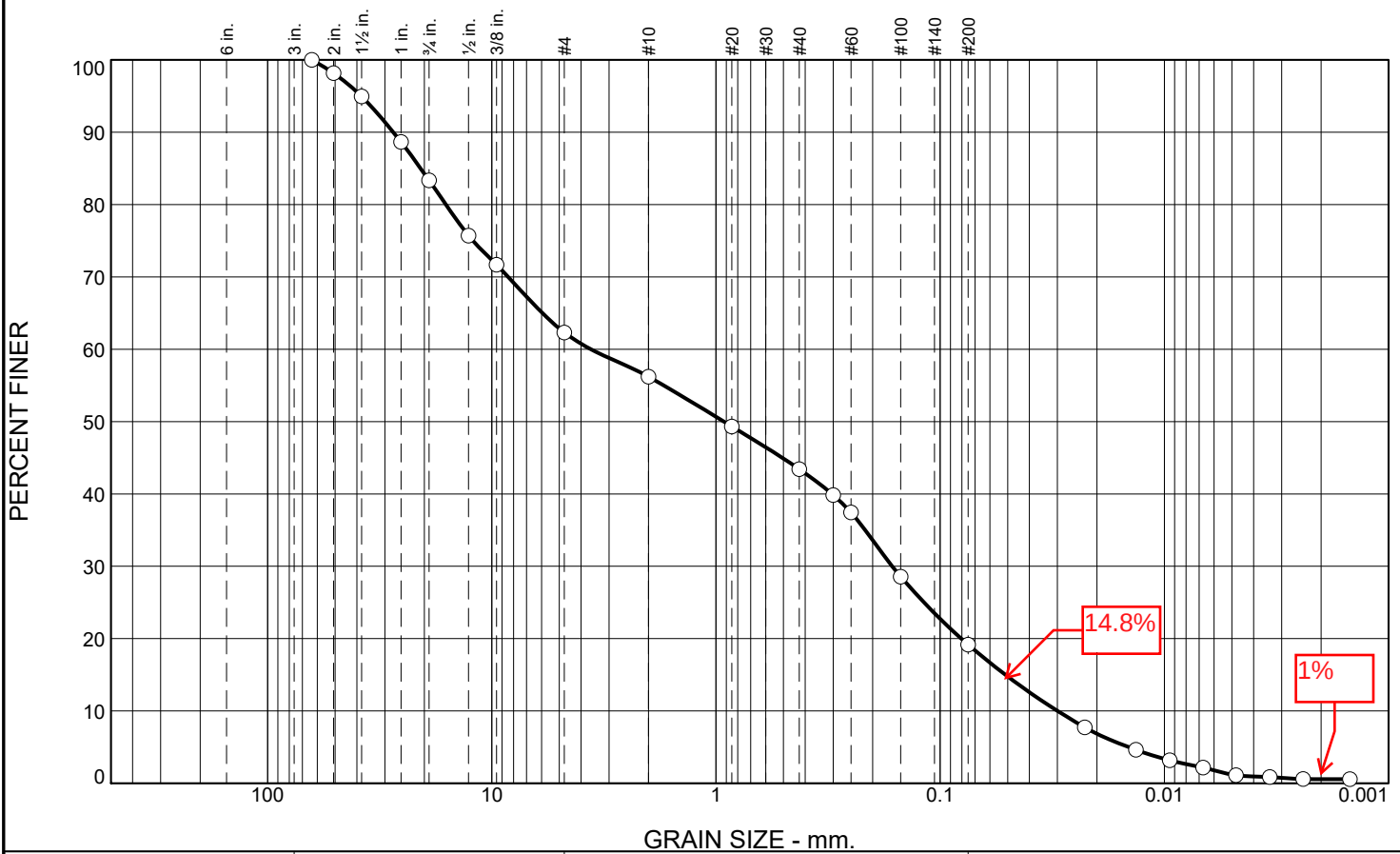
**YANKEE ENGINEERING
& TESTING, INC.**

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK

Checked By: SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.6	21.1	6.1	12.8	24.2	18.0	1.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5"	100.0		
2"	98.2		
1.5	95.0		
1	88.7		
.75	83.4		
.5	75.7		
3/8	71.7		
#4	62.3		
#10	56.2		
#20	49.3		
#40	43.4		
#50	39.8		
#60	37.4		
#100	28.6		
#200	19.2		

* (no specification provided)

Material Description

Brown 2.5" max silty sand and gravel
USDA Class I Loamy Sand

Atterberg Limits

PL= NP

LL= NV

PI= NP

Coefficients

D₈₅= 20.7906

D₆₀= 3.6143

D₅₀= 0.9228

D₃₀= 0.1638

D₁₅= 0.0511

D₁₀= 0.0300

C_u= 120.63

C_c= 0.25

Classification

USCS= SM

AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

Sample No.: L-33931
Location: S-2 Sample

Source of Sample: Farm Rd - Sherborn MA

Date: 1/9/24
Elev./Depth: submitted

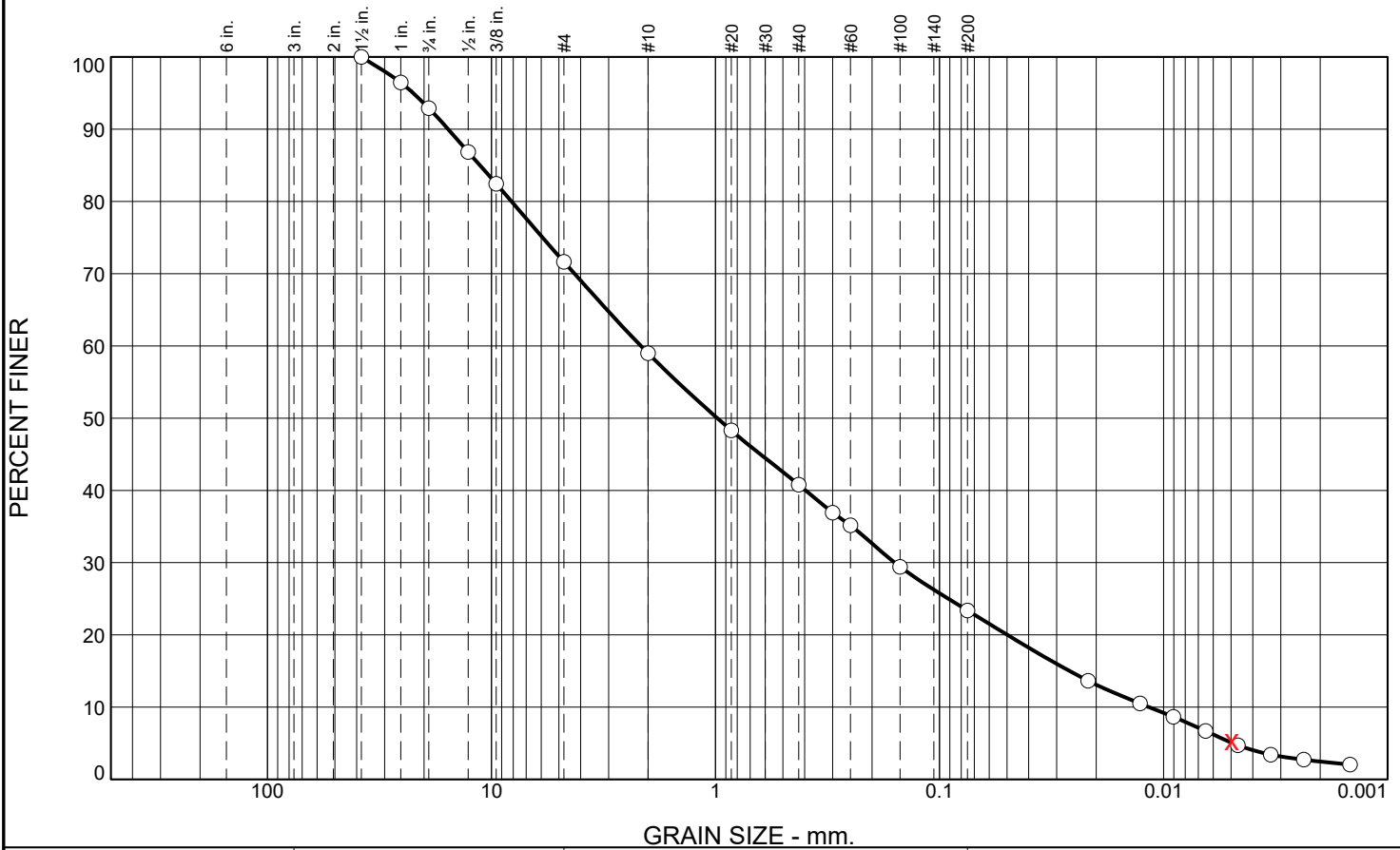
**YANKEE ENGINEERING
& TESTING, INC.**

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK / AH

Checked By: SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.1	21.3	12.6	18.2	17.4	18.3	5.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.5		
.75	92.9		
.5	86.8		
3/8	82.4		
#4	71.6		
#10	59.0		
#20	48.3		
#40	40.8		
#50	36.9		
#60	35.2		
#100	29.4		
#200	23.4		

* (no specification provided)

Material Description

Light brown 1.5" max silty sand some gravel
USDA Class II Sandy Loam

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D₈₅= 11.2532 D₆₀= 2.1529 D₅₀= 0.9818
D₃₀= 0.1587 D₁₅= 0.0263 D₁₀= 0.0116
C_u= 185.43 C_c= 1.01

Classification

USCS= SM AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

Sample No.: L-33926
Location: SA-1 Sample

Source of Sample: Farm Rd - Sherborn MA

Date: 1/9/24
Elev./Depth: submitted

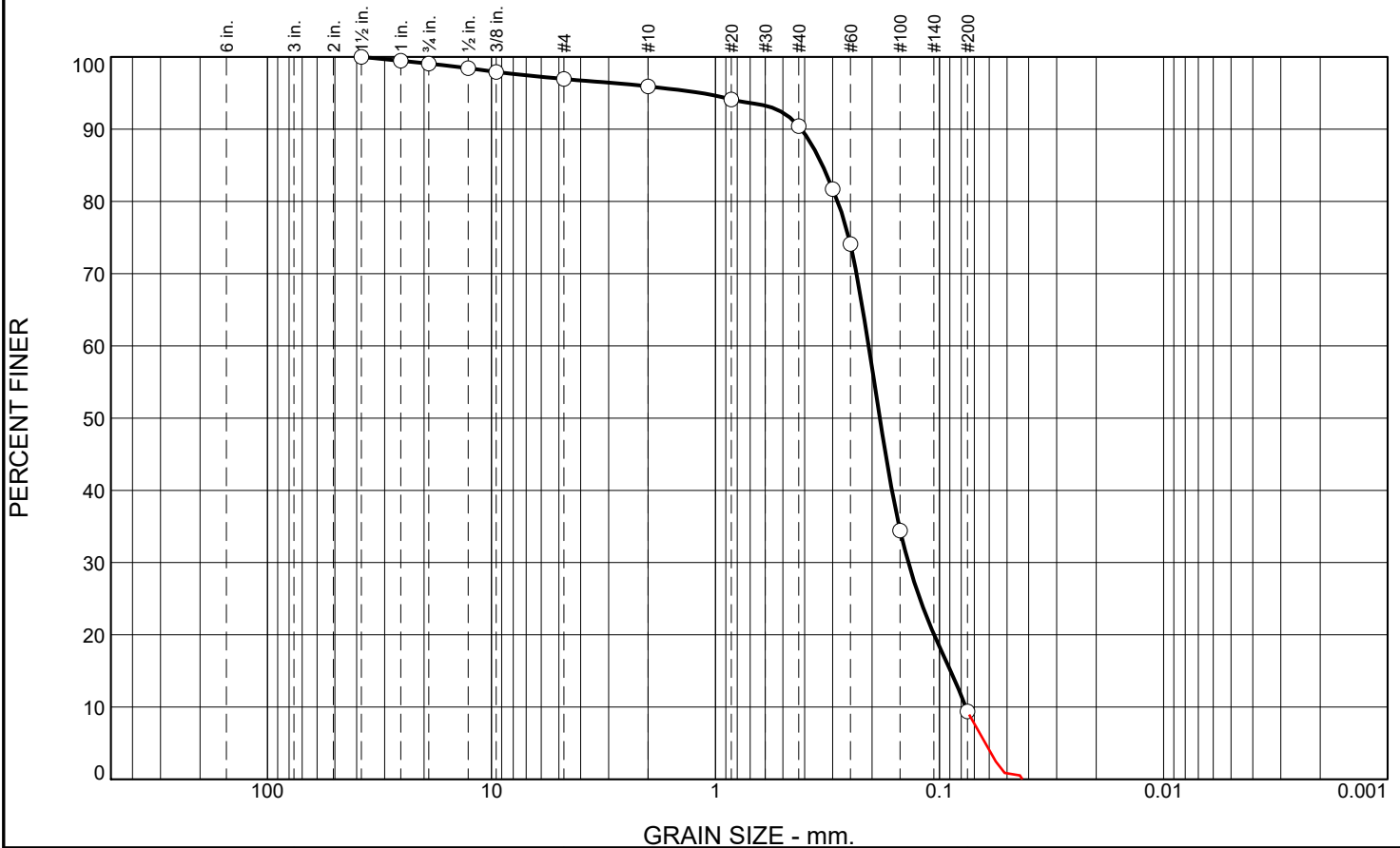
**YANKEE ENGINEERING
& TESTING, INC.**

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK / AH

Checked By: SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.9	2.2	1.0	5.5	81.0	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	99.5		
.75	99.1		
.5	98.5		
3/8	97.9		
#4	96.9		
#10	95.9		
#20	94.1		
#40	90.4		
#50	81.7		
#60	74.1		
#100	34.4		
#200	9.4		

* (no specification provided)

Material Description Brown fine sand trace silt trace gravel USDA Class I Loamy Sand		
Atterberg Limits PL= NP LL= NV PI= NP		
Coefficients D ₈₅ = 0.3335 D ₆₀ = 0.2073 D ₅₀ = 0.1847 D ₃₀ = 0.1378 D ₁₅ = 0.0893 D ₁₀ = 0.0763 C _u = 2.72 C _c = 1.20		
Classification USCS= SP-SM AASHTO= A-3		
Remarks Sample submitted by client on 01/03/24		

Sample No.: L-33928
Location: SB-1 Sample

Source of Sample: Farm Rd - Sherborn MA

Date: 1/9/24
Elev./Depth: submitted

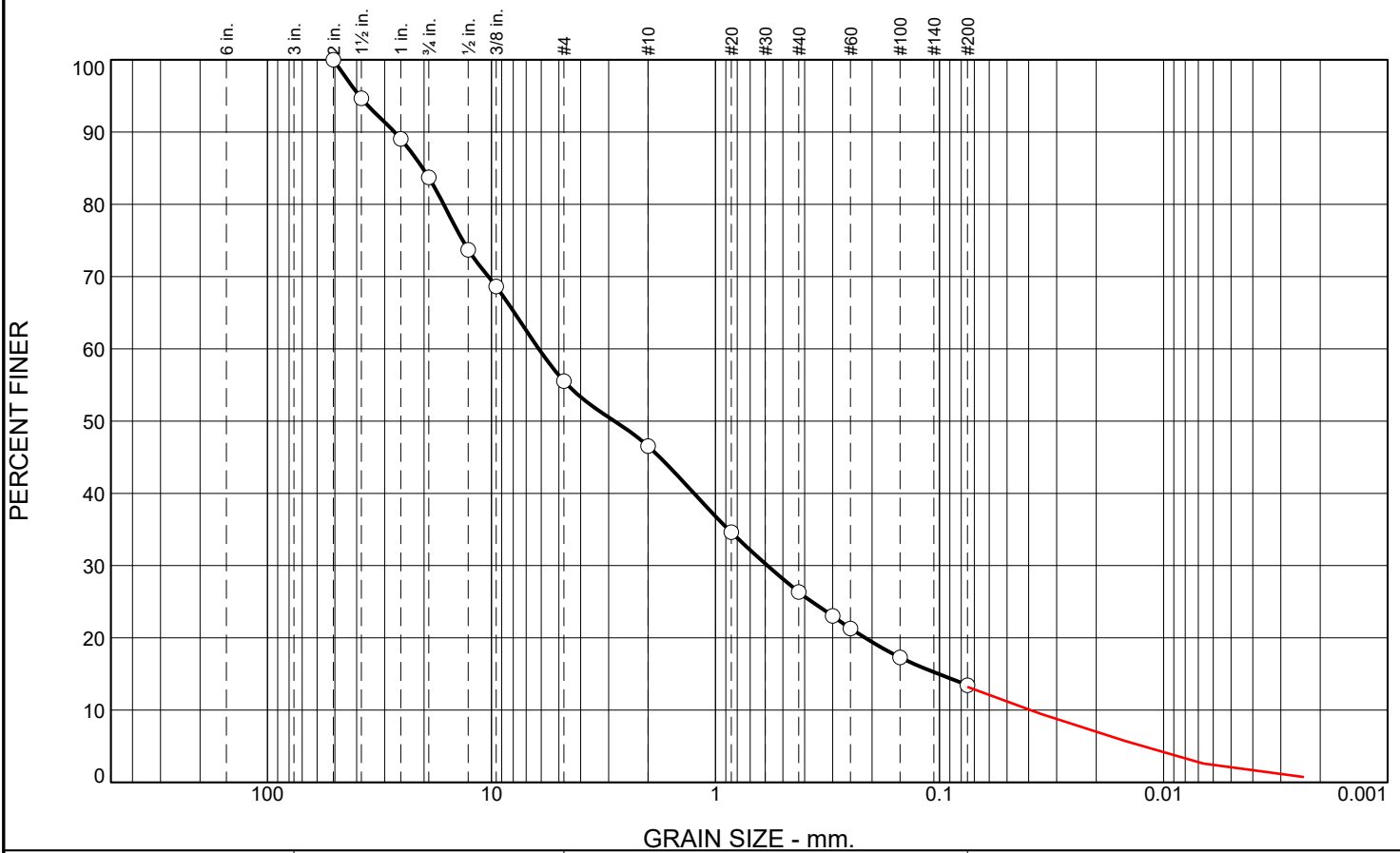
**YANKEE ENGINEERING
& TESTING, INC.**

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
 Various Sites/Projects
Project No: 15027

Tested By: AK

Checked By: SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.3	28.2	9.0	20.1	13.0	13.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100.0		
1.5	94.7		
1	89.0		
.75	83.7		
.5	73.7		
3/8	68.6		
#4	55.5		
#10	46.5		
#20	34.6		
#40	26.4		
#50	23.0		
#60	21.3		
#100	17.3		
#200	13.4		

* (no specification provided)

Material Description

Brown 2" max silty gravel and sand
USDA Class I Loamy Sand

Atterberg Limits

PL= NP

LL= NV

PI= NP

Coefficients

D₈₅= 20.2613

D₆₀= 6.1500

D₅₀= 2.8246

D₃₀= 0.5866

D₁₅= 0.1008

D₁₀=

C_u=

C_c=

Classification

USCS= GM

AASHTO= A-1-a

Remarks

Sample submitted by client on 01/03/24

Sample No.: L-33930
Location: SB-2 Sample

Source of Sample: Farm Rd - Sherborn MA

Date: 1/9/24
Elev./Depth: submitted

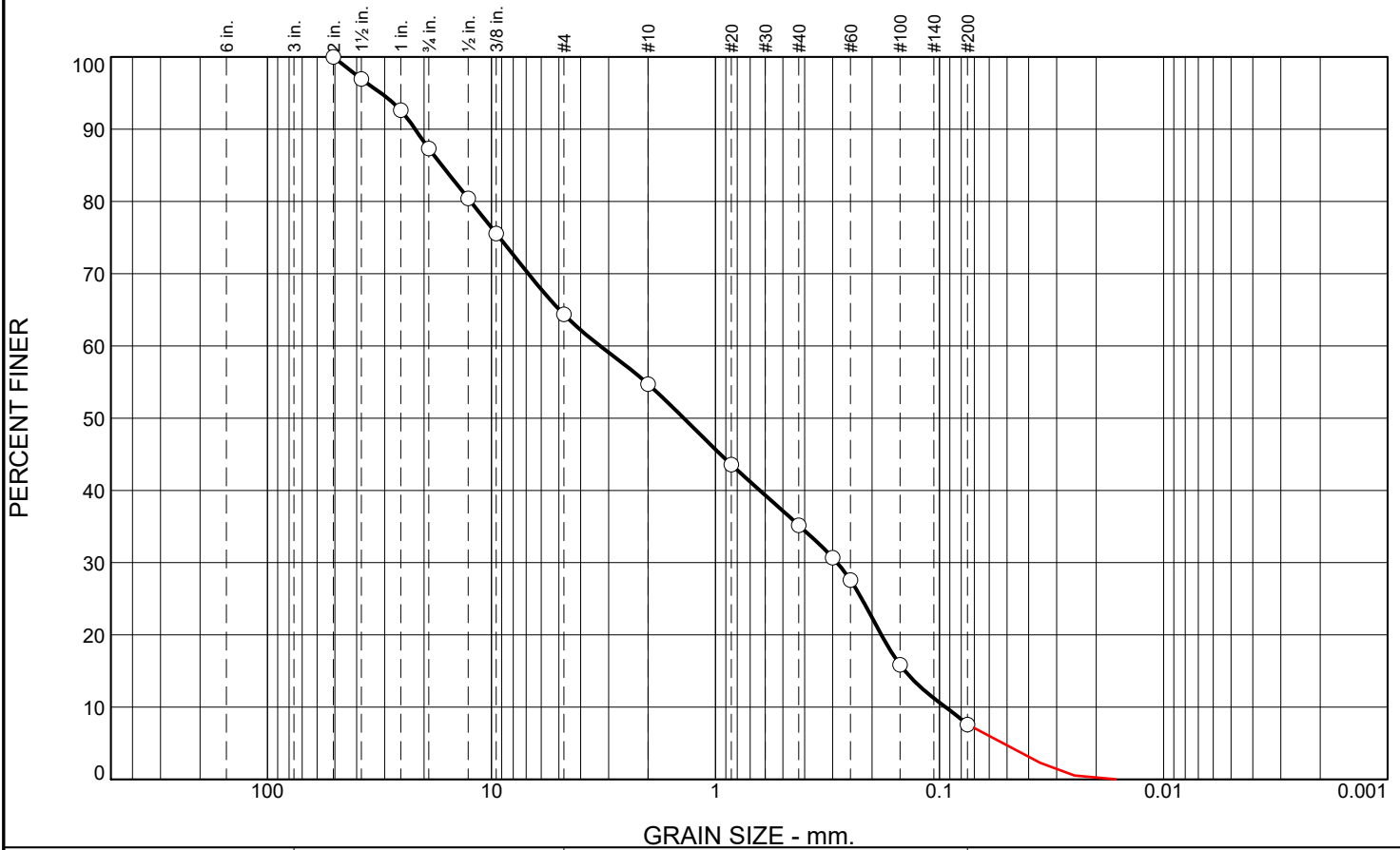
**YANKEE ENGINEERING
& TESTING, INC.**

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK

Checked By: SMM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.7	22.9	9.7	19.5	27.6	7.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100.0		
1.5	96.9		
1	92.6		
.75	87.3		
.5	80.4		
3/8	75.6		
#4	64.4		
#10	54.7		
#20	43.6		
#40	35.2		
#50	30.7		
#60	27.6		
#100	15.8		
#200	7.6		

* (no specification provided)

Material Description

Brown 2" max f/m sand and gravel trace silt
USDA Class I Loamy Sand

Atterberg Limits

PL= NP

LL= NV

PI= NP

Coefficients

D₈₅= 16.6628

D₆₀= 3.2736

D₅₀= 1.3851

D₃₀= 0.2868

D₁₅= 0.1425

D₁₀= 0.0940

C_u= 34.84

C_c= 0.27

Classification

USCS= SP-SM

AASHTO= A-1-b

Remarks

Sample submitted by client on 01/03/24

Sample No.: L-33927
Location: SC Sample

Source of Sample: Farm Rd - Sherborn MA

Date: 1/9/24
Elev./Depth: submitted

**YANKEE ENGINEERING
& TESTING, INC.**

Client: Creative Land & Water Eng., LLC
Project: Creative Land & Water Eng., LLC
Various Sites/Projects
Project No: 15027

Tested By: AK

Checked By: SMM

Massachusetts Department of Environmental Management
Office of Water Resources

Well Completion Report

11/11/05 - 4/1/06 Carla
Let's message
to have applicant
call on issues w/ results
143573

TYPE OR PRINT ONLY

1. WELL LOCATION		GPS (OPTIONAL)	LATITUDE	LONGITUDE	DATUM
Address at Well Location: <u>419 Farm Rd</u>		Property Owner/Client: <u>Mary Dillon</u>			
Subdivision Name:		Mailing Address: <u>540 Hill Hill Rd</u>			
City/Town: <u>Sherborn</u>		City/Town: <u>Ancram, NY 12502</u>			
Assessors Map		Assessors Lot #:		NOTE: Assessors Map and Lot # mandatory if no street address available	
Board of Health permit obtained: Yes ☒ Not Required ☐		Permit Number <u>05-59</u>		Date Issued	

2. WORK PERFORMED		3. PURPOSE		4. DRILLING METHOD	
☒ New Well	☐ Abandon	☒ Domestic	☐ Irrigation	☐ Cable	☐ Auger
☐ Deepen	☐ Recondition	☐ Monitoring	☐ Municipal	☒ Air Hammer	☐ Direct Push
☐ Replace	☐ Other	☐ Industrial	☐ Other	☐ Mud Rotary	☐ Other

5. WELL LOG		Water Bearing Zones		Unconsolidated				Consolidated		6. SITE SKETCH	
From (ft)	To (ft)	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Other Material	Rock Type and Description		
0	20									Farm St ↑ 50' Well	
20	25								Shale		
25	400										

7. WELL CONSTRUCTION		8. CASING			
Total Depth Drilled <u>400</u>	From (ft)	To (ft)	Casing Type and Material	Size I.D. (in)	Well Seal Type
Date Complete <u>10-4-05</u>	<u>2</u>	<u>38</u>	<u>1710 Steel</u>	<u>6"</u>	<u>driveshoe</u>

9. SCREEN		Slot Size		Screen Type and Material		Screen Diameter	
From (ft)	To (ft)						

10. FILTER PACK / GROUT / ABANDONMENT MATERIAL				11. ADDITIONAL WELL INFORMATION			
From (ft)	To (ft)	Material Description	Purpose	Developed?	☐ Yes ☒ No	Fracture Enhancement?	☐ Yes ☒ No
				Method		Disinfected?	☒ Yes ☐ No

12. WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)							13. STATIC WATER LEVEL (ALL WELLS)	
Date	Method	Yield (GPM)	Time Pumped (hrs & min)	Drawdown to (Ft. BGS)	Time to Recover (hrs & min)	Recovery to (Ft. BGS)	Date Measured	Depth Below Ground Surface (FT)
<u>10-13</u>	<u>30MC</u>	<u>20</u>	<u>4:HR</u>	<u>182</u>	<u>2:HR</u>	<u>82</u>	<u>10-13</u>	<u>27</u>

14. PERMANENT PUMP (IF AVAILABLE)				15. NAME/ADDRESS OF PUMP INSTALLATION COMPANY	
Pump Description <u>Goulds</u>	Horsepower <u>1</u>	A4W Artesian Well			
Pump Intake Depth <u>200</u> (ft)	Nominal Pump Capacity <u>10</u> (gpm)				

16. COMMENTS		17. WELL DRILLER'S STATEMENT	
		This well was drilled, altered, and/or abandoned under my supervision, according to applicable rules and regulations, and this report is complete and correct to the best of my knowledge.	
Driller: <u>Nelson Deasse</u>	Supervising Driller Signature: <u>Mollan F. Mott</u>	Registration #: <u>1101</u>	
Firm: <u>A4W Artesian Well</u>	Date: <u>10-25-05</u>	Rig Permit #: <u>121613</u>	

NOTE: Well Completion Reports must be filed by the registered well driller within 30 days of well completion.

Clerical error corrected 11/20/2022
location is # 53 Farm Road.

SHERBORN BOARD OF HEALTH

The following information must be supplied to the Board of Health for its review before any approval can be given for the use of the well:

WELL AND PUMP TEST DATA (Must be signed by Well Contractor and by the company performing the pump test):

The well should be pumped for a period of four (4) hours at a fairly constant draw down water level. Record the following:

LOCATION: 53 Farm Road DATE OF TEST: Nov 15, 2021
WELL DEPTH: 300 Feet WELL DIAMETER: 6 Inches
DEPTH OF LEDGE BELOW SURFACE GRADE: 18 Feet
DEPTH OF CASING: 40 Feet TYPE OF SEAL: Band/Bentall's Dr. Shoe
DEPTH OF WATER LEVEL BELOW GROUND SURFACE BEFORE ANY PUMPING: 5.5 Feet
BEFORE TEST: 5.5 Feet
AT END OF TEST (4 Hours): 89.8 Feet
PUMPING RATE (SHOULD BE CONSTANT THROUGHOUT TEST):
STARTED PUMPING AT 5.5 AT RATE OF 12.6 GPM
STOPPED PUMPING AT 89.8 AT RATE OF 11.4 GPM
DURING PUMP TEST: DEPTH OF PUMP: 240 Feet SIZE OF PUMP: 1 HP
DEPTH OF PUMP TO BE INSTALLED FOR HOUSE Same Feet
SIZE OF PUMP TO BE INSTALLED FOR HOUSE Same HP

NAME OF WELL DRILLING COMPANY: Bay State Pump Company Inc
(Must be registered with the Commonwealth of Massachusetts)

Authorized Signature: [Signature] VM

NAME OF COMPANY PERFORMING PUMP TEST: Bay State Pump Company Inc

Authorized Signature: [Signature] [Green Mark]

TWO (2) REQUIRED WATER ANALYSIS REPORTS:

The following Bacteriological and Chemical Analyses must be performed by a Massachusetts DEP certified laboratory, and results submitted to the Board of Health. The first sample is to be taken at the well head and the second sample is to be taken from a tap in the building.

Total Coliform Bacteria	Total Iron	9:AM	5.5'	start
Total Bacteria (HPC)	Manganese	9:30	28'	12.6 GPM
Ammonia Nitrogen	Color	10:AM	59.3'	12 GPM
Nitrite Nitrogen	Turbidity	10:30	70.5'	12 GPM
Nitrate Nitrogen	Odor	11:AM	76.5'	12 GPM
Chloride	pH	11:30	80.9'	11.76 GPM
Sodium	Total Alkalinity	NOON	83.9'	11.5 GPM
Lead	Total Hardness			
Arsenic	Volatile Organic Compounds (EPA 524 testing method)			
		12:30	86.3'	11.4 GPM
		1:PM	88'	11.4 GPM

Other parameters may be required on a case-by-case basis if deemed to be necessary in the opinion of the Board of Health.

55 Farm Rd

Well Test

Date 5/20/80

Name and address of owner or builder

Tel: 655-6195

D. McLAUGHLIN
20 DEXTER DR.

Location of property — Street and Lot #

LOT #1 FARM RD.

Name and address of well contractor

A+W

Type of well P.T. DRILLED

Depth 520'

Diameter 6"

Depth to ledge 17' 27' of casing

Duration of pump test 6 HRS

Gallons per minute at end of test 10 G.P.M.

Inspector: J. Fenger

Driller:

Developments in Geotechnical Engineering

Jay Ameratunga
Nagaratnam Sivakugan
Braja M. Das

Correlations of Soil and Rock Properties in Geotechnical Engineering

 Springer

2.6 Permeability

2 Soil

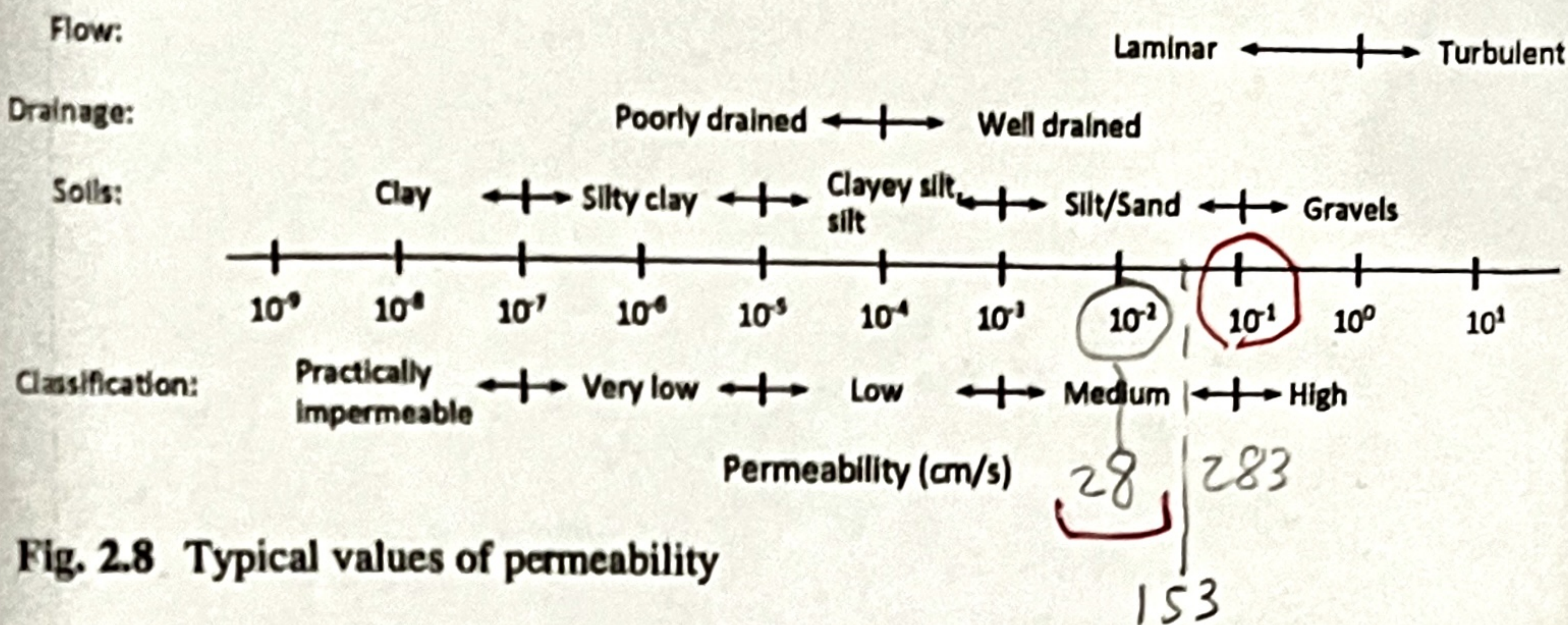


Fig. 2.8 Typical values of permeability

2.6.3 Reynold's Number and Laminar Flow

Figure 2.8 can be used as a rough guide for the flow (laminar or turbulent) drainage (well or poorly drained) characteristics of the major soil groups, a ranges of their permeability values. A simple classification based on permeability suggested by Terzaghi and Peck (1967) is also shown. Reynold's number R for flow through soils can be defined as

$$R = \frac{vD\rho_w}{\mu_w}$$

where v = discharge velocity, D = average diameter of the pores, ρ_w = density of water (1000 kg/m^3), and μ_w = dynamic viscosity of water ($1.002 \times 10^{-3} \text{ N s/m}^2$) which is also known as the *absolute viscosity*. The ratio μ_w/ρ_w is the kinematic viscosity of water. Muskat (1946) and Scheidegger (1957) discussed the experimental work that has been carried by several researchers out to determine the limiting value of R beyond which the flow will not be laminar and D'Arcy's law becomes invalid. It appears that $R = 1$ can be taken as a conservative estimate for flow through coarse sands and gravels is generally turbulent. In computing Reynold's number from Eq. (2.30), D is sometimes taken as D_{10} or the average grain diameter.

2.6.4 Anisotropy

The permeability of cohesive soils can be *anisotropic*, where it is generally lower in the horizontal direction than in the vertical direction. In special case of stratified deposits, the vertical permeability can be larger than the horizontal permeability (Harr 1962). The ratio k_h/k_v reported in the literature is generally less than 1 for most soils. Fukushima and Ishii (1986) showed that for a weathered and compacted at different water contents, this ratio can be quite high, sometimes exceeding 10. In varved clays and stratified fluvial deposits, this ratio can exceed 10 (Casagrande and Poulos 1969; Tavenas and Leroueil 1980; et al. 1978). Some anisotropic behavior of natural clays reported by Tavenas

Appendix G: Nitrogen Loading Analysis (to be added to the Hydrogeological Evaluation Report)

Under the existing condition, the property is draining from east to west. The proposed SAS is located in central west of the property about 108 ft from downgradient BVW, which is the closest receptor to the SAS. The SAS straddles about 175 ft across the broad mild valley consisting of thick very permeable soil (3-5 mpi percolation rates). The groundwater mounding analysis shows that plum will spread out 841 ft on each side of the SAS fields and will cover the entire western property line, which received ground water recharge from about 25.57 acres and 22.88 acres of land net for nitrogen loading excluding 53 and 55 Farm Road and including off site town conservation open space to the northeast. See USGS locus map and site plan for reference.

Based on our soil testing, the site in general has mixed ledge outcrops in the upper hill area and very permeable soil in the lower western part of the land. There will be four stormwater basins and exfiltration swales uniformly scattered through the site, which will provide better groundwater recharge. The existing man-dug farm pond takes contributing runoff and infiltrate groundwater entirely. The groundwater monitoring shows that this pond contributes to the west for groundwater flow.

There will be minimum lawn for the developed condition. No fertilizer will be allowed in any of the landscape areas or lawn.

Average precipitation in Sherborn area is 45.60 inches based on NATNWS of 163 years of record. The actual precipitation will likely increase based on the trend, which will further reduce nitrogen level.

Based on the basic site conditions described above, the general nitrogen loading and detailed nitrogen concentration at the downgradient reception line is analyzed. The results are presented in the following:

Section 15.214 of Title V (Nitrogen Loading Limitations) states that any new sewage system constructed within a Nitrogen Sensitive Area shall be designed to receive not more than 440 gallons per day (gpd) of design flow per 40,000 square feet (SF). With the proposed I/A system to treat the influent to 19 mg/l, the loading of sewer effluent can be increased to 660 gpd per 40,000 SF. The total land area of 14 acres of land has a capacity of 10,062 gpd, which is 20% more than the proposed 8360 gpd.

As we can see above that the project site has provided adequate design to handle the nitrogen loading together with the overall uniformly distributed groundwater recharge facilities at the site. There will be more preserved forested open space of Town conservation land to provide even more groundwater recharge to lower the nitrogen level to the downgradient receptor. To further demonstrate the compliance to the most stringent standard, a detailed nitrogen budget analysis according to DEP Policy BRP/DWM/PeP-P99-7 is provided to confirm that the proposed SAS will comply with all required DEP standards for four site condition scenarios, see Table G2 for reference. The water budget was analyzed for both onsite area and including upgradient off site recharge area. See Figures G1 and G2. The results showed that nitrogen concentration at the downgradient receptor, BVW will be much less than 10 mg/l. The results are presented in Table G4.

Table G 1. Nitrogen Source:					
Unit:	1 lb =	454000	mg		
Sewage		35	mg/l	Conventional septic	
Sewage		19	mg/l	with I/A	
Fertilizer		33	lbs/acre/yr		
Golf course fertilizer		3.5	lbs/acre		
Rain water		0.1	mg/l		
Runoff		1.5	mg/l		

Table G2. Input Scenarios for Nitrogen Budget Analysis

Scenario	Sewage flow	Effluent Nitrogen	Lawn fertilize	Off site Recharge	Assumptions for notrogen budget analysis
	GPD	mg/l	%		
1	8360	19	0	yes	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
2	8360	35	0	yes	1. Using Title 5 design daily flow for sewage nitrogen loading without I/A treatment. 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
3	8360	19	0	no	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge IS NOT included.
4	8360	19	40	yes	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will be fertilized 3. Off site upgradient area recharge included.

Table G3. Output Nitrogen Concentration at downgradient Receptor- Budget Analysis

Scenario	Sewage flow	Effluent Nitrogen	Lawn fertilize	Off site Recharge	Calculated Nitrogen at Downgradient, mg/l	Assumptions for notrogen budget analysis
	GPD	mg/l	%			
1	8360	19	0	yes	3.89	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
2	8360	35	0	yes	6.95	1. Using Title 5 design daily flow for sewage nitrogen loading without I/A treatment. 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge included.
3	8360	19	0	no	5.6	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will not be fertilized 3. Off site upgradient area recharge IS NOT included.
4	8360	19	40	yes	6.32	1. Using Title 5 design daily flow for sewage nitrogen loading with I/A treatment 2. Assume all lawn will be fertilized 3. Off site upgradient area recharge included.

Table G4. Nitrogen Loading Analysis

SCN #1 Nitrogen Loading - 65 Farm Road - With full I/A Treatment								
Assumption:	1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;							
	2. Assume all lawn will not be fertilized.							
	3. Offsite upgradient recharge included.							
Nitrogen Loading:							Treated Sewage	Treated quality
		Concentration	Site Input	factor	lb/yr		%	mg/l
Sewage		35 mg/l	8360 gpd	0.00304301	483.35		100.00%	19
Fertilizer		33 lbs/acre/yr	0 acres	1	0.00			0.543
Golf course fertilizer		3.5 lbs/acre	0 acres	1	0.00			
rain water-impvious		1.5 mg/l	7.49 acre-ft	2.71643614	30.52			
Rain water-lawn,forest, pond		0.05 mg/l	32.17 acre-ft	2.71643614	4.37			
Total load					518.24 lb			
Capacity								
Sewage		10 mg/l	8360 gpd	0.00304301	254.40 lb			
rain water-impvious		10 mg/l	7.49 acre-ft	2.71643614	203.46 lb			
Rain water-lawn,forest, pond		10 mg/l	32.17 acre-ft	2.71643614	873.88 lb			
Total capacity with		3.89 mg/l			1331.73 lb			
Budget	OK!				813.49 lb			
SCN #2 Nitrogen Loading - 65 Farm Road - Without I/A Treatment								
Assumption:	1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;							
	2. Assume all lawn will not be fertilized.							
	3. Offsite upgradient recharge included.							
Nitrogen Loading:							Treated Sewage	Treated quality
		Concentration	Site Input	factor	lb/yr		%	mg/l
Sewage		35 mg/l	8360 gpd	0.00304301	890.38		0.00%	19
Fertilizer		33 lbs/acre/yr	0 acres	1	0.00			1.000
Golf course fertilizer		3.5 lbs/acre	0 acres	1	0.00			
rain water-impvious		1.5 mg/l	7.49 acre-ft	2.71643614	30.52			
Rain water-lawn,forest, pond		0.05 mg/l	32.17 acre-ft	2.71643614	4.37			
Total load					925.27 lb			
Capacity								
Sewage		10 mg/l	8360 gpd	0.00304301	254.40 lb			
rain water-impvious		10 mg/l	7.49 acre-ft	2.71643614	203.46 lb			
Rain water-lawn,forest, pond		10 mg/l	32.17 acre-ft	2.71643614	873.88 lb			
Total capacity with		6.95 mg/l			1331.73 lb			
Budget	OK!				406.46 lb			
SCN# 3 Nitrogen Loading - 65 Farm Road - With I/A Treatment and onsite recharge only								
Assumption:	1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;							
	2. Assume all lawn will not be fertilized.							
	3. Onsite recharge only.							
Nitrogen Loading:							Treated Sewage	Treated quality
		Concentration	Site Input	factor	lb/yr		%	mg/l
Sewage		35 mg/l	8360 gpd	0.00304301	483.35		100.00%	19
Fertilizer		33 lbs/acre/yr	0 acres	1	0.00			0.543
Golf course fertilizer		3.5 lbs/acre	0 acres	1	0.00			
rain water-impvious		1.5 mg/l	7.49 acre-ft	2.71643614	30.52			
Rain water-lawn,forest, pond		0.05 mg/l	17.06 acre-ft	2.71643614	2.32			
Total load					516.19 lb			
Capacity								
Sewage		10 mg/l	8360 gpd	0.00304301	254.40 lb			
rain water-impvious		10 mg/l	7.49 acre-ft	2.71643614	203.46 lb			
Rain water-lawn,forest, pond		10 mg/l	17.06 acre-ft	2.71643614	463.42 lb			
Total capacity with		5.60 mg/l			921.28 lb			
Budget	OK!				405.09 lb			
SCN# 4 Nitrogen Loading - 65 Farm Road - With I/A Treatment and onsite recharge only								
Assumption:	1. Using Title 5 sewage design flow (8360 gpd) for sewage nitrogen loading;							
	2. Assume all lawn (2 acres) will not be fertilized.							
	3. Onsite recharge only.							
Nitrogen Loading:							Treated Sewage	Treated quality
		Concentration	Site Input	factor	lb/yr		%	mg/l
Sewage		35 mg/l	8360 gpd	0.00304301	483.35		100.00%	19
Fertilizer		33 lbs/acre/yr	2 acres	1	66.00			0.543
Golf course fertilizer		3.5 lbs/acre	0 acres	1	0.00			
rain water-impvious		1.5 mg/l	7.49 acre-ft	2.71643614	30.52			
Rain water-lawn,forest, pond		0.05 mg/l	17.06 acre-ft	2.71643614	2.32			
Total load					582.19 lb			
Capacity								
Sewage		10 mg/l	8360 gpd	0.00304301	254.40 lb			
rain water-impvious		10 mg/l	7.49 acre-ft	2.71643614	203.46 lb			
Rain water-lawn,forest, pond		10 mg/l	17.06 acre-ft	2.71643614	463.42 lb			
Total capacity with		6.32 mg/l			921.28 lb			
Budget	OK!				339.09 lb			

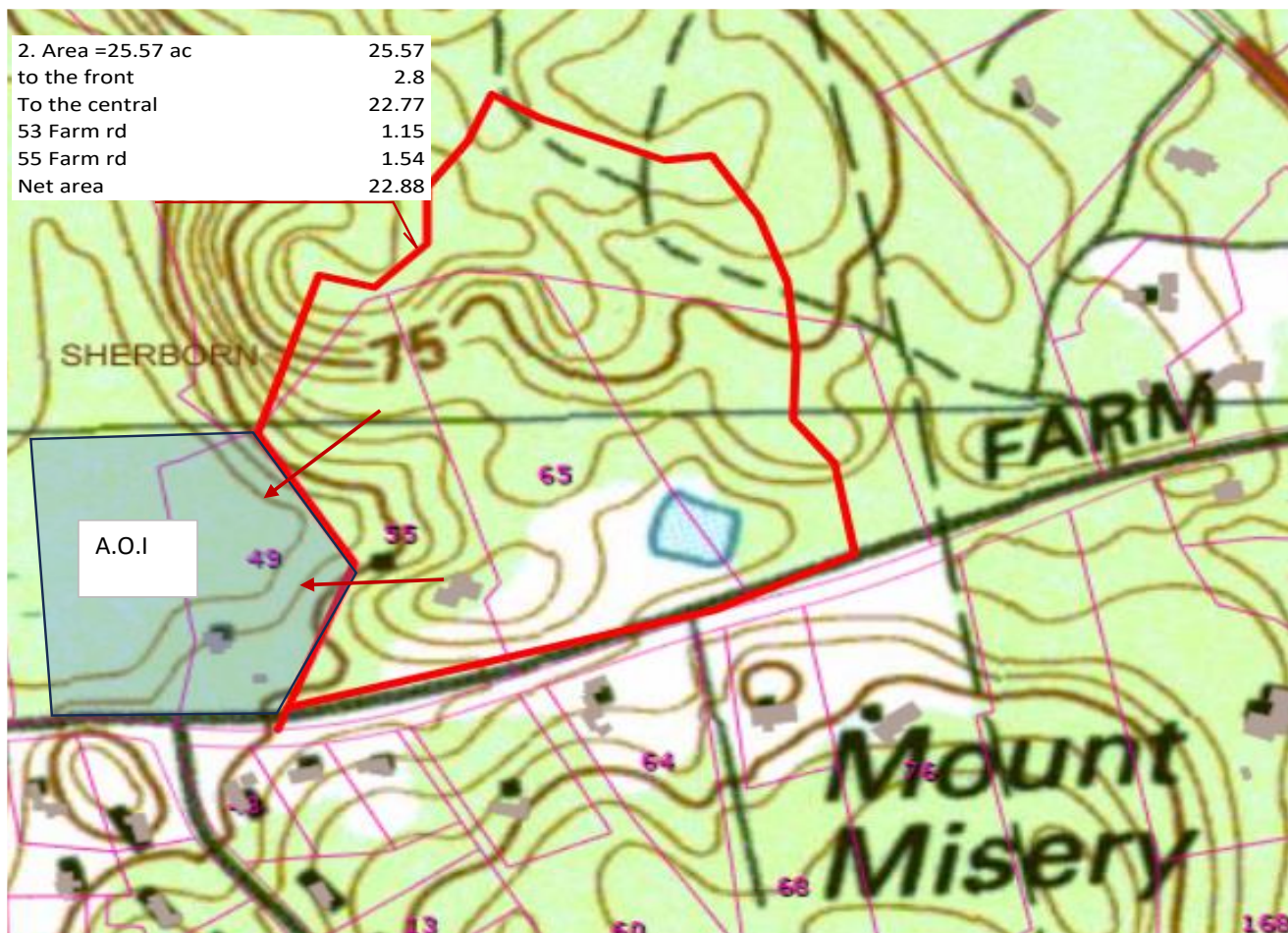


Figure G1 . Area of Impact plan

Figure G2: Water Budget - Proposed Conditions (with off site area)

Project:	Homes at Farm Road	User:	DSW	Date:	02/03/24	Check:		Date:	
	65 Farm Road	Precip. (in):	45.60	Snowfall (in):	45	Lake evap. (in):	26.00	Runoff (in):	26.00
	Sherborn, MA	Wet-trans1:	2.00	Wet-trans2:	1.80	Open water:	1.00		
								Job:	269-12
								Sheet:	1 of 2

Land use	Vegetation (%)		Hydrologic Soil Group	Area Acres	Rainfall Inches	Interception Inches	Transpiration Inches	Available Water		Natural Recharge Ac-ft	Natural Runoff ac-ft	% of runoff	Man-made Recharge Ac-ft	Total Recharge Ac-ft	Managed Runoff Ac-ft
	Deciduous	Evergreen						Inches	Ac-ft						
Impervious					45.60	0.88	0.00	44.72	8.27	0.41	7.86	90.00%	7.07	7.49	0.79
Lawns			a		45.60	4.15	11.13	30.32	0.00	0.00	0.00	90.00%	0.00	0.00	0.00
			b	4.350	45.60	4.15	12.31	29.14	10.56	7.58	2.99	0.00%	0.00	7.58	2.99
			c		45.60	4.15	12.31	29.14	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d	0.000	45.60	4.15	12.00	29.45	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Meadow			a		45.60	4.49	11.13	29.98	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			b		45.60	4.49	11.86	29.26	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			c		45.60	4.49	12.31	28.80	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d		45.60	4.49	12.00	29.11	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Forests	15	85	a		45.60	10.83	12.28	22.48	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	b		45.60	6.28	13.32	26.00	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	c	15.370	45.60	6.28	13.32	26.00	33.30	26.14	7.16	0.00%	0.00	26.14	7.16
	75	25	d		45.60	6.93	13.84	24.83	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Wetland-1	90	10	d	0.940	45.60	4.49	52.00	-10.89	-0.85	-1.55	0.70	0.00%	0.00	-1.55	0.70
Wetland-2	90	10	c		45.60	5.95	46.80	-7.15	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Man-made pond			c		45.60		26.00	19.60	0.00	0.00	0.00	100.00%	0.00	0.00	0.00
Total				22.88	45.60		18.70		51.28	32.58	18.70		7.07	39.66	11.63
Depth (in)									26.90	17.09	9.81		3.71	20.80	6.10

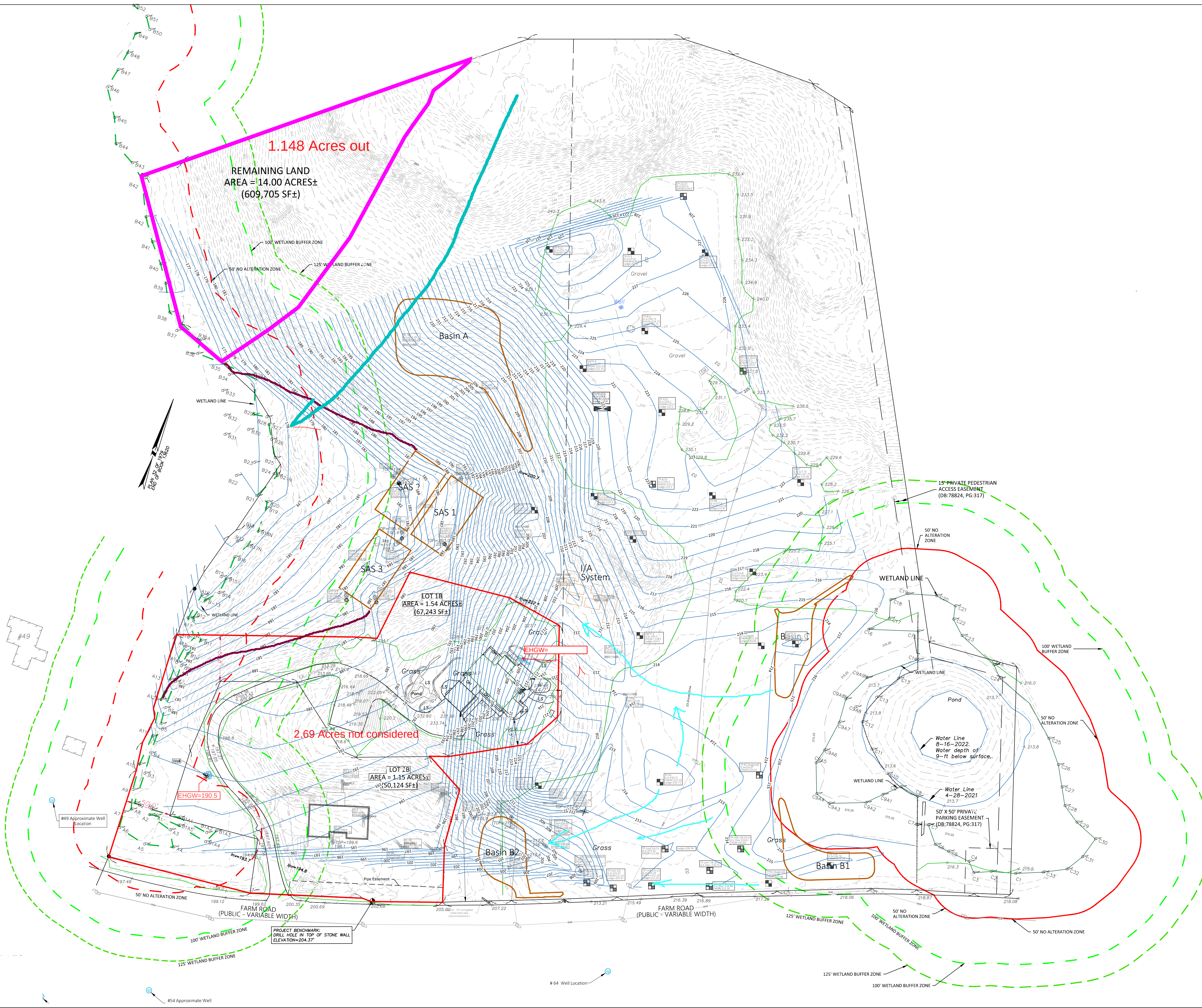
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Figure G3: Water Budget - Proposed Conditions no offsite area

Project:	Homes at Farm Road	User:	DSW	Date:	02/03/24	Check:		Date:	
	65 Farm Road	Precip. (in):	45.60		45	Lake evap. (in):	26.00	Runoff (in):	26.00
	Sherborn, MA	Wet-trans:1:	2.00		1.80	Open water:	1.00		
								Job:	269-12
								Sheet:	1 of 2

Land use	Vegetation (%)		Hydrologic Soil Group	Area Acres	Rainfall Inches	Interception Inches	Transpiration Inches	Available Water		Natural Recharge Ac-ft	Natural Runoff ac-ft	Man-made Recharge		Total Recharge Ac-ft	Managed Runoff Ac-ft
	Deciduous	Evergreen						Inches	Ac-ft			% of runoff	Ac-ft		
Impervious				2.220	45.60	0.88	0.00	44.72	8.27	0.41	7.86	90.00%	7.07	7.49	0.79
Lawns			a		45.60	4.15	11.13	30.32	0.00	0.00	0.00	90.00%	0.00	0.00	0.00
			b	4.350	45.60	4.15	12.31	29.14	10.56	7.58	2.99	0.00%	0.00	7.58	2.99
			c		45.60	4.15	12.31	29.14	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d	0.000	45.60	4.15	12.00	29.45	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Meadow			a		45.60	4.49	11.13	29.98	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			b		45.60	4.49	11.86	29.26	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			c		45.60	4.49	12.31	28.80	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
			d		45.60	4.49	12.00	29.11	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Forests	15	85	a		45.60	10.83	12.28	22.48	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	b		45.60	6.28	13.32	26.00	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
	85	15	c	6.490	45.60	6.28	13.32	26.00	14.06	11.04	3.02	0.00%	0.00	11.04	3.02
	75	25	d		45.60	6.93	13.84	24.83	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Wetland-1	90	10	d	0.940	45.60	4.49	52.00	-10.89	-0.85	-1.55	0.70	0.00%	0.00	-1.55	0.70
Wetland-2	90	10	c		45.60	5.95	46.80	-7.15	0.00	0.00	0.00	0.00%	0.00	0.00	0.00
Man-made pond			c		45.60		26.00	19.60	0.00	0.00	0.00	100.00%	0.00	0.00	0.00
Total				14.00	45.60		18.13		32.04	17.48	14.57		7.07	24.55	7.49
Depth (in)									27.47	14.98	12.49		6.06	21.04	6.42

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- LEGEND**
- CATCHBASIN
 - ROOF DRAIN
 - VENT
 - WELL
 - ELECTRIC METER
 - UTILITY POLE
 - GUY WIRE
 - LIGHT POLE
 - HANDHOLE
 - SIGN
 - MAILBOX
 - POST
 - WETLAND FLAG
 - TEST PIT LOCATED
 - DECIDUOUS TREE
 - CONIFEROUS TREE
 - SHRUB
 - OHW
 - INDEX CONTOUR
 - INTERMEDIATE CONTOUR
 - SPOT GRADE
 - + 58.7
 - TW
 - EOP
 - OH
 - MBW
 - RTW
 - TOP

Line Legend

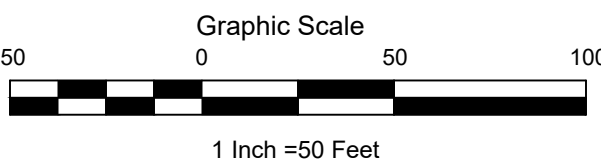
- 50' No Alteration Zone
- 100' Wetland Buffer Zone
- 125' Wetland Buffer Zone

APPROVED UNDER MASSACHUSETTS GENERAL
LAW CHAPTER 40B

DATE APPROVED: _____
DATE ENDORSED: _____
SHERBORN ZONING BOARD OF APPEALS

I HEREBY CERTIFY THAT 20 DAYS HAVE
LAPSED SINCE THE SHERBORN ZONING
BOARD OF APPEALS APPROVAL HAS FILED
WITH THE SHERBORN TOWN CLERK AND
THAT NO APPEAL HAS BEEN FILED WITH THIS
OFFICE.

DATE _____ JACKLYN R. MORRIS
SHERBORN TOWN CLERK



Creative Land & Water Engineering, LLC

Environmental Scientists and Engineers

P.O. Box 584 - Southborough - MA - 01772

774-454-0266 www.claweng.com

Plan Title: Groundwater Contours

Project Name: Farm Road Homes

Site Address: 65 Farm Road, Sherborn, MA

Owner: Fenix Partners Farm Road Development, LLC Client: Robert Murchison

Project No: J269-12 Drawn by: FA Date: 02/26/24 Sheet No: 1 of 1

Designed by: DSW, FA Approved by: DSW Scale: Indicated

Rev.: _____ Date: _____ Description: _____ By: _____

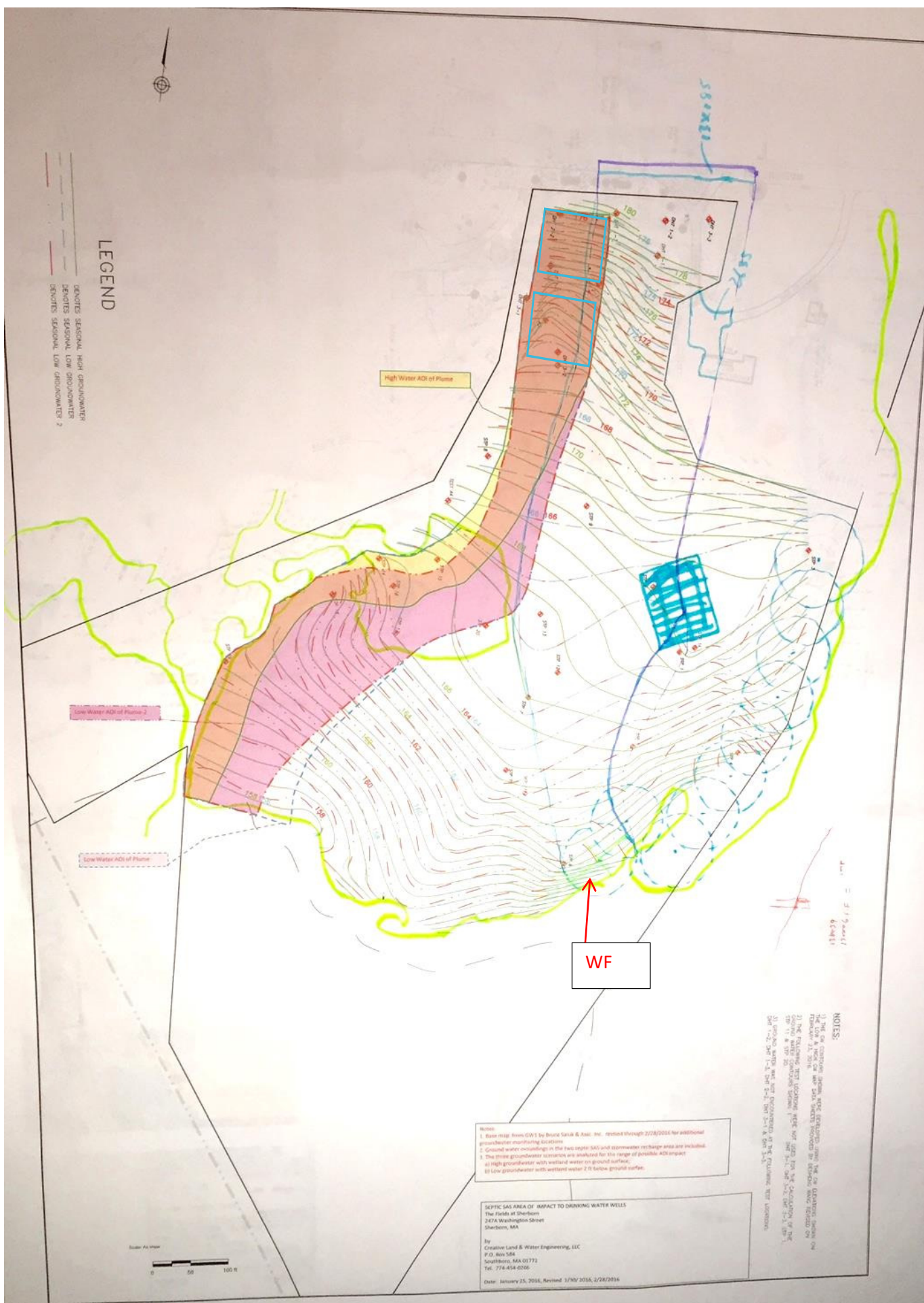


LEGEND

--- DENOTES SEASONAL HIGH GROUNDWATER

--- DENOTES SEASONAL LOW GROUNDWATER

--- DENOTES SEASONAL LOW GROUNDWATER 2



WF

Scale = 1" = 50 feet
6/14/18

NOTES:

- 1) The GW contour lines were generated using the GW contouring software (GW Contouring v. 2.0) and the data points provided by the client. The contour lines are based on the data points and are not intended to represent the actual groundwater conditions.
- 2) The following GW contouring software (GW Contouring v. 2.0) was used for the GW contouring. The software was developed by the client and is not intended to represent the actual groundwater conditions.
- 3) The GW contouring software (GW Contouring v. 2.0) was used for the GW contouring. The software was developed by the client and is not intended to represent the actual groundwater conditions.

- Notes:
1. Base map: Aerial GWS by Bruce Sisk & Assoc. Inc. revised through 2/28/2016 for additional groundwater monitoring locations.
 2. Ground water monitoring in the two larger SAS and groundwater recharge area are included.
 3. The three groundwater scenarios are analyzed for the range of possible A20 impact:
 - a) High groundwater with wetland water on ground surface.
 - b) Low groundwater with wetland water 2 ft below ground surface.

SEPTIC GAS AREA OF IMPACT TO DRINKING WATER WELLS
The Fields at Sherborn
247A Washington Street
Sherborn, MA

By
Creative Land & Water Engineering, LLC
P.O. Box 584
Southboro, MA 01772
Tel: 774-454-0096

Date: January 25, 2018, Revised 3/20/2018, 2/28/2016