# Fourth Line Well Field Expansion, Acton, Municipal Class Environmental Assessment Study – PROJECT FILE

Prepared for:
Halton Region

Prepared by:
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## Sign-off Sheet

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Prepared by ______________________________
(signature)

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# 1.0 INTRODUCTION

In 2011, Halton Region completed the Sustainable Halton Water and Wastewater Master Plan (2011 SH W/WW MP) to provide a Region-wide strategy for the development of water and wastewater servicing projects for urban service areas to the year 2031, including Acton. The Master Plan was prepared to address Phases 1 and 2 of the Municipal Class EA process, October 2000, as amended in 2007 and 2011.

The Master Plan evaluated and recommended a preferred strategy to increase water supply for urban area in Acton. Increasing water taking from the existing Fourth Line Well Field in Acton was recommended in the Master Plan as one component of the preferred Acton water strategy. Prior to the proposed increase in water takings from 1,309 $m^3$/d to 1,709 $m^3$/d, Fourth Line well field was subject to additional study. Accordingly, Halton Region has completed the necessary long term pumping test and hydrogeological impact assessment study and confirmed the ability to expand the existing Fourth Line Well Field.

The Fourth Line Well Field Expansion is subject to Schedule 'B' of the Class EA. The requirements of this Schedule 'B' Study were satisfied through the Sustainable Halton Water and Wastewater Master Plan process, including public consultation. The relevant sections from the 2011 SH W/WW MP are provided for reference in Appendix B which include documented decision making process for Acton water servicing and previous public consultation.

In accordance with the recommendations of the 2011 SH W/WW MP, Halton Region undertook additional technical study in consultation with the Ministry of the Environment and Climate Change and Credit Valley Conservation. Specifically, Halton Region completed a long term pumping test and hydrogeological impact assessment. The details and results of this additional technical study are presented in Section 6 of this report. The results of the study confirm the ability of the Fourth Line well field to provide additional water supply.

# 2.0 PROBLEM/OPPORTUNITY STATEMENT

The Problem/Opportunity Statement developed for 2011 SH W/WW MP and presented to the Public during PICs can be summarized as follows:

- Water and wastewater infrastructure upgrades will be required to meet Best Planning Estimates (BPEs) to 2031 and service future residential and non-residential lands.
- A comprehensive Water and Wastewater Master Plan will ensure implementation of a sustainable growth strategy.
- 2008 South Halton Water and Wastewater Master Plan will be updated under this study.

The problem statement has been further refined for this Schedule B Class EA Study as follows:

- To supply additional municipal water to the Acton Urban Area by evaluating a sustainable increase in daily water takings at the Fourth Line Well Field from 1,309 $m^3$/d to 1,709 $m^3$/d.

# 3.0 STUDY AREA – COMMUNITY OF ACTON

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 , 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 (See Figure 1), which obtains its water from one (1) well (Well A). Well A pumps water from the underlying 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.

The community of Acton is located between Guelph and Georgetown along the Highway 7 corridor, approximately 15 kilometers north of Milton. Acton has approximately 10,200 permanent residents and 3,900 employees and the municipal boundary encompasses approximately 6.6 $km^2$. The community is largely residential, with some commercial and rural agricultural lands. Industrial uses are a small component of the land use mix.

## 3.1 WATER SUPPLY

Acton is serviced entirely on groundwater supplies. Currently there are four (4) wells in service plus one (1) additional production well in development as shown in Table 2-1.

**Table 3-1: Well Summary**

| Well | Classification | Permitted Capacity ($m^3$/day) |
|---|---|---|
| Davidson Wells 1 and 2 | GUDI with effective in-situ filtration | 2,500[1] |
| Fourth Line Well | GUDI with effective in-situ filtration | 1,309 |
| Prospect Park Wells 1 and 2 | GUDI with effective in-situ filtration | 2,273[2] |
| **Total** | | **6,081** |

*GUDI = Groundwater under the Direct Influence of surface water*

[1] 1,250 $m^3$/day per well.
[2] Restricted to 1,137 $m^3$/day during the spawning season from October 1 through May 31.

## 3.2 WATER QUALITY

The Acton wells are generally of good quality, with some variation between sources.

**Davidson**

The Davidson wells are currently classified as GUDI with effective in-situ filtration; however, these are the only wells within Acton that have shown any microbiological levels in regular sampling. Given the geological setting and the wells proximity to the adjacent creek, it is believed that the wells may have to be reclassified as GUDI. Treatment for GUDI groundwater source has been designed and implemented at this wellhouse.

**Fourth Line**

The Fourth Line well is classified as a GUDI with effective in-situ filtration. The production well casing has undergone relining and rehabilitation to address previous water quality concerns. In general the groundwater quality is very good, with no specific parameters of concern. As a proactive measure, treatment for GUDI groundwater source has been designed and implemented at this wellhouse as part of the recent wellhouse upgrade project.

**Prospect Park**

The Prospect Park wells show elevated levels of iron (Fe), manganese (Mn) and Ammonia ($NH_3$). The wells are classified as GUDI with effective in-situ filtration.

## 3.3 TREATMENT

All groundwater in Acton is treated with ultraviolet light for the disinfection of cysts and oocysts, as per the requirements for GUDI wells, followed by chlorination and fluoridation. Each well site has a wellhouse with treatment equipment to treat the respective wells. The Prospect Park wells are filtered for Fe and Mn by way of manganese greensand pressure filters prior to UV disinfection. Davidson and Fourth Line wells have been equipped with cartridge filtration in addition to disinfection and fluoridation.

## 3.4 POTABLE WATER STORAGE

Potable water is stored at the 3rd Line reservoir, located at the intersection of 3rd Line and 32 Sideroad in the north of Acton. The reservoir is made up of two in-ground[3] circular concrete cells each with a usable capacity of 2,273 $m^3$. Total storage capacity is 4,546 $m^3$. The top water level is calculated at 412.33 mASL based on available record drawings. The reservoir was constructed in 1964 and, based on the most recent asset review in 2009, has an estimated life cycle of 60 years.

[3] Partially buried with an earthen cover.

# 3.5 GROWTH

## 3.5.1 Groundwater Supply Capacity

The projected Maximum Day Water Demand Requirements as determined in the Sustainable Halton Master Plan are as follows:

| Year | Demand (MLD) |
|---|---|
| Existing (2011) | **5.48** |
| Year 2021 | **6.26** |
| Year 2031 | **8.34** |

The Overall Water Servicing Strategy for Acton is to maintain the independent groundwater supplies to service the growing community. This strategy will require expansions and upgrades to the existing water system infrastructure.[4]

As per the Master Plan process, Halton Region is pursuing projects to expand the capacity of the groundwater supply in Acton, such as the Prospect Park Well Field and Water Purification Plant Expansion and ***this study for the Fourth Line Well Field Expansion***.

[4] Sustainable Halton Master Plan, Section 13.1 (page 143, Aecom 2011)

# 4.0 ALTERNATIVE SERVICE STRATEGIES FOR ACTON

The 2011 SH W/WW MP identified six (6) servicing concepts for evaluation as follows:

- Concept 1 is based on increasing both the Prospect Park and Fourth Line well capacities. Acton would continue to be serviced form the existing well systems.
- Concept 2 is based on increasing the Fourth Line Well Field capacity and constructing a new well field. Studies would need to be undertaken to determine new feasible well field locations. Acton would continue to be serviced from existing well systems plus the new well.
- Concept 3 is based on increasing the Prospect Park Well Field capacity and constructing a new well field. Studies would need to be undertaken to determine new feasible well field locations. Acton would continue to be serviced from existing well systems plus the new well.
- Concept 4 is based on increasing the Prospect Park and Fourth Line Well Field capacities and constructing a new well field. Studies would need to be undertaken to determine new feasible well field locations. Acton would continue to be serviced from existing well systems and the new well systems.
- Concept 5 is based on connecting the Acton water system to another system – either the Wellington County system or the South Halton Lake-Based Water System. This would involve constructing infrastructure to service some areas of Acton from either the Wellington County system or the South Halton Lake-Based Water System. A small area of Acton would remain on the existing groundwater system.
- Concept 6 is based on increasing both the Prospect Park and Fourth Line Well Field capacities and implementing an Aquifer Recharge program. The Acton water system would continue to be serviced from the existing well systems.

## 4.1 EVALUATION OF SERVICING STRATEGIES

As part of the evaluation process in the Master Plan, the various concepts were evaluated against the stated criteria. The result of this evaluation identified a preferred strategy for Acton. The decision making process is summarized in Figure 10 (refer to Appendix A). The preferred concept for the Acton Water System is **Concept 4, increasing the Prospect Park and Fourth Line Well Field capacities and constructing a new well field.**

# 5.0 PUBLIC CONSULTATION PROCESS

The Region's Public Consultation requirements for this Schedule B project were satisfied under the 2011 SH W/WW MP. Specifically, series of formal Public Information Centres (PICs) were held in May and June of 2010 as well as February and March of 2011 to introduce the Master Plan study and present the preferred water and wastewater servicing strategies respectively. During the PICs, background information regarding the preferred water servicing strategy for Acton and the proposed Fourth Line Well Field expansion was provided. Of the eight (8) PICs hosted during the 2011 SH W/WW MP process, two (2) were held in the Town of Halton Hills:

- PIC#1 held on June 2, 2010 at Acton Arena & Community Centre in Acton; and,
- PIC#2 held on February 24, 2011 at Christ the King High School in Georgetown.

Input received from PICs, review agencies and other key stakeholders' consultations were incorporated into the Master Plan. In addition, ongoing consultation with interested stakeholders, including members of the public, special interest groups and review agencies occurred throughout the Study process.

Since the completion of 2011 SH W/WW MP , the Region has continued to consult with the Ministry of the Environment & Climate Change and the Credit Valley Conservation Authority regarding the proposed increase in water taking. As part of this technical review and consultation, Halton Region completed a Hydrogeological Impact Assessment for the proposed increase in water taking from the Fourth Line Well Field. As part of the preparation of the Impact Assessment Report, extensive consultation was undertaken with the Credit Valley Conservation Authority (CVCA) on the methodology of the field investigations and the pump testing. A preliminary review of the findings of the field work was presented to the CVCA for their review and comment. Halton Region and Stantec attended a review meeting to address and discuss preliminary comments received from the CVCA staff.

The Impact Assessment concluded that the net environmental impact of the proposed increase in water taking was negligible and that it will not alter the pre-existing environmental conditions. The Impact Assessment Report was finalized on the basis of CVCA comments and correspondence was received on October 9, 2014 indicating that there were no further comments on the report and its findings.

A supplementary Public Information Session will be held on February 19, 2015 by the Region, where the findings of the Impact Assessment for Fourth Line will be presented to the Public.

## 5.1 PREFERRED SERVICING STRATEGY

As noted in Section 4.1, the Preferred Servicing Strategy for Acton included increasing existing water taking at Prospect Park and Fourth Line, subject to additional impact assessment work for these proposed increases.

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[5] even under a drought conditions.

As demonstrated by the pumping test, the higher proposed rate of 19.8 L/s for sustained periods of time is 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 this, it is recommended that 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 TWI-87 in the Fourth Line Well field.

## 5.2 IMPLEMENTATION

This Project File outlines the findings of the Impact Assessment as it relates to the proposed increased water taking at Fourth Line, as identified in the Sustainable Halton Master Plan. To complete the required Class EA process for this project, this report will be placed on public record for 30 days. If concerns regarding this project cannot be resolved in discussion with the Region, a person may request that the Ministry of the Environment make an order for the project to comply with Part II of the Environmental Assessment Act, which addresses individual environmental assessments. Requests for a Part II Order must be received by the Minister within 30 days of filling this Report. Should no unfavorable comments be received, the Region may proceed to the implementation phase of this solution, namely application to the MOE for an amended Permit to Take Water. No mitigation measures are noted or required for this proposed increase at the Fourth Line Well Field.

[5] Above mean sea level

# 6.0 SUMMARY OF IMPACT ASSESSMENT REPORT

The Region has undertaken an Impact Assessment study to investigate the potential of expanding the water 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 intent is to increase the water taking from the bedrock aquifer by about 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).

This was the preferred solution identified in the Sustainable Halton Master Plan. This 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.

## 6.1 SITE SETTING AND EXISTING CONDITIONS

### 6.1.1 Location and Surrounding Land Use

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. The wellhouse itself is located on the north side of Sideroad 32, within the municipal boundaries of the Town of Erin. The location is shown in Figure 3.

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.

### 6.1.2 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 4), and described in the Black Creek Subwatershed Study[6]. Both Beeney Creek and Fairy Lake discharge into Black Creek which is within the Credit River Watershed[7]. These catchment areas are presented in Figure 5.

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.

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, 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[8]. 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. Some adjustments identified and described in the Dillon report have been adopted in this Impact Assessment.

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 4 and discussed below.

### 6.1.3 Tributary to Beeney Creek

As shown in Figure 4 and 5, 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 cold water stream. 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

[6] (CVC, 2011)
[7] Dillon, 2012
[8] Dillon, 2012

Station 485) Brook Trout are present. Data provided by the CVCA indicated that two possible Brook Trout redds had been observed just south of Sideroad 32. The preferred spawning habitat of Brook Trout consists of gravel beds in shallow areas of headwater streams, in locations where groundwater upwelling is present.

### 6.1.4 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. The tributary is one (1) of six (6) tributaries which discharge to Fairy Lake and is unclassified according to CVCA. 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. Fairy Lake provides habitat for warm water fish species.

### 6.1.5 Other Features

Other surface water and environmentally sensitive features located in the vicinity of the Study Area are discussed below.

#### 6.1.5.1 Acton Swamp

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. It supports a number of provincial species at risk and regionally rare species. Provincial species at risk and regionally rare species were observed at the Fourth Line well field, with those observed during the background survey within ESA No. 28. Background reviews 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*).

#### 6.1.5.2 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. 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. The complex consists of vegetation communities associated with 99% swamp and 1% marsh habitat. Nesting of colonial water birds, winter cover for wildlife with local significance for Deer, and Brook Trout fish spawning and rearing areas have been observed.

#### 6.1.5.3 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. 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.

### 6.1.6 Adjacent Well Fields

#### 6.1.6.1 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.

#### 6.1.6.2 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.

## 6.2 EXISTING 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 (1), two (2), three (3), and four (4) 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.

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 (1) to two (2) and increased to 20 and 150 CFU/500 mL in the sample collected during steps three (3) and four (4) 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).

Detailed results are found in Table 6 in the attached Impact Assessment Report.

## 6.3 HYDROGEOLOGICAL ASSESSMENT

### 6.3.1 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. 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. 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; CVCA, 2011). The Fourth Line well field is located near the southeastern 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.

The ground surface topography is presented in Figure 6 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, 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.

### 6.3.2 Regional Geology

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

#### 6.3.2.1 Surficial Geology

Figure 6 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. 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. 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).

### 6.3.2.2 Overburden Geology

Overburden thickness in the area of the Fourth Line well field is presented in Figure 7. 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 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. The cross-section locations are presented on Figure 7 with cross-sections shown in the Impact Assessment Report.

**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. 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. 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 (CVCA, 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.

#### 6.3.2.3 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.

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. [9]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. Additional mapping 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. 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. The Eramosa Formation consists of the Reformatory Quarry Member and the Vinemount Member.

The Reformatory Quarry Member is 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. 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. This dark grey to black dolostone unit was commonly identified in water well records as 'black shale' and generally mapped as the Eramosa Member.

[9] 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).

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).

## 6.4 HYDROGEOLOGY

The regional southwest-northeast trending topographic high area identified as the Paris Moraine located west of the well field 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. 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. Groundwater flow within the shallow Eramosa Formation bedrock aquifer in the area of the Fourth Line well field is generally southwards toward the Niagara Escarpment. As indicated by previous 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*** (see Figures 7a and 7b in the Impact Assessment Report which provide results of shallow groundwater level monitoring completed for the 2013 well field pumping test investigation. This shows the groundwater discharge conditions along Beeney Creek during both the permitted pumping rate at 15.2 L/s and the proposed increased pumping rate of 19.8 L/s.

Preliminary estimates of the zone of influence (ZOI) for current pumping conditions at the Fourth Line well field were initially estimated by Dillon and were based on the Tier 3 water budget model results (see Figure 8). Modelled equipotential surfaces indicated that the drawdown greater than 0.5 m extends 900 m north, 400 m south, 500 m east, and 750 m west of the well field. 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.

## 6.5 PUMPING TEST AND RESULTS

### 6.5.1 Groundwater

The Fourth Line well field monitoring network, 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. These locations were shown in Figure 3. Hydrographs for the groundwater monitoring locations and for the two (2) pumping wells are presented in the Impact Assessment Report in Appendix D.

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

#### 6.5.1.1 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 21 days) – 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, 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. 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. 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.

#### 6.5.1.2 Bedrock Aquifer

Groundwater levels were monitored in bedrock monitoring wells[10] and hydrographs presenting the data are provided in the Impact Assessment Report in Appendix C. 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 21 days) – 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.
- 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, and 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

[10] MW1-11, MW23/09-I/D, TW1-84, MW2A-13, MW3A-13, and MW5A-13

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.

#### 6.5.1.3 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. These residential wells (RW) are shown in Figure 3 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 3. 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. Hydrographs for these private water wells monitored during the 2013 well field pumping test investigation are presented in the Impact Assessment Report.

A review of the water level results for private wells RW01 and RW02 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.

#### 6.5.1.4 Overburden Aquifer

Groundwater levels were monitored in overburden monitoring wells[11] and hydrographs presenting the data are provided in the Impact Assessment Report in Appendix D. 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.
- 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

[11] MW1-12, MW23/09-S, MW4 13, MW2B-13, MW3B-13, and MW5B-13

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.

### 6.5.2 Surface Water

#### 6.5.2.1 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).
- Monitors that did not respond to pumping (MP1-13, MP4-13, MP6D-13, MP8-13, MP10-13 through MP12-13, DP1-13 and WM4B).

##### *6.5.2.1.1 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.
- 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.

##### *6.5.2.1.2 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.

#### *6.5.2.1.3 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.

### 6.5.2.2 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.

#### *6.5.2.2.1 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.

#### *6.5.2.2.2 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.

#### 6.5.2.3 Extent of Drawdown

Figure 9 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.

### 6.5.3 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 and 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.

The data suggests that near steady-state pumping conditions were achieved during the testing. The drawdown observed in both wells was projected out by Stantec 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 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.

# 6.6 SUMMARY OF OBSERVED IMPACTS

This Impact Assessment was conducted to evaluate the preferred option of increasing the taking from the Fourth Line well field by including a test well (TWI-87) which is currently on standby and not included in the existing PTTW. 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). This option includes pumping Well A at 9.9 L/s as well as TWI-87 at 9.9 L/s.

The following sections provide an assessment on the potential long term impacts associated with this preferred solution on natural heritage features, private wells and nearby municipal wells.

## 6.6.1 Natural Heritage Features

### 6.6.1.1 Surface Water Features

No pumping related impacts were identified in any of the surface water monitoring data, with the exception of one station (MP5-13). The drive point monitor at this location showed water level responses to the pumping test. However, no vertical hydraulic gradient reversals occurred at this location when the pumping rate was increased to 19.8 L/s. This indicated that no new impact was generated by the increased pumping rate.

### 6.6.1.2 Wetlands

No wetland monitors indicated any response to the pumping test. It is interpreted that there were no wetland impacts resulting from the increased pumping.

### 6.6.1.3 Fisheries

One station (Station MP5-13) showed any response to the pumping test. This station is situated to the south of the well field where a "window" or opening in the Wentworth Till formation was identified. Through the latter stages of the pump test, there was a vertical (downward) gradient and a 47% reduction in stream flow was observed. 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 July and August 2013. These findings have been interpreted that the station was NOT impacted by the increased pumping rate.

### 6.6.1.4 Natural Heritage Summary

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

## 6.6.2 Groundwater Sources

### 6.6.2.1 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.

### 6.6.2.2 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 Water Well Records (WWR) indicated that within a one (1) km radius of the well field, 25 private wells were identified. 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). A review of the hydrographs 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 to RW05 are consistent with the predicted zone of influence. 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.

## 6.7 OTHER IMPACTS

Consistent with the 5 Point Evaluation Criteria of the Sustainable Halton Master Plan[12], the following additional impacts were considered.

### 6.7.1 Social

The increased water taking has no impact on existing development and can contribute to servicing new development. It has no additional land requirements. It contributes no nuisance impacts, nor does it require any constructions resulting in temporary social impacts.

### 6.7.2 Cultural

The increased water taking has no impact on any historic or archaeological sites.

### 6.7.3 Technical

The proposed water taking is compliant with the Provincial Water Quality Objectives. The increased water taking contributes to meeting the goal to service the projected demands to 2031, but cannot do so entirely. An increased taking does not disrupt any existing services, nor impact the security of the drinking water supply as the existing infrastructure is capable of pumping the increased rate.

### 6.7.4 Economic

There are no capital cost implications to implement the increased taking. Any increased Operation and Maintenance costs related to increased flowrates are deemed negligible.

[12] Sustainable Halton, Table 7, page 37 (Aecom, 2011)

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