• Canadian Tire Real Estate Ltd.

Water Resources Study

Project Name
Water Resources Study – Revised Draft

Project Number
BRM-00011787-A0

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1 Introduction

Canadian Tire Real Estate Limited (CTRE) **exp** *the new identity of* ***Trow Associates Inc.*** to conduct a Water Resources Study in support of a Town of Bolton Zoning By-Law Amendment application required to proceed with proposed development at 13074 and 13304 Coleraine Drive in Bolton, Town of Caledon, Ontario, hereinafter referred to as the 'Site'.

The study area is bound by Coleraine Drive to the north, Healey Road to the southeast, agricultural land to the south and commercial development to the northwest. The Site consists of two properties; 13074 Colerain Drive property is 47 hectares (ha) and 13304 Coleraine Drive property is 26 ha in area. The total land area is approximately 73 ha as shown on Figure 1.

The Water Resources Study report utilizes the field data collected as part of the Hydrogeological Investigation carried out at the Site by **exp**.

1.1 Study Objective

The Water Resource Study was prepared to satisfy the Toronto and Region Conservation Authority (TRCA) requirement for a detailed characterization of the surface water and groundwater system in order to identify any explicit development constraints.

This report also identifies appropriate strategies to address the constraints.

1.2 Scope of Work

The scope of work for the Water Resources Study includes the following:

- Collecting and review available information including geological, geotechnical and hydrogeological information for the Site. Information reviewed included data from the Ontario Geological Survey, Ministry of the Environment Water Well records, existing geological, geotechnical and hydrogeological reports in the project area, and information on existing on-Site monitoring wells;
- Installing three shallow piezometer nest and surface water gauging stations at a selected location to quantify and assess the groundwater / surface water interaction at the Site;
- Completing an elevation survey of the monitoring points installed at the Site;
- Conducting two rounds of water level monitoring at the Site, including any existing groundwater monitoring wells;
- Conducting Single Well Response Tests (SWRT) on five (5) monitoring wells to characterize the local groundwater flow system at the Site; and,
- Data evaluation and preparation of Water Resources Study Report.

2 Characterization of Hydrogeological Setting

2.1 Physiography

The Bolton area is located in the physiographic region known as the South Slope, which extends from Lake Ontario to the Oak Ridges Moraine. The South slope includes the southern slope of the Oak Ridges Moraine and it occupies a part south of the Peel plains (Chapman and Putnam, 1984). The area is characterized by undulating tracts of land faintly drumlinized. The South Slope deposits typically consist of and silt and clay and are primarily surficial soils.

The Site is located within the Humber River Watershed. The Humber River is located approximately 1.6 kilometers north of the Site. The Site slopes to the southeast. The eastern portion of the Site near the Coleraine Drive and Healey Road intersection slopes to south, towards the creek.

The Site is undulating and generally has a gentle downward slope to the east, with localized drainage toward the two creeks that run within the Site. The elevation of the Site ranges between 250 m and 260 m above sea level. The slope of the Site is generally less than 1 percent.

The study Site is located within the Humber River watershed. The Humber River is located approximately 1.5 km north of the Site (Figure 1).

2.2 Surface Water Resources

Surface water is delivered to the subject lands by two drainage channels:

- Westerly Drainage Channel: obtain water from a 12" culvert draining a SWM facility and a 48" culvert which appears to convey water under the parking surface from lands further north (Figures 2 and 2A).
- Easterly Drainage Channel: Flows from the east are delivered a road side ditch on the west side of Coleraine Drive and two outlets which drain lands east of Coleraine Drive (Figures 2 and 2A).

  The northerly inlet of the eastern channel drains the east road side ditch and overland flow from a small SWM pond. The southerly inlet drains from the SWM pond and possibly other drainage from the developed lands to the east.

These two channels converge on the southeast side of the Site just before crossing Healey Road.

Both drainage channels report to the Clarkway Tributary, which is a tributary of the Humber River Watershed. Chanel sections within the site, both of these drainage channels are seasonal. Downtream of Healey Road appeared to be a permanent stream.

Water flow measurements were taken as part of the Water Resources Study Program. There are drainage ditches running along Healey Road as well as Coleraine Drive. These drainage ditches are dry in general and water is available only during and after rain events.

The Humber River is located approximately 1.5 km north of the Site.

2.3 Regional Geology and Hydrogeology

The Bolton area lies approximately 2.0 km south of the Oak Ridges Moraine (ORM). ORM sediments occur as channel deposits within the Newmarket or Northern Till.

The silty sand/sandy silt layers located within the subject area are influenced by an aquifer system known as the Oak Ridges Moraine Aquifer Complex (ORAC). The sediments in the ORAC aquifer generally consist of silty fine sand and fine sand and can occur at various depths.

The upper till layer (Halton till) acts as a weak to moderate confining layer in the area.

The overburden soil strata are underlain by bedrock belonging to the Upper Ordovician Georgian Bay Formation. The bedrock consists of shale with inter-bedded limestone. Based on the data collected from the MOE Water Well records in the adjacent areas, the bedrock surface is expected to be located at depths greater than 50 mbgs (Appendix A).

The sand layers found below approximately 50 m can be considered to be part of the deeper aquifer system in the area.

Based on the Site topography and the measured groundwater levels, the anticipated regional groundwater flow direction across the Site is to southeast, towards Lake Ontario.

2.4 Site Geology and Hydrogeology

2.4.1 Site Geology

The Ontario Division of Mines (1976) has historically differentiated a localized area around the Site as silt-rich Wildfield Till, which is similar in composition, and is considered by some researchers to be part of the Halton Till unit (*OGS*, 2009).

As part of a Phase II ESA completed by Malroz Engineering Inc. (Malroz, December 17, 2010), nineteen (19) boreholes were drilled to depths ranging from approximately 6.1 m to 12.2 m below ground surface (mbgs). Nine (9) of the boreholes were instrumented with groundwater monitoring wells. The borehole/monitoring well locations are shown on Figure 2. The main overburden soil encountered during drilling was clay and silt till.

A layer of fill material was encountered at four locations (BH101, BH103, BH104 and BH108) from the surface to a maximum depth of 0.91 mbgs. Topsoil was documented at fourteen locations (BH102, BH105, BH106, BH107, BH108, BH109, BH110, BH111, BH112, BH113, BH116, BH117, BH118 and BH119) from the surface to approximately 0.76 mbgs (Figures 3, 4, and 5).

No bedrock was encountered during borehole investigation carried out at the Site. Based on the data collected from the MOE Water Well records in the adjacent areas, the bedrock surface is expected to be located at depths greater than 50 mbgs (Appendix A).

2.4.2 Site Hydrogeology

There are three water-bearing units across the Site.

- Shallow water-bearing unit: This overburden water bearing unit extends to approximately 10 mbgs
- Intermediate overburden water-bearing unit: this overburden unit is encountered at depths deeper than approximately 15 m to 20 m below ground surface and extends to a depth of approximately 50 mbgs
- Deep Aquifer Unit: Bedrock and deep overburden water bearing unit found at depths deeper than approximately 50 mbgs

Shallow Water Bearing Unit: The discontinuous thin sandy/gravelly beds within the till formation form the shallow groundwater unit in the area. This shallow overburden unit extends to depths approximately 10 meters below the ground surface.

During the monitoring period, the water level (SWL) at the shallow piezometers at the creek banks vary from 0.5 m to 1.05 m below ground surface. These water levels are subjected to short term changes due to rain events and long term changes due seasonal variations. The measured static water levels can be considered as representative of the SWL of time of measurement.

All nine (9) on-site groundwater monitoring wells are installed in the shallow water bearing units (clay and silt till layers). Based on the water level monitoring carried out at the on-Site monitoring wells, the static water level across the Site varies from 1.3 to 5.3 mbgs.

Single Well Response Testing (SWRT) results carried out at the Site show that the hydraulic conductivity (K) of the clayey silt to silty clay formation (to a depth of 6 m below grade) varies between 3×10^{-7} m/s to 4×10^{-8} m/s. The variation of the K value is expected to be reflective of the varying amounts of thin sand and gravel layers within the till formation. The mean (Geometric) hydraulic conductivity of the till formation to a depth of 6 m below grade of the entire Site can be estimated at 8.6×10^{-8} m/s. The results of the SWRT test analysis are included in Appendix B.

The shallow groundwater flow direction across the Site varies from southeast to southwest as indicated on the Groundwater Contour Map (Figure 6). The groundwater gradient close to the northwest boundary of the Site is greater than the groundwater gradient towards the south west part of the Site.

The average gradient of the shallow overburden unit was estimated between 0.01 and 0.03. Assuming the effective porosity of the till formation 0.35, the ground water flow rate across the Site was estimated between 1 to 3 meters a year.

The shallow over bearing unit represents the local groundwater flow system in the area.

Intermediate Water-Bearing Unit: This intermediate overburden aquifer consists of sand and gravel formations. This aquifer is found at depths deeper than approximately 15 to 20 m from the existing ground surface and extends to depths of approximately 50 mbgs. This aquifer unit is used as the main water supply aquifer in the local residential water wells.

Given the low conductive clay and silty clay/clayey silt at shallow depths (as indicated on the Cross Sections on Figure 3, 4 and 5), no hydraulic connection is expected between the shallow water-bearing unit and overburden or bedrock aquifer system in the area.

Deep Water-Bearing Unit: There is a bedrock aquifer consisting of fractured/weathered shale. Several wells in the area are screened in this formation. These wells are generally deeper than 50 m. These wells draw water within approximately 5 m to 10 m from the bedrock surface. The bedrock aquifer behaves as a confined aquifer due to the effect of the thick clay or clayey silt to silty clay till layer.

The sand layers found below approximately 50 m can also be considered to be a part of the deeper aquifer unit in the area. The information provided in the MOE water well records indicate that deeper aquifer unit is under confined conditions. Due to the presence of low to moderately conductive clay and silty clay at various depths between 10 m and 50 m below ground surface, no hydraulic connection is expected between shallow/intermediate and deep aquifers in the study area.

The anticipated regional groundwater flow direction across the Site is to southeast, towards Lake Ontario.

2.4.3 MOE Water Well Records

The MOE Water Well records indicate that the main water aquifer system in the area is 0.3 m to 10 m thick medium to coarse sand and gravel layers. These sand and gravel beds are mostly discontinuous and vertically separated from each other by approximately 5 to 20 m thick clay beds. The confined beds identified in the water well records as clay beds are parts of the upper silty clay to clayey sit till layer (Halton till) and act as a weak to moderate confining layer in the area.

The MOE Water Well Records are included in Appendix A.

Water well location map is provided as Figure 7.

2.5 Groundwater Recharge and Discharge

Three stream gauging locations were established at the Site to characterize the drainage channel run-off across the Site. The two drainage channels present at the Site are fed by surface run-off and, during shorter periods of time, by shallow groundwater unit.

With the exception of a narrow corridor along two drainage channels, the whole Site can be categorized as a groundwater recharging area. Groundwater recharge areas allow a part of infiltration of precipitation and water from snow melting into the shallow groundwater system. At the Site, since the shallow groundwater system is hydraulically separated from the intermediate and deep water bearing units due to the influence of low conductive soil strata between water bearing formations, the groundwater recharge from precipitation and snow melting is expected to be restricted to the shallow water bearing unit, which forms the local groundwater flow system at the site.

In general, groundwater recharge is governed by multiple factors including the available water for recharge, hydraulic properties of surficial soil types, vegetation cover and topography (grading).

The dominant surficial soil type at the subject Site is clayey silt till to silty clay till and topographically the Site is undulating/gently sloping. These Site conditions provide moderate groundwater recharge. The water balance study carried out by **exp** for the Site suggests that the pre-development groundwater recharge across the Site is approximately 103 mm/year. Since the Site conditions are consistent throughout the Site, the recharge conditions are also considered consistent across the Site.

Figure 2-A shows the catchment area for the drainage channels that run across the Site. The channel flow measurements undertaken as part of this study show that the groundwater has a minor contribution to the two drainage channels across the Site.

Based on the channel flow measurements taken in April 2011, the surface water inflow of the two drainage channels run across the Site is approximately 13.8 m^3/h. The sum of the stream flows at a location downstream of the conjunction of the two drainage channels at the southeast boundary of the Site was measured at 12.3 m^3/h. These readings suggest that there is limited groundwater recharge from the surface water running within the Site.

This observation should be confirmed by additional surface water and ground water monitoring including temperature monitoring.

Table C-1 (Appendix C) provides a summary of the channel flow measurements.

During and after the rain events a portion of the surface run-off across the Site recharges the two drainage channels. Based on the pattern of Site topography, approximately 40% of the surface run-off is estimated to drain into the two channels. The balance of the sheet flow (60%) is expected to be collected in the roadside ditches.

2.6 Surface Water and Groundwater Interaction

At selected locations along the two drainage channels, three shallow piezometer nests and three staff gauges were installed to characterize the groundwater/surface water interaction at the drainage channels (Figure 3).

Water level measurements were carried out as part of the water resources study on April 15 and May 7, 2011. The recorded water levels are provided in Table D-1 (Appendix D).

The water level measurements at shallow piezometer nests suggest strong downward hydraulic gradients (Average 0.69) just downstream of the location of two tributaries converge (P-101/102) and weak upward hydraulic gradients (averages 0.05 and 0.14) at the upstream property boundaries (P-103/104 and P-105/106). On March 8/9, 2011 monitoring round, the upward hydraulic gradient at P-105/106 was 0.94 (Table D-1, Appendix D).These observations suggest that at the time of measurement, at P101/102 and P103/104 groundwater is discharging to the channels and at P105/106, shallow groundwater unit is recharged by the channels.

During both monitoring events, the difference of water level elevations between shallow and deep piezometers and the shallow piezometer and channel was within 2 cm to 5 cm. This suggests that groundwater recharge or discharge

associated with the drainage channels is minor. The conductance of the channel bed material is not available, however, based on the low hydraulic conductivity of the near surface soil strata at the Site, it can be expected that the hydraulic conductivity of the stream (tributary) bed material is low.

Low channel bed material conductance and minor vertical gradients suggest insignificant groundwater recharge from two channels at the time of measurement.

Since the piezometer nests are 1.5 m and 2.0 m deep, the monitoring results explain the behavior of the shallow (near surface) groundwater flow system. Due to the presence of weak confining layer, deeper groundwater flow system (beneath the confining bed) does not discharge at the tributaries. Therefore, no interaction of surface water with the deeper groundwater flow unit is expected at the two drainage channels.

The documented groundwater/surface water discharge/recharge rates coupled with channel flow measurements it can be concluded that, as a whole, the shallow groundwater unit at the site is recharged by two on-site drainage channels. The recharge rate is expected to be minor based on the low channel bed conductance. Given that the intermediate and deep water bearing units are hydraulically not connected to the shallow water bearing unit, no interaction is expected between channels and intermediate/deep water bearing unites.

3 Impact Assessment

The potential development impacts on the surface water and groundwater resources within and in the vicinity of the Site are twofold.

1. Potential Impacts During Construction

2. Potential post development impacts

3.1 Potential Impacts During Construction

Based on the proposed development details, the depth of excavations for the underground services and building basement are expected to extend between 5 m and 6 m below ground surface. Based on the static water level measurements taken during the Hydrogeological Assessment conducted by **exp** (**exp**, 2011), the excavations are expected to extend into the shallow overburden aquifer.

Based on the hydraulic conductivity of the clayey silt to silty clay till formation the anticipated groundwater seepage into the excavations will require limited construction dewatering at the Site.

The dewatering zone of influence will also be limited to a small area.

Limited dewatering rates are not expected to significantly lower the groundwater level in the shallow water bearing unit during the construction.

3.2 Potential Post Development Impacts

Based on the hydrogeologic characteristics and the observed groundwater/surface water interaction at the site the potential post development impacts can be summarized as:

- Reduced recharge of shallow water bearing unit due to proposed development land cover
- Increased sheet flow contribution to flow in drainage channels
- No hydraulic connection with intermediate and deep water bearing units; therefore pre/post conditions expected to be similar
- No net change to the surface water flow volumes

The primary potential post development impact at the Site is the decrease of post development groundwater infiltration compared to the predevelopment conditions. The Water Balance/Budget Analysis conducted by **exp** (**exp**, 2011), suggests that, during the post development phase, the predevelopment groundwater infiltration can be decreased by approximately 83%.

The two on-Site drainage channels report to the Clarkway Tributary which flows to the Humber River. The channels flow across the Site from the northwest to the southeast and converge on the southeast edge of the Site boundary prior to crossing beneath Healy Road through a culvert.

In general, the channels were found to be losing water to the shallow groundwater system.

Regional groundwater unit is appeared to be independent of the shallow groundwater unit.

Therefore, it is expected that a minor reduction of groundwater recharge at tributaries would not have a significant contribution to the regional groundwater system.

Based on the available information, the reduced infiltration is not expected to have a significant impact on the base flow of the tributaries given the groundwater contribution to the tributaries is low.

4 Summary and Conclusions

Based on the findings of the Water Resources Study, the following is a summary of the conclusions are provided:

- The Water Resource Study was prepared to satisfy the Toronto and Region Conservation Authority (TRCA) requirement for a detailed characterization of the surface water and groundwater system in order to identify any explicit development constraints.

- The study Site is located within the Humber River watershed. The Humber River is located approximately 1.5 km north of the Site. Surface water features available on-Site include two drainage channels that run across the Site.

- The Bolton area lies approximately 2.0 km south of the Oak Ridges Moraine (ORM). The silty sand/sandy silt layers located within the subject area are influenced by an aquifer system known as the Oak Ridges Moraine Aquifer Complex (ORAC). The upper till layer (Halton till) acts as a weak to moderate confining layer in the area. ORM sediments occur as channel deposits within the Newmarket or Northern Till.

- The main water supply aquifer (intermediate overburden aquifer) in the area is found at depths deeper than approximately 15 to 20 m from the existing ground surface and extends to a depth of approximately 50 mbgs.

- Due to the presence of low to moderately conductive clay and silty clay/clayey silt at shallow depths, no hydraulic connection is expected between the shallow overburden aquifer and the intermediate or bedrock aquifer system in the area.

- SWRT testing results carried out at the Site show that the hydraulic conductivity (K) of the clayey silt to silty clay formation to a depth of 6 m below existing grade varies between 3.2 x 10^{-8} m/s and 7.6 x 10^{-7} m/s.

- The anticipated regional groundwater flow direction across the Site is to southeast, towards Lake Ontario. The shallow groundwater flow direction across the Site varies from southeast to southwest.

- At the time of measuring, the shallow groundwater was discharging at both tributaries. However, the groundwater discharge at the tributaries is considered a temporary scenario and groundwater recharge and discharge at drainage channels are minor.

- Due to expected very low vertical hydraulic conductivity and low vertical hydraulic gradients the groundwater infiltration trough leaky confining layer is expected to be insignificant to minor.

- Given that the groundwater contribution to the base flow of the two tributaries at the Site, low dewatering rates during the construction phase of the project will have negligible impact on the water balance of the two on-site drainage channels.

- The main potential post development impact at the Site is the decrease of post development groundwater infiltration compared to the predevelopment conditions. Appropriate remedial measures to maintain the pre-

construction water balance under the post construction conditions have been proposed in the **exp** Water Balance/Budget Report (2011).

- Site development will not have any effect on the residential water wells in the vicinity of the Site. However, taking into consideration that several residential wells are available in a close proximity to the Site boundary, it is recommended to conduct a residential well monitoring program in all three phases (pre, during and post) of the development.

5 Limitations

The information presented in this letter report is based on a limited investigation designed to provide information to support an assessment of the current hydrogeological conditions within the study area. The conclusions and recommendations presented in this report reflect Site conditions existing at the time of the assessment.

Our undertaking at **exp**, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the geoscience/engineering profession. No other warranty or representation, either expressed or implied, is included or intended in this report.

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6 References

exp Services Inc. (2011). *Draft Water Balanc/Budget Analysis, 13074 and 13304 Coleraine Drive, Bolton, Ontario*. (Ref: BRM-00011787-A0).

exp Services Inc. (2011). *Draft Hydrogeological Assessment, 13074 and 13304 Coleraine Drive, Bolton, Ontario*. (Ref: BRM-00011787-A0).

Malroz Engineering Inc. (December 17, 2010). *Phase II ESA, Proposed Distribution Centre, 13704 & 13304 Coleraine Drive, Bolton, Ontario.* (File: 757.00/107).

We trust that this information is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact this office.

Sincerely,

exp

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Appendix A –
MOE Water Well Records

Appendix A
Table A-1
Water Well Details

No	WELL_ID	X	Y	Well Type	Well Depth (m)	Water Found Depth (m)	Final_Status	Well Use1	Well Use2
1	4900257	601223.6	4856103	Overburden	39.6	39.6	Water Supply	Domestic	
2	4900261	601833.6	4856480	Bedrock	53.3	51.2	Water Supply	Livestock	Domestic
3	4900263	601537.6	4857086	Overburden	24.4	24.4	Water Supply	Domestic	
4	4900265	600992.6	4857721	Overburden	25.9	12.2	Water Supply	Domestic	
5	4900266	600985.6	4857704	Overburden	28.0	24.4	Abandoned-Supply		
6	4903037	601784.6	4857073	Overburden	47.2	45.7	Water Supply	Domestic	
7	4903038	601614.6	4857273	Overburden	56.4	54.9	Water Supply	Domestic	
8	4903043	601984.6	4856723	Bedrock	61.0	59.4	Water Supply	Domestic	
9	4903330	601394.6	4856283	Overburden	15.2	6.1	Water Supply	Domestic	
10	4903356	601624.6	4857403	Bedrock	56.7	N/A	Abandoned-Supply		
11	4903453	600364.6	4856573	Bedrock	57.3	57.3	Water Supply	Domestic	
12	4903720	601114.6	4857543	Overburden	29.0	12.2	Water Supply	Domestic	
13	4903824	601194.6	4857553	Overburden	29.0	29.0	Water Supply	Domestic	
14	4904240	600664.6	4856423	Overburden	67.1	N/A	Abandoned-Supply		
15	4904431	600290.6	4856733	Bedrock	76.8	71.9	Water Supply	Domestic	
16	4904676	601798.6	4857046	Bedrock	58.5	57.0	Water Supply	Domestic	
17	4905421	601914.6	4857223	Overburden	16.5	9.8	Water Supply	Domestic	
18	4906653	601176.6	4856653	Bedrock	52.4	51.8	Water Supply	Domestic	
19	4907247	602054.6	4856768	Overburden	27.7	27.4	Water Supply	Domestic	
20	4907815	601629.6	4856207	Overburden	18.3	9.1	Water Supply	Domestic	
21	4908481	600760	4858002	Bedrock	134.1	N/A	Abandoned-Supply		
22	4909105	602006	4857711	Bedrock	44.8	40.5	Water Supply	Domestic	

N/A Not Available

Appendix A
Table A-2
Geologic Formations

WELL_ID	Material	Material2	Material3	Depth_m
4900257	CLAY			21.3
	SILT	CLAY		38.4
	COARSE SAND	GRAVEL		39.6
4900261	CLAY			11.0
	CLAY	SILT		47.2
	HARDPAN			52.4
	SHALE			53.3
4900263	TOPSOIL			3.7
	CLAY	STONES		23.8
	MEDIUM SAND			24.4
4900265	TOPSOIL			4.6
	CLAY			10.7
	MEDIUM SAND			12.2
	COARSE SAND			14.0
	CLAY			24.4
	GRAVEL			24.7
	CLAY			25.9
4903037	TOPSOIL			0.9
	CLAY			28.3
	HARDPAN			39.0
	MEDIUM SAND	GRAVEL		40.5
	CLAY	MEDIUM SAND		45.1
	COARSE SAND			47.2
4903038	TOPSOIL			0.9
	CLAY			28.3
	HARDPAN			39.9
	MEDIUM SAND	GRAVEL		41.8
	CLAY	MEDIUM SAND		46.0
	MEDIUM SAND			50.9
	FINE SAND	CLAY		54.3
	COARSE SAND			56.4
4903043	TOPSOIL			0.3
	CLAY			4.9
	CLAY			54.9
	CLAY	MEDIUM SAND		56.7
	SHALE			61.0
4903330	CLAY			6.1
	CLAY	STONES		15.2
4903453	CLAY			4.9
	CLAY			7.9
	SILT			23.8
	GRAVEL	CLAY		55.8
	SHALE			57.3

Appendix A
Table A-2
Geologic Formations

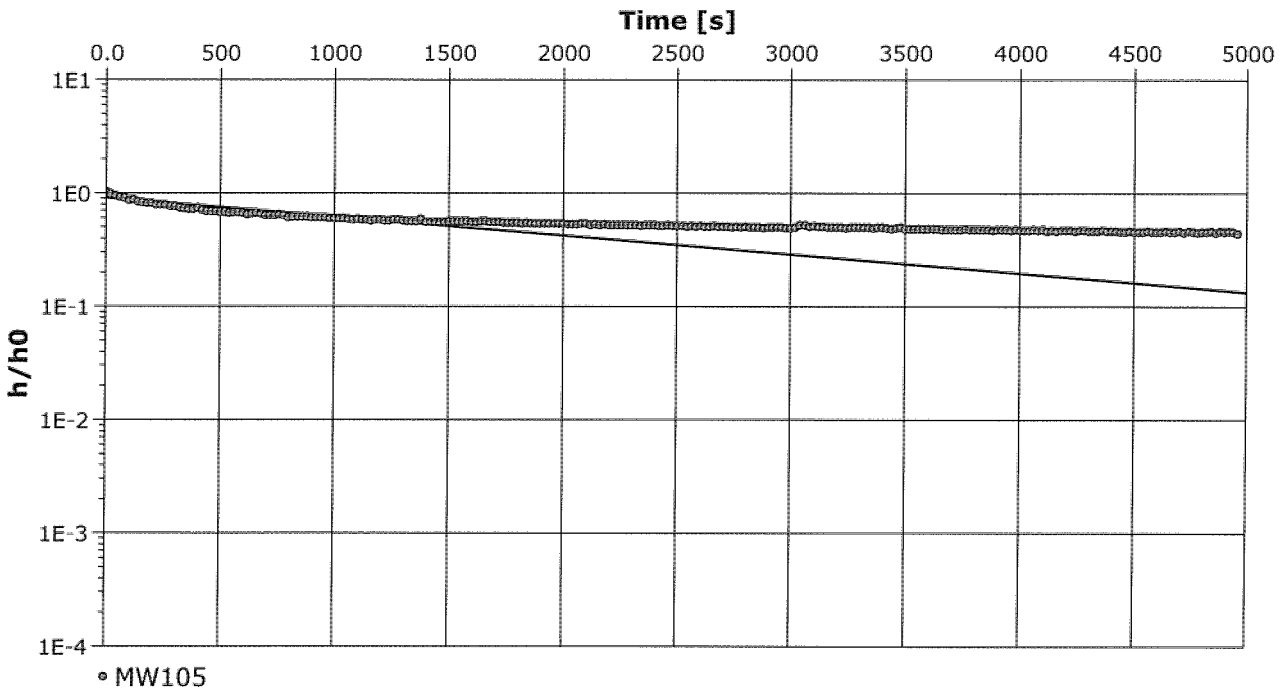
WELL_ID	Material	Material2	Material3	Depth_m
4903720	CLAY			3.7
	CLAY			12.2
	MEDIUM SAND			12.8
	CLAY			29.0
4903824	TOPSOIL			3.7
	CLAY			13.1
	SAND			13.7
	CLAY			28.3
	COARSE SAND			29.0
4904431	PREV. DRILLED			66.1
	SAND	GRAVEL	CLAY	71.9
	GRAVEL			72.2
	SHALE			72.8
	SHALE			76.8
4904676	PREVIOUSLY DUG			13.7
	CLAY	GRAVEL		21.6
	CLAY			45.7
	CLAY	SILT		50.3
	HARDPAN	SHALE		57.0
	SHALE			58.5
4905421	CLAY	SAND		4.3
	CLAY	SAND		8.5
	SILT			9.8
	SILT	CLAY	STONES	16.5
4906653	UNKNOWN TYPE			5.5
	SAND	GRAVEL		18.3
	GRAVEL	BOULDERS		29.0
	CLAY	GRAVEL		29.0
	CLAY	GRAVEL	BOULDERS	41.8
	LIMESTONE			52.4
4907247	TOPSOIL	HARD		0.3
	CLAY	HARD		6.1
	CLAY	HARD		27.4
	SAND	LOOSE		27.7
4907815	TOPSOIL	HARD		0.3
	CLAY	HARD		12.2
	SAND	LOOSE		18.3
4909105	GRAVEL	FILL		0.3
	CLAY	SAND		3.7
	CLAY	SAND		23.2
	CLAY			31.1
	GRAVEL	SILTY		34.1
	GRAVEL	CLAY		34.4
	SHALE			44.8

Appendix B –
SWRT Analysis

exp.
1595 Clark Boulevard
Brampton, Ontario

Slug Test Analysis Report	
Project: Hydrogeological Investigation	
Number: BRM-00011787-A0	
Client: Canadian Tire	

Location: Bolton, Ontario	Slug Test: MW105	Test Well: MW105
Test conducted by: J.M.		Test date: 3/8/2011
Analysis performed by: J.M.	MW105 Slug Test Analysis	Date: 3/10/2011
Aquifer Thickness:		

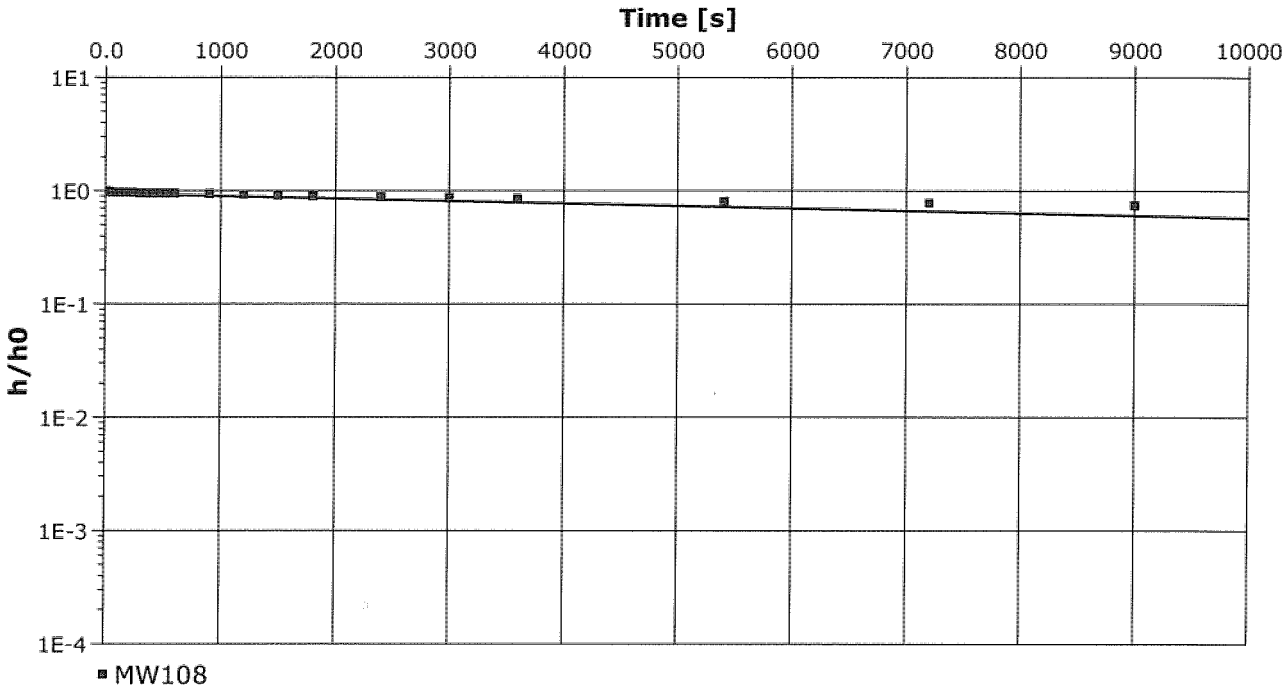


Calculation after Hvorslev

Observation well	K [m/s]	
MW105	7.59×10^{-7}	

exp. 1595 Clark Boulevard Brampton, Ontario	Slug Test Analysis Report
	Project: Hydrogeological Investigation
	Number: BRM-00011787-A0
	Client: Canadian Tire

Location: Bolton, Ontario	Slug Test: MW108	Test Well: MW108
Test conducted by: J.M.		Test date: 3/8/2011
Analysis performed by: J.M.	MW108 Slug Test Analysis	Date: 3/11/2011
Aquifer Thickness:		

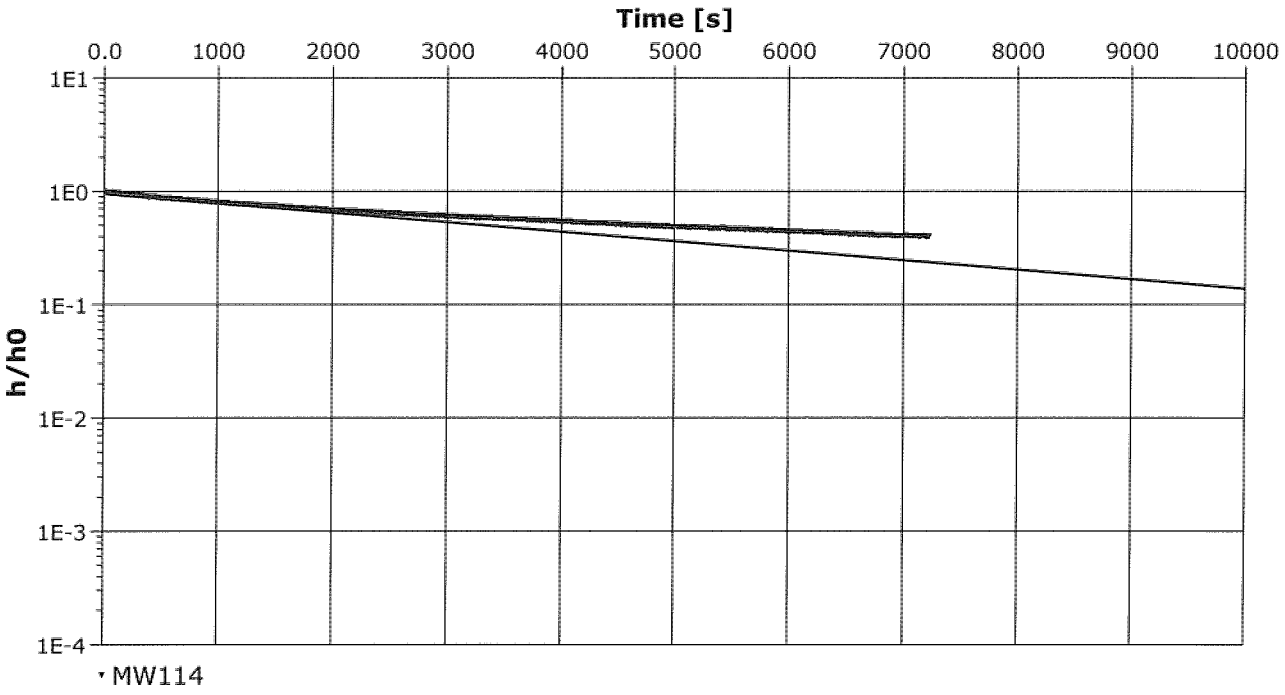


Calculation after Hvorslev

Observation well	K [m/s]	
MW108	9.77×10^{-8}	

exp. 1595 Clark Boulevard Brampton, Ontario	Slug Test Analysis Report
	Project: Hydrogeological Investigation
	Number: BRM-00011787-A0
	Client: Canadian Tire

Location: Bolton, Ontario	Slug Test: MW114	Test Well: MW114
Test conducted by: J.M.		Test date: 3/9/2011
Analysis performed by: J.M.	MW114 Slug Test Analysis	Date: 3/11/2011
Aquifer Thickness:		



Calculation after Hvorslev

Observation well	K [m/s]	
MW114	3.82×10^{-7}	

exp.
1595 Clark Boulevard
Brampton, Ontario

Slug Test Analysis Report

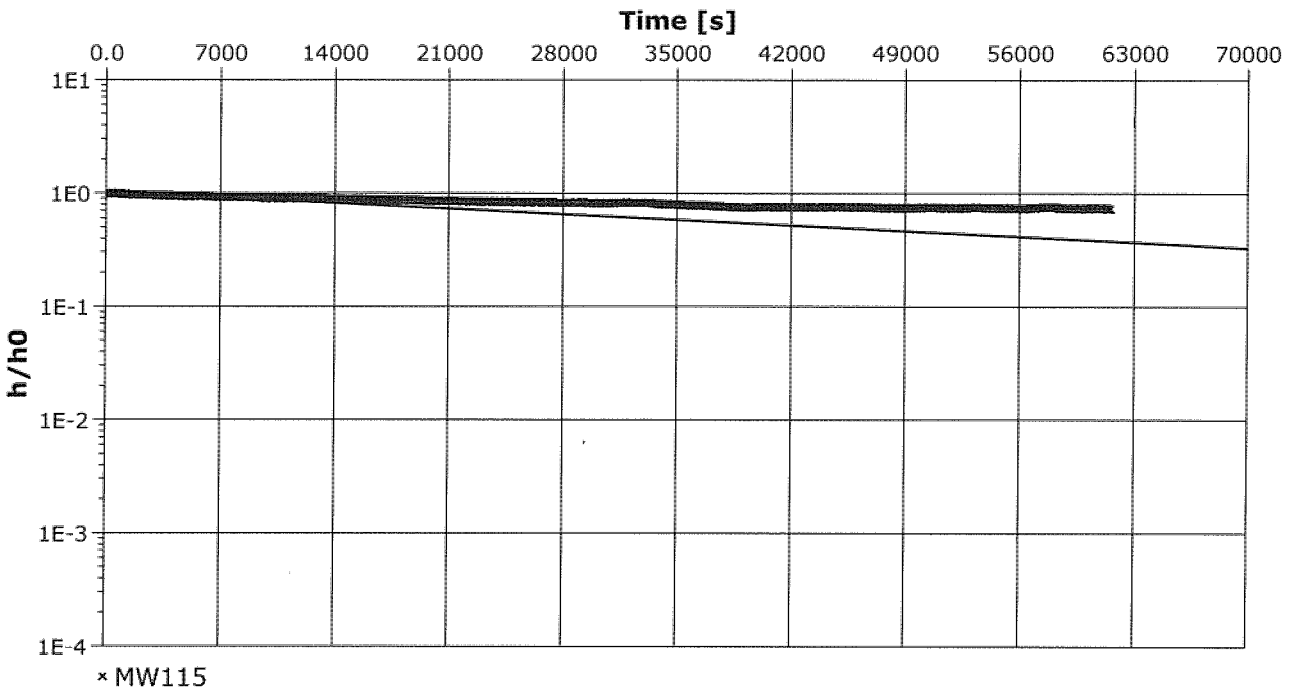
Project: Hydrogeological Investigation

Number: BRM-00011787-A0

Client: Canadian Tire

Location: Bolton, Ontario	Slug Test: MW115	Test Well: MW115
Test conducted by: J.M.		Test date: 3/9/2011
Analysis performed by: J.M.	MW115 Slug Test Analysis	Date: 3/30/2011

Aquifer Thickness:

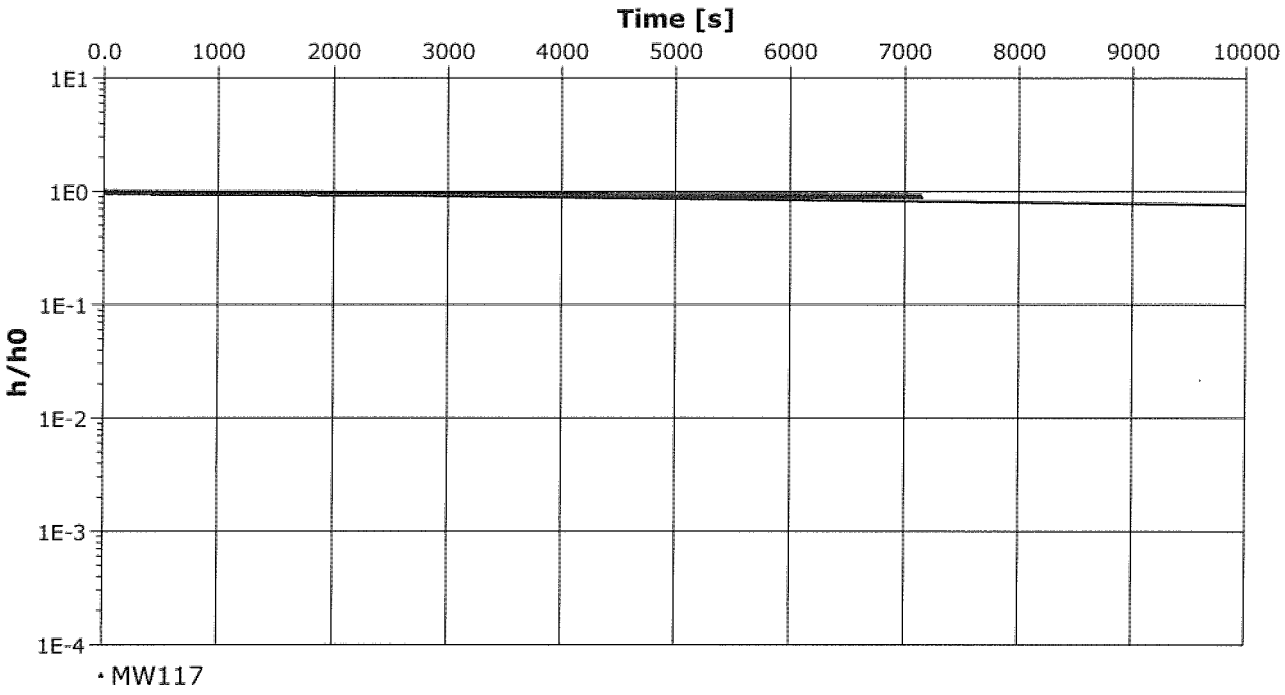


Calculation after Hvorslev

Observation well	K [m/s]	
MW115	3.20×10^{-8}	

exp. 1595 Clark Boulevard Brampton, Ontario	Slug Test Analysis Report
	Project: Hydrogeological Investigation
	Number: BRM-00011787-A0
	Client: Canadian Tire

Location: Bolton, Ontario	Slug Test: MW117	Test Well: MW117
Test conducted by: J.M.		Test date: 3/9/2011
Analysis performed by: J.M.	MW117 Slug Test Analysis	Date: 3/11/2011
Aquifer Thickness:		



Calculation after Hvorslev

Observation well	K [m/s]	
MW117	5.26×10^{-8}	

Appendix C
Stream Flow Measurements

Table C-1

Tributary Flow Measurements

Date Measured	P101/P102	P103/P104	P105/P106	Total Inflow	Total Out-flow	Remarks
	m^3/h	m^3/h	m^3/h	m^3/h	m^3/h	
Mar-11	30.74	1.3 (partially frozen)	frozen	na	30.4	High flow rates at out let (P101/102) is due to snow melting
7-Apr-11	12.3	9.8	4.0	13.8	12.5	
6-May-11	16.4	5.8	6.5	12.3	12.5	Raining, direct surface water inflow to thr tributeries expected

Appendix D
Water Level Measurements

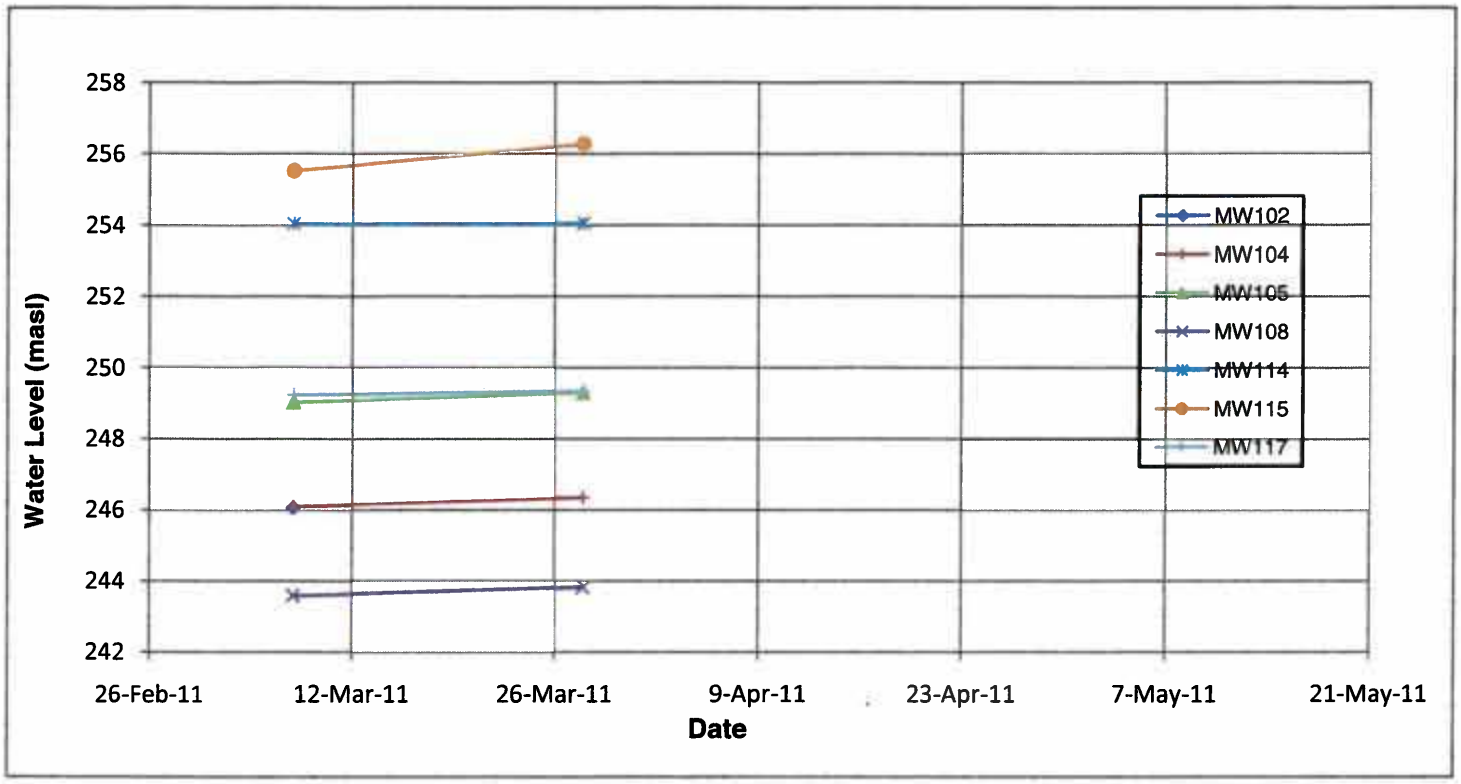


Figure C-1

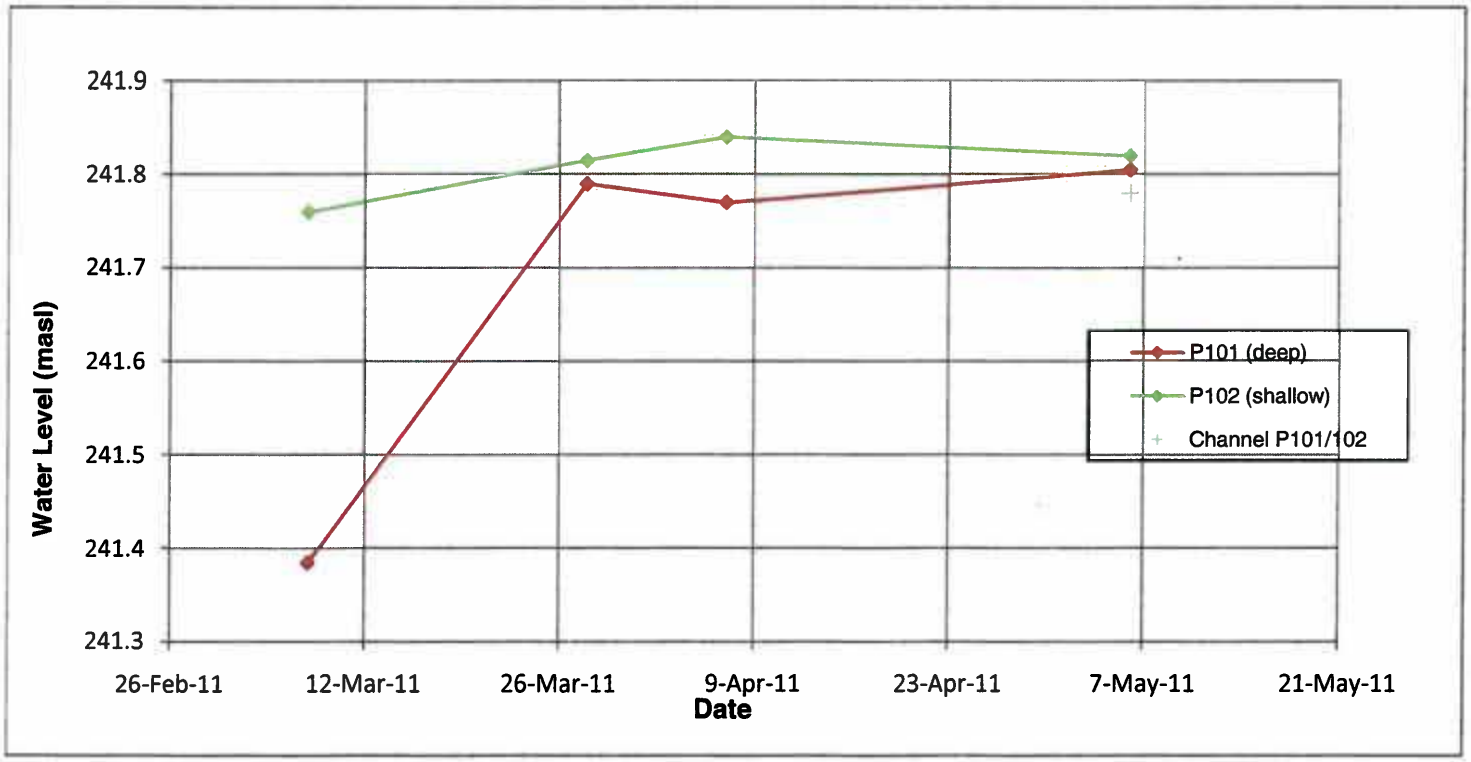


Figure C-2

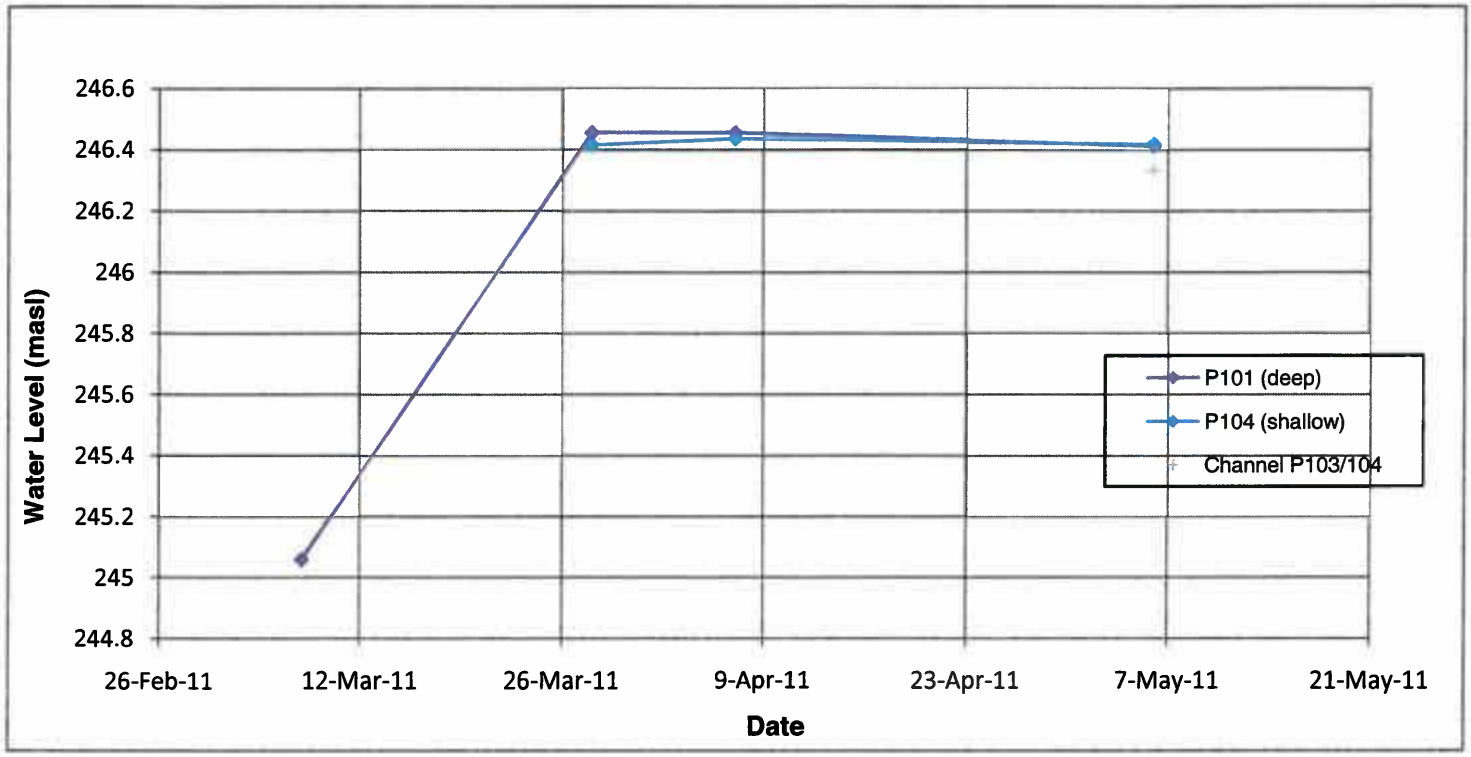


Figure C-3

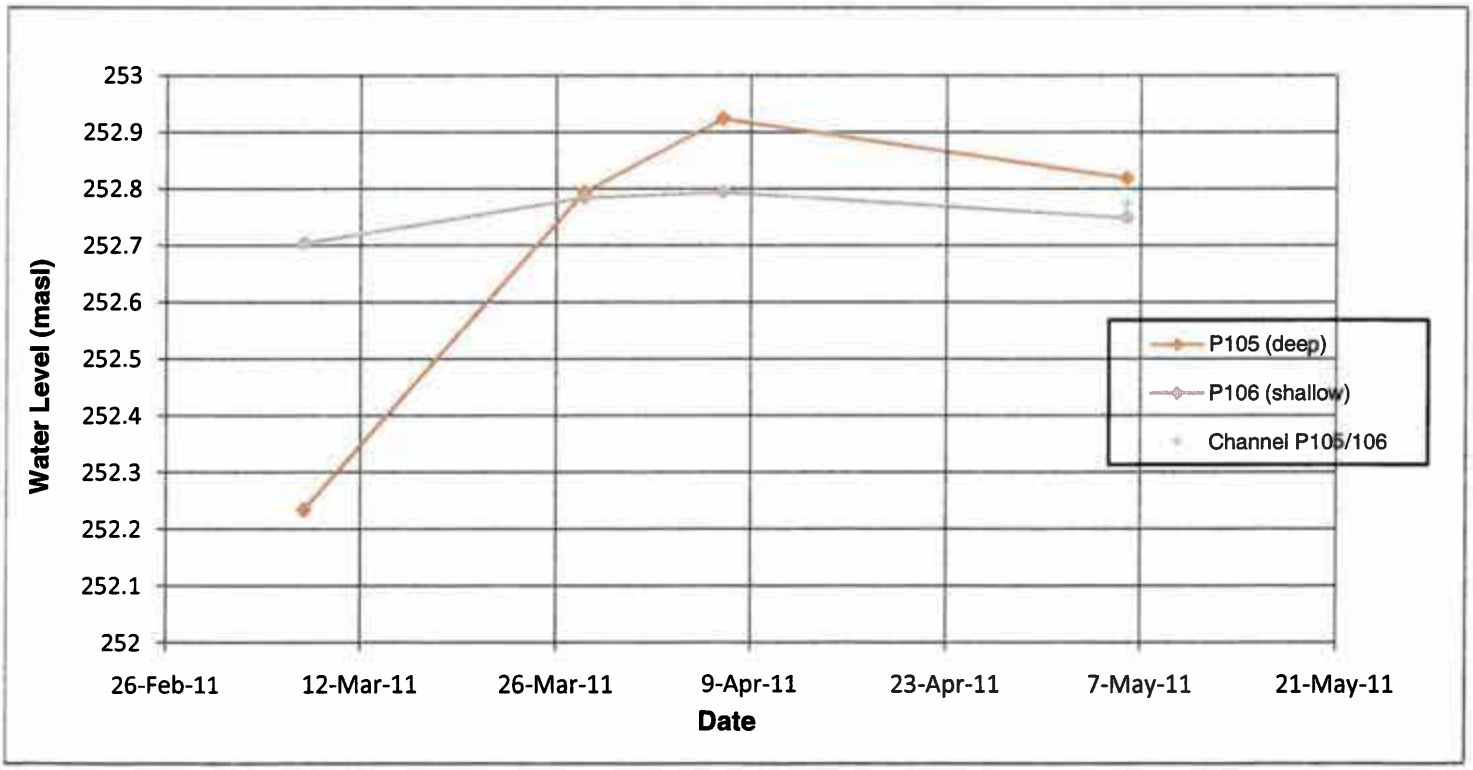


Figure C-4

Table D-1
Summary of Water Level Monitoring

Well ID	Ground Elevation	Well Depth	Groundwater Levels												Stream Levels
			March 8 and 9, 2011	SWL elevation	Gradient	28-Mar-11	SWL elevation	Gradient	7-Apr-11	SWL elevation	Gradient	6-May-11	SWL elevation	Gradient	May 6, 2011
	masl	m bgs	m bgs	masl		m bgs	masl					m bgs	masl		masl
MW102	246.95	6.70	0.87	246.08		N/A	N/A					-	-		-
MW104	246.98	5.90	0.86	246.12		0.63	246.36					-	-		-
MW105	249.99	6.10	0.96	249.03		0.69	249.30					-	-		-
MW108	244.56	6.10	0.97	243.60		0.73	243.83					-	-		-
MW114	255.43	6.10	1.38	254.06		1.38	254.05					-	-		-
MW115	256.62	6.10	1.09	255.54		0.34	256.28					-	-		-
MW117	251.08	6.10	1.85	249.24		1.74	249.35					-	-		-
P-101	242.08	1.05	0.70	241.39	Downward 1.2	0.29	241.79	Downward 1.3	0.31	241.77	Downward 0.23	0.28	241.81	Downward 0.03	241.78
P-102	242.18	0.65	0.42	241.76		0.37	241.82		0.34	241.84		0.36	241.82		
P-103	246.56	1.50	1.50	245.06	-	0.10	246.46	upward 0.06	0.10	246.46	upward 0.03	0.14	246.42	level 0.0	246.33
P-104	246.56	0.86	Dry	N/A		0.14	246.42		0.12	246.44		0.14	246.42		
P-105	252.96	1.13	0.72	252.24	downward 0.94	0.16	252.80	upward 0.02	0.03	252.93	upward 0.26	0.14	252.82	upward 0.14	252.78
P-106	252.92	0.63	0.21	252.71		0.13	252.79		0.12	252.80		0.17	252.75		

Notes:

m bsg meters below ground surface

masl meters above sea level

N/A not available

Figures

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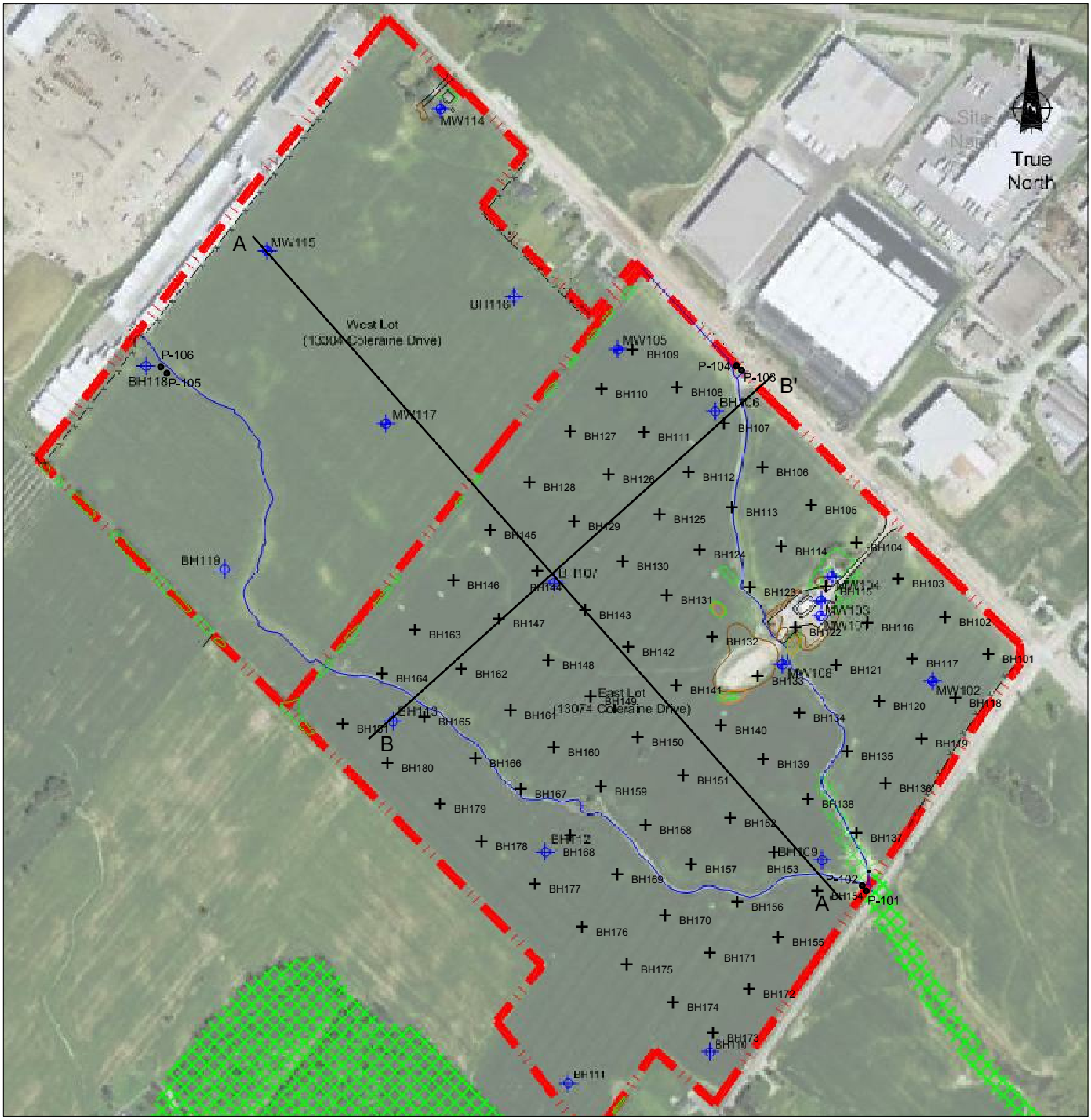
WATER RESOURCES STUDY
SITE LOCATION PLAN
13074 AND 13304 COLERAINE DRIVE
BOLTON, ONTARIO

PROJECT NO.: BRM-00011787-A0	DWN.: AZ
SCALE: NTS	DWN.: JM
DATE: MAY 2011	FIG NO: 1



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- EDGE OF PAVEMENT/BUILDING FOOTPRINT
- —x—x—x— FENCE
- CREEK
- A—— A' CROSS-SECTION
- BH116 MW111 BOREHOLE AND MONITORING WELL INSTALLED FOR PHASE 2 ESA (MALROZ 2010)
- P-105 PIEZOMETERS INSTALLED BY **exp** (MARCH, 2011)
- + BH177 BOREHOLES INSTALLED BY V.A.WOODS (2006)

0 200 400

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BOLTON, ONTARIO

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SCALE: AS NOTED	DWN.: JM
DATE: APRIL 2011	FIG NO.: 2

Approximate Channel
Catchment Area

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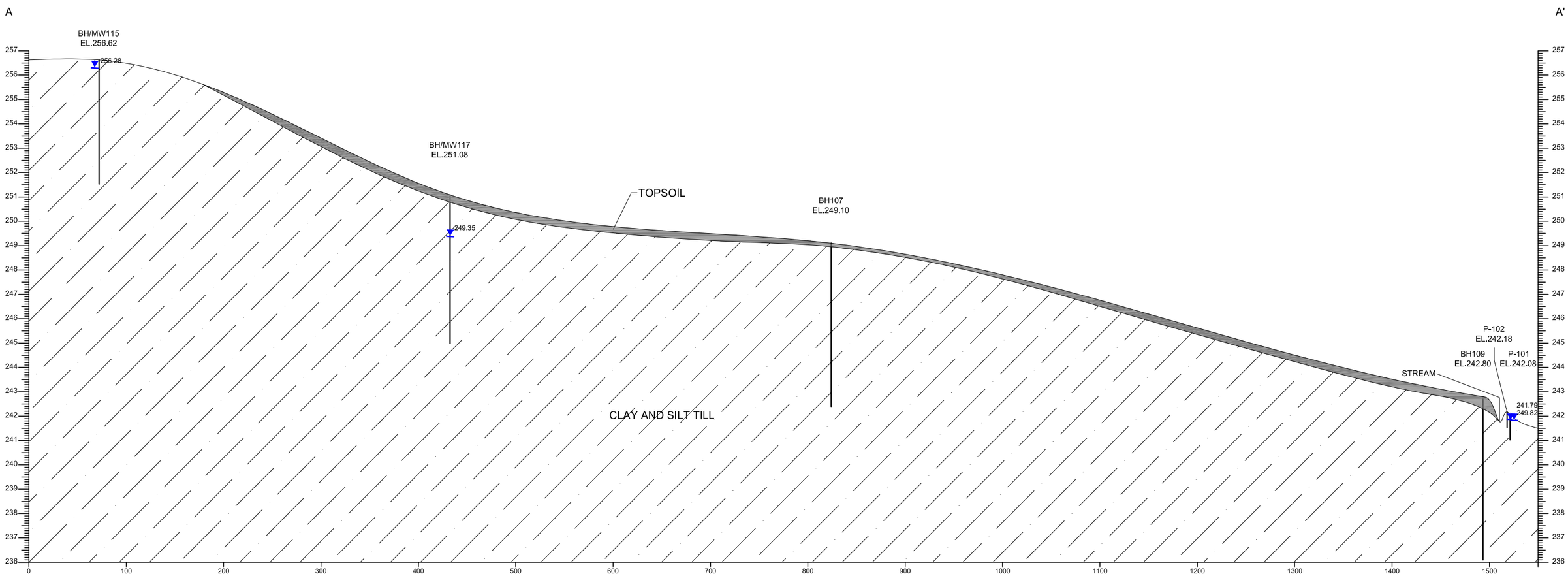
DRAINAGE CHANNEL CHATCHMENT AREA
13074 AND 13304 COLERAINE DRIVE
BOLTON, ONTARIO

DRAWING TITLE:

APPROXIMATE DRAINAGE CHANNEL
CATCHMENT AREA

PROJECT NO.: BRM-00010787-A0	DWN.: JS
SCALE: AS NOTED	DWN.: JM
DATE: APRIL 2011	FIG NO.: 2-A



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13074 AND 13304 COLERAINE DRIVE
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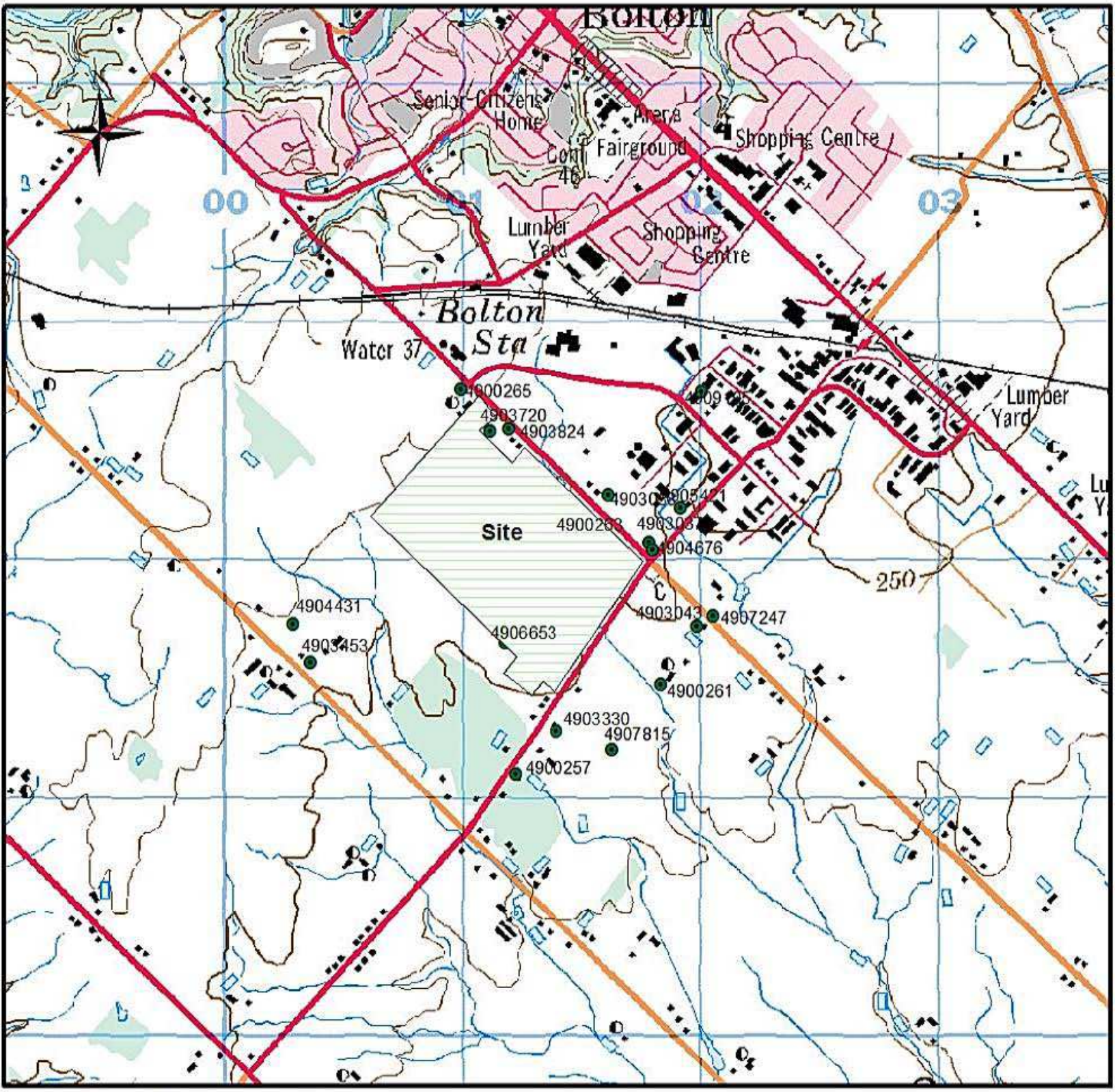
DRAWING TITLE:

CROSS SECTION A-A'

PROJECT NO.: BRM-00011787-A0	DWN.: AZ
SCALE: AS NOTED	DWN.: JM
DATE: MAY 2011	FIG. NO: 3



(Reference: Ministry of the Natural Resources NTSC map 030-M-13-1-1, Bolton)

0.5 0 0.5 1 Kilometers

Site

Wells within 500 m of the Trunk Sewer

Water Well Location Map

exp Services Inc.
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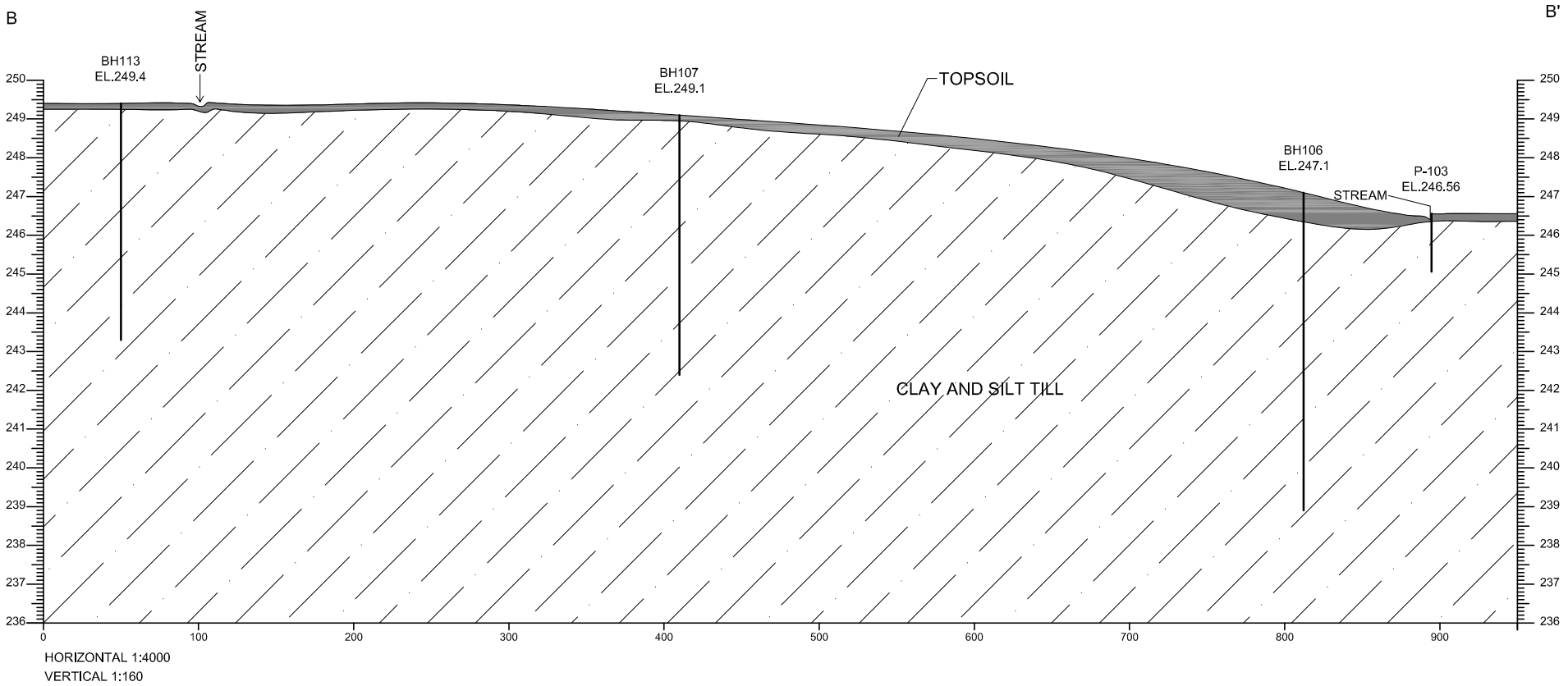
Brampton, Ontario
(905) 793-9800

Water Resources Study
Canadian Tire Distribution Centre
Bolton, Ontario

PROJECT NO.: BRN00011787A0	DWN: JS
SCALE: AS NOTED	CHKD:
DATE: April 2011	FIG. NO.: 7



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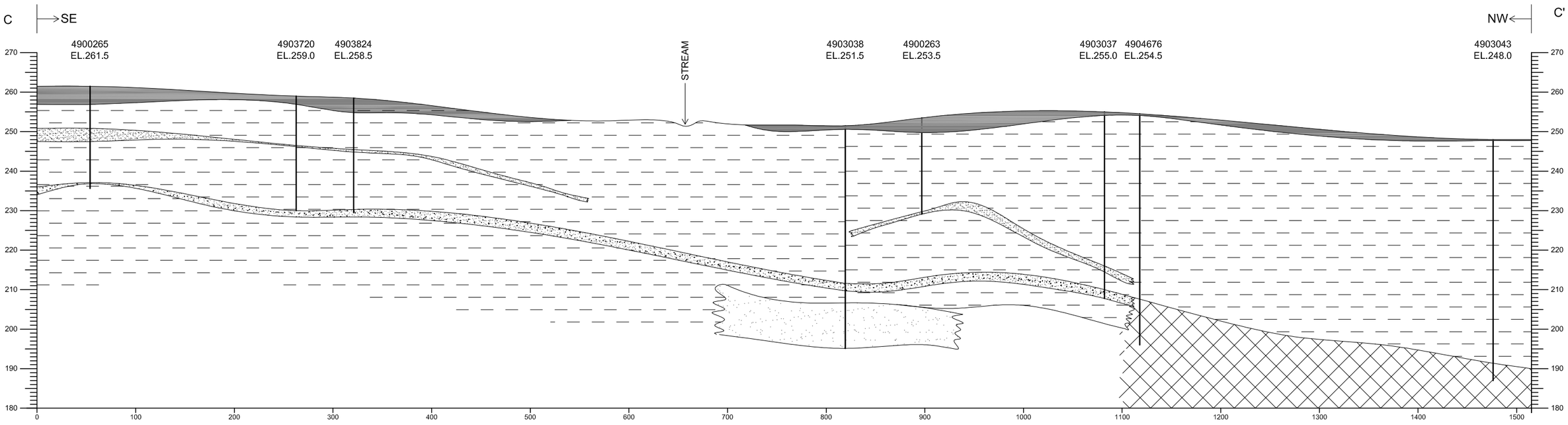
DRAWING TITLE:

CROSS SECTION B-B'

PROJECT NO.: BRM-00011787-A0	DWN.: AZ
SCALE: AS NOTED	DWN.: JM
DATE: MAY 2011	FIG. NO: 4



LEGEND:

- TOP SOIL
- MEDIUM SAND
- MEDIUM TO COARSE SAND
- COARSE SAND TO GRAVEL
- CLAYEY SILT TO SILTY CLAY TILL
- SHALE BEDROCK

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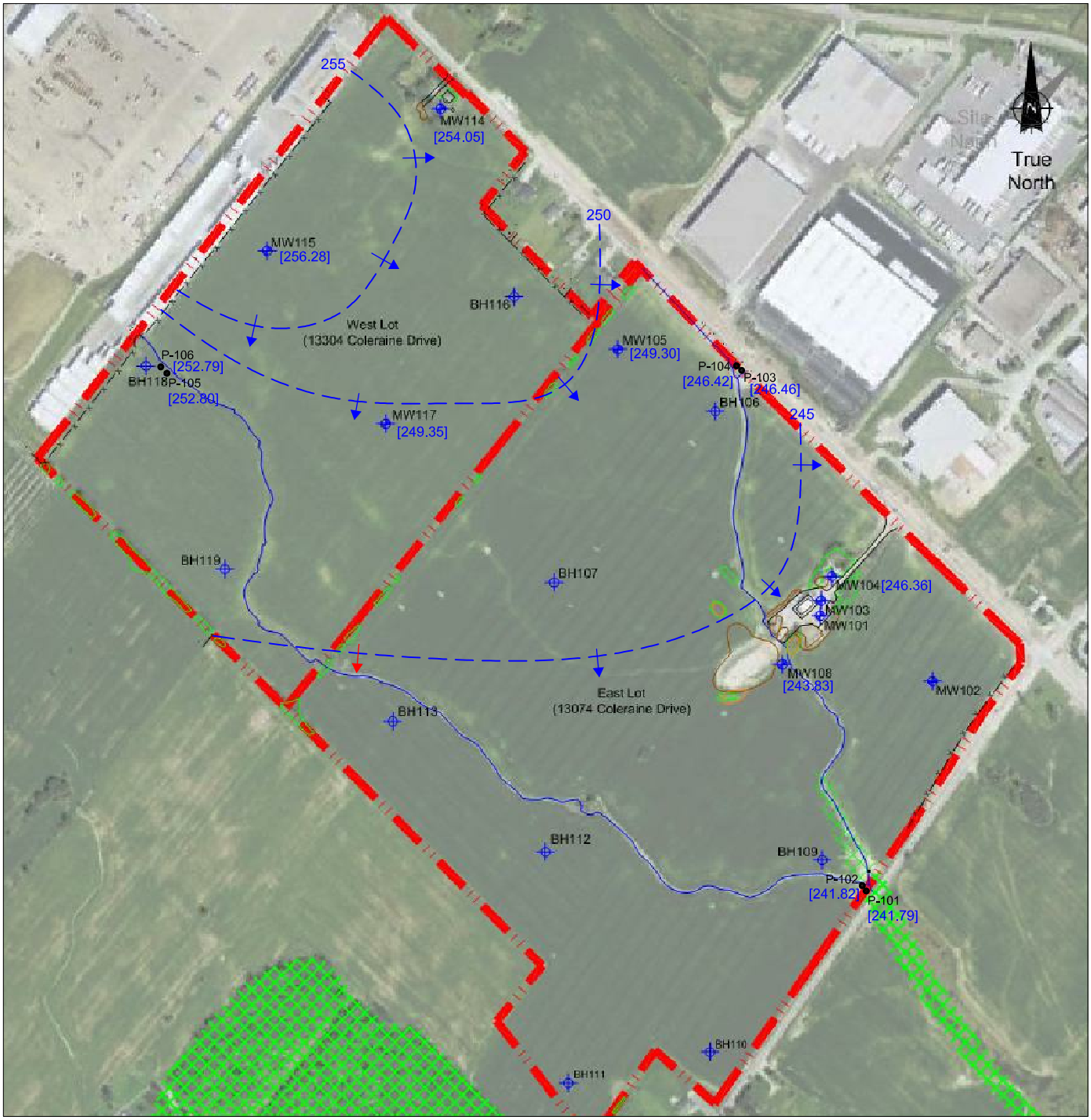
DRAWING TITLE:

CROSS SECTION C-C'

PROJECT NO.: BRM-00011787-A0	DWN.: AZ
SCALE: AS NOTED	DWN.: JM
DATE: MAY 2011	FIG. NO: 5



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- EDGE OF PAVEMENT/BUILDING FOOTPRINT
- FENCE
- CREEK
- MW111 / BH116 — BOREHOLE AND MONITORING WELL INSTALLED FOR PHASE 2 ESA (MALROZ 2010)
- P-105 — PIEZOMETERS INSTALLED BY **exp** (MARCH, 2011)
- 250 — GROUNDWATER CONTOURS AND FLOW DIRECTION

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GROUNDWATER CONTOUR MAP
13074 AND 13304 COLERAINE DRIVE
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PROJECT NO.: BRM-00011787-A0	DWN.: AZ
SCALE: AS NOTED	DWN.: JM
DATE: MAY 2011	FIG. NO.: 6