Beacon Environmental Inc.

ADDITIONAL WORK: WETLAND FUNCTION ASSESSMENT

7370 Centre Road,
Uxbridge, Ontario

REPORT

November 27, 2020

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1.0 INTRODUCTION

This report includes the findings of the Wetland Function Assessment, undertaken by Terrapex Environmental Ltd. (Terrapex) for the property located at 7370 Centre Road, Uxbridge, Ontario. The work has been undertaken in accordance with the work plan proposed by Terrapex (QT2143.00-revised), dated September 21, 2020.

The purpose of this Wetland Function Assessment is to provide greater understanding of the hydrology and function of the wetland features located on the subject property; specifically, if it can be determined that groundwater is providing input or influence to the features.

2.0 STUDY SCOPE

The scope of this work is limited to identifying the function of the wetland communities located on the subject properties through surface water and groundwater monitoring, identification of surface water and groundwater inputs.

3.0 SITE AND AREA PHYSICAL CONTEXT

The subject property is approximately 40.3 hectares (approximately 403,000 m^2) in area. As shown on **Figure 1,** the subject property is generally rectangular in shape, and is bounded to the east and west by Centre Road and Concession Road 6, respectively, and located north of Bolton Drive in Uxbridge, Ontario.

The subject property is currently occupied by agricultural farm fields, with untilled and areas at the south-east and northeast corners.

3.1 TOPOGRAPHY AND DRAINAGE CONTEXT

Surface

The subject property is situated within the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA) and the Lake Simcoe and Couchiching/Black River Source Protection Area (SPA) in the City of Uxbridge. The subject property is located within the Severn-Lake Simcoe Quaternary Watershed (02EC-04).

The subject property is located within the *Protected Countryside – Towns and Villages* lands of the *Greenbelt Plan* area, and is therefore, subject to the corresponding policies of the *Greenbelt Plan* as well as the Regional Municipality of Durham and Township of Uxbridge Official Plans and Lake Simcoe Region Conservation Authority (LSRCA) regulations. A tributary of Uxbridge Brook traverses the southeast corner of the subject property.

The topography of the subject property is summarized as highest in the west, with a general gradient downward towards the east. Topographic elevations for the subject property range from approximately 330 metres above sea level (masl) to approximately 280 masl. The subject property is drained by sheet overflow to the wetlands and a portion of Uxbridge Brook, located in the east of the property.

Subsurface

Ministry of the Environment, Conservation and Parks (MECP) mapping indicates that the subject property is located within a Wellhead Protection Area for quantity (WHPA-Q2; Stress = moderate) and Intake Protection Zone (Score = 4.5). Parts of the subject property are situated over Highly Vulnerable Aquifers, and significant groundwater recharge areas (Score = 2).

MW6 Uxbridge Well Supply (220000763) lies approximately 1.2 km to the south of the subject property. The closest extent of the Wellhead Protection Area (WHPA-D) lies approximately 1.2 km south of the subject property.

A reconnaissance of the subject property was carried out by a certified Hydrogeologist on September 23, 2020. Within the subject property, no obvious groundwater-dependent features or seepage areas were observed at that time. It is understood that there are four Headwater

Drainage Features, designated HDF1 through HDF4, as defined under separate cover (Beacon, 2020).

3.2 PHYSIOGRAPHY AND GEOLOGY

The subject property is located on drumlinized Till Plains (MRD228), in an areas dominated by glaciolacustrine, glacial outwash, and till deposits (OGS, 2000) adjacent to sandplains in the east. Coarse-textured glaciolacustrine deposits, characterized by sand, gravel and minor silt and clay are reported on the east and west parts of the subject property, bisected by a deposit of stone-poor sandy silt to silty sand textured till (in the general area of BH3, BH4, and BH8 described in the methodology below; MRD128).

The bedrock beneath the described overburden is reported to be composed of limestone, dolostone and shale (MRD126 2011). Bedrock units were not encountered during this investigation or during the drilling operations required to install the groundwater monitoring wells.

3.3 AVAILABLE BACKGROUND GROUNDWATER INFORMATION

A review of the MECP water well record database was carried out under separate cover as part of a hydrogeological investigation (Beacon, 2020). Based on the search of the available MECP water well record database entries, 9 wells are reported on the subject property, designated 7304950, 7304143/7304142, 7304144, 7304138, 7304141, 7304145, 7304140/7304139. These wells appear to represent the groundwater monitoring wells constructed as part of the SoilEng geotechnical investigation. Three other wells, designated ID-1910316 and ID-1916323, appear to be drilled for the purposes of fresh drinking water between 2002 and 1989. The reported locations of the reported wells are included in Figure 2 of the hydrogeological report (Beacon, 2020).

A review of the available well records presented in the hydrogeological report shows that there are 104 reported wells within 500 metres of the subject property. Groundwater monitoring wells purposed for domestic use were constructed between 1962 and 2011. It is noted that older wells may no longer be operational, and that historically there was not a requirement to register dug wells with the MECP; as such, they can be under-represented in the water well record database.

4.0 FIELDWORK

The fieldwork programme consisted of the installation of instrumentation to monitor groundwater and surface water conditions, as well as the monitoring of those instruments using manual measurements.

4.1 INSTRUMENTATION

As part of the field operations programme, a mini-piezometer pair (nested cluster) was installed in select locations within the wetland hyporheic zone of each of four potential headwater drainage features (HDFs), designated HDF1, HDF2, HDF3, and HDF4. The purpose of these pairs was to identify any existing shallow groundwater, if present, and to test the hydraulic conductivity of the shallow subsurface, and to test the vertical gradient (infiltration or exfiltration) between surface water and groundwater. The instrument construction specifications are summarized in **Table 1**, below.

4.2 WATER LEVEL MONITORING

Groundwater piezometric head measurements were measured manually at the mini-piezometer locations over the course of four (4) monitoring events carried out over two months. The recorded water levels reflect the groundwater conditions on the dates they were measured and are provided in **Table 2**.

As summarized in **Table 2**, measurements indicate that groundwater at locations MP20-2 and MP20-3, and MP20-4did not approach within 2 metres of the ground surface, and the wetland areas were found to be dry throughout the monitoring period. This is not unexpected, as late summer through autumn are considered drier months. It should be noted that groundwater levels are subject to seasonal fluctuations. Groundwater levels are generally not expected to fluctuate greater than 2 metres seasonally. As such, groundwater is not anticipated to reach the ground surface.

Location MP20-1D appears to have groundwater piezometric head elevations of approximately 0.3 mbgl, whereas location MP20-1S appears to have groundwater piezometric head elevations of 1.1 mbgl. These measurements show that there is a greater head pressure at the deeper screened interval than at the shallow screened interval at this location, and is indicative of an upward vertical gradient (exfiltration conditions).

4.3 HYDRAULIC TESTING

To estimate the hydraulic conductivity (K) of the soil materials adjacent to the screened intervals at the tested mini-piezometers, single well response tests were carried out at locations MP20-1D, MP20-2D, MP20-4S, and MP20-4D. The tests were carried out by rapidly adding a volume

of water to the mini-piezometer and monitoring the subsequent water level recovery to previous conditions.

The Bouwer and Rice (1976) method was applied to the falling head test data, using the unconfined solution. The data was analysed using the AQTESOLV™ (v. 4.50). A summary of the single well response tests carried out is presented below in **Table 3**. The analytical hydraulic reports are provided in (**Appendix A**).

The estimates provided in **Table 3** are based on *in situ* testing. In addition to the size of grains in the soil, *in situ* testing considers compaction, effective porosity (as opposed to simple porosity), and existing sedimentary feature factors. As summarized in **Table 3**, hydraulic conductivities in the shallow screens ranged from approximately 1.3×10^{-5} cm/s to 6.1×10^{-5} cm/s in the locations tested; these represent the softer soils of the feature. Hydraulic conductivities in the deeper screens ranged from 6.6×10^{-7} cm/s to 3.0×10^{-8} cm/s in the locations tested; these represent the hardgrounds that the features rest on.

These results indicate features with relatively semi-pervious materials, resting on relatively impervious subsoils (Bear 1972). In accordance with The Low Impact Development Stormwater Management Planning and Design Guide (TRCA and CVC, 2010), the features would be expected to infiltrate approximately 13 mm/hr to 18 mm/hr of water per unit area for the first meter or so, and would be unable to infiltrate further into the substrate. These observed drainage conditions support the existence of generally wet staging areas that would rely on runoff or evapotranspiration to dry out.

5.0 SUMMARY AND DISCUSSION

The following summarizes the information above, obtained during the investigations carried out by Terrapex. Monitoring and testing indicate that:

- HDF1 appeared to have exfiltration conditions during the period monitored.
- HDF2 appeared to have no contribution from groundwater during the period monitored.
- HDF3 appeared to have no contribution from groundwater during the period monitored.
- HDF4 appeared to have no contribution from groundwater during the period monitored.
- Based on the existing information available, it is not anticipated that seasonal groundwater levels will vary sufficiently to reach the ground surface at locations HDF2 through HDF4.

The observed conditions generally support the existence of seasonally ephemeral wet areas that can store water in the top 1.5 metres of soil, but cannot adequately infiltrate deeper. Water

appears to be held staged in these areas until runoff or evapotranspiration has dried them.

We trust that this meets your immediate needs.

Respectfully submitted,

TERRAPEX ENVIRONMENTAL LTD.

Zen Keizars, *P*.Geo., *F*.G.C.
Senior Hydrogeologist

TABLES

Table 1. Summary of Monitoring Instrumentation Construction

Location ID	Associated HDF	Reported Date of Construction (2020)	Approximate Location		Ground Elevation	Top of Pipe Elevation	Top of Pipe Stickup	Approximate Screened Interval	Screened Interval
					(masl)	(masl)	(mbgl)	mbgs	
MP20-1S	HDF1	23 Sept	4886058.30	4886058.18	309.610	310.657	0.945	1.17 to1.32	'Hyporheic softground'
MP20-1D		30 Sept	4886058.52	648641.35	309.596	310.080	0.35	1.89 to 2.05	'Hardground' beneath wetland
MP20-2S	HDF2	23 Sept	4886283.48	648797.92	299.082	299.372	0.3	1.02 to 1.18	'Hyporheic softground'
MP20-2D		23 Sept	4886283.22	648797.62	299.086	299.554	0.43	1.95 to 2.11	'Hardground' beneath wetland
MP20-3S	HDF3	30 Sept	4886320.58	649059.00	286.126	286.920	0.76	1.15to 1.3	'Hyporheic softground'
MP20-3D		30 Sept	4886321.00	649058.95	286.090	286.478	0.021	2.07 to 2.22	'Hardground' beneath wetland
MP20-4S	HDF4	30 Sept	4886321.00	649058.95	286.090	286.478	0.195	1.05 to 1.22	'Hyporheic softground'
MP20-4D		30 Sept	4886533.47	649018.71	288.036	288.241	0.2	2.07 to 2.23	'Hardground' beneath wetland

mbgs – indicates 'metres below ground surface'
masl – indicates 'metres above sea level'
HDF – indicated Headwater Drainage Feature

Table 2. Measured Groundwater Levels and Equivalent Elevations

Location Identification	Approximate Top of Pipe	Groundwater Levels (2020)			
		23 Sept	30 Sept	13 Oct	22 Oct
	masl (ΔGS)	mbgs (masl)	mbgs (masl)	mbgs (masl)	mbgs (masl)
MP20-1S	(310.657) 0.945	-	installed	1.1	1.1
MP20-1D	(310.080) 0.35	installed	0.3	0.3	0.2
MP20-2S	(299.372) 0.3	installed	dry	dry	dry
MP20-2D	(299.554) 0.43	installed	dry	dry	dry
MP20-3S	(286.920) 0.76	-	installed	dry	dry
MP20-3D	(286.478) 0.021	-	installed	2.1	2.0
MP20-4S	(286.478) 0.195	-	installed	dry	dry
MP20-4D	(288.241) 0.2	-	installed	2.1	2.0

mbgs – indicates 'metres below ground surface'
masl – indicates 'metres above sea level'
ΔGS – indicates difference from ground surface

Table 3. Summary of Hydraulic Conditions

Location Identification	Description of Soil Moisture Conditions	Reported Screened Interval	Estimated Hydraulic Conductivity	Estimated Infiltration Potential [1]
		mbgl	K (cm/s)	K_{fs} (mm/hr) [2]
MP20-1D	*saturated*	1.89 to 2.05	8.1×10^{-7}	- [3]
MP20-2S	*unsaturated*	1.02 to 1.18	6.1×10^{-5}	46 (18)
MP20-2D	*unsaturated*	1.95 to 2.11	6.6×10^{-7}	- [3]
MP20-4S	*unsaturated*	1.05 to 1.22	1.3×10^{-5}	32 (13)
MP20-4D	*saturated*	2.07 to 2.23	3.0×10^{-8}	- [3]

mbgl – indicates 'metres below ground surface'

[1] Low Impact Development Stormwater Management Planning and Design Guide Version 1.0, 2010 (produced by Toronto Region Conservation and Credit Valley Conservation)

[2] Value in bracket is K_{fs} with a Factor of Safety of 2.5, per the Low Impact Development Stormwater Management Planning and Design Guide Version 1.0, 2010 (produced by Toronto Region Conservation and Credit Valley Conservation)

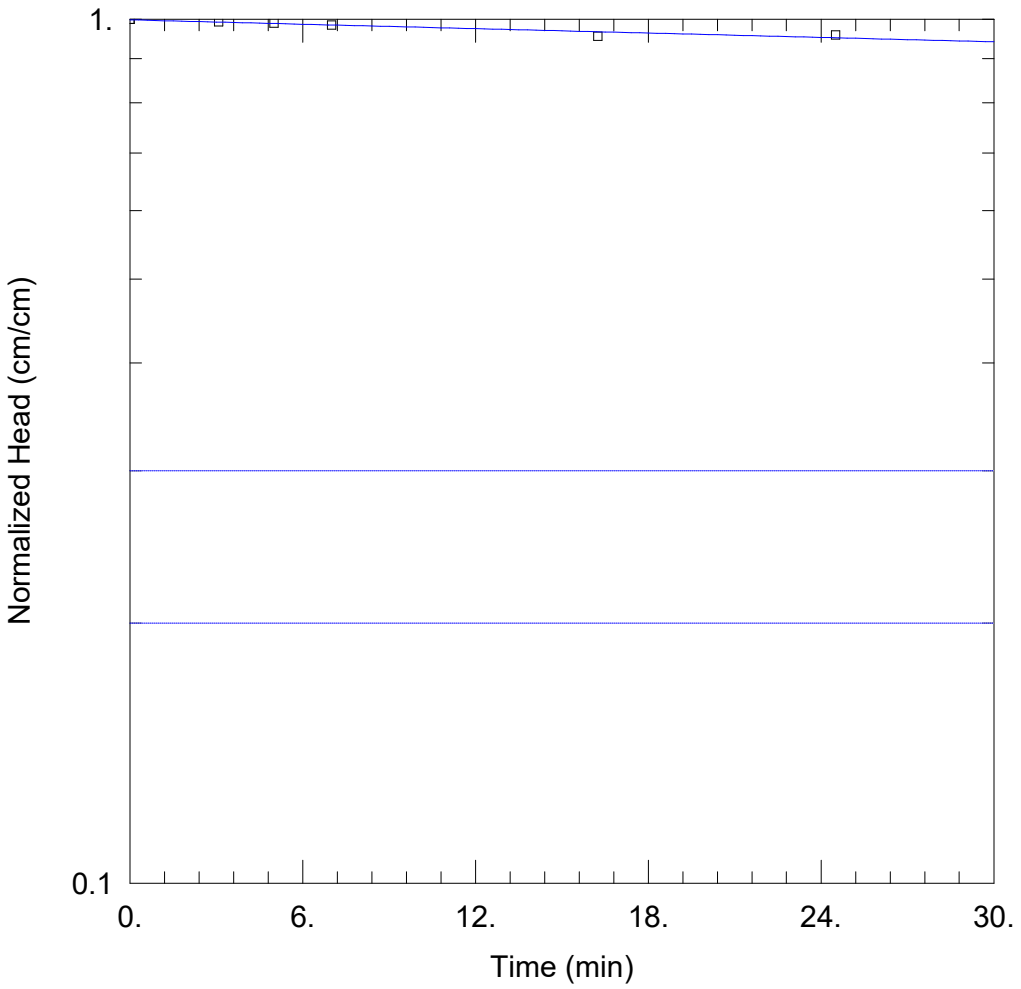
[3] The Low Impact Development Stormwater Management Planning and Design Guide Version 1.0, 2010 (produced by Toronto Region Conservation and Credit Valley Conservation) does not consider values less than 10^{-6}

FIGURES

Site Location	Figure 1
7370 Centre Rd, Uxbridge Ontario	
TERRAPEX	CT 3058.00 Last Revised: December 2020
Client: Bridge Brook Corp	Prepared by: BD Updated by: SJ
N 1:8,100	Inset Map: 1:50,000
Contains information licensed under the Open Government License–Ontario Orthoimagery Baselayer: 2017	

C:\Dropbox\Dropbox (Beacon)\All GIS Projects\2017\217431\MXD\2018-08-13_Figure01_SiteLocation_217431.mxd

APPENDIX A
HYDRAULIC ANALYSES



WELL TEST ANALYSIS

Data Set: I:\...\FHT_MW20-1D.aqt
Date: 11/26/20 Time: 15:37:27

PROJECT INFORMATION

Company: Terrapex Environmental
Project: CT3053
Location: 7370 Centre Road, Uxbridge
Test Well: MP20-1D
Test Date: 22 Oct 2020

AQUIFER DATA

Saturated Thickness: 1000. cm Anisotropy Ratio (Kz/Kr): 1.

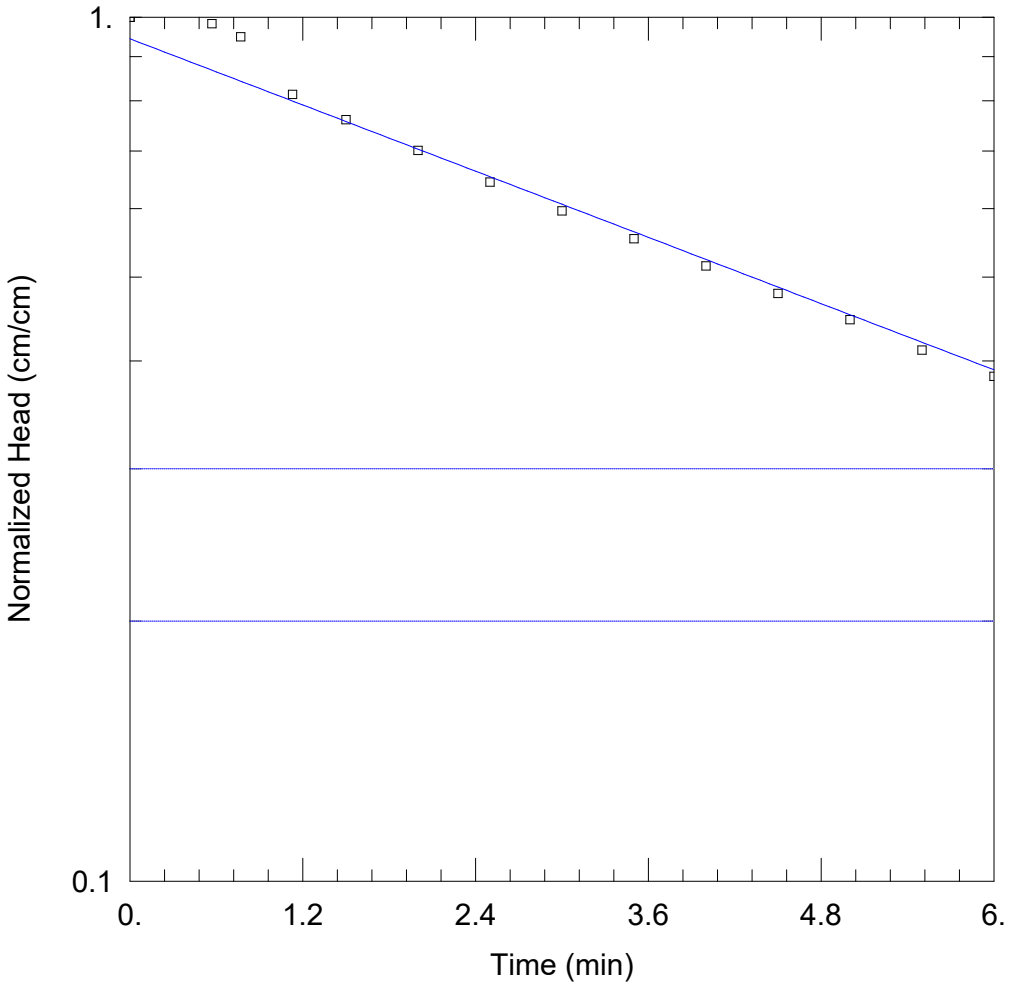
WELL DATA (MW20-1D)

Initial Displacement: 203. cm
Total Well Penetration Depth: 0.154 cm
Casing Radius: 1.9 cm
Static Water Column Height: 0. cm
Screen Length: 0.154 cm
Well Radius: 1.905 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 8.079E-7 cm/sec y0 = 202.6 cm



WELL TEST ANALYSIS

Data Set: I:\...\FHT_MW20-2S.aqt
Date: 11/26/20 Time: 14:01:48

PROJECT INFORMATION

Company: Terrapex Environmental
Project: CT3053
Location: 7370 Centre Road, Uxbridge
Test Well: MP20-1D
Test Date: 22 Oct 2020

AQUIFER DATA

Saturated Thickness: 1000. cm Anisotropy Ratio (Kz/Kr): 1.

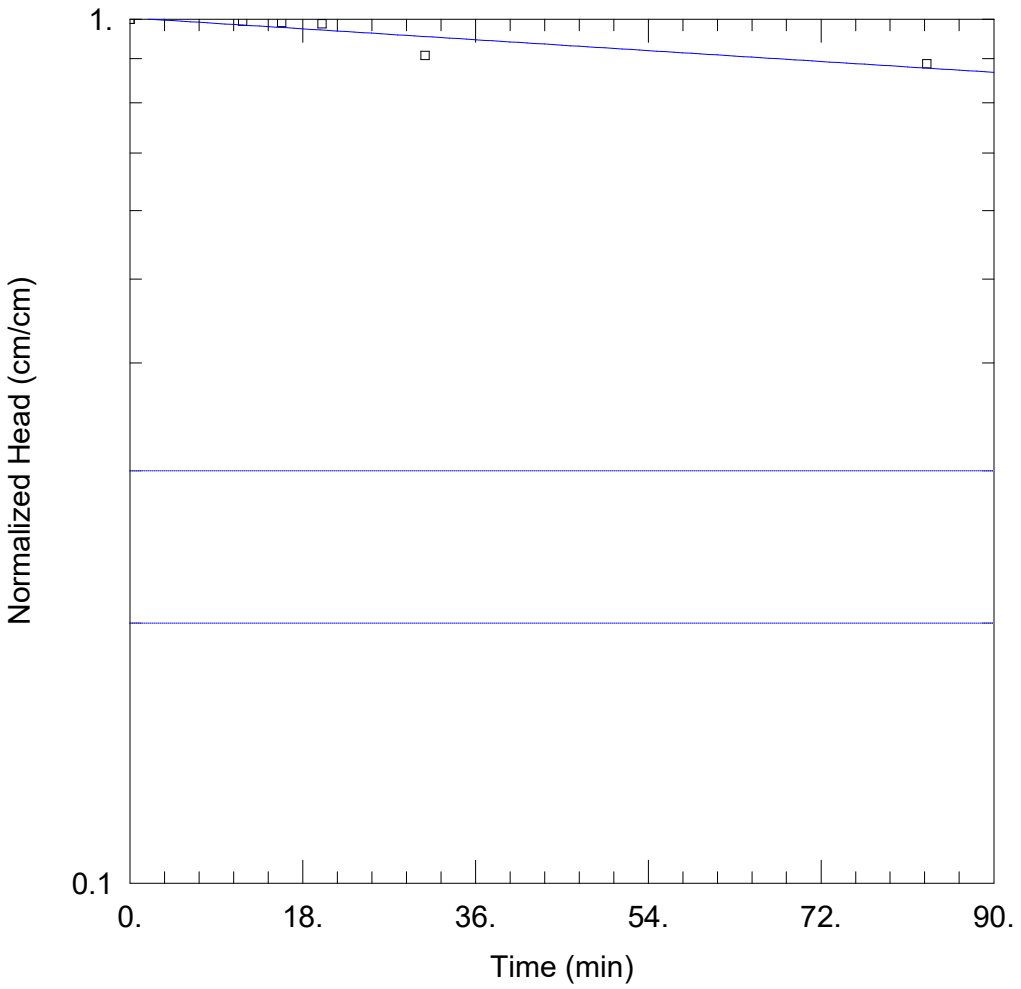
WELL DATA (MP20-2S)

Initial Displacement: 118. cm
Total Well Penetration Depth: 0.154 cm
Casing Radius: 1.9 cm
Static Water Column Height: 0. cm
Screen Length: 0.154 cm
Well Radius: 1.905 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 6.084E-5 cm/sec y0 = 111.4 cm



WELL TEST ANALYSIS

Data Set: I:\...\FHT_MW20-2D.aqt
Date: 11/26/20 Time: 14:09:26

PROJECT INFORMATION

Company: Terrapex Environmental
Project: CT3053
Location: 7370 Centre Road, Uxbridge
Test Well: MP20-2D
Test Date: 22 Oct 2020

AQUIFER DATA

Saturated Thickness: 1000. cm Anisotropy Ratio (Kz/Kr): 1.

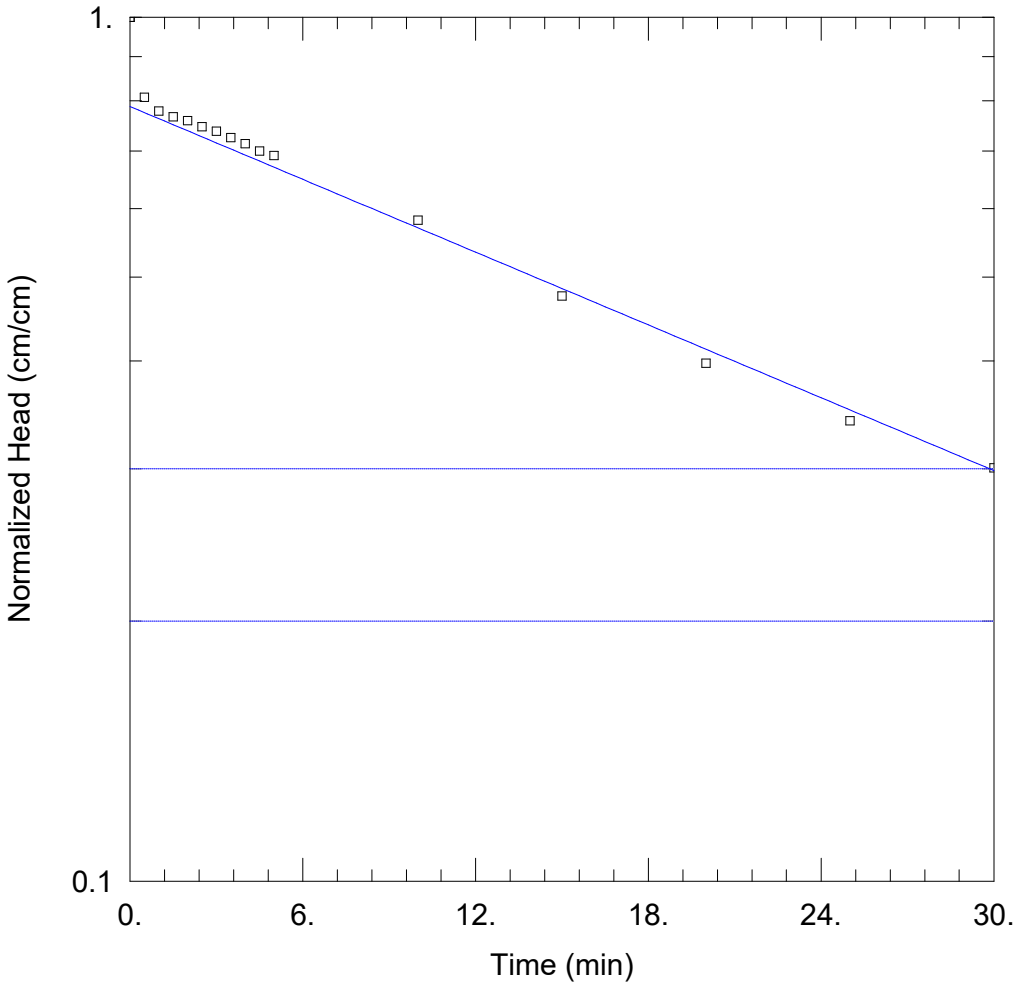
WELL DATA (MP20-2S)

Initial Displacement: 211. cm
Total Well Penetration Depth: 0.154 cm
Casing Radius: 1.9 cm
Static Water Column Height: 0. cm
Screen Length: 0.154 cm
Well Radius: 1.905 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 6.664E-7 cm/sec y0 = 211.6 cm



WELL TEST ANALYSIS

Data Set: I:\...\FHT_MW20-4S.aqt
Date: 11/26/20 Time: 14:26:20

PROJECT INFORMATION

Company: Terrapex Environmental
Project: CT3053
Location: 7370 Centre Road, Uxbridge
Test Well: MP20-4S
Test Date: 22 Oct 2020

AQUIFER DATA

Saturated Thickness: 1000. cm Anisotropy Ratio (Kz/Kr): 1.

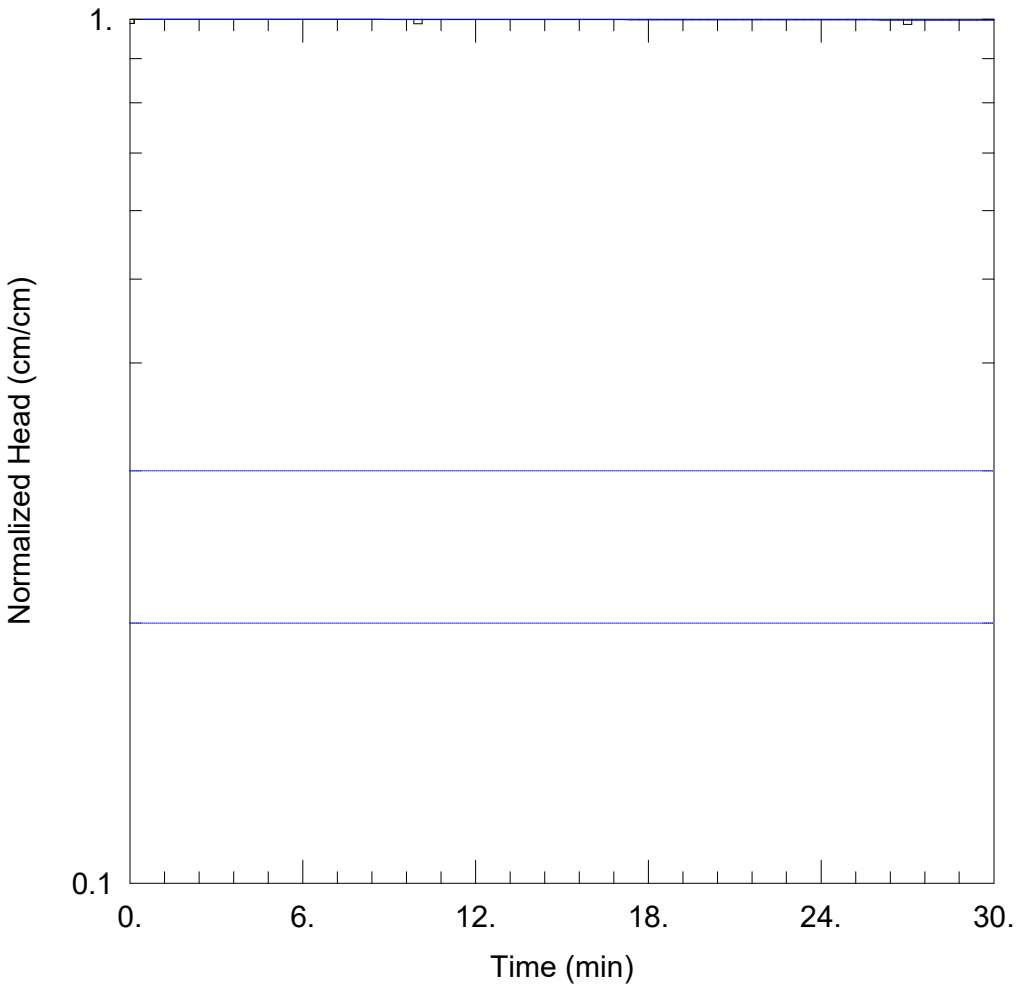
WELL DATA (MP20-4S)

Initial Displacement: 122. cm
Total Well Penetration Depth: 0.154 cm
Casing Radius: 1.9 cm
Static Water Column Height: 0. cm
Screen Length: 0.154 cm
Well Radius: 1.905 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.339E-5 cm/sec y0 = 96.14 cm



WELL TEST ANALYSIS

Data Set: I:\...\FHT_MW20-4D.aqt
Date: 11/26/20 Time: 14:29:17

PROJECT INFORMATION

Company: Terrapex Environmental
Project: CT3053
Location: 7370 Centre Road, Uxbridge
Test Well: MP20-4S
Test Date: 22 Oct 2020

AQUIFER DATA

Saturated Thickness: 1000. cm Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MP20-4D)

Initial Displacement: 223. cm
Total Well Penetration Depth: 0.154 cm
Casing Radius: 1.9 cm
Static Water Column Height: 0. cm
Screen Length: 0.154 cm
Well Radius: 1.905 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.155E-8 cm/sec
y0 = 223. cm