HYDROGEOLOGICAL
LEVEL 1 AND LEVEL 2 ASSESSMENT

PROPOSED BARDOEL PIT

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), County of Oxford, Ontario

Prepared for:
J-AAR Materials Limited
3003 Page Street,
London, Ontario
N5V 4J1

March 20, 2025

Prepared by:
Novaterra Environmental Ltd.
39 Winship Close,
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Cover page photograph: Aerial imagery showing the site and surrounding area dated November 2020 obtained from Google Earth.

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1.0 INTRODUCTION

1.1 Background

J-AAR Materials Limited (hereafter J-AAR) is proposing to extract sand and gravel deposits at a site located in Part of Lots 26 and 27, Broken Front Concession, in the Township of South-West Oxford (Geographic Township of West Oxford), County of Oxford, Ontario. The proposed application calls for the extraction of sand and gravel deposits to 1.0 m above the established groundwater table. In this report, the proposed licensed area is referred to as Bardoel Pit or the site.

This report shall form part of a submission to the Ontario Ministry of Natural Resources and Forestry (MNRF) to comply with the requirements of the Aggregate Resources Act (O. Reg. 244/97).

The site plans were prepared by MHBC (2025) in the set of engineering drawings titled: Existing Features (1 of 4), Operational Plan (2 of 4), Rehabilitation Plan (3 of 4), and Cross Sections Plan (4 of 4) which are dated March 2025.

1.2 Scope and Methodology

The purpose of this report is to assess geological and hydrogeological conditions at the site including adjacent area and the potential for adverse effects of the proposed extraction operation on water resources in the area and their uses.

The initial intention of the applicant with this proposal in the summer of 2016 was to have a licenced pit to extract aggregate from below the maximum predicted water table. Having this in mind, Novaterra, responded by collecting the required hydrogeological field data to meet such requirements. In March of 2017, the proposed depth of aggregate extraction was changed to have aggregate removal no closer than 1.0 metres above the maximum predicted water table. In spite of this, Novaterra staff continued to utilize all collected data resulting in the accomplishment of this hydrogeological site assessment report which is considered a "Water Report Level 1 and Level 2" (MNRF, 2020).

This report meets the requirements for a Class "A" license for a pit which intends to extract aggregate material from within 1.0 m of the established maximum groundwater table (see Operational Plan in MHBC, 2025).

The scope of work includes, among other things:

- A review of published geological and water resources maps, air photographs, and water well records on file with the Ontario Ministry of the Environment Conservation and Park (MECP).
- Reconnaissance of the Site and adjacent lands was carried out during the autumn of 2017 and early winter of 2018, which included a domestic well door-to-door survey.
- Water level monitoring from November 2017 to October 2023.
- Assessment of hydraulic relationship between the water table aquifer and the bedrock aquifer.
- Prediction of maximum water table elevation.

The information contained in this report has been prepared in accordance with accepted professional standards.

2.0 SITE PHYSICAL FEATURES

2.1 Location and Site Description

The site location is shown on Figures 1 and 2. There are two entrances to the subject site. In the north, it is accessed from the paved Hamilton Road which is approximately 230 m distance from the proposed license area. The second entrance is from Thomas Road which is a gravel road that abuts the southern margin of the site. The 911 address of the site is 583398 Hamilton Road, Ingersoll, Ontario. It is located approximately 2 km southwest from the Town of Ingersoll.

The proposed sand and gravel extraction area is roughly rectangular in shape and consist of two large parcels of land which are elongated in a northwesterly-to-southeasterly direction. The parcels abut Thomas Road to the south and are separated by a farm roadway which connects the two site entrances (see Figures 2 and 3). The northern margin of the site abuts a large pond, local residences along Hamilton Road, and a large woodlot to the east.

According to the site description (marginal notes) given on the "Existing Features" Site Plan (Drawing 1 of 4 by MHBC, 2025) the proposed license area has the following characteristics:

- Licence area of 49.4 hectares (122.1 acres)
- Limit of extraction of 45.3 hectares (111.9 acres).

The length of the southern boundary is 646 m, the western boundary is 300 m long, the eastern boundary is 891 m. The northern boundary is much longer than the southern boundary line due to its winding border which follows the edge of a large pond and a short section which is parallel to Hamilton Road.

2.2 The Current Use of the Site and Adjacent Lands

The subject site is owned by the Bardoel Family which has an occupied residence and several farm structures immediately north of the proposed licensed area. The farm roadway which bisects through the middle of this large farm is used by the landowner (Soniusfield Farms – The Bardoel family) to transport farm products from the farm buildings to a dairy cow facility some 300 m south of the subject site and across Thomas Road. The subject site is used as farmland to grow cash crop in order to support the dairy operation.

Along Hamilton Road, zoning is Residential (RE) where several residences exist (see Figure 3). To the east, zoning is Agricultural (A2) but consists of a large woodlot. To the south, zoning is also Agricultural (A2), as well as a small portion of land adjacent to the southwest corner of the site. Most of the western boundary abuts a property zoned as Aggregate Industrial (ME) which is an active sand and gravel pit with MNRF License Number 16190. The pond area adjacent to the northwest corner of the site is zoned Environmental Protection.

2.3 Topography and Drainage

Regional topography and drainage are shown on Figure 1 with contour intervals of 5 m. The highest elevation within this map area is 291 metres above mean sea level (m amsl) located in the

southeastern section of the subject site. This high elevation point is part of a ridge oriented in the northwest to southeast direction. This topographic divide becomes subdued in the northern segment of the site, but its presence continues outside and north of the subject site. It ends at the Thames River some 140 m distance north of the proposed license boundary.

Along the farm roadway, which generally follows the dividing line between Lots 26 and 27, exists a subdued swale-like feature (valley) which also act as the dividing line between the two parcels of this large farmland. This feature can clearly be observed on Figure 3 where the topographic contours are given in 1 m intervals. This broad swale or dish-like shallow valley has an elevation of 281 m amsl at its upper reaches near Thomas Road and decreases to its lowest elevation of 270 m amsl near the pond in its northern end (Figure 3).

In the west-central portion of the site there is a broad and gentle decrease in the topographic gradient in the southwesterly direction, as shown by the 277 m amsl contour line near MW6.

In general, the prevailing topographic gradients at the subject site are in the northerly direction. It follows that any runoff that might occur during the snow melt while the ground is still frozen, or during intensive rainfall events, is in the northerly direction. Based on the major topographic features at the site, the majority of runoff would end up in the local pond which is located near the northwestern quadrant of the site (Figures 1, 2, and 3). The broad swale which exists along the dividing line between Lots 26 and 27 provides the major avenue for runoff. Minor runoff may also move in the easterly direction along the eastern slope of the aforementioned minor topographic ridge.

2.4 Natural Heritage Features

According to MNRF data, the pond in the northwestern area of the subject site, and the narrow 20 to 30 m wide strip of land surrounding it, are zoned Environmental Protection and are evaluated as a Provincially Significant Wetland (PSW). This wetland unit is part of the larger Five Points Woods Wetland Complex which has other occurrences in the area. Another small portion of this Wetland is found 60 m southwest of the site, while the main portion of the Wetland Complex is found 500 m southeast of the site (Figure 1).

There are two major woodlots in the immediate vicinity of the site: the first is adjacent to the eastern license boundary, and the second is part of the small wetland unit 60 m southwest of the license boundary. The woodlot facing the eastern site boundary consists of a shallow valley with occasional flow during snowmelt events. A small man-made dam has created a pond near MW3 which is used by the nearby household for recreational purposes.

Natural environment including vegetation communities in the area were assessed by MTE Consultants Inc. (hereafter MTE), the results of which are presented in the Natural Environment Report (MTE, 2025). According to the report, there were no sensitive features identified within the proposed extraction area. It is noted that the adjacent lands contain the PSW surrounding the pond, as wells as a number of vegetation communities and Candidate Significant Wildlife Habitat within the woodlot adjacent to the northeast margin of the site, which is identified as a significant woodlot. However, a 30 m buffer is proposed around the PSW and a 15 m buffer around the woodlot, therefore no direct impacts are anticipated from the proposed operation (MTE, 2025).

2.5 Field Investigation and Instrumentation

The initial field investigation was done by J-AAR Materials Limited on November 20, 2016, when 14 test pits were excavated to depths ranging from 3.25 to 8.53 m using hydraulic excavator. The locations of test pits are shown on Figure 2.

The major component of field work consisted of drilling of nine (9) sampled boreholes which was carried out by Englobe (2018) on November 21 to 23, 2017 and March 12, 2018. The locations of the boreholes are shown on Figures 1 and 2. The boreholes were advanced to the sampling depths by a track mounted power auger machine equipped with conventional split-spoon soil sampling equipment. Fifty-millimeter diameter monitoring wells were installed in six of the nine boreholes which are identified as MW1 to MW6. In the Aggregate Assessment Report (Englobe 2018), the same wells are identified as MW-01 to MW-06. Boreholes BH07-17, BH08-18 and BH09-18 were not completed as monitoring wells, and are referred to as BH7, BH8, and BH9 in this report. Geodetic ground survey elevations and a site plan were provided by Wm. Bradshaw, P.Eng. This was transferred to MHBC in 2018 due to the changes of business operations by Wm. Bradshaw, P. Eng.

Field investigations performed by Novaterra are summarized below:

- Initial site reconnaissance work was done on October 24, 2017, when the locations of future monitoring wells were marked and the existence of local water features were investigated and mapped,
- Measurement of the depths to water levels in monitoring wells was initiated on November 24, 2017, and is ongoing,
- Staff gauge SG1 was installed in the pond on November 27, 2017,
- Door-to-door survey with the aim of identifying the source and type of water supply of local residences was done on December 2, 2017,
- Development of monitoring wells and local hydrogeological mapping on December 19, 2017,
- Additional field mapping and field reconnaissance on December 19 and 20, 2017,
- Water sampling of MW1, MW2, MW6 and the large pond at SG1 for chemical analyses was done on December 20, 2017. Additional sampling of MW6 was done on April 26, 2018.
- Hydraulic conductivity tests done in situ were performed on September 22, 2023.

Results of the door-to-door survey are summarized in Table 1. Water level data collected over the course of the monitoring period mentioned above, are summarized in Tables 2 and 3. Relevant geological and hydrogeological data are presented in Table 4. The results of chemical analyses are summarised on Tables 5 for groundwater and Table 6 for surface water.

3.0 GEOLOGY

3.1 Bedrock Geology

The Lucas Formation of the Detroit River Group of formations constitutes the bedrock under the site (Sanford, 1969). The Lucas Formation is of Middle Devonian age and consists of brown and tan microcrystalline and sublithographic limestone. The site is located east of the contact with the Dundee Formation which overlies the Lucas Formation further to the south.

Based on the information from the nearest bedrock well, which is located near the northern section of the site (MECP water well record 7052266, shown on Figure 1), bedrock is found at a depth of 25.0 m below ground surface (bgs).

3.2 Quaternary Geology

The Quaternary Geology at the subject site and the surrounding area is depicted on Figure 4. According to the Quaternary Geology map (Cowan, 1975 and Barnett, 1982) three geological units are identified on the subject site, which are:

- Glaciofluvial outwash gravel and gravelly sand frequently overlain by several feet of sand or silt. These deposits are present in the northern and northwestern area of the site,
- Glaciofluvial outwash sand unsubdivided, in the southwestern and southern areas of the site,
- Sandy silt till (Catfish Creek till or Zorra Till), present in the southeastern area of the site.

The driller's log for the nearest bedrock well (water well record 7052266) indicates that the thickness of glacial drift is 25.0 m and that the glacial deposits at this site consist of grey hardpan, gravel, and large stones. Relevant information from the driller's log for this well is summarized in Table 3.1.

Table 3.1. Summary of Information from MECP Water Well Record Number 7052266.

WWR Number 7052266 Ontario Well Tag A062660			
Depth (m)		Lithology	Well Construction Data
From	To		
0.0	6.7	Brown gravel	Well diameter: 24.13 cm Casing length: 25.3 m Water found: 33.54 m bgs, fresh Open hole: 25.3 – 33.5 m bgs Water level: 19.51 m bgs Date completed: 2007/10/12
6.7	25.0	Hardpan and gravel, stones	
25.0	33.5	Grey limestone	

m bgs – metres below ground surface.

Regional cross-section A2-A2' (Figure 5) was generated using information from local water well records and illustrates the geology at the subject site and the surrounding area.

3.3 Subsurface Condition at the Site

A detailed description of glacial deposits at the site is given in the Aggregate Assessment Report (Englobe, 2018) which summarises the subsurface investigation which consisted of drilling nine boreholes. Borehole logs are given in Appendix A of this report.

An examination of borehole logs indicates that valuable aggregate deposits of sand and gravel with some silt are found at four boreholes (MW1, MW2, MW6, BH7) to depths varying between 5.20 m and 8.20 m bgs. These deposits are underlain by grey clayey silt to silt till which was found near the ground surface at MW4 and MW5. At MW3, BH8, and BH9, near-surface deposits consisted of silty

sand with trace to some gravel and extended to 4.9 m bgs at MW3, 8.5 m bgs at BH9, and to a depth exceeding 12.6 m bgs at BH8.

Information from onsite borehole logs were used to construct regional cross-section A2-A2' and local cross-section B2-B2' which are shown on Figures 5 and 6, respectively. Information relating to the aggregate deposits at the subject site was taken from the borehole logs and information presented in Table 4. Additional information was obtained from test pit data provided by J-AAR, the locations of which are shown on Figure 2.

The field investigations have revealed that the site contains considerable quantities of sand and gravel with commercial value as indicated in the Englobe (2018) report which, among other things, states:

> *"The investigation has revealed that the property contains significant quantities of sand and gravel. The granular deposit can be separated into two areas, the northern portion containing sand and gravel and the southwest corner which contains silty sand."*

The commercially valuable sand and gravel deposits appear to be limited to the northern half and southwestern area of the site. The southeastern area, which encompasses the topographic ridge north of MW4, is comprised of till which has no commercial value.

4.0 HYDROGEOLOGY

4.1 Regional Hydrogeology

Assessment of regional hydrogeologic setting is based on an analysis of water well records on file with the MECP which are shown on Figures 1 and 2. A printout of wells within 1 km radius is provided in Appendix B. This was enhanced by a domestic well door-to-door survey which was conducted by Novaterra on December 2, 2017 (see Table 1). Regional hydrogeological conditions in the study area are illustrated on cross-section A2-A2' on Figure 5.

The collected and analyzed data indicate that the primary aquifer for the local area is the confined bedrock aquifer and some from the overburden aquifer. Some wells also obtain water from the shallow water table aquifer in the form of dug wells or sand points, particularly on the opposite side of the local pond and along Thomas Road to the southwest. Domestic well use is discussed in more detail in Section 4.6.

4.2 Site Hydrogeology and Water Table Aquifer

Hydrogeological conditions in the shallow subsurface at the site are illustrated on cross-sections A2-A2' and B2-B2' (Figures 5 and 6). Monitoring wells MW1 and MW2 intercepted sand and gravel deposits to depths of 8.2 m and 7.6 m bgs, underlain by clayey silt of till to their bottoms. Monitoring well MW3 intercepted sand and silty sand to 4.9 m bgs, underlain by clayey silt till to the bottom of this monitor at 8.1 m bgs. Monitoring wells MW4 and MW5 reported clayey silt till to depths of 9.6 m and 6.5 m bgs. Monitoring well MW6 intercepted unsaturated and gravel to 5.1 m bgs underlain by clayey silt till to 10.1 m bgs reported to be saturated.

Boreholes BH7, BH8, and BH9 intercepted near surface silty sand and gravel deposits considered to be aquifer and they were saturated. They are underlain by clayey silt till which is aquitard material. These boreholes were not constructed as monitoring wells and therefore groundwater behavior in them was not studied.

The deeper portion of the sand and gravel deposits in MW1, MW2, and sand in MW3 are saturated and represent the water table aquifer. Also, clayey silt till present in MW4, MW5, and MW6 is saturated, thus together with water levels in other monitoring wells they all represent water table at the subject site.

The depth to water table from ground surface is depicted on Figure 7 for the date of April 6, 2023, which is the shallowest depth to recorded over the entire 2017 to 2023 monitoring period. These data are tabulated on Table 2. The saturated portion of the sand and gravel aquifer as obtained in monitoring wells MW1, MW2, and MW3 varies on average between 0.89 and 6.60 m bgs (Figure 7). It is noted that water level at MW6 is deeper than the bottom of sand and gravel deposits (i.e. aquifer material) and is on average 1.2 m below the till surface. This means that there is no actual aquifer at MW6 and its vicinity. The extent of such condition in the area of MW6 cannot be outlined with any degree of confidence. However, a similar condition exists at MW4 and MW5 where water level is also within the clayey silt till which is found immediately below the topsoil at those two wells.

It is therefore important to recognize the difference of groundwater condition found in the sand and gravel, which is truly speaking an aquifer, and groundwater found in the silty sand and clayey silt till which is typically considered an aquitard.

Existence of the shallow water table aquifer at the site and surrounding area is also documented on Sheet 6 of the Thames River Basin Study (MOE, 1981).

We acknowledge that Map 4-3-2 in the Upper Thames River Source Protection Area Assessment Report prepared by Thames-Sydenham and Region Source Protection Committee (2015) identifies Highly Vulnerable Aquifers (HVA). This map indicates that the site is located in a HVA (Vulnerability Score of 6.0). At this point in time there are no Policies or Source Protection Plans as to which human activities may be restricted in such areas.

4.3 Shallow Groundwater Flow and Hydraulic Gradients

Water table elevation in the water table aquifer for the hydrologic high is shown on Figure 8, while the water level elevation for the hydrologic low is depicted in Figure 9. Water level elevations shown and used at reference points on Figure 8 is the highest recorded water level, which was on April 6, 2023. The water level elevations shown on Figure 9 are the average of annual low water levels measured during the 2017 to 2023 monitoring period. Although there is some difference in the rate of movement of groundwater in the sand and gravel aquifer, and groundwater in the silty sand and clayey silt till, these differences are insignificant for the purpose of assessing groundwater flow direction.

An examination of Figures 8 and 9 indicate that groundwater movement is in the northwesterly direction for both cases. The ultimate groundwater discharge is the local pond and the South Branch of the Thames River. The highest groundwater elevation is at the topographic ridge in the

southeastern corner of the site, which results in minor flow in the southeasterly direction. The only difference between hydrologic high and low is in the slightly lower water level elevation during hydrologic low.

Groundwater gradients were calculated between MW1 and the most northern edge of the 282 m amsl groundwater contour southwest of MW3. During hydrologic high the gradient is 0.0188 m/m and during hydrologic low it is 0.0212 m/m.

In situ falling and rising head hydraulic conductivity tests were performed at MW1, MW3, MW5, and MW6 on September 22, 2023. The tests were performed by inserting and then removing a slug of known volume into the wells and recording the water level response using data logging pressure transducers. The results of the slug tests are provided in Appendix C, which reveals a hydraulic conductivity of 1.16×10^{-2} cm/s for the sand and gravel, and a hydraulic conductivity of 2.04×10^{-4} cm/s for the clayey silt till.

4.4 Water Level Fluctuations

Depths to water levels in six monitoring wells and the local pond were measured on a monthly basis from November 2017 to November 2019 and continued to be measured two to four times a year until early 2023. From April 2023 to October 2023, water levels were measured again on a monthly basis. The collected depth to water level data are given in Table 2 and water level elevations are given in Table 3.

Depths to water level data given in Table 2 were used to produce depth to water level hydrographs which are shown on Figure 10. The shallowest depth to groundwater is in MW3, MW4, and MW5 and generally varies between ground surface and 2 m bgs. This is followed by MW2 which varies between 3 and 5 m bgs, and then MW6 and MW1 which have very similar depth to water level that varies between 6 and 7 m bgs.

It is noted that limited groundwater measurements are available for 2020, 2021, and 2022, but there are nearly three years of complete record for 2018, 2019, and 2023 which give ample data to understand the groundwater conditions at the site.

Water level elevation data given in Table 3 were used to produce water level elevation hydrographs which are shown on Figure 11. The highest water level elevation is near MW4 and decreases with topography towards MW3 and MW5, followed by MW6, and then MW1 and MW2. The highest water level elevation occurs in the April to May period coinciding with spring freshet, while the lowest occurs during the September to October time period.

The influence of precipitation, which is also plotted on Figures 10 and 11, on water level fluctuations is not immediately obvious. However, a closer examination of April 2018 and April 2019 reveals that greater precipitation in those months caused the hydrologic high for those years. Similarly, September 2019 was a very dry month and was followed by above-average precipitation in October 2019 which caused a rise in groundwater levels at all monitoring wells except MW1 and MW6. Monitoring wells MW1 and MW6 have the smallest magnitude of fluctuations which is typically less than 1 m, but for the other monitoring wells it is between 1.5 to 2.2 m.

4.5 Prediction of Maximum Groundwater Table

Water level monitoring at the subject site from 2017 up to the end of 2023 has provided a detailed understanding of the hydrogeological characteristics of the subject site. Depths to water levels in six monitoring wells and one staff gauge were used to predict the maximum and minimum groundwater table elevations that occur at the subject site.

These data are given on Table 2 for depth to water level below top of casing and on Table 3 for water level elevation, which are plotted on hydrographs on Figures 10 and 11, respectively. An examination of these data indicates that the highest water level elevation (i.e. shallowest depth to water level) of the entire record occurred on April 6, 2023. The depth to water level below ground surface for this date is depicted on Figure 7. The groundwater flow configuration for the same date is depicted on Figure 8 which represents the maximum groundwater table elevation at the site.

Considering that the highest groundwater levels were chosen from a monitoring record which covers a seven year period, it is considered to be a very reliable representation of the maximum (i.e. highest) groundwater level to which groundwater will rise during aggregate removal from Bardoel Pit.

The minimum water table elevation (i.e. greatest depth to water level) was evaluated by taking the average of the annual minimum water level elevation in each year and is given on Figure 9. Water level elevations during the minimum are approximately 1 to 2 m lower than the maximum water levels.

It is important to note that the thickness of sand and gravel deposits at MW6 is 5.2 m and is underlain by clayey silt and silt till. The measured depths to water levels at MW6 are always lower than the bottom of sand and gravel thus indicating that there is no saturated zone (aquifer) at this location. The extent of the unsaturated zone in the area of MW6 is not known. But it is considered that in the areas where no saturated sand and gravel exist, aggregate removal can be done to the under laying clayey silty till without adverse effect to groundwater.

4.6 Watercourses and Surface Water Bodies

The nearest watercourse to the site is the South Branch of the Thames River which is located approximately 140 metres due north from the nearest portion of the proposed license boundary (Figures 1 and 2). According to the groundwater table configuration maps (Figures 8 and 9), the South Thames River is the eventual discharge location for groundwater originating at the subject site.

At the northwestern boundary of the site is a pond approximately 330 m by 200 m in size. The northeastern corner of this pond has an outflow over a concrete structure (dam) into a manhole which leads into a concrete culvert under Hamilton Road. The northern end of this culvert is 100 m from the concrete dam where it outflows some distance from Hamilton Road. The elevation of the dam outlet structure (concrete dam) is 270.56 m amsl, and during the wet period of the year water level in the pond rises to that elevation and flows over the top of the outlet structure (see Photograph 1). Most of the year there is no overflow over the dam, but there is water leakage through fractures developed in the concrete dam.

Photograph 1. Looking south at the concrete dam structure and discharge from large pond on April 20, 2018. The Bardoel farm is behind and to the left of the pond.

Photograph 2. Looking downstream and to the east, groundwater spring discharge is seen on February 24, 2018 at 110 m west of the large pond. The flow from the spring feeds the large pond.

On October 24, 2017, it was observed that minor seepage through the concrete structure of the dam occurs and cascades into the culvert leading beneath Hamilton Road. Subsequent site visits and observations of the concrete structure indicate that water seepage from the pond is continuous.

On the day of the above-noted initial observation of the dam, the outflow from the culvert along the northern slope from Hamilton Road was estimated to be 200 L/min creating a short-lived rivulet which empties into the Thames River approximately 60 m distance from the culvert outflow.

The pond is fed by a small stream which enters the western margin of the pond. This small stream originates from a spring located approximately 110 m west from the pond, or 200 m from the proposed license boundary. The spring is depicted by Photograph 2 and its location is identified on Figure 1. Local residents consider this "spring" location to be discharge from a tile drain but this could not be confirmed by Novaterra during the field investigation.

This hydrogeological feature is located in the permanently dry shallow channel coming from the southwesterly direction. From Figure 1 we can see that a drainage feature exists further south of this "spring" and has intermittent flow but drains in the southerly direction.

Biologists from MTE identified what they considered a spring at the edge of the wooded area along the eastern margin of the site. By definition this should be considered a seep rather than a spring, as there is not continuous flow of water from this area. There are no other groundwater springs on the subject site itself, or within 120 m of the site.

A small recreational and residential pond exists approximately 150 m east of the proposed license boundary in the wooded area (Figures 1 and 2). According to local residents, this pond was created by the construction of an earthen dam across a ravine. The area of the pond was enlarged by excavation and soil removal prior to dam construction. A leakage beneath the earthen dam was observed on December 20, 2017, which forms a small stream for about 50 m downstream and northward. Slow flowing water reaches about 200 m to the northwest where it disappears into the subsurface.

There is no open water body or watercourse on the site itself. There is no proposed water diversion or storage, nor any proposed construction of drainage facilities on the site.

4.7 Groundwater and Surface Water Use

Water well records (WWR) on file with the MECP were obtained and analyzed, and are plotted on Figures 1 and 2. There are 12 WWRs within 500 m radius of the proposed license boundary. For those wells which have WWRs on MECP files, information from the WWRs is given in Appendix B. The wells are mainly located along Hamilton Road and Thomas Road. Of these WWRs, 7 wells were completed in bedrock and 4 wells were completed into the overburden, and a fifth has unknown depth.

One of the overburden wells (WWR 4709174) was drilled for geotechnical purposes during reconstruction of the water treatment plant located at the northwestern corner of Hamilton Road and 25th Line. The well was abandoned a few months later and WWR 4709198 was issued for the work. A third WWR (7258041) is a monitoring well associated with the aggregate license to the west of the subject site. It is presumed that the monitoring well was constructed to assess potential impacts from that license on the adjacent PSW.

A door-to-door survey, which was performed by Novaterra staff on December 2, 2017, included all residences within approximately 500 m east, south, and west of the subject site. Each visited location was attributed with a Survey ID which provides cross-reference between Table 1 and the locations shown on Figure 1. For those locations which have WWRs, the information shown on Table 1 was taken from the WWR. Otherwise, the information was provided from the well owner. The existence of the wells plotted on Figure 1 was not field verified except for the nearest domestic wells located south, north, and east of the subject site. However, the exact water well record numbers for other locations cannot be confirmed because the wells were completed prior to 2003 when the Ontario Well Tag requirement was instituted.

The residents who were not at home during our initial visit were left with survey questionnaire form with self-addressed return envelope. None of them (4 residences) replied, so repeated visits were made until all residents within 500 m of the site were interviewed.

Only two residences (ID 7 and 14) were visited to the north of the site along Hamilton Road because municipal water supply is available to all residences in that area. These two residences are at the end of the watermain which does not extend west beyond 25th Line. The Town of Ingersoll watermain stretches from the intersection of Hamilton Road and 25th Line along the north side of Hamilton Road towards Ingersoll. At the northwestern intersection of Hamilton Road and 25th Line is the pumphouse for Ingersoll Municipal Well 3 which has Survey ID 5. Ingersoll Municipal Well 3 is located at Survey ID 6, which is the northeast corner of Hamilton Road and 25th Line.

The nearest domestic well is located adjacent to the northern margin of the site and supplies water to the family which own the subject lands (ID 13). It is a 33.54 m deep drilled well completed into the bedrock which was intercepted at 25 m bgs. It has WWR number 7052266.

A number of unregistered WWRs were discovered in the local area. This includes four dug wells (ID 2, 3, 4, 19) and one sand point (ID 20). Three other residences on the north side of the large pond

did not have information about their well supply (ID 10, 11) or were not home during the survey attempts (ID 12).

Of the eight bedrock wells within 500 m of the site, seven are associated with domestic well supply (ID 8, 9, 12, 13, 16, 17, 18), one is for Ingersoll Municipal Well 3 (no WWR) at 225 m distance from the site. A ninth bedrock well is located 620 m west of the site (WWR 4707243) is for a vegetable processing plant located 620 m west of the site. The bedrock wells vary in depth between 19 m and 34 m bgs (see Appendix B).

Water takings from WWR 4707243 are authorized by PTTW Number 2662-9F7QAX, which also includes another bedrock well with WWR 4703331. The water taking is associated with a vegetable processing plant operated by Nortera Foods Inc. (formerly Bonduelle Canada Inc.), which is located 620 m west of the subject site. The relationship between the Nortera supply wells and the water table sand and gravel aquifer was assessed in detail during the application for aggregate license west of the Nortera facility (Novaterra, 2021). The assessment showed that there is hydraulic separation between the bedrock aquifer and the water table aquifer. It is noted that the PTTW expired in January 2024, but it is presumed that the PTTW will be renewed.

Water takings from Ingersoll Municipal Well 3 are authorized by Permit to Take Water (PTTW) Number 1744-B3FHQ8. The coordinates of the PTTW plot on the western edge of the large pond which is incorrect. The correct location is the northeast corner of Hamilton Road and 25th Line, as shown on Figure 1. The Municipal Well is discussed in more detail in Section 4.7.

There is a recreational pond located in the forested area about 150 m east of proposed licence boundary. The pond is manmade and seepage from the earthen dam exists only during the wet period of the year. The swale which continues in the northwesterly direction through the forested area into the residential area is shown on Figure 3 and is an intermittent surface water feature. Before leaving the residence on the swale's pathway there is a small recreational pond at 583430 Hamilton Road.

4.8 Ingersoll Municipal Well 3

Ingersoll Municipal Well 3 (hereafter Well 3) is part of a system of seven wells which supply the Town of Ingersoll with drinking water. Water takings from the wells are authorized by PTTW Number 1744-B3FHQ8. The water well record number is not available on MECP files, but an inquiry was made by Novaterra directed to Deborah Goudreau of Oxford County in an email dated December 5, 2017, to learn more about this municipal well. The following answer was provided to Novaterra by the hydrogeological consultant for Oxford County, A.R. (Tony) Lotimer M.Sc., P.Geo. of Lotowater, in an email of December 12, 2017:

> *"…Well 3 is bedrock production well originally constructed with 300 mm nominal casing to a depth of approximately 15 m, and open hole in the carbonate bedrock to a depth of approximately 119 m. We do not have copy of the original construction record for the well, but a detailed investigation undertaken in 1997 reported historical water level information for the site dating back to 1945. The 1997 well investigation identified water producing zones in the well at depth of 22.7 m (this was the main producing zone), 71 m 105 m and 114 m. A liner was installed in the well at that time to a depth of approximately 21.5 m. Ingersoll Well 3 is permitted and equipped to produce water at a rate of 38 L/s."*

Ingersoll Municipal Well 3 does not have a water well record number, but from the information provided by Lotowater, we can see that the primary producing zone is found at a depth of 22.7 m bgs. Water well records for the nearest bedrock wells (7052266 and 4702794) indicate that 6.7 to 8.5 m of sand and gravel at ground surface is underlain by 12.5 to 18.3 m of low permeability clay and hardpan, followed by bedrock found at 21.0 to 25 m bgs. Therefore, it is reasonable to assume that Well 3 is sourced from a confined aquifer which is isolated from the water table aquifer and surface water features by the relatively large thickness of the low permeability deposits.

According to Schedule "A" to the Amendment No. 282 to the County of Oxford Official Plan, Schedule "C-5" shows that the subject site is located in the Source Protection Screening Area. In this regard, it is also noted that part of the subject site occupies an area designated as WHPA (Well Head Protection Area) in which the 2-year travel time for Ingersol Municipal Well 3 partially falls within the limits of the subject site. One of the key purposes of Amendment No. 282 is to permit only these uses that do not represent a significant threat to municipal drinking water sources within designated area. In light of this, a detailed hydrogeological site assessment has been completed and is presented in the form of this Water Report Level 1 and Level 2. So, this report should be considered to meet requirements of the Amendment No. 282 of the County of Oxford Official Plan.

The relevant excerpt from the Amendment document is provided in Appendix D. The assessment demonstrating that the proposed aggregate operation at Bardoel Pit does not pose a threat to municipal drinking water is contained in Section 4.9.

4.9 Assessment of Potential Effect on Ingersoll Municipal Well 3

Although the establishment of aggregate extraction licenses within the WHPA is not prohibited, the potential threat to Ingersoll Municipal Well 3 was assessed by Novaterra. In particular, the potential hydraulic relationship between the water table aquifer at the subject site and Well 3 which is sourced from the bedrock aquifer was examined and is discussed in the following paragraphs.

The shallow sand and gravel aquifer is underlain by clayey silt till that ranges in thickness from 12.5 to 18.3 m in the northern area of the site. The clayey silt till is underlain by limestone bedrock and has a low permeability which restricts vertical movement of groundwater. Therefore, the till unit is expected to confine the bedrock aquifer thus providing hydraulic separation between the two aquifers.

If a hydraulic connection between the aquifers were to exist, then water withdrawals from Well 3 would affect water levels in the water table aquifer. With this in mind, a data logging pressure transducer was maintained in MW1 for the time period of January 2019 to September 2020 and recorded water levels and groundwater temperature at 15-minute intervals.

Similarly, Oxford County maintains a data logging pressure transducer in Well 3 which records water levels at 1-hour intervals, as well as hourly pumping rate data. Novaterra reached out to the Oxford County Water and Wastewater Department which graciously provided the water level data from Well 3. These data, along with water levels from MW1, for the period of January 2019 to September 2020 are plotted on Figure 12 and Figure E1 in Appendix E. Figures E2 through E6 in Appendix E show the same data, but are split in a series of hydrographs each covering periods of 2 months.

An examination of the above-noted figures indicates that there is an obvious water level response in Well 3 to water withdrawals from this well, as expected. However, there is no indication that water takings from Well 3 influence the water level in MW1. That is to say, water takings from the bedrock aquifer at Well 3 do not induce a response in the water table aquifer that exists in the sand and gravel deposits at the Bardoel site.

The data from the above-noted graphs were examined and water level hydrographs from MW1 were compared with the intensity of water taking sequences and water levels in Well 3. In particular, the following time periods were significant:

i. **March 6 to 22, 2019 (Figure E2)**
   During this period, there were intensive water takings from Well 3, yet there is no notable water level response in MW1. A response in MW1 would have been expected if there was hydraulic connection between the two aquifers of those wells.

ii. **April 20 to 30, 2019 (Figure E2)**
   Over this period there was a recovery of approximately 0.3 m in MW1, followed by gentle recession towards the end of the month. This was due to intensive rainfall from April 16 to 19, 2019. The same response did not occur in Well 3.

iii. **December 8 to 20, 2019 (Figure E4)**
   Similar to (i) above, intensive water takings during this period did not cause a response in MW1. During this period there was a gentle rise of water levels in MW1.

iv. **January 6 to 28, 2020 (Figure E5)**
   There is no data available for Well 3 during this time period. Rise in water level in MW1 beginning on January 11, is due to 56.6 mm of rainfall on that day.

Significantly, close examination of water level hydrographs for MW1 does not show the daily upward and downward response which is typically observed during water level interference. All water level rise or decline are gradual except for the periods noted above which are the result of precipitation.

As noted above, Well 3 is approximately 119 m in depth completed into the limestone bedrock. Monitoring well MW1 is completed into sand and gravel deposits and clayey silt till with well screen interval placed between 7.6 and 10.6 m bgs. The bedrock surface in the area of MW1 is found at depth of 25 m, as reported at WWR 7052266 located at 140 m distance. The clayey silt till is reported at 8.2 m at MW1, so the separation distance between the sand and gravel aquifer and the bedrock in the area of monitoring well MW1 is 16.8 m. These glacial deposits form the hydraulic separation between sand and gravel aquifer and the limestone bedrock aquifer.

The comparison of water level hydrographs from monitoring well MW1 and water taking from Ingersoll Municipal Well 3 indicates that there is no hydraulic connection between water table aquifer at Bardoel site and the limestone bedrock aquifer in the area of Ingersoll Municipal Well 3. Therefore, proposed aggregate extraction operations at the Bardoel site do not pose a threat to the Ingersoll municipal water supply.

4.10 Relationship Between Groundwater and Local Surface Waters

The local pond adjacent to the proposed aggregate extraction is considered as a part of the groundwater system found in the sand and gravel deposits (see Figure 5). Naturally, the pond is fed by groundwater discharge, as observed from Figures 8 and 9 which show a groundwater gradient towards SG1. A closer examination of Figure 11 shows that water level elevation in the pond is nearly identical with water level in the adjacent water table aquifer as observed in MW1.

The obvious pond recharge comes from a short stream which originates 110 m west of the pond (Photograph 2). Local residents believes that the stream is actually the result of tile drain discharge which originates some distance from the point of discharge.

Inflow to the pond is significant during the wet period of the year from roughly November to June. But the rise in pond water levels is limited by the overflow structure at the northern end of the pond (Photograph 1). Furthermore, even when pond level is lower than the top of the concrete dam there is continuous water seepage occurring beneath it and through the fractures that exists in the concrete dam. Surface water entering the overflow structure enters the culvert which leads to a discharge point on the north side of Hamilton Road, and eventually reaches the South Thames River.

The South Thames River is a distant discharge area for groundwater which originates at the subject site.

4.11 Chemical Quality of Groundwater and Pond Water

Water quality sampling of groundwater was undertaken at three of the onsite monitoring wells (MW1, MW2, and MW6) and from the large pond at SG1. The purpose of the water analyses was to establish a groundwater quality baseline.

Water samples were analysed for four groups of chemical parameters, which include: general inorganics, anions, metals, and volatiles. Samples collected from MW1 and MW2 were also analysed for petroleum hydrocarbon parameters. The rationale for selecting the sampling locations was that two groundwater samples be taken downgradient from the proposed aggregate extraction area (MW1 and MW2) and one sample be taken from upgradient and adjacent to the local pond (MW6).

Sampling procedures consisted of pumping at least three volumes of water from MW1 and MW2, allowing water levels to stabilize, and then taking samples using bailers. This was not possible with MW6 which was still in the process of extremely slow recovery stage during the collection of the water sample. Collected samples were immediately placed into sampling bottles and stored in a cooler with ice packs to preserve sample temperature and quality. Water samples were delivered to AGAT Laboratories in London, Ontario, in accordance with the acceptable chain of custody procedure.

The results of the chemical quality analysis of groundwater in these three wells are given in Table 5 while analytical result of pond water was tabulated on Table 6. The Laboratory Certificate of Analysis is given in Appendix F.

The analytical results for groundwater were compared with Ontario Drinking Water Standards (ODWS) which are given in column 8 in Table 5. It can be seen from this table that all chemical

parameters for which water samples were analysed are lower than ODWS or, Provincial Water Quality Objectives (PWQO) for surface water (Column 5 in Table 6) .

It should be noted that that initial sampling results of MW6 which occurred on December 20, 2017, showed slightly elevated benzene and toluene. This was due to poor development of the well caused by slow water level recovery during development prior to obtaining the water sample. In late April 2018, MW6 was developed again and subsequently sampled on April 26, 2018. No BTEX values were detected in the second sampling event (Table 5).

The results of chemical analyses were also plotted on trilinear diagram of the type proposed by Piper (1944) shown on Figure 4.1. This graph enables water classification based on the percentage of equivalent per million.

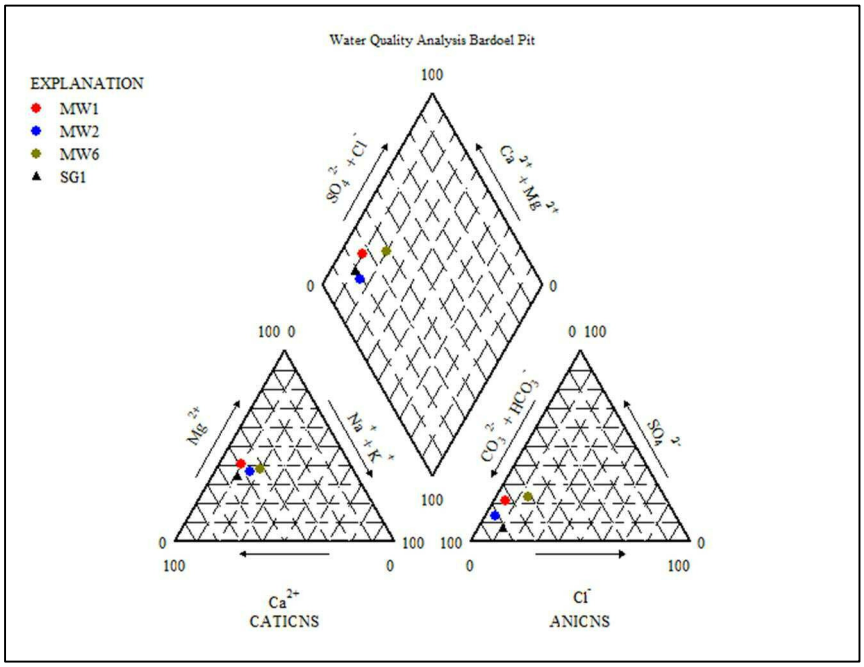

Figure 4.1. Piper diagram showing groundwater and pond water quality.

It can be seen from the graph in Figure 4.1 that the groundwater at three monitoring wells and from the pond belongs to the same water classification: it represents calcium-bicarbonate water. The results from the pond water show similar concentration to groundwater samples, suggesting the pond is primarily groundwater fed.

5.0 PROPOSED OPERATION AND POTENTIAL IMPACT

5.1 Proposed Mining of Aggregate Deposits

The mining of aggregate resources at the site is proposed to be limited to 1.0 m above the established water table. The expected highest water table elevation is shown on Figure 8. The groundwater table

contour lines were drawn by taking the highest water level elevation on record, which occurred on April 6, 2023.

With the above in mind, the sequence of operations was developed and is shown on the Operational Plan, Drawing 2 of 4, prepared by MHBC (2024).

It is recognized that there is a lack of control points in the centre of the site from which to interpret the groundwater table configuration. The groundwater contours in those areas are expected to follow the topography and were drawn as such. But the water table may be found to differ during extraction and the operator should undertake regular test pit excavation to assess the appropriate depth of extraction. The most sensitive area is near the southeastern corner of the large pond where the low elevation of the swale and laneway result in a relatively thin depth of extraction.

In the southeastern corner of the site, roughly covering the area between the farm laneway and the topographic ridge along the eastern margin of the site, near-surface deposits consist of clayey silt till of no commercial value. However, it is possible that some portions of this area contain aggregate deposits and so it is included in the proposed extraction area.

The southwestern area, roughly between MW5, the farm laneway, and the southern site boundary, near-surface deposits are silty sand with trace to some gravel. This area encompasses the topographic ridge where the highest groundwater levels are expected range from 276 to 281 m amsl during the wet period of the year. Shallow aggregate deposits in this area consist of silty sand with some gravel.

In the area surrounding MW6, the highest water level elevation is approximately 272.35 m amsl (measured on April 6, 2023), which is approximately 1.05 m below the till surface found at 273.26 m amsl. In this area, aggregate deposits may be removed to the till surface. It is uncertain to which distance around MW6 this condition exists, but it is likely that it extends to the edge of the proposed extraction area near the large pond.

In the northeastern area of the site, between the southeast corner of the pond and to the northeastern corner of the site, the water table is quite flat, with range of approximately 270 to 268 m amsl. The western margin of this area has a thin unsaturated zone near the pond, but the thickness increases eastward with rising topography and decreasing groundwater elevation. In this area, the thickness of unsaturated aggregate deposits ranges from 1.40 to 3.56 metres (see Table 4).

5.2 Final Land Use

The proposed mining of sand and gravel would result in the reduction of topography of the mined area and consequently a reduction of the depth to the water table. The topographic gradient would become gentler but would still follow the same general pattern as it exists at present.

Final rehabilitation configurations showing the future ground surface topography are shown on Drawing 3 of 4 (MHBC, 2025) which has been adapted as Figure 13 of this report.

As part of site rehabilitation, the mined-out area would be covered with ample thickness of topsoil and the land would be returned to agricultural use.

5.3 Water Budget and Assessment of Potential for Groundwater Impact

The proposed mining of sand and gravel will not reach the water table, and therefore will not cause lowering of the water table beneath the area of aggregate removal or in the adjacent lands of the proposed operation.

Of course, the thickness of the unsaturated zone would be reduced from ground surface to become close to 1.0 m above the maximum water table elevation (see Figure 8). The results of these activities would cause insignificant increase in the potential evaporation. Having this in mind, it is not necessary to perform water budget and associated calculations in order to assess potential for groundwater impact. Furthermore, groundwater flow for a large portion of the site is towards the large pond which is subjected to increased temperature during the summer months which has a greater influence on water temperature than any potential increase by groundwater discharged to the pond.

In its current condition, surface water runoff is mostly in the northerly direction, with the central area of the site grading towards the large pond north of the site. But along a narrow eastern segment and southwestern segment, part of the generated runoff would drain offsite. Once final rehabilitation is completed, ground surface would be lower than the surrounding land, which would retain runoff within the site limits. Any runoff generated onsite would eventually reach the large pond which would in part contribute to the overall groundwater system at the site. Of course, the above-noted situation would only occur during periods of intense rainfall when the soil is unable to absorb the runoff. Through most of the year, rainfall would readily infiltrate into the ground surface.

6.0 CONTINGENCY PLAN AND MITIGATION MEASURES

The use of equipment for site operations may pose a potential risk of petroleum hydrocarbons such as fuels, oil, and grease to enter the exposed groundwater system unless the proper operation and refuelling procedures are followed. To address these potential risks, the licensee shall ensure that a spill contingency plan is developed prior to any operation of the pit, and followed during the operations.

The potential for interference with local domestic wells and water supply wells was assessed, and it was determined have very little to no risk. Nevertheless, the following water well interference complaint shall be incorporated into the site plans to ensure that those water supplies are protected:

Water Supply Interference Complaint Response Procedures:

This response applies to domestic and farm water supplies for properties located within 120 m of the licensed boundary.

1. Owners of domestic and farm water supplies experiencing disruption or quality problems shall immediately notify the Licensee. The Licensee shall, upon receipt of any water supply disruption complaint, notify the Ministry of Northern Development Mines Natural Resources and Forestry (MNRF) and the Ministry of Environment Conservations and Parks (MECP).

2. Should the owner of domestic and farm water supplies experience a significant disruption in their supply of water, or should they experience significant adverse effects upon their water supply; and if the operation of the pit cannot obviously and definitively be excluded as the cause, the licensee shall supply such resident with a temporary water supply within 24 hours and thereafter until such time as the cause of the disturbance can be determined and the situation addressed. The Licensee shall investigate the cause of the water supply disturbance and shall report to the MNRF, MECP and the resident.

3. If, after consultation with the affected resident and the Licensee, the MNRF and/or the MECP determine that the operation of the pit has caused a domestic or farm water supply to be adversely affected, the Licensee shall, at the Licensee's expense, either restore or replace the water supply to ensure that historic water supply and quality are restored for such a resident.

4. If MNRF and/or MECP have concurred that the operation of the pit has not caused any domestic or farm water supply to be adversely affected the Licensee shall maintain the temporary water supply provided for under Item 2 for an additional 24 hours to allow the resident to make alternate water supply arrangements.

7.0 MONITORING PROGRAM

There is no proposed dewatering of the gravel pit. Aggregate extraction is proposed for excavation no closer than 1.0 m above the water table using a hydraulic excavator. Changes to water balance are small and inconsequential. As such, measurable interference with local water supplies would not occur.

A monitoring program was implemented at the site from November 2017 to October 2023 which included six monitoring wells (MW1, MW2, MW3, MW4, MW5 and MW6), and one staff gauge (SG1). Historically, water levels were monitored on a monthly basis capturing nearly three full years of record, as wells as three years with limited data, followed by nearly one full year of monthly data. The collected data form a solid baseline of groundwater conditions at the subject site.

A baseline of groundwater and surface water quality was established by the analysis of water samples collected from monitoring well MW1, MW2, and MW6 and from the pond at SG1. Analyzed parameters include pH, conductivity, alkalinity, anions, cations, nitrogen cycle, metal scan and BTEX. Water samples from MW1 and MW2 were also analysed for petroleum hydrocarbons. Ongoing monitoring of groundwater quality is not necessary.

Considering the low potential for ecological impact of this operation, a basic monitoring program should be implemented and would consist of twice-annual water level measurements at the six monitoring wells and one staff gauge. Monitoring would be conducted annually, and the collected data would be regularly reviewed to assess changes to hydrogeological conditions and whether operations have impacted groundwater at the site. However, reporting to MNRF would only be done if major changes are observed. The monitoring program will continue as noted in the Recommendations Section.

8.0 CONCLUSIONS

Based on the information collected in the field and analysis of available data, the following conclusions are made:

1. Overburden deposits at the proposed Bardoel Pit were documented by the drilling of nine boreholes, which ranged in total depth from 6.55 to 10.67 m bgs. Six of the boreholes were completed as monitoring wells designated as MW1 to MW6. Subsurface deposits are described as sand and gravel with trace of silt, and silty sand with trace gravel, which are underlain by clayey silt to silt till.

2. There exists a substantial quantity of sand and gravel at the site, with the highest quality material concentrated in the northern half of the site. In this area (MW1, MW2, MW6, BH7) sand and gravel is found to a depth of 5.2 to 8.2 m bgs. Along the eastern margin of this area, lower quality silty sand is found at MW3 to a depth of 4.9 m bgs.

3. Additional aggregate material is found along the topographic ridge in the southwestern quadrant of the site (BH8, BH9), where silty sand with trace to some gravel from 8.5 m to more than 12.6 m bgs. Aggregate deposits are underlain by clayey silt to silt till which was found immediately below the topsoil in the southeastern quadrant of the site at MW4, and in the west at MW5.

4. The monitoring wells were equipped with 1.5 to 3.0 m long 50-mm diameter PVC screens with riser pipe assembly. The screen intervals range from 2.3 to 10.6 m bgs and were installed in the sand and gravel at MW1 and MW2, and in the clayey silt till at the other four wells. The lower portion of the sand and gravel is saturated, thus constituting a water table aquifer. The clayey silt till is also saturated but is not considered an aquifer due to the low permeability of the material.

5. There is no actual aquifer at MW6 because the water table is found at 1 m below the bottom of the aggregate deposits. Similarly, water level in MW4 and MW5 is within the till, which was found near ground surface at those locations.

6. Water level monitoring was conducted at the site from November 2017 to October 2023, and revealed that groundwater flow is in the northerly direction. Eventual discharge is to the large pond north of the site and to the South Thames River which is located 140 m of the site. The pond is considered part of the groundwater system, and it is the groundwater discharge zone for the shallow groundwater aquifer found at the Bardoel site.

7. It is proposed to mine sand and gravel deposits to 1.0 m above the established water table and return the land to agricultural use. The maximum water table elevation was established by taking the highest recorded water level which occurred on April 6, 2023. Water levels on this date ranged from 285.56 m amsl in the south to 268.35 m amsl in the north of the site. There are areas, particularly near the large pond, and near MW3, where the depth to water level is less than 1 m bgs and therefore do not meet the criteria for aggregate extraction in those areas.

8. The nearest residence is adjacent to the proposed operation and is occupied by the Bardoel family who owns the subject site. This residence is supplied by a drilled well completed into

bedrock at 33.54 m bgs. The bedrock at this well is reported to be at 25 m bgs and it is overlain by 18.3 m of hardpan and gravel, and 6.7 m thick sand and gravel deposits at surface. The other domestic wells are located more than 250 m from the proposed licenced area. The residences located immediately north of the subject site along the Hamilton Road are on municipal water supply.

9. Ingersol Municipal Well 3 is located at 255 m distance from the nearest limit of the proposed aggregate extraction. This is a 119 m deep bedrock well where there is approximately 15 m of overburden. Analysis of available water levels and pumping data for that well in 2019 and 2020 indicate that the bedrock aquifer is hydraulically separated from the water table aquifer at Bardoel Pit.

10. No changes in water budget would occur as a result of the aggregate extraction, provided extraction is limited to be above the water table. The reduction of the unsaturated zone would not have a thermal impact on local ecology.

11. The hydrogeological site assessment and associated calculations indicate that the proposed mining of sand and gravel deposits will not have any adverse effect on water resources, natural environment in the area, and domestic water wells including Ingersoll Municipal Well 3.

9.0 RECOMMENDATIONS

Based on the conclusions drawn from the work described herein, the following recommendations are made and should be incorporated into the site plans:

1. Fuel storage onsite shall be in compliance with the Technical Standards and Safety Act 2000 and the Liquid Fuels Handling Code 2001, as may be amended.

2. Maintenance and refueling of mobile excavation equipment and other vehicles shall take place in the fuel storage area. Crushers, stackers, and screening plants shall be refueled and maintained on the pit floor during daylight hours. Any minor drips or spills shall be immediately cleaned up and properly disposed of.

3. The Licensee shall ensure that a spill contingency plan is developed prior to any operation of the pit, and followed during the operations.

4. The monitoring program shall consist of twice-annual (Spring and Fall) water level measurements at six monitoring wells (MW1, MW2, MW3, MW4, MW5 and MW6) and one staff gauge (SG1). Monitoring wells shall be maintained until the operation is completed and the site is rehabilitated.

5. After issuance of the pit license, an initial report summarizing baseline conditions at the site shall be prepared and shall include all monitoring data up to the end of the calendar year in which the license was issued, and shall be submitted to the MNRF. Subsequent monitoring data collected at the site shall be regularly reviewed to assess changes to hydrogeological

conditions and shall be reported to the MNRF only if major changes are observed; otherwise, the data will be made available to the MNRF upon request.

6. If complaints regarding groundwater interferences are received, the "Water Supply Interference Complaint Response Procedures" shall be followed and the licensee shall take appropriate measures as deemed necessary by the MECP and/or MNRF to rectify the problem(s).

Respectfully Submitted,

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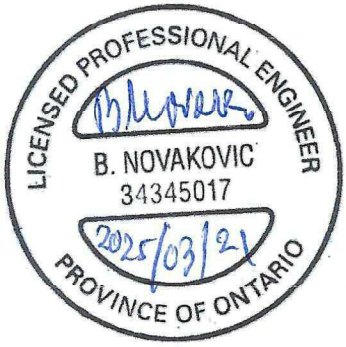
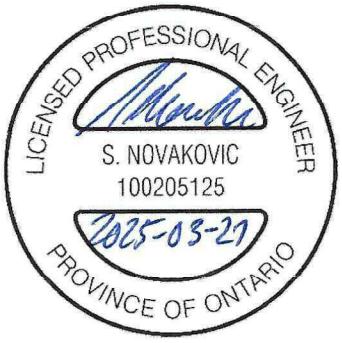




10.0 REFERENCES

Barnett, P. J. 1982.
Quaternary Geology of the Tillsonburg Area, Southern Ontario. Ontario Geological Survey Report 220, Ministry of Natural Resources.

Cowan, W.R. 1975.
Quaternary Geology of the Woodstock Area Southern Ontario. Geological Report 119, Map 2473. Ministry of Natural Resources

Englobe Ltd. 2018.
Aggregate Assessment Report Part of Lots 26 & 27 Brocken Front concession Township of Southwest Oxford, Oxford County Municipality of South West Oxford, Oxford County. May 2018.

MHBC, 2025.
J-AAR Materials Limited, 3003 Page Street, London, Ontario, Bardoel Pit, For Submittal to MNR, File No. 18218A, Engineering Drawings: "Existing Features" (Drawing 1 of 4), "Operational Plan" (Drawing 2 of 4), "Rehabilitation Plan" (Drawing 3 of 4), "Cross Section Plan" (Drawing 4 of 4), Scale 1:3,000. March 2025.

MTE Consultants Inc., 2025.
Bardoel Pit, Natural Environment Report, 583398 Hamilton Road, South-West Oxford, ON, J-AAR Materials Ltd., MTE File No.: 45731-101. February 2025.

Novaterra Environmental Ltd., 2021.
Letter to Johnston Bros. (Bothwell) Limited, *RE: Assessment of Relationship Between Overburden Aquifer and Bedrock Aquifer, Proposed Erwin South Pit, Part Lot 29A, Broken Front Concession, (formerly West Oxford) Township of South-West Oxford, Oxford County.* April 16, 2021.

Ontario Ministry of the Environment, 1981.
Thames River Basin, Water Management Study, Technical Report, Groundwater Resources. Water Resources Report 14.

Ontario Ministry of Environment and Energy (MOEE) 1994.
Policies Guidelines Provincial Water Quality Objectives of the Ministry of Environment and Energy. Queens Printer for Ontario Toronto. July 1994.

Ontario Ministry of Environment and Energy 1995.
MOEE Hydrogeological Technical information requirements for land development application. April 1995.

Ontario Ministry of Natural Resources and Forestry 2020.
Aggregate Resources of Ontario Standards: A compilations of the four standards adopted by Ontario Regulation 244/97 under the Aggregate Resources Act. August 2020.

Sanford, B.V., 1969.
Geology of Toronto-Windsor Area, Ontario. Geol. Surv. Canada, Map 1263A, scale 1:250,000

Thames-Sydenham and Region Source Protection Committee, 2010.
Thames-Sydenham & Region, Tier 1 Water Budget, Version 1.0 (Draft Accepted), September 15, 2010.

Thames-Sydenham and Region Source Protection Committee, 2015.
Upper Thames River Source Protection Area Assessment Report. Approved September 17, 2015.

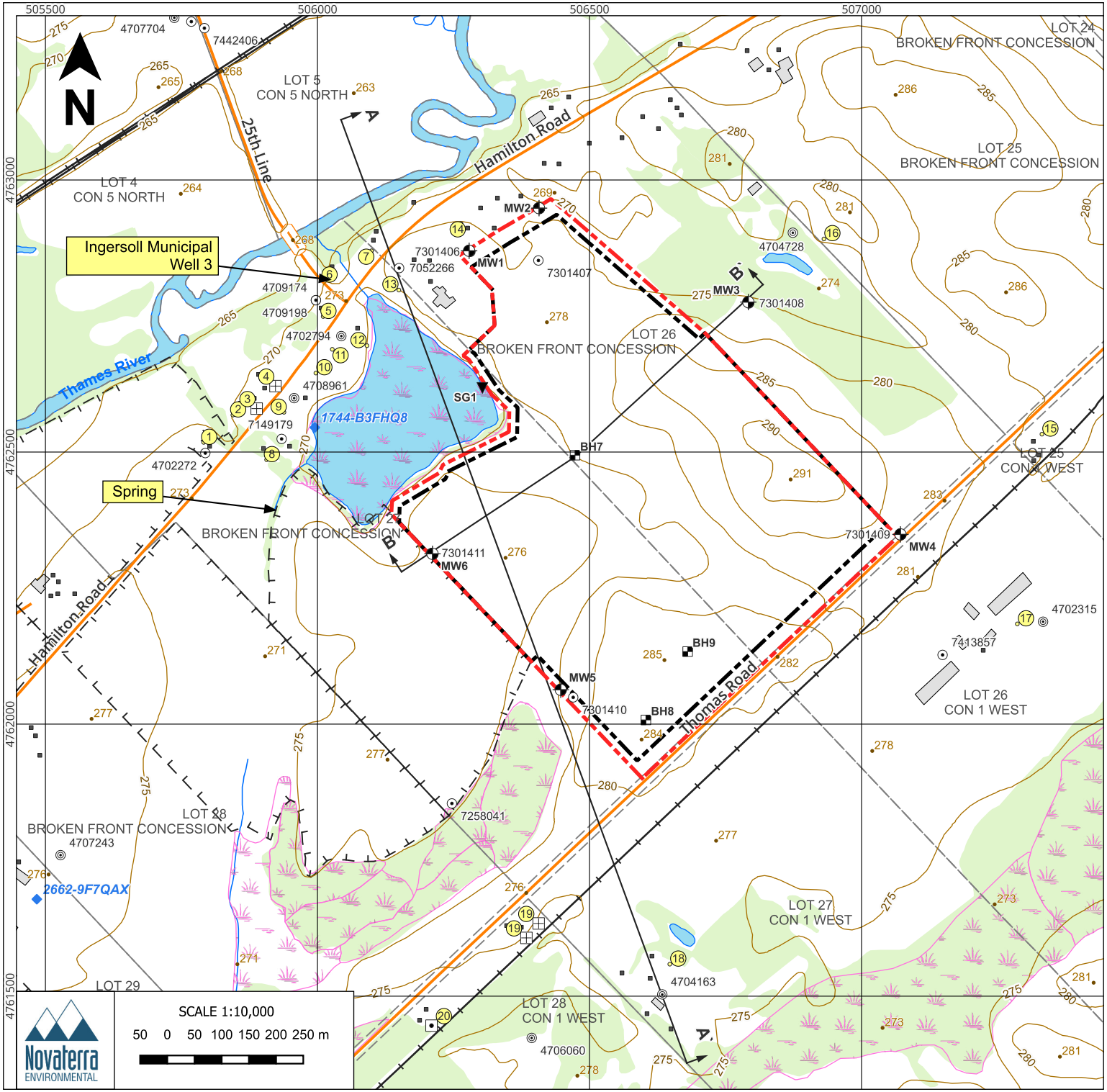
11.0 LIMITATIONS

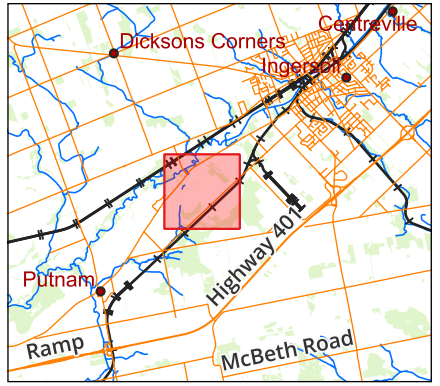
This report was prepared by Novaterra Environmental Ltd. (Novaterra) for the exclusive use of J-AAR Materials Limited. The material in it reflects Novaterra's best judgement considering the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Novaterra accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The report was prepared based, in part, on information and data for the site provided to Novaterra Environmental Ltd., by other parties. It is assumed that the information provided is factual and accurate. We accept no responsibility for any deficiencies, misstatements or inaccuracies contained in this report as a result of omissions, misinterpretations, or fraudulent acts of these other parties.

FIGURES

Figures 1 to 13 inclusive





INDEX MAP

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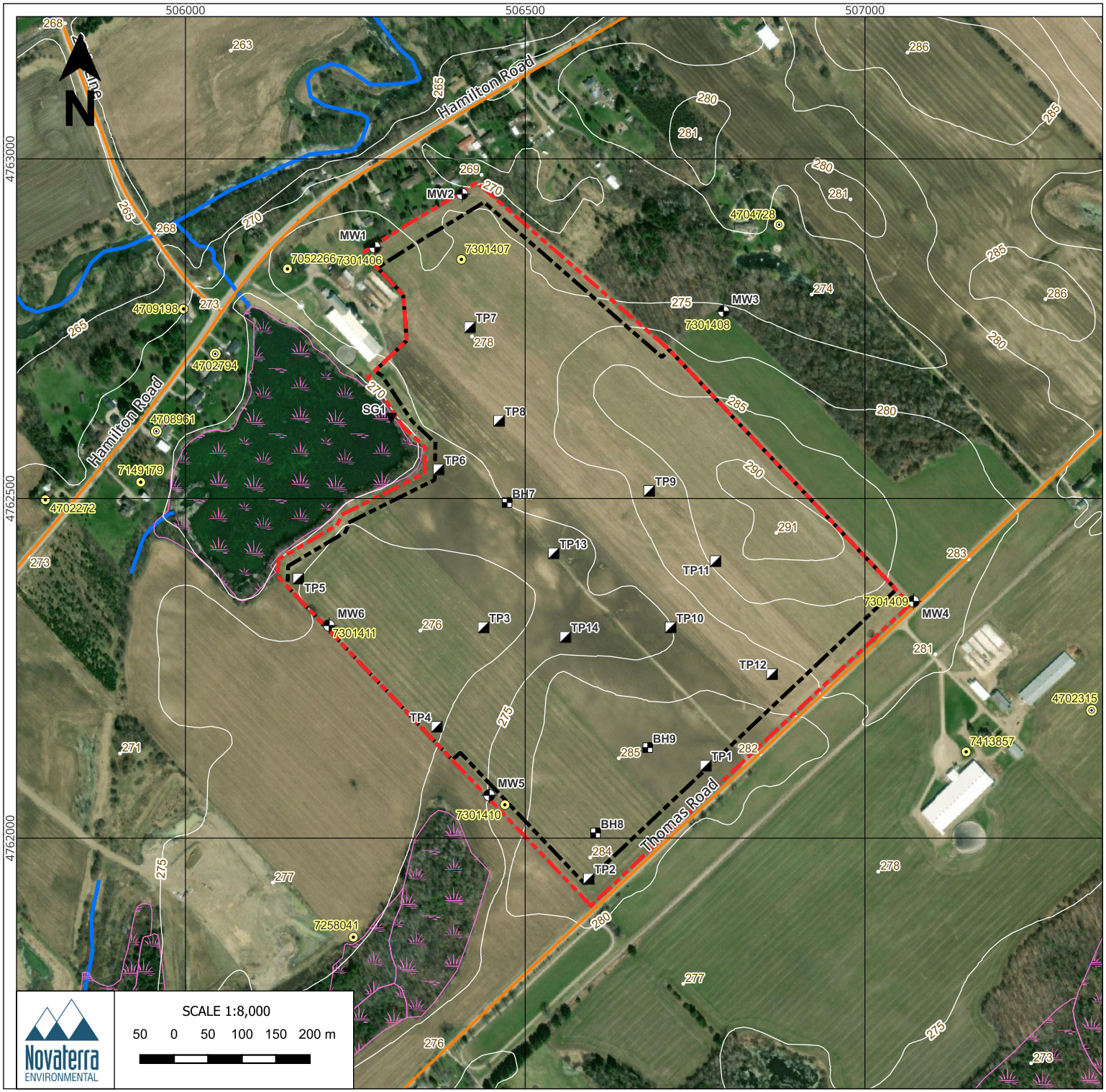
- Overburden well
- Bedrock well
- Active Permit to Take Water
- Cross-section
- Active aggregate license
- Wetland not significant or not evaluated
- Provincially Significant Wetland

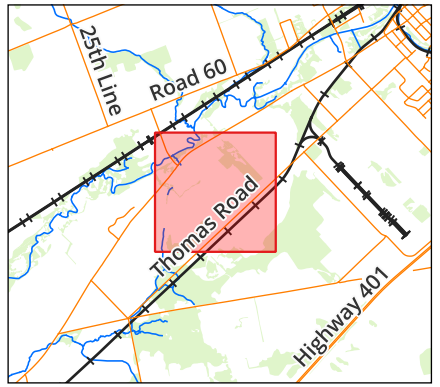
Figure 1. Location map

PROPOSED BARDOEL PIT
J-AAR Materials Limited

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), County of Oxford

March 20, 2025





INDEX MAP

LEGEND

- Proposed License Boundary
- Proposed Extraction Limit

Monitoring stations

- Borehole
- Monitoring well
- Staff gauge

MECP Water Well Records

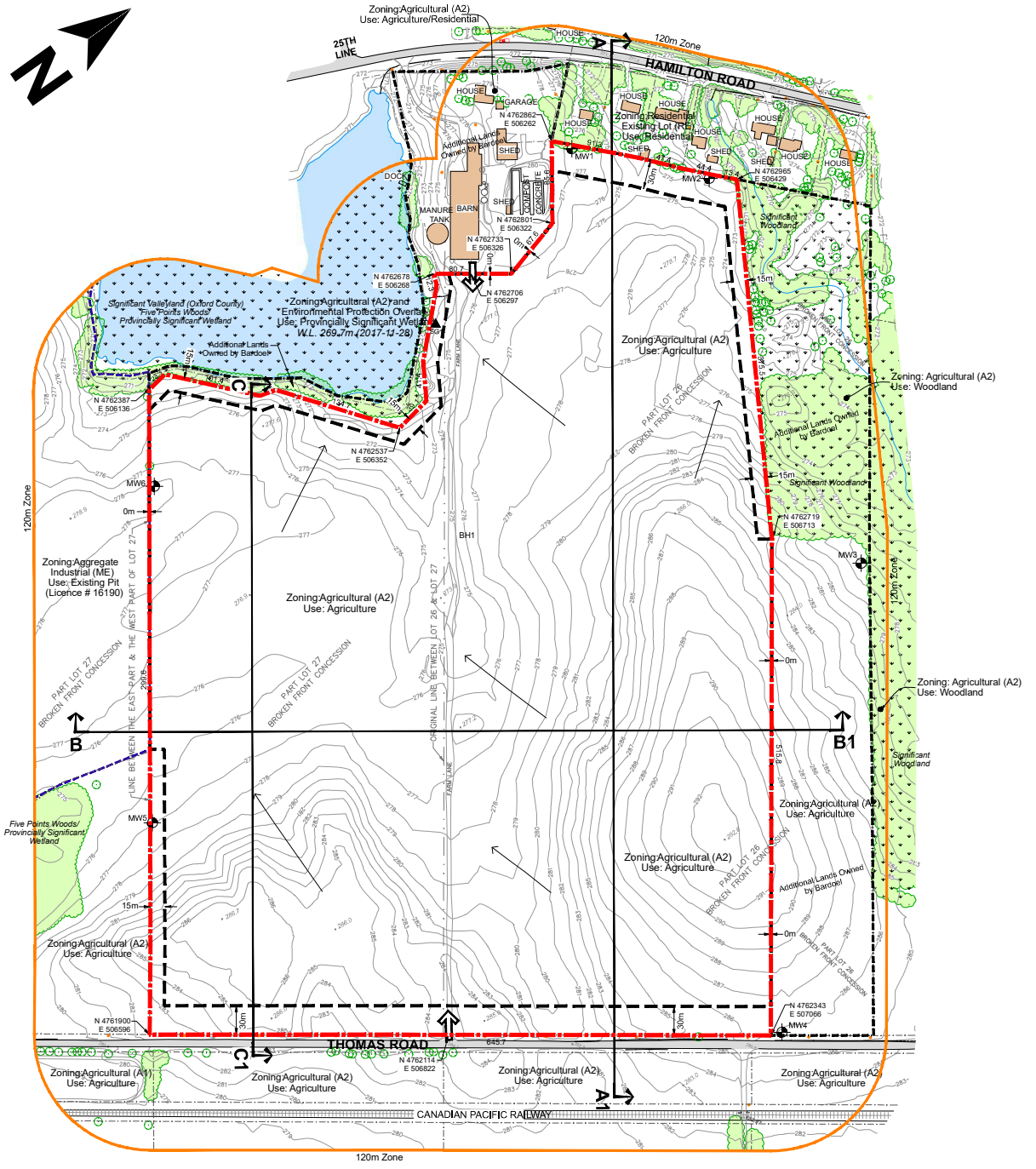
- Overburden well
- Bedrock well
- Wetland not significant or not evaluated
- Provincially Significant Wetland

Figure 2. Aerial photo showing detailed view of subject site and nearby water well records.

PROPOSED BARDOEL PIT
J-AAR Materials Limited

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), County of Oxford

March 20, 2025



Legend

- Boundary of Area to be Licensed
- Additional Lands Owned by Bardoel (Lessor)
- Existing Licensed Boundary (LICENCES #16190)
- Limit of Extraction (ALL SETBACKS ARE DRAWN TO SCALE AND SHOW LABELLED DISTANCES)
- Direction of Surface Drainage
- Candidate Significant Wildlife Area
- Farm/Field Access
- MW6 / SG1 Monitoring Well/ Staff Gauge (NOVATERRA ENVIRONMENTAL (2017))

SCALE
50 0 50 100
METRES

Taken from Existing Features Drawing 1 of 4 (MHBC, 2025)

Novaterra ENVIRONMENTAL

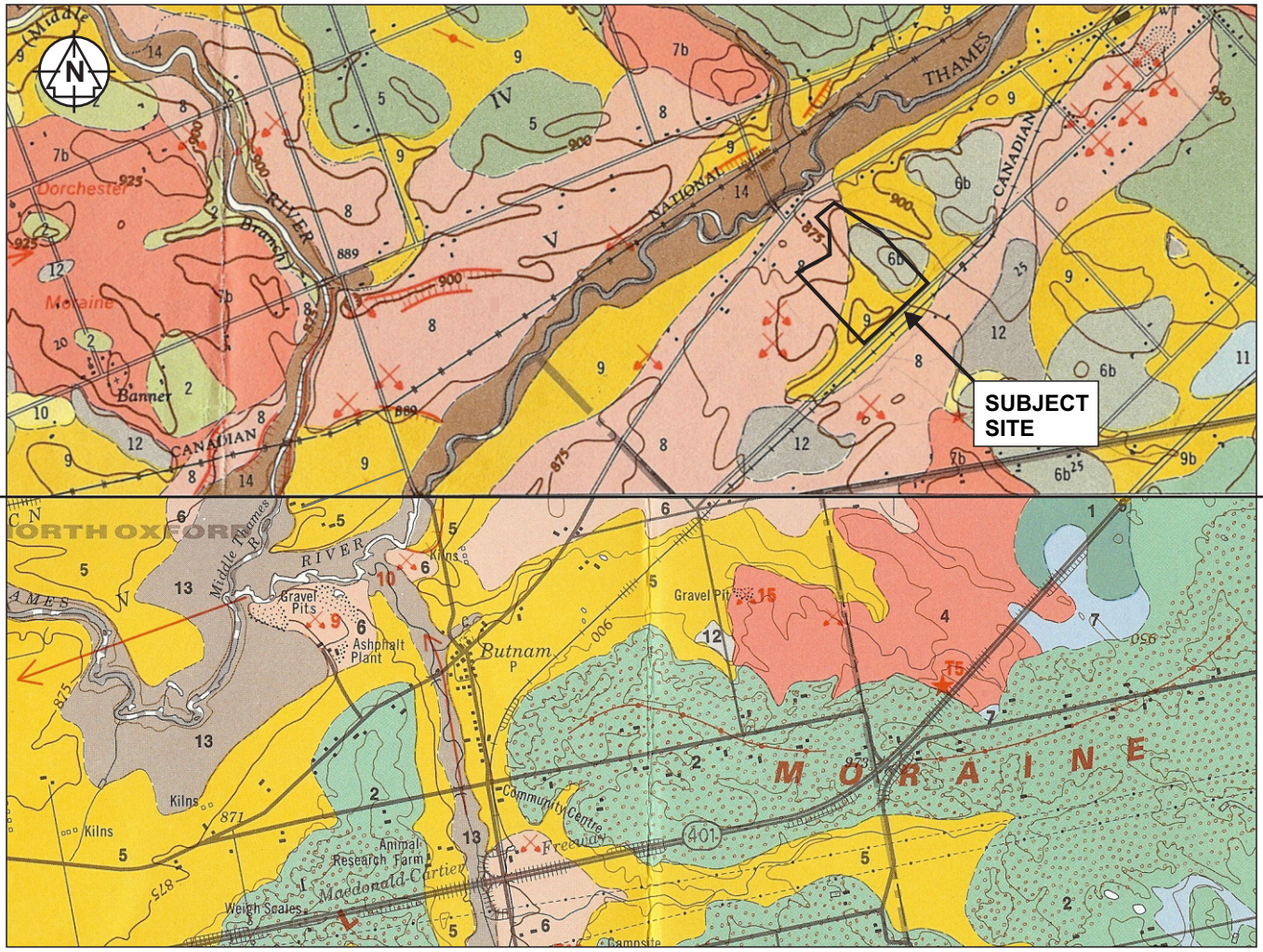
EXISTING FEATURES

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), Oxford County

Figure 3

PROPOSED BARDOEL PIT
J-AAR Materials Limited

March 20, 2025



Adapted from: Upper map: Cowan, 1975
Lower map: Barnett, 1982

LEGEND

UPPER MAP

- 14 Modern alluvium, unsubdivided: silt, sand, gravel
- 12 Bog deposits: peat, muck, marl
- 11 Fine-grained glaciolacustrine or pond deposits: silt and clay
- 10 Glaciolacustrine or pond deposits: sand and silty fine sand
- 9 9 Glaciofluvial outwash sand, unsubdivided
  - 9a Glaciofluvial outwash sand including some gravel
  - 9b Glaciofluvial outwash sand frequently underlain by gravel
- 8 Glaciofluvial outwash gravel and gravelly sand frequently overlain by several feet of sand or silt
- 7 7 Ice-contact stratified drift, unsubdivided: sand and gravel including some till or silt
  - 7a Ice-contact stratified drift, mainly gravel
  - 7b Ice-contact stratified drift, mainly sand
- 6 6a Silt till (Port Stanley Till or fine-grained Zorra till, or older till)
  - 6b Sandy silt till (Catfish Creek Till or Zorra till)
- 5 Zorra till: yellowish brown silt to sand silt till
- 2 CATFISH CREEK TILL: stony, sandy silt till; may include older drift in valley walls

LOWER MAP

- 13 Modern alluvium: clay, silt, sand, muck
- 12 Bog deposits: muck, peat or marl
- 7 Glaciolacustrine deepwater deposits: massive to laminated clay, minor silt
- 6 Glaciofluvial outwash and deltaic deposits: gravel and gravelly sand
- 5 Glaciofluvial outwash and deltaic deposits: sand
- 4 Glaciofluvial ice-contact stratified drift: morainic or kame sand and gravelly sand
- 2 PORT STANLEY TILL: silt to silty clay till
- 1 CATFISH CREEK TILL: stony sandy silt till

SCALE
1:50 000

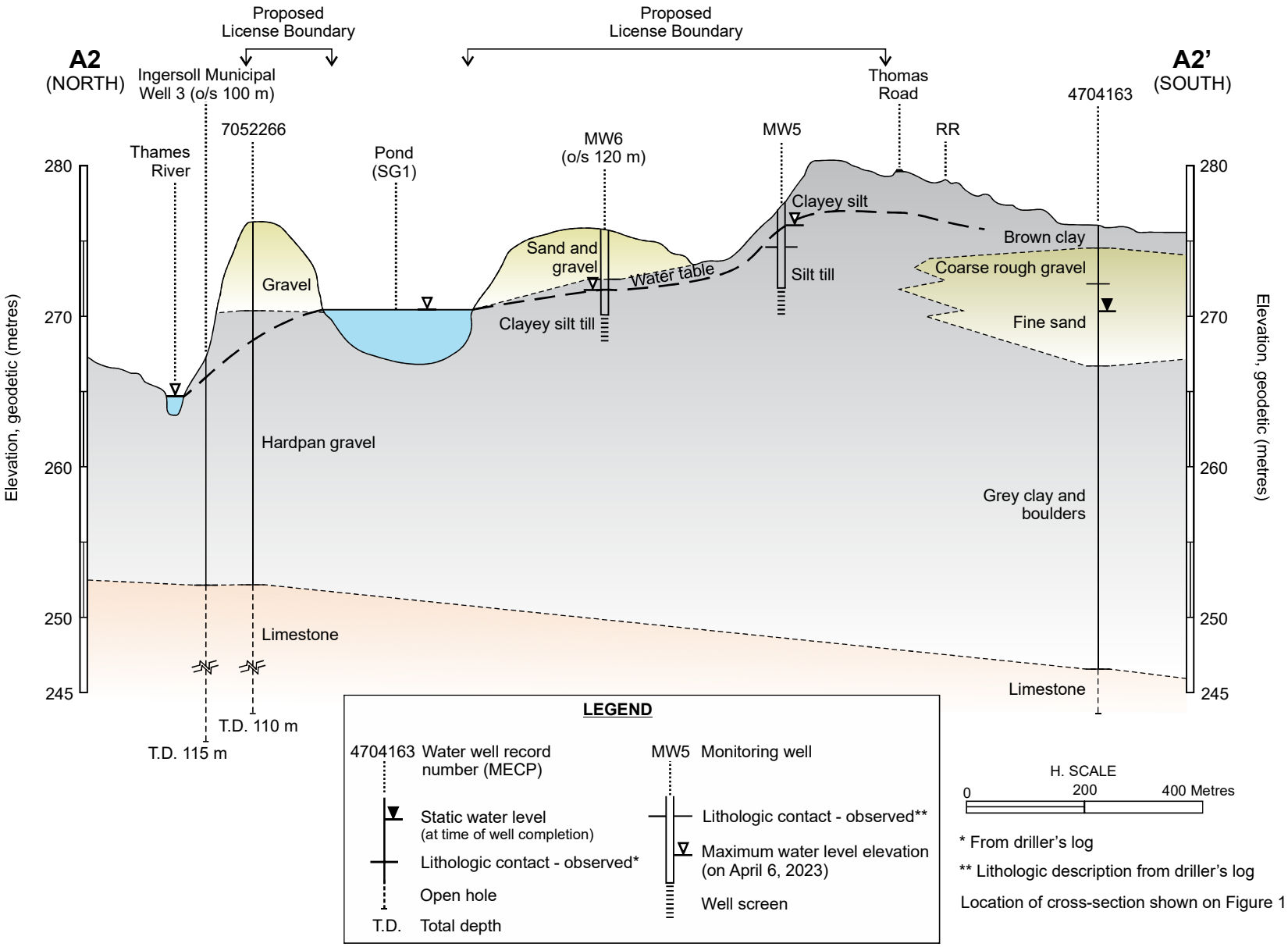
0 2000 metres

Novaterra ENVIRONMENTAL

QUATERNARY GEOLOGY MAP

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), Oxford County

Figure 4
PROPOSED BARDOEL PIT
J-AAR Materials Limited
February 16, 2024



Novaterra ENVIRONMENTAL

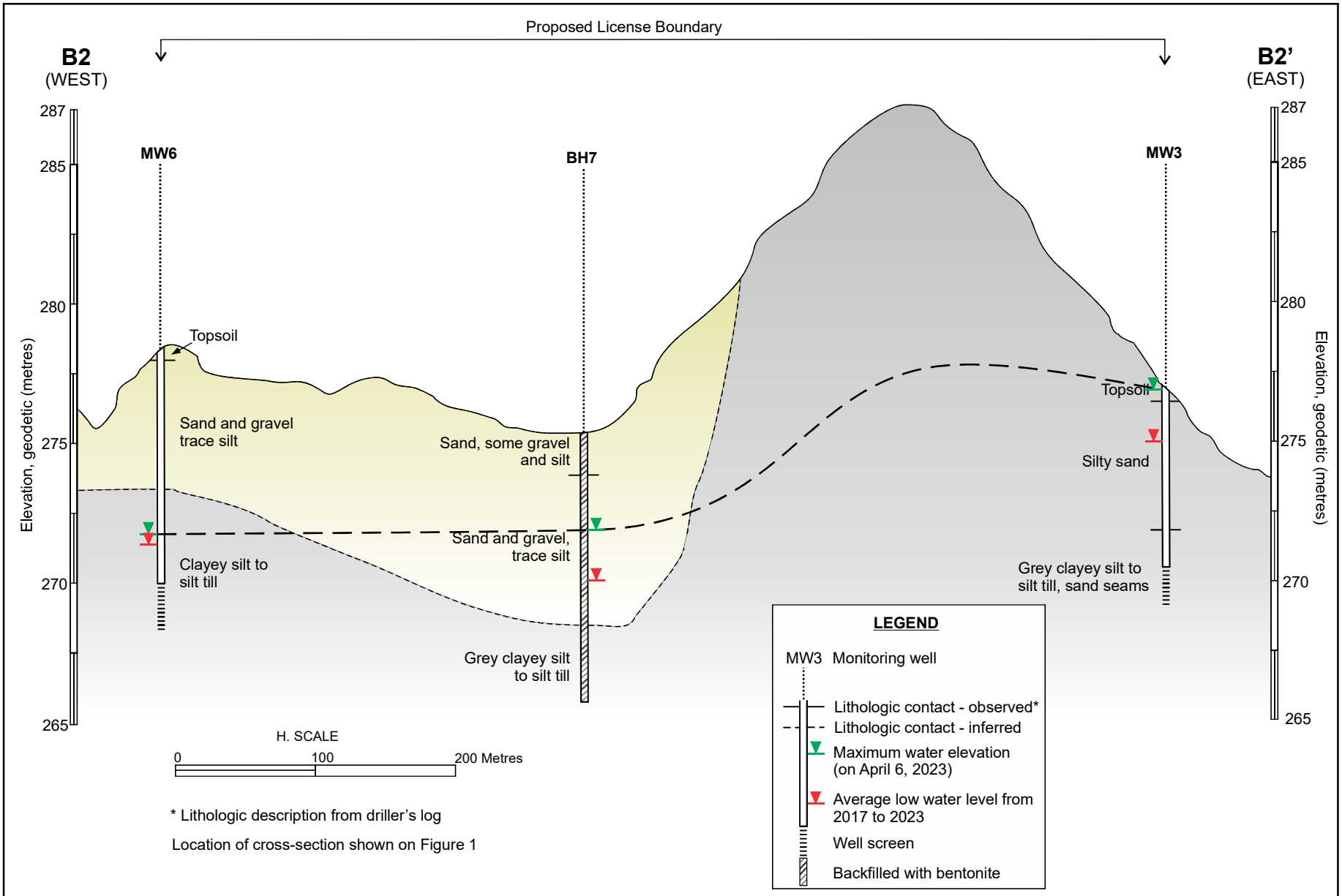
REGIONAL CROSS-SECTION A2-A2'

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford
(Formerly West Oxford Township), Oxford County

Figure 5

PROPOSED BARDOEL PIT
J-AAR Materials Limited

February 16, 2024



Novaterra ENVIRONMENTAL

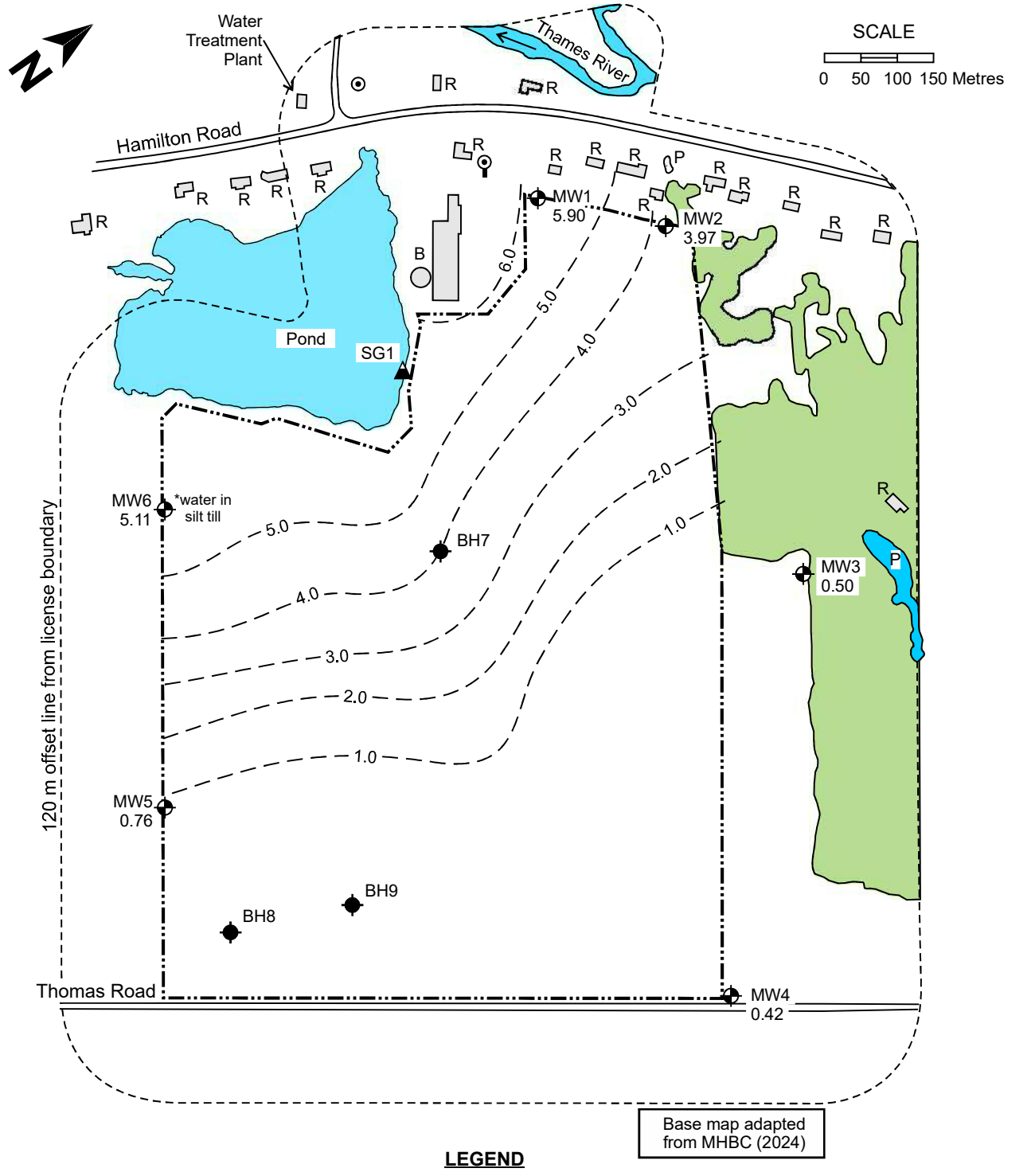
LOCAL CROSS-SECTION B2-B2'

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford
(Formerly West Oxford Township), Oxford County

Figure 6

PROPOSED BARDOEL PIT
J-AAR Materials Limited

February 16, 2024



LEGEND

- Proposed licensed boundary
- R Residence
- B Barn
- P Pond
- Monitoring well
- Borehole
- Drilled domestic well in bedrock
- Drilled municipal well in bedrock
- Staff gauge
- 5.90 Depth to groundwater (mbgs) on April 6, 2023
- 3.0 Inferred water level contour (mbgs) Contour interval 1.0 m

Novaterra ENVIRONMENTAL

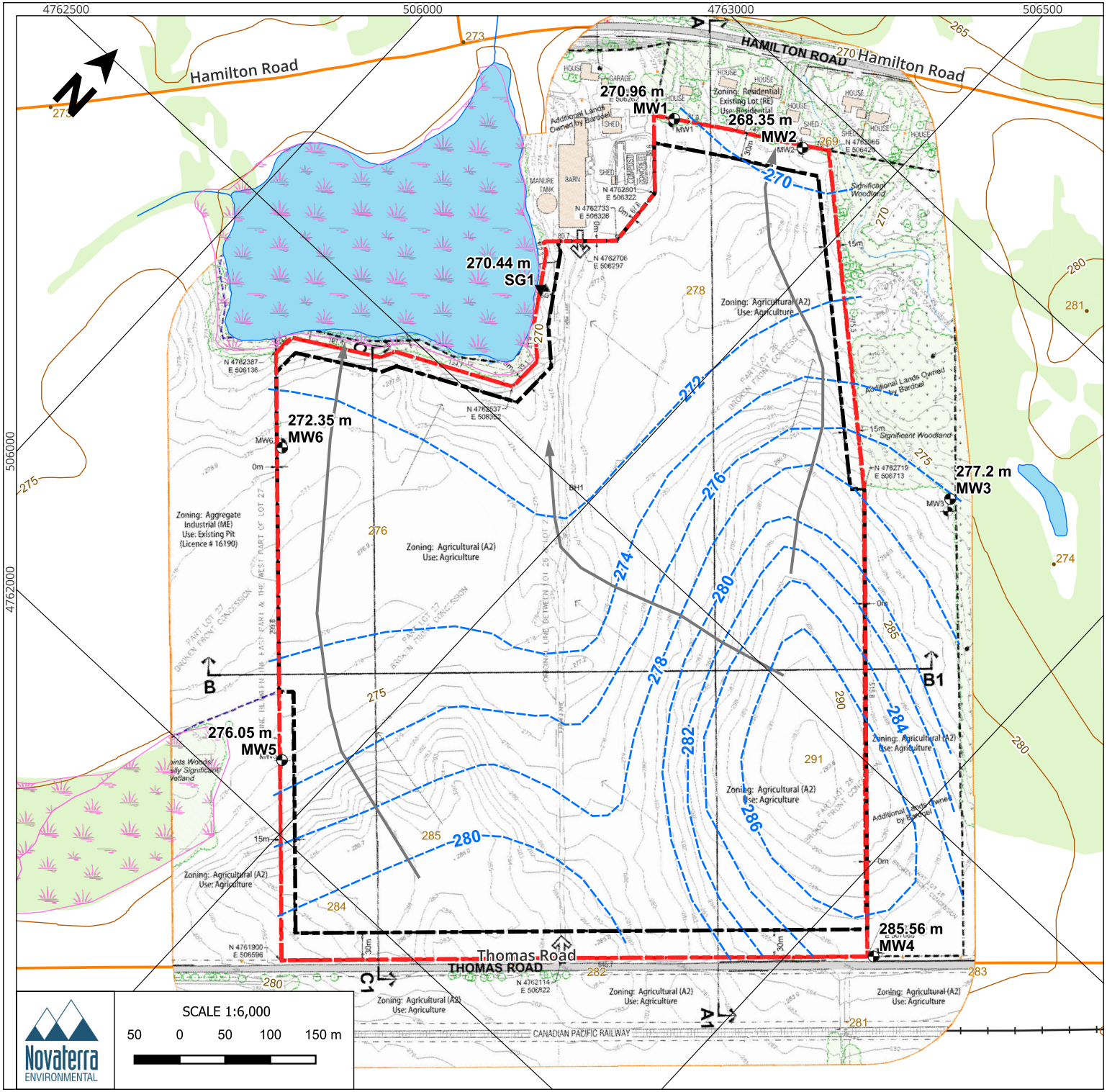
MINIMUM DEPTH TO WATER LEVEL BELOW GROUND SURFACE DURING HYDROLOGIC HIGH

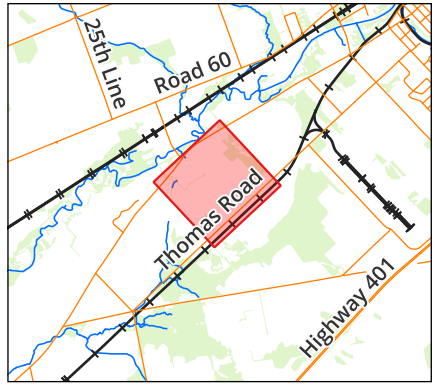
Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), Oxford County

Figure 7

PROPOSED BARDOEL PIT
J-AAR Materials Limited

April 17, 2024





INDEX MAP

LEGEND

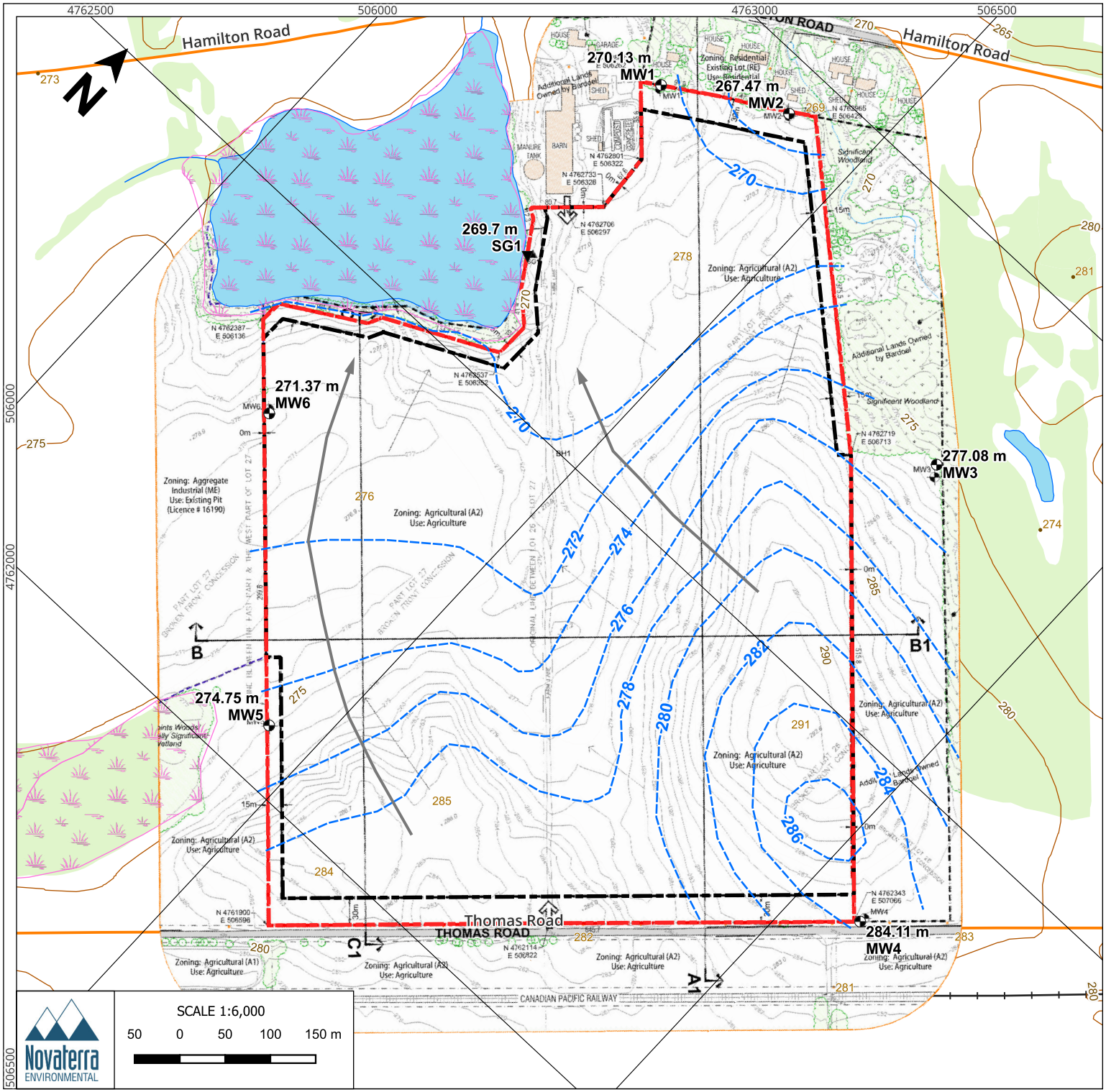
- Proposed License Boundary
- Proposed Extraction Limit
- Groundwater level elevation (m amsl) on April 6, 2023
- Pond water elevation (m amsl) on April 6, 2023
- Inferred water level elevation (m amsl) on April 6, 2023. Contour interval 2 m.
- Groundwater flow direction

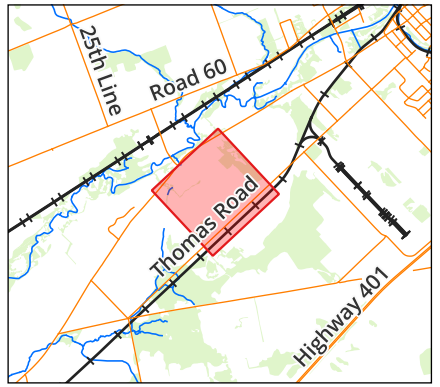
Figure 8. Maximum predicted groundwater table elevation

PROPOSED BARDOEL PIT
J-AAR Materials Limited

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), County of Oxford

March 20, 2025





INDEX MAP

LEGEND

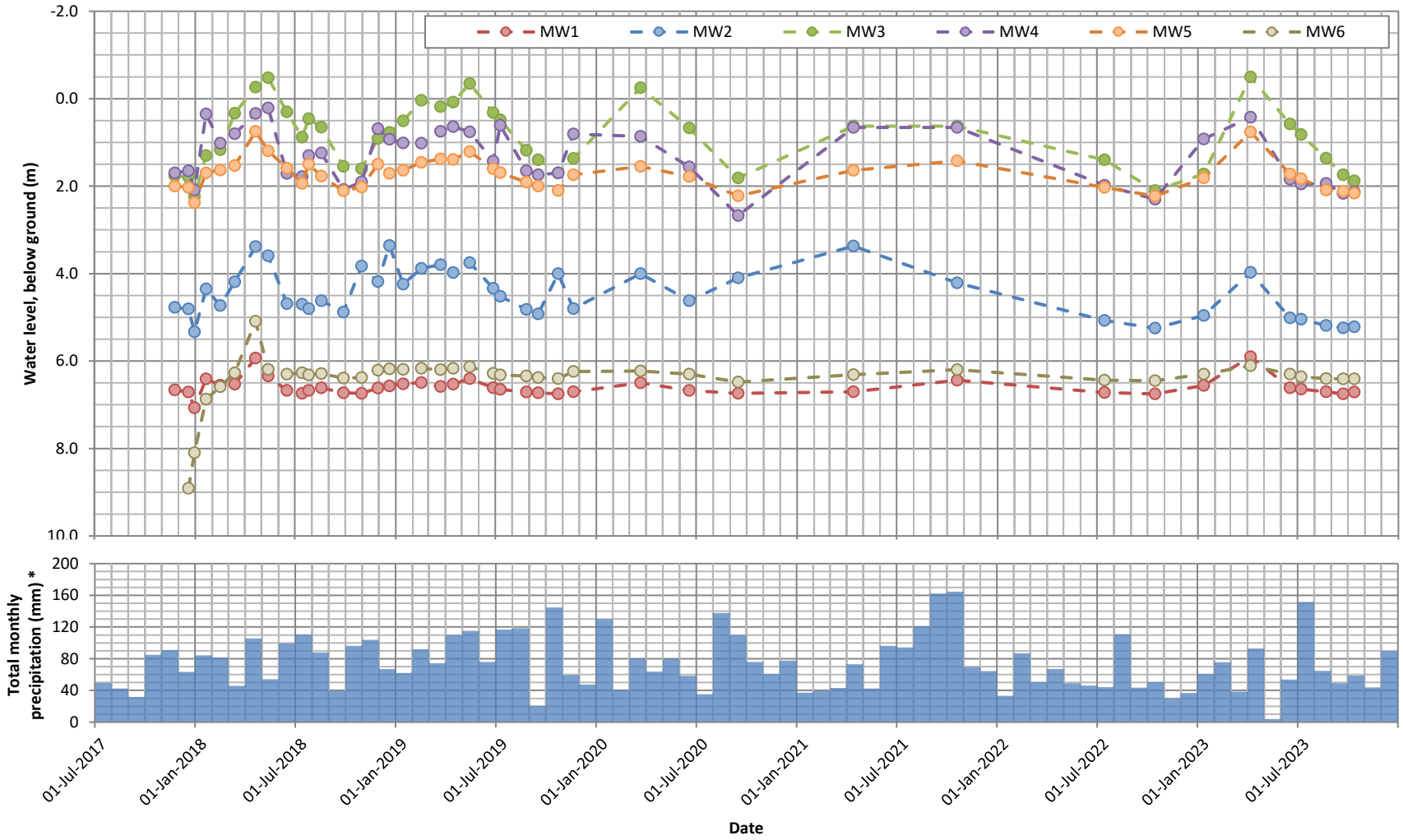
- Proposed License Boundary
- Proposed Extraction Limit
- Average yearly low groundwater level elevation (m amsl) from 2017 to 2023
- Average yearly low pond water elevation (m amsl) from 2017 to 2023
- Inferred average yearly low water level elevation (m amsl) from 2017 to 2023. Contour interval 2 m.
- Groundwater flow direction

Figure 9. Average yearly low groundwater table elevation from 2017 to 2023.

PROPOSED BARDOEL PIT
J-AAR Materials Limited

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), County of Oxford

March 20, 2025



* Precipitation measured at London Climate Station (Source: http://www.climate.weatheroffice.ec.gc.ca)
Negative value below ground indicates water level is above ground surface.

Novaterra ENVIRONMENTAL

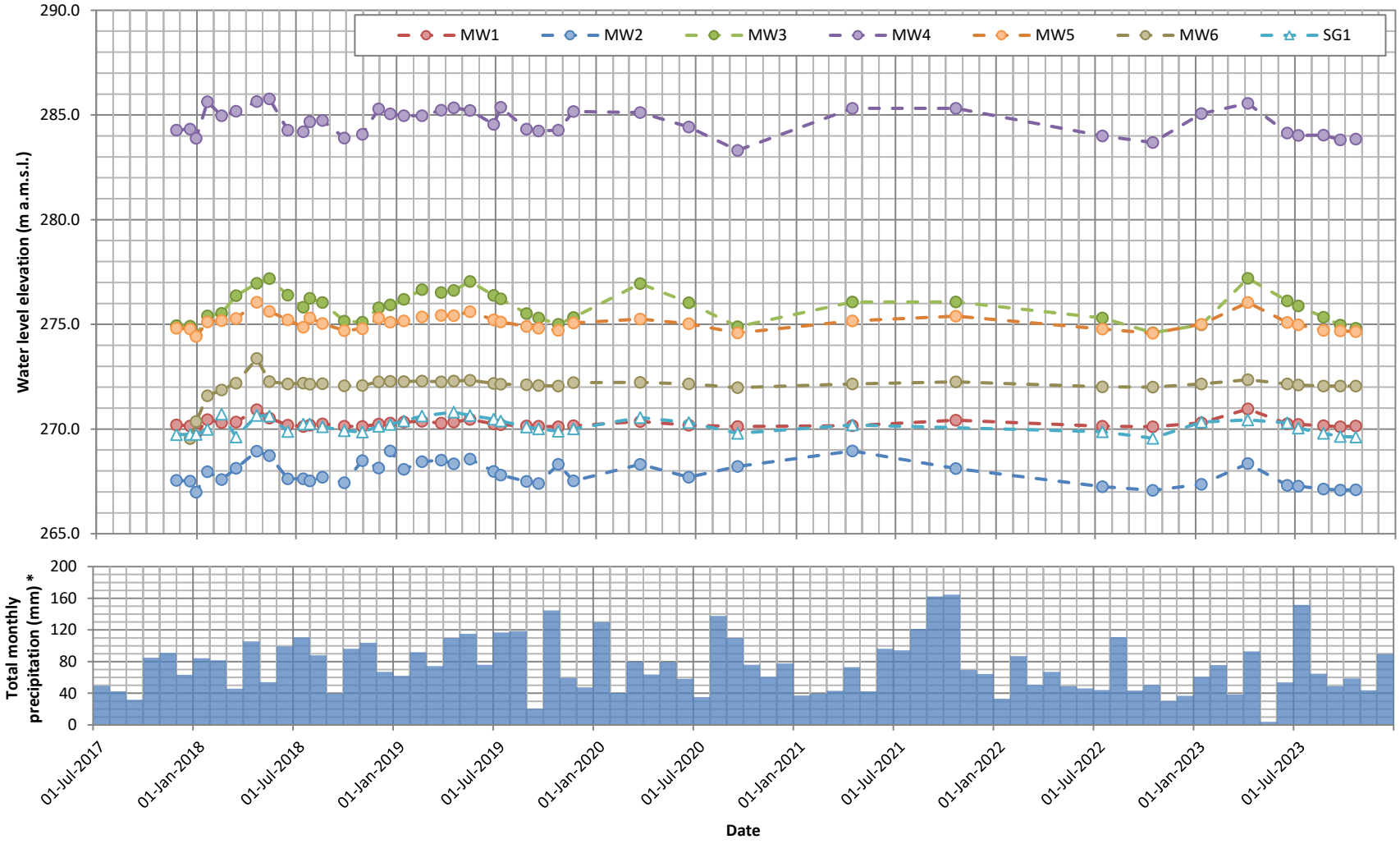
DEPTH TO WATER LEVEL HYDROGRAPHS AND PRECIPITATION

Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford
(Formerly West Oxford Township), Oxford County

Figure 10

PROPOSED BARDOEL PIT
J-AAR Materials Limited

February 16, 2024



* Precipitation measured at London Climate Station (Source: http://www.climate.weatheroffice.ec.gc.ca

Novaterra ENVIRONMENTAL

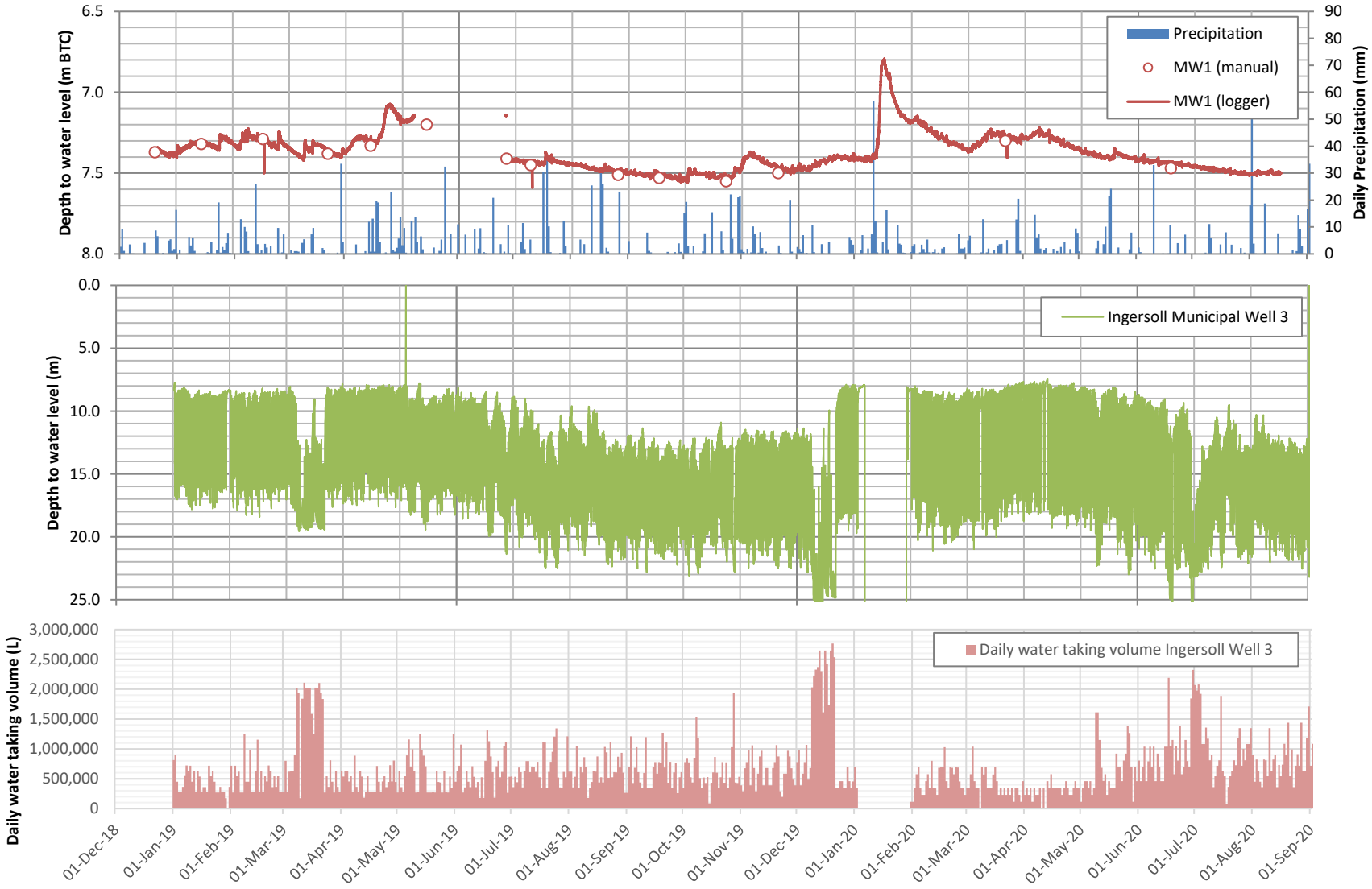
WATER LEVEL ELEVATION HYDROGRAPHS AND PRECIPITATION

Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford
(Formerly West Oxford Township), Oxford County

Figure 11

PROPOSED BARDOEL PIT
J-AAR Materials Limited

February 16, 2024



Novaterra ENVIRONMENTAL

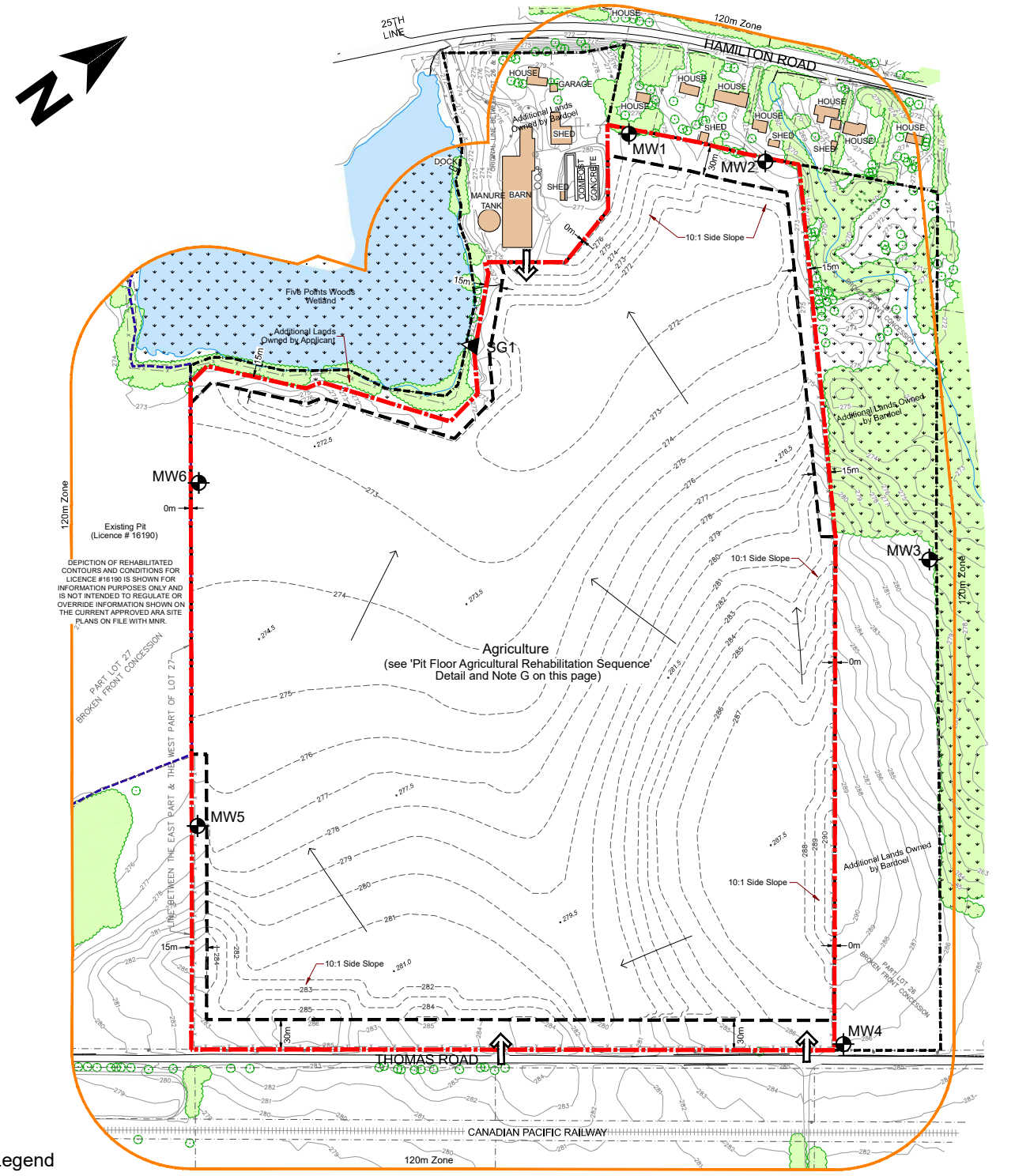
WATER LEVEL HYDROGRAPHS FOR MW1 AND INGERSOLL MUNICIPAL WELL 3
AND WATER TAKING FROM INGERSOLL MUNICIPAL WELL 3

Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford
(Formerly West Oxford Township), Oxford County

Figure 12

PROPOSED BARDOEL PIT
J-AAR Materials Limited

February 16, 2024



Legend

- Boundary of Area to be Licensed
- Additional Lands Owned by Bardoel (Lessor)
- Existing Licensed Boundary (LICENCES #16190)
- Limit of Extraction (ALL SETBACKS ARE DRAWN TO SCALE AND SHOW LABELED DISTANCES)
- Contour with Elevation (METRES ABOVE SEA LEVEL)
- Existing Fence (1.2m POST & WIRE FARM FENCE UNLESS OTHERWISE NOTED)
- Proposed Contour and Elevation (METRES ABOVE SEA LEVEL (MASL))
- Proposed Elevation (RAHABILITATED ELEVATION (MASL))
- Farm/Field Access
- Direction of Surface Drainage
- Candidate Significant Wildlife Area
- Monitoring Well/ Staff Gauge (NOVATERRA ENVIRONMENTAL (2017))

SCALE 1:6,000

50 0 50 100 METRES

Taken from Rehabilitation Plan Drawing 3 of 4 (MHBC, 2025)

Novaterra ENVIRONMENTAL

FINAL REHABILITATION PLAN

Part Lots 26 and 27, Broken Front Concession, Township of South-West Oxford, Township of West Oxford, Oxford County

Figure 13

PROPOSED BARDOEL PIT
J-AAR Materials Limited

October 24, 2024

TABLES

Tables 1 to 6 inclusive

Table 1. Summary of Information on Door-to-Door Well Survey in the vicinity of Bardoel Pit.

Location: Part Lots 26 and 27 Broken Front Concession, South-West Oxford Township, (Formerly West Oxford Township) Oxford County;
Date of survey: December 2, 2017; Surveyed by: Blagy Novakovic

Survey ID [1)]	911 Address	MECP water well record number [2)]	Well type; Date completed [3)]	Casing diameter (cm) [3)]	Well depth (m bgs) [3)]	Depth to water level (m BTC) [3)]	Screen or open hole interval (m bgs) [3)]	Well use, geology, and comments
1	583353 Hamilton Rd.	4702272	Drilled; Oct 1960	10	7.3	3.66	Open at 7.3	Owner present during visit.
2	583361 Hamilton Rd.	N/A	Unknown	Unknown	Unknown	Unknown	Unknown	Owner (lady) moved in one year ago. Does not know what kind of well it is.
3	583365 Hamilton Rd.	N/A	Dug; Unknown	91 cm (36")	6.0	n/m	Unknown	According to owner, well located in basement, has never run out of water.
4	583367 Hamilton Rd.	N/A	Dug; Unknown	Unknown	7.6	n/m	Unknown	According to owner, well located in basement. Similar in construction as at Survey ID 3
5	254297 25th Line	4709174	Drilled; Unknown	21	8.0	Unknown	6.4 – 7.9	Geotechnical borehole associated with the treatment plant for the Town of Ingersoll.
		4709198	AB	-	-	-	-	Abandonment record for 4709174.
6	254196 25th Line	N/A	< 1945; Unknown	30	119	N/A	15 - 119	Ingersoll Municipal Well 3. Lithology according to Oxford County: 0-15 m overburden 15-119 m carbonate bedrock
7	583403 Hamilton Rd.	-	-	-	-	-	-	No well; on municipal water supply.
8	583362 Hamilton Rd.	7149179	Drilled; June 2010	15.88	27.7	21.95	Open at 20.1	According to owner, drilled 90 ft (29 m) deep well.
9	583374 Hamilton Rd.	4708961	Bedrock Drilled; Jan 2005	15.56	28.4	13.41	Open at 21.9	No answer at the door. Left letter with survey questionnaire, never received a response.

1) Well location is identified in Figure 1;
2) Unless stated otherwise, water well records could not be verified in the field if they were drilled prior to 2003 or permission was not granted to access the well. Water well records listed in this column are those which are thought to roughly correspond to the residences. Please see "Appendix B" for construction and lithology details;
3) Obtained from water well record (see Appendix B) where one could be associated with the residence. Otherwise, information was provided by well owner;
BTC – Below top of casing; N/A – Not available; AB – Abandoned; n/m – Not measured.

Survey ID [1)]	911 Address	MECP water well record number [2)]	Well type; Date completed [3)]	Casing diameter (cm) [3)]	Well depth (m bgs) [3)]	Depth to water level (m BTC) [3)]	Screen or open hole interval (m bgs) [3)]	Well use, geology, and comments
10	583380 Hamilton Rd.	N/A	N/A	N/A	N/A	N/A	N/A	Owner does not know what kind of well he has. Has lived there for 9 years.
11	583382 Hamilton Rd.	N/A	N/A	N/A	N/A	N/A	N/A	Lady answered the door, does not known what kind of well.
12	583386 Hamilton Rd.	4702794	Drilled; Apr 1969	13	28.3	13.72	Open 21.0 – 28.3	No one home, left letter with survey questionnaire in mailbox. Never received a response.
13	583398 Hamilton Rd.	7052266	Bedrock drilled; Oct 2007	15.88	33.5	19.51	Open 25.3 – 33.5	Bedrock well. Residence at the subject site.
14	58342 Hamilton Rd.	-	-	-	-	-	-	No well; on municipal water supply.
15	563470 Thomas Rd.	N/A	Drilled; Unknown	N/A	24.4	N/A	N/A	Owner indicated well is 80 ft (24.4 m) deep, located in front of house. Septic bed at back of house.
16	563469 Thomas Rd.	4704728	Drilled; Jan 1978	12.7	42.7	8.53	Open 24.7 – 42.7	Owner does not know well depth. Concrete at the top, access was denied.
17	563440 Thomas Rd.	4702315	Drilled; June 1967	13.33	34.7	7.62	Open 33.8 – 34.7	No one home. House appears unoccupied.
18	563362 Thomas Rd.	4704163	Drilled; June 1975	15.24	31.4	5.49	Open 29.6 – 31.4	No answer at door. Left letter with survey questionnaire. Never received a reply.
19	563332 Thomas Rd.	N/A	Dug; Unknown	N/A	5.5	n/m	N/A	Two dug wells on property, info provided by well owner. Indicated 18 ft (5.5 m) deep well supplies house; 12 ft (3.66 m) deep well supplies animals.
		N/A	Dug; Unknown	N/A	3.66	n/m	N/A	
20	563320 Thomas Rd.	N/A	Sand point; Unkown	N/A	N/A	n/m	N/A	Limited info provided by well owner.

1) Well location is identified in Figure 1;
2) Unless stated otherwise, water well records could not be verified in the field if they were drilled prior to 2003 or permission was not granted to access the well. Water well records listed in this column are those which are thought to roughly correspond to the residences. Please see "Appendix B" for construction and lithology details;
3) Obtained from water well record (see Appendix B) where one could be associated with the residence. Otherwise, information was provided by well owner;
BTC – Below top of casing; N/A – Not available; AB – Abandoned; n/m – Not measured.

Table 2. Wells construction data and depths to water levels in monitoring wells and pond at Bardoel Pit.

Monitoring station [1)]	Elevation, m amsl		Well construction data [2)]							Date and depth to water level, m BTC						
	Ground	Top of well casing	Original well depth (m bgs)	Casing stick-up (m)	Well diam. (cm)	Screen interval (m bgs)	Gravel pack, (m bgs)	Bentonite interval, m	Screen slot number	24-Nov-17	19-Dec-17	30-Dec-17	20-Jan-18	15-Feb-18	13-Mar-18	20-Apr-18
MW1	276.86	277.66	10.67	0.80	5.0	7.6 - 10.6	7.0 - 10.6	0.3 - 7.0	10	7.46	7.51	7.87	7.21	7.35	7.33	6.73
MW2	272.32	273.02	9.37	0.70	5.0	6.0 - 7.5	5.8 - 7.6	0.3 - 5.8	10	5.47	5.51	6.03	5.05	5.43	4.89	4.08
MW3	276.7	277.50	7.62	0.80	5.0	6.0 - 7.5	5.8 - 7.6	0.3 - 5.8	10	2.56	2.59	3.04	2.10	1.97	1.13	0.54
MW4	285.98	286.73	9.60	0.75	5.0	6.0 - 9.0	5.8 - 9.0	0.3 - 5.8	10	2.45	2.40	2.84	1.10	1.77	1.55	1.09
MW5	276.81	277.67	6.55	0.86	5.0	2.3 - 3.8	0.3 - 3.8	none	10	2.86	2.89	3.24	2.56	2.49	2.39	1.61
MW6	278.46	279.06	10.06	0.60	5.0	8.5 - 10.0	7.6 - 10.1	0.3 - 7.6	10	dry	9.51	8.70	7.47	7.19	6.87	5.69
SG1	N/A	270.81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.08	1.07	1.06	0.83	0.10	1.20	0.16
Dam at pond	N/A	270.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	n/i	n/i	n/i	n/i	n/i	sub.	0.06

NOTE: Monitoring wells were constructed on November 21, 22 and 23, 2017 and developed on December 19, 2017;
m amsl – Metres above sea level; m bgs – Metres below ground surface; BTC - Below top of casing;
N/A - Not applicable; n/m – Not measured; n/i – Not installed; sub. – Water overtopping staff gauge, unable to measure;
[1)] Locations are shown on Figure 1. [2)] Based on Englobe (2018) borehole logs data.

Table 2. Cont'd.

Monitoring station	Elevation, m amsl		Date and depth to water level, m BTC																
	Ground	Top of well casing	13-May-18	16-Jun-18	14-Jul-18	26-Jul-18	18-Aug-18	27-Sep-18	30-Oct-18	29-Nov-18	20-Dec-18	14-Jan-19	16-Feb-19	23-Mar-19	15-Apr-19	15-May-19	27-Jun-19	10-Jul-19	26-Aug-19
MW1	276.86	277.66	7.14	7.47	7.54	7.47	7.41	7.53	7.54	7.42	7.37	7.32	7.29	7.38	7.33	7.20	7.41	7.45	7.51
MW2	272.32	273.02	4.29	5.39	5.40	5.50	5.32	5.58	4.53	4.88	4.06	4.94	4.58	4.50	4.68	4.45	5.04	5.22	5.52
MW3	276.7	277.50	0.32	1.10	1.68	1.26	1.45	2.35	2.40	1.71	1.57	1.31	0.84	0.98	0.88	0.45	1.12	1.28	1.98
MW4	285.98	286.73	0.96	2.46	2.53	2.05	1.99	2.83	2.65	1.44	1.68	1.76	1.77	1.50	1.39	1.51	2.18	1.36	2.40
MW5	276.81	277.67	2.05	2.45	2.80	2.36	2.63	2.97	2.88	2.36	2.57	2.50	2.32	2.24	2.25	2.07	2.46	2.55	2.77
MW6	278.46	279.06	6.79	6.90	6.87	6.92	6.89	6.99	6.98	6.81	6.78	6.79	6.77	6.80	6.77	6.73	6.88	6.92	6.94
SG1	N/A	270.81	0.19	0.93	0.57	0.56	0.70	0.89	0.95	0.67	0.59	0.43	0.19	0.20	0.20	0.16	0.34	0.42	0.71
Dam at pond	N/A	270.56	sub.	sub.	n/m	n/m	-0.49	0.65	n/m	n/m	0.37	0.21	0.00	-0.04	-0.04	0.05	0.12	n/m	n/m

m amsl – Metres above sea level; N/A - Not applicable; n/m – Not measured; sub. – Water overtopping staff gauge, unable to measure;

Table 2. Cont'd.

Monitoring station	Elevation, m amsl		Date and depth to water, m BTC															
	Ground	Top of well casing	17-Sep-19	23-Oct-19	20-Nov-19	21-Mar-20	18-Jun-20	15-Sep-20	13-Apr-21	19-Oct-21	14-Jul-22	14-Oct-22	11-Jan-23	06-Apr-23	17-Jun-23	07-Jul-23	22-Aug-23	22-Sep-23	20-Oct-23
MW1	276.86	277.66	7.53	7.55	7.50	7.30	7.47	7.54	7.50	7.24	7.52	7.55	7.36	6.70	7.41	7.44	7.50	7.55	7.51
MW2	272.32	273.02	5.62	4.70	5.50	4.70	5.32	4.80	2.07	4.91	5.77	5.95	5.66	4.67	5.71	5.74	5.89	5.94	5.92
MW3	276.7	277.50	2.20	2.50	2.17	0.55	1.47	2.61	1.43	1.43	2.20	2.90	2.52	0.30	1.38	1.62	2.16	2.54	2.68
MW4	285.98	286.73	2.49	2.45	1.56	1.61	2.31	3.42	1.41	1.41	2.73	3.05	1.67	1.17	2.59	2.70	2.69	2.92	2.88
MW5	276.81	277.67	2.86	2.96	2.60	2.41	2.64	3.08	2.50	2.28	2.89	3.09	2.67	1.62	2.58	2.69	2.95	2.98	3.02
MW6	278.46	279.06	6.98	7.00	6.84	6.83	6.90	7.08	6.91	6.80	7.04	7.05	6.90	6.71	6.90	6.96	7.00	7.01	7.01
SG1	N/A	270.81	0.80	0.91	0.80	0.26	0.50	1.02	0.61	n/m	0.94	1.25	0.47	0.37	0.51	0.76	1.01	1.16	1.19
Dam at pond	N/A	270.56	n/m	n/m	0.61	0.03	-0.27	n/m	0.30	n/m	n/m	n/m	n/m	n/m	n/m	n/m	n/m	n/m	n/m

m amsl – Metres above sea level; N/A - Not applicable; n/m – Not measured; sub. – Water overtopping staff gauge, unable to measure;

Table 3. Water level elevations in monitoring well and pond at Bardoel Pit.

Monitoring station [1)]	Elevation, m amsl		Date and water level elevation, m amsl												
	Ground	Top of well casing	24-Nov-17	19-Dec-17	30-Dec-17	20-Jan-18	15-Feb-18	13-Mar-18	20-Apr-18	13-May-18	16-Jun-18	14-Jul-18	26-Jul-18	18-Aug-18	27-Sep-18
MW1	276.86	277.66	270.20	270.15	269.79	270.45	270.31	270.33	270.93	270.52	270.19	270.12	270.19	270.25	270.13
MW2	272.32	273.02	267.55	267.51	266.99	267.97	267.59	268.13	268.94	268.73	267.63	267.62	267.52	267.70	267.44
MW3	276.7	277.50	274.94	274.91	274.46	275.40	275.53	276.37	276.96	277.18	276.40	275.82	276.24	276.05	275.15
MW4	285.98	286.73	284.28	284.33	283.89	285.63	284.96	285.18	285.64	285.77	284.27	284.20	284.68	284.74	283.90
MW5	276.81	277.67	274.81	274.78	274.43	275.11	275.18	275.28	276.06	275.62	275.22	274.87	275.31	275.04	274.70
MW6	278.46	279.06	dry	269.55	270.36	271.59	271.87	272.19	273.37	272.27	272.16	272.19	272.14	272.17	272.07
SG1	N/A	270.81	269.73	269.74	269.75	269.98	270.71	269.62	270.66	270.62	269.89	270.24	270.25	270.11	269.92
Dam at pond	N/A	270.56	n/i	n/i	n/i	n/i	n/i	sub.	270.50	sub.	sub.	n/m	n/m	271.05	269.91

NOTE: Monitoring wells were constructed on November 21, 22 and 23, 2017 and developed on December 19, 2017.
m amsl – Metres above sea level; N/A - Not applicable; n/m – Not measured; n/i – Not installed; sub. – Water overtopping staff gauge, unable to measure.
[1)] Locations are shown on Figure 1.

Table 3. Cont'd.

Monitoring station [1)]	Elevation, m amsl		Date and water level elevation, m amsl												
	Ground	Top of well casing	30-Oct-18	29-Nov-18	20-Dec-18	14-Jan-19	16-Feb-19	23-Mar-19	15-Apr-19	15-May-19	27-Jun-19	10-Jul-19	26-Aug-19	17-Sep-19	23-Oct-19
MW1	276.86	277.66	270.12	270.24	270.29	270.34	270.37	270.28	270.33	270.46	270.25	270.21	270.15	270.13	270.11
MW2	272.32	273.02	268.49	268.14	268.96	268.08	268.44	268.52	268.34	268.57	267.98	267.80	267.50	267.40	268.32
MW3	276.7	277.50	275.10	275.79	275.93	276.19	276.66	276.52	276.62	277.05	276.38	276.22	275.52	275.30	275.00
MW4	285.98	286.73	284.08	285.29	285.05	284.97	284.96	285.23	285.34	285.22	284.55	285.37	284.33	284.24	284.28
MW5	276.81	277.67	274.79	275.31	275.10	275.17	275.35	275.43	275.42	275.60	275.21	275.12	274.90	274.81	274.71
MW6	278.46	279.06	272.08	272.25	272.28	272.27	272.29	272.26	272.29	272.33	272.18	272.14	272.12	272.08	272.06
SG1	n/a	270.81	269.86	270.14	270.22	270.38	270.62	n/m	270.81	270.65	270.47	270.39	270.10	270.01	269.90
Dam at pond	n/a	270.56	n/m	n/m	270.19	270.35	270.56	270.56	270.56	270.51	270.44	270.56	270.56	270.56	270.56

m amsl – Metres above sea level; N/A - Not applicable; n/m – Not measured.

Table 3. Cont'd.

Monitoring station [1)]	Elevation, m amsl		Date and water level elevation, m amsl													
	Ground	Top of well casing	20-Nov-19	21-Mar-20	18-Jun-20	15-Sep-20	13-Apr-21	19-Oct-21	14-Jul-22	11-Jan-23	06-Apr-23	17-Jun-23	07-Jul-23	22-Aug-23	22-Sep-23	20-Oct-23
MW1	276.86	277.66	270.16	270.36	270.19	270.12	270.16	270.42	270.14	270.30	270.96	270.25	270.22	270.16	270.11	270.15
MW2	272.32	273.02	267.52	268.32	267.70	268.22	270.95	268.11	267.25	267.36	268.35	267.31	267.28	267.13	267.08	267.10
MW3	276.70	277.50	275.33	276.95	276.03	274.89	276.07	276.07	275.30	274.98	277.20	276.12	275.88	275.34	274.96	274.82
MW4	285.98	286.73	285.17	285.12	284.42	283.31	285.32	285.32	284.00	285.06	285.56	284.14	284.03	284.04	283.81	283.85
MW5	276.81	277.67	275.07	275.26	275.03	274.59	275.17	275.39	274.78	275.00	276.05	275.09	274.98	274.72	274.69	274.65
MW6	278.46	279.06	272.22	272.23	272.16	271.98	272.15	272.26	272.02	272.01	272.16	272.35	272.16	272.10	272.06	272.05
SG1	n/a	270.81	270.01	270.55	270.31	269.79	270.20	n/m	269.87	270.34	270.44	270.30	270.05	269.80	269.65	269.62
Dam at pond	n/a	270.56	269.95	270.53	270.83	n/m	270.26	n/m	n/m	n/m	n/m	n/m	n/m	n/m	n/m	n/m

m amsl – Metres above sea level; N/A - Not applicable; n/m – Not measured.

Table 4. Geological and hydrogeological data at monitoring wells and test pits at Bardoel Pit used to construct figures in the hydrogeological report *).

Well and borehole designation	Elevation (m amsl)		High water level on April 6, 2023 [2)]			Depth to bottom of sand and gravel [1)] (m bgs)	Thickness of unsaturated sand and gravel [1)] (m bgs)	Elevation of underlying silt till (m amsl)	Thickness of saturated sand and gravel (m)
	Ground	Top of casing	(m BTC)	(m bgs)	(m amsl)				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MW1	276.86	277.66	6.70	5.90	270.96	8.2	5.90	268.66	2.30
MW2	272.32	273.02	4.67	3.97	268.35	7.6	3.97	264.72	3.63
MW3	276.70	277.50	0.30	-0.50	277.20	4.9	0	271.80	4.90
MW4	285.98	286.73	1.17	0.42	285.56	n/p	n/p	285.63	n/p
MW5	276.81	277.67	1.62	0.76	276.05	n/p	n/p	276.36	n/p
MW6	278.46	279.06	6.71	6.11	272.35	5.2	5.2	273.26	0.00
BH7 [2)]	275.40	N/A	N/A	5.5	269.90	6.9	5.5	268.50	1.40
BH8 [2)]	286.73	N/A	N/A	9.4	277.33	> 12.60	~ 9.4	< 274.13	> 3.2
BH9 [2)]	286.24	N/A	N/A	dry	dry	8.5	8.5	277.74	0.00
SG1	N/A	270.81	0.37	N/A	270.44	N/A	N/A	N/A	N/A
TP1 to TP14 logs not included	-	-	-	-	-	-	-	-	-

*) Figures 7, 8 and 9; BTC – Below top of casing; m bgs – Metres below ground surface; m amsl – Metres above mean sea level.
[1)] Includes topsoil up to 0.60 m in thickness; [2)] For boreholes, water level is based on depth of water found during borehole advancement.
n/p – Not present; N/A - Not applicable; MW – Monitoring well; SG – Staff gauge; TP – Test pit designation.

Table 5. Results of groundwater quality analyses in MW1, MW2, and MW6 at Bardoel Pit.

Parameter	Units	RDL	Sample results and date of sampling (mm/dd/yyyy)				Regulation
			Monitoring Well MW1	Monitoring Well MW2	Monitoring Well MW6	Monitoring Well MW6	
			12/20/2017	12/20/2017	12/20/2017	04/26/2018	ODWS *)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inorganic Chemistry							
Electrical Conductivity	uS/cm	2	502	391	571	N/A	
pH	pH Units	-	7.85	7.92	7.97	N/A	
Alkalinity (as $CaCO_3$)	mg/L	5	223	193	203	N/A	500 mg/L
Chloride	mg/L	0.10	11.8	8.33	33.8	N/A	250 mg/L
Nitrate as N	mg/L	0.05	0.29	0.23	ND	N/A	10 mg/L
Nitrite as N	mg/L	0.05	ND	ND	ND	N/A	1 mg/L
Sulphate	mg/L	0.10	62.1	30.6	74.3	N/A	500 mg/L
Calcium	mg/L	0.05	53.8	43.8	54.7	N/A	
Magnesium	mg/L	0.05	29.1	20.4	29.7	N/A	
Sodium	mg/l	0.05	12.9	15.3	23.8	N/A	200 mg/L
Potassium	mg/L	0.95	1.67	2.71	11.4	N/A	
Full metal scan							
Aluminum	mg/L	0.004	0.372	0.162	0.110	N/A	100 ug/L
Antimony	mg/L	0.001	ND	ND	ND	N/A	6 ug/L
Arsenic	mg/L	0.001	0.010	0.004	ND	N/A	25 ug/L
Barium	mg/L	0.002	0.081	0.038	0.086	N/A	1000 ug/L
Beryllium	mg/L	0.001	ND	ND	ND	N/A	
Bismuth	mg/L	0.002	ND	ND	ND	N/A	
Boron	mg/L	0.01	0.04	0.05	0.14	N/A	5000 ug/L
Cadmium	mg/L	0.001	ND	ND	ND	N/A	5 ug/L
Chromium	mg/L	0.002	ND	ND	0.005	N/A	50 ug/L
Cobalt	mg/L	0.001	0.001	ND	ND	N/A	
Copper	mg/L	0.002	0.134	0.217	0.129	N/A	1000 ug/L
Iron	mg/L	0.01	0.94	0.33	0.42	N/A	300 ug/L
Lead	mg/L	0.001	0.008	0.010	0.007	N/A	10 ug/L
Lithium	mg/L	0.010	ND	ND	0.014	N/A	
Manganese	mg/L	0.002	0.119	0.075	0.101	N/A	50 ug/L
Molybdenum	mg/L	0.001	0.001	0.002	0.020	N/A	
Nickel	mg/L	0.002	ND	ND	ND	N/A	
Phosphorus	mg/L	0.05	ND	ND	ND	N/A	
Selenium	mg/L	0.004	ND	ND	ND	N/A	10 ug/L
Silicon	mg/L	0.05	8.06	6.55	4.63	N/A	
Silver	mg/L	0.001	ND	ND	ND	N/A	
Strontium	mg/L	0.005	0.781	0.503	0.943	N/A	
Thallium	mg/L	0.001	ND	ND	ND	N/A	
Tin	mg/L	0.002	0.003	0.004	0.010	N/A	
Titanium	mg/L	0.001	0.017	0.007	0.004	N/A	
Uranium	mg/L	0.001	ND	ND	0.003	N/A	20 ug/L
Vanadium	mg/L	0.001	ND	ND	ND	N/A	

Parameter	Units	RDL	Sample results and date of sampling (mm/dd/yyyy)				Regulation
			Monitoring Well MW1	Monitoring Well MW2	Monitoring Well MW6	Monitoring Well MW6	
			12/20/2017	12/20/2017	12/20/2017	04/26/2018	ODWS *)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Zinc	mg/L	0.005	0.024	0.023	0.024	N/A	5000 ug/L
Zirconium	mg/L	0.004	ND	ND	ND	N/A	
PHCs F1-F4							
Benzene	ug/L	0.20	ND	ND	0.38	ND	5 ug/L
Toluene		0.20	ND	ND	0.26	ND	
Ethylbenzene	ug/L	0.10	ND	ND	ND	ND	2.4 ug/L
Xylene Mixture	ug/L	0.20	ND	ND	ND	ND	24 ug/L
F1 (C6 to C10)	ug/L	25	ND	ND	ND	N/A	
F1 (C6 to C10) minus BTEX	ug/L	25	ND	ND	ND	N/A	
F2 (C10-C16)	ug/L	100	ND	ND	N/A	N/A	
F3 (C16-C34)	ug/L	100	ND	ND	N/A	N/A	
F4 (C34-C50)	ug/L	100	ND	ND	N/A	N/A	
Gravimetric heavy hydrocarbons	ug/L	500	NA	NA	N/A	N/A	

NOTE: Samples were analyzed by AGAT Laboratories. Certificate of analysis is provided in Appendix F.
RDL – Reported detection limit; N/A – Not analyzed; N/D – Not detected (concentration below RDL).
*) Ontario Drinking water standards (ODWS).

Table 6. Results of water quality analyses in the pond at SG1, at Bardoel Pit.

Parameter	Units	RDL	Sample results and date of sampling (mm/dd/yyyy)	Regulation
			Pond at SG1 12/20/2017	PWQO *)
(1)	(2)	(3)	(4)	(5)
Inorganic Chemistry				
Electrical Conductivity	uS/cm	2	410	
pH	pH Units	-	7.97	6.5 - 8.5
Alkalinity (as $CaCO_3$)	mg/L	5	189	
Chloride	mg/L	0.10	19.2	
Nitrate as N	mg/L	0.05	1.38	
Nitrite as N	mg/L	0.05	ND	
Sulphate	mg/L	0.10	15.3	
Calcium	mg/L	0.05	49.7	
Magnesium	mg/L	0.05	18.5	
Sodium	mg/l	0.05	10.6	
Potassium	mg/L	0.95	3.36	
Full Metal Scan				
Aluminum	mg/L	0.004	0.027	
Antimony	mg/L	0.001	ND	20 ug/L
Arsenic	mg/L	0.001	0.001	5 ug/L
Barium	mg/L	0.002	0.031	
Beryllium	mg/L	0.001	ND	1100 ug/L
Bismuth	mg/L	0.002	ND	
Boron	mg/L	0.01	0.02	200 ug/L
Cadmium	mg/L	0.001	ND	0.5 ug/L
Chromium	mg/L	0.002	ND	100 ug/L
Cobalt	mg/L	0.001	0.001	0.6 ug/L
Copper	mg/L	0.002	0.137	5 ug/L
Iron	mg/L	0.01	0.03	300 ug/L
Lead	mg/L	0.001	0.017	5 ug/L
Lithium	mg/L	0.010	ND	
Manganese	mg/L	0.002	0.005	
Molybdenum	mg/L	0.001	ND	10 ug/L
Nickel	mg/L	0.002	ND	25 ug/L
Phosphorus	mg/L	0.05	ND	20 ug/L
Selenium	mg/L	0.004	ND	100 ug/L
Silicon	mg/L	0.05	0.66	
Silver	mg/L	0.001	ND	0.1 ug/L
Strontium	mg/L	0.005	0.114	
Thallium	mg/L	0.001	ND	0.3 ug/L
Tin	mg/L	0.002	ND	
Titanium	mg/L	0.001	0.002	
Uranium	mg/L	0.001	0.001	5 ug/L
Vanadium	mg/L	0.001	ND	7 ug/L

Parameter	Units	RDL	Sample results and date of sampling (mm/dd/yyyy)	Regulation
			Pond at SG1 12/20/2017	PWQO *)
(1)	(2)	(3)	(4)	(5)
Zinc	mg/L	0.005	0.009	30 ug/L
Zirconium		0.004	ND	4 ug/L
PHCs F1-F4				
Benzene	ug/L	0.20	ND	100 ug/L
Toluene		0.20	ND	0.08 ug/L
Ethylbenzene	ug/L	0.10	ND	8 ug/L
m & p Xylene	ug/L	0.20	ND	32 ug/L
o-Xylene	ug/L	0.10	ND	40 ug/L
Xylene Mixture (Total)	ug/L	20	ND	

NOTE: Samples were analyzed by AGAT Laboratories;
RDL – Reported detection limit; N/D – Not detected (concentration below RDL).
*) Provincial Water Quality Objective (PWQO)

APPENDIX A

Borehole and Instrumentation Logs

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
MW01-17

Encl. No. 1 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Nov 21, 2017

SUBSURFACE PROFILE													
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
276.86	0	450mm sandy topsoil									0.8m stickup; Concrete
276	1										
275	2	Sand and gravel, trace of silt			1	ss	22				
274	3				2	ss	32				Bentonite seal
273	4										
272	5				3	ss	100+				
271	6										
270	7			▼	4	ss	29				
269	8				5	ss	54				
268	9	Grey clayey silt to silt till									50mm diameter screen with sand pack
267	10				6	ss	39				
266	11				7	ss	82				
		End of Borehole									

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
MW02-17

Encl. No. 2 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Nov 21, 2017

SUBSURFACE PROFILE												
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
272.32	0	300mm sandy topsoil									0.7m stickup; Concrete
272	1										
271	2	Sand and gravel, trace of silt			1	ss	36				
270	3				2	ss	34				Bentonite seal
269	4			▼							
268	5				3	ss	37				
267	6	Fine to coarse sand, trace of silt			4	ss	8				
266	7										50mm diameter screen with sand pack
265	8	Grey clayey silt to silt till			5	ss	100+				
264	9										
263		End of Borehole			6	ss	100+				

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
MW03-17

Encl. No. 3 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Nov 21, 2017

SUBSURFACE PROFILE												
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
276.70	0	450mm sitly topsoil									0.8m stickup; Concrete
276	1										
275	2			▼	1	ss	15				
274	3				2	ss	23				Bentonite seal
273	4										
272	5				3	ss	25				
271	6	Grey clayey silt to silt till, sand seam			4	ss	33				
270	7										50mm diameter screen with sand pack
269	8				5	ss	37				
		End of Borehole									

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
MW04-17

Encl. No. 4 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Nov 23, 2017

SUBSURFACE PROFILE												
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
285.98	0	350mm topsoil									0.75m stickup Concrete
285	1	Brown clayey silt till		▼	1	ss	15				
284	2										
283	3				2	ss	33				Bentonite seal
282	4										
281	5				3	ss	100+				
280	6				4	ss	100+				
279	7	Grey clayey silt till, silt seams									50mm diameter screen with sand pack
278	8				5	ss	24				
277	9				6	ss	57				
		End of Borehole									

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
MW05-17

Encl. No. 5 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Nov 22, 2017

SUBSURFACE PROFILE												
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
276.81	0	450mm sandy topsoil									0.86m stickup; Concrete
276	1	Brown clayey silt till									
275	2			▼	1	ss	5				
274	3				2	ss	20				50mm diameter screen with sand pack
273	4	Grey clayey silt till									
272	5				3	ss	100+				
271	6				4	ss	100+				
		End of Borehole									

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
MW06-17

Encl. No. 6 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Nov 21, 2017

SUBSURFACE PROFILE												
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
277.86	0	450mm sandy topsoil									0.6m stickup; Concrete
277	1	Sand and gravel, trace of silt			1	ss	57				
276	2										
275	3				2	ss	25				
274	4										Bentonite seal
273	5				3	ss	50				
272	6				4	ss	37				
271	7	Grey clayey silt to silt till									
270	8				5	ss	100+				
269	9				6	ss	100+				50mm diameter screen with sand pack
268	10	End of Borehole									

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
BH07-17

Encl. No. 7 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Nov 22, 2017

SUBSURFACE PROFILE												
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %
275.40	0	300mm sandy topsoil								
275	1	Sand, some gravel and silt								
274	2				1	ss	18			
273	3	Sand and gravel, trace of silt			2	ss	19			
272	4									
271	5			▽	3	ss	13			
270	6									
269	7				4	ss	20			
268	8	Grey clayey silt to silt till			5	ss	100+			
267	9									
266		End of Borehole			6	ss	100+			

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
BH08-18

Encl. No. 8 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Mar 12, 2018

SUBSURFACE PROFILE											
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %
286.73	0	600mm Topsoil								
286	1									
285	2				1	ss	19			
284	3	Silty sand, trace of gravel			2	ss	16			
283	4									
282	5				3	ss	30			
281	6									
280	7				4	ss	38			
279	8				5	ss	35			
278	9			▽	6	ss	100+			
277	10									
276	11				7	ss	30			
275	12				8	ss	50			
		End of Borehole								

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: B-0018478-1
CLIENT: Aaroc Aggregates Ltd.
PROJECT: Aggregate Assessment
LOCATION: 583398 Hamilton Road, Oxford County
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
BH09-18

Encl. No. 9 (Sheet 1 of 1)
DRILLING DATA: D50T
METHOD: Hollow stem
DIAMETER: 200mm
DATE: Mar 12, 2018

SUBSURFACE PROFILE												
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %
286.24	0	450mm sandy topsoil								
					1	ss	12			
		Silty sand, some gravel			2	ss	21			
					3	ss	35			
					4	ss	35			
					5	ss	32			
		Grey sandy clayey silt till			6	ss	64			
					7	ss	100+			
					8	ss	99			
		End of Borehole								

LOG OF BOREHOLE B-0018478-1.GPJ ATK_DAV.GDT 5/17/18

APPENDIX B

Printout from MECP Water Well Records Within 1 km

Water Well Records

January 16, 2024
5:25:13 PM

WELL	TOWNSHIP CON L	DATE CN	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	FORMATION
7442406 (Z400404) A356367 P	INGERSOLL TOWN	2022-12 7643						
4707704 (177843)	NORTH OXFORD TOWNSHI CON 05 004	1997-10 3563	6 6	FR 0051	21/40/20/2:0	ST		BRWN SAND 0015 GRVL SAND SILT 0043 BRWN LMSN 0051
7336904 (Z307679) A260634	NORTH OXFORD TOWNSHI CON 05 004	2019-05 7343	6.25	UT 0052	12/32/20/2:	DO		BLCK LOAM 0001 BRWN SAND 0008 GREY GRVL SAND LYRD 0040 GREY HPAN 0044 GREY LMSN HARD 0055
7301407 (Z273548) A237535	WEST OXFORD TOWNSHIP	2017-11 7190	2	UT 0017	17///:	MO	0020 5	BRWN LOAM SILT SOFT 0002 BRWN SAND GRVL LOOS 0017 BRWN SAND LOOS 0025
7301406 (Z273547) A237534	WEST OXFORD TOWNSHIP	2017-11 7190	2	UT 0025	25///:	MO	0025 5	BRWN SAND SILT LOOS 0002 BRWN SAND GRVL LOOS 0025 BRWN SAND SILT HARD 0030
7301408 (Z273549) A229769	WEST OXFORD TOWNSHIP	2017-11 7190	2	UT 0010	10///:	MO	0020 5	BRWN LOAM SILT SOFT 0002 BRWN SILT SAND HARD 0016 GREY SILT CLAY 0025
7301409 (Z273544) A237536	WEST OXFORD TOWNSHIP	2017-11 7190	2			MO	0028 5	BRWN LOAM SILT 0002 BRWN SAND GRVL DNSE 0020 GREY SILT CLAY HARD 0033
7301410 (Z273545) A237537	WEST OXFORD TOWNSHIP	2017-11 7190	2 3	UT 0005	5///:	MO	0005 5	BRWN LOAM SILT SOFT 0001 BRWN SAND SILT SOFT 0005 BRWN CLAY SILT SOFT 0010
7301411 (Z273546) A237524	WEST OXFORD TOWNSHIP	2017-11 7190	2	UT 0020	20///:	MO	0020 10	BRWN LOAM SAND LOOS 0002 BRWN CLAY SILT SOFT 0010 GREY SILT GRVL SOFT 0030
7413857 (Z372514) A328514 P	WEST OXFORD TOWNSHIP	2022-03 6824						
7419956 (C57033) A339726 P	WEST OXFORD TOWNSHIP	2022-01 7282						
7258041 (Z210655) A184196	WEST OXFORD TOWNSHIP	2016-02 6370	2	UT 0013		MT	0015 10	BRWN SAND GRVL MSND 0025
7052266 (Z69446) A062660	WEST OXFORD TOWNSHIP 027	2007-10 3563	6.25	FR 0110	64/85/30/1:30	ST		BRWN GRVL 0022 GREY HPAN GRVL STNS 0082 GREY LMSN HARD 0110
4702712 ()	WEST OXFORD TOWNSHIP BF 024	1968-06 3511	4 4	FR 0086	30/35/6/2:0	ST DO		MSND 0006 BRWN CLAY STNS 0035 BLUE CLAY STNS 0079 LMSN 0086

WELL	TOWNSHIP CON L	DATE CN	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	FORMATION
4704728 ()	WEST OXFORD TOWNSHIP BF 026	1978-01 3563	5 5	FR 0087 FR 0140	28/80/5/3:0	DO		BRWN CLAY SNDY 0015 CGVL 0020 GREY CLAY SAND LYRD 0080 LMSN 0140
7149179 (Z109814) A099777	WEST OXFORD TOWNSHIP BF 027	2010-06 3563	6.5	UT 0091	72/83/10/1:30	DO		BRWN GRVL 0042 GREY HPAN 0065 BRWN LMSN 0091
4702272 ()	WEST OXFORD TOWNSHIP BF 027	1960-10 3511	4	FR 0024	12/14/5/2:0	DO		GRVL 0014 BLUE CLAY 0022 GRVL 0024
4702794 ()	WEST OXFORD TOWNSHIP BF 027	1969-04 3511	5 5	FR 0093	45/60/6/5:0	DO		GRVL STNS 0028 BLUE CLAY 0050 HPAN STNS 0069 LMSN 0093
4708961 (Z09360) A009282	WEST OXFORD TOWNSHIP BF 027	2004-10 3563	6.13	FR 0093	44/60/10/2:	DO		BRWN GRVL STNS 0035 GREY CLAY 0045 GREY CLAY GRVL 0070 BRWN LMSN 0093
4709198 (Z44230) A036845 A	WEST OXFORD TOWNSHIP BF 027	2006-03 6607		0011				
4709174 (Z42245) A036845	WEST OXFORD TOWNSHIP BF 027	2006-01 6607	0.75	0011			0021 5	BRWN SILT SAND GRVL 0011 BRWN SAND GRVL 0013 BRWN SILT SAND GRVL 0021 BRWN SAND 0024 BRWN SILT SAND 0026
4702315 ()	WEST OXFORD TOWNSHIP CON 01 026	1967-06 3511	5 5	FR 0114	25/35/15/4:0	ST DO		BRWN CLAY 0007 GRVL 0016 MSND GRVL 0050 HPAN 0070 GRVL STNS 0100 HPAN 0111 LMSN 0114
4704163 ()	WEST OXFORD TOWNSHIP CON 01 027	1975-06 3563	6 4	FR 0103	18/27/7/3:0	ST DO		BRWN CLAY 0004 CGVL 0012 FSND 0030 GREY CLAY BLDR 0097 BRWN ROCK SHLY 0103
4706060 (04005)	WEST OXFORD TOWNSHIP CON 01 028	1987-07 3563	5 5	FR 0110	35/55/12/1:30	DO		BRWN SAND 0005 BRWN SAND GRVL 0017 BLUE CLAY STKY 0060 GREY HPAN STNS 0095 BRWN SHLE 0103 BRWN LMSN 0110

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83;
L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completed and Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of depth in feet. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

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

2. Core Colour

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

3. Well Use

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

4. Water Detail

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

APPENDIX C

Results of In situ Hydraulic Conductivity Tests

APPENDIX C

CALCULATION OF HYDRAULIC CONDUCTIVITIES

In situ falling head slug tests were performed on September 22, 2023 at four monitoring wells (MW1, MW3, MW5, and MW6). The purpose of the slug tests was to estimate hydraulic conductivity of the overburden deposits at the site. Specifically, there are two overburden units which were assessed: the near-surface sand and gravel deposits which represent the water table aquifer at the site, and the underlying clayey silt till.

Physical characteristics of the tested wells and relevant aquifer properties obtained from borehole data are summarized in Table C1, below.

Table C1. Physical characteristics of monitoring wells and the aquifer.

Borehole ID	Ground surface elevation	Depth, m BGS					22-Sep-2023	
		Top of screen	Bottom of screen	Aquifer top	Aquifer bottom	Bottom of borehole	Water level BGS	Water Column height (m)
MW1	276.86	7.6	10.6	0.0	8.2	11.1	6.75	3.85
MW3	276.70	6.0	7.5	0.0	4.9	8.1	1.74	5.76
MW5	276.81	2.3	3.8	N/A	N/A	6.5	2.12	1.68
MW6	277.86	8.5	10.0	0.0	5.2	10.1	6.41	3.59

BTC – Below top of casing; BGS – Below ground surface. All wells 5-cm diameter casing and screen.

All four wells have the same diameter (50-mm) well casing and screen. Well screen length at MW1 is 3 m, while the remaining three wells have 1.5 m long screens. Monitoring well MW1 is the only tested well which is screened within the sand and gravel deposits. Monitoring wells MW3, MW5, and MW6 are screened in the clayey silt till. Therefore, only the slug test results from MW1 are capable of being used for hydraulic conductivity of the water table aquifer. Attempts were made to perform slug tests in MW2, but a restriction within the well casing made it impossible to lower the slug to the water level. Monitoring well MW4 was not tested.

For each slug test, a data logging pressure transducer was installed near the bottom of each well prior to the test and was set to record water level at one-second intervals. Water in the wells was displaced by rapidly lowering a solid slug in the well to induce falling head conditions. After water levels were allowed to re-equilibrate, the slug was removed in order to lower water levels and create rising head conditions. This was done multiple times in each well.

The collected data are presented on Figure C1, on the following page. Data collected from the slug tests were evaluated using the Hvorslev (1951) method.

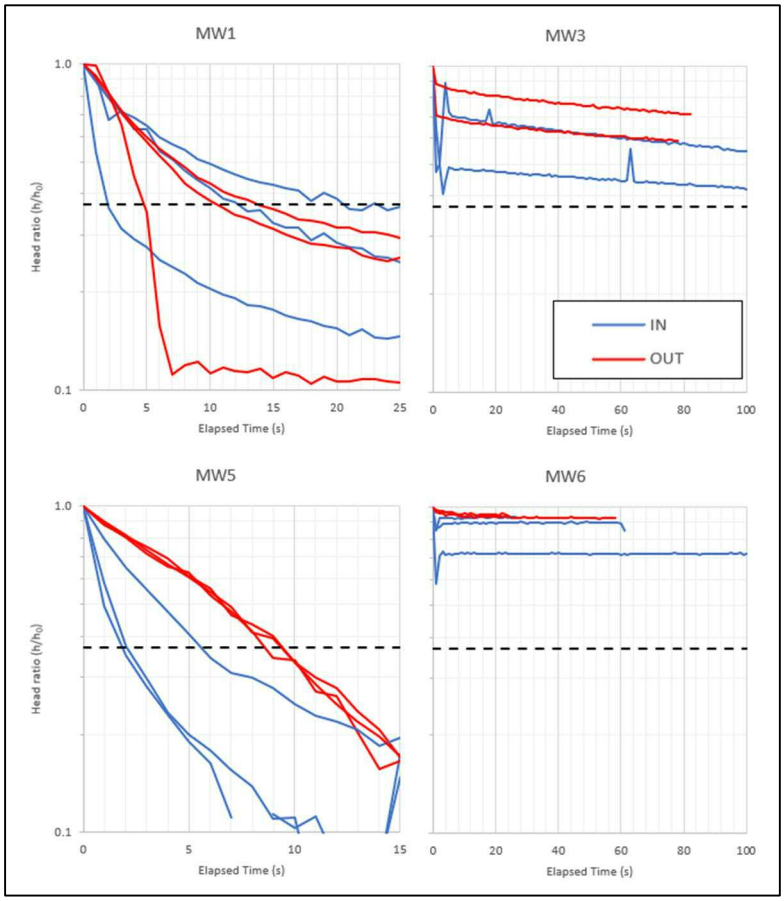


Figure C1. Slug test data collected at monitoring wells at Bardoel Pit.

As it can be seen from Figure C1, MW1 and MW5 showed generally similar response, while MW3 and MW6 showed extremely slow responses. The results MW6 were discarded because the water level response to slug insertion and removal was non-existent. The resulting hydraulic conductivities for the other three wells are summarized in Table C2.

Table C2. Hydraulic conductivity obtained from Slug Test Data.

Trial No.	Hydraulic Conductivity (cm/s)		
	MW1	MW3	MW5
1	8.76×10^{-3}	1.91×10^{-4}	2.91×10^{-2}
2	9.17×10^{-3}	1.85×10^{-4}	6.13×10^{-3}
3	4.70×10^{-3}	3.43×10^{-4}	2.91×10^{-2}
4	6.88×10^{-3}	1.44×10^{-4}	6.85×10^{-3}
5	4.82×10^{-3}	-	1.06×10^{-2}
6	1.93×10^{-2}	-	6.13×10^{-3}
Geo. Mean	**1.16×10^{-2}**	**2.04×10^{-4}**	**1.15×10^{-2}**

It is noted that the hydraulic response in MW5 is much faster than anticipated for clayey silt till. A review of the borehole log for MW5 reveals that the bottom 2.5 meters of the borehole was backfilled, presumably with drill cuttings, and may have some influence on the water level response. Or, it may be that the brown clayey silt till may be more loosely deposited in this area and possibly contain sand seams within. Due to these uncertainties, the results from MW5 were discarded.

At MW3, the well screen is entirely within the clayey silt till and the annular seal is also below the top of the till surface, so the results therefore represent the hydraulic conductivity of the clayey silt till, which is 2.04×10^{-4} cm/s. At MW1, the response appears typical of sand and gravel deposits, which shows a hydraulic conductivity of 1.16×10^{-2} cm/s.

APPENDIX D

Excerpt from Oxford County Official Plan Amendment No. 282 Relating to Source Protection

Report No: CP 2022-329

COMMUNITY PLANNING

Council Date: September 14, 2022

Report No. CP 2022-329 - Attachment No. 1

AMENDMENT NUMBER 282

TO THE COUNTY OF OXFORD OFFICIAL PLAN

the following plan and schedules attached hereto constitutes

Amendment Number 282 to the County of Oxford Official Plan.

1.0 PURPOSE OF THE AMENDMENT

The purpose of the Amendment is to update to policies of Section 3.2.7.2.3, Water Quality, to reflect the requirements of the Clean Water Act, 2006, as per the approved Source Protection Plans which apply within the County of Oxford.

2.0 LOCATION OF LANDS AFFECTED

This Amendment applies to all lands within the County of Oxford, subject to the applicability of the specific source protection policies.

3.0 BASIS FOR THE AMENDMENT

This amendment revises the existing policies within the Official Plan to reflect the requirements which are currently in place under the Clean Water Act, 2006. More specifically the amendment will incorporate the policies as contained within the four Source Protection Plans which apply in the County of Oxford.

This includes updating the schedules within the Official Plan to show those areas where Source Protection Plan policies may apply based on the approved technical information pertaining to Well Head Protection Areas (WHPAs) and/or Issue Contributing Areas (ICAs) contained in the applicable Assessment Report and/or Source Protection Plan.

4.0 DETAILS OF THE AMENDMENT

4.1 That the text within Section 3.2.7.2.3, Water Quality, but not including the subsequent subsections, is amended by deleting the existing text and replacing it with the following:

> 3.2.7.2.3 Water Quality
>
> Protection, conservation and enhancement of water resources, including water quality and water quantity, are integral to sustaining the environmental, social and economic well-being of the Area Municipalities, and the County as a whole. Water resource protection and conservation helps ensure long term sustainability of both *surface water features* and *ground water features*. The specific measures identified in this Plan to protect existing and future municipal sources of drinking water are intended to reflect and support the implementation measures contained in the applicable Source Protection Plans (SPPs) and increase awareness of the SPP policies and their potential land use implications.

4.2 That the following policies are relocated from the end of Section 3.2.7.2.3.1 - Municipal Well Head Protection Area Policies, and added to the end of Section 3.2.7.2.3.2, General Water Quality Protection Policies.

PERFORMANCE REQUIREMENTS

In addition to any of the foregoing requirements and any land use policies and *development* criteria contained in this Plan, the following performance requirements shall also apply to proposals on lands subject to development within WHPAs:

ABANDONED WELLS

- Prior to *development*, proponents will be required to carry out an investigation for unused water and oil and gas wells on the subject lands and provide for the proper abandonment of same, in accordance with the policies of Section 3.3.3.4 of this Plan and/or relevant Provincial legislation and regulations.

REMOVAL OF UNDERGROUND STORAGE TANKS OR SEPTIC SYSTEMS

- Prior to *development*, proponents will be required to carry out an investigation on the subject lands for underground storage tanks or unused septic systems and provide for the removal and/or proper decommissioning of same.

BEST MANAGEMENT PRACTICES

- The County and/or Area Municipalities will use whatever legal authorities are available to ensure the implementation, maintenance and monitoring of structural *best management practices* that are identified during the development review process for new and expanding non-residential uses within WHPAs.

4.3 That the remainder of Section 3.2.7.2.3.1 -Municipal Well Head Protection Area Policies, is amended by deleting the existing subsection title and text and replacing it with the following:

3.2.7.2.3.1 Source Water Protection

SOURCE PROTECTION PLANS

It is crucial that the County's municipal drinking water supplies are protected in order to secure a long term, potable water supply to meet the needs of existing and future residents and businesses.

Given the costs and challenges associated with trying to address groundwater contamination and/or depletion once it has occurred, the focus of these policies is on prevention. One of the key means of prevention is to permit only those uses that do not represent a significant threat to municipal drinking water sources within *designated vulnerable areas*.

The Clean Water Act, 2006 is intended to ensure the protection of municipal drinking water supplies through watershed-based Source

Protection Plans (SPPs). Science-based Assessment Reports provide the detailed technical information that informs each of the SPPs and form part of the approved plans.

The Assessment Reports identify the *designated vulnerable areas* and associated *drinking water threats* and issues for the Source Protection Area to which they apply. The SPPs contain policies intended to eliminate or reduce the potential risks posed by those identified threats and issues.

There are four SPPs that apply within Oxford County:

- Grand River Source Protection Plan
- Catfish Creek Source Protection Plan
- Long Point Region Source Protection Plan
- Thames-Sydenham and Region Source Protection Plan

These four Source Protection Areas that correspond with these SPPs are shown on Schedule C-5.

DEFINED TERMS

In addition to the Definitions included in Section 1.6 of this plan, for the purposes of this subsection the meaning of the following italicized terms shall be as defined in the Clean Water Act, 2006:

- drinking water threat
- issue contributing area (ICA)
- prescribed instrument
- risk management official
- significant drinking water threat
- well head protection area (WHPA)

DRINKING WATER THREATS

Drinking water threats are prescribed by Ontario Regulation 287/07 of the Clean Water Act, 2006. The list below is intended to reflect those threats which have been prescribed and may be updated to reflect the applicable regulations, as amended, without amendment to this Plan.

Prescribed *drinking water threats* include:

- Waste disposal sites within the meaning of Part V of the Environmental Protection Act.
- The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.
- The application (to land) and/or handling and storage of:
  - agricultural source material,
  - non-agricultural source material,

  - application of commercial fertilizer, or
  - pesticide.
- The management of agricultural source material.
- The application of road salt.
- The handling and storage of:
  - road salt,
  - fuel,
  - a dense non-aqueous phase liquid (DNAPL), or
  - organic solvent.
- The storage of snow.
- The management of runoff that contains chemicals used in the de-icing of aircraft.
- An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.
- An activity that reduces the recharge of an aquifer.
- The use of land as livestock grazing or pasturing land, an outdoor confinement area or farm-animal yard.

These prescribed *drinking water threats* can only be *significant drinking water threats* in the specific circumstances set out in the approved SPPs and, if so, may be prohibited, restricted, or otherwise regulated in accordance with the applicable SPP policies.

NITRATES

In Oxford County, nitrate issues have been identified in ICAs associated with County drinking water systems. As such, any land use activity that may pose a *drinking water threat* due to the presence of nitrates, as prescribed by Ontario Regulation 287/07 of the Clean Water Act, 2006, is considered to be a *significant drinking water threat* in these ICAs.

MAPPING

The mapping of the WHPAs and ICAs from the approved Assessment Reports for each of the respective SPPs has been incorporated into Schedule C-5 of this Plan for information and screening purposes. As potential development restrictions resulting from the application of the SPP policies is currently limited exclusively to *significant drinking water threats*, only the areas of WHPAs and ICAs where *significant drinking water threats* can occur are currently identified on Schedule C-5 as 'WHPA/ICA Significant Threat Screening Areas'.

The addition of new WHPAs or ICAs, changes to the extent of a WHPA or ICA, or removal of a WHPA or ICA, will be reflected on Schedule C-5 without requiring an amendment to this Plan. Mapping updates will only be completed based on mapping available from an approved Assessment Report and/or SPP.

In the event of a conflict between the mapping shown on Schedule C-5 and the mapping in an approved Assessment Report and/or SPP, the mapping in the applicable approved Assessment Report shall take precedence.

DEVELOPMENT REVIEW PROCESS

The following development review policies are intended to ensure awareness of the applicable SPP policies and potential land use implications and support the integration of related SPP requirements into development review processes, as applicable.

In addition to any other applicable policies of this plan, the following SPP related policies apply to lands within the County of Oxford that are located within the 'WHPA/ICA Significant Threat Screening Areas' identified on Schedule C-5 of this Plan.

In the event of a conflict between these policies and those contained in an approved SPP, the policies in the SPP shall take precedence.

SIGNIFICANT DRINKING WATER THREATS

The specific policies and circumstances that apply to each *significant drinking water threat*, including any prohibitions through prescribed instruments or under Section 57 of the Clean Water Act, 2006, are set out in the applicable SPPs. The SPP policies generally require the management of existing *significant drinking water threats* and prohibit the establishment of new *significant drinking water threats*, with the goal of ensuring they cease to be, or never become,
significant drinking water threats.

RESTRICTED LAND USE POLICY

In accordance with Section 59(2) of the Clean Water Act, 2006, and where applicable in accordance with the applicable SPP policies, a Planning Act and/or building permit application for any use, except an exclusively residential use, within a portion of a WHPA or ICA where a *significant drinking water threat* could occur, shall not be deemed complete unless it includes the applicable notice issued by the *Risk Management Official*.

Through the notice process, the County *Risk Management Official* will determine whether a new use or activity is, or involves, a *significant drinking water threat* in accordance with the Clean Water Act, 2006 and, if so, whether that use or activity is prohibited, restricted or otherwise regulated by the policies of the applicable SPP.

SUPPRORTING STUDIES AND/OR INFORMATION

In order to inform the issuance of the Section 59(2) notice and/or consideration of a development proposal, the *Risk Management Official* may require various information and/or technical studies prepared by a qualified professional, to assess for *drinking water threats*, determine where they may constitute *significant drinking water threats* and mitigate the potential impacts as part of a proposed development. Such information and/or studies may be required in advance of, or as part of, a complete application under the Planning Act.

Studies that may be requested include, but are not limited, to a Disclosure Report, Environmental Site Assessment (ESA), Hydrogeological Study, and a Spill Prevention and Contingency Plan. For the purposes of this policy, a Disclosure Report may include, but is not limited to, a threats inventory, a vulnerability analysis, risk analysis and, where applicable, an analysis of risk management measures which may be applied to mitigate the risks to drinking water sources.

PLANNING DECISIONS

All planning decisions shall conform to the *significant drinking water threat* policies and have regard for other applicable policies (including low or moderate *drinking water threat* policies), as set out in the SPPs, as may be amended from time to time, in accordance with Section 39 of the Clean Water Act, 2006.

NEW SEPTIC SYSTMS AND HOLIDING TANKS

Uses, buildings and/or structures that would require a new septic system and/or septic system holding tank shall be prohibited in an area of a WHPA where these activities would be a *significant drinking water threat.* This prohibition shall not apply to new septic systems and/or septic system holding tanks that are required for a municipal water supply well or where located within an ICA, but outside of the area of the WHPA where it represents a *significant drinking water threat*. For the purposes of this policy 'new' shall have the same meaning as defined in the applicable SPPs.

The Area Municipalities shall amend their respective Zoning By-Laws to include any provisions required to conform with the policies of the approved SPPs including, but not limited to, provisions to prohibit uses, buildings and/or structures that would require a new septic system and/or septic system holding tank in the circumstances described above.

ENVIRONMENTAL SITE ASSESSMENTS OR REMEDIATION PROJECTS

For all environmental site assessments or remediation projects on lands within a WHPA, the County requires the application of a Potable Groundwater Condition as outlined in Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, as amended.

IMPLEMENTATION SUPPORTS

Other tools and measures that may assist in the implementation of the SPPs and protection of municipal drinking water supplies include, but are not necessarily limited to, the following:

EDUCATION AND OUTREACH

- The County will work collaboratively with Conservation Authorities, and other bodies wherever possible, to develop and implement education and outreach programs directed at any, or all, *significant drinking water threats*, where such programs are deemed necessary and/or appropriate by the County and subject to available funding.

OTHER POTENTIAL ACTIONS

- The County may consider various other actions to protect drinking water identified in the applicable SPP policies including, but not limited to, placement of advisory signage, reviewing emergency response plans, restricting and/or reporting on the creation of new transport pathways, developing programs to identify and/or manage existing transport pathways etc.

MONITORING

- The County's *Risk Management Official* shall report to the appropriate Source Protection Authority on the actions taken to implement the policies of the relevant SPP on an annual basis, in accordance with applicable SPP policies.

4.4 That Schedule C-5 entitled "County Of Oxford Wellhead Protection Area Plan County Of Oxford Official Plan" is amended by deleting the existing Schedule C-5 and replacing it with a new Schedule C-5 entitled "County Of Oxford Source Water Protection Screening County Of Oxford Official Plan" and as included as Schedule "A" to this amendment.

4.5 That Schedules B-5, E-5, I-6, N-3, S-3, T-5, W-6 and Z-4, all entitled "wellhead protection area plan", are hereby deleted.

5.0 <u>IMPLEMENTATION</u>

This Official Plan Amendment shall be implemented in accordance with the implementation policy of the Official Plan.

6.0 INTERPRETATION

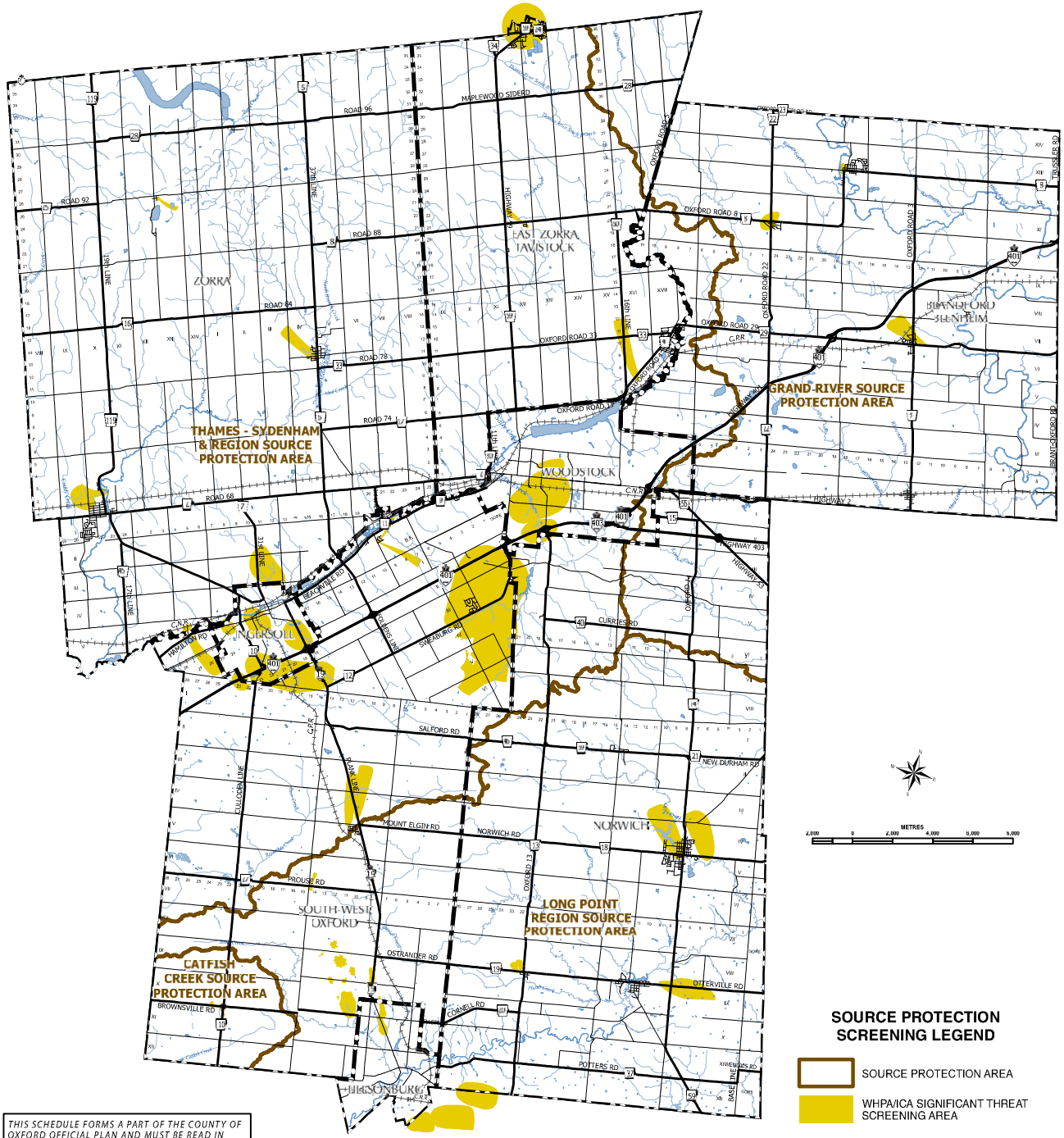
This Official Plan Amendment shall be interpreted in accordance with the interpretation policy of the Official Plan.

SCHEDULE "A"
To Amendment No 282
to the

COUNTY OF OXFORD OFFICIAL PLAN

SCHEDULE "C-5"

COUNTY OF OXFORD SOURCE PROTECTION SCREENING



THIS SCHEDULE FORMS A PART OF THE COUNTY OF OXFORD OFFICIAL PLAN AND MUST BE READ IN CONJUNCTION WITH THE WRITTEN TEXT.

THIS IS AN OFFICE CONSOLIDATION PREPARED FOR CONVENIENCE ONLY. FOR ACCURATE REFERENCE RECOURSE SHOULD BE HAD TO THE ORIGINAL DOCUMENT AND AMENDMENTS HERETO.

SOURCE PROTECTION SCREENING LEGEND

- SOURCE PROTECTION AREA
- WHPA/ICA SIGNIFICANT THREAT SCREENING AREA

BASE MAP LEGEND

- MUNICIPAL BOUNDARY
- MAJOR ROADS
- OTHER ROADS
- RAILWAY
- WATERCOURSE

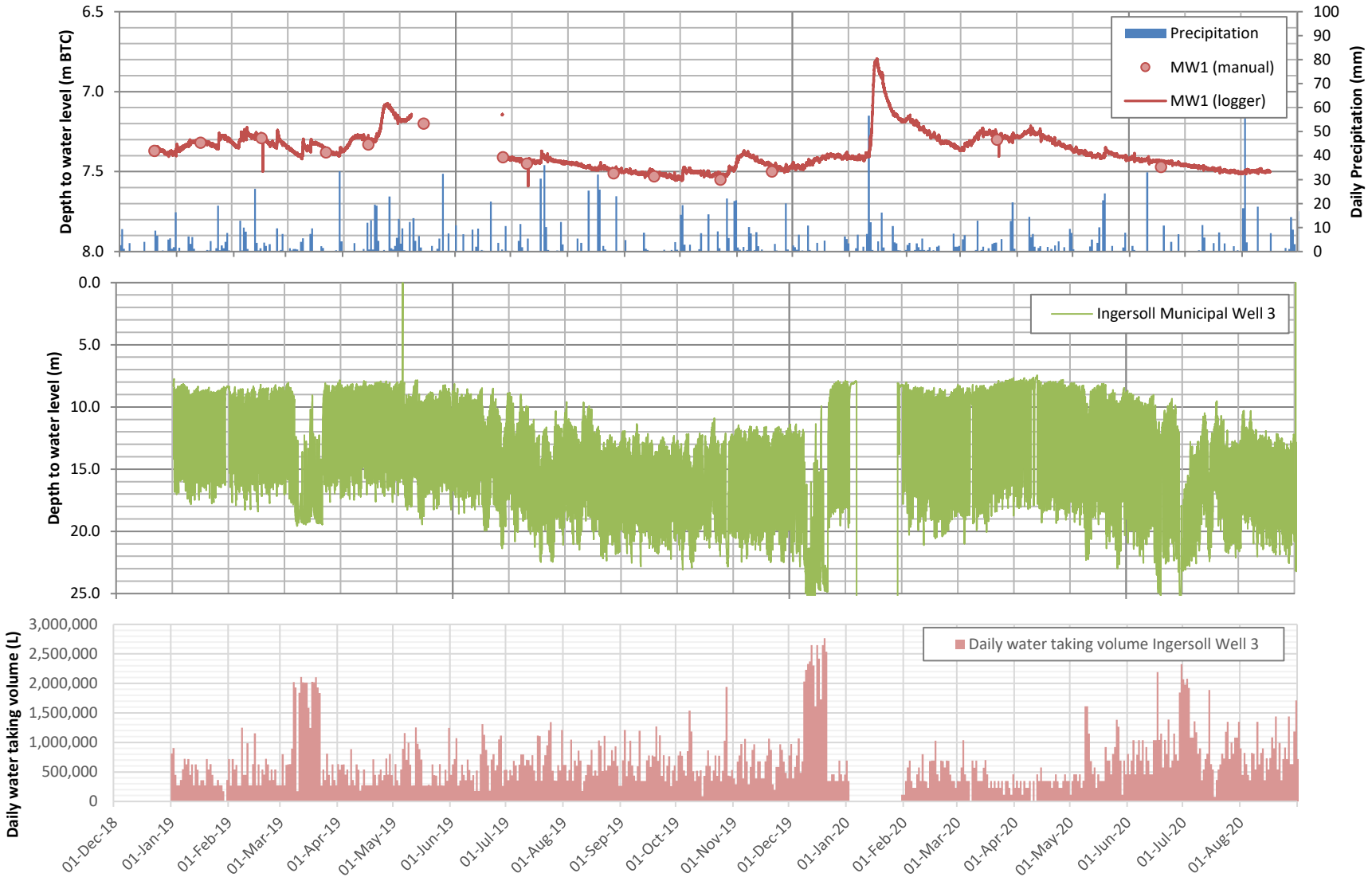
COUNTY COUNCIL APPROVAL:

Oxford County
Growing stronger together

SCHEDULE "C-5"

APPENDIX E

Water Levels and Water Taking Volume Graphs from Ingersoll Municipal Well 3 and Water Level Hydrographs from MW1



Novaterra ENVIRONMENTAL

WATER LEVEL HYDROGRAPHS FOR MW1 AND INGERSOLL MUNICIPAL WELL 3
AND WATER TAKING FROM INGERSOLL MUNICIPAL WELL 3

Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford
(Formerly West Oxford Township), Oxford County

Figure E1

PROPOSED BARDOEL PIT
J-AAR Materials Limited

February 16, 2024

Novaterra ENVIRONMENTAL	WATER LEVEL HYDROGRAPHS AND WATER TAKING VOLUME FROM JANUARY TO APRIL 2019	**Figure E2**
	Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), Oxford County	PROPOSED BARDOEL PIT J-AAR Materials Limited
		February 16, 2024

Novaterra ENVIRONMENTAL	WATER LEVEL HYDROGRAPHS AND WATER TAKING VOLUME FROM MAY TO AUGUST 2019	**Figure E3**
	Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), Oxford County	PROPOSED BARDOEL PIT J-AAR Materials Limited
		February 16, 2024

Novaterra ENVIRONMENTAL	WATER LEVEL HYDROGRAPHS AND WATER TAKING VOLUME FROM SEPTEMBER TO DECEMBER 2019	**Figure E4**
	Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), Oxford County	PROPOSED BARDOEL PIT J-AAR Materials Limited
		February 16, 2024

Novaterra ENVIRONMENTAL

WATER LEVEL HYDROGRAPHS AND WATER TAKING VOLUME FROM JANUARY TO APRIL 2020

Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford
(Formerly West Oxford Township), Oxford County

Figure E5

PROPOSED BARDOEL PIT
J-AAR Materials Limited

February 16, 2024

Novaterra ENVIRONMENTAL	WATER LEVEL HYDROGRAPHS AND WATER TAKING VOLUME FROM MAY TO AUGUST 2020	**Figure E6**
	Part Lots 25 and 27, Broken Front Concession, Township of South-West Oxford (Formerly West Oxford Township), Oxford County	PROPOSED BARDOEL PIT J-AAR Materials Limited
		February 16, 2024

APPENDIX F

Laboratory Certificate of Analyses

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD
39 WINSHIP CLOS
LONDON, ON N6C5M8
(519) 690-1796

ATTENTION TO: BLAGOJE NOVAKOVIC

PROJECT: Bordeal Pit

AGAT WORK ORDER: 17L297278

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

WATER ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: Dec 29, 2017

PAGES (INCLUDING COVER): 13

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 17L297278
PROJECT: Bordeal Pit

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD **ATTENTION TO: BLAGOJE NOVAKOVIC**
SAMPLING SITE: **SAMPLED BY:**

BTEX - Water (P & T - GC/MS)

DATE RECEIVED: 2017-12-21 **DATE REPORTED: 2017-12-29**

		SAMPLE DESCRIPTION:		4 (Pond) SG1
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-12-20
Parameter	Unit	G / S	RDL	8992464
Benzene	µg/L		0.20	<0.20
Toluene	µg/L		0.20	<0.20
Ethylbenzene	µg/L		0.10	<0.10
m & p-Xylene	µg/L		0.20	<0.20
o-Xylene	µg/L		0.10	<0.10
Xylene Mixture (Total)	µg/L		0.20	<0.20
Surrogate	**Unit**	**Acceptable Limits**		
Toluene-d8	% Recovery	60-130		93
4-Bromofluorobenzene	% Recovery	70-130		86

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
8992464 Results relate only to the items tested.
Dilution factor=
The sample was diluted to keep the target compounds in the calibration range of the instrument and avoid contaminating the Purge and Trap system. The method detection limit has been corrected for the dilution factor used.

Certified By: NPopnikolova

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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 17L297278

PROJECT: Bordeal Pit

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD

ATTENTION TO: BLAGOJE NOVAKOVIC

SAMPLING SITE:

SAMPLED BY:

PHCs F1 - F4 (Water)

DATE RECEIVED: 2017-12-21

DATE REPORTED: 2017-12-29

		SAMPLE DESCRIPTION:		1 Monitoring Well MW1	2 Monitoring Well MW2
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2017-12-20	2017-12-20
Parameter	Unit	G / S	RDL	8992421	8992426
Benzene	µg/L		0.20	<0.20	<0.20
Toluene	µg/L		0.20	<0.20	<0.20
Ethylbenzene	µg/L		0.10	<0.10	<0.10
Xylene Mixture	µg/L		0.20	<0.20	<0.20
F1 (C6 to C10)	µg/L		25	<25	<25
F1 (C6 to C10) minus BTEX	µg/L		25	<25	<25
F2 (C10 to C16)	µg/L		100	<100	<100
F3 (C16 to C34)	µg/L		100	<100	<100
F4 (C34 to C50)	µg/L		100	<100	<100
Gravimetric Heavy Hydrocarbons	µg/L		500	NA	NA
Surrogate	**Unit**	**Acceptable Limits**			
Terphenyl	%	60-140		98	78

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8992421-8992426 The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and nC34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16 - C50 and are only determined if the chromatogram of the C34 - C50 Hydrocarbons indicated that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6-C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153/04, results are considered valid without determining the PAH contribution if not requested by the client.
NA = Not Applicable

Certified By: NPopnikoff

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Certificate of Analysis

AGAT WORK ORDER: 17L297278

PROJECT: Bordeal Pit

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD

ATTENTION TO: BLAGOJE NOVAKOVIC

SAMPLING SITE:

SAMPLED BY:

PHCs F1/BTEX (Water)

DATE RECEIVED: 2017-12-21

DATE REPORTED: 2017-12-29

		SAMPLE DESCRIPTION:		3 Monitoring Well MW6
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2017-12-20
Parameter	Unit	G / S	RDL	8992427
Benzene	µg/L		0.20	0.38
Toluene	µg/L		0.20	0.26
Ethylbenzene	µg/L		0.10	<0.10
Xylene Mixture	µg/L		0.20	<0.20
F1 (C6 to C10)	µg/L		25	<25
F1 (C6 to C10) minus BTEX	µg/L		25	<25

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8992427 The C6-C10 fraction is calculated using Toluene response factor.
Total C6-C10 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
Extraction and holding times were met for this sample.
NA = Not Applicable

Certified By: NPopnikoff

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Certificate of Analysis

AGAT WORK ORDER: 17L297278

PROJECT: Bordeal Pit

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD

ATTENTION TO: BLAGOJE NOVAKOVIC

SAMPLING SITE:

SAMPLED BY:

Full Metal Scan (Water)

DATE RECEIVED: 2017-12-21

DATE REPORTED: 2017-12-29

		SAMPLE DESCRIPTION:		1 Monitoring Well MW1	2 Monitoring Well MW2	3 Monitoring Well MW6	4 (Pond) SG1
		SAMPLE TYPE:		Water	Water	Water	Water
		DATE SAMPLED:		2017-12-20	2017-12-20	2017-12-20	2017-12-20
Parameter	Unit	G / S	RDL	8992421	8992426	8992427	8992464
Aluminum	mg/L		0.004	0.372	0.162	0.110	0.027
Antimony	mg/L		0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L		0.001	0.010	0.004	<0.001	0.001
Barium	mg/L		0.002	0.081	0.038	0.086	0.031
Beryllium	mg/L		0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	mg/L		0.002	<0.002	<0.002	<0.002	<0.002
Boron	mg/L		0.01	0.04	0.05	0.14	0.02
Cadmium	mg/L		0.001	<0.001	<0.001	<0.001	<0.001
Chromium	mg/L		0.002	<0.002	<0.002	0.005	<0.002
Cobalt	mg/L		0.001	0.001	<0.001	<0.001	<0.001
Copper	mg/L		0.002	0.134	0.217	0.129	0.137
Iron	mg/L		0.01	0.94	0.33	0.42	0.03
Lead	mg/L		0.001	0.008	0.010	0.007	0.017
Lithium	mg/L		0.010	<0.010	<0.010	0.014	<0.010
Manganese	mg/L		0.002	0.119	0.075	0.101	0.005
Molybdenum	mg/L		0.001	0.001	0.002	0.020	<0.001
Nickel	mg/L		0.003	<0.003	<0.003	<0.003	<0.003
Phosphorus	mg/L		0.05	<0.05	<0.05	<0.05	<0.05
Selenium	mg/L		0.004	<0.004	<0.004	<0.004	<0.004
Silicon	mg/L		0.05	8.06	6.55	4.63	0.66
Silver	mg/L		0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L		0.005	0.781	0.503	0.943	0.114
Thallium	mg/L		0.001	<0.001	<0.001	<0.001	<0.001
Tin	mg/L		0.002	0.003	0.004	0.010	<0.002
Titanium	mg/L		0.001	0.017	0.007	0.004	0.002
Uranium	mg/L		0.001	<0.001	<0.001	0.003	0.001
Vanadium	mg/L		0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L		0.005	0.024	0.023	0.024	0.009
Zirconium	mg/L		0.004	<0.004	<0.004	<0.004	<0.004

Certified By: Iris Verástegui

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Certificate of Analysis
AGAT WORK ORDER: 17L297278
PROJECT: Bordeal Pit
CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD
ATTENTION TO: BLAGOJE NOVAKOVIC
SAMPLING SITE:
SAMPLED BY:
Full Metal Scan (Water)
DATE RECEIVED: 2017-12-21
DATE REPORTED: 2017-12-29

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Iris Verástegui

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Certificate of Analysis

AGAT WORK ORDER: 17L297278
PROJECT: Bordeal Pit

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD
SAMPLING SITE:

ATTENTION TO: BLAGOJE NOVAKOVIC
SAMPLED BY:

Inorganic Chemistry (Water)

DATE RECEIVED: 2017-12-21 **DATE REPORTED: 2017-12-29**

Parameter	Unit	G / S	RDL	1 Monitoring Well MW1 Water 2017-12-20 8992421	2 Monitoring Well MW2 Water 2017-12-20 8992426	3 Monitoring Well MW6 Water 2017-12-20 8992427	4 (Pond) SG1 Water 2017-12-20 8992464
Electrical Conductivity	uS/cm		2	502	391	571	410
pH	pH Units		NA	7.85	7.92	7.97	7.97
Alkalinity (as CaCO3)	mg/L		5	223	193	203	189
Chloride	mg/L		0.10	11.8	8.33	33.8	19.2
Nitrate as N	mg/L		0.05	0.29	0.23	<0.05	1.38
Nitrite as N	mg/L		0.05	<0.05	<0.05	<0.05	<0.05
Sulphate	mg/L		0.10	62.1	30.6	74.3	15.3
Calcium	mg/L		0.05	58.8	43.8	54.7	49.7
Magnesium	mg/L		0.05	29.1	20.4	29.7	18.5
Sodium	mg/L		0.05	12.9	15.3	23.8	10.6
Potassium	mg/L		0.05	1.67	2.71	11.4	3.36

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Iris Verastegui

AGAT Laboratories

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MISSISSAUGA, ONTARIO
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD
PROJECT: Bordeal Pit
SAMPLING SITE:

AGAT WORK ORDER: 17L297278
ATTENTION TO: BLAGOJE NOVAKOVIC
SAMPLED BY:

Trace Organics Analysis

RPT Date: Dec 29, 2017

PARAMETER	Batch	Sample Id	DUPLICATE Dup #1	DUPLICATE Dup #2	DUPLICATE RPD	Method Blank	REFERENCE MATERIAL Measured Value	REFERENCE MATERIAL Acceptable Limits Lower	REFERENCE MATERIAL Acceptable Limits Upper	METHOD BLANK SPIKE Recovery	METHOD BLANK SPIKE Acceptable Limits Lower	METHOD BLANK SPIKE Acceptable Limits Upper	MATRIX SPIKE Recovery	MATRIX SPIKE Acceptable Limits Lower	MATRIX SPIKE Acceptable Limits Upper
PHCs F1 - F4 (Water)															
Benzene	8994315		< 0.20	< 0.20	NA	< 0.20	127%	50%	140%	110%	60%	130%	97%	50%	140%
Toluene	8994315		< 0.20	< 0.20	NA	< 0.20	118%	50%	140%	105%	60%	130%	87%	50%	140%
Ethylbenzene	8994315		< 0.10	< 0.10	NA	< 0.10	107%	50%	140%	100%	60%	130%	79%	50%	140%
Xylene Mixture	8994315		< 0.20	< 0.20	NA	< 0.20	73%	50%	140%	124%	60%	130%	72%	50%	140%
F1 (C6 to C10)	8994315		< 25	< 25	NA	< 25	87%	60%	140%	99%	60%	140%	109%	60%	140%
F2 (C10 to C16)		TW	< 100	< 100	NA	< 100	96%	60%	140%	73%	60%	140%	72%	60%	140%
F3 (C16 to C34)		TW	<100	<100	NA	< 100	102%	60%	140%	108%	60%	140%	94%	60%	140%
F4 (C34 to C50)		TW	< 100	< 100	NA	< 100	96%	60%	140%	107%	60%	140%	98%	60%	140%
PHCs F1/BTEX (Water)															
Benzene	8994315		< 0.20	< 0.20	NA	< 0.20	127%	50%	140%	110%	60%	130%	97%	50%	140%
Toluene	8994315		< 0.20	< 0.20	NA	< 0.20	118%	50%	140%	105%	60%	130%	87%	50%	140%
Ethylbenzene	8994315		< 0.10	< 0.10	NA	< 0.10	107%	50%	140%	100%	60%	130%	79%	50%	140%
F1 (C6 to C10)	8994315		< 25	< 25	NA	< 25	87%	60%	140%	99%	60%	140%	109%	60%	140%
BTEX - Water (P & T - GC/MS)															
Benzene	8986541		< 0.20	< 0.20	NA	< 0.20	113%	60%	130%	90%	60%	130%	91%	60%	130%
Toluene	8986541		< 0.20	< 0.20	NA	< 0.20	101%	60%	130%	82%	60%	130%	85%	60%	130%
Ethylbenzene	8986541		< 0.10	< 0.10	NA	< 0.10	99%	60%	130%	113%	60%	130%	109%	60%	130%
m & p-Xylene	8986541		< 0.20	< 0.20	NA	< 0.20	97%	60%	130%	100%	60%	130%	102%	60%	130%
o-Xylene	8986541		< 0.10	< 0.10	NA	< 0.10	81%	60%	130%	102%	60%	130%	95%	60%	130%

Comments: Tap water analysis has been performed as QC sample testing for duplicate and matrix spike due to insufficient sample volume.
When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: N Popnikolof

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Quality Assurance

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD | **AGAT WORK ORDER: 17L297278**

PROJECT: Bordeal Pit | **ATTENTION TO: BLAGOJE NOVAKOVIC**

SAMPLING SITE: | **SAMPLED BY:**

Water Analysis

RPT Date: Dec 29, 2017			DUPLICATE				REFERENCE MATERIAL				METHOD BLANK SPIKE				MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits			
								Lower	Upper		Lower	Upper		Lower	Upper		
Full Metal Scan (Water)																	
Aluminum	8991831		0.128	0.138	7.5%	< 0.004	107%	90%	110%	104%	90%	110%	94%	70%	130%		
Antimony	8991831		<0.001	<0.001	NA	< 0.001	100%	90%	110%	104%	90%	110%	104%	70%	130%		
Arsenic	8991831		<0.001	<0.001	NA	< 0.001	106%	90%	110%	102%	90%	110%	104%	70%	130%		
Barium	8991831		0.022	0.024	8.7%	< 0.002	102%	90%	110%	104%	90%	110%	108%	70%	130%		
Beryllium	8991831		<0.001	<0.001	NA	< 0.001	101%	90%	110%	101%	90%	110%	102%	70%	130%		
Bismuth	8991831		<0.002	<0.002	NA	< 0.002	106%	90%	110%	106%	90%	110%	115%	70%	130%		
Boron	8991831		<0.01	<0.01	NA	< 0.01	97%	90%	110%	102%	90%	110%	101%	70%	130%		
Cadmium	8991831		<0.001	<0.001	NA	< 0.001	100%	90%	110%	101%	90%	110%	111%	70%	130%		
Chromium	8991831		<0.002	<0.002	NA	< 0.002	100%	90%	110%	102%	90%	110%	106%	70%	130%		
Cobalt	8991831		<0.001	<0.001	NA	< 0.001	107%	90%	110%	107%	90%	110%	108%	70%	130%		
Copper	8991831		0.003	0.003	NA	< 0.002	104%	90%	110%	110%	90%	110%	112%	70%	130%		
Iron	8991831		0.12	0.13	8.0%	< 0.01	101%	90%	110%	108%	90%	110%	108%	70%	130%		
Lead	8991831		<0.001	<0.001	NA	< 0.001	104%	90%	110%	106%	90%	110%	107%	70%	130%		
Lithium	8991831		<0.010	<0.010	NA	< 0.010	110%	90%	110%	104%	90%	110%	115%	70%	130%		
Manganese	8991831		0.031	0.033	6.3%	< 0.002	104%	90%	110%	104%	90%	110%	103%	70%	130%		
Molybdenum	8991831		<0.001	<0.001	NA	< 0.001	100%	90%	110%	100%	90%	110%	102%	70%	130%		
Nickel	8991831		0.011	0.011	NA	< 0.003	107%	90%	110%	106%	90%	110%	107%	70%	130%		
Phosphorus	8991831		<0.05	<0.05	NA	< 0.05	110%	90%	110%	110%	90%	110%	111%	70%	130%		
Selenium	8991831		<0.004	<0.004	NA	< 0.004	100%	90%	110%	99%	90%	110%	105%	70%	130%		
Silicon	8991831		4.01	4.17	3.9%	< 0.05	102%	90%	110%	99%	90%	110%	89%	70%	130%		
Silver	8991831		<0.001	<0.001	NA	< 0.001	103%	90%	110%	110%	90%	110%	112%	70%	130%		
Strontium	8991831		0.023	0.024	NA	< 0.005	105%	90%	110%	103%	90%	110%	103%	70%	130%		
Thallium	8991831		<0.001	<0.001	NA	< 0.001	104%	90%	110%	106%	90%	110%	108%	70%	130%		
Tin	8991831		<0.002	<0.002	NA	< 0.002	105%	90%	110%	108%	90%	110%	108%	70%	130%		
Titanium	8991831		<0.001	<0.001	NA	< 0.001	103%	90%	110%	98%	90%	110%	101%	70%	130%		
Uranium	8991831		<0.001	<0.001	NA	< 0.001	103%	90%	110%	107%	90%	110%	111%	70%	130%		
Vanadium	8991831		<0.001	<0.001	NA	< 0.001	103%	90%	110%	101%	90%	110%	104%	70%	130%		
Zinc	8991831		0.006	0.007	NA	< 0.005	101%	90%	110%	106%	90%	110%	116%	70%	130%		
Zirconium	8991831		<0.004	<0.004	NA	< 0.004	94%	90%	110%	92%	90%	110%	92%	70%	130%		
Inorganic Chemistry (Water)																	
Electrical Conductivity	8990675		719	718	0.1%	< 2	100%	80%	120%								
pH	8990675		8.16	8.03	1.6%	NA	99%	90%	110%								
Alkalinity (as CaCO3)	8990675		234	232	0.9%	< 5	108%	80%	120%								
Chloride	8992010		67.7	61.0	10.4%	< 0.10	91%	90%	110%	101%	90%	110%	104%	80%	120%		
Nitrate as N	8992010		2.39	2.27	5.2%	< 0.05	98%	90%	110%	105%	90%	110%	109%	80%	120%		
Nitrite as N	8992010		<0.25	<0.25	NA	< 0.05	NA	90%	110%	106%	90%	110%	104%	80%	120%		
Sulphate	8992010		36.6	33.8	8.1%	< 0.10	102%	90%	110%	104%	90%	110%	103%	80%	120%		
Calcium	8990701		85.1	84.7	0.4%	< 0.05	97%	90%	110%	99%	90%	110%	100%	70%	130%		
Magnesium	8990701		28.6	28.6	0.0%	< 0.05	99%	90%	110%	102%	90%	110%	98%	70%	130%		

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Quality Assurance

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD | **AGAT WORK ORDER: 17L297278**

PROJECT: Bordeal Pit | **ATTENTION TO: BLAGOJE NOVAKOVIC**

SAMPLING SITE: | **SAMPLED BY:**

Water Analysis (Continued)

RPT Date: Dec 29, 2017			DUPLICATE				REFERENCE MATERIAL				METHOD BLANK SPIKE				MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits			
								Lower	Upper		Lower	Upper		Lower	Upper		
Sodium	8990701		36.6	36.5	0.4%	< 0.05	101%	90%	110%	102%	90%	110%	102%	70%	130%		
Potassium	8990701		3.51	3.50	0.3%	< 0.05	97%	90%	110%	99%	90%	110%	101%	70%	130%		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Iris Verástegui

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested

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Method Summary

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD **AGAT WORK ORDER: 17L297278**

PROJECT: Bordeal Pit **ATTENTION TO: BLAGOJE NOVAKOVIC**

SAMPLING SITE: **SAMPLED BY:**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Xylene Mixture (Total)	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Benzene	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
Toluene	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
Ethylbenzene	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
Xylene Mixture	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
F1 (C6 to C10)	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
F2 (C10 to C16)	VOL-91-5010	MOE PHC-E3421	GC/FID
F3 (C16 to C34)	VOL-91-5010	MOE PHC-E3421	GC/FID
F4 (C34 to C50)	VOL-91-5010	MOE PHC-E3421	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5010	MOE PHC-E3421	BALANCE
Terphenyl	VOL-91-5010		GC/FID

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Method Summary

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD **AGAT WORK ORDER: 17L297278**

PROJECT: Bordeal Pit **ATTENTION TO: BLAGOJE NOVAKOVIC**

SAMPLING SITE: **SAMPLED BY:**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Aluminum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Antimony	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Bismuth	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lithium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Nickel	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Phosphorus	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Selenium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Silicon	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Silver	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Strontium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Thallium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Tin	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Titanium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Uranium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zirconium	MET-93-6103	EPA SW 846 6020A & 200.8	ICP-MS
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES

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Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 17L297278

Cooler Quantity:

Arrival Temperatures: 3.6 | 2.2 | 3.1

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

Report Information:

Company: Novaterra Environmental Ltd.
Contact: Blagy Novakovic
Address: 39 Winship Close, London, ON N6C 5M8
Phone: (519) 686-8884 Fax: (519) 690-0756
Reports to be sent to:
1. Email: novaterra@sympatico.ca
2. Email:

Regulatory Requirements: ☒ No Regulatory Requirement
(Please check all applicable boxes)

☐ Regulation 153/04 — Table ___ (Indicate One): ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One): ☐ Coarse ☐ Fine
☐ Sewer Use: ☐ Sanitary ☐ Storm — Region ___ (Indicate One)
☐ MISA
☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other ___ (Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☒ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: Bardoel pit-form
Site Location: Lots 26 & 27 B.F. Conc. S.W. Oxford
Sampled By: BLAGY NOVAKOVIC
AGAT Quote #: ___ PO: Aaroc P.O # 502
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information: Bill To Same: Yes ☐ No ☐

Company: Aaroc Aggregates Ltd.
Contact: Jim Aarts
Address: 3003 Page St. London ON N5V 4J1
Email: jimaarts@johnaartsgroup.com

Sample Matrix Legend

- B — Biota
- GW — Ground Water (circled)
- O — Oil
- P — Paint
- S — Soil
- SD — Sediment
- SW — Surface Water (circled)

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	Metals and Inorganics (O. Reg 153)	☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides) (O. Reg 153)	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr6+ ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR (O. Reg 153)	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH3 ☐ TKN ☐ NO3 ☒ NO_3+NO_2 ☐ NO2	Volatiles: ☐ VOC ☒ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	pH, EC, Conductivity	Alkalinity	Ca, Mg, Na, K	Cl, SO4	Metal scan
① Monitoring Well MW1	20 Dec '17	12:15	6	GW								✓	✓	✓							✓	✓	✓	✓	✓
② Monitoring Well MW2	20 Dec 2017	12:40	6	GW								✓	✓	✓							✓	✓	✓	✓	✓
③ Monitoring Well MW6	20 Dec 2017	10:15	6	GW								✓	✓	✓							✓	✓	✓	✓	✓
④ Staff gauge (pond) SG1	20 Dec 2017	11:40	5	SW								✓	✓								✓	✓	✓	✓	✓

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
B. NOVAKOVIC [signature]	21 Dec. 2017	12:06pm	Laura Robinson [signature]	Dec 21, 17	12:06pm

Page ___ of ___

Nº: T 059845

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CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD
39 WINSHIP CLOS
LONDON, ON N6C5M8
(519) 690-1796

ATTENTION TO: BLAGOJE NOVAKOVIC

PROJECT: Bardoel Farm

AGAT WORK ORDER: 18L332944

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Apr 30, 2018

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18L332944
PROJECT: Bardoel Farm

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CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD **ATTENTION TO: BLAGOJE NOVAKOVIC**
SAMPLING SITE: **SAMPLED BY:Blagy Novakovic**

BTEX - Water (P & T - GC/MS)

DATE RECEIVED: 2018-04-26 **DATE REPORTED: 2018-04-30**

				MWG -
SAMPLE DESCRIPTION:				**Monitoring Well**
SAMPLE TYPE:				**Water**
DATE SAMPLED:				
Parameter	**Unit**	**G / S**	**RDL**	**9207547**
Benzene	µg/L		0.20	<0.20
Toluene	µg/L		0.20	<0.20
Ethylbenzene	µg/L		0.10	<0.10
m & p-Xylene	µg/L		0.20	<0.20
o-Xylene	µg/L		0.10	<0.10
Xylene Mixture (Total)	µg/L		0.20	<0.20
Surrogate	**Unit**	**Acceptable Limits**		
Toluene-d8	% Recovery	60-130		79
4-Bromofluorobenzene	% Recovery	70-130		101

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
9207547 Results relate only to the items tested.

Certified By:

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Quality Assurance

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD | **AGAT WORK ORDER: 18L332944**

PROJECT: Bardoel Farm | **ATTENTION TO: BLAGOJE NOVAKOVIC**

SAMPLING SITE: | **SAMPLED BY:Blagy Novakovic**

Trace Organics Analysis

RPT Date: Apr 30, 2018			DUPLICATE				REFERENCE MATERIAL				METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
BTEX - Water (P & T - GC/MS)															
Benzene	9203617		< 0.20	< 0.20	NA	< 0.20	84%	60%	130%	99%	60%	130%	117%	60%	130%
Toluene	9203617		< 0.20	< 0.20	NA	< 0.20	80%	60%	130%	99%	60%	130%	100%	60%	130%
Ethylbenzene	9203617		< 0.10	< 0.10	NA	< 0.10	82%	60%	130%	99%	60%	130%	95%	60%	130%
m & p-Xylene	9203617		< 0.20	< 0.20	NA	< 0.20	83%	60%	130%	101%	60%	130%	94%	60%	130%
o-Xylene	9203617		< 0.10	< 0.10	NA	< 0.10	86%	60%	130%	100%	60%	130%	94%	60%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: NOVATERRA ENVIRONMENTAL LTD | **AGAT WORK ORDER: 18L332944**

PROJECT: Bardoel Farm | **ATTENTION TO: BLAGOJE NOVAKOVIC**

SAMPLING SITE: | **SAMPLED BY:Blagy Novakovic**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Xylene Mixture (Total)	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only
Work Order #: 18-332944
Cooler Quantity:
Arrival Temperatures:
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes:

Report Information:
Company: Novaterra Environmental Ltd
Contact: Blazy Novakovic
Address: 39 Wimbledon Close
London, Ont. N6G 3M8
Phone: (519) 686 690 1796 Fax: (519) 690-0756
Reports to be sent to:
1. Email: novaterra@sympatico.ca
2. Email:

Regulatory Requirements: ☐ No Regulatory Requirement
(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One): ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One): ☐ Coarse ☐ Fine
☐ Sewer Use: ☐ Sanitary ☐ Storm
Region (Indicate One): ☐ MISA
☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other (Indicate One)

Project Information:
Project: BALDOCK FARM
Site Location: 583398 HAMILTON ROAD, Thorndale
Sampled By: BLAZY NOVAKOVIC
AGAT Quote #: PO: Interpool #561
Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:
Regular TAT ☑ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*
For 'Same Day' analysis, please contact your AGAT CPM

Invoice Information: Bill To Same: Yes ☐ No ☐
Company: Interpool Aggregates Ltd.
Contact: Jim Aarts
Address: 3003 Page St. London, ON N5V 4J1
Email: jmaarts@johnaartsgroup.com

Sample Matrix Legend
B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides))	O. Reg 153: ORPs: ☐ B-HWS ☐ CN ☐ CrVI ☐ Hg ☐ F1 - BTEX ☐ F2 - PHC ☐ F3 - PHC ☐ F4 - PHC	O. Reg 153: Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH3 ☐ TKN ☐ NO2 ☐ NO3 ☐ NO3+NO2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use					
MW1-Monitoring Well	26/04/2018	12:45	3	GW																								

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
B. NOVAKOVIC	26/04/2018	15:26	Jessica Smith	4/26/18	3:00

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N°: T 059970

Document ID:DW-76-1311-014

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Date Issued: February 09, 2017

APPENDIX G

Resumes

Curriculum Vitae
Mr. Blagy (Blagoje) Novakovic, M. Sc. P. Eng.

email: novaterra@sympatico.ca Tel.:(519) 690-1796

Principal and Senior Hydrogeologist of Novaterra Environmental Ltd.

- Retired on December 31, 2001 from the Ontario Ministry of the Environment after 27 years of service
- Established consulting firm Novaterra Environmental Ltd. which was incorporated on January 9, 2002.
- Mr. B. Novakovic is the President of Novaterra Environmental Ltd. The firm carries out consulting work in the fields of hydrogeology and geological engineering.

EDUCATION

University of Waterloo, Waterloo, Ontario, Canada
Master of Sciences in Hydrogeology, 1973
Department of Earth Sciences

University of Belgrade, Belgrade, Yugoslavia
Bachelor of Science in Geological Engineering, 1963
Faculty of Mining and Geological Engineering

WORK EXPERIENCE

NOVATERRA ENVIRONMENTAL LTD., London, Ontario

Principal and Senior Hydrogeologist, January 2002 - Present

Member of Peer Review Committee, 2006 to 2014
- Upper Thames River Conservative Authority.
- Essex and Region Conservation Authority.
- The Committee provides critical technical review of the different stages of the technical reports prepared according to Provincial "Source Water Protection" program.

Ontario Municipal Board Hearing as an expert witness, 2008
- Relating to the proposed commercial plaza development and the protection of municipal wells in the Police Village of Dorchester, Middlesex County.

Hydrogeological Site Assessment and Technical Report Preparation Relating to Applications for Pits and Quarry License
- Preparation of hydrogeological assessment reports (Hydrogeological Level 1 and Level 2 Study) in support of the application for pits and quarries licence to be approved under Aggregate Resources Act by Ontario Ministry of Natural Resources and Forestry (MNRF).
- Preparation of over 25 hydrogeological reports

Hydrogeological Site Assessment and Technical Report Preparation Relating to Permit to Take Water and Water Resources
- Preparation of Hydrogeological Assessment Report involving aquifer pumping tests in support of for Category 3 application for Permit to Take Water. Permit to be issued by the Ontario Ministry of the Environment and Climate Change (MOECC) under Ontario Water Resources Act (OWRA).
- Over 40 hydrogeological reports were prepared.

Hydrogeological Site Assessment and Technical Report Preparation Relating to Environmental Site Assessment and Remediation
- Hydrogeological Site Assessment and Technical Report preparation relating to Environmental Site Assessment and Remediation under the Ontario Regulation 153/04 Environmental Protection Act (EPA).

- Phase I, Phase II and Phase III were involved, and in several cases actual remediation was implemented.
- 11 reports were prepared.

Provincial and Regional Groundwater Study Reports

- Peer Review of Provincial and Regional Groundwater Study report prepared by various consultants for the Ministry of the Environment. Four geographical area reports were involved and reviewed for the Ontario Ministry of the Environment.

Groundwater Under the Direct Influence of Surface Water (GUDI) reports

- Peer Review of Groundwater Under the Direct Influence of Surface Water (GUDI) reports prepared by various consultants for the Ministry of the Environment. At least 17 hydrogeological reports of this nature were reviewed for the Ontario Ministry of the Environment.

ONTARIO MINISTRY OF THE ENVIRONMENT, Southwest Region, London, Ontario

Regional Hydrogeologist, June 1975 – December 2001

Carried out numerous and variety of *investigations* relating to groundwater quality and quantity problems caused by human activities. Besides writing numerous Ministry of the Environment (MOE) interim reports relating to the variety of projects described below, Mr. B. Novakovic wrote up to10 technical papers published in referenced journals or conferences proceedings.

Main duties and responsibilities:

- *Groundwater contamination* including communal and domestic wells caused by the operation of waste disposal sites, former coal tar sites, deep injection wells of industrial liquid waste, operation of municipal sewage treatment facilities (sewage lagoon system), farming operations, operation of industrial plants, application of road salt, etc.
- *Groundwater quantity interference* mainly caused by the operation of communal/municipal wells and well fields, irrigation wells, dewatering relating to the construction of highways, roads, municipal sewage systems, communal water supply systems, dewatering of pit and quarries, etc. Many of these investigations resulted in the production of comprehensive technical reports written and produced in order to defend MOE's position at court proceedings, at the meetings of technical experts regarding a particular subject matter, and to support corrective remedial measures to be undertaken.
- *Undertaken pioneering work* in municipal and communal well fields protection in Ontario (Dorchester, Strathroy, Otterville, etc.), and municipal sewage effluent treatment by rapid infiltration into the subsurface (i.e. Markdale, Lucknow, etc.).
- *Review and assess* the comprehensive technical reports prepared by the consultants (hydrogeologists, professional engineers, etc.) dealing with suitability assessment, proposed design and the operation of landfill sites, the proposed communal water well systems, municipal sewage effluent disposal by way of spray irrigation, rapid infiltration into the subsurface, operation and dewatering of pits and quarries, proposed deep injection wells, etc. Many of these reports included mathematical model simulation of contaminants transport, groundwater flow, pumping tests analyses. These facilities proposed to be established under the OWRA, EPA, Environmental Assessment Act (EAA).
- *Critical review* of the comprehensive technical reports of the former coal and oil tar sites, to ensure that the proposed remediation measures were adequate and furthermore that the cleanup measures were implemented according to the prescribed Ontario regulations and standards.
- *Review and comments* on the proposed municipal official plans, amendments to such plans-aspects of such documents relating to groundwater and soils.
- *Testified* as an expert witness for the MOE in Court Proceedings, Public Hearings held under the OWRA, EPA, Consolidated Hearing Act, Environmental Review Tribunal, etc.
- *Interpretation and implementation* of the relevant Ontario Regulations made under OWRA, EPA and provide advice with such interpretation to municipalities, consulting communities, general public. Worked closely on such matters with legal profession representing the Crown.

NEW BRUNSWICK DEPARTMENT OF THE ENVIRONMENT, Fredericton, New Brunswick

Resource Manager, 1973 – 1975

Main duties included:

- Carrying out groundwater contamination investigations relating to leaks from gasoline service stations, accidental spills from transport trucks, utilities vehicles, from unloading petroleum hydrocarbons from ships, etc.
- Supervised pumping tests to assess hydraulic capacities of communal water supply wells and groundwater availability, potential and extent of saltwater intrusion into freshwater aquifer.
- Overseeing the establishment of the Provincial groundwater monitoring network.
- Provide advice and assisted municipalities and general public with the establishment and improvement of adequate and better-quality groundwater supplies.

CANADA DEPARMENT OF THE ENVIRONMENT, Ottawa-Hull, Ontario, and Quebec

Project Hydrogeologist, 1973

Worked on Joint project sponsored by the Canada Department of the Environment and the Ontario Ministry of the Environment. Work involved an assessment of deep well injection of industrial liquid waste and cavern washing brines into the subsurface formation in Lambton County, Ontario. Available data were analyzed with an aim of assessing the direction of groundwater flow and subsequently the direction and the extent of injected fluid movement in the deep subsurface formations. Reservoir capacity and the potential for trans-boundary contaminants movement were assessed. This work resulted in the publication of Technical Bulletin published by Environment Canada, of which B. Novakovic is coauthor.

DEPARTMENT OF EARTH SCIENCES, University of Waterloo, Waterloo, Ontario

Research Assistant and Graduate Student, 1970 – 1972

- Obtained M. Sc. Degree in Hydrogeology. Thesis title: The Scale of Groundwater Flow Systems in Big Creek and Big Otter Creeks Drainage Basins, Ontario.
- During the summer of 1971 worked for the Ontario Water Resources Commission
- This work resulted in the publication of: Groundwater Probability Map for Elgin County, Ontario.

FALCONBRIDGE NICKEL MINES COMPANY, Toronto, Ontario

Geological Engineer, 1968 – 1970

Carried out mineral exploration including geophysical surveys at various mining properties located at Temagami Lake, Ontario, southwestern Quebec, northern Manitoba, and at La Luz Mines, Nicaragua, a subsidiary of Falconbridge Nickel Mines.

GEOLOGICAL INSTITUTE, Sarajevo, Yugoslavia

Research Assistant, 1964 – 1968

Carried out regional water resources studies and then hydrogeological mapping of various areas of that Province with the aim of complete assessment of groundwater resources, availability and producing hydrogeological maps at the scale of 1:25,000. Such maps included a complete assessment of water resources, regime and balance of groundwater, quality, and vulnerability of groundwater to contamination for the area covered by these maps. Works also included performing long term pumping tests to define the hydraulic capacity of the identified aquifer systems in the consolidated-hard rocks and unconsolidated deposits. Groundwater outcrops such as huge karst springs were also mapped and the flow monitored by the construction of weirs, staff gauges and associated water quality monitoring were also carried out. These works resulted in publishing a comprehensive reports and associated maps depicting the finding results of such studies. Carried out geotechnical studies, including test drilling and mapping for the locations of small irrigation dams.

ASSOCIATIONS MEMBERSHIP

- Association of Professional Engineers of Ontario,
- National Ground Water Association (Groundwater Scientists and Engineers Division).

PUBLICATIONS

Mellary, A. A., Novakovic B. 1972.
Groundwater Probability Map, County of Elgin. Map 3106-1, Ontario Ministry of the Environment

Novakovic, B., Farvolden R.N., 1974.
Investigations of groundwater flow systems in Big Creek and Big Otter Creek Drainage Basins, Ontario. Canadian Earth Sci. Journal, Vol II, PP. 964-975.

Vandenberg A., Lawson, D. W. Charron, J.E. and Novakovic, B. 1977.
Subsurface Waste Disposal in Lambton County, Ontario – Piezometric Head in the Disposal Formation and Groundwater Chemistry of the Shallow Aquifer. Inland Waters Directorate, Water Resources Branch, Fisheries and Environment Canada, Technical Bulletin No. 90. Ottawa.

Novakovic B. 1984a.
Impact and Recovery of Chromium Waste Leaked Beneath an Industrial Plant. Proceedings of the Fourth National Symposium on Aquifer Restoration and Ground Water Monitoring. National Water Well association, Worthington Ohio. The Fawcett Center, Columbus, Ohio. May 23-25, 1984

Novakovic, B., Longworth J. 1984b.
Well Field Protection and Management through a Municipal Official Plan. NWWA Conference on Groundwater Management, October 29-31, 1984 Orlando, Florida. National Water Well Association.

Novakovic B., Jagger, D. 1992.
Application of hydraulic confinement concept of landfill design and operation. 1992 Conference of the Canadian National Chapter, International Association of Hydrogeologists. Modern Trend in Hydrogeology. Hamilton, Ontario May 11-13, 1992. WCGR and Env. Canada

RESUME

SASHA NOVAKOVIC, B.A.Sc., P.Eng.

email: sasha@novaterra-env.ca Tel.: 519-690-1796

Hydrogeologist – Novaterra Environmental Ltd.

- Initially involved with Phase I, II, and III ESAs, currently focusing on hydrogeological assessments of aggregate extraction pits and assessments supporting PTTW applications
- Involved in over 40 projects relating to Permit to Take Water applications for groundwater takings.

EDUCATION

University of Waterloo, Waterloo, Ontario Canada
Bachelor of Applied Sciences, 2013
Geological Engineering – Specialization in Water Resources

EMPLOYMENT HISTORY

Novaterra Environmental Ltd., Hydrogeologist, *London, ON* 2001 - Present
- Conducting elevation surveys, water level monitoring, soil and groundwater sampling, field reconnaissance and instrument installation.
- Performing pumping tests, analyzing results with AQTESOLV software, writing well assessment reports, and submitting Permit to Take Water applications to regulatory agencies.
- Creating groundwater contour maps and hydrographs, and analyzing data to assess hydrogeological and hydrological conditions at proposed gravel pits.
- Writing Environment Site Assessment report and Hydrogeological Site Assessment reports
- Drafting responses to comments by regulatory agencies regarding submitted reports.

Golder Associates Ltd., Geological Engineering Intern, *Mississauga, ON* Sept. - Dec. 2011
- Performed field compaction tests during construction of a tailings dam in Northern Manitoba for a 3-week period.
- Analyzed current and historical geologic data to generate geological cross-sections and contour maps.
- Conducted laboratory experiment to test settling, moisture and beach slope of mine tailings.
- Performed slope stability analysis using GeoSlope software.
- Limited water budget analysis, and field investigation of water reservoir in Niagara Falls used for power generation.

Matrix Solutions Inc., Environmental Engineering Intern, *Calgary, AB* Jan. - Apr. 2011
- Authored Phase II ESA reports and proposals for both the Alberta and B.C. regulatory jurisdictions relating to upstream oil and gas well sites, facilities, and spills.
- Ensured site compliance with Alberta and B.C. soil and groundwater guidelines and standards.
- Created contour maps and site diagrams, while ensuring quality control of figures and data tables included in reports.

MEMBERSHIPS AND CERTIFICATIONS

- Licensed Engineer with the Association of Professional Engineers of Ontario
- Member of the International Association of Hydrogeologists
- Member of National Ground Water Association
- Certified with Class 5 Ontario Well Technicians License