PHASE 14 SOLID WASTE PERMIT APPLICATION

VOLUME III OF VI

Geologic and Hydrogeologic Assessment

Crossroads Landfill
Norridgewock, Maine

Prepared for

Waste Management Disposal Services of Maine, Inc.

357 Mercer Road
Norridgewock, Maine

Prepared by

Golder Associates Inc.
670 N Commercial Street, Suite 103
Manchester, New Hampshire 03101

Project 19119078

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1.0 INTRODUCTION

At the request of Waste Management Disposal Services of Maine, Inc. – Crossroads Landfill (WMDSM, also referred to the Crossroads Landfill), Golder Associates Inc. (Golder) prepared this Geologic and Hydrogeological Assessment Report in support of the proposed Phase 14 landfill at the WMDSM facility in Norridgewock, Maine (the Site).

1.1 Objective

This report was prepared to satisfy the requirements established by the Maine Department of Environmental Protection (MEDEP) related to the geologic and hydrogeologic conditions, specifically, Chapter 401 Section 2.B, 2.C, 2.G, and 2.K of the Maine Solid Waste Management Rules (Maine SWMR), effective 2 November 1998 (revisions effective 12 April 2015). This document represents Volume III of the Phase 14 Permit Application package, which, in its entirety, is organized as follows:

- Volume I - Application Form and General Information Requirements
- Volume II - Natural Resources Protection Act (NRPA) Application
- Volume III - Geologic and Hydrogeologic Assessment
- Volume IV - Landfill Engineering Report
- Volume V - Site Operations Manual
- Volume VI - Draft Construction Bid Documents

The requirements of Chapter 401 Section 2.B, 2.C, 2.G, and 2.K are listed below along with the location (in either this report or other parts of the application) where the requirements are addressed:

Maine SWMR Chapter	Regulatory Requirements	Location Within Report/Application
401.2.B	Site Specific Investigation	Volume III, Section 2.0
401.2.B(1)	Geological Investigation	Volume III, Section 2.0
401.2.B(1)(a)	Bedrock Investigation	Volume III, 2.0, 3.4 and 4.4
401.2.B(1)(a)(i)	Bedrock lithology	Volume III, 3.4 and 4.4
401.2.B(1)(a)(ii)	Structure	Volume III 3.4 and 4.4
401.2.B(1)(a)(iii)	Aquifer characteristics	Volume III, Section 5.1.1.4 and 5.2.4
401.2.B(1)(a)(iv)	The degree of weathering	Volume III, Section 4.4
401.2.B(1)(b)	Hydraulic Conductivity Tests	Volume III, Section 5.2
401.2.B(1)(c)	Hydrogeological Site Conditions	Volume III, Section 5.0 through 5.4
401.2.B(2)	Ground and Surface Water Investigation	Volume III, Section 2.0

Maine SWMR Chapter	Regulatory Requirements	Location Within Report/Application
401.2.B(2)(b)	Water Table Observation Wells/Piezometers	Volume III, Figures 12a and 12c
401.2.B(2)(b)	Site Characterization Monitoring	Volume III, Section 7.0
401.2.B(2)(c)	Summary and Interpretation of Water Quality Data	Volume III, Section 7.0
401.2.B(3)	Geotechnical Investigation	Volume IV, Section 2.0
401.2.C	Site Assessment Report:	Volume III
401.2.C(1)	Maps, Drawings and Sections showing:	As follows:
401.2.C(1)(a)	Topographic base map	Volume III, Figure 2
401.2.C(1)(b)	Surficial geologic map	Volume III, Figure 3
401.2.C(1)(c)	Geologic cross-sections	Volume III, Figures 11a and 11b
401.2.C(1)(d)	Isopach map of surficial deposits	Volume III, Figures 5b, 6b, 7b, and 8b
401.2.C(1)(e)	Bedrock contour map	Volume III, Figure 9
401.2.C(1)(f)	Two phreatic surface contour maps	Volume III, Figures 12a and 12c
401.2.C(1)(g)	Vertical flow	Volume III, Figure 15
401.2.C(1)(h)	Drawings showing:	As follows:
401.2.C(1)(h)(i)	Existing grade of the site and proposed initial and final grades	Volume IV Appendix IV (a)
401.2.C(1)(h)(ii)	The location of all test pits, borings and other explorations	Volume III, Figure 1
401.2.C(1)(h)(iii)	The location and elevation of the permanent on-site benchmark	Volume III Figure 12b
401.2.C(1)(h)(iv)	The property boundary when located within 500-ft. of the facility site	Volume I Appendix 26A Figure S26-2
401.2.C(1)(h)(v)	The location of protected natural resources and drainageways when located with 500-ft. of the facility site	Volume II Attachment 9
401.2.C(1)(h)(vi)	The location of existing and proposed water supply wells or water supply springs within 1000-ft. of the solid waste boundary	Volume I, Figure S1-1 of Appendix 1B
401.2.C(1)(h)(vii)	The locations of existing and proposed access roads	Volume IV Appendix IV(a)

Maine SWMR Chapter	Regulatory Requirements	Location Within Report/Application
401.2.C(1)(h)(viii)	The location of all proposed surface and groundwater monitoring points	Volume III, Figure 16
401.2.C(1)(h)(ix)	The location and identification of buffer zones and visual screening provisions	Volume I Section 7 and 26 and Appendix 26A Figure S26-2
401.2.C(1)(h)(x)	The location of the proposed solid waste boundary and all proposed waste handling area boundaries	Volume IV Appendix IV(a)
401.2.C(2)	Time of Travel Calculations	Volume III, Sections 6.3, 6.4
401.2.C(3)	Geotechnical Results	Volume IV Section 2.4
401.2.G	Contaminant Transport Analysis	Volume III, Section 6
401.2.K	Water Quality Report and Proposed Monitoring Program	Volume III, Section 7.0

1.2 General Site Description

The WMDSM facility is located in Norridgewock, Maine, approximately 15 miles northwest of Waterville, Maine. A site location map is provided as Figure 1. WMDSM is proposing to construct a new, approximately 48.6-acre landfill (Phase 14) to the east of previously permitted landfills at the location illustrated on Figure 1.

Extensive subsurface investigations have been conducted at the WMDSM facility in support of previous landfill permitting activities. Information from these previous investigations is used to supplement the subsurface investigation data collected for the Phase 14 solid waste permit application. Specifically, geologic and hydrogeologic information from the following reports is incorporated in this report:

- Hydrogeologic Report, Phase 8 Permit Application, Crossroads Landfill, Norridgewock, Maine (Golder, 2001), herein referred to as the “Phase 8 Permit Application (Golder, 2001)”
- Phases 9, 11, and 12 Landfill Expansion (Robert G. Gerber, May 1996), herein referred to as the “Gerber Report (1996)”
- Phase VIII and Phase X Landfill Expansion Application, Consolidated Waste Services, Inc., Norridgewock, Maine, Volume III, Hydrogeological Investigations” (Robert G. Gerber, January 1993), herein referred to as the “Gerber Report (1993)”

Where appropriate, information from these documents has been incorporated into this report.

2.0 SITE SPECIFIC INVESTIGATIONS

Golder conducted a series of subsurface investigations in 2017, 2018 and 2019 in the area of Phase 14 to obtain site-specific geologic and hydrogeologic information. The subsurface investigations included:

- Installation of 64 overburden monitoring wells and piezometers
- Installation of 4 bedrock monitoring wells

- Installation of 7 stream piezometers/staff gauges
- Collection of 25 soil samples for laboratory testing of grain size, Atterberg limits and/or permeability
- Slug testing (i.e., hydraulic testing) of 40 monitoring wells and piezometers
- Completion of 29 rounds of water level measurements

Information obtained from these investigations was supplemented by information from subsurface investigations conducted by Geosyntec Consultants (Geosyntec) to support the Phase 14 landfill engineering design, which included:

- Piezocone penetration testing (CPT) at 46 locations
- 22 geotechnical borings
- Installation of 14 vibrating wire piezometers and 6 standpipe piezometers.

2.1 Investigation Methodologies

The following sections describe the investigation methods used by Golder to collect geologic and hydrogeologic information in the area of Phase 14.

2.1.1 Soil and Bedrock Borings

Between September 2017 and April 2019, Golder subcontracted New England Boring Contractors of Hermon, Maine (NEB) and S.W. Cole Explorations (S.W. COLE) of Bangor, Maine to advance soil and bedrock borings, collect soil samples, and install piezometers and monitoring wells.

Golder advanced a soil boring at each piezometer/monitoring well location (i.e., one soil boring at each piezometer/well cluster) and collected continuous split-spoon samples into the glacial till, after which split-spoon samples were collected at five-foot intervals until bedrock was encountered. Blow counts and N- values (blows per foot) were recorded during split-spoon sampling. Golder personnel logged split spoon samples and lithologically classified soil using a method based on the Unified Soil Classification System (USCS).

Golder also advanced borings approximately 40 ft. into bedrock at four locations (MW14-01, MW14-02, MW14-03, and MW14-04) using HQ (3.78-inch diameter) diamond bit coring techniques. Continuous core samples up to 5 feet long were collected and logged in general accordance with the International Society of Rock Mechanic (ISRM) protocols. Soil and bedrock boring logs are provided in Appendix A.

Golder's Site-specific geologic interpretations (see Section 4.0) were supplemented by data from Geosyntec's CPT results and geotechnical borings (see Figure 2 for locations).

2.1.2 Soil Sampling

Golder collected soil samples representative of each stratigraphic unit from a subset of boreholes (PZ-1S, PZ-2S, PZ-3S, PZ-4S, PZ-5D, PZ-6S, PZ-8, PZ-9, PZ-13, and PZ-14) for laboratory testing by GeoTesting Express Inc. of Acton, Massachusetts (GeoTesting Express). All samples were analyzed for particle size (ASTM D422 or ASTM D6913/D7928). Samples from PZ-1S, PZ-2S, PZ-3S, PZ-4S, PZ-5D, and PZ-6S were also analyzed for USCS classification (ASTM D2487) and Atterberg limits (ASTM D4318).

Shelby tube samples were collected from the upper stiff clay facies of the Presumpscot Formation at Golder borings PZ-3S, PZ-4S and Geosyntec borings GB-06 and GB-16 and from the lower soft clay facies of the Presumpscot Formation at Golder borings PZ-2S and PZ-3S, and Geosyntec borings GB-06 and GB-16. GeoTesting Express tested the samples for permeability/hydraulic conductivity (ASTM D5084). Laboratory soil testing results are provided in Appendix B.

2.1.3 Piezometer and Monitoring Well Installation

Borings advanced for soil sampling were typically completed as either a piezometer or monitoring well. At most locations multiple borings were advanced for the installation of piezometers or monitoring wells in both the overburden and bedrock hydrogeologic units. Piezometers and monitoring wells in overburden were constructed with either 1-inch or 2-inch diameter PVC casing and a 0.010-inch slot size well screen up to five-feet long depending on lithologic thickness. Monitoring wells installed in bedrock were constructed with 2-inch diameter PVC casing and twenty- foot long, 0.010-inch slot size well screens. The space surrounding the well screens was backfilled with clean filter sand. Bentonite chips or a bentonite-grout slurry mix was used to seal the filter pack from the ground surface. Each piezometer and monitoring well was completed with a 4-inch diameter above grade well cover. Well construction logs are provided in Appendix A and construction details are summarized in Table 1.

In September 2018, Golder installed 7 stainless steel 0.75-inch Solinist® 615 Drive Point stream piezometers (S-1 through S-7) with a 6” screen into the intermittent streams around the Phase 14 boundary (see Figure 2). Stream piezometers were installed using hand tools to advance the probe to refusal and/or approximately 4 feet below the stream bed. Steam piezometer construction details are presented in Table 2.

2.1.4 Piezometer and Monitoring Well Development

Golder developed the overburden and bedrock piezometers and monitoring wells by pumping and intermittent surging using a submersible pump. At least one well volume was pumped out of piezometers and monitoring wells screened in the clay and at least three well volumes were pumped out of piezometers and monitoring wells screen in the sand, glacial till, and bedrock. Piezometers and monitoring wells which did not have a large enough water column for the pump to gain suction were not developed.

2.1.5 Water Level Monitoring

Water levels measurements were collected monthly at PZ-1S, PZ-2S, PZ-3S, PZ-4S, PZ-5D, and PZ-6S from September 2017 through March 2019. Water level measurements in piezometers installed in September 2018 (PZ-7 through PZ-14) were collected in October 2018, February 2019 and March 2019. Water level measurements were collected biweekly (once every other week) at all Phase 14 piezometers and monitoring wells and select Phase 11 and 12 monitoring wells between May 2019 and August 2019. Water level measurements are provided in Table 3a (Fine Silty Sand Unit) and Table 3b (Phreatic, Glacial Till, and Bedrock units).

Depth to groundwater measurements and depth to surface water measurements were collected in stream piezometers in October 2018, February 2019, and on a biweekly basis beginning in May 2019. Groundwater and surface water measurements collected from the stream piezometers are provided in Table 2.

2.1.6 Slug Testing

Golder performed falling and rising head slug tests in 40 monitoring wells and piezometers to obtain estimates of horizontal hydraulic conductivity of the screened lithology. Golder analyzed the slug test data using the Hvorslev and Bouwer-Rice methods (Hvorslev, 1951; Bouwer and Rice, 1976). Only data from rising head tests were analyzed for wells with partially saturated well screens.

The following steps were completed for each slug test:

- An initial manual water level measurement was collected.
- A transducer was placed near the bottom of the well and set to record pressure (water level) at linear intervals from 0.125 seconds up to 5 minutes.
- A PVC slug was rapidly lowered into the well until fully submerged. A PVC slug with a displacement of 12 inches, 18 inches, or 24 inches was used for the two-inch diameter wells and piezometers. A slug with approximately 7 inches of displacement was used in the one-inch diameter piezometers. The choice of slug was dependent on the well diameter and length of the standing water column.
- The slug was rapidly removed from the well after the water level recovered to at least approximately 90% of the initial water level. However, recovery in some wells was very slow due to the low hydraulic conductivity of the formation at the well screen, and 90% recovery was not achieved during all tests. Although 90% recovery was not achieved in all wells tested, sufficient representative data were collected to allow for analysis of hydraulic conductivity.
- To verify the transducer data, manual water level measurements were periodically collected.

Slug tests could not be conducted in the following shallow wells/piezometers because there was an insufficient water column in the well/piezometer: MW14-02S, MW14-05S, MW14-06S, PZ-7M, PZ-8S, PZ-11S, PZ-14M, PZ-20S, or PZ-21S.

The slug test analyses are presented in Appendix C. Slug testing results are presented in Tables 4a through 4e and are discussed in Section 5.2.

3.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

The following sections describe the regional geologic and hydrogeologic conditions.

3.1 Site Setting

The Site is located within the uplands section of Central Maine, which is characterized by steeply dipping metasedimentary rocks that have been intruded in many places by granitic rocks. Both bedrock terrains exhibit a strong secondary overprint from the effects of glaciation. The bedrock in the highland areas is typically covered by a thin veneer of bouldery glacial till. Local accumulations of windblown sand and silt are present. In the lower elevations, below approximately 300-feet msl, surficial deposits are quite thick. The general surficial sequence features till on top of the bedrock surface, followed by overlying glaciofluvial deposits, glaciomarine bottom sediments, proglacial fluvial or nearshore marine sediments, windblown sand, and river terrace deposits as well as recent alluvium along the major river valleys (Gerber, 1993, Golder, 2001).

Local relief ranges from over 600 feet above mean sea level (msl) to the south in the granitic terrain near Rome, Maine, to less than 200 feet above msl in the broad region bounded by the Sandy River, the Kennebec River, and Route 2. The topographic highs and lows generally trend northeast-southwest and are controlled by the bedding of the underlying metasedimentary rocks. Topography above the granitic plutons is typically knobby, with rugged local relief (Gerber 1993, Golder, 2001).

3.2 Regional Overburden Geology

Work by Weddle (1991 and 1992) indicates that the overburden deposits in the region are a complex series of diamicton facies deposited in a proglacial environment and glacial marine sediments. Recession of the continental ice sheet likely began very rapidly after the start of climatic warming. As the amount of free water increased at the base of the ice, subglacial meltwater systems began to develop. These streams integrated to form major englacial and subglacial meltwater systems. The large esker chain which follows the Kennebec River valley from the upper Dead River to Augusta is a good example of one such feature. A portion of this esker complex lies to the northeast of the Site, along the west side of the Kennebec. The esker system in the Kennebec River valley was graded to a late-glacial sea, which was rising due to the addition of large quantities of glacial meltwater to global ocean basins. The sediments associated with this late glacial sea are collectively known as the Presumpscot Formation (Bloom, 1960). These deposits are generally clay and silt believed to be caused by rock flour flocculation as meltwaters entered the saline sea. The silt and clay blanket interfingers with the sand and gravel of the esker, as observed in gravel pits along the Kennebec River west of Norridgewock village.

The period of marine submergence in Maine lasted from roughly 13,200 to 12,000 years before present (Smith, 1982). At maximum submergence, the marine waters extended well up the Kennebec River valley, at least as far as Caratunk (Caldwell, 1977). In the portion of the Kennebec River valley near Norridgewock, the present elevation of the highest strandline was approximately 375 feet above msl (Thompson and others, 1981), as indicated by a surveyed glaciomarine delta south of Norridgewock, along Route 8.

During marine submergence, the surface of the ice sheet lowered as large volumes of ice calved into the sea, and to a much lesser extent, by surface melting. The effect of this "flattening" in the Upper Kennebec River valley was to cut off large stagnant ice masses from each other as the ice surface intersected the Boundary and Longfellow Mountains. The sediment trapped on and within these ice blocks was released over time and carried down the Kennebec River valley by meltwater streams. The sedimentation of the Kennebec River valley was maintained as the sea level fell, so that in many places, the granular glaciofluvial sand and gravel completely blanket the Presumpscot Formation. These sand and gravel deposits have been named the Emden Formation (Borns and Hagar, 1965). The large terraces in Norridgewock (at or below 220 feet above msl) are features formed during this time.

Before the development of vegetation in the area, large amounts of fine sand and silt were picked up by strong, late glacial winds and deposited in the lee of hills and on many of the previously formed glaciofluvial or glaciomarine surfaces. Locally, these windblown sediments attained a thickness great enough to form dunes. Several dune fields exist in Norridgewock, the most extensive being to the east of the village near Martin Stream. Fine sand currently exposed at the surface in the Site area is likely of windblown (eolian) origin.

The Pleistocene Epoch ended and the modern (Holocene) geologic environment was established with the final melting of ice in the upper Kennebec and the establishment of a sea level close to its current elevation. In the Norridgewock region, the principal features associated with Holocene sedimentation are the alluvial terraces and floodplains, which border the Kennebec and Sandy River valleys. Of lesser importance in terms of quantities are the accumulations of organic debris in small topographic basins. These generally are limited to bog and swamp deposits; thick peat deposits are rare in central Maine.

The most widespread and laterally continuous surficial deposits are the clay and silt of the Presumpscot Formation and the stratified outwash sand of the Emden Formation. Pit exposures and subsurface data gathered both at the Site and in the surrounding region indicate that the largest volume of surficial materials are the clay and silt of the Presumpscot Formation.

The average thickness of surficial deposits in the region is approximately 50 feet but can be quite variable. Thicknesses greater than 100 feet occur along the high crest of the esker adjacent to the Kennebec River and to the southwest of the village of Norridgewock, where an inferred relatively deep bedrock trough diverted glaciofluvial sedimentation away from the axis of the Kennebec River valley.

3.3 Regional Overburden Hydrogeology

The various overburden deposits represent discrete hydrogeologic units with unique physical properties and characteristics as described in the following sections.

3.3.1 Kennebec Esker

The esker sand and gravel deposits along the Kennebec River valley (shown on Figure 1 as the glacial stream deposits) constitute one of the most significant regional surficial aquifers in southern Somerset County. However, as discussed in the Section 5.0, there is no hydraulic connection between the hydrogeologic units present beneath the Site and the Kennebec Esker. The esker deposits are locally greater than 100 feet thick as observed in exposures in local gravel pits and as confirmed by subsurface data from published literature (Adamik and others, 1987; Tolman and Lanctot, 1982) and the results of a 1984 drilling program conducted cooperatively by the Maine Geological Survey (MGS) and the U.S. Geological Survey (USGS). The saturated thickness of the esker sands and gravels is substantially less than the total thickness because the esker deposits are highly permeable. Many portions of the esker system are overlain by, or interfingered with Presumpscot clay and silt. Locally, artesian conditions likely exist on the lower flanks of the esker, where a significant thickness of clay overlies the esker system. Given the depositional environment of the sediments, the esker aquifer materials are probably quite heterogeneous and vertically anisotropic. The esker deposits represent a groundwater resource due to their high permeability and their proximity to the Kennebec River and the likelihood of induced recharge from the river when water is withdrawn. The Norridgewock water supply is developed in the esker on a river terrace at the location presented on Figure 1.

3.3.2 Glacial Till

The surface exposure of glacial till in the region is limited to high hills or stream valleys, where erosion has removed the overlying materials. Glacial till at the Site directly overlies the bedrock and is typically fully saturated. Data collected during investigations for Phase 14 and data from previous Site investigations indicate that the permeability of the till is quite variable. The till is primarily recharged in upland areas where overlying of low permeability silt/clay Presumpscot Formation deposits are thin and absent and can also receive flow from the underlying bedrock.

3.3.3 Glacial Outwash (Emden Formation)

The character of the Emden outwash deposits in the region is not known in detail because of a lack of good exposure and because subsurface records of the deposits are not detailed enough to distinguish it from eolian deposits. Mapping by Gerber (1993) suggests that the outwash is quite thin in the inter-fluvial area between the Sandy and Kennebec rivers where the Site is located. It appears that the outwash in the Norridgewock area is largely unsaturated. Thicker deposits may exist immediately adjacent to the Sandy and Kennebec rivers, where the saturated thickness may be relatively large. The potential for the outwash to serve as a ground water resource is likely limited to those areas immediately adjacent to the rivers.

The Emden Formation and the Kennebec esker are hydraulically indistinguishable where they are in direct contact. Given the depositional sequence in the region, it is probable that an aquitard of Presumpscot clay-silt exists over much of the area where the outwash is super-adjacent to the esker.

3.3.4 Eolian Sand

Because of the close textural similarity between the Emden outwash and eolian sand, their hydraulic properties are likely similar. However, the groundwater resource potential of the eolian sand is likely minimal due to the limited thickness, the limited areal extent, and the preferential distribution of the deposits away from the river valleys.

3.3.5 Presumpscot Formation

The clay-silt Presumpscot Formation is not an aquifer. However, due to its low permeability, thickness and widespread distribution, it exerts a strong influence on the regional groundwater setting. It is an impediment to meteoric recharge to the underlying bedrock and till and can create artesian heads in underlying hydrostratigraphic units resulting in upward vertical gradients.

In some areas, the upper few feet of the Presumpscot are weathered to a brown or olive brown color. Where present, the weathered Presumpscot can exhibit post-depositional features such as desiccation fissuring, disruption by roots and other biological activity, frost fracturing and expansion joints. These features can make the upper Presumpscot relatively more permeable than the unweathered Presumpscot. Where desiccation fissuring is present, vertical prismatic structure is observed, which can result in higher vertical permeability than the lateral permeability, a feature that when present, distinguishes it from the underlying unweathered gray Presumpscot clay-silt. These post-depositional weathered features were not as prevalent within the upper Presumpscot formation of the Phase 14 area (see Sections 4 and 5).

Unweathered clay-silt Presumpscot deposits are generally gray-brown to gray, massive, devoid of secondary structures, and relatively impermeable. Because of the low permeability and low specific yield of the unweathered clay-silt Presumpscot Formation, it never drains or becomes unsaturated before the next annual cycle of recharge. The long-term average water table position is in the olive-brown (weathered) unit of the Presumpscot.

3.4 Regional Bedrock Geology

Figure 4 presents a regional bedrock geology map. As shown, the Site is located in a terrain of regionally metamorphosed sedimentary rocks, locally intruded by granite, known collectively as the Sangerville Formation (Moench and others, 1982; Osberg, 1988). The Sangerville Formation is grouped with the Silurian System of rocks because of its stratigraphic position and fossil fauna assemblages. The absolute ages of the rocks in the Sangerville Formation are not known with certainty but are estimated to span most of the Silurian Period, currently taken as 435 million years to 395 million years before present.

Several members of the Sangerville Formation have been mapped in the area bounded by the Sandy and Kennebec Rivers. These units are distinguished from one another by texture and lime content. In general, all members of the Sangerville Formation are part of a thick miogeosynclinal sequence of clastic and calcareous sediments, deposited in a westward-facing tectonic basin. In central Maine, the entire basin sequence is believed to have been thrust to the west during the Acadian Orogeny as a direct result of the closing of the proto-Atlantic Ocean basin during the mid- to late-Paleozoic Era. During this episode of active tectonism, the Sangerville Formation rocks were metamorphosed to greenschist facies. Metamorphic grades are locally higher in areas adjacent to igneous intrusions. In some cases, the relatively high temperatures associated with these magmatic stocks obliterated the original sedimentary structures and substantially altered pre-existing mineralogy.

Such intrusive contacts occur on the north side of the Site, near the "Old Point Pluton" and roughly two miles south of the Site, where the "Rome or Norridgewock Pluton" is exposed.

The regional strike of the Sangerville Formation, as inferred from published maps and from previous outcrop investigations, is approximately N50ºE (Moench and others, 1982, and Hussey and others, 1984). The area surrounding the Site lies between two large-scale northeast-trending structural features: the Currier Hill Syncline and the Strickland Hill Anticline. Map patterns to the northeast of the Site (to the south of Lakewood) indicate the presence of a small syncline within the Site area located on its southeastern flank. There are no mapped faults in the immediate Site area, but there are several large-scale northeast-trending pre-metamorphic faults to the northwest. These features have trends in the range of N20°E to N50°E. Post-metamorphic faults have trends that are oblique or normal to the general northeast grain, averaging N30°W.

Gerber (1993) evaluated the regional structural features that may affect the directional permeability of the bedrock. Gerber’s evaluation included:

- A photo-geologic fracture trace analysis using conventional and high-altitude imagery
- A structural analysis of features exposed in outcrop (Gerber, 1985)
- A photo-linear analysis focusing on the Site area
- A geophysical survey to verify the photo-linear interpretation and precisely locate features on the ground
- Detailed logging of rock core obtained from Site rock borings and monitoring well installations
- Bedrock pumping tests conducted at selected locations at the Site

The regional photo-geologic study was initiated to identify any linear terrain features that could be related to bedrock structure and locally control aquifer permeability. The outcrop investigation allowed Gerber to test the hypotheses developed during the regional photo-geologic study, and to develop a structural model that would give insight into the regional aquifer properties. The Site area photo-linear analysis and geophysical survey allowed for locating bedrock wells at specific locations in predicted high yield zones. The results of these investigations formed the basis to define geometric and topological aspects of the bedrock and anisotropic conditions within the bedrock aquifer.

3.4.1 Photo-geologic Investigation

Stereoscopic evaluation of aerial photographs identified linear features that likely represent the horizontal traces of planar elements associated with bedrock structure. Gerber (1993) identified only a limited number of distinct linear elements in the immediate vicinity of the Site at the regional scale. However, features such as joints and cleavage are regional structural effects. Therefore, an investigation of linear elements included not only those features expressed locally at the area of interest, but also features that likely reflect the overall brittle fracture setting.

Gerber identified sixty-two (62) linear elements in the Site region (Gerber, 1987) and plotted the elements on a rose diagram. Four principal directions of photo-linear orientation were identified in order of decreasing abundance as follows:

1) N8°E to S8°W. The relative abundance of features in this group suggest the presence of a very prominent conjugate joint set, possibly related to regional folding.

2) N10°W - 30°W to S10°E - S30°E. Although many of these linear elements appear to be joint-related, subsequent investigation indicate that many are of glacial origin.

3) N50°E to S50°W. This prominent set marks the strike of the Sangerville Formation. Although other sets are more abundant in imagery, this set has the strongest topographic and photographic imprint. The linear course of the Kennebec river from Norridgewock to Skowhegan is aligned to the regional strike of the Sangerville Formation. Similarly, the reach of Mill Stream that passes through the Site follows the same alignment. Gerber identified several linear features with this orientation within the Site area investigation.

4) N70°E - S50°E to - S70°W - N50°W. This set is identified solely by photo-geologic and topographic expression. It was not possible to distinguish discrete sets of linear elements in this group with any degree of certainty.

3.4.2 Outcrop Fracture Analyses

Gerber’s field investigation of fracture features entailed measurements of the strike and dip of joints and bedding, and a general description of the lithology. Because of the paucity of outcrop within the region bounded by the Sandy and Kennebec Rivers (which were taken as the most likely local boundaries of the bedrock aquifer), the investigation covered terrain as far north as Madison, as far south as Rome, and from Mercer to Fairfield in the east and west. Gerber (1993) examined twenty-seven (27) outcrops, including igneous and metasedimentary lithologies. Fracture data were plotted on a Schmidt equal-area stereo-nets. The resulting distribution of points were counted and reduced to percentages of total planar features. The diagrams closely corroborate the interpretations of the photo-geologic study and show the three-dimensional orientations of fracture sets. Several important features are visible on the stereo-nets from which the following conclusions were drawn:

1) The textures of the Sangerville Formation rocks, regardless of local lithology, suggest that rock matrix permeability would be very low. This conclusion was supported by the results of field permeability tests conducted on monitoring wells at the Site. Therefore, the factors controlling hydraulic conductivity in the bedrock are believed to be almost entirely related to brittle fracture.

2) There is a coincidence between bedding in the Sangerville Formation rocks and cleavage, most likely an axial plan cleavage related to the folding described above. Both bedding and cleavage are essentially vertical.

3) The four sets of linear features expressed in remote imagery are part of a regional system. In addition, granite sheeting was observed in the field that was not seen in the aerial photographs due to shallow dips.

4) The prominent north-south set of photo-lineaments is only weakly expressed in outcrop. Only 5% of the observed planar elements have strikes in this direction.

5) The northwest-southeast set of photo-lineaments includes an abundance of glacial features (local striations occurred in the range of S20° to 30°E), but also includes a very prominently developed joint set. As with axial plane cleavage and bedding, the dips on this set approach the vertical, although there is greater variability in dips measured on the Sangerville Formation than on the granites.

6) Except for the nearly horizontal sheet joints seen on the stereogram for granitic rocks, there are no statistically significant differences between the planar features in Sangerville Formation rocks and in the granitic rocks. This implies that the granite was in place and largely cold at the time of deformation of the country rock.

7) No evidence of faulting occurs in outcrop, nor are there stratigraphic displacements that suggest faulting. Gerber (1993) observed slickensided surfaces only along partings associated with bedding in the Sangerville and interpreted these to be a result of bedding plan slip related to folding.

3.5 Regional Bedrock Hydrogeology

Groundwater presence and flow in bedrock primarily occurs because of secondary porosity created by bedrock joints and fractures. The principal axes of permeability are controlled by two major fracture sets: bedding plane fractures and rock cleavage that trend northeast-southwest with secondary conjugate joints, oriented northwest-southeast. Because of the relative abundance of vertical dips, the greatest percentage of fracture intersections is also vertical. Many of the joints have shallower dips. In two dimensions, the bedrock is considered anisotropic, with the principal direction of permeability N51°E, and the secondary direction normal at approximately N39°W.

4.0 SITE GEOLOGY

The overburden and bedrock geology at the Site are generally consistent with the regional geology of the Norridgewock region as described above. The following sections describe geologic conditions encountered in the Phase 14 area.

4.1 Surficial Deposits

Silty fine sand, interpreted to be of eolian origin, was encountered at or within approximately six inches of the ground surface in most borings in the Phase 14 area. In some areas the silty fine sand is overlain by a thin layer of organic material and silty clay and/or by fill material stockpiled during development of previous landfill or infrastructure construction at the Crossroads facility. These materials referred to herein as “undifferentiated materials” are unsaturated and discontinuous. Figure 3 illustrates the interpreted surficial geology in the Phase 14 area.

Golder submitted five samples of the silty fine sand to GeoTesting Express for laboratory testing to determine the USCS classification, particle size, and Atterberg limits (PZ-2S and PZ-4S samples only). Laboratory testing results are presented in Appendix B. The following summarizes laboratory testing results:

- Sample PZ-2S (0 to 4 feet below ground surface (ft. bgs)): classified as a poorly graded sand (93.7%) with silt (6.3% silt and clay) with an identified group symbol of SP-SM. 88% of particles passed the #40 sieve, indicating the sand portion is predominantly fine grained. The sample is non-plastic with a medium dry strength.
- Sample PZ-4S (2 to 6 ft. bgs): classified as a silty sand (62.5% sand, 37.5% silt and clay) with an identified group symbol of SM. 92% of particles passed the #40 sieve, indicating the sand portion is predominantly fine grained. The sample is non-plastic with a high dry strength.
- Sample PZ-8S (6 to 8 ft. bgs): classified as a sand (90.9%) with silt (9.1% silt and clay). 92% of particles passed the #40 sieve, indicating the sand portion is predominantly fine grained.

- Sample PZ-9S (9-11 ft. bgs): classified as a sand (88.3%) with silt (11.7% silt and clay). 88% of particles passed the #40 sieve, indicating the sand portion is predominantly fine grained.
- Sample PZ-13S (7-8.2 ft. bgs): classified as a silty sand (82.2% sand, 17.8% silt and clay). 89% of particles passed the #40 sieve, indicating the sand portion is predominantly fine grained.

Figure 5a illustrates the interpreted elevation of the top of the silty fine sand, which generally slopes from an elevation of approximately 305 ft. msl on the north end of Phase 14 to approximately 275 ft. msl to the south, southwest of Phase 14. Where exposed at the ground surface, the top of sand elevation is controlled by the local topography.

An interpreted isopach (thickness) contour map for the silty fine sand is presented as Figure 5b. As illustrated, the silty fine sand is absent in some areas of Phase 14. In most of the Phase 14 area the silty fine sand ranges in thickness from approximately one to six feet. Thicker mounds of silty fine sand were encountered in some areas, particularly in the southeast corner of Phase 14 where one boring encountered 21 feet of silty fine sand.

4.2 Presumpscot Formation

Golder encountered silt and clay interpreted to be the Presumpscot Formation in all borings within the footprint of the expansion area. The silt and clay are separated into the following two facies based on observations of the lithology: a stiff upper clay facies and a soft lower clay facies. The contact between the upper stiff facies and the lower soft facies is transitional as evidenced by a reduction in N-value and stiffness observations, over a range of approximately one to five feet. Golder generally differentiated the two facies based on the stiffness observations, with the stiff/medium-stiff material an indicator for the stiff clay, and soft/very soft material indicating a soft clay which would extrude between fingers when squeezed. N-values for the stiff clay typically ranged from 6 to 26 and from 0 (weight of hammer) up to approximately 6 for the soft lower clay.

4.2.1 Stiff Upper Clay Facies

The stiff upper clay facies was encountered underlying the surficial deposits in all borings. The material is a gray-brown, medium stiff to very stiff clay that is typically moist and exhibits orange and red mottling and occasional silt partings. In boreholes advanced in other areas of Crossroads Landfill facility, the upper gray-brown facies exhibits post-depositional features such as desiccation fissures, disruption by roots, frost fracturing, and expansion fracturing. These features were infrequently observed in the samples from borings within and adjacent to the Phase 14 footprint.

Golder submitted three samples of the stiff upper clay facies to GeoTesting Express for laboratory testing to determine particle size, Atterberg limits and USCS classification (PZ-3S and PZ-4S samples only). Laboratory testing reports are included in Appendix B. The following summarizes laboratory testing results:

- Sample PZ-3S (10 to 12 ft. bgs): classified as a lean clay (0.8% sand, 99.2% silt and clay), with a liquid limit of 33, a plastic limit of 21, a very high dry strength, low toughness and a group symbol of CL.
- Sample PZ-4S (8 to 10 ft. bgs): classified as a lean clay (2.9% sand, 97.1% silt and clay), with a liquid limit of 31, a plastic limit of 20, a very high dry strength, low toughness and a group symbol of CL.
- Sample PZ-14M (8.5-10.5 ft. bgs): classified as a lean clay (0.1% gravel, 0.4% sand, 99.5% silt and clay).

Figure 6a illustrates the interpreted elevation of the top of the stiff upper clay facies, which generally slopes from an elevation of approximately 290 ft. msl on the north side of Phase 14 to approximately 270 ft. msl on the south, southeast side of Phase 14.

An interpreted isopach (thickness) contour map for the stiff upper clay facies is presented as Figure 6b. The upper clay facies ranges in thickness from approximately 2 to 3 feet on the north side of Phase 14 to more than 10 feet in the central portion and south side of Phase 14. Because the contact between the upper stiff clay facies and the lower soft clay facies is transitional, the identified thickness of each individual facies is considered approximate.

4.2.2 Soft Lower Clay Facies

The soft lower clay facies of the Presumpscot Formation was encountered underlying the upper stiff clay facies in most borings at the Phase 14 area. The material is a gray, soft to very soft clay that is typically moist or wet, and relatively homogenous. Two samples of the lower soft facies were submitted to GeoTesting Express for laboratory testing to determine particle size, Atterberg limits and USCS classification. The following summarizes laboratory testing results:

- Sample PZ-2S (15 to 17 ft. bgs): classified as a lean clay (1.3% sand, 98.7% silt and clay), with a liquid limit of 33, a plastic limit of 19, a very high dry strength, low toughness and a group symbol of CL.
- Sample PZ-3S (16 to 18 feet bgs): classified as a lean clay (0.2% sand, 99.8% silt and clay), with a liquid limit of 35, a plastic limit of 20, a very high dry strength, low toughness and a group symbol of CL.
- As described above, the contact between the upper stiff facies and the lower soft facies is transitional. Golder submitted one sample considered representative of the transition zone for laboratory testing to determine USCS classification, particle size, and Atterberg limits.
- Sample PZ-2S (8 to 10 ft. bgs): classified as a lean clay (0.7% sand, 99.3% silt and clay), with a liquid limit of 31, a plastic limit of 20, a very high dry strength, low toughness and a group symbol of CL.

Figure 7a illustrates the extent and the elevation of the top of the soft lower facies clay. The lower facies clay was not encountered in the northern corner of Phase 14 or in isolated areas in the vicinity of borings GB-09 and GB-10 and the vicinity of CPT-30.

Where encountered, the top of the soft lower clay facies slopes from an elevation of approximately 280 ft. msl on the northern side of Phase 14 to approximately 262 ft. msl on the south, southwest side of Phase 14.

An interpreted isopach (thickness) contour map for the soft lower clay facies is presented as Figure 7b. The lower clay facies ranges in thickness from zero feet where it is absent to greater than 17 feet on southwestern side of Phase 14. Because the contact between the upper stiff clay facies and the lower soft clay facies is transitional, the identified thickness of each individual facies is considered approximate.

4.3 Glacial Till

A gray-brown, clayey fine to coarse sand and fine to coarse, angular gravel interpreted to be a glacial till was encountered beneath the Presumpscot silt and clay in all borings that penetrated the clay. The till is typically moist to wet with a medium density.

Golder submitted six samples of the glacial till to GeoTesting Express for laboratory testing to determine the particle size, Atterberg limits and USCS classification (PZ-4S and PZ-5S samples only). Laboratory testing reports are included in Appendix B. The following summarizes laboratory testing results:

- Sample PZ-4S (14 to 18 ft. bgs): classified as a sandy silt with gravel (17.5% gravel, 32.1% sand, 50.4% silt and clay). 100% of particles passed the 0.75-inch sieve, indicating the gravel portion is fine grained. A relatively even distribution of particles passed the #4 through #100 sieves, indicating the sand portion is fine, medium, and coarse grained. The sample is non-plastic with a high dry strength, and a group symbol of ML.
- Sample PZ-5D (12.8 to 16.8 ft. bgs): classified as a silty gravel with sand (36.5% gravel, 31.1% sand, 32.4% silt and clay). 71% of particles passed the 1-inch sieve and 66% passed the 0.375-inch sieve, indicating the gravel portion is fine to coarse grained. A relatively even distribution of particles passed the #4 through #100 sieves, indicating the sand portion is fine, medium, and coarse grained. The sample is non-plastic with a high dry strength, and a group symbol of GM.
- Sample PZ-8D (16 to 18 ft. bgs): classified as a silty gravel with sand (45% gravel, 40.5% sand, 13.8% silt and clay). 89% of particles passed the 0.75-inch sieve, indicating the gravel portion is primarily fine grained.
- Sample PZ-9D (53 to 55 ft. bgs): classified as a silty gravel with sand (33.1% gravel, 23.9% sand, 43.0% silt and clay). 80% of particles passed through the 0.75-inch sieve and 71% passed the 0.375- inch sieve, indicating the gravel portion is fine to coarse grained. A relatively even distribution of particles passed the #4 through #100 sieves, indicating the sand portion is fine, medium, and coarse grained.
- Sample PZ-13D (32-34 ft. bgs): classified as a silty sand with gravel (15.2% gravel, 59.6% sand, 25.2% silt and clay). 100% of particles passed through the 0.5-inch sieve, indicating the gravel portion is fine grained. A relatively even distribution of particles passed the #4 through #100 sieves, indicating the sand portion is fine, medium and coarse grained.
- Sample PZ-14D (38-40 ft. bgs): classified as a sand with silt and gravel (38.2% gravel, 50.4% sand, 11.4% silt and clay). 86% of particles passed the 0.75-inch sieve and 67% of particles passed the 0.375-inch sieve, indicating the gravel portion is fine to coarse grained. A relatively even distribution of particles passed the #4 through #100 sieves, indicating the sand portion is fine, medium, and coarse grained.

Figure 8a illustrates the interpreted elevation of the top of the till, which slopes from an elevation of approximately 290 ft. msl on the northeast side of Phase 14 to less than 260 ft. msl to the south, southwest side of Phase 14.

An interpreted isopach (thickness) contour map for the till is presented as Figure 8b. The till thickness is variable ranges in thickness from less than 1 foot in the area of GB-2 to over 20 feet in the area of MW14-05D.

4.4 Bedrock

Bedrock was encountered underlying the glacial till in borings that penetrated the till. Bedrock in the Site area has previously been identified as meta-sedimentary rock (meta-sandstones and quartzites) of the Sangerville Formation and intrusive igneous rocks.

Golder collected rock cores in the uppermost 40 feet of bedrock at MW14-01, MW14-02, MW14-03, and MW14-04. The bedrock encountered in the Phase 14 area is primarily a medium dark to dark gray, moderately foliated, very fine, sandy meta-limestone with calcite veins up to 0.75 inches thick. The rock was fresh (W1) and medium strong (R3). Little weathering was observed with the exception of the top 5 feet at MW14-02 which was slightly weathered. The mean rock quality designation (RQD) in the upper 20 feet of core was 73%. The mean RQD for rock core collected from 20 to 40 feet was slightly higher (83%) indicating that the rock becomes slightly more competent at depth. Overall RQD values at MW14-01 (92%), MW14-03 (85%), and MW14-04 (82%) indicate good to very good rock quality at these locations. MW14-02 had an RQD of 52% which indicates fair rock quality. Observed discontinuities were planar, smooth to very rough to stepped, with dip angles from near vertical to near horizontal. Spacing of discontinuities in the rock cores ranged from extremely closely spaced (<1”) to widely spaced (48”). Many discontinuities were coated with calcite up to 0.25 inches thick and iron hydroxide staining.

Figure 9 illustrates the interpreted top of bedrock elevation. The top of bedrock slopes from an elevation of approximately 280 ft msl on the north side of Phase 14 to less than 250 ft msl on the south side of Phase 14.

4.5 Geologic Cross-Sections

Figure 10 illustrates the location of two geologic cross sections. Figures 11a and11b present the geologic cross sections and illustrate the location of nearby subsurface investigations with their respective offset distances, the proposed solid waste boundary and leachate management system components, the existing base grade, the proposed constructed base preparation grade, and the intersections of the cross-sections.

Key items illustrated on the cross-sections include:

- The top of bedrock surface dips from north-northeast to south-southwest
- The overburden sequence dips and thickens from north-northeast to south-southwest
- The thickness of the glacial till is variable, but generally thickens to the south
- The soft lower facies of the Presumpscot Clay was not encountered in the northern portion of the Phase 14 area, but generally thickens to the south
- The stiff upper facies of the Presumpscot Clay is continuous across the Phase 14 area
- The undifferentiated fill materials and silty fine sands are discontinuous across the Phase 14 area
- The proposed base grades of Phase 14 are generally coincident with the top of the Presumpscot clay

5.0 SITE HYDROGEOLOGY

The hydrogeologic conditions in the area of Phase 14 are consistent with the hydrogeological conditions encountered in other areas of the Crossroads Landfill facility. Four distinct hydrostratigraphic units have been identified:

- Silty Fine Sand – contains disconnected areas of saturated, seasonally saturated, and perched groundwater.
- Presumpscot Clays – including the upper stiff clay facies within which a continuous phreatic surface is present, and the lower soft clay facies. These units represent an aquitard which creates perched groundwater conditions in the overlying silty fine sand, which impedes meteoric recharge, and creates artesian heads in the underlying glacial till.
- Glacial Till – a relatively permeable zone of fine to coarse sand and gravel. Groundwater in this unit is confined beneath the Presumpscot clays.

- Bedrock – the bedrock is less permeable than the glacial till, but the two units are in direct hydraulic communication.

The following sections summarize and evaluate the investigation data collected to characterize the hydrogeologic conditions in the Phase 14 area.

5.1 Hydraulic Gradients and Groundwater Flow Directions

Golder interpreted hydraulic gradients and groundwater flow directions using the groundwater elevation data described in Section 2.1.6 and summarized in Tables 3a and 3b. Groundwater elevations measured in May 2019 represent the approximate seasonal high. Therefore, groundwater elevations measured on May 2, 2019 were used to prepare seasonal high phreatic surface maps (Figure 12a – Phase 14 Area, Figure 12b – Facility-wide) and seasonal high potentiometric surface maps for the glacial till (Figure 13a – Phase 14 Area, Figure 13b – Facility-wide) and bedrock (Figure 14a – Phase 14 Area, Figure 14b – Facility-wide).

Water levels measured in August 2019 represent the most complete dataset that approximates seasonal low phreatic surface. Therefore, groundwater elevations measured on August 23, 2019 were used to prepare a seasonal low phreatic surface map (Figure 12c).

5.1.1 Horizontal Hydraulic Gradients and Groundwater Flow Directions

The following sections discuss the water levels measured in each hydrostratigraphic unit and describes hydraulic gradients and interpreted flow directions based on the potentiometric surface maps developed from the water level measurements.

5.1.1.1 Groundwater in the Silty Fine Sand

Twenty-six piezometers, monitoring wells and vibrating wire piezometers were installed with screened intervals within the silty fine sand. However, piezometers could not be installed in the silty fine sand at some locations because the silty fine sand was either not present, was too thin, or no water was encountered in the unit at the time of boring advancement.

Water levels measured in piezometers, monitoring wells and vibrating wire piezometers installed in the fine silty sand are summarized in Table 3a. Water levels were recorded as “dry” in ten of the 26 locations during one or more water level monitoring events. These measurements indicate that the silty fine sand is only seasonally saturated in some areas. At an additional ten locations there was three feet or less of standing water during one or more monitoring events. The three locations where the average saturated thickness of the fine silty sand is greater than 6 feet are located far upgradient of Phase 14 (PZ-11S and PZ-12S) or southeast of Phase 14 (PZ-20S, outside of the Phase 14 footprint) in an area of thicker sand.

The fine silty sandy is generally only saturated year-round in areas of thicker undifferentiated soil/fill and silty fine sand. In areas of thinner undifferentiated soil/fill and silty fine sand, the silty find sand is often only seasonally saturated or dry year-round. The Phase 14 design incorporates removal of undifferentiated soil/fill material and silty fine sand, and stormwater will be routed to drainage basins. As a result, any areas of saturated, seasonally saturated, and/or perched groundwater beneath Phase 14 will be removed as part of construction.

5.1.1.2 Phreatic Surface

A continuous phreatic surface is present in the Presumpscot clays. The interpreted seasonal high phreatic surface based on groundwater levels measured on May 2, 2019 is presented in Figure 12a. The elevation of the approximate seasonal high phreatic surface within the Phase 14 footprint is interpreted to range from over 290 ft msl in the north to approximately 275 ft msl along the south side of Phase 14. Consistent with the topography and geologic structure, the phreatic surface decreases from northeast to southwest/southeast. As a result, the overall direction of phreatic groundwater flow is from the northeast to south-southwest/southeast. This flow direction is consistent with the interpreted site-wide phreatic surface as presented in Figure 12b. Phreatic groundwater in the Phase 14 area primarily flows towards the existing Phase 12 landfill.

Phreatic groundwater in the immediate Phase 14 area is recharged through a combination of local meteoric recharge (infiltration of precipitation) and groundwater inflow from the northeast. Data collected from the stream piezometers/staff gauges were used to evaluate whether phreatic groundwater discharges to the nearby streams. Groundwater and surface water levels measured at the seven stream piezometer/staff gauge locations are summarized in Table 2. The majority of measurements indicate that the streams in the Phase 14 area are either losing streams (i.e., surface water recharges groundwater) and/or that the surface water is perched on top of the Presumpscot clay, as evidenced by the consistently higher surface water elevations compared to the groundwater elevations (i.e., downward gradients). The exception is the consistent upward gradient observed at stream piezometer/staff gauge S-6, and the intermittently upward gradients observed at piezometer/staff gauges S-2 and S-7. Phreatic groundwater may discharge to the streams on an intermittent basis at these locations[1].

Stream piezometer/staff gauge location S-7 is located hydraulically upgradient of Phase 14. Therefore, phreatic groundwater beneath Phase 14 would not discharge to the stream in the area of S-7. Piezometer/staff gauge location S-6 is located side-gradient of Phase 14. The upward gradients observed at S-6 are interpreted to be the result of higher phreatic surface head values to the north of S-6 where the ground surface elevation rises to an elevation of over 310 ft. msl. Therefore, any phreatic groundwater that discharges to the stream in the area of S-6 is interpreted to be groundwater flow from the north.

Piezometer/staff gauge location S-2 is also located side-gradient of Phase 14. The upward gradients observed at S-2 are interpreted to be the result of the higher phreatic surface to the north of S-2 as indicated by head elevations measured in phreatic piezometer PZ-10M, indicating that, any phreatic groundwater that discharges to the streams in the area of S-2 originates north of S-2.

Consistent losing stream conditions (i.e., higher surface water elevations than groundwater elevations) were observed at all other stream piezometers/staff gauge locations, indicating that phreatic groundwater does not discharge to the stream at these locations.

Horizontal phreatic surface groundwater flow gradients under seasonal high and season low conditions in the Phase 14 area where calculated at the locations illustrated on Figures 12a and 12b, respectively. The calculated gradients range from 0.012 to 0.032 under seasonal high conditions, and 0.016 to 0.030 under seasonal low conditions. Horizontal hydraulic gradients may be higher in the immediate area of streams and/or in areas of steeper topography. The difference in phreatic groundwater elevations between seasonal high and seasonal low conditions ranges from approximately 0.4 to 4.3 feet based on a comparison of minimum and maximum values at each location.

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[1] Because the stream piezometers are steel drive points the lithology of the screened interval could not be confirmed. Therefore, some of these screened intervals may extend to the glacial till, where the groundwater elevation is representative of the potentiometric surface of the confined till, and not phreatic conditions which would result in discharging conditions.

5.1.1.3 Glacial Till

The interpreted potentiometric surface for the glacial till based on groundwater levels measured on May 2, 2019 is presented in Figure 13a. The elevation of the potentiometric surface within the Phase 14 footprint ranges from over 295 ft. msl on the northeast side of Phase 14 to between approximately 260 ft. msl and 270 ft. msl along the southwest side of Phase 14. Consistent with geologic structure, the elevation of the potentiometric surface in the glacial till decreases from northeast to southwest/southeast. As a result, the overall direction of groundwater flow in the glacial till is from the northeast to south-southwest/southeast. This flow direction is consistent with the interpreted site-wide potentiometric surface in the glacial till as presented in Figure 13b.

Glacial till in the Phase 14 area is primarily recharged via groundwater inflow from the north-northeast and can also receive flow from the underlying bedrock. Glacial till groundwater does not discharge locally. Glacial till groundwater is confined beneath the Presumpscot clays that thicken to the south-southeast and is interpreted to eventually discharge to Mill Stream approximately 1,500 feet downgradient of Phase 12, where the Presumpscot clays are thin or absent.

Horizontal groundwater flow gradients in the glacial till in the Phase 14 area were calculated at the locations illustrated on Figure 13a. The calculated gradients range from approximately 0.011 ft./ft. to 0.044 ft./ft.

5.1.1.4 Bedrock

The interpreted potentiometric surface for the bedrock based on groundwater levels measured on May 2, 2019 is presented in Figure 14a. The elevation of the potentiometric surface within the Phase 14 footprint ranges from approximately 295 ft. msl on the northeast side of Phase 14 to between approximately 265 ft. msl and 275 ft. msl along the southwest side of Phase 14. Like the other hydrostratigraphic units and consistent with the geologic structure, the elevation of the potentiometric surface in the bedrock decreases from northeast to southwest/southeast. As a result, the overall direction of groundwater flow in the bedrock is from the northeast to southwest/southeast. This flow direction is consistent with the interpreted site-wide potentiometric surface in the bedrock as presented in Figure 14b.

The bedrock in the Phase 14 area is primarily recharged via groundwater inflow from the north-northeast and regionally appears to be recharged in the area of the bedrock ridge to the east-northeast of Phase 14. Bedrock groundwater does not discharge locally. Like the glacial till, bedrock groundwater in the Phase 14 area is confined beneath the Presumpscot clays that thicken to the south-southeast under Phase 11 and is interpreted to eventually discharge to Mill Stream approximately 1,500 feet downgradient of Phase 12, where the Presumpscot clays are thin or absent. As described above, groundwater in the bedrock also likely flows into the overlying glacial till in some area.

Horizontal groundwater flow gradients in the bedrock in the Phase 14 area calculated at the locations illustrated on Figure 14a. The calculated gradients range from approximately 0.013 ft./ft. to 0.025 ft./ft.

Figure 14c illustrates the interpreted regional bedrock potentiometric surface and regional groundwater divides. Phase 14 and all existing landfill phases are within a groundwater flow system with a prevailing groundwater flow direction from the upland areas to the north of Phase 14 towards Mill Stream to the south. There is a groundwater divide coincident with the upland areas to the north and east of Phase 14. The presence of this groundwater divide precludes groundwater flow from Phase 14 to the “Significant Sand and Gravel Aquifer” located along the banks of the Kennebec River, the Town of Norridgewock water supply well, and the Kennebec River. Groundwater east of the divide flows away from Phase 14 and towards the Kennebec River.

5.1.2 Vertical Hydraulic Gradients

Vertical hydraulic gradients between the phreatic surface and the glacial till, and between the glacial till and the bedrock were calculated at five locations, as summarized in Table 5. The vertical gradients were calculated under seasonal high (May 2, 2019) and seasonal low (August 2019) conditions, and indicate the following:

- Vertical gradients from the phreatic surface to the glacial till are generally downwards at the well locations evaluated. Gradients ranged from 0.18 ft/ft to 1.05 ft/ft.
- The direction of vertical gradients between the glacial till and the bedrock are variable, ranging from a downward gradient of 0.01 ft/ft to an upward gradient of -0.09 ft/ft.

While downward vertical gradients from the phreatic surface to the till are observed in some areas, vertical groundwater flow through the Presumpscot clays is negligible due to the very low vertical hydraulic conductivity of the clays, which precludes recharge of the underlying glacial till and bedrock through the clays in the immediate area of Phase 14.

5.2 Hydraulic Conductivity and Other Hydraulic Parameters

As described in Sections 2 and 3, slug tests and laboratory permeability tests were conducted to evaluate the hydraulic conductivity of the hydrostratigraphic units encountered in the Phase 14 area. Results of this work are compared to and supplemented by findings from hydrogeologic investigations completed in other areas of the Crossroads Landfill facility. Specifically, the hydraulic conductivity, transmissivity and storativity of the various hydrostratigraphic units across the site were analyzed in detail by Gerber (1993 and 1995). Investigations included over 180 slug tests and five groundwater pumping tests. The Gerber groundwater pumping tests included:

- An approximately 51-hour pumping test at bedrock pumping well 101F located east of Phases 1-6.
- Approximately 72-hour bedrock pumping tests at four wells: B-1101; B-1103B, B-1104, and B-1106. These bedrock wells were installed to intersect bedrock fracture zones delineated from geophysical studies and aerial photography interpretation. Well B-1101 is in the Phase 9 area. Well B-1104 is located adjacent (west) to Phase 10. Well B-1106 is located south of Phase 11A, and 1103B is located on the north side of Phase 12.

Pumping test locations are illustrated on Figure 14b. Results of Gerber’s testing are presented below as appropriate. The following sections present the measured and calculated hydraulic parameters for each of the hydrostratigraphic units tested during this investigation.

5.2.1 Silty Fine Sand

Slug tests could not be completed in all wells/piezometers screened in the silty fine sand because the water column was very limited in some of the installations. Table 4a presents the results of the slug tests that were conducted, and the geometric mean, maximum, and minimum hydraulic conductivity values derived from the slug tests are presented in Table 4e. Estimated horizontal hydraulic conductivity values for wells screened in the silty fine sand ranged from 1.31E-04 cm/sec to 8.06E-02 cm/sec with a geometric mean of 7.06E-03 cm/sec.

The saturated thickness of the silty fine sand unit is limited and the Phase 14 design incorporates removal of undifferentiated soil/fill material and silty fine sand. Golder considers the hydraulic significance of the silty fine sand to be minimal, consistent with previous interpretations (Gerber, 1996).

5.2.2 Presumpscot Clay

The horizontal hydraulic conductivity of the Presumpscot clay was estimated by conducting slug tests in eight wells/piezometers screened within the clay: four within the stiff upper clay, one within the soft lower clay, and three across the contact between the stiff upper and soft lower clays. Slug test results are presented in Table 4b and the geometric mean, maximum, and minimum hydraulic conductivity values derived from the slug tests are presented in Table 4e. The following summarizes the results:

- The estimated horizontal hydraulic conductivity values for wells/piezometers screened solely in the stiff upper clay facies ranges from 1.84E-07 cm/sec to 1.89E-05 cm/sec with a geometric mean of 1.19E-06 cm/sec.
- The estimated geometric mean horizontal hydraulic conductivity value for the one well (MW14-02M) screened solely in the soft lower clay facies is 1.70E-07 cm/sec.
- The estimated horizontal hydraulic conductivity values for wells/piezometers screened across the upper and lower clay facies ranges from 1.36E-07 cm/sec to 2.04E-06 cm/sec with a geometric mean of 7.21E-07 cm/sec.

The highest calculated horizontal conductivity value for any well screened in the Presumpscot clay is 1.7E-05 cm/sec based on the slug testing results for piezometer PZ-16M, which is screened in the stiff upper clay facies.

Comparison of the Phase 14 slug test results to slug test results from other areas of the Crossroads facility indicates that the geometric mean horizontal hydraulic conductivity for the stiff upper clays in the Phase 14 area (1.19E-06 cm/sec) is about an order of magnitude lower than geometric mean horizontal hydraulic conductivity for the stiff upper clays in other areas (2.5E-05 cm/sec based on 55 slug tests (Gerber, 1996)). The generally lower horizontal hydraulic conductivities values for the stiff upper clay in the Phase 14 area is consistent with the finding that post-depositional features such as desiccation fissures, disruption by roots, frost fracturing, and expansion fracturing were infrequently observed in the samples from borings within and adjacent to the Phase 14 footprint as compared to other areas of the site.

The geometric mean horizontal hydraulic conductivity value calculated for the lower soft clay in other areas of the Crossroads facility (based on forty slug tests (Gerber 1996)) is 2.3E-06 cm/sec. This is about half an order of magnitude higher than the geometric mean value calculated for wells/piezometers screened across the upper and lower clay facies in the Phase 14 area.

The vertical hydraulic conductivity of the Presumpscot clay was estimated by GeoTesting Express using a flexible wall permeameter in accordance with ASTM D5084. Laboratory results are presented in Appendix B. The following summarizes vertical hydraulic conductivity testing results for the two clay facies:

- Stiff Upper Clay Facies:
  - Sample PZ-3S (9 to 11 ft. bgs): 1.2E-07 cm/sec
  - Sample PZ-4S (9 to 11 ft bgs): 1.1E-07 cm/sec
  - Sample GB-06 (21 to 23 ft bgs): 7.7E-08 cm/sec
  - Sample GB-16 (17 to 19 ft bgs): 2.9E-07 cm/sec
  - Geometric mean: 1.31E-7 cm/sec

- Soft Lower Clay Facies:
  - Sample PZ-3S (16 to 18 ft. bgs): 2.4E-07 cm/sec
  - Sample PZ-2S (10 to 12 ft. bgs): 4.2E-07 cm/sec
  - Sample GB-06 (29 to 31 ft bgs): 1.2E-07 cm/sec
  - Sample GB-16 (27 to 29 ft bgs): 8.4E-08 cm/sec
  - Geometric mean: 1.79E-07 cm/sec

Gerber calculated a geometric mean vertical hydraulic conductivity value of 6.2E-08 cm/sec (Gerber, 1993) for the soft lower clay facies (gray facies) in other areas of the Crossroads Landfill facility using data collected during groundwater pumping tests. This value compares favorably to vertical hydraulic conductivity values obtained from the laboratory testing of Phase 14 area samples.

The Presumpscot clays are very fine-grained and have a consistently low tested horizontal and vertical hydraulic conductivity. Given these characteristics, Golder considers both the upper and lower facies of the Presumpscot clay in the Phase 14 area to be aquitards. The almost impermeable nature of the formation impedes meteoric recharge and creates artesian heads in the underlying glacial till as described further in Section 5.1.2.

5.2.3 Glacial Till

The horizontal hydraulic conductivity of the glacial till was estimated by conducting slug tests in 16 wells/ piezometers screened within the glacial till. Results are summarized in Table 4c and the geometric mean, maximum, and minimum hydraulic conductivity values derived from the slug tests are presented in Table 4e. Estimated geometric mean values of horizontal conductivity values for wells screened in the glacial till ranged from 3.77E-07 cm/sec (MW14-02D) to 1.94E-02 cm/sec (PZ-11D) with a geometric mean of 7.60E-04 cm/sec for all tested wells/piezometers.

These results compare very favorably with the geometric mean horizontal hydraulic conductivity value (3.3E-04 cm/sec) calculated from 86 slug tests conducted in wells screened in the glacial till in other areas of the Crossroads Landfill facility (Gerber, 1996).

Transmissivity and storativity values for the glacial till were calculated using data from pumping tests conducted in other areas of the Crossroads Landfill facility (Gerber, 1996). The following summarizes the calculated values:

- Transmissivity: 115 ft^2/day to 4,085 ft^2/day
- Storativity: 7.0E-02 to 2.6E-05

5.2.4 Bedrock

Slug tests were completed in the four Phase 14 bedrock monitoring wells. Results are summarized in Table 4d. and the geometric mean, maximum, and minimum hydraulic conductivity values derived from the slug tests are presented in Table 4e. Estimated geometric mean values of horizontal hydraulic conductivity at each location ranged from 2.11E-04 cm/sec (MW14-03B) to 8.73E-06 cm/sec (MW14-04B) with a geometric mean for all bedrock slug tests of 3.18E-05 cm/sec. These results compare very favorably with the geometric mean horizontal hydraulic conductivity value (1.9E-05 cm/sec) calculated from 50 slug tests conducted in wells screened in the bedrock in other areas of the Crossroads Landfill facility (Gerber, 1996).

Transmissivity and storativity values for the till were calculated for the bedrock using data from pumping tests conducted in other areas of the Crossroads Landfill facility (Gerber, 1996). The following summarizes the calculated values:

- Transmissivity: 35.9 ft^2/day to 4,980 ft^2/day
- Storativity: 4.5E-07 to 2.9E-01

5.3 Hydrostratigraphic Cross-Section

Figure 15 presents a conceptual hydrostratigraphic cross-section (i.e., vertical flow net) that illustrates the three-dimensional groundwater flow in the Phase 14 area. The hydrostratigraphic cross-section was constructed to be generally consistent with the tangent law for the refraction of groundwater flowlines at geologic boundaries. This law describes the refraction of flowlines created by the hydraulic conductivity contrast between geologic units. When the hydraulic conductivity contrast increases so does the amount of refraction that occurs at the hydraulic boundary. When there is vertical exaggeration along the cross-section or when the media is anisotropic the equipotential lines and flow lines will not intersect at right angles (Fetter, 1980). These complexities, along with thickness changes of the Site strata precludes the development of quantitative flow nets for the Site. However, the conceptual hydrostratigraphic cross-section depicted in Figure 15 is a good tool for understanding the three-dimensional flow of groundwater in the Phase 14 area.

Comparison of the relative elevation of the phreatic, glacial till, and bedrock potentiometric surfaces in Figure 15 indicates the following:

- Upgradient of Phase 14 the glacial till potentiometric surface is higher than the phreatic surface, consistent with the confining nature of the Presumpscot Clays.
- The elevation of the phreatic, glacial till, and bedrock potentiometric surfaces are approximately equal between MW14-01 and VW-5, indicating weak vertical gradients under much of Phase 14.
- To the southeast of VW-5, the phreatic surface is generally higher than the glacial till potentiometric surface because the till thickens to south, which increases the overall transmissivity till and results in lower heads in the till. The potentiometric surface in the bedrock is generally higher than the glacial till southeast of VW-4, indicating upward flow of groundwater from the bedrock into the thicker, more transmissive glacial till.
- Horizontal flow in all three hydrostratigraphic units is generally from north to south along this hydrostratigraphic cross-section, coincident with the slope of the topography and geologic structure.

5.4 Horizontal Groundwater Seepage Velocity Estimates

Groundwater flow (seepage) velocities were estimated using an analytical approach and conservative assumptions that results in velocities in the high end of an expected range. The calculations are presented in Appendix D and are discussed below. The seepage velocities were estimated using Darcy's Law and input parameters described below. For the horizontal hydraulic conductivity, site-wide geometric mean hydraulic conductivity values as presented in Section 5.2 were used. An effective porosity of 10% was used as required in Maine SWMR Chapter 401.2.C(2).

6.0 TIME OF TRAVEL ANALYSIS

Maine SWMR, Chapter 401.2.G, requires a "thorough analysis of the proposed site and the adjacent area that could be affected during operation and after closure of the landfill in the event of releases of contaminants to groundwater beyond engineered systems". It is required that this analysis identifies the potential for an "unreasonable threat to all identified sensitive receptors." The rules define an "unreasonable threat" as an "arrival time of less than 6 years from the landfill or less than 3 years from a leachate storage structure and pump stations of a concentration of a pollutant which would result in contamination of that sensitive receptor". To address this requirement a “time-of-travel” analysis was completed.

6.1 Identification of Potential Sensitive Receptors

The first step in the time-of-travel analysis was to identify potential sensitive receptors. The Maine SWMR, Chapter 400.1.Aaa, defines a sensitive receptor as "public and private water supply aquifers and wellhead protection zone; public and private drinking water supplies; significant groundwater aquifers and primary sand and gravel recharge areas; sand and gravel deposits; and Class AA, A and B surface water bodies and great ponds." A review of published data for the Site and surrounding area was performed to evaluate each of the above to identify potential sensitive receptors.

- There are no public water supplies or well-head protection areas in the immediate vicinity of Phase 14 or the WMDSM facility. As noted in Section 3.3.1, the Town of Norridgewock water supply well field is developed in the esker on the bank of the Kennebec River. However, there is no hydraulic connection between groundwater in the Phase 14 area and the esker (shown as the “Significant Sand and Gravel Aquifer” on Figure 14c) because groundwater flow in all hydrostratigraphic units in the Phase 14 area are primarily to the south-southwest/southeast (consistent with the topography and geologic structure) away from the Town of Norridgewock water supply, which is located approximately 6,000 feet to the northeast of Phase 14. Therefore, there are no public water supplies or well-head protection areas that represent a sensitive receptor.

- Locations of private water supply wells, as identified by the Maine Geological Survey, are provided in Figure S1-1 of Volume I Appendix 1B. There is no hydraulic connection between groundwater in the Phase 14 area and the private water supply wells located on Airport Road because groundwater flow in all hydrostratigraphic units in the Phase 14 area is to the south-southwest/southeast, away from Airport Road. The WMDSM supply well identified as “New Office Well” on Figure 13b is the closest well considered potentially downgradient of Phase 14 and is identified as the potential sensitive receptor for the purpose of the time-of-travel calculation.

- A “significant sand and gravel aquifer” is defined by Maine SWMR Chapter 400.1.Ddd as “a porous formation of ice-contact and glacial outwash sand and gravel that contains significant recoverable quantities of water likely to provide drinking water supplies.” Significant sand and gravel aquifers identified by the Maine Geological Survey in the Norridgewock quadrangle (Neil, 2000) are presented on Figure 14c. The identified significant sand and gravel aquifers are located north and east of the Crossroads Landfill and Phase 14. There is no hydraulic connection between groundwater in the Phase 14 area and the significant sand and gravel aquifers because groundwater flow in all hydrostratigraphic units in the Phase 14 area is primarily to the south-southwest/southeast, away from the aquifers. The Crossroads Landfill facility and Phase 14 are located in an area where the Maine Geological Survey identified surficial deposits with “less favorable aquifer characteristics”, which are described by the Maine Geological Survey as “areas with moderate to low or no potential ground-water yield (includes areas underlain by till, marine deposits, eolian deposits, alluvium, swamps, thin glacial sand and gravel deposits, or bedrock)" (Neil, 2000). As described Sections 4 and 5, surficial soils within the proposed Phase 14 area include eolian silty fine sand and glaciomarine clay underlain by glacial till. These findings are consistent with the Maine Geological Survey's mapping of deposits "with less favorable aquifer characteristics" in the Phase 14 area. These deposits do not meet the definition of a significant sand and gravel aquifer. Therefore, there are no significant sand and gravel aquifers identified as sensitive receptors.

- Recharge to the significant sand and gravel aquifers does not occur in the Phase 14 area. Meteoric recharge to the significant sand and gravel aquifer likely occurs in areas where the sand and gravel is not overlain by low permeability Presumpscot clays (i.e., the upland areas to the east of the groundwater divide illustrated on Figure 14b) and from flow from the underlying bedrock in the immediate area of the esker. Under pumping conditions, recharge is likely induced from the Kennebec River.
- Streams mapped in the area of Phase 14 are classified by MEDEP as Class B streams. Normandeau field-delineated five intermittent Class B streams in the vicinity of Phase 14. Two of these streams are interpreted to be downgradient of Phase 14 and are identified as potential sensitive receptors. There are no great ponds in the area of Phase 14.

In summary, the sensitive receptors identified for Phase 14 include:

- WMDSM's "New Office" well (see Figure 13b)
- Two classified (Class B) streams located downgradient of Phase 14 (see Figure 12b)

6.2 Potential Pathways

The second step in the time-of-travel analysis was to identify potential pathways from theoretical release points to the identified potential sensitive receptors. Phase 14 will comprise of five cells with base grades in each cell that slope to a sump located in the western/southwestern part of the cells (see Figure 12a). The sumps are identified as theoretical release points because they represent locations where leachate could theoretically accumulate and create a hydraulic head on the liner for a leachate release. The sumps are also located on the downgradient side of the landfill cells, and therefore conservatively reduce the length of the potential pathway to the potential sensitive receptors.

For each of the potential sensitive receptors, the closest sump is identified as the theoretical release point. The following summarizes the identified pathways:

- Pathway 1 (Figure 12) - Cell 14E sump to the stream to the west of Phase 14 (near stream gauge/piezometer S-5)
- Pathway 2 (Figure 12b) - Cell 14A sump to the stream to the south-southeast of Phase 14 (near stream gauge/piezometer S-4)
- Pathway 3 (Figure 13b) - Cell 14A sump to WMDSM's "New Office" well

The following summarizes the general assumptions used to complete the time of travel calculations:

- Pathway 1 – the sump in Cell 14E will be directly underlain by the upper stiff clay facies of the Presumpscot Formation. Therefore, a theoretical release from the Cell 14E sump would enter the groundwater flow pathway and migrate horizontally through the stiff upper clay to the stream west of Phase 14. For the purpose of this evaluation, it is conservatively assumed that the pathway is a straight line from the Phase 14E sump to the S-5 stream gauge/piezometer, and that groundwater discharges to the stream at this location as shown on Figure 12b.

- Pathway 2 – the sump in Cell 14A will be directly underlain by the upper stiff clay facies of the Presumpscot Formation. Therefore, a theoretical release from the Cell 14A sump would enter the groundwater flow pathway and migrate horizontally through the stiff upper clay to the stream south-southeast of Phase 14. For the purpose of this evaluation, it is conservatively assumed that the pathway is a straight line from the Phase 14A sump to the S-4 stream gauge/piezometer, and that groundwater discharges to the stream at this location as shown on Figure 12b.
- Pathway 3 – this pathway originates from a theoretical release from the Cell 14A sump (see Figure 13b) which is directly underlain by the upper stiff clay facies of the Presumpscot Formation. It is then assumed that the theoretical release migrates vertically downward through the upper stiff clay and lower soft clay to the underlying glacial till. The assumption that a release would migrate straight downward through the two clay units is considered conservative because the actual flow path through the two clay units would include a horizontal flow component, which would increase the travel time through the vertical thickness of the clays. While the New Office well is a bedrock well, the groundwater flow pathway through the glacial till, which is in direct hydraulic communication with the bedrock, is assumed to be the fastest flow path to the potential well because the average hydraulic conductivity of the glacial till is higher than hydraulic conductivity of the bedrock.

6.3 Time of Travel Calculations

Time of travel calculations for each of the flow paths described above were made by calculating a seepage velocity for each component of the flow pathway and multiplying the seepage velocity by the length of the pathway. Time of travel values are based on average hydraulic conductivity and horizontal hydraulic gradient values. An effective porosity of 10% was used as required in the Maine SWMR, Chapter 401.2.C(2). Time of travel calculations are presented in Appendix D.

6.4 Time of Travel Results

The following summarizes the time of travel analysis results:

Pathway	Time of Travel
Pathway 1	637 years
Pathway 2	1,538 years
Pathway 3	25 years

These travel times significantly exceeded the 6-year minimum travel time required to prevent an unreasonable threat to the sensitive receptors and likely underpredict the true time of travel between the theoretical release areas and the potential sensitive receptors for the following reasons:

- The flow paths are assumed to be a straight line between the theoretical release areas (i.e. sumps) to the potential sensitive receptors and are not constructed perpendicular to the potentiometric contours. Groundwater flows perpendicular to potentiometric lines, and thus the actual flow paths would be longer than the assumed straight lines. A longer groundwater flow path would increase the length of the time of travel.
- Stream gauges/piezometers indicate downward gradients (i.e., surface water elevations are higher than groundwater elevations) at the potential receptor locations (stream gauge/piezometer S-5 for Phreatic Pathway 1 and stream gauge/piezometer S-4 for Phreatic Pathway 2), which indicates that the streams are losing streams and that phreatic groundwater does not discharge in the area of the potential sensitive receptors. Phreatic groundwater in these areas likely discharges to surface water further downstream, which would increase the length of the flow path and increase the time of travel.
- Flow through the upper and lower clay facies was assumed to be entirely vertical with no horizontal component for Pathway 3. If the horizontal component of flow was considered, the flow path through the two clay units would be longer, resulting in a greater time of travel.
- The time for downward vertical flow from the till into the bedrock was not accounted for (added to) the travel time for Pathway 3 (where the potential sensitive receptor is a bedrock well).

Maine SWMR Chapter 401.2.G requires the applicant to provide an analysis of the proposed site and the adjacent area that could be affected during operation and after closure of the landfill, in the event of releases of contaminants to groundwater beyond engineered systems. The purpose of this analysis is to assess the potential for an unreasonable threat to all identified sensitive receptors and to identify any operational or monitoring measures needed to ensure protection of the sensitive receptors. The potential for an unreasonable threat to a sensitive receptor is defined by Chapter 401.2.G as arrival time of less than 6 years from the landfill of a concentration of a pollutant which would result in contamination of that sensitive receptor.

As described above, calculated times of travel from theoretical potential release areas associated with Phase 14 to potential sensitive receptors far exceed the 6-year time frames that would represent “an unreasonable threat to a sensitive receptor”. Therefore, potential releases from Phase 14 do not represent an unreasonable threat to sensitive receptors.

Chapter 401.2.G also indicates that “an unreasonable threat to a sensitive receptor” is a time of travel less than three years from leachate storage structures and pump stations that would result in contamination of a sensitive receptor. However, no new leachate storage structures or pump stations will be constructed for Phase 14. Leachate generated from Phase 14 will be transported to existing leachate management structures near Phase 12.

Th results of the Phase 14 time-of travel evaluations are consistent with analyses completed for the other landfill phases at the WMDSM facility. Gerber performed extensive numerical groundwater modeling of the Site and the area surrounding the Site for the Phases 9, 11, and 12 (Gerber, 1996) permit application and the Phases 8 and 10 (Gerber, 1993) permit application. These modeling efforts corroborate the analytical time of travel calculations completed for Phase 14 because the model domains include the area of Phase 14.

Appendix E provides the modeling section from the Phases 9, 11 and 12 permit application (Gerber, 1996), which describes the model development, calibration and simulation results. The following summarizes Gerber's modeling efforts, focusing on the results of the simulations for Phases 11 and 12 (located downgradient of Phase 14) and describes how the results support the Phase 14 evaluations.

Gerber first developed a two-dimensional finite element numerical model using AQUIFEM (Townley and Wilson, 1980) to evaluate regional groundwater flow in the bedrock aquifer and to define boundary conditions for a three-dimensional model. Gerber used MODFLOW (McDonald and Harbaugh, 1988) for the three-dimensional finite-difference numerical groundwater flow model which encompassed a 2.67 square-mile area, including the area of Phase 14 Site (see Appendix D, Figure 4-43 - Model Finite Difference Grid). Following calibration and verification of the MODFLOW model, Gerber used a particle-tracking post-processor (MODPATH) to predict the path of advective plumes from theoretical releases from Phase 11 and 12.

The MODPATH simulations indicate the average time of time travel for a theoretical release from Phases 11 and 12 to nearby streams through the shallow groundwater flow pathways was 8 and 15 years, respectively. 29% of the pathways originating at Phase 11 had a time of travel to discharge of greater than 200 years. Similarly, 18% of the pathways originating at Phase 12 had a time of travel to discharge of greater than 200 years. The longer flow paths (i.e., those greater than 200 years) represent those pathways through the Presumpscot clay.

Gerber (1996) also calculated shallow groundwater travel times based upon Darcy’s law and hand-calculated seepage velocities. Using this method Gerber estimated time of travel from Phase 11 potential release areas to nearby shallow streams ranging from 21 to 97 years, and estimated time of travel from Phase 12 potential release areas to nearby shallow streams ranging from 13.9 to 46 years. These results were used to support the determination that the all calculated travel times exceed the 6-year time of travel requirement. Gerber’s results compare favorably to those calculated by Golder for Phase 14.

Lastly, Gerber used analytical methods and groundwater modeling (MODPATH and MT3D) to simulate theoretical failure scenarios from Phases 11 and 12. As detailed in Attachment E, Gerber simulated impacts on ground water under three failure scenarios and evaluated the potential impact on six different surface water points. The evaluation identified nearby drainage ways, Mill Stream, and bedrock as potential receptors from the landfill and simulated average travel times to discharge at greater than six years for Phase 11 and 12. The analytical evaluations predicted no measurable long-term change in water quality in Mill Stream or other drainage ways. Computer simulations of the liner system failure and pumping station leak also predicted no impact to sensitive receptors and minimal impact to local drainage ways. Gerber concluded that the site has good hydrogeologic controls to back up the engineered systems, which serve to reduce the effect of any unforeseen event over the life of the facility.

7.0 WATER QUALITY MONITORING PROGRAM

Maine SWMR Chapter 401.2.C(1)(h)(viii) requires identification of proposed surface and groundwater monitoring points. Table 6 lists the proposed groundwater and surface water quality monitoring points. Monitoring locations are illustrated on Figure 16. The following sections describe the proposed water quality monitoring program.

7.1 Proposed Groundwater Water Quality Monitoring Program

The proposed groundwater monitoring program includes one (1) upgradient monitoring location and five (5) downgradient monitoring locations. Two hydrostratigraphic units will be monitored at each downgradient location as follows:

- Upgradient location MW14-01 - includes glacial till monitoring well (MW14-01D)

- Downgradient location MW14-08 - includes a phreatic unit monitoring well (MW14-08M) and a glacial till monitoring well (MW14-08D) to monitor groundwater quality downgradient of Phase 14A[2]
- Downgradient location MW14-03 - includes a phreatic unit monitoring well (MW14-03M) and a glacial till monitoring well (MW14-03D) to monitor groundwater quality downgradient of Phase 14B
- Downgradient location MW14-04 - includes a phreatic unit monitoring well (MW14-04M) and a glacial till monitoring well (MW14-04D) to monitor groundwater quality downgradient of Phase 14C
- Downgradient location MW14-05 - includes a phreatic unit monitoring well (MW14-05M) and a glacial till monitoring well (MW14-05D) to monitor groundwater quality downgradient of Phase 14D
- Downgradient location MW14-07 - includes a phreatic unit monitoring well (MW14-07M) and a glacial till monitoring well (MW14-07D) to monitor groundwater quality downgradient of Phase 14E

In accordance with Chapter 405.2.C(1) site characterization monitoring will be conducted prior to waste placement in Phase 14 to establish the parameters to be monitored and their concentrations in groundwater in the vicinity of the Phase 14. The site characterization monitoring program will comprise four independent samples from each groundwater monitoring well. In accordance with Chapter 405.2.C(1)(d), all samples will be analyzed for the Column 2 parameters during the first two sampling events. Samples collected during the subsequent sampling rounds will be analyzed for the Column 1 parameters and any Column 2 parameters detected in the first two sampling rounds.

7.2 Proposed Surface Water Quality Monitoring Program

Surface water samples will be collected as part of the water quality monitoring program from streams located upgradient and downgradient of Phase 14. Surface water sampling locations are illustrated on Figure 16 and identified on Table 6. Sampling locations include:

- Upgradient location SW14-07 at stream piezometer/staff gauge S-7
- Upgradient location SW14-02 at stream piezometer/staff gauge S-2
- Downgradient location SW14-05 at stream piezometer/staff gauge S-5
- Downgradient location SW14-08 at a new location downstream of existing piezometer/staff gauges S-1 and S-4

In accordance with Chapter 405.2.C(1), site characterization monitoring will be conducted prior to waste placement in Phase 14 to establish the parameters to be monitored and their concentrations in groundwater in the vicinity of the Phase 14. The site characterization monitoring program will comprise of four independent samples from each surface water sampling location. In accordance with Chapter 405.2.C(1)(d), all samples will be analyzed for the Column 2 parameters during the first two sampling events. Samples collected during the subsequent sampling rounds will be analyzed for the Column 1 parameters and any Column 2 parameters detected in the first two sampling rounds.

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[2] Wells to be installed.

7.3 Proposed Water Level Monitoring Program

Water levels will be monitored at each groundwater sampling location and surface water sampling location during each monitoring event. Water levels will also be monitored at the monitoring wells, piezometers, and stream staff gauges identified on Figure 16 and listed in Table 6.

8.0 PIEZOMETER AND WELL DECOMMISSIONING PROGRAM

Existing monitoring wells and piezometers within the footprint of the proposed expansion area will be appropriately decommissioned prior to landfill construction to ensure that well materials (well casings etc.) do not compromise the integrity of the liner system. Wells and piezometers within the disturbed area for a particular phase will be decommissioned prior to construction of that phase. The wells and piezometers to be decommissioned and the associated landfill construction phases are provided on Figure 16.

The following standard well decommissioning procedures will be used:

1. Record Well Information: The total well or piezometer depth and depth to water will be recorded at each well or piezometer prior to decommissioning. If available, the design well depth will be compared to the measured well or piezometer depth. All information will be recorded on well decommissioning forms.

2. Remove Protective Well Cover: The protective well cover will be removed from the wells or piezometers by securing a chain or pulley wire around the well or piezometer cover and pulling straight up with the drill rig.

3. Remove Well Casing Materials: PVC well casing and screen will be removed from the borehole by securing a chain or pulley wire around the casing and pulling straight up using the drill rig.

4. Over-drill Borehole: To remove remaining well materials including PVC casing/well screen, filter sand material, and grout materials, boreholes will be over-drilled using drive and wash drilling techniques and 4-inch casing. The casing will be either driven or spun to the full design well depth and the borehole will be flushed with water. If the PVC material cannot be pulled from the ground, a roller bit will be used to grind up and flush out the PVC material.

5. Grouting of Borehole: Each borehole will be grouted by placing a tremie pipe to the bottom of the boring inside the 4-inch casing and pumping grout into the borehole through the tremie pipe. The 4-inch casing will be completely filled with grout through the tremie pipe. The casing will then be pulled from the borehole and additional grout added as necessary to keep the level of grout at the ground surface. Each decommissioned borehole will be inspected within five days to check for grout settlement. Additional grout or bentonite chips will be added as required.

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Golder Associates Inc.

B. Lennon

Brendan Lennon
Senior Project Geologist

Alistair P. T. Macdonald, PG, LSP
Senior Program Leader and Principal

STATE OF MAINE
Alistair
Macdonald
No. GE 431
REGISTERED GEOLOGIST

BL/APTM/drb

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TABLES

Table 1: Phase 14 Groundwater Monitoring Well, Piezometer, and Vibrating Wire Construction Details

Location	Northing (ft)	Easting (ft)	Ground Surface Elevation (ft-msl)	Top of Casing Elevation (ft-msl)	Screen Interval					Casing Diameter (inches)
					Top (ft-bgs)	Top Elevation (ft-msl)	Bottom (ft-bgs)	Bottom Elevation (ft-msl)	Geologic Unit	
PZ-1S	684724.127	3039798.472	295.045	298.003	15.0	280.0	20.0	275.0	Sand	1
PZ-1M	684739.513	3039786.688	292.554	295.43	23.0	269.6	28.0	264.6	Stiff and soft clay	2
PZ-2S	685073.046	3040231.132	284.351	287.198	3.0	281.4	8.0	276.4	Sand	1
PZ-3S	685214.472	3039508.576	289.787	292.733	4.0	285.8	9.0	280.8	Sand	1
PZ-4S	685581.992	3039291.466	292.187	295.155	3.0	289.2	8.0	284.2	Sand	1
PZ-5M	685620.631	3038720.586	286.117	289.65	7.0	279.1	12.0	274.1	Stiff clay	2
PZ-5D	685622.533	3038731.437	286.266	289.157	12.5	273.8	17.5	268.8	Till	1
PZ-6S	686040.955	3039226.078	300.007	302.752	7.0	293.0	12.0	288.0	Sand	1
PZ-7M	685074.106	3040470.860	280.642	283.680	8.2	272.4	13.2	267.4	Stiff clay	2
PZ-7D	685071.000	3040477.652	280.568	283.529	20.6	260.0	25.6	255.0	Till	2
PZ-8S	686287.020	3038917.478	297.104	299.693	4.0	293.1	7.0	290.1	Sand	2
PZ-8D	686286.016	3038924.719	296.805	299.852	14.0	282.8	19.0	277.8	Till	2
PZ-9S	685574.598	3041101.674	289.693	292.395	5.5	284.2	10.5	279.2	Sand	2
PZ-9D	685578.109	3041098.784	289.409	292.475	53.0	236.4	58.0	231.4	Till	2
PZ-10S	685707.805	3040644.885	291.614	294.273	5.5	286.1	10.5	281.1	Sand	2
PZ-10M	685704.282	3040641.795	291.313	294.228	14.4	276.9	19.4	271.9	Stiff clay	2
PZ-10D	685704.677	3040636.036	291.319	294.029	26.0	265.3	31.0	260.3	Till	2
PZ-11S	686187.024	3040263.705	298.871	303.061	2.5	296.4	5.5	293.4	Sand	2
PZ-11D	686182.597	3040262.096	298.780	301.747	14.7	284.1	19.7	279.1	Till	2
PZ-12S	686432.606	3039619.520	307.797	310.739	4.0	303.8	8.0	299.8	Sand	2
PZ-12D	686436.957	3039615.841	307.488	310.329	12.0	295.5	14.0	293.5	Till	2
PZ-13S	684340.176	3040266.523	275.807	278.755	3.4	272.4	8.4	267.4	Sand	2
PZ-13D	684339.156	3040275.599	275.302	277.456	29.0	246.3	34.0	241.3	Till	2
PZ-14M	684586.348	3041209.820	267.057	269.919	4.2	262.9	9.2	257.9	Stiff clay	2
PZ-14D	684572.504	3041217.893	266.839	269.534	37.5	229.3	42.5	224.3	Till	2
PZ-15M	686286.809	3038512.774	284.758	287.63	2.5	282.3	7.5	277.3	Stiff clay	2
PZ-15D	686290.061	3038513.811	284.382	287.51	12.5	271.9	17.5	266.9	Till	2
PZ-16M	685023.194	3039774.733	291.661	296.43[1]	16.0	275.7	21.0	270.7	Stiff clay	2
PZ-17M	685296.472	3040174.123	279.687	282.76	5.0	274.7	10.0	269.7	Soft clay	2
PZ-18M	685176.317	3039569.786	291.279	294.84	14.0	277.3	17.0	274.3	Stiff clay	2
PZ-19M	685140.964	3038806.948	294.181	297.40	25.0	269.2	35.0	259.2	Stiff and soft clay	2
PZ-20S	684538.13	3040074.184	283.867	286.67	6.5	277.4	11.5	272.4	Sand	2
PZ-21S	686033.544	3038607.465	298.963	301.84	6.5	292.5	11.5	287.5	Sand	2
MW14-01S	685930.678	3039595.616	294.157	298.36	2.0	292.2	4.0	290.2	Sand	2
MW14-01D	685939.725	3039600.346	294.268	297.65	8.5	285.8	13.5	280.8	Till	2
MW14-01B	685935.406	3039598.259	294.299	297.27	36.0	258.3	56.0	238.3	Bedrock	2
MW14-02S	684675.807	3040260.342	276.690	280.45	1.4	275.3	3.4	273.3	Sand	2
MW14-02M	684680.149	3040256.953	276.842	279.83	12.5	264.3	17.5	259.3	Soft clay	2
MW14-02D	684688.399	3040250.435	276.446	279.99	24.5	251.9	29.5	246.9	Till	2
MW14-02B	684684.4702	3040253.367	276.914	279.44	72.1	204.8	92.1	184.8	Bedrock	2
MW14-03S	684509.987	3039435.016	277.466	280.46	3.9	273.6	5.9	271.6	Sand	2
MW14-03M	684506.892	3039430.044	277.363	280.13	10.5	266.9	15.5	261.9	Stiff clay	2
MW14-03D	684504.177	3039425.578	276.905	280.28	23.0	253.9	28.0	248.9	Till	2
MW14-03B	684500.912	3039420.818	277.001	279.62	50.0	227.0	70.0	207.0	Bedrock	2
MW14-04S	684723.97	3038829.487	276.529	279.73	3.7	272.8	7.7	268.8	Sand	2
MW14-04M	684718.749	3038829.978	277.205	280.32	13.5	263.7	23.5	253.7	Stiff and soft clay	2
MW14-04D	684713.443	3038830.683	277.232	280.21	28.0	249.2	30.0	247.2	Till	2
MW14-04B	684708.257	3038831.308	277.009	279.86	62.5	214.5	82.5	194.5	Bedrock	2
MW14-05S	685207.543	3038285.844	276.643	279.60	2.9	273.7	5.9	270.7	Sand	2
MW14-05M	685211.884	3038283.181	276.254	279.29	11.5	264.8	21.5	254.8	Stiff and soft clay	2
MW14-05D	685216.494	3038280.589	275.967	278.91	40.5	235.5	45.8	230.2	Till	2
MW14-06S	685986.044	3038477.65	285.215	288.33	0.5	284.7	2.5	282.7	Sand	2
MW14-06M	685987.327	3038482.249	285.562	288.76	3.0	282.6	6.0	279.6	Stiff clay	2
MW14-06D	685989.819	3038477.75	285.488	288.31	16.5	269.0	21.5	264.0	Till	2
VW-1S	685580.814	3041108.771	289.752	-	-	-	-	279.8	Sand	-
VW-1D	685580.814	3041108.771	289.752	-	-	-	-	253.2	Till	-
VW-2S	685366.437	3040797.499	276.908	-	-	-	-	274.9	Sand	-
VW-2D	685366.437	3040797.499	276.908	-	-	-	-	267.1	Till	-
VW-3S	685027.660	3039768.948	292.232	-	-	-	-	280.2	Sand	-
VW-3D	685027.660	3039768.948	292.232	-	-	-	-	266.8	Till	-
VW-4S	684760.040	3039331.534	294.410	-	-	-	-	276.4	Sand	-
VW-4D	684760.040	3039331.534	294.410	-	-	-	-	255.4	Till	-
VW-5S	685215.611	3039084.187	286.142	-	-	-	-	280.1	Sand	-
VW-5D	685215.611	3039084.187	286.142	-	-	-	-	262.8	Till	-
VW-6S	685304.528	3038508.779	280.200	-	-	-	-	274.2	Sand	-
VW-6D	685304.528	3038508.779	280.200	-	-	-	-	260.2	Till	-
VW-7S	685836.483	3039124.351	292.789	-	-	-	-	286.8	Sand	-
VW-7D	685836.483	3039124.351	292.789	-	-	-	-	281.8	Till	-

Notes:
Coordinate System = North American Datum 1983 Stateplane Maine West
Elevations = North American Vertical Datum 1988
ft-bgs = feet below ground surface
ft-msl = feet above mean sea level
"-" = Not applicable
1 = On 7/11/2019, the TOC elevation at PZ-16M was reduced by 5-inches (296.01 ft msl) by GeoSyntec in order to add protective cover.

Created by: LWL
Checked by: BDL
Reviewed by: APTM

Table 2: Stream Piezometer Construction Details and Water Level Measurements

				10/15/2018			5/2/2019			5/16/2019			5/30/2019			6/14/2019			7/1/2019			7/15/2019			7/25/2019			8/23/2019			9/5/2019		
Location	Top of Casing Elevation (ft-msl)	Top of Screen Elevation (ft-msl)	Bottom of Screen Elevation (ft-msl)	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient	Groundwater Elevation (ft-msl)	Surface Water Elevation (ft-msl)	Direction of Gradient
S-1	255.57	250.52	250.02	250.36	251.92	Down	251.35	251.97	Down	251.38	251.83	Down	251.42	251.71	Down	251.45	251.82	Down	251.50	251.72	Down	251.49	Dry	Down	251.48	Dry	Down	251.19	Dry	Down	251.17	Dry	Down
S-2	261.713	253.633	253.133	Dry	258.41	Down	259.30	258.91	Up	259.41	259.53	Down	259.23	258.61	Up	259.11	258.61	Up	258.95	258.41	Up	258.61	258.16	Up	258.31	258.20	Up	258.30	258.31	Down	258.38	258.23	Up
S-3	278.371	269.291	268.791	269.31	275.31	Down	273.99	275.22	Down	274.20	275.20	Down	274.36	275.17	Down	274.51	274.61	Down	274.66	275.17	Down	274.74	275.12	Down	274.78	Dry	Down	274.70	275.14	Down	274.72	275.17	Down
S-4	261.467	252.347	251.847	252.64	257.01	Down	256.13	257.22	Down	256.23	257.07	Down	256.32	257.03	Down	256.39	257.06	Down	256.46	256.98	Down	256.47	256.92	Down	256.40	Dry	Down	255.31	256.88	Down	255.21	256.87	Down
S-5	263.72	257.67	257.17	258.38	260.59	Down	259.27	260.55	Down	259.30	260.53	Down	259.32	260.49	Down	259.34	260.47	Down	259.36	260.47	Down	259.36	260.42	Down	259.35	260.42	Down	259.31	260.49	Down	259.30	260.46	Down
S-6	283.354	277.314	276.814	280.42	279.95	Up	281.58	279.99	Up	281.51	279.85	Up	281.43	279.78	Up	281.45	279.80	Up	281.35	279.75	Up	280.88	279.65	Up	280.55	279.59	Up	280.65	279.71	Up	280.81	279.69	Up
S-7	293.999	287.959	287.459	289.16	290.93	Down	291.01	291.04	Down	291.03	291.00	Up	291.06	290.96	Up	291.06	290.90	Up	291.06	290.95	Up	291.04	290.81	Up	291.02	290.80	Up	290.97	290.84	Up	290.95	290.82	Up

Notes:
Coordinate System = North American Datum 1983 Stateplane Maine West
Elevations reference North American Vertical Datum 1988
ft-msl = feet above mean sea level
NM = not measured
Dry = water level was below piezometer at time of measurement and groundwater or surface water elevation could not be calculated

Created by: LWL
Checked by: BDL
Reviewed by: APTM

Table 3a: Water Elevation Data - Silty Fine Sand

		Groundwater Elevation (ft-msl)																													Sand Saturation			
Location	Geologic Unit	9/21/2017	10/24/2017	11/17/2017	12/15/2017	1/15/2018	2/12/2018	3/21/2018	4/24/2018	5/22/2018	6/15/2018	7/23/2018	8/23/2018	9/7/2018	9/12/2018	10/15/2018	11/21/2018	12/11/2018	12/13/2018	2/10/2019	3/11/2019	5/2/2019	5/16/2019	5/30/2019	6/14/2019	7/1/2019	7/15/2019	7/25/2019	8/23/2019	9/5/2019	Minimum Saturated Sand Thickness (ft)	Maximum Saturated Sand Thickness (ft)	Average Saturated Sand Thickness (ft)	Number of "Dry" Measurements
PZ-1S	Fine Silty Sand	279.75	279.29	280.28	280.42	280.55	280.98	281.65	282.96	282.09	281.25	280.18	279.72	279.51	NM	279.03	280.18	NM	280.65	280.60	280.23	283.19	282.85	282.54	282.01	281.66	281.26	280.90	280.07	279.95	2.79	6.95	4.64	0
PZ-2S	Fine Silty Sand	279.57	278.92	278.46	280.82	277.63	278.65	278.43	280.80	281.00	280.25	279.38	279.40	279.11	NM	Dry	277.75	NM	280.90	280.90	280.26	277.83	281.16	281.60	281.32	281.08	280.30	279.80	280.07	279.93	0.00	3.55	1.74	1
PZ-3S	Fine Silty Sand	284.79	284.19	286.25	285.98	286.88	286.08	287.10	287.50	286.86	286.02	285.06	284.78	284.41	NM	284.58	286.22	NM	286.18	286.32	285.88	287.66	287.45	287.30	287.20	286.84	286.10	285.54	286.11	285.55	2.41	5.88	4.32	0
PZ-4S	Fine Silty Sand	287.81	286.56	290.42	290.14	Frozen[1]	286.98	288.68	289.23	290.22	289.05	287.63	287.67	287.23	NM	287.31	290.73	NM	Frozen[2]	Frozen[3]	289.42	292.04	291.97	291.32	290.88	290.66	289.42	288.76	288.52	288.71	0.00	4.85	2.33	0
PZ-6S	Fine Silty Sand	292.65	291.96	293.93	292.80	293.95	293.90	288.70	289.80	290.76	288.85	288.00	292.80	292.49	NM	292.41	288.55	NM	288.25	288.35	293.78	292.80	292.70	292.76	289.05	288.20	288.55	288.55	288.55	Dry	0.00	4.94	2.02	1
PZ-8S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry	NM	NM	NM	290.69	Dry	Dry	Dry	Dry	Dry	Dry	290.76	Dry	Dry	Dry	0.00	1.26	0.20	10
PZ-9S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	280.84	NM	NM	NM	282.79	282.39	284.15	284.43	284.09	283.67	283.44	283.01	282.65	282.02	281.85	1.14	4.73	3.27	0
PZ-10S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	282.31	NM	NM	NM	284.42	284.20	286.68	286.15	285.80	285.40	285.14	284.64	284.30	283.71	283.44	0.70	5.07	3.11	0
PZ-11S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	296.87	NM	NM	NM	297.27	297.18	297.82	297.66	297.48	297.49	297.36	296.84	296.31	297.00	296.95	5.60	7.95	7.19	0
PZ-12S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	305.13	NM	NM	NM	305.42	305.28	306.34	305.99	305.72	305.62	305.49	305.04	304.81	305.32	305.19	6.91	8.44	7.55	0
PZ-13S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270.92	NM	NM	NM	271.89	271.49	272.77	272.76	272.24	271.78	271.78	272.60	269.93	270.25	270.90	2.32	5.16	3.99	0
PZ-20S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	281.10	280.72	280.38	279.96	279.63	279.12	278.78	278.41	278.24	7.24	9.93	8.47	0
PZ-21S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	288.33	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.00	1.37	0.15	8
MW14-01S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	294.49	294.52	294.55	294.52	294.46	294.16	292.86	294.20	293.93	1.45	3.01	2.68	0
MW14-02S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	276.15	276.13	276.11	276.12	276.06	275.94	275.82	275.96	275.85	1.87	2.96	2.74	0
MW14-03S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	276.09	276.04	276.00	276.03	275.93	275.71	275.46	275.67	275.64	3.00	5.13	4.50	0
MW14-04S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	275.16	274.90	274.71	274.77	274.52	273.57	273.01	273.88	273.58	4.46	6.63	5.64	0
MW14-05S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.00	0.00	0.00	9
MW14-06S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	283.10	283.23	282.95	Dry	Dry	Dry	Dry	Dry	Dry	0.00	0.71	0.19	6
VW-1S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	281.9	282.9	281.1	283.1	NM	282.8	283.3	283.1	285.3	284.7	284.4	284.0	283.8	283.4	283.0	282.4	282.3	1.8	6.0	4.1	0
VW-2S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	Dry	276.1	Dry	275.5	NM	Dry	275.4	Dry	275.6	275.5	275.4	275.4	275.1	Dry	Dry	275.2	Dry	0.0	1.2	0.4	7
VW-3S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	283.3	283.2	282.7	284.3	284.7	NM	284.6	Dry	287.0	286.7	286.3	285.9	285.6	285.0	284.5	283.8	283.7	0.0	6.8	4.3	1
VW-4S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	277.4	277.5	277.1	279.3	279.9	NM	279.3	278.9	281.6	281.3	280.6	280.0	279.8	279.0	278.7	277.9	278.1	3.2	7.7	5.5	0
VW-5S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	Dry	280.4	280.2	281.0	281.1	NM	280.9	Dry	282.3	282.2	281.8	281.4	281.2	280.4	Dry	280.2	280.3	0.0	2.2	0.9	3
VW-6S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	Dry	277.9	Dry	274.3	NM	Dry	274.4	Dry	276.5	275.8	275.4	274.9	274.7	274.4	Dry	Dry	Dry	0.0	4.5	1.3	7
VW-7S	Fine Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	289.7	290.9	290.1	291.6	NM	291.0	291.5	291.1[4]	292.2	291.9	291.6	291.5	291.2	290.4	290.0	290.5	290.4	2.9	5.4	4.3	0

Notes:

Coordinate System = North American Datum 1983 Stateplane Maine West

Elevations = North American Vertical Datum 1988

ft-msl = feet above mean sea level

"-" = not applicable

MW = groundwater monitoring well

PZ = groundwater piezometer

VW = vibrating wire piezometer

NM = not measured

1 = PZ-4S frozen at 291.81 ft-msl, could not break through ice

2 = PZ-4S frozen at 291.31 ft-msl, could not break through ice

3 = PZ-4S frozen at 292.01 ft-msl, could not break through ice

4 = Measurement was collected on 3/13/2019

🟦 Maximum groundwater elevation at a specific well/piezometer

🟨 Minimum groundwater elevation at a specific well/piezometer

Created by: LWL

Checked by: TK

Reviewed by: APTM

Table 3b: Water Elevation Data - Phreatic, Glacial Till, and Bedrock Units

Location	Geologic Unit	Groundwater Elevation (ft-msl)																												
		9/21/2017	10/24/2017	11/17/2017	12/15/2017	1/15/2018	2/12/2018	3/21/2018	4/24/2018	5/22/2018	6/15/2018	7/23/2018	8/23/2018	9/7/2018	9/12/2018	10/15/2018	11/21/2018	12/11/2018	12/13/2018	2/10/2019	3/11/2019	5/2/2019	5/16/2019	5/30/2019	6/14/2019	7/1/2019	7/15/2019	7/25/2019	8/23/2019	9/5/2019
PZ-1M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	279.87	279.57	279.26	278.76	278.53	278.00	277.63	276.82	276.90
PZ-5M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	284.20	283.72	283.40	283.14	282.85	282.16	281.62	281.57	281.63
PZ-7M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry[1]	NM	NM	NM	275.40	274.89	276.71	276.30	276.06	275.91	275.95	275.35	274.80	273.74	274.62
PZ-10M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	281.81	NM	NM	NM	284.01	283.69	286.07	285.47	285.14	284.76	284.61	284.17	283.84	283.12	283.09
PZ-14M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	258.61	NM	NM	NM	259.67	259.36	261.92	260.92	260.77	260.33	260.62	260.14	259.85	258.89	259.82
PZ-15M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	284.08	284.12	284.08	284.06	284.08	283.89	283.75	283.77	283.80
PZ-16M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	284.59	284.43	284.11	283.77	283.45	283.74	283.30	282.74	282.70
PZ-17M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	279.46	279.46	279.36	279.24	279.22	278.61	278.11	277.97	278.61
PZ-18M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	287.08	286.86	286.55	286.18	285.89	285.23	285.06	284.62	284.40
PZ-19M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	278.39	277.76	277.30	276.62	276.40	275.67	275.20	274.13	274.47
MW14-02M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270.38	270.34	270.29	270.13	270.16	269.94	269.73	269.34	269.55
MW14-03M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	273.17	273.07	272.95	272.75	272.78	272.37	272.02	271.78	272.04
MW14-04M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	272.96	272.68	272.44	272.07	272.11	271.30	270.76	270.23	270.84
MW14-05M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	272.20	271.92	271.70	271.49	271.49	271.01	270.69	270.78	270.80
MW14-06M	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	283.90	283.44	283.03	282.66	282.44	281.86	281.33	Dry	Dry
W11-1ER	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	263.67	263.80	263.33	262.66	263.16	260.30	259.01	256.70	256.67
W11-2E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	261.85	261.89	261.72	261.80	261.73	259.63	258.45	259.10	259.86
W11-3E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257.93	257.92	257.88	257.75	257.55	256.41	255.61	255.11	255.37
W11-4E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257.14	256.91	256.71	256.38	256.03	255.76	255.49	255.27	255.25
W11-5E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	259.80	260.05	259.45	258.98	258.93	258.44	258.02	257.92	257.81
W11-6E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	261.24	261.06	260.63	260.07	259.88	259.34	258.94	258.42	258.21
W12-1E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	256.48	256.51	256.15	254.40	255.66	252.55	251.03	Dry	Dry
W12-2E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257.76	256.80	255.70	256.40	262.24	261.55	261.34	261.58	261.66
W12-3E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	242.73	242.64	242.44	242.46	242.41	242.29	242.11	242.57	242.48
W12-4E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	245.59	245.54	245.26	244.47	243.95	244.43	244.22
W12-5E	Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	254.66	252.23	250.91	250.66	250.54	250.19	249.53	250.14	250.26
PZ-5D	Till	280.27	279.46	282.36	282.08	282.53	282.18	282.43	283.02	282.24	281.36	280.03	280.55	279.74	NM	280.52	282.33	NM	282.08	282.29	282.07	283.11	282.90	282.69	282.57	282.36	281.40	280.66	280.57	280.98
PZ-7D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	262.10	NM	NM	NM	263.21	263.09	263.67	263.59	263.44	263.26	263.13	262.61	262.23	262.05	262.32
PZ-8D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	289.22	NM	NM	NM	289.69	289.59	290.09	289.91	289.79	289.69	289.59	289.42	289.25	289.26	289.23
PZ-9D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	278.07	NM	NM	NM	280.73	280.42	282.33	281.93	281.68	281.32	280.99	280.65	280.30	279.86	279.84
PZ-10D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	281.26	NM	NM	NM	282.54	282.31	283.52	283.22	283.01	282.79	282.49	282.20	281.84	281.63	281.71
PZ-11D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	297.24	NM	NM	NM	297.97	297.76	298.61	298.37	298.17	298.05	297.90	297.38	297.04	297.33	297.39
PZ-12D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	305.42	NM	NM	NM	305.76	305.62	306.63	306.34	306.05	305.95	305.80	305.32	305.05	305.56	305.45
PZ-13D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	252.19	NM	NM	NM	254.99	Damaged[2]	255.28	255.22	255.04	254.50	254.47	253.64	252.91	251.70	252.31
PZ-14D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	241.79	NM	NM	NM	245.23	245.00	246.06	245.98	245.78	245.40	245.31	244.48	243.85	242.25	242.73
PZ-15D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	282.14	281.99	281.78	281.66	281.51	280.89	280.43	280.58	280.76
MW14-01D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	295.11	294.82	294.59	294.39	294.16	293.55	293.00	293.08	293.14
MW14-02D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	262.82	262.64	262.39	261.99	261.96	261.39	260.79	259.99	260.25
MW14-03D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	268.04	267.89	267.64	267.21	267.17	266.24	265.55	264.82	265.28
MW14-04D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	268.64	269.51	269.16	268.71	268.68	267.56	266.79	266.15	266.71
MW14-05D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257.83	257.72	257.28	256.89	256.89	255.66	254.65	254.47	255.24
MW14-06D	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	281.22	280.94	280.69	280.54	280.30	278.87	278.16	277.43	278.31
W11-1B	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	252.55	252.42	251.96	251.70	251.59	250.83	249.96	249.94	250.31
W11-5B	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	248.43	248.24	247.24	247.44	246.50	245.94	243.47	245.40	245.73
W12-1B	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	248.50	248.36	246.44	247.56	245.34	245.53	241.91	245.39	245.65
W12-4B	Till	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	234.37	234.43	234.01	233.74	232.90	233.19	233.25
VW-1D	Till	-	-	-	-	-	-	-	-	-	-	-	-	279.9	281.3	279.8	281.5	NM	281.2	281.8	281.7	283.3	282.8	282.6	282.3	281.9	281.5	281.2	280.7	280.7
VW-2D	Till	-	-	-	-	-	-	-	-	-	-	-	-	271.8	272.9	271.8	273.5	NM	273.0	273.6	273.6	274.5	274.1	274.0	273.8	273.6	273.0	272.6	272.4	272.6
VW-3D	Till	-	-	-	-	-	-	-	-	-	-	-	-	275.6	275.7	276.0	277.8	278.0	NM	279.2	278.5	280.1	279.9	279.5	279.0	278.8	278.1	277.6	277.2	277.5
VW-4D	Till	-	-	-	-	-	-	-	-	-	-	-	-	275.5	273.7	274.0	276.3	276.4	NM	276.1	275.8	277.2	276.9	276.7	276.2	276.1	275.2	274.6	274.0	274.5
VW-5D	Till	-	-	-	-	-	-	-	-	-	-	-	-	275.5	276.9	277.6	280.1	280.2	NM	280.0	279.6	281.0	280.8	280.5	280.1	280.0	278.8	278.0	277.6	278.2
VW-6D	Till	-	-	-	-	-	-	-	-	-	-	-	-	264.2	265.1	265.2	267.2	NM	266.5	267.1	267	267.6	267.5	267.2	266.9	266.9	265.6	264.7	264.6	265.4
VW-7D	Till	-	-	-	-	-	-	-	-	-	-	-	-	290.2	291.3	290.1	291.8	NM	291.4	291.9	291.5[3]	293.1	292.6	292.3	292.1	291.8	291.3	290.8	290.7	290.7
MW14-01B	Bedrock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	296.18	295.97	295.75	295.48	295.14	294.54	294.18	293.78	294.09
MW14-02B	Bedrock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	262.19	262.09	261.86	261.48	261.41	260.74	260.21	259.44	259.90
MW14-03B	Bedrock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	267.60	267.45	267.19	266.74	266.70	265.73	265.06	264.30	264.75
MW14-04B	Bedrock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	272.34	272.19	271.87	271.39	271.33	270.24	269.53	268.85	269.41

Notes:

Coordinate System = North American Datum 1983 Stateplane Maine West

Elevations = North American Vertical Datum 1988

ft-msl = feet above mean sea level

"-" = not applicable

MW = groundwater monitoring well

PZ = groundwater piezometer

VW = vibrating wire piezometer

NM = not measured

Dry = water level was below piezometer/well screen at time of measurement and groundwater elevation could not be calculated

1 = Suspect measurement - well cap was under vacuum

2 = PZ-13D was damaged at time of measurement.

3 = Measurement was collected on 3/13/2019

🟦 Maximum groundwater elevation at a given location

🟧 Minimum groundwater elevation at a given location

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4a: Slug Testing Results - Silty Fine Sand

Location ID	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)
MW14-01S	Falling Head 1	1.90E-04	1.73E-04	1.57E-04
	Rising Head 1	1.41E-04	1.31E-04	
MW14-03S	Falling Head	2.56E-03	2.27E-03	2.41E-03
	Rising Head	2.47E-03	2.22E-03	
	Falling Head 2	2.59E-03	2.23E-03	
	Rising Head 2	2.59E-03	2.37E-03	
MW14-04S	Falling Head 1	3.03E-03	3.07E-03	3.02E-03
	Rising Head 1	3.07E-03	3.43E-03	
	Falling Head 2	2.84E-03	2.85E-03	
	Rising Head 3	3.00E-03	2.95E-03	
	Falling Head 3	2.90E-03	2.87E-03	
	Rising Head 3	3.20E-03	3.09E-03	
PZ-1S	Rising Head 1	2.21E-02	2.21E-02	3.07E-02
	Rising Head 2	2.64E-02	2.58E-02	
	Rising Head 3	5.21E-02	4.84E-02	
PZ-2S	Rising Head 1	6.72E-02	6.09E-02	6.40E-02
PZ-3S	Rising Head 1	8.06E-02	7.86E-02	7.96E-02
PZ-4S	Rising Head 1	5.81E-02	5.07E-02	6.03E-02
	Rising Head 2	7.57E-02	7.18E-02	
	Rising Head 3	5.51E-02	5.47E-02	
PZ-6S	Rising Head 1	5.32E-02	5.13E-02	5.27E-02
	Rising Head 2	5.50E-02	5.08E-02	
	Rising Head 3	5.05E-02	5.55E-02	
PZ-9S	Rising Head 1	1.62E-02	1.44E-02	1.33E-02
	Rising Head 1	1.16E-02	1.14E-02	
PZ-10S	Rising Head 1	1.49E-03	1.24E-03	1.19E-03
	Rising Head 2	1.20E-03	9.19E-04	
PZ-12S	Rising Head 1	1.18E-02	1.13E-02	1.15E-02
	Rising Head 2	1.14E-02	1.17E-02	
PZ-13S	Rising Head 1	1.38E-03	1.36E-03	1.43E-03
	Rising Head 2	1.47E-03	1.52E-03	

Notes:

cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4b: Slug Testing Results - Presumpscot Clay Formation

Well ID	Screened in Stiff or Soft Clay	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)	Geometric Mean (ft/day)
MW14-02M	Soft Clay	Falling Head 1	2.16E-07	2.14E-07	1.70E-07	4.83E-04
		Rising Head 1	1.31E-07	1.39E-07		
MW14-03M	Stiff Clay	Falling Head 1	3.77E-07	3.88E-07	2.71E-07	7.67E-04
		Rising Head 1	1.84E-07	1.99E-07		
MW14-05M	Stiff and Soft Clay	Falling Head 1	1.00E-06	1.14E-06	1.06E-06	2.99E-03
		Rising Head 1	1.05E-06	1.04E-06		
PZ-10M	Stiff and Soft Clay	Falling Head 1	4.43E-07	4.52E-07	2.48E-07	7.03E-04
		Rising Head 1	1.36E-07	1.39E-07		
PZ-15M	Stiff Clay	Falling Head 1	3.93E-07	4.02E-07	4.50E-07	1.28E-03
		Rising Head 1	5.13E-07	5.07E-07		
PZ-16M	Stiff Clay	Falling Head 1	1.56E-05	1.51E-05	1.70E-05	4.82E-02
		Rising Head 1	1.87E-05	1.89E-05		
PZ-17M	Stiff and Soft Clay	Falling Head 1	1.04E-06	1.02E-06	1.43E-06	4.06E-03
		Rising Head 1	1.95E-06	2.04E-06		
PZ-18M	Stiff Clay	Falling Head 1	8.87E-07	8.91E-07	9.71E-07	2.75E-03
		Rising Head 1	1.07E-06	1.05E-06		

Notes:

cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4c: Slug Testing Results - Glacial Till

Well ID	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)
MW14-01D	Falling Head 1	1.27E-03	1.19E-03	1.30E-03
	Rising Head 1	1.35E-03	1.41E-03	
MW14-02D	Falling Head 1	7.52E-07	7.68E-07	3.77E-07
	Rising Head 1	1.87E-07	1.88E-07	
MW14-03D	Falling Head 1	4.24E-04	4.10E-04	4.37E-04
	Rising Head 1	4.48E-04	4.54E-04	
	Falling Head 2	4.63E-04	4.64E-04	
	Rising Head 2	4.15E-04	4.22E-04	
MW14-04D	Falling Head 1	1.95E-04	1.76E-04	2.07E-04
	Rising Head 1	2.38E-04	2.23E-04	
MW14-05D	Falling Head 1	6.59E-04	5.78E-04	6.02E-04
	Rising Head 1	6.28E-04	5.48E-04	
MW14-06D	Falling Head 1	5.36E-04	5.41E-04	5.42E-04
	Rising Head 1	5.39E-04	5.53E-04	
PZ-5D	Falling Head 1	1.40E-03	1.36E-03	2.80E-03
	Rising Head 1	2.21E-03	2.31E-03	
	Falling Head 2	4.24E-03	4.40E-03	
	Rising Head 2	4.64E-03	4.45E-03	
PZ-7D	Falling Head 1	1.13E-03	1.13E-03	1.18E-03
	Rising Head 1	1.10E-03	1.06E-03	
	Falling Head 2	1.16E-03	1.22E-03	
	Rising Head 2	1.40E-03	1.30E-03	
	Falling Head 3	1.15E-03	1.13E-03	
	Rising Head 3	1.18E-03	1.18E-03	
PZ-8D	Falling Head 1	5.60E-04	5.64E-04	7.33E-04
	Rising Head 1	7.36E-04	7.36E-04	
	Falling Head 2	1.04E-03	1.06E-03	
	Rising Head 2	6.64E-04	6.71E-04	
PZ-9D	Falling Head 1	4.11E-05	4.13E-05	4.17E-05
	Rising Head 1	4.20E-05	4.24E-05	
PZ-10D	Falling Head 1	3.16E-03	3.05E-03	3.06E-03
	Rising Head 1	3.11E-03	2.92E-03	
PZ-11D	Falling Head 1	1.67E-02	1.60E-02	1.94E-02
	Rising Head 1	2.06E-02	2.24E-02	
	Falling Head 2	1.80E-02	1.76E-02	
	Rising Head 2	2.28E-02	2.26E-02	
PZ-12D	Falling Head 1	1.35E-03	1.30E-03	1.51E-03
	Rising Head 1	1.38E-03	1.33E-03	
	Falling Head 2	1.54E-03	1.42E-03	
	Rising Head 2	1.52E-03	1.41E-03	
	Falling Head 3	1.77E-03	1.62E-03	
	Rising Head 3	1.79E-03	1.78E-03	
PZ-13D	Falling Head 1	6.57E-04	6.52E-04	1.13E-03
	Rising Head 1	1.41E-03	1.36E-03	
	Falling Head 2	1.36E-03	1.28E-03	
	Rising Head 2	1.34E-03	1.37E-03	
PZ-14D	Falling Head 1	9.93E-04	1.04E-03	9.11E-04
	Rising Head 1	9.07E-04	9.51E-04	
	Falling Head 2	8.58E-04	9.32E-04	
	Rising Head 2	8.13E-04	8.15E-04	
PZ-15D	Falling Head 1	9.10E-05	9.01E-05	1.02E-04
	Rising Head 1	1.16E-04	1.12E-04	

Notes:

cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4d: Slug Testing Results - Bedrock

Well ID	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)
MW14-01B	Falling Head 1	1.90E-04	2.23E-04	2.20E-04
	Rising Head 1	2.37E-04	2.32E-04	
MW14-02B	Falling Head 1	6.28E-06	6.20E-06	2.53E-06
	Rising Head 1	9.85E-07	1.07E-06	
MW14-03B	Falling Head 1	1.80E-04	1.81E-04	2.11E-04
	Rising Head 1	2.84E-04	2.15E-04	
MW14-04B	Falling Head 1	1.21E-05	1.14E-05	8.73E-06
	Rising Head 1	7.11E-06	5.92E-06	

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Notes:
cm/sec = centimeters per second

Table 4e: Slug Testing Results - Summary by Geologic Unit

Geologic Unit	Hydraulic Conductivity (cm/s)		
	Geometric Mean	Minimum	Maximum
Silty Fine Sand	7.06E-03	1.31E-04	8.06E-02
Clay	7.74E-07	1.31E-07	1.89E-05
Till	7.60E-04	1.87E-07	2.28E-02
Bedrock	3.18E-05	9.85E-07	2.84E-04

Notes:

cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4a: Slug Testing Results - Silty Fine Sand

Location ID	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)
MW14-01S	Falling Head 1	1.90E-04	1.73E-04	1.57E-04
	Rising Head 1	1.41E-04	1.31E-04	
MW14-03S	Falling Head	2.56E-03	2.27E-03	2.41E-03
	Rising Head	2.47E-03	2.22E-03	
	Falling Head 2	2.59E-03	2.23E-03	
	Rising Head 2	2.59E-03	2.37E-03	
MW14-04S	Falling Head 1	3.03E-03	3.07E-03	3.02E-03
	Rising Head 1	3.07E-03	3.43E-03	
	Falling Head 2	2.84E-03	2.85E-03	
	Rising Head 3	3.00E-03	2.95E-03	
	Falling Head 3	2.90E-03	2.87E-03	
	Rising Head 3	3.20E-03	3.09E-03	
PZ-1S	Rising Head 1	2.21E-02	2.21E-02	3.07E-02
	Rising Head 2	2.64E-02	2.58E-02	
	Rising Head 3	5.21E-02	4.84E-02	
PZ-2S	Rising Head 1	6.72E-02	6.09E-02	6.40E-02
PZ-3S	Rising Head 1	8.06E-02	7.86E-02	7.96E-02
PZ-4S	Rising Head 1	5.81E-02	5.07E-02	6.03E-02
	Rising Head 2	7.57E-02	7.18E-02	
	Rising Head 3	5.51E-02	5.47E-02	
PZ-6S	Rising Head 1	5.32E-02	5.13E-02	5.27E-02
	Rising Head 2	5.50E-02	5.08E-02	
	Rising Head 3	5.05E-02	5.55E-02	
PZ-9S	Rising Head 1	1.62E-02	1.44E-02	1.33E-02
	Rising Head 1	1.16E-02	1.14E-02	
PZ-10S	Rising Head 1	1.49E-03	1.24E-03	1.19E-03
	Rising Head 2	1.20E-03	9.19E-04	
PZ-12S	Rising Head 1	1.18E-02	1.13E-02	1.15E-02
	Rising Head 2	1.14E-02	1.17E-02	
PZ-13S	Rising Head 1	1.38E-03	1.36E-03	1.43E-03
	Rising Head 2	1.47E-03	1.52E-03	

Notes:

cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4b: Slug Testing Results - Presumpscot Clay Formation

Well ID	Screened in Stiff or Soft Clay	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)	Geometric Mean (ft/day)
MW14-02M	Soft Clay	Falling Head 1	2.16E-07	2.14E-07	1.70E-07	4.83E-04
		Rising Head 1	1.31E-07	1.39E-07		
MW14-03M	Stiff Clay	Falling Head 1	3.77E-07	3.88E-07	2.71E-07	7.67E-04
		Rising Head 1	1.84E-07	1.99E-07		
MW14-05M	Stiff and Soft Clay	Falling Head 1	1.00E-06	1.14E-06	1.06E-06	2.99E-03
		Rising Head 1	1.05E-06	1.04E-06		
PZ-10M	Stiff and Soft Clay	Falling Head 1	4.43E-07	4.52E-07	2.48E-07	7.03E-04
		Rising Head 1	1.36E-07	1.39E-07		
PZ-15M	Stiff Clay	Falling Head 1	3.93E-07	4.02E-07	4.50E-07	1.28E-03
		Rising Head 1	5.13E-07	5.07E-07		
PZ-16M	Stiff Clay	Falling Head 1	1.56E-05	1.51E-05	1.70E-05	4.82E-02
		Rising Head 1	1.87E-05	1.89E-05		
PZ-17M	Stiff and Soft Clay	Falling Head 1	1.04E-06	1.02E-06	1.43E-06	4.06E-03
		Rising Head 1	1.95E-06	2.04E-06		
PZ-18M	Stiff Clay	Falling Head 1	8.87E-07	8.91E-07	9.71E-07	2.75E-03
		Rising Head 1	1.07E-06	1.05E-06		

Notes:
cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4c: Slug Testing Results - Glacial Till

Well ID	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)
MW14-01D	Falling Head 1	1.27E-03	1.19E-03	1.30E-03
	Rising Head 1	1.35E-03	1.41E-03	
MW14-02D	Falling Head 1	7.52E-07	7.68E-07	3.77E-07
	Rising Head 1	1.87E-07	1.88E-07	
MW14-03D	Falling Head 1	4.24E-04	4.10E-04	4.37E-04
	Rising Head 1	4.48E-04	4.54E-04	
	Falling Head 2	4.63E-04	4.64E-04	
	Rising Head 2	4.15E-04	4.22E-04	
MW14-04D	Falling Head 1	1.95E-04	1.76E-04	2.07E-04
	Rising Head 1	2.38E-04	2.23E-04	
MW14-05D	Falling Head 1	6.59E-04	5.78E-04	6.02E-04
	Rising Head 1	6.28E-04	5.48E-04	
MW14-06D	Falling Head 1	5.36E-04	5.41E-04	5.42E-04
	Rising Head 1	5.39E-04	5.53E-04	
PZ-5D	Falling Head 1	1.40E-03	1.36E-03	2.80E-03
	Rising Head 1	2.21E-03	2.31E-03	
	Falling Head 2	4.24E-03	4.40E-03	
	Rising Head 2	4.64E-03	4.45E-03	
PZ-7D	Falling Head 1	1.13E-03	1.13E-03	1.18E-03
	Rising Head 1	1.10E-03	1.06E-03	
	Falling Head 2	1.16E-03	1.22E-03	
	Rising Head 2	1.40E-03	1.30E-03	
	Falling Head 3	1.15E-03	1.13E-03	
	Rising Head 3	1.18E-03	1.18E-03	
PZ-8D	Falling Head 1	5.60E-04	5.64E-04	7.33E-04
	Rising Head 1	7.36E-04	7.36E-04	
	Falling Head 2	1.04E-03	1.06E-03	
	Rising Head 2	6.64E-04	6.71E-04	
PZ-9D	Falling Head 1	4.11E-05	4.13E-05	4.17E-05
	Rising Head 1	4.20E-05	4.24E-05	
PZ-10D	Falling Head 1	3.16E-03	3.05E-03	3.06E-03
	Rising Head 1	3.11E-03	2.92E-03	
PZ-11D	Falling Head 1	1.67E-02	1.60E-02	1.94E-02
	Rising Head 1	2.06E-02	2.24E-02	
	Falling Head 2	1.80E-02	1.76E-02	
	Rising Head 2	2.28E-02	2.26E-02	
PZ-12D	Falling Head 1	1.35E-03	1.30E-03	1.51E-03
	Rising Head 1	1.38E-03	1.33E-03	
	Falling Head 2	1.54E-03	1.42E-03	
	Rising Head 2	1.52E-03	1.41E-03	
	Falling Head 3	1.77E-03	1.62E-03	
	Rising Head 3	1.79E-03	1.78E-03	
PZ-13D	Falling Head 1	6.57E-04	6.52E-04	1.13E-03
	Rising Head 1	1.41E-03	1.36E-03	
	Falling Head 2	1.36E-03	1.28E-03	
	Rising Head 2	1.34E-03	1.37E-03	
PZ-14D	Falling Head 1	9.93E-04	1.04E-03	9.11E-04
	Rising Head 1	9.07E-04	9.51E-04	
	Falling Head 2	8.58E-04	9.32E-04	
	Rising Head 2	8.13E-04	8.15E-04	
PZ-15D	Falling Head 1	9.10E-05	9.01E-05	1.02E-04
	Rising Head 1	1.16E-04	1.12E-04	

Notes:

cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4d: Slug Testing Results - Bedrock

Well ID	Test Type and Number	Hydraulic Conductivity Bouwer & Rice Method (cm/sec)	Hydraulic Conductivity Hvorslev Method (cm/sec)	Geometric Mean (cm/sec)
MW14-01B	Falling Head 1	1.90E-04	2.23E-04	2.20E-04
	Rising Head 1	2.37E-04	2.32E-04	
MW14-02B	Falling Head 1	6.28E-06	6.20E-06	2.53E-06
	Rising Head 1	9.85E-07	1.07E-06	
MW14-03B	Falling Head 1	1.80E-04	1.81E-04	2.11E-04
	Rising Head 1	2.84E-04	2.15E-04	
MW14-04B	Falling Head 1	1.21E-05	1.14E-05	8.73E-06
	Rising Head 1	7.11E-06	5.92E-06	

Notes:
cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 4e: Slug Testing Results - Summary by Geologic Unit

Geologic Unit	Hydraulic Conductivity (cm/s)		
	Geometric Mean	Minimum	Maximum
Silty Fine Sand	7.06E-03	1.31E-04	8.06E-02
Clay	7.74E-07	1.31E-07	1.89E-05
Till	7.60E-04	1.87E-07	2.28E-02
Bedrock	3.18E-05	9.85E-07	2.84E-04

Notes:

cm/sec = centimeters per second

Prepared by: LWL
Checked by: TK
Reviewed by: APTM

Table 5: Vertical Hydraulic Gradients

	MW14-01		MW14-02			MW14-03		
Well ID	**MW14-01D**	**MW14-01B**	**MW14-02M**	**MW14-02D**	**MW14-02B**	**MW14-03M**	**MW14-03D**	**MW14-03B**
Ground Surface Elevation (ft msl)	**294.268**	**294.299**	**276.842**	**276.446**	**276.914**	**277.363**	**276.905**	**277.001**
Screen Interval Lithology	**Till**	**Bedrock**	**Clay**	**Till**	**Bedrock**	**Clay**	**Till**	**Bedrock**
Center of Screen (ft bgs)	**11.0**	**46.0**	**15.0**	**27.0**	**82.1**	**13.0**	**25.5**	**60.0**
Center of Screen (ft msl)	**283.3**	**248.3**	**261.8**	**249.4**	**194.8**	**264.4**	**251.4**	**217.0**
Groundwater Elevation Data								
5/2/2019 (Seasonal High)	295.11	296.18	270.38	262.82	262.19	273.17	268.04	267.60
8/23/2019 (Seasonal Low)	293.08	293.78	269.34	259.99	259.44	271.78	264.82	264.3
Gradient Calculations								
Well ID	**MW14-01**		**MW14-02**				**MW14-03**	
	Till - Bedrock		**Clay - Till**		**Till - Bedrock**		**Clay - Till**	
Measurement Date	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**
5/2/2019 (Seasonal High)	-0.09	UP	0.61	DOWN	0.01	DOWN	0.40	DOWN
8/23/2019 (Seasonal Low)	-0.06	UP	0.75	DOWN	0.01	DOWN	0.54	DOWN

Notes:

ft msl = feet above mean sea level

ft bgs = feet below ground surface

NA - not applicable. MW14-06M was dry.

Table 5: Vertical Hydraulic Gradients

	MW14-04			MW14-05		MW14-06		PZ-5		PZ-7
Well ID	**MW14-04M**	**MW14-04D**	**MW14-04B**	**MW14-05M**	**MW14-05D**	**MW14-06M**	**MW14-06D**	**PZ-5M**	**PZ-5D**	**PZ-7M**
Ground Surface Elevation (ft msl)	277.205	277.232	277.009	276.254	275.967	285.562	285.488	286.117	286.266	280.642
Screen Interval Lithology	Clay	Till	Bedrock	Clay	Till	Clay	Till	Clay	Till	Clay
Center of Screen (ft bgs)	18.5	29.0	72.5	16.5	43.2	4.5	19.0	9.5	15.0	10.7
Center of Screen (ft msl)	258.7	248.2	204.5	259.8	232.8	281.1	266.5	276.6	271.3	269.9
	Groundwater Elevation Data									
5/2/2019 (Seasonal High)	272.96	268.64	272.34	272.20	257.83	283.90	281.22	284.20	283.11	276.71
8/23/2019 (Seasonal Low)	270.23	266.15	268.85	270.78	254.47	DRY	277.43	281.57	280.57	273.74
	Gradient Calculations									
Well ID	**MW14-03**		**MW14-04**				**MW14-05**		**MW14-06**	
	Till - Bedrock		**Clay - Till**		**Till - Bedrock**		**Clay - Till**		**Clay - Till**	
Measurement Date	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**
5/2/2019 (Seasonal High)	0.01	DOWN	0.41	DOWN	-0.08	UP	0.53	DOWN	0.18	DOWN
8/23/2019 (Seasonal Low)	0.02	DOWN	0.39	DOWN	-0.06	UP	0.61	DOWN	NA	NA

Notes:

ft msl = feet above mean sea level
ft bgs = feet below ground surface
NA - not applicable. MW14-06M was dry.

Table 5: Vertical Hydraulic Gradients

	PZ-7	PZ-10		PZ-14		PZ-15	
Well ID	**PZ-7D**	**PZ-10M**	**PZ-10D**	**PZ-14M**	**PZ-14D**	**PZ-15M**	**PZ-15D**
Ground Surface Elevation (ft msl)	**280.568**	**291.313**	**291.319**	**267.057**	**266.839**	**284.758**	**284.382**
Screen Interval Lithology	**Till**	**Clay**	**Till**	**Clay**	**Till**	**Clay**	**Till**
Center of Screen (ft bgs)	**23.1**	**16.9**	**28.5**	**6.7**	**40.0**	**5.0**	**15.0**
Center of Screen (ft msl)	**257.5**	**274.4**	**262.8**	**260.4**	**226.8**	**279.8**	**269.4**
	Groundwater Elevation Data						
5/2/2019 (Seasonal High)	263.67	286.07	283.52	261.92	246.06	284.08	282.14
8/23/2019 (Seasonal Low)	262.05	283.12	281.63	258.89	242.25	283.77	280.58

	Gradient Calculations									
Well ID	**PZ-5**		**PZ-7**		**PZ-10**		**PZ-14**		**PZ-15**	
	Clay - Till		**Clay - Till**		**Clay - Till**		**Clay - Till**		**Clay - Till**	
Measurement Date	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**	**Gradient**	**Direction**
5/2/2019 (Seasonal High)	0.20	DOWN	1.05	DOWN	0.22	DOWN	0.47	DOWN	0.19	DOWN
8/23/2019 (Seasonal Low)	0.19	DOWN	0.94	DOWN	0.13	DOWN	0.50	DOWN	0.31	DOWN

Notes:

ft msl = feet above mean sea level

ft bgs = feet below ground surface

NA - not applicable. MW14-06M was dry.

Created by: LWL
Checked by: TK/ERW
Approved by: APTM

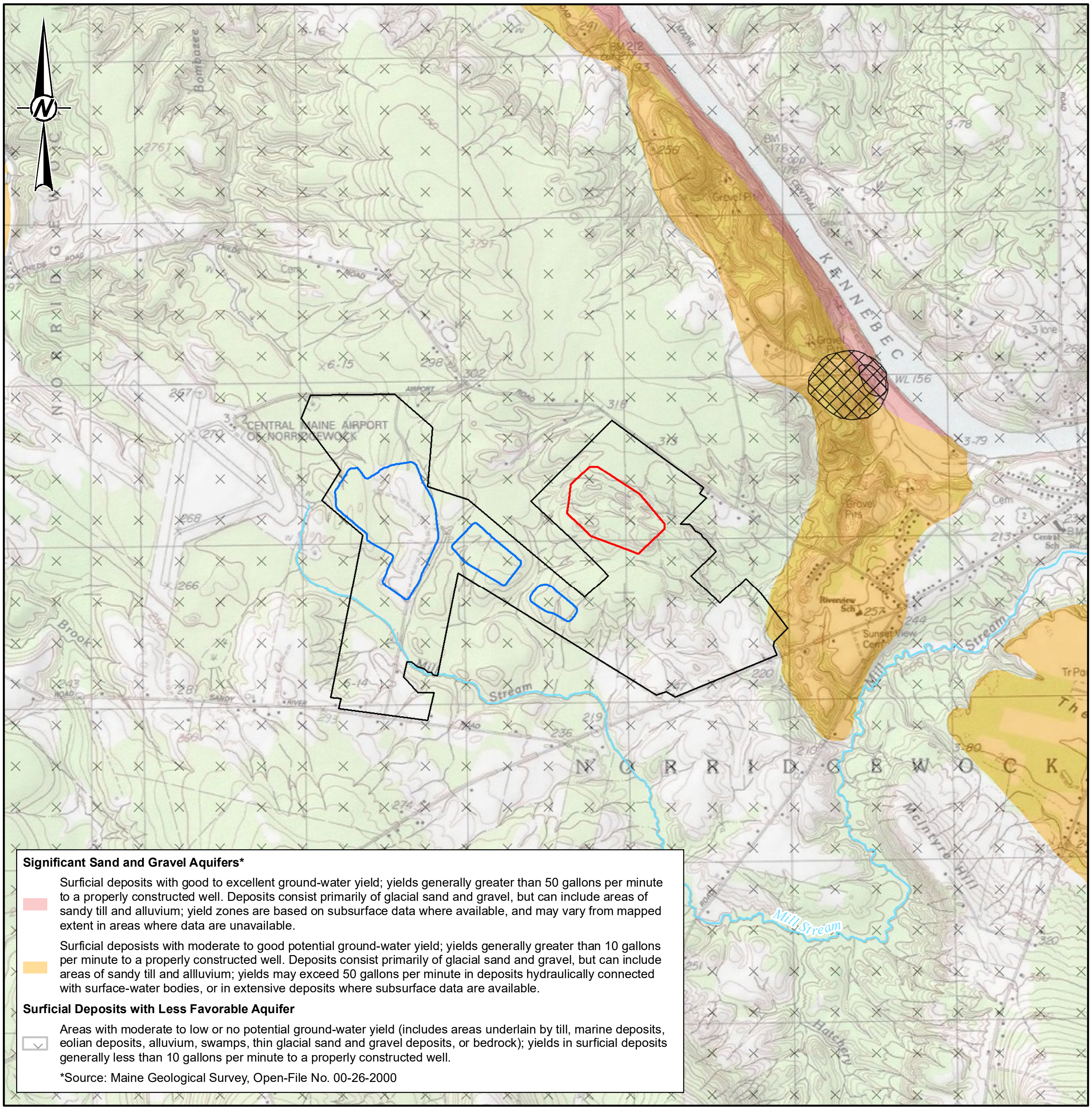
Table 6: Proposed Groundwater and Surface Water Monitoring Locations

Location ID	Water Quality Monitoring Program	Water Level Monitoring Program
MW14-01S		x
MW14-01D	x	x
MW14-01B		x
MW14-02S		x
MW14-02M		x
MW14-02D		x
MW14-02B		x
MW14-03S		x
MW14-03M	x	x
MW14-03D	x	x
MW14-03B		x
MW14-04S		x
MW14-04M	x	x
MW14-04D	x	x
MW14-04B		x
MW14-05S		x
MW14-05M	x	x
MW14-05D	x	x
MW14-06S		x
MW14-06M		x
MW14-06D		x
MW14-07M	x	x
MW14-07D	x	x
MW14-08M	x	x
MW14-08D	x	x
PZ-7M		x
PZ-7D		x
PZ-8S		x
PZ-8D		x
PZ-9S		x
PZ-9D		x
PZ-10S		x
PZ-10M		x
PZ-10D		x
PZ-11S		x
PZ-11D		x
PZ-12S		x
PZ-12D		x
PZ-13S		x
PZ-13D		x
PZ-14S		x
PZ-14D		x
PZ-15M		x
PZ-15D		x
PZ-20S		x
S-1		x
S-3		x
S-4		x
S-6		x
SW14-02	x	x
SW14-05	x	x
SW14-07	x	x
SW14-08	x	x
VW-1S		x
VW-1D		x
VW-2S		x
VW-2D		x

Notes:
MW = groundwater monitoring well
PZ = groundwater piezometer
S/SW = stream piezometer/staff gauge
VW = vibrating wire piezometer

Created by: LWL
Checked by: AMH
Reviewed by: APTM

FIGURES



Significant Sand and Gravel Aquifers*

🟥 Surficial deposits with good to excellent ground-water yield; yields generally greater than 50 gallons per minute to a properly constructed well. Deposits consist primarily of glacial sand and gravel, but can include areas of sandy till and alluvium; yield zones are based on subsurface data where available, and may vary from mapped extent in areas where data are unavailable.

🟨 Surficial deposits with moderate to good potential ground-water yield; yields generally greater than 10 gallons per minute to a properly constructed well. Deposits consist primarily of glacial sand and gravel, but can include areas of sandy till and allluvium; yields may exceed 50 gallons per minute in deposits hydraulically connected with surface-water bodies, or in extensive deposits where subsurface data are available.

Surficial Deposits with Less Favorable Aquifer

☐ Areas with moderate to low or no potential ground-water yield (includes areas underlain by till, marine deposits, eolian deposits, alluvium, swamps, thin glacial sand and gravel deposits, or bedrock); yields in surficial deposits generally less than 10 gallons per minute to a properly constructed well.

*Source: Maine Geological Survey, Open-File No. 00-26-2000

LEGEND

- — Proposed Phase 14 Waste Boundary
- — Facility Site Boundary
- — Existing Landfill Cell
- ▨ Public Drinking Water Bedrock Source Water Protection Area

0 3,000 6,000

1 " = 3,000 feet Feet

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. IMAGERY COPYRIGHT:© 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED
3. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
4. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
5. SIGNIFICANT SAND AND GRAVEL AQUIFERS, AND PUBLIC DRINKING WATER BEDROCK SOURCE WATER PROTECTION AREA FROM MAINE.GOV WEBPAGE.

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT
PHASE 14 SITE ASSESSMENT REPORT

CONSULTANT
GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

TITLE
SITE LOCATION MAP AND
SIGNIFICANT SAND AND GRAVEL AQUIFERS

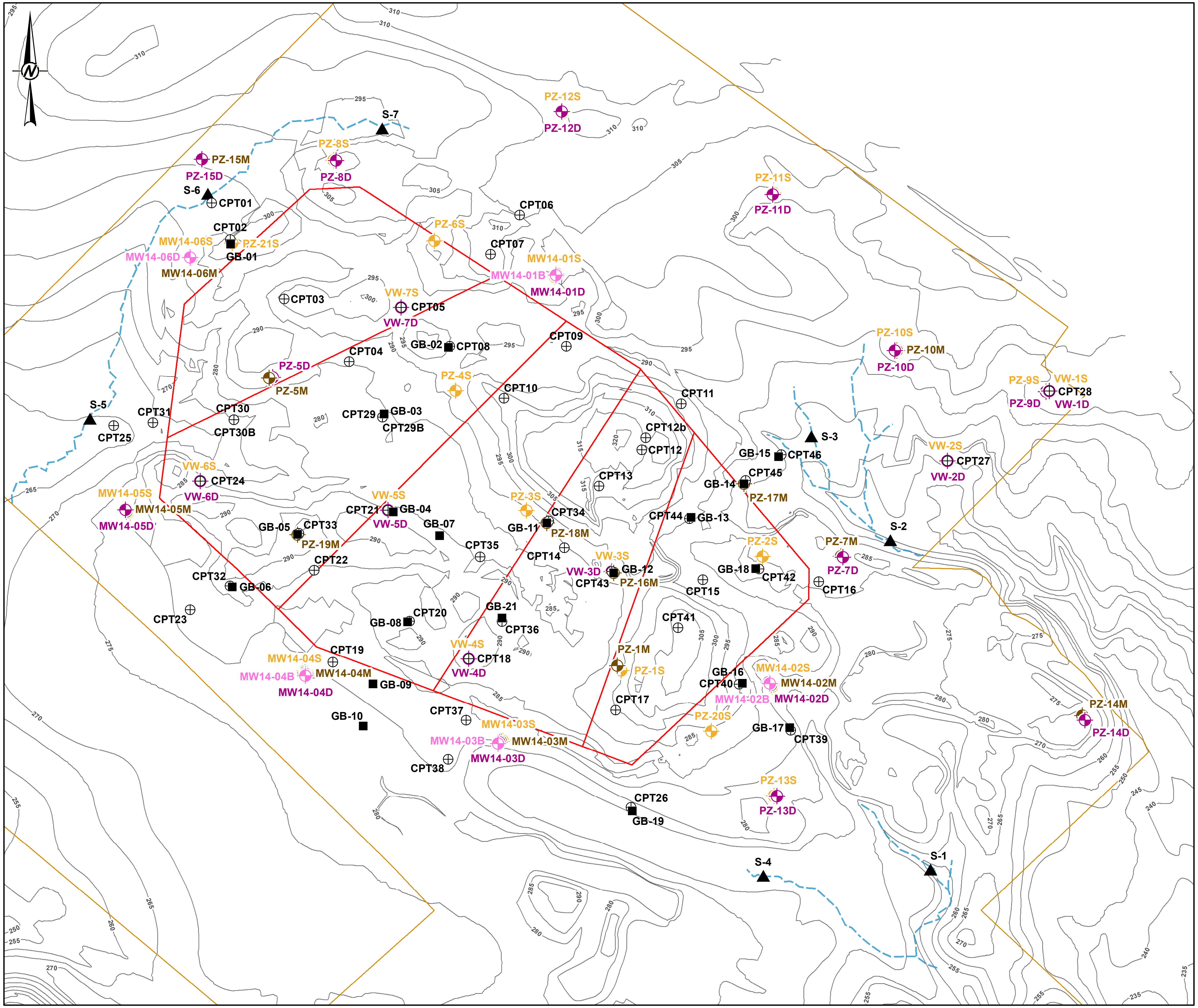
PROJECT NO.	CONTROL	REV.	FIGURE
19119078	-	-	1

B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0001_FIG1.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

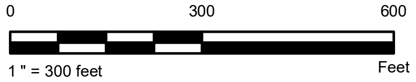
1 in

0



LEGEND

⊕	Geosyntec Cone Penetrometer (CPT) Test Location
■	Geosyntec Geotechnical Boring
⊕	Sand Piezometer/Monitoring Well
⊕	Clay Piezometer/Monitoring Well
⊕	Till Piezometer/Monitoring Well
⊕	Bedrock Piezometer/Monitoring Well
▲	Stream Piezometer/Staff Gauge
—	Proposed Phase 14 Waste Boundary
—	Facility Site Boundary
—	Ground Surface Topographic Contour
- -	Stream



NOTE(S)

1. CONTINUOUS SOIL SAMPLES COLLECTED AT THE DEEPEST SOIL BORING OF EACH PIEZOMETER/MONITORING WELL CLUSTER.
2. ALL PIEZOMETERS/MONITORING WELLS INSTALLED BY GOLDER, WITH THE EXCEPTION OF PZ-1M, PZ-5M, PZ-16M, PZ-17M, PZ-18M, AND PZ-19M.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
4. STREAMS LAYER FROM SHAPEFILE RECEIVED FROM NORMANDEAU ENVIRONMENTAL CONSULTANTS (NORMANDEAU) DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
5. PIEZOMETER AND SOIL BORING LOCATIONS SURVEYED BY BOYNTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFROMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT.2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCTIONS 04.17.2019").
6. EXISTING GROUND SURFACE WITHIN PHASE 14 AREA FROM CAD FILE "WM MAINE WEST PHASE 14 TOPO NOV 2017 (DELIVERABLE (2))".DWG CREATED BY BOYNTON AND PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE SURROUNDING PHASE 14 AREA FROM CAD FILE "BE0232 TOPO 09-2016 (SP)".DWG CREATED BY AERIAL SURVEY & PHOTO INC. AND BOYNTON & PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE CONTOUR DATA WERE MERGED.

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT
PHASE 14 SITE ASSESSMENT REPORT

TITLE
BORING, PIEZOMETER, MONITORING WELL AND CPT LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	2

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0002_FIG2.mxd PRINTED ON: 2019-10-21 AT: 3:25:24 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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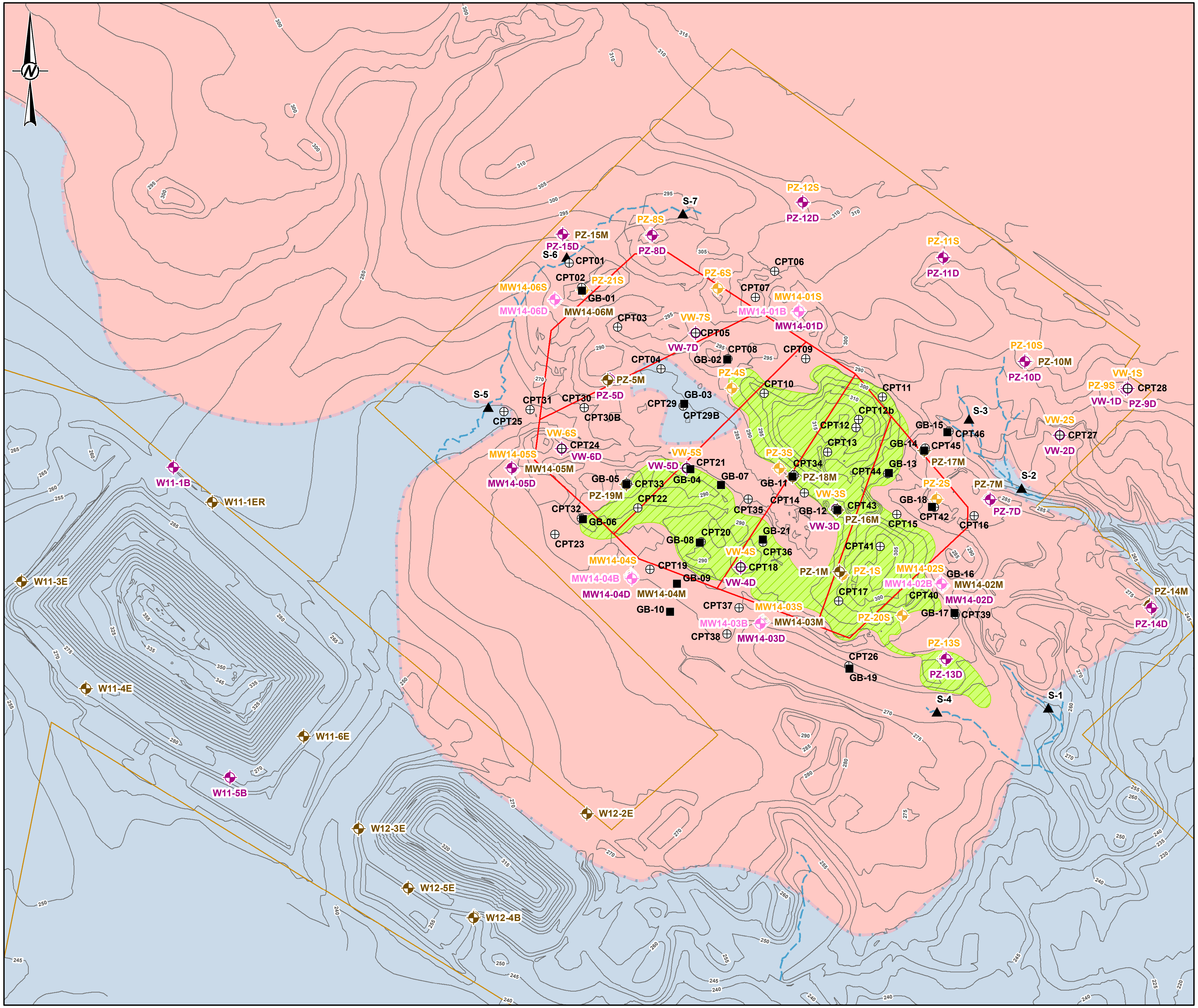
1 in



LEGEND

⊕	Geosyntec Cone Penetrometer (CPT) Test Location
■	Geosyntec Geotechnical Boring
⊕	Sand Piezometer/Monitoring Well
⊕	Clay Piezometer/Monitoring Well
⊕	Till Piezometer/Monitoring Well
⊕	Bedrock Piezometer/Monitoring Well
▲	Stream Piezometer/Staff Gauge
—	Proposed Phase 14 Waste Boundary
—	Facility Site Boundary
- -	Stream
—	Ground Surface Topographic Contour

Regional Surficial Geology

▨	Very uniform fine sand some silt, shown only where landforms exhibit well-developed dune morphology or identified on-site. Possibly of eolian origin.
▨	Glacio-marine deposits (Presumpscot Formation). Generally well-laminated clay/silt with varying amounts of inter-stratified fine sand.
🟩	Anthropogenic Disturbance Area

0 450 900

1 " = 450 feet Feet

NOTE(S)

1. SURFICIAL GEOLOGY BASED ON FIELD MAPPING BY WILLIAM HOLLAND IN 1984, RGGI EXPLORATIONS FOR LANDFILL SITING, AND RECENT EXPLORATIONS FOR THE PHASE 14 SITING EFFORT.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

SURFICIAL GEOLOGY MAP

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

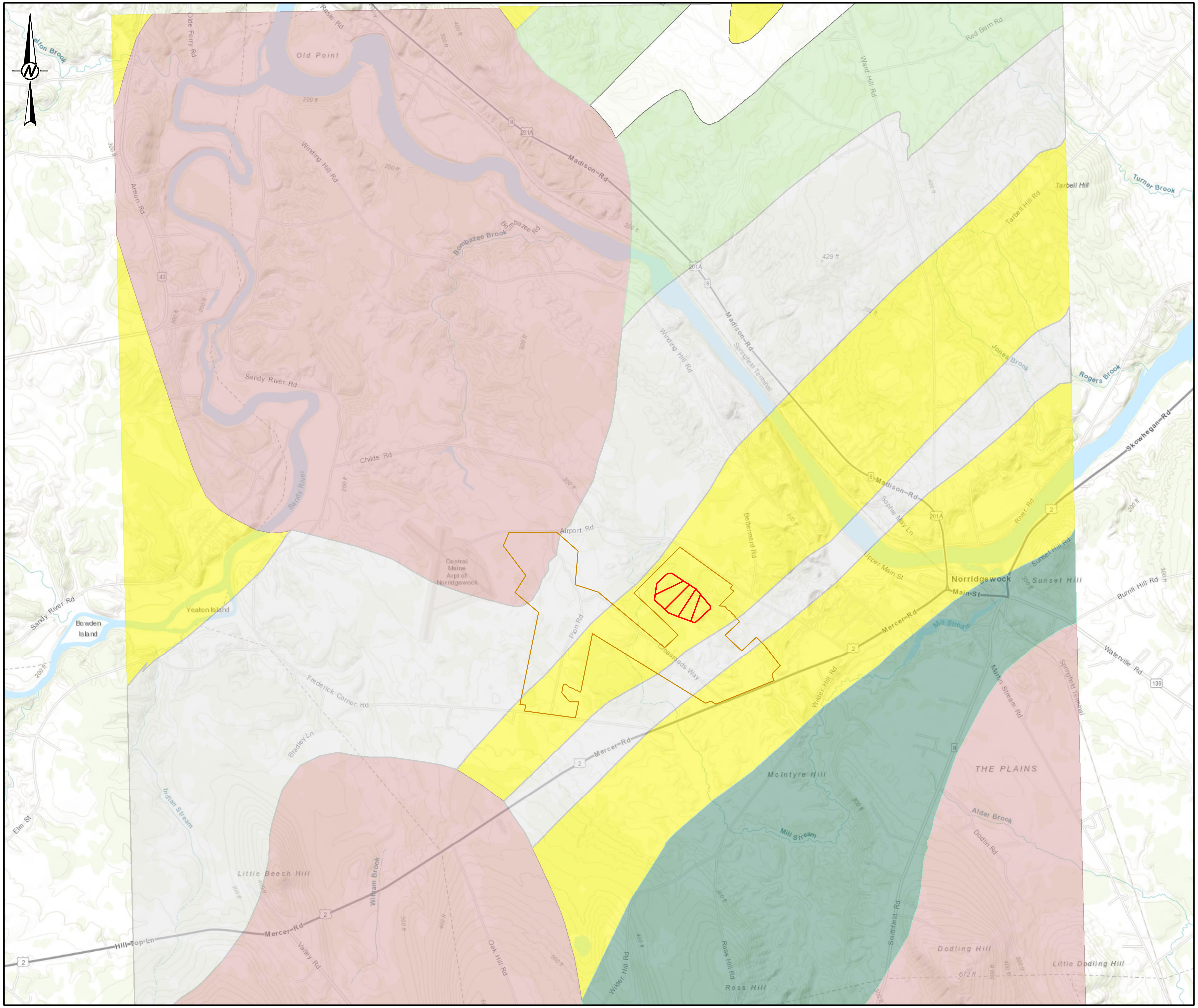
PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	3

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0003_FIG3.mxd PRINTED ON: 2019-10-21 AT: 3:31:36 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

0



LEGEND

🟥 Proposed Phase 14 Waste Boundary

🟧 Facility Site Boundary

Regional Surficial Geology

Plutonic Rocks

🟥	Two-Mica Granite pale gray. Fine-to-medium-grained. Massive to weakly foliated.

Stratified Metamorphic Rocks

🟩	Smalls falls formation. Eastern Facies. Rusty-weathering sulfdic graphitic shale and quartz-rich sandstone contains zones of lamnated siltstone and thickly-bedded granule conglomerate.
🟨	Sangerville formation. Principal facies. predominantly weakly calcareous sandstone with interbedded massive gray shale or interlaminated shale and siltstone.
☐	Upper conglomerate lenses of the Sangerville FM. Thickly-bedded sandstone with granule to small pebble conglomerate.
🟩	Anasagunticook member. Sangerville FM. the fine-grained facies of the Sangerville FM. Typically very thick sequences of interlaminated siltstone and shale.
⬜	Patch Mountain Member of the Sangerville FM. Calcareous Rocks: Generally Limestones, limey sandstones and sandy limestones with minor non-calcareous rocks.

0 3,500 7,000

1 " = 3,500 feet Feet

NOTE(S)

1. BEDROCK GEOLOGY BASED ON FIELD MAPPING BY ROBERT GERBER INC. IN 1996, RGGI EXPLORATIONS FOR LANDFILL SITING, AND RECENT EXPLORATIONS FOR THE PHASE 14 SITING EFFORT.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
4. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.

CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

REGIONAL BEDROCK GEOLOGY MAP

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	4

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0004_FIG4.mxd PRINTED ON: 2019-10-21 AT: 3:30:53 PM

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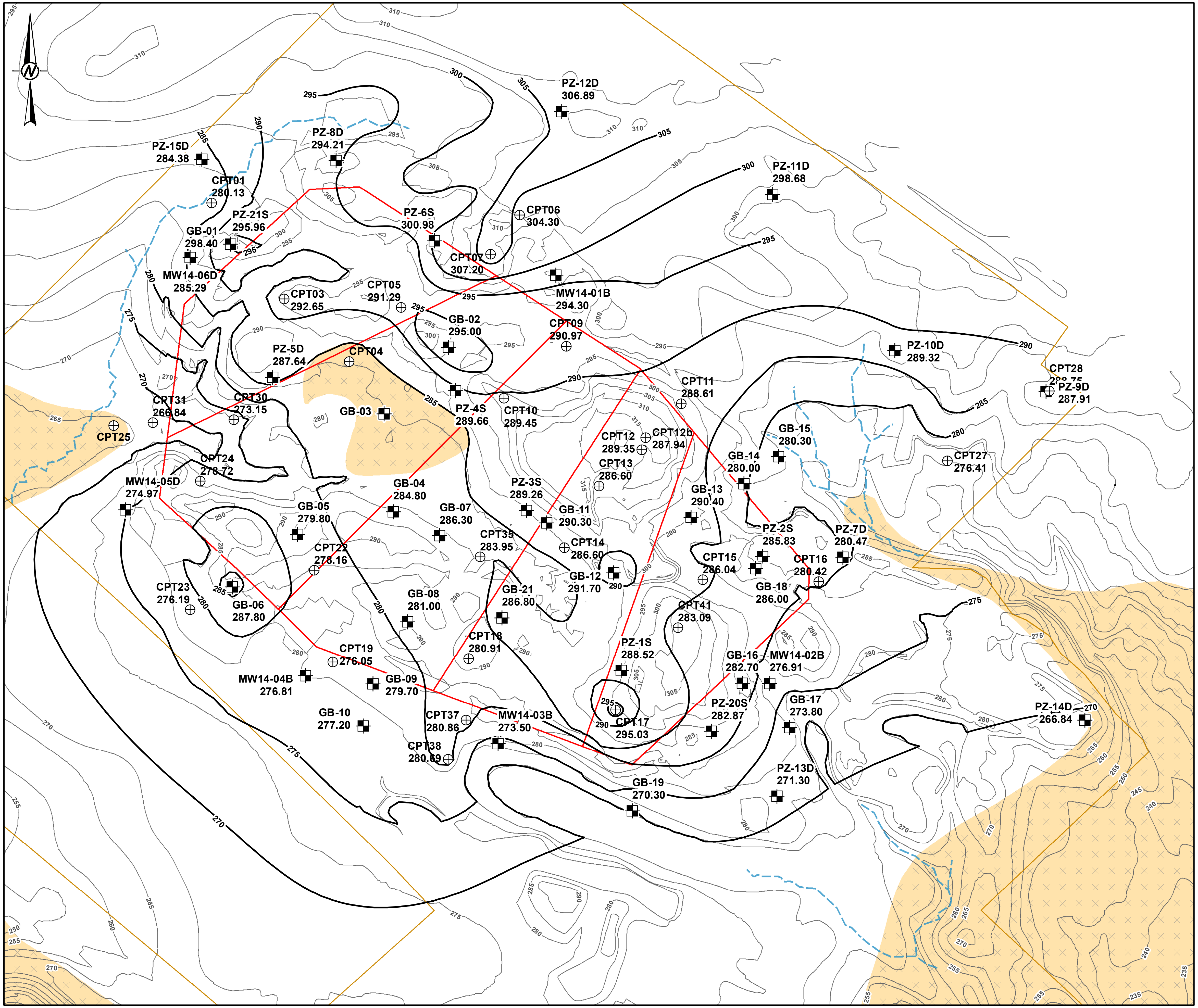

LEGEND

⊕ Geosyntec Cone Penetrometer (CPT) Test Location

▚ Soil Boring Location

Interpreted Top of Silty Fine Sand Elevation Contour

Proposed Phase 14 Waste Boundary

Facility Site Boundary

Ground Surface Topographic Contour

Stream

Interpreted Area of No Silty Fine Sand

0 300 600

1 " = 300 feet Feet

NOTE(S)

THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

TOP OF SILTY FINE SAND CONTOUR MAP

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	5a

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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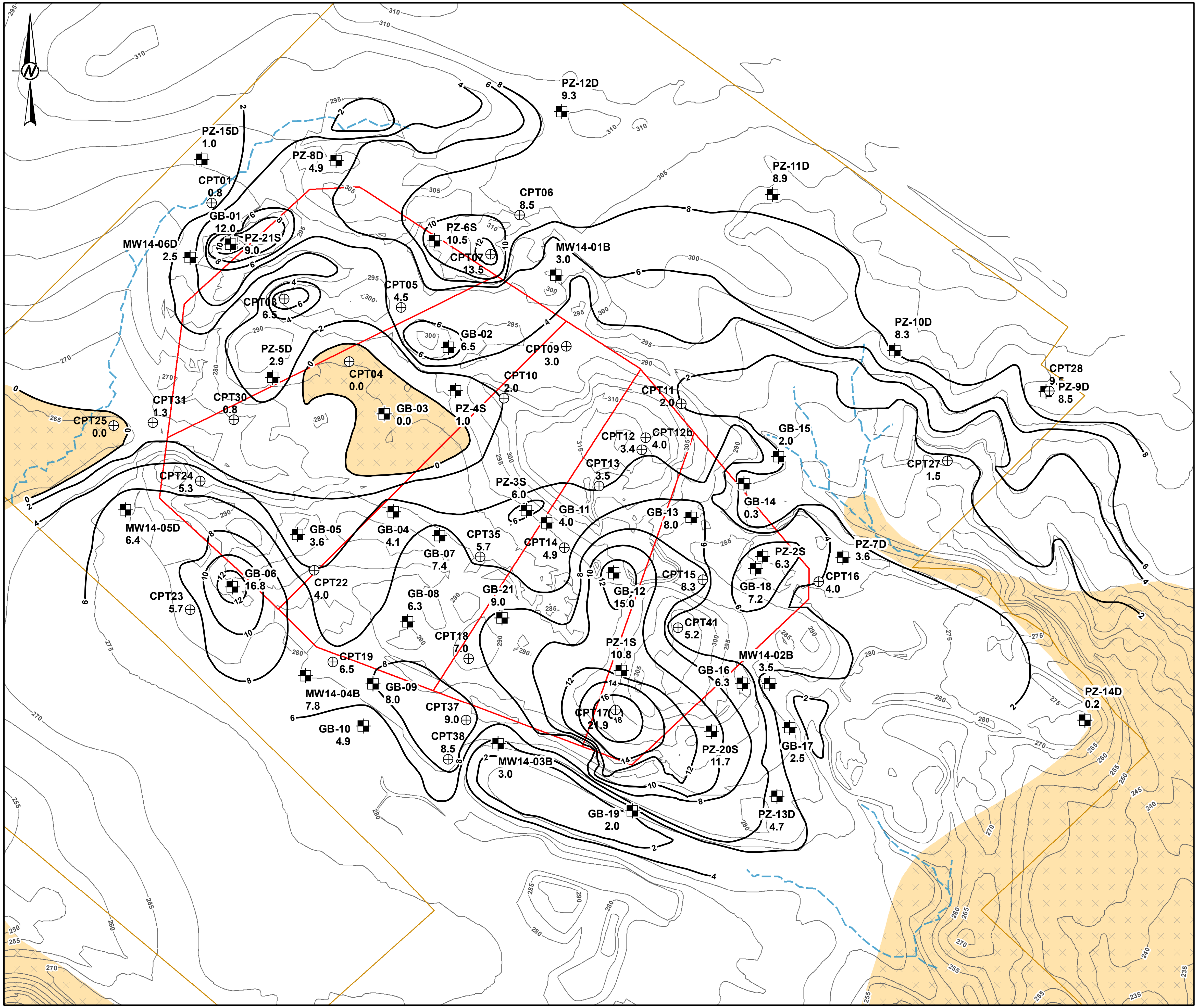

LEGEND

- ⊕ Geosyntec Cone Penetrometer (CPT) Test Location
- ▚ Soil Boring Location
- ━ Interpreted Silty Fine Sand Thickness Contour (feet)
- ━ Proposed Phase 14 Waste Boundary
- ━ Facility Site Boundary
- ━ Ground Surface Topographic Contour
- ╌ Stream
- ▨ Interpreted Area of No Silty Fine Sand

0 300 600

1 " = 300 feet Feet

NOTE(S)

THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

ISOPACH MAP OF SILTY FINE SAND

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	5b

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0006_FIG5B.mxd PRINTED ON: 2019-10-21 AT: 3:48:17 PM

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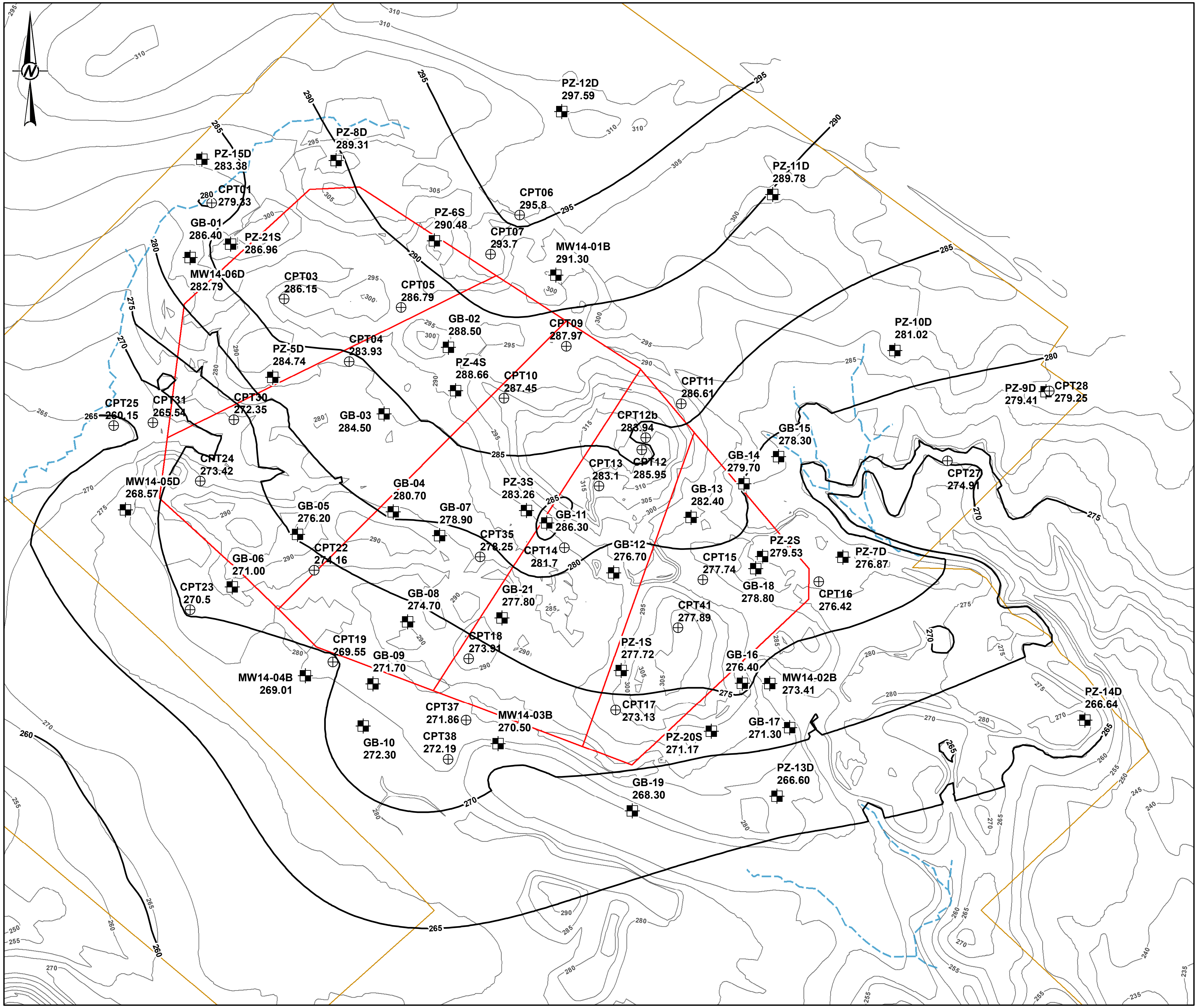

LEGEND

⊕	Geosyntec Cone Penetrometer (CPT) Test Location
▣	Soil Boring Location
▬	Interpreted Top of Stiff Upper Presumpscot Clay Elevation Contour
🟥	Proposed Phase 14 Waste Boundary
🟧	Facility Site Boundary
─	Ground Surface Topographic Contour
╌	Stream

0 300 600

1 " = 300 feet Feet

NOTE(S)

THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
4. STREAMS LAYER FROM SHAPEFILE RECEIVED FROM NORMANDEAU ENVIRONMENTAL CONSULTANTS (NORMANDEAU) DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
5. PIEZOMETER AND SOIL BORING LOCATIONS SURVEYED BY BOYNTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFROMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT.2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCTIONS 04.17.2019").
6. EXISTING GROUND SURFACE WITHIN PHASE 14 AREA FROM CAD FILE "WM MAINE WEST PHASE 14 TOPO NOV 2017 (DELIVERABLE (2))".DWG CREATED BY BOYNTON AND PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE SURROUNDING PHASE 14 AREA FROM CAD FILE "BE0232 TOPO 09-2016 (SP)".DWG CREATED BY AERIAL SURVEY & PHOTO INC. AND BOYNTON & PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE CONTOUR DATA WERE MERGED.

CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

TOP OF STIFF UPPER CLAY FACIES OF PRESUMPSCOT FORMATION

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	6a

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0007_FIG6A.mxd PRINTED ON: 2019-10-21 AT: 3:28:45 PM

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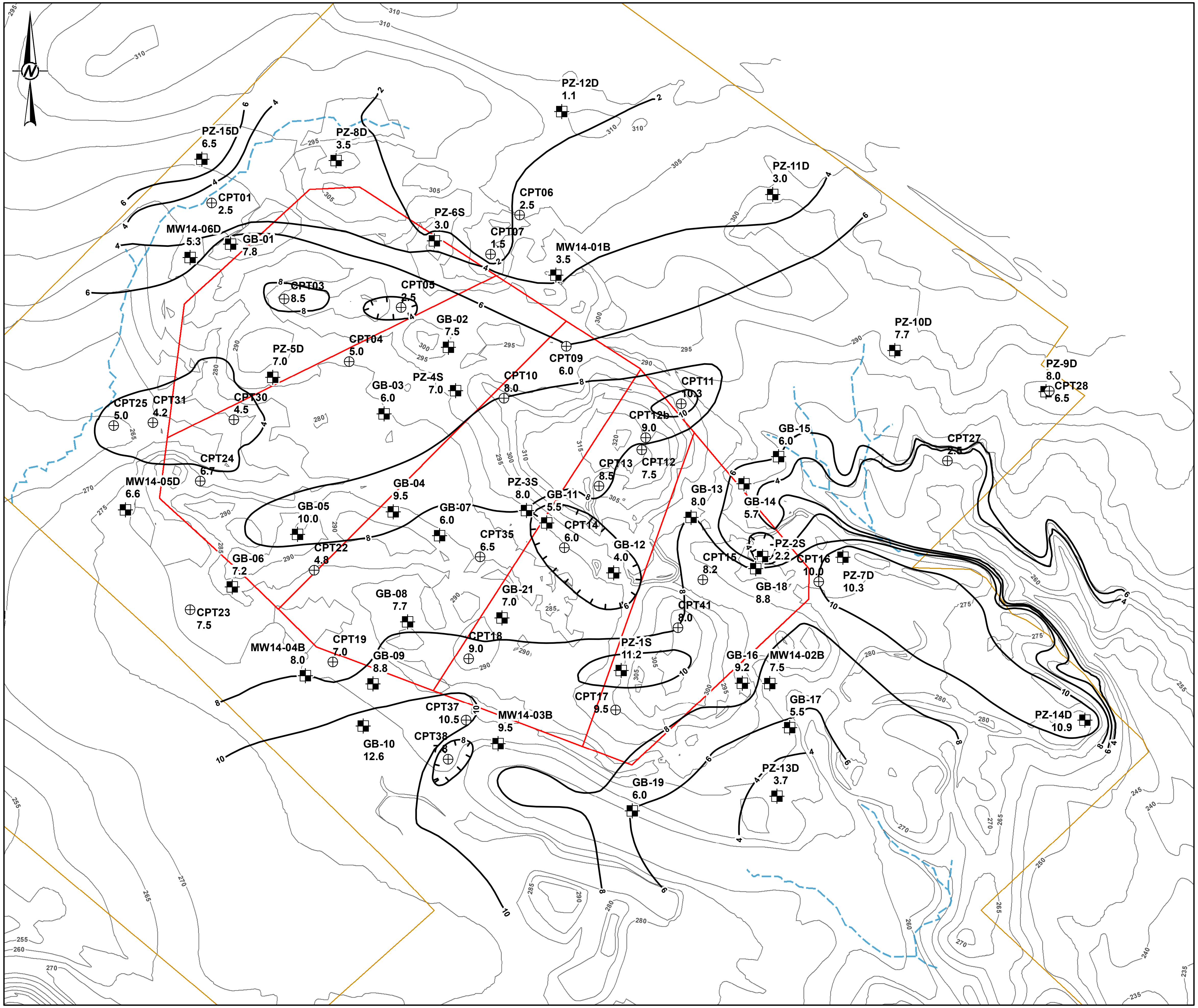
0 1 in



0 300 600

1 " = 300 feet Feet

LEGEND

- ⊕ Geosyntec Cone Penetrometer (CPT) Test Location
- ▣ Soil Boring Location
- — Interpreted Stiff Upper Presumpscot Clay Thickness Contour (feet)
- ┬ Interpreted Stiff Upper Presumpscot Clay Thickness Depression Contour (feet)
- — Proposed Phase 14 Waste Boundary
- — Facility Site Boundary
- — Ground Surface Topographic Contour
- - - Stream

NOTE(S)

THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE

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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

ISOPACH MAP OF STIFF UPPER CLAY FACIES OF PRESUMPSCOT FORMATION

CONSULTANT

GOLDER

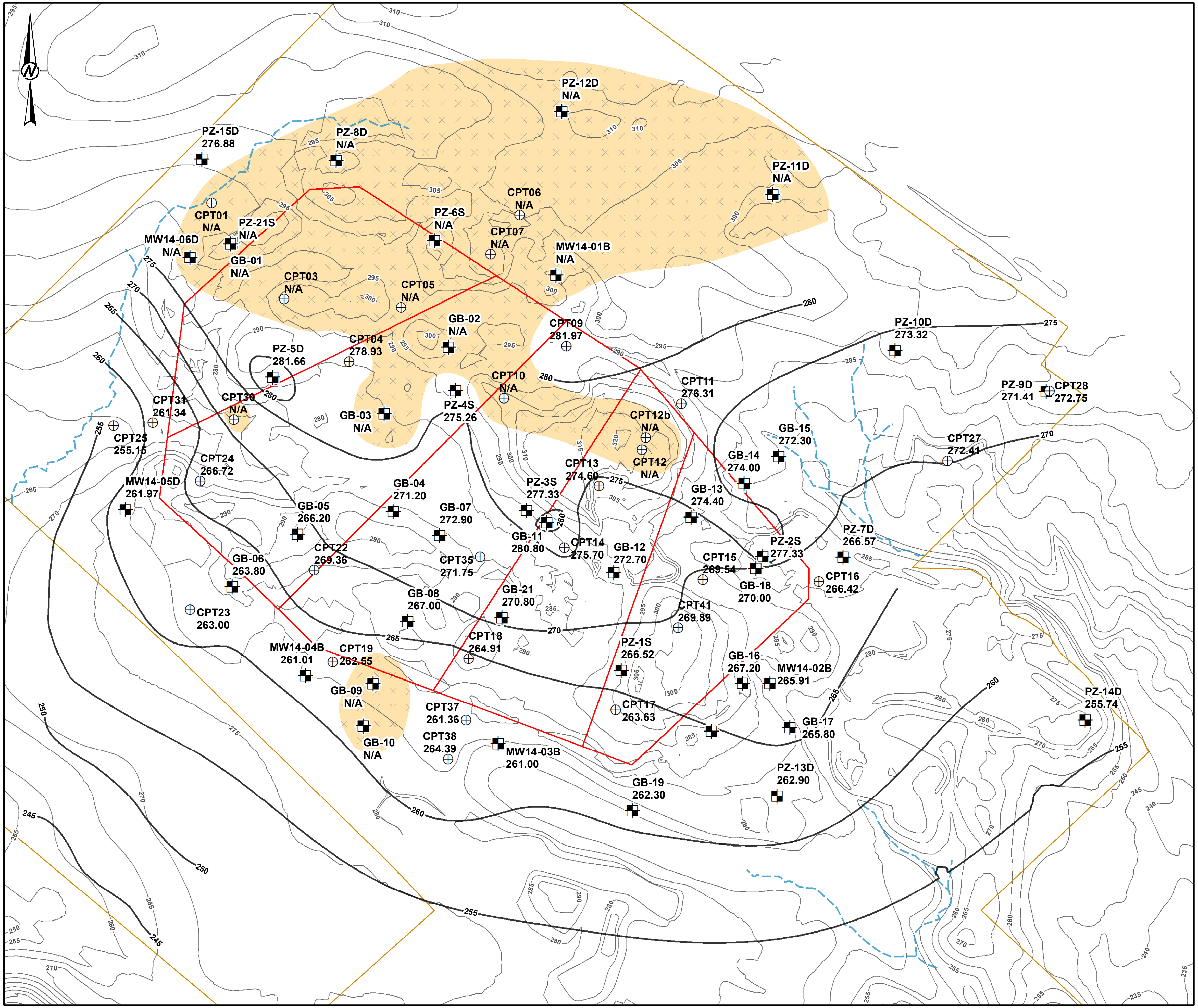
YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	6b

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 1 in

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0008_FIG6B.mxd PRINTED ON: 2019-10-21 AT: 3:28:12 PM



LEGEND

⊕ Geosyntec Cone Penetrometer (CPT) Test Location

▣ Soil Boring Location

— Interpreted Top of Soft Lower Presumpscot Clay Elevation Contour

▨ Approximate Extent of Area With No Soft Lower Clay

— Proposed Phase 14 Waste Boundary

— Facility Site Boundary

— Ground Surface Topographic Contour

-- Stream

0 300 600

1 " = 300 feet

Feet

NOTE(S)

1. N/A = ELEVATION NOT AVAILABLE, SOFT LOWER CLAY NOT PRESENT
2. THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE

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2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
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6. EXISTING GROUND SURFACE WITHIN PHASE 14 AREA FROM CAD FILE "WM MAINE WEST PHASE 14 TOPO NOV 2017 (DELIVERABLE (2))".DWG CREATED BY BOYNTON AND PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE SURROUNDING PHASE 14 AREA FROM CAD FILE "BE0232 TOPO 09-2016 (SP)".DWG CREATED BY AERIAL SURVEY & PHOTO INC. AND BOYNTON & PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE CONTOUR DATA WERE MERGED.

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT
PHASE 14 SITE ASSESSMENT REPORT

TITLE
TOP OF SOFT LOWER CLAY FACIES OF PRESUMPSCOT FORMATION

CONSULTANT
GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	7a

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0009_FIG7A.mxd PRINTED ON: 2019-10-21 AT: 3:27:42 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

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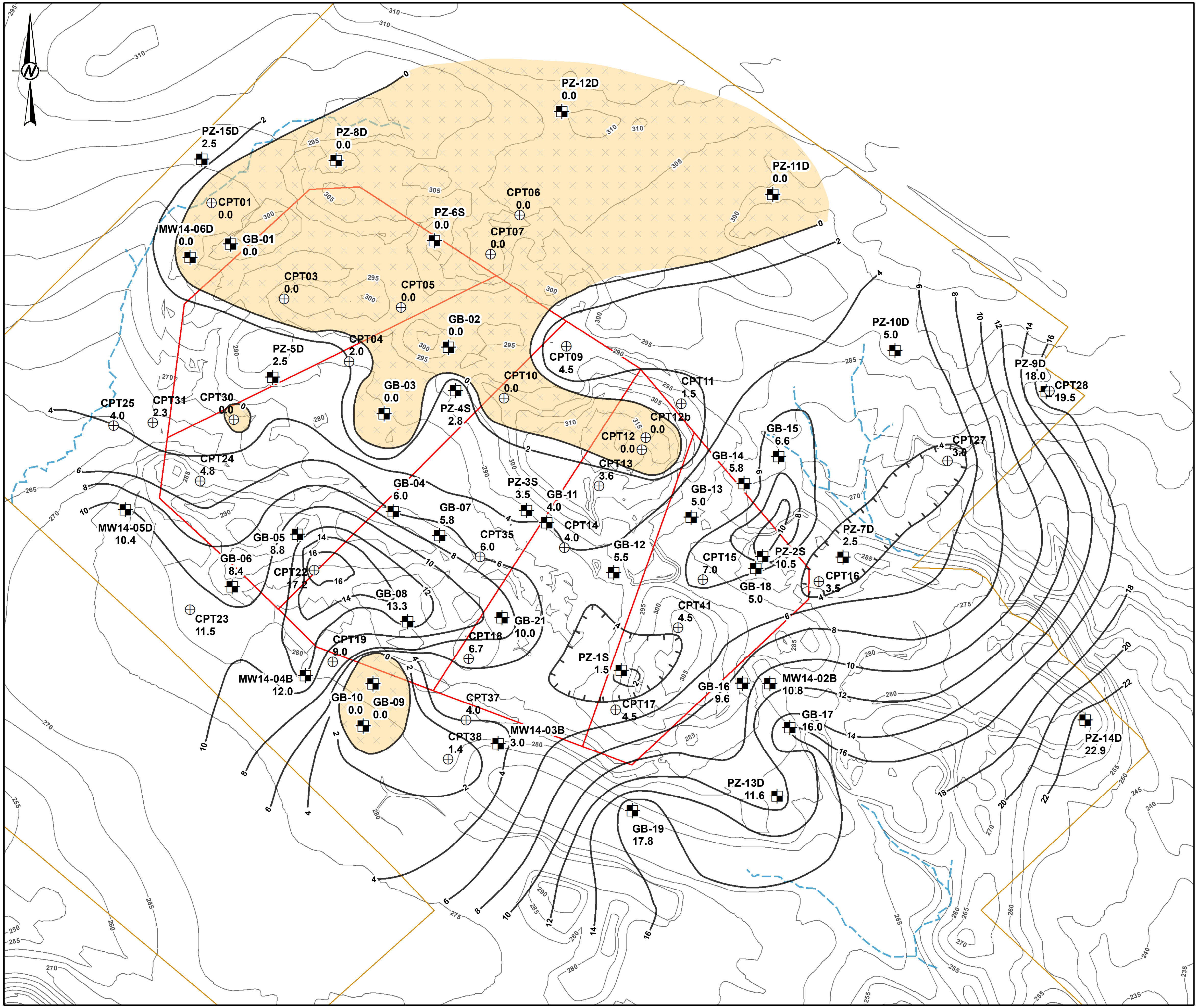

LEGEND

⊕	Geosyntec Cone Penetrometer (CPT) Test Location
▣	Soil Boring Location
—	Interpreted Soft Lower Presumpscot Clay Thickness Contour (feet)
┬┬	Interpreted Soft Lower Presumpscot Clay Thickness Depression Contour (feet)
🟨	Approximate Extent of Area With No Soft Lower Clay
🟥	Proposed Phase 14 Waste Boundary
🟧	Facility Site Boundary
—	Ground Surface Topographic Contour
- -	Stream

0 300 600

1 " = 300 feet Feet

NOTE(S)

THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

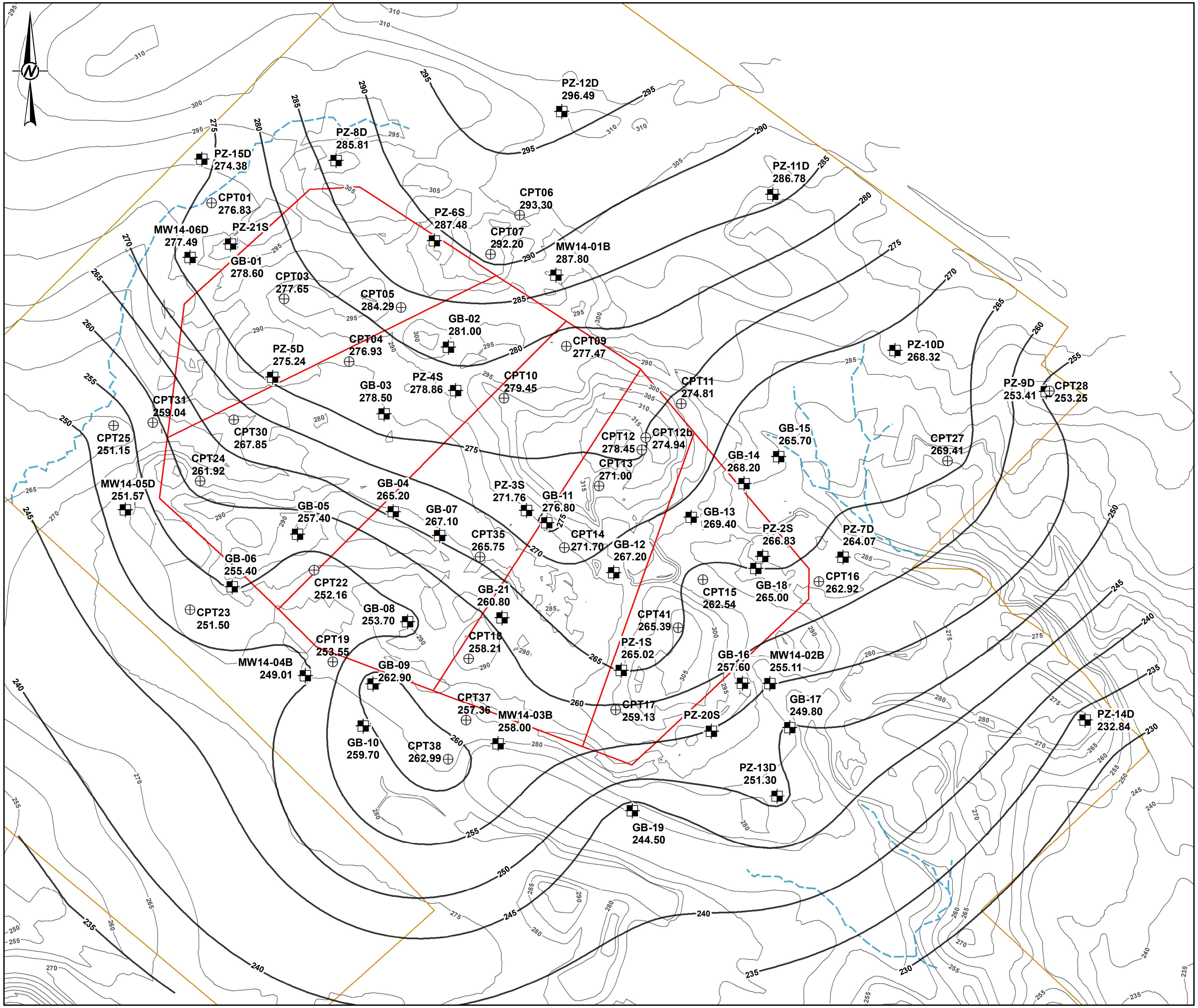
ISOPACH MAP OF SOFT LOWER CLAY FACIES OF PRESUMPSCOT FORMATION

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	7b



LEGEND

- ⊕ Geosyntec Cone Penetrometer (CPT) Test Location
- ◩ Soil Boring Location
- — Interpreted Top of Till Elevation Contour
- — Proposed Phase 14 Waste Boundary
- — Facility Site Boundary
- — Ground Surface Topographic Contour
- - - Stream

0 300 600

1 " = 300 feet

Feet

NOTE(S)

THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

TOP OF GLACIAL TILL CONTOUR MAP

CONSULTANT

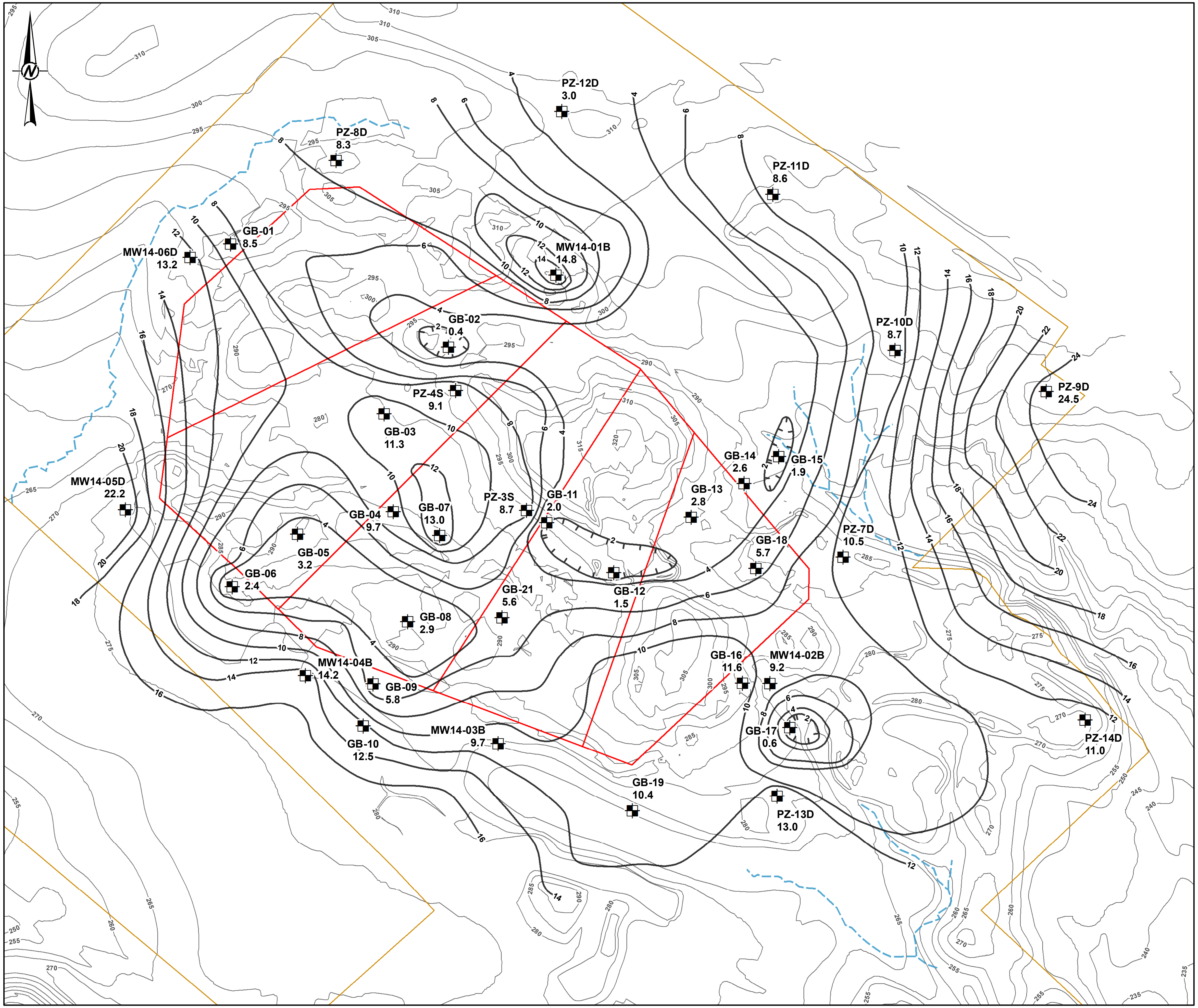
GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	8a

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0012_FIG8A.mxd PRINTED ON: 2019-10-21 AT: 3:21:01 PM



LEGEND

- ▣ Soil Boring Location
- — Interpreted Till Thickness Contour (feet)
- ┬ Interpreted Till Thickness Depression Contour (feet)
- — Proposed Phase 14 Waste Boundary
- — Facility Site Boundary
- — Ground Surface Topographic Contour
- - - Stream

0 300 600

1 " = 300 feet Feet

NOTE(S)

THIS FIGURE ILLUSTRATES AN INTERPRETATION OF THE SURFACE BASED ON THE DATA ILLUSTRATED. PROFESSIONAL JUDGMENT HAS BEEN USED IN THE DEVELOPMENT OF THE CONTOURS. THE ACTUAL SURFACE MAY BE MORE HETEROGENEOUS THAN SHOWN AND CONTOURS BETWEEN BORING LOCATIONS ARE INFERRED. ACTUAL CONDITIONS WILL VARY FROM THOSE ILLUSTRATED. OTHER INTERPRETATIONS ARE POSSIBLE.

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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

ISOPACH MAP OF GLACIAL TILL

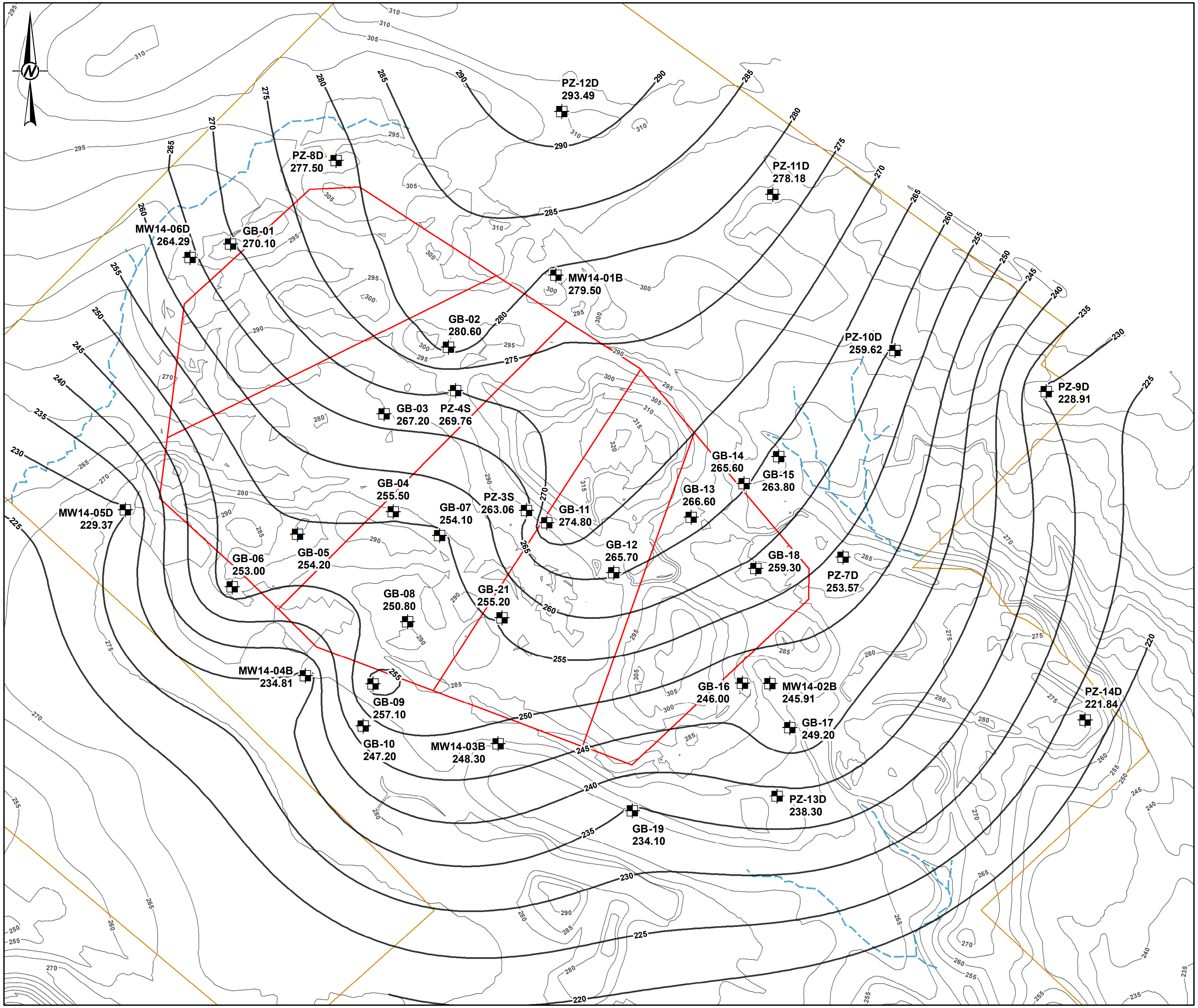
CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	8b

0 1 in



LEGEND

- ▣ Soil Boring Location
- — Interpreted Top of Bedrock Elevation Contour
- — Proposed Phase 14 Waste Boundary
- — Facility Site Boundary
- — Ground Surface Topographic Contour
- - - Stream

0 300 600

1 " = 300 feet Feet

NOTE(S)

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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

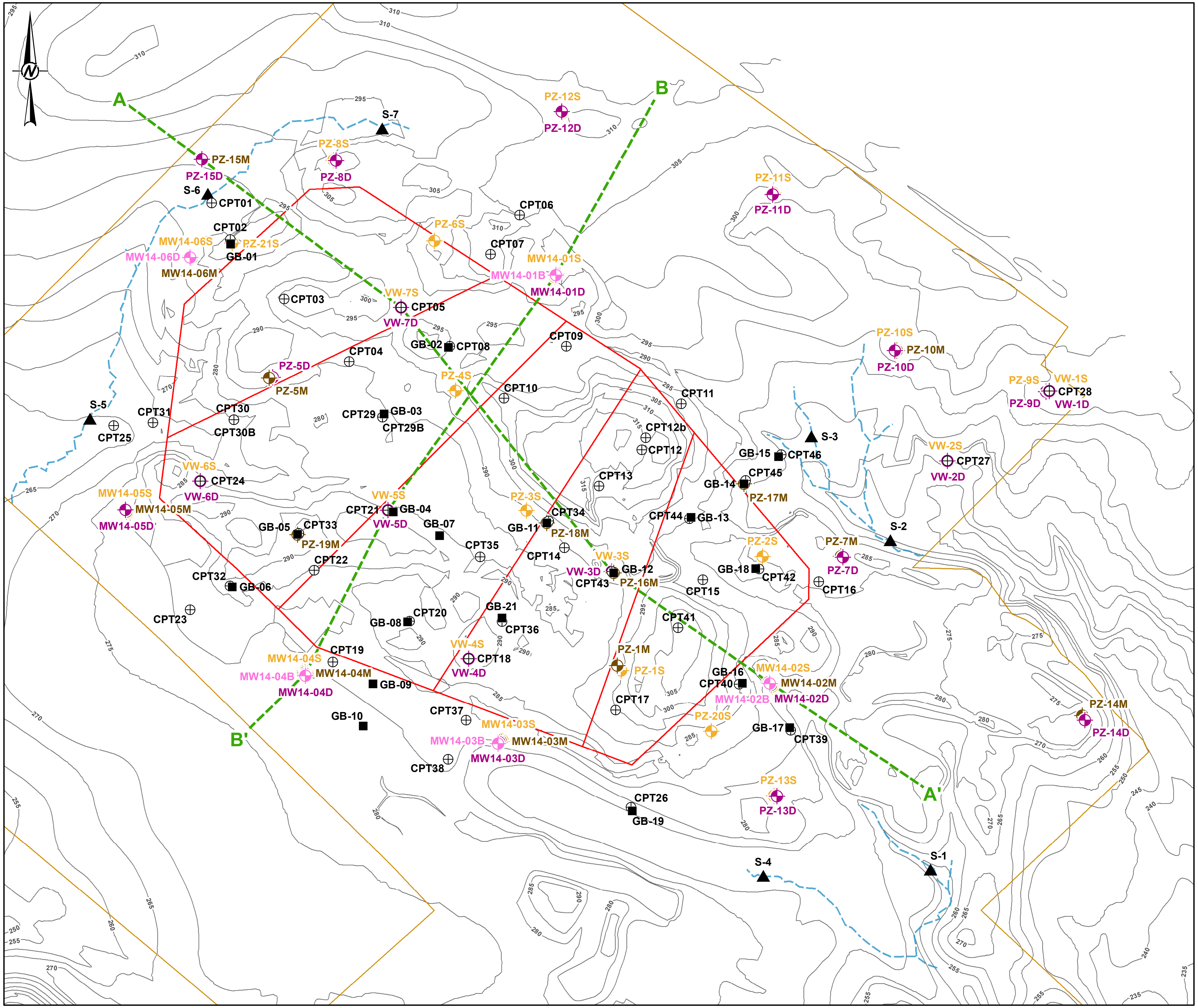
TOP OF BEDROCK CONTOUR MAP

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	9



LEGEND

⊕ Geosyntec Cone Penetrometer (CPT) Test Location

■ Geosyntec Geotechnical Boring Location

⊕ Sand Piezometer/Monitoring Well

⊕ Clay Piezometer/Monitoring Well

⊕ Till Piezometer/Monitoring Well

⊕ Bedrock Piezometer/Monitoring Well

▲ Stream Piezometer/Staff Gauge

— Proposed 14 Waste Boundary

— Facility Site Boundary

- - Cross Section Location

— Ground Surface Topographic Contour

- - Stream

0 350 700

1 " = 300 feet Feet

NOTE(S)

1. CONTINUOUS SOIL SAMPLES COLLECTED AT THE DEEPEST SOIL BORING OF EACH PIEZOMETER CLUSTER.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

CROSS SECTION LOCATION MAP

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	10

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0015_FIG10.mxd PRINTED ON: 2019-10-21 AT: 3:17:45 PM

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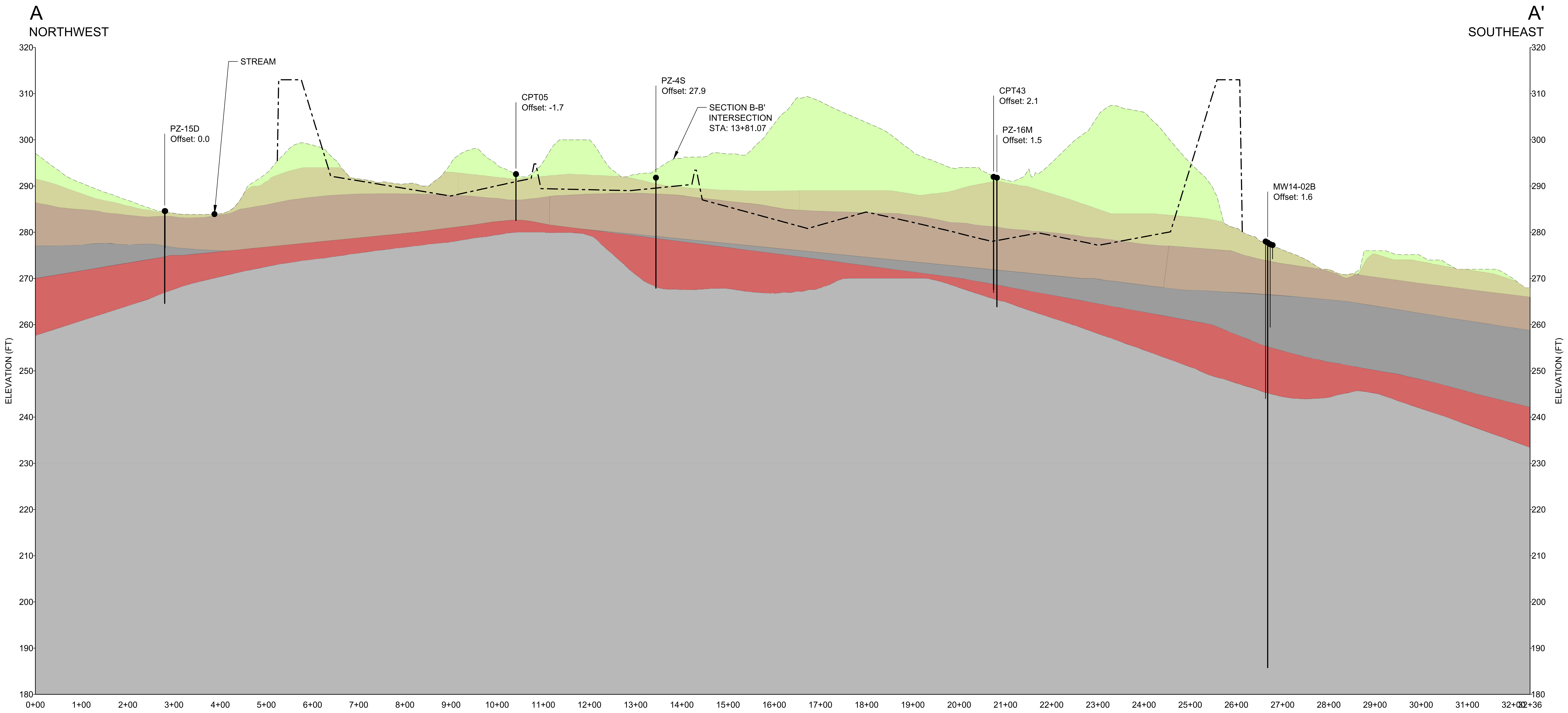


LEGEND

MW14-01D Offset:-0.3	SOIL BORING OR CONE PENETROMETER TEST ID SAMPLE POINT OFFSET FROM SECTION (NEGATIVE = LEFT OFFSET - POSITIVE = RIGHT OFFSET
🟩	FILL AND UNDIFFERENTIATED MATERIAL
🟨	SILTY FINE SAND
🟫	STIFF UPPER CLAY FACIES OF PRESUMPSCOT FORMATION
⬛	SOFT LOWER FACIES OF PRESUMPSCOT FORMATION
🟥	GLACIAL TILL
⬜	BEDROCK
— · — · —	PROPOSED PHASE 14 BASE GRADE ELEVATION (PROVIDED BY GEOSYNTEC CONSULTANTS ON AUGUST 3, 2019)

0 12 24
1" = 12' FEET
VERTICAL

0 120 240
1" = 120' FEET
HORIZONTAL

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE
CROSSROADS LANDFILL
NORRIDGEWOCK, ME

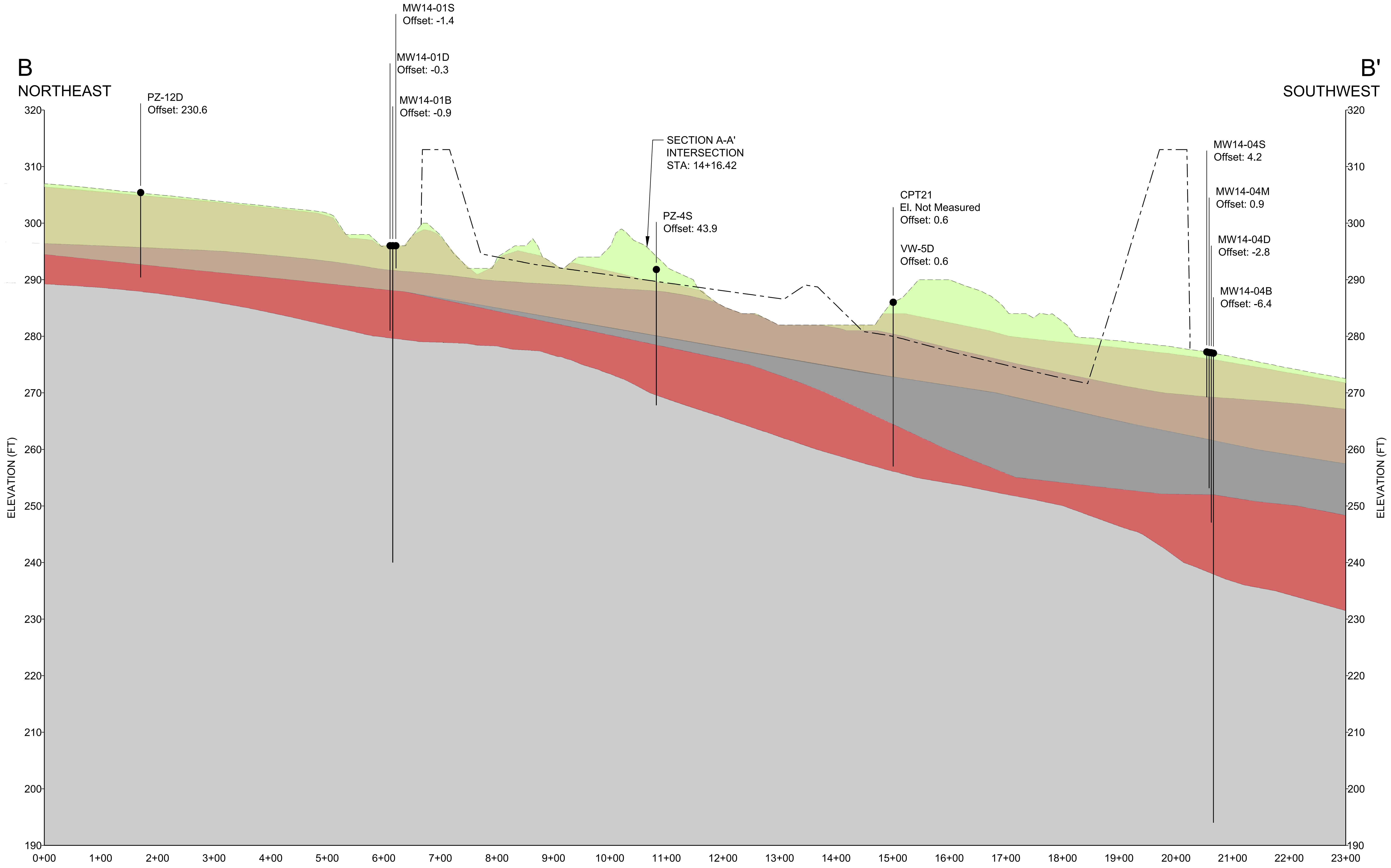
CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-27
DESIGNED	RWC
PREPARED	AAZ
REVIEWED	BDL
APPROVED	APTM

PROJECT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE
PHASE 14 SITE ASSESSMENT REPORT
NORRIDGEWOCK, MAINE

TITLE
GEOLOGY CROSS SECTION A-A'

PROJECT NO.	CONTROL	REV.	FIGURE
19119078	500	0	11a



LEGEND

MW14-01D Offset:-0.3	SOIL BORING OR CONE PENETROMETER TEST ID SAMPLE POINT OFFSET FROM SECTION (NEGATIVE = LEFT OFFSET - POSITIVE = RIGHT OFFSET
🟩	FILL AND UNDIFFERENTIATED MATERIAL
🟨	SILTY FINE SAND
🟫	STIFF UPPER CLAY FACIES OF PRESUMPSCOT FORMATION
⬛	SOFT LOWER FACIES OF PRESUMPSCOT FORMATION
🟥	GLACIAL TILL
⬜	BEDROCK
— · — · —	PROPOSED PHASE 14 BASE GRADE ELEVATION (PROVIDED BY GEOSYNTEC CONSULTANTS ON AUGUST 3, 2019)

0 12 24
1" = 12' FEET
VERTICAL

0 120 240
1" = 120' FEET
HORIZONTAL

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE
CROSSROADS LANDFILL
NORRIDGEWOCK, ME

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-27
DESIGNED	RWC
PREPARED	AAZ
REVIEWED	BDL
APPROVED	APTM

PROJECT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE
PHASE 14 SITE ASSESSMENT REPORT
NORRIDGEWOCK, MAINE

TITLE
GEOLOGY CROSS SECTION B-B'

PROJECT NO.	CONTROL	REV.	FIGURE
19119078	500	0	11b

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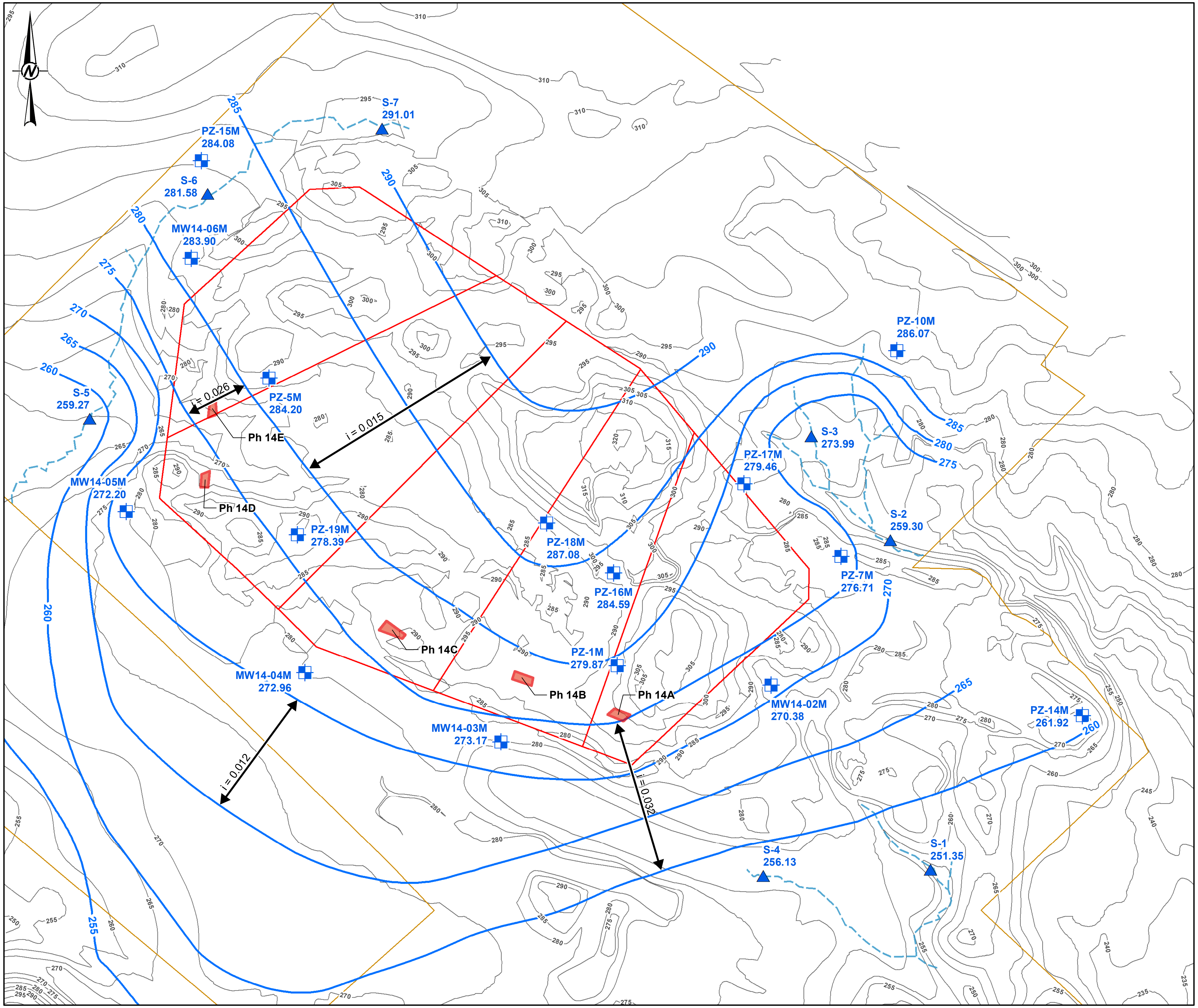

LEGEND

- ⊞ Monitoring Well Location and Groundwater Elevation
- ▲ Stream Piezometer
- 🟥 Approximate Leachate Collection Sump Location
- — Phreatic Surface Contour (ft-msl)
- — Proposed Phase 14 Waste Boundary
- — Facility Site Boundary
- — Ground Surface Topographic Contour
- - - Stream
- ↔ Location of Calculated Hydraulic Gradient (i)

i = 0.013

NOTE(S)

1. DEPTH TO GROUNDWATER AND SURFACE WATER MEASURED IN MAY 2019.

FIGURE NARRATIVE

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION AS MEASURED IN PIEZOMETERS AND GROUNDWATER MONITORING WELLS AND SURFACE WATER, AND IS INTENDED TO REPRESENT THE APPROXIMATE ELEVATION OF THE PHREATIC SURFACE.THE DIRECTION OF HORIZONTAL GROUNDWATER FLOW CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER CONTOURS.

GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED. THE ACTUAL ELEVATION OF THE GROUNDWATER SURFACE IS LIKELY MORE HETEROGENOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. OTHER INTERPRETATIONS ARE POSSIBLE. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
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7. APPROXIMATE LEACHATE COLLECTION SUMP LOCATIONS PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019.

CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

PHASE 14 AREA SEASONAL HIGH PHREATIC SURFACE CONTOUR MAP (MAY 2019)

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	12a

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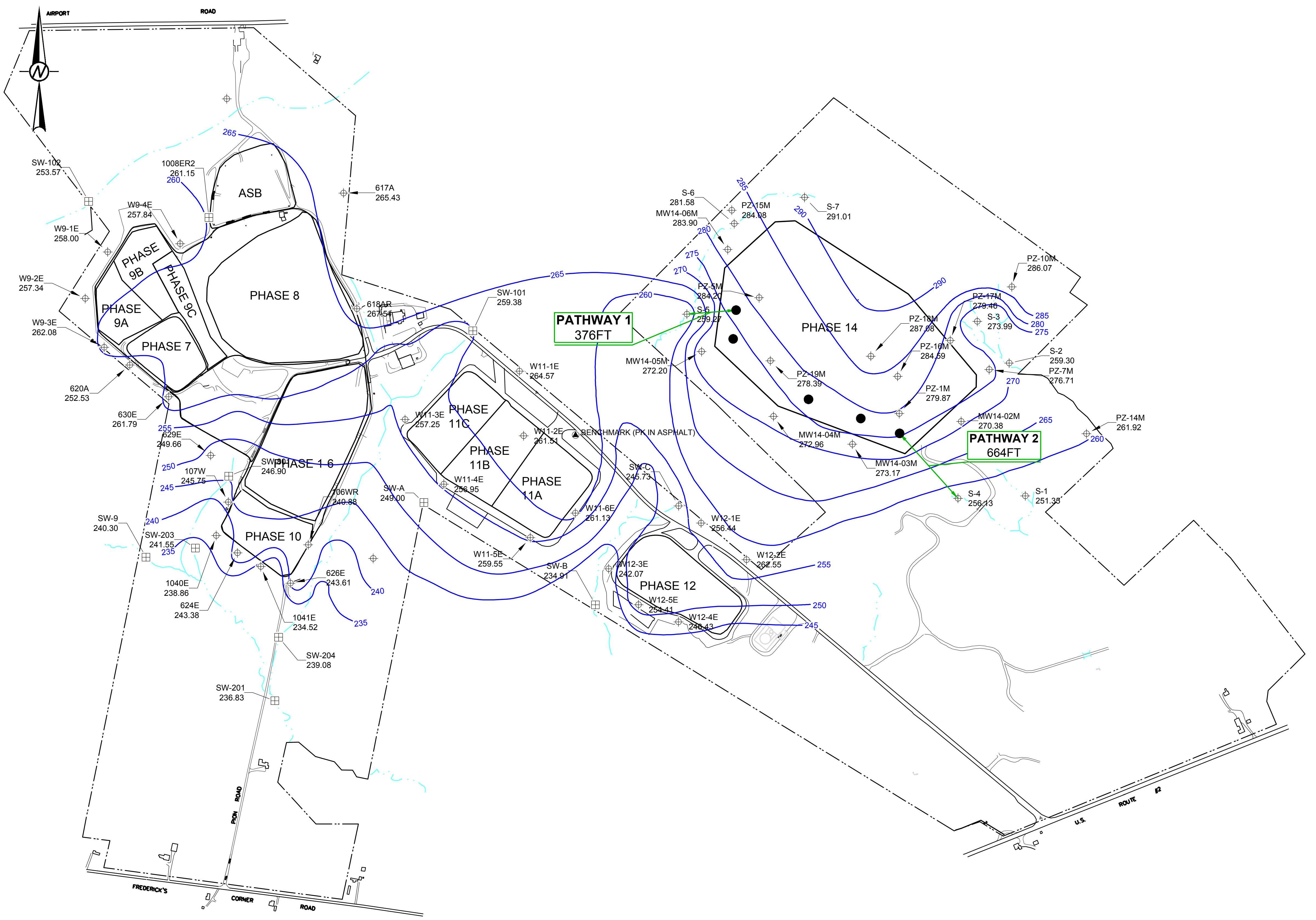
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

— - - —	FACILITY SITE BOUNDARY
∼	STREAM
═	ROAD
⌐	BUILDING
⌖	MONITORING WELL/ PIEZOMETER LOCATION
⊞	STREAM GAUGE LOCATION
●	APPROXIMATE LEACHATE COLLECTION SUMP LOCATION
▲	PERMANENT ON-SITE BENCHMARK
↔	POTENTIAL PATHWAY FOR TIME-OF-TRAVEL ANALYSIS
— 280	PHREATIC SURFACE CONTOUR (FT-MSL)

FIGURE NARRATIVE:

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION AS MEASURED IN PIEZOMETERS, GROUNDWATER MONITORING WELLS AND SURFACE WATER, AND IS INTENDED TO REPRESENT THE APPROXIMATE ELEVATION OF THE PHREATIC SURFACE. THE POSTED DATA WERE CALCULATED FROM DEPTH TO WATER MEASUREMENTS MADE BY KAHTAHDIN ON APRIL 26, 2019 DURING THE GROUNDWATER MONTORIN PROGRAM. PHASE 14 GROUNDWATER ELEVATIONS WERE COLLECTED BY GOLDER ASSOCIATES ON MAY 2, 2019. THE DIRECTION OF HORIZONTAL GROUNDWATER FLOW CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER ELEVATION CONTOURS.

GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED. THE ACTUAL ELEVATION OF THE GROUNDWATER SURFACE IS LIKELY MORE HETEROGENEOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

REFERENCE(S)

1. BASE PLAN PREPARED FROM PLANS ENTITLED "TOPOGRAPHIC PLAN SHOWING WETLANDS DELINEATION, NORRIDGEWOCK FACILITY, SHEETS 1-13," PREPARED BY AERIAL SURVEY & PHOTO, INC. OF NORRIDGEWOCK, MAINE; PHOTO DATED 10/20/94 WITH GROUND CONTROL PROPERTY LINE INFORMATION, AND MAPPING UPDATE PROVIDED BY SACKETT & BRAKE SURVEY, INC. OF SKOWHEGAN, MAINE IN 1995; ORIGINAL SCALE: 1" = 100'.
2. VERTICAL DATUM IS USGS MEAN SEA LEVEL, HORIZONTAL DATUM IS NAD83 STATEPLANE MAINE WEST FIPS 1802 FEET.
3. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
4. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
5. STREAMS LAYER FROM SHAPE FILES RECEIVED FROM NORMANDEAU ASSOCIATES DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
6. PHASE 14 PIEZOMETER LOCATIONS SURVEYED BY BOYTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFORMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT. 2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCATIONS 04.17.2019").
7. APPROXIMATE LEACHATE COLLECTION SUMP LOCATIONS PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
8. THE BENCHMARK IS LOCATED IN AN ARIEL TARGET (PK IN ASPHALT). THIS BENCHMARK WAS ESTABLISHED IN THE STATE PLANE MAINE WEST COORDINATE SYSTEM (NAD83(2011) HORIZONTAL DATUM AND NAVD88 VERTICAL DATUM (U.S. SURVEY FEET). NORTHING: 684575.399, EASTING: 3037326.000, ELEVATION: 267.630. PERMANENT BENCHMARK LOCATION AND ELEVATION PROVIDED BY BOYNTON & PICKETT ON JULY 23, 2019.

0 400 800
1" = 800' FEET

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE

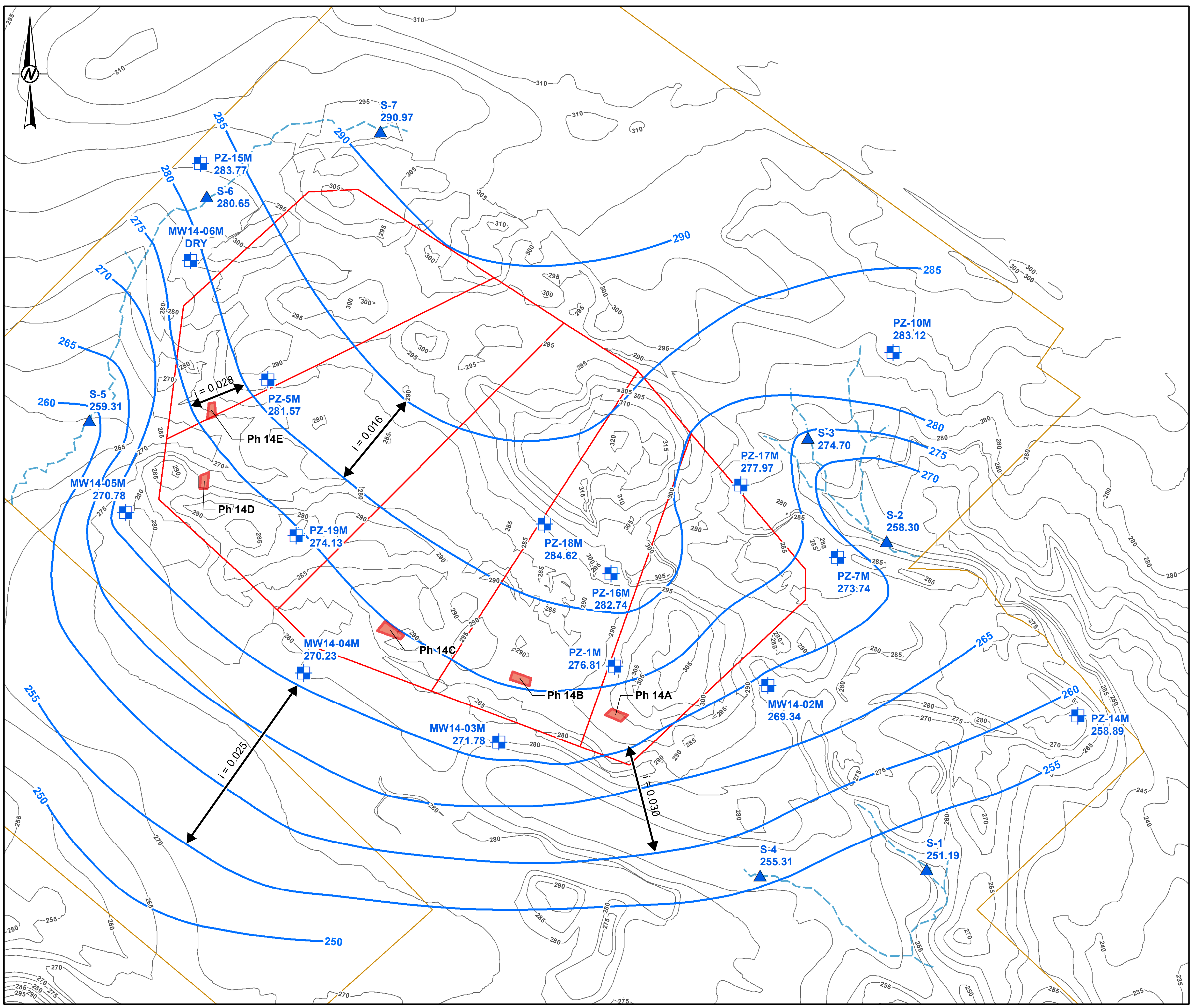
PROJECT
PHASE 14 SITE ASSESSMENT REPORT
NORRIDGEWOCK, MAINE

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09_27
DESIGNED	RWC
PREPARED	AAZ
REVIEWED	BDL
APPROVED	APTM

TITLE
FACILITY-WIDE SEASONAL HIGH PHREATIC SURFACE CONTOUR MAP (MAY 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
19119078	500	0	12b



LEGEND

- Monitoring Well Location and Groundwater Elevation
- ▲ Stream Piezometer
- 🟥 Approximate Leachate Collection Sump Location
- Phreatic Surface Contour (ft-msl)
- Proposed Phase 14 Waste Boundary
- Facility Site Boundary
- Ground Surface Topographic Contour
- Stream
- ↔ Location of Calculated Hydraulic Gradient (i)

i = 0.025

0 300 600

1 " = 300 feet Feet

NOTE(S)

1. DEPTH TO GROUNDWATER AND SURFACE WATER MEASURED ON AUGUST 23, 2019.

FIGURE NARRATIVE

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION AS MEASURED IN PIEZOMETERS AND GROUNDWATER MONITORING WELLS AND SURFACE WATER, AND IS INTENDED TO REPRESENT THE APPROXIMATE ELEVATION OF THE PHREATIC SURFACE.THE DIRECTION OF HORIZONTAL GROUNDWATER FLOW CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER CONTOURS.

GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED. THE ACTUAL ELEVATION OF THE GROUNDWATER SURFACE IS LIKELY MORE HETEROGENOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. OTHER INTERPRETATIONS ARE POSSIBLE. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
4. STREAMS LAYER FROM SHAPEFILE RECEIVED FROM NORMANDEAU ENVIRONMENTAL CONSULTANTS (NORMANDEAU) DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
5. PIEZOMETER AND SOIL BORING LOCATIONS SURVEYED BY BOYNTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFROMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT.2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCTIONS 04.17.2019").
6. EXISTING GROUND SURFACE WITHIN PHASE 14 AREA FROM CAD FILE "WM MAINE WEST PHASE 14 TOPO NOV 2017 (DELIVERABLE (2))".DWG CREATED BY BOYNTON AND PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE SURROUNDING PHASE 14 AREA FROM CAD FILE "BE0232 TOPO 09-2016 (SP)".DWG CREATED BY AERIAL SURVEY & PHOTO INC. AND BOYNTON & PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE CONTOUR DATA WERE MERGED.
7. APPROXIMATE LEACHATE COLLECTION SUMP LOCATIONS PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019.

CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

PHASE 14 AREA SEASONAL LOW PHREATIC SURFACE CONTOUR MAP (AUGUST 2019)

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

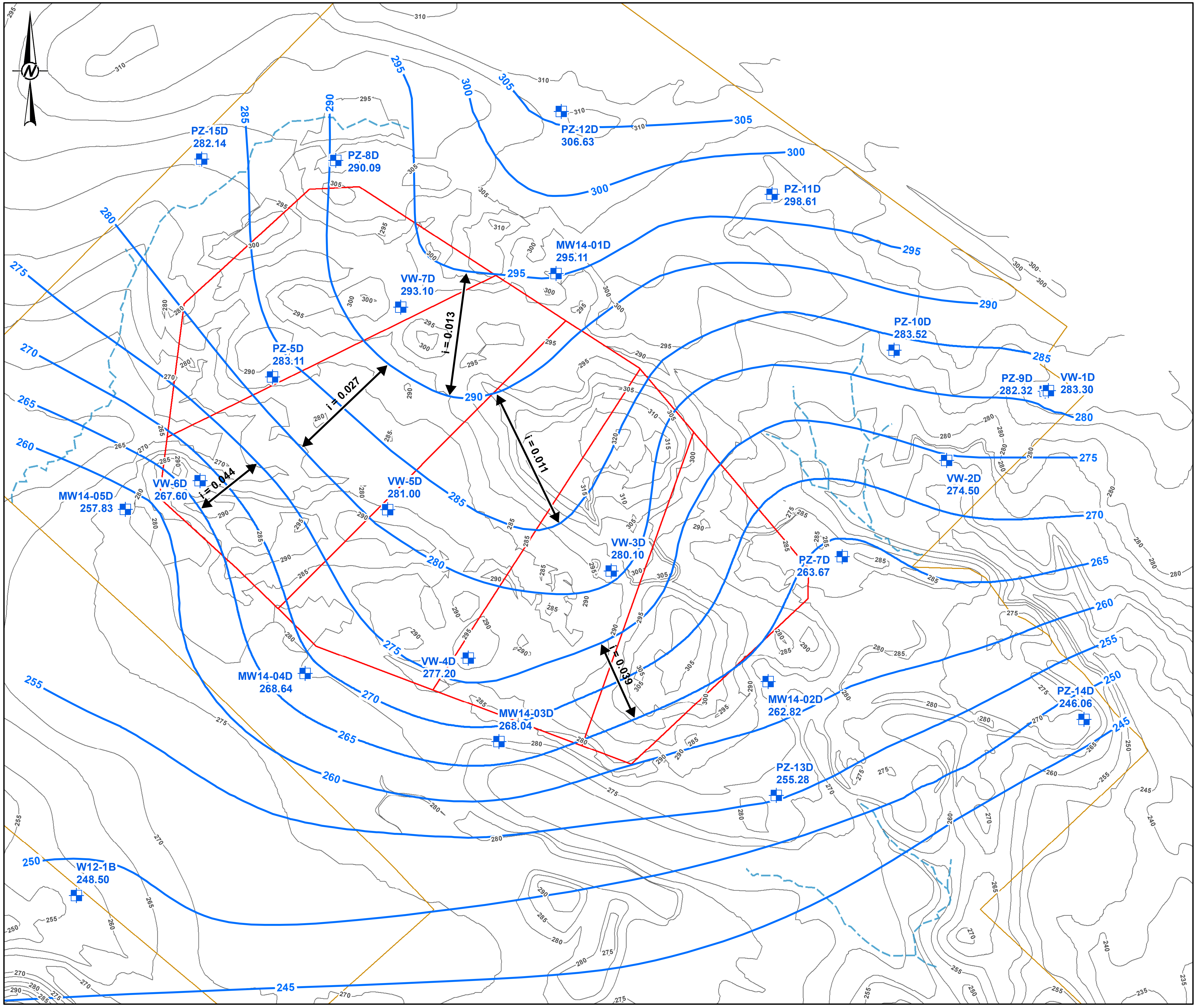
PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	12c

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

0

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0017_FIG12C_rev1.mxd PRINTED ON: 2019-10-21 AT: 3:15:00 PM



PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0018_FIG13A.mxd PRINTED ON: 2019-10-22 AT: 11:33:49 AM

LEGEND

⊞	Monitoring Well Location and potentiometric level
—	Glacial Till Potentiometric Contour (ft-msl)
—	Proposed Phase 14 Waste Boundary
—	Facility Site Boundary
—	Ground Surface Topographic Contour
- -	Stream
↔ i = 0.002	Location of horizontal hydraulic gradient calculation (i)

0 300 600

1 " = 300 feet

Feet

NOTE(S)

1. DEPTH TO GROUNDWATER AND SURFACE WATER MEASURED IN MAY 2019.

FIGURE NARRATIVE

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION AS MEASURED IN PIEZOMETERS AND GROUNDWATER MONITORING WELLS AND REPRESENTS THE GROUNDWATER POTENTIOMETRIC SURFACE IN THE GLACIAL TILL. THE DIRECTION OF HORIZONTAL GROUNDWATER FLOW CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER CONTOURS.

GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED. THE ACTUAL ELEVATION OF THE GROUNDWATER SURFACE IS LIKELY MORE HETEROGENOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. OTHER INTERPRETATIONS ARE POSSIBLE. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
4. STREAMS LAYER FROM SHAPEFILE RECEIVED FROM NORMANDEAU ENVIRONMENTAL CONSULTANTS (NORMANDEAU) DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
5. PIEZOMETER AND SOIL BORING LOCATIONS SURVEYED BY BOYNTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFROMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT.2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCTIONS 04.17.2019").
6. EXISTING GROUND SURFACE WITHIN PHASE 14 AREA FROM CAD FILE "WM MAINE WEST PHASE 14 TOPO NOV 2017 (DELIVERABLE (2))".DWG CREATED BY BOYNTON AND PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE SURROUNDING PHASE 14 AREA FROM CAD FILE "BE0232 TOPO 09-2016 (SP)".DWG CREATED BY AERIAL SURVEY & PHOTO INC. AND BOYNTON & PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE CONTOUR DATA WERE MERGED.

CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

PHASE 14 AREA GLACIAL TILL POTENTIOMETRIC SURFACE MAP (MAY 2019)

CONSULTANT

GOLDER

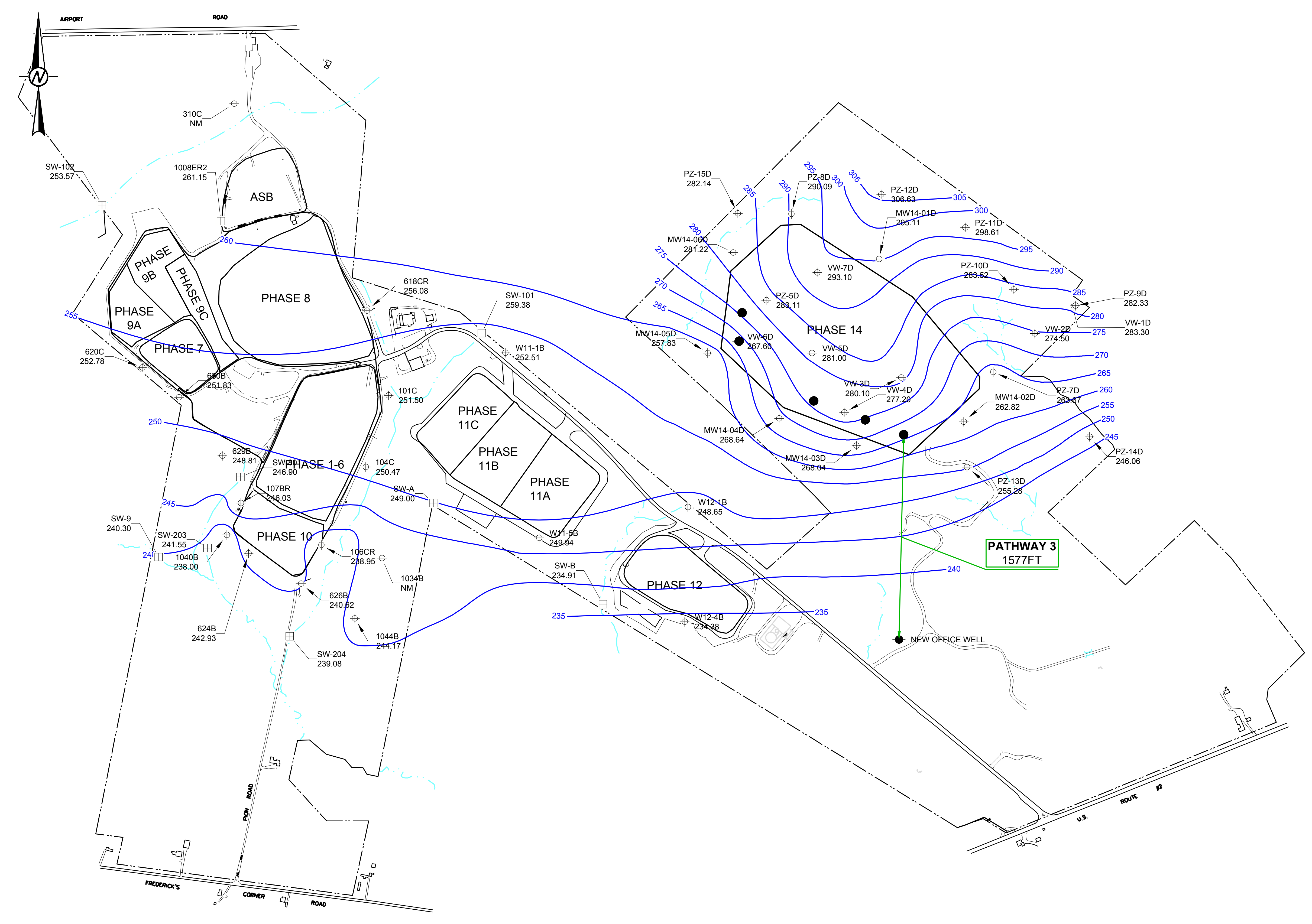
YYYY-MM-DD	10/22/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	13a

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

0



LEGEND

― ‒ ‒ ―	FACILITY SITE BOUNDARY
	STREAM
═	ROAD
280	TILL POTENTIOMETRIC CONTOUR (FT-MSL)
●	LEACHATE COLLECTION SUMP LOCATION
⊕	APPROXIMATE LOCATION OF NEW OFFICE WELL
	BUILDING
⌖	MONITORING WELL/ PIEZOMETER LOCATION
⟷	POTENTIAL PATHWAY FOR TIME-OF-TRAVEL ANALYSIS

FIGURE NARRATIVE:

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION AS MEASURED IN PIEZOMETERS, GROUNDWATER MONITORING WELLS AND SURFACE WATER, AND IS INTENDED TO REPRESENT THE APPROXIMATE ELEVATION OF THE TILL POTENTIOMETRIC SURFACE. THE POSTED DATA WERE CALCULATED FROM DEPTH TO WATER MEASUREMENTS MADE BY KAHTAHDIN ON APRIL 26, 2019 DURING THE GROUNDWATER MONTORIN PROGRAM. PHASE 14 GROUNDWATER ELEVATIONS WERE COLLECTED BY GOLDER ASSOCIATES ON MAY 2, 2019. THE DIRECTION OF HORIZONTAL GROUNDWATER FLOW CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER ELEVATION CONTOURS.

GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED. THE ACTUAL ELEVATION OF THE GROUNDWATER SURFACE IS LIKELY MORE HETEROGENEOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

REFERENCE(S)

1. BASE PLAN PREPARED FROM PLANS ENTITLED "TOPOGRAPHIC PLAN SHOWING WETLANDS DELINEATION, NORRIDGEWOCK FACILITY, SHEETS 1-13," PREPARED BY AERIAL SURVEY & PHOTO, INC. OF NORRIDGEWOCK, MAINE; PHOTO DATED 10/20/94 WITH GROUND CONTROL PROPERTY LINE INFORMATION, AND MAPPING UPDATE PROVIDED BY SACKETT & BRAKE SURVEY, INC. OF SKOWHEGAN, MAINE IN 1995; ORIGINAL SCALE: 1" = 100'.
2. VERTICAL DATUM IS USGS MEAN SEA LEVEL, HORIZONTAL DATUM IS NAD83 STATEPLANE MAINE WEST FIPS 1802 FEET.
3. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
4. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
5. STREAMS LAYER FROM SHAPE FILES RECEIVED FROM NORMANDEAU ASSOCIATES DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
6. PHASE 14 PIEZOMETER LOCATIONS SURVEYED BY BOYTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFORMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT. 2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCATIONS 04.17.2019").

0 400 800
1" = 800' FEET

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE

PROJECT
PHASE 14 SITE ASSESSMENT REPORT
NORRIDGEWOCK, MAINE

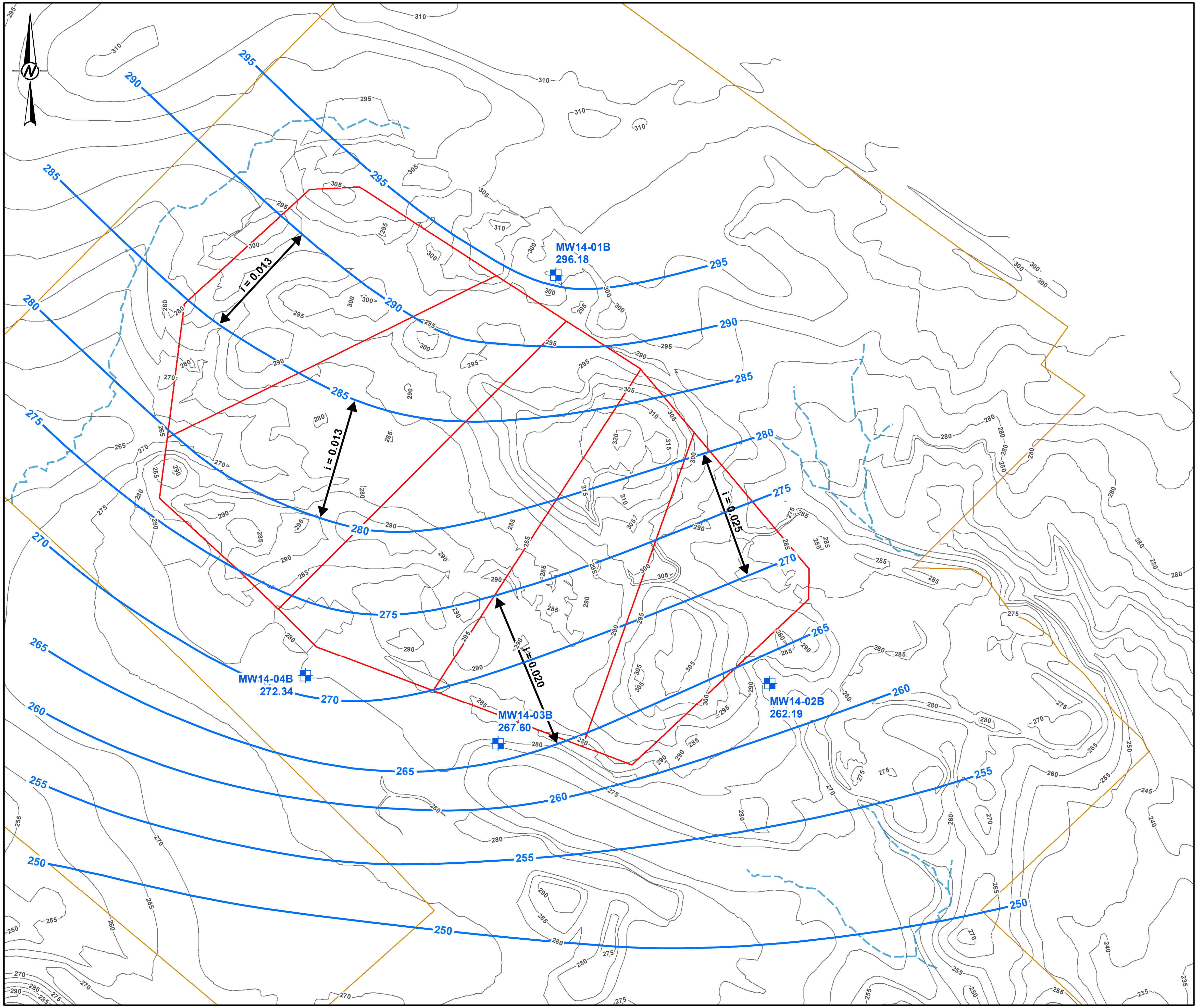
CONSULTANT

GOLDER

YYYY-MM-DD	2019-06-18
DESIGNED	RWC
PREPARED	AAZ
REVIEWED	BDL
APPROVED	APTM

TITLE
FACILITY-WIDE GLACIAL TILL POTENTIOMETRIC SURFACE CONTOUR MAP (MAY 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
19119078	500	0	13b



LEGEND

- ✚ Monitoring Well Location and potentiometric level
- i = 0.002 ⟷ Location of horizontal hydraulic gradient calculation (i)
- Bedrock Potentiometric Surface Contour (ft-msl)
- Proposed Phase 14 Waste Boundary
- Facility Site Boundary
- Ground Surface Topographic Contour
- Stream

0 300 600

1 " = 300 feet Feet

NOTE(S)

1. DEPTH TO GROUNDWATER AND SURFACE WATER MEASURED IN MAY 2019.

FIGURE NARRATIVE

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION AS MEASURED IN PIEZOMETERS AND GROUNDWATER MONITORING WELLS AND REPRESENTS THE GROUNDWATER POTENTIOMETRIC SURFACE IN THE BEDROCK. THE DIRECTION OF HORIZONTAL GROUNDWATER FLOW CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER CONTOURS.

GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED. THE ACTUAL ELEVATION OF THE GROUNDWATER SURFACE IS LIKELY MORE HETEROGENOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. OTHER INTERPRETATIONS ARE POSSIBLE. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
4. STREAMS LAYER FROM SHAPEFILE RECEIVED FROM NORMANDEAU ENVIRONMENTAL CONSULTANTS (NORMANDEAU) DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
5. PIEZOMETER AND SOIL BORING LOCATIONS SURVEYED BY BOYNTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFROMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT.2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCTIONS 04.17.2019").
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CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

PHASE 14 AREA BEDROCK POTENTIOMETRIC SURFACE MAP (MAY 2019)

CONSULTANT

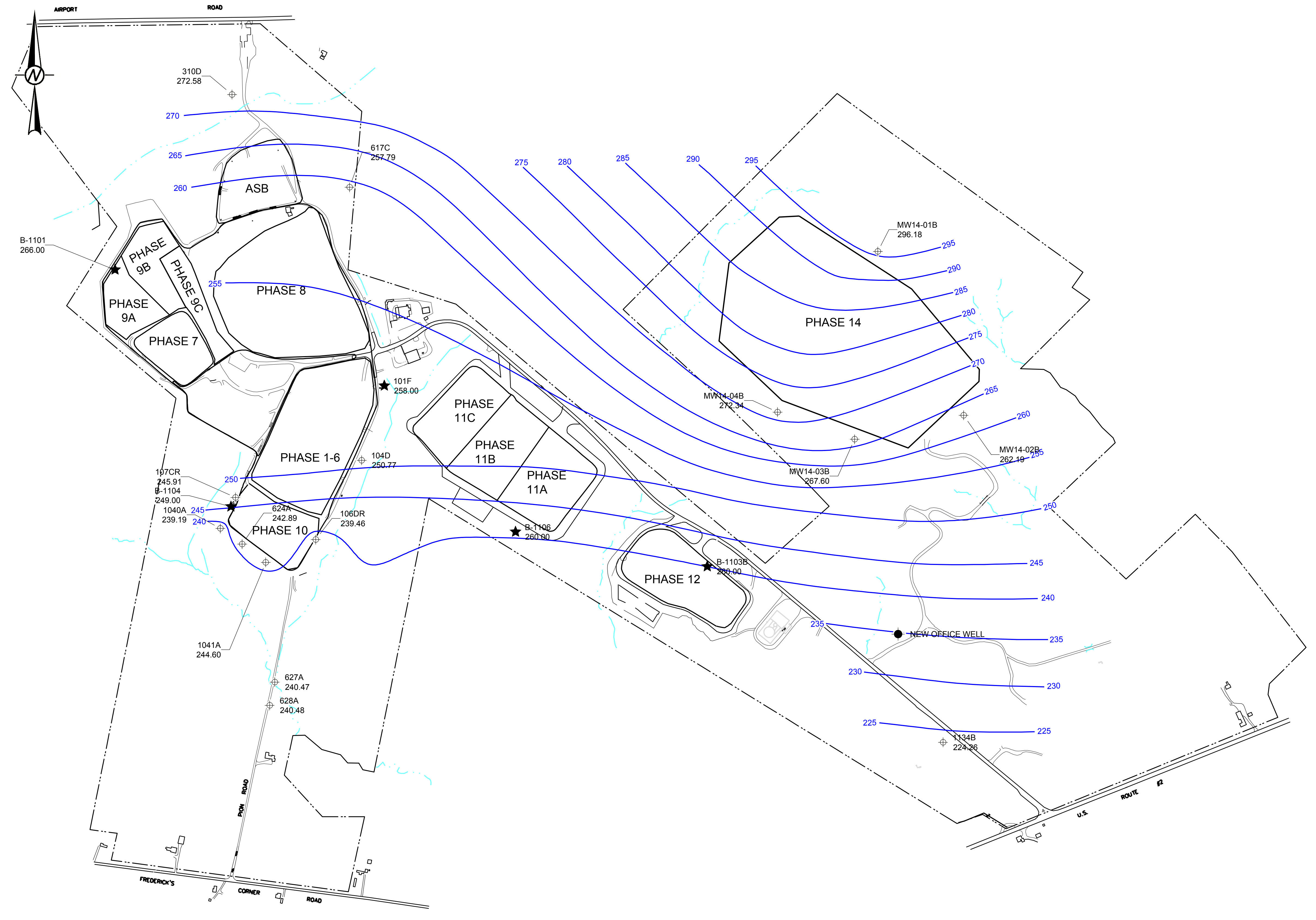
GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	14a

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0019_FIG14A.mxd PRINTED ON: 2019-10-21 AT: 3:26:09 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

FACILITY SITE BOUNDARY

STREAM

ROAD

280 BEDROCK POTENTIOMETRIC SURFACE CONTOUR (FT-MSL)

● APPROXIMATE LOCATION OF NEW OFFICE WELL

BUILDING

⌖ MONITORING WELL/ PIEZOMETER LOCATION

★ APPROXIMATE GERBER BEDROCK PUMPING TEST LOCATIONS

FIGURE NARRATIVE:

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION AS MEASURED IN PIEZOMETERS, GROUNDWATER MONITORING WELLS AND SURFACE WATER, AND IS INTENDED TO REPRESENT THE APPROXIMATE ELEVATION OF THE BEDROCK POTENTIOMETRIC SURFACE. THE POSTED DATA WERE CALCULATED FROM DEPTH TO WATER MEASUREMENTS MADE BY KAHTAHDIN ON APRIL 26, 2019 DURING THE GROUNDWATER MONTORIN PROGRAM. PHASE 14 GROUNDWATER ELEVATIONS WERE COLLECTED BY GOLDER ASSOCIATES ON MAY 2, 2019. THE DIRECTION OF HORIZONTAL GROUNDWATER FLOW CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER ELEVATION CONTOURS.

GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED. THE ACTUAL ELEVATION OF THE GROUNDWATER SURFACE IS LIKELY MORE HETEROGENEOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

REFERENCE(S)

1. BASE PLAN PREPARED FROM PLANS ENTITLED "TOPOGRAPHIC PLAN SHOWING WETLANDS DELINEATION, NORRIDGEWOCK FACILITY, SHEETS 1-13," PREPARED BY AERIAL SURVEY & PHOTO, INC. OF NORRIDGEWOCK, MAINE; PHOTO DATED 10/20/94 WITH GROUND CONTROL PROPERTY LINE INFORMATION, AND MAPPING UPDATE PROVIDED BY SACKETT & BRAKE SURVEY, INC. OF SKOWHEGAN, MAINE IN 1995; ORIGINAL SCALE: 1" = 100'.
2. VERTICAL DATUM IS USGS MEAN SEA LEVEL, HORIZONTAL DATUM IS NAD83 STATEPLANE MAINE WEST FIPS 1802 FEET.
3. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
4. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
5. STREAMS LAYER FROM SHAPE FILES RECEIVED FROM NORMANDEAU ASSOCIATES DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
6. PHASE 14 PIEZOMETER LOCATIONS SURVEYED BY BOYTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFORMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT. 2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCATIONS 04.17.2019").

0 400 800

1" = 800' FEET

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE

PROJECT
PHASE 14 SITE ASSESSMENT REPORT
NORRIDGEWOCK, MAINE

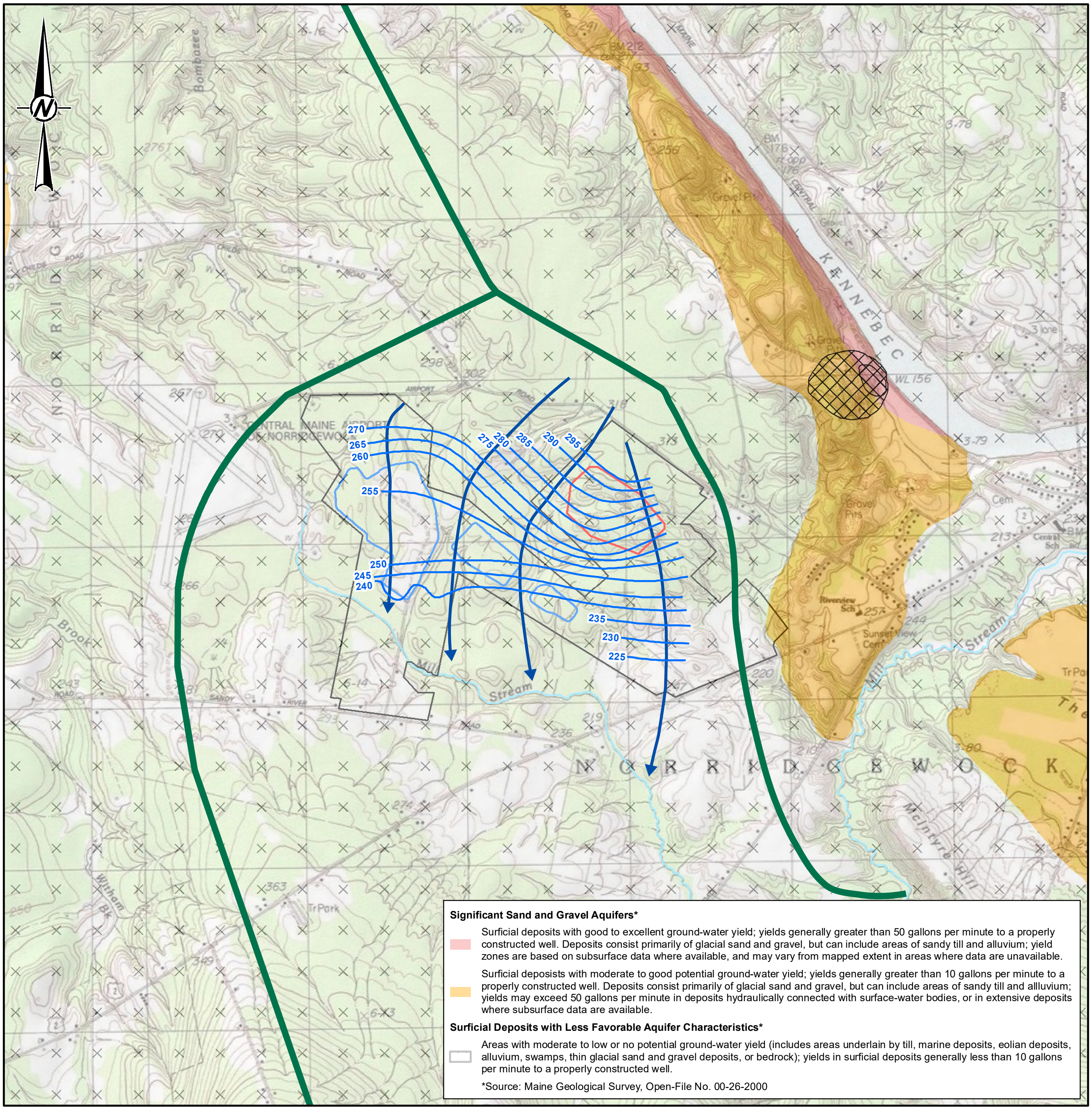
CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-27
DESIGNED	RWC
PREPARED	AAZ
REVIEWED	BDL
APPROVED	APTM

TITLE
FACILITY-WIDE BEDROCK POTENTIOMETRIC SURFACE CONTOUR MAP (MAY 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
19119078	500	0	14b

0 1 in



Significant Sand and Gravel Aquifers*

🟥	Surficial deposits with good to excellent ground-water yield; yields generally greater than 50 gallons per minute to a properly constructed well. Deposits consist primarily of glacial sand and gravel, but can include areas of sandy till and alluvium; yield zones are based on subsurface data where available, and may vary from mapped extent in areas where data are unavailable.
🟧	Surficial deposists with moderate to good potential ground-water yield; yields generally greater than 10 gallons per minute to a properly constructed well. Deposits consist primarily of glacial sand and gravel, but can include areas of sandy till and alluvium; yields may exceed 50 gallons per minute in deposits hydraulically connected with surface-water bodies, or in extensive deposits where subsurface data are available.

Surficial Deposits with Less Favorable Aquifer Characteristics*

☐	Areas with moderate to low or no potential ground-water yield (includes areas underlain by till, marine deposits, eolian deposits, alluvium, swamps, thin glacial sand and gravel deposits, or bedrock); yields in surficial deposits generally less than 10 gallons per minute to a properly constructed well.

*Source: Maine Geological Survey, Open-File No. 00-26-2000

LEGEND

—	Bedrock Potentiometric Surface Contour (May 2, 2019)
—	Proposed Phase 14 Waste Boundary
—	Existing Landfill Phase Boundary
—	Direction of Inferred Regional Groundwater Divide
←	Inferred Regional Groundwater Flow Path
☐	Facility Site Boundary
▨	Public Drinking Water Bedrock Source Water Protection Area

0 3,000 6,000

1 " = 3,000 feet

Feet

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. IMAGERY COPYRIGHT:© 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED
3. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
4. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
5. SIGNIFICANT SAND AND GRAVEL AQUIFERS AND PUBLIC DRINKING WATER BEDROCK SOURCE WATER PROTECTION AREA FROM MAINE.GOV WEBPAGE.

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT
PHASE 14 SITE ASSESSMENT REPORT

CONSULTANT
GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

TITLE
REGIONAL BEDROCK GROUNDWATER FLOW

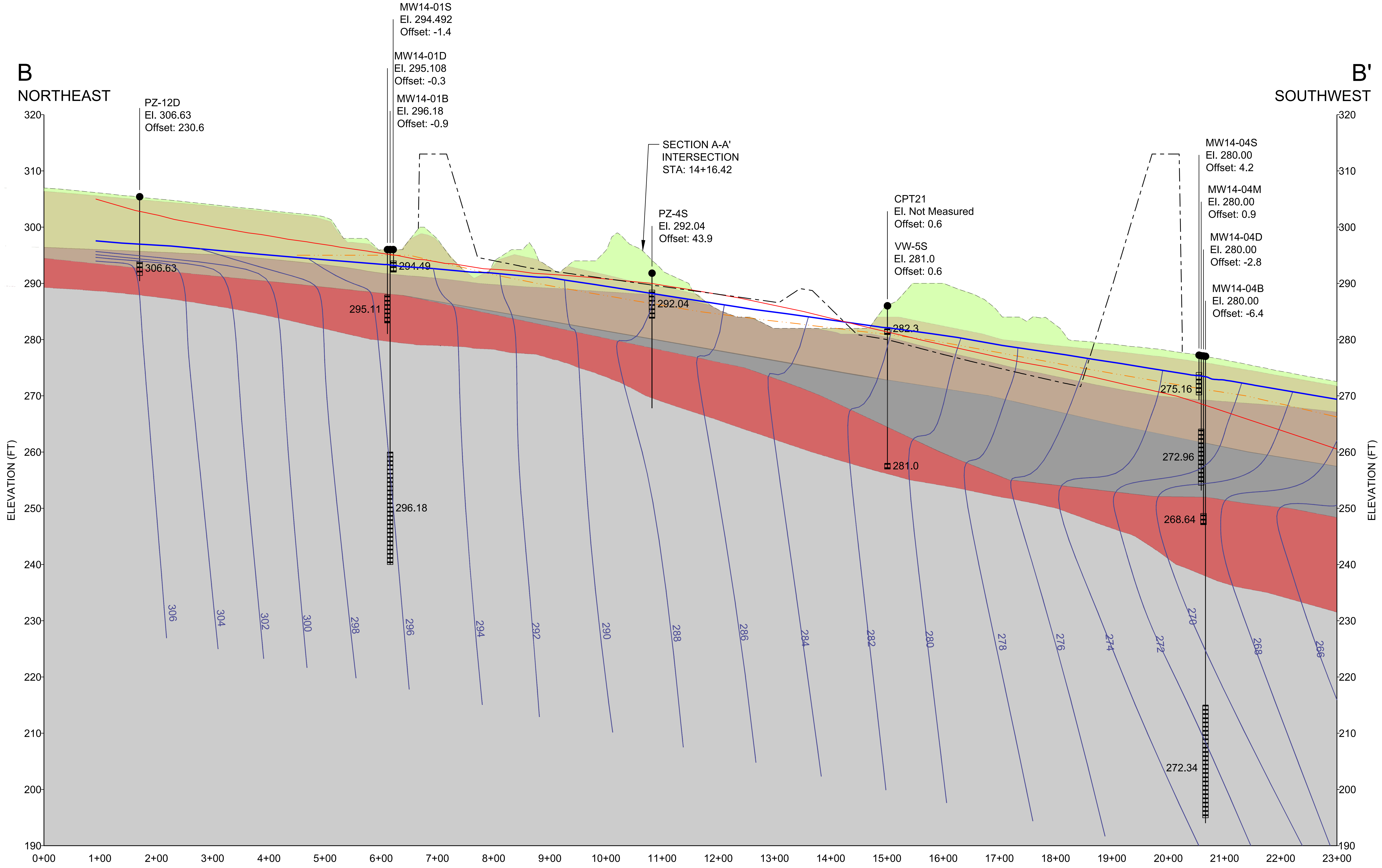
PROJECT NO.	CONTROL	REV.	FIGURE
19119078	-	-	14C

B:\Waste Management\Norridgewock Maine\99 PROJ\19119078 Crossroads\0002 SiteAssessmentRpt DataAnalysis\40 PROD\19119078-0002-HS-0021 FIG14C.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

1 in

0



LEGEND

MW14-01D EL. 296.00 Offset:-0.3	PIEZOMETER OR MONITORING WELL ID MAY 2, 2019 GROUNDWATER ELEVATION SAMPLE POINT OFFSET FROM SECTION (NEGATIVE = LEFT OFFSET - POSITIVE = RIGHT OFFSET
S	SCREENED IN SAND
M	SCREENED IN CLAY
D	SCREENED IN TILL
B	SCREENED IN BEDROCK
🟩	FILL AND UNDIFFERENTIATED MATERIAL
🟨	SILTY FINE SAND
🟫	STIFF UPPER CLAY FACIES OF PRESUMPSCOT FORMATION
⬛	SOFT LOWER FACIES OF PRESUMPSCOT FORMATION
🟥	GLACIAL TILL
⬜	BEDROCK
———	PHREATIC GROUNDWATER ELEVATION (msl)
———	TILL GROUNDWATER ELEVATION (msl)
-·-·-·-	BEDROCK GROUNDWATER ELEVATION (msl)
—·—·—·—	PROPOSED PHASE 14 BASE GRADE ELEVATION (PROVIDED BY GEOSYNTEC CONSULTANTS ON AUGUST 3, 2019)

0 12 24
1" = 12' FEET
VERTICAL

0 120 240
1" = 120' FEET
HORIZONTAL

CLIENT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE
CROSSROADS LANDFILL
NORRIDGEWOCK, ME

CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-27
DESIGNED	RWC
PREPARED	AAZ
REVIEWED	BDL
APPROVED	APTM

PROJECT
WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE
PHASE 14 SITE ASSESSMENT REPORT
NORRIDGEWOCK, MAINE

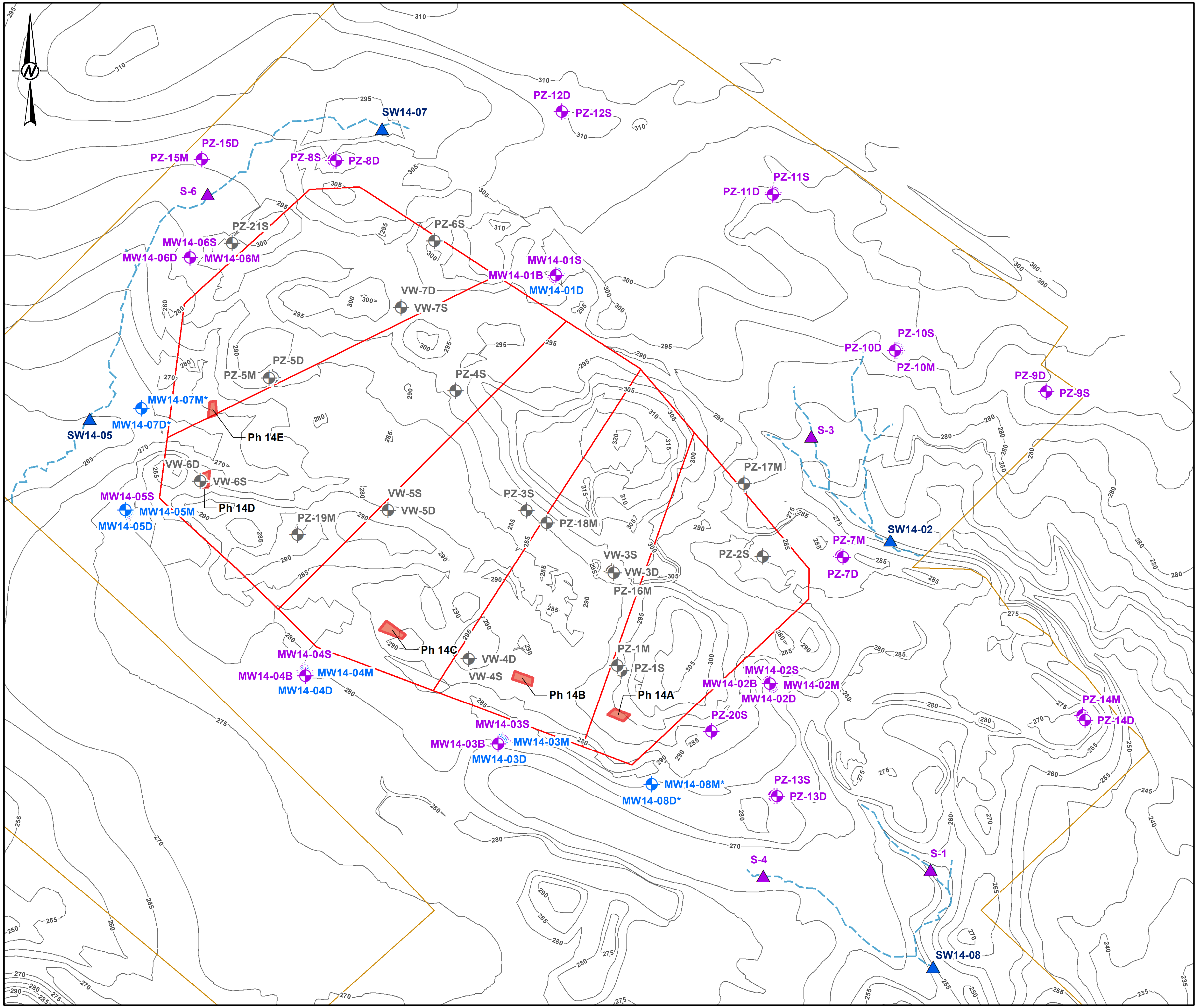
TITLE
CONCEPTUAL HYDROSTRATIGRAPHIC CROSS SECTION B-B'

PROJECT NO.	CONTROL	REV.	FIGURE
19119078	500	0	15

Path: \\manchester\sim\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\500_Phase14_GW_Contours\40_PROD\ | File Name: 19119078_500_010.dwg | Last Edited By: azumbado Date: 2019-09-27 Time:10:44:28 AM | Printed By: AZumbado Date: 2019-09-27 Time:10:54:10 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in



LEGEND

- ⊕ Proposed Groundwater Quality Monitoring Location
- ▲ Proposed Surface Water Quality Sampling Location
- ⊕ Piezometer Maintained for Water Level Monitoring
- ▲ Proposed Stream Gauge Maintained for Water Level Monitoring
- ⊕ Piezometer to be decommissioned
- 🟥 Approximate Leachate Collection Sump Location
- — Proposed 14 Waste Boundary
- — Facility Site Boundary
- — Ground Surface Topographic Contour
- - - Stream

0 300 600

1 " = 300 feet Feet

NOTE(S)

1. CONTINUOUS SOIL SAMPLES COLLECTED AT THE DEEPEST SOIL BORING OF EACH PIEZOMETER CLUSTER.
2. * INDICATES INSTALLATION IS REQUIRED

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE MAINE WEST FIPS 1802 FEET
2. PROPOSED PHASE 14 WASTE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 23, 2019.
3. FACILITY SITE BOUNDARY PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019 AND UPDATED WITH DATA PROVIDED BY BOYNTON & PICKETT LLC ON OCTOBER 18, 2019.
4. STREAMS LAYER FROM SHAPEFILE RECEIVED FROM NORMANDEAU ENVIRONMENTAL CONSULTANTS (NORMANDEAU) DATED MAY 3, 2019 AND GEOSYNTEC CONSULTANTS ON JULY 25, 2019.
5. PIEZOMETER LOCATIONS SURVEYED BY BOYNTON & PICKETT AND PROVIDED ON 25 SEPTEMBER 2017 ("SURVEY INFROMATION"), OCTOBER 2018 ("WM MW CROSSROADS PIEZOMETER LOCATION OCT.2018), 17 APRIL 2019 ("WM MW PHASE 14 PZ GB MW LOCTIONS 04.17.2019").
6. EXISTING GROUND SURFACE WITHIN PHASE 14 AREA FROM CAD FILE "WM MAINE WEST PHASE 14 TOPO NOV 2017 (DELIVERABLE (2))".DWG CREATED BY BOYNTON AND PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE SURROUNDING PHASE 14 AREA FROM CAD FILE "BE0232 TOPO 09-2016 (SP)".DWG CREATED BY AERIAL SURVEY & PHOTO INC. AND BOYNTON & PICKETT, AS PROVIDED BY GEOSYNTEC DATED 7 SEPTEMBER 2018. EXISTING GROUND SURFACE CONTOUR DATA WERE MERGED.
7. APPROXIMATE LEACHATE COLLECTION SUMP LOCATIONS PROVIDED BY GEOSYNTEC CONSULTANTS ON JULY 25, 2019.

CLIENT

WASTE MANAGEMENT DISPOSAL SERVICES OF MAINE,
CROSSROADS LANDFILL, NORRIDGEWOCK, ME

PROJECT

PHASE 14 SITE ASSESSMENT REPORT

TITLE

PROPOSED SITE MONITORING LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	10/21/2019
DESIGNED	JMB
PREPARED	SHL
REVIEWED	BDL
APPROVED	APTM

PROJECT NO.	CONTROL	REV.	FIGURE
19119078.500	-	-	16

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 1 in

PATH: B:\Waste_Management\Norridgewock_Maine\99_PROJ\19119078_Crossroads\0002_SiteAssessmentRpt_DataAnalysis\40_PROD\19119078-0002-HS-0020_FIG16.mxd PRINTED ON: 2019-10-21 AT: 3:34:01 PM

APPENDIX A

Boring Logs and Well Construction Diagrams

RECORD OF BOREHOLE MW14-01B

SHEET 1 of 2

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 56.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/28/19
DATE COMPLETED: 3/28/19

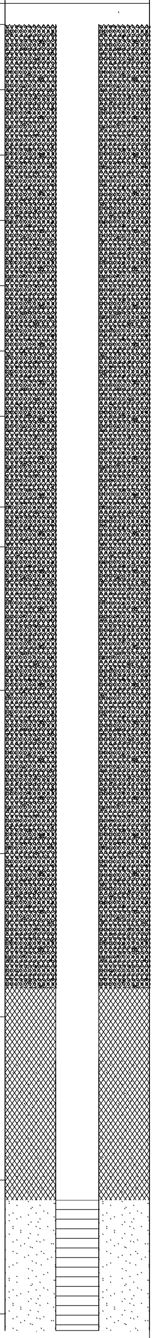
COORDS: N: 685,935.41 E: 3,039,598.26
GS ELEVATION: 294.3 ft
TOC ELEVATION: 297.3 ft
WEATHER: Partly cloudy
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE				SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0		0.0 - 3.0ft Fine SILTY SAND; gray-brown	SM	0.0	1	2-3-3-5	6	1.4 / 2.0	(SM) Fine SILTY SAND, little fines, well sorted; gray-brown; wet
		3.0 - 6.5ft Medium stiff CLAY; olive gray-brown	CL	2.0	2	3-3-2-1	5	0.9 / 2.0	2-3': (SM) Fine SILTY SAND, little fines, well sorted; gray-brown; wet 3-4': (CL) CLAY; olive gray-brown, medium stiff; moist
5.0	290			4.0	3	1-1-3-3	4	1.0 / 2.0	(CL) CLAY; olive gray-brown, soft/medium stiff; moist
		6.5 - 14.8ft Glacial Till - SILTY GRAVEL and SAND; gray	GM	6.0	4	3-16-42-13	58	1.4 / 2.0	6-6.5': (CL) CLAY; olive gray-brown, soft/medium stiff; moist 6.5-8': (SM) Fine SILTY SAND, little fines, well sorted; gray; wet
	285			8.0	5	24-20-28-16	48	0.6 / 2.0	(GM) Sandy SILTY GRAVEL, fine to coarse, little fines, well graded, subangular; wet
10.0				10.0	6	25-11-15-21	26	0.7 / 2.0	(GM) Sandy SILTY GRAVEL, little fines, fine to coarse, well graded, subangular; gray; wet; gravel up to 0.5" in diameter
	280			12.0		NA	NA	NA	
15.0		14.8 - 56.0ft Bedrock - Very fine SANDY METALIMESTONE; medium dark to dark gray .		14.8		NA	NA	NA	Angular rock fragments in wash water
20.0	275			16.0	7	NA	NA	NA	Begin HQ coring Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
25.0	270			20.4	8	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
30.0	265			25.4	9	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
35.0	260			30.4	10	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
	255			35.4	11	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
40.0				39.5	12	NA	NA	NA	

WELL INFORMATION

WELL GRAPHICS



Log continued on next page

WELL CASING
Interval (ft): 0-36
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 36-56
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 31.7-56
Type: #2 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft): 29.5-31.7
Type: Bentonite Chips
Quantity: 15 lbs

SURFACE SEAL
Interval (ft): 0-29.5
Type: Bentonite Grout Mix
Quantity: 360 lbs

▨ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)
▨ USCS Silty Gravel
▨ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE MW14-01B

SHEET 2 of 2

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 56.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/28/19
DATE COMPLETED: 3/28/19

COORDS: N: 685,935.41 E: 3,039,598.26
GS ELEVATION: 294.3 ft
TOC ELEVATION: 297.3 ft
WEATHER: Partly cloudy
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
40.0				▧		12	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
45.0	250			▧	44.2	13	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
50.0	245			▧	49.2	14	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
55.0	240			▧	54.2	15	NA	NA	NA	Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock; some iron hydroxide staining parallel to foliation	

Boring completed at 56.0 ft

WELL CASING
Interval (ft): 0-36
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 36-56
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 31.7-56
Type: #2 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft): 29.5-31.7
Type: Bentonite Chips
Quantity: 15 lbs

SURFACE SEAL
Interval (ft): 0-29.5
Type: Bentonite Grout Mix
Quantity: 360 lbs

⁙ USCS Silty Sand (SM)	▨ USCS Low Plasticity Clay (CL)	◌ USCS Silty Gravel	▧ Bedrock

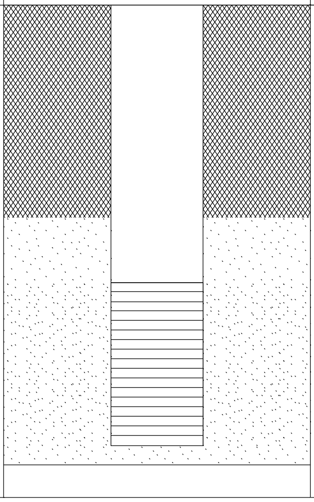
DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF WELL CONSTRUCTION MW14-01D

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 685,939.73 E: 3,039,600.35	INCLINATION: 90
PROJECT NUMBER: 19119078	DRILL RIG: Diedrich D-50 T	GS ELEVATION: 294.27 ft	DEPTH W.L.: NA
DRILLED DEPTH: 15.1 ft	HAMMER TYPE: Auto SPT	TOC ELEVATION: 297.65 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE STARTED: 3/27/19	WEATHER: Sunny	DATE W.L.: NA
LOCATION: Norridgewock, ME	DATE COMPLETED: 3/27/19	TEMPERATURE: 30's°C	TIME W.L.: NA

DEPTH ft	ELEVATION ft	SOIL PROFILE LITHOLOGY DESCRIPTION*	GRAPHIC LOG	USCS	N Value	WELL DETAILS WELL GRAPHICS	Well Construction Information
0.0		0.0 - 3.0ft Fine SILTY SAND; gray-brown		SM			
	290	3.0 - 6.5ft Medium stiff CLAY; olive gray-brown		CL			Filter pack Seal
5.0 10.0	285 280	6.5 - 14.8ft Glacial Till - SILTY GRAVEL and SAND; gray		GM			Filter Pack Screen
15.0							

Boring completed at 15.1 ft

*No soil samples collected at this location.
Lithology at this well cluster determined at MW14-01B.

20.0
25.0
30.0
35.0
40.0

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-8.5	Interval (ft): 8.5-13.5	Interval (ft): 6.5-14.1	Interval (ft):	Interval (ft): 0-6.5
Material: PVC	Material: PVC	Type: #2 Sand	Type:	Type: Bentonite Chips
Diameter (in): 2	Diameter (in): 2	Quantity: 125 lbs		Quantity: 50 lbs
Joint Type: Threaded	Slot Size: 0.01			

▥ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ▥ USCS Silty Gravel

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom

GA INSPECTOR: LWL
CHECKED BY: BDL
DATE: 7/15/19

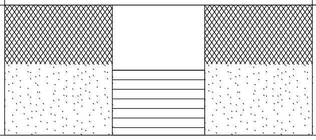
Golder Associates

RECORD OF WELL CONSTRUCTION MW14-01S

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 685,930.68 E: 3,039,595.62	INCLINATION: 90
PROJECT NUMBER: 19119078	DRILL RIG: Diedrich D-50 T	GS ELEVATION: 294.16 ft	DEPTH W.L.: NA
DRILLED DEPTH: 4.0 ft	HAMMER TYPE: Auto SPT	TOC ELEVATION: 298.36 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE STARTED: 3/28/19	WEATHER: Partly cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME	DATE COMPLETED: 3/28/19	TEMPERATURE: 40's°C	TIME W.L.: NA

DEPTH ft	ELEVATION ft	SOIL PROFILE				WELL DETAILS	
		LITHOLOGY DESCRIPTION*	GRAPHIC LOG	USCS	N Value	WELL GRAPHICS	Well Construction Information
0.0		0.0 - 3.0ft Fine SILTY SAND; gray-brown	⁚	SM			Surface Seal
		3.0 - 4.0ft Medium stiff CLAY; olive gray-brown	▨	CL			Filter Pack Screen
5.0							
10.0							
15.0							
20.0							
25.0							
30.0							
35.0							
40.0							



Boring completed at 4.0 ft

*No soil samples collected at this location.
Lithology at this well cluster determined at MW14-01B.

WELL CASING
Interval (ft): 0-2
Material: PVC
Diameter (in): 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 2-4
Material: PVC
Diameter (in): 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 1.8-4
Type: #2 Sand
Quantity: 50 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-1.8
Type: Bentonite Chips
Quantity: 15 lbs

⁚ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom

GA INSPECTOR: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-02B

SHEET 1 of 3

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 92.6 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/12/19
DATE COMPLETED: 3/18/19

COORDS: N: 684,684.47 E: 3,040,253.37
GS ELEVATION: 276.9 ft
TOC ELEVATION: 279.4 ft
WEATHER: Partly cloudy
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE

DEPTH ft	ELEVATION ft
0.0	
	275
5.0	
	270
10.0	
	265
15.0	
	260
20.0	
	255
25.0	
	250
30.0	
	245
35.0	
	240
40.0	

LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG
0.0 - 3.5ft Fine SILTY SAND; gray-brown	SM	░
3.5 - 5.5ft Medium stiff CLAY; olive gray-brown	CL	▨
5.5 - 11.0ft Medium stiff CLAY; olive gray	CL	▨
11.0 - 21.8ft Soft to very soft CLAY; olive gray	CL	▨
21.8 - 25.0ft Glacial till - Fine SILTY SAND; gray	SM	░
25.0 - 26.0ft Glacial till - SANDY SILTY GRAVEL; gray	GM	◌
26.0 - 31.0ft Glacial till - Fine SILTY SAND, trace gravel; gray	SM	░
31.0 - 92.6ft Bedrock - Very fine SANDY METALIMESTONE; medium dark to dark gray		▩

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	1-1-3	4	1.0 / 1.5	(SM) Fine SILTY SAND, little fines, well sorted; gray-brown; dry
1.5	2	3-5-3-3	8	1.3 / 2.0	(SM) Fine SILTY SAND, little fines, well sorted; gray-brown; moist/wet
3.5	3	2-2-4-4	6	1.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; dry
5.5	4	2-3-4	7	1.1 / 1.5	(CL) CLAY; olive gray; medium stiff; dry
7.0	5	5-7-8-9	15	1.1 / 2.0	(CL) CLAY; olive gray; medium stiff; dry
9.0	6	2-3-5-4	8	1.6 / 2.0	(CL) CLAY; olive gray; medium stiff; dry
11.0	7	1-2-2-2	4	1.7 / 2.0	(CL) CLAY; olive gray; soft; moist
13.0	8	WOH-WOH-2-1	NA	1.7 / 2.0	(CL) CLAY; olive gray; very soft; moist
15.0	9	WOH-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist
17.0	10	WOR-WOH-WOH-WOH	NA	1.5 / 2.0	(CL) CLAY; olive gray; very soft; moist
19.0	11	WOR-WOH-WOH-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist
21.0	12	WOH-3-21-10	NA	1.2 / 2.0	21-21.8': (CL) CLAY; olive gray; very soft; moist 21.8-23': (SM) Fine to medium SILTY SAND, little fines, well sorted; gray; moist; 1" gravel at 23 ft
23.0	13	15-15-12-15	27	0.6 / 2.0	23-24.8': (SM) Fine to coarse SILTY SAND, little fines, poorly sorted; gray; wet 24.8-25': (SM) Fine SILTY SAND, little fines, well sorted; gray; wet
25.0	14	25-25-9-8	34	1.0 / 2.0	25-26': (GM) Fine to coarse Sandy SILTY GRAVEL; subangular; poorly sorted; gray; wet; gravel up to 1" in diameter 26-27': (SM) Fine SILTY SAND, little medium to coarse sand; well sorted; gray; wet
27.0	15	17-13-12-13	25	1.9 / 2.0	(SM) Fine to medium SILTY SAND, little fines; well sorted; gray; moist
29.0	16	11-13-22-12	35	1.5 / 2.0	(SM) Fine to medium SILTY SAND, little fines, trace gravel; well sorted; gray; moist; gravel up to 1" in diameter
31.0		NA	NA	NA	Angular rock fragments in wash water. Advanced casing through fractured zone.

WELL INFORMATION

WELL GRAPHICS

Log continued on next page

WELL CASING
Interval (ft): 0-72.1
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 72.1-92.1
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 92.6-69
Type: #2 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft): 63.5-69
Type: Bentonite Chips
Quantity: 25 lbs

SURFACE SEAL
Interval (ft): 0-63.5
Type: Bentonite Grout Mix
Quantity: 360 lbs

░ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)
◌ USCS Silty Gravel
▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-02B

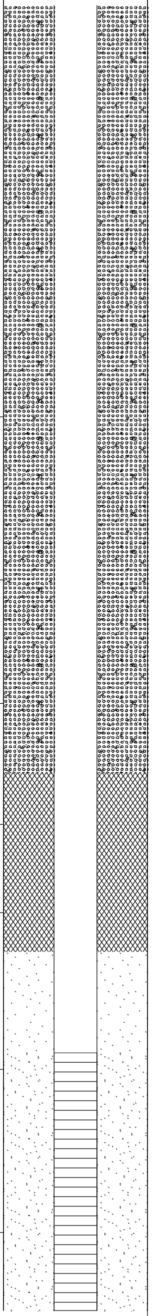
SHEET 2 of 3

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,684.47 E: 3,040,253.37	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 276.9 ft	DEPTH W.L.: NA
DRILLED DEPTH: 92.6 ft	DATE STARTED: 3/12/19	TOC ELEVATION: 279.4 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 3/18/19	WEATHER: Partly cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 30's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC/ATT	SAMPLE DESCRIPTION
40.0										
	235									
45.0										
	230									
50.0										
	225									
					52.6	17	NA	NA	NA	Begin HQ coring Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; slightly weathered (W2), medium strong (R3) rock
55.0										
	220									
					57.6	18	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
60.0										
					61.4	19	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
	215									
65.0										
					65.1	20	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
	210									
					67.8	21	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
70.0										
	205									
					72.6	22	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
75.0										
	200									
					77.6	23	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
80.0										

WELL INFORMATION

WELL GRAPHICS



Log continued on next page

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-72.1 Material: PVC Diameter: 2 Joint Type: Threaded	Interval (ft): 72.1-92.1 Material: PVC Diameter: 2 Slot Size: 0.01	Interval (ft): 92.6-69 Type: #2 Sand Quantity: 150 lbs	Interval (ft): 63.5-69 Type: Bentonite Chips Quantity: 25 lbs	Interval (ft): 0-63.5 Type: Bentonite Grout Mix Quantity: 360 lbs

⁙ USCS Silty Sand (SM)　▨ USCS Low Plasticity Clay (CL)　◌ USCS Silty Gravel　▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-02B

SHEET 3 of 3

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,684.47 E: 3,040,253.37	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 276.9 ft	DEPTH W.L.: NA
DRILLED DEPTH: 92.6 ft	DATE STARTED: 3/12/19	TOC ELEVATION: 279.4 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 3/18/19	WEATHER: Partly cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 30's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC/ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
80.0	195			▨		23	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
85.0	190			▨	82.6	24	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
				▨	87.6	25	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
90.0	185			▨	89.2	26	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	

Boring completed at 92.6 ft

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-72.1 Material: PVC Diameter: 2 Joint Type: Threaded	Interval (ft): 72.1-92.1 Material: PVC Diameter: 2 Slot Size: 0.01	Interval (ft): 92.6-69 Type: #2 Sand Quantity: 150 lbs	Interval (ft): 63.5-69 Type: Bentonite Chips Quantity: 25 lbs	Interval (ft): 0-63.5 Type: Bentonite Grout Mix Quantity: 360 lbs

⁙ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ⁙ USCS Silty Gravel ▨ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-02M

SHEET 1 of 1

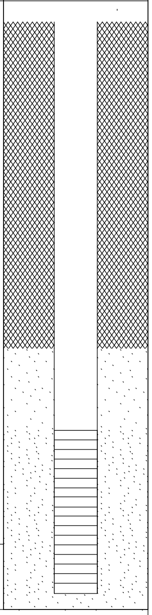
PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 18.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/12/19
DATE COMPLETED: 3/12/19

COORDS: N: 684,680.15 E: 3,040,256.95
GS ELEVATION: 276.8 ft
TOC ELEVATION: 279.8 ft
WEATHER: Partly cloudy
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0	275	0.0 - 3.5ft Fine SILTY SAND; gray-brown	SM								
5.0		3.5 - 5.5ft Medium stiff CLAY; olive gray-brown	CL								
10.0	270	5.5 - 11.0ft Medium stiff CLAY; olive gray	CL								
15.0	265 260	11.0 - 21.8ft Soft to very soft CLAY; olive gray	CL		16.0	1	WOH-1-1-1	2	1.7 / 2.0	(CL) CLAY; olive gray; very soft; moist	



Boring completed at 18.0 ft

*Where no soil samples collected at this location, lithology determined at MW14-02B.

WELL CASING
Interval (ft): 0-12.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 12.5-17.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 10-18
Type: #2 Sand
Quantity: 125 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-10
Type: Bentonite Chips
Quantity: 100 lbs

⋮ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF WELL CONSTRUCTION MW14-02D

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,688.40 E: 3,040,250.44	INCLINATION: 90
PROJECT NUMBER: 19119078	DRILL RIG: Diedrich D-50 T	GS ELEVATION: 276.45 ft	DEPTH W.L.: NA
DRILLED DEPTH: 31.4 ft	HAMMER TYPE: Auto SPT	TOC ELEVATION: 279.99 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE STARTED: 3/11/19	WEATHER: Partly cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME	DATE COMPLETED: 3/11/19	TEMPERATURE: 30's°C	TIME W.L.: NA

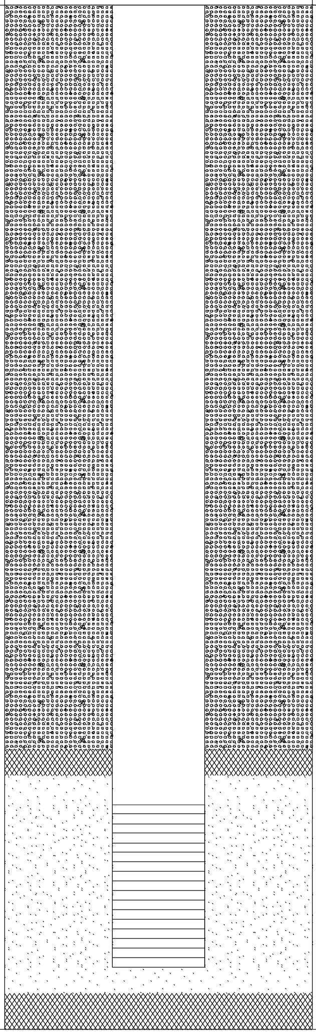
DEPTH ft: 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0

ELEVATION ft: 275, 270, 265, 260, 255, 250

SOIL PROFILE			
LITHOLOGY DESCRIPTION*	GRAPHIC LOG	USCS	N Value
0.0 - 3.5ft Fine SILTY SAND; gray-brown		SM	
3.5 - 5.5ft Medium stiff CLAY; olive gray-brown	▨	CL	
5.5 - 11.0ft Medium stiff CLAY; olive gray	▨	CL	
11.0 - 21.8ft Soft to very soft CLAY; olive gray	▨	CL	
21.8 - 25.0ft Glacial till - Fine SILTY SAND; gray		SM	
25.0 - 26.0ft Glacial till - SILTY GRAVEL and SAND, little fines; gray		GM	
26.0 - 31.0ft Glacial till - SILTY SAND, little fines, trace gravel; gray		SM	

WELL DETAILS

WELL GRAPHICS



Well Construction Information

- Annulus Seal
- Filter pack Seal
- Filter Pack Screen
- Filter Pack
- Backfill

Boring completed at 31.4 ft

*No soil samples collected at this location.
Lithology at this well cluster determined at MW14-02B.

WELL CASING
Interval (ft): 0-24.5
Material: PVC
Diameter (in): 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 24.5-29.5
Material: PVC
Diameter (in): 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 23.6-30.3
Type: #2 Sand
Quantity: 350 lbs

FILTER PACK SEAL
Interval (ft): 30.3 - 31.4
Type: Bentonite Chips
Quantity: 75 lbs

SURFACE SEAL
Interval (ft): 0.5-22.8
Type: Bentonite Grout Mix
Quantity: 135 lbs

▥	USCS Silty Sand (SM)
▨	USCS Low Plasticity Clay (CL)
▥	USCS Silty Gravel

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom

GA INSPECTOR: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF WELL CONSTRUCTION MW14-02S

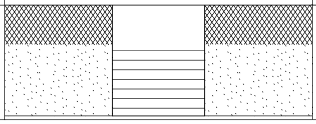
SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 3.5 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
DRILL RIG: Diedrich D-50 T
HAMMER TYPE: Auto SPT
DATE STARTED: 4/5/19
DATE COMPLETED: 4/5/19

COORDS: N: 684,675.81 E: 3,040,260.34
GS ELEVATION: 276.69 ft
TOC ELEVATION: 280.45 ft
WEATHER: Cloudy
TEMPERATURE: 30's°C

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

DEPTH ft	ELEVATION ft	SOIL PROFILE				WELL DETAILS	
		LITHOLOGY DESCRIPTION*	GRAPHIC LOG	USCS	N Value	WELL GRAPHICS	Well Construction Information
0.0	275	0.0 - 3.5ft Fine SILTY SAND; gray-brown		SM			Annulus Seal Filter Pack Screen

Boring completed at 3.5 ft

*No soil samples collected at this location.
Lithology at this well cluster determined at MW14-02B.

DEPTH ft: 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0

WELL CASING
Interval (ft): 0-1.4
Material: PVC
Diameter (in): 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 1.4-3.4
Material: PVC
Diameter (in): 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 1.4-3.4
Type: #2 Sand
Quantity: 50 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-1.2
Type: Bentonite Chips
Quantity: 25 lbs

▥ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom

GA INSPECTOR: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-03B

SHEET 1 of 2

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 70.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/19/19
DATE COMPLETED: 3/20/19

COORDS: N: 684,500.91 E: 3,039,420.82
GS ELEVATION: 277.0 ft
TOC ELEVATION: 279.6 ft
WEATHER: Partly cloudy
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE				SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0		0.0 - 3.5ft ORGANICS; root and wood material; brown		0.0	1	3-1 for 18"	NA	1.1 / 2.0	ORGANICS; root and wood material; brown
	275			2.0	2	WOH-WOH-WOH-5	NA	0.3 / 2.0	2-3.5': ORGANICS; root and wood material; brown 3.5-4': (SM) Fine SILTY SAND, little fines; gray-brown; wet
5.0		3.5 - 6.5ft Fine SILTY SAND; olive gray-brown	SM	4.0	3	5-7-7-7	14	1.1 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet
	270	6.5 - 10.0ft Medium stiff CLAY; olive gray-brown	CL	6.0	4	4-5-6-7	11	1.5 / 2.0	6-6.5': (SM) Fine SILTY SAND, little fines; gray-brown; wet 6.5-8': (CL) CLAY; olive gray-brown, medium stiff; moist
				8.0	5	5-6-8-9	14	1.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; dry
10.0		10.0 - 16.0ft Medium stiff CLAY; olive gray	CL	10.0	6	3-4-7-7	11	1.8 / 2.0	(CL) CLAY; olive gray; medium stiff; dry
	265			12.0	7	3-4-4-5	8	1.9 / 2.0	(CL) CLAY; olive gray; medium stiff; dry/moist
15.0				14.0	8	2-3-4-5	7	1.9 / 2.0	(CL) CLAY; olive; medium stiff; moist
	260	16.0 - 19.0ft Soft to very soft CLAY; olive gray	CL	16.0	9	2-2-2-2	4	1.7 / 2.0	(CL) CLAY; olive gray; soft; moist
		19.0 - 20.0ft Glacial till - Fine SILTY SAND, some medium to coarse sand; gray-brown	SM	18.0	10	WOH-WOH-11-14	NA	1.4 / 2.0	18-19': (CL) CLAY; olive gray; very soft; moist 19-20': (SM) Fine SILTY SAND, some medium to coarse sand, little fines; gray-brown; moist
20.0		20.0 - 25.0ft Glacial till - Fine to coarse SANDY SILTY GRAVEL; gray-black	GM	20.0	11	13-13-13-11	26	0.9 / 2.0	(GM/SM) Fine to coarse SILTY GRAVEL AND SAND, little fines; gray-black; wet; gravel up to 1" in diameter
	255			22.0	12	10-12-10-9	22	0.7 / 2.0	(GM/SM) Fine to coarse SILTY GRAVEL AND SAND, little fines; gray-black; wet; gravel up to 1" in diameter
				24.0	13	8-4-5-5	9	0.3 / 2.0	(SM) Fine to coarse SILTY SAND, little fine to coarse gravel, little fines; gray; wet; gravel up to 1.5" in diameter
25.0		25.0 - 28.0ft Glacial till - Fine to coarse SILTY SAND, little fine to coarse gravel; gray	SM	25.0	14	7-10-8-11	18	0.3 / 2.0	(SM) Fine to coarse SILTY SAND, little fine to coarse gravel; gray; wet; gravel up to 1" in diameter
	250								
		28.0 - 28.7ft Glacial till - Fine to coarse SANDY SILTY GRAVEL; gray-black	GM	28.0	15	30-60 for 2"	NA	0.2 / 0.7	(GM/SM) Fine to coarse SANDY SILTY GRAVEL; gray-black; wet; gravel up to 0.75" in diameter
		28.7 - 70.0ft Bedrock - Very fine SANDY METALIMESTONE; medium dark to dark gray		28.7		NA	NA	NA	Angular rock fragments in wash water
30.0	245			30.0	16	NA	NA	NA	Begin HQ Coring Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
35.0	240			35.0	17	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock
40.0									

WELL INFORMATION — WELL GRAPHICS

Log continued on next page

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-50 Material: PVC Diameter: 2 Joint Type: Threaded	Interval (ft): 50-70 Material: PVC Diameter: 2 Slot Size: 0.01	Interval (ft): 47-70 Type: #2 Sand Quantity: 150 lbs	Interval (ft): Type:	Interval (ft): 0-47 Type: Bentonite Grout Mix Quantity: 360 lbs

▤ Organics/Topsoil ⁞ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ▥ USCS Silty Gravel ▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-03B

SHEET 2 of 2

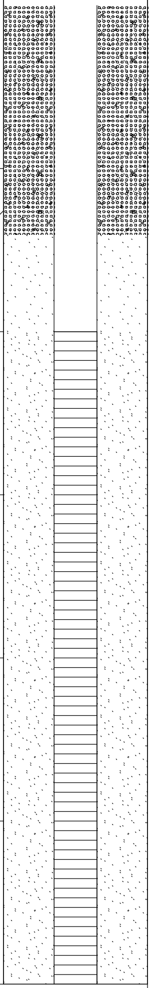
PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 70.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/19/19
DATE COMPLETED: 3/20/19

COORDS: N: 684,500.91 E: 3,039,420.82
GS ELEVATION: 277.0 ft
TOC ELEVATION: 279.6 ft
WEATHER: Partly cloudy
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
40.0	235			▧	40.0	18	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
45.0	230			▧	45.0	19	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
				▧	46.3	20	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
50.0	225			▧	50.0	21	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
55.0	220			▧	55.0	22	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
60.0	215			▧	60.0	23	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
65.0	210			▧	65.0	24	NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock; muscovite flakes up to 1/2" at bottom of run	
70.0		Boring completed at 70.0 ft									



WELL CASING
Interval (ft): 0-50
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 50-70
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 47-70
Type: #2 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-47
Type: Bentonite Grout Mix
Quantity: 360 lbs

▤	Organics/Topsoil
⁞	USCS Silty Sand (SM)
▨	USCS Low Plasticity Clay (CL)
○	USCS Silty Gravel
▧	Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-03D

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 29.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/20/19
DATE COMPLETED: 3/20/19

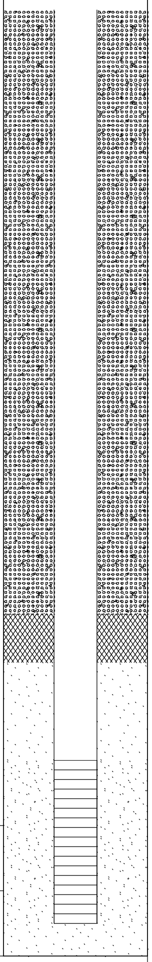
COORDS: N: 684,504.18 E: 3,039,425.40
GS ELEVATION: 276.9 ft
TOC ELEVATION: 280.3 ft
WEATHER: Sunny
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	275	0.0 - 3.5ft ORGANICS; root and wood material; brown								
5.0		3.5 - 6.5ft Fine SILTY SAND; olive gray-brown	SM							
	270	6.5 - 10.0ft Medium stiff CLAY; olive gray-brown	CL							
10.0 15.0	265	10.0 - 16.0ft Medium stiff CLAY; olive gray	CL							
	260	16.0 - 19.0ft Soft to very soft CLAY; olive gray	CL							
		19.0 - 20.0ft Glacial till - Fine SILTY SAND, some medium to coarse sand; gray-brown	SM							
20.0	255	20.0 - 25.0ft Glacial till - Fine to coarse SANDY SILTY GRAVEL; gray-black	GM							
25.0	250	25.0 - 28.0ft Glacial till - Fine to coarse SILTY SAND, little fine to coarse gravel; gray	SM		25.0	1	7-10-8-11	18	0.3 / 2.0	(SM) Fine to coarse SILTY SAND, little fine to coarse gravel; gray; wet; gravel up to 1" in diameter
		28.0 - 28.7ft Glacial till - Fine to coarse SANDY SILTY GRAVEL; gray-black	GM							

WELL INFORMATION

WELL GRAPHICS



Boring completed at 29.0 ft

*When no soil samples were collected, lithology at this well cluster determined at MW14-03B.

WELL CASING
Interval (ft): 0-23
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 23-28
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 20-29
Type: #2 Sand
Quantity: 100 lbs

FILTER PACK SEAL
Interval (ft): 18.5-20
Type: Bentonite Chips
Quantity: 10 lbs

SURFACE SEAL
Interval (ft): 0-18.5
Type: Bentonite Grout Mix
Quantity: 180 lbs

▤ Organics/Topsoil ▥ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ▦ USCS Silty Gravel

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

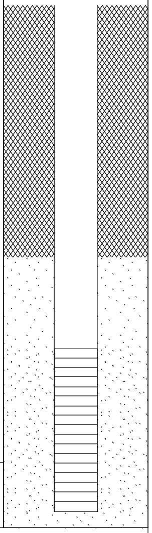
LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-03M

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,506.89 E: 3,039,430.04	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 277.4 ft	DEPTH W.L.: NA
DRILLED DEPTH: 16.0 ft	DATE STARTED: 3/20/19	TOC ELEVATION: 280.1 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 3/20/19	WEATHER: Sunny	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 40's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC/ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0	275	0.0 - 3.5ft ORGANICS; root and wood material; brown		▤							
5.0		3.5 - 6.5ft Fine SILTY SAND; olive gray-brown	SM	⁝							
	270	6.5 - 10.0ft Medium stiff CLAY; olive gray-brown	CL	▨							
10.0	265	10.0 - 16.0ft Medium stiff CLAY; olive gray	CL	▨							
15.0					14.0	1	2-2-3-4	5	1.5/2.0	(CL) CLAY; olive gray; medium stiff; moist	

Boring completed at 16.0 ft

*When no soil samples were collected,
lithology at this well cluster determined at MW14-03B.

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-10.5 Material: PVC Diameter: 2 Joint Type: Threaded	Interval (ft): 10.5-15.5 Material: PVC Diameter: 2 Slot Size: 0.01	Interval (ft): 7.7-16 Type: #2 Sand Quantity: 100 lbs	Interval (ft): Type:	Interval (ft): 0-7.7 Type: Bentonite Chips Quantity: 50 lbs

▤ Organics/Topsoil ⁝ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-03S

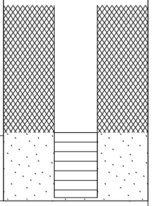
SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 6.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/21/19
DATE COMPLETED: 3/21/19

COORDS: N: 684,509.99 E: 3,039,435.02
GS ELEVATION: 277.5 ft
TOC ELEVATION: 280.5 ft
WEATHER: Cloudy
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0	275	0.0 - 3.5ft ORGANICS; root and wood material; brown		▤							
5.0		3.5 - 6.5ft Fine SILTY SAND; olive gray-brown	SM	⁘	4.0	1	8-7-7-8	14	1.1 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet	

Boring completed at 6.0 ft

*When no soil samples were collected,
lithology at this well cluster determined at MW14-03B.

WELL CASING
Interval (ft): 0-3.9
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 3.9-5.9
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 3.9-6
Type: #2 Sand
Quantity: 50 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-3.9
Type: Bentonite Chips
Quantity: 50 lbs

▤ Organics/Topsoil ⁘ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE MW14-04B

SHEET 1 of 3

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,708.26 E: 3,038,831.31	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 277.0 ft	DEPTH W.L.: NA
DRILLED DEPTH: 83.0 ft	DATE STARTED: 3/26/19	TOC ELEVATION: 279.9 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 3/27/19	WEATHER: Sunny	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 30's F	TIME W.L.: NA

SOIL PROFILE

DEPTH ft	ELEVATION ft
0.0	
	275
5.0	
	270
10.0	
	265
15.0	
	260
20.0	
	255
25.0	
	250
30.0	
	245
35.0	
	240
40.0	

LITHOLOGY DESCRIPTION	USCS
0.0 - 0.2ft ORGANICS	
0.2 - 8.0ft Fine SILTY SAND, little fines; gray-brown	SM
8.0 - 10.0ft Stiff CLAY; olive gray-brown	CL
10.0 - 16.0ft Medium stiff to stiff CLAY; olive gray	CL
16.0 - 28.0ft Very soft to soft CLAY; olive gray	CL
28.0 - 30.0ft Soft CLAYEY SAND; gray	SC
30.0 - 40.0ft Glacial till - Fine to coarse SANDY GRAVEL; gray	GM

Log continued on next page

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	8-4-2-1	6	1.7 / 2.0	0-0.2': ORGANICS 0.2-2': (SM) Soft SILTY CLAY; orange; dry
2.0	2	4-8-7-6	15	1.6 / 2.0	(SM) Fine SILTY SAND; little fines; gray-brown; moist
4.0	3	4-5-6-5	11	1.3 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet
6.0	4	5-5-4-5	9	1.2 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet
8.0	5	3-6-8-10	14	1.3 / 2.0	(CL) Stiff CLAY; olive gray-brown; dry
10.0	6	3-5-6-7	11	1.6 / 2.0	(CL) Stiff CLAY; olive gray; dry
12.0	7	4-4-5-6	9	1.7 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
14.0	8	2-3-3-4	6	1.6 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
16.0	9	1-2-2-2	4	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
18.0	10	WOR-WOH-2-2	NA	1.4 / 2.0	(CL) CLAY; olive gray; very soft to soft; moist
20.0	11	WOR-WOH-WOH-WOH	NA	1.8 / 2.0	(CL) CLAY; olive gray; very soft; moist
22.0	12	WOR-WOR-WOH-WOH	NA	1.7 / 2.0	(CL) CLAY; olive gray; very soft; moist
24.0	13	WOR-WOH-1-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist
26.0	14	WOR-WOR-WOR-WOR	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist
28.0	15	3-4-6-50 for 2"	10	– / 2.0	(SC) CLAYEY SAND; gray; soft; gravel at bottom of sample
35.0	16	39-66-13-11	79	0.9 / 2.0	(GM) Fine to coarse SANDY GRAVEL; well graded; gray; moist

WELL INFORMATION

WELL GRAPHICS

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-62.5	Interval (ft): 62.5-82.5	Interval (ft): 59.0-83	Interval (ft): 52-59	Interval (ft): 0-52
Material: PVC	Material: PVC	Type: #2 Sand	Type: Bentonite Chips	Type: Bentonite Grout Mix
Diameter: 2	Diameter: 2	Quantity: 150 lbs	Quantity: 25 lbs	Quantity: 540 lbs
Joint Type: Threaded	Slot Size: 0.01			

▤ Organics/Topsoil ▥ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ▨ USCS Clayey Sand (SC) ▥ USCS Silty Gravel

▧ Bedrock

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-04B

SHEET 2 of 3

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,708.26 E: 3,038,831.31	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 277.0 ft	DEPTH W.L.: NA
DRILLED DEPTH: 83.0 ft	DATE STARTED: 3/26/19	TOC ELEVATION: 279.9 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 3/27/19	WEATHER: Sunny	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 30's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
40.0		40.0 - 42.2ft Glacial till - Fine to coarse SILTY SAND, little fines and gravel; gray	SM		40.0	17	15-8-22-30	30	1.3 / 2.0	(SM) Fine to coarse SILTY SAND, little fines and gravel; gray; wet	
	235	42.2 - 83.0ft Bedrock - Very fine SANDY METALIMESTONE; medium dark to dark gray			42.2		NA	NA	NA	Angular rock fragments in wash water	
45.0					43.0		NA	NA	NA	Begin HQ Coring Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
50.0	230				47.1		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
55.0	225				52.1		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock; iron hydroxide staining	
	220				57.1		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
60.0					59.0		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
65.0	215				62.1		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
70.0	210				67.1		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
75.0	205				72.1		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	
80.0	200				77.1		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	

Log continued on next page

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-62.5 Material: PVC Diameter: 2 Joint Type: Threaded	Interval (ft): 62.5-82.5 Material: PVC Diameter: 2 Slot Size: 0.01	Interval (ft): 59.0-83 Type: #2 Sand Quantity: 150 lbs	Interval (ft): 52-59 Type: Bentonite Chips Quantity: 25 lbs	Interval (ft): 0-52 Type: Bentonite Grout Mix Quantity: 540 lbs

- ▤ Organics/Topsoil
- ⋮ USCS Silty Sand (SM)
- ▨ USCS Low Plasticity Clay (CL)
- ▨ USCS Clayey Sand (SC)
- ▥ USCS Silty Gravel
- ▩ Bedrock

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-04B

SHEET 3 of 3

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 83.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/26/19
DATE COMPLETED: 3/27/19

COORDS: N: 684,708.26 E: 3,038,831.31
GS ELEVATION: 277.0 ft
TOC ELEVATION: 279.9 ft
WEATHER: Sunny
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
80.0	195			▨	80.3		NA	NA	NA	Bedrock - Very fine SANDY METALIMESTONE; moderately foliated with calcareous veins up to 1/4" thick parallel to foliation; medium dark to dark gray; fresh (W1), medium strong (R3) rock	▤

Boring completed at 83.0 ft

WELL CASING
Interval (ft): 0-62.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 62.5-82.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 59.0-83
Type: #2 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft): 52-59
Type: Bentonite Chips
Quantity: 25 lbs

SURFACE SEAL
Interval (ft): 0-52
Type: Bentonite Grout Mix
Quantity: 540 lbs

▤ Organics/Topsoil
▥ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)
▨ USCS Clayey Sand (SC)
▥ USCS Silty Gravel
▨ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF WELL CONSTRUCTION MW14-04D

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,713.22 E: 3,038,830.66	INCLINATION: 90
PROJECT NUMBER: 19119078	DRILL RIG: Diedrich D-50 T	GS ELEVATION: 277.23 ft	DEPTH W.L.: NA
DRILLED DEPTH: 30.1 ft	HAMMER TYPE: Auto SPT	TOC ELEVATION: 280.21 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE STARTED: 3/22/19	WEATHER: Light snow	DATE W.L.: NA
LOCATION: Norridgewock, ME	DATE COMPLETED: 3/22/19	TEMPERATURE: 30's°C	TIME W.L.: NA

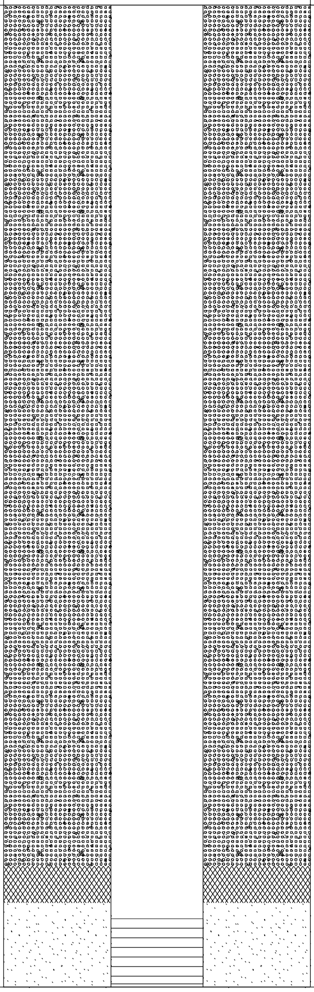
SOIL PROFILE

DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	GRAPHIC LOG	USCS	N Value
0.0		0.0 - 0.2ft ORGANICS			
	275	0.2 - 8.0ft Fine SILTY SAND, little fines; gray-brown		SM	
5.0	270				
		8.0 - 10.0ft Stiff CLAY; olive gray-brown		CL	
10.0	265	10.0 - 16.0ft Medium stiff to stiff CLAY; olive gray		CL	
15.0	260	16.0 - 28.0ft Very soft to soft CLAY; olive gray		CL	
20.0	255				
25.0	250				
		28.0 - 30.0ft Soft CLAYEY SAND; gray		SC	
30.0		30.0 - 30.1ft Glacial till - Fine to coarse SANDY GRAVEL; gray			
35.0					
40.0					

Boring completed at 30.1 ft

*No soil samples collected.
Lithology at this well cluster determined at MW14-04B.

WELL DETAILS



Well Construction Information

- Annulus Seal
- Filter pack Seal
- Filter Pack
- Screen

WELL CASING
Interval (ft): 0-28
Material: PVC
Diameter (in): 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 28-30
Material: PVC
Diameter (in): 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 27.5-30
Type: #2 Sand
Quantity: 100 lbs

FILTER PACK SEAL
Interval (ft): 26.4-27.5
Type:

SURFACE SEAL
Interval (ft): 0-26.4
Type: Bentonite Grout Mix
Quantity: 180 lbs

- ▤ Organics/Topsoil
- ⁞ USCS Silty Sand (SM)
- ▨ USCS Low Plasticity Clay (CL)
- ▨ USCS Clayey Sand (SC)
- ▯ USCS Silty Gravel

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom

GA INSPECTOR: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-04M

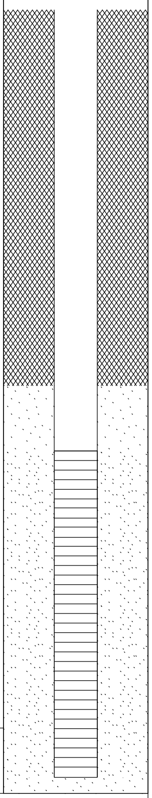
SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 684,718.75 E: 3,038,829.98	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 277.2 ft	DEPTH W.L.: NA
DRILLED DEPTH: 24.0 ft	DATE STARTED: 3/22/19	TOC ELEVATION: 280.3 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 3/22/19	WEATHER: Light snow	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 30's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC/ATT	SAMPLE DESCRIPTION
0.0		0.0 - 0.2ft ORGANICS		▤						
5.0	275 270	0.2 - 8.0ft Fine SILTY SAND, little fines; gray-brown	SM	⁝						
		8.0 - 10.0ft Stiff CLAY; olive gray-brown	CL	▨						
10.0 15.0	265	10.0 - 16.0ft Medium stiff to stiff CLAY; olive gray	CL	▨						
20.0	260	16.0 - 24.0ft Very soft to soft CLAY; olive gray	CL	▨						
	255			▨	22.0	1	WOR- WOH- WOH-1	NA	2.0/2.0	(CL) CLAY; olive gray; very soft; moist

WELL INFORMATION

WELL GRAPHICS



Boring completed at 24.0 ft

*When no soil samples collected, lithology at this well cluster determined at MW14-04B.

WELL CASING
Interval (ft): 0-13.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 13.5-23.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 11.5-24
Type: #2 Sand
Quantity: 100 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-11.5
Type: Bentonite Chips
Quantity: 50 lbs

▤	Organics/Topsoil
⁝	USCS Silty Sand (SM)
▨	USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-04S

SHEET 1 of 1

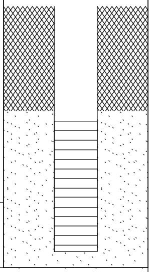
PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 8.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/22/19
DATE COMPLETED: 3/22/19

COORDS: N: 684,723.97 E: 3,038,829.49
GS ELEVATION: 276.5 ft
TOC ELEVATION: 279.7 ft
WEATHER: Light snow
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.2ft ORGANICS									
	275	0.2 - 7.7ft Fine SILTY SAND, little fines; gray-brown	SM								
5.0											
	270				6.0	1	3-2-2-3	4	1.0 / 2.0	6-7.7': (SM) Fine SILTY SAND, little fines; gray-brown; wet 7.7-8': (CL) CLAY; brown; medium stiff; dry	
		7.7 - 8.0ft Medium stiff CLAY; brown	CL								



Boring completed at 8.0 ft

*When no soil samples collected, lithology at this well cluster determined at MW14-04B.

WELL CASING
Interval (ft): 0-3.7
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 3.7-7.7
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 3.2-7.8
Type: #2 Sand
Quantity: 50 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-3.2
Type: Bentonite Chips
Quantity: 25 lbs

▤ Organics/Topsoil
▥ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE MW14-05D

SHEET 1 of 2

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 48.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 4/1/19
DATE COMPLETED: 4/1/19

COORDS: N: 685,216.49 E: 3,038,280.59
GS ELEVATION: 276.0 ft
TOC ELEVATION: 278.9 ft
WEATHER: Partly cloudy
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE

DEPTH ft: 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0

ELEVATION ft: 275, 270, 265, 260, 255, 250, 245, 240

LITHOLOGY DESCRIPTION	USCS
0.0 - 0.1ft ORGANICS	CL
0.1 - 1.0ft Soft SILTY CLAY; orange	
1.0 - 7.4ft Fine SILTY SAND; gray-brown	SM
7.4 - 14.0ft Medium stiff CLAY; olive gray	CL
14.0 - 24.4ft Very soft to soft CLAY; olive gray	CL
24.4 - 26.0ft Medium stiff SANDY CLAY; gray	CL
26.0 - 36.0ft Glacial till - Fine to coarse SILTY SAND, little coarse gravel; gray-black	SM
36.0 - 46.6ft Glacial till - Fine SILTY SAND, little coarse gravel; gray	GM

Log continued on next page

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	1 for 12"-2-2	NA	1.2 / 2.0	0-0.1': ORGANICS 0.1-1: Soft SILTY CLAY; orange; dry 1-2': Fine SILTY SAND, little fines; gray-brown; moist
2.0	2	5-9-8-7	17	1.2 / 2.0	(SP) Fine SILTY SAND, little fines; gray-brown; wet
4.0	3	5-7-8-7	15	1.3 / 2.0	(SP) Fine SILTY SAND, little fines; gray-brown; wet
6.0	4	4-5-6-7	11	2.0 / 2.0	6-7.4': (SP) Fine SILTY SAND, little fines; gray-brown; moist 7.4-8: (CL) CLAY; gray-brown; medium stiff; dry
8.0	5	4-5-5-7	10	1.8 / 2.0	(CL) CLAY; olive gray; medium stiff; dry
10.0	6	3-5-5-5	10	1.5 / 2.0	(CL) CLAY; olive gray; medium stiff; damp
12.0	7	1-3-3-4	6	1.7 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
14.0	8	1-2-2-2	4	1.8 / 2.0	(CL) CLAY; olive gray; soft; moist
16.0	9	WOH-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
18.0	10	WOH-WOH-WOH-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist
20.0	11	WOR-WOH-WOH-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist
22.0	12	WOR-WOR-WOR-WOR	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist
24.0	13	WOR-3-12-14	NA	1.3 / 2.0	24-24.4': (CL) CLAY; olive gray; very soft; moist 24.4-26': (SC) SANDY CLAY; gray; medium stiff; dry
26.0	14	7-9-4-8	13	0.7 / 2.0	(SM) Fine to medium SILTY SAND, little coarse sand and fine to coarse gravel; gray; wet
28.0	15	18-14-14-12	28	0.5 / 2.0	(SM) Fine to coarse SILTY SAND, little coarse gravel; gray-black; wet
30.0	16	24-10-9-12	19	0.3 / 2.0	(GM) Fine to coarse SANDY GRAVEL, little fines; gray-black; wet; gravel up to 1" in diameter
35.0	17	74-57-18-18	75	0.6 / 2.0	(GM) 35-36': Fine to coarse SANDY GRAVEL; gray-black; wet, gravel up to 1" in diameter (SM) 36-37': Fine to medium SILTY SAND; gray-black; wet

WELL INFORMATION

WELL CASING
Interval (ft): 0-40.8
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 40.8-45.8
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 36.5-38.5
Type: #2 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft): 36.5-38.5
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-36.5
Type: Bentonite Grout Mix
Quantity: 270 lbs

▨ USCS Low Plasticity Clay (CL)
▨ USCS Silty Sand (SM)
▨ USCS Silty Gravel
▨ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE MW14-05D

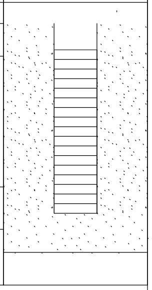
SHEET 2 of 2

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 48.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 4/1/19
DATE COMPLETED: 4/1/19

COORDS: N: 685,216.49 E: 3,038,280.59
GS ELEVATION: 276.0 ft
TOC ELEVATION: 278.9 ft
WEATHER: Partly cloudy
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
40.0	235		GM		40.0	18	49-129	NA	0.7 / 1.0	(SM) Fine SILTY SAND, little coarse gravel; gray; wet	
45.0	230				45.0	19	36-49-136 for 4"	NA	1.0 / 1.3	(SM) Fine SILTY SAND; gray; wet	
		46.6 - 48.0ft BEDROCK (?)									

Boring completed at 48.0 ft

WELL CASING
Interval (ft): 0-40.8
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 40.8-45.8
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 36.5-38.5
Type: #2 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft): 36.5-38.5
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-36.5
Type: Bentonite Grout Mix
Quantity: 270 lbs

▨ USCS Low Plasticity Clay (CL)
▨ USCS Silty Sand (SM)
▨ USCS Silty Gravel
▨ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

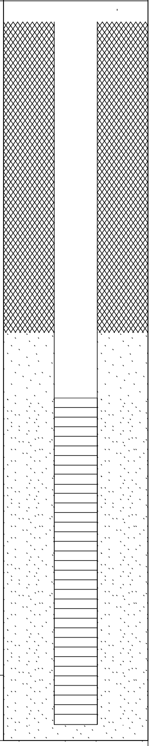
Golder Associates

RECORD OF BOREHOLE MW14-05M

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 685,211.79 E: 3,038,283.21	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 276.3 ft	DEPTH W.L.: NA
DRILLED DEPTH: 22.0 ft	DATE STARTED: 4/2/19	TOC ELEVATION: 279.3 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 4/2/19	WEATHER: Partly cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 40's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS									
	275	0.1 - 1.0ft Soft SILTY CLAY; orange	CL	▨							
5.0	270	1.0 - 7.4ft Fine SILTY SAND; gray-brown	SM	⸬							
10.0	265	7.4 - 14.0ft Medium stiff CLAY; olive gray	CL	▨							
15.0 20.0	260 255	14.0 - 22.0ft Very soft to soft CLAY; olive gray	CL	▨	20.0	1	WOR-WOH-WOH-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; very soft; moist	



Boring completed at 22.0 ft

*When no soil samples collected, lithology at this well cluster determined at MW14-05D.

WELL CASING
Interval (ft): 0-11.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 11.5-21.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 22.1-9.5
Type: #2 Sand
Quantity: 125 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-9.5
Type: Bentonite Chips
Quantity: 50 lbs

▨ USCS Low Plasticity Clay (CL)

⸬ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-05S

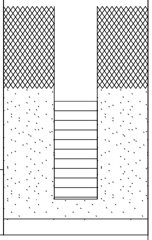
SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 7.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 4/2/19
DATE COMPLETED: 4/2/19

COORDS: N: 685,207.27 E: 3,038,285.80
GS ELEVATION: 276.6 ft
TOC ELEVATION: 279.6 ft
WEATHER: Partly cloudy
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS	CL	▨							
	275	0.1 - 1.0ft Soft SILTY CLAY; orange									
		1.0 - 6.0ft Fine SILTY SAND, little fines; gray-brown	SM	▥							
5.0					5.0	1	6-6-2-3	8	1.1 / 2.0	5-6': (SM) Fine SILTY SAND, little fines; gray-brown; wet 6-7': (CL) CLAY; olive gray-brown; medium stiff; dry	
	270	6.0 - 7.0ft Medium stiff CLAY; olive gray-brown	CL	▨							

Boring completed at 7.0 ft

*When no soil samples collected, lithology at this well cluster determined at MW14-05D.

WELL CASING
Interval (ft): 0-4.9
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 2.9-5.9
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 2.5-6.5
Type: #2 Sand
Quantity: 25 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-2.5
Type: Bentonite Chips
Quantity: 15 lbs

☰	Organics/Topsoil
▨	USCS Low Plasticity Clay (CL)
▥	USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE MW14-06D

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 22.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/29/19
DATE COMPLETED: 3/29/19

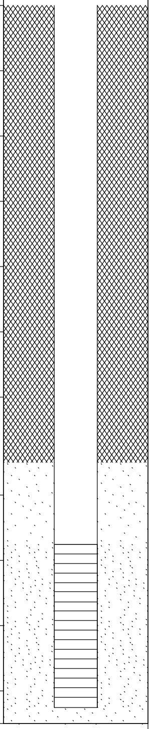
COORDS: N: 685,989.82 E: 3,038,477.75
GS ELEVATION: 285.5 ft
TOC ELEVATION: 288.3 ft
WEATHER: Light rain
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE				SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	285	0.0 - 0.1ft ORGANICS 0.1 - 0.2ft Soft SILTY CLAY; orange 0.2 - 2.7ft Fine SILTY SAND; gray-brown	CL SM	0.0	1	2-3-4-4	7	1.2 / 2.0	0-0.1: ORGANICS 0.1-0.2: (CL) SILTY CLAY; orange; soft; dry 0.2-2: (SP) Fine SILTY SAND, little fines; gray-brown; moist
		2.7 - 6.0ft Stiff CLAY; brown	CL	2.0	2	4-5-5-5	10	1.3 / 2.0	2-2.7': (SM) Fine SILTY SAND, little fines; gray-brown; moist 2.7-4': (CL) CLAY; stiff; brown; dry
5.0	280			4.0	3	4-6-9-15	15	1.5 / 2.0	(CL) CLAY; olive gray-brown; stiff; dry
		6.0 - 8.0ft Stiff CLAY; olive gray-brown	CL	6.0	4	15-13-13-14	26	1.0 / 2.0	(CL) CLAY; olive gray-brown; stiff; dry
		8.0 - 15.0ft Glacial till - Fine to coarse SILTY GRAVEL, some fine coarse sand, little fines; gray-black	GM	8.0	5	20-38-62-31	100	0.5 / 2.0	(GM) Coarse SILTY GRAVEL, some coarse sand, little fines; gray; gravel up to 1" in diameter
10.0	275			10.0	6	24-19-16-19	35	0.6 / 2.0	(GM) Fine to coarse SILTY GRAVEL, some fine coarse sand, little fines; gray-black; wet
15.0	270	15.0 - 21.2ft Glacial till - Fine to coarse SILTY SAND, little fines and coarse gravel; gray-black	SM	15.0	7	10-10-16-23	26	0.4 / 2.0	(SM) Fine to coarse SILTY SAND, little fines; gray-black; wet
20.0	265			19.0	8	10-11-33-14	44	0.6 / 2.0	(SM) Fine to coarse SILTY SAND, little fines and coarse gravel; gray-black; moist
		21.2 - 22.0ft BEDROCK (?)							

WELL INFORMATION

WELL GRAPHICS



Boring completed at 22.0 ft

WELL CASING
Interval (ft): 0-16.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 16.5-21.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 22.4-14
Type: #2 Sand
Quantity: 100 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-14
Type: Bentonite Chips
Quantity: 50 lbs

▨ USCS Low Plasticity Clay (CL)
⁝ USCS Silty Sand (SM)
▯ USCS Silty Gravel
▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

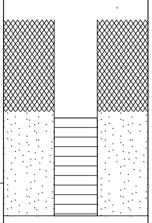
LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE MW14-06M

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 685,987.33 E: 3,038,482.25	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 285.6 ft	DEPTH W.L.: NA
DRILLED DEPTH: 7.0 ft	DATE STARTED: 3/29/19	TOC ELEVATION: 288.8 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 3/29/19	WEATHER: Light rain	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 40's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS									
	285	0.1 - 0.2ft Soft SILTY CLAY; orange	CL								
		0.2 - 2.7ft Fine SILTY SAND; gray-brown	SM	⋮							
		2.7 - 7.0ft Stiff CLAY; brown	CL	▨							
5.0	280			▨	5.0	1	5-7-7-17	14	1.5 / 2.0	(CL) CLAY; brown; stiff; dry	



Boring completed at 7.0 ft

*When no soil samples collected, lithology at this well cluster determined at MW14-06D.

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-3	Interval (ft): 3-6	Interval (ft): 2.8-6	Interval (ft):	Interval (ft): 0-2.8
Material: PVC	Material: PVC	Type: #2 Sand	Type:	Type: Bentonite Chips
Diameter: 2	Diameter: 2	Quantity: 75 lbs		Quantity: 25 lbs
Joint Type: Threaded	Slot Size: 0.01			

▨ USCS Low Plasticity Clay (CL)

⋮ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 7/15/19

Golder Associates

RECORD OF WELL CONSTRUCTION MW14-06S

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 685,986.04 E: 3,038,477.65	INCLINATION: 90
PROJECT NUMBER: 19119078	DRILL RIG: Diedrich D-50 T	GS ELEVATION: 285.22 ft	DEPTH W.L.: NA
DRILLED DEPTH: 2.5 ft	HAMMER TYPE: Auto SPT	TOC ELEVATION: 288.33 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE STARTED: 3/29/19	WEATHER: Light rain	DATE W.L.: NA
LOCATION: Norridgewock, ME	DATE COMPLETED: 3/29/19	TEMPERATURE: 40's°C	TIME W.L.: NA

DEPTH ft	ELEVATION ft	SOIL PROFILE LITHOLOGY DESCRIPTION*	GRAPHIC LOG	USCS	N Value	WELL DETAILS WELL GRAPHICS	Well Construction Information
0.0	285	0.0 - 0.1ft ORGANICS	▨	CL			Filter pack Seal
		0.1 - 0.2ft Soft SILTY CLAY; orange	⁙	SM			Filter Pack Screen
		0.2 - 2.5ft Fine SILTY SAND; gray-brown					

Boring completed at 2.5 ft

*No soil samples collected. Lithology at this well cluster determined at MW14-05D.

5.0

10.0

15.0

20.0

25.0

30.0

35.0

40.0

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-0.5 Material: PVC Diameter (in): 2 Joint Type: Threaded	Interval (ft): 0.5-2.5 Material: PVC Diameter (in): 2 Slot Size: 0.01	Interval (ft): 2.5-0.4 Type: #2 Sand Quantity: 50 lbs	Interval (ft): Type:	Interval (ft): 0-0.4 Type: Bentonite Chips Quantity: 25 lbs

▨ USCS Low Plasticity Clay (CL)

⁙ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom

GA INSPECTOR: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE PZ-1S/SB-1

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: SSA and 4-inch D&W	COORDS: N: 684,724.10 E: 3,039,798.68	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE:	GS ELEVATION: 295.0 ft	DEPTH W.L.: NA
DRILLED DEPTH: 32.0 ft	DATE STARTED: 9/13/17	TOC ELEVATION:	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/14/17	WEATHER:	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE:	TIME W.L.: NA

SOIL PROFILE

DEPTH ft	ELEVATION ft
0.0	295
5.0	290
10.0	285
15.0	280
20.0	275
25.0	270
30.0	265

LITHOLOGY DESCRIPTION	USCS
0.0 - 0.5ft ORGANICS	
0.5 - 2.0ft Stiff SILTY CLAY; gray-brown	CL
2.0 - 8.0ft Fill - Fine to coarse SAND, some angular gravel; gray-brown	SP
8.0 - 18.8ft Fine SILTY SAND, some fines; gray-brown	SM
18.8 - 30.0ft Medium stiff to stiff CLAY; olive gray-brown	CL
30.0 - 31.5ft Soft CLAY; olive gray	CL
31.5 - 32.0ft Glacial till - Medium stiff gravelly CLAY; some medium to coarse sand; gray	SC

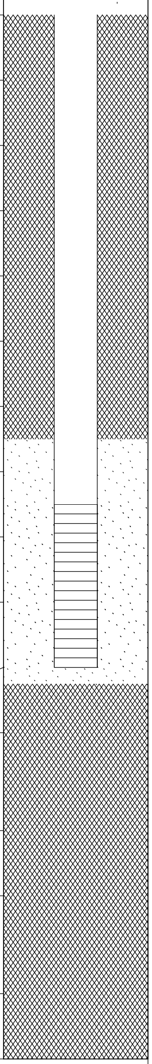
Boring completed at 32.0 ft

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	1-4-5-8	9	1.0 / 2.0	0-0.5': ORGANICS, gray-brown; dry 0.5-2': (CL) Stiff SILTY CLAY; olive gray-brown; dry
2.0	2	3-8-8-7	16	1.3 / 2.0	2-4': (SP) Fine to coarse SAND, some angular gravel; gray-brown; dry; medium dense
4.0	3	6-7-6-6	13	1.3 / 2.0	4-6': (SP) Fine to coarse SAND, some angular gravel; gray-brown; moist; medium dense
6.0	4	5-4-4-4	8	0.8 / 2.0	6-8': 4-6': (SP) Fine to coarse SAND, some angular gravel; gray-brown; moist; loose
8.0	5	5-5-4-5	9	0.8 / 2.0	8-10': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; moist; medium dense
10.0	6	3-6-6-8	12	0.7 / 2.0	10-12': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; moist; medium dense
12.0	7	5-5-5-6	10	0.8 / 2.0	12-14': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; moist; medium dense
14.0	8	4-6-6-7	12	0.8 / 2.0	14-16': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; moist; medium dense
16.0	9	3-4-6-9	10	1.2 / 2.0	16-18': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; wet; medium dense
18.0	10	3-5-4-8	9	1.3 / 2.0	18-18.75': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; wet; loose 18.75-20': (CL) CLAY; olive gray-brown; stiff; moist; minor red mottling
20.0	11	3-7-8-9	15	2.0 / 2.0	20-22': (CL) CLAY; olive gray-brown; stiff; moist; minor red mottling
25.0	12	3-2-3-3	5	2.0 / 2.0	25-27': (CL) CLAY; olive gray-brown; medium stiff; moist
30.0	13	WOH-WOH-2-7	2	2.0 / 2.0	30-31.5': (CL) CLAY; olive gray; very soft; moist 31.5-32': (SC) Gravelly CLAY; some medium to coarse sand, angular; gray; medium stiff; moist

WELL INFORMATION

WELL GRAPHICS



WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-20	Interval (ft): 15-20	Interval (ft): 13.5-20	Interval (ft): 13-13.5	Interval (ft): 0-13
Material: PVC	Material: PVC	Type: #1 Sand	Type: #0 Sand	Type: Bentonite Chips
Diameter: 1	Diameter: 1	Quantity: 50 lbs	Quantity: 25 lbs	Quantity: 250 lbs
Joint Type:	Slot Size: 0.01			

- ▤ Organics/Topsoil
- ▥ Silty Clay
- ⛆ USCS Poorly-graded Sand (SP)
- ⛆ Sand
- ▨ Clay
- ▨ USCS Clayey Sand (SC)

DRILLING COMPANY: New Engand Boring Inc.
DRILLER: M. Porter
DRILL RIG: Mobile B-53 Track Mounted

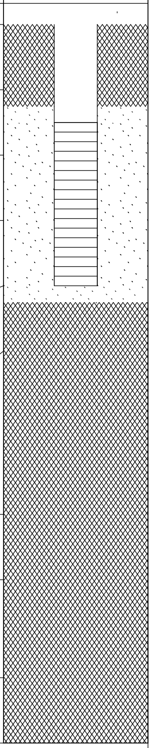
LOGGED BY: STD
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE PZ-2S/SB-2

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: SSA and 4-inch D&W	COORDS: N: 685,072.90 E: 3,040,231.21	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE:	GS ELEVATION: 584.4 ft	DEPTH W.L.: NA
DRILLED DEPTH: 22.0 ft	DATE STARTED: 9/13/17	TOC ELEVATION:	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/13/17	WEATHER:	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE:	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 6.3ft Fine SILTY SAND, some fines; gray-brown	SM	▥	0.0	1	WoH-1-2-5	NA	1.5 / 2.0	0-2': (SM) Fine SILTY SAND, some fines, poorly-graded, subangular; gray-brown; dry; very loose	
					2.0	2	3-4-5-8	9	1.6 / 2.0	2-4': (SM) Fine SILTY SAND, some fines, poorly-graded, subangular; gray-brown; moist; loose	
5.0	580				4.0	3	3-5-6-4	11	1.5 / 2.0	4-6': (SM) Fine SILTY SAND, some fines, poorly-graded, subangular; gray-brown; moist; medium dense	
		6.3 - 8.5ft Medium stiff CLAY; olive gray-brown	CL	▨	6.0	4	1-3-4-4	7	1.7 / 2.0	6-6.25': (SM) Fine SILTY SAND, some fines, poorly-graded, subangular; gray-brown; wet; loose 6.25-8': (CL) CLAY; olive gray-brown; medium stiff; moist; red mottling	
	575	8.5 - 19.0ft Soft CLAY; olive gray	CL	▨	8.0	5	2-2-4-6	6	1.8 / 2.0	8-8.5': 6.25-8': (CL) CLAY; olive gray-brown; medium stiff; moist; minor red mottling 8.5-10': (CL) CLAY, olive gray; soft to medium stiff; moist Shelby Tube sample collected 10-12'	
10.0											
15.0	570				15.0	6	WOH-WOH-WOH-WOH	0	2.0 / 2.0	15-17': (CL) CLAY; olive gray; very soft; moist	
20.0	565	19.0 - 22.0ft Glacial till - Fine gravelly, clayey, SAND; gray	SP	⁘	20.0	7	15-11-10-9	21	1.0 / 2.0	20-22': (SP) Fine gravelly, clayey, SAND, angular; gray; wet; medium dense	

Boring completed at 22.0 ft

WELL CASING
Interval (ft): 0-8
Material: PVC
Diameter: 1
Joint Type:

WELL SCREEN
Interval (ft): 3-8
Material: PVC
Diameter: 1
Slot Size: 0.01

FILTER PACK
Interval (ft): 3-8
Type: #1 Sand
Quantity: 50 lbs

FILTER PACK SEAL
Interval (ft): 2.5-3
Type: #0 Sand
Quantity: 25 lbs

SURFACE SEAL
Interval (ft): 0-2.5
Type: Bentonite Chips
Quantity: 100 lbs

▥ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)
⁘ USCS Poorly-graded Sand (SP)

DRILLING COMPANY: New Engand Boring Inc.
DRILLER: M. Porter
DRILL RIG: Mobile B-53 Track Mounted

LOGGED BY: STD
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE PZ-3S/SB-3

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 18.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: SSA and 4-inch D&W
HAMMER TYPE:
DATE STARTED: 9/11/17
DATE COMPLETED: 9/12/17

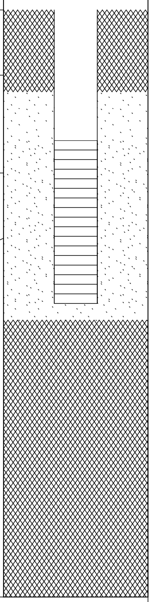
COORDS: N: 685,214.74 E: 3,039,508.81
GS ELEVATION: 289.8 ft
TOC ELEVATION:
WEATHER:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0		0.0 - 0.5ft ORGANICS		▤	0.0	1	1-2-2-3	4	1.1 / 2.0	0-0.25': ORGANICS 0.25-2': (SC) silty sandy CLAY; gray-brown; medium stiff; dry
		0.5 - 2.0ft Stiff SILTY CLAY; olive gray	CL	▨						
5.0	285	2.0 - 8.0ft Fine to medium SILTY SAND; gray-brown	SM	▥	5.0	2	2-5-8-8	13	1.5 / 2.0	5-7': (SM) Fine SILTY SAND, some fines, poorly-graded, subrounded; gray-brown; wet, medium dense Shelby Tube sample collected 9-11' Shelby Tube sample collected 16-18'
10.0 15.0	280 275	8.0 - 16.0ft Medium stiff to stiff CLAY; olive gray-brown	CL	▨						
		16.0 - 19.5ft Soft to very soft CLAY; olive gray	CL	▨						

WELL INFORMATION

WELL GRAPHICS



Boring completed at 18.0 ft

WELL CASING
Interval (ft): 0-9
Material: PVC
Diameter: 1
Joint Type:

WELL SCREEN
Interval (ft): 4-9
Material: PVC
Diameter: 1
Slot Size: 0.01

FILTER PACK
Interval (ft): 3-9
Type: #1 Sand
Quantity: 100 lbs

FILTER PACK SEAL
Interval (ft): 2.5-3
Type: #0 Sand
Quantity: 25 lbs

SURFACE SEAL
Interval (ft): 0-2.5
Type: Bentonite Chips
Quantity: 100 lbs

▤ Organics/Topsoil

▨ USCS Low Plasticity Clay (CL)

▥ USCS Silty Sand (SM)

DRILLING COMPANY: New Engand Boring Inc.
DRILLER: M. Porter
DRILL RIG: Mobile B-53 Track Mounted

LOGGED BY: STD
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE PZ-3S/SB-3a

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: SSA and 4-inch D&W	COORDS: N: 685,218.29 E: 3,039,504.61	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE:	GS ELEVATION: 289.7 ft	DEPTH W.L.: NA
DRILLED DEPTH: 29.0 ft	DATE STARTED: 9/11/17	TOC ELEVATION:	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/11/17	WEATHER:	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE:	TIME W.L.: NA

SOIL PROFILE

DEPTH ft	ELEVATION ft
0.0	
5.0	285
10.0	280
15.0	275
20.0	270
25.0	265

LITHOLOGY DESCRIPTION	USCS
0.0 - 0.5ft ORGANICS	
0.5 - 2.0ft Stiff SILTY CLAY; olive gray	CL
2.0 - 8.0ft Fine to medium SILTY SAND; gray-brown	SM
8.0 - 16.0ft Medium stiff to stiff CLAY; olive gray-brown	CL
16.0 - 19.5ft Soft to very soft CLAY; olive gray	CL
19.5 - 22.0ft Soft to stiff sandy, gravelly, CLAY, fine to coarse sand and fine to coarse gravel; olive gray	SC
22.0 - 25.0ft Coarse SILTY GRAVEL, some fine sand; gray	GM
25.0 - 28.2ft Fine to coarse gravelly SAND; gray-brown	SM
28.2 - 29.0ft Bedrock	

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	2-4-4-3	8	1.2 / 2.0	0-0.5': ORGANICS, dark brown; dry 0.5-2': (CL) silty CLAY; gray; stiff; dry
2.0	2	3-4-6-6	10	1.5 / 2.0	2-4': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; dry; medium dense, some red mottling
4.0	3	5-6-6-7	12	1.7 / 2.0	4-6': (SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; wet; loose, some red mottling
6.0	4	5-11-7-7	18	2.0 / 2.0	6-8':(SM) Fine SILTY SAND, poorly-graded, subrounded; gray-brown; wet; medium dense, some red mottling
8.0	5	WOH-2-3-6	5	1.7 / 2.0	8-10': (CL) CLAY; olive gray-brown; medium stiff; moist; some red mottling
10.0	6	3-5-6-7	11	1.9 / 2.0	10-12': (CL) CLAY, trace gravel; olive gray-brown; stiff; moist; some red mottling
12.0	7	3-2-4-4	6	2.0 / 2.0	12-14': (CL) CLAY; olive gray-brown; medium stiff; moist; some red mottling
14.0	8	1-2-3-5	5	1.8 / 2.0	14-16': (CL) CLAY, olive gray-brown; medium stiff; moist
16.0	9	2-1-WOH-1	1	2.0 / 2.0	16-18': (CL) CLAY; olive gray; very soft; moist
18.0	10	1-2-WOH-6	2	2.0 / 2.0	18-19.5': (CL) CLAY, olive gray; soft; moist 19.5-20': (SC) sandy, gravelly, CLAY, medium to coarse sand with fine to coarse angular gravel up to 1" in diameter; olive gray; soft; moist
20.0	11	11-7-5-3	12	1.2 / 2.0	20-22': (SC) sandy, gravelly, CLAY, fine to coarse sand and fine to coarse angular gravel up to 1" in diameter; gray; stiff to soft alternation; dry
22.0	12	7-5-8-15	13	0.5 / 2.0	22-24': (GM) Coarse SILTY GRAVEL, some fine sand; gray; dry; medium dense; gravel up to 2" in diameter
25.0	13	13-8-7-13	15	0.8 / 2.0	25-27': (SM) Fine to coarse gravelly SAND; gray-brown; wet, medium dense; gravel up to 1" in diameter

WELL INFORMATION

WELL GRAPHICS

Boring completed at 29.0 ft

WELL CASING	**WELL SCREEN**	**FILTER PACK**	**FILTER PACK SEAL**	**SURFACE SEAL**
Interval (ft):	Interval (ft):	Interval (ft):	Interval (ft):	Interval (ft):
Material:	Material:	Type:	Type:	Type:
Diameter:	Diameter:			
Joint Type:	Slot Size:			

▤ Organics/Topsoil　▨ USCS Low Plasticity Clay (CL)　▥ USCS Silty Sand (SM)　▨ USCS Clayey Sand (SC)　▥ USCS Silty Gravel

▧ Bedrock

DRILLING COMPANY: New Engand Boring Inc.	LOGGED BY: STD
DRILLER: M. Porter	CHECKED BY: BDL
DRILL RIG: Mobile B-53 Track Mounted	DATE: 7/15/19

RECORD OF BOREHOLE PZ-4S/SB-4

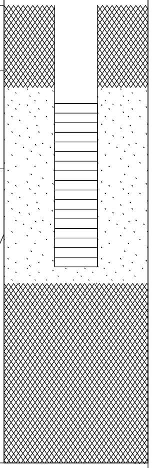
SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 14.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: SSA and 4-inch D&W
HAMMER TYPE:
DATE STARTED: 9/12/17
DATE COMPLETED: 9/12/17

COORDS: N: 685,581.88 E: 3,039,291.19
GS ELEVATION: 292.2 ft
TOC ELEVATION:
WEATHER:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.3ft ORGANICS		▤	0.0	1	1-4-4-5	8	1.1 / 2.0	0-0.25': ORGANICS, dark brown, dry 0.25-2': (CL) SILTY CLAY, some angular gravel up to 1/2" in diameter; olive gray-brown; medium stiff; dry	
	290	0.3 - 4.0ft SILTY CLAY, some angular gravel; gray-brown	CL	▨							
		4.0 - 5.0ft Fine SILTY SAND; brown	SM	▥							
5.0	285	5.0 - 12.0ft Stiff to very stiff CLAY; olive gray-brown	CL	▨	5.0	2	4-4-4-6	8	1.6 / 2.0	5-5.5': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; wet, loose 5.5-7': CL) CLAY; olive gray-brown; very stiff; moist, minor red-brown mottling Shelby Tube sample 9-11'	
10.0											
	280	12.0 - 14.0ft Soft CLAY; olive gray	CL	▨							

Boring completed at 14.0 ft

WELL CASING	**WELL SCREEN**	**FILTER PACK**	**FILTER PACK SEAL**	**SURFACE SEAL**
Interval (ft): 0-8	Interval (ft): 3-8	Interval (ft): 3-8	Interval (ft): 2.5-3	Interval (ft): 0-2.5
Material: PVC	Material: PVC	Type: #1 Sand	Type: #0 Sand	Type: Bentonite Chips
Diameter: 1	Diameter: 1	Quantity: 50 lbs	Quantity: 25 lbs	Quantity: 50 lbs
Joint Type:	Slot Size: 0.01			

▤ Organics/Topsoil

▨ USCS Low Plasticity Clay (CL)

▥ USCS Silty Sand (SM)

DRILLING COMPANY: New Engand Boring Inc.
DRILLER: M. Porter
DRILL RIG: Mobile B-53 Track Mounted

LOGGED BY: STD
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE PZ-4S/SB-4a

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: SSA and 4-inch D&W	COORDS: N: 685,589.63 E: 3,039,291.12	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE:	GS ELEVATION: 292.0 ft	DEPTH W.L.: NA
DRILLED DEPTH: 24.0 ft	DATE STARTED: 9/12/17	TOC ELEVATION:	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/12/17	WEATHER:	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE:	TIME W.L.: NA

SOIL PROFILE

DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG
0.0		0.0 - 0.2ft ORGANICS		▤
	290	0.2 - 4.0ft SILTY CLAY, some angular gravel; gray-brown	CL	▨
		4.0 - 5.0ft Fine SILTY SAND; brown	SM	░
5.0 10.0	285	5.0 - 12.0ft Stiff to very stiff CLAY; olive gray-brown	CL	▨
	280	12.0 - 14.8ft Soft CLAY; olive gray	CL	▨
15.0	275	14.8 - 20.0ft Glacial till - Stiff to very stiff fine to coarse SANDY SILT, some gravel; gray	SM	░
20.0		20.0 - 20.5ft Glacial till - Medium to coarse SAND and GRAVEL; gray	SP-SM	▥
	270	20.5 - 23.9ft Glacial till - Fine SILTY SAND, some angular gravel and clay; gray-brown	SM	░
		23.9 - 24.0ft BEDROCK (?)		

Boring completed at 24.0 ft

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	2-4-5-11	9	0.5 / 2.0	0-0.17': ORGANICS, dark brown, dry 0.17-2': (CL) SILTY CLAY, some angular gravel; olive gray-brown; medium stiff; dry
2.0	2	3-3-9-8	12	0.8 / 2.0	2-2.42': (CL) SILTY CLAY; olive gray-brown; stiff; moist 2.42-4': (CL) CLAY; olive gray-brown; stiff; moist
4.0	3	2-4-4-8	8	1.9 / 2.0	4-5': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; wet, loose 5-6': (CL) CLAY; olive gray-brown; stiff; moist
6.0	4	6-7-10-12	17	1.7 / 2.0	6-8': (CL) CLAY; olive gray-brown; very stiff; moist
8.0	5	6-11-11-17	22	2.0 / 2.0	8-10': (CL) CLAY; olive gray-brown; very stiff; moist
10.0	6	2-3-3-4	6	2.0 / 2.0	10-12': (CL) CLAY; olive gray-brown; medium stiff; moist, minor silt partings
12.0	7	WOH-1-1-1	2	1.8 / 2.0	12-14': (CL) CLAY; olive gray; soft; moist, minor silt partings
14.0	8	8-12-29-17	41	1.8 / 2.0	14-14.83': (CL) CLAY; olive gray; soft to medium stiff; moist 14.83-16': (SM) Sandy SILT, some gravel up to 1" in diameter, gray; stiff; dry, some red mottling
16.0	9	9-10-14-18	24	1.0 / 2.0	16-18': (SM) Fine to coarse sandy SILT, some gravel up to 2" in diameter; gray; very stiff; dry
20.0	10	11-11-6-8	17	1.0 / 2.0	20-20.5': (SP-SM) Medium to coarse SAND and GRAVEL up to 1" in diameter; gray; wet, medium dense 20.5'-22': (SM) Fine SILTY SAND, some angular gravel and clay; gray-brown; wet, medium dense

WELL INFORMATION

WELL GRAPHICS

WELL CASING
Interval (ft):
Material:
Diameter:
Joint Type:

WELL SCREEN
Interval (ft):
Material:
Diameter:
Slot Size:

FILTER PACK
Interval (ft):
Type:

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft):
Type:

▤	Organics/Topsoil
▨	USCS Low Plasticity Clay (CL)
░	USCS Silty Sand (SM)
▥	USCS Poorly-graded Sand with Silt (SP-SM)
▩	Bedrock

DRILLING COMPANY: New Engand Boring Inc.
DRILLER: M. Porter
DRILL RIG: Mobile B-53 Track Mounted

LOGGED BY: STD
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE PZ-5D/SB-5

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 17.5 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: SSA and 4-inch D&W
HAMMER TYPE:
DATE STARTED: 9/14/17
DATE COMPLETED: 9/14/17

COORDS: N: 685,622.91 E: 3,038,731.24
GS ELEVATION: 286.3 ft
TOC ELEVATION:
WEATHER:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0	285	0.0 - 0.3ft Fine SILTY SAND, little fines; orange-brown 0.3 - 3.0ft Fine SILTY SAND, little fines; gray-brown	SM SM		0.0	1	1-1-1-2	2	1.2 2.0	0-0.33': (SM) Fine SILTY SAND, some clay; orange-brown; dry, very loose, some red-orange mottling 0.33-2': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; moist, very loose	
		3.0 - 10.0ft Stiff CLAY; olive gray-brown	CL		2.0	2	2-5-4-5	9	1.8 2.0	2-3': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; moist, loose 3-4': (CL) CLAY, olive gray-brown; stiff; moist, minor orange mottling	
5.0	280				4.0	3	3-3-5-5	8	2.0 2.0	4-6': (CL) CLAY, olive gray-brown; stiff; moist, minor orange mottling	
10.0	275	10.0 - 11.0ft Very soft CLAY; olive gray-brown 11.0 - 12.5ft Very soft CLAY; olive gray	CL CL		10.0	4	WOH-WOH-WOH-WOH	0	2.0 2.0	10-11': (CL) CLAY; olive gray-brown; very soft; moist 11-12': (CL) CLAY; olive gray; very soft; moist	
		12.5 - 17.5ft Glacial till - SILTY GRAVEL, some sand, angular; gray; moist to wet; medium dense	GM		13.0	5	9-9-15-15	24	0.8 2.0	13-15': (GM/SM) SILTY GRAVEL, some sand, angular; gray; moist to wet; medium dense	
15.0	270				15.0	6	16-10-7-10	17	1.1 2.0	15-17': (GM/SM) SILTY GRAVEL, some sand, angular; gray; wet; medium dense	

Boring completed at 17.5 ft

WELL CASING
Interval (ft): 0-17.5
Material: PVC
Diameter: 1
Joint Type:

WELL SCREEN
Interval (ft): 12.5-17.5
Material: PVC
Diameter: 1
Slot Size: 0.01

FILTER PACK
Interval (ft): 11-17.5
Type: #1 Sand
Quantity: 150 lbs

FILTER PACK SEAL
Interval (ft): 10.5-11
Type: #0 Sand
Quantity: 25 lbs

SURFACE SEAL
Interval (ft): 0-10.5
Type: Bentonite Chips
Quantity: 100 lbs

▤ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ▦ USCS Silty Gravel

DRILLING COMPANY: New Engand Boring Inc.
DRILLER: M. Porter
DRILL RIG: Mobile B-53 Track Mounted

LOGGED BY: STD
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE PZ-6S/SB-6

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 16.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: SSA and 4-inch D&W
HAMMER TYPE:
DATE STARTED: 9/14/17
DATE COMPLETED: 9/14/17

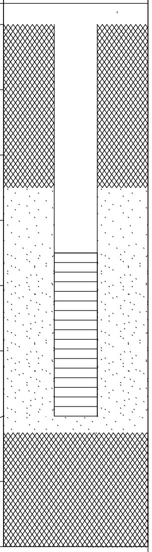
COORDS: N: 686,041.13 E: 3,039,226.32
GS ELEVATION: 300.0 ft
TOC ELEVATION:
WEATHER:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	300	0.0 - 0.5ft ORGANICS 0.5 - 2.0ft Fine SILTY SAND; orange-brown	SM		0.0	1	WOH-WOH-1-1	1	1.3 / 2.0	0-0.5': ORGANICS 0.5-2': (SM) Fine SILTY SAND, some organics; orange-brown; dry, very loose
		2.0 - 11.0ft Fine SILTY SAND; gray-brown	SM		2.0	2	1-2-4-5	6	1.6 / 2.0	2-4': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; dry, loose
5.0	295				4.0	3	3-3-4-4	7	1.8 / 2.0	4-6': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; dry, loose, minor red-orange mottling
					6.0	4	4-4-4-7	8	1.7 / 2.0	6-8': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; moist-wet, loose, minor red-orange mottling
					8.0	5	7-8-7-7	15	2.0 / 2.0	8-10': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; wet, medium dense
10.0	290	11.0 - 14.0ft Medium stiff CLAY; gray-brown	CL		10.0	6	4-5-6-7	11	1.3 / 2.0	10-11': (SM) Fine SILTY SAND, well-graded, subrounded; gray-brown; wet, medium dense 11-12': (CL) CLAY, some sand, olive gray-brown; medium stiff; moist
					12.0	7	2-3-4-7	7	1.2 / 2.0	12-14': (CL) CLAY, olive gray-brown; medium stiff; moist
15.0	285	14.0 - 16.0ft Gravelly, sandy, CLAY, fine to coarse sand, gray	SC		14.0	8	6-8-10-16	18	1.0 / 2.0	14-16': (SC) Gravelly, sandy, CLAY, fine to coarse sand, gray; wet, medium dense, maximum gravel 1.5"

WELL INFORMATION

WELL GRAPHICS



Boring completed at 16.0 ft

WELL CASING
Interval (ft): 0-12
Material: PVC
Diameter: 1
Joint Type:

WELL SCREEN
Interval (ft): 7-12
Material: PVC
Diameter: 1
Slot Size: 0.01

FILTER PACK
Interval (ft): 5.5-12
Type: #1 Sand
Quantity: 100 lbs

FILTER PACK SEAL
Interval (ft): 5-5.5
Type: #0 Sand
Quantity: 25 lbs

SURFACE SEAL
Interval (ft): 0-5
Type: Bentonite Chips
Quantity: 50 lbs

▤ Organics/Topsoil
⁞ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)
▨ USCS Clayey Sand (SC)

DRILLING COMPANY: New Engand Boring Inc.
DRILLER: M. Porter
DRILL RIG: Mobile B-53 Track Mounted

LOGGED BY: STD
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE PZ-7D

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 27.1 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA and D+W
HAMMER TYPE: Auto SPT
DATE STARTED: 9/27/18
DATE COMPLETED: 9/27/18

COORDS: N: 685,071.00 E: 3,040,477.65
GS ELEVATION: 280.6 ft
TOC ELEVATION: 283.5 ft
WEATHER: Partly cloudy
TEMPERATURE: 50's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE

DEPTH ft	ELEVATION ft
0.0	280
5.0	275
10.0	270
15.0	265
20.0	260
25.0	255

LITHOLOGY DESCRIPTION	USCS
0.0 - 0.1ft ORGANICS	
0.1 - 3.7ft Fine SILTY SAND; gray-brown	SM
3.7 - 16.5ft Medium stiff CLAY; olive gray-brown	CL
16.5 - 18.0ft Glacial till - Stiff CLAY, some coarse sand and fine gravel; gray; moist	CL
18.0 - 20.0ft Glacial till - Fine SILTY SAND, little fines, gray-brown	SM
20.0 - 25.0ft Glacial till - Fine SILTY SAND, some fines and fine to coarse sand and gravel; gray-brown	SM
25.0 - 26.0ft Glacial till - Coarse SAND, some medium sand and fine to coarse gravel, gray; moist	SP
26.0 - 27.0ft Glacial till - Fine SILTY SAND, some fines, coarse sand, and fine gravel; brown; moist	SM
27.0 - 27.1ft BEDROCK (?)	

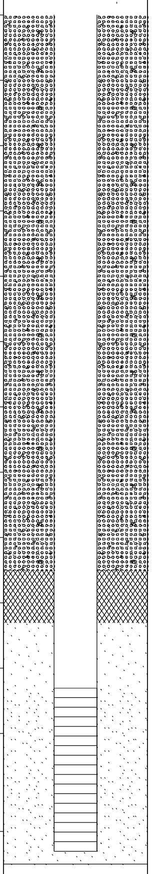
Boring completed at 27.1 ft

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	1-2-3-4	5	1.1 / 2.0	0-0.1': ORGANICS, gray-brown; dry 0.1-2': (SM) Fine to medium SILTY SAND, little fines well sorted; gray-brown; dry; loose
2.0	2	4-5-4-3	9	1.4 / 2.0	2-3.7': (SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; dry 3.7-4.0'; (CL) CLAY; gray-brown; dry, stiff
4.0	3	2-4-6-8	10	1.8 / 2.0	(CL) CLAY; olive gray-brown; stiff; damp
6.0	4	4-5-5-6	10	1.6 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; moist
8.0	5	3-4-5-7	9	2.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; moist
10.0	6	3-3-4-4	7	2.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; moist
12.0	7	4-4-4-5	8	2.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; moist
14.0	8	2-2-3-3	5	2.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; moist
16.0	9	3-17-28-25	45	1.4 / 2.0	16.0-16.5': (CL) CLAY; olive gray-brown; medium stiff; moist 16.5-18.0': (CL) CLAY, some coarse sand and fine gravel up to 0.5" in diameter; olive gray; stiff; moist
18.0	10	16-16-14-16	30	1.1 / 2.0	(SM) Fine SILTY SAND, little fines, well sorted, gray-brown; moist
20.0	11	14-25-23-24	48	0.8 / 2.0	(SM) Fine SILTY SAND, some fines and fine to coarse sand and gravel up to 1" in diameter, poorly sorted; gray-brown; moist
25.0	12	13-15-13-13	28	0.9 / 2.0	25-26': (SP) Coarse SAND, some medium sand and fine to coarse gravel up to 1" in diameter, gray; moist 26-27': (SM) Fine SILTY SAND, some fines, coarse sand, and fine gravel up to 0.5" in diameter, poorly sorted; brown; moist

WELL INFORMATION

WELL GRAPHICS



WELL CASING
Interval (ft): 0-25.6
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 20.6-25.6
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 18.6-26
Type: #2 Sand

FILTER PACK SEAL
Interval (ft): 17-18.6
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-17
Type: Bentonite Grout Mix

▤ Organics/Topsoil
▥ USCS Silty Sand (SM)
▨ USCS Low Plasticity Clay (CL)
░ USCS Poorly-graded Sand (SP)
▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-7M

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 16.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

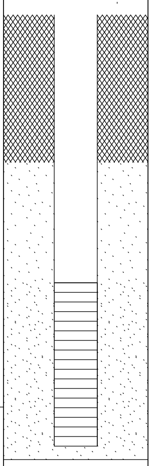
DRILL METHOD: HSA and D+W
HAMMER TYPE: Auto SPT
DATE STARTED: 9/27/18
DATE COMPLETED: 9/27/18

COORDS: N: 685,074.11 E: 3,040,470.86
GS ELEVATION: 280.6 ft
TOC ELEVATION: 283.7 ft
WEATHER: Partly cloudy
TEMPERATURE: 60's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC/ATT	SAMPLE DESCRIPTION
0.0	280	0.0 - 0.1ft ORGANICS								
		0.1 - 3.7ft Fine SILTY SAND; gray-brown	SM							
		3.7 - 14.0ft Medium stiff CLAY; olive gray-brown	CL							
5.0	275									
10.0	270									
					12.0	1	2-3-3-3	6	2.0/2.0	(CL) CLAY; olive gray-brown; medium stiff, moist
		14.0 - 16.0ft Soft CLAY; olive gray	CL		14.0	2	3-3-3-2	6	2.0/2.0	(CL) CLAY; olive gray; medium stiff; wet
15.0	265									

WELL INFORMATION



Boring completed at 16.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-07D.

WELL CASING
Interval (ft): 0-13.2
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 8.2-13.2
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 4.5-13.6
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-4.5
Type: Bentonite Chips

▤ Organics/Topsoil ⁞ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-8D

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 20.1 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA and D+W
HAMMER TYPE: Auto SPT
DATE STARTED: 9/26/18
DATE COMPLETED: 9/26/18

COORDS: N: 686,286.02 E: 3,038,924.72
GS ELEVATION: 296.8 ft
TOC ELEVATION: 299.9 ft
WEATHER: Cloudy
TEMPERATURE: 60's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

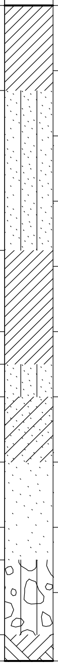
SOIL PROFILE

DEPTH ft: 0.0, 5.0, 10.0, 15.0, 20.0
ELEVATION ft: 295, 290, 285, 280

LITHOLOGY DESCRIPTION	USCS
0.0 - 2.6ft Soft SILTY CLAY; orange-brown	CL
2.6 - 7.5ft Fine SILTY SAND; gray-brown	SM
7.5 - 10.0ft Stiff CLAY; olive gray-brown	CL
10.0 - 11.0ft Stiff CLAY; olive gray	CL
11.0 - 12.0ft Glacial till - Fine SILTY SAND, little fines; gray	SM
12.0 - 14.0ft Glacial till - Stiff CLAYEY SAND, some fines and fine to coarse gravel; gray	SC
14.0 - 16.0ft Glacial till - Coarse SILTY SAND, some fines, fine sand, and fine to coarse gravel; gray	SP
16.0 - 17.0ft Glacial till - Fine to coarse SILTY SAND, little fines; gray	SP
17.0 - 19.3ft Glacial till - Fine to coarse SILTY GRAVEL, some fine to coarse sand, little fines; gray	GM
19.3 - 20.1ft BEDROCK (?)	

Boring completed at 20.1 ft

GRAPHIC LOG

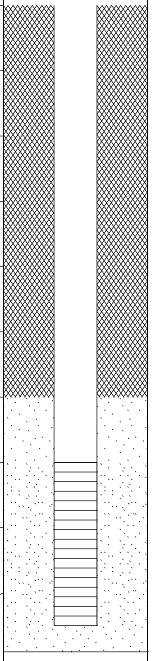


SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	1 for 18"-2	NA	0.5 / 2.0	(CL) SILTY CLAY; orange-brown; very soft; dry
2.0	2	3-5-7-9	12	1.4 / 2.0	2-2.6': (CL) SILTY CLAY; orange-brown; soft; dry 2.6-4.0': (SM) Fine to medium SILTY SAND, little fines, well sorted, gray-brown; dry
4.0	3	7-8-8-9	16	1.3 / 2.0	(SM) fine to medium SILTY SAND, little fines, well sorted, gray-brown; dry
6.0	4	8-8-7-6	15	1.0 / 2.0	6-7.5': (SM) Fine to medium SILTY SAND, little fines, well sorted, gray-brown; dry 7.5-8.0': (CL) CLAY; olive gray-brown; medium stiff; damp
8.0	5	3-4-5-5	9	1.3 / 2.0	(CL) CLAY; olive gray-brown; stiff; moist
10.0	6	2-3-11-13	14	1.5 / 2.0	10-11': (CL) CLAY; olive gray; stiff; moist 11-12': (SM) Fine SILTY SAND, little fines, poorly sorted, gray; moist
12.0	7	13-11-14-14	25	1.6 / 2.0	(SC) CLAYEY SAND, some fines and fine to coarse gravel up to 1" in diameter, poorly sorted; gray; stiff; moist
14.0	8	15-19-28-28	47	0.8 / 2.0	(SP) Coarse SILTY SAND, some fines, fine sand, and fine to coarse gravel up to 1" in diameter, poorly sorted, gray; moist
16.0	9	11-16-14-18	30	0.8 / 2.0	16-17': (SP) Fine to coarse SILTY SAND, little fines, poorly sorted, gray; moist 17-18': (GM) Fine to coarse SILTY GRAVEL, some fine to coarse sand, little fines, poorly sorted, gray; moist

WELL INFORMATION

WELL GRAPHICS



WELL CASING
Interval (ft): 0-19
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 14-19
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 12-19
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-12
Type: Bentonite Chips

▨ USCS Low Plasticity Clay (CL)
▥ USCS Silty Sand (SM)
▨ USCS Clayey Sand (SC)
░ USCS Poorly-graded Sand (SP)
▥ USCS Silty Gravel
▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

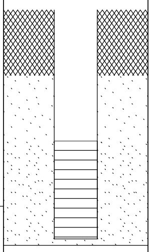
Golder Associates

RECORD OF BOREHOLE PZ-8S

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: HSA	COORDS: N: 686,287.02 E: 3,038,917.48	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 297.1 ft	DEPTH W.L.: NA
DRILLED DEPTH: 8.0 ft	DATE STARTED: 9/26/18	TOC ELEVATION: 299.7 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/26/18	WEATHER: Cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 60's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 2.6ft Soft SILTY CLAY; orange-brown	CL	▨							
	295	2.6 - 7.6ft Fine SILTY SAND; gray-brown	SM	⋮							
5.0											
					6.0	1	4-7-5-6	12	1.6 / 2.0	6-7.6': (SM) Fine to medium SILTY SAND, little fines, well sorted, brown-gray; dry 7.6-8': (CL) CLAY; olive gray-brown; medium stiff; damp	
	290	7.6 - 8.0ft Medium stiff CLAY; olive gray-brown	CL	▨							



Boring completed at 8.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-08D.

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-7 Material: PVC Diameter: 2 Joint Type: Threaded	Interval (ft): 4-7 Material: PVC Diameter: 2 Slot Size: 0.01	Interval (ft): 2-7 Type: #2 Sand	Interval (ft): Type:	Interval (ft): 0-2 Type: Bentonite Chips

▨ USCS Low Plasticity Clay (CL)

⋮ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-9D

SHEET 1 of 2

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 61.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA and D+W
HAMMER TYPE: Auto SPT
DATE STARTED: 10/2/18
DATE COMPLETED: 10/3/18

COORDS: N: 685,578.11 E: 3,041,098.78
GS ELEVATION: 289.4 ft
TOC ELEVATION: 292.5 ft
WEATHER: Light rain
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE

DEPTH ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG
0.0	0.0 - 0.1ft ORGANICS		▤
0.1	0.1 - 1.5ft Soft SILTY CLAY; orange	CL	▨
1.5	1.5 - 10.0ft Fine SILTY SAND; gray-brown	SM	⁞
10.0	10.0 - 11.5ft Stiff CLAY; olive gray-brown	CL	▨
11.5	11.5 - 18.0ft Medium stiff CLAY; olive gray	CL	▨
18.0	18.0 - 36.0ft Soft CLAY; olive gray	CL	▨
36.0	36.0 - 49.0ft Glacial till - Fine to coarse SILTY SAND, some fines and fine to coarse gravel; gray; moist	SM	⁞

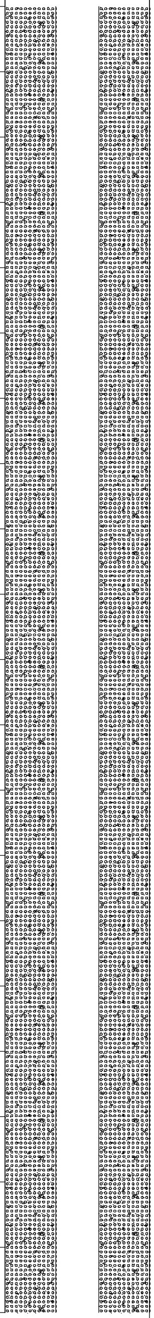
Depth scale (ft): 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0
Elevation scale (ft): 285, 280, 275, 270, 265, 260, 255, 250

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	1-1-1-4	2	0.8 / 2.0	0-0.1': ORGANICS 0.1-1.5': (CL) Soft SILTY CLAY; orange-brown; dry 1.5-2.0' (SM) Fine to medium SILTY SAND, gray-brown; dry
2.0	2	5-6-7-7	13	1.0 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted, gray-brown; dry
4.0	3	4-5-4-5	9	1.0 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted, gray-brown; moist
6.0	4	4-5-6-6	11	1.6 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted, gray-brown; moist
8.0	5	3-3-4-3	7	1.1 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted, gray-brown; moist
10.0	6	3-3-4-3	7	0.9 / 2.0	10-11.5': (CL) CLAY; olive gray-brown; stiff; moist 11.5-12': (CL) CLAY; olive gray; medium stiff; moist
12.0	7	5-5-6-7	11	1.3 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
14.0	8	3-4-5-6	9	1.6 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
16.0	9	7-7-7-6	14	2.0 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
18.0	10	2-2-3-2	5	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
20.0	11	WOH-WOH-3-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
22.0	12	2-3-2-2	5	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
24.0	13	WOH-WOH-WOH-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
26.0	14	WOR-WOH-WOH-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
28.0	15	WOR-WOR-WOR-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
30.0	16	WOR-WOH-WOH-WOH	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
32.0	17	WOR-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
34.0	18	WOH-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
36.0	19	25-26-31-36	57	1.6 / 2.0	(SM) Fine to medium SILTY SAND, some fines and fine gravel, poorly sorted; gray; moist
38.0	20	15-12-13-12	25	0.8 / 2.0	(SM) Fine to medium SILTY SAND, some fines and fine gravel, poorly sorted; gray; moist

WELL INFORMATION

WELL GRAPHICS



Log continued on next page

WELL CASING
Interval (ft): 0-58
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 53-58
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 51-60.1
Type: #2 Sand

FILTER PACK SEAL
Interval (ft): 49-51
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-49
Type: Bentonite Grout Mix

▤ Organics/Topsoil
▨ USCS Low Plasticity Clay (CL)
⁞ USCS Silty Sand (SM)
▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-9D

SHEET 2 of 2

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 61.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA and D+W
HAMMER TYPE: Auto SPT
DATE STARTED: 10/2/18
DATE COMPLETED: 10/3/18

COORDS: N: 685,578.11 E: 3,041,098.78
GS ELEVATION: 289.4 ft
TOC ELEVATION: 292.5 ft
WEATHER: Light rain
TEMPERATURE: 40's F

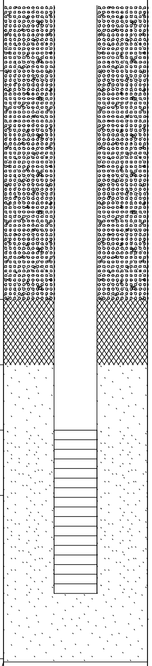
INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE				SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
40.0			SM	40.0	21	14-22-39-37	61	0.6 / 2.0	(SM) Fine to coarse SILTY SAND, some fines and fine to coarse gravel up to 1" in diameter, poorly sorted; gray; moist
45.0	245								
49.0	240	49.0 - 60.0ft Glacial till - Fine to coarse SILTY SAND, some fines; gray; moist	SM	49.0	22	22-20-22-30	42	0.9 / 2.0	(SM) Fine to coarse SILTY SAND, some fines, poorly sorted; gray; moist
50.0									
				53.0	23	28-26-59-64	85	0.8 / 2.0	(SM) Fine to coarse SILTY SAND, some fines, poorly sorted; gray; moist
55.0	235								
	230								
60.0		60.0 - 60.5ft Glacial till - Fine to coarse SILTY SAND, some fines and fine to coarse gravel; gray; moist	SM	60.0	24	50 for 2"	NA	0.1 / 0.1	(SM) Fine to coarse SILTY SAND, some fines and fine to coarse gravel up to 1" in diameter, poorly sorted; gray; moist
		60.5 - 61.0ft BEDROCK (?)							

Boring completed at 61.0 ft

WELL INFORMATION

WELL GRAPHICS



WELL CASING
Interval (ft): 0-58
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 53-58
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 51-60.1
Type: #2 Sand

FILTER PACK SEAL
Interval (ft): 49-51
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-49
Type: Bentonite Grout Mix

▤ Organics/Topsoil ▨ USCS Low Plasticity Clay (CL) ▥ USCS Silty Sand (SM) ▩ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

001A MANCHESTER NH ENV. LOG & WELL 9836836- CROSSROADS EXPANSION.GPJ GOLDER NH 2011.GDT 10/10/19

RECORD OF BOREHOLE PZ-9S

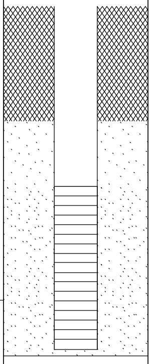
SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 11.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA
HAMMER TYPE: Auto SPT
DATE STARTED: 10/3/18
DATE COMPLETED: 10/3/18

COORDS: N: 685,574.60 E: 3,041,101.67
GS ELEVATION: 298.7 ft
TOC ELEVATION: 292.4 ft
WEATHER: Cloudy
TEMPERATURE: 50's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS									
		0.1 - 1.5ft Soft SILTY CLAY; orange	CL								
	295	1.5 - 11.0ft Fine SILTY SAND; gray-brown									
5.0			SM								
	290										
10.0					9.0	1	3-3-3-3	6	1.0 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	

Boring completed at 11.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-09D.

WELL CASING
Interval (ft): 0-10.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 5.5-10.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 5.5-10.5
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-3.5
Type: Bentonite Chips

▤	Organics/Topsoil
▨	USCS Low Plasticity Clay (CL)
⁙	USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

RECORD OF BOREHOLE PZ-10D

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 32.7 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA and D+W
HAMMER TYPE: Auto SPT
DATE STARTED: 10/1/18
DATE COMPLETED: 10/2/18

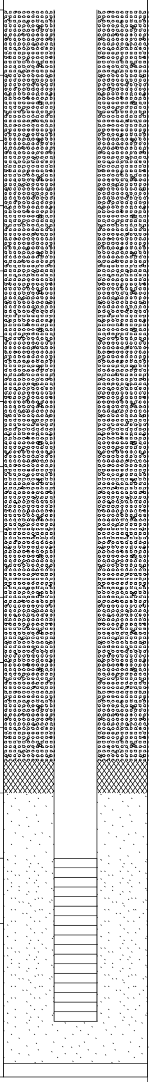
COORDS: N: 685,704.68 E: 3,040,636.04
GS ELEVATION: 291.3 ft
TOC ELEVATION: 294.0 ft
WEATHER: Partly cloudy
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	290	0.0 - 2.0ft Soft SILTY CLAY; orange	CL		0.0	1	1-1-1-3	2	0.6 / 2.0	(CL) SILTY CLAY; orange; very soft, dry
		2.0 - 10.3ft Fine SILTY SAND, gray-brown	SP-SM		2.0	2	4-4-4-5	8	1.0 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted; orange-brown transitioning to gray-brown; dry
5.0					4.0	3	5-4-3-5	7	1.0 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; dry
	285				6.0	4	5-5-5-5	10	0.9 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; dry
					8.0	5	5-5-5-5	10	1.0 / 2.0	(SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; dry
10.0	280	10.3 - 18.0ft Medium stiff CLAY; olive gray	CL		10.0	6	1-1-1-1	2	1.5 / 2.0	10-10.3': (SM) Fine to medium SILTY SAND, little fines, well sorted, gray-brown; damp 10.3-12': (CL) CLAY, olive gray; soft; moist
					12.0	7	2-2-3-3	5	1.2 / 2.0	(CL) CLAY, olive gray; medium stiff; moist
15.0					14.0	8	1-3-3-3	6	1.3 / 2.0	(CL) CLAY, olive gray; medium stiff; moist
	275				16.0	9	3-3-2-2	5	1.4 / 2.0	(CL) CLAY, olive gray; medium stiff; moist
		18.0 - 23.0ft Soft CLAY; olive gray	CL		18.0	10	WOR-WOR-WOH-1	NA	1.7 / 2.0	(CL) CLAY, olive gray; very soft; moist
20.0	270				20.0	11	WOR-WOH-WOH-1	NA	2.0 / 2.0	(CL) CLAY, olive gray; soft; moist
					22.0	12	WOH-1-16-22	NA	1.2 / 2.0	22-23.0': (CL) CLAY, olive gray; soft; moist 23-24':(SM) Fine to medium SAND, little fines and angular gravel up to 0.5" in diameter, poorly sorted; gray; moist
25.0		23.0 - 26.0ft Glacial till - Fine to medium SAND, little fines and angular gravel; gray	SM		24.0	13	13-21-19-17	40	0.6 / 2.0	(SM) Fine to medium SAND, little fines and angular gravel up to 0.5" in diameter, poorly sorted; gray; moist
	265	26.0 - 31.7ft Glacial till - Fine to coarse SAND and GRAVEL, little fines; gray	SM		26.0	14	13-14-19-22	33	0.6 / 2.0	(SM) Fine to coarse SAND and GRAVEL, little fines, poorly sorted, angular; gray; moist; gravel up to 0.25" in diameter
30.0	260									
		31.7 - 32.7ft BEDROCK (?)								

WELL INFORMATION

WELL GRAPHICS



Boring completed at 32.7 ft

WELL CASING
Interval (ft): 0-31
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 26-31
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 24-31
Type: #2 Sand

FILTER PACK SEAL
Interval (ft): 23-24
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-23
Type: Bentonite Grout Mix

▨ USCS Low Plasticity Clay (CL)
▥ USCS Poorly-graded Sand with Silt (SP-SM)
▥ USCS Silty Sand (SM)
▧ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

RECORD OF BOREHOLE PZ-10M

SHEET 1 of 1

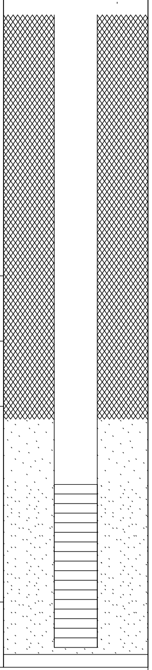
PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 20.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA
HAMMER TYPE: Auto SPT
DATE STARTED: 10/1/18
DATE COMPLETED: 10/1/18

COORDS: N: 685,704.28 E: 3,040,641.80
GS ELEVATION: 291.3 ft
TOC ELEVATION: 294.2 ft
WEATHER: Light rain
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0	290	0.0 - 2.0ft soft SILTY CLAY; orange	CL	▨							
5.0	285	2.0 - 10.8ft Fine SILTY SAND, little fines; gray-brown	SP-SM	⁙	8.0	1	1-1-3-3	4	0.8 / 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; dry	
10.0	280	10.8 - 20.0ft Medium stiff CLAY; olive gray	CL	▨	10.0	2	2-1-1-3	2	1.7 / 2.0	10-10.8': (SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; dry 10.8-12.0': (CL) CLAY, olive gray; medium stiff; dry	
15.0	275										
					18.0	3	2-3-3-2	6	1.3 / 2.0	(CL) CLAY, olive gray; medium stiff; moist	
20.0											



Boring completed at 20.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-10D.

WELL CASING
Interval (ft): 0-19.4
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 14.4-19.4
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 12.4-19.4
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-12.4
Type: Bentonite Chips

▨ USCS Low Plasticity Clay (CL)
⁙ Sand
▨ Clay

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-10S

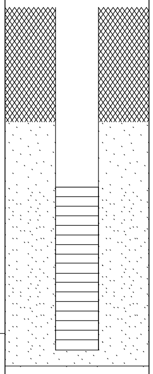
SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 12.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA
HAMMER TYPE: Auto SPT
DATE STARTED: 10/4/18
DATE COMPLETED: 10/4/18

COORDS: N: 685,707.81 E: 3,040,644.89
GS ELEVATION: 291.6 ft
TOC ELEVATION: 294.3 ft
WEATHER: Partly cloudy
TEMPERATURE: 50's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 2.0ft soft SILTY CLAY; orange	CL	▨							
	290	2.0 - 12.0ft Fine SILTY SAND, little fines; gray-brown	SP-SM	▥							
5.0											
	285										
10.0					10.0	1	2-2-2-1	4	0.6 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	
	280										

Boring completed at 12.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-10D.

WELL CASING
Interval (ft): 0-10.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 5.5-10.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 3.5-10.5
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-3.5
Type: Bentonite Chips

▨ USCS Low Plasticity Clay (CL)

▥ USCS Poorly-graded Sand with Silt (SP-SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

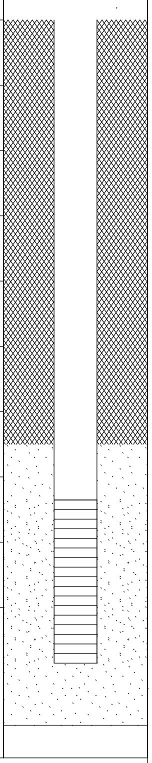
Golder Associates

RECORD OF BOREHOLE PZ-11D

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: HSA and D+W	COORDS: N: 686,182.60 E: 3,040,262.10	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 298.8 ft	DEPTH W.L.: NA
DRILLED DEPTH: 22.6 ft	DATE STARTED: 9/28/18	TOC ELEVATION: 301.7 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 10/1/18	WEATHER: Cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 50's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS 0.1 - 9.0ft Fine SILTY SAND, little fines; gray-brown	SM		0.0	1	1-1-3-3	4	1.1 / 2.0	0-0.1': ORGANICS 0.1-2': (SP-SM) Fine to medium SILTY SAND; gray-brown; damp	
	295				2.0	2	5-6-6-6	12	1.2 / 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	
5.0					4.0	3	3-3-5-5	8	1.3 / 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	
					6.0	4	6-4-3-4	7	2.0 / 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	
	290	9.0 - 12.0ft Medium stiff CLAY; olive gray	CL		8.0	5	7-5-4-4	9	1.3 / 2.0	8-9.0': (SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist 9-10': (CL) CLAY; olive gray; medium stiff; damp	
10.0					10.0	6	2-3-4-4	7	2.0 / 2.0	(CL) CLAY, olive gray, medium stiff; moist	
	285	12.0 - 20.6ft Glacial till - Medium to coarse SAND, some fine to coarse gravel, little fines; gray	SP		12.0	7	22-20-10-14	30	0.6 / 2.0	(SP) Medium to coarse SAND, some fine to coarse gravel, little fines; poorly sorted; gray; wet; gravel up to 1" in diameter	
15.0					14.0	8	14-20-15-10	35	0.9 / 2.0	(SP) Medium to coarse SAND, some fine to coarse gravel, little fines; poorly sorted; gray; wet; gravel up to 1" in diameter	
					16.0	9	9-7-18-18	25	1.0 / 2.0	(SP) Medium to coarse SAND, some fine to coarse gravel, little fines; poorly sorted; gray; wet; gravel up to 1" in diameter	
	280										
20.0		20.6 - 22.6ft BEDROCK (?)									



Boring completed at 22.6 ft

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-19.7	Interval (ft): 14.7-19.7	Interval (ft): 13-19.7	Interval (ft):	Interval (ft): 0-13
Material: PVC	Material: PVC	Type: #2 Sand	Type:	Type: Bentonite Chips
Diameter: 2	Diameter: 2			
Joint Type: Threaded	Slot Size: 0.01			

▤ Organics/Topsoil ░ Sand ▨ Clay ░ USCS Poorly-graded Sand (SP) ▩ Bedrock

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-11S

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 10.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA
HAMMER TYPE: Auto SPT
DATE STARTED: 10/1/18
DATE COMPLETED: 10/1/18

COORDS: N: 686,187.02 E: 3,040,263.71
GS ELEVATION: 298.9 ft
TOC ELEVATION: 303.1 ft
WEATHER: Light rain
TEMPERATURE: 50's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS									
		0.1 - 6.0ft Fine SILTY SAND, little fines; gray-brown	SM								
	295										
5.0											
		6.0 - 7.0ft Medium stiff CLAY; olive gray-brown	CL		6.0	1	3-3-5-6	8	1.3 / 2.0	6-7.0': (CL) CLAY; olive gray-brown; medium stiff; moist 7-8': (CL) CLAY; olive gray; medium stiff; moist	
		7.0 - 10.0ft Medium stiff CLAY; olive gray	CL		8.0	2	5-5-5-6	10	1.3 / 2.0	(CL) CLAY; olive gray; medium stiff; moist	
	290										
10.0											

Boring completed at 10.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-11D.

WELL CASING
Interval (ft): 0-5.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 2.5-5.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 2-6
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-2
Type: Bentonite Chips

▤ Organics/Topsoil ⁞ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

RECORD OF BOREHOLE PZ-12D

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 15.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA and D+W
HAMMER TYPE: Auto SPT
DATE STARTED: 9/28/18
DATE COMPLETED: 9/28/18

COORDS: N: 686,436.96 E: 3,039,615.84
GS ELEVATION: 307.5 ft
TOC ELEVATION: 310.3 ft
WEATHER: Cloudy
TEMPERATURE: 50's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS 0.1 - 0.6ft Soft SILTY CLAY; orange-brown 0.6 - 9.9ft Fine SILTY SAND; gray-brown	CL		0.0	1	1 for 12"-2-6	NA	1.2 / 2.0	0-0.1': ORGANICS 0.1-0.6': (CL) SILTY CLAY; orange-brown; soft; dry 0.6-2': (SP-SM) SILTY SAND, fine to medium, little fines; gray-brown; dry	
	305				2.0	2	6-11-10-9	21	1.3 / 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; dry with increasing dampness 2': Watertable @ 3ft bgs	
5.0			SM		4.0	3	4-3-2-2	5	1.1 / 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	
	300				6.0	4	2-2-1-1	3	0.6 / 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	
					8.0	5	6-8-9-3	17	1.1 / 2.0	8-9.9': (SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist 9.9-10.0': (CL) CLAY; olive gray; medium stiff; moist	
10.0		9.9 - 11.0ft Medium stiff CLAY; olive gray	CL		10.0	6	3-4-18-30	22	0.8 / 2.0	10-11': (CL) CLAY; olive gray; medium stiff; moist 11-12': (SP-SM) Fine to coarse SILTY SAND, some fine to coarse gravel up to 1" in diameter, little fines, poorly sorted; gray; moist	
	295	11.0 - 14.0ft Glacial till - Fine to coarse SILTY SAND, some fine to coarse gravel, little fines; gray	SP-SM		12.0	7	47-38-28-39	66	1.7 / 2.0	12-12.7': (SP-SM) Fine to coarse SILTY SAND, little fines, poorly sorted; gray; moist 12.7-14': (SP-SM) Fine to coarse SILTY SAND, some fine to coarse gravel up to 1" in diameter, little fines, poorly sorted; gray; moist	
15.0		14.0 - 15.0ft BEDROCK (?)									

Boring completed at 15.0 ft

WELL CASING
Interval (ft): 0-14
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 12-14
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 11.6-14.2
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-11.6
Type: Bentonite Chips

▤ Organics/Topsoil	▨ USCS Low Plasticity Clay (CL)	▥ USCS Silty Sand (SM)	▥ USCS Poorly-graded Sand with Silt (SP-SM)	⊠ Bedrock

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

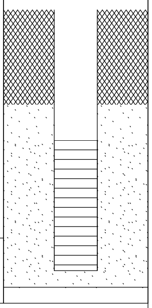
LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-12S

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: HSA	COORDS: N: 686,432.61 E: 3,039,619.52	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 307.8 ft	DEPTH W.L.: NA
DRILLED DEPTH: 9.0 ft	DATE STARTED: 9/28/18	TOC ELEVATION: 310.7 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/28/18	WEATHER: Cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 50's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS									
		0.1 - 0.6ft Soft SILTY CLAY; orange-brown	CL								
	305	0.6 - 9.0ft Fine SILTY SAND; gray-brown									
5.0			SM								
	300				7.0	1	3-3-1-5	4	1.0 2.0	(SP-SM) Fine to medium SILTY SAND, little fines, well sorted; gray-brown; moist	

Boring completed at 9.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-12D.

WELL CASING	**WELL SCREEN**	**FILTER PACK**	**FILTER PACK SEAL**	**SURFACE SEAL**
Interval (ft): 0-8	Interval (ft): 4-8	Interval (ft): 2.9-8.5	Interval (ft):	Interval (ft): 0-2.9
Material: PVC	Material: PVC	Type: #2 Sand	Type:	Type: Bentonite Chips
Diameter: 2	Diameter: 2			
Joint Type: Threaded	Slot Size: 0.01			

▤ Organics/Topsoil ▨ USCS Low Plasticity Clay (CL) ⁞ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-13D

SHEET 1 of 1

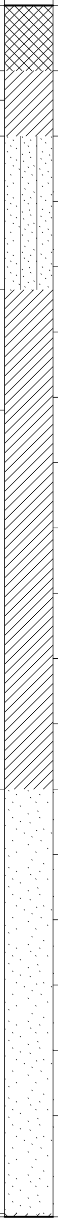
PROJECT: Crossroads Expansion	DRILL METHOD: HSA	COORDS: N: 684,339.16 E: 3,040,275.60	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 275.3 ft	DEPTH W.L.: NA
DRILLED DEPTH: 37.1 ft	DATE STARTED: 9/24/18	TOC ELEVATION: 277.5 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/24/18	WEATHER: Partly cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 50's F	TIME W.L.: NA

SOIL PROFILE

DEPTH ft	ELEVATION ft
0.0	275
5.0	270
10.0	265
15.0	260
20.0	255
25.0	250
30.0	245
35.0	240

LITHOLOGY DESCRIPTION	USCS
0.0 - 2.0ft UNSUITABLES	
2.0 - 2.9ft Soft SILTY CLAY; olive gray	CL
2.9 - 4.0ft Medium stiff CLAY; olive gray-brown	CL
4.0 - 8.7ft Fine SILTY SAND; gray-brown	SM
8.7 - 12.4ft Medium stiff CLAY; olive gray-brown	CL
12.4 - 24.0ft Medium stiff CLAY; olive gray	CL
24.0 - 37.0ft Glacial till - Fine to coarse SAND, some fines and fine to coarse grave; gray	SP
37.0 - 37.1ft BEDROCK (?)	

GRAPHIC LOG



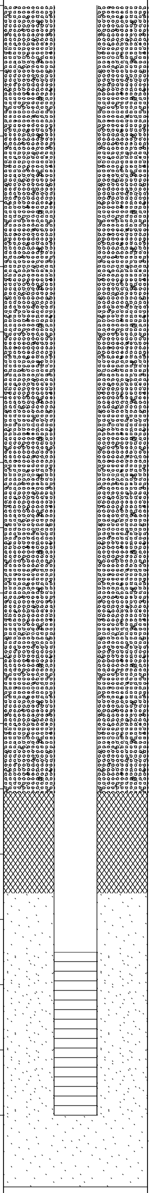
Boring completed at 37.1 ft

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC/ATT	SAMPLE DESCRIPTION
0.0	1	2-4-3-3	7	1.6/2.0	0-0.2': ORGANICS 0.2-1': (SM) Fine SAND, gray-brown; dry 1-2': (CL) CLAY, gray, trace fine sand; dry
2.0	2	3-3-5-6	8	1.7/2.0	2-2.9': (CL) CLAY, little fines; olive gray, medium stiff; dry 2.9-4': (CL) CLAY; olive gray-brown, medium stiff; dry
4.0	3	5-5-6-8	11	1.6/2.0	(SM) Fine to medium SAND, little fines, well sorted; gray-brown; dry
6.0	4	5-8-6-7	14	1.8/2.0	(SM) Fine to medium SAND, little fines, well sorted; gray-brown; moist
8.0	5	2-2-5-5	7	2.0/2.0	8-8.7': (SM) Fine to medium SAND, little fines, well sorted; gray-brown; moist 8.7-10': (CL) CLAY, some fine sand; olive gray-brown, medium stiff
10.0	6	2-3-3-3	6	2.0/2.0	(CL) CLAY; gray-brown; medium stiff; moist
12.0	7	4-6-7-10	13	1.9/2.0	12-12.4': (CL) CLAY; olive gray-brown; medium stiff; moist 12.4-14': (CL) CLAY; olive gray; medium stiff; moist
14.0	8	2-3-3-5	6	2.0/2.0	(CL) CLAY; olive gray; medium stiff; moist
16.0	9	7-6-7-10	13	2.0/2.0	(CL) CLAY; olive gray; medium stiff; moist
18.0	10	2-3-4-3	7	2.0/2.0	(CL) CLAY; olive gray; medium stiff; moist
20.0	11	5-4-5-5	9	2.0/2.0	(CL) CLAY; olive gray; medium stiff; moist
22.0	12	3-3-4-20	7	2.0/2.0	(CL) CLAY; olive gray; medium stiff; moist
24.0	13	6-21-31-34	52	2.0/2.0	(SP) Fine to coarse SAND, some fines and fine angular gravel up to 0.5" in diameter, poorly sorted; gray; moist
26.0	14	15-15-10-9	25	1.0/2.0	(SP) Fine to coarse SAND, some fines and fine to coarse angular gravel up to 1" in diameter, poorly sorted, gray; moist
28.0	15	8-9-9-10	18	0.9/2.0	(SP) Fine to coarse SAND, poorly sorted; gray; moist
30.0	16	9-8-6-6	14	0.4/2.0	(SP) Coarse SAND, some fines and fine to coarse angular gravel up to 1" in diameter, poorly sorted; gray; moist
32.0	17	9-9-13-70	22	0.9/2.0	(SP) Fine to coarse SAND, some fines and fine to coarse angular gravel up to 1" in diameter, poorly sorted; gray; moist

WELL INFORMATION

WELL GRAPHICS



WELL CASING
Interval (ft): 0-34
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 29-34
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 27-34
Type: #2 Sand

FILTER PACK SEAL
Interval (ft): 25-27
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-25
Type: Bentonite Grout Mix

▩ Fill/Overburden ▨ USCS Low Plasticity Clay (CL) ▥ USCS Silty Sand (SM) ░ USCS Poorly-graded Sand (SP) ▧ Bedrock

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-13S

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 9.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA
HAMMER TYPE: Auto SPT
DATE STARTED: 9/25/18
DATE COMPLETED: 9/25/18

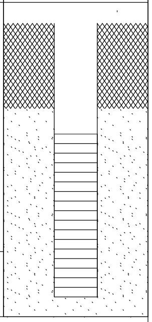
COORDS: N: 684,340.18 E: 3,040,266.52
GS ELEVATION: 275.8 ft
TOC ELEVATION: 278.8 ft
WEATHER: Cloudy
TEMPERATURE: 50's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION					
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	275	0.0 - 2.0ft UNSUITABLES		▩						
		2.0 - 2.9ft Soft SILTY CLAY; olive gray	CL	▨						
		2.9 - 4.0ft Medium stiff CLAY; olive gray-brown	CL	▨						
5.0	270	4.0 - 8.2ft Fine SILTY SAND; gray-brown	SM	▥	7.0	1	3-3-2-3	5	1.9 / 2.0	7-8.2': (SM) Fine to medium SAND, litte fines, well sorted; gray-brown; moist 8.2-9': (CL) CLAY; gray-brown; soft; moist
		8.2 - 9.0ft Soft CLAY; olive gray-brown	CL	▨						

WELL INFORMATION

WELL GRAPHICS



Boring completed at 9.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-13D.

WELL CASING
Interval (ft): 0-8.4
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 3.4-8.4
Material: 3.6
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 2.6-8.4
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-2.6
Type: Bentonite Chips

▩ Fill/Overburden
▨ USCS Low Plasticity Clay (CL)
▥ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-14D

SHEET 1 of 2

PROJECT: Crossroads Expansion	DRILL METHOD: HSA and D+W	COORDS: N: 684,572.50 E: 3,041,217.89	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 266.8 ft	DEPTH W.L.: NA
DRILLED DEPTH: 45.6 ft	DATE STARTED: 9/25/18	TOC ELEVATION: 269.5 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/25/18	WEATHER: Cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 50's F	TIME W.L.: NA

SOIL PROFILE

DEPTH ft: 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0

ELEVATION ft: 265, 260, 255, 250, 245, 240, 235, 230

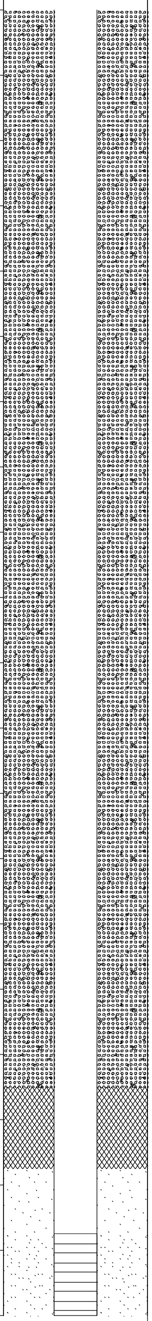
LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG
0.0 - 0.2ft Fine SILTY SAND; gray-brown	SM	⬚
0.2 - 11.1ft Medium stiff CLAY; olive gray-brown	CL	▨
11.1 - 34.0ft Soft CLAY; olive gray	CL	▨
34.0 - 45.6ft Glacial till - Fine to coarse SAND, some fines and fine to coarse gravel; gray-brown	SP	⬚

SAMPLE INFORMATION

SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION
0.0	1	2-2-4-6	6	1.3 / 2.0	0-0.2': (SM) Fine to medium SAND, little fines, well sorted; gray-brown; dry 0.2-2': (CL) CLAY; brown; stiff; dry
2.0	2	4-5-6-7	11	2.0 / 2.0	(CL) CLAY; olive gray-brown; stiff; dry
4.0	3	3-4-5-6	9	2.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; dry with increasing dampness
6.0	4	4-5-6-7	11	2.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; damp
8.0	5	5-5-5-6	10	2.0 / 2.0	(CL) CLAY; olive gray-brown; medium stiff; damp
10.0	6	2-2-3-3	5	2.0 / 2.0	10-11.1': (CL) CLAY; olive gray-brown; medium stiff; moist 11.1-12': (CL) CLAY; olive gray; soft; moist
12.0	7	3-4-4-4	8	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
14.0	8	2-2-2-3	4	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
16.0	9	1-3-3-3	6	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
18.0	10	2-1-2-3	3	2.0 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
20.0	11	WOH-2-2-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
22.0	12	WOH-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
24.0	13	WOH-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
26.0	14	WOH-WOH-1-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; medium stiff; moist
28.0	15	WOH-WOH-WOH-3	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
30.0	16	WOH-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
32.0	17	WOH-WOH-2-7	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft; moist
34.0	18	11-7-8-12	15	0.4 / 2.0	(SP) Fine to medium SAND, some fines and fine to coarse angular gravel up to 1" in diameterl, poorly sorted; gray-brown; moist
36.0	19	20-18-24-16	42	0.6 / 2.0	(SP) Medium to coarse SAND, some fines, some fine to coarse angular gravel up to 1" in diameter, poorly sorted, gray; moist
38.0	20	32-17-16-16	33	0.8 / 2.0	(SP) Medium to coarse SAND, some fines, some fine to coarse angular gravel up to 1" in diameter, poorly sorted, gray; moist

WELL INFORMATION

WELL GRAPHICS



Log continued on next page

WELL CASING
Interval (ft): 0-24.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 37.5-42.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 35.5-42.5
Type: #2 Sand

FILTER PACK SEAL
Interval (ft): 33.5-35.5
Type: Bentonite Chips

SURFACE SEAL
Interval (ft): 0-33.5
Type: Bentonite Grout Mix

⬚ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ⬚ USCS Poorly-graded Sand (SP)

DRILLING COMPANY: SW Cole	LOGGED BY: LWL
DRILLER: K. Hanscom	CHECKED BY: BDL
DRILL RIG: Diedrich D-50 T	DATE: 12/7/18

Golder Associates

RECORD OF BOREHOLE PZ-14D

SHEET 2 of 2

PROJECT: Crossroads Expansion	DRILL METHOD: HSA and D+W	COORDS: N: 684,572.50 E: 3,041,217.89	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 266.8 ft	DEPTH W.L.: NA
DRILLED DEPTH: 45.6 ft	DATE STARTED: 9/25/18	TOC ELEVATION: 269.5 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 9/25/18	WEATHER: Cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 50's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
40.0											
	225		SP								
45.0					45.0	21	70-50 for 1"	Refusal	0.4 0.6	(SP) Coarse SAND, some fines, some fine to coarse angular gravel up to 1" in diameter, poorly sorted; gray; moist	

Boring completed at 45.6 ft

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-24.5	Interval (ft): 37.5-42.5	Interval (ft): 35.5-42.5	Interval (ft): 33.5-35.5	Interval (ft): 0-33.5
Material: PVC	Material: PVC	Type: #2 Sand	Type: Bentonite Chips	Type: Bentonite Grout Mix
Diameter: 2	Diameter: 2			
Joint Type: Threaded	Slot Size: 0.01			

▥ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL) ⁘ USCS Poorly-graded Sand (SP)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

RECORD OF BOREHOLE PZ-14M

SHEET 1 of 1

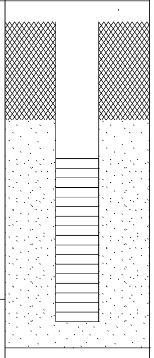
PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 10.5 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: HSA
HAMMER TYPE: Auto SPT
DATE STARTED: 9/26/18
DATE COMPLETED: 9/26/18

COORDS: N: 684,586.35 E: 3,041,209.82
GS ELEVATION: 267.1 ft
TOC ELEVATION: 269.9 ft
WEATHER: Cloudy
TEMPERATURE: 60's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.2ft Fine SILTY SAND; gray-brown	SM								
	265	0.2 - 9.5ft Medium stiff CLAY; olive gray-brown	CL	▨							
5.0											
	260										
10.0		9.5 - 10.5ft Medium stiff CLAY; olive gray	CL	▨	8.5	1	2-3-4-5	7	2.0 / 2.0	8.5-9.5': (CL) CLAY; olive gray-brown, medium stiff; moist 9.5-10.5': (CL) CLAY; olive gray, medium stiff; moist	



Boring completed at 10.5 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-14D.

WELL CASING
Interval (ft): 0-10
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 5-10
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 3-10
Type: #2 Sand

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-3
Type: Bentonite Chips

⁘ USCS Silty Sand (SM) ▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 12/7/18

RECORD OF BOREHOLE PZ-15D

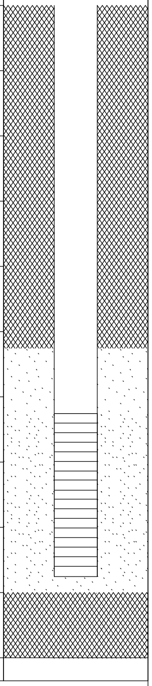
SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 20.7 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/13/19
DATE COMPLETED: 3/13/19

COORDS: N: 686,290.16 E: 3,038,513.38
GS ELEVATION: 284.4 ft
TOC ELEVATION: 287.5 ft
WEATHER: Sunny
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 1.0ft Fine SILTY SAND; gray-brown 1.0 - 7.5ft Stiff CLAY; olive gray-brown	SM CL	░ ▨	0.0	1	WOH-1-3-3	NA	1.0 / 2.0	0-1': (SM) Fine SILTY SAND, little fines; gray-brown; dry 1-2': (CL) CLAY; olive gray-brown; stiff; dry	
				▨	2.0	2	3-4-6-5	10	2.0 / 2.0	(CL) CLAY; olive gray; stiff; dry	
5.0	280			▨	4.0	3	4-5-5-5	10	1.4 / 2.0	(CL) CLAY; olive gray; stiff; dry	
				▨	6.0	4	4-3-3-2	6	1.7 / 2.0	(CL) CLAY; olive gray; medium stiff; moist	
	275	7.5 - 10.0ft Very soft to medium stiff CLAY; olive gray	CL	▨	8.0	5	WOH-WOH-WOH-2	NA	2.0 / 2.0	(CL) CLAY; olive gray; soft to very soft; moist	
10.0		10.0 - 18.0ft Glacial till - Stiff gravelly sandy SILTY CLAY, some fine to coarse sand and gravel; gray	CL	▨	10.0	6	5-12-7-5	19	0.5 / 2.0	10.5': Driller noted change in lithology at 10.5 ft bgs (GM) Coarse angular gravel up to 1" in diameter; gray; moist	
				▨	12.0	7	4-6-5-5	11	0.7 / 2.0	(CL) CLAYEY GRAVEL, fine to coarse gravel up to 1" in diameter; stiff; gray; moist	
15.0	270			▨	14.0	8	7-7-2-3	9	0.6 / 2.0	(CL/SC) gravelly sandy SILTY CLAY, some fine to coarse sand and gravel up to 1" in diameter; stiff; gray; moist	
				▨	16.0	9	6-8-5-6	13	0.5 / 2.0	(CL/SC) gravelly sandy SILTY CLAY, some fine to coarse sand and gravel up to 1" in diameter; stiff; gray; moist	
20.0	265	18.0 - 20.7ft Glacial till - SILTY SAND and GRAVEL, fine to coarse sand and gravel, little fines; gray	SP	░	18.0	10	13-7-17-9	24	0.2 / 2.0	(SP) SILTY SAND and GRAVEL, fine to coarse sand and gravel up to 1" in diameter, little fines; gray; wet	

Boring completed at 20.7 ft

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-12.5	Interval (ft): 12.5-17.5	Interval (ft): 10.5-18	Interval (ft):	Interval (ft): 0-10.5
Material: PVC	Material: PVC	Type: #2 Sand	Type:	Type: Bentonite Chips
Diameter: 2	Diameter: 2	Quantity: 225 lbs		Quantity: 100 lbs
Joint Type: Threaded	Slot Size: 0.01			

░ Sand
▨ USCS Low Plasticity Clay (CL)
░ USCS Poorly-graded Sand (SP)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE PZ-15M

SHEET 1 of 1

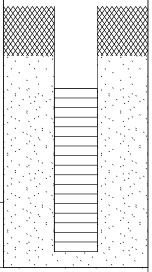
PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 8.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 3/13/19
DATE COMPLETED: 3/13/19

COORDS: N: 686,287.06 E: 3,038,512.71
GS ELEVATION: 284.8 ft
TOC ELEVATION: 287.6 ft
WEATHER: Sunny
TEMPERATURE: 30's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION*	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.4ft Fine SILTY SAND; gray-brown	SM	░							
		0.4 - 2.0ft Stiff CLAY; olive gray-brown	CL	▨							
5.0	280	2.0 - 8.0ft Very soft to stiff CLAY; olive gray	CL	▨							
				▨	6.0	1	4-4-5-6	9	2.0 / 2.0	(CL) CLAY; olive gray; medium stiff; dry	



Boring completed at 8.0 ft

*When no soil samples collected, lithology at this well cluster determined at PZ-15D.

WELL CASING
Interval (ft): 0-2.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 2.5-7.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 1.5-8
Type: #2 Sand
Quantity: 50 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-1.5
Type: Bentonite Chips

░ Sand

▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

RECORD OF BOREHOLE PZ-20S

SHEET 1 of 1

PROJECT: Crossroads Expansion
PROJECT NUMBER: 19119078
DRILLED DEPTH: 14.0 ft
AZIMUTH: N/A
LOCATION: Norridgewock, ME

DRILL METHOD: Drive and Wash
HAMMER TYPE: Auto SPT
DATE STARTED: 4/5/19
DATE COMPLETED: 4/5/19

COORDS: N: 684,538.13 E: 3,040,074.18
GS ELEVATION: 283.9 ft
TOC ELEVATION: 286.7 ft
WEATHER: Cloudy
TEMPERATURE: 40's F

INCLINATION: 90
DEPTH W.L.: NA
ELEVATION W.L.:
DATE W.L.: NA
TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 1.0ft Organics 1.0 - 12.7ft Fine SILTY SAND; gray-brown	SM		0.0	1	1-1-3-2	4	1.3 / 2.0	0-1': ORGANICS 1-2': (SM) Fine SILTY SAND, little fines; gray-brown; dry	
					2.0	2	4-5-6-7	11	1.5 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; moist	
5.0	280				4.0	3	4-6-6-6	12	1.3 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; moist	
					6.0	4	6-7-7-7	14	1.6 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; moist	
	275				8.0	5	6-7-7-7	14	1.2 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; moist	
10.0					10.0	6	5-6-6-4	12	1.5 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; moist	
	270	12.7 - 14.0ft Stiff CLAY; brown	CL	▨	12.0	7	3-4-5-6	9	2.0 / 2.0	12-12.7': (SM) Fine SILTY SAND, little fines; gray-brown; moist 12.7-14: (CL) CLAY; brown; medium stiff; dry	

Boring completed at 14.0 ft

WELL CASING
Interval (ft): 0-6.5
Material: PVC
Diameter: 2
Joint Type: Threaded

WELL SCREEN
Interval (ft): 6.5-11.5
Material: PVC
Diameter: 2
Slot Size: 0.01

FILTER PACK
Interval (ft): 4.5-12
Type: #2 Sand
Quantity: 75 lbs

FILTER PACK SEAL
Interval (ft):
Type:

SURFACE SEAL
Interval (ft): 0-4.5
Type: Bentonite Chips
Quantity: 25 lbs

USCS Silty Sand (SM)

▨ USCS Low Plasticity Clay (CL)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

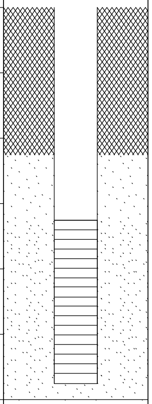
LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

RECORD OF BOREHOLE PZ-21S

SHEET 1 of 1

PROJECT: Crossroads Expansion	DRILL METHOD: Drive and Wash	COORDS: N: 686,033.54 E: 3,038,607.47	INCLINATION: 90
PROJECT NUMBER: 19119078	HAMMER TYPE: Auto SPT	GS ELEVATION: 299.0 ft	DEPTH W.L.: NA
DRILLED DEPTH: 14.0 ft	DATE STARTED: 4/5/19	TOC ELEVATION: 301.8 ft	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 4/5/19	WEATHER: Cloudy	DATE W.L.: NA
LOCATION: Norridgewock, ME		TEMPERATURE: 40's F	TIME W.L.: NA

SOIL PROFILE					SAMPLE INFORMATION						WELL INFORMATION
DEPTH ft	ELEVATION ft	LITHOLOGY DESCRIPTION	USCS	GRAPHIC LOG	SAMPLE DEPTH	NUMBER	BLOW COUNT	N	REC / ATT	SAMPLE DESCRIPTION	WELL GRAPHICS
0.0		0.0 - 0.1ft ORGANICS 0.1 - 3.0ft Soft CLAY; brown	CL	▨	0.0	1	2-2-2-2	4	0.6 / 2.0	0-0.1': Organics 0.1-2': (CL) CLAY; brown; soft; dry	
		3.0 - 12.0ft Fine SILTY SAND; gray-brown	SM	░	2.0	2	2-2-6-8	8	0.0 / 2.0	No recovery	
5.0	295			░	4.0	3	7-8-7-7	15	1.3 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet	
				░	6.0	4	8-6-5-5	11	1.4 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet	
	290			░	8.0	5	3-3-3-5	6	1.0 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet	
10.0				░	10.0	6	4-5-7-6	12	1.0 / 2.0	(SM) Fine SILTY SAND, little fines; gray-brown; wet	
		12.0 - 14.0ft Medium stiff CLAY; olive gray	CL	▨	12.0	7	2-3-3-6	6	1.6 / 2.0	(CL) CLAY; olive gray; medium stiff; dry	
	285										

Boring completed at 14.0 ft

WELL CASING	WELL SCREEN	FILTER PACK	FILTER PACK SEAL	SURFACE SEAL
Interval (ft): 0-6.5	Interval (ft): 6.5-11.5	Interval (ft): 4.5-12	Interval (ft):	Interval (ft): 0-4.5
Material: PVC	Material: PVC	Type: #2 Sand	Type:	Type: Bentonite Chips
Diameter: 2	Diameter: 2	Quantity: 75 lbs		Quantity: 50 lbs
Joint Type: Threaded	Slot Size: 0.01			

▤ Organics/Topsoil ▨ USCS Low Plasticity Clay (CL) ░ USCS Silty Sand (SM)

DRILLING COMPANY: SW Cole
DRILLER: K. Hanscom
DRILL RIG: Diedrich D-50 T

LOGGED BY: LWL
CHECKED BY: BDL
DATE: 7/15/19

Golder Associates

APPENDIX B

Laboratory Soil Testing Results

Client:	Golder Associates		
Project:	Crossroads Landfill Investigation		
Location:	Norridgewock, ME	Project No:	GTX-307036

Boring ID:	---	Sample Type:	---	Tested By:	cam
Sample ID:	---	Test Date:	10/10/17	Checked By:	emm
Depth :	---	Test Id:	425889		

USCS Classification - ASTM D2487

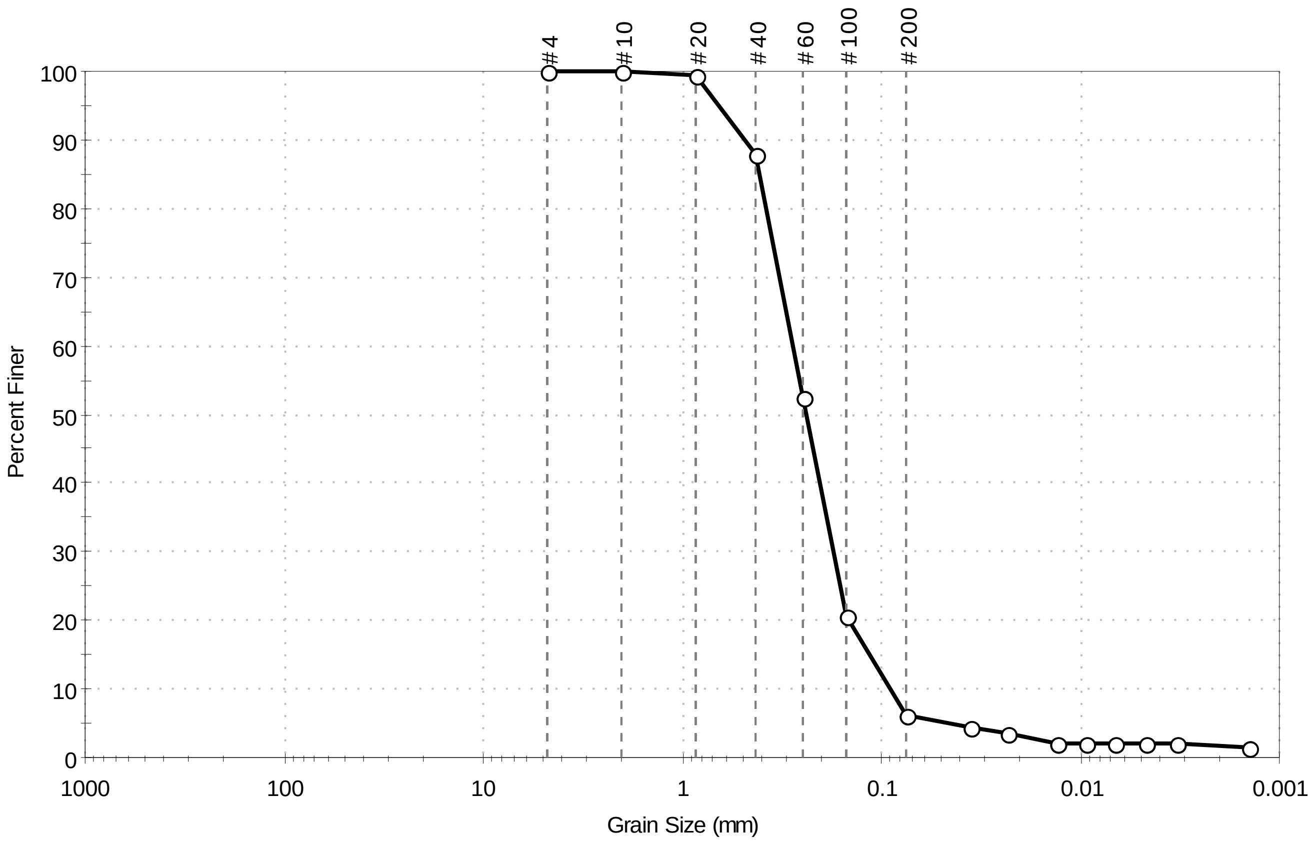
Boring ID	Sample ID	Depth	Group Name	Group Symbol	Gravel, %	Sand, %	Fines, %
SB-2 PZ-2S	SS1, SS2	0-4	Poorly graded sand with silt	SP-SM	0.0	93.7	6.3
SB-2 PZ-2S	SS5	8-10	Lean clay	CL	0.0	0.7	99.3
SB-2 PZ-2S	SS6	15-17	Lean clay	CL	0.0	1.3	98.7
SB-3 PZ-3S	SS6	10-12	Lean clay	CL	0.0	0.8	99.2
SB-3 PZ-3S	SS9	16-18	Lean clay	CL	0.0	0.2	99.8
SB-4 PZ-4S	SS2, SS3	2-6	Silty sand	SM	0.0	62.5	37.5
SB-4 PZ-4S	SS5	8-10	Lean clay	CL	0.0	2.9	97.1
SB-4 PZ-4S	SS8, SS9	14-18	Sandy Silt with gravel	ML	17.5	32.1	50.4
SB-5 PZ-5D	SS5, SS6	12.8-16.8	Silty gravel with sand	GM	36.5	31.1	32.4

Remarks: Grain Size analysis performed by ASTM D422 results enclosed
Atterberg Limits performed by ASTM D4318, results enclosed

GeoTesting EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-2 ← i.e. PZ-2S
Sample Type: jar
Tested By: jbr
Sample ID: SS1, SS2
Test Date: 09/27/17
Checked By: emm
Depth : 0-4
Test Id: 425900
Test Comment: ---
Visual Description: Moist, brown sand with silt
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	93.7	6.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	88		
#60	0.25	53		
#100	0.15	21		
#200	0.075	6.3		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0359	4		
---	0.0232	3		
---	0.0132	2		
---	0.0095	2		
---	0.0067	2		
---	0.0048	2		
---	0.0033	2		
---	0.0014	1		

Coefficients

D_{85} =0.4066 mm
D_{30} =0.1740 mm
D_{60} =0.2794 mm
D_{15} =0.1140 mm
D_{50} =0.2398 mm
D_{10} =0.0897 mm
C_u =3.115
C_c =1.208

Classification

ASTM Poorly graded sand with silt (SP-SM)

AASHTO Fine Sand (A-3 (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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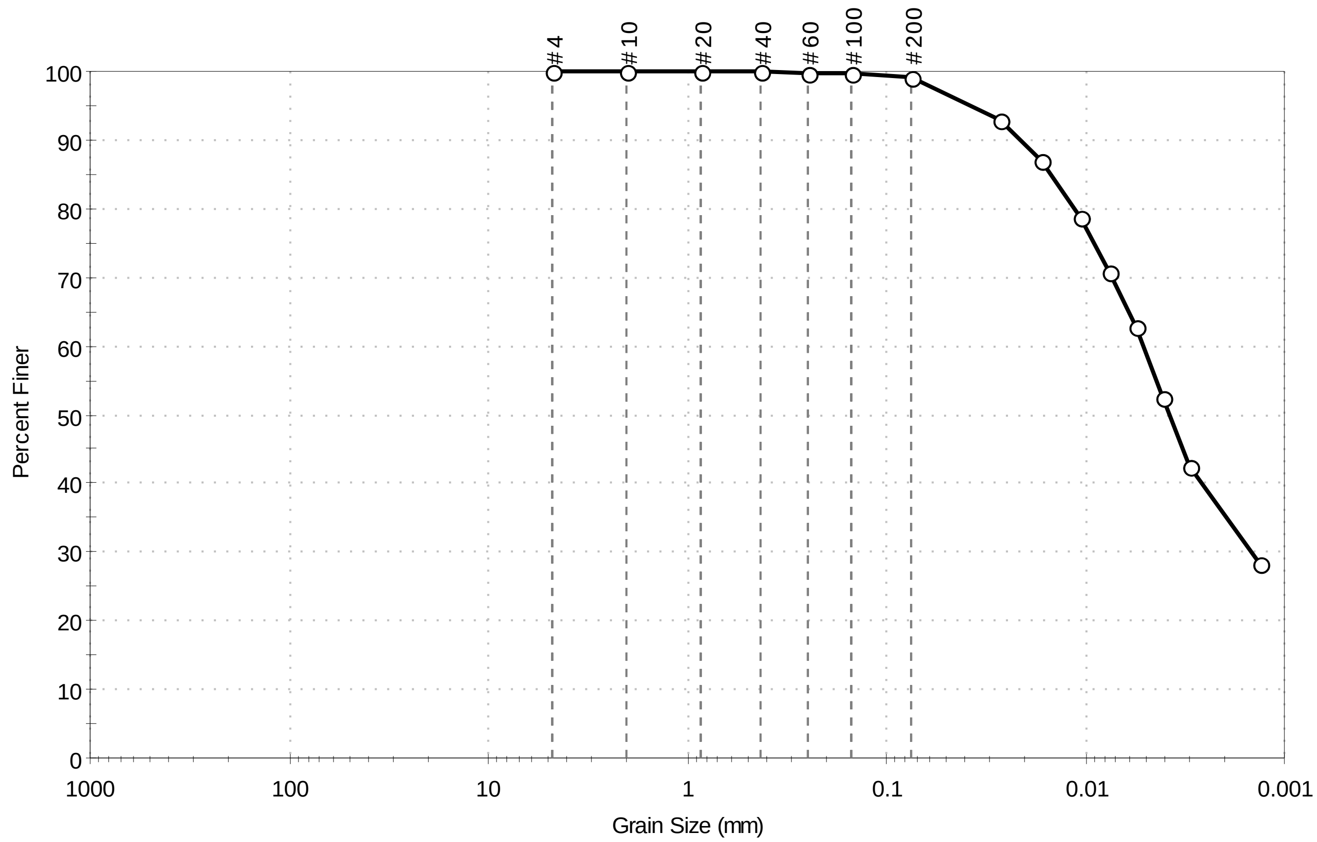
Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-2 i.e. PZ-2S
Sample Type: jar
Tested By: jbr
Sample ID: SS5
Test Date: 09/27/17
Checked By: emm
Depth : 8-10
Test Id: 425905
Test Comment: ---
Visual Description: Moist, gray clay
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	0.7	99.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	99		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0267	93		
---	0.0165	87		
---	0.0105	79		
---	0.0076	71		
---	0.0056	63		
---	0.0041	53		
---	0.0030	42		
---	0.0013	28		

Coefficients

D_{85} = 0.0148 mm
D_{30} = 0.0015 mm
D_{60} = 0.0051 mm
D_{15} = N/A
D_{50} = 0.0038 mm
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-6 (11))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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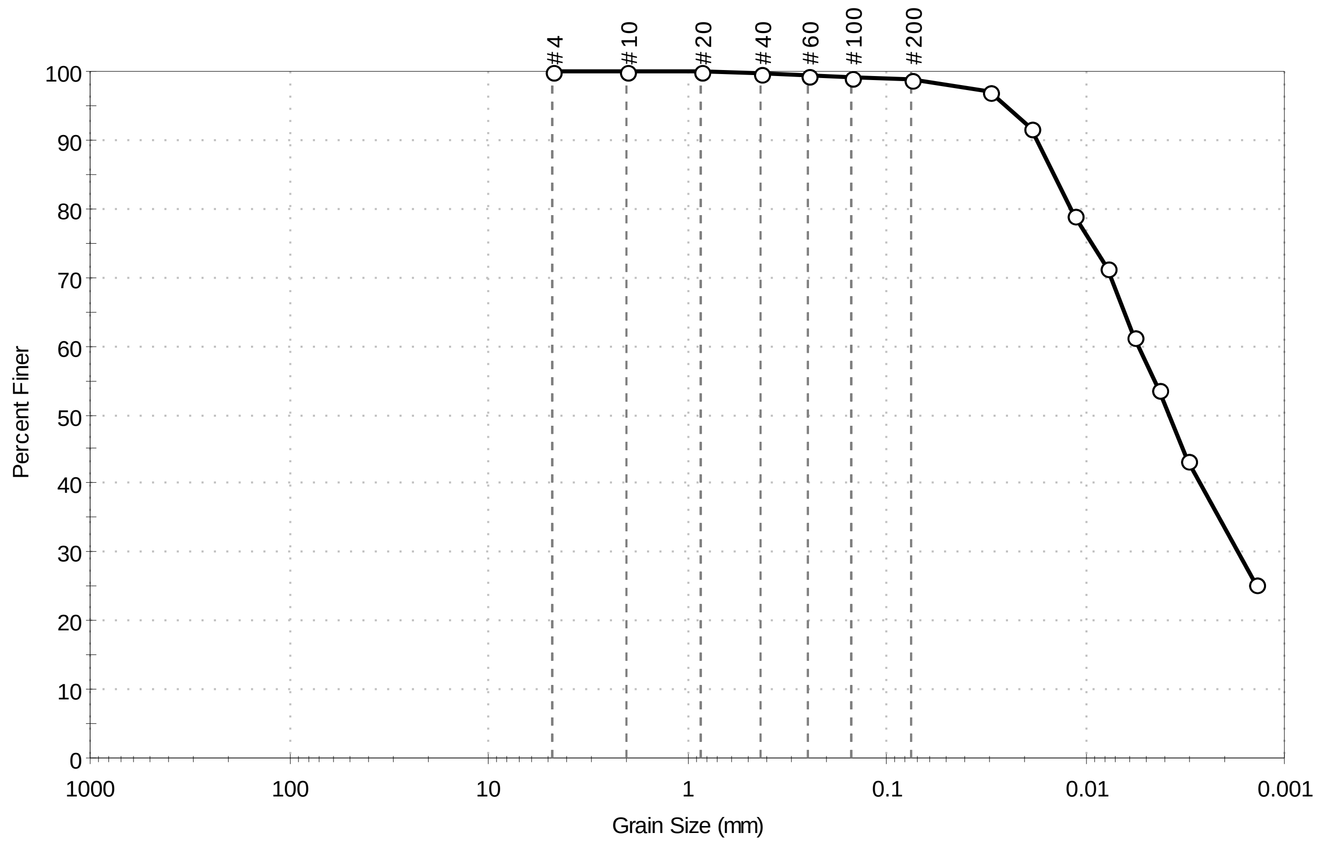
Client:	Golder Associates				
Project:	Crossroads Landfill Investigation				
Location:	Norridgewock, ME			Project No:	GTX-307036
Boring ID:	SB-2 ← i.e. PZ-2S	Sample Type:	jar	Tested By:	jbr
Sample ID:	SS6	Test Date:	09/29/17	Checked By:	emm
Depth :	15-17	Test Id:	425904		

Test Comment: ---
Visual Description: Moist, gray clay
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	1.3	98.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	99		
#200	0.075	99		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0300	97		
---	0.0187	92		
---	0.0113	79		
---	0.0079	71		
---	0.0057	61		
---	0.0042	54		
---	0.0031	43		
---	0.0014	26		

Coefficients

D_{85} = 0.0143 mm	D_{30} = 0.0017 mm
D_{60} = 0.0055 mm	D_{15} = N/A
D_{50} = 0.0038 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

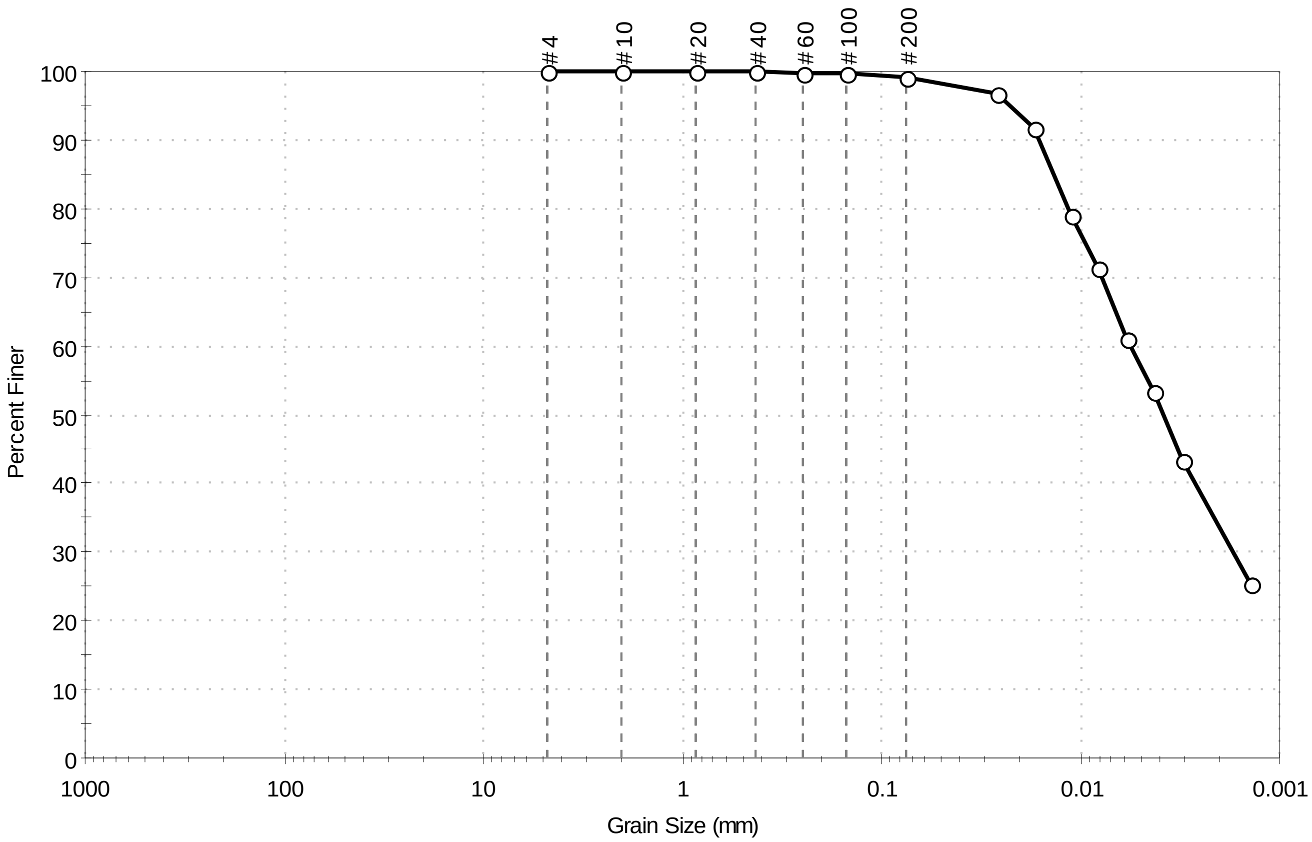
ASTM	Lean clay (CL)
AASHTO	Clayey Soils (A-6 (14))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-3 ← i.e. PZ-3S
Sample ID: SS6
Depth : 10-12
Sample Type: jar
Test Date: 09/27/17
Test Id: 425902
Tested By: jbr
Checked By: emm
Test Comment: ---
Visual Description: Moist, olive clay
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	0.8	99.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	99		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0260	97		
---	0.0170	92		
---	0.0112	79		
---	0.0082	71		
---	0.0059	61		
---	0.0043	54		
---	0.0031	43		
---	0.0014	25		

Coefficients

D_{85} =0.0136 mm
D_{30} =0.0017 mm
D_{60} =0.0056 mm
D_{15} =N/A
D_{50} =0.0038 mm
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-6 (12))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

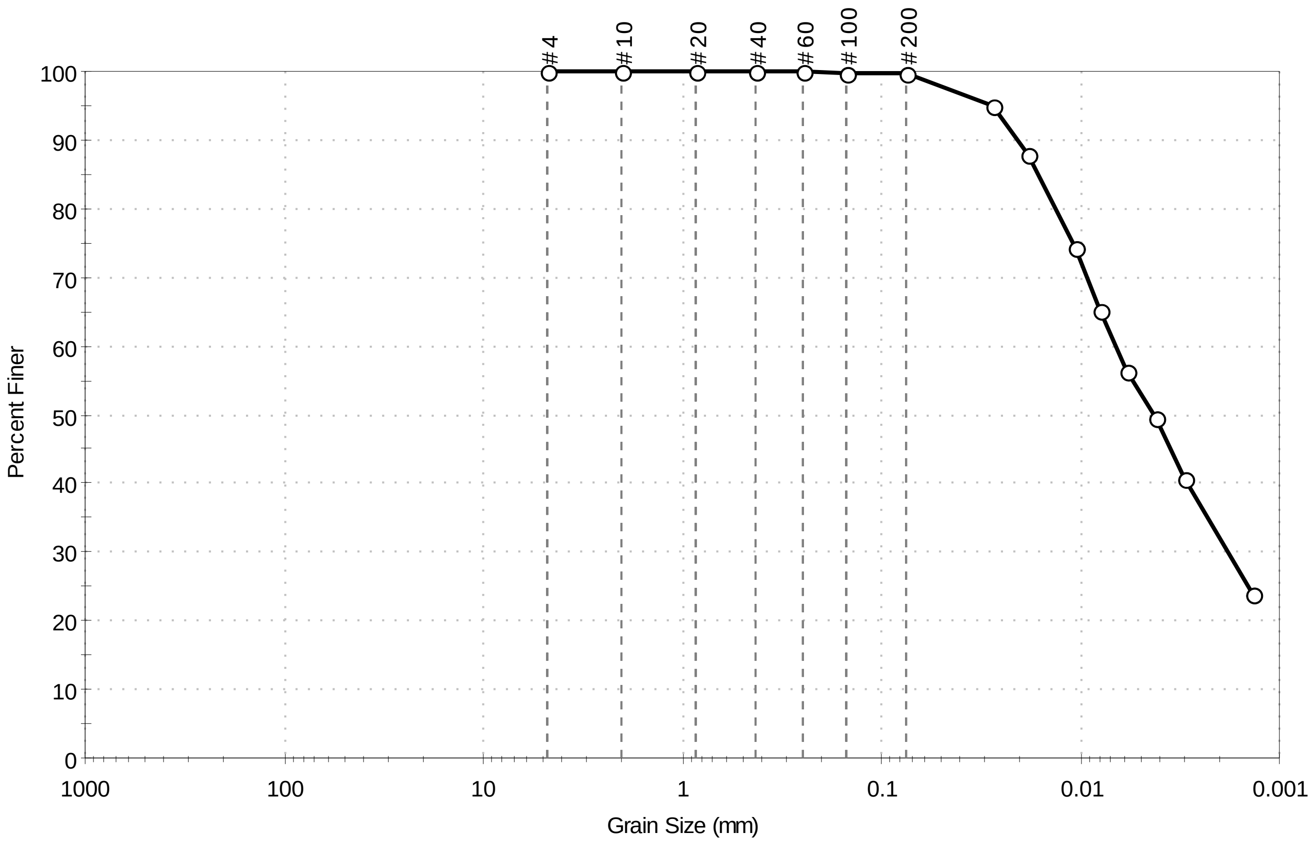
Specific Gravity : 2.65

Separation of Sample: #200 Sieve

GeoTesting
EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-3 ← i.e. PZ-3S
Sample Type: jar
Tested By: jbr
Sample ID: SS9
Test Date: 09/27/17
Checked By: emm
Depth : 16-18
Test Id: 425903
Test Comment: ---
Visual Description: Moist, gray clay
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	0.2	99.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0274	95		
---	0.0183	88		
---	0.0106	74		
---	0.0080	65		
---	0.0058	56		
---	0.0042	49		
---	0.0030	41		
---	0.0014	24		

Coefficients

D_{85} =0.0163 mm
D_{30} =0.0018 mm
D_{60} =0.0066 mm
D_{15} =N/A
D_{50} =0.0043 mm
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-6 (16))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

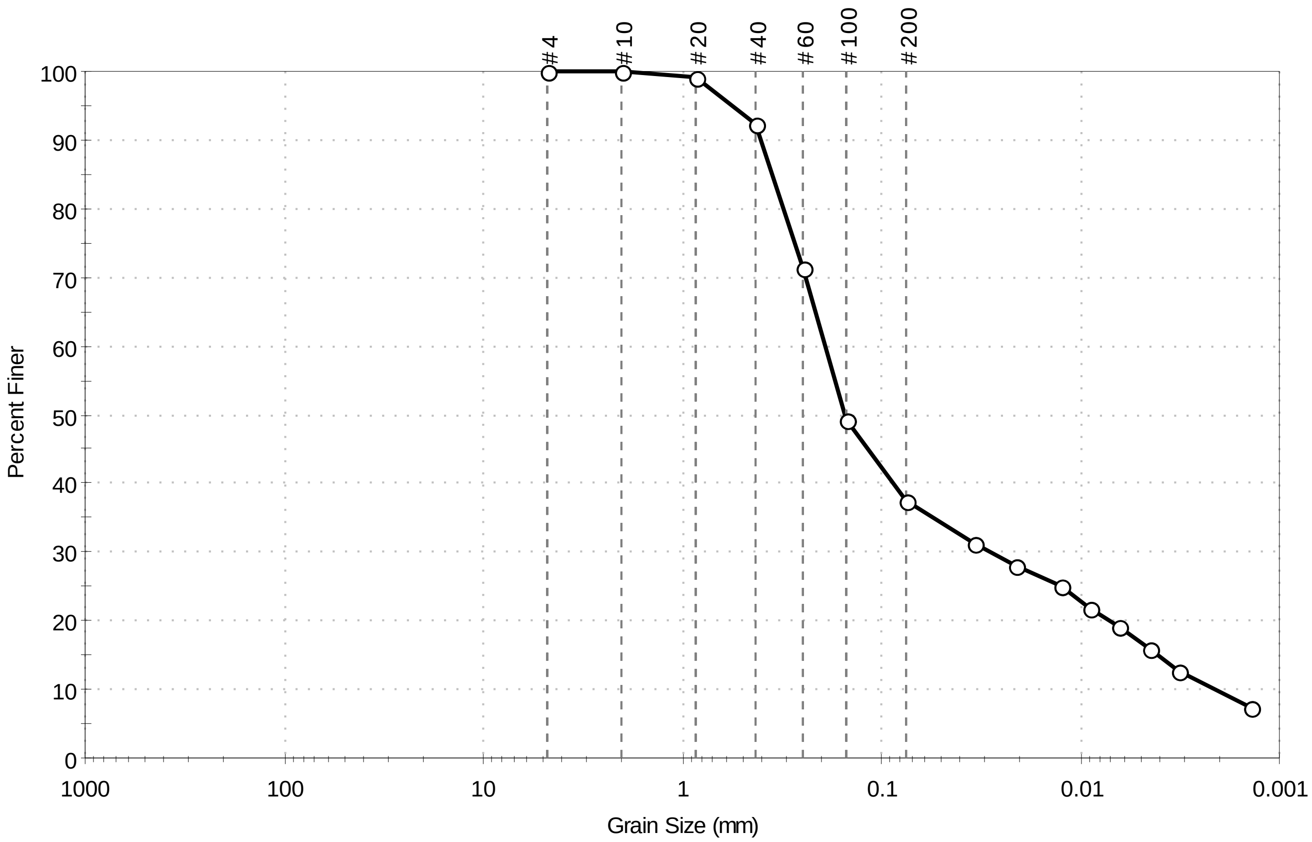
Specific Gravity : 2.65

Separation of Sample: #200 Sieve

GeoTesting EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-4 ← i.e. PZ-4S
Sample Type: jar
Tested By: jbr
Sample ID: SS2, SS3
Test Date: 09/27/17
Checked By: emm
Depth : 2-6
Test Id: 425899
Test Comment: ---
Visual Description: Moist, brown silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	62.5	37.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	92		
#60	0.25	71		
#100	0.15	49		
#200	0.075	38		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0340	31		
---	0.0213	28		
---	0.0124	25		
---	0.0089	22		
---	0.0064	19		
---	0.0045	16		
---	0.0032	13		
---	0.0014	7		

Coefficients

D_{85} = 0.3534 mm
D_{30} = 0.0278 mm
D_{60} = 0.1925 mm
D_{15} = 0.0041 mm
D_{50} = 0.1528 mm
D_{10} = 0.0021 mm
C_u = 91.667
C_c = 1.912

Classification

ASTM Silty sand (SM)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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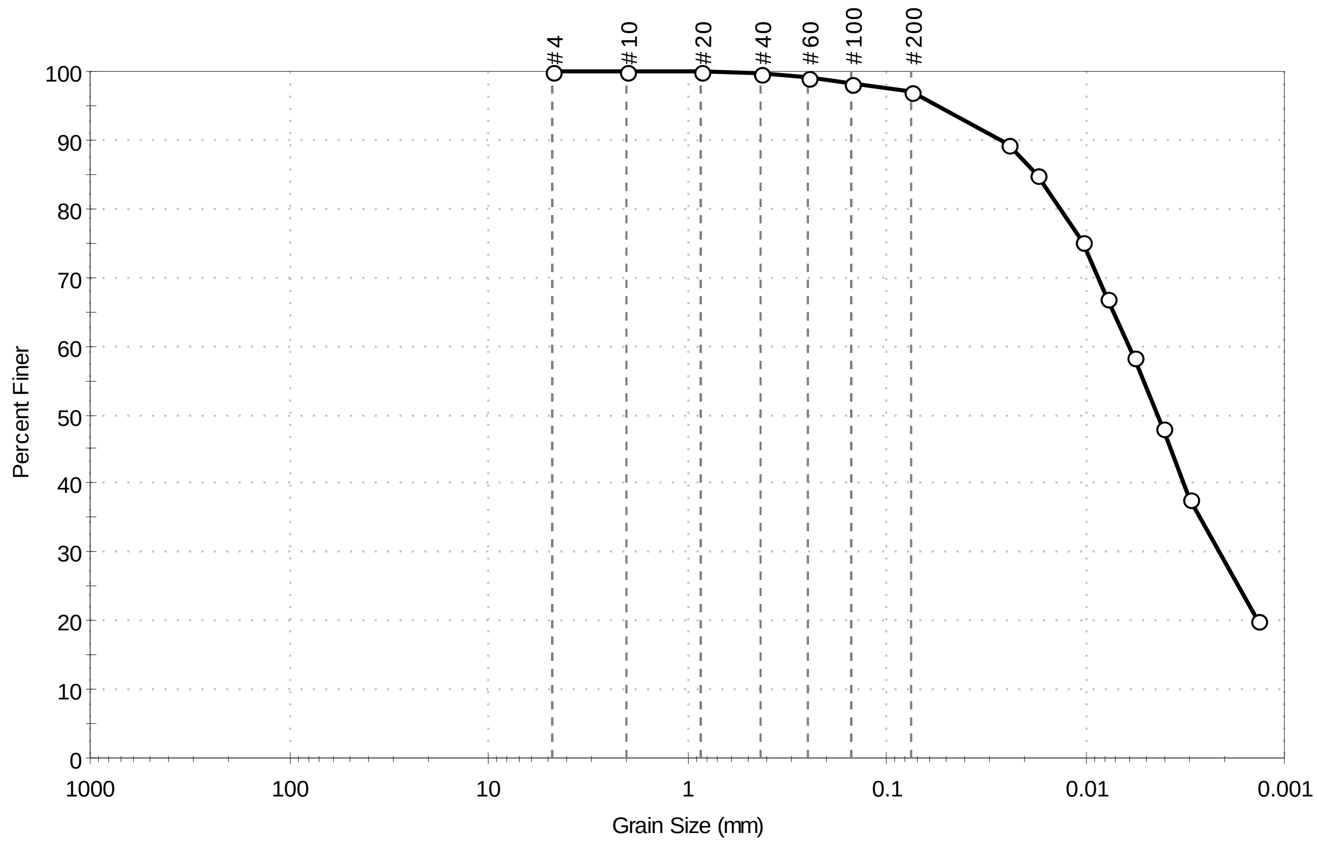
GeoTesting
EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-4 i.e. PZ-4S
Sample Type: jar
Tested By: jbr
Sample ID: SS5
Test Date: 09/27/17
Checked By: emm
Depth : 8-10
Test Id: 425901
Test Comment: ---
Visual Description: Moist, olive clay
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	2.9	97.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	98		
#200	0.075	97		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0246	89		
---	0.0177	85		
---	0.0104	75		
---	0.0078	67		
---	0.0057	58		
---	0.0041	48		
---	0.0030	38		
---	0.0014	20		

Coefficients

D_{85} = 0.0176 mm
D_{30} = 0.0021 mm
D_{60} = 0.0060 mm
D_{15} = N/A
D_{50} = 0.0044 mm
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-6 (10))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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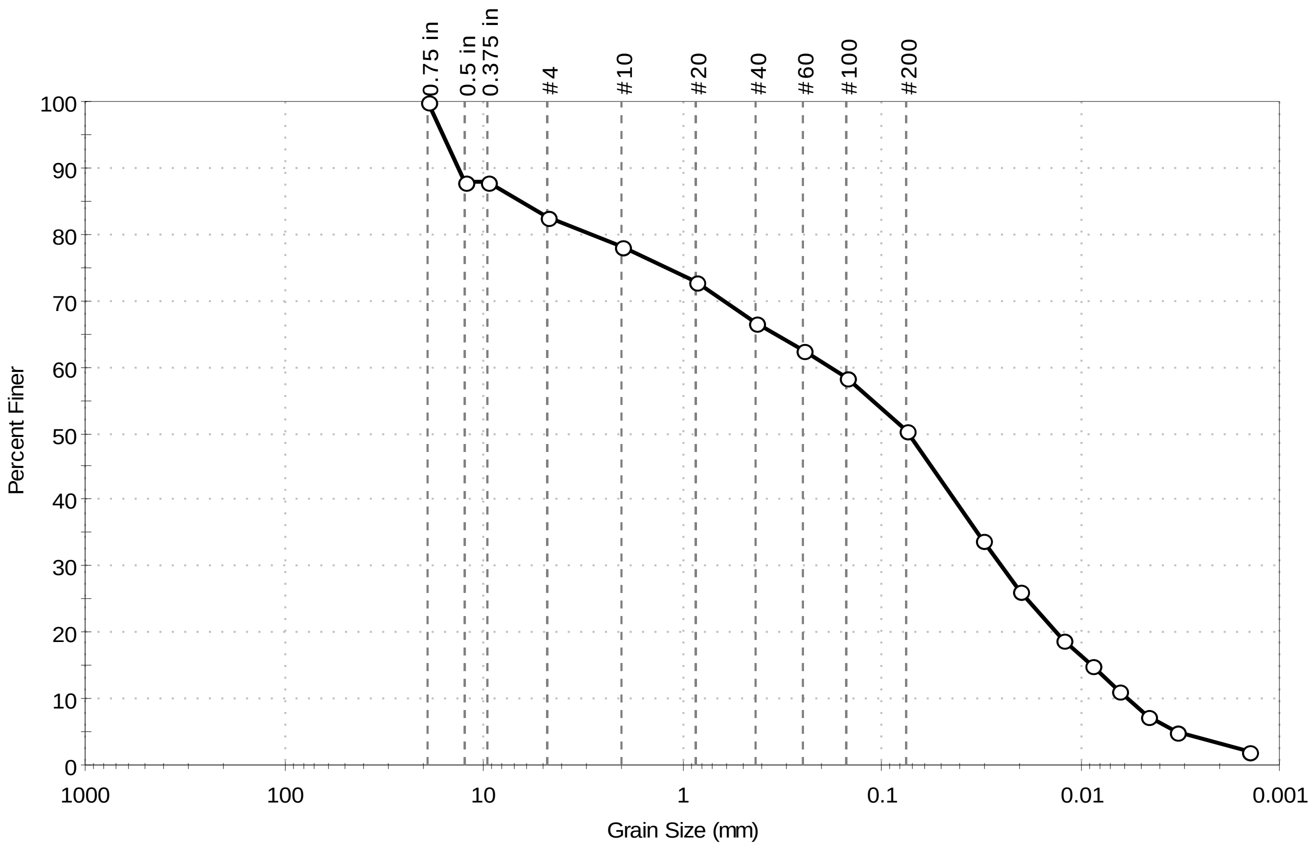
Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-4 ← i.e. PZ-4S
Sample Type: jar
Tested By: jbr
Sample ID: SS8, SS9
Test Date: 09/27/17
Checked By: emm
Depth : 14-18
Test Id: 425897
Test Comment: ---
Visual Description: Moist, brown sandy silt with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	17.5	32.1	50.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	88		
0.375 in	9.50	88		
#4	4.75	83		
#10	2.00	78		
#20	0.85	73		
#40	0.42	67		
#60	0.25	62		
#100	0.15	58		
#200	0.075	50		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0308	34		
---	0.0202	26		
---	0.0123	19		
---	0.0088	15		
---	0.0065	11		
---	0.0046	8		
---	0.0033	5		
---	0.0014	2		

Coefficients

D_{85} = 6.5454 mm
D_{30} = 0.0250 mm
D_{60} = 0.1844 mm
D_{15} = 0.0087 mm
D_{50} = 0.0735 mm
D_{10} = 0.0057 mm
C_u = 32.351
C_c = 0.595

Classification

ASTM	Sandy Silt with gravel (ML)
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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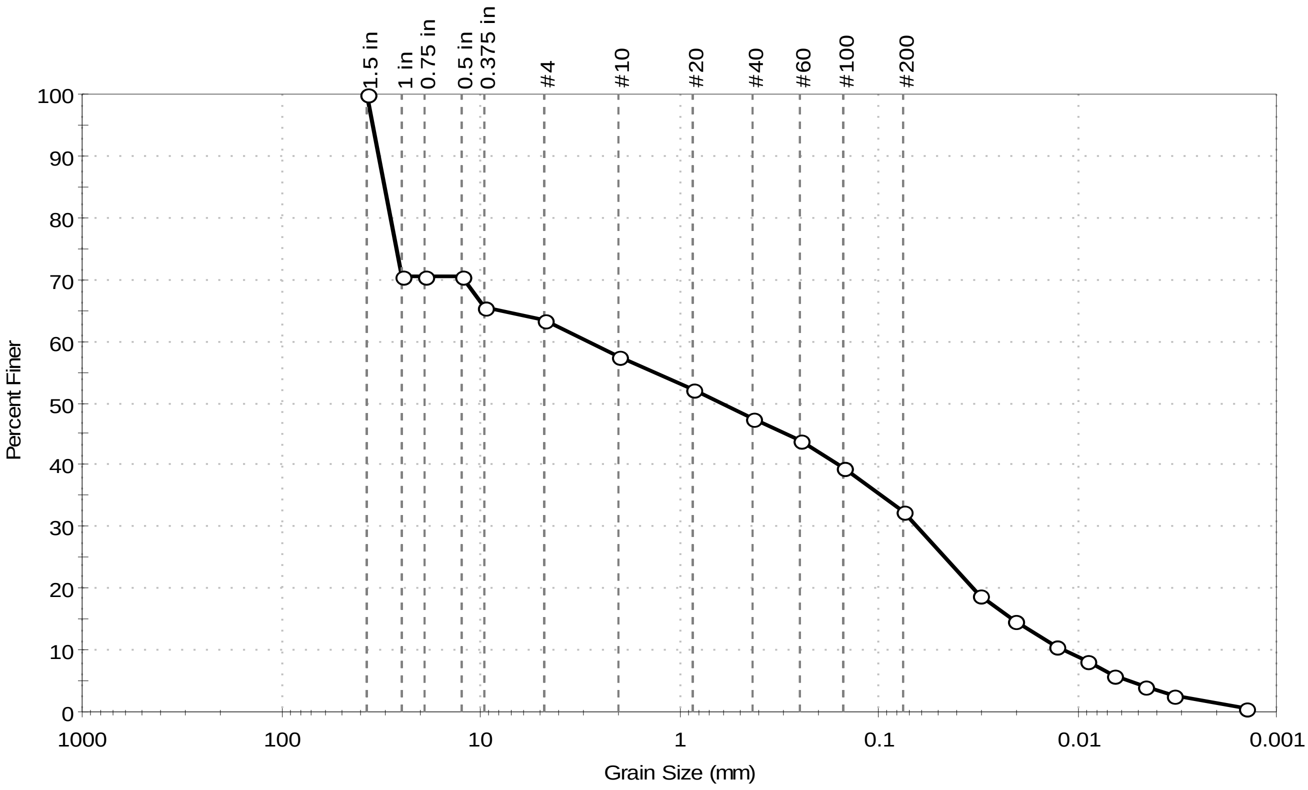
GeoTesting EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-5 ← i.e. PZ-5D
Sample Type: jar
Tested By: jbr
Sample ID: SS5, SS6
Test Date: 09/27/17
Checked By: emm
Depth : 12.8-16.8
Test Id: 425898
Test Comment: ---
Visual Description: Moist, gray silty gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	36.5	31.1	32.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	71		
0.75 in	19.00	71		
0.5 in	12.50	71		
0.375 in	9.50	66		
#4	4.75	64		
#10	2.00	58		
#20	0.85	52		
#40	0.42	48		
#60	0.25	44		
#100	0.15	40		
#200	0.075	32		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0312	19		
---	0.0205	15		
---	0.0127	11		
---	0.0089	8		
---	0.0065	6		
---	0.0047	4		
---	0.0033	3		
---	0.0014	1		

Coefficients

D_{85} = 30.4820 mm
D_{30} = 0.0641 mm
D_{60} = 2.8469 mm
D_{15} = 0.0210 mm
D_{50} = 0.6099 mm
D_{10} = 0.0116 mm
C_u = 245.422
C_c = 0.124

Classification

<u>ASTM</u> Silty gravel with sand (GM)

<u>AASHTO</u> Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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Client:	Golder Associates		
Project:	Crossroads Landfill Investigation		
Location:	Norridgewock, ME	Project No:	GTX-307036
Boring ID:	SB-2 ← i.e. PZ-2S	Sample Type: jar	Tested By: cam
Sample ID:	SS1, SS2	Test Date: 09/27/17	Checked By: emm
Depth :	0-4	Test Id: 425882	
Test Comment:	---		
Visual Description:	Moist, brown sand with silt		
Sample Comment:	---		

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS1, SS2	SB-2	0-4	9	n/a	n/a	n/a	n/a	Poorly graded sand with silt (SP-SM)

12% Retained on #40 Sieve

Dry Strength: MEDIUM

Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

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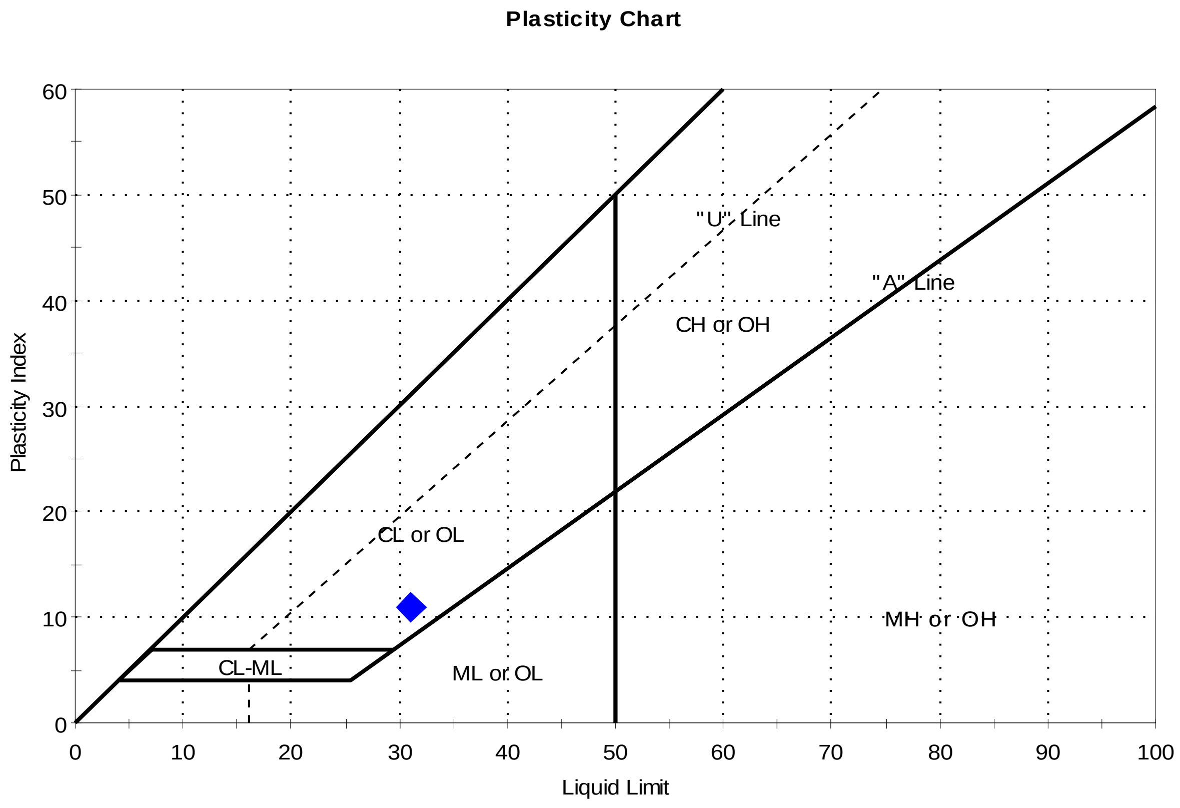
GeoTesting
EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-2 ← i.e. PZ-2S
Sample Type: jar
Tested By: cam
Sample ID: SS5
Test Date: 10/05/17
Checked By: emm
Depth : 8-10
Test Id: 425887
Test Comment: ---
Visual Description: Moist, gray clay
Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS5	SB-2	8-10	28	31	20	11	0.7	Lean clay (CL)

Sample Prepared using the WET method

0% Retained on #40 Sieve

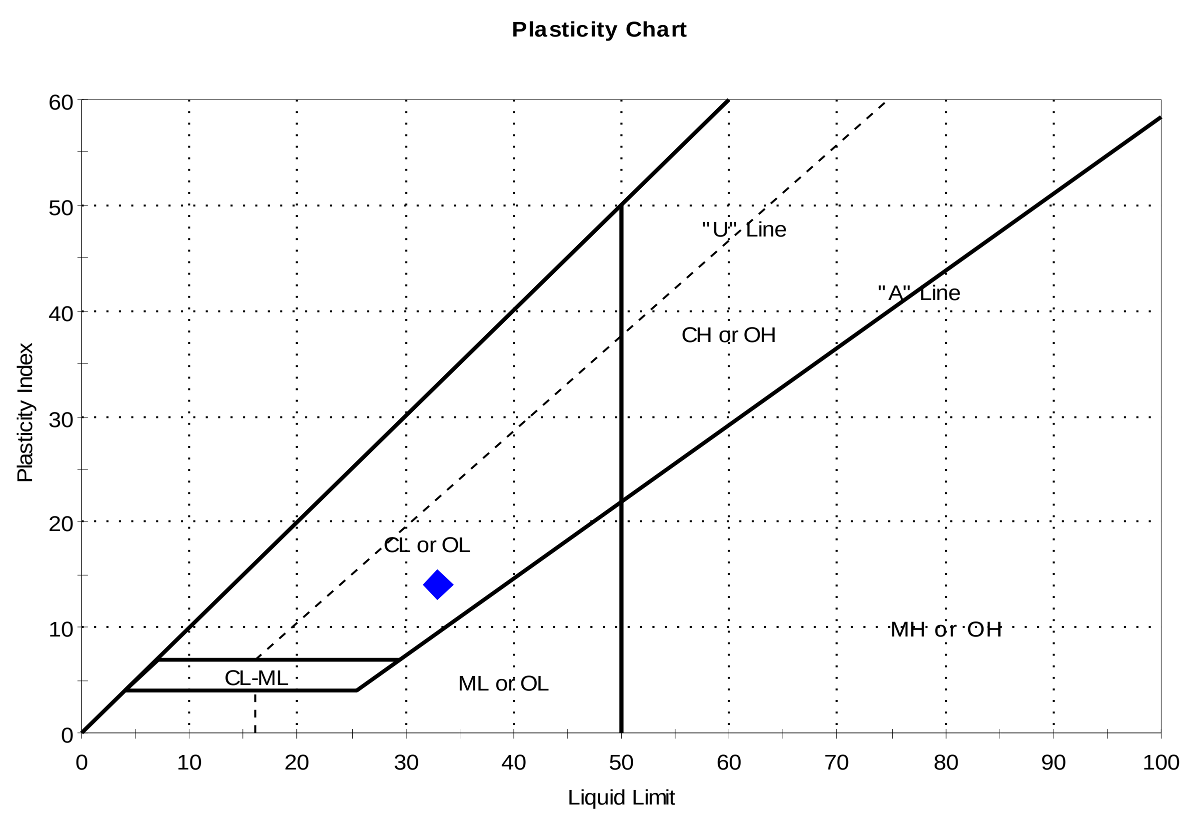
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Golder Associates		
Project:	Crossroads Landfill Investigation		
Location:	Norridgewock, ME	Project No:	GTX-307036
Boring ID:	SB-2 ← i.e. PZ-2S	Sample Type: jar	Tested By: cam
Sample ID:	SS6	Test Date: 10/05/17	Checked By: emm
Depth :	15-17	Test Id: 425886	
Test Comment:	---		
Visual Description:	Moist, gray clay		
Sample Comment:	---		

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS6	SB-2	15-17	30	33	19	14	0.8	Lean clay (CL)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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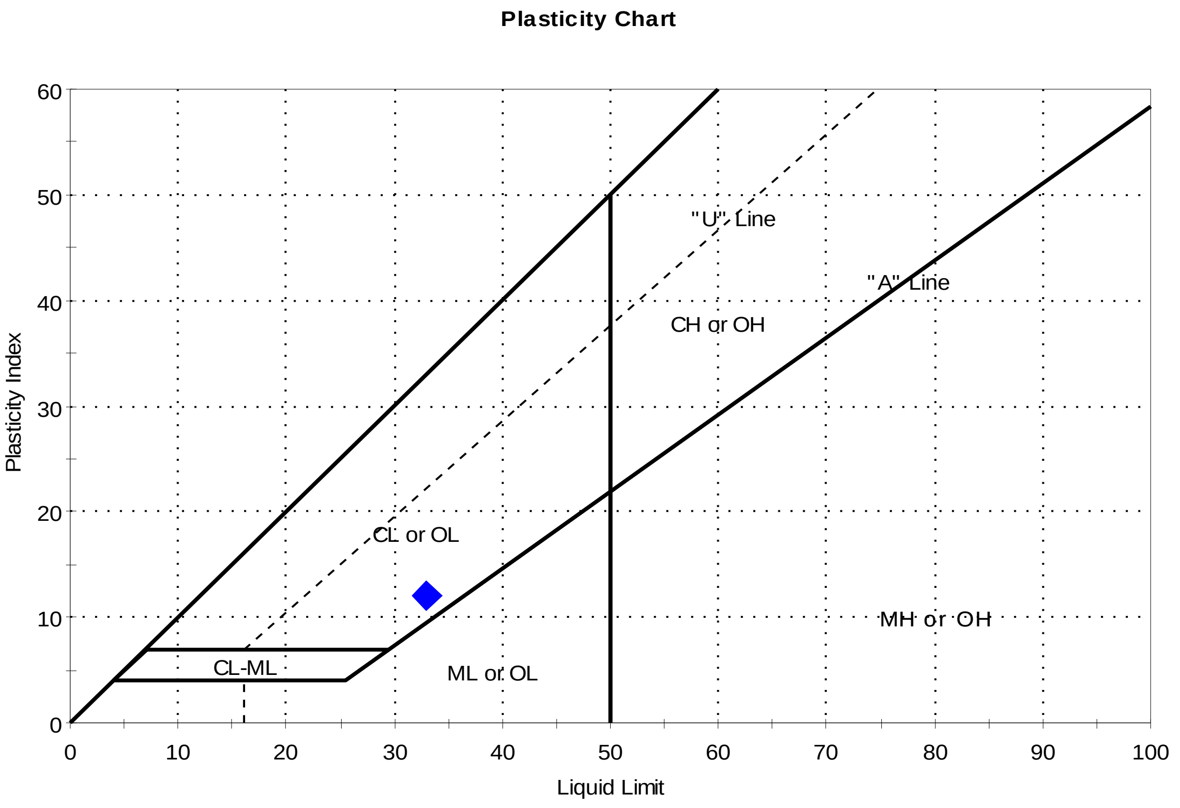
GeoTesting
EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-3 i.e. PZ-3S
Sample Type: jar
Tested By: cam
Sample ID: SS6
Test Date: 10/04/17
Checked By: emm
Depth : 10-12
Test Id: 425884
Test Comment: ---
Visual Description: Moist, olive clay
Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS6	SB-3	10-12	26	33	21	12	0.4	Lean clay (CL)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

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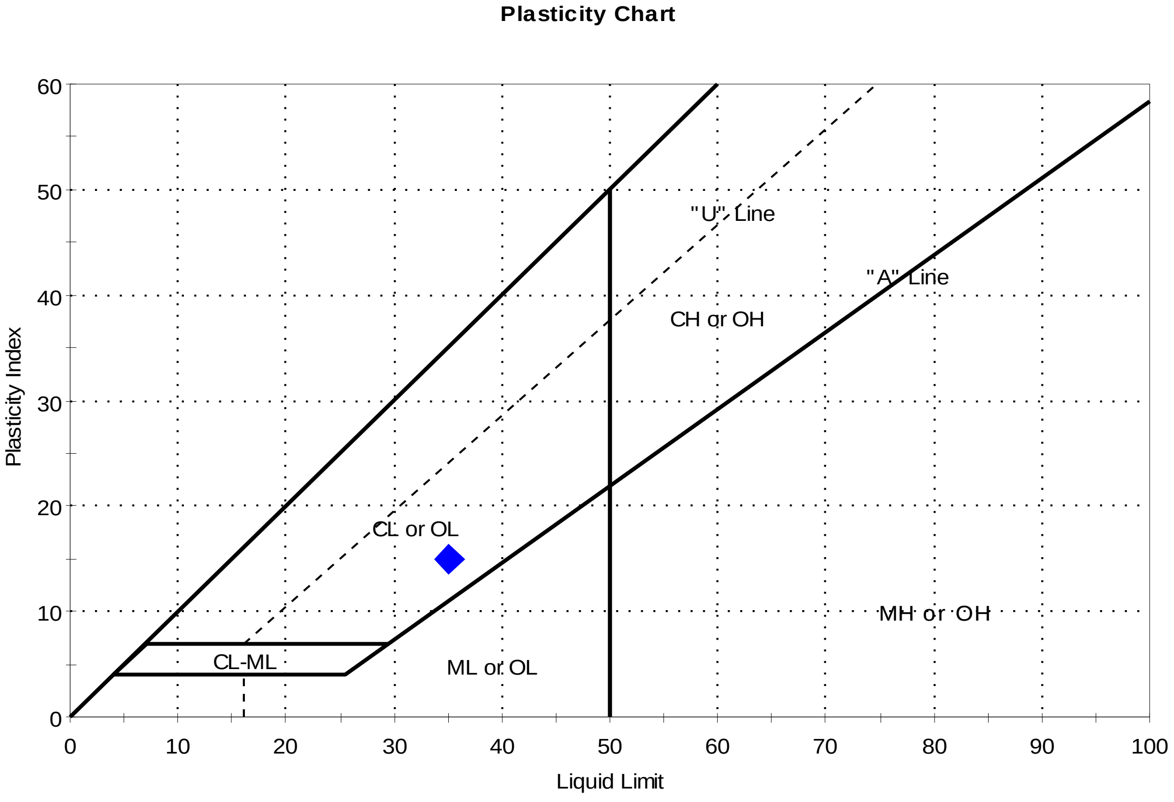
Client:	Golder Associates		
Project:	Crossroads Landfill Investigation		
Location:	Norridgewock, ME	Project No:	GTX-307036
Boring ID:	SB-3 ← i.e. PZ-3S	Sample Type: jar	Tested By: cam
Sample ID:	SS9	Test Date: 10/04/17	Checked By: emm
Depth :	16-18	Test Id: 425885	
Test Comment:	---		
Visual Description:	Moist, gray clay		
Sample Comment:	---		

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS9	SB-3	16-18	27	35	20	15	0.5	Lean clay (CL)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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GeoTesting EXPRESS

Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-4 ← i.e. PZ-4S
Sample Type: jar
Tested By: cam
Sample ID: SS2, SS3
Test Date: 10/05/17
Checked By: emm
Depth : 2-6
Test Id: 425881
Test Comment: ---
Visual Description: Moist, brown silty sand
Sample Comment: ---

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS2, SS3	SB-4	2-6	20	n/a	n/a	n/a	n/a	Silty sand (SM)

8% Retained on #40 Sieve
Dry Strength: HIGH
Dilatancy: RAPID
Toughness: n/a
The sample was determined to be Non-Plastic

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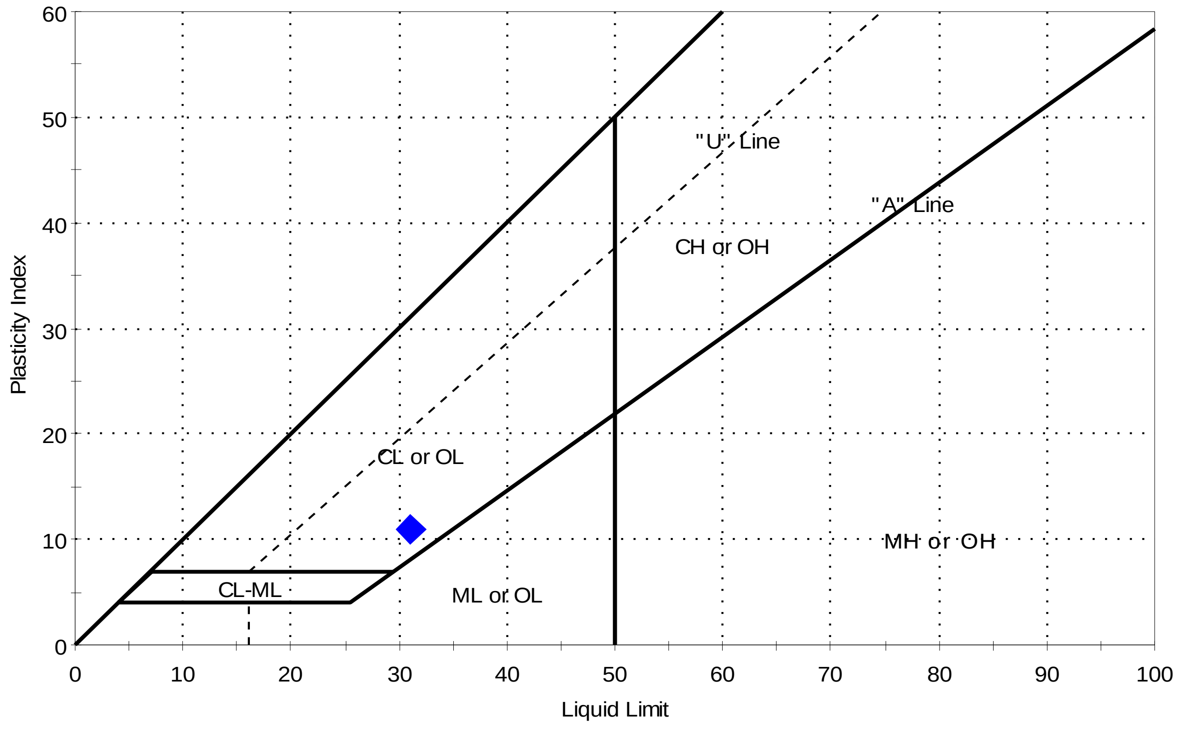
Client: Golder Associates
Project: Crossroads Landfill Investigation
Location: Norridgewock, ME
Project No: GTX-307036
Boring ID: SB-4 ← i.e. PZ-4S
Sample ID: SS5
Depth : 8-10
Sample Type: jar
Test Date: 10/05/17
Test Id: 425883
Tested By: cam
Checked By: emm
Test Comment: ---
Visual Description: Moist, olive clay
Sample Comment: ---

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS5	SB-4	8-10	29	31	20	11	0.8	Lean clay (CL)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

Client:	Golder Associates		
Project:	Crossroads Landfill Investigation		
Location:	Norridgewock, ME	Project No:	GTX-307036

Boring ID:	SB-4 ← i.e. PZ-4S	Sample Type:	jar	Tested By:	cam
Sample ID:	SS8, SS9	Test Date:	10/05/17	Checked By:	emm
Depth :	14-18	Test Id:	425879		

Test Comment: ---
Visual Description: Moist, brown sandy silt with gravel
Sample Comment: ---

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS8, SS9	SB-4	14-18	8	n/a	n/a	n/a	n/a	Sandy Silt with gravel (ML)

33% Retained on #40 Sieve
Dry Strength: HIGH
Dilatancy: RAPID
Toughness: n/a
The sample was determined to be Non-Plastic

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Client:	Golder Associates		
Project:	Crossroads Landfill Investigation		
Location:	Norridgewock, ME	Project No:	GTX-307036
Boring ID:	SB-5 ← i.e. PZ-5D	Sample Type: jar	Tested By: cam
Sample ID:	SS5, SS6	Test Date: 10/05/17	Checked By: emm
Depth :	12.8-16.8	Test Id: 425880	
Test Comment:	---		
Visual Description:	Moist, gray silty gravel with sand		
Sample Comment:	---		

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS5, SS6	SB-5	12.8-16.8	8	n/a	n/a	n/a	n/a	Silty gravel with sand (GM)

52% Retained on #40 Sieve

Dry Strength: HIGH

Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

Client:	Golder Associates		
Project Name:	Crossroads Landfill Investigation		
Project Location:	Norridgewock, ME		
GTX #:	307036		
Start Date:	10/4/2017	Tested By:	eec
End Date:	10/11/2017	Checked By:	emm
Boring #:	SB-3a		
Sample #:	Sample 1		
Depth:	9-11 ft		
Visual Description:	Moist, gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 26.6%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	3.58	3.64
Diameter, in	2.78	2.82
Area, in^2	6.07	6.25
Volume, in^3	21.7	22.7
Mass, g	727.9	739.0
Bulk Density, pcf	127.3	123.6
Moisture Content, %	24.5	26.4
Dry Density, pcf	102.3	97.8
Degree of Saturation, %	99	96

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	95.01	Cell Pressure Increment, psi:	5.01
Sample Pressure, psi:	84.40	Corresponding Sample Pressure, psi:	89.38	Sample Pressure Increment, psi:	4.98
				B Coefficient:	0.99

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
10/9	1	90.0	84.4	11.0	10.9	0.1	43	15.0	1.2E-07	19.5	1.013	1.2E-07
10/9	2	90.0	84.4	11.0	10.9	0.1	41	15.0	1.3E-07	19.5	1.013	1.3E-07
10/9	3	90.0	84.4	11.0	10.9	0.1	46	15.0	1.1E-07	19.5	1.013	1.2E-07
10/9	4	90.0	84.4	11.0	10.9	0.1	42	15.0	1.2E-07	19.5	1.013	1.3E-07

PERMEABILITY AT 20° C: 1.2 x 10^{-7} cm/sec (@ 5.6 psi effective stress)

GeoTesting EXPRESS

Client:	Golder Associates		
Project Name:	Crossroads Landfill Investigation		
Project Location:	Norridgewock, ME		
GTX #:	307036		
Start Date:	10/4/2017	Tested By:	eec
End Date:	10/11/2017	Checked By:	emm
Boring #:	SB-3a		
Sample #:	Sample 2		
Depth:	16-18 ft		
Visual Description:	Moist, gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	16-18 ft	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 28.1%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	3.45	3.50
Diameter, in	2.83	2.87
Area, in^2	6.29	6.47
Volume, in^3	21.7	22.6
Mass, g	706.8	716.5
Bulk Density, pcf	123.8	120.3
Moisture Content, %	27.2	29.0
Dry Density, pcf	97.3	93.3
Degree of Saturation, %	98	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.01	Increased Cell Pressure, psi:	95.01	Cell Pressure Increment, psi:	5.01
Sample Pressure, psi:	81.89	Corresponding Sample Pressure, psi:	86.77	Sample Pressure Increment, psi:	4.88
				B Coefficient:	0.98

FLOW DATA

	Trial	Pressure, psi		Manometer Readings			Elapsed Time,		Permeability K,	Temp,		Permeability K @ 20 °C,
Date	#	Cell	Sample	Z_1	Z_2	Z_1-Z_2	sec	Gradient	cm/sec	°C	R_t	cm/sec
10/9	1	90.0	81.9	10.0	9.8	0.2	41	14.2	2.6E-07	19.5	1.013	2.7E-07
10/9	2	90.0	81.9	10.0	9.8	0.2	43	14.2	2.5E-07	19.5	1.013	2.5E-07
10/9	3	90.0	81.9	10.0	9.8	0.2	39	14.2	2.8E-07	19.5	1.013	2.8E-07
10/9	4	90.0	81.9	10.0	9.8	0.2	40	14.2	2.7E-07	19.5	1.013	2.7E-07

PERMEABILITY AT 20° C: 2.4 x 10^{-7} cm/sec (@ 8.1 psi effective stress)

Client:	Golder Associates		
Project Name:	Crossroads Landfill Investigation		
Project Location:	Norridgewock, ME		
GTX #:	307036		
Start Date:	10/3/2017	Tested By:	eec
End Date:	10/11/2017	Checked By:	emm
Boring #:	SB-4a		
Sample #:	Sample 3		
Depth:	9-11 ft		
Visual Description:	Moist, gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 27.5%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	2.75	2.75
Diameter, in	2.87	2.80
Area, in^2	6.47	6.16
Volume, in^3	17.8	16.9
Mass, g	576.4	574.5
Bulk Density, pcf	123.2	129.0
Moisture Content, %	22.9	22.5
Dry Density, pcf	100.3	105.3
Degree of Saturation, %	88	98

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.01	Increased Cell Pressure, psi:	95.00	Cell Pressure Increment, psi:	5.00
Sample Pressure, psi:	84.59	Corresponding Sample Pressure, psi:	89.50	Sample Pressure Increment, psi:	4.91
				B Coefficient:	0.98

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
10/4	1	90.0	84.6	10.5	10.4	0.1	37	18.9	1.1E-07	19.5	1.013	1.1E-07
10/4	2	90.0	84.6	10.5	10.4	0.1	39	18.9	1.1E-07	19.5	1.013	1.1E-07
10/4	3	90.0	84.6	10.5	10.4	0.1	40	18.9	1.0E-07	19.5	1.013	1.1E-07
10/4	4	90.0	84.6	10.5	10.4	0.1	38	18.9	1.1E-07	19.5	1.013	1.1E-07

PERMEABILITY AT 20° C: 1.1 x 10^{-7} cm/sec (@ 5.4 psi effective stress)

GeoTesting
EXPRESS

Client:	Golder Associates		
Project Name:	Crossroads Landfill Investigation		
Project Location:	Norridgewock, ME		
GTX #:	307036		
Start Date:	10/4/2017	Tested By:	eec
End Date:	10/11/2017	Checked By:	emm
Boring #:	SB-2 ← SB-2S		
Sample #:	Sample 4		
Depth:	2-4 ft		
Visual Description:	Moist, gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084
Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 25.3%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	3.12	3.02
Diameter, in	2.84	2.90
Area, in^2	6.33	6.61
Volume, in^3	19.8	19.9
Mass, g	655.6	664.5
Bulk Density, pcf	126.1	126.6
Moisture Content, %	23.6	25.2
Dry Density, pcf	102.0	101.1
Degree of Saturation, %	95	99

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	95.02	Cell Pressure Increment, psi:	5.02
Sample Pressure, psi:	83.99	Corresponding Sample Pressure, psi:	88.97	Sample Pressure Increment, psi:	4.98
				B Coefficient:	0.99

FLOW DATA

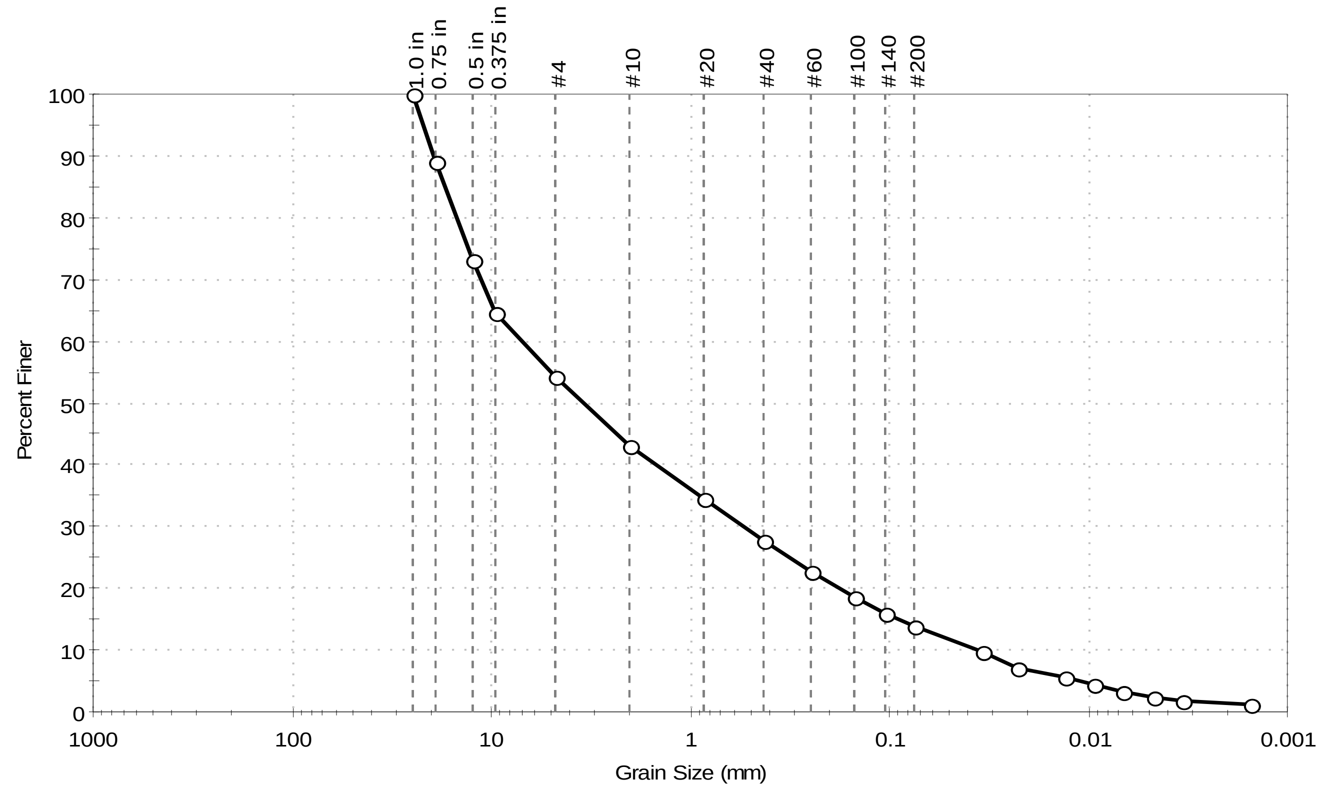
Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
10/4	1	90.0	84.0	10.5	10.2	0.3	35	17.2	3.7E-07	19.5	1.013	3.8E-07
10/4	2	90.0	84.0	10.5	10.2	0.3	34	17.2	3.8E-07	19.5	1.013	3.9E-07
10/4	3	90.0	84.0	10.5	10.2	0.3	32	17.2	4.1E-07	19.5	1.013	4.1E-07
10/4	4	90.0	84.0	10.5	10.2	0.3	34	17.2	3.8E-07	19.5	1.013	3.9E-07

PERMEABILITY AT 20° C: 3.9×10^{-7} cm/sec (@ 6 psi effective stress)

GeoTesting
EXPRESS

Client: Golder Associates
Project: WM Crossroads
Location: Maine
Project No: GTX-309120
Boring ID: ---
Sample Type: jar
Tested By: GA
Sample ID: PZ-8D
Test Date: 11/16/18
Checked By: emm
Depth : 16-18
Test Id: 480928
Test Comment: ---
Visual Description: Moist, grayish brown silty gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	45.7	40.5	13.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.0 in	25.00	100		
0.75 in	19.00	89		
0.5 in	12.50	73		
0.375 in	9.50	65		
#4	4.75	54		
#10	2.00	43		
#20	0.85	34		
#40	0.42	28		
#60	0.25	23		
#100	0.15	19		
#140	0.11	16		
#200	0.075	14		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0344	10		
---	0.0227	7		
---	0.0131	6		
---	0.0094	4		
---	0.0067	3		
---	0.0047	2		
---	0.0034	2		
---	0.0016	1		

Coefficients

D_{85} = 17.0107 mm
D_{30} = 0.5432 mm
D_{60} = 6.9735 mm
D_{15} = 0.0919 mm
D_{50} = 3.4155 mm
D_{10} = 0.0370 mm
C_u = 188.473
C_c = 1.144

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

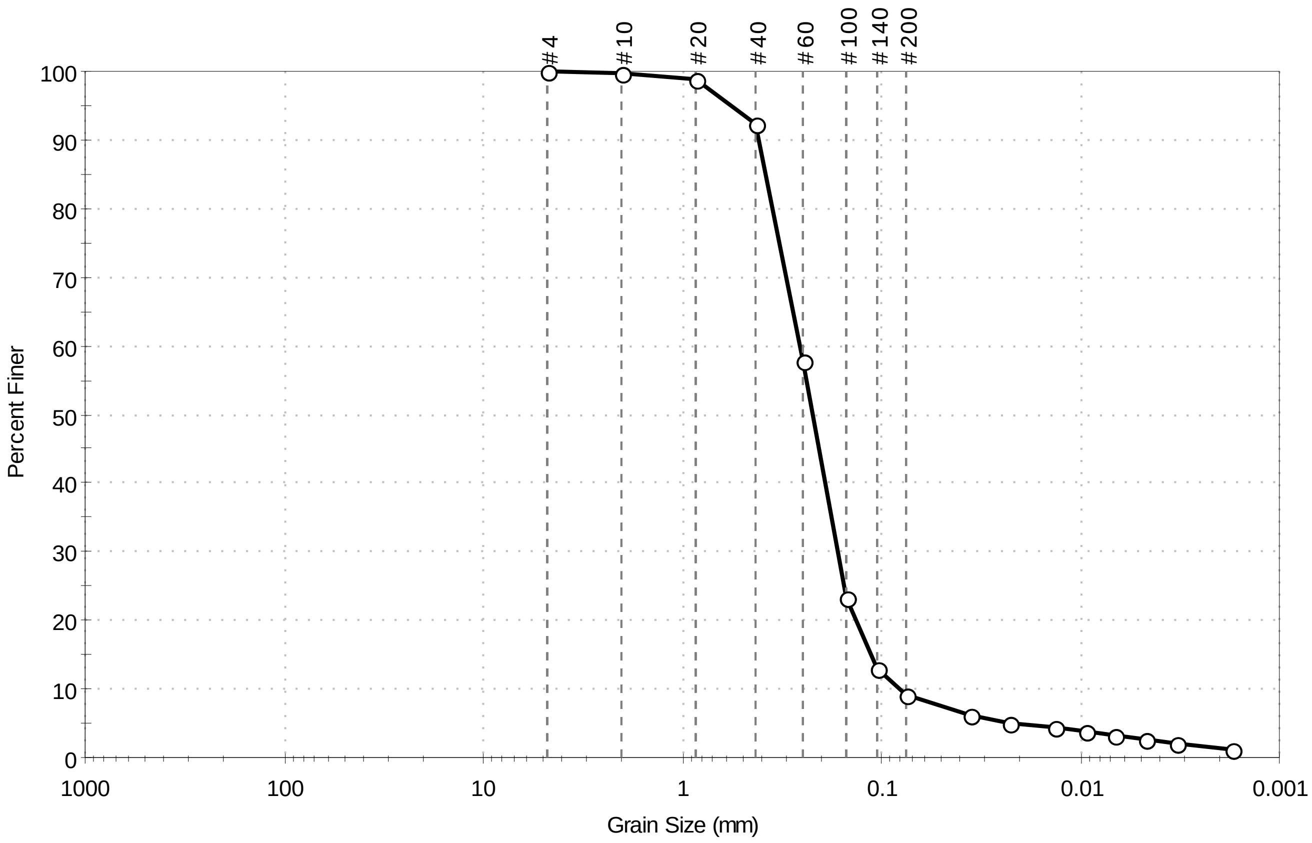
Separation of Sample: #200 Sieve

printed 11/20/2018 10:10:25 AM

GeoTesting EXPRESS

Client: Golder Associates
Project: WM Crossroads
Location: Maine
Project No: GTX-309120
Boring ID: ---
Sample Type: jar
Tested By: GA
Sample ID: PZ-8S
Test Date: 11/16/18
Checked By: emm
Depth : 6-8
Test Id: 480929
Test Comment: ---
Visual Description: Moist, olive brown sand with silt
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	90.9	9.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	92		
#60	0.25	58		
#100	0.15	23		
#140	0.11	13		
#200	0.075	9.1		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0358	6		
---	0.0228	5		
---	0.0134	4		
---	0.0094	4		
---	0.0067	3		
---	0.0048	3		
---	0.0033	2		
---	0.0017	1		

Coefficients

D_{85} = 0.3800 mm
D_{30} = 0.1657 mm
D_{60} = 0.2581 mm
D_{15} = 0.1134 mm
D_{50} = 0.2225 mm
D_{10} = 0.0811 mm
C_u = 3.182
C_c = 1.312

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

printed 11/20/2018 10:10:26 AM

GeoTesting EXPRESS

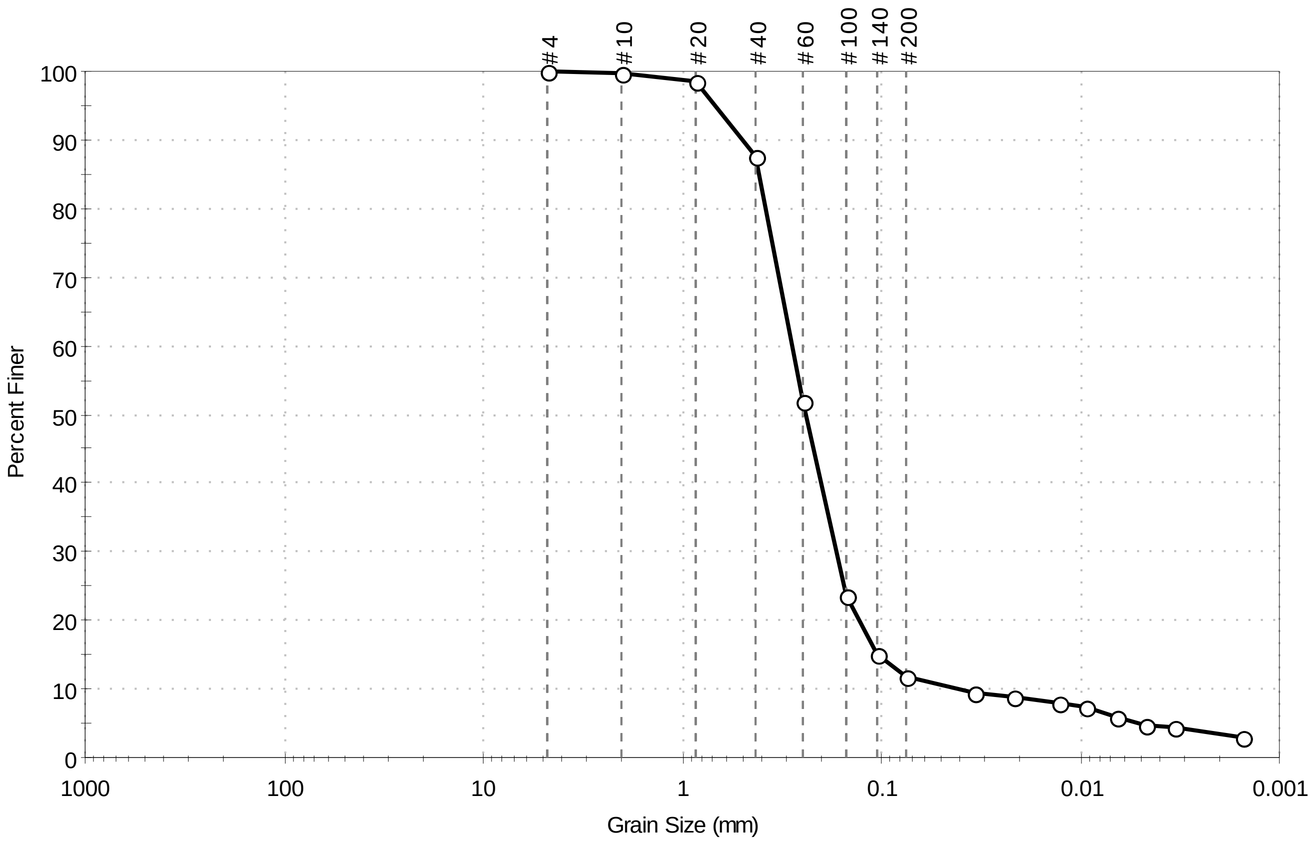
Client:	Golder Associates			
Project:	WM Crossroads			
Location:	Maine		Project No:	GTX-309120
Boring ID:	---	Sample Type: jar	Tested By:	GA
Sample ID:	PZ-9S	Test Date: 11/16/18	Checked By:	emm
Depth :	9-11	Test Id: 480930		

Test Comment: ---

Visual Description: Moist, olive sand with silt

Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	88.3	11.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	88		
#60	0.25	52		
#100	0.15	24		
#140	0.11	15		
#200	0.075	12		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0342	9		
---	0.0218	9		
---	0.0129	8		
---	0.0093	7		
---	0.0066	6		
---	0.0047	5		
---	0.0033	4		
---	0.0015	3		

Coefficients

D_{85} =0.4085 mm	D_{30} =0.1684 mm
D_{60} =0.2817 mm	D_{15} =0.1046 mm
D_{50} =0.2413 mm	D_{10} =0.0415 mm
C_u =6.788	C_c =2.426

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

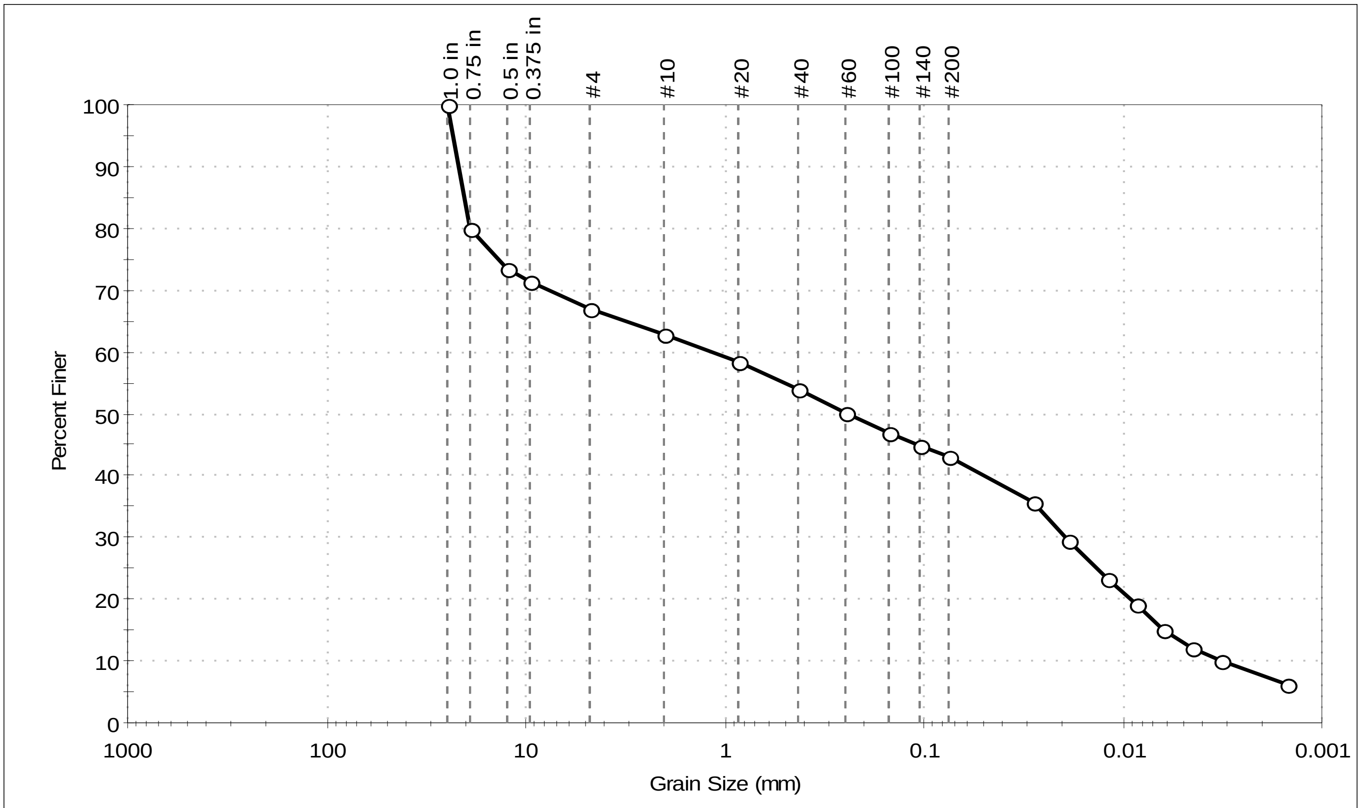
printed 11/20/2018 10:10:27 AM

GeoTesting
EXPRESS

Client:	Golder Associates				
Project:	WM Crossroads				
Location:	Maine			Project No:	GTX-309120
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	PZ-9D	Test Date:	11/16/18	Checked By:	emm
Depth :	53-55	Test Id:	480931		

Test Comment: ---
Visual Description: Moist, dark gray silty gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	33.1	23.9	43.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.0 in	25.00	100		
0.75 in	19.00	80		
0.5 in	12.50	74		
0.375 in	9.50	71		
#4	4.75	67		
#10	2.00	63		
#20	0.85	59		
#40	0.42	54		
#60	0.25	50		
#100	0.15	47		
#140	0.11	45		
#200	0.075	43		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0285	36		
---	0.0189	30		
---	0.0119	23		
---	0.0086	19		
---	0.0063	15		
---	0.0045	12		
---	0.0032	10		
---	0.0015	6		

Coefficients

D_{85} = 20.3844 mm	D_{30} = 0.0195 mm
D_{60} = 1.1500 mm	D_{15} = 0.0062 mm
D_{50} = 0.2448 mm	D_{10} = 0.0033 mm
C_u = 348.485	C_c = 0.100

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

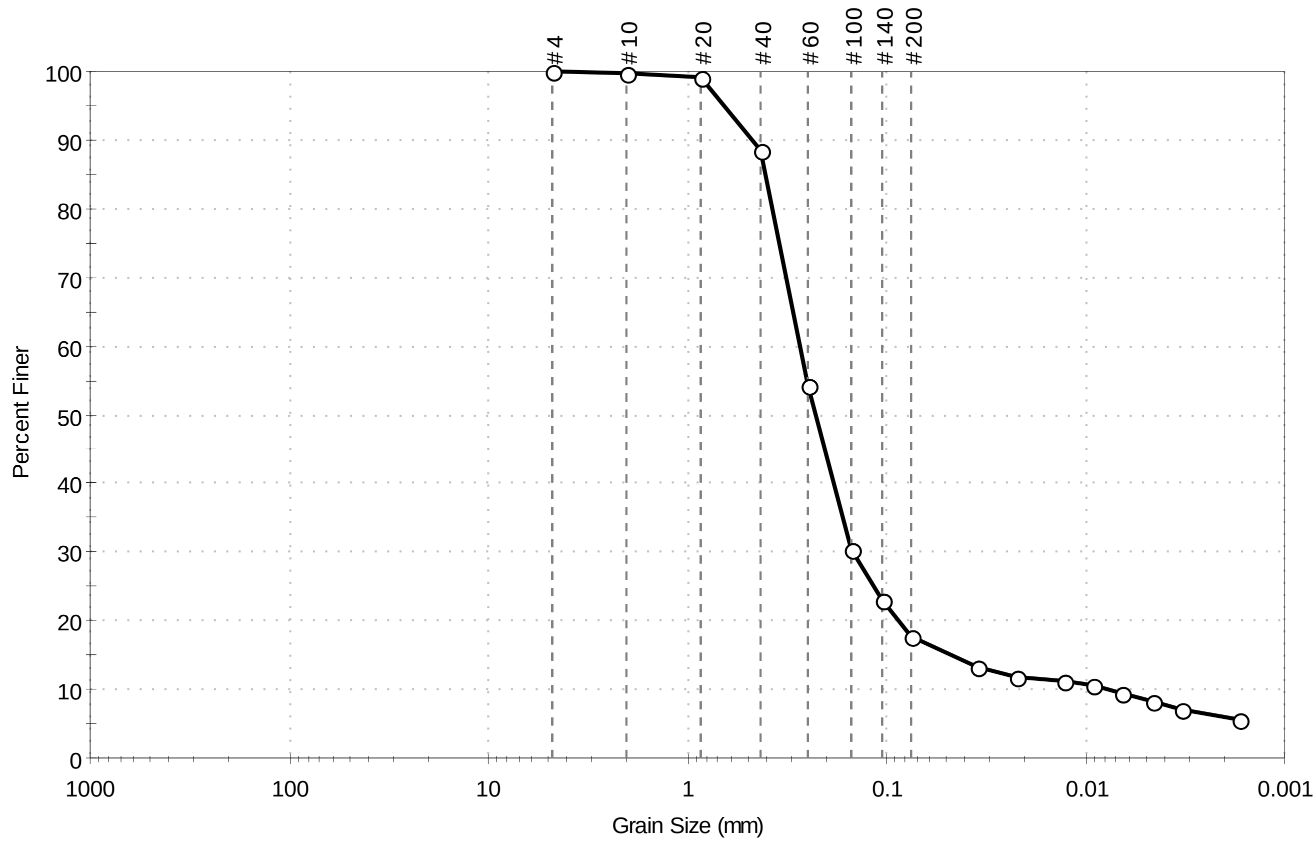
Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

printed 11/20/2018 10:10:28 AM

Client: Golder Associates
Project: WM Crossroads
Location: Maine
Project No: GTX-309120
Boring ID: ---
Sample Type: jar
Tested By: GA
Sample ID: PZ-13S
Test Date: 11/16/18
Checked By: emm
Depth : 7-8.2
Test Id: 480932
Test Comment: ---
Visual Description: Moist, olive gray silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	82.2	17.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	89		
#60	0.25	54		
#100	0.15	30		
#140	0.11	23		
#200	0.075	18		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0354	13		
---	0.0225	12		
---	0.0130	11		
---	0.0091	11		
---	0.0065	9		
---	0.0046	8		
---	0.0033	7		
---	0.0017	6		

Coefficients

D_{85} =0.4019 mm
D_{30} =0.1480 mm
D_{60} =0.2728 mm
D_{15} =0.0477 mm
D_{50} =0.2279 mm
D_{10} =0.0075 mm
C_u =36.373
C_c =10.706

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

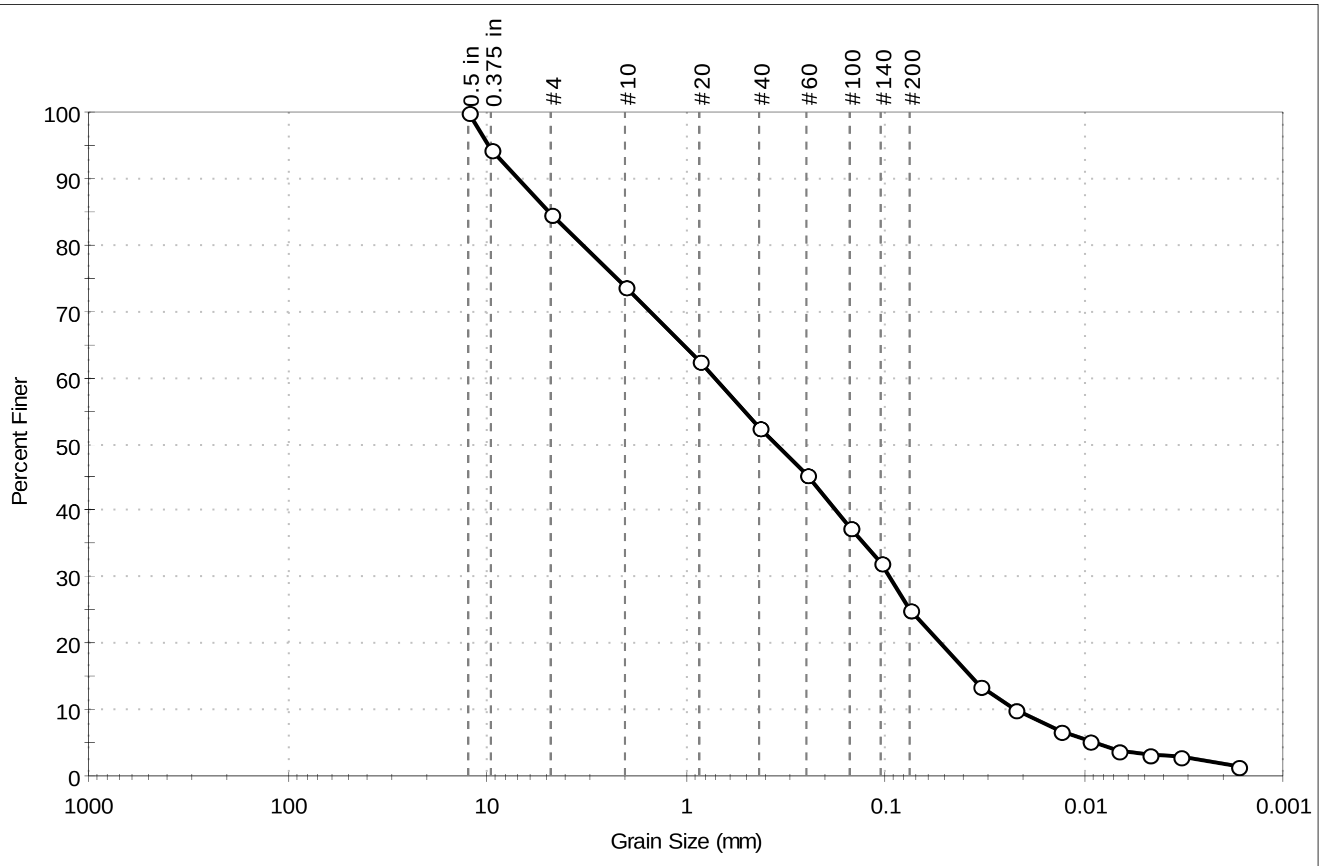
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

printed 11/20/2018 10:10:29 AM

GeoTesting EXPRESS

Client: Golder Associates
Project: WM Crossroads
Location: Maine
Project No: GTX-309120
Boring ID: ---
Sample Type: jar
Tested By: GA
Sample ID: PZ-13D
Test Date: 11/16/18
Checked By: emm
Depth : 32-34
Test Id: 480933
Test Comment: ---
Visual Description: Moist, light grayish brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	15.2	59.6	25.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	94		
#4	4.75	85		
#10	2.00	74		
#20	0.85	63		
#40	0.42	53		
#60	0.25	45		
#100	0.15	38		
#140	0.11	32		
#200	0.075	25		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0330	14		
---	0.0224	10		
---	0.0132	7		
---	0.0093	5		
---	0.0067	4		
---	0.0047	3		
---	0.0033	3		
---	0.0017	2		

Coefficients

D_{85} = 4.8355 mm
D_{30} = 0.0954 mm
D_{60} = 0.7124 mm
D_{15} = 0.0366 mm
D_{50} = 0.3508 mm
D_{10} = 0.0225 mm
C_u = 31.662
C_c = 0.568

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

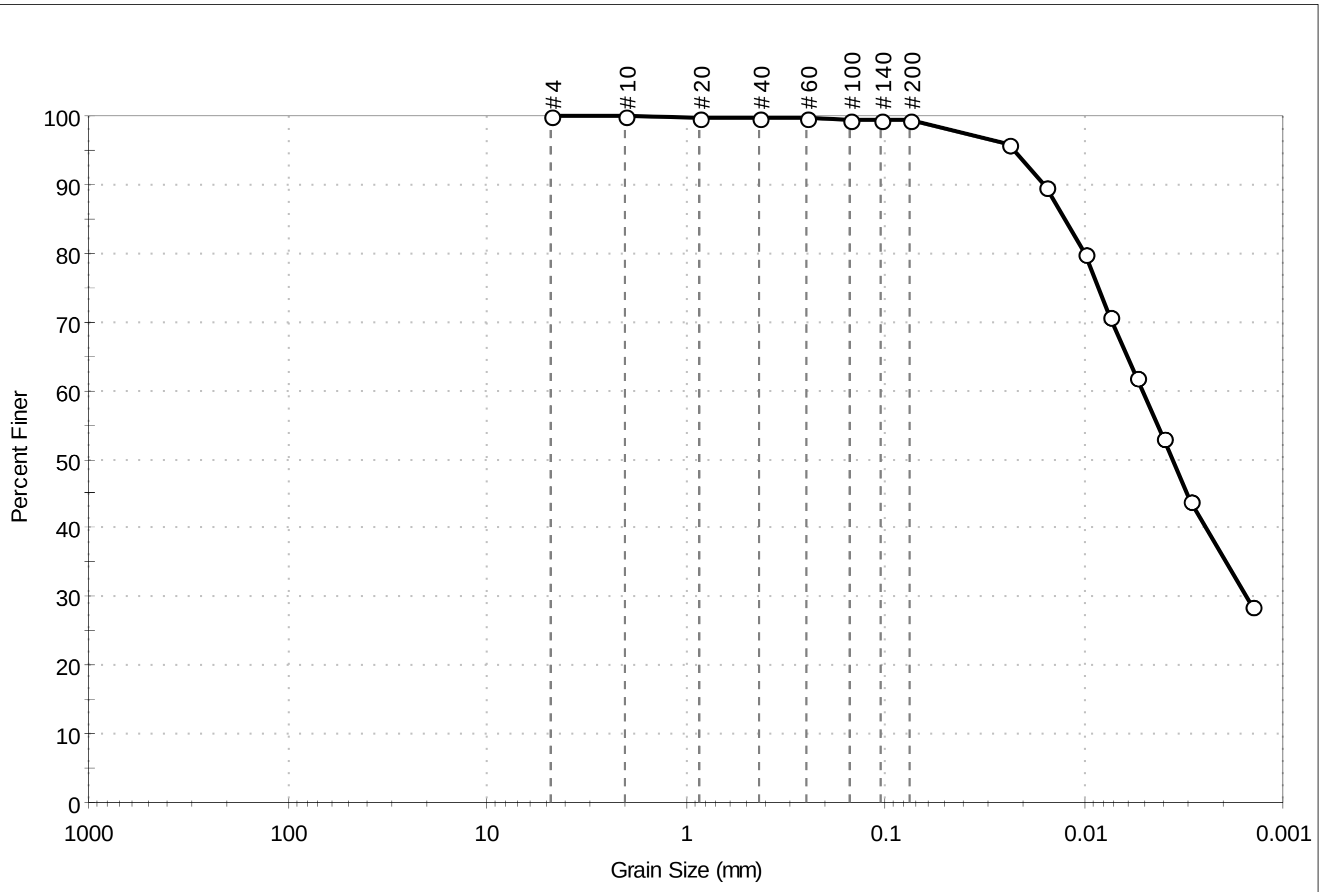
Separation of Sample: #200 Sieve

printed 11/20/2018 10:10:30 AM

Client:	Golder Associates				
Project:	WM Crossroads	PZ-14M			
Location:	Maine			Project No:	GTX-309120
Boring ID:	---	Sample Type:	jar	Tested By:	GA
Sample ID:	PZ-14S	Test Date:	11/16/18	Checked By:	emm
Depth :	8.5-10.5	Test Id:	480934		

Test Comment: ---
Visual Description: Moist, olive gray clay
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.1	0.4	99.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#140	0.11	100		
#200	0.075	99		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0239	96		
---	0.0155	90		
---	0.0100	80		
---	0.0074	71		
---	0.0054	62		
---	0.0040	53		
---	0.0029	44		
---	0.0014	29		

Coefficients

D_{85} =0.0126 mm
D_{30} =0.0015 mm
D_{60} =0.0051 mm
D_{15} =N/A
D_{50} =0.0036 mm
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

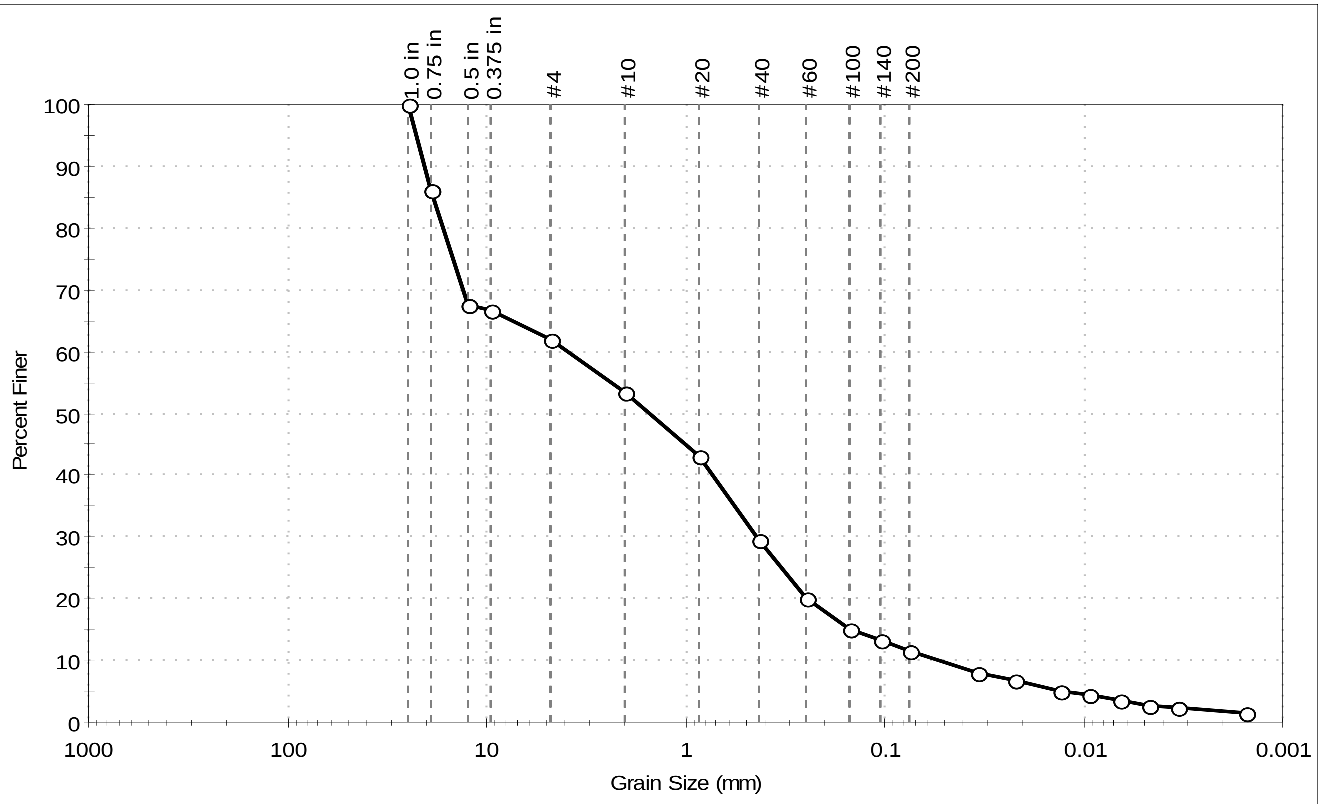
Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

GeoTesting
EXPRESS

Client: Golder Associates
Project: WM Crossroads
Location: Maine
Project No: GTX-309120
Boring ID: ---
Sample Type: jar
Tested By: GA
Sample ID: PZ-14D
Test Date: 11/16/18
Checked By: emm
Depth : 38-40
Test Id: 480935
Test Comment: ---
Visual Description: Moist, dark gray sand with silt and gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	38.2	50.4	11.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.0 in	25.00	100		
0.75 in	19.00	86		
0.5 in	12.50	68		
0.375 in	9.50	67		
#4	4.75	62		
#10	2.00	53		
#20	0.85	43		
#40	0.42	29		
#60	0.25	20		
#100	0.15	15		
#140	0.11	13		
#200	0.075	11		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0341	8		
---	0.0223	7		
---	0.0130	5		
---	0.0093	4		
---	0.0066	4		
---	0.0047	3		
---	0.0033	2		
---	0.0015	1		

Coefficients

D_{85} = 18.5545 mm
D_{30} = 0.4385 mm
D_{60} = 3.9479 mm
D_{15} = 0.1449 mm
D_{50} = 1.5150 mm
D_{10} = 0.0538 mm
C_u = 73.381
C_c = 0.905

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

GeoTesting
EXPRESS

Client:	Geosyntec Consultants		
Project Name:	Crossroads Phase 14		
Project Location:	Norridgewock, ME		
GTX #:	309940		
Start Date:	6/25/2019	Tested By:	jlw
End Date:	6/28/2019	Checked By:	emm
Boring #:	GB-06		
Sample #:	21-23		
Depth:	21-23 ft		
Visual Description:	Moist, dark gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 24.6%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	2.00	2.00
Diameter, in	2.86	2.86
Area, in^2	6.42	6.42
Volume, in^3	12.8	12.8
Mass, g	427.8	428.2
Bulk Density, pcf	126.6	126.7
Moisture Content, %	24.6	24.7
Dry Density, pcf	101.6	101.6
Degree of Saturation, %	98	99

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	95.01	Cell Pressure Increment, psi:	5.01
Sample Pressure, psi:	71.70	Corresponding Sample Pressure, psi:	75.95	Sample Pressure Increment, psi:	4.25
				B Coefficient:	0.85

*B value did not increase with increase in pressure. Final degree of saturation >95%.

FLOW DATA

	Trial	Pressure, psi		Manometer Readings			Elapsed Time,		Permeability K,	Temp,		Permeability K @ 20 ^oC,
Date	#	Cell	Sample	Z_1	Z_2	Z_1-Z_2	sec	Gradient	cm/sec	^oC	R_t	cm/sec
6/27	1	90.0	71.7	11.0	10.9	0.1	37	27.3	7.5E-08	19.5	1.013	7.6E-08
6/27	2	90.0	71.7	11.0	10.9	0.1	35	27.3	8.0E-08	19.5	1.013	8.1E-08
6/27	3	90.0	71.7	11.0	10.9	0.1	37	27.3	7.5E-08	19.5	1.013	7.6E-08
6/27	4	90.0	71.7	11.0	10.9	0.1	38	27.3	7.3E-08	19.5	1.013	7.4E-08

PERMEABILITY AT 20° C: 7.7 x 10^{-8} cm/sec (@ 22.0 psi effective stress)

Client:	Geosyntec Consultants		
Project Name:	Crossroads Phase 14		
Project Location:	Norridgewock, ME		
GTX #:	309940		
Start Date:	6/24/2019	Tested By:	jlw
End Date:	7/1/2019	Checked By:	emm
Boring #:	GB-06		
Sample #:	29-31		
Depth:	29-31 ft		
Visual Description:	Moist, olive gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 30.2%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	2.21	2.10
Diameter, in	2.86	2.75
Area, in^2	6.42	5.94
Volume, in^3	14.2	12.5
Mass, g	413.3	404.7
Bulk Density, pcf	110.7	123.3
Moisture Content, %	30.2	27.5
Dry Density, pcf	85.0	96.7
Degree of Saturation, %	81	98

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.01	Increased Cell Pressure, psi:	95.05	Cell Pressure Increment, psi:	5.04
Sample Pressure, psi:	67.97	Corresponding Sample Pressure, psi:	72.17	Sample Pressure Increment, psi:	4.20
				B Coefficient:	0.83

*B value did not increase with increase in pressure. Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
6/25	1	90.0	68.0	8.0	7.9	0.1	37	18.9	1.2E-07	19.5	1.013	1.2E-07
6/25	2	90.0	68.0	8.0	7.9	0.1	33	18.9	1.3E-07	19.5	1.013	1.3E-07
6/25	3	90.0	68.0	8.0	7.9	0.1	37	18.9	1.2E-07	19.5	1.013	1.2E-07
6/25	4	90.0	68.0	8.0	7.9	0.1	40	18.9	1.1E-07	19.5	1.013	1.1E-07

PERMEABILITY AT 20° C: 1.2×10^{-7} cm/sec (@ 22.0 psi effective stress)

GeoTesting EXPRESS

Client:	Geosyntec Consultants		
Project Name:	Crossroads Phase 14		
Project Location:	Norridgewock, ME		
GTX #:	309940		
Start Date:	6/24/2019	Tested By:	jlw
End Date:	7/1/2019	Checked By:	emm
Boring #:	GB-16		
Sample #:	17-19		
Depth:	17-19		
Visual Description:	Moist, olive gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 28.2%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	2.00	1.98
Diameter, in	2.86	2.85
Area, in^2	6.42	6.38
Volume, in^3	12.8	12.6
Mass, g	420.4	416.6
Bulk Density, pcf	124.4	125.4
Moisture Content, %	28.0	26.9
Dry Density, pcf	97.2	98.8
Degree of Saturation, %	100	100

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	94.98	Cell Pressure Increment, psi:	4.98
Sample Pressure, psi:	75.20	Corresponding Sample Pressure, psi:	79.36	Sample Pressure Increment, psi:	4.16
				B Coefficient:	0.84

*B value did not increase with increase in pressure. Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
6/25	1	90.0	75.2	8.0	7.7	0.3	38	20.0	3.1E-07	19.5	1.013	3.1E-07
6/25	2	90.0	75.2	8.0	7.7	0.3	39	20.0	3.0E-07	19.5	1.013	3.0E-07
6/25	3	90.0	75.2	8.0	7.7	0.3	47	20.0	2.5E-07	19.5	1.013	2.5E-07
6/25	4	90.0	75.2	8.0	7.7	0.3	40	20.0	2.9E-07	19.5	1.013	2.9E-07

PERMEABILITY AT 20° C: 2.9 x 10^{-7} cm/sec (@ 14.8 psi effective stress)

GeoTesting EXPRESS

Client:	Geosyntec Consultants		
Project Name:	Crossroads Phase 14		
Project Location:	Norridgewock, ME		
GTX #:	309940		
Start Date:	6/25/2019	Tested By:	jlw
End Date:	6/28/2019	Checked By:	emm
Boring #:	GB-16		
Sample #:	27-29		
Depth:	27-29		
Visual Description:	Moist, olive gray clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	---

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 30.9%.

Assumed Specific Gravity: 2.75

Parameter	Initial	Final
Height, in	1.87	1.82
Diameter, in	2.86	2.80
Area, in^2	6.42	6.16
Volume, in^3	12.0	11.2
Mass, g	352.0	351.0
Bulk Density, pcf	111.4	119.1
Moisture Content, %	30.9	30.5
Dry Density, pcf	85.1	91.2
Degree of Saturation, %	84	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.00	Increased Cell Pressure, psi:	95.03	Cell Pressure Increment, psi:	5.03
Sample Pressure, psi:	68.29	Corresponding Sample Pressure, psi:	72.43	Sample Pressure Increment, psi:	4.14
				B Coefficient:	0.82

*B value did not increase with increase in pressure. Final degree of saturation >95%.

FLOW DATA

Date	Trial #	Pressure, psi		Manometer Readings			Elapsed Time,	Gradient	Permeability K,	Temp,		Permeability K @ 20 °C,
		Cell	Sample	Z_1	Z_2	Z_1-Z_2	sec		cm/sec	°C	R_t	cm/sec
6/27	1	90.0	68.3	8.0	7.9	0.1	44	21.8	8.3E-08	19.5	1.013	8.4E-08
6/27	2	90.0	68.3	8.0	7.9	0.1	45	21.8	8.1E-08	19.5	1.013	8.2E-08
6/27	3	90.0	68.3	8.0	7.9	0.1	44	21.8	8.3E-08	19.5	1.013	8.4E-08
6/27	4	90.0	68.3	8.0	7.9	0.1	44	21.8	8.3E-08	19.5	1.013	8.4E-08

PERMEABILITY AT 20° C: 8.4 x 10^{-8} cm/sec (@ 21.7 psi effective stress)

APPENDIX C

Slug Test Calculations

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-01B

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

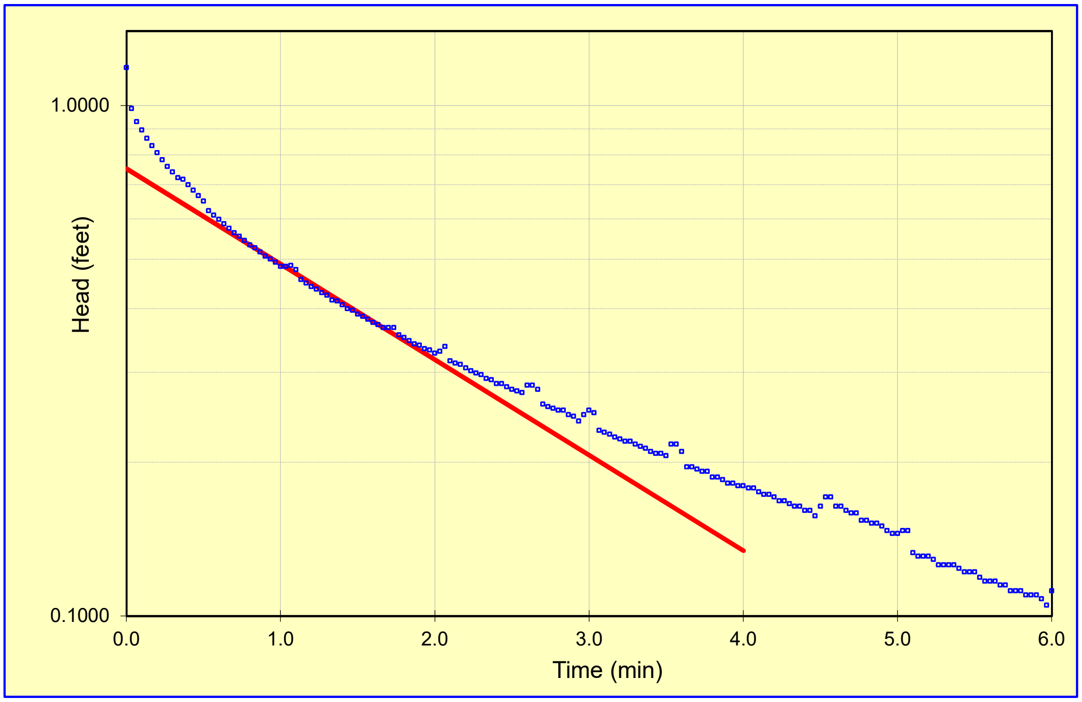
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	**0.08**
r_w =	**0.17**
L_e =	**20**
$\ln(R_e/r_w)$=	**4.99**
y_0 =	**0.75**
y_t =	**0.134**
t =	**4.0**

RESULTS

K=	**1.90E-04**	**cm/sec**
K=	**5.38E-01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-01B

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

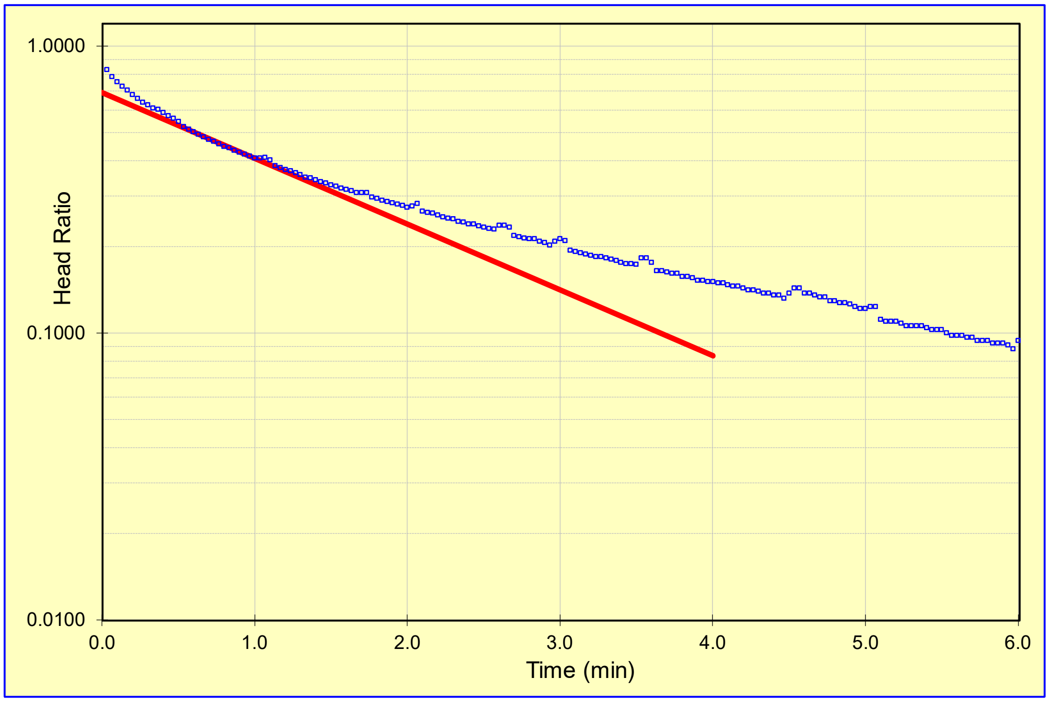
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 20.0
t_1 = 0.00
t_2 = 4.00
$h_{1(t1)}$ = 0.69
$h_{2(t2)}$ = 0.084

RESULTS

K=	**2.23E-04**	**cm/sec**
K=	**6.32E-01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
Rising Head Test MW14-01B

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

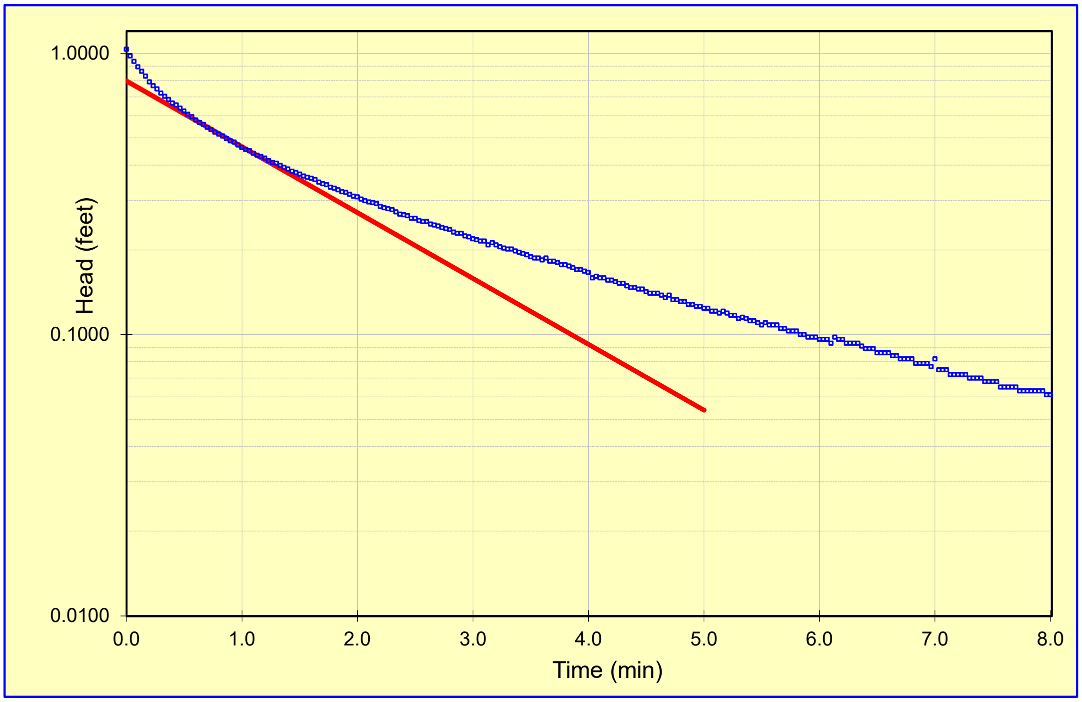
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	20
$ln(R_e/r_w)$=	4.99
y_0 =	0.80
y_t =	0.054
t =	5.0

RESULTS

K=	2.37E-04	cm/sec
K=	6.72E-01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

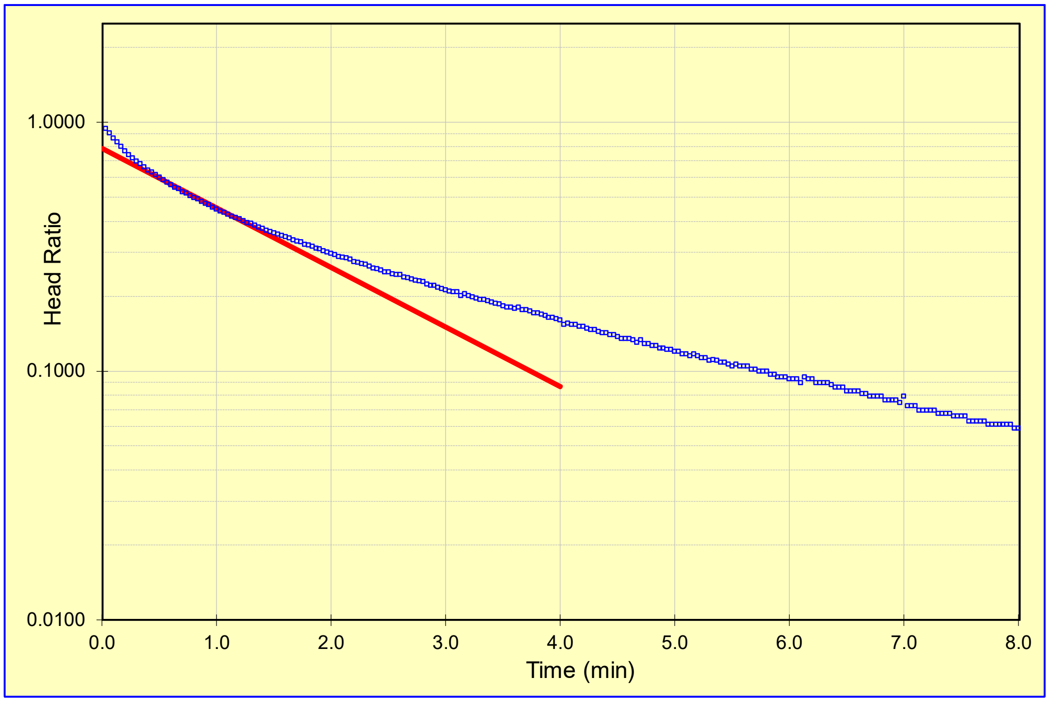
HVORSLEV SLUG TEST ANALYSIS
Rising Head Test MW14-01B

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	20.0	K=	2.32E-04	cm/sec
t_1 =	0.00	K=	6.58E-01	ft/day
t_2 =	4.00			
$h_{1(t1)}$ =	0.79			
$h_{2(t2)}$ =	0.087			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/11/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
Falling Head Test MW14-01D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

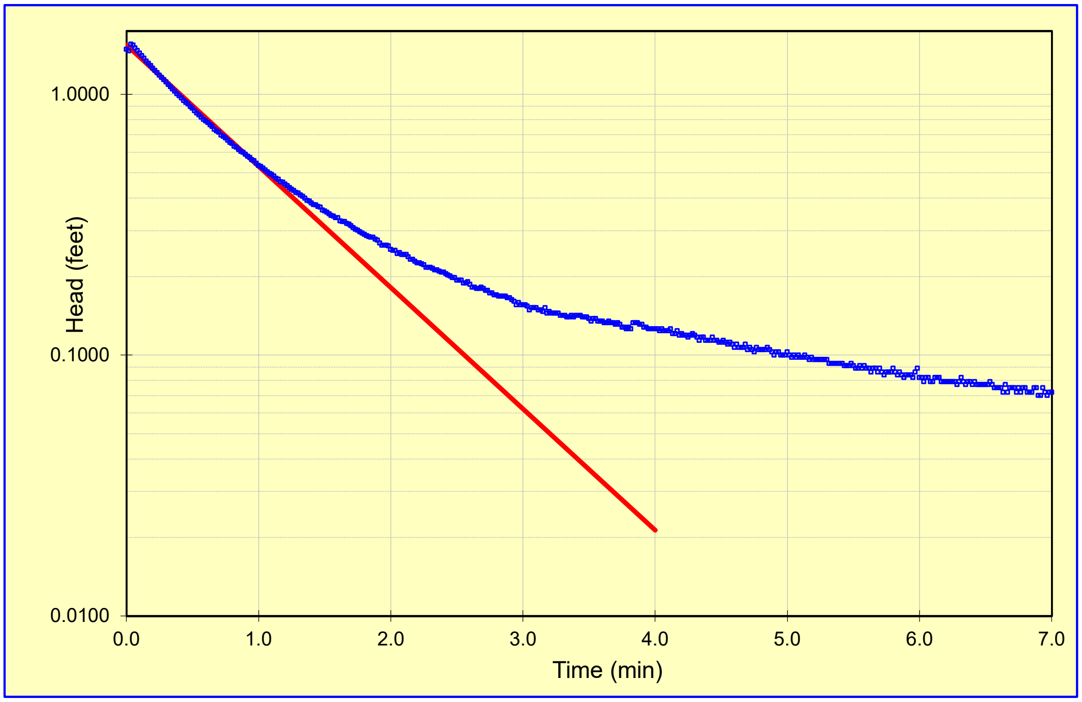
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$ln(R_e/r_w)$=	**3.38**
y_0 =	**1.54**
y_t =	**0.021**
t =	**4.0**

RESULTS

K=	**1.27E-03**	**cm/sec**
K=	**3.61E+00**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/4/2019

HVORSLEV SLUG TEST ANALYSIS
Falling Head Test MW14-01D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

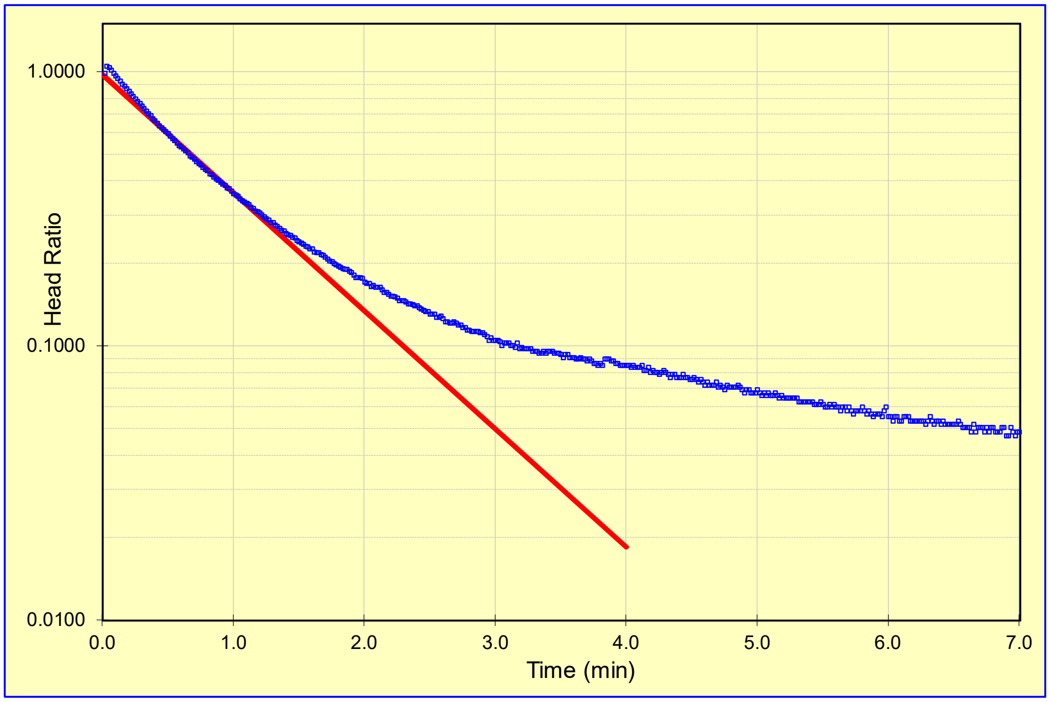
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 4.00
$h_{1(t1)}$ = 0.98
$h_{2(t2)}$ = 0.019

RESULTS

K= 1.19E-03 cm/sec
K= 3.37E+00 ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-01D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

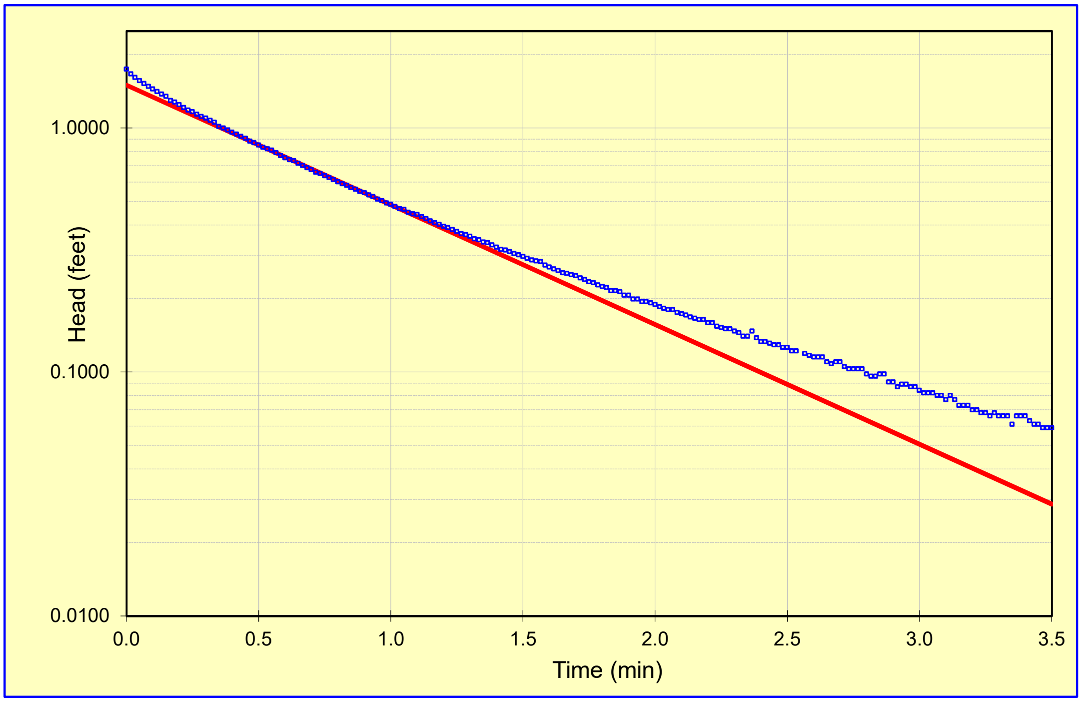
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.50
y_t =	0.029
t =	3.5

RESULTS

K=	1.35E-03	cm/sec
K=	3.81E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-01D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

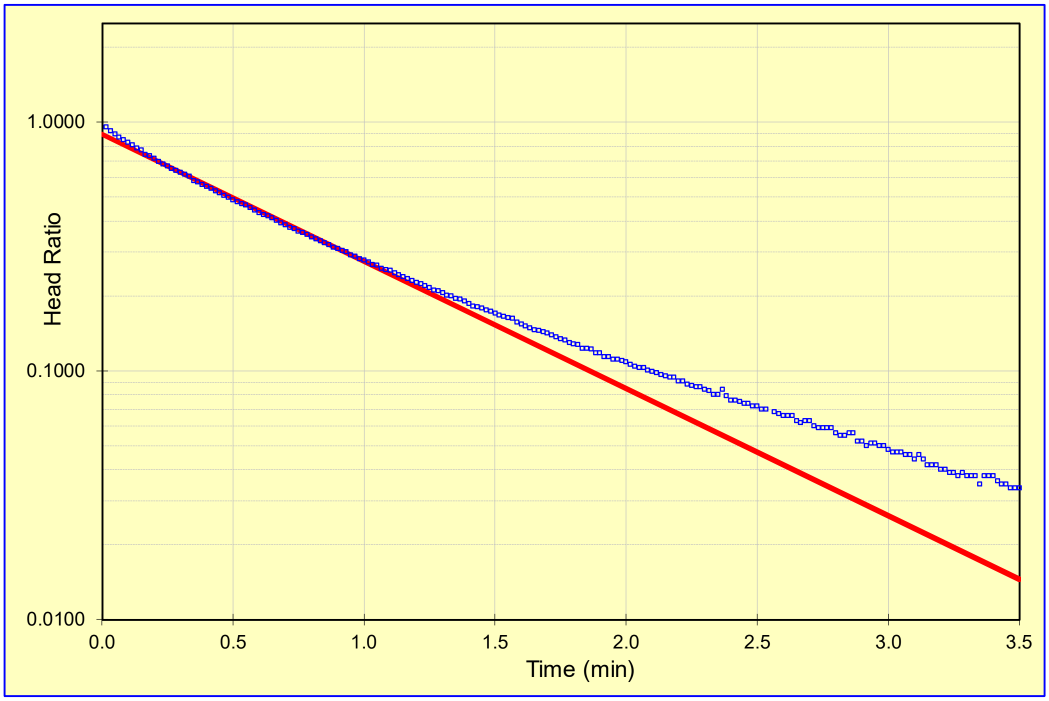
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 3.50
$h_{1(t1)}$ = 0.90
$h_{2(t2)}$ = 0.015

RESULTS

K=	**1.41E-03**	**cm/sec**
K=	**4.01E+00**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-01S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

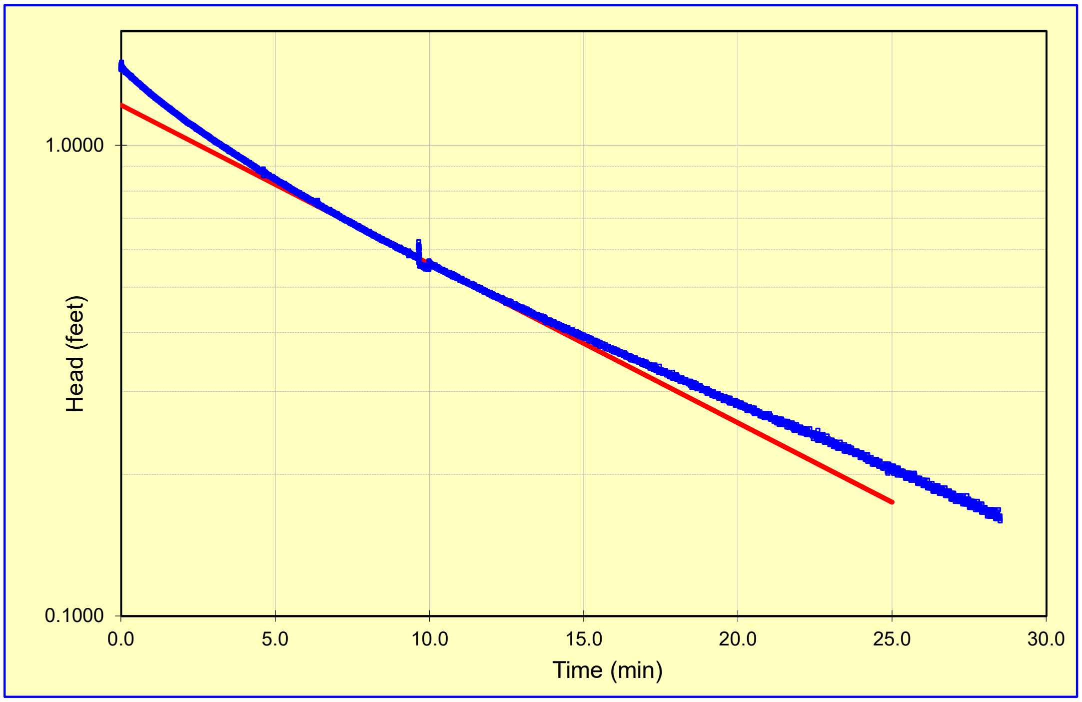
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**2**
$ln(R_e/r_w)$=	**2.77**
y_0 =	**1.22**
y_t =	**0.175**
t =	**25.0**

RESULTS

K=	**1.90E-04**	**cm/sec**
K=	**5.39E-01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-01S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

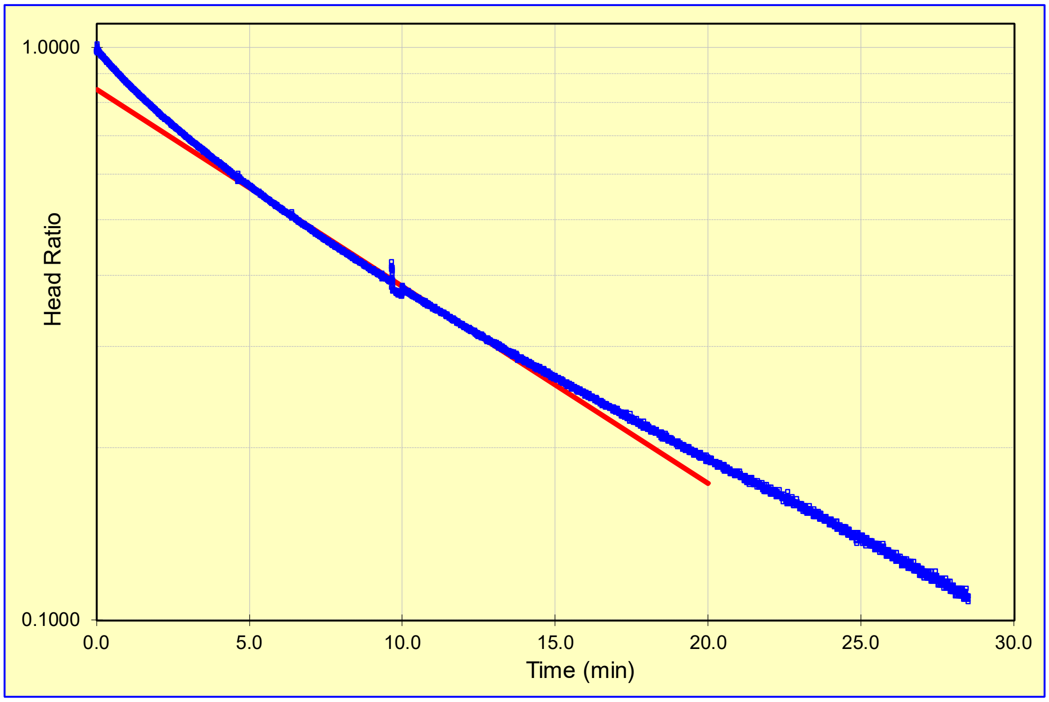
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = **0.08**
R_e = **0.17**
L_e = **2.0**
t_1 = **0.00**
t_2 = **20.00**
$h_{1(t1)}$ = **0.84**
$h_{2(t2)}$ = **0.173**

RESULTS

K= 1.73E-04 cm/sec
K= 4.91E-01 ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	TK
Test Date:	04/09/19	Analysis Date:	6/12/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-01S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

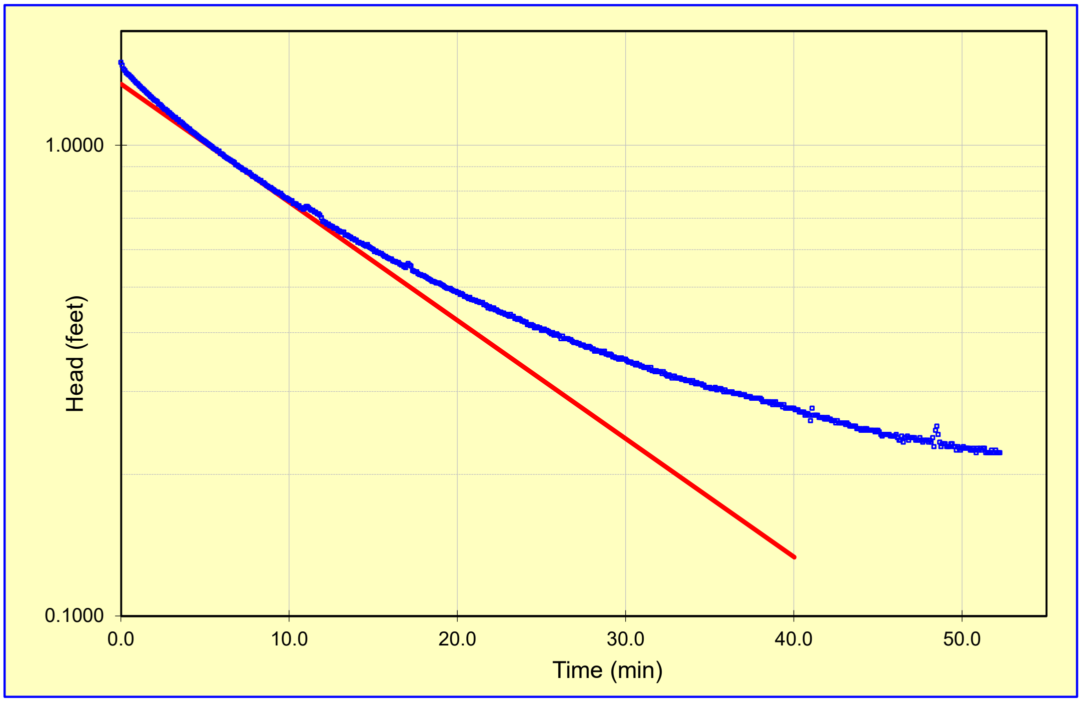
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2
$\ln(R_e/r_w)$=	2.77
y_0 =	1.35
y_t =	0.133
t =	40.0

RESULTS

K=	1.41E-04	cm/sec
K=	4.01E-01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

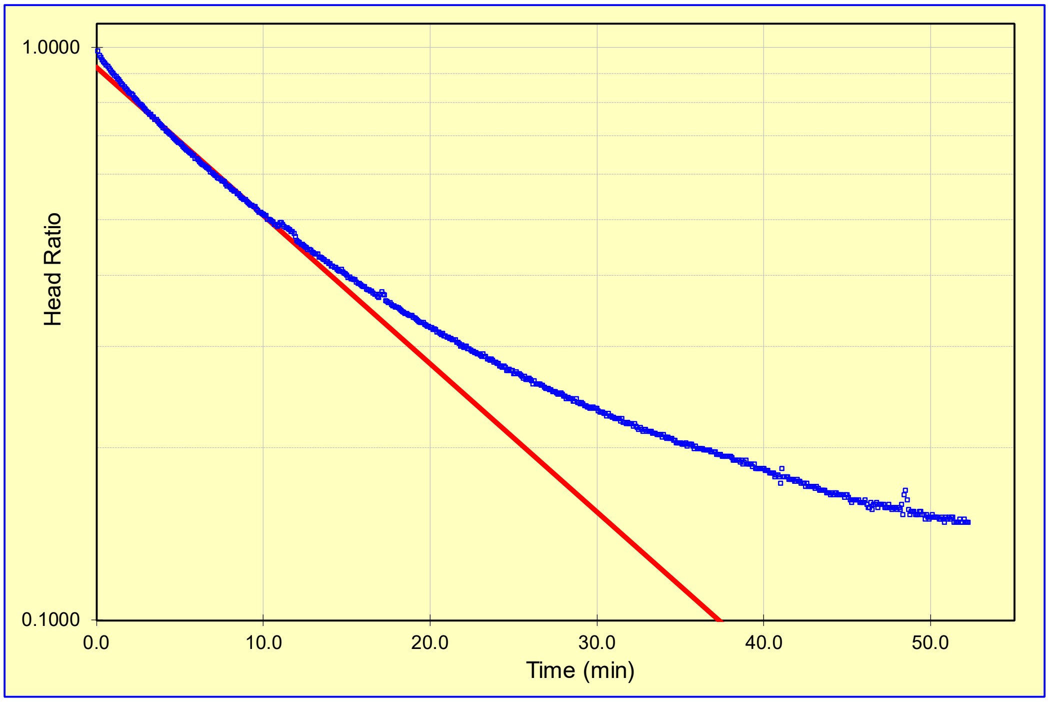
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-01S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
R_e =	**0.17**			
L_e =	**2.0**	**K=**	**1.31E-04**	**cm/sec**
t_1 =	**0.00**	**K=**	**3.70E-01**	**ft/day**
t_2 =	**40.00**			
$h_{1(t1)}$ =	**0.92**			
$h_{2(t2)}$ =	**0.085**			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-02B

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

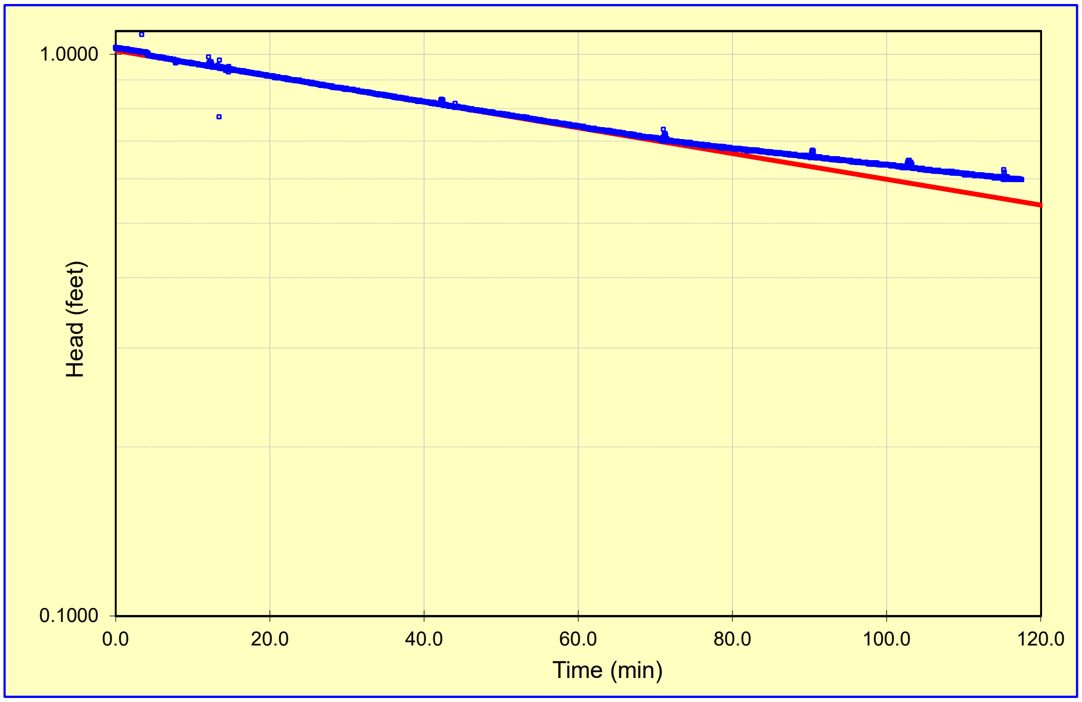
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.02
y_t =	0.354
t =	200.0

RESULTS

K=	6.28E-06	cm/sec
K=	1.78E-02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

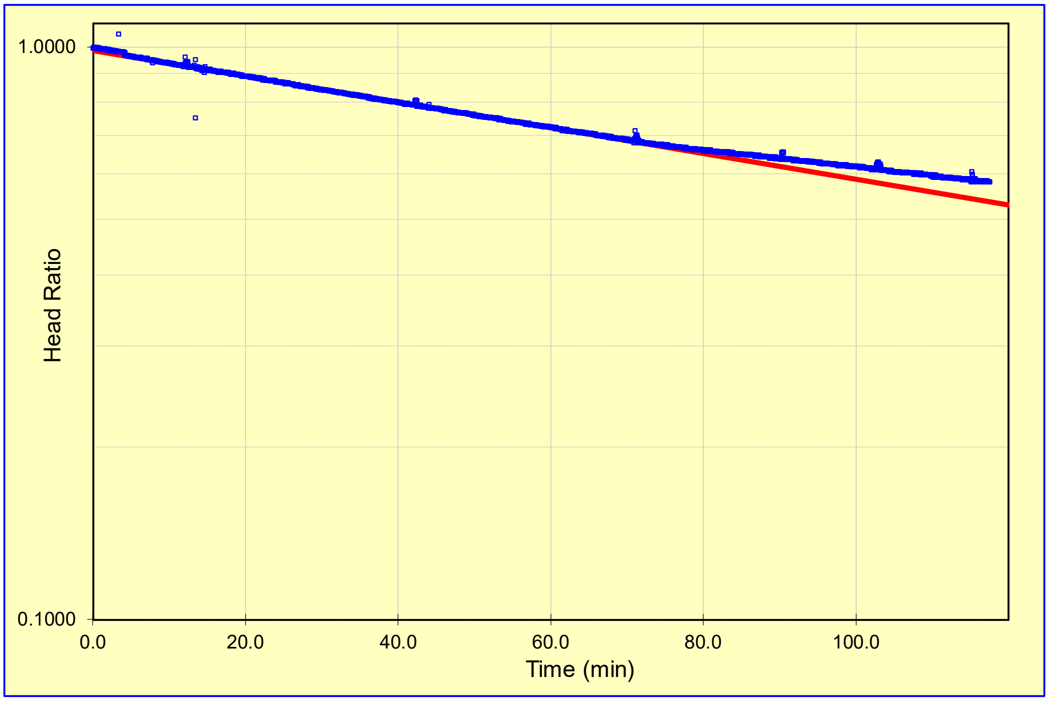
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-02B

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	6.20E-06	cm/sec
t_1 =	0.00	K=	1.76E-02	ft/day
t_2 =	200.00			
$h_{1(t1)}$ =	0.99			
$h_{2(t2)}$ =	0.351			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-02B

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

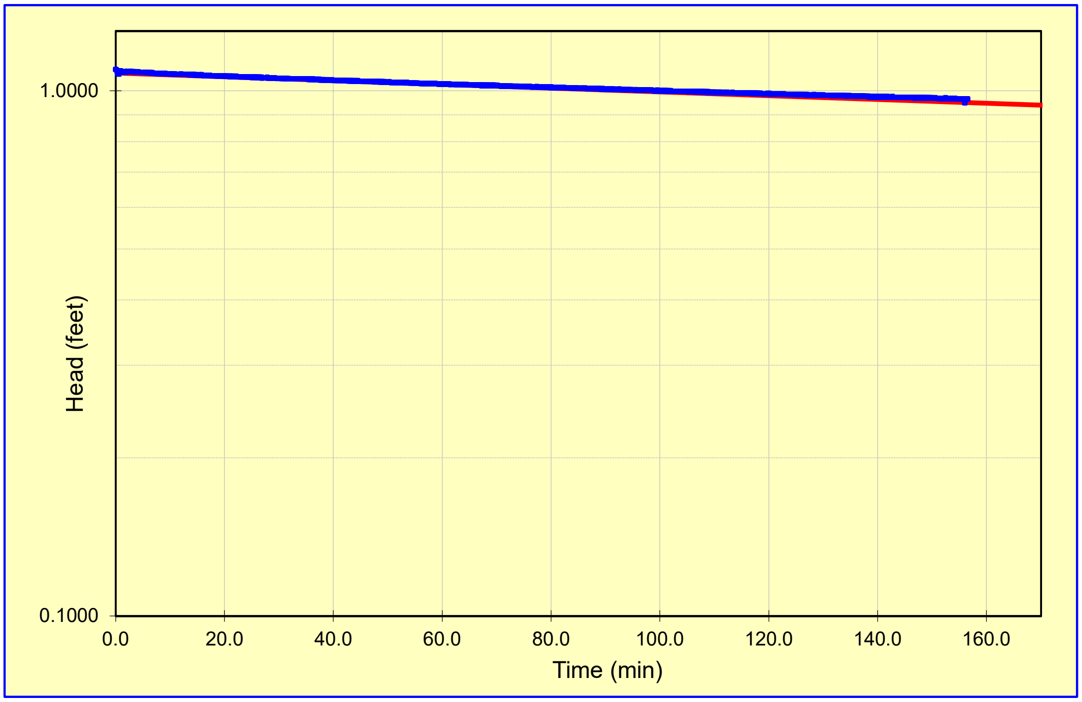
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.08
y_t =	0.917
t =	200.0

RESULTS

K=	9.85E-07	cm/sec
K=	2.79E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-02B

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

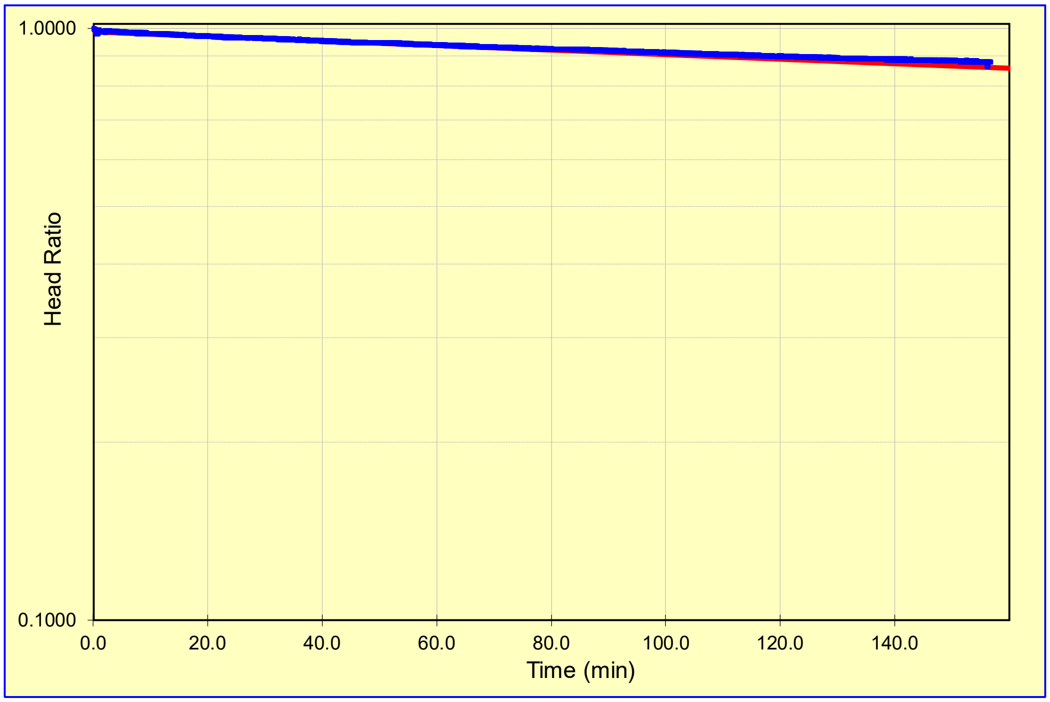
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	200.00
$h_{1(t1)}$ =	0.99
$h_{2(t2)}$ =	0.827

RESULTS

K=	1.07E-06	cm/sec
K=	3.04E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-02D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

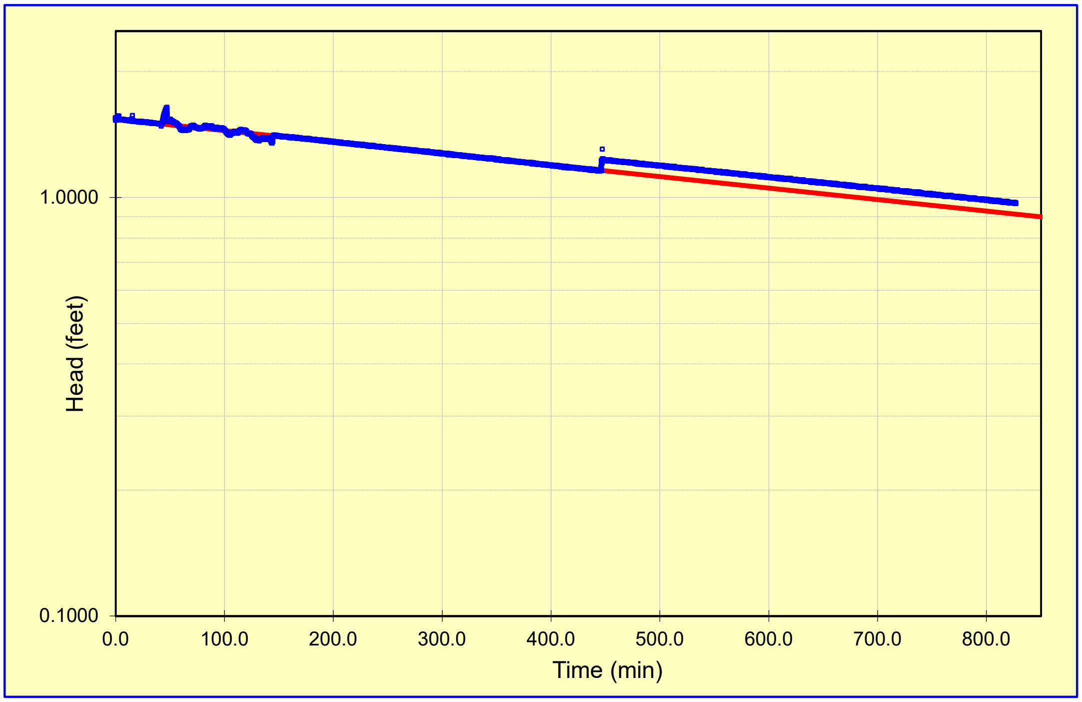
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.54
y_t =	0.872
t =	900.0

RESULTS

K=	7.52E-07	cm/sec
K=	2.13E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

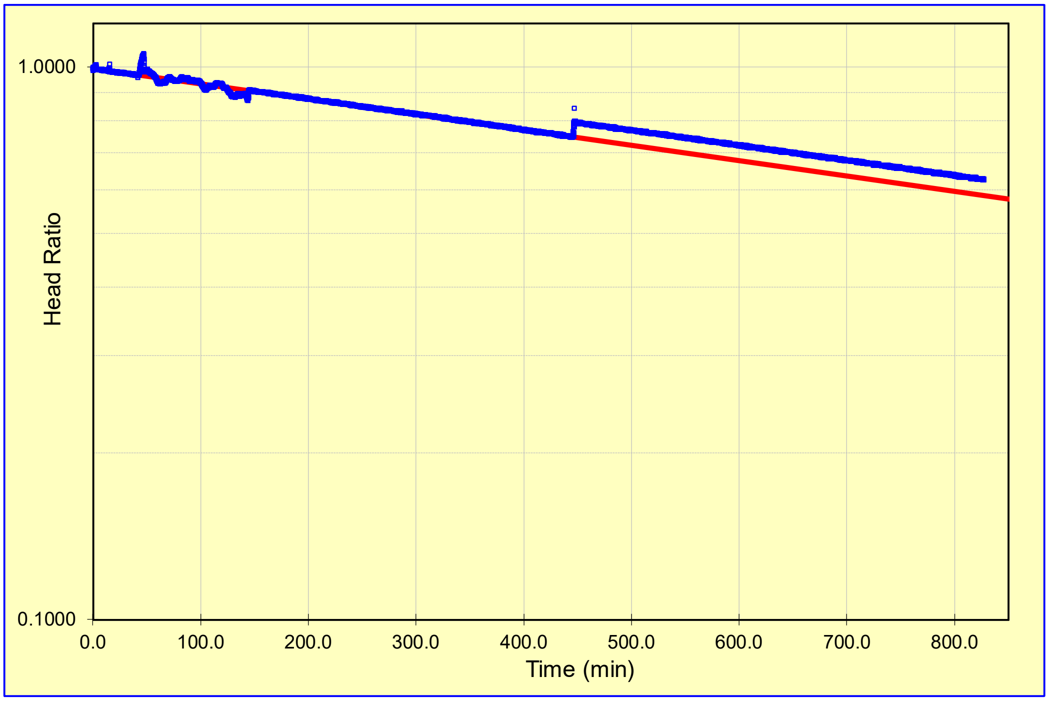
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-02D

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	**0.08**	
R_e =	**0.17**	
L_e =	**5.0**	**K= 7.68E-07 cm/sec**
t_1 =	**0.00**	**K= 2.18E-03 ft/day**
t_2 =	**900.00**	
$h_{1(t1)}$ =	**0.99**	
$h_{2(t2)}$ =	**0.559**	



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/10/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-02D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

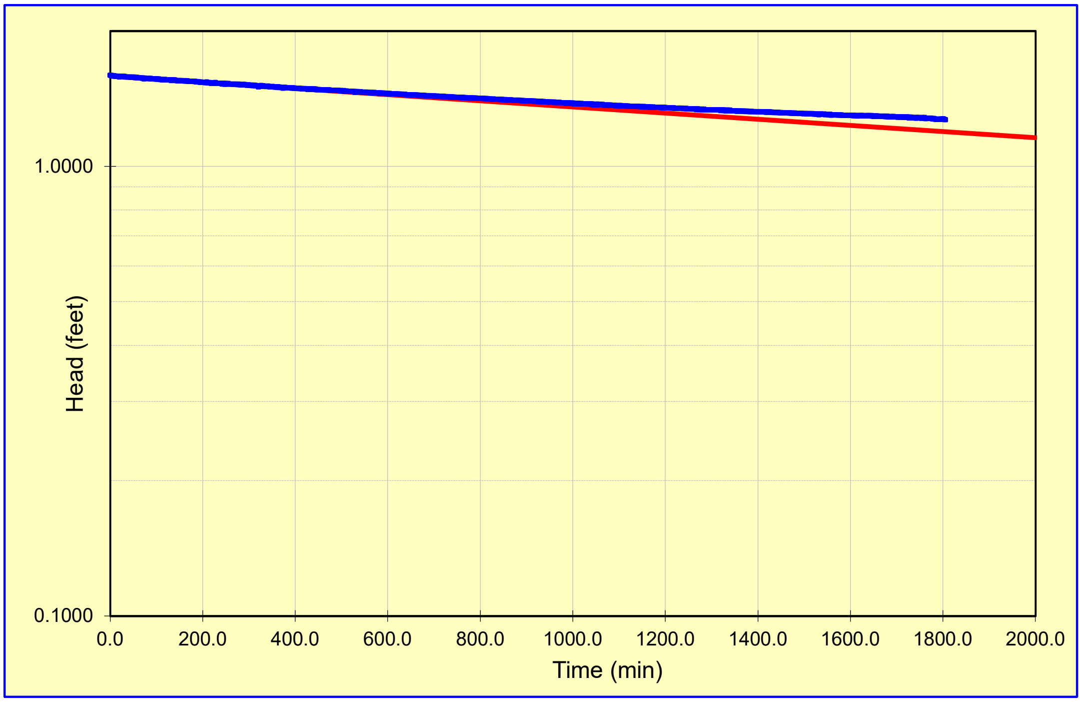
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.17
L_e = 5
$\ln(R_e/r_w)$= 3.38
y_0 = 1.59
y_t = 1.158
t = 2000.0

RESULTS

K=	**1.87E-07**	**cm/sec**
K=	**5.31E-04**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-02D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

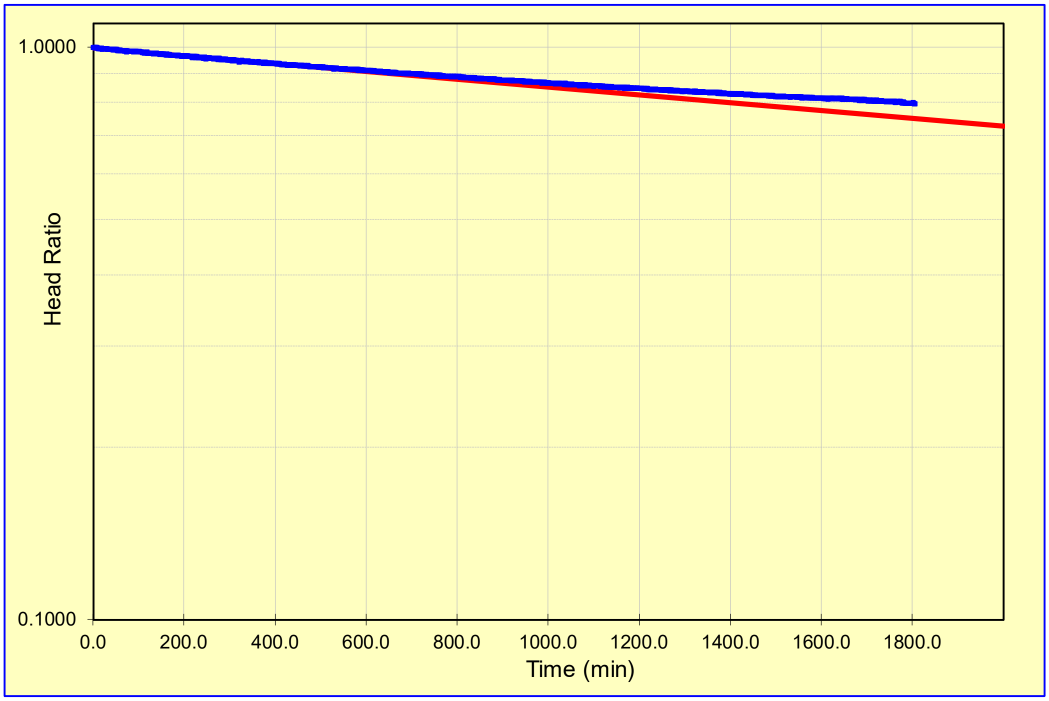
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 2000.00
$h_{1(t1)}$ = 1.00
$h_{2(t2)}$ = 0.728

RESULTS

K= 1.88E-07 cm/sec
K= 5.33E-04 ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/11/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-02M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

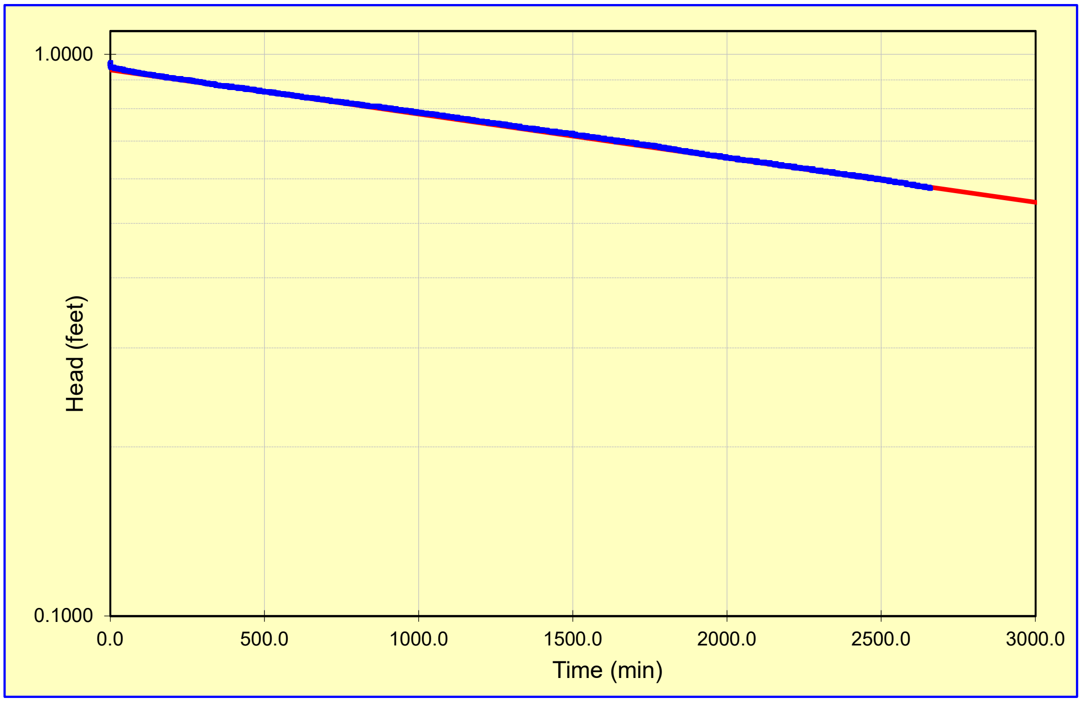
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$\ln(R_e/r_w)$=	**3.38**
y_0 =	**0.94**
y_t =	**0.455**
t =	**4000.0**

RESULTS

K=	**2.16E-07**	**cm/sec**
K=	**6.11E-04**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

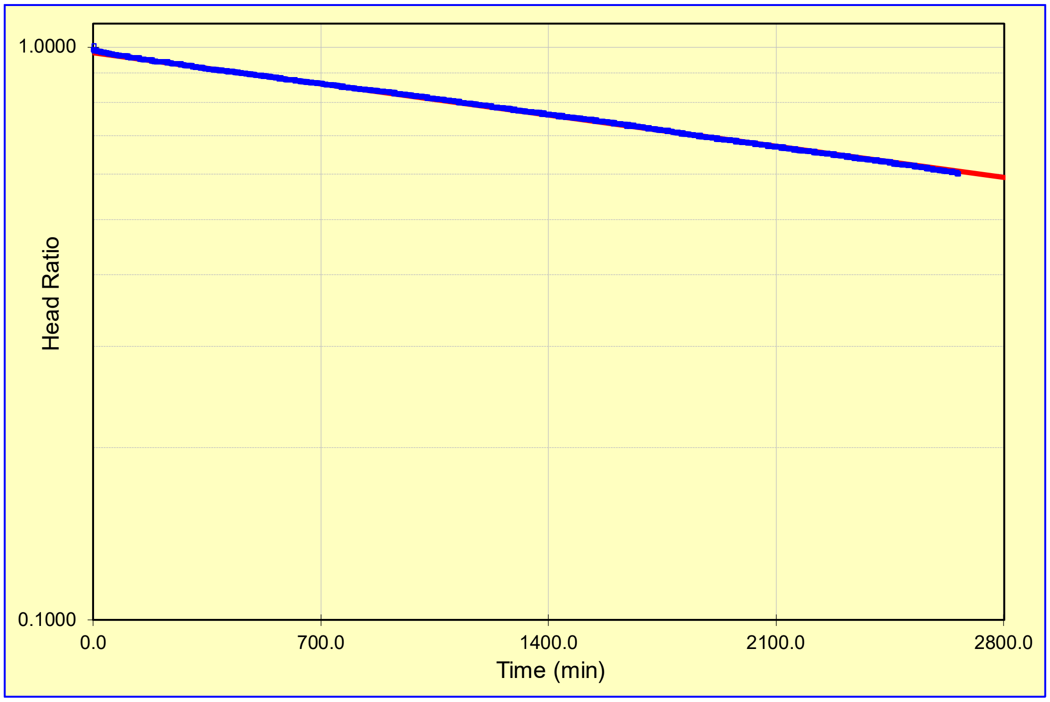
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-02M

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)}\right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	2.14E-07	cm/sec
t_1 =	0.00	K=	6.08E-04	ft/day
t_2 =	4000.00			
$h_{1(t1)}$ =	0.98			
$h_{2(t2)}$ =	0.479			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-02M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_o}{y_t}$$

where:

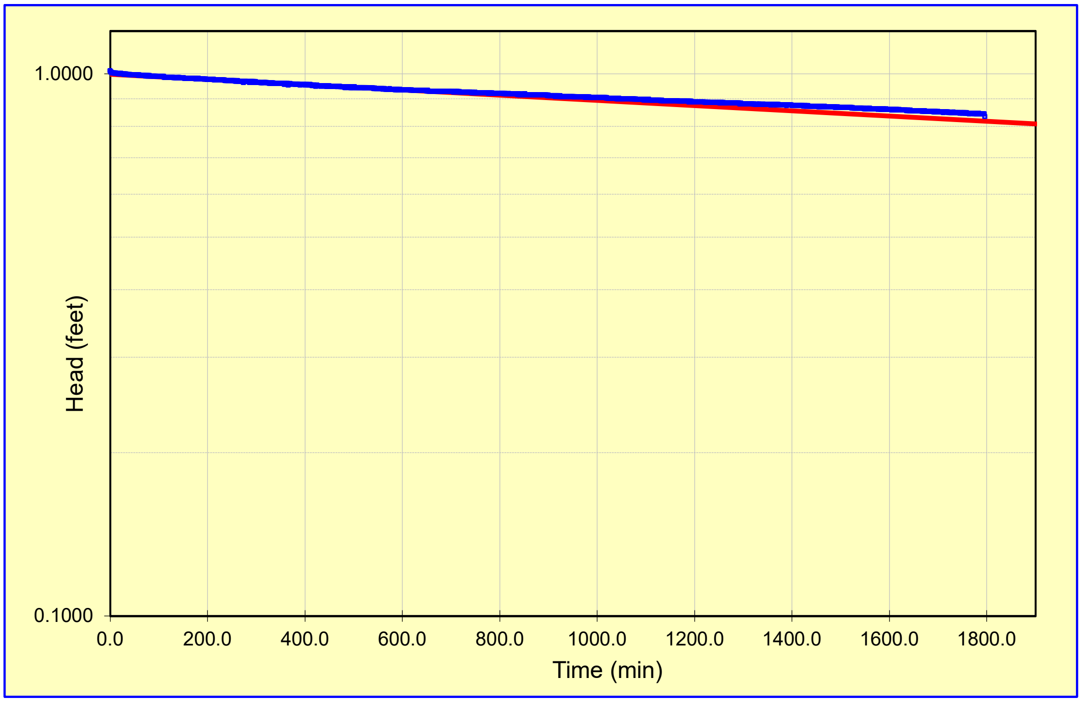
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.00
y_t =	0.801
t =	2000.0

RESULTS

K=	1.31E-07	cm/sec
K=	3.72E-04	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

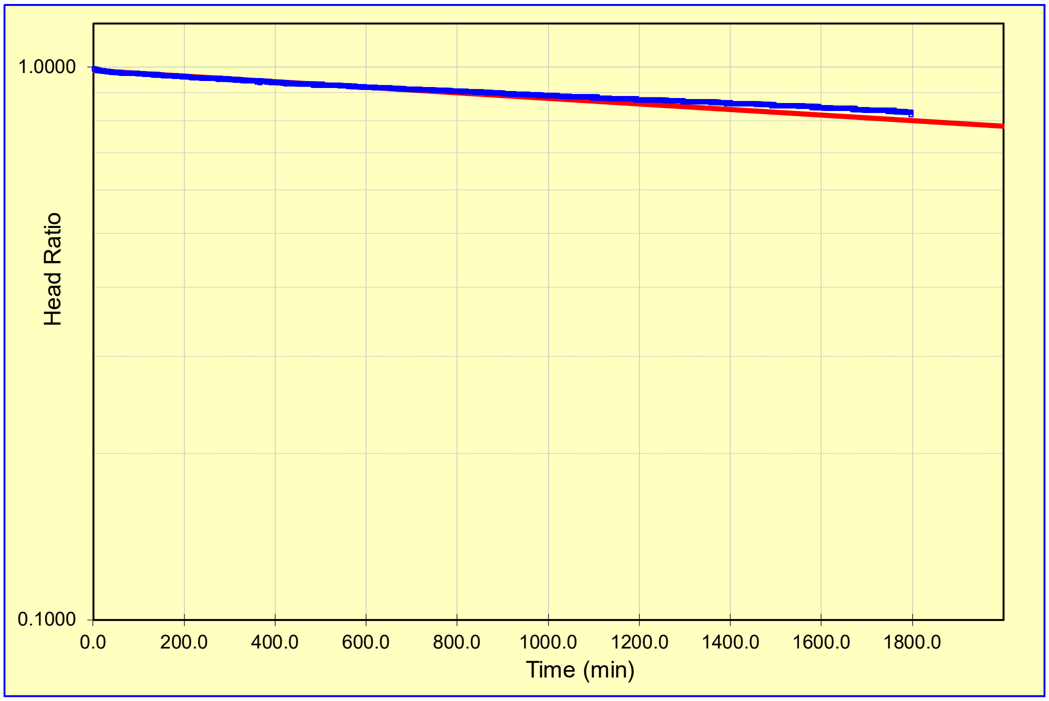
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-02M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	1.39E-07	cm/sec
t_1 =	0.00	K=	3.95E-04	ft/day
t_2 =	2000.00			
$h_{1(t1)}$ =	0.99			
$h_{2(t2)}$ =	0.783			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-03B

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

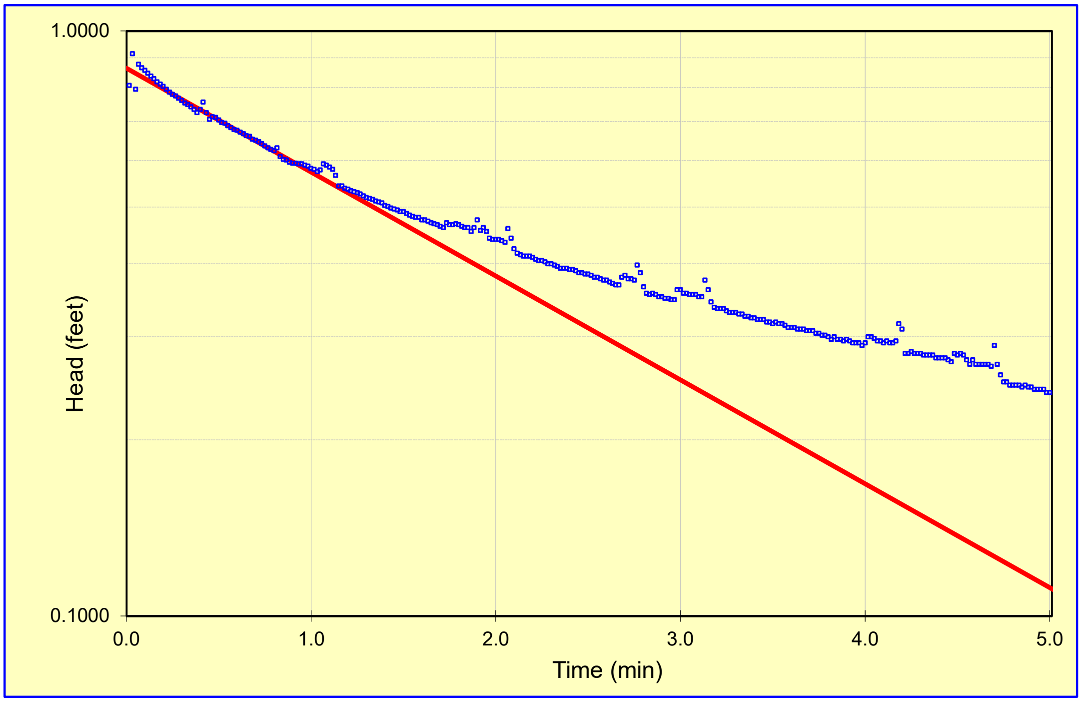
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	20
$\ln(R_e/r_w)$=	4.99
y_0 =	0.86
y_t =	0.074
t =	6.0

RESULTS

K=	1.80E-04	cm/sec
K=	5.10E-01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

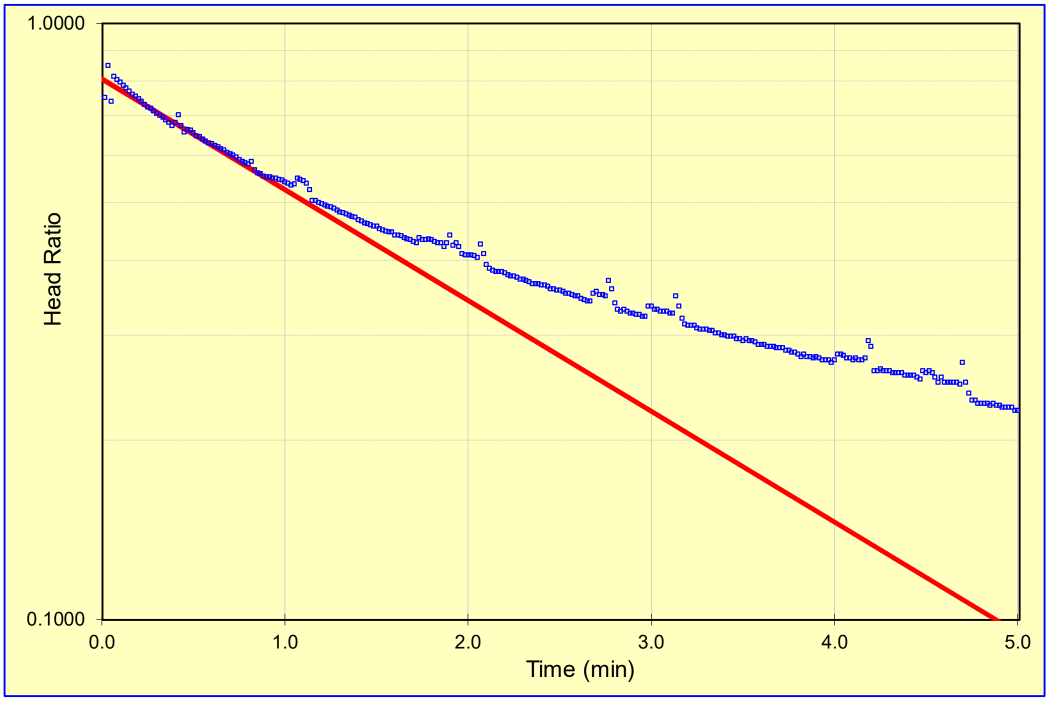
Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-03B

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where: r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	0.08	
R_e =	0.17	
L_e =	20.0	**K= 1.81E-04 cm/sec**
t_1 =	0.00	**K= 5.12E-01 ft/day**
t_2 =	6.00	
$h_{1(t1)}$ =	0.81	
$h_{2(t2)}$ =	0.062	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-03B

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

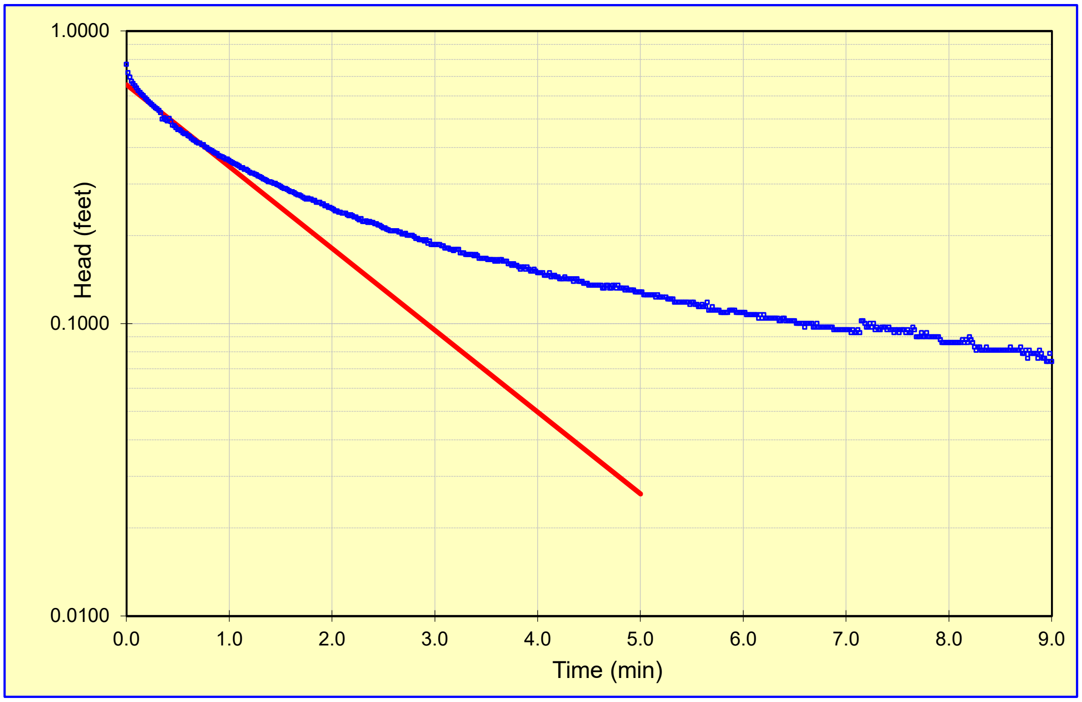
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.17
L_e = 20
$\ln(R_e/r_w)$= 4.99
y_0 = 0.66
y_t = 0.026
t = 5.0

RESULTS

K=	**2.84E-04**	**cm/sec**
K=	**8.04E-01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-03B

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

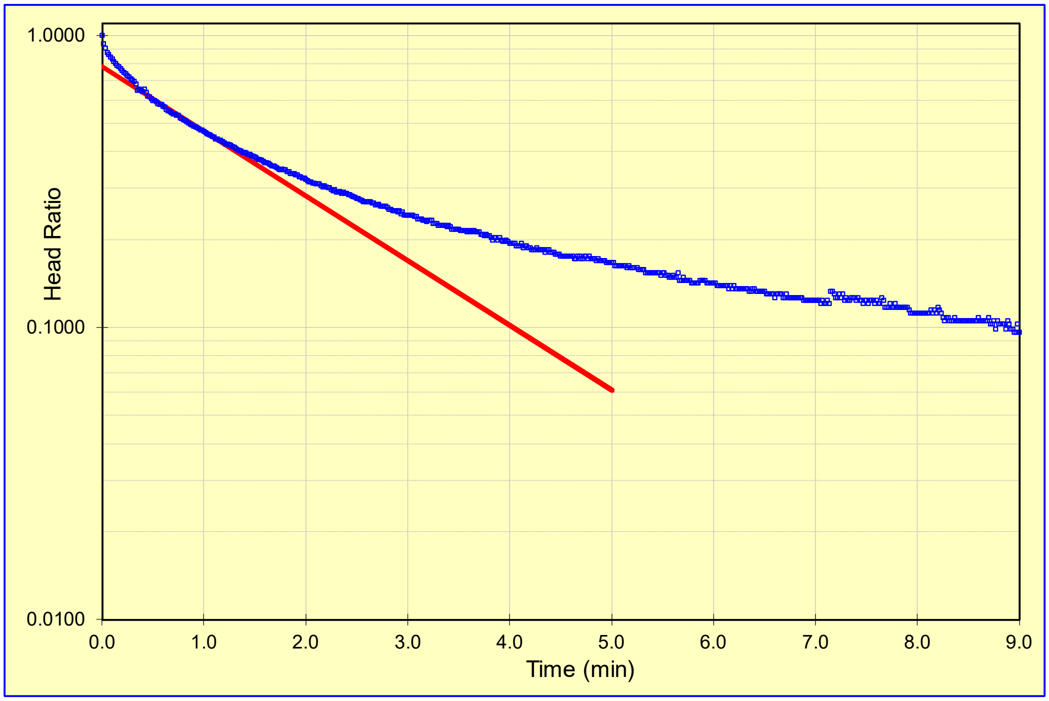
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	20.0
t_1 =	0.00
t_2 =	5.00
$h_{1(t1)}$ =	0.78
$h_{2(t2)}$ =	0.061

RESULTS

K=	2.15E-04	cm/sec
K=	6.11E-01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-03D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08

r_w = 0.17

L_e = 5

$\ln(R_e/r_w)$= 3.38

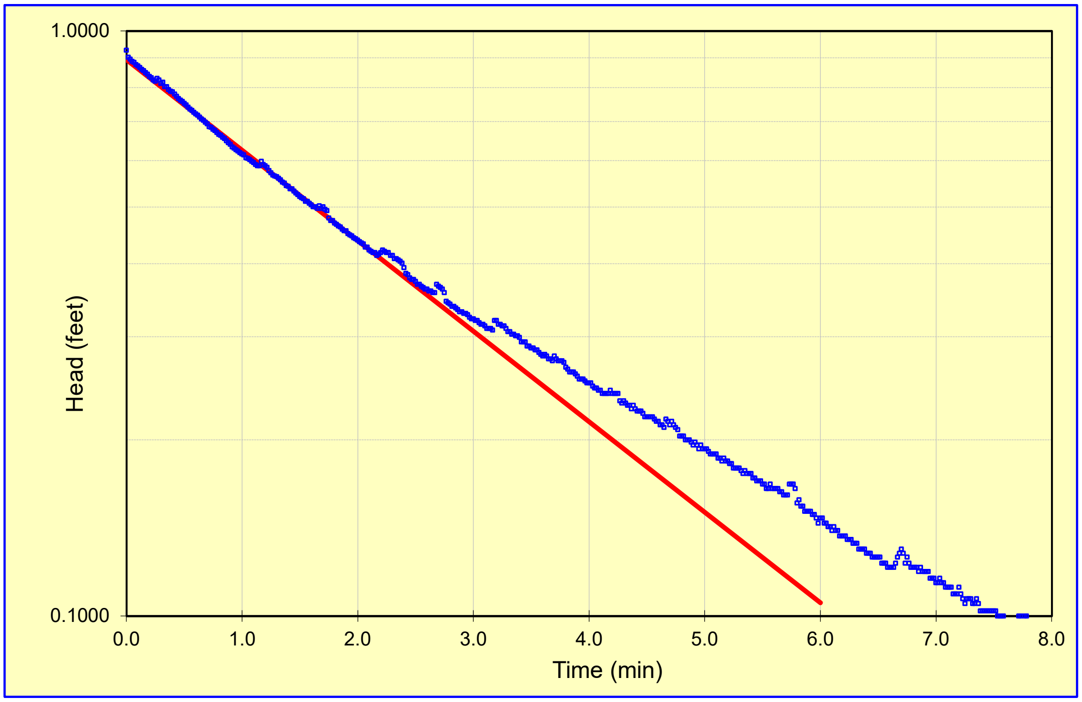
y_0 = 0.89

y_t = 0.105

t = 6.0

RESULTS

K=	**4.24E-04**	**cm/sec**
K=	**1.20E+00**	**ft/day**



Project Name: Crossroads - Phase 14

Project No.: 19119078

Test Date: 04/11/19

Analysis By: TK

Checked By: LWL

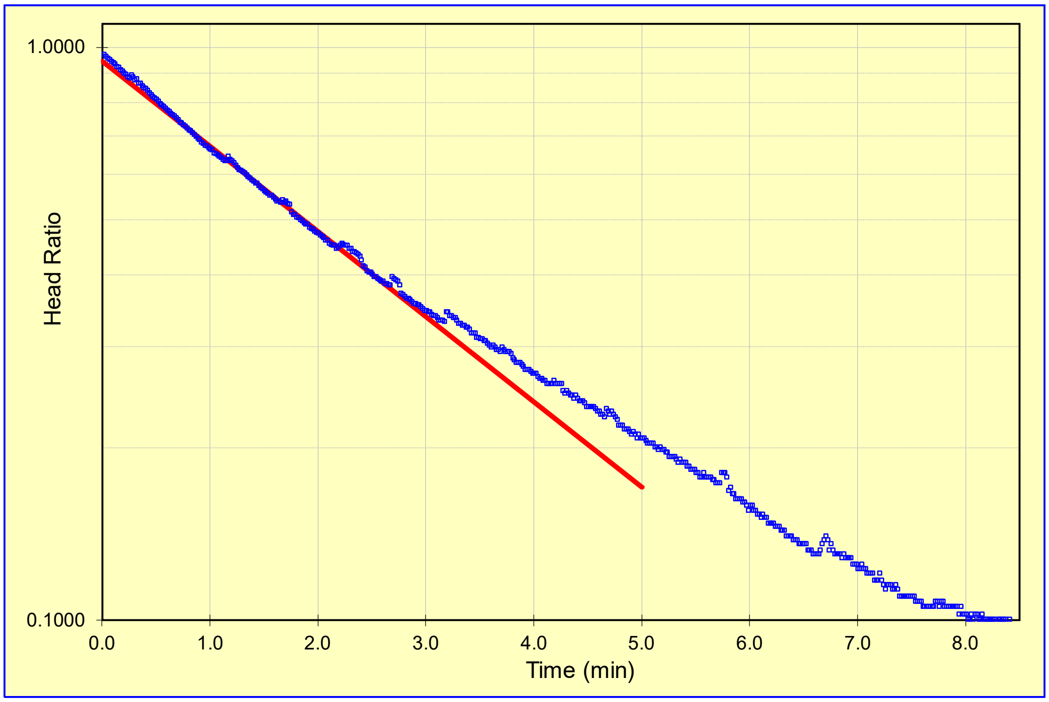
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-03D

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)}\right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	4.10E-04	cm/sec
t_1 =	0.00	K=	1.16E+00	ft/day
t_2 =	5.00			
$h_{1(t1)}$ =	0.95			
$h_{2(t2)}$ =	0.171			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 2 MW14-03D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

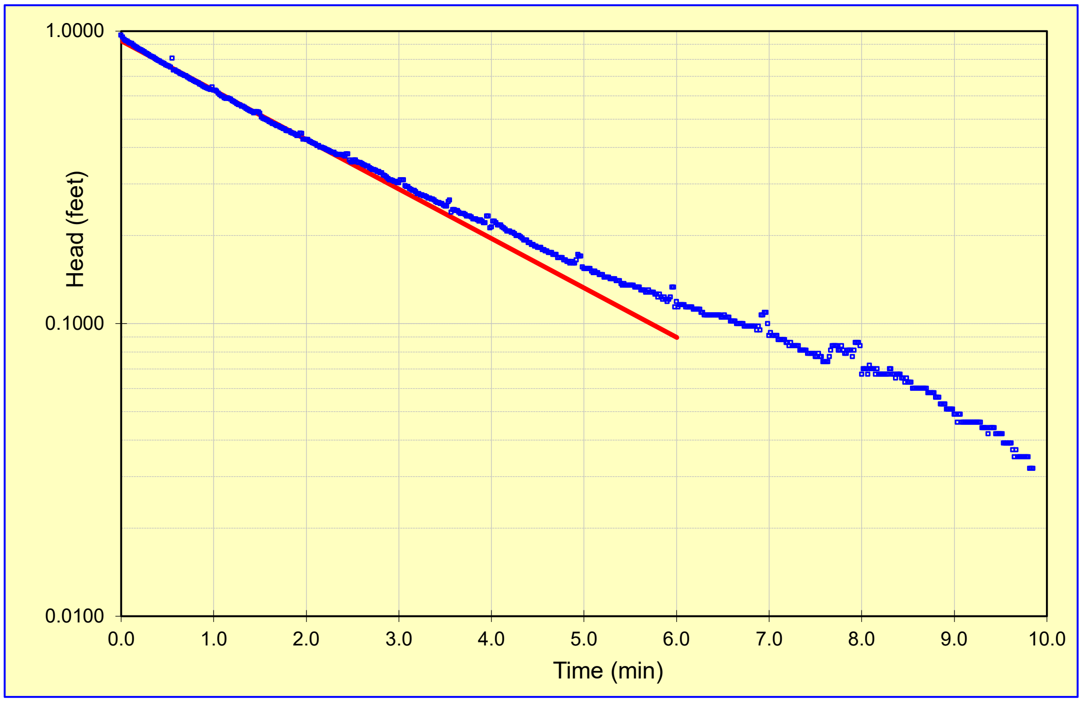
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	0.93
y_t =	0.090
t =	6.0

RESULTS

K=	4.63E-04	cm/sec
K=	1.31E+00	ft/day



Project Name: Crossroads - Phase 14

Project No.: 19119078

Test Date: 04/11/19

Analysis By: TK

Checked By: LWL

Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 2 MW14-03D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

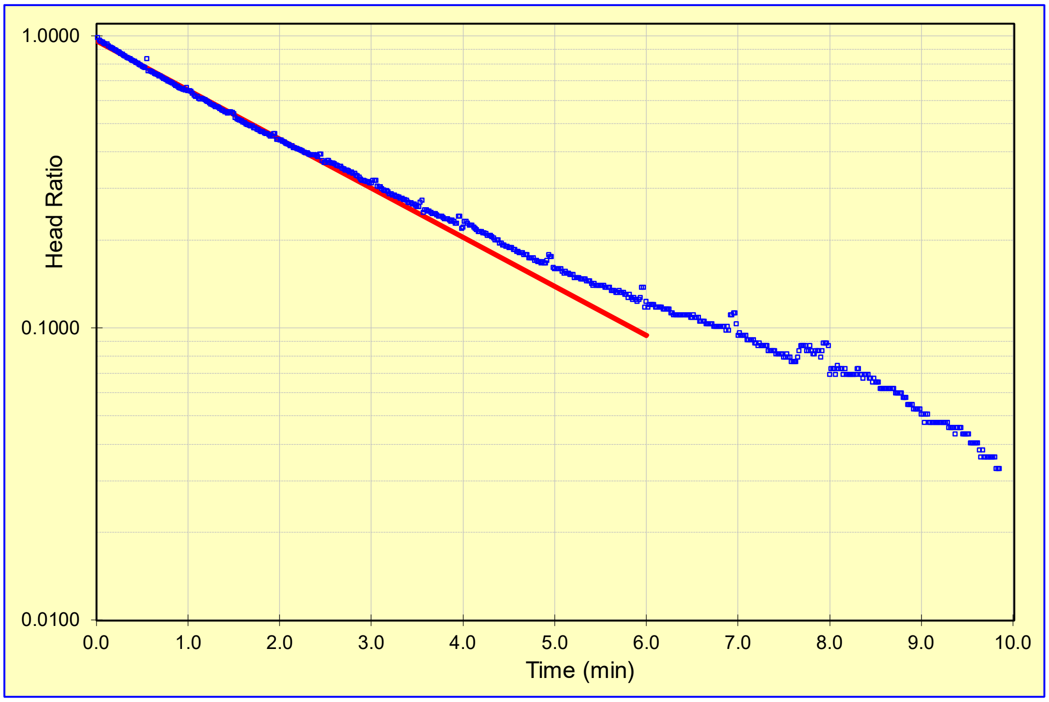
where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	6.00
$h_{1(t1)}$ =	0.96
$h_{2(t2)}$ =	0.094

RESULTS

K=	4.64E-04	cm/sec
K=	1.32E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-03D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

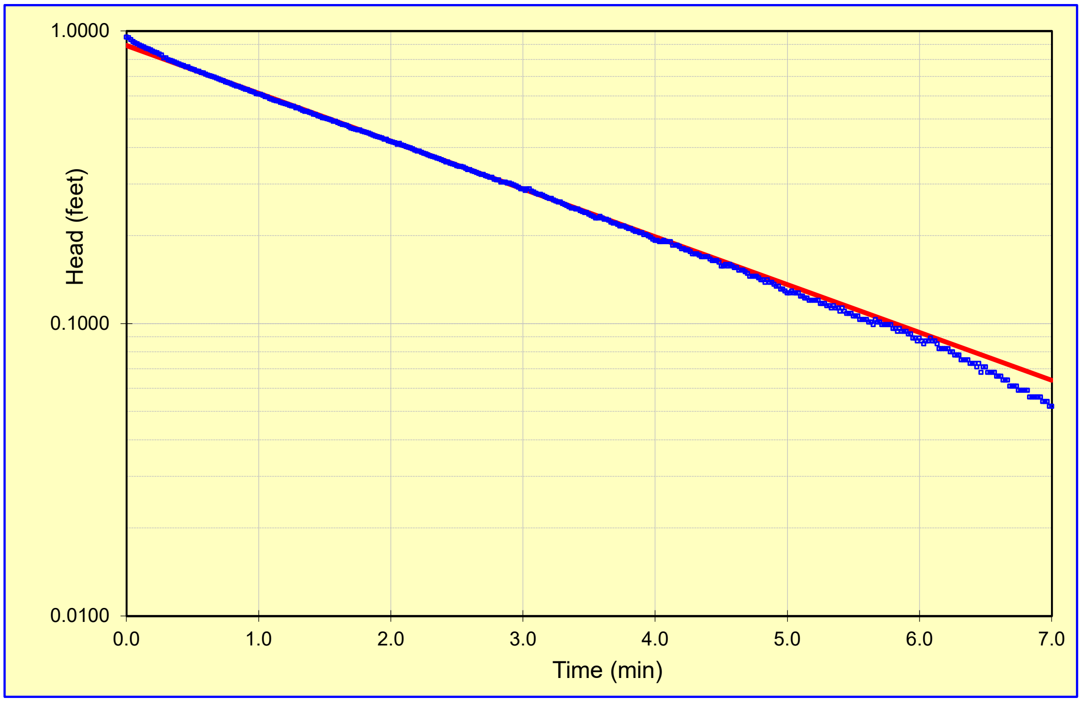
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	0.89
y_t =	0.064
t =	7.0

RESULTS

K=	4.48E-04	cm/sec
K=	1.27E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

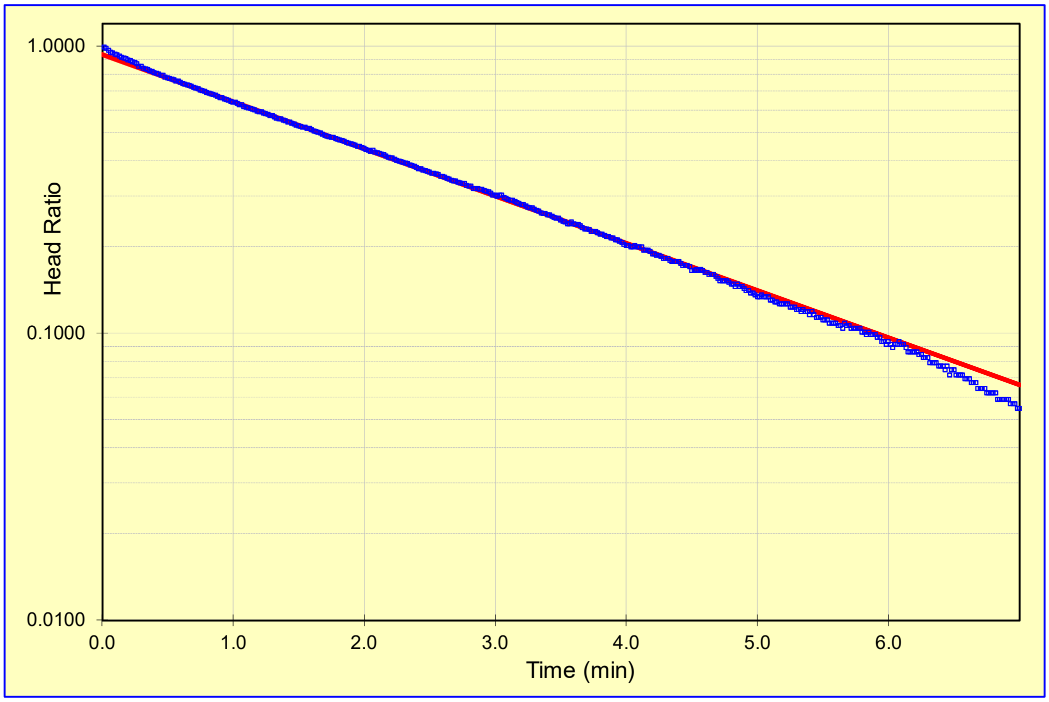
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-03D

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)}\right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time *t* (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	0.08	
R_e =	0.17	
L_e =	5.0	K= 4.54E-04 cm/sec
t_1 =	0.00	K= 1.29E+00 ft/day
t_2 =	7.00	
$h_{1(t1)}$ =	0.94	
$h_{2(t2)}$ =	0.066	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 MW14-03D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

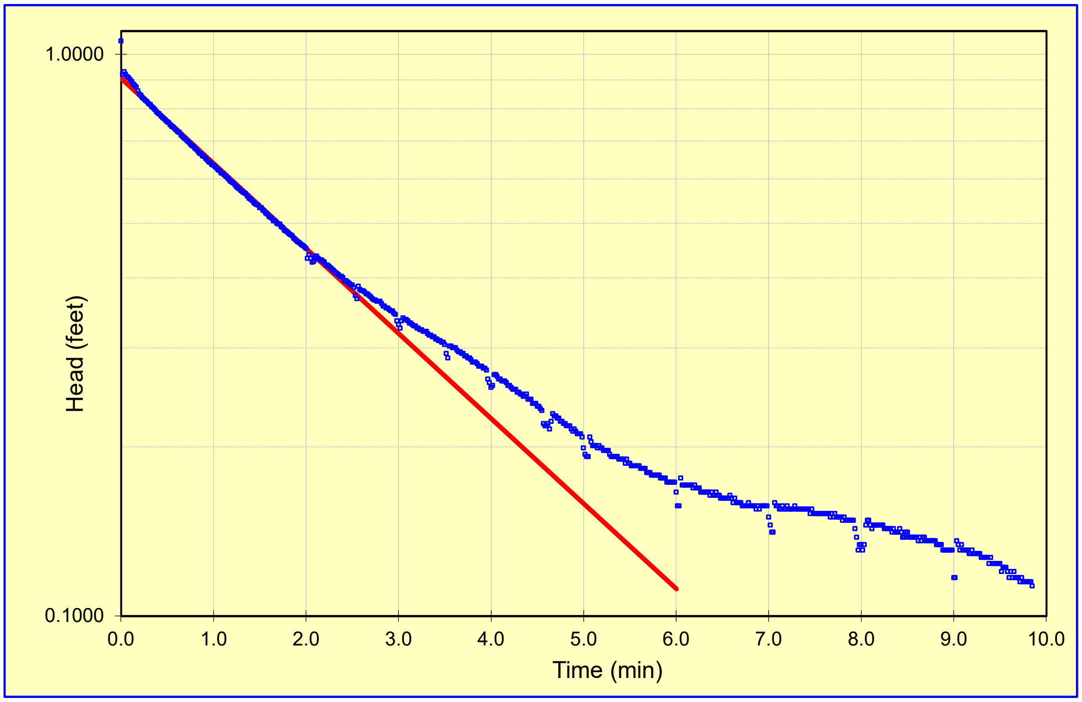
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$\ln(R_e/r_w)$=	**3.38**
y_0 =	**0.91**
y_t =	**0.112**
t =	**6.0**

RESULTS

K=	**4.15E-04**	**cm/sec**
K=	**1.18E+00**	**ft/day**



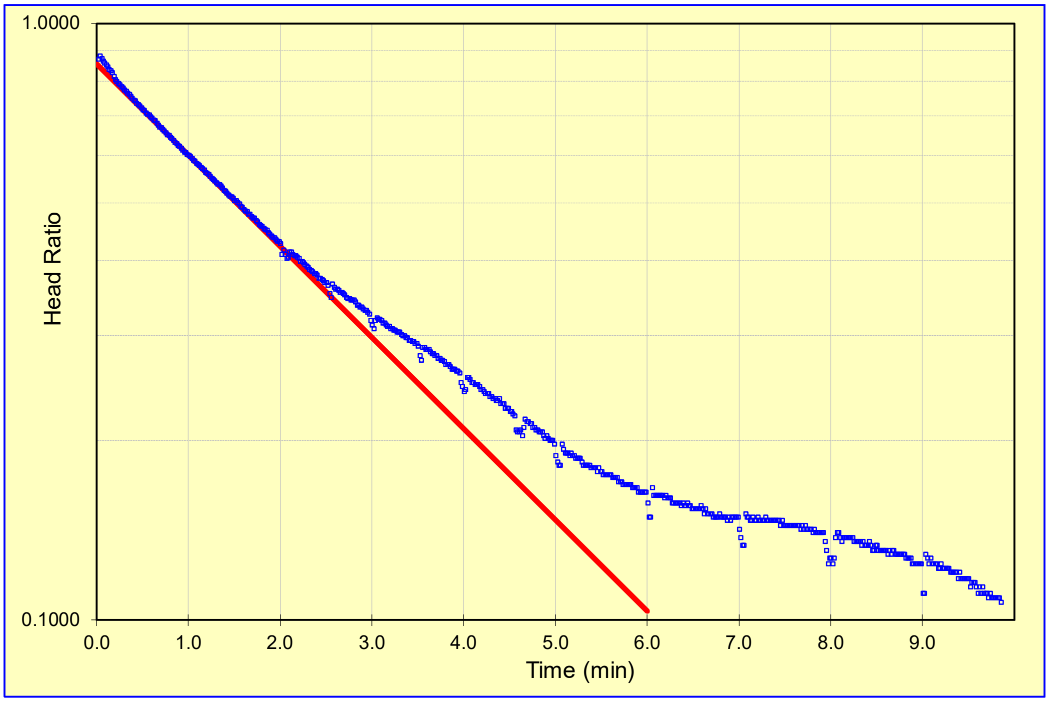
Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/11/19	Analysis Date:	6/4/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 MW14-03D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	4.22E-04	cm/sec
t_1 =	0.00	K=	1.20E+00	ft/day
t_2 =	6.00			
$h_{1(t1)}$ =	0.86			
$h_{2(t2)}$ =	0.104			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

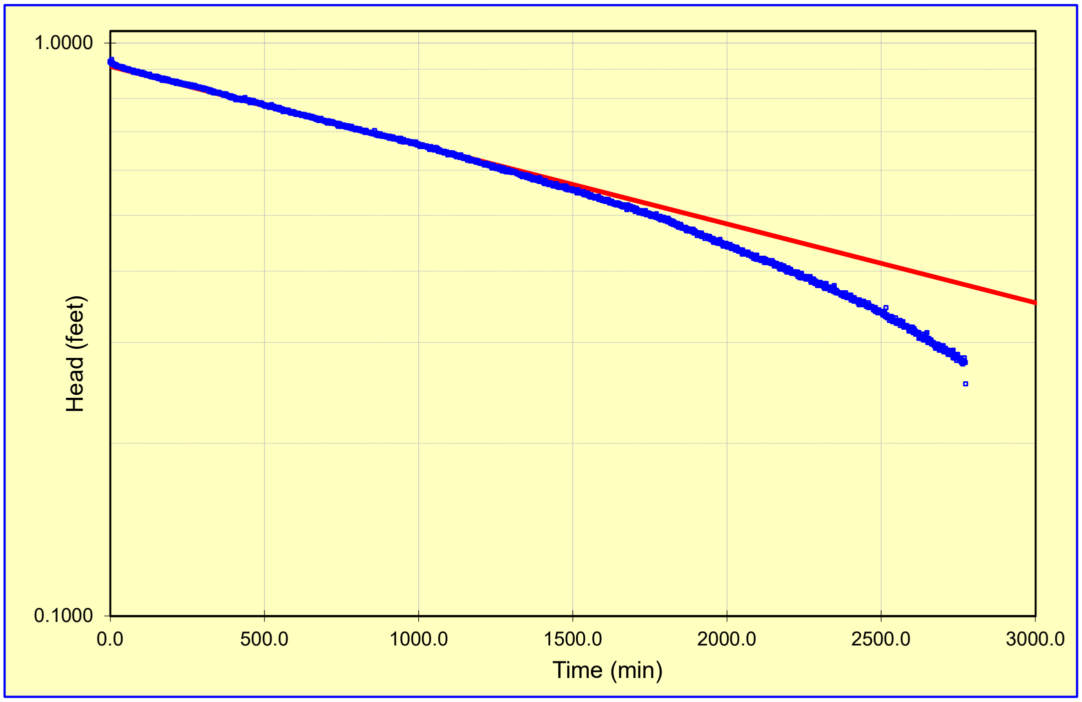
BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-03M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
r_w =	**0.17**			
L_e =	**5**	**K=**	**3.77E-07**	**cm/sec**
$\ln(R_e/r_w)$=	**3.38**	**K=**	**1.07E-03**	**ft/day**
y_0 =	**0.91**			
y_t =	**0.352**			
t =	**3000.0**			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

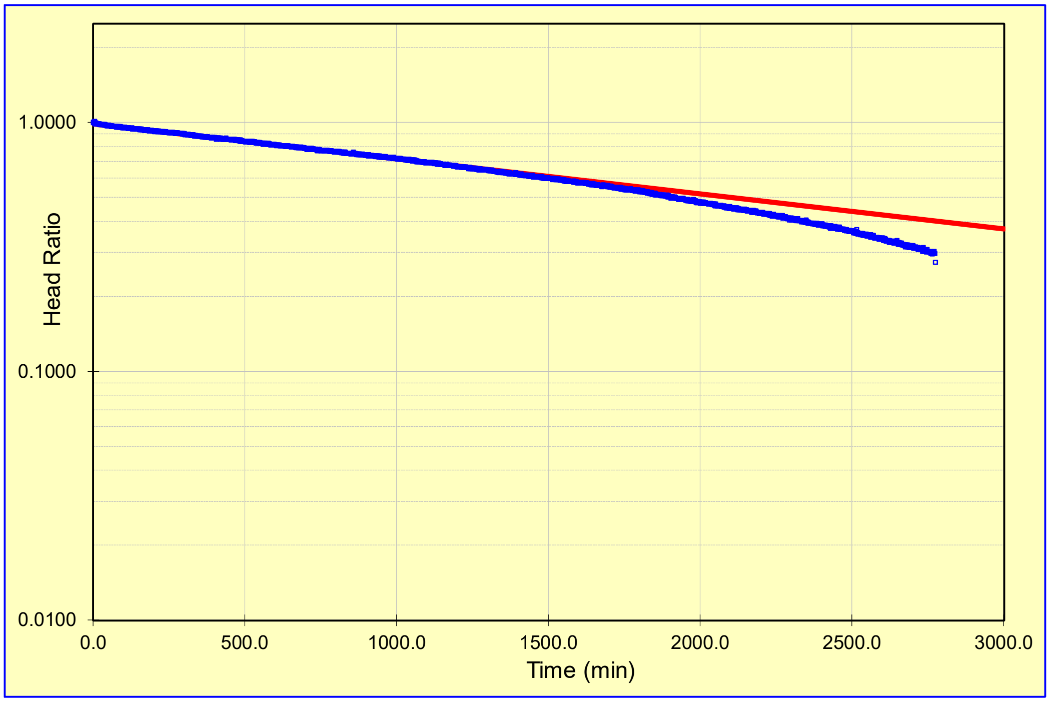
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-03M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	3.88E-07	cm/sec
t_1 =	0.00	K=	1.10E-03	ft/day
t_2 =	3000.00			
$h_{1(t1)}$ =	0.99			
$h_{2(t2)}$ =	0.375			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-03M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

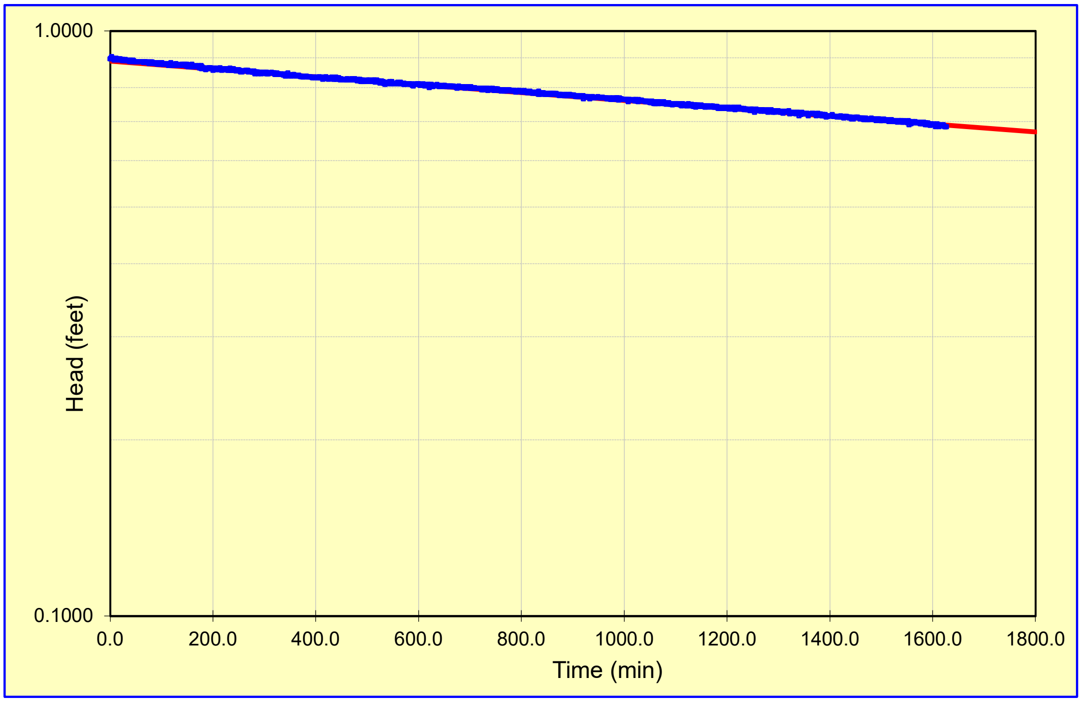
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.89
y_t =	0.672
t =	1800.0

RESULTS

K=	1.84E-07	cm/sec
K=	5.21E-04	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-03M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

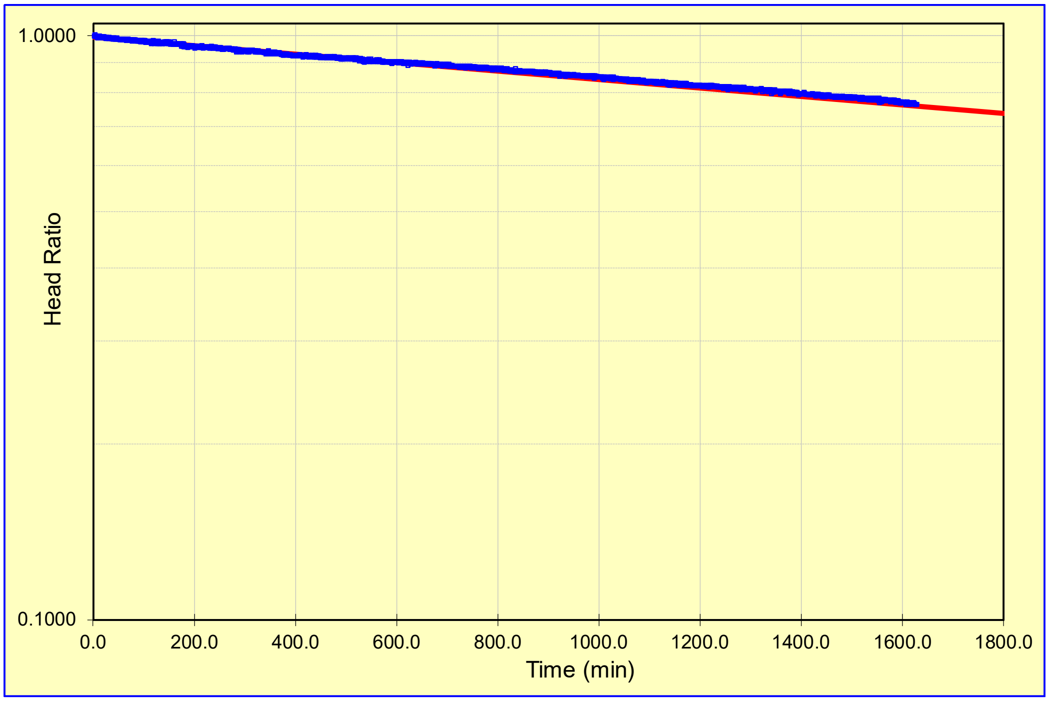
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 1800.00
$h_{1(t1)}$ = 0.99
$h_{2(t2)}$ = 0.738

RESULTS

K= 1.99E-07 cm/sec
K= 5.65E-04 ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 1 MW14-03S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln\frac{y_0}{y_t}$$

where:

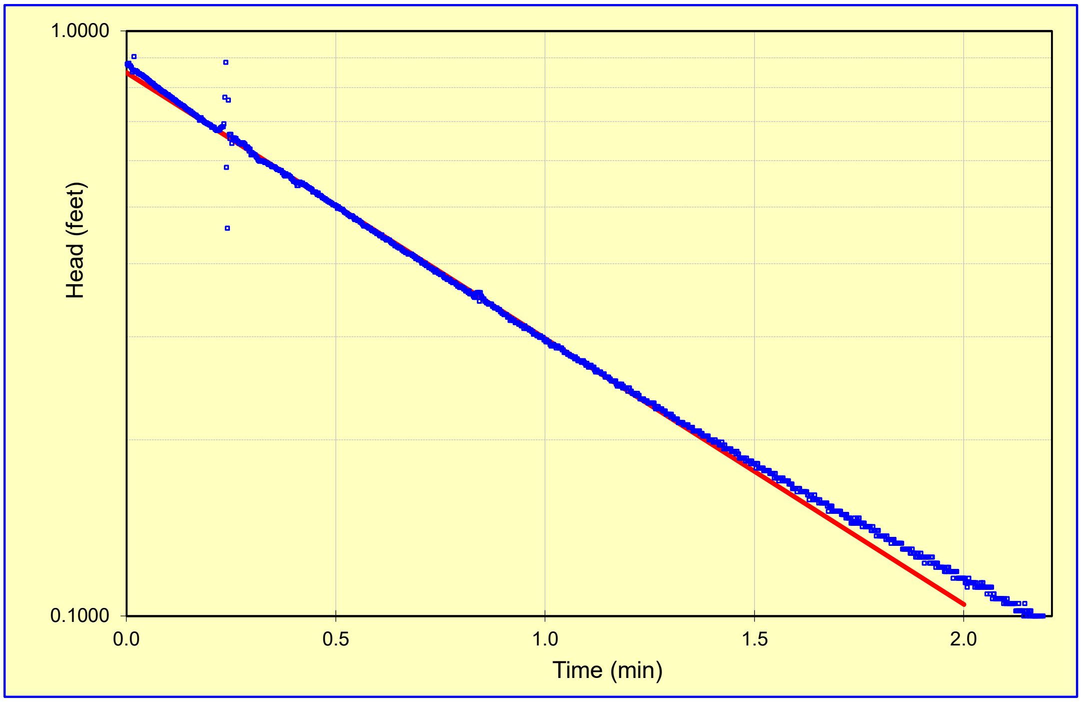
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2
$ln(R_e/r_w)$=	2.77
y_0 =	0.85
y_t =	0.105
t =	2.0

RESULTS

K=	2.56E-03	cm/sec
K=	7.25E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 1 MW14-03S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

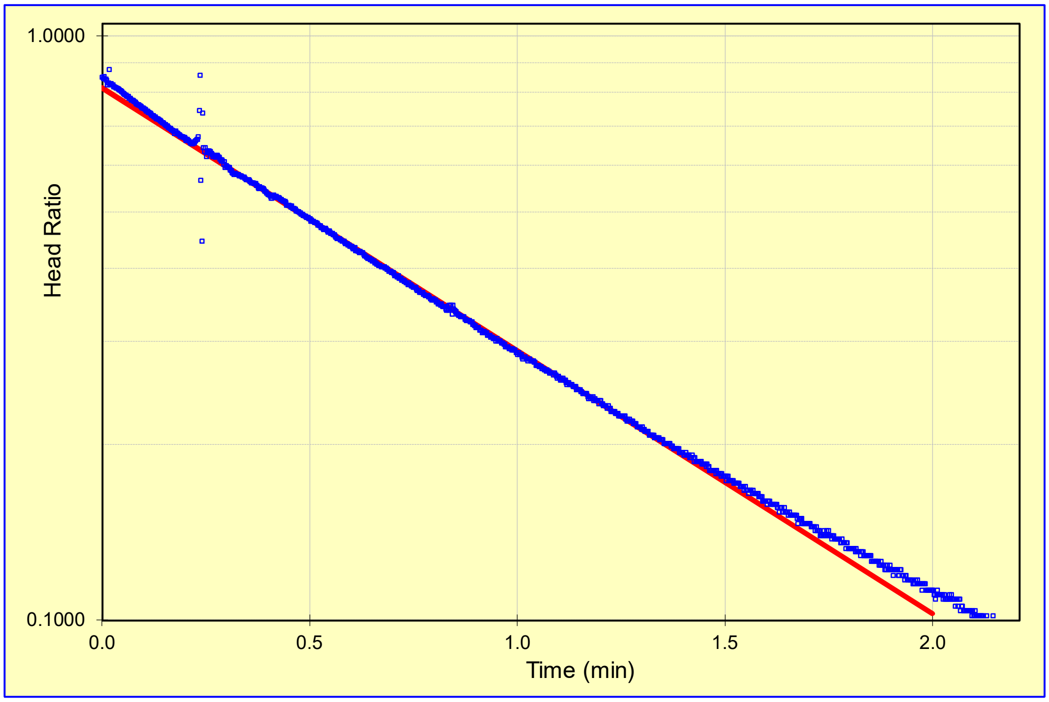
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	2.0
t_1 =	0.00
t_2 =	2.00
$h_{1(t1)}$ =	0.82
$h_{2(t2)}$ =	0.103

RESULTS

K=	2.27E-03	cm/sec
K=	6.44E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	TK
Test Date:	04/10/19	Analysis Date:	6/12/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 2 MW14-03S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

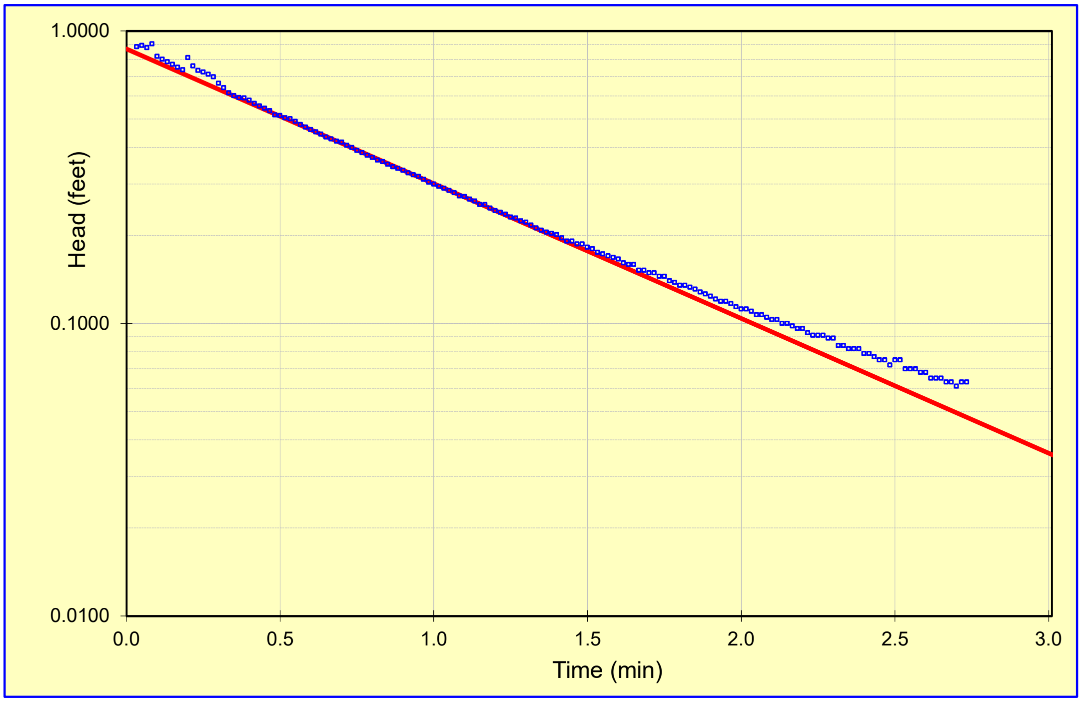
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	2
$ln(R_e/r_w)$=	2.77
y_0 =	0.87
y_t =	0.012
t =	4.0

RESULTS

K=	2.59E-03	cm/sec
K=	7.35E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

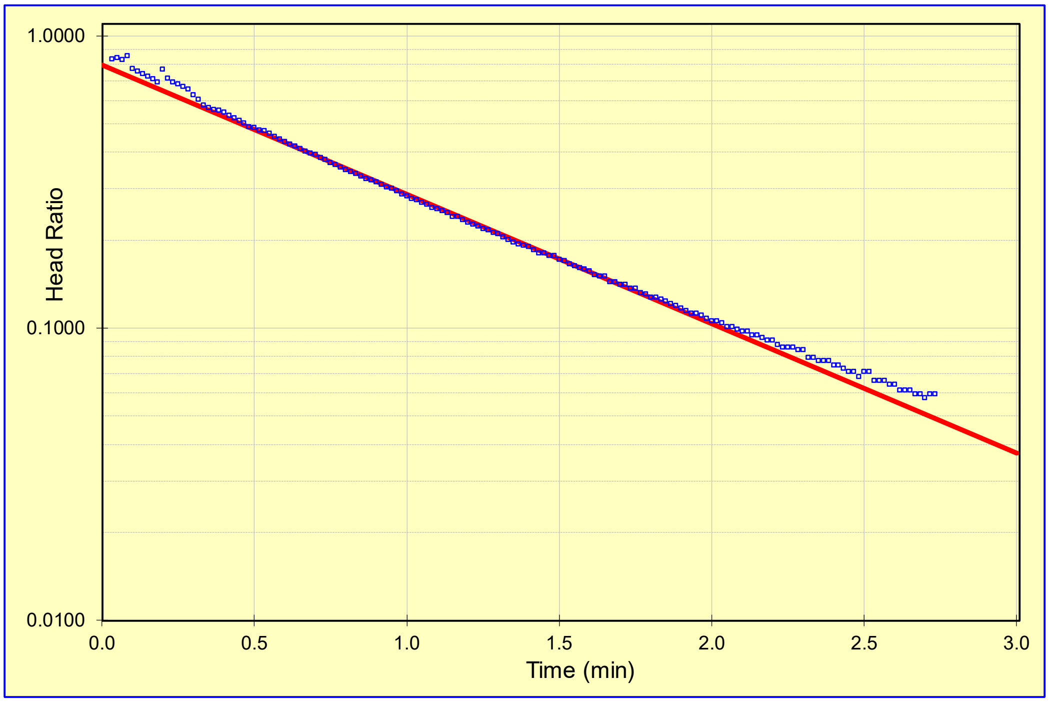
Analysis By: TK
Checked By: LWL
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 2 MW14-03S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS
r_c =	0.08	
R_e =	0.17	
L_e =	2.0	K= 2.23E-03 cm/sec
t_1 =	0.00	K= 6.33E+00 ft/day
t_2 =	3.00	
$h_{1(t1)}$ =	0.80	
$h_{2(t2)}$ =	0.038	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 MW14-03S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

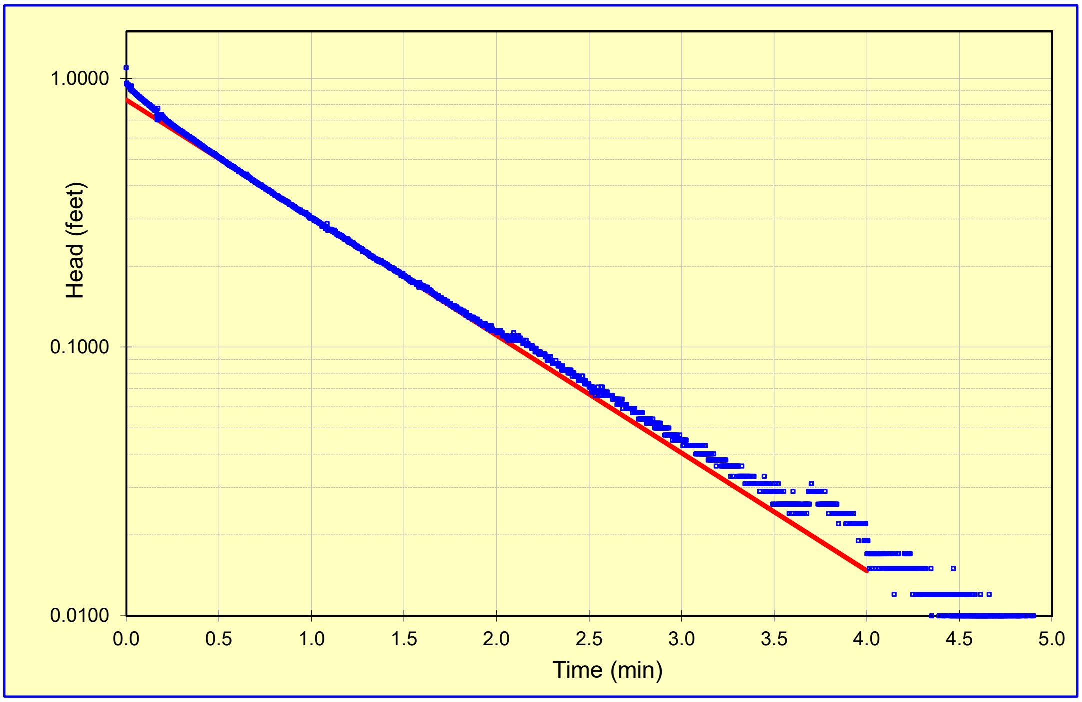
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.17
L_e = 2
$\ln(R_e/r_w)$= 2.77
y_0 = 0.83
y_t = 0.015
t = 4.0

RESULTS

K=	**2.47E-03**	**cm/sec**
K=	**6.99E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

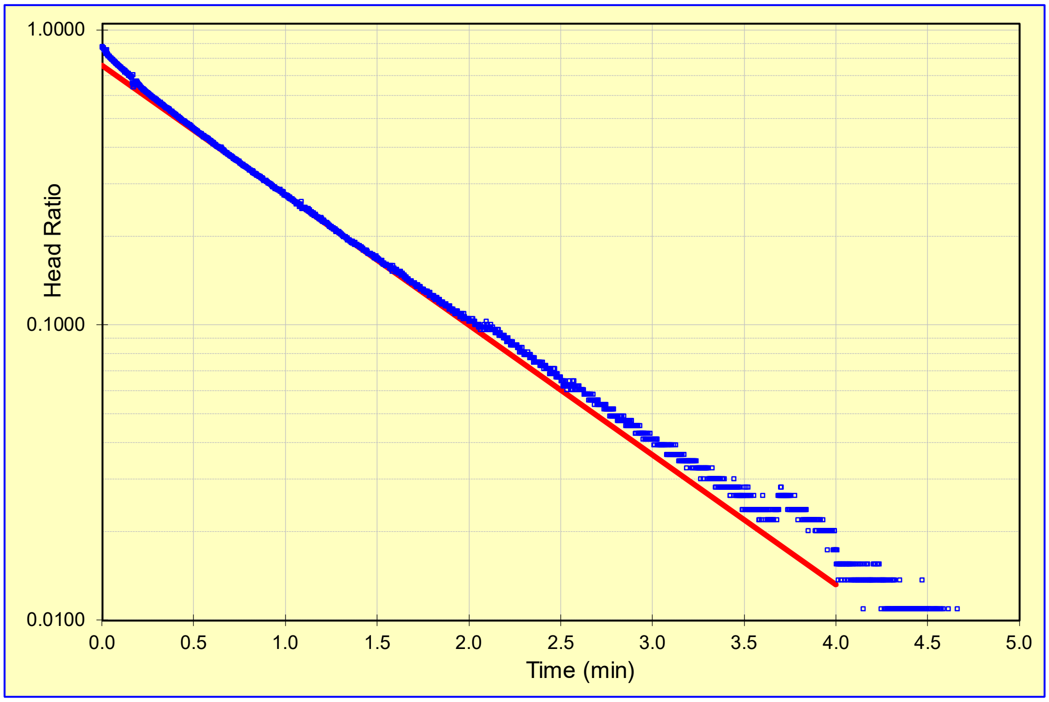
Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 MW14-03S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	2.0	K=	2.22E-03	cm/sec
t_1 =	0.00	K=	6.29E+00	ft/day
t_2 =	4.00			
$h_{1(t1)}$ =	0.76			
$h_{2(t2)}$ =	0.013			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/10/19	Analysis Date:	6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 MW14-03S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

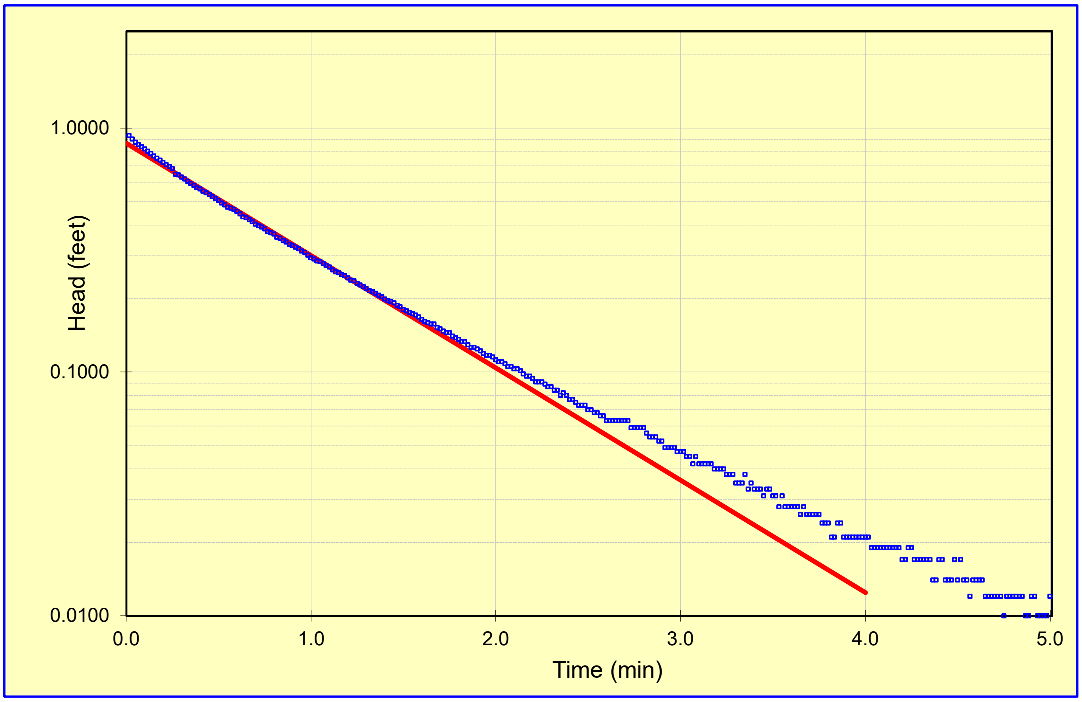
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2
$ln(R_e/r_w)$=	2.77
y_0 =	0.87
y_t =	0.012
t =	4.0

RESULTS

K=	2.59E-03	cm/sec
K=	7.35E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

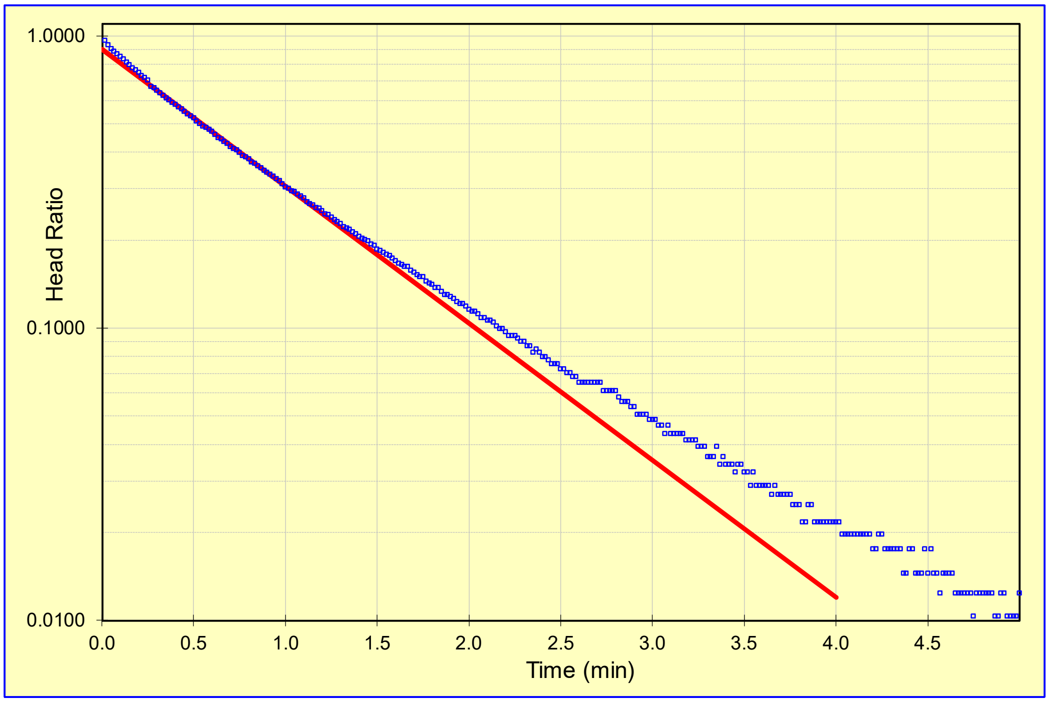
Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 MW14-03S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS
r_c =	0.08	
R_e =	0.17	
L_e =	2.0	K= 2.37E-03 cm/sec
t_1 =	0.00	K= 6.71E+00 ft/day
t_2 =	4.00	
$h_{1(t1)}$ =	0.90	
$h_{2(t2)}$ =	0.012	



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/10/19	Analysis Date:	6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-04B

$$K = \frac{r_c^2 \, ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

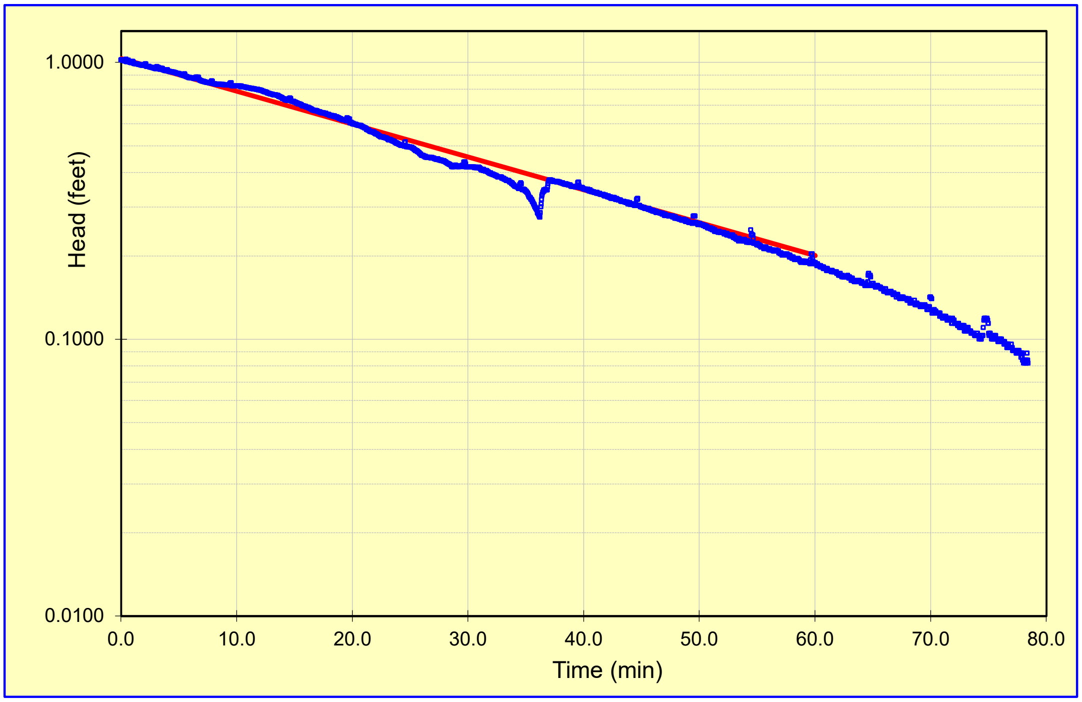
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
r_w =	0.17			
L_e =	19.96	K=	1.21E-05	cm/sec
$ln(R_e/r_w)$=	4.99	K=	3.42E-02	ft/day
y_0 =	1.04			
y_t =	0.201			
t =	60.0			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/13/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-04B

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

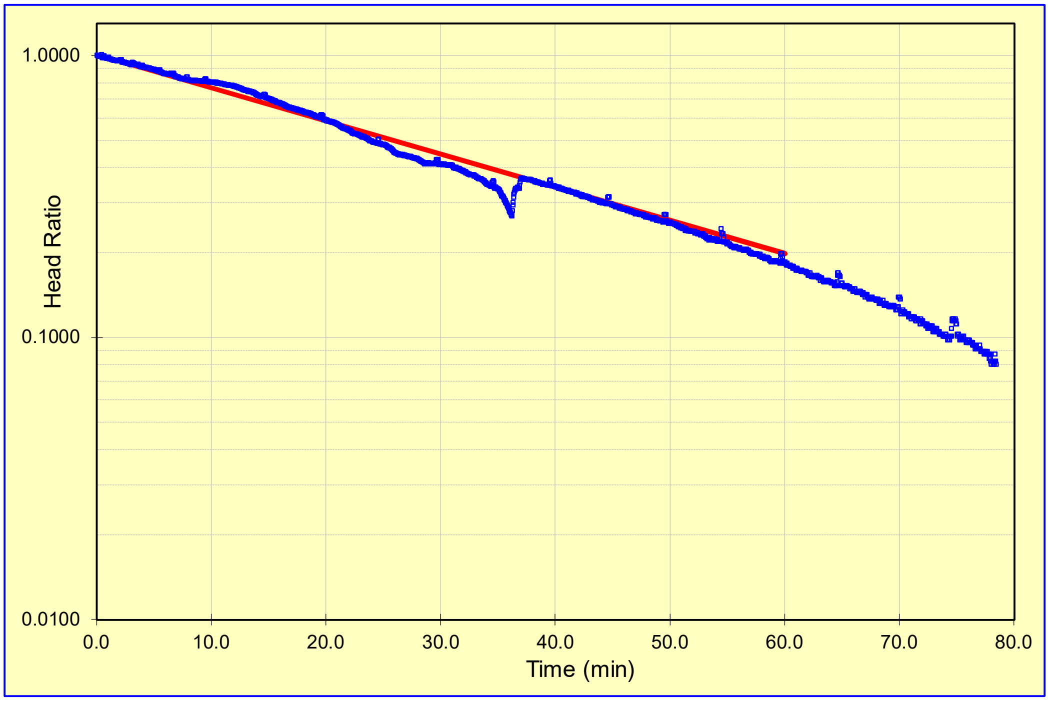
where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	**0.08**
R_e =	**0.17**
L_e =	**20.0**
t_1 =	**0.00**
t_2 =	**60.00**
$h_{1(t1)}$ =	**1.01**
$h_{2(t2)}$ =	**0.199**

RESULTS

K=	**1.14E-05**	**cm/sec**
K=	**3.24E-02**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/13/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-04B

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

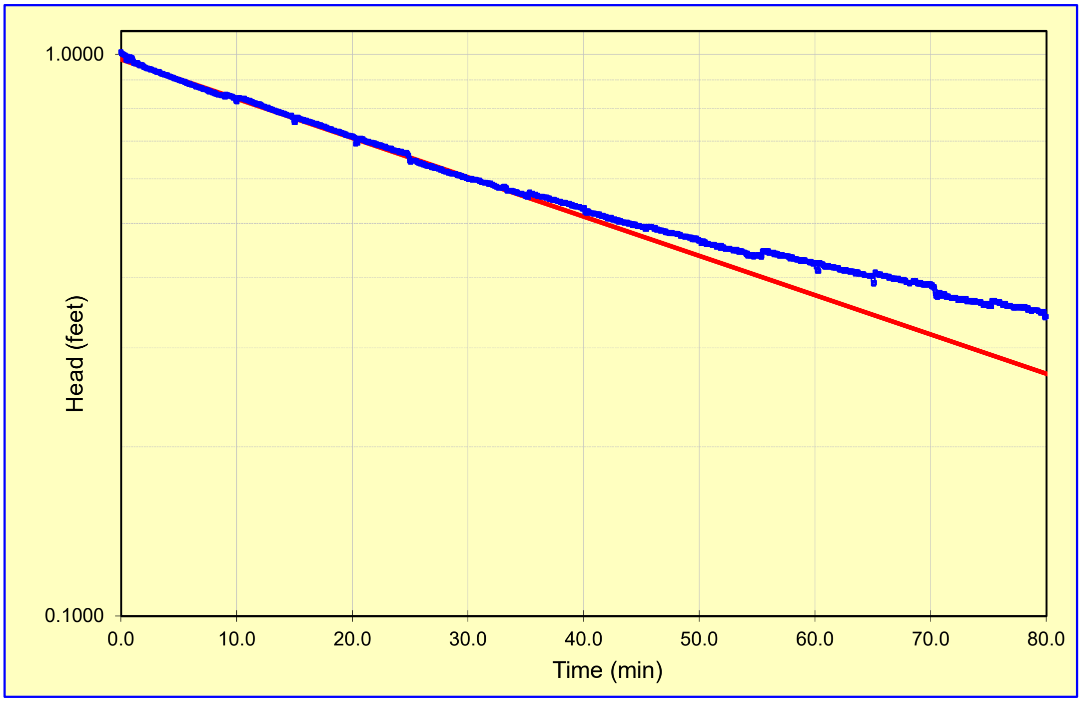
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	19.96
$\ln(R_e/r_w)$=	4.99
y_0 =	0.98
y_t =	0.196
t =	100.0

RESULTS

K=	7.11E-06	cm/sec
K=	2.01E-02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-04B

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

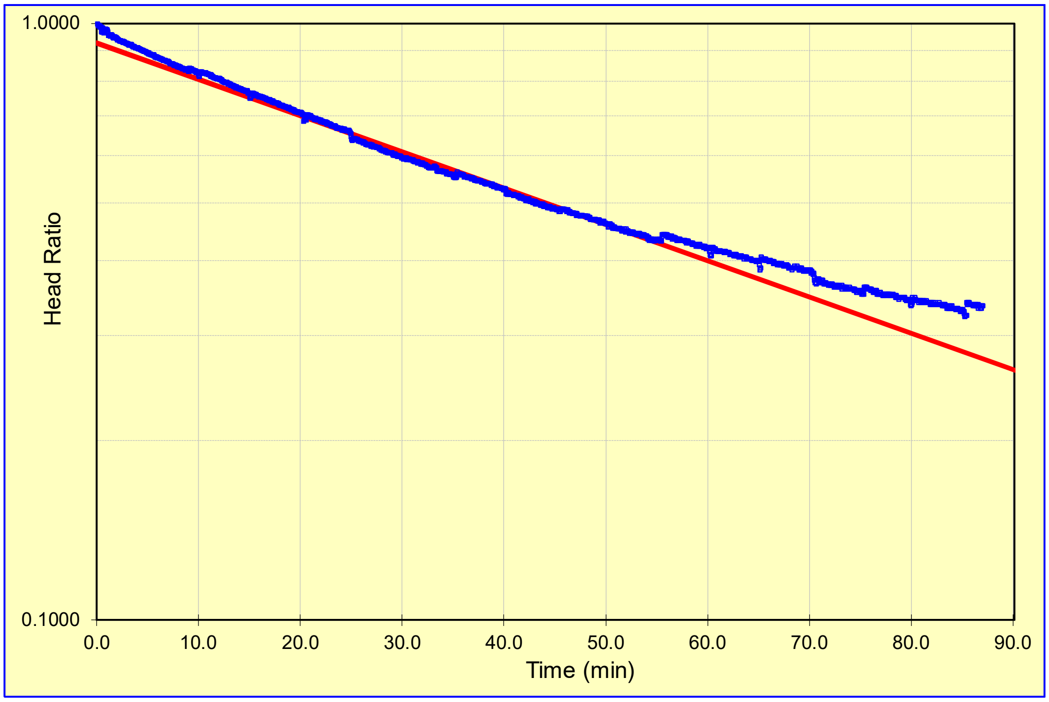
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 20.0
t_1 = 0.00
t_2 = 100.00
$h_{1(t1)}$ = 0.93
$h_{2(t2)}$ = 0.229

RESULTS

K=	**5.92E-06**	**cm/sec**
K=	**1.68E-02**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-04D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

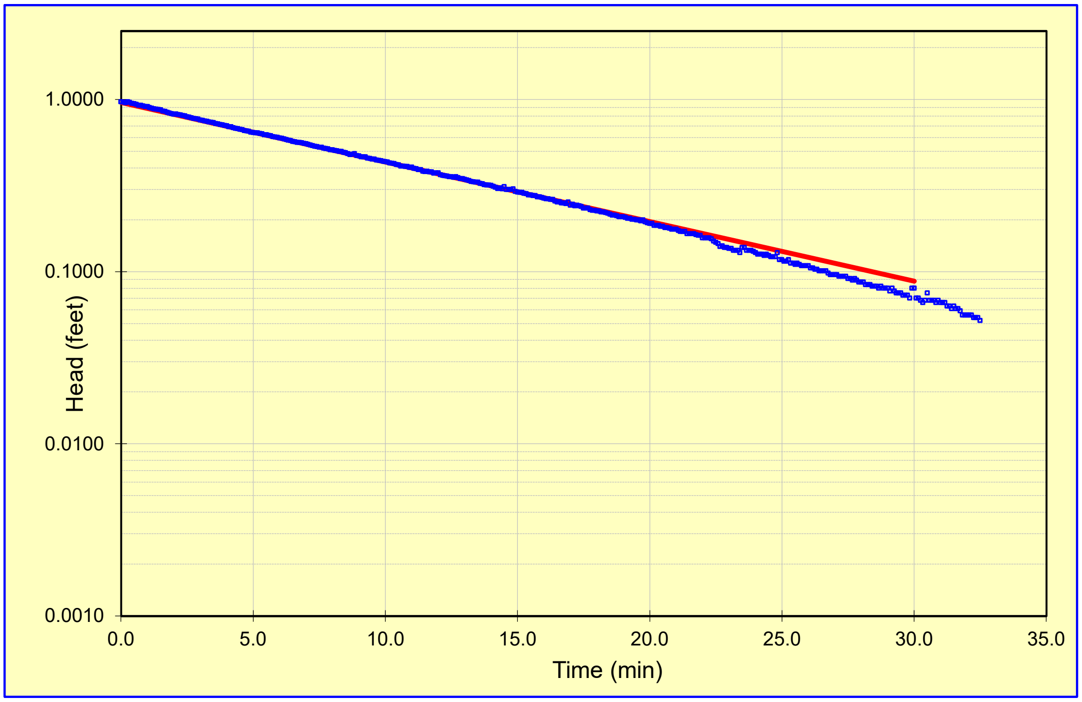
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2
$\ln(R_e/r_w)$=	2.77
y_0 =	0.96
y_t =	0.088
t =	30.0

RESULTS

K=	1.95E-04	cm/sec
K=	5.52E-01	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/10/19	Analysis Date:	6/4/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-04D

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

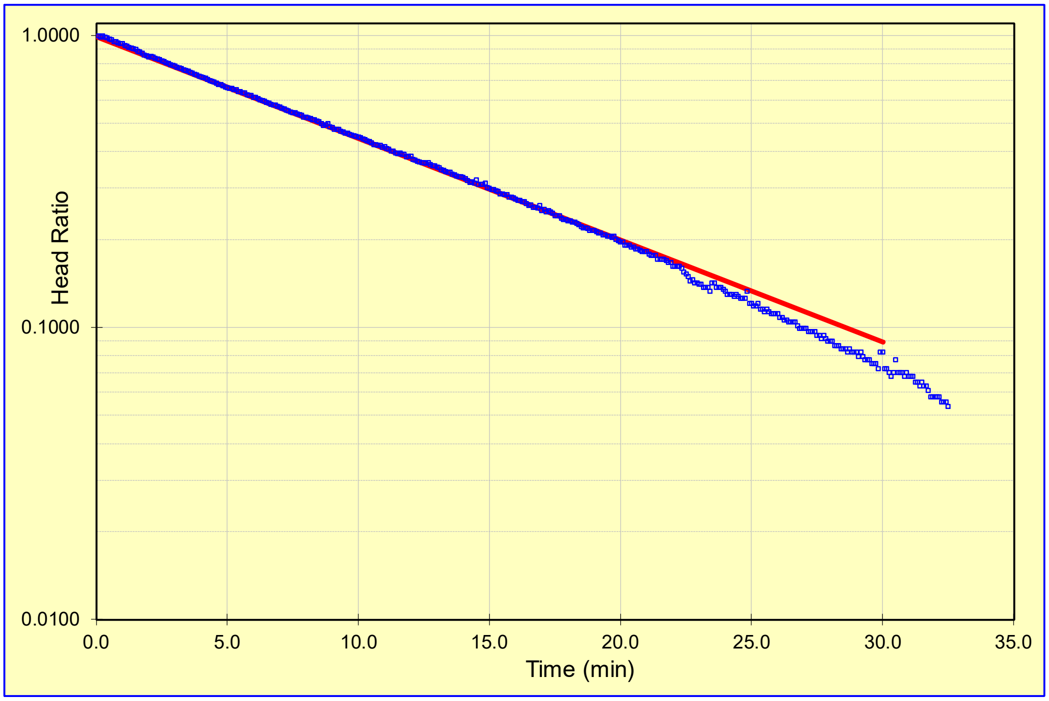
where: r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 2.0
t_1 = 0.00
t_2 = 30.00
$h_{1(t1)}$ = 0.99
$h_{2(t2)}$ = 0.089

RESULTS

K= 1.76E-04 cm/sec
K= 4.99E-01 ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-04D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

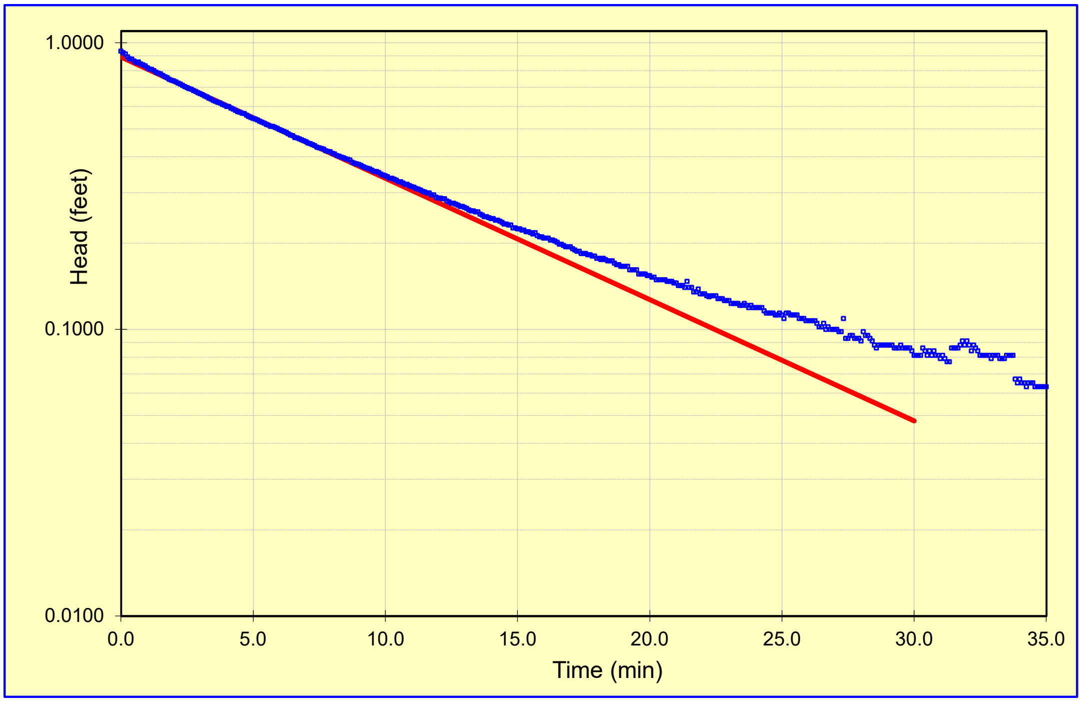
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2
$ln(R_e/r_w)$=	2.77
y_0 =	0.89
y_t =	0.048
t =	30.0

RESULTS

K=	2.38E-04	cm/sec
K=	6.75E-01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

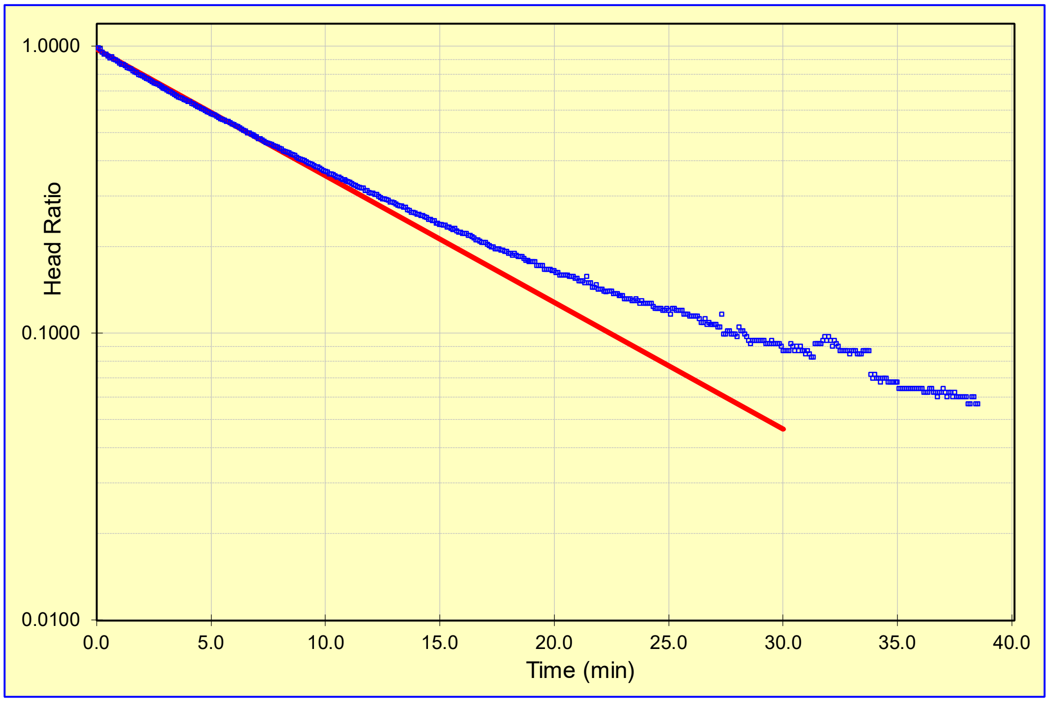
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-04D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
R_e =	**0.17**			
L_e =	**2.0**	**K=**	**2.23E-04**	**cm/sec**
t_1 =	**0.00**	**K=**	**6.32E-01**	**ft/day**
t_2 =	**30.00**			
$h_{1(t1)}$ =	**0.98**			
$h_{2(t2)}$ =	**0.046**			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/10/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 1 MW14-04S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

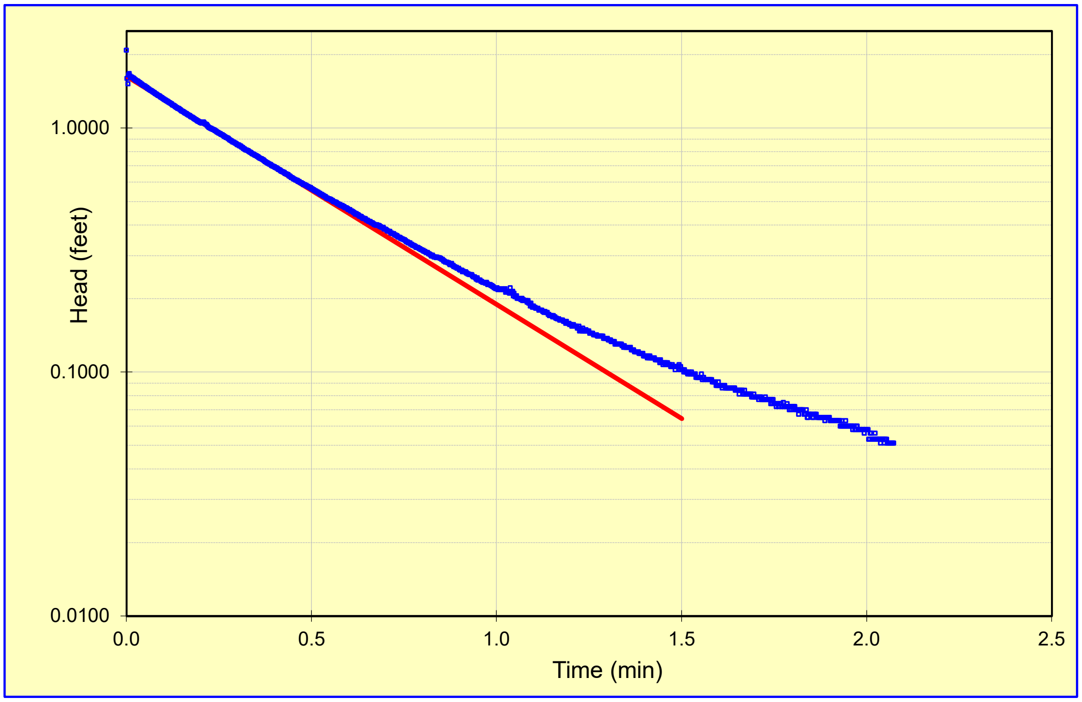
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**4**
$ln(R_e/r_w)$=	**3.19**
y_0 =	**1.63**
y_t =	**0.064**
t =	**1.5**

RESULTS

K=	**3.03E-03**	**cm/sec**
K=	**8.60E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 1 MW14-04S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

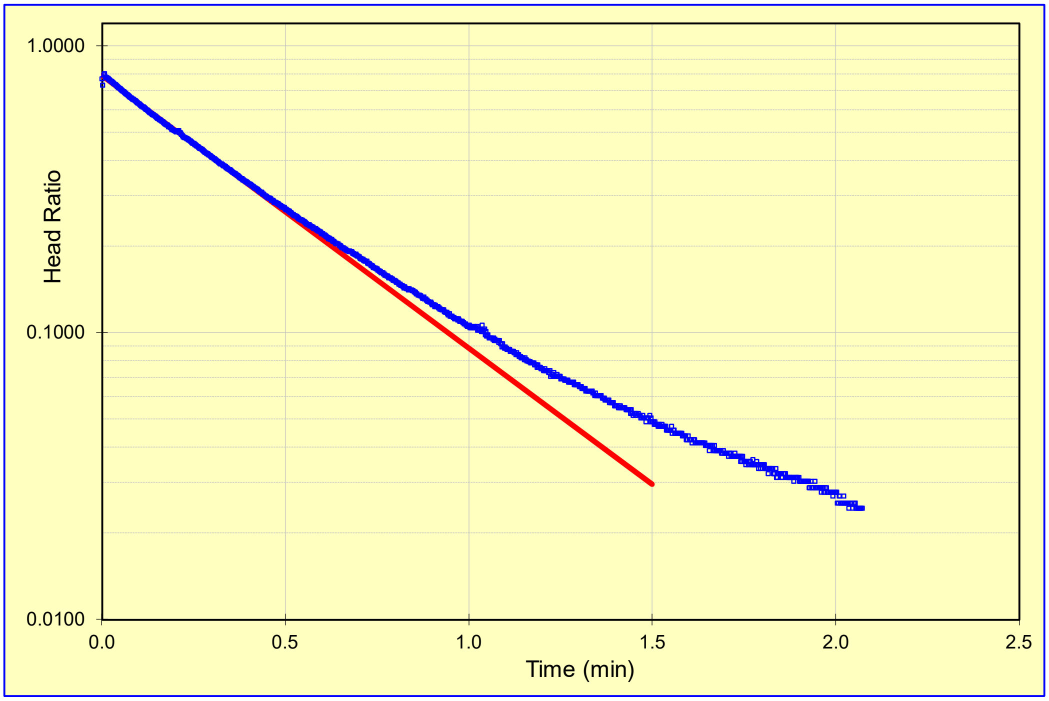
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	4.0
t_1 =	0.00
t_2 =	1.50
$h_{1(t1)}$ =	0.79
$h_{2(t2)}$ =	0.030

RESULTS

K=	3.07E-03	cm/sec
K=	8.69E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 2 MW14-04S

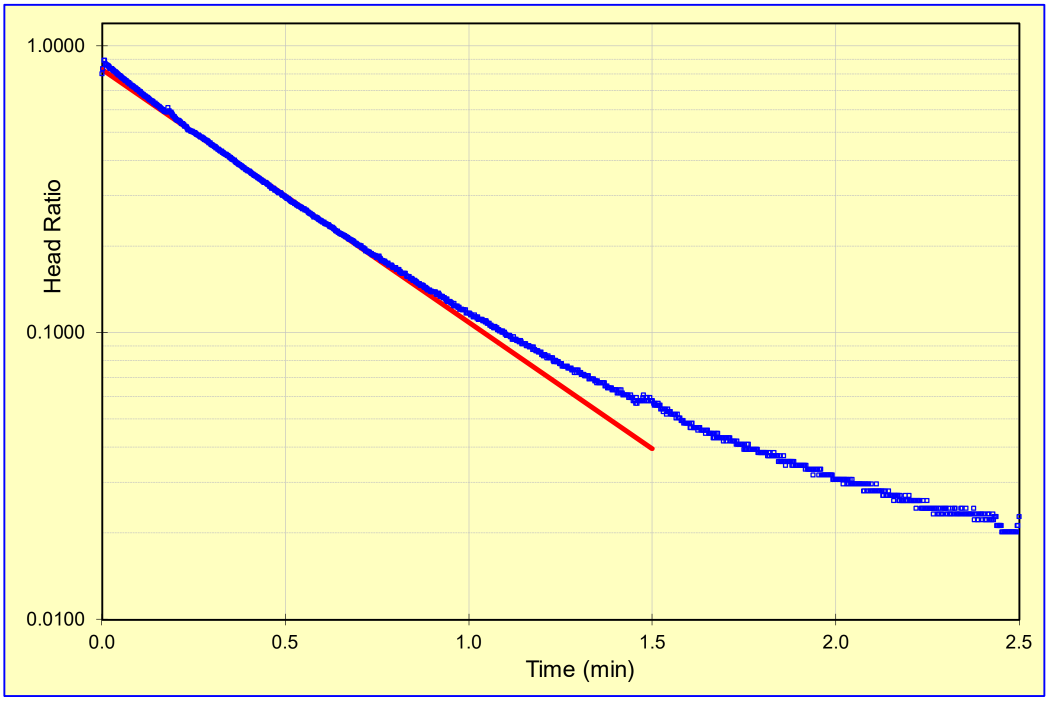
$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where: r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	0.08
R_e =	0.17
L_e =	4.0
t_1 =	0.00
t_2 =	1.50
$h_{1(t1)}$ =	0.83
$h_{2(t2)}$ =	0.040

RESULTS

K=	**2.85E-03**	**cm/sec**
K=	**8.07E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 2 MW14-04S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

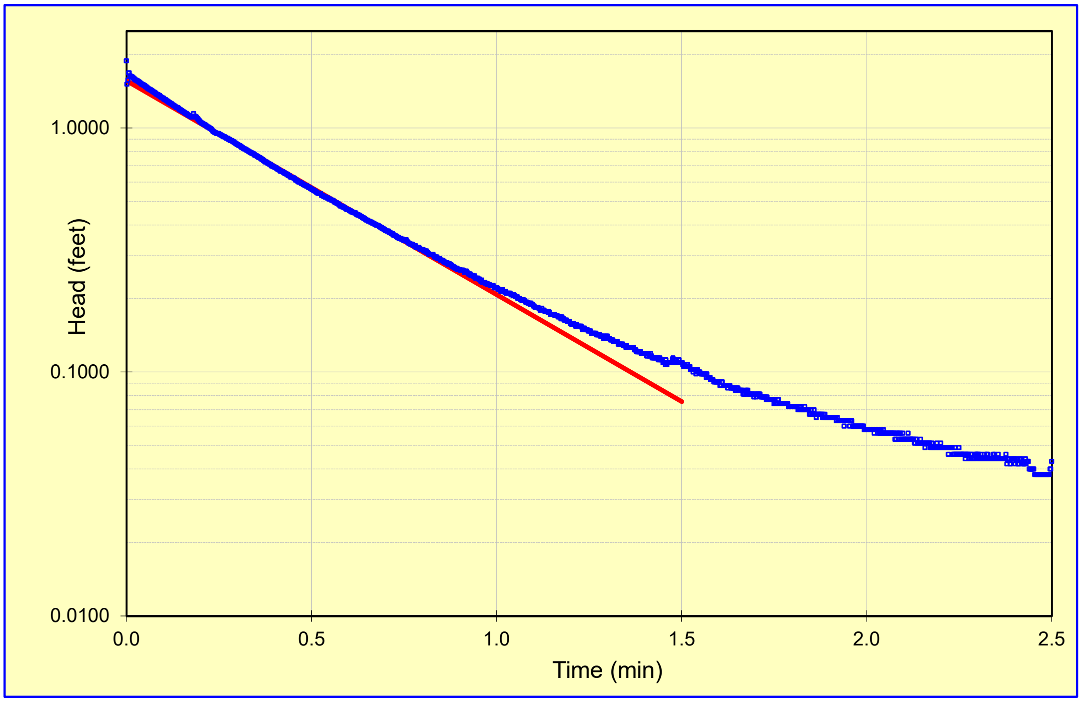
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	**0.08**
r_w =	**0.17**
L_e =	**4**
$\ln(R_e/r_w)$=	**3.19**
y_0 =	**1.56**
y_t =	**0.076**
t =	**1.5**

RESULTS

K=	**2.84E-03**	**cm/sec**
K=	**8.06E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 3 MW14-04S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

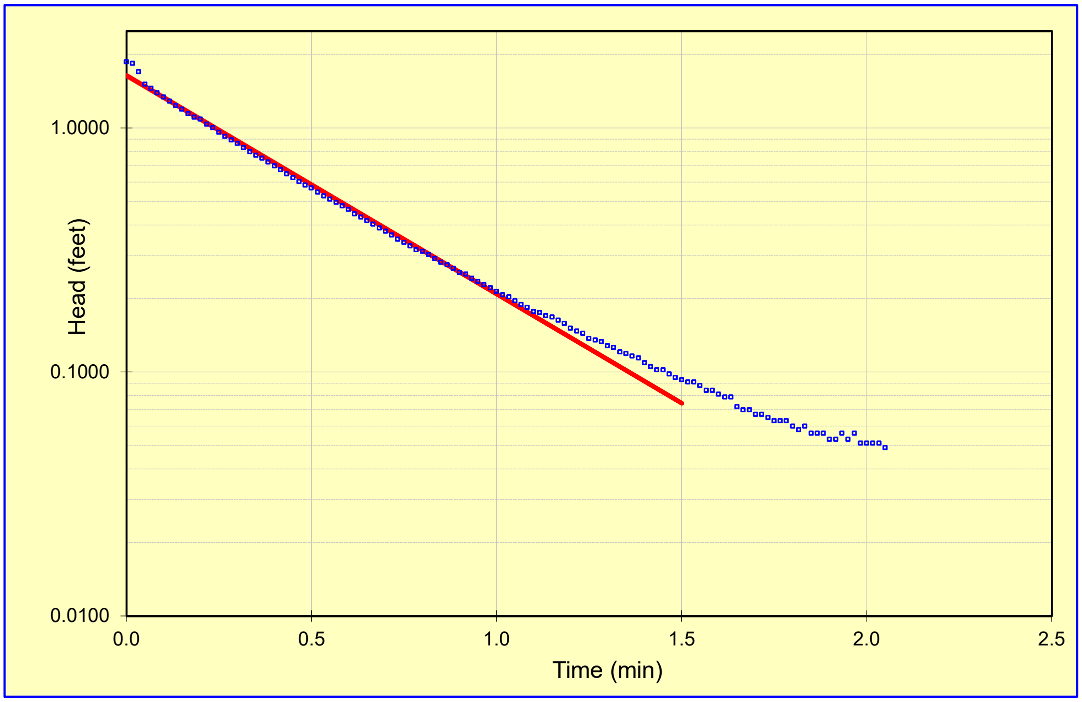
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	4
$\ln(R_e/r_w)$=	3.19
y_0 =	1.64
y_t =	0.075
t =	1.5

RESULTS

K=	2.90E-03	cm/sec
K=	8.23E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 3 MW14-04S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

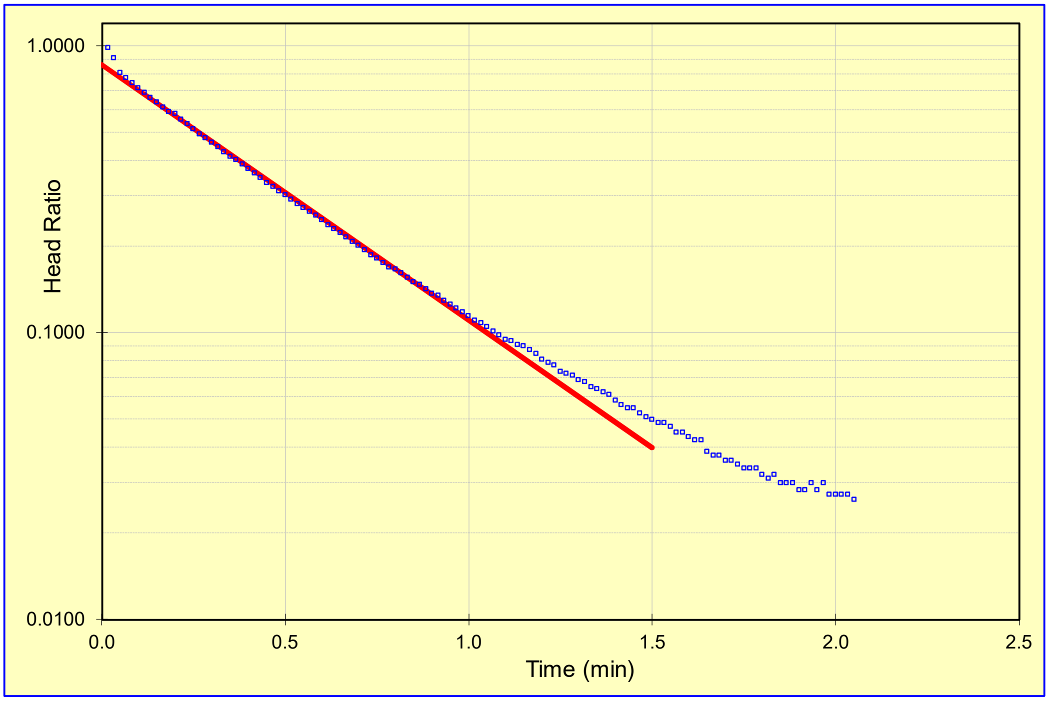
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	**0.08**
R_e =	**0.17**
L_e =	**4.0**
t_1 =	**0.00**
t_2 =	**1.50**
$h_{1(t1)}$ =	**0.86**
$h_{2(t2)}$ =	**0.040**

RESULTS

K=	**2.87E-03**	**cm/sec**
K=	**8.15E+00**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/10/19	Analysis Date:	6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 MW14-04S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

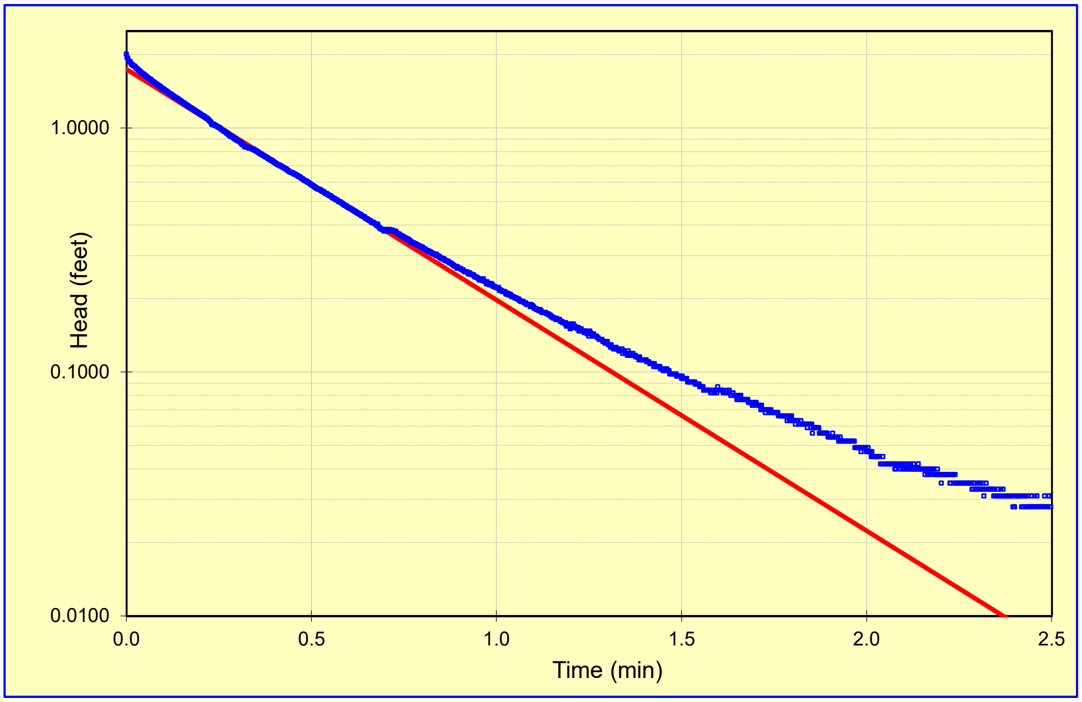
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	4
$ln(R_e/r_w)$=	3.19
y_0 =	1.74
y_t =	0.003
t =	3.0

RESULTS

K=	3.07E-03	cm/sec
K=	8.69E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

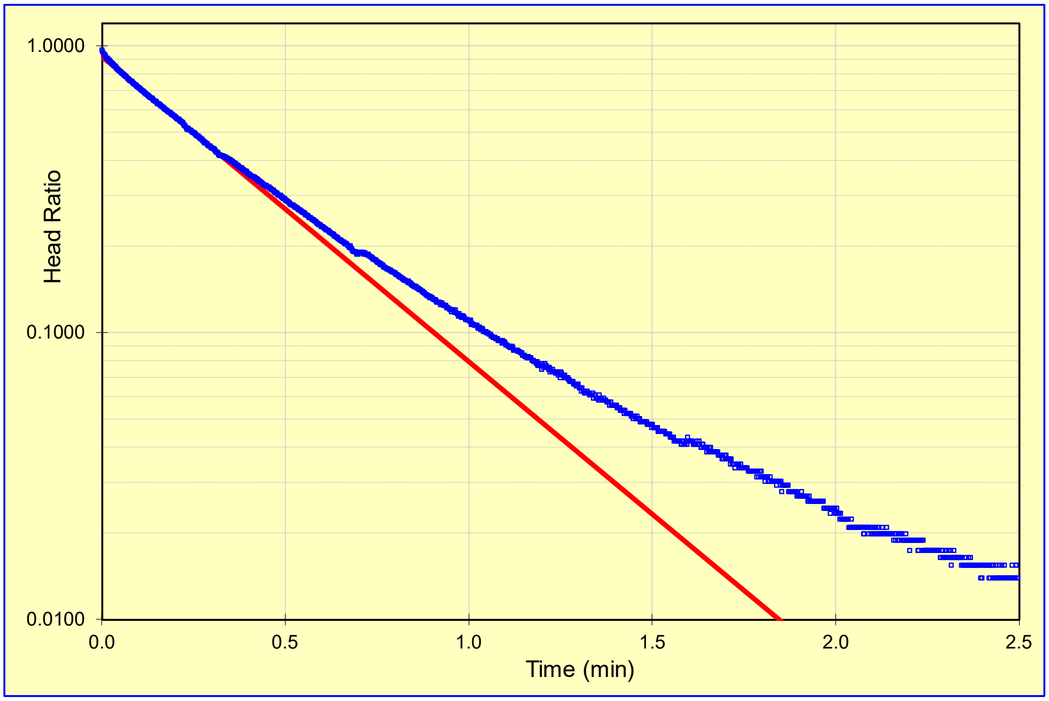
Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 MW14-04S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	4.0	K=	3.43E-03	cm/sec
t_1 =	0.00	K=	9.73E+00	ft/day
t_2 =	3.00			
$h_{1(t1)}$ =	0.92			
$h_{2(t2)}$ =	0.001			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/10/19	Analysis Date:	6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 MW14-04S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

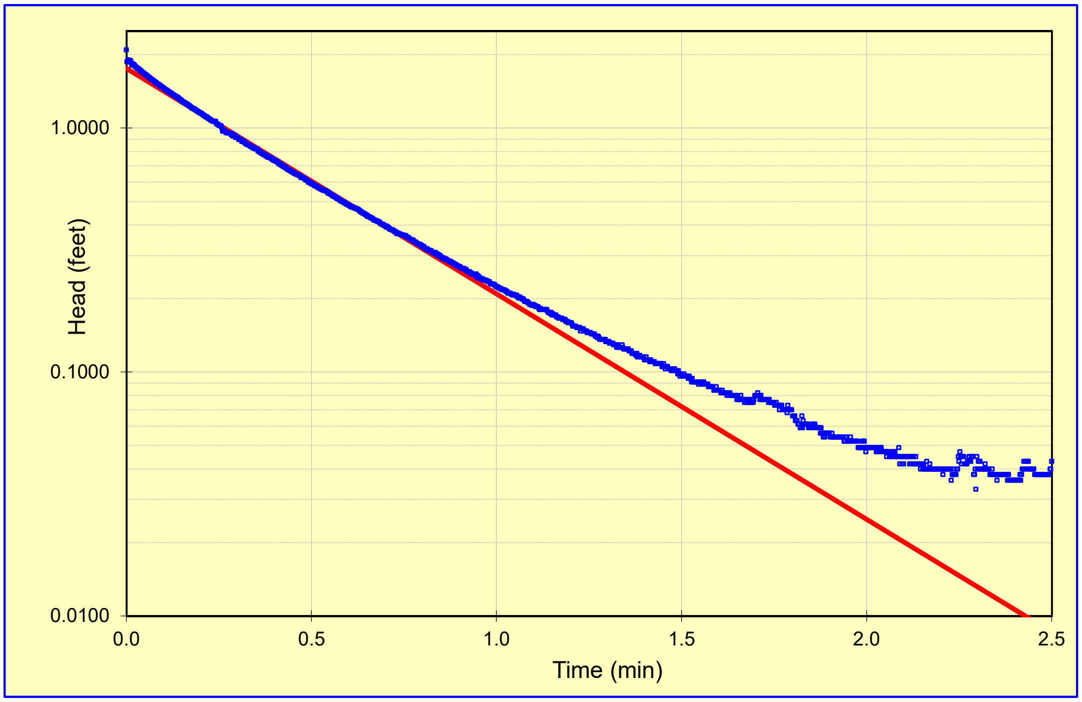
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	4
$ln(R_e/r_w)$=	3.19
y_0 =	1.75
y_t =	0.003
t =	3.0

RESULTS

K=	3.00E-03	cm/sec
K=	8.49E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

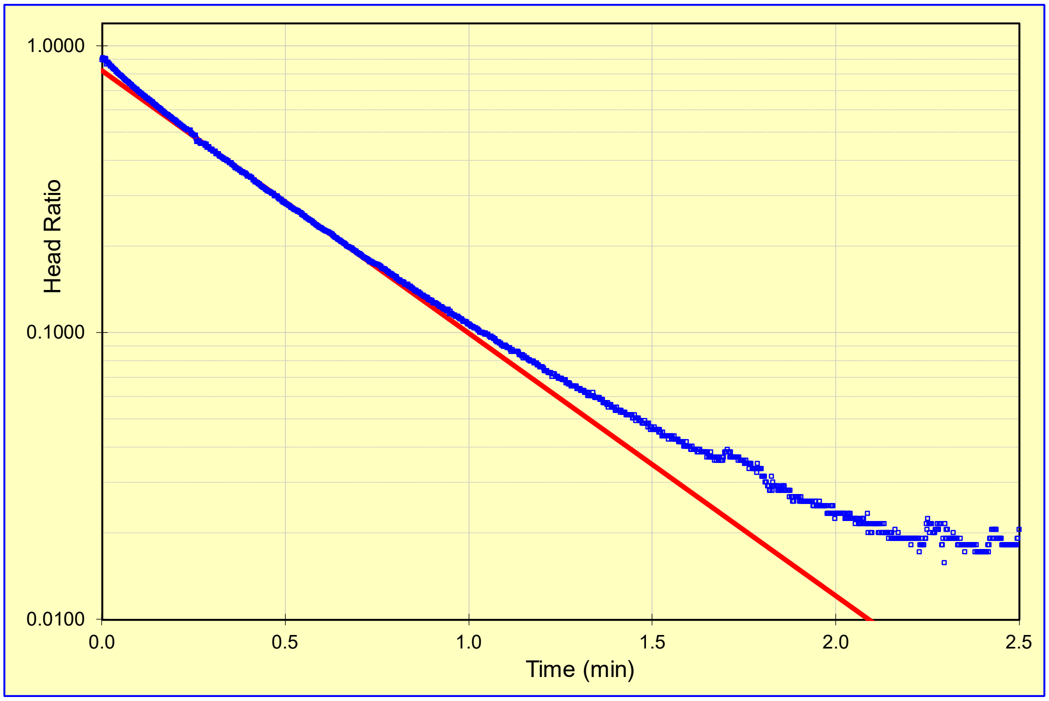
Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 MW14-04S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS
r_c =	0.08	
R_e =	0.17	
L_e =	4.0	K= 2.95E-03 cm/sec
t_1 =	0.00	K= 8.38E+00 ft/day
t_2 =	3.00	
$h_{1(t1)}$ =	0.82	
$h_{2(t2)}$ =	0.001	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 3 MW14-04S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

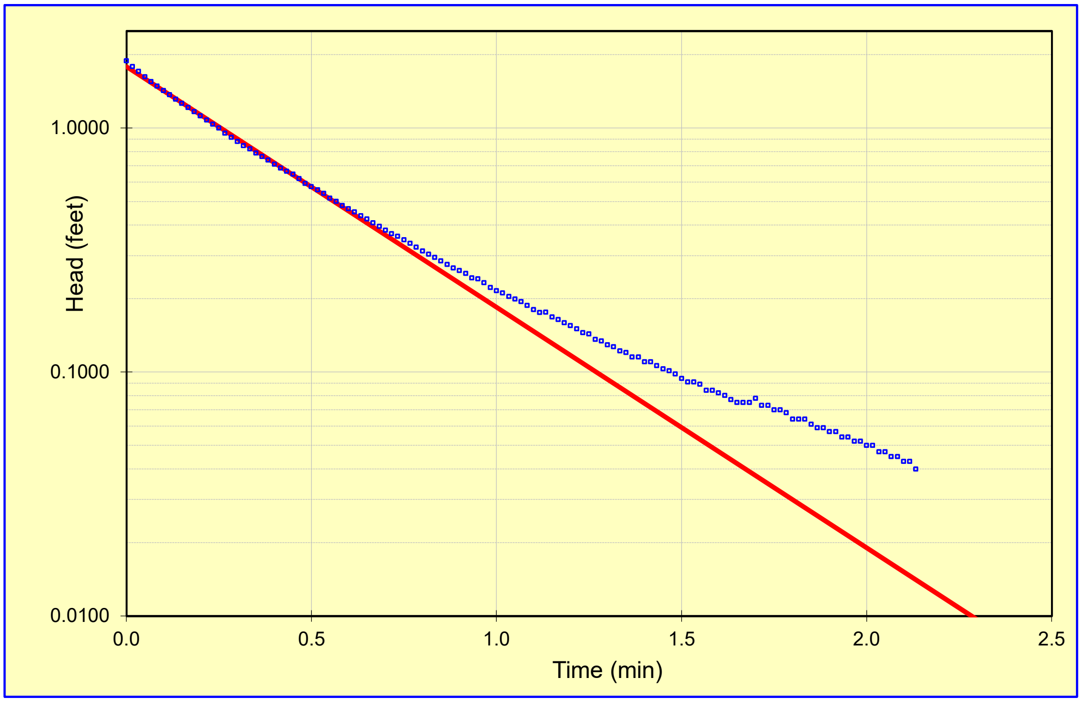
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	4
$ln(R_e/r_w)$=	3.19
y_0 =	1.79
y_t =	0.002
t =	3.0

RESULTS

K=	3.20E-03	cm/sec
K=	9.06E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

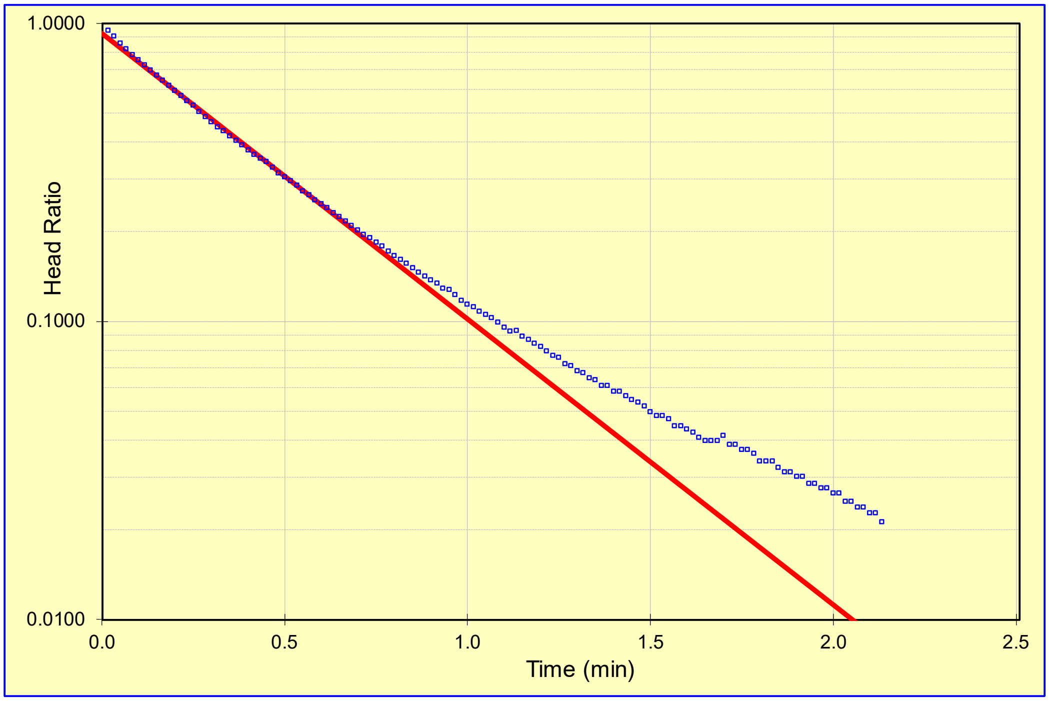
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 3 MW14-04S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	4.0	K=	3.09E-03	cm/sec
t_1 =	0.00	K=	8.77E+00	ft/day
t_2 =	3.00			
$h_{1(t1)}$ =	0.93			
$h_{2(t2)}$ =	0.001			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/10/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-05D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

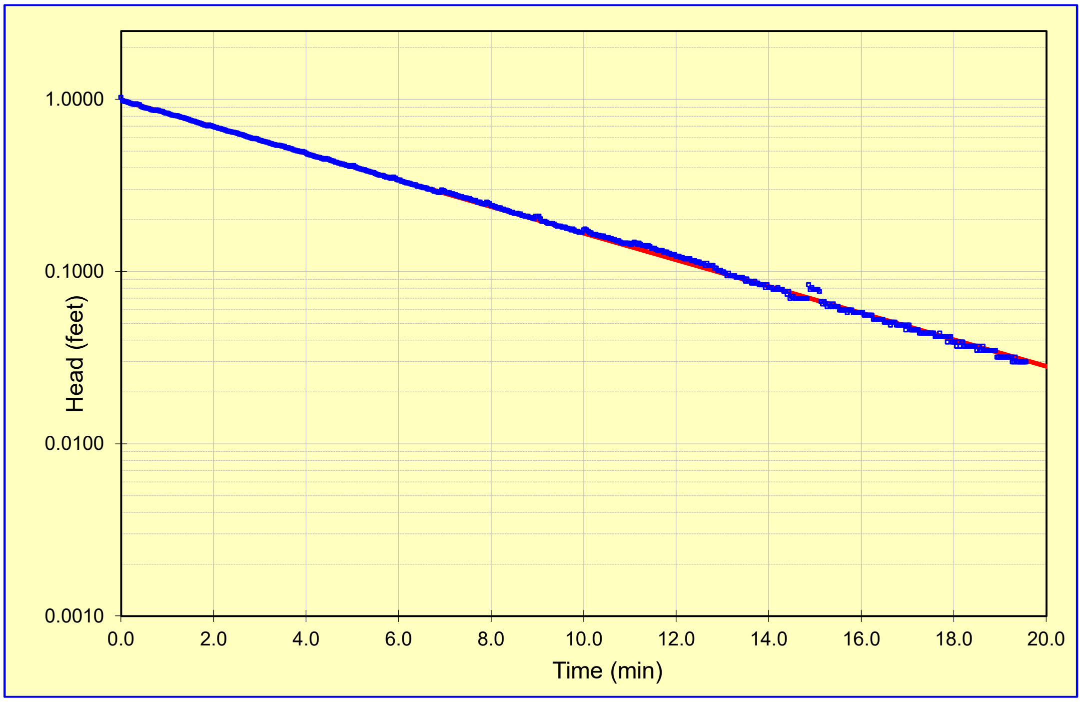
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	1
$\ln(R_e/r_w)$=	2.10
y_0 =	0.99
y_t =	0.028
t =	20.0

RESULTS

K=	6.59E-04	cm/sec
K=	1.87E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

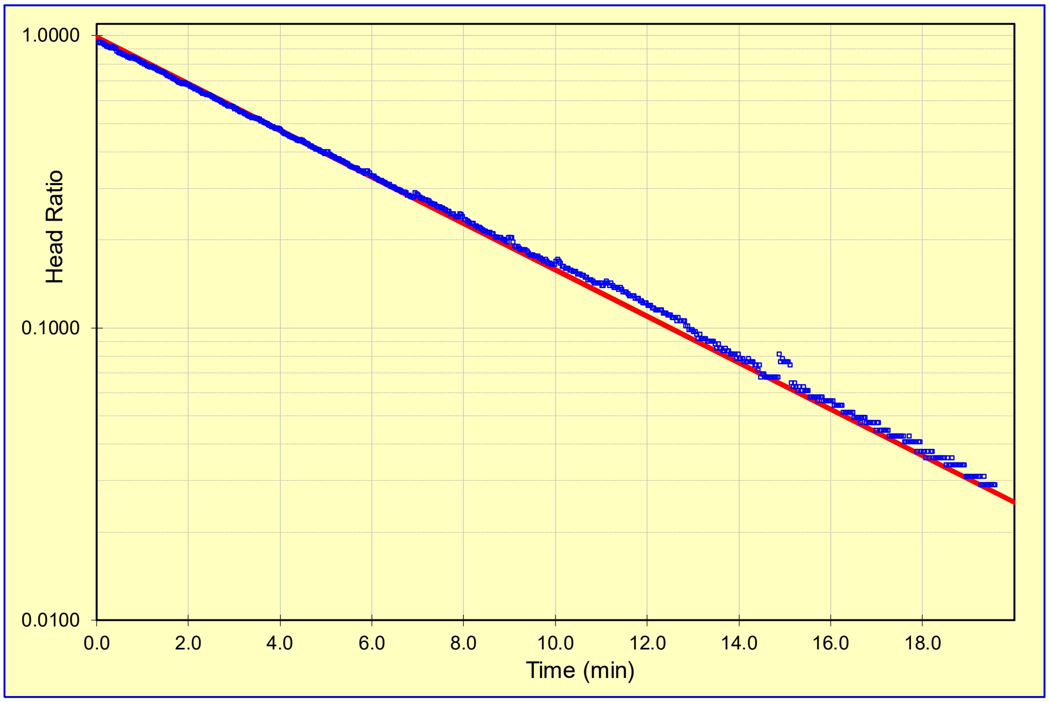
Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-05D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**	
r_c =	**0.08**		
R_e =	**0.17**		
L_e =	**1.0**	**K=**	**5.78E-04 cm/sec**
t_1 =	**0.00**	**K=**	**1.64E+00 ft/day**
t_2 =	**20.00**		
$h_{1(t1)}$ =	**0.99**		
$h_{2(t2)}$ =	**0.025**		



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/4/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-05D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

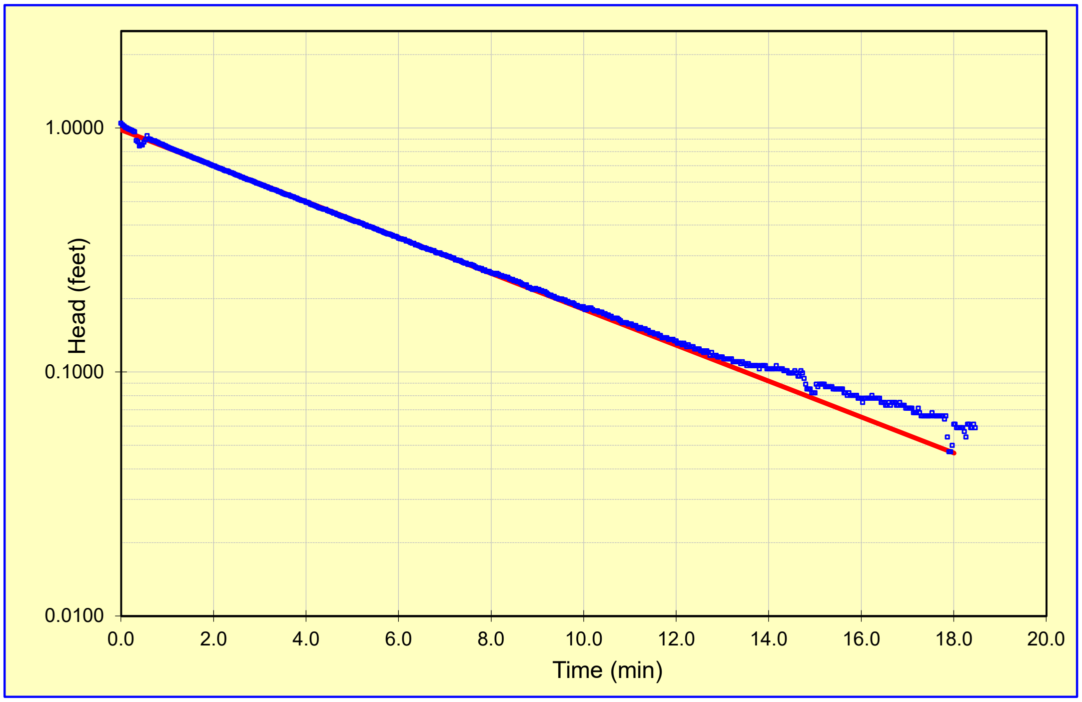
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**1**
$\ln(R_e/r_w)$=	**2.10**
y_0 =	**0.98**
y_t =	**0.047**
t =	**18.0**

RESULTS

K=	**6.28E-04**	**cm/sec**
K=	**1.78E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

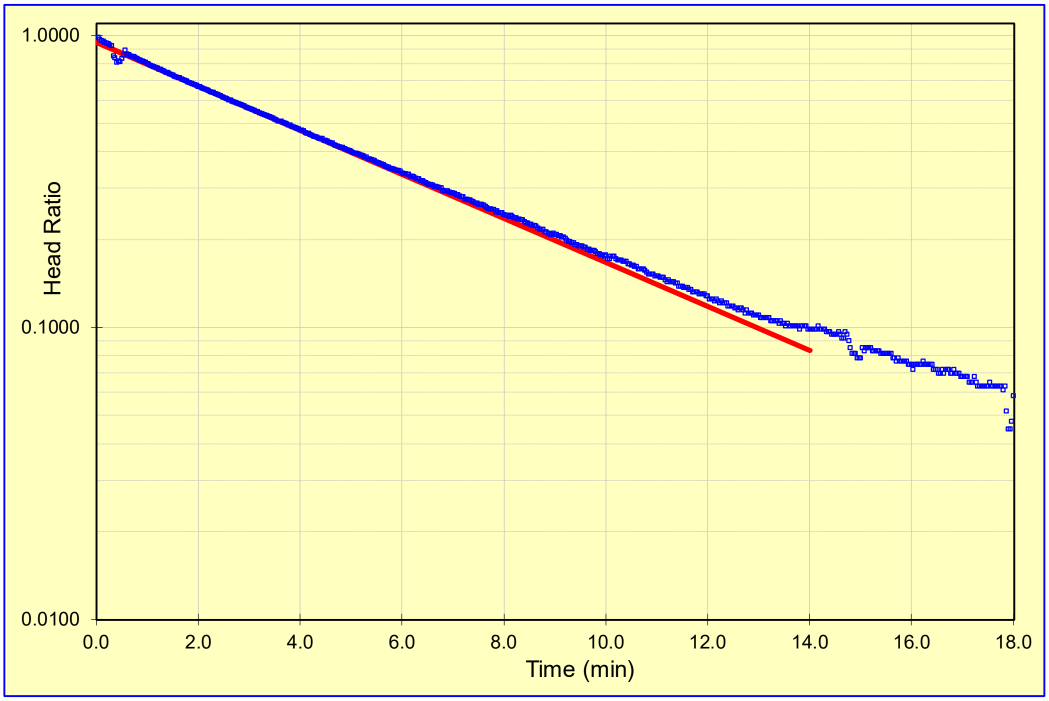
Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-05D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	1.0	K=	5.48E-04	cm/sec
t_1 =	0.00	K=	1.55E+00	ft/day
t_2 =	14.00			
$h_{1(t1)}$ =	0.95			
$h_{2(t2)}$ =	0.084			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/12/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-05M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

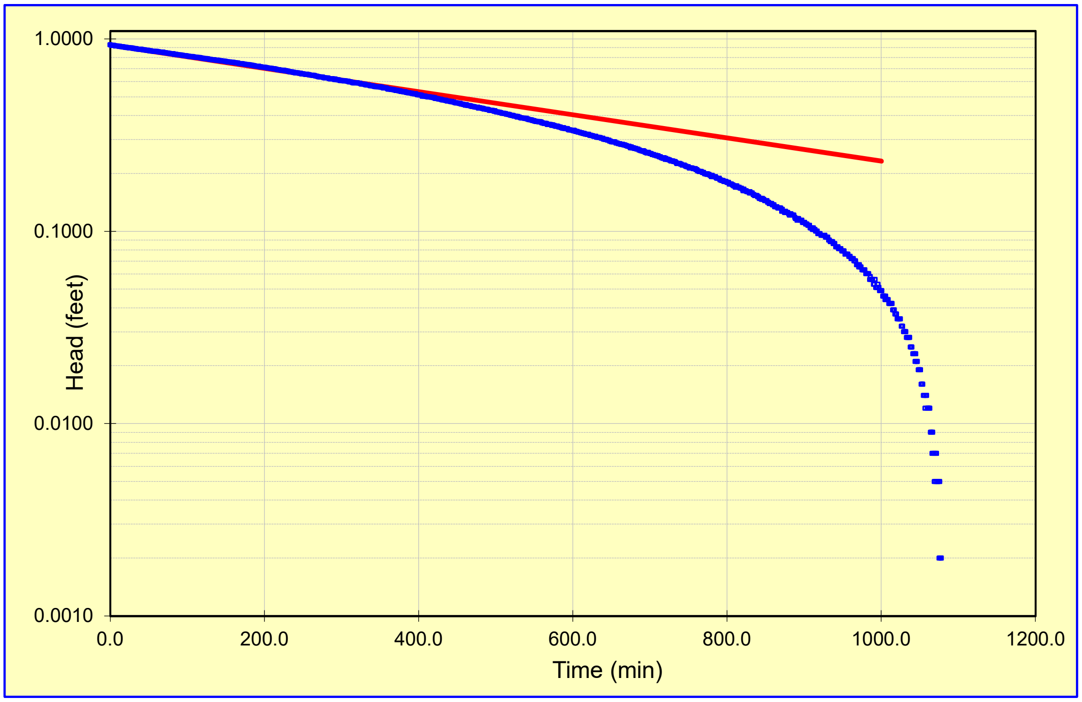
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	10
$ln(R_e/r_w)$=	4.11
y_0 =	0.93
y_t =	0.232
t =	1000.0

RESULTS

K=	1.00E-06	cm/sec
K=	2.85E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-05M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

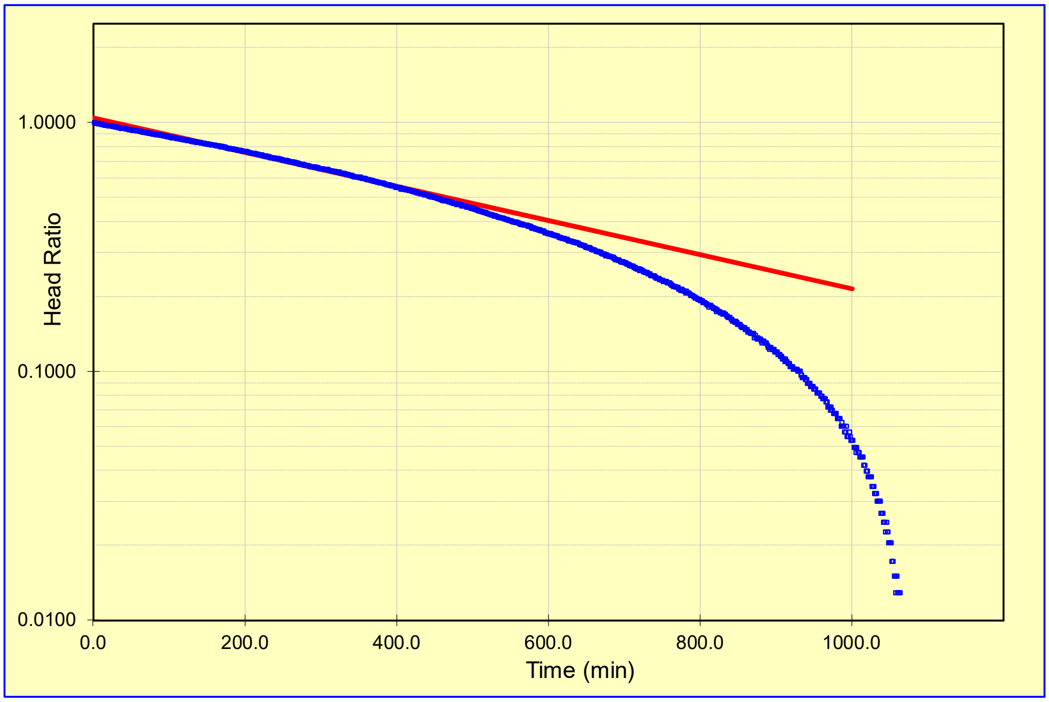
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 10.0
t_1 = 0.00
t_2 = 1000.00
$h_{1(t1)}$ = 1.05
$h_{2(t2)}$ = 0.215

RESULTS

K=	**1.14E-06**	**cm/sec**
K=	**3.24E-03**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/09/19	Analysis Date:	6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-05M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

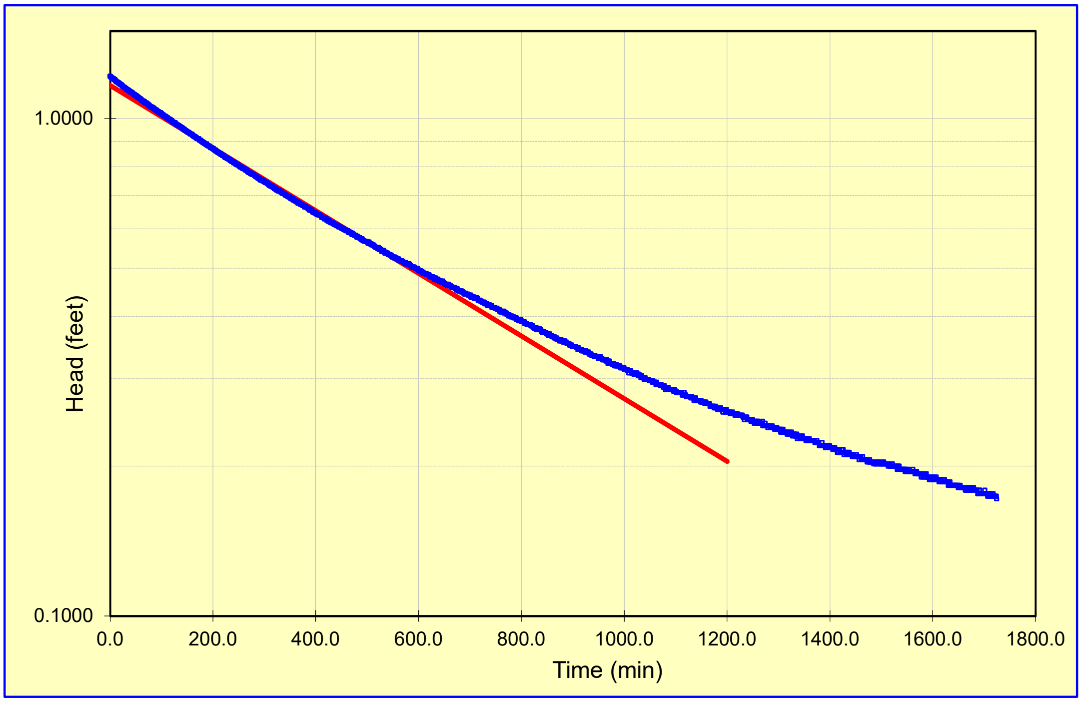
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**10**
$ln(R_e/r_w)$=	**4.11**
y_0 =	**1.17**
y_t =	**0.205**
t =	**1200.0**

RESULTS

K=	**1.05E-06**	**cm/sec**
K=	**2.98E-03**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-05M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

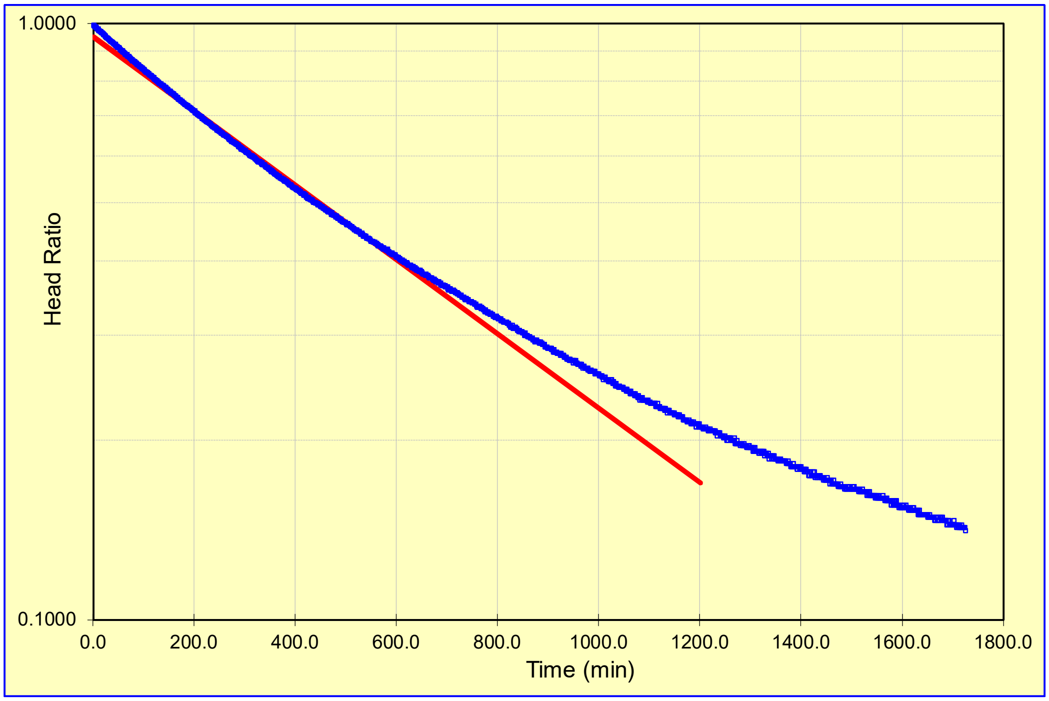
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 10.0
t_1 = 0.00
t_2 = 1200.00
$h_{1(t1)}$ = 0.95
$h_{2(t2)}$ = 0.170

RESULTS

K=	**1.04E-06**	**cm/sec**
K=	**2.94E-03**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/09/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

GOLDER

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-1S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

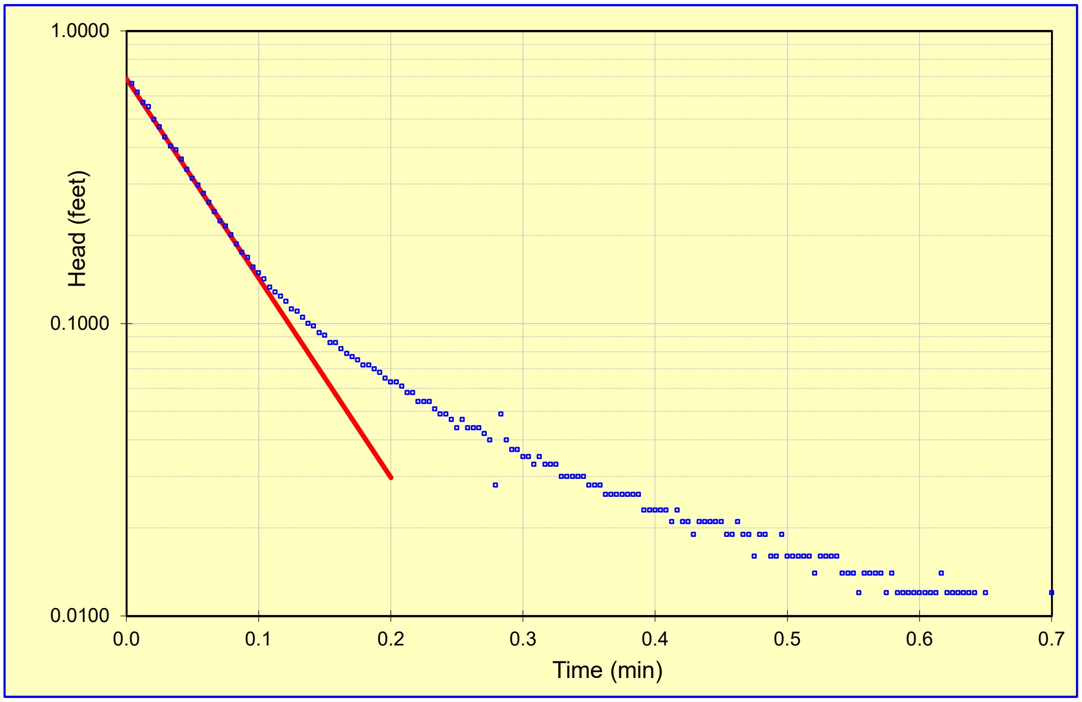
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**4.01**
$ln(R_e/r_w)$=	**3.20**
y_0 =	**0.69**
y_t =	**0.030**
t =	**0.2**

RESULTS

K=	**2.21E-02**	**cm/sec**
K=	**6.25E+01**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/11/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-1S

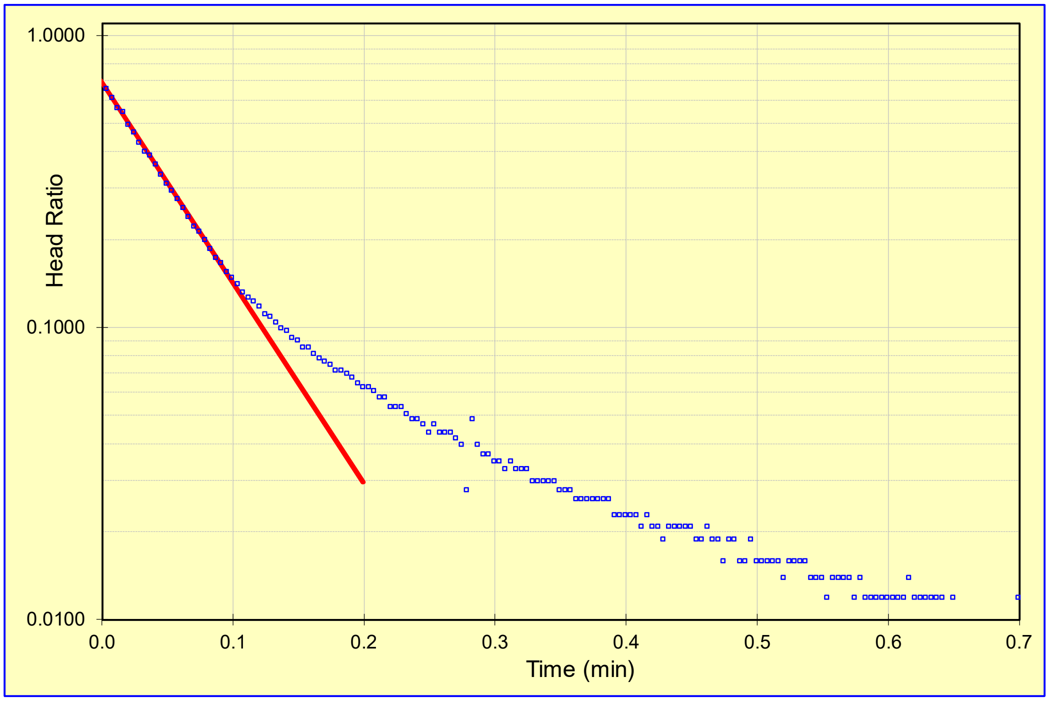
$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	0.08
R_e =	0.17
L_e =	4.0
t_1 =	0.00
t_2 =	0.20
$h_{1(t1)}$ =	0.70
$h_{2(t2)}$ =	0.030

RESULTS

K=	2.21E-02	cm/sec
K=	6.27E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/11/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-1S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

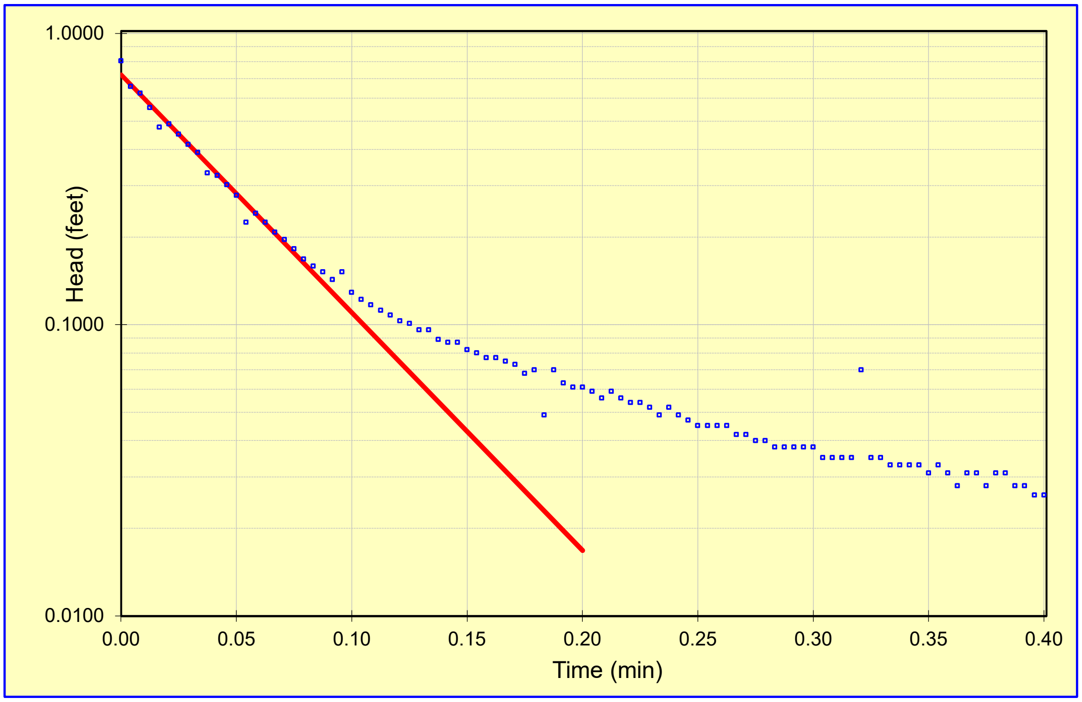
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	4.01
$ln(R_e/r_w)$=	3.20
y_0 =	0.72
y_t =	0.017
t =	0.2

RESULTS

K=	2.64E-02	cm/sec
K=	7.49E+01	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/11/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-1S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

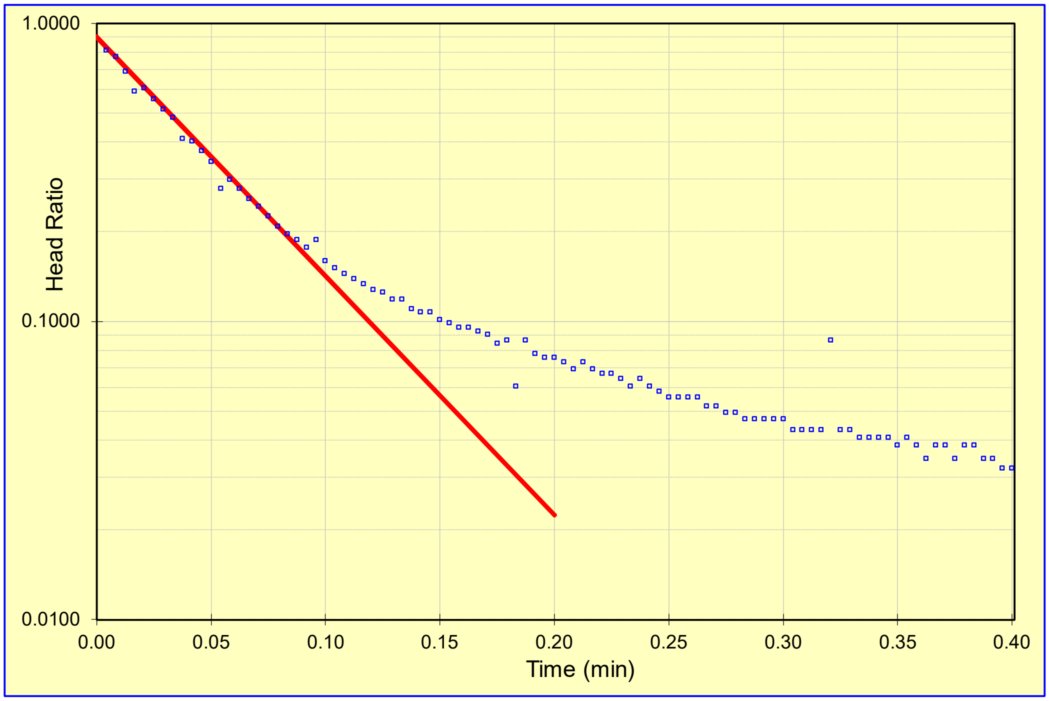
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	4.0
t_1 =	0.00
t_2 =	0.20
$h_{1(t1)}$ =	0.90
$h_{2(t2)}$ =	0.022

RESULTS

K=	2.58E-02	cm/sec
K=	7.32E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/11/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-1S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

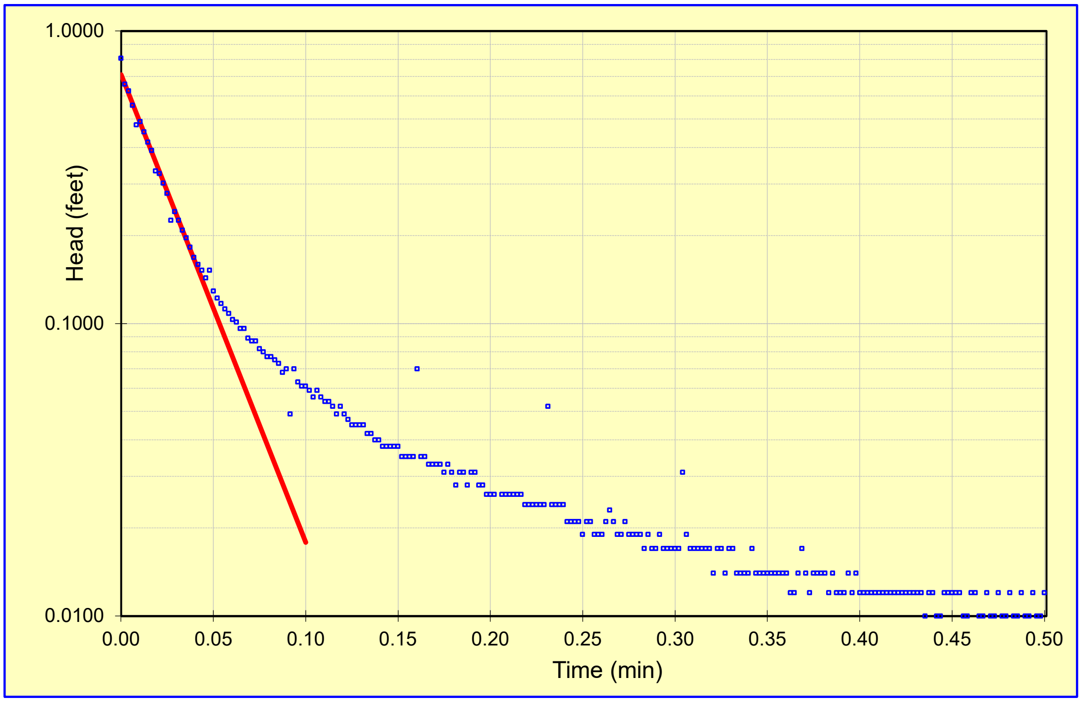
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	3.968
$\ln(R_e/r_w)$=	3.19
y_0 =	0.71
y_t =	0.018
t =	0.1

RESULTS

K=	5.21E-02	cm/sec
K=	1.48E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/11/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-1S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

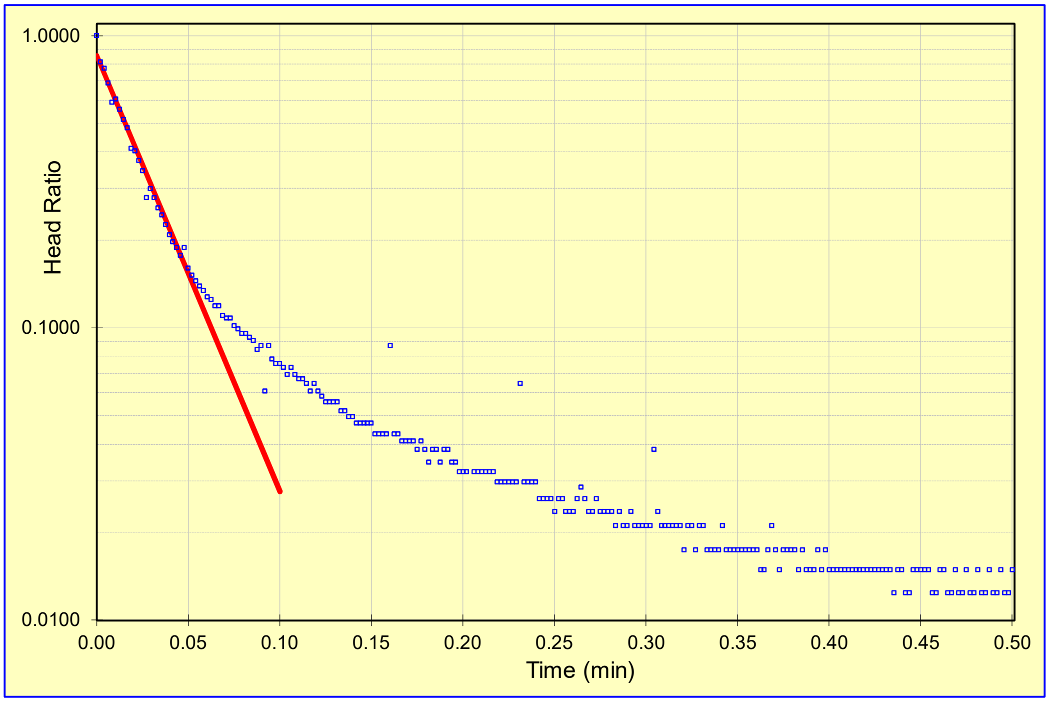
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	4.0
t_1 =	0.00
t_2 =	0.10
$h_{1(t1)}$ =	0.86
$h_{2(t2)}$ =	0.028

RESULTS

K=	4.84E-02	cm/sec
K=	1.37E+02	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/11/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-2S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

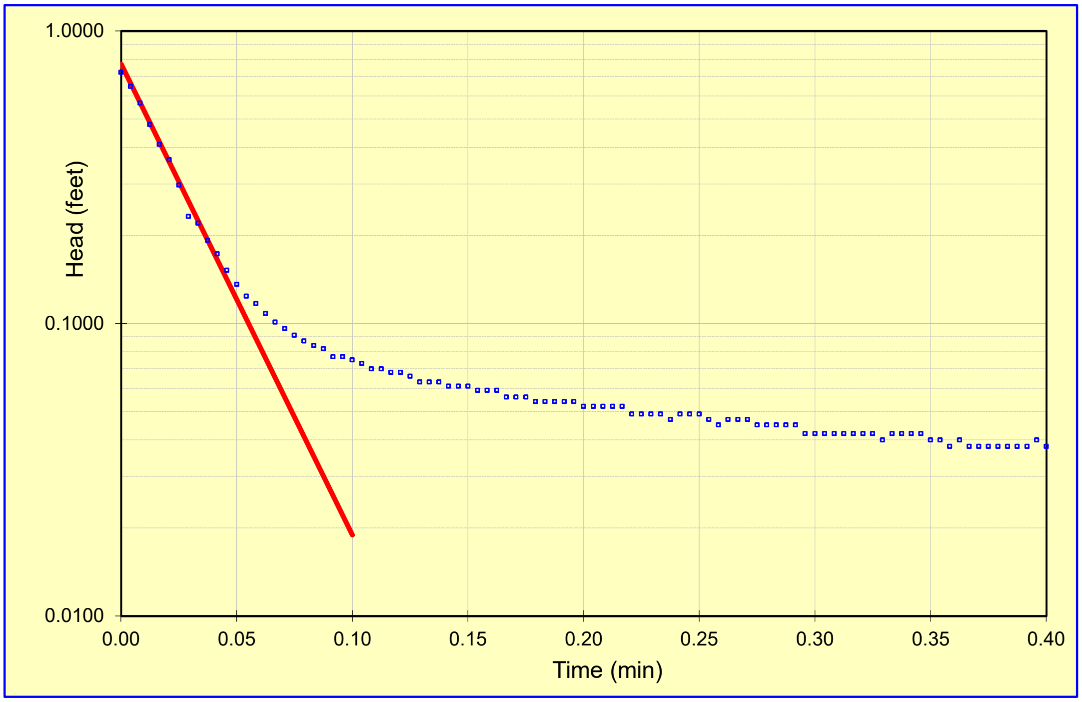
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2.897
$\ln(R_e/r_w)$=	2.98
y_0 =	0.77
y_t =	0.019
t =	0.1

RESULTS

K=	6.72E-02	cm/sec
K=	1.90E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/11/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-2S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

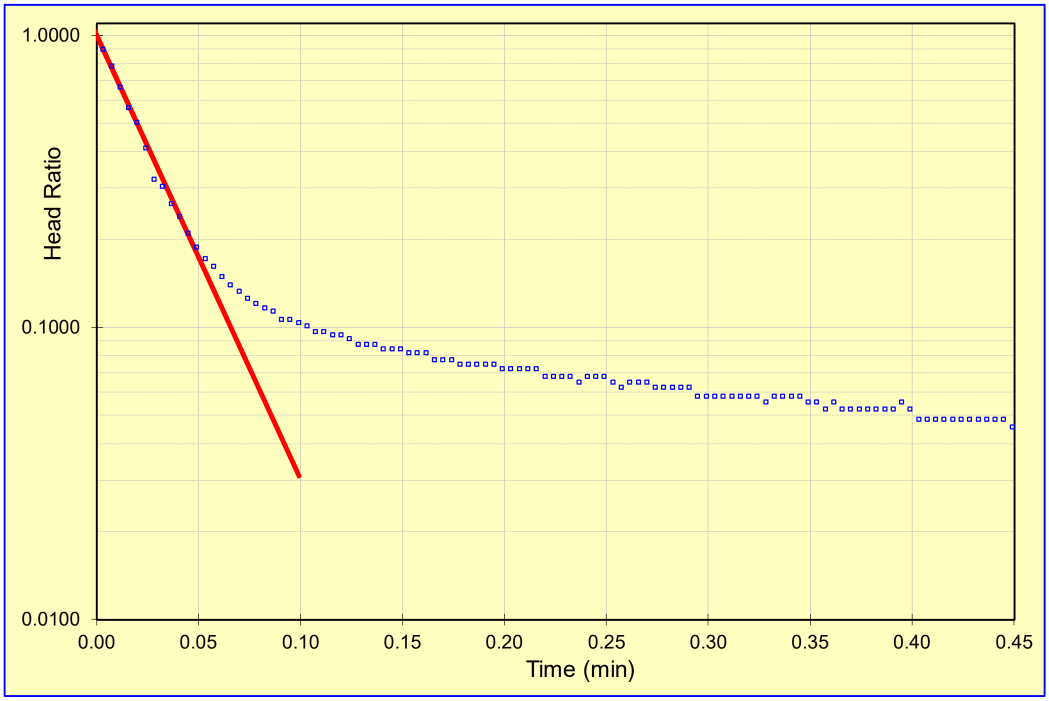
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 2.90
t_1 = 0.00
t_2 = 0.10
$h_{1(t1)}$ = 1.03
$h_{2(t2)}$ = 0.031

RESULTS

K=	6.09E-02	cm/sec
K=	1.73E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/11/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-3S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

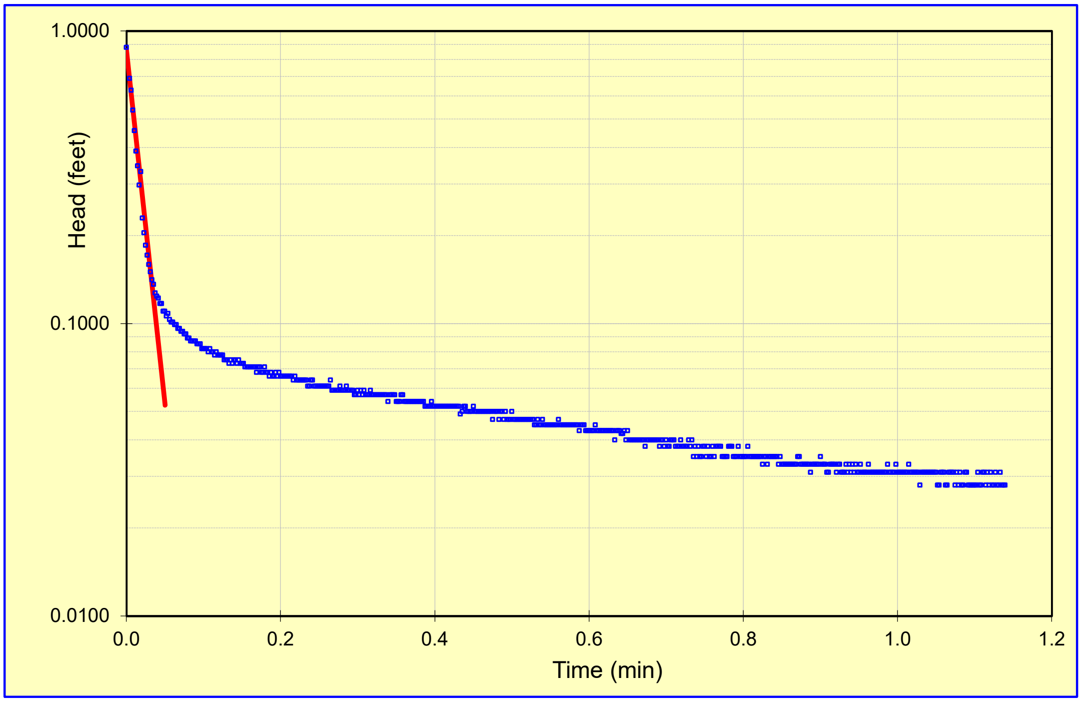
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
r_w =	0.17			
L_e =	3.88	K=	8.06E-02	cm/sec
$\ln(R_e/r_w)$=	3.17	K=	2.28E+02	ft/day
y_0 =	0.86			
y_t =	0.053			
t =	0.1			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: ANB
Analysis Date: 1/15/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-3S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

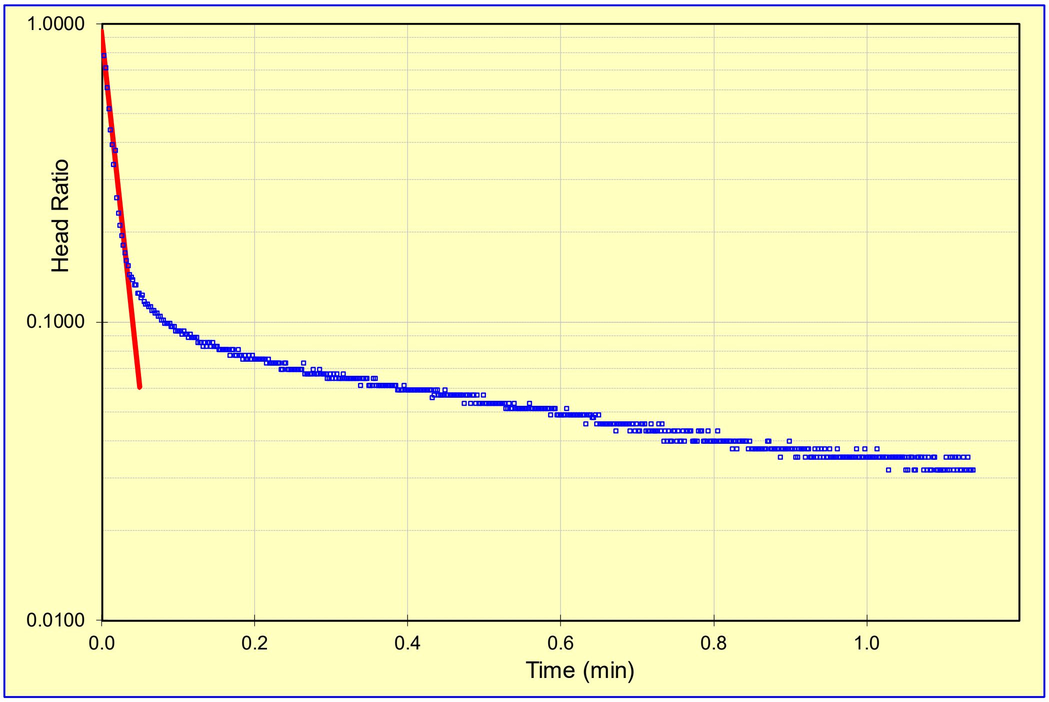
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	3.9
t_1 =	0.00
t_2 =	0.05
$h_{1(t1)}$ =	0.95
$h_{2(t2)}$ =	0.061

RESULTS

K=	7.86E-02	cm/sec
K=	2.23E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 1/15/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-4S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

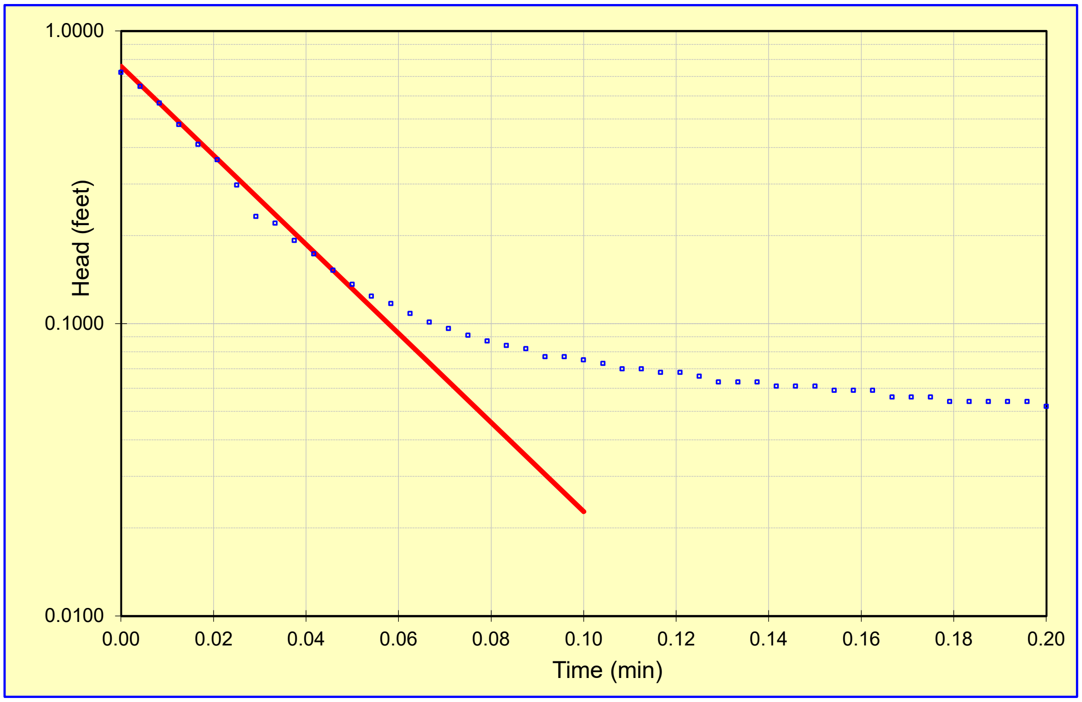
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	**0.08**
r_w =	**0.17**
L_e =	**3.24**
$\ln(R_e/r_w)$=	**3.05**
y_0 =	**0.76**
y_t =	**0.023**
t =	**0.1**

RESULTS

K=	**5.81E-02**	**cm/sec**
K=	**1.65E+02**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/8/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-4S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

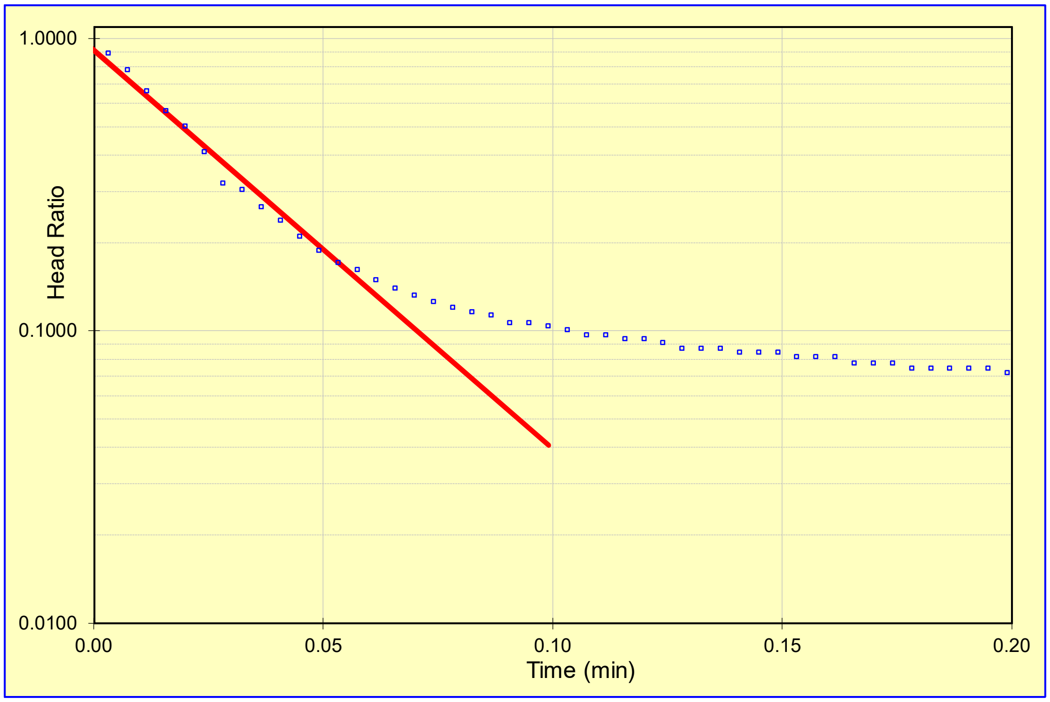
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	**0.08**
R_e =	**0.17**
L_e =	**3.2**
t_1 =	**0.00**
t_2 =	**0.10**
$h_{1(t1)}$ =	**0.94**
$h_{2(t2)}$ =	**0.041**

RESULTS

K=	**5.07E-02**	**cm/sec**
K=	**1.44E+02**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/8/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-4S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

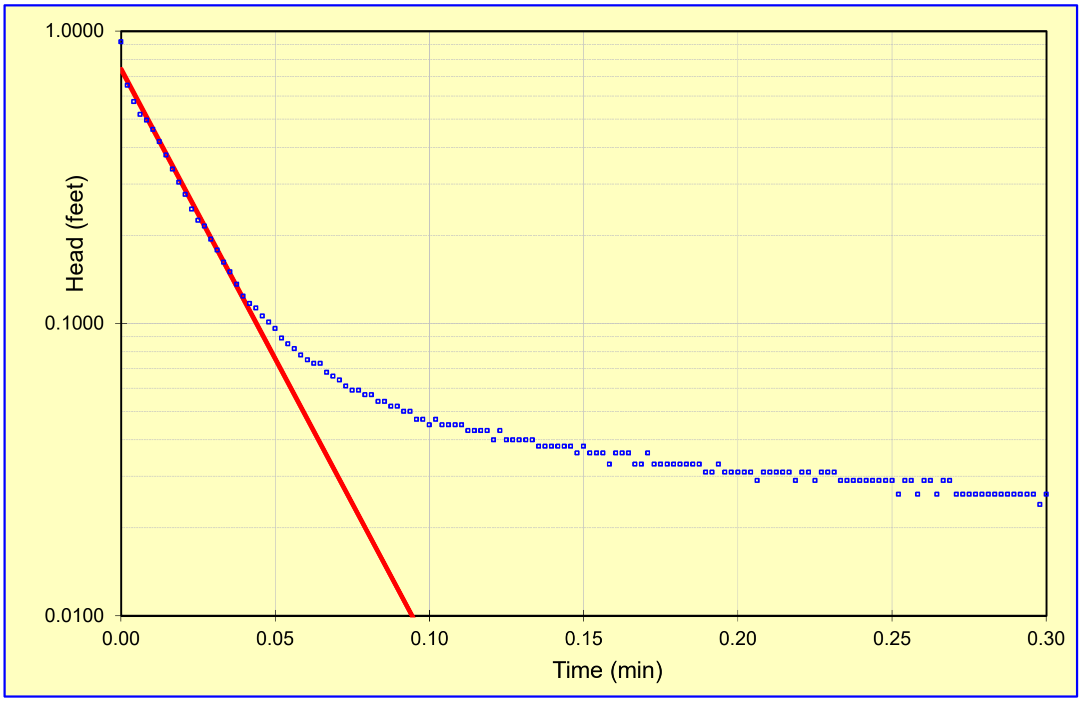
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	3.24
$\ln(R_e/r_w)$=	3.05
y_0 =	0.74
y_t =	0.008
t =	0.1

RESULTS

K=	7.57E-02	cm/sec
K=	2.15E+02	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/8/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-4S

$$K = \frac{r_c^{2}}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)}\right]$$

where:

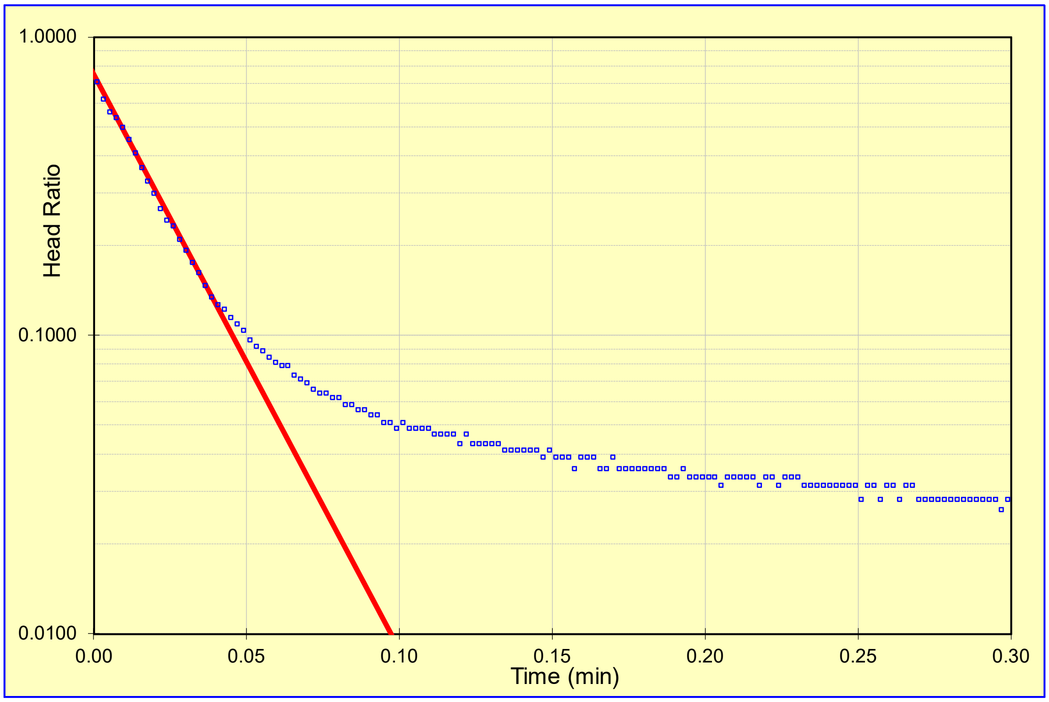
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 3.2
t_1 = 0.00
t_2 = 0.10
$h_{1(t1)}$ = 0.78
$h_{2(t2)}$ = 0.009

RESULTS

K=	**7.18E-02**	**cm/sec**
K=	**2.04E+02**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/8/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-4S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

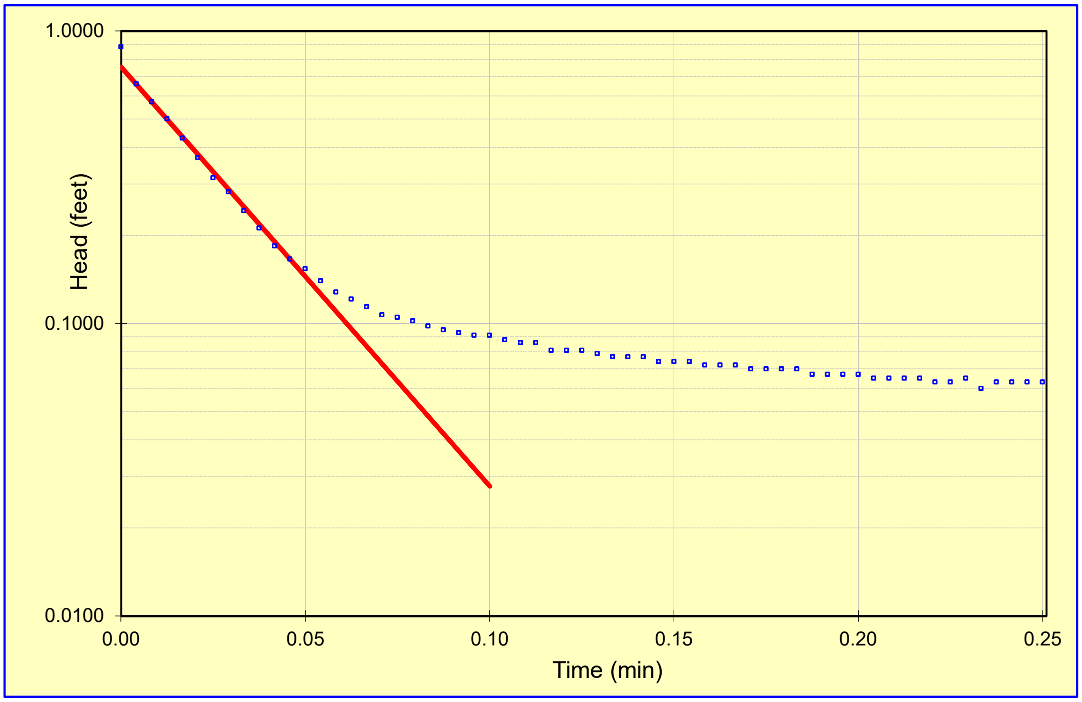
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	3.24
$\ln(R_e/r_w)$=	3.05
y_0 =	0.75
y_t =	0.028
t =	0.1

RESULTS

K=	5.47E-02	cm/sec
K=	1.55E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/11/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-4S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

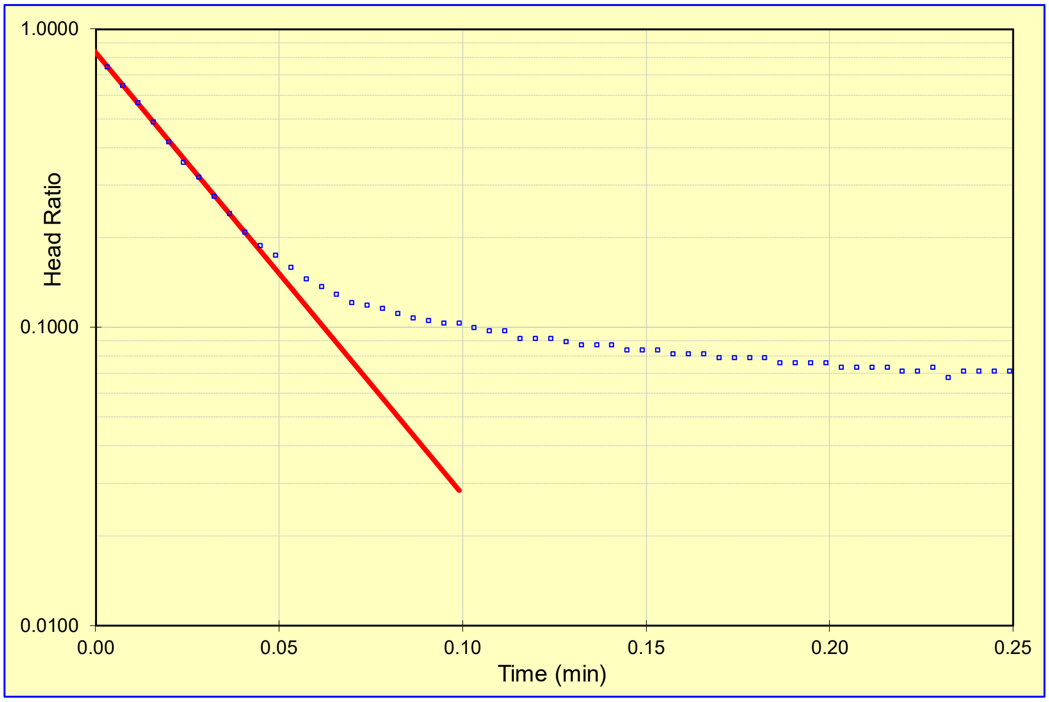
where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	0.08
R_e =	0.17
L_e =	3.2
t_1 =	0.00
t_2 =	0.10
$h_{1(t1)}$ =	0.86
$h_{2(t2)}$ =	0.028

RESULTS

K=	5.51E-02	cm/sec
K=	1.56E+02	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/8/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 1 PZ-5D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

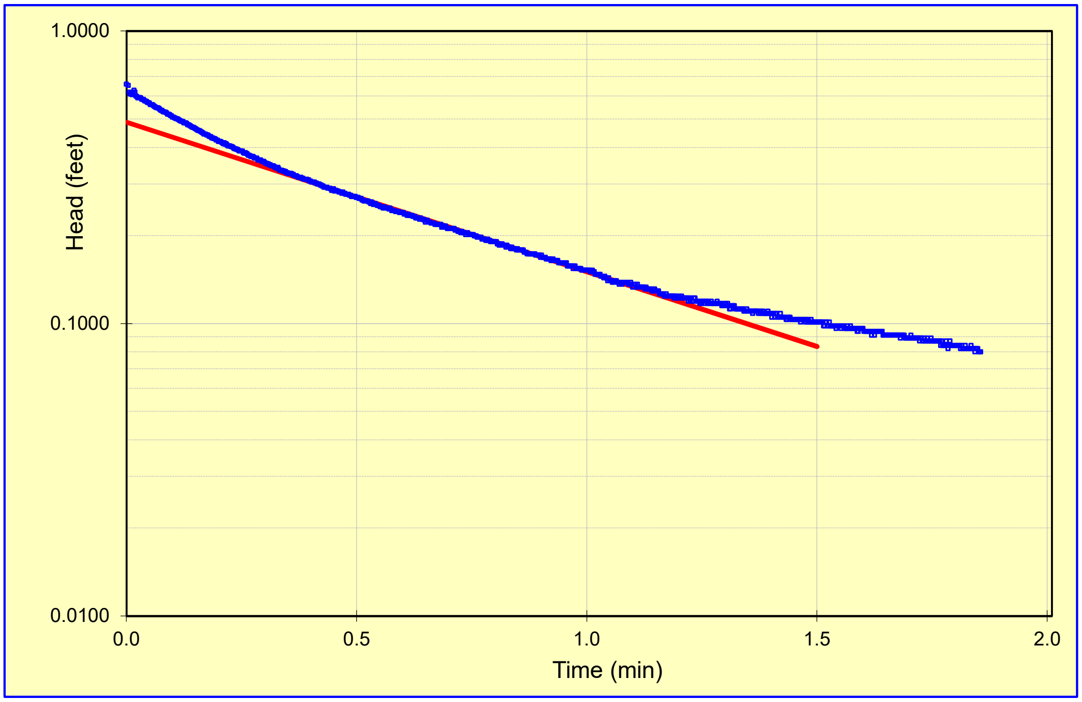
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$\ln(R_e/r_w)$=	**3.38**
y_0 =	**0.49**
y_t =	**0.084**
t =	**1.5**

RESULTS

K=	**1.40E-03**	**cm/sec**
K=	**3.97E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 6/13/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 1 PZ-5D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

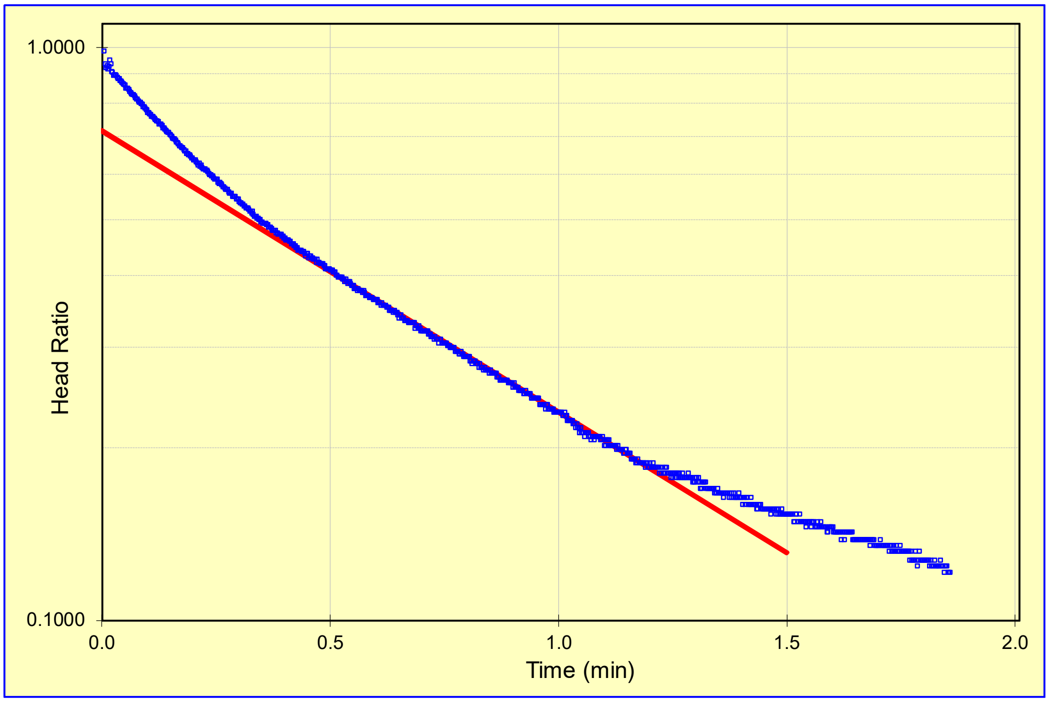
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 1.50
$h_{1(t1)}$ = 0.72
$h_{2(t2)}$ = 0.131

RESULTS

K=	**1.36E-03**	**cm/sec**
K=	**3.85E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 6/13/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-5D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

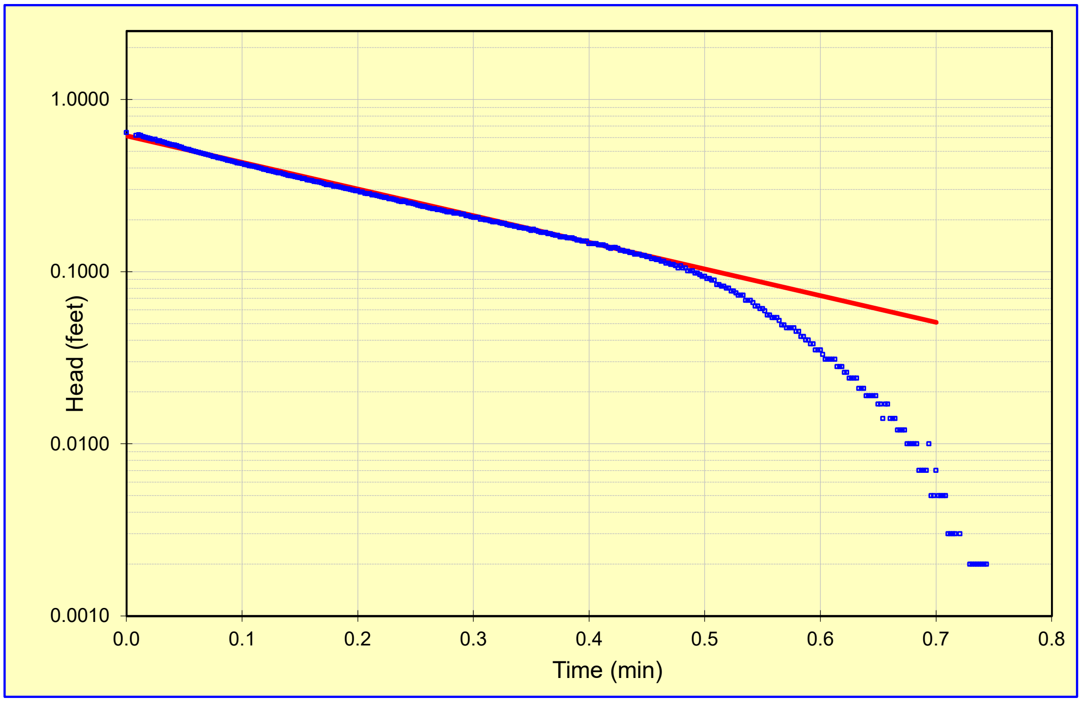
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.62
y_t =	0.051
t =	0.7

RESULTS

K=	4.24E-03	cm/sec
K=	1.20E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 6/13/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-5D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

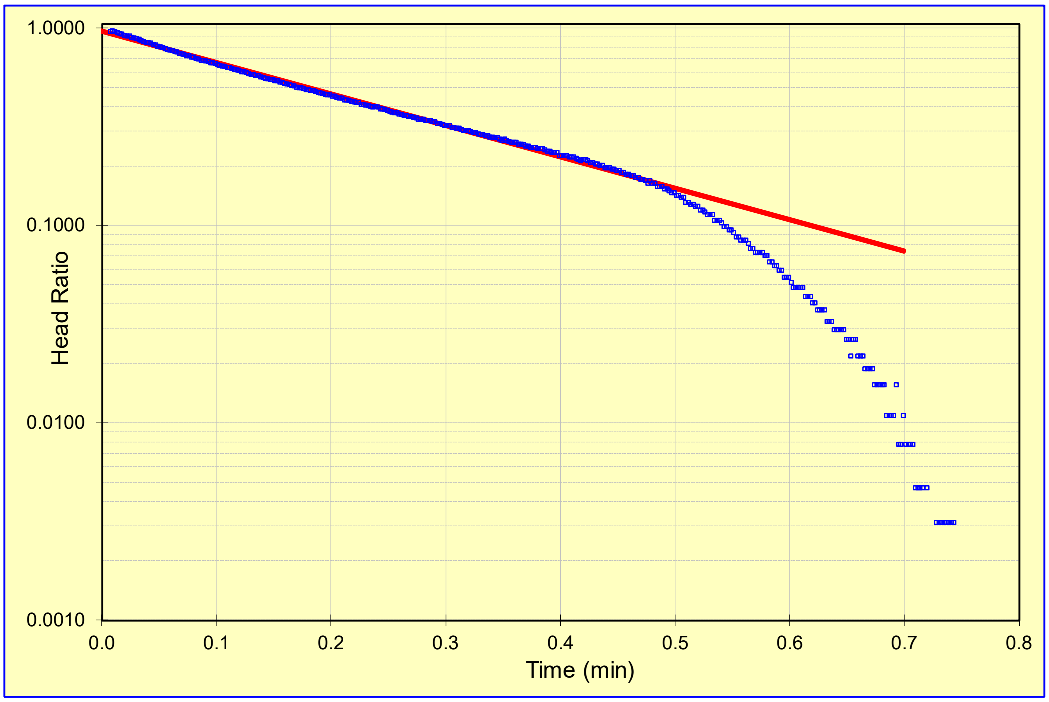
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 0.70
$h_{1(t1)}$ = 0.97
$h_{2(t2)}$ = 0.074

RESULTS

K=	**4.40E-03**	**cm/sec**
K=	**1.25E+01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 6/13/2019

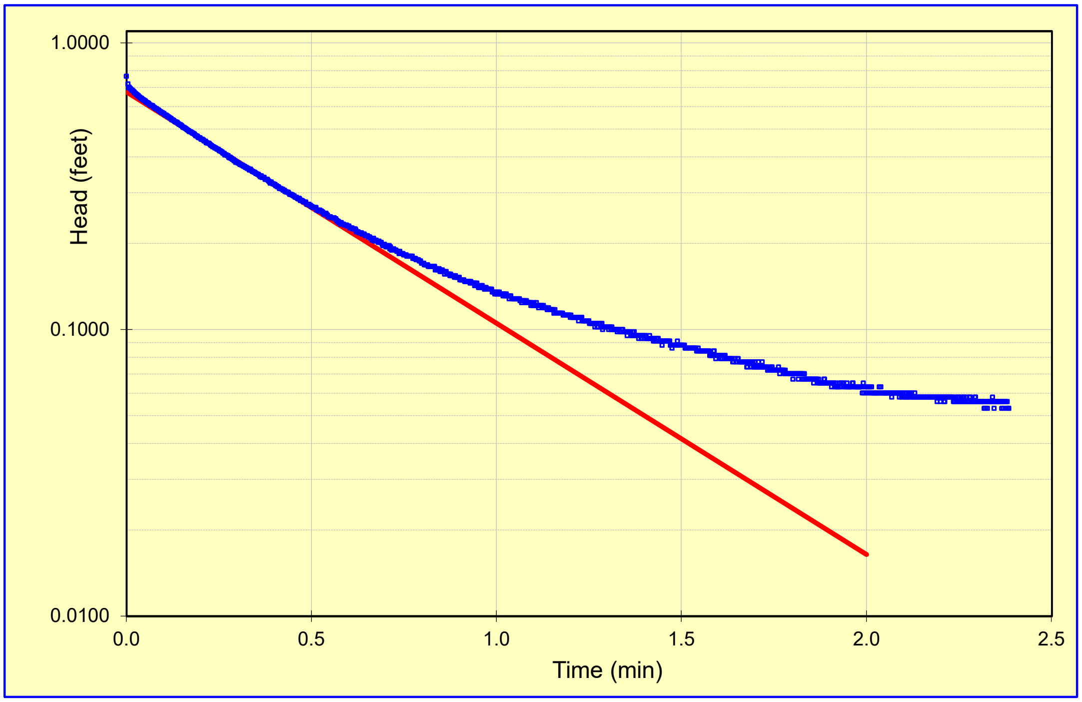
BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-5D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
r_w =	**0.17**			
L_e =	**5**	**K=**	**2.21E-03**	**cm/sec**
$\ln(R_e/r_w)$=	**3.38**	**K=**	**6.27E+00**	**ft/day**
y_0 =	**0.67**			
y_t =	**0.016**			
t =	**2.0**			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

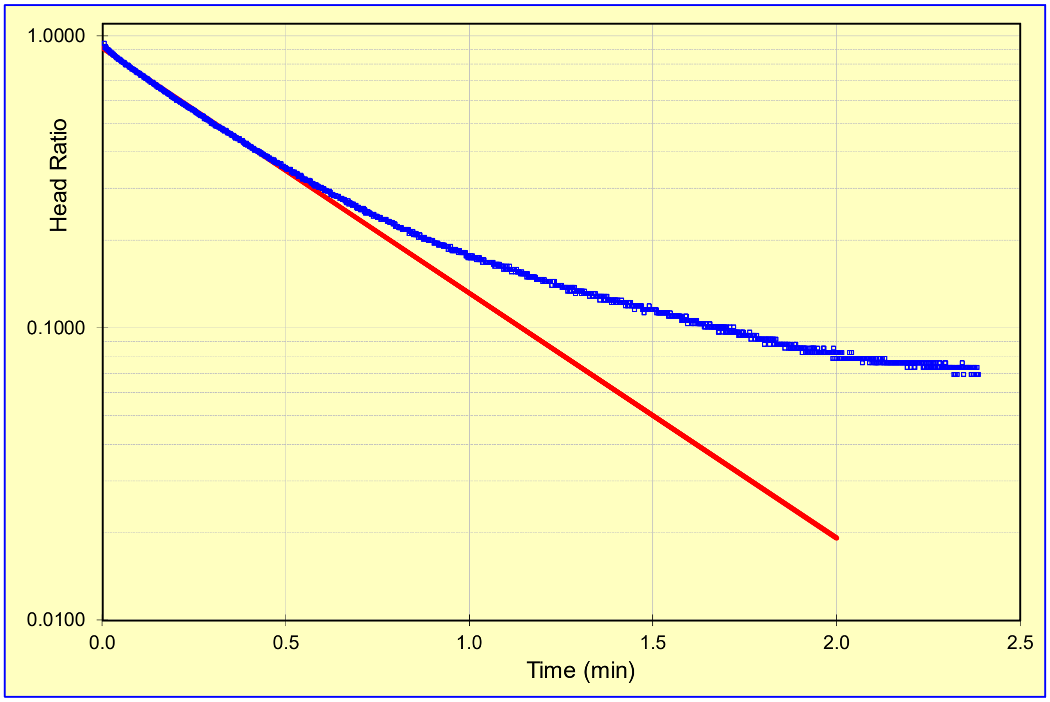
Analysis By: LWL
Checked By: BDL
Analysis Date: 6/13/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-5D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
R_e =	**0.17**			
L_e =	**5.0**	**K=**	**2.31E-03**	**cm/sec**
t_1 =	**0.00**	**K=**	**6.56E+00**	**ft/day**
t_2 =	**2.00**			
$h_{1(t1)}$ =	**0.91**			
$h_{2(t2)}$ =	**0.019**			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: ANB
Analysis Date: 1/15/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-5D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

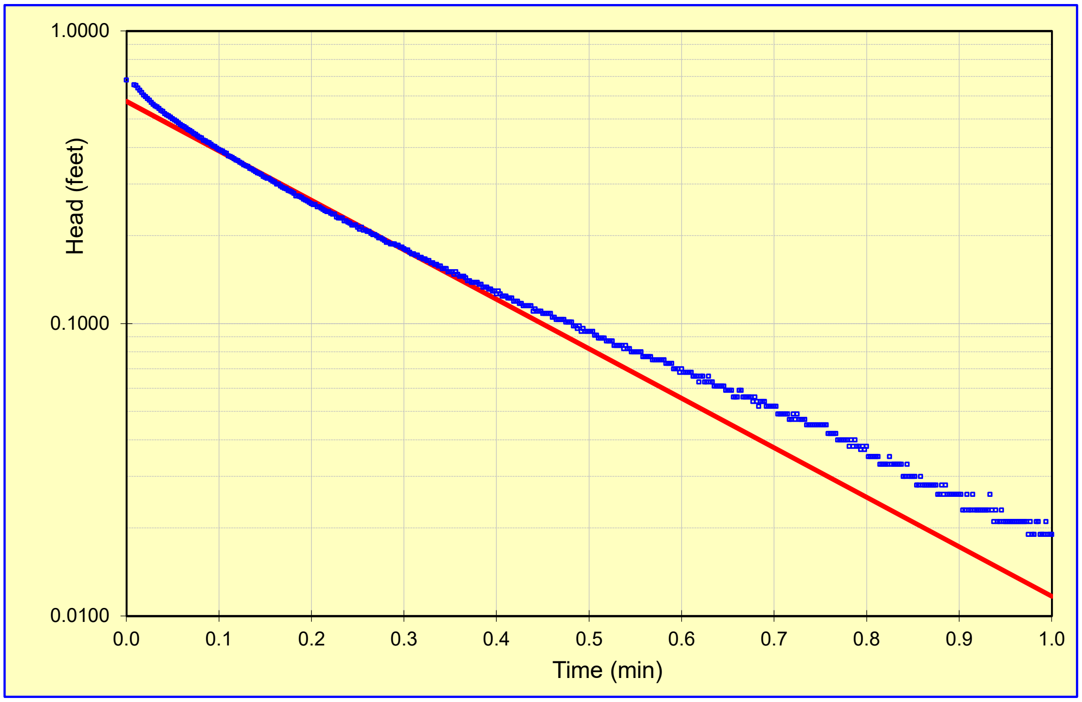
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	0.58
y_t =	0.012
t =	1.0

RESULTS

K=	4.64E-03	cm/sec
K=	1.31E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 6/13/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-5D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

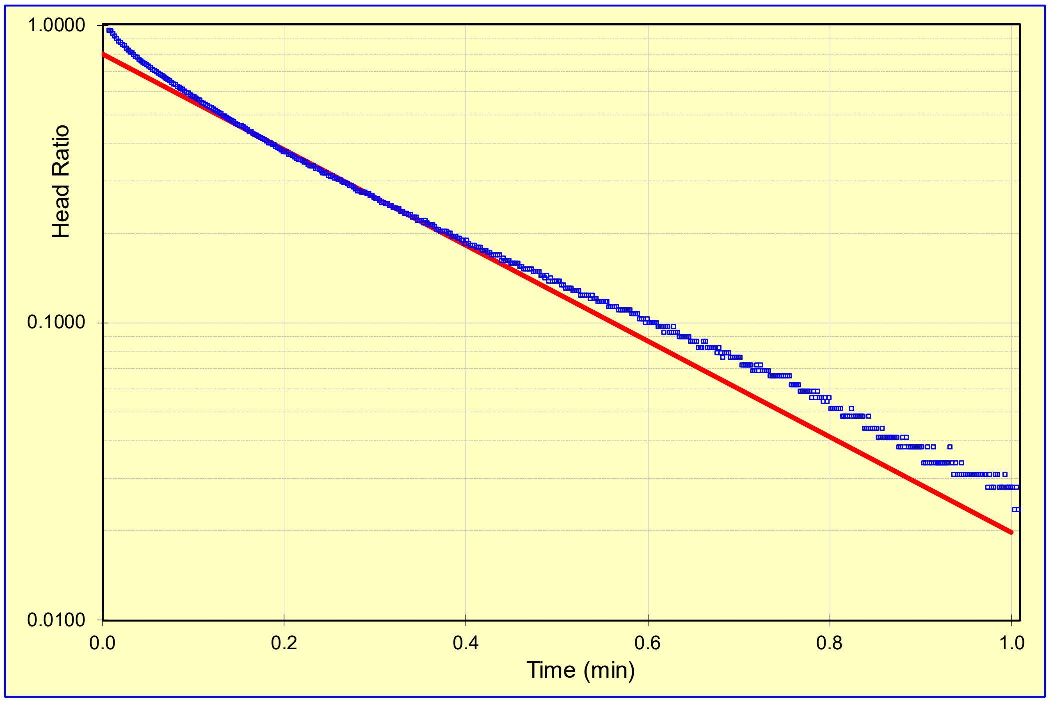
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	1.00
$h_{1(t1)}$ =	0.80
$h_{2(t2)}$ =	0.020

RESULTS

K=	4.45E-03	cm/sec
K=	1.26E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 6/13/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-6S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

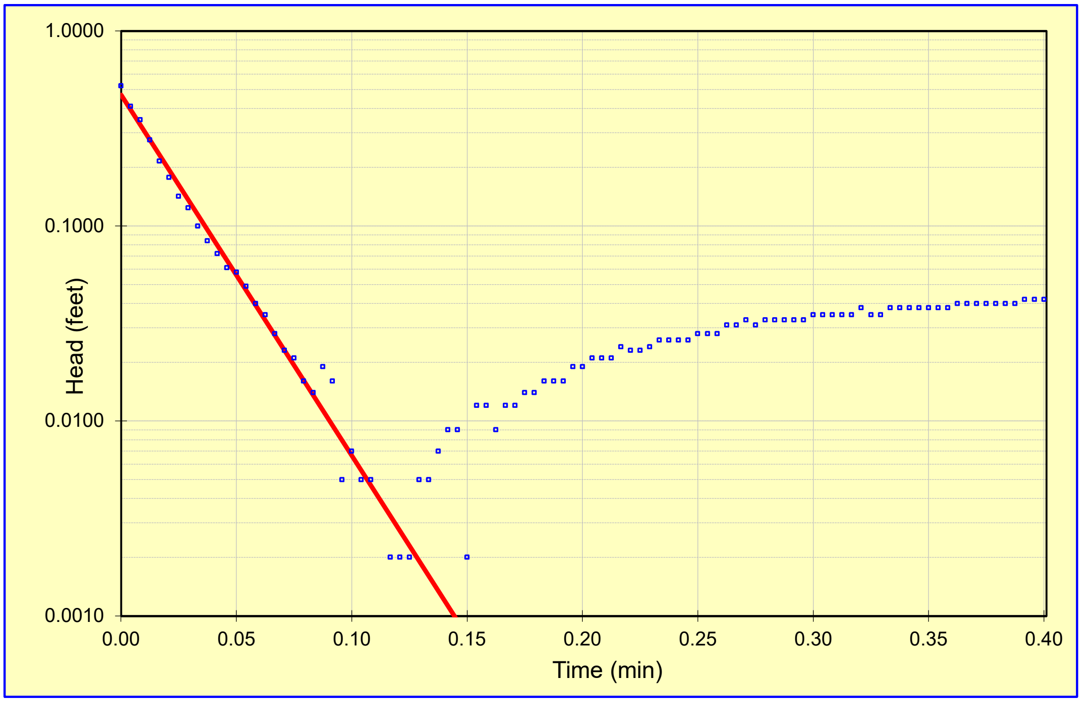
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	4.69
$\ln(R_e/r_w)$=	3.32
y_0 =	0.47
y_t =	0.001
t =	0.2

RESULTS

K=	5.32E-02	cm/sec
K=	1.51E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

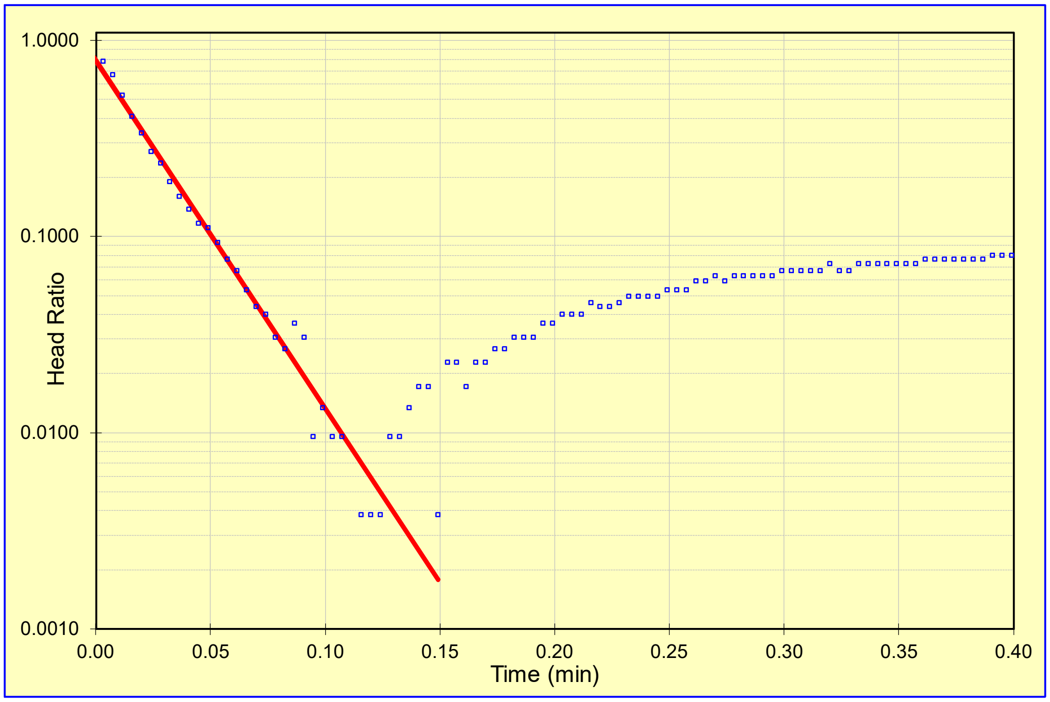
Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-6S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	4.7	K=	5.13E-02	cm/sec
t_1 =	0.00	K=	1.45E+02	ft/day
t_2 =	0.15			
$h_{1(t1)}$ =	0.82			
$h_{2(t2)}$ =	0.002			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-6

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

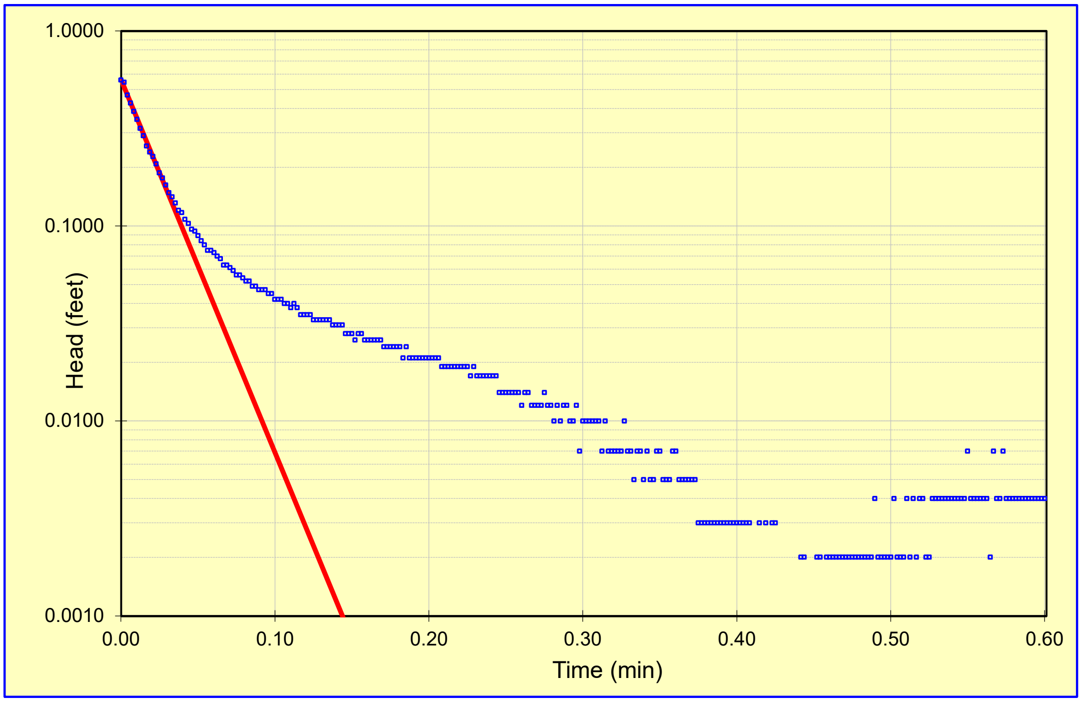
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	**0.08**
r_w =	**0.17**
L_e =	**4.69**
$\ln(R_e/r_w)$=	**3.32**
y_0 =	**0.56**
y_t =	**0.001**
t =	**0.2**

RESULTS

K=	**5.50E-02**	**cm/sec**
K=	**1.56E+02**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	
Test Date:	10/17/18	Analysis Date:	6/10/2019

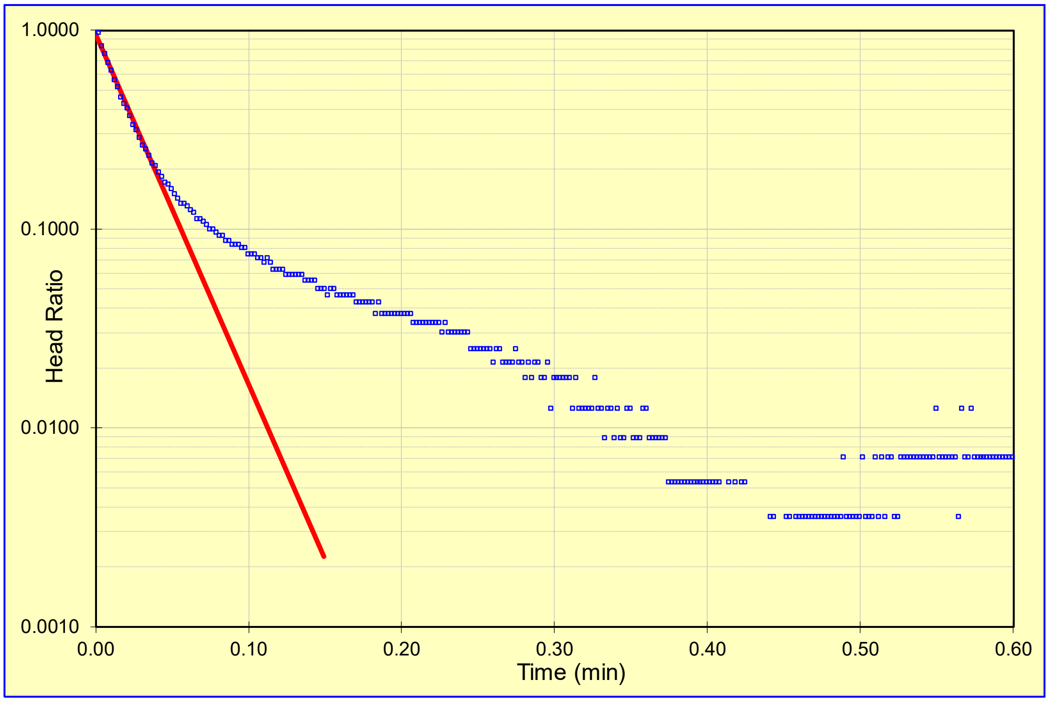
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-6

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	4.7	K=	5.08E-02	cm/sec
t_1 =	0.00	K=	1.44E+02	ft/day
t_2 =	0.15			
$h_{1(t1)}$ =	0.98			
$h_{2(t2)}$ =	0.002			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/17/18	Analysis Date:	6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-6S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

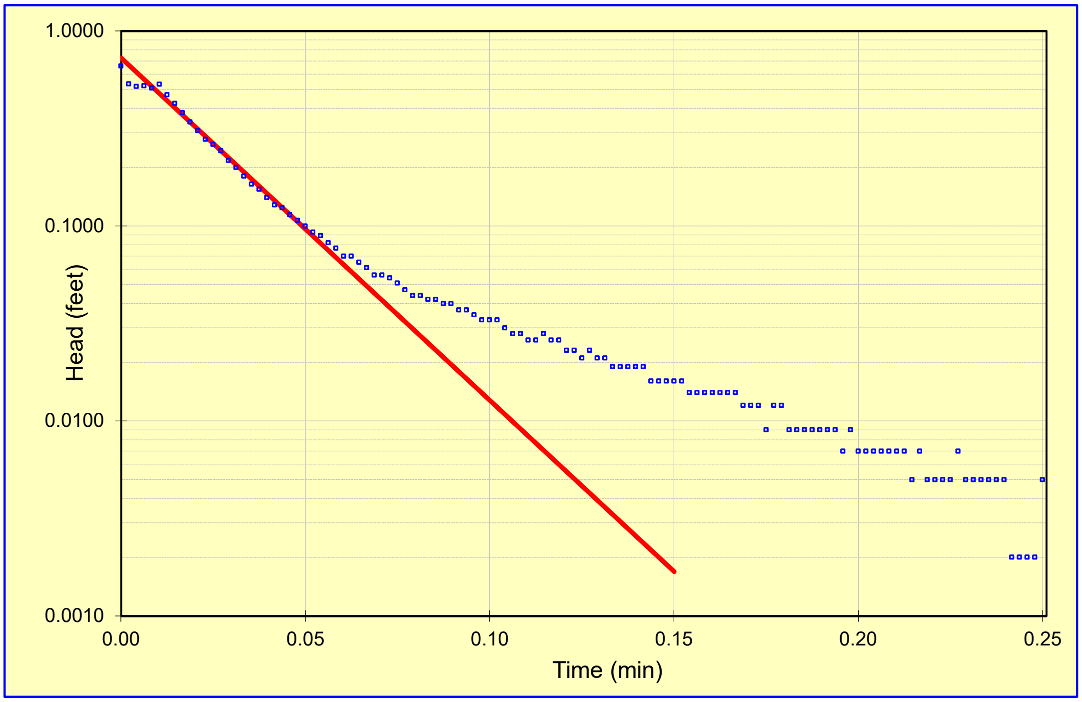
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	4.69
$ln(R_e/r_w)$=	3.32
y_0 =	0.73
y_t =	0.002
t =	0.2

RESULTS

K=	5.05E-02	cm/sec
K=	1.43E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-6S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

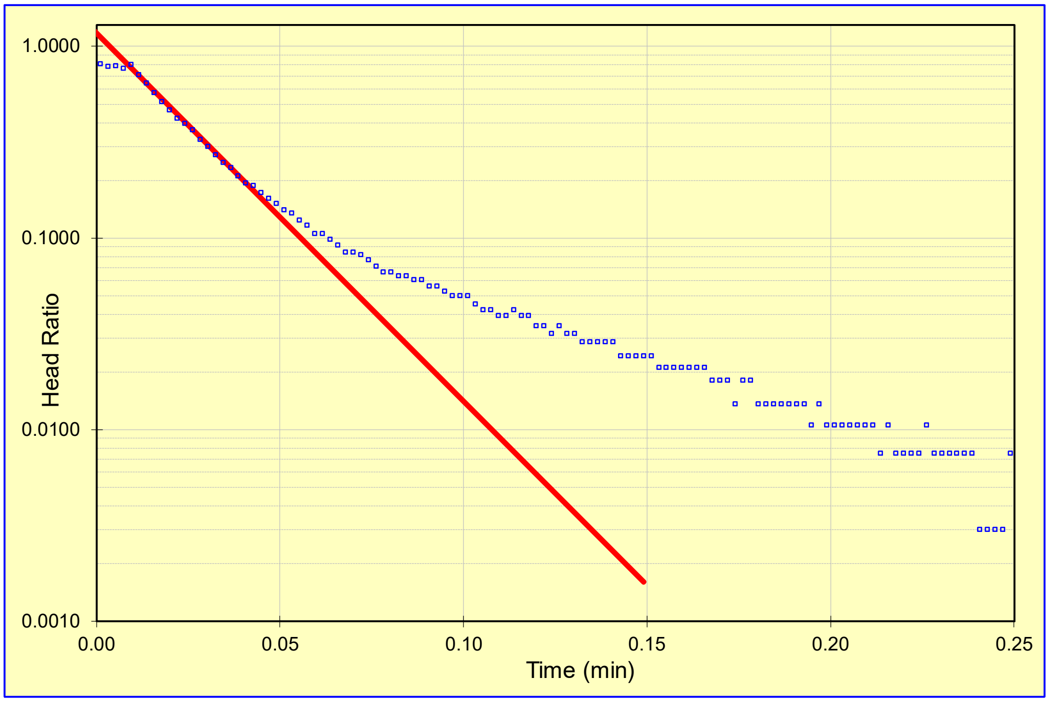
where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	0.08
R_e =	0.17
L_e =	4.7
t_1 =	0.00
t_2 =	0.15
$h_{1(t1)}$ =	1.23
$h_{2(t2)}$ =	0.002

RESULTS

K=	5.55E-02	cm/sec
K=	1.57E+02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 1 PZ-7D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

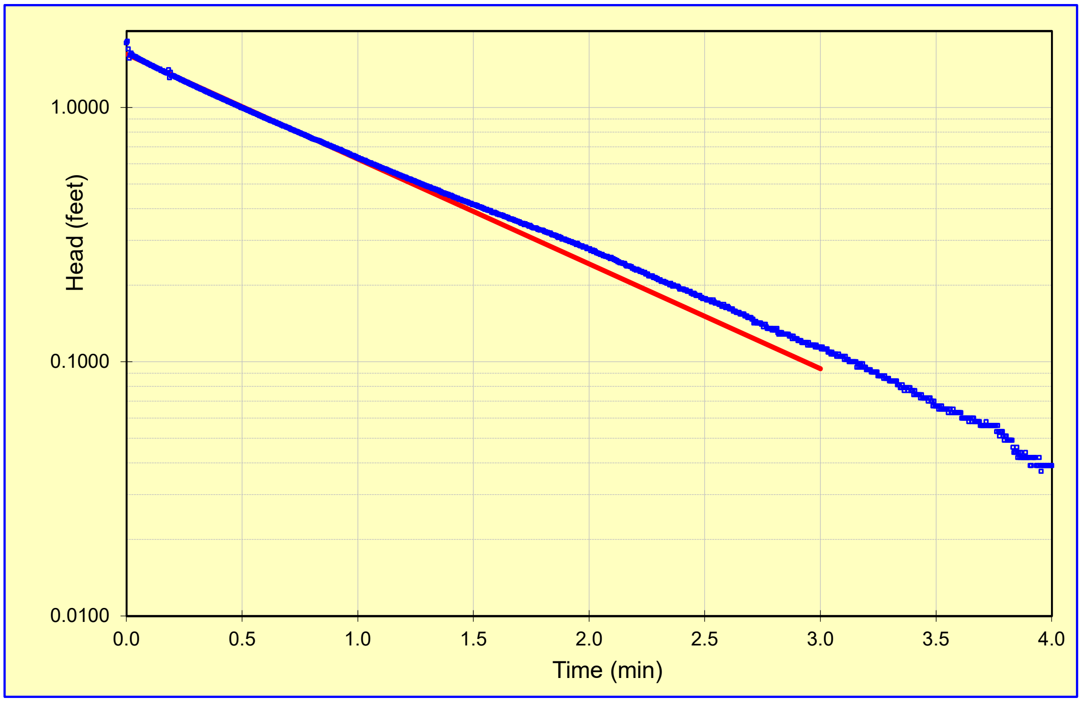
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.62
y_t =	0.094
t =	3.0

RESULTS

K=	1.13E-03	cm/sec
K=	3.20E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

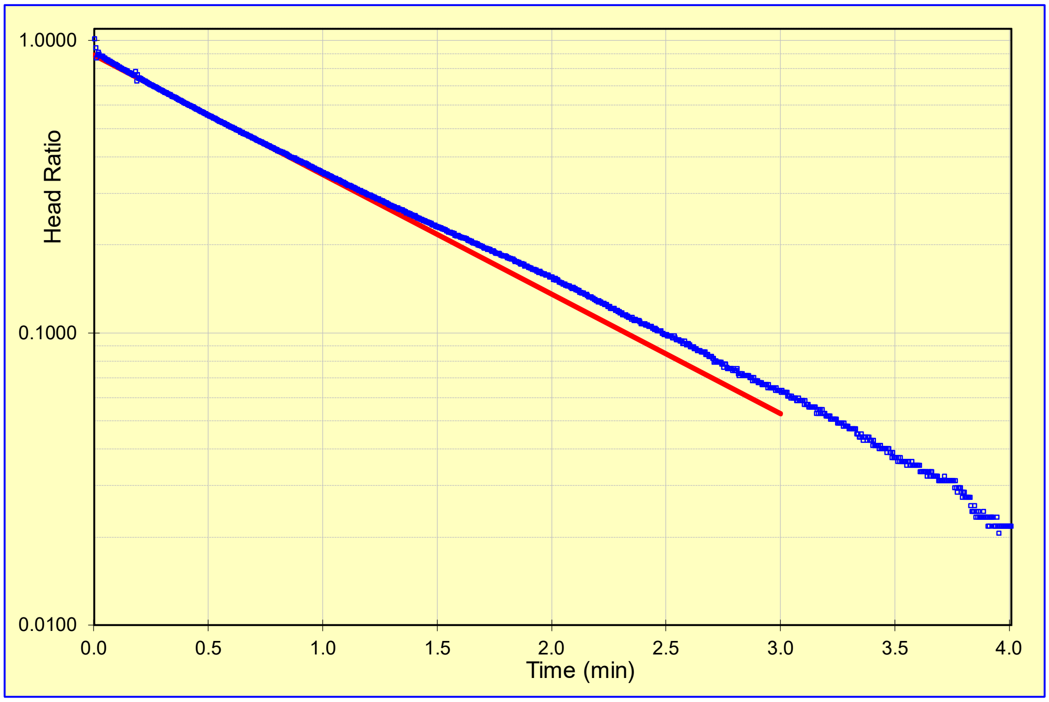
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 1 PZ-7D

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	0.08	
R_e =	0.17	
L_e =	5.0	**K= 1.13E-03 cm/sec**
t_1 =	0.00	**K= 3.21E+00 ft/day**
t_2 =	3.00	
$h_{1(t1)}$ =	0.89	
$h_{2(t2)}$ =	0.053	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-7D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

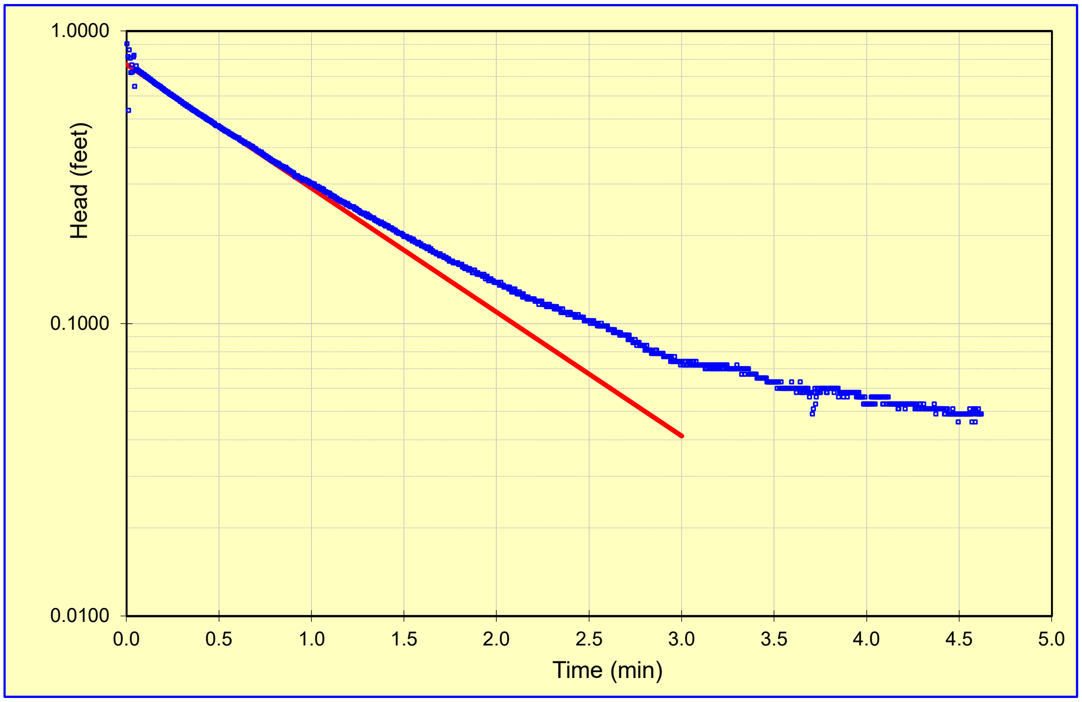
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	0.77
y_t =	0.041
t =	3.0

RESULTS

K=	1.16E-03	cm/sec
K=	3.29E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

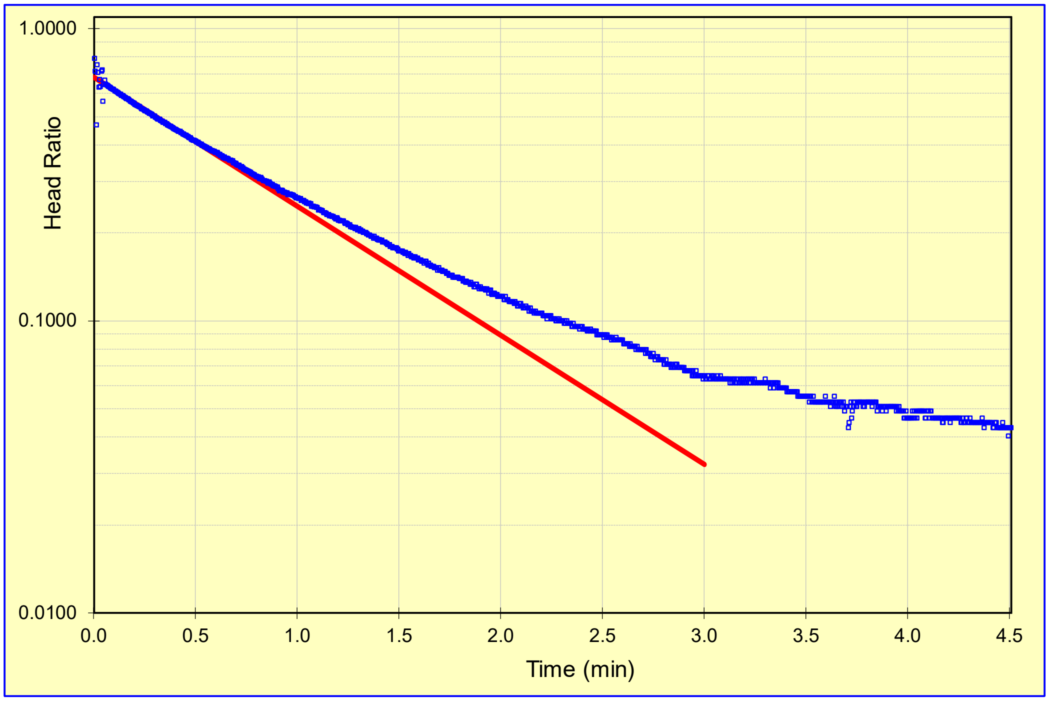
Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-7D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	**0.08**	
R_e =	**0.17**	
L_e =	**5.0**	**K= 1.22E-03 cm/sec**
t_1 =	**0.00**	**K= 3.46E+00 ft/day**
t_2 =	**3.00**	
$h_{1(t1)}$ =	**0.68**	
$h_{2(t2)}$ =	**0.032**	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: LWL
Checked By: TK
Analysis Date: 6/12/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 3 PZ-7D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

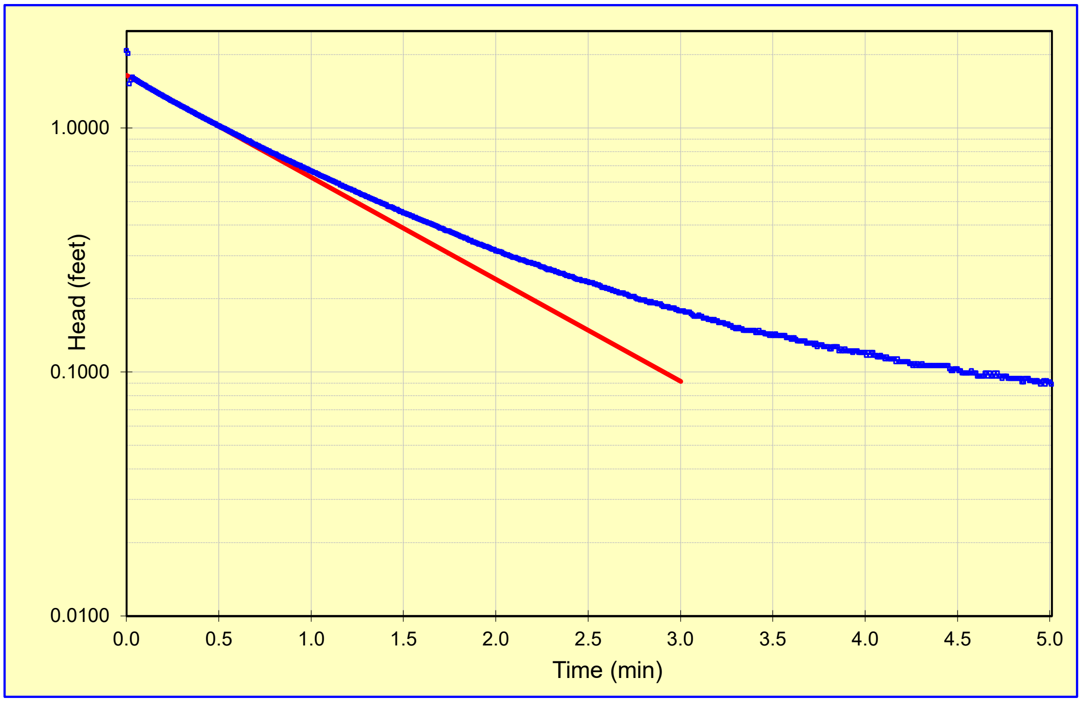
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$ln(R_e/r_w)$=	**3.38**
y_0 =	**1.65**
y_t =	**0.092**
t =	**3.0**

RESULTS

K=	**1.15E-03**	**cm/sec**
K=	**3.25E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 3 PZ-7D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

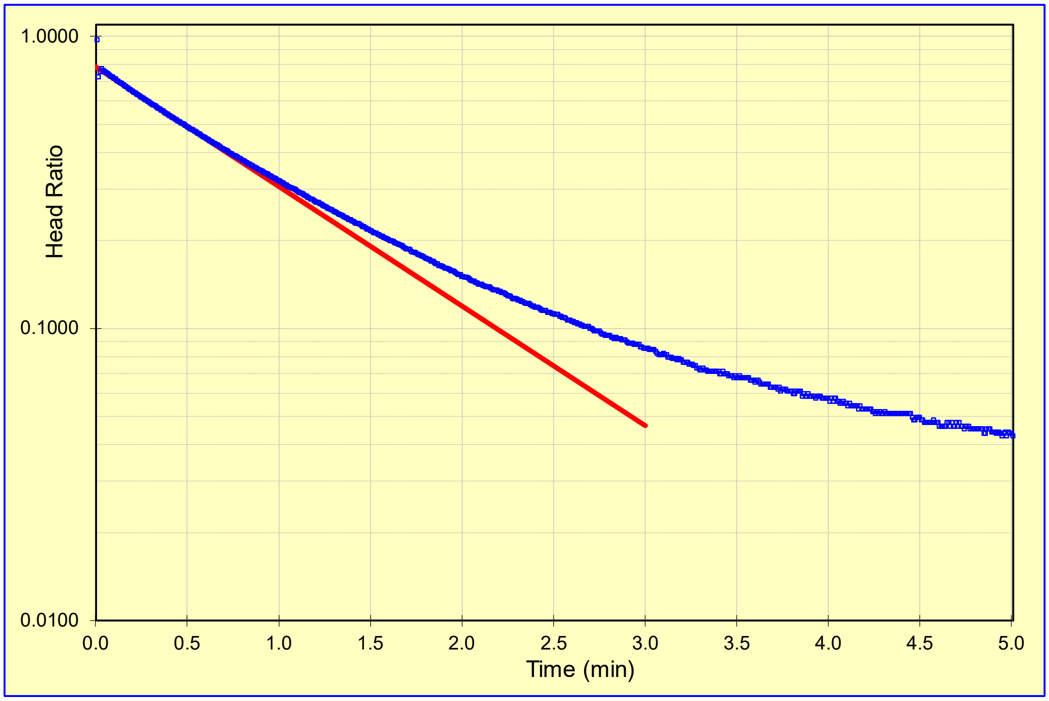
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	3.00
$h_{1(t1)}$ =	0.79
$h_{2(t2)}$ =	0.047

RESULTS

K=	1.13E-03	cm/sec
K=	3.21E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	TK
Test Date:	10/18/18	Analysis Date:	6/12/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-7D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

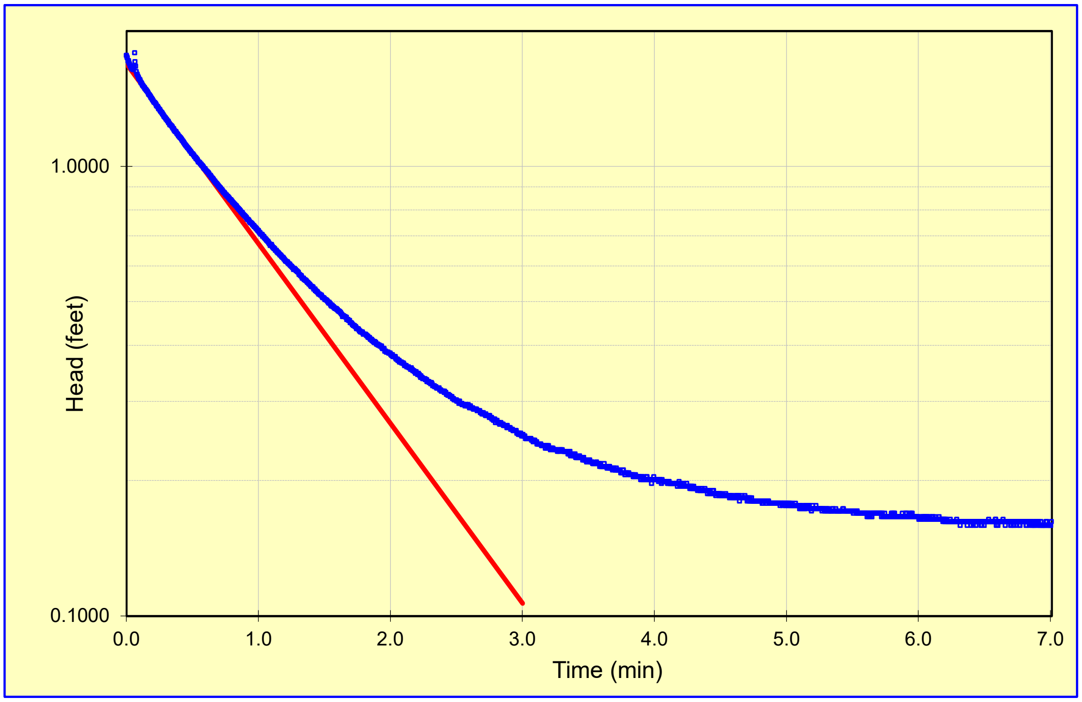
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.69
y_t =	0.107
t =	3.0

RESULTS

K=	1.10E-03	cm/sec
K=	3.11E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-7D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

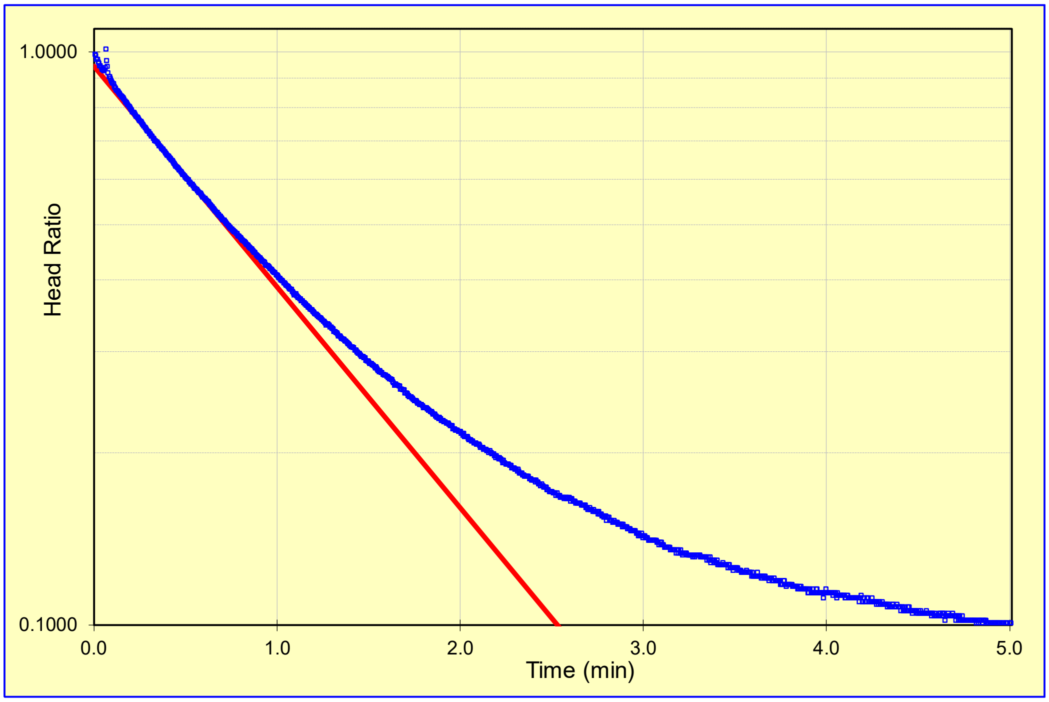
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 3.00
$h_{1(t1)}$ = 0.95
$h_{2(t2)}$ = 0.066

RESULTS

K= 1.06E-03 cm/sec
K= 3.02E+00 ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-7D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

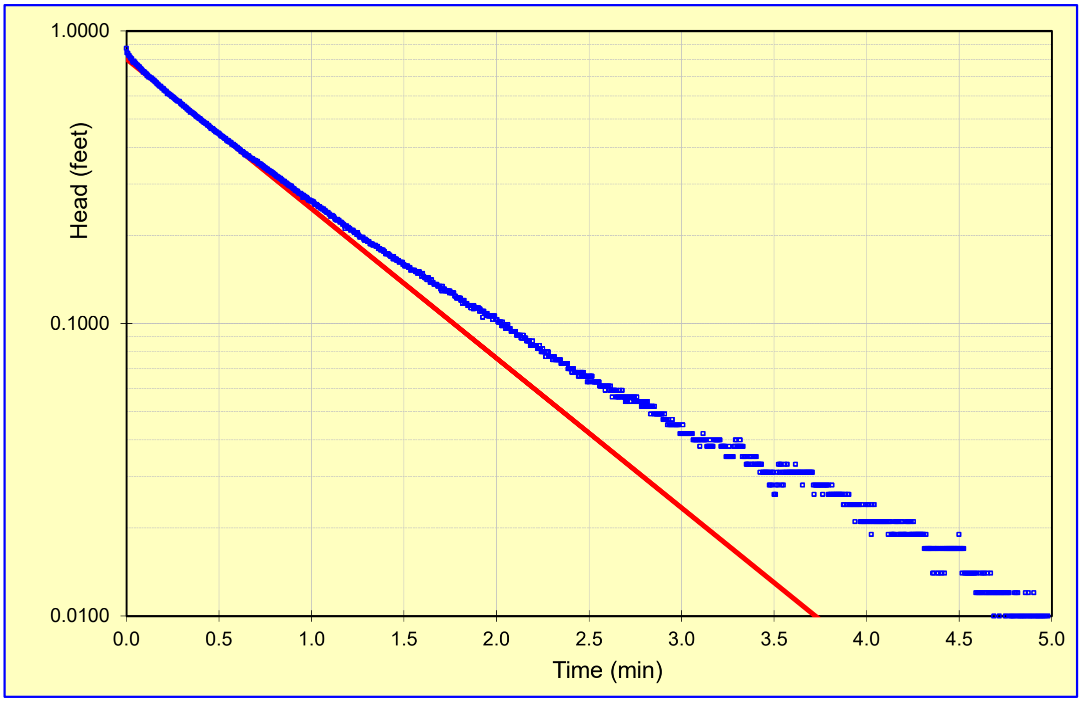
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.80
y_t =	0.007
t =	4.0

RESULTS

K=	1.40E-03	cm/sec
K=	3.98E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-7D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

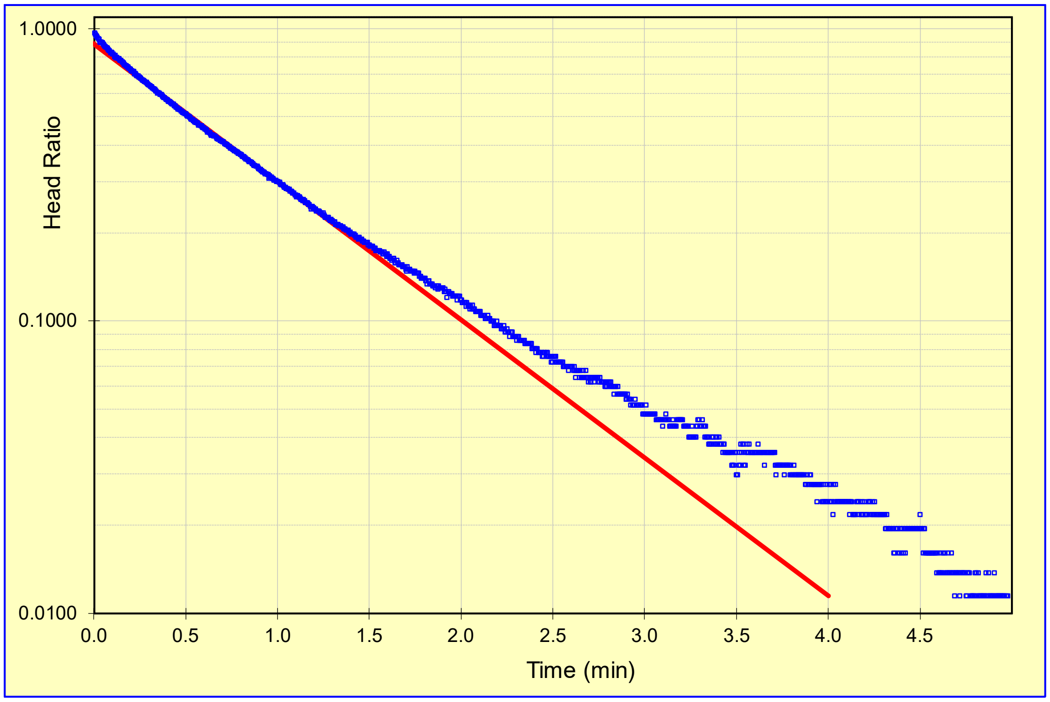
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	4.00
$h_{1(t1)}$ =	0.89
$h_{2(t2)}$ =	0.012

RESULTS

K=	1.30E-03	cm/sec
K=	3.70E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/18/18	Analysis Date:	6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-7D

$$K = \frac{r_c^{2} \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

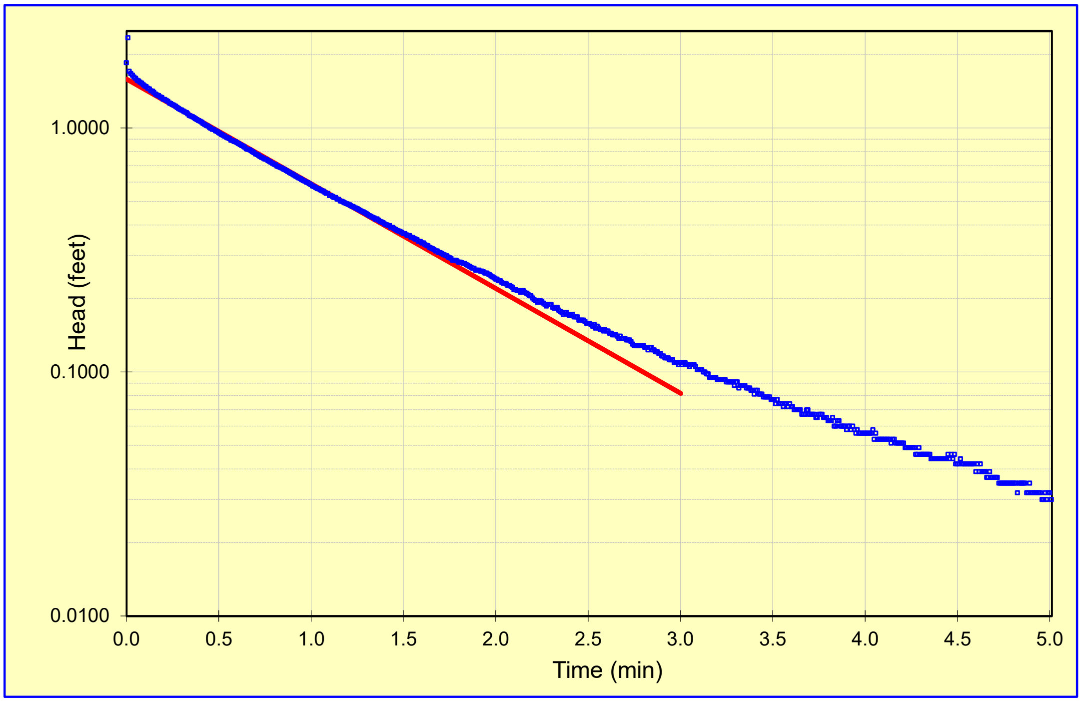
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$\ln(R_e/r_w)$=	**3.38**
y_0 =	**1.59**
y_t =	**0.082**
t =	**3.0**

RESULTS

K=	**1.18E-03**	**cm/sec**
K=	**3.34E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

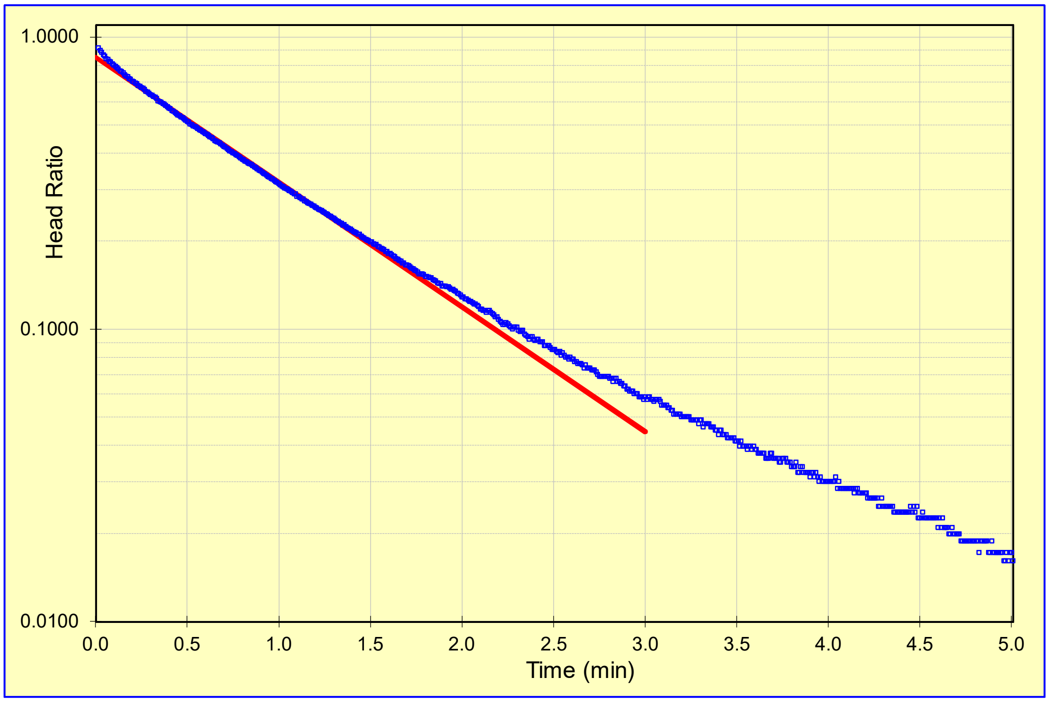
Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-7D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	0.08	
R_e =	0.17	
L_e =	5.0	K= 1.18E-03 cm/sec
t_1 =	0.00	K= 3.34E+00 ft/day
t_2 =	3.00	
$h_{1(t1)}$ =	0.85	
$h_{2(t2)}$ =	0.045	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-8D - FALLING HEAD TEST

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

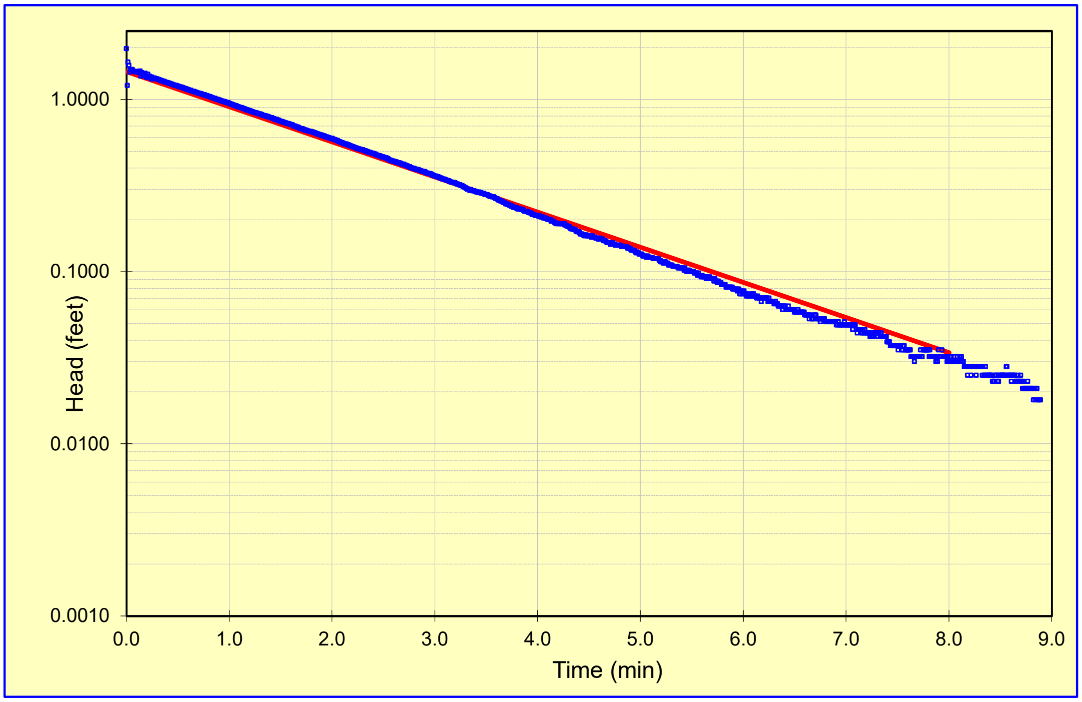
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.45
y_t =	0.034
t =	8.0

RESULTS

K=	5.60E-04	cm/sec
K=	1.59E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 1/15/2019

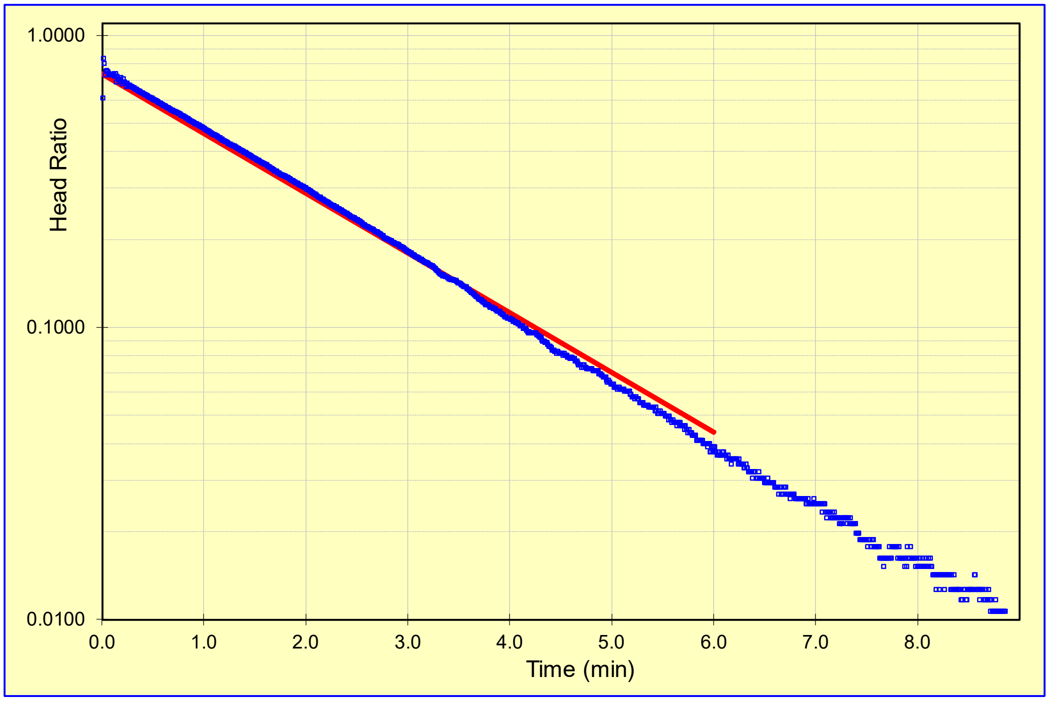
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-8D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	5.64E-04	cm/sec
t_1 =	0.00	K=	1.60E+00	ft/day
t_2 =	6.00			
$h_{1(t1)}$ =	0.74			
$h_{2(t2)}$ =	0.044			



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	BDL
Test Date:	10/17/18	Analysis Date:	1/15/2019

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-8D - FALLING HEAD TEST 2

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

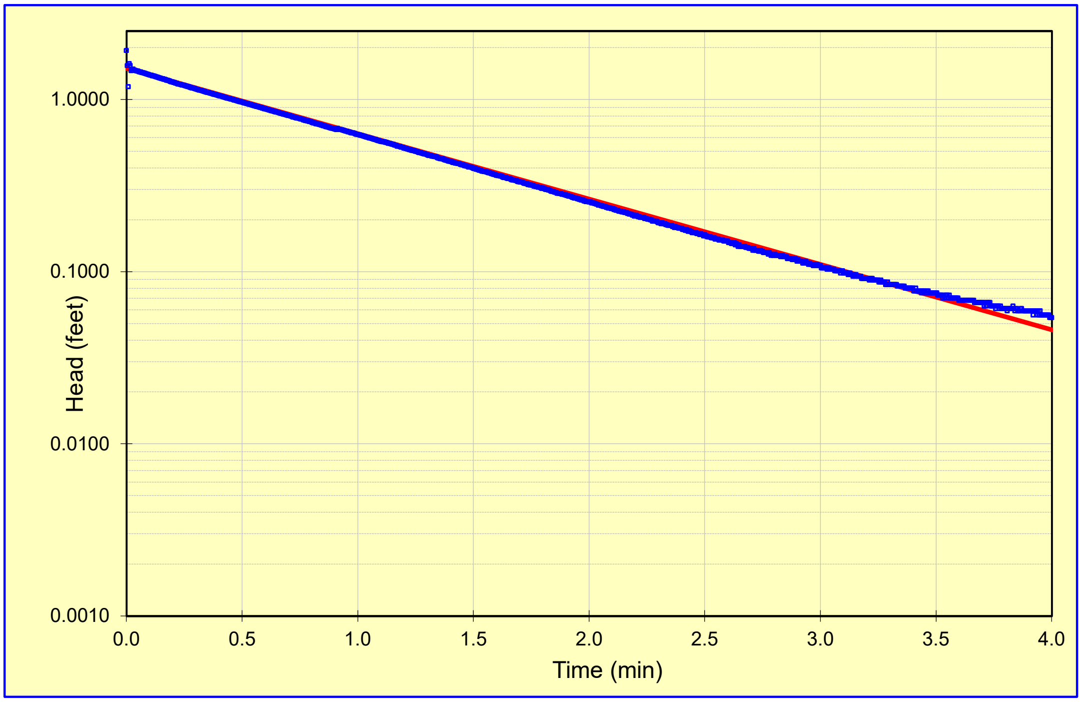
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.52
y_t =	0.001
t =	8.0

RESULTS

K=	1.04E-03	cm/sec
K=	2.95E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	ANB
Test Date:	10/17/18	Analysis Date:	1/15/2019

HVORSLEV SLUG TEST ANALYSIS
PZ-8D - FALLING HEAD TEST 2

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

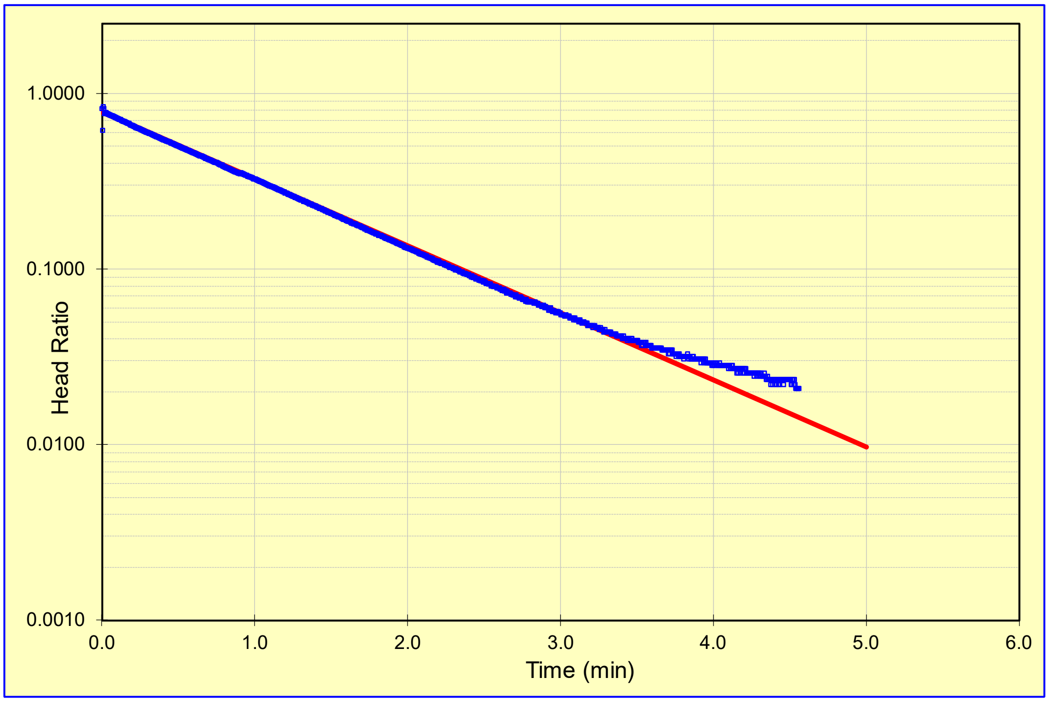
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 5.00
$h_{1(t1)}$ = 0.79
$h_{2(t2)}$ = 0.010

RESULTS

K=	1.06E-03	cm/sec
K=	2.99E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 1/15/2019

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-8D - RISING HEAD TEST 1

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

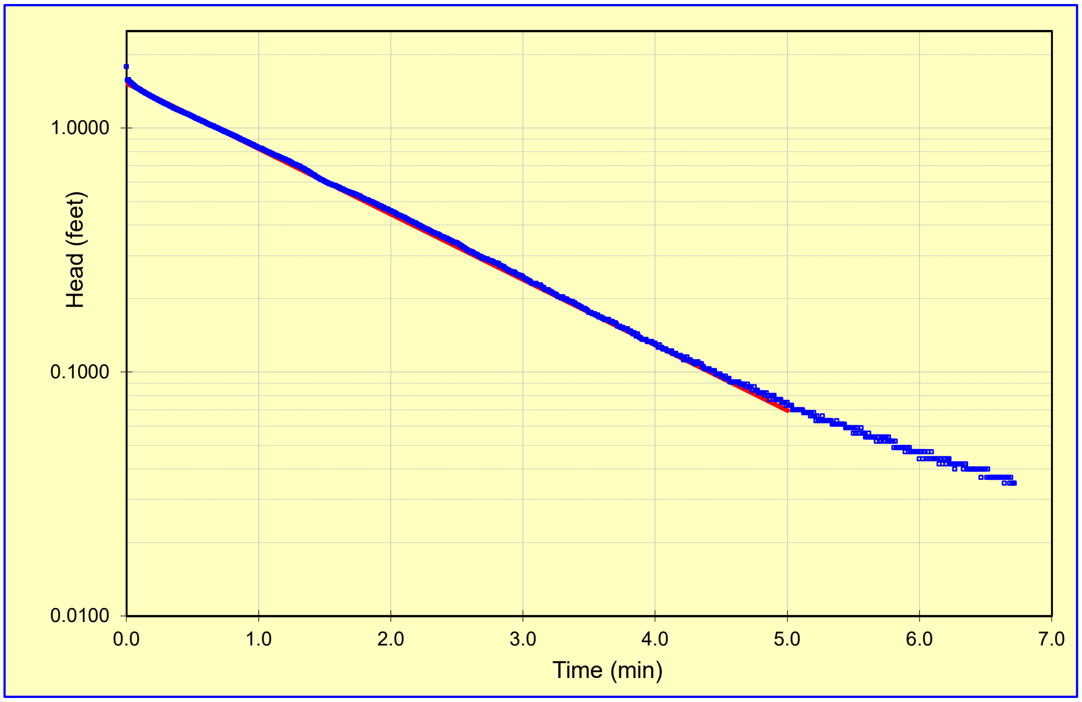
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
r_w =	0.17			
L_e =	5	K=	7.36E-04	cm/sec
$\ln(R_e/r_w)$=	3.38	K=	2.09E+00	ft/day
y_0 =	1.53			
y_t =	0.070			
t =	5.0			



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	BDL
Test Date:	10/17/18	Analysis Date:	1/15/2019

HVORSLEV SLUG TEST ANALYSIS
PZ-8D - RISING HEAD TEST 1

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

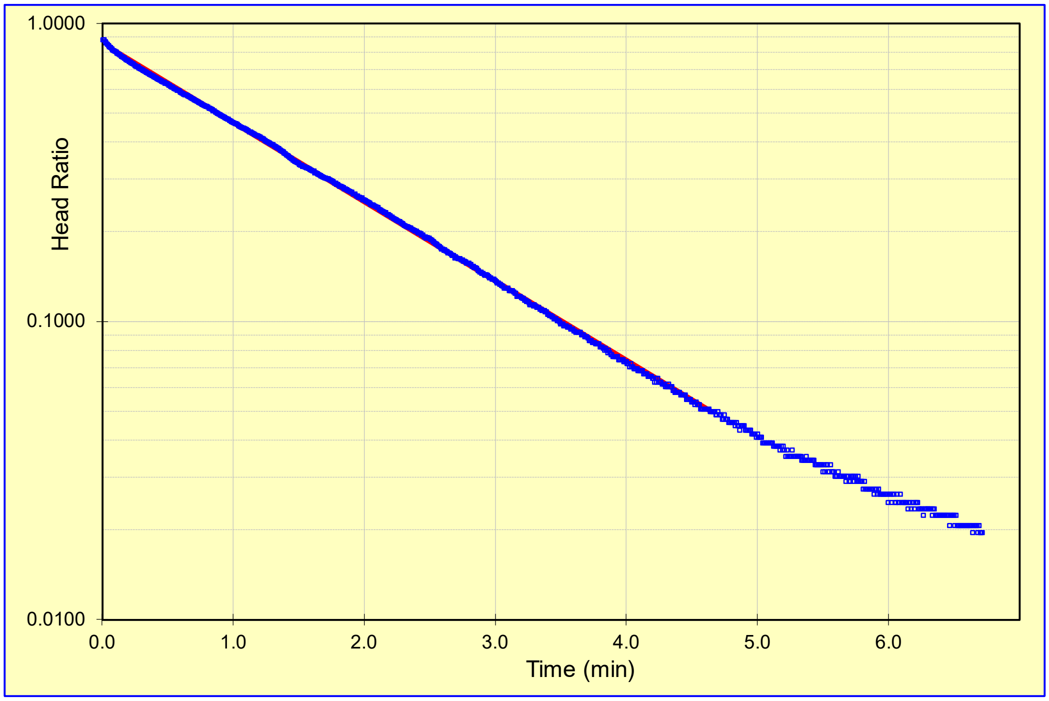
where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.10
t_2 =	4.64
$h_{1(t1)}$ =	0.81
$h_{2(t2)}$ =	0.050

RESULTS

K=	7.36E-04	cm/sec
K=	2.09E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 1/15/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-8D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

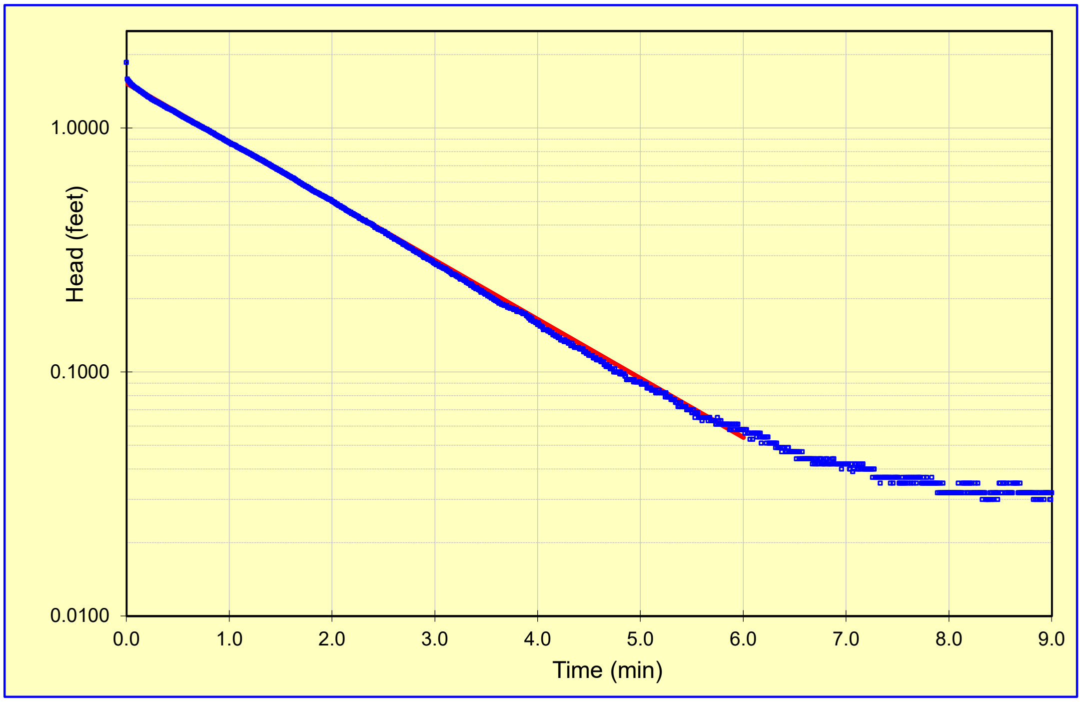
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.53
y_t =	0.054
t =	6.0

RESULTS

K=	6.64E-04	cm/sec
K=	1.88E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/17/18

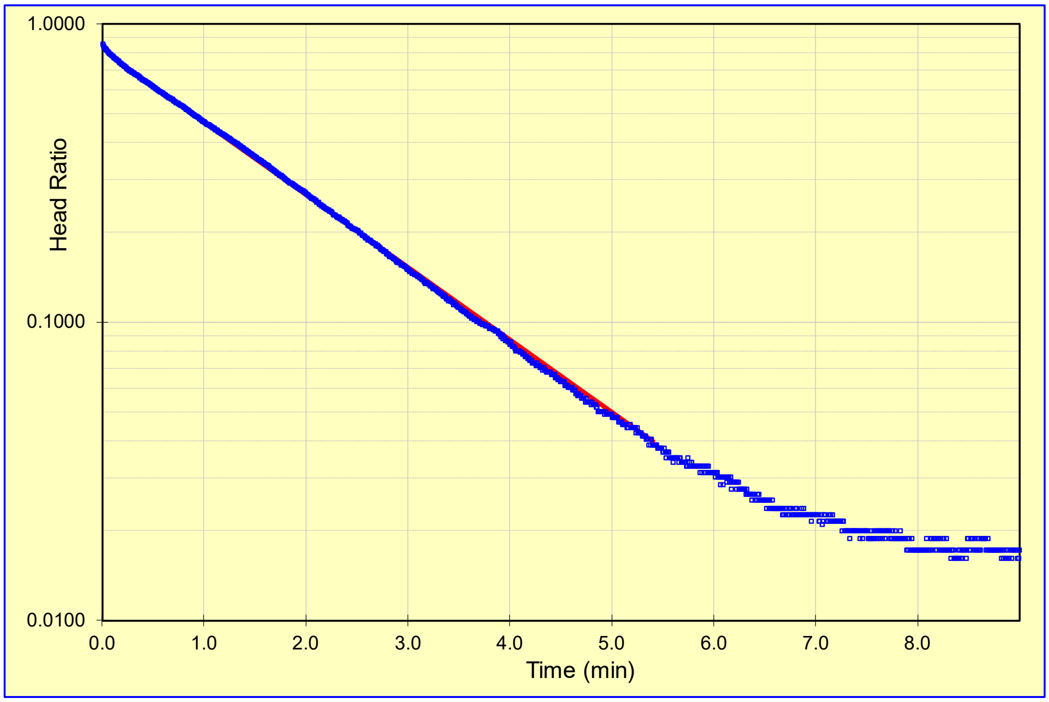
Analysis By: LWL
Checked By: BDL
Analysis Date: 7/11/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-8D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	**0.08**	
R_e =	**0.17**	
L_e =	**5.0**	**K= 6.71E-04 cm/sec**
t_1 =	**0.13**	**K= 1.90E+00 ft/day**
t_2 =	**5.40**	
$h_{1(t1)}$ =	**0.76**	
$h_{2(t2)}$ =	**0.040**	



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	BDL
Test Date:	10/17/18	Analysis Date:	1/15/2019

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-9D - FALLING HEAD TEST

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

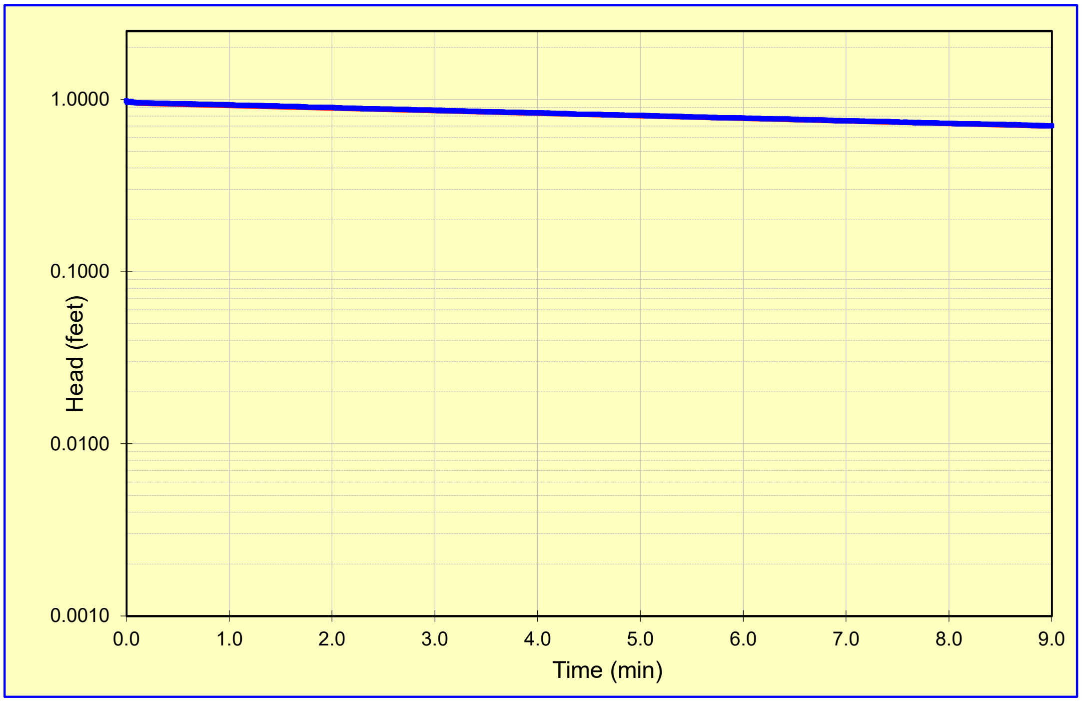
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.95
y_t =	0.700
t =	8.9

RESULTS

K=	4.11E-05	cm/sec
K=	1.17E-01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/19/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 1/15/2019

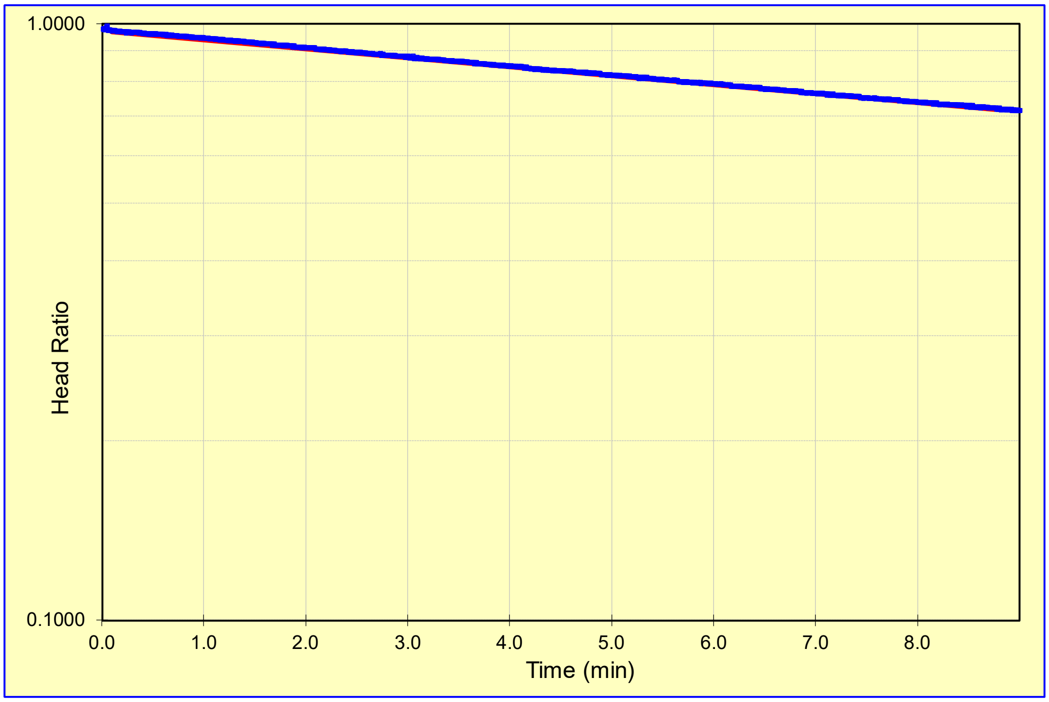
HVORSLEV SLUG TEST ANALYSIS
PZ-9D - FALLING HEAD TEST

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	4.13E-05	cm/sec
t_1 =	0.10	K=	1.17E-01	ft/day
t_2 =	8.75			
$h_{1(t1)}$ =	0.97			
$h_{2(t2)}$ =	0.720			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/19/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 1/15/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-9D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

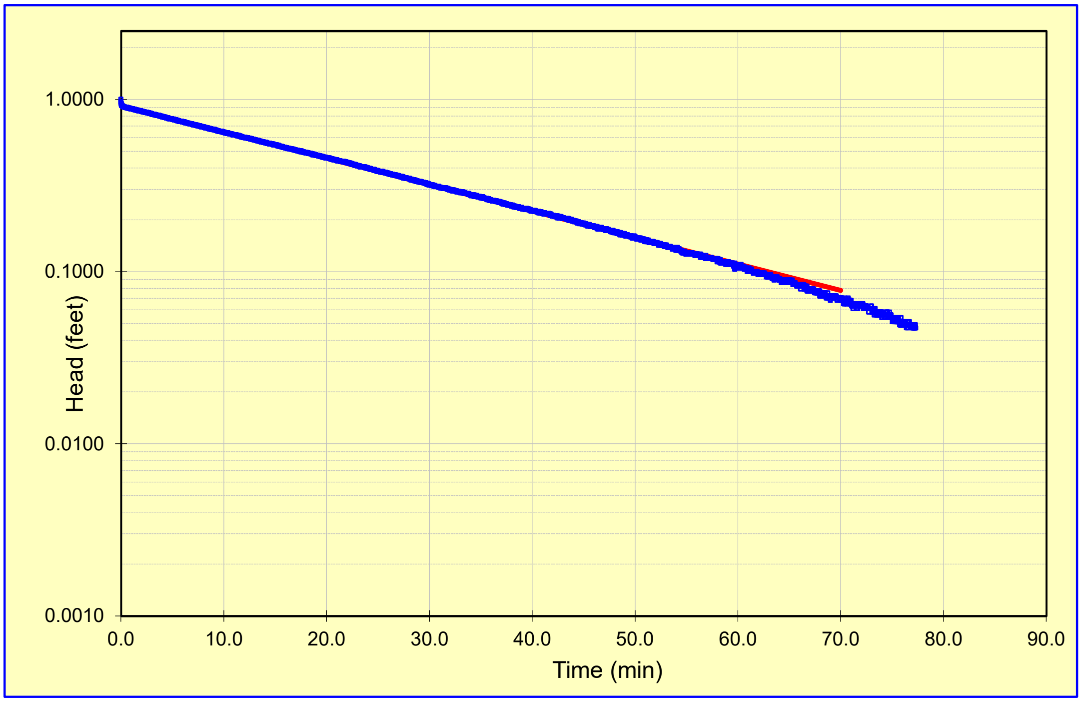
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	0.92
y_t =	0.078
t =	70.0

RESULTS

K=	4.20E-05	cm/sec
K=	1.19E-01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/19/18

Analysis By: LWL
Checked By: ANB
Analysis Date: 11/26/2018

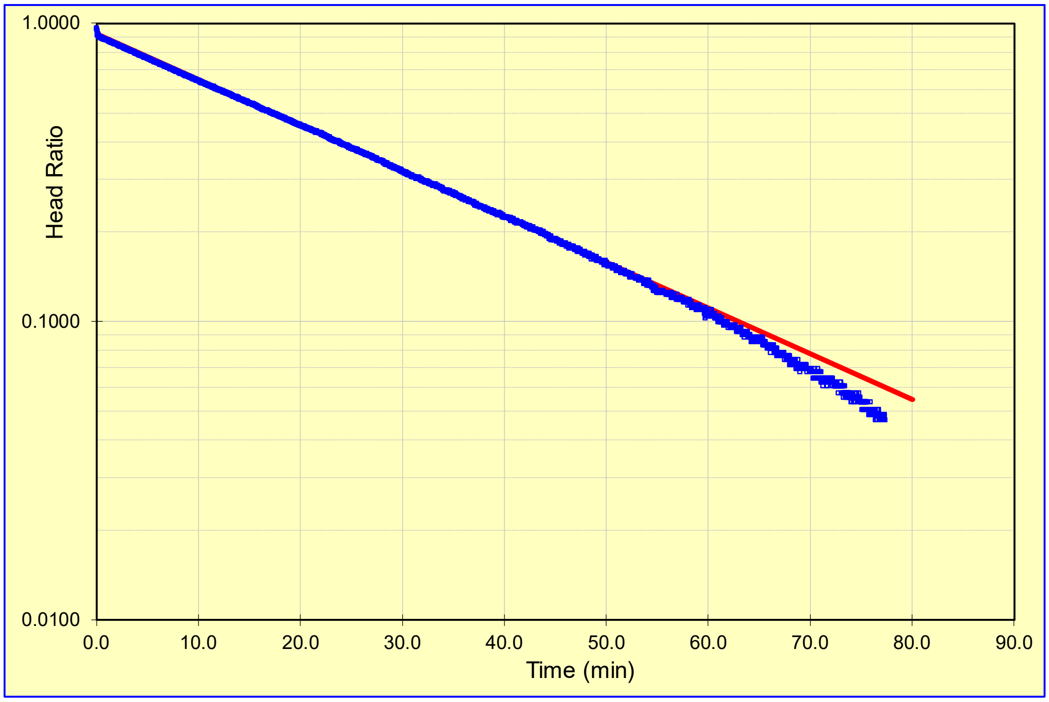
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-9D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	4.24E-05	cm/sec
t_1 =	0.00	K=	1.20E-01	ft/day
t_2 =	80.00			
$h_{1(t1)}$ =	0.92			
$h_{2(t2)}$ =	0.055			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/19/18

Analysis By: LWL
Checked By: ANB
Analysis Date: 11/26/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-9S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08

r_w = 0.17

L_e = 1.93

$\ln(R_e/r_w)$= 2.75

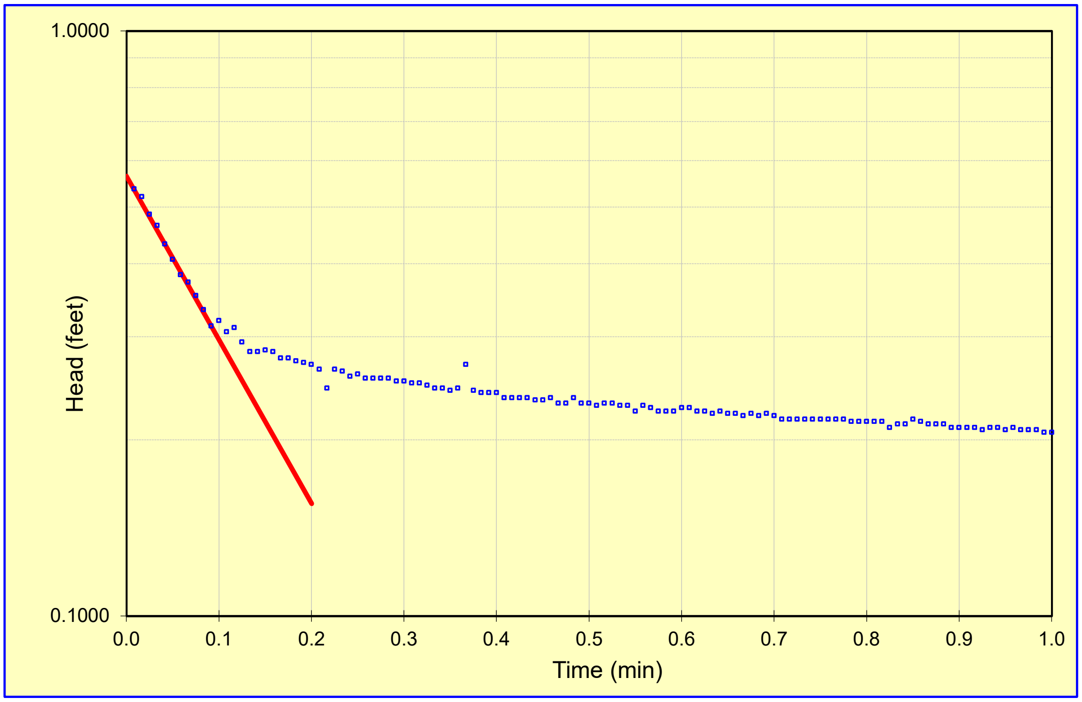
y_0 = 0.57

y_t = 0.156

t = 0.2

RESULTS

K=	**1.62E-02**	**cm/sec**
K=	**4.60E+01**	**ft/day**



Project Name: Crossroads - Phase 14

Project No.: 19119078

Test Date: 10/19/18

Analysis By: LWL

Checked By: BDL

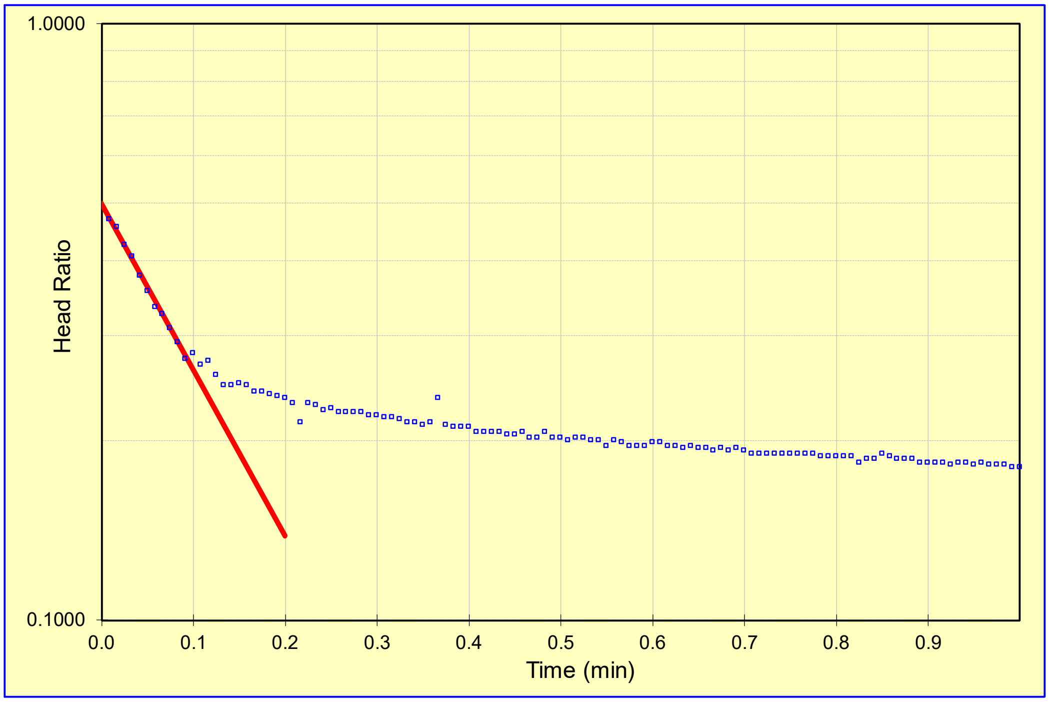
Analysis Date: 11/26/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-9S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	**0.08**	
R_e =	**0.17**	
L_e =	**1.9**	**K= 1.44E-02 cm/sec**
t_1 =	**0.00**	**K= 4.07E+01 ft/day**
t_2 =	**0.20**	
$h_{1(t1)}$ =	**0.50**	
$h_{2(t2)}$ =	**0.139**	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/19/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-9S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

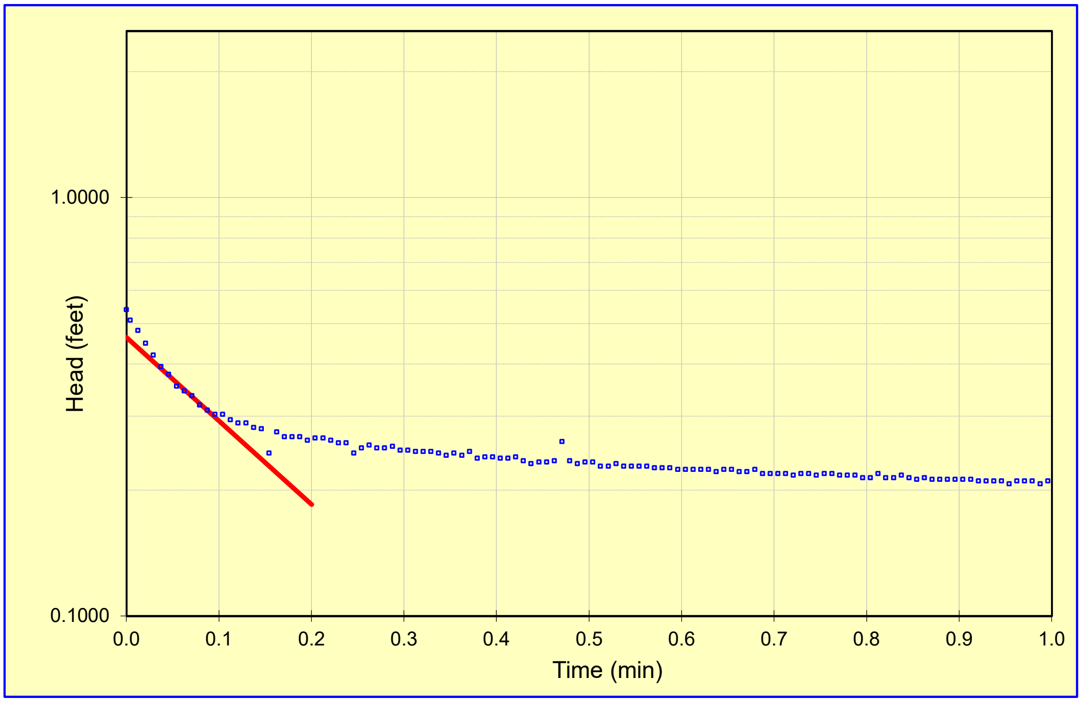
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	1.93
$\ln(R_e/r_w)$=	2.75
y_0 =	0.46
y_t =	0.185
t =	0.2

RESULTS

K=	1.16E-02	cm/sec
K=	3.27E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/19/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

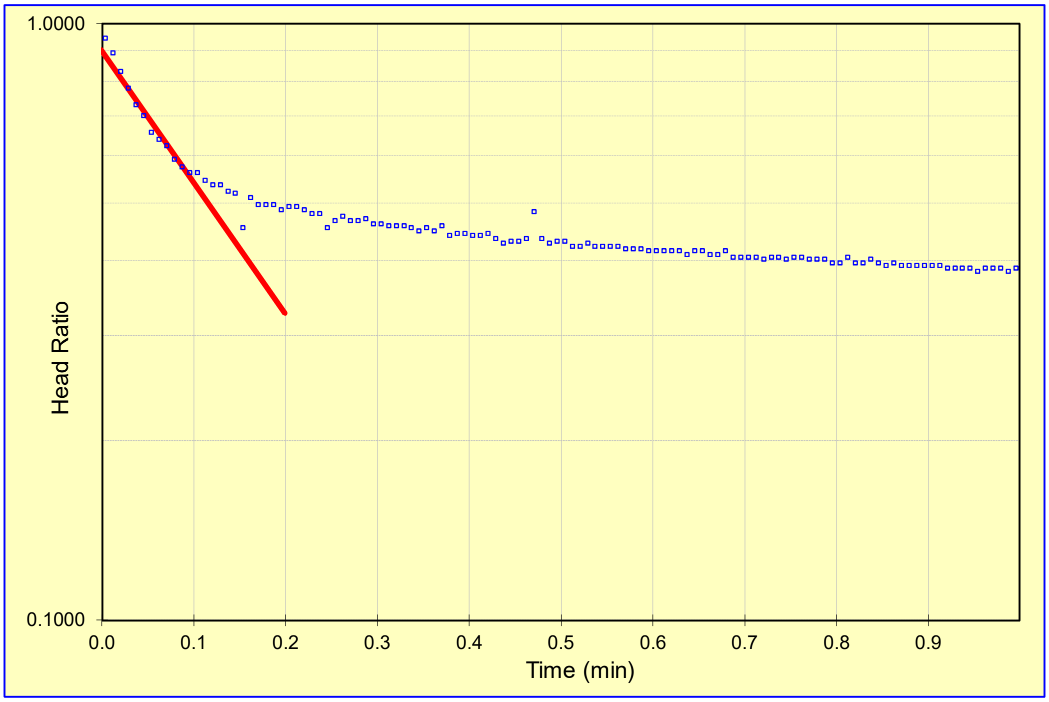
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-9S

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)}\right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	**0.08**	
R_e =	**0.17**	
L_e =	**1.9**	**K= 1.14E-02 cm/sec**
t_1 =	**0.00**	**K= 3.22E+01 ft/day**
t_2 =	**0.20**	
$h_{1(t1)}$ =	**0.90**	
$h_{2(t2)}$ =	**0.328**	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/19/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-10D - FALLING HEAD TEST 1

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

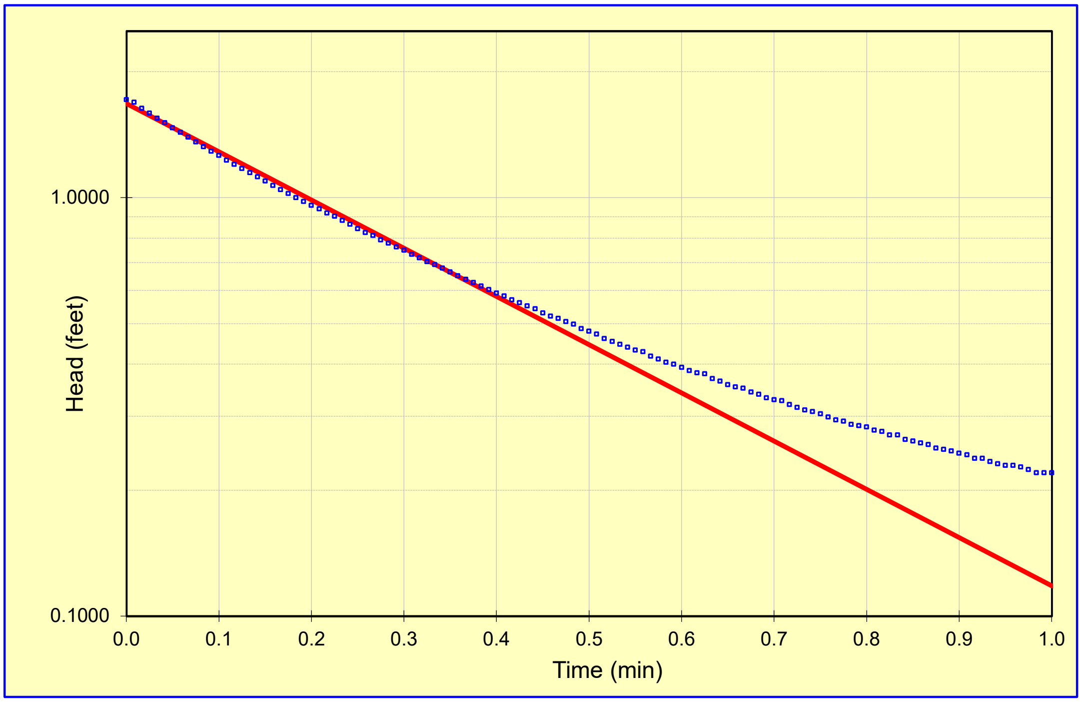
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

r_c = 0.08
r_w = 0.17
L_e = 5
$\ln(R_e/r_w)$= 3.38
y_0 = 1.68
y_t = 0.118
t = 1.0

RESULTS

K= 3.16E-03 cm/sec
K= 8.96E+00 ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

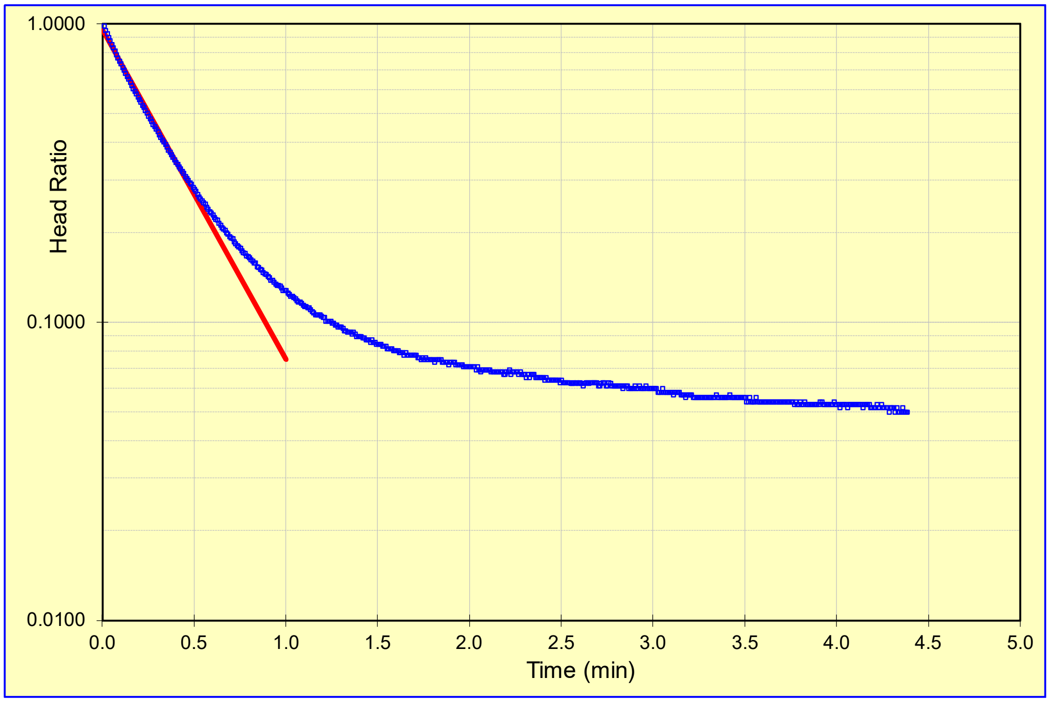
HVORSLEV SLUG TEST ANALYSIS
PZ-10D - FALLING HEAD TEST 1

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
R_e =	**0.17**			
L_e =	**5.0**	**K=**	**3.05E-03**	**cm/sec**
t_1 =	**0.00**	**K=**	**8.64E+00**	**ft/day**
t_2 =	**1.00**			
$h_{1(t1)}$ =	**0.95**			
$h_{2(t2)}$ =	**0.075**			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-10D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

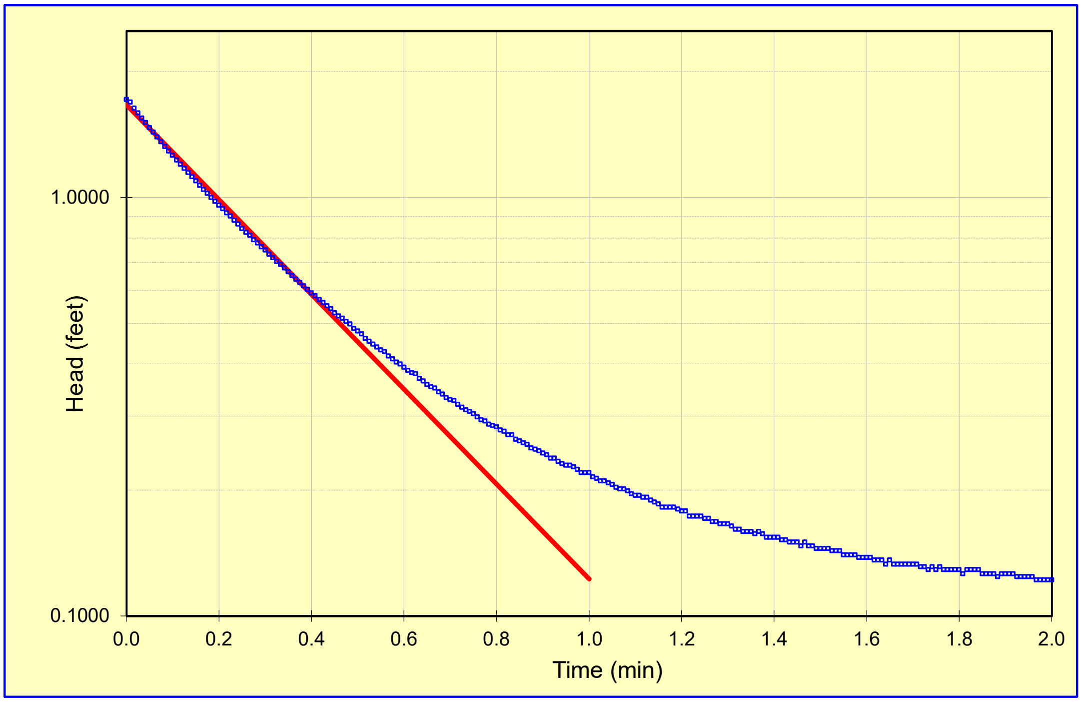
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.67
y_t =	0.123
t =	1.0

RESULTS

K=	3.11E-03	cm/sec
K=	8.81E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-10D

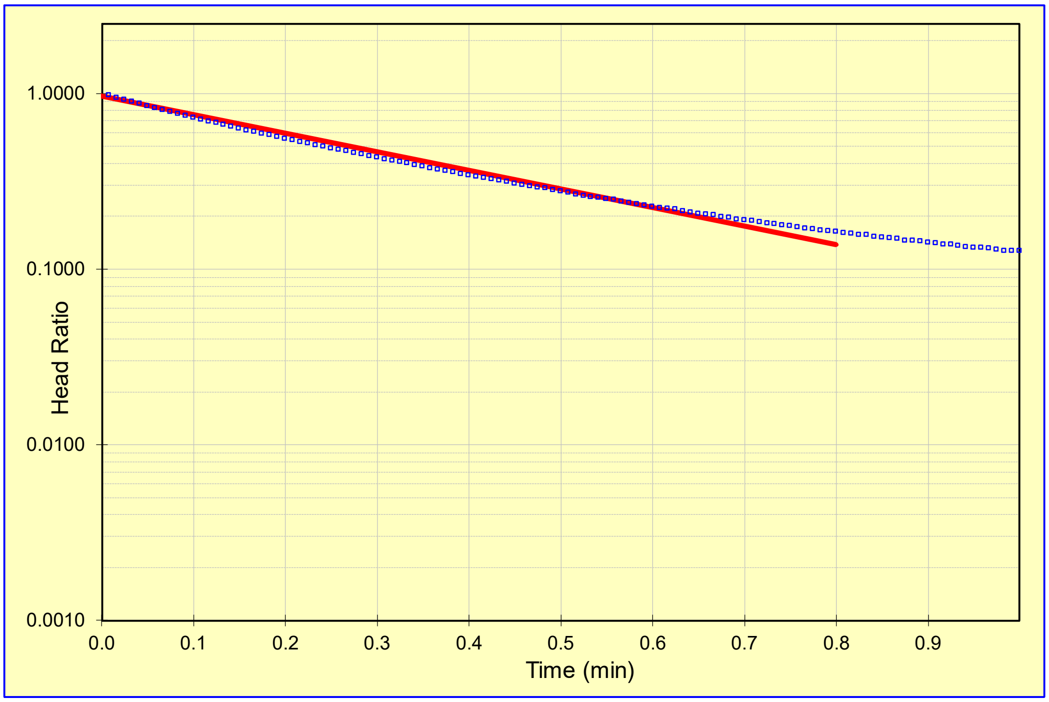
$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	**0.08**
R_e =	**0.17**
L_e =	**5.0**
t_1 =	**0.00**
t_2 =	**0.80**
$h_{1(t1)}$ =	**0.97**
$h_{2(t2)}$ =	**0.139**

RESULTS

K=	**2.92E-03**	**cm/sec**
K=	**8.28E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-10M - FALLING HEAD TEST

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

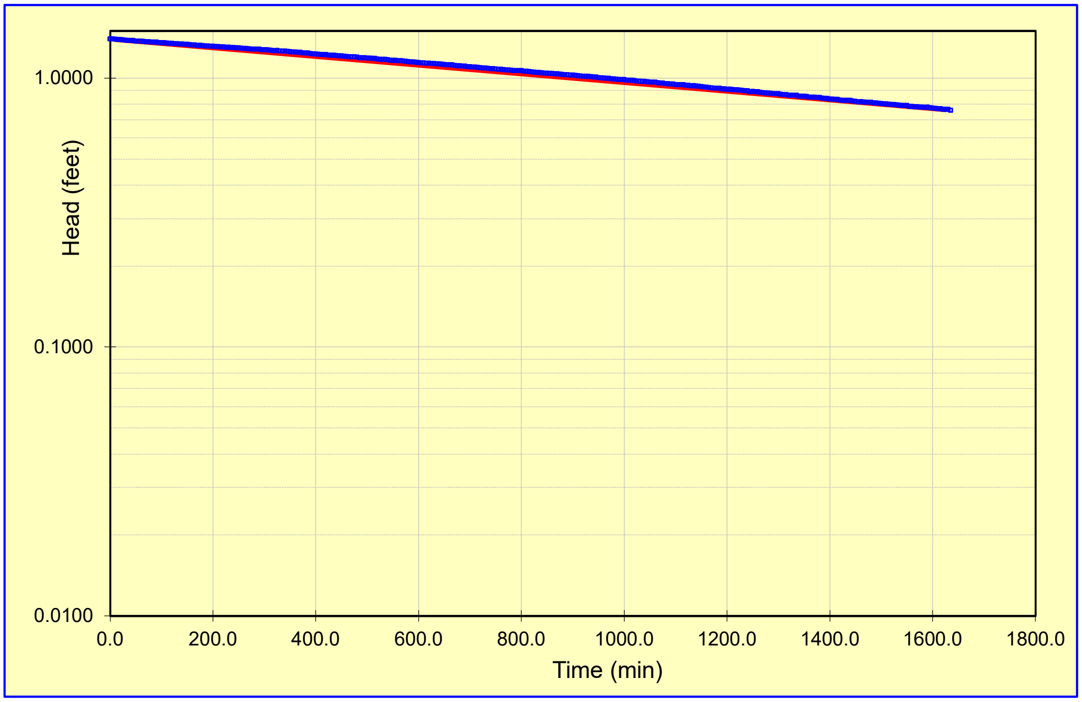
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.40
y_t =	0.764
t =	1625.0

RESULTS

K=	4.43E-07	cm/sec
K=	1.26E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

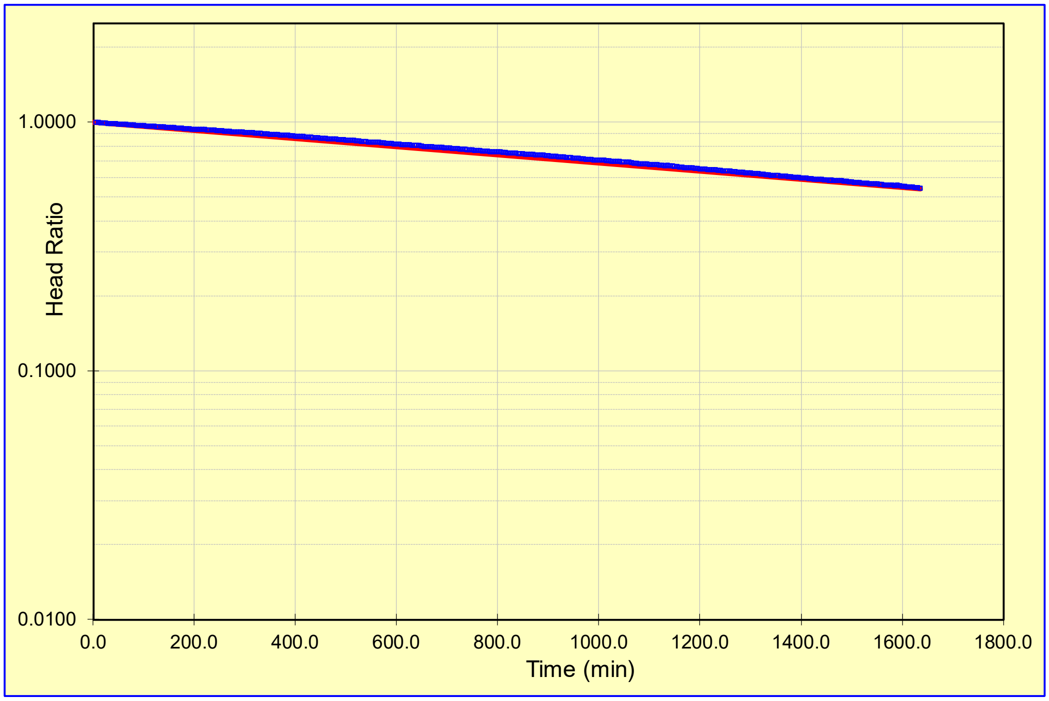
Analysis By: BDL
Checked By: ANB
Analysis Date: 12/28/2018

HVORSLEV SLUG TEST ANALYSIS
PZ-10M - FALLING HEAD TEST

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	4.52E-07	cm/sec
t_1 =	0.08	K=	1.28E-03	ft/day
t_2 =	1635.00			
$h_{1(t1)}$ =	1.00			
$h_{2(t2)}$ =	0.540			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: BDL
Checked By: ANB
Analysis Date: 12/28/2018

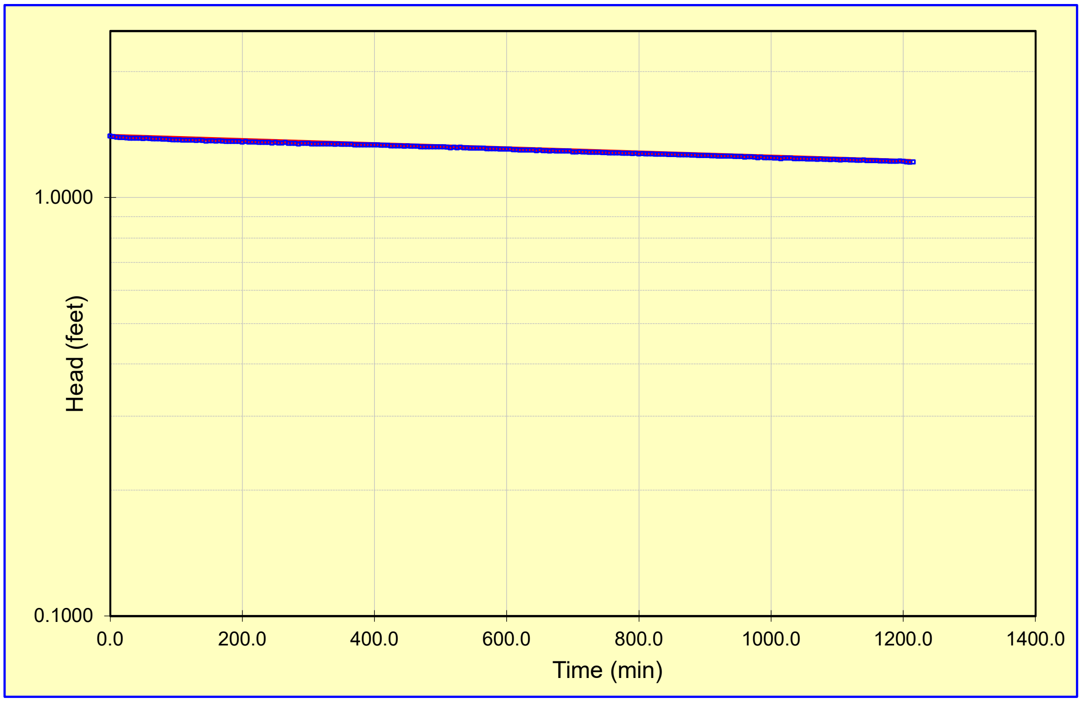
BOUWER AND RICE SLUG TEST ANALYSIS
PZ-10M - RISING HEAD TEST

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
r_w =	0.17			
L_e =	5	K=	1.36E-07	cm/sec
$\ln(R_e/r_w)$=	3.38	K=	3.85E-04	ft/day
y_0 =	1.40			
y_t =	1.220			
t =	1210.0			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: BDL
Checked By: ANB
Analysis Date: 12/28/2018

HVORSLEV SLUG TEST ANALYSIS
PZ-10M - RISING HEAD TEST

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

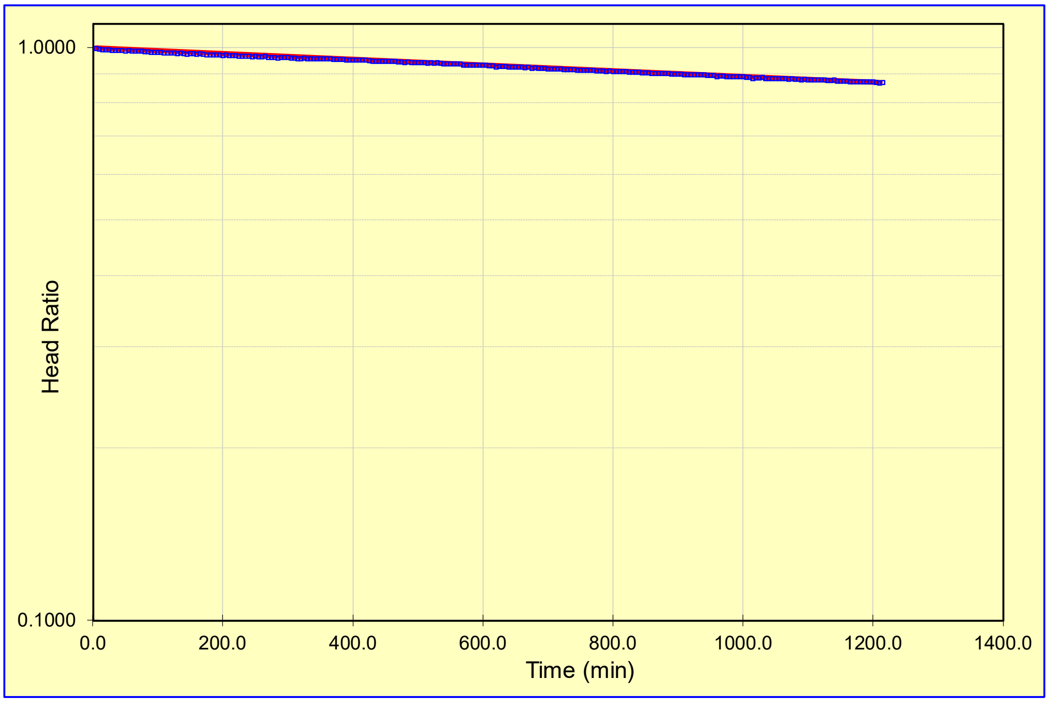
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 5.00
t_2 = 1210.00
$h_{1(t1)}$ = 1.00
$h_{2(t2)}$ = 0.870

RESULTS

K= 1.39E-07 cm/sec
K= 3.93E-04 ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	BDL
Project No.:	19119078	Checked By:	ANB
Test Date:	10/18/18	Analysis Date:	12/28/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-10S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

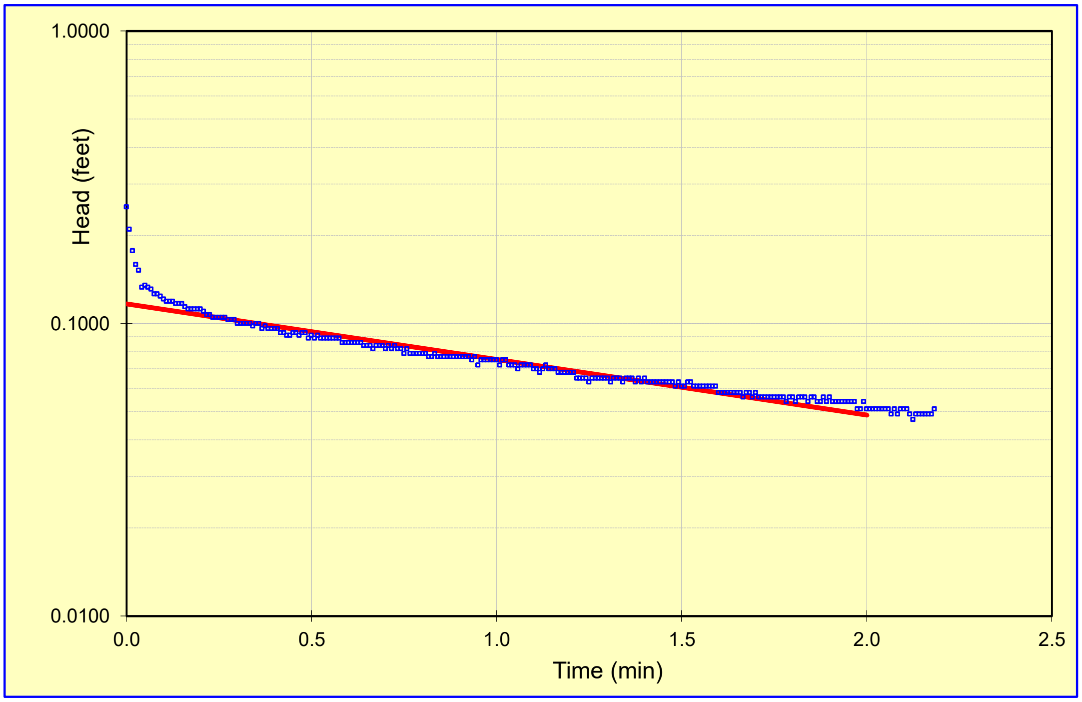
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	1.25
$\ln(R_e/r_w)$=	2.41
y_0 =	0.12
y_t =	0.049
t =	2.0

RESULTS

K=	1.49E-03	cm/sec
K=	4.22E+00	ft/day



Project Name: Crossroads - Phase 14

Project No.: 19119078

Test Date: 10/16/18

Analysis By: LWL

Checked By: BDL

Analysis Date: 11/20/2018

GOLDER

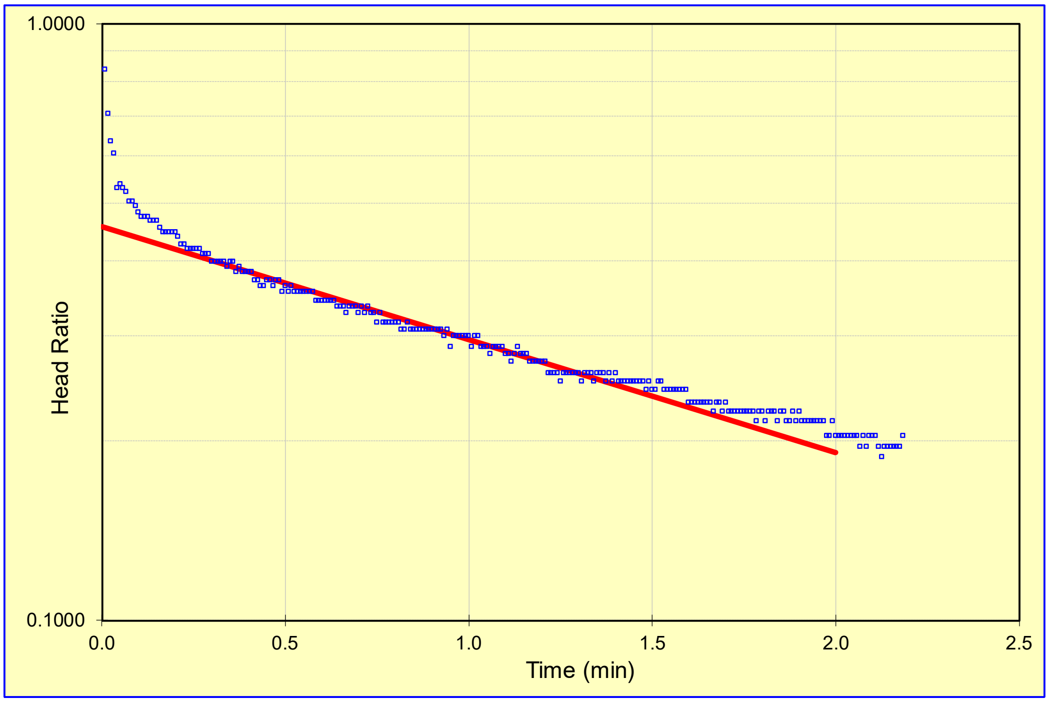
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-10S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	0.08	
R_e =	0.17	
L_e =	1.3	K= 1.24E-03 cm/sec
t_1 =	0.00	K= 3.51E+00 ft/day
t_2 =	2.00	
$h_{1(t1)}$ =	0.46	
$h_{2(t2)}$ =	0.191	



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	BDL
Test Date:	10/16/18	Analysis Date:	11/20/2018

GOLDER

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-10S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

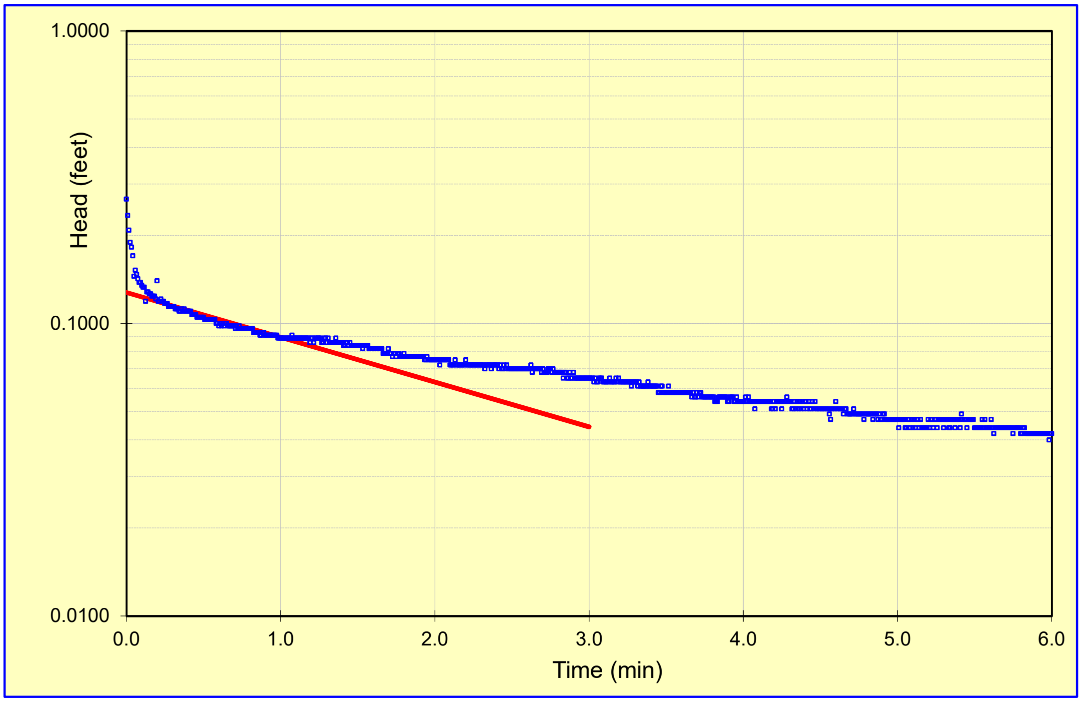
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	1.25
$ln(R_e/r_w)$=	2.41
y_0 =	0.13
y_t =	0.044
t =	3.0

RESULTS

K=	1.20E-03	cm/sec
K=	3.40E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: BDL
Checked By: ANB
Analysis Date: 11/20/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-10S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

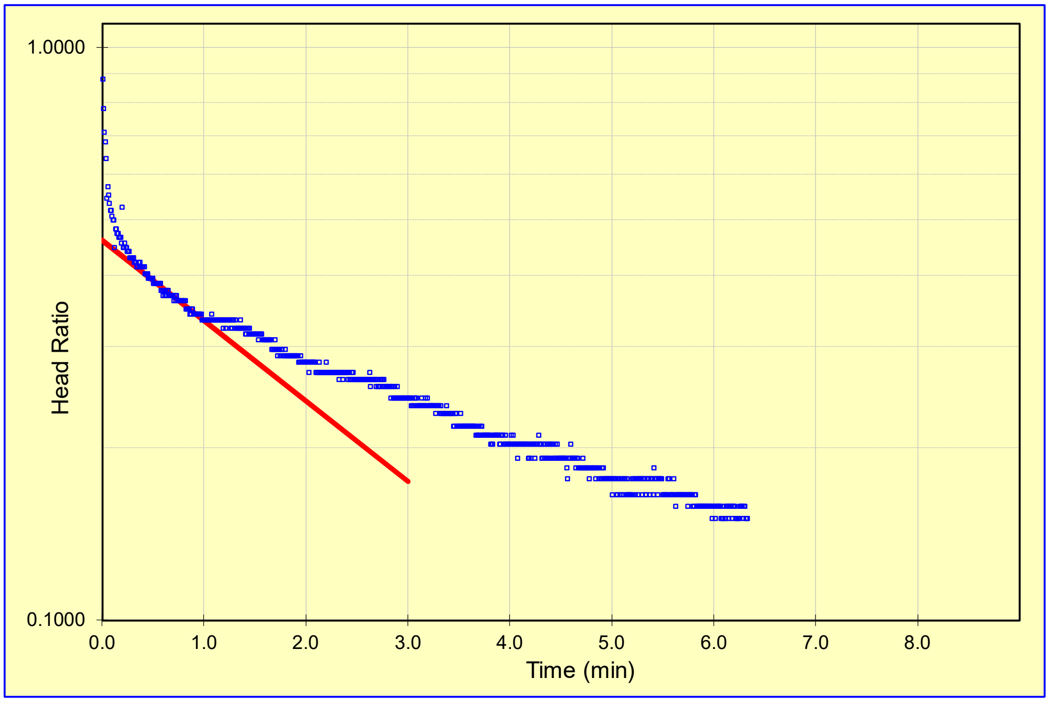
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	1.3
t_1 =	0.00
t_2 =	3.00
$h_{1(t1)}$ =	0.46
$h_{2(t2)}$ =	0.175

RESULTS

K=	9.19E-04	cm/sec
K=	2.61E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: BDL
Checked By: ANB
Analysis Date: 11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 1 PZ-11D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

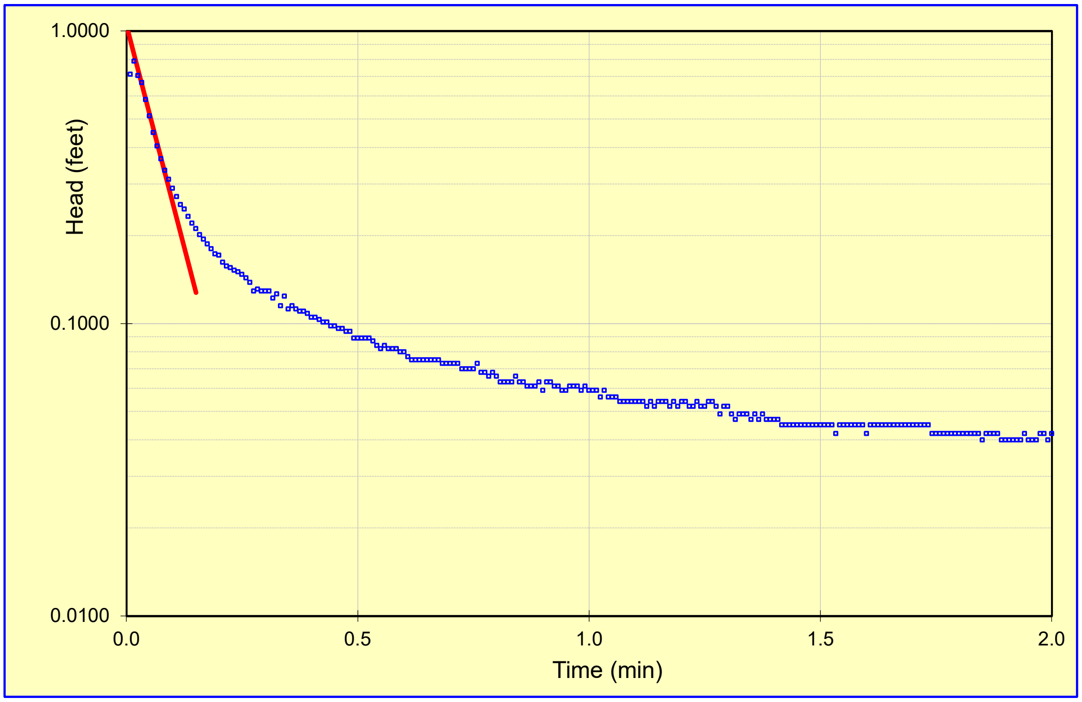
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.04
y_t =	0.128
t =	0.2

RESULTS

K=	1.67E-02	cm/sec
K=	4.72E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 1 PZ-11D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

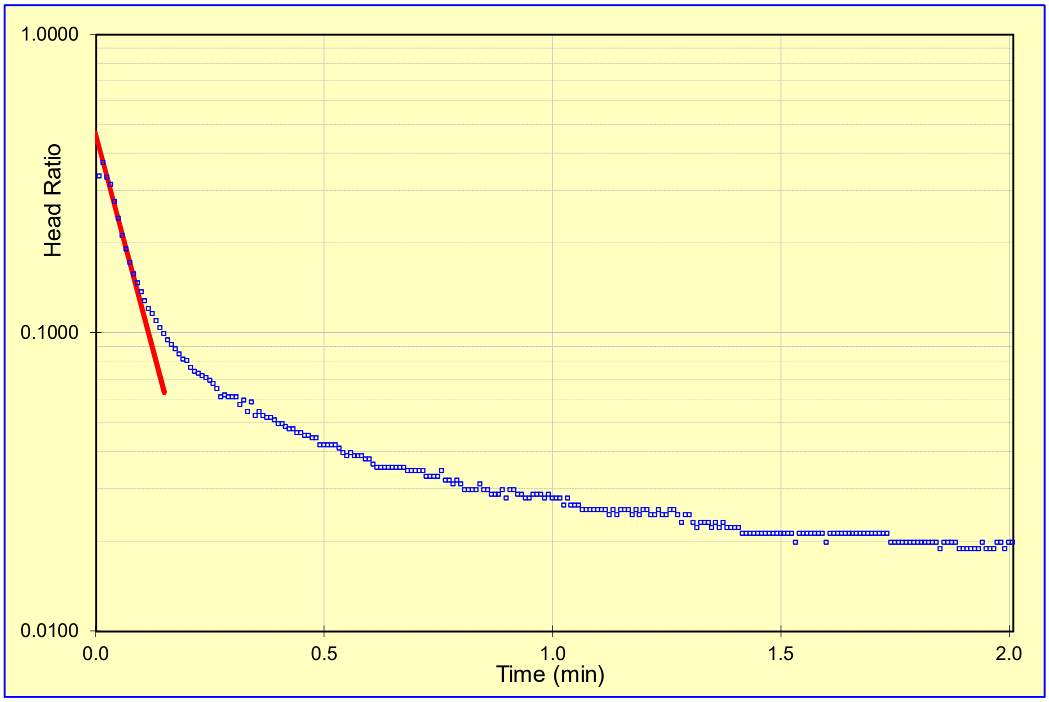
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 0.15
$h_{1(t1)}$ = 0.47
$h_{2(t2)}$ = 0.063

RESULTS

K= 1.60E-02 cm/sec
K= 4.54E+01 ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/18/18	Analysis Date:	6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-11D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

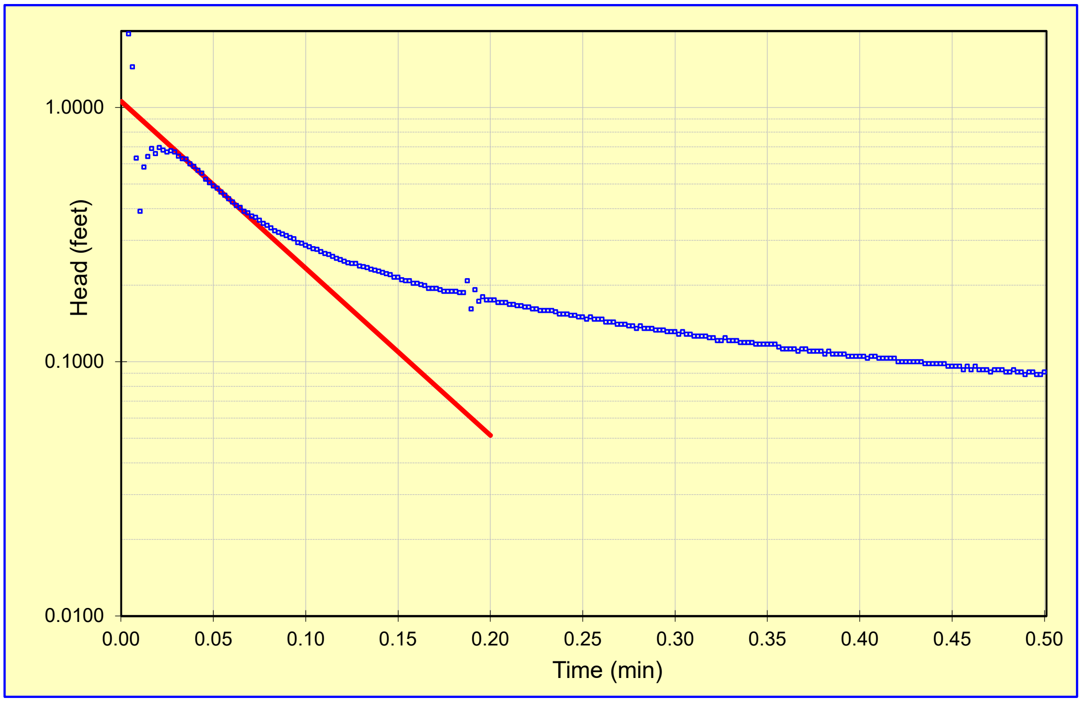
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.06
y_t =	0.051
t =	0.2

RESULTS

K=	1.80E-02	cm/sec
K=	5.11E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-11D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

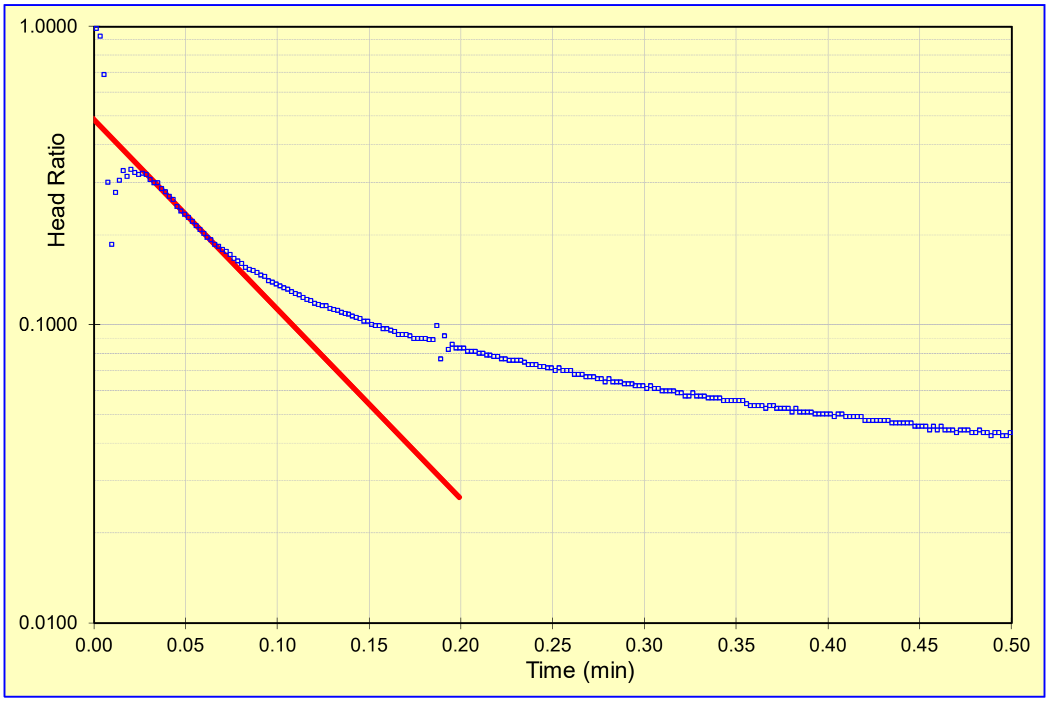
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	0.20
$h_{1(t1)}$ =	0.49
$h_{2(t2)}$ =	0.026

RESULTS

K=	1.76E-02	cm/sec
K=	4.98E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-11D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

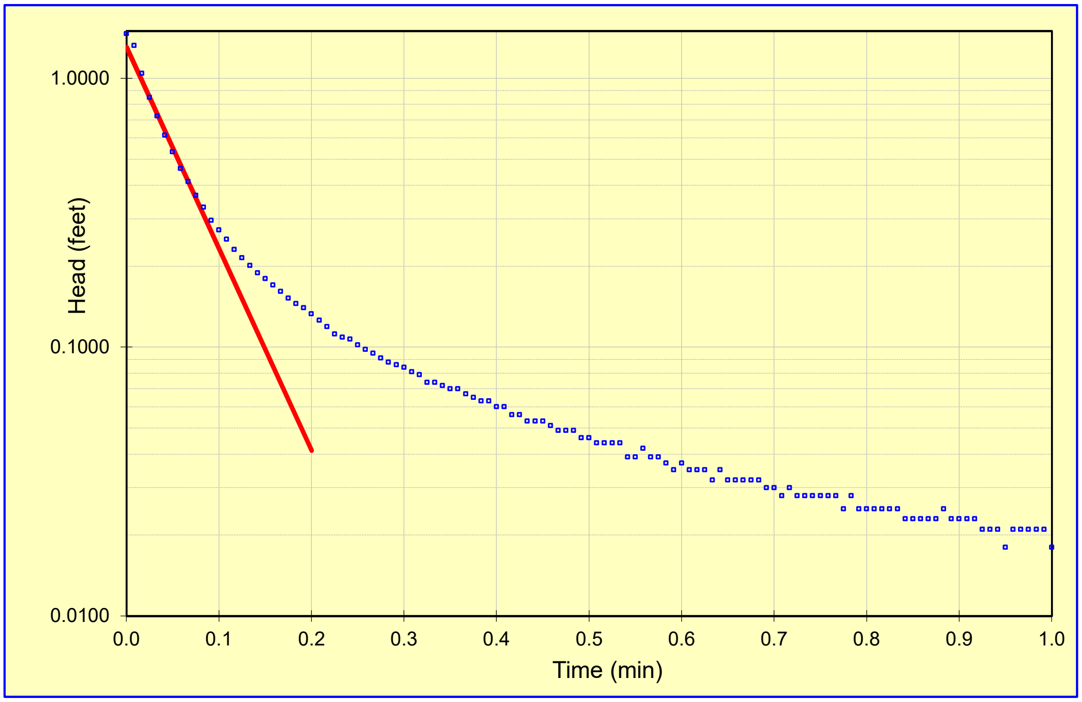
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.31
y_t =	0.041
t =	0.2

RESULTS

K=	2.06E-02	cm/sec
K=	5.83E+01	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	
Test Date:	10/18/18	Analysis Date:	6/10/2019

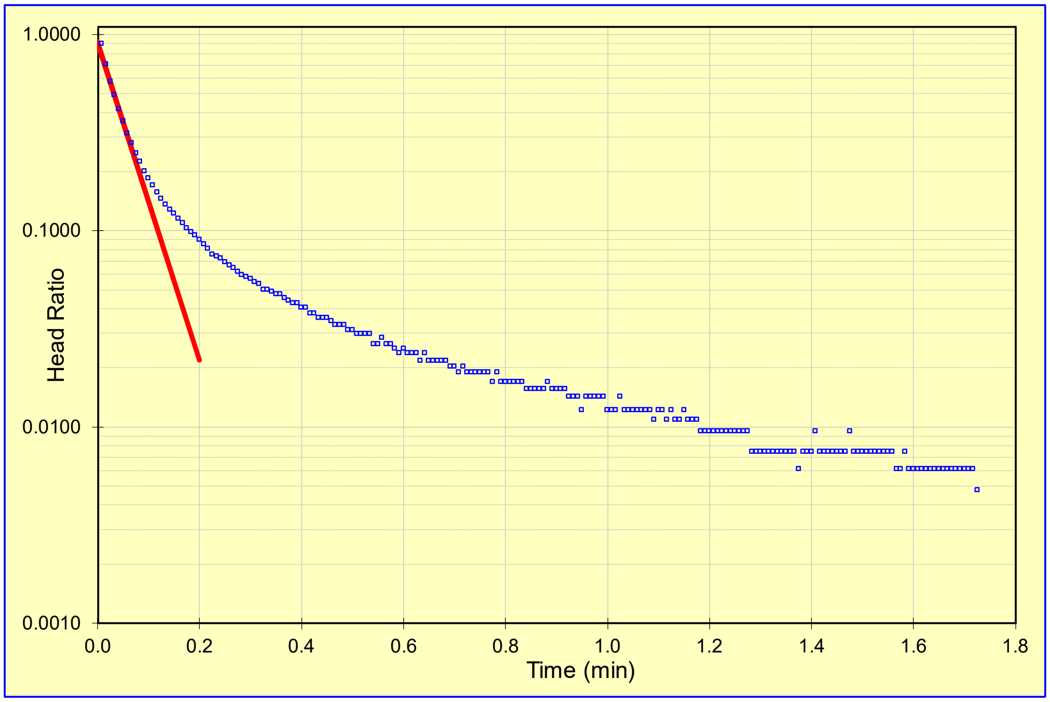
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-11D

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	2.24E-02	cm/sec
t_1 =	0.00	K=	6.35E+01	ft/day
t_2 =	0.20			
$h_{1(t1)}$ =	0.92			
$h_{2(t2)}$ =	0.022			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-11D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

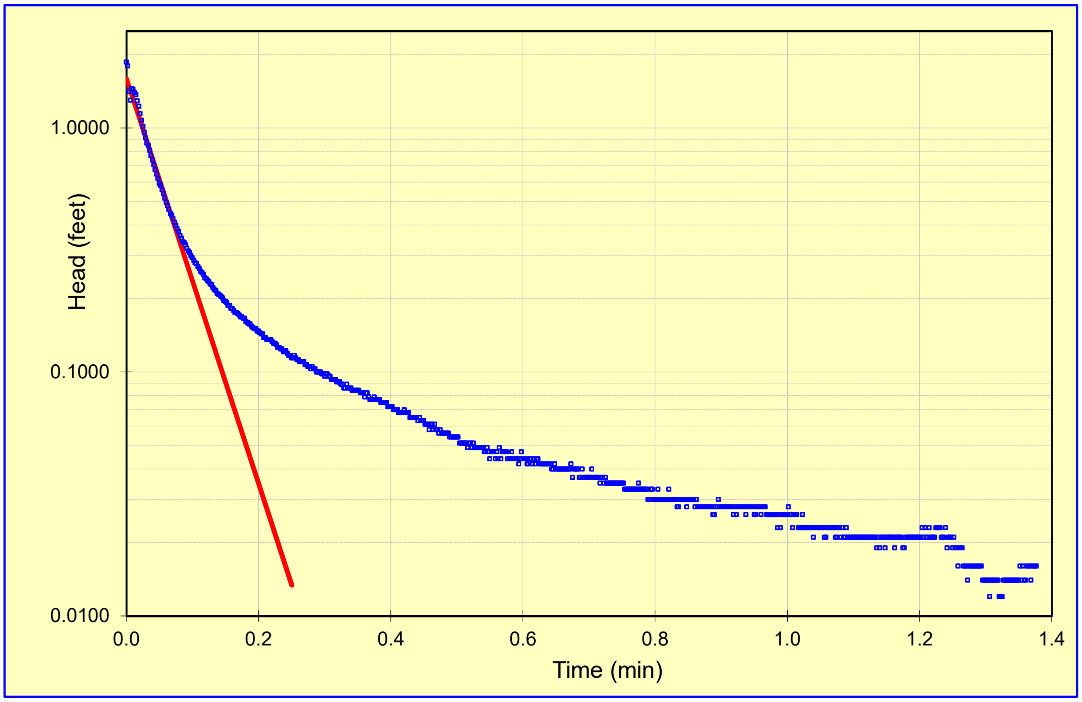
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.59
y_t =	0.013
t =	0.3

RESULTS

K=	2.28E-02	cm/sec
K=	6.45E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-11D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

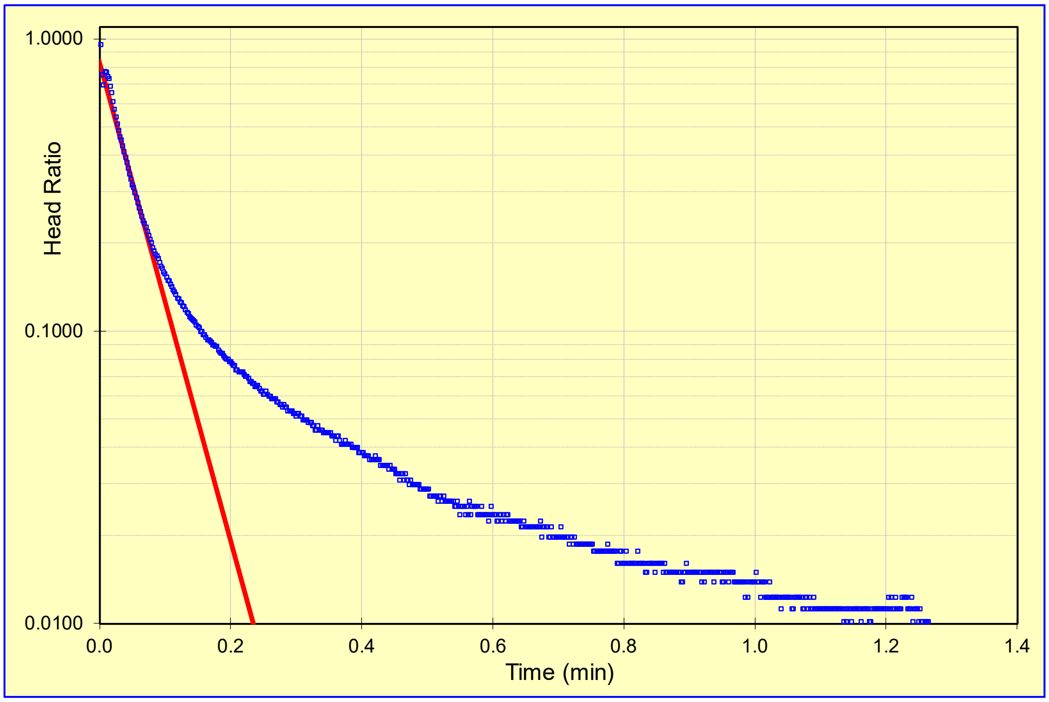
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = **0.08**
R_e = **0.17**
L_e = **5.0**
t_1 = **0.00**
t_2 = **0.25**
$h_{1(t1)}$ = **0.84**
$h_{2(t2)}$ = **0.008**

RESULTS

K=	**2.26E-02**	**cm/sec**
K=	**6.41E+01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-12D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

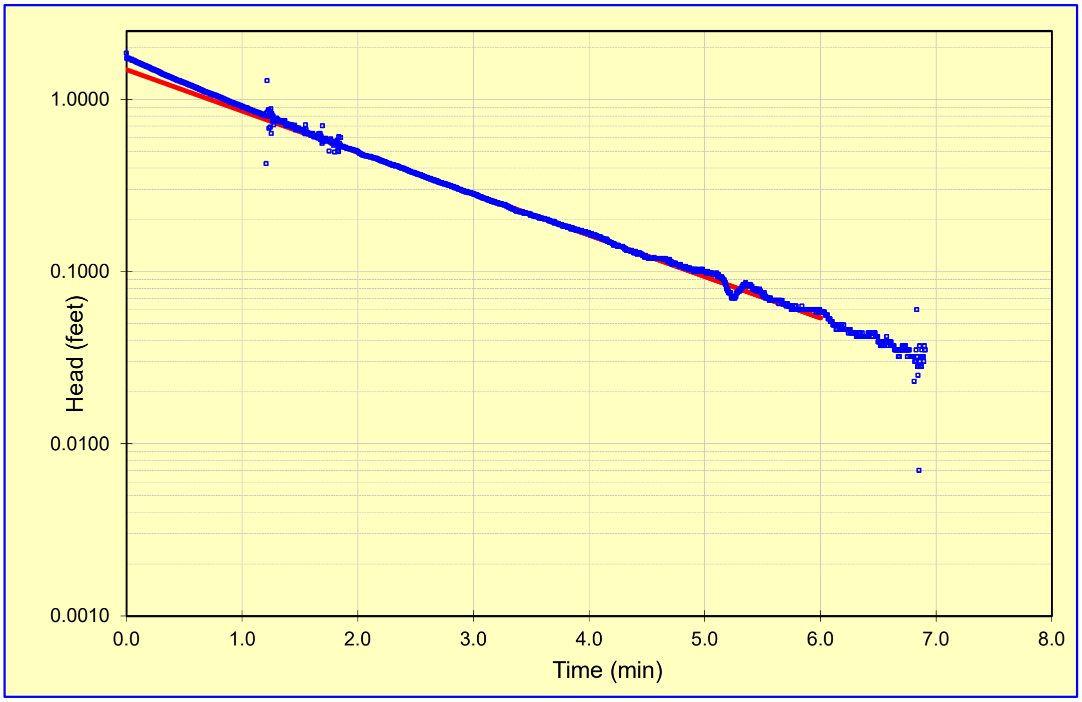
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	2
$\ln(R_e/r_w)$=	2.77
y_0 =	1.49
y_t =	0.054
t =	6.0

RESULTS

K=	1.35E-03	cm/sec
K=	3.84E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 5/2/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-12D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

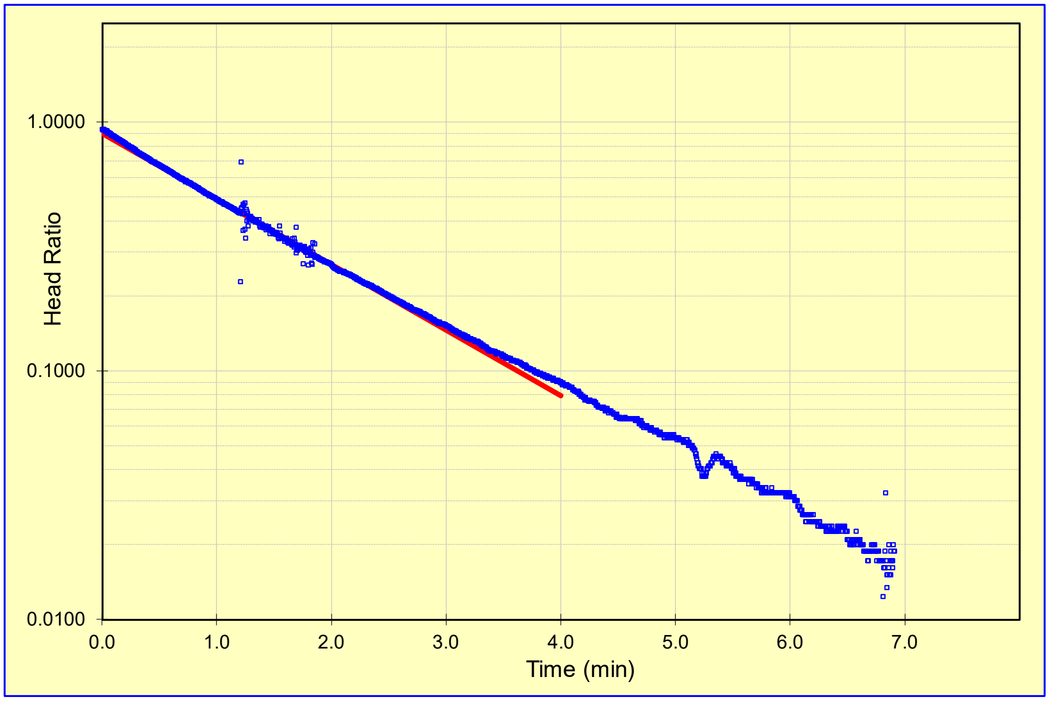
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = **0.08**
R_e = **0.17**
L_e = **2.0**
t_1 = **0.00**
t_2 = **4.00**
$h_{1(t1)}$ = **0.90**
$h_{2(t2)}$ = **0.080**

RESULTS

K=	**1.33E-03**	**cm/sec**
K=	**3.77E+00**	**ft/day**



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/18/18	Analysis Date:	5/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-12D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

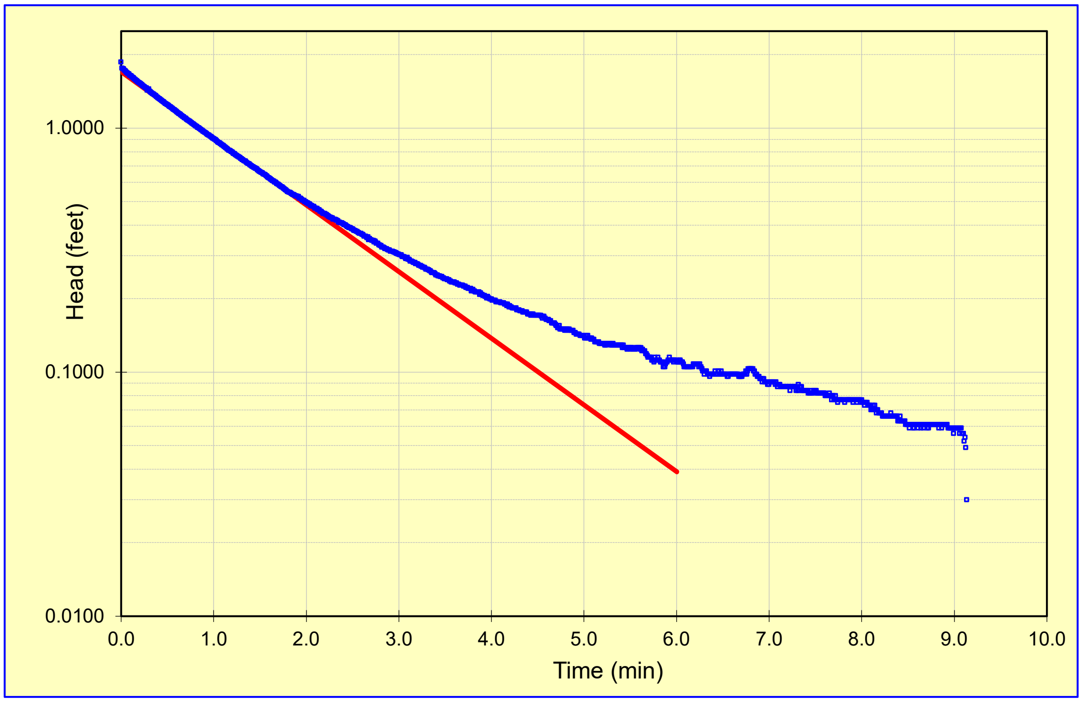
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2
$ln(R_e/r_w)$=	2.77
y_0 =	1.70
y_t =	0.039
t =	6.0

RESULTS

K=	1.54E-03	cm/sec
K=	4.36E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 5/10/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 2 PZ-12D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

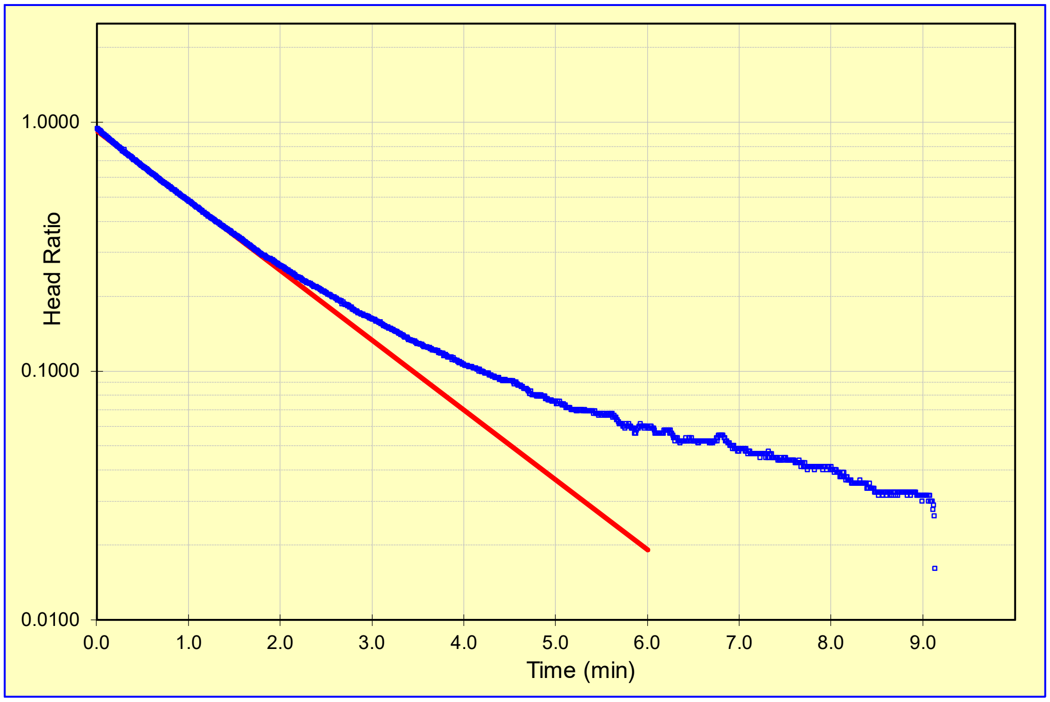
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	2.0
t_1 =	0.00
t_2 =	6.00
$h_{1(t1)}$ =	0.93
$h_{2(t2)}$ =	0.019

RESULTS

K=	1.42E-03	cm/sec
K=	4.02E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/18/18	Analysis Date:	5/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST 3 PZ-12D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_o}{y_t}$$

where:

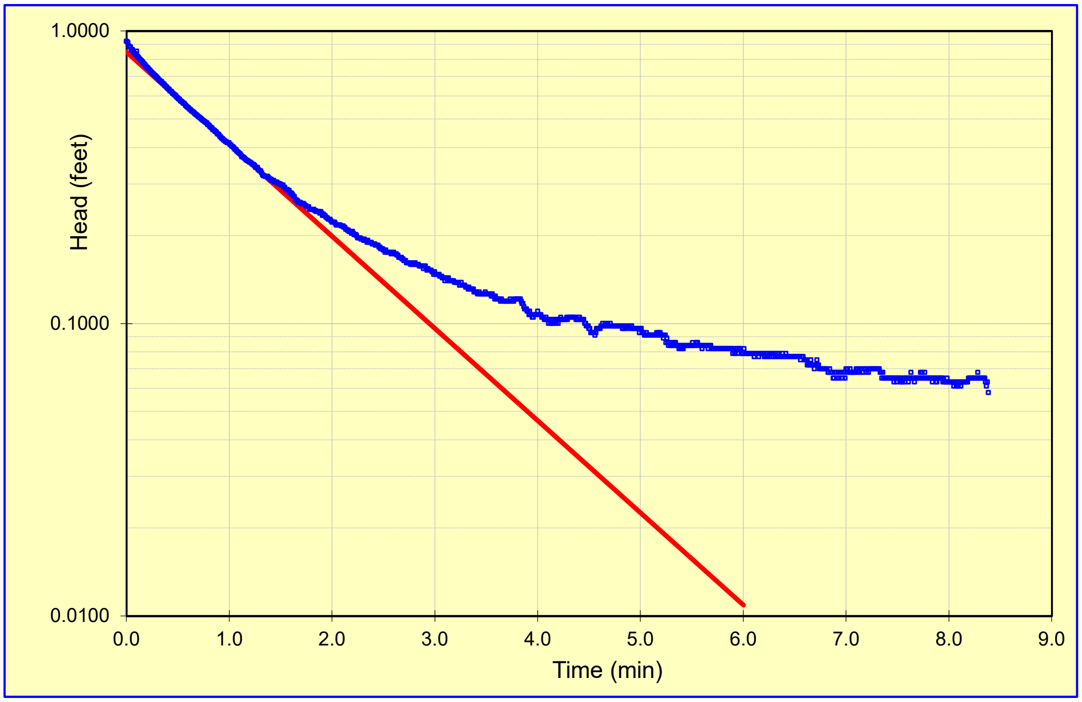
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	2
$ln(R_e/r_w)$=	2.77
y_0 =	0.85
y_t =	0.011
t =	6.0

RESULTS

K=	1.77E-03	cm/sec
K=	5.03E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 5/10/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 3 PZ-12D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

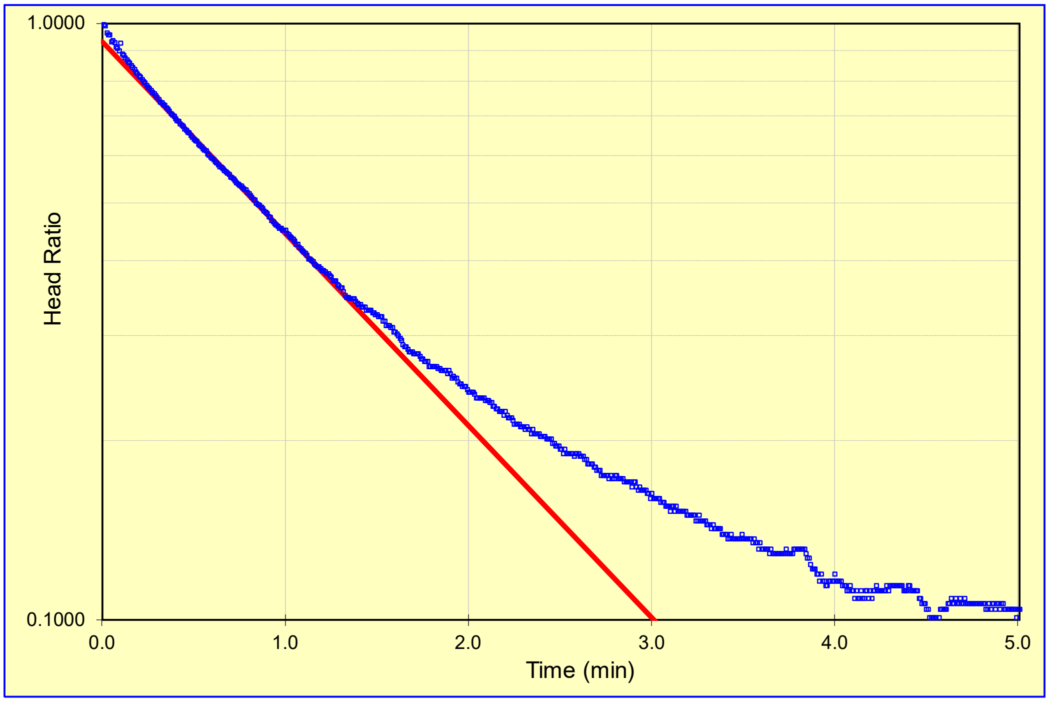
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	2.0
t_1 =	0.00
t_2 =	6.00
$h_{1(t1)}$ =	0.93
$h_{2(t2)}$ =	0.011

RESULTS

K=	1.62E-03	cm/sec
K=	4.60E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/18/18	Analysis Date:	5/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-12D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

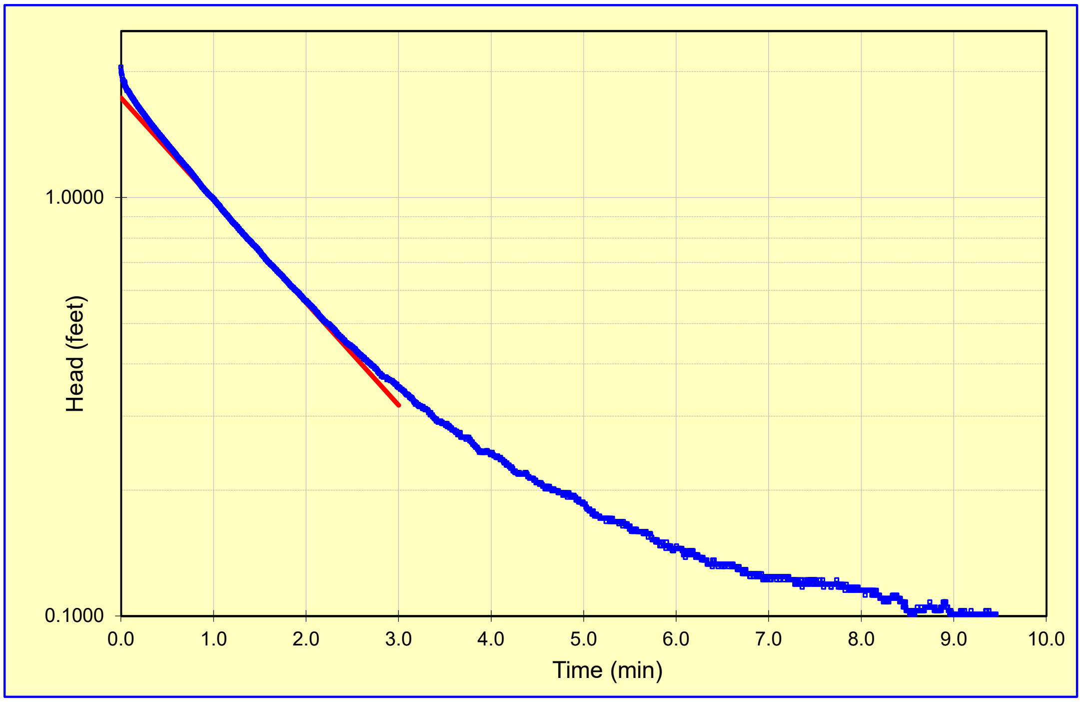
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**2**
$\ln(R_e/r_w)$=	**2.77**
y_0 =	**1.73**
y_t =	**0.319**
t =	**3.0**

RESULTS

K=	**1.38E-03**	**cm/sec**
K=	**3.91E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 5/10/2019

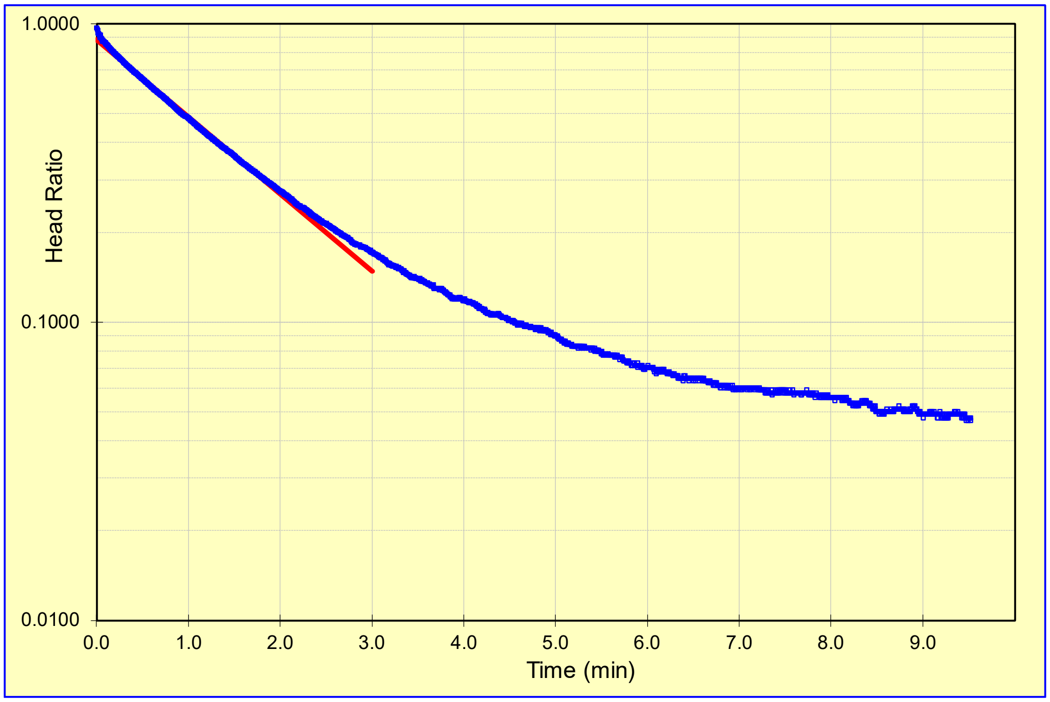
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST 1 PZ-12D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
R_e =	**0.17**			
L_e =	**2.0**	**K=**	**1.30E-03**	**cm/sec**
t_1 =	**0.00**	**K=**	**3.70E+00**	**ft/day**
t_2 =	**3.00**			
$h_{1(t1)}$ =	**0.88**			
$h_{2(t2)}$ =	**0.148**			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/18/18	Analysis Date:	5/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-12D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

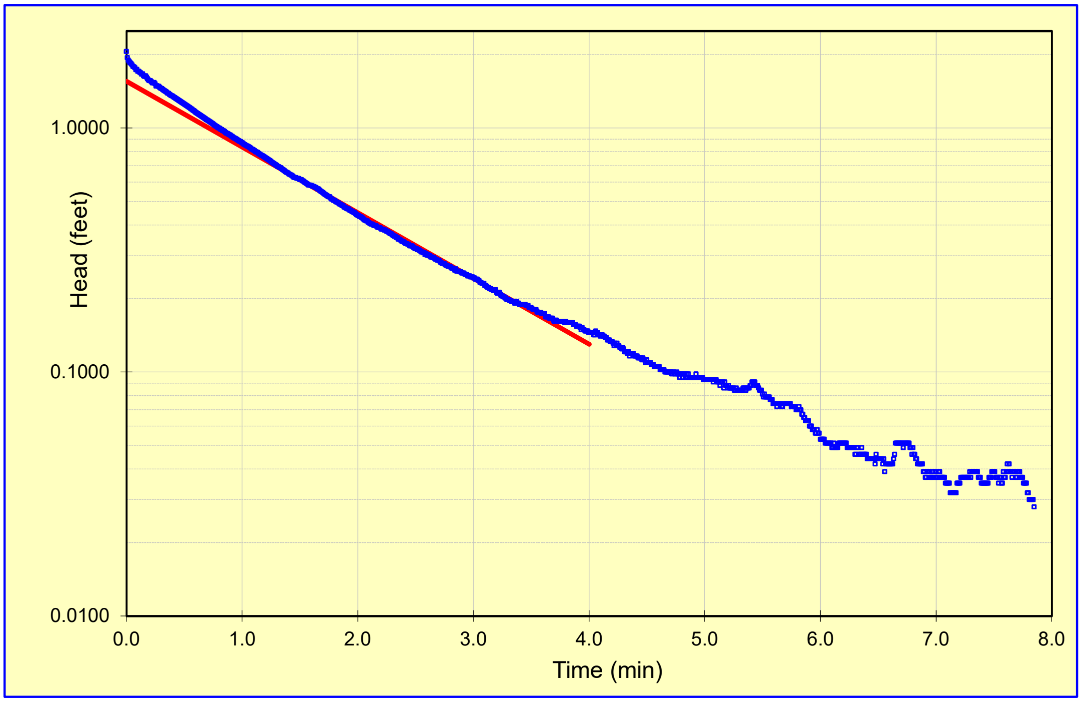
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.17
L_e = 2
$ln(R_e/r_w)$= 2.77
y_0 = 1.56
y_t = 0.130
t = 4.0

RESULTS

K=	**1.52E-03**	**cm/sec**
K=	**4.30E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

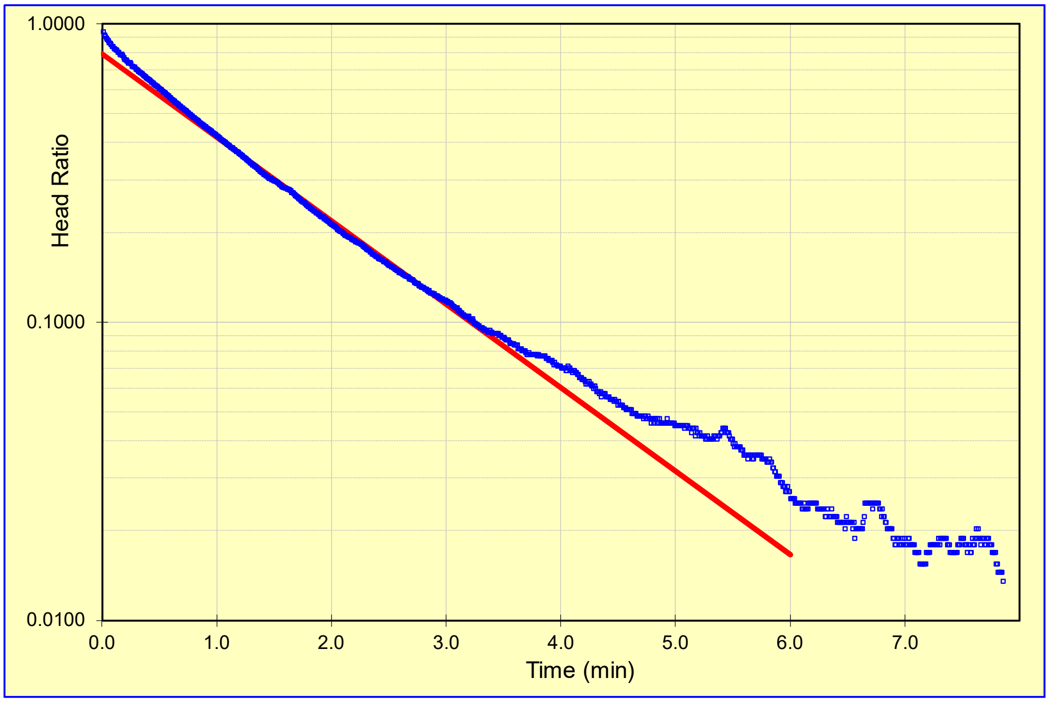
Analysis By: TK
Checked By: LWL
Analysis Date: 5/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-12D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	**0.08**	
R_e =	**0.17**	
L_e =	**2.0**	**K= 1.41E-03 cm/sec**
t_1 =	**0.00**	**K= 4.00E+00 ft/day**
t_2 =	**6.00**	
$h_{1(t1)}$ =	**0.80**	
$h_{2(t2)}$ =	**0.017**	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 5/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-12D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

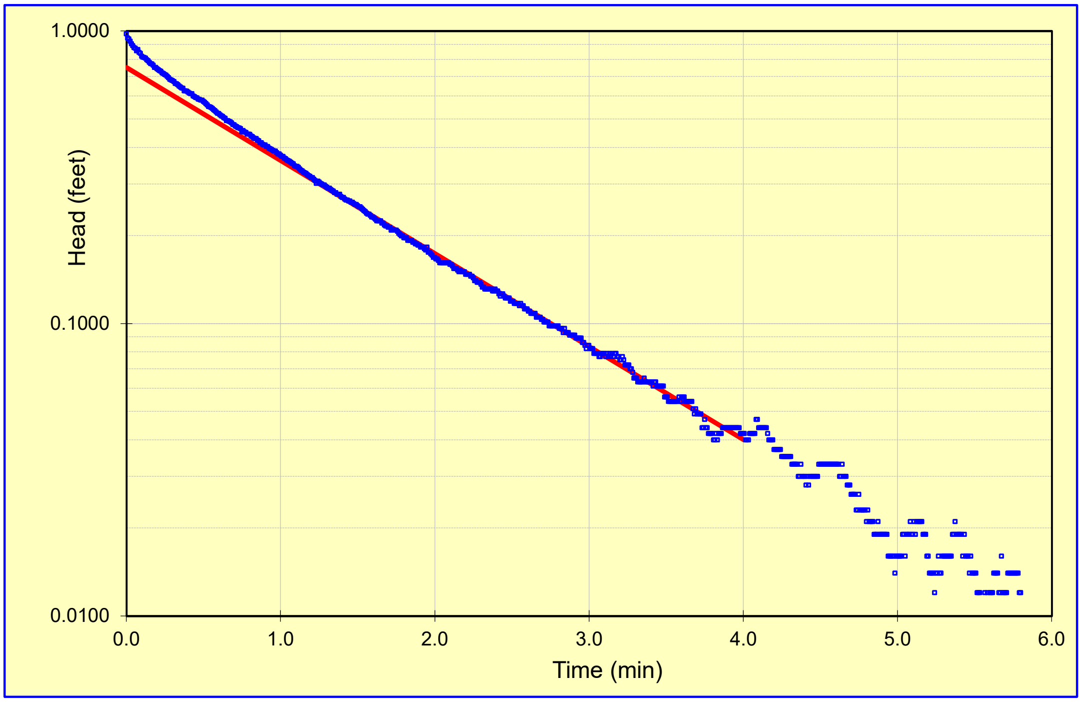
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	2
$ln(R_e/r_w)$=	2.77
y_0 =	0.75
y_t =	0.040
t =	4.0

RESULTS

K=	1.79E-03	cm/sec
K=	5.08E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: TK
Checked By: LWL
Analysis Date: 5/11/2019

GOLDER

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 3 PZ-12D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

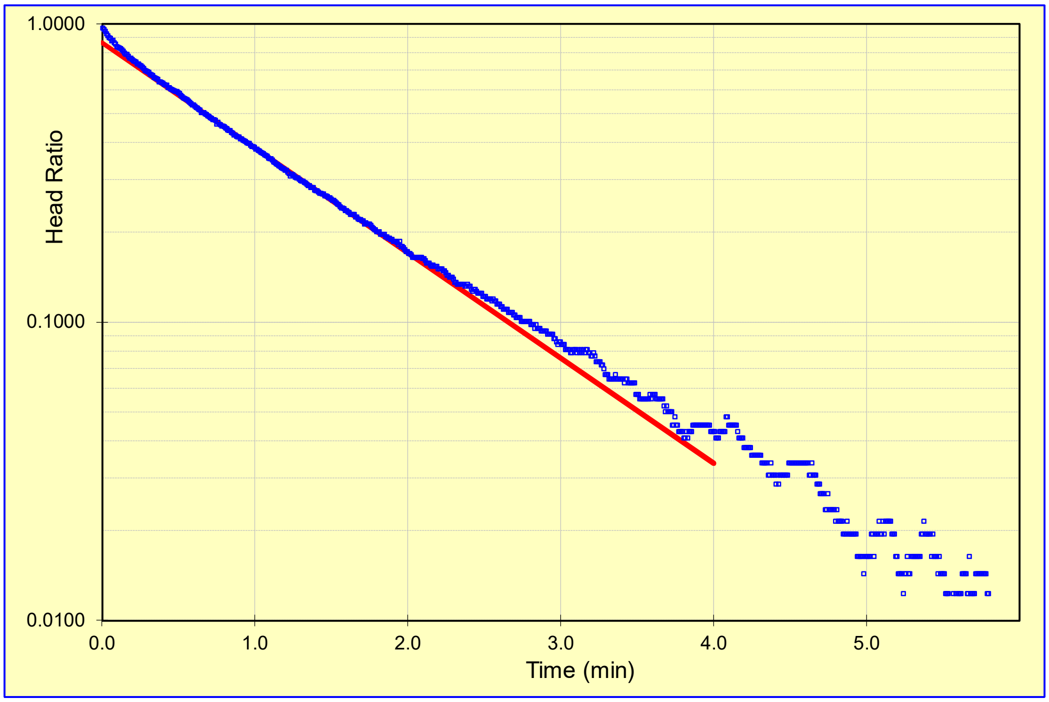
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	2.0
t_1 =	0.00
t_2 =	4.00
$h_{1(t1)}$ =	0.87
$h_{2(t2)}$ =	0.034

RESULTS

K=	1.78E-03	cm/sec
K=	5.04E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	10/18/18	Analysis Date:	5/11/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-12S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

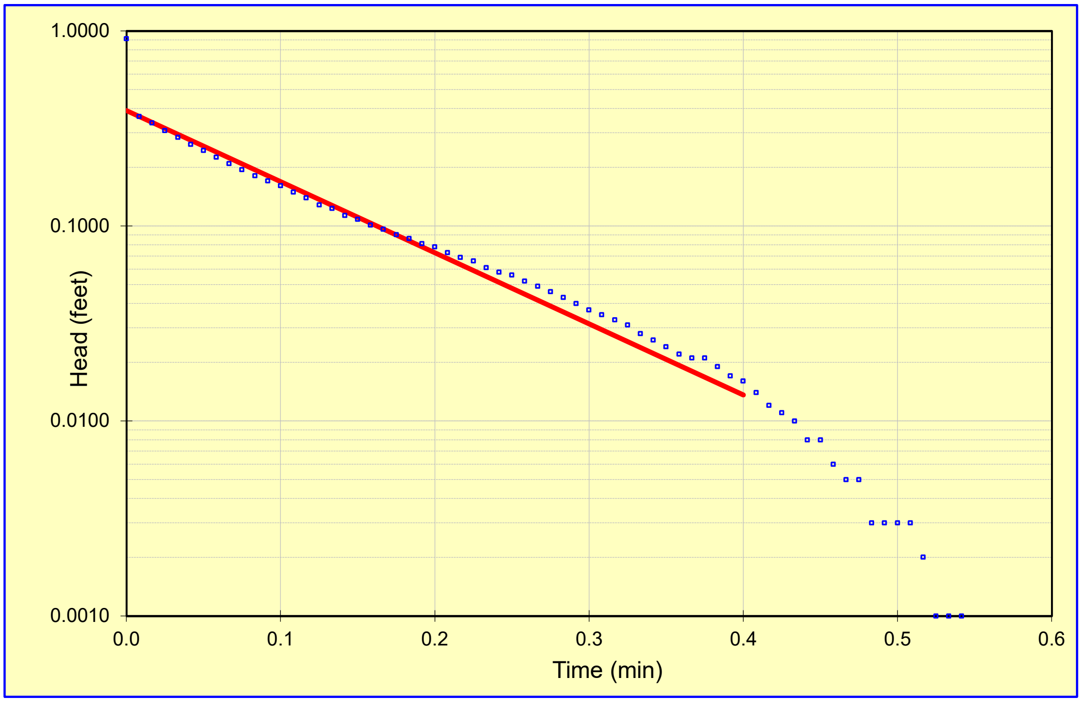
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	4
$ln(R_e/r_w)$=	3.19
y_0 =	0.39
y_t =	0.014
t =	0.4

RESULTS

K=	1.18E-02	cm/sec
K=	3.35E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-12S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

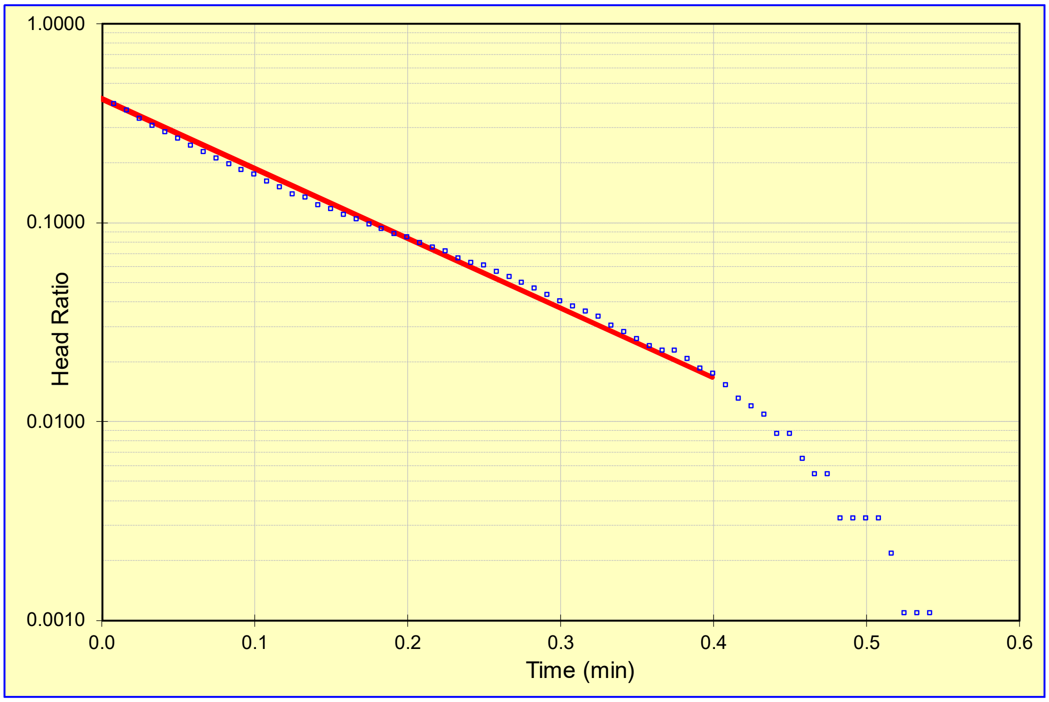
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 4.0
t_1 = 0.00
t_2 = 0.40
$h_{1(t1)}$ = 0.42
$h_{2(t2)}$ = 0.017

RESULTS

K=	**1.13E-02**	**cm/sec**
K=	**3.21E+01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-12S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

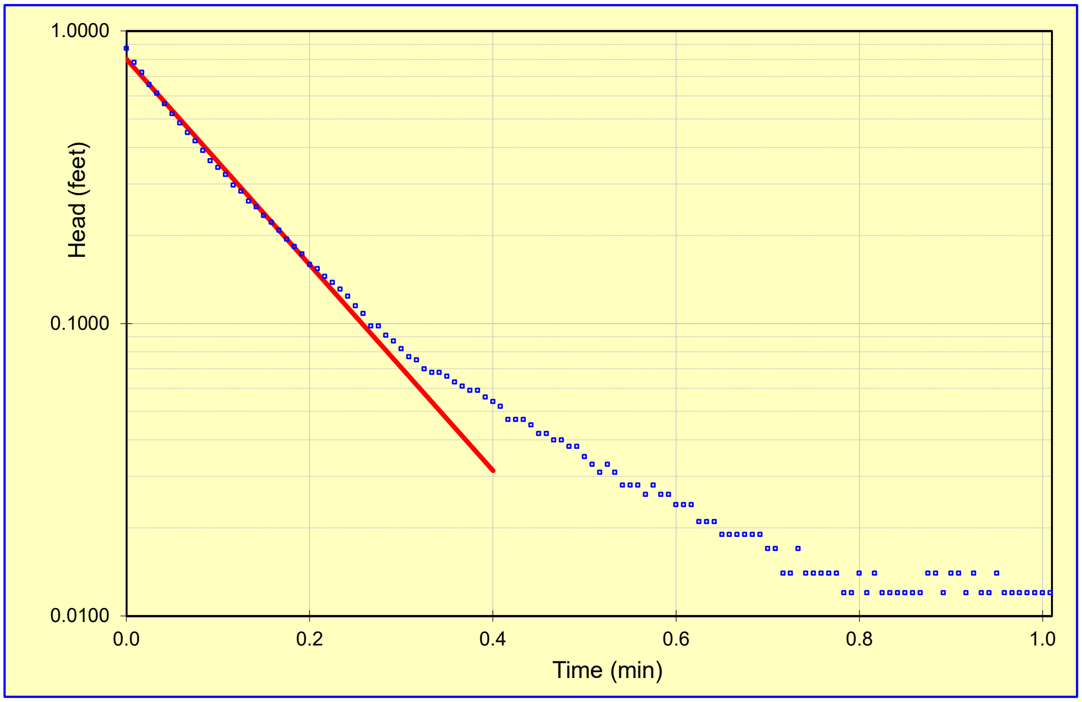
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	4
$ln(R_e/r_w)$=	3.19
y_0 =	0.80
y_t =	0.031
t =	0.4

RESULTS

K=	1.14E-02	cm/sec
K=	3.23E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/26/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-12S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

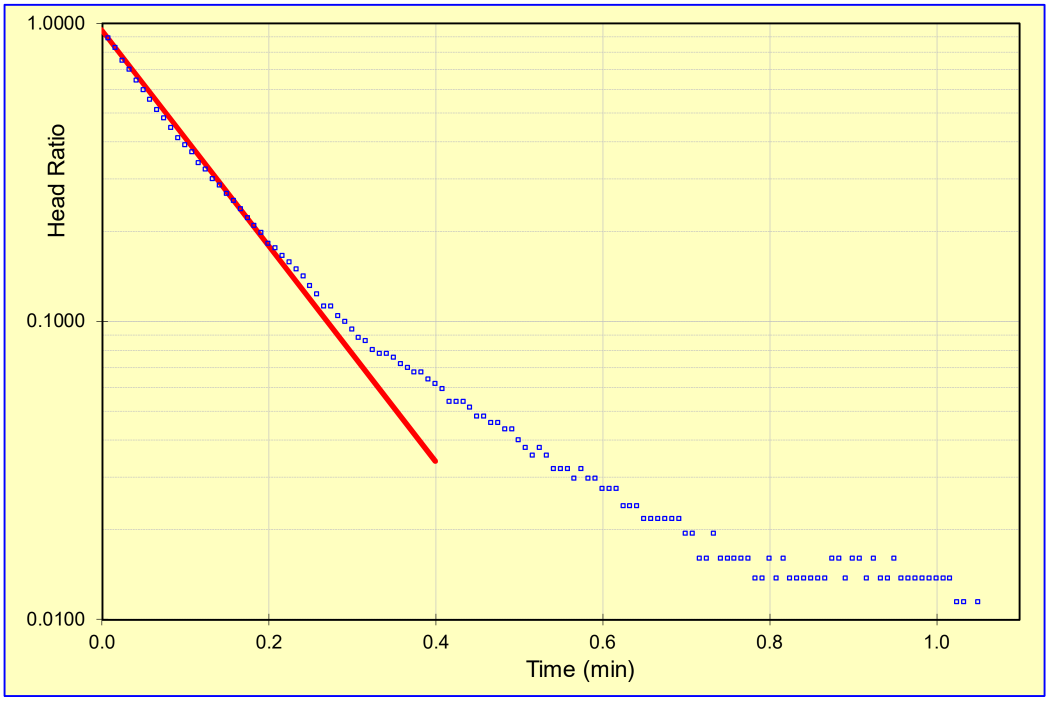
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	4.0
t_1 =	0.00
t_2 =	0.40
$h_{1(t1)}$ =	0.95
$h_{2(t2)}$ =	0.034

RESULTS

K=	1.17E-02	cm/sec
K=	3.31E+01	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/18/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 7/22/2019

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-13D - FALLING HEAD TEST 1

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

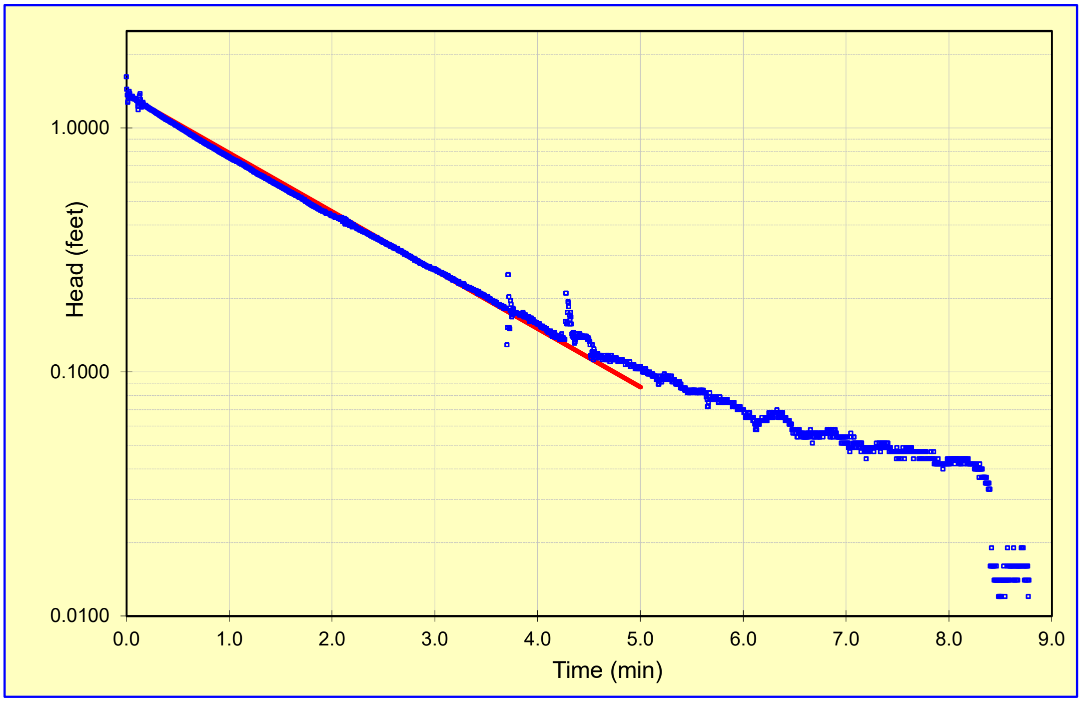
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.37
y_t =	0.087
t =	5.0

RESULTS

K=	6.57E-04	cm/sec
K=	1.86E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

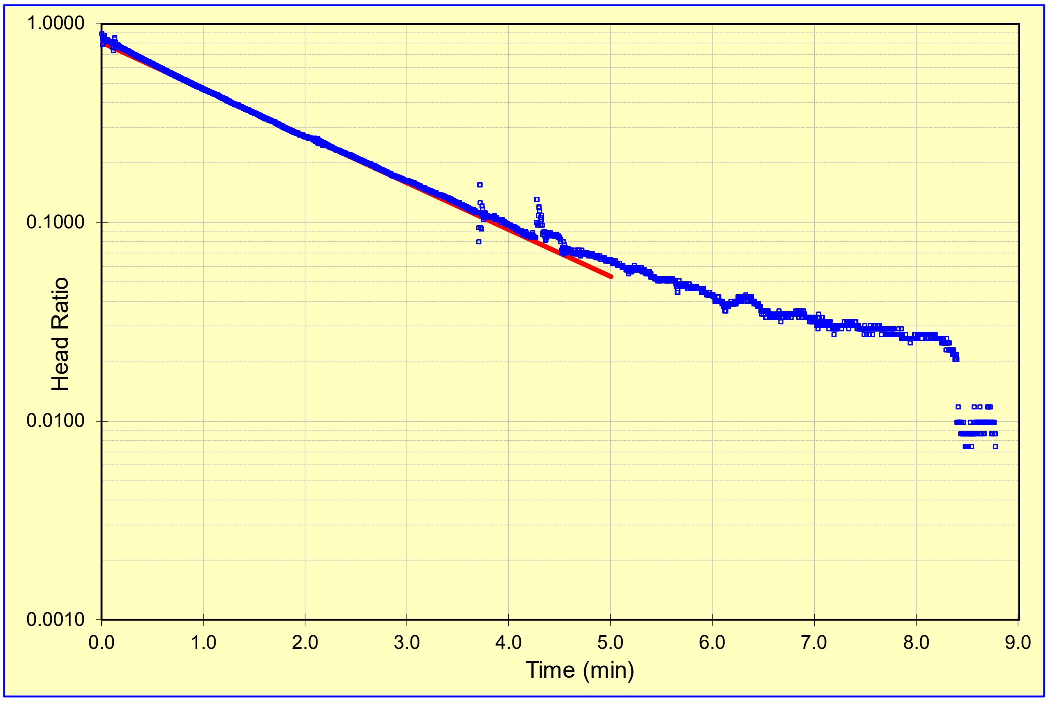
HVORSLEV SLUG TEST ANALYSIS
PZ-13D - FALLING HEAD TEST 1

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	**0.08**	
R_e =	**0.17**	
L_e =	**5.0**	**K= 6.52E-04 cm/sec**
t_1 =	**0.00**	**K= 1.85E+00 ft/day**
t_2 =	**5.00**	
$h_{1(t1)}$ =	**0.81**	
$h_{2(t2)}$ =	**0.053**	



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-13D - FALLING HEAD TEST 2

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

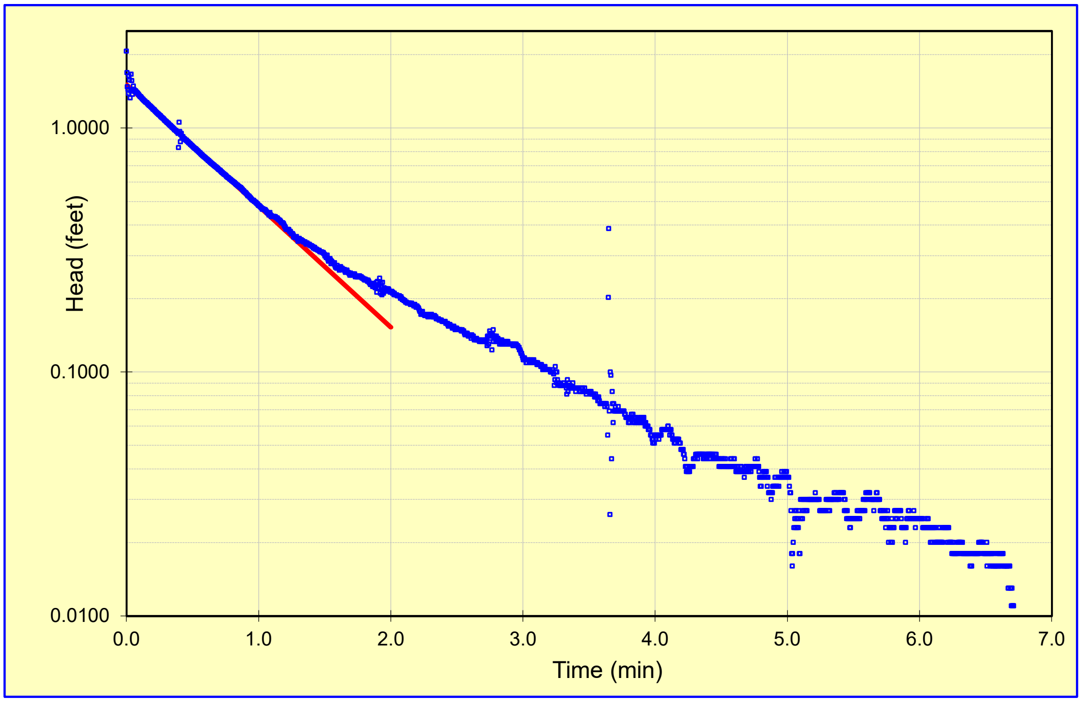
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.51
y_t =	0.153
t =	2.0

RESULTS

K=	1.36E-03	cm/sec
K=	3.86E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	BDL
Test Date:	10/16/18	Analysis Date:	11/20/2018

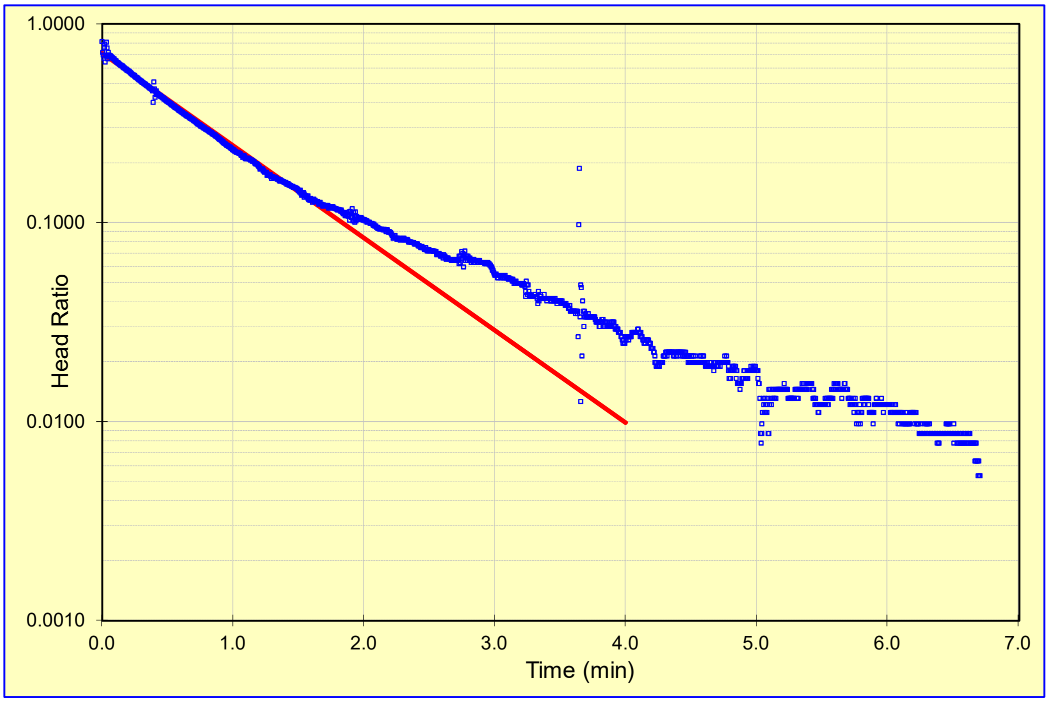
HVORSLEV SLUG TEST ANALYSIS
PZ-13D - FALLING HEAD TEST 2

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	1.28E-03	cm/sec
t_1 =	0.00	K=	3.64E+00	ft/day
t_2 =	4.00			
$h_{1(t1)}$ =	0.72			
$h_{2(t2)}$ =	0.010			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-13D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

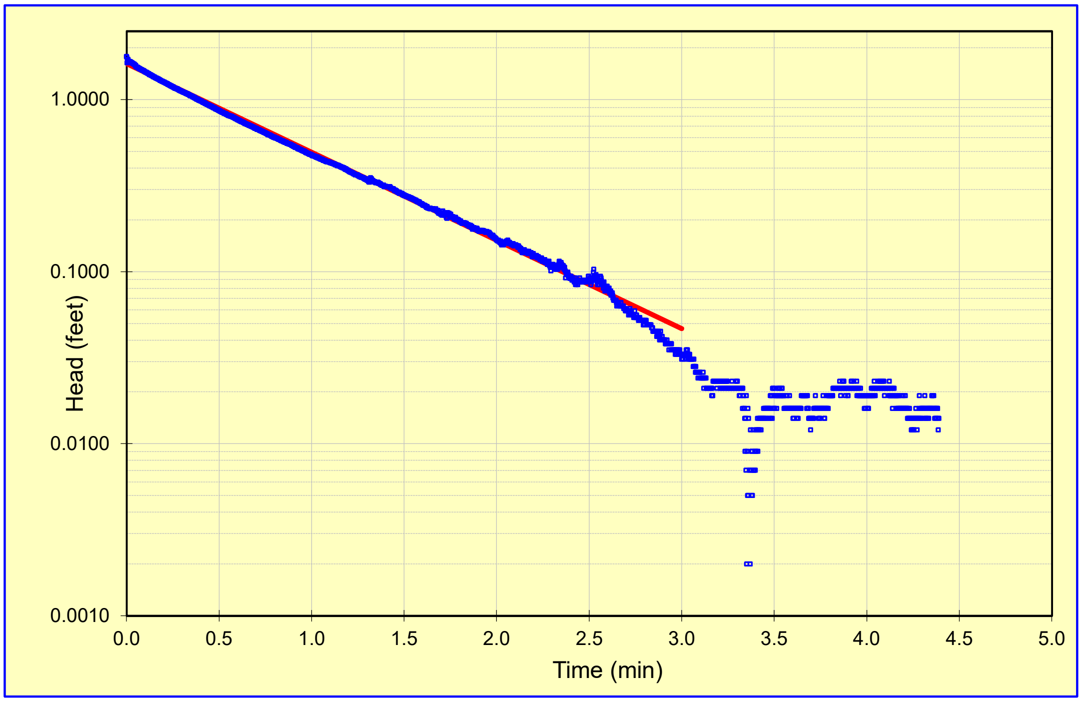
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.62
y_t =	0.047
t =	3.0

RESULTS

K=	1.41E-03	cm/sec
K=	3.99E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-13D

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

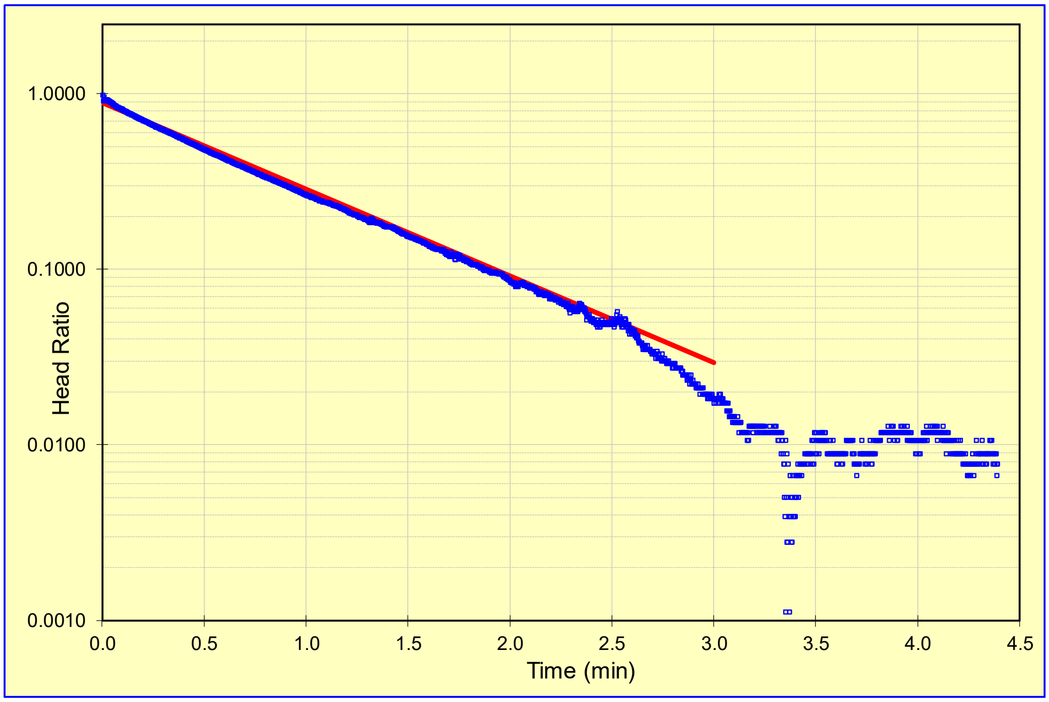
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	3.00
$h_{1(t1)}$ =	0.90
$h_{2(t2)}$ =	0.029

RESULTS

K=	1.36E-03	cm/sec
K=	3.87E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	BDL
Test Date:	10/16/18	Analysis Date:	11/20/2018

GOLDER

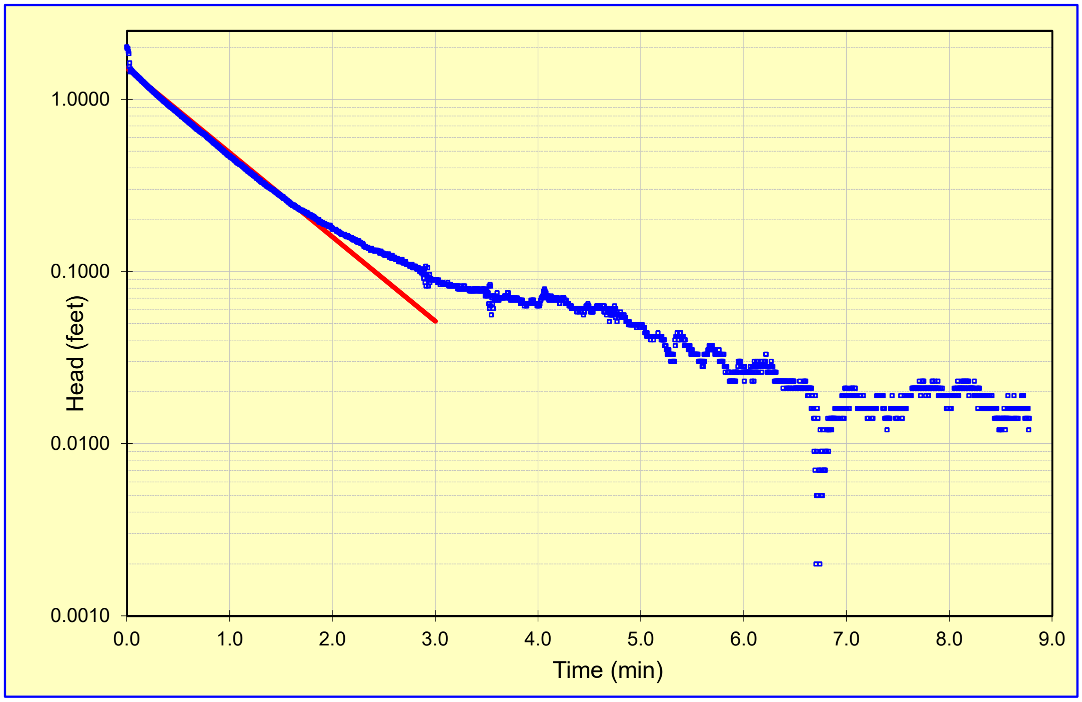
BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-13D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
r_w =	0.17			
L_e =	5	K=	1.34E-03	cm/sec
$\ln(R_e/r_w)$=	3.38	K=	3.80E+00	ft/day
y_0 =	1.52			
y_t =	0.052			
t =	3.0			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/18/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-13D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

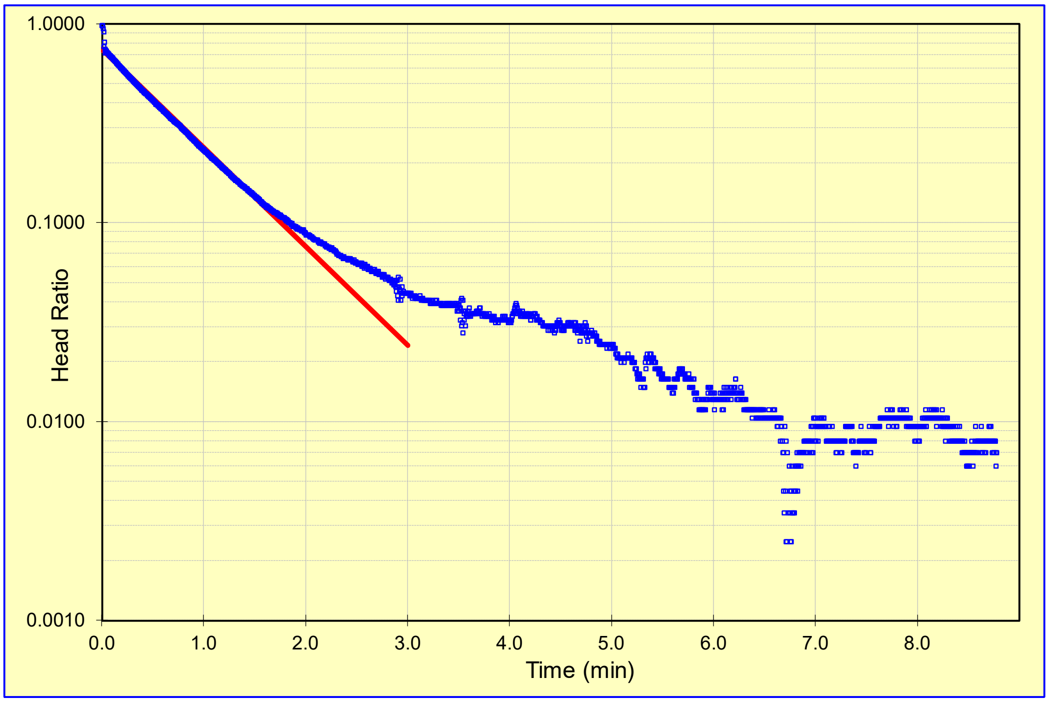
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	3.00
$h_{1(t1)}$ =	0.75
$h_{2(t2)}$ =	0.024

RESULTS

K=	1.37E-03	cm/sec
K=	3.89E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/18/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-13S

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

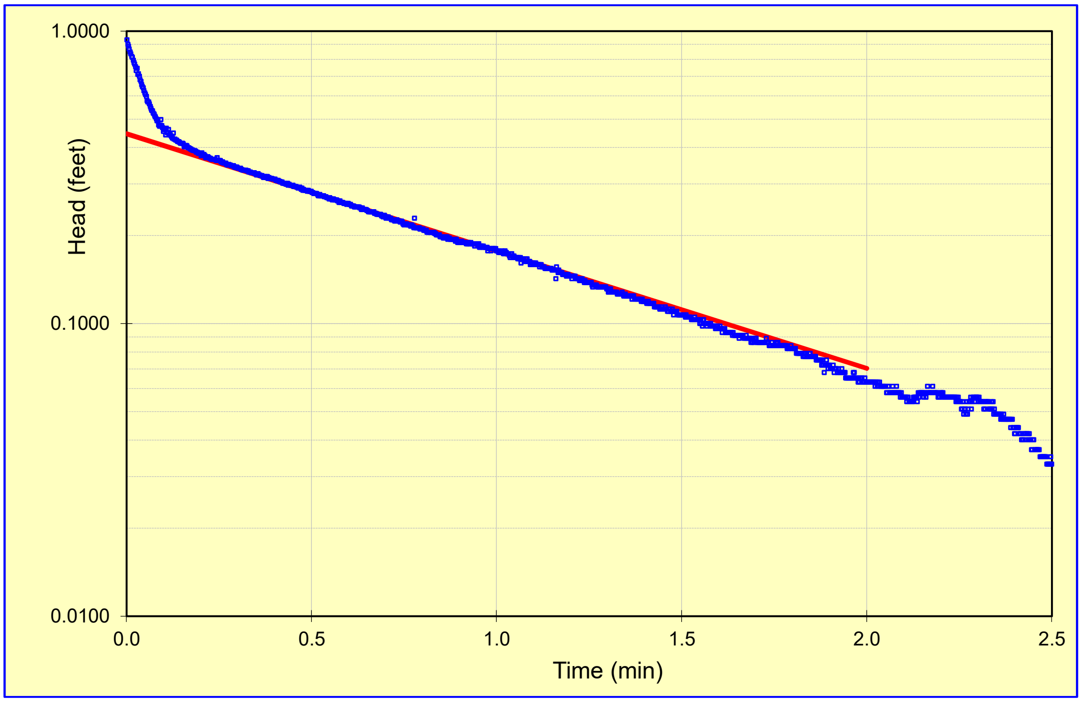
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	3.71
$ln(R_e/r_w)$=	3.14
y_0 =	0.45
y_t =	0.070
t =	2.0

RESULTS

K=	1.38E-03	cm/sec
K=	3.91E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-13S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

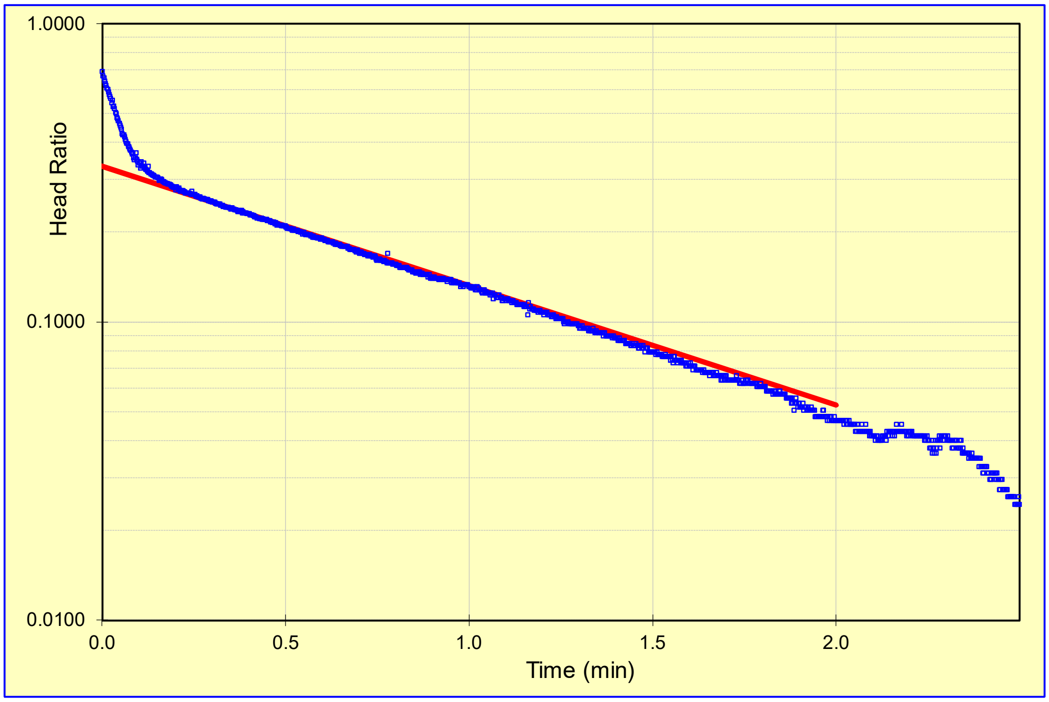
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	3.7
t_1 =	0.00
t_2 =	2.00
$h_{1(t1)}$ =	0.33
$h_{2(t2)}$ =	0.053

RESULTS

K=	1.36E-03	cm/sec
K=	3.86E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-13S

$$K = \frac{r_c^2 \, ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} ln \frac{y_0}{y_t}$$

where:

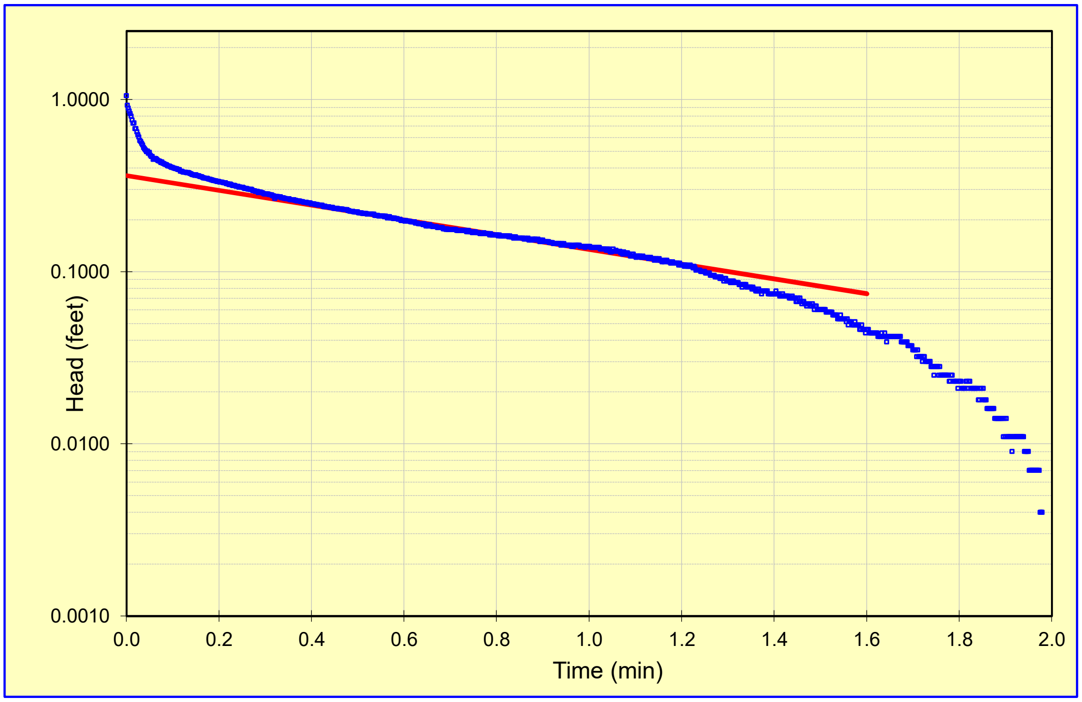
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.17
L_e = 3.71
$ln(R_e/r_w)$= 3.14
y_0 = 0.36
y_t = 0.075
t = 1.6

RESULTS

K=	**1.47E-03**	**cm/sec**
K=	**4.17E+00**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

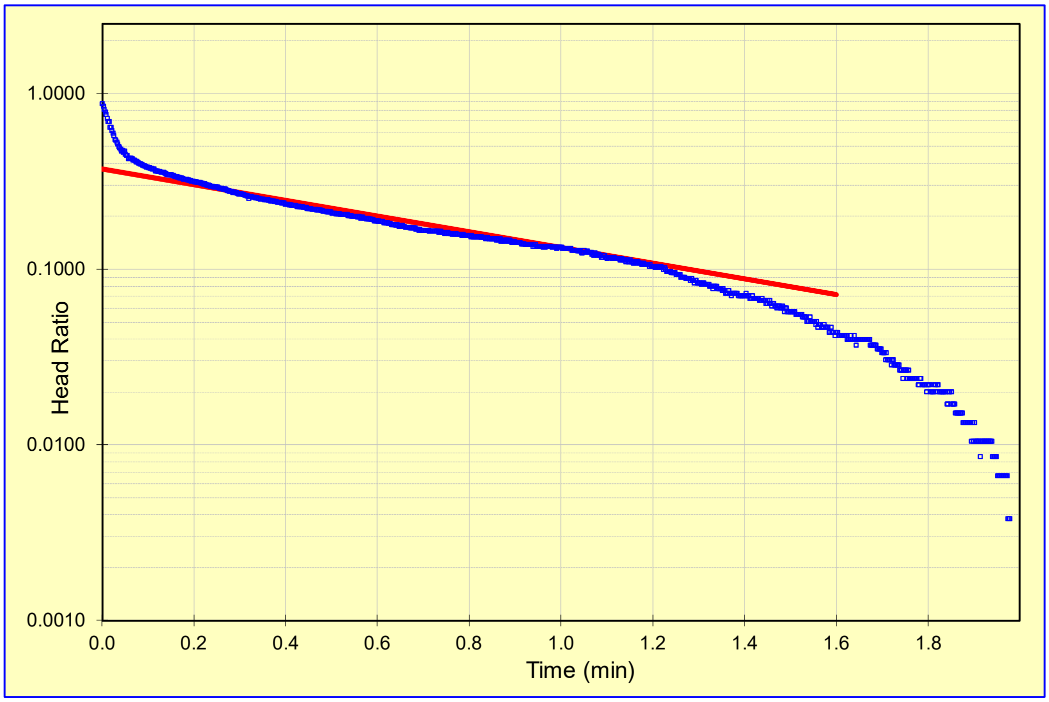
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-13S

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	3.7	K=	1.52E-03	cm/sec
t_1 =	0.00	K=	4.30E+00	ft/day
t_2 =	1.60			
$h_{1(t1)}$ =	0.37			
$h_{2(t2)}$ =	0.072			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-14D - FALLING HEAD TEST 1

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

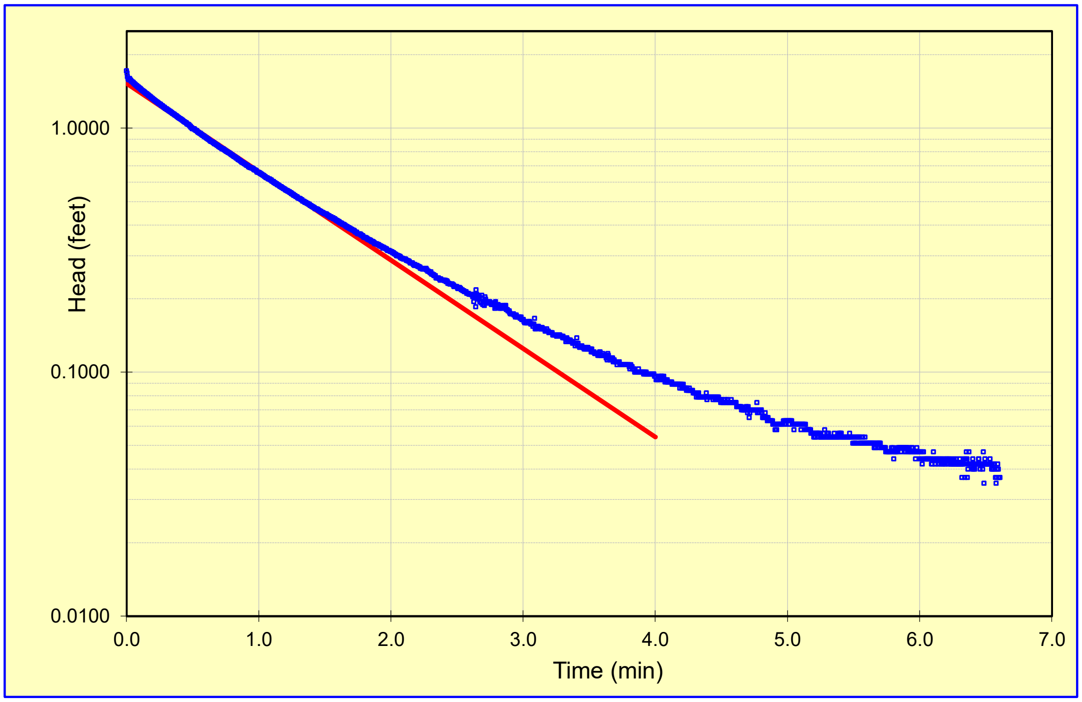
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.53
y_t =	0.054
t =	4.0

RESULTS

K=	9.93E-04	cm/sec
K=	2.82E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

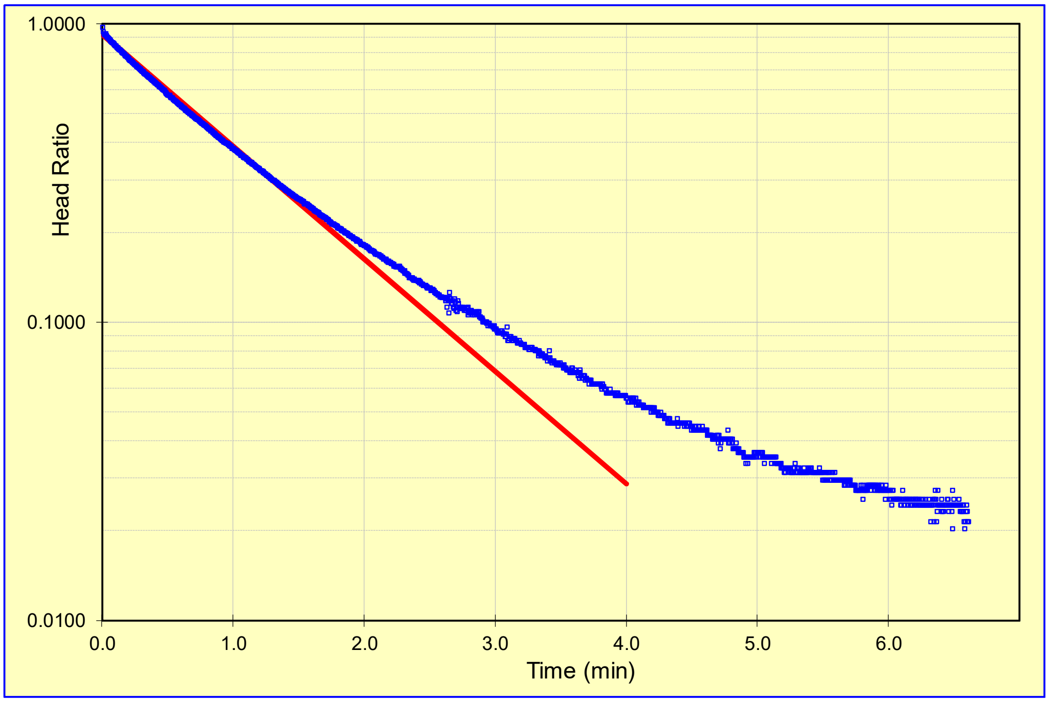
HVORSLEV SLUG TEST ANALYSIS
PZ-14D - FALLING HEAD TEST 1

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	1.04E-03	cm/sec
t_1 =	0.00	K=	2.95E+00	ft/day
t_2 =	4.00			
$h_{1(t1)}$ =	0.93			
$h_{2(t2)}$ =	0.029			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
PZ-14D - FALLING HEAD TEST 2

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

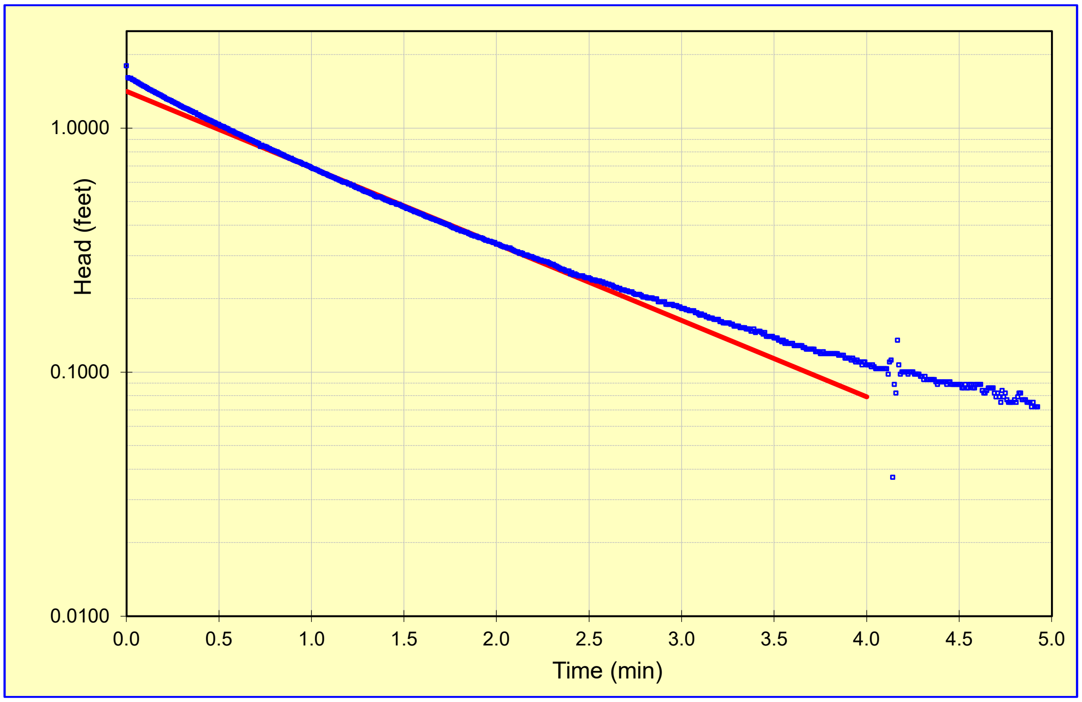
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	1.42
y_t =	0.079
t =	4.0

RESULTS

K=	8.58E-04	cm/sec
K=	2.43E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: BDL
Analysis Date: 11/20/2018

HVORSLEV SLUG TEST ANALYSIS
PZ-14D - FALLING HEAD TEST 2

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

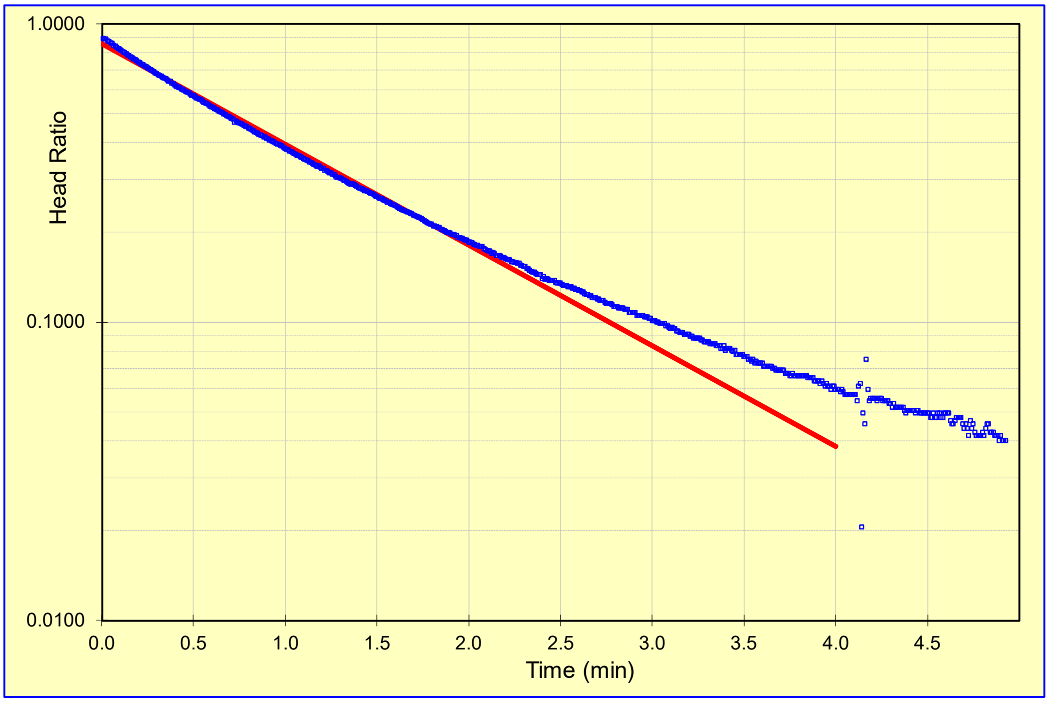
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	4.00
$h_{1(t1)}$ =	0.86
$h_{2(t2)}$ =	0.038

RESULTS

K=	9.32E-04	cm/sec
K=	2.64E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	BDL
Test Date:	10/16/18	Analysis Date:	11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-13D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

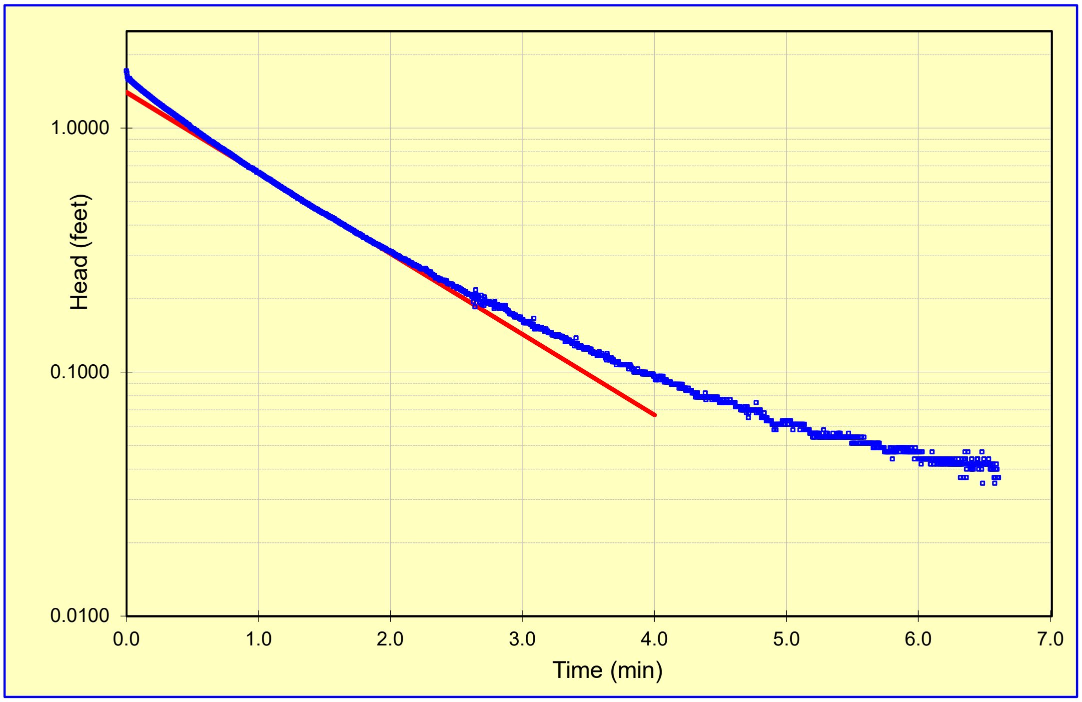
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.40
y_t =	0.067
t =	4.0

RESULTS

K=	9.07E-04	cm/sec
K=	2.57E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: ANB
Analysis Date: 11/20/2018

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 1 PZ-13D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

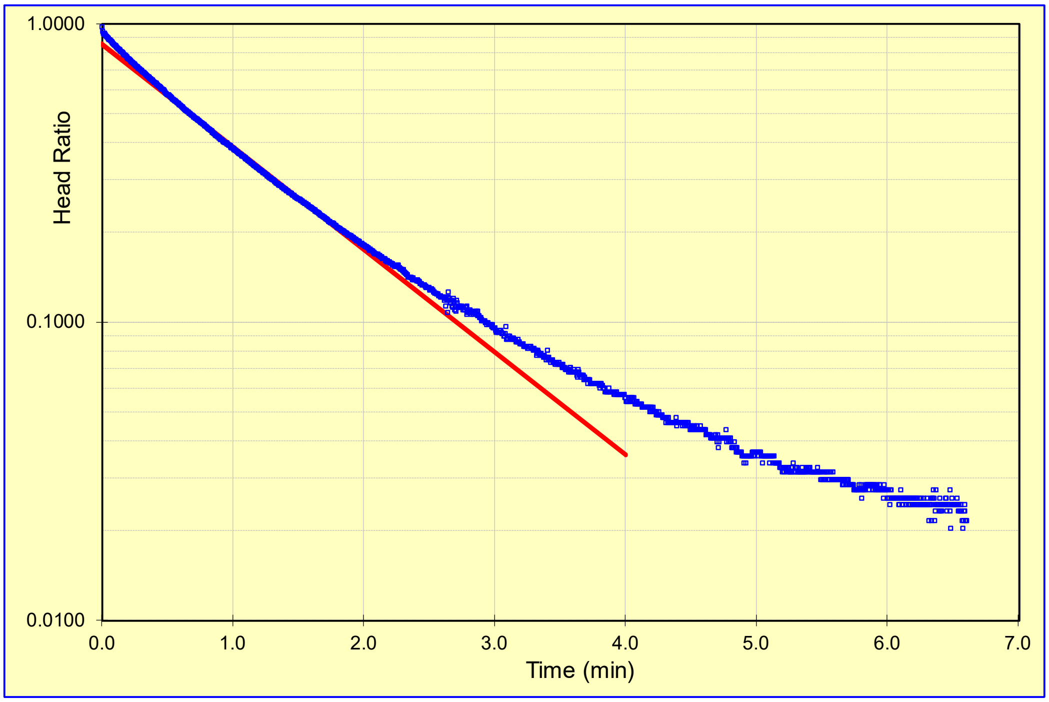
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	4.00
$h_{1(t1)}$ =	0.86
$h_{2(t2)}$ =	0.036

RESULTS

K=	9.51E-04	cm/sec
K=	2.70E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	ANB
Test Date:	10/16/18	Analysis Date:	11/20/2018

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-14D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

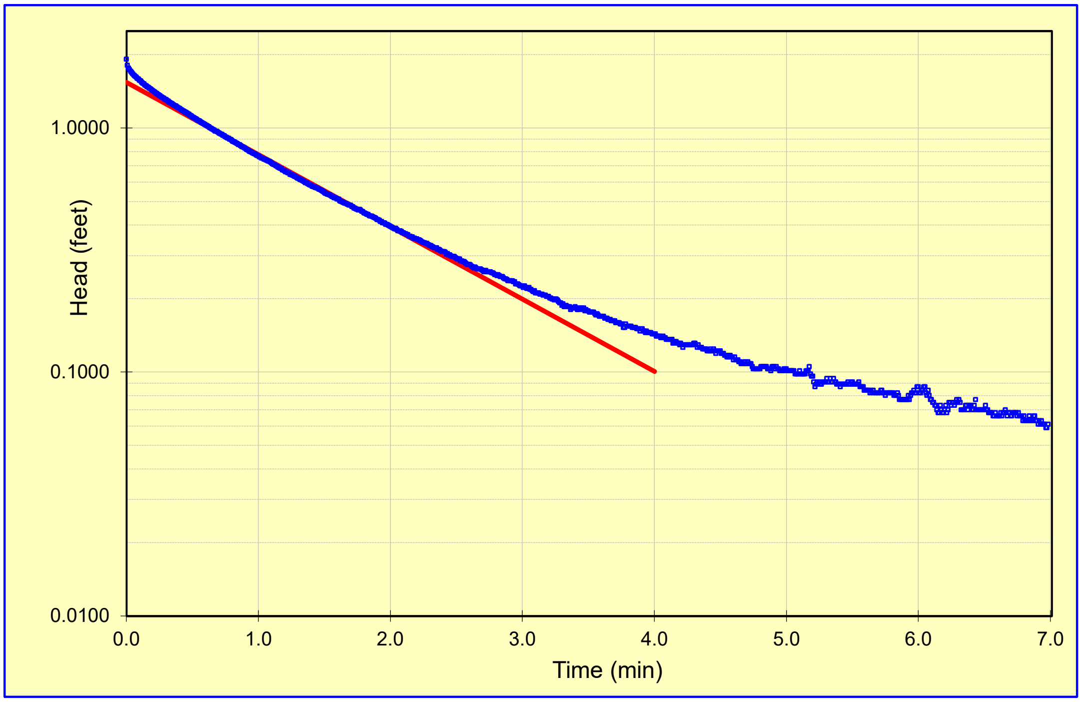
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	1.54
y_t =	0.101
t =	4.0

RESULTS

K=	8.13E-04	cm/sec
K=	2.30E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: BDL
Checked By: ANB
Analysis Date: 11/20/2018

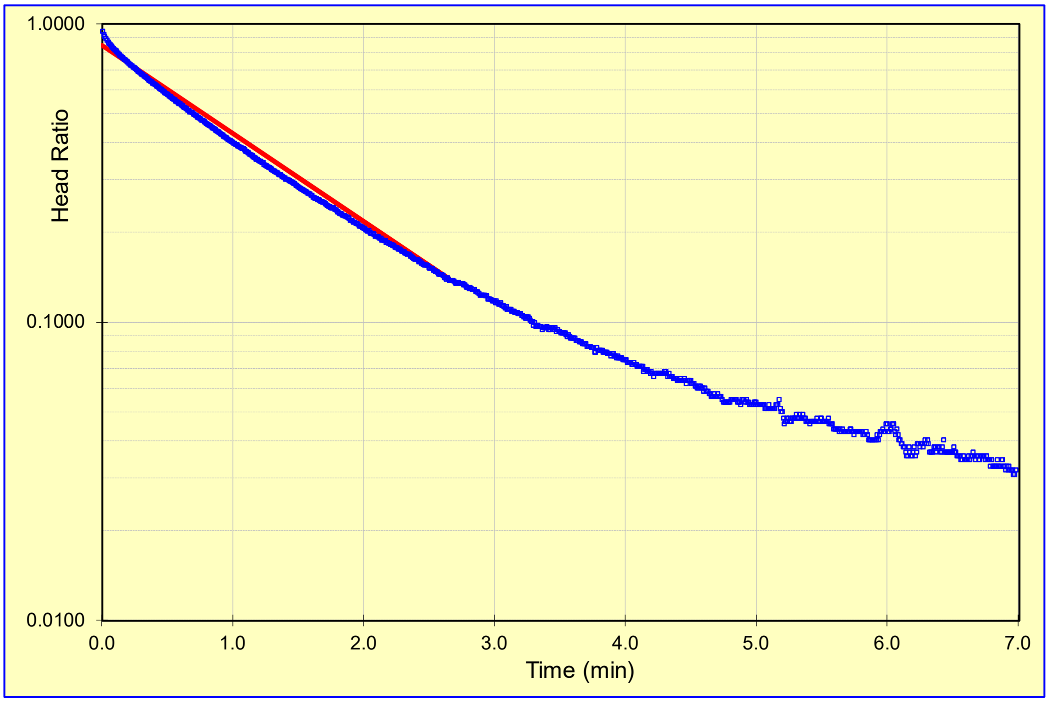
HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST 2 PZ-14D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	8.15E-04	cm/sec
t_1 =	0.00	K=	2.31E+00	ft/day
t_2 =	2.65			
$h_{1(t1)}$ =	0.85			
$h_{2(t2)}$ =	0.140			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 10/16/18

Analysis By: LWL
Checked By: ANB
Analysis Date: 7/23/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-06D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

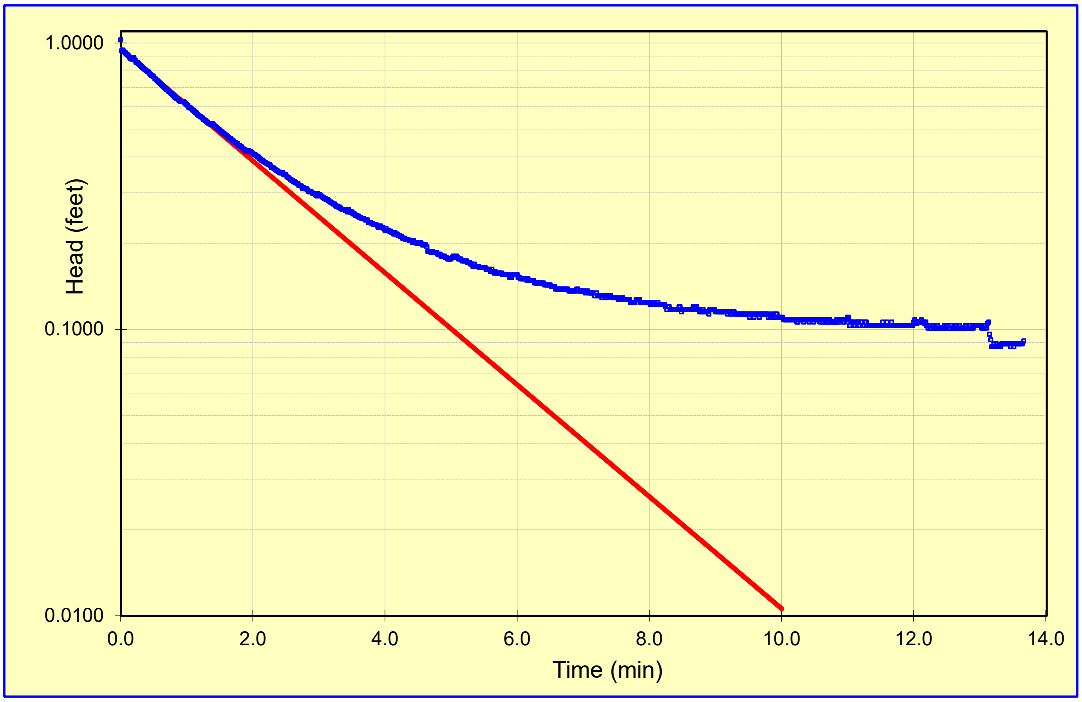
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.95
y_t =	0.011
t =	10.0

RESULTS

K=	5.36E-04	cm/sec
K=	1.52E+00	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST MW14-06D

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)}\right]$$

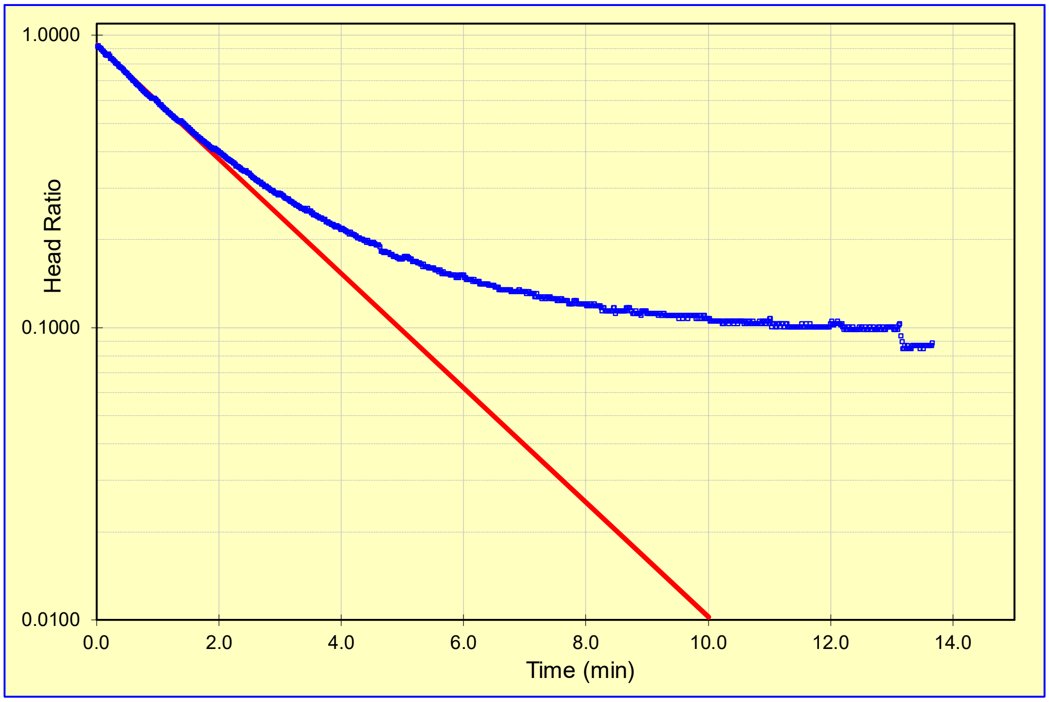
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	10.00
$h_{1(t1)}$ =	0.93
$h_{2(t2)}$ =	0.010

RESULTS

K=	5.41E-04	cm/sec
K=	1.53E+00	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/11/19	Analysis Date:	6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST MW14-06D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

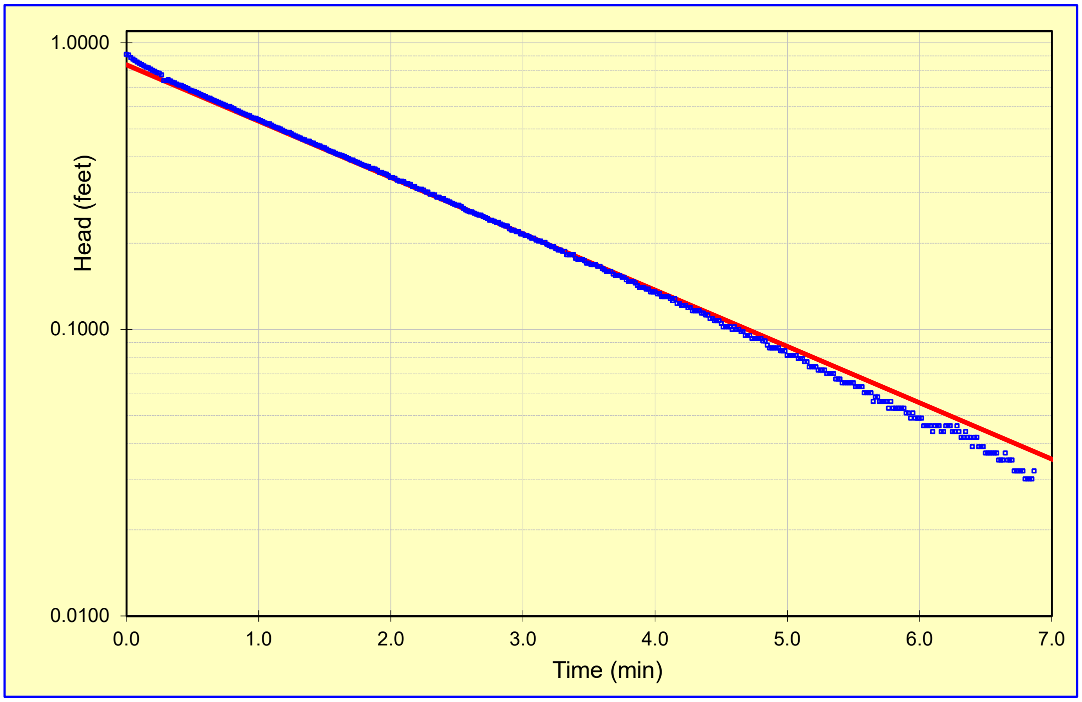
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.84
y_t =	0.009
t =	10.0

RESULTS

K=	5.39E-04	cm/sec
K=	1.53E+00	ft/day



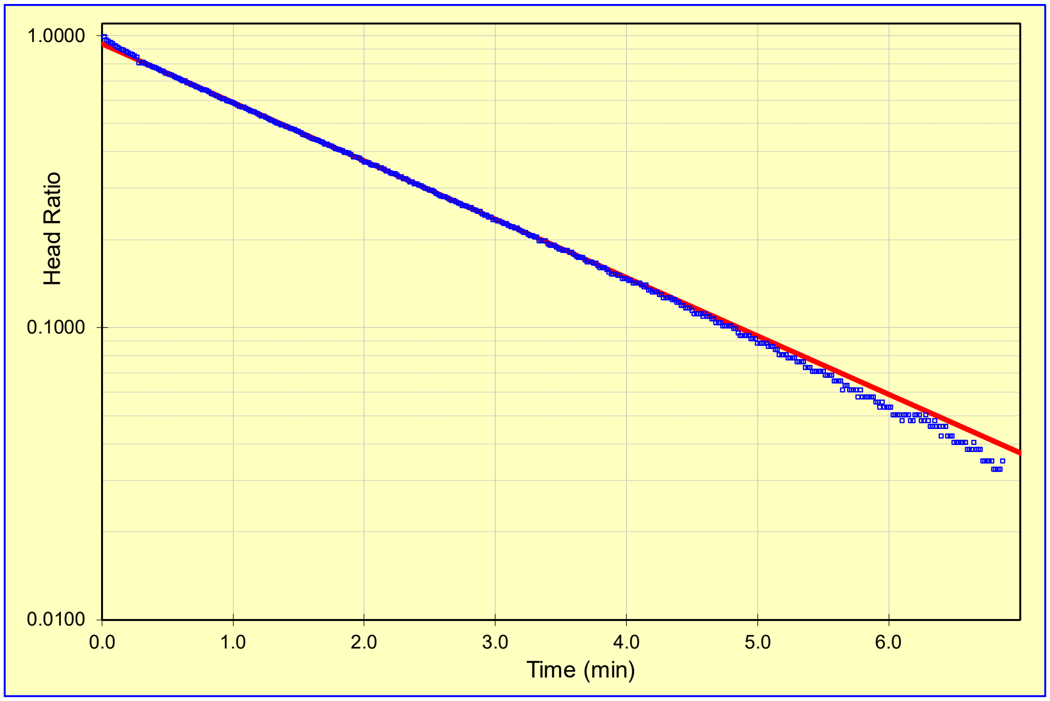
Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	04/11/19	Analysis Date:	6/5/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST MW14-06D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time *t* (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	5.53E-04	cm/sec
t_1 =	0.00	K=	1.57E+00	ft/day
t_2 =	10.00			
$h_{1(t1)}$ =	0.94			
$h_{2(t2)}$ =	0.009			



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 04/11/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-15D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

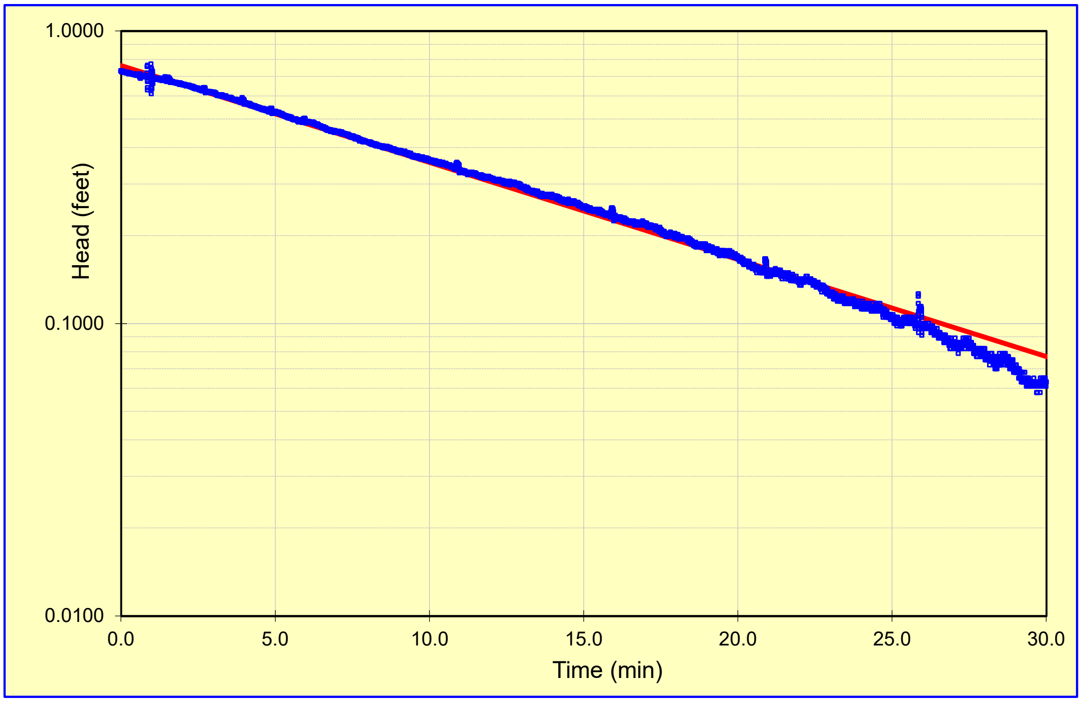
L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS		RESULTS		
r_c =	0.08			
r_w =	0.17			
L_e =	5	K=	9.10E-05	cm/sec
$ln(R_e/r_w)$=	3.38	K=	2.58E-01	ft/day
y_0 =	0.76			
y_t =	0.053			
t =	35.0			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	03/25/19	Analysis Date:	6/5/2019

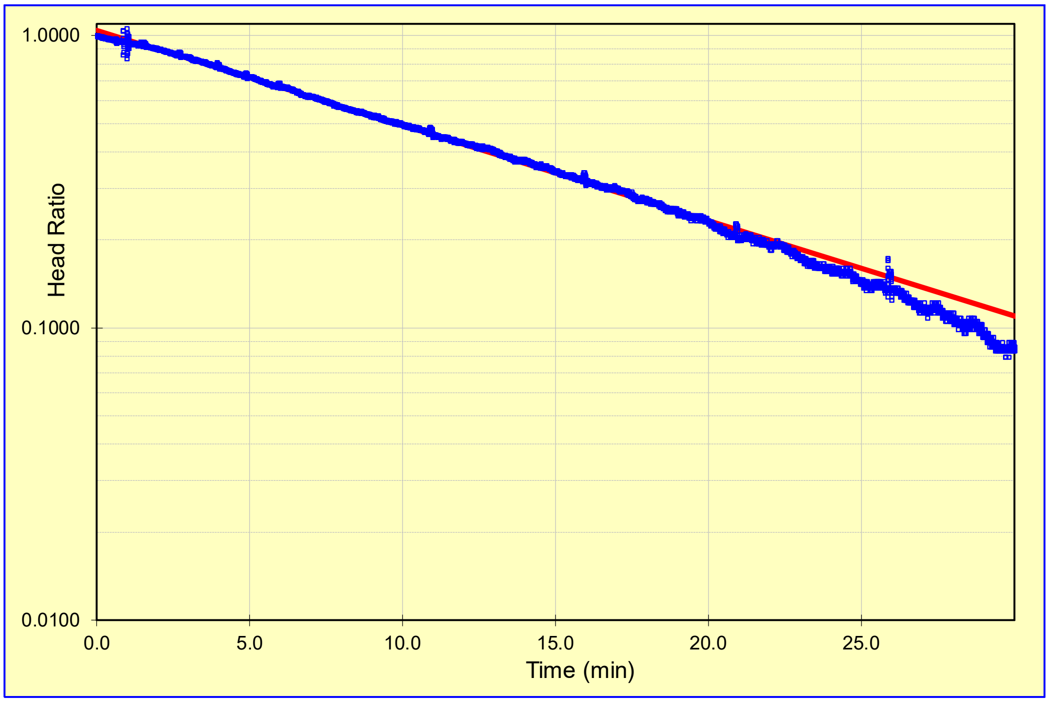
HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-15D

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	0.08			
R_e =	0.17			
L_e =	5.0	K=	9.01E-05	cm/sec
t_1 =	0.00	K=	2.55E-01	ft/day
t_2 =	35.00			
$h_{1(t1)}$ =	1.05			
$h_{2(t2)}$ =	0.076			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	03/25/19	Analysis Date:	6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-15D

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

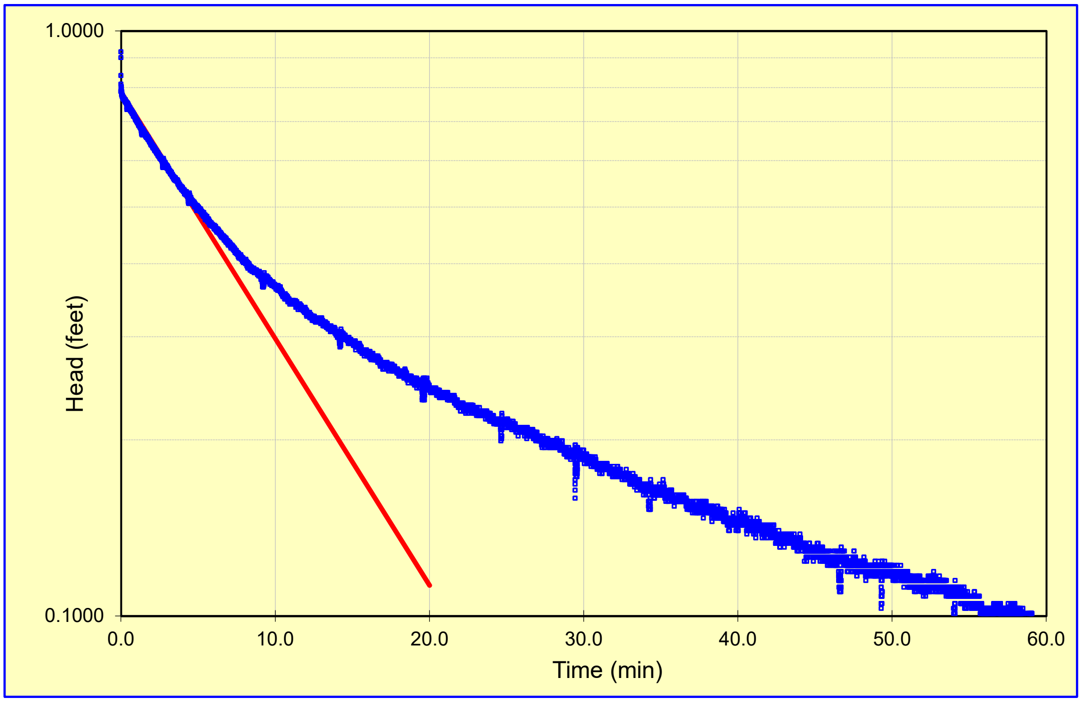
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$\ln(R_e/r_w)$=	**3.38**
y_0 =	**0.79**
y_t =	**0.113**
t =	**20.0**

RESULTS

K=	**1.16E-04**	**cm/sec**
K=	**3.28E-01**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/25/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-15D

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)}\right]$$

where:

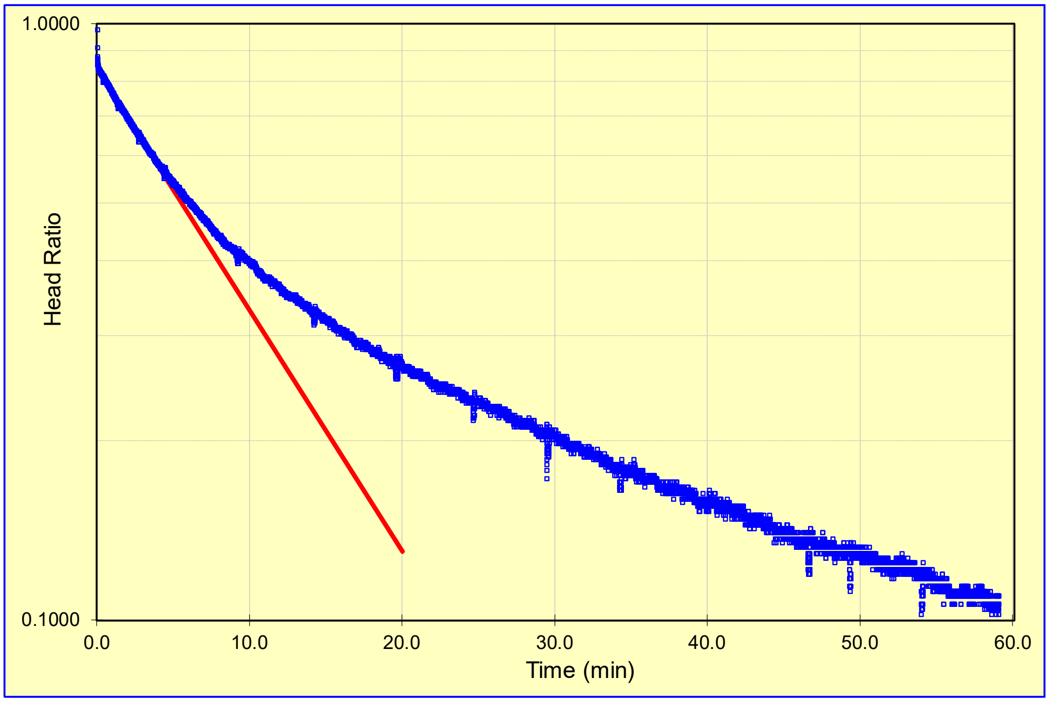
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 20.00
$h_{1(t1)}$ = 0.84
$h_{2(t2)}$ = 0.131

RESULTS

K= 1.12E-04 cm/sec
K= 3.16E-01 ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	03/25/19	Analysis Date:	6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-15M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

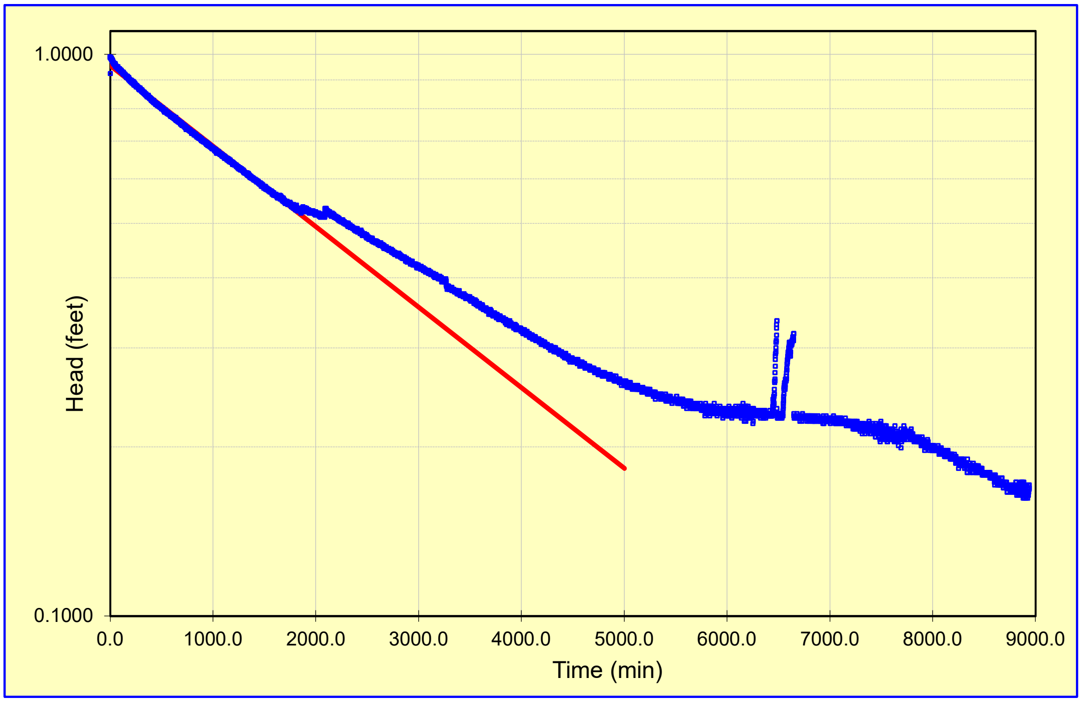
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.17
L_e = 5
$\ln(R_e/r_w)$= 3.38
y_0 = 0.95
y_t = 0.183
t = 5000.0

RESULTS

K=	**3.93E-07**	**cm/sec**
K=	**1.11E-03**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/27/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/12/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-15M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

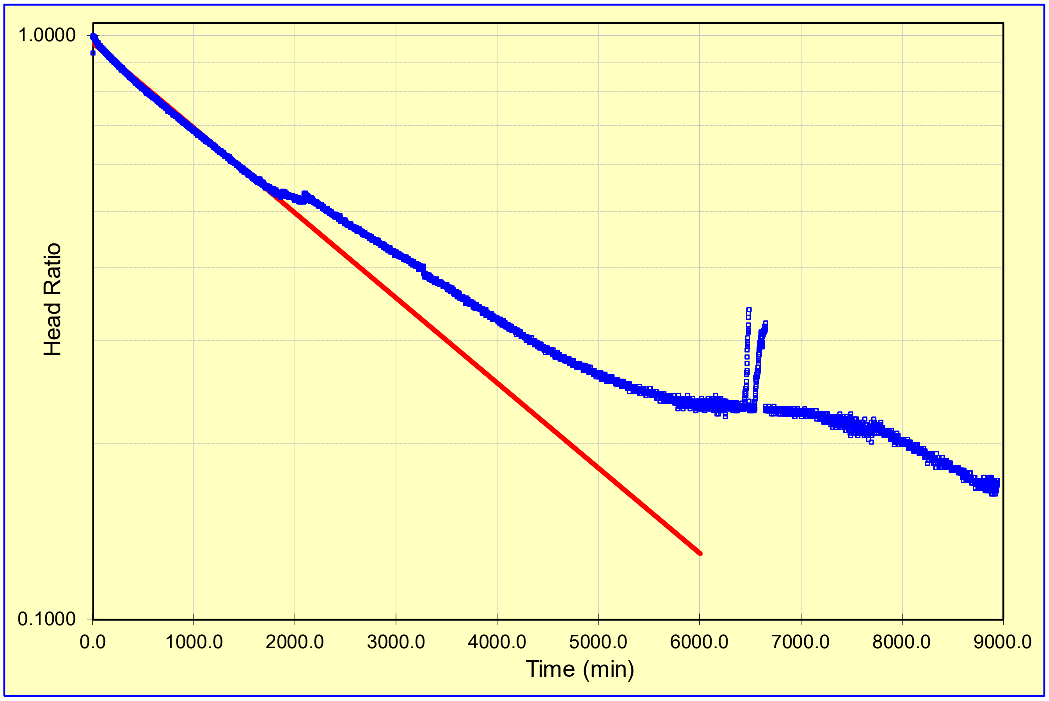
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	6000.00
$h_{1(t1)}$ =	0.97
$h_{2(t2)}$ =	0.130

RESULTS

K=	4.02E-07	cm/sec
K=	1.14E-03	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	LWL
Project No.:	19119078	Checked By:	TK
Test Date:	03/27/19	Analysis Date:	6/12/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-15M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

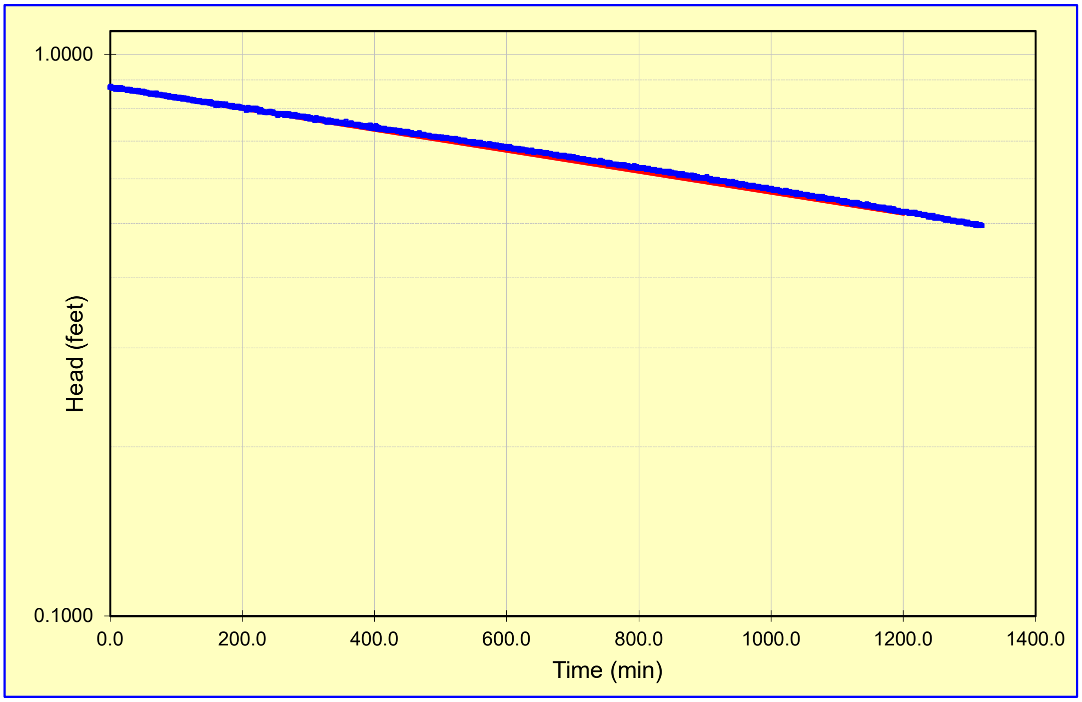
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$\ln(R_e/r_w)$=	**3.38**
y_0 =	**0.87**
y_t =	**0.521**
t =	**1200.0**

RESULTS

K=	**5.13E-07**	**cm/sec**
K=	**1.45E-03**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/27/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/10/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-15M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

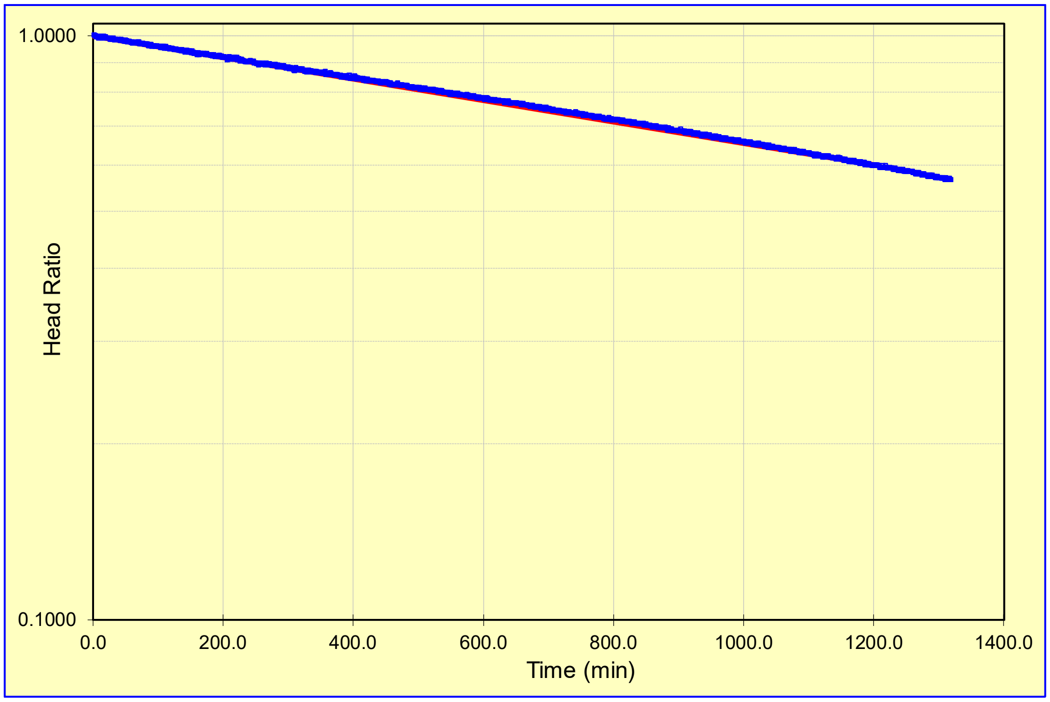
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	1200.00
$h_{1(t1)}$ =	1.00
$h_{2(t2)}$ =	0.602

RESULTS

K=	5.07E-07	cm/sec
K=	1.44E-03	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	03/27/19	Analysis Date:	6/10/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-16M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

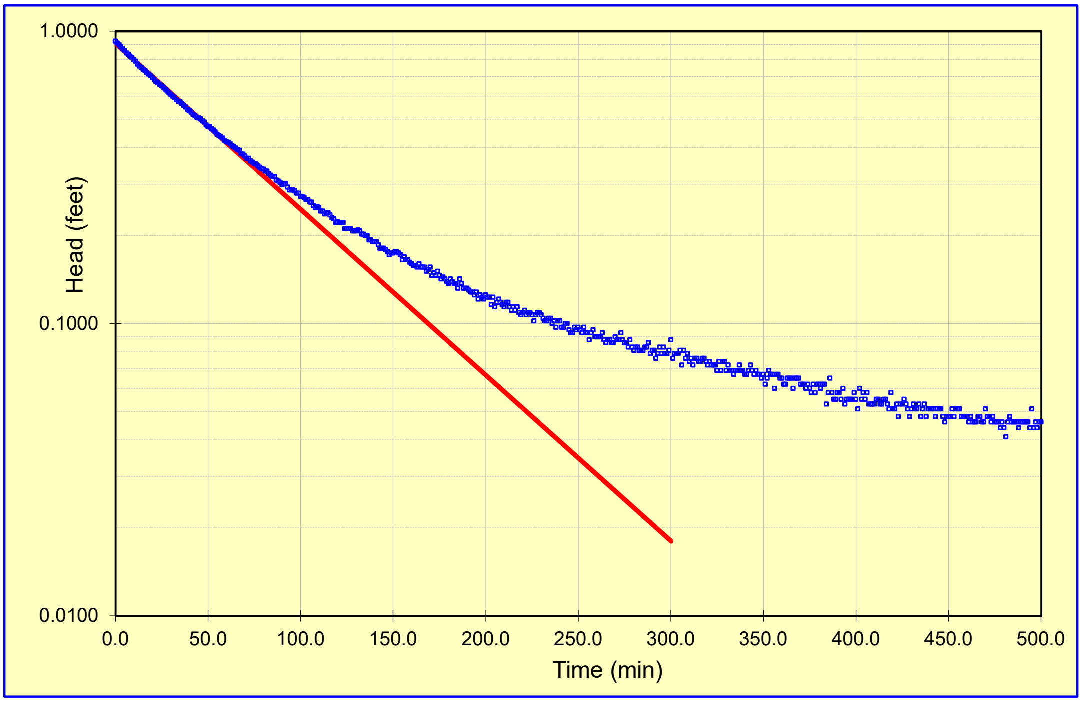
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.91
y_t =	0.018
t =	300.0

RESULTS

K=	1.56E-05	cm/sec
K=	4.41E-02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/27/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-16M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

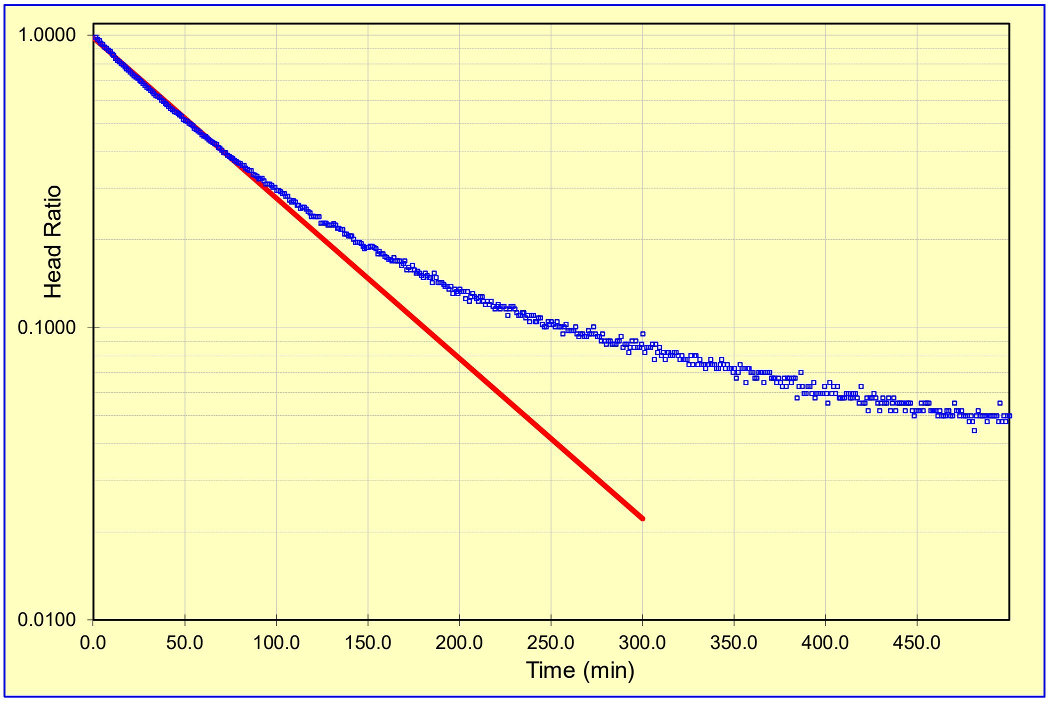
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	300.00
$h_{1(t1)}$ =	0.98
$h_{2(t2)}$ =	0.022

RESULTS

K=	1.51E-05	cm/sec
K=	4.29E-02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/27/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-16M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

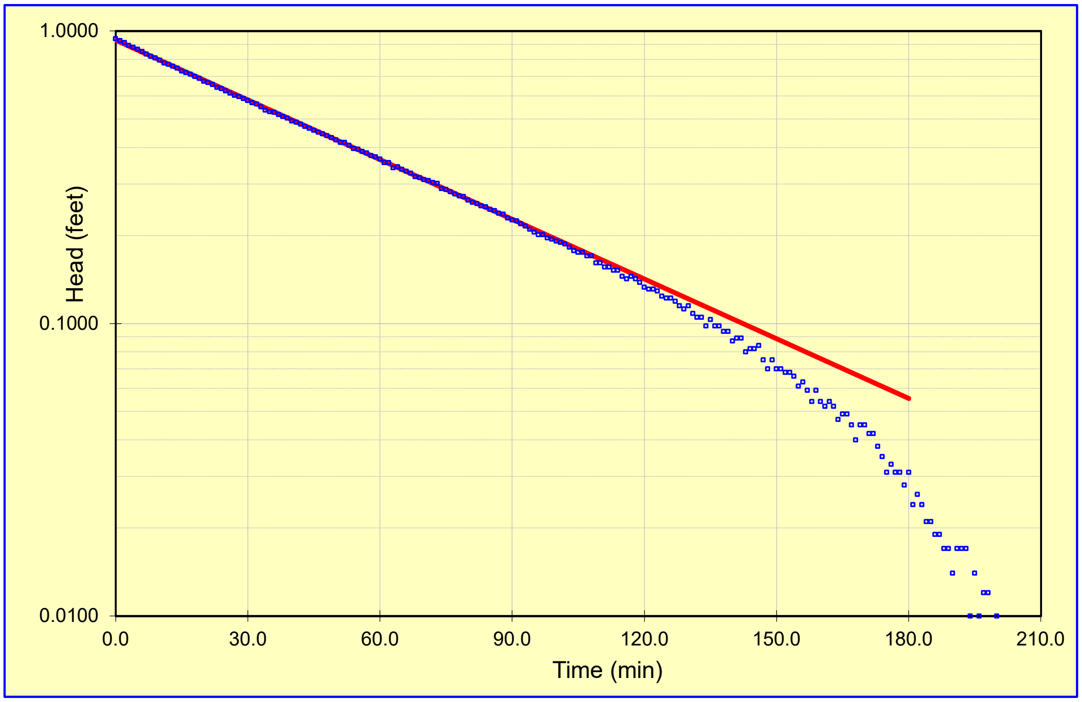
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	0.93
y_t =	0.055
t =	180.0

RESULTS

K=	1.87E-05	cm/sec
K=	5.29E-02	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/27/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-16M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

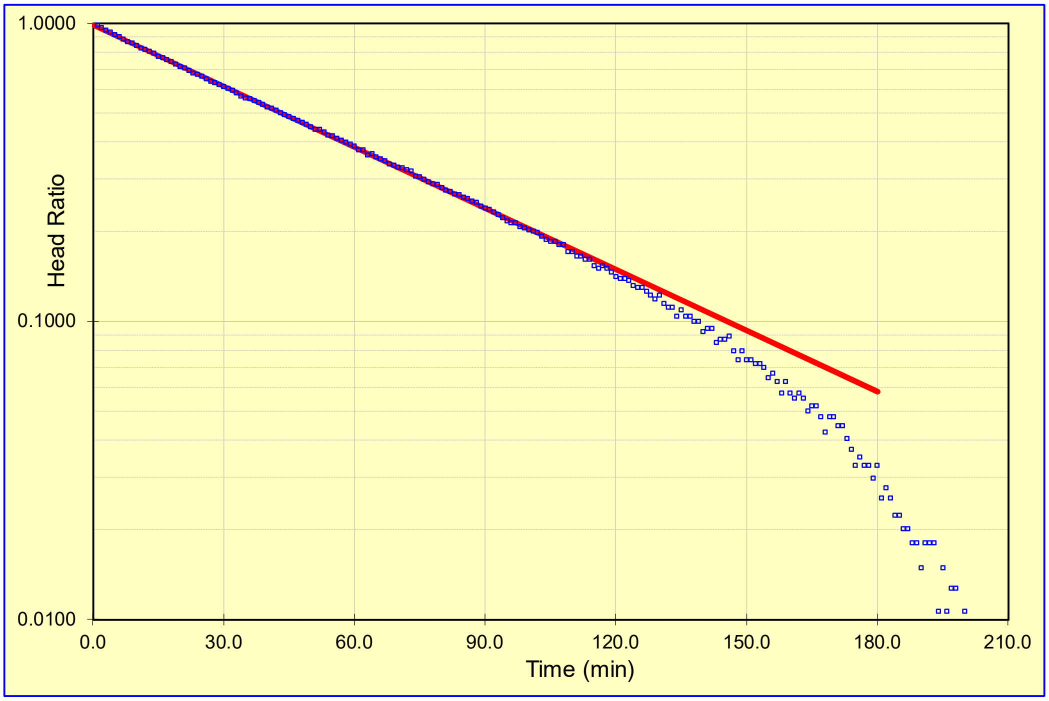
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.17
L_e = 5.0
t_1 = 0.00
t_2 = 180.00
$h_{1(t1)}$ = 0.99
$h_{2(t2)}$ = 0.058

RESULTS

K= 1.89E-05 cm/sec
K= 5.35E-02 ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/27/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/5/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-17M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);

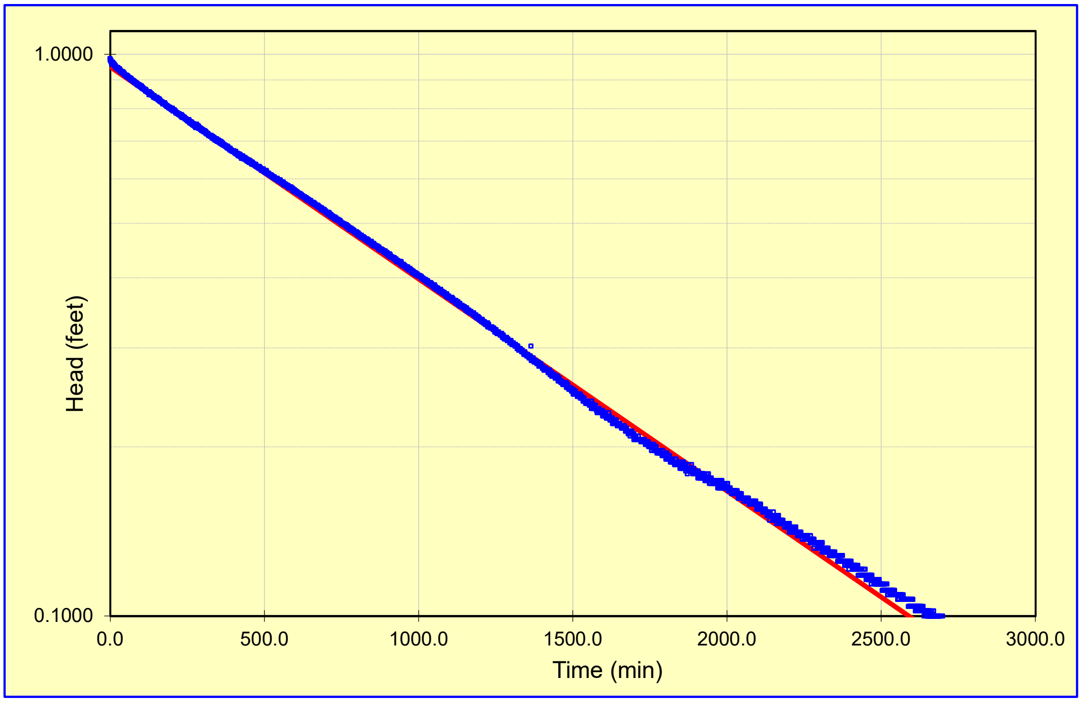
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.17
L_e = 5
$\ln(R_e/r_w)$= 3.38
y_0 = 0.95
y_t = 0.070
t = 3000.0

RESULTS

K= 1.04E-06 cm/sec
K= 2.93E-03 ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/25/19

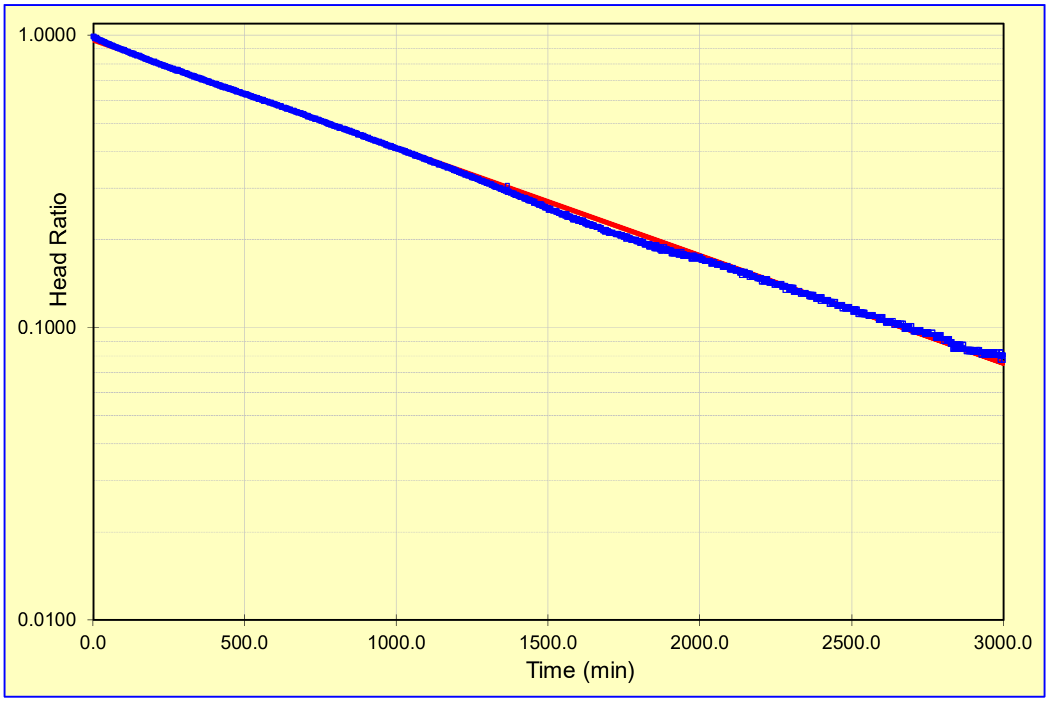
Analysis By: TK
Checked By: LWL
Analysis Date: 6/6/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-17M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**
r_c =	0.08	
R_e =	0.17	
L_e =	5.0	K= 1.02E-06 cm/sec
t_1 =	0.00	K= 2.88E-03 ft/day
t_2 =	3000.00	
$h_{1(t1)}$ =	0.96	
$h_{2(t2)}$ =	0.076	



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	03/25/19	Analysis Date:	6/6/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-17M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

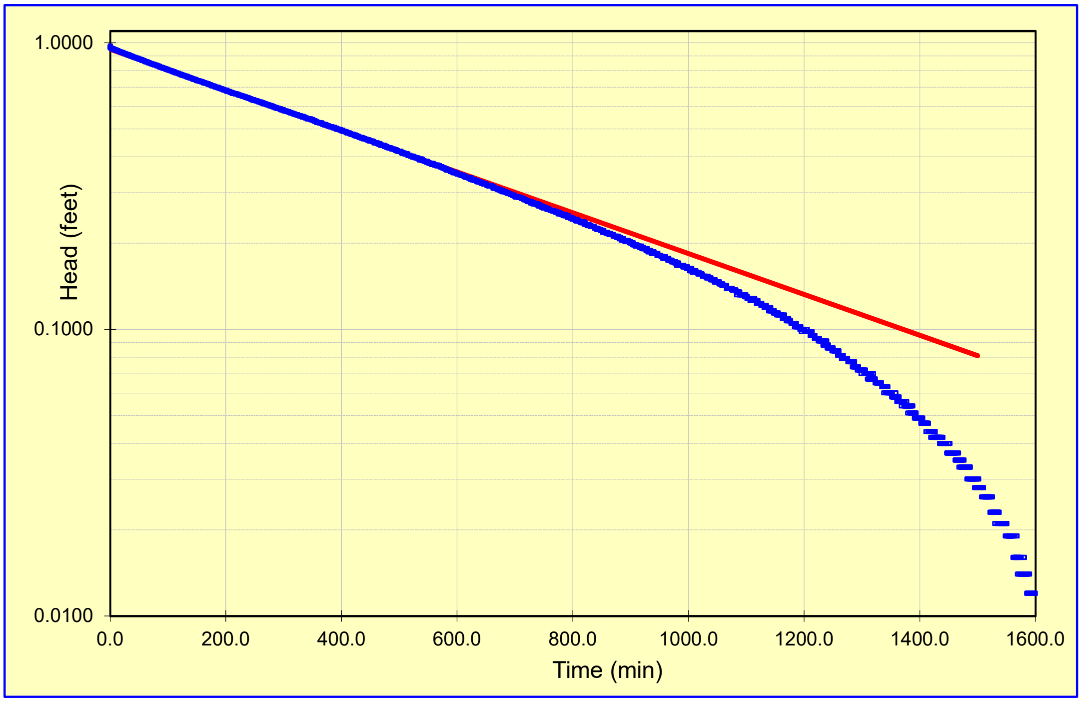
y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.17
L_e =	5
$ln(R_e/r_w)$=	3.38
y_0 =	0.95
y_t =	0.081
t =	1500.0

RESULTS

K=	1.95E-06	cm/sec
K=	5.54E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/25/19

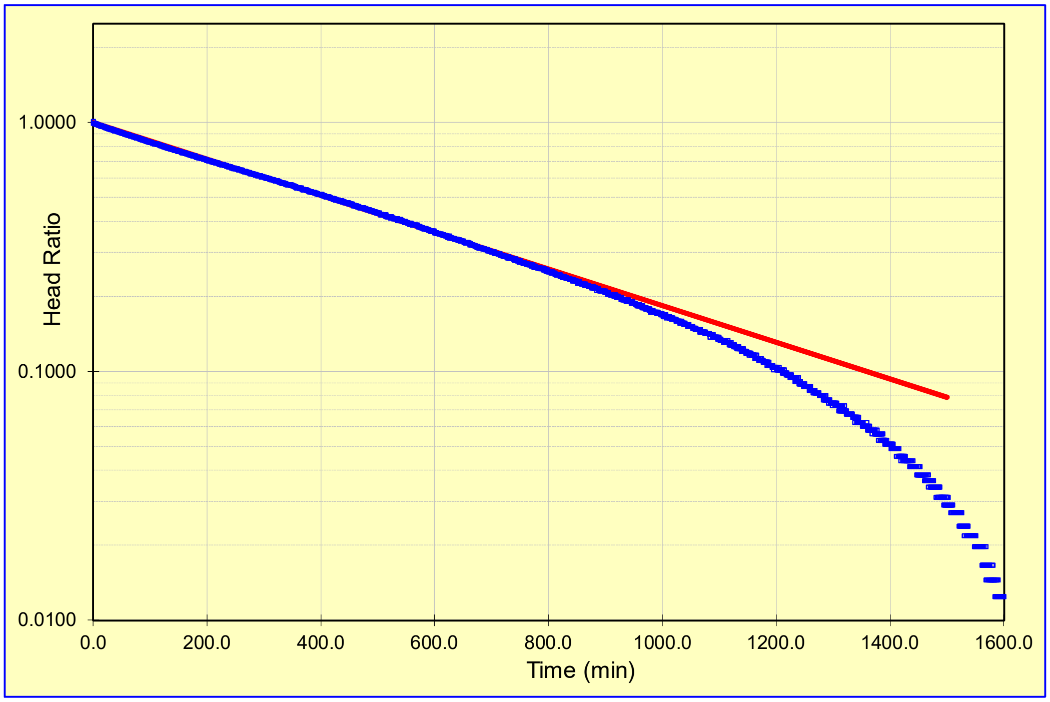
Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-17M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS		**RESULTS**		
r_c =	**0.08**			
R_e =	**0.17**			
L_e =	**5.0**	**K=**	**2.04E-06**	**cm/sec**
t_1 =	**0.00**	**K=**	**5.77E-03**	**ft/day**
t_2 =	**1500.00**			
$h_{1(t1)}$ =	**1.00**			
$h_{2(t2)}$ =	**0.079**			



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	03/25/19	Analysis Date:	6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-18M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

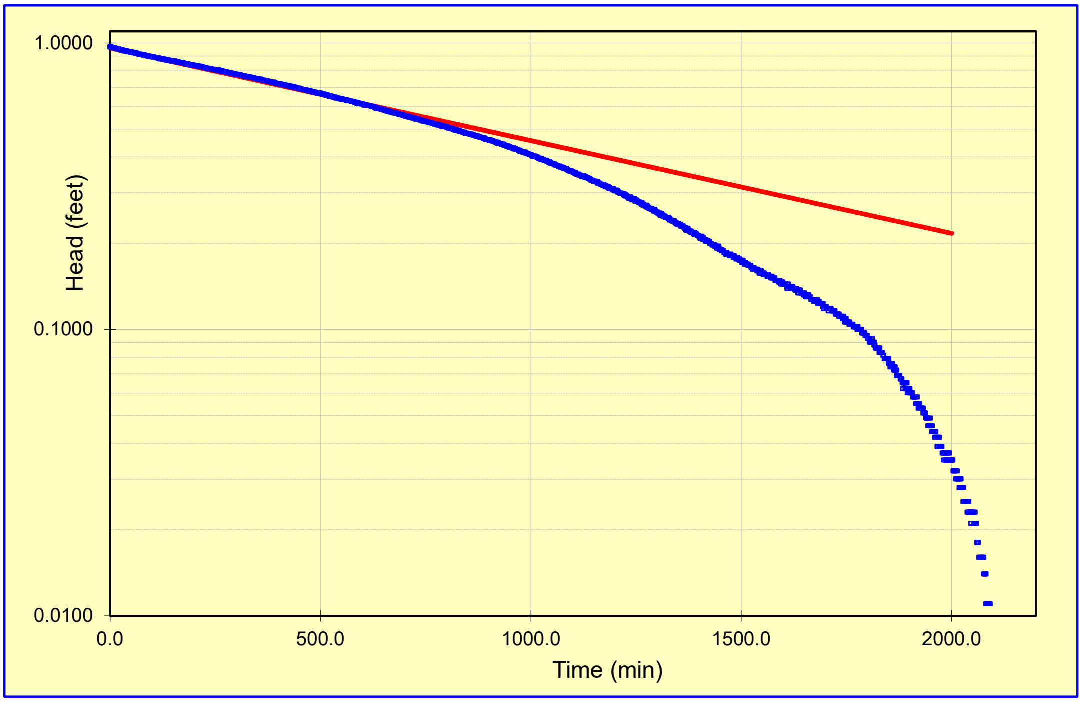
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.17
L_e =	5
$\ln(R_e/r_w)$=	3.38
y_0 =	0.96
y_t =	0.217
t =	2000.0

RESULTS

K=	8.87E-07	cm/sec
K=	2.51E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/25/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST PZ-18M

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

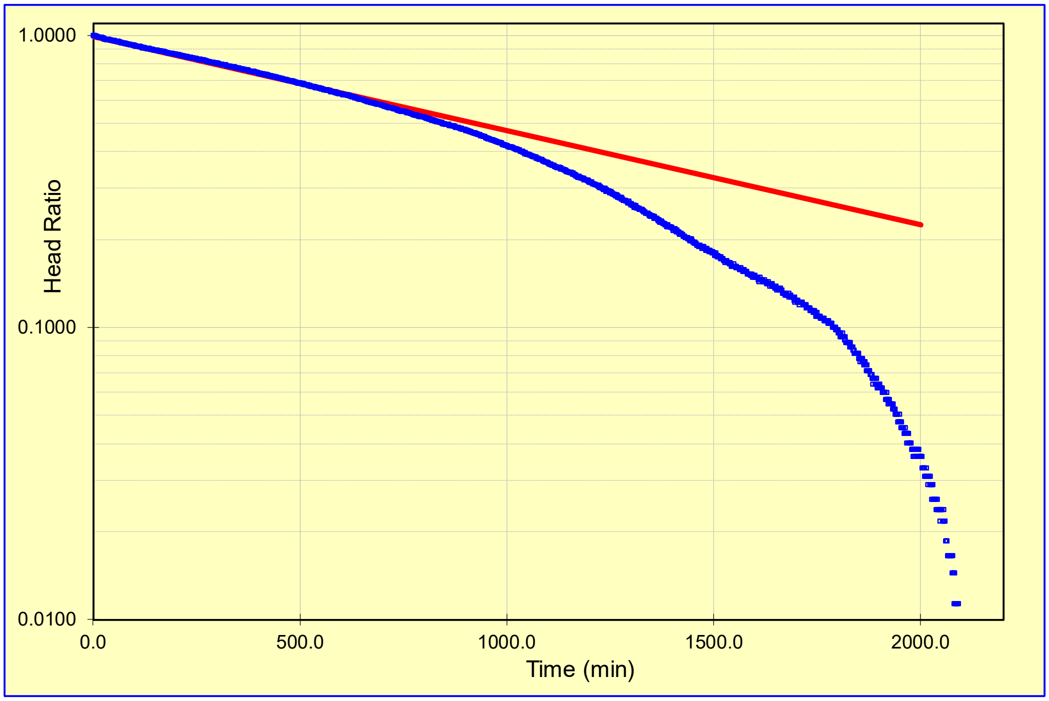
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	2000.00
$h_{1(t1)}$ =	0.99
$h_{2(t2)}$ =	0.225

RESULTS

K=	8.91E-07	cm/sec
K=	2.53E-03	ft/day



Project Name:	Crossroads - Phase 14	Analysis By:	TK
Project No.:	19119078	Checked By:	LWL
Test Date:	03/25/19	Analysis Date:	6/7/2019

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST PZ-18M

$$K = \frac{r_c^2 \ln\left(\frac{L_e}{R_e}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

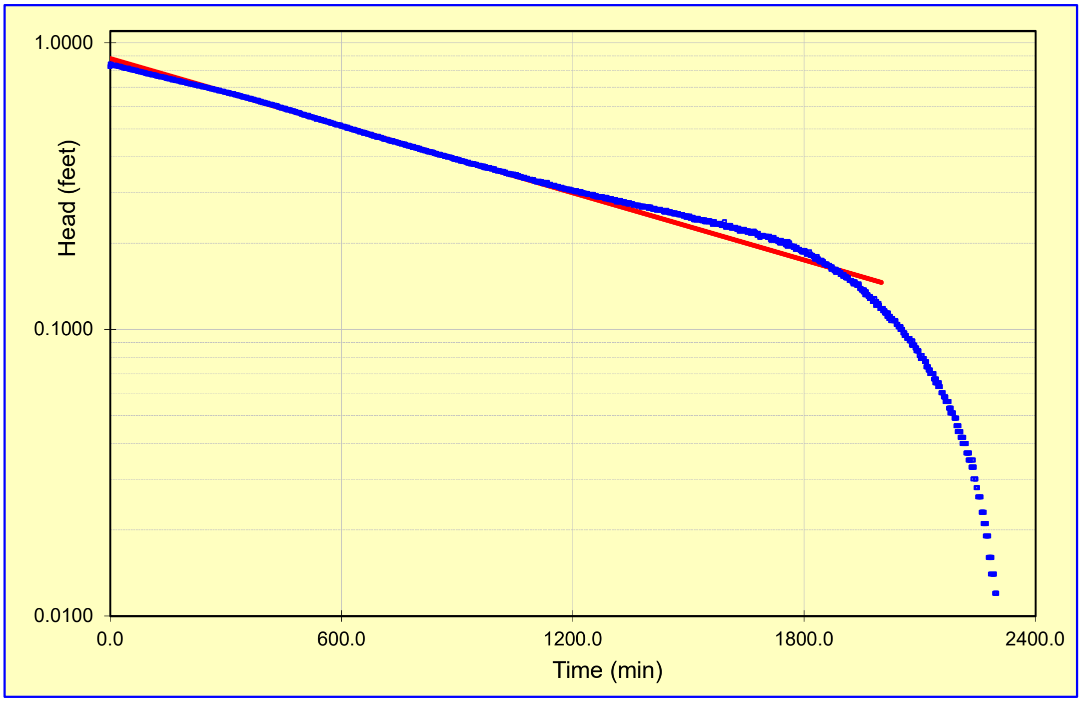
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	**0.08**
r_w =	**0.17**
L_e =	**5**
$ln(R_e/r_w)$=	**3.38**
y_0 =	**0.88**
y_t =	**0.146**
t =	**2000.0**

RESULTS

K=	**1.07E-06**	**cm/sec**
K=	**3.03E-03**	**ft/day**



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/25/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST PZ-18M

$$K = \frac{r_c^2}{2L_e} ln \frac{L_e}{R_e} \left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_1 - t_2)} \right]$$

where:

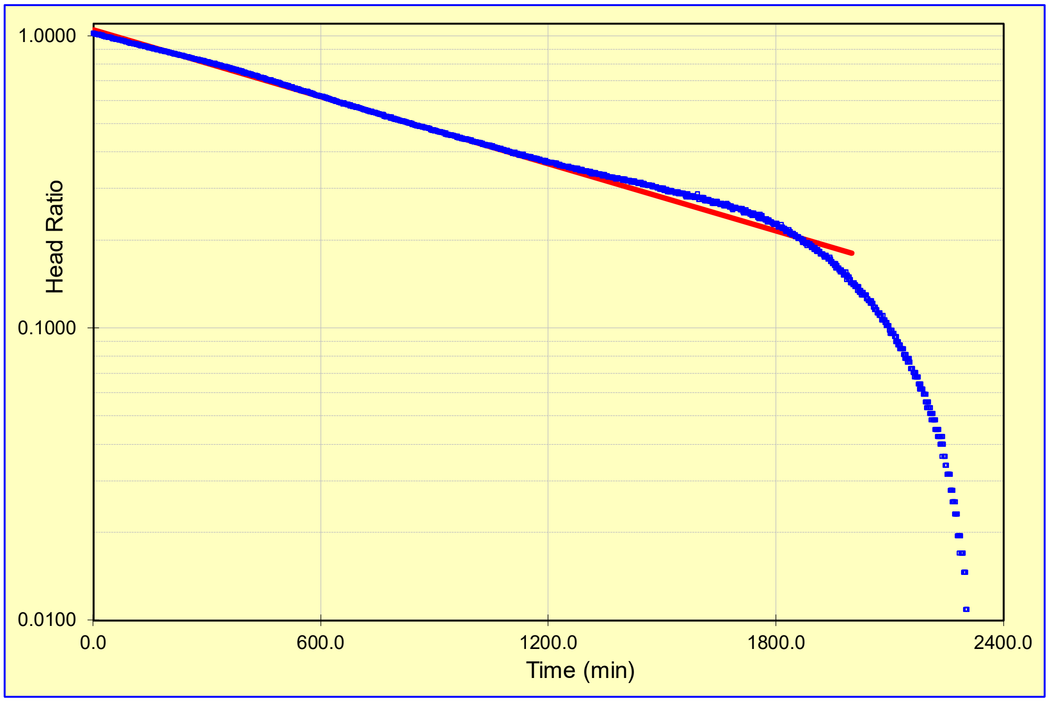
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.17
L_e =	5.0
t_1 =	0.00
t_2 =	2000.00
$h_{1(t1)}$ =	1.05
$h_{2(t2)}$ =	0.181

RESULTS

K=	1.05E-06	cm/sec
K=	2.99E-03	ft/day



Project Name: Crossroads - Phase 14
Project No.: 19119078
Test Date: 03/25/19

Analysis By: TK
Checked By: LWL
Analysis Date: 6/7/2019

APPENDIX D

Seepage Velocity and Time of Travel Calculations

Seepage Velocity and Time of Travel Calculation
WMDSM Phase 14 - Site Assessment Report

Pathway 1: Phase 14E Sump to Stream West of Phase 14 Waste Boundary

Purpose: Calculate a time of travel for groundwater at the Phase 14E sump, horizontally through the stiff clay to the location of the closest stream.

Calculations:

A.1 - Calculate horizontal seepage velocity through the stiff clay

Seepage Velocity: V= K(I)/(n)

Input Parameters		Value	Units	Source
Horizontal hydraulic conductivity of stiff clay	K=	1.23	ft/yr	Geomean of all stiff clay unit slug tests
Horizontal Hydraulic Gradient	I=	0.047	ft/ft	Gradient from Phase 14E Sump to S-5 ((277 ft msl to 259.27 ft msl) / Distance (376 ft))
Effective porosity	n	0.1	-	Default value per MEDEP Chapter 401.2.C(2)
Horizontal seepage velocity through the till	**V=**	**0.6**	**ft/yr**	

A.2 - Calculate time of travel through stiff clay, from sump 14E west to closest stream

Time of Travel: T= X/V

Input Parameters		Value	Units	Source
Distance, Phase 14E sump to closest stream	X=	382	ft	Figure 12b, Pathway 1
Horizontal seepage velocity of stiff clay	V=	0.6	ft/yr	Calculation A.1
Total Pathway Time of Travel	**T=**	**637**	**years**	

Prepared by: BDL
Checked by: LWL
Approved by: APTM

Seepage Velocity and Time of Travel Calculation
WMDSM Phase 14 - Site Assessment Report

Pathway 2: Phase 14A Sump to Stream Southeast of Phase 14 Waste Boundary

Purpose: Calculate a time of travel for theoretical release to groundwater at the Phase 14A sump, horizontally through the stiff clay to the location of the closest stream.

Calculations:

A.1 - Calculate horizontal seepage velocity through the stiff clay

Seepage Velocity: V= K(I)/(n)

Input Parameters		Value	Units	Source
Horizontal hydraulic conductivity of stiff clay	K=	1.23	ft/yr	Geomean of all stiff clay unit slug tests
Horizontal Hydraulic Gradient	i=	0.036	ft/ft	Gradient from Phase 14A Sump to S-4 ((275 ft msl to 251.35 ft msl) / Distance (664 ft))
Effective porosity	n	0.1	-	Default value per MEDEP Chapter 401.2.C(2)
Horizontal seepage velocity through the till	**V=**	**0.4**	**ft/yr**	

A.2 - Calculate time of travel through stiff clay, from sump 14A southeast to closest stream

Time of Travel: T= X/V

Input Parameters		Value	Units	Source
Distance, Phase 14A sump to closest stream	X=	615	ft	Figure 12b
Horizontal seepage velocity of stiff clay	V=	0.4	ft/yr	Calculation A.1
Total Pathway Time of Travel	**T=**	**1,538**	**years**	

Prepared by: BDL
Checked by: LWL
Approved by: APTM

Seepage Velocity and Time of Travel Calculation
WMDSM Phase 14 - Site Assessment Report

Pathway 3: Phase 14A to WMDSM New Office Well

Purpose: Calculate a time of travel for theoretical release to groundwater at the Phase 14A sump, vertically through the clay to the till, horizontal through the till to the location of the WMDSM New Ofice well.

Calculations:

A.1 - Calculate vertical seepage velocity through the stiff upper Presumpscot clay

Seepage Velocity: V= K(I)/n

Input Parameters		Value	Units	Note
Vertical hydraulic conductivity of stiff clay	K=	0.14	ft/yr	Geometric mean of stiff clay permeameter tests
Hydraulic gradient of phreatic and till units	I=	0.396	ft/ft	Calculated between MW14-03M and MW14-03D. Table 5
Effective porosity	n	0.1	-	Default value per MEDEP Chapter 401.2.C(2)
Vertical seepage velocity of stiff clay	**V=**	**0.6**	**ft/yr**	

A.2 - Calculate time of travel through stiff clay

Travel Time: T= X/V

Input Parameters		Value	Units	Note
Distance, thickness of stiff clay	X=	6.5	ft	Thickness measured at CPT17 (9.5 ft), sump bottom approx 3 ft below top of unit
Vertical seepage velocity of stiff clay	V=	0.6	ft/yr	Calculation A.1
Time of travel through stiff clay	**T=**	**10.8**	**years**	

B.1 - Calculate vertical seepage velocity through the soft lower Presumpscot clay

Seepage Velocity: V= K(I)/n

Input Parameters		Value	Units	Note
Vertical hydraulic conductivity of soft clay	K=	0.18	ft/yr	Geometric mean of soft clay permeameter tests
Hydraulic gradient of phreatic and till units	I=	0.40	ft/ft	Calculated between MW14-03M and MW14-03D. Table 5
Effective porosity	n	0.1	-	Default value per MEDEP Chapter 401.2.C(2)
Vertical seepage velocity of soft clay	**V=**	**0.7**	**ft/yr**	

B.2 - Calculate time of travel through soft clay

Time of Travel: T= X/V

Input Parameters		Value	Units	Note
Distance, thickness of soft clay	X=	4.5	ft	As measured at CPT17
Vertical seepage velocity of soft clay	V=	0.7	ft/yr	Calculation B.1
Time of travel through soft clay	**T=**	**6.4**	**years**	

C.1 - Calculate horizontal seepage velocity through the till

Seepage Velocity: V= K(I)/n

Input Parameters		Value	Units	Note
Horizontal hydraulic conductivity of till	K=	786.19	ft/yr	Geomean of all till unit slug tests
Horizontal Hydraulic Gradient	i=	0.027	ft/ft	Average gradient, Figure 13a
Effective porosity	n	0.1	-	Default value per MEDEP Chapter 401.2.C(2)
Horizontal seepage velocity through the till	**V=**	**212.3**	**ft/yr**	

C.2 - Calculate time of travel through till, from bottom of clay beneath sump, to WMDSM Well

Time of Travel: T= X/V

Input Parameters		Value	Units	Note
Distance, Phase 14A sump to WMDSM well	X=	1577	ft	Figure 13b, Pathway 3
Horizontal seepage velocity of till	V=	212.3	ft/yr	Calculation C.1
Time of travel horizontal through till	**T=**	**7**	**years**	

D - Calculate time of travel time from sump bottom to WMDSM Well

T= T+T+T

Time of travel through stiff clay	**T=**	**10.8**	**years**
Time of travel through soft clay	**T=**	**6.4**	**years**
Time of travel horizontal through till	**T=**	**7**	**years**
Total Pathway Time of Travel	**T=**	**25**	**years**

Prepared by: BDL
Checked by: LWL
Approved by: APTM

APPENDIX E

Groundwater Modeling Excerpts from Gerber, 1996

APPENDIX C

GROUNDWATER MODELING EXCERPTS FROM GERBER, 1996

Phase 9, 11 and 12 Permit Applications

4.3. COMPUTER SIMULATIONS

4.3.1 Introduction

RGGI uses numerical models to simulate ground water flow and to perform the landfill failure analysis. Numerical models allow for the flexibility of including the complexities of the site, such as the drainage features and the heterogeneous geology. The numerical models are used for predictive simulations, and in addition as a tool to integrate the field data and refine our conceptual model describing the site hydrogeology.

Two ground water flow models and a solute transport model were used. A detailed three-dimensional ground water flow model analyzes the detailed flow at the site. A two-dimensional regional bedrock ground water flow model determines appropriate boundary conditions for the bedrock portion of the detailed site model. The landfill failure analysis is investigated using a three-dimensional advective particle tracking model to determine travel times, and the extent of the advective transport. A three-dimensional solute transport model is used to simulate ground water concentrations and mass fluxes for failure scenarios.

Three failure scenarios evaluate the impacts of potential leaks on the ground water quality. In addition, we evaluate surface water impacts from both the existing and proposed landfills at the site. As required in the regulations, failure scenario #1 investigates a total engineered systems failure to evaluate all potential receptors from the proposed landfill footprints. This scenario assumes no liners, leachate collection system or other engineered systems are in place and that rainfall infiltrates through the trash and becomes leachate.

For failure scenario #2, we focus on the long term effect of leaks through the landfill liners. Although short term failures having greater leakage rates are possible, these would be apparent by visual inspection during operation. Consequently, these failures could be repaired, and occur only for a limited time period. However, an undetected leak through both primary and secondary liners, though very unlikely, could have a larger cumulative impact over time.

Failure scenario #3 investigates the impacts of a leak from two leachate pumping stations. Although there will be alarms within the double walled south central station, this scenario involves a pumping station overflow for a three day period. Leachate would flow overland and a portion of that leachate would saturate the surface and infiltrate to ground water. This scenario does not include any provisions for remediation of the topsoil.

A final series of analytical calculations considers the long term impact on surface water quality from the engineering systems design failure scenario. We have chosen five locations on local drainage ways that represent potential receptor locations of shallow ground water flow from within the proposed landfill footprints. In addition, site-wide cumulative surface water impacts are calculated for surface water at Mill Stream where it crosses Route 2.

Failure scenario simulations are extremely conservative in that they do not consider the implementation of any remediation measures and simulations are modeled for long periods of time. The potential incremental impacts from the failure scenarios presented would be significantly lower if remediation measures were implemented.

We simulated ground water flow in the regional bedrock aquifer using the AQUIFEM model (Townley and Wilson, 1980). AQUIFEM is a two-dimensional finite element model, used to model the regional bedrock of this site since 1985. We have used AQUIFEM over the course of our work to maintain consistency with previous studies. We simulated local flow in three dimensions using the USGS MODFLOW model (McDonald and Harbaugh, 1988). MODFLOW is a three-dimensional finite difference model. AQUIFEM was used to simulate the general regional bedrock flow and to establish perimeter bedrock head boundary conditions for the local flow and transport models. We used this same approach in our 1987 study (RGGI, 1987) and our 1993 study (RGGI, 1993). However, the local area of interest is now larger and, therefore, a new and larger MODFLOW site grid was required. The MODFLOW grid was extended 1325' to the southeast and 1750' to the northeast. We discuss the models and simulations in greater detail below.

4.3.2 Elements of a Ground Water Model

Development of a ground water model application entails several steps.

Conceptual Model

The steps taken in setting up the regional and local models are essentially identical. The first task is to develop a conceptual picture of the system. This requires a clear understanding of the geologic setting, physical and hydrologic boundaries, climatic inputs, and the important anthropogenic impacts on the aquifer. The ultimate success of the numerical model depends heavily on the underlying conceptual model.

Discretization

Ground water models such as AQUIFEM or MODFLOW are numerical implementations of system conceptual models. The framework of the implementation consists of the partial differential equations of ground water flow. Analytical solutions to the flow equations are available for only the simplest flow regimes. Therefore, approximate solutions are obtained by discretizing the continuous equations in time and space. Finite difference and finite element methods are alternative approaches to approximating the basic flow equations. Regardless of the method, fine discretization is employed in areas of interest. Coarser discretization is allowed in all other parts of the model.

Parameterization

Solution of the flow equations requires specification of aquifer parameters and numerical values for boundary conditions and forcing functions (pumping and recharge). This step is called "parameterization". Basic aquifer parameters include conductivity K (L/T), storativity S, thickness b (L), and leakance K' (vertical permeability divided by formation thickness) (1/T). Boundary conditions include fixed head reference head elevations, drain reference head elevations and conductances, and specified fluxes. System forcing functions include areal recharge and imposed pumping and recharge. Some parameters are known with sufficient confidence that they are subject to little or no revision. Other parameter values specified at this stage are only "starting values" that must be adjusted in the calibration process.

Calibration

Calibration is the "fine tuning" of a model to produce some kind of "best-fit" agreement with observed water levels. This is formally known as the "inverse problem" of ground water modeling. For practical reasons, calibration of parameters other than storativity and specific yield are almost always done with a steady state model. Ideally, calibration should be accomplished by systematic variation of just a small number of parameters. The adjustment of individual nodal parameter values should be avoided.

Calibration is more than just fitting model simulations to water level observations. As noted above, calibration must confirm the reasonableness of all salient aspects of the conceptual model. The obvious hydrogeologic parameters, conductivities and recharge, are usually of primary interest. However, it is also important to examine horizontal and vertical gradients and fluxes at specified head boundaries near areas of interest.

Verification

If there are enough data, we verify a calibrated model by running it with a second, independent data set that was not used in the calibration. Successful simulation of a pumping test can also indicate a good calibration. If the model is calibrated to steady state conditions, then storativity must be estimated for the pumping test simulation. As a practical matter, a pumping test simulation often serves the dual purposes of calibrating storativity as well as verifying the rest of the model calibration.

Scenario Simulation

Models are used to evaluate the impact of some proposed development by comparing pre-development and post-development simulations. Proposed development is typically implemented in a model by changing recharge patterns, boundary conditions, pumping and solute loading. The potential impact on ground water quality is often of interest. Then solute source loading is implemented in the model for mass transport.

4.3.3 Regional Bedrock Aquifer Flow Simulation

Conceptual Model

We modeled the regional bedrock aquifer as a two-dimensional confined aquifer subject to leaky overlying recharge. We used the AQUIFEM model developed for our 1985, 1987 and 1993 studies to simulate bedrock ground water flow in the regional system. We refined the AQUIFEM model based on knowledge gained during previous model applications and additional field information obtained for the site and regional area. We implemented the following changes to the 1993 model:

- Refined the grid in the vicinity of upper Mill Stream (near Wilder Hill Road) to improve simulation of Mill Stream in that area. Previous model runs suggested that the model grid was coarse in this area. We increased the number of nodes from 275 to 280 and the number of grid elements from 485 to 495.
- Increased the number of prescribed boundary head nodes from 33 to 40 to add fixed head nodes along the Sandy River;
- Enabled the model to simulate direct recharge at 18 elements in the vicinity of Ross Hill where our geologic interpretation suggests a very thin or non-existent overlying aquifer. We based our geologic interpretation on the presence of bedrock outcropping or thin surficial deposits.

- Zoned the model leakance by surficial deposit material type. We defined 8 leakance zones that included: lower Mill Stream; upper Mill Stream; thick gray clay; thin gray clay; glacial till; esker deposits; Witham Brook; and thin sand.
- Added two high transmissivity zones in the bedrock at the site based on photolineament analysis and hydraulic testing. We identified these zones in the model as two strings of connected nodes where bedrock transmissivity is higher than the nodes in the remainder of the model grid.
- Set reference heads in the overlying aquifer a given distance below ground surface depending on the surficial deposit material type.

The model domain is intentionally large because we extended the boundaries to natural physical aquifer boundaries taken from the U.S.G.S. 7.5' Topographic Quadrangle for Norridgewock. Perimeter boundary conditions are specified as either fixed head or no-flow. Model boundaries along major surface water bodies (the Kennebec and the Sandy Rivers) are specified as fixed head nodes. All other exterior boundaries (i.e.. terrestrial boundaries that run along topographic divides and across mountain saddles) are specified as no-flow nodes. The perimeter boundaries are distant from the site area. This is desirable, since uncertainties in the boundary conditions and values will have minimal impact on the results in the site area.

We treated the bedrock as a confined aquifer subject to overlying leaky recharge. As indicated in the model refinements above, we applied direct recharge to 18 elements in the vicinity of Ross Hill where the overlying aquifer is thin or non-existent. We did not include any pumping wells in the model, since the few pumping wells for which we have data would have a limited effect on the large area regional flow model. Based on our knowledge of the bedrock geology, we inferred that the bedrock system is anisotropic. We assumed that the major transmissivity axis (Y-direction in the AQUIFEM mesh) is N51E. This matches the site 3-D model (MODFLOW). Even though water movement is through bedrock fractures, we have found that fractured bedrock aquifers behave as porous media at the regional scale (RGGI and others, 1991).

Discretization

Finite element models are flexible in that they allow arbitrary domain discretization conforming to natural boundaries and areas of interest. Unlike variable grid finite difference models, a wide range of element sizes can be used without introducing undesirable element aspect ratio problems. The two main purposes of the regional model were to provide a general understanding of regional bedrock flow and to provide estimates of head for arbitrarily located fixed head boundaries around the outside of the detailed finite difference site model. Therefore, we did not have to employ fine mesh resolution in the regional model. The finite element mesh is shown in **Figure 4-40**. We used the smallest elements in the site area. Elements there are on the order of $5\text{x}10^4$ ft^2 in area. The elements removed from the site are on the order of $1\text{x}10^6$ ft^2 in area. The model mesh consists of 280 nodes and 495 triangular elements.

Parameterization

We used AQUIFEM in a linear, steady-state mode with overlying leaky recharge. We used a similar parameter set as the 1993 model with the exceptions of decreasing the transmissivity and the addition of direct recharge which we applied to 18 elements in the vicinity of Ross Hill. We set reference heads a given distance below ground surface depending on the surficial material zone. Reference heads at fixed head nodes were set equal to river water levels as shown on the U.S.G.S. 7.5' Topographic Quadrangle for Norridgewock.

The required model parameters included transmissivity, leakance, reference head elevations, bottom of aquifer elevation, recharge rate, and fixed head elevations. We used a uniform major transmissivity of 62 ft^2/day. The anisotropy ratio (minor to major) was taken as 1/3, so the minor transmissivity was 21 ft^2/day. The equivalent isotropic transmissivity is 35.8 ft^2/day. As illustrated in **Figure 4-40**, we increased transmissivity for 14 nodes along two high transmissivity zones in the bedrock at the site based on photolineament analysis and hydraulic testing at the site. We set the major transmissivity for these two zones at 1040 ft^2/day and the minor transmissivity at 350 ft^2/day.

To consider the effect of spatially variable surficial deposits on bedrock recharge, we varied leakance based on the presence of competent surface water courses, overburden type, and overburden thickness. We used our findings from vertical hydraulic conductivity testing performed for the Phase 8 & 10 Expansion report to evaluate model leakance with the exception of esker material which is based on hydraulic testing that RGGI has performed in esker deposits at other sites in Maine. To calculate the preliminary leakance for initial model runs, we divided the vertical hydraulic conductivity by the average saturated overburden thickness for each surficial material zone. We obtained values for the average saturated overburden thickness from Maine Geological Survey Open File Report 87-24d (Significant Sand and Gravel Aquifer Map 31). We adjusted the leakance based on our simulations and knowledge of the regional surficial geology. A larger leakance indicates a greater hydraulic connection between the bedrock aquifer and the overlying water table aquifer. Calibrated values for leakance parameters are shown in the table below:

Final Aquifem Leakance Values

Material	Leakance (1/day)
Mill Stream (lower reach)	1.0E-01
Mill Stream (upper reach)	9.0E-03
Gray Clay (lower leakance)	1.0E-05
Gray Clay (higher leakance)	2.1E-04
Glacial Till	8.4E-03
Esker Deposits	9.5E-02
Witham Brook	1.0E-01
Thin Sand	9.5E-02

Total leakage through the model results in an effective recharge rate of 1.3 inches/year or about 3% of annual precipitation.

Calibration

We developed a calibration table using available offsite data proximal to the site (7 domestic well locations), and 27 on site data points. The data points are concentrated in the vicinity of the site since that is the focus of the model. Water levels for the on-site data set were measured between April 5-12, 1993. Water levels for the domestic wells were measured between 1/24/89 and 7/22/93.

The simulated and measured data are summarized in **Table 4-18** along with summary statistics. The calibration statistics for the head residual average and standard deviation differ slightly from the 1993 model. The average of the residuals (simulated heads minus observed heads) during the 1993 model was 0.8 ft and during the recent model the average was -0.82. The standard deviation, on the other hand, was higher during the recent modeling at 4.86 ft compared to 1.6 ft for the 1993 model. The standard deviation is greater in the recent modeling because of the larger number of calibration wells spread over a larger area. The standard deviation decreases considerably when the outlying domestic wells are removed from the calibration table. The domestic well data are from well driller reports collected by the Maine Geological Survey. We have less confidence in the MGS well data since the records for those types of wells are not collected with the same level of quality control and assurance as the data we have for the on site wells. However, changing the calibration table violates the "random" aspect of data point selection. We conclude that the model is adequately calibrated. **Figure 4-41** shows the regional bedrock potentiometric surface as simulated by the calibrated AQUIFEM model.

Verification

Verification of a regional model would require many data points evenly distributed over a regional scale. As indicated above for Calibration, we used all available off site data points proximal to the site and 27 on site data points. Although there are other potential data points beyond the area proximal to the site, the data are sparse, unsurveyed, difficult to access and by no means as complete as the combination of the on site data set and surrounding domestic wells.

Therefore, we conclude that the regional data are too sparse to verify the model by comparison to a separate data set. Since the regional bedrock model is used only to set boundary conditions for the site model, the regional model is sufficiently calibrated for its intended use.

Scenario Simulation

The bedrock model was developed so it could be used to establish boundary conditions for the site 3-D finite difference flow and transport models. Therefore, the only scenario of interest was the regional steady state conditions as portrayed by the calibration data.

The potentiometric surface of the bedrock aquifer as simulated by the AQUIFEM flow model shows contours for the vertically-averaged potentials at mid-depth of the bedrock aquifer. In general, the potentiometric contours are a subdued reflection of ground surface contours. In the west, and northeast parts of the model domain, regional bedrock ground water discharges to the Kennebec and Sandy Rivers.

There is a ground water divide northeast of the site. The model indicates that bedrock ground water northeast of this divide flows into the Kennebec River as part of the regional flow regime. Bedrock ground water southwest of this divide flows in two directions depending on proximity to a ground water saddle located in the vicinity of the Norridgewock Airport. Bedrock ground water east of the saddle flows to Mill Stream. Bedrock ground water west of the saddle flows to Witham Brook (a tributary of the Sandy River) or directly into the Sandy River.

4.3.4 Site 3-D Flow Simulation

Conceptual Model

The widely used three-dimensional flow model MODFLOW (McDonald and Harbaugh,1988) was selected for use as the site flow model. MODFLOW is a three-dimensional finite difference flow model developed by the US Geological Survey. The numerical basis of MODFLOW is well documented in the model manual.

The regional ground water flow, which was analyzed with the bedrock aquifer flow simulation, is towards Sandy River, the Kennebec River and their tributaries, including Mill Stream. The Crossroads site is located in a topographic low, and the local flow is generally towards Mill Stream. The sources of ground water are recharge and horizontal flow through the model boundaries as determined by the regional model. The sinks of ground water are the discharge to surface water streams and groundwater flow through the model boundaries.

The domain of the site model is shown in **Figure 4-42**, the Site Model Base Map. The dimensions of the model are 9475 feet by 10975 feet, which encompasses an area of 3.73 square miles. The model domain extends away from the site area of interest to limit the influence of the model boundaries. The 1993 model was expanded 1325 feet to the southeast and 1750 feet to the northeast. The simulations are steady-state, with the conditions modeled approximating average annual ground water flow conditions. The ground water flow model is linear, with the transmissivity independent of the water table elevation. A linear model was chosen because of the increased numerical efficiency. Since the phreatic surface is near ground surface throughout the model area, the saturated thickness is approximately known. Consequently the use of a nonlinear model would not produce significantly different results, because changes in the water table would affect the transmissivity only to a small degree.

The dominant geologic feature at the Crossroads site is the thick layer of gray glaciomarine clay-silt with a very low hydraulic conductivity. This clay-silt layer pinches out near the southern edge of the property. The upper few feet of the clay-silt is a weathered olive clay-silt, and consequently fissured. Between the clay-silt and the bedrock is a layer of glacial till. Where the clay-silt thins out, the till layer is sometimes exposed at the surface. The coarse-grained (silty sand) facies of the Presumpscot Formation blankets the finer-grained olive brown and gray clay-silt to the north of the site. A lobe of this sequence extends down into the property boundary and across proposed Phase 11. Localized eolian fine sands are also evident throughout the region. A mappable area of these eolian deposits is located in the proposed Phase 11 area.

Because of the low hydraulic conductivity of the gray clay-silt compared to the overlying fissured olive clay-silt, the gray clay-silt acts as an aquitard with primarily vertical ground water flow despite a pronounced anisotropy that would favor horizontal flow. The ground water flow is primarily horizontal in the olive clay-silt and the till. The low hydraulic conductivity of the gray clay-silt limits recharge from precipitation, and also creates a relatively shallow upper ground water flow system with ground water discharging locally to surface water drainage features. The recharge is greater where the gray clay-silt thins, and where the till is exposed.

Discretization

An irregular grid was used for the horizontal discretization, with varying cell widths. The model was discretized into 77 rows by 107 columns as displayed in **Figure 4-43**, the Site Model Finite Difference Grid. The entire grid was used in the ground water flow simulations. The grid has fine cells of 75 feet on a side in the vicinity of the Crossroads property, and the cell width gradually increases in size to 200 feet on a side at the model perimeters. The fine grid size was used over existing and proposed waste disposal areas to increase the resolution of the model, while the coarser grid was used near the perimeter of the model. The grid is oriented with the columns parallel to the regional bedrock bedding strike which trends northeast (N51E). **Figure 4-43** illustrates this orientation with the site coordinate grid.

The domain was discretized into eight vertical layers. Eight layers were used to increase the vertical resolution for the transport simulations. The approach used for discretizing and parameterizing the model is illustrated in the table below.

The layers represent the following materials:

Layer	Material	Range of Thickness (ft)
1	Olive Clay-silt/Silty-Sand/Fill/Till	2.5-5
2	Gray Clay-silt/Olive Clay-silt/Till	1-25
3	Gray Clay-silt or Till	1-31
4	Gray Clay-silt or Till	1-26
5	Till	3-43
6	Upper Bedrock	50
7	Mid Bedrock	100
8	Lower Bedrock	250

Layer number 1 represents either the silty sand of the coarse-grained Presumpscot Formation, the Olive clay-silt, fill or till. The fill is located in the unlined Municipal Solid Waste landfill. There is also one area along Mill Stream where bedrock is exposed. Model layer number 1 is simulated as bedrock in that area. The zonation of model layer 1, according to the surficial geology, is illustrated in **Figure 4-47**, *Site Model Recharge Zonation*. The saturated thickness of layer one is 5 feet with the exception of the silty sand zone which has an average saturated thickness of 2.5 feet.

The total thickness of the gray clay-silt modeled is shown in **Figure 4-45**. In the site area the thickness was interpolated from boring data. The maximum gray clay-silt thickness is 78.0 feet at boring 1004AB, north of Phase 9. Where boring data were not available, away from the landfills, the gray clay-silt thickness was interpreted based on extrapolating boring data, our surficial geology maps, and terrain analysis. The gray clay-silt pinches out at the southern end of the Crossroads property. However, this area is still mantled by a layer of olive brown clay-silt.

Model layers 2 through 4 represent the gray clay-silt and were discretized based on the total thickness of the clay-silt illustrated in **Figure 4-45**. Where the gray clay-silt is 0 to 5 feet thick the model layer 2 is 1 foot thick; layer 3 is one foot thick and layer three is 1 foot thick. Layers are increased in thickness to total the total thickness of the gray clay-silt in that zone. In areas where gray clay-silt is absent, layers 2, 3 and 4 are represented by bedrock or till.

The total thickness of the till modeled is shown in **Figure 4-46**. In the site area the thickness was interpolated from boring data. The maximum site till thickness is 59.0 feet at boring 1134B. Where boring data were not available, away from the landfills, the till thickness was interpreted based on extrapolating boring data, our surficial geology maps, and terrain analysis. The till thins to less than 5 feet at the westerly edge of Phase 12 and in the area of Phase 10. Till is absent in one area along Mill Stream where bedrock is exposed. However, in general, the average till thickness is 8 feet.

Model layer 5 represents the till and was discretized based on the total thickness of the till illustrated in **Figure 4-46**. Where the till is 0 to 5 feet thick the model layer 5 is 3 feet thick; if the till thickness is 5-10 feet thick the model layer 5 is 7 feet thick. Layers are increased in thickness to total the total thickness of the till in that zone. In areas where till is absent, layer 5 represents bedrock.

Model layers 6, 7, and 8 represent bedrock, and have uniform thicknesses of 50, 100, and 250 feet, respectively. The selection of the thickness of bedrock to include in the model is somewhat subjective, since the transmissivity (not the thickness) is the parameter of interest for the flow model. A total bedrock thickness of 400 feet was selected to include the total depth of the deep bedrock wells (1101 through 1106) used for pumping tests. Bedrock transmissivities were reduced from our 1992 model based on optimization during calibration using the MODFLOW optimization module MODFLOWP.

Figure 4-44 displays the location of the higher transmissivity bedrock lineaments which were included in the flow model. The higher transmissivity lineaments are included in the model in addition to the bedrock anisotropy. Transmissivity values have been modified from our 1992 model to account for more recent pumping test results.

Parameterization

The horizontal boundaries located along the perimeter of the model domain are treated as fixed heads. Head in the bedrock layers (layers 6, 7 and 8) are from the regional ground water simulations. The heads in the top layer (layer 1) were set at five feet below the ground surface representing the water table. The heads of the other layers were linearly interpolated between the layer 1 and layer 6 values. The bottom of the model domain, which is greater than 400 feet below the ground surface, was treated as a no flow boundary condition.

Mill Stream was modeled as drains as were other smaller drainage features. The flow of water from the aquifer to the drains depends on the simulated head in the aquifer. The leachate collection toe drains around the MSW and asbestos landfills were included in the model. When the simulated head in a model cell is less than the reference head for the drain, the drain is inactive. When the simulated head in a model cell is greater than the reference head for the drain, the flow of water out of the cell is proportional to the product of the difference between the simulated and reference head and the drain conductance.

Recharge was applied over the entire model, with the magnitude of the recharge dependent on the surficial geology. There were four recharge zones: areas underlain by gray clay-silt, areas underlain by silty-sand, areas underlain by till, and areas already covered by a landfill liner or cover system. **Figure 4-47**, *Zonation of Recharge*, shows the location of the recharge zones.

Calibration and Verification

Piezometric heads measured at monitoring wells were used for the calibration. Data from the weeks of April 5 and 12, 1993 were used, since they represent the largest data set available and closely approximate average annual conditions. The date representing average annual conditions was selected by analyzing data from the USGS index wells KW-872A and SMW-61, which are wells screened in bedrock and glaciomarine clay-silt respectively. These data are discussed in more detail in Section 4.2.3., *Seasonal Fluctuations of Ground Water.*

A total of 183 separate head measurements were used for model calibration. The data are from clusters of multilevel piezometers. The data were randomly separated into two groups, with the first group of wells used for model calibration (N=117) and the second group used for model validation (N=66).

The site flow model was calibrated with a number of goals in mind. The mean head residual (the mean difference between the simulated and observed head) should be near zero. The RMSE head residual (standard deviation) should be minimized. The simulated flow directions should match directions interpreted from field data. The simulated vertical gradients should agree with the observed gradients. The recharge and hydraulic conductivities were varied within reasonable ranges to meet these calibration goals.

Table 4-19 displays the final calibration parameters for the horizontal and vertical hydraulic conductivity, and the recharge. The base bedrock hydraulic conductivity is specified as being in the MODFLOW row (grid x) direction; therefore using the horizontal anisotropy of K_{row}/K_{col}=1/3, the hydraulic conductivity along the column (grid y) direction is three times the hydraulic conductivity along the row (grid x) direction. The transmissivity is the product of the hydraulic conductivity and the aquifer thickness. The bedrock transmissivity in the row direction is 25.6 ft^2/day. The equivalent isotropic bedrock hydraulic conductivity is 44.3 ft^2/day. The regional model equivalent isotropic transmissivity is 35.8 ft^2/day.

Table 4-19 also lists the recharge values used for the clay-silt, silty-sand, liner areas and till zones. We have increased the recharge rates from our 1993 model from 1% over the gray clay-silt (0.42 inches/year) to 2.7% or 1.17 inches/year. Recharge over the silty sand facies of the Presumpscot Formation is 1.4 inches/year or 3.3%. This area is still underlain by the gray clay-silt which limits infiltration of recharge. Recharge over the till remains at our 1993 model conditions at 2 inches/year or about 5% of annual rainfall. This relatively low rate for sandy till reflects the fact that most of the exposed till is located near or within discharge areas.

Table 4-20 lists the calibration and validation statistics. The calibration statistics are based on the head residual, which is the difference between the simulated and observed heads. For all of the wells the mean residual is 0.60 feet, and the RMSE residual is 3.49 feet. The RMSE residual gives an indication of the distribution of head residuals. For the calibration wells the mean head residual is 0.62 feet, and the RMSE head residual is 3.55 feet. For the validation wells the mean head residual is 0.56 feet, and the RMSE head residual is 3.39 feet. The calibration and validation statistics show good agreement, indicating that the model was not "point" calibrated for a specific data set.

Figure 4-48 displays a scatter plot of the observed versus simulated heads for the calibrated model. Ideally the data in the scatter plot would fall along the line with a slope of 1. The data basically fall along this line. The spreading of the data points off of the line is described by the RMSE head residual. **Figure 4-49** is a frequency histogram of the distribution of head residuals. The data in the bar chart are clustered about a head residual of zero, and display a normal distribution. **Table 4-21** lists the observed and simulated heads for the monitoring wells and piezometers used for the model calibration and validation.

Table 4-22, *Vertical Gradient Statistics*, analyzes the observed and simulated ground water vertical gradients. In April of 1993, vertical gradients are primarily downward from the phreatic wells to the till wells. There are some upward gradients noted in the area of Stream D and along the East Drainage. In general, the vertical gradients from the till to the bedrock are also primarily downward, with the exception of the western portion of the site. This is dramatically shown by the overflowing bedrock wells located at the northwestern end of the site. Gradients are upward from the bedrock to the till wells in the Phase 9 and Phase 1-5 areas. Upward gradients are also noted in well clusters B-1015 and B-1028 around Phase 11 and in well clusters B-1105 and B-1102, south of Phase 12. Analysis of the actual gradients indicate that the till layer acts as a sink for ground water, with water flowing vertically into the till from both the overlaying gray clay-silt and the bedrock.

The general spatial pattern of phreatic to till vertical gradients is captured by the model. The simulated phreatic to till gradients are in good agreement with the magnitude of the observed gradients as well. The exception to this is in the Phase 10 area where simulated gradients are primarily upward while observed gradients are primarily downward. In this location the gray clay-silt thins over a short distance. The simulated till to bedrock gradients are in general small and slightly upward while the observed gradients 46% upward and 54% downward.

A sensitivity analysis of the calibrated flow model is reported using results of a series of runs made during calibration by varying model parameters, and analyzing the changes of the mean and RMSE head residuals in various layers. The global hydraulic conductivity, olive clay-silt hydraulic conductivity, bedrock hydraulic conductivity, and till hydraulic conductivity were all tested.

We also used the program MODFLOWP to optimize many of the modeled input parameters. This optimization program also acts in many ways as a sensitivity analysis for the model. MODFLOWP is a three-dimensional finite-difference ground water flow model developed by the

U. S. Geological Survey. It is a version of the program MODFLOW with the addition of a parameter estimation package that estimates parameters by nonlinear regression. It is useful for investigating parameters that are difficult to measure accurately in the field. Parameters are estimated by minimizing a weighted least-squares objective function with a choice of the Gauss-Newton, or conjugate-direction method. The program output includes statistics to determine the credibility of parameter estimates.

A number of parameters are chosen which are allowed to vary within set criteria. The output consists of the change in the parameter variable value and the changing RMSE value associated with it. We used this program in the calibration process to optimize the recharge ratio between the till and gray clay-silt, the bedrock hydraulic conductivity, the till hydraulic conductivity and the vertical anisotropy in the gray clay-silt. We also made MODFLOWP runs to optimize recharge on the gray clay-silt and silty sand with varying hydraulic conductivity values of the silty-sand. Another set of runs tested the sensitivity of the bedrock hydraulic conductivity with the recharge rates. The first optimization runs were used earlier in the calibration process and we returned to optimization runs near the end of calibration to fine-tune and verify the effects of the changes we had made to model parameters. Results of MODFLOWP optimization runs are summarized in the **Table 4-23**.

Overall, the results of this sensitivity analysis show that through the calibration process we selected parameter values which are near their optimal values. The magnitude of the perturbations used for the sensitivity analysis are relatively small compared to the possible range of the parameters, since the sensitivity analysis was used to fine tune the model. This causes the RMSE value not to vary over a large range. The parameters tested in the sensitivity analysis could have been perturbed to a greater degree, which would cause the RMSE head residual to increase dramatically. Therefore, over the reasonably expected range of parameters, which we used in the sensitivity analysis, the parameter values are near their optimal values.

Figure 4-50 is a contour plot of the simulated phreatic surface, and also includes the observed water levels. Overall the flow is towards Mill Stream, although the local drainage features have an effect on the local ground water flow direction.

Figure 4-51 shows the simulated till potentiometric surface contours under average annual conditions. **Figure 4-52** shows the simulated bedrock potentiometric contours. **Figures 4-51** and **4-52** are very similar as simulated vertical gradients are very low. The bedrock flow is towards Mill Stream, where the ground water discharges to Mill Stream. In general the simulated ground water flow on the site is towards the south. The flow in the Phase 9 area is more in a southwesterly direction. The flow in the Phase 11 and 12 area is southerly. The area south of Phase 12 shows a more southwesterly ground water flow towards Mill Stream. This is in good agreement with the observed data.

4.3.5 Simulated Changes to the Water Table

The site flow model was used to simulate the long term, post closure ground water flow conditions. The scenario is that Phases 9, 11 and 12 landfills had been constructed, and all the landfills are closed and capped. This scenario is very conservative in that it predicts maximum potential water level declines as it does not account for any infiltration of storm water runoff in sedimentation basins and surface water collection ditches.

To perform this simulation, the recharge was reduced over the areas of the landfills to represent leakage through the clay-silt caps and into the ground water. The recharge simulated was equal to the engineered systems design failure scenario of 0.9 gallons per acre per day (gpad). This value is discussed in more detail in this application by GZA Geoenvironmental, Inc. (GZA) in Vol. VI, Appendix A.3, Failure Analysis-Base Liner System.

The simulated flux of 0.9 gpad yields 0.01 inches/year over the lined or covered landfills. 4-53 **Figure ~~5~~-53** illustrates the Post Development Water Table Change. Water levels are predicted to decrease up to 5 feet beneath Phases 9; up to 8 feet beneath Phase 11 and up to 3 feet beneath Phase 12. The simulated post-closure phreatic surface for Phase 9 retains the current radial flow pattern.

As stated above, this analysis uses conservative assumptions. During the active operation of each landfill phase, all the precipitation within the waste area will be collected as leachate and removed from the site. This results in a net removal of a portion of the precipitation. The remainder of the precipitation will run off the slopes of the perimeter road into the adjacent lands or be treated as storm water and released. At closure, all precipitation will run off the landfill cap into the sedimentation or infiltration basins. This water will be released as surface water flows or as infiltration through the detention or infiltration basins. Therefore, at closure the volume of surface water flow flowing from the landfills will approximate the volume of water currently occurring on each site. Post-construction lowering of the water table in the vicinity of the liners is likely to occur due to the shift from ground water to surface water (storm water discharge). However, water level monitoring of the existing lined landfills at the site suggests that the change in ground water levels will be less than predicted by the model.

In summary, the incremental drawdown resulting from the construction of Phases 9, 11 and 12 will have a small effect on the water table in the vicinity of the landfill liners. The simulated ground water declines do not consider the return of storm water through infiltration in infiltration or detention basins, or surface water collection ditches.

4.3.6 Site Three-dimensional Advective Transport and Solute Transport Simulations

Conceptual Model

A three-dimensional approach was used for analyzing solute transport to include the complex geometry and heterogeneity of the site. The three-dimensional aspects of the ground water flow system at the site are important for solute transport. The geology of the site may be thought of as an olive clay-silt aquifer separated from the till/bedrock aquifer by a thick gray clay-silt aquitard. The ground water flow is primarily horizontal in the aquifers, and primarily vertical in the aquitard. The geometry of the gray clay-silt varies across the site, with the clay-silt forming a thick layer of varying thickness across most of the site and pinching out at the southwestern edge of the site.

Advection and advection-driven dispersion are the dominant transport process in the silty sand, olive clay-silt, till and bedrock. In the gray clay-silt, which has a very low hydraulic conductivity, diffusion is the dominant transport mechanism in the vertical direction. The flow simulations show that the ground water flow is primarily local, with most ground water originating on the site discharging locally to small drainage ways. Only a small fraction of the recharge moves through the clay-silt after long times to travel to the till and bedrock toward Mill Stream.

The model MODPATH was used for advective transport simulations (Pollack, 1989). MODPATH is a particle tracking post-processing package developed by the U.S. Geological Survey for three-dimensional path lines using steady-state output from MODFLOW. Particle tracking analyzes the advective component of solute transport, and can be used to calculate advective travel times and flow paths. Particle tracking does not include the effects of dispersion, reactions, or decay, and can not be used to calculate concentrations or mass fluxes.

The model MT3D (Zheng, 1990) was selected for use as the solute transport model. MT3D is designed to work in conjunction with MODFLOW, and use the same discretization and data output files. MT3D uses an Eulerian-Lagrangian approach to solve the three-dimensional advective-dispersion equations. MT3D is a three-dimensional application of the Method of Characteristics model MOC (Konikow, 1978), with some added enhancements. The MT3D model was verified by its author by comparing the model results to a number of analytical solutions.

Discretization

The discretization is the same as used for the site flow model, since both the particle tracking and solute transport models are designed to work in conjunction with the flow model.

Parameterization

MODPATH uses the flow model results to calculate flow paths, and requires the effective porosity and source locations be specified. The effective porosity was specified for each material type and is noted in **Table 4-19**, *Final Calibration Parameters for the Site Model*. The bedrock porosities are representative of fractured media. The weathered and more fractured upper bedrock is assigned a higher porosity than the less weathered and less fractured deeper bedrock.

MT3D requires specifying the dispersion coefficients, as well as the sources. The longitudinal dispersivity was set at 0.5 ft. While this longitudinal dispersivity is low, it is conservative in that concentrations will be higher at a given point. However, it is non-conservative in terms of predicting the potential degree of lateral (transverse) spreading. This has no effect on the prediction of travel times using MODPATH. The ratio of the transverse horizontal to the longitudinal dispersivity was 0.1, and the ratio of the transverse vertical to the longitudinal dispersivity was 0.01. The effective molecular diffusion coefficient, which is determined by the free solution coefficient and the tortuosity, was set at $4.65*10^{-4}$ ft^2/day (0.016 m^2/yr). The diffusion coefficient is representative for the chloride ion in clay (Johnson and others, 1989). The diffusion coefficient for chloride was chosen because chloride has a relatively low molecular weight, and consequently a high diffusion coefficient. This will maximize the diffusion through the gray clay-silt. We did not attempt to define diffusion in the bedrock as advective flow dominates. Chemical reactions, such as adsorption and chemical decay, were not included in the analysis. Including chemical reactions would have the effect of reducing concentrations at a given point in time and space.

The source concentration for all of the failure scenarios modeled was set at 100 or 100%. This allows evaluation of model results in terms of the percentage of the original source application. Simulated concentration contours are illustrated as the percent of the original application and do not include background concentrations. Therefore, contours represent simulated incremental changes. Selection of any leachate chemical parameter of concern and the resulting incremental change in concentration of that parameter in the ground water can be determined at various locations with the model results. As an example we discuss iron. The average concentration of iron in the special waste landfill leachate is 31.1 mg/l. Assuming iron were a non-reactive element, the simulated incremental concentration contour of 1 or 1% represents an incremental change in the iron concentration of about 0.3 mg/l (the drinking water standard for iron (secondary MCL)). Therefore, with a source strength of 100%, the 1% contour represents compliance with drinking water standards. The 3 or 3% contour represents iron incremental concentrations of 1 mg/l (the freshwater chronic aquatic toxicity level). The 0.1% contour represents iron concentrations of 0.031 mg/l (the limit of detecting iron in the lab is 0.025 mg/l). To be conservative , we have shown the 0.01% contour in our analyses. Using iron as an example, this contour would represent an iron incremental concentration of 0.003 mg/l.

In the long term, the water passing through the waste, either from infiltration or ground water flow, creates the leachate. We assumed that any water passing through waste would reach chemical equilibrium with the waste, and consequently the concentration of the ground water would be at the concentration of leachate from the waste. This is conservative as it does not consider dilution from through flow. Another conservative assumption we use is that the leachate concentrations remain consistent throughout the 30 year simulation. We have observed that the concentration of the leachate at this site has decreased with time.

The sources for the landfills were treated as specified flux sources. The recharge, as assigned in the simulation of the site flow model, was assigned a concentration of 100%. Although leaks through the liner systems of the landfills would probably occur over limited areas of liner failure, the sources were defined to be the entire footprints of the landfills. This provided another very conservative estimate, since it provided the maximum area over which diffusion could occur. The source cells for the failure scenarios in the model were chosen as all cells in the top model layer with more than 50% of their area within the footprint of the landfill.

Calibration

Field data are not available to calibrate or validate the particle tracking or the solute transport models. Instead the results will be compared to simplified analytical solutions in the failure analysis.

4.3.7 Failure Analysis

4.3.7.1 Introduction

The State of Maine Solid Waste Management Regulations 401.2(B)(3)(f), Failure Analysis, requires that the applicant provide an assessment of the "*area that could be affected during operation of the site or in the event of unforseen circumstances*". This includes the (II) "*projected extent and quality of plumes*". Section GG includes the "*time of travel to the bedrock aquifer, classified bodies of surface water, springs, significant sand and gravel aquifers, and public and private water supplies*". The first step in evaluating this requirement is to identify all potential receptors from the landfill footprint.

<u>Failure Scenario #1</u>, Total Engineered Systems Failure, identifies all potential receptors and the travel times to those receptors. Through this failure scenario we show that springs, significant sand and gravel aquifers and public and private water supplies are **not** potential receptors from the proposed Phases 9, 11 and 12. The only identified potential receptors are the bedrock aquifer, the local drainage ways and Mill Stream. We discuss the model results of this failure scenario and analytical calculations of travel times to the bedrock aquifer, the small drainage ways and Mill Stream.

<u>Failure scenario #2</u>, Engineered Systems Design Failure after 30 Years, evaluates a more reasonable , although conservative, scenario of an adverse impact from an engineered systems failure over a longer time period. This scenario shows that simulated concentrations in the ground water are not significantly impacted from such a long term failure.

<u>Failure scenario #3</u>, Leachate Pump Station Failures, evaluates a shorter term operational failure scenario. This scenario shows that the simulated short term failures have no long term significant impact on ground water quality. In addition, this scenario illustrates that the natural hydrogeologic conditions at this site provide more than adequate lead time to implement remediation measures to counteract a short term failure.

<u>Evaluation of Surface Water Impacts.</u> Finally, we evaluate the potential impacts from the entire development on the surface water of the area. We calculate surface water impacts from the

proposed and existing landfills using analytical methods.

The three ground water failure scenarios are simulated using MODPATH and MT3D. The transport simulations were made using MT3D with an active subgrid smaller than the full finite difference grid. The area of the subgrid was chosen by extending horizontally outwards from the limits of the advective plume beyond the nearest surface stream. The simulations were for a time period of 30 years.

All failure analysis scenario transport simulations utilize a source concentration of 100 or 100% in the applied failure recharge. This is conservative, since we expect the leachate concentrations to continue to decrease over time. Results are illustrated in terms of a percentage of the original source concentration so that they can be scaled to any parameter of interest as discussed above. For interpretation of the results of the failure analysis we assumed that the chemistry of any leaks would be the same as current leachate. Details of the leachate chemistry are discussed in Section 4.2.6., *Leachate Chemistry*.

We chose to use iron and chromium as representative parameters for the failure analysis calculations, although the calculations could be made for any of the chemical parameters. We chose iron and chromium for our calculations by examining the concentration of the various chemical parameters in the leachate, and comparing those to the water quality standards. Iron and chromium are sensitive parameters in that they require the most dilution to maintain water quality standards.

For iron we used the average concentration for the special waste leachate which is 31.1 mg/l. The drinking water standard for iron (secondary MCL) is 0.3 mg/l (or about 1% of 31.1 mg/l). Therefore, with a source strength of 100 or 100% and negligible background concentrations, the 1 or 1% contour represents compliance with drinking water standards. The freshwater chronic aquatic toxicity level for iron is 1 mg/l (or 3% of 31.1 mg/l). Therefore, the 3% contour represents compliance of iron concentrations with aquatic toxicity standards, if background concentrations are negligible. The detection limit for iron is about 0.025 mg/l (or about 0.1% of 31.1 mg/l). Therefore, the 0.1% contour represents the limits of detecting iron in the lab. We have conservatively shown the 0.01% contour in our simulations.

For chromium we also used the average concentration in the special waste leachate, 0.019 mg/l. The Maine MEG and the aquatic toxicity standard for chromium is 0.01 mg/l. Therefore, the 52% contour represents compliance for drinking water and aquatic toxicity standards for chromium, if background concentrations are negligible. **Table 4-14** illustrates the incremental percent of the original concentration required for compliance for each parameter of interest.

For discussion purposes below we have not considered background concentrations of the ground water. Rather, we consider the incremental change on the concentration of the ground water system.

4.3.7.2 Scenario #1 - Total Engineered Systems Failure

This scenario evaluates all potential receptors from failures within the proposed landfill footprints. The objective is to locate all potential receptors from ground water flow beneath the landfill footprints, without regard to travel time or concentration. Simulated pre-construction conditions are used with average annual recharge applied to the footprint areas. Travel times would be longer for post-development conditions as recharge would be reduced because of the liner system resulting in decreased gradients.

The particle tracking model MODPATH was used to simulate the advective plume caused by sources located at each landfill. Simulations were performed for each landfill phase separately, with particles originating in the top of the source cells. **Figure 4-54** displays the advective plumes for Phases 9, 11 and 12 in plan view. Much of the flow from the footprints is local, with the pathlines terminating at nearby drainage ways. However, some of the pathlines travel through the gray clay-silt and into the till and upper bedrock before discharging to Mill Stream.

To illustrate the advective particle front we have indicated the 200-year front in **Figure 4-54.** Shallow flow from Phase 9 ranges from 4 to 49 years before discharge to the wetland; the average travel time of the shallow flow paths is 14 years. 42% of the footprint contains flow paths that discharge at times greater than 200 years. Shallow flow from Phase 11 ranges from 2 to 54 years before discharge with an average travel time of 15 years. 29% of the footprint contains flow paths that discharge at times greater than 200 years. Phase 12 shallow flow paths range from 4 to 16 years and the average travel time is 8 years. 18% of the footprint contains flow paths that discharge at times greater than 200 years.

In general, of the flow paths that do not discharge locally, flow paths remain in the top layer of the model for 8 to 9 years before traveling downward into the gray clay-silt. These flow paths remain in the gray clay-silt and reach the till after more than 200 years.

Pre-Development Simulated Travel Time Summary

Phase	Range of travel times for shallow flow paths (years)	Mean of shallow flow paths (years)	% of footprint with flow paths >200 years
9	4 to 49	14	42%
11	2 to 54	15	29%
12	4 to 16	8	18%

We hand-calculated the travel times based on observed water level data as displayed in **Figures 4-14** and **4-18** which are titled Phase 9 May Phreatic Surface with Flow Lines and Phases 11 &

12 Seasonal May Phreatic Surface with Flow Lines respectively, and insitu hydraulic conductivities . Since the gradients are greater for the May versus February phreatic surface, calculating the travel times using the May water level data produces conservative (i.e. shorter) travel times. We calculated the travel times from the proposed limit of waste to surface water along the flow paths displayed on **Figures 4-14** and **4-18**.

For the hydraulic conductivity we used the materials defined on the surficial geology maps **Figures 3-3** and **3-4**. The unit Pp represents theolive brown clay-silt, and the geometric mean of the 55 site variable head tests is 2.54×10^{-5} cm/sec (**Table 4-10**). Variable head testing was not conducted in the Pps and Qe units (coarse Presumpscot and Eolian) which occur in Phase 11, because these units are usually dry. We estimated the hydraulic conductivity for these units using grain size data $K=Ad_{10}^2$ (equation 8.47, Freeze and Cheery, 1979). The units are K [cm/sec], A=1, and d_{10} is the grain size diameter in mm at which 10% by weight of the soil particles are finer.

Hydraulic Conductivity of Eolian Deposits

Location	Depth [ft]	D10 [mm]	Surficial Unit	Field Description	Thickness Coarser Material [ft]	K [cm/sec]
B-1016G	1.0-2.0	0.0023	Qe	silty fine sand	3.0	5.3E-06
B-1022G	1.0-1.3	0.0061	Qe	fine sand some silt	2.8	3.7E-05
B-1022G	2.0-3.0	0.0190	Qe	fine sand some silt	2.8	3.6E-04
B-1022G	2.8-3.0	0.0786	Qe	fine sand trace silt	2.8	6.2E-03
TP-90-42	3.0	0.0200	Qe	silty fine sand	3.6	4.0E-04
TP-90-46	4.0	0.0950	Qe	fine sand	5.7	9.0E-03

The geometric mean of the six values above is 3.4×10^{-4} cm/sec. We have grain size data at boring B-1023G, which is located in the Pps unit. The Pps unit has a greater silt content than the Qe unit, and would consequently have a lower hydraulic conductivity. Since we have only limited grain size data for the Pps unit, we conservatively used the estimated Qe hydraulic conductivity. We used the same effective porosity values as used in the model: for the olive brown clay-silt (Ppo) n_e=0.1, and for the silty sand (Pps) or eolian (Qe) n_e=0.25 (**Table 4-19**).

Travel times along flow paths from Phase 9 range from 30 to 80 years before discharge to the surface waters. Travel times along flow paths from Phase 11 range from 21 to 97 years. Travel times along flow paths from Phase 12 range from 13.9 to 46 years. All of the travel times calculated for the three proposed phases using the observed seasonal high water level data are greater than 6 years to surface waters.

Observed Seasonal High Water Travel Time Summary

Phase	Range of travel times (years)
9	30 to 80
11	21 to 97
12	13.9 to 46

There are two important differences between the travel times calculated using the model and the hand-calculated travel times. First, the calibrated hydraulic conductivity used for the Pp and Qe units are greater for the model by factors of 26/1 and 3/1 respectively than for the hand calculations. During the model calibration the hydraulic conductivities are varied to obtain the best calibration for the model, and the final calibrated values are dependent on the scale of the discretization of the model and the overall combination of parameters used to calibrate the model. The hydraulic conductivity values used for the hand calculated travel times are the average of site data. Since the model hydraulic conductivity values are greater in the model, the model calculated travel times are shorter.

The second difference between the model and hand calculated travel times involves travel through the gray clay-silt. The hand calculated travel times are for shallow flow paths, while the model also includes very long travel times calculated for flow paths through the gray clay-silt.

In summary, both the mean simulated pre-development travel times and the travel times calculated using observed water level data are greater than 6 years to small drainages and Mill Stream for all three of the proposed landfill phases. The travel time to bedrock is greater than 200 years, since the gray clay-silt aquitard protects the underlying bedrock. Ground water originating from the proposed phases does not discharge to springs, significant sand and gravel aquifers or public or private water supplies.

For post-development conditions, the water table declines up to about 5 feet under Phase 9; up to about 8 feet beneath Phase 11 and up to 4 feet under Phase 12, see **Figure 4-53**. This decline, and the coupled reduction in the gradients, result in even longer travel times to discharge.

4.3.7.3 Scenario #2 - Engineered Systems Design Failure after 30 Years

This scenario examines a long term liner leak. The details of the failure assumptions and calculation of the flux through the landfill liner systems was provided by GZA and is discussed in more detail in this Application in Vol.VI, Appendix A.3, Failure Analysis-Base Liner System.

We simulated the solute transport for a period of thirty years. **Figure 4-55** illustrates the simulated incremental concentrations in the phreatic zone after 30 years. The 1% contour represents compliance with drinking water standards for iron assuming negligible background concentrations. As illustrated, the 1% contour is almost contained within the property boundary. The area where the 1% contour lies off the property would only be of concern if a drinking water supply were located in this area as this is not a discharge location. The 3% contour represents compliance with aquatic toxicity standards (assuming negligible background concentrations) and is relevant when it occurs at discharge locations. However, we discuss the potential impacts to surface water in a separate section below 4.3.7.5, *Surface Water Impacts of Proposed and Existing landfills.*

Figure 4-57 illustrates an idealized graph of the maximum simulated incremental concentrations from each model layer. The maximum values illustrated do not occur in one location in the model, rather they represent the maximum in each layer. In addition, the depths are generalized to represent an average section in the model. The graph clearly illustrates how dramatically the concentrations decrease with depth through the gray clay-silt. Maximum incremental concentrations decline from a high of 95.9% in the phreatic zone, to 39.0% in the upper gray clay-silt, to 4.7% in the mid gray clay-silt and only 0.3% in the lower gray clay-silt. The maximum concentration in the till is at 0.01% as located in **Figure 4-56**. The gray clay-silt effectively limits the vertical distribution of the plume through time. **Figure 4-56** illustrates the concentrations in the till after 30 years. The 0.01% concentration in the till occurs in a small area of Phase 12. We have shown the 0.001 simulated contour as the 0.01 contour is not mappable. With iron as an example, this represents that iron concentration increases would not even begin to be detected in the till after 30 years.

Figures 4-58 through 4-63 represent graphs of incremental concentrations over time in simulated monitoring wells down gradient of each Phase. Simulated monitoring well locations are noted in **Figure 4-55** as MW#1 near Phase 9, MW#2 near Phase 11 and MW#3 near Phase 12. **Figure 4-58** illustrates the incremental concentration in the phreatic zone near Phase 9 as it increases over time to just over 1% after 30 years. An increase in iron concentration would not even be detected until after 4 years. **Figure 4-59** illustrates incremental concentrations in the upper and mid clay as simulated in MW#1. As illustrated, detections of increased concentrations would not occur in the upper gray clay-silt until almost 30 years and are not simulated to occur in the mid gray clay-silt even after 30 years. **Figure 4-60** illustrates a simulated monitoring well near Phase 11. Incremental concentrations begin to level out after about 10 years to around 20%. **Figure 4-61** illustrates incremental concentrations in the upper gray-clay-silt and the mid gray clay-silt for this simulated well. Concentrations are still rising somewhat in the upper gray clay-silt to 10% but remain virtually undetectable in the mid gray clay-silt. **Figure 4-62** illustrates the simulated monitoring well near Phase 12. The simulated incremental concentrations in the phreatic zone reach 1% after about 10 years and are about level after 30 years at simulated concentration of about 3.3%. **Figure 4-63** illustrates that simulated incremental concentrations in the upper gray clay-silt reach 0.1% (or detection) after about 18 years and are continuing to rise after 30 years at less than 0.3%. Incremental concentrations in the mid gray clay-silt are virtually undetectable for the entire simulation.

The mass balance calculated from the MT3D simulations for this failure scenario was examined as an indication of the numerical accuracy of the solute transport simulations. The mass balance computes the difference between the mass entering the system from sources, and the mass leaving the system into sinks. The maximum mass balance error for this scenario was about 9.8% after 3 years and reduced to -2.8% after 30 years. This is well within acceptable ranges.

4.3.7.4 Scenario #3 - Leachate Pumping Station Failure

The third failure scenario examined impacts to ground water from leaks at the South-Central and Central Leachate Pumping Stations. This scenario involves a leachate pumping station overflow for a three day period. Leachate would flow overland and a portion of that leachate would saturate the surface and impact the ground water. This scenario does not include any provisions for remediation of the topsoil and assumes that all leachate that infiltrates the ground in three days remains as a source over time. This scenario also does not address the impact on the surface water of the overland flow of the leachate. Soil removal involving the olive clay-silt after a spill of this nature would virtually remove any remaining source to the ground water. As illustrated in simulated monitoring wells, there is more than adequate reaction time for soil removal in this situation to remove the source before it has traveled through the ground water any significant distance.

The locations of the simulated leaks are illustrated in **Figure 4-65.** Spillage from the Central Pumping Station, near Phase 9, would flow down into a sedimentation basin (ECS-9) which is bermed. This bermed area is about 50' by 200' or 10,000 ft^2. Using the hydraulic conductivity from the calibrated model we can calculate the vertical infiltration. With a vertical hydraulic conductivity of the olive clay-silt at 1.84 ft/d (Kv), 18,395 ft^3 (137,595 gals) could infiltrate in one day under a unit gradient. However, with about 5' of thickness of olive clay-silt (as simulated in the model) and a porosity of 0.1, infiltration will be limited to saturation of the olive brown clay-silt to 5000 ft^3 (37,400 gals). At that point the vertical hydraulic conductivity of the gray clay-silt ($1.2x10^{-4}$ ft/day) will limit infiltration to negligible levels (1.2 ft^3/d (9 gals/d)) before the leak is found and stopped. This brings the three day total infiltration in the olive and gray clay-silt to a maximum of 5003.6 ft^3 (37,427 gals) in three days. We have modeled this source as replacing all ground water in 3 model cells in layer 1 (16,875 ft^2 area). With a thickness of 5' and a porosity of 0.1, a total of 8437 ft^3 (63,108 gals) of leachate is simulated in layer 1 at this location.

For the South-Central Pumping Station near Phase 12, the topography would restrict overland flow to a drainage swale into Stream D between Phase 11 and 12. Considering a constant overland flow down this drainage swale (about 20' wide, 250' long, Kv=1.84 ft/d) about 9200 ft^3 (68,816 gals) could infiltrate in 1 day . However, with about 5' thickness of olive clay-silt and a porosity of 0.1, infiltration will be limited to saturation of the olive brown clay-silt at 2500 ft^3 (18,700 gals). At that point the vertical hydraulic conductivity of the gray clay-silt will limit infiltration to negligible levels (0.6 ft^3/d (4.5 gals/d)) before the leak is found and stopped. This brings the three day total infiltration in the olive and gray clay-silt to a maximum of 2501.8 ft^3 (18,713 gals) in three days. We have modeled this source as replacing all the groundwater in 2 model cells in layer 1 (11,250 ft^2 area). With a thickness of 5' and a porosity of 0.1 a total of 5,625 ft^3 (42,075 gals) of leachate is simulated in layer 1 in this location.

We simulated the solute transport for a period of thirty years. The source was simulated as an initial concentration in layer 1 of 100%. The simulated concentrations after 2 years indicate the limits of advective flow. Therefore, we illustrate the incremental concentrations in the phreatic zone after 2 years in **Figure 4-66.** As illustrated, the simulated incremental concentrations are reduced to undetectable levels within 100' of the failure at the Central Pump Station and within 200' of the failure at the South Central Pump Station. In the till, the maximum simulated incremental concentration at 30 years was 0.001%, virtually non-detectable. Incremental concentrations are not detectable in the bedrock layers. **Figure 4-67** illustrates the incremental concentrations over time in a simulated monitoring well within a source cell at the South Central Pump Station. The illustrated simulated monitoring well is for the South Central Pump Station as the Central Pump Station simulated well contained much lower concentrations. In the phreatic zone, incremental concentrations decline rapidly to about 10% after 2 years and to less than 1% after 5 years. Incremental concentrations are undetectable (0.1%) after about 8 years. In the model layer 2, the upper gray clay-silt, simulated incremental concentrations are increasing to 1% after one half year to a high of 3% after 3 years. Incremental concentrations then decline in the upper gray clay-silt to about 1% after 30 years. Simulated incremental concentrations in the mid gray clay-silt are just over 0.5% after 30 years and are approaching 0.1% after 30 years.

The low concentrations and long time required for concentrations to peak in the gray clay-silt indicate that there is a long lead time for potential remediation measures to be implemented. Implementation of remediation measures would remove the source and significantly reduce resulting peak concentrations.

4.3.7.5 Surface Water Impacts of Proposed and Existing Landfills

The existing landfills have been and the proposed phases 9, 11 and 12 landfills will be developed separately. We have modeled leachate flows from all the landfills to evaluate the cumulative impact on the surface and ground water quality. Since the impact from the landfills on water quality will increase gradually over time and eventually reach a maximum value, the long term impact from all the landfills is examined here. We conservatively assume that any water passing through the waste in the landfills reaches the concentration of the leachate and is piped or mixed directly with the surface water of the drainages or Mill Stream. We do not include dilution that would occur with travel through the ground water and discharge to the surface waters.

This Section, 4.3.7.5, *Surface Water Impacts of Proposed and Existing Landfills*, was reviewed by Normandeau Associates for the potential aquatic toxicological impacts at the Crossroads site. A copy of that review is located in **Appendix A** of this volume. Normandeau concludes that using the information discussed below and the USEPA (1992) ecological Hazard Quotient method for risk analysis, development of the proposed Phases 9, 11 and 12 will not add any significant incremental toxicity to the areas surface waters.

The increase in surface water concentrations due to the addition of Phases 9, 11 and 12 is small. This is due to the leachate chemistry and the effect of the engineering design measures implemented in the construction of the landfills. These systems significantly limit the potential leaks of leachate. The MSW has the greatest potential impact, because it is not lined and some waste is below the water table. The asbestos landfill is also not lined. However, both these landfills have implemented cover systems. Since the asbestos landfill has a small footprint area and the waste is located above the water table, the simulated mass flux is less than one-tenth of the MSW mass flux. The Phases 1-5 and Phase 7 landfills are lined, and the leakage rates are reduced by the liner system. The Phase 10 landfill is also a small simulated impact because it is relatively small in size and it is lined.

Calculated leachate fluxes are summarized in **Table 4-24**. Fluxes for MSW, Asbestos, Phases 1-5, Phase 7 and Phases 8 and 10 were calculated in the Phase 8 and 10 Application (RGGI, 1992). Leachate chemistry is discussed in more detail in this application in Section 4.2.6, *Leachate Chemistry*. The MSW and Asbestos average concentration for iron is 107 mg/l and for chromium is 0.047 mg/l. We have not included organic parameters in our mass balance summary, since they occur infrequently and at low concentrations in the leachate testing.

The flux through the MSW landfill is the sum of the horizontal and the vertical fluxes. The vertical flux is the infiltration through the cap, which we estimate as 0.122 inches/year. The horizontal flux was calculated using the Darcy equation and a hydraulic conductivity of 2 ft/day and a gradient of 0.00155 ft/ft. The cross-sectional area is defined as the waste located below the water table. The flux through the asbestos landfill is the infiltration from precipitation, which has the same value as for the MSW landfill. Fluxes for Phases 1-5 and for Phase 7 were modeled in the 1993 MT3D model based on a liner flux of 0.9 gallons per acre per day (gpad). Fluxes for Phases 9, 11 and 12 are the engineering design failure fluxes of 0.9 gpad calculated by GZA for the computer failure scenario #2.

The impacts from Phase 9, 11 and 12 were calculated for 6 separate surface water sampling locations using a mass balance calculation. The impact locations are illustrated in **Figure 4-64**. Results of particle tracking indicate that flow from various parts of Phase 11 and 12 discharge to a number of different drainage ways. This includes flow paths from areas of both Phase 11 and 12 (indicated as 11-M and 12-M on **Figure 4-64**) which travel through the gray clay-silt and into the till and discharge into Mill Stream near Route 2 in over 200 years time. These locations, as well as the portions of each footprint which discharge to various drainage ways, are illustrated in **Figure 4-64.**

Impact from Phase 9 is calculated at Mill Stream above Pion Road. Impact, from Phase 11 is calculated at the Far East drainage way, the East drainage way, Stream D and at Mill Stream. Impact from Phase 11 is calculated at Stream D, Stream E and at Mill Stream/Route 2. Site wide full development impacts, which include the existing landfill Phases, are calculated at Mill Stream where it crosses Route 2.

The background concentration of Mill Stream at SW-201 was calculated as the average value from the last two years of sampling. This same concentration was assumed to apply to all points at which surface water input was calculated. The average iron concentration is 0.89 mg/l. The chromium concentration was below the detection limit of 0.01 mg/l, therefore we used a chromium concentration of one-half the detection limit which is 0.005 mg/l. The mean annual stream flow for Mill Stream at Route 2 was calculated for the watershed which encompasses 3.04 square miles, using the USGS regression equation (Parker, 1977). The calculated mean annual stream flow is 6.4 cfs.

Results of the various calculated impact areas are summarized in **Table 4-24**. Cumulative impact from both Phase 11 and 12 to Drainage D is also calculated. We report the results to five significant digits only to allow for comparison between the pre-construction and post-construction cases.

Results from potential long term surface water impacts from proposed Phases 9, 11 and 12, indicate no measurable changes. The largest post development change from Phases 9, 11 and 12 is impact to Stream E from a small portion of Phase 12. This calculation predicts iron concentrations to rise 1.59x10^{-3} mg/l and chromium to increase 7.36x10^{-7} mg/l. The next highest impact area is the cumulative impact from both Phase 11 and 12 to Stream D. This calculation predicts a change in iron concentration to be 5.29x10^{-4} mg/l and a change in chromium concentration to be 2.45 x10^{-7} mg/l. Calculated impact from Phase 9 predicts a change in iron concentration of 1.95x10^{-4} mg/l and increase in chromium of 9.04x10^{-8} mg/l. Calculated impact from all three Phases on Mill stream at Route 2 predicts an increase in iron of 2.36x10^{-4} mg/l and chromium of 1.09x10^{-7} mg/l. These incremental concentrations are all well below the detection limit for iron and chromium and as a percent change from background conditions are unmeasurable and statistically insignificant.

For all cases the predicted iron concentration is below the aquatic freshwater chronic toxicity value of 1 mg/l (EPA, 1986). The background Mill Stream iron concentration is greater than the EPA secondary drinking water standard of 0.3 mg/l, which is determined by aesthetic and not health criteria. The results of the analytical calculations for the cumulative impact of the existing and proposed landfills predict a long term iron concentration increase in Mill Stream from the present value of 0.887 to 0.906 mg/l. The incremental increase due to the proposed Phase 9, 11 and 12 landfills is 0.0002 mg/l.

The predicted Mill Stream chromium concentrations are also below the Maine MEG of 0.01 mg/l and the aquatic freshwater chronic toxicity value of 0.011 mg/l for hexavalent chromium. The aquatic freshwater chronic toxicity value of chromium was corrected for the Mill Stream hardness of 31.5 mg/l $CaCO_3$. The results predict a long term chromium concentration increase in Mill Stream from the present value of 0.005 (non-detect) to 5.007 x 10^{-3} mg/l, an increase of 7.4 x 10^{-6} mg/l. The incremental increase due to the proposed Phase 9, 11 and 12 is 1.09 x 10^{-7} mg/l.

The analytical results predict no measurable long term change in water quality in Mill Stream or other drainage ways. Computer simulations of the liner system failure and pumping station leak also predict no impact to sensitive receptors and minimal impact to local drainage ways. The site has good hydrogeologic controls to back up the engineered systems, which will serve to reduce the effect of any unforeseen event over the life of the facility.

4.3.8 Proposed Monitoring Program

The Crossroads Landfill has an ongoing DEP approved environmental monitoring program. The program is titled *WMDSM Water Quality Monitoring Program*, and the original document is dated October 1991. This program is part of the site operations manual, and includes ground water monitoring, surface water monitoring and leachate monitoring. Below we define the ground and surface water monitoring plan for the proposed Phases 9, 11 and 12 expansion. The expanded plan consists of additional ground and surface water monitoring locations. The sampling, analytical, QA/QC, statistical analysis and reporting procedures are already defined in the WMDSM Water Quality Monitoring Program.

The primary detection system for the proposed phases is the leak detection system incorporated in the landfill liner systems. There will also be ground water and surface water monitoring locations. The locations of the proposed ground water monitoring wells are based on the direction of ground water flow. The ground water flow is described in Section 4.2.2, *Ground Water Equipotentials and Flow Directions*, and displayed for observed high and lower water level conditions in **Figures 4-14** through **4-21**. The ground water flow is also described in Section 4.2.4, *Vertical Ground Water Flow Paths*, and displayed for observed average annual water level conditions in **Figures 4-22a-e**. In addition, the results of the ground water modeling and hydrogeological failure analysis were incorporated into the selection of water quality monitoring locations.

Figure 4-69, *Proposed Water Quality Sampling Locations*, displays the existing and proposed ground water and surface water sampling locations. The proposed phreatic wells are displayed on the May Phreatic Surface with Flow Lines figures (**Figures 4-14** and **4-18**), and the proposed till wells are displayed on the May Bedrock Potentiometric Surface with Flow Lines (**Figures 4-16** and **4-20**). **Table 4-25**, *Proposed Water Quality Sampling Points*, lists the proposed sampling locations with coordinates and monitoring well screened intervals. The continuous layer of low permeability gray clay-silt beneath the three proposed phases limits the potential for vertical flow to the till and bedrock. Consequently the proposed ground water monitoring program emphasizes phreatic wells screened above the gray clay-silt.

In addition, there are proposed till monitoring wells. Since the review of the field data and modeling results do not indicate the potential of contamination to the bedrock and till, we propose that the till wells are sampled on a reduced program. One year of background data will be collected to characterize the till ground water chemistry. After the initial one year period, the wells will be maintained but not sampled. If contamination is detected in the phreatic wells in the future, the till wells can be added to the sampling program to monitor the till water quality.

Phase 9 is located in an area of existing landfills, and the sampling locations will include existing and new locations. Phases 11 and 12 are located in areas hydrologically separate from the existing phases, and will use new sampling locations.

Phase 9

The proposed Phase 9 is located adjacent to the existing Phase 7 landfill. Three new downgradient phreatic monitoring (W9-1E, W9-2E, and W9-3E) are proposed. Existing well B-620C will be used as a downgradient till well. For statistical analysis, Phase 9 will use the existing background wells.

Since Phase 9 is located in the area of existing landfills, the surface water monitoring plan will use the existing locations. Surface water sampling location SW-301 is an upgradient point, and SW-201 is a downgradient point located at the property boundary north of Phase 9. Surface water sampling locations SW-9 and SW-201 are also downgradient of Phase 9.

Phase 11

Seven new monitoring wells will be installed for Phase 11, and three new surface water sampling locations will be defined. Phase 11 will have two phreatic background wells (W11-1E and W11-2E), and one background till well (W11-1B). The phase will have three downgradient phreatic wells (W11-3E, W11-4E and W11-5E), and one downgradient till well (W11-5B). The surface water sampling locations will consist of existing and new sampling locations. The existing sampling locations in the east drainage way will be used. These are upgradient location SW-101 and downgradient location SW-201. There will be three new surface water sampling locations. SW-A and SW-B will be downgradient locations, and SW-C will be an upgradient location.

Phase 12

Seven new monitoring wells will be installed for Phase 12. Phase 12 will have two phreatic background wells (W12-1E and W12-2E), and one background till well (W12-1B). The phase will have three downgradient phreatic wells (W12-3E, W12-4E and W12-5E), and one downgradient till well (W12-4B). Phreatic well W12-4E is located down gradient of the landfill and up gradient of the existing wetland mitigation area, and should detect any potential contamination flowing toward the wetland mitigation area. For the surface water sampling locations, SW-B will be a downgradient location, and SW-C will be an upgradient location.

5.0 SUMMARY

This report summarizes the hydrogeologic investigations, analyses, and conclusions relative to the potential impact of Phases 9, 11 and 12 of the Crossroads Landfill in Norridgewock, Maine, on the ground and surface water resources of the area. This work was performed by the staff and subcontractors of Robert G. Gerber, Inc. (RGGI), Freeport, Maine. RGGI has been working with this site for many years and has prepared numerous previous reports relating to the WMDSM landfill. This report builds on the work of previous studies and describes the work done since the Phase 10 submissions in 1993.

RGGI's interpretation of the regional surficial and bedrock geology and associated hydrogeology has not changed from that described in past reports. The site is located generally on a sequence of glaciomarine clay-silt overlying glacial diamicton (till). The clay-silt deposits are desiccated, stiff in consistency, and fissured near ground surface and show a gradual transition to a saturated, soft, relatively homogeneous deposit at 10 feet and deeper below ground surface. Although there are some overlying silty-sand and eolian sands occurring locally on top of the clay-silt, these are not important hydrogeologically and do not constitute sand and gravel aquifers within the site boundaries. The site is not connected through ground water to any mapped sand and gravel aquifers. The nearest significant sand and gravel aquifer is the esker that lies 4000' to the north and east of Phase 12. The esker is not connected hydraulically to the site.

Within the Phase 11 footprint there are fine sand deposits we have interpreted as eolian origin. Within the Phase 11 and 12 footprints there are silty sand deposits of the coarse-grained Presumpscot Formation. Both these deposits are shallow, localized, and appear to be only seasonally saturated. They are unlikely to serve as significant recharge areas to deeper ground water flow systems, since both deposits are primarily underlain by the glaciomarine clay-silt and the coarse-grained Presumpscot Formation is interbedded with glaciomarine clay-silt.

The regional bedrock ground water flow direction is toward Mill Stream to the south from within the site boundaries. We infer the bedrock to be generally anisotropic with a transmissivity 3 times greater along the direction of the foliation strike (N51°E) than the transmissivity perpendicular to the foliation strike. Through a series of studies involving photolinear interpretation, geophysical surveys and deep bedrock drilling and pumping tests, RGGI has identified a number of high yield fracture zones within and near the WMDSM site.

The regional surficial ground water flow direction is also toward Mill Stream to the south from within the site boundaries. Although most of the precipitation recharge to the site soils travels in a relatively horizontal path, a small portion of the ground water recharge travels through the clay-silt to the underlying glacial diamicton. Ground water also discharges upward from the bedrock beneath the site into the diamicton, making the diamicton the primary ground water conduit for horizontal flow under the site.

Radiometric age-dating of the ground water under the site, combined with recent pumping test interpretations, proves that a long travel time exists through the site clay-silt deposits. Profiling of tritium content in the clay-silts shows a penetration since 1953 of only 12 feet into the deposit below ground surface. Radio-carbon dating of ground water in the diamicton under clay-silt of Phase 11 indicates an age on the order of 2000 years. The average effective vertical hydraulic conductivity in the soft gray clay-silt is estimated to be 4 x 10^{-8} cm/sec. The average horizontal hydraulic conductivity is estimated to be about 50 times greater than the vertical due to the presence of bedding planes including fine sand seams in the clay-silt.

We have performed insitu testing of the hydraulic conductivity of the gray clay-silt underlying the three proposed phases. The mean hydraulic conductivity at all of the three phases meets the regulatory requirement of less than 10^{-5} cm/sec.

The incremental water level drawdown resulting from the construction of Phases 9, 11 and 12 may have a small effect on the water table in the vicinity of the landfill liners. Water level monitoring of existing lined landfills at the site suggests that ground water declines will be less than those simulated. Simulated reductions of the water table beneath the proposed footprints do not consider the return of any precipitation recharge over the footprint through infiltration. Precipitation recharge over the lined footprint area will be removed from the system while the landfill is operational. However, once a phase is closed, some infiltration of precipitation recharge through nearby storm water management systems will occur. This will reduce the simulated reduction of water levels. We do not project any measurable long or short term off-site impact from this quantity-related effect.

On a regional scale we have refined our AQUIFEM model to establish boundary conditions for site ground water flow and transport simulations. We expanded our 1992 site MODFLOW model to simulate flow, used MODPATH for particle tracking (travel times) and MT3D for contaminant transport simulations. Simulated heads in the phreatic zone indicate that flow from Phases 9, 11 and 12 is primarily localized with discharge occurring to local small drainage ways and for Phase 9 to the wetland to the west. Simulations of advective flow using MODPATH indicate that flow from portions of Phase 11 and portions of Phase 12 travels through the gray clay-silt and into the till and upper bedrock before discharging to Mill Stream north of Route 2. Simulated travel times through the gray clay-silt into the till are greater than 200 years. Simulated potentiometric heads in the till and bedrock indicate flow to the south and southeast with discharge to Mill Stream

Through this failure scenario we showed that springs, significant sand and gravel aquifers and existing public and private water supplies are **not** potential receptors from the proposed Phases 9, 11 and 12. The only identified potential receptors are the bedrock aquifer and the local drainage ways including Mill Stream. The project does not pose an unreasonable threat to an underlying fractured bedrock aquifer because of the very long travel times (>200 years) to bedrock. Computer simulations of failure scenarios for potential ground water impacts and mass balance calculations for potential surface water impacts do not predict a significant impact on local drainage ways from the proposed development of Phases 9, 11 and 12.

We calculated travel times using the calibrated site model, and by hand calculations using observed potentiometric data. First we discuss the simulated travel times. Shallow flow travel times from Phase 9 range from 4 to 49 years before discharge to the wetland; the average travel time of the shallow flow paths is 14 years. 42% of the footprint contains flow paths that discharge at times greater than 200 years. Shallow flow travel times from Phase 11 range from 2 to 54 years before discharge with an average travel time of 15 years. 29% of the footprint contains flow paths that discharge at times greater than 200 years. Phase 12 shallow flow travel times range from 4 to 16 years and the average travel time is 8 years. 18% of the footprint contains flow paths that discharge at times greater than 200 years.

The hand-calculated travel times give the following results. Travel times along flow paths from Phase 9 range from 30 to 80 years before discharge to wetlands and small drainage ways. Travel times along flow paths from Phase 11 range from 21 to 97 years before discharge. Travel times along flow paths from Phase 12 range from 14 to 46 years. All of the travel times calculated for the three proposed phases using the observed seasonal high water level data are greater than 6 years to surface waters.

There are two important differences between the travel times calculated using the model and the hand-calculated travel times. First, the model calibrated hydraulic conductivity values are greater than average site wide data used for the hand calculations. During the model calibration the hydraulic conductivities are varied to obtain the best calibration for the model, and the final calibrated values are dependent on the scale of the discretization of the model and the overall combination of parameters used to calibrate the model. The hydraulic conductivity values used for the hand calculated travel times are the average of site data. Since the model hydraulic conductivity values are greater in the model, the model calculated travel times are shorter.

The second difference between the model and hand calculated travel times involves travel through the gray clay-silt. The hand calculated travel times are for shallow flow paths, while the model also includes very long travel times calculated for flow paths through the gray clay-silt. In our opinion, the hand calculated travel times are more accurate for site specific application.

In summary, the average simulated and the hand calculated travel times to discharge for ground water flow at average annual conditions are greater than six years for the three proposed phases.

We simulated impacts on ground water in three failure scenarios and calculated the impact of the existing and proposed development at six different surface water points throughout the area. The total engineered system failure locates the nearby drainage ways including Mill Stream and the bedrock aquifer as the potential receptors from the landfill and simulates average travel times to discharge at greater than six years for all of the proposed phases. Travel times to bedrock are in excess of 200 years. The engineered systems design failure illustrates that there will be minimal impact to ground and surface water from such a failure after 30 years. The simulated failures from the leachate pumping stations also indicate nearly undetectable impacts to ground water and nearby drainage ways. Total site-wide impact (all existing and proposed phases) is also calculated for Mill Stream at Route 2. Iron and chromium have been presented as the most sensitive constituents in current sampling of the special waste leachate. Predicted incremental increases in Mill Stream concentrations from development of Phase 9, 11 and 12 are only 0.02% for iron and 0.003% for chromium as compared to current background concentrations. Site-wide development incremental impacts are predicted to remain below aquatic freshwater chronic toxicity standards for iron and chromium. Current background conditions exceed drinking water standards for iron but incremental increases from the site are predicted to have no significant impact on surface water quality.

The analytical results predict no measurable long term change in water quality in Mill Stream or other drainage ways. Computer simulations of the liner system failure and pumping station leak also predict no impact to sensitive receptors and minimal impact to local drainage ways. The site has good hydrogeologic controls to back up the engineered systems, which will serve to reduce the effect of any unforeseen event over the life of the facility.

While there have been a number of water quality changes at the site, the recurring patterns are associated with site development processes and historical site use as a farm. The influence of land clearing, road building and maintenance, and general site disturbance is correlated with most of the water quality changes. The majority of the wells with observed trends are phreatic wells, and are screened above the water table with minimal surface seals. Thus, they reflect soil and local land use conditions. Some of the observed geochemical changes are associated with historical leachate seeps (pre-1989) at the former municipal solid waste landfill. The current landfill operations do not appear to be having an adverse impact on local ground and surface water quality. Both surface and ground water quality within the site and in nearby Mill Stream can currently be characterized as good.

The hydrogeologic investigation has identified the need for two variances from the Maine Solid Waste regulations. The variances are requested for, 1) CMR 401.1(D)(1)(b) - "The landfill handling area shall not lie closer than 300' of a sand and gravel deposit", and, 2) CMR 401.2(B)(1)(e) - Geologic Cross-Sections.

> *1.) CMR 401.1(D)(1)(b) "The landfill handling area shall not lie closer than 300' of a sand and gravel deposit"*

Glaciomarine silty sand and eolian fine sand deposits are located within proposed Phase 11 and 12 areas. The definition of sand and gravel deposit reads: [CMR 400.1 (ZZZ)] - *""Sand and gravel deposit" means a surficial geological formation such as an esker, outwash plain, glaciomarine delta, kame, stratified moraine or other stratified deposits commonly consisting of sand and/or gravel."*

The deposits referenced in the regulations are commonly both laterally extensive and tens to hundreds of feet thick. The intent of protecting sand and gravel deposits stems from the realization that some of these deposits may be unmapped aquifers, or may be permeable enough to represent significant sources of recharge to sand and gravel or bedrock aquifers. Since sand and gravel has little capacity to retard or attenuate landfill leachate, it is inappropriate to locate waste disposal sites on or near major sand and gravel deposits without careful consideration. Thus, a variance would be required to locate a landfill within 300 feet of an identified "sand and/or gravel deposit".

The glaciomarine and eolian fine sand over the glaciomarine clay-silt in the Phase 11 and 12 areas do not constitute sand and gravel deposits within the meaning of the definition, as they do not serve the functions which are protected by the regulations. These deposits appear to be neither a significant source of recharge to a ground water flow system, nor are they unmapped sand and gravel aquifers. Therefore, we conclude that the requested variance meets the intent of the regulations.

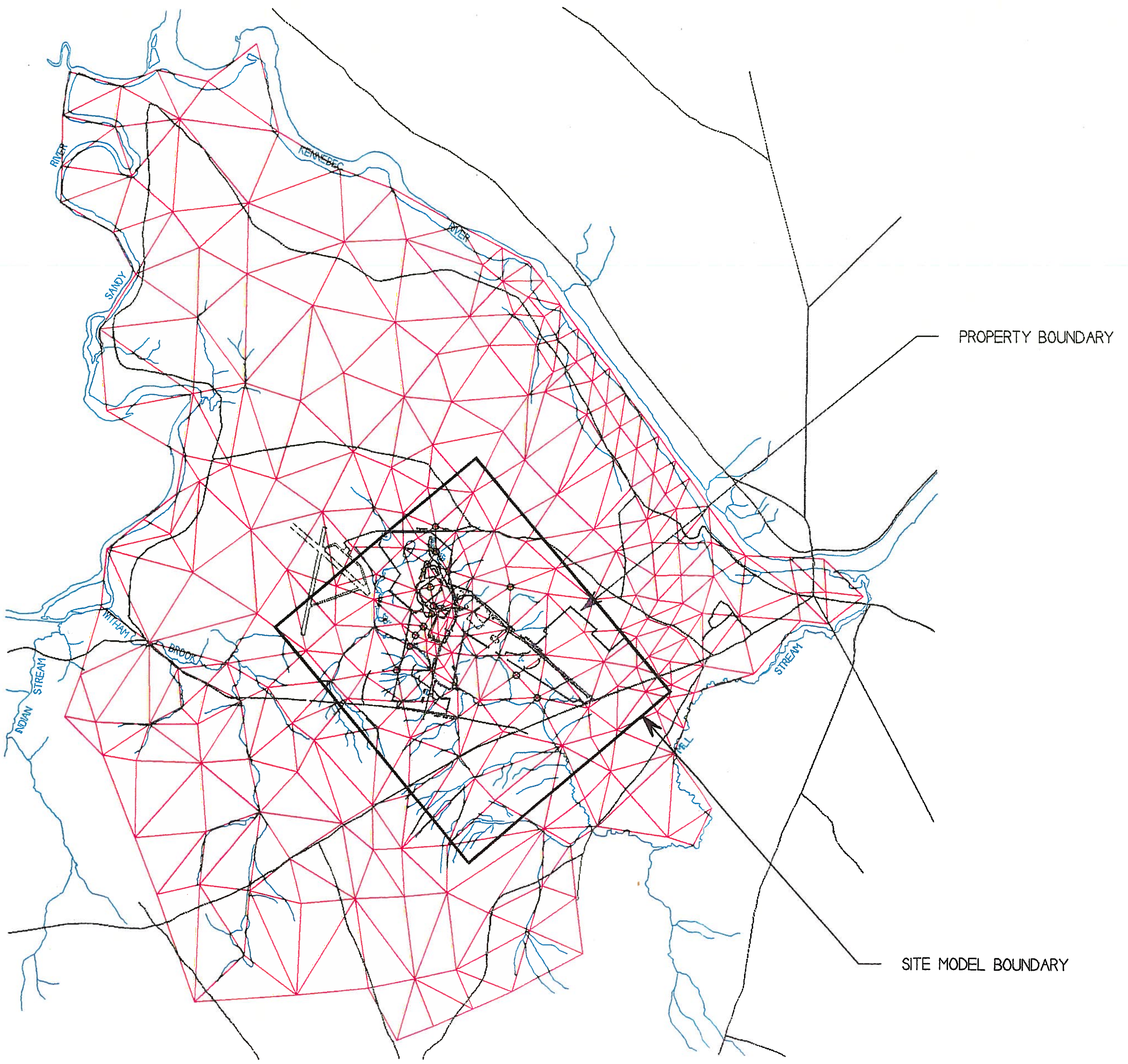


Figure 4-40

Crossroads Landfill
Phases 9, 11, & 12 Expansion

W.M.D.S.M.
Norridgewock, Maine
prepared by

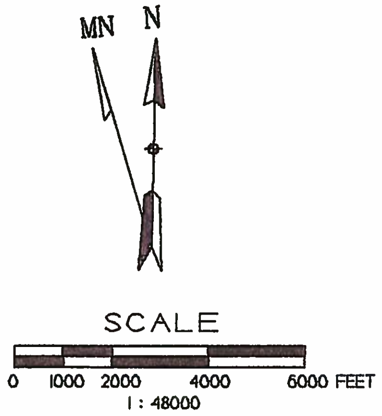
ROBERT G. GERBER, INC.
Freeport, Maine

Project 1329 May 1996

REGIONAL MODEL FINITE ELEMENT GRID

EXPLANATION:

▽	AQUIFEM FINITE ELEMENT MESH
□	OUTLINE OF MODFLOW FINITE DIFFERENCE GRID
○	HIGH TRANSMISSIVITY NODE



Topographic Base: USGS 1982 7.5 min. Norridgewock Quad.

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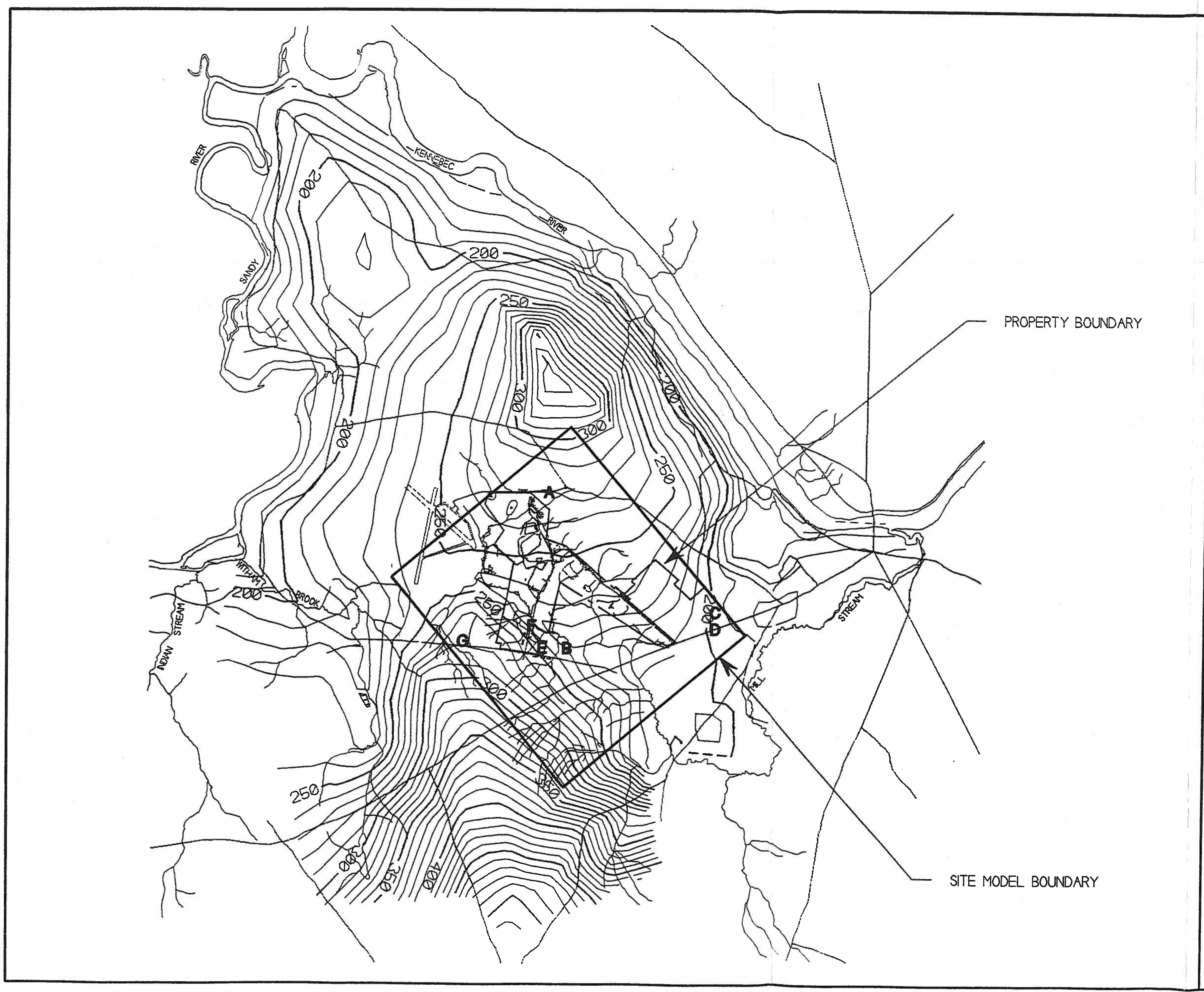
Figure 4-41

Crossroads Landfill
Phases 9, 11, & 12 Expansion

W.M.D.S.M.
Norridgewock, Maine
prepared by
ROBERT G. GERBER, INC.
Freeport, Maine

Project 1329 May 1996

SIMULATED REGIONAL BEDROCK POTENTIOMETRIC SURFACE



EXPLANATION:

—200— SIMULATED POTENTIOMETRIC SURFACE

OFF-SITE CALIBRATION WELLS:

A	DECATO
B	MGS-1047
C	MGS-1208
D	MGS-1215
E	MGS-43
F	MGS-897
G	VILES

SEE TABLE 4-18 AND FIGURE 3-1 FOR ON-SITE CALIBRATION WELLS.

MN N

SCALE

0 1000 2000 4000 6000 FEET
1 : 48000

Topographic Base: USGS 1982 7.5 min. Norridgewock Quad.

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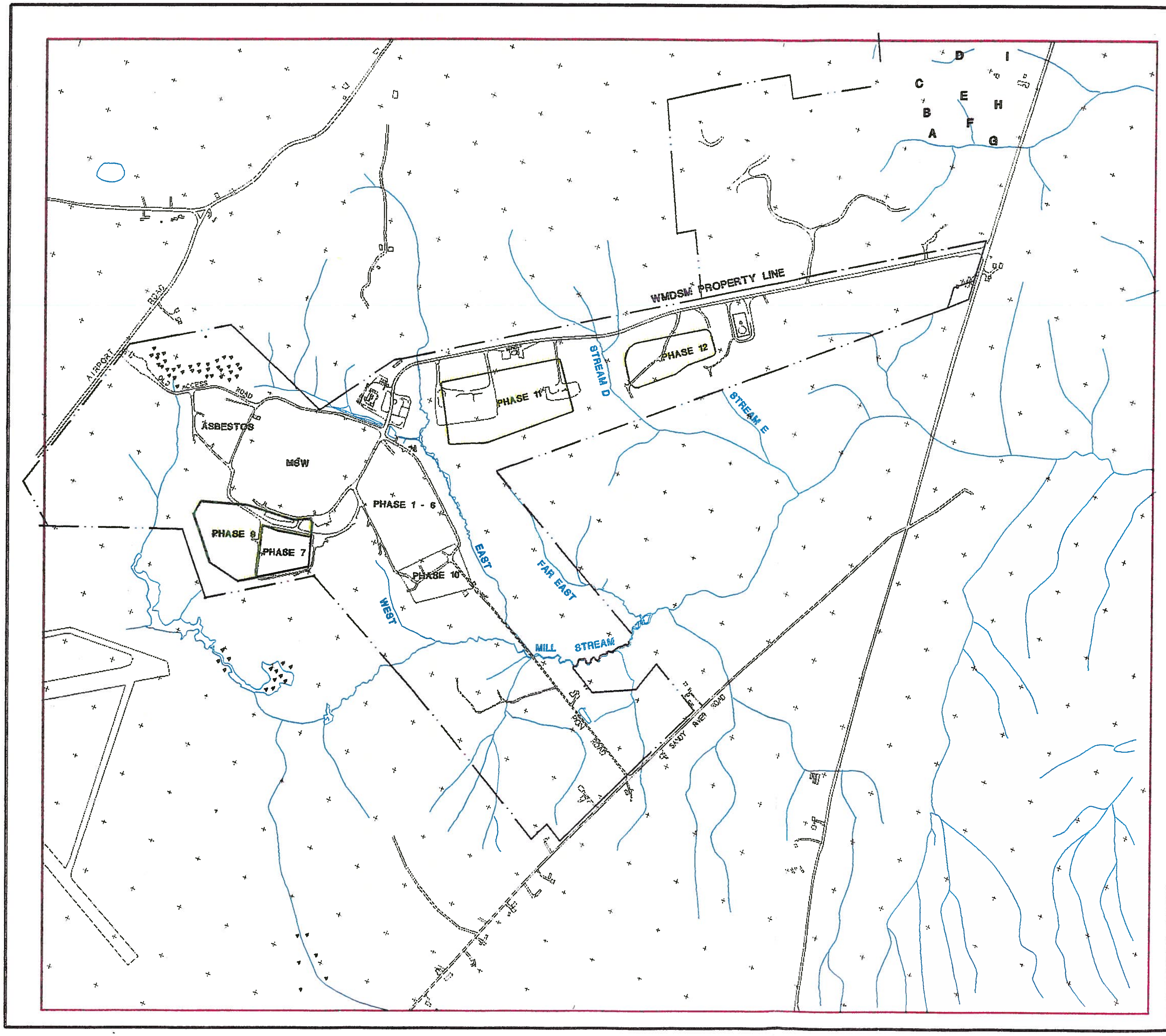
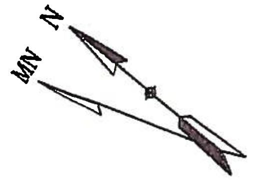
R:\1300S\1329\1329SITE.GCD





LEGEND:

+	SITE GRID - 500 FEET
▭	MODFLOW MODEL AREA
—··—	PROPERTY BOUNDARY
⬡	PHASE - LIMIT OF WASTE

BAKER CALIBRATION WELLS:

A	B-137A
B	B-138A
C	B-139A
D	B-140A
E	B-141A
F	B-142A
G	B-143A
H	B-144A
I	B-145A

SEE TABLE 4-21 AND FIGURE 3-1 FOR ON-SITE WELL LOCATIONS

SCALE

0 500 1000 2000 ft

SITE MODEL BASE MAP

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	MAY 1, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 1000 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-42

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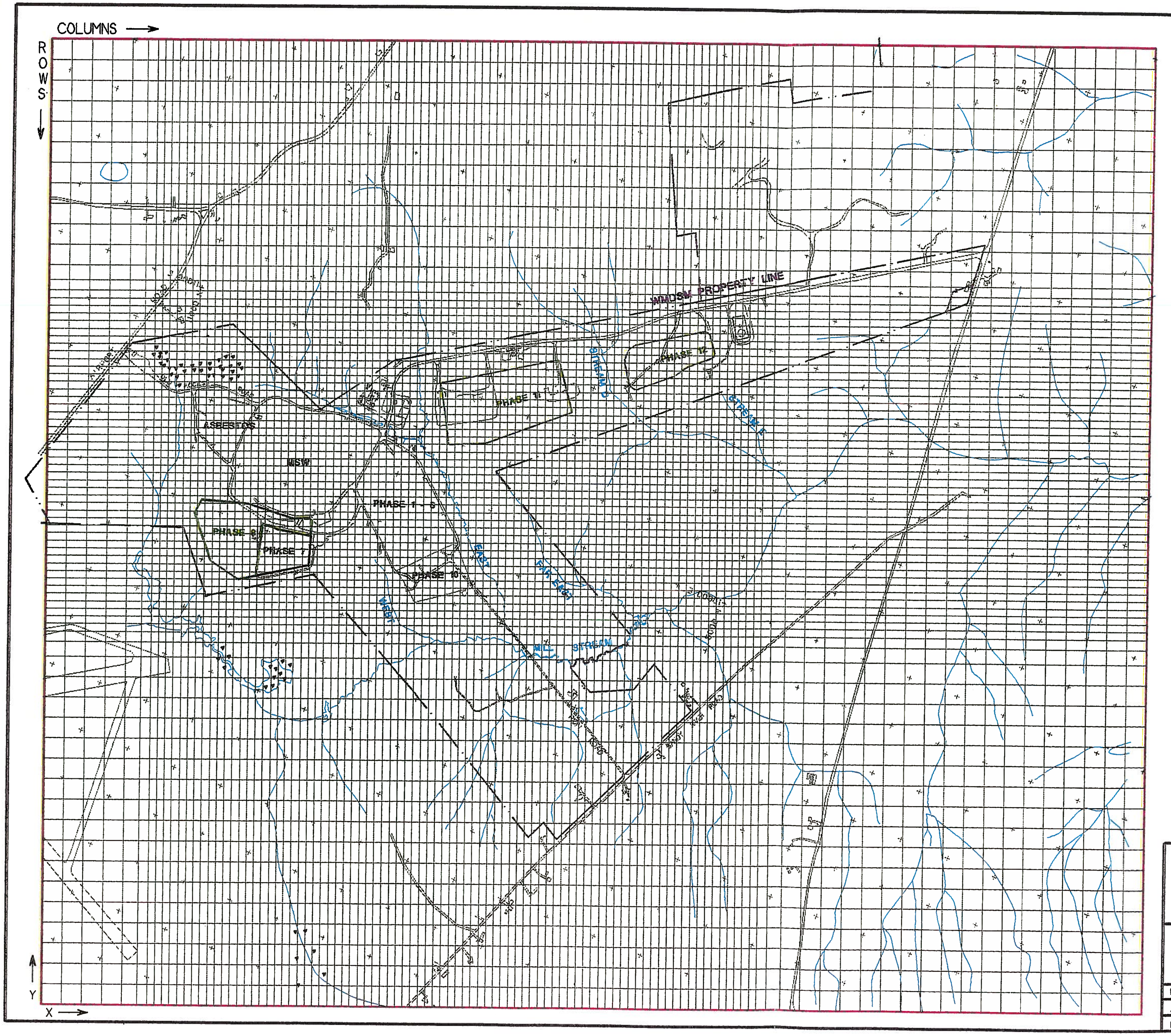

LEGEND:

✛ SITE GRID - 500 FEET

▦ FINITE DIFFERENCE GRID

▭ MODFLOW MODEL AREA

— · · — PROPERTY BOUNDARY

⬠ PHASE - LIMIT OF WASTE

SCALE

0 500 1000 2000 ft

SITE MODEL FINITE DIFFERENCE GRID

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	MAY 6, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 1000 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-43

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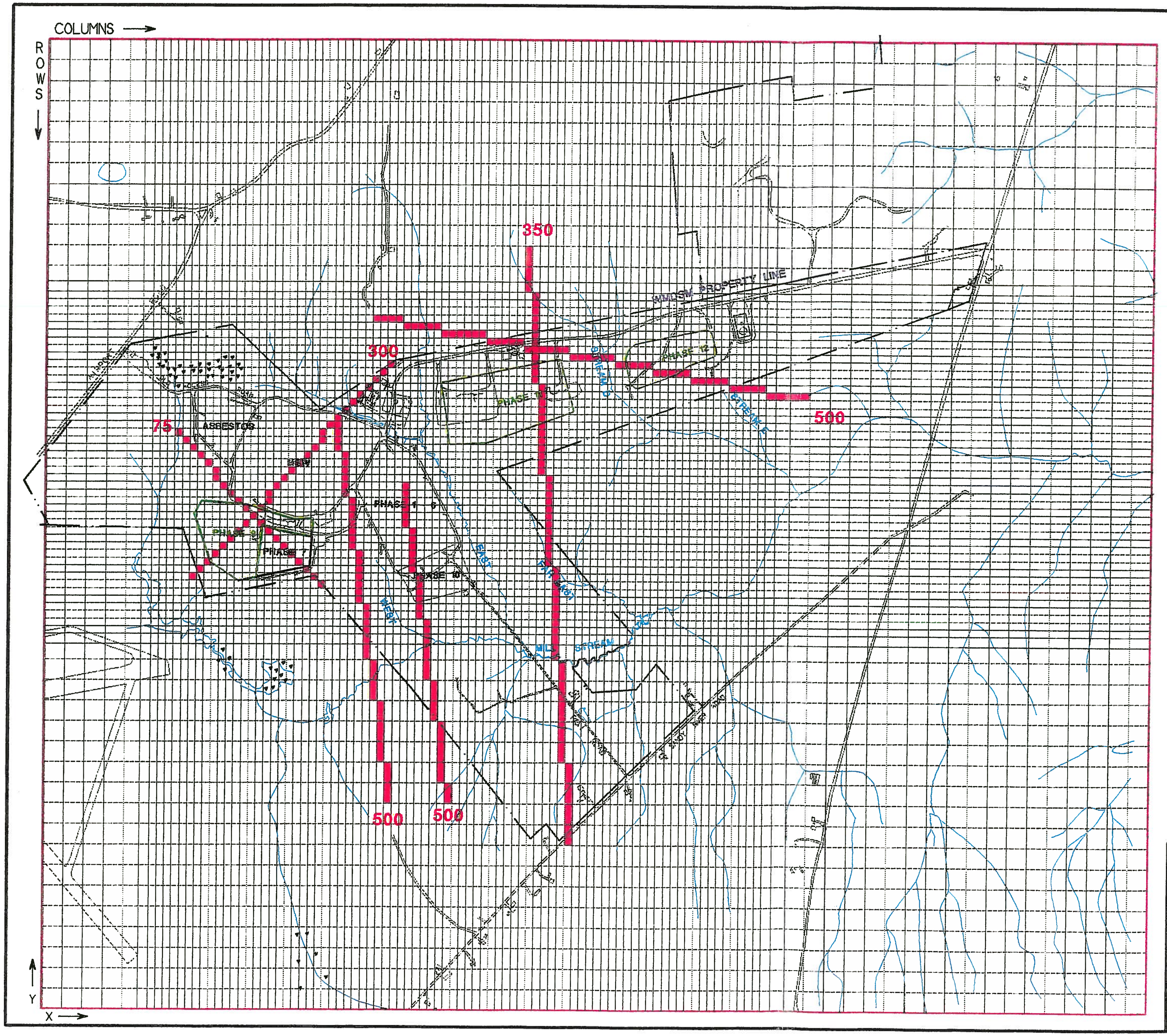
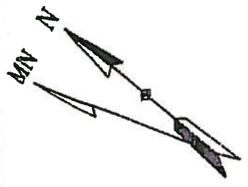




NOTES:

1. TRANSMISSIVITY OF BEDROCK IN LAYERS 6. 7. AND 8 IS 26 FT^2/DAY.

2. THICKNESS OF LAYER 6 IS 50 FEET: LAYER 7 IS 100 FEET: AND LAYER 8 IS 250 FEET.

LEGEND:

⊞	FINITE DIFFERENCE GRID
▭	MODFLOW MODEL AREA
— · · —	PROPERTY BOUNDARY
⬠	PHASE - LIMIT OF WASTE
🟥	SITE MODEL BEDROCK HIGH YIELD FRACTURES
500	TRANSMISSIVITY OF MODELED BEDROCK FRACTURE ZONE (FT^2/DAY) IN LAYERS: 6. 7. AND 8.

SCALE

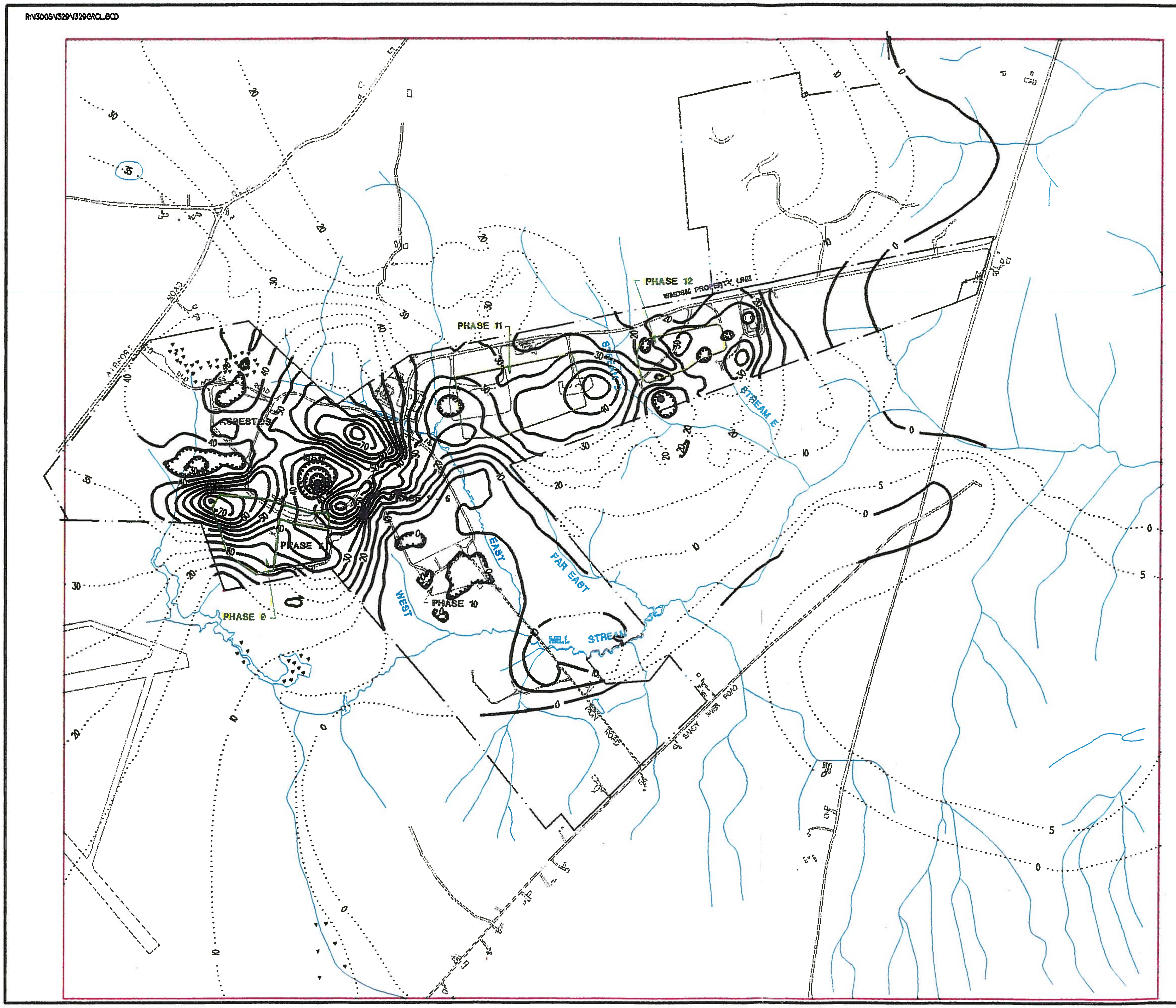
SITE MODEL BEDROCK HIGH YIELD FRACTURES
CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	APRIL 30, 1996
APPROVED BY:	KmB	SCALE:	1 INCH - 1000 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-44



LEGEND:

— 20 —	GRAY CLAY-SILT THICKNESS CONTOURS (5 FOOT INTERVAL)
▭	MODFLOW MODEL AREA
—— · · ——	PROPERTY BOUNDARY
⬠	PHASE - LIMIT OF WASTE

SCALE

0 500 1000 2000 ft

SITE MODEL GRAY CLAY-SILT THICKNESS

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	APRIL 30, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 1000 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-45

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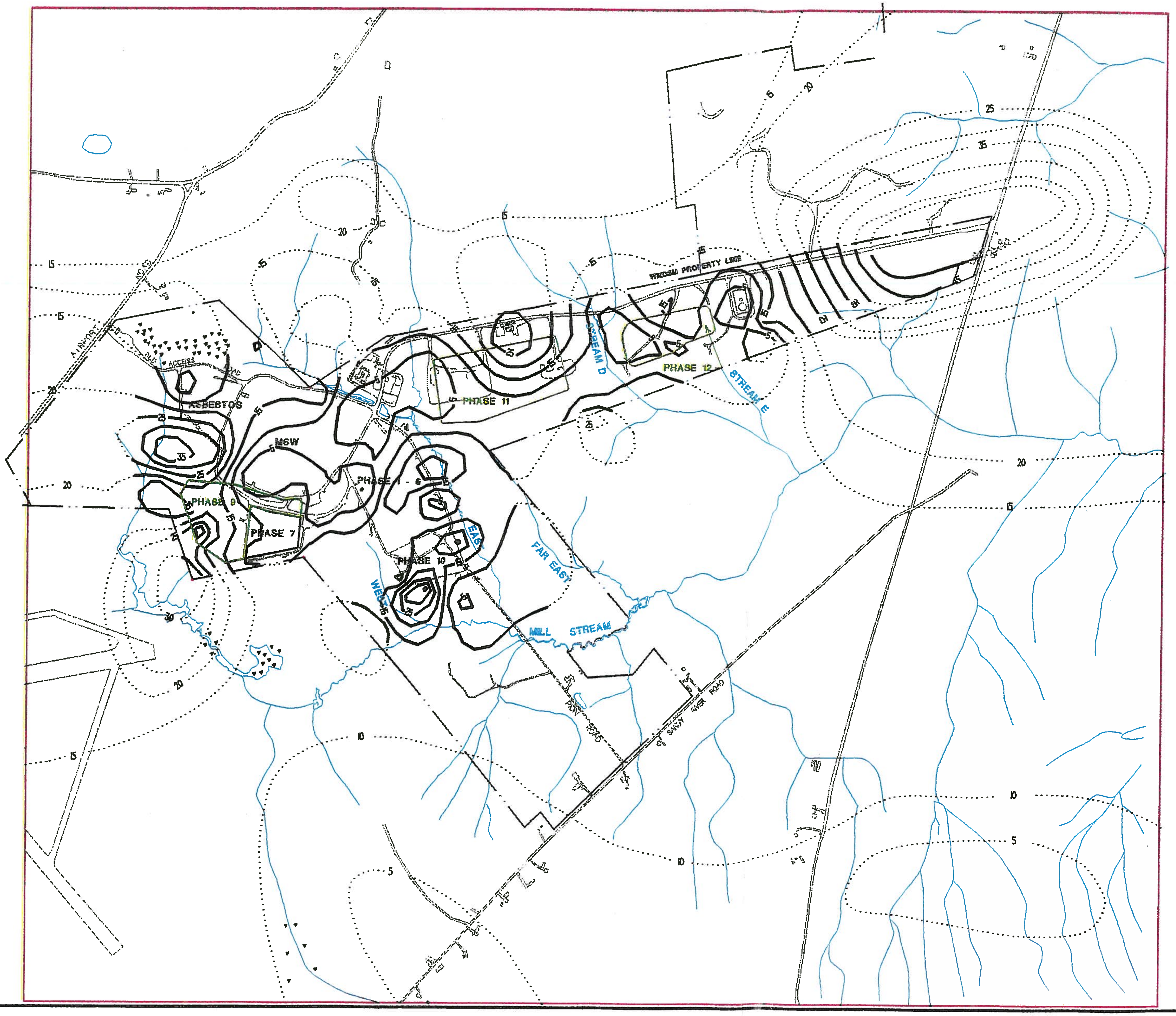

MN
N

LEGEND:

- — 20 — TILL THICKNESS CONTOURS (5 FOOT INTERVAL)
- ▭ MODFLOW MODEL AREA
- —··— PROPERTY BOUNDARY
- ⬠ PHASE - LIMIT OF WASTE

NOTE:

1. SITE MODEL TILL HYDRAULIC CONDUCTIVITY:
HORIZONTAL: Kh = 8.88E-04 cm/sec
VERTICAL: Kv = 2.96E-04 cm/sec

SCALE

0 500 1000 2000 ft

SITE MODEL TILL THICKNESS
CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION
prepared for
W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	MAY 6, 1996
APPROVED BY:	KMB	SCALE:	1 INCH = 1000 FEET
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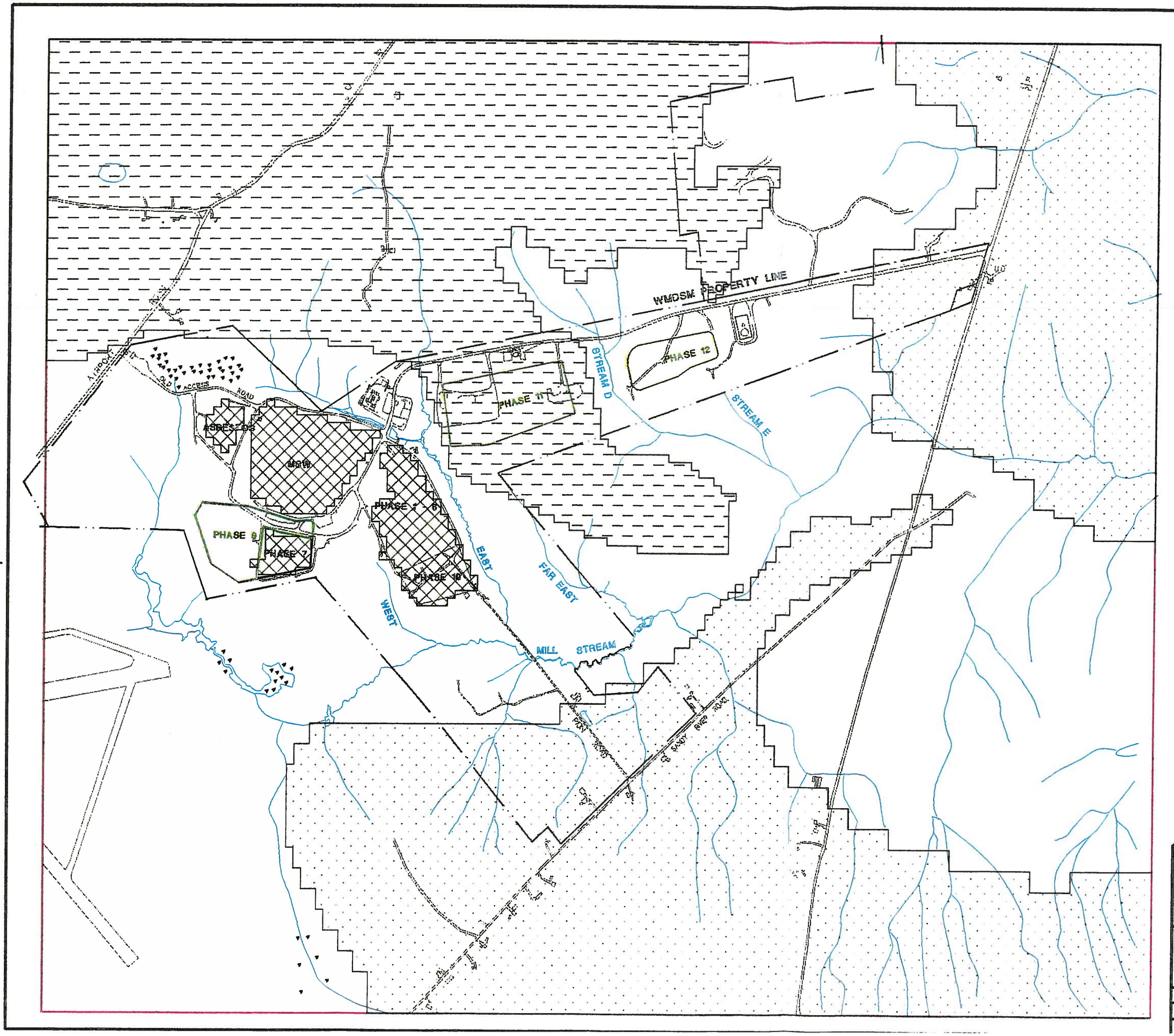


SITE MODEL RECHARGE ZONATION
CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	APRIL 29, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 1000 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-47

Crossroads Landfill Phases 9, 11 & 12

Observed versus Simulated Heads

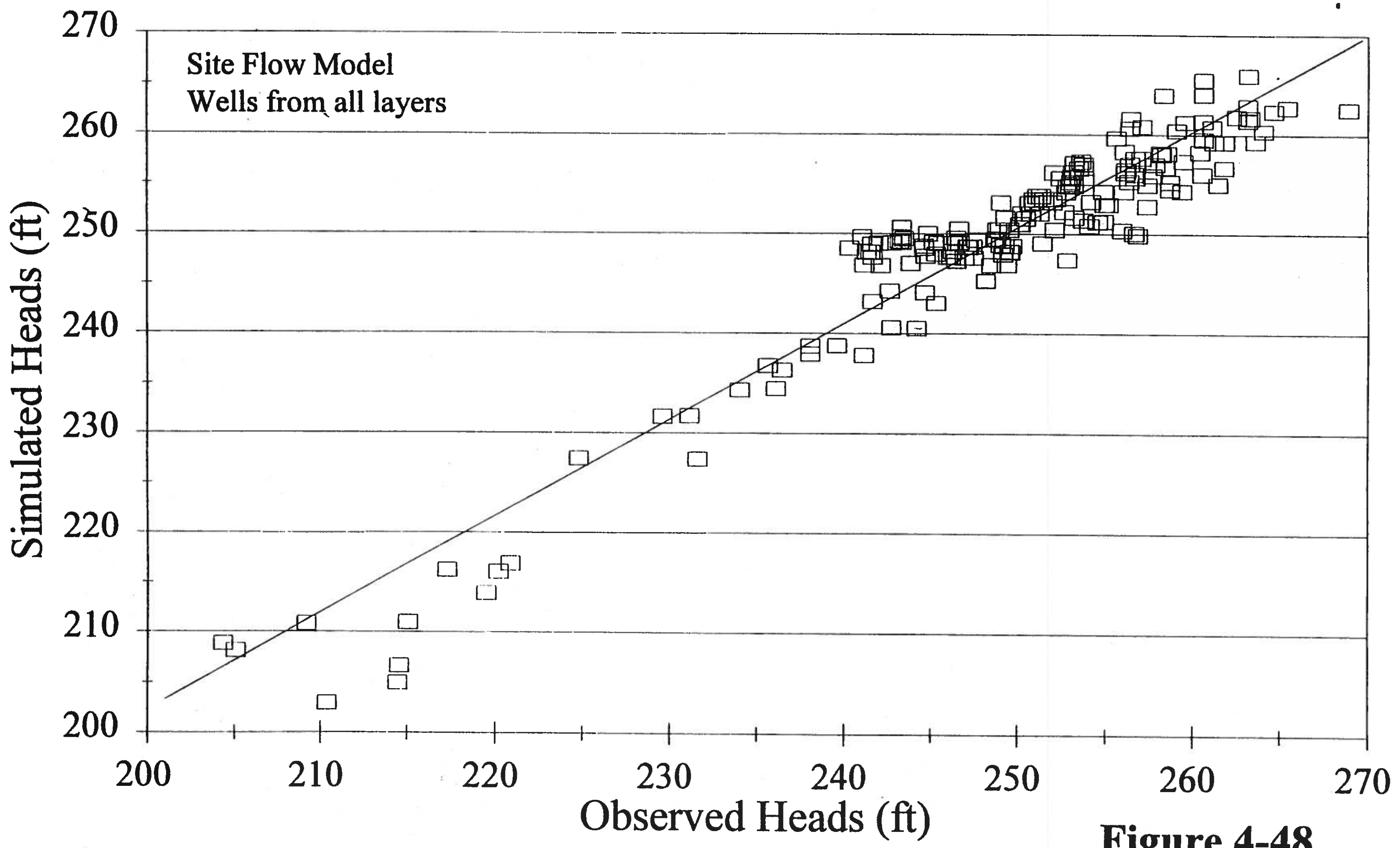


Figure 4-48

Crossroads Landfill Phases 9, 11 & 12

Frequency Histogram of Residuals

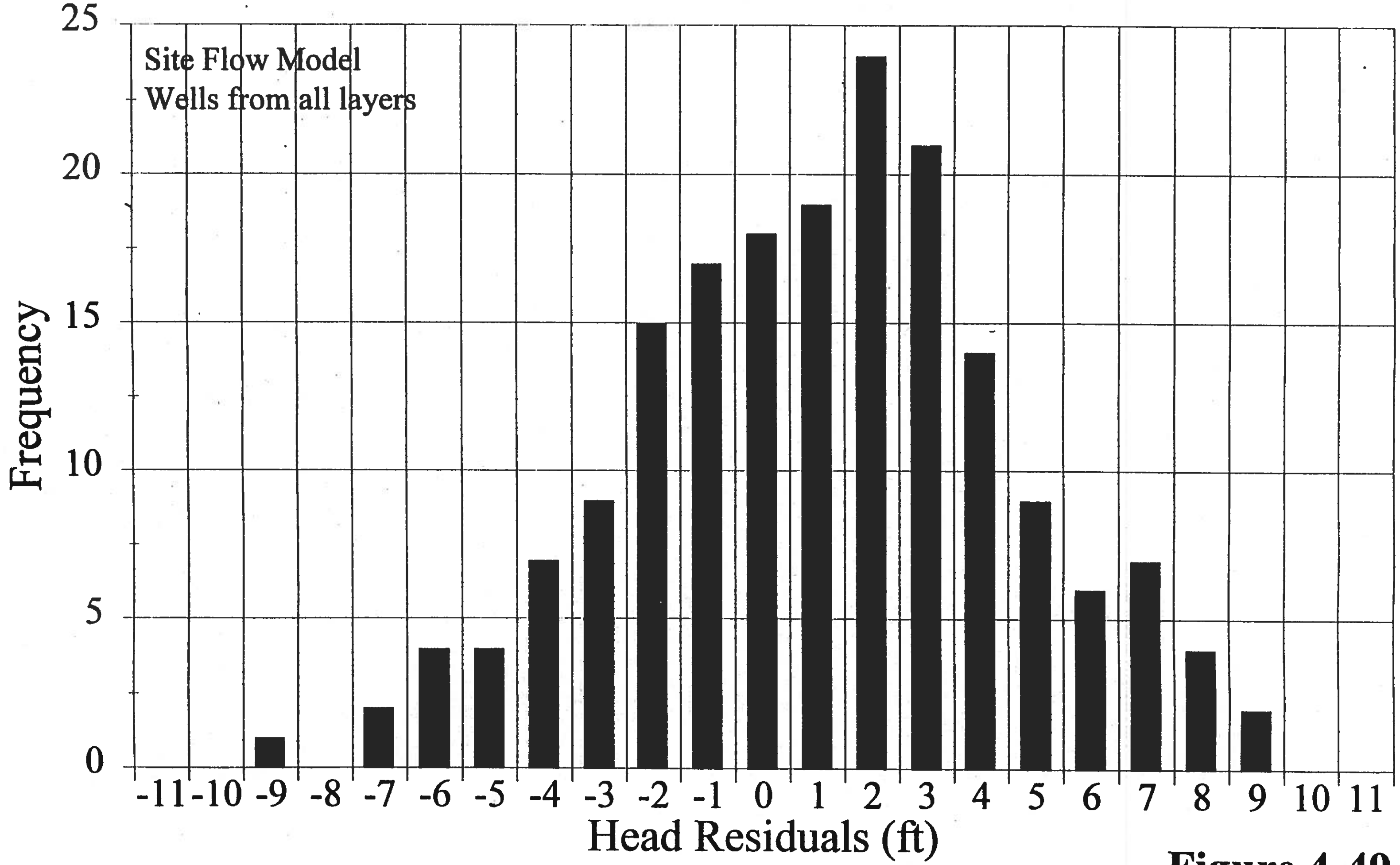
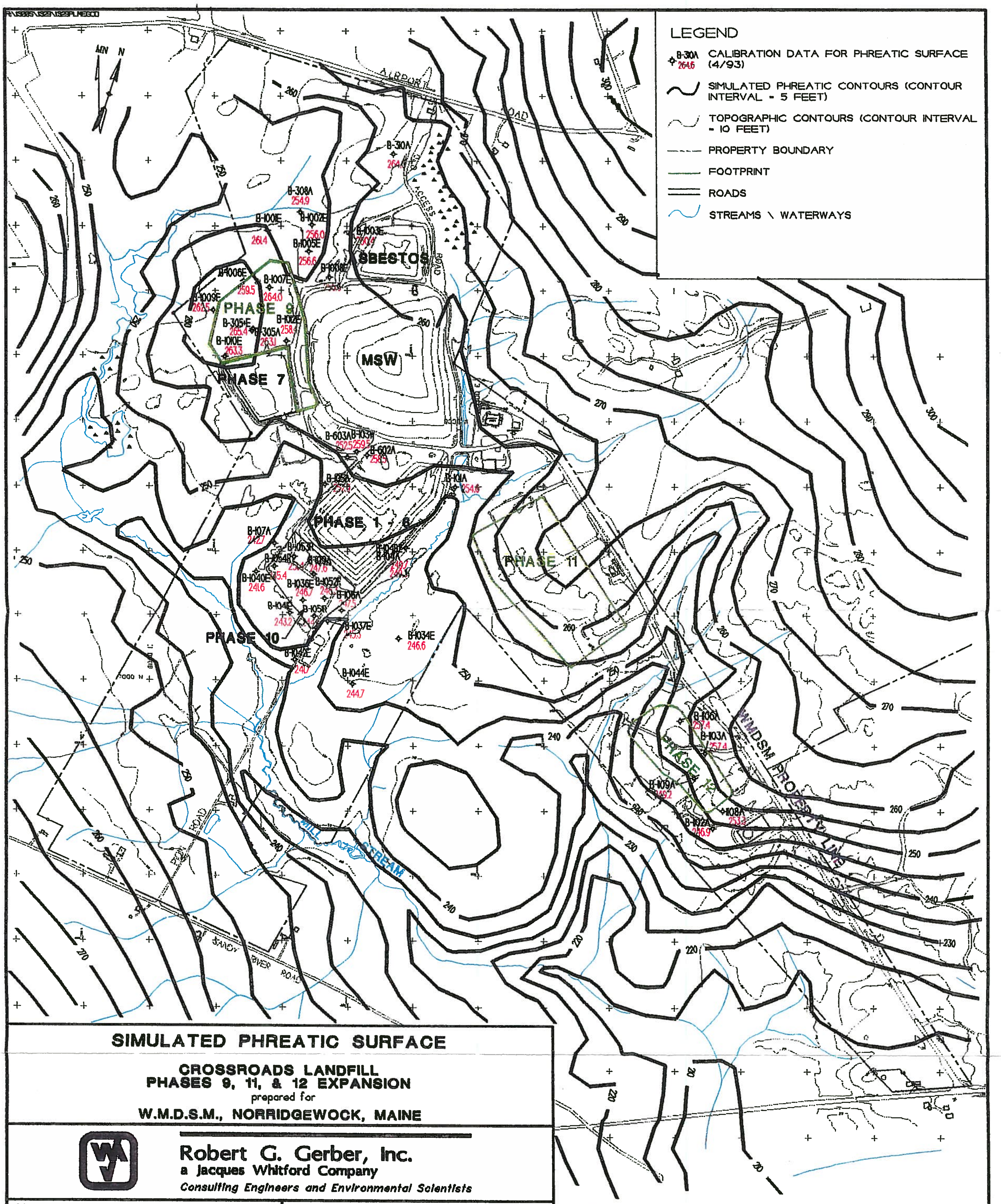


Figure 4-49



SIMULATED PHREATIC SURFACE

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

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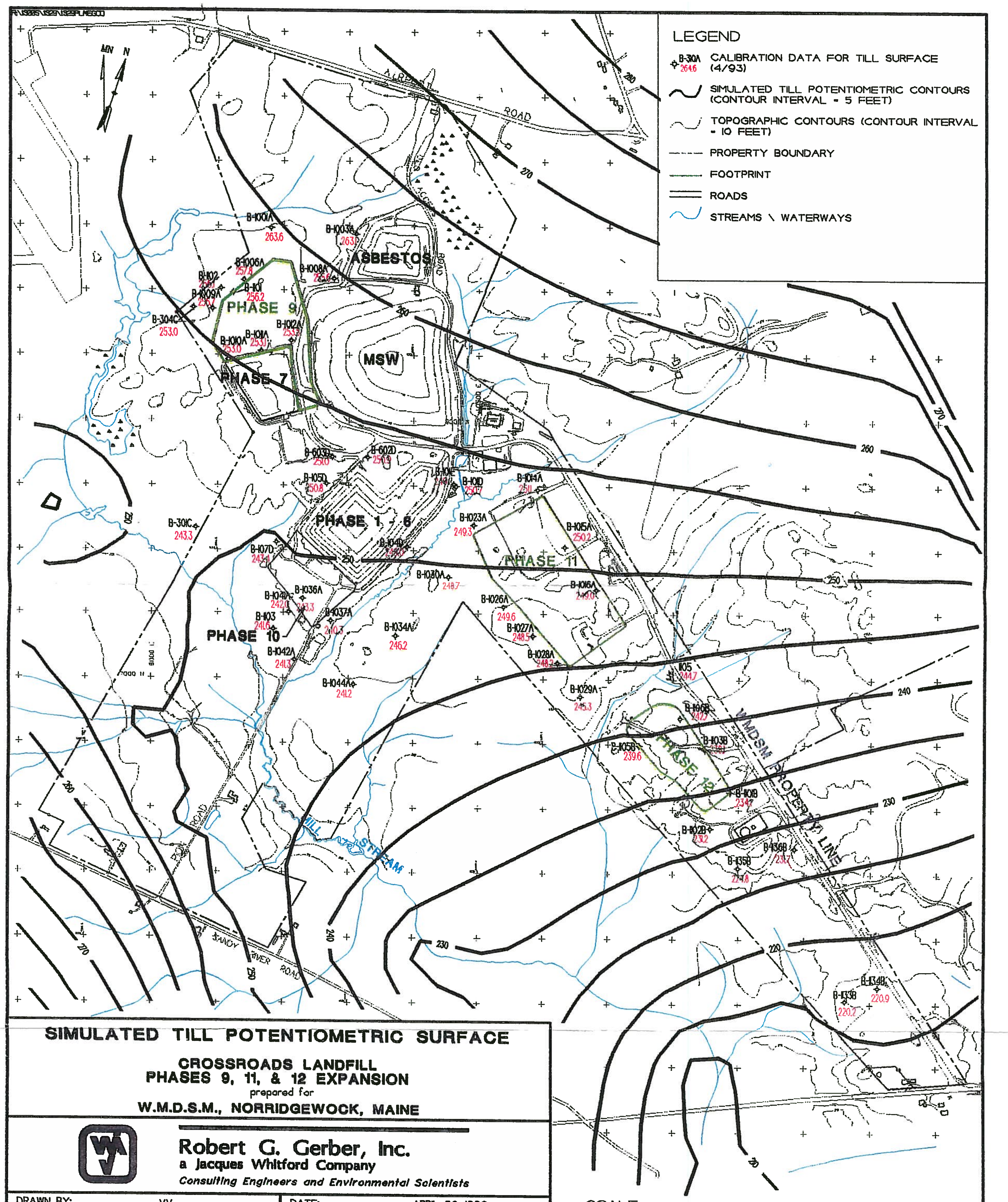
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-50



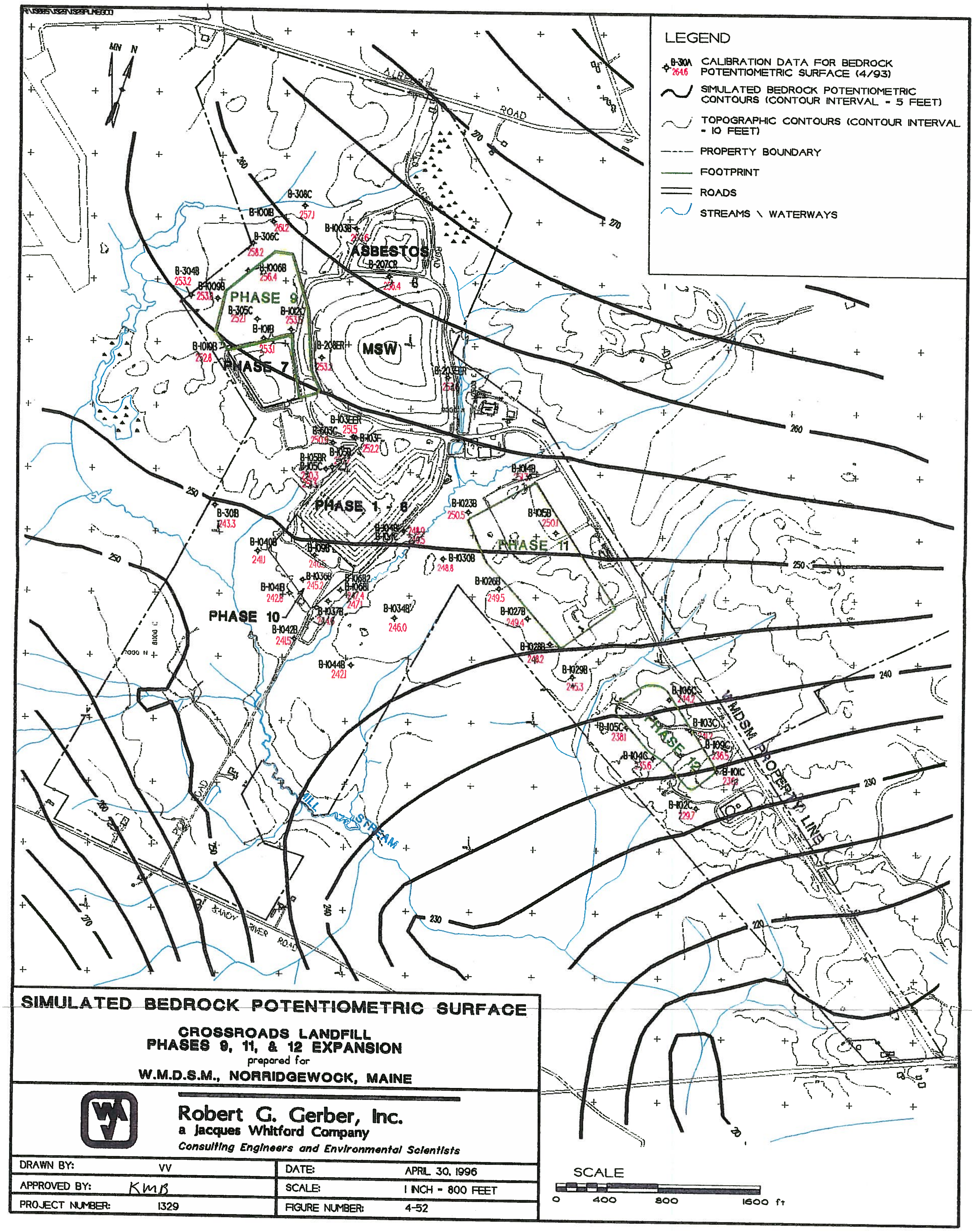
SIMULATED TILL POTENTIOMETRIC SURFACE

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION
prepared for
W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	APRIL 30, 1996
APPROVED BY:	KMB	SCALE:	1 INCH = 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-51

SCALE
0 400 800 1600 FT



LEGEND

✣ B-30A 264.6	CALIBRATION DATA FOR BEDROCK POTENTIOMETRIC SURFACE (4/93)
～	SIMULATED BEDROCK POTENTIOMETRIC CONTOURS (CONTOUR INTERVAL - 5 FEET)
～	TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 10 FEET)
----	PROPERTY BOUNDARY
──	FOOTPRINT
═	ROADS
～	STREAMS \ WATERWAYS

SIMULATED BEDROCK POTENTIOMETRIC SURFACE

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
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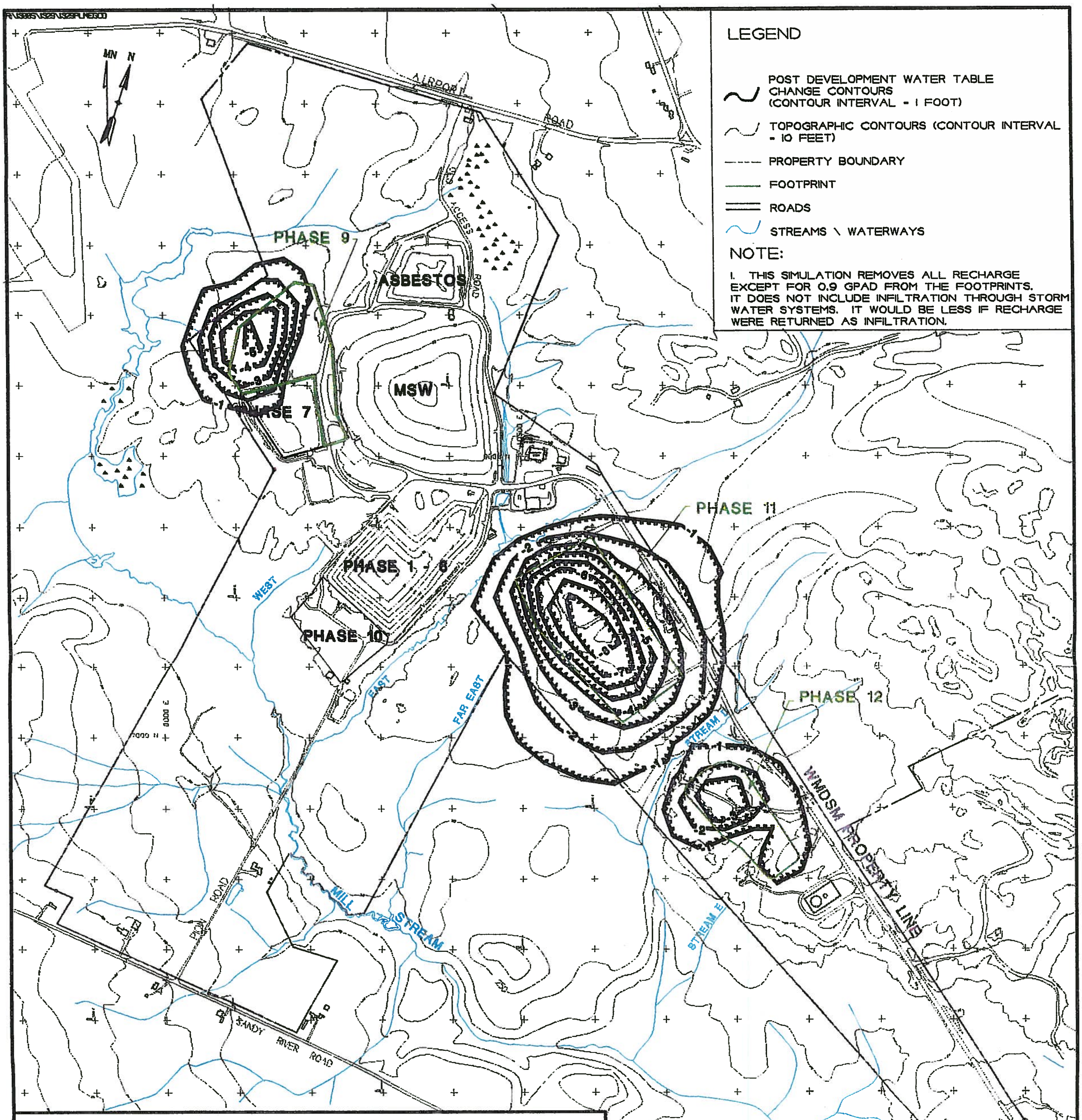
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	APRIL 30, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-52

SCALE
0 400 800 1600 ft



LEGEND

POST DEVELOPMENT WATER TABLE CHANGE CONTOURS (CONTOUR INTERVAL - 1 FOOT)

TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 10 FEET)

PROPERTY BOUNDARY

FOOTPRINT

ROADS

STREAMS \ WATERWAYS

NOTE:

1. THIS SIMULATION REMOVES ALL RECHARGE EXCEPT FOR 0.9 GPAD FROM THE FOOTPRINTS. IT DOES NOT INCLUDE INFILTRATION THROUGH STORM WATER SYSTEMS. IT WOULD BE LESS IF RECHARGE WERE RETURNED AS INFILTRATION.

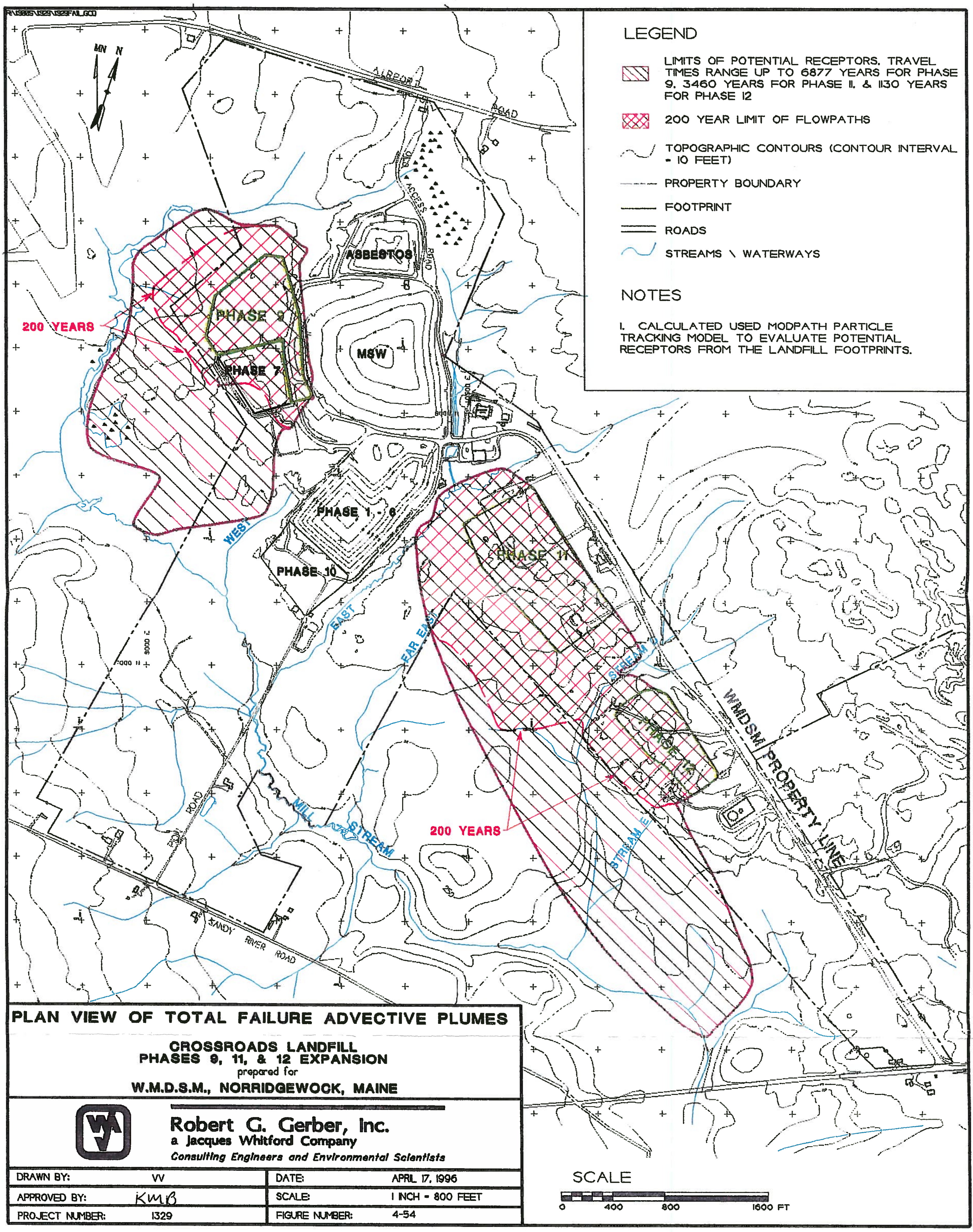
POST DEVELOPMENT WATER TABLE CHANGE

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION
prepared for
W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	MAY 1, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-53

SCALE
0 400 800 1600 ft



LEGEND

▨ LIMITS OF POTENTIAL RECEPTORS. TRAVEL TIMES RANGE UP TO 6877 YEARS FOR PHASE 9, 3460 YEARS FOR PHASE 11, & 1130 YEARS FOR PHASE 12

▩ 200 YEAR LIMIT OF FLOWPATHS

TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL = 10 FEET)

PROPERTY BOUNDARY

FOOTPRINT

ROADS

STREAMS \ WATERWAYS

NOTES

1. CALCULATED USED MODPATH PARTICLE TRACKING MODEL TO EVALUATE POTENTIAL RECEPTORS FROM THE LANDFILL FOOTPRINTS.

PLAN VIEW OF TOTAL FAILURE ADVECTIVE PLUMES

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION
prepared for
W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
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Consulting Engineers and Environmental Scientists

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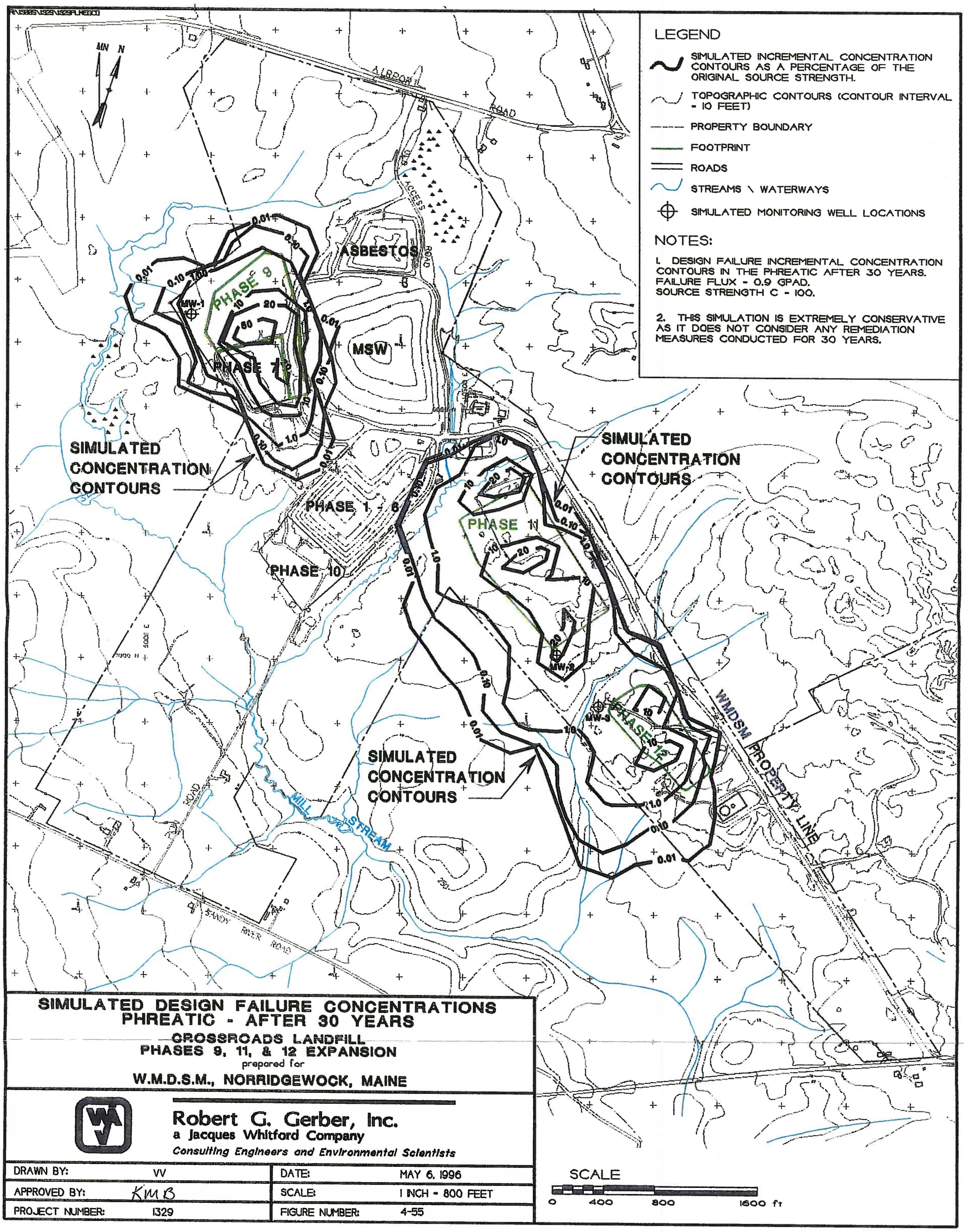
APPROVED BY:	KMB	SCALE:	1 INCH = 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-54



LEGEND

- SIMULATED INCREMENTAL CONCENTRATION CONTOURS AS A PERCENTAGE OF THE ORIGINAL SOURCE STRENGTH.
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 10 FEET)
- PROPERTY BOUNDARY
- FOOTPRINT
- ROADS
- STREAMS \ WATERWAYS
- ⌖ SIMULATED MONITORING WELL LOCATIONS

NOTES:

1. DESIGN FAILURE INCREMENTAL CONCENTRATION CONTOURS IN THE PHREATIC AFTER 30 YEARS. FAILURE FLUX - 0.9 GPAD. SOURCE STRENGTH C - 100.
2. THIS SIMULATION IS EXTREMELY CONSERVATIVE AS IT DOES NOT CONSIDER ANY REMEDIATION MEASURES CONDUCTED FOR 30 YEARS.

SIMULATED DESIGN FAILURE CONCENTRATIONS
PHREATIC - AFTER 30 YEARS
CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION
prepared for
W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	MAY 6, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-55

SCALE
0 400 800 1600 ft

Example Calculation

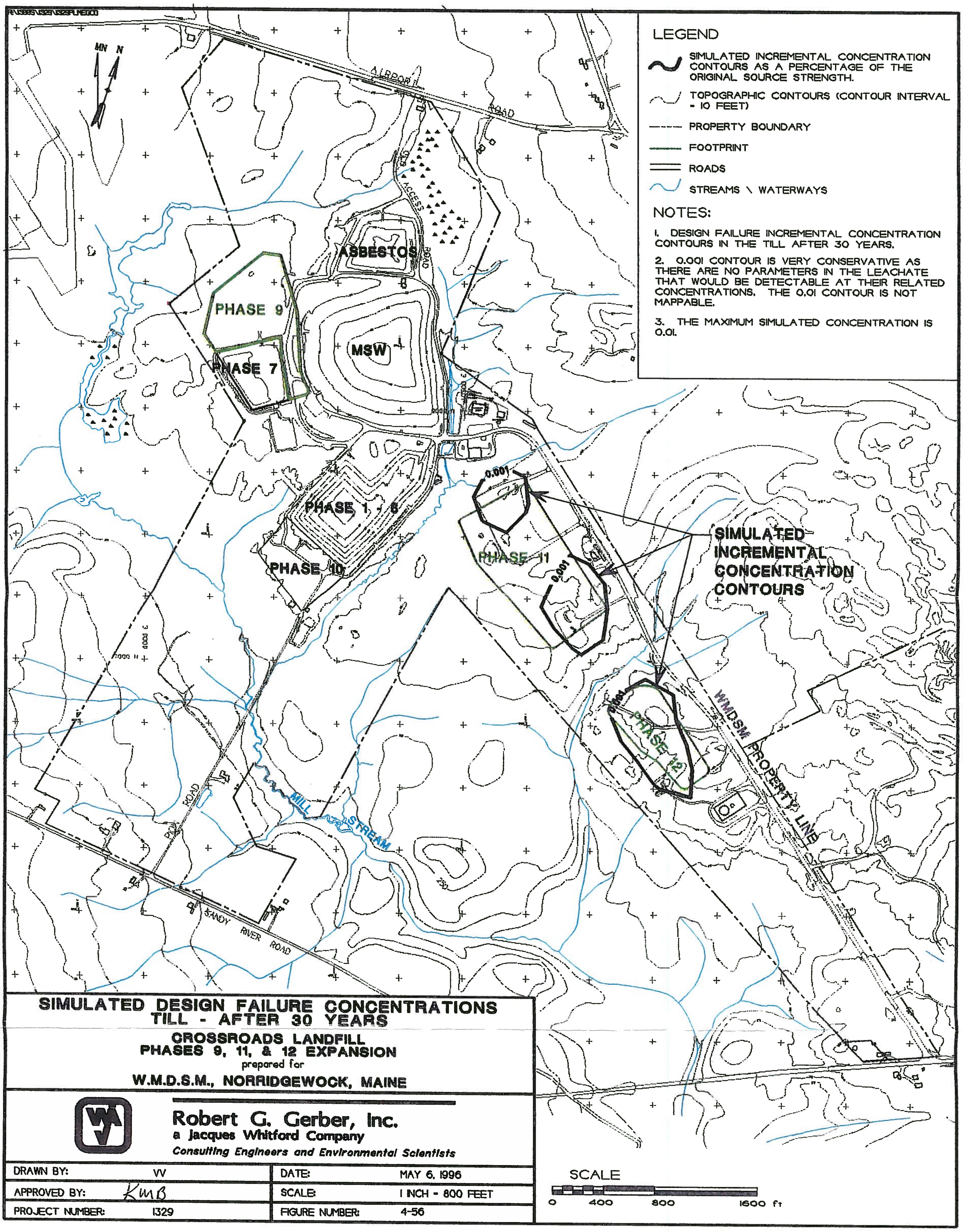
Iron as the parameter of concern -

Leachate average Fe concentration = 31.1 mg/l.
Source strength of Fe = 100% = 31.1. mg/l.

Simulated isocon C = 1.0 represents 1% of the source strength.

Concentration of Fe at the 1.0% contour = $\frac{31.1\ \text{mg/l}}{100\%\text{source}}$ * 1.0 = **0.3 mg/l Fe**

Chronic Aquatic Toxicity Standard for Fe = 1.0 mg/l



LEGEND

SIMULATED INCREMENTAL CONCENTRATION CONTOURS AS A PERCENTAGE OF THE ORIGINAL SOURCE STRENGTH.

TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL - 10 FEET)

PROPERTY BOUNDARY

FOOTPRINT

ROADS

STREAMS \ WATERWAYS

NOTES:

1. DESIGN FAILURE INCREMENTAL CONCENTRATION CONTOURS IN THE TILL AFTER 30 YEARS.

2. 0.001 CONTOUR IS VERY CONSERVATIVE AS THERE ARE NO PARAMETERS IN THE LEACHATE THAT WOULD BE DETECTABLE AT THEIR RELATED CONCENTRATIONS. THE 0.01 CONTOUR IS NOT MAPPABLE.

3. THE MAXIMUM SIMULATED CONCENTRATION IS 0.01.

SIMULATED DESIGN FAILURE CONCENTRATIONS TILL - AFTER 30 YEARS

CROSSROADS LANDFILL PHASES 9, 11, & 12 EXPANSION

prepared for

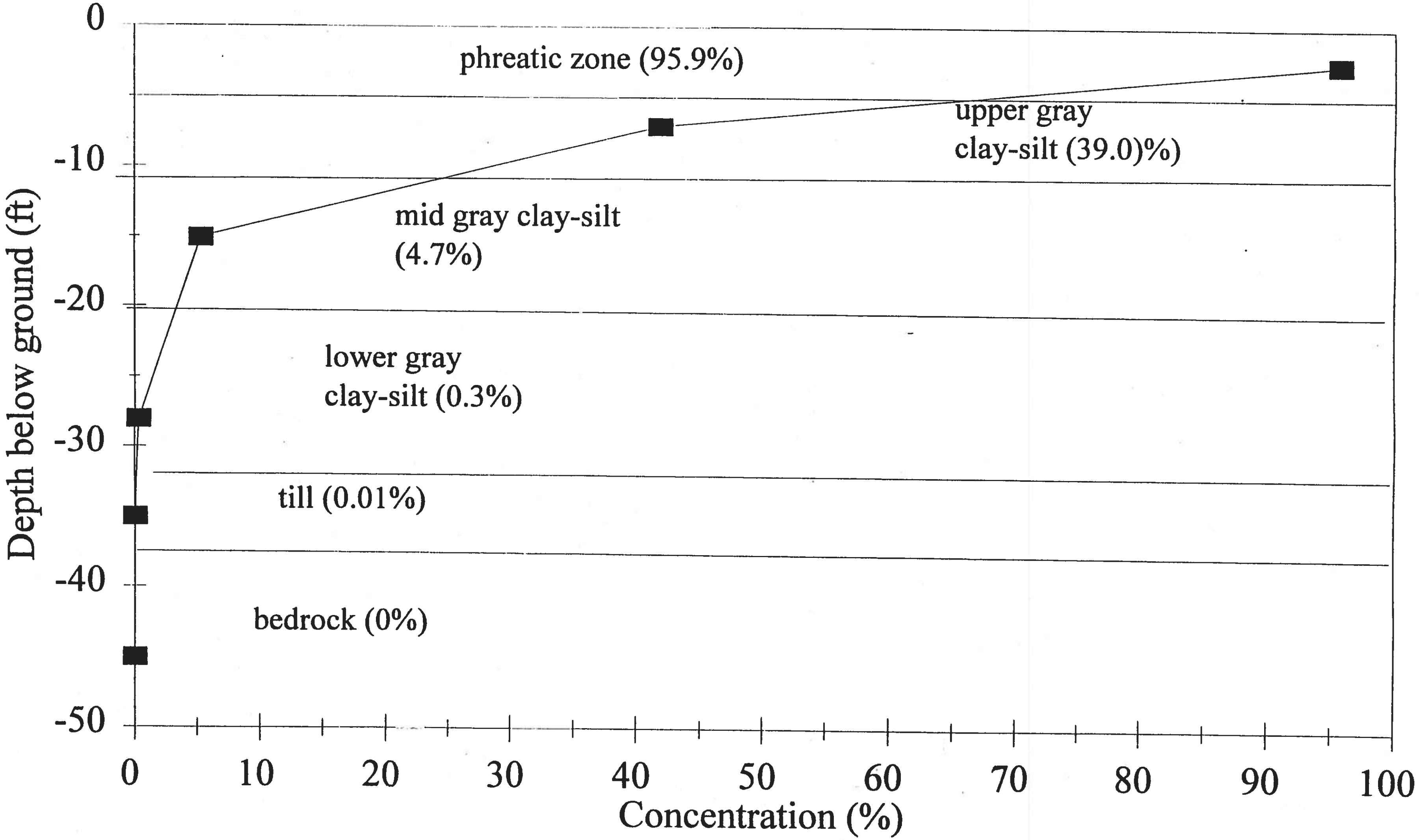
W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	MAY 6, 1996
APPROVED BY:	KMB	SCALE:	1 INCH - 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-56

Engineered Systems Design Failure

Maximum Simulated Concs. with Depth



This is an idealized graph representing maximum simulated concentrations from each model layer. Maximum values for each layer do not all occur in the same location. Depths are also generalized for a site wide average section.

FIGURE 4-57

Engineered Systems Design Failure

Simulated Conc. in MW #1 - Phase 9

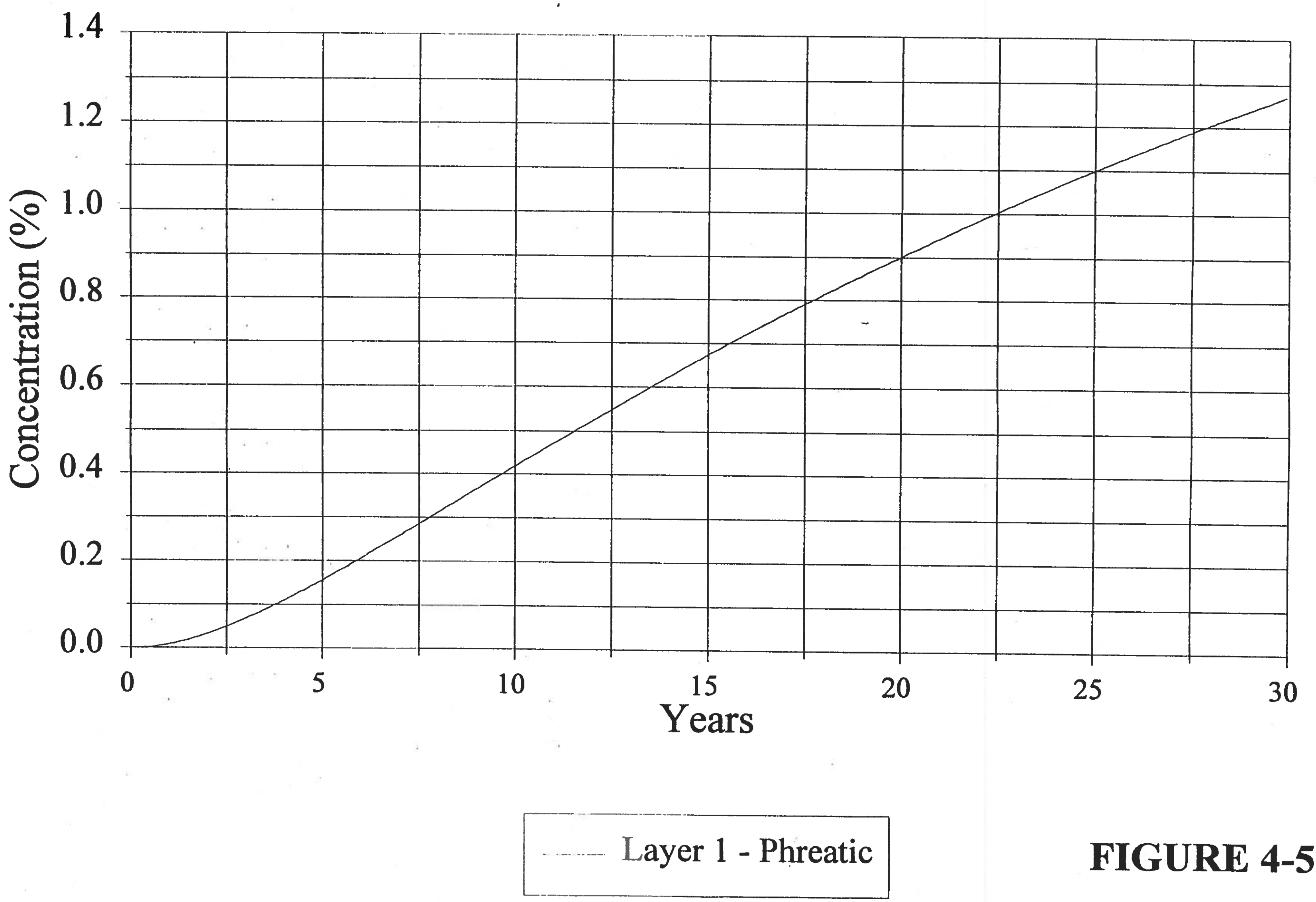


FIGURE 4-58

Engineered Systems Design Failure

Simulated Conc. in MW #1 - Phase 9

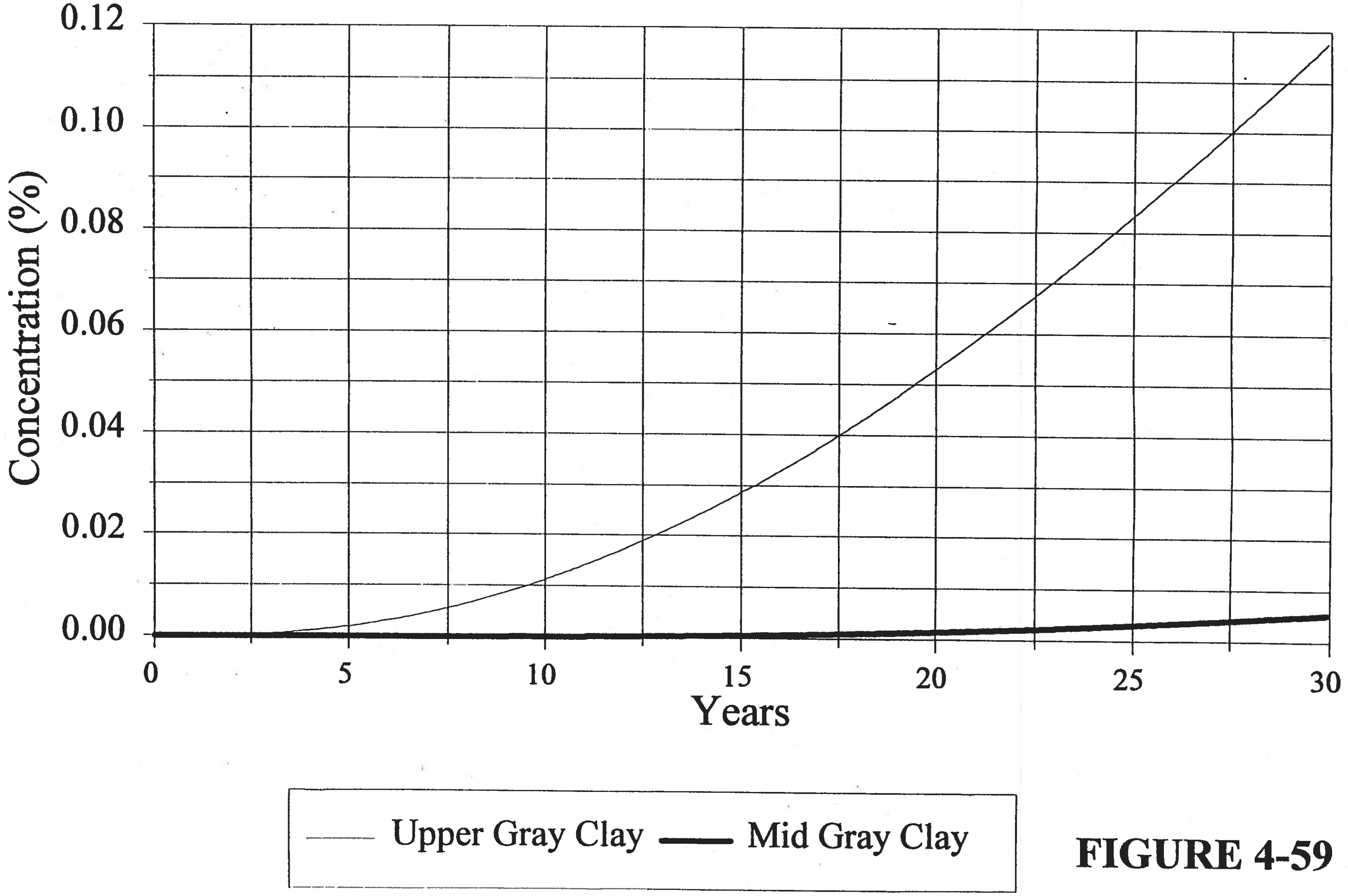


FIGURE 4-59

Engineered Systems Design Failure

Simulated Conc. in MW #2 - Phase 11

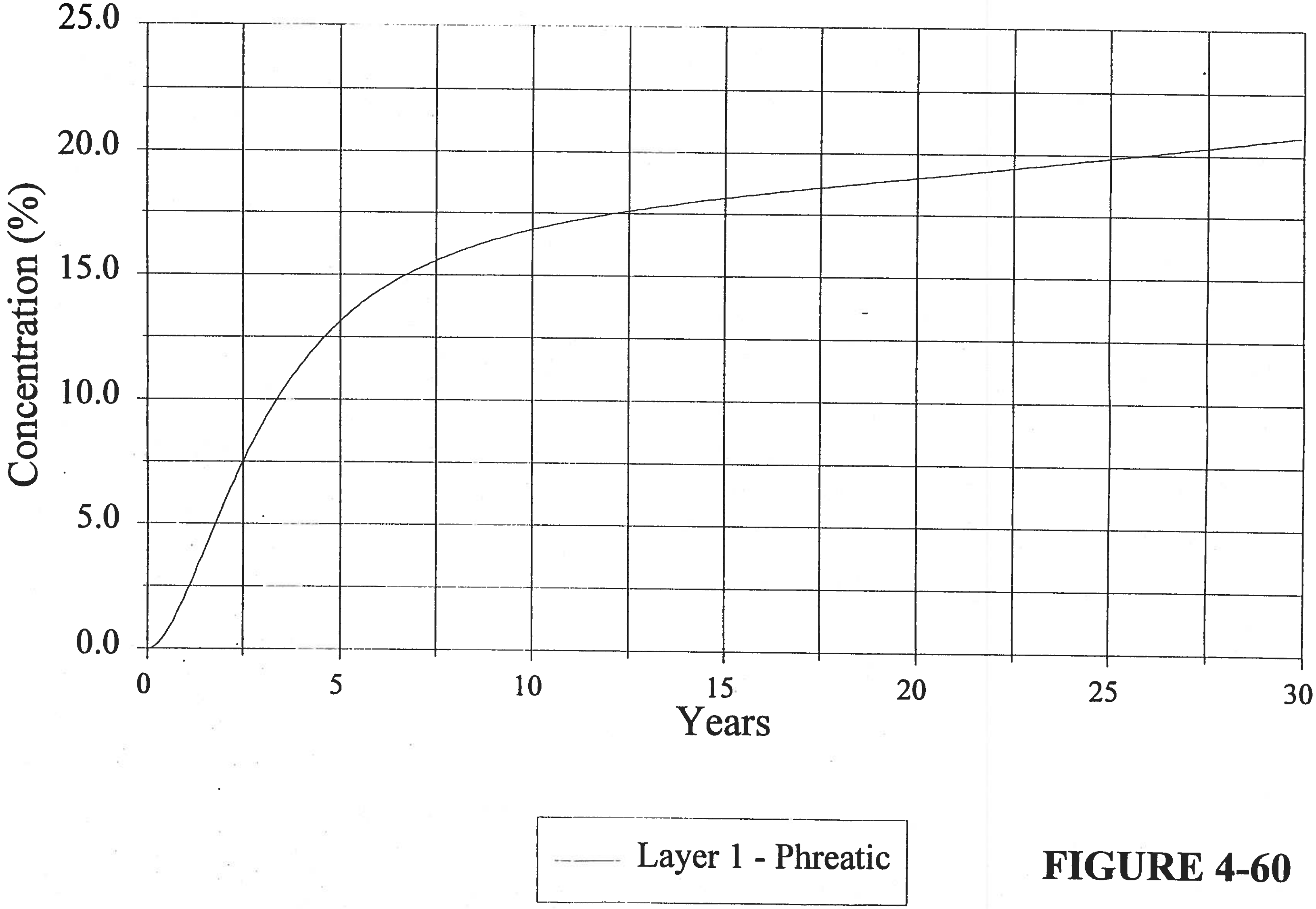


FIGURE 4-60

Engineered Systems Design Failure

Simulated Conc. in MW #2 - Phase 11

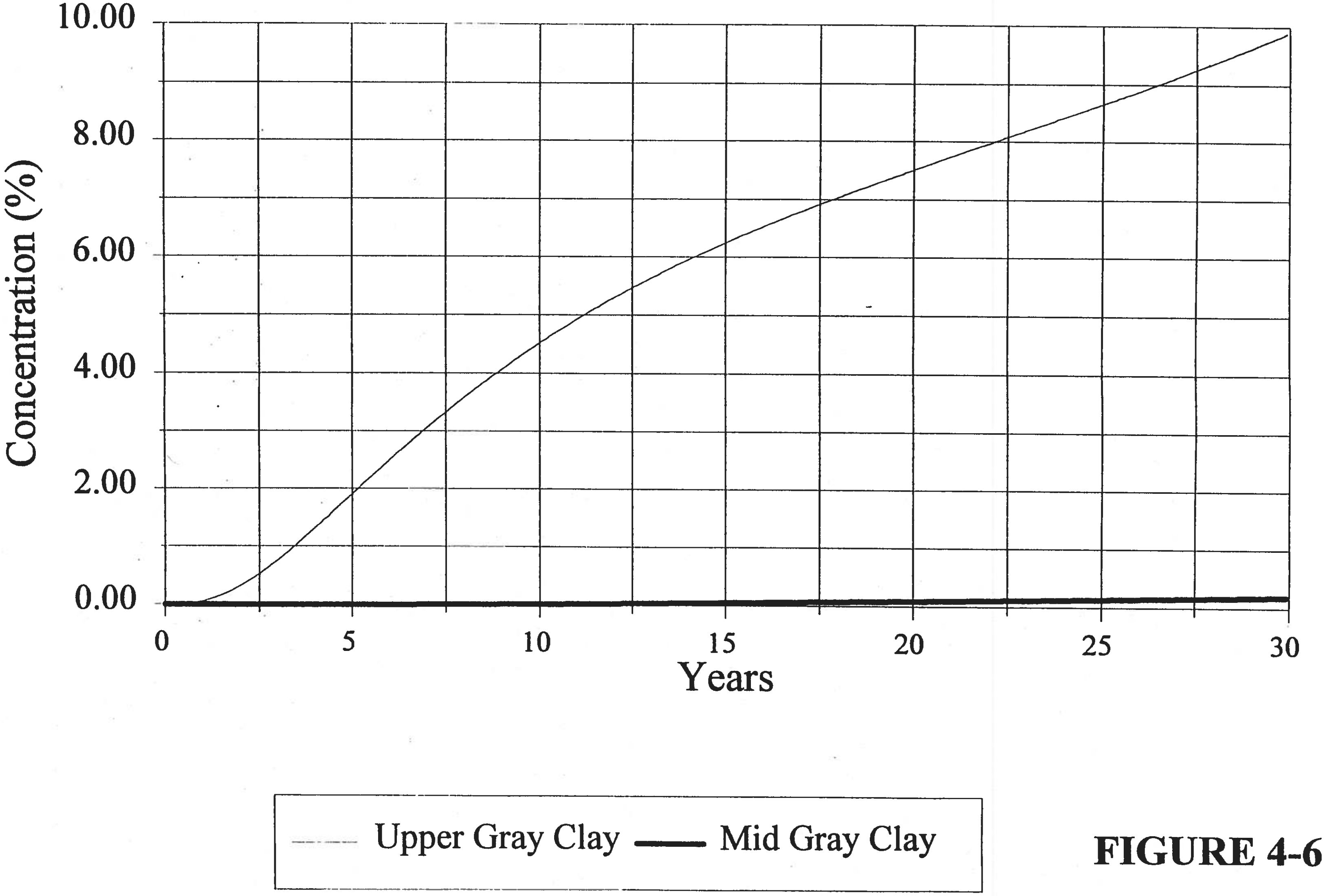


FIGURE 4-61

Engineered Systems Design Failure

Simulated Conc. in MW #3 - Phase 12

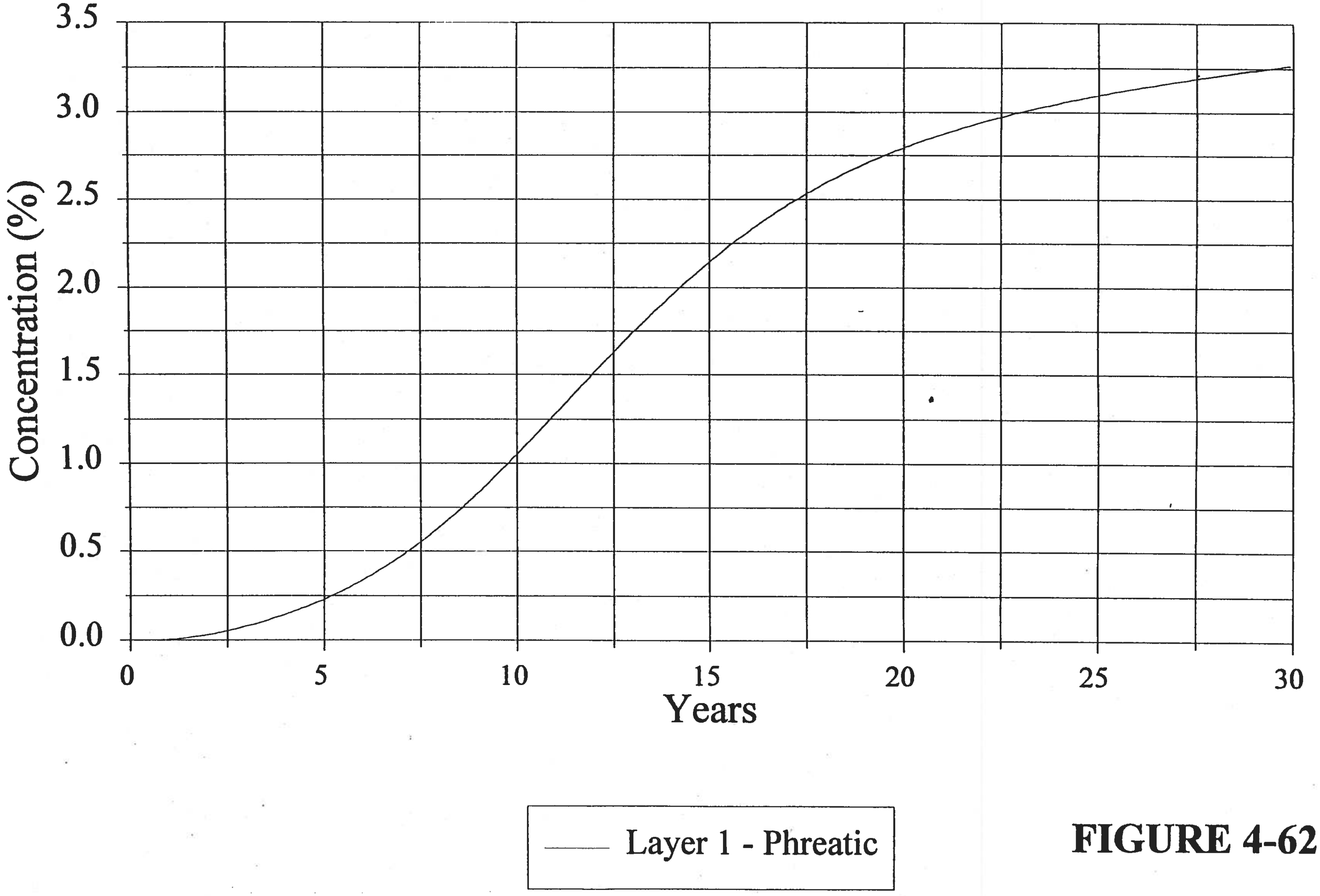


FIGURE 4-62

Engineered Systems Design Failure

Simulated Conc. in MW #3 - Phase 12

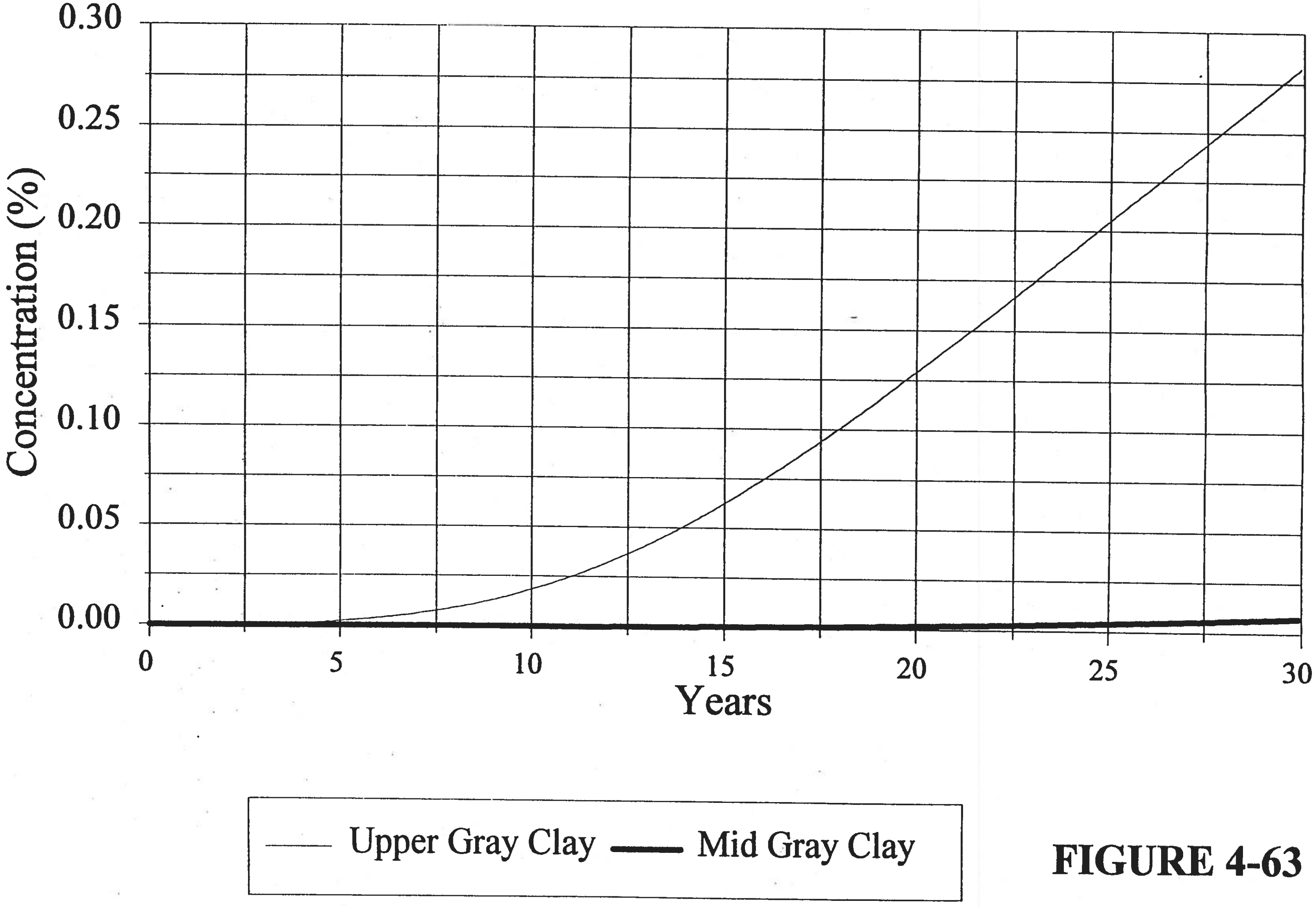
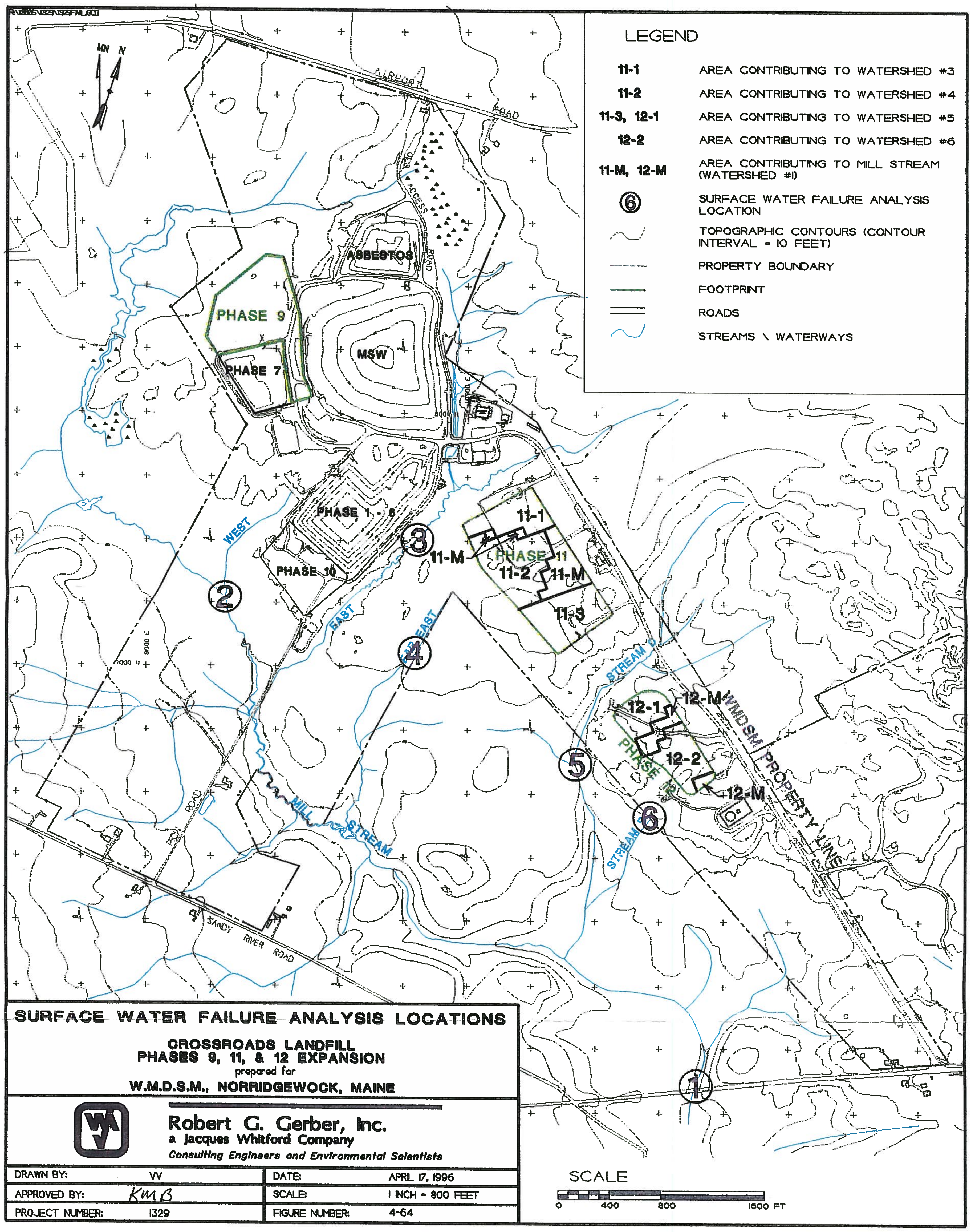


FIGURE 4-63

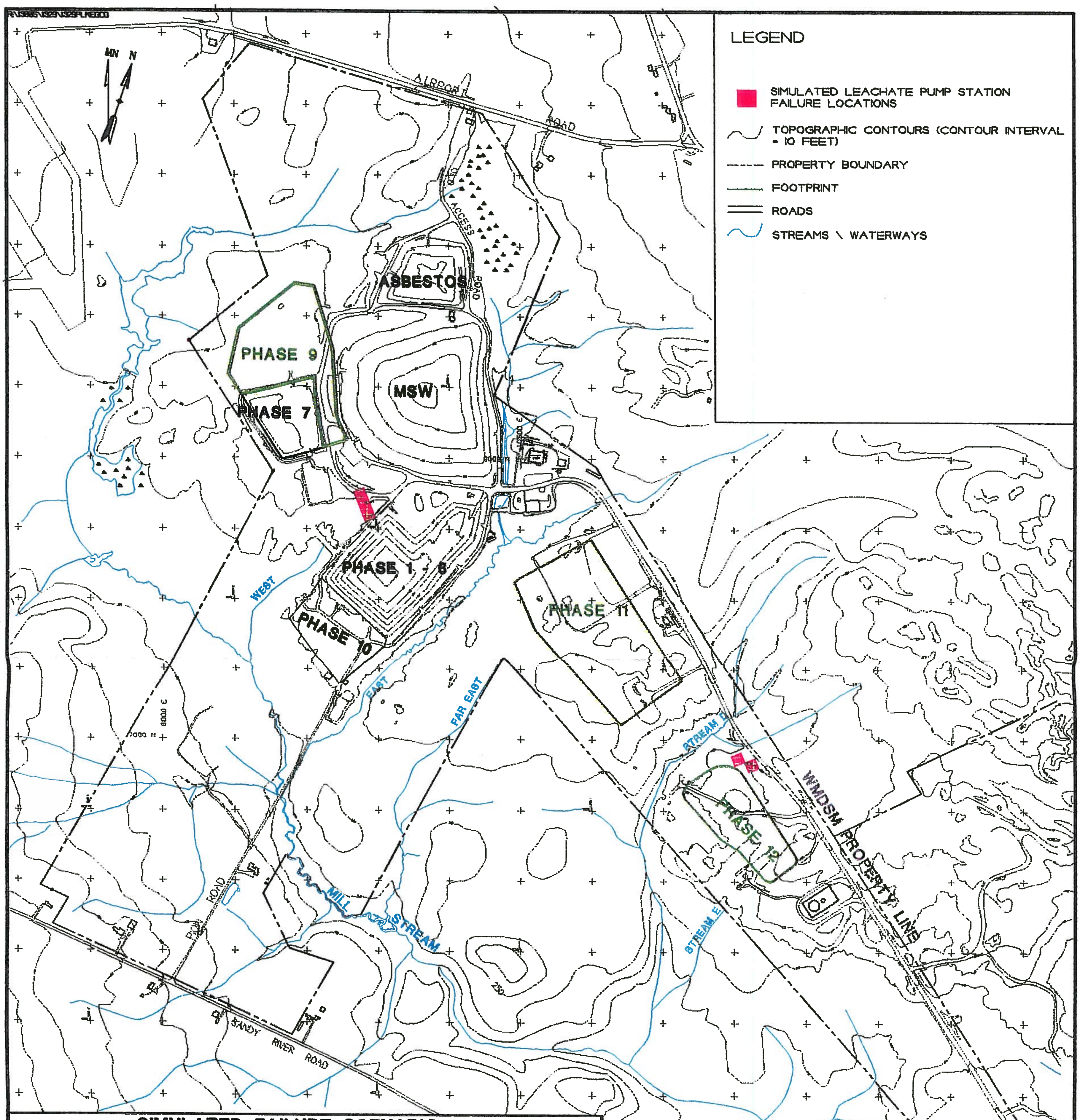


SURFACE WATER FAILURE ANALYSIS LOCATIONS

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION
prepared for
W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	APRIL 17, 1996
APPROVED BY:	KMB	SCALE:	1 INCH = 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-64



SIMULATED FAILURE SCENARIO #3
LEACHATE PUMP STATION FAILURE LOCATIONS

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
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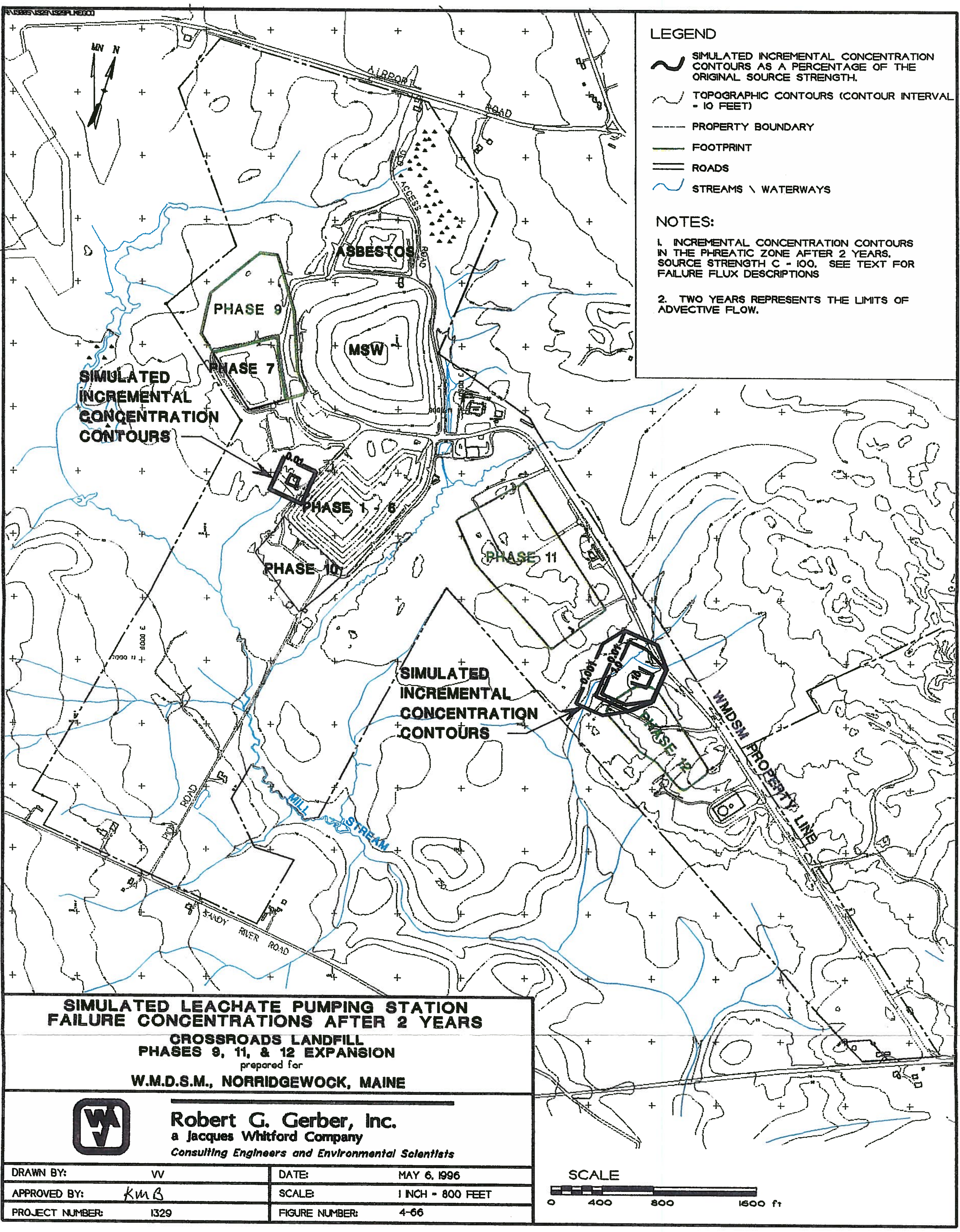
Consulting Engineers and Environmental Scientists

DRAWN BY:	VV	DATE:	MAY 6, 1996
APPROVED BY:	KmB	SCALE:	1 INCH = 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-65

SCALE

0 400 800 1600 ft



LEGEND

SIMULATED INCREMENTAL CONCENTRATION CONTOURS AS A PERCENTAGE OF THE ORIGINAL SOURCE STRENGTH.

TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL = 10 FEET)

PROPERTY BOUNDARY

FOOTPRINT

ROADS

STREAMS \ WATERWAYS

NOTES:

1. INCREMENTAL CONCENTRATION CONTOURS IN THE PHREATIC ZONE AFTER 2 YEARS. SOURCE STRENGTH C = 100. SEE TEXT FOR FAILURE FLUX DESCRIPTIONS

2. TWO YEARS REPRESENTS THE LIMITS OF ADVECTIVE FLOW.

SIMULATED LEACHATE PUMPING STATION FAILURE CONCENTRATIONS AFTER 2 YEARS

CROSSROADS LANDFILL
PHASES 9, 11, & 12 EXPANSION

prepared for

W.M.D.S.M., NORRIDGEWOCK, MAINE

Robert G. Gerber, Inc.
a Jacques Whitford Company
Consulting Engineers and Environmental Scientists

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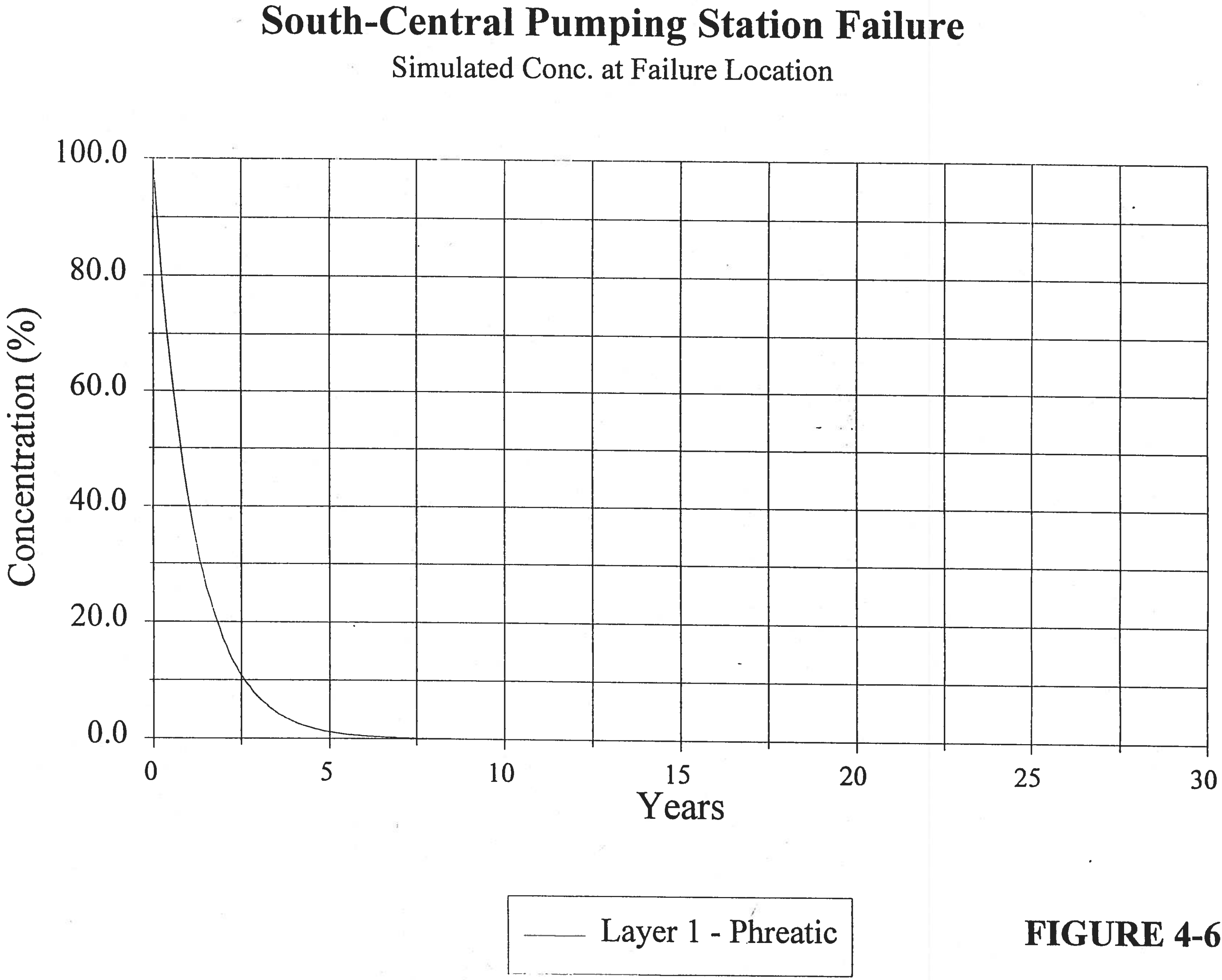
APPROVED BY:	KMB	SCALE:	1 INCH = 800 FEET
PROJECT NUMBER:	1329	FIGURE NUMBER:	4-66



South-Central Pumping Station Failure

Simulated Conc. at Failure Location

FIGURE 4-67

South-Central Pumping Station Failure

Simulated Conc. at Failure Location

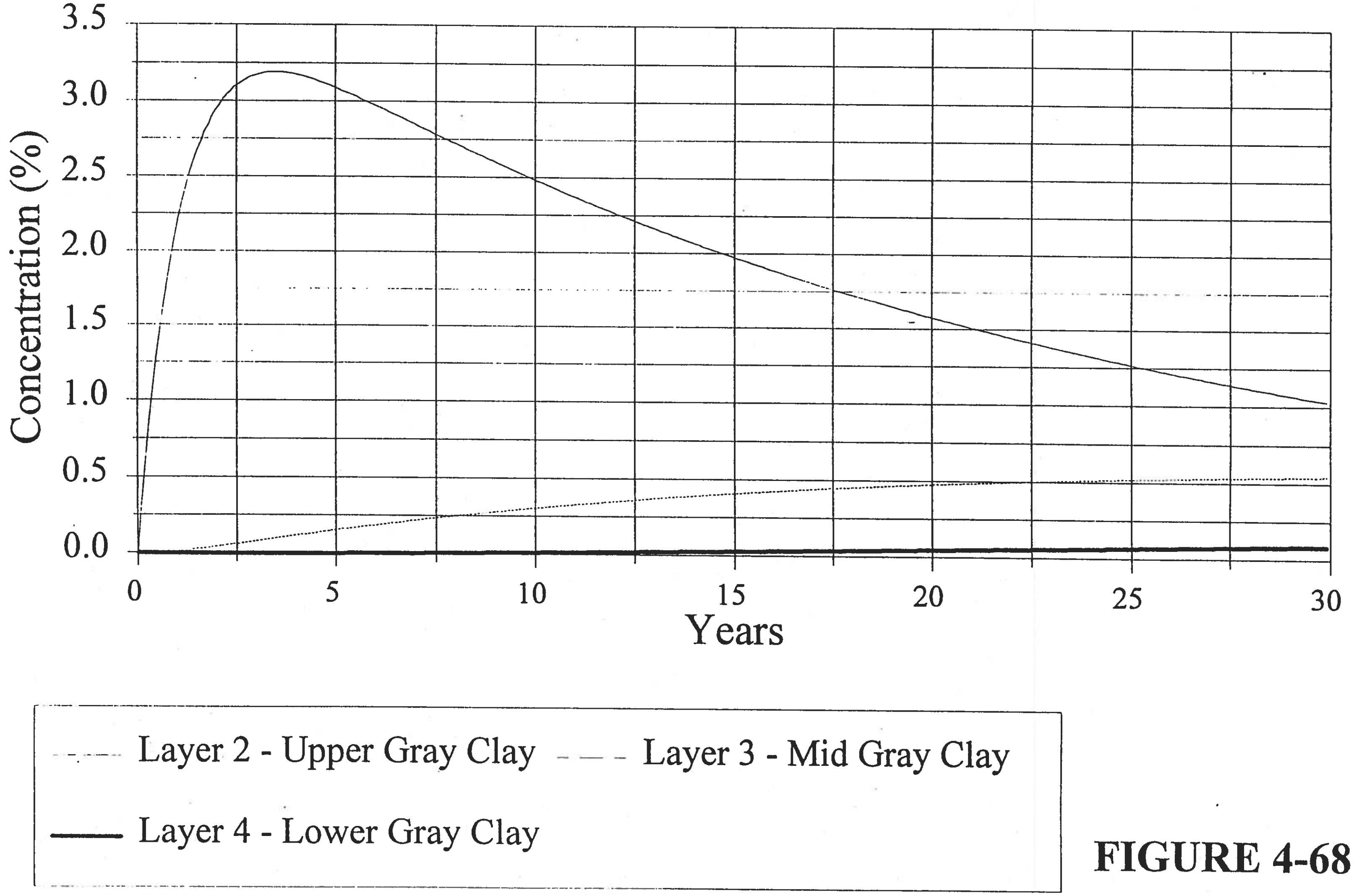


FIGURE 4-68

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