Appendix D Impact Assessment Report (Stantec, 2014)

Environmental Impact Assessment Fourth Line Well Field, Acton Ontario

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Sign-off Sheet

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1.0 Introduction

The Community of Acton in the Town of Halton Hills (Town) is supplied with potable water from three (3) well fields; Fourth Line, Prospect Park, and Davidson well fields, which are operated by the Region of Halton (Region). Approximately one third of the Community's average daily water supply originates from the Fourth Line well field, which obtains its water from one well (Well A, Figure 1; Appendix A). Well A pumps water from the underlying fractured dolostone bedrock aquifer, and is currently permitted to pump at a rate of 15.2 L/s under the existing Permit to Take Water (PTTW No. 62181-7WFQB3), which expires on May 31, 2015.

In order to maintain a safe reliable water supply for the Community, the Region has undertaken this study to investigate the potential of expanding the taking from the Fourth Line well field by including a test well (TW1-87) which is currently on standby and not included in the existing PTTW. Test well TW1-87 is completed in the same aquifer as Well A and preliminary testing conducted in 2010 indicated that additional water was available by pumping both wells together to minimize drawdown (Stantec Consulting Ltd., 2010). Additionally, the existing well house/treatment building is being expanded under a separate contract to upgrade process equipment and to connect the standby well (TW1-87) to the treatment system. The Region retained Stantec Consulting Ltd. (Stantec) to complete the an environmental impact assessment which documents the results of natural heritage and well field pumping test investigations to determine the appropriateness of increasing the water taking from the well field. Subject to the results of this investigation, the intent is to increase the water taking from the bedrock aquifer by 400 m^3/day, from the current permitted rate of 1,309 m^3/day (15.2 L/s) to 1,711 m^3/day (19.8 L/s).

1.1 STUDY OBJECTIVES

The scope of work for the Fourth Line well field is to assess the impacts of increasing the daily taking from the well field by about 400 m^3/day, from the existing permitted rate of 1,309 m^3/day to 1,711 m^3/day. This environmental impact assessment includes the results of a comprehensive well pumping test to determine impacts to groundwater users, and an ecological review of nearby terrestrial and aquatic habitat to determine impacts to natural features.

The specific objectives of this study are to:

- Confirm aquifer sustainability at the higher pumping rate;
- Assess the impact of the increased water taking on the natural environment and existing water users in the area; and
- Satisfy all the requirements for the submission of an application for a Permit To Take Water, should the assessment support such an application.

1.2 REPORT ORGANIZATION

The report is arranged in ten (10) sections, including this introduction. Section 2 presents available background information. Section 3 presents the methodology used during the study. Section 4 presents the results of field investigations. Section 5 presents a discussion of sustainable yield. The assessment of impacts is presented in Section 6. A discussion of permitting compliance is provided in Section 7. The assessment of quality assurance / quality control is provided in Section 8. The study conclusions and references are presented in Sections 9 and 10, respectively.

All figures and tables referenced in the report are presented in Appendices A and B, respectively. Appendix C presents the existing PTTW No. 621-7WFQB3 and Temporary PTTW No. 3663-97JKBF for the pumping test. Appendix D presents borehole logs and MOE WWRs. Appendix E presents agency correspondence including a sample residential notification letter, and Credit Valley Conservation Authority (CVC) memo regarding establishment of monitoring triggers. Appendix F presents hydrographs providing groundwater and surface water monitoring data. Appendix G presents the laboratory certificates of analysis for samples collected and Appendices H and I present the aquatic monitoring data and stream flow rating curves, respectively.

2.0 Background

The following sections provide background information on the physical setting and history of the Fourth Line well field.

2.1 WELL FIELD HISTORY

The Fourth Line well field pumping well, Well A, was originally constructed in 1956 by International Water Supply (IWS) as a pumping well (Appendix D). The original well construction consisted of a 250 mm (10-inch) nominal diameter steel casing set to depth of 7.39 m below top of casing (BTOC) and completed in bedrock to depth of 53.6 m below ground surface (BGS). Due to poor water quality (high hardness), the well was not brought on line until 1971 after the lower portion of the bedrock was sealed off with concrete to a depth of 21.6 m BGS. Following sealing of the lower portion of the bedrock, IWS completed a pumping test and confirmed a supply capacity of 15.8 L/s, and suggested that a portion of the water to Well A was obtained from the nearby spring fed creek through leakage to the bedrock aquifer (Stantec, 2010). A second test well (TW1-87) was constructed in 1987 in the bedrock aquifer as a standby well but was never connected into the water distribution system and is not included in the existing permit to take water (PTTW#6281-7WFQB3). TW1-87 was constructed with a 250 mm (10-inch) nominal diameter steel casing set to depth of 8.56 m BTOC and completed in bedrock to depth of 22.92 m BGS.

In 2002, a Groundwater Treatment Needs Assessment (Halton, 2002) was completed for the Fourth Line Well System. The assessment involved a review of the original aquifer testing program by IWS, and a source water quality assessment. The source water quality for Fourth Line Well A indicated that *Escherichia coli (E.coli.)* was detected in 45 of the 873 (5.1%) samples between 1997 and 2002 with no clear correlation to precipitation events. Raw water turbidity was generally low (0.01 NTU) with occasional spikes in turbidity related to pump start-up or instrument interference. A sample for Microscopic Particulate Analysis (MPA) was collected and indicated the presence of algae and diatoms, suggesting a potential surface water influence. Based on the analysis completed, Halton (2002) concluded that Fourth Line Well A could be at risk of surface water influences and therefore the well was classified as GUDI with effective in-situ filtration (GUDI-EF) (Stantec, 2010).

In response to increasing water demand, the Region initiated a study on the Fourth Line well field to determine if additional water could be safely taken. In 2010, Stantec, assisted by Lotowater Technical Services Inc. (Lotowater), conducted a well assessment at the Fourth Line well field to evaluate the location of water producing fracture zones, determine the safe yield from Well A and the well field and to obtain additional information to update the GUDI status of the wells (Stantec, 2010). A summary of the investigation results pertaining to aquifer sustainable yield is provided to follow in Section 2.1.1.

In 2011, Golder Associates Limited (Golder), assisted by Lotowater, conducted a staged testing and well rehabilitation program of Well A and Test Well TW1-87. As part of the well rehabilitation program, the bottoms of both Well A and TW1-87 were sealed with bentonite seal and a cement

cap, with current bottom depths for each well at 12.92 m BTOC and 15.04 m BTOC, respectively. In October 2010, a liner was installed at Well A to reduce the risk of well failure due to casing corrosion, and was installed to a depth of 8.7 m BTOC or 366.27 m AMSL. A summary of the investigation results pertaining to aquifer sustainable yield is provided in Section 2.1.1.

Additionally, in 2011, Stantec assisted in the installation of bedrock monitoring well MW1-11 located adjacent to Well A, with further well drilling completed subsequently in 2012, with the installation of overburden monitoring well MW1-12 also located adjacent to Well A.

Dillon (2012a) completed a natural heritage, water resources and hydrogeological investigation to assist with the future re-rating of the well field. The study involved the completion of a background data review, some limited field work, identification of potential data gaps, and the preparation of a draft work program for a future aquifer testing and ecological monitoring program and forms the basis of the work program for this assessment.

2.1.1 Previous Well Field Sustainable Yield Investigations

Well field sustainability was most recently evaluated in studies completed by Stantec (2010) and Golder (2011). The following key conclusions regarding well field sustainability are provided below:

- To increase pumping above 15 L/s on a sustained basis, sealing of the upper fracture zone would be required through the installation of a liner within Well A. By installing a liner to an elevation of 365.0 m AMSL , an additional 1.5 m of available drawdown would be obtained.

- TW1/87 should be considered as a potential supply well and recommended a pumping scenario whereby each well would pump concurrently at a rate of about 9 L/s to limit drawdown and well losses.

- Comparison of the well performance plots after well rehabilitation and after the liner installation completed in Well A to depth of 8.7 m BTOC, indicated that there was essentially no well yield loss due to the installation of the liner. Installation of the liner has eliminated the potential for cascading water within Well A from producing zones above 366.27 m AMSL.

- An interpretation of the available data indicated that TW1-87 has a slightly higher specific capacity but less available drawdown, however under long term pumping conditions the wells will most likely perform at similar pumping rates.

- Flow distribution profiles completed within Well A and TW1-87 (Appendix D) indicated that post well rehabilitation and pre Well A liner installation, most of the water producing zone is located between the elevations of approximately 365.5 m AMSL and 367.3 m AMSL, with relatively minor production occurring below 365.5 m AMSL and negligible production occurring below approximately 364.0 m AMSL.

Based on the existing well constructions, it is interpreted that water levels within the pumping wells should not be lowered below the production zone fracture observed at 365.5 m AMSL. A further discussion of the results of sustainable yield analysis completed as part of the 2013 well field pumping test investigation is provided in Section 5.0.

2.2 WELL FIELD SETTING

The area surrounding the Fourth Line well field extends into multiple agency jurisdictions. There are two (2) Ministry of Natural Resources (MNR) district regions; the Aurora District situated southeast of Sideroad 32, and the Guelph District situated northwest of Sideroad 32. Sideroad 32 is also the boundary between the Region situated to the south and the County of Wellington situated to the north. The area surrounding the Fourth Line well field is almost entirely located within the Credit River watershed.

Land use within the area of the Fourth Line well field is primarily agricultural with significant portions still forested. Most residents within one (1) km of the well field obtain their drinking water from groundwater, with those in the Community of Acton obtaining groundwater supplied by the Region from the Prospect Park, Davidson, or Fourth Line well fields.

2.2.1 Physiography and Topography

The area surrounding the Fourth Line well field straddles two physiographic regions defined by Chapman and Putnam (1986) as the Guelph Drumlin Field and the Horseshoe Moraine System (Figure 2). The Guelph Drumlin Field encompasses the immediate area of the Fourth Line well field and area to the north and south, whereas the Horseshoe Moraine System encompasses the majority of the area immediately to the west of the well field (Figure 2). The Guelph Drumlin Field consists of a series of broad oval hills with axes trending in a northwest to southeast direction. The drumlins, or groups of drumlins, are flanked by broad sand and gravel terraces which are separated by swampy valleys that trend at almost right angles to the drumlins. The Horseshoe Moraine physiographic feature includes the Galt Moraine and Paris Moraine (Chapman and Putnam, 1984; CVC, 2011). The Fourth Line well field is located near the south eastern toe of the Paris Moraine, with the crest of the Paris Moraine located approximately 2 km northwest of the well field. The Paris Moraine forms a broad, high, topographic ridge composed primarily of sandy Wentworth Till, which becomes more broken up by outwash deposits and occasional kames (Karrow, 1968). The moraine trends northeast to southwest located to the west of the Fourth Line well field and contains numerous closed depressions. A spill channel is also located to the east of the well field associated with the Acton-Silver Creek Wetland complex (Figure 2).

The ground surface topography is presented in Figure 3 and is based on the Ministry of Natural Resources (MNR, 2006) Digital Elevation Model (DEM). The topography is hummocky with the topographic highs represented by the tops of drumlins and the Paris Moraine at about 400 m above mean sea level (AMSL) with the intervening hollows and closed depressions representing an elevation of about 370 m AMSL. The Paris Moraine forms the major south-west-northeast trending topographic high (Figure 3) which separates the Grand River watershed to the northwest from the Credit Valley watershed to the southeast. The topographic low within the

area of the Fourth Line Well field is located to the east represented by the Acton-Silver Creek Wetland complex and tributaries of Silver Creek and Black Creek at an elevation of about 360 m AMSL.

2.2.2 Regional Geology

The following sections provide a discussion of the regional geologic setting in the area of the Fourth Line well field.

2.2.2.1 Surficial Geology

Figure 3 presents the surficial Quaternary geology for the area of the Fourth Line well field based on compiled mapping by the Ontario Geological Survey (OGS) (2003). The surficial geology in the area of the Community of Acton is composed predominantly of Wentworth Till, which is characterized by sandy silt till (OGS, 2003), with ice-contact stratified deposits (Unit 6) mapped in the area east of the well field (Figure 3). In the vicinity of the Fourth Line well field, the surficial geology is mapped as stone-poor carbonate derived, silty to sandy till (Unit 5b) also known as Wentworth Till. In some areas, outwash deposits of gravel and cobbles underlie the Wentworth Till and were noted at the time of monitoring well drilling at the Site. Additionally, glaciofluvial deposits of mainly sandy material (Unit 7a) are present in some areas north and west of the well field (Figure 3). The edge of the Niagara Escarpment is evident to the southeast of the Community of Acton and generally corresponds to where the Gasport Formation is mapped at surface as Paleozoic Bedrock (Unit 3).

2.2.2.2 Overburden Geology

Overburden thickness in the area of the Fourth Line well field is presented in Figure 4. The overburden material ranges from 30 m up to 50 m in thickness in the core area of the moraine to not present to the east of the well field in the spillway area associated with the Acton-Silver Creek Wetland complex. The overburden material in the vicinity of the Fourth Line well field is about 6 m in thickness (Figure 4) increasing to the northwest along Fourth Line to approximately 40 m in thickness. The overburden material consists of sand and gravel deposits, Wentworth Till, and minor amounts of present day alluvial deposits in the river valleys. The overburden was primarily deposited during the last major ice advance and retreat during the late Wisconsin period. These geological units are described in more detail below from youngest to oldest and presented in local cross sections completed along Fourth Line and Sideroad 32 (Figures 5 and 6, respectively). The cross-section locations are presented on Figure 4.

Glaciofluvial and Organic Deposits – Modern day glaciofluvial deposits are located predominantly in the area of the Acton-Silver Creek Wetland complex and tributaries of Silver Creek and Black Creek. Organic deposits are associated with closed depressions, such as wetland areas, and interpreted to be limited in extent.

Coarse Sand Deposits – Coarse sand deposits with some gravel of glacial and glaciofluvial origin are interpreted to extend north and west from the Paris Moraine and are based on

borehole logs and MOE WWR to be present in discontinuous layers throughout the area surrounding the Fourth Line well field. As shown on Figures 5 and 6, generally, deposits are less than 5 m thick occurring on isolated areas of higher topography (drumlins), with thicker deposits of sand and gravel located in areas associated with the Paris Moraine. In some areas thin (1 m to 2 m thick) sand and gravel deposits directly overly bedrock (Figures 5, and 6). The sand and gravel deposits are also interbedded with the Wentworth Till associated with the Paris Moraine.

Wentworth Till – Wentworth Till is present through most of the area within the vicinity of the Fourth Line well field. The Wentworth Till is a stony, sandy silt to sand texture till and is commonly described on the MOE well logs as being clay, even though there is little clay content. This till was deposited by the last glacier to advance in the area and is mapped as a surficial deposit covering most of the Paris and Galt moraines. Thicker layers of Wentworth Till, generally attaining thickness of up to 15 m are located predominantly west of the well field in the area of the Paris Moraine, and are often interbedded with sand and gravel (CVC, 2011). Remaining areas not associated with the Paris Moraine are generally less than 10 m thick. The coarse-grained as well as the loose nature of this till indicates that it is a leaky aquitard or poor aquifer that is readily recharged from precipitation. The relatively low clay content of this till results in a low natural gamma response that can be difficult to distinguish from other coarse tills and sand and gravel deposits.

2.2.2.3 Bedrock Geology

The overburden material overlies Paleozoic bedrock which comprises an extensive fractured shallow bedrock aquifer system that is utilized by the Fourth Line well field. In the surrounding area of the Fourth Line well field, the top of bedrock generally corresponds to elevations of 350 m AMSL to 380 m AMSL, with a general slope in bedrock topography towards the east. Within the immediate vicinity of the Fourth Line well field bedrock is observed to occur generally at an elevation of 369 m AMSL.

The OGS is currently mapping the Silurian carbonate strata along the Niagara Escarpment and has proposed revisions to the Silurian stratigraphy of this area. The stratigraphy described in this report is consistent with the revised stratigraphic framework described by the OGS (Brunton, 2009). Within the shallow bedrock system in the area of the well field two (2) bedrock formations are observed from youngest to oldest as the Guelph Formation and the Eramosa Formation. However, the Guelph Formation is observed to the north and west and not observed directly beneath the well field, where the Eramosa Formation is observed at bedrock surface (Stantec, 2011). Additionally, mapping presented in CVC (2011) has identified the top unit of the bedrock underlying the Fourth Line well field as the Eramosa Formation. The following provides some description of the surficial bedrock formations present in the area of the Fourth Line well field.

Guelph Formation – The Guelph Formation consists of medium to thickly bedded crinoidal grainstones and wackestone reefal complexes (Brunton, 2009). The Guelph Formation subcrops to the north and west of the Fourth Line well field. The Guelph Formation thins towards the south and east and is not present beneath the Fourth Line well field where the Eramosa Formation is observed at bedrock surface.

Eramosa Formation –The Eramosa Formation underlies the Guelph Formation to the north and west of the Fourth Line well field, and is present at bedrock surface beneath the well field. It is about 25 m thick in the area, as indicated in the borehole log for monitoring well MW23-09 completed as part of the Halton Hills Tier 3 Pilot Water Budget (Appendix D). The Eramosa Formation consists of the Reformatory Quarry Member and the Vinemount Member. The Reformatory Quarry Member is described by Brunton (2009) as light brown to cream coloured, pseudonodular, thickly bedded and coarsely crystalline dolostone. The Reformatory Quarry Member generally represents a poor aquifer or poor aquitard. This unit is susceptible to karstification due to its uniform fine dolomite crystallinity (Brunton, 2009). This unit also contains mud-rich and microbial mat-bearing lithofacies that may act as aquitard materials, reducing the vertical permeability across the unit. The Vinemount Member is comprised of thinly bedded, fine crystalline dolostone with shaley beds that give off a distinctive petroliferous odour when broken (Brunton, 2009). This dark grey to black dolostone unit was commonly identified in water well records as 'black shale' and generally mapped as the Eramosa Member.

Coring conducted during the completion of onsite monitoring well MW1-11 describes the bedrock as a fractured brown dolostone with black shale partings containing vugs and secondary mineral precipitates, consistent with the Eramosa Formation (Stantec, 2011).

2.2.3 Regional Hydrogeology

The regional southwest-northeast trending topographic high area identified as the Paris Moraine located west of the well field (Figure 3) has a significant effect on both the surface water and groundwater flow regime in the portion of the watershed present at the Fourth Line well field (Dillon, 2012a). Hummocky topography is common in the area of the well field, particularly upgradient to the north, which provides enhancement to groundwater recharge.

Regional shallow overburden flow generally mimics surface water flow and is directed to the southeast in the area of the Fourth Line well field. As discussed further in Section 4.5, groundwater flow within the shallow Eramosa Formation bedrock aquifer in the area of the Fourth Line well field is generally towards the south toward the Niagara Escarpment. As indicated by CVC (2011) mapping, the tributary to Beeney Creek located adjacent to the Fourth Line well field is situated in an area of converging equipotential lines, suggesting potential groundwater discharge conditions. Figures 7a and 7b provide results of shallow groundwater level monitoring completed for the 2013 well field pumping test investigation which shows the groundwater discharge conditions along Beeney Creek during both the permitted pumping rate

at 15.2 L/s (Figure 7a) and the proposed increased pumping rate of 19.8 L/s (Figure 7b). These data results are further discussed in Section 4.5.

Preliminary estimates of the zone of influence (ZOI) for current pumping conditions at the Fourth Line well field were estimated by Dillon (2012a) (Figure 8), and based on the Tier 3 water budget model results (AECOM et al., 2011a and 2011b). Modelled equipotential surfaces indicated that the drawdown equating to greater than 0.5 m extends 900 m north, 400 m south, 500 m east, and 750 m west of the well field (Dillon, 2012a). Within the estimated zone of influence are tributaries associated with the headwaters of Beeney Creek and Fairy Lake, as well as other small wetland areas.

2.2.4 Surface Water Features and Environmental Areas

The main surface water features in the vicinity of the Fourth Line well field are two tributaries (tributary to Beeney Creek and tributary to Fairy Lake) that are part of the greater Credit River Watershed located outside of the area of study (Figure 9), and described in the Black Creek Subwatershed Study (CVC, 2011). Both Beeney Creek and Fairy Lake discharge into Black Creek which is within the Credit River Watershed (Dillon, 2012a). These catchment areas are presented in Figure 10 (Dillon, 2012a), and all major drainage pathways are identified as regulated areas by the CVC, under Section 28 of Ontario Regulation 160/06 of the Conservation Authorities Act (CVC et al., 2011). Dillon (2012a) indicated that the Fairy Lake catchment area has a drainage area of approximately 20.4 km^2 and this headwater area is characterized by well drained, hummocky terrain supporting a network of small, intermittent drainage channels. Additionally, Dillon (2012a) indicated that the Beeney Creek catchment area has a drainage area of 27.7 km^2 and, in the area of the well field, is generally similar to the Fairy Lake catchment area in soil composition and drainage network development.

The Fourth Line well field is situated upstream of Black Creek and Fairy Lake within the headwaters, although variability in the numerous flow paths straddle the catchment area associated with Beeney Creek, and the relevant contribution of the well field to each catchment may vary seasonally with water levels (Dillon, 2012a). An initial field investigation completed by Dillon in December 2011 indicated that the prevailing flow paths are not accurately represented by the mapped stream lines, with some adjustments identified and described by Dillon (2012a) as follows:

- *At low flow periods, the dominant flow path draining the well field area appears to be via the Sideroad 32 culvert* (located at F13) *immediately west of Fourth Line, forming part of the Beeney Creek system* (Figure 9). *Another culvert* (located at WM4B) *is located further west along Sideroad 32 and contributes flow to the Fairy Lake system. At the time of the initial field investigation in 2011, the Fairy Lake culvert was not flowing*.

- *Flow across Fourth Line, north of Sideroad 32, from east to west is likely a seasonal occurrence and flow was not observed during the initial field visit.*

- *Upstream of the Fourth Line well field, the dominant flow contribution is via a central tributary* (located between MP6-13 and MP7-13) *and situated in the agricultural hedgerow in the parcel of land immediately north of the well field.*

Also present are nearby ponds and wetlands associated with closed depressions, and the Acton-Silver Creek Wetland complex to the east of the well field. The key surface water features and environmental areas are presented on Figure 9 and discussed below. The watercourse data presented in Figure 9 is sourced from MNR (2013); however, it has been modified slightly to reflect existing conditions as confirmed by field surveys completed by the CVC as well as by Dillon in 2012 and Stantec in 2013.

2.2.4.1 Tributary to Beeney Creek

As shown in Figure 9 and 10, a tributary to Beeney Creek situated along the eastern side of Fourth Line flows across Fourth Line and then towards the southeast in the area of the Fourth Line well field. The tributary is classified as a coldwater stream (CVC, 2011). Dillon (2012a) indicates that based on a review of the MNR "fish dot" records, there are no historical fish community sampling stations situated within the vicinity of the Fourth Line well field, however 2 km downstream outside of the study area boundary (MNR Station 856) Creek Chub were observed in 2001 and further downstream in Beeney Creek (MNR Station 485) Brook Trout are present. Data provided to Dillon by the CVC indicated that two possible Brook Trout redds had been observed just south of Sideroad 32 (CVC, 2011). The preferred spawning habitat of Brook Trout consists of gravel beds in shallow areas of headwater streams, in locations where groundwater upwelling is present.

2.2.4.2 Tributary to Fairy Lake

A tributary to Fairy Lake in the vicinity of the Fourth Line well field crosses Sideroad 32 and flows southeast and then south towards Fairy Lake in the Community of Acton (Figure 9 and 10). The tributary is one (1) of six (6) tributaries which discharge to Fairy Lake and is unclassified according to CVC (2011). Dillon (2012a) indicates that based on a review of the MNR "fish dot" records, there are no historical fish community sampling stations situated within the vicinity of the Fourth Line well field, however a tributary to Fairy Lake to the south of the Fourth Line well field contains Brook Trout (CVC, 2011). Fairy Lake provides habitat for warmwater fish species.

2.2.4.3 Other Features

Other surface water and environmentally sensitive features located in the vicinity of the Study Area (Figure 9 and 10) include:

<u>Acton Swamp</u>

Designated provincially significant, this approximate 201 hectare Environmentally Significant Area (ESA No. 28), comprises a large mixed swamp within the Town of Halton Hills located approximately 550 m to the south of the Fourth Line well field (Figure 9 and 10). It supports a

number of provincial species at risk and regionally rare species. Provincial species at risk and regionally rare species observed at the Fourth Line well field are summarized in Section 4.4.1, with those observed during the background survey within ESA No. 28 are provided by Dillon (2012a). Additionally, as indicated in Dillon (2012a), further information can be obtained from the survey of the Acton Swamp completed as part of the 2004 Halton Natural Areas Inventory, for species of birds, butterflies, odonates, and herpetofauna. Background reviews completed by Dillon (2012a) indicated that the dominant tree species in the area of the Acton Swamp are Eastern White Cedar (*Thuja occidentalis*), White Birch (*Betula papyrifera*), Ash (*Fraxinus sp.*), Balsam Poplar (*Populus balsamifera ssp. Balsamifera*), and Red Maple (*Acer rubrum*), with heavy thickets of Winterberry Holly (Ilex verticillata) (NHIC, 2009).

Acton-Silver Creek Wetland Complex

Designated as a Provincially Significant Wetland (PSW), this wetland complex is located in the immediate area surrounding the Fourth Line well field and extending to the southeast (Figure 9 and 10). The wetland complex consists of 56 individual wetlands which include the Acton Swamp, Silver Creek Swamp, Snow's Creek Woods, Ballinafad Pond and Silver Creek Valley (Dillon, 2012a). The complex consists of vegetation communities associated with 99% swamp and 1% marsh habitat. As indicated by NHIC (2009), nesting of colonial waterbirds, winter cover for wildlife with local significance for Deer, and Brook Trout fish spawning and rearing areas have been observed.

Eramosa River and Blue Springs Creek Wetland Complex

Designated as a Provincially Significant Wetland (PSW), this wetland complex is located approximately one (1) km to the northwest of the Fourth Line well field (Figure 9 and 10). As indicated by Dillon (2012a), the complex supports tamarack-spruce-cedar bog with associated fen and marl ponds. A relatively undisturbed Eastern White Cedar forest occurs in areas of bottomlands and valley slopes. The headwaters of Blue Springs Creek have been designated as a Regionally Significant Life Science Area of Natural or Scientific Interest (ANSI). Special features include a trout stream and reported deer yard (NHIC, 2009).

2.2.5 Prospect Park Well Field

The Prospect Park well field consists of two (2) pumping wells; Well 1 and Well 2, screened within an approximate 30 m thick unit of gloaciofluvial interbedded sand and gravel found within a buried bedrock valley aquifer, known locally as the Prospect Park aquifer. Both Well 1 and Well 2 are screened between 17 m and 24 m BGS. Interpretations of local borehole data suggest the Prospect Park Aquifer contains thin (<2 m thick) discontinuous silt or clay layers within the upper 15 m BGS, and is overlain by silty surficial deposits of approximately 4 m in thickness at the Prospect Park well field (Dillon, 2012a). Beneath the aquifer is a potential confining unit consisting of the regional Wentworth till layer.

The Prospect Park well field is permitted in the Acton Water Supply PTTW No. 6281-7WFQB3 at maximum rates of 2,273 m^3/day at each well. The Prospect Park well field is located

approximately six (6) km southeast of the Fourth Line well field and well interferences are not expected.

2.2.6 Davidson Well Field

The Davidson well field consists of two (2) pumping wells; Well 1 and Well 2, completed approximately 14 m BGS within the dolostone of the Gasport Formation. Bedrock is relatively shallow in the area of the Davidson well field, occurring at depths between 0 m to 3 m BGS, with a layer of sandy silt Wentworth till overlying the bedrock aquifer. Bedrock is approximately 40 m thick within the vicinity of the Davidson well field, with high levels of weathering / fracturing near bedrock surface.

The Davidson well field is permitted in the Acton Water Supply PTTW No. 6281-7WFQB3 at maximum rates of 1,250 m^3/day at each well. The Davidson well field is located approximately two (2) km southeast of the Fourth Line well field and well interferences are not expected.

3.0 Methodology

The methodologies for the 2013 monitoring activities are presented below. Additional details related to the study methodology are provided in version 2.0 of the Quality Assurance Project Plan for the Fourth Line Well Field Monitoring Program (Stantec, 2012). The Study comprised three (3) main components, including:

- Natural Heritage Investigation;
- Establishment of groundwater and surface water monitoring network and instrumentation; and
- Well Field Pumping Test.

Input from Halton Region, CVC and MOE were sought for each main component of the study, as appropriate. Details related to each study component are provided below.

3.1 NATURAL HERITAGE INVESTIGATION

Background natural heritage investigations were completed by Dillon (2012a and 2012b).

The 2013 natural heritage investigations completed by Stantec consist of three (3) components including a terrestrial field program, a species at risk and provincially rare species assessment, and an aquatic field program, as follows:

3.1.1 Terrestrial Field Program

Stantec's terrestrial field program focused on vegetation communities, flora species including species at risk and rare species, amphibians, and incidental observations of other wildlife. Vegetation communities were classified and mapped using Ecological Land Classification (ELC) protocols for southern Ontario to document vegetation species, structure and cover of vegetation, and substrate texture and moisture where appropriate. The program included a three (3) season vegetation inventory, including spring (April - May), summer (June - July) and fall (late August - September) surveys to target peak flowering seasons for treed, wetland and open-canopy upland habitats respectively. Field investigations included documentation of significant habitat features as defined by the Significant Wildlife Habitat Technical Guide (OMNR, 2000) and Eco-region Criteria (OMNR, 2012).

Terrestrial field investigations in the area of the Fourth Line well field followed the work plan in the QAPP report (Stantec, 2012). A summary of the terrestrial field program is provided in the table below.

Date Surveyor	Survey Type Description
August 21, 2012 Sean Spisani	**Ecological Land Classification/Fall Flora** • Site investigations were completed where access permitted and roadside reconnaissance level confirmation of ELC reported by Dillon (2012a) where access was not available. • Documentation included dominant vegetation by structural layer, soil texture and moisture classification, and any sensitive habitat features such as ground water seeps. • A flora inventory was also completed to document species encountered, and collect UTMs for rare species, species at risk, and groundwater indicator species.
April 17, 2013 Sean Spisani	**Amphibian Call Survey Visit #1** • Calling amphibian surveys were completed during suitable weather to capture early season breeding species.

April 25, 2013
Sean Spisani, Ryan Park, Aaron Vandenhoff
	Ecological Land Classification/Fall Flora/Amphibian Egg Mass Visit #1
	• Site investigations were completed where access permitted and roadside reconnaissance level confirmation of ELC reported by Dillon (2012a) where access was not available.
	• Documentation included dominant vegetation by structural layer, soil texture and moisture classification, and any sensitive habitat features such as ground water seeps.
	• A flora inventory was also completed to document species encountered, and collect UTMs for rare species, species at risk, and groundwater indicator species.
	• Survey of vernal pools and other surface water features for amphibian egg masses (visit #1).
	• Review of wetland instrumentation, resulting in the following additional monitoring stations (refer to the accompanying Figure 1):
	  • **WM3** – new drive points (MP12) with water level loggers
	  • **WM4** – new drive points (MP8) with water level loggers installed
	  • **WM4B** – new surface water logger installed
	  • **WM8** (reference wetland) – new drive points (MP11) with water level loggers

May 30, 2013 Sean Spisani	**Amphibian Call Survey Visit #2** • Implementation calling amphibian surveys during suitable weather to capture mid-season breeding species.
July 17, 2013 Andrea Orr	**Vernal Pool Assessment / Amphibian Egg Masses Visit #2** • Assessment of vernal pool features, including surveys for the presence of amphibian eggs and tadpoles (visit #2).

Amphibians were used as important surrogates of healthy ecosystems in the study area. The background review and field schedule captured key windows for early, mid-season and late breeding species according to accepted protocols (ex., the Marsh Monitoring Program; Environment Canada, 1997 and Bird Studies Canada, 1994). Surveys for calling amphibians were

supplemented with assessment of candidate breeding amphibian habitats and surveys for amphibian eggs and tadpoles.

Additional feature specific monitoring components designed to protect sensitive natural functions identified within the background review including: flora composition, pool depth, temperature, water table fluctuations, hydraulic gradient, seep flow, soil moisture and interspersion (i.e., the pool edge to area ratio) were investigated. These factors influence the migration of flora species and ultimately wetland habitat boundaries, as stability of these factors is particularly important during some critical timing windows, such as early developmental stages of amphibians.

3.1.2 Species at Risk and Provincially Rare Species Assessment

Potential species at risk and provincially rare species records were assembled from the background review, including background reports prepared by Dillon (2012 and 2012b), and the following information sources:

- Species at Risk Act (SARA), Schedule 1;
- Species at Risk in Ontario (SARO) List (updated May 14, 2013);
- MNR's Natural Heritage Information Centre (NHIC) Biodiversity Explorer;
- MNR's Land Information Ontario (LIO) digital mapping of natural heritage features;
- The Ontario Breeding Bird Atlas (Cadman et al. 2007), Atlas of Mammals of Ontario (Dobbyn 1994) and Ontario Herpetofaunal Summary Atlas internet database (Oldham and Weller 2001);
- Black Creek Subwatershed Study, Phase 1 Characterization (Credit Valley Conservation, 2011); and
- MNR (pers. comm., 2012) species at risk records for the project area.

The vegetation field program noted in Section 3.1.1, provided documentation of plant species encountered where access permitted. Habitat assessments were completed concurrent with ELC investigations for wetland associated species, including consideration of of significant habitat features as defined by the Significant Wildlife Habitat Technical Guide (OMNR 2000) and Eco-region Criteria (OMNR 2012), including amphibian breeding habitat, turtle wintering areas, turtle nesting areas, and snake hibernacula.

Amphibian surveys (Section 3.1.1) were completed in sufficient detail to document breeding occurrences. No direct habitat removal is proposed; therefore, targeted surveys for other wildlife species were not conducted.

3.1.3 Aquatics Field Program

The fish habitat survey and spawning (redd) survey were based on the principles of the Ontario Stream Assessment Protocol. At the time of the Stantec field surveys, the Notice of Study

Commencement had not been issued and permissions to enter private property had not been obtained. As a result, the only reaches that could be surveyed from locations other than road crossings was the reach of the Tributary of Beeney Creek immediately upstream of Sideroad 32 within the Region's property limits, and the reach that is parallel to Fourth Line downstream of Sideroad 32. Figure 11 provides the locations for the aquatic habitat assessment stations completed by Stantec in 2013.

Fish Community Survey

The fish community survey was conducted on June 19, 2012 by Dillon Consulting Ltd (Dillon, 2012a) as part of the baseline existing conditions report. Two reaches of the Tributary to Beeney Creek were electrofished and all fish captured were identified and enumerated. The results of this survey are discussed in Section 4.4.3. The field memo provided by Dillon is included in Appendix H.

Fish Habitat Survey

Fish habitat surveys were conducted on September 21, 2012 during low flow conditions within the vicinity of the well field at Stations F10, MP10-13, MP 8-13, MP7-13 and MP 5-13 (Figure 1). The reach within the vicinity of the well field was divided into four stations, which are described in the discussion of results. The fish habitat surveys were conducted to assess physical habitat conditions and habitat quality provided by watercourses in the area. Measurements included: wetted width, bankfull width, mean water depth, and maximum pool depth. Additional data regarding substrate composition, channel morphology, instream cover, bank stability, canopy cover and riparian vegetation were recorded. Detailed data regarding the fish habitat surveys are presented in Figure 11 and Appendix H.

Fish Spawning (Redd) Survey

A Brook Trout redd is typically round in shape and located near cover such as a stream banks or an overhanging branch or log. Redds are distinguishable since gravel within the redd is cleaner than the surrounding substrate. Redd surveys were completed on November 8, 2012. Areas surveyed were the Tributary to Beeney Creek (within the well field property and the reach parallel to Fourth Line), MP8-13 and MP10-13. Experienced fisheries biologists carried out the surveys wearing polarized glasses to facilitate the identification of redds. The watercourses were surveyed from the creek banks, looking for signs of Brook Trout spawning activity (redds).

3.2 ESTABLISHMENT OF MONITORING NETWORK

The monitoring program was designed to evaluate the effect of increased pumping from the Fourth Line well field on the surrounding area. A monitoring network was established to provide details on the specific objectives of the investigation as follows:

- Confirm the maximum rate that the aquifer can be pumped between the two pumping wells at the well field;

- Estimate the zone of influence in the overburden and bedrock aquifers to assist in determining if the increased pumping will result in unacceptable impacts to the natural environment and/or other users of the groundwater resource; and

- Collect sufficient information to be used in an impact assessment as part of a revised Permit to Take Water application for the well field.

The monitoring network consisted of the key components discussed below.

3.2.1 Monitoring Well Construction

To supplement the existing monitoring well network, Stantec installed two shallow monitors (MW1-12 and MW4-13) and three (3) monitoring well nests (MW2S/D-13, MW3S/D-13 to MW5S/D-13) as part of this study. The shallow monitors were situated beside previously completed deeper monitors MW1-11 and TW1-84 to form nested pairs at these locations. Table 2 provides well construction details for all monitoring wells included in the 2013 well field pumping test investigation. The monitoring well locations are shown on Figure 1.

Stantec observed the initial test borehole drilling of the overburden sequence and documented the geological formations and aquifer characteristics encountered at the drilling site. The deep borehole at each location was continuously cored for detailed soil and rock identification, with the core stored and clearly labeled in core boxes. Following completion of the deep monitoring well, Stantec recommended the preferred installation depth for the remaining monitoring wells comprising the monitoring well nest. Each monitoring well was constructed in compliance with Ontario Regulation 903, with 51 mm (2-inch) diameter PVC pipe and screen and completed with an above ground protective, lockable steel casing. A geodetic survey of all monitoring locations was completed to confirm spatial and vertical coordinates.

3.2.2 Installation of Drive Point Piezometers

Drive point piezometers DP1-10 and DP2-10 were installed in February / March 2010 within the vicinity of the Fourth Line well field to measure groundwater/surface water interaction and potential responses to pumping (Stantec, 2010).

In April / May 2013, a total of 20 additional drive point piezometers identified as MP-1 to MP-12, with eight (8) being nested piezometers containing both shallow and deep individual monitors, were installed in four (4) nearby surface water tributaries. The additional drive point piezometers further assisted in measurement of groundwater/surface water interaction and potential responses to pumping. The exact locations for the drive point piezometers (Figure 1) were determined based on monitoring well and stream flow locations, and a review of potential upwelling areas completed during the site reconnaissance. The drive point piezometers were located primarily within the existing modeled zone of pumping influence. The drive point piezometers consisted of 19 mm diameter, 0.43 m long steel screens connected to 25 mm diameter galvanized steel risers. The drive point piezometers were installed by hand driving methods. The installation details are summarized in Table 2.

3.2.3 Wetland Monitors

Ten (10) additional wetland monitoring stations (WM1 to WM8, including additional upgradient stations WM2B and WM4B) were established in wetland features within the vicinity of the well field in early 2013, which were used as control points for the natural heritage investigation as described in Section 3.1. Similar to the drive point piezometer locations, the exact locations for the wetland monitors (Figure 1) were determined based on a review of potential upwelling areas and other sensitive natural heritage areas identified during field investigations. The wetland monitors were located primarily within the existing modeled zone of pumping influence. There was no physical monitor placed at the wetland monitor locations, with the exception of at WM4B which was constructed similar to the drive point piezometers described in Section 3.2.2. All other wetland monitoring locations were located with global positioning coordinates obtained in the field and generally positioned near established drive point piezometers as shown in Figure 1.

3.2.4 Surface Water Flow Stations

Stream flow monitoring was completed at nine (9) established stations (F1, F2, F5, F9, F10, F11, F13, F14, and F15, Figure 1) to confirm gaining and losing reaches of surface water features lying within the modeled zone of pumping influence. These locations were determined based on the prevailing flow paths in the area of the well field. Surface water flow was collected manually on 13 individual dates during the four (4) stages of the 2013 pumping test. An effort was made to time stream flow monitoring events around lower flow conditions. Stream flow measurements were collected during the pumping test in Stage 1 on (June 28), in Stage 2 (July 23, August 1, 8, 15), in Stage 3 (August 22, 29, September 5, 13, 19), and in Stage 4 (September 26, and October 4, 10, 2013), with results provided in Table 5 and discussed in Section 4.6. Stream flow at each location was calculated using the velocity-area method (Dingman, 1994). Measurements were obtained by placing a measuring tape across the width of the stream, perpendicular to flow, and dividing the distance into equal sections. At each point, the depth of the tributary was measured and the flow rate recorded using a Marsh-McBirney Inc. Model 201 portable water velocity meter. Total discharge through the section was then calculated using the U.S. Geological Survey approved mid-section method as discussed in Hipolito and Loureiro (1988) and Dingman (1994). At each monitoring location a pressure transducer was installed within a nearby drive point piezometer (Section 3.2.2) to provide continuous water level and temperature data and to allow development of stream flow rating curves present in Appendix I.

3.2.5 Surface Water and Streambed Temperature Stations

Stream and groundwater upwelling temperature data was to be collected at select monitoring locations, by burying a pressure transducer connected to a direct read cable in the stream bed sediments. At the time of project initiation it was determined that surface water and streambed temperature monitoring would not occur as the investigation would not be completed during winter months when this type of monitoring data is the most meaningful.

3.2.6 Geodetic Survey

Ground surface and top of casing elevations and spatial coordinates at monitoring wells, drive-point piezometers, and surface water monitoring locations were measured by Stantec using a total station GPS unit in June 2013. Following completion, the accuracy of the survey was determined to be +/- 0.02 m.

Ground surface and top of casing elevations as well as spatial coordinates for all monitoring wells, pumping wells, drive-point piezometers, surface water monitoring and wetland monitoring locations used in this study are presented in Table 2.

3.2.7 Private Well Survey

A private well survey was completed in support of the temporary Category 3 Permit To Take Water application for the pumping test completed in August / September 2013. A letter was delivered to each resident within the modeled zone of pumping influence notifying them of the impending pumping test and inviting them to participate in the program. Wherever possible, the surveyor spoke directly with the resident to confirm participation. Based on a review of aerial photography and MOE WWRs, within a one (1) km radius of the Fourth Line well field, 25 private wells were identified (Figure 1). A total of 5 residents of the 25 identified private well locations participated in the program. Appendix E provides a copy of the residential notification letter.

3.2.8 Instrumentation of Monitoring Network

All monitoring wells, private wells, drive point piezometers, wetland monitor WM4B, and stream flow monitoring stations included in the 2013 well field pumping test investigation were equipped with Herron™ datalogger pressure transducers to provide continuous water level and temperature data. Manual measurements were collected at all wells using a battery operated probe and calibrated tape. Manual measurements were collected whenever pressure transducers were downloaded. The manual measurements were used to verify the transducer measurements. Depth to water was measured with respect to the top of the surveyed measurement point which is typically the top of the well casing. An effort was made to use the same water level tape for all groundwater and surface water measurements throughout the monitoring period for consistency. Water depths were recorded to an accuracy of 0.01 m. Hydrographs prepared for each monitoring well are presented in Appendix F.

At some drive point piezometer locations, where conditions allowed, surface water levels were also monitored. Locations included in the water level monitoring program are presented in Figure 1, and listed as follows:

- Pumping Wells (Well A and TW1-87);
- Existing Bedrock Wells (MW1-11, TW1-84, OW3-85, OW4-85);

- Bedrock/Overburden Well Pairs (MW1-11/MW1-12, MW2A/B-13, MW3A/B-13, MW4-13/TW1-84, MW5A/B-13, MW23/09-S/I/D);
- Wetland Monitors (WM4B);
- Drive Point Piezometers (MP1-13S/D, MP2-13S/D, MP3-13S/D, MP4-13S/D, MP5-13S/D, MP6-13S/D, MP7-13S/D, MP8-13S/D, MP9-13S/D, MP10-13S/D, MP11-13, MP12-13);
- Stream Flow Monitoring Stations (F13, F14, F15); and
- Five (5) private wells (RW01 through RW05) for property owners who chose to participate in the monitoring program.

The monitoring program extended over a period of seven (7) months, spanning April 8, 2013 to October 10, 2013. Stantec field staff installed the Region supplied pressure transducers, with the exception of private wells that were instrumented by Lotowater Technical Services Inc. (Lotowater). The data loggers were set to record at 15 minute intervals for the duration of the study. The automated data was supplemented with manual data collection. The frequency of manual data depended on the location of the monitor and the pumping test stage. During the pre-test stage, manual data collection was quarterly and ranged from several times daily to weekly during the pumping test. Manual water level data was collected from the entire Fourth Line well field monitoring network on a quarterly basis, and completed where possible on a single day to provide a water level snapshot. Water level data for the pumping wells, which include Well A and TW1-87, were provided by the Region and not monitored directly by Stantec.

The continuous water level information obtained was plotted onto hydrographs which include comparison with precipitation trends and daily pumping rates from the Fourth Line well field and are provided in Appendix F.

3.2.9 Climate Data

Daily precipitation and hourly temperature data from January 2013 to October 2013 were obtained from the Environment Canada website and were downloaded in digital format. The nearest Environment Canada climate station with a near complete data set was the Fergus MOE climate station located approximately 25 km west of the Fourth Line well field. The Fergus MOE climate station had a complete data set for 2013 with the exception of missing temperature and precipitation records for September 3rd to 8th, 2013. The next closest Environment Canada climate stations were reviewed which included the Fergus Shand Dam (approximately 26 km west) and Elora RCS (approximately 28 km west) climate stations. All three (3) weather stations had data that indicated precipitation occurring on the same day had a similar magnitude. The Fergus Shand Dam climatic station also had missing data only for September 6th and 7th, 2013; however, the Elora RCS climate station had data available for the period of missing data at the Fergus MOE climate station. Data from the Elora RCS climate station was used for the six (6) dates that precipitation data was missing. The available daily climate data is presented in hydrographs provided in Appendix F.

3.3 WELL FIELD PUMPING TEST

The 2013 well field pumping test investigation was arranged into four (4) stages, with the first stage consisting of a three (3) week well field shutdown period (Stage 1), followed by four (4) weeks of pumping Well A at 15.2 L/s (Stage 2), followed by four (4) weeks of Well A and TW1/87 each pumping at a rate of 9.9 L/s (Stage 3), followed by one (1) week of pumping Well A at 15.2 L/s (Stage 4). The following table provides a summary.

Stage	Well A		TW1-87	
	Rate (L/s)	Duration (days)	Rate (L/s)	Duration (days)
Stage 1: Shutdown (Jun 27 – Jul 18)	0	21	0	21
Stage 2: Pumping Well A (Jul 18 – Aug 19)	15.2	32	0	32
Stage 3: Pumping Well A and TW1-87 (Aug 19 – Sep 16)	9.9	28	9.9	28
Stage 4: Recovery (Sep 16 – Sept 24)	15.2	8	0	8

As part of the 2013 well field pumping test the following tasks were completed.

3.3.1 Temporary Category 3 PTTW Application

At the outset of the Study, an application for a Category 3 PTTW was prepared by Stantec to allow the constant rate pumping test to be completed in the manner described above. Stantec prepared all the required documentation for submission of a Category 3 PTTW. The temporary PTTW (PTTW No. 3663-97JKBF) was issued on May 9, 2013 and allowed for the completion of a combined pumping test for both Well A and TW1-87 at maximum rates for each well of 1,200 L/min (20 L/s). A copy of PTTW No. 62181-7WFQB3 and temporary PTTW No. 3663-97JKBF is provided in Appendix C.

3.3.2 Interim Trigger Development

Triggers were established on key ecosystem attributes with the objective to sustain and protect the environmental conditions that support existing local aquatic life and habitat. Figures 12a and 13a provide organizational flow charts to assess both local wetland and fisheries communities. The interim triggers were reviewed and discussed with the Credit Valley Conservation Authority (CVC) and modified as per comments received prior to the

implementation of the pumping test at the Fourth Line well field (see CVC memo date July 4, 2013; Appendix E). It was recommended by the CVC that:

- the test trigger for the fisheries assessment for areas with upward vertical gradients should be "no reduction in the magnitude of the gradient attributable to pumping of the Fourth Line well field", and
- the test trigger for the wetland assessment should be no change in groundwater elevation attributable to pumping of the Fourth Line well field.

These were considered by the CVC to be appropriate triggers for notification of CVC staff and should be protective of aquatic and wetland habitat. The CVC also noted that based on the assessment of the data, timing relative to fish and other wildlife activity, and discussion with Stantec and the Region, it is possible that the test may continue despite reaching this trigger.

Interim triggers were developed for groundwater levels (wetland assessment) or vertical hydraulic gradients (fisheries assessment) at surface water monitoring stations MP2-13, MP5-13, MP6-13, MP7-13, MP8-13, MP10-13, MP11-13 and DP1-10 as follows:

The interim triggers for wetland assessment (Figure 12a) consisted of:

- Weekly reviews of groundwater levels in trigger wetlands WM1 (MP6-13), WM2 (MP7-13), WM4/WM4B (MP8-13);
- Review of control wetland WM8 (MP11-13) and precipitation trends in the event of a change in groundwater levels; and
- Consultation with the CVC and review by a qualified ecologist in the event of confirmed pumping test interferences.

Results of vertical hydraulic gradient analysis used to confirm compliance with established interim triggers for wetland assessment monitors are presented in Figure 12b.

The interim triggers for fisheries assessment (Figure 13a) consisted of:

- Weekly reviews of vertical hydraulic gradients in trigger drive point piezometers MP2-13, DP1-10, MP5-13, MP10-13;
- Review of control drive point piezometer MP11-13 and precipitation trends in the event of a change in vertical hydraulic gradients; and
- Consultation with the CVC and review by a qualified ecologist in the event of confirmed pumping test interferences.

Results of vertical hydraulic gradient analysis used to confirm compliance with established interim triggers for fisheries assessment monitors are presented in Figure 13b.

A discussion of the results associated with monitoring completed for the interim triggers is provided in Section 4.3.

3.3.3 Pumping Test Setup

During the four (4) stage pumping test, activities were coordinated with Region Operations staff to ensure that the testing was completed according to the specifications and without any disruptions to the water supply. Test well TW1-87 was equipped with a temporary test pump by Lotowater. Flow rates from test well TW1-87 were monitored by a temporary flow meter connected to the Region's SCADA system. As TW1-87 is not currently connected to the water supply system at the Fourth Line well field, discharge was directed approximately 700 m to the west of the well field along Sideroad 32 via a lay flat hose to discharge near stream flow monitor F10 (MP10-13, Figure 1), which took the discharged water outside of the modeled zone of pumping influence and minimized any chance of the discharge water interfering with the monitoring network. All water from Well A was directed to the distribution system during the pumping test. Table 4 provides the daily discharge volumes obtained from the Region for both pumping wells, Well A and TW1-87, with the results of testing further discussed in Section 4.5.

3.3.4 Private Well Notification

In June 2013, prior to the commencement of the study, the Region delivered letters to residents near or adjacent to monitoring locations within the area of the Fourth Line well field. The letters detailed the purpose, approximate timing, and duration of the well testing program and requested permission to access individual properties at selected locations to carry out the monitoring program. The letters discussed the potential for well interference during the well testing program and provided the necessary contact information for residents should interference occur. A copy of the sample notification letter is provided in Appendix E.

To document potential drawdown effects in the vicinity of private wells, water level monitoring was completed at a total of five (5) nearby private wells. Monitoring was completed with the instrumentation of pressure transducers within private wells where owner's provided permission and depended on well access and condition. The pressure transducers were set to record at 15 minute intervals to capture insitu pumping condition within each private well. The hydrographs provided in Appendix F present the results of monitoring completed at the five (5) instrumented private wells. The residential well locations that were monitored are shown in Figure 1.

3.3.5 Water Quality Sampling

Water quality samples were collected from Well A on August 29, 2013 and from TW1-87 on August 29 and September 13, 2013 near the end of the Stage 3 pumping test period as described in Section 3.3.3. Both the 2010 and 2013 samples were collected from a sampling tap attached to the pump column pipe and placed directly into appropriate laboratory supplied sample containers. Samples were not filtered and as a result represent total concentrations. Samples were placed in coolers with ice and delivered under chain-of-custody documentation

to Maxxam Analytics Inc. (Maxxam) for general chemistry, metals and inorganic parameter analysis. The analytical results are summarized in Table 6 and compared to the Ontario Drinking Water Standards (ODWS). Appendix G contains a copy of the Laboratory Certificates of Analysis and chain-of-custody forms.

4.0 Results

The following sections provide discussion of the results of the monitoring program completed for the Fourth Line well field 2013 pumping test investigation.

4.1 LOCAL GEOLOGY

The results of the drilling work completed during this study, confirmed previous geological interpretations, in that the overburden and upper bedrock consist of four (4) key geological units, as follows:

- *Coarse/Medium Sand Deposits* – Coarse/medium sand deposits with some gravel of glacial and glaciofluvial origin are interpreted to extend north and west from the Paris Moraine and are observed in discontinuous surficial layers in the area of the Fourth Line well field mainly to the northwest along the Paris Moraine and to the east along Sideroad 32 in the vicinity of MW2-13 Figures 3 and 6. A surficial sand deposit was also observed at MW3-13 (also near MP5-13) and based on MOE WWR is interpreted to extend about 500 m south along Fourth Line (Figure 5). Deposits are generally less than 5 m thick occurring in isolated areas of higher topography (drumlins), with thicker deposits of sand and gravel located in areas associated with the Paris Moraine. The sand and gravel deposits are also interbedded with the Wentworth Till associated with the Paris Moraine.

- *Wentworth Till* – In most areas the surficial geological unit was identified as the Wentworth Till which is characterized as sandy silt to sand till with trace clay and gravel and extends to a depth of about four (4) m to six (6) m BGS. Wentworth Till was encountered in all boreholes completed by Stantec in 2013, with the exception of MW3-13 (also near MP5-13), which contained a surficial sand deposit not characterized as a till present from ground surface to the underlying outwash sand and gravel deposit (Figure 5).

- *Outwash Deposits* – In some areas (MW1-11, MW3-13, MW5-13; Appendix D) outwash deposits of sand and gravel with cobbles underlies the Wentworth Till and is present overlying the bedrock surface encountered with thickness ranging from approximately one (1) m to two (2) m.

- *Eramosa Formation* – In the vicinity of the Fourth Line well field and at all of the boreholes completed by Stantec in 2013, the overburden deposits were underlain by bedrock of the Eramosa Formation. The Eramosa Formation consisted of brown dolostone with black shale partings evident throughout the cores at each borehole. Also prominent within this formation were vugs and secondary mineral precipitate. Fractures were also noted in the bedrock in the area of the well field, with the main fractures occurring generally in the upper six (6) m from bedrock surface.

As shown in cross sections provided in Figures 5 and 6, Wentworth Till is present throughout the area of the Fourth Line well field, generally from ground surface to the underlying Eramosa

Formation or outwash deposit, if present. The exceptions are at MW2-13 where surficial medium sand deposit exists underlain by Wentworth Till consistent with MNR mapping in Figure 3, and at MW3-13 where Wentworth Till is not observed and surficial sand deposits exist underlain by outwash deposits.

4.2 CLIMATIC CONDITIONS

The 2013 climate data was compared with the 1993 to 2006 historic averages presented on the Environment Canada website for the Fergus MOE climate station. In 2013, 1075 mm of precipitation occurred for the period from January 1 to November 1, 2013. . The 2013 data were compared to the historic average of about 874 mm, indicating that overall 2013 was wetter than average. A comparison of the 2013 monthly precipitation data to the historical (1993-2006) average monthly precipitation data is provided in the table below.

Month	Average Precipitation (mm) 1993-2006	Total Precipitation (mm) 2013
January	76.7	94.9
February	53.0	81.0
March	58.6	40.4
April	72.8	111.5
May	88.7	106.0
June	91.2	136.6
July	86.1	158.4
August	71.8	53.2
September	81.4	123.8
October	70.6	169.5

As shown above, with the exception of the months of March and August 2013, the precipitation observed in 2013 was consistently above the average monthly precipitation calculated for the historical period between 1993 and 2006.

4.3 INTERIM TRIGGERS

As described in Section 3.3.2, interim triggers were developed through consultation with the CVC for surface water monitoring stations at MP2-13, MP5-13, MP6-13, MP7-13, MP8-13, MP10-13 and DP1-10, with a background station at MP11-13. Figures 12a and 13a present flow charts showing the established wetland and fisheries assessment triggers, respectively. Figures 12b and 13b present the results of vertical hydraulic gradient analysis for established trigger location. The following presents the results of interim trigger analysis:

Wetland Assessment Triggers

In summary, no wetland assessment triggers were interpreted to be affected by the pumping test. The following presents details of the observations made at each wetland trigger location:

- Background Station, WM8 (MP11-13): No change in groundwater elevations attributable to pumping occurred during the testing. Groundwater levels remained relatively stable at approximately 378.3 m AMSL, with little variability through the period during Stage 2 and Stage 3 of the pumping test. Similarly, surface water levels remained slightly (less than 5 cm) below groundwater levels, with the exception of two (2) water level spikes in the surface water of approximately 0.3 m and 0.2 m, coinciding to high level precipitation events, occurring on August 1 and September 1, 2013.

- WM1 (MP6-13): No change in groundwater elevations attributable to pumping occurred during the testing. Similar to the background station (MP11-13), groundwater levels within MP6D-13 remained stable through the pumping test period at approximately 375.9 m AMSL. Within MP6S-13, the drying up of surface water levels due to low seasonal precipitation observed in mid-August and continuing through to October 2013, resulted in shallow groundwater levels declining (about 0.14 m) during Stage 2 of the pumping test. Groundwater levels continued to decline in Stage 3 (about 0.23 m), with subsequent water level recovery (about 0.19 m) following a 50.8 mm precipitation event occurring on September 20, 2013 (late Stage 4).

- WM2 (MP7-13): No change in groundwater elevations attributable to pumping occurred during the testing. Similar to the background station (MP11-13), groundwater levels remained slightly above surface water levels throughout the entire monitoring period, however, with the exception of a decline in water levels beginning on September 2, 2013 (Stage 3). Similar to station MP6S-13, the decline in shallow groundwater levels coincides with the drying up of the surface water feature, interpreted to result from seasonally low precipitation occurring in late July and in August 2013. Groundwater levels continued to decline through to September 20, 2013 when water levels recovered to closely match surface water levels, and attributed to a 50.8 mm precipitation event occurring on September 20, 2013 (late Stage 4).

- WM4/WM4B (MP8-13): No change in groundwater elevations were attributed to the pumping test. Similar to the background station (MP11-13), groundwater levels remained relatively stable at approximately 373.9 m AMSL, with little variability through the entire monitoring period. Shallow groundwater levels remained below (about 0.02 m) the deeper groundwater levels through Stage 2 and Stage 3 of the pumping test, which both remained below (about 0.3 m) surface water levels measured at WM4B.

Fisheries Assessment Triggers

In summary, only one (1) fisheries assessment station (MP5-13) was interpreted to respond to the pumping test and the details of this response are discussed below and in Section 4.5.4. The following provides detailed observations of the data collected at each fisheries assessment location:

- Background station, MP11-13: A weak upward vertical hydraulic gradient between the shallow groundwater and surface water remained through Stage 2 and Stage 3 periods

of the pumping test. Vertical hydraulic gradients remained between 0.01 m/m and 0.05 m/m through the Stage 2 and Stage 3 period of the pumping test, with the exception of two (2) water level spikes in the surface water of approximately 0.3 m and 0.2 m, resulting temporarily in downward vertical hydraulic gradients, and coinciding to high level precipitation events occurring on August 1 and September 1, 2013.

- DP1-10: Similar to background station, MP11-13, a weak upward vertical hydraulic gradient between the shallow groundwater and surface water remained through Stage 2 and Stage 3 periods of the pumping test. Vertical hydraulic gradients remained upward between 0.01 m/m and 0.08 m/m through the Stage 2 and Stage 3 period of the pumping test, except on three (3) dates (August 24, September 1 and 8, 2013). During these three (3) instances gradients changed to weakly downward (less than 0.04 m/m) attributed to surface water level increases coinciding to high level precipitation events. No reductions in the magnitude of the upward vertical hydraulic gradients were interpreted to result from pumping at the well field.

- MP2-13: The interim trigger is interpreted to not apply at this location, as vertical hydraulic gradients remained downwards during Stage 2 following July 21, 2013 and remained through to the end of monitoring on October 10, 2013. Within MP2-13, the drying up of surface water levels due to low seasonal precipitation observed in mid-August through to October 2013, resulted in shallow groundwater levels declining during Stage 2 of the pumping test. In Stage 3, vertical hydraulic gradients could not be determined as both the surface water and shallow groundwater monitors were dry. Subsequently, water levels recovered in early October following a 41.2 mm precipitation event on October 6, 2013, and a downward vertical hydraulic gradient was observed.

- MP5-13: The interim trigger is interpreted to not apply at this location, as vertical hydraulic gradients remained downwards during Stage 2 and Stage 3 of the pumping test and remained through to the end of monitoring in October 2013. An observed pumping test influence occurred within the shallow groundwater monitor, with downward vertical hydraulic gradients ranging from -0.10 m/m to -0.85 m/m, and is discussed further in Section 4.5.4.

- MP10-13: Similar to background station, MP11-13, a weak upward vertical hydraulic gradient (about 0.15 m/m) between the shallow groundwater and surface water remained through the entire monitoring period. Vertical hydraulic gradients remained stable at about 0.15 m/m, except on three (3) dates (August 22, September 1 and 7, 2013). During these three (3) instances upward vertical hydraulic gradients weakened to between 0.01 m/m and 0.07 m/m attributed to surface water level increases coinciding to high level precipitation events. No reductions in the magnitude of the upward vertical hydraulic gradients were interpreted to result from pumping at the well field.

Based on the results presented above, the interim triggers associated with the 2013 well field pumping test investigation as provided in Figures 12a and 13a, were not considered to be breached.

4.4 NATURAL HERITAGE

The following sections provide a discussion of the results of the natural heritage assessment completed as part of the 2013 well field pumping test investigation.

4.4.1 Terrestrial

Table 3 provides a summary of the results of terrestrial field work completed in 2013, including Ecosite and Vegetation Type – classifications as per ELC. Ecosites documented include:

- Fresh-Moist Lowland Deciduous Forest (FOD7) near monitor F3
- Ash Mineral Deciduous Swamp (SWD2) near monitor WM5
- Maple Mineral Deciduous Swamp (SWD3) near monitors WM1 and WM7
- Mineral Deciduous Swamp (SWD4) near monitor WM8
- Maple Organic Deciduous Swamp (SWD6) near monitor WM4 and WM4B
- White Cedar Mineral Mixed Swamp (SWM1) near monitors WM2, WM2B, and WM3
- Mineral Thicket Swamp (SWT2) near monitor WM3B
- Graminoid Mineral Shallow Marsh (MAS2) near monitor WM6

Figure 1 provides the general location for the monitors associated with each of the ecosites as indicated above. Data is organized in by site to inform the feature specific approach to monitoring, with an emphasis on features that interact with the groundwater table and other sensitive features, including:

- organic substrates
- vernal pools
- breeding amphibians (calling anurans and eggs masses)
- groundwater indicator flora
- rare species

Provincially significant amphibian breeding habitat (woodland) was documented by Stantec at monitoring location WM1 near monitor MP6-13, and by Dillon (2013b) in three (3) additional wetlands (Table 3).

Based on findings of terrestrial investigations completed prior to commencement of the 2013 pumping test at the Fourth Line well field, the following wetlands were recommended and included in the 2013 well field pump test monitoring program.

- Trigger wetlands – WM1 (MP6-13), WM2 (MP7-13), WM4/WM4B (MP8-13),
- Reference wetlands – WM8 (MP11-13)

Monitoring, assessment of potential impacts and implementation of contingency as required as per the wetland assessment trigger chart provided in Figure 12a was completed by Stantec, and summarized in Section 6.1.1.

4.4.2 Species At Risk

4.4.2.1 Background Review

Results of the background review are presented under separate headers below for species protected by the provincial Endangered Species Act, 2007 (ESA), and other species at risk and provincially rare species.

Species Protected by the Provincial Endangered Species Act, 2007

Dillon (2102a) reported seven (7) species at risk that are protected under ESA as potentially occurring in the area of the Fourth Line well field:

- Barn Swallow (threatened provincially and nationally)
- Bobolink (threatened provincially and nationally)
- Chimney Swift (threatened provincially and nationally)
- Eastern Meadowlark (threatened provincially and nationally)
- Henslow's Sparrow (endangered provincially and nationally, SHB – historical breeder in Ontario)
- Butternut (endangered provincially and federally)

Of these species, correspondence with the MNR (pers. comm., 2012) identified records of Butternut in the area.

Other recently listed species afforded protected under the ESA include:

- Little Brown Myotis (endangered provincially and federally)
- Northern Myotis (endangered provincially and federally)

Although no records exist in the OMNR database for these species, they have not been tracked by MNR and may occur in the area. The potential presence of the species is supported by range maps appearing in Dobbyn (1994).

The Committee on the Status of Species at Risk in Ontario (COSSARO) has recently assessed some "Priority List" species for that are known to occur in the Area, including:

- Eastern Wood-Pewee (special concern federally)

- Wood Thrush (threatened federally)

COSSARO recommendations for these species have not yet been made public.

Other Species at Risk and Provincially Rare Species

Some additional species at risk (not protected by ESA), provincially rare species and species of conservation concern are known to occur in the general vicinity the well field, including (Dillon, 2012a):

- Peregrine Falcon (special concern provincially and federally)
- Snapping Turtle (special concern provincially and federally)
- Western Chorus Frog (threatened federally, S3-vulnerable in Ontario)
- Eastern Ribbon Snake (special concern provincially and federally, S3 – vulnerable in Ontario)
- Eastern Milksnake (threatened provincially and federally, S3-vulnerable in Ontario)
- Clamp-tipped Emerald (S2S3 – Rare in Ontario)
- Hart's-tongue Fern (special concern provincially and federally, S3 – vulnerable in Ontario)
- Grape Fern (S2 – rare in Ontario)
- Carey's Wood Sedge (S2 – provincially rare)

Of these species, MNR (pers. comm., 2012) provided records of Snapping Turtle and Milksnake.

4.4.2.2 Field Investigations

Table 3 provides a summary of the results of species at risk assessments completed in 2013. Flora inventories identified one (1) Butternut at monitoring location WM2B near monitor MP3-13.

Targeted amphibian breeding surveys completed by Dillon (2012b) and Stantec did not document Western Chorus Frog.

No other species at risk or provincially rare species were observed by Dillon (2102a and 2012b) or Stantec during field investigations.

4.4.3 Aquatic

The Tributary to Beeney Creek is designated by the MNR as a coldwater stream with a resident Brook Trout population. The Tributary to Fairy Lake is unclassified with respect to thermal regime (Dillon 2012a). Both tributaries are in the Credit River Watershed and fall within the jurisdictions of the Aurora District MNR (southeast of Sideroad 32) and Guelph District MNR (northwest of Sideroad 32) (Dillon 2012a). Fish habitat and fish spawning surveys were conducted to document aquatic habitat quality in the vicinity of the Fourth Line well fields. The data were

used to assess the sensitivity of the habitat and evaluate potential impacts of increased water taking from the Fourth Line Well Field on fish habitat.

Previous aquatic monitoring has been conducted by Dillon (2012a) and where applicable, Stantec's 2012 survey data are compared to historic results. Stantec's 2012 survey included the area immediately upstream and downstream of Fourth Line where it is visible from the road. Figure 11 provides the locations for the aquatics habitat assessment stations (Stn 1 through Stn 6) completed by Stantec in 2012.

Fish Community Survey

A fish community survey of the tributary to Beeney Creek was conducted by Dillon Consulting Ltd on June 19, 2012 (Dillon, 2012a). The survey encompassed the reach within the pump station property and the area downstream that is parallel to Fourth Line. A total of 18 fish representing two species (Brook Trout and Brook Stickleback) were captured south (downstream) of Sideroad 32. No fish were captured north of Sideroad 32. Fish were observed in the tributary to Fairy Lake in a pool south of Sideroad 32; however, shallow water and soft substrates did not allow for safe electrofishing within this reach (Dillion 2012a).

Fish Habitat Survey

Survey results are summarized by location below, with additional details provided in Figure 11 and in Appendix H.

i) Tributary to Beeney Creek

The fisheries assessment station extending downstream from the northern boundary of the Fourth Line well field (Stn 1) was approximately 20 m in length (Figure 11). This reach was comprised of flat morphology, with an average wetted width of 2 m and an average depth of 10 cm. Substrates were dominated by fines such as silt (50%) and sand (10%), with coarser substrates like gravel/cobble and detritus comprising the remainder. Upstream of the property boundary, a large concrete structure in the stream channel, previously associated with an online trout pond operation (anecdotal from local landowner), is holding back flow and was full of stagnant water at the time of the field investigation. A dry tributary channel lined with cobble converged with the main tributary near DP2-10.

The fisheries assessment station (Stn 2) extended for 20 m from the downstream end of Stn 1, near DP2-10.This station was comprised of flat morphology, with an average wetted width of 3.5 m and depth of 5 cm. Substrates were dominated by fines such as sand (40%) and silt (30%), with minimal detritus and gravel observed. Undercut banks provide cover during high flows, but these areas were dry during the low flow conditions of the survey. A channel draining from the east was comprised of diffuse flow through the White Cedar and muck. Within 10 m upstream of the confluence with the main channel, there was no defined channel associated with this inflow.

The fisheries assessment station (Stn 3) extending from the end of Stn 2, was approximately 15 m in length with flat morphology, an average wetted width of 3.5 m and depth of 5 cm. Substrates were dominated by fines such as silt (40%) and muck (40%), with coarser substrates like boulder/cobble and detritus comprising the remainder. This reach includes frequent occurrences of large overhanging woody debris. A short reach of cobble/boulder substrate may provide riffle morphology during periods of high flow.

The fourth station in this reach (Stn 4) extended from the end of Stn 3 to Sideroad 32 for a station length of approximately 15 m. This reach was comprised of run morphology, with an average wetted width of 1 to 2 m and a depth of 5 cm. Substrates were dominated by coarser material such as gravel (40%) and cobble (30%), with detritus, sand and muck also observed. Large patches of watercress were located on both the east and west banks near the culvert. Canopy cover was minimal in the lower portion of the reach near the road; however, overhanging grasses and isolated trees trees provided some canopy cover.

Downstream of Sideroad 32, the substrates consisted of sand, gravel and cobble within 5 m of the culvert, but the watercourse widens to approximately 5 m and is lined with finer substrates such as sand and detritus.

Stn 5 was located on Fourth Line, just north of Sideroad 32 near MP7-13. No evidence of a permanent channel was visible and this area likely provides surficial drainage during periods of high flow.

Stn 6 starts where the Tributary to Beeney Creek emerges from the woodlot and flows south adjacent to Fourth Line, near MP5-13. The average wetted width was approximately 50 cm with sand and gravel substrates and reaches of large cobble. Watercress was noted along the northern reach before the watercourse crossed Fourth Line. Upstream of Fourth Line the channel is well shaded with overhanging trees; while downstream of Fourth Line the channel widens slightly and loses most of its riparian cover.

No visible channel was observed on either side of Sideroad 32 at MP8-13. A small culvert was located in this area however it was dry at the time of the survey and dry within the area visible from Sideroad 32.

ii) Tributary to Fairy Lake

Station F8 is located on Sideroad 32. On the upstream side of Sideroad 32 the watercourse flowed out of a dense cedar woodlot into dense grasses within the road right-of-way. The channel was narrow and overgrown such that it was not easily visible from the road. Downstream of the road the perched culvert (30 cm high) conveyed flow into a large gravel/cobble pool. Downstream of the pool, the channel was approximately 40 cm to 60 cm wide with a wetted depth of 5 cm and flowed through a dense cedar woodlot.

iii) Tributary at Fifth Line

An unnamed mapped watercourse was assessed at the culvert under Fifth Line. This site was identified as monitoring location F10. The watercourse flows in a northerly direction across the road within a large concrete culvert. There was watercress in the channel however it was mostly overgrown with reed canary grass on both sides of the road. A narrow (20 cm wide) channel was visible at the road crossing however beyond the immediate culvert area there was no distinct channel visible on the downstream side of the road. This watercourse may provide fish habitat in spring when flows are higher.

Fish Spawning Survey

Brook Trout spawn in late summer to fall with specific times dependent on location and local flow and temperature conditions. Preferred spawning habitat is gravel beds in shallow areas of headwater streams in locations where groundwater upwelling is present. A Brook Trout redd can be distinguished from the surrounding stream bottom by its shape and colour. It is typically oval in shape and located near some form of cover such as an overhanging log or stream bank. The gravel of a redd is cleaner than the surrounding substrate, as it has been turned over and cleaned by spawning fish. Brook Trout eggs incubate within the gravel substrate and hatch within approximately 100 days, with actual time dependent on water temperature.

A Brook Trout spawning survey was completed for the section of the Tributary to Beeney Creek located on the well field property (Stations 1 through 4, Figure 11) an for the sections of the watercourse flowing adjacent and parallel to Fourth Line south of Sideroad 32. There was no evidence of Brook Trout spawning activity within the areas surveyed on November 8, 2012. At the time of the spawning survey, the following water quality measurements were recorded at the upstream end of the Sideroad 32 culvert:

Water Temperature: 6.5°C
Dissolved Oxygen: 10.5 mg/L
Conductivity: 374 µS/cm
pH: 7.69

Historical spawning surveys from the study area were previously summarized by Dillon (Dillon, 2012a). Data provided to Dillon by the CVC indicated two possible Brook Trout redds had been identified south of Sideroad 32, however they had not been confirmed as spawning redds (Dillon 2012a). Due to land access restrictions, this reach could not be reassessed to confirm whether Brook Trout were using this area as spawning habitat. There was no evidence of Brook Trout spawning either upstream of Sideroad 32 or downstream beside Fourth Line. Trout spawning activity is dependent on a number of factors including, but not limited to, optimum stream temperature, physical habitat characteristics, dissolved oxygen concentration, and groundwater upwelling conditions. As a result, spawning activity will vary naturally from year to year dependent on these parameters. Data from drive point piezometer DP1-10 indicates there is a weak upward vertical hydraulic gradient in the creek bed upstream of Sideroad 32.

4.5 GROUNDWATER / SURFACE WATER LEVELS

The Fourth Line well field monitoring network as described in Section 3.2, was used to assess the extent of pumping influence and potential for well interference effects on local surface water features and domestic wells in the area of the well field.

Ground water / surface water levels were monitored at a total of 52 monitoring locations in the vicinity of the Fourth Line well field, including pumping wells, monitoring wells, drive point piezometers, and surface water monitoring locations. Figure 1 presents the monitoring locations and Table 2 presents the well construction details. Hydrographs for the groundwater monitoring locations are presented in Appendix F, and Figure 14 presents hydrographs for the two (2) pumping wells. Figures 15a and 15b provide groundwater contours observed within the Eramosa Formation under Stage 2 (15.2 L/s) and Stage 3 (19.8 L/s) steady-state pumping conditions. Additionally, Figure 16 provides the interpreted difference in drawdown observed as a result of increasing the pumping rate from 15.2 L/s to 19.8 L/s.

Water level responses in the pumping wells, bedrock monitoring wells, overburden monitoring wells and surface water monitors are discussed below.

4.5.1 Pumping Wells

An effort was made to keep pumping rates as steady as possible during each stage of the pumping test. The following groundwater level responses were observed in the pumping wells during the 2013 well field pumping test investigation:

- Stage 1 (no pumping for 21days) – Following a three (3) week period of well field shut-down the static water levels measurement in Well A and TW1-87 were at 370.3 m and 370.4 m AMSL, respectively (Figure 14), which was approximately 3.7 m above the main water bearing fracture.

- Stage 2 (Well A at permitted rate of 15.2 L/s) – An initial, almost immediate, drawdown of about 1.5 m was observed within both Well A and TW1-87 and water levels remained relatively consistent throughout Stage 2 at about 368.6 m AMSL, with the exception of rapid instances of recovery attributed to precipitation. Of particular note was a 43 mm rain event on July 31, 2013 that resulted in nearly a 1.5 m spike in water levels in both pumping wells (Figure 14). Throughout this stage, water levels within the pumping wells remained about 2.0 m above the main water bearing fracture, suggesting that additional water was available.

- Stage 3 (Well A and TW1-87 at 9.9 L/s) – Groundwater levels in both wells were virtually identical throughout this stage with additional drawdown of about 0.9 m observed as a result of increasing the pumping rate from 15.2 L/s to 19. L/s. Steady-state pumping conditions were interpreted to occur after about 3 days of pumping at the increased rate. Total drawdown compared to static conditions was approximately 3.0 m in both

wells with water levels remaining approximately 0.8 m above the main water bearing fracture.

- Stage 4 (Well A at permitted rate of 15.2 L/s) – An immediate change in water levels was observed at both wells in response to change in pumping when Stage 4 was implemented. As shown in Figure 14, water levels recovered almost instantaneously to 90% of those observed at the end of Stage 2. Full recovery to Stage 2 levels was observed within one (1) week.

A review of historical water level data (2012-2013) available from the Region's SCADA system for Well A and TW1-87 indicated that groundwater levels under pumping conditions fluctuate seasonally by up to about 3.0 m. The data indicates that groundwater levels in the aquifer were approximately 1.5 m higher during the pumping test than during the drought conditions experienced over the same period in 2012. Given that approximately 2 m of available drawdown remained in the productions wells during pumping at a rate of 19.8 L/s, this rate is expected to be sustainable even during drought years. A further discussion of sustainable yield is provided in Section 5.0.

4.5.2 Bedrock Aquifer

Groundwater levels were monitored in bedrock monitoring wells MW1-11, MW23/09-I/D, TW1-84, MW2A-13, MW3A-13, and MW5A-13 and hydrographs presenting the data are provided in Appendix F. The following groundwater level responses were observed in the bedrock aquifer monitoring wells during the 2013 well field pumping test investigation:

- Stage 1 (no pumping for 21days) – During Stage 1, static groundwater levels remained relatively stable in all bedrock monitoring wells, with few instances of drawdown and recovery cycle fluctuations observed at monitors MW1-11, TW1-84, MW3A-13 when Well A briefly pumped for water sampling purposes. Additionally, a spike in water levels ranging from approximately 0.1 m to 0.55 m was observed between July 7 and 10, 2013 at all bedrock monitoring wells attributed to numerous precipitation events occurring in early July 2013. Following a three (3) week period of well field shut-down the static water levels measured at each of the bedrock monitoring wells were approximately 370.5 m AMSL at MW1-11, 375.6 m AMSL at both MW23/09-I/D, 371.0 m AMSL at TW1-84, 376.3 m AMSL at MW2A-13, 370.4 m AMSL at MW3A-13, and 374.8 m AMSL at MW5A-13.

- Stage 2 (Well A at permitted rate of 15.2 L/s) – Shortly following the commencement of Stage 2, an initial almost immediate drawdown response to the pumping test was observed at bedrock monitoring wells MW1-11, TW1-84, and MW3A-13. The initial drawdown observed had magnitudes of 1.5 m, 0.7 m, 0.6 m, respectively. Groundwater levels remained relatively consistent through Stage 2 at these levels of drawdown, with the exception of rapid instances of recovery at the end of July 2013 attributed to a 43 mm precipitation event occurring on July 31, 2013. Within the remaining bedrock monitoring wells at MW2A-13, MW5A-13, and MW23/09-I/D water levels remained relatively stable through Stage 2 with little fluctuation at groundwater elevations of

approximately 375.8 m AMSL, 374.6 m AMSL, and 375.8 m AMSL, respectively. There was no water level response attributed to the pumping test within bedrock monitoring wells MW2A-13, MW5A-13, and MW23/09-I/D.

- Stage 3 (Well A and TW1-87 at 9.9 L/s) – Immediate drawdowns of 1.0 m, 0.4 m, and 0.4 m in response to the increased water taking were observed within bedrock monitoring wells MW1-11, TW1-84, and MW3A-13. Groundwater levels stabilized within two (2) days after the Stage 3 implementation, with a slight decline of less than 0.1 m in water levels observed by the end of Stage 3 within these effected bedrock monitoring wells. Within the remaining bedrock monitoring wells at MW2A-13, MW5A-13, and MW23/09-I/D water levels declined slightly through Stage 3 attributed to seasonally low precipitation observed in August/early September 2013, with observed declines in groundwater elevations through Stage 3 of 0.5 m, 0.16 m, and 0.13 m, respectively. There was no water level response attributed to the pumping test within bedrock monitoring wells MW2A-13, MW5A-13, and MW23/09-I/D. The magnitudes of vertical hydraulic gradients remained relatively consistent within all bedrock monitoring wells throughout the Stage 2 and Stage 3 of the pumping test.

- Stage 4 (Well A at permitted rate of 15.2 L/s) – An immediate change in water levels was observed within bedrock monitoring wells MW1-11, TW1-84, and MW3A-13, in response to change in pumping when Stage 4 was implemented. As shown in hydrographs provided in Appendix F, water levels recovered rapidly to 90% of those observed at the end of Stage 2 and continued to recover to those levels observed in Stage 2 within one (1) week of Stage 4 implementation. Within the remaining bedrock monitoring wells at MW2A-13, MW5A-13, and MW23/09-I/D water levels continued to decline slightly following Stage 4 implementation and subsequently began to slowly recover following a 50.8 mm precipitation event occurring on September 20, 2013. Groundwater levels continued to recover through September and October 2013 attributed to the relatively high seasonal precipitation occurring in Fall 2013.

Private Wells

Based on discussions with those owners of private water wells monitored during the pumping test and a review of MOE WWRs, it is noted that private water wells RW01 through RW05 are interpreted as bedrock wells. Figure 1 provides the general location of RW02 situated west of the Fourth Line well field along Fourth Line Road, with RW01 situated further west along Fourth Line Road, but outside of the area depicted in Figure 1. RW03 and RW04 are situated south of the Fourth Line well field along Sideroad 32, with RW05 situated to the east along Fourth Line Road. Appendix F provides hydrographs for these private water wells monitored during the 2013 well field pumping test investigation.

A review of the water level results for private wells RW01 and RW02 (Appendix F) indicate that there was no water level response attributed to the pumping test within RW01 and RW02, with the main influence being seasonal fluctuations resulting from precipitation trends. Within these

two (2) bedrock private wells water levels were observed to begin declining late in Stage 2 and subsequently recovered slightly following a 50.8 mm precipitation event occurring four days following the cessation of Stage 3 on September 20. Groundwater levels remained below those observed in Stage 2 through to the end of the monitoring program on October 10, 2013, attributed to the relatively dry late summer observed in 2013.

A review of the water level results for private wells RW03, RW04 and RW05 (Appendix F) indicates that there were water level responses attributed to the increased pumping in Stage 3 of the pumping test of 0.28 m, 0.48 m and 0.15 m, respectively. However, these water level responses are not significant compared with the estimated available drawdown of these wells. A review of MOE WWRs indicate that for bedrock wells completed near the Fourth Line well field, available drawdowns of more than 10 m are typical, with some wells having up to 35 m of available drawdown.

4.5.3 Overburden Aquifer

Groundwater levels were monitored in overburden monitoring wells MW1-12, MW23/09-S, MW4-13, MW2B-13, MW3B-13, and MW5B-13 and hydrographs presenting the data are provided in Appendix F. The following groundwater level responses were observed in the overburden aquifer monitoring wells during the 2013 well field pumping test investigation:

- Stage 1 (no pumping for 21days) – During Stage 1, static groundwater levels remained relatively stable in all overburden monitoring wells, with few instances of drawdown and recovery cycle fluctuations observed at monitor MW3B-13, when Well A briefly pumped for water sampling purposes. Additionally, a spike in water levels ranging from approximately 0.2 m to 0.65 m was observed between July 7 and 10, 2013 at all overburden monitoring wells except at MW23/09-S which remained stable. These spikes in water levels are attributed to numerous precipitation events occurring in early July 2013. Following a three (3) week period of well field shut-down the static water levels measured at each of the overburden monitoring wells were approximately 374.3 m AMSL at MW1-12, 386.0 m AMSL at MW23/09-S, 378.5 m AMSL at MW4-13, 378.2 m AMSL at MW2B-13, 370.6 m AMSL at MW3B-13, and 374.8 m AMSL at MW5B-13.

- Stage 2 (Well A at permitted rate of 15.2 L/s) – Shortly following the commencement of Stage 2, an initial almost immediate drawdown response to the pumping test of 0.6 m was observed at overburden monitoring well MW3B-13, which was similar to that observed in the bedrock (MW3A-13) at this location. Water levels remained relatively consistent through Stage 2 at these levels of drawdown, with the exception of rapid instances of recovery at the end of July 2013 attributed to a 43 mm precipitation event occurring on July 31, 2013. Within the remaining overburden monitoring wells water levels remained relatively stable through Stage 2 with little fluctuation. There was no water level response attributed to the pumping test within overburden monitoring wells MW1-12, MW2B-13, MW4-13, MW5B-13, and MW23/09-S. The continual decline in water levels observed at MW23/09-S from July 2013 through October 2013 is attributed to low

seasonal precipitation occurring in late summer / early fall and not attributed to the pumping test.

- Stage 3 (Well A and TW1-87 at 9.9 L/s) – Prior to the start of Stage 3 of the pumping test, all monitoring wells within the area of the Fourth Line well field exhibited a typical slight declining water level trend related to the dry conditions in late July and through August. Drawdown within overburden monitoring well MW3B-13 was calculated based on the subtraction of the observed water levels between the end of Stage 2 and the end of Stage 3. An immediate drawdown of 0.5 m in MW3B-13 in response to the increased water taking was observed, which are consistent with drawdowns observed at the beginning of Stage 2 (Appendix F). Steady state conditions were observed within one (1) day after the Stage 3 implementation. Declining water levels exhibited within the remaining overburden monitoring wells were considered not to be pumping related and were interpreted to occur because of the relatively low precipitation in late July and August 2013.

- Stage 4 (Well A at permitted rate of 15.2 L/s) – An immediate change in water levels was observed within monitoring well MW3B-13, considered to be influenced by the pumping test, in response to change in pumping when Stage 4 was implemented. As shown the hydrograph for MW3B-13 provided in Appendix F, water levels recovered within one (1) week to 90% of those observed at the end of Stage 2 and continued to recover. Increasing water levels exhibited within those overburden monitoring wells considered to not be influenced by the pumping test are interpreted to be a result of the relatively high precipitation occurring in September and October 2013 as indicated in Section 4.2. It is noted that at overburden monitoring well MW23/09-S, water levels declined consistently from the beginning of Stage 1 through to the end of the monitoring program in October 2013, this is not considered a result of the pumping test, as bedrock monitors MW23/09-I/D were interpreted as unaffected. The decline in water levels observed at monitoring well MW23/09-S was interpreted to be due to low seasonal summer precipitation levels in late July and through August.

4.5.4 Tributary and Wetland Surface Water Levels

Groundwater levels were monitored within the tributary and wetland surface water monitoring locations MP1-13 through MP12-13, DP1-13, and WM4B, and hydrographs presenting the data are provided in Appendix F. The monitoring stations were grouped into three (3) broad categories:

- Monitors that responded to pumping (MP5-13);

- Monitors that at first glance appeared like they may have responded to pumping, however, other reasons were identified for the response (MP2S/D-13, MP3S/D-13, MP6S-13, MP7-13 and MP9S/D-13); and

- Monitors that did not respond to pumping (MP1-13, MP4-13, MP6D-13, MP8-13, MP10-13 through MP12-13, DP1-13 and WM4B).

Monitors That Responded To Pumping

A review of the water level data indicates that drive point piezometer location MP5-13 was the only drive point location that responded to the pumping test. As indicated in Section 4.1, within the vicinity of MP5-13, a window in the Wentworth Till was discovered. This is significant because the Wentworth Till represents a poor aquitard and provides hydraulic separation between the bedrock aquifer system and natural heritage features in the vicinity of the well field. Natural heritage features are more vulnerable wherever the Wentworth Till is absent. The location of MP5-13 was the only place where the Wentworth Till was not observed.

A water level response was observed in this drive point piezometer nest whenever the pumping rate was adjusted at the well field. The key observations were, as follows:

- The vertical hydraulic gradient was consistently downward during Stage 2 (baseline) pumping conditions (ranging between -0.1 m/m and -0.55 m/m), which means that groundwater was not discharging to the creek at this location; and

- Under Stage 3 pumping conditions the additional drawdown in the shallow groundwater system beneath the creek was observed, resulting in an increase in the downward vertical hydraulic gradient (ranging between -0.55 m/m and -0.85 m/m).

- As shown in Table 5, there was a reduction in stream flow observed at this location (F5) of 47% through Stage 2 and Stage 3, however, the reduction in flow observed at upstream station F13 was 51% and at the background flow station F11 was 63%. These reductions in flow are interpreted as resulting from seasonally low precipitation occurring in late July and in August 2013.

This monitoring station also responded strongly to a number of precipitation events with the most notable occurring between July 7 and 10, on July 31, on September 1, and on September 20, 2013.

Monitors That Appeared To Respond But Are Considered Not To Be Influenced

Shallow groundwater levels observed within piezometers MP2S/D-13, MP3S/D-13, MP6S-13, MP7-13, and MP9 S/D-13 were observed to decline within the period of pumping at the Fourth Line well field, however the decline in water levels at these piezometers are not attributed to influences from the pumping test. A review of the data indicates that at piezometer locations MP2S/D-13 and MP3S/D-13 shallow groundwater levels began to decline prior to Stage 1 when surface water levels were observed to dry in mid to late summer 2013. Water levels continued to decline with some recovery occurring in mid-July and mid-August, associated with relatively high precipitation events. Water levels continued to decline, until mid-October when recovery was observed associated with the occurrence of relatively high precipitation.

At MP6S-13 and MP9S/D-13, water levels were observed to decline significantly (0.4 m and 0.7 m, respectively) just prior to the commencement of Stage 3 and continued to decline slightly for about one (1) week beyond the commencement of Stage 4 when recovery was observed. The decline in water levels at MP6S-13 and MP9S/D-13 is interpreted to be the result of the surface water drying up at these locations in late July and August 2013 due to a lack of precipitation.

At MP7-13, water levels remained stable through Stage 2 and for about one (1) week into Stage 3, and then declined by approximately 0.5 m through to about one (1) week following the commencement of Stage 4 when recovery occurred. The decline in shallow groundwater levels occurred when surface water levels were observed to dry. Increasing water levels exhibited are interpreted to be a result of the relatively high precipitation occurring in September and October 2013 as indicated in Section 4.2.

Monitors That Did Not Respond

Water levels monitored within the remaining drive point piezometer locations MP1-13, MP4-13, MP6D-13, MP8-13, MP10-13 through MP12-13, DP1-13 and WM4B showed no observed response to pumping at the Fourth Line well field. Water levels within these piezometers remained relatively stable through the pumping test period, with slight declines associated with relatively low precipitation occurring in late July and August 2013.

4.5.5 Vertical Hydraulic Gradients

The vertical hydraulic gradients were calculated for nested monitoring wells within the Study Area. Vertical hydraulic gradients are presented for monitoring locations in hydrographs provided in Appendix F. A discussion of vertical hydraulic gradients observed for trigger locations is provided in Section 4.3, and provided for remaining monitoring well nests and drive point piezometer nests as follows.

Monitoring Wells

Generally, downward vertical hydraulic gradients were observed at monitoring well nests located within the area of the Fourth Line well field. Between the overburden and Eramosa Formation downward vertical hydraulic gradients of -0.3 m/m to -1.4 m/m were observed, prior to the implementation of the pumping test (Stage 3). During the implementation of Stage 3 pumping the vertical downward gradients increased in monitors MW1-11, TW1-84, and MW3A-13 to -0.5 m/m to -1.6 m/m. Upon return to permitted rate conditions the vertical hydraulic gradients generally returned to pre-Stage 3 values (Appendix F). There were no observed reversals in vertical hydraulic gradient within monitoring wells interpreted to have resulted from the 2013 well field pumping test investigation.

Drive Point Piezometers

Generally, weak upward vertical hydraulic gradients were observed at drive point piezometers located near the Fourth Line well field, with the exception of monitors MP5-13 and MP6-13 which

showed downward gradients. There was no significant change in magnitude or direction as a result of precipitation or changes in pumping rates, with the exception of changes in vertical hydraulic gradients from weakly upwards to downwards at monitor MP7-13 near the mid-point of Stage 3 pumping (Appendix F, Section 4.3). This is not attributed to the pumping test, as declines in shallow groundwater levels in late summer 2013 are considered the result of low levels of precipitation occurring from late July through August. The total drawdown observed at MP7-13 within the groundwater was approximately 0.4 m. MP7-13 is considered a wetland monitor and is located 150 m west of the well field. There were no observed reversals in vertical hydraulic gradient within drive point piezometers interpreted to have resulted from the 2013 well field pumping test investigation.

4.5.6 Extent of Drawdown

Figure 16 presents the interpreted zone of influence of pumping from the pumping wells at the well field based on data obtained during the 2013 well field pumping test investigation. The maximum drawdown data was collected near the end of the increased pumping period (September 13, 2013) when the bedrock aquifer was under near steady state conditions. A water level response to the increased pumping was observed within the bedrock aquifer (greater than 0.5 m drawdown) as far as approximately 420 m east and 180 m west along Fourth Line, and approximately 300 m north and 400 m south along Sideroad 32 from the Fourth Line well field. Additionally, within the bedrock aquifer a water level response to increased pumping resulting in greater than 0.1 m of drawdown was observed as far as approximately 570 m east and 240 m west along Fourth Line, and approximately 400 m north and 550 m south along Sideroad 32. The resultant drawdown cone was elongated both in an easterly and southerly direction from the pumping wells.

The lack of water level response within overburden monitoring wells, with the exception of MW3B-13 and MP5-13, indicates no observed impacts at the monitored locations associated with the increased water taking at the Fourth Line well field on groundwater levels within the shallow overburden aquifer. Overburden monitors MW3B-13 and MP5-13 are both located 250 m south of the Fourth Line well field within an area where there is a window in the Wentworth Till. Drawdowns of approximately 1.3 m were observed within both MW3B-13 and MP5S/D-13, however the vertical hydraulic gradient was constantly downward during both Stage 2 (baseline) and Stage 3 of the pumping test.

4.6 STREAM FLOW

Stream flow measurements were collected at nine (9) surface water monitoring stations, F1, F2, F5, F9, F10, F11, F13, F14, and F15 (Figure 1) in the area of the Fourth Line well field to monitor for potential impacts to baseflow from the increased rate of water taking at the well field. A series of rating curves were developed for stream flow monitoring stations F1, F2, F5, F10, F11, F13, F14, and F15 and are present in Appendix I. A rating curve for stream flow monitoring station F9 could not be completed as the location was consistently reported as dry during the monitoring period. Stream flow measurement results are provided in Table 5.

Rating curves were developed for each of the eight (8) surface water monitoring stations (F9 exempted) to establish the relationship between stage and discharge of the tributaries located near the well field. The rating curve was developed by correlating the manual flow measurement data with surface water level elevation data at the same point in time. Using regression methods, an equation was derived that best represented the correlation between stream flow and surface water elevation. Manual data points collected throughout 2013 under a variety of conditions were used in the creation of each rating curve. Equations derived from the rating curves can then be used to convert the continuous surface water level data to estimates of stream discharge (m^3/s), if necessary in future studies of the well field. The rating curve established for each surface water monitoring station is presented in Appendix I. Each rating curve presents the calculated curve equation, the correlation coefficient (R^2), and the number of data points used in the creation the rating curve.

The correlation coefficient (R^2) is the proportion of variability in the data set that is accounted for by the statistical model, or rating curve. The correlation coefficient (R^2) provides a measure of how well the model, or rating curve, can predict future stream discharge based on surface water level data. The correlation coefficient (R^2) varies between 0 and 1 with a higher value indicating a closer relationship between the rating curve (regression line) and measured values. A correlation coefficient (R^2) of 1.0 indicates that the regression line perfectly fits the data. The calculated correlation coefficient (R^2) ranged from 0.64 to 0.99 for the eight (8) rating curves developed, with the exception of those developed for station F2 (R^2 of 0.09), F13 (R^2 of 0.11) and F15 (R^2 of 1.0). The 2013 rating curves developed for each surface water monitoring stations were considered good, with the exception of those derived at station F2, F13, and F15. At station F2 there were only three (3) data points to provide data for the rating curve which was insufficient to provide a good R^2 value. At station F13 the rating curve developed was considered not accurate as water levels appear to decrease when flow increases, this may be caused by an unscheduled movement of the pressure transducer during the monitoring period. At station F15 there were only two (2) monitoring events when flow was observed to be of sufficient magnitude to be recordable, and therefore the rating curve is based from two (2) data points only causing a R^2 value of 1.0.

The rating curves developed from the 2013 field measurements are considered to be interim and will be refined over time if additional data are collected, which would allow for the development of more accurate models. The accuracy of the interim rating curves (modeled curve) was restricted to a range of measured flow and surface water elevation conditions used to establish the measured curve. When the recorded water level values deviated from the measured values used to establish the rating curve, the error in the discharge calculation increased substantially. This was mainly restricted to the extreme ends of the curve (areas of low or high discharge) where insufficient data was available to extend the curve to where these data points existed. Additionally, the rating curves were only viable under non-bank full conditions (normal to low flow stages) obtaining reliable discharge measurements to calibrate the rating curve during greater than bank full conditions (flood stages) is difficult and generally not accomplished, since concerns with the safety of field staff collecting the data under these conditions becomes the overriding factor.

The following summarizes the details regarding the development of each rating curve for those stations considered to have good data for model development.

F1

Surface water station F1 is situated next to surface water level monitor MP1-13SW which are located 800 m northwest and upstream of the Fourth Line well field. A total of 5 manual stream flow measurement values were obtained and used to develop the rating curve. The rating curve correlation coefficient (R^2) of 0.99 indicated a good relationship between stream flow and surface water elevation. It was appearant from the lack of flow response to changes in the pumping test rates that the upstream location at stream flow monitor F1 was not influenced by pumping at the well field.

F5

Surface water station F5 is situated next to surface water level monitor MP5-13SW which are located 250 m southeast and downstream of the Fourth Line well field. A total of 12 manual stream flow measurement values were obtained and used to develop the rating curve. The rating curve correlation coefficient (R^2) of 0.64 indicated a good relationship between stream flow and surface water elevation.

F10

Surface water station F10 is situated next to surface water level monitor MP10-13SW which are located 600 m south of the Fourth Line well field. A total of 12 manual stream flow measurement values were obtained and used to develop the rating curve. The rating curve correlation coefficient (R^2) of 0.78 indicated a good relationship between stream flow and surface water elevation.

F11

Surface water station F11 is situated next to surface water level monitor MP1-13SW which are located 1,500 m north of the Fourth Line well field. A total of 13 manual stream flow measurement values were obtained and used to develop the rating curve. The rating curve correlation coefficient (R^2) of 0.85 indicated a good relationship between stream flow and surface water elevation.

F14

Surface water station F14 is instrumented with a surface water level monitoring device and located 1.4 km along Third Line southwest of the Fourth Line well field. A total of 11 manual stream flow measurement values were obtained and used to develop the rating curve. The rating curve correlation coefficient (R^2) of 0.71 indicated a good relationship between stream flow and surface water elevation.

4.7 WATER QUALITY

Historical groundwater samples were collected from the Fourth Line well field Well A on February 25, 2010 and from TW1-87 on March 2, 2010 during variable rate testing completed by Stantec (2010), representing samples after one, two, three, and four hours of pumping. During the 2013 well field pumping test investigation samples were obtained at Well A on August 29, 2013 and at TW1-87 on August 29 and September 13, 2013. Table 6 presents the 2010 and 2013 water quality data in comparison to the Ontario Drinking Water Standards (ODWS).

In 2010, algae, diatoms and *E. coli*. were not detected in any of the samples collected from either Well A or TW1-87. It should be noted that the laboratory method detection limit for *E.coli*. was 1 CFU/100 mL, which exceeded the ODWS of 0 CFU/100 mL. Total aerobic spores were less than 7 CFU/500 mL for the samples collected during steps one to three and increased to 40 CFU/500 mL in the sample collected during step four at Well A. Similarly, total aerobic spores were less than 4 CFU/500 mL for the samples collected during steps one to two and increased to 20 and 150 CFU/500 mL in the sample collected during steps three and four at TW1-87. These later samples corresponded with the increase in turbidity that was observed due to cascading water within the wells. There is no ODWS for total aerobic spores. Algae, diatoms and E.coli were not sampled for in 2013.

Overall, water chemistry between the two (2) pumping wells and between the 2010 and 2013 pumping test periods were observed to be similar. There were no exceedances of the ODWS Maximum Acceptable Concentration (MAC), Operation Guidelines (OG), Aesthetic Objectives (AO) or Medical Officer of Health (MOH) reporting criteria, with the exception of hardness (OG of 80 mg/L to 100 mg/L). Hardness ranged from 300 mg/L to 360 mg/L during both the 2010 and 2013 pumping tests conducted at Well A and TW1-87.

Slight increases in sodium, chloride, and nitrate concentrations were observed during the 2010 and 2013 pumping with concentrations remaining well below the applicable ODWS. Sodium, chloride, and nitrate can be indicator parameters for winter road salting and agricultural practices. The 2010 and 2013 groundwater quality results for Well A and TW1-87 are within the range of historic concentrations for Fourth Line Well A as presented in the raw water assessment for the Acton Drinking Water System (Halton, 2009).

5.0 Sustainable Yield

The safe long term yield of the wells was estimated based on the maximum pumping rate that would allow continuous pumping over a 12 month pumping period without drawing the water below the main groundwater producing fracture occurring at 365.5 m AMSL. A review of historical data trends was completed for data between 2008 -2013, which indicated that low historical water levels were present in July 2012, which were about 1.5 m below those levels observed during the well field pumping test in 2013 (Figure 17).

Figure 18 presents semi-log plots of the drawdown versus time for Well A and TW1-87, during the Stage 2 and Stage 3 constant rate pumping tests. The data suggests that near steady-state pumping conditions were achieved during the testing. At the request of the CVC, the drawdown observed in both wells was projected out for a period of 20 years, which represents the theoretical drawdown that would be observed if both wells operated continuously for a 20 year period. The data indicates that about 1.5 m of available drawdown remains above the main water producing fracture. Seasonally adjusting the groundwater level data by 1.5 m to account for future drought conditions (Scenario B; Figure 18) indicates that a pumping rate of 19.8 L/s is still sustainable. This rate corresponds to a combined daily maximum taking of 1,711 m^3/day.

6.0 Impact Assessment

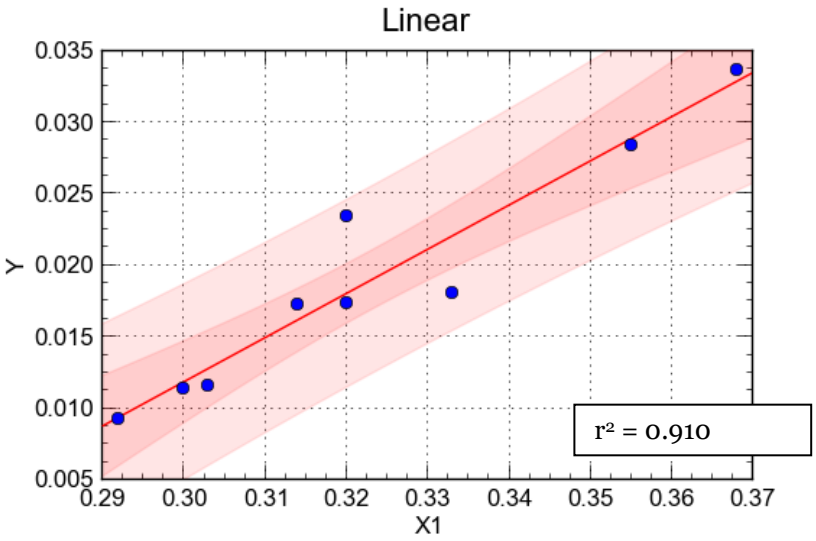
The following sections provide an assessment on the potential long term impacts associated with pumping the well field at the higher rate on natural heritage features, private wells and nearby municipal wells.

6.1.1 Natural Heritage Features

The only natural heritage station interpreted to respond to the increased pumping rate was the fisheries assessment station situated at piezometer MP5-13 (fisheries assessment Stn 6). The response at this station was attributed to the absence of the Wentworth Till. This was the only window in the Wentworth Till identified during the 2013 well field study.

At piezometer MP5-13, during both the permitted (baseline) pumping (Stage 2) and the increased pumping (Stage 3) periods, the vertical hydraulic gradient was observed to be consistently downward ranging between -0.1 m/m and -0.85 m/m, which means that groundwater was not discharging to the creek at this location. There was a reduction in stream flow observed at this location (F5) of 47% through Stage 2 and Stage 3 (Table 5); however, the reduction in flow observed at upstream station F13 was 51% and at the background flow station F11 was 63%. These reductions in flow are interpreted as resulting from seasonally low precipitation occurring in late July and in August 2013.

The potential for impacts to Brook Trout habitat resulting from increased pumping and associated drawdown effects observed in the vicinity of MP5-13 were investigated by Stantec, specifically with respect to effects on surface flow and water temperature. A level logger located at flow station F5 (located in proximity to MP5-13) recorded water level and temperature every 15 minutes. A total of 12 manual flow measurements were taken at the culvert at the same location. A rating curve was developed using nine (9) of the 12 manual flow measurements, with three (3) outliers not shown, and the logger data (height of water, corrected for pressure) and is provided below. Outlier data could be the result of instrument malfunction and/or measurement location error. Stantec recognizes there are few data points during high flow events; however, the range of measurements is suitable for estimating flows within the range of the manual measurements.



X1 = Logger reading (corrected) at the time of flow measurement
Y = measured flow (m^3/s)

Estimated flows and manual flow measurements are illustrated in Figure 19.

Stream discharge was variable throughout the latter part of June through to July 18, which marked the end of Stage 1 of the pumping test where no pumping occurred. The large broad spike in surface water flow in the middle of Stage 1 (Figure 19) was attributed to several consecutive days of precipitation and is consistent with data recorded at other stations in the study area. When pumping stopped on June 27 (start of Stage 1), there was no corresponding increase in stream flow, in fact stream flows were declining over this period until the rainfall events in the middle of July (Figure 19). Similar trends were observed at the end of Stage 3 when pumping was reduced from 19.8 L/s to 15.2 L/s.

Measured stream depth at F5 (located in proximity to MP5-13) on June 28 (Stage 1 - no pumping) ranged from 0.18 to 0.20 m, with most of the channel at a depth of 0.18 m deep. On August 22 (start of Stage 3 pumping at 19.8 L/s), water depth was 0.17 m across the channel. On September 16 (end of Stage 3 pumping at 19.8 L/s) water depth was 0.15 m across most of the channel, with a maximum depth of 0.16 m. These minor variations in stream depths are likely attributed to seasonal changes. What is evident is that stream levels are very responsive to seasonal variations in precipitation and pumping-related influences are not measurable.

The surface water temperature at MP5-13 was between 10°C and 14°C for most of the test period (Figure 19), with the exception of increases associated with rain events which occurred during all stages. Temperatures remained well within the range of a coldwater thermal regime for the entirety of the test program.

Based on data collected for the study, the reach of Beeney Creek downstream of MP5-13 (parallel to Fourth Line) does not provide Brook Trout spawning habitat since under current pumping conditions there is no groundwater input to the creek bed in this reach. Additionally, based on the available stream discharge, water depth and temperature data from monitoring station MP5-13/F5, the reach of Beeney Creek located downstream of MP5-13 remains suitable for general Brook Trout feeding and movement through the area. As a result, no mitigation is necessary.

Based on the available results it is interpreted that no impacts occurred to the local terrestrial, species at risk, or fish or fish habitat as a result of pumping completed at the Fourth Line well field in 2013.

6.1.2 Municipal Wells

The Region currently provides municipal water to residents of the Community of Acton through three (3) well fields, namely:

- Fourth Line Well Field (Well A);
- Prospect Park Well Field (Well 1 and 2); and
- Davidson Well Field (Well 1 and 2).

Near steady-state drawdown observed during the pump testing of the Fourth Line Well Field did not extend far enough west or south to impact the performance of either the Prospect Park or Davidson Well Fields.

6.1.3 Private Wells

There are a number of domestic wells located within the vicinity of the Fourth Line well field. It is interpreted that these wells are used for water supply. Review of MOE WWR indicates that within a one (1) km radius of the well field, 25 private wells were identified (Appendix D). According to the records the following can be noted:

- A total of 19 wells (76 percent) are for domestic use only,
- Two (2) of the 25 wells are used for both domestic and livestock,
- Three (3) of the 25 wells are for public use, while one (1) of these wells is also used for domestic use, and;
- One (1) of the 25 wells has an unknown use.

Review of the MOE WWR indicates that the private wells within the area of the Fourth Line well field are installed within the bedrock. There were no private well interference complaints recorded during the pumping test. A total of five (5) private wells were included in the monitoring program (RW01 through RW05, Figure 1), with results provided in Appendix F and

discussed in Section 4.5.2. A review of the hydrographs presented in Appendix F indicates that observed drawdowns were as follows:

- RW01: no water level response attributed to the pumping test, with the main influence being seasonal fluctuations resulting from precipitation trends.
- RW02: no water level response attributed to the pumping test, with the main influence being seasonal fluctuations resulting from precipitation trends.
- RW03: a water level response of 0.28 m was observed attributed to the increased pumping in Stage 3 of the pumping test.
- RW04: a water level response of 0.48 m was observed attributed to the increased pumping in Stage 3 of the pumping test.
- RW05: a water level response of 0.15 m was observed attributed to the increased pumping in Stage 3 of the pumping test.

The water level responses observed within private wells RW03 – RW05 are consistent with the predicted zone of influence provided in Figure 16. However, these water level responses are not significant compared with the estimated available drawdown of these wells. A review of MOE WWRs indicate that for bedrock wells completed near the Fourth Line well field, available drawdowns of more than 10 m are typical, with some wells having up to 35 m of available drawdown.

7.0 Permitting Compliance

Pumping well; Well A, at the Fourth Line well field is operated under the Acton Water Supply PTTW No. 62181-7WFQB3, which was issued on October 16, 2009 and expires on May 31, 2015. The permit allowed a pumping rate of 909 L/min (15.2 L/s) and a total daily amount not to exceed 1,309,000 L/day. Test well TW1-87 acts as a standby pumping well for the Fourth Line well field, but was never connected into the water distribution system and is not included in the existing permit to take water. Subsequently, a temporary PTTW (PTTW No. 3663-97JKBF) was issued on May 9, 2013 and allowed for the completion of a combined pumping test for both Well A and TW1-87 at maximum rates for each well of 1,200 L/min (20 L/s). A copy of PTTW No. 62181-7WFQB3 and temporary PTTW No. 3663-97JKBF is provided in Appendix C.

The pumped volumes from Well A and TW1-87 were reviewed for compliance with the issued PTTWs. Pumping volumes were recorded by the Region on a daily basis. Table 4 provides a summary of the daily totals, for the period for April 1 to November 1, 2013. Figure 14 presents hydrographs for the two (2) pumping wells and provides the combined and individual daily pumped volumes for each pumping well.

The total volume of water supplied by the two (2) bedrock wells at the Fourth Line well field was 175,726 m^3 between April 1, 2013 and November 1, 2013. The calculated average day and maximum day combined pumping rates between April 1, 2013 and November 1, 2013 was 817 m^3/day and 1,701 m^3/day, respectively (Table 4). The average day and maximum day pumping rates were constantly below the maximum permitted day rate of 1,728 m^3/day under temporary PTTW No. 3663-97JKBF.

When in operation between April 1, 2013 and November 1, 2013, the daily average instantaneous pumping rates based on the hourly data for pumping wells Well A and TW1-87 were 441 L/min and 126 L/min, respectively. The maximum instantaneous pumping rates based on the hourly data were 926 L/min and 828 L/min, respectively. The instantaneous pumping rates for each was consistently below the maximum permitted rate of 1,200 L/min (temporary PTTW No. 3663-97JKBF).

7.1 PRIVATE WELL MONITORING

As described in Section 3.3.4, prior to the start of the 2013 well testing program the Region delivered notification letters to residents within the selected area of the Fourth Line well field informing them of the planned increase in water taking. A copy of the notification letter is provided in Appendix E. Residents were informed to fill out an attached well survey form and return to the region, also indicating their interest in participating in the private well monitoring program. Permission to enter private property was received from 14 of 16 residents that contacted the Region. Stantec subsequently completed a door-to-door residential survey at those residences interested in well monitoring. A total of five (5) private wells were considered to

be accessible and dataloggers were installed. Hydrographs providing water level data from private wells are provided in Appendix F. It is Stantec's understanding that the Region did not receive any well interference complaints from local residents during the 2013 Fourth Line well field pumping test period.

8.0 Data Validation and Quality Assessment

The QA/QC procedures applied to the well field pumping test investigation were documented in version 2.0 of the Quality Assurance Project Plan (QAPP) prepared by Stantec and submitted to the Region in September 2012.

The data quality objectives (DQOs) for the well field pumping test investigation are described in the QAPP (Stantec, 2012). The level of quality required for field analysis is such that the resulting data:

- Adequately describes the hydrogeological and ecological systems within the study area at levels necessary to understand the relationship between additional water taking from the Fourth Line well field and the surrounding natural environment and existing water users in the area;
- Falls within a reasonable range of expected and/or previously collected data;
- Is above the method detection limits (MDLs) of the instruments used to collect the data;
- Is reported within the number of significant digits that is appropriate for the accuracy of the instruments used; and,
- Under similar conditions, can be easily reproduced within a reasonable range of accuracy (i.e. a second reading taken to verify the first should be within a reasonable range of the first).

The QAPP (Stantec, 2012) identified data quality indicators (DQIs) for each analytical parameter and field measurement to define acceptable data quality for the monitoring programs. The data quality was described in terms of precision, accuracy, completeness, representativeness, and comparability as outlined in the QAPP (Stantec 2012). The following presents a summary of the well field pumping test investigation data compared to the DQIs for 2013.

8.1 GROUNDWATER AND SURFACE WATER LEVEL MONITORING

As described in the QAPP report (Stantec, 2012), groundwater level monitoring was conducted at 52 monitoring locations (required a minimum of 29 locations), with groundwater and surface water level monitoring completed using a combination of manual and automated techniques. Groundwater and surface water level monitoring was completed in accordance with the required analytical protocol as outlined in the QAPP (Stantec, 2012). Water depths were recorded to 0.01 m, and were accurate to about +/-0.01 m for each 100 m measurement (0.01%).

Precision of the groundwater and surface water level data was assessed quantitatively with duplicate measurements taken one (1) or two (2) minutes apart. The duplicate measurements

were analyzed by calculating the relative percent difference (RPD) (Stantec, 2012). Table 7 presents the RPDs for all available field measurements. The RPDs for all duplicate water level measurements were below the screening criteria of 10% for field measurements, with the exception of five (5) measurements obtained on August 1, 2013 when a duplicate water level measurement was not obtained during the baseline Stage 2 period of the pumping test (Table 7). Additionally, there were three (3) measurements obtained on June 28, 2013 and 37 measurements obtained on October 10, 2013, completed outside of the four (4) stage period of the pumping test when a duplicate water level measurement was not obtained. In 2013, 52 of 52 (100%) pressure transducers were downloaded with a complete data set.

Based on the above assessment, it was concluded that the DQOs for the groundwater and surface water level monitoring program were satisfied during the pumping test.

8.2 WATER QUALITY SAMPLING

Groundwater and surface water samples were handled in accordance with the required analytical protocol, including holding time, preservation method, storage requirements and container type as outlined in the QAPP (Stantec, 2012). In addition, a laboratory Certificate of Analysis was received for each water quality sample submitted for analysis. Copies of the laboratory Certificates of Analysis in their entirety are included in Appendix G. Maxxam indicated that laboratory surrogate standard recoveries were within acceptable limits for all parameters analyzed for water quality.

As described in Section 3.3.5, groundwater samples were collected during the pumping test at the pumping wells (Well A and TW1-87). Groundwater samples for laboratory analysis were collected from a port at the well heads. Samples were obtained from Well A on August 29, 2013 and from TW1-87 on August 29 and September 13, 2013. Field measurements of conductivity, temperature, pH and redox potential were made using a multi-parameter water quality meter. This meter was calibrated prior to use according to the manufacturers' specifications with the appropriate calibration standards.

Based on the above assessment, it was concluded that the DQOs for groundwater quality sampling data were satisfied, with modifications made to the surface water sampling program.

8.3 STREAM FLOW MEASUREMENTS

Stream flow measurements were conducted in accordance with the required analytical protocol and completed using a calibrated Marsh-McBirney Inc. Model 201 portable water flow meter as outlined in the QAPP (Stantec, 2012). Surface water flow was collected manually on a weekly basis (a total of 13 separate monitoring events) during the four (4) stages of the pumping test. Stream flow at each location was calculated using the velocity-area method (Dingman, 1994). Measurements were obtained by placing a measuring tape across the width of the stream, perpendicular to flow, and dividing the distance into equal sections. At each point, the depth of the tributary is measured and the flow rate recorded using a Marsh-McBirney Inc. Flow-Mate 2000 portable water flow meter. Total discharge through the

section was then calculated using the U.S. Geological Survey approved mid-section method as discussed in Hipolito and Loureiro (1988) and Dingman (1994). Stream flow measurements were within +/-10% accuracy. An effort was made to use the same stream flow meter for all stream flow measurements throughout the study period for consistency.

The QAPP report (Stantec, 2012) indicated that manual stream discharge measurements would be collected at up to ten (10) surface water flow stations. In 2013 stream flow was obtained at a total of nine (9) monitoring locations, with one (1) of the nine (9) locations having consistently dry conditions.

The stream flow data were assessed for completeness by comparing the percentage of valid data reported compared to the total number of samples that were scheduled to be collected for each monitoring event. During 2013, 89% (8 of 9) of stream flow measurements were obtained which was slightly under the completeness target of 90%, resulting only from the fact that one (1) location was reported as consistently dry and therefore no stream flow measurement could be obtained.

Based on the above assessment, it was concluded that the DQOs for stream flow measurements were considered satisfied, due to limitations from environmental conditions only.

8.4 SURFACE WATER AND STREAMBED TEMPERATURE MONITORING

The analytical protocol outlined within the Stantec QAPP report (Stantec, 2012) indicated that stream and groundwater upwelling temperature data was to be collected at selected four (4) monitoring locations in the area of the well field. Streambed temperature loggers were not installed at the stream flow monitoring locations as prescribed in the QAPP report (Stantec 2012). The primary purpose of identifying and monitoring streambed temperatures is to identify potential impacts on the success of spawning Brook Trout and to a lesser extent Brown Trout. These species prefer redd locations associated with groundwater upwelling, which provide stable water temperatures during the embryo growth and development period, approximately 100 days, that extends from fall into early to mid-winter when the fry emerge from redds. The pumping tests occurred outside of this critical period, as such the installations of the drive point piezometers and surface water temperature loggers were deemed adequate to assess potential impacts to surface water temperatures and groundwater gradients without the use of streambed temperature loggers.

8.5 FISH SPAWNING REDD SURVEY

A spawning redd survey was conducted on November 8, 2012 in accordance with the required analytical protocol as outlined in the QAPP (Stantec, 2012). There is a degree of interpretation on the part of field biologists when conducting redd surveys. To limit the uncertainty associated with the red survey, an experienced fisheries biologist carried out the surveys wearing polarized glasses to facilitate the identification of redds.

Based on the above assessment, it was concluded that the DQOs for redd surveys were satisfied.

8.6 FISH HABITAT SURVEY

A fish habitat survey was conducted on September 21, 2013 in accordance with the required analytical protocol as outlined in the QAPP (Stantec, 2012) thus meeting the DQOs for this survey.

8.7 FISH COMMUNITY SURVEY

A fish community survey was not completed as part of the pumping test monitoring program as recent background information was available from the 2012 Spring Field Survey Results (Dillon, 2012a). The fish community completed by Dillon (2012a) confirmed the presence of Brook Trout in the tributary to Beeney Creek south of Sideroad 32.

8.8 PUMPING WELL DATA

The Region supplied hourly and daily pumped volumes and run times from the SCADA system for pumping wells, Well A and TW1-87. The data was a complete set for the period from April 1, 2013 through to November 12, 2013.

8.9 PRECIPITATION DATA

Two (2) weather stations (Fergus MOE and Elora RCS climate stations) located near the Fourth Line well field supplied a complete set of daily precipitation and temperature data. The Fergus MOE climate station had data missing for 6 dates in the period from January 1, 2013 to November 1, 2013, which was supplemented by data from the Elora RCS climate station.

9.0 Conclusions and Recommendations

Based on the above, the following conclusions are provided:

- The QA/QC procedures implemented as part of this study resulted in all of the data quality objectives being met.

- The geology encountered in the vicinity of the Fourth Line well field consisted of approximately 6.5 m of overburden comprising Wentworth Till and Outwash Deposits underlain by bedrock characterized as dolostone with shale partings associated with the Eramosa Formation. The Wentworth Till was encountered at all but one location to the south of the well field along Fourth Line. No shallow groundwater level responses to pumping in the overburden were observed wherever the Wentworth Till was present.

- Based on the results of the 2013 well field pumping test investigation, a pumping rate of 19.8 L/s is sustainable with projected water levels over a 12 month period remaining above the upper water producing fracture elevation of 365.5 m AMSL even under a drought conditions.

- Station MP5-13 was the only fisheries station interpreted to respond to the pumping test. This station is situated to the south of the well field where a window in the Wentworth Till was identified. The vertical hydraulic gradient was observed to be consistently downward at this location through Stages 2 and 3 of the pumping test. During this period a 47% reduction in stream flow was observed at this location; however, greater reductions in stream flow were observed upstream and in the background flow station, suggesting that the reduction in flow was related to seasonally low precipitation occurring in late July and August 2013. As a result station MP5-13 was *not* interpreted to be impacted by the increase in pumping rate.

- Based on data collected for the study, the reach of Beeney Creek downstream of MP5-13 (parallel to Fourth Line) does not provide Brook Trout spawning habitat and under current pumping conditions there is no groundwater input to the creek bed in this reach. Additionally, stream discharge, water depth and temperature in the reach of Beeney Creek located downstream of MP5-13 remained suitable for Brook Trout and fish passage through the area during the pump test. As a result, no mitigation is necessary.

- No wetland monitors were interpreted to respond to the pumping test.

- The well field operated in compliance of both PTTW No. 62181-7WFQB3 and temporary PTTW No. 3663-97JKBF throughout 2013.

- The interpreted zone of pumping influence, as measured by the 0.5 m drawdown contour, extended approximately 900 m east and 200 m west along Fourth Line, and approximately 350 m north and 400 m south along Sideroad 32 from the Fourth Line well field.

- No pumping related impacts were identified in any of the surface water monitoring data, with the exception of the water level data obtained from drive point monitor MP5-13, attributed to its location in an area where the Wentworth Till was absent. However, no vertical hydraulic gradient reversals occurred at this location as a result of increasing the pumping rate from 15.2 L/s to 19.8 L/s.

Based on results of the 2013 well field pumping test investigation, impacts from pumping at the higher proposed rate of 19.8 L/s for sustained periods of time are not anticipated to have any measurable impacts to the local natural heritage features, private wells in the area or other nearby municipal well fields. Based on the above, the following recommendation is provided:

- The Region should proceed with Permit To Take Water application requesting that the pumping rate be increased to 19.8 L/s from any combination of Well A and TW1-87.

10.0 References

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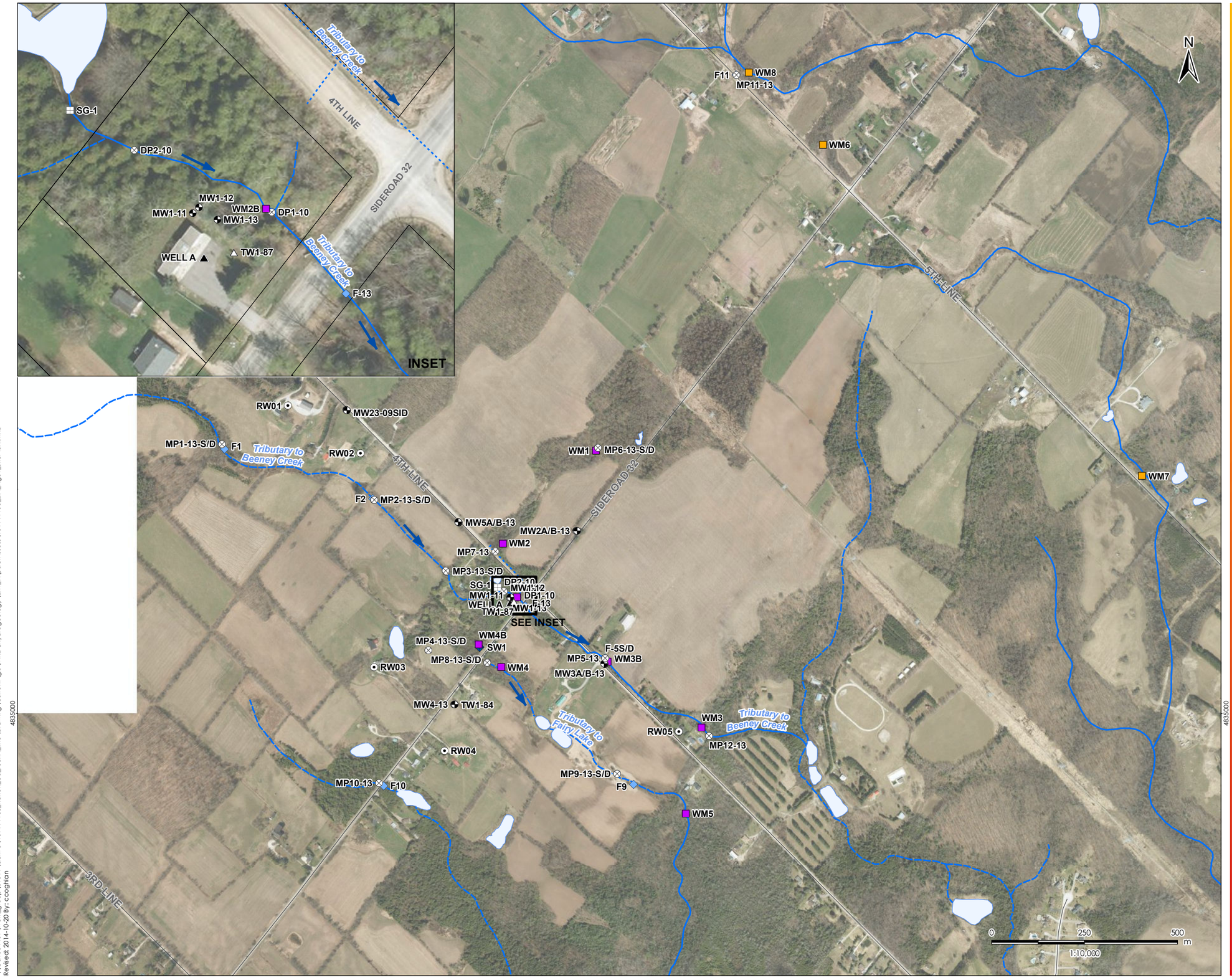
Appendix A
Figures



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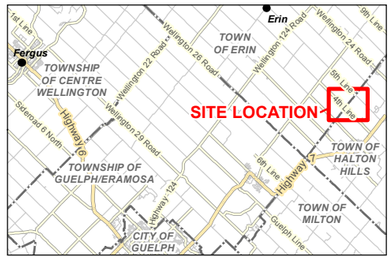
Revised: 2014-10-20 By: ccoghlan

4835000

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- Direction of Flow
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody



Notes

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3. Orthoimagery © First Base Solutions, 2010.
4. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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Client/Project

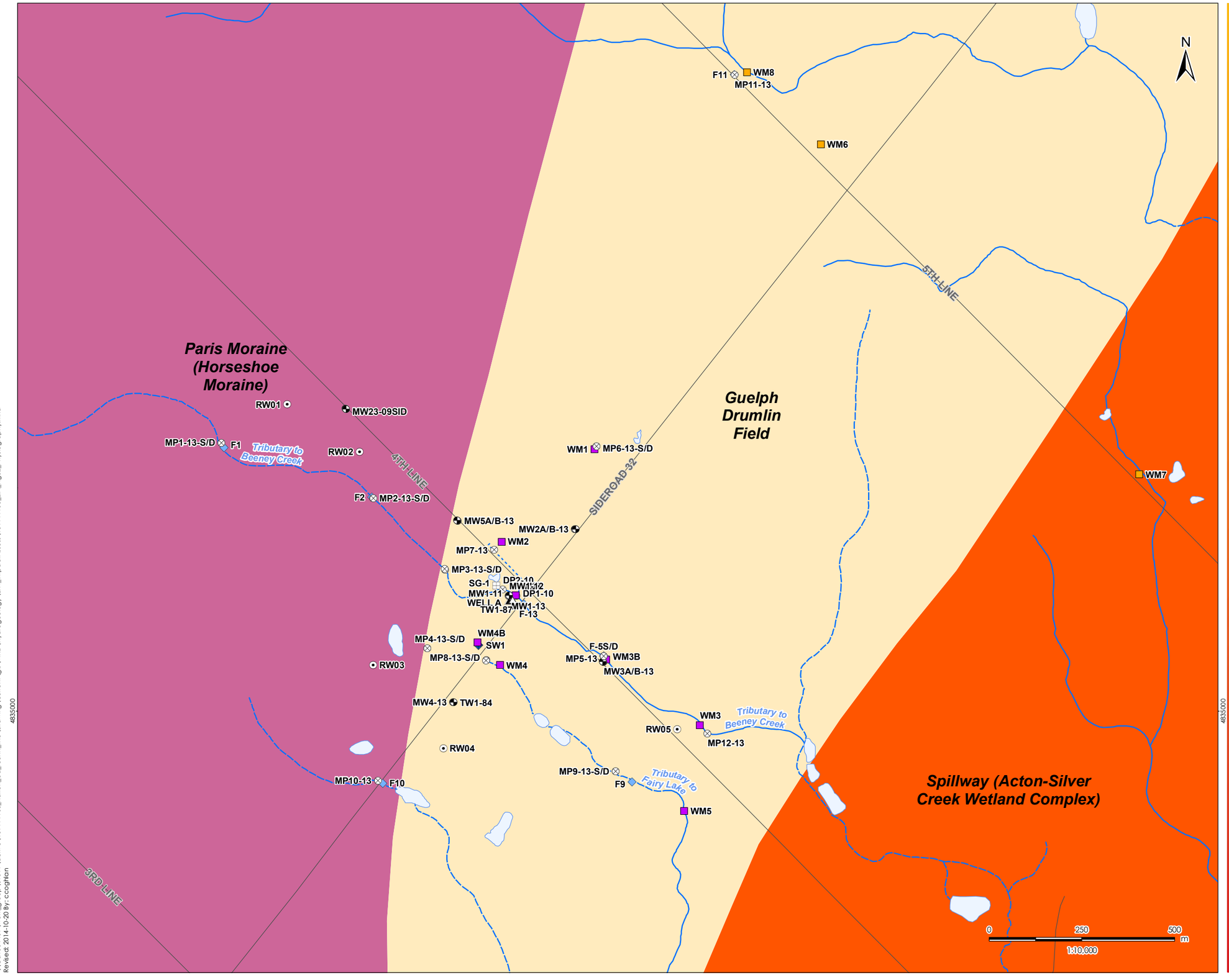
Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

1

Title

Site Plan



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Revised: 2014-10-20 By: ccoghlan

Stantec

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Physiography

- 6: Till Plains (Drumlinized)
- 3: Spillways
- 2: Till Moraines

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 228.
4. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

2

Title

Physiography

Stantec

N

Paris Moraine (Horseshoe Moraine)

Wentworth Till

SIDEROAD 32

4TH LINE

5TH LINE

3RD LINE

Tributary to Beeney Creek

Tributary to Fairy Lake

F11 WM8 MP11-13

WM6

RW01 MW23-09SID

MP1-13-S/D F1

RW02

F2 MP2-13-S/D

WM1 MP6-13-S/D

MW5A/B-13

MW2A/B-13

WM2

MP7-13

MP3-13-S/D

DP2-10

SG-1 MW1-12

MW1-11 DP1-10

WELL A TW1-87 MW1-13

F-13

WM4B

SW1 MP8-13-S/D

MP4-13-S/D

RW03

WM4

F-5S/D

MP5-13 WM3B

MW3A/B-13

MW4-13 TW1-84

RW04

RW05 WM3

MP12-13

MP10-13 F10

MP9-13-S/D F9

WM5

WM7

7a

5b

6

3

0 250 500 m

1:10,000

4835000

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Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- Road
- Topographic Contour (mAMSL)
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Surficial Geology

- 7a: Glaciofluvial deposits (Sandy deposits)
- 6: Ice-contact stratified deposits
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 3: Paleozoic bedrock

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Surficial geology produced by the Ontario Geological Survey 2003. Surficial geology of Southern Ontario; Ontario Geological Survey, MRD 128.
4. Topography derived from the Southwestern Ontario Orthophotography Project (2010) - Digital Elevation Model © Queen's Printer for Ontario, 2010.
5. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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Client/Project

Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

3

Title

Surficial Geology and Ground Surface Topography

Stantec

N

Paris Moraine (Horseshoe Moraine)

A

A'

B

B'

F11 WM8 MP11-13

WM6

WM7

STH-LINE

RW01 MW23-09SID

MP1-13-S/D F1

Tributary to Beeney Creek

RW02

4TH LINE

F2 MP2-13-S/D

WM1 MP6-13-S/D

SIDEROAD 32

MW5A/B-13

MW2A/B-13

WM2

MP7-13

MP3-13-S/D

SG-1 DP2-10 MW1-12

MW1-11 DP1-10

WELL A MW1-13

TW1-87 F-13

WM4B

MP4-13-S/D SW1

MP8-13-S/D WM4

RW03

F-5S/D

MP5-13 WM3B

MW3A/B-13

MW4-13 TW1-84

WM3

Tributary to Beeney Creek

RW05

MP12-13

RW04

MP9-13-S/D

Tributary to Fairy Lake

F9

MP10-13 F10

WM5

3RD LINE

Acton-Silver Creek Wetland Complex

4835000

4835000

0 250 500 m

1:10,000

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Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- Cross-Section Location
- Road
- Overburden Thickness Contour (mBGS)
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Overburden Thickness (mBGS)

60
50
40
30
20
10
0

Notes

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

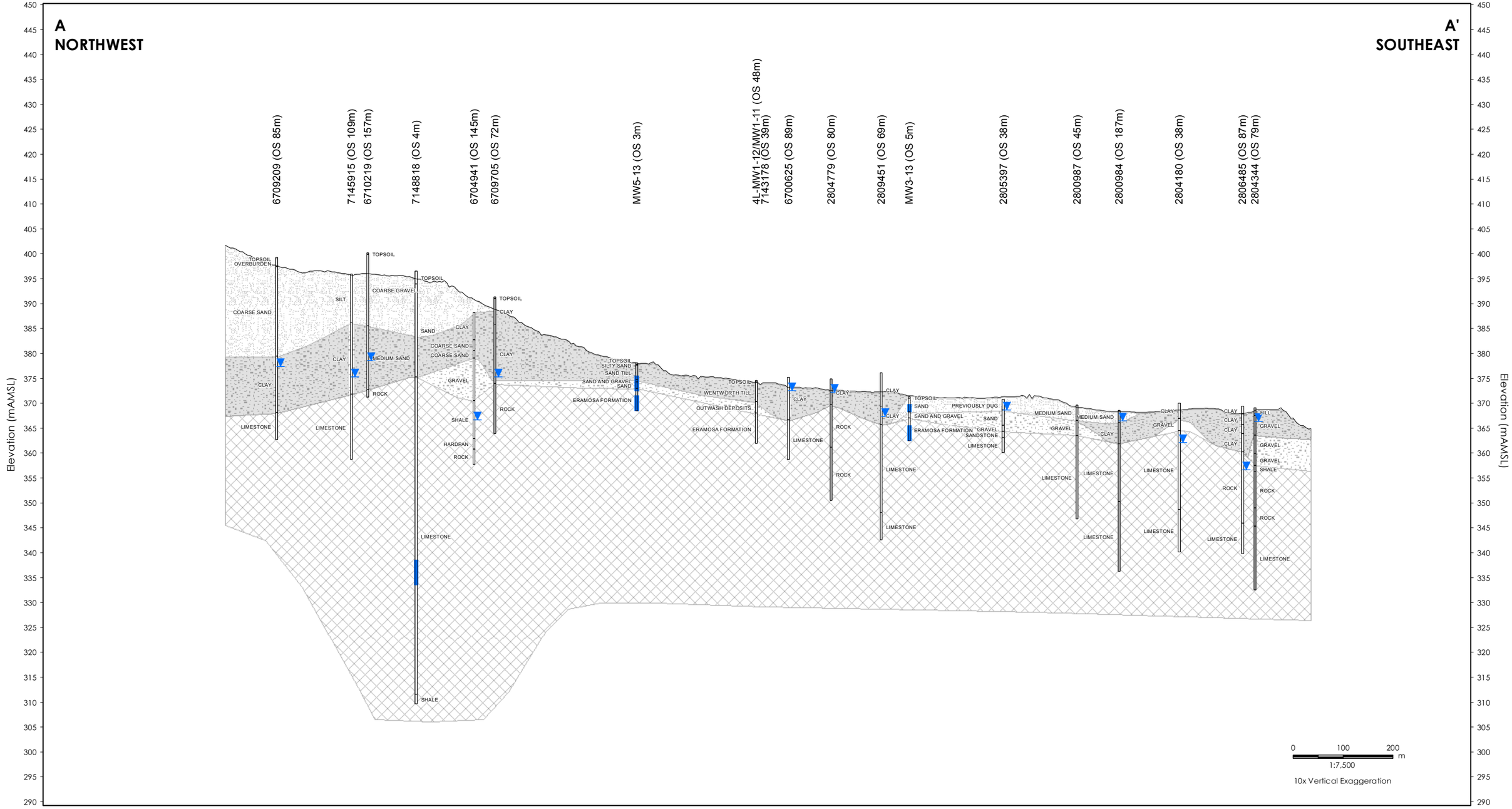
4

Title

Overburden Thickness

A
NORTHWEST

A'
SOUTHEAST



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December 2013
161111105

Stantec

Legend

2807874 (OS m)
Well ID (Offset)

Sand
Stratigraphy
Water Level
Well Screen

Sand
Sand & Gravel
Silty Till (Wentworth Till)
Bedrock

Notes
1. Notes

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.
5

Title
Cross-Section A-A' - 4th Line

B
SOUTHWEST

B'
NORTHEAST

6703220 (OS 4m)
6713499 (OS 122m)
MW4-13 (OS 22m)
2810581 (OS 115m)
2809451 (OS 208m)
4L-MW1-12/MW1-11 (OS 38m)
2804779 (OS 126m)
MW2-13 (OS 10m)
2809806 (OS 307m)
6712184 (OS 88m)

Elevation (mAMSL)

435 430 425 420 415 410 405 400 395 390 385 380 375 370 365 360 355 350 345 340 335 330 325 320 315 310

CLAY
LIMESTONE
TOPSOIL
CLAY
CLAY
SAND
CLAY
CLAY
LIMESTONE
LIMESTONE
LIMESTONE
TOPSOIL
SILTY SAND
SAND TILL
CLAY
LIMESTONE
CLAY
CLAY
LIMESTONE
TOPSOIL
WENTWORTH TILL
OUTWASH DEPOSITS
ERAMOSA FORMATION
CLAY
ROCK
ROCK
TOPSOIL
SILTY SAND TILL
ERAMOSA FORMATION
CLAY
CLAY
ROCK
FILL
CLAY
LIMESTONE
LIMESTONE

0 100 200 m
1:6,000
10x Vertical Exaggeration

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Revised: 2013-12-18 By: ccoghlan

December 2013
161111105

Stantec

Notes
1. Notes

Legend

2807874 (OS m) — Well ID (Offset)
Sand — Stratigraphy
Water Level
Well Screen

Sand
Sand & Gravel
Silty Till (Wentworth Till)
Bedrock

Client/Project
Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.
6

Title
Cross-Section B-B' - Side Road 32

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Revised: 2014-10-20 By: ccoghlan

Stantec

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- 374.54 Groundwater Elevation (mAMSL)
- Groundwater Contour (mAMSL)
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Notes

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

7a

Title

Interpreted Shallow Groundwater Flow - Overburden Stage 2 Pumping Conditions

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- 374.54 Groundwater Elevation (mAMSL)
- Groundwater Contour (mAMSL)
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Notes

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

7b

Title

Interpreted Shallow Groundwater Flow - Overburden Stage 3 Pumping Conditions

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Revised: 2014-10-20 By: ccoghlan

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- Modelled Drawdown Contour
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Notes

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

8

Title

Modelled Drawdown Contours (Tier 3 Water Budget)

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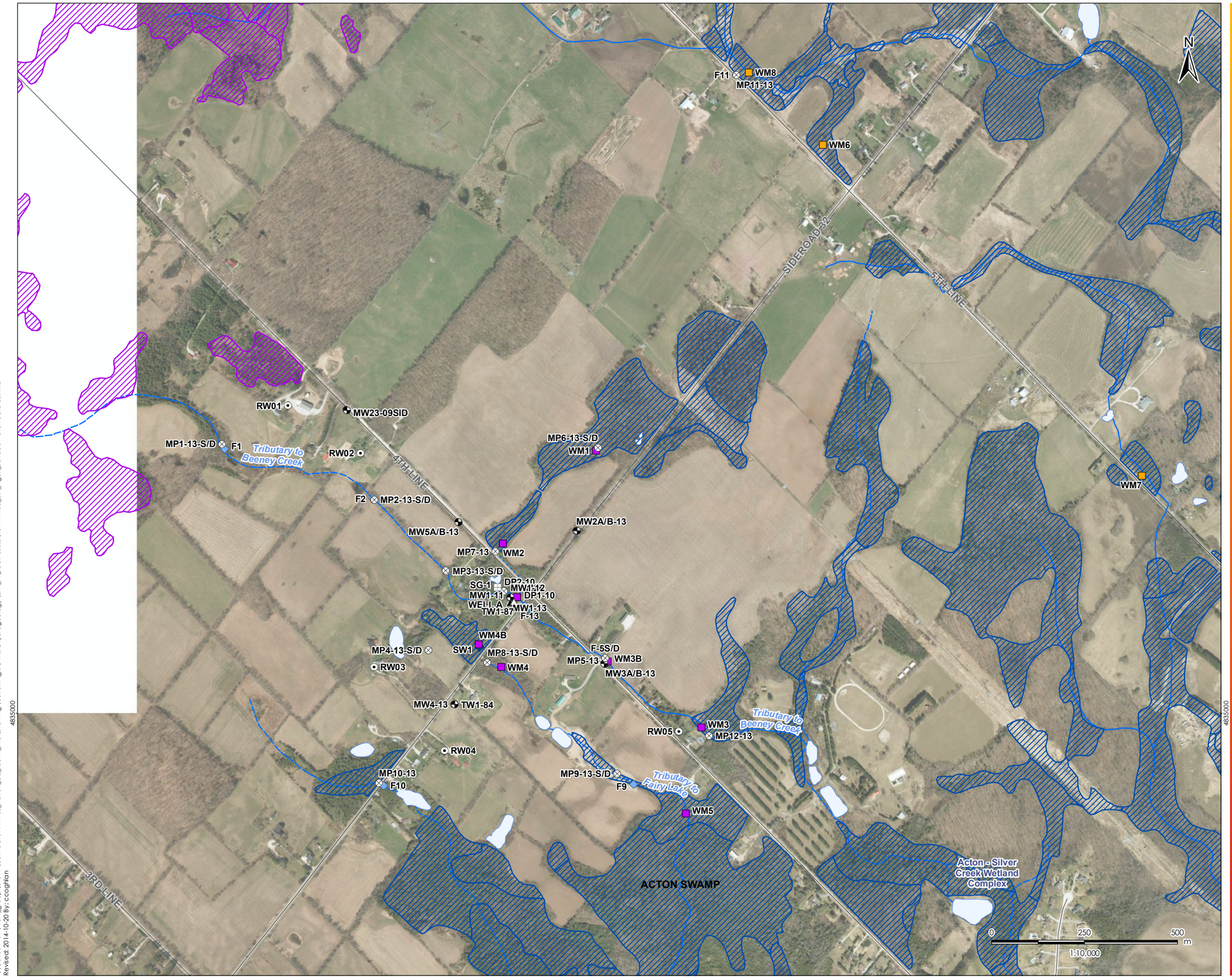

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Stantec

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Provincially Significant Wetlands

- Acton - Silver Creek Wetland Complex
- Eramosa River - Blue Springs Creek Wetland Complex

Notes

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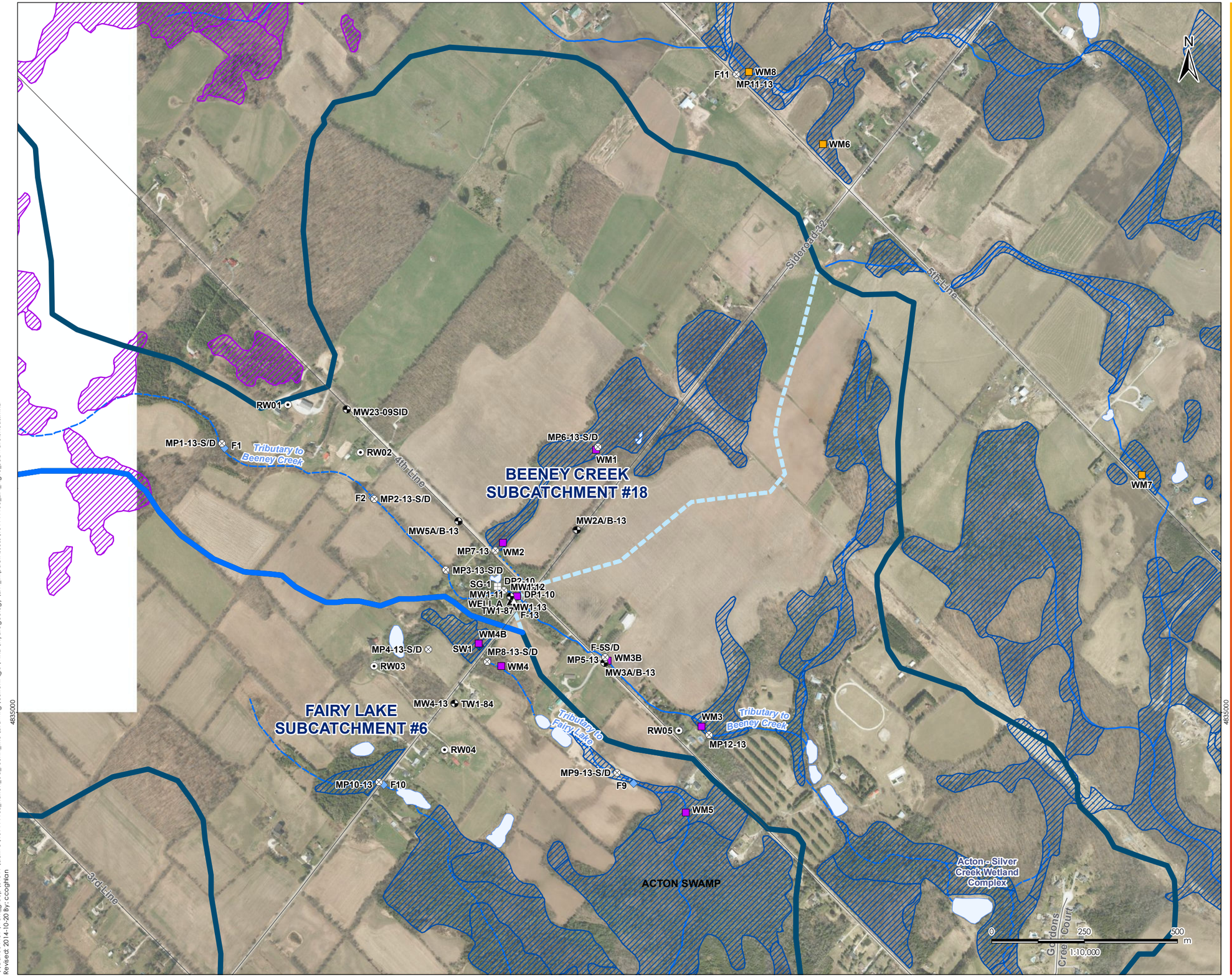
Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

9

Title

Surface Water Features



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Revised: 2014-10-20 By: ccoghlan

Stantec

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Fairy Lake/Beeney Creek Subcatchment Boundary as per Dillon 2012
- Revised Fairy Lake/Beeney Creek Subcatchment Boundary
- Fairy Lake/Beeney Creek Subcatchment Boundary
- Waterbody

Provincially Significant Wetlands

- Acton - Silver Creek Wetland Complex
- Eramosa River - Blue Springs Creek Wetland Complex

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2010.
4. Subcatchments presented in Dillon 2012 (provided by MNR and Halton Region) are modified based on field observations made in 2014 (CVC and Stantec).
5. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

10

Title

Credit River Subcatchments

Stantec

Legend

- ▲ Production Well
- Aquatic Habitat Assessment Station
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Provincially Significant Wetlands

- Acton - Silver Creek Wetland Complex

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2010.
4. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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Client/Project

Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

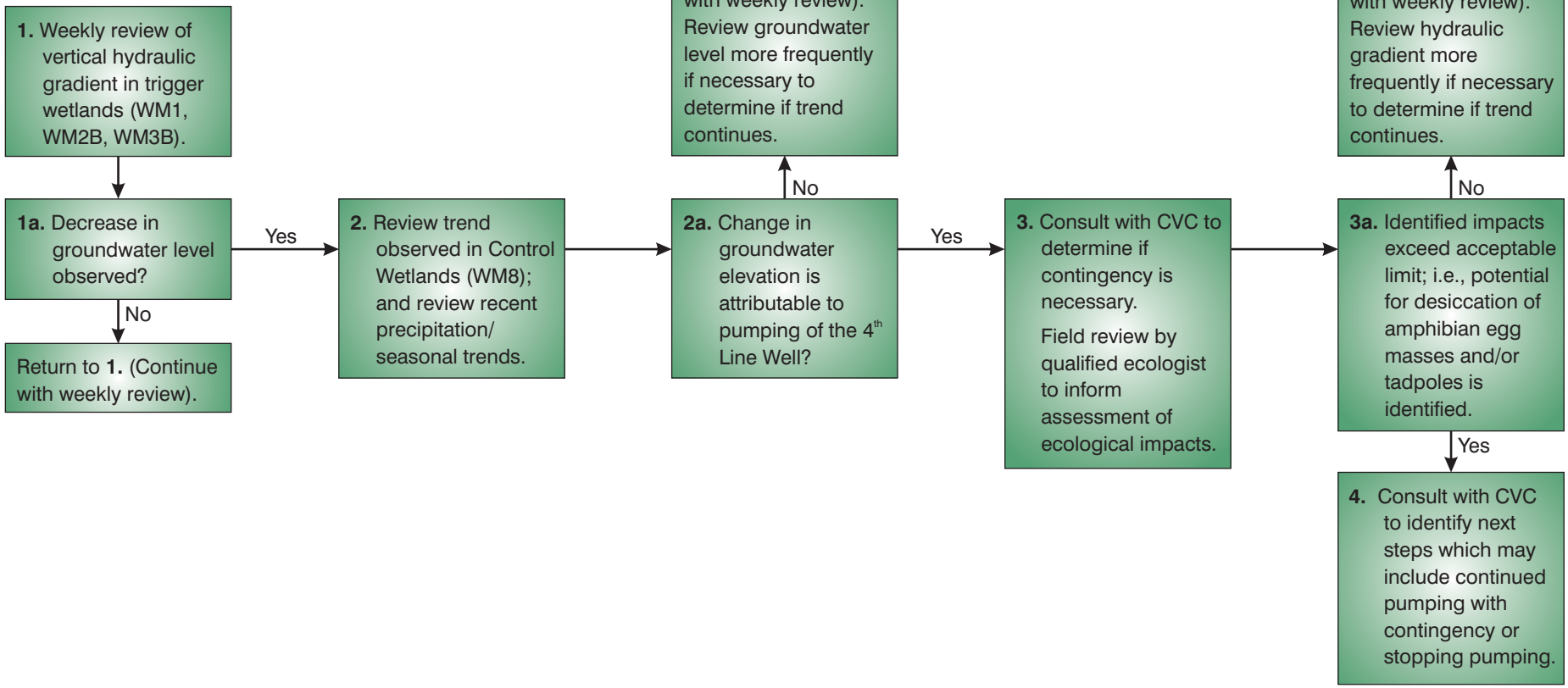
Figure No.

11

Title

Aquatic Habitat Assessment Stations

\\Cd1004-f01\work_group\01611\active\161111105_halton_eia_fourth_line\drawing\current\gis\MXD\Hydrogeology\Env_ImpactAssess\161111105_EIA_Fig11_AquaticsHabitatStations.mxd
Revised: 2014-10-20 By: ccoghlan



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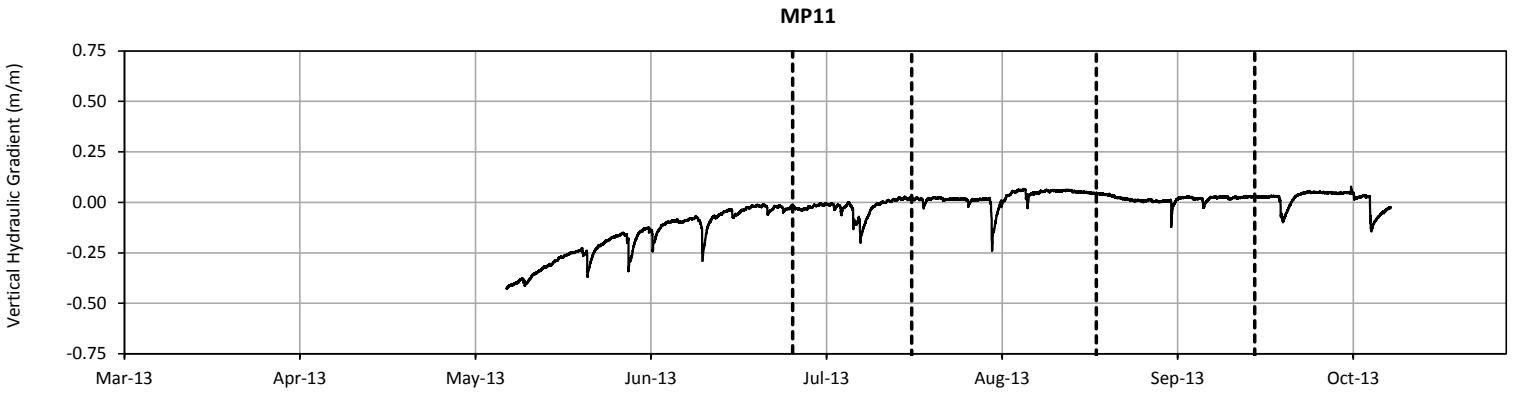
Halton Region
Fourth Line Well Field
Pump Test Monitoring Plan

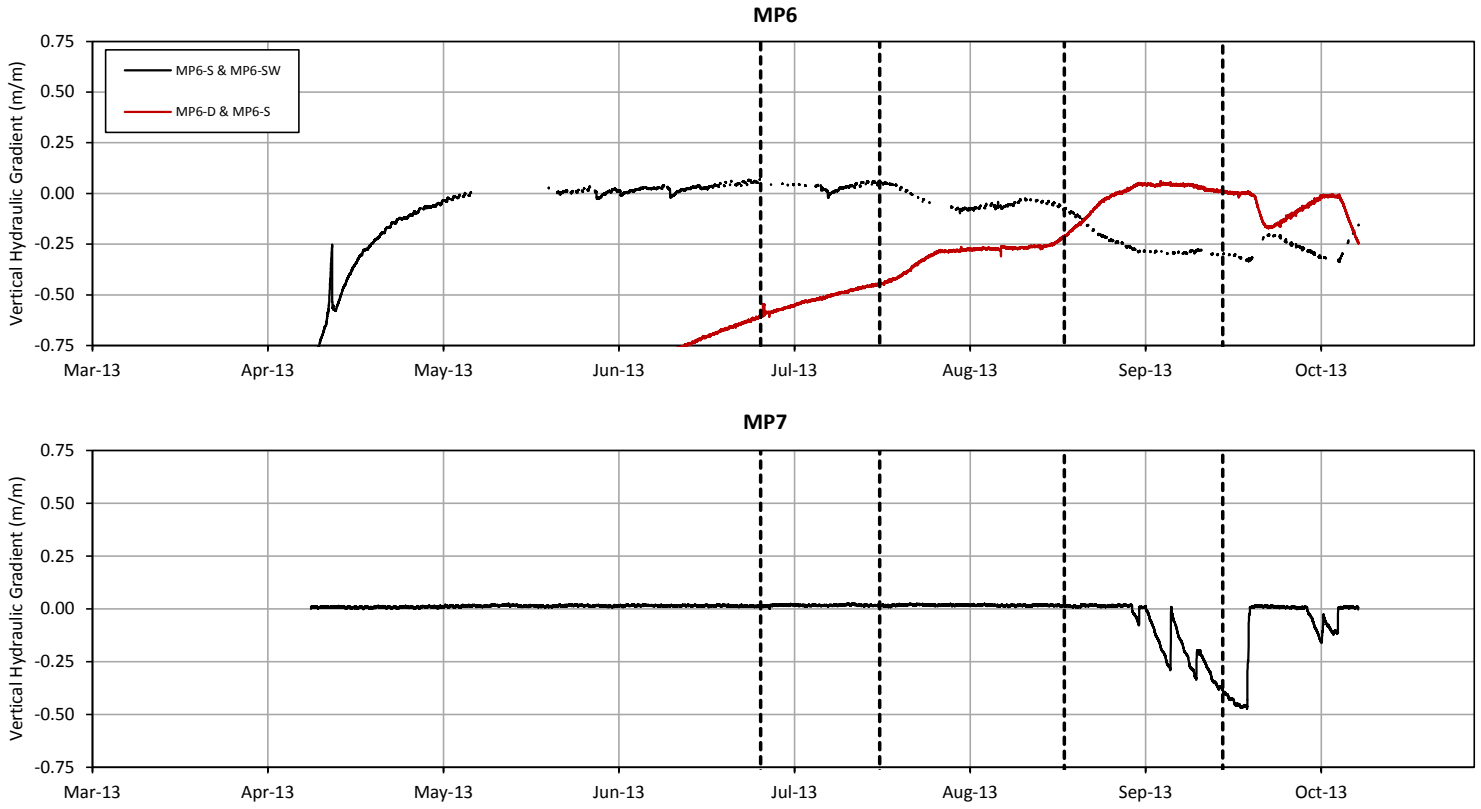
Figure No.
12a

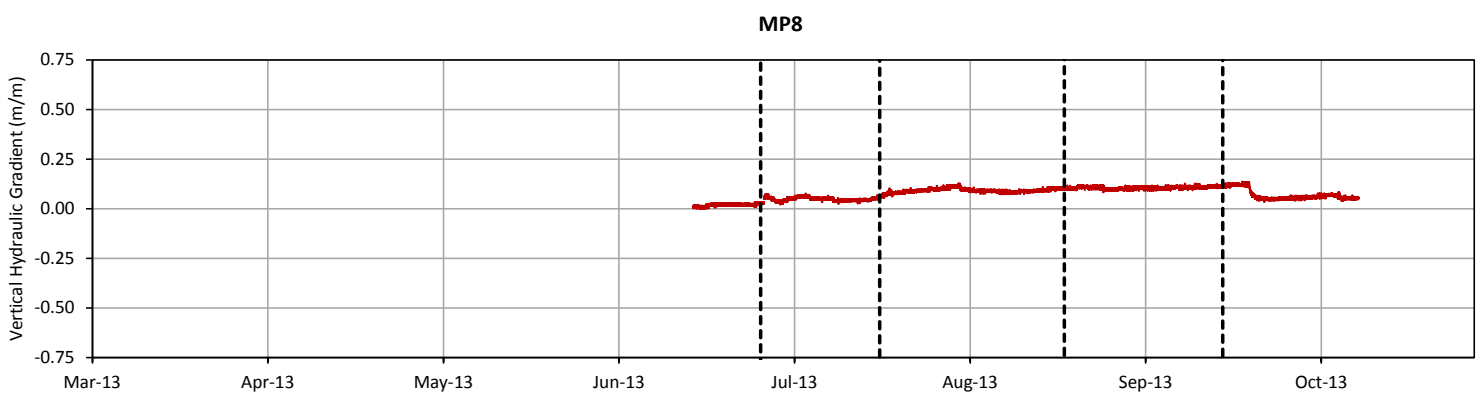
DRAFT

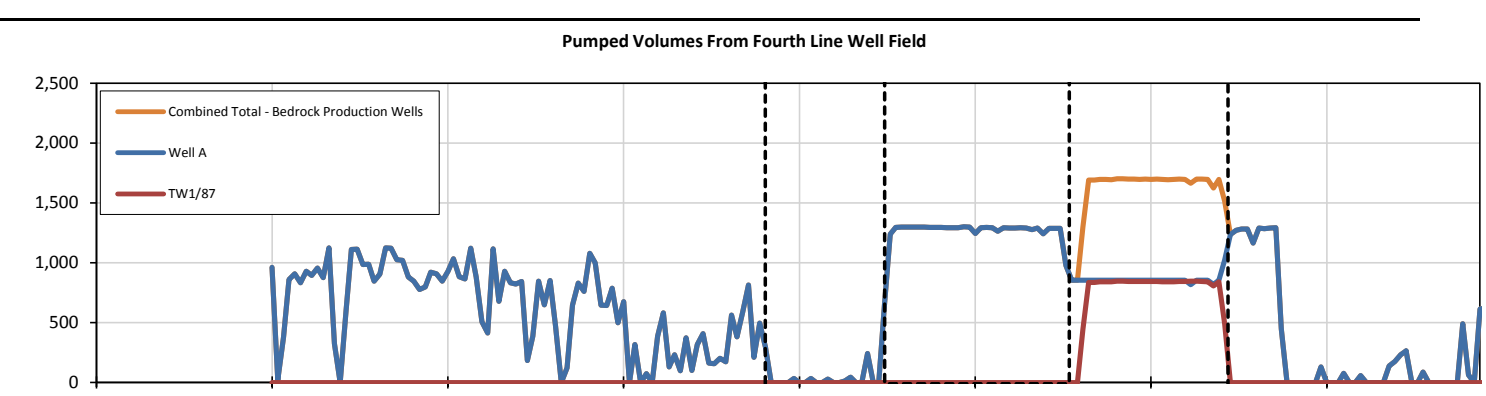
Title

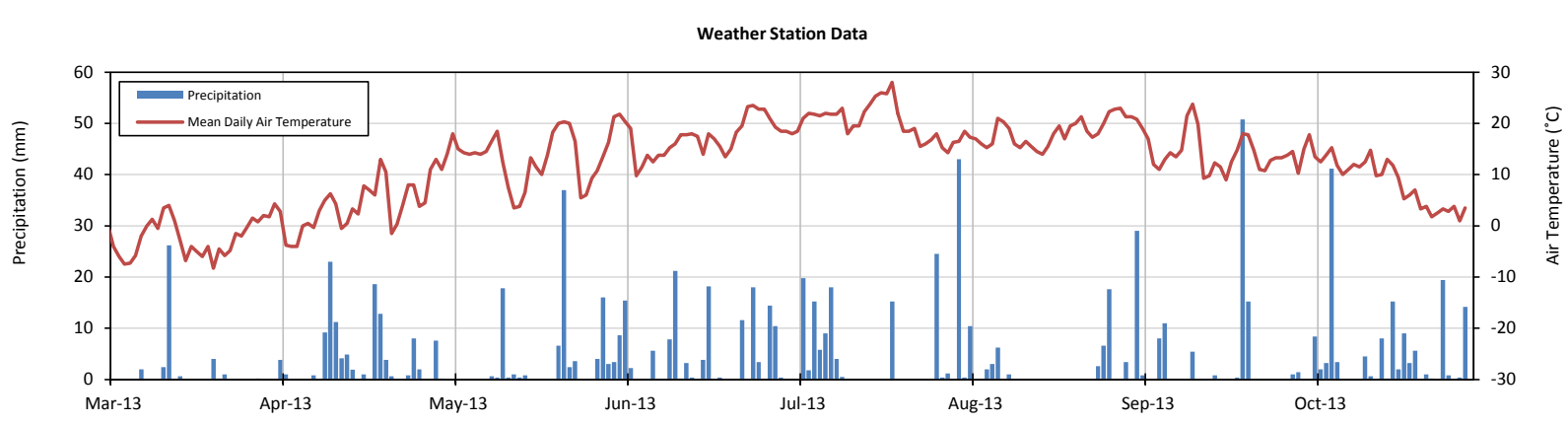
Wetland Assessment Chart











Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

12b

Title

Vertical Hydraulic Gradients
Wetland Locations
Fourth Line Well Field

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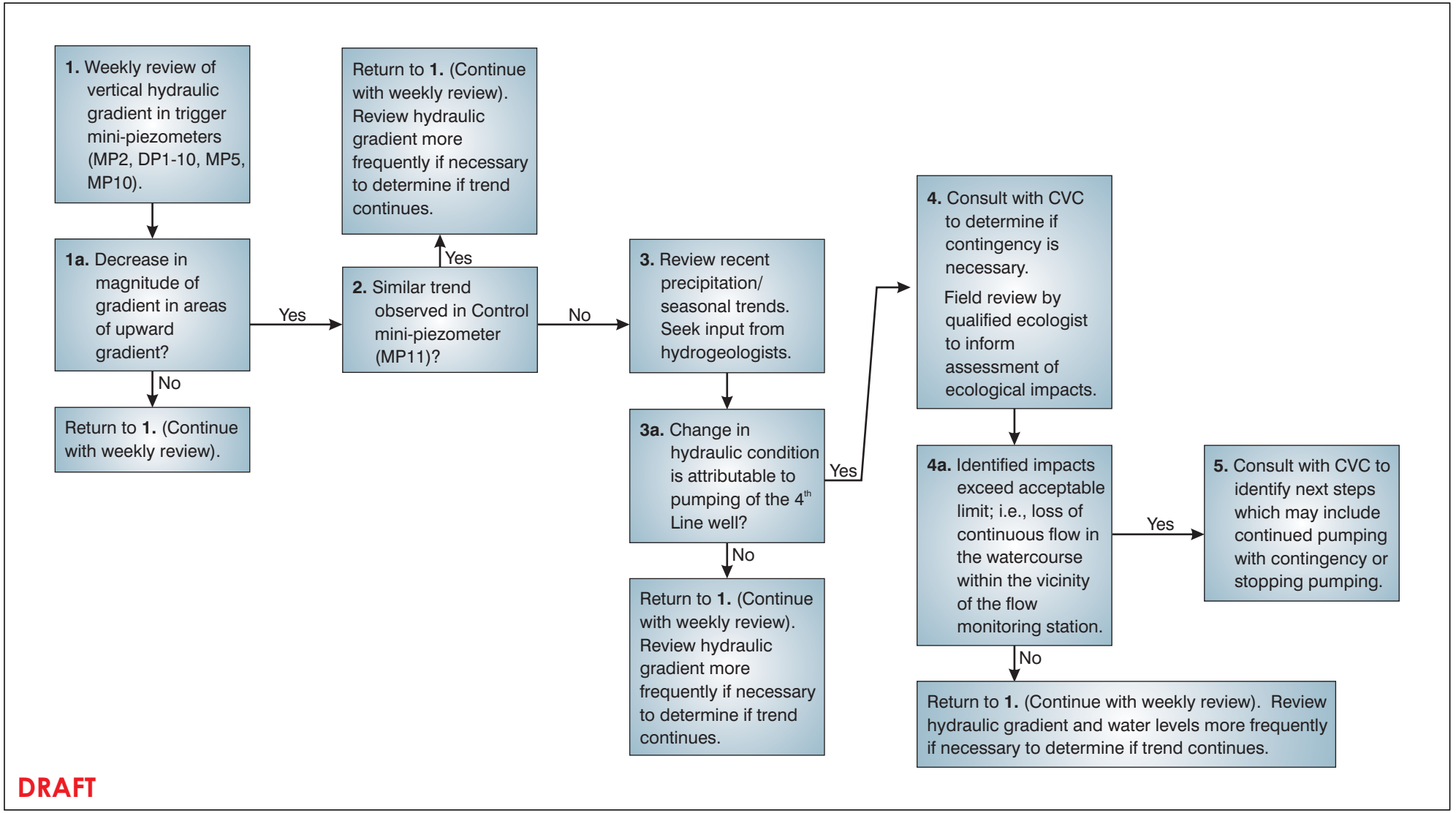

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Client/Project

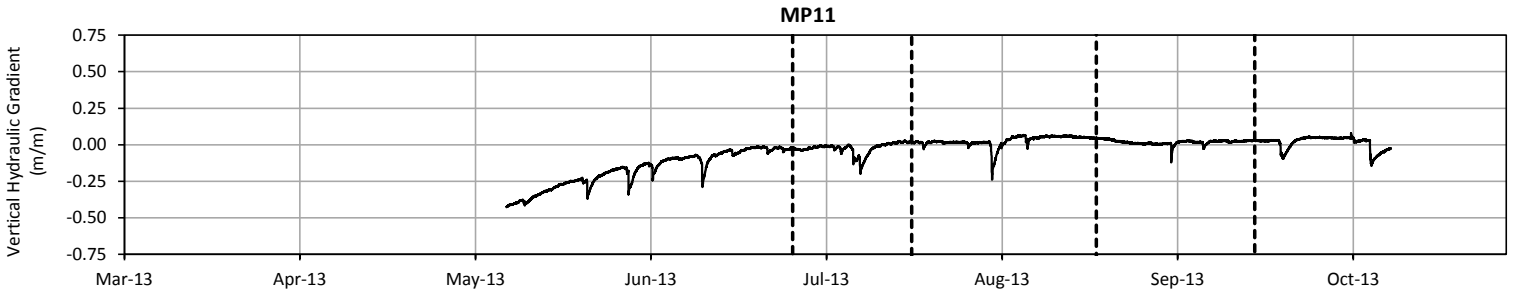
Halton Region
Fourth Line Well Field
Pump Test Monitoring Plan

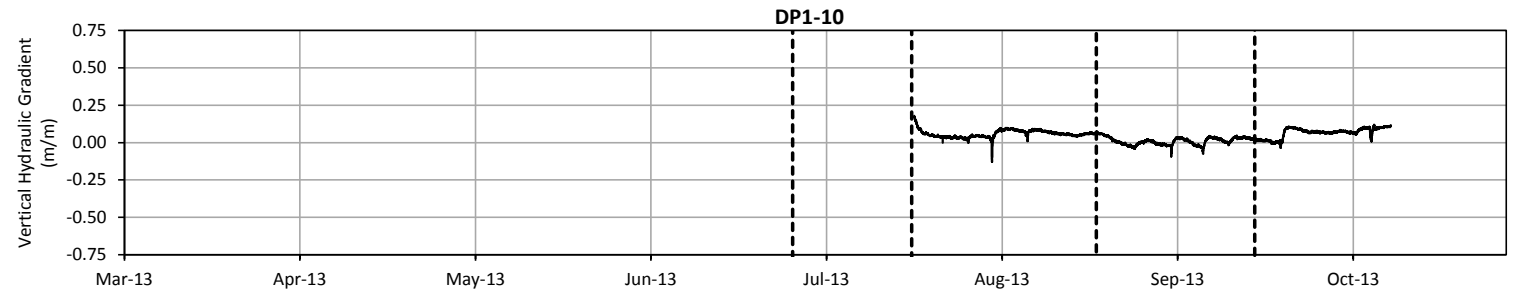
Figure No.
13a

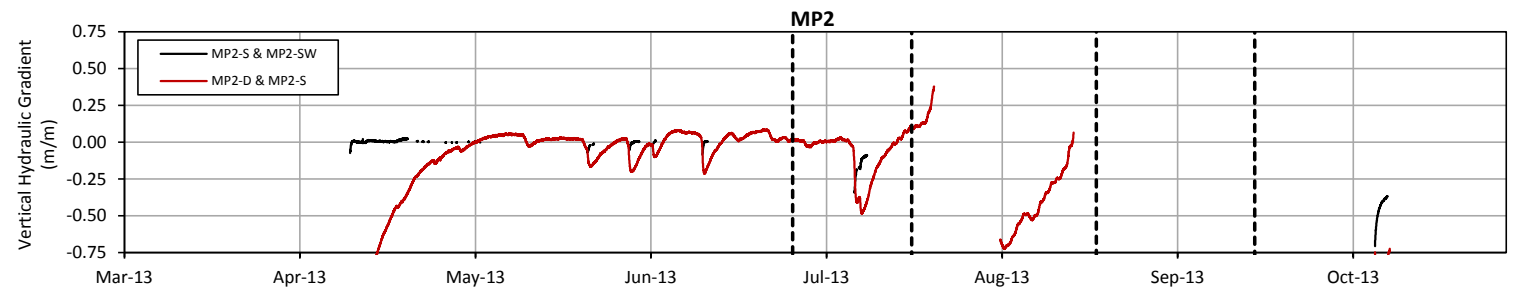
DRAFT

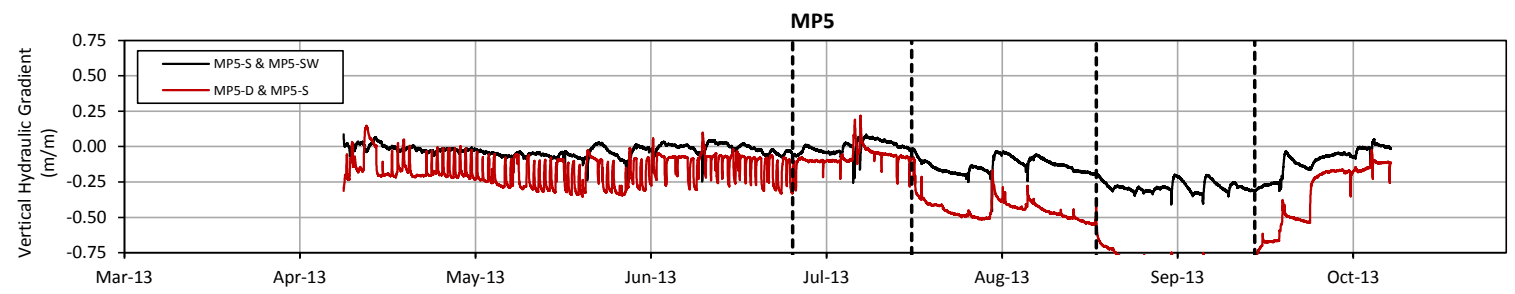
Title

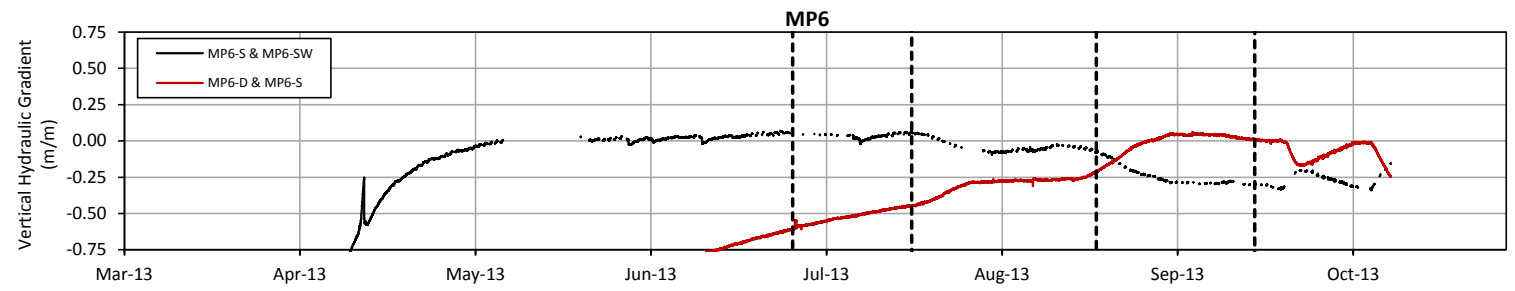
Fisheries Assessment Chart

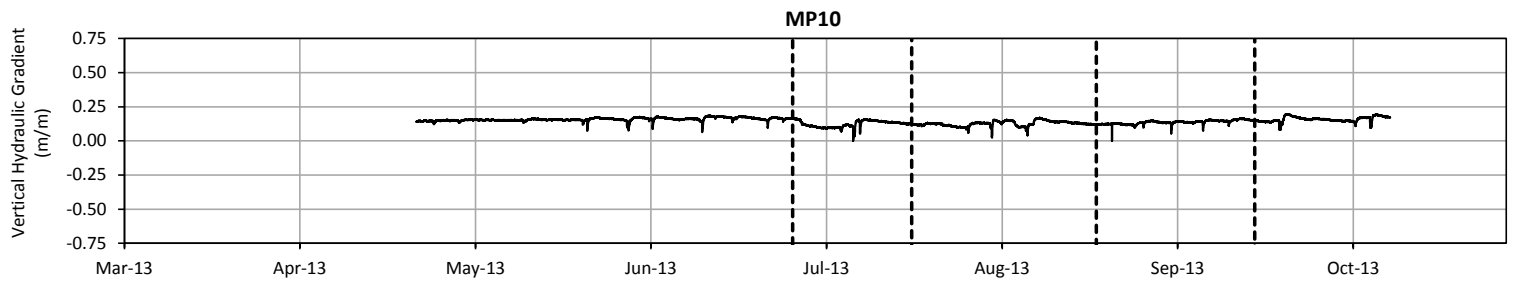


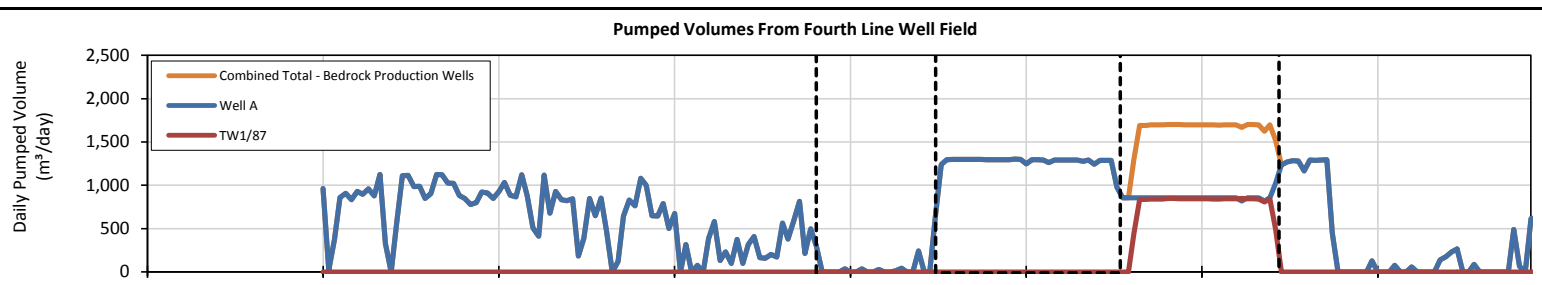


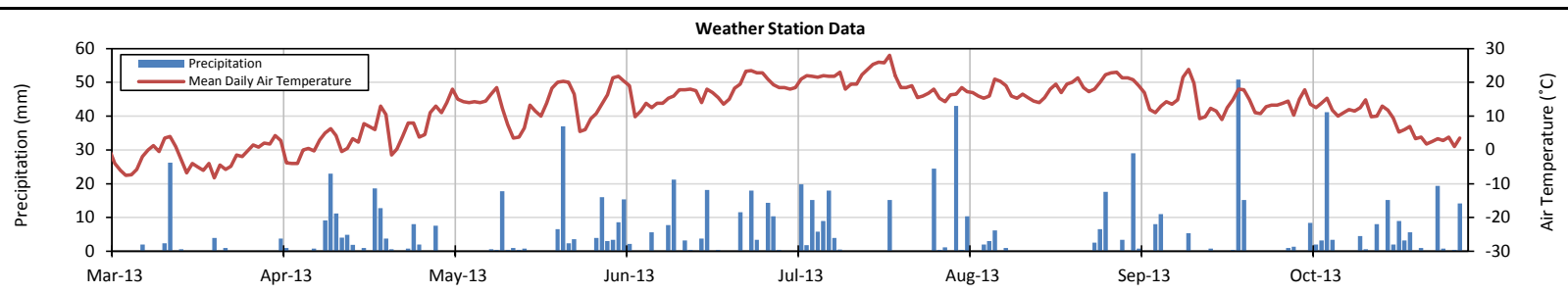












Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Orangeville MOE Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

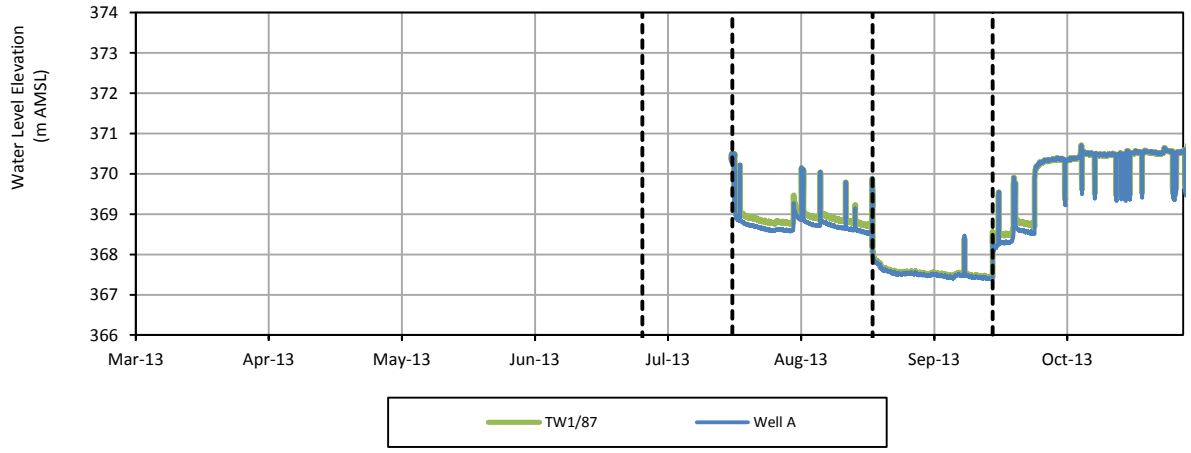
Figure No.

13b

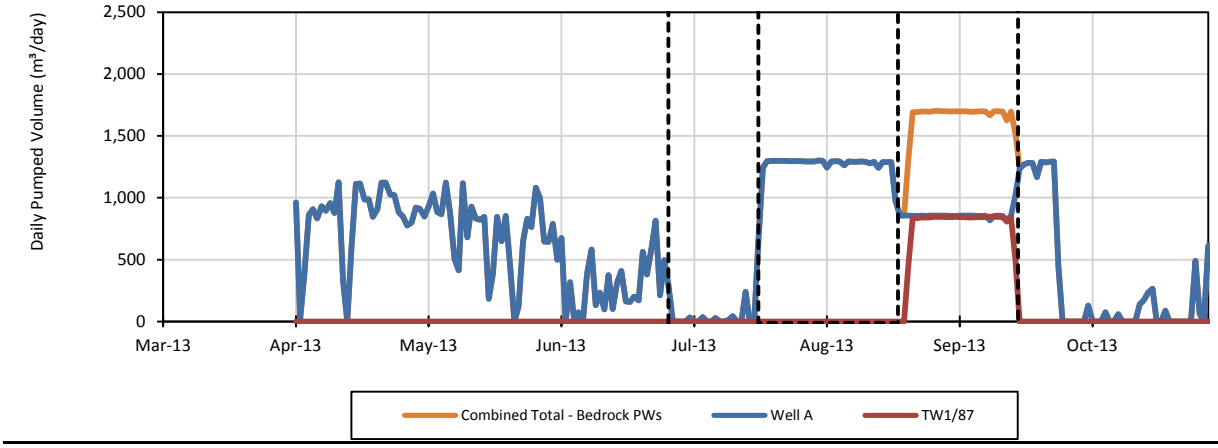
Title

Vertical Hydraulic Gradients
Trigger Monitoring Locations
Fourth Line Well Field

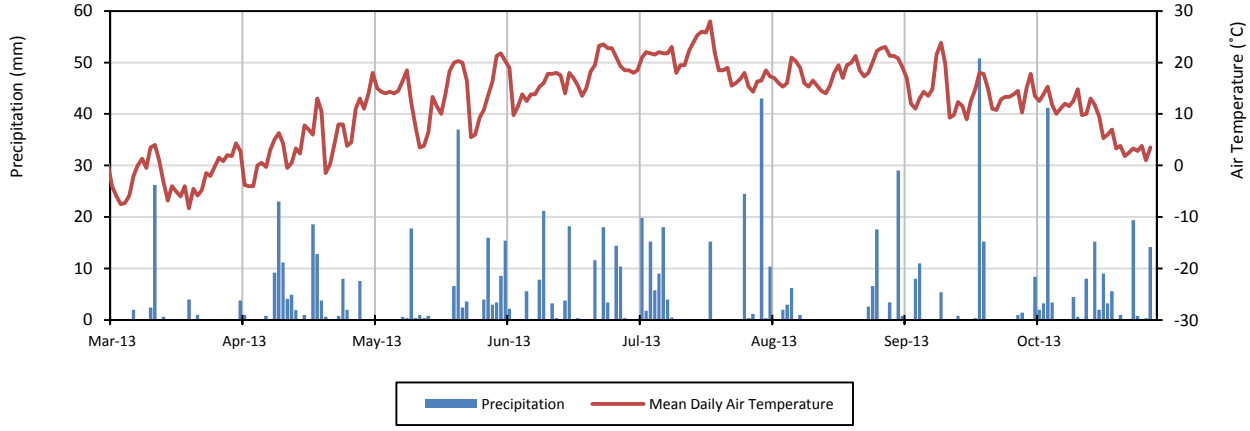
U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\A_Figures\fig 13b_sw and dp wls_trigger-locations.xlsx



Pumped Volumes From Fourth Line Well Field



Weather Station Data - Fergus MOE Station



Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

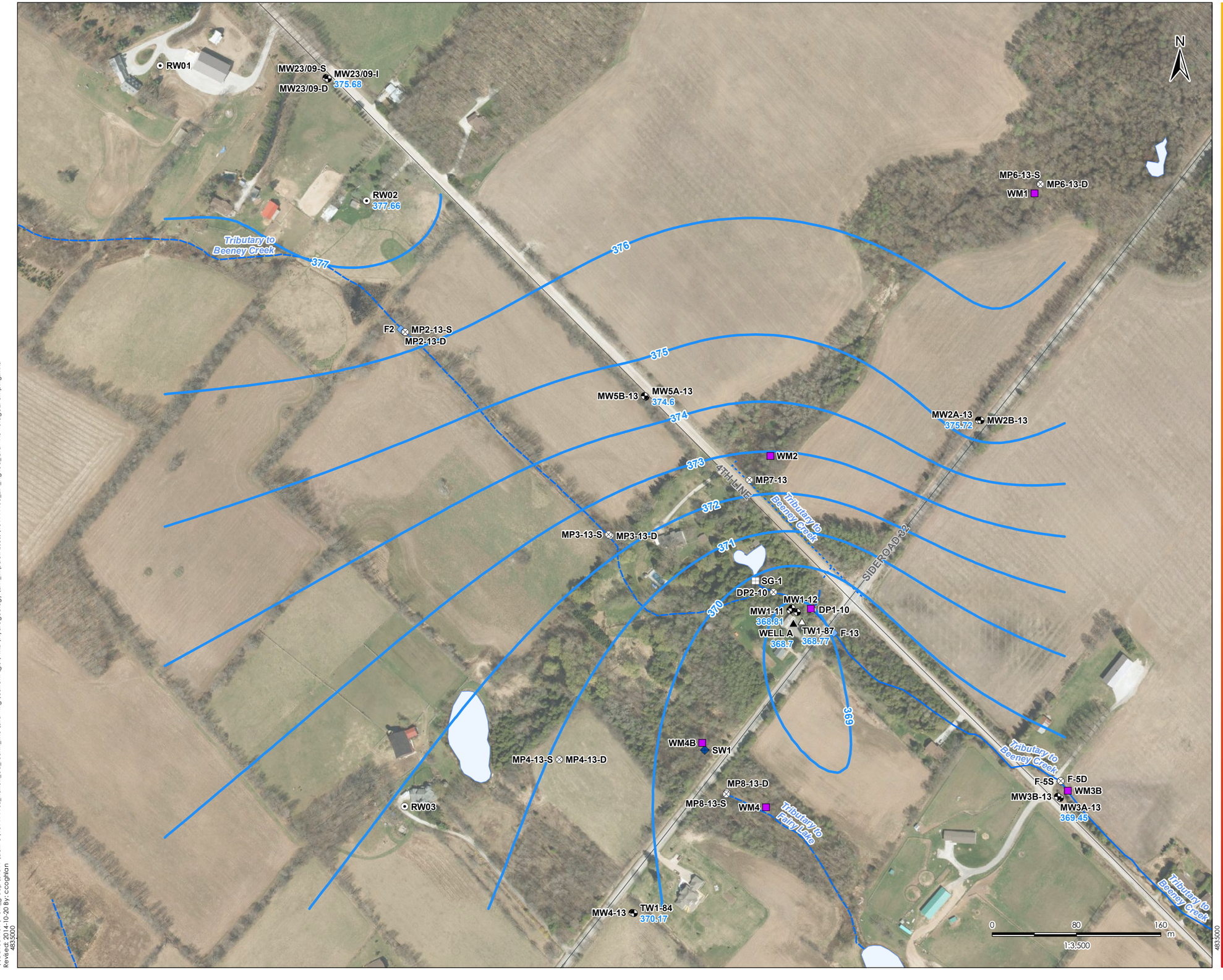
14

Stantec

Title

Hydrograph - TW1/87 and Well A

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\A_Figures\fig 14_tw1-87 and Well A.xlsx



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Revised: 2014-10-20 By: ccoghlan

Stantec

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- 374.54 Groundwater Elevation (mAMSL)
- Groundwater Contour (mAMSL)
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
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4. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

15a

Title

Interpreted Groundwater Flow - Bedrock Stage 2 Pumping Conditions

\\Cd1004-f01\work_group\01611\active\161111105_halton_ea_fourth_line\drawing\current\gis\MXD\Hydrogeology\Env_ImpactAssess\161111105_EIA_Fig15b_GrdwFlowStage3Pumping.mxd
Revised: 2014-10-20 By: ccoghlan

Stantec

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- 374.54 Groundwater Elevation (mAMSL)
- Groundwater Contour (mAMSL)
- Road
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2010.
4. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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Client/Project

Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

Figure No.

15b

Title

Interpreted Groundwater Flow - Bedrock Stage 3 Pumping Conditions

\\Cd1004-f01\work_group\01611\active\161111105_halton_eia_fourth_line\drawing\current\gis\MXD\Hydrogeology\Env_ImpactAssess\161111105_EIA_Fig16_ZoneOfPumpingInfluence.mxd
Revised: 2014-10-20 By: ccoghlan

Stantec

Legend

- Production Well
- Test Well
- Monitoring Well
- Drive-Point Piezometer
- Staff Gauge
- Flow Monitoring Station
- Surface Water Monitor
- Control Wetland Monitor/Vegetation Assessment Point
- Wetland Monitor/Vegetation Assessment Point
- Private Well
- 2.5 Estimated Drawdown (m)
- Drawdown Contour (m)
- Road
- Watercourse - Permanent
- Watercourse - Intermittent
- Watercourse - Ephemeral Flow
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2010.
4. Watercourses beyond the site limits are based on the MNRs interpretation and should be considered approximate.

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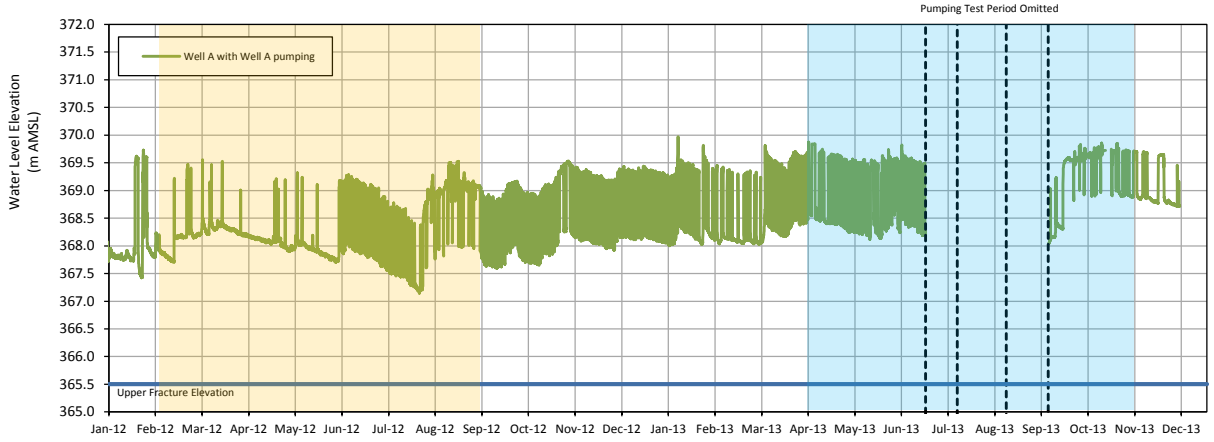
Halton Region
Fourth Line Well Field
Environmental Impact Assessment Report

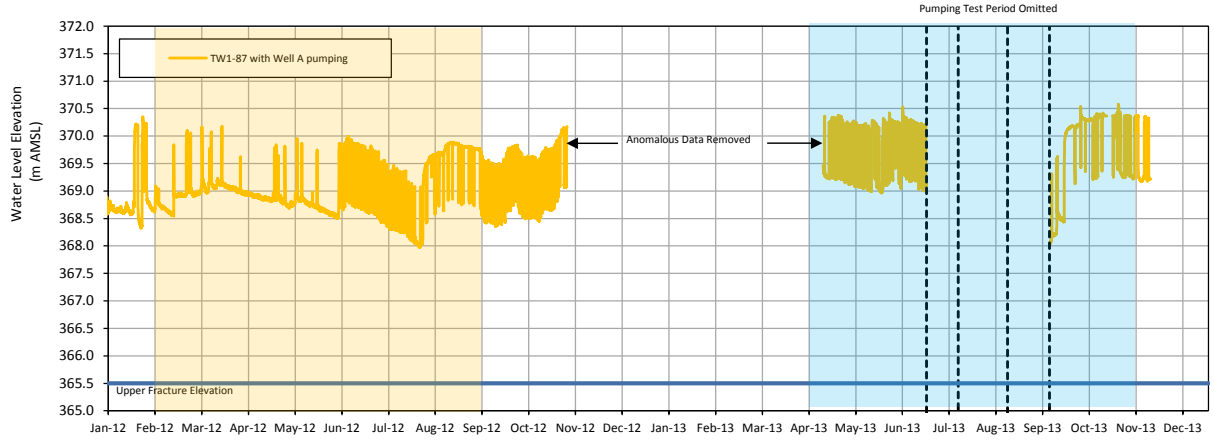
Figure No.

16

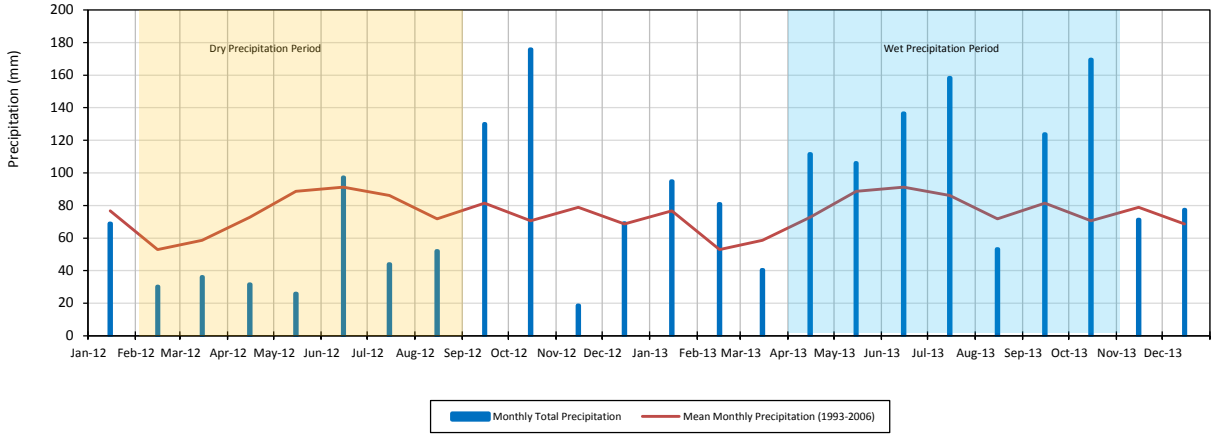
Title

Interpreted Zone of Pumping Influence - Bedrock Formation





Weather Station Data - Fergus MOE Station



Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13 and 14-Nov-13 supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

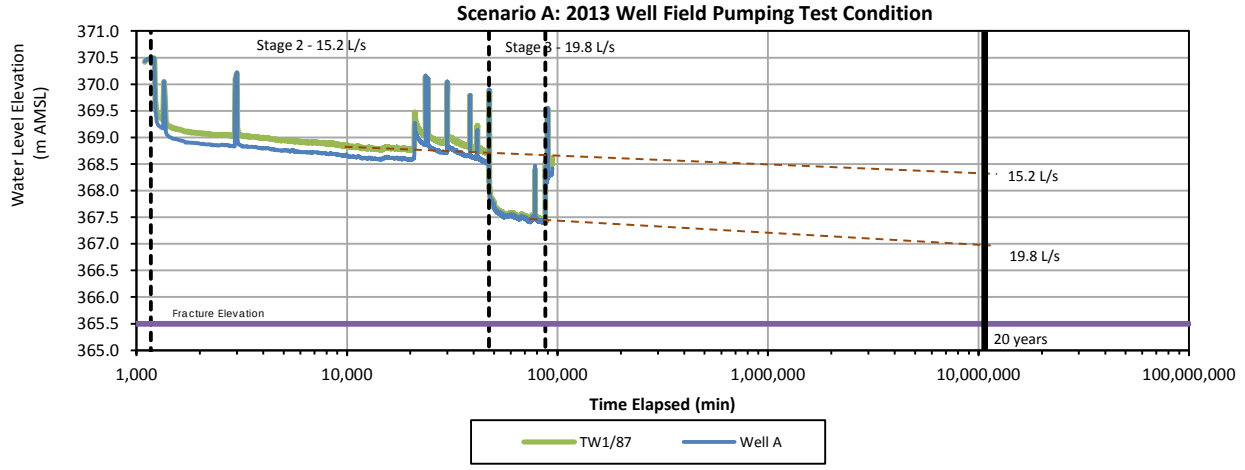
17

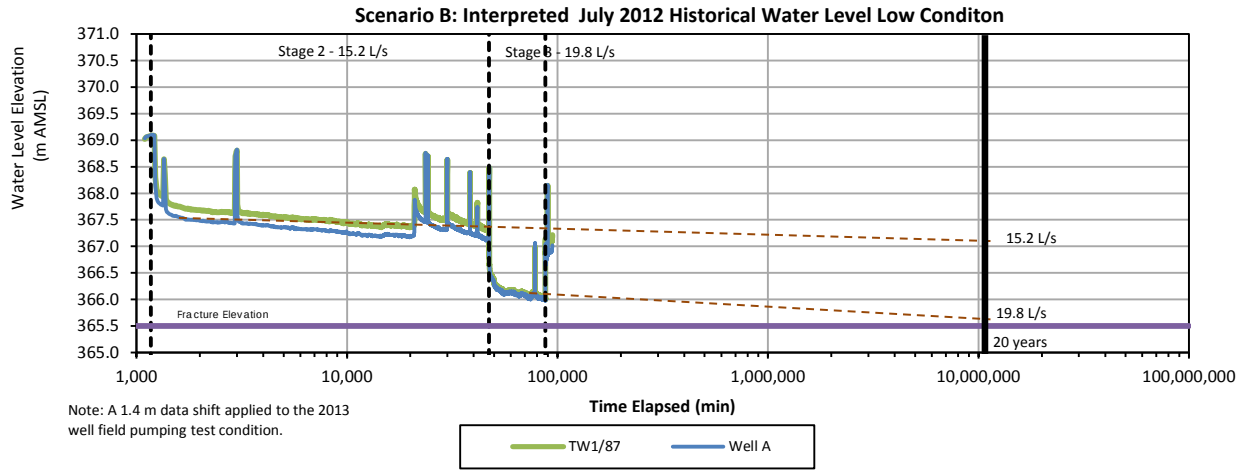
Title

Historical Water Level Data - Sustainable Yield Analysis

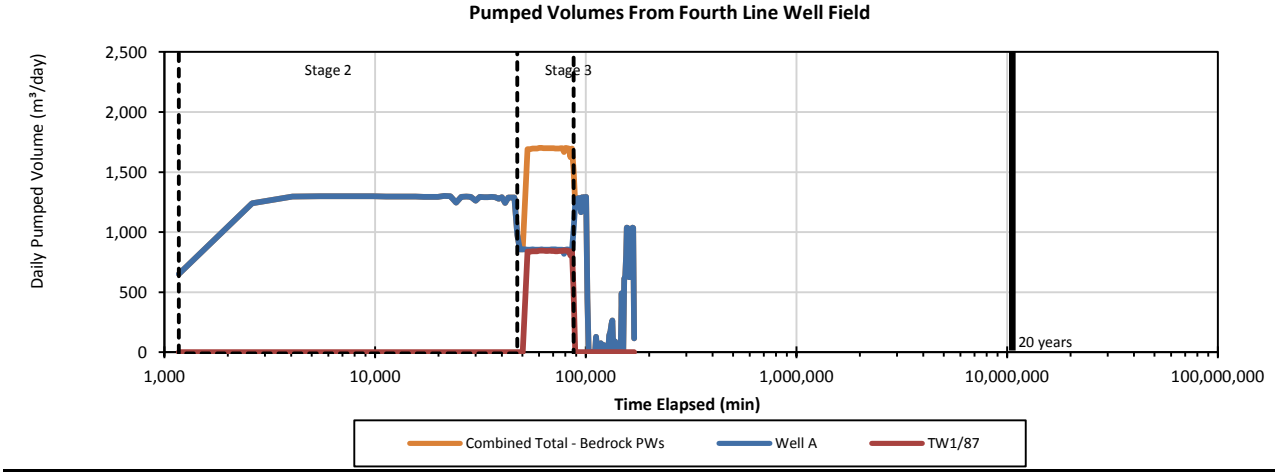
Stantec

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\A_Figures\Fig_17_Historical_water_levels_4th_Line_pumping_rates.xlsx





Note: A 1.4 m data shift applied to the 2013 well field pumping test condition.



Notes: Dashed lines represent changes in pumping rate or regime.

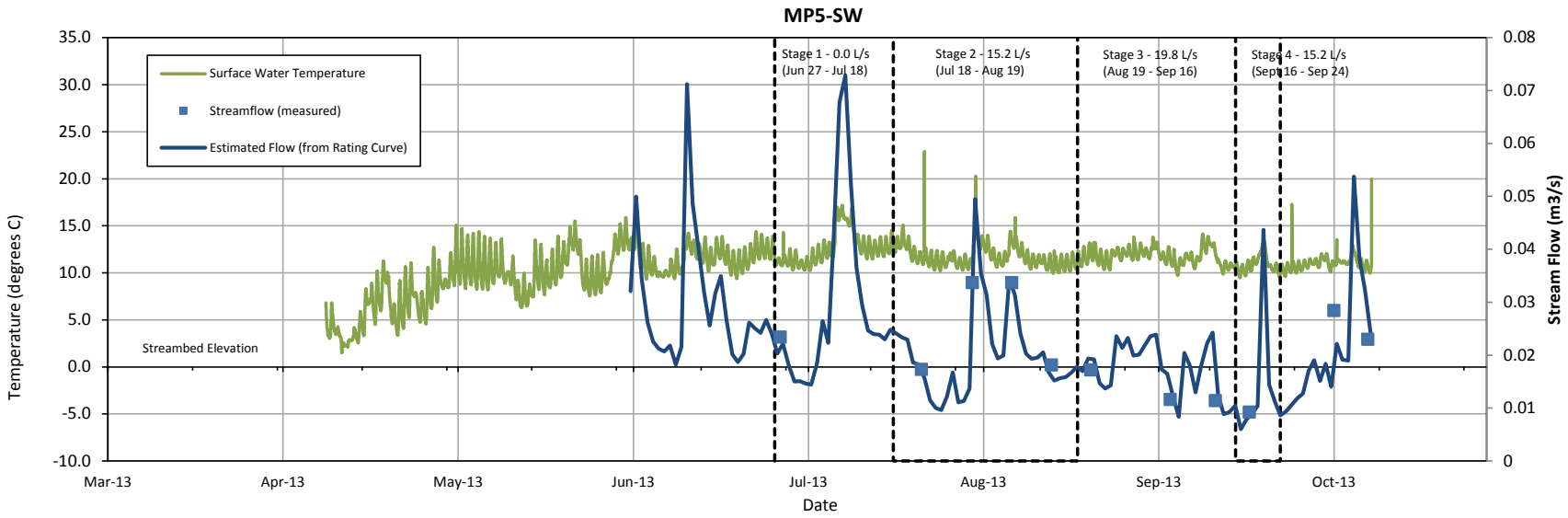
Client/Project
Fourth Line Well Field
Halton Hills
Region of Halton

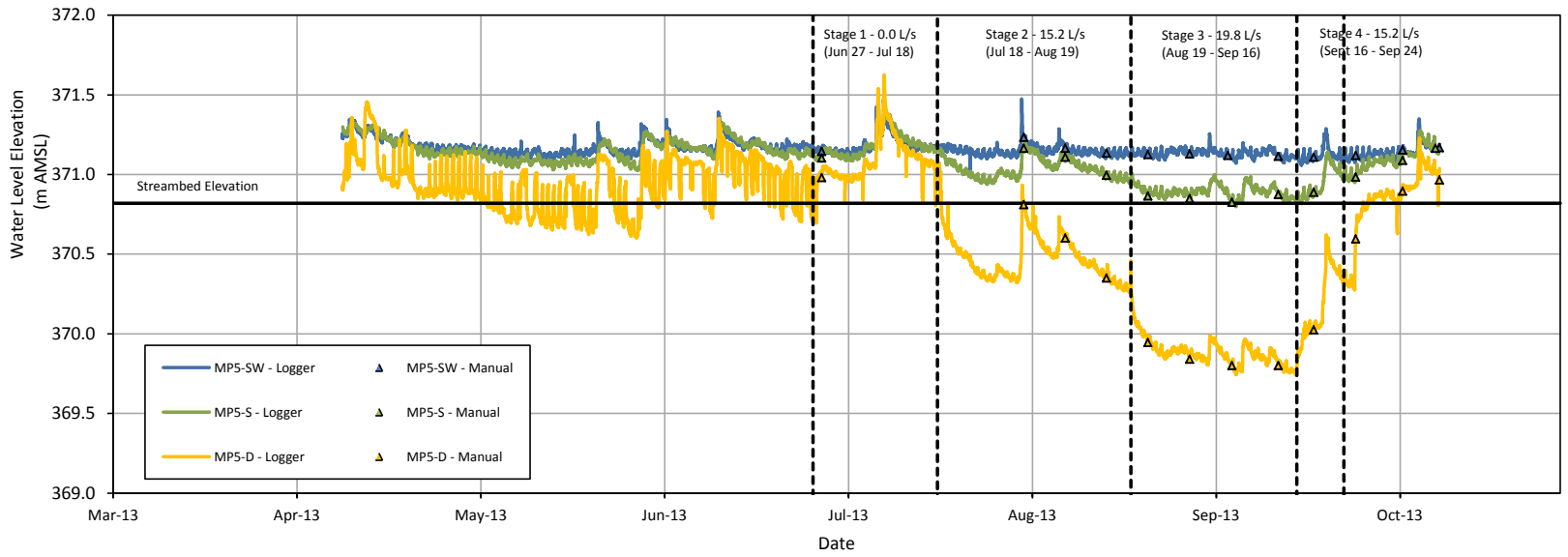
Figure No.
18

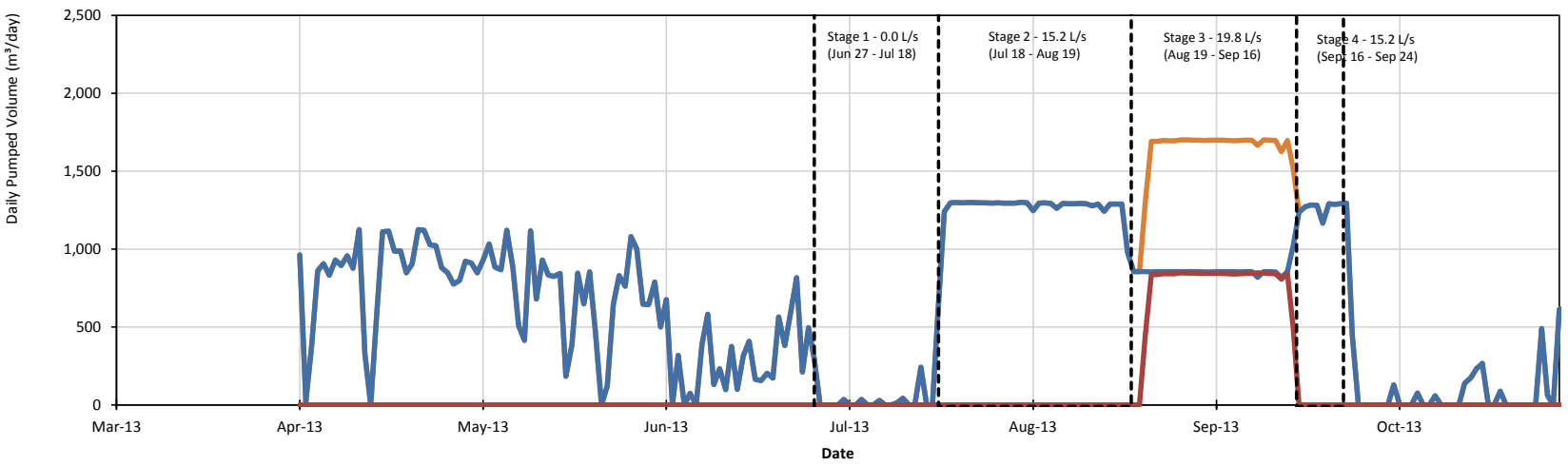
Title **Time-Drawdown Analysis for Sustainable Yield**

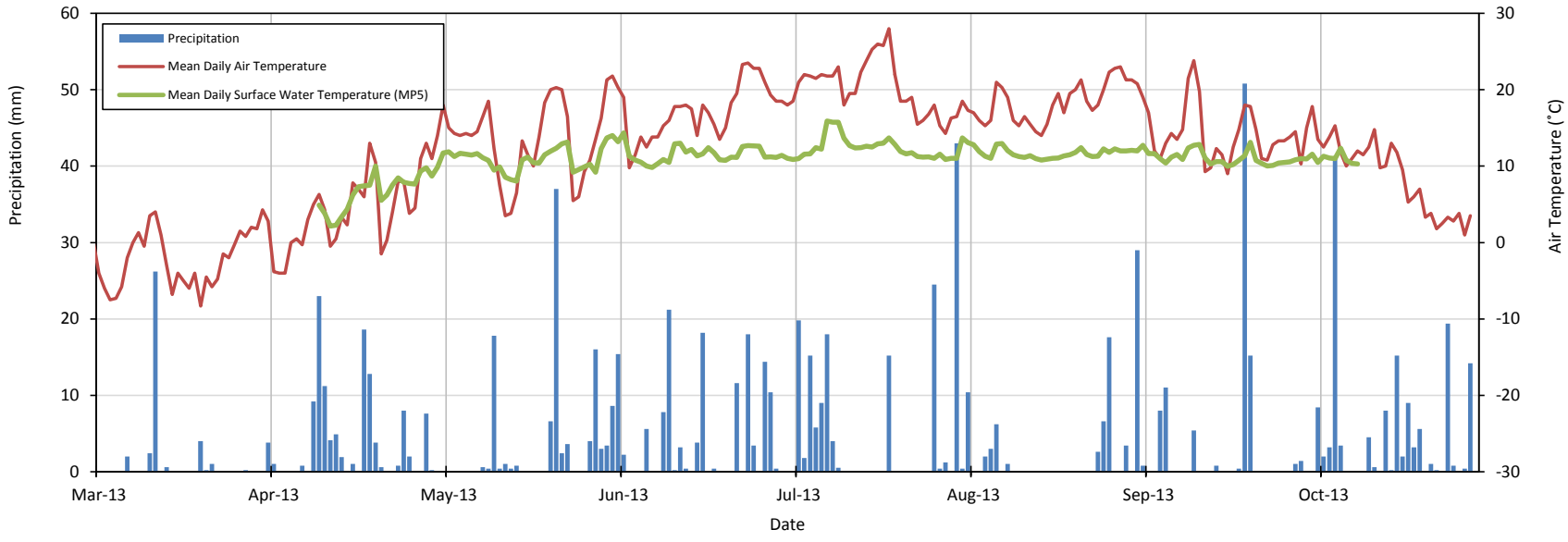
Stantec

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\A_Figures\Fig_18_sustainability_tw1_87_and_Well_A_20yrproj.xlsx









Notes:

Dashed lines represent changes in pumping rate or regime.

Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

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Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure/Well No.

19

Title

Estimated and Manual Flow Measurements at MP5/F5

Appendix B
Tables

Table 1
Schedule of Monitoring Activities
Fourth Line Well Field
Regional Municipality of Halton

Monitoring Activity	Locations	Date(s) Manual Data Recorded	Frequency of Continuous Measurements
Groundwater Level Monitoring	Well A, TW1-87, MW1-11, MW1-12, MW2A-13, MW2B-13, MW3A-13, MW3B-13, MW4-13, MW5A-13, MW5B-13, OW3-85, OW4-85, MW23/09-S, MW23/09-I, MW23/09-D, TW1-84, DP1-10, MP1-13 S/D, MP2-13 S/D, MP3-13 S/D, MP4-13 S/D, MP5-13 S/D. MP6-13 S/D, MP7-13, MP8-13 S/D, MP9-13 S/D, MP10-13, MP11-13, MP12-13, plus 5 private wells (RW01 through RW05)	Full round monitoring June 28, August 22, and October 10, 2013; Trigger locations only July 23, and weekly from August 1 through to October 4, 2013	15 minute frequency (downloaded during each manual monitoring event)
Surface Water Level Monitoring	DP1-10SW, MP1-13SW, MP2-13SW, MP3-13SW, MP4-13SW, MP5-13SW, MP6-13SW, MP7-13SW, MP9-13SW, MP10-13SW, MP11-13SW, MP12-13SW	Full round monitoring June 28, August 22, and October 10, 2013; Trigger locations only July 23, and weekly from August 1 through to October 4, 2013	15 minute frequency (downloaded during each manual monitoring event)
Streamflow Measurements	F1, F2, F5, F9, F10, F11, F13, F14, F15	June 28; July 23; weekly from August 1 through to October 10, 2013	N/A
Redd Survey	Tributary to Beeney Creek (well field property and parallel to Fourth Line), MP8, and MP10	November 8, 2012	N/A
Fish Habitat Survey	F10, MP10, MP8, MP7, MP5	September 21, 2012	N/A
Groundwater Sampling	Well 1, TW1-87	August 29, and September 13, 2013 at TW1-87, August 29, 2013 at Well A	N/A
Fall Flora Inventory/Ecological Land Classification	Study Area	August 21, 2012	N/A
Amphibian #1 - Early Breeders	Study Area	April 17, 2013	N/A
Spring Flora Inventory/Ecological Land Classification/Amphibian Egg Mass	Study Area	April 25, 2013	N/A
Amphibian #2 - Mid-season Breeders	Study Area	May 30, 2013	N/A
Summer Flora Inventory/Ecological Land Classification/Vernal Pool Assessment/Amphibian Egg Mass	Study Area	July 17, 2013	N/A

TABLE 2
MONITORING WELL COMPLETION DETAILS
FOURTH LINE WELL FIELD
REGIONAL MUNICIPALITY OF HALTON

Well ID	Date Installed	Well Status	Georeference					Borehole Depth	Well Casing			Stick-up	Screened/Open Hole Interval				Screened Material Description
			Northing	Easting	Top of Casing	Ground Surface	Source		Depth	Diameter	Diameter		Top of Screen/Open Hole		Bottom of Screen/Open Hole		
			NAD83	NAD83	(mAMSL)	(mAMSL)		(mBTOC)	(mBTOC)	(inch)	(mm)	(mAGS)	(mBTOC)	(mAMSL)	(mBTOC)	(mAMSL)	
Production Wells																	
Well A	1956	Existing	577004	4835301	374.97	374.73 / 374.03 [1]	Stantec Survey, 2013	21.00	7.39	8.0	200	0.24	7.39	367.58	12.92	362.05	Eramosa Formation (dolostone)
TW1-87	1987	Existing	577013	4835302	375.55	374.68	Stantec Survey, 2013	22.92	8.56	10.0	250	0.87	8.56	366.99	15.04	360.51	Eramosa Formation (dolostone)
Monitoring Wells																	
MW1-11	12-May-11	Existing	4835311	577002	375.23	374.55	Stantec Survey, 2013	13.33	7.39	6.0	152	0.68	7.39	367.84	13.33	361.90	Eramosa Formation (dolostone)
MW1-12	20-Sep-12	Existing	4835313	577003	375.07	374.48	Stantec Survey, 2013	7.14	5.62	2.0	51	0.59	5.62	369.45	7.14	367.93	gravel and cobbles
MW2A-13	15-Feb-13	Existing	4835492	577181	381.50	380.29	Stantec Survey, 2013	13.63	10.58	2.0	51	1.21	10.58	370.92	13.63	367.87	Eramosa Formation (dolostone)
MW2B-13	15-Feb-13	Existing	4835491	577183	381.48	380.16	Stantec Survey, 2013	7.72	4.67	2.0	51	1.32	4.67	376.81	7.72	373.76	silty sand till, trace gravel
MW3A-13	13-Feb-13	Existing	4835133	577258	372.22	371.31	Stantec Survey, 2013	9.77	6.73	2.0	51	0.91	6.73	365.49	9.77	362.45	Eramosa Formation (dolostone)
MW3B-13	13-Feb-13	Existing	4835134	577256	372.28	371.32	Stantec Survey, 2013	4.01	2.48	2.0	51	0.96	2.48	369.80	4.01	368.27	sand, some silt to silty
MW4-13	26-Mar-13	Existing	4835024	576852	379.70	378.77	Stantec Survey, 2013	7.48	4.44	2.0	51	0.93	4.44	375.26	7.48	372.22	sand till, some silt
MW5A-13	11-Feb-13	Existing	4835514	576865	378.85	378.07	Stantec Survey, 2013	10.41	7.36	2.0	51	0.78	7.36	371.49	10.41	368.44	Eramosa Formation (dolostone)
MW5B-13	7-Feb-13	Existing	4835515	576863	378.95	378.08	Stantec Survey, 2013	7.27	3.46	2.0	51	0.87	3.46	375.49	6.51	372.44	sand to sand and gravel
MW23/09-D	9-Jul-09	Existing	4835815	576563	395.42	394.63	Stantec Survey, 2013	87.69	58.7	-	-	0.79	58.7	336.73	63.6	331.83	Gasport Formation
MW23/09-I	9-Jul-09	Existing	4835815	576563	395.42	394.63	Stantec Survey, 2013	87.69	25.2	-	-	0.79	25.2	370.23	28.2	367.23	Guelph Formation
MW23/09-S	9-Jul-09	Existing	4835817	576562	395.61	394.62	Stantec Survey, 2013	15.19	13.9	-	-	0.99	13.9	381.72	15.2	380.42	sand with gravel and cobbles
TW1-84	1984	Existing	4835023.72	576853.807	379.227	378.633	Stantec Survey, 2013	-	-	-	-	-	-	-	-	-	-
Drivepoint Piezometers																	
MP1-13-S	9-Apr-13	Existing	4835725	576227	394.63	393.40	Stantec Survey, 2013	-	2.22	1.0	25	1.22	2.22	392.41	2.64	391.99	-
MP1-13-D	9-Apr-13	Existing	4835725	576227	394.76	393.42	Stantec Survey, 2013	-	3.15	1.0	25	1.32	3.15	391.61	3.57	391.19	-
MP2-13-S	9-Apr-13	Existing	4835575	576637	382.87	381.76	Stantec Survey, 2013	-	2.22	1.0	25	1.07	2.22	380.65	2.64	380.23	-
MP2-13-D	9-Apr-13	Existing	4835575	576636	382.97	381.81	Stantec Survey, 2013	-	3.15	1.0	25	1.17	3.15	379.82	3.57	379.40	-
MP3-13-S	9-Apr-13	Existing	4835383	576829	377.43	376.29	Stantec Survey, 2013	-	2.22	1.0	25	1.11	2.22	375.21	2.64	374.79	-
MP3-13-D	9-Apr-13	Existing	4835382	576831	377.52	376.28	Stantec Survey, 2013	-	3.15	1.0	25	1.21	3.15	374.37	3.57	373.95	-
MP4-13-S	9-Apr-13	Existing	4835170	576783	384.76	383.74	Stantec Survey, 2013	-	2.22	1.0	25	0.97	2.22	382.54	2.64	382.12	-
MP4-13-D	9-Apr-13	Existing	4835170	576783	384.72	383.81	Stantec Survey, 2013	-	3.15	1.0	25	0.95	3.15	381.57	3.57	381.15	-
MP5-13-S	8-Apr-13	Existing	4835149	577259	372.40	370.81	Stantec Survey, 2013	-	2.22	1.0	25	1.60	2.22	370.18	2.64	369.76	-
MP5-13-D	8-Apr-13	Existing	4835149	577259	372.38	370.82	Stantec Survey, 2013	-	3.46	1.0	25	1.57	3.46	368.92	3.88	368.50	-
MP6-13-S	9-Apr-13	Existing	4835716	577239	377.25	376.22	Stantec Survey, 2013	-	2.22	1.0	25	1.00	2.22	375.03	2.64	374.61	-
MP6-13-D	9-Apr-13	Existing	4835716	577239	377.27	376.21	Stantec Survey, 2013	-	3.15	1.0	25	1.01	3.15	374.12	3.57	373.70	-
MP7-1-3	8-Apr-13	Existing	4835435	576963	376.05	374.53	Stantec Survey, 2013	-	2.21	1.0	25	1.43	2.21	373.84	2.63	373.42	-
MP8-13-S	7-May-13	Existing	4835137	576941	375.46	373.97	Stantec Survey, 2013	-	2.22	1.0	25	1.46	2.22	373.24	2.64	372.82	-
MP8-13-D	7-May-13	Existing	4835138	576942	375.03	374.02	Stantec Survey, 2013	-	2.22	1.0	25	0.91	2.22	372.81	2.64	372.39	-
MP9-13-S	9-Apr-13	Existing	4834838	577290	371.07	370.01	Stantec Survey, 2013	-	2.22	1.0	25	1.03	2.22	368.85	2.64	368.43	-
MP9-13-D	9-Apr-13	Existing	4834838	577291	371.08	370.02	Stantec Survey, 2013	-	3.15	1.0	25	1.08	3.15	367.93	3.57	367.51	-
MP10-13	9-Apr-13	Existing	4834813	576650	382.16	381.60	Stantec Survey, 2013	-	2.22	1.0	25	0.53	2.22	379.94	2.64	379.52	-
MP11-13	24-Apr-13	Existing	4836717	577611	379.24	378.19	Stantec Survey, 2013	-	2.20	1.0	25	1.05	2.20	377.04	2.62	376.62	-
MP12-13	7-May-13	Existing	4834940	577538	368.99	368.17	Stantec Survey, 2013	-	1.32	1.0	25	0.77	1.32	367.67	1.74	367.25	-
DP1-10	40232	Existing	4835308	577030	373.72	372.8	Stantec Survey, 2013	-	2.01	1	25	0.92	1.59	372.13	2.93	370.79	-
DP2-10	1-Mar-10	Existing	576991	4835329	-	-	Stantec Survey, 2013	-	1.72	1.0	25	0.70	1.30	-	1.72	-	-

Notes:
(mAMSL) meters above mean sea level
(mBTOC) meters below top of casing
- information not available or not applicable
MOE WWR Ontario Ministry of the Environment Water Well Record
OBM Ontario Base Map
1 Surveyed pump house floor elevation is 374.728 m AMSL and estimated ground surface at time of Well4A well construction was 374.03 m AMSL

Table 3
Summary of Terrestrial and Species at Risk Assessment Results
Fourth Line Well Field
Regional Municipality of Halton

									Stantec	Dillon (2012b)					
Wetland ID	**Parcel#**	**Instrument**	**ELC**	**Substrate**	**Texture**	**Vernal Pools**	**Breeding Amphibians (Dillon)**	**Breeding Amphibians (Stantec)***	**SWH - Amphibian Breeding as per Ecoregion Criteria (6E)**		**Incidental Amphibians**	**Egg Mass**	**GW Flora**	**Rare Species**	**Wetland Program**
none	38	F3	FOD7-2	Mineral	not sampled	no	none	none	no	N/A	none	no	watercress	none	none
WM1	114	MP6	SWD3-3	Mineral	fSand	yes	SPPE, LEFR, WOFR	SPPE, WOFR, GRTR, GRFR	yes	yes	none	not sampled	none	none	MP control, staff gauge (vernal pool)
WM2	114	MP7	SWM1-1	MIneral	Silty fSand	no	WOFR	none	no	yes	none	no	marsh marigold	none	none
WM2B	109	MP3	SMW1-1	Mineral	Silty fSand	no	none	none	no	no	GRFR	no	jewelweed, sensitive fern, marsh marigold, watercress	butternut	MP trigger, visual health assessment (flora)
WM3	36	MP12	SWM1-1	Mineral	Loamy fSand	yes	GRTR	WOFR	no	yes	none	not sampled	marsh marigold, yellow birch, crested wood fern, sensitive fern	none	MP control, visual health assessment (flora)
WM3B	36	MP5	SWT2	Mineral	Loamy fSand	no	none	none	no	N/A	none	no	marsh marigold, sensitive fern, watercress	none	MP trigger, visual health assessment (flora)
WM4	37	MP8	SWD6-3	Organic	Sand	no	WOFR, GRFR	GRTR	no	N/A	none	no	sensitive fern, marsh marigold, yellow birch	none	Visual health assessment
WM4B	111	SW1	SWD6-3	Organic	Sand	yes	WOFR	none	no	yes	none	not sampled	none	none	Staff gauge (vernal pool)
WM5	31	none	SWD2-1	Mineral	fSandy Clay	yes	WOFR	WOFR	no	N/A	none	not sampled	none	none	none
WM6	136	none	MAS2-1	Mineral	not sampled	yes	none	none	no	N/A	WOFR	not sampled	none	none	none
WM7	17	none	SWD3-3	Mineral	vfSandy Clay	yes	WOFR	SPPE, WOFR	no	N/A	none	not sampled	none	none	none
WM8	134	MP11	SWD4	Mineral	fSand	no	LEFR	none	no	N/A	none	no	watercress, marsh marigold, sensitive fern	none	MP control, visual health assessment
No access	112	MP10	not sampled	not sampled	not sampled	pond on airphoto	SPPE, GRFR	SPPE, WOFR	no	yes (north of Sideroad 22)	not sampled	not sampled	not sampled	not sampled	no access

Notes:
Denotes trigger wetland
Denotes control wetland

Table 4
Daily Pumping Data
Fourth Line Well Field
Regional Municipality of Halton

Date	Well A (m3/day)	TW1/87 (m3/day)	Combined (m3/day)
4/1/2013	962.05	0.00	962.05
4/2/2013	21.21	0.00	21.21
4/3/2013	379.24	0.00	379.24
4/4/2013	860.61	0.00	860.61
4/5/2013	906.91	0.00	906.91
4/6/2013	832.33	0.00	832.33
4/7/2013	929.94	0.00	929.94
4/8/2013	895.36	0.00	895.36
4/9/2013	957.46	0.00	957.46
4/10/2013	876.63	0.00	876.63
4/11/2013	1124.24	0.00	1124.24
4/12/2013	326.02	0.00	326.02
4/13/2013	0.00	0.00	0.00
4/14/2013	588.14	0.00	588.14
4/15/2013	1111.66	0.00	1111.66
4/16/2013	1114.94	0.00	1114.94
4/17/2013	986.06	0.00	986.06
4/18/2013	987.71	0.00	987.71
4/19/2013	846.75	0.00	846.75
4/20/2013	904.70	0.00	904.70
4/21/2013	1123.89	0.00	1123.89
4/22/2013	1121.44	0.00	1121.44
4/23/2013	1026.72	0.00	1026.72
4/24/2013	1020.51	0.00	1020.51
4/25/2013	881.25	0.00	881.25
4/26/2013	847.18	0.00	847.18
4/27/2013	776.04	0.00	776.04
4/28/2013	799.21	0.00	799.21
4/29/2013	921.40	0.00	921.40
4/30/2013	909.40	0.00	909.40
5/1/2013	847.25	0.00	847.25
5/2/2013	928.40	0.00	928.40
5/3/2013	1033.66	0.00	1033.66
5/4/2013	884.50	0.00	884.50
5/5/2013	866.70	0.00	866.70
5/6/2013	1121.80	0.00	1121.80
5/7/2013	880.85	0.00	880.85
5/8/2013	507.72	0.00	507.72
5/9/2013	413.78	0.00	413.78
5/10/2013	1117.56	0.00	1117.56
5/11/2013	679.23	0.00	679.23
5/12/2013	928.89	0.00	928.89
5/13/2013	833.31	0.00	833.31
5/14/2013	823.27	0.00	823.27
5/15/2013	844.56	0.00	844.56

Table 4
Daily Pumping Data
Fourth Line Well Field
Regional Municipality of Halton

Date	Well A (m3/day)	TW1/87 (m3/day)	Combined (m3/day)
5/16/2013	183.25	0.00	183.25
5/17/2013	387.16	0.00	387.16
5/18/2013	846.19	0.00	846.19
5/19/2013	648.91	0.00	648.91
5/20/2013	852.62	0.00	852.62
5/21/2013	471.32	0.00	471.32
5/22/2013	0.00	0.00	0.00
5/23/2013	121.80	0.00	121.80
5/24/2013	646.28	0.00	646.28
5/25/2013	830.00	0.00	830.00
5/26/2013	761.95	0.00	761.95
5/27/2013	1080.46	0.00	1080.46
5/28/2013	999.19	0.00	999.19
5/29/2013	646.75	0.00	646.75
5/30/2013	644.17	0.00	644.17
5/31/2013	788.58	0.00	788.58
6/1/2013	499.14	0.00	499.14
6/2/2013	675.74	0.00	675.74
6/3/2013	0.00	0.00	0.00
6/4/2013	317.58	0.00	317.58
6/5/2013	0.00	0.00	0.00
6/6/2013	74.53	0.00	74.53
6/7/2013	0.00	0.00	0.00
6/8/2013	386.57	0.00	386.57
6/9/2013	582.17	0.00	582.17
6/10/2013	130.73	0.00	130.73
6/11/2013	231.96	0.00	231.96
6/12/2013	97.66	0.00	97.66
6/13/2013	374.71	0.00	374.71
6/14/2013	100.11	0.00	100.11
6/15/2013	316.62	0.00	316.62
6/16/2013	408.24	0.00	408.24
6/17/2013	163.39	0.00	163.39
6/18/2013	156.49	0.00	156.49
6/19/2013	202.60	0.00	202.60
6/20/2013	171.64	0.00	171.64
6/21/2013	563.85	0.00	563.85
6/22/2013	380.52	0.00	380.52
6/23/2013	589.20	0.00	589.20
6/24/2013	815.35	0.00	815.35
6/25/2013	211.01	0.00	211.01
6/26/2013	496.56	0.00	496.56
6/27/2013	295.14	0.00	295.14
6/28/2013	0.00	0.00	0.00
6/29/2013	0.00	0.00	0.00
6/30/2013	0.00	0.00	0.00
7/1/2013	0.00	0.00	0.00

Table 4
Daily Pumping Data
Fourth Line Well Field
Regional Municipality of Halton

Date	Well A (m3/day)	TW1/87 (m3/day)	Combined (m3/day)
7/2/2013	34.46	0.00	34.46
7/3/2013	0.00	0.00	0.00
7/4/2013	0.00	0.00	0.00
7/5/2013	34.93	0.00	34.93
7/6/2013	0.00	0.00	0.00
7/7/2013	0.00	0.00	0.00
7/8/2013	28.76	0.00	28.76
7/9/2013	0.00	0.00	0.00
7/10/2013	0.00	0.00	0.00
7/11/2013	13.54	0.00	13.54
7/12/2013	43.82	0.00	43.82
7/13/2013	0.00	0.00	0.00
7/14/2013	0.00	0.00	0.00
7/15/2013	241.51	0.00	241.51
7/16/2013	0.00	0.00	0.00
7/17/2013	0.00	0.00	0.00
7/18/2013	652.23	0.00	652.23
7/19/2013	1240.77	0.00	1240.77
7/20/2013	1295.94	0.00	1295.94
7/21/2013	1299.52	0.00	1299.52
7/22/2013	1297.51	0.00	1297.51
7/23/2013	1299.53	0.00	1299.53
7/24/2013	1298.96	0.00	1298.96
7/25/2013	1297.25	0.00	1297.25
7/26/2013	1297.10	0.00	1297.10
7/27/2013	1295.51	0.00	1295.51
7/28/2013	1295.76	0.00	1295.76
7/29/2013	1294.13	0.00	1294.13
7/30/2013	1294.16	0.00	1294.16
7/31/2013	1294.35	0.00	1294.35
8/1/2013	1300.59	0.00	1300.59
8/2/2013	1297.51	0.00	1297.51
8/3/2013	1245.36	0.00	1245.36
8/4/2013	1294.54	0.00	1294.54
8/5/2013	1295.99	0.00	1295.99
8/6/2013	1292.16	0.00	1292.16
8/7/2013	1262.46	0.00	1262.46
8/8/2013	1292.42	0.00	1292.42
8/9/2013	1291.74	0.00	1291.74
8/10/2013	1291.24	0.00	1291.24
8/11/2013	1292.59	0.00	1292.59
8/12/2013	1290.67	0.00	1290.67
8/13/2013	1276.70	0.00	1276.70
8/14/2013	1289.52	0.00	1289.52
8/15/2013	1242.05	0.00	1242.05
8/16/2013	1289.19	0.00	1289.19
8/17/2013	1288.25	0.00	1288.25

Table 4
Daily Pumping Data
Fourth Line Well Field
Regional Municipality of Halton

Date	Well A (m3/day)	TW1/87 (m3/day)	Combined (m3/day)
8/18/2013	1287.98	0.00	1287.98
8/19/2013	978.95	0.00	978.95
8/20/2013	855.54	0.00	855.54
8/21/2013	855.55	0.00	855.55
8/22/2013	855.35	442.72	1298.08
8/23/2013	854.28	837.14	1691.41
8/24/2013	854.51	836.28	1690.79
8/25/2013	855.12	841.46	1696.58
8/26/2013	854.63	841.13	1695.76
8/27/2013	854.85	840.73	1695.58
8/28/2013	854.84	846.61	1701.45
8/29/2013	854.96	846.23	1701.19
8/30/2013	854.82	844.84	1699.66
8/31/2013	854.93	844.12	1699.05
9/1/2013	854.26	843.58	1697.84
9/2/2013	854.28	844.54	1698.82
9/3/2013	855.06	842.98	1698.04
9/4/2013	855.08	843.36	1698.44
9/5/2013	855.08	841.35	1696.43
9/6/2013	854.84	840.49	1695.34
9/7/2013	854.29	842.52	1696.81
9/8/2013	854.55	844.16	1698.71
9/9/2013	854.83	843.10	1697.93
9/10/2013	818.13	848.01	1666.14
9/11/2013	854.80	845.87	1700.67
9/12/2013	855.20	844.50	1699.70
9/13/2013	854.17	842.22	1696.39
9/14/2013	818.70	806.46	1625.16
9/15/2013	854.59	841.57	1696.15
9/16/2013	1023.45	491.34	1514.78
9/17/2013	1237.03	0.00	1237.03
9/18/2013	1270.56	0.00	1270.56
9/19/2013	1282.05	0.00	1282.05
9/20/2013	1281.49	0.00	1281.49
9/21/2013	1165.92	0.00	1165.92
9/22/2013	1290.11	0.00	1290.11
9/23/2013	1286.49	0.00	1286.49
9/24/2013	1290.98	0.00	1290.98
9/25/2013	1293.92	0.00	1293.92
9/26/2013	447.80	0.00	447.80
9/27/2013	0.00	0.00	0.00
9/28/2013	0.00	0.00	0.00
9/29/2013	0.00	0.00	0.00
9/30/2013	0.00	0.00	0.00
10/1/2013	0.00	0.00	0.00
10/2/2013	0.00	0.00	0.00
10/3/2013	129.43	0.00	129.43

Table 4
Daily Pumping Data
Fourth Line Well Field
Regional Municipality of Halton

Date	Well A (m3/day)	TW1/87 (m3/day)	Combined (m3/day)
10/4/2013	0.00	0.00	0.00
10/5/2013	0.00	0.00	0.00
10/6/2013	0.00	0.00	0.00
10/7/2013	75.85	0.00	75.85
10/8/2013	0.00	0.00	0.00
10/9/2013	0.00	0.00	0.00
10/10/2013	59.22	0.00	59.22
10/11/2013	0.00	0.00	0.00
10/12/2013	0.00	0.00	0.00
10/13/2013	0.00	0.00	0.00
10/14/2013	0.00	0.00	0.00
10/15/2013	138.74	0.00	138.74
10/16/2013	174.29	0.00	174.29
10/17/2013	231.80	0.00	231.80
10/18/2013	264.88	0.00	264.88
10/19/2013	0.00	0.00	0.00
10/20/2013	0.00	0.00	0.00
10/21/2013	88.15	0.00	88.15
10/22/2013	0.00	0.00	0.00
10/23/2013	0.00	0.00	0.00
10/24/2013	0.00	0.00	0.00
10/25/2013	0.00	0.00	0.00
10/26/2013	0.00	0.00	0.00
10/27/2013	0.00	0.00	0.00
10/28/2013	490.81	0.00	490.81
10/29/2013	63.55	0.00	63.55
10/30/2013	0.00	0.00	0.00
10/31/2013	614.10	0.00	614.10
11/1/2013	620.91	0.00	620.91
11/2/2013	806.95	0.00	806.95
11/3/2013	1036.74	0.00	1036.74
11/4/2013	1035.65	0.00	1035.65
11/5/2013	721.95	0.00	721.95
11/6/2013	624.82	0.00	624.82
11/7/2013	922.97	0.00	922.97
11/8/2013	810.36	0.00	810.36
11/9/2013	769.39	0.00	769.39
11/10/2013	1036.83	0.00	1036.83
11/11/2013	1035.51	0.00	1035.51
11/12/2013	116.22	0.00	116.22
		Total	166723.72
		Average Daily	737.72
		Maximum Daily	1701.45

TABLE 5
Stream Flow Results
Fourth Line Well Field
Regional Municipality of Halton

	28-Jun-13	23-Jul-13	1-Aug-13	8-Aug-13	15-Aug-13	22-Aug-13	29-Aug-13	5-Sep-13	13-Sep-13	19-Sep-13	26-Sep-13	4-Oct-13	10-Oct-13
F1	0.0006	0	0.0204	0.0034	0	0	0	0	0	0	0.0001	0	0.0073
F2	0	0	0.0122	0.0034	0	0	0	0	0	0	0	0	0.0063
F5	0.0234	0.0173	0.0337	0.0337	0.0181	0.0172	0.0063	0.0116	0.0114	0.0092	-	0.0284	0.023
F9	0	0	0	0	0	0	0	0	0	0	0	0	0
F10	0.003	0.0015	0.0058	0.0014	0.0015	0.0006	0.0003	0.0002	0.0001	0.0004	0.0002	0.0061	0.001
F11	0.0132	0.0049	0.0993	0.0076	0.003	0.0047	0.0022	0.002	0.0026	0.0018	0.0036	0.0066	0.0156
F13	0.02	0.0193	0.0297	0.0213	0.0177	0.0124	0.0099	0.0091	0.0094	0.0054	-	0.019	0.0213
F14	0.0052	0.0045	0.4018	0.0153	0.0009	0	0.0023	0.0018	0.0032	0.0001	0.0006	0.0012	0.0153
F15	0	0	0.0102	0.0004	0	0	0	0	0	0	-	0	0

Note: Stream flow units of m^3/s

TABLE 6
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
FOURTH LINE WELL FIELD
REGIONAL MUNICIPALITY OF HALTON

Sample Location			TW1/87						Well A				
Sample Date			2-Mar-10	2-Mar-10	2-Mar-10	2-Mar-10	29-Aug-13	13-Sep-13	25-Feb-10	25-Feb-10	25-Feb-10	25-Feb-10	29-Aug-13
Sample ID			WG-160900623-20100302-MF-01	WG-160900623-20100302-MF-02	WG-160900623-20100302-MF-03	WG-160900623-20100302-MF-04	WG-161111105-20130829-AV02	WG-161111105-20130913-AV01	WG-160900623-20100225-MF-01	WG-160900623-20100225-MF-02	WG-160900623-20100225-MF-03	WG-160900623-20100225-MF-04	WG-161111105-20130829-AV01
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX
Laboratory Work Order			B024955	B024955	B024955	B024955	B3E4656	B3F4718	B023173	B023173	B023173	B023173	B3E4656
Laboratory Sample ID			FF5401	FF5402	FF5403	FF5404	SW0604	TB2375	FE5735	FE5736	FE5737	FE5738	SW0603
Sample Type	Units	ODWS											
Microbiological Analysis													
Algae & Diatom	P_A per 10ml	n/v	**nd**	**nd**	**nd**	**nd**	-	-	**nd**	**nd**	**nd**	**nd**	-
Total Aerobic Sporeformers	cfu/500mL	n/v	**3**	**4**	**20**	**150**	-	-	**7**	**1**	**5**	**40**	-
Escherichia coli (E.Coli)	cfu/100mL	0[A]	***< 1***	***< 1***	***< 1***	***< 1***	-	-	***< 1***	***< 1***	***< 1***	***< 1***	-
Total Coliform Background	cfu/100mL	n/v	-	-	-	-	-	-	-	-	-	-	-
Total Coliforms	cfu/100mL	0[A]	-	-	-	-	-	-	-	-	-	-	-
General Chemistry													
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	**271**	**272**	**271**	**272**	**270**	**270**	**267**	**270**	**272**	**271**	**260**
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	**2**	**2**	**2**	**2**	**1.7**	**2.6**	**2**	**2**	**2**	**2**	**1.6**
Alkalinity, Total (as CaCO3)	mg/L	30-500[F]	**273**	**274**	**273**	**274**	**270**	**280**	**269**	**272**	**274**	**273**	**260**
Ammonia (as N)	mg/L	n/v	< 0.05	< 0.05	< 0.05	< 0.05	< 0.050	< 0.050	< 0.05	< 0.05	< 0.05	< 0.05	< 0.050
Anion Sum	meq/L	n/v	**6.45**	**6.50**	**6.51**	**6.53**	**6.63**	**6.84**	**6.35**	**6.42**	**6.51**	**6.54**	**6.36**
Cation Sum	meq/L	n/v	**6.35**	**6.35**	**6.62**	**7.52**	**6.59**	**6.83**	**6.14**	**6.34**	**6.33**	**6.47**	**6.42**
Chloride	mg/L	250[D]	**6**	**8**	**9**	**10**	**18**	**17**	**7**	**8**	**9**	**11**	**12**
Dissolved Organic Carbon (DOC)	mg/L	5[D]	**0.8**	**0.7**	**0.7**	**0.8**	**0.91**	**1.6**	**0.7**	**0.7**	**0.7**	**0.7**	**0.84**
Electrical Conductivity, Lab	µmhos/cm	n/v	**586**	**590**	**593**	**597**	**620**	**630**	**582**	**587**	**592**	**598**	**600**
Hardness (as CaCO3)	mg/L	80-100[E]	**310[F]**	**310[F]**	**320[F]**	**360[F]**	**310[F]**	**320[F]**	**300[F]**	**310[F]**	**310[F]**	**310[F]**	**310[F]**
Ion Balance	%	n/v	**0.730**	**1.17**	**0.820**	**7.05**	**0.330**	**0.0700**	**1.69**	**0.600**	**1.36**	**0.540**	**0.490**
Langelier Index (at 20 C)	none	n/v	**0.798**	**0.788**	**0.793**	**0.863**	**0.753**	**0.953**	**0.736**	**0.812**	**0.727**	**0.761**	**0.713**
Langelier Index (at 4 C)	none	n/v	**0.549**	**0.539**	**0.544**	**0.615**	**0.505**	**0.704**	**0.487**	**0.563**	**0.478**	**0.512**	**0.464**
Nitrate (as N)	mg/L	10.0_d[C]	**2.2**	**2.4**	**2.5**	**2.8**	**2.7**	**2.4**	**2.1**	**2.4**	**2.5**	**2.7**	**3.1**
Nitrate + Nitrite (as N)	mg/L	10.0_d[C]	-	-	-	-	-	**2.4**	-	-	-	-	-
Nitrite (as N)	mg/L	1.0_d[C]	< 0.01	< 0.01	< 0.01	< 0.01	< 0.010	< 0.010	< 0.01	< 0.01	< 0.01	< 0.01	< 0.010
Orthophosphate(as P)	mg/L	n/v	< 0.01	< 0.01	< 0.01	< 0.01	< 0.010	< 0.010	< 0.01	0.01	< 0.01	< 0.01	< 0.010
pH	S.U.	6.5-8.5[F]	**7.9**	**7.9**	**7.9**	**7.9**	**7.83**	**8.00**	**7.8**	**7.9**	**7.8**	**7.8**	**7.81**
Saturation pH (at 20 C)	none	n/v	**7.08**	**7.08**	**7.07**	**7.02**	**7.08**	**7.05**	**7.10**	**7.08**	**7.08**	**7.08**	**7.10**
Saturation pH (at 4 C)	none	n/v	**7.32**	**7.32**	**7.32**	**7.27**	**7.33**	**7.30**	**7.35**	**7.33**	**7.33**	**7.33**	**7.34**
Sulfate	mg/L	500_h[D]	**31**	**30**	**29**	**28**	**27**	**30**	**30**	**29**	**29**	**28**	**24**
Total Dissolved Solids (Calculated)	mg/L	500[D]	**333**	**335**	**340**	**356**	**346**	**360**	**326**	**333**	**335**	**339**	**333**
Metals													
Aluminum	mg/L	0.1[F]	< 0.005	< 0.005	**0.010**	**0.033**	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	**0.013**	**0.0087**
Antimony	mg/L	0.006[B]	**0.0008**	< 0.0005	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050
Arsenic	mg/L	0.025[B]	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0010	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010
Barium	mg/L	1[C]	**0.046**	**0.045**	**0.045**	**0.046**	**0.047**	**0.049**	**0.044**	**0.045**	**0.045**	**0.046**	**0.054**
Beryllium	mg/L	n/v	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050
Boron	mg/L	5[B]	**0.01**	**0.01**	< 0.01	**0.01**	< 0.010	**0.023**	< 0.01	**0.01**	**0.01**	**0.01**	< 0.010
Cadmium	mg/L	0.005[C]	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010
Calcium	mg/L	n/v	**83**	**83**	**85**	**94**	**83**	**87**	**79**	**82**	**81**	**82**	**81**
Chromium (Total)	mg/L	0.05[C]	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050
Cobalt	mg/L	n/v	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050
Copper	mg/L	1[D]	**0.001**	< 0.001	< 0.001	**0.001**	< 0.0010	**0.0011**	**0.001**	< 0.001	< 0.001	**0.001**	< 0.0010
Iron	mg/L	0.3[D]	< 0.1	< 0.1	< 0.1	**0.2**	< 0.10	< 0.10	< 0.1	< 0.1	< 0.1	< 0.1	< 0.10
Lead	mg/L	0.01_c[C]	< 0.0005	< 0.0005	**0.0021**	**0.0056**	< 0.00050	**0.00081**	< 0.0005	< 0.0005	**0.0005**	**0.0019**	< 0.00050
Magnesium	mg/L	n/v	**25**	**25**	**26**	**31**	**25**	**26**	**24**	**25**	**25**	**26**	**25**
Manganese	mg/L	0.05[D]	< 0.002	< 0.002	**0.005**	**0.018**	< 0.0020	< 0.0020	< 0.002	< 0.002	< 0.002	**0.005**	< 0.0020
Molybdenum	mg/L	n/v	**0.002**	**0.002**	**0.002**	**0.001**	**0.00096**	**0.0013**	**0.002**	**0.002**	**0.002**	**0.002**	**0.0016**
Nickel	mg/L	n/v	**0.001**	**0.001**	**0.001**	**0.001**	< 0.0010	< 0.0010	**0.003**	< 0.001	**0.001**	**0.001**	**0.0012**
Phosphorus	mg/L	n/v	< 0.1	< 0.1	< 0.1	< 0.1	< 0.10	< 0.10	< 0.1	< 0.1	< 0.1	< 0.1	< 0.10
Potassium	mg/L	n/v	**0.9**	**0.9**	**0.9**	**1.0**	**1.3**	**1.4**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Selenium	mg/L	0.01[C]	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0020	< 0.0020	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0020
Silicon	mg/L	n/v	**4.8**	**4.7**	**4.7**	**4.8**	**4.6**	**4.8**	**4.8**	**5.0**	**4.9**	**4.9**	**4.9**
Silver	mg/L	n/v	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010
Sodium	mg/L	200_g[D] 20_g[E]	**3.7**	**3.9**	**4.2**	**4.7**	**7.4**	**7.3**	**3.5**	**4.0**	**4.4**	**5.0**	**6.0**
Strontium	mg/L	n/v	**0.13**	**0.13**	**0.13**	**0.13**	**0.17**	**0.18**	**0.12**	**0.12**	**0.12**	**0.13**	**0.13**
Thallium	mg/L	n/v	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.000050	< 0.000050	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.000050
Titanium	mg/L	n/v	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050
Uranium	mg/L	0.02[C]	**0.0009**	**0.0008**	**0.0009**	**0.0008**	**0.00083**	**0.00090**	**0.0009**	**0.0009**	**0.0008**	**0.0008**	**0.00083**
Vanadium	mg/L	n/v	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00050	< 0.00050	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00050
Zinc	mg/L	5[D]	**0.073**	**0.075**	**0.069**	**0.074**	**0.059**	**0.062**	**0.074**	**0.079**	**0.070**	**0.080**	**0.060**

See notes on last page

TABLE 6
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
FOURTH LINE WELL FIELD
REGIONAL MUNICIPALITY OF HALTON

Notes:

ODWS	Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, June 2003, Revised June 2006
[A]	ODWS Table 1 - Microbiological Standards, Maximum Acceptable Concentration
[B]	ODWS Table 2 - Chemical Standards, Interim Maximum Acceptable Concentration
[C]	ODWS Table 2 - Chemical Standards, Maximum Acceptable Concentration
[D]	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Aesthetic Objectives
[E]	ODWS Table 4 - Medical Officer of Health Reporting Limit
[F]	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Operational Guidelines
6.5[A]	Concentration exceeds the indicated standard.
15.2	Concentration was detected but did not exceed applicable standards.
< 0.50	Laboratory reportable detection limit exceeded standard.
< 0.03	The analyte was not detected above the laboratory reportable detection limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
[c]	This standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed fo
[d]	Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L (as nitrogen).
[DE]	The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be commur
[h]	When sulfate levels exceed 500 mg/L, water may have a laxative effect on some people.
cfu/500mL	colony forming units per 500 milliliters
cfu/100mL	colony forming units per 100 milliliters
P_A	Presence/Absence

TABLE 7
RPDS OF FIELD MEASUREMENTS
FOURTH LINE WELL FIELD
REGIONAL MUNICIPALITY OF HALTON

Field Measurement			Sampling Date												
			June 28, 2013	July 23, 2013	August 1, 2013	August 8, 2013	August 15, 2013	August 22, 2013	August 29, 2013	September 5, 2013	September 13, 2013	September 19, 2013	September 26, 2013	October 4, 2013	October 10, 2013
Water Level	DP1-10 (GW)	Reading 1		0.663	0.61	0.6	0.650	0.705	0.71	0.72	0.69	0.715	0.65	0.66	0.59
		Reading 2		0.664	0.61	0.6	0.655	0.705	0.71	0.72	0.69	0.715	0.65	0.66	
		RPD		0.15%	0.00%	0.00%	0.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-
	DP1-10 SW	Reading 1		0.705	0.66	0.685	0.710	0.71	0.71	0.73	0.715	0.73	0.72	0.7	0.67
		Reading 2		0.705	0.66	0.685	0.710	0.71	0.71	0.73	0.72	0.73	0.72	0.7	
		RPD		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.70%	0.00%	0.00%	0.00%	-
	MP1-13 D (GW)	Reading 1	1.690	1.925				1.43							1.46
		Reading 2	1.685	1.930				1.43							1.46
		RPD	0.30%	0.26%				0.00%							0.00%
	MP1-13 S (GW)	Reading 1	1.195	2.120	1.08			1.19							1.22
		Reading 2	1.190	2.120				1.19							1.22
		RPD	0.42%	0.00%	-			0.00%							0.00%
	MP1-13 SW	Reading 1	1.160	dry				dry							1.12
		Reading 2	1.160	dry				dry							1.12
		RPD	0.00%	-				-							0.00%
	MP2-13 D (GW)	Reading 1	1.455	1.530	2.585	2.12	1.975	2.39	2.695	dry	dry	dry	dry	dry	2.17
		Reading 2	1.460	1.520	2.59	2.125	1.980	2.39	2.695	dry	dry	dry	dry	dry	
		RPD	0.34%	0.66%	0.19%	0.24%	0.25%	0.00%	0.00%	-	-	-	-	-	-
	MP2-13 S (GW)	Reading 1	1.355	1.175	dry	1.62	1.880	dry	dry	dry	dry	dry	dry	dry	1.5
		Reading 2	1.360	1.175	dry	1.625	1.880	dry	dry	dry	dry	dry	dry	dry	
		RPD	0.37%	0.00%	-	0.31%	0.00%	-	-	-	-	-	-	-	-
	MP2-13 SW	Reading 1	1.065	dry	1.045	1.055	dry	dry	dry	dry	dry	dry	dry	dry	1.02
		Reading 2	1.065	dry	1.025	1.055	dry	dry	dry	dry	dry	dry	dry	dry	
		RPD	0.00%	-	1.93%	0.00%	-	-	-	-	-	-	-	-	-
	MP3-13 D (GW)	Reading 1	2.590					2.805							2.83
		Reading 2	2.605					2.805							
		RPD	0.58%					0.00%							-
	MP3-13 S (GW)	Reading 1	dry					dry							dry
		Reading 2	dry					dry							dry
		RPD	-					-							-
	MP3-13 SW	Reading 1	dry					dry							1.03
		Reading 2	dry					dry							
		RPD	-					-							-
	MP4-13 D (GW)	Reading 1	0.465					0.57							0.39
		Reading 2	0.480					0.57							
		RPD	3.17%					0.00%							-
	MP4-13 S (GW)	Reading 1	0.765					0.815							0.79
		Reading 2	0.765					0.815							
		RPD	0.00%					0.00%							-
	MP4-13 SW	Reading 1	0.950					0.95							0.93
		Reading 2	0.950					0.95							
		RPD	0.00%					0.00%							-
	MP5-13 D (GW)	Reading 1	1.395	1.942	1.57	1.78	2.030	2.435	2.54	2.58	2.58	2.355	1.785	1.485	1.415
		Reading 2	1.390	1.920	1.57	1.785	2.020	2.435	2.54	2.59	2.58	2.355	1.785	1.485	
		RPD	0.36%	1.14%	0.00%	0.28%	0.49%	0.00%	0.00%	0.39%	0.00%	0.00%	0.00%	0.00%	-
	MP5-13 S (GW)	Reading 1	1.300	1.415	1.170	1.295	1.410	1.54	1.555	1.580	1.525	1.515	1.420	1.315	1.240
		Reading 2	1.305	1.423	1.170	1.295	1.415	1.545	1.555	1.580	1.525	1.520	1.420	1.315	
		RPD	0.38%	0.56%	0.00%	0.00%	0.35%	0.32%	0.00%	0.00%	0.00%	0.33%	0.00%	0.00%	-
	MP5-13 SW	Reading 1	1.260	1.265	1.170	1.240	1.270	1.28	1.275	1.285	1.290	1.295	1.285	1.250	1.235
		Reading 2	1.260	1.265		1.240	1.270	1.28	1.275	1.285	1.290	1.295	1.285	1.250	
		RPD	0.00%	0.00%	-	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-
	MP6-13 D (GW)	Reading 1	1.480	1.330	1.340	1.315	1.270	1.305	1.335	1.375	1.385	1.425	1.425	1.455	1.415
		Reading 2	1.485	1.340	1.345	1.320	1.290	1.305	1.335	1.380	1.390	1.425	1.430	1.455	
		RPD	0.34%	0.75%	0.37%	0.38%	1.56%	0.00%	0.00%	0.36%	0.36%	0.00%	0.35%	0.00%	-
	MP6-13 S (GW)	Reading 1	0.905	0.975	1.060	1.025	1.015	1.135	1.310	1.380	1.370	1.395	1.255	1.430	1.170
		Reading 2	0.915	0.985	1.060	1.030	1.010	1.135	1.310	1.380	1.370	1.395	1.255	1.430	
		RPD	1.10%	1.02%	0.00%	0.49%	0.49%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-
	MP6-S SW	Reading 1	0.970	dry	0.950	0.935	dry	dry	dry	dry	dry	dry	dry	dry	dry
		Reading 2	0.970	dry	0.950	0.935	dry	dry	dry	dry	dry	dry	dry	dry	dry
		RPD	0.00%	-	0.00%	0.00%	-	-	-	-	-	-	-	-	-
	MP7-13 (GW)	Reading 1	1.285					1.355							1.3
		Reading 2	1.275					1.355							
		RPD	0.78%					0.00%							-
	MP7-13 SW	Reading 1	1.295					1.36							1.305
		Reading 2	1.295					1.36							
		RPD	0.00%					0.00%							-
	MP8-13 D (GW)	Reading 1	1.030					1.065							1.04
		Reading 2	1.035					1.065							
		RPD	0.48%					0.00%							-
	MP8-13 S (GW)	Reading 1	1.460					1.545							1.5
		Reading 2	1.480					1.545							
		RPD	1.36%					0.00%							-
	MP9-13 D (GW)	Reading 1	1.100		1.105			1.185							1.24
		Reading 2						1.185							
		RPD	-		-			0.00%							-
	MP9-13 S (GW)	Reading 1	1.005		1.13			1.265							1.485
		Reading 2						1.265							
		RPD	-		-			0.00%							-
	MP9-13 SW	Reading 1	dry		1.02			dry							1.03
		Reading 2	dry					dry							
		RPD	-		-			-							-
	MP10-13 (GW)	Reading 1	0.150	0.245	0.120	0.210	0.210	0.23	0.185	0.215	0.170	0.205	0.175	0.200	0.135
		Reading 2	0.160	0.255	0.120	0.210	0.210	0.23	0.185	0.215	0.170	0.205	0.175	0.200	
		RPD	6.45%	4.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-
	MP10-13 SW	Reading 1	0.440	0.450	0.415	0.445	0.460	0.465	0.465	0.475	0.465	0.465	0.475	0.430	0.455
		Reading 2	0.440	0.450	0.415	0.445	0.460	0.465	0.465	0.475	0.465	0.465	0.475	0.430	
		RPD	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-
	MP11-13 (GW)	Reading 1	0.980		0.905	0.890	0.910	0.94	0.960	0.945	0.920	0.925	0.890	0.910	0.850
		Reading 2	0.985		0.905	0.890	0.910	0.94	0.960	0.945	0.920	0.925	0.890	0.910	
		RPD	0.51%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-

TABLE 7
RPDS OF FIELD MEASUREMENTS
FOURTH LINE WELL FIELD
REGIONAL MUNICIPALITY OF HALTON

Field Measurement			Sampling Date												
			June 28, 2013	July 23, 2013	August 1, 2013	August 8, 2013	August 15, 2013	August 22, 2013	August 29, 2013	September 5, 2013	September 13, 2013	September 19, 2013	September 26, 2013	October 4, 2013	October 10, 2013
Water Level	MP11-13 SW	Reading 1	0.925	0.090	0.705	0.950	0.980	0.99	0.980	0.970	0.960	0.970	0.945	0.940	0.820
		Reading 2	0.920	0.090	0.705	0.950	0.980	0.995	0.980	0.970	0.960	0.970	0.950	0.940	
		RPD	0.54%	0.00%	0.00%	0.00%	0.00%	0.50%	0.00%	0.00%	0.00%	0.00%	0.53%	0.00%	-
	MP12-13 (GW)	Reading 1	0.640					0.745							0.555
		Reading 2	0.640					0.745							
		RPD	0.00%					0.00%							-
	MP12-13 SW	Reading 1	0.630					0.650							0.58
		Reading 2	0.630					0.650							
		RPD	0.00%					0.00%							-
	MW1-11	Reading 1	4.790					7.370							
		Reading 2	4.790					7.370							
		RPD	0.00%					0.00%							
	MW1-12	Reading 1	0.770					1.020							
		Reading 2	0.760					1.020							
		RPD	1.31%					0.00%							
	MW2A-13	Reading 1	5.320					6.000							5.72
		Reading 2	5.305					6.000							
		RPD	0.28%					0.00%							-
	MW2B-13	Reading 1	3.415					4.325							4.33
		Reading 2	3.390					4.325							
		RPD	0.73%					0.00%							-
	MW3A-13	Reading 1	1.915					3.415							1.89
		Reading 2	1.940					3.415							1.91
		RPD	1.30%					0.00%							1.05%
	MW3B-13	Reading 1	1.625					2.770							1.57
		Reading 2	1.620					2.770							1.58
		RPD	0.31%					0.00%							0.63%
	MW4-13	Reading 1	1.200					1.650							1.02
		Reading 2	1.200					1.650							
		RPD	0.00%					0.00%							-
	MW5A-13	Reading 1	4.100					4.330							4.31
		Reading 2	4.100					4.330							
		RPD	0.00%					0.00%							-
	MW5B-13	Reading 1	4.320					4.565							4.55
		Reading 2						4.565							
		RPD	-					0.00%							-
	OW3-85	Reading 1						2.730							
		Reading 2						2.730							
		RPD						0.00%							
	OW4-85	Reading 1						1.990							
		Reading 2						1.990							
		RPD						0.00%							
	MW23/09-S	Reading 1						10.945							13.595
		Reading 2						10.945							
		RPD						0.00%							-
	MW23/09-I	Reading 1						19.740							19.8
		Reading 2						19.740							
		RPD						0.00%							-
	MW23/09-D	Reading 1						19.870							19.82
		Reading 2						19.870							
		RPD						0.00%							-
	TW1-84	Reading 1						9.595							8.22
		Reading 2						9.595							
		RPD						0.00%							-

Appendix C
Existing PTTW No. 6281-7WFQB3 and Temporary PTTW No. 3663-97JKBF

Ontario

Ministry of the Environment
Ministère de l'Environnement

AMENDED PERMIT TO TAKE WATER
Ground Water
NUMBER 6281-7WFQB3

Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

The Regional Municipality of Halton
1151 Bronte Rd
Oakville, Ontario
L6M 3L1

For the water taking from: Prospect Park Well 1, Prospect Park Well 2
Davidson Well 1, Davidson Well 2
4th Line Well A

Located at: Lot 28, Concession II
Halton Hills, Regional Municipality of Halton

14032 Churchill Rd
Halton Hills, Regional Municipality of Halton

4th Line
Halton Hills, Regional Municipality of Halton

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment.

(d) "District Office" means the Halton-Peel District Office.

(e) "Permit" means this Permit to Take Water No. 6281-7WFQB3 including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

(f) "Permit Holder" means The Regional Municipality of Halton.

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated August 26, 2009 and signed by John McIntosh, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation

2.1 Inspections

The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act*, R.S.O. 1990, the *Pesticides Act*, R.S.O. 1990, or the *Safe Drinking Water Act*, S. O. 2002.

2.2 Other Approvals

The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act*, and the *Environmental Protection Act*, and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including

the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 **Expiry**

This Permit expires on **May 31, 2015**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	Prospect Park Well No.1 * Note: See Conditions Section 3 Below	Well Drilled	Municipal	Water Supply	1,578	24	2,273,000	365	17 576827 4830878
2	Prospect Park Well No.2 * Note: See Conditions Section 3 Below	Well Drilled	Municipal	Water Supply	1,578	24	2,273,000	365	17 576821 4830857
3	Davidson Well No.1	Well Drilled	Municipal	Water Supply	868	24	1,250,000	365	17 576866 4833280
4	Davidson Well No.2	Well Drilled	Municipal	Water Supply	868	24	1,250,000	365	17 576873 4833288
5	4th Line Well No. A	Well Drilled	Municipal	Water Supply	909	24	1,309,000	365	17 577000 4835322
						Total Taking:	6,082,000		

3.3 From the date of issuance of this Permit until **May 31, 2010** the Permit Holder may operate either or both Prospect Park Well 1 and Prospect Park Well 2 **singly or in combination** at individual rates of taking up to **2000 L/min**. The maximum combined daily takings from the 2 wells shall not however, exceed **4546 m^3 / day** during the test period.

3.4 During the testing of the Prospect Park Wells, the Permit Holder shall maintain a daily log of all operations for the Prospect Park Wells including the time and date of all pump rate changes and the total combined daily taking from these two wells up to and including May 31, 2010.

3.5 On **June 1, 2010**, the maximum rate of **1578 L/min** listed in **Table A** for Prospect Park Well 1 and Prospect Park Well 2 shall apply and remain in effect for the remaining life under

this Amended Permit. In addition, Prospect Park Well 1 and Prospect Park Well 2 may **not be operated simultaneously** after May 31, 2010.

3.6 From **June 1, 2010** to **September 30, 2010** and for each identical time period in ensuing years over the life of this Amended Permit the maximum combined daily takings from Prospect Park Well 1 and Prospect Park Well 2 shall be limited to **2273** m^3 **/ day.**

3.7 From **October 1, 2010** to **May 31, 2011** and for each identical time period in ensuing years over the life of this Amended Permit the maximum combined daily takings from Prospect Park Well 1 and Prospect Park Well 2 shall be limited to **1137 m^3 / day.**

3.8 In the event of an emergency within the Acton Municipal Water Supply System, the limitations imposed by **Conditions 3.6 or 3.7** may be temporarily suspended to allow the Permit Holder to increase the combined daily taking takings from Prospect Park Well 1 and Prospect Park Well 2 to a maximum of **3456 m^3 /day** for up to **20 non consecutive days** or **4546 m^3 /day** for **5 consecutive days** in any one year. To accommodate these temporary increases after June 1, 2010, contrary to Condition 3.5 simultaneous pumping of the two wells is permissible for the duration of the emergency taking. The Permit Holder shall notify the Director and DW Inspector in writing as reasonably practical in the event of an emergency and shall include details as to the action that has or will be taken to correct the problem.

3.9 With respect to Davidson Wells 1 and 2 as described in Table A, the Permit Holder shall take such action that will maintain a sufficient flow in the stream on the Acri property to provide water for the rearing of trout in at least three smaller ponds, and only when the ponds are used for this purpose, provided that at no time the Permit Holder be required to maintain a flow in the stream in excess of **304.5 L / min.** during the period from May 1 to October 31 and **227 L / min.** during the period from November 1 to April 30.

4. Monitoring

4.1 The Permit Holder shall install and maintain flow meters in each of the wells listed in Table A. Using the Region's SCADA System, the Permit Holder shall maintain a record of the daily rate, hours of operation and total volumes pumped from each production well in the system. All records shall be available for inspection by a Provincial Officer upon his or her request.

4.2 With respect to the proposed test of the Prospect Park well field, the Permit Holder shall implement and follow the water level quality and quantity program proposed in the Dillon Consulting Limited plan dated August 11, 2009. A complete list of monitoring sites and the method of monitoring for each site shall be provided to the Director in advance of the start of the proposed test. The list shall include the past period of monitoring and a projection of future service for each site once the test has been completed.

4.3 With regard to the monitoring of water levels at the Davidson Well site, **TW 1/85**

and **TW 2/85** shall be equipped with continuous water level recorders or linked to the SCADA System to provide a record of on going water levels at this location.

4.4 With regard to the monitoring of water levels at the 4th Line Well site, **OW 4** and **TW 1/84** shall be equipped with continuous water level recorders or linked to the SCADA System to provide a record of on going water levels at this location.

4.5 All data collected under Conditions 4.2, 4.3 and 4.4 shall be available to Ministry staff electronically upon request.

4.6 Any request for a permanent increase from the Prospect Park Wells beyond June 1, 2010 or the future renewal of this Amended Permit must be accompanied by a report by a Qualified Person (P.Geo. or equivalent) detailing the results of the proposed test of the Prospect Park wells and the conclusions reached from the assessment of the data collected.

5. Impacts of the Water Taking

5.1 Notification

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Groundwater Takings

If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

5.3 The Permit Holder shall provide public notice of the proposed pumping of Prospect Park Well 1 and Prospect park Well 2 at the higher daily amount in advance of the start of the test program. That notice shall include a contact telephone number for any complaints that may be related to the pumping activity. The Permit Holder shall have a plan of action in place prior to the test period to investigate and implement corrective action to resolve the complaint where necessary. The Permit Holder shall maintain a complete log of all calls received listing the time and date and the action taken to resolve the issue. This information shall be available to a

Provincial Officer upon his or her request.

6. Director May Amend Permit

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto ON
M5G 1E5

AND

The Director, Section 34
Ministry of the Environment
8th Floor
5775 Yonge St
Toronto ON M2M 4J1
Fax: (416)325-6347

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

by telephone at (416) 314-4600 by fax at (416) 314-4506 by e-mail at www.ert.gov.on.ca

This Permit cancels and replaces Permit Number 7672-6BFJYL, issued on 2005/05/13.

Dated at Toronto this 16th day of October, 2009.

Christopher Munro
Director, Section 34
Ontario Water Resources Act , R.S.O. 1990

Schedule A

This Schedule “A” forms part of Permit To Take Water 6281-7WFQB3, dated October 16, 2009.

1. Permit amendment application signed by John McIntosh on August 26, 2009.

2. Dillon Consulting Limited report entitled " Acton Water Supply System Prospect Park Well Field 2009 Pumping Test Work Plan" dated August 11, 2009 submitted in support of this application.

Ministry of the Environment
West-Central Region
Technical Support Section
Water Resources
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905)521-7820
Tel: (905) 521-7640

Ministère de l'Environnement
Direction régionale du Centre-Ouest
Secteur du Soutien Technique
Ressource en eau
12e étage
119 rue King W
Hamilton ON L8P 4Y7
Télécopieur: (905)521-7820
Tél:(905) 521-7640

Ontario

May 9, 2013

The Regional Municipality of Halton
Unit 27 - 1075 North Service Road W.
Oakville, Ontario
L6M 2G2

Dear Sir/Madam:

RE: Lot 1, Concession 4
Geographic Township of Erin
Wellington County
Permit Number 3663-97JKBF

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water, dated March 19, 2013 and signed by Michelle Gillespie.

This Permit expires on April 30, 2014. Authorized rates and amounts are indicated on Table A.

Ontario Regulation 387/04 (Water Taking) requires all water takers to report daily water taking amounts to the Water Taking Reporting System (WTRS) electronic database: http://www.ene.gov.on.ca/envision/water/pttw.htm . Daily water taking must be reported on a calendar year basis. If no water is taken, then a "no taking" report must be entered. Please consult the Regulation and Section 4 of this Permit for monitoring requirements.

If you have questions about reporting requirements, please call the WTRS Help Desk at 416-235-6322 (toll free: 1-877-344-2011) or by email, WTRSHelpdesk@ontario.ca . It is preferred that you submit your data directly and electronically to the WTRS. Where this is impracticable, please use the Water Taking Submission Form *(included as Appendix C of the Technical Bulletin: Permit To Take Water (PTTW)-Monitoring and Reporting of Water Takings),* which can be downloaded from the above website, and fax your completed forms to 416-235-6549 or mail them to: Water User Reporting Section, 125 Resources Rd. Toronto, ON M9P 3V6.

Please also note Condition 1.4 specifically indicates that this Permit is not transferable to another party. Any queries regarding a change in owner/operator should be made to the Permit to Take Water Evaluator at the above address.

Take notice that in issuing this Permit, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,

B. Koblik

Belinda Koblik
Director, Section 34
Ontario Water Resources Act, R.S.O. 1990
West Central Region

File Storage Number: AP28 ERHA

Ontario

Ministry of the Environment
Ministère de l'Environnement

PERMIT TO TAKE WATER
Pumping Test
NUMBER 3663-97JKBF

Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

The Regional Municipality of Halton
Unit 27 - 1075 North Service Road W.
Oakville, Ontario L6M 2G2

For the water taking from: Well A and well TW1-87

Located at: Lot 1, Concession 4, Geographic Township of Erin
Erin, County of Wellington

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment.

(d) "District Office" means the Guelph District Office.

(e) "Permit" means this Permit to Take Water No. 3663-97JKBF including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

(f) "Permit Holder" means The Regional Municipality of Halton.

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated March 19, 2013 and signed by Michelle Gillespie, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

2. General Conditions and Interpretation

2.1 Inspections

The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act* , R.S.O. 1990, the *Pesticides Act* , R.S.O. 1990, or the *Safe Drinking Water Act,* S. O. 2002.

2.2 Other Approvals

The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act* , and the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any

further information related to this Permit.

2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 **Expiry**

This Permit expires on **April 30, 2014**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken:	Zone/ Easting/ Northing:
1	Well A	Well Drilled	Pumping Test	Miscellaneous	1,200	24	1,728,000	120	17 577004 4835301
2	TW1-87	Well Drilled	Pumping Test	Miscellaneous	1,200	24	1,728,000	120	17 577013 4835302
						Total Taking:	3,456,000		

3.3 Notwithstanding the Maximum Taken per Minute and Total Taking specified in Table A of Condition 3.2, the combined rate and total amount of taking from two wells when in operation together shall not exceed 1,200 litres per minute(LPM) and 1,728,000 litres per day (LPD), respectively.

3.4 The Permit is valid from the date of issuance to April 30, 2014.

4. Monitoring

4.1 Notification to Well Owners
Prior to commencement of the pumping test, the Permit Holder shall identify all wells within the area of the anticipated potential cone of influence, or within 500 metres of the test site, whichever is greater. At least 24 hours prior to beginning the pumping test, the Permit Holder shall provide written notification to the owners of the wells identified within the potential cone of influence. The notification shall include the expected date, time and duration of the pumping test, and a contact telephone number that may be used to report any interferences with water supplies.

4.2 Measuring Water Depths
To establish baseline conditions, well depths and depths to water levels for identified representative wells in the area of the water taking shall be recorded by the Permit Holder. During the pumping test, water levels in the identified wells shall be recorded. The pumping test must be of sufficient duration to accurately predict the long term impacts of the proposed water taking. Water levels in the identified wells shall continue to be monitored beyond the water taking period until at least 85% recovery is achieved.

4.3 Under section 9 of O. Reg. 387/04, and as authorized by subsection 34(6) of the Ontario Water Resources Act, the Permit Holder shall, on each day water is taken under the authorization of this Permit, record the date, the volume of water taken on that date and the rate at which it was taken. The daily volume of water taken shall be measured by a flow meter or calculated in accordance with the method described in the application for this Permit, or as otherwise accepted by the Director. The Permit Holder shall keep all records required by this condition

current and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request. The Permit Holder, unless otherwise required by the Director, shall submit, on or before March 31st in every year, the records required by this condition to the ministry's Water Taking Reporting System.

4.4 The Permit Holder shall implement the ground and surface water monitoring plan outlined in Section 4.1 of Stantec Consulting Ltd. report: "Hydrogeological Assessment, Fourth Line Well Field PTTW Application, February 15, 2013".

5. Impacts of the Water Taking

5.1 Notification

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 Restoration of Water Supply

Where the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of doing so.

6. Director May Amend Permit

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto ON
M5G 1E5
Fax: (416) 314-4506
Email: ERTTribunalsecretary@ontario.ca

AND

The Director, Section 34
Ministry of the Environment
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905)521-7820

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

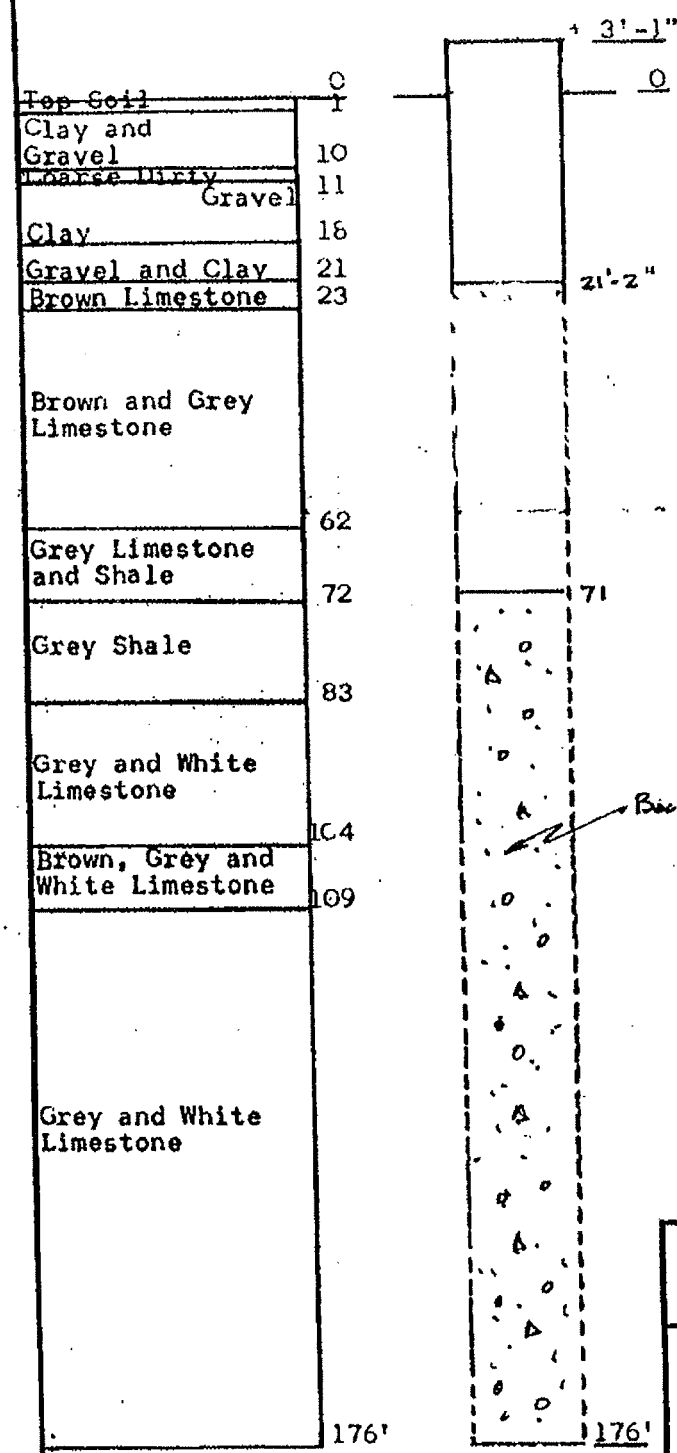
by telephone at (416) 314-4600 ***by fax at (416) 314-4506*** ***by e-mail at www.ert.gov.on.ca***

Dated at Hamilton this 9th day of May, 2013.

B. Koblik

Belinda Koblik
Director, Section 34
Ontario Water Resources Act , R.S.O. 1990

Appendix D
Borehole Logs



Well Material

Outer Casing	24'-3" x 10"
Inner Casing	None
Screen	None
Plug	None
Gravel	None

Pump

No. 73256	Setting BP-MB 40'
No. Stages 7	Length Bowl 5'-2
Bowl 8" PRIC.	Size & Lgth. Suction 5'
Head TF413	Size Column 5" x 7/8"

Materials or setting details other than standard:

Motor

Make West	Phase 3
Shaft	Cycles 60
H. P. 20	Volts 575
R. P. M. 1800	Amps.
Type HSB	Base
Frame 254-6TP	Serial 1-19 51270

Special Equipment

Well

B. P. referred to original Ground Level	
Started Nov. 8, 56	Clear Depth
Preliminary Test Nov. 27/56	Length Air Line 4
Final Test	Static Level 5'-9½"
Guarantee None	Pumping Level 39'
Pressure	Capacity ~~637 IGM~~ 208 IGM
Driller: D. Bauerlein	
Installer:	

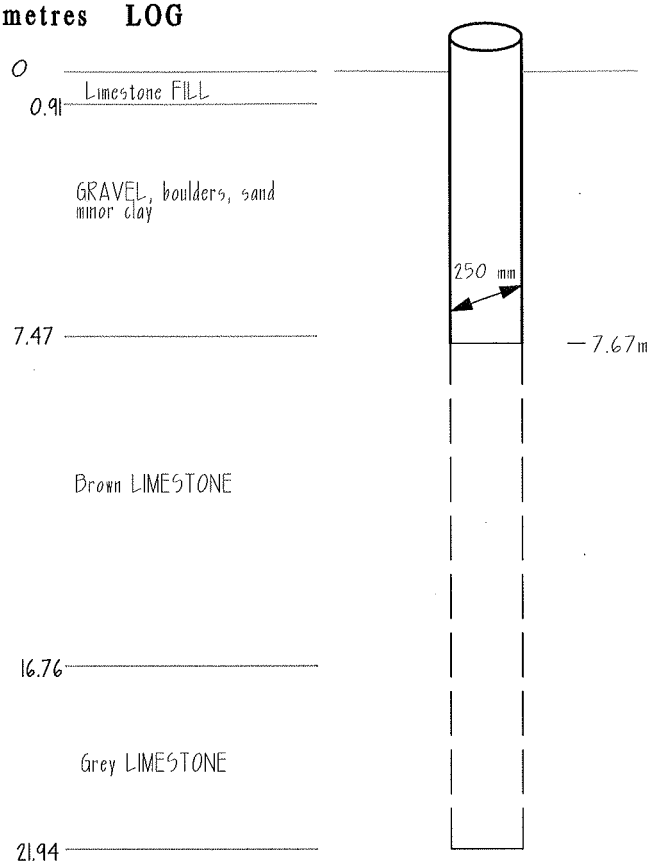
INTERNATIONAL WATER SUPPLY LTD.
LONDON, CANADA
WATER SUPPLY CONTRACTORS

ACTON, ONTARIO, PUC
WELL No 4:
4th line

DRAWN BY MB APPROVED BY

WELL NO. 1-56

metres LOG



WELL MATERIAL

Outer Casing: ____ mm dia. ____ mm Wall Thk. Mat'l ____

Inner Casing: 250 mm dia. 9.5 mm Wall Thk. Mat'l Steel

Cemented from ____ m to ____ m

Screen: Make: ____ mm dia. Opening & Mat'l: ____

Plug: Type: ____ Mat'l ____ Other ____

Gravel: Type: ____ Size: ____ Quantity: ____

AQUIFER TEST DATA

Date: January 14, 1987 By: W. Nobes

Static Level 4.07m Above M.P. 0.3 m A.G.L.

Pumping Rate L/s : 9.4

Pumping Duration: 0 hrs. 30 min.

Pumping Level at Test End: 5.19 m

Performance Plots: dd-t Dwg. ____

dd-r Dwg. ____

Step Test ____

EQUIPPED WELL DATA

Date: ____ By: ____

Rated Well Capacity L/s ____

Pumping Rate L/s ____ Static Level ____ m

Pumping Level ____ m at ____ hrs. ____ min.

Pump Pressure: ____ kPa Main Pressure ____ kPa

Shut Off: AGH ____ kPa W.L. ____ m

Clear Well Depth from B.P ____ m Air Line ____ m

PUMP & MOTOR DATA

Pump Make: ____ Rating: ____ L/s @ ____ m T.H

Head: Type: ____ S.N. ____

Column: ____ m X ____ mm X ____ mm X ____ mm Shaft Mat'l ____

Bowl: ____ Stage: ____ Curve: ____

Suction: ____ mm dia. ____ m Long

Special: Zinc Sleeves ____ Taped Oil Line ____

Other ____

Motor Make: ____ Frame: ____ S.N. ____

____ kW ____ phase ____ hz ____ rpm ____ Volts

Bearing No. Upper ____

Lower ____

Special Equipment

WELL REVISIONS AND REHABILITATION

DATE	WORK DONE	BY

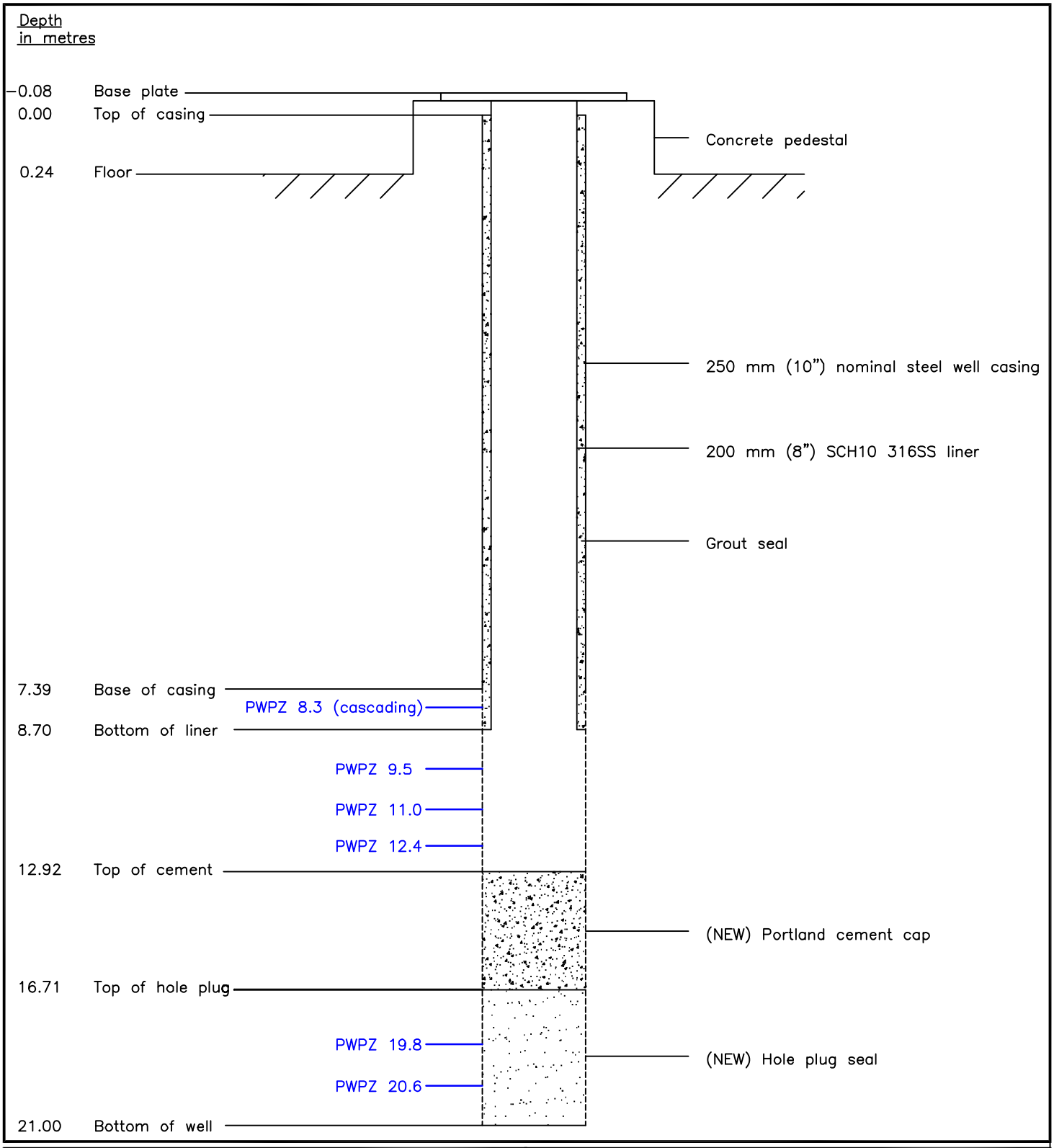
International Water Supply Ltd.

- BARRIE -

CLIENT: Region of Halton

WELL No: Acton - TW 1/87

DRILLED BY: A. Grimster	DATE: Jan/87	DRAWN: T. Brown
INSTALLED BY:	DATE:	DATE: Feb/10



Lotowater TECHNICAL SERVICES INC.

CLIENT
REGIONAL MUNICIPALITY OF HALTON

TITLE
Acton Fourth Line Well 1
Liner and Seal Installation (As-Built)

PROJECT No. 191-050			G:\Lotowater Projects\191 Halton Region\050 Acton Fourth Line Testing and Rehab\Lower Zone Testing		FIGURE 25
DESIGN			REVISION No. 2011-01-26	SCALE N.T.S.	
DRAWN	MG	2010/11/02			
CHECKED	BB	2011/01/26			

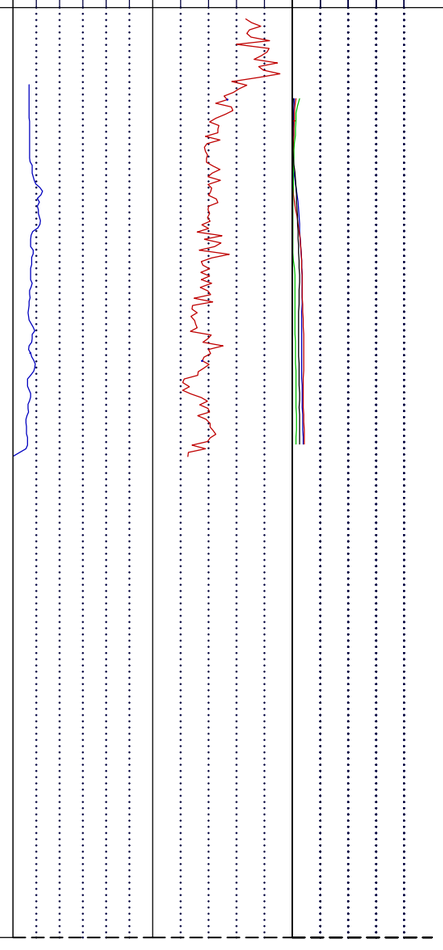
Monitoring Well: 4L-MW1-11

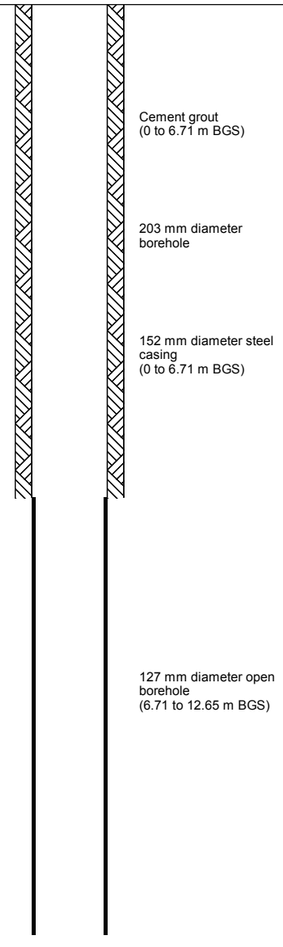
Project:	4th Line Drilling	**Drillrig:**	CME75 Track Mount	**Casing Diameter:**	152
Client:	Region of Halton	**Bit Type:**	Diamond, PQ Coring	**Inclination:**	90°
Location:	9098 32nd Sideroad, Halton, ON	**Flush:**	Air/Water	**Azimuth:**	n/a
Number:	161110938	**Core Diameter:**	85 mm	**Date Started - Date Completed:**	05/10/2011 - 5/12/2011
Field investigator:	E. Hayman				
Contractor:	Aardvark Drilling Inc.				

SUBSURFACE PROFILE

CORE RECOVERY DATA

Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Run Number	TCR	SCR	RQD	Fractures per 1.52 m
			Ground Surface						
			TOPSOIL	0.00					
			silt, trace organics (roots), dark brown, firm	0.28	1	100%			
			WENTWORTH TILL clayey silt, trace coarse sand, trace gravel (subangular), light orange brown, loose, moist						
			increased clay content with black laminations, dense, moist from 0.6 m to 1.0 m BGS						
5			grey at 1.1 m BGS		2	100%			
	2		wet at 1.9 m BGS increasing coarse sand and fine gravel content		3	80%			
10									
	4				4	83%			
15			OUTWASH DEPOSITS gravel and cobbles up to 152 mm in size, well graded, sub-angular	4.27					
					5	100%			
20	6			6.55					
			ERAMOSA FORMATION brown dolostone with black shale partings, fine crystalline, some vugs and secondary mineralization (calcite)		6	100%	83%	83%	
25			slight colour change (lighter), decreased shale content and increased porosity from 7.2 m to 7.8 m BGS						
	8				7	100%	90%	84%	
30			driller noted 25 mm to 50 mm fracture with all drilling fluid lost to formation at about 8.8 m BGS						
	10				8	92%	90%	87%	
35			vuggy from 11.0 m to 11.3 m BGS						
					9	95%	95%	93%	
40	12		End of Borehole	12.65					





NOTES:

TCR - Total Core Recovery

SCR - Solid Core Recovery

RQD - Rock Quality Designation

mAMSL - metres above mean sea level

mBGS - metres below ground surface

Electrode spread

No.8

No.16

No.32

No.64

Stantec

Monitoring Well: MW2-13

Project: 4th Line Environmental Assessment
Client: Regional Municipality of Halton
Location: 4th Line and Erin-Halton Hills Townline (Sideroad 32), Ontario
Number: 161111105

Field Investigator: A. Vandenhoff
Contractor: Aardvark Drilling Inc.
Drilling method: Track Mount CME 75 HSA Continuous Soil Coring/Christensen PQ Rock Coring
Date started/completed: 14-Feb-2013 / 15-Feb-2013

SUBSURFACE PROFILE				SAMPLE DETAILS						WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Sample Number	Sample Type	Recovery	SCR	RQD	Fractures per 1.52m	
											Name: MW2A-13 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a Name: MW2B-13 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a
0	0		Ground Surface								100 mm Steel Monument Above Ground Protective Casing
			TOPSOIL silty sand, trace gravel, trace organics, dark brown, moist	0.00							
			SAND some silt to silty, trace rootlets, fine grained sand, trace coarse grained sand, brown (7.5 YR 4/3), moist, trace oxidation staining	0.33							
			SILTY SAND TILL trace to little gravel in zones, fine grained sand, trace coarse grained sand, pale brown (10 YR 6/3), mostly dense with loose weathered zones, blocky, trace oxidation staining	0.66	1	CC	42" 70%	n/a	n/a	n/a	
5	2				2	CC	46" 79%	n/a	n/a	n/a	Bentonite Chips
10	4				3	CC	52" 87%	n/a	n/a	n/a	51 mm Diameter Schedule 40 PVC Riser
15					4	CC	18" 30%	n/a	n/a	n/a	Top of Sand (2.90 m BGS) Top of Screen (3.35 m BGS) No. 2 Silica Sand Bentonite Chips
20	6		30 cm sand layer, little gravel, fine grained sand, some medium grained sand, little coarse grained gravel, angular (6.20 m BGS)		5	CC	51" 84%	n/a	n/a	n/a	No. 10 Slot Schedule 40 PVC screen 51 mm Diameter Bottom of Screen and Sand (6.40 m BGS)
			colour change to grey (10 YR 5/1) (7.09 m BGS)								
25	8		ERAMOSA FORMATION dolostone, brown, trace dark grey shale partings, pinpoint porosity, trace vugs, horizontal laminations, fracturing dominantly horizontal, oxidation staining on most vug and fracture surfaces, trace calcite remineralization	7.57	6	PQ	8.5" 94%	8.5" 94%	8.5" 94%	0	
			trace fossils (8.3 m BGS)		7	PQ	62" 100%	37" 60%	34" 55%	>10	Top of Sand (8.76 m BGS) Top of Screen (9.37 m BGS)
30	10				8	PQ	59" 100%	56" 95%	56" 95%	6	No. 2 Silica Sand
35			decrease in vugs, trace coral (11.4 m BGS)		9	PQ	60" 98%	57" 94%	49" 80%	7	No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
40	12		End of Borehole	12.42							Bottom of Screen and Sand (12.42 m BGS)

Screen Interval: 3.35 - 6.40; 9.37 - 12.42 m BGS
Sand Pack Interval: 8.76 - 12.42 m BGS
Well Seal Interval: 0.00 - 2.90 m BGS

Drawn By/Checked By: AV/RF

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
CC - continuous core sample
PQ - wireline continuous core sample

n/a - not available/applicable

Stantec

Monitoring Well: MW3-13

Project: 4th Line Environmental Assessment
Client: Regional Municipality of Halton
Location: 4th Line and Erin-Halton Hills Townline (Sideroad 32), Ontario
Number: 161111105

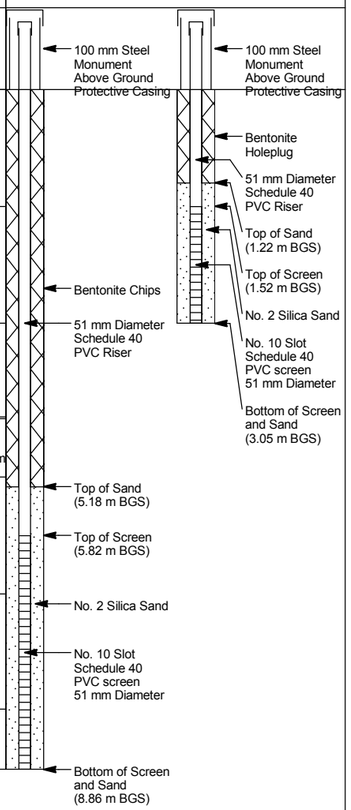
Field Investigator: A. Vandenhoff
Contractor: Aardvark Drilling Inc.
Drilling method: Track Mount CME 75 HSA Continuous Soil Coring/Christensen PQ Rock Coring
Date started/completed: 12-Feb-2013 / 13-Feb-2013

SUBSURFACE PROFILE				SAMPLE DETAILS						WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Sample Number	Sample Type	Recovery	SCR	RQD	Fractures per 1.52m
			Ground Surface							
0	0		TOPSOIL silt, some sand, little organics, dark brown, moist	0.00						
			SAND some silt to silty, trace to little gravel, greenish grey (GLEY 1 6/1), loose, some compact lenses, wet, gravel sub-angular to rounded coarse gravel/cobbles on augers	0.36	1	CC	37" 62%	n/a	n/a	n/a
5	2		colour change to light brownish-grey (10 YR 6/2) (1.5 m BGS)		2	CC	14" 23%	n/a	n/a	n/a
10	4		SAND AND GRAVEL little silt, grayish-brown (10 YR 5/2), dense lenses of till-like material colour change to pale brown (10 YR 6/3) (3.4 m BGS)	3.05	3	CC	28" 58%	n/a	n/a	n/a
15			ERAMOSA FORMATION dolostone, brown, trace dark grey shale partings, pinpoint porosity, trace vugs, horizontal laminations, highly fractured, mostly horizontal fractures, trace vertical fractures, little oxidation staining on vug and fracture surfaces, oxidation halos on undeveloped fractures, trace calcite remineralization	4.32	4	PQ	25.5" 85%	20" 67%	15" 50%	4 / 0.76 m
20	6		increased shale content below 5.5 m BGS 15 cm vuggy zone (5.61 m BGS)		5	PQ	58" 97%	22" 37%	7" 12%	>10
25	8		0.6 m zone irregular bedding (7. 32 m BGS)		6	PQ	59" 100%	19" 32%	11" 19%	>10
			20 cm highly fractured zone (8.31 m BGS)		7	PQ	31" 100%	16" 52%	0" 0%	>10
30	10		End of Borehole	8.86						
35										
40	12									

WELL DETAILS

Name: MW3A-13
GS Elev: n/a
TOC Elev: n/a
Easting: n/a
Northing: n/a
Stick-up: n/a

Name: MW3B-13
GS Elev: n/a
TOC Elev: n/a
Easting: n/a
Northing: n/a
Stick-up: n/a



Screen Interval: 1.52 - 3.05; 5.82 - 8.86 m BGS
Sand Pack Interval: 5.18 - 8.86 m BGS
Well Seal Interval: 0.00 - 1.22 m BGS

Drawn By/Checked By: AV/RF

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
CC - continuous core sample
PQ - wireline continuous core sample

n/a - not available/applicable

Stantec

Monitoring Well: MW5-13

Project: 4th Line Environmental Assessment
Client: Regional Municipality of Halton
Location: 4th Line and Erin-Halton Hills Townline (Sideroad 32), Ontario
Number: 161111105

Field Investigator: A. Vandenhoff
Contractor: Aardvark Drilling Inc.
Drilling method: Track Mount CME 75 HSA Continuous Soil Coring/Christensen PQ Rock Coring
Date started/completed: 07-Feb-2013 / 11-Feb-2013

SUBSURFACE PROFILE				SAMPLE DETAILS						WELL DETAILS
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Sample Number	Sample Type	Recovery	SCR	RQD	Fractures per 1.52m	
											Name: MW5A-13 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a
0	0		Ground Surface								100 mm Steel Monument Above Ground Protective Casing
			TOPSOIL silty sand, trace gravel, little organics and rootlets, dark brown	0.00							
			SILTY SAND fine grained sand, little medium grained sand, trace coarse grained sand, strong brown, moist	0.28 0.46							
			SAND TILL some silt to silty, trace gravel and cobbles, fine grained sand, little medium and coarse grained sand, yellowish-brown (10 YR 5/4), compact, blocky, moist to wet in zones		1	CC	32" 53%	n/a	n/a	n/a	
5	2				2	CC	13" 22%	n/a	n/a	n/a	51 mm Diameter Schedule 40 PVC Riser
10											Bentonite Holeplug
			SAND AND GRAVEL well graded, wet, subrounded to very angular gravel	3.35							
	4		SAND trace gravel, fine grained sand, some medium grained sand, brown, well sorted, wet	3.79	3	CC	42" 70%	n/a	n/a	n/a	
15			becomes poorly sorted, some gravel (4.82 m BGS)		4A	CC	8" 36%	n/a	n/a	n/a	
			ERAMOSA FORMATION dolostone, brown, little vugs, some coral, trace stylolites, highly fractured zones with no preferred fracture orientation, little calcite remineralization	5.13	4B	PQ	49" 100%	33" 67%	30" 61%	5 / 1.24 m	Top of Sand (5.79 m BGS)
20	6										Top of Screen (6.58 m BGS)
			below 7.0 m BGS changes to pinpoint porosity, trace vugs, trace coral		5	PQ	68" 100%	43" 63%	43" 63%	>10	No. 2 Silica Sand
25	8										No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
30					6	PQ	60" 100%	28" 47%	26" 43%	>10	
	10		End of Borehole	9.63							Bottom of Screen and Sand (9.63 m BGS)
35											
	12										
40											

WELL DETAILS
Name: MW5B-13 GS Elev: n/a TOC Elev: n/a Easting: n/a Northing: n/a Stick-up: n/a
100 mm Steel Monument Above Ground Protective Casing
Bentonite Holeplug
51 mm Diameter Schedule 40 PVC Riser
Top of Sand (2.13 m BGS)
Top of Screen (2.59 m BGS)
No. 2 Silica Sand
No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
Bottom of Screen and Sand (5.64 m BGS)
Native Sand Cave
Bottom of Hole 6.40 m BGS

Screen Interval: 2.59 - 5.64; 6.58 - 9.63 m BGS
Sand Pack Interval: 5.79 - 9.63 m BGS
Well Seal Interval: 0.00 - 2.13 m BGS

Drawn By/Checked By: AV/RF

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
m BTOC - metres below top of casing
CC - continuous core sample
PQ - wireline continuous core sample

n/a - not available/applicable

Stantec

Monitoring Well: MW4-13

Project:	4th Line Environmental Assessment	**Drilling method:**	Truck Mount CME 55 HSA Continuous Spoons
Client:	Regional Municipality of Halton	**Date started/completed:**	26-Mar-2013
Location:	4th Line and Erin-Halton Hills Townline (Sideroad 32), Ontario	**Ground surface elevation:**	n/a
Number:	161111105	**Top of casing elevation:**	n/a
Field investigator:	A. Vandenhoff	**Easting:**	n/a
Contractor:	Aardvark Drilling Inc.	**Northing:**	n/a

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
			Ground Surface						100 mm Steel Monument Above Ground Protective Casing
0	0		TOPSOIL silt, trace fine sand, dark brown, very loose	0.00 0.25	1	SS	12" 50%	1-1-2-2 (3)	Concrete
			SILTY SAND trace gravel, fine grained sand, trace medium and coarse grained sand, fine grained gravel, yellowish-brown, loose with dense lenses, trace 12-15 mm sand seams, moist		2	SS	13" 54%	1-3-2-2 (5)	51 mm Diameter Schedule 40 PVC Riser
5			SAND TILL some silt, trace to little gravel, fine grained sand, trace medium and coarse grained sand, fine and coarse grained gravel, greyish-brown (2.5 Y 5/2), dense to very dense, moist to wet in zones, trace oxidation staining	1.35	3	SS	24" 100%	16-16-22-26 (38)	Bentonite Holeplug
	2				4	SS	24" 100%	n/a	
10					5	SS	17" 71%	n/a	Top of Sand (2.90 m BGS)
					6	SS	21" 88%	n/a	No. 2 Silica Sand
	4		colour change to grey (10 YR 5/1), no oxidation staining (4.0 m BGS)		7	SS	23" 96%	n/a	Top of Screen (3.51 m BGS)
15					8	SS	13" 54%	n/a	
					9	SS	24" 100%	n/a	No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
	6				10	SS	24" 100%	n/a	
20			76 mm sand seam, medium and coarse grained sand, some silt, grey (6.1 m BGS)		11	SS	18" 100%	n/a	
			auger refusal on bedrock (6.55 m BGS) End of Borehole	6.55					Bottom of Screen and Sand (6.55 m BGS)
25	8								
30									
	10								
35									
40	12								

Screen Interval: 3.51 - 6.55 m BGS
Sand Pack Interval: 2.90 - 6.55 m BGS
Well Seal Interval: 0.30 - 2.90 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By: AV/RF

Stantec

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BOREHOLE LOG	PROJECT: 107960	BOREHOLE: MW23_09 1 of 9
Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Methodology:** PQ Core **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
0.2 397.6		**TOPSOIL** Brown to reddish-brown sandy topsoil. Some organics and gravel.			1		SS	22		21	- ground surface elevation not surveyed. Hand held GPS estimation used.
		FILL Reddish-brown sandy fill. Soft. Disturbed appearance. Some wood fragments. Moist.			2		SS	4.5		21	
1.2 396.6		**SILTY SAND** Dark brown fine silty sand with orange-brown mottles. Loose to dense. Moist.			3		SS	2.5		33	
					4		SS	11		33	
2.6 395.2		**SAND and GRAVEL** Pale brown silty sand matrix with angular to subround sedimentarily-derived gravel, trace cobbles. Moist to wet.			5		PQ			51	- some cobbles (dolomitic) at 2.4 m.
					6		PQ			63	
					7		PQ			27	- coarsening below 4.8 m. - gravel interfering with sample recovery.
6.4 391.4					8		PQ			45	- below 6.4 m, becoming reddish-brown fine-medium sand, poorly graded. Saturated.
7.5 390.3					9		PQ			50	- below 7.5 m, fine to medium well graded sand with gravel (subround to subangular). Trace cobbles.
					10		PQ			68	- some coarse sand to fine gravel below 9.3 m.
10.0											

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Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Methodology:** PQ Core **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	SAMPLE: MONITOR DETAILS & NUMBER	WATER LEVEL	NUMBER	INTERVAL	TYPE	N VALUE	% WATER	% REC	COMMENTS
387.8 10.4 387.4 11.1 386.7 11.3 386.5 11.7 386.1 12.3 385.5 13.7 384.1 18.2 379.6 18.6 379.2 19.8 378.0		**SANDY SILT TILL** Pale brown to grey-brown sandy silt till with polylithic gravels and rare cobbles. Gravel clasts primarily small, (<3mm) rounded, and black. Dense. Moist. Some silty separations. **SANDY SILT TILL** Moderately to weakly laminated greyish-red to grey silty fine sand. Sub-Horizontal laminations. **SANDY SILT and GRAVEL** Red brown to grey-brown sandy silt and gravels with angular clasts. **DIAMICT**	11 12 13 14 15 16 17	▽			PQ PQ PQ PQ PQ PQ PQ		81 75 69 99 95 95 70		- fining downward into light brown fine sand with trace silt below 10 m. - becoming light brown sandy silt to clayey silt below 10.4 m. Dense. - medium sand bed with sharp upper and lower contacts at 11.1 m. - boulder at 11.1 m; 40 cm diameter - brown to pale brown gravel with sand and silt matrix at 11.7 m. - coarsening into brown medium sand with gravel and cobbles at 12.2 m. - 5 cm wide sand bed/seam at 16.1 m. - below 16.9 m, 40% reddish-brown mottles with some orange FeO mottling on silty separations. - matrix becoming silty sand and clay, approximately 40% gravels at 17.2 m. - below 17.8, becoming pale brown to grey-brown sandy silt till with gravels continuing. - hard mineralized (CaCO3, FeO2) concretion at 18.4 m. - waterlevel in MW23_09I, 19.1 mBGS, taken on Aug. 24, 2009.

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Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Methodology:** PQ Core **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
21		Brown diamicton with silt-sand matrix and polylithic gravel-sized clasts. Some angular shale (red-grey). Large cobbles (or boulders) near 20 m and 21 m.									- some small rounded black gravels at 19.2 m. - some laminations with trace orange FeO2 on silt separations below 19.6 m.
21.3 376.5		**GUELPH FORMATION, DOLOMITIC LIMESTONE** Light grey to grey-brown, moderately porous, fine to medium crystalline, irregularly medium to massively bedded. Zones of strong local local weathering, fracturing and increased vugginess (typically < 2mm diam.). Weakly to moderately fossiliferous. Some sucrosic secondary mineralization in larger vugs.			18		PQ			96	
22											
23		Upper 3.5 m moderately to strongly weathered and fractured (e.g. 21. 5 to 22.05, 24.5 to 24.9 m)			19 20		HQ HQ			100 100	
24											
25					21		HQ			99	- Video: Fracture Zone 24.4 - 25.6 m - fracture zone: large vertical fracture from 24.5 to 24.9 m with open horizontal fractures intersecting. Strongly weathered, abundant FeO staining.
26					22		HQ			100	- Lost return circulation while drilling. Did not recover. - below 26 m, shaley interbeds at 10 to 30 cm spacing. Thickly to medium bedded medium grey/brown dolostone beds separated by thin (< 2 mm), dark, finely laminated shaley partings. Shaley beds subhorizontal (85 deg. to core axis). Weakly fractured.
27											
28					23		HQ			99	- Video: Small Fracture - Video: Small Fracture - open fractures at: 28.6 m (clay-filled), 30.4 m (some CaCO3), 30.8 m, 31.7m (weathered), 31.9 m.
29					24		HQ			100	- Video: Small Fracture - Video: Open fracture - Video: Small Fracture

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BOREHOLE LOG	PROJECT: 107960	BOREHOLE: MW23_09 4 of 9
Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Methodology:** PQ Core **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
31					25		HQ			100	- some carbonate-filled vugs near 31 m adjacent disturbed bedding (undulating). - Video: Open fracture
32					26		HQ			100	
32.4 365.4		**ERAMOSA FORMATION, SHALEY DOLOMITIC LIMESTONE** Shaley dolomitic limestone. Brown to black, medium to thinly bedded, aphanitic to finely crystalline brown-black. Some layers bituminous with slight petroliferous odour. Gradational upper contact over 2 m.									
33											- Video: Open fracture - weathered and fractured at 32.9 m. Some precipitation of yellow mineral in voids.
34					27		HQ			99	- pale grey-brown aphanitic with few vuggy fossil traces (possible stromotoporoid) containing CaCO3 and trace pyrite between 33.5 and 34.4 m. Some crack-reseal textures.
35											- below 34.4 m, becoming irregularly banded dark grey to grey-brown moderately to finely laminated. Weak to no fracturing with common bedding plane separations. Rare vugs.
36					28		HQ			100	- Video: Small Fracture
37					29		HQ			99	
38					30		HQ			100	- open clay-filled fracture near 37.3 m. - weathering near fracture at 37.5 m. - Video: Open Fracture
39											- fractures: 38.2 m , 38.3 m, 38.6 m, 38.8 m (weathered), 39.1 m (open), 39.3 m (open and vuggy), 39.5 m, 39.9 (strongly weathered). - Video: Small Fracture
					31		HQ			100	- Video: Small Fracture

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Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Methodology:** PQ Core **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
41					32		HQ			99	- slightly more competent below 40.2 m consisting mainly of bedding plane separations. - weakly weathered with some moderate sized (>10mm) vugs near 41.5 m.
42											
43					33		HQ			100	
44											- Video: Open Fracture
45					34		HQ			99	- vugs at: 44.4 and 45.2 m associated with fractures. - Video: Small Fracture
46					35		HQ			99	- slightly paler grey in colour below 45.7 m. - Video: Small Fracture
47											- 3 to 4 cm wide clay-filled fracture at 46.4 m moderately weathered below. - 40 x 30 mm vug at 47.1 m.
					36		HQ			100	- Video: Small Fracture
48											- Video: Small Fracture
49					37		HQ			100	- 2 cm wide grey clay filled fracture at 48.6 m. - Video: Large open fracture
											- becoming grey to medium

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Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Methodology:** PQ Core **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
					38		HQ			99	grey in colour with coarsening grain size fining to frequent shale interbeds below 49.8 m.
51											- Video: Small Fracture
51.8 346.0		**GOAT ISLAND FORMATION, DOLOMITIC LIMESTONE** Also known as the upper unsubdivided Amabel formation. Dolomitic limestone; pale grey to grey-buff, massive to thickly bedded, finely crystalline. Weakly to moderately porous. Moderately vuggy. Vugs typically <1.5mm. Very thin stylolites at 10 to 20 cm intervals. Some thin shale beds.			39		HQ			100	- Video: Vuggy
53											- weathered fractures at 53 m and 53.2 m.
					40		HQ			100	- finer grained to microcrystalline with darker appearance and shaley interbeds at 10 - 30 cm intervals below 53.2 m. - vuggy below 54.3 m, large carbonate-filled vugs at 54.3 and 54.8 m.
55					41		HQ			99	- Video: Vuggy - Video: Vuggy - fractured from 55.1 to 55.9 m with moderate weathering. Some clay infill of fractures.
56											- Video: Vuggy - Video: Small Fracture
56.5 341.3		**GASPORT FORMATION REEFAL, DOLOMITIC LIMESTONE** Also known as the unsubdivided Amabel Formation. Reefal dolomitic limestone. Mottle grey to buff-grey, porous and fossiliferous dolostone. Vuggy appearance. Competent. Slightly to moderately weathered.			42		HQ			100	- Video: Vuggy
58					43		HQ			100	- fractures: 58.5 m (open, vuggy), 59.7 m (open), 60.2 (open), 60.95 m (open). - Video: Vuggy
59											
					44		HQ			97	

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Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Methodology:** PQ Core **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
61.2 336.6		**LOWER GASPORT FORMATION, DOLOMITIC LIMESTONE** Also known as the lower unsubdivided Amabel Formation. Dolomitic Limestone. Pale grey to pale blue-grey, massive to thickly bedded, finely crystalline. Very competent. Primarily pinpoint porosity. Decreasing vugginess downhole.			45		HQ			100	- large vugs (5cm x 2cm and 7cm x 5cm) near 60.6 to 60.9 m. - Video: Vuggy
											- Video: Vuggy
					46		HQ			99	- large open fractures at 62.6 m. - Video: Vuggy
					47		HQ			100	
65.7 332.1		**IRONDEQUOIT then ROCKWAY FORMATION, DOLOMITIC LIMESTONE** Also known as the Lower unsubdivided Amabel Formation Medium grey to blue-grey, fossiliferous (primarily crinoids) dolostone. Crystalline. Thin stylolites at approximately 15 - 40 cm intervals. Rare shaley parting (e.g. ~70m). Very competent.			48		HQ			100	- Video: Turbid.
					49		HQ			100	
					50		HQ			100	

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DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
					51		HQ			99	
71											
					52		HQ			98	
72											- below 72m, stylolites at approximately 5 - 10 cm intervals.
73											
					53		HQ			100	
74											- Large vugs (>4 cm diameter infilled with soft white carbonate) at 74 m.
					54		HQ			100	
75											
76											
					55		HQ			100	- gradually more porous downhole. Stylolite frequency increasing to 10 to 15cm intervals. Fossil trace textures becoming less distinct.
77											
78					56		HQ			100	
79											- fractures at: 78.8 m (open stylolite), 79.1, 80 m (open), 81.5 m, 81.6 m, 81.7 m, 81.8 m, and 82.1 m.
					57		HQ			100	- more weathered/porous below about 79.5m.

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DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	WATER LEVEL	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	COMMENTS
81					58		HQ			100	
82					59		HQ			100	- gradational lower contact. - fossil traces destroyed but calcite/pyrite-filled voids common near 83.5 m. - <5 mm wide dark, undulating, subhorizontal bands common.
83.0 314.8		**MERRITON FORMATION, DOLOMITIC LIMESTONE** Also known as the Fossil Hill Formation. Pale grey-green to grey-pink limey mudstone transitioning over 0.5 m into grey pink fossiliferous limestone.			60		HQ			100	- clay-filled fractures at: 83.5, 84.4, and 84.8 m. - sharp lower contact.
84.8 313.0		**CABOT HEAD FORMATION, SHALE** Pale green shale; soft to hard, thinly bedded; many clay-filled partings at approximately 10-30 cm spacing. Harder beds typically <15 mm wide.			61		HQ			98	
86											- open fracture at 86.6 m.
86.9 310.8		Borehole terminated at 86.9 mBGS in pale green Cabot Head Formation shale.									

Well Flow Profile

Project Number:	191-030	
Well Name:	Halton MW23_09	
Date Logged:	2009/07/15	
Logged By:	Rodney Secor	
Measuring Point:	Top of casing	
Flow Rate:	2.85	**L/s**
Casing Diameter:	96.5	**mm**
Theoretical Max V:	0.39	**m/s**
Test Start:		
Test Stop:		
Bottom of Casing:	23.80	**mbtbp**
TD:	87.2	**mbtbp**
Pump inlet:	19.8	**mbtbp**
Pump model:	30 SQ	
SWL:	19.42	**mbtbp**
PWL (100 min):	19.55	**mbtbp**
Flow Tool:	Swoffer Open Body 2" impeller	
Note:	No measurable flow below 26.5m	

Depth (ft)	Depth (m)	Velocity* (m/s)	% of Flow
74.0	22.6	0.38	97%
75.0	22.9	0.38	97%
76.0	23.2	0.37	94%
77.0	23.5	0.38	97%
78.0	23.8	0.38	97%
79.0	24.1	0.38	97%
80.0	24.4	0.38	97%
81.0	24.7	0.37	94%
82.0	25.0	0.38	97%
83.0	25.3	0.22	56%
84.0	25.6	0.25	65%
85.0	25.9	0.06	15%
86.0	26.2	0.02	6%
87.0	26.5	0.00	0%
88.0	26.8	0.00	0%
89.0	27.1	0.00	0%
90.0	27.4	0.00	0%
95.0	29.0	0.00	0%
100.0	30.5	0.00	0%
105.0	32.0	0.00	0%
110.0	33.5	0.00	0%
115.0	35.1	0.00	0%
120.0	36.6	0.00	0%
125.0	38.1	0.00	0%
130.0	39.6	0.00	0%
135.0	41.1	0.00	0%
140.0	42.7	0.00	0%
145.0	44.2	0.00	0%
150.0	45.7	0.00	0%
155.0	47.2	0.00	0%
160.0	48.8	0.00	0%
165.0	50.3	0.00	0%
170.0	51.8	0.00	0%
175.0	53.3	0.00	0%
180.0	54.9	0.00	0%
185.0	56.4	0.00	0%
190.0	57.9	0.00	0%
195.0	59.4	0.00	0%
200.0	61.0	0.00	0%
205.0	62.5	0.00	0%
210.0	64.0	0.00	0%
215.0	65.5	0.00	0%
220.0	67.1	0.00	0%
225.0	68.6	0.00	0%
230.0	70.1	0.00	0%
235.0	71.6	0.00	0%
240.0	73.1	0.00	0%
245.0	74.7	0.00	0%
250.0	76.2	0.00	0%
255.0	77.7	0.00	0%
260.0	79.2	0.00	0%
265.0	80.8	0.00	0%
270.0	82.3	0.00	0%
275.0	83.8	0.00	0%
280.0	85.3	0.00	0%
285.0	86.9	0.00	0%

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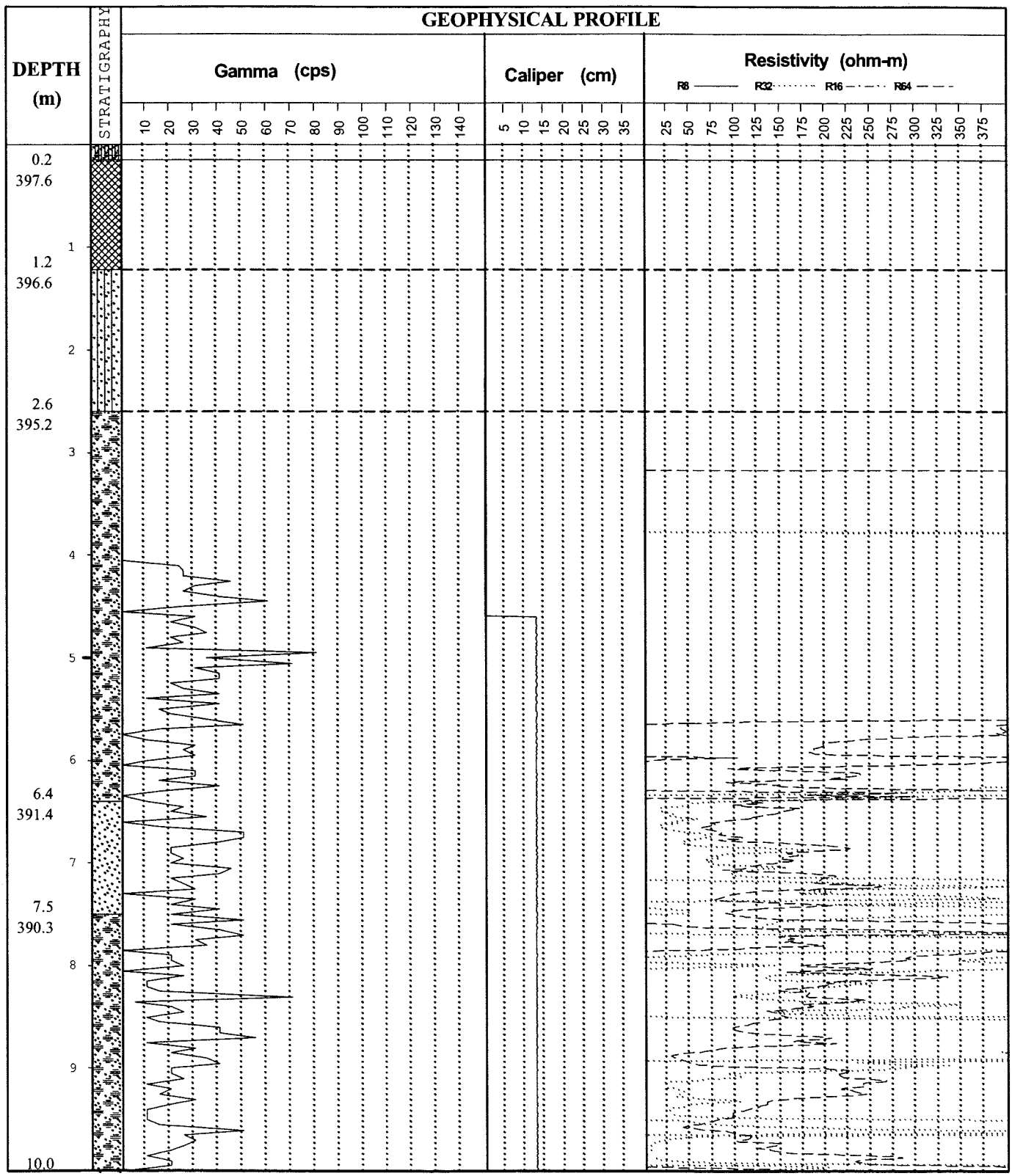

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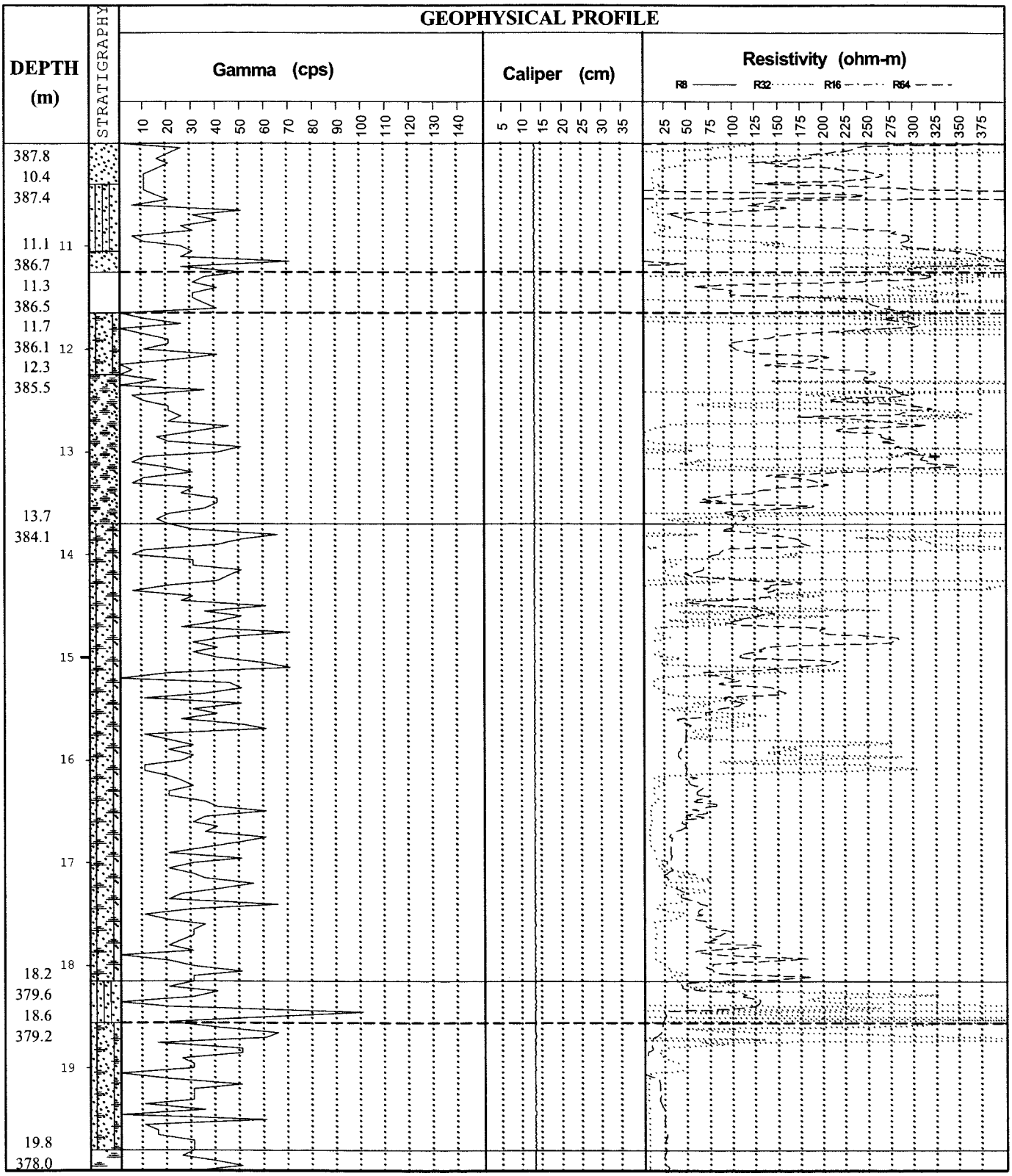

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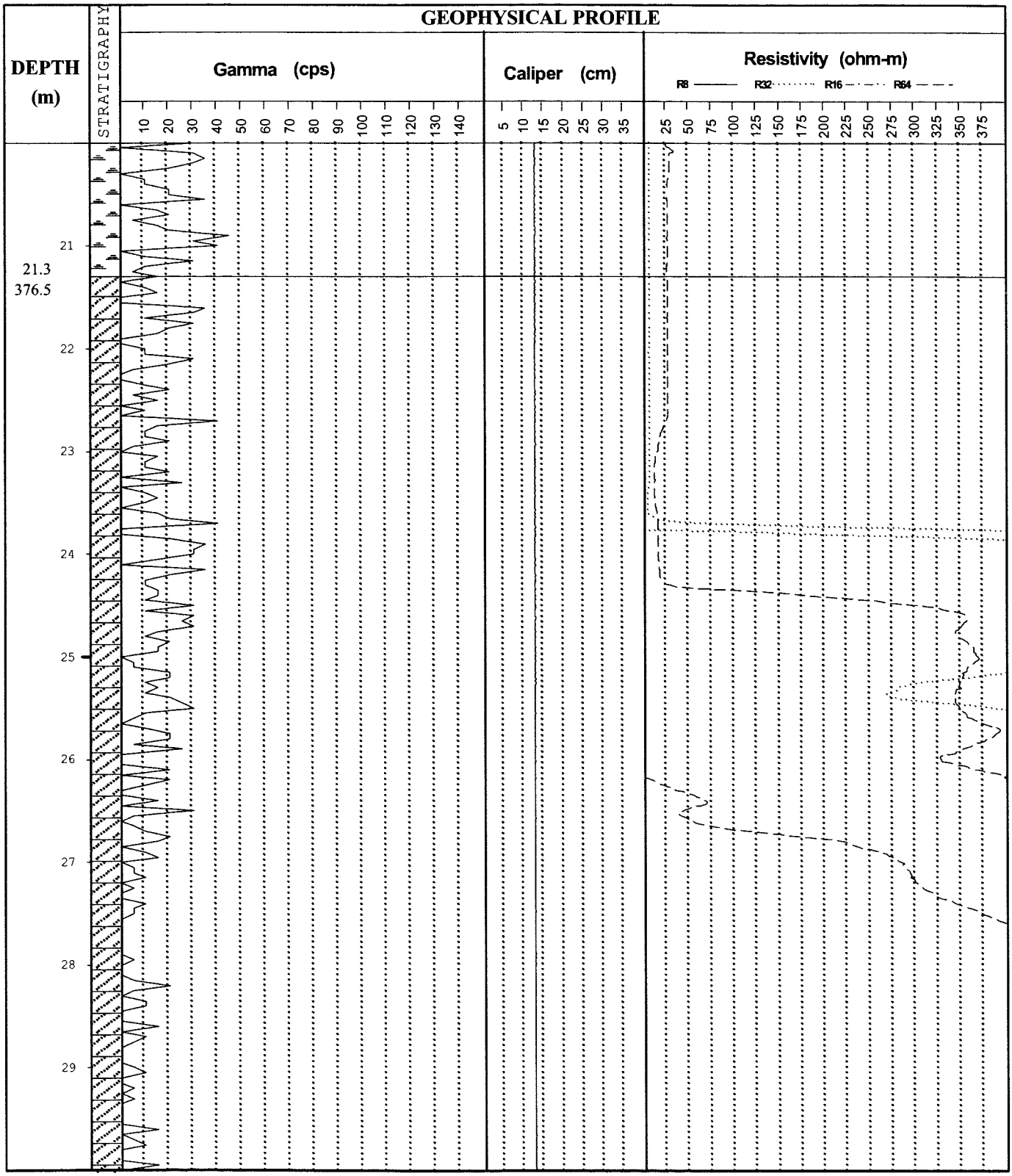

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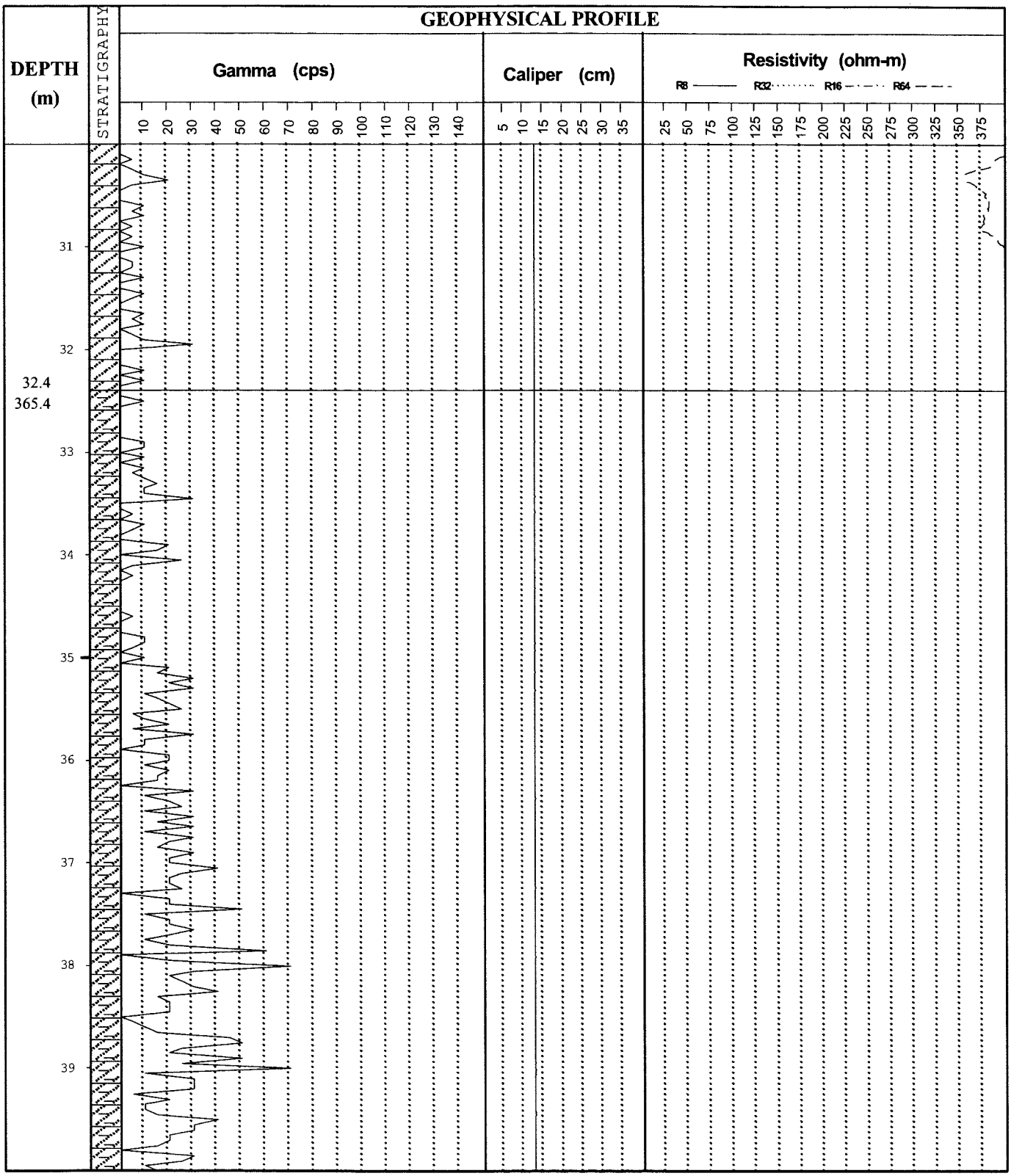
GEOPHYSICAL LOG	PROJECT: 107960	BOREHOLE: MW23_09 4 of 9
Halton Hills Tier 3 Pilot Water Budget 4943 4th Line, North of Townline, Acton **Client:** Regional Municipality of Halton	**Northing:** 4835827 **Easting:** 576551 **Contractor:** ProCore	**DATE:** 9 July 2009 **LOGGED BY** ML **GROUND ELEV** 397.78 m ASL



Printed: 15 Oct 09
File Location:

AECOM

DRAFT FOR DISCUSSION
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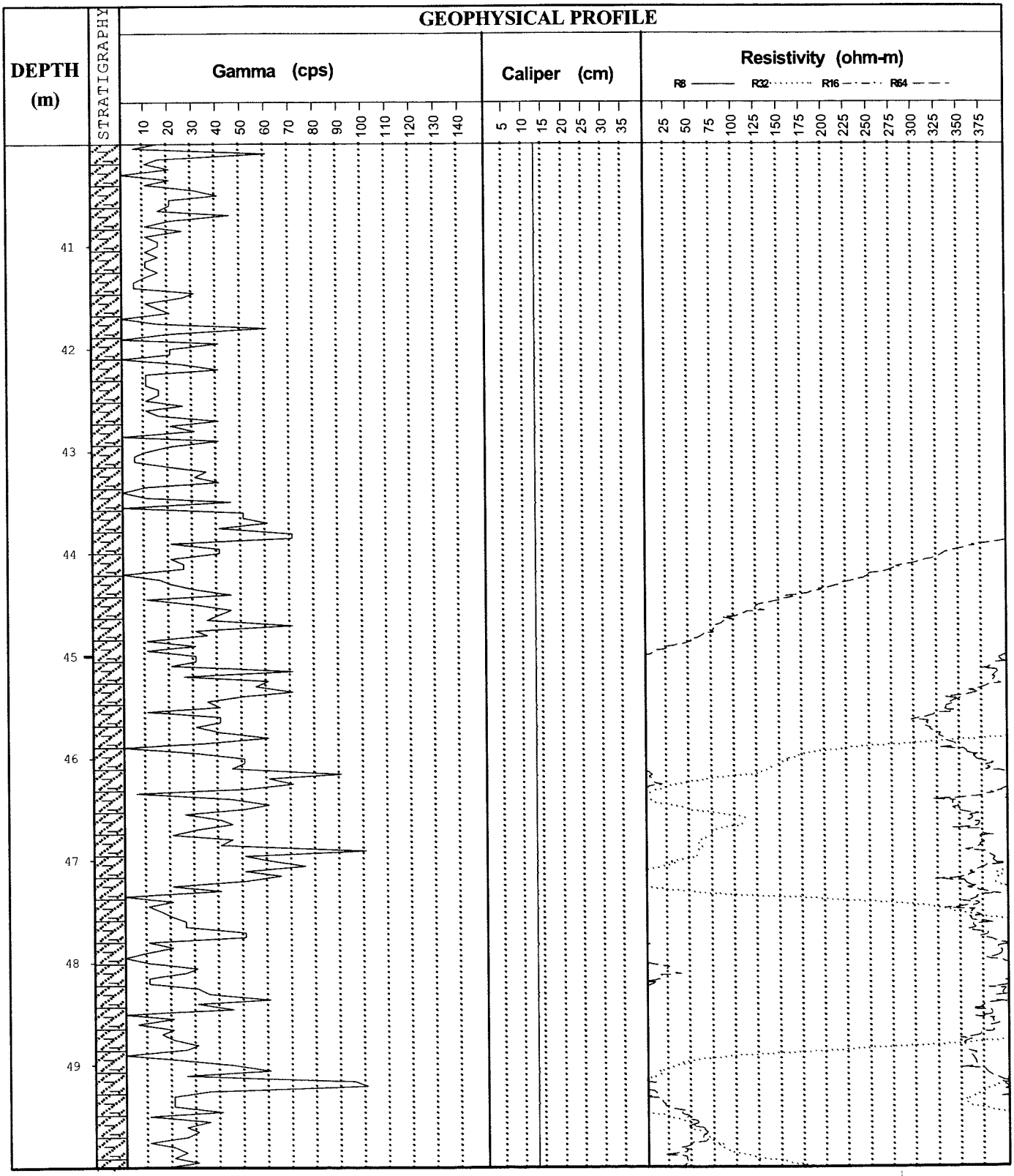

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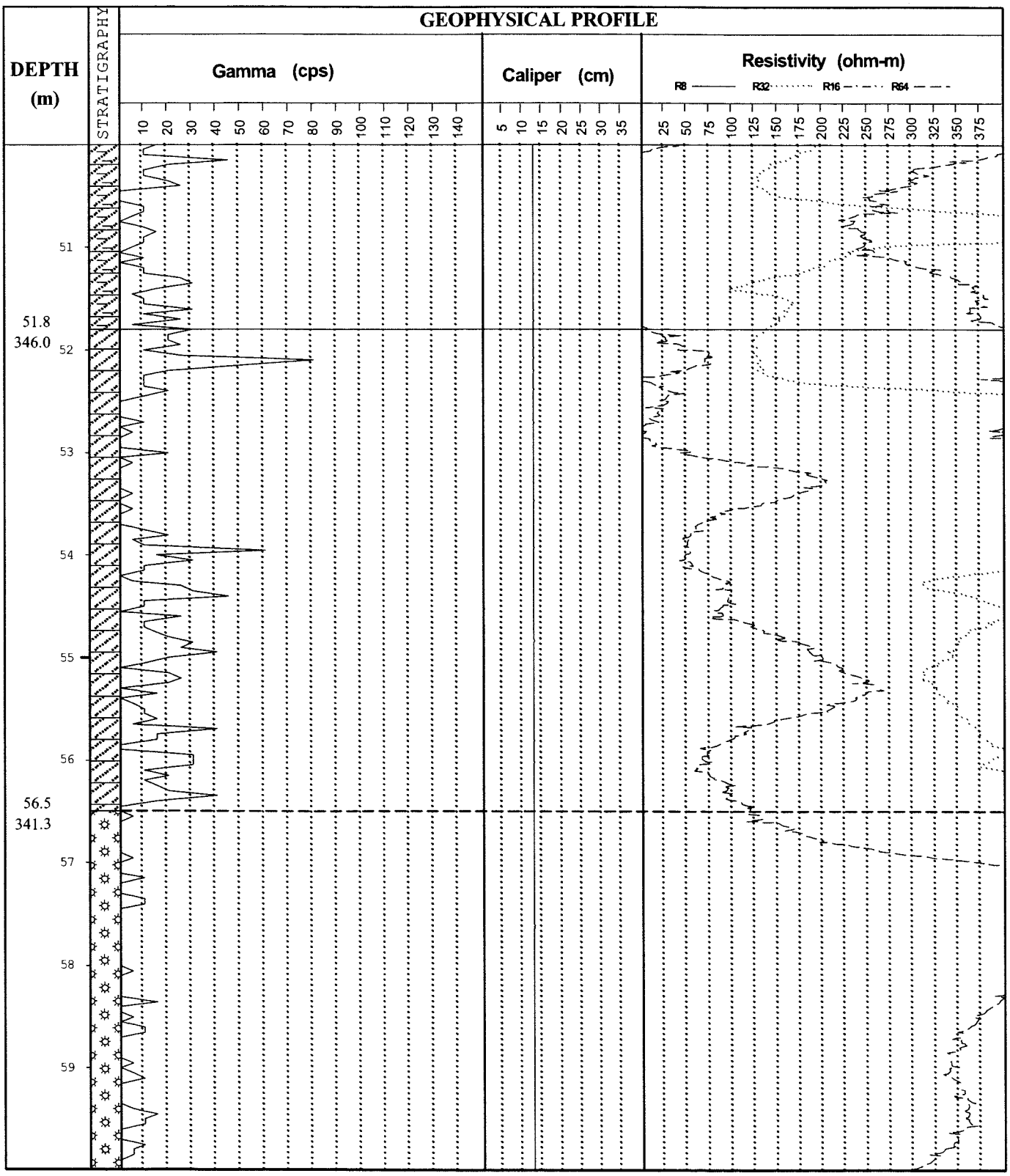

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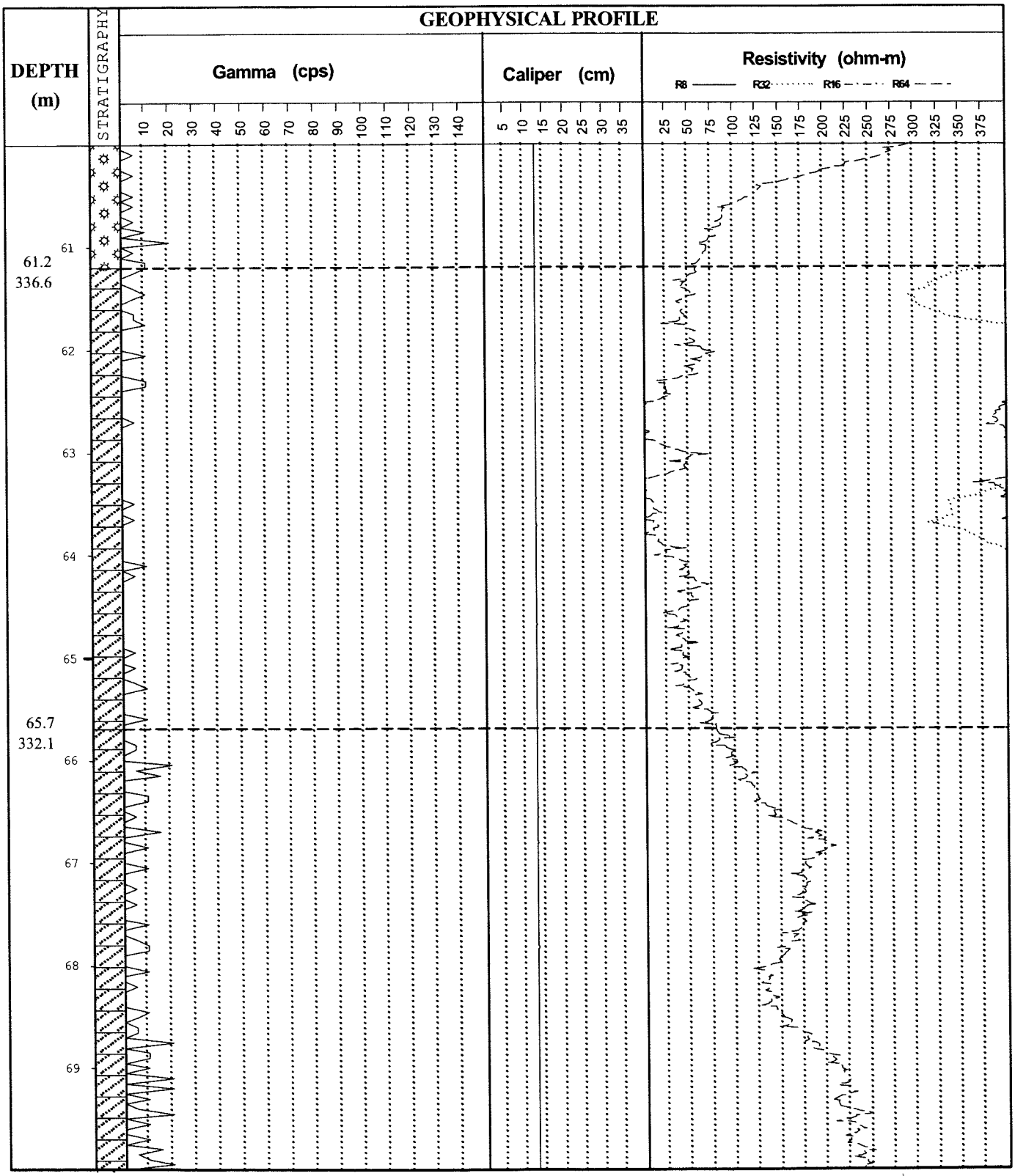

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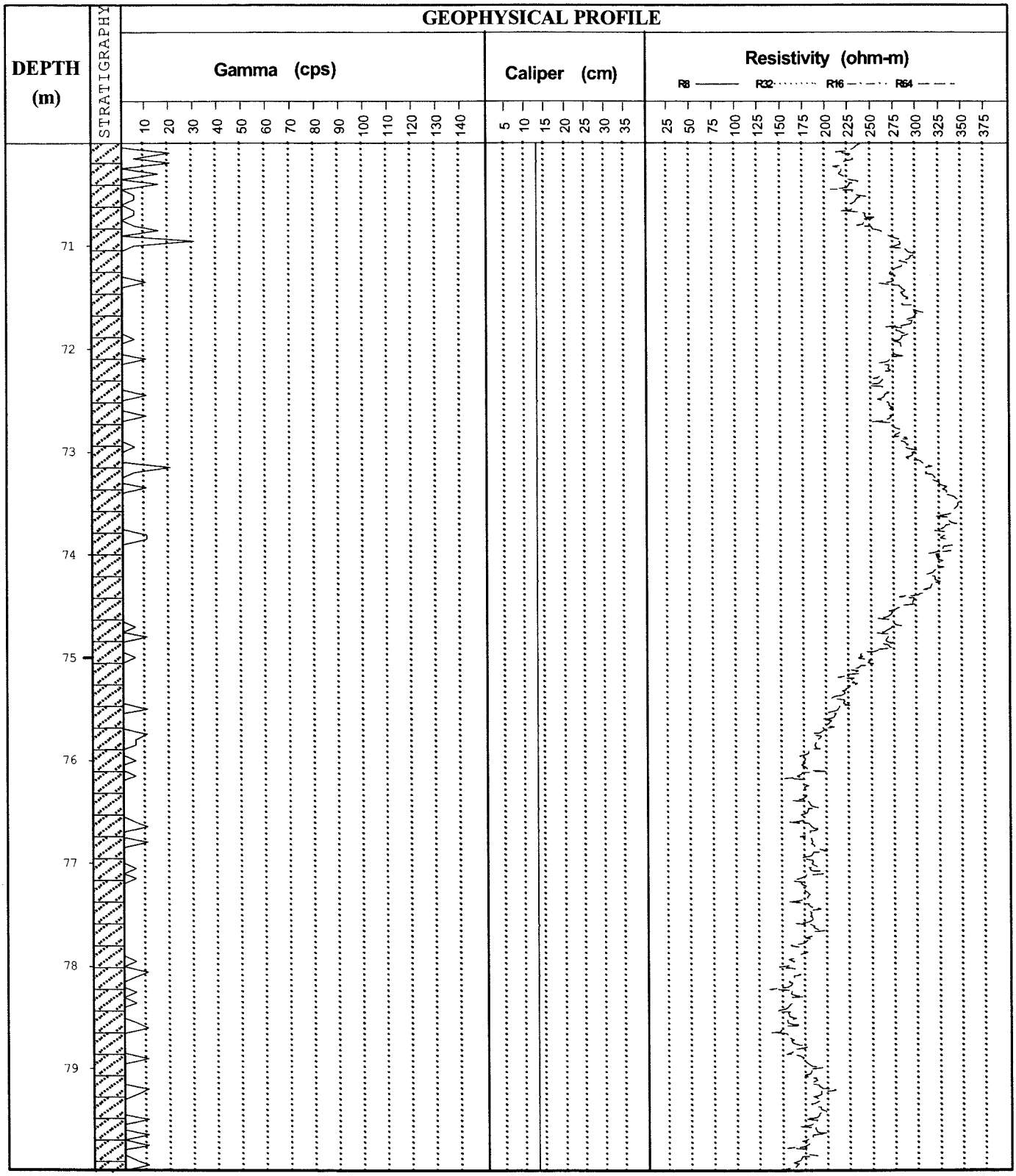

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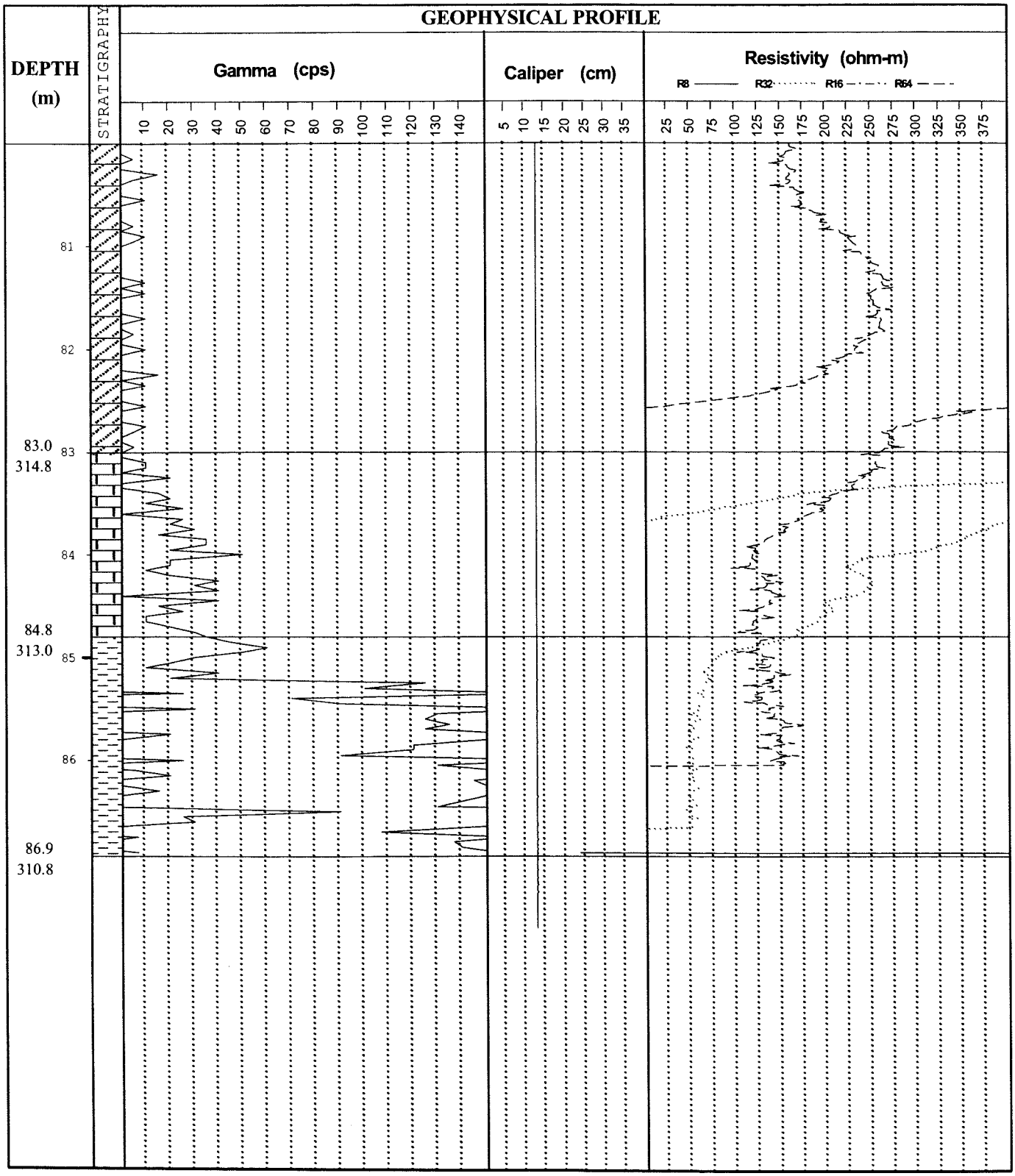

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TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # STATE[12] DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HALTON HILLS TOWN (E CON 04(030)	17 577918 4834349 W	1967/10 4838	04 04	FR 0077 FR 0075 FR 0048	008 / 012 010 / 2:0	DO		2800948 () CLAY GRVL 0011 GREY LMSN 0082
HALTON HILLS TOWN (E CON 04(030)	17 577961 4834365 W	1974/08 3349	07 07	FR 0044 FR 0069	028 / 059 010 / 1:0	DO		2804672 () BLCK LOAM 0001 BRWN CLAY STNS BLDR 0034 GREY LMSN 0073
HALTON HILLS TOWN (E CON 04(031)	17 577777 4834509 W	1974/09 2332	04 04	FR 0065	012 / 032 005 / 2:0	DO		2804719 () BRWN CLAY GRVL 0025 BRWN GRVL LMSN BLDR 0033 WHIT SHLE LMSN 0049 GREY ROCK 0107
HALTON HILLS TOWN (E CON 04(031)	17 577822 4834505 W	2006/11 3349	06	FR 0045	009 / 034 003 / 24:0	DO		2810670 (Z71500) A040595 BLCK LOAM 0098 BRWN SAND BLDR 0005 WHIT LMSN 0050
HALTON HILLS TOWN (E CON 04(031)	17 577666 4834595 W	1986/04 3317	05 05	FR 0090	041 / 060 006 / 1:30	DO		2806485 () BRWN CLAY SAND 0005 CLAY BLDR 0012 CLAY SAND GRVL 0018 GREY CLAY STNS 0030 BRWN ROCK 0077 GREY LMSN 0097
HALTON HILLS TOWN (E CON 04(031)	17 577689 4834583 W	1973/09 2332	04	FR 0090	008 / 050 008 / 2:30	DO		2804344 () BRWN FILL 0005 BRWN GRVL SAND 0018 BRWN GRVL CLAY 0030 BRWN GRVL LMSN 0038 GREY SHLE SAND 0042 BLCK ROCK SHLE 0066 GREY ROCK SHLE 0078 WHIT LMSN 0120
HALTON HILLS TOWN (E CON 04(031)	17 577688 4834583 W	1973/08 4805	04	FR 0024 FR 0037	010 / / :0	DO		2804315 () A BRWN FILL SAND 0004 BRWN LOAM 0007 BRWN SAND CLAY 0024 BRWN GRVL 0027 BLDR 0030 BLCK ROCK 0043 BLCK ROCK 0070
HALTON HILLS TOWN (E CON 04(032)	17 577166 4835121 W	2001/10 7154	06 06	FR 0071 FR 0106	028 / 034 015 / 3:0	DO ST		2809451 (235949) BRWN CLAY SAND 0022 GREY CLAY STNS 0034 BRWN LMSN 0092 GREY LMSN 0110
HALTON HILLS TOWN (E CON 04(032)	17 577164 4835173 W	1979/08 4868	06 30	FR 0033 FR 0028	011 / 014 020 / 1:30	DO		2805378 () PRDG 0010 BRWN SAND GRVL CMTD 0023 BRWN GRVL STNS LOOS 0025 BRWN SNDS LOOS 0029 GREY LMSN HARD 0031 BRWN SNDS SOFT 0033 GREY LMSN HARD 0039
HALTON HILLS TOWN (E CON 04(032)	17 576983 4835039 W	2006/05 2663	06	FR 0082	032 / 036 004 / 1:0	DO		2810581 (Z43924) A039495 BRWN CLAY STNS 0034 BRWN LMSN 0082

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # STATE[12] DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HALTON HILLS TOWN (E CON 05(030)	17 577633 4835510 W	1999/07 2663	06	FR 0035 FR 0082 FR 0065	025 / 033 020 / 1:0	DO		2809030 (198892) BRWN CLAY SNDS 0005 BRWN LMSN 0025 GREY LMSN 0035 GREY LMSN 0082
HALTON HILLS TOWN (E CON 05(030)	17 578008 4834379 W	1956/10 4838	04 04	FR 0042 FR 0048 FR 0054	020 / 025 004 / 1:30	DO		2800983 () GRVL STNS CLAY 0006 GREY LMSN 0055
HALTON HILLS TOWN (E CON 05(031)	17 577684 4834964 W	1956/06 4838	06 06	FR 0085 FR 0028 FR 0065 FR 0104	006 / 035 025 / 2:0	PS		2800984 () MSND 0008 CLAY GRVL STNS 0022 BLCK LMSN 0060 GREY LMSN 0106
HALTON HILLS TOWN (E CON 05(031)	17 577664 4834773 W	1973/05 4805	04 04	FR 0085 FR 0065 FR 0045 FR 0095	025 / 025 020 / 1:0	PS DO		2804180 () BRWN CLAY 0010 BRWN GRVL CLAY 0018 GREY LMSN 0070 WHIT LMSN 0098
HALTON HILLS TOWN (E CON 05(031)	17 577880 4834855 W	1966/12 4838	04 04	FR 0054 FR 0075 FR 0082	017 / 030 007 / 2:0	PS		2800986 () CLAY GRVL STNS 0020 GRVL CLAY 0035 BRWN LMSN 0045 GREY LMSN 0085
HALTON HILLS TOWN (E CON 05(032)	17 577524 4834923 W	1958/09 4838	04 04	FR 0054 FR 0063 FR 0072	/ 075 002 / 2:0	DO		2800987 () MSND 0010 GRVL CLAY 0020 LMSN 0075
HALTON HILLS TOWN (E CON 05(032)	17 577199 4835297 W	1975/08 1906	04	FR 0077	008 / 040 012 / 2:0	DO		2804779 () CLAY STNS 0017 BRWN ROCK 0045 BLUE ROCK 0080
HALTON HILLS TOWN (E CON 05(032)	17 577703 4835643 L	2003/09 2336	06 06	FR 0060	025 / 025 016 / 1:0	DO ST		2809806 (260756) BRWN CLAY STNS 0030 GREY CLAY GRVL 0035 BRWN ROCK 0060
HALTON HILLS TOWN (E CON 05(032)	17 577414 4835023 W	1979/08 4868	36 06	FR 0028 FR 0017	006 / 014 015 / 1:0	DO		2805397 () PRDG 0007 BRWN SAND GRVL CMTD 0017 BRWN GRVL STNS LOOS 0021 BRWN SNDS LOOS 0025 GREY LMSN HARD 0035
HALTON HILLS TOWN (A 04(031)	17 577791 4834533 W	2008/06 7385				NU		7107750 (Z80631) A

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # STATE[12] DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HALTON HILLS TOWN (A 05(003)	17 577987 4836279 W	2007/09 2336	06	FR 0080	025 / 037 012 / 1:0	DO		7050886 (Z68544) A053082 BRWN CLAY STNS 0010 BRWN ROCK 0035 GREY ROCK 0080
ERIN TOWNSHIP CON 04(001)	17 576464 4834573 W	1968/06 3316	05 05	FR 0170	068 / 075 010 / 1:0	DO		6703220 () CLAY LMSN 0075 GREY LMSN 0180
ERIN TOWNSHIP CON 04(001)	17 577019 4835238 W	1960/06 4838	04 04	FR 0039 FR 0048 FR 0052	008 / 012 020 / 1:0	DO		6700625 () CLAY GRVL 0028 BLCK LMSN 0054
ERIN TOWNSHIP CON 04(001)	17 577014 4835243 W	1956/11 2801	10 10		006 / 039 637 / 33:0	MN		6700624 () LOAM 0001 CLAY GRVL 0010 GRVL 0011 CLAY 0018 GRVL CLAY 0021 BRWN LMSN 0062 GREY LMSN SHLE 0072 GREY SHLE 0083 GREY LMSN 0176
ERIN TOWNSHIP CON 04(001)	17 577002 4835308 W	2011/05 7238	05 05					7164276 (Z129172) A113967 BLCK LOAM SOFT 0002 BRWN SILT CLAY DNSE 0012 BRWN SAND GRVL PORS 0021 GREY LMSN 0041
ERIN TOWNSHIP CON 04(001)	17 576788 4834781 W	2000/09 3317	06 06	FR 0161	058 / 068 012 / 1:30	DO		6713499 (219516) BLCK LOAM 0001 BRWN CLAY SNDY 0006 GREN CLAY SAND SLTY 0010 BRWN SAND SILT 0034 GREN CLAY SILT SNDY 0065 GREN CLAY STNS 0076 BRWN LMSN 0114 GREN LMSN 0128 GREN LMSN 0162
ERIN TOWNSHIP CON 04(001)	17 576616 4834945 W	1989/10 2332	05 05	FR 0220	057 / 059 010 / 2:0	DO		6710239 (59437) BRWN CLAY SAND 0008 BRWN CSND FGVL 0024 BLUE CLAY 0086 GREY ROCK 0220
ERIN TOWNSHIP CON 04(002)	17 576533 4835645 W	1973/09 2332	04	FR 0100	070 / 070 008 / 1:0	DO		6704941 () BRWN CLAY BLDR 0018 BRWN CSND STNS 0025 BRWN CSND 0030 BRWN GRVL STNS 0058 BRWN SHLE GRVL STNS 0083 HPAN ROCK 0090 BRWN ROCK 0100
ERIN TOWNSHIP CON 04(002)	17 576374 4835788 W	1989/05 2332	05 05	FR 0094	070 / 070 010 / 1:0	DO		6710219 (59401) BLCK LOAM 0001 BRWN CGVL CLAY 0048 BRWN MSND PCKD HPAN 0090 BRWN ROCK 0095

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # STATE[12] DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
ERIN TOWNSHIP CON 04(002)	17 576147 4835945 W	2001/06 7154	06	FR 0158	019 / 051 010 / 1:30	DO		6713700 (232913) BRWN GRVL STNS SAND 0062 GREY CLAY STNS 0099 GREY LMSN 0127 BRWN LMSN 0161
ERIN TOWNSHIP CON 05(001)	17 577560 4836100 W	1997/01 2663	06 06	FR 0004 FR 0128 FR 0080 FR 0100	018 / 060 020 / 1:0	DO		6712184 (176540) FILL 0003 BRWN CLAY SNDS GRVL 0023 BRWN LMSN 0090 GREY LMSN 0128
ERIN TOWNSHIP CON 05(001)	17 577784 4836263 W	1969/07 3316	04 04	FR 0051	027 / 032 010 / 3:0	DO		6703526 () GRVL CLAY 0047 BRWN LMSN 0052
ERIN TOWNSHIP CON 05(002)	17 576539 4835999 W	2010/04 7154	06 06	FR 0102 FR 0112	067 / 068 015 / 2:0	DO		7145915 (Z107317) A084648 BRWN SILT CLAY STNS 0032 GREY CLAY STNS 0079 BRWN LMSN SOFT 0122
ERIN TOWNSHIP CON 05(002)	17 576716 4835769 W	1988/09 2332	05 05	FR 0065	052 / 053 012 / 2:0	DO		6709705 (36108) BLCK LOAM 0001 BRWN CLAY STNS 0018 GREY CLAY ROCK 0057 GREY ROCK LMSN 0090
ERIN TOWNSHIP CON 05(002)	17 576416 4836088 W	1987/12 2332	05 05	FR 0110	071 / 082 010 / 2:0	DO		6709209 (18760) BLCK LOAM 0001 BRWN OBDN SAND 0006 BRWN CSND CSND 0065 GREY CLAY ROCK 0102 GREY LMSN 0120
ERIN TOWNSHIP CON 05(003)	17 576262 4836197 W	1984/11 2332	05 05	FR 0115	032 / 036 009 / 1:0	DO		6708170 () BRWN LOAM SAND 0012 BRWN CGVL STNS 0060 GREY CLAY ROCK SAND 0108 BRWN ROCK SOFT 0120
ERIN TOWNSHIP ()	17 576551 4835827 W	2009/07 7440		0062			190 16	7148818 (Z111025) A096144 BRWN LOAM FILL LOOS 0009 BRWN SAND GRVL SILT 0070 GREY LMSN HARD 0279 GREN SHLE HARD 0285
ERIN TOWNSHIP ()	17 577077 4835362 W	2010/02 3428						7143178 (Z108194) A021819
ERIN TOWNSHIP ()	17 577002 4835302 W	2010/12 3428	10 10 10 08					7158763 (Z124230) A054411
ERIN TOWNSHIP ()	17 577013 4835301 W	2010/12 3428	10 10 10					7158762 (Z124231) A054418

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # STATE[12] DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
ERIN TOWNSHIP ()	17 577053 4835463 W	2012/09 7238						7188335 (Z155411) A135559 P

Notes:
1. UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
2. Date Work Completed
3. Well Contractor Licence Number
4. Casing diameter in inches
5. Unit of Depth in Feet
6. See Table 4 for Meaning of Code
7. STAT LVL: Static Water Level in Feet ; PUMP LVL: Water Level After Pumping in Feet
8. Pump Test Rate in GPM, Pump Test Duration in Hour : Minutes
9. See Table 3 for Meaning of Code
10. Screen Depth and Length in feet
11. See Table 1 and 2 for Meaning of Code
12. A: Abandonment; P: Partial Data Entry Only

1. Core Material and Descriptive terms

Code	Description	…	Code	Description	…	Code	Description	…	Code	Description	…	Code	Description
BLDR	BOULDERS		FCRD	FRACTURED		IRFM	IRON FORMATION		PORS	POROUS		SOFT	SOFT
BSLT	BASALT		FGRD	FINE-GRAINED		LIMY	LIMY		PRDG	PREVIOUSLY DUG		SPST	SOAPSTONE
CGRD	COARSE-GRAINED		FGVL	FINE GRAVEL		LMSN	LIMESTONE		PRDR	PREV. DRILLED		STKY	STICKY
CGVL	COARSE GRAVEL		FILL	FILL		LOAM	TOPSOIL		QRTZ	QUARTZITE		STNS	STONES
CHRT	CHERT		FLDS	FELDSPAR		LOOS	LOOSE		QSND	QUICKSAND		STNY	STONEY
CLAY	CLAY		FLNT	FLINT		LTCL	LIGHT-COLOURED		QTZ	QUARTZ		THIK	THICK
CLN	CLEAN		FOSS	FOSILIFEROUS		LYRD	LAYERED		ROCK	ROCK		THIN	THIN
CLYY	CLAYEY		FSND	FINE SAND		MARL	MARL		SAND	SAND		TILL	TILL
CMTD	CEMENTED		GNIS	GNEISS		MGRD	MEDIUM-GRAINED		SHLE	SHALE		UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE		GRNT	GRANITE		MGVL	MEDIUM GRAVEL		SHLY	SHALY		VERY	VERY
CRYS	CRYSTALLINE		GRSN	GREENSTONE		MRBL	MARBLE		SHRP	SHARP		WBRG	WATER-BEARING
CSND	COARSE SAND		GRVL	GRAVEL		MSND	MEDIUM SAND		SHST	SCHIST		WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED		GRWK	GREYWACKE		MUCK	MUCK		SILT	SILT		WTHD	WEATHERED
DLMT	DOLOMITE		GVLY	GRAVELLY		OBDN	OVERBURDEN		SLTE	SLATE			
DNSE	DENSE		GYPS	GYPSUM		PCKD	PACKED		SLTY	SILTY			
DRTY	DIRTY		HARD	HARD		PEAT	PEAT		SNDS	SANDSTONE			
DRY	DRY		HPAN	HARDPAN		PGVL	PEA GRAVEL		SNDY	SANDY			

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Water Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial		
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

Appendix E
Correspondence

Public Works
Water Design & Construction
1151 Bronte Road
Oakville ON L6M 3L1
Fax: 905-825-0267

June 3, 2013

Dear Resident/Property Owner:

RE: Notice of Well Water Monitoring Program for Fourth Line Pumping Test, Municipal Class Environmental Assessment for Fourth Line Well Field Expansion, Town of Halton Hills (Acton), Ward 1, Our File: PR-2826

Halton Region is investigating the possibility of increasing the capacity of the Fourth Line Well Field, which provides water to the community of Acton, and we are inviting you to participate in a free Well Monitoring Program.

During the period of July 2013 to September 2013, Halton Region will be conducting a pumping test at the Fourth Line Well Field site located at 9098 Erin-Halton Hills Townline. The water drawn from the Fourth Line Well Field will be temporarily increased from its current maximum permitted rate of 1,309 m^3/day to a maximum proposed rate of 1,709 m^3/day.

Halton Region has retained Stantec Consulting Ltd. (Stantec) to conduct the Well Monitoring Program. If you are a well owner and wish to participate, please fill out the attached well survey form to the best of your ability and return to Halton Region by **June 14, 2013**. Return envelops are enclosed with paid postage.

Starting the week of **June 17, 2013**, Stantec will begin conducting a door-to-door survey with interested residents. The survey will include interviews with homeowners to discuss their water supply, a measurement of water levels and, where possible, installation of electronic data loggers to monitor water levels throughout the pumping test. If you wish to make an appointment for the site visit, please contact Stantec's Environmental Scientist, Aaron Vanderhoff, at 519-585-7116 or by email at Aaron.Vanderhoff@stantec.com.

Stantec will also collect a minimum of two water quality samples throughout the duration of the Well Monitoring Program and the resulting information will be shared with the property owner. Should water quality concerns be noted by Halton Regional staff during their analysis of the collected sample, staff will immediately notify the property owner by phone and will provide copies of the water quality results.

We will continue to monitor your well water during and following the pumping test. It is always important to us that your water supply is protected, so we have developed a Well Mitigation Protocol in the event that there is a water supply interruption. Please see the enclosed for more details on this protocol.

We appreciate your cooperation as we continue to provide a safe and reliable water supply for the residents of Acton. The results of the pumping test will form the basis of an Environmental Study Report which will be available for review on Halton Region's website: www.halton.ca/haltonhills_ea.

If you have any questions or would like further information about the Well Monitoring Program or the study, please feel free to contact Halton Region's Project Manager at 905-825-6000, ext. 3309 (Toll Free: 1-866-442-5866) or by email at Michelle.Gillespie@halton.ca.

If you have any questions about the quality of your well water or have questions about the water quality results, please feel free to contact Halton's Health Department at Halton Region by dialling 311 or 905-825-6000.

Sincerely,

Michelle Gillespie, P.Eng.
Project Manager, Water Design and Construction

c: Gary Carr, Halton Regional Chair
Rick Bonnette, Mayor, Town of Halton Hills
Tom Adams, Regional Councillor & Chair of the Planning & Public Works Committee
Clark Somerville, Regional Councillor, Town of Halton Hills, Ward 1
Jon Hurst, Town Councillor, Town of Halton Hills, Ward 1
Mike O'Leary, Town Councillor, Town of Halton Hills, Ward 1
Jane MacCaskill, CAO, Halton Region
Mitch Zamojc, P. Eng. Commissioner, Public Works, Halton Region
Kiyoshi Oka, P.Eng., Director, Water Services, Halton Region
Jacqueline Weston, P.Eng., Manager, Water Design & Construction , Halton Region
Chris Mills, P.Eng., Director, Infrastructure Services and Town Engineer, Town of Halton Hills
Robert Weirsma, Project Manager, Stantec Consulting Ltd.
Roger Freymond, Senior Hydrogeologist, Stantec Consulting Ltd.
Access Halton

CREDIT VALLEY CONSERVATION

MEMO

To: **Roger Freymond**
Stantec
To: **Tom Renic**
Halton Region
From: **Liam Marray**
Manager Planning Ecology
Date: **July 4th, 2013**
Re: **Halton Region 4th Line Pumping Test - Additional Details**

Tom/Roger

Staff of Credit Valley Conservation (CVC) have had an opportunity to review the above information and provide the following comments for your consideration.

It is our understanding that the main purpose for the 4th Line pumping test is to identify the long term safe yield for this well that will not impact aquatic and wetland habitats, as well as other receptors (e.g., private wells). We recommend that the triggers applied to the test should more closely match the criteria for long term protection of these receptors, and therefore we recommend that the test trigger for the fisheries assessment for areas with upward vertical gradients should be "no reduction in the magnitude of the gradient attributable to pumping of the 4th Line well" and for the wetland assessment no change is groundwater elevation attributable to pumping of the 4th Line well. These are appropriate triggers for notification of CVC staff and should be protective of aquatic and wetland habitat. Based on the assessment of the data, timing relative to fish and other wildlife activity, and discussion with Stantec and the Region, it is possible that the test may continue despite reaching this trigger.

As a result, CVC recommends that Fisheries Assessment be revised to Step 1 "no reduction in the magnitude of the gradient in areas of upward gradient" and the Wetland Assessment be revised to Step 1 " no decrease in groundwater level". For both assessments, Step 3 CVC contacted and advised that the trigger has been hit. Step 4 CVC, Region and Stantec identify next step which could be continue pumping with no contingency (therefore no potential to mask the impacts from pumping), continue pumping with contingency or stop pumping.

On the plan, CVC could not identify all the monitoring locations identified in the Aquatic and Wetland Assessment Charts. Could you please provide a Figure with just the monitoring locations identified on the Assessment Charts? As well, could you provide a brief explanation of why these monitoring locations were identified?

Please clarify on Table 2 that there is monitoring activity that has already occurred but the location is to be determined.

Liam Marray
Credit Valley Conservation
Manager Planning Ecology
1255 Old Derry Road West
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Fax: (905) 670-2210
Email: lmarray@creditvalleyca.ca

CREDIT VALLEY CONSERVATION

MEMO

To: **Roger Freymond**
Stantec
CC: **Tom Renic**
Region of Halton
From: **Liam Marray**
Manager Planning Ecology
Date: **July 23, 2014**
Re: **4th Line Wells**
Region of Halton

Roger/Tom

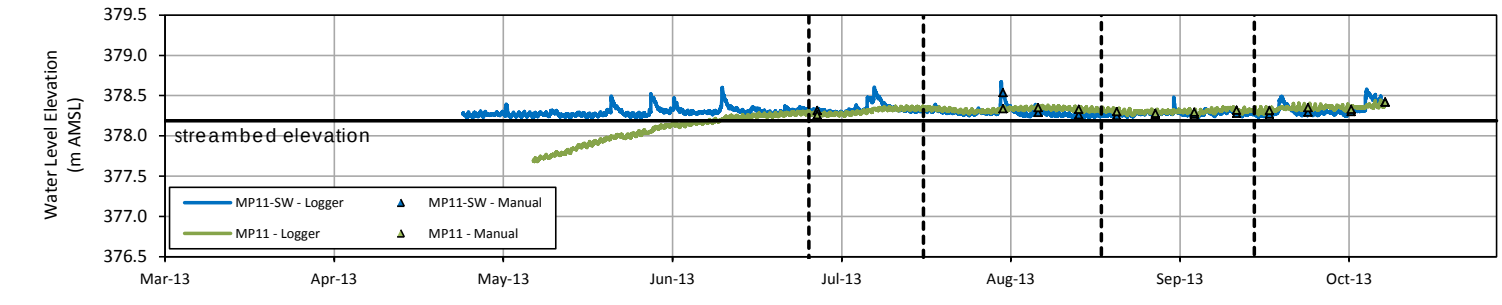
Thank you for the meeting on June 27, 2014. CVC staff has reviewed the information provided and would like to request some additional information.

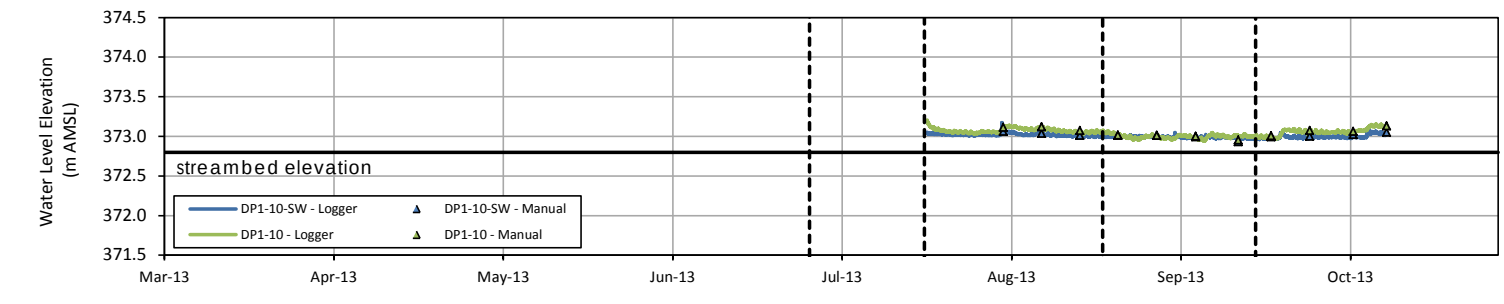
a) Zoomed in/blown up graphs and Tables showing groundwater levels from May – Oct for MP7 and MP2
b) Drawdown cone showing the 0.1 m line
c) The impact on the aquifer if the pumping was carried out for 20 years
d) Discussion/anlaysis of the ecological impacts resulting from the drawdown in the area surrounding MP5-13. It appears that the Dillon spawning survey did not include the area around MP5-13, did Stantec's surveys include this area?

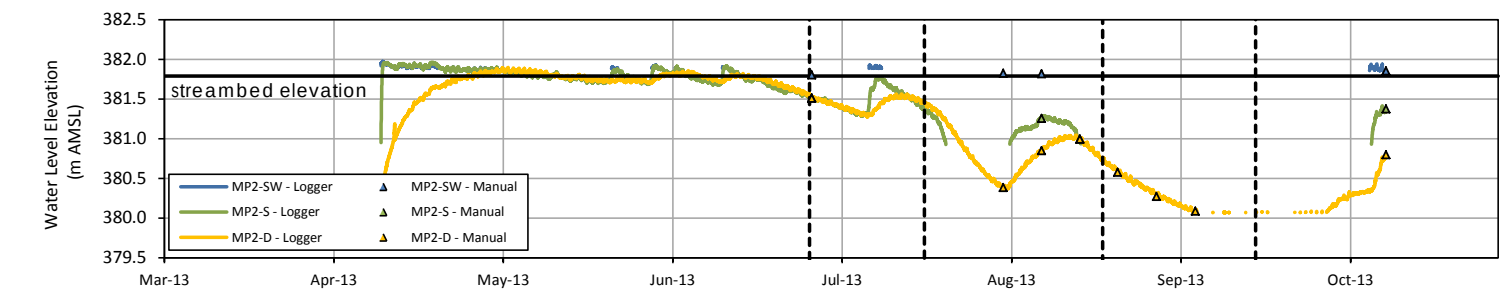
If you have any additional questions or comments do not hesitate to contact me.

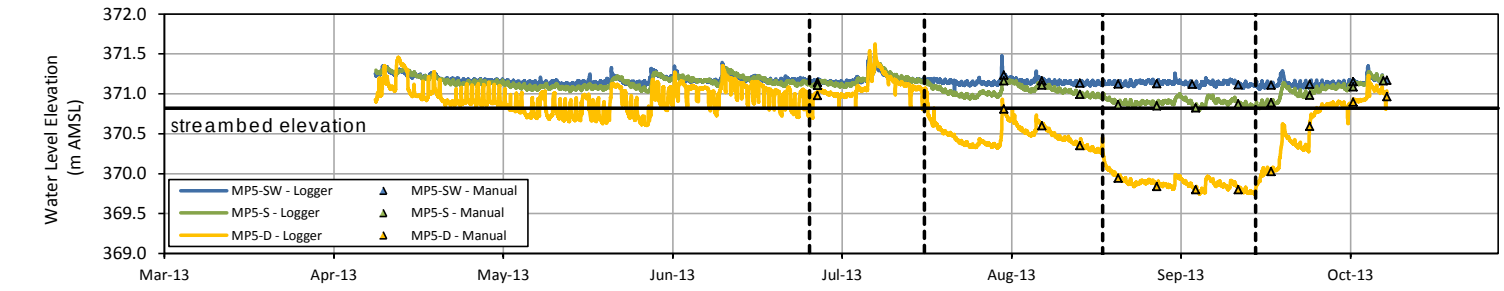
Liam Marray
Manager Planning Ecology
Credit Valley Conservation
lmarray@creditvalleyca.ca | 905.670.1615 ext 239

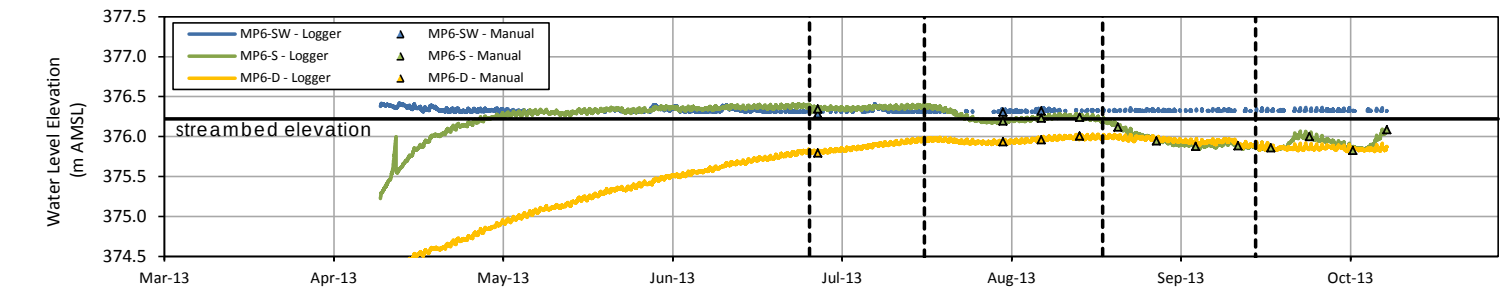
Appendix F
Hydrographs

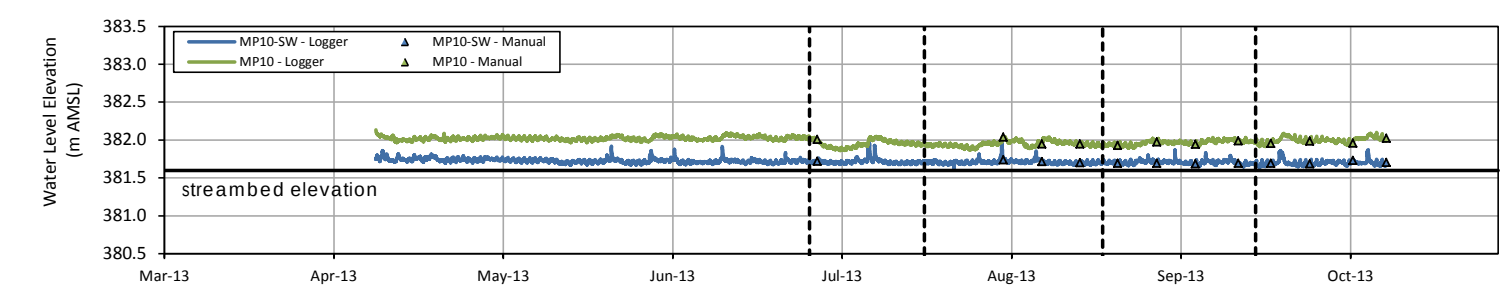


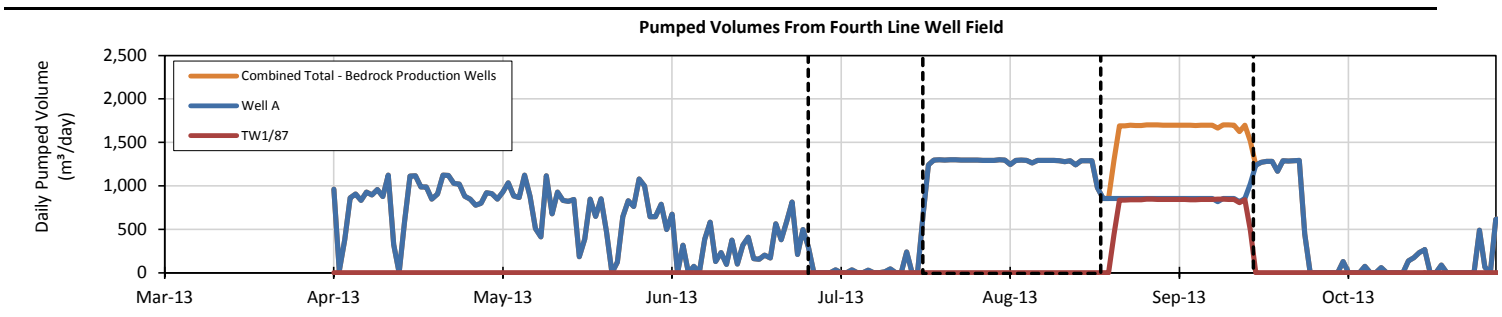


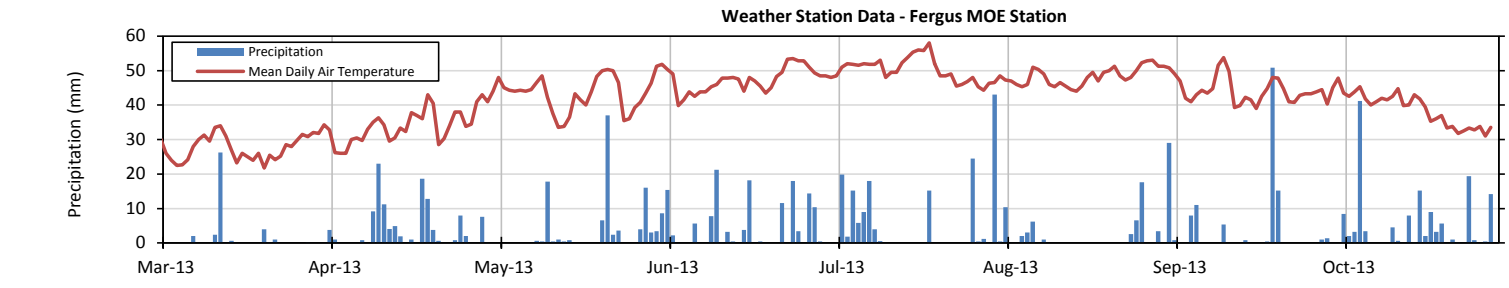












Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

F-1a (Appendix F)

Title

Hydrograph - Trigger Locations
Fourth Line Well Field

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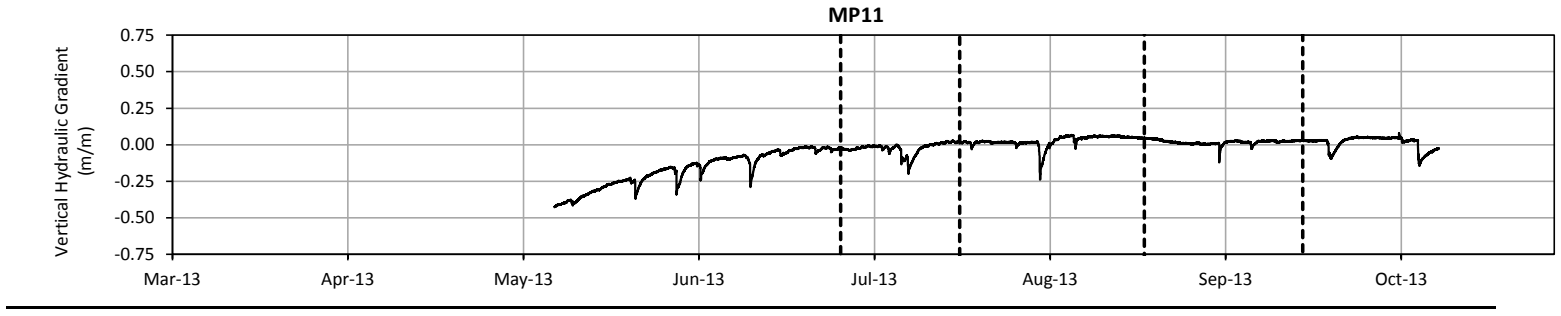

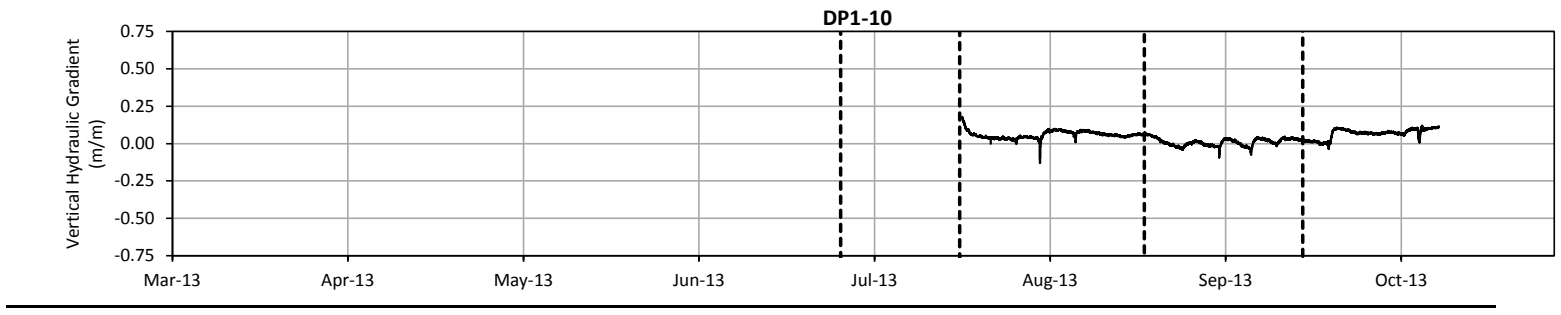

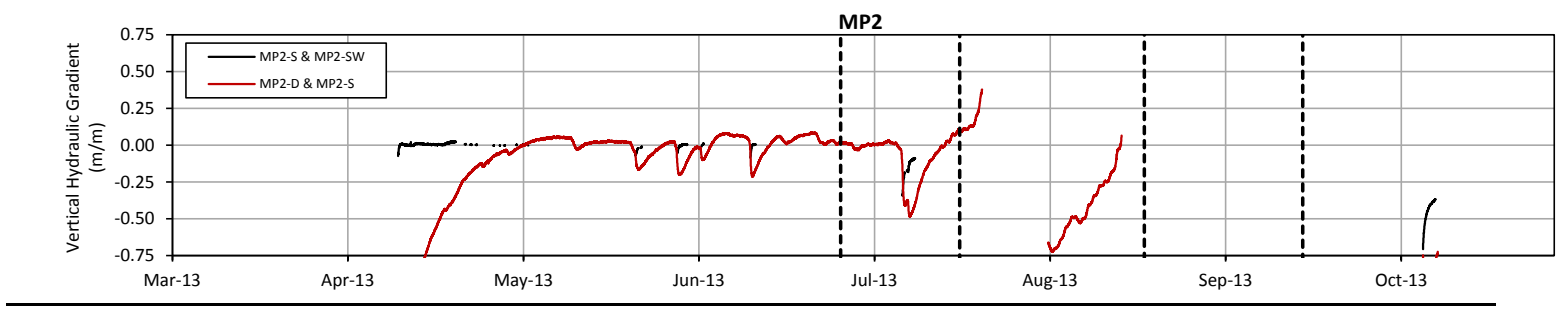

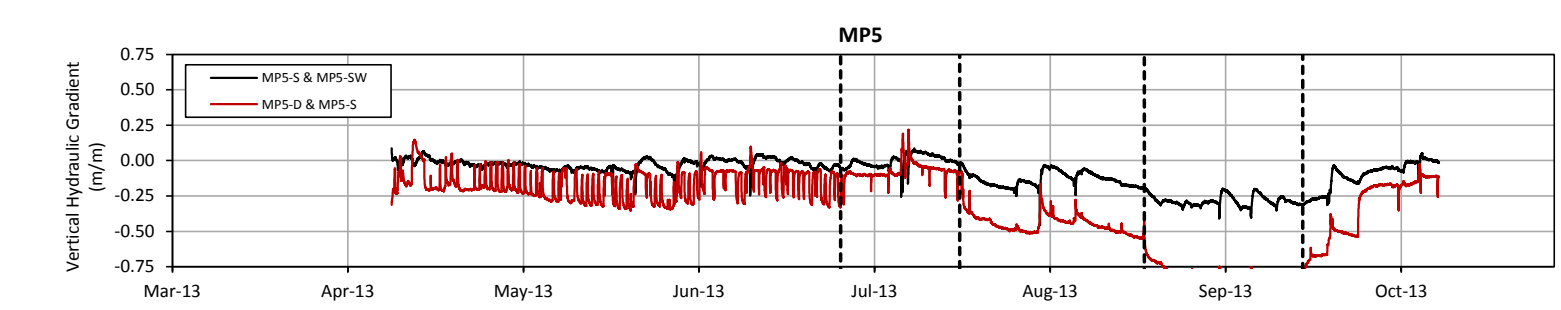

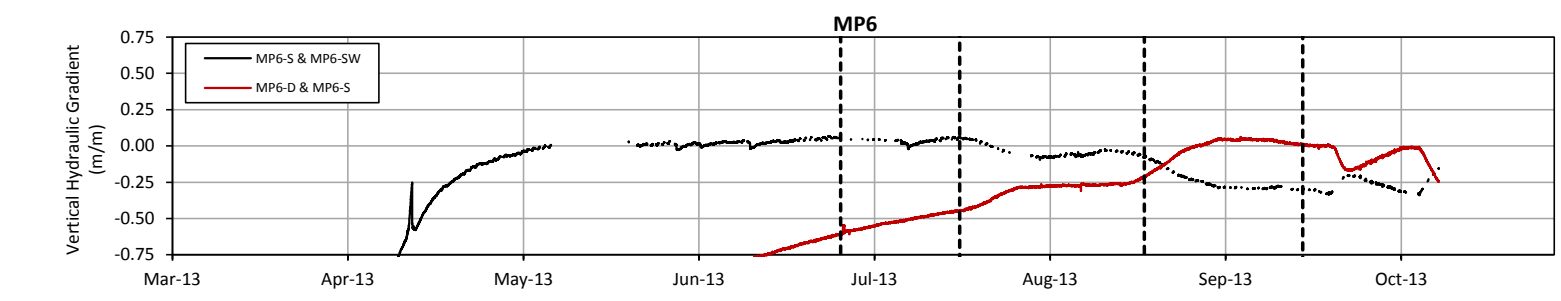

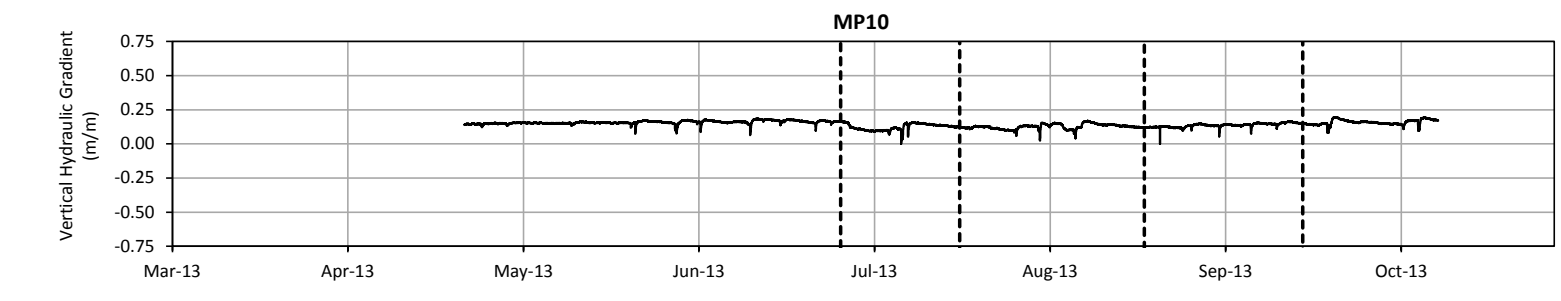

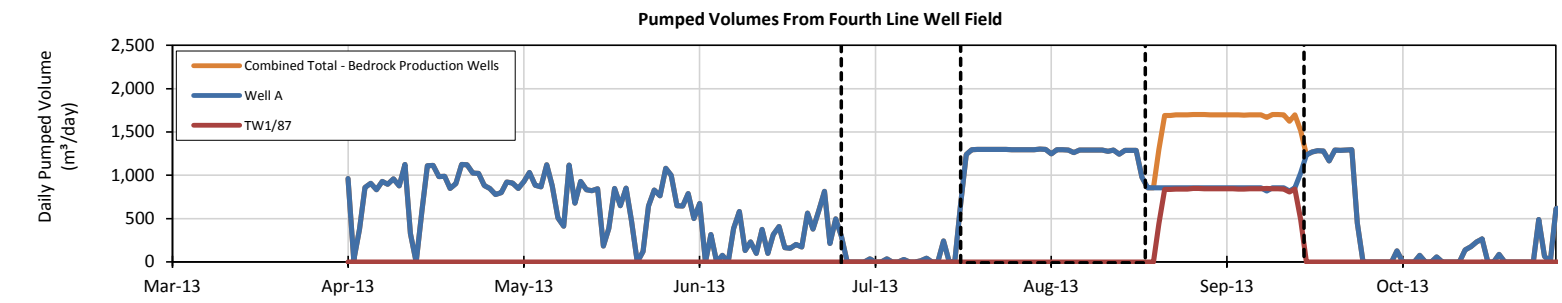

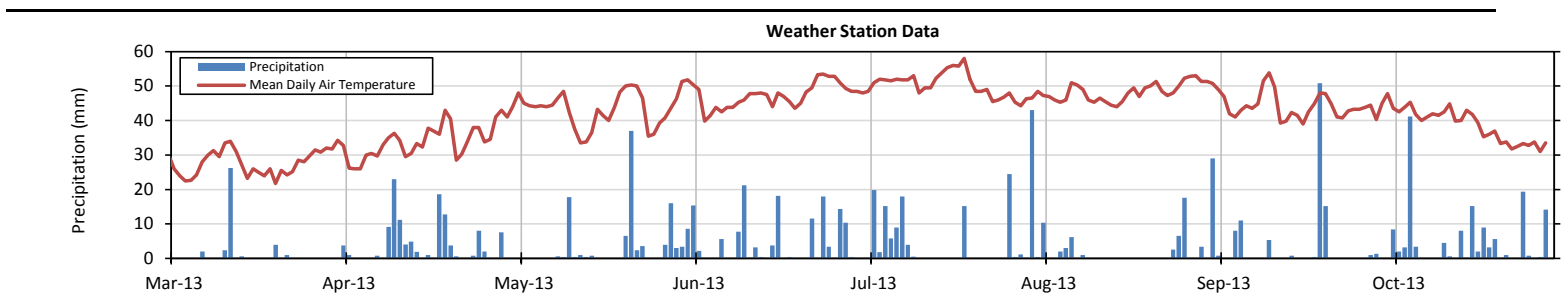

Notes:

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Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

F-1b (Appendix F)

Title

Vertical Hydraulic Gradients
Trigger Monitoring Locations
Fourth Line Well Field

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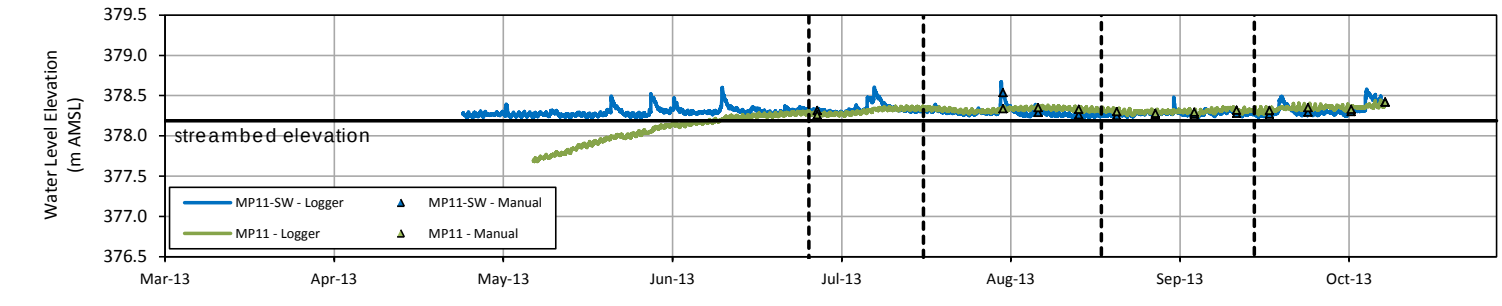

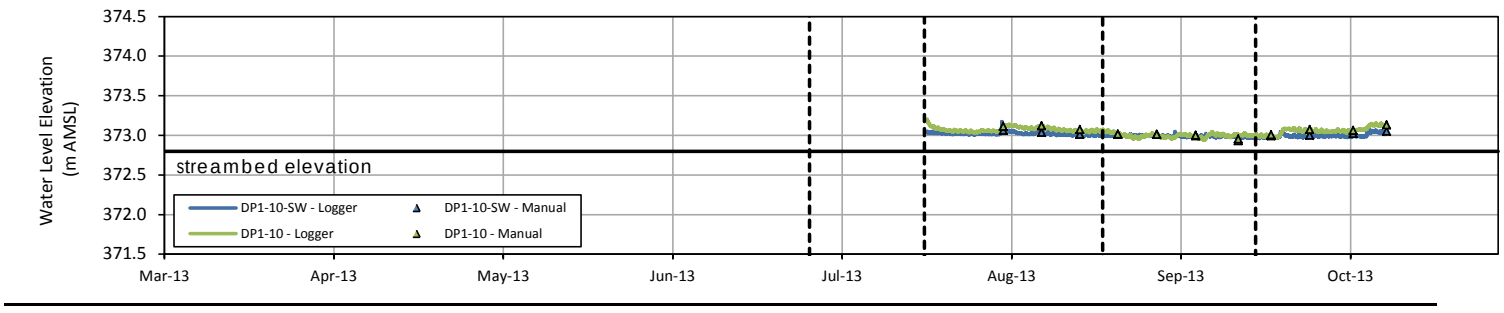

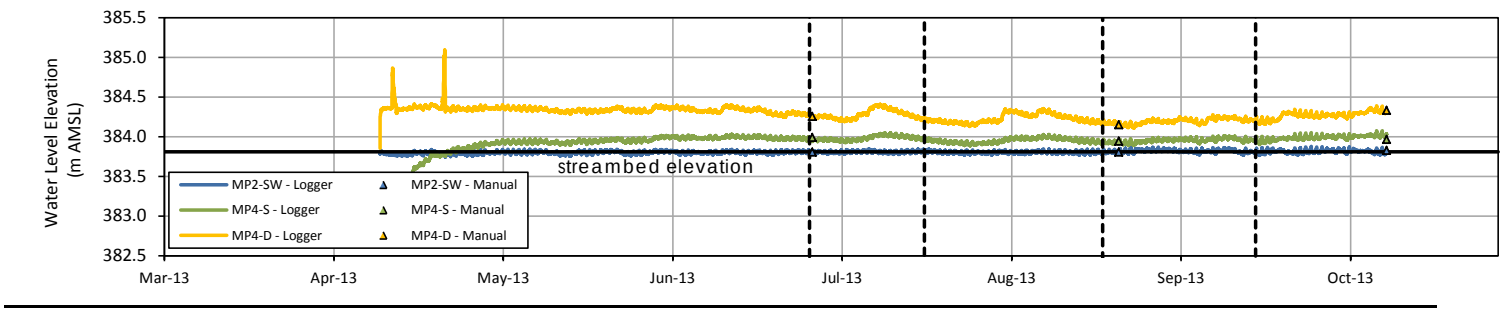

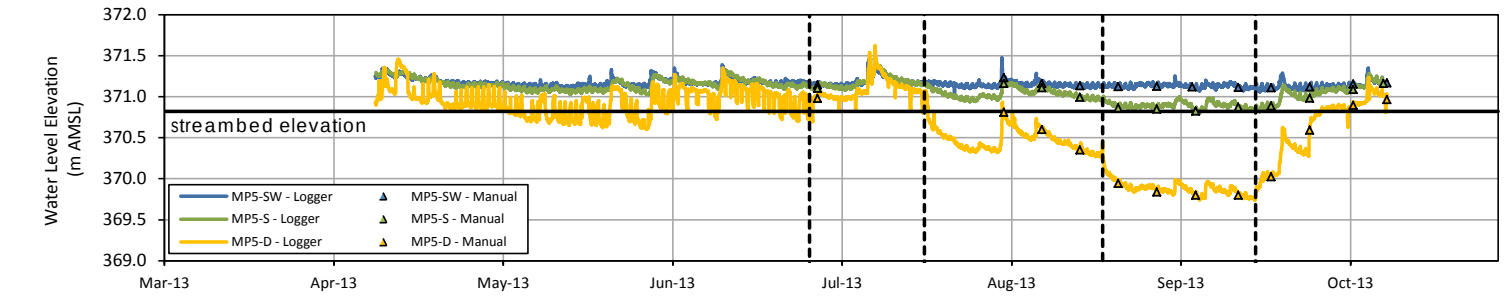

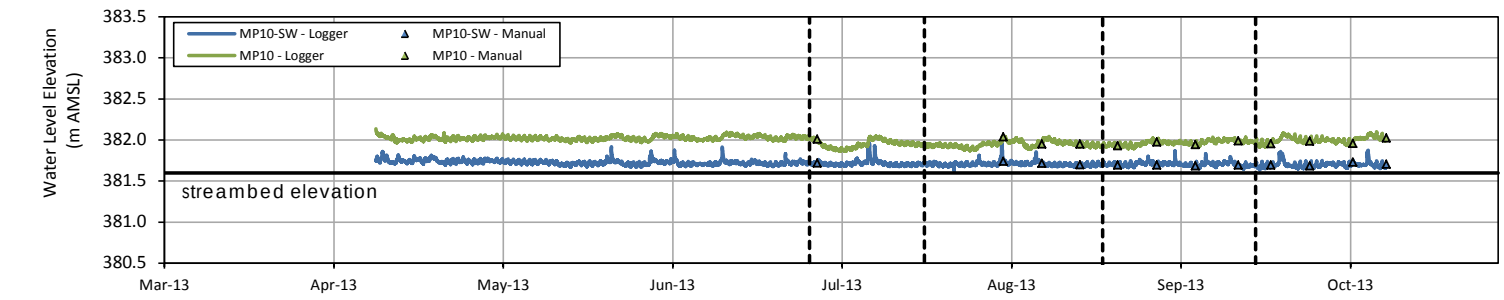

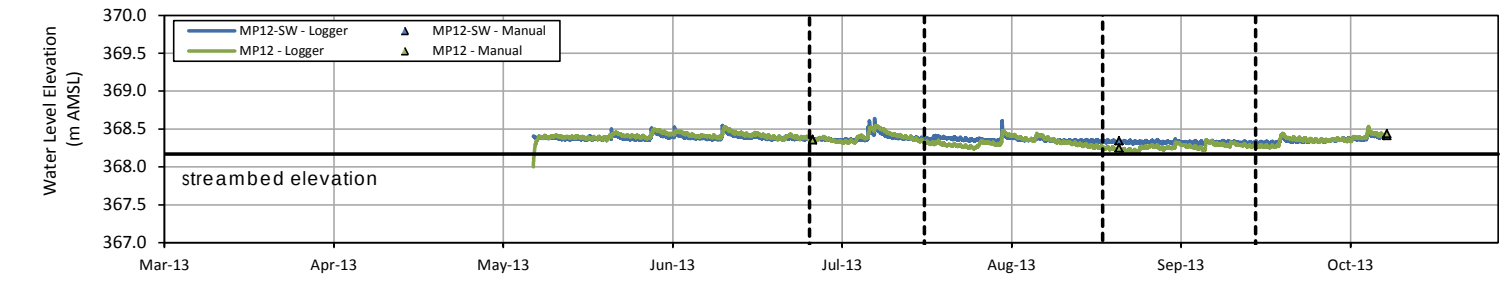

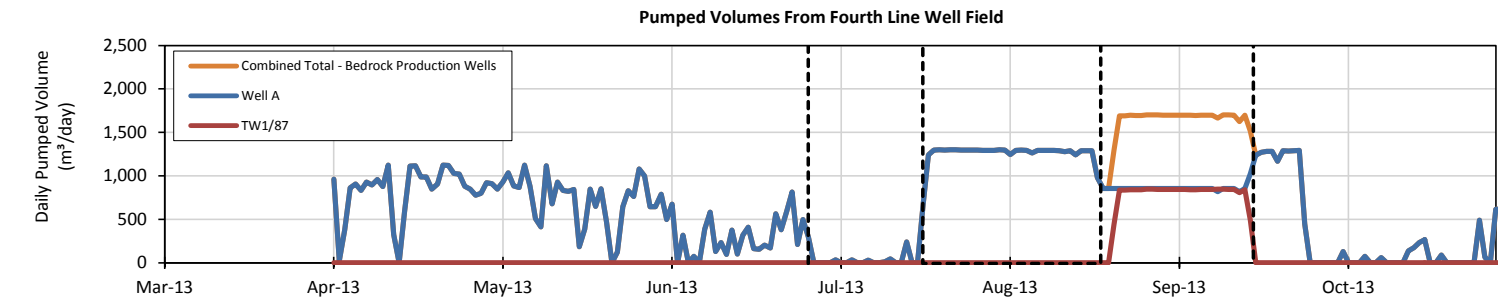

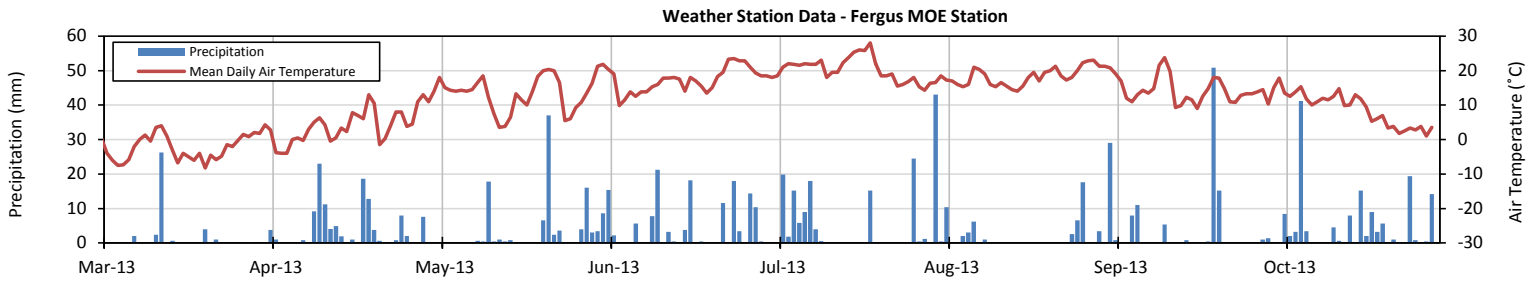

Notes:

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Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

F-2a (Appendix F)

Title

Hydrograph - Persistent Flow Locations
Fourth Line Well Field

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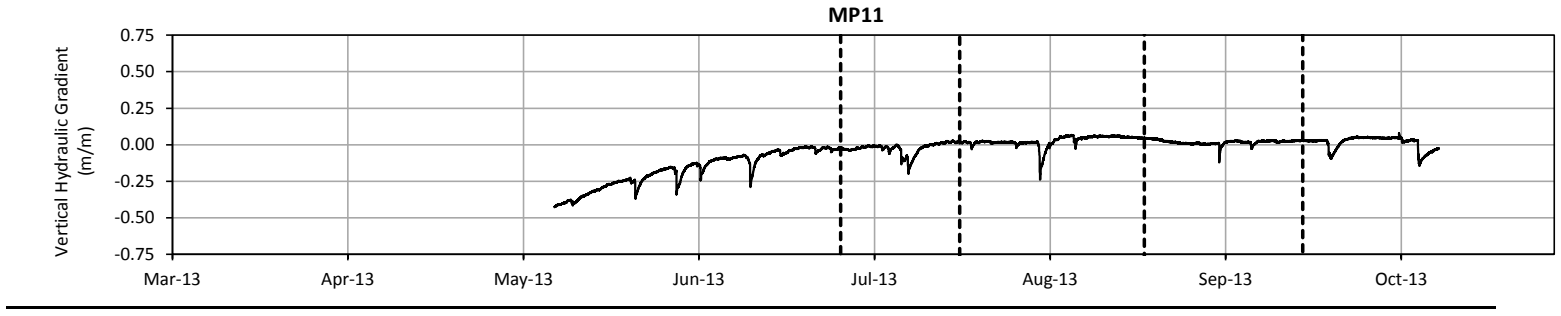

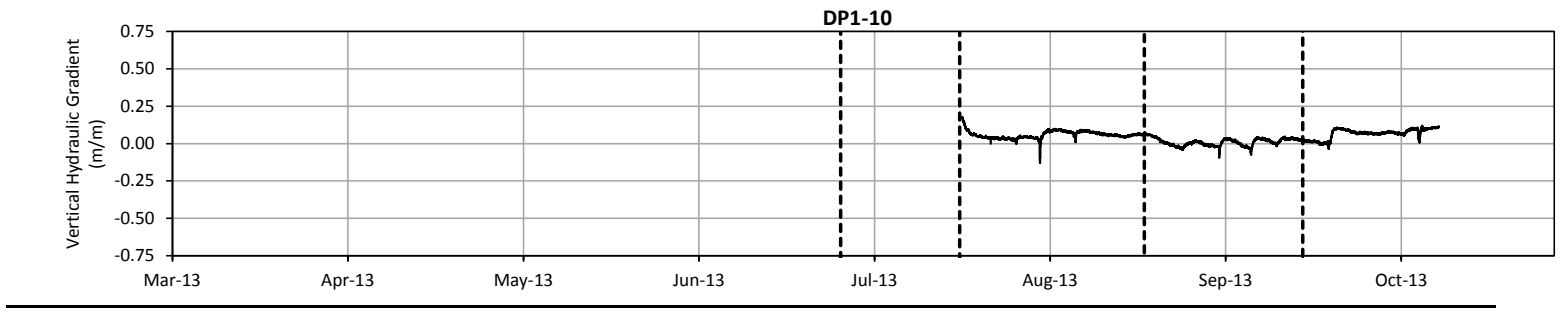

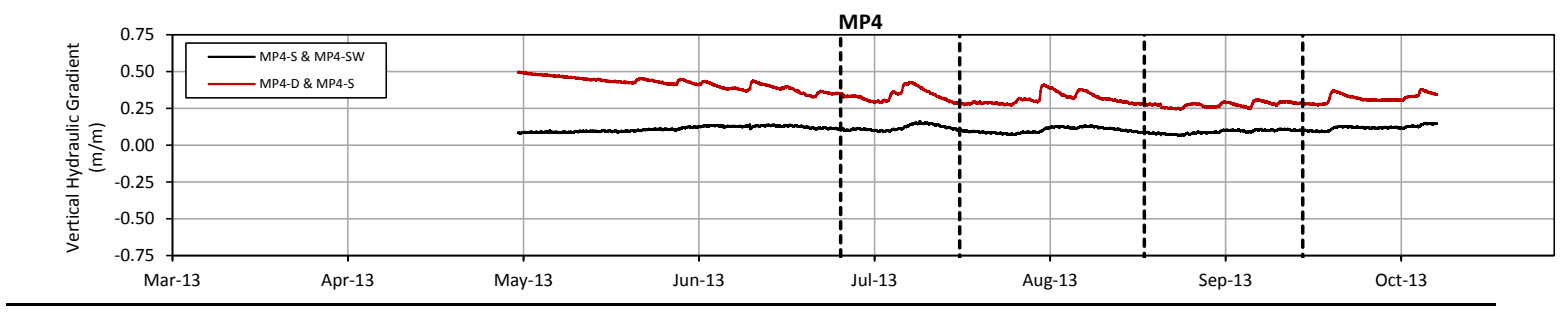

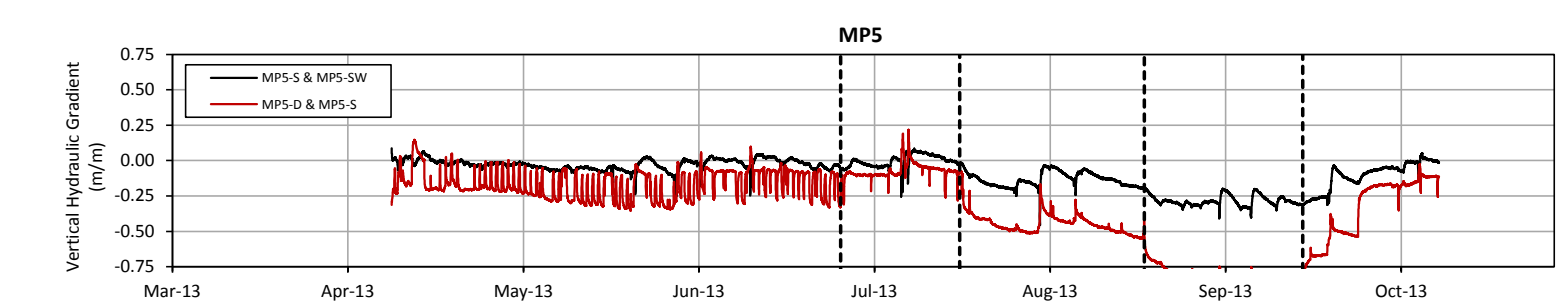

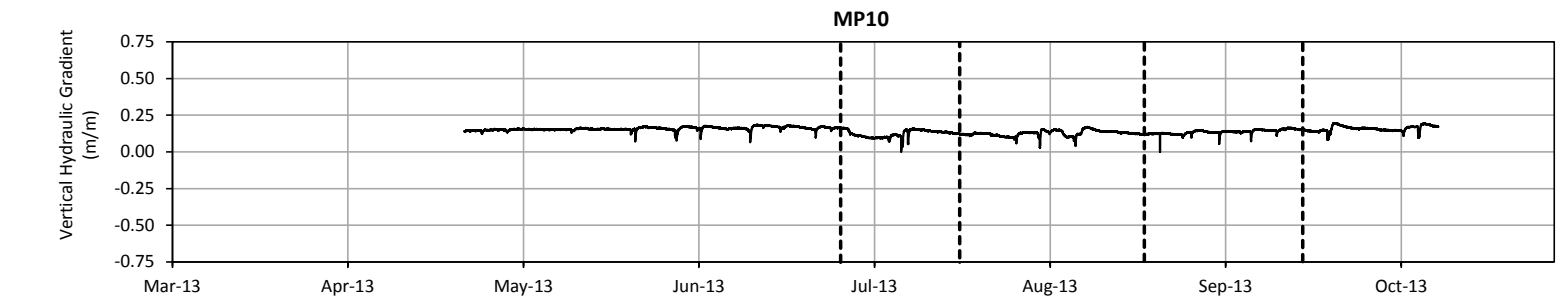

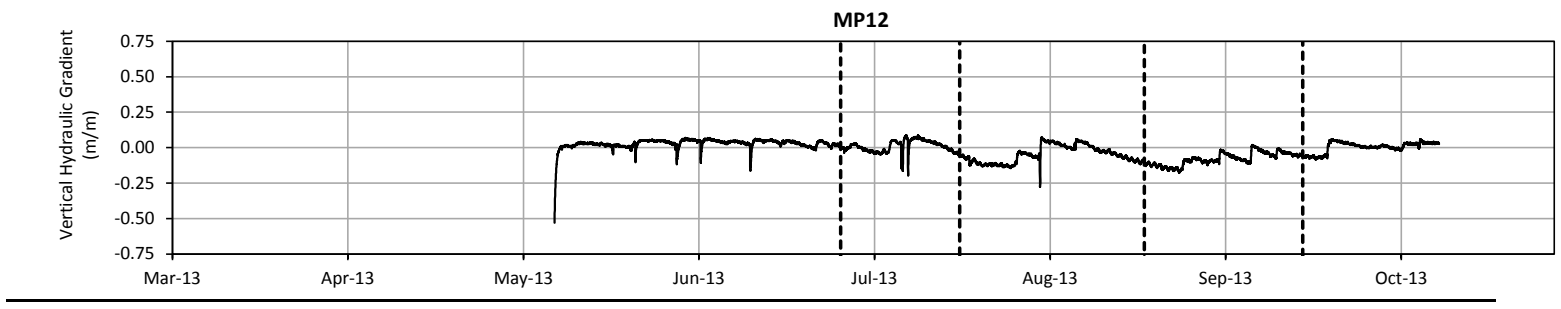

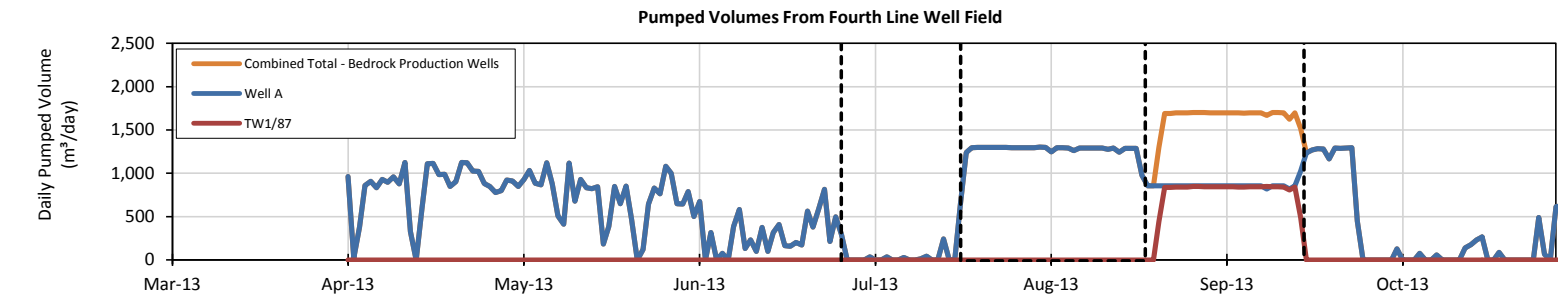

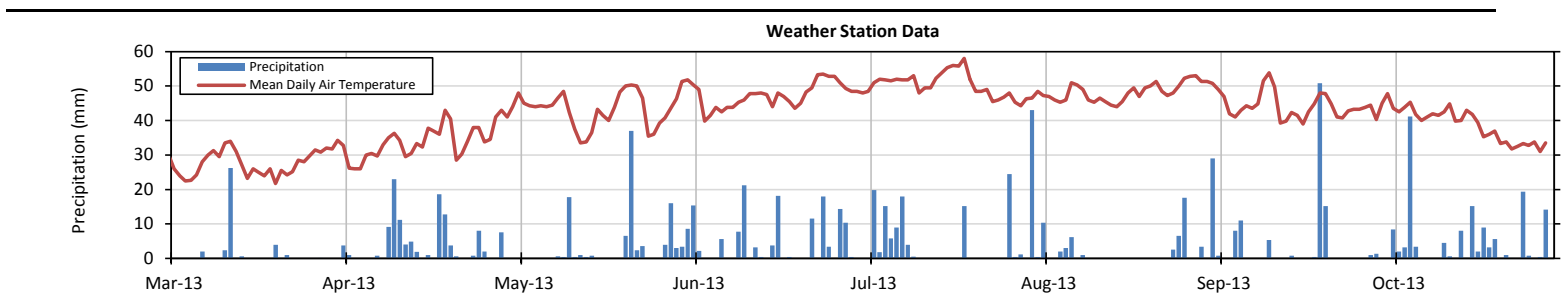

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Client/Project
Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.
F-2b (Appendix F)

Title
Vertical Hydraulic Gradients
Persistent Flow Locations
Fourth Line Well Field

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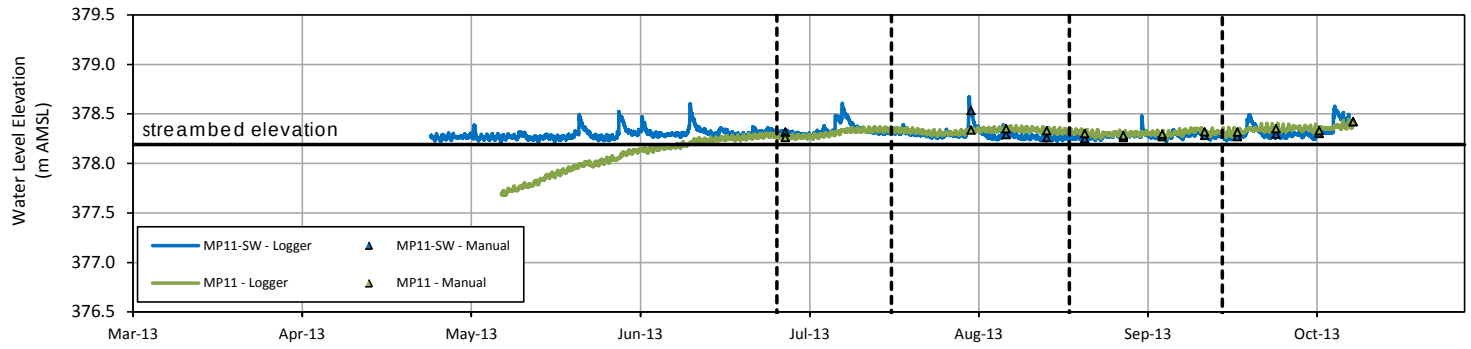
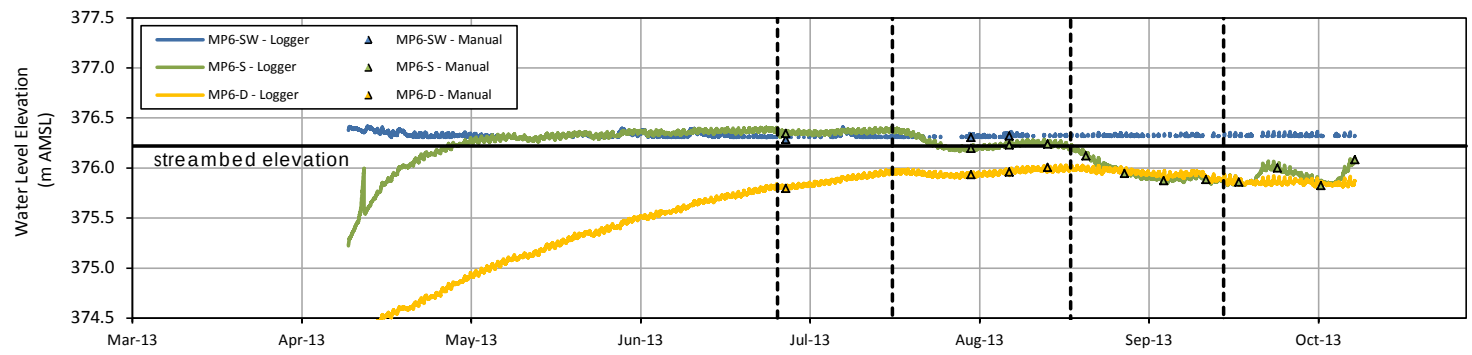
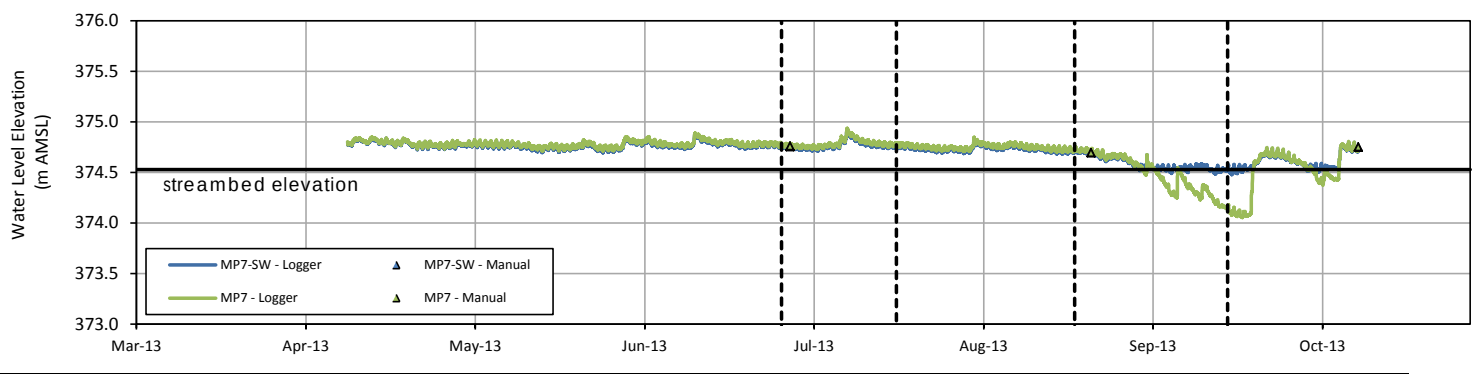
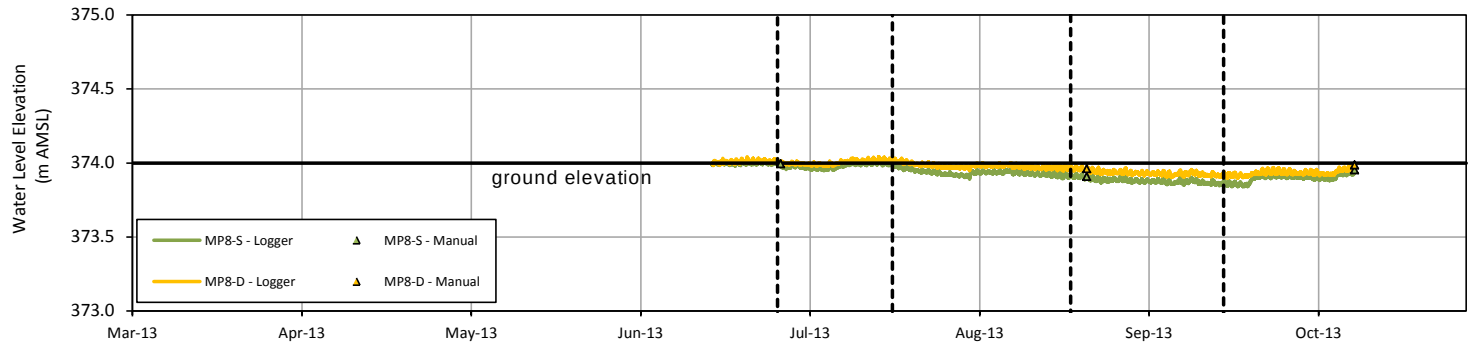
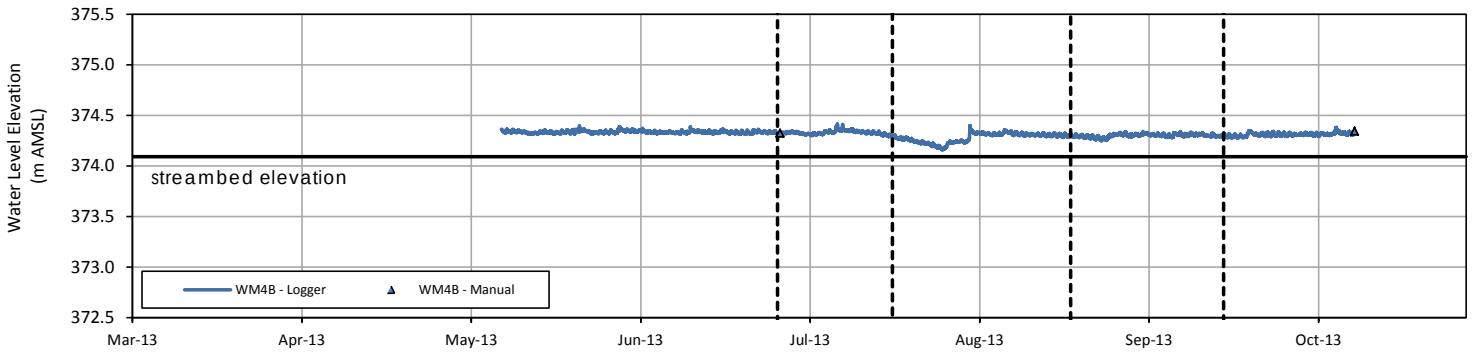
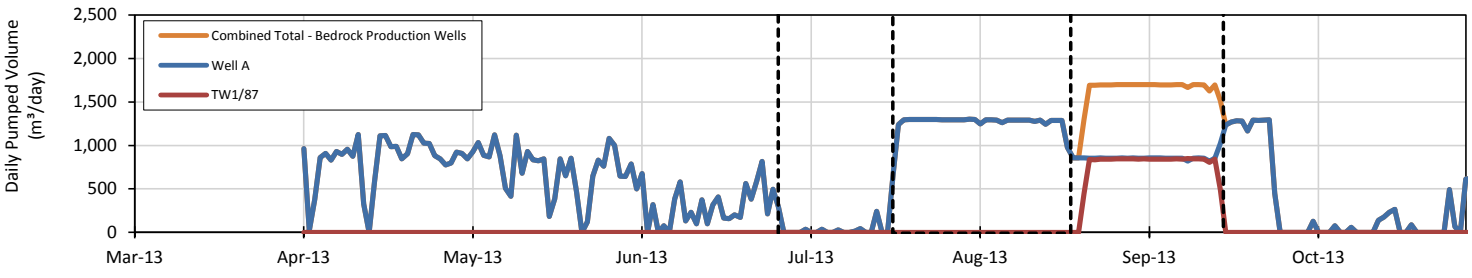


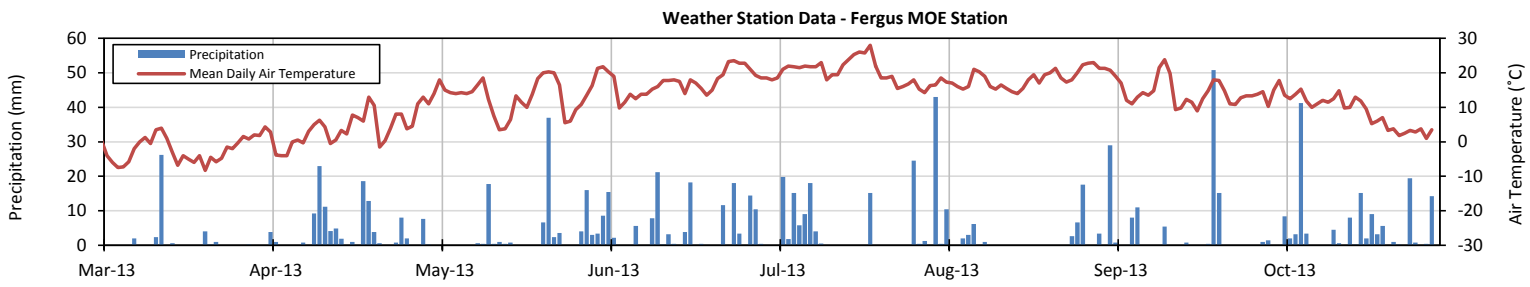












Notes: Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

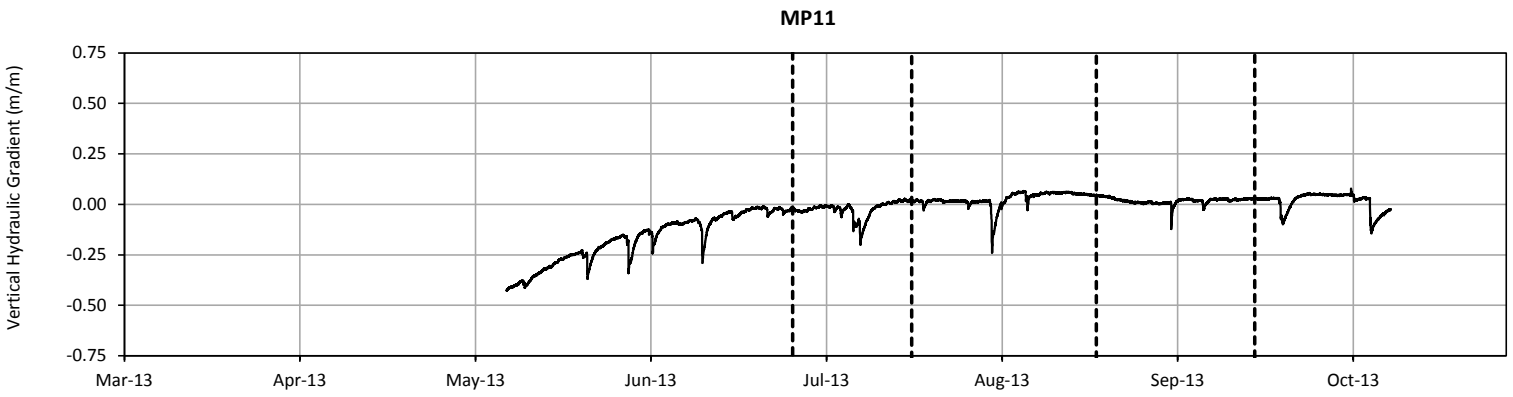
Fourth Line Well Field
Halton Hills
Region of Halton

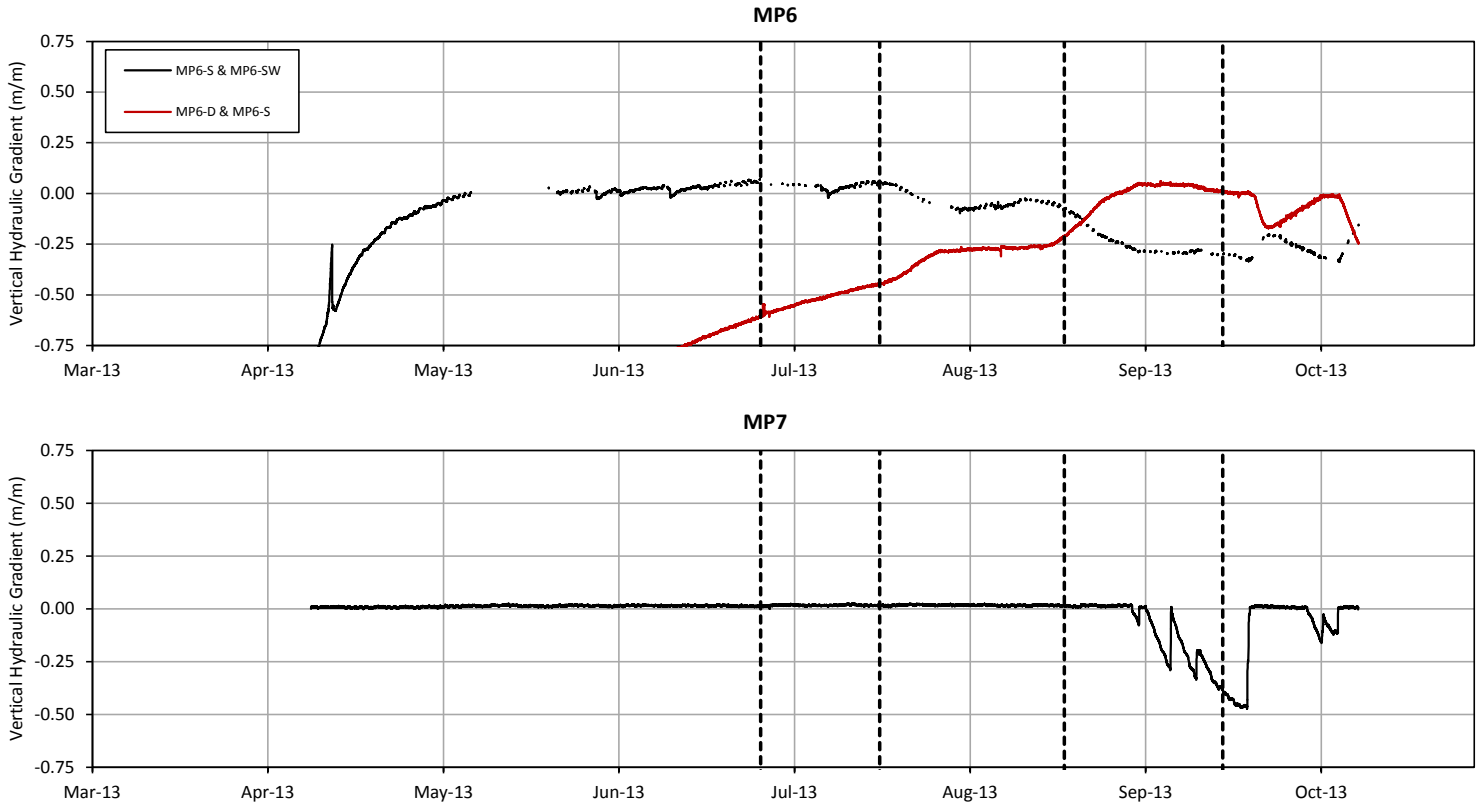
Figure No.

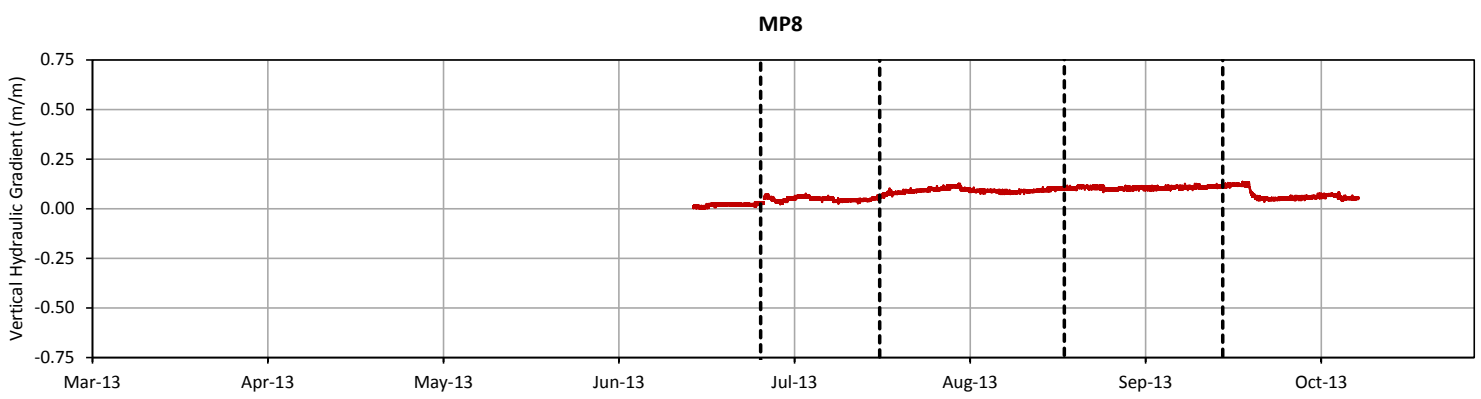
F-3a (Appendix F)

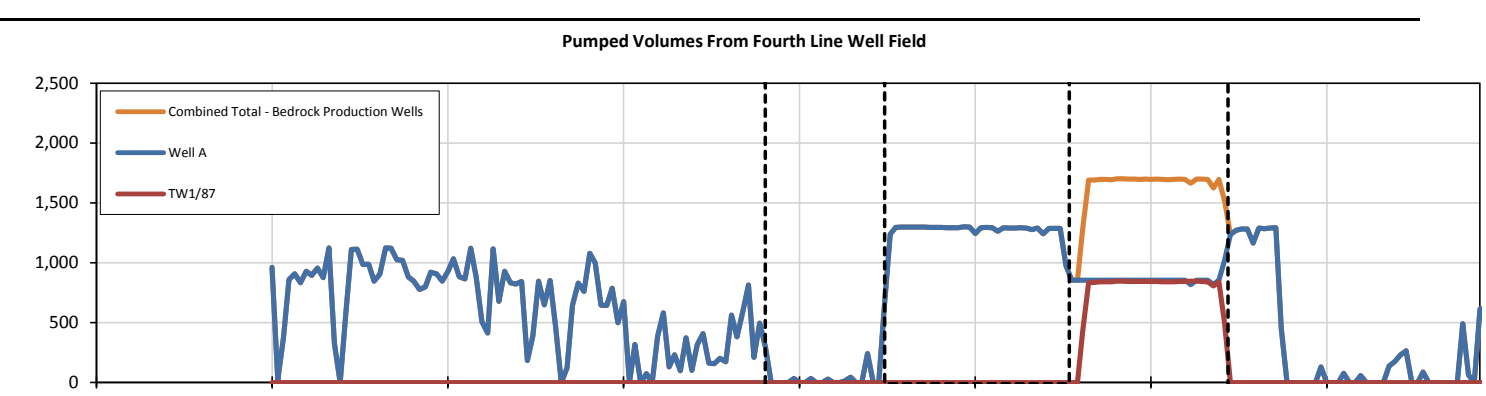
Title

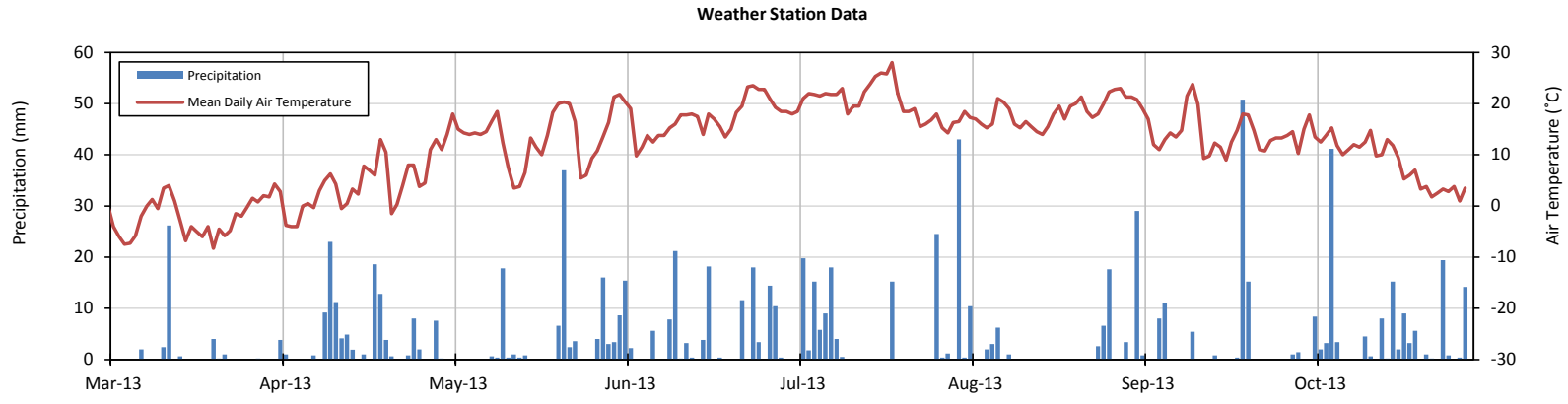
Hydrograph - Wetland Locations
Fourth Line Well Field











Notes:

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Client/Project

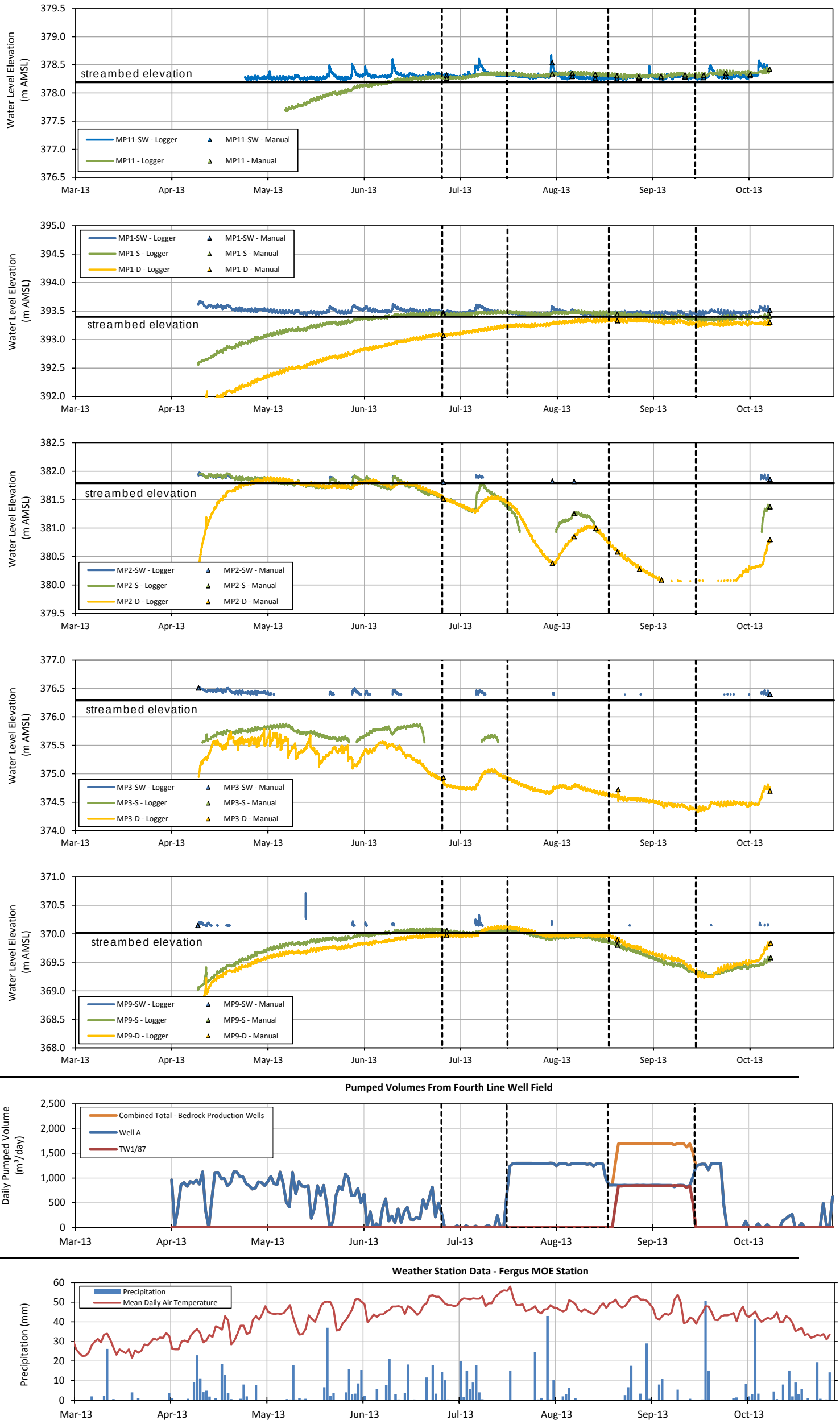
Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

F-3b (Appendix F)

Title

Vertical Hydraulic Gradients
Wetland Locations
Fourth Line Well Field



Notes:

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Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

F-4a (Appendix F)

Title

Hydrograph - Seasonal Stream Locations
Fourth Line Well Field

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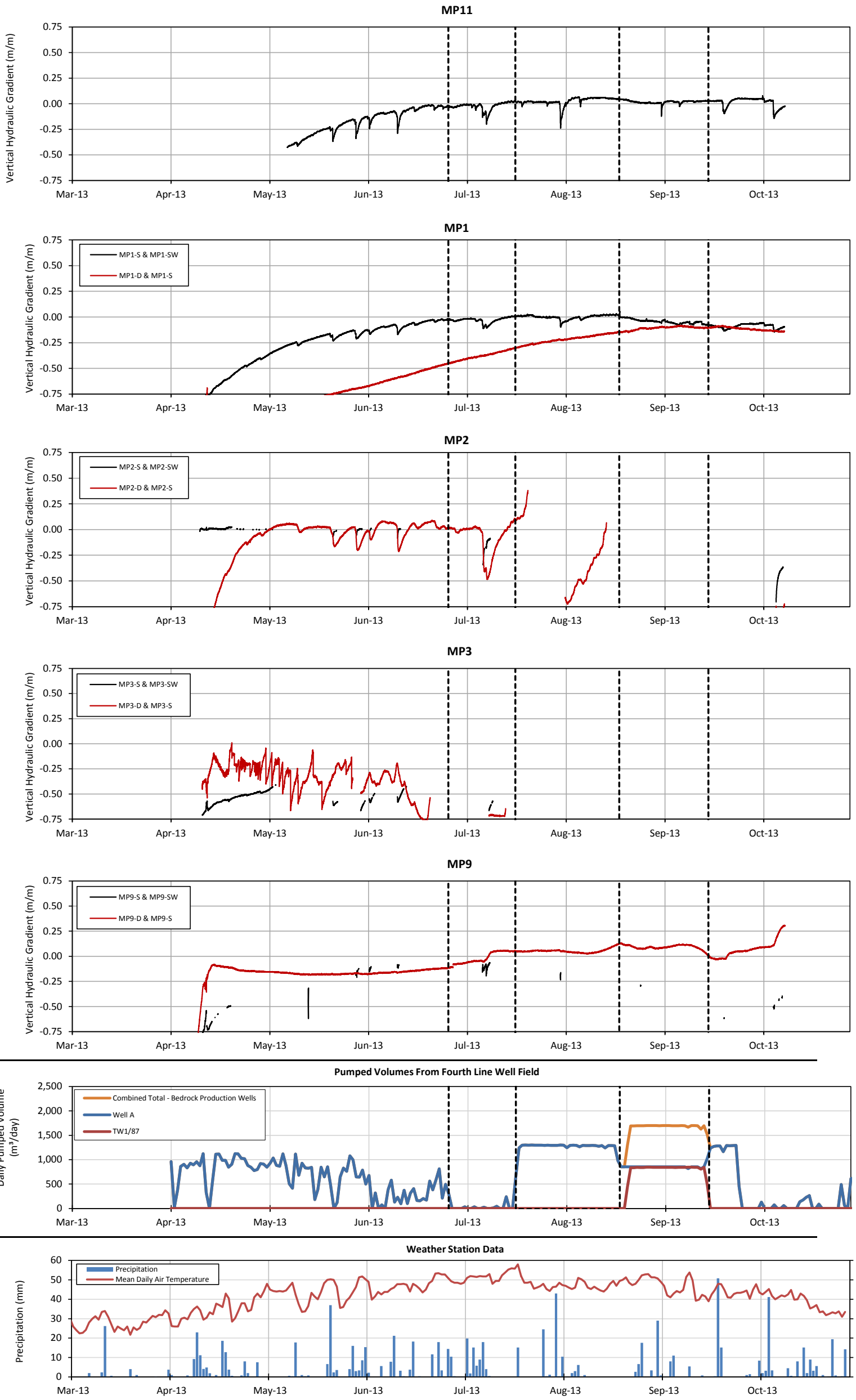

Notes: Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

F-4b (Appendix F)

Title

Vertical Hydraulic Gradients
Seasonal Stream Locations
Fourth Line Well Field

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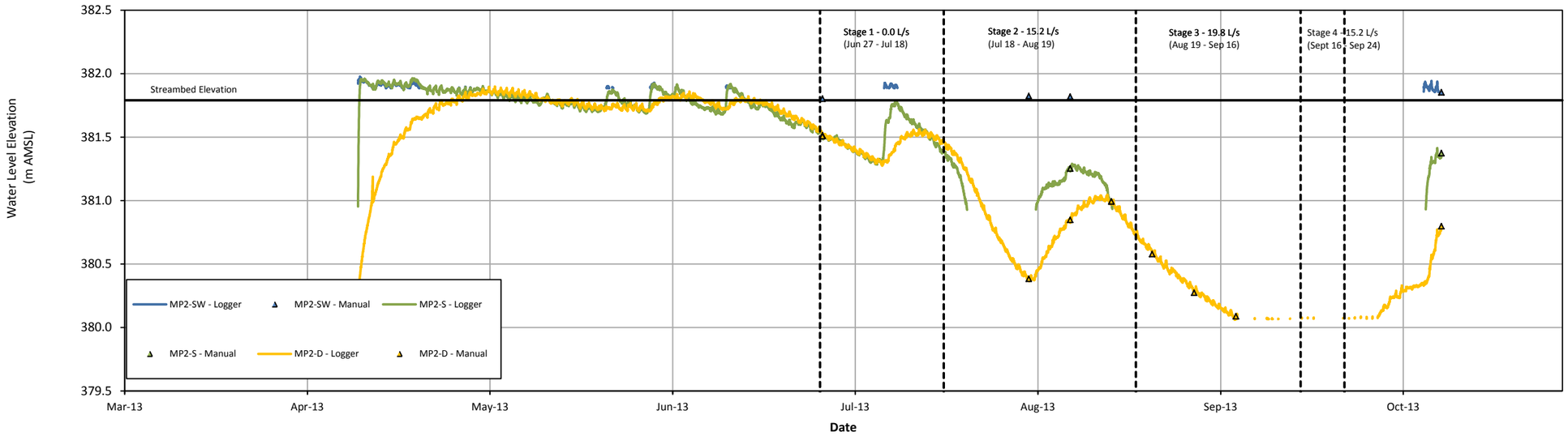
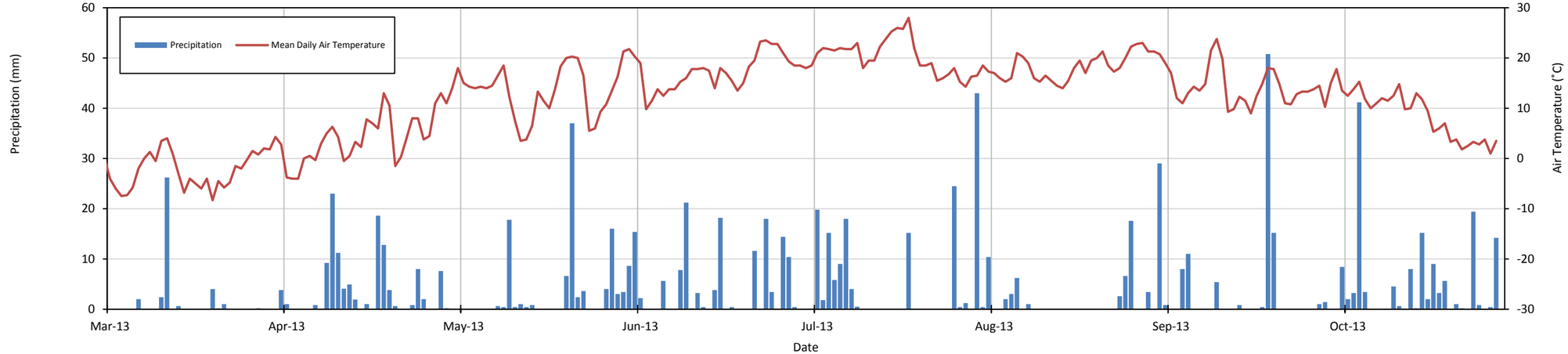


Weather Station Data - Fergus MOE Station



Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Stantec

Client/Project

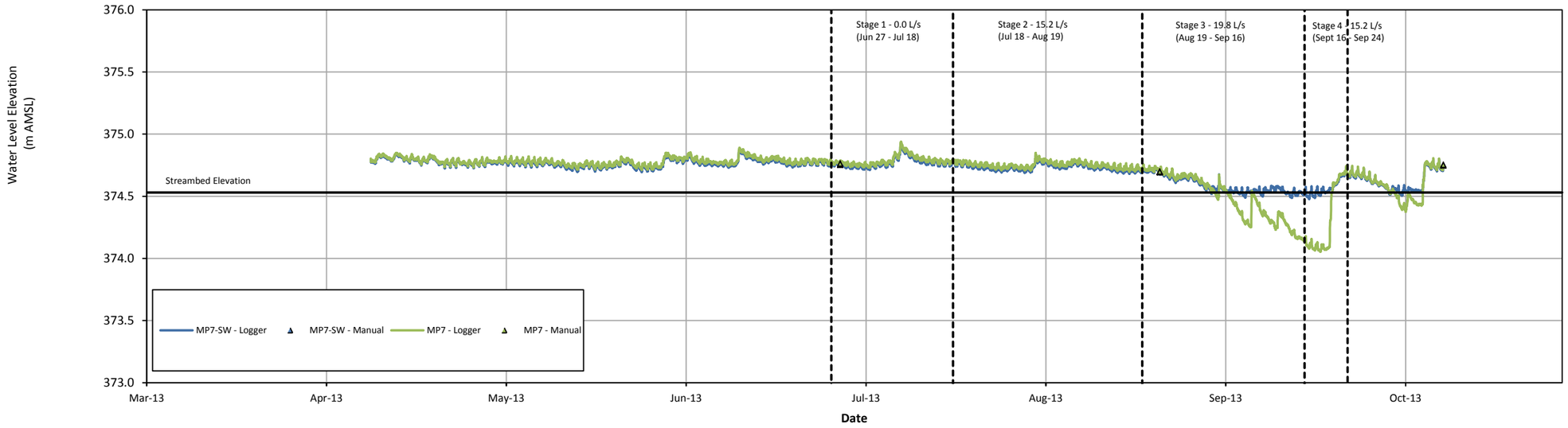
Fourth Line Well Field
Halton Hills
Region of Halton

Figure/Well No.

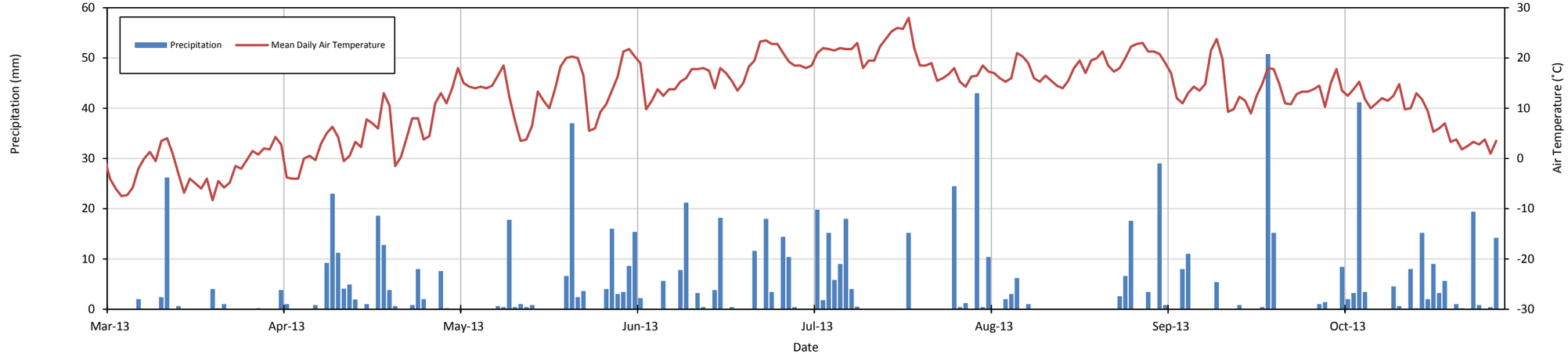
F-5 (Appendix F)

Title

Hydrograph - MP2-13



Weather Station Data - Fergus MOE Station



Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Stantec

Client/Project

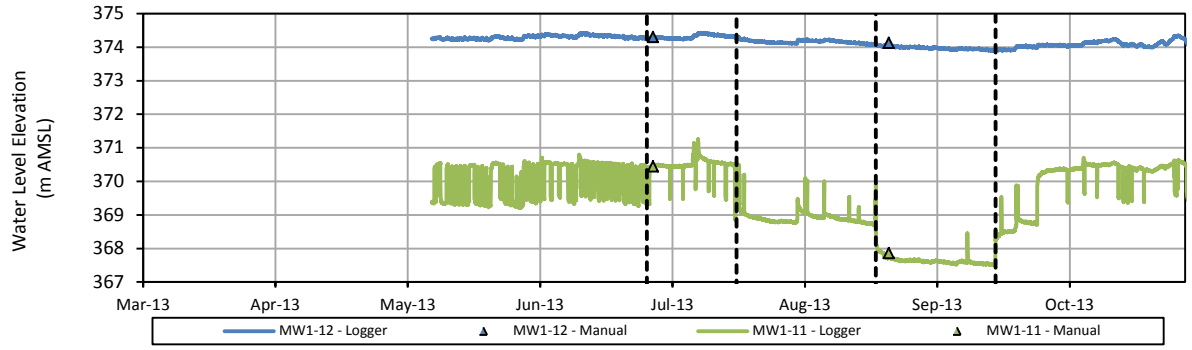
Fourth Line Well Field
Halton Hills
Region of Halton

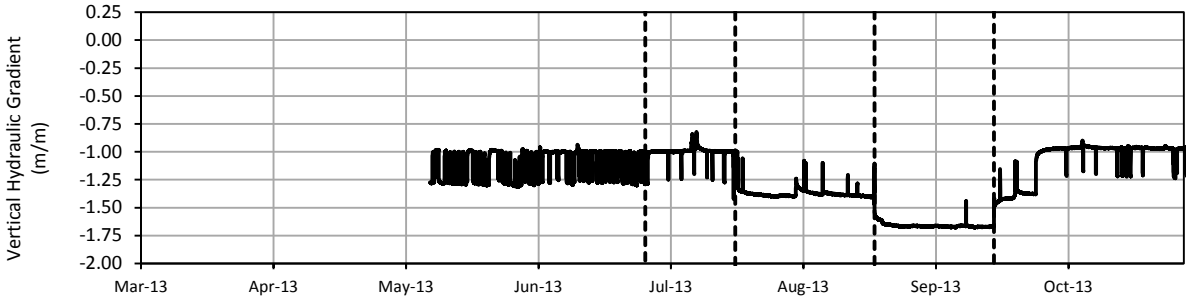
Figure/Well No.

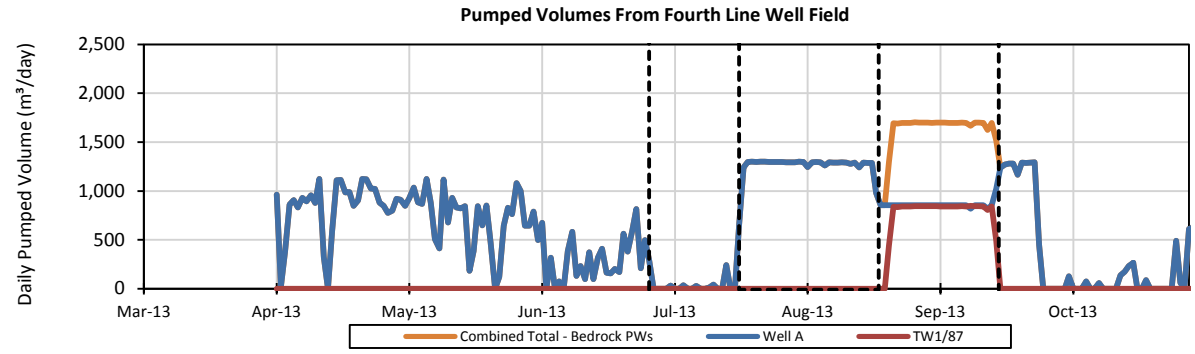
F-6 (Appendix F)

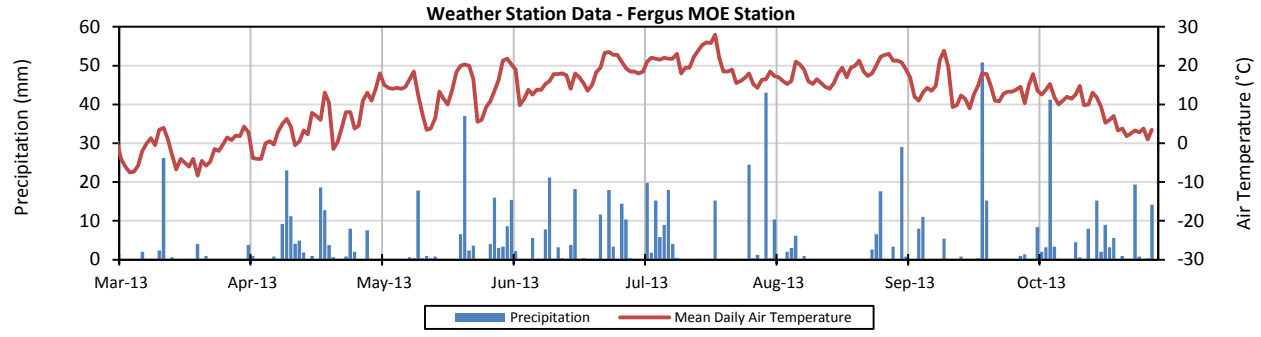
Title

Hydrograph - MP7-13









Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

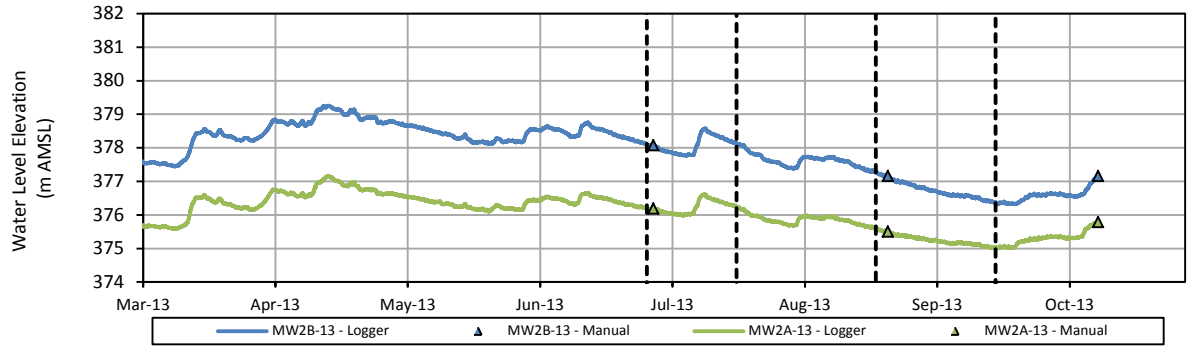
F-7 (Appendix F)

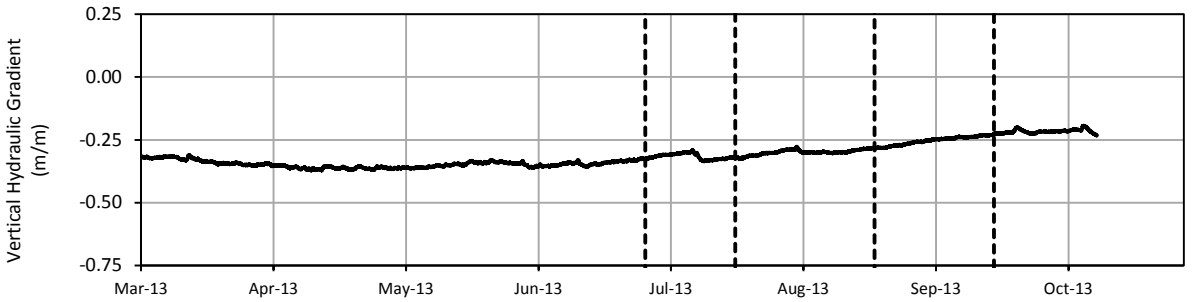
Title

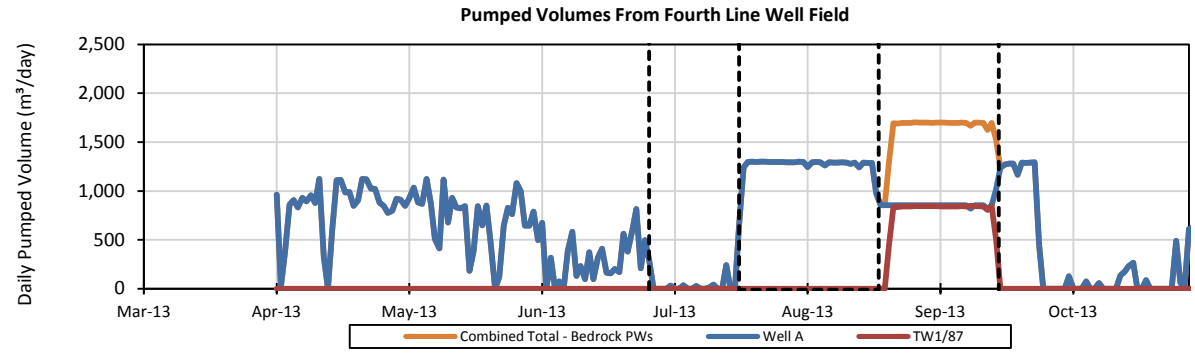
Hydrograph - MW1-11 & MW1-12

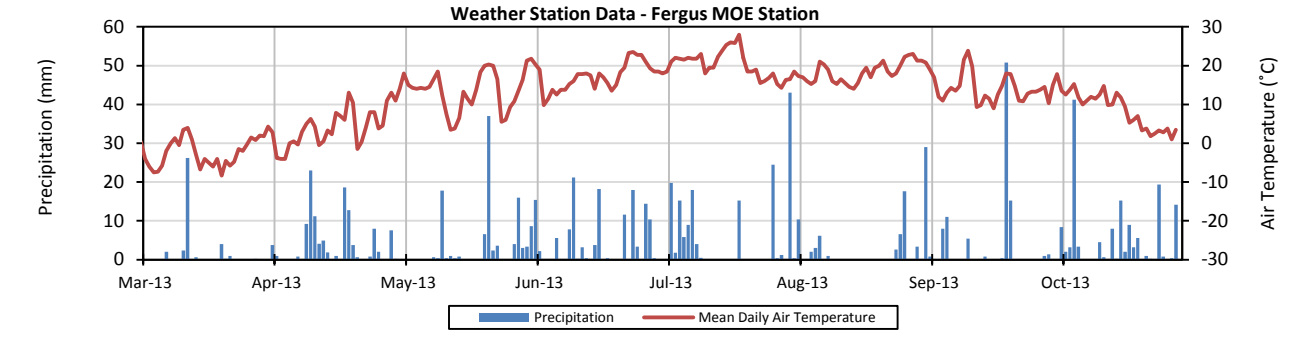
Stantec

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 7_mw1-11 and mw1-12.xlsx









Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

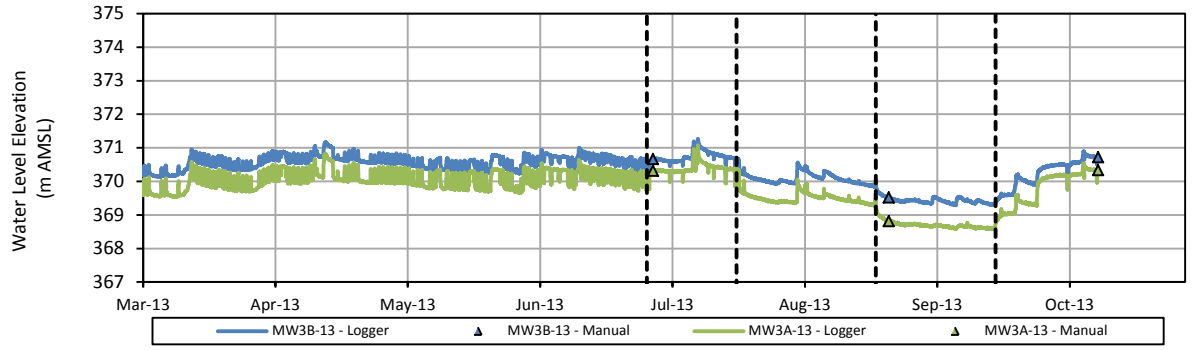
F-8 (Appendix F)

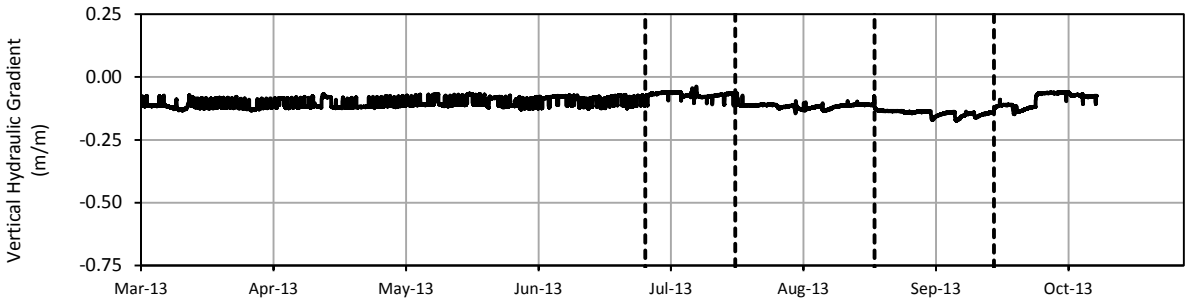
Title

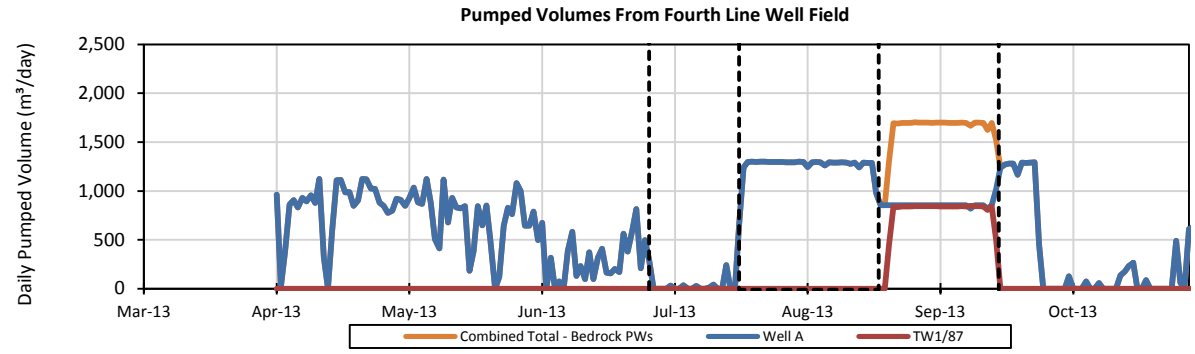
Hydrograph - MW2-13

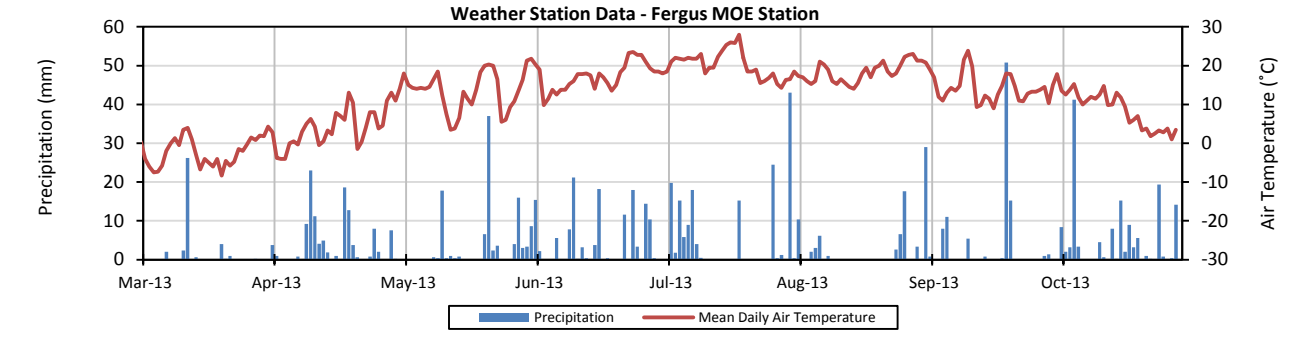
Stantec

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 8_mw2-13.xlsx









Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

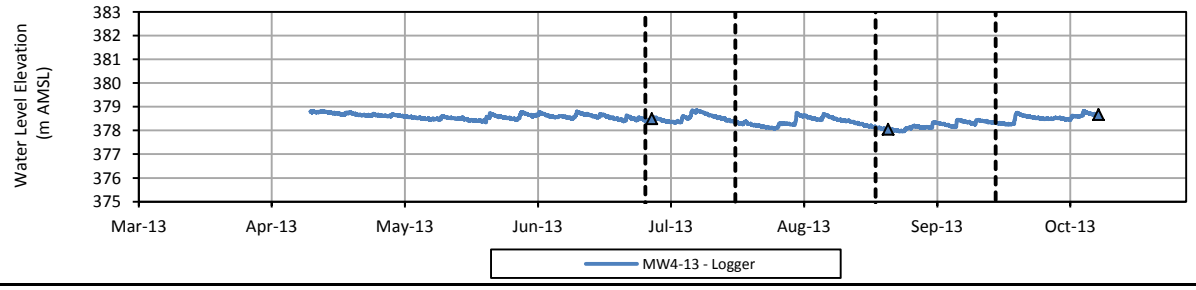
F-9 (Appendix F)

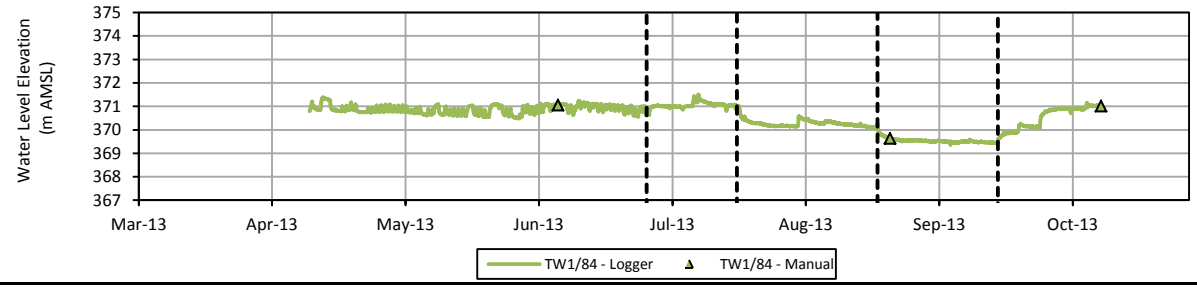
Title

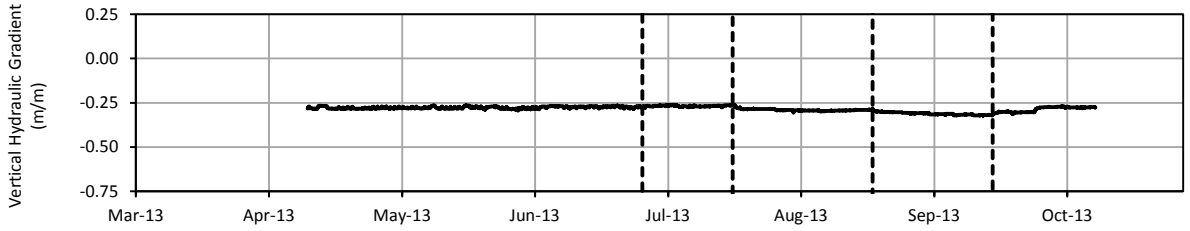
Hydrograph - MW3-13

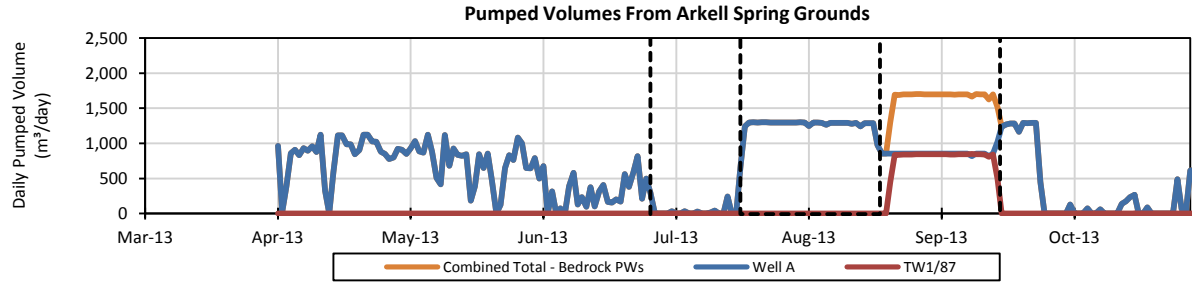
Stantec

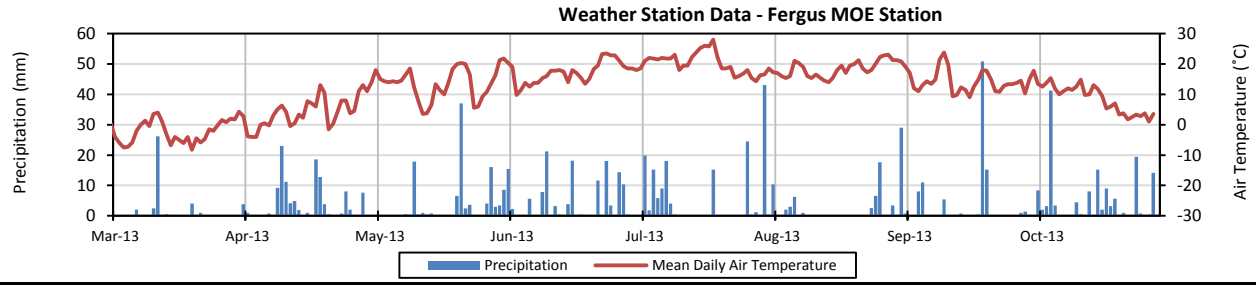
U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 9_mw3-13.xlsx











Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

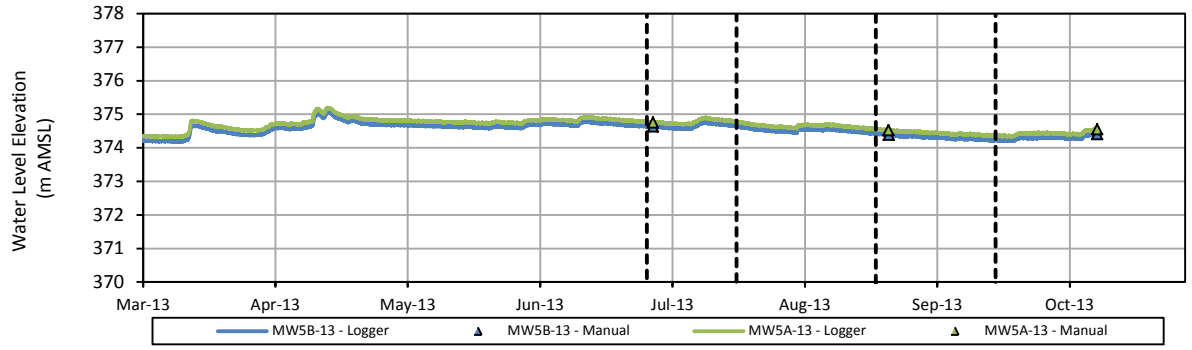
F-10 (Appendix F)

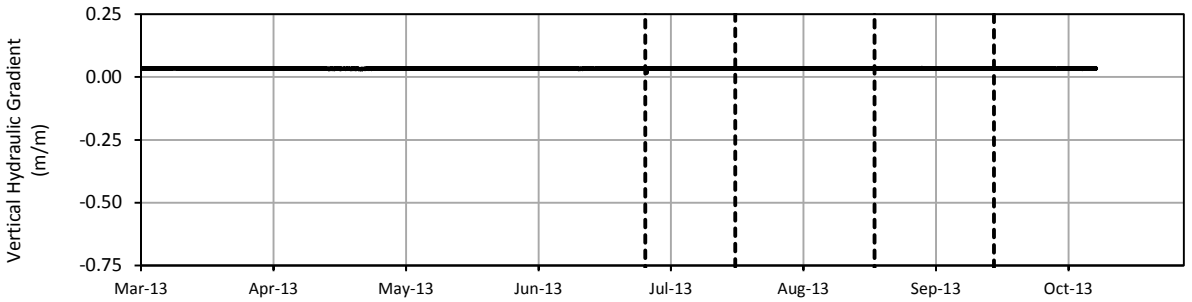
Title

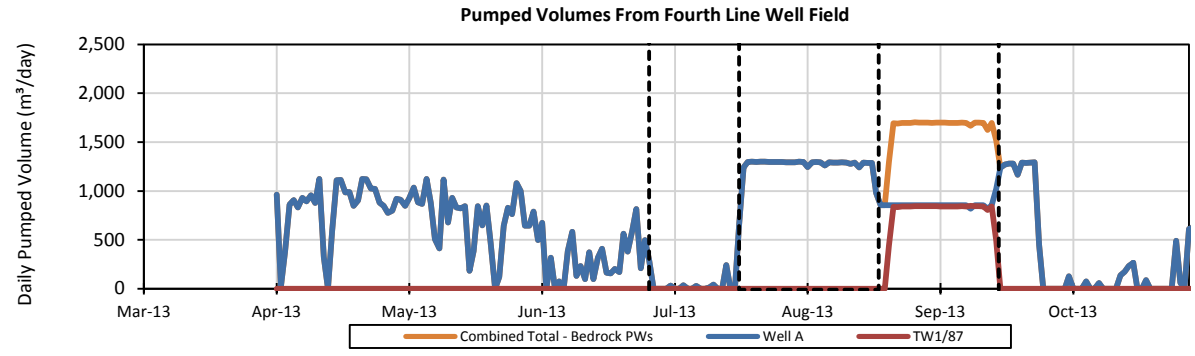
Hydrograph - TW1/84 and MW4-13

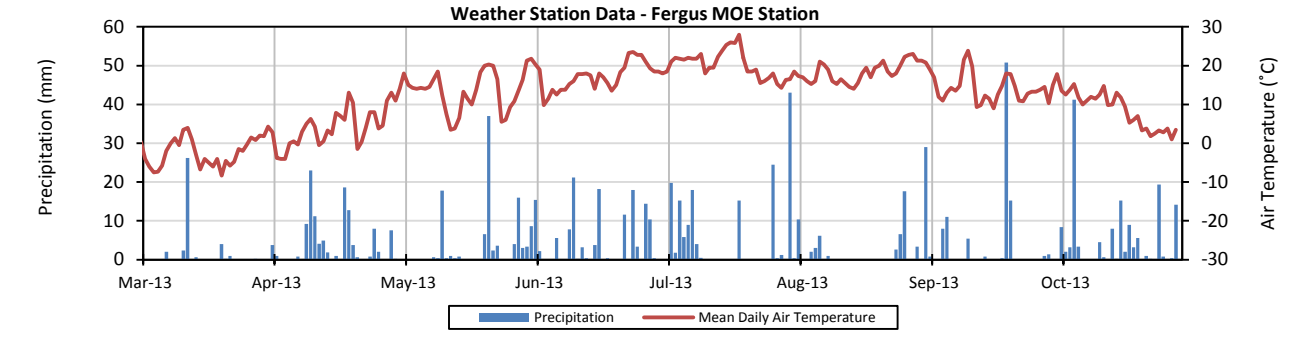
Stantec

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 10_tw1-84 and mw4-13.xlsx









Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

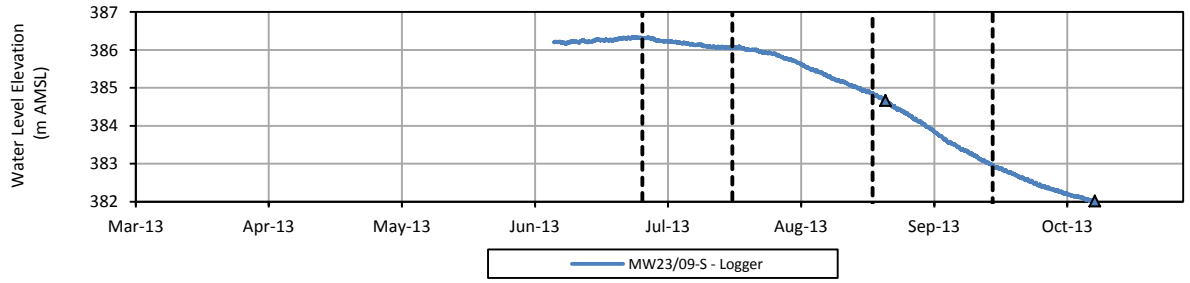
F-11 (Appendix F)

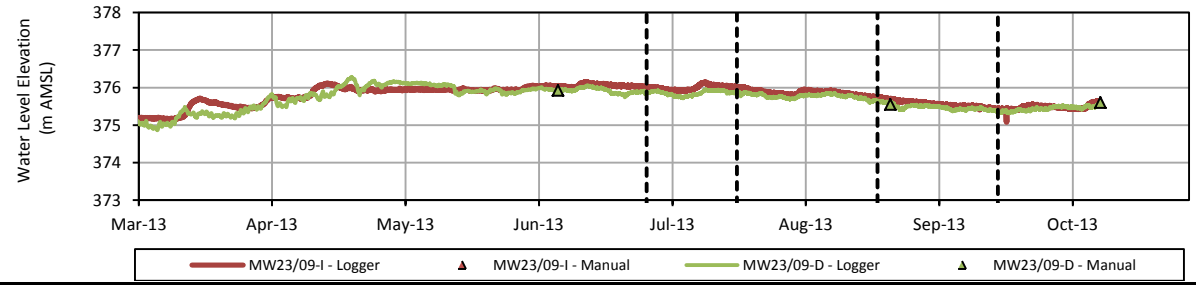
Title

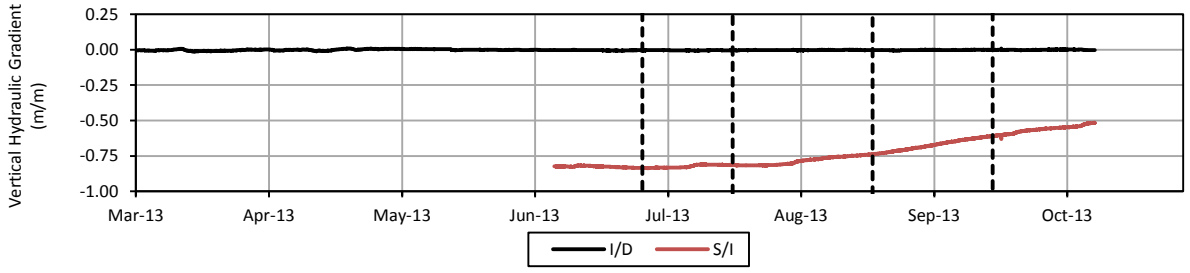
Hydrograph - MW5-13

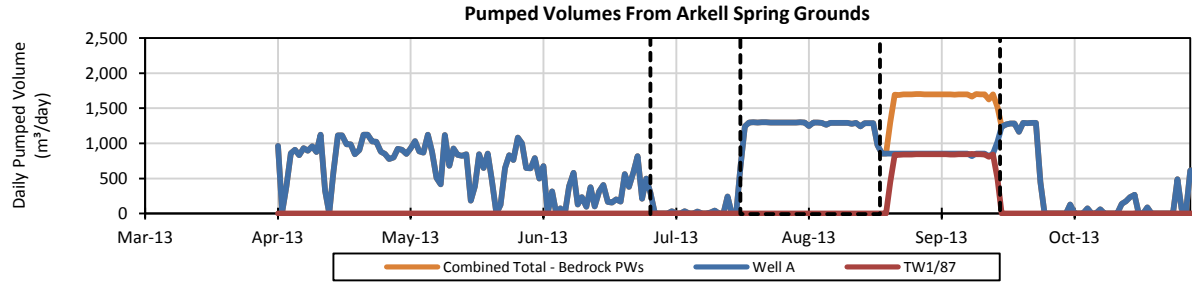
Stantec

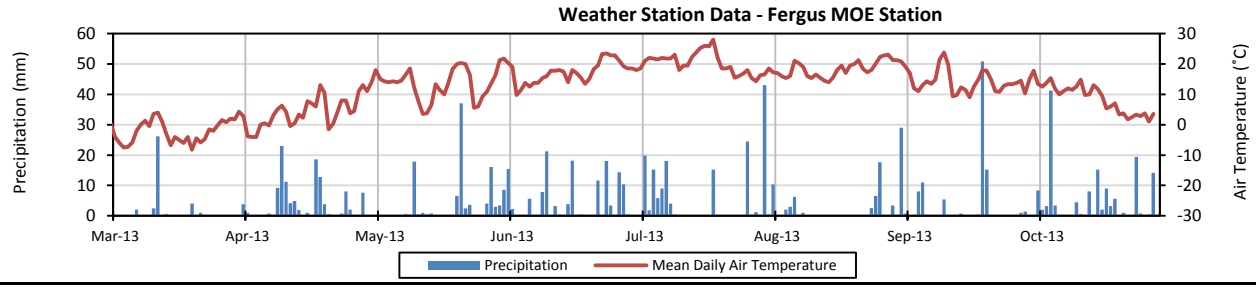
U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 11_mw5-13.xlsx











Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

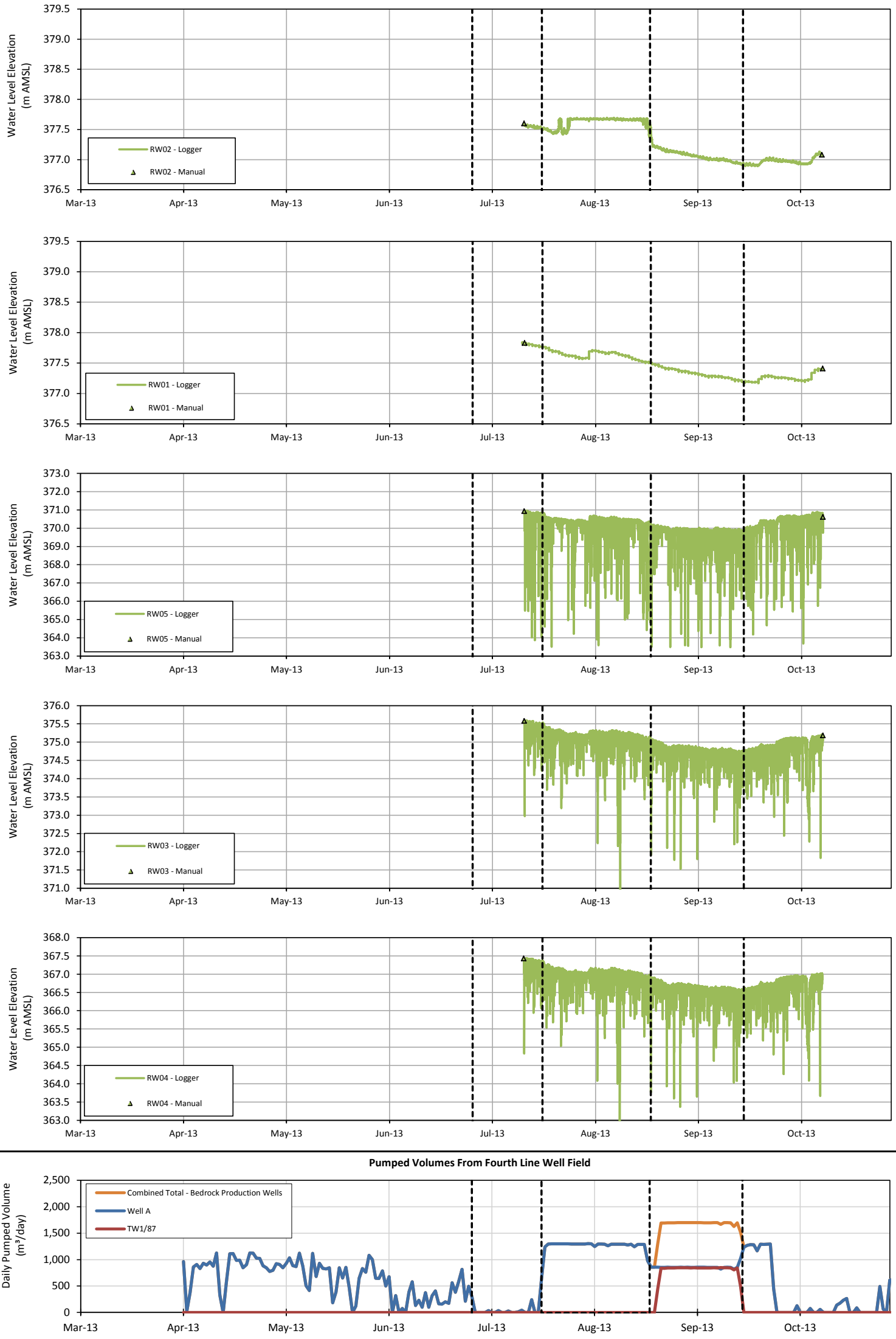
F-12 (Appendix F)

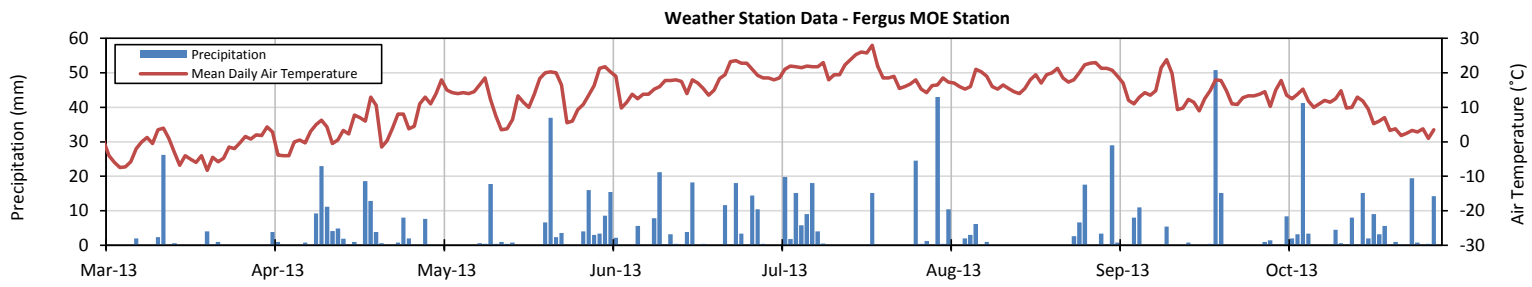
Title

Hydrograph - MW23/09

Stantec

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 12_mw23-09.xlsx





Notes: Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

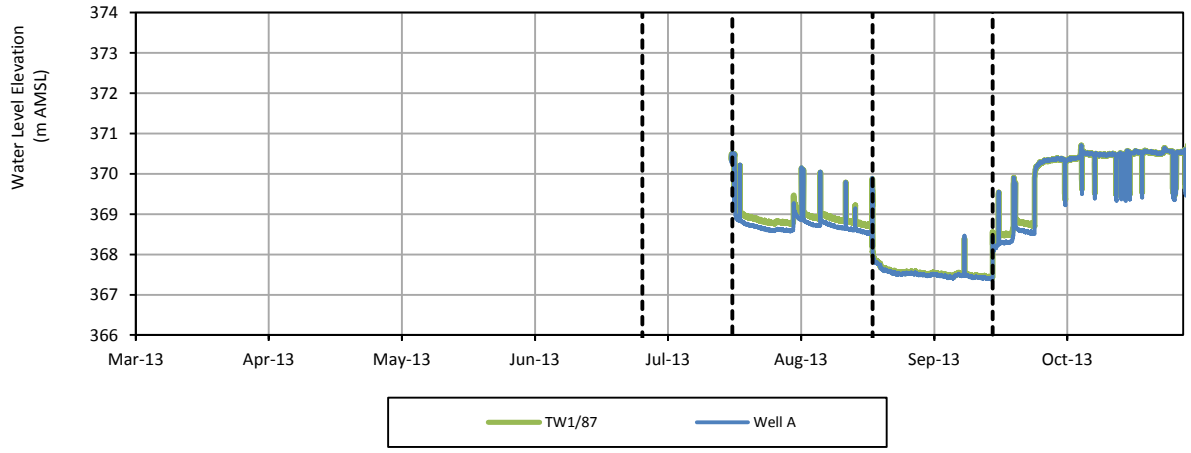
F-13 (Appendix F)

Title

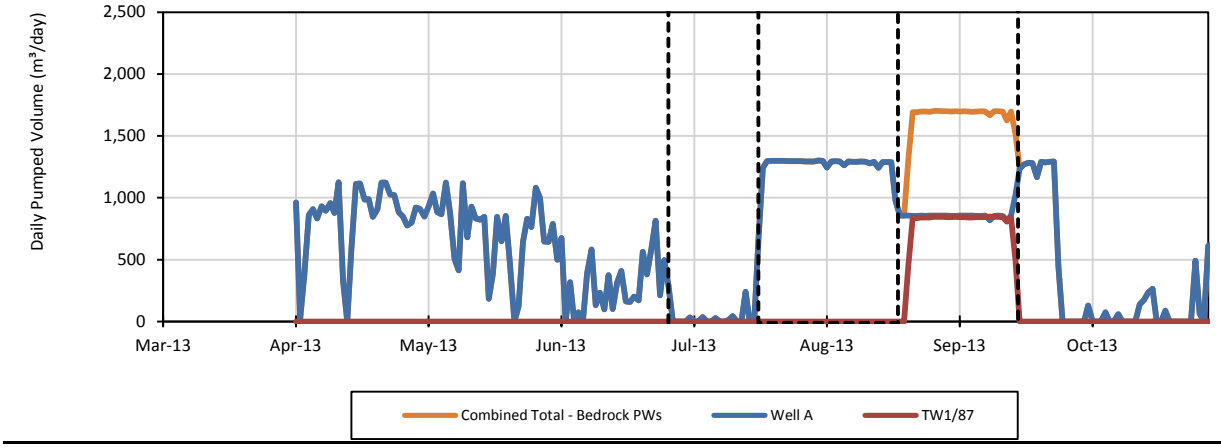
Hydrograph - Residential Wells
Fourth Line Well Field

Stantec

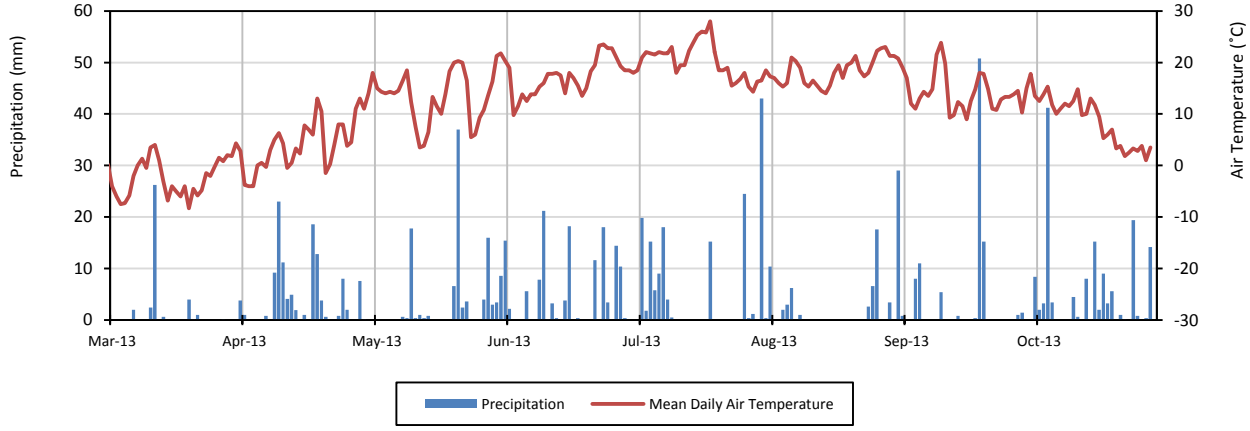
U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 13_residential wells.xlsx



Pumped Volumes From Fourth Line Well Field



Weather Station Data - Fergus MOE Station



Notes:

Dashed lines represent changes in pumping rate or regime.
Climate data from Fergus MOE Station missing for 3-Sep-13 to 8-Sep-13, supplemented with data from Elora RCS Station.

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

F-14 (Appendix F)

Title

Hydrograph - TW1/87 and Well A

Stantec

U:\01611\active\161111105_halton_ea_fourth_line\preliminary\Hydroge\report\hydrog\HydroG_Assessment\Appendices\F_Hydrographs\fig 14_tw1-87 and Well A.xlsx

Appendix G
Laboratory Certificates of Analysis

Your P.O. #: 16300R-20
Your Project #: 1611-11105
Your C.O.C. #: 13431

Attention: Roger Freymond
Stantec Consulting Ltd
Kitchener Standing Offer
49 Frederick St
Kitchener, ON
CANADA N2H 6M7

Report Date: 2013/09/04

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B3E4656
Received: 2013/08/29, 14:34

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Alkalinity	2	N/A	2013/09/03	CAM SOP-00448	SM 2320B
Carbonate, Bicarbonate and Hydroxide	2	N/A	2013/09/04	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	2	N/A	2013/09/04	CAM SOP-00463	EPA 325.2
Conductivity	2	N/A	2013/09/03	CAM SOP-00448	SM 2510
Dissolved Organic Carbon (DOC)	2	N/A	2013/08/30	CAM SOP-00446	SM 5310 B
Hardness (calculated as CaCO3)	2	N/A	2013/09/03	CAM SOP 00102	SM 2340 B
Metals Analysis by ICPMS (as received) (1)	2	2013/09/03	2013/09/03	CAM SOP-00447	EPA 6020
Ion Balance (% Difference)	2	N/A	2013/09/04		
Anion and Cation Sum	2	N/A	2013/09/04		
Total Ammonia-N	2	N/A	2013/09/03	CAM SOP-00441	US GS I-2522-90
Nitrate (NO3) and Nitrite (NO2) in Water (2)	2	N/A	2013/09/03	CAM SOP-00440	SM 4500 NO3I/NO2B
pH	2	N/A	2013/09/03	CAM SOP-00448	SM 4500H+ B
Orthophosphate	2	N/A	2013/09/03	CAM SOP-00461	EPA 365.1
Sat. pH and Langelier Index (@ 20C)	2	N/A	2013/09/04		
Sat. pH and Langelier Index (@ 4C)	2	N/A	2013/09/04		
Sulphate by Automated Colourimetry	2	N/A	2013/09/03	CAM SOP-00464	EPA 375.4
Total Dissolved Solids (TDS calc)	2	N/A	2013/09/04		

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons. The extraction date for samples field preserved with methanol for F1 and Volatile Organic Compounds is considered to be the date sampled.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Metals analysis was performed on the sample 'as received'.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Maria Contreras, Project Manager
Email: MContreras@maxxam.ca
Phone# (905) 817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B3E4656
Report Date: 2013/09/04

Stantec Consulting Ltd
Client Project #: 1611-11105

Your P.O. #: 16300R-20
Sampler Initials: AV

RESULTS OF ANALYSES OF WATER

Maxxam ID		SW0603	SW0604		
Sampling Date		2013/08/29	2013/08/29		
	Units	**WG-161111105-20130829-AV01**	**WG-161111105-20130829-AV02**	**RDL**	**QC Batch**
Calculated Parameters					
Anion Sum	me/L	6.36	6.63	N/A	3332022
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	260	270	1.0	3331825
Calculated TDS	mg/L	333	346	1.0	3331830
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.6	1.7	1.0	3331825
Cation Sum	me/L	6.42	6.59	N/A	3332022
Hardness (CaCO3)	mg/L	310	310	1.0	3332170
Ion Balance (% Difference)	%	0.490	0.330	N/A	3332021
Langelier Index (@ 20C)	N/A	0.713	0.753		3331828
Langelier Index (@ 4C)	N/A	0.464	0.505		3331829
Saturation pH (@ 20C)	N/A	7.10	7.08		3331828
Saturation pH (@ 4C)	N/A	7.34	7.33		3331829
Inorganics					
Total Ammonia-N	mg/L	<0.050	<0.050	0.050	3333561
Conductivity	umho/cm	600	620	1.0	3334917
Dissolved Organic Carbon	mg/L	0.84	0.91	0.20	3333595
Orthophosphate (P)	mg/L	<0.010	<0.010	0.010	3333892
pH	pH	7.81	7.83		3334918
Dissolved Sulphate (SO4)	mg/L	24	27	1	3333893
Alkalinity (Total as CaCO3)	mg/L	260	270	1.0	3334914
Dissolved Chloride (Cl)	mg/L	12	18	1	3333884
Nitrite (N)	mg/L	<0.010	<0.010	0.010	3333613
Nitrate (N)	mg/L	3.1	2.7	0.10	3333613

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B3E4656
Report Date: 2013/09/04

Stantec Consulting Ltd
Client Project #: 1611-11105

Your P.O. #: 16300R-20
Sampler Initials: AV

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		SW0603	SW0604		
Sampling Date		2013/08/29	2013/08/29		
	Units	**WG-161111105-20130829-AV01**	**WG-161111105-20130829-AV02**	**RDL**	**QC Batch**
Metals					
. Aluminum (Al)	mg/L	0.0087	<0.0050	0.0050	3335626
. Antimony (Sb)	mg/L	<0.00050	<0.00050	0.00050	3335626
. Arsenic (As)	mg/L	<0.0010	<0.0010	0.0010	3335626
. Barium (Ba)	mg/L	0.054	0.047	0.0020	3335626
. Beryllium (Be)	mg/L	<0.00050	<0.00050	0.00050	3335626
. Boron (B)	mg/L	<0.010	<0.010	0.010	3335626
. Cadmium (Cd)	mg/L	<0.00010	<0.00010	0.00010	3335626
. Calcium (Ca)	mg/L	81	83	0.20	3335626
. Chromium (Cr)	mg/L	<0.0050	<0.0050	0.0050	3335626
. Cobalt (Co)	mg/L	<0.00050	<0.00050	0.00050	3335626
. Copper (Cu)	mg/L	<0.0010	<0.0010	0.0010	3335626
. Iron (Fe)	mg/L	<0.10	<0.10	0.10	3335626
. Lead (Pb)	mg/L	<0.00050	<0.00050	0.00050	3335626
. Magnesium (Mg)	mg/L	25	25	0.050	3335626
. Manganese (Mn)	mg/L	<0.0020	<0.0020	0.0020	3335626
. Molybdenum (Mo)	mg/L	0.0016	0.00096	0.00050	3335626
. Nickel (Ni)	mg/L	0.0012	<0.0010	0.0010	3335626
. Phosphorus (P)	mg/L	<0.10	<0.10	0.10	3335626
. Potassium (K)	mg/L	1.0	1.3	0.20	3335626
. Selenium (Se)	mg/L	<0.0020	<0.0020	0.0020	3335626
. Silicon (Si)	mg/L	4.9	4.6	0.10	3335626
. Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	3335626
. Sodium (Na)	mg/L	6.0	7.4	0.10	3335626
. Strontium (Sr)	mg/L	0.13	0.17	0.0010	3335626
. Thallium (Tl)	mg/L	<0.000050	<0.000050	0.000050	3335626
. Titanium (Ti)	mg/L	<0.0050	<0.0050	0.0050	3335626
. Uranium (U)	mg/L	0.00083	0.00083	0.00010	3335626
. Vanadium (V)	mg/L	<0.00050	<0.00050	0.00050	3335626
. Zinc (Zn)	mg/L	0.060	0.059	0.0050	3335626

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B3E4656
Report Date: 2013/09/04

Stantec Consulting Ltd
Client Project #: 1611-11105

Your P.O. #: 16300R-20
Sampler Initials: AV

Test Summary

Maxxam ID SW0603 **Collected** 2013/08/29
Sample ID WG-161111105-20130829-AV01 **Shipped**
Matrix Water **Received** 2013/08/29

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3334914	N/A	2013/09/03	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3331825	N/A	2013/09/04	Automated Statchk
Chloride by Automated Colourimetry	AC	3333884	N/A	2013/09/04	Alina Dobreanu
Conductivity	COND	3334917	N/A	2013/09/03	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3333595	N/A	2013/08/30	Anastasia Hamanov
Hardness (calculated as CaCO3)		3332170	N/A	2013/09/03	Automated Statchk
Metals Analysis by ICPMS (as received)	ICP/MS	3335626	2013/09/03	2013/09/03	Hua Ren
Ion Balance (% Difference)	CALC	3332021	N/A	2013/09/04	Automated Statchk
Anion and Cation Sum	CALC	3332022	N/A	2013/09/04	Automated Statchk
Total Ammonia-N	LACH/NH4	3333561	N/A	2013/09/03	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3333613	N/A	2013/09/03	Sandeep Singh
pH	PH	3334918	N/A	2013/09/03	Surinder Rai
Orthophosphate	AC	3333892	N/A	2013/09/03	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	3331828	N/A	2013/09/04	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3331829	N/A	2013/09/04	Automated Statchk
Sulphate by Automated Colourimetry	AC	3333893	N/A	2013/09/03	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	3331830	N/A	2013/09/04	Automated Statchk

Maxxam ID SW0604 **Collected** 2013/08/29
Sample ID WG-161111105-20130829-AV02 **Shipped**
Matrix Water **Received** 2013/08/29

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3334914	N/A	2013/09/03	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3331825	N/A	2013/09/04	Automated Statchk
Chloride by Automated Colourimetry	AC	3333884	N/A	2013/09/04	Alina Dobreanu
Conductivity	COND	3334917	N/A	2013/09/03	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3333595	N/A	2013/08/30	Anastasia Hamanov
Hardness (calculated as CaCO3)		3332170	N/A	2013/09/03	Automated Statchk
Metals Analysis by ICPMS (as received)	ICP/MS	3335626	2013/09/03	2013/09/03	Hua Ren
Ion Balance (% Difference)	CALC	3332021	N/A	2013/09/04	Automated Statchk
Anion and Cation Sum	CALC	3332022	N/A	2013/09/04	Automated Statchk

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Maxxam Job #: B3E4656
Report Date: 2013/09/04

Stantec Consulting Ltd
Client Project #: 1611-11105

Your P.O. #: 16300R-20
Sampler Initials: AV

Test Summary

Total Ammonia-N	LACH/NH4	3333561	N/A	2013/09/03	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3333613	N/A	2013/09/03	Sandeep Singh
pH	PH	3334918	N/A	2013/09/03	Surinder Rai
Orthophosphate	AC	3333892	N/A	2013/09/03	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	3331828	N/A	2013/09/04	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3331829	N/A	2013/09/04	Automated Statchk
Sulphate by Automated Colourimetry	AC	3333893	N/A	2013/09/03	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	3331830	N/A	2013/09/04	Automated Statchk

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Maxxam Job #: B3E4656
Report Date: 2013/09/04

Stantec Consulting Ltd
Client Project #: 1611-11105

Your P.O. #: 16300R-20
Sampler Initials: AV

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
3333561	Total Ammonia-N	2013/09/03	96	80 - 120	97	85 - 115	<0.050	mg/L	NC	20		
3333595	Dissolved Organic Carbon	2013/08/30	104	80 - 120	104	80 - 120	<0.20	mg/L	0.9	20		
3333613	Nitrite (N)	2013/09/03	NC	80 - 120	104	85 - 115	<0.010	mg/L	0.4	25		
3333613	Nitrate (N)	2013/09/03	NC	80 - 120	95	85 - 115	<0.10	mg/L	1.4	25		
3333884	Dissolved Chloride (Cl)	2013/09/04	NC	80 - 120	102	80 - 120	<1	mg/L	2.2	20		
3333892	Orthophosphate (P)	2013/09/03	99	75 - 125	101	80 - 120	<0.010	mg/L	NC	25		
3333893	Dissolved Sulphate (SO4)	2013/09/03	NC	75 - 125	92	80 - 120	<1	mg/L	0.2	20		
3334914	Alkalinity (Total as CaCO3)	2013/09/03					<1.0	mg/L	0.7	25	96	85 - 115
3334917	Conductivity	2013/09/03					<1.0	umho/cm	0.06	25	100	85 - 115
3335626	. Aluminum (Al)	2013/09/03	102	80 - 120	98	80 - 120	<0.0050	mg/L	1	20		
3335626	. Antimony (Sb)	2013/09/03	106	80 - 120	101	80 - 120	<0.00050	mg/L	NC	20		
3335626	. Arsenic (As)	2013/09/03	102	80 - 120	98	80 - 120	<0.0010	mg/L	NC	20		
3335626	. Barium (Ba)	2013/09/03	102	80 - 120	99	80 - 120	<0.0020	mg/L	0.1	20		
3335626	. Beryllium (Be)	2013/09/03	107	80 - 120	105	80 - 120	<0.00050	mg/L	NC	20		
3335626	. Boron (B)	2013/09/03	103	80 - 120	103	80 - 120	<0.010	mg/L	NC	20		
3335626	. Cadmium (Cd)	2013/09/03	104	80 - 120	100	80 - 120	<0.00010	mg/L	NC	20		
3335626	. Calcium (Ca)	2013/09/03	NC	80 - 120	97	80 - 120	<0.20	mg/L	0.9	20		
3335626	. Chromium (Cr)	2013/09/03	99	80 - 120	97	80 - 120	<0.0050	mg/L	NC	20		
3335626	. Cobalt (Co)	2013/09/03	99	80 - 120	92	80 - 120	<0.00050	mg/L	NC	20		
3335626	. Copper (Cu)	2013/09/03	101	80 - 120	96	80 - 120	<0.0010	mg/L	12.1	20		
3335626	. Iron (Fe)	2013/09/03	98	80 - 120	92	80 - 120	<0.10	mg/L	NC	20		
3335626	. Lead (Pb)	2013/09/03	103	80 - 120	97	80 - 120	<0.00050	mg/L	NC	20		
3335626	. Magnesium (Mg)	2013/09/03	103	80 - 120	98	80 - 120	<0.050	mg/L	0.2	20		
3335626	. Manganese (Mn)	2013/09/03	96	80 - 120	92	80 - 120	<0.0020	mg/L	NC	20		
3335626	. Molybdenum (Mo)	2013/09/03	104	80 - 120	100	80 - 120	<0.00050	mg/L	NC	20		
3335626	. Nickel (Ni)	2013/09/03	101	80 - 120	94	80 - 120	<0.0010	mg/L	NC	20		
3335626	. Phosphorus (P)	2013/09/03	106	80 - 120	98	80 - 120	<0.10	mg/L	NC	20		
3335626	. Potassium (K)	2013/09/03	100	80 - 120	97	80 - 120	<0.20	mg/L	0.2	20		
3335626	. Selenium (Se)	2013/09/03	106	80 - 120	99	80 - 120	<0.0020	mg/L	NC	20		
3335626	. Silicon (Si)	2013/09/03	105	80 - 120	101	80 - 120	<0.050	mg/L	0.6	20		
3335626	. Silver (Ag)	2013/09/03	94	80 - 120	92	80 - 120	<0.00010	mg/L	NC	20		
3335626	. Sodium (Na)	2013/09/03	NC	80 - 120	99	80 - 120	<0.10	mg/L	0.5	20		
3335626	. Strontium (Sr)	2013/09/03	107	80 - 120	101	80 - 120	<0.0010	mg/L	0.3	20		
3335626	. Thallium (Tl)	2013/09/03	101	80 - 120	97	80 - 120	<0.000050	mg/L	NC	20		
3335626	. Titanium (Ti)	2013/09/03	100	80 - 120	95	80 - 120	<0.0050	mg/L	NC	20		
3335626	. Uranium (U)	2013/09/03	102	80 - 120	97	80 - 120	<0.00010	mg/L	NC	20		

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Maxxam Job #: B3E4656
Report Date: 2013/09/04

Stantec Consulting Ltd
Client Project #: 1611-11105

Your P.O. #: 16300R-20
Sampler Initials: AV

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
3335626	. Vanadium (V)	2013/09/03	100	80 - 120	96	80 - 120	<0.00050	mg/L	NC	20		
3335626	. Zinc (Zn)	2013/09/03	103	80 - 120	97	80 - 120	<0.0050	mg/L	NC	20		

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

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Validation Signature Page

Maxxam Job #: B3E4656

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere, Scientific Services

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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CHAIN OF CUSTODY RECORD

13431 Page 1 of 1

Maxxam 6740 Campobello Road, Mississauga, ON L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779

29-Aug-13 14:34
Maria Contreras
B3E4656
TST WAT-001

INVOICE INFORMATION	REPC	PROJECT INFORMATION	MAXXAM JOB NUMBER
Company Name: #9197 Stantec Consulting Ltd.	Company Nam	Quotation #:	
Contact Name: Roger Freymond	Contact Name:	P.O. #: 16300R-40	CHAIN OF CUSTODY #
Address: 49C FREDERICK ST. KITCHENER, ON N2H 6M7	Address:	Project #: Task owning PC 1609	00
Phone: (519)-585-7381 Fax: (519)579-4239	Phone: Fax:	Site Location:	
Email: roger.freymond@stantec.com; EDD@stantec.com; aaron.vandenhoff@stantec.com		Site #: 16111105 Sampled By: A.VANDENHOFF	

Note: For MOE Regulated Drinking Water samples, please use the Drinking Water CofC.

Regulation 153 (2011)			Other Regulations	
Table 1	Res/Park	Med/Fine	CCME	Sanitary Sewer Bylaw
Table 2	Ind/Comm	Coarse	Reg. 558	Storm Sewer Bylaw
Table 3	Agri/Other	For RSC	MISA	Municipality:
Table ___		Yes	PWQO	
		No	Other (specify): ODWS	

Include Criteria on Certificate of Analysis (Y/N)?

SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.

ANALYSIS REQUESTED (Please be specific)

TURNAROUND TIME (TAT) REQUIRED

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.

Regular (Standard) TAT: ✓
(5-7 working days for most tests)

Rush TAT:
Samples must be received by 3pm to guarantee your TAT
Rush Confirmation #: PN ____
☐ 1 day ☐ 2 days ☐ 3 days
Date Req'd: ____

TATs for certain tests are > 5 days. Please contact your Project Manager for details.

	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	MOE Regulated Drinking Water? (Y / N)	Metals Field Filtered? (Y / N)	RCAP Comp?	# of Cont.	COMMENTS / TAT COMMENTS
1	WG-16111105-20130829-AV01	29-Aug		GW	N	N*	✓	4	* tap samples, please
2	↓ ↓ ↓ -AV02	↓		↓	N	N*	✓	4	analyse as received.
3									
4									
5									
6									
7									
8									
9									
10									

REC'D IN WATERLOO

*RELINQUISHED BY (Signature/Print)	Date (YYYY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date (YYYY/MM/DD)	Time:	#JARS USED AND NOT SUBMITTED
AARON VANDENHOFF	2013/08/29	14:35	Debbie Lobsinger	2013-08-29	14:31	

Laboratory Use Only

Custody Seal	Yes	No	Temperature (°C) on Receipt
Present		✓	4.2, 4.4
Intact		✓	

*MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

COC-1004 (06/12) - ENV. ENG. Maxxam Analytics International Corporation o/a Maxxam Analytics White: Maxxam Yellow: Mail Pink: Client

Your P.O. #: 16300R-40
Your Project #: 161111105
Your C.O.C. #: 38224502, 382245-02-01

Attention: Roger Freymond
Stantec Consulting Ltd
Kitchener Standing Offer
49 Frederick St
Kitchener, ON
CANADA N2H 6M7

Report Date: 2013/09/23

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B3F4718
Received: 2013/09/13, 15:47

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Alkalinity	1	N/A	2013/09/17	CAM SOP-00448	SM 2320B
Carbonate, Bicarbonate and Hydroxide	1	N/A	2013/09/17	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2013/09/16	CAM SOP-00463	EPA 325.2
Conductivity	1	N/A	2013/09/17	CAM SOP-00414	SM 2510
Dissolved Organic Carbon (DOC)	1	N/A	2013/09/16	CAM SOP-00446	SM 5310 B
Hardness (calculated as CaCO3)	1	N/A	2013/09/23	CAM SOP 00102	SM 2340 B
Metals Analysis by ICPMS (as received) (1)	1	2013/09/20	2013/09/20	CAM SOP-00447	EPA 6020
Ion Balance (% Difference)	1	N/A	2013/09/23		
Anion and Cation Sum	1	N/A	2013/09/23		
Total Ammonia-N	1	N/A	2013/09/19	CAM SOP-00441	US GS I-2522-90
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2013/09/16	CAM SOP-00440	SM 4500 NO3I/NO2B
pH	1	N/A	2013/09/17	CAM SOP-00413	SM 4500H+ B
Orthophosphate	1	N/A	2013/09/16	CAM SOP-00461	EPA 365.1
Sat. pH and Langelier Index (@ 20C)	1	N/A	2013/09/23		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2013/09/23		
Sulphate by Automated Colourimetry	1	N/A	2013/09/16	CAM SOP-00464	EPA 375.4
Total Dissolved Solids (TDS calc)	1	N/A	2013/09/23		

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons. The extraction date for samples field preserved with methanol for F1 and Volatile Organic Compounds is considered to be the date sampled.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Metals analysis was performed on the sample 'as received'.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Maria Contreras, Project Manager
Email: MContreras@maxxam.ca
Phone# (905) 817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B3F4718
Report Date: 2013/09/23

Stantec Consulting Ltd
Client Project #: 161111105

Your P.O. #: 16300R-40
Sampler Initials: AV

RESULTS OF ANALYSES OF WATER

Maxxam ID		TB2375		
Sampling Date		2013/09/13 11:22		
	Units	**WG-161111105-20130913-AV01**	**RDL**	**QC Batch**
Calculated Parameters				
Anion Sum	me/L	6.84	N/A	3348820
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	270	1.0	3348816
Calculated TDS	mg/L	360	1.0	3348824
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.6	1.0	3348816
Cation Sum	me/L	6.83	N/A	3348820
Hardness (CaCO3)	mg/L	320	1.0	3348818
Ion Balance (% Difference)	%	0.0700	N/A	3348819
Langelier Index (@ 20C)	N/A	0.953		3348821
Langelier Index (@ 4C)	N/A	0.704		3348823
Saturation pH (@ 20C)	N/A	7.05		3348821
Saturation pH (@ 4C)	N/A	7.30		3348823
Inorganics				
Total Ammonia-N	mg/L	<0.050	0.050	3352523
Conductivity	umho/cm	630	1.0	3350190
Dissolved Organic Carbon	mg/L	1.6	0.20	3349958
Orthophosphate (P)	mg/L	<0.010	0.010	3350173
pH	pH	8.00		3350191
Dissolved Sulphate (SO4)	mg/L	30	1	3350172
Alkalinity (Total as CaCO3)	mg/L	280	1.0	3350189
Dissolved Chloride (Cl)	mg/L	17	1	3350170
Nitrite (N)	mg/L	<0.010	0.010	3350074
Nitrate (N)	mg/L	2.4	0.10	3350074
Nitrate + Nitrite	mg/L	2.4	0.10	3350074

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B3F4718
Report Date: 2013/09/23

Stantec Consulting Ltd
Client Project #: 161111105

Your P.O. #: 16300R-40
Sampler Initials: AV

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		TB2375		
Sampling Date		2013/09/13 11:22		
	Units	**WG-161111105-20130913-AV01**	**RDL**	**QC Batch**
Metals				
. Aluminum (Al)	mg/L	<0.0050	0.0050	3357316
. Antimony (Sb)	mg/L	<0.00050	0.00050	3357316
. Arsenic (As)	mg/L	<0.0010	0.0010	3357316
. Barium (Ba)	mg/L	0.049	0.0020	3357316
. Beryllium (Be)	mg/L	<0.00050	0.00050	3357316
. Boron (B)	mg/L	0.023	0.010	3357316
. Cadmium (Cd)	mg/L	<0.00010	0.00010	3357316
. Calcium (Ca)	mg/L	87	0.20	3357316
. Chromium (Cr)	mg/L	<0.0050	0.0050	3357316
. Cobalt (Co)	mg/L	<0.00050	0.00050	3357316
. Copper (Cu)	mg/L	0.0011	0.0010	3357316
. Iron (Fe)	mg/L	<0.10	0.10	3357316
. Lead (Pb)	mg/L	0.00081	0.00050	3357316
. Magnesium (Mg)	mg/L	26	0.050	3357316
. Manganese (Mn)	mg/L	<0.0020	0.0020	3357316
. Molybdenum (Mo)	mg/L	0.0013	0.00050	3357316
. Nickel (Ni)	mg/L	<0.0010	0.0010	3357316
. Phosphorus (P)	mg/L	<0.10	0.10	3357316
. Potassium (K)	mg/L	1.4	0.20	3357316
. Selenium (Se)	mg/L	<0.0020	0.0020	3357316
. Silicon (Si)	mg/L	4.8	0.050	3357316
. Silver (Ag)	mg/L	<0.00010	0.00010	3357316
. Sodium (Na)	mg/L	7.3	0.10	3357316
. Strontium (Sr)	mg/L	0.18	0.0010	3357316
. Thallium (Tl)	mg/L	<0.000050	0.000050	3357316
. Titanium (Ti)	mg/L	<0.0050	0.0050	3357316
. Uranium (U)	mg/L	0.00090	0.00010	3357316
. Vanadium (V)	mg/L	<0.00050	0.00050	3357316
. Zinc (Zn)	mg/L	0.062	0.0050	3357316

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B3F4718
Report Date: 2013/09/23

Stantec Consulting Ltd
Client Project #: 161111105

Your P.O. #: 16300R-40
Sampler Initials: AV

Test Summary

Maxxam ID TB2375
Sample ID WG-161111105-20130913-AV01
Matrix Water

Collected 2013/09/13
Shipped
Received 2013/09/13

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3350189	N/A	2013/09/17	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3348816	N/A	2013/09/17	Automated Statchk
Chloride by Automated Colourimetry	AC	3350170	N/A	2013/09/16	Alina Dobreanu
Conductivity	COND	3350190	N/A	2013/09/17	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3349958	N/A	2013/09/16	Anastasia Hamanov
Hardness (calculated as CaCO3)		3348818	N/A	2013/09/23	Automated Statchk
Metals Analysis by ICPMS (as received)	ICP/MS	3357316	2013/09/20	2013/09/20	Prempal Bhatti
Ion Balance (% Difference)	CALC	3348819	N/A	2013/09/23	Automated Statchk
Anion and Cation Sum	CALC	3348820	N/A	2013/09/23	Automated Statchk
Total Ammonia-N	LACH/NH4	3352523	N/A	2013/09/19	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3350074	N/A	2013/09/16	Sandeep Singh
pH	PH	3350191	N/A	2013/09/17	Surinder Rai
Orthophosphate	AC	3350173	N/A	2013/09/16	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	3348821	N/A	2013/09/23	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3348823	N/A	2013/09/23	Automated Statchk
Sulphate by Automated Colourimetry	AC	3350172	N/A	2013/09/16	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	3348824	N/A	2013/09/23	Automated Statchk

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Maxxam Job #: B3F4718
Report Date: 2013/09/23

Stantec Consulting Ltd
Client Project #: 161111105

Your P.O. #: 16300R-40
Sampler Initials: AV

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
3349958	Dissolved Organic Carbon	2013/09/16	NC	80 - 120	96	80 - 120	<0.20	mg/L	2.8	20		
3350074	Nitrite (N)	2013/09/16	101	80 - 120	102	85 - 115	<0.010	mg/L	NC	25		
3350074	Nitrate (N)	2013/09/16	NC	80 - 120	99	85 - 115	<0.10	mg/L	1.8	25		
3350170	Dissolved Chloride (Cl)	2013/09/16	NC	80 - 120	102	80 - 120	<1	mg/L	2.4	20		
3350172	Dissolved Sulphate (SO4)	2013/09/16	NC	75 - 125	102	80 - 120	<1	mg/L	2.8	20		
3350173	Orthophosphate (P)	2013/09/16	107	75 - 125	101	80 - 120	<0.010	mg/L	NC	25		
3350189	Alkalinity (Total as CaCO3)	2013/09/17					1.5, RDL=1.0	mg/L	0.9	25	97	85 - 115
3350190	Conductivity	2013/09/17					<1.0	umho/cm	1.4	25	102	85 - 115
3352523	Total Ammonia-N	2013/09/19	91	80 - 120	93	85 - 115	<0.050	mg/L	NC	20		
3357316	. Aluminum (Al)	2013/09/20	102	80 - 120	99	80 - 120	<0.0050	mg/L	NC	20		
3357316	. Antimony (Sb)	2013/09/20	104	80 - 120	100	80 - 120	<0.00050	mg/L	NC	20		
3357316	. Arsenic (As)	2013/09/20	101	80 - 120	98	80 - 120	<0.0010	mg/L	NC	20		
3357316	. Barium (Ba)	2013/09/20	100	80 - 120	99	80 - 120	<0.0020	mg/L	NC	20		
3357316	. Beryllium (Be)	2013/09/20	103	80 - 120	101	80 - 120	<0.00050	mg/L	NC	20		
3357316	. Boron (B)	2013/09/20	NC	80 - 120	102	80 - 120	<0.010	mg/L	2.8	20		
3357316	. Cadmium (Cd)	2013/09/20	102	80 - 120	100	80 - 120	<0.00010	mg/L	NC	20		
3357316	. Calcium (Ca)	2013/09/20	103	80 - 120	99	80 - 120	<0.20	mg/L	NC	20		
3357316	. Chromium (Cr)	2013/09/20	102	80 - 120	100	80 - 120	<0.0050	mg/L	NC	20		
3357316	. Cobalt (Co)	2013/09/20	102	80 - 120	100	80 - 120	<0.00050	mg/L	NC	20		
3357316	. Copper (Cu)	2013/09/20	100	80 - 120	98	80 - 120	<0.0010	mg/L	NC	20		
3357316	. Iron (Fe)	2013/09/20	100	80 - 120	98	80 - 120	<0.10	mg/L	NC	20		
3357316	. Lead (Pb)	2013/09/20	99	80 - 120	98	80 - 120	<0.00050	mg/L	NC	20		
3357316	. Magnesium (Mg)	2013/09/20	98	80 - 120	95	80 - 120	<0.050	mg/L	NC	20		
3357316	. Manganese (Mn)	2013/09/20	103	80 - 120	101	80 - 120	<0.0020	mg/L	NC	20		
3357316	. Molybdenum (Mo)	2013/09/20	103	80 - 120	98	80 - 120	<0.00050	mg/L	1.5	20		
3357316	. Nickel (Ni)	2013/09/20	101	80 - 120	99	80 - 120	<0.0010	mg/L	NC	20		
3357316	. Phosphorus (P)	2013/09/20	113	80 - 120	103	80 - 120	<0.10	mg/L	NC	20		
3357316	. Potassium (K)	2013/09/20	102	80 - 120	98	80 - 120	<0.20	mg/L	1.3	20		
3357316	. Selenium (Se)	2013/09/20	105	80 - 120	99	80 - 120	<0.0020	mg/L	NC	20		
3357316	. Silicon (Si)	2013/09/20	101	80 - 120	96	80 - 120	<0.050	mg/L	0.3	20		
3357316	. Silver (Ag)	2013/09/20	95	80 - 120	96	80 - 120	<0.00010	mg/L	NC	20		
3357316	. Sodium (Na)	2013/09/20	NC	80 - 120	95	80 - 120	0.26, RDL=0.10	mg/L	0.2	20		
3357316	. Strontium (Sr)	2013/09/20	103	80 - 120	101	80 - 120	<0.0010	mg/L	0.7	20		
3357316	. Thallium (Tl)	2013/09/20	99	80 - 120	99	80 - 120	<0.000050	mg/L	NC	20		
3357316	. Titanium (Ti)	2013/09/20	98	80 - 120	97	80 - 120	<0.0050	mg/L	NC	20		
3357316	. Uranium (U)	2013/09/20	102	80 - 120	98	80 - 120	<0.00010	mg/L	NC	20		

Maxxam Job #: B3F4718
Report Date: 2013/09/23

Stantec Consulting Ltd
Client Project #: 161111105

Your P.O. #: 16300R-40
Sampler Initials: AV

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
3357316	. Vanadium (V)	2013/09/20	103	80 - 120	100	80 - 120	<0.00050	mg/L	NC	20		
3357316	. Zinc (Zn)	2013/09/20	99	80 - 120	98	80 - 120	<0.0050	mg/L	NC	20		

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

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Validation Signature Page

Maxxam Job #: B3F4718

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere, Scientific Services

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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STANTEC CHAIN OF CUSTODY RECORD

13-Sep-13 15:47
Renata Spena
B3F4718
CK1 ENV-908

Page 1 of 1

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:		BOTTLE ORDER #: 382245
Company Name:	#23998 Stantec Consulting Ltd	Company Name:		Quotation #:	B21988	
Contact Name:	Accounts Payable	Contact Name:	Aaron Vandenhoff	Task #:	16300R-40	
Address:	49 Frederick St Kitchener ON N2H 6M7	Address:		Project #:	1609-16111105	CHAIN OF CUSTODY #: C#382245-02-01
Phone:	(519)579-4410 Fax: (519)579-6733	Phone:	Roger.Freymond@stantec.com EDD@stantec.com	Profit Centre:	1609	PROJECT MANAGER: Renata Spena
Email:	Stantec.Accounts.Payable.Invoices@Stantec.com	Email:	Aaron.Vandenhoff@stantec.com	Site #:		
				Sampled By:	A. VANDENHOFF	

Regulation 153 (2011): ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ___ ☐ Res/Park ☐ Ind/Comm ☐ Agri/Other ☐ Medium/Fine ☐ Coarse ☐ For RSC

Other Regulations: ☐ CCME ☐ Reg. 558 ☐ MISA ☐ PWQO ☑ Other ODWS ☐ Sanitary Sewer Bylaw ☐ Storm Sewer Bylaw Municipality ___

SPECIAL INSTRUCTIONS

Include Criteria on Certificate of Analysis (Y/N)? ___

Note: For MOE regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: _____ Time Required: _____ ☐
Rush Confirmation Number: _____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N)	ANALYSIS REQUESTED (Please be specific): RCAp - Comprehensive			# of Bottles	Comments
1		WG-16111105-20130913-AV01	13-Sep	11:22	GW	N	N*	✓			4	* tap sample, please analyze bs rec'd
2												
3												
4												
5												
6												
7												
8												
9												REC'D IN WATERLOO
10												

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal: Present / Intact	Yes	No
AARON VANDENHOFF	13-SEP-13	15:47	DAVID CHAN	2013-09-13	15:47			2°, 2°, 2°			
			DAVID CHAN	2013/09/13	18:18						

White: Maxxam Yellow: Client

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

Maxxam Analytics International Corporation o/a Maxxam Analytics

6/7/6°C WB#222164

Your P.O. #: 16300R
Your Project #: 160900623
Your C.O.C. #: 18336501, 183365-0

Attention: Michelle Fraser
Stantec Consulting Ltd
49 Frederick St
Kitchener, ON
CANADA N2H 6M7

Report Date: 2010/03/04

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B023173
Received: 2010/02/26, 10:02

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Alkalinity	4	N/A	2010/03/01	CAM SOP-00448	SM 2320B
Carbonate, Bicarbonate and Hydroxide	4	N/A	2010/03/03		
Chloride by Automated Colourimetry	4	N/A	2010/03/02	CAM SOP-00463	SM 4500 Cl E
Conductivity	4	N/A	2010/03/01	CAM SOP-00448	SM 2510
Dissolved Organic Carbon (DOC)	2	N/A	2010/03/02	CAM SOP-00446	SM 5310 B
Dissolved Organic Carbon (DOC)	2	N/A	2010/03/03	CAM SOP-00446	SM 5310 B
Hardness (calculated as CaCO3)	4	N/A	2010/03/03	CAM SOP 00102	SM 2340 B
Metals Analysis by ICPMS (as received) (1)	4	2010/03/03	2010/03/03	CAM SOP-00447	EPA 6020
Ion Balance (% Difference)	4	N/A	2010/03/03		
Anion and Cation Sum	4	N/A	2010/03/03		
Ammonia-N	4	N/A	2010/03/04	CAM SOP-00441	US GS I-2522-90
Nitrate (NO3) and Nitrite (NO2) in Water (2)	2	N/A	2010/03/01	CAM SOP-00440	SM 4500 NO3I/NO2B
Nitrate (NO3) and Nitrite (NO2) in Water (2)	2	N/A	2010/03/02	CAM SOP-00440	SM 4500 NO3I/NO2B
pH	4	N/A	2010/03/01	CAM SOP-00448	SM 4500H
Orthophosphate	4	N/A	2010/03/02	CAM SOP-00461	SM 4500 P-F
Sat. pH and Langelier Index (@ 20C)	4	N/A	2010/03/03		
Sat. pH and Langelier Index (@ 4C)	4	N/A	2010/03/03		
Sulphate by Automated Colourimetry	4	N/A	2010/03/02	CAM SOP-00464	EPA 375.4
Total Dissolved Solids (TDS calc)	4	N/A	2010/03/03		

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Metals analysis was performed on the sample 'as received'.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

RENATA SPENA, Project Manager
Email: Renata.Spena@maxxamanalytics.com
Phone# (905) 817-5700 Ext:5818

==========

Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 2

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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

RESULTS OF ANALYSES OF WATER

Maxxam ID		FE5735	FE5735		FE5736		
Sampling Date		2010/02/25 11:36	2010/02/25 11:36		2010/02/25 12:33		
	Units	**WG-160900623-20100225-MF-01**	**WG-160900623-20100225-MF-01 Lab-Dup**	**QC Batch**	**WG-160900623-20100225-MF-02**	**RDL**	**QC Batch**
Calculated Parameters							
Anion Sum	me/L	6.35		2088552	6.42	N/A	2088552
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	267		2088550	270	1	2088550
Calculated TDS	mg/L	326		2088555	333	1	2088555
Carb. Alkalinity (calc. as CaCO3)	mg/L	2		2088550	2	1	2088550
Cation Sum	me/L	6.14		2088552	6.34	N/A	2088552
Hardness (CaCO3)	mg/L	300		2088185	310	1	2088185
Ion Balance (% Difference)	%	1.69		2088551	0.600	N/A	2088551
Langelier Index (@ 20C)	N/A	0.736		2088553	0.812		2088553
Langelier Index (@ 4C)	N/A	0.487		2088554	0.563		2088554
Saturation pH (@ 20C)	N/A	7.10		2088553	7.08		2088553
Saturation pH (@ 4C)	N/A	7.35		2088554	7.33		2088554
Inorganics							
Total Ammonia-N	mg/L	<0.05		2090344	<0.05	0.05	2090344
Conductivity	umho/cm	582		2089813	587	1	2089491
Dissolved Organic Carbon	mg/L	0.7		2089232	0.7	0.2	2089266
Orthophosphate (P)	mg/L	<0.01		2089769	0.01	0.01	2089385
pH	pH	7.8		2089826	7.9		2089489
Dissolved Sulphate (SO4)	mg/L	30		2089770	29	1	2089386
Alkalinity (Total as CaCO3)	mg/L	269		2089789	272	1	2089481
Dissolved Chloride (Cl)	mg/L	7		2089760	8	1	2089376
Nitrite (N)	mg/L	<0.01	<0.01	2089723	<0.01	0.01	2089346
Nitrate (N)	mg/L	2.1	2.1	2089723	2.4	0.1	2089346

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

RESULTS OF ANALYSES OF WATER

Maxxam ID		FE5737	FE5737		
Sampling Date		2010/02/25 13:37	2010/02/25 13:37		
	Units	**WG-160900623-20100225-MF-03**	**WG-160900623-20100225-MF-03 Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters					
Anion Sum	me/L	6.51		N/A	2088552
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	272		1	2088550
Calculated TDS	mg/L	335		1	2088555
Carb. Alkalinity (calc. as CaCO3)	mg/L	2		1	2088550
Cation Sum	me/L	6.33		N/A	2088552
Hardness (CaCO3)	mg/L	310		1	2088185
Ion Balance (% Difference)	%	1.36		N/A	2088551
Langelier Index (@ 20C)	N/A	0.727			2088553
Langelier Index (@ 4C)	N/A	0.478			2088554
Saturation pH (@ 20C)	N/A	7.08			2088553
Saturation pH (@ 4C)	N/A	7.33			2088554
Inorganics					
Total Ammonia-N	mg/L	<0.05		0.05	2090344
Conductivity	umho/cm	592		1	2089491
Dissolved Organic Carbon	mg/L	0.7		0.2	2089232
Orthophosphate (P)	mg/L	<0.01	<0.01	0.01	2089385
pH	pH	7.8			2089489
Dissolved Sulphate (SO4)	mg/L	29	29	1	2089386
Alkalinity (Total as CaCO3)	mg/L	274		1	2089481
Dissolved Chloride (Cl)	mg/L	9	9	1	2089376
Nitrite (N)	mg/L	<0.01		0.01	2089346
Nitrate (N)	mg/L	2.5		0.1	2089346

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

RESULTS OF ANALYSES OF WATER

Maxxam ID		FE5738	FE5738		
Sampling Date		2010/02/25 14:39	2010/02/25 14:39		
	Units	**WG-160900623-20100225-MF-04**	**WG-160900623-20100225-MF-04 Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters					
Anion Sum	me/L	6.54		N/A	2088552
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	271		1	2088550
Calculated TDS	mg/L	339		1	2088555
Carb. Alkalinity (calc. as CaCO3)	mg/L	2		1	2088550
Cation Sum	me/L	6.47		N/A	2088552
Hardness (CaCO3)	mg/L	310		1	2088185
Ion Balance (% Difference)	%	0.540		N/A	2088551
Langelier Index (@ 20C)	N/A	0.761			2088553
Langelier Index (@ 4C)	N/A	0.512			2088554
Saturation pH (@ 20C)	N/A	7.08			2088553
Saturation pH (@ 4C)	N/A	7.33			2088554
Inorganics					
Total Ammonia-N	mg/L	<0.05		0.05	2090344
Conductivity	umho/cm	598		1	2089813
Dissolved Organic Carbon	mg/L	0.7	0.7	0.2	2089232
Orthophosphate (P)	mg/L	<0.01		0.01	2089769
pH	pH	7.8			2089826
Dissolved Sulphate (SO4)	mg/L	28		1	2089770
Alkalinity (Total as CaCO3)	mg/L	273		1	2089789
Dissolved Chloride (Cl)	mg/L	11		1	2089760
Nitrite (N)	mg/L	<0.01		0.01	2089723
Nitrate (N)	mg/L	2.7		0.1	2089723

N/A = Not Applicable
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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FE5735		
Sampling Date		2010/02/25 11:36		
	Units	**WG-160900623-20100225-MF-01**	**RDL**	**QC Batch**
Metals				
. Aluminum (Al)	mg/L	<0.005	0.005	2091396
. Antimony (Sb)	mg/L	<0.0005	0.0005	2091396
. Arsenic (As)	mg/L	<0.001	0.001	2091396
. Barium (Ba)	mg/L	0.044	0.005	2091396
. Beryllium (Be)	mg/L	<0.0005	0.0005	2091396
. Boron (B)	mg/L	<0.01	0.01	2091396
. Cadmium (Cd)	mg/L	<0.0001	0.0001	2091396
. Calcium (Ca)	mg/L	79	0.2	2091396
. Chromium (Cr)	mg/L	<0.005	0.005	2091396
. Cobalt (Co)	mg/L	<0.0005	0.0005	2091396
. Copper (Cu)	mg/L	0.001	0.001	2091396
. Iron (Fe)	mg/L	<0.1	0.1	2091396
. Lead (Pb)	mg/L	<0.0005	0.0005	2091396
. Magnesium (Mg)	mg/L	24	0.05	2091396
. Manganese (Mn)	mg/L	<0.002	0.002	2091396
. Molybdenum (Mo)	mg/L	0.002	0.001	2091396
. Nickel (Ni)	mg/L	0.003	0.001	2091396
. Phosphorus (P)	mg/L	<0.1	0.1	2091396
. Potassium (K)	mg/L	1.0	0.2	2091396
. Selenium (Se)	mg/L	<0.002	0.002	2091396
. Silicon (Si)	mg/L	4.8	0.05	2091396
. Silver (Ag)	mg/L	<0.0001	0.0001	2091396
. Sodium (Na)	mg/L	3.5	0.1	2091396
. Strontium (Sr)	mg/L	0.12	0.001	2091396
. Thallium (Tl)	mg/L	<0.00005	0.00005	2091396
. Titanium (Ti)	mg/L	<0.005	0.005	2091396
. Uranium (U)	mg/L	0.0009	0.0001	2091396
. Vanadium (V)	mg/L	<0.001	0.001	2091396
. Zinc (Zn)	mg/L	0.074	0.005	2091396

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FE5736	FE5737		
Sampling Date		2010/02/25 12:33	2010/02/25 13:37		
	Units	**WG-160900623-20100225-MF-02**	**WG-160900623-20100225-MF-03**	**RDL**	**QC Batch**
Metals					
. Aluminum (Al)	mg/L	<0.005	<0.005	0.005	2091396
. Antimony (Sb)	mg/L	<0.0005	<0.0005	0.0005	2091396
. Arsenic (As)	mg/L	<0.001	<0.001	0.001	2091396
. Barium (Ba)	mg/L	0.045	0.045	0.005	2091396
. Beryllium (Be)	mg/L	<0.0005	<0.0005	0.0005	2091396
. Boron (B)	mg/L	0.01	0.01	0.01	2091396
. Cadmium (Cd)	mg/L	<0.0001	<0.0001	0.0001	2091396
. Calcium (Ca)	mg/L	82	81	0.2	2091396
. Chromium (Cr)	mg/L	<0.005	<0.005	0.005	2091396
. Cobalt (Co)	mg/L	<0.0005	<0.0005	0.0005	2091396
. Copper (Cu)	mg/L	<0.001	<0.001	0.001	2091396
. Iron (Fe)	mg/L	<0.1	<0.1	0.1	2091396
. Lead (Pb)	mg/L	<0.0005	0.0005	0.0005	2091396
. Magnesium (Mg)	mg/L	25	25	0.05	2091396
. Manganese (Mn)	mg/L	<0.002	<0.002	0.002	2091396
. Molybdenum (Mo)	mg/L	0.002	0.002	0.001	2091396
. Nickel (Ni)	mg/L	<0.001	0.001	0.001	2091396
. Phosphorus (P)	mg/L	<0.1	<0.1	0.1	2091396
. Potassium (K)	mg/L	1.0	1.0	0.2	2091396
. Selenium (Se)	mg/L	<0.002	<0.002	0.002	2091396
. Silicon (Si)	mg/L	5.0	4.9	0.05	2091396
. Silver (Ag)	mg/L	<0.0001	<0.0001	0.0001	2091396
. Sodium (Na)	mg/L	4.0	4.4	0.1	2091396
. Strontium (Sr)	mg/L	0.12	0.12	0.001	2091396
. Thallium (Tl)	mg/L	<0.00005	<0.00005	0.00005	2091396
. Titanium (Ti)	mg/L	<0.005	<0.005	0.005	2091396
. Uranium (U)	mg/L	0.0009	0.0008	0.0001	2091396
. Vanadium (V)	mg/L	<0.001	<0.001	0.001	2091396
. Zinc (Zn)	mg/L	0.079	0.070	0.005	2091396

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FE5738		
Sampling Date		2010/02/25 14:39		
	Units	**WG-160900623-20100225-MF-04**	**RDL**	**QC Batch**
Metals				
. Aluminum (Al)	mg/L	0.013	0.005	2091396
. Antimony (Sb)	mg/L	<0.0005	0.0005	2091396
. Arsenic (As)	mg/L	<0.001	0.001	2091396
. Barium (Ba)	mg/L	0.046	0.005	2091396
. Beryllium (Be)	mg/L	<0.0005	0.0005	2091396
. Boron (B)	mg/L	0.01	0.01	2091396
. Cadmium (Cd)	mg/L	<0.0001	0.0001	2091396
. Calcium (Ca)	mg/L	82	0.2	2091396
. Chromium (Cr)	mg/L	<0.005	0.005	2091396
. Cobalt (Co)	mg/L	<0.0005	0.0005	2091396
. Copper (Cu)	mg/L	0.001	0.001	2091396
. Iron (Fe)	mg/L	<0.1	0.1	2091396
. Lead (Pb)	mg/L	0.0019	0.0005	2091396
. Magnesium (Mg)	mg/L	26	0.05	2091396
. Manganese (Mn)	mg/L	0.005	0.002	2091396
. Molybdenum (Mo)	mg/L	0.002	0.001	2091396
. Nickel (Ni)	mg/L	0.001	0.001	2091396
. Phosphorus (P)	mg/L	<0.1	0.1	2091396
. Potassium (K)	mg/L	1.0	0.2	2091396
. Selenium (Se)	mg/L	<0.002	0.002	2091396
. Silicon (Si)	mg/L	4.9	0.05	2091396
. Silver (Ag)	mg/L	<0.0001	0.0001	2091396
. Sodium (Na)	mg/L	5.0	0.1	2091396
. Strontium (Sr)	mg/L	0.13	0.001	2091396
. Thallium (Tl)	mg/L	<0.00005	0.00005	2091396
. Titanium (Ti)	mg/L	<0.005	0.005	2091396
. Uranium (U)	mg/L	0.0008	0.0001	2091396
. Vanadium (V)	mg/L	<0.001	0.001	2091396
. Zinc (Zn)	mg/L	0.080	0.005	2091396

RDL = Reportable Detection Limit
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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2089232	Dissolved Organic Carbon	2010/03/02	94	80 - 120	100	80 - 120	<0.2	mg/L	NC	20		
2089266	Dissolved Organic Carbon	2010/03/02	94	80 - 120	100	80 - 120	<0.2	mg/L	NC	20		
2089346	Nitrite (N)	2010/03/01	NC	75 - 125	104	80 - 120	<0.01	mg/L	3.0	25		
2089346	Nitrate (N)	2010/03/01	83	75 - 125	103	80 - 120	<0.1	mg/L	NC	25		
2089376	Dissolved Chloride (Cl)	2010/03/02	108	75 - 125	101	80 - 120	<1	mg/L	1.4	20		
2089385	Orthophosphate (P)	2010/03/02	104	75 - 125	95	80 - 120	<0.01	mg/L	NC	25		
2089386	Dissolved Sulphate (SO4)	2010/03/02	NC	75 - 125	102	80 - 120	<1	mg/L	0.1	25		
2089481	Alkalinity (Total as CaCO3)	2010/03/01					<1	mg/L	0.3	25	97	85 - 115
2089491	Conductivity	2010/03/01					<1	umho/cm	0.06	25	102	85 - 115
2089723	Nitrite (N)	2010/03/02	104	75 - 125	104	80 - 120	<0.01	mg/L	NC	25		
2089723	Nitrate (N)	2010/03/02	NC	75 - 125	105	80 - 120	<0.1	mg/L	0.8	25		
2089760	Dissolved Chloride (Cl)	2010/03/02	NC	75 - 125	107	80 - 120	<1	mg/L	0.7	20		
2089769	Orthophosphate (P)	2010/03/02	106	75 - 125	93	80 - 120	<0.01	mg/L	0.1	25		
2089770	Dissolved Sulphate (SO4)	2010/03/02	NC	75 - 125	102	80 - 120	<1	mg/L	0.5	25		
2089789	Alkalinity (Total as CaCO3)	2010/03/01					<1	mg/L	0.2	25	96	85 - 115
2089813	Conductivity	2010/03/01					<1	umho/cm	0.2	25	103	85 - 115
2090344	Total Ammonia-N	2010/03/04	95	80 - 120	102	85 - 115	<0.05	mg/L	NC	25		
2091396	. Aluminum (Al)	2010/03/03	98	80 - 120	100	90 - 110	<0.005	mg/L				
2091396	. Antimony (Sb)	2010/03/03	105	80 - 120	103	90 - 110	<0.0005	mg/L	NC	25		
2091396	. Arsenic (As)	2010/03/03	105	80 - 120	103	90 - 110	<0.001	mg/L	NC	25		
2091396	. Barium (Ba)	2010/03/03	94	80 - 120	97	90 - 110	<0.005	mg/L	0.6	25		
2091396	. Beryllium (Be)	2010/03/03	103	80 - 120	105	90 - 110	<0.0005	mg/L				
2091396	. Boron (B)	2010/03/03	102	80 - 120	104	90 - 110	<0.01	mg/L	NC	25		
2091396	. Cadmium (Cd)	2010/03/03	103	80 - 120	101	90 - 110	<0.0001	mg/L	NC	25		
2091396	. Calcium (Ca)	2010/03/03	NC	80 - 120	103	90 - 110	<0.2	mg/L				
2091396	. Chromium (Cr)	2010/03/03	95	80 - 120	96	90 - 110	<0.005	mg/L	NC	25		
2091396	. Cobalt (Co)	2010/03/03	94	80 - 120	96	90 - 110	<0.0005	mg/L				
2091396	. Copper (Cu)	2010/03/03	96	80 - 120	100	90 - 110	<0.001	mg/L				
2091396	. Iron (Fe)	2010/03/03	97	80 - 120	98	90 - 110	<0.1	mg/L				
2091396	. Lead (Pb)	2010/03/03	95	80 - 120	100	90 - 110	<0.0005	mg/L	NC	25		
2091396	. Magnesium (Mg)	2010/03/03	NC	80 - 120	102	90 - 110	<0.05	mg/L				
2091396	. Manganese (Mn)	2010/03/03	95	80 - 120	97	90 - 110	<0.002	mg/L				
2091396	. Molybdenum (Mo)	2010/03/03	105	80 - 120	103	90 - 110	<0.001	mg/L				
2091396	. Nickel (Ni)	2010/03/03	98	80 - 120	100	90 - 110	<0.001	mg/L				
2091396	. Phosphorus (P)	2010/03/03	110	80 - 120	102	90 - 110	<0.1	mg/L				
2091396	. Potassium (K)	2010/03/03	103	80 - 120	103	90 - 110	<0.2	mg/L				
2091396	. Selenium (Se)	2010/03/03	104	80 - 120	100	90 - 110	<0.002	mg/L	NC	25		
2091396	. Silicon (Si)	2010/03/03	101	80 - 120	102	90 - 110	<0.05	mg/L				
2091396	. Silver (Ag)	2010/03/03	95	80 - 120	92	90 - 110	<0.0001	mg/L				

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Maxxam Job #: B023173
Report Date: 2010/03/04

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2091396	. Sodium (Na)	2010/03/03	NC	80 - 120	101	90 - 110	<0.1	mg/L				
2091396	. Strontium (Sr)	2010/03/03	101	80 - 120	101	90 - 110	<0.001	mg/L				
2091396	. Thallium (Tl)	2010/03/03	99	80 - 120	104	90 - 110	<0.00005	mg/L				
2091396	. Titanium (Ti)	2010/03/03	104	80 - 120	102	90 - 110	<0.005	mg/L				
2091396	. Uranium (U)	2010/03/03	103	80 - 120	108	90 - 110	<0.0001	mg/L	9.2	25		
2091396	. Vanadium (V)	2010/03/03	96	80 - 120	97	90 - 110	<0.001	mg/L				
2091396	. Zinc (Zn)	2010/03/03	99	80 - 120	100	90 - 110	<0.005	mg/L				

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

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Validation Signature Page

Maxxam Job #: B023173

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CRISTINA CARRIERE, Scientific Services

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

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Maxxam Analytics

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CHAIN OF CUSTODY RECORD

26-Feb-10 10:02
RENATA SPENA
B023173
TST WAT-001

INVOICE INFORMATION:			
Company Name:	#9197 Stantec Consulting Ltd	Company Name:	
Contact Name:	Michelle Fraser	Contact Name:	
Address:	49 Frederick St Kitchener ON N2H 6M7	Address:	
Phone:	(519)585-7421 Fax: (519)579-6733	Phone:	
Email:	michelle.fraser@stantec.com	Email:	

PROJECT INFORMATION:	
Quotation #:	A96103
P.O. #:	1609023
Project #:	160900623
Project Name:	
Site #:	
Sampled By:	

Laboratory Use Only:	
MAXXAM JOB #:	BOTTLE ORDER #: 183365
CHAIN OF CUSTODY #: C#183365-01-01	PROJECT MANAGER: RENATA SPENA

REGULATORY CRITERIA:
- ☐ MISA — Reg. 153/04 — Sewer Use: ☐ Sanitary ☐ Storm ☐ Combined
- ☐ PWQO — ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table 6 — ☐ Residential/Parkland ☐ Industrial/Commercial ☐ Medium/Fine ☐ Coarse — Municipality: _____
- ☐ Reg. 558 — ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table 6 — ☐ Residential/Parkland ☐ Industrial/Commercial ☐ Medium/Fine ☐ Coarse — Municipality: _____
- Other (specify): _____ Report Criteria on C of A ? ☐

SPECIAL INSTRUCTIONS:

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: _____ Time Required: _____ ☐
Rush Confirmation Number: _____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y / N)	Metals Field Filtered ? (Y / N)	RCAp - Comprehensive Groundwater Drinking	# of Bottles	Comments
1		WG-160900623-20100225-MF-01	Feb 25 2010	11:36	GW	N	N	X	4	Metals Not filtered Analyze As Received
2		WG-160900623-20100225-MF-02	Feb 25 2010	12:33	GW	N	N	X	4	
3		WG-160900623-20100225-MF-03	Feb 25 2010	13:37	GW	N	N	X	4	
4		WG-160900623-20100225-MF-04	Feb 25/10	14:34	GW	N	N	X	4	
5										
6										
7										
8										
9										REC'D IN WATERLOO
10										

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted
Michelle Fraser	10/02/25	16:32		2010 02 25	4:30	

Laboratory Use Only		
Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
X	2 2 2	☐ Yes ☐ No

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Your P.O. #: 16300R
Your Project #: 160900623
Your C.O.C. #: 18396201, 183962-0

Attention: Michelle Fraser
Stantec Consulting Ltd
49 Frederick St
Kitchener, ON
CANADA N2H 6M7

Report Date: 2010/03/08

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B024955
Received: 2010/03/02, 15:39

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Alkalinity	4	N/A	2010/03/04	CAM SOP-00448	SM 2320B
Carbonate, Bicarbonate and Hydroxide	4	N/A	2010/03/05		
Chloride by Automated Colourimetry	4	N/A	2010/03/05	CAM SOP-00463	SM 4500 Cl E
Conductivity	4	N/A	2010/03/04	CAM SOP-00448	SM 2510
Dissolved Organic Carbon (DOC)	4	N/A	2010/03/04	CAM SOP-00446	SM 5310 B
Hardness (calculated as CaCO3)	4	N/A	2010/03/08	CAM SOP 00102	SM 2340 B
Metals Analysis by ICPMS (as received) (1)	4	2010/03/08	2010/03/08	CAM SOP-00447	EPA 6020
Ion Balance (% Difference)	4	N/A	2010/03/08		
Anion and Cation Sum	4	N/A	2010/03/08		
Ammonia-N	4	N/A	2010/03/08	CAM SOP-00441	US GS I-2522-90
Nitrate (NO3) and Nitrite (NO2) in Water (2)	3	N/A	2010/03/03	CAM SOP-00440	SM 4500 NO3I/NO2B
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2010/03/04	CAM SOP-00440	SM 4500 NO3I/NO2B
pH	4	N/A	2010/03/04	CAM SOP-00448	SM 4500H
Orthophosphate	4	N/A	2010/03/05	CAM SOP-00461	SM 4500 P-F
Sat. pH and Langelier Index (@ 20C)	4	N/A	2010/03/08		
Sat. pH and Langelier Index (@ 4C)	4	N/A	2010/03/08		
Sulphate by Automated Colourimetry	4	N/A	2010/03/05	CAM SOP-00464	EPA 375.4
Total Dissolved Solids (TDS calc)	4	N/A	2010/03/08		

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Metals analysis was performed on the sample 'as received'.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

RENATA SPENA, Project Manager
Email: Renata.Spena@maxxamanalytics.com
Phone# (905) 817-5700 Ext:5818

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section

Maxxam Job #: B024955
Report Date: 2010/03/08

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 2

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Maxxam Job #: B024955
Report Date: 2010/03/08

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

RESULTS OF ANALYSES OF WATER

Maxxam ID		FF5401	FF5402		FF5403		
Sampling Date		2010/03/02 11:09	2010/03/02 12:09		2010/03/02 13:09		
	Units	**WG-160900623-20100302-MF-01**	**WG-160900623-20100302-MF-02**	**QC Batch**	**WG-160900623-20100302-MF-03**	**RDL**	**QC Batch**
Calculated Parameters							
Anion Sum	me/L	6.45	6.50	2090310	6.51	N/A	2090310
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	271	272	2090307	271	1	2090307
Calculated TDS	mg/L	333	335	2090313	340	1	2090313
Carb. Alkalinity (calc. as CaCO3)	mg/L	2	2	2090307	2	1	2090307
Cation Sum	me/L	6.35	6.35	2090310	6.62	N/A	2090310
Hardness (CaCO3)	mg/L	310	310	2090308	320	1	2090308
Ion Balance (% Difference)	%	0.730	1.17	2090309	0.820	N/A	2090309
Langelier Index (@ 20C)	N/A	0.798	0.788	2090311	0.793		2090311
Langelier Index (@ 4C)	N/A	0.549	0.539	2090312	0.544		2090312
Saturation pH (@ 20C)	N/A	7.08	7.08	2090311	7.07		2090311
Saturation pH (@ 4C)	N/A	7.32	7.32	2090312	7.32		2090312
Inorganics							
Total Ammonia-N	mg/L	<0.05	<0.05	2094208	<0.05	0.05	2094208
Conductivity	umho/cm	586	590	2092733	593	1	2092733
Dissolved Organic Carbon	mg/L	0.8	0.7	2092531	0.7	0.2	2092531
Orthophosphate (P)	mg/L	<0.01	<0.01	2093399	<0.01	0.01	2093399
pH	pH	7.9	7.9	2092734	7.9		2092734
Dissolved Sulphate (SO4)	mg/L	31	30	2093400	29	1	2093400
Alkalinity (Total as CaCO3)	mg/L	273	274	2092730	273	1	2092730
Dissolved Chloride (Cl)	mg/L	6	8	2093397	9	1	2093397
Nitrite (N)	mg/L	<0.01	<0.01	2091753	<0.01	0.01	2092432
Nitrate (N)	mg/L	2.2	2.4	2091753	2.5	0.1	2092432

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B024955
Report Date: 2010/03/08

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

RESULTS OF ANALYSES OF WATER

Maxxam ID		FF5403		FF5404		
Sampling Date		2010/03/02 13:09		2010/03/02 14:09		
	Units	**WG-160900623-20100302-MF-03 Lab-Dup**	**QC Batch**	**WG-160900623-20100302-MF-04**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L		2090310	6.53	N/A	2090310
Bicarb. Alkalinity (calc. as CaCO3)	mg/L		2090307	272	1	2090307
Calculated TDS	mg/L		2090313	356	1	2090313
Carb. Alkalinity (calc. as CaCO3)	mg/L		2090307	2	1	2090307
Cation Sum	me/L		2090310	7.52	N/A	2090310
Hardness (CaCO3)	mg/L		2090308	360	1	2090308
Ion Balance (% Difference)	%		2090309	7.05	N/A	2090309
Langelier Index (@ 20C)	N/A		2090311	0.863		2090311
Langelier Index (@ 4C)	N/A		2090312	0.615		2090312
Saturation pH (@ 20C)	N/A		2090311	7.02		2090311
Saturation pH (@ 4C)	N/A		2090312	7.27		2090312
Inorganics						
Total Ammonia-N	mg/L	<0.05	2094208	<0.05	0.05	2094208
Conductivity	umho/cm		2092733	597	1	2092733
Dissolved Organic Carbon	mg/L		2092531	0.8	0.2	2092531
Orthophosphate (P)	mg/L		2093399	<0.01	0.01	2093399
pH	pH		2092734	7.9		2092734
Dissolved Sulphate (SO4)	mg/L		2093400	28	1	2093400
Alkalinity (Total as CaCO3)	mg/L		2092730	274	1	2092730
Dissolved Chloride (Cl)	mg/L		2093397	10	1	2093397
Nitrite (N)	mg/L		2092432	<0.01	0.01	2091753
Nitrate (N)	mg/L		2092432	2.8	0.1	2091753

N/A = Not Applicable
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Maxxam Job #: B024955
Report Date: 2010/03/08

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FF5401	FF5402		
Sampling Date		2010/03/02 11:09	2010/03/02 12:09		
	Units	**WG-160900623-20100302-MF-01**	**WG-160900623-20100302-MF-02**	**RDL**	**QC Batch**
Metals					
. Aluminum (Al)	mg/L	<0.005	<0.005	0.005	2094902
. Antimony (Sb)	mg/L	0.0008	<0.0005	0.0005	2094902
. Arsenic (As)	mg/L	<0.001	<0.001	0.001	2094902
. Barium (Ba)	mg/L	0.046	0.045	0.005	2094902
. Beryllium (Be)	mg/L	<0.0005	<0.0005	0.0005	2094902
. Boron (B)	mg/L	0.01	0.01	0.01	2094902
. Cadmium (Cd)	mg/L	<0.0001	<0.0001	0.0001	2094902
. Calcium (Ca)	mg/L	83	83	0.2	2094902
. Chromium (Cr)	mg/L	<0.005	<0.005	0.005	2094902
. Cobalt (Co)	mg/L	<0.0005	<0.0005	0.0005	2094902
. Copper (Cu)	mg/L	0.001	<0.001	0.001	2094902
. Iron (Fe)	mg/L	<0.1	<0.1	0.1	2094902
. Lead (Pb)	mg/L	<0.0005	<0.0005	0.0005	2094902
. Magnesium (Mg)	mg/L	25	25	0.05	2094902
. Manganese (Mn)	mg/L	<0.002	<0.002	0.002	2094902
. Molybdenum (Mo)	mg/L	0.002	0.002	0.001	2094902
. Nickel (Ni)	mg/L	0.001	0.001	0.001	2094902
. Phosphorus (P)	mg/L	<0.1	<0.1	0.1	2094902
. Potassium (K)	mg/L	0.9	0.9	0.2	2094902
. Selenium (Se)	mg/L	<0.002	<0.002	0.002	2094902
. Silicon (Si)	mg/L	4.8	4.7	0.05	2094902
. Silver (Ag)	mg/L	<0.0001	<0.0001	0.0001	2094902
. Sodium (Na)	mg/L	3.7	3.9	0.1	2094902
. Strontium (Sr)	mg/L	0.13	0.13	0.001	2094902
. Thallium (Tl)	mg/L	<0.00005	<0.00005	0.00005	2094902
. Titanium (Ti)	mg/L	<0.005	<0.005	0.005	2094902
. Uranium (U)	mg/L	0.0009	0.0008	0.0001	2094902
. Vanadium (V)	mg/L	<0.001	<0.001	0.001	2094902
. Zinc (Zn)	mg/L	0.073	0.075	0.005	2094902

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B024955
Report Date: 2010/03/08

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FF5402	FF5403	FF5404		
Sampling Date		2010/03/02 12:09	2010/03/02 13:09	2010/03/02 14:09		
	Units	**WG-160900623-20100302-MF-02 Lab-Dup**	**WG-160900623-20100302-MF-03**	**WG-160900623-20100302-MF-04**	**RDL**	**QC Batch**
Metals						
. Aluminum (Al)	mg/L	<0.005	0.010	0.033	0.005	2094902
. Antimony (Sb)	mg/L	<0.0005	<0.0005	<0.0005	0.0005	2094902
. Arsenic (As)	mg/L	<0.001	<0.001	<0.001	0.001	2094902
. Barium (Ba)	mg/L	0.047	0.045	0.046	0.005	2094902
. Beryllium (Be)	mg/L	<0.0005	<0.0005	<0.0005	0.0005	2094902
. Boron (B)	mg/L	0.01	<0.01	0.01	0.01	2094902
. Cadmium (Cd)	mg/L	<0.0001	<0.0001	<0.0001	0.0001	2094902
. Calcium (Ca)	mg/L	83	85	94	0.2	2094902
. Chromium (Cr)	mg/L	<0.005	<0.005	<0.005	0.005	2094902
. Cobalt (Co)	mg/L	<0.0005	<0.0005	<0.0005	0.0005	2094902
. Copper (Cu)	mg/L	<0.001	<0.001	0.001	0.001	2094902
. Iron (Fe)	mg/L	<0.1	<0.1	0.2	0.1	2094902
. Lead (Pb)	mg/L	<0.0005	0.0021	0.0056	0.0005	2094902
. Magnesium (Mg)	mg/L	25	26	31	0.05	2094902
. Manganese (Mn)	mg/L	<0.002	0.005	0.018	0.002	2094902
. Molybdenum (Mo)	mg/L	0.002	0.002	0.001	0.001	2094902
. Nickel (Ni)	mg/L	0.001	0.001	0.001	0.001	2094902
. Phosphorus (P)	mg/L	<0.1	<0.1	<0.1	0.1	2094902
. Potassium (K)	mg/L	1.0	0.9	1.0	0.2	2094902
. Selenium (Se)	mg/L	<0.002	<0.002	<0.002	0.002	2094902
. Silicon (Si)	mg/L	4.8	4.7	4.8	0.05	2094902
. Silver (Ag)	mg/L	<0.0001	<0.0001	<0.0001	0.0001	2094902
. Sodium (Na)	mg/L	4.0	4.2	4.7	0.1	2094902
. Strontium (Sr)	mg/L	0.13	0.13	0.13	0.001	2094902
. Thallium (Tl)	mg/L	<0.00005	<0.00005	<0.00005	0.00005	2094902
. Titanium (Ti)	mg/L	<0.005	<0.005	<0.005	0.005	2094902
. Uranium (U)	mg/L	0.0009	0.0009	0.0008	0.0001	2094902
. Vanadium (V)	mg/L	<0.001	<0.001	<0.001	0.001	2094902
. Zinc (Zn)	mg/L	0.076	0.069	0.074	0.005	2094902

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B024955
Report Date: 2010/03/08

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2091753	Nitrite (N)	2010/03/03	101	75 - 125	105	80 - 120	<0.01	mg/L	NC	25		
2091753	Nitrate (N)	2010/03/03	95	75 - 125	106	80 - 120	<0.1	mg/L	NC	25		
2092432	Nitrite (N)	2010/03/04	104	75 - 125	105	80 - 120	<0.01	mg/L	NC	25		
2092432	Nitrate (N)	2010/03/04	NC(1)	75 - 125	101	80 - 120	<0.1	mg/L	0.3	25		
2092531	Dissolved Organic Carbon	2010/03/04	95	80 - 120	96	80 - 120	<0.2	mg/L	NC	20		
2092730	Alkalinity (Total as CaCO3)	2010/03/04					<1	mg/L	0.1	25	99	85 - 115
2092733	Conductivity	2010/03/04					<1	umho/cm	0.2	25	102	85 - 115
2093397	Dissolved Chloride (Cl)	2010/03/05	104	75 - 125	96	80 - 120	<1	mg/L	NC	20		
2093399	Orthophosphate (P)	2010/03/05	103	75 - 125	96	80 - 120	<0.01	mg/L	NC	25		
2093400	Dissolved Sulphate (SO4)	2010/03/05	110	75 - 125	103	80 - 120	<1	mg/L	NC	25		
2094208	Total Ammonia-N	2010/03/08	95	80 - 120	101	85 - 115	<0.05	mg/L	NC	25		
2094902	. Aluminum (Al)	2010/03/08	95	80 - 120	100	90 - 110	<0.005	mg/L	NC	25		
2094902	. Antimony (Sb)	2010/03/08	103	80 - 120	106	90 - 110	<0.0005	mg/L	NC	25		
2094902	. Arsenic (As)	2010/03/08	104	80 - 120	106	90 - 110	<0.001	mg/L	NC	25		
2094902	. Barium (Ba)	2010/03/08	102	80 - 120	105	90 - 110	<0.005	mg/L	4.1	25		
2094902	. Beryllium (Be)	2010/03/08	101	80 - 120	104	90 - 110	<0.0005	mg/L	NC	25		
2094902	. Boron (B)	2010/03/08	99	80 - 120	102	90 - 110	<0.01	mg/L	NC	25		
2094902	. Cadmium (Cd)	2010/03/08	101	80 - 120	105	90 - 110	<0.0001	mg/L	NC	25		
2094902	. Calcium (Ca)	2010/03/08	NC	80 - 120	103	90 - 110	<0.2	mg/L	0.3	25		
2094902	. Chromium (Cr)	2010/03/08	98	80 - 120	101	90 - 110	<0.005	mg/L	NC	25		
2094902	. Cobalt (Co)	2010/03/08	97	80 - 120	100	90 - 110	<0.0005	mg/L	NC	25		
2094902	. Copper (Cu)	2010/03/08	95	80 - 120	100	90 - 110	<0.001	mg/L	NC	25		
2094902	. Iron (Fe)	2010/03/08	99	80 - 120	102	90 - 110	<0.1	mg/L	NC	25		
2094902	. Lead (Pb)	2010/03/08	96	80 - 120	101	90 - 110	<0.0005	mg/L	NC	25		
2094902	. Magnesium (Mg)	2010/03/08	NC	80 - 120	104	90 - 110	<0.05	mg/L	1.4	25		
2094902	. Manganese (Mn)	2010/03/08	97	80 - 120	101	90 - 110	<0.002	mg/L	NC	25		
2094902	. Molybdenum (Mo)	2010/03/08	104	80 - 120	107	90 - 110	<0.001	mg/L	NC	25		
2094902	. Nickel (Ni)	2010/03/08	96	80 - 120	99	90 - 110	<0.001	mg/L	NC	25		
2094902	. Phosphorus (P)	2010/03/08	122(2)	80 - 120	104	90 - 110	<0.1	mg/L	NC	25		
2094902	. Potassium (K)	2010/03/08	100	80 - 120	103	90 - 110	<0.2	mg/L	NC	25		
2094902	. Selenium (Se)	2010/03/08	102	80 - 120	104	90 - 110	<0.002	mg/L	NC	25		
2094902	. Silicon (Si)	2010/03/08	101	80 - 120	104	90 - 110	<0.05	mg/L	2.9	25		
2094902	. Silver (Ag)	2010/03/08	98	80 - 120	102	90 - 110	<0.0001	mg/L	NC	25		
2094902	. Sodium (Na)	2010/03/08	99	80 - 120	103	90 - 110	<0.1	mg/L	1.5	25		
2094902	. Strontium (Sr)	2010/03/08	98	80 - 120	100	90 - 110	<0.001	mg/L	2.3	25		
2094902	. Thallium (Tl)	2010/03/08	97	80 - 120	100	90 - 110	<0.00005	mg/L	NC	25		
2094902	. Titanium (Ti)	2010/03/08	101	80 - 120	102	90 - 110	<0.005	mg/L	NC	25		
2094902	. Uranium (U)	2010/03/08	99	80 - 120	105	90 - 110	<0.0001	mg/L	2.3	25		

Maxxam Job #: B024955
Report Date: 2010/03/08

Stantec Consulting Ltd
Client Project #: 160900623

Your P.O. #: 16300R

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2094902	. Vanadium (V)	2010/03/08	100	80 - 120	101	90 - 110	<0.001	mg/L	NC	25		
2094902	. Zinc (Zn)	2010/03/08	95	80 - 120	101	90 - 110	<0.005	mg/L	1.8	25		

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - The recovery in the matrix spike was not calculated (NC). Spiked concentration was less than 2x that native to the sample.
(2) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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Validation Signature Page

Maxxam Job #: B024955

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

EWA PRANJIC, M.Sc., C.Chem, Scientific Specialist

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

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Maxxam Analytics

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CHAIN OF CUSTODY RECORD

Page 1 of 1

2-Mar-10 15:39
RENATA SPENA
B024955
TST
WAT-001

INVOICE INFORMATION:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#23998 Stantec Consulting Ltd	Quotation #:	A96103	MAXXAM JOB #:	BOTTLE ORDER #: 183962
Contact Name:	Michelle Frasier	P.O. #:			
Address:	49 Frederick St Kitchener ON N2H 6M7	Project #:		CHAIN OF CUSTODY #: C#183962-01-01	PROJECT MANAGER: RENATA SPENA
Phone:	(519)579-4410 Fax: (519)579-6733	Project Name:			
Email:	Michelle.fraser@stantec.com	Site #:			
		Sampled By:			

REGULATORY CRITERIA:
☐ MISA Reg. 153/04 Sewer Use ☐ Sanitary ☐ Storm ☐ Combined
☐ PWQO ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table 6 ☐ Residential/Parkland ☐ Industrial/Commercial ☐ Medium/Fine ☐ Coarse
☐ Reg. 558 Municipality _____
Other (specify) _____ Report Criteria on C of A? ☐

SPECIAL INSTRUCTIONS

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10ºC) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

ANALYSIS REQUESTED (Please be specific):

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required: _____ Time Required: _____
Rush Confirmation Number: _____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N)	RCAp - Comprehensive Drinking Water								# of Bottles	Comments
1		WG-1609D623-20100302-MF-01	March 2, 2010	11:09	GW	N	N	X								4	Metals not filtered
2		WG-1609D623-20100302-MF-02	↓	12:09	GW	N	N	X								4	Analyze NR
3		WG-1609D623-20100302-MF-03		13:09	GW	N	N	X								4	recieved
4		WG-1609D623-20100302-MF-04		14:09	GW	N	N	X								4	↓
5																	
6																	
7																	
8																	
9																	REC'D IN WATERLOO
10																	

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted
Michelle Fraser	10/03/02	15:35		2010 03 02	3:30	

Laboratory Use Only		
Time Sensitive	Temperature (ºC) on Receipt	Custody Seal Intact on Cooler?
X	4° 6° 5°	☐ Yes ☐ No

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

Appendix H
Aquatic Monitoring Data

October 29, 2012

DILLON
CONSULTING

1155 North Service
Rd. West
Unit 14
Oakville, Ontario
Canada
L6M 3E3
Telephone
(905) 901-2912
Fax
(905) 901-2918

Water Planning
Public Works Department
The Regional Municipality of Halton
1151 Bronte Road
Oakville, Ontario
L6M 3L1

Attention: Mr. Tomislav Renic, P.Eng.
Project Manager

Re: Spring Field Survey Results

Dear Mr. Renic:

Dillon Consulting Limited (Dillon) is pleased to provide a summary of spring 2012 field work conducted as part of the preparations for the future re-rating of the Fourth Line Well Field in the Town of Halton Hills. The need for spring field work was determined as necessary to address data gaps reported in the Fourth Line Well Field Existing Conditions and Draft Pumping Test Program (Dillon 2012). Specific spring field work tasks undertaken as part of this scope of work include the following:

- Amphibian surveys;
- Spring botanical survey;
- Species at risk screening including Ministry of Natural Resources (MNR) consultation; and
- Spring fish community survey;

Spring field work focused on the well field property, located west of the Sideroad 32 and Fourth Line intersection, and the immediately adjacent lands, where access was permitted (i.e. Botanical Survey areas and Fish Survey Locations on **Attachment I - Figure 1**). Additional coverage of the larger Study Area for Field Work was assessed through roadside investigations for breeding amphibian. Below, we provide a summary of the methodology used to collect field data and summarize the results.

1. Amphibian Surveys

1.1 Methods

Amphibian monitoring followed the Marsh Monitoring Program protocol (Bird Studies Canada 1994). Three different surveys were conducted between late March and late June, 2012, with at least two weeks between each survey. Surveys began at least one half hour after

....Continued

sunset during evenings with a minimum night temperature of 5°C, 10°C and 17°C for each of the three respective surveys. Each amphibian survey involved standing at a predetermined station for 3 minutes and listening for frog calls. The calling activity of individuals estimated to be within 100 metres of the observation point were documented. All individuals beyond 100 metres were recorded as outside of the count circle and calling activity was not recorded. Calling activity was ranked using one of the following three abundance code categories:

Code 1: Calls not simultaneous, number of individuals can be accurately counted

Code 2: Some calls simultaneous, number of individuals can reliably be estimated

Code 3: Calls continuous and overlapping, number of individuals cannot be estimated.

In areas where appropriate habitat existed, vernal pools were examined for egg masses and amphibian larvae. Amphibian monitoring sites are shown on **Attachment I - Figure 1**.

1.2 Results

The results of the road side surveys are shown below in **Table 1**. The first survey was conducted on the evening of May 1, 2012. Temperature was 6°C with a wind of 2 on the Beaufort scale and 10% cloud cover. The second survey was conducted on the evening of May 29, 2012. Temperature was 16°C with a wind of 2 on the Beaufort scale and 10% cloud cover. The third survey was conducted on the evening of June 20, 2012, when the temperature was 27°C with a wind of 3 on the Beaufort scale and 0% cloud cover.

Species observed are common in Ontario and are not federally or provincially as species at risk. According to the Significant Wildlife Habitat Ecoregion 6E Criterion Schedule (MNR 2012), all of the amphibian habitats are considered woodland breeding habitats since each pond or wetland is located within 120 m of a woodland. Significant amphibian breeding habitat (woodland) are identified by the presence of a breeding population of Eastern Newt, Blue-spotted Salamander, Gray Treefrog, Spring Peeper, Western Chorus Frog and Wood Frog with at least 20 individuals (adults, juveniles, eggs/larval masses). According to the MNR criteria, 7 of the 9 pond/wetland areas assessed through amphibian surveys would be considered significant wildlife habitat, including locations 1, 2-W, 3, 4-NW, 5-NW, 5-SE and 6. Amphibian survey location 2E was the only area where no amphbians were documented.

Table 1. Amphibians Observed During Spring Surveys

Station	Visit 1 (May 1, 2012)	Visit 2 (May 29, 2012)	Visit 3 (June 20, 2012)
1	Spring Peeper • Code 3	Gray Treefrog • Code 2: 2 overlapping individual calls	---
2-W	Spring Peeper • Code 3 American Toad • Code 2: 3 overlapping individual calls	Gray Treefrog • Code 3	Green Frog • Code 1: 4 individual calls
2-E	---	---	---
3	Spring Peeper • Code 3	Gray Treefrog • Code 1: 8 individual calls	Green Frog • Code 1: 2 individual calls
4-NW	Spring Peeper • Code 3	Gray Treefrog • Code 1: 8 individual calls	Gray Treefrog • Code 2: 5 overlapping individual calls
4-SE	---	---	Green Frog • Code 1: 1 individual call • Egg masses observed in pond along with individual green frogs
5-NW	Spring Peeper • Code 3	Gray Treefrog • Code 1: 1 individual call	---
5-SE	Spring Peeper • Code 3	---	---
6	---	Gray Treefrog • Code 3	Gray Treefrog • Code 3

--- no species observed

....Continued

2. Spring Botanical Survey

Methods
A spring botanical survey was carried out on May 2, 2012 using wandering transects, subject to property access (**Attachment I - Figure 1**), to determine species presence within the study area. During the surveys, air temperature averaged 12°c, with a wind of 2 on the Beaufort scale and 80% cloud cover.

Results
A complete list of species documented during spring surveys is presented in **Attachment II**. This work supplements the botanical survey conducted during the fall Ecological Land Classification (ELC) investigation summarized in the Fourth Line Well Field Existing Conditions and Draft Pumping Test Program (Dillon 2012). No plant species of conservation concern or considered species at risk in Ontario were observed in the area identified as Botanical Survey on **Attachment I - Figure 1**. Watercress was found throughout Beeney Creek which is an indicator of possible groundwater inputs.

3. Spring Fish Community Survey

A single-pass electrofishing fish community survey within select reaches of Beeny Creek was completed on June 19, 2012 (**Attachment I - Figure 1**). Weather conditions consisted of partial cloud with an approximate air temperature of 25°C and very light winds. The results of the survey are shown in **Table 2** below. Both species observed are common in Ontario and are not listed federally or provicinally as species at risk. Brook Trout require cold, headwater areas of tributaries with groundwater upwellings to spawn. The precence of Watercress in Beeney Creek suggest groundwater inputs are supporting habitat for this species. Fish were only captured in Beeney Creek south of Sideroad 32. Low flows, lack of gravel substrate and potential woody debris barriers may be preventing fish migration northwest of Sideroad 32 where the tributary flows through the Fourth Line Well Field property.

Table 2. Fish Species Observed in Beeney Creek During Spring Surveys

Species	Scientific Name	Number Observed	Provincial SRank
Brook Trout	*Salvelinus fontinalis*	13	S5
Brook Stickleback	*Culaaea inconstans*	5	S5

Low flow conditions and small channel width prevented accessibility for electrofishing within the tributary to Fairy Lake. Fish were observed in a large pool reach south of Sideroad 32, however depth of water and soft substrate did not allow for safe electrofishing. No fish were observed in the tributary upstream or downstream of the pooled reach.

....Continued

4. Species at Risk Screening and MNR Consultation

Our review of existing information identified historical accounts for seven species at risk protected under the provincial *Endangered Species Act* in the area surrounding the study area for this assignment. After consultation with the MNR, only one species protected under the *Endangered Species Act*, 2007 was identified as having the potential to occur in the study area, Butternut (*Juglans cinerea*) (**Attachement III**). This species was not identified on the lands that were accessible during the spring botanical survey or visible from the roads within the study area for field work. The other two species (Snapping Turtle and Milksnake) mentioned in **Attachment III** are considered *Special Concern* and are not protected under the *Endangered Species Act* prohibitions. The two later species are considered species of conservation concern. No species of conservation concern or species at risk were observed during spring field investigations.

5. Conclusions

Field investigations were completed in the spring of 2012, where access was permitted, to address data gaps identified as part of the Fourth Line Well Field Existing Conditions and Draft Pumping Test Program (Dillon 2012). Multiple areas of amphibian breeding habitat associated with wetlands and headwater tributaries occur within the study area for field work. No plant, fish or wildlife species protected by the *Endangered Species Act* or considered to be a species of conservation concern were observed during spring field work. Sensitive fish species, dependent on groundwater upwellings for successful spawning do occur in tributary reaches assessed during field investigations, immediately southeast of Sideroad 32 (adjacent to the Fourth Line Well Field property).

Should you have any questions, please do not hesitate to call Michael Enright at (905) 901-2912 (ext. 3401).

Sincerely,

DILLON CONSULTING LIMITED

Michael Enright, B.Sc., Associate
Project Manager

Our file: 11-5562

ATTACHMENT I
FIGURE 1

Halton Region
FOURTH LINE WELL FIELD

Amphibian Survey Station and Direction
Fish Survey Location
Road
Watercourse
Water Body
Study Area for Field Work
Botanical Survey

FIGURE 1:
SPRING SURVEY LOCATIONS

DILLON CONSULTING

Halton REGION

MAP DRAWING INFORMATION:
DATA PROVIDED BY Credit Valley Conservation

MAP CREATED BY: JJA
MAP CHECKED BY: BH
MAP PROJECTION: NAD 1983 UTM Zone 17N

1:8,000
0 100 200 400 m

FILE LOCATION:
I:\GIS\11-5562\Mapping\Figure 1 Spring Survey Locations.mxd

PROJECT: 11-5562 STATUS: DRAFT DATE: 221012

ATTACHMENT II
SPRING BOTANICAL LIST

Table 1. Fourth Line Well Field Spring Botanical List

Scientific Name	Common Names	Coefficient Conservation	Coefficient Wetness	GlobalRank	SRank	Introduced
Acer saccharum ssp. saccharum	Sugar Maple	4	3	G5	S5	
Alliaria petiolata	Garlic Mustard	0	0	G?	SE5	I
Caltha palustris	Marsh Marigold	5	-5	G5	S5	
Carex communis	Fibrous Rooted Sedge	6	5	G5	S5	
Cornus alternifolia	Alternate-leaved Dogwood	6	5	G5	S5	
Cornus stolonifera	Red-osier Dogwood	2	-3	G5	S5	
Dryopteris carthusiana	Spinulose Wood Fern	5	-2	G5	S5	
Dryopteris marginalis	Marginal Wood Fern	5	3	G5	S5	
Equisetum arvense	Field Horsetail	0	0	G5	S5	
Erythronium sp	Trout Lily Species					
Fraxinus nigra	Black Ash	7	-4	G5	S5	
Fraxinus pennsylvanica	Green Ash	3	-3	G5	S5	
Geranium robertianum	Herb Robert	0	5	G5	SE5	I
Impatiens capensis	Spotted Touch-me-not	4	-3	G5	S5	
Lemna minor	Lesser Duckweed	2	-5	G5	S5	
Matteuccia struthiopteris var. pensylvanica	Ostrich Fern	5	-3	G5	S5	
Nasturtium officinale	Water-cress	0	-5	G?	SE	I
Onoclea sensibilis	Sensitive Fern	4	-3	G5	S5	
Populus balsamifera ssp. balsamifera	Balsam Poplar	4	-3	G5	S5	
Populus tremuloides	Trembling Aspen	2	0	G5	S5	
Prunus virginiana ssp. virginiana	Choke Cherry	2	1	G5	S5	
Ribes triste	Swamp Red Currant	6	-5	G5	S5	
Rumex crispus	Curly Dock	0	-1	G?	SE5	I
Salix discolor	Pussy Willow	3	-3	G5	S5	
Sanguinaria canadensis	Bloodroot	5	4	G5	S5	
Solanum dulcamara	Bittersweet Nightshade	0	0	G?	SE5	I
Solidago flexicaulis	Zig-zag Goldenrod	6	3	G5	S5	
Taraxacum officinale	Common Dandelion	0	3	G5	SE5	I

Scientific Name	Common Names	Coefficient Conservation	Coefficient Wetness	GlobalRank	SRank	Introduced
Thuja occidentalis	Eastern White Cedar	4	-3	G5	S5	
Tilia americana	Basswood	4	3	G5	S5	
Trifolium pratense	Red Clover	0	2	G?	SE5	I
Tussilago farfara	Coltsfoot	0	3	G?	SE5	I
Typha sp.	Cattail species					
Ulmus americana	White Elm	3	-2	G5?	S5	
Viburnum sp	Viburnum Species					
Vitis riparia	Riverbank Grape	0	-2	G5	S5	

ATTACHMENT III
MNR LETTER

Southern Region
Aurora District Office
50 Bloomington Road West
Aurora, ON L4G 0L8

Ontario

Ministry of Natural Resources | **Ministere des Richesses Naturelles**

January 26, 2012

Lindsay Knezevich, B.Sc.
Dillon Consulting Limited
1155 North Service Road West, Unit 14
Oakville, ON L6M 3E3
lknezevich@dillon.ca

Re: Information Request -4th Line Well Field

Dear Ms. Knezevich,

In your email dated January 19, 2012 you requested information on natural heritage features and element occurrences occurring on or adjacent to the above mentioned location.

MNR has records of Butternut, Snapping Turtle and Milksnake in the vicinity of your study area. Some of these species may receive protection under the *Endangered Species Act 2007* and thus, a permit may be required if the work you are proposing could cause harm to these species and/or their habitat. Please provide additional information on your proposal to our office, and we will assess it to determine whether a permit under the ESA 2007 is required for the works to proceed.

Natural heritage features recorded for your area include the Provincially Significant Acton-Silver Creek Wetland Complex, the Ballinafad Swamp and Bog ANSI, as well as the Acton Swamp, Waterfall Woods, Ballinafad Pond and Snows Creek Woods Environmentally Significant Areas.

This species at risk information is highly sensitive and is not intended for any person or project unrelated to this undertaking. Please do not include any specific information in reports that will be available for public record. As you complete your fieldwork in these areas, please report all information related to any species at risk to the NHIC and to our office. This will assist with updating our database.

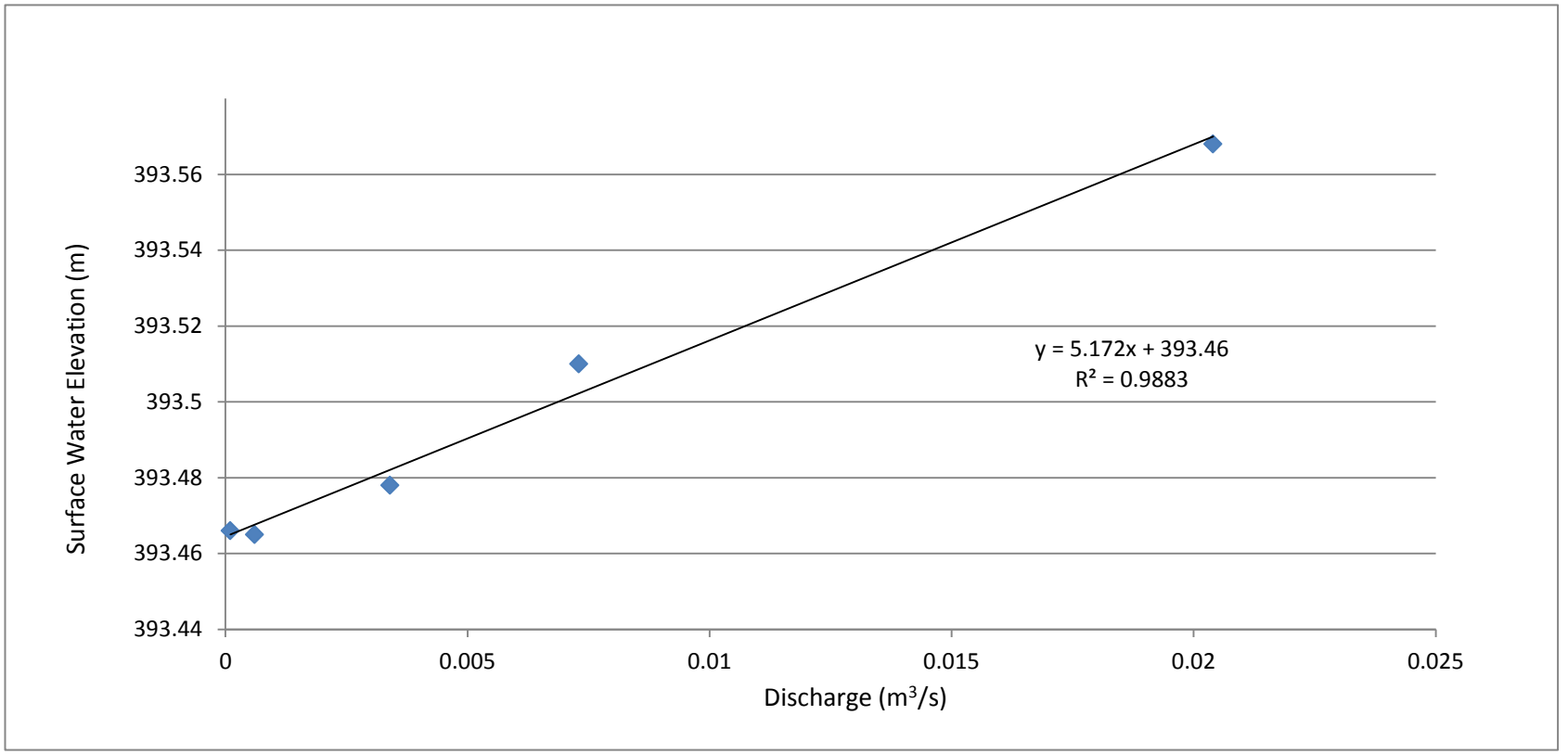
If you have any questions or comments, please do not hesitate to contact me at 905-713-7425.

Sincerely,

Melinda Thompson

Melinda Thompson
Species at Risk Biologist
Ontario Ministry of Natural Resources, Aurora District

Appendix I
Rating Curves



Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Stantec

Figure No.

Appendix I

Title

Rating Curve - F1

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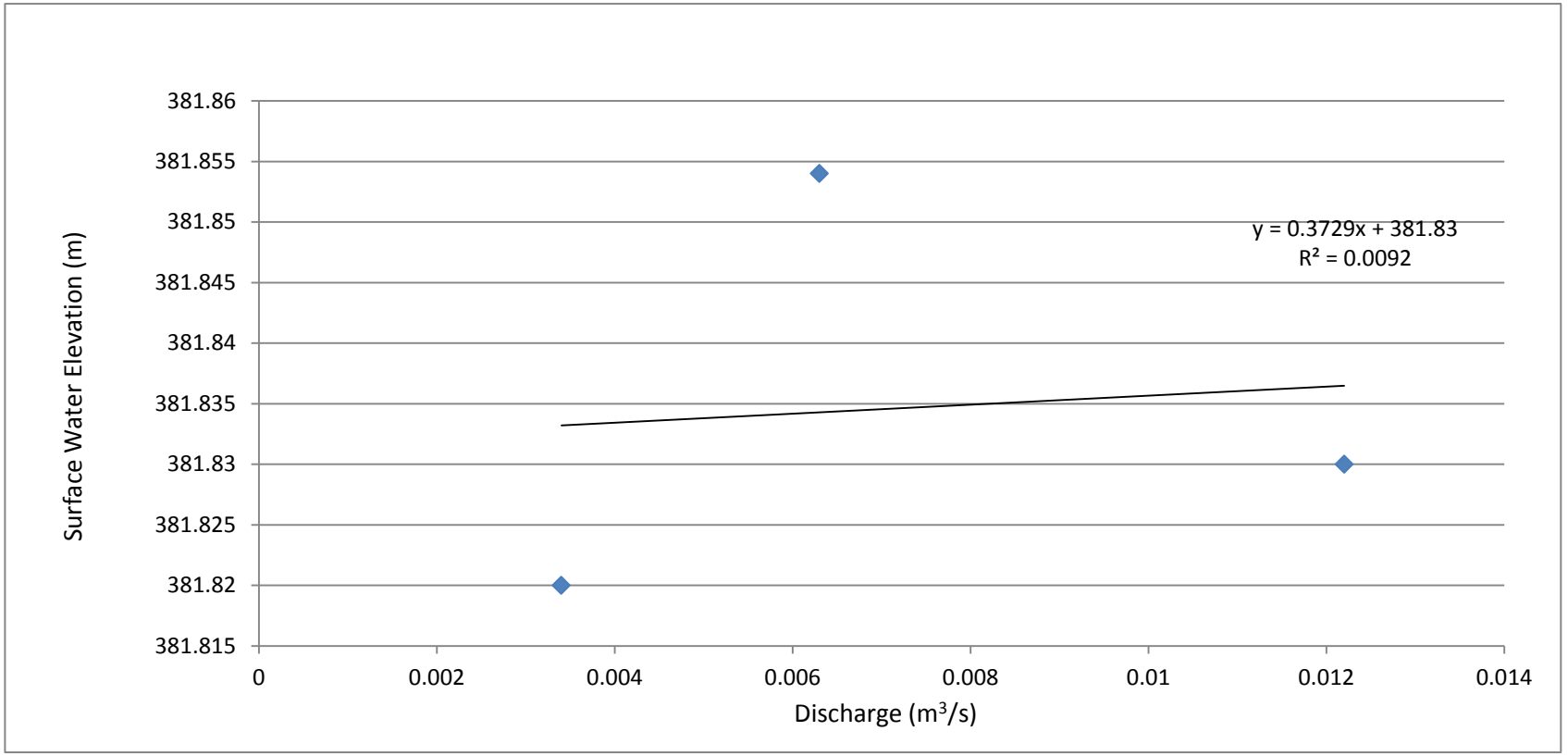

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Stantec

Figure No.

Appendix I

Title

Rating Curve - F2

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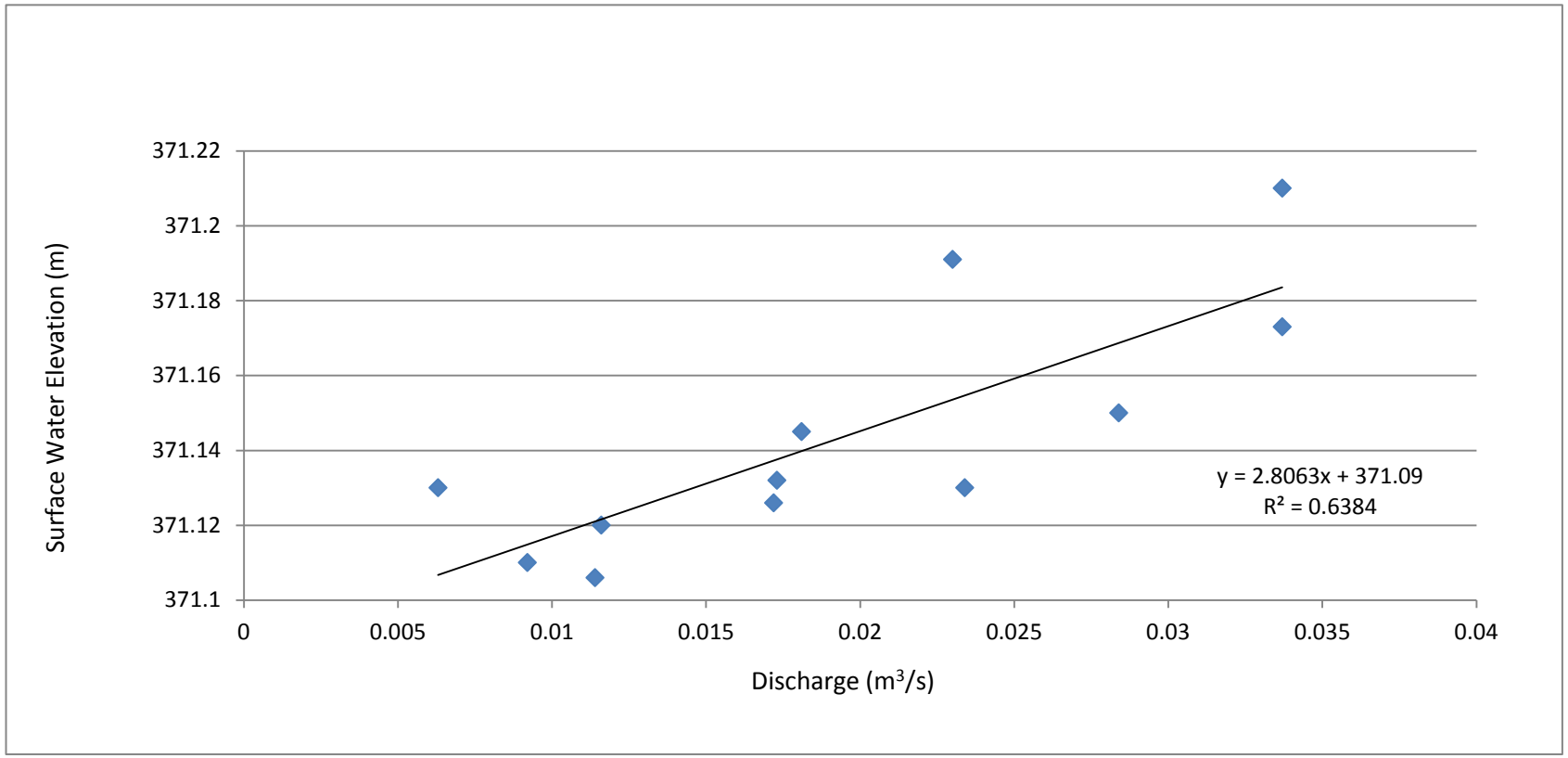


Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

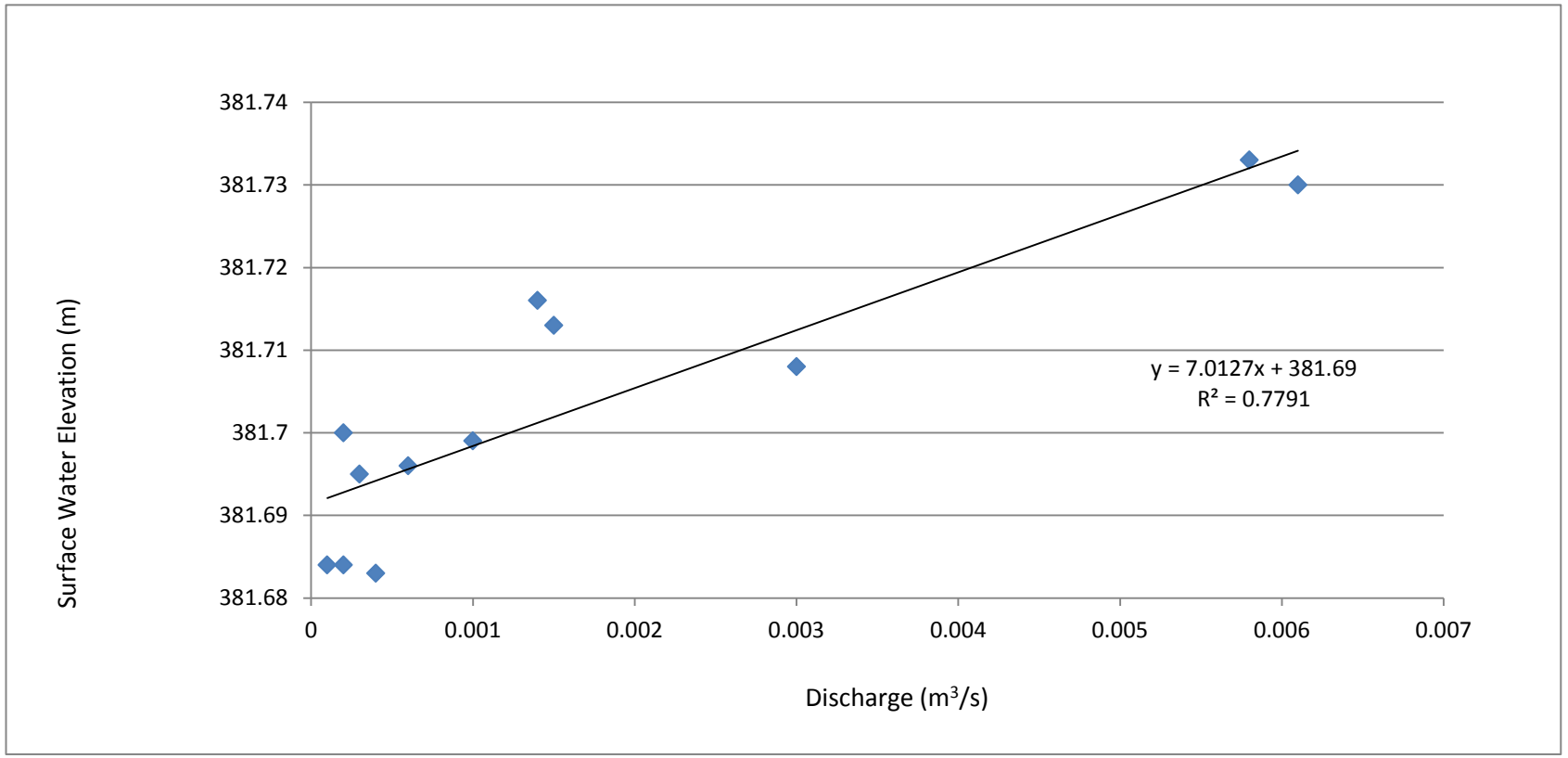
Stantec

Figure No.

Appendix I

Title

Rating Curve - F5



Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

Appendix I

Title

Rating Curve - F10

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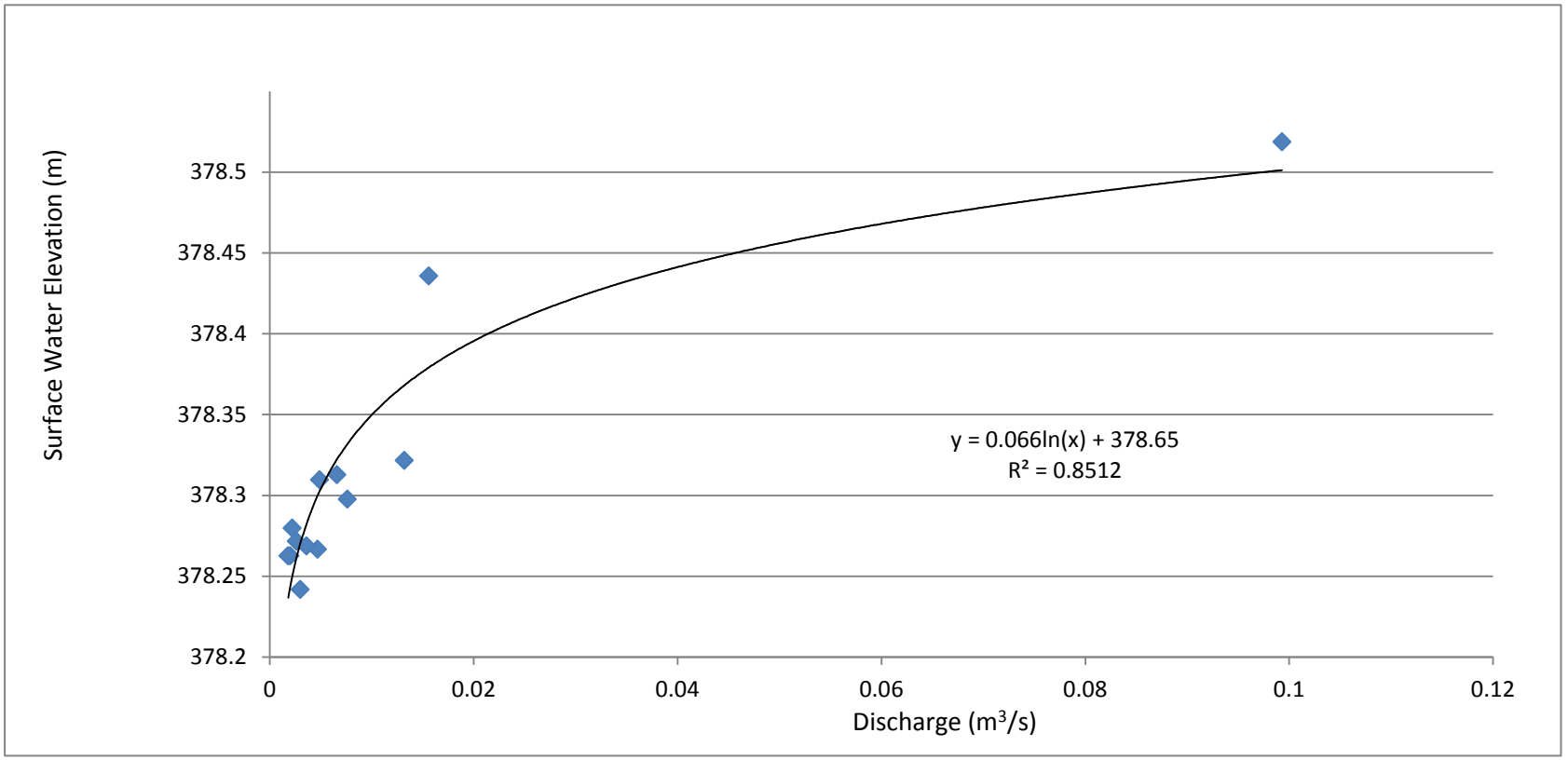

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

Appendix I

Title

Rating Curve - F11

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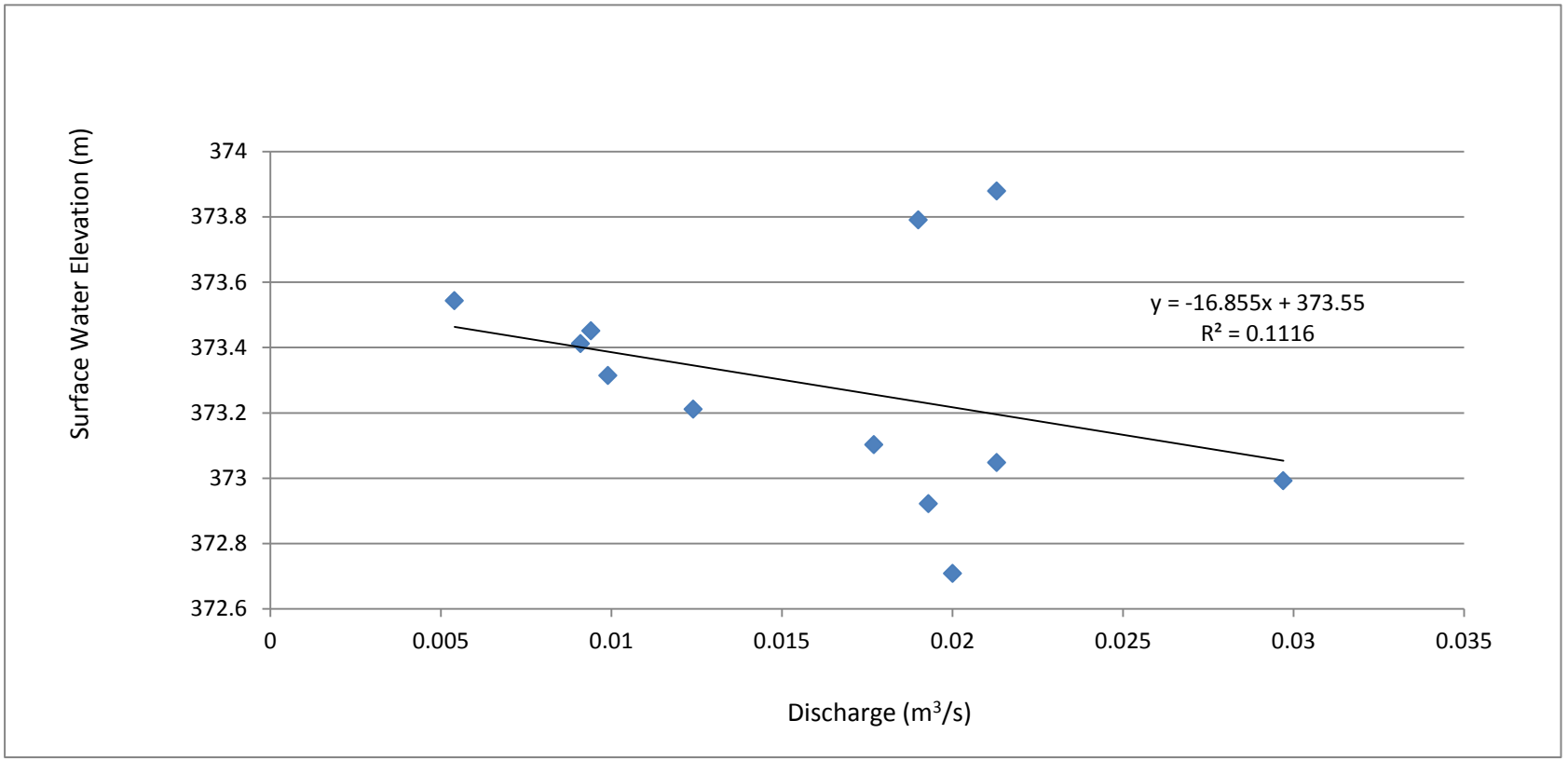

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

Appendix I

Title

Rating Curve - F13

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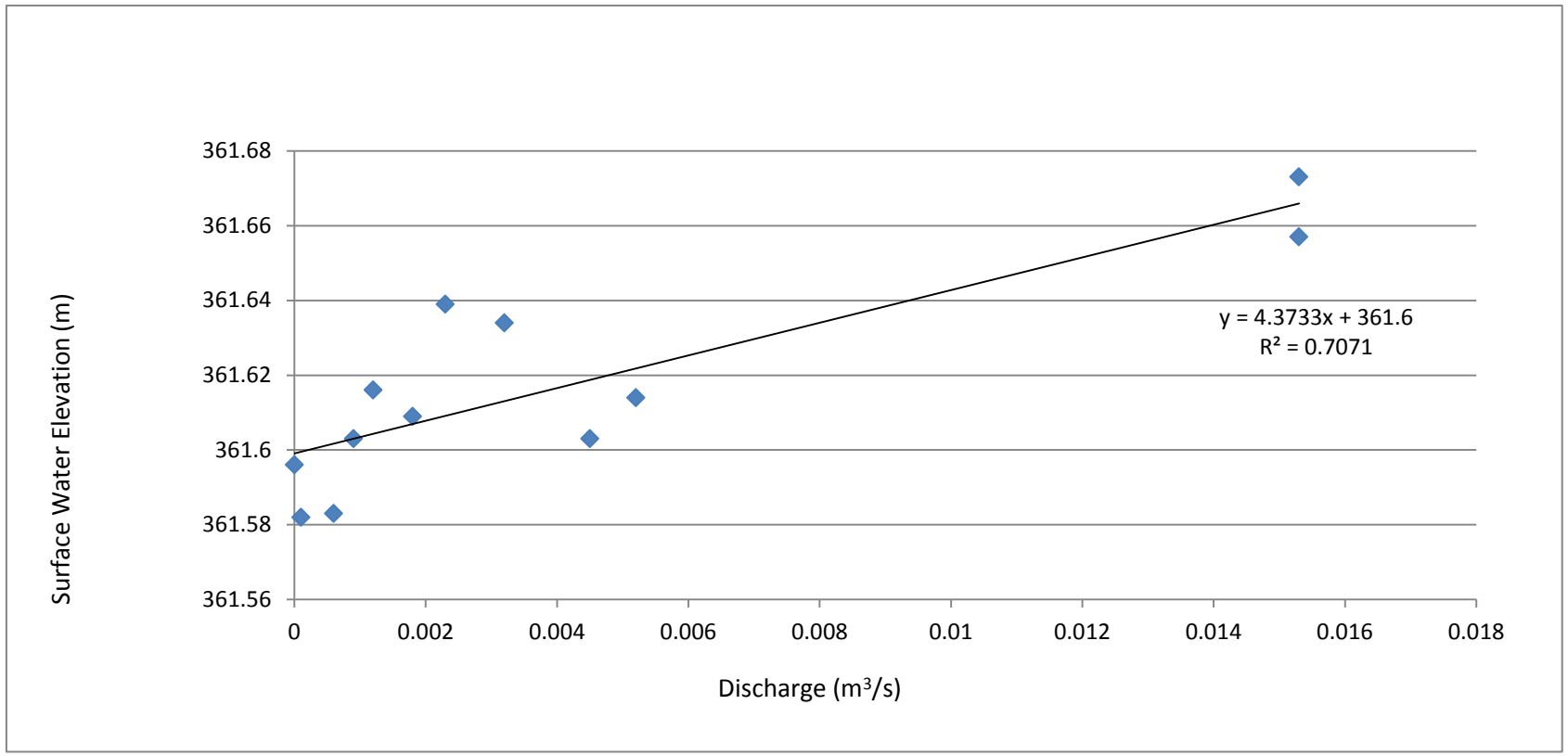

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Stantec

Figure No.

Appendix I

Title

Rating Curve - F14

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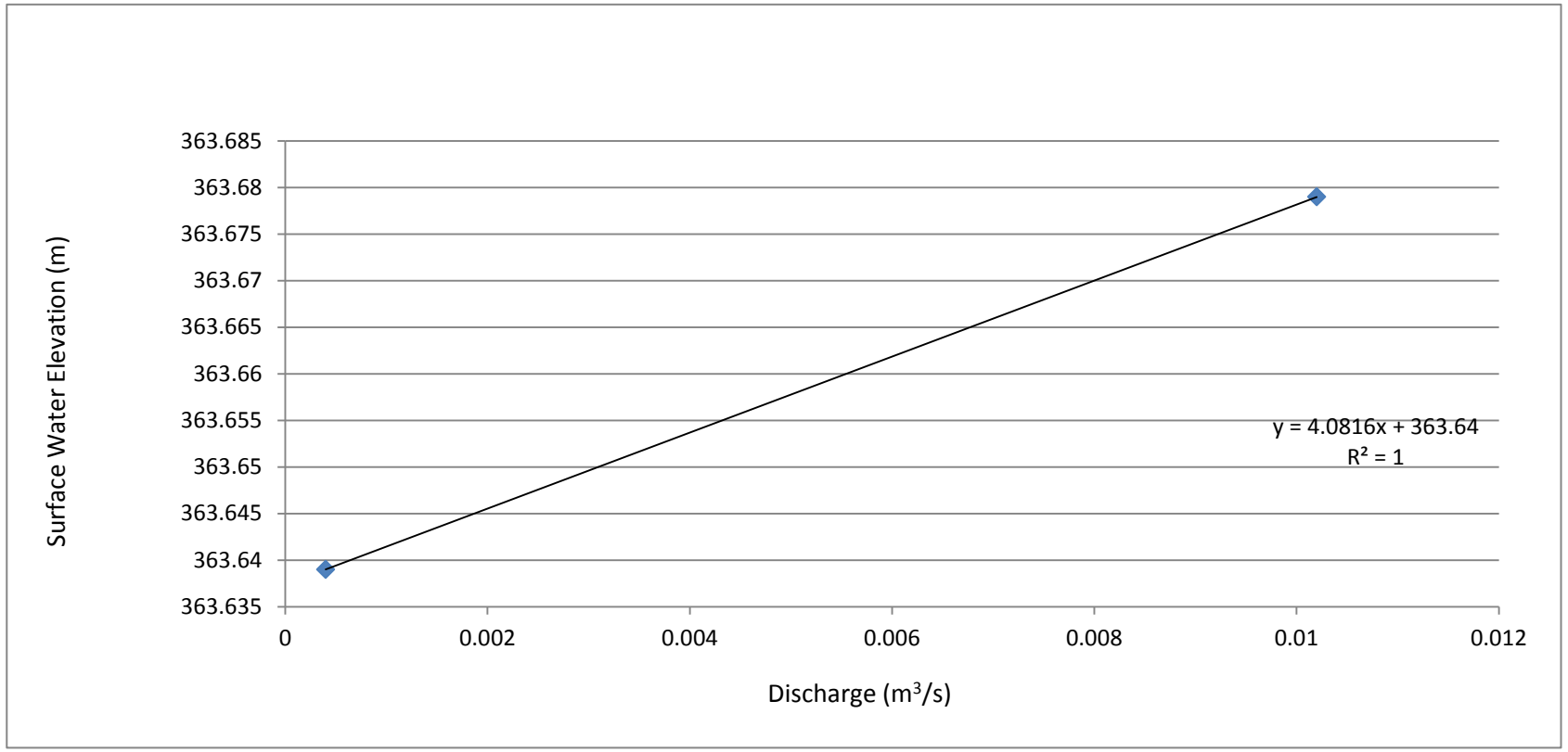

Client/Project

Fourth Line Well Field
Halton Hills
Region of Halton

Figure No.

Appendix I

Title

Rating Curve - F15

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