Attachment I
Water Resource Protection Overlay District Analysis

Attachment I

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MEMORANDUM

TO: Sudbury Planning Board
FROM: William C. Henchy, Counsel to Quarry North Road LLC
RE: Sudbury Zoning—Section 4200
Date: March 3, 2020

Introduction.

Pursuant to a Land Disposition and Development Agreement dated February 28, 2019, Quarry North Road LLC proposes to create 173 units of housing in the NRROD Overlay District. 80 Units will be age restricted.

The NRROD Overlay District Zoning (Section 4700A of the Sudbury Zoning By-law) provides that the proponent of any development proposed under the NRROD Overlay District

> May choose to have its project conform to either, but not both, all of the controls and processes which govern the Research District or to all of the controls and processes contained in Section 4700A. Except as explicitly provided elsewhere in Section 4700A, the provisions and requirements of other applicable zoning districts, and any rules, regulations, approval processes and/or design or performance standards contained elsewhere in this Zoning Bylaw, shall not apply to any project developed pursuant to Section 4700A. Notwithstanding the above, 3200 (Signs and Advertising Devices). Any NRROD Project shall comply with Section 4200 (Water Resource Protection Overlay Districts) to the maximum extent practicable.

Section 4200 of the Sudbury Zoning By-law establishes a Water Resources Overlay Protection District that is designed to protect the groundwater resources of the Town that are located within Zones I, II, and III of the Sudbury Water District wells. Permitted uses generally include conservation uses, construction and operation of water supply facilities, and residential construction, provided that no more than 15% of the lot is rendered impervious. See sec. 4241.

Prohibited uses include solid waste facilities, storage of hazardous or toxic materials, stockpiling of snow containing road salt or de-icing chemicals that are brought in from outside the Zone II, fuel oil bulk terminals, underground storage tanks, facilities that generate or treat hazardous waste, and automobile graveyards and junkyards.

On-Site wastewater systems are specifically limited to 550 gpd per 40,000 sq. ft., subject to increases based upon a written certification by the Board of Health that DEP has approved a nitrogen loading analysis that the groundwater goal of 5 mg/l of nitrates will not be exceeded in any present or proposed public water supply well. See sec. 4242.

Pursuant to Section 4243, certain uses may be allowed by Special Permit within the Water Resource Overlay Protection District. These uses include impervious lot overage of more that 15% of the overall lot or 2500 sq. ft., whichever is greater, the application of fertilizers for non-domestic or non-agricultural uses, storage of commercial fertilizers as defined in G.L. c. 128 sec. 64 within a containment structure, storage of road salt of de-icing chemicals within a containment structure, and certain treatment works (See Sec. 4243(m)).

Earth moving and grading is subject to a Special Permit in accordance with Section 4260.

Special Permits are subject to the criteria established in Section 4275. Stormwater is to be managed in accordance with the provisions of Section 4280.

Analysis

Overall, Section 4200 establishes a comprehensive set of regulations intended to preserve the quality and quantity of groundwater within the Town's Zone I, Zone II and Zone III regions. Few activities are allowed as a matter of right, some are allowed by Special Permit, and many are prohibited.

Section 4700A was adopted to promote the development of complementary land uses including multifamily housing within the overlay district. Section 4700B (the SMOG Overlay District) is a c. 40R Smart Growth by-right zoning District intended to promote the development of multifamily affordable housing;

There are direct conflicts between Section 4200 and Sections 4700A and 4700B. These conflicts are both substantive and procedural.

First, the Special Permit provisions of Section 4200 cannot apply to either Section 4700A or 4700B, both of which are by-right zoning by-laws, subject to the Planning Board's right to impose reasonable conditions under its site-approval power, expressed in Section 4742A.

Second, any development proposed under Sections 4700A and 4700B would be not allowable under Section 4200's substantive provisions.

Therefore, Section 4720A provides that any proposal under Section 4700 shall conform to Section 4200 "to the maximum extent practicable".

The purpose of this Memorandum is to detail how, even though the proposed development cannot comply with many of the provisions of Section 4200, the proponent has (a) extensively studied groundwater resources on the site; (b) the study has been approved by MassDEP; (c) measures have been carefully taken to both maximize the time and distance of flow between any wastewater leachate and the Sudbury No. 5 inactive well; (d) the proposed leaching facility has been carefully situated to preclude any flow of leachate into the Concord White Pond Wells; (e) the wastewater treatment plant has been designed to exceed the 5 mg/l nitrate threshold contained in Section 4242(i); (f) the wastewater treatment plant has been designed to meet extremely stringent MassDEP requirements for all other constituents in wastewater within a Zone II; (g) no earthmoving will result in bringing the finished surface grade to anywhere near 5 feet of groundwater, as required by Section 4242(j); (h) all stormwater will be managed in accordance with best management practices so.

In summary, though the proposed development cannot comply with many of the requirements of Section 4200, the proposal will meet the test established for special permit uses in the Water Resources Overlay Protection District at Section 4275, which requires that the development meet the following criteria:

a. Will in no way during construction or any time thereafter, adversely affect the existing or potential quality or quantity of water that is available in the Water Resource Protection Overlay District;

b. Will not cause the groundwater quality to fall below the standard established in 314 CMR 6.00 Massachusetts Groundwater Quality Standards or for parameters where no standards exist, below standards established by the Board of Health and, where existing groundwater quality is already below those standards, upon determination that the proposed activity will result in no further degradation;

c. Is in harmony with the purpose and intent of the bylaw and will promote the purposes of the Water Resource Protection Overlay District;

d. Is appropriate to the natural topography, soils and other characteristics of the site to be developed, and is designed to avoid substantial disturbance of the soils, topography, drainage, vegetation, and other water related natural characteristics of the site to be developed;

e. Will not, during construction or thereafter, have an adverse environmental impact on any water body or course in the district; and

f. Will not adversely affect an existing or potential water supply.

A. GROUNDWATER STUDY AND MONITORING

As a first step following signing of the Land Development and Disposition Agreement on February 28, 2019, Quarry North Road LLC began extensive investigation into soils and groundwater on the site. Between April 16 and April 19, extensive test pits and monitoring wells were installed on the site.

Groundwater depth measurements were taken on 4/22/19, 5/7/19, 5/16/19 and 6/11/19. Multiple test trenches (13) and percolation tests (4) were conducted on July 1, 2019 and July 2, 2019, witnessed by MassDEP personnel. An additional observation well was installed on July 2, 2019.

These investigations were done for three primary reasons; (1) to determine the suitability of soils for on-site wastewater disposal; (2) tp establish the depth and flow of groundwater under the site and the surrounding areas; and (3) to site any wastewater disposal works in the most appropriate place given the nearby wells in both Sudbury and Concord.

Attached hereto as Exhibit "A" is the resulting report by GeoHyrdoCycle, Inc., dated July 30, 2019. Groundwater was found at depths ranging from 11 feet below existing grade to over 70 feet below grade (See Exhibit A Figure 14). Soils were largely coarse sand and perced at rates suitable for subsurface wastewater disposal.

Based upon the groundwater table, regional direction of flow, mounding analysis, and location of Zone II boundaries, the proposed wastewater-leaching field was located outside of the Concord Zone II and as far away from the Sudbury Well Number 5 as practicable.

The time of travel of leachate to both the Concord wells and the Sudbury Number 5 well were calculated based upon existing and proposed conditions. The time to travel to the Concord wells is infinity—the wastewater does not travel to the Concord Wells at all. The travel time to the Sudbury Number 5 well was 356 days, slightly under a year.

The results of the draft report were presented to both the Sudbury Water District and the Concord Water Department for review and comment before submission to MassDEP for review. The suggestions of each were incorporated into the final submission to MassDEP.

On October 1, 2019, MassDEP approved the results of the Geologic-Hydrological investigation (see Exhibit "B"). As proposed, ongoing monitoring wells are required to continue to monitor the groundwater and ensure that the quality of the leachate does not impair the quality of the aquifer as a source of drinking water.

B. PROTECTION OF GROUNDWATER THROUGH STRINGENT WASTEWATER DESIGN SPECIFICATIONS

DEP wastewater design specifications are exceptionally stringent if a proposed facility is within a Zone II and the travel time to the wellhead is less than two years.

First and foremost, total nitrogen is limited to not more than 5 mg/l, which is one-half of the allowed level of Nitrogen in drinking water. Since that level of total niotrogen will be discharged at the rate of less than 50,000 gpd into a vastly larger aquifer, the proposed wastewater facility will more than ensure that the limit of 5 mg/l in drinking water wells established by Section 4242(h) will be met or surpassed.

All other constituents in wastewater are similarly limited. Biochemical Oxygen Demand (BOD) is limited to 10mg/l, which is one-third the normal allowable rate. Total Suspended Solids (TSS) are limited to 5 mg/l, one-half the otherwise allowable rate. Total Organic Carbon (TOC) is limited to 1 mg/l, one-third of the otherwise allowable rate of 3 mg/l. Zero colonies of fecal coliform bacterial are allowed in leachate.

B. PROTECTION OF GROUNDWATER THROUGH LANDSCAPE DESIGN, FERTILIZER MANAGEMENT, AND SNOW REMOVAL MANAGEMENT

The landscape design plan by Boehler Engineering emphasizes drought resistant native species, and limited applications of organic fertilizers in order to limit and reduce the total; nitrogen and phosphorous load from the site. Snow management will be limited to non-harmful de-icing materials.

C. EARTH MOVING AND GRADING WILL BE APPROPRIATE AND WILL NOT VIOLATE THE REQUIRED 5-FOOT SEPERATION FROM GROUNDWATER

The grading plan prepared in connection with the proposed development indicates that the lowest point will be within a proposed stormwater detention swale near the entrance drive, approximately 6 feet above the seasonally adjusted, mounded high groundwater level of 123 feet MSL. Throughout the rest of the site, finished grades will generally exceed 10-20 feet above groundwater.

SUMMARY

A primary focus of the applicant's efforts to date have been directed at documenting the groundwater resources on-site, and carefully siting the proposed development so that these groundwater resources will be protected. Though the Special Permit provisions of Section 4200 do not apply to the proposed development, the substantive requirements for

the issuance of such a Special Permit contained in Section 4275 will be met, and the Board has the power to impose such reasonable conditions on the development as may be necessary to protect groundwater resources pursuant to Section 4742A.

Quarry North Road LLC look forward to further discussion of these matters during the public hearing process.

Hydrogeologic Evaluation
Quarry North Road
Sudbury, MA 01776

Prepared by
GeoHydroCycle, Inc.

Prepared for:
Quarry North Road

July 30, 2019

GeoHydroCycle, Inc.

Wastewater Disposal
Water Supply

Assessment
Analyses
Permitting
Modeling
Software

July 30, 2019

Mr. Kevin Brander
MassDEP Northeast Regional Office
205B Lowell Street
Wilmington, MA 01887

re: Hydrogeologic Evaluation and Groundwater Mounding Analyses
Quarry North Road
36 North Road
Sudbury, MA 01776
Transmittal No. X283990
GHC #19004

Dear Mr. Brander:

GeoHydroCycle, Inc. (GHC) is pleased to present the results of our Hydrogeologic Evaluation and Groundwater Mounding Analyses in accordance with our Scope of Work dated April 4, 2019 for the proposed discharge of treated wastewater discharge at Quarry North Road, 36 North Road (Route 117), Sudbury, Massachusetts 01776 (the Site), see Figure 1 in Enclosure 1 for Site Location. This Hydrogeologic Evaluation was done in support of a Groundwater Discharge Permit Application (GWDPA) for the Site. As part of this evaluation, GHC completed a groundwater model to conduct a Groundwater Mounding Analyses.

1.0 Introduction

GHC's scope of work for the Hydrogeologic Evaluation and Groundwater Mounding included: 1) a review of the available hydrogeologic data including: USGS topographic and hydrogeologic maps, and Site soils information provided by Provencher Engineering, LLC; 2) a site reconnaissance; 3) observation of seven soil borings and the installation of six groundwater monitoring wells into the bore holes at the Site; 4) performance of single well aquifer tests; 5) constructing a groundwater model to estimate the increase in groundwater height due to the application of 49,755 gallons per day of treated wastewater into a leach field with a total disposal area of 20,000 square feet; 6) conducting a groundwater time-of-travel analysis to estimate the travel time to the Sudbury #5 Well;[1] 8) preparation of a Groundwater Monitoring Plan; and 9) preparation of this report.

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[1] As noted in Section 12.2.1, *infra* at pg. 11, discharge from the proposed WWTP does not travel to the Town of

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2.0 Site Description

The proposed project is a planned residential subdivision located at 36 North Road (Route 117) in Sudbury, Massachusetts 01776. The property is a former sand and gravel quarry that has remained undeveloped. Generally, the land surface is uneven but slopes upward from Route 117 heading to the north and west. Figures 1 and 2 show the general Site locus and a plan view of the Site features.

The plan is to develop multiple units with a total of 490 bedrooms on 25.50 acres of undeveloped land. Based on the number of bedrooms a wastewater discharge rate of 49,755 gallons per day was determined using Title 5[2].

3.0 Witnessed Test Pits

On July 1, 2019, GHC was on Site to observe the excavation of two test pits. A total of 13 witnessed test pits were excavated on July 1 and 2, 2019, and based on the test pit data, four percolation tests showed results of between less than 2 to 6 minutes per inch (TP 203, TP 205, TP 207 and TP 211). Test pits were logged by Donald Provencher, P.E. and witnessed by Paul Blaine on behalf of MassDEP. Soils encountered during the test pit excavations varied between sand and loamy sand, which is consistent with what GHC observed during Site drilling. Test pit data and a figure showing test pit locations are presented in Enclosure 2. Also shown in Enclosure 2 is a National Resources Conservation Service soils map that focuses on Site soils.

4.0 Soil Boring and Well Installation

Between April 16 and 18, 2019, GHC was at the Site to observe the drilling of seven borings and the installation of six groundwater monitoring wells, see Figure 3. Borings were advanced by Drilex Environmental using a 8.5 inch diameter hollow stem auger. Soil samples were obtained at five foot intervals during the drilling using a 24-inch split spoon sampler. The installed monitoring wells were constructed using 2-inch diameter PVC that consisted of 10-slot screens and solid risers. All wells were enclosed in steel standpipes with locks.

Soils encountered during the drilling were visually classified as primarily sands with low silt content, especially below the water table. Following the well installations and during the excavation of TP 205, a question was raised about an observed high mottling that could indicate seasonal high water table. To aid in assessing whether the mottling was valid a new observation well was installed near test pit TP 205 on July 2, 2019. Well MW-7 was advanced to 65 feet and encountered groundwater at 55 feet. Based on the drilling information and observed depth to groundwater in well MW-7, it was determined by Paul Blaine and Don Provencher that the suspected high mottling

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Concord's White Pond wells.

[2] Massachusetts DEP, The State Environmental Code, Title 5, 310 CMR 15.00.

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was a relic from a historic hydrology that occurred long ago and was not a valid indication of seasonal high groundwater.

Drilling logs describing the soil samples, the drilling process, and the construction of the wells are included in Enclosure 3. Figure 4 shows a schematic profile of the existing monitoring wells at the Site.

Three monitoring wells that existed prior to GHC's work were discovered at the Site and are shown in Figure 3. Wells OMW-1 and OMW-3, located adjacent to the wetlands, were accessible and showed groundwater levels near the surface, which is consistent with groundwater discharging to the wetlands. Without knowing the construction or screen settings of any of the three wells, GHC did not use them for groundwater contour plotting.

5.0 Local Hydrogeology

The former quarry area is a southeastern portion of a terrace structure that is aligned in a northwest to southeast direction. The removal of sand and gravel lowered the terrace an estimated 50 feet in the area of the quarry. However, quarry excavation stopped short of reaching groundwater, leaving as much as 15 to 20 feet of unsaturated soils above groundwater.

Bordering the quarry to the northeast is a large wetland that is drained by an Unnamed Stream. To the south, across Route 117, Cold Brook flows to the northeast and joins the Unnamed Stream just south of Route 117 near the Sudbury/Concord town line. From there Cold Brook turns southeast to join Pantry Brook, then easterly into the Sudbury River approximately one mile southeast of the site.

Figure 5 is a surficial geology map obtained from MassGIS which shows Site soils as being sands and gravels. This description is consistent with the types of soils GHC encountered during well installations and the soils GHC observed during test pit excavations. As a large sand and gravel area, most of the quarry's rainfall readily infiltrates down to groundwater with little surface runoff. Once reaching groundwater the infiltrated water flows to discharge areas like the nearby wetlands and the Unnamed Stream.

During the drilling and well installations, bedrock was encountered in only one location, boring B-1, at an elevation of 150.5. About 143 feet to the east of boring B-1 is monitoring well MW-1 where bedrock was not encountered at a bottom of hole elevation of 112.0, indicating a bedrock surface underlying the Site and sloping up to the west. Groundwater in Site monitoring wells on April 22, 2019 was measured between elevations 119 and 121, which means the sloping bedrock acts to restrict groundwater flow to the west. As will be shown, GHC incorporated a restriction to westerly flow in the groundwater mounding model.

As Figure 2 shows, to the north of the proposed leach field an Intermittent Unnamed Stream which flows easterly into the large abutting wetland. Following the

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Newton, Massachusetts
02460

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v-shaped topographic features of the stream upgradient leads to White Pond, implying that in the past the stream may have been a high water discharge point for the pond. Based on the steep gradient of the stream as it flows down to the wetlands, the stream has cut into the sands and gravels and is running on bedrock. This observation adds support to bedrock rising up to the west and allowed GHC to extend the flow restriction north to where the stream intercepted the 120 foot topographic contour, an elevation that coincides with the elevation groundwater intercepts bedrock between boring B-1 and well MW-1.

GHC personnel were at the Site on 4/22/19, 5/7/19, 5/16/19 and 6/11/19 to take groundwater depth measurements in the recently installed monitoring wells. Using the surveyed top of well (TOC) elevations obtained from Connorstone Engineering, Inc., GHC converted the depth measurements to water table elevations. The following tables present groundwater elevations for the four measurement dates.

Table 5.0.1. Groundwater Elevation Data, 4/22/19 Measurements.

Well	Measuring Point Elevation (feet, MSL)	Depth to Groundwater from TOC (feet, MSL)	Groundwater Elevation, 4/22/19 (feet, MSL)
MW-1	159.25	38.70	120.55
MW-2	142.79	23.11	119.68
MW-3	138.54	18.65	119.89
MW-4	142.04	21.86	120.18
MW-5	152.32	32.59	119.73
MW-6	135.78	16.76	119.02

Table 5.0.2. Groundwater Elevation Data, 5/7/19 Measurements.

Well	Measuring Point Elevation (feet, MSL)	Depth to Groundwater from TOC (feet, MSL)	Groundwater Elevation, 5/7/19 (feet, MSL)
MW-1	159.25	38.59	120.66
MW-2	142.79	22.75	120.04
MW-3	138.54	18.57	119.97
MW-4	142.04	21.97	120.07
MW-5	152.32	32.62	119.70
MW-6	135.78	16.57	119.21

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Newton, Massachusetts
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Table 5.0.3. Groundwater Elevation Data, 5/16/19 Measurements.

Well	Measuring Point Elevation (feet, MSL)	Depth to Groundwater from TOC (feet, MSL)	Groundwater Elevation, 5/16/19 (feet, MSL)
MW-1	159.25	38.78	120.47
MW-2	142.79	22.92	119.87
MW-3	138.54	18.82	119.72
MW-4	142.04	22.28	119.76
MW-5	152.32	32.86	119.46
MW-6	135.78	16.79	118.99

Table 5.0.4. Groundwater Elevation Data, 6/11/19 Measurements.

Well	Measuring Point Elevation (feet, MSL)	Depth to Groundwater from TOC (feet, MSL)	Groundwater Elevation, 6/11/19 (feet, MSL)
MW-1	159.25	39.45	119.80
MW-2	142.79	23.42	119.37
MW-3	138.54	19.46	119.08
MW-4	142.04	23.08	118.96
MW-5	152.32	33.45	118.87
MW-6	135.78	17.21	118.57

Based on the groundwater elevation data presented in Table 5.0.4, GHC has prepared Figure 6 showing groundwater contour elevations. As this figure illustrates, groundwater flows in an easterly direction toward the large wetland and Unnamed Stream at an average gradient of 1.7 feet per 1,000 feet.

6.0 Seasonal High Groundwater

Because site test pits did not encounter soil mottling, as a basis to determine seasonal high groundwater elevation (SHGW) at the Site, GHC used the Frimpter Method[3]. For this method, GHC used the USGS Concord 167 well to conduct the analysis.

The results of the Frimpter analysis is presented in the following Table 6.0.1 below.

321 Walnut Street #450
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[3] *Frimpter, M.H., 1981. Probable High Groundwater Levels in Massachusetts. USGS, WRI 80-1205.*

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Table 6.0.1. Frimpter Method.

Parameter	Depths (feet)	Notes
Measured Depth to Groundwater (Sc)	18.65	MW-3 on 4/22/19
Range in GW levels in similar topography (Sr)	9.10	Terrace - 10%
Measured depth to GW at similar time (OWc)	6.40	USGS 3/1/19
Measured depth of max GW level (OWmax)	4.40	
Maximum GW range (OWr)	6.03	
Predicted depth to SHGW (Sh)	15.63	
Difference between measured and predicted	3.02	Frimpter Adjustment

As Table 6.0.1 illustrates, the measured depth to groundwater in MW-3 is 3.02 feet lower than the predicted seasonal high groundwater. As a result, to estimate SHGW beneath the proposed leach field, a value of 3.02 feet was added to the groundwater elevations taken on 4/22/19.

Using the Frimpter adjustment, the estimated SHGW in each of the wells is calculated in the Table 6.0.2 below.

Table 6.0.2. Estimated SHGW in Monitoring Wells.

Well	Groundwater Elevations 4/22/19 (feet, MSL)	Estimated SHGW Elevation (feet, MSL)[4]
MW-1	120.55	123.57
MW-2	119.68	122.70
MW-3	119.89	122.91
MW-4	120.18	123.20
MW-5	119.73	122.75
MW-6	119.02	122.04

GHC prepared a groundwater contour map for SHGW using the elevations calculated in Table 6.0.2, see Figure 7.

7.0 Saturated Thickness

The saturated thickness for the aquifer was estimated by subtracting the elevation of the bottom of Site wells from the SHGW elevation and averaging the results. Table 7.0.1 below demonstrates that calculation.

321 Walnut Street #450
Newton, Massachusetts
02460

(617) 527-8074 (v)

[4] Static groundwater elevation at the Concord White Pond Wells is at el. 125.9. Weston & Sampson Concord Zone II report, 1997. The proposed leaching field is outside the Zone II of those wells.

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Table 7.0.1. Saturated Thickness.

Well	SHGW Elevation (feet, MSL)	Bottom Elevation (feet, MSL)	Saturated Thickness (feet)
MW-1	123.6	112.1	11.5
MW-2	122.7	109.6	13.1
MW-3	122.9	110.3	12.6
MW-4	123.2	109.6	13.6
MW-5	122.8	109.0	13.8
MW-6	122.0	107.5	14.5
		Average:	13.2

The resulting average saturated thickness that was used in the groundwater model was 13.2 feet.

8.0 Aquifer Testing

GHC personnel conducted slug tests in monitoring wells at the property on 5/16/19. GHC used both rising and falling head tests for each well. All wells were developed by the drilling contractor following installation.

The falling head/rising head slug test protocol involved: 1) measuring the depths to groundwater in the well; 2) installing a pressure transducer in the well to be tested; 3) connecting the transducer cable to the data storage unit; 4) recording the static depth of the transducer as the initial reference level; 5) inserting a solid slug into the well and electronically recording a falling head test; 6) allowing the water level to recover to at least 95 percent of pretest level; 7) beginning the rising head test by removing the solid slug from the well and electronically recording the data.

9.0 Aquifer Testing Results

To determine a representative value of hydraulic conductivity for the outwash sands beneath the Site, GHC used a statistical method published by the Connecticut DEP[5]. The method calculates the statistics of the hydraulic conductivity data and determines whether the results are within confidence limits and eliminates statistical outliers. Using this analysis, resulted in a geometric mean hydraulic conductivity of 82.5 feet per day for the outwash sands. This value is within the range of expected hydraulic conductivity for outwash sands. A table presenting the hydraulic conductivity analysis and statistics is shown in Enclosure 4.

321 Walnut Street #450
Newton, Massachusetts
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[5] Connecticut DEP. *2006. Guidance for the Design of Large Scale On-Site Wastewater Renovation Systems, Appendix C - Selecting Hydraulic Conductivity Values for Design.*

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10.0 Groundwater Model Development and Simulation

GHC accomplished the groundwater mounding analyses for the Site with the widely used and accepted numeric groundwater model, MODFLOW. Input parameters to the model were obtained from GHC's field work and analyses, including: environmental drilling logs, field observations, and test data.

Information concerning the design of the leach field was obtained from Mr. Chris Claussen and included: 1) the wastewater application rate, and 2) the location and layout of the leach field.

11.1 Conceptual Model

In developing the groundwater model to predict the mounding height beneath the proposed leach field area, GHC prepared a conceptual model of the aquifer. Features of the conceptual model include:

1. The aquifer is unconfined with the water table as the upper surface;
2. The wetlands and Unnamed Stream to the north and east act as a local groundwater discharge area;
3. Seasonal high groundwater can be estimated by adding a Frimpter adjustment to contours of measured groundwater elevations;
4. The aquifer lower surface is not known, but can be estimated using the difference between seasonal high groundwater and the depth of the wells drilled on the Site;
5. Aquifer hydraulic conductivity can be estimated using single well tests (slug tests);
6. A geometric mean hydraulic conductivity can be used in the model to be representative of the aquifer; and
7. The simulation can be achieved by modeling the proposed SAS area on a flat water table with the resulting groundwater mound superimposed onto the seasonal high groundwater.

10.2 MODFLOW Setup

The following paragraphs describe the MODFLOW model input parameters. Figures 8A and 8B shows the MODFLOW features

10.2.1 Grid Definition

The MODFLOW model was designed to represent the overburden aquifer as described above using a 4,096 foot by 4,096 foot grid and one unconfined layer. In plan view, the aquifer was gridded using a variable node spacing consisting of 64 by 64 feet at the edges of the model and telescoping to 16 by 16 feet in the area of the leach field. The smaller grid spacing was used in the area directly around the leach field where

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Newton, Massachusetts
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(617) 527-8074 (v)

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discharge to groundwater causes steeper gradients. Higher resolution allows for a more accurate model prediction of groundwater flow around leach field areas.

10.2.2 Wetland Boundary

The wetland and Unnamed Stream to the north and east of the leach field acts as a local groundwater discharge area. To simulate the wetland and stream in the model, GHC used the MODFLOW River module. This feature allows groundwater to discharge to a water body when groundwater is above the water body and to receive water from the water body when groundwater falls below the bottom of a water body. As noted, MODFLOW was set up to model wastewater discharge on a flat water table hydraulically connected to the wetland as a flat water body with the same water levels.

The MODFLOW River module requires the following parameters: river stage - the level of the water body; river bottom level - the level of the water body bed; and river bed conductance - a measure of the ability of water body bed to transmit or receive water to or from the aquifer.

For both the wetland and the Unnamed Stream, the stage elevation in the river module was input at the same elevation as the aquifer saturated thickness (13.2 feet), and the river bottom elevation was set one foot below that elevation in the tributary cells (12.2 feet).

Conductance was calculated using the following equation:

$COND = (K_v \times W \times L)/M$

where:

COND ≡ the wetland and river conductance,

K_v ≡ the vertical hydraulic conductivity,

W ≡ the node width,

L ≡ the node length, and

M ≡ the thickness of the bottom material.

Vertical hydraulic conductivity of the bottom material was obtained from Walton[6] and assumed to be K_v = 1.0 feet per day. The width (W) and the length (L) of river model component was equal to the model node dimensions because the wetland and stream filed the model nodes. The thickness of bed materials in the rivers (M) was assumed to be 1 foot.

10.2.3 Wastewater Recharge

To simulate the application of 49,755 gallons per day of treated wastewater into a single leach fields with a footprint area of 19,000 square feet, GHC designated 75 nodes in the model to simulate the wastewater recharge into the leach field area. This results in a leach field area in the model of 19,200 square feet which is larger than the design disposal area. To account for the difference in areas, values of the simulated

321 Walnut Street #450
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02460

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[6] Walton, W.C. 1988. *Analytical Groundwater Modeling, Flow and Contaminant Migration*. Lewis Publishers. 1988, p. 139.

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recharge to these nodes were decreased by the ratio of the design area divided by the modeled area (0.989583). The result was that the model would simulate the design discharge of 49,755 gpd. As allowed by DEP guidelines[7], the applications rate was reduced to 80% of the maximum daily discharge rate, 39,804 gpd for the model.

10.3 MODFLOW Simulation

To predict the groundwater mounding beneath the proposed soil absorption system, GHC ran a steady-state MODFLOW simulation. Table 11.3.1 summarizes the parameters used in the model.

Table 10.3.1. MODFLOW Model Input Parameters.

Parameter	Value	Unit
Max Daily Discharge Rate:	49,755	gallons per day (total)
Model Soil Absorption Area:	19,200	square feet
Model Recharge Rate:	0.277156	cubic feet/day/square foot (80%)
Hydraulic Conductivity:	82.5	feet per day
Saturated Thickness:	13.2	feet
Mounding Time	90	days

11.0 MODFLOW Mounding Results

Results of the MODFLOW groundwater mounding simulation indicated that the increase in groundwater elevations due to the application of treated wastewater into the leach field would be 2.78 feet beneath the leach field, see Figure 9. Superimposing the mound on the Seasonal High Groundwater elevations yields simulated groundwater elevations under the proposed primary leach field, see Figure 10. This figure demonstrates that the predicted mounded groundwater elevation at the Site beneath the leach field will be elevation 126.3 beneath the leach field. Figure 14 presents a hydrogeologic cross-section showing the separation distance between the bottom of the proposed leach field and mounded seasonal high groundwater.

12.0 Sensitive Receptors and Natural Resource Protection

12.1 Environmental Resources

GHC's review of the Priority Resources Map from MassGIS, see Figure 11A, shows the following Environmental Priority Resources within one mile of the proposed leach fields, including:

321 Walnut Street #450
Newton, Massachusetts
02460

(617) 527-8074 (v)

[7] Massachusetts DEP. November 2014. *Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal.*

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Table 12.0.1. Priority Resources Within One Mile of the Proposed Leach Field.

Resource	Distance (ft)	Compass Direction
NHESP Potential Vernal Pool	840	SW
NHESP Potential Vernal Pool	1,860	ENE
NHESP Potential Vernal Pool	3,020	WSW
NHESP Potential Vernal Pool	4,180	NNW
NHESP Potential Vernal Pool	3,970	SE
Wetlands	370	NE and E
Wetlands	1,440	SE

Groundwater flow under mounded conditions beneath the proposed leach fields is to the north and east toward the nearby wetlands, and the amount of wastewater proposed to be discharged is 49,755 gallons per day. Under these flow conditions and discharge amounts, it is unlikely that any of the above resource areas will be adversely impacted by the proposed wastewater discharge.

12.2 Groundwater Travel Time

GHC's review of the Priority Resources Map from MassGIS, see Figure 11A, shows the following Public Water Supply Wells within one mile of the proposed leach fields, including:

Table 12.0.1. Priority Resources Within One Mile of the Proposed Leach Field.

Resource	Distance (ft)	Compass Direction
White Pond Well, PWS 3067000-09G	1,070	N
Sudbury Well #5, PWS 3288000-05G	1,365	SE

12.2.1 White Pond Well

The proposed leach field is outside the Zone II boundary for the White Pond Well. Figure 12 presents groundwater streamlines that show groundwater from the leach field discharges to the nearby wetland without crossing the White Pond Zone II boundary. Once the discharge reachs the wetland it travels East (away from the White Pond Wells), then to un-named stream, then South along Cold Brook, to the East along Pantry Brook, and then into the Sudbury River approximately one mile away. Also, looking at the forces influencing groundwater flow to the White Pond Well:

- The White Pond Well is located about the same distance from White Pond as it is from the proposed leach field, and
- Groundwater elevation at the leach field is at 126.3 under mounded seasonal high groundwater conditions, but White Pond is higher at elevation 144 and the pond bottom is at elevation 117.

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- An ESS[8] study shows that White Pond as being connected to local groundwater, with groundwater entering the pond from the north sides and discharging from the south sides.

As a result, the pond is acting as a reservoir and source of groundwater and is generally forcing groundwater movement to the south. Under these conditions when the White Pond Well is pumping the pond is a large (349 Mgals), deep source of water that is higher in elevation than groundwater at the leach field and will provide water to the pumping well while the leach field discharges to the nearby wetlands.

The un-named stream within the wetland acts as a boundary to northward movement of the discharge, and sends it to the East and to the South. The Zone II delineation of the White Pond Wells confirms that discharge from the proposed WWTP leaching facility is unlikely to reach the Concord White Pond Wells.

12.2.2 Sudbury Well #5

Because the proposed leach field is located within the Zone II aquifer protection area for the Sudbury #5 Well, GHC conducted a groundwater travel time analysis to estimate the time groundwater would take to travel from the leach field to the Sudbury well. As shown in Figure 12, groundwater discharges from the proposed leach field in a southeasterly direction from the southwest corner of the field. From that point it travels 1,371 feet before being drawn into Sudbury Well #5.

To estimate the travel time over that distance, GHC used an analytic method that includes the overall groundwater gradient between the leach field and the well, and the additional gradient induced by long term pumping of the Sudbury Well at it's MassDEP approved rate of 351 gallons per minute.

Aquifer hydraulic conductivity was estimated for two areas along the 1,371 foot flow path. First, within the area defined by Site monitoring, the hydraulic conductivity was set at 82.5 feet per day as determined by Site slug test. For the remainder of the flow path the hydraulic conductivity was set at 271.7 feet per day as determined in the Zone II analysis for the Sudbury Well #5.

The travel pathway was divided into 50 equally spaced sections and a pumping gradient was determined for each segment using the steady-state analytic equation for radial groundwater flow to a pumping well. The natural gradient was determined by using the top mounded elevation at the leach field (126.3) and the static well elevation at the Sudbury Well #5 (116) over the 1,371 foot travel path. For each travel segment the pumping gradient was added to the natural gradient and along with the respective hydraulic conductivity an average groundwater velocity was determined. The travel time for each segment was calculated using the segment groundwater velocity and the length of the segment. An overall travel time of 356 days was calculated by summing the individual segment travel times. Enclosure 4 presents a summary of the Groundwater Travel Time calculations.

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[8] ESS Group, Inc. Oct. 1, 2014. White Pond Watershed Management Plan. Figure 6.

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13.0 Groundwater Monitoring Plan

In accordance with 314 CMR 5.00, long-term groundwater monitoring activities are required for groundwater discharges with design flows greater than or equal to 10,000 gallons per day.

The objective of the long-term groundwater monitoring plan (GWMP) is to establish background water quality for the new discharge, and to establish long-term groundwater quality at points near sensitive receptors and/or downgradient property boundaries. To accomplish this objective GHC proposes: 1) three groundwater monitoring wells, 2) monitoring well construction details, 3) groundwater quality sampling parameters, and 4) groundwater sampling frequency.

13.1 Compliance Monitoring Well Locations

Proposed compliance monitoring well locations are based on Groundwater Discharge Permit guidelines, and from our hydrogeologic evaluation and groundwater modeling at Quarry North Road in Sudbury such that one well will monitor groundwater quality upgradient and two wells downgradient of the proposed leach field.

Unstressed groundwater in the vicinity of the proposed leach field will flow to the nearby wetland, see Figure 6. The objective of an upgradient compliance monitoring well is to monitor groundwater quality outside of the influence of the proposed discharge. Based on GHCs hydrogeologic evaluation and mounding analysis of the Site, discharge of treated groundwater from the leach fields creates a groundwater flow field as shown in Figure 10. To monitor groundwater quality upgradient of the fields, GHC proposes compliance monitoring well CMW-1, and to monitor groundwater quality downgradient of the discharge, compliance wells CMW-2, and CMW-3, see Figure 13.

Massachusetts DEP may require additional compliance monitoring wells depending upon the Site's hydrogeologic complexity and the type, number, and proximity of sensitive receptors. These locations will be revised as necessary.

13.2 Monitoring Well Construction

Compliance monitoring wells installed at the Site have been constructed in accordance with the MADEP's Standard Reference for Monitoring Wells[9].

13.3 Groundwater Quality Sampling

The following parameters will be sampled in upgradient and down gradient compliance monitoring wells on the following schedule:

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(617) 527-8074 (v)

[9] *The Massachusetts Department of Environmental Protection, Standard Reference for Monitoring Wells, DEP Publication # WSC-310-91, January 1991.*

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Table 13.3.1. Compliance Sampling.

Parameter	Schedule
static water level	monthly
pH	monthly
specific conductance	monthly
nitrate nitrogen	quarterly
total nitrogen (nitrate, nitrite, TKN)	quarterly
total phosphorus	quarterly
orthophosphate	quarterly
volatile organic compounds (Method 624)	annually

To establish background water quality, all compliance monitoring wells will be sampled for the parameters of concern before the startup of the wastewater discharge. Monthly results of water quality sampling will be reported to the MADEP Northeast Regional Office.

If you have any questions, please call me.

Sincerely,
GeoHydroCycle, Inc.

Stephen W. Smith, P.E., P.HGW.

Enclosures: 1 - Figures
2 - Test Pit Logs
3 - Environmental Drilling Logs
4 - Slug Test Analyses Summaries
5 - Time of Travel Calculations
6 - Transmittal Form X283990 and BRP WP 83

cc: Mr. Chris Claussen
Mr. William Henchy
Mr. Donald Provencher

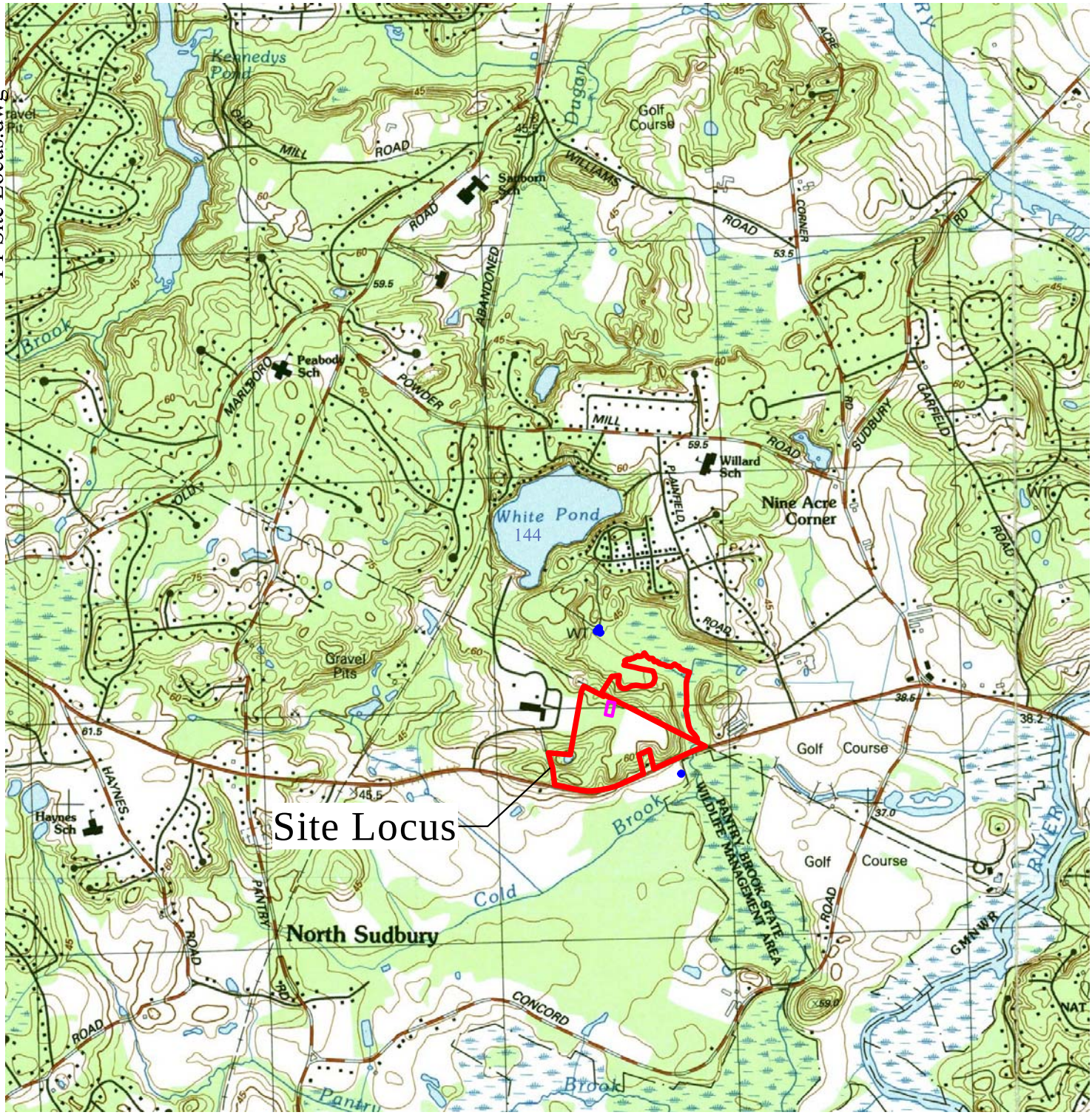
HE Report 19004.lwp

321 Walnut Street #450
Newton, Massachusetts
02460

(617) 527-8074 (v)

Enclosure 1 - Figures

F1 Site Locus.dwg



0 2,000

Scale in feet

Figure 1. Site Locus.

Base Map: MassGIS Quads.

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Project No. GHC #19004

Drafted SWS Checked

Date 3/20/19 Rev 7/19/19

Quarry North Road
36 North Road
Sudbury, MA 01776

Concord Whie Pond Wells

White Pond Well Zone II Boundary

Unnamed Stream

Property Line

TOWN LINE

Intermittent Unnamed Stream

CONCORD

SUDBURY

MW-4

MW-5

Reserve Leach Field

MW-7

B-1

MW-1

MW-3

Primary Leach Field

MW-6

MW-2

Monitoring Wells

Property Line

Well #5 Zone II Boundary

Route 117

Sudbury Well #5

To Cold Brook

0 250

Scale in feet

Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 2. Site Features.

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev
Base Map: CAD files obtained from Client and Lidar Topography.

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Concord Whie Pond Wells

White Pond Well Zone II Boundary

TOWN LINE

CONCORD

SUDBURY

OMW-1

OMW-2

Property Line

MW-4

OMW-3

MW-5

MW-7

B-1

MW-1

MW-3

MW-6

MW-2

Property Line

Well #5 Zone II Boundary

Route 117

Sudbury Well #5

Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 3. Monitoring Wells.

0 250

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev
Base Map: CAD files obtained from Client and Lidar Topography.

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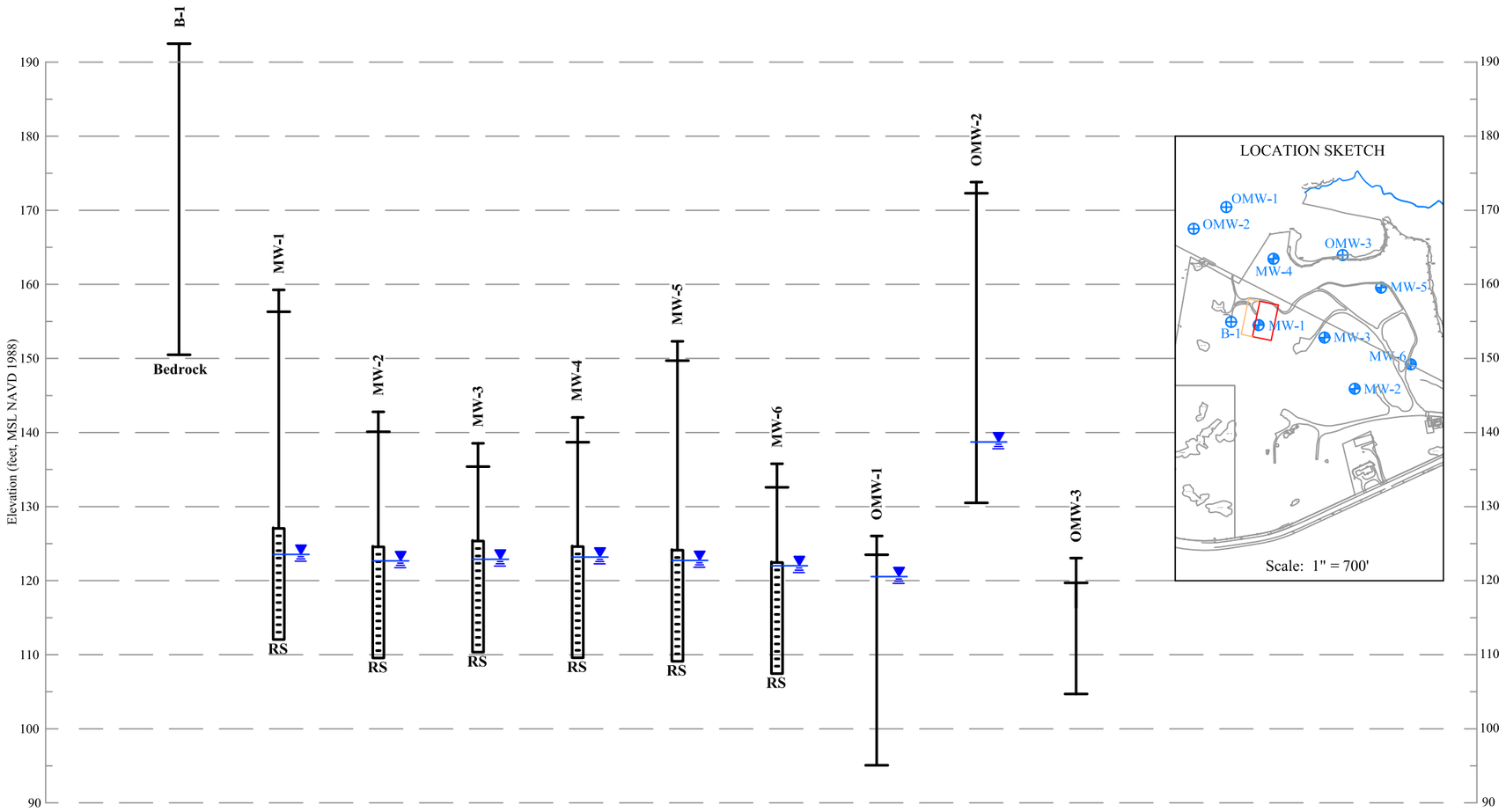
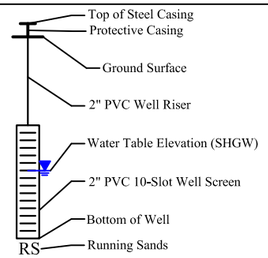


SCALES AS SHOWN

LEGEND:



NOTES:

1. Wells installed by Drilex Environmental on 4/16, 4/17 and 4/18/19.
2. Groundwater levels represent Seasonal High Groundwater as described in the text.
3. Groundwater data is presented in this figure is solely for the purposes of this report.

Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 4. Monitoring Well and Boring Schematic.

Project No. GHC#19004
Drafted SWS Checked
Date 6/10/19 Rev 6/20/19
Base Map: Insert from CAD file from Client.

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0 2,000

Scale in feet

Figure 5. Surficial Geology.

Base Map: MassGIS
Datalayer Download.

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Project No. GHC #19004

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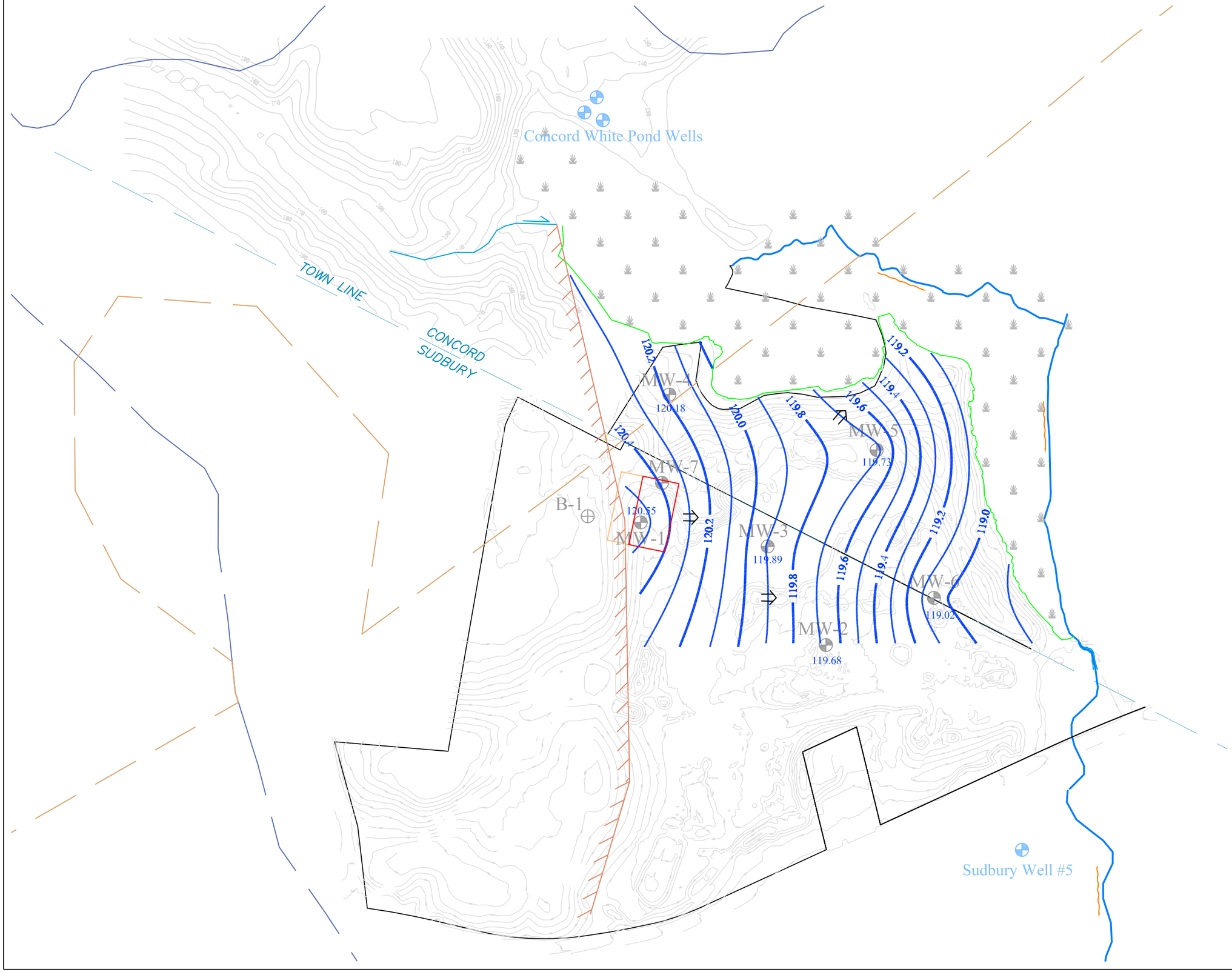
Date 3/20/19 Rev

Quarry North Road
36 North Road
Sudbury, MA 01776

Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 6. Groundwater Contour Elevations, Measured 4/22/19.



LEGEND:

306 Groundwater Elevation Contours. Interval = 0.1 foot.

Groundwater Monitoring Well Locations.

NOTES:

1. Groundwater contour data are calculated and interpreted as described in the text.
2. Groundwater contours are based on widely spaced well locations and may not reflect actual groundwater elevations.
3. Groundwater contours are presented for the purposes of this report only.

0 250

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev 07/22/19
Base Map: CAD files obtained from Client and Lidar Topography.

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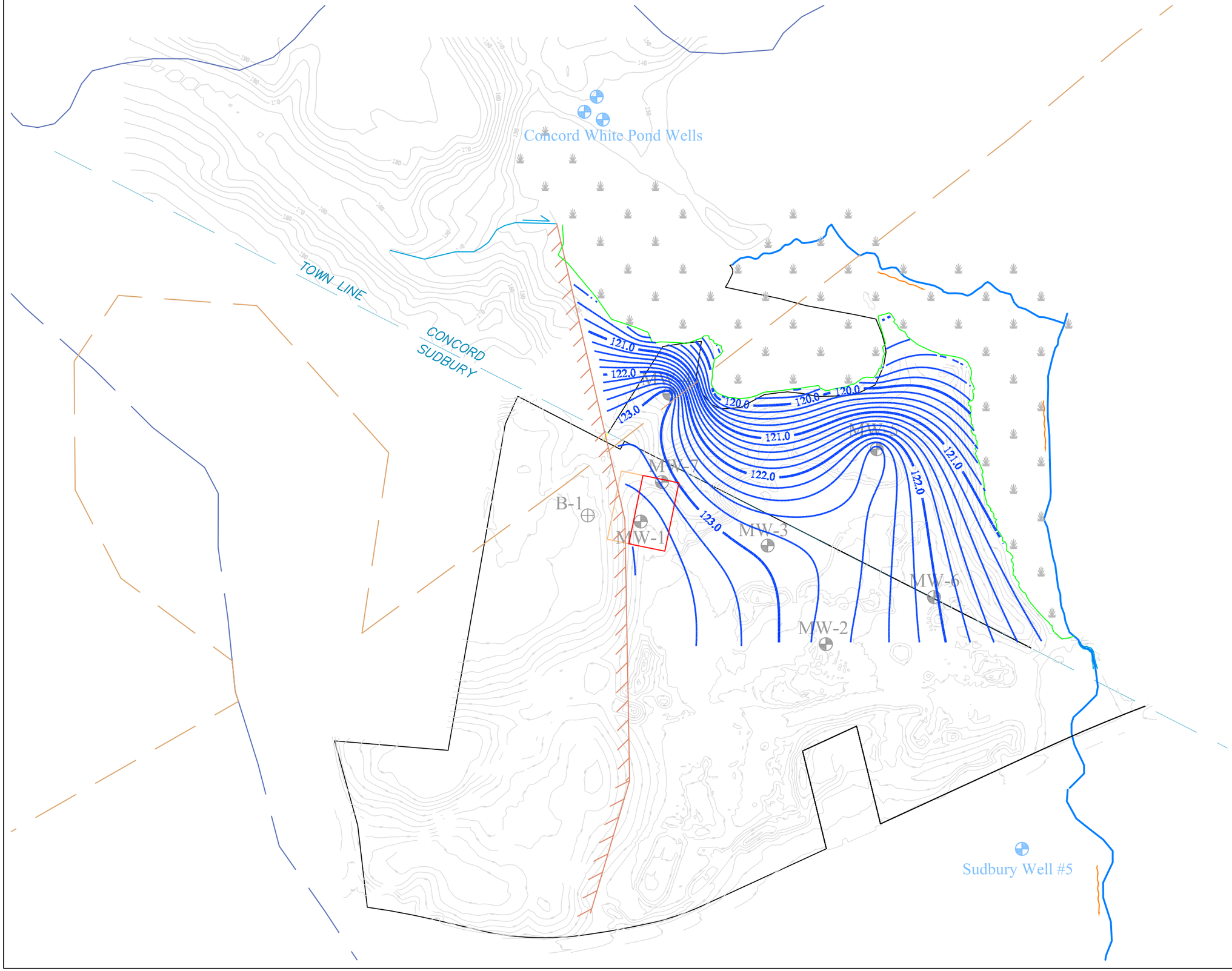


Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 7. Estimated Seasonal High Groundwater Contour Elevations.

LEGEND:

306 Groundwater Elevation Contours. Interval = 0.2 foot.

Groundwater Monitoring Well Locations.

NOTES:

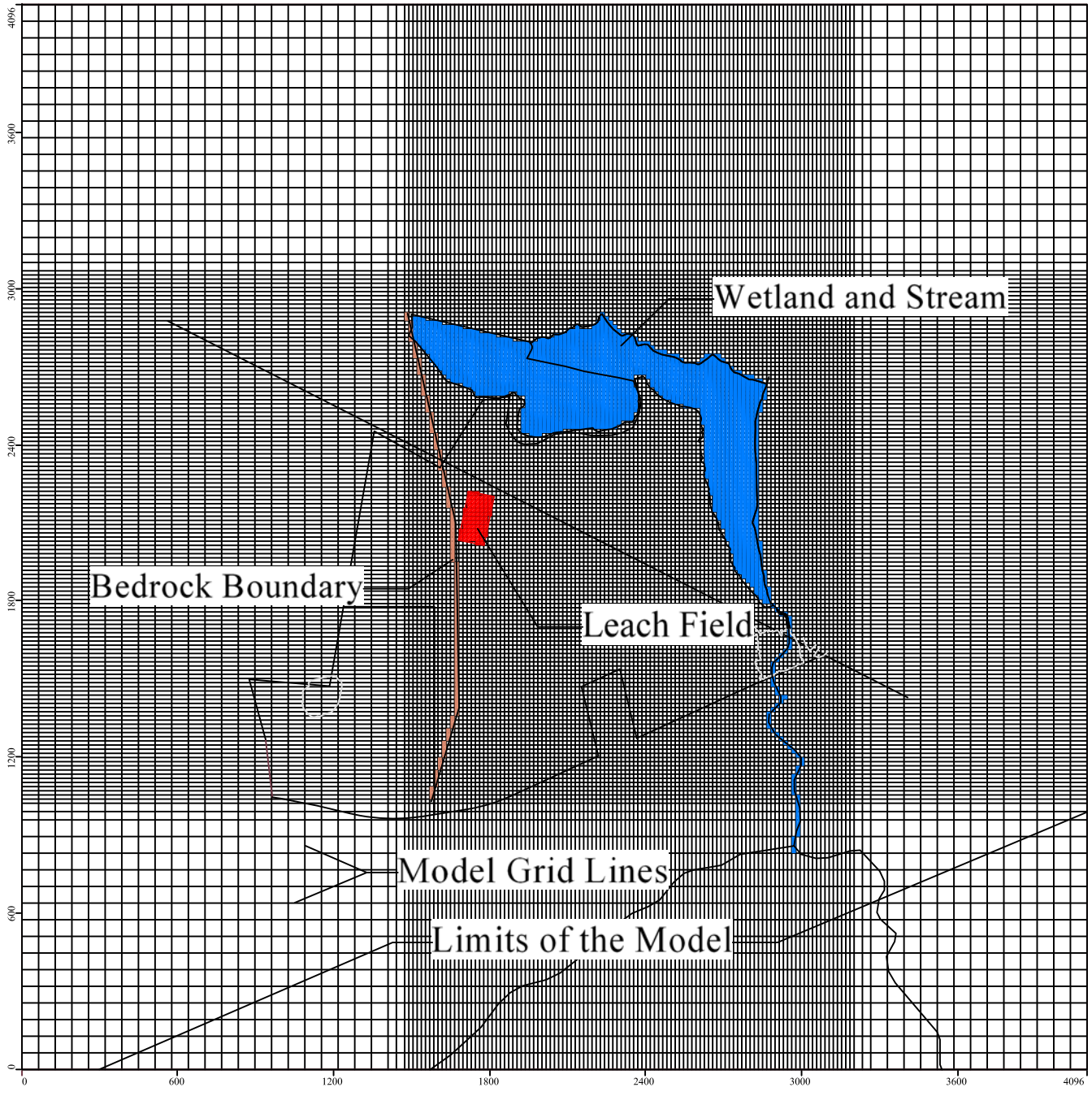
1. Groundwater contour data are calculated and interpreted as described in the text.
2. Groundwater contours are based on widely spaced well locations and may not reflect actual groundwater elevations.
3. Groundwater contours are presented for the purposes of this report only.

0 250

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev 07/22/19
Base Map: CAD files obtained from Client and Lidar Topography.

GeoHydroCycle, Inc.



Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 8A. MODFLOW Layout.

0 600

Scale in feet

Project No. GHC#19004
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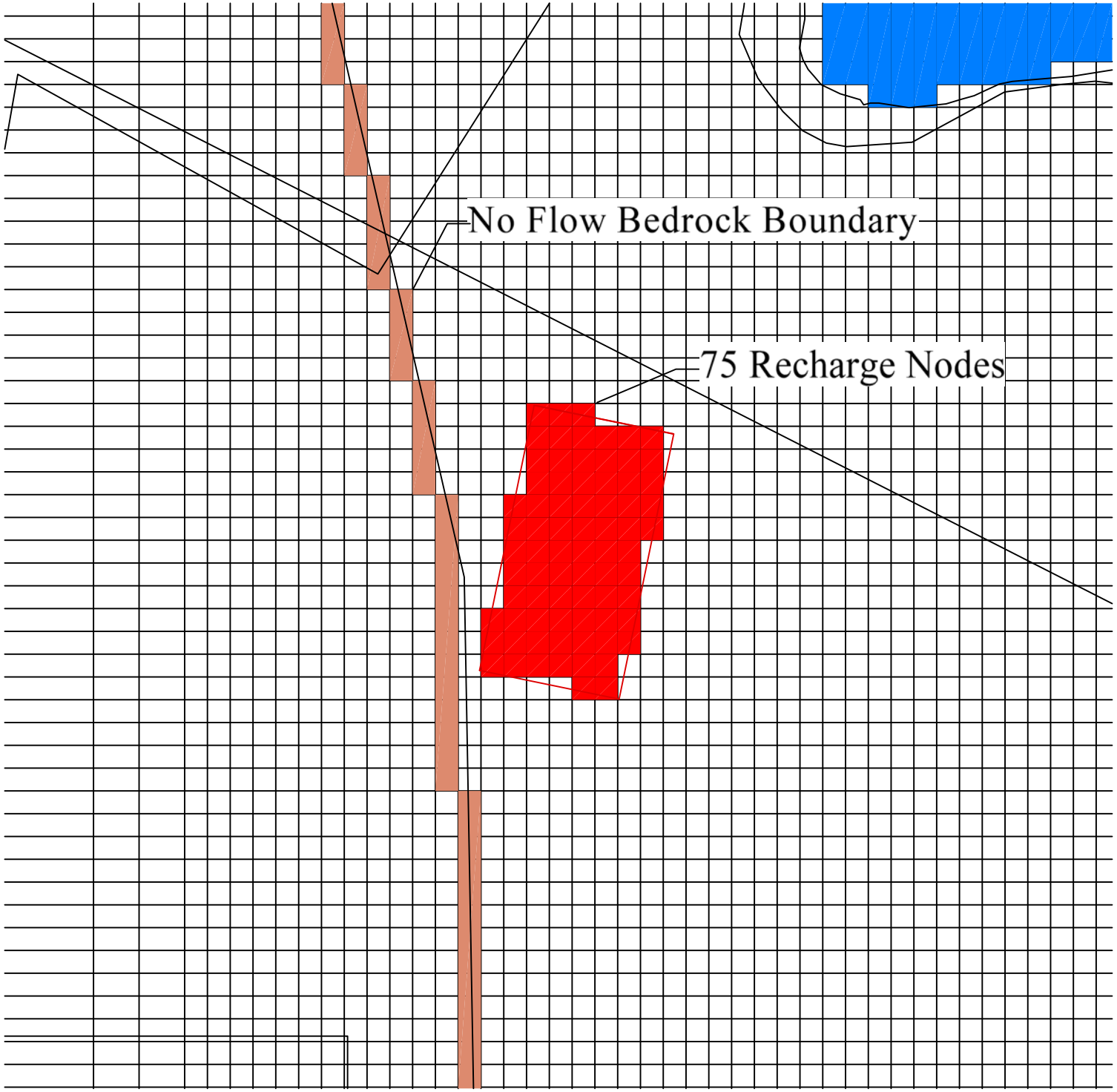
Date 7/23/19 Rev
Base Map: MODFLOW.

GeoHydroCycle, Inc.



Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 8B. Model Recharge.

0 100

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 7/23/19 Rev
Base Map: MODFLOW.

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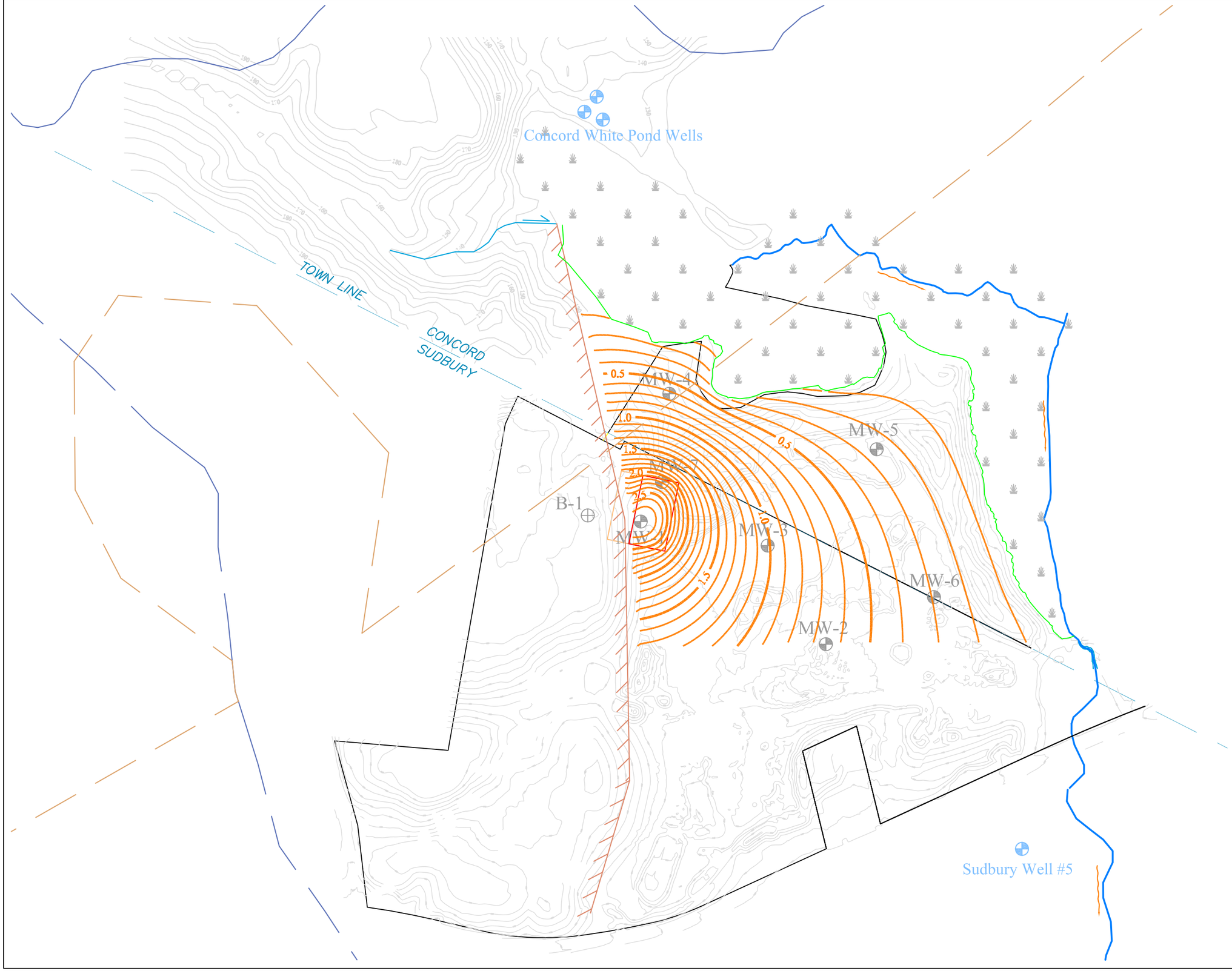
Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 9. Simulated Groundwater Mound Height Contours, Wastewater Discharge: 80% of 49,755 GPD.



LEGEND:

- 1.0 — Groundwater Elevation Contours. Interval = 0.1 foot.
- Groundwater Monitoring Well Locations.

NOTES:

1. Groundwater contour data are calculated and interpreted as described in the text.
2. Treated wastewater discharge = 80% of 49,755 gallons per day.
3. Total Leach Field footprint = 19,000 square feet.

0 250

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev 07/22/19
Base Map: CAD files obtained from Client and Lidar Topography.

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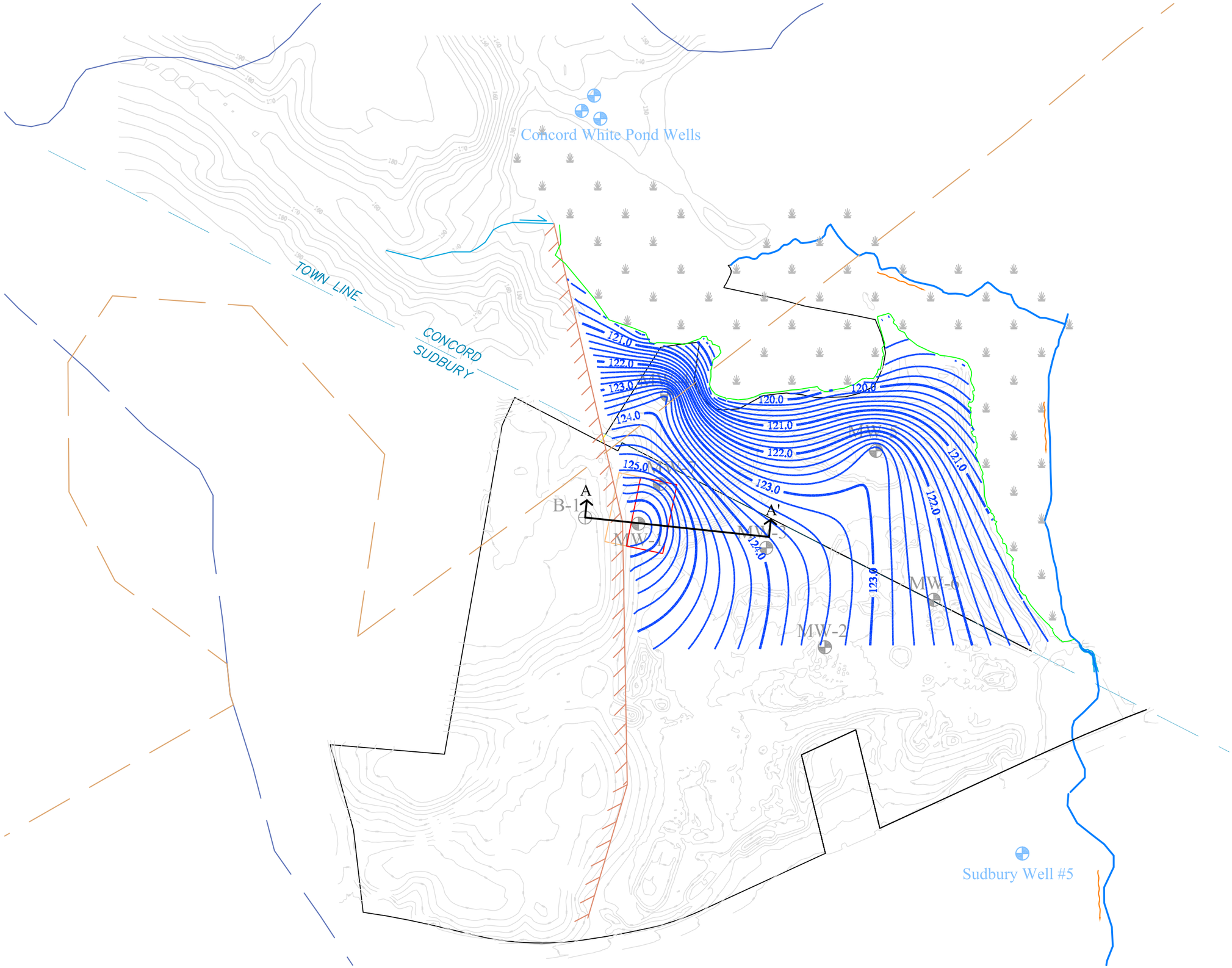
Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 10. Simulated Mounded Seasonal High Groundwater Contour Elevations, Wastewater Discharge: 80% of 49,755 GPD.



LEGEND:

- 306 — Groundwater Elevation Contours. Interval = 0.2 foot.
- Groundwater Monitoring Well Locations.
- A A' — Cross-Section Location (Figure 14).

NOTES:

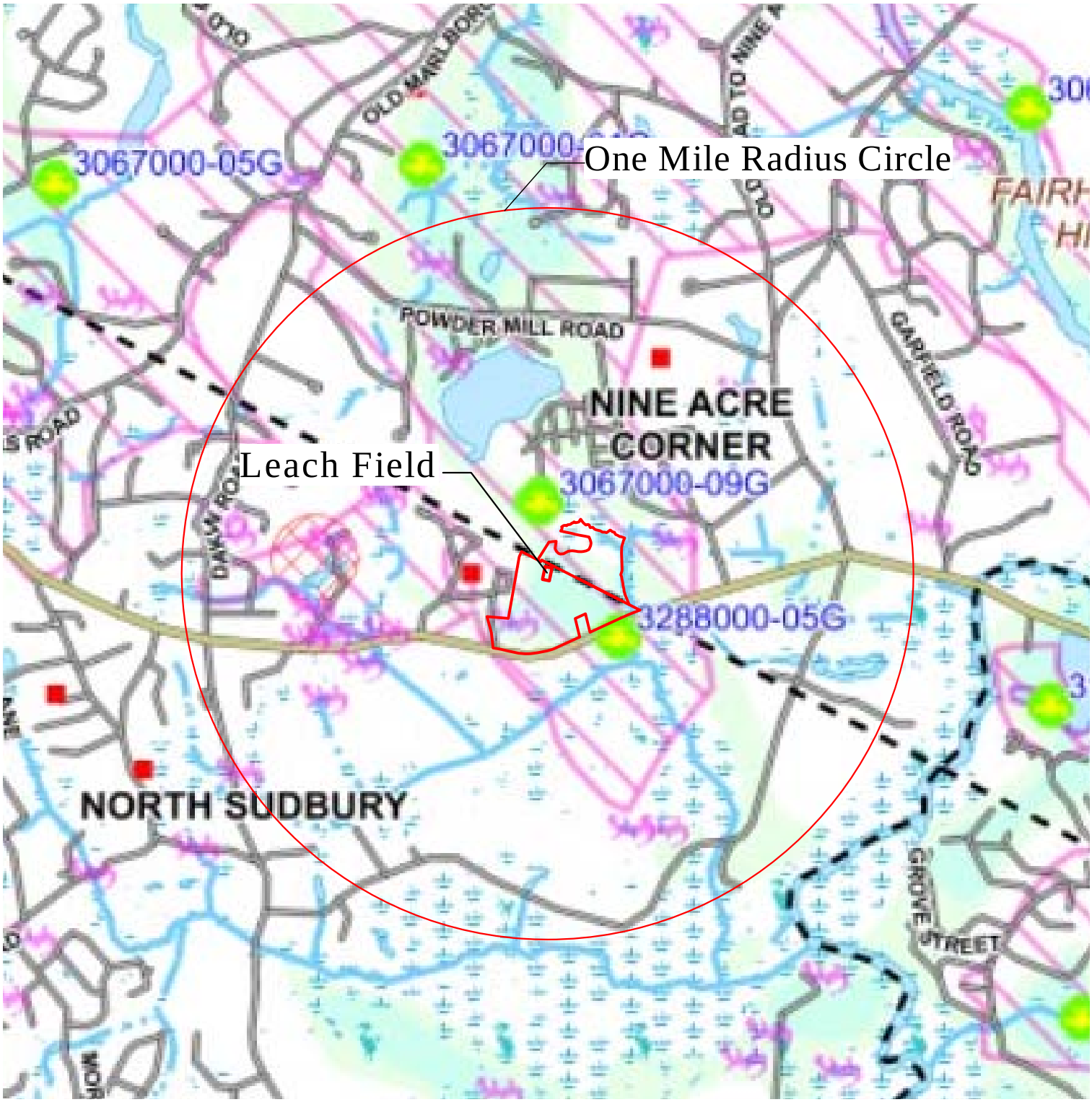
1. Groundwater contour data are calculated and interpreted as described in the text.
2. Treated wastewater discharge = 80% of 49,755 gallons per day.
3. Total SAS footprint = 19,000 square feet.
4. Groundwater contours are presented for the purposes of this report only.

0 250

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev 07/22/19
Base Map: CAD files obtained from Client and Lidar Topography.

GeoHydroCycle, Inc.



0 2,000

Scale in feet

Base Map: MassGIS website.

GeoHydroCycle, Inc.

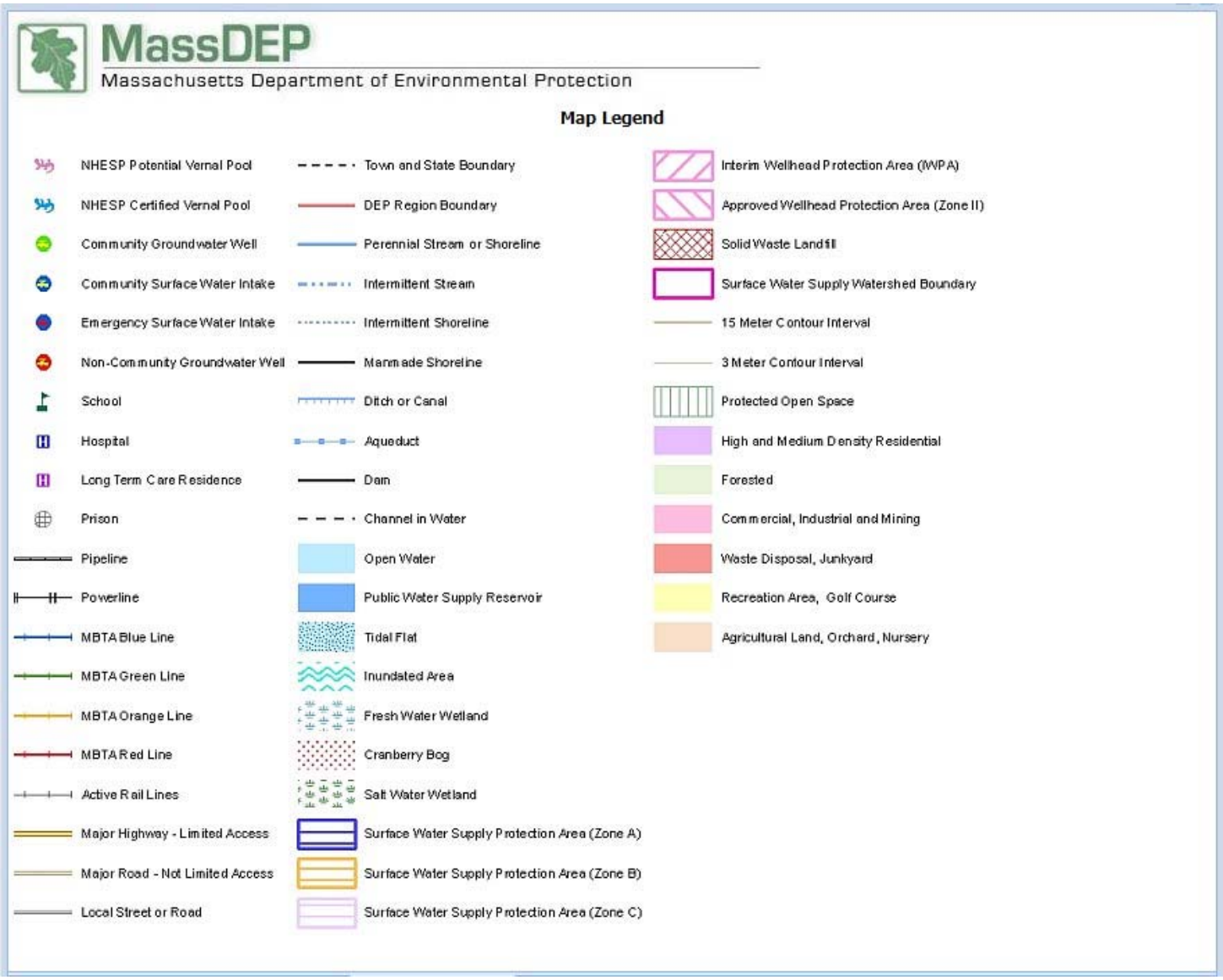
Figure 11A. Priority Resources Map.

Project No. GHC #19004

Drafted SWS Checked

Date 7/23/19 Rev

Quarry North Road
36 North Road
Sudbury, MA 01776



No Scale

Base Map: MassGIS Online Mapping.

GeoHydroCycle, Inc.

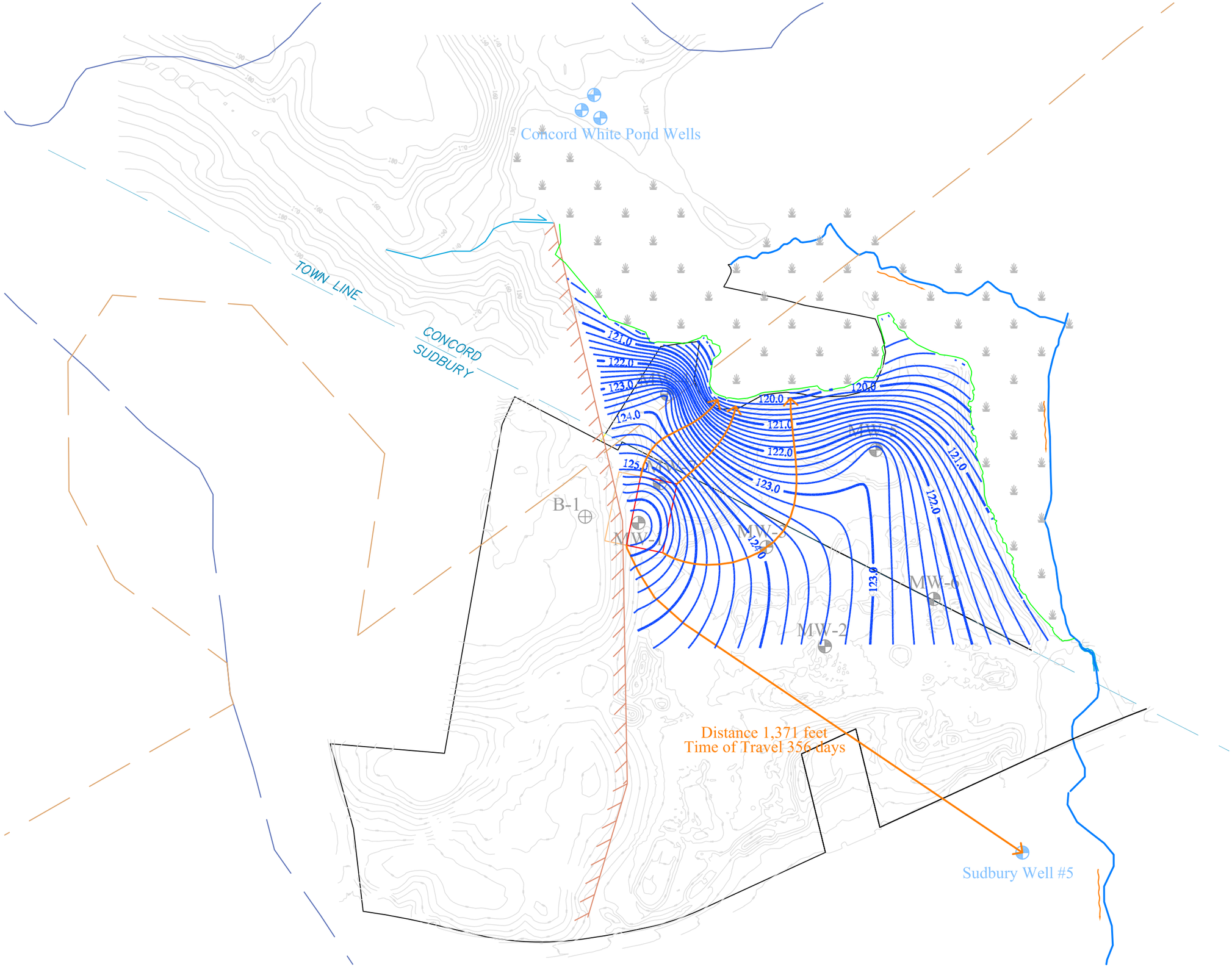
Figure 11B. Priority Resources Map Legend.

Project No. GHC# 19004

Drafted SWS

Date 7/15/19 Rev

Quarry North Road
36 North Road
Sudbury, MA 01776



Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 12. Simulated Mounded Seasonal High Groundwater Contour Elevations with Streamlines, Wastewater Discharge: 80% of 49,755 GPD.

LEGEND:

306 Groundwater Elevation Contours. Interval = 0.2 foot.

Groundwater Monitoring Well Locations.

NOTES:

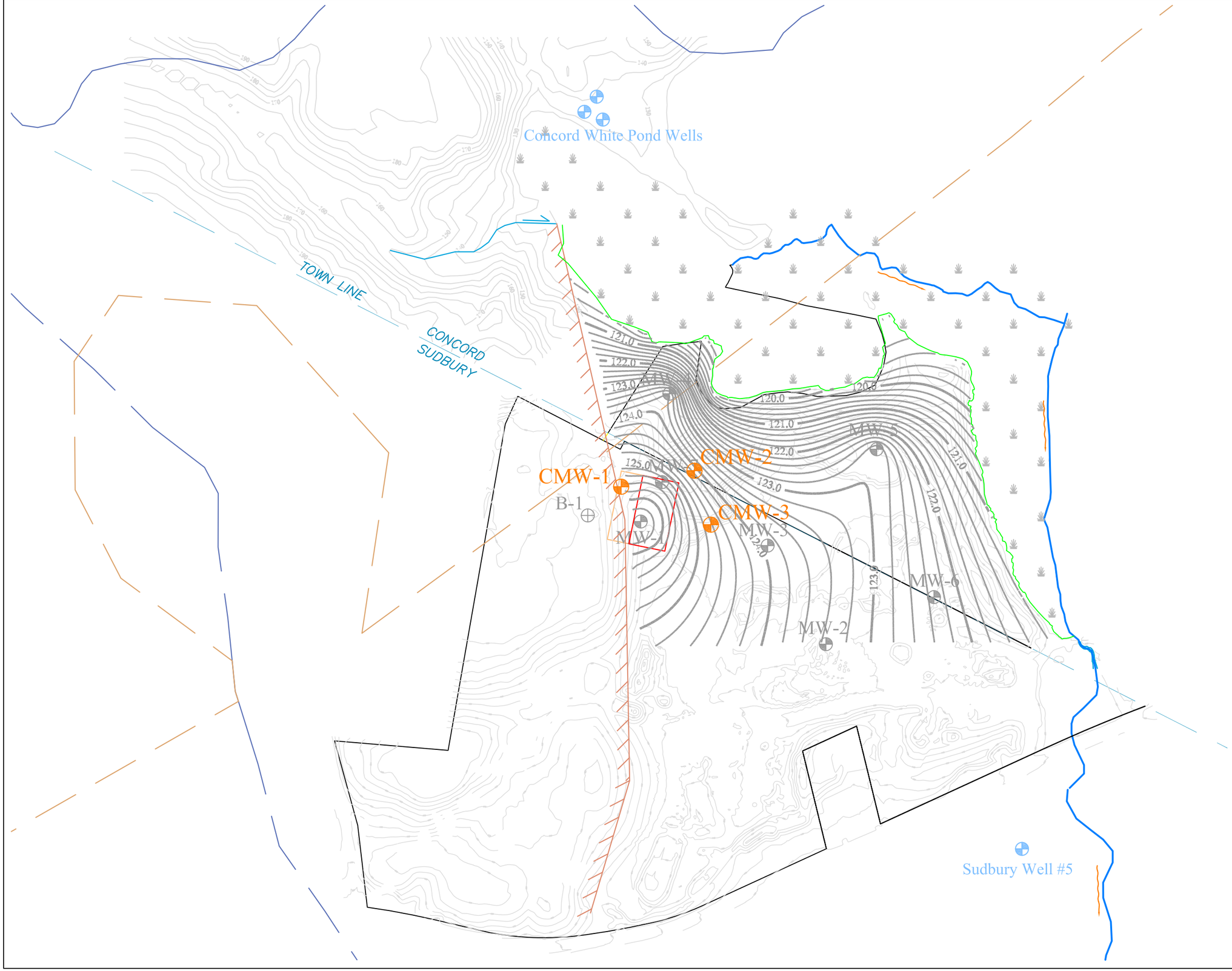
1. Groundwater contour data are calculated and interpreted as described in the text.
2. Treated wastewater discharge = 80% of 49,755 gallons per day.
3. Total SAS footprint = 19,000 square feet.
4. Groundwater contours are presented for the purposes of this report only.

0 250

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev 07/22/19
Base Map: CAD files obtained from Client and Lidar Topography.

GeoHydroCycle, Inc.



Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 13. Proposed Locations of Compliance Wells.

LEGEND:

306 Groundwater Elevation Contours. Interval = 1.0 foot.

Proposed Compliance Monitoring Well Locations.

NOTES:

1. Groundwater contour data are calculated and interpreted as described in the text.
2. Groundwater contours represent mounded seasonal high groundwater, see Figure_.
2. If monitoring wells GHC-1 and GHC-3 are still present after leach field construction, it is proposed that they serve as Compliance Wells CMW-2 and CMW-1, respectively.
3. Groundwater contours are presented for the purposes of this report only.

0 250

Scale in feet

Project No. GHC#19004
Drafted SWS Checked
Date 07/18/19 Rev 07/22/19
Base Map: CAD files obtained from Client and Lidar Topography.

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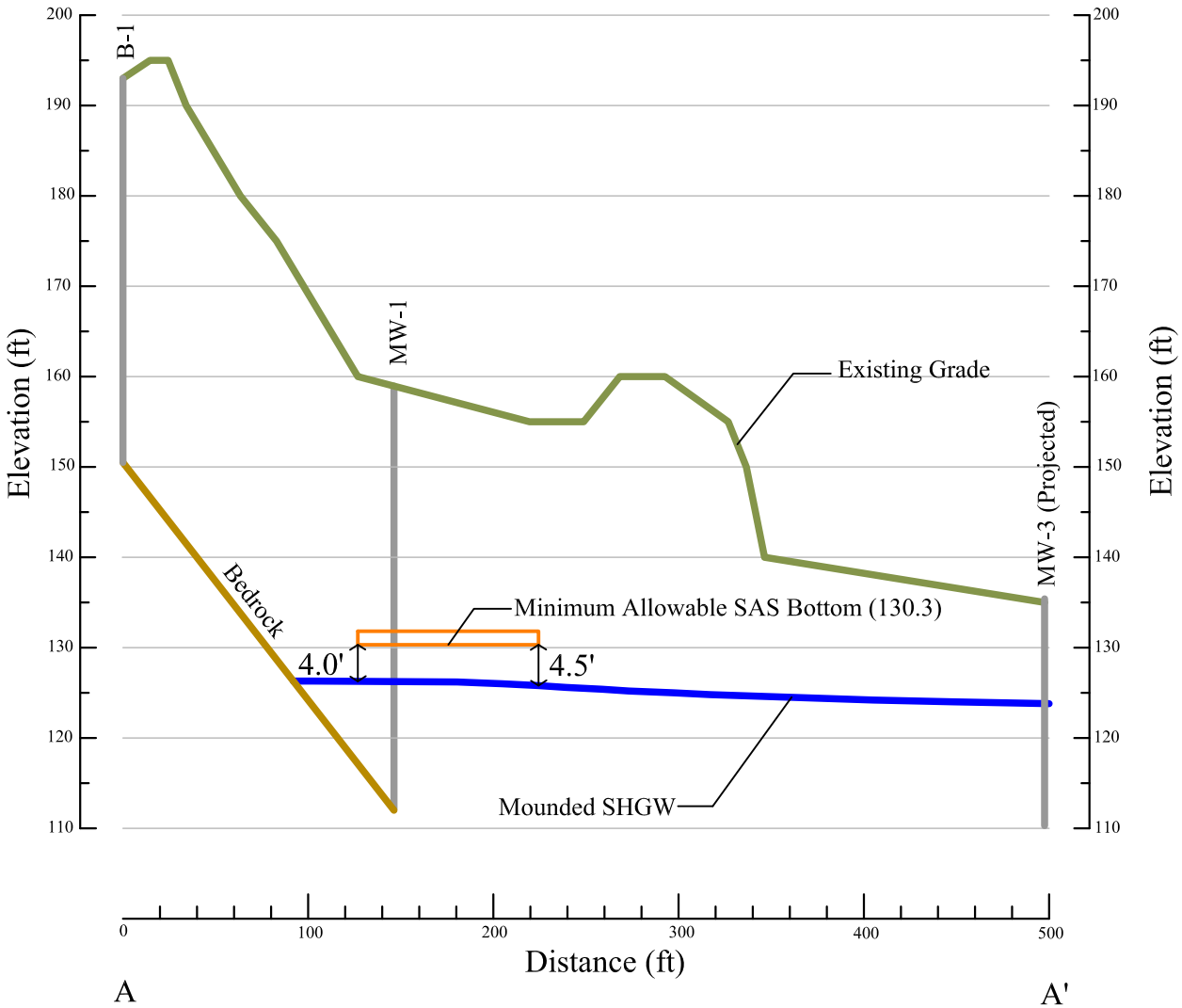
Scales as Shown



Cross-Section A-A'

Total Length 500 feet

Quarry North Road
36 North Road
Sudbury, MA 01776

Figure 14.
Cross-Section A-A'.

NOTES

1. Mounded seasonal high groundwater derived from Figure 10. See text for sizing and rates.
2. Leach field dimensions obtained from Porvencher Engineering, Inc.
3. Not for Construction.

Project No. GHC#19004
Drafted SWS Checked
Date 7/29/19 Rev
Base Map: Figure 10.

GeoHydroCycle, Inc.

Enclosure 2 - Test Pits

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Town of Sudbury
Owner Name

278 Old Sudbury Road — C12/0100
Street Address — Map/Lot #

Sudbury — Massachusetts — 01776
City — State — Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: NRCS - Middlesex County (Source) 254B (Soil Map Unit)

Merrimac (Soil Name) None (Soil Limitations)

Sand and Gravel, Outwash (Geologic/Parent Material) Kame (Landform)

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 1977/Ward S Motts (Year Published/Source) 1" = 2000' (Publication Scale) QKD (Map Unit)

4. Flood Rate Insurance Map

Above the 500-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5.

Within the 100-year flood boundary? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No MassGIS Wetland Data Layer: N/A (Wetland Type)

7. Current Water Resource Conditions (USGS): July/2019 (Month/Year) Range: ☒ Above Normal ☐ Normal ☐ Below Normal

8. Other references reviewed: None

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-201 | 7/1/2019 (Date) | 8:30 AM (Time) | Sunny (Weather)

1. Location

   Ground Elevation at Surface of Hole: 161.6 feet Latitude/Longitude: 42-25-12 / 71-23-17

   Description of Location: On slope

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 38.5 (Slope (%))

   Brush (Vegetation) | Kame delta (Landform) | FS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☒ No

   If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-201

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A (fill)	10YR3/4				Loamy Sand			Massive	Loose	Fine/Fill
12-60	BW1 (fill)	2.5Y6/3				Loamy Sand			Small Grain	Loose	Fine/Fill
60-156	C1	2.5Y6/3				Sand			Small Grain	Loose	Fine/Med

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-202 | 7/1/2019 (Date) | 9:22 AM (Time) | Sunny (Weather)

1. Location

   Ground Elevation at Surface of Hole: 154.7 feet Latitude/Longitude: 42-25-12 / 71-23-16

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 4.8 (Slope (%))

   Brush (Vegetation) | Kame Delta (Landform) | FS (Position on Landscape (SU, SH, BS, FS,

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches | N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-202

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-66	C1 (fill)	2.5Y6/4				Sand			Massive	V. Friable	Fine/Fill
66-156	C1	2.5Y6/4				Loamy Sand			Massive	V. Friable	Fine/Med

Additional Notes:

Soil sample collected at 156 inches.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-203 | 7/1/2019 (Date) | 10:00 AM (Time) | Sunny (Weather)

1. Location

   Ground Elevation at Surface of Hole: 158.2 feet Latitude/Longitude: 42-25-13 / 71-23-16

   Description of Location: On slope

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 10.6 (Slope (%))

   Brush (Vegetation) | Kame delta (Landform) | FS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from:

Open Water Body	>100 ft	Drainage Way	>100 ft	Wetlands	>100 ft
Property Line	>100 ft	Drinking Water Well	>100 ft	Other	

   (feet)

4. Parent Material: Outwash Unsuitable Materials Present: ☐ Yes ☒ No

   If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☐ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-203

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-156	C1	2.5Y6/3	42	10YR6/8 10YR5/1	2	Sand			S. Grain	Loose	Fine/ Med

Additional Notes:

Few pockets of fine silt-loam 36 to 42 inches on west side of pit.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-204 | 7/1/2019 (Date) | 11:00 AM (Time) | Sunny (Weather)

1. Location

   Ground Elevation at Surface of Hole: 158.1 feet Latitude/Longitude: 42-25-14 / 71-23-16

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 7.8 (Slope (%))

   Brush (Vegetation) | Kame Delta (Landform) | FS (Position on Landscape (SU, SH, BS, FS,

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches | N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-204

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-60	1C1 (fill)	2.5Y5/3				Loamy Sand			S. Grain	V. Friable	Fine/Fill
60-72	A	2.5Y3/3				Loamy Sand			S. Grain	V. Friable	Fine
72-168	2C1	2.5Y3/3	168	10YR6/8 10YR7/1	<5	Sand			S. Grain	Loose	Medium
168-192	2C2	10YR5/2				Sandy Loam			Massive	V. Friable	Fine

Additional Notes:

Pocket of fine sandy loam at 144 inches.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-205 | 7/1/2019 (Date) | 12:15 PM (Time) | Sunny (Weather)

1. Location

   Ground Elevation at Surface of Hole: 172.9 feet Latitude/Longitude: 42-25-14 / 71-23-16

   Description of Location: On slope

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 2.6 (Slope (%))

   Brush (Vegetation) | Kame delta (Landform) | SU (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from:

Open Water Body	>100 ft	Drainage Way	>100 ft	Wetlands	>100 ft
Property Line	>100 ft	Drinking Water Well	>100 ft	Other	

   (feet)

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-205

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-48	1C1 (fill)	2.5Y5/3				Sand			S. Grain	V. Friable	Fine/Fill
48-168	2C1	2.5Y6/3	166	10YR6/8	<5	Sand			S. Grain	Loose	Fine/Med.

Additional Notes:

Possible mottles at 14 feet.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-206 | 7/1/2019 (Date) | 1:30 PM (Time) | Sunny (Weather)

1. Location

Ground Elevation at Surface of Hole: 178.3 feet Latitude/Longitude: 42-25-14 / 71-23-15

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0.0 (Slope (%))

Brush (Vegetation) | Kame Delta (Landform) | SU (Position on Landscape (SU, SH, BS, FS,

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

Estimated Depth to High Groundwater: N/A inches | N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-206

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-48	1C1 (fill)	10YR5/4				Loamy Sand			S. Grain	V. Friable	Fine/Fill
48-96	2C1	10YR4/5				Sand	10	5	S. Grain	Loose	Fine, Med, Coar, Stra
96-156	2C2	10YR6/3	156	10YR6/8	<5	Sand			S. Grain	Loose	Fine

Additional Notes:

Stratified fine/coarse lenses from 48 to 96 inches. Possible mottles at 156 inches.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-207 | 7/1/2019 (Date) | 2:30 PM (Time) | Sunny (Weather)

1. Location

Ground Elevation at Surface of Hole: 136.4 feet Latitude/Longitude: 42-25-12 / 71-23-15

Description of Location: On slope

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 4.1 (Slope (%))

Brush (Vegetation) | Kame delta (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

Estimated Depth to High Groundwater: N/A inches N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-207

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-24	1C1 (fill)	2.5Y6/4				Sand			S. Grain	loose	Fine/Fill
24-36	A	2.5Y4/3				Loamy Sand			S. Grain	loose	Fine
36-156	2C1	10YR6/2				Sand			S. Grain	loose	Med, Coa, Stratified

Additional Notes:

Possible fill extends to 9 feet on Southern side of pit.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-208 | 7/2/2019 (Date) | 9:00 AM (Time) | Sunny/Partly Cloudy (Weather)

1. Location

Ground Elevation at Surface of Hole: 158.7 feet Latitude/Longitude: 42-25-13 / 71-23-15

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 25.0 (Slope (%))

Brush (Vegetation) | Kame Delta (Landform) | BS (Position on Landscape (SU, SH, BS, FS,

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

Estimated Depth to High Groundwater: N/A inches | N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-208

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-204	A (fill)	10YR3/3				Sandy Loam			Massive	Loose	Rts to 144" Comm/Fill

Additional Notes:

Unsuitable material. No original material observed (all fill).

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-209 | 7/2/2019 (Date) | 9:30 AM (Time) | Sunny/Partly Cloudy (Weather)

1. Location

   Ground Elevation at Surface of Hole: 152.5 feet Latitude/Longitude: 42-25-13 / 71-23-15

   Description of Location: On slope

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 11.8 (Slope (%))

   Brush (Vegetation) | Kame delta (Landform) | FS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from:

Open Water Body	>100 ft	Drainage Way	>100 ft	Wetlands	>100 ft
Property Line	>100 ft	Drinking Water Well	>100 ft	Other	

   (feet)

4. Parent Material: Outwash Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-209

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-180	A (fill)	10YR3/3				Sandy Loam			Massive	V. Friable	Rts to 120" Fine/Fill
180-192	C1	2.5Y6/3				Sand			S. Grain	V. Friable	Medium

Additional Notes:

Unsuitable due to excessive fill

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-210 | 7/2/2019 (Date) | 11:00 AM (Time) | Sunny/Partly Cloudy (Weather)

1. Location

Ground Elevation at Surface of Hole: 172.1 feet Latitude/Longitude: 42-25-14 / 71-23-15

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 10.4 (Slope (%))

Brush (Vegetation) | Kame Delta (Landform) | SH (Position on Landscape (SU, SH, BS, FS,

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

Estimated Depth to High Groundwater: N/A inches | N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-210

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	Ap	10YR3/2				Loamy Sand			Massive	Friable	Fine
12-30	BW1	10YR6/8				Loamy Sand			Massive	Friable	Fine
30-48	C1	10YR6/4				Loamy Sand			Massive	Firm	Fine
48-60	C2	10YR6/2	60	10YR6/8 10YR6/1	5	Loamy Sand			Massive	Firm	Fine
60-156	C3	10YR5/6				Loamy Sand			Massive	Firm	Fine/Med.

Additional Notes:

Estimated seasonal high water table not based on mottles (55 feet to groundwater in MW-7).

No fill encountered

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-211 | 7/2/2019 (Date) | 12:00 PM (Time) | Sunny/Partly Cloudy (Weather)

1. Location

   Ground Elevation at Surface of Hole: 174.9 feet Latitude/Longitude: 42-25-14 / 71-23-16

   Description of Location: On slope

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 13.5 (Slope (%))

   Brush (Vegetation) | Kame delta (Landform) | SH (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from:

Open Water Body	>100 ft	Drainage Way	>100 ft	Wetlands	>100 ft
Property Line	>100 ft	Drinking Water Well	>100 ft	Other	

   (feet)

4. Parent Material: Outwash Unsuitable Materials Present: ☐ Yes ☒ No

   If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-211

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-120	C1	10YR5/4				Sand			S. Grain	Loose	Fine
120-132	C2	10YR5/2				Sand	5		S. Grain	Loose	Fine/Med.

Additional Notes:

No A and B horizons present.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-212 | 7/2/2019 (Date) | 1:00 PM (Time) | Sunny/Partly Cloudy (Weather)

1. Location

   Ground Elevation at Surface of Hole: 176.1 feet Latitude/Longitude: 42-25-13 / 71-23-17

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 30.3 (Slope (%))

   Brush (Vegetation) | Kame Delta (Landform) | BS (Position on Landscape (SU, SH, BS, FS,

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☐ Yes ☒ No

   If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches | N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-212

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-24	Ap	10YR3/2				Loamy Sand			S. Grain	Loose	Fine/Med.
24-156	C1	10YR5/4				Sand			S. Grain	V. Friable	Fine/Med.

Additional Notes:

No B horizon present.

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-213 | 7/2/2019 (Date) | 2:00 PM (Time) | Sunny/Partly Cloudy (Weather)

1. Location

   Ground Elevation at Surface of Hole: 190.8 feet Latitude/Longitude: 42-25-12 / 71-23-18

   Description of Location: On slope

2. Land Use: Former gravel pit (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 26.5 (Slope (%))

   Brush (Vegetation) | Kame delta (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from:

Open Water Body	>100 ft feet	Drainage Way	>100 ft feet	Wetlands	>100 ft feet
Property Line	>100 ft feet	Drinking Water Well	>100 ft feet	Other	feet

4. Parent Material: Outwash Unsuitable Materials Present: ☐ Yes ☒ No

   If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A (Depth Weeping from Pit) | N/A (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: N/A inches N/A elevation

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-213

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-14	Ap	10YR3/2				Loamy Sand			S. Grain	V. Friable	Fine/Med.
14-156	C1	10YR5/4				Sand			S. Grain	V. Friable	Fine/Med.

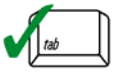
Additional Notes:

No B horizon present.

Commonwealth of Massachusetts
City/Town of Sudbury
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A. Site Information

Town of Sudbury
Owner Name

278 Old Sudbury Road
Street Address or Lot #

Sudbury	MA	01776
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	7/1/2019 Date	10:20 AM Time	7/1/2019 Date	12:27 PM Time
Observation Hole #	PT-203		PT-205	
Depth of Perc	45-63"		33-51"	
Start Pre-Soak	10:20		!2:27	
End Pre-Soak	10:35		12:36	
Time at 12”	10:35			
Time at 9”	10:41		25 gal/9 min	
Time at 6”	10:51			
Time (9”-6”)	10			
Rate (Min./Inch)	4		<2	
	Test Passed: ☒ Test Failed: ☐		Test Passed: ☒ Test Failed: ☐	

Don Provencher
Test Performed By:

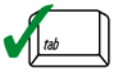
Paul Blain
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of Sudbury
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A. Site Information

Town of Sudbury
Owner Name

278 Old Sudbury Road
Street Address or Lot #

Sudbury	MA	01776
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	7/2/2019 Date	8:00 AM Time	7/2/2019 Date	11:41 AM Time
Observation Hole #	PT-207		PT-211	
Depth of Perc	30-48"		30-48"	
Start Pre-Soak	8:03		11:41	
End Pre-Soak	8:10		11:56	
Time at 12”	8:10		11:56	
Time at 9”	25 gals / 7 minutes		12:09	
Time at 6”			12:27	
Time (9”-6”)			18	
Rate (Min./Inch)	<2		6	
	Test Passed: ☒ Test Failed: ☐		Test Passed: ☒ Test Failed: ☐	

Don Provencher
Test Performed By:

Paul Blain
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # _____	Obs. Hole # _____
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
☒ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Acton 158 (Index Well Number) 7/1/2019 (Reading Date)

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

	S_c	S_r	OW_c	OW_{max}	OW_r	S_h
Obs. Hole # _____	N/A	_____	16.85	13.34	5.4	N/A
Obs. Hole # _____	_____	_____	_____	_____	_____	_____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

      ☒ Yes ☐ No

   b. If yes, at what depth was it observed? Upper boundary: 156 inches Lower boundary: 90 inches

   c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Sudbury

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Board of Health Witness

Paul Blain	MassDEP
Name of Board of Health Witness	Board of Health

G. Soil Evaluator Certification

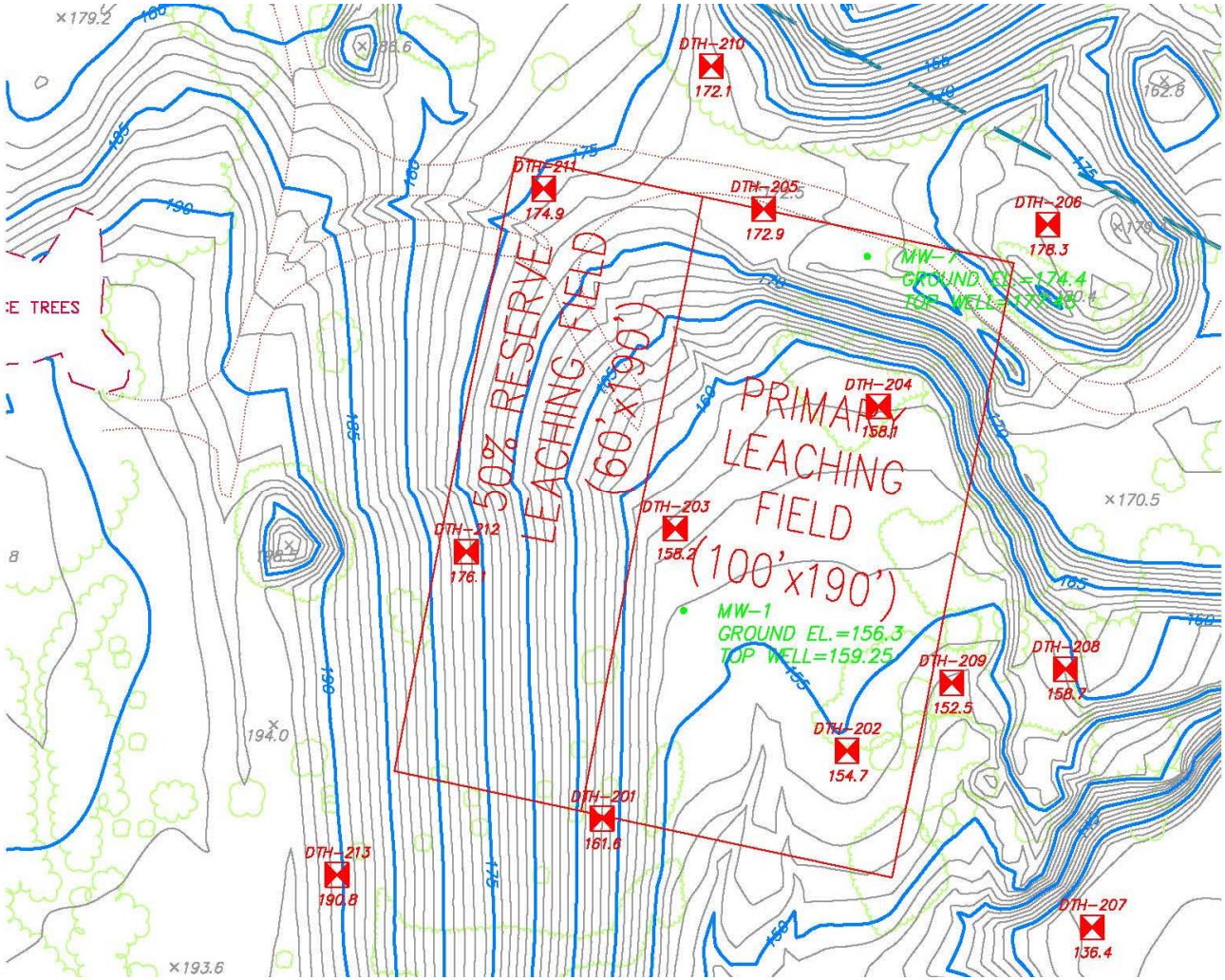
I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

	July 18, 2019
Signature of Soil Evaluator	Date
Donald A. Provencher	6/30/2022
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams

Use this sheet for field diagrams:



United States Department of Agriculture

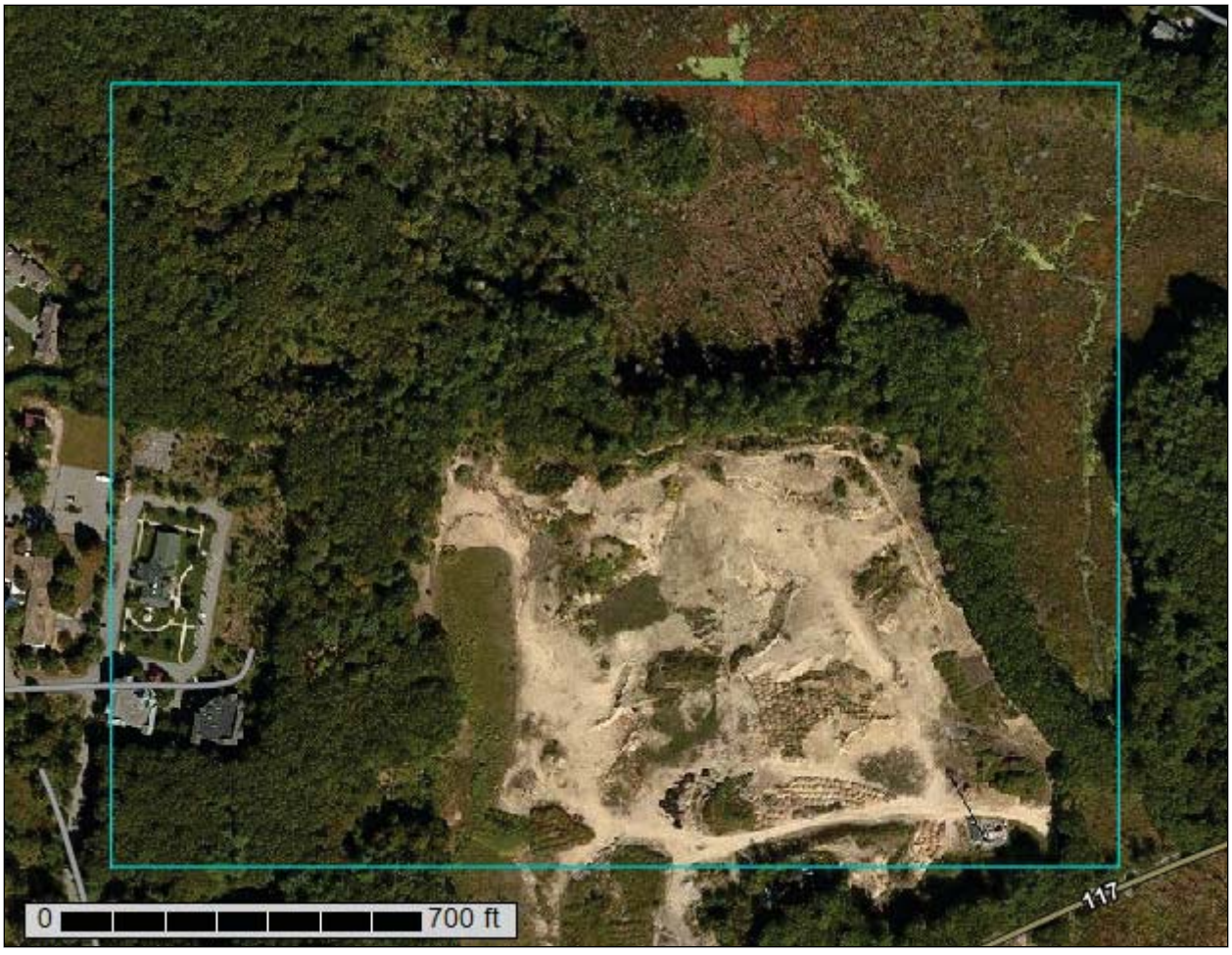
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Middlesex County, Massachusetts

Malone Property



July 17, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,900 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 18, Sep 7, 2018

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	25.7	37.8%
253C	Hinckley loamy sand, 8 to 15 percent slopes	0.2	0.3%
253D	Hinckley loamy sand, 15 to 25 percent slopes	9.4	13.9%
253E	Hinckley loamy sand, 25 to 35 percent slopes	10.6	15.6%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	9.2	13.5%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	0.6	0.9%
600	Pits, gravel	6.3	9.3%
622C	Paxton-Urban land complex, 3 to 15 percent slopes	6.0	8.8%
Totals for Area of Interest		**68.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a

given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Middlesex County, Massachusetts

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Freetown

Setting

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

Typical profile

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

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 5 percent
Landform: Bogs, kettles, depressions, depressions, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

253C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svm9
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Hinckley

Setting

Landform: Moraines, outwash terraces, outwash deltas, kame terraces, outwash plains, kames, eskers
Landform position (two-dimensional): Shoulder, toeslope, footslope, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Linear, convex, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

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

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 5 percent
Landform: Moraines, outwash deltas, outwash terraces, kame terraces, outwash plains
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, kames, eskers, moraines, outwash terraces
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Kames, eskers, moraines, kame terraces, outwash plains, outwash terraces, outwash deltas
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser

Down-slope shape: Linear, concave, convex
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

253D—Hinckley loamy sand, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2svmc
Elevation: 0 to 1,460 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Hinckley

Setting

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

Typical profile

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

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Kames, outwash terraces, eskers, moraines, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

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

Sudbury

Percent of map unit: 2 percent
Landform: Outwash deltas, kame terraces, eskers, outwash terraces, outwash plains, moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear, convex
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

253E—Hinckley loamy sand, 25 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2svmf
Elevation: 0 to 1,200 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Hinckley

Setting

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

Typical profile

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

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 10 percent
Landform: Outwash terraces, outwash deltas, kames, eskers, moraines, kame terraces, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Linear, concave, convex
Across-slope shape: Convex, linear, concave

Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent
Landform: Outwash plains, kames, outwash terraces, kame terraces, eskers, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent
Landform: Outwash plains, moraines, outwash deltas, outwash terraces, kame terraces
Landform position (two-dimensional): Backslope, footslope, toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Merrimac

Setting

Landform: Moraines, outwash terraces, outwash plains, kames, eskers
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 5 percent
Landform: Terraces, deltas, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Outwash plains, eskers, kames, deltas
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Windsor

Percent of map unit: 3 percent
Landform: Outwash plains, deltas, dunes, outwash terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Stream terraces, moraines, outwash terraces, outwash plains, kames, eskers
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

305C—Paxton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w66y
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Paxton

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 7 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 2 percent
Landform: Drainageways, drumlins, hills, ground moraines, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

600—Pits, gravel

Map Unit Setting

National map unit symbol: 994w
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits, gravel: 95 percent
Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Gravel

Setting

Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loose sandy and gravelly glaciofluvial deposits derived from granite and gneiss

Minor Components

Rock outcrop

Percent of map unit: 3 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

Water

Percent of map unit: 2 percent
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Unranked

622C—Paxton-Urban land complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w67k
Elevation: 0 to 930 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Paxton

Setting

Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, summit, backslope

Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 0 inches to manufactured layer
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, summit, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave

Across-slope shape: Linear
Hydric soil rating: No

Charlton

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Udorthents

Percent of map unit: 4 percent
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 1 percent
Landform: Drainageways, hills, ground moraines, depressions, drumlins
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Hydric soil rating: Yes

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Enclosure 3 - Environmental Drilling Logs

GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. **B-1**	Sheet 1 of 2
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA	Begun: 4/16/19		
	Finished: 4/16/19		
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: Clear/windy.	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 40s	4/16/2019	~42 / Grade

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
5	S-1	5-7	14"		3,2,2,4	**S-1** Yellow-brown, v loose, f SAND, t- Silt.		
10	S-2	10-12	15"		2,3,2,3	**S-2** Yellow-brown, loose, f SAND, t- Silt.		
15	S-3	15-17	15"		2,3,5,5	**S-3** Yellow-brown, loose, f SAND, t- Silt.	OUTWASH SANDS	
20	S-4	20-22	17"		4,6,6,4	**S-4** Yellow-brown, med dense, f SAND, t- Silt.		
25	S-5	25-27	14"		2,2,2,2	**S-5** Yellow-brown, v loose, f SAND, t- Silt.		
30	S-6	30-32	18"		4,5,6,5	**S-6** Yellow-brown, med dense, f SAND, t- Silt.		
35								

MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Boring No. **B-1**	Sheet 2 of 2

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description	Stratigraphic Description	Materials Installed
	S-7	35-37	14"		7,3,12,12	**S-7** Top 5" - Yellow-brown, v loose, f SAND, t- Silt.		
						Bot 9" - Brown, med dense, f-m SAND, lit Cobbles.		
							OUTWASH SANDS	
40								
	S-8	40-42	14"		4,13,28,60 for 2"	**S-8** Top 8" - Brown, dense, f-m SAND, lit Gravel, t Silt.		
						Bot 6" - Red-brn, dense, f-m SAND, t+ Silt. Wet.		
						Refusal @ 42' - Bedrock/Groundwater		
45								
50								
55								
60								
65								
70								
75								
80								

Remarks:

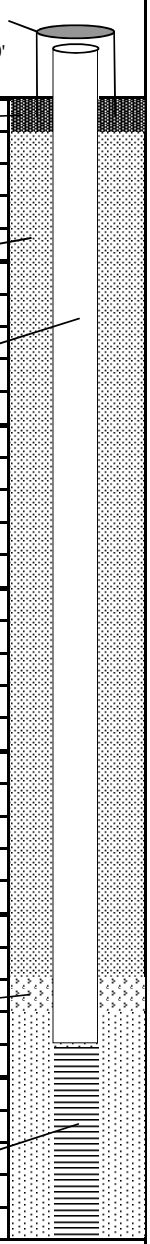
GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. **MW-1**	Sheet 1 of 2
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA	Begun: 4/16/19	Finished: 4/17/19	
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: 4/16 - Clear/windy. 4/17 - Clear.	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 4/16 - 40s. 4/17 - 60s.	4/22/2019	38.70 / TOC

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
								Stand Pipe TOC; Stickup = 2.99'
								Concrete
5								Native Soil
	S-1	5-7	17"		2,2,2,2	**S-1** Yellow-brown, v loose, f-m SAND, t Silt.		
								2" PVC Riser
10								
	S-2	10-12	14"		2,2,2,2	**S-2** Yellow-brown, v loose, f-m SAND, t- Silt.		
15								
	S-3	15-17	16"		3,3,4,4	**S-3** Yellow-brown, loose, f-m SAND, t- Silt.	OUTWASH SANDS	
20								
	S-4	20-22	16"		8,9,10,10	**S-4** Yellow-brown, med dense, f-m SAND, t- Silt.		
25								
	S-5	25-27	17"		8,44,51,43	**S-5** Top 8" - Yellow-brown, v dense, f-m SAND, t- Silt. Bot 9" - Tan, v dense, f-m SAND and GRAVEL, t Silt.		Bentonite
30								
	S-6	30-32	16"		48,61,39,34	**S-6** Yellow-brown, v dense, f-m SAND and GRAVEL, t Silt.		2" PVC 10-Slot Screen
35								



MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Boring No. **MW-1**	Sheet 2 of 2

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description	Stratigraphic Description	Materials Installed
	S-7	35-37	14"		12,11,13,21	**S-7** Brown, m dense, f-c SAND, lit Gravel, t Silt.		
								Filter Sand
40							OUTWASH SANDS	
	S-8	40-42	12"		5,21,8,10	**S-8** Brown, med dense, f-c SAND, t Gravel, t Silt.		
						Water was added to prevent running sands.		
45						End of Boring @ 44'		
						Well developed by driller.		
50								
55								
60								
65								
70								
75								
80								

Remarks:

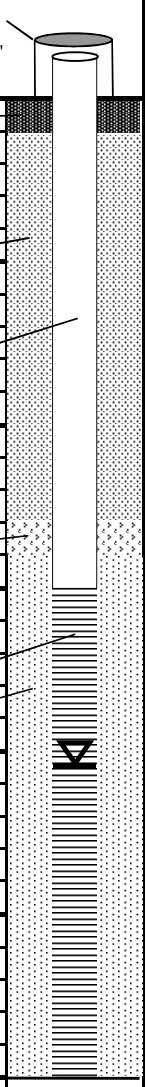
GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. MW-2	Sheet 1 of 1
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA	Begun: 4/17/19		
	Finished: 4/17/19		
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: Clear.	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 60s	4/22/2019	23.11 TOC

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
								Stand Pipe TOC
								Stickup = 2.65'
								Concrete
5								Native Soil
	S-1	5-7	21"		7,8,8,8	**S-1** Tan, med dense, f SAND, t- Silt.		
								2" PVC Riser
10								
	S-2	10-12	15"		4,4,5,6	**S-2** Tan, med dense, f SAND, t- Silt.		
								Bentonite
15								
	S-3	15-17	11"		25,12,9,10	**S-3** Tan, med dense, f SAND, t- Silt.	OUTWASH SANDS	2" PVC 10-Slot
								Screen
								Filter Sand
20								
	S-4	20-22	16"		5,7,9,10	**S-4** Tan, med dense, f SAND, t- Silt.		
25								
	S-5	25-27	24"		5,9,10,13	**S-5** Tan, med dense, f SAND, t- Silt.		
30						Water added to prevent running sands.		
						End of Boring @ 30'		
						Well developed by driller.		
35								



MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

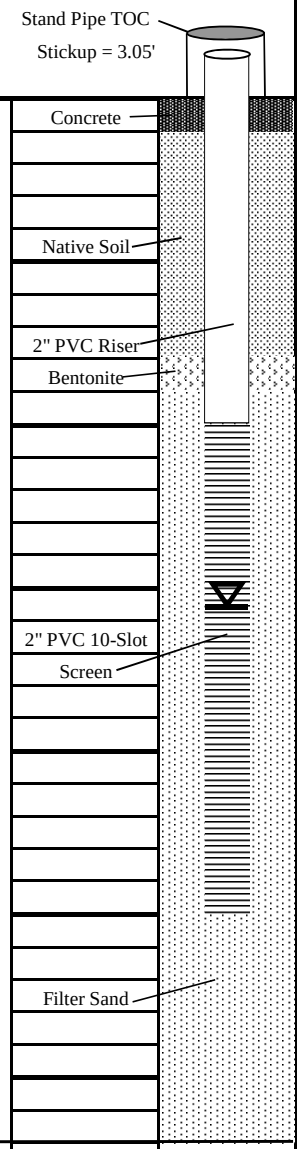
GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. **MW-3**	Sheet 1 of 1
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA M	Begun: 4/16/19	Finished: 4/16/19	
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: Clear/windy	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 40s	4/22/2019	18.65 TOC

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
5	S-1	5-7	18"		1,1,2,1	**S-1** Tan, v loose, f SAND, t- Silt.		
10	S-2	10-12	17"		1,2,1,2	**S-2** Tan, v loose, f SAND, t- Silt.		
15	S-3	15-17	14"		4,6,10,9	**S-3** Brown, med dense, f-c SAND, some Gravel, t- Silt.	OUTWASH SANDS	
20	S-4	20-22	17"		14,15,15,33	**S-4** Brown, med dense, f-c SAND and GRAVEL, t- Silt.		
25	S-5	25-27	18"		14,14,29,20	**S-5** Brown, dense, f-c SAND and GRAVEL, t- Silt.		
30	S-6	30-32	10"		2,4,5,15	**S-6** Brown, loose, f-c SAND and GRAVEL, t- Silt.		
						Water added to prevent running sands.		
						End of Boring @ 32'		
35						Well developed by driller.		



MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. **MW-4**	Sheet 1 of 1
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA	Begun: 4/18/19		
	Finished: 4/18/19		
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: Rain/sleet.	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 40s	4/22/2019	21.86 TOC

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
								Stand Pipe TOC
								Stickup = 3.29'
								Concrete
5								Native Soil
	S-1	5-7	12"		4,9,8,7	**S-1** Tan-brown, med dense, f-m SAND, lit Gravel, t- Silt.		
								2" PVC Riser
10								
	S-2	10-12	0"		8,11,11,10	**S-2** No sample.	OUTWASH SANDS	
								Bentonite
15								
	S-3	15-17	12"		5,17,19,48	**S-3** Top 4" - Brown, f-m SAND, t Gravel, t Silt.		
						Bot 8" - Grey, f-c SAND, lit Gravel, t Silt.		2" PVC 10-Slot Screen
20								
	S-4	20-22	8"		10,14,14,17	**S-4** Brown, med dense, f-c SAND, lit Gravel, t+ Silt.		Filter Sand
25								
	S-5	25-27	19"		6,6,3,4	**S-5** Brown, loose, f-c Sand, t Gravel, t Silt.		
30						Water added to prevent runing sands.		
						End of Boring @ 30'.		
						Well developed by driller.		
35								

MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

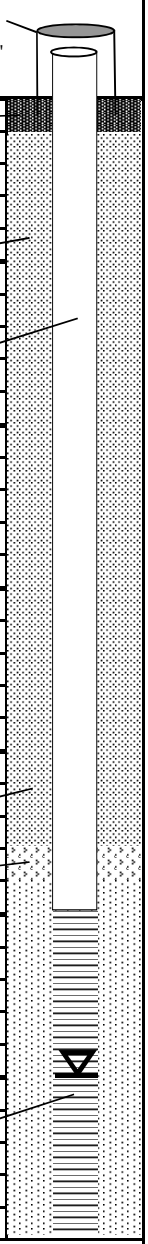
GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. **MW-5**	Sheet 1 of 2
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA	Begun: 4/18/19	Finished: 4/18/19	
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: Rain/sleet.	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 40s	4/22/2019	32.59 TOC

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
								Stand Pipe TOC
								Stickup = 2.60'
								Concrete
5								Native Soil
	S-1	5-7	18"		2,1,2,2	**S-1** Tan, v loose, f SAND, t- Silt.		
								2" PVC Riser
10								
	S-2	10-12	14"		2,1,2,2	**S-2** Tan, v loose, f SAND, t- Silt.		
15								
	S-3	15-17	18"		8,16,20,20	**S-3** Tan-brown, dense, f-m SAND, t- Silt.	OUTWASH SANDS	
20								
	S-4	20-22	14"		5,5,5,6	**S-4** Top 4" - Tan, loose, f SAND, t- Silt.		
						Bot 10" - Tan, loose, f-m SAND, t- Silt.		Native Soil
								Benonite
25								
	S-5	25-27	15"		4,5,6,6	**S-5** Tan, med dense, f-m SAND, t- Silt.		
30								
	S-6	30-32	14"		3,5,7,6	**S-6** Brown, med dense, f SAND, t- Silt.		2" PVC 10-Slot Screen
35								



MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Boring No. **MW-5**	Sheet 2 of 2

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description	Stratigraphic Description	Materials Installed
	S-7	35-37	24"		5,5,6,15	**S-7** Brown, med dense, f-c SAND, t Silt.		
								Filter Sand
							OUTWASH SANDS	
40						Added water to prevent running sands.		
						End of Boring @ 40'		
						Well developed by driller.		
45								
50								
55								
60								
65								
70								
75								
80								

Remarks:

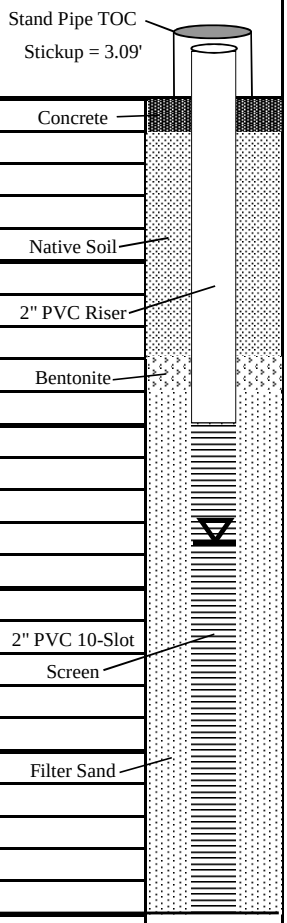
GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. **MW-6**	Sheet 1 of 1
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA	Begun: 4/17/19		
	Finished: 4/17/19		
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: Clear	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 60s	4/22/2019	16.76 TOC

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
5	S-1	5-7	15"		3,4,2,3	**S-1** Tan, loose, f-m SAND, t- Silt.	OUTWASH SANDS	Concrete; Native Soil; 2" PVC Riser; Bentonite
10	S-2	10-12	14"		1,2,2,5	**S-2** Tan-brown, loose, f-m SAND, t- Silt.		
15	S-3	15-17	24"		4,6,7,7	**S-3** Brown, med dense, f-m SAND, t- Silt.		2" PVC 10-Slot Screen
20	S-4	20-22	24"		6,3,14,16	**S-4** Brown, med dense, f-m SAND, t- Silt.		Filter Sand
25						Added water to prevent running sands.		
						End of Boring @ 25'		
						Well developed by driller.		
30								
35								



MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

Well Driller

Please specify work performed:
New Well

Please specify well type:
Monitoring

Number Of Wells:
1

Well Location

In public right-of-way:
○ Yes ◉ No

Subdivision/Property/Description:

Property Owner:
QUARRY NORTH ROAD LLC

Engineering Firm:

Address at well location:
Street Number: Street Name:
10 NORTH RD
Building Lot#: Assessor's Map #:

Assessor's Lot#: ZIP Code:

City/Town:
SUDBURY

GPS (GPS for the deepest well)
North: West:
42.41948 71.38411

Mailing Address:
☐ click here if same as well location address
Street Number: Street Name:
2134 SEVILLA WAY
City/Town: State:
NAPLES FLORIDA
ZIP Code:

Board of health permit obtained:
○ Yes ◉ Not Required
Permit Number: Date Issued:

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Well Driller Program
Well Completion Reports(Monitoring)

Well Driller - Monitoring Form

DRILLING METHOD

Overburden Auger **Bedrock** -- Choose Bedrock --

WELL LOG OVERBURDEN LITHOLOGY

From(ft)	To(ft)	Code	Color	Comment	Drop in drill stem	Extra fast or slow drill rate	Loss or addition of fluid
0	10	Sand And Gravel	Brown		YES NO	Fast Slow	Loss Addition
10	25	Silty Sand And Gra	Brown		YES NO	Fast Slow	Loss Addition
25	45	Silty Sand	Reddish Brown		YES NO	Fast Slow	Loss Addition
45	65	Sand And Gravel	Reddish Brown		YES NO	Fast Slow	Loss Addition

PERMIT INFORMATION

DEP 21E RTN # DEP Groundwater Discharge #

ADDITIONAL WELL INFORMATION

Developed Yes No Are these wells nested? Yes No
Surface Seal Type Concrete Area of group (sq. ft)
Total Well Depth 65 Depth to Bedrock

CASING

Is Casing above ground? From:3To:0

From	To	Type	Thickness	Diameter
0	50	Polyvinyl Chloride	Schedule 40	2

SCREEN No Screen

From">	To	Type	Slot Size	Diameter
50	65	Slotted PVC	0.01	2

WATER-BEARING ZONES

From	To	Yield (gpm)
55	65	

ANNULAR SEAL / FILTER PACK

From	To	Material 1">	Weight	Material 2	Weight	Water (gal)	Batches	Method Of Placement
48	65	Sand		--- Choose Material ---				Gravity
46	48	Bentonite Chips/Pellets		--- Choose Material ---				Gravity
0	46	Native Material		--- Choose Material ---				Gravity

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Well Driller Program
Well Completion Reports(Monitoring)

WATER LEVEL

Date Measured	Static Depth BGS (ft)	Flowing Rate (gpm)
07/02/2019	55	

COMMENTS

WELL DRILLERS STATEMENT

This well was drilled or altered under my direct supervision, according to the applicable rules and regulations, and this report is complete and accurate to the best of my knowledge.

Driller	JAMES HASTINGS	Registration #	956	Monitoring [M]	Supervising Driller Signature	BROCK, BRAD,
Firm	DRILEX ENVIRONMENTAL	Rig Permit #	253		Date Job Complete	07/02/2019

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

Enclosure 4 - Hydraulic Conductivity

Statistics for Hydrauic Conductvity Values

K (ft/day)	Ln K	Function
92.2	4.52396	=LN(A6)
65.6	4.18358	
44.7	3.79997	
65.6	4.18358	
84.9	4.44147	
46.7	3.84374	
57.6	4.05352	
52.1	3.95316	
60.1	4.09601	
120.0	4.78749	
73.4	4.29592	
134.0	4.89784	
29.8	3.39451	
21.3	3.05871	
84.1	4.43201	
122.0	4.80402	
102.0	4.62497	
70.3	4.25277	
64.7	4.16976	
43.8	3.77963	
86.4	4.45899	
61.1	4.11251	
241.0	5.48480	
159.0	5.06890	
97.1	4.57574	
91.9	4.52070	
121.0	4.79579	
85.3	4.44617	
70.5	4.25561	
90.1	4.50092	
174.0	5.15906	
132.0	4.88280	
72.0	4.27667	
59.7	4.08933	
189.0	5.24175	
76.9	4.34251	
79.6	4.37701	
73.6	4.29865	
46.1	3.83081	
63.3	4.14789	
124.0	4.82028	
152.0	5.02388	
145.0	4.97673	
155.0	5.04343	
128.0	4.85203	
168.0	5.12396	
67.7	4.21509	
61.2	4.11415	
94.0	4.54329	
57.2	4.04655	
98.6	4.59107	
92.6	4.52829	
44.1	3.78646	
55.1	4.00915	
121.0	4.79579	

98.1	4.58599
61.7	4.12228
86.2	4.45667
83.3	4.42245
86.2	4.45667
44.8	3.80221
60.7	4.10594
148.0	4.99721
132.0	4.88280
60.7	4.10594
81.4	4.39938

4.41289	Average	Mean of LNs = Geomean	82.5
4.42723	Median	Median of LNs	83.7
0.45288	Stnd Deviation	Std Dev of Geomean = s	1.6
66	Count	Number of K Values	
4.11292	1st quartile		61.1
4.42723	2nd quartile		83.7
4.79372	3rd quartile		120.7

Confidence Interval for Geomean

66	Count
8.12	Sq Root of Count
1.997	Student's t for 95% Confidence and N-1 Degrees of Freedom
82.5	Mid value of interval, which is Geometric Mean
92.2	High end of the 95% interval
73.8	Low end of the 95% interval

Does the Geometric Mean lie between the Low and High intervals?

Low: **Yes**

High: **Yes**

Check for Outliers

5.48480	Max of LNs	
0.61903	LN of T statistic for Highest K value	
1.86	T statistic for the Highest K value	
3.05871	Min of LNs	
0.90131	LN of T statistic for Lowest K value	
2.46	T statistic for the Lowest K value	
2.96	From Figure 2 for N-1 DoF	
241	ft/day	**OK, not an outlier**
21.3	ft/day	**OK, not an outlier**

Calculate 95% Percentile Value of K

5.11020	LN of 95% Percentile Value of K
165.7	95% Percentile Value of K

Calculate Coefficient of Variation C_v

-3.96002	LN of Cv
0.02	Coefficeint of Variation Cv

BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

==========

Quarry North Road
MW-1-1
GeoHydroCycle, Inc.

Results

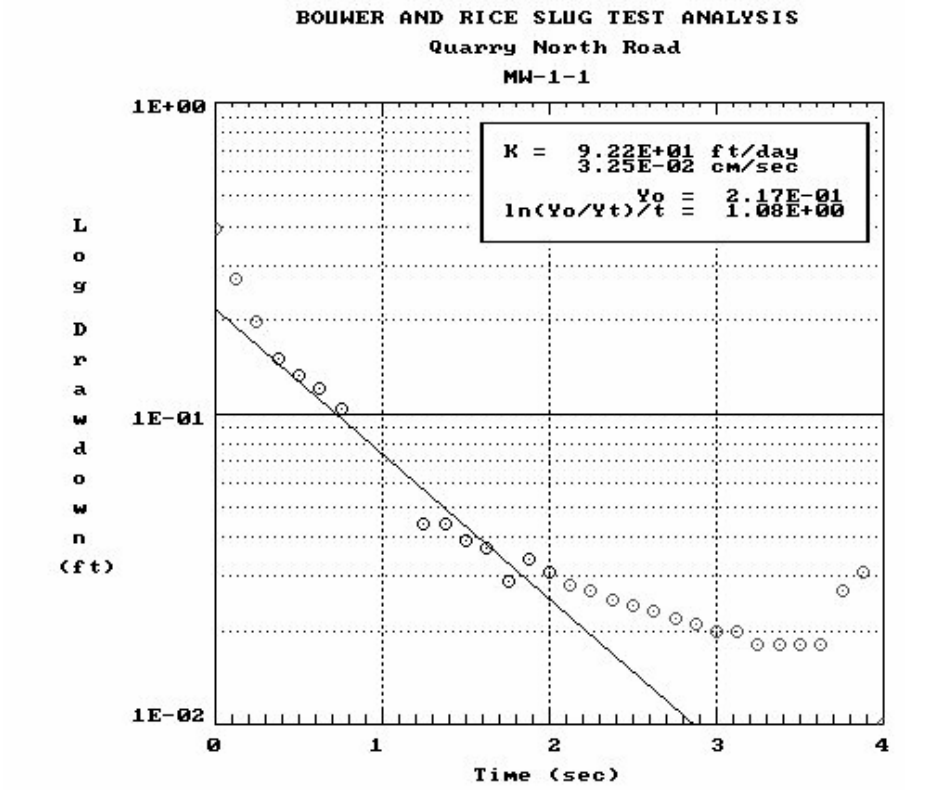
Hydraulic Conductivity: 9.22E+01 ft/day
3.25E-02 cm/sec
Y-Intercept (Yo): 2.17E-01 ft
Well Screen Ratio (Le/rw): 23.2
Dimensionless Parameter C: 1.83
Slope of Line [ln(Yo/Yt)/t]: 1.077E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 4.251E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.331
Effective Radius [Re]: 3.64 ft
Volume Tested [rw<Vol<Re]: 3.38E+02 ft^3

Well/Aquifer Parameters

Depth of well: 8.20 ft
Length of well screen: 8.20 ft
Saturated thickness: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.392	2	0.1250	0.272	3	0.2500	0.197
4	0.3750	0.149	5	0.5000	0.133	6	0.6250	0.120
7	0.7500	0.104	8	1.2500	0.044	9	1.3750	0.044
10	1.5000	0.039	11	1.6250	0.037	12	1.7500	0.029
13	1.8750	0.034	14	2.0000	0.031	15	2.1250	0.028
16	2.2500	0.027	17	2.3750	0.025	18	2.5000	0.024
19	2.6250	0.023	20	2.7500	0.022	21	2.8750	0.021
22	3.0000	0.020	23	3.1250	0.020	24	3.2500	0.018
25	3.3750	0.018	26	3.5000	0.018	27	3.6250	0.018
28	3.7500	0.027	29	3.8750	0.031	30	4.0000	0.010



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
mw-1-2
GeoHydroCycle, Inc.

Results

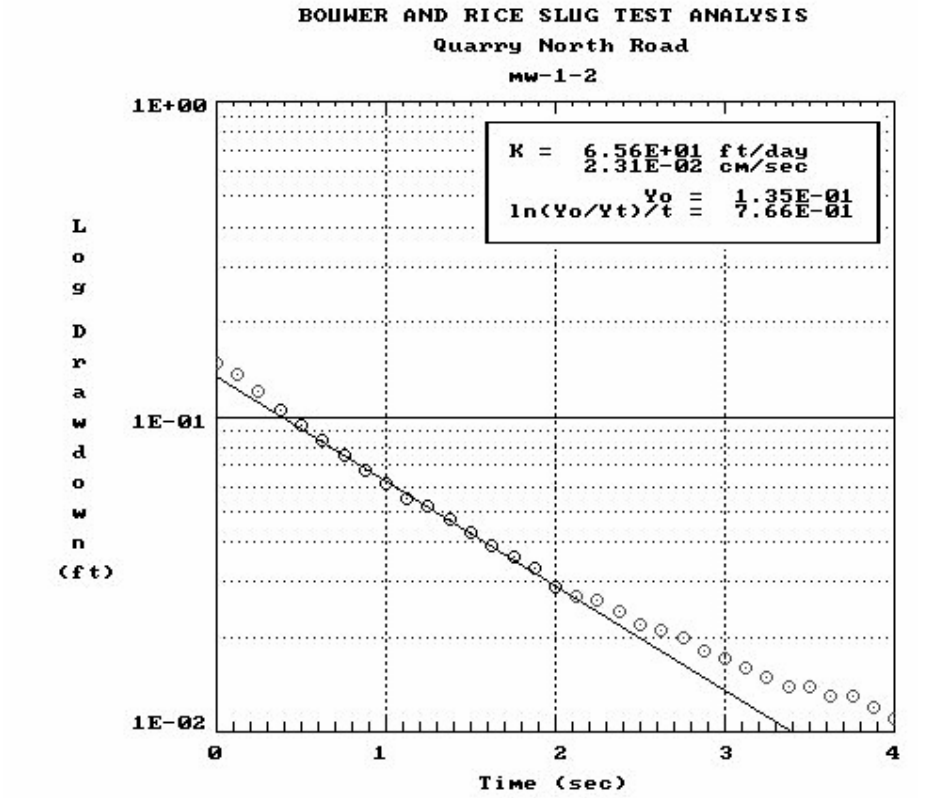
Hydraulic Conductivity: 6.56E+01 ft/day
2.31E-02 cm/sec
Y-Intercept (Yo): 1.35E-01 ft
Well Screen Ratio (Le/rw): 23.2
Dimensionless Parameter C: 1.83
Slope of Line [ln(Yo/Yt)/t]: 7.661E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 4.251E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.331
Effective Radius [Re]: 3.64 ft
Volume Tested [rw<Vol<Re]: 3.38E+02 ft^3

Well/Aquifer Parameters

Depth of well: 8.20 ft
Length of well screen: 8.20 ft
Saturated thickness: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.148	2	0.1250	0.137	3	0.2500	0.120
4	0.3750	0.105	5	0.5000	0.094	6	0.6250	0.084
7	0.7500	0.075	8	0.8750	0.068	9	1.0000	0.061
10	1.1250	0.055	11	1.2500	0.052	12	1.3750	0.047
13	1.5000	0.043	14	1.6250	0.039	15	1.7500	0.036
16	1.8750	0.033	17	2.0000	0.029	18	2.1250	0.027
19	2.2500	0.026	20	2.3750	0.024	21	2.5000	0.022
22	2.6250	0.021	23	2.7500	0.020	24	2.8750	0.018
25	3.0000	0.017	26	3.1250	0.016	27	3.2500	0.015
28	3.3750	0.014	29	3.5000	0.014	30	3.6250	0.013
31	3.7500	0.013	32	3.8750	0.012	33	4.0000	0.011



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-1-3
GeoHydroCycle, Inc.

Results

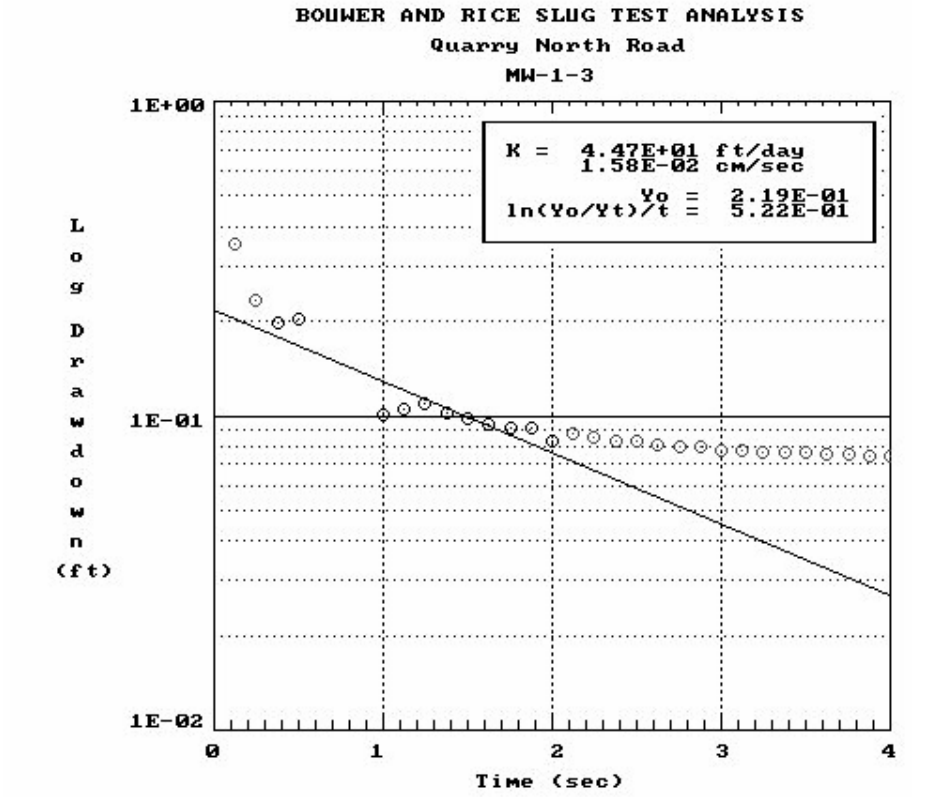
Hydraulic Conductivity: 4.47E+01 ft/day
1.58E-02 cm/sec
Y-Intercept (Yo): 2.19E-01 ft
Well Screen Ratio (Le/rw): 23.2
Dimensionless Parameter C: 1.83
Slope of Line [ln(Yo/Yt)/t]: 5.220E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 4.251E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.331
Effective Radius [Re]: 3.64 ft
Volume Tested [rw<Vol<Re]: 3.38E+02 ft^3

Well/Aquifer Parameters

Depth of well: 8.20 ft
Length of well screen: 8.20 ft
Saturated thickness: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.1250	0.354	2	0.2500	0.233	3	0.3750	0.197
4	0.5000	0.202	5	1.0000	0.101	6	1.1250	0.105
7	1.2500	0.109	8	1.3750	0.102	9	1.5000	0.098
10	1.6250	0.094	11	1.7500	0.092	12	1.8750	0.091
13	2.0000	0.083	14	2.1250	0.088	15	2.2500	0.085
16	2.3750	0.083	17	2.5000	0.083	18	2.6250	0.081
19	2.7500	0.080	20	2.8750	0.080	21	3.0000	0.078
22	3.1250	0.078	23	3.2500	0.077	24	3.2500	0.077
25	3.3750	0.076	26	3.3750	0.076	27	3.5000	0.076
28	3.5000	0.076	29	3.6250	0.075	30	3.7500	0.075
31	3.8750	0.074	32	4.0000	0.074	33	4.0000	0.011



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-1-4
GeoHydroCycle, Inc.

Results

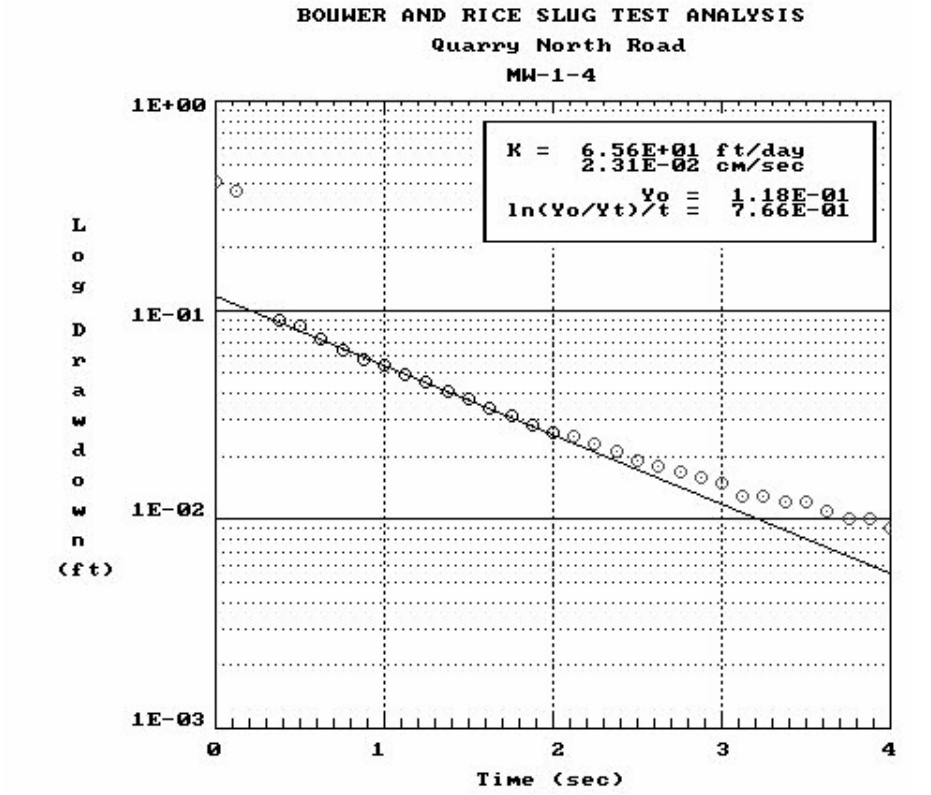
Hydraulic Conductivity: 6.56E+01 ft/day
2.31E-02 cm/sec
Y-Intercept (Yo): 1.18E-01 ft
Well Screen Ratio (Le/rw): 23.2
Dimensionless Parameter C: 1.83
Slope of Line [ln(Yo/Yt)/t]: 7.658E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 4.251E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.331
Effective Radius [Re]: 3.64 ft
Volume Tested [rw<Vol<Re]: 3.38E+02 ft^3

Well/Aquifer Parameters

Depth of well: 8.20 ft
Length of well screen: 8.20 ft
Saturated thickness: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.411	2	0.1250	0.371	3	0.3750	0.090
4	0.5000	0.084	5	0.6250	0.073	6	0.7500	0.065
7	0.8750	0.058	8	1.0000	0.055	9	1.1250	0.049
10	1.2500	0.045	11	1.3750	0.041	12	1.5000	0.038
13	1.6250	0.034	14	1.7500	0.031	15	1.8750	0.028
16	2.0000	0.026	17	2.1250	0.025	18	2.2500	0.023
19	2.3750	0.021	20	2.5000	0.019	21	2.6250	0.018
22	2.7500	0.017	23	2.8750	0.016	24	3.0000	0.015
25	3.1250	0.013	26	3.2500	0.013	27	3.3750	0.012
28	3.5000	0.012	29	3.6250	0.011	30	3.7500	0.010
31	3.8750	0.010	32	4.0000	0.009	33	4.0000	0.011



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-2-1
GeoHydroCycle, Inc.

Results

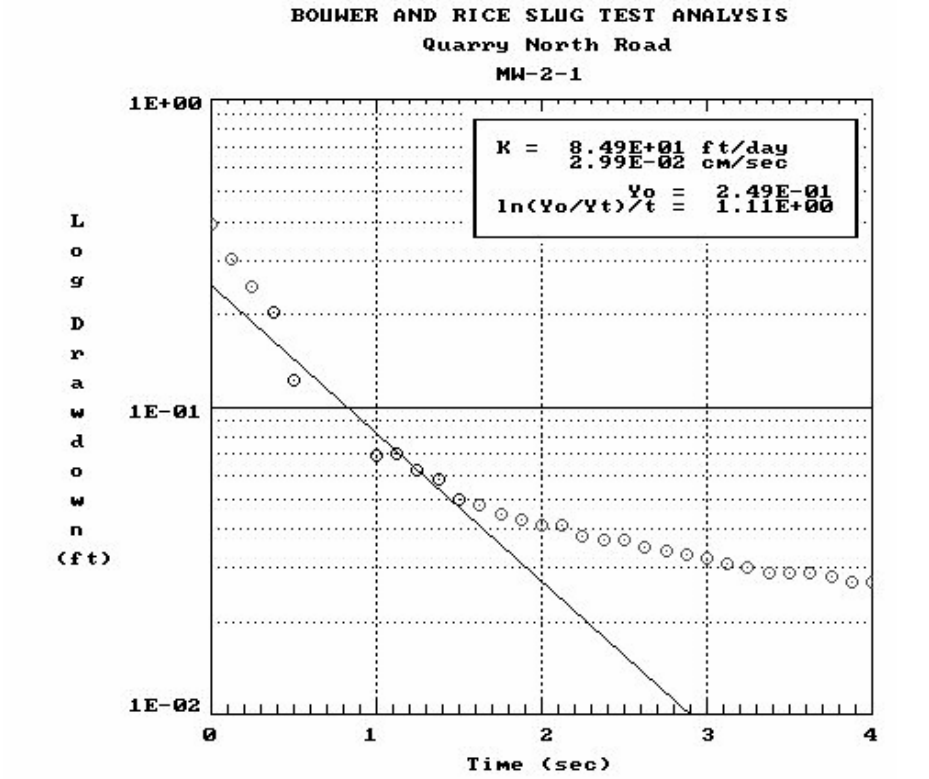
Hydraulic Conductivity: 8.49E+01 ft/day
2.99E-02 cm/sec
Y-Intercept (Yo): 2.49E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 1.110E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.392	2	0.1250	0.304	3	0.2500	0.247
4	0.3750	0.203	5	0.5000	0.122	6	1.0000	0.069
7	1.1250	0.070	8	1.2500	0.062	9	1.3750	0.058
10	1.5000	0.050	11	1.6250	0.048	12	1.7500	0.045
13	1.8750	0.043	14	2.0000	0.041	15	2.1250	0.041
16	2.2500	0.038	17	2.3750	0.037	18	2.5000	0.037
19	2.6250	0.035	20	2.7500	0.034	21	2.8750	0.033
22	3.0000	0.032	23	3.1250	0.031	24	3.2500	0.030
25	3.3750	0.029	26	3.5000	0.029	27	3.6250	0.029
28	3.7500	0.028	29	3.8750	0.027	30	4.0000	0.027



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-2-2
GeoHydroCycle, Inc.

Results

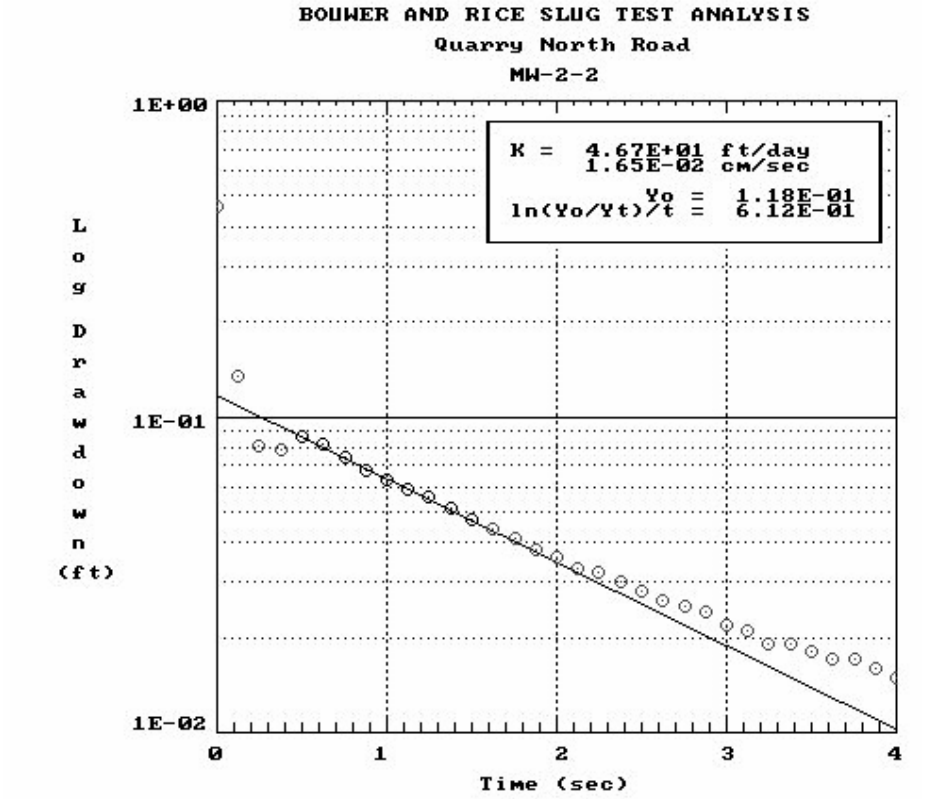
Hydraulic Conductivity: 4.67E+01 ft/day
1.65E-02 cm/sec
Y-Intercept (Yo): 1.18E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 6.116E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.460	2	0.1250	0.134	3	0.2500	0.081
4	0.3750	0.079	5	0.5000	0.087	6	0.6250	0.082
7	0.7500	0.074	8	0.8750	0.068	9	1.0000	0.063
10	1.1250	0.059	11	1.2500	0.056	12	1.3750	0.051
13	1.5000	0.047	14	1.6250	0.044	15	1.7500	0.041
16	1.8750	0.038	17	2.0000	0.036	18	2.1250	0.033
19	2.2500	0.032	20	2.3750	0.030	21	2.5000	0.028
22	2.6250	0.026	23	2.7500	0.025	24	2.8750	0.024
25	3.0000	0.022	26	3.1250	0.021	27	3.2500	0.019
28	3.3750	0.019	29	3.5000	0.018	30	3.6250	0.017
31	3.7500	0.017	32	3.8750	0.016	33	4.0000	0.015



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-2-3
GeoHydroCycle, Inc.

Results

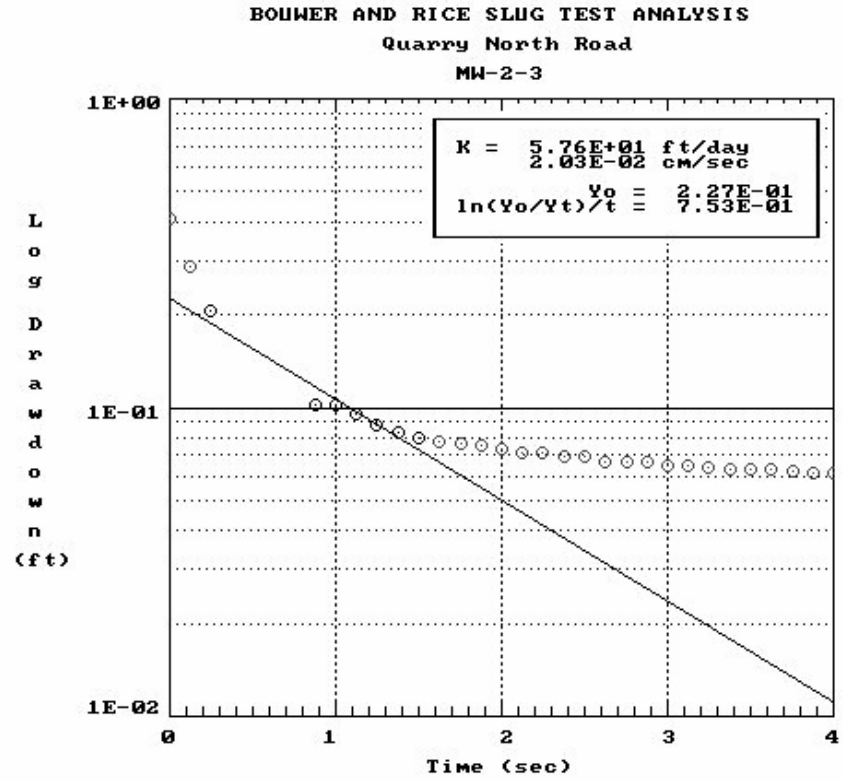
Hydraulic Conductivity: 5.76E+01 ft/day
2.03E-02 cm/sec
Y-Intercept (Yo): 2.27E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 7.534E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.408	2	0.1250	0.288	3	0.2500	0.206
4	0.8750	0.102	5	1.0000	0.102	6	1.1250	0.095
7	1.2500	0.088	8	1.3750	0.083	9	1.5000	0.080
10	1.6250	0.078	11	1.7500	0.076	12	1.8750	0.075
13	2.0000	0.073	14	2.1250	0.071	15	2.2500	0.071
16	2.3750	0.069	17	2.5000	0.069	18	2.6250	0.067
19	2.7500	0.067	20	2.8750	0.067	21	3.0000	0.065
22	3.1250	0.065	23	3.2500	0.064	24	3.3750	0.063
25	3.5000	0.063	26	3.6250	0.063	27	3.7500	0.062
28	3.8750	0.061	29	4.0000	0.061	30	3.6250	0.017



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-2-4
GeoHydroCycle, Inc.

Results

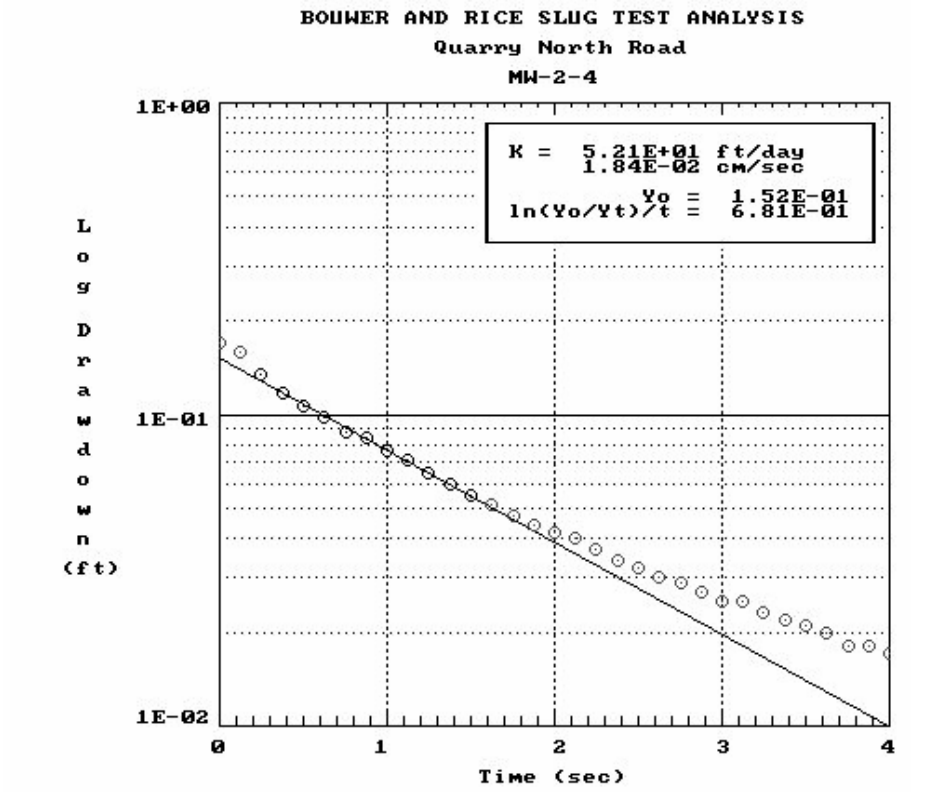
Hydraulic Conductivity: 5.21E+01 ft/day
1.84E-02 cm/sec
Y-Intercept (Yo): 1.52E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 6.814E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.170	2	0.1250	0.159	3	0.2500	0.134
4	0.3750	0.117	5	0.5000	0.106	6	0.6250	0.098
7	0.7500	0.088	8	0.8750	0.084	9	1.0000	0.077
10	1.1250	0.071	11	1.2500	0.065	12	1.3750	0.060
13	1.5000	0.055	14	1.6250	0.051	15	1.7500	0.047
16	1.8750	0.044	17	2.0000	0.042	18	2.1250	0.040
19	2.2500	0.037	20	2.3750	0.034	21	2.5000	0.032
22	2.6250	0.030	23	2.7500	0.029	24	2.8750	0.027
25	3.0000	0.025	26	3.1250	0.025	27	3.2500	0.023
28	3.3750	0.022	29	3.5000	0.021	30	3.6250	0.020
31	3.7500	0.018	32	3.8750	0.018	33	4.0000	0.017



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

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Quarry North Road
MW-3-1
GeoHydroCycle, Inc.

Results

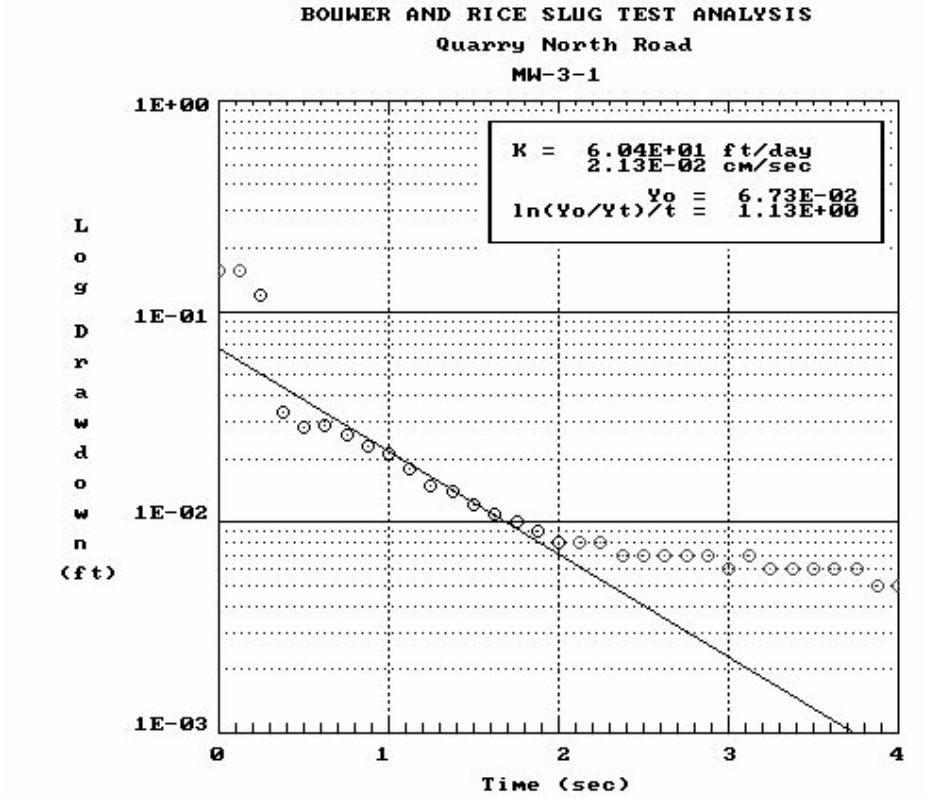
Hydraulic Conductivity: 6.04E+01 ft/day
2.13E-02 cm/sec
Y-Intercept (Yo): 6.73E-02 ft
Well Screen Ratio (Le/rw): 46.0
Dimensionless Parameter C: 2.65
Slope of Line [ln(Yo/Yt)/t]: 1.126E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 2.139E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.900
Effective Radius [Re]: 6.43 ft
Volume Tested [rw<Vol<Re]: 2.11E+03 ft^3

Well/Aquifer Parameters

Depth of well: 16.30 ft
Length of well screen: 16.30 ft
Saturated thickness: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.156	2	0.1250	0.155	3	0.2500	0.120
4	0.3750	0.033	5	0.5000	0.028	6	0.6250	0.029
7	0.7500	0.026	8	0.8750	0.023	9	1.0000	0.021
10	1.1250	0.018	11	1.2500	0.015	12	1.3750	0.014
13	1.5000	0.012	14	1.6250	0.011	15	1.7500	0.010
16	1.8750	0.009	17	2.0000	0.008	18	2.1250	0.008
19	2.2500	0.008	20	2.3750	0.007	21	2.5000	0.007
22	2.6250	0.007	23	2.7500	0.007	24	2.8750	0.007
25	3.0000	0.006	26	3.1250	0.007	27	3.2500	0.006
28	3.3750	0.006	29	3.5000	0.006	30	3.6250	0.006
31	3.7500	0.006	32	3.8750	0.005	33	4.0000	0.005



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-3-2
GeoHydroCycle, Inc.

Results

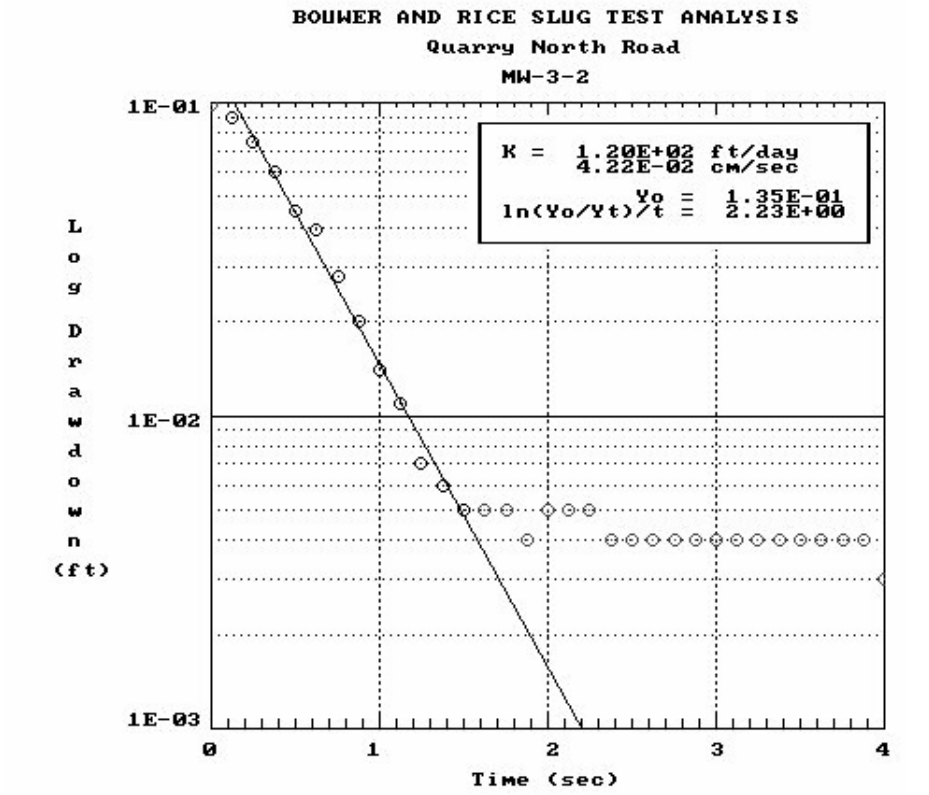
Hydraulic Conductivity: 1.20E+02 ft/day
4.22E-02 cm/sec
Y-Intercept (Yo): 1.35E-01 ft
Well Screen Ratio (Le/rw): 46.0
Dimensionless Parameter C: 2.65
Slope of Line [ln(Yo/Yt)/t]: 2.235E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 2.139E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.900
Effective Radius [Re]: 6.43 ft
Volume Tested [rw<Vol<Re]: 2.11E+03 ft^3

Well/Aquifer Parameters

Depth of well: 16.30 ft
Length of well screen: 16.30 ft
Saturated thickness: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.098	2	0.1250	0.089	3	0.2500	0.075
4	0.3750	0.060	5	0.5000	0.045	6	0.6250	0.039
7	0.7500	0.028	8	0.8750	0.020	9	1.0000	0.014
10	1.1250	0.011	11	1.2500	0.007	12	1.3750	0.006
13	1.5000	0.005	14	1.6250	0.005	15	1.7500	0.005
16	1.8750	0.004	17	2.0000	0.005	18	2.1250	0.005
19	2.2500	0.005	20	2.3750	0.004	21	2.5000	0.004
22	2.6250	0.004	23	2.7500	0.004	24	2.8750	0.004
25	3.0000	0.004	26	3.1250	0.004	27	3.2500	0.004
28	3.3750	0.004	29	3.5000	0.004	30	3.6250	0.004
31	3.7500	0.004	32	3.8750	0.004	33	4.0000	0.003



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-3-3
GeoHydroCycle, Inc.

Results

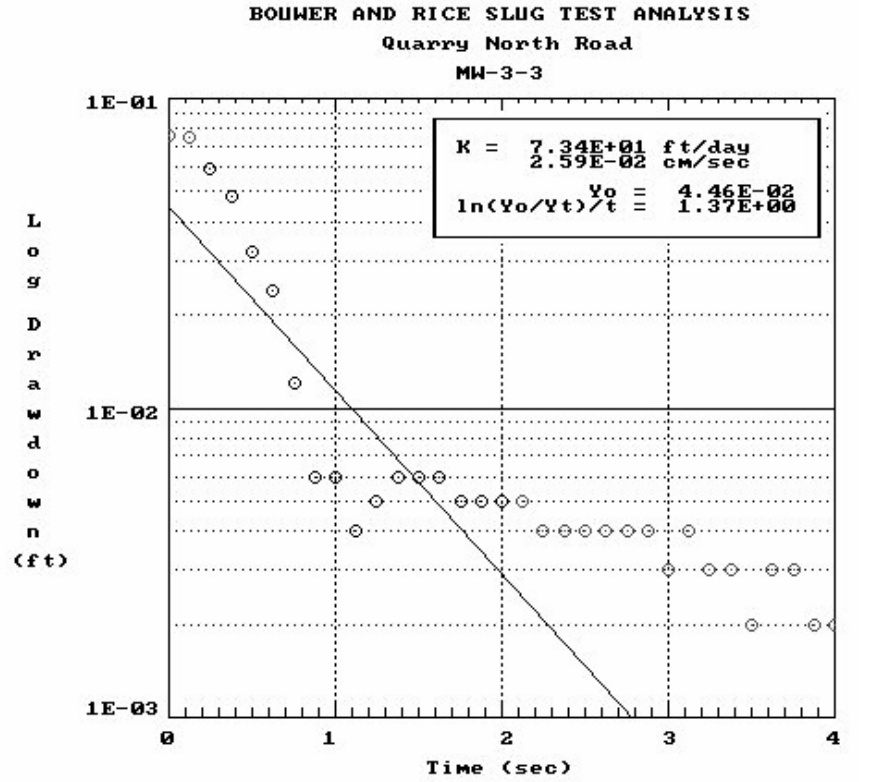
Hydraulic Conductivity: 7.34E+01 ft/day
2.59E-02 cm/sec
Y-Intercept (Yo): 4.46E-02 ft
Well Screen Ratio (Le/rw): 46.0
Dimensionless Parameter C: 2.65
Slope of Line [ln(Yo/Yt)/t]: 1.370E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 2.139E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.900
Effective Radius [Re]: 6.43 ft
Volume Tested [rw<Vol<Re]: 2.11E+03 ft^3

Well/Aquifer Parameters

Depth of well: 16.30 ft
Length of well screen: 16.30 ft
Saturated thickness: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.076	2	0.1250	0.075	3	0.2500	0.059
4	0.3750	0.048	5	0.5000	0.032	6	0.6250	0.024
7	0.7500	0.012	8	0.8750	0.006	9	1.0000	0.006
10	1.1250	0.004	11	1.2500	0.005	12	1.3750	0.006
13	1.5000	0.006	14	1.6250	0.006	15	1.7500	0.005
16	1.8750	0.005	17	2.0000	0.005	18	2.1250	0.005
19	2.2500	0.004	20	2.3750	0.004	21	2.5000	0.004
22	2.6250	0.004	23	2.7500	0.004	24	2.8750	0.004
25	3.0000	0.003	26	3.1250	0.004	27	3.2500	0.003
28	3.3750	0.003	29	3.5000	0.002	30	3.6250	0.003
31	3.7500	0.003	32	3.8750	0.002	33	4.0000	0.002



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-3-4
GeoHydroCycle, Inc.

Results

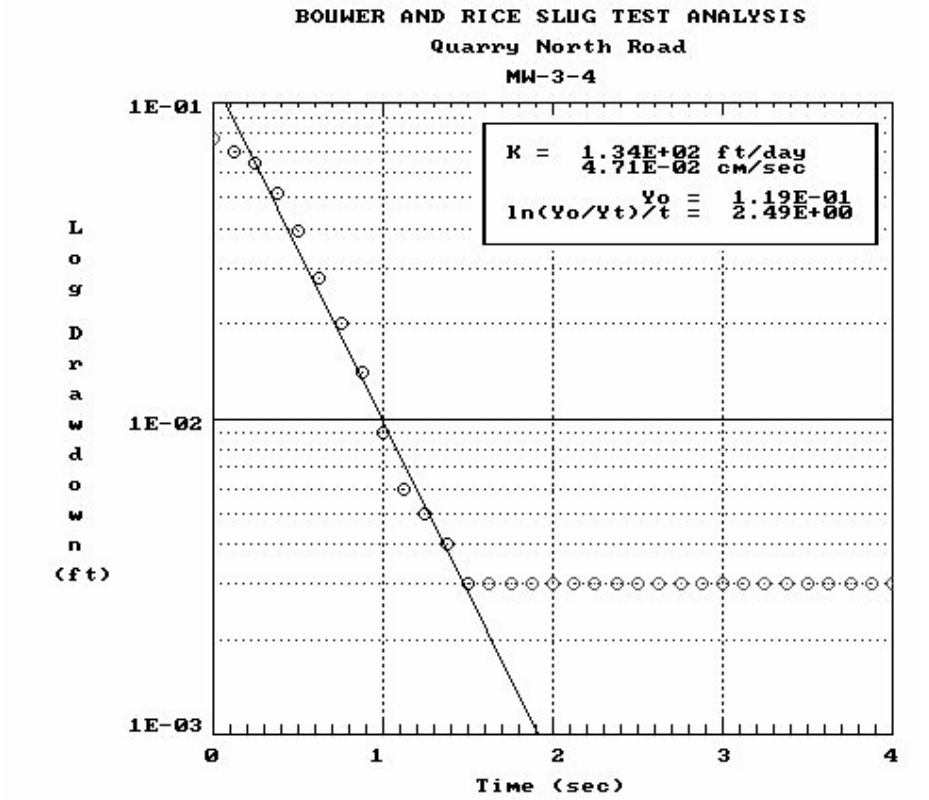
Hydraulic Conductivity: 1.34E+02 ft/day
4.71E-02 cm/sec
Y-Intercept (Yo): 1.19E-01 ft
Well Screen Ratio (Le/rw): 46.0
Dimensionless Parameter C: 2.65
Slope of Line [ln(Yo/Yt)/t]: 2.493E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 2.139E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.900
Effective Radius [Re]: 6.43 ft
Volume Tested [rw<Vol<Re]: 2.11E+03 ft^3

Well/Aquifer Parameters

Depth of well: 16.30 ft
Length of well screen: 16.30 ft
Saturated thickness: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.077	2	0.1250	0.070	3	0.2500	0.064
4	0.3750	0.052	5	0.5000	0.039	6	0.6250	0.028
7	0.7500	0.020	8	0.8750	0.014	9	1.0000	0.009
10	1.1250	0.006	11	1.2500	0.005	12	1.3750	0.004
13	1.5000	0.003	14	1.6250	0.003	15	1.7500	0.003
16	1.8750	0.003	17	2.0000	0.003	18	2.1250	0.003
19	2.2500	0.003	20	2.3750	0.003	21	2.5000	0.003
22	2.6250	0.003	23	2.7500	0.003	24	2.8750	0.003
25	3.0000	0.003	26	3.1250	0.003	27	3.2500	0.003
28	3.3750	0.003	29	3.5000	0.003	30	3.6250	0.003
31	3.7500	0.003	32	3.8750	0.003	33	4.0000	0.003



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-4-1
GeoHydroCycle, Inc.

Results

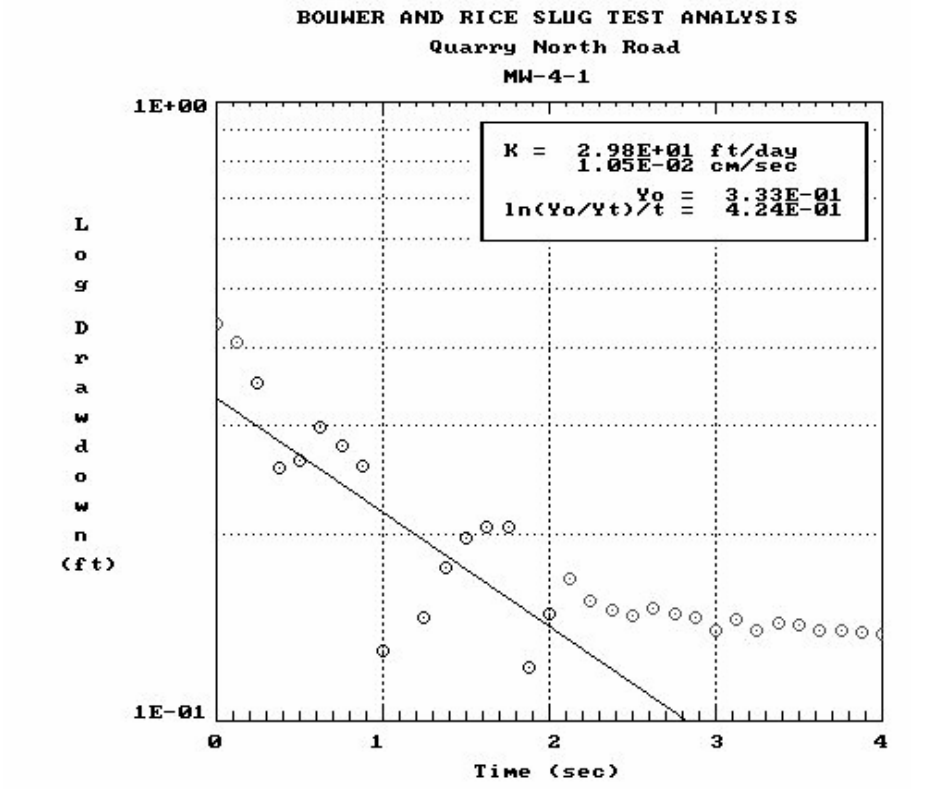
Hydraulic Conductivity: 2.98E+01 ft/day
1.05E-02 cm/sec
Y-Intercept (Yo): 3.33E-01 ft
Well Screen Ratio (Le/rw): 31.4
Dimensionless Parameter C: 2.11
Slope of Line [ln(Yo/Yt)/t]: 4.242E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.169E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.586
Effective Radius [Re]: 4.70 ft
Volume Tested [rw<Vol<Re]: 7.60E+02 ft^3

Well/Aquifer Parameters

Depth of well: 11.10 ft
Length of well screen: 11.00 ft
Saturated thickness: 11.10 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.439	2	0.1250	0.409	3	0.2500	0.352
4	0.3750	0.257	5	0.5000	0.263	6	0.6250	0.298
7	0.7500	0.279	8	0.8750	0.258	9	1.0000	0.130
10	1.2500	0.147	11	1.3750	0.177	12	1.5000	0.198
13	1.6250	0.206	14	1.7500	0.206	15	1.8750	0.122
16	2.0000	0.149	17	2.1250	0.170	18	2.2500	0.156
19	2.3750	0.151	20	2.5000	0.148	21	2.6250	0.152
22	2.7500	0.149	23	2.8750	0.147	24	3.0000	0.140
25	3.1250	0.146	26	3.2500	0.140	27	3.3750	0.144
28	3.5000	0.143	29	3.6250	0.140	30	3.7500	0.140
31	3.8750	0.139	32	4.0000	0.138	33	4.0000	0.003



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-4-3
GeoHydroCycle, Inc.

Results

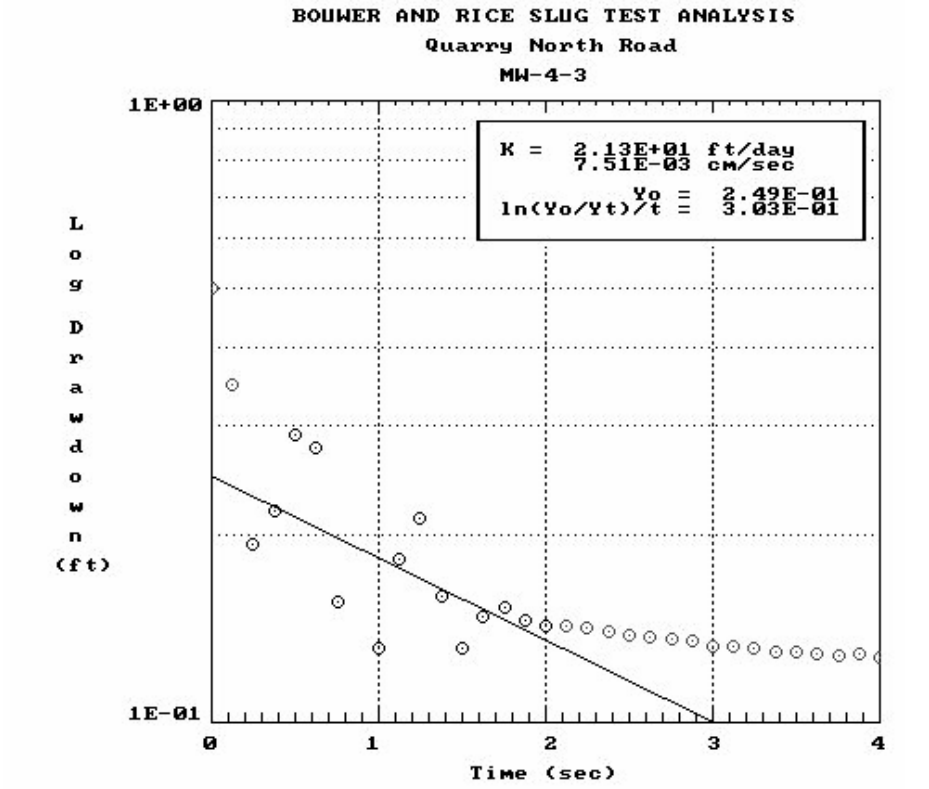
Hydraulic Conductivity: 2.13E+01 ft/day
7.51E-03 cm/sec
Y-Intercept (Yo): 2.49E-01 ft
Well Screen Ratio (Le/rw): 31.4
Dimensionless Parameter C: 2.11
Slope of Line [ln(Yo/Yt)/t]: 3.033E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.141E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.586
Effective Radius [Re]: 4.70 ft
Volume Tested [rw<Vol<Re]: 7.66E+02 ft^3

Well/Aquifer Parameters

Depth of well: 11.10 ft
Length of well screen: 11.10 ft
Saturated thickness: 11.10 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.498	2	0.1250	0.349	3	0.2500	0.193
4	0.3750	0.219	5	0.5000	0.291	6	0.6250	0.276
7	0.7500	0.156	8	1.0000	0.132	9	1.1250	0.183
10	1.2500	0.213	11	1.3750	0.160	12	1.5000	0.132
13	1.6250	0.148	14	1.7500	0.153	15	1.8750	0.146
16	2.0000	0.143	17	2.1250	0.143	18	2.2500	0.142
19	2.3750	0.140	20	2.5000	0.138	21	2.6250	0.137
22	2.7500	0.136	23	2.8750	0.135	24	3.0000	0.133
25	3.1250	0.133	26	3.2500	0.132	27	3.3750	0.130
28	3.5000	0.130	29	3.6250	0.129	30	3.7500	0.128
31	3.8750	0.129	32	4.0000	0.127	33	4.0000	0.003



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-5-1
GeoHydroCycle, Inc.

Results

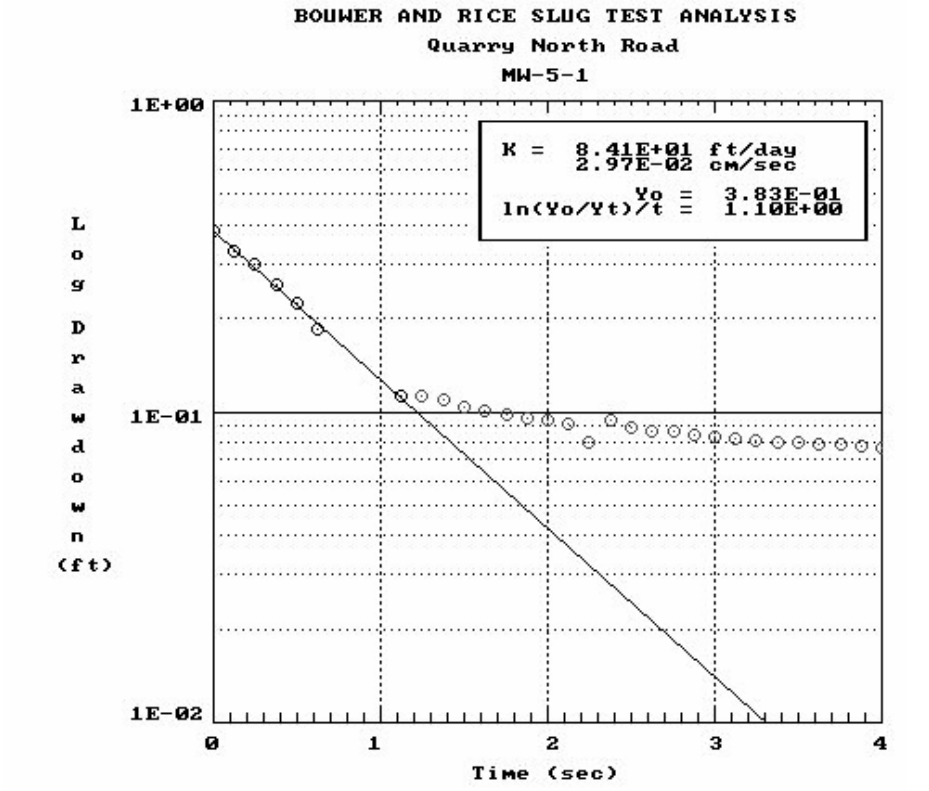
Hydraulic Conductivity: 8.41E+01 ft/day
2.97E-02 cm/sec
Y-Intercept (Yo): 3.83E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 1.100E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.380	2	0.1250	0.329	3	0.2500	0.299
4	0.3750	0.256	5	0.5000	0.224	6	0.6250	0.184
7	1.1250	0.112	8	1.2500	0.112	9	1.3750	0.110
10	1.5000	0.104	11	1.6250	0.101	12	1.7500	0.098
13	1.8750	0.095	14	2.0000	0.094	15	2.1250	0.092
16	2.2500	0.080	17	2.3750	0.094	18	2.5000	0.089
19	2.6250	0.087	20	2.7500	0.086	21	2.8750	0.084
22	3.0000	0.083	23	3.1250	0.082	24	3.2500	0.081
25	3.3750	0.080	26	3.5000	0.080	27	3.6250	0.079
28	3.7500	0.079	29	3.8750	0.078	30	4.0000	0.077



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-5-2
GeoHydroCycle, Inc.

Results

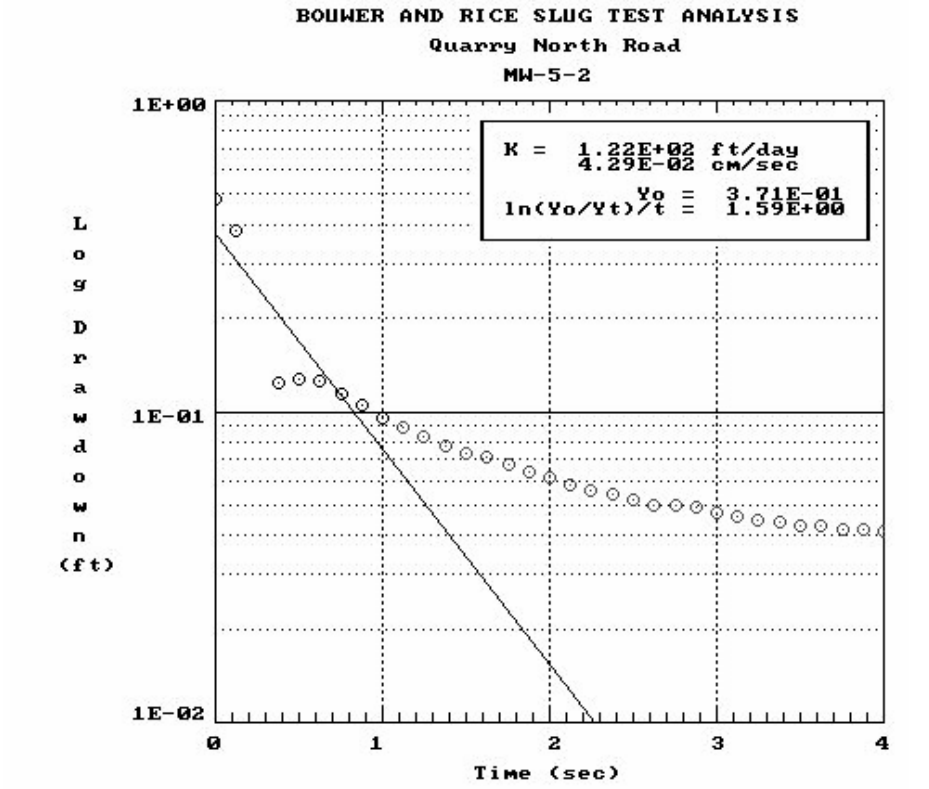
Hydraulic Conductivity: 1.22E+02 ft/day
4.29E-02 cm/sec
Y-Intercept (Yo): 3.71E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 1.590E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.480	2	0.1250	0.384	3	0.3750	0.124
4	0.5000	0.128	5	0.6250	0.125	6	0.7500	0.114
7	0.8750	0.105	8	1.0000	0.095	9	1.1250	0.089
10	1.2500	0.083	11	1.3750	0.078	12	1.5000	0.073
13	1.6250	0.071	14	1.7500	0.068	15	1.8750	0.064
16	2.0000	0.061	17	2.1250	0.058	18	2.2500	0.056
19	2.3750	0.054	20	2.5000	0.052	21	2.6250	0.050
22	2.7500	0.050	23	2.8750	0.049	24	3.0000	0.047
25	3.1250	0.046	26	3.2500	0.045	27	3.3750	0.044
28	3.3750	0.044	29	3.5000	0.043	30	3.6250	0.043
31	3.7500	0.042	32	3.8750	0.042	33	4.0000	0.041



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-5-3
GeoHydroCycle, Inc.

Results

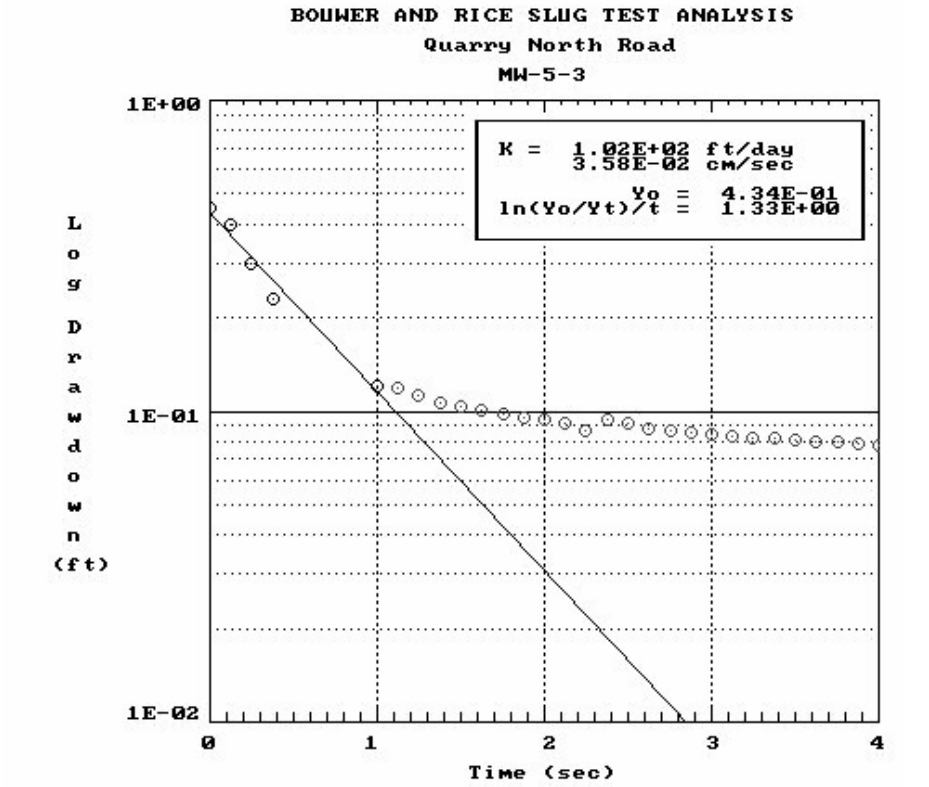
Hydraulic Conductivity: 1.02E+02 ft/day
3.58E-02 cm/sec
Y-Intercept (Yo): 4.34E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 1.328E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.453	2	0.1250	0.400	3	0.2500	0.299
4	0.3750	0.231	5	1.0000	0.121	6	1.1250	0.119
7	1.2500	0.113	8	1.3750	0.106	9	1.5000	0.103
10	1.6250	0.101	11	1.7500	0.098	12	1.8750	0.095
13	2.0000	0.094	14	2.1250	0.092	15	2.2500	0.086
16	2.3750	0.094	17	2.5000	0.092	18	2.6250	0.088
19	2.7500	0.086	20	2.8750	0.085	21	3.0000	0.084
22	3.1250	0.083	23	3.2500	0.082	24	3.3750	0.082
25	3.5000	0.081	26	3.6250	0.080	27	3.7500	0.080
28	3.8750	0.079	29	4.0000	0.078	30	3.6250	0.043



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-5-4
GeoHydroCycle, Inc.

Results

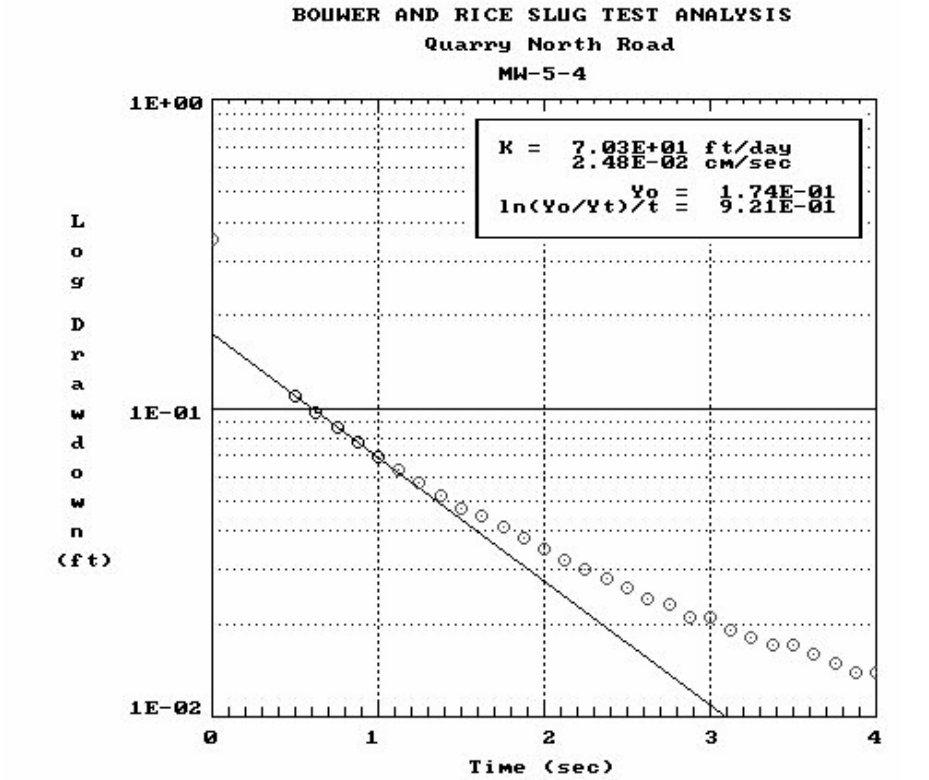
Hydraulic Conductivity: 7.03E+01 ft/day
2.48E-02 cm/sec
Y-Intercept (Yo): 1.74E-01 ft
Well Screen Ratio (Le/rw): 27.7
Dimensionless Parameter C: 1.96
Slope of Line [ln(Yo/Yt)/t]: 9.206E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.557E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.486
Effective Radius [Re]: 4.25 ft
Volume Tested [rw<Vol<Re]: 5.53E+02 ft^3

Well/Aquifer Parameters

Depth of well: 9.80 ft
Length of well screen: 9.80 ft
Saturated thickness: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.351	2	0.5000	0.110	3	0.6250	0.097
4	0.7500	0.087	5	0.8750	0.078	6	1.0000	0.069
7	1.1250	0.063	8	1.2500	0.057	9	1.3750	0.052
10	1.5000	0.047	11	1.6250	0.045	12	1.7500	0.041
13	1.8750	0.038	14	2.0000	0.035	15	2.1250	0.032
16	2.2500	0.030	17	2.3750	0.028	18	2.5000	0.026
19	2.6250	0.024	20	2.7500	0.023	21	2.8750	0.021
22	3.0000	0.021	23	3.1250	0.019	24	3.2500	0.018
25	3.3750	0.017	26	3.5000	0.017	27	3.6250	0.016
28	3.7500	0.015	29	3.8750	0.014	30	4.0000	0.014



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-6-1
GeoHydroCycle, Inc.

Results

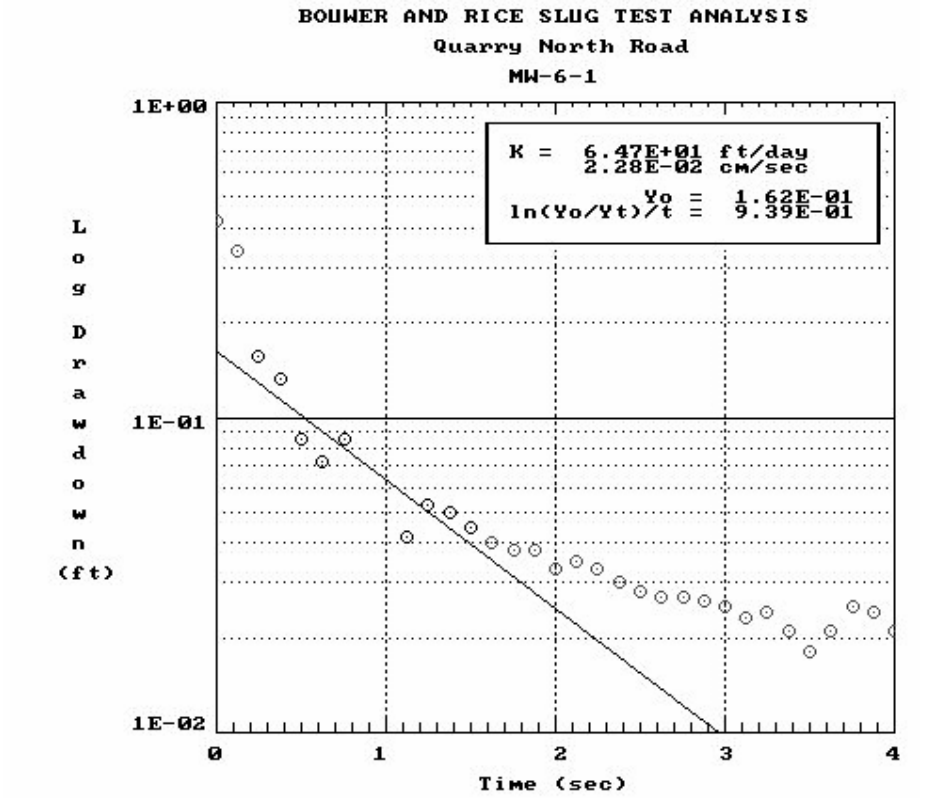
Hydraulic Conductivity: 6.47E+01 ft/day
2.28E-02 cm/sec
Y-Intercept (Yo): 1.62E-01 ft
Well Screen Ratio (Le/rw): 32.2
Dimensionless Parameter C: 2.15
Slope of Line [ln(Yo/Yt)/t]: 9.394E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.058E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.607
Effective Radius [Re]: 4.80 ft
Volume Tested [rw<Vol<Re]: 8.20E+02 ft^3

Well/Aquifer Parameters

Depth of well: 11.40 ft
Length of well screen: 11.40 ft
Saturated thickness: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.418	2	0.1250	0.338	3	0.2500	0.156
4	0.3750	0.133	5	0.5000	0.085	6	0.6250	0.072
7	0.7500	0.085	8	1.1250	0.042	9	1.2500	0.053
10	1.3750	0.050	11	1.5000	0.045	12	1.6250	0.040
13	1.7500	0.038	14	1.8750	0.038	15	2.0000	0.033
16	2.1250	0.035	17	2.2500	0.033	18	2.3750	0.030
19	2.5000	0.028	20	2.6250	0.027	21	2.7500	0.027
22	2.8750	0.026	23	3.0000	0.025	24	3.1250	0.023
25	3.2500	0.024	26	3.3750	0.021	27	3.5000	0.018
28	3.6250	0.021	29	3.7500	0.025	30	3.8750	0.024
31	4.0000	0.021						



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-6-2
GeoHydroCycle, Inc.

Results

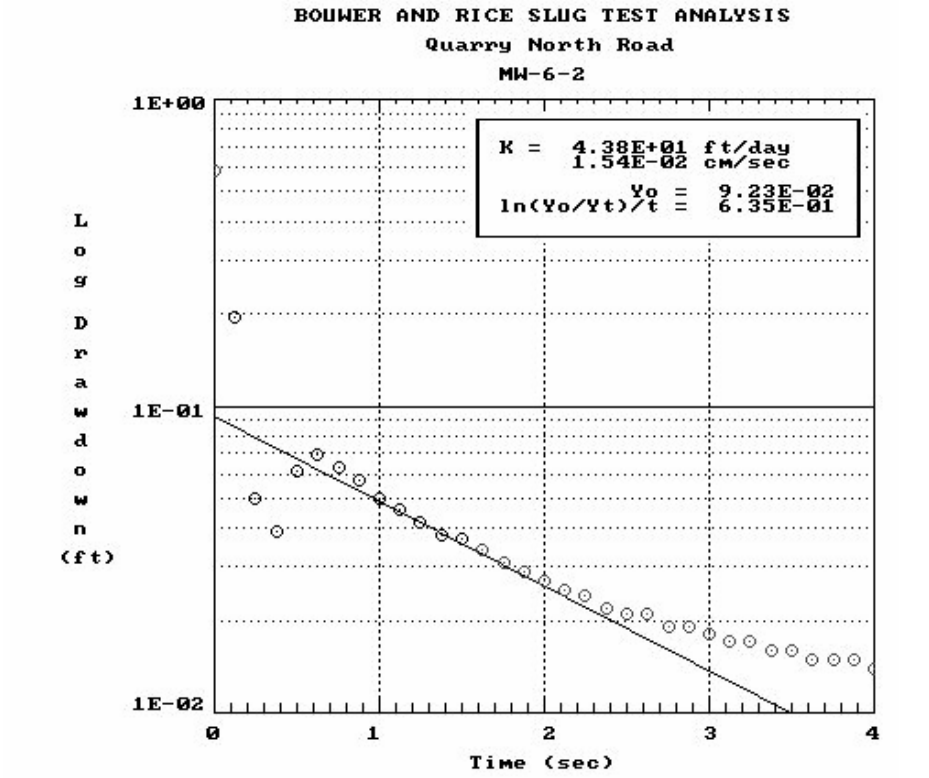
Hydraulic Conductivity: 4.38E+01 ft/day
1.54E-02 cm/sec
Y-Intercept (Yo): 9.23E-02 ft
Well Screen Ratio (Le/rw): 32.2
Dimensionless Parameter C: 2.15
Slope of Line [ln(Yo/Yt)/t]: 6.353E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.058E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.607
Effective Radius [Re]: 4.80 ft
Volume Tested [rw<Vol<Re]: 8.20E+02 ft^3

Well/Aquifer Parameters

Depth of well: 11.40 ft
Length of well screen: 11.40 ft
Saturated thickness: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.587	2	0.1250	0.195	3	0.2500	0.050
4	0.3750	0.039	5	0.5000	0.061	6	0.6250	0.069
7	0.7500	0.063	8	0.8750	0.057	9	1.0000	0.050
10	1.1250	0.046	11	1.2500	0.042	12	1.3750	0.038
13	1.5000	0.037	14	1.6250	0.034	15	1.7500	0.031
16	1.8750	0.029	17	2.0000	0.027	18	2.1250	0.025
19	2.2500	0.024	20	2.3750	0.022	21	2.5000	0.021
22	2.6250	0.021	23	2.7500	0.019	24	2.8750	0.019
25	3.0000	0.018	26	3.1250	0.017	27	3.2500	0.017
28	3.3750	0.016	29	3.5000	0.016	30	3.6250	0.015
31	3.7500	0.015	32	3.8750	0.015	33	4.0000	0.014



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-6-3
GeoHydroCycle, Inc.

Results

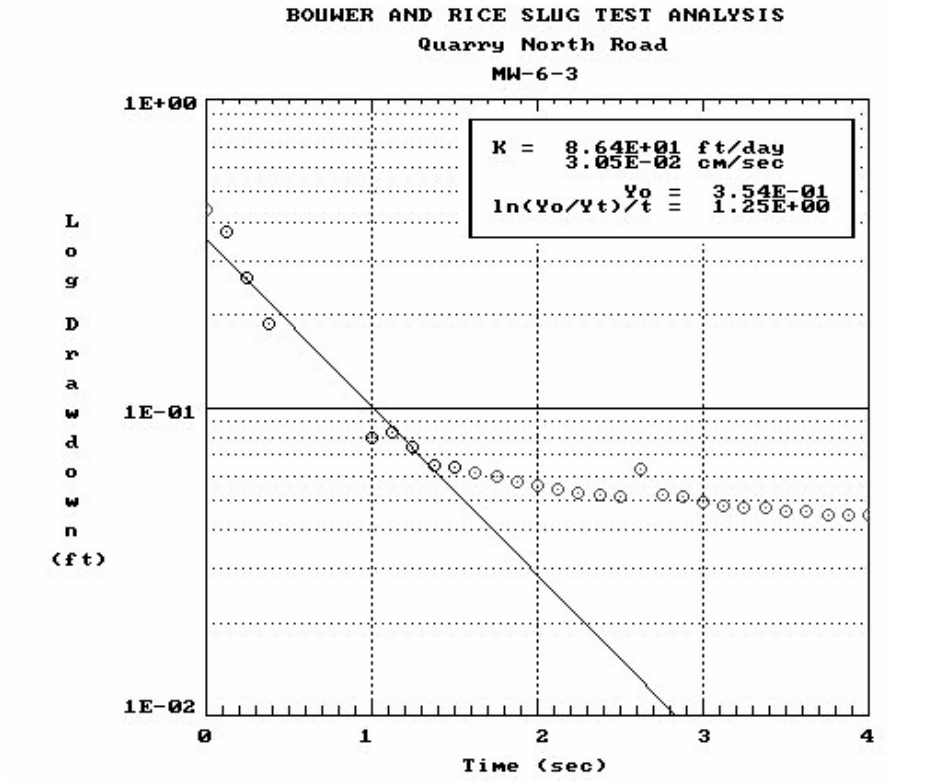
Hydraulic Conductivity: 8.64E+01 ft/day
3.05E-02 cm/sec
Y-Intercept (Yo): 3.54E-01 ft
Well Screen Ratio (Le/rw): 32.2
Dimensionless Parameter C: 2.15
Slope of Line [ln(Yo/Yt)/t]: 1.255E+00 1/sec
Well Parameters (Rc^2 / 2*Le): 3.058E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.607
Effective Radius [Re]: 4.80 ft
Volume Tested [rw<Vol<Re]: 8.20E+02 ft^3

Well/Aquifer Parameters

Depth of well: 11.40 ft
Length of well screen: 11.40 ft
Saturated thickness: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.436	2	0.1250	0.374	3	0.2500	0.264
4	0.3750	0.186	5	1.0000	0.080	6	1.1250	0.083
7	1.2500	0.074	8	1.3750	0.065	9	1.5000	0.064
10	1.6250	0.061	11	1.7500	0.060	12	1.8750	0.057
13	2.0000	0.056	14	2.1250	0.054	15	2.2500	0.053
16	2.3750	0.052	17	2.5000	0.051	18	2.6250	0.063
19	2.7500	0.052	20	2.8750	0.051	21	3.0000	0.049
22	3.1250	0.048	23	3.2500	0.047	24	3.3750	0.047
25	3.5000	0.046	26	3.6250	0.046	27	3.7500	0.045
28	3.8750	0.045	29	4.0000	0.045	30	3.6250	0.015



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

Quarry North Road
MW-6-4
GeoHydroCycle, Inc.

Results

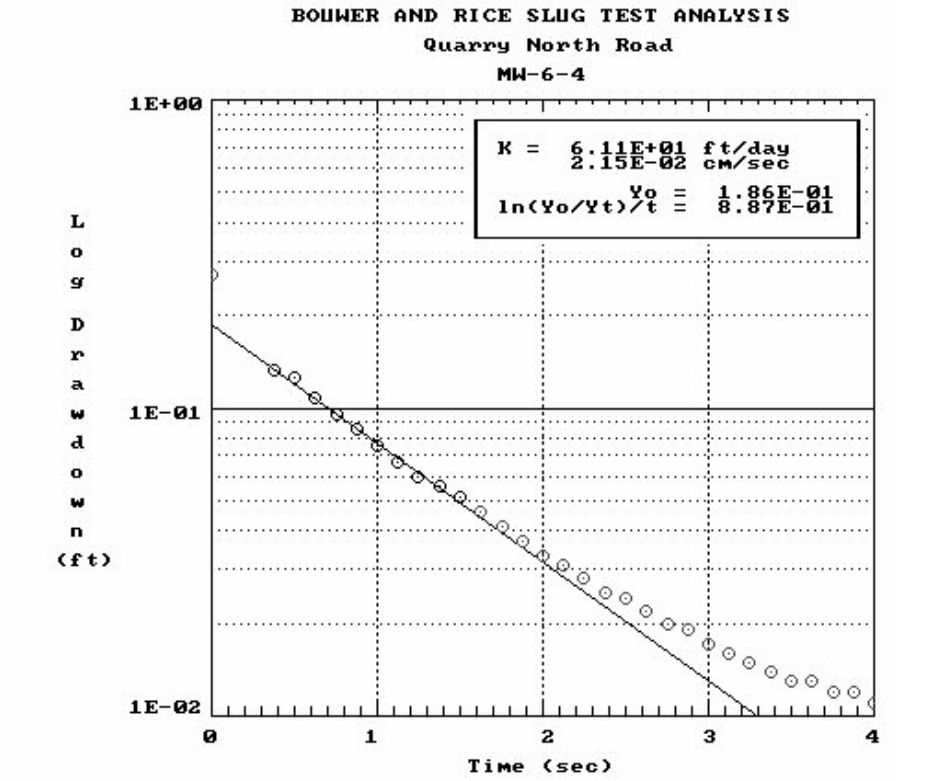
Hydraulic Conductivity: 6.11E+01 ft/day
2.15E-02 cm/sec
Y-Intercept (Yo): 1.86E-01 ft
Well Screen Ratio (Le/rw): 32.2
Dimensionless Parameter C: 2.15
Slope of Line [ln(Yo/Yt)/t]: 8.868E-01 1/sec
Well Parameters (Rc^2 / 2*Le): 3.058E-04 ft
Dimensionless Ratio [ln(Re/rw)]: 2.607
Effective Radius [Re]: 4.80 ft
Volume Tested [rw<Vol<Re]: 8.20E+02 ft^3

Well/Aquifer Parameters

Depth of well: 11.40 ft
Length of well screen: 11.40 ft
Saturated thickness: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well filter: 0.708 ft

Time vs Drawdown Data

No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)	No.	Time (sec)	Drawdown (ft)
1	0.0000	0.272	2	0.3750	0.132	3	0.5000	0.125
4	0.6250	0.108	5	0.7500	0.095	6	0.8750	0.085
7	1.0000	0.075	8	1.1250	0.067	9	1.2500	0.060
10	1.3750	0.056	11	1.5000	0.051	12	1.6250	0.046
13	1.7500	0.041	14	1.8750	0.037	15	2.0000	0.033
16	2.1250	0.031	17	2.2500	0.028	18	2.3750	0.025
19	2.5000	0.024	20	2.6250	0.022	21	2.7500	0.020
22	2.8750	0.019	23	3.0000	0.017	24	3.1250	0.016
25	3.2500	0.015	26	3.3750	0.014	27	3.5000	0.013
28	3.6250	0.013	29	3.7500	0.012	30	3.8750	0.012
31	4.0000	0.011						



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-1-1
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 2.41E+02 ft/day
8.49E-02 cm/sec
Basic Time Lag: 0.48 s
2.3 Times Basic Time Lag: 1.10 s
(Equalization Ratio ÷ 0.90)

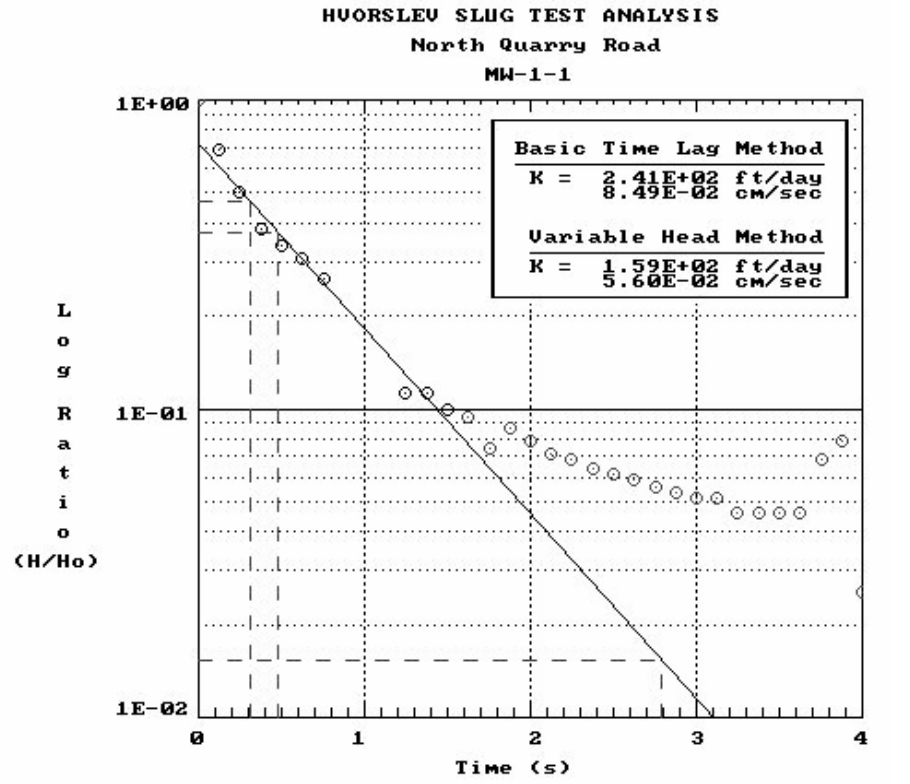
Variable Head-
Hydraulic Conductivity (Kh): 1.59E+02 ft/day
5.60E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 2.8 s
Head Ratio Coordinate H1: 46.71E-02
Head Ratio Coordinate H2: 15.33E-03

Well/Aquifer Parameters

Length of well screen: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.694	3	0.2500	0.503
4	0.3750	0.380	5	0.5000	0.339	6	0.6250	0.306
7	0.7500	0.265	8	1.2500	0.112	9	1.3750	0.112
10	1.5000	0.099	11	1.6250	0.094	12	1.7500	0.074
13	1.8750	0.087	14	2.0000	0.079	15	2.1250	0.071
16	2.2500	0.069	17	2.3750	0.064	18	2.5000	0.061
19	2.6250	0.059	20	2.7500	0.056	21	2.8750	0.054
22	3.0000	0.051	23	3.1250	0.051	24	3.2500	0.046
25	3.3750	0.046	26	3.5000	0.046	27	3.6250	0.046
28	3.7500	0.069	29	3.8750	0.079	30	4.0000	0.026



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-1-2
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 9.71E+01 ft/day
3.42E-02 cm/sec
Basic Time Lag: 1.19 s
2.3 Times Basic Time Lag: 2.74 s
(Equalization Ratio ÷ 0.90)

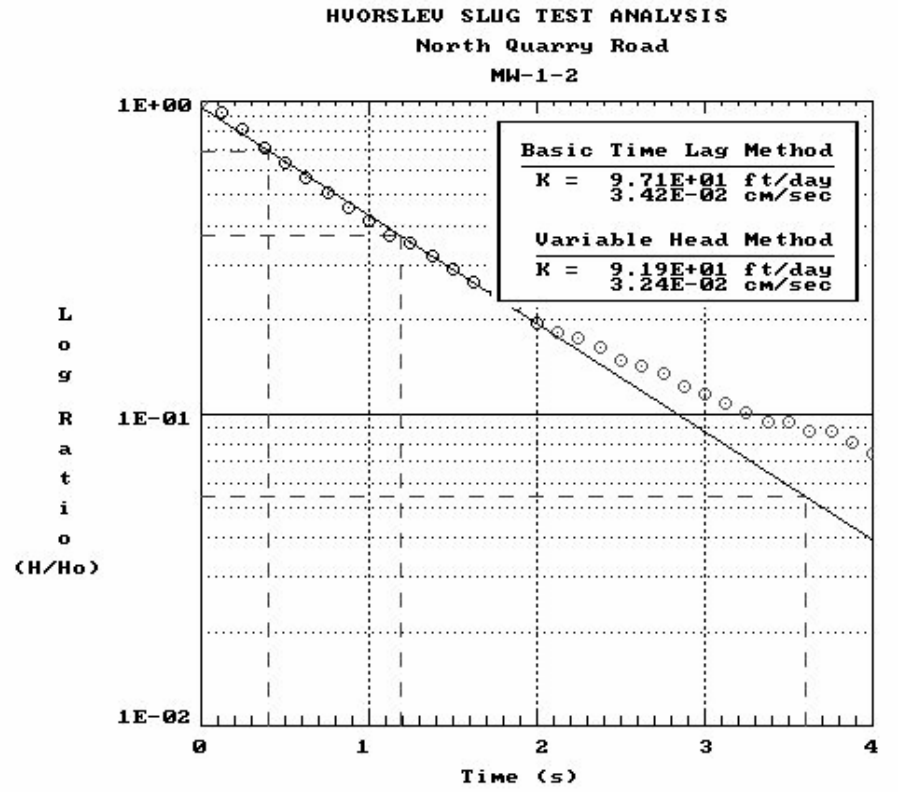
Variable Head-
Hydraulic Conductivity (Kh): 9.19E+01 ft/day
3.24E-02 cm/sec
Time Coordinate T1: 0.4 s
Time Coordinate T2: 3.6 s
Head Ratio Coordinate H1: 69.38E-02
Head Ratio Coordinate H2: 54.25E-03

Well/Aquifer Parameters

Length of well screen: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.926	3	0.2500	0.811
4	0.3750	0.709	5	0.5000	0.635	6	0.6250	0.568
7	0.7500	0.507	8	0.8750	0.459	9	1.0000	0.412
10	1.1250	0.372	11	1.2500	0.351	12	1.3750	0.318
13	1.5000	0.291	14	1.6250	0.264	15	1.7500	0.243
16	1.8750	0.223	17	2.0000	0.196	18	2.1250	0.182
19	2.2500	0.176	20	2.3750	0.162	21	2.5000	0.149
22	2.6250	0.142	23	2.7500	0.135	24	2.8750	0.122
25	3.0000	0.115	26	3.1250	0.108	27	3.2500	0.101
28	3.3750	0.095	29	3.5000	0.095	30	3.6250	0.088
31	3.7500	0.088	32	3.8750	0.081	33	4.0000	0.074



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-1-3
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.21E+02 ft/day
4.25E-02 cm/sec
Basic Time Lag: 0.96 s
2.3 Times Basic Time Lag: 2.20 s
(Equalization Ratio ÷ 0.90)

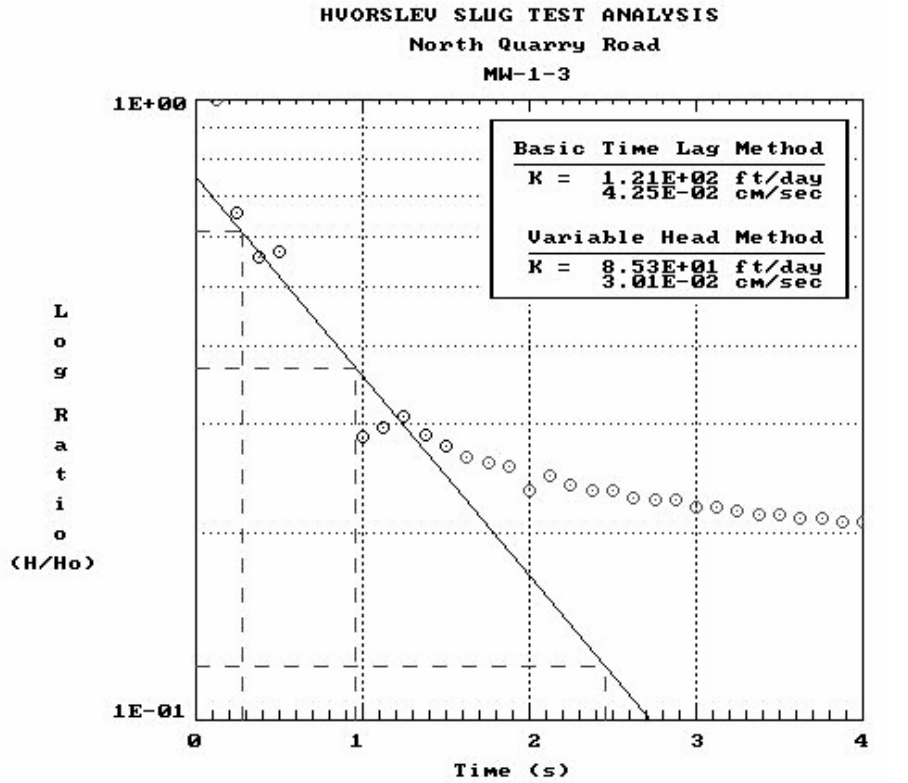
Variable Head-
Hydraulic Conductivity (Kh): 8.53E+01 ft/day
3.01E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 2.5 s
Head Ratio Coordinate H1: 61.38E-02
Head Ratio Coordinate H2: 12.23E-02

Well/Aquifer Parameters

Length of well screen: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.1250	1.000	2	0.2500	0.658	3	0.3750	0.556
4	0.5000	0.571	5	1.0000	0.285	6	1.1250	0.297
7	1.2500	0.308	8	1.3750	0.288	9	1.5000	0.277
10	1.6250	0.266	11	1.7500	0.260	12	1.8750	0.257
13	2.0000	0.234	14	2.1250	0.249	15	2.2500	0.240
16	2.3750	0.234	17	2.5000	0.234	18	2.6250	0.229
19	2.7500	0.226	20	2.8750	0.226	21	3.0000	0.220
22	3.1250	0.220	23	3.2500	0.218	24	3.2500	0.218
25	3.3750	0.215	26	3.3750	0.215	27	3.5000	0.215
28	3.5000	0.215	29	3.6250	0.212	30	3.7500	0.212
31	3.8750	0.209	32	4.0000	0.209	33	4.0000	0.074



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-1-4
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 7.05E+01 ft/day
2.49E-02 cm/sec
Basic Time Lag: 1.64 s
2.3 Times Basic Time Lag: 3.76 s
(Equalization Ratio ÷ 0.90)

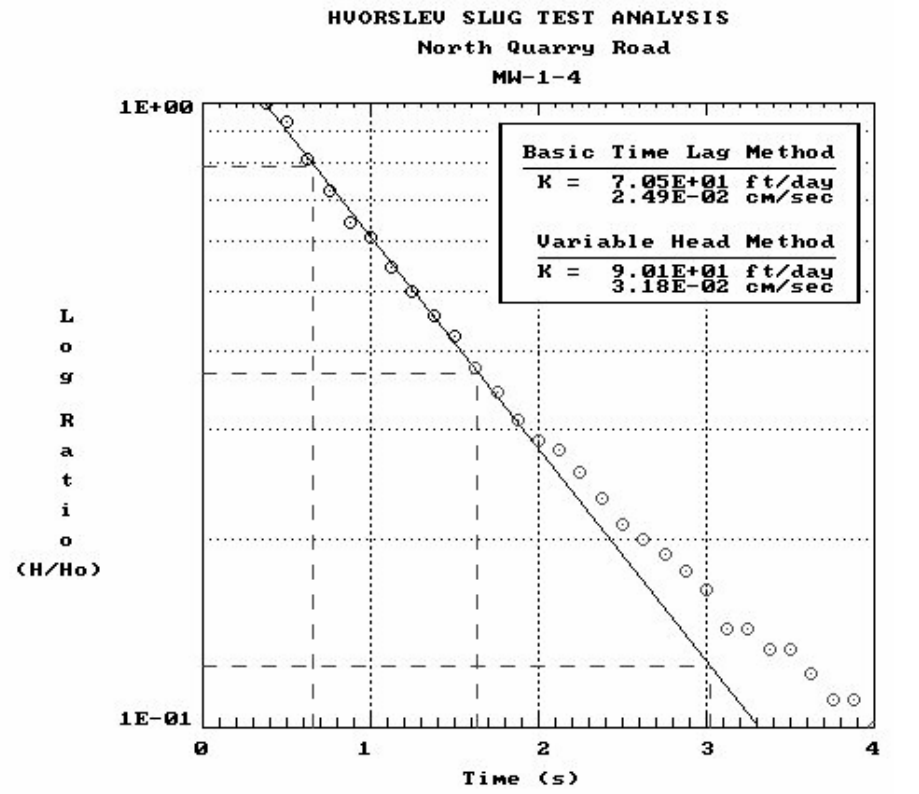
Variable Head-
Hydraulic Conductivity (Kh): 9.01E+01 ft/day
3.18E-02 cm/sec
Time Coordinate T1: 0.7 s
Time Coordinate T2: 3.0 s
Head Ratio Coordinate H1: 79.43E-02
Head Ratio Coordinate H2: 12.59E-02

Well/Aquifer Parameters

Length of well screen: 8.20 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.3750	1.000	2	0.5000	0.933	3	0.6250	0.811
4	0.7500	0.722	5	0.8750	0.644	6	1.0000	0.611
7	1.1250	0.544	8	1.2500	0.500	9	1.3750	0.456
10	1.5000	0.422	11	1.6250	0.378	12	1.7500	0.344
13	1.8750	0.311	14	2.0000	0.289	15	2.1250	0.278
16	2.2500	0.256	17	2.3750	0.233	18	2.5000	0.211
19	2.6250	0.200	20	2.7500	0.189	21	2.8750	0.178
22	3.0000	0.167	23	3.1250	0.144	24	3.2500	0.144
25	3.3750	0.133	26	3.5000	0.133	27	3.6250	0.122
28	3.7500	0.111	29	3.8750	0.111	30	4.0000	0.100



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-2-1
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.74E+02 ft/day
6.13E-02 cm/sec
Basic Time Lag: 0.59 s
2.3 Times Basic Time Lag: 1.35 s
(Equalization Ratio ÷ 0.90)

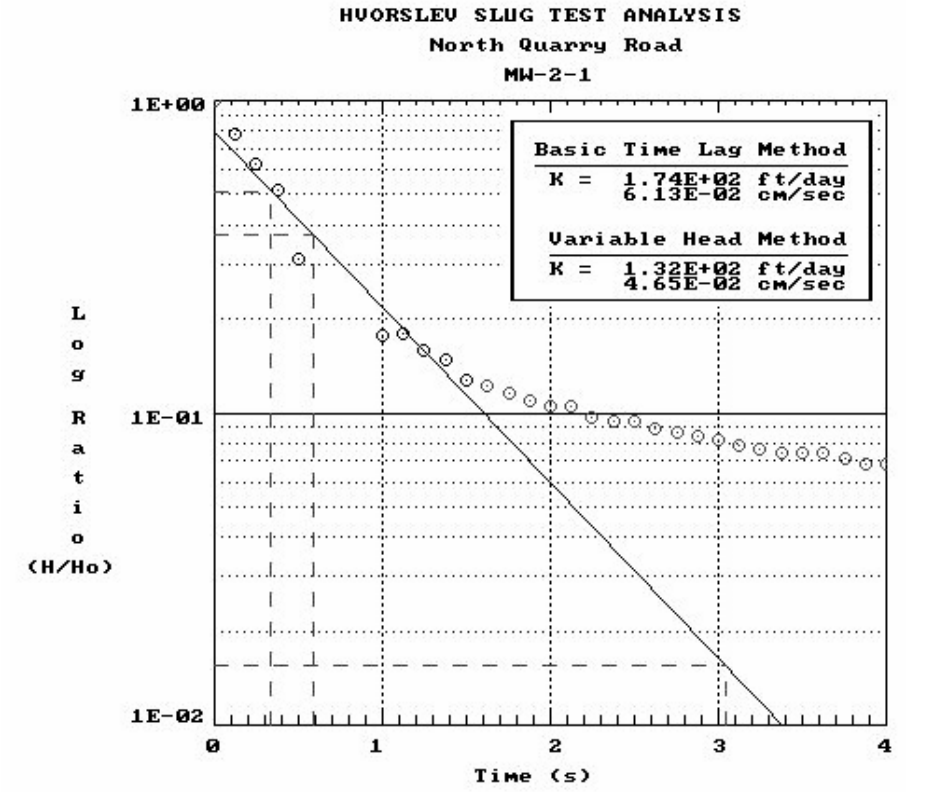
Variable Head-
Hydraulic Conductivity (Kh): 1.32E+02 ft/day
4.65E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 3.0 s
Head Ratio Coordinate H1: 51.05E-02
Head Ratio Coordinate H2: 15.48E-03

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.776	3	0.2500	0.630
4	0.3750	0.518	5	0.5000	0.311	6	1.0000	0.176
7	1.1250	0.179	8	1.2500	0.158	9	1.3750	0.148
10	1.5000	0.128	11	1.6250	0.122	12	1.7500	0.115
13	1.8750	0.110	14	2.0000	0.105	15	2.1250	0.105
16	2.2500	0.097	17	2.3750	0.094	18	2.5000	0.094
19	2.6250	0.089	20	2.7500	0.087	21	2.8750	0.084
22	3.0000	0.082	23	3.1250	0.079	24	3.2500	0.077
25	3.3750	0.074	26	3.5000	0.074	27	3.6250	0.074
28	3.7500	0.071	29	3.8750	0.069	30	4.0000	0.069



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-2-2
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 7.20E+01 ft/day
2.54E-02 cm/sec
Basic Time Lag: 1.42 s
2.3 Times Basic Time Lag: 3.26 s
(Equalization Ratio ÷ 0.90)

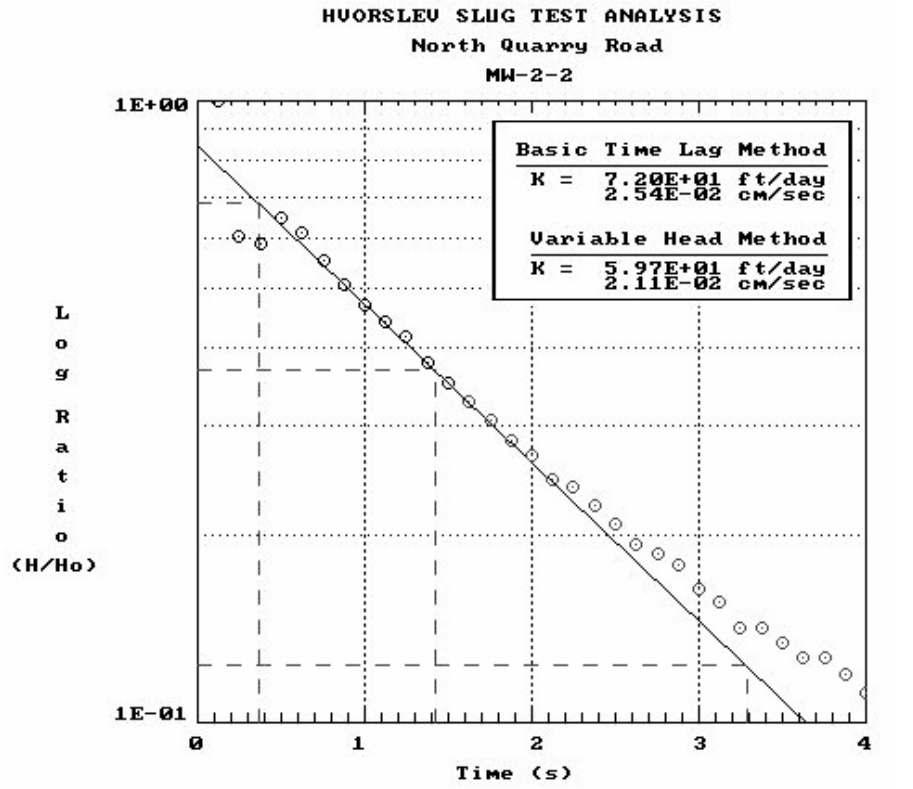
Variable Head-
Hydraulic Conductivity (Kh): 5.97E+01 ft/day
2.11E-02 cm/sec
Time Coordinate T1: 0.4 s
Time Coordinate T2: 3.3 s
Head Ratio Coordinate H1: 68.45E-02
Head Ratio Coordinate H2: 12.38E-02

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.1250	1.000	2	0.2500	0.604	3	0.3750	0.590
4	0.5000	0.649	5	0.6250	0.612	6	0.7500	0.552
7	0.8750	0.507	8	1.0000	0.470	9	1.1250	0.440
10	1.2500	0.418	11	1.3750	0.381	12	1.5000	0.351
13	1.6250	0.328	14	1.7500	0.306	15	1.8750	0.284
16	2.0000	0.269	17	2.1250	0.246	18	2.2500	0.239
19	2.3750	0.224	20	2.5000	0.209	21	2.6250	0.194
22	2.7500	0.187	23	2.8750	0.179	24	3.0000	0.164
25	3.1250	0.157	26	3.2500	0.142	27	3.3750	0.142
28	3.5000	0.134	29	3.6250	0.127	30	3.7500	0.127
31	3.8750	0.119	32	4.0000	0.112	33	0.0000	1.000



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-2-3
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.89E+02 ft/day
6.67E-02 cm/sec
Basic Time Lag: 0.54 s
2.3 Times Basic Time Lag: 1.24 s
(Equalization Ratio ÷ 0.90)

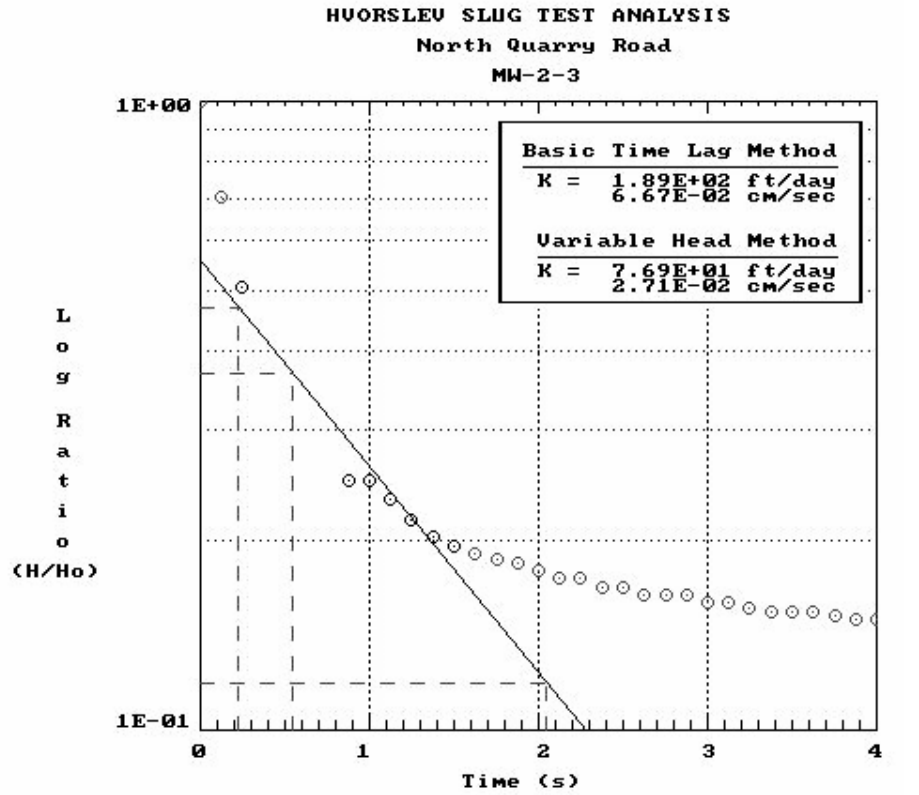
Variable Head-
Hydraulic Conductivity (Kh): 7.69E+01 ft/day
2.71E-02 cm/sec
Time Coordinate T1: 0.2 s
Time Coordinate T2: 2.0 s
Head Ratio Coordinate H1: 46.81E-02
Head Ratio Coordinate H2: 11.87E-02

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.706	3	0.2500	0.505
4	0.8750	0.250	5	1.0000	0.250	6	1.1250	0.233
7	1.2500	0.216	8	1.3750	0.203	9	1.5000	0.196
10	1.6250	0.191	11	1.7500	0.186	12	1.8750	0.184
13	2.0000	0.179	14	2.1250	0.174	15	2.2500	0.174
16	2.3750	0.169	17	2.5000	0.169	18	2.6250	0.164
19	2.7500	0.164	20	2.8750	0.164	21	3.0000	0.159
22	3.1250	0.159	23	3.2500	0.157	24	3.3750	0.154
25	3.5000	0.154	26	3.6250	0.154	27	3.7500	0.152
28	3.8750	0.150	29	4.0000	0.150	30	3.7500	0.127



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-2-4
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 7.96E+01 ft/day
2.81E-02 cm/sec
Basic Time Lag: 1.28 s
2.3 Times Basic Time Lag: 2.95 s
(Equalization Ratio ÷ 0.90)

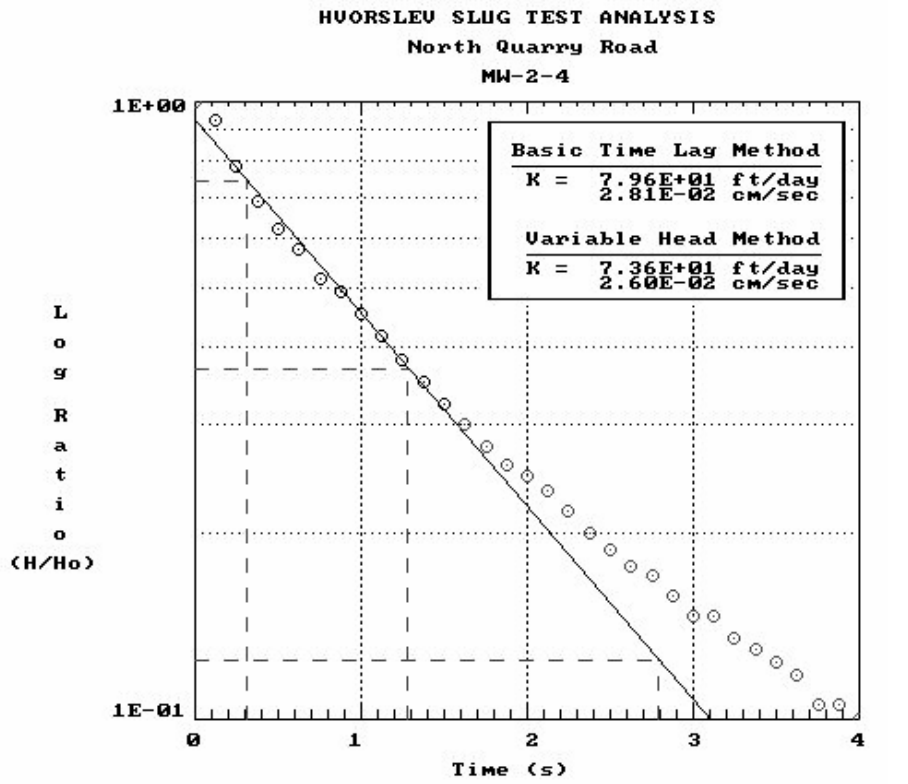
Variable Head-
Hydraulic Conductivity (Kh): 7.36E+01 ft/day
2.60E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 2.8 s
Head Ratio Coordinate H1: 74.66E-02
Head Ratio Coordinate H2: 12.50E-02

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.935	3	0.2500	0.788
4	0.3750	0.688	5	0.5000	0.624	6	0.6250	0.576
7	0.7500	0.518	8	0.8750	0.494	9	1.0000	0.453
10	1.1250	0.418	11	1.2500	0.382	12	1.3750	0.353
13	1.5000	0.324	14	1.6250	0.300	15	1.7500	0.276
16	1.8750	0.259	17	2.0000	0.247	18	2.1250	0.235
19	2.2500	0.218	20	2.3750	0.200	21	2.5000	0.188
22	2.6250	0.176	23	2.7500	0.171	24	2.8750	0.159
25	3.0000	0.147	26	3.1250	0.147	27	3.2500	0.135
28	3.3750	0.129	29	3.5000	0.124	30	3.6250	0.118
31	3.7500	0.106	32	3.8750	0.106	33	4.0000	0.100



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-3-1
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 4.61E+01 ft/day
1.63E-02 cm/sec
Basic Time Lag: 1.53 s
2.3 Times Basic Time Lag: 3.53 s
(Equalization Ratio ÷ 0.90)

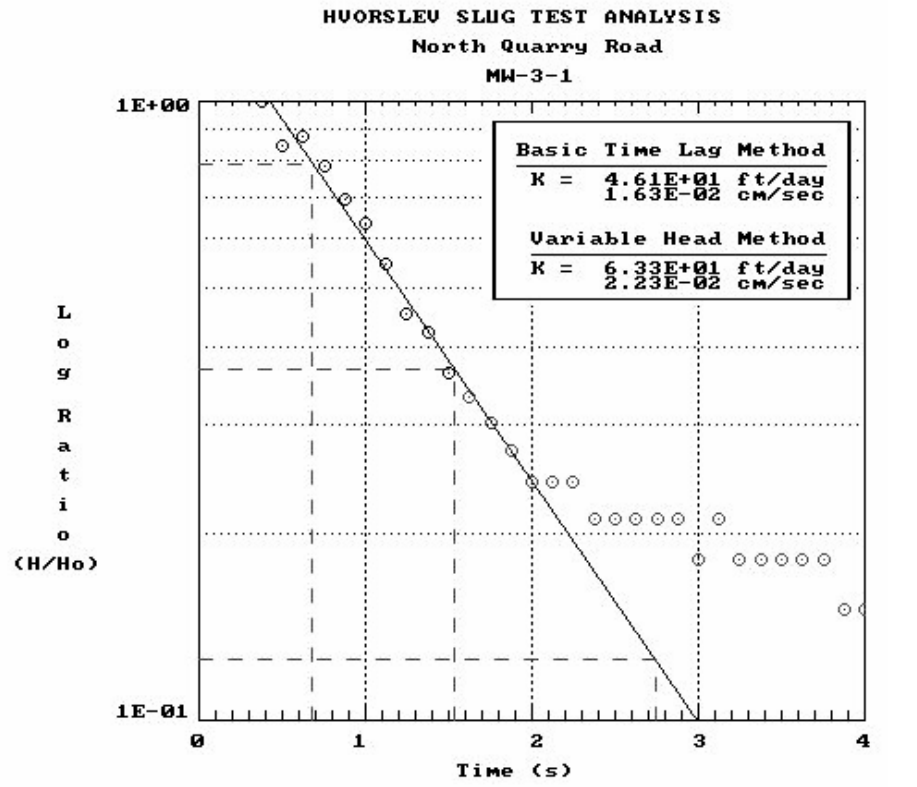
Variable Head-
Hydraulic Conductivity (Kh): 6.33E+01 ft/day
2.23E-02 cm/sec
Time Coordinate T1: 0.7 s
Time Coordinate T2: 2.7 s
Head Ratio Coordinate H1: 79.43E-02
Head Ratio Coordinate H2: 12.59E-02

Well/Aquifer Parameters

Length of well screen: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.3750	1.000	2	0.5000	0.848	3	0.6250	0.879
4	0.7500	0.788	5	0.8750	0.697	6	1.0000	0.636
7	1.1250	0.545	8	1.2500	0.455	9	1.3750	0.424
10	1.5000	0.364	11	1.6250	0.333	12	1.7500	0.303
13	1.8750	0.273	14	2.0000	0.242	15	2.1250	0.242
16	2.2500	0.242	17	2.3750	0.212	18	2.5000	0.212
19	2.6250	0.212	20	2.7500	0.212	21	2.8750	0.212
22	3.0000	0.182	23	3.1250	0.212	24	3.2500	0.182
25	3.3750	0.182	26	3.5000	0.182	27	3.6250	0.182
28	3.7500	0.182	29	3.8750	0.152	30	4.0000	0.152



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-3-2
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.24E+02 ft/day
4.37E-02 cm/sec
Basic Time Lag: 0.57 s
2.3 Times Basic Time Lag: 1.31 s
(Equalization Ratio ÷ 0.90)

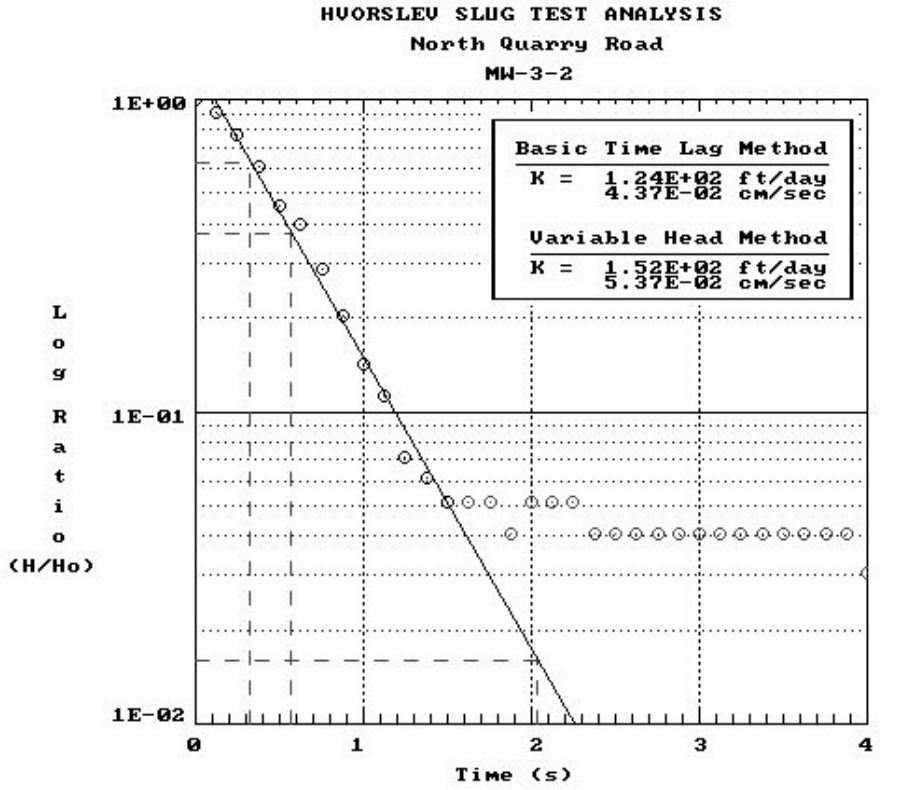
Variable Head-
Hydraulic Conductivity (Kh): 1.52E+02 ft/day
5.37E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 2.0 s
Head Ratio Coordinate H1: 63.10E-02
Head Ratio Coordinate H2: 15.85E-03

Well/Aquifer Parameters

Length of well screen: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.908	3	0.2500	0.765
4	0.3750	0.612	5	0.5000	0.459	6	0.6250	0.398
7	0.7500	0.286	8	0.8750	0.204	9	1.0000	0.143
10	1.1250	0.112	11	1.2500	0.071	12	1.3750	0.061
13	1.5000	0.051	14	1.6250	0.051	15	1.7500	0.051
16	1.8750	0.041	17	2.0000	0.051	18	2.1250	0.051
19	2.2500	0.051	20	2.3750	0.041	21	2.5000	0.041
22	2.6250	0.041	23	2.7500	0.041	24	2.8750	0.041
25	3.0000	0.041	26	3.1250	0.041	27	3.2500	0.041
28	3.3750	0.041	29	3.5000	0.041	30	3.6250	0.041
31	3.7500	0.041	32	3.8750	0.041	33	4.0000	0.031



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-3-3
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.45E+02 ft/day
5.12E-02 cm/sec
Basic Time Lag: 0.49 s
2.3 Times Basic Time Lag: 1.12 s
(Equalization Ratio ÷ 0.90)

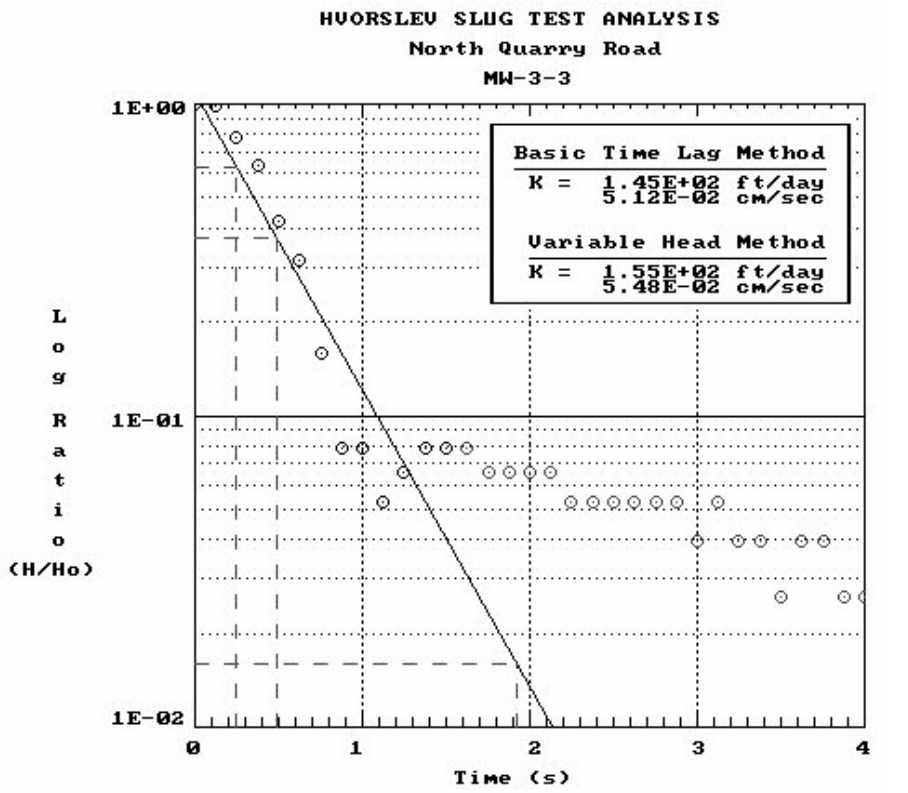
Variable Head-
Hydraulic Conductivity (Kh): 1.55E+02 ft/day
5.48E-02 cm/sec
Time Coordinate T1: 0.2 s
Time Coordinate T2: 1.9 s
Head Ratio Coordinate H1: 63.10E-02
Head Ratio Coordinate H2: 15.85E-03

Well/Aquifer Parameters

Length of well screen: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.987	3	0.2500	0.776
4	0.3750	0.632	5	0.5000	0.421	6	0.6250	0.316
7	0.7500	0.158	8	0.8750	0.079	9	1.0000	0.079
10	1.1250	0.053	11	1.2500	0.066	12	1.3750	0.079
13	1.5000	0.079	14	1.6250	0.079	15	1.7500	0.066
16	1.8750	0.066	17	2.0000	0.066	18	2.1250	0.066
19	2.2500	0.053	20	2.3750	0.053	21	2.5000	0.053
22	2.6250	0.053	23	2.7500	0.053	24	2.8750	0.053
25	3.0000	0.039	26	3.1250	0.053	27	3.2500	0.039
28	3.3750	0.039	29	3.5000	0.026	30	3.6250	0.039
31	3.7500	0.039	32	3.8750	0.026	33	4.0000	0.026



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-3-4
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.28E+02 ft/day
4.52E-02 cm/sec
Basic Time Lag: 0.55 s
2.3 Times Basic Time Lag: 1.27 s
(Equalization Ratio ÷ 0.90)

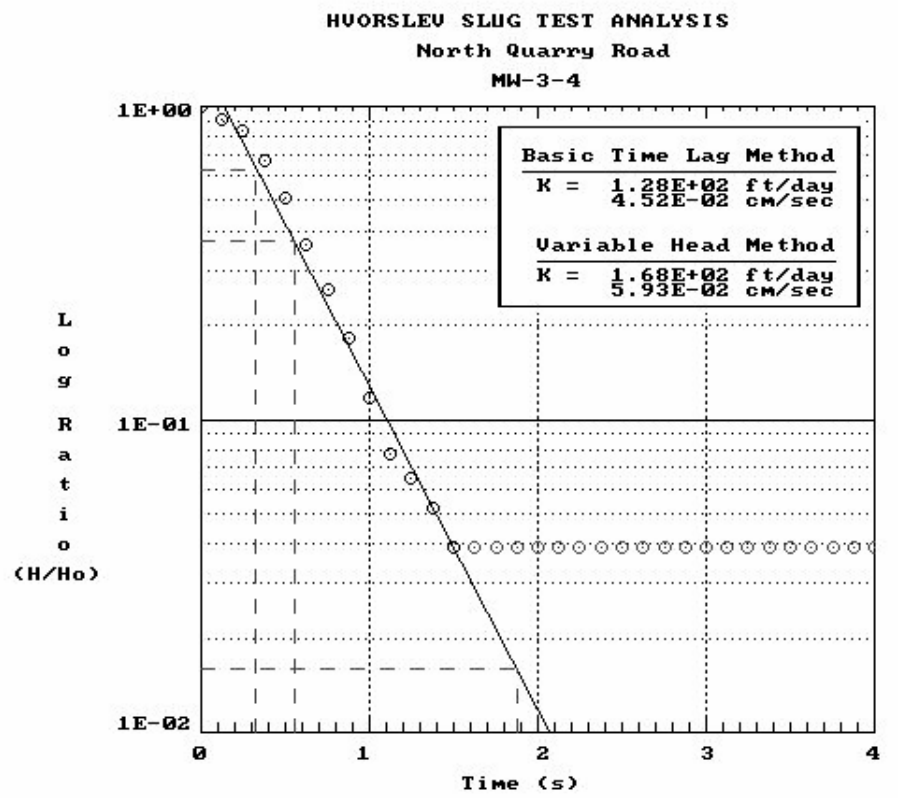
Variable Head-
Hydraulic Conductivity (Kh): 1.68E+02 ft/day
5.93E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 1.9 s
Head Ratio Coordinate H1: 63.10E-02
Head Ratio Coordinate H2: 15.85E-03

Well/Aquifer Parameters

Length of well screen: 16.30 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.909	3	0.2500	0.831
4	0.3750	0.675	5	0.5000	0.506	6	0.6250	0.364
7	0.7500	0.260	8	0.8750	0.182	9	1.0000	0.117
10	1.1250	0.078	11	1.2500	0.065	12	1.3750	0.052
13	1.5000	0.039	14	1.6250	0.039	15	1.7500	0.039
16	1.8750	0.039	17	2.0000	0.039	18	2.1250	0.039
19	2.2500	0.039	20	2.3750	0.039	21	2.5000	0.039
22	2.6250	0.039	23	2.7500	0.039	24	2.8750	0.039
25	3.0000	0.039	26	3.1250	0.039	27	3.2500	0.039
28	3.3750	0.039	29	3.5000	0.039	30	3.6250	0.039
31	3.7500	0.039	32	3.8750	0.039	33	4.0000	0.039



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-4-1
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 6.77E+01 ft/day
2.39E-02 cm/sec
Basic Time Lag: 1.38 s
2.3 Times Basic Time Lag: 3.18 s
(Equalization Ratio ÷ 0.90)

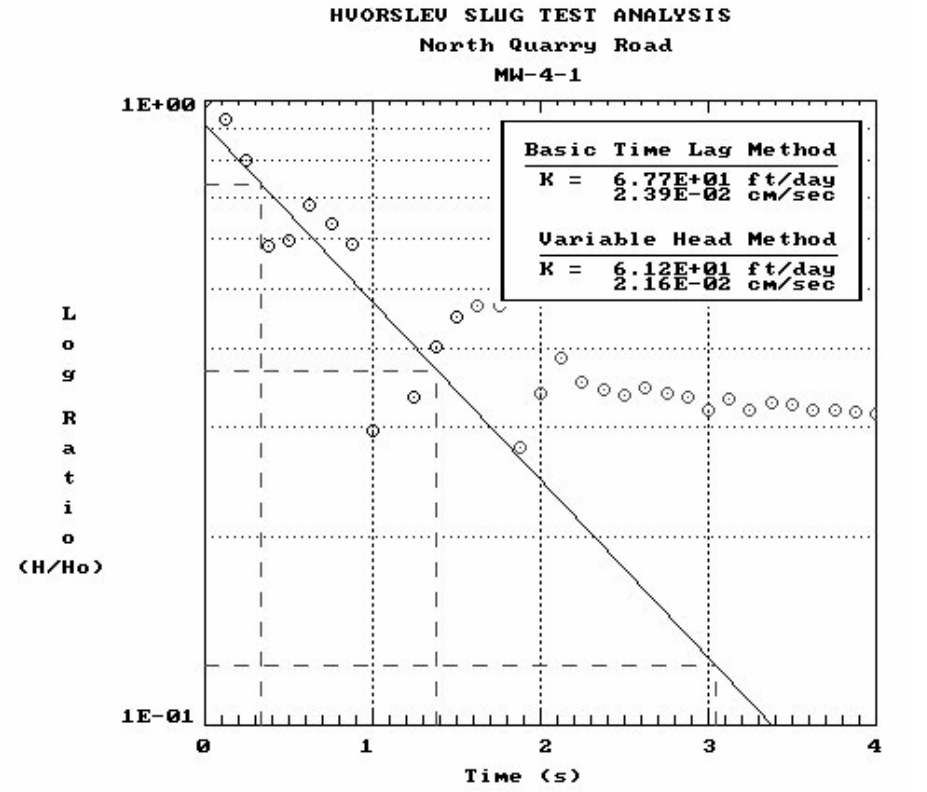
Variable Head-
Hydraulic Conductivity (Kh): 6.12E+01 ft/day
2.16E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 3.0 s
Head Ratio Coordinate H1: 73.23E-02
Head Ratio Coordinate H2: 12.48E-02

Well/Aquifer Parameters

Length of well screen: 11.10 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.932	3	0.2500	0.802
4	0.3750	0.585	5	0.5000	0.599	6	0.6250	0.679
7	0.7500	0.636	8	0.8750	0.588	9	1.0000	0.296
10	1.2500	0.335	11	1.3750	0.403	12	1.5000	0.451
13	1.6250	0.469	14	1.7500	0.469	15	1.8750	0.278
16	2.0000	0.339	17	2.1250	0.387	18	2.2500	0.355
19	2.3750	0.344	20	2.5000	0.337	21	2.6250	0.346
22	2.7500	0.339	23	2.8750	0.335	24	3.0000	0.319
25	3.1250	0.333	26	3.2500	0.319	27	3.3750	0.328
28	3.5000	0.326	29	3.6250	0.319	30	3.7500	0.319
31	3.8750	0.317	32	4.0000	0.314	33	4.0000	0.039



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-4-3
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 9.40E+01 ft/day
3.31E-02 cm/sec
Basic Time Lag: 1.00 s
2.3 Times Basic Time Lag: 2.29 s
(Equalization Ratio ÷ 0.90)

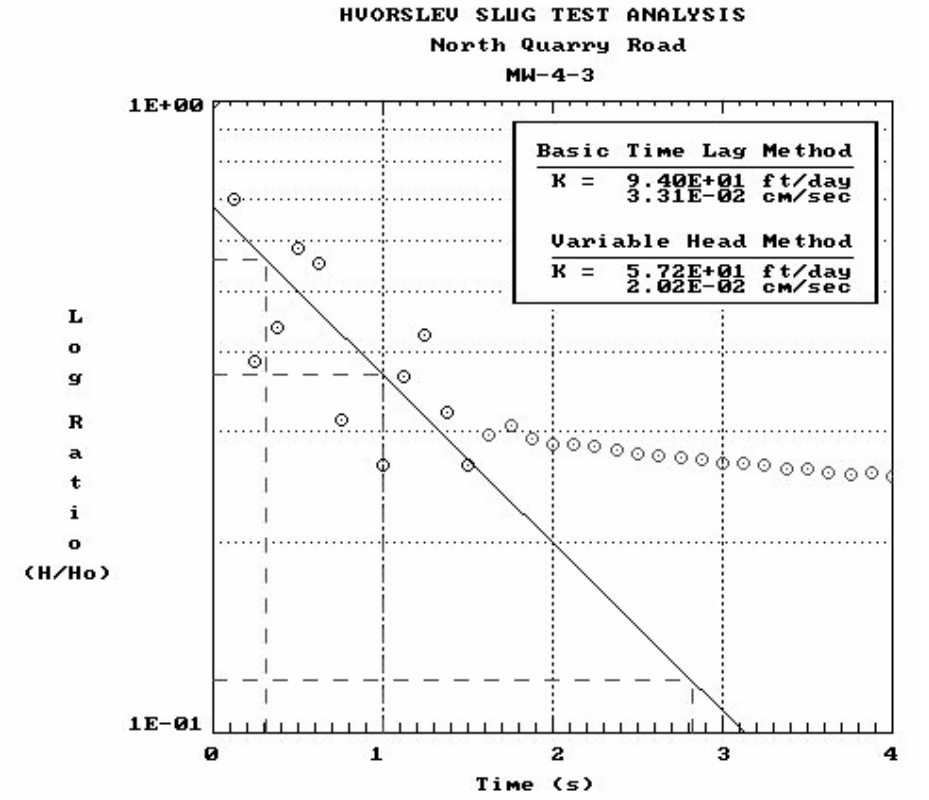
Variable Head-
Hydraulic Conductivity (Kh): 5.72E+01 ft/day
2.02E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 2.8 s
Head Ratio Coordinate H1: 56.16E-02
Head Ratio Coordinate H2: 12.11E-02

Well/Aquifer Parameters

Length of well screen: 11.10 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.701	3	0.2500	0.388
4	0.3750	0.440	5	0.5000	0.584	6	0.6250	0.554
7	0.7500	0.313	8	1.0000	0.265	9	1.1250	0.367
10	1.2500	0.428	11	1.3750	0.321	12	1.5000	0.265
13	1.6250	0.297	14	1.7500	0.307	15	1.8750	0.293
16	2.0000	0.287	17	2.1250	0.287	18	2.2500	0.285
19	2.3750	0.281	20	2.5000	0.277	21	2.6250	0.275
22	2.7500	0.273	23	2.8750	0.271	24	3.0000	0.267
25	3.1250	0.267	26	3.2500	0.265	27	3.3750	0.261
28	3.5000	0.261	29	3.6250	0.259	30	3.7500	0.257
31	3.8750	0.259	32	4.0000	0.255	33	4.0000	0.039



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-5-1
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 9.86E+01 ft/day
3.48E-02 cm/sec
Basic Time Lag: 1.04 s
2.3 Times Basic Time Lag: 2.38 s
(Equalization Ratio ÷ 0.90)

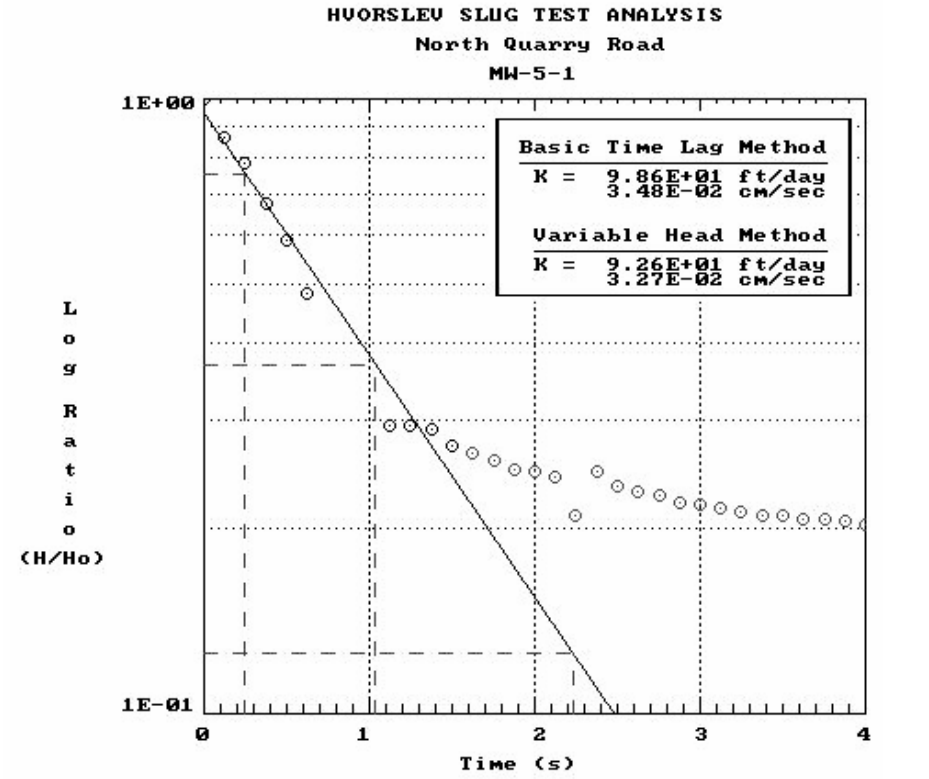
Variable Head-
Hydraulic Conductivity (Kh): 9.26E+01 ft/day
3.27E-02 cm/sec
Time Coordinate T1: 0.2 s
Time Coordinate T2: 2.2 s
Head Ratio Coordinate H1: 75.64E-02
Head Ratio Coordinate H2: 12.52E-02

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.866	3	0.2500	0.787
4	0.3750	0.674	5	0.5000	0.589	6	0.6250	0.484
7	1.1250	0.295	8	1.2500	0.295	9	1.3750	0.289
10	1.5000	0.274	11	1.6250	0.266	12	1.7500	0.258
13	1.8750	0.250	14	2.0000	0.247	15	2.1250	0.242
16	2.2500	0.211	17	2.3750	0.247	18	2.5000	0.234
19	2.6250	0.229	20	2.7500	0.226	21	2.8750	0.221
22	3.0000	0.218	23	3.1250	0.216	24	3.2500	0.213
25	3.3750	0.211	26	3.5000	0.211	27	3.6250	0.208
28	3.7500	0.208	29	3.8750	0.205	30	4.0000	0.203



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-5-2
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 4.41E+01 ft/day
1.56E-02 cm/sec
Basic Time Lag: 2.31 s
2.3 Times Basic Time Lag: 5.32 s
(Equalization Ratio ÷ 0.90)

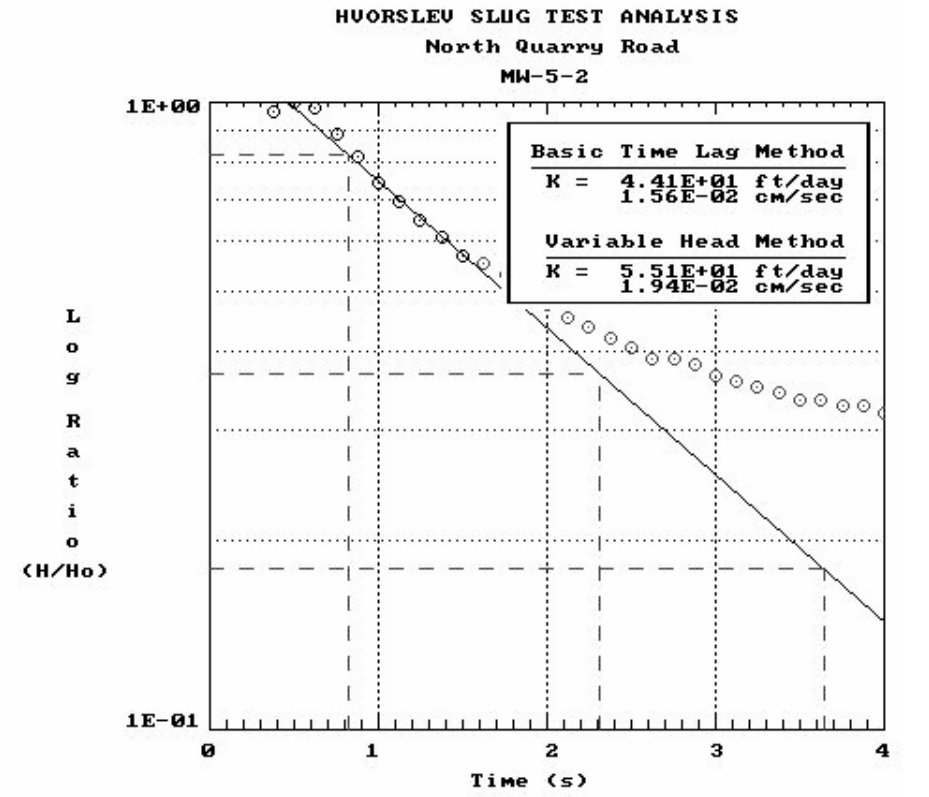
Variable Head-
Hydraulic Conductivity (Kh): 5.51E+01 ft/day
1.94E-02 cm/sec
Time Coordinate T1: 0.8 s
Time Coordinate T2: 3.6 s
Head Ratio Coordinate H1: 82.66E-02
Head Ratio Coordinate H2: 18.02E-02

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.3750	0.969	2	0.5000	1.000	3	0.6250	0.977
4	0.7500	0.891	5	0.8750	0.820	6	1.0000	0.742
7	1.1250	0.695	8	1.2500	0.648	9	1.3750	0.609
10	1.5000	0.570	11	1.6250	0.555	12	1.7500	0.531
13	1.8750	0.500	14	2.0000	0.477	15	2.1250	0.453
16	2.2500	0.438	17	2.3750	0.422	18	2.5000	0.406
19	2.6250	0.391	20	2.7500	0.391	21	2.8750	0.383
22	3.0000	0.367	23	3.1250	0.359	24	3.2500	0.352
25	3.3750	0.344	26	3.3750	0.344	27	3.5000	0.336
28	3.6250	0.336	29	3.7500	0.328	30	3.8750	0.328
31	4.0000	0.320						



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-5-3
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.21E+02 ft/day
4.27E-02 cm/sec
Basic Time Lag: 0.84 s
2.3 Times Basic Time Lag: 1.94 s
(Equalization Ratio ÷ 0.90)

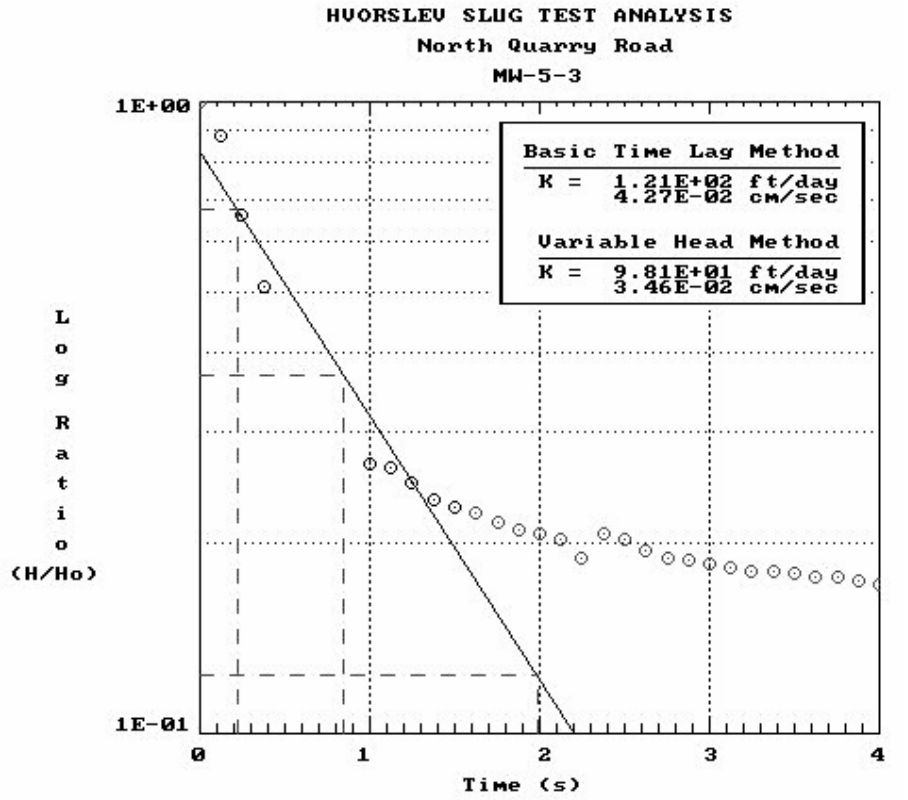
Variable Head-
Hydraulic Conductivity (Kh): 9.81E+01 ft/day
3.46E-02 cm/sec
Time Coordinate T1: 0.2 s
Time Coordinate T2: 2.0 s
Head Ratio Coordinate H1: 67.36E-02
Head Ratio Coordinate H2: 12.36E-02

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.883	3	0.2500	0.660
4	0.3750	0.510	5	1.0000	0.267	6	1.1250	0.263
7	1.2500	0.249	8	1.3750	0.234	9	1.5000	0.227
10	1.6250	0.223	11	1.7500	0.216	12	1.8750	0.210
13	2.0000	0.208	14	2.1250	0.203	15	2.2500	0.190
16	2.3750	0.208	17	2.5000	0.203	18	2.6250	0.194
19	2.7500	0.190	20	2.8750	0.188	21	3.0000	0.185
22	3.1250	0.183	23	3.2500	0.181	24	3.3750	0.181
25	3.5000	0.179	26	3.6250	0.177	27	3.7500	0.177
28	3.8750	0.174	29	4.0000	0.172	30	3.8750	0.328



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-5-4
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 6.17E+01 ft/day
2.18E-02 cm/sec
Basic Time Lag: 1.65 s
2.3 Times Basic Time Lag: 3.80 s
(Equalization Ratio ÷ 0.90)

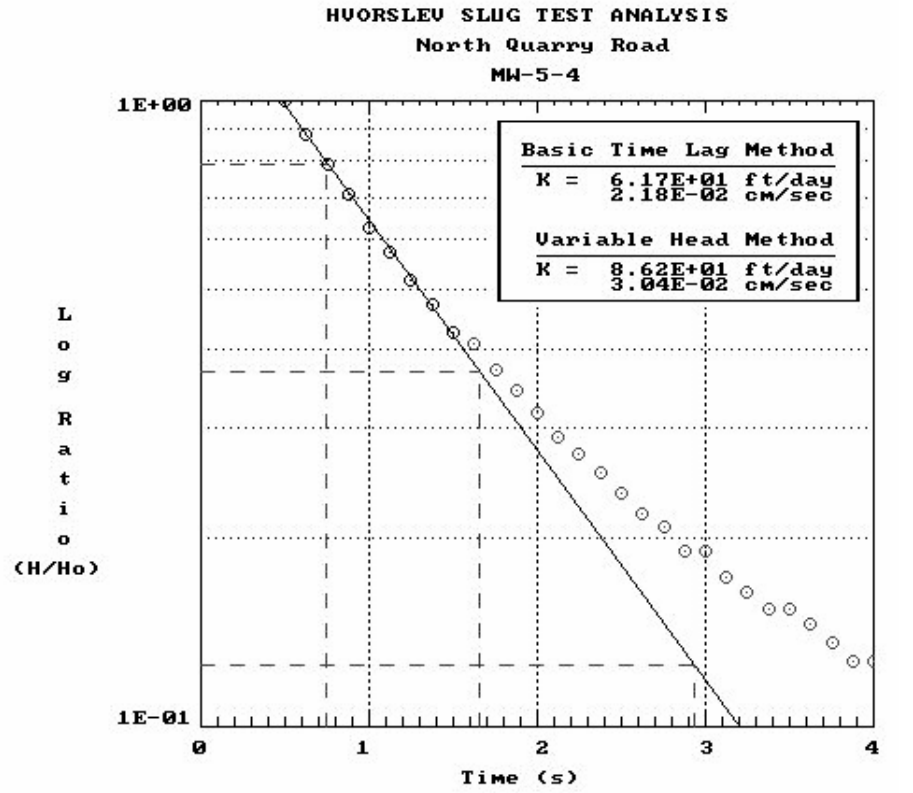
Variable Head-
Hydraulic Conductivity (Kh): 8.62E+01 ft/day
3.04E-02 cm/sec
Time Coordinate T1: 0.7 s
Time Coordinate T2: 2.9 s
Head Ratio Coordinate H1: 79.43E-02
Head Ratio Coordinate H2: 12.59E-02

Well/Aquifer Parameters

Length of well screen: 9.80 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.5000	1.000	2	0.6250	0.882	3	0.7500	0.791
4	0.8750	0.709	5	1.0000	0.627	6	1.1250	0.573
7	1.2500	0.518	8	1.3750	0.473	9	1.5000	0.427
10	1.6250	0.409	11	1.7500	0.373	12	1.8750	0.345
13	2.0000	0.318	14	2.1250	0.291	15	2.2500	0.273
16	2.3750	0.255	17	2.5000	0.236	18	2.6250	0.218
19	2.7500	0.209	20	2.8750	0.191	21	3.0000	0.191
22	3.1250	0.173	23	3.2500	0.164	24	3.3750	0.155
25	3.5000	0.155	26	3.6250	0.145	27	3.7500	0.136
28	3.8750	0.127	29	4.0000	0.127	30	4.0000	0.040



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-6-1
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 8.33E+01 ft/day
2.94E-02 cm/sec
Basic Time Lag: 1.10 s
2.3 Times Basic Time Lag: 2.53 s
(Equalization Ratio ÷ 0.90)

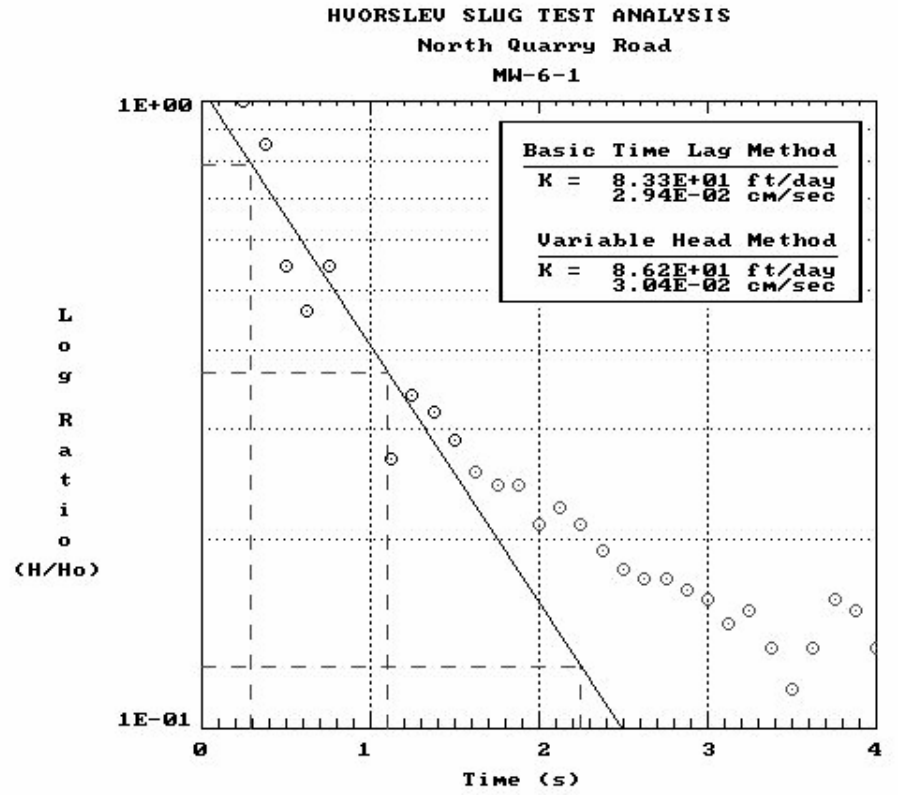
Variable Head-
Hydraulic Conductivity (Kh): 8.62E+01 ft/day
3.04E-02 cm/sec
Time Coordinate T1: 0.3 s
Time Coordinate T2: 2.2 s
Head Ratio Coordinate H1: 79.43E-02
Head Ratio Coordinate H2: 12.59E-02

Well/Aquifer Parameters

Length of well screen: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.2500	1.000	2	0.3750	0.853	3	0.5000	0.545
4	0.6250	0.462	5	0.7500	0.545	6	1.1250	0.269
7	1.2500	0.340	8	1.3750	0.321	9	1.5000	0.288
10	1.6250	0.256	11	1.7500	0.244	12	1.8750	0.244
13	2.0000	0.212	14	2.1250	0.224	15	2.2500	0.212
16	2.3750	0.192	17	2.5000	0.179	18	2.6250	0.173
19	2.7500	0.173	20	2.8750	0.167	21	3.0000	0.160
22	3.1250	0.147	23	3.2500	0.154	24	3.3750	0.135
25	3.5000	0.115	26	3.6250	0.135	27	3.7500	0.160
28	3.8750	0.154	29	4.0000	0.135	30	3.8750	0.057



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-6-2
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 4.48E+01 ft/day
1.58E-02 cm/sec
Basic Time Lag: 2.05 s
2.3 Times Basic Time Lag: 4.71 s
(Equalization Ratio ÷ 0.90)

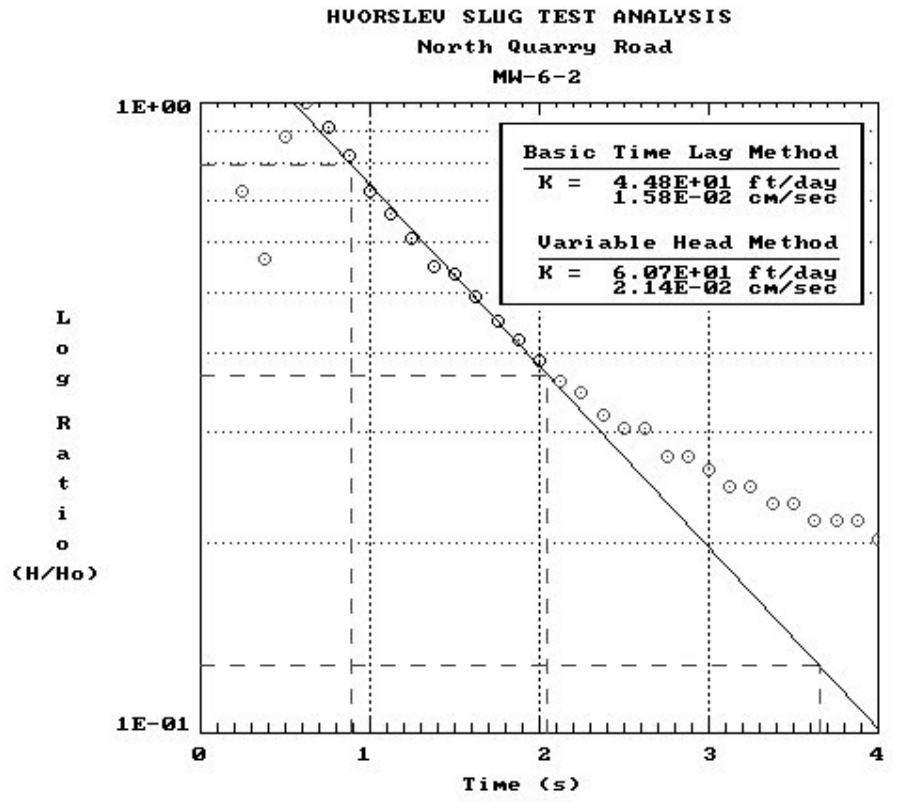
Variable Head-
Hydraulic Conductivity (Kh): 6.07E+01 ft/day
2.14E-02 cm/sec
Time Coordinate T1: 0.9 s
Time Coordinate T2: 3.7 s
Head Ratio Coordinate H1: 79.56E-02
Head Ratio Coordinate H2: 12.76E-02

Well/Aquifer Parameters

Length of well screen: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.2500	0.725	2	0.3750	0.565	3	0.5000	0.884
4	0.6250	1.000	5	0.7500	0.913	6	0.8750	0.826
7	1.0000	0.725	8	1.1250	0.667	9	1.2500	0.609
10	1.3750	0.551	11	1.5000	0.536	12	1.6250	0.493
13	1.7500	0.449	14	1.8750	0.420	15	2.0000	0.391
16	2.1250	0.362	17	2.2500	0.348	18	2.3750	0.319
19	2.5000	0.304	20	2.6250	0.304	21	2.7500	0.275
22	2.8750	0.275	23	3.0000	0.261	24	3.1250	0.246
25	3.2500	0.246	26	3.3750	0.232	27	3.5000	0.232
28	3.6250	0.217	29	3.7500	0.217	30	3.8750	0.217
31	4.0000	0.203						



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-6-3
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 1.48E+02 ft/day
5.21E-02 cm/sec
Basic Time Lag: 0.62 s
2.3 Times Basic Time Lag: 1.43 s
(Equalization Ratio ÷ 0.90)

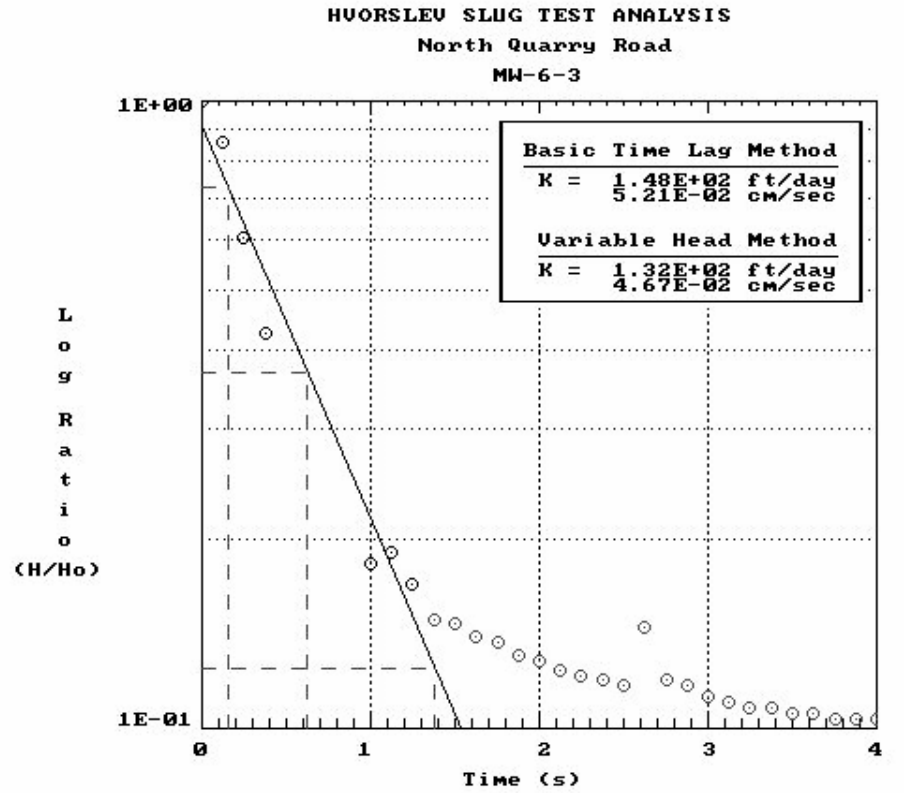
Variable Head-
Hydraulic Conductivity (Kh): 1.32E+02 ft/day
4.67E-02 cm/sec
Time Coordinate T1: 0.2 s
Time Coordinate T2: 1.4 s
Head Ratio Coordinate H1: 72.78E-02
Head Ratio Coordinate H2: 12.47E-02

Well/Aquifer Parameters

Length of well screen: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.0000	1.000	2	0.1250	0.858	3	0.2500	0.606
4	0.3750	0.427	5	1.0000	0.183	6	1.1250	0.190
7	1.2500	0.170	8	1.3750	0.149	9	1.5000	0.147
10	1.6250	0.140	11	1.7500	0.138	12	1.8750	0.131
13	2.0000	0.128	14	2.1250	0.124	15	2.2500	0.122
16	2.3750	0.119	17	2.5000	0.117	18	2.6250	0.144
19	2.7500	0.119	20	2.8750	0.117	21	3.0000	0.112
22	3.1250	0.110	23	3.2500	0.108	24	3.3750	0.108
25	3.5000	0.106	26	3.6250	0.106	27	3.7500	0.103
28	3.8750	0.103	29	4.0000	0.103	30	3.8750	0.217



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 05-23-2019

North Quarry Road
MW-6-4
GeoHydroCycle, Inc.

Results

Basic Time Lag-
Hydraulic Conductivity (Kh): 6.07E+01 ft/day
2.14E-02 cm/sec
Basic Time Lag: 1.51 s
2.3 Times Basic Time Lag: 3.47 s
(Equalization Ratio ÷ 0.90)

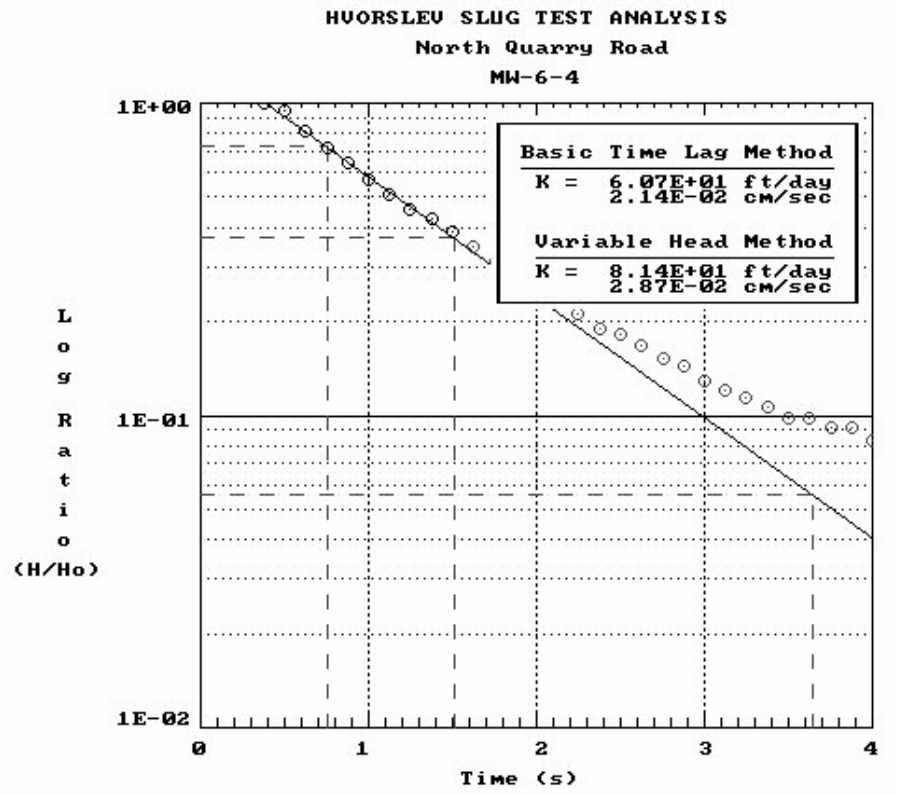
Variable Head-
Hydraulic Conductivity (Kh): 8.14E+01 ft/day
2.87E-02 cm/sec
Time Coordinate T1: 0.8 s
Time Coordinate T2: 3.6 s
Head Ratio Coordinate H1: 72.60E-02
Head Ratio Coordinate H2: 56.01E-03

Well/Aquifer Parameters

Length of well screen: 11.40 ft
Diameter of the well casing: 0.167 ft
Diameter of the well bore: 0.708 ft
Kh/Kv ratio: 1.0

Time vs Drawdown Ratio Data

No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)	No.	Time (s)	H/Hmax (ft)
1	0.3750	1.000	2	0.5000	0.947	3	0.6250	0.818
4	0.7500	0.720	5	0.8750	0.644	6	1.0000	0.568
7	1.1250	0.508	8	1.2500	0.455	9	1.3750	0.424
10	1.5000	0.386	11	1.6250	0.348	12	1.7500	0.311
13	1.8750	0.280	14	2.0000	0.250	15	2.1250	0.235
16	2.2500	0.212	17	2.3750	0.189	18	2.5000	0.182
19	2.6250	0.167	20	2.7500	0.152	21	2.8750	0.144
22	3.0000	0.129	23	3.1250	0.121	24	3.2500	0.114
25	3.3750	0.106	26	3.5000	0.098	27	3.6250	0.098
28	3.7500	0.091	29	3.8750	0.091	30	4.0000	0.083



Enclosure 5 - Groundwater Time of Travel

Time of Travel to a Single Pumping Well Calculation
Plus a Natural Gradient

Project: Quarry North Road
Well: Sudbury #5

Input

Pumping Well Parameters

Pumping Rate (Q):	67,380	cf/day	504,000 GPD
Hydraulic Conductivity (K):	271.7	ft/day	350 GPM
Saturated Thickness:	65	ft	
Transmissivity:	17,661	sf/day	

Natural Gradient

Hydraulic Conductivity (K):	82.5	ft/day				
Natural Gradient (i_h):	0.0075	ft/ft	Mnd + SHGW:	126.3	GWE @ Sudbury 5:	116.0
Effective Porosity (φ):	0.30					

Calculations

Q/(2*Pi*T) = 0.607 ft

Table Parameters

Start: 1,371 ft
Increment: 27.42 ft

Step	Incremental Distance (feet)		(feet)	Natural Gradient (ft/ft)	Pumping Gradient (ft/ft)	Hydraulic Conductivity (ft/day)	Effective Porosity (φ):	Groundwater Velocity (ft/day)	Incremental Trav Time (days)	Cumulative Travel Time (days)	(years)
1	1,371	to	1,344	0.0075	0.0004	82.5	0.30	2.189	12.5	13	0.03
2	1,344	to	1,316	0.0075	0.0005	82.5	0.30	2.192	12.5	25	0.07
3	1,316	to	1,289	0.0075	0.0005	82.5	0.30	2.194	12.5	38	0.10
4	1,289	to	1,261	0.0075	0.0005	82.5	0.30	2.197	12.5	50	0.14
5	1,261	to	1,234	0.0075	0.0005	82.5	0.30	2.200	12.5	62	0.17
6	1,234	to	1,206	0.0075	0.0005	82.5	0.30	2.203	12.4	75	0.21
7	1,206	to	1,179	0.0075	0.0005	82.5	0.30	2.206	12.4	87	0.24
8	1,179	to	1,152	0.0075	0.0005	82.5	0.30	2.209	12.4	100	0.27
9	1,152	to	1,124	0.0075	0.0005	82.5	0.30	2.213	12.4	112	0.31
10	1,124	to	1,097	0.0075	0.0005	82.5	0.30	2.216	12.4	125	0.34
11	1,097	to	1,069	0.0075	0.0006	82.5	0.30	2.220	12.4	137	0.38
12	1,069	to	1,042	0.0075	0.0006	82.5	0.30	2.224	12.3	149	0.41
13	1,042	to	1,015	0.0075	0.0006	82.5	0.30	2.228	12.3	162	0.44
14	1,015	to	987	0.0075	0.0006	82.5	0.30	2.233	12.3	174	0.48
15	987	to	960	0.0075	0.0006	82.5	0.30	2.238	12.3	186	0.51
16	960	to	932	0.0075	0.0006	82.5	0.30	2.243	12.2	198	0.54
17	932	to	905	0.0075	0.0007	82.5	0.30	2.248	12.2	210	0.58
18	905	to	877	0.0075	0.0007	82.5	0.30	2.253	12.2	223	0.61
19	877	to	850	0.0075	0.0007	82.5	0.30	2.259	12.1	235	0.64
20	850	to	823	0.0075	0.0007	82.5	0.30	2.266	12.1	247	0.68
21	823	to	795	0.0075	0.0008	82.5	0.30	2.272	12.1	259	0.71
22	795	to	768	0.0075	0.0008	82.5	0.30	2.280	12.0	271	0.74
23	768	to	740	0.0075	0.0008	271.7	0.30	7.533	3.6	275	0.75
24	740	to	713	0.0075	0.0008	271.7	0.30	7.561	3.6	278	0.76
25	713	to	686	0.0075	0.0009	271.7	0.30	7.591	3.6	282	0.77
26	686	to	658	0.0075	0.0009	271.7	0.30	7.623	3.6	285	0.78
27	658	to	631	0.0075	0.0009	271.7	0.30	7.658	3.6	289	0.79
28	631	to	603	0.0075	0.0010	271.7	0.30	7.695	3.6	293	0.80
29	603	to	576	0.0075	0.0010	271.7	0.30	7.737	3.5	296	0.81
30	576	to	548	0.0075	0.0011	271.7	0.30	7.782	3.5	300	0.82
31	548	to	521	0.0075	0.0011	271.7	0.30	7.833	3.5	303	0.83
32	521	to	494	0.0075	0.0012	271.7	0.30	7.888	3.5	307	0.84
33	494	to	466	0.0075	0.0013	271.7	0.30	7.950	3.4	310	0.85
34	466	to	439	0.0075	0.0013	271.7	0.30	8.020	3.4	314	0.86
35	439	to	411	0.0075	0.0014	271.7	0.30	8.098	3.4	317	0.87
36	411	to	384	0.0075	0.0015	271.7	0.30	8.187	3.3	320	0.88
37	384	to	356	0.0075	0.0016	271.7	0.30	8.290	3.3	324	0.89
38	356	to	329	0.0075	0.0018	271.7	0.30	8.409	3.3	327	0.90
39	329	to	302	0.0075	0.0019	271.7	0.30	8.548	3.2	330	0.90
40	302	to	274	0.0075	0.0021	271.7	0.30	8.714	3.1	333	0.91
41	274	to	247	0.0075	0.0023	271.7	0.30	8.915	3.1	336	0.92
42	247	to	219	0.0075	0.0026	271.7	0.30	9.164	3.0	339	0.93
43	219	to	192	0.0075	0.0030	271.7	0.30	9.478	2.9	342	0.94
44	192	to	165	0.0075	0.0034	271.7	0.30	9.890	2.8	345	0.94
45	165	to	137	0.0075	0.0040	271.7	0.30	10.451	2.6	348	0.95
46	137	to	110	0.0075	0.0049	271.7	0.30	11.261	2.4	350	0.96
47	110	to	82	0.0075	0.0063	271.7	0.30	12.534	2.2	352	0.96
48	82	to	55	0.0075	0.0089	271.7	0.30	14.827	1.8	354	0.97
49	55	to	27	0.0075	0.0148	271.7	0.30	20.175	1.4	355	0.97
50	27	to	0	0.0075	0.0443	271.7	0.30	46.916	0.6	**356**	**0.98**

Enclosure 6 - Copies of Transmittal Form X283990 and BRP WP 83

Enter your transmittal number → X283990 (Transmittal Number)

Your unique Transmittal Number can be accessed online:
http://www.mass.gov/eea/agencies/massdep/service/approvals/transmittal-form-for-payment.html

Massachusetts Department of Environmental Protection

Transmittal Form for Permit Application and Payment

1. Please type or print. A separate Transmittal Form must be completed for each permit application.

2. Make your check payable to the Commonwealth of Massachusetts and mail it with a copy of this form to: MassDEP, P.O. Box 4062, Boston, MA 02211.

3. Three copies of this form will be needed.

Copy 1 - the original must accompany your permit application. **Copy 2** must accompany your fee payment. **Copy 3** should be retained for your records

4. Both fee-paying and exempt applicants must mail a copy of this transmittal form to:

MassDEP
P.O. Box 4062
Boston, MA
02211

*** Note:**
For BWSC Permits, enter the LSP.

A. Permit Information

1. Permit Code: 4 to 7 character code from permit instructions	2. Name of Permit Category
BRP WP 83	Hydrogeologic Evaluation

3. Type of Project or Activity: Groundwater Discharge Permit

B. Applicant Information – Firm or Individual

1. Name of Firm - Or, if party needing this approval is an individual enter name below: Quarry North Road LLC

2. **Last Name** of Individual	3. **First Name** of Individual	4. MI

5. Street Address: 2134 Sevilla Way

6. City/Town	7. State	8. Zip Code	9. Telephone #	10. Ext. #
Naples	FL	34109	2395715500	

11. Contact Person	12. e-mail address
Chris Claussen	cgclaussen@gmail.com

C. Facility, Site or Individual Requiring Approval

1. Name of Facility, Site Or Individual

2. Street Address

3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #

8. DEP Facility Number (if Known)	9. Federal I.D. Number (if Known)	10. BWSC Tracking # (if Known)

D. Application Prepared by (if different from Section B)*

1. Name of Firm Or Individual: GeoHydroCycle, Inc.

2. Address: 5 Madison Avenue

3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #
Newtonville	MA	02460	(617) 527-8074	

8. Contact Person	9. LSP Number (BWSC Permits only)
Stephen W. Smith, P.E.	

E. Permit - Project Coordination

1. Is this project subject to MEPA review? ☐ yes ☒ no
If yes, enter the project's EOEA file number - assigned when an Environmental Notification Form is submitted to the MEPA unit:

EOEA File Number

F. Amount Due

DEP Use Only

Permit No:

Rec'd Date:

Reviewer:

Special Provisions:

1. ☐ **Fee** Exempt (city, town or municipal housing authority)(state agency if fee is $100 or less).
There are no fee exemptions for BWSC permits, regardless of applicant status.
2. ☐ Hardship Request - payment extensions according to 310 CMR 4.04(3)(c).
3. ☐ Alternative Schedule Project (according to 310 CMR 4.05 and 4.10).
4. ☐ Homeowner (according to 310 CMR 4.02).

Check Number	Dollar Amount	Date
	$10,005.	

Massachusetts Department of Environmental Protection
Bureau of Resource Protection–Groundwater Discharge Permit Program

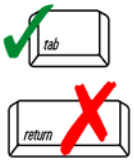
BRP WP 83 Application to Prepare a Hydrogeological Evaluation

X283990
Transmittal Number #

Facility ID/Permit # (if known)

A. General Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



1. Applicant Information:

Name

Quarry North Road LLC
Company Name (If applicable)

2134 Sevilla Way
Address

Naples
City/Town

FL
State

2395715500
Telephone

34109
Zip Code

cgclaussen@gmail.com
Email address

2. Applicant Contact Information (if different from above):

Chris Claussen
Contact Name

Quarry North Road LLC
Company Name (If applicable)

Manager
Title

2134 Sevilla Way
Address

Naples
City/Town

FL
State

2395715500
Telephone

34109
Zip Code

cgclaussen@gmail.com
email address

B. Project Information

1. Has a pre-scoping meeting been held with MassDEP personnel?

☒ Yes ☐ No If yes, date of pre-scoping meeting: 05/01/2019

2. Has a public notice been placed in the Environmental Monitor that the scope of work has been prepared and will be submitted to MassDEP in accordance with 314 CMR 5.09(1)(b)?

☒ Yes ☐ No If yes, date of Environmental Monitor: 04/24/2019

3. Is there a discharge presently located on the site?

☐ Yes ☒ No If yes, answer the following:

When did the discharge begin? Date of startup:

Description of discharge:

BRP WP 83 Application to Prepare a Hydrogeological Evaluation

X283990
Transmittal Number #

Facility ID/Permit # (if known)

B. Project Information (cont.)

4. Improvements - Are you required by any Federal, State or local authority to meet any implementation schedule for the construction, upgrading or operation of wastewater treatment equipment or practices or any other environmental programs which may affect the discharges described in this application? This includes, but is not limited to; permit conditions, administrative or enforcement orders, enforcement compliance schedule letters, stipulations, court orders, and grant or loan conditions.

☐ Yes ☒ No

If yes, answer the following:

Description of order or agreement (include enforcement document number, if applicable):

Identification No. of Affected Treatment Facility

Description of Project

Final Compliance Date

C. Site Information

1. GPS Coordinates:

   a) Enter Latitude and Longitude to the nearest whole second for the proposed site.

   Latitude: N 42º 25' 13" Longitude: W 71º 23' 16"

   b) Provide a narrative description of the site and the feature to be permitted. As an example: "The site is on the west side of Main Street, the third building north of High Street. The disposal field lies 100 feet off the southwest corner of the building."

   c) Attach a site map based on the MassGIS Coordinate Information Tool that clearly indicates the site. The Coordinate Information Tool is available at http://maps.massgis.state.ma.us/images/dep/xyinfo/get_xy.html.

BRP WP 83 Application to Prepare a Hydrogeological Evaluation

X283990
Transmittal Number #

Facility ID/Permit # (if known)

C. Site Information (cont.)

2. Provide a topographic map or maps of the area extending at least to one mile beyond the property boundaries of the site which clearly show the following:

   1) The legal boundaries of the site;
   2) All hazardous waste management facilities;
   3) All springs and surface water bodies in the area, plus all drinking water wells within one mile of the facility which are identified in the public record or otherwise known to you.
   4) All Zone II's or IWPA's.

3. Please list any public or private drinking water supply wells within 2,500 feet of the proposed site:

Well Location	Type of Well (Public/Private)	Status (Active/Inactive)	Safe Yield
GP Well #5	Sudbury Public	Inactive	351
White Pond Well	Concord Public	Active	535

D. Certification

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I will be responsible for publication of public notice of the applicable permit proceedings identified under 314 CMR 2.06(1)(a) through (d)."

	Chris Claussen
Signature of Applicant	Printed Name of Applicant
Date Signed	
Stephen W. Smith	(617) 527-8074
Name of Preparer	Telephone
President, GeoHydroCycle, Inc.	swsmith@geohydrocycle.com
Title of Preparer	email

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

October 1, 2019

Mr. Chris Claussen
Quarry North Road, LLC
2134 Sevilla Way
Naples, FL 34109

RE: Approval of Supplemental Hydrogeological Evaluation Report
WP83 Application: Hydrogeologic Report
Quarry North Road, LLC. Sudbury, Massachusetts
Transmittal number: X283990

Dear Mr. Claussen:

The Massachusetts Department of Environmental Protection (MassDEP) has completed its review of a report titled *Hydrogeological Evaluation and Groundwater Mounding Analysis* ("Report") that was submitted by GeoHydroCycle, Inc. (GHC) and received by MassDEP on August 7, 2019. Subsequently, additional information was provided by Provencher Engineering, LLC via email on September 30, 2019 addressing the reserve soil absorption system. The report summarizes the results of a hydrogeologic evaluation conducted by GHC to support a future Groundwater Discharge Permit Application located at 36 North Road, Sudbury, MA 01776. The evaluation was conducted in accordance with the scope of work submitted by GHC during the pre-application meeting with MassDEP on May 1, 2019. Notice of the availability of the scope of work was published in the Environmental Monitor on April 24, 2019.

The proposed project is a planned residential subdivision located at 36 North Road/ Route 117 in Sudbury, MA. The site was a former sand and gravel quarry that has seen extensive excavation as evidenced by its irregular topography. The facility proposes to develop 1, 2, & 3- bedroom units of regular residential and elderly housing with a total of 490 bedrooms and a wastewater discharge design flow rate of 49,700 gallons per day (GPD) which will be discharged to a proposed primary subsurface absorption system (SAS) of 19,000 square feet. A reserve SAS of

11,400 square feet is proposed to the west of the primary SAS. There are two active public water supply wells within one mile of the SAS: the Concord White Pond Wells to the northwest and Sudbury Well #5 to the southeast. The proposed site for the SAS is located outside of the Zone II boundary for the White Pond Wells, but within the Zone II for Sudbury Well #5. The Sudbury Well #5 is located 1,365 feet southeast of the proposed SAS. A travel time analysis performed to estimate the time groundwater would take to travel from the SAS to Sudbury Well #5 resulted in an estimated travel time of 356 days or 0.98 year. The groundwater elevation data obtained from April through June 2019 from monitoring wells MW-1 through MW-6 indicates that the groundwater generally flows towards the southeast, as shown in Figure 6. *Groundwater Contour Elevation, Measured 4/22/2019* of the report.

The property is located on a kame delta formed in glacial Lake Sudbury. Soils test and borings, included six (6) monitoring wells, thirteen (13) test pits and four (4) percolation tests, were performed within and around the foot print of the proposed SAS. The monitoring/boring well data indicates that outwash deposits consist of mostly fine to medium sand with a trace of silt from the surface to the bottom of the excavations with the exception of boring B-1 which encountered bedrock refusal at 42 feet indicating an upward sloping of the bedrock surface to the west of the proposed site. The soil logs for the thirteen (13) test pits indicate sand and loamy sand to depths of 192 inches. The percolation test results ranged from less than 2 minutes per inch (mpi) to 6 mpi. A hydraulic conductivity of 82.5 feet/day was estimated for the site which is appropriate for the soils that were evidenced in the boring logs and test pits.

No evidence of redoximorphic features indicative of Estimated Seasonal High Groundwater (ESHGW) were observed during the soils tests. The report utilized a 10% exceedance value in the Frimpter Method calculations, resulting in an ESHGW of El. 123.3 feet. MassDEP recommends that future calculations be performed using a 5% exceedance value which would increase the ESHGW in the monitoring wells by 0.3 ft. as well as the elevation of the top of the mound to El. 126.6 feet rather than El. 126.3 feet.

Based on our review of the proposed monitoring well locations and the flow field as illustrated in Figure 10, we agree, based on our review of currently available data, that CMW-1, CMW-2 and CMW-3 are appropriately located. CMW-1 should be outside of the influence of the proposed discharge and based on Figure 13, CMW-2 and CMW-3 are downgradient of the proposed SAS location. Further sampling of the three monitoring wells will provide more details on the suitability of the well location.

Pursuant to 314 CMR 5.09(l)(f), MassDEP hereby approves the hydrogeologic report submitted by GHC and authorizes the applicant to apply for an **Individual Groundwater Discharge Permit (BRPWP79)** subject to the following conditions:

1) The design flow to the proposed subsurface absorption system shall not exceed 49,755 gallons per day.

2) The long term application rate to the SAS shall not be greater than 2.59 gallons/day/ square foot.

3) The proposed SAS shall not be constructed until a Groundwater Discharge Permit has been obtained from MassDEP. The proposed SAS shall be constructed within the footprint indicated on Figure 13 titled "Proposed Locations of Compliance Wells" of the August 7, 2019 Hydrogeologic Evaluation Report.

4) The minimum allowable bottom elevation of the proposed SAS shall be constructed at El. 136 feet. Unsuitable organics shall be removed and the excavation shall be backfilled with Title 5 fill.

5) MassDEP approves the use of monitoring well locations as shown in Figure 13, titled "Proposed Locations of Compliance Wells" of the Report and understands these will remain unchanged. Any changes to the monitoring well network are to be submitted to this office for approval prior to well installation. MassDEP requires all monthly sampling of the monitoring wells beginning from the issuance of this approval to be submitted along with the Individual Groundwater Discharge application. The location of the monitoring wells will be subject to further review and approval during that time.

6) An Initial Groundwater Monitoring Well and Groundwater Quality Report must be submitted to this office prior to any discharge of wastewater. This report must include:
    a. A final surveyed site plan with the location of the SAS, monitoring wells, the appropriate surveyed elevation data including top-of-casing and top-of-PVC elevations for all monitoring wells, location of cultural features such as buildings, roads, athletic fields, leach fields, and groundwater flow direction;
    b. Boring logs and well construction details for all monitoring wells; and
    c. Analytical results of the groundwater samples collected from the final groundwater monitoring wells. These results will establish the baseline groundwater quality for the site.

Please be advised that this approval **is not** a Groundwater Discharge Permit. It does, however, authorize the project proponent to submit an Individual Groundwater Discharge Permit application for the project site. MassDEP requires that the Individual Groundwater Discharge Permit application (BRPWP 79) be accompanied by a MassDEP Transmittal form and include all required supporting documentation. Included in the supporting documentation shall be a certification from a Massachusetts Registered Professional Engineer that the approved

Hydrogeological Report has been reviewed and accurately reflects site conditions as of the date of the permit application. Information on any changes noted during the review shall be included in the Engineering Report that accompanies the application.

If you have questions regarding the comments and conditions of this approval, please contact Tenzin Lama of my staff at 978-694-3241 or via email at Tenzin.Lama@mass.gov.

Sincerely,

Kevin Brander, P.E.
Section Chief
Wastewater Management Section

KB/PB/JN/TL

Enclosure

Cc: Steve Smith, P.E., President, GeoHydroCycle, Inc.
Donald A. Provencher, P.E., Provencher Engineering, LLC
Paul Blain/Bureau of Water Resources/MassDEP/Boston
Bill Murphy, Board of Health, Town of Sudbury
Marybeth Chubb/Wastewater Management Program/MassDEP/Boston