Hydrogeology Study

Future Solid Waste Disposal Needs Environmental Assessment

Town of St. Marys

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Executive Summary

The Town of St. Marys (Town) is conducting an Individual Environmental Assessment to review alternative means to manage solid waste for a forty year period. The existing St. Marys landfill site (the Site) is nearing its approved fill capacity. The approved Terms of Reference eliminate a number of Alternatives to the Undertaking based on technical, financial and environmental criteria. The information presented in this report follows the *Hydrogeological Work Plan* developed after *Expansion of the Existing Landfill* was identified as the preferable Alternative to the Undertaking.

The property that the landfill occupies was originally owned by St. Marys Cement Co. (SMC) and was included in its quarry licence. Prior to the landfill development surficial clay was mined from portions of the Site and the north corner of the Site used to stockpile materials associated with cement production.

The Site was approved as the Town of St. Marys landfill in 1983. Phase I operated from 1984 to 1993 and Phase II/III is the current fill area. The Site is a 37 ha waste disposal Site with an 8 ha landfill area that includes the collection and diversion of recyclable waste, acceptance and transfer of Municipal Hazardous or Special Waste (MHSW) and the composting of leaf and yard waste. The Site has a perimeter leachate collection system (Phase I) and a perimeter system with lateral collector lines below the waste (Phase II/III). The leachate collection system gravity drains to the Town's sanitary sewer.

The study considered the geology and hydrogeology of the On-Site Study Area (the Site) and Study Area Vicinity (1,000 m radius). The study included collection of background data, analysis of operating and monitoring data, and collection of new field data.

The surface of the Site was impacted by industrial activity (quarry) prior to the landfill. By 1978, no part of the Site was in a natural state. The groundwater was also impacted by quarry dewatering. The topography of the Site is a result of the overburden mining, stripping and filling, kiln dust stock, realignment of the internal watercourse and landfill construction. The highest elevation is the cement kiln dust stockpile (CKD) and the lowest elevations occur along the watercourse.

On a regional scale, the overburden consists of layers of glacial till separated by inter-till meltwater deposits. The bedrock is limestone and dolostone consisting of the Dundee Formation, underlain by the Lucas Formation of the Detroit River Group. The top 8 to 10 m of bedrock is unsaturated. This is partially attributed to regionally low water levels and partially to quarry dewatering.

The bedrock is a regional water supply aquifer with the Town of St. Marys obtaining its water supply from three bedrock wells northeast of the Site. The Site is not within the

municipal Well Head Protection Areas. There are no Significant Groundwater Recharge Areas on the landfill site. The SMC quarry north of the landfill and the northeast corner of the landfill site are mapped as Highly Vulnerable Aquifer. This is due to the removal of the soil by the quarry which exposed the bedrock. The rural residential homes along the west side of Perth Road 123 are supplied by private wells. Most of these are drilled into the bedrock.

The groundwater flow direction in the bedrock is toward the west and northwest. This is the direction of the regional groundwater flow, as well as the location of the North Thames River and the SMC Thomas Street Quarry. The elevation of the River is above the bedrock water level; therefore, there is no groundwater discharge to the river from the bedrock.

The overburden consists primarily of silt and clay glacial till. The thickness varies from 10 m to 20 m due to an upward slope on the bedrock surface from southwest to northeast, as well as removal of soil by SMC. There are no regional overburden aquifers in the vicinity. There are shallow alluvial deposits associated with the river, as well as localized sand seems that may be used by shallow wells. The shallow groundwater flow is inward from high points along Perth Road 123 and the cement kiln dust stockpile toward the internal watercourse.

Monitoring wells on the Site have been tested since 1984 and are currently tested twice a year. There is no indication of landfill impact to the bedrock aquifer. Three shallow wells located on the west side of Phase II/III have elevated chloride concentrations. These wells are screened in a sand seam in the till that extends below part of Phase II/III. The wells are downgradient of Perth Road 123 and upgradient of the landfill, therefore road salt is a possible source. However, in 2015, elevated concentrations of boron and iron were noted in a monitoring well. These wells west of Phase II/III are to be investigated as part of on-going operations and monitoring of the site.

Water samples collected from the internal watercourse show similar water quality between upstream and downstream sampling stations. This indicates no landfill impact on the watercourse.

Five preliminary landfill concepts were developed in order to assess the Alternative Methods. These included vertical expansion, horizontal expansion, a new waste footprint and combinations thereof. Each alternative was evaluated according to how Site alterations would impact the groundwater and surface water. Mitigation measures were identified for each potential impact. The impact and associated mitigation measures were ranked according to the magnitude. The rankings were:

- Minor potential impact - requires monitoring with potential for future mitigation;
- Low potential impact - requires site feature alterations with continued monitoring;
- Medium potential impact - requires enhanced engineering with monitoring; or

- Major potential impact - requires substantial engineering measures.

The purpose of outlining the mitigation measures was not to provide all the possible outcomes, but to evaluate the magnitude of the impact by the scale of the mitigation measures that may be needed. The Alternative Methods were then ranked from least impact (fewest major mitigation measures required) to most impact (major mitigation measures required).

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1.0 Introduction

1.1 Background

The Town of St. Marys (Town) is conducting an Individual Environmental Assessment under the *Environmental Assessment Act* to review alternative means to manage solid waste over a forty year planning period. The existing St. Marys landfill site (the Site), Environmental Compliance Approval (ECA) Number A150203, is located at 1221 Water St. South, St. Marys, Ontario. The 37 ha Site was part of a former clay borrow pit that was used by St. Marys Cement in cement manufacturing and contains an approved fill area of 8 ha. The landfill is nearing its approved fill capacity and a new means to manage post-diversion solid waste is required. The location of the existing landfill is shown on Figure 1 Site Location and Figure 2 Regional Location.

Terms of Reference (TOR) were approved by the Minister of the Environment and Climate Change on December 29, 2014. The TOR laid out a strategy for completing the EA. The TOR also included a summary of pre-planning work which had been done to eliminate a number of *Alternatives to the Undertaking*. Those *Alternatives* which were eliminated due to a variety of technical, financial and environmental criteria included:

- Do Nothing;
- Energy From Waste;
- Enhance Waste Diversion; and
- Construct a new landfill site at a new location in the Town.

Further assessment was conducted to evaluate transporting waste to a landfill in another jurisdiction or expanding the current landfill Site. This assessment completed in 2015 eliminated waste *Export to Another Jurisdiction* from further consideration.

Work Plans, a requirement of the TOR following identification of Expansion of the Existing Landfill as the preferable *Alternative to the Undertaking*, were prepared in July 2015. The Work Plans provide methodologies for completing the evaluation of *Alternative Methods for Carrying out the Undertaking*. Work Plans were prepared for the following disciplines:

- Terrestrial and Aquatic Ecology;
- Geology and Hydrogeology;
- Socio-Economic Environment;
- Air Quality; and
- Archaeological and Cultural Heritage.

The information presented in this report follows the framework provided by the *Hydrogeological Work Plan*.

1.2 Study Purpose

If it is decided to expand the existing landfill, the Undertaking will be defined as:

> *The expansion of the St. Marys landfill in order to provide the necessary capacity to fulfill the Town's post-diversion solid waste disposal needs for the next 40 years.*

The purpose of this study is, therefore:

> *To evaluate a variety of Alternative Methods for expanding the St. Marys landfill in order to fulfill the Town's post-diversion solid waste disposal needs for the next 40 years.*

1.3 Alternatives to Be Assessed

Several design options or *Alternative Methods* were considered with respect to landfill expansion. *Alternative Methods* are technically, economically and environmentally feasible ways of *Carrying out the Undertaking*. For this Study, the *Alternative Methods* included various design options associated with the expansion. Increased waste diversion will be considered for the preferred *Alternative Method* but will not constitute part of the undertaking. The *Alternative Methods* to be reviewed are identified in Table 1.

Table 1: Alternative Methods for Carrying Out the Undertaking

Alternative Methods		Description
1	Vertical expansion of the existing landfill	This *Method* involves an expansion in the vertical direction within the existing footprint of the landfill.
2	Horizontal expansion of the existing landfill	This *Method* involves an expansion outside of the existing landfill footprint.
3	A combination of vertical and horizontal expansion	This *Method* would involve partial vertical expansion along with some horizontal expansion of the landfill footprint, basically a mixture of *Methods* 1 and 2.
4	Development of a new landfill footprint	This *Method* involves closure of the existing 8 ha footprint and development of a new landfill footprint elsewhere on the 37 ha Site.
5	Vertical expansion plus a new footprint	This *Method* is a combination of *Methods* 1 and 4.

1.4 Study Area

Two specific study areas were identified for study and are shown on Figure 3 Study Areas. These were:

- On-site Study Area - includes all lands associated with the existing St. Marys landfill, the 37 ha site located as 1221 Water St. South, St. Marys; and
- Study Area Vicinity - all lands within a 1,000 m radius of the On-site Study Area.

1.5 Study Scope

The scope of this study involved setting out the known characteristics of the On-site Study Area and the Study Area Vicinity, then assessing the Alternative Methods in light of the following considerations.

What would be the potential negative effects on:

- groundwater quality, quantity and movement?
- surface water quality, quantity and movement?
- surface or ground water from accidental spills or releases to the environment (e.g., leachate)?
- soil erosion or sedimentation on or off site?

1.6 Study Timeframe

The EA considered the potential effects over two time periods:

- Construction and operation of the expanded landfill:
  - Construction is currently anticipated to commence in 2018; and,
  - Operations would then occur over a 40 year period, ending around 2058.
- Closure and post-closure of the landfill, including possible impacts due to climate change.

2.0 Site History

2.1 Site Development

The property that the landfill occupies was originally owned by St. Marys Cement Co. (SMC) now a wholly-owned subsidiary of Votorantim Cimentos based in Sao Paulo, Brazil. Founded in 1912, SMC offices and the cement plant are still located north of the landfill in an area that was formerly a quarry (see Figure 4 Regional Aerial Photograph).

Prior to the development of the landfill, the property was licenced by the Ministry of Natural Resources as part of the SMC quarry. Historical aerial photographs show that soil was stripped from the north end of the Site and possibly some rock quarried. The surficial clay was also mined on portions of the Site for use in the cement production. More recently, the north end of the Site was used to stockpile soils and materials associated with cement production.

Appendix A contains photographs that show the Site from 1955 to 2013. The table below describes the main activities or changes to the main features.

Table 2: History of the Site through Aerial Photographs

Year	Description
1955	- agricultural fields - water course enters Site in the current location but bends north (not northwest as it does now) and appears to outlet at the southwest corner of the quarry - swale in the field west of the watercourse appears to drain east into the watercourse - area north of landfill boundary stripped of overburden, possibly rock quarried - several elevations (lifts) and rock faces visible on quarry property
1963	- still primarily agricultural field - a shallow lift of quarrying has moved into northeast corner, deeper lifts are still north of landfill boundary - watercourse in same location - stockpile between quarry face and watercourse appears to be overburden stripped from the quarry north of the stockpile
1978	- excavations and earth moving visible over entire Site (clay mining) - no agricultural fields remain - a large stockpile is present in northeast corner (assumed to be cement kiln dust), partially on the previous stockpile (overburden) and partially on the shallow edge of the quarry - watercourse has been re-routed - water in quarry ponds north of landfill
1980	- appears to show extent of clay mining on landfill Site

Year	Description
	- poor photo quality
1989	- clay pit face visible along full south boundary of Site - landfilling is occurring on Site, Phase I is visible - cement kiln dust pile is visible
2000	- Phase I completed - Phase II/III landfilling in east half of footprint - minimal change east of watercourse since 1989 - landfill stormwater management ponds visible
2006	- Phase II/III continues landfilling in east half of footprint - vegetation starting to develop on kiln dust stockpile
2013	- Phase II/III east half covered, landfilling in west half of footprint - increasing vegetation cover along watercourse and on kiln dust stockpile

2.2 Landfill Construction

In 1979, the Town began investigating the feasibility of using a portion of a former clay pit owned by SMC as a municipal landfill site (CRA, 1982). The 16.2 ha property was smaller than the current Site. The property was leased from SMC. At the time, the long-term end use planned for the Site was to become part of a greenbelt buffer zone surrounding the SMC plant (CRA, 2011).

A Hydrogeologic Investigation was completed with a report issued in November 1982. The Site was approved in 1983, landfilling began in December 1984 in the area known as Phase I. The proposed bottom elevation was 315 m amsl (CRA, 1982 Plan 2). Phase I was completed and finished with final cover in the summer of 1993 (CRA, 2012).

A second Hydrogeologic Investigation was completed in November 1992 for Phase II/III. Phase II/III was divided into 8 stages, which corresponded with the development of the leachate collection system from east to west. Stage 7 was constructed in the fall of 2010 and began receiving waste in December 2010. A weigh scale was installed in 2012 to assist in operations and filling control. Stage 8 was constructed in late summer 2013 and began receiving waste in September 2013 (Burnside, 2013). This is the current cell.

The Town purchased the property from SMC in 2009. ECA No. A150203 dated June 24, 2010 (amended 2013 and 2015), reflects Site ownership by the Town and incorporated additional land from SMC to bring the Site to its current size. The Site is now a 37 ha waste disposal Site with an 8 ha landfill area. The ECA also approved the Site for the collection and diversion of recyclable waste (including WEEE), acceptance and transfer of Municipal Hazardous or Special Waste (MHSW), and the composting of leaf and yard waste.

Phase I had a volume of 104,000 m^3 and Phase II/III had a maximum volume of 276,000 m^3. The maximum waste volume that can be landfill per year is 20,000 m^3. ECA Notice No. 2 dated November 16, 2015 increased the approved volume of Phase II/III to a maximum of 291,850 m^3 for an interim period ending September 30, 2016.

The EA Terms of Reference (December 2013) determined that the disposals capacity required for the Town for a 40 year planning period would be 708,000 m^3. As discussed in the EA Document, this has been confirmed in accordance with the TOR.

2.3 Leachate Collection System

The Phase I leachate collection system is a perimeter system consisting of perforated collector pipes connected between manholes. It was installed as a contingency system to control mounding within the waste.

The Phase II/III collection system incorporates perimeter collectors as well as lateral collectors passing beneath the waste. The system was extended as each new Phase was constructed. Both the perimeter system of Phase I and the underdrain system of Phase II/III restrict the movement of leachate beyond the landfilling footprint and control the leachate mound within the waste. The location of the leachate collection systems in Phase I and Phase II/III are shown Figure 5 Site Plan.

Initially, leachate from Phase I was collected in a holding tank near MH1 (PH1). Leachate from Phase II/III was collected in a holding tank near MH3. In 1997, a sewer was installed to gravity drain the leachate directly from the leachate collection systems to the Town's sanitary sewer system. The Phase I leachate holding tank was decommissioned in 2008. The Phase II/III leachate holding tank was used to connect the Phase II/III leachate collection system to the gravity sewer. It contains a valve to shut off leachate flow for maintenance of the sewer line. There is no leachate storage on site.

3.0 Study Methods

The study considered the geology and hydrogeology of the On-Site Study Area and Study Area Vicinity. Preliminary landfill concepts were developed in order to assess the Alternative Methods. Alternative methods included vertical expansion, horizontal expansion, a new waste footprint, and combinations thereof.

The Hydrogeological Work Plan was based on potential impacts from these alternatives. For example, a vertical expansion could add to the contaminant loading of the existing footprint. A leachate collection system that controls the mounding within the waste could be used to reduce leachate migration from the waste and minimize impact on groundwater flow direction. A horizontal expansion that increases the waste footprint could shift the contaminant load to a different part of the Site. This could create impacts downgradient and downstream of the new footprint and alter the location of the downgradient monitoring boundaries.

The EA Terms of Reference (December 2013) determined that landfilling capacity required for the Town for a 40 year planning period would be 708,000 m^3. To achieve this volume, preliminary concepts indicate that a combination of vertical and horizontal expansion may be required; vertical expansion alone may not provide the necessary capacity.

Components that were considered in assessing the expansion concepts included:

- Regional geology and hydrogeology - aquifers and water use;
- Site geology - soil depth, texture and stratification, bedrock depth and characterization; and
- Site hydrology - occurrence and movement of water across the Site including groundwater & surface water interaction.

3.1 Background Data Collection

A substantial amount of data already existed for the landfill Site, although not all of it was readily accessible. The Site is not a green field and has been used for resource extraction, production, and landfilling for over 50 years. In addition, adjacent properties have also been used for resource extraction and monitoring, and for individual homes. Data from various sources was located and incorporated into an updated Site conceptual model. Data sources are listed below and individual references are provided at the end of this report.

Background data sources included:

- Published geology and hydrogeology maps and reports;
- Landfill hydrogeological investigations and design documents (1982 and 1992);

- Landfill monitoring reports (2010 to 2015);
- Aerial photography and satellite imagery;
- Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA);
- Ontario Ministry of Natural Resources and Forestry (MNRF);
- Ontario Ministry of the Environment and Climate Change (MOECC);
- Thames-Sydenham and Region Source Protection;
- Upper Thames River Conservation Authority;
- Environment Canada;
- Town of St. Marys; and
- St. Marys Cement Co. (SMC).

3.2 Field Data Collection

The need to collect additional field data to fill in data gaps was acknowledged. This data collection began in the late fall of 2015 following the approval of the TOR and the first public information centre that allow input from the community. However, due to the nature of groundwater investigations and the freezing of surface water during the winter of 2015/2016, the collection of field data is ongoing and will continue for some time (approximately 6 to 15 months depending on the type of data). The new data will be added to the knowledge data base for the Site and used for potential landfill design, EPA application, and for the ongoing monitoring of the existing Site.

Test Pits

Test pits were excavated east of the existing Phase I and Phase II/III landfill areas, east of the watercourse and around the cement kiln dust pile. The purpose of the test pits was to determine the surficial soils beyond the current landfill footprint. The pits were excavated using a tire-mounted backhoe. Observations on soils and water occurrence were recorded. Soil samples were collected and retained. The locations of the test pits are shown on Figure 5 Site Plan.

Drive Point Piezometers

Three drive point piezometers were installed along the watercourse. The locations are shown on Figure 5. The purpose was to provide water level data below the watercourse. The drive points were installed beside the existing surface water sampling stations, with the exception of the upstream station (SP1-10). The channel is wider at SP1-10 and the water tends to pond. The drive point (DP1) was installed further west where there is measurable flow in the channel.

The drive point piezometers consisted of a 20 mm diameter, stainless-steel screen with a drive tip at the bottom. The screen is 0.3 m long and is coupled to a length of 20 mm diameter steel pipe. The piezometers were driven into the bottom of the watercourse channel until the bottom of the screen was approximately 0.7 m below the base of the channel. A fourth piezometer was to be driven deeper into channel at the location of SP2-93 and DP2. However, the drive tip met refusal at 0.9 m, assumed to be dense native silt/clay till. Continuing to drive the tip into the dense till bent the steel pipe and screen without obtaining any more depth. The piezometer was removed.

Existing Non-Monitoring Wells

Existing wells were identified that are not part of the monitoring program (non-monitoring wells). These wells, on the landfill and on adjacent properties, provide additional geology and water level data relevant to this assessment. Three wells were found in the cement kiln dust stockpile (MW04-1, MW04-2 and MW04-3) and a fourth well (a bedrock well) was located east of Phase II/III (MW04-4). The locations are shown on Figure 5. The wells were originally installed for SMC; however, SMC was unable to provide well logs. Burnside measured the depths, elevations and water levels in December 2015.

Another well has been located at the north property boundary. This is a 42 m deep, 150 mm diameter steel cased well. It was likely installed by SMC when they owned the property; however, they have not been able to provide a borehole log for this well. Likewise, the well is not in the MOECC Well Record database. The depth and elevation were measured by Burnside. The depth of the well suggests that it is completed in bedrock. Water levels are also being measured.

Water Levels

The Work Plan stipulates monthly water levels be measured on Site for a minimum of six months. These water level events are in addition to the water levels measured as part of the current monitoring program. Water levels are measured in the monitoring wells, in the non-monitoring wells, in the drive points and at the surface water stations. To date, water levels were measured on December 14, 2015, March 8, 2016, and March 29, 2016. Levels were not measured in January or February 2016 as surface water and shallow groundwater installations would have been frozen. Water levels will continue to be measured through the spring into summer.

Automatic Water Level Data Loggers

Automatic loggers were installed in three wells to collect continuous water level measurements. The purpose is to collect data on seasonal variations and well response to rainfall events and external pumping.

The wells instrumented were MW04-4 (bedrock), OW5-84 (deep overburden) and OW8B-10 (shallow overburden near bedrock well). The Work Plan stipulates that this data continue to be collected for up to 15 months. The initial frequency is hourly, but may be reduced depending on variability of water levels. The data will be downloaded monthly coinciding with the manual monthly water level measurements.

Surface Water Flows

Surface water flow rates are measured at the downstream surface water station (SP3) for the Site's annual monitoring program. The Work Plan requires additional measurements upstream (near DP1). The first measurements that included both stations were made on March 29, 2016. The flow rates upstream and downstream will be measured monthly through the spring into summer in conjunction with the monthly water level measurements.

Geomorphic Study of Watercourse

A detailed assessment of the existing watercourse was completed by Parish Geomorphic[1] during the summer of 2015. The study was completed as part of the Ecological Work Plan.

Elevation Survey

All test pits, drive points and non-monitoring wells were surveyed to establish locations, ground elevations and measuring point elevations.

Installation of New Groundwater Wells

The Work Plan included a program of drilling and new well installation. The reason for including drilling at this early stage was the lack of data available for the Site. When the Work Plan was prepared, borehole logs and well details were not available for most of the monitoring wells in the current monitoring program. There were no records for the previous landfill investigations and no wells on the east side of the watercourse.

Additional efforts by the Town in the fall of 2015, resulted in all of the logs from previous Site work and monitoring installations to be made available. In addition, SMC was able to provide information on their wells, excavations and dewatering. Wells were located in the cement kiln dust stockpile and accessed. This information allowed for the creation of Site cross-sections and a better understanding of the Site conceptual model.

If the EA results in horizontal expansion of the landfill, construction could occur over a substantial part of the Site. There is a possibility that the watercourse would be relocated. The Site operational areas could be relocated, as could the stormwater

[1] As of 2016, Parish Geomorphic is now referred to as Matrix Solutions Inc.

control features. Several existing monitoring wells would need to be decommissioned and replaced. Therefore, it was difficult to find locations for new wells that would be clear of all future alterations and still be in locations to provide useful data.

In December 2015, a decision was made to defer the drilling program until later in the approval stage. A call was made to the MOECC to discuss this alteration to the Work Plan. It is acknowledged by Burnside that the Site is in need of new monitoring wells for the existing landfill, whether the expansion occurs or not. However, the best monitoring network will result from delaying installation until later in the process when the configuration of Site facilities has been determined.

3.3 Data Analysis and Existing Conditions Review

All of the data collected to this point has been analyzed. In addition, the geologic data was used to develop cross-sections of the Study Area Vicinity and the On-Site Study Area, and update geology and groundwater mapping.

At this point, the data has been analyzed to identify knowledge gaps and to determine if the new data significantly changes the conceptual model. Significant knowledge gaps or changes to the conceptual model may impact the selection of alternatives or the design of the alternatives.

The analysis considered the following:

- Occurrence of surficial shallow sand or gravel in the potential footprint;
- Depth and character of till above the bedrock;
- Depth to water (perched conditions);
- Shallow groundwater movement across a potential landfill area;
- Influence of the watercourse on shallow groundwater movement;
- Potential for landfill contaminants to reach the watercourse;
- Potential for landfill contaminants to reach the bedrock;
- Leachate production and collection;
- Potential for mutual interference with licenced aggregate operations; and
- Characteristics of the existing cement kiln dust stockpile.

4.0 Existing Conditions

4.1 Regional Setting

As shown on Figure 2, the St. Marys Landfill Site is located in the southwest corner of the Town of St. Marys. The Site is approximately 2.4 km south of the downtown area on Water Street South (which becomes Perth Road 123). Between the Site and the Town's residential/commercial core is the SMC Plant, several former quarries and a recreational area (tennis courts and supervised swimming in one of the abandoned quarries).

The SMC owns the land surrounding the north, east and south sides of the Site (see Figure 4). The mined out rock quarry and ponds within which the cement plant is located, is directly north of the Site.

Mined-out clay pits east of the Site are currently used for stockpiling raw materials and waste materials produced in the cement-making process. Beyond this disturbed area is a small agricultural field and industrial land.

The area south of the Site is licenced for aggregate resource extraction but is currently under agricultural use. The area west of the Site (between Perth Road 123 and the North Thames River, has been developed into a strip of low density, rural residential properties. There is also a residence on a small block of land between Water Street South and the Site's western property boundary (see Figures 4 and 5).

4.2 Regional Geology

4.2.1 Topography and Drainage

Regionally, the ground surface slopes downward from east to west. In the Study Vicinity Area (within 1,000 m of the Site), ground surface elevations range from less than 295 metres above mean sea level (m amsl) adjacent to the Thames River to approximately 325 m amsl adjacent to the landfill site. Elevations rise to 330 m amsl east and south of the landfill.

The North Thames River lies approximately 300 m northwest of the Site limits. The North Thames River is a major watercourse formed as a spillway by glacial meltwaters from the ice lobe that created the Mitchell Moraine northwest of the river. The Site is within the Upper (North) Thames River Drainage Basin. The North Thames flows south to London and then southwest where it discharges to Lake St. Clair. Locally, the river flows in a southwesterly direction from St. Marys.

There is an unnamed watercourse that flows through the landfill Site. It has a relatively small drainage area of approximately 600 ha. This small watershed is bounded to the north and east by Trout Creek which flows westward through the Town and joins the

North Thames River north of Queen Street (see Figure 2). To the south is Gregory Creek that flows south and west. To the west are a number of small creeks that flow northward directly to the North Thames River.

4.2.2 Overburden

The surficial geology of the area is shown on Figure 6 Surficial Geology. The regional overburden consists of successive glacial till deposits. Glacial till is unsorted material deposited in direct contact with the ice sheets that covered large areas of the continent. This type of soil contains varying amounts of clay, silt, sand, and gravel, as well as cobbles and occasional boulders. Where there is more than one layer of till, each layer marks the advance of progressively younger ice sheets (therefore deeper layers are older).

The oldest till, which rests on the bedrock surface over a large part of Southern Ontario, is the Catfish Creek Till. There are no outcrops of this till mapped in the vicinity of the landfill because it has been buried by younger tills. Catfish Creek Till is an olive to buff stony sandy to silty till. It is characteristically hard and often referred to as hardpan in drill logs (Karrow, 1977). Karrow reported a silt till between the bedrock and the Catfish Creek Till in an exposure at the St. Marys Cement old quarry south of St. Marys. This till may be older than the Catfish Creek.

The surficial geology map (Figure 6) shows small outcrops of a clayey silt till south of St. Marys. It is thought to be younger than the Catfish Creek Till but may be quite local and not present at the landfill.

The dominant surficial till east of the North Thames River is a sand-silt till (Sado and Vagners, 1975). It may correlate to the Tavistock Till north of St. Marys. The Tavistock Till is a gritty clayey silt till. Near Wildwood Lake it is approximately 14% clay, 58% silt and 28% sand.

The dominant surficial till west of the North Thames River is a clayey silt till that correlates to the Rannoch Till. It is not found in the vicinity of the landfill.

The large continental ice sheets alternated between advances and retreats. Advances were usually marked by the deposition of till and the retreats by water sorted deposits carried from the ice by the meltwater. Therefore, the various layers of till may be separated by lenses or seams of gravel and sand, silt and clay. This type of soil can be highly sorted and may consist of only sand or only clay. These inter-till deposits can be small and isolated or significant and regional. One such significant deposit is the Wildwood Silts located near Wildwood Lake approximately four kilometers east of the Site. These are a thick lacustrine sequence of stratified silts (several tens of feet) often overlain by sand and minor gravel.

The most recent deposits lie on top of the till southwest of the Site. Meltwater from the last ice advance left gravel deposits along the Thames River channel and a large area of sand south of the River and west of Perth Road 123. There is a small area between the sand deposit and the Site mapped as lacustrine (sand, silt and clay). This extends onto the western part of the Site and was likely the source of the mined clay. Most of the Site is mapped as "Man-made" as the Site had already been disturbed by human activity before 1973-1974 when the mapping took place.

The various deposits that may make up the overburden within the vicinity of the Site are summarized below. The order is from oldest (lowermost) to youngest (uppermost).

1. Possibly a local clay or silt till directly overlying bedrock that may be the oldest local till.
2. Catfish Creek Till, a regionally extensive stony sandy silt till that is very hard (hardpan) generally considered to be the oldest regional till.
3. Clayey Silt Till, local, probably younger than the Catfish Creek till (outcrops south of the Site and may or may not be present at the Site).
4. Inter-till deposits associated with meltwater, possibly related to the Wildwood Silts.
5. Tavistock Till, regional, a gritty clayey to sandy silt till that occurs extensively at the surface south and east of the North Thames River.
6. Surficial glacio-lacustrine and glacial outwash deposits associated with last meltwater event.

Drift thickness mapping (Sado and Jones, 1980) indicates that the overburden in vicinity of the Site ranges from 10 to 15 m thick (north of the Site) to 30 m thick (south of the Site). This mapping was based not only on MOECC water well records, but on the numerous geotechnical boreholes drilled on SMC properties.

Three cross-sections were constructed through the Study Area Vicinity using geologic data from the MOECC water well records, from deeper boreholes on the landfill Site and from information provided by SMC. The locations of the wells and cross-sections are shown on Figure 7, Regional Topography and Cross-Sections. The MOECC well records are summarized in Appendix B. The monitoring well and borehole logs for the landfill site and SMC properties are contained in Appendix C. The MOECC wells were not field checked, however the UTM coordinates were checked against the location sketch provided on the original well record. Table B1, Summary Table of Wells on Figure 7, notes four wells that are believed to have incorrect UTMs and have been removed from Figure 7. Three records appeared to be on the wrong side of Water Street (i.e., UTM indicated east side on landfill or SMC properties and sketch indicated west side of Water Street). The fourth record was from Lambton County.

The Regional Cross-Sections (Figures 8, 9 and 10) show that the overburden is primarily glacial till (or hardpan) overlying the bedrock. Isolated seams of silt, sand and gravel do occur within the till and may mark the division between till sheets. Most of these seams occur in monitoring wells or boreholes on the Site. This may be the result of the detail of logging that was conducted on cores taken at the Site. Such small seams may have also occurred in the water wells beyond the Site, but where not considered significant enough to log.

The sections show that the overburden thickness is approximately 10 to 15 m north and east of the Site (B-B' and C'C') and 30 m south and west of the Site (A-A' and C-C') as observed on the drift thickness mapping.

4.2.3 Bedrock

The bedrock geology of the area is shown on Figure 11 Bedrock Geology. The study area is underlain by two bedrock formations. The youngest is the Dundee Formation. It is a grey to tan medium to thickly-bedded, fossiliferous limestone and minor dolostone. Bituminous partings are common and oil staining occurs in more porous fossiliferous beds and along fractures. Chert nodules are locally abundant.

The Dundee Formation is underlain by the Lucas Formation of the Detroit River Group. The Lucas Formation consists of thin to medium-bedded, light-brown to grey-brown, fine crystalline, poorly fossiliferous, limestone and dolostone. At the St. Marys quarry exposed Lucas Formation is characterized by laminated limestone (Armstrong and Carter, 2010). The bedrock mapping (Figure 11) indicates that in the south part of the landfill Site, the Dundee Formation is absent and the overburden lies on the Lucas Formation.

Regionally, the surface of the bedrock slopes downward from east to west. This can be seen in the mapping completed for the 2003 Perth County Groundwater Study (Waterloo Hydrogeologic 2003, Figure 2.17). Selected mapping from this report are included in Appendix D. The bedrock surface in the St. Marys area is approximately 300 m amsl.

The Cross-Sections (Figures 8, 9 and 10) show more local variation in the surface of the bedrock. On Sections A-A' and B-B' the bedrock elevation rises to the north and east. Figure 12 shows the topography of the bedrock around the Site constructed from well records, landfill site logs and SMC logs. It shows the downward slope on the bedrock surface from east to west. This is consistent with more regional mapping that shows a general east to west slope with local variations. Figure 12 also shows a small valley in the bedrock surface south of the Site.

4.3 Regional Hydrogeology

Previous Site investigations reported that there were no regional overburden aquifers in the vicinity of the Site, citing the Thames River Basin Study (MOE, 1981). The MOE study did map localized occurrences of a deep overburden aquifer north of St. Marys and an intermediate aquifer south of Highway 7 (Elginfield Road). Overburden aquifers were mapped mainly along the major water courses and as isolated areas.

Mapping of the water table for the Perth County Groundwater Study (Appendix D, Figure 2.21) shows a regional water table sloping downward from east to west; however, flow along major rivers is toward those rivers. Therefore, in the St. Marys area, flow in the overburden is toward Trout Creek and the North Thames River. The general water table elevation in the St. Marys area is in the 310 m to 320 m range.

The same study mapped the bedrock water levels to show the regional flow in the bedrock is also from east to west (Appendix D, Figure 2.22). The bedrock water level in the St. Marys area is about 300 m amsl. When this water level is compared to the elevation of the top of the bedrock it appears the water level is below the bedrock surface around St. Marys and over the western side of Perth County (Appendix D Figure 2.23). This is also evident on the Regional Cross-Sections where the well records report static water levels below the top of the bedrock surface.

The higher water level in the overburden compared to the bedrock means that regionally, water movement is downward with groundwater in the bedrock being recharged from the overburden.

The limestone and dolomite bedrock of the Dundee and Lucas Formations form the regional water supply aquifer(s). The Town of St. Marys obtains its water supply from three bedrock wells located northeast of the Site. Map E-1 and Map E-2 in Appendix E are maps created by the Thames-Sydenham Source Protection Region for Upper Thames Source Water Protection Planning. The maps show the locations of the municipal wells and the associated Well Head Protection Areas (WHPA) A to C. Each well has Protection Areas associated with travel time of groundwater to each well. These areas are also north and east of the Site and outside of the Study Area Vicinity (1,000 m offset from Site property limits).

An additional WHPA-E was delineated for Wells 1 and 3 as these wells were assessed as GUDI wells (Groundwater Under Direct Influence of surface water). Map E-2 shows the extent to the WHPA-E which includes surface water features upstream of the wells. The landfill Site is located downstream of St. Marys and is not within the WHPA-E.

The Planning Policy for *New Prescribed Instruments Related to Moderate and Low Threats* including waste management are as follows:

> *3.03 To reduce the risk to municipal drinking water sources from new activities that would be subject to one or more Prescribed Instruments and located in areas where the activity would be a moderate or low drinking water threat, the province should consider incorporating terms and conditions. These terms and conditions, when implemented, should manage the activity such that it does not become a Significant Drinking Water Threat. Where appropriate these terms and conditions should reduce the risk.*

In other words, in issuing an ECA for an expanded landfill the policy states that the MOECC should consider the type of the threat and include appropriate approval conditions to reduce the risk that may be presented by the proposed land use.

Map E-3 shows areas of Significant Groundwater Recharge (SGWR). In the St. Marys area, the SGWR areas are generally the same as those mapped as surficial sand or gravel on Figure 6. Within the Study Area Vicinity, this includes surficial lacustrine sand above the till and the gravel along the Thames River. The sand deposits south of the Site are likely separated from the bedrock by the underlying till, and therefore, the recharge is local and shallow. There is no significant recharge on the landfill Site as the surface soils are primarily clay and glacial till.

Map E-4 shows areas of highly vulnerable aquifers (HVA). These are areas where an aquifer is close to or exposed at the ground surface. Human activities in these areas could impact the aquifer, potentially impacting wells that rely on the aquifer. The quarry sites both north of the landfill (SMC plant) and the Thomas Street Quarry west of the landfill are mapped as HVA. This is because the surficial soil has been removed and the bedrock has been exposed. Because of the quarry activity and dewatering, groundwater is discharging into the quarries, containing human impact to the quarries. This will reverse if dewatering ceases and the water level in the quarries is allowed to return to the natural water table.

The Town of St. Marys supplies water to town residents; however, there is a strip of rural residential along the west side of Perth Road 123. These homes are supplied by private wells. A private well survey for the 1982 Hydrogeology Investigation identified four dug wells on the west side of Perth Road 123. These wells were north and west of the landfill and varied from 5 m to 13 m deep. The remainder of the local private wells were completed in the bedrock. As a result of this survey, five wells (the 4 dug wells and one drilled well) located west of the landfill were added to the monitoring program. The wells are shown in the Table 3.

Table 3: Shallow Private Wells

1982 Hydrogeology Investigation		Current (2016) Status		
Well Reference	**Type**	**Drilled Replacement**	**MOECC Well No.**	**Well Reference**
#25 C Hall	Dug	2011	7175685	PW1
#26 D Riordan	Dug			PW2
#3 A Riordan	Drilled (1973)		5002038	PW3
#27 W Heard	Dug	1996	5004319	PW4
#24 M Cubberly/McCurdy	Dug	1988	5003434	PW5

A follow up survey for the 1992 Hydrogeology Investigation reported that one of the dug wells had been replaced by a drilled bedrock well (5003434). Since that time, two more of the dug wells have been replace by drilled bedrock wells (5004319 and 7175685). The one remaining dug well (PW2) and the four drilled wells are used for the current monitoring program to provide background data on the water quality.

The dug well, PW2, supplies a house on the east side of Perth Road 123 north of the landfill. According to the 2012 Monitoring Report, this well has a ground elevation of 321.54 m amsl, a bottom elevation of 309.14, and is 12.4 m deep. As there is no well record, it is not known if or at what depth PW2 intersects a water bearing zone. The closest well to PW2 is OW33-96. OW33-96 was continuously cored and reports till from ground surface to the bottom of well (elevation 307.1 m). However, it does note small seams (less than 3 cm) of sand, silt, gravel and clay. According to the 2012 Annual Monitoring Report, PW2 is reportedly susceptible to seasonal water level fluctuations and has occasionally been dry. In the past, a licensed water hauler reportedly fills the well with imported water.

Several residences have been constructed on the west side of Perth Road 123 since the 1992 survey. Water well records show additional drilled wells along the road. At this point, the well survey has not been repeated as it is expected new homes are on drilled bedrock wells.

4.4 Local Geology

4.4.1 Topography and Drainage

It has already been noted that the surface of the Site has been impacted by industrial activity since around 1960. It was around that time that the quarry operation to the north progressed onto what is now the landfill Site. It is likely that there were impacts to the groundwater prior to that time with earlier dewatering of the quarry. By 1978, none of the Site was in a natural state. The topography of the Site today is a result of the overburden stripping/filling east of the watercourse, kiln dust stockpiling, the realignment

of the watercourse, clay mining over most of the Site west of the watercourse, and finally the construction of the landfill.

The highest elevation on the Site today is the cement kiln dust stockpile (CKD), its peak being around 334 m amsl. The elevations of the fill areas are approximately 327 m (Phase I) and 326 m amsl (Phase II/III). The lowest elevations on the Site occur along the watercourse. This channel enters the east side of the Site at an elevation of approximately 310.0 m amsl and exits at the north end under Water Street South at 306.8 m amsl (see Figure 5). This is an elevation change of 3.2 m over a distance of approximately 840 m, resulting in a grade of 0.4%. However, the elevation change between SP1-10, the surface water station at the east side of the Site and SP3-93 near the north end is approximately 0.2% (1.5 m elevation over 660 m distance). The grade on the watercourse increases between SP3-93 and Water Street South to 1% (1.7 m over 150 m).

Perth County Road 123 is a topographic ridge on the west side of the Site and acts as a drainage divide. West of the ridge, runoff flows to the Thames River. East of the road, runoff is eastward toward the stormwater retention basins and the watercourse (see Figure 5).

Surface water from the completed landfill areas is directed through a series of perimeter ditches and swales around the landfill footprints and along the interior roadways. The ditches and swales convey runoff generated to two stormwater retention basins (see Figure 5). These stormwater basins attenuate the peak flows during storm events and allow sedimentation. The 2012 Annual Report noted that riser pipes were replaced and sediment was removed from both stormwater basins during the landfill earthworks in October and November 2007.

The stormwater basins outlet to the watercourse via control features. The watercourse leaves the Site by a culvert under Perth Road 123 and eventually discharges into the Thames River approximately 500 m downstream of the Site.

Upstream of the Site, this watercourse divides into two branches (see Figure 2). The north branch skirts the south edge of the SMC quarry and drains industrial properties and agricultural fields east of the Site. The south branch occupies a vegetated channel between the agricultural fields and the excavated/filled areas on the SMC property. It drains industrial and agricultural land further south and east before crossing James Street and Elginfield Road (Highway 7). According to the 1982 Hydrogeological Report, it drains an area of approximately 607 ha.

Site reconnaissance in 2015 indicated that Site drainage is less defined east of the watercourse. Surface water runoff from the relatively steep slopes of the kiln dust stockpile flows radially in all directions, including west toward the watercourse and north

toward the quarry. There are relatively flat areas between the stockpile and the watercourse with isolated water-filled depressions, some of which contain cattails.

4.4.2 Site Overburden

Three cross-sections were constructed using the logs from the on-site monitoring wells, boreholes, test pits, and the bedrock elevations from the regional cross-sections and bedrock contour mapping (Figure 12). The locations of the cross-sections are shown on Figure 13. The cross-sections (D-D', E-E', and F-F') are Figures 14, 15 and 16.

The regional geology (Section 4.2) noted that the overburden consists of layers of glacial till possibly separated by inter-till meltwater deposits. The Site cross-sections also show primarily silt till above the bedrock. All three sections show the main stratigraphic sequence of the Site from top to bottom to be:

1. Lacustrine (clay and/or silt removed by mining);
2. Upper till (possibly Tavistock);
3. Localized inter-till meltwater deposits;
4. Lower till (possibly Catfish Creek); and
5. Bedrock.

East of the watercourse, there is also fill at ground surface. The fill is likely local resulting from overburden stripped during quarrying or from the realignment of the watercourse. The thickness of the overburden varies from 20 m on the south and west parts of the site to about 10 m on the north edge of the site. This is due partly to soil removal from mining and from an upward slope on the bedrock surface from southwest to northeast.

4.4.2.1 Lacustrine

There is very little of this soil remaining on the Site. As noted, the original ground surface has been substantially altered. The ground surface south of the Site (along the southern property boundary) is approximately 324 m amsl. The base of the Phase II/III footprint was 314 m at the east end and 317 m at the west end. Therefore 7 to 10 m of material was removed along the south edge of the Site. The ground surface on the lot adjoining the northwest side of the Site is 318 m to 320 m. The base of Phase I was approximately 315 m, therefore 3 to 5 m of material was removed during borrow pit operations.

Most of the soil logs record till at surface. There are exceptions (monitoring wells and test pits along the watercourse) but these are thought to be related to the inter-till meltwater deposits (discussed below). One test pit (TP9) in the northwest corner of the

Site encountered 0.75 m of sand and gravel over 0.65 m of varved silty fine sand. This could be a remnant of the original deposit.

It is not known if any of this deposit remains below the cement kiln dust stockpile. The historical airphotos (Appendix A) show a possible soil stockpile in 1963 that may have been placed over the native soil. The kiln dust stockpile was built partially over this soil stockpile and partially over the shallow quarry edge. Therefore the lacustrine material may have been removed from the northeast part of the kiln dust stockpile.

4.4.2.2 Upper and Lower Till

The glacial till is discussed as one unit as it is not possible to reliable differentiate between the till sheets on the Site. Till was reported at all of the drilling locations on the Site. The cross-section shows that it is 18 to 20 m thick below Phase II/III and 15 to 19 m thick below Phase I. East of the watercourse, the rising bedrock surface reduces the depth to about 14 m. At the north property boundary, coinciding with the quarry edge, the till depth may be reduced to 9 to 10 m. This is based on extrapolation of bedrock contours in that area, it has not been confirmed by drilling.

The till is primarily silt and clay. The table below summarizes the grain size analyses completed during the 1982 and 1992 investigations.

Table 4: Grain-Size Distribution in Till

Location	Sample Interval (m)	Analysis Results (%)				Geologic Material
		Gravel > 2 mm	Sand 2-0.06 mm	Silt 0.06-0.002 mm	Clay <0.002 mm	
OW1-80	6.1	14	21	37	28	silt till
OW4-80	0.8	7	12	48	33	silt till
OW4-80	5.3	11	22	41	26	silt till
BH10-91	1.22 – 2.13	3.77	28.68	46.66	20.88	silt till
BH10-91	7.32 – 8.53	9.06	29.34	39.94	21.66	silt till
BH11-91	1.83 – 3.05	0	12.22	55.93	31.85	silt till
BH12-91	4.27 – 5.79	16.45	21.57	38.33	23.64	silt till
BH13-91	4.57 – 5.64	2.93	26.71	42.27	28.09	silt till
OW17-91	0.61 – 1.22	11.70	10.20	53.50	25.00	silt till
BH13-91	13.26 – 14.78	15.20	40.05	36.62	8.13	silt and sand till

The samples are predominantly silt (36 to 55%) with a clay content of 21 to 32% and sand content of 10 to 29%. The deeper sample from BH13-91 (13.26 m) had a clay content of only 8% and a sand content of 40%. This sample, taken just above the bedrock, may be more representative of the deeper Catfish Creek Till. While higher in sand content, it is generally considered to be of greater density.

4.4.2.3 Localized Inter-Till Deposits

This unit is the meltwater material between the upper and lower till. This local unit, which may consist of sand, gravel or silt, was first noted during drilling for the 1992 Hydrogeological Investigation. Additional drilling and a geophysical ground survey were completed to better define the extent.

This unit is most evident on Cross-Section D-D' (Figure 14) below Phase II/III. The cross-section runs through the centre of a group of boreholes that reported sand and gravel below a surface till. To the north, east and south, seams of silt or silt and clay were reported that are likely the same deposit but formed in a lower energy depositional environment.

The thickness and elevation of the seam varies but it generally lies between elevations of 310 to 315 m amsl. It is thickest in the vicinity of boreholes BH16-91 (2.90 m) and BH19-91 (3.35 m) below Phase II/III. BH19-91 is also where it is at its highest elevation (315.56 m). The seam is evident as silt on Cross-Section E-E' (Figure 15) below Phase I and may exist along Cross-Section F-F' (Figure 16). The locations where this unit has been reported are shown on Figure 13. Locations reporting sand and gravel are circled in yellow, while locations reporting silt or clay are circled in green.

Boreholes and test pits along both sides of the watercourse report silt at ground surface. This is interpreted to be the same unit given that the elevations are consistent (310 to 315 m). The unit appears to be missing east of Phase II/III, but may extend under the western side of the soil and kiln dust stockpile.

The 1992 Phase II/III hydrogeologic investigation included an isopach of the central sand portion of this unit. This figure has been included in Appendix C. The isopach lines indicated that the main axis of the sand deposit runs northwest to southeast below Phase II/III. Laterally, the unit grades into silt with little to some fine sand and trace to some clay. The sand may also be overlain or underlain by silt and clay (see Figure 14 Cross-Section D-D').

The 1992 report noted that the seam appeared continuous to the west and northwest as three shallow private wells to the west were completed at approximately the same elevation. Those three wells are no longer available for measurement as they have been replaced with bedrock wells (PW1, PW4 and PW5).

Grain-sizes for samples from this deposit are summarized in the table below. The deeper sample from OW15-91 is primarily sand and gravel while the shallower sample is the overlying silt and clay. The samples from OW4-80 and BH12-91 are more representative of the unit beyond the sand core.

Table 5: Grain-Size Distribution in Inter-Till Deposits

Location	Sample Interval (m)	Analysis Results (%)				Geologic Material
		Gravel > 2 mm	Sand 2-0.06 mm	Silt 0.06-0.002 mm	Clay <0.002 mm	
OW4-80	1.5	-	5	80	15	silt some clay
BH16-91	2.74 – 3.35	0	10.32	46.18	43.50	silt and clay
BH12-91	2.90 – 4.11	2.90	25.51	68.32	3.36	sandy silt
OW15-91	3.51 – 4.57	2.58	13.64	42.07	41.72	silt and clay
OW15-91	4.57 – 5.79	43.79	50.85	5.36		sand and gravel

The 2012 Annual Monitoring Report stated that "*A portion of this sub-unit was removed in 1993, 1997, and 2003 as part of base preparation activities in the active Phase II/III landfilling area. This sub-unit was not encountered during the base preparation of Stage 6 in 2007 or Stage 7 in 2010, of Phase II/III*". The details of the excavation and construction are not currently known. Burnside observed construction of Stage 8 in 2013 and noted that the sub-unit was not encountered.

4.4.2.4 Till - Bedrock Interface

Sand was reported between the till and the bedrock at BH12-91 (below Phase II/III near the south Site boundary, at the OW3-84/OW7-91 nest and in OW5-84 (mid Site along the watercourse). The seam was not reported at the six other on-site boreholes that reached the bedrock (OW8A-91, OW9A-91, OW32A-02, BH10-91, BH11-91, and BH13-91). It is expected to be a very local deposit.

Table 6: Characteristics of Above Bedrock Granular Seam

Location	Soil	Thickness	Groundwater
OW3-84/ OW7-91	Fine to med sand	0.76 1.3	Dry moist
OW5-84	Med to coarse sand with gravel	1.98	Saturated
BH12-91	Fine Sand	0.76	dry

4.4.3 Site Bedrock

The Site and the Study Area Vicinity are underlain grey to tan brown fossiliferous limestone and minor dolostone of the Dundee Formation. This formation is underlain by a light-brown to grey-brown, poorly fossiliferous, laminated limestone and dolostone of the Lucas Formation (Detroit River Group).

According the 1992 Hydrogeologic Report, a clay seam marks the disconformable contact between the two formations on the quarry wall immediately north of the Site. Erosion occurred on the surface of the older lower rock before the younger rock was

formed above it. A geophysical borehole log from OW8A-91 indicated a seam emitting high gamma particle radiation at a depth of 24.5 m. This may correlate with the clay seam separating the Dundee and Lucas Formations. Although less prominent, this geographical marker may correlate to depths of 22 m at OW7-91 and 28.5 m at OW9-91. As such, the bedrock core (observation well screened interval) which was obtained from the lower section of the three bedrock boreholes on Site was interpreted to be the Lucas Formation (CRA, 1992).

An unsaturated interval of bedrock of approximately 12 to 14 m in thickness was noted at each of the bedrock drilling locations. At OW7-91, OW8A-91 and OW9A-91, the bedrock core was taken just below the first indication of the bedrock water table and was found to be moderately fractured (RQD 30 to 45 percent), relatively competent (core recovery 100 percent) and contained numerous stylolites (pressure solution structures).

4.5 Site Hydrogeology

4.5.1 Bedrock Hydrogeology

The primary aquifer in the area is the limestone bedrock. The Town's municipal wells and the majority of private wells use this bedrock aquifer. Regionally, the groundwater flow within the bedrock is from east to west.

The water levels are measured in the on-site monitoring wells, in the leachate collection system and at surface water stations twice a year (spring and fall). The data are contained in tables in Appendix F1 and maps and hydrographs constructed from the data in Appendix F2.

Maps F2.1 and F2.2 show the bedrock flow contours for May and September 2015. The flow direction is toward the west and northwest. This is in the direction of the North Thames River and the regional groundwater flow. However, the North Thames River (at an elevation of approximately 296 m) is above the surface of the bedrock and above the water level in the bedrock (see Figure 9 Cross-Section B-B' and Hydrograph F2.4). At OW32A-02 at the west side of the Site, the water level is 7.7 to 10.4 m (286.6 to 283.7 m amsl) below the top of the bedrock. Therefore, there is no groundwater discharge to the river at this point in the river. The groundwater flow direction is controlled by the regional flow to the west.

The SMC plant is located northeast of the Site within the former limestone quarry. This quarry and the active Thomas Street Quarry located to the northwest of the Site, across the Thames River, are currently dewatered by pumping systems which discharge to the Thames River. This is discussed in more detail in Section 4.6.

According to information provided by SMC, the surface elevation at the plant (east side of Water Street) is approximately 282 m amsl. This is also the bottom of the ponds west

of the plant. The water level of the ponds is approximately 285 m. As of Dec. 16, 2015, the deepest depth of the Thomas Street Quarry was 273 m. The Thomas Street Quarry sump sits at 276 to 277 m; resulting in a water level in the Thomas Street Quarry no lower than 277 m.

Dewatering of the quarry below the water level in the bedrock will affect the water levels in the bedrock at the landfill. However, the regional water levels are already within the bedrock in this area and throughout western Perth County. There are no pre-quarry water levels at the landfill site, therefore the total quarry impact is not known. The dewatering at the Thomas Street quarry to levels below 280 m will be depressing the bedrock water levels in that area, but natural flow is from the landfill toward the quarry. The dewatering may be steepening the gradient, thereby increasing the flow rate, but not affecting flow direction.

Hydraulic conductivity testing was completed in three bedrock wells in 1992. The results are in Table 7.

Table 7: Single Well Response Tests – Bedrock Wells

Well	Test Type	Hydraulic Conductivity (m/sec)	Screened Unit
OW7-91 (run 1)	Falling	$2.0x10^{-4}$	limestone bedrock
OW7-91 (run 2)	Falling	$2.1x10^{-4}$	limestone bedrock
OW7-91 (run 3)	Falling	$2.5x10^{-4}$	limestone bedrock
OW7-91 (average)	-	$2.2x10^{-4}$	
OW8A-91	Falling	$3.8x10^{-5}$	limestone bedrock
OW9A-91 (run 1)	Falling	$2.0x10^{-4}$	limestone bedrock
OW9A-91 (run 2)	Falling	$2.3x10^{-4}$	limestone bedrock
OW9A-91 (average)	-	$2.2x10^{-4}$	
Geometric Mean		$2.2x10^{-4}$	

Source: CRA 1992

4.5.2 Overburden Hydrogeology

There are no regional overburden aquifers in the vicinity of the Site. There are some shallow alluvial deposits associated with the river and localized sand, either overlying or within the upper till that may be used by shallow dug wells.

As noted above, the water table in the bedrock is 8 to 10 m below the bedrock surface. The top of the bedrock is dry. Therefore water found above the bedrock is perched in localized and possibly isolated permeable seams. For example, water is found in the

surficial lacustrine deposit (OW4-84), the upper till (OW8B-10), the inter-till deposits (OW9B-91, OW21-91, OW32-96), and the interface between the till and the bedrock (OW5-84).

However, these units can also be dry. For example, the shallow well at OW6-84 and the deep well at OW3-84 screened at the till-bedrock interface are both dry and have been since installation. These wells are important to understanding the conceptual model of the Site.

Map F2.3 in Appendix F shows shallow water levels for December 14, 2015. Water levels on that date were measured at all possible locations on the Site. These include the wells in the monitoring program, wells not in the program, drive points, and surface water locations. Shallow wells and surface water points were used to contour the shallow groundwater system.

Earlier groundwater investigations described a shallow groundwater divide along Perth Road 123 with water flowing west and east from the road. The December 2015 levels show that the water levels are higher along the road (approximately 317 m amsl) and fall across the landfill to the watercourse (309 to 310 m at monitoring stations).

What is not known is the amount of mounding within the landfill cells. Mounding above 317 m could create a small area of westward movement between the landfill and the property boundary. The leachate control systems were installed to minimize mounding. The invert elevations in Phase I are in the range of 314.2 (MH1) to 316.8 m amsl (MH4). Recent water levels in the manholes show that the system is either dry (MH4 and MH5) or the levels are too low to measure (wet to very slow flow). Therefore, the leachate control system is maintaining levels at or below 316.8 m at the perimeter of the footprint.

The 1982 investigation reported water level elevations in the dug wells west of Phase I as 320.62 m (PW1) and 320.12 m (PW2). The water level at OW3-80 (an on-site monitoring well that has since been decommissioned) was 312.32 m at that time. Current water levels at OW34-96 are 315.8 to 317.8 m and at OW2-84 are 317.2 to 319.1 m. These wells are west of OW3-80 (see Figure 5). A water level above 319 m along Perth Road 123 would prevent the westward movement of water from the landfill.

The highest leachate elevation measured in Phase II/III is 316.7 m at MW14 on the south side. The new manholes at the west end of the fill area (highest part of the leachate collection system) are dry or have insufficient water to measure. Inverts at these manholes are at 316.13 m (MH10) to 317.60 m (MH11). With water levels at OW9B-91 around 315.4 m there is some potential for westward flow between the landfill and this well. Water level elevations above 315.4 m west of OW9B-91 would prevent further westward flow and could create stagnant water within the inter-till deposit below Phase II/III.

On the east side of the fill areas, groundwater in the shallow soils moves east toward the watercourse. At DP1, the water in the watercourse is slightly higher than in the DP indicating water moving from surface water to groundwater. At DP2, the gradient is neutral. At DP3 (downstream), the movement is slightly upward indicating groundwater discharge to the watercourse.

On the east side of the watercourse, groundwater is mounded below the cement kiln dust stockpile, driving flow toward the watercourse from the east part of the Site. While there are no wells on the northeast side of the stockpile, approximate water levels in TP6 and TP10 in November 2015 show contours wrapping around the stockpile creating radial flow out from the stockpile, toward the watercourse and the exposed edge of the quarry. Both watercourse and quarry would be discharge points for the shallow flow.

The hydraulic conductivity of the overburden was tested at several wells in previous studies. The values are contained in Table 8. The CRA 1982 report noted that after installation of wells in the till in 1980, the water levels took approximately one year to reach static.

Table 8: Single Well Response Tests – Overburden

Well	Test Type	Hydraulic Conductivity (m/sec)	Screened Unit
OW1-80	-	$2.0x10^{-11}$	clayey silt till
OW2-80	-	$2.0x10^{-9}$	clayey silt till
OW3-80	-	$4.0x10^{-10}$	clayey silt till
OW4-80	-	$6.0x10^{-12}$	clayey silt till
Geometric Mean		$9.9x10^{-11}$	
OW1-84	Rising	$6.0x10^{-7}$	gravel seams
OW2-84	Rising	$3.0x10^{-6}$	gravel seams
OW15-91 (run 1)	Falling	$6.7x10^{-6}$	sand and gravel
OW15-91 (run 2)	Rising	$8.7x10^{-6}$	sand and gravel
OW15-91 (average)	-	$7.7x10^{-6}$	
OW25-91	Rising	$4.7x10^{-6}$	sand
Geometric Mean		$3.0x10^{-6}$	
OW7-91 (run 1)	Falling	$2.0x10^{-4}$	limestone bedrock
OW7-91 (run 2)	Falling	$2.1x10^{-4}$	limestone bedrock
OW7-91 (run 3)	Falling	$2.5x10^{-4}$	limestone bedrock
OW7-91 (average)	-	$2.2x10^{-4}$	
OW8A-91	Falling	$3.8x10^{-5}$	limestone bedrock
OW9A-91 (run 1)	Falling	$2.0x10^{-4}$	limestone bedrock
OW9A-91 (run 2)	Falling	$2.3x10^{-4}$	limestone bedrock
OW9A-91 (average)	-	$2.2x10^{-4}$	
Geometric Mean		$2.2x10^{-4}$	

Source: CRA 1992

The velocity of water movement depends on the soil type and gradient. Most of the shallow lacustrine soils have been removed; therefore, flow is either through the shallow till or the inter-till deposits. Table 8 contains geometric means for the hydraulic conductivity of wells tested. The hydraulic conductivity for the till is $1x10^{-10}$ m/s and for the inter-till sand is $3x10^{-6}$ m/s.

Estimating velocity using the Darcy relationship of:

$V = Ki/n$ where V = average linear velocity
K = hydraulic conductivity
i = hydraulic gradient
n = porosity

The horizontal hydraulic gradient west of the watercourse was approximately 0.04, calculated from the December 2015 flow map. This is slightly steeper than the gradients of 0.01 to 0.03 noted in the 2013 and 2014 Monitoring Reports.

The horizontal hydraulic gradient east of the watercourse ranged from 0.04 to 0.09 in December 2015, with the steepest gradients occurring on the south side of the CKD stockpile.

Using the horizontal gradient upgradient of DP2 (0.03 in December 2015) and porosities of 0.34 for the silt till and 0.39 for the medium to coarse sand, the velocity would be less than 0.001 m/year through the till and 3 m/year through the sand.

4.5.3 Inter-Till Sand Below Phase II/III

The Hydrogeology Investigation for Phase II/III documented the shallow buried sand and gravel seam under the central part of that fill area. The 2012 Monitoring Report also stated that "*During the construction of cell 5 of Phase II/III a seam of sandy soil was excavated. As a contingency measure, a drainpipe was installed to facilitate the removal of leachate contaminated groundwater in the event the clay base of the landfill failed to provide adequate leachate attenuation in that area. The drainpipe is accessible through MH-A and MH-B located, respectively, on the south and north sides of Phase II/III*". This drainpipe was reported to run along the eastern limit of the inter-till unit. The drainpipe has no outlet.

The inverts of manholes A and B are 311.76 m and 310.79 m respectively. The pipe is shown on Site Cross-Section D-D' (Figure 14) at an average elevation of 311.3 m. The base of the landfill in this area is approximately 315 m. The invert of the leachate collection manhole MH6, near MHB, is 314.79 m.

Water levels are measured in all of the manholes as part of the monitoring program. In September 2015, the water level in MHA was 315.13 m and in MHB 315.36. This is approximately the same level as the landfill base. The leachate level in MH6 was too

low to measure (near invert of 314.79 m). This indicates an upward gradient from the sand seam to the leachate collection system near this perforated pipe. However, leachate levels in the MH14 to the west have been measured at 316.57 m indicating that there could be sufficient mounding in some parts of the landfill to create a downward gradient.

Occasionally, water is noted flowing from the top of MH-B, resulting from a hydraulic head above the top of the manhole (elevation 315.72 m). When this happens, the water flows by roadside swale into Stormwater Basin B. This water has not been part of the monitoring program but was sampled in 2015.

4.5.4 Vertical Movement

It is expected that the primary direction of groundwater movement on the Site is downward. While there is some horizontal movement within the inter-till silt/sand seams and the till-bedrock interface sand, the perched conditions and deep bedrock water levels create a dominant downward movement.

There are seven pairs of nested wells on Site. Table F1.2 in Appendix F contains vertical gradients calculated at five of these well nests. The other two nests are not included, as each have a well that is always dry (OW3-84 and OW6-84). OW3-84 is reported to be screened in a deep sand and gravel unit below the till aquitard and above the bedrock. In the same nest, OW4-84 (shallow sand and gravel) and OW7-91 (bedrock) normally contain water; however OW4-84 has been dry the past two years. This indicates a perched condition in the shallow sand and gravel with the deeper water table occurring in the bedrock. OW6-84 is completed in the till while OW5-84 in the same nest is completed in the deep sand and gravel below the till and produces water.

Four of the five nests in Table F1.2 compare an overburden well and a bedrock well. The water level elevations are higher in all of the overburden wells than in the bedrock wells. The groundwater hydrograph in Figure F2.4 also illustrates that the water level elevations in the shallow overburden wells are consistently higher than the water level elevations in the bedrock wells. This shows downward movement of water from overburden to bedrock.

The gradients in Table F1.2 are in the range of 0.7 to 1.0. These are significant gradients and reflect the pronounced difference in water levels between the overburden and the bedrock. The vertical difference in water levels at the four nests ranges from 22 m to 30 m. The actual magnitude of the calculated gradients is not always meaningful because of dry soils between shallow and deep wells.

The fifth nest in Table F1.2 compares two wells in the overburden; OW33-96 and OW34-96. Both wells are reported to be completed in the aquitard but at different depths. The downward gradient of 1.20 to 1.65 indicates perched conditions in the

shallow well attributed to the low-permeability till between the shallow and deeper well screens. The low permeability soil impedes the downward movement of water.

4.6 St. Marys Cement Activity

SMC is a wholly-owned subsidiary of Votorantim Cimentos, one of the largest cement producers in the world with 25 operating cement plants in the Americas resulting in a combined capacity of 28 million metric tonnes per year. SMC manufactures a variety of cement for different purposes. Their plant is located at 585 Water Street South, St. Marys, Ontario.

The Site boundary for the SMC Quarry and Pit (Site ID 4494), as shown in the online pits and quarries database, is provided on Figure 17. The quarry has a Class A License covering a licensed area of 448.79 ha with a maximum annual extraction rate of 3,250,000 tonnes.

The proximity of the quarries to the landfill site and the potential for mutual interference in the future makes the quarry activity important to the landfill assessment. Below is a summary of historical and current operations at the two SMC quarries; the Thomas Street Quarry and the South Quarry.

4.6.1 1982 Hydrogeologic Investigation for the St. Marys Landfill

The 1982 report indicates that SMC operated two bedrock water supply wells to provide processing water to the cement plant. The Thomas Street Quarry was dewatered by draining the quarry to a pond and pumping from the pond at 3,400 to 4,500 L/min. The report suggested that the combined effect of these pumping activities would create a depression in the groundwater contour around the quarry causing the local bedrock groundwater to flow toward the quarry. Dewatering of the quarry was expected to continue for the life of the landfill since the cement plant is located on the quarry floor.

4.6.2 1992 Hydrogeologic Investigation, Phase II/III for the St. Marys Landfill

The 1992 report indicates SMC was quarrying rock from the area north of the Thames River (Thomas Street Quarry) and transporting the limestone to the Plant Site via an overhead conveyor system that crossed the Thames River and Water Street South at a point north of the landfill. Dewatering was largely maintained by one pump at the Cement Plant Site and by three dewatering pumps along the north side of the Thames River in the active Thomas Street Quarry.

The operational plan for the Thomas Street Quarry involved the limestone being removed in two lifts (1 and 2) over three phased areas: A, B and C. The first lift in an area would be removed while the overburden was being removed from the next area. Quarrying would proceed in the following order of area and lifts: A1, B1, A2, C1, B2 and

C2. The three phased areas are outlined on Figure 17. The first lift was to be approximately 18 m in thickness while the second 12 m; resulting in a final, completed extraction depth in the order of 267 m amsl. Rehabilitation plans in 1992 indicated the Thomas Street Quarry would be allowed to equilibrate with the water level, forming a 136.4 ha lake with a bottom of elevation of 267 m and a water surface elevation of 281 m. Overburden material would be used to form 2:1 slopes against the quarry walls.

The report also made reference to a "Clay Pit/Rock Quarry" southeast of the Thames River; which is known today as the South Quarry (see Figure 17). This pit/quarry was also divided into three phased areas (I, II and III). Within each area, two lifts would occur: A) extraction of the clay resource, and; B) extraction of the limestone resource. Operations would proceed as follows: IA, IB, IIA, IIB, IIIA and IIIB. The three phased areas are also outlined on Figure 17. Extraction in the Clay Pit/Rock Quarry area would be terminated at an elevation of 278 m amsl. The quarry was expected to remain dry at this elevation. The rehabilitation plan for this area was to leave the excavation open. Unused overburden material would be used to create 2:1 slopes against the quarry walls with 3:1 slopes above in the overburden (CRA, 1992).

4.6.3 2012 Hydrogeological Assessment for Proposed Quarry Deepening at the St. Marys Cement Thomas Street Quarry

This report was submitted due to a condition in the quarry's PTTW that limited the mining to an elevation of 277 m amsl. The quarry floor elevation was at 277 m amsl in 2012. Drilling investigations demonstrated that the base of the limestone at the site occurs at elevations between approximately 271 m amsl and 276 m amsl, approximately 1 to 6 m below the elevation restriction.

The stratigraphic sequence in the Thomas Street Quarry consists of limestone of the Dundee Formation and the directly underlying Upper Lucas Formation; both suitable for Portland cement production. The limestone strata overlie dolostone of the Lower Lucas Formation. Investigations indicated that there is approximately 7 m to 10 m of comparatively low permeability dolostone strata separating the limestone base from the first major, highly permeable water bearing horizon beneath the quarry.

Modelling in the report suggested dewatering could lower static groundwater levels at the surrounding municipal/industrial wells by approximately 1 m to 2 m. This lateral expansion and deepening of the quarry would occur within the current area of the southern half of the quarry property, taking place over approximately 10 years. Once the limestone is extracted, the mined out area will be progressively backfilled to the original grade (300-305 m amsl) using the extensive quantities of overburden to be stripped from the northern half of the site; limiting the groundwater inflow.

4.6.4 St. Marys Cement Permits to Take Water

Based on the MOECC online Permits to Take Water (PTTW) database, the main PTTW under the permit holder "St. Marys Cement Inc. (Canada)" is Permit No. 5440-8YFHPP. This Permit corresponds to an Environmental Registry of May 2012. The Permit includes the following locations:

Table 9: St Marys Cement Permits to Take Water

St. Marys Cement Identification	Purpose	Specific Purpose	Max L/day	Source Type
Source #1 (Deep Well 3)	Industrial	Cooling Water	4,354,560	Ground Water
Source #2 (Deep Well 4)	Industrial	Cooling Water	3,892,320	Ground Water
Source #3 (Deep Well 5)	Industrial	Other - Industrial	4,091,000	Ground Water
Source #4 (Garage Well)	Water Supply	Communal	10,000	Ground Water
Source #5 (Crusher Well)	Water Supply	Communal	2,000	Ground Water
Source #6 (North Quarry Sump)	Dewatering	Pits and Quarries	30,240,000	Ground Water
Source #7 (South Quarry Pond)	Dewatering	Pits and Quarries	10,000,000	Ground Water

The source locations are shown on Figure 17 and are based on Figure 1 (Site Location and Site Features) from the 2014 Annual Groundwater Monitoring Report for the St. Marys Cement Facility completed by AMEC Foster Wheeler.

The MOECC PTTW database also lists two other Permits held by SMC. The first is Permit No. 5758-8TANYB for an industrial aggregate washing source with a maximum water taking of 6,813,900 L/day. The second, Permit No. 77-P-1009 issued in 1977 for two dewatering locations and renewed in 1997 as Permit No. 97-P-1059. These two permits were likely replaced by the more recent consolidated permit.

4.6.5 Direct Communications with St. Marys Cement Plant

Email communication occurred with the SMC Environmental Coordinator throughout November and December 2015 in order to obtain information on current operations and future plans of the SMC Plant and quarries. The majority of the information provided was for the active Thomas Street Quarry. The Thomas Street Quarry site plan provided to Burnside is dated November 2011.

SMC confirmed that there are no plans for future dewatering locations. They also indicated that the southernmost dewatering location (Source #7) is used only as a fire suppression source; it is tested monthly to ensure it works and it uses a negligible amount of water. They noted that on the Plant Site, Source #3 (Deep Well 5) is not currently in use. This is the SMC well closest to the landfill.

As of December 16, 2015, the lowest elevation at the Thomas Street Quarry was 273 m amsl and the highest elevation was 279 m amsl. The quarry sump maintains the water level at no lower than 277 m amsl. The surface elevation at the plant is approximately 282 m amsl; which is also the bottom of the surface ponds located west of the plant. The surface level of the ponds is approximately 285 m amsl.

SMC only has a mining plan for the Thomas Street Quarry. Based on current resources and production assets, the estimated lifespan of the two quarries is approximately 60 years. SMC indicated that they may be reviewing their licence and Site Plans in 2016.

5.0 Monitoring Data and Analysis

Annual monitoring at the Site is conducted in accordance with the ECA. Monitoring of groundwater and surface water on the Site began in 1984. The monitoring is conducted twice each year, in the spring and in the fall. Monitoring locations are shown on Figure 18.

The programs and the data presented here is a summary of the information contained in the monitoring reports. If additional detail is required, it can be found in the most recent Annual Monitoring and Operations Report.

5.1 Leachate

The purpose of the leachate monitoring is to:

- Identify the compounds that are present in the leachate generated at the Site;
- Assist in the identification of landfill-derived impacts on the surface water and groundwater; and
- Assess the strength of the leachate going to the sewage treatment plant.

Leachate samples are collected and analyzed for general chemistry parameters, metals and volatile organic compounds (VOC). The monitoring program includes the following parameters:

Table 10: Leachate Monitoring Parameters

Samples from MH1 (Phase I) and MH3 (Phase II/III)			
chloride	BOD	aluminum	lead
sulphate	COD	barium	manganese
alkalinity	TSS	beryllium	molybdenum
calcium	ammonia	bismuth	nickel
magnesium	nitrate	cadmium	silver
potassium	TKN	chromium	strontium
sodium	phosphorous	cobalt	tungsten
field pH	phenols	copper	vanadium
field temp	VOCs	iron	zinc
field conductivity			
All Manholes in Phase I and Phase II/III			
Measure leachate levels			

The following is the range of typical leachate parameters reported from 1991 to 2015.

Table 11: Leachate Concentrations 1991 to 2015

Parameter	Units	MH-1 (Phase I)		MH-3 (Phase II/III)	
		Range	Current	Range	Current
Chloride	mg/L	<40 – 760	423	13 – 3,050	1,760
Conductivity (field)	µS/cm	485 – 7,800	3312	1,320 – 15,700	5,923
BOD	mg/L	4.3 – 250	51	21 – 4,695	232
COD	mg/L	23 – 1,110	131	80 – 7,348	692
Ammonia	mg/L	0.8 – 248	142	32 – 1,132	414
Nitrate	mg/L	<0.1 – 3.84	<2.5	<0.1 – 1.79	<5
Total Phosphorous	mg/L	0.04 – 79.4	0.28	0.45 – 39.9	10.4
Iron	mg/L	0.51 - 694	46.2	1 - 290	1.06
Phenols	mg/L	<0.001 - 0.065	0.025	<0.001 – 1.9	0.072

Both Phases show large variations and there is considerable variation during both the active and closed stages. Current concentrations in both Phases are mid-range values.

The results show concentrations are higher in Phase II/III. This is expected as the Phase II/III is active and the leachate is younger. Sampling of the Phase I perimeter LCS did not start until 1991, approximately two years before the Phase was completed. Phase I was only active for 9 years, while Phase II/III has been active for 23 years and has a greater mass of waste.

Chloride was identified during the 1992 investigation as the critical contaminant for evaluation of groundwater impact. The chloride concentration in Phase I has declined from the highest recorded concentration of 760 mg/L in 1991 but is still above background. The current chloride concentration in Phase II/III (1,760 mg/L) is typical for landfill leachate and is lower than previous highs of 2,480 to 3,050 mg/L (2003 to 2004).

As expected, ammonia is high and nitrate is low. Nitrate is expected to increase away from the reducing environment of the landfill. Iron is also high, particularly in Phase I.

VOC testing has reported sporadic occurrences of selected parameters since testing began in 1991 and 1993 (for Phase I and Phase II/III respectively). In the last two years, the parameters detected are primarily BTEX. These are found in both Phases with concentrations being higher in Phase II/III. In addition, low levels of chlorobenzene and chloroethane have been detected in Phase I. The concentration detected in 2014 and 2015 are contained in the tables below.

Table 12: VOC Concentrations in MH1 (Phase I) 2014-2015

	Sewer Use By-Law	Jun-14	Nov-14	May-15	Sep-15
Chlorobenzene (µg/L)		<0.40	1.30	2.80	<1.00
Chloroethane (µg/L)		2.7	<0.40	2.10	<2.00
Benzene (µg/L)	10	1.5	1.4	2.4	3.5

	Sewer Use By-Law	Jun-14	Nov-14	May-15	Sep-15
Ethylbenzene (µg/L)	60	1.6	1.5	3.0	<1.00
Toluene (µg/L)	20	<0.80	0.85	0.89	5.6
m,p- Xylenes (µg/L)		<0.80	<0.40	0.78	<2.00
o-Xylene (µg/L)		<0.40	<0.20	<0.20	<1.00
Xylenes (Total) (µg/L)	300	<0.80	<0.40	0.78	<2.00

Table 13: VOC Concentrations in MH3 (Phase II/III) 2014-2015

	Sewer Use By-Law	Jun-14	Nov-14	May-15	Sep-15
Chlorobenzene (µg/L)		<1.00	<0.40	<10.0	<1.00
Chloroethane (µg/L)		<2.00	<0.80	<20.0	<2.00
Benzene (µg/L)	10	<2.00	1.2	<20.0	<2.00
Ethylbenzene (µg/L)	60	8.5	14	<10.0	12
Toluene (µg/L)	20	5.7	12	<20.0	11
m,p- Xylenes (µg/L)		17	28	<20.0	22
o-Xylene (µg/L)		4.7	8.2	<10.0	7.1
Xylenes (Total) (µg/L)	300	22	36	<20.0	29

The results are compared to the Town's sewer use bylaws, currently *By-Law Number 46 of 2014, Schedule E - Limits for Sanitary and Combined Sewer Discharge*. All concentrations are below the sewer use criteria.

The measurement of leachate levels in the manholes reports low flow to stagnant conditions in the manholes. The samples collected under these conditions may not be representative of leachate characteristics in the waste mound.

5.2 Groundwater

The groundwater monitoring locations and parameters are listed below. Monitoring well logs are included in Appendix C and well details are summarized on Table C-1 Appendix C. Well records available for the private wells are in Appendix B.

Table 14: Landfill Groundwater Monitoring Locations

Overburden			Bedrock
OW2-84	OW8B-91*	OW32-96	OW7-91
OW3-84	OW9B-91	OW33-96	OW8A-91
OW4-84	OW15-91	OW34-96	OW9A-91
OW5-84	OW21-91		OW32A-02
OW6-84	OW25-91		

Table 15: Private Groundwater Monitoring Locations

Current No.	Well Location	MOECC No.	ECA Designation
PW1	1760 Perth Road 123	7175685	Hall (#25)
PW2	1025 Water Street South	NA	Riordan Farm (#26)
PW3	1774 Perth Road 123	5002038	Riordan (#3)
PW4	1736 Perth Road 123	5004319	Heard (#27)
PW5	1764 Perth Road 123	5003434	McCurdy (#24)

Table 16: Groundwater Program Parameters

Parameters		Wells
Field pH	Alkalinity	OW2-84
Field conductivity	Sodium	OW4-84
Field temperature	Sulphate	OW5-84
Chloride	Boron	OW8B-10
Hardness	Iron	OW9B-91
DOC	Manganese	OW15-91
Calcium	BTEX	OW21-91
Magnesium		OW32-96
Phenols	Water levels	OW32A-02
		OW34-96
Field pH	Water levels	OW7-91
Field conductivity		OW8A-91
Field temperature		OW9A-91
Chloride		OW25-91
Hardness		OW33-96
DOC		
Calcium		
Magnesium		
Phenols		
Field pH		PW1
Field conductivity		PW2
Field temperature		PW3
Chloride		PW4
Hardness		PW5
DOC		
Calcium		
Magnesium		
Phenols		
Historically dry wells	Water levels	OW3-84
		OW6-84

5.2.1 Overburden Groundwater Results

OW2-84 and OW25-91 (overburden) are up-gradient of the fill areas and have been considered the background wells for the Site (see Figures F2.3 Appendix F). OW2-84 is the most northwesterly overburden well. Located along the west property boundary it is up-gradient of the Phase I fill area. OW25-91 is the most southerly overburden well. Located along the southern property boundary, it is up-gradient of the Phase II/III fill area.

The range of concentrations for typical leachate indicators reported at these two wells over the last 10 years is summarized below.

Table 17: Overburden Background Concentrations 2006 to 2015

Parameter	Units	OW2-84	OW25-91
Chloride	mg/L	3.6 – 9.0	5.0 – 12.0
Conductivity	µS/cm	260 – 380	500 – 750
Hardness	mg/L	120 – 180	300 – 700
DOC	mg/L	0.8 – 3.0	<1.0 – 2.5

Overburden wells OW9B-91, O15-91, OW21-91, OW32-96, OW33-96 and OW34-96 are up-gradient or cross-gradient relative to the fill areas. The 2015 groundwater chemistry at these wells is summarized below.

Table 18: Upgradient/Cross-Gradient Groundwater Concentrations Phase I - 2015

Indicator	Unit	OW32-96		OW33-96		OW34-96	
		May	Sept	May	Sept	May	Sept
Chloride	mg/L	49.7	56.9	32.8	37.1	18.6	23.7
Conductivity	µS/cm	563	446	533	506	609	626
Hardness	mg/L	245	258	159	168	276	295
DOC	mg/L	0.9	0.8	2.0	1.2	1.2	0.8

The chloride concentrations are all elevated above background. The levels at OW32-96 and OW34-96 are within their historical ranges, although both are at the top end of those ranges. OW33-96 has been rising slowly since 2002. Conductivity, hardness and DOC are either within or close to the background levels.

Wells OW9B-91, OW15-91 and OW21-91 are located up-gradient of Phase II/III. The 2015 groundwater chemistry at these wells is summarized below.

Table 19: Upgradient Groundwater Concentrations Phase II/III - 2015

Indicator	Unit	OW9B-91		OW15-91		OW21-91	
		May	Sept	May	Sept	May	Sept
Chloride	mg/L	311	402	67.3	99.0	344	578
Conductivity	µS/cm	1,628	1,763	743	808	1,232	1,525
Hardness	mg/L	586	674	243	296	551	798
DOC	mg/L	3.9	4.5	1.9	2.1	2.7	2.8

Prior to 1999, OW21-91 exhibited elevated chloride concentrations up to 50 mg/L. After 1999, the concentrations increased, peaking at 556 mg/L in November 2007. Since that time, the concentration has fluctuated, being as low of 70 mg/L in 2011 and as high as 578 mg/L in September 2015. Conductivity, calcium and magnesium all increased over this same time period (1999 to present). Phenols are also typically elevated at OW21-91; the concentration was 28 µg/L in May and 23 µg/L in September.

Chloride concentrations at OW9B-91 began increasing in April 2012 reaching 402 mg/L in September of 2015. The following chloride ranges have been observed at OW9B-91 since installation.

Table 20: Chloride Range at OW9B-91

Time Period	Chloride Range
1991 – 2005	1 to 6 mg/L
2005 – 2011	10 to 40 mg/L
2012 – 2013	161 to 194 mg/L
2014 – 2015	257 to 402 mg/L

DOC, iron and manganese concentrations are also elevated at OW9B-91. In 2015 the DOC levels ranged from 3.9 to 4.5 mg/L, which is within the historical range and just below the Ontario Drinking Water Quality Standards (ODWQS). Iron and manganese were measured for the first time at OW9B-91 in 2015. Iron had a concentration of 2.54 mg/L in May and 3.11 mg/L in September; manganese concentrations ranged from 0.101 to 0.126 mg/L.

Elevated chloride levels have been observed at OW15-91 since 2013. Prior to 2013, chloride concentrations ranged from 1 to 15 mg/L at OW15-91. Since 2013, the range has increased to 50 to 99 mg/L. Conductivity and DOC are also elevated above background levels in OW9B-91.

All three of these wells are located along the base of the access road. OW21-91 is located between the access road and the scales. The discussion on topography and local geology noted that Perth Road 123 is along a ridge forming a surface water and shallow groundwater divide. Water levels measured in these wells have always

indicated that the wells are up-gradient of the landfill. Therefore, it was thought that the elevated chlorides in this area were due to road salt.

The concentrations of boron and iron at OW15-91 and OW21-91 remain within historic ranges (2003 to 2015), also suggesting a non-landfill source of chloride. However, these additional parameters were added at OW9B-91 in 2015 and the 2015 results showed elevated concentrations of boron and iron. The source of the elevated chloride, boron and iron is to be investigated as part of the on-going operations and monitoring of the site.

According to the water levels and shallow flow mapping, the down-gradient wells are located east of the fill area. Groundwater flow in the shallow overburden is toward the east - northeast.

Monitoring wells OW4-84 and OW6-84 are screened in the shallow overburden. OW3-84 and OW5-84 are screened in the deeper sand and gravel between the till and the bedrock. Both are downgradient of Phase I. Due to the deep water table in the bedrock and the perched conditions in the overburden, OW3-84 (deep overburden) and OW6-84 (shallow overburden) have always been dry, therefore not sampled.

OW4-84 (shallow) was installed in 1984 and has been sporadically dry since 1993. It was dry in 2014 and 2015. Original chloride concentrations in 1984 and 1985 are low (less than 10 mg/L). Concentrations rose from 1988 to 1992 reaching a high of 354 mg/L. After 1992, the concentrations gradually declined and from 2002 to present have been below 10 mg/L.

Table 21: Downgradient Groundwater Concentrations Phase I - 2015

Indicator	Unit	OW5-84	
		May	Sept
Chloride	mg/L	46.7	36.2
Conductivity	µS/cm	877	686
Hardness	mg/L	354	299
DOC	mg/L	1.2	1.0

Chloride levels at OW5-84 have been in the range of 15 to 60 mg/L since 2006. Prior to 2006, chloride concentrations were at background. There is no increasing trend. October 2013 was the first time the additional parameters were sampled at OW5-84. Results indicate that sulphate and iron are also elevated at this location. This well is screened in sand and gravel just above the bedrock. There are no background wells in this formation. A comparison with the water quality in the bedrock wells indicates that the water in this sand lense may be influenced by the bedrock.

OW8B-10 is screened in the shallow overburden, in the till aquitard, downgradient direction from Phase II/III.

Table 22: Downgradient Groundwater Concentrations Phase II/III – 2015

Indicator	Unit	OW8B-10		MHB
		May	Sept	May
Chloride	mg/L	10.5	12.5	96.9
Conductivity	µS/cm	1,052	1,025	812
Hardness	mg/L	487	498	448
DOC	mg/L	2.2	1.9	5.2

Chloride concentrations at OW8B-10 are at background levels. Conductivity and DOC levels are slightly elevated above the concentrations at the up-gradient wells. Additional parameters were also analyzed at OW8B-10 for the first time in October 2013. The results continue to show sulphate to be higher at this location (350 mg/L) than at the background well OW2-84 (23.2 mg/L). This well is screened in the till rather than the sand or silt.

MHB is the overflow from the perforated pipe under Stage 5 of Phase II/III. Previous monitoring reports stated that a water sample from the overflow of MHB was tested in November 2007 and the results indicated that "MH-B is not impacted by the landfill" (CRA, 2011). Burnside sampled the overflow in May 2015. Leachate indicator results are included in Table 22. The chloride concentration was 96.9 mg/L and the remaining leachate indicator parameters were also slightly elevated. MHB is being added to the monitoring program beginning in 2016 to establish a database. The results will be used to identify trends and assist in determining if leachate impacts are present.

5.2.2 Bedrock Results

OW8A-91 is up-gradient of the fill areas and is considered the background bedrock well for the Site. OW8A-91 located east of the Phase II/III filling area, 90 m from the southern property boundary and 280 m from the eastern property boundary.

OW7-91, located east of stormwater management Basin A, is up-gradient to Phase I and cross-gradient to Phase II/III.

The range of concentrations reported for typical leachate indicator parameters over the last 10 years for the background wells are summarized below.

Table 23: Bedrock Background Concentrations 2006 to 2015

Parameter	Units	OW8A-91	OW7-91
Chloride	mg/L	2.0 – 17	<3.0 – 42.2
Conductivity	µS/cm	570 – 1,140	402 - 1,800
Hardness	mg/L	279 – 1,230	300 – 1,270
DOC	mg/L	<1.0 – 14.5	<0.5 – 10.8

The water quality in the two wells is similar. Comparison of the overburden and bedrock chemistry indicates all of the parameters above are higher in the bedrock.

There are two downgradient bedrock wells. OW9A-91 is located at the western side of the property at the bottom of the slope of the entrance lane to the Site, downgradient of Phase II/III. OW32A-02 is located near the northwest corner of the Site beside Perth Rd. 123 and is downgradient of Phase I.

Table 24: Downgradient Bedrock Concentrations – 2015

Indicator	Unit	OW9A-91		OW32A-02	
		May	Sept	May	Sept
Chloride	mg/L	3.64	5.92	5.34	7.23
Conductivity	µS/cm	764	728	612	488
Hardness	mg/L	268	273	240	253
DOC	mg/L	3.6	2.9	1.4	1.2

The parameters analyzed at OW9A-91 and OW32A-02 exhibit the same characteristics as the background bedrock wells. Chloride concentrations at these wells range from 1.5 to 11 mg/L. Historically, iron concentrations at OW32A-02 have been elevated above the ODWQS and were 0.769 mg/L and 0.726 mg/L in 2015. Iron is not analyzed in the background bedrock well. There is no indication of landfill impact to the bedrock aquifer.

5.2.3 Private Well Results

Five private water supply wells are sampled as part of the monitoring program. The approximate locations of the private wells are shown on Figure 18. The well owners are provided with the laboratory reports for their wells annually.

The wells are only sampled if the owners are present as the sampling points are inside the residences. For that reason, PW2 and PW3 are sampled periodically. The table below contains the results of the last two samples at each well.

Table 25: Groundwater Concentrations – Private Wells

Well	Date	Chloride (mg/L)	Hardness (mg/L)	Conductivity (µS/cm)	DOC (mg/L)
Overburden					
PW2	Oct 2013	131	285	891	2.0
	May 2015	137	317	988	1.8
Bedrock					
PW1	May 2015	3.52	258	664	1.2
	Sep 2015	4.36	286	573	0.9

Well	Date	Chloride (mg/L)	Hardness (mg/L)	Conductivity (µS/cm)	DOC (mg/L)
PW3	Nov 2012	557	318	574	1.1
	May 2013	62.8	269	726	1.2
PW4	May 2015	3.09	299	761	1.2
	Sep 2015	3.50	321	605	1.1
PW5	May 2015	29.4	291	732	1.1
	Sep 2015	16.3	319	619	1.0

Overburden Private Wells

PW2 is located on high ground relative to the Site and is considered to be in an upgradient position as indicated by the shallow groundwater flow patterns. The reported depth suggests it is completed at the same elevation as the inter-till unit identified on site.

PW2 has displayed historically fluctuating levels of chloride. Chloride has ranged from 22 mg/L (May 1985) to 326 mg/L (September 2003). Phenols are generally less than 1 µg/L and the other indicator parameters are generally consistent with background conditions. PW2 is reportedly susceptible to seasonal water level fluctuations and has occasionally become dry during summer months. In the past, a licensed water hauler has reportedly filled the well with imported water in such instances. For these reasons, the meaningfulness of the monitoring results is questionable. Only three samples have been obtained in the last five years due to a resident not being present. Access to the sampling point is from inside the residence.

Bedrock Private Wells

The dug well at PW1 was replaced by a drilled bedrock well in 2011. Two samples were obtained during 2015. The concentrations of calcium, chloride, hardness and DOC in the new bedrock well are significantly lower than the historical concentrations in the old overburden well.

PW3 has not been sampled since May 2013 as there has not been a resident available to provide access permission. Historically, the chloride concentration has been relatively stable and consistent within a range of 30 to 100 mg/L. The first sample in 1985 was 82.5 mg/L. The waste placement in Phase I began in December 1984, therefore the chloride may be naturally occurring in the bedrock aquifer. The well did have two isolated spikes, one in March 2011 at 1,130 mg/L and one in November 2012 at 557 mg/L. Both times the next sample returned to normal levels.

The groundwater quality at PW4 has been stable and is consistent with background concentrations.

PW5 displayed parameter concentrations similar to background groundwater quality for the current reporting period with the exception of chloride. Chloride concentrations in the range of 24 to 38 mg/L are higher than PW1 and PW4 but lower than PW3. Other parameters analyzed at this location are consistent with historical data and the background bedrock aquifer concentrations.

5.3 Surface Water

Surface water monitoring conducted at the Site consists of semi-annual samples from the watercourse and from the two stormwater management basins (Basin A and Basin B). The purpose of this monitoring is to identify impacts on the surface water passing through the Site but not in direct contact with the waste.

The watercourse flows across the Site from the southeast corner to the northwest corner. This watercourse provides drainage of the SMC lands located upgradient of the landfill, as well as industrial land and agricultural land further upstream.

Surface water monitoring location SP1-10 is the upstream surface water station and SP3-93 is the downstream station. SP2-93 is located mid-site between the outlets of the two stormwater management basins.

The stormwater management basins collect runoff from the Site and provide sediment control before releasing stormwater to the onsite watercourse. Basin A is located east of Phase I and Basin B is located northeast of Phase II/III. Samples are collected from the inlets and outlets of these ponds to assess the surface water quality on the Site and to provide a basis for the evaluation of the effectiveness of the stormwater basins.

Water levels are also measured at surface water stations during each monitoring event and stream flows are measured at the downstream station SP3-93. The purpose of the data is to provide a general indication of the flow conditions at the monitoring locations at the time of sampling.

Table 26: Surface Water Monitoring Stations

Location	Description
Watercourse	
SP1-10[1]	Upstream (background conditions)
SP2-93	Midstream (between Pond A & B outlets)
SP3-93	Downstream (Site discharge)
Stormwater Pond A (Phase I)	
SP3A-94	Pond A south inlet
SP5A-94	Pond A north inlet
SP4A-94	Pond A outlet

Location	Description
Stormwater Pond B (Phase II/III)	
SP1B-94	Pond B inlet
SP2B-94	Pond B outlet

[1] SP1-93 at the former property boundary was moved upstream to SP1-10 at the new property boundary as a result of the property transfer in 2009.

Table 27: Surface Water Program Parameters

Parameters		Surface Water Station
Field pH Field conductivity Field temperature Chloride Hardness Calcium Magnesium Iron Manganese	Ammonia Un-ionized ammonia BOD5 Total phosphorus Turbidity TSS TDS Phenols Water levels	SP1-10 SP2-93 SP3-93 SP1B-94 SP2B-94 SP3A-94 SP5A-94 SP4A-94
Flow Measurement		SP3-93

Benthic surveys of the ditch running through the Site were also conducted in 1993, 1994, 1995, 1996, 1998, 2000, 2002, 2004 and 2006. The surveys compared qualitative and quantitative samples taken from SP1-93 (upstream) and SP3-93 (downstream). The results of these surveys indicated no landfill impact on the benthic communities in the watercourse.

Based on the leachate testing and the background water quality, chloride, total phosphorus, iron and TSS were selected as leachate indicator parameters.

Basin A

Surface water collected from the cover of Phase I is directed from the perimeter ditches to channels that enter stormwater Basin A at the south (SP3A-94) and north (SP5A-94). The Basin outlets to the watercourse via a corrugated steel pipe (CSP). The outlet sampling location (SP4A-94) is at the downstream end of the pipe.

Historically, chloride concentrations tended to be the highest at the inlet (SP5A-95) which receives water from the north end of Phase I. The concentrations for 2004 to 2012 were in the 60 to 160 mg/L range. This sampling point has been dry since 2013. The concentrations are generally lowest at the south inlet (SP3A-94) which is typically below 100 mg/L and has also been sporadically dry.

The chloride concentrations at the outlet (SP4A-94) are ranging from 30 to 130 mg/L. Iron and total phosphorus concentrations at the outlet are sporadically above the PWQO. TSS levels at the outlet spiked during 2008 monitoring but returned to the historical range of less than 10 mg/L.

Basin B

Surface water collected from the cover and perimeter of Phase II/III is directed to stormwater Basin B by a corrugated steel pipe (CSP) beneath the access roadway. The inlet sample location SP1B-94 is at the discharge of the CSP to Basin B. The Basin also outlets to the watercourse via a CSP. The outlet sampling station (SP2B-94) is at the downstream end of the pipe. These sampling stations are sporadically dry and, for this reason, were only sampled once (November 2014) in the last two years.

Chloride concentrations at the inlet (SP1B-94) are typically higher than the outlet (SP2B-94). In the last ten years, chloride at the outlet has exceeded the Aquatic Protection Value (APV) of 180 mg/L on two occasions (August 2012 and November 2014).

Historical results indicate that the surface water generated from the Phase II/III disposal area and Site operations has elevated levels of iron and phosphorous. Iron levels typically exceed the PWQO at both sampling stations. Levels were at the lower end of the historical range when last sampled in November 2014. Total phosphorus has typically exceeded the PWQO at both stations. It was below the detection limit in November 2014. In the last ten years, TSS at the outlet has generally been below 50 mg//L with occasional spikes to 60 to 80 mg/L.

The quality at the Basin A outlet is better than the quality from Basin B. Both Basins A and B were inspected for sediment buildup in 2015; no significant sediment accumulation was noted in Basin A. The sediment depth was measured near the T-bar in Basin B with approximately 43 cm noted in 2015 which represents a 5 cm increase from 2014. The Basin outlets should be inspected on a regular basis and the structures cleaned of roots/vegetation.

On-Site Watercourse

Flow rates have been measured and volumes calculated at the downstream surface water station (SP3-93) since 1994. These flow rates are included in Table F1.3 in Appendix F. Flow rates vary from highs ranging from 200 to 600 L/s to lows of less than 5 L/s. In September of 2015, there was no flow and the channel was dry. This was the first time the watercourse was reported to be dry.

As part of the EA work, flows are being measured monthly at SP3-93, as well as an upstream location. The upstream location is approximately 30 m east of DP1 (between

DP1 and SP1-10). The water at SP1-10 is ponded during low flow conditions and would not have been a reliable measuring location. The channel at DP1 is wide and was also not a suitable location for good flow measurements.

Measurements were not made in January or February 2016 due to frozen conditions. Measurements were made on March 29, 2016 when water levels were high due to snow melt and rainfall. The flows were 167 L/s at the upstream station east of DP1 and 171 L/s at the downstream station SP3-93, a gain of 4 L/s between stations. Monthly measurements will continue over the spring and summer months.

There are three water quality sampling stations along the watercourse. The mid-site location, SP2-93 has only been sampled since 2013. Typically, the water quality is similar between upstream (SP1-10) and downstream (SP3-93). This indicates no landfill impact on the watercourse. Chlorides at the upstream station have varied from 13 to 887 mg/L, phosphorus from less than detection limit to 0.69 mg/L and iron from 0.05 to 127 mg/L. Iron and phosphorous typically exceed PWQO at all three locations.

6.0 Assessment of Alternative Methods

6.1 Alternative Methods to Expand the Existing Landfill

As stated in Section 1.0, the preferred *Alternative to the Undertaking* is to expand the existing landfill. Therefore, the *Alternative Methods* are design options for an expansion. The purpose of this study, as stated in the Hydrogeology Work Plan is:

> *To evaluate a variety of Alternative Methods for expanding the St. Marys landfill in order to fulfill the Town's post-diversion solid waste disposal needs for the next 40 years.*

Five *Alternative Methods* were proposed and are summarized in Table 28. A conceptual drawing has been created for each method. These are included in Appendix G. These are not landfill designs, but rather general footprint areas taking into account required buffers, setbacks and maximum slopes.

Table 28: Alternative Methods for Carrying Out the Undertaking

Alternative Methods		Description
1	Vertical expansion of the existing landfill	This *Method* involves an expansion in the vertical direction within the existing footprint of the landfill.
2	Horizontal expansion of the existing landfill	This involves an expansion outside of the existing landfill footprint.
3	A combination of vertical and horizontal expansion	This *Method* would involve partial vertical expansion along with some horizontal expansion of the landfill footprint, basically a mixture of *Methods* 1 and 2.
4	Development of a new landfill footprint	This *Method* involves closure of the existing 8 ha footprint and development of a new landfill footprint elsewhere on the 37 ha Site.
5	Vertical expansion plus a new footprint	This *Method* is a combination of Methods 1 and 4.

To assist in assessing how each method will alter the Site, schematic outlines of the Alternative Methods have been added to the cross-sections (see Figures 19, 20 and 21).

The potential volume available with each Alternative Method has been calculated based on the footprint area and proposed height-of-fill contours. The contours will be adjusted during the EPA design stage. The estimated volume required by the Town for 40 years of waste and cover capacity is approximately 708,000 m^3.

6.2 Impact and Mitigation Evaluation

Each alternative was evaluated according the how it would alter the Site. The alterations included, for example, increasing the height of the waste mound, increasing the waste

footprint area, changing topography and slopes, creating new areas of the Site covered by a waste footprint, or altering current stormwater and leachate controls. The impact of each alteration was then considered on:

- Leachate generation
- Groundwater quantity
- Groundwater quality
- Surface water quantity
- Surface water quality

The geological and hydrogeological data contained in Section 4.0 and 5.0 was used in the evaluation of alternative methods. The advantages and disadvantages of the alternatives were determined based on their potential for impact on the hydrology of the Site. Potential impacts could include:

- Construction Phase(s):
  - Encountering silt, sand or gravel seams during construction of cells and stormwater control features;
  - Encountering shallow saturated soil during construction of cells and stormwater control features, and,
  - Encountering contaminated soil during construction.
- Active Filling Phase:
  - Leachate production, mounding and outbreaks;
  - Surface water control;
  - Alteration of shallow groundwater flow;
  - Contaminant migration away from the landfill in shallow groundwater toward surface water features and the property boundary; and,
  - Downward contaminant movement into till.
- Closure and Post-Closure Phase:
  - Leachate production, mounding and outbreaks;
  - Contaminating life span; and,
  - Aggregate resource nearby.

The potential for impacts was based on the expectation that the landfill features required for proper operations would be of sound design and construction. As a minimum, they will be equal to the current design. For example, if the current stormwater control basins need to be relocated, it is assumed that the replacement basins will be properly designed and will meet the same or higher levels of quantity and quality control now in place.

Tables H-1 in Appendix H, evaluate the expected Site alterations for each Alternative Method and the related potential impacts. The Site alterations use the existing conditions and the current landfill design and operations as the baseline. Therefore, if a Site alteration is judged to have No Net Impact to groundwater and surface water that does not mean no impact at all, but rather no new impact beyond current Site conditions.

The potential impacts outlined in Table H-1 could be either positive or negative. Some impacts apply to more than one Alternative Method. Each negative impact was given a sequential number (N1, N2, N3, etc.). The negative impacts were then listed in Table H-2 Groundwater or H-3 Surface Water in Appendix H. The tables outline possible mitigation measures for each impact. Each impact and the associated mitigation measures were ranked according to the perceived magnitude. The magnitude was based on both the severity of the impact and the scale of the mitigation measures needed to address it. The rankings were:

- Minor potential impact - requires monitoring with potential for future mitigation (e.g. monitoring around CKD stockpile);
- Low potential impact - requires Site feature alterations with continued monitoring (e.g. stormwater controls);
- Medium potential impact - requires enhanced engineering with monitoring (e.g. extension of current leachate collection system); or
- Major potential impact - requires substantial engineering measures (e.g. redesigned or enhanced leachate collection system).

The following sections summarize the impacts and outline some of the possible mitigation measures. The purpose of outlining the mitigation measures is not to provide all the possible outcomes, but to evaluate the magnitude of the impact by the scale of the mitigation measures that may be needed. Alternative methods that have many minor impacts would be more acceptable than methods that have one or two major impacts.

The impacts and mitigation measures are focused on the On-site Study Area and not the Study Area Vicinity. The impacts in this study are all water related and the goal is to minimize the on-site impacts with mitigation measures to eliminate the off-site impacts in the Study Area Vicinity.

6.2.1 Leachate Generation

While this report is focused on groundwater and surface water quantity and quality, the alternative methods could affect the amount and the strength of the leachate produced. This in turn could impact the water resources. Therefore, impacts that affect leachate generation are included in the impact assessment. Leachate related impacts fall into three categories:

1) Increased leachate generation:

Impact - This includes an increase in the volume of leachate produced by increasing the footprint area and exposing a larger surface area of waste. It also includes changes to topography within the footprint that could induce more infiltration of precipitation.

Mitigation - Design and Operations to reduce work area (keep working area small), good use of interim, final cover and grading to promote runoff, vegetation to promote evapotranspiration, and stormwater collection and controls. An extension of the current leachate collection system to cover additional footprint areas will require an assessment of the sewage treatment capacity and measuring of the volume produced by the Site. Reducing infiltration into the waste will lower the annual production of leachate but could increase leachate strength or increase the contaminating life expectancy.

2) Increased mounding of leachate in the waste:

Impact – Increasing the height of the waste mound could also increase the height of the leachate mounding within the waste. The current leachate collection system was put in place to control the mounding in the existing phases. It was recognized in the design of the phases that infiltration of leachate into the till would be low due to the low permeability of the till. To reduce the potential for leachate breakouts on the side slopes, the current systems were constructed. Controlling the leachate head was also a consideration to controlling the downward movement of leachate into the sand seam underlying Phase II/III. The 1992 design noted higher hydraulic heads in the groundwater in the sand seam than in the leachate collection system.

Mitigation – The design of the leachate collection system would need to be modified or enhanced to maintain the current leachate levels within the waste.

3) Change in leachate chemistry or strength

Impact – Placing new waste over existing waste or over the existing cement kiln dust stockpile (CKD) could change the chemistry of the leachate.

Mitigation – Monitoring chemistry in the leachate collection system and/or the CKD and evaluating the ability of the STP to treat it. The municipality has a sewer use by-law in place but it was meant for commercial and industrial sewage generators.

6.2.2 Groundwater Quantity

Changes to groundwater quantity fall into two categories:

1) Infiltration

The most significant impact to groundwater quantity would be reducing infiltration or increasing discharge. Extensions of the Leachate Control System (LCS) would increase the removal of water from the Site through the STP. Steeper side slopes or additional slope area would increase rainfall runoff to stormwater features for release into the surface water system, rather than infiltration into groundwater.

While these were noted as impacts, the change to infiltration on the Site has not been considered to be significant. The amount of groundwater recharge at the Site is already low. The current groundwater conditions include a low permeable till that is partially dry with perched water near the surface or in the inter-till sand/silt seams. The top of the bedrock is dry as there is little downward movement of groundwater from till to bedrock.

2) Flow Direction

Impact - The shallow groundwater flow pattern below the existing footprint is from west to east toward the watercourse with some discharge of groundwater into the watercourse. East of the watercourse, there is a groundwater mound below the CKD stockpile. The shallow groundwater moves from the CKD stockpile westward toward the watercourse. Moving the watercourse or altering the topography of the Site without controlling groundwater mounding could alter the shallow flow path. Re-aligning the watercourse and using the current channel as part of a future footprint would remove a shallow groundwater discharge point. With no outlet, water levels in that area would rise until the flow direction reversed.

Mitigation – A conceptual model of current flow and potential flow taking into account the mounding in the waste, in the CKD mound, the location of the new watercourse may be needed to design new footprint areas. An extended leachate collection system would control mounding in the waste but a more comprehensive system may be required to maintain shallow flow from CKD mound toward the current watercourse location. Ideally, this flow would be cut off before reaching the waste or it would have to be picked up in the LCS. Water level monitoring is needed to track changes to the shallow groundwater movement.

6.2.3 Groundwater Quality

1) Leachate or stormwater runoff moving downward to sand/silt seam.

Impact – An inter-till sand seam has been identified below Phase II/III. The seam is not present or is present as silt over the remainder of the Site. Adding more waste above Phase II/III could result in higher leachate heads moving water downward into

this seam. There is also potential for additional footprint areas or new Site features such as excavated stormwater basins or a re-aligned watercourse to open pathways for water to reach the seam (if present).

Mitigation – The presence of the seam would be determined in proposed construction locations. If present and shallow, it may need to be excavated and replace with more impermeable soil if necessary. The leachate head in waste may need to be controlled by an extension of the current LCS or by modifying and enhancing the LCS.

2) Leachate moving laterally into sand/silt seam from excavation of new footprint or filling of existing watercourse channel.

Impact – Excavating 5 m of soil from new footprint areas would result in the bottom of the new landfill being at approximately the depth of the current watercourse channel (the channel is approximately 5 m deep from top of bank). Therefore, silt and sand noted in OW4-84, OW6-84, TP5 and TP6 (see Figures15 and 16, Site Cross-Sections) would be exposed in sidewalls of excavation. If the seam is not saturated, leachate could migrate into the sidewalls. If the seam is saturated, shallow groundwater would seep into the excavation or into the waste once in place.

Mitigation – The presence of the seam would be determined in proposed construction locations. If present and shallow, it may need to be excavated and replace with more impermeable soil. The depth of excavation may need to be reduced to maintain the bottom of landfill above the seams, increasing the above ground contours. Another alternative would be a liner designed to separate groundwater in the seam from the waste. Where the seam is not present, construction inspection of floor and side walls for permeable seams would be required.

3) Reduced separation between bottom of waste and bedrock.

Impact – The elevation of the top of the bedrock appears to rise toward the north and east sides of the Site. Placing waste in those areas, in conjunction with excavation below current ground level, places the waste closer to the top of the bedrock (the regional aquifer). This reduces till thickness separating the waste from the bedrock.

Mitigation – The depth to bedrock and characteristics of soil between surface and bedrock would need to be confirmed. Current groundwater flow in the bedrock is toward the west (toward private wells and the Thomas Street Quarry) and toward the north (the SMC plant and quarry wall). Major enhancement of the LCS (such as adding a liner) may need to be considered to provide additional separation between waste and bedrock.

6.2.4 Surface Water Quantity

1) Increased Runoff

Impact – Adding height to the current fill areas (increasing slope length), adding more waste footprint area (creating more sloped areas), creating slopes on areas that are currently flat, and creating slopes closer to the top of watercourse bank will increase runoff. Runoff could be more rapid with slightly less infiltration; however infiltration is low in existing conditions due to low permeable surface soil. There could be less retention of water in flat areas or surface depressions and less potential for evaporation or evapotranspiration.

Mitigation – Stormwater and erosion controls measures would have to be incorporated into the design. This could include berms, retention ponds, grassed waterways and vegetated buffer strips.

2) Altered surface water movement across the Site

Impact – Altering the location of the watercourse and stormwater basins or altering Site topography by adding new footprint areas will redirect surface water movement across the Site. Currently, surface water is channeled to the stormwater basins and from there into the watercourse in the centre of the Site. Similarly, runoff from the west side of the CKD stockpile moves toward the centre of the Site. Realigning the watercourse to a position along the eastern and northern property boundary will require moving water from the west and south part of the Site across the Site.

Mitigation – Landfill design will need to incorporate proper grading and stormwater controls to direct, slow and retain water.

6.2.5 Surface Water Quality

1) Potential for contaminated runoff

Impact – The risk of precipitation and clean runoff coming in contact with waste may be increased by adding waste above the current Phase I and Phase II/III footprints, adding new footprint areas, and moving the footprint closer to the stormwater basins and watercourse.

Mitigation – The Design and Operations of an expanded landfill will need to incorporate proper stormwater design and best management practices. These could include:

- Control of the size of active working areas.
- Timely grading and covering of completed or dormant areas.

- Diverting clean water away from the waste (including drop-off, recycling, MHSW, and compost areas).
- Retaining water that contacts waste within the footprint and LCS.
- Slowing release of runoff to the watercourse and controlling erosion and sedimentation.
- Berms or vegetated buffer strips to separate footprint areas and watercourse/stormwater retention areas.
- Final cover and erosion control vegetation to maintain cover.
- Contain waste to waste handling areas (including drop-off, recycling, MHSW, compost areas, and wood wastes).
- Encouraging growth of native vegetation in stormwater retention areas.

2) Leachate break out on side slopes

Impact – Mounding of leachate within the waste could lead to leachate seeps along slide slopes. There is a potential for seeps to mix with clean runoff and move into the stormwater system.

Mitigation – Leachate mounding must be controlled by reducing infiltration into the top of the waste, facilitating seepage of leachate out the bottom of the waste (LCS) or adding a leachate drainage layer on the above-grade side slope to direct leachate seeps to the LCS. Operations, final cover and proper grading are important in reducing infiltration. Depressions that hold water on the landfill surface must be eliminated. Due to the low permeability soils at this Site, removing leachate from the mound requires the installation and maintenance of a leachate control system.

3) Re-alignment of watercourse closer to CKD stockpile

Impact – Re-aligning the watercourse from the centre of the Site to the eastern and northern boundary could put the watercourse closer to the CKD stockpile. Water levels within the stockpile indicate mounding and radial flow outwards from the pile. Cutting a new channel near the toe of the stockpile could induce shallow flow from the stockpile into the channel.

Mitigation – The water quality within the stockpile should be monitored.

7.0 Permits and Authorizations

Other permits or authorizations may be required prior to construction. Permits and authorizations often associated with hydrogeology include:

- Environmental Compliance Approval (monitoring, trigger mechanisms and contingency planning);

- Conservation Authority Regulations; and
- Ontario Water Resources Act, approvals for storm water control and leachate collection systems.

A Source Water Protection Risk Management Plan is not required as the Site is not within a Municipal Wellhead Protection Area or Intake Protection Zone.

8.0 Conclusions

An overall preferred alternative method will be determined based on a review of the advantages and disadvantages of all the areas of study being conducted. This report has outlined only the impacts and potential impact mitigation measures related to ground and surface water. This report has also not considered the volume of waste or Site life provide by each alternative method.

Based on the Site characteristics as described in this report and the impacts outlined in Section 6.0 and Appendix H, the alternative methods have been ranked from least impact to most impact. The magnitude of the impacts were ranked base on the magnitude of site alterations required to mitigate each potential impact.

Leachate Generation and Groundwater

Least Impact - Method 1

Method 3 and Method 4

Method 2

Most Impact - Method 5

Surface Water

Least Impact - Method 2 and Method 3

Method 4

Most Impact - Method 1 and Method 5

9.0 References

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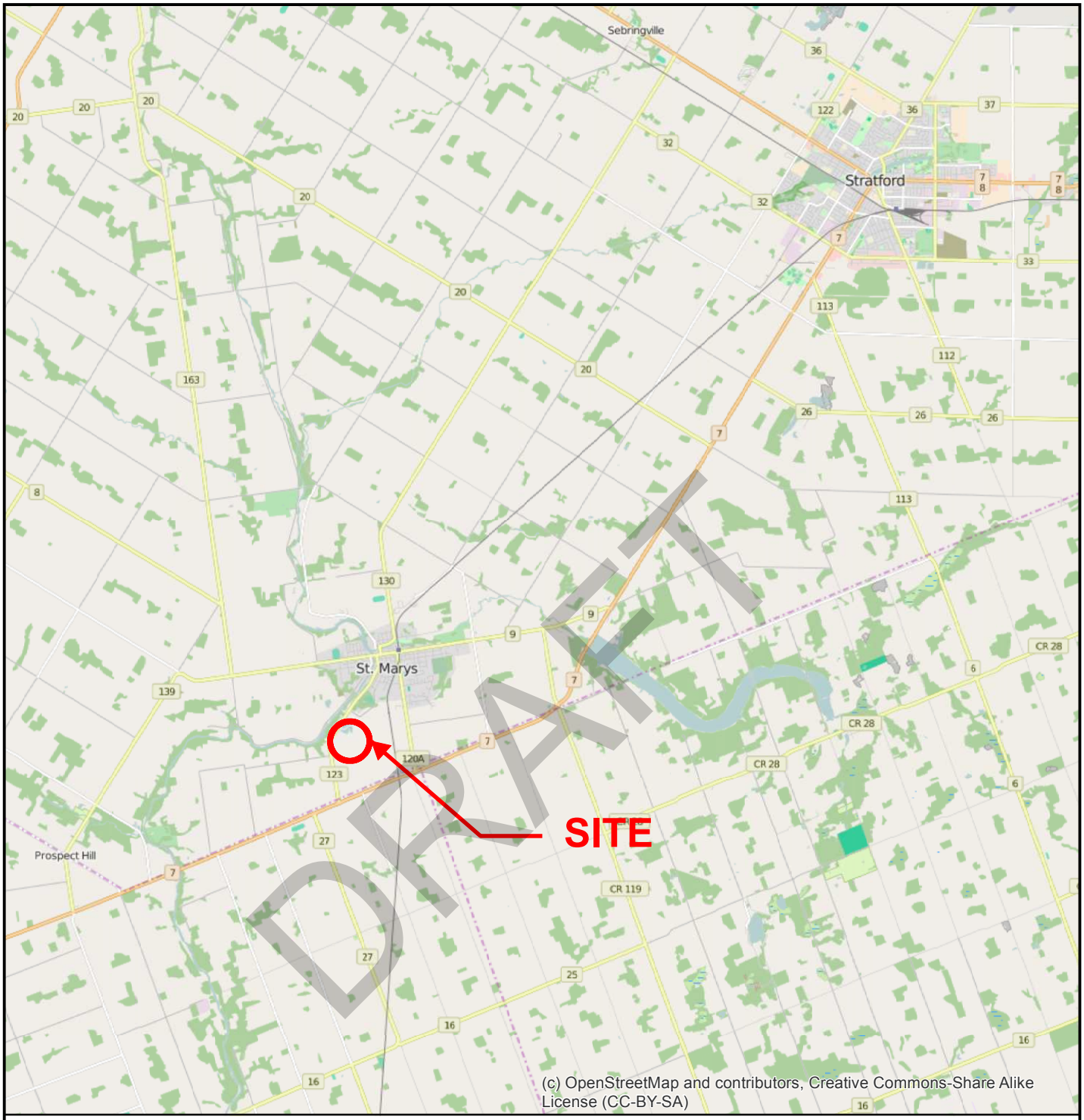
BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Figures



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BURNSIDE

Map Title

SITE LOCATION

Client / Report

THE TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

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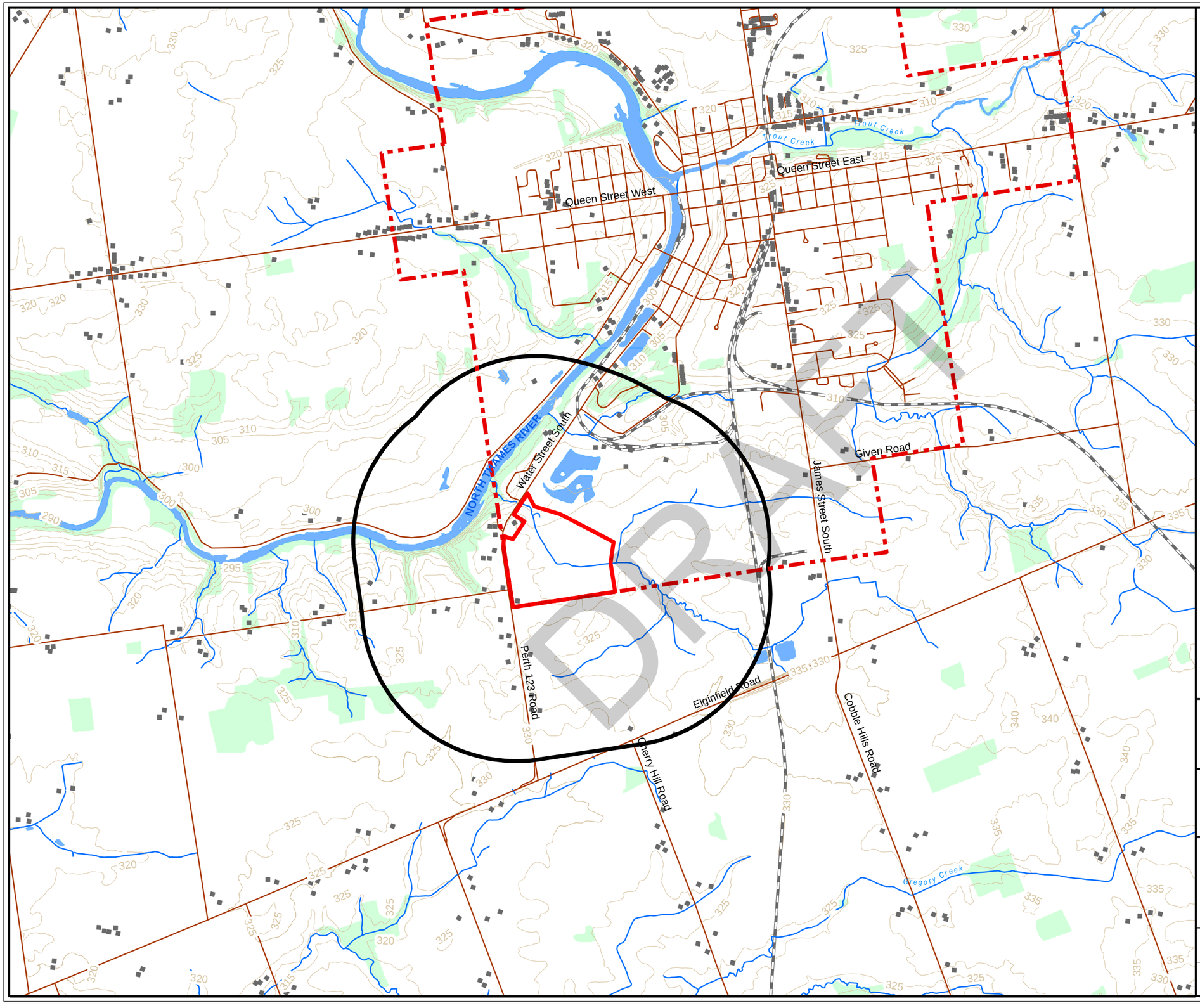

LEGEND

- ON-SITE STUDY AREA
- STUDY AREA VICINITY
- ST MARYS TOWN LIMIT
- ROADWAY
- BUILDING
- WATERCOURSE
- RAILWAY
- CONTOUR (5m intervals - masl)
- WETLAND
- WATERBODY
- WOODED AREA

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

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Client / Report

THE TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

REGIONAL LOCATION

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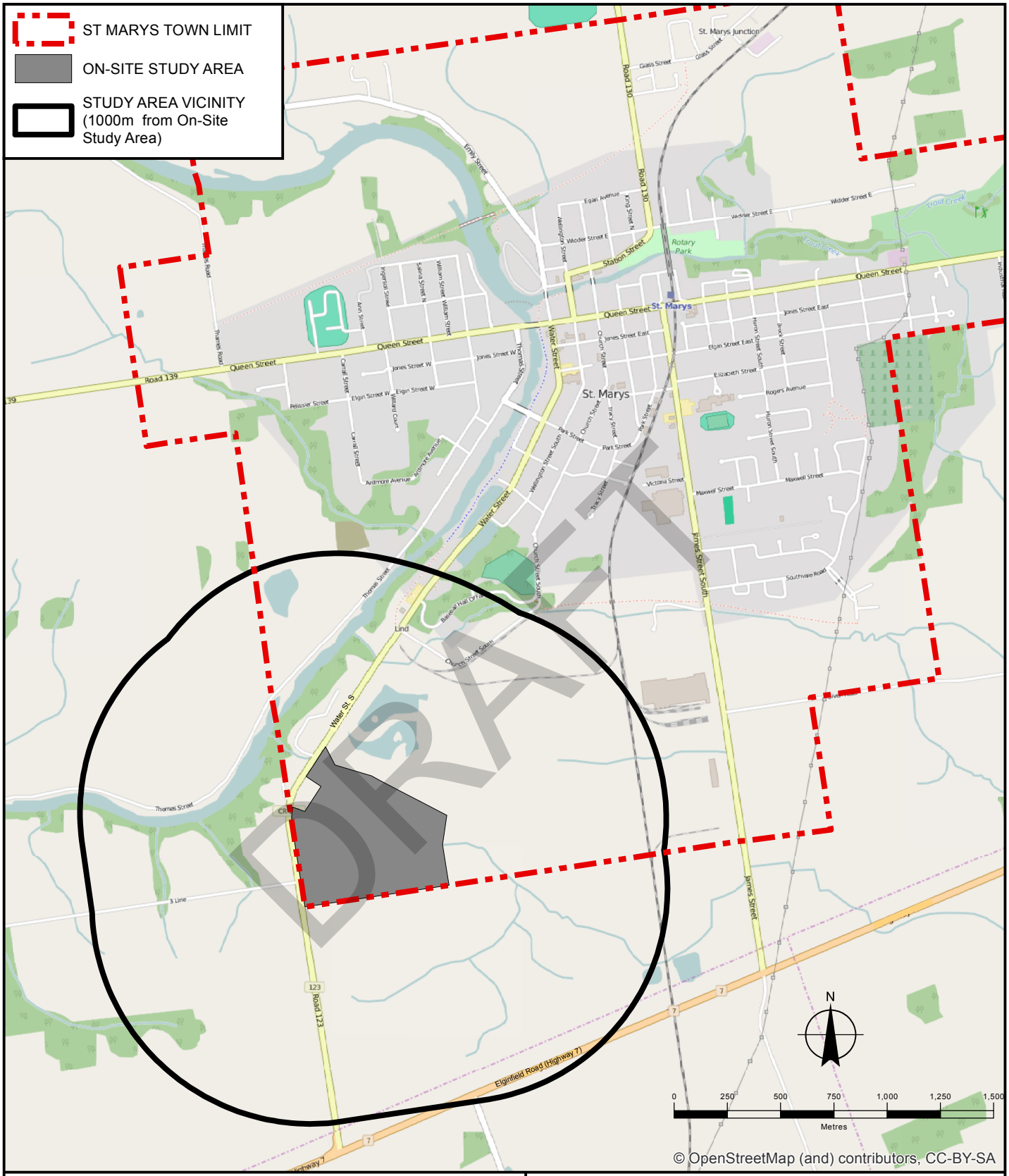

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Map Title

STUDY AREAS

Client / Report

THE TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

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LEGEND

- ON-SITE STUDY AREA / LANDFILL PROPERTY
- STUDY AREA VICINITY

Sources:

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Metres

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THE TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

REGIONAL AERIAL PHOTOGRAPH

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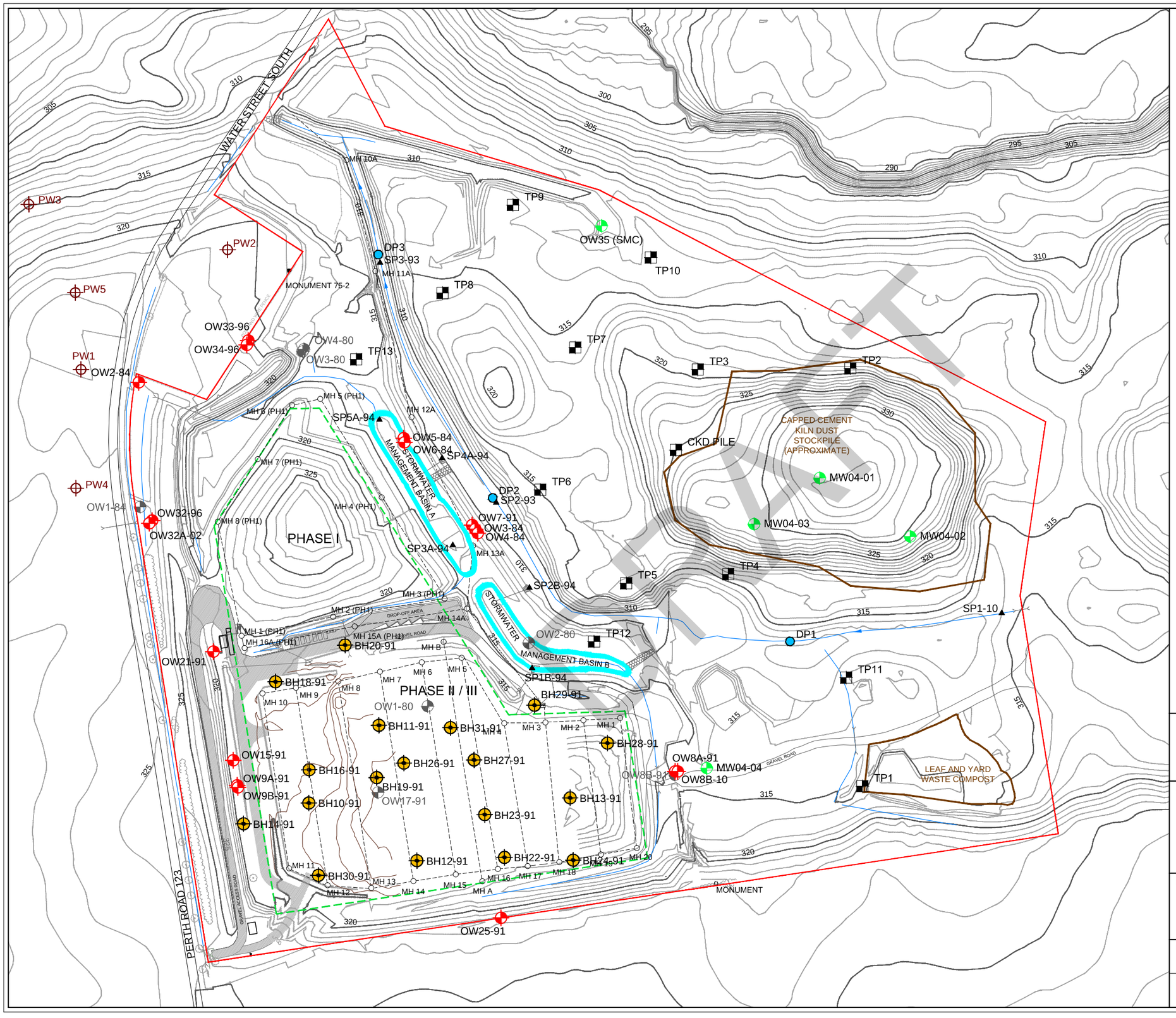

LEGEND

- LANDFILL PROPERTY BOUNDARY / ON-SITE STUDY AREA
- LIMIT OF REFUSE DISPOSAL
- WATERCOURSE
- CONTOUR (5m intervals - masl) (MNR - SWOOP2010 - digital elevation data)
- CONTOUR (1m intervals - masl) (MNR - SWOOP2010 - digital elevation data)
- CONTOUR (1m intervals - masl) (RJB 2015 Survey)
- STORM WATER MANAGEMENT BASIN
- LEACHATE COLLECTION SYSTEM
- LEACHATE MANHOLE
- OBSERVATION WELL (ANNUAL MONITORING REPORT)
- OBSERVATION WELL (ABANDONED AND SEALED)
- OBSERVATION WELL
- DRIVE POINT PIEZOMETER
- BOREHOLE
- PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
- SURFACE WATER MONITORING LOCATION
- TEST PIT

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0 60 120 180 240

Metres

BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

SITE PLAN

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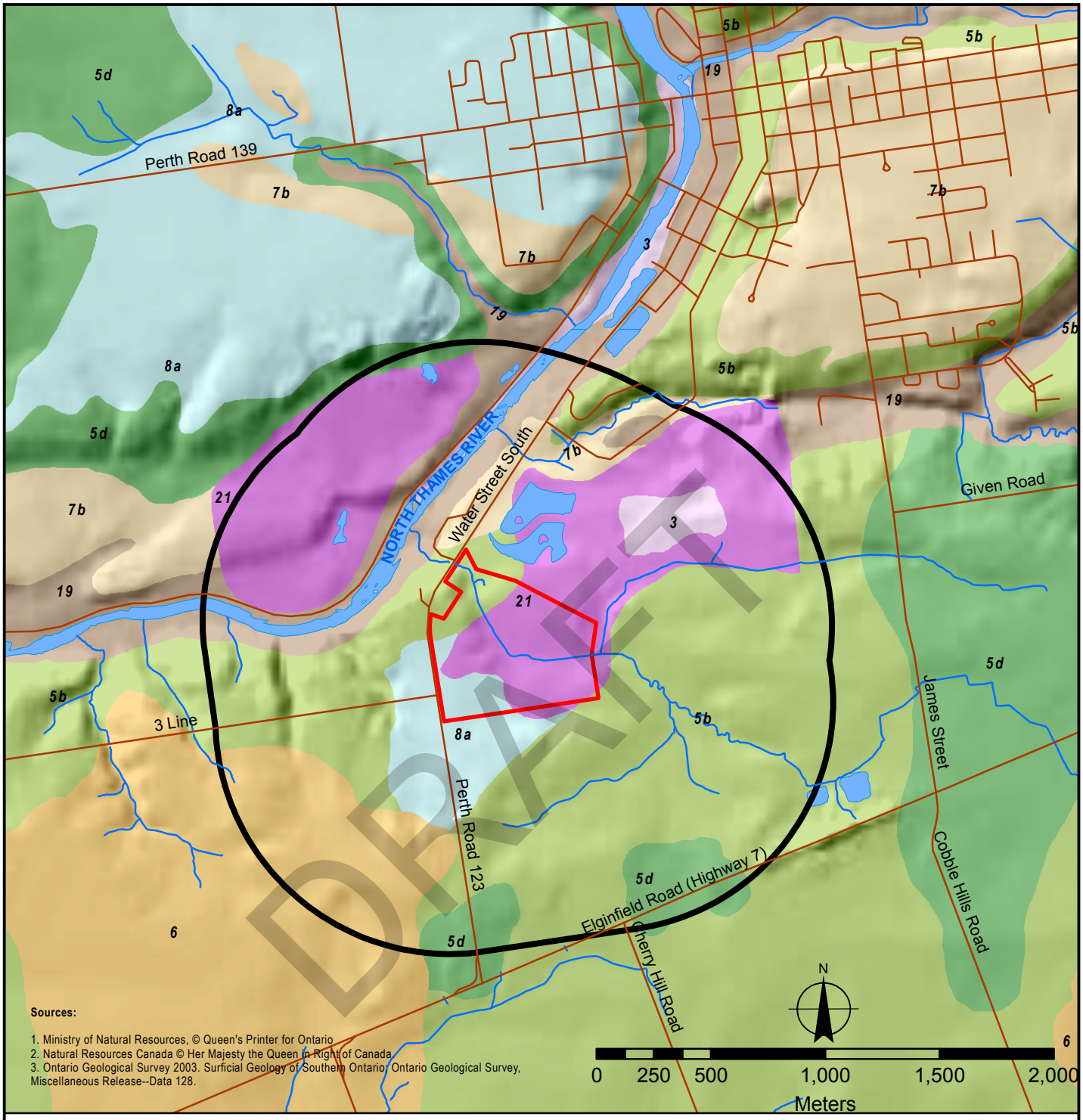

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada
3. Ontario Geological Survey 2003. Surficial Geology of Southern Ontario, Ontario Geological Survey, Miscellaneous Release--Data 128.

LEGEND

- ON-SITE STUDY AREA
- STUDY AREA VICINITY
- ROADWAY
- WATERCOURSE
- WATERBODY
- Terrace
- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7b: Glaciofluvial deposits: Gravelly deposits
- 8a: Fine-textured glaciolacustrine deposits: Massive-well laminated
- 19: Modern alluvial deposits
- 21: Man-made deposits

BURNSIDE

Map Title

SURFICIAL GEOLOGY

Client / Report

THE TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

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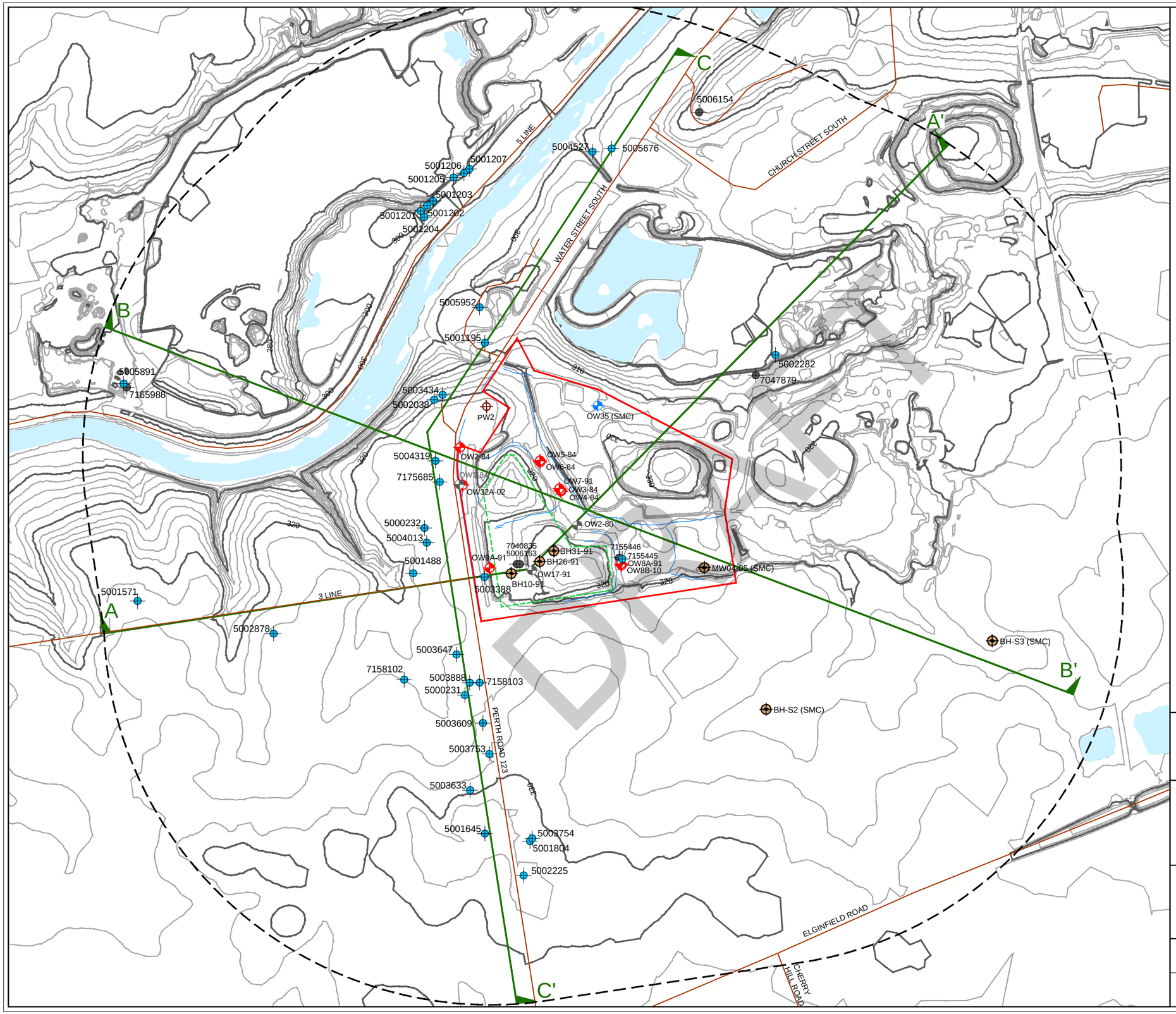

LEGEND

- LANDFILL PROPERTY BOUNDARY / ON-SITE STUDY AREA
- STUDY AREA VICINITY
- LIMIT OF REFUSE DISPOSAL
- WATERCOURSE
- CONTOUR (10m intervals - masl)
- CONTOUR (2m intervals - masl)
- ROADWAY
- OBSERVATION WELL
- OBSERVATION WELL (ABANDONED AND SEALED)
- OBSERVATION WELL (SOURCE UNKNOWN)
- PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
- MOECC WELL RECORD LOCATION
- MOECC WELL RECORD LOCATION (ABANDONED)
- BOREHOLE
- A — A' CROSS SECTION LOCATION KEY

Note: Well locations were not field checked

N

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Metres

BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

REGIONAL TOPOGRAPHY AND CROSS SECTIONS

Drawn	Checked	Date	Figure No.
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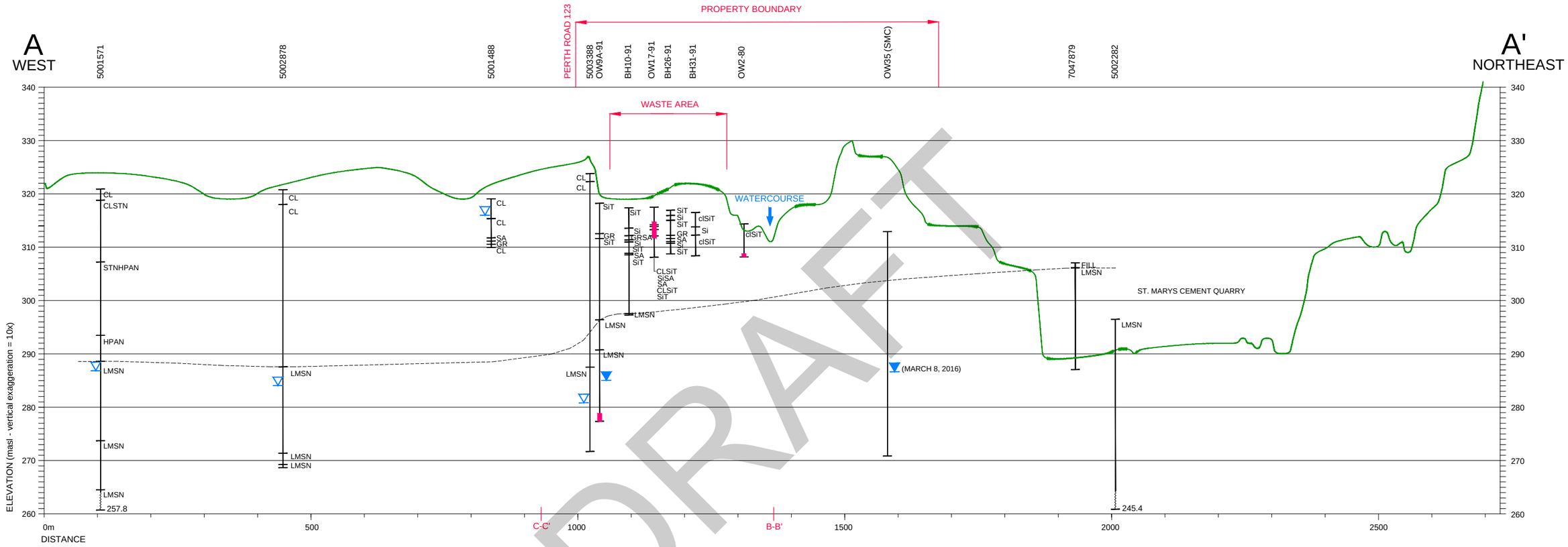

LEGEND

4901807 MW10 — WELL / BOREHOLE ID
MOECC WELL RECORD NUMBER
GROUND LEVEL
WELL
CLGR — GEOLOGICAL STRATIGRAPHY
STATIC WATER LEVEL (REPORTED ON MOECC WELL RECORD)
MEASURED WATER LEVEL (DECEMBER 14, 2015)
WELL SCREEN

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

cl	CLAYEY	CL	CLAY	TS	TOPSOIL
si	SILTY	Si	SILT	T	TILL
sa	SANDY	SA	SAND	F	FILL
gr	GRAVELLY	GR	GRAVEL	MRL	MARL
		STN	STONES	HPAN	HARDPAN
		BLD	BOULDER	RCK	ROCK
		LMSN	LIMESTONE	PRDG	PREDUG

BURNSIDE

Client / Report
TOWN OF ST. MARYS
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title
REGIONAL CROSS SECTION A-A'

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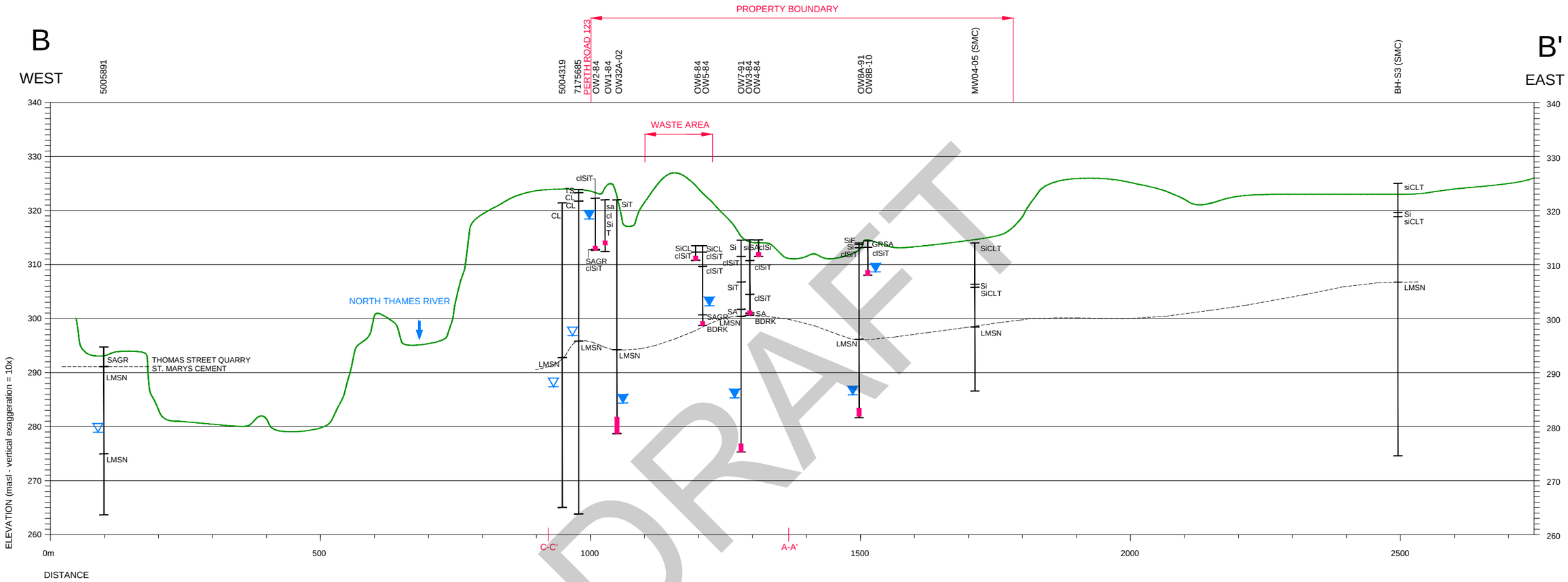

LEGEND

4901807 MW10 — WELL / BOREHOLE ID

MOECC WELL RECORD NUMBER

GROUND LEVEL

WELL

CLGR — GEOLOGICAL STRATIGRAPHY

STATIC WATER LEVEL (REPORTED ON MOECC WELL RECORD)

MEASURED WATER LEVEL (DECEMBER 14, 2015)

WELL SCREEN

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

cl	CLAYEY	CL	CLAY	TS	TOPSOIL
si	SILTY	Si	SILT	T	TILL
sa	SANDY	SA	SAND	F	FILL
gr	GRAVELLY	GR	GRAVEL	MRL	MARL
		STN	STONES	HPAN	HARDPAN
		BLD	BOULDER	RCK	ROCK
		LMSN	LIMESTONE	PRDG	PREDUG

BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

REGIONAL CROSS SECTION B-B'

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C

NORTH

C'

SOUTH

5005676 5004527 5005952 5001195 PW2 PW 5 (5003434) PW3 (5002038) 5004319 7175685 5000232 5004013 5001488 5003647 5003888 5000231 5003609 5003753 5003633 5001645 5001804 5002225

PROPERTY FRONTAGE ALONG PERTH ROAD 123

ELEVATION (masl - vertical exaggeration = 10x)

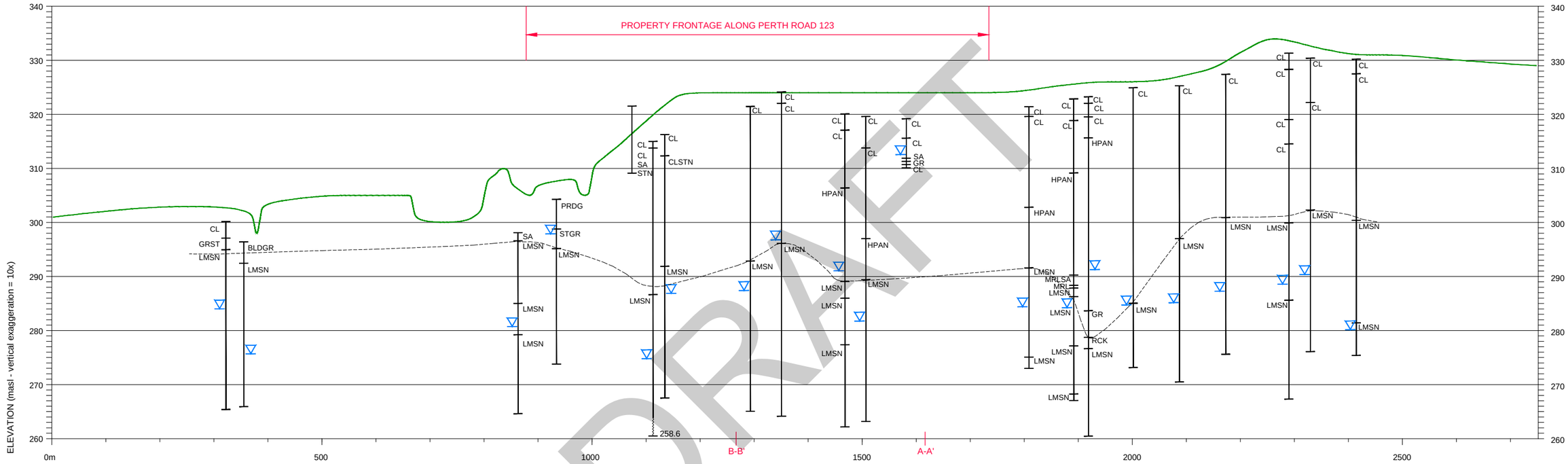
DISTANCE

0m 500 1000 1500 2000 2500

340 330 320 310 300 290 280 270 260

B-B' A-A'

258.6



LEGEND

4901807 MW10

- WELL / BOREHOLE ID
- MOECC WELL RECORD NUMBER
- GROUND LEVEL
- WELL
- CLGR — GEOLOGICAL STRATIGRAPHY
- STATIC WATER LEVEL (REPORTED ON MOECC WELL RECORD)
- MEASURED WATER LEVEL (DECEMBER 14, 2015)
- WELL SCREEN

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

cl	CLAYEY	CL	CLAY	TS	TOPSOIL
si	SILTY	Si	SILT	T	TILL
sa	SANDY	SA	SAND	F	FILL
gr	GRAVELLY	GR	GRAVEL	MRL	MARL
		STN	STONES	HPAN	HARDPAN
		BLD	BOULDER	RCK	ROCK
		LMSN	LIMESTONE	PRDG	PREDUG

BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

REGIONAL CROSS SECTION C-C'

Drawn	Checked	Date	Figure No.
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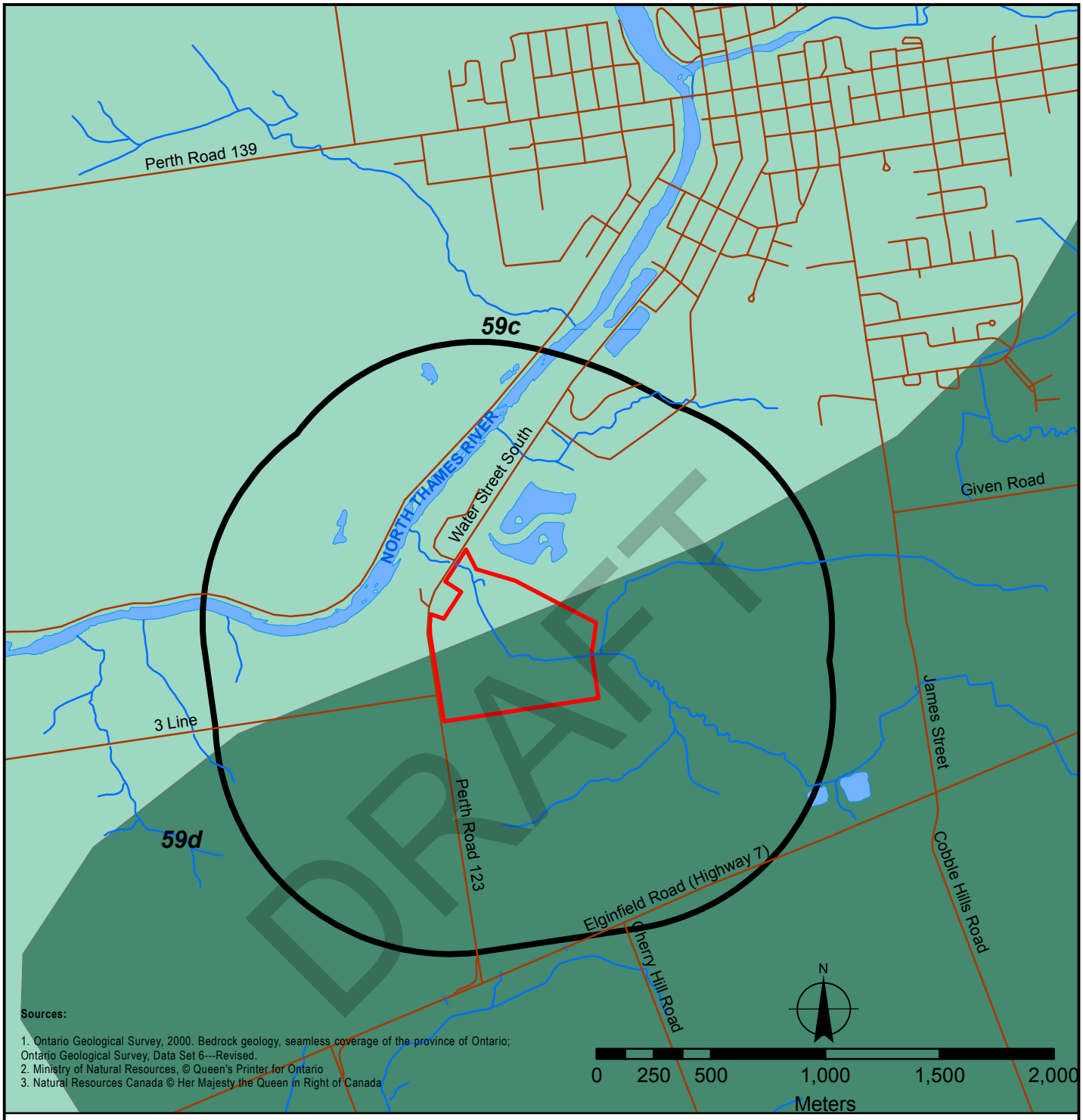

LEGEND

- ON-SITE STUDY AREA
- STUDY AREA VICINITY
- ROADWAY
- WATERCOURSE
- WATERBODY

Bedrock Geology

- 59c: Dundee Fm:;limestone, dolostone, shale
- 59d: Detroit River Gp:; Onondaga Fm; limestone, dolostone, shale

BURNSIDE

Map Title

BEDROCK GEOLOGY

Client / Report

THE TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Drawn	Checked	Date	Figure No.
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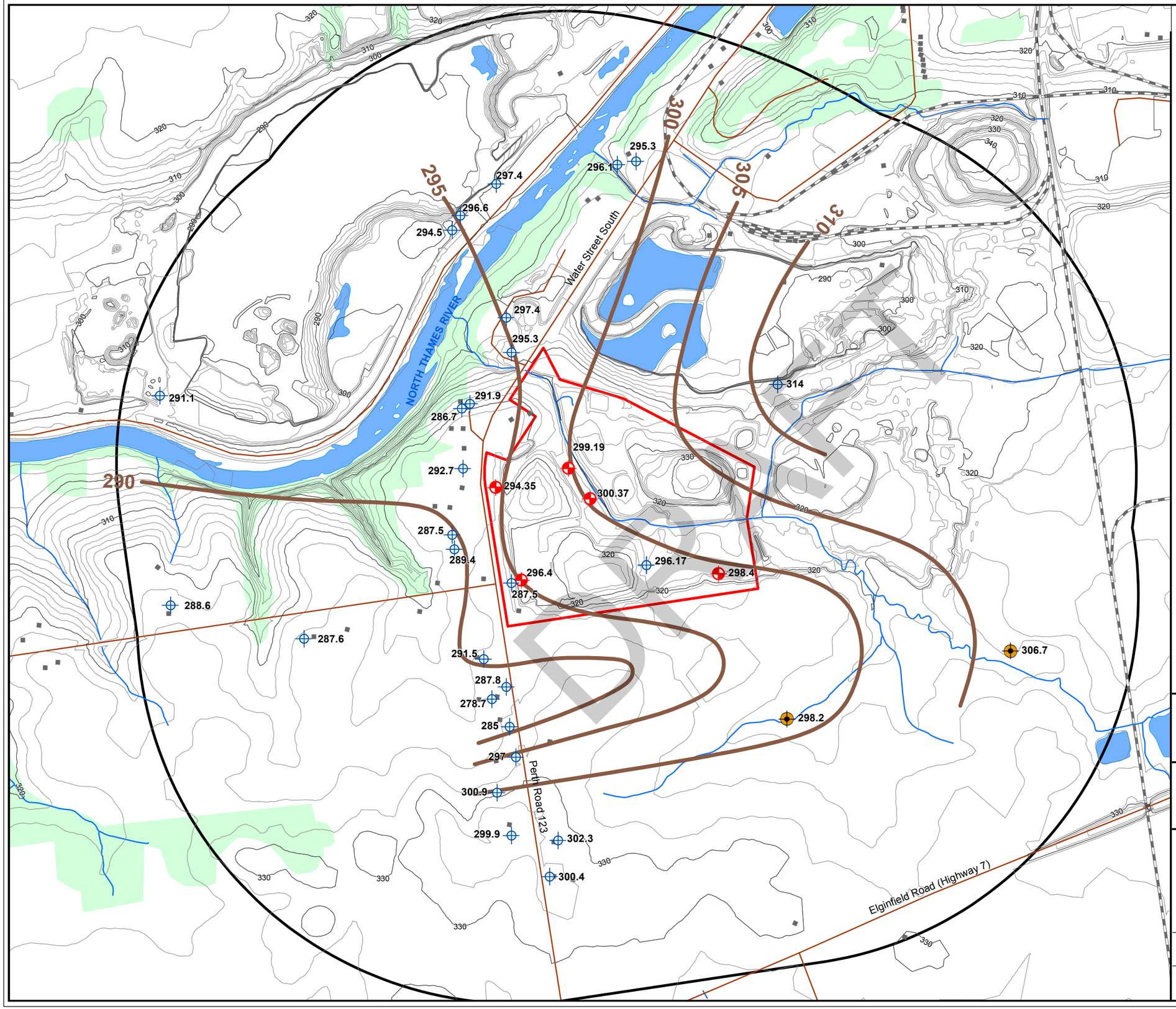

LEGEND

- ON-SITE STUDY AREA
- STUDY AREA VICINITY
- ROADWAY
- CONTOUR (10m intervals)
- CONTOUR (2m intervals - masl)
- BUILDING
- WATERCOURSE
- RAILWAY
- WATERBODY
- WOODED
- MOECC WELL RECORD LOCATION
- OBSERVATION WELL
- BOREHOLE
- BEDROCK SURFACE CONTOUR (5m intervals)
- 306.7 BEDROCK ELEVATION (masl)

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

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Metres

BURNSIDE

Client / Report

THE TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

BEDROCK SURFACE TOPOGRAPHY

Drawn	Checked	Date	Figure No.
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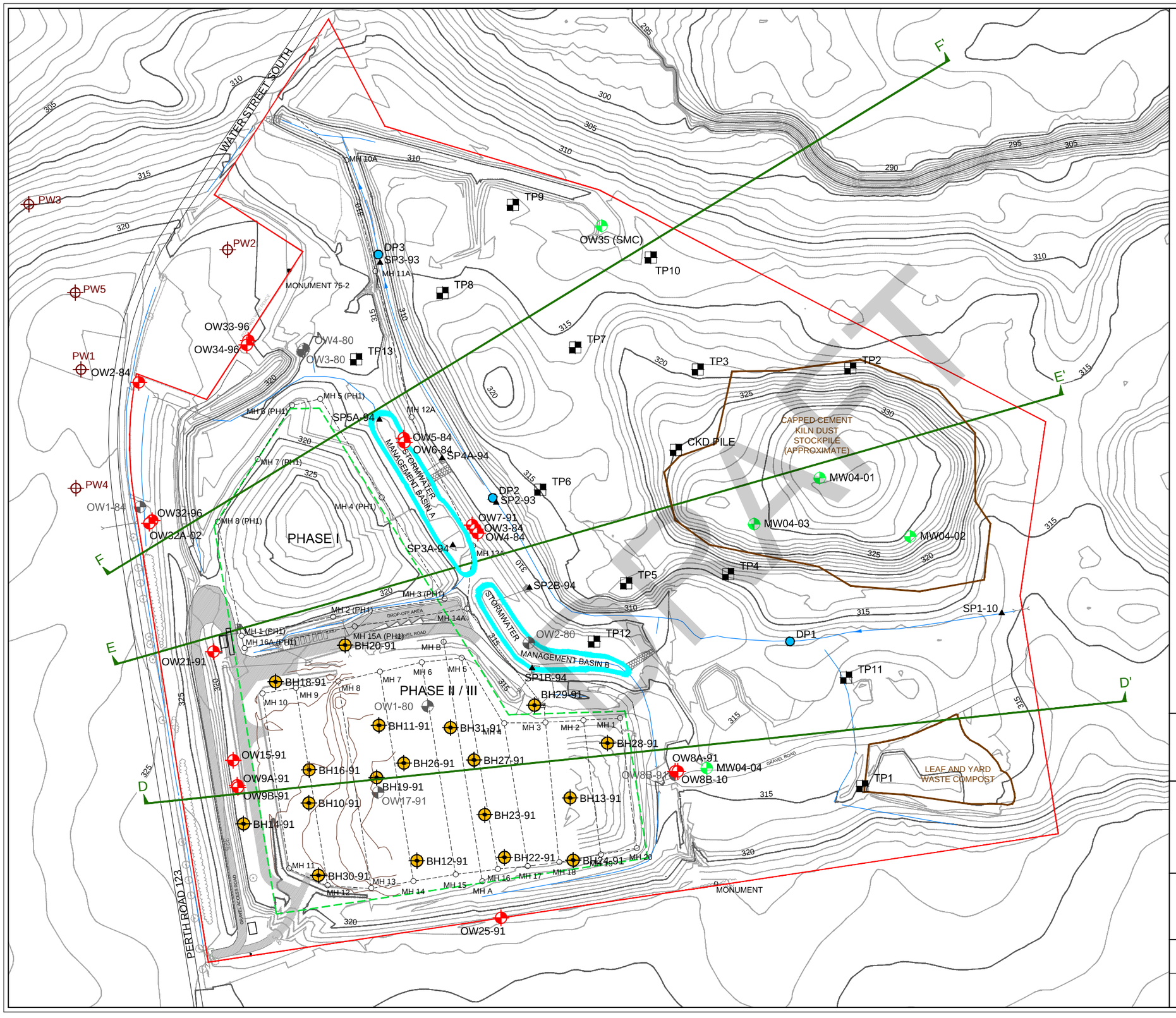

LEGEND

- LANDFILL PROPERTY BOUNDARY / ON-SITE STUDY AREA
- LIMIT OF REFUSE DISPOSAL
- WATERCOURSE
- CONTOUR (5m intervals - masl) (MNR - SWOOP2010 - digital elevation data)
- CONTOUR (1m intervals - masl) (MNR - SWOOP2010 - digital elevation data)
- CONTOUR (1m intervals - masl) (RJB 2015 Survey)
- STORM WATER MANAGEMENT BASIN
- LEACHATE COLLECTION SYSTEM
- LEACHATE MANHOLE
- OBSERVATION WELL (ANNUAL MONITORING REPORT)
- OBSERVATION WELL (ABANDONED AND SEALED)
- OBSERVATION WELL
- DRIVE POINT PIEZOMETER
- BOREHOLE
- PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
- SURFACE WATER MONITORING LOCATION
- TEST PIT
- CROSS SECTION LOCATION KEY

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Metres

BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

SITE TOPOGRAPHY AND CROSS SECTIONS

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	13
Scale		Project No.	
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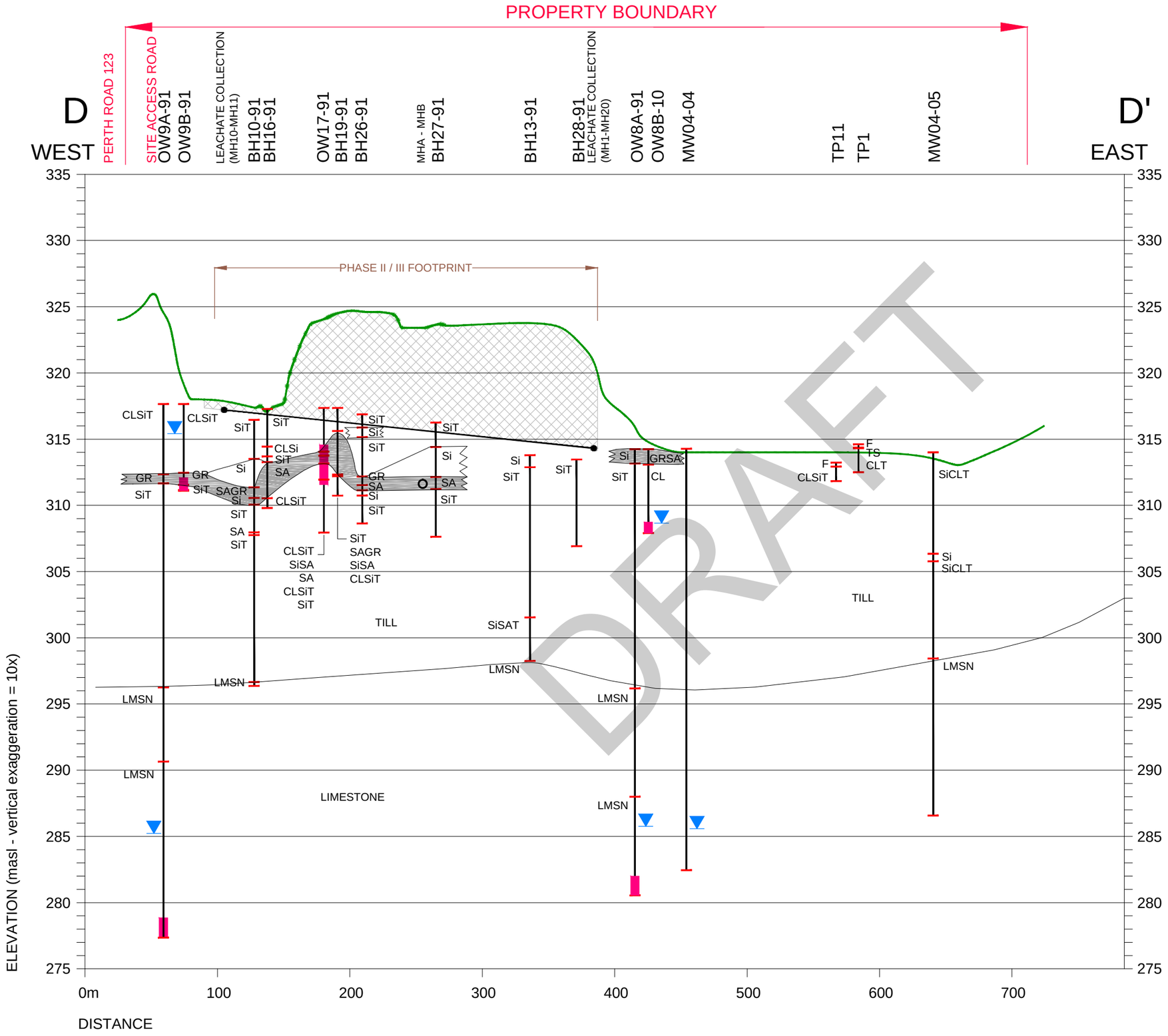
File Name: 032339 2016 EA HG STUDY FIGURES 1 TO 6, 13 & 18.dwg Date Plotted: April 28, 2016 - 2:27 PM



LEGEND

MW9 — WELL NUMBER

GEOLOGICAL STRATIGRAPHY

MEASURED WATER LEVEL (DEC.14, 2015)

WELL SCREEN

cl	clayey	CL	Clay	TS	Topsoil
si	silty	Si	Silt	T	Till
sa	sandy	SA	Sand	F	Fill
gr	gravelly	GR	Gravel	HPAN	Hardpan
		STN	Stones	RCK	Rock
		BLD	Boulder		
		LMSN	Limestone		

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

LEACHATE COLLECTION SYSTEM

DRAIN PIPE BETWEEN MHA AND MHB

BURNSIDE

Client / Report

TOWN OF ST. MARYS

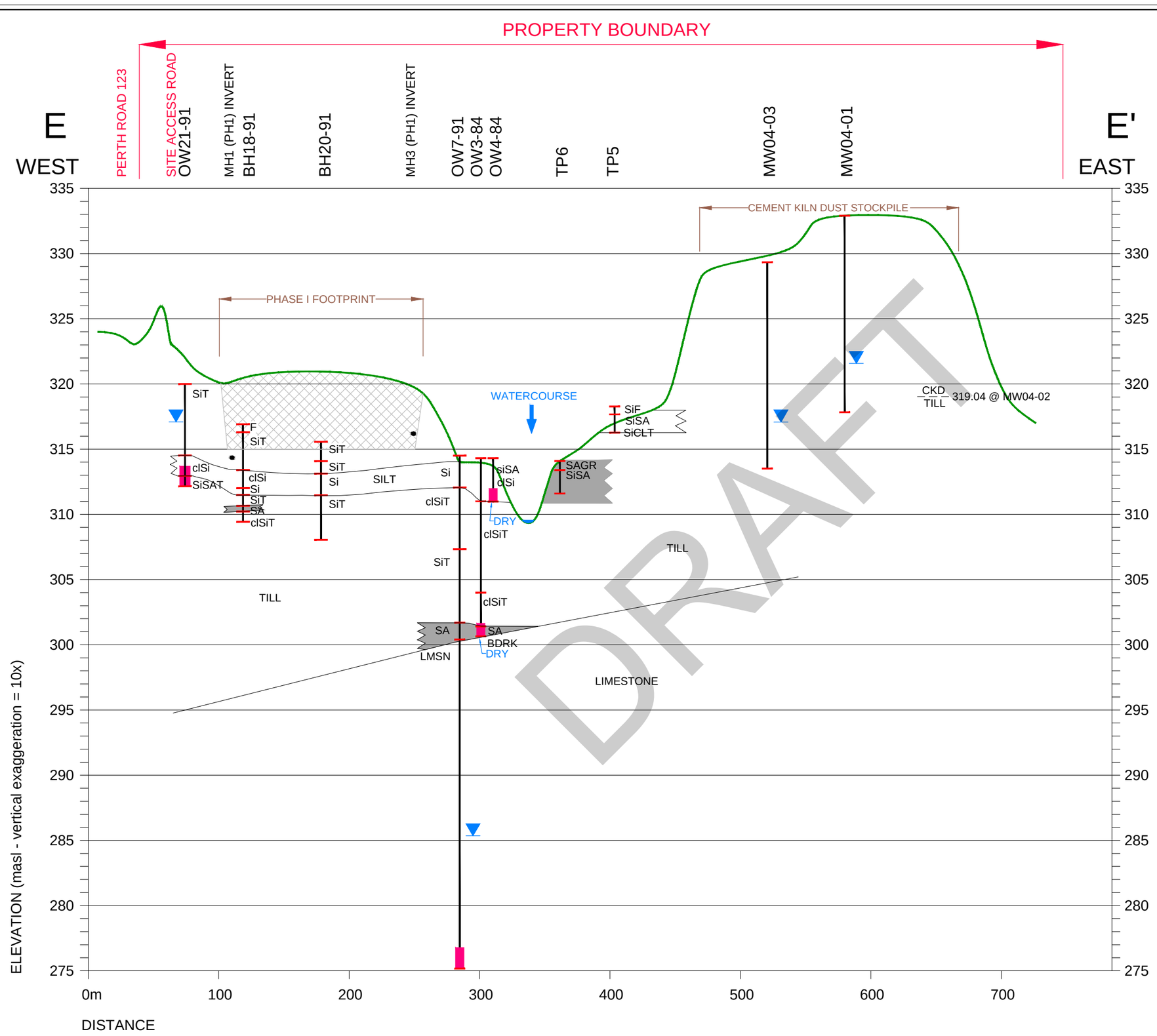
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

SITE CROSS SECTION D-D'

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	14
Scale		Project No.	
H - 1:3,000 V - 1:300		300032339	

File Name: 032339 2016 EA HG STUDY REGIONAL AND SITE CROSS SECTIONS.dwg Date Plotted: April 28, 2016 - 2:21 PM



LEGEND

MW9 — WELL NUMBER

GEOLOGICAL STRATIGRAPHY

MEASURED WATER LEVEL (DEC.14, 2015)

WELL SCREEN

cl	clayey	CL	Clay	TS	Topsoil
si	silty	Si	Silt	T	Till
sa	sandy	SA	Sand	F	Fill
gr	gravelly	GR	Gravel	HPAN	Hardpan
		STN	Stones	RCK	Rock
		BLD	Boulder		
		LMSN	Limestone		

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

LEACHATE COLLECTION SYSTEM

BURNSIDE

Client / Report

TOWN OF ST. MARYS

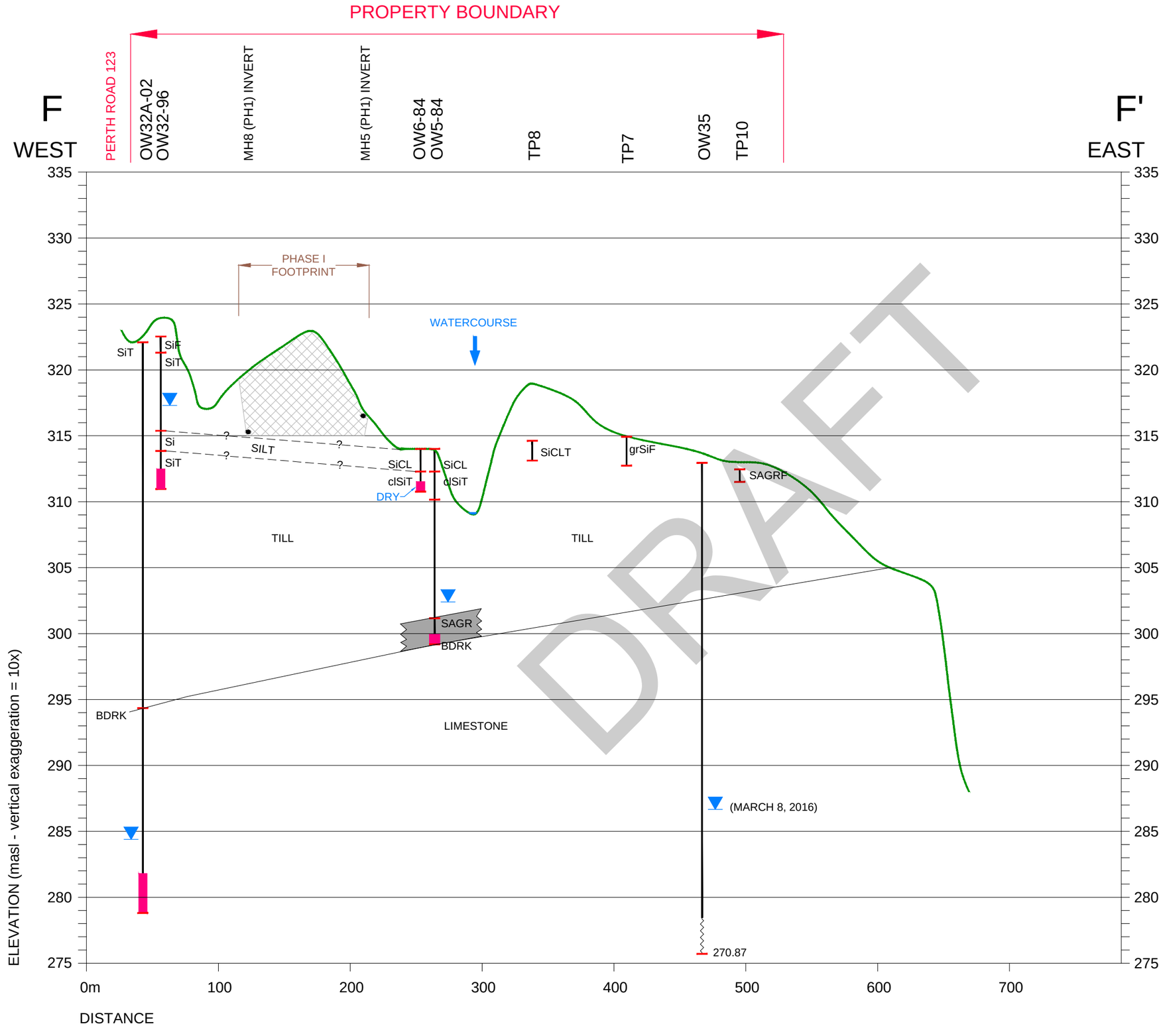
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

SITE CROSS SECTION E-E'

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	15
Scale		Project No.	
H - 1:3,000 V - 1:300		300032339	

File Name: 032339 2016 EA HG STUDY REGIONAL AND SITE CROSS SECTIONS.dwg Date Plotted: April 28, 2016 - 2:21 PM



LEGEND

MW9 — WELL NUMBER

GEOLOGICAL STRATIGRAPHY

MEASURED WATER LEVEL (DEC.14, 2015)

WELL SCREEN

cl	clayey	CL	Clay	TS	Topsoil
si	silty	Si	Silt	T	Till
sa	sandy	SA	Sand	F	Fill
gr	gravelly	GR	Gravel	HPAN	Hardpan
		STN	Stones	RCK	Rock
		BLD	Boulder		
		LMSN	Limestone		

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

LEACHATE COLLECTION SYSTEM

BURNSIDE

Client / Report

TOWN OF ST. MARYS

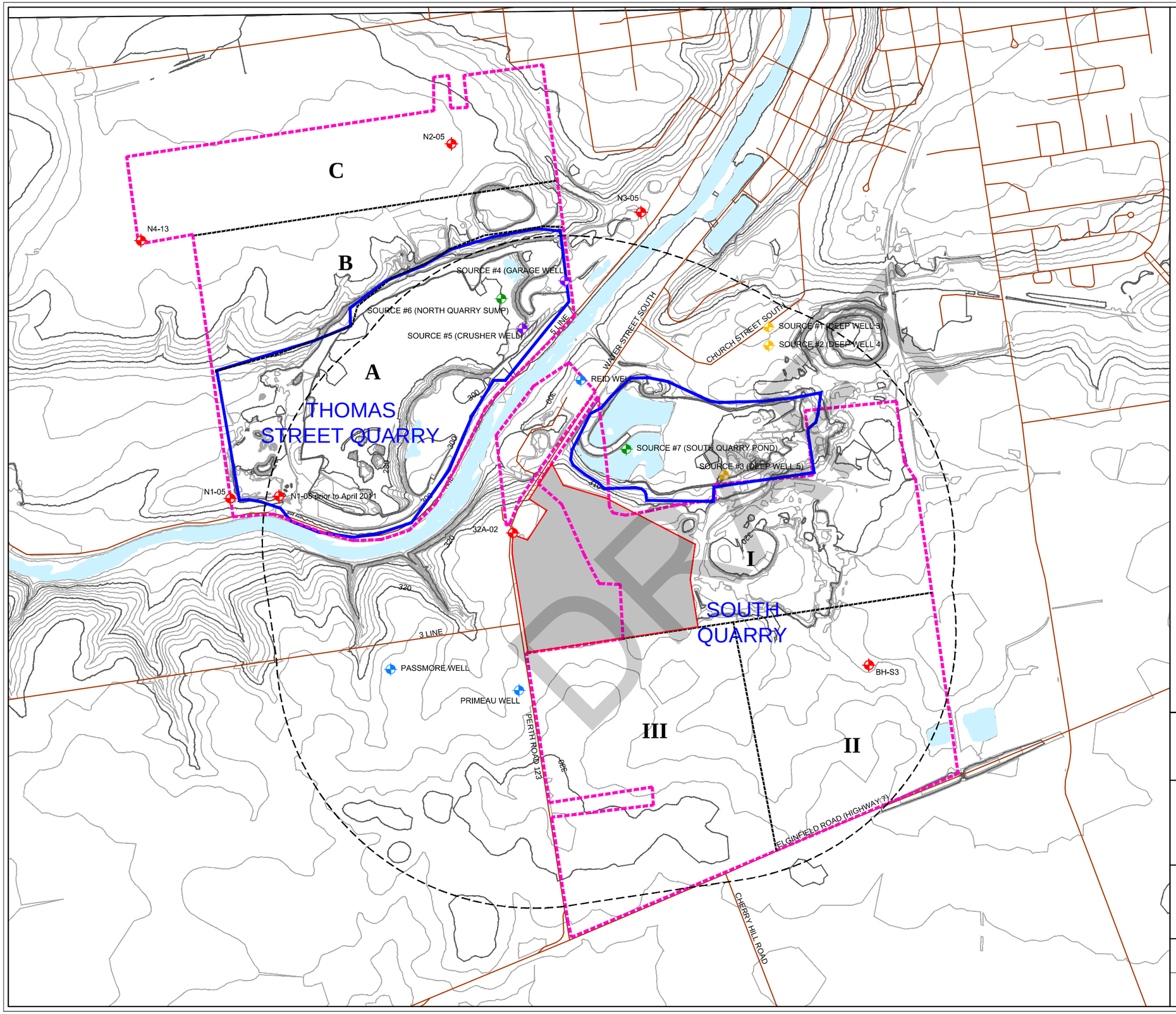
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

SITE CROSS SECTION F-F'

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	16
Scale		Project No.	
H - 1:3,000 V - 1:300		300032339	

File Name: 032339 2016 EA HG STUDY REGIONAL AND SITE CROSS SECTIONS.dwg Date Plotted: April 28, 2016 - 2:22 PM



LEGEND

- QUARRY BOUNDARIES (from the Pits and Quarries Online Database)
- APPROXIMATE QUARRY EXTENTS (EXISTING)
- ON-SITE STUDY AREA
- STUDY AREA VICINITY
- A — PHASED EXTRACTION AREA
- APPROXIMATE LIMIT OF PHASED EXTRACTION AREAS
- DRAINAGE SWALE
- CONTOUR (10m intervals - masl)
- CONTOUR (2m intervals)
- MONITORING WELL
- INDUSTRIAL WATER SUPPLY WELL
- WATER SUPPLY WELL
- DOMESTIC WELL MONITORING WELL
- DEWATERING (APPROXIMATE)

Note: The information provided in this drawing is based on Figure 1 from the 2014 Annual Groundwater Monitoring Report for St. Marys Cement and Figure 2.2 from the 1992 Phase II/III Hydrogeologic Investigation for the St. Marys Landfill Site.

N

0 300 600 900 1,200

Metres

BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

ST. MARYS CEMENT SITE FEATURES

Drawn	Checked	Date	Figure No.
SK	CM	MARCH 2016	17
Scale		Project No.	
1:15,000		300032339	

LEGEND

- LANDFILL PROPERTY BOUNDARY / ON-SITE STUDY AREA
- LIMIT OF REFUSE DISPOSAL
- WATERCOURSE
- LEACHATE COLLECTION SYSTEM
- LEACHATE MANHOLE
- OBSERVATION WELL
- OBSERVATION WELL (ABANDONED AND SEALED)
- PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
- SURFACE WATER MONITORING LOCATION

AIR PHOTO SOURCE:
GOOGLE EARTH PRO 2013 SATELLITE IMAGE

N

0 60 120 180 240
Metres

BURNSIDE

Client / Report

TOWN OF ST. MARYS

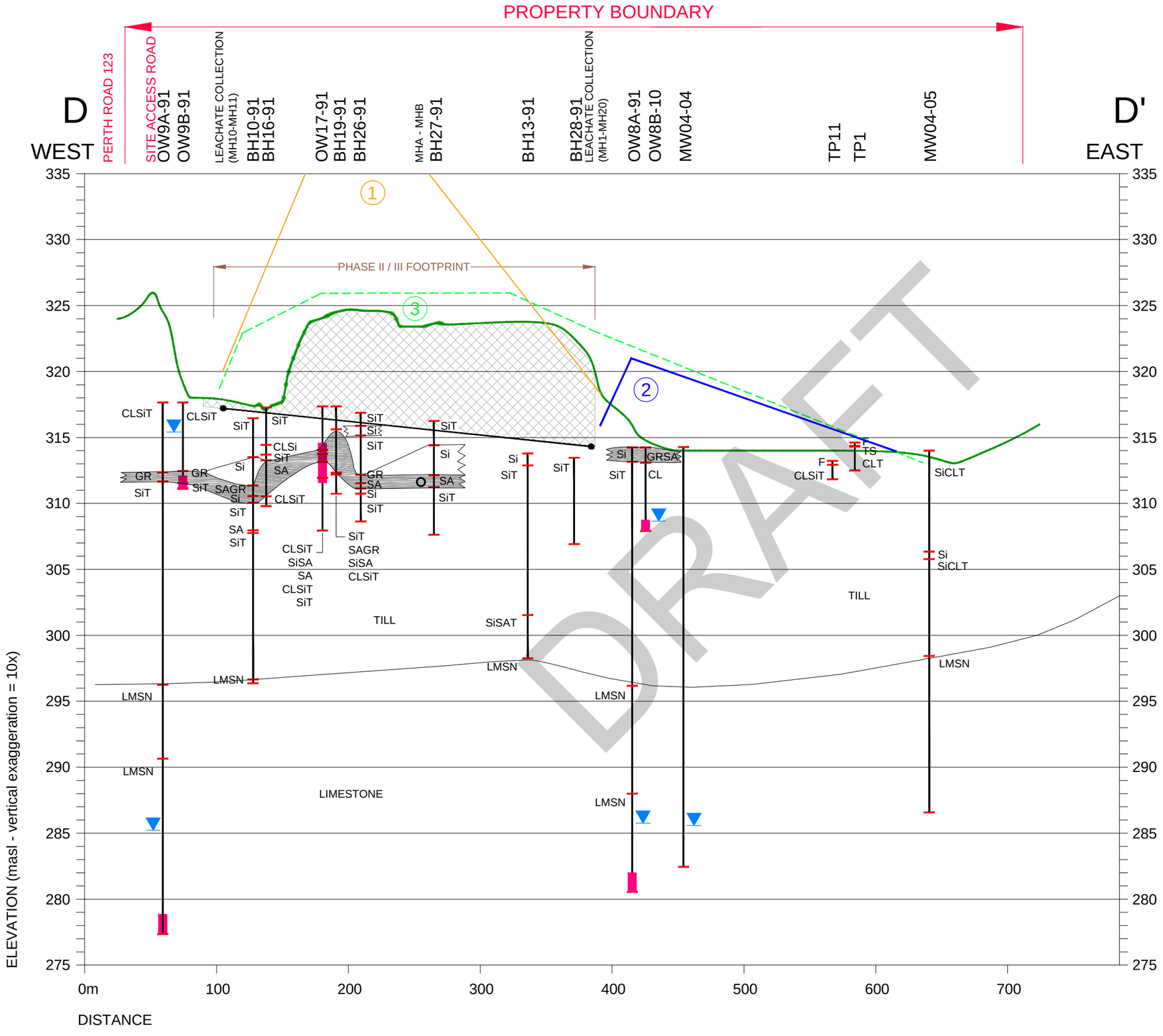
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

MONITORING LOCATIONS

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	18
Scale		Project No.	
1:3,000		300032339	

File Name: 032339 2016 EA HG STUDY FIGURES 1 TO 6, 13 & 18.dwg Date Plotted: April 28, 2016 - 2:28 PM



LEGEND

MW9 — WELL NUMBER

GEOLOGICAL STRATIGRAPHY

MEASURED WATER LEVEL (DEC.14, 2015)

WELL SCREEN

cl	clayey	CL	Clay	TS	Topsoil
si	silty	Si	Silt	T	Till
sa	sandy	SA	Sand	F	Fill
gr	gravelly	GR	Gravel	HPAN	Hardpan
		STN	Stones	RCK	Rock
		BLD	Boulder		
		LMSN	Limestone		

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

LEACHATE COLLECTION SYSTEM

DRAIN PIPE BETWEEN MHA AND MHB

1 ALTERNATIVE METHOD 1

2 ALTERNATIVE METHOD 2

3 ALTERNATIVE METHOD 3

4 ALTERNATIVE METHOD 4

1 + 4 ALTERNATIVE METHOD 5
(Alternative Method 1 and Alternative Method 4)

BURNSIDE

Client / Report

TOWN OF ST. MARYS

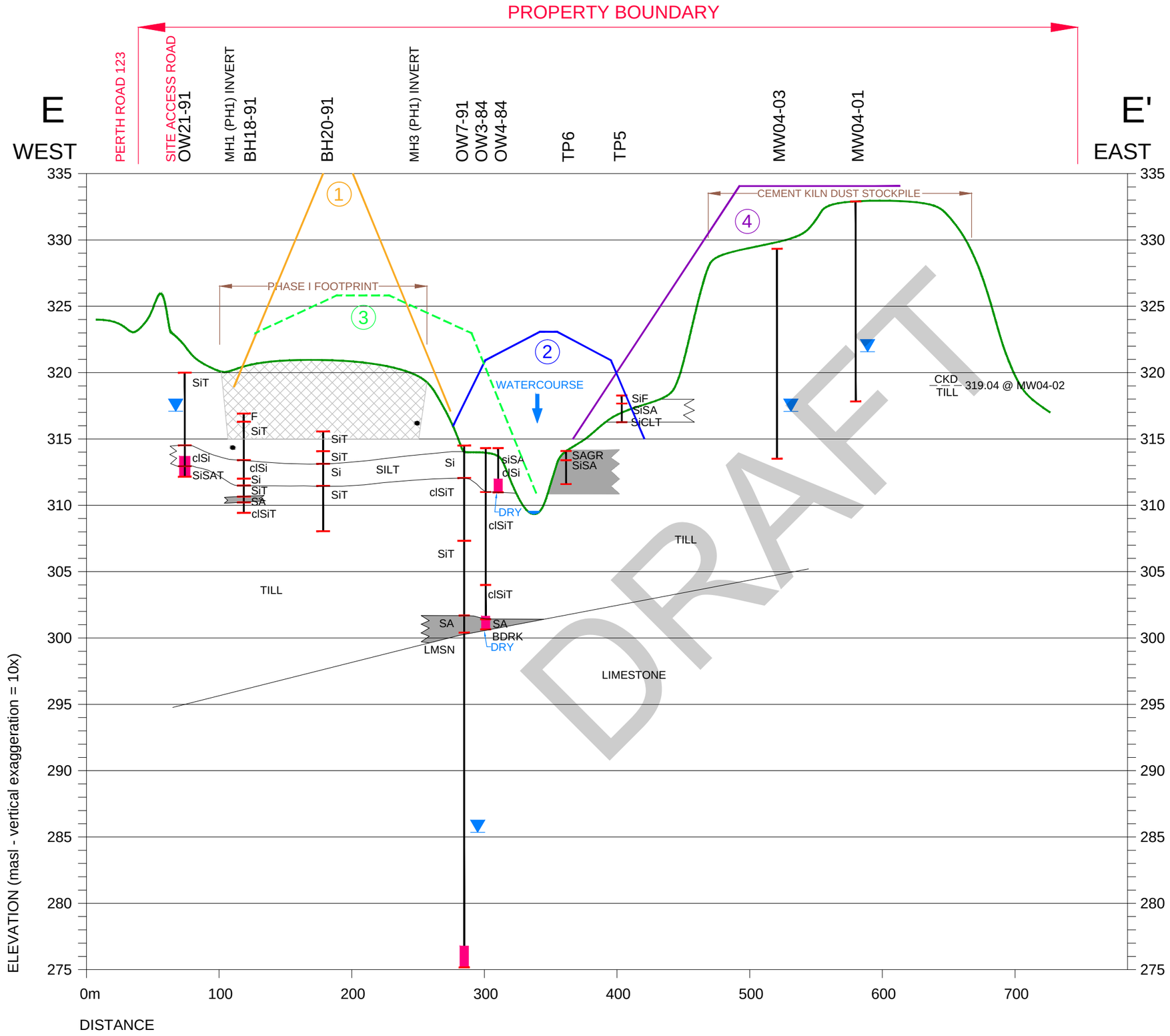
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

ALTERNATIVE METHODS
CROSS SECTION D-D'

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	19
Scale		Project No.	
H - 1:3,000 V - 1:300		300032339	

File Name: 032339 2016 EA HG STUDY REGIONAL AND SITE CROSS SECTIONS.dwg Date Plotted: April 28, 2016 - 2:23 PM



LEGEND

MW9 — WELL NUMBER

GEOLOGICAL STRATIGRAPHY

MEASURED WATER LEVEL (DEC.14, 2015)

WELL SCREEN

cl	clayey	CL	Clay	TS	Topsoil
si	silty	Si	Silt	T	Till
sa	sandy	SA	Sand	F	Fill
gr	gravelly	GR	Gravel	HPAN	Hardpan
		STN	Stones	RCK	Rock
		BLD	Boulder		
		LMSN	Limestone		

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

LEACHATE COLLECTION SYSTEM

1 ALTERNATIVE METHOD 1

2 ALTERNATIVE METHOD 2

3 ALTERNATIVE METHOD 3

4 ALTERNATIVE METHOD 4

1 + 4 ALTERNATIVE METHOD 5
(Alternative Method 1 and Alternative Method 4)

BURNSIDE

Client / Report

TOWN OF ST. MARYS

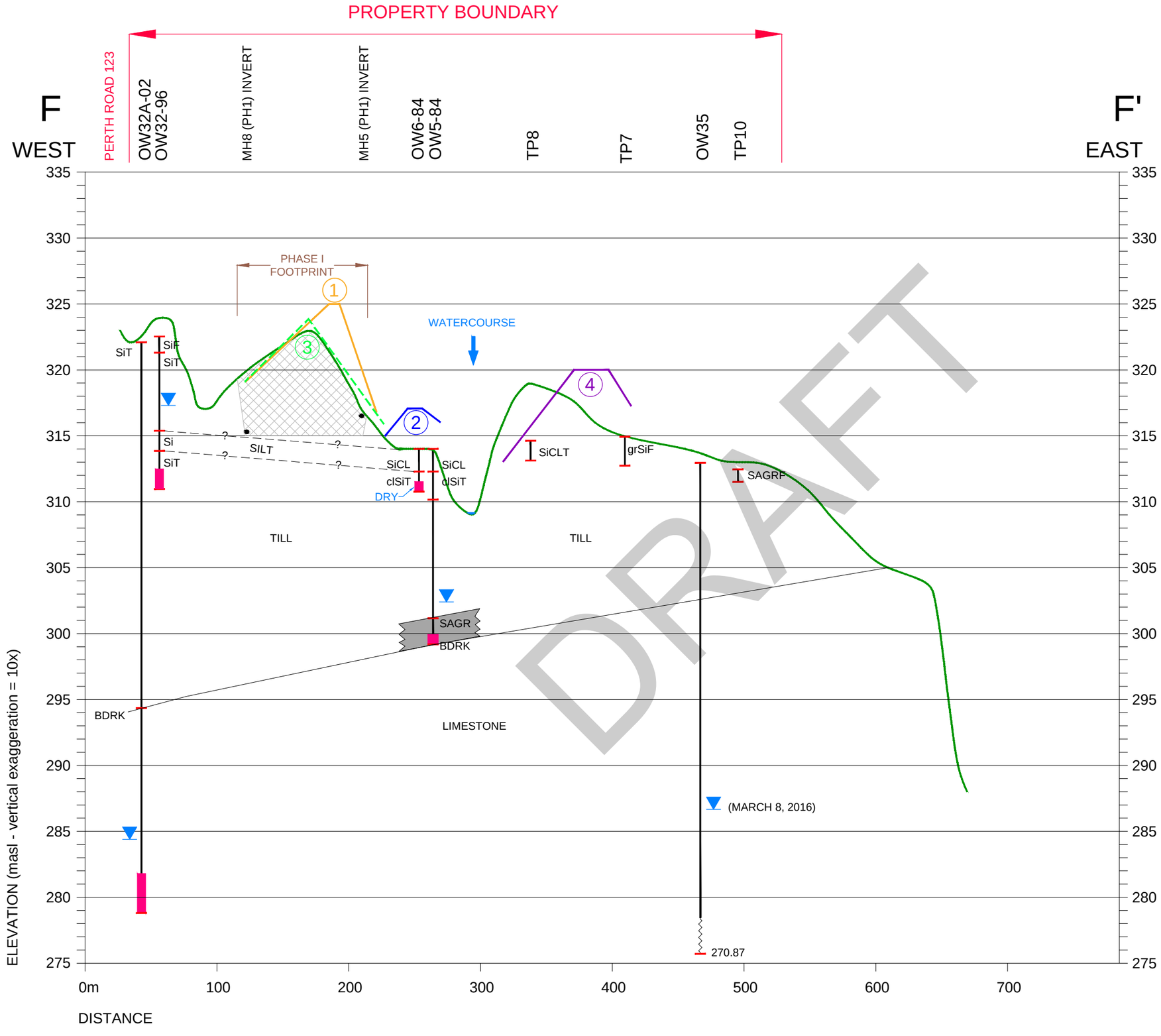
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

ALTERNATIVE METHODS
CROSS SECTION E-E'

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	20
Scale		Project No.	
H - 1:3,000 V - 1:300		300032339	

File Name: 032339 2016 EA HG STUDY REGIONAL AND SITE CROSS SECTIONS.dwg Date Plotted: April 28, 2016 - 2:23 PM



LEGEND

MW9 — WELL NUMBER

GEOLOGICAL STRATIGRAPHY

MEASURED WATER LEVEL (DEC.14, 2015)

WELL SCREEN

cl	clayey	CL	Clay	TS	Topsoil
si	silty	Si	Silt	T	Till
sa	sandy	SA	Sand	F	Fill
gr	gravelly	GR	Gravel	HPAN	Hardpan
		STN	Stones	RCK	Rock
		BLD	Boulder		
		LMSN	Limestone		

INTERPRETED GEOLOGICAL CONTACT

WATERCOURSE CROSSING

LEACHATE COLLECTION SYSTEM

1 ALTERNATIVE METHOD 1

2 ALTERNATIVE METHOD 2

3 ALTERNATIVE METHOD 3

4 ALTERNATIVE METHOD 4

1 + 4 ALTERNATIVE METHOD 5
(Alternative Method 1 and Alternative Method 4)

BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

ALTERNATIVE METHODS
CROSS SECTION F-F'

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	21
Scale		Project No.	
H - 1:3,000 V - 1:300		300032339	

File Name: 032339 2016 EA HG STUDY REGIONAL AND SITE CROSS SECTIONS.dwg Date Plotted: April 28, 2016 - 2:23 PM

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[THE DIFFERENCE IS OUR PEOPLE]

Appendix A

Historical Aerial Photographs

LEGEND

- CURRENT PROPERTY BOUNDARY
- SOUTHERN EXTENT OF QUARRYING
- WATERCOURSE

Sources:

1. 1955 airphoto obtained from National Airphoto Library

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

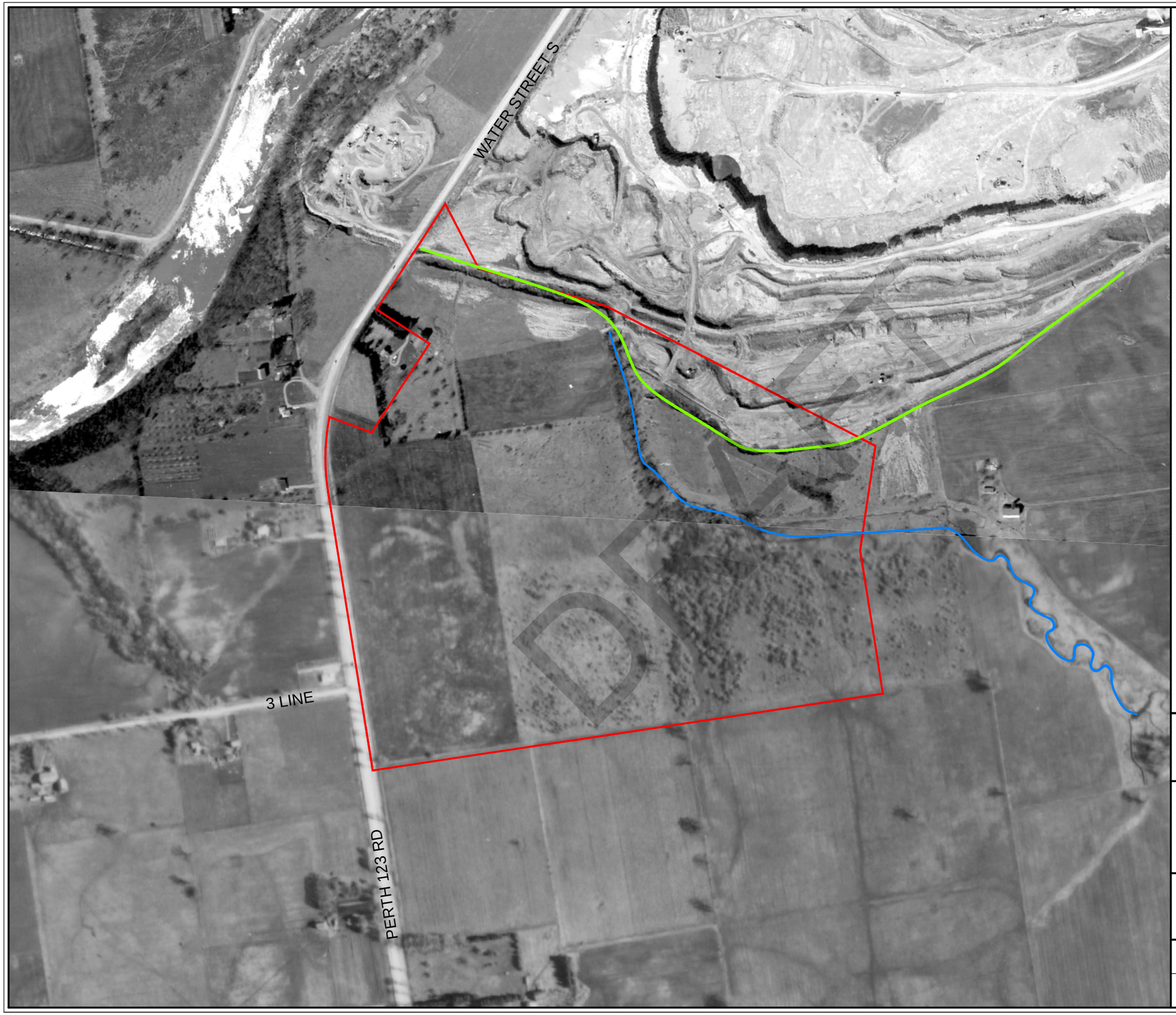
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

1955 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-1**
Scale		Project No.	
1:5,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX A.dwg Date Plotted: June 1, 2016 - 12:33 PM



LEGEND

- CURRENT PROPERTY BOUNDARY
- SOUTHERN EXTENT OF QUARRYING
- WATERCOURSE

Sources:
1. 1963 airphoto obtained from National Airphoto Library

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

1963 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-2**
Scale		Project No.	
1:5,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX A.dwg Date Plotted: June 1, 2016 - 12:34 PM

LEGEND

- CURRENT PROPERTY BOUNDARY
- FORMER WATERCOURSE
- NEW WATERCOURSE

Sources:

1. 1978 airphoto obtained from National Airphoto Library

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

1978 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-3**
Scale		Project No.	
1:5,000		300032339	

LEGEND

CURRENT PROPERTY BOUNDARY

WATERCOURSE

Sources:

1. 1980 airphoto obtained from National Airphoto Library

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

1980 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-4**
Scale		Project No.	
1:5,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX A.dwg Date Plotted: June 1, 2016 - 2:47 PM

LEGEND

- CURRENT PROPERTY BOUNDARY
- WATERCOURSE
- FILLING

Sources:

1. 1989 airphoto obtained from National Airphoto Library

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

1989 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-5**
Scale		Project No.	
1:5,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX A.dwg Date Plotted: June 1, 2016 - 12:40 PM

LEGEND

CURRENT PROPERTY BOUNDARY

WATERCOURSE

Sources:

1. 2000 airphoto obtained from National Airphoto Library

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

2000 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-6**
Scale		Project No.	
1:5,000		300032339	

LEGEND

CURRENT PROPERTY BOUNDARY

WATERCOURSE

Sources:

1. 2006 airphoto obtained from Upper Thames River Conservation Authority.

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

2006 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-7**
Scale		Project No.	
1:5,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX A.dwg Date Plotted: June 1, 2016 - 12:30 PM

LEGEND

CURRENT PROPERTY BOUNDARY

WATERCOURSE

Sources:

1. 2013 airphoto obtained from Google Earth Pro.

N

0 50 100 200 300 400

Metres

BURNSIDE

Client / Report

TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

2013 AIR PHOTO

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**A-8**
Scale		Project No.	
1:5,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX A.dwg Date Plotted: June 1, 2016 - 12:31 PM

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Water Well Records

Appendix B-1
Summary Table for Wells on Figure 7
Water Well Records - Ministry of the Environment and Climate Change
St. Marys Landfill

Well Number	Date Drilled	Well Type	Elev. (m)	Borehole Depth (m)	Depth to Bedrock (m)	Bedrock Elevation (m)	Water Found (m)	Static Level (m)	Pumping Level (m)	Pumping Rate (Lpm)	Test Hours	Test Min
3408626*												
5000230*	Jun-59	Well: Supply	296.32	55.80	30.50	265.80	49	24	25	45.5	3	0
5000231	Aug-60	Well: Supply	323.19	62.80	44.50	278.70	58	32	34	45.5	3	0
5000232	Jul-62	Well: Supply	319.99	57.90	31.10	288.90	49	29	30	40.9	3	0
5001195	Jun-47	Well: Supply	304.39	30.50	9.10	295.30	6	6	0	45.5	1	0
5001196*	Aug-47	Well: Supply	319.93	32.30	7.30	312.60	10	10	0	45.5	1	0
5001201	Feb-65	Borehole: Test	296.40	28.00								
5001202	Mar-65	Borehole: Test	296.50	46.30								
5001203	May-65	Borehole: Test	296.56	34.40								
5001204	Jun-65	Borehole: Test	296.07	41.10	1.50	294.50	25	7	20	309.1	8	0
5001205	Nov-66	Borehole: Test	297.45	22.90			2					
5001206	Dec-66	Borehole: Test	297.36	21.00			2					
5001207	Nov-66	Borehole: Test	297.40	22.90			2					
5001209*	Dec-67	Well: Supply	318.21	22.90	1.20	317.00	23	7	11	54.6	2	30
5001488	Jun-68	Well: Supply	319.35	9.10			7	7				
5001571	Feb-69	Well: Supply	320.87	63.10	32.30	288.60	56	34	35	54.6	1	30
5001645	Apr-70	Well: Supply	331.31	64.00	31.40	299.90	55	43	43	36.4	2	0
5001804	Dec-71	Well: Supply	330.30	54.30	28.00	302.30	50	40	43	40.9	5	0
5002038	Nov-73	Well: Supply	316.29	48.80	24.40	291.90	31	29	34	22.7	1	0
5002225	Oct-74	Well: Supply	330.22	54.90	29.90	300.40	55	50	52	45.5	1	0
5002282	Oct-75	Well: Supply	315.11	50.30			10	2	10	3568.6	8	0
5002878	Oct-80	Well: Supply	320.81	52.10	33.20	287.60	52	37	46	36.4	1	0
5003388	Oct-87	Well: Supply	323.75	52.10	36.30	287.50	52	43	45	31.8	1	0
5003434	Jun-88	Well: Supply	315.03	56.40	28.30	286.70	56	40	48	31.8	1	0
5003609	Aug-89	Well: Supply	324.94	51.80	39.90	285.00	52	40	44	36.4	1	0
5003633	Sep-89	Well: Supply	327.42	51.80	26.50	300.90	52	40	46	36.4	1	0
5003647	Sep-89	Well: Supply	321.40	48.50	29.90	291.50	47	37	39	45.5	1	30
5003753	Jul-90	Well: Supply	325.30	54.90	28.30	297.00	55	40	44	54.6	1	0
5003754**	Aug-90	Well: Supply	330.19				66	45	57	27.3	2	0
5003888	Jul-91	Well: Supply	322.86	55.80	35.10	287.80	47	39	41	77.3	3	0
5004013	Sep-92	Well: Supply	319.85	56.40	30.50	289.40	43	38		54.6	1	30
5004319	Aug-96	Well: Supply	321.38	56.40	28.70	292.70	56	34	47	36.4	1	0
5004527	Nov-97	Well: Supply	296.39	30.50	0.30	296.10	24	21		45.5	1	30
5005676	May-04	Well: Supply	300.43	34.80	5.20	295.30	35	16.2	24.4	46.0	2	0
5005891	May-05	Well: Observation	294.75	31.10	3.70	291.10	28	16		136.4		
5005952	Aug-05	Well: Supply	298.90	33.50	1.50	297.40	32	17	22	227.3	1	0
5006154	Jul-06	Well: Abandoned	311.38	40.80								
5006163	Sep-06	Well: Abandoned	321.14	6.10								
7040835	Sep-06	Well: Abandoned	321.14									
7047879	Jun-07	Well: Abandoned	314.87	20.70	0.90	314.00	16	16				
7155445	Oct-10	Well: Observation		6.40								
7155446	Oct-10	Well: Abandoned		0.40								
7158102	Jun-10	Well: Supply		60.00	31.40		55	36	40	113.7	1	30
7158103	Jun-10	Well: Supply		60.00	31.40		54	37	39	113.7	1	30
7165988	Apr-11	Well: Abandoned										
7175685	Aug-11	Well: Supply		60.00	28.00		58	27	30	136.4	1	30

Notes:
WWR - water well record
* Well location was not included on mapping due to expected wrong location based on information in the MOECC WWR
** 11m extension of existing MOECC WWR No. 5001804

40P/38

UTM 1 7 Z 4 8 7 1 4 7 E

~~THAMES RIVER CON~~ 5 R 4 7 8 6 4 5 7 N

Elev. 5 R 4 0 6 1 3 Lot 37

Basin 2 3

The Ontario Water Resources Commission Act, 1957

WATER WELL RECORD

County or District: PERTH — Township, Village, Town or City: BLANSHARD

[redacted]te completed: 6 (day) Aug. (month) 60 (year)

[redacted]dress: R.R. 3 St. Marys

Casing and Screen Record

Inside diameter of casing: 4"

Total length of casing: 153'

Type of screen: —

Length of screen: —

Depth to top of screen: none

Diameter of finished hole: 4"

Pumping Test

Static level: 105'

Test-pumping rate: 10 G.P.M.

Pumping level: 110'

Duration of test pumping: 3 hrs.

Water clear or cloudy at end of test: clear

Recommended pumping rate: 10 G.P.M.

with pumping level of: 110

Well Log / Water Record

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, sulphur)
top soil	0	1			
yellow clay	1	4			
sandy clay	4	12			
blue clay	12	25			
stoney hardpan	25	130			
Cemented gravel	130	146			
Caving rock	146	153			
brown limestone	153	206	190-206	101	FRESH

For what purpose(s) is the water to be used? farm

Is well on upland, in valley, or on hillside?

Drilling Firm: W. D. HOPPER & SONS

Address: SEAFORTH

Licence Number: 672

Name of Driller: NEIL HOPPER

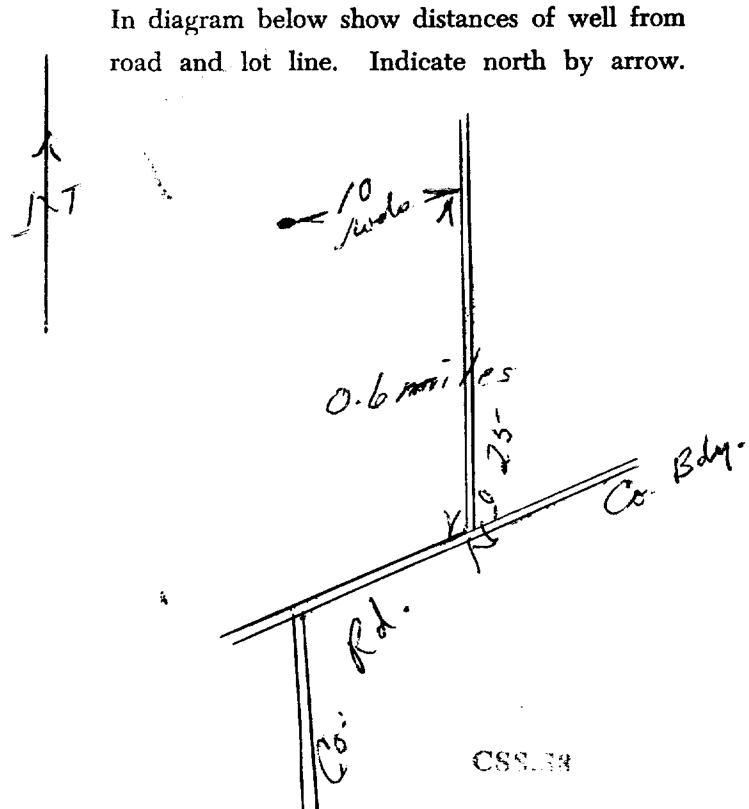
Address: SEAFORTH

Date: Nov. 16/60

Neil Hopper
(Signature of Licensed Drilling Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 5

CSS.38

40 P/38

UTM 17 Z 487040 E
5 R 4786960 N
Lot 37

Elev. 5 R 1055

GROUND WATER BRANCH
SEP 5 1962
ONTARIO WATER RESOURCES COMMISSION

No. 232

The Ontario Water Resources Commission Act

WATER WELL RECORD

Basin 23 | Perth
County or District

Township, Village, Town or City Blanshard

Con. Thames Rd. Lot ~~10~~ 37

Date completed 6 (day) June (month) 62 (year)

[redacted] ress RR#3 St Marys

Casing and Screen Record

Inside diameter of casing 4"
Total length of casing 112'
Type of screen —
Length of screen —
Depth to top of screen —
Diameter of finished hole 4"

Pumping Test

Static level 95'
Test-pumping rate 9 G.P.M.
Pumping level 98'
Duration of test pumping 3 hrs.
Water clear or cloudy at end of test Clear
Recommended pumping rate 9 G.P.M.
with pump setting of 125' feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Topsoil & Yellow Clay	0	10	166-198	Fresh.
Blue Clay	10	45		
Hard pan	45	102		
Start of limestone	102	112		
Grey limestone	112	140		
Brown Limestone	140	190		

For what purpose(s) is the water to be used?
Domestic

Is well on upland, in valley, or on hillside? upland.

Drilling or Boring Firm W.P. Hopper & Son.

Address Seaforth

Licence Number 741

Name of Driller or Borer Neil Hopper

Address RR#2 Seaforth

Date June 6, 62

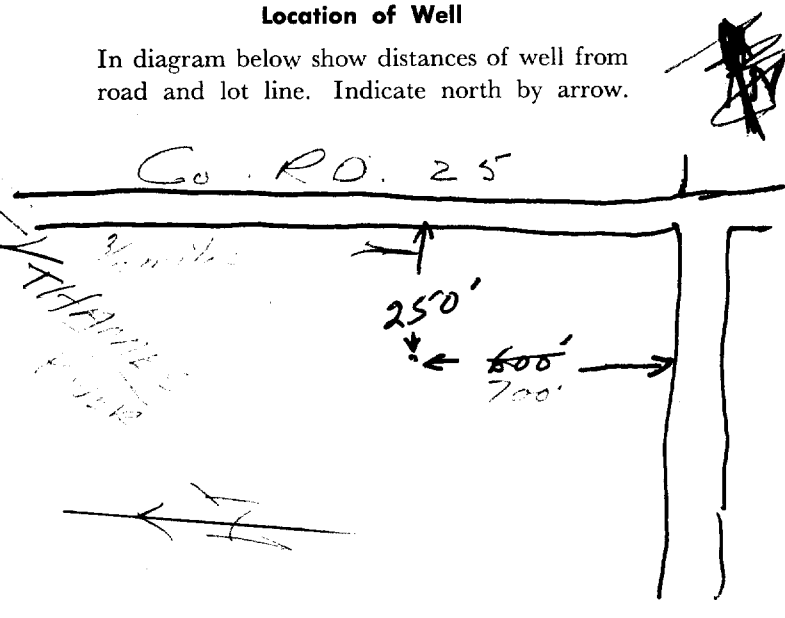
Neil Hopper
(Signature of Licensed Drilling or Boring Contractor)

Form 7 5M-61-3852

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS.38

40 P/39

1

UTM | 1 7 | Z | 4 8 7 2 0 0 | E
| 9 | R | 4 7 8 7 3 9 1 | N

Elev. | 9 | R | 1 0 0 0 |

Basin | 2 3 | | | | |

ONTARIO

The Well Drillers Act

Department of Mines, Province of Ontario

RECEIVED
DEC 3 194?
GEOLOGICAL BRANCH
DEPARTMENT OF MINES

1195

Water Well Record

County or District Perth Tp St Marys ~~Township Concession~~ Con. .... Lot ~~30~~ .... Pt. Lot

[redacted]ter St. St Marys. Ont.

[redacted]cluding pump) ....

Pipe and Casing Record		Pumping Test	
Casing diameter(s)	4"	Date	
Length(s) of casing(s)	30 ft.	Developed Capacity	600 gal. per hr.
Length of screen		Duration of Test	1 hr
Type of screen		Pumping Rate	600 gal per hr.
Type of pump		Drawdown	
Capacity of pump		Static level of completed well	100 ft. 21'
Depth of pump setting		Is well a gravel-wall type?	no

Water Record

Kind (fresh or mineral) fresh.

Quality (hard, soft, contains iron, sulphur etc.) hard

Appearance (clear, cloudy, coloured)

For what purpose(s) is the water to be used? domestic

How far is well from possible source of contamination?

What is source of contamination?

Enclose a copy of any mineral analysis that has been made of water

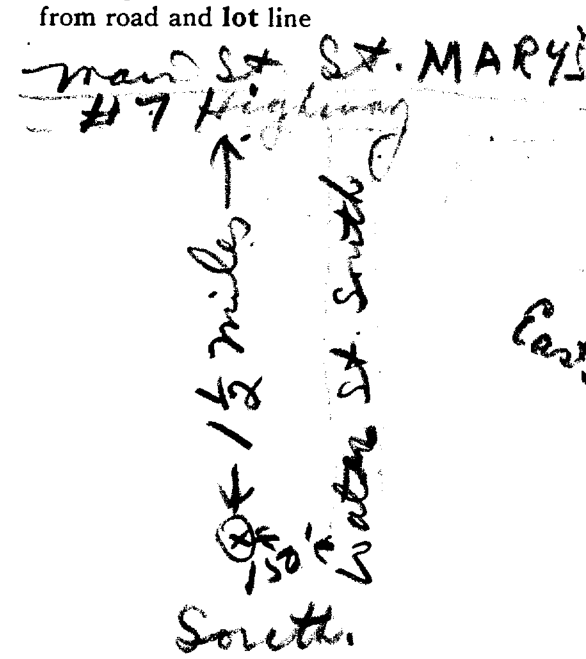
Depth(s) to Water Horizon(s)	Kind of Water	No. of Feet Water Rises
21'		

Well Log

Drift and Bedrock Record	From	To
dug well. started drilling in bottom.	0 ft.	18 ft.
stoney & gravel.	18	30
grey limestone rock	30	100

Location of Well

In diagram below show distances of well from road and lot line



Situation: Is well on upland, in valley, or on hillside? hillside

Drilling Firm McCauley & Hayden

Address

Recorded by Lorne Hayden Address RR4 Denfield Ont.

Date .... Licence Number

CSS.S8

UTM 17 (45) 4870110
5 R 4786780
Elev. 6 R 1105
Basin 23

Con TR L137

CODED

5001488
3 9

7

The Ontario Water Resources Commission Act

WATER WELL RECORD

County or District PERTH | Township, Village, Town or City Blanchard
Con. ~~Thames S.B.C.~~ T.R. Lot ~~44~~ 37 | Date completed 18 (day) June (month) 1968 (year)

[redacted] Address ~~262 Wellington St.~~ St Marys Ont. R.R. #3

Casing and Screen Record

Inside diameter of casing 30"
Total length of casing 30'
Type of screen gravelpacked
Length of screen
Depth to top of screen
Diameter of finished hole 30"

Pumping Test

Static level 22 feet
~~Test pumping~~ Recovery rate 3 G.P.M.
~~Pumping level~~ ~~28~~
Duration of test pumping Timed recovery
Water clear or cloudy at end of test cloudy
Recommended pumping rate 2-3 G.P.M.
with pump setting of 27 feet below ground surface

Well Log / Water Record

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
Top soil	0	6"		
Dark Brown Clay	6"	12'		
Grey Clay	12	24		
Sand	24	26	24	fresh
Gravel	26	28		
Grey clay	28	30		

For what purpose(s) is the water to be used? Domestic

Is well on upland, in valley, or on hillside? level

Drilling or Boring Firm Hades Well Digging & Drilling

Address Elmira Ontario.

Licence Number 2862

Name of Driller or Borer R L Franklin

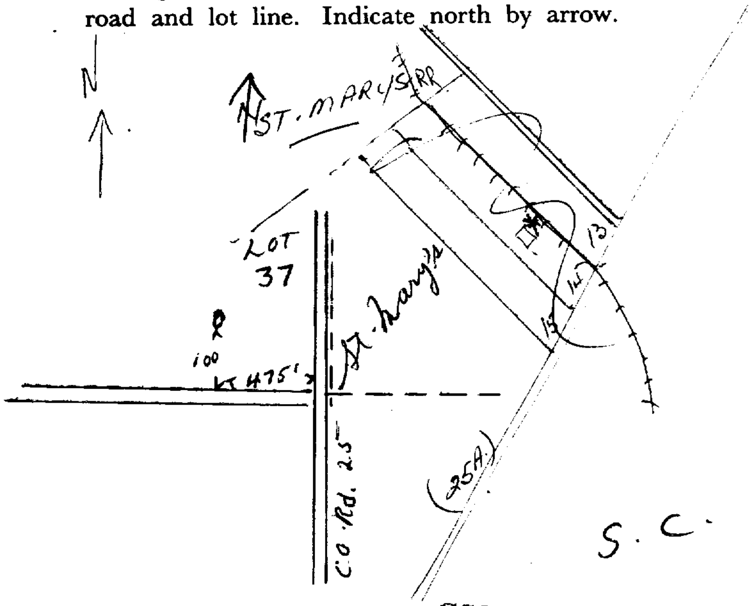
Address c/o Hades

Date June 30/68

R L Hatleton
(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



S.C.

CSS.58

Form 7 5M 60-20912

OWRC COPY

UTM 17 Z 481280 TR. Lot 39
CODED
4 R 4786710
Elev. 5 R 1060
Basin 23

5001571

3 9

The Ontario Water Resources Commission Act

WATER WELL RECORD

DIVISION OF WATER RESOURCES
1969
WATER RESOURCES COMMISSION

County or District *Perth* Township, Village, Town or City *Blanshard*

Con. *Thames River Con.* Lot *North Pt Lot 39* Date completed *25* (day) *Feb.* month *1969* year)

[redacted] dress *St Mary's RR#3*

SB

Casing and Screen Record	
Inside diameter of casing	*4"*
Total length of casing	*107*
Type of screen	*none used*
Length of screen	
Depth to top of screen	
Diameter of finished hole	*4"*

Pumping Test	
Static level	*112'*
Test-pumping rate	*12* G.P.M.
Pumping level	*114'*
Duration of test pumping	*1½ hrs.*
Water clear or cloudy at end of test	*Clear*
Recommended pumping rate	*10-12* G.P.M.
with pump setting of	*135* feet below ground surface

Well Log: Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
top clay	*0*	*7*		
clay + stones	*7*	*45*		
stones + hardpan	*45*	*90*		
hardpan	*90*	*106*		
brown limestone	*106*	*155*		
light brown limestone	*155*	*185*		
white limestone	*185*	*207*	*185-207*	*fresh*

For what purpose(s) is the water to be used? *F + D + S.*

Is well on upland, in valley, or on hillside? *upland*

Drilling or Boring Firm *D. Hopper Well Drilling*

Address *R.R.#2 Seaforth*

Licence Number ~~*3211*~~ *3178*

Name of Driller or Borer *Durl Hopper*

Address *R.R.#2 Seaforth, Ontario*

Date *April 13, 1969*

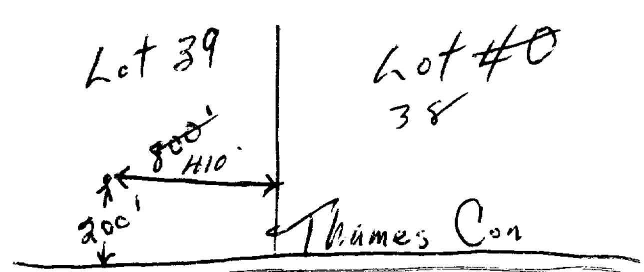
Durl Hopper
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



S.C'

The Ontario Water Resources Commission Act

40P/39

WATER WELL RECORD

Water management in Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 5001645 — MUNICIP. 50001 — CON. SB

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
PERTH	BLANCHARD	SOUTH BOUNDARY	018

[redacted] R. #3 ST. MARY'S

DATE COMPLETED: DAY 06 MO. ~~APRIL~~ 04 YR. 70

RC. 4 — ELEVATION 1090 — RC. 5 — BASIN CODE 23

18609 0

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH – FEET FROM	DEPTH – FEET TO
yellow	clay	sandy	packed	0	10
grey	clay	stones	hard	10	40
blue	clay		soft	40	55
grey	clay	stones	hard	55	103
grey	limestone		hard	103	114
grey	limstone	brown streaks	hard	114	150
brown	limestone		medium	150	210

31 0010 05 05 09 | 0040 20 05 12 | 0055 30 05 | 0103 20 05 12 | 0150 21 05 | 0210 6 15

41 WATER RECORD

WATER FOUND AT – FEET	KIND OF WATER
~~180~~ 0180	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
~~180-210~~	
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH – FEET FROM	DEPTH – FEET TO
~~6~~	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.205	0	~~114~~
04				0114
~~4~~	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		114	~~210~~
04				0210
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT – FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER — PUMPING RATE 0008 GPM. — DURATION OF PUMPING 02 HOURS 00 MINS.

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
140 FEET	142 FEET	FEET	FEET	FEET	FEET

1 ☐ PUMPING 2 ☐ RECOVERY

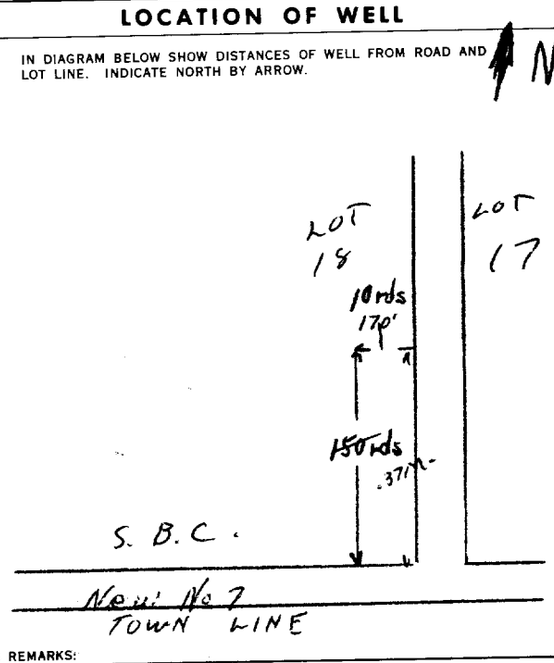
IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM.	FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	170 FEET	0010 GPM.

50-53 0004.0 GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL

54 — 1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE

55-56 — 1 ☒ DOMESTIC 2 ☒ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

12

METHOD OF DRILLING

57 — 1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: W. D. HOPPER & SONS — LICENCE NUMBER ~~3495~~ 2604

ADDRESS: R.R. # 2 SEAFORTH, ONT.

NAME OF DRILLER OR BORER: NEIL HOPPER — LICENCE NUMBER

SIGNATURE OF CONTRACTOR: Neil Hopper — SUBMISSION DATE: DAY 6 MO. MAY YR. 70

OFFICE USE ONLY

58 DATA SOURCE 1 — 59-62 CONTRACTOR 2604 — 63-68 DATE RECEIVED ~~8 05 71~~ 8 05 7

DATE OF INSPECTION 6, 11, 70 — INSPECTOR 71P S.C.

REMARKS:

OWRC COPY

40P39

The Ontario Water Resources Commission Act

WATER WELL RECORD

Water management in Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 5001804 | MUNICIP. 50001 | CON. SB

COUNTY OR DISTRICT: North

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Blanchard

CON., BLOCK, TRACT, SURVEY, ETC.: south bounty of ~~Blanchard~~

LOT: 017

[redacted] #3 St. Marys, Ontario

DATE COMPLETED: DAY 23 MO. 12 YR. 71

86070 | RC. 4 | ELEVATION 1072 | RC. 4 | BASIN CODE 23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH – FEET FROM	DEPTH – FEET TO
brown	clay	stones		0	27
				27	92
blue	clay	stones			
grey	limestone		hard	92	178

31 | 9927605712 | 0092305712 | 91782157

32

41 WATER RECORD

WATER FOUND AT – FEET	KIND OF WATER
0165 ~~165~~ to ~~178~~	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH – FEET FROM	DEPTH – FEET TO
05	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	244	0	0093
05	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		93	0178
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT – FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER

PUMPING RATE: 0009 GPM. DURATION OF PUMPING: 05 HOURS 00 MINS.

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
132 FEET	140 FEET	140 FEET	FEET	FEET	FEET

IF FLOWING, GIVE RATE: GPM.

PUMP INTAKE SET AT: 160 FEET

WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

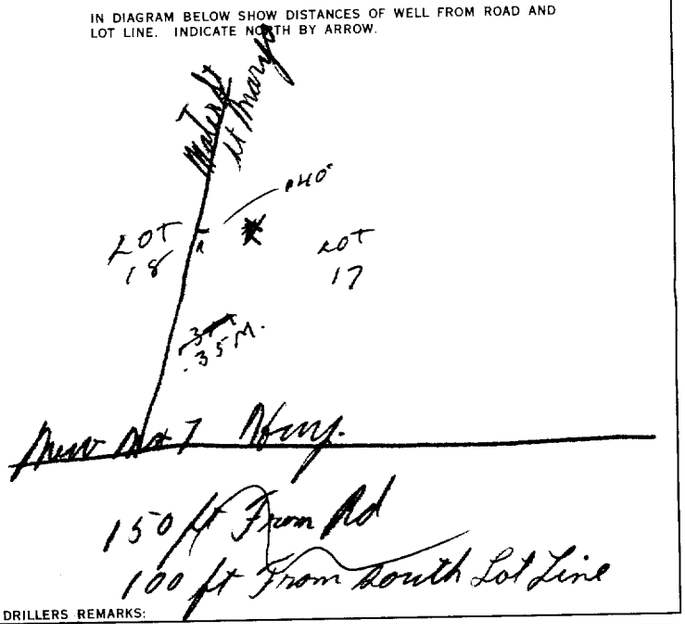
RECOMMENDED PUMP SETTING: 165 FEET

RECOMMENDED PUMPING RATE: 0008 GPM.

50-53 001.1 GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL

54: 1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE

55-56: 12 — 1 ☒ DOMESTIC 2 ☒ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING ☐ OTHER 9 ☐ NOT USED

METHOD OF DRILLING

57: 1 ☒ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Mervin Jones — LICENCE NUMBER: 3009

ADDRESS: RR#3 Thorndale, Ontario

NAME OF DRILLER OR BORER: Murray Jones — LICENCE NUMBER:

SIGNATURE OF CONTRACTOR: Mervin Jones — SUBMISSION DATE: DAY 28 MO. 12 YR. 71

WRC COPY

OFFICE USE ONLY

DATA SOURCE: 1 — CONTRACTOR: 3009 — DATE RECEIVED: 060172

DATE OF INSPECTION: 28, 2, 72 — INSPECTOR:

REMARKS: CSS.38

P 7

WI

MINISTRY OF THE ENVIRONMENT

The Ontario Water Resources Act

WATER WELL RECORD

40 P/36

Ontario

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11 5002038 MUNICIP. 50021 CON. TR

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Perth	Blanshard	Thames R.	037

[redacted] R.R.#3 St. Marys Onyario.

DATE COMPLETED DAY 14 MO. Nov YR. 73

5002038 17 487088 4787240 4 1042 4 23 MAR 20, 1975 51

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Brown	Clay			0	13
Grey	Clay & Stones			13	80
Grey	Limestone			80	160

31 0013605 0081295 1216021

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0103	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
05	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	188	0	0168
05 3/4	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		68	0160
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER

PUMPING RATE 0805 GPM — DURATION OF PUMPING 01 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
0 96 FEET	110 FEET	FEET	FEET	FEET	110 FEET

IF FLOWING GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	130 FEET	1 ☒ CLEAR 2 ☐ CLOUDY

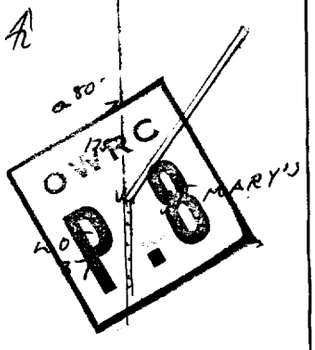
RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	130 FEET	0805 GPM

GPM./FT. SPECIFIC CAPACITY 002.4

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.

Follow rd. out of St. Marys past past St. Marys Cement plant to top of hill turn right 2nd place on left side.



DRILLERS REMARKS:

FINAL STATUS OF WELL (54)
1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE (55-56) 01
1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING (57)
1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Hadco Wehl Drilling & Digging Ltd. — LICENCE NUMBER: 2519

ADDRESS: P.O.Box 730 Elmira Ontario.

NAME OF DRILLER OR BORER: R.L.Franklin — LICENCE NUMBER:

SIGNATURE OF CONTRACTOR: [signature] — SUBMISSION DATE: DAY 6 MO. Dec YR. 73

OFFICE USE ONLY

DATA SOURCE 1 (58) — CONTRACTOR 2519 (59-62) — DATE RECEIVED 17 12 73 (63-68)

DATE OF INSPECTION 26 2 74 — INSPECTOR

REMARKS: CSS.58 — P 2 — WI

FORM 7 07-091

MINISTRY OF THE ENVIRONMENT COPY

40 P/36

MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act

WATER WELL RECORD

Ontario

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11 | 5002225 | MUNICIP. 50001 | CO. SB

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
~~Bruce~~ Perth	Blanchard	South Boundary	017

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
ST. MARYS, CEMENT CO.	St. Marys, Ontario	DAY 23 MO. 10 YR 74

21 | UTM ZONE 17 | EASTING 487303 | NORTHING 4785979 | RC 4 | ELEVATION 1082 | RC 4 | BASIN CODE 23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
black	topsoil			0	1
brown	clay			1	9
grey	clay	sand and stones		9	98
grey	limestone			98	160
brown	limestone			160	180

31 | 0001802 | 0009605 | 0098205281/2 | 0160215 | 0180615

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
180	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
05	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	188	0	0100
05	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		100	0180
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER | PUMPING RATE: 0010 GPM | DURATION OF PUMPING: 01 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
165 FEET	170 FEET	FEET	110 FEET	FEET	FEET

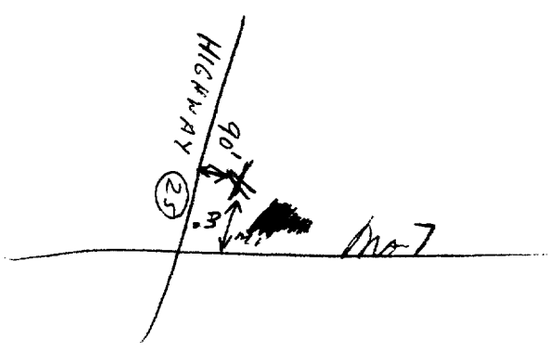
IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	175 FEET	0008 GPM

002.0 GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL 8785

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL: 1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE 01: 1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING: 1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Mervin Jones | LICENCE NUMBER: 3009

ADDRESS: R. R. #3, Thorndale, Ont.

NAME OF DRILLER OR BORER: Murray Jones | LICENCE NUMBER: 3034

SIGNATURE OF CONTRACTOR: Mervin Jones | SUBMISSION DATE: DAY 24 MO. 10 YR. 74

OFFICE USE ONLY

DATA SOURCE 1 | CONTRACTOR 3009 | DATE RECEIVED 24 01 75

DATE OF INSPECTION May 2/75 | INSPECTOR

REMARKS: COVERED

P S.S.

WI

CSS. 38

FORM 7 07-091

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MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act

WATER WELL RECORD

Ontario

407/3g

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11 | 15002282 | MUNICIP. 50601 | CON.

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT 25-27
Perth	~~Blanchard~~ ST MARY'S TOWN	South Boundary Conc	[redacted]

OWNER (SURNAME FIRST) 28-47	ADDRESS	DATE COMPLETED 48-53
[redacted]	St. Marys, Ontario.	DAY 01 MO. 10 YR. 75

21 | UTM ZONE 17 | EASTING 488020 | NORTHING 4787380 | RC. 4 | ELEVATION 0970 | RC. 3 | BASIN CODE 23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
Grey	Limestone			0'	33'
Brown	Limestone			33'	40'
Brown	Limestone		Hard	40'	82'
	Limestone		Broken	82'	85'
Brown	Limestone		Hard	85'	95'
Brown&Grey	Limestone			95'	163'
Brown	Limestone		Hard	163'	165'

31 | 0033215 | 0040615 | 008261573 | 0085 1571 | 009561573 | 0163615 | 1
32 | 016561573

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0033	1 ☐ FRESH 2 ☒ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
15-18	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
20-23	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
25-28	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
30-33	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
12	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.330	0'	0015'
12	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		15	0165
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
None	INCHES	FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER
PUMPING RATE: 0785 GPM
DURATION OF PUMPING: 08 HOURS 00 MINS

STATIC LEVEL: 006 (5'-7R)
WATER LEVEL END OF PUMPING: 033 (33.0 FEET)

WATER LEVELS DURING: 1 ☐ PUMPING 2 ☒ RECOVERY

15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
008 (8.48)	008 (7.82)		007 (7.36)

IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: FEET
WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING: 060 FEET
RECOMMENDED PUMPING RATE: 600 GPM
50-53 GPM./FT. SPECIFIC CAPACITY

FINAL STATUS OF WELL: 1

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE: 04

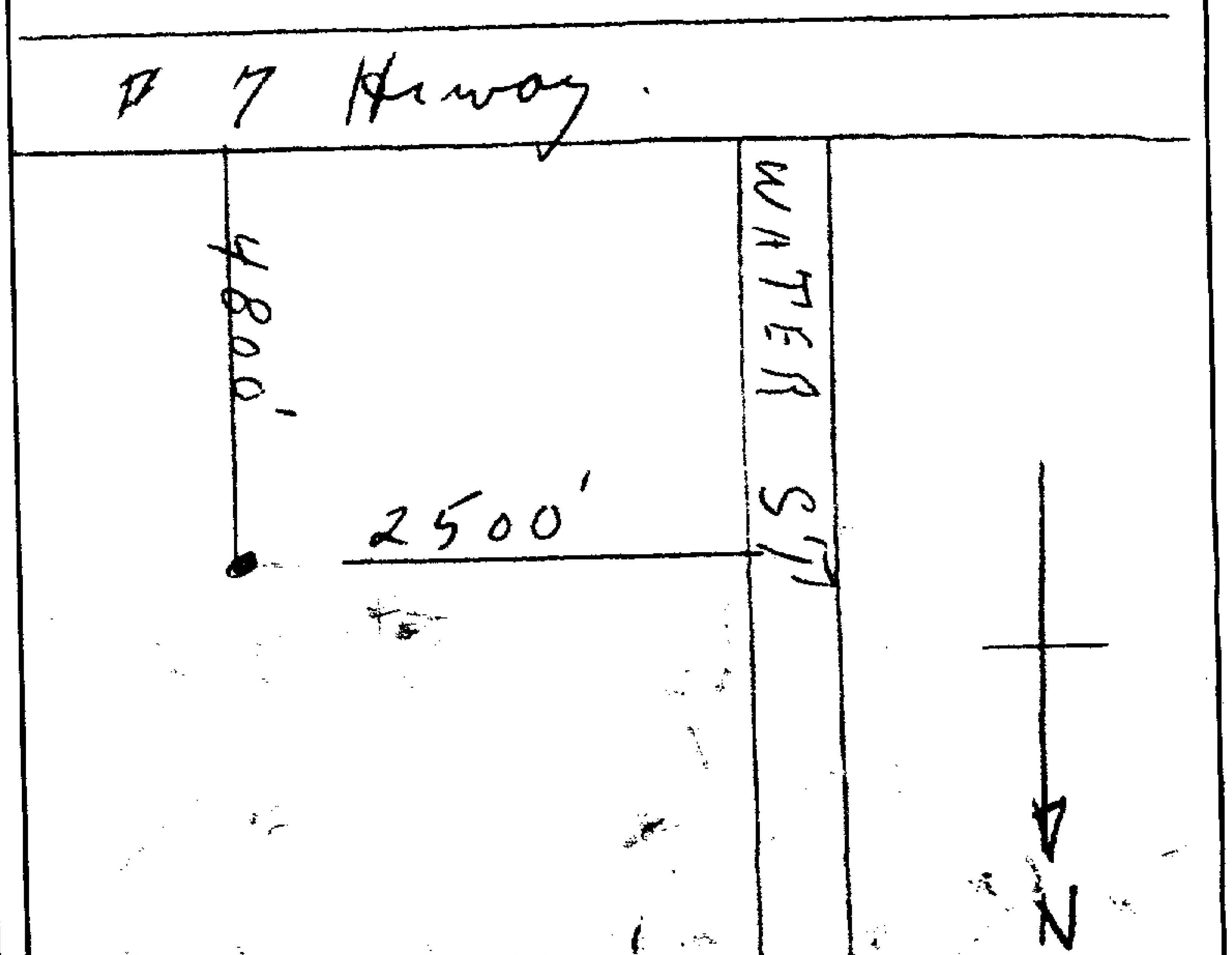
1 ☒ ~~DOMESTIC~~ 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☒ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING: 2

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

LOCATION OF WELL 8887

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

CONTRACTOR

NAME OF WELL CONTRACTOR: International Water Supply Ltd. | LICENCE NUMBER: 2801
ADDRESS: Barrie, Ontario.
NAME OF DRILLER OR BORER: Tom Kyle | LICENCE NUMBER: 2801
SIGNATURE OF CONTRACTOR: B. Hodg— | SUBMISSION DATE: DAY 3 MO. OCT YR. 75

OFFICE USE ONLY

DATA SOURCE: 1 | CONTRACTOR: 2801 | DATE RECEIVED: 071075
DATE OF INSPECTION: 14/9/76 | INSPECTOR: 7
REMARKS: CSS.S8
P B.J.
WI B.J.

FORM 7 07-091

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Ministry of the Environment
Ontario

(27)

The Ontario Water Resources Act

WATER WELL RECORD

5002878

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(11)

MUNICIP. 50001 CON TR

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
PERTH	BLANSHARD	THAMES R.	038

[redacted] R. R. #3 ST. MARYS

DATE COMPLETED: DAY 28 MO 10 YR 80

UTM 786620 RC 4 ELEVATION 1060 RC 4 BASIN CODE 23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	topsoil			0	2
brown	clay	with sand and gravel		2	9
grey	clay	sand and stones		9	109
brown	limestone			109	162
grey	limestone			162	169
brown	limestone			169	171

(31) 0002 02 0009 6 05 28 1 1 0 1 09 2 05 28 1 2 0 1 6 2 6 1 5 0 1 6 9 2 1 5 0 1 7 1 6 1 5

(32)

(41) WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0171	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL

(51) CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
05	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	188	0	0110
05	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		110	0171
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

(61) PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)

(71) PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER

PUMPING RATE: 0008 GPM

DURATION OF PUMPING: 01 HOURS 00 MINS

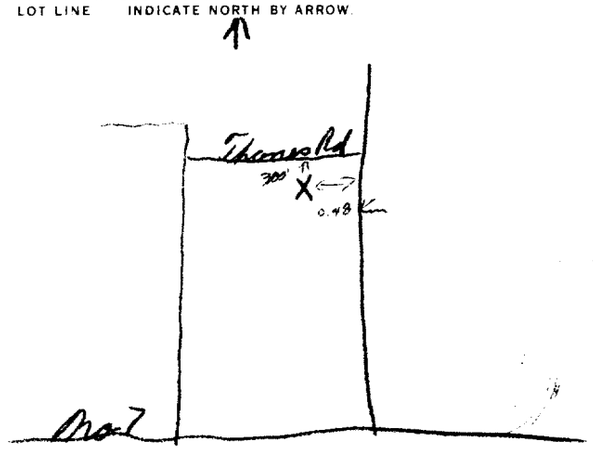
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
120 FEET	150 FEET		150 FEET	150 FEET	150 FEET	150 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	160 FEET	0007 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL 1
1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE 12
1 ☒ DOMESTIC 2 ☒ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING 2
1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: MERVIN JONES — LICENCE NUMBER: 3009

ADDRESS: R. R. #3 THORNDALE, ONTARIO

NAME OF DRILLER OR BORER: MURRAY S. JONES — LICENCE NUMBER: 3034

SIGNATURE OF CONTRACTOR: Mervin Jones — SUBMISSION DATE: DAY ____ MO ____ YR. ____

OFFICE USE ONLY

DATA SOURCE: 1 — CONTRACTOR: 3009 — DATE RECEIVED: 101180

DATE OF INSPECTION: 12/31 — INSPECTOR:

REMARKS: Letters

CSS.58

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506-4-77

Ministry of the Environment
Ontario

(51)

The Ontario Water Resources Act 40P/34

WATER WELL RECORD

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11 | 5003388 | MUNICIP 50601 | CON

COUNTY OR DISTRICT: [redacted]

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Blancha rd St. Marys Villiage. St. Marys, Ont.

CON., BLOCK, TRACT, SURVEY, ETC.: South Boundry

LOT: ~~36~~ 17

DATE COMPLETED: DAY ~~26~~ MO 10 YR 87

ELEVATION: 1063

BASIN CODE:

21 | 17 | 86770

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
				0	1
black	topsoil			1	5
brown	clay	sand			
grey	clay	sand and stones		5	119
grey	limestone			119	171

31 | 32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
171	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	121
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		121	171
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER

PUMPING RATE: 7 GPM

DURATION OF PUMPING: 1 HOURS ___ MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
141 FEET	147 FEET		147 FEET	147 FEET	147 FEET	147 FEET

IF FLOWING, GIVE RATE: ___ GPM

PUMP INTAKE SET AT: ___ FEET

WATER AT END OF TEST: 1 ☐ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 165 FEET

RECOMMENDED PUMPING RATE: 7 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.

NORTH

STMARYS

X

NOT HIGHWAY

14419

DRILLERS REMARKS:

FINAL STATUS OF WELL

1 ☐ WATER SUPPLY 2 ☒ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 8 ☐ ABANDONED, INSUFFICIENT SUPPLY 8 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED 9 ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Mervin Jones

WELL CONTRACTOR'S LICENCE NUMBER: 3009

ADDRESS: R,r. 3, Thorndale, Ont.

NAME OF WELL TECHNICIAN: Murray S. Jones

WELL TECHNICIAN'S LICENCE NUMBER: 10668

SIGNATURE OF TECHNICIAN/CONTRACTOR: Mervin Jones

SUBMISSION DATE: DAY 26 MO 10 YR 87

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR | DATE RECEIVED: NOV 04 1987

DATE OF INSPECTION: 3/9/88 | INSPECTOR

REMARKS: CSS.88

FORM NO. 0506 (11/86) FORM 7

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Ontario

30

The Ontario Water Resources Act

WATER WELL RECORD

5003434 SB

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COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY ETC	LOT	PLAN
	BLANSHARD	THAMES		295

[redacted] R. #3 St. Marys, Ontario N0M 2V0

DATE COMPLETED: DAY 15 MO 6 YR 88

UTM 787253 ELEVATION 1060 BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Black	Topsoil			0	1
Brown	Clay	Stones		1	4
Grey	Clay	Sand and Stones		4	93
Grey	Limestone			93	185

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
185	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	94
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		94	185
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☐ PUMP 2 ☒ BAILER	7 GPM	1 HOURS ___ MINS

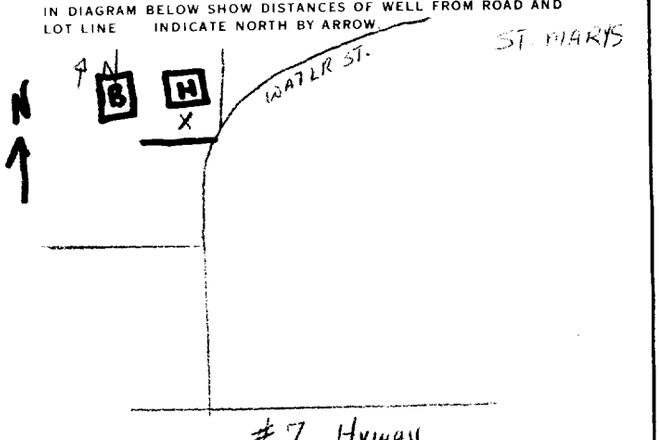
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING (1 ☒ PUMPING 2 ☐ RECOVERY)	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
132 FEET	156 FEET		156 FEET	156 FEET	156 FEET	156 FEET

IF FLOWING, GIVE RATE ___ GPM | PUMP INTAKE SET AT ___ FEET | WATER AT END OF TEST 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING 180 FEET | RECOMMENDED PUMPING RATE 7 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE INDICATE NORTH BY ARROW



27648

DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED 9 ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Mervin Jones | WELL CONTRACTOR'S LICENCE NUMBER: 3009

ADDRESS: R. R. #3 Thorndale, Ontario N0M 2P0

NAME OF WELL TECHNICIAN: Murray S. Jones | WELL TECHNICIAN'S LICENCE NUMBER: T 0068

SIGNATURE OF TECHNICIAN/CONTRACTOR: Mervin Jones | SUBMISSION DATE: DAY 16 MO 6 YR 88

MINISTRY OF THE ENVIRONMENT COPY

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 3009 | DATE RECEIVED JUN 22 1988

DATE OF INSPECTION | INSPECTOR

REMARKS

CSS.38

FORM NO. 0506 (11/86) FORM 9

Ministry of the Environment
Ontario

H9

The Ontario Water Resources Act

WATER WELL RECORD

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2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 5003609 | MUNICIP. 5,0,0,0,1 | CON. SB | 18

COUNTY OR DISTRICT: [redacted]
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: BLANSHARD
CON. BLOCK, TRACT, SURVEY, ETC: Thames Concession
Reg. | LOT: P
ADDRESS OF WELL LOCATION: [redacted] R. #3 St. Marys, Ontario NOM 2V0
DATE COMPLETED: DAY 03 MO 08 YR 89

21 | T M [redacted] | UTM [redacted] 4786383 | RC | ELEVATION 1080 | RC | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
				0	131
Grey	Clay	Sand and Stones		131	170
Grey	Limestone				

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
170	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	131
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		131	170
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)

PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☐ PUMP 2 ☒ BAILER	8 GPM	1 HOURS ___ MINS

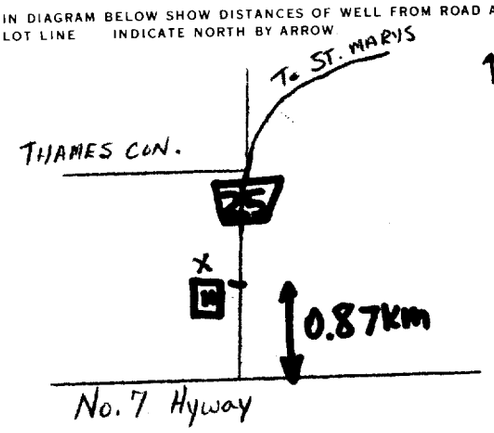
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING (1 ☐ PUMPING 2 ☐ RECOVERY)	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
132 FEET	145 FEET		145 FEET	145 FEET	145 FEET	145 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	150 FEET	8 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE INDICATE NORTH BY ARROW



46764

DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: MERVIN JONES DRILLING LTD.
WELL CONTRACTOR'S LICENCE NUMBER: 3009
ADDRESS: R. R. #3 Thorndale, Ontario NOM 2P0
NAME OF WELL TECHNICIAN: MURRAY S. JONES
WELL TECHNICIAN'S LICENCE NUMBER: T-0068
SIGNATURE OF TECHNICIAN/CONTRACTOR: Mervin Jones
SUBMISSION DATE: DAY 03 MO 08 YR 89

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 3009 | DATE RECEIVED AUG 14 1989
DATE OF INSPECTION | INSPECTOR
REMARKS

CSS.38

FORM NO. 0506 (11/86) FORM 9

MINISTRY OF THE ENVIRONMENT COPY

Ministry of the Environment
Ontario

(65)

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 5003633 | MUNICIP 50001 | CON. SB

COUNTY OR DISTRICT: [redacted]
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Blanshard
CON. BLOCK, TRACT, SURVEY, ETC: Thames
LOT: 18
DATE COMPLETED: DAY 18 MO 9 YR 89
[redacted], St.Marys, Ontario,
RC. | ELEVATION: 1080 | RC. | BASIN CODE

21 | [illegible] | 17 | [illegible] | 86205

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
brown	clay	sand		0	12
grey	clay	sand and stones		12	87
grey	limestone			87	170

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
170	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	88
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC		88	170
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER ETC.)

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☐ PUMP 2 ☒ BAILER	8 GPM	1 HOURS ___ MINS

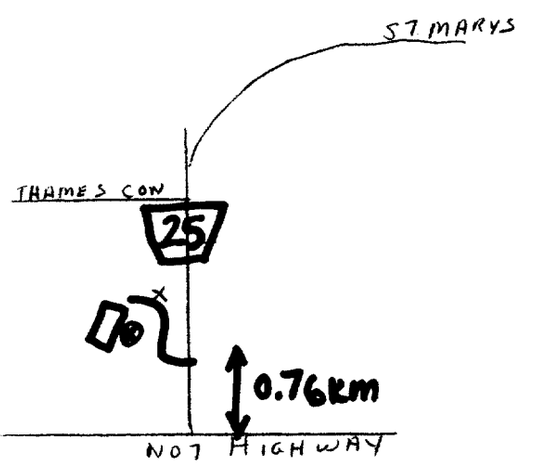
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
132 FEET	150 FEET	1 ☒ PUMPING 2 ☐ RECOVERY	150 FEET	150 FEET	150 FEET	150 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	160 FEET	8 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



46786

DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☐ WATER SUPPLY 2 ☒ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: MErvin Jones Drilling LTD
WELL CONTRACTOR'S LICENCE NUMBER: 3009
ADDRESS: R.R.3 Thorndale, Ontario,
NAME OF WELL TECHNICIAN: Murray S. Jones
WELL TECHNICIAN'S LICENCE NUMBER: T0068
SIGNATURE OF TECHNICIAN/CONTRACTOR: Mervin Jones
SUBMISSION DATE: DAY 18 MO 9 YR 89

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 3009 | DATE RECEIVED SEP 27 1989
DATE OF INSPECTION | INSPECTOR
REMARKS: CSS.S8

FORM NO. 0506 (11/86) FORM 9

MINISTRY OF THE ENVIRONMENT COPY

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11

5003647 MUNICIP 50991 CON. SB

COUNTY OR DISTRICT: [redacted]

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Blanshard Twp.

CON., BLOCK, TRACT, SURVEY, ETC: Con. S.B.

LOT: Pt.18

[redacted] c/o F. Weitzel
R.R. 2, Tavistock, ON N0B 2R0

DATE COMPLETED: DAY 13 MO Sept. YR 89.

RC 4865 65 RC ELEVATION 1080 RC BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Brown	Clay		Hard	0	6
Grey	Clay	STones	Hard	6	61
Grey	Hardpan	Stones	Hard	61	98
Grey-Brn.	Limestone		Hard	98	152
Brown	Limestone		Medium	152	159

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
138	1 ☒ FRESH 2 ☐ SALTY — 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
153	
159	

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.188	0	100-8
6	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☒ PLASTIC		100-8	159
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER — air

PUMPING RATE: 10 GPM

DURATION OF PUMPING: 1 HOURS 30 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
121 FEET	129 FEET		125 FEET	127 FEET	129 FEET	129 FEET

IF FLOWING, GIVE RATE: GPM

PUMP INTAKE SET AT: 150 FEET

WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY

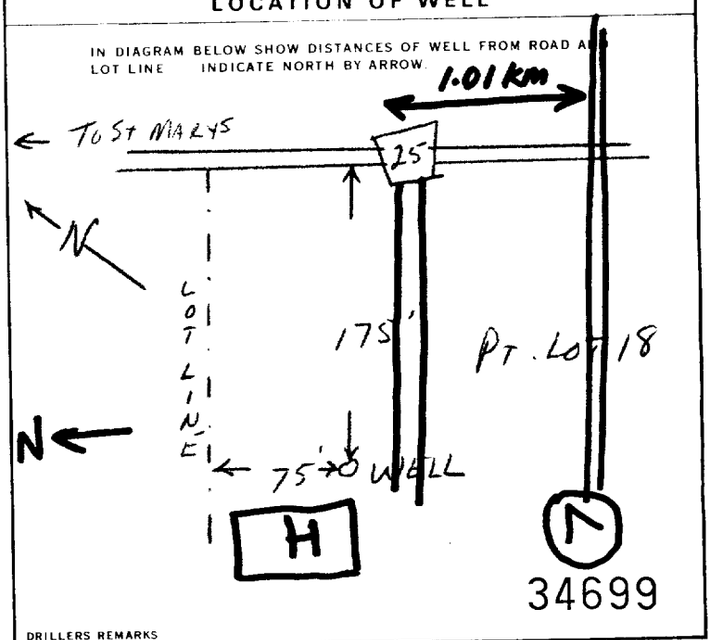
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 150 FEET

RECOMMENDED PUMPING RATE: 10 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED 9 ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Davidson Well Drilling Limited

WELL CONTRACTOR'S LICENCE NUMBER: 1737

ADDRESS: Box 486, Wingham, Ontario. N0G 2W0

NAME OF WELL TECHNICIAN: D. Casemore

WELL TECHNICIAN'S LICENCE NUMBER: T0154

SIGNATURE OF TECHNICIAN/CONTRACTOR

SUBMISSION DATE: DAY 20 MO Sept. YR 89.

OFFICE USE ONLY

DATA SOURCE

CONTRACTOR: 1737

DATE RECEIVED: OCT 18 1989

DATE OF INSPECTION

INSPECTOR

REMARKS

CSS.88

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

(40)

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 — 5003753 — MUNICIP 5,000,1 — CON. SB

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON. BLOCK, TRACT, SURVEY, ETC.	LOT
[redacted]	BLANSHARD	THAMES	18

[redacted] #3 St. Marys, Ontario NOM 2V0

DATE COMPLETED: DAY 23 MO 07 YR 90

21 — UTM — RC — ELEVATION 1080 — RC — BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Grey	Clay	Sand and Stones		0	93
Brown	Limestone			93	180

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
175 to 180	1 ☐ FRESH 2 ☒ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	94
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		94	180
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE — DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER — PUMPING RATE: 12 GPM — DURATION OF PUMPING: 1 HOURS ____ MINS

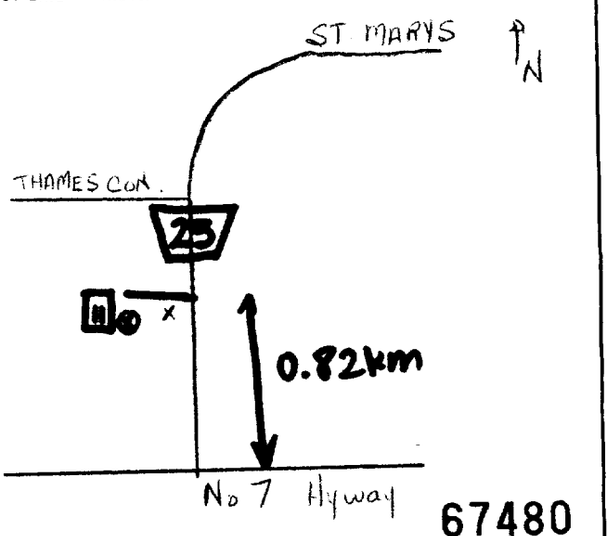
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☑ PUMPING 2 ☐ RECOVERY	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
132 FEET	145 FEET		145 FEET	145 FEET	145 FEET	145 FEET

IF FLOWING, GIVE RATE — GPM — PUMP INTAKE SET AT — FEET — WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP — RECOMMENDED PUMP SETTING: 170 FEET — RECOMMENDED PUMPING RATE: 10 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



67480

DRILLERS REMARKS

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: MERVIN JONES DRILLING LTD. — WELL CONTRACTOR'S LICENCE NUMBER: 3009

ADDRESS: R. R. #3 Thorndale, Ontario NOM 2P0

NAME OF WELL TECHNICIAN: STEPHEN BLIGHT — WELL TECHNICIAN'S LICENCE NUMBER: T-1626

SIGNATURE OF TECHNICIAN/CONTRACTOR: Mervin Jones — SUBMISSION DATE: DAY 24 MO 07 YR 90

OFFICE USE ONLY

DATA SOURCE — CONTRACTOR 3009 — DATE RECEIVED SEP 06 1990

DATE OF INSPECTION — INSPECTOR

REMARKS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 5003888 MUNICIP. 50091 CON. S.8 LOT 18

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC	LOT
[redacted]	ARD	TRC	

DATE COMPLETED 48-52: DAY 18/ MO 7/ YR 1991

[redacted] ST. MARYS ONT.

21 T [redacted] 86490 RC ELEVATION 1080 RC BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
YELLOW	CLAY			0	13
~~GREY~~	~~CLAY~~			13	45
GREY	HARDPAN	STONES		45	107
WHITE	MARL	SAND		107	113
~~WHITE~~	~~MARL~~			~~113~~	~~115~~
GREY	LIMESTONE			115	120
BROWN	LIMESTONE		FRACTURED	120	150
~~BROWN~~	~~LIMESTONE~~	~~GREY LIMESTONE~~	~~LAYERED~~	~~150~~	~~179~~
BROWN	LIMESTONE		LOOSE	179	183

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
153	1 ☐ FRESH 2 ☒ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
160	1 ☐ FRESH 2 ☒ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
179	1 ☐ FRESH 2 ☒ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
183	1 ☐ FRESH 2 ☒ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5"	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	ST .188 +1		118
5"	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	OP	118	183
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER — PUMPING RATE: 17 GPM — DURATION OF PUMPING: 3 HOURS ___ MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING (1 ☐ PUMPING 2 ☐ RECOVERY)	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
127 FEET	134 FEET	RC	127 FEET	FEET	FEET	FEET

IF FLOWING, GIVE RATE: GPM

PUMP INTAKE SET AT: 175 FEET

WATER AT END OF TEST: 1 ☐ CLEAR 2 ☒ CLOUDY

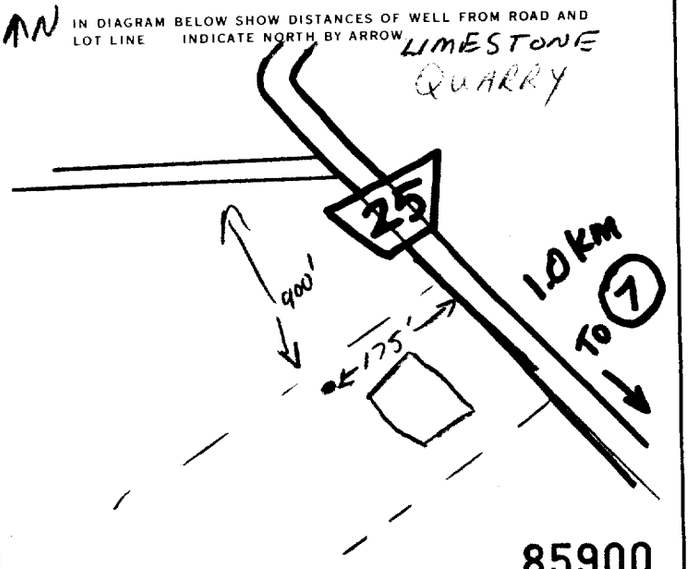
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 165 FEET

RECOMMENDED PUMPING RATE: 15 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE — INDICATE NORTH BY ARROW



85900

PUMP BY W.D.HOPPER & SONS
DRILLERS REMARKS

FINAL STATUS OF WELL

WATER SUPPLY — 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☐ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER — DOMS — 5 ☐ COMMERCIAL ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING — COOL — 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) — CONV 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) — AIR 5 ☐ AIR PERCUSSION — ☐ BORING ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: W.D.HOPPER & SONS LTD. — WELL CONTRACTOR'S LICENCE NUMBER: 2604

ADDRESS: RR# 2 SEAFORTH ONT.

NAME OF WELL TECHNICIAN: RON HOPPER — WELL TECHNICIAN'S LICENCE NUMBER: T-0135

SIGNATURE OF TECHNICIAN/CONTRACTOR: Ron Hopper — SUBMISSION DATE: DAY 30/ MO 9/ YR 1991

OFFICE USE ONLY

DATA SOURCE 58 — CONTRACTOR 59-62: 2604 — DATE RECEIVED 63-68: NOV 12 1991

DATE OF INSPECTION — INSPECTOR

REMARKS: A.P.L

CSS.S8

FORM NO. 0506 (11/86) FORM 9

MINISTRY OF THE ENVIRONMENT COPY

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 — 5004013 — MUNICIP 50001 — CON. TR

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON. BLOCK, TRACT, SURVEY, ETC.	LOT
PERTH	BLANSHARD	T. RD.	37

[redacted] MARYS, ONT.

DATE COMPLETED: DAY 29 / MO 9 / YR 1992

NG | RC | ELEVATION | RC | BASIN CODE | II | III | IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BRN	CLAY	STONES		0	19
GREY	CLAY	STONES		19	74
GREY	HARDPAN	STONES		74	100
BRN	LIMESTONE			100	185

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
140-185 FR	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 5 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 5 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 5 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 5 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 5 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5"	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC — ST	.188	+ 2	105
5"	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC — OP		105	185
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☒ PUMP 2 ☐ BAILER	12 GPM	1 HOURS 30 MINS

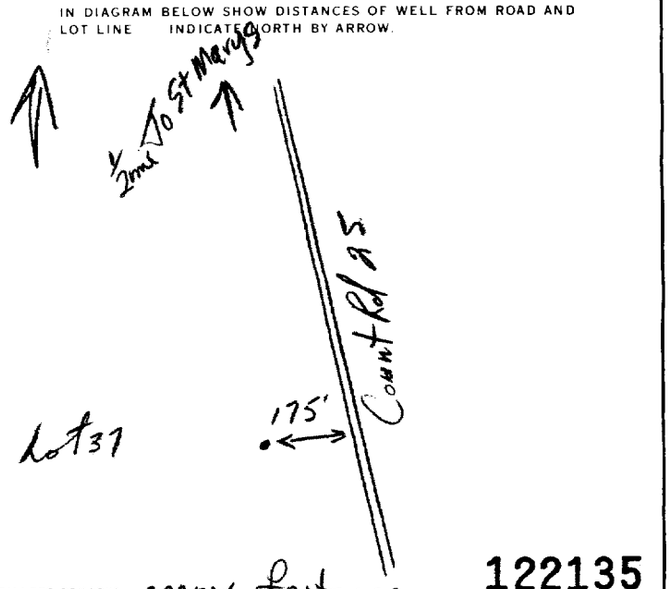
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
124 FEET	FEET	1 ☐ PUMPING 2 ☐ RECOVERY	FEET	FEET	FEET	FEET

IF FLOWING GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☐ CLEAR 2 ☐ CLOUDY — CL

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP — X	150 FEET	12 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS: approx footages

122135

FINAL STATUS OF WELL

WATR

1 ☐ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

DOMS

1 ☐ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

ROTY AIR

1 ☐ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: DURL HOPPER LIMITED

WELL CONTRACTOR'S LICENCE NUMBER: 2644

ADDRESS: R.R.# 7, ST.MARYS, ONT. N4X 1C9

NAME OF WELL TECHNICIAN: SHAWN HOPPER

WELL TECHNICIAN'S LICENCE NUMBER: 92-149

SIGNATURE OF TECHNICIAN/CONTRACTOR

SUBMISSION DATE: DAY ____ MO 10 / 14 / YR 1992

MINISTRY OF THE ENVIRONMENT COPY

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 2644 | DATE RECEIVED JUL 19 1993

DATE OF INSPECTION | INSPECTOR

REMARKS: CSS.ES

FORM NO. 0506 (11/86) FORM 9

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 — 5004319 — MUNICIP 50091 — CON. TR

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON. BLOCK, TRACT, SURVEY, ETC.	LOT
Perth	Blanshard	Thames River	37 6=7

[redacted]
1740 Perth Rd. 23
R.3, St.Marys, Ontario, N4x 1c6

DATE COMPLETED: DAY 15 MO 8 YR 96

HING | RC. | ELEVATION | RC | BASIN CODE | II | III | IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
grey	clay	sand and stones		0	94
grey	limestone			94	185

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
185	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	95
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☒ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC		95	185
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☐ PUMP 2 ☒ BAILER	8 GPM	1 HOURS ___ MINS

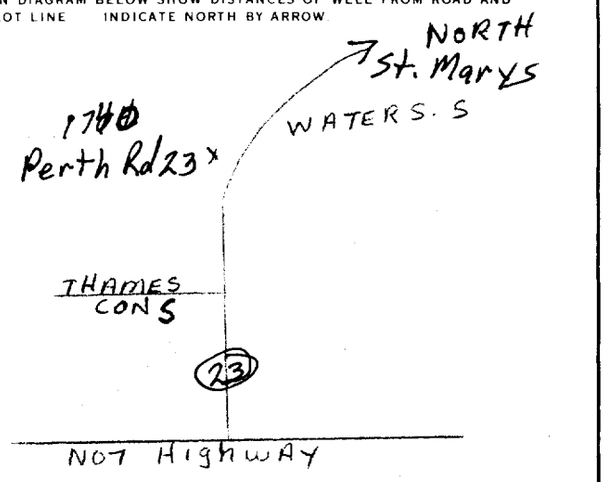
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
112 FEET	155 FEET	1 ☒ PUMPING 2 ☐ RECOVERY	155 FEET	155 FEET	155 FEET	155 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	170 FEET	8 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS: 146532

FINAL STATUS OF WELL	WATER USE	METHOD OF CONSTRUCTION
1 ☒ WATER SUPPLY	1 ☒ DOMESTIC	1 ☐ CABLE TOOL
2 ☐ OBSERVATION WELL	2 ☐ STOCK	2 ☒ ROTARY (CONVENTIONAL)
3 ☐ TEST HOLE	3 ☐ IRRIGATION	3 ☐ ROTARY (REVERSE)
4 ☐ RECHARGE WELL	4 ☐ INDUSTRIAL	4 ☐ ROTARY (AIR)
5 ☐ ABANDONED, INSUFFICIENT SUPPLY	☐ OTHER	5 ☐ AIR PERCUSSION
6 ☐ ABANDONED, POOR QUALITY	5 ☐ COMMERCIAL	6 ☐ BORING
7 ☐ UNFINISHED	6 ☐ MUNICIPAL	7 ☐ DIAMOND
☐ DEWATERING	7 ☐ PUBLIC SUPPLY	8 ☐ JETTING
	8 ☐ COOLING OR AIR CONDITIONING	9 ☐ DRIVING
	9 ☐ NOT USED	☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENCE NUMBER
Mervin Jones Drilling LTD	3009

ADDRESS	
R.R.3, Thorndale, Ontario, NOM 2po	

NAME OF WELL TECHNICIAN	WELL TECHNICIAN'S LICENCE NUMBER
Murray S, Jones	T0068

SIGNATURE OF TECHNICIAN/CONTRACTOR	SUBMISSION DATE
Murray S Jones	DAY 16 MO 8 YR 96

OFFICE USE ONLY

DATA SOURCE	CONTRACTOR	DATE RECEIVED
	3009	AUG 27 1996

DATE OF INSPECTION | INSPECTOR

REMARKS: CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

11 | 5004527 | Municipality 50601 | Con.

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
[redacted]	BLANSHARD	TOWN OF ST.MARYS (Front Street)	1
	Address: WATER ST. S, ST.MARYS, ONTARIO	Date completed: 18 /11 /1997 (day month year)	

Northing | RC | Elevation | RC | Basin Code | ii | iii | iv

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
BRN	TOP SOIL			0	1
GREY	GRANITE	BOULDERS & GRAVEL		1	13
GREY	LIMESTONE			13	100

31
32

WATER RECORD (41)

Water found at – feet	Kind of water
80-100	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas

CASING & OPEN HOLE RECORD (51)

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6"	☐ Steel ☑ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic	.188	0	20
6"	☐ Steel ☐ Galvanized ☐ Concrete ☑ Open hole ☐ Plastic		20	100
	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open hole ☐ Plastic			

SCREEN

Sizes of opening (Slot No.)	Diameter (inches)	Length (feet)
Material and type	Depth at top of screen (feet)	

PLUGGING & SEALING RECORD (61)

☒ Annular space ☐ Abandonment

Depth set at – feet From	To	Material and type (Cement grout, bentonite, etc.)
0	18	BEN.CLA.SLUR

PUMPING TEST (71)

Pumping test method	Pumping rate	Duration of pumping
☑ Pump ☐ Bailer	10 GPM	1 Hours 30 Mins

Static level	Water level end of pumping	Water levels during: ☐ Pumping ☑ Recovery — 15 minutes	30 minutes	45 minutes	60 minutes
60 feet	feet	60 feet	feet	feet	feet

If flowing give rate: GPM | Pump intake set at: feet | Water at end of test: ☑ Clear ☐ Cloudy

Recommended pump type: ☐ Shallow ☑ Deep | Recommended pump setting: 75 feet | Recommended pump rate: 10 GPM

FINAL STATUS OF WELL

☑ Water supply ☐ Observation well ☐ Test hole ☐ Recharge well ☐ Abandoned, insufficient supply ☐ Abandoned, poor quality ☐ Abandoned (Other) ☐ Dewatering ☐ Unfinished ☐ Replacement well

WATER USE

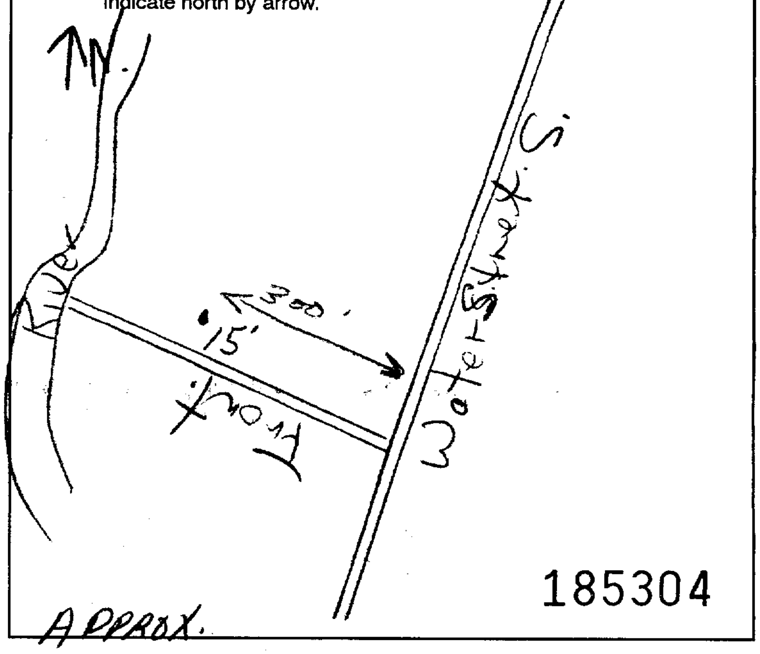
☑ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Commercial ☐ Municipal ☐ Public supply ☐ Cooling & air conditioning ☐ Not used ☐ Other ....

METHOD OF CONSTRUCTION

☐ Cable tool ☑ Rotary (conventional) ☐ Rotary (reverse) ☐ Rotary (air) ☐ Air percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other ....

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



185304

Name of Well Contractor	Well Contractor's Licence No.
DURL HOPPER LIMITED	2644
Address: RR # 7, ST.MARYS, ONTARIO N4X 1C9	
Name of Well Technician: DOUGLAS HOPPER	Well Technician's Licence No.: T-2323
Signature of Technician/Contractor: [signature]	Submission date: 15 /12 /1997 (day mo yr)

MINISTRY USE ONLY

Data source	Contractor	Date received
	2644	MAY 22 1998
Date of inspection	Inspector	
Remarks		CSS.S8

0506 (07/94) Front Form 9

2 - MINISTER OF ENVIRONMENT & ENERGY COPY

DRAFT

Ontario Ministry of the Environment

Well Tag No. A 009296 (below) — A 009296

Well Record

Regulation 903 Ontario Water Resources Act

page ___ of ___

Instructions for Completing Form

- For use in the **Province of Ontario** only. This document is a permanent **legal** document. Please retain for future reference.
- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

Ministry Use Only

[redacted]

Address of Well Location (County/District/Municipality)	Township	Lot	Concession
Perth	Town of St. Marys	-	-

RR#/Street Number/Name	City/Town/Village	Site/Compartment/Block/Tract etc.
Box 1646, Water Street	St. Marys	

GPS Reading	NAD	Zone	Easting	Northing	Unit Make/Model	Mode of Operation: X Undifferentiated / Differentiated, specify / Averaged
305 Elev	8 3	17	0487550	4788129	Garmin/etrex	

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Metres To
Brown	Clay			0	3.05
Brown	Gravel	Stones		3.05	5.18
Brown	Limestone			5.18	34.76

Hole Diameter

Depth From	Metres To	Diameter Centimetres
0	6.40	24.13

Water Record

Water found at ___ Metres — Kind of Water

34.76 — X Fresh, Sulphur, Gas, Salty, X Minerals, Other:

m — Fresh, Sulphur, Gas, Salty, Minerals, Other:

m — Fresh, Sulphur, Gas, Salty, Minerals, Other:

After test of well yield, water was
X Clear and sediment free
Other, specify

Chlorinated X Yes No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Metres To
Casing				
15.558	X Steel, Fibreglass, Plastic, Concrete, Galvanized	0.48	+0.61	0
"	X Steel, Fibreglass, Plastic, Concrete, Galvanized	"	0	6.40
	Steel, Fibreglass, Plastic, Concrete, Galvanized			
Screen				
Outside diam	Steel, Fibreglass, Plastic, Concrete, Galvanized — Slot No.			
No Casing or Screen				
	X Open hole		6.40	34.76

Test of Well Yield

Pumping test method: Pump

Pump intake set at - (metres) 25.91

Pumping rate - (litres/min) 45.46

Duration of pumping 2 hrs + 00 min

Final water level end of pumping 24.39 metres

Recommended pump type: Shallow X Deep

Recommended pump depth 25.91 metres

Recommended pump rate. 45.46 (litres/min)

If flowing give rate - (litres/min)

If pumping discontinued, give reason: Clear

	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Static Level		16.16		
1		18.29	1	21.34
2		19.82	2	19.82
3		21.34	3	16.77
4		22.87	4	16.16
5		24.39	5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60		24.39	60	16.16

Plugging and Sealing Record

X Annular space ☐ Abandonment

Depth set at - Metres From	To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	6.40	Bentonite Slurry	0.14

Method of Construction

☐ Cable Tool, X Rotary (air), ☐ Diamond, ☐ Digging
X Rotary (conventional), ☐ Air percussion, ☐ Jetting, ☐ Other
☐ Rotary (reverse), ☐ Boring, ☐ Driving

Water Use

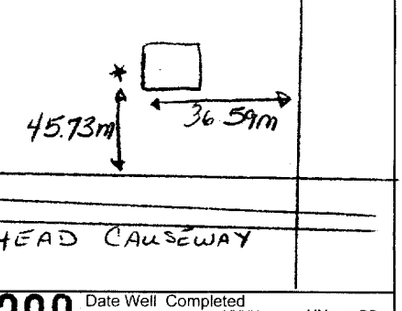
X Domestic, ☐ Industrial, ☐ Public Supply, ☐ Other
☐ Stock, ☐ Commercial, ☐ Not used
☐ Irrigation, ☐ Municipal, ☐ Cooling & air conditioning

Final Status of Well

X Water Supply, ☐ Recharge well, ☐ Unfinished, ☐ Abandoned, (Other)
☐ Observation well, ☐ Abandoned, insufficient supply, ☐ Dewatering
☐ Test Hole, ☐ Abandoned, poor quality, ☐ Replacement well

Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No. Z 09299 — Date Well Completed YYYY 2004 MM 05 DD 27

Was the well owner's information package delivered? X Yes ☐ No — Date Delivered YYYY 2004 MM 06 DD 07

Well Contractor/Technician Information

Name of Well Contractor	Well Contractor's Licence No.
Mc Leod Well Drilling Ltd	3563

Business Address (street name, number, city etc.): R.R. 4, 293810 Culloden Line, Ingersoll, Ont N5C 3J7

Name of Well Technician (last name, first name)	Well Technician's Licence No.
Ralph H. Mc Leod	T-0073

Signature of Technician/Contractor: X Ralph H. Mc Leod — Date Submitted YYYY MM DD

Ministry Use Only

Data Source — Contractor 3563

Date Received JUN 28 2004 — Date of Inspection YYYY MM DD

Remarks — Well Record Number 5005676

Ontario Ministry of the Environment

Well Tag Number (Place sticker and print number below): A010930

Well Record

Regulation 903 Ontario Water Resources Act

page 1 of 1

Instructions for Completing Form

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- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported ~~to 1/10th of a metre~~.**
- Please print clearly in blue or black ink only. FEET

Ministry Use Only

MUN | CON | LOT

Well Owner's Information and Location of Well Information

[redacted]

PERTH | BLANSHARD | 29 | TRN

RR#/Street Number/Name: PERTH LINE 5 | City/Town/Village: ST. MARYS | Site/Compartment/Block/Tract etc.

GPS Reading: NAD 83 | Zone 17 | Easting 486260 | Northing 4787504 | Unit Make/Model MAG/MEE | Mode of Operation: ☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To
BROWN	SAND/GRAVEL	COBBLES		0	12
GREY	LIMESTONE			12	65
BROWN	LIMESTONE			65	102

NI-05

Hole Diameter

Depth From	Depth To (Metres)	Diameter (Centimetres)
0	18	8 3/4
18	102	5 7/8

Water Record

Water found at Metres: 92 m | Kind of Water: ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

☐ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

☐ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was: ☒ Clear and sediment free ☐ Other, specify

Chlorinated ☐ Yes ☒ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Depth To (Metres)
Casing				
6"	☒ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	.188	+2	18
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
No Casing or Screen				
	☒ Open hole		18	102

Test of Well Yield

Pumping test method: AIR

	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Pump intake set at - (metres)	Static Level	52		
Pumping rate - (litres/min) 30gpm	1		1	
Duration of pumping ____hrs +____ min	2		2	
Final water level end of pumping ____metres	3		3	
Recommended pump type. ☐ Shallow ☐ Deep	4		4	
Recommended pump depth. ____metres	5		5	
Recommended pump rate. (litres/min)	10		10	
If flowing give rate - (litres/min)	15		15	
If pumping discontinued, give reason.	20		20	
	25		25	
	30		30	
	40		40	
	50		50	
	60		60	

Plugging and Sealing Record ☒ Annular space ☐ Abandonment

Depth set at - Metres From	Depth set at - Metres To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	18	BENTONITE SLURRY	0.2cu/m

Method of Construction

☐ Cable Tool ☐ Rotary (air) ☐ Diamond ☐ Digging
☒ Rotary (conventional) ☒ Air percussion ☐ Jetting ☐ Other
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

☐ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☒ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☐ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other)
☒ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Well Contractor/Technician Information

Name of Well Contractor: DURL HOPPER LIMITED | Well Contractor's Licence No.: 2644

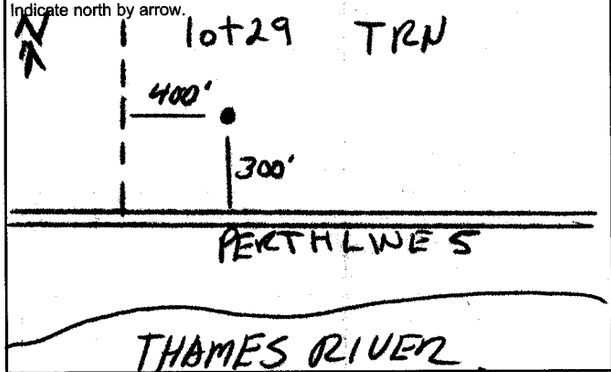
Business Address (street name, number, city etc.): R.R.#7, ST.MARYS, ON N4X 1C9

Name of Well Technician (last name, first name): HOPPER, DOUGLAS | Well Technician's Licence No.: T-2323

Signature of Technician/Contractor: X [signature] | Date Submitted YYYY MM DD: 2005 06 02

Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No.: Z 29730 | Date Well Completed YYYY MM DD: 2005 05 06

Was the well owner's information package delivered? ☐ Yes ☒ No | Date Delivered YYYY MM DD:

Ministry Use Only

Data Source | Contractor: 2644

Date Received YYYY MM DD: AUG 08 2005 | Date of Inspection YYYY MM DD:

Remarks | Well Record Number

0506E (09/03) Contractor's Copy ☐ Ministry's Copy ☑ Well Owner's Copy ☐

Cette formule est disponible en français

Ontario Ministry of the Environment

Well Tag Number (Place sticker and print number below) A029218

Well Record

Regulation 903 Ontario Water Resources Act

page 1 of 1

Instructions for Completing Form

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- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to ~~1/10th of a metre~~** Feet
- Please print clearly in blue or black ink only.

Ministry Use Only

MUN | CON | LOT

Well Owner's Information and Location of Well Information

[redacted]

PERTH | Blanshard | PT 37 | TRS

RR#/Street Number/Name: Rd 123 - 750 WATER ST | City/Town/Village: ST MARYS | Site/Compartment/Block/Tract etc.:

GPS Reading: NAD 83 | Zone 17 | Easting 481209 | Northing 4787708 | Unit Make/Model: GARMIN | Mode of Operation: ☐ Undifferentiated ☑ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To
Brown	Sand	Cobbles		0	5
Grey	limestone	Brown layers		5	43
Grey	limestone			43	62
Brown	limestone			62	110

Hole Diameter

Depth From	Depth To	Diameter Centimetres
0	20'	8 3/4"
20	110	6 1/4"

Water Record

Water found at ___ Metres	Kind of Water
95' m	☑ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
105' m	☑ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
110' m	☑ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was ☑ Clear and sediment free ☐ Other, specify

Chlorinated ☑ Yes ☐ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Depth To
Casing				
6 1/4"	☑ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	.188	+2	20
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
No Casing or Screen				
	☑ Open hole		20	110

Test of Well Yield

Pumping test method: pump

	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Pump intake set at - (metres) 80	Static Level	57'		
Pumping rate - (litres/min) 50gpm	1	63	1	59
Duration of pumping 1 hrs + 0 min	2	65	2	58
Final water level end of pumping 71' metres	3	67	3	58
Recommended pump type. ☐ Shallow ☑ Deep	4	69	4	57
Recommended pump depth. 85' metres	5	70	5	
Recommended pump rate. 50gpm (litres/min)	10	71	10	57
If flowing give rate - (litres/min)	15		15	
	20		20	
	25		25	
If pumping discontinued, give reason.	30		30	
	40		40	
	50		50	
	60	71	60	57

Plugging and Sealing Record

☑ Annular space ☐ Abandonment

Depth set at - Metres From	Depth set at - Metres To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	22	Bentonite chips	

Method of Construction

☐ Cable Tool ☑ Rotary (air) ☐ Diamond ☐ Digging
☑ Rotary (conventional) ☐ Air percussion ☐ Jetting ☐ Other
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

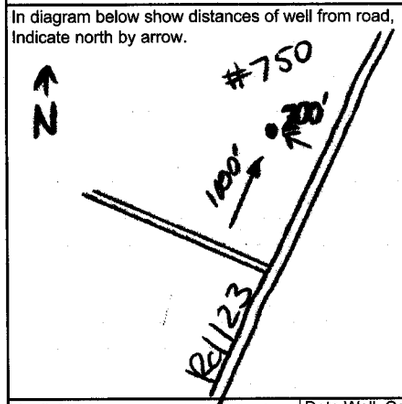
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☑ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☑ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other)
☐ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No. Z 29760

Date Well Completed YYYY MM DD: Approx 2005 08 11

Was the well owner's information package delivered? ☑ Yes ☐ No

Date Delivered YYYY MM DD: 2005 08 11

Well Contractor/Technician Information

Name of Well Contractor: DURL HOPPER LTD | Well Contractor's Licence No.: 2644

Business Address (street name, number, city etc.): RR#7 ST MARYS ONT N4X1C9

Name of Well Technician (last name, first name): HOPPER SIMON | Well Technician's Licence No.: 05-1029

Signature of Technician/Contractor: X [signature] | Date Submitted YYYY MM DD: 2005 08 30

Ministry Use Only

Data Source	Contractor 2644
Date Received YYYY MM DD: OCT 25 2005	Date of Inspection YYYY MM DD
Remarks	Well Record Number

Ontario Ministry of the Environment

Well Tag Number (Place sticker and print number below): NA.

Well Record

Regulation 903 Ontario Water Resources Act

page 1 of 1

Instructions for Completing Form

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- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to ~~1/10th of a metre.~~ Feet.**
- Please print clearly in blue or black ink only.

Ministry Use Only: MUN | CON | LOT

Well Owner's Information and Location of Well Information

First Name	Last Name	Mailing Address (Street Number/Name, RR, Lot, Concession)
ST MARY'S	CEMENT INC.	PO BOX 1000 ST MARYS

County/District/Municipality	Township/City/Town/Village	Province	Postal Code	Telephone Number (include area code)
PERTH	BLANSHARD	Ontario	N4X 1B6	519-284-1020

Address of Well Location (County/District/Municipality)	Township	Lot	Concession
PERTH / ST MARYS TOWN	BLANSHARD		TR.

RR#/Street Number/Name	City/Town/Village	Site/Compartment/Block/Tract etc.
WATER ST	ST MARYS	THAMES RIVER.

GPS Reading	NAD	Zone	Easting	Northing	Unit Make/Model	Mode of Operation
	83	17	487932	4787528	Magellan	☐ Undifferentiated ☑ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To (Metres)
Brown	Fill		Hard.	0	3
Grey	Limestone.			3	68

Hole Diameter

Depth From	Depth To (Metres)	Diameter (Centimetres)
0	6'	6 5/8
6'	68'	6"

Water Record

Water found at ___ Metres / Kind of Water

- 52 m ☑ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was: ☐ Clear and sediment free ☐ Other, specify

Chlorinated ☑ Yes ☐ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From	Depth To (Metres)
Casing				
6 1/4	☑ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	.188	0	6
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
No Casing or Screen				
	☑ Open hole		6	68

Test of Well Yield

Pumping test method: NA.

	Draw Down Time (min)	Draw Down Water Level (Metres)	Recovery Time (min)	Recovery Water Level (Metres)
Pump intake set at - (metres)	Static Level	52		
Pumping rate - (litres/min)	1		1	
Duration of pumping ___hrs + ___ min	2		2	
Final water level end of pumping ___metres	3		3	
Recommended pump type. ☐ Shallow ☐ Deep	4		4	
Recommended pump depth. ___metres	5		5	
Recommended pump rate. (litres/min)	10		10	
	15		15	
If flowing give rate - (litres/min)	20		20	
	25		25	
If pumping discontinued, give reason.	30		30	
	40		40	
	50		50	
	60		60	

Plugging and Sealing Record

☐ Annular space ☑ Abandonment

Depth set at - Metres From	Depth set at - Metres To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
3	68	Chip + Granular Bentonite	
0	3	Backfill Casing removed.	

Method of Construction

☐ Cable Tool ☐ Rotary (air) ☐ Diamond ☐ Digging
☐ Rotary (conventional) ☐ Air percussion ☐ Jetting ☐ Other
☐ Rotary (reverse) ☐ Boring ☐ Driving

NA.

Water Use

☐ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☐ Commercial ☑ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☐ Water Supply ☐ Recharge well ☐ Unfinished ☑ Abandoned, (Other) Location
☐ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Well Contractor/Technician Information

Name of Well Contractor	Well Contractor's Licence No.
DURL HOPPER LTD	2644

Business Address (street name, number, city etc.)	
RR#7 ST MARYS ONT	N4X 1C9.

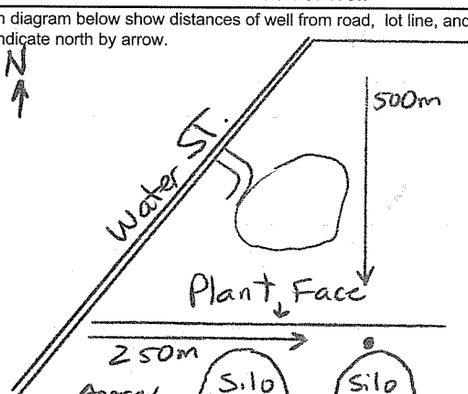
Name of Well Technician (last name, first name)	Well Technician's Licence No.
HOPPER SHAWN	T2315

Signature of Technician/Contractor: X

Date Submitted: 2007 07 17

Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No. Z 31269

Date Well Completed: 2007 06 27

Was the well owner's information package delivered? ☐ Yes ☑ No

Date Delivered

Ministry Use Only

Data Source

Contractor: 2644

Date Received: AUG 10 2007

Date of Inspection

Remarks

Well Record Number

Ontario — Ministry of the Environment

Well Tag No. *(Place Sticker and/or Print Below)* A109023

Well Record

Regulation 903 Ontario Water Resources Act

[redacted]

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
1760 Road 123	Blanshard Township	37	TR

County/District/Municipality	City/Town/Village	Province	Postal Code
Perth	Kirkton	Ontario	N0K 1K0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	487094	4787245		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Black	Top Soil			0	2
Brown	Clay	Stones		2	7
Grey	Clay			7	92
Grey	Limestone			92	197

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	24	Benseal Slurry	400 lbs
24	98	Quickgel Slurry	

Method of Construction

- ☐ Cable Tool
- ☒ Rotary (Conventional)
- ☐ Rotary (Reverse)
- ☐ Boring
- ☐ Air percussion
- ☐ Other, specify
- ☐ Diamond
- ☐ Jetting
- ☐ Driving
- ☐ Digging

Well Use

- ☐ Public
- ☒ Domestic
- ☐ Livestock
- ☐ Irrigation
- ☐ Industrial
- ☐ Other, specify
- ☐ Commercial
- ☐ Municipal
- ☐ Test Hole
- ☐ Cooling & Air Conditioning
- ☐ Not used
- ☐ Dewatering
- ☐ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 5/8"	Steel	0.188 Wall	+2	98
Open hole			98	197

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

- ☒ Water Supply
- ☐ Replacement Well
- ☐ Test Hole
- ☐ Recharge Well
- ☐ Dewatering Well
- ☐ Observation and/or Monitoring Hole
- ☐ Alteration (Construction)
- ☐ Abandoned, Insufficient Supply
- ☐ Abandoned, Poor Water Quality
- ☐ Abandoned, other, specify
- ☐ Other, specify

Water Details

Water found at Depth	Kind of Water	
189 (m/ft) ☐ Gas	☒ Fresh ☐ Untested	☐ Other, specify
195 (m/ft) ☐ Gas	☒ Fresh ☐ Untested	☐ Other, specify
(m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, specify

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	197	9

Results of Well Yield Testing

After test of well yield, water was:
- ☒ Clear and sand free
- ☐ Other, specify

If pumping discontinued, give reason: CLEAR

Pump intake set at (m/ft): 175

Pumping rate (l/min / GPM): 30

Duration of pumping: 1 hrs + 30 min

Final water level end of pumping (m/ft): 99

If flowing give rate (l/min / GPM): NOT FLOWING

Recommended pump depth (m/ft): 175

Recommended pump rate (l/min / GPM): 20

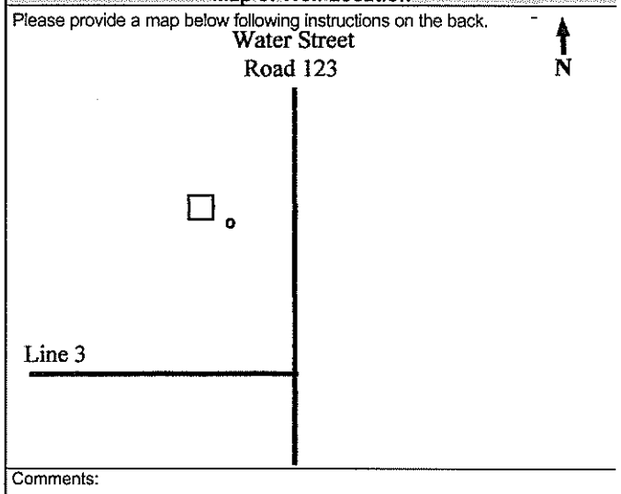
Well production (l/min / GPM): 30

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		90		99
1		91.3	1	98.5
2		92.6	2	98.1
3		93.9	3	97.7
4		94.11	4	97.1
5		96.3	5	96.5
10		98.4	10	94.5
15		99	15	92.3
20		99	20	91.1
25		99	25	90
30		99	30	90
40		99	40	90
50		99	50	90
60		99	60	90

Map of Well Location

Please provide a map below following instructions on the back.



Comments: Well is 70 feet off road

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
HAYDEN WATER WELLS CO.,INC.	7090

Business Address (Street Number/Name)	Municipality
35339 Saintsbury Line RR # 1	Lucan

Province	Postal Code	Business E-mail Address
Ontario	N0M2J0	haydenwaterwells@on.aibn.com

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
5192270057	Hayden, Jay

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
1014		

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	20110823	20110823

Ministry Use Only

Audit No. Z136378

Received JAN 27 2012