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Technical Memo – Environmental Management Plan (EMP)

To/Attention	Mr. John Spina The Manors of Belfountain Corp 7681 Highway 27, Unit 16 Woodbridge, ON L4L 4M5	Date	July 8, 2021
From	Aron Zhao, P. Eng. Steve Davies, P. Geo.	Project No	131667 2017-0646
cc			
Subject	Environmental Management Plan -Manors of Belfountain, Caledon, Ontario - FINAL		

1. INTRODUCTION

IBI Group Professional Services (Canada) Inc. (“IBI Group”) developed an Environmental Management Plan (EMP) to identify, monitor and manage potential impacts associated with the proposed Manors of Belfountain residential subdivision located in the Hamlet of Belfountain in Caledon, ON (the “Site”).

The EMP has been developed based on discussion and input from review agencies. We understand that water supply will be provided by individual water wells. Each lot will include a greywater recycling system that will reduce aquifer withdrawal stress by a target level of 25%. Individual cisterns will be installed at lots where the individual yield tests indicate the well unable to meet the peak demand rate specified by the Ministry of Environment, Conservation and Parks (MECP). Individual septic systems will be completed with a Waterloo Biofilter or similar technology, intended to reduce nitrate family concentrations by over 50%.

2. ENVIRONMENTAL MANAGEMENT PLAN

The EMP was developed to address the potential impacts to water quantity and water quality associated with the development of an estate residential subdivision based on the principle of pro-active monitoring and mitigation. This EMP was developed with consideration of the *Interim TRCA Technical Guidelines for the Development of Environmental Management Plans for Dewatering* (TRCA, September 2013) as well as monitoring, phasing and mitigation plans that have been discussed through the peer review and agency review processes. Compliance with this EMP and other regulatory requirements will be the responsibility of the Developer with appropriate securities posted as necessary with the Town of Caledon pursuant to the provisions of a subdivision agreement.

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The EMP includes three (3) components, as follows:

1. A proposed development phasing plan.
2. A comprehensive monitoring plan to assess impacts associated with the development.
3. A list of contingency actions for mitigating the impacts.

Details regarding each of these components are provided below.

2.1 Development Phasing Plan

The Site is proposed to be developed in two (2) phases. The portion of the Site generally to the west along Shaw's Creek Road is to be developed first (Phase 1) and monitoring data collected during this phase will be reviewed and reported before the Phase 2 lands to the north and west proceed to development. Phase 1 of the development will include 44 of the original 75 lots covering approximately 25.88 hectares, mainly on the western portion of the site. A revised Site Plan showing Phase 1 is included as **Attachment A**.

Impacts to the village of Belfountain wells along Bush Street from the Phase 1 development are unlikely since they are generally more than 200m away from the proposed Phase 1 lands and well outside of the calculated zone of influence of pumping associated with Phase 1. The development of Phase 1 will allow for a detailed site-level understanding of water quality and water quantity effects including:

- Downgradient nitrate concentrations in groundwater;
- Water levels and drawdowns in the aquifer;
- Lot-level Zone of Influence (ZOI);
- Lot level and downgradient chloride concentrations in groundwater;
- Lot-level and cumulative water usage for the proposed development; and
- Lot –level sampling of wastewater treated effluent to measure impacts on groundwater.

In addition, the proposed phasing can be considered as a long-term pumping test, based on the actual well usage. This should corroborate the results of the pumping tests already completed and should demonstrate the lack of water quantity impacts before the second proposed phase is developed.

The proposed phased approach to the development is intended to demonstrate the sustainability of the water supply in terms of both water quantity and water quality for every lot during the first phase before the second phase proceeds.

Phase 2 of the development will proceed once it is demonstrated that Phase 1 is not resulting in unacceptable water quality or water quantity impacts to the on-Site or downgradient users of groundwater, such as the existing domestic wells in the Hamlet of Belfountain.

2.2 Integrated Monitoring Plan

The key objective of the proposed monitoring plan is to identify potential water quantity and water quality impacts to existing domestic well supplies, both on and off Site.

Data already collected as part of the hydrogeological investigation will represent baseline conditions, however some additional baseline monitoring data will be required, particularly baseline residential water well data for private wells within a 500m radius of Phase 1, as well as

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any private wells immediately outside of the 500m radius. This will be subject to participation by nearby residents.

A groundwater monitoring program is proposed to be implemented through the pre-construction, during-construction, and post-construction periods of both the Phase 1 and Phase 2 development.

Key trigger levels have been currently identified and Phase 2 of the development will proceed once the Monitoring Program demonstrates that these key water quality and quantity triggers have not been exceeded during the Phase 1 monitoring.

2.2.1 Groundwater Monitoring

Groundwater monitoring will be conducted on:

- Existing monitoring wells and test wells installed at the Site; and
- Residential wells within the zone of influence and immediately outside of it where IBI Group receives owner approval.

These wells are collectively referred to as monitoring wells. Water levels at the indicated monitoring wells should be monitored quarterly during pre-construction. Select monitoring wells will be instrumented with automated groundwater level dataloggers to track the water level fluctuations over time in the construction and post-construction periods. Measurements will be compared with baseline water level data to assess changes in water levels that may be attributed to on-site residential pumping activities, changes in Site infiltration, and any other development-related impacts.

Wells to be monitored include: TW1-09, PW1, PW2, PW3, TW4, TW5, TW6, TW7, TW8, TW11 and OW1. None of these wells are proposed for use as a domestic supply well. In addition, a door-to-door well survey will be completed in advance of construction in Phase 1, and the well of any participating private resident within 500m of the Site's boundary and immediately outside of it will be included in the monitoring program. The enclosed **Attachment B** shows the proposed location of the monitoring stations.

Groundwater quality at identified monitoring wells should be sampled quarterly during the pre-construction period to establish baseline conditions in each location within 12 months of the start of construction. **Table 1** summarizes the proposed groundwater monitoring work. The groundwater samples will be tested for nitrates, chloride, sulphate, other inorganic parameters, bacteriological parameters, and total metals. The raw water temperature, dissolved oxygen, pH, electrical conductivity, and turbidity should also be measured in the field.

Groundwater triggers have been set to identify if the water quantity impacts and water quality impacts are exceeding the established thresholds during construction. **Table 2** summarizes the groundwater triggers and response actions.

Generally, if a groundwater parameter were to exceed an identified trigger level, the first response would be to review the available data and identify possible reasons that the trigger may have been exceeded (e.g., natural fluctuations or development influence) and whether there was a corresponding impact to a groundwater receptor (e.g., natural feature, private well, supply aquifer). A potentially unacceptable impact would trigger the indicated response actions.

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Table 1 Proposed Groundwater Monitoring Work

Monitoring Parameters	Rationale	Methodology
Lot-level 2-hour yield test at location-specific recommended rate	<ul style="list-style-type: none"> Determine the individual lot-specific yield. Assess need for supplemental water supply storage. 	<ul style="list-style-type: none"> Yield test to be completed by licensed water well driller upon completion of each lot-level domestic well.
Groundwater quality (nitrates, bacteriological parameters, chloride, total metals, and inorganic parameters) at indicated monitoring locations	<ul style="list-style-type: none"> Characterization of groundwater quality. Assess changes in groundwater quality through the development. 	<ul style="list-style-type: none"> Laboratory analysis of collected water samples. Field measurement (temperature, DO, pH, EC, and turbidity) using Horiba U-50 Multiparameter Water Quality Probe or similar.
Groundwater quality (nutrients, microbiological parameters, chloride, and inorganics) at participating private wells (community wells)	<ul style="list-style-type: none"> Characterization of domestic water quality Assess changes in domestic water quality through the development. 	<ul style="list-style-type: none"> Laboratory analysis of collected water samples. Field measurement (temperature, DO, pH, EC, and turbidity) using Horiba U-50 Multiparameter Water Quality Probe or similar.
Groundwater quality (nutrients, microbiological parameters, chloride, and inorganics) at each domestic well to be installed at the Site	<ul style="list-style-type: none"> Characterization of domestic water quality. 	<ul style="list-style-type: none"> Laboratory analysis of collected water samples. Field measurement (temperature, DO, pH, EC, and turbidity) using Horiba U-50 Multiparameter Water Quality Probe or similar.
Groundwater levels at identified monitoring wells, observation wells and participating private wells	<ul style="list-style-type: none"> Track and assess the drawdown and fluctuation of the water levels over time. 	<ul style="list-style-type: none"> Manual water level measurements using a water level tape. Continuous hourly groundwater level measurements collected using datalogger.
Lot-level effluent quality	<ul style="list-style-type: none"> Confirm effluent quality conforms with design target 	<ul style="list-style-type: none"> Grab sampling from sampling port as part of annual maintenance by service contractor provider as required by the OBC. Additional quarterly monitoring of first 15 lots developed for two (2) years. Analysis of cBOD, COD, TSS, NO₃, NH_{3,4}-N/TKN, and PO₄-P/TP

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Table 2 Groundwater Triggers

Trigger	Response Action
<p>Lot-level yield test cannot sustain 18.75L/min rate</p>	<ul style="list-style-type: none"> • Lots with wells with recommended pumping rates between 4.5L/min and 18.75L/min will need to install a suitable water storage system (such as a cistern). • Alternatively, a new well may be installed and re-tested. • Wells producing at a rate below 4.5L/min are not suitable for water supply.
<p>Nitrate levels greater than 10mg/L at an individual downgradient monitoring location</p>	<ul style="list-style-type: none"> • Inspection and performance monitoring of the implemented tertiary treatment method to be completed. • If found to be not performing, the implemented treatment method to be replaced with a suitable comparable that can be demonstrated to meet performance objectives. • Phase 2 of the development not to proceed until nitrate levels are shown to decrease to <10mg/L for two (2) consecutive monitoring events.
<p>Chloride concentration above 120mg/L at an individual downgradient monitoring location</p>	<ul style="list-style-type: none"> • Chloride concentration identified in groundwater to be above 120mg/L in an individual groundwater monitoring location will trigger implementation of a source-reduction program by the Town of Caledon.
<p>Groundwater Quality Impacts (above ODWS and Baseline Conditions) at Private Wells</p>	<ul style="list-style-type: none"> • If changes in groundwater quality at residential wells are identified through the monitoring program, determine if impacts are expected to be temporary or long-term. • If impact is expected to be temporary, the provision of a temporary alternative water supply, such as a cistern, will be implemented by the developer. • If impact is expected to be long-term, deepening of the existing well, provision of a replacement well, or provision of a suitable treatment system may be required. • Possible alternative temporary and long-term water supply options are discussed further in Section 2.3.
<p>Individual drawdown over 4m greater than anticipated, at identified off-site monitoring locations, as outlined in Table 6.7 of the hydrogeological report.</p>	<ul style="list-style-type: none"> • Drawdown of over 4m more than what has been estimated in the hydrogeology report at the following monitoring locations: TW1-09, PW1, PW2, PW3, TW4, TW5, TW6, TW7, TW8, TW11 and OW1. • Since water levels are seasonal, and fluctuate between years, it will need to be determined that the elevated drawdown is resulting from cumulative water takings at the Site. • An assessment of each well with excessive drawdown should be considered and an alternate well may be installed. • Phase 2 of the development will not proceed if the drawdown threshold is exceeded for three (3) consecutive monitoring events in most of the wells monitored. • Additional restrictions on water use (e.g., irrigation or pools) may be implemented in order not to exceed the drawdown threshold. These restrictions will be added as warning clauses in the subdivision agreement and the agreement of purchase and sale will have provisions allowing the developer / or the Town to enforce them against the first or subsequent homeowners.

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Trigger	Response Action
Maximum concentration of 20mg/L NO ₃ -N in the discharge in lot-level septic effluent	<ul style="list-style-type: none"> • NO₃-N in the discharge >20mg/L at any individual lot will trigger further inspection / repairs / filters to individual septic system followed by a re-sample. • If concentration(s) remain >20mg/L, the individual septic system will be retrofit with a Nitrex™ filter at the developer's expense, followed by a re-sample. • If concentration(s) remain >20mg/L for >10% of lots with Nitrex™ filters, Phase 2 of the development will not proceed.

2.2.2 Monitoring and Reporting Frequencies

Baseline data has been collected as part of this and previous hydrogeological investigations. However, additional baseline for the key identified groundwater parameters should be collected during a 12-month period prior to construction. This will provide a clear baseline comparison for water quantity and water quality conditions at the Site. A Baseline Conditions Report should summarize the existing pre-development conditions and serve as reference for key trigger levels.

Following the commencement of construction, monitoring of groundwater levels and groundwater quality will be conducted to track and assess potential changes. Groundwater levels should be checked quarterly and fitted with digital dataloggers to record continuous fluctuations in water levels. Quarterly Monitoring Reports will be generated through the entire duration of construction to track progress and change of key parameters.

At the end of the construction monitoring, a Post-development Monitoring Report will be prepared that summarizes pre-construction, during construction, and post-construction groundwater conditions. The report will be issued every three (3) years following completion of Phase 1. The report will also provide recommendations on any additional on-going mitigation action and/or monitoring, if required.

Post-development monitoring can be discontinued after the fourth tri-annual report (Year 12), if groundwater triggers have not been exceeded for the last three (3) years.

Table 3 summarizes the proposed monitoring activities and monitoring frequency for the project.

Table 3: Summary of the Proposed Monitoring Frequency [KS1]

Monitoring Parameters	Frequency / Interval		
	Pre-Construction	During-Construction	Post-Construction
Groundwater level at identified monitoring wells, observation wells and participating private wells	Quarterly and continuously with dataloggers	Quarterly and continuously with dataloggers	Quarterly and continuously with dataloggers
Groundwater quality (nitrates, bacteriological parameters, chloride, sulphate, total metals and inorganic parameters) at identified monitoring locations	Quarterly	Quarterly	Quarterly

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Monitoring Parameters	Frequency / Interval		
	Pre-Construction	During-Construction	Post-Construction
Groundwater quality (nutrients, microbiological parameters, chloride, sulphate, and inorganics) at participating private wells (community wells)	Quarterly	Quarterly	Annually
Effluent Quality (cBOD, COD, TSS, NO3, NH3,4-N/TKN, and PO4-P/TP)	-	Quarterly (first 15 lots, annually for remainder)	Annually
Reporting	Baseline Conditions Report (1)	Quarterly Monitoring Reports (TBD*1)	Tri-Annual Post-Development Monitoring Reports (4)

Note: *1 To be determined. The number of reports will be dependent of the duration of construction.

2.3 Contingency and Mitigation Plan

The proposed monitoring program will be put in place to identify potential impacts. An experienced team will be assembled to provide the expertise necessary to identify potential issues related to the development. In the event of an identified impact, the contingency and mitigation plan will be initiated.

2.3.1 Contingency Actions for Addressing Private Well Interference Complaints

If an unacceptable level of interference is observed on- and off-site, an alternative water supply will be provided for the well owner. An investigation will be conducted to determine whether the reported impact is directly related to the development activities. Based on the results of the investigation, one or more of the following mitigation measures could be implemented, at the cost of the developer:

- Water supply tank;
- Well modification / deepening;
- Replacement well; and/or
- Water quality treatment system, suitable to the identified parameter(s) of concern.

A letter will be provided to the well owner, indicating the investigation outcome, and the proposed mitigation plan.

If there are extensive private well interference issues related to water quality or quantity, then Phase 2 of the development will not proceed. Should unacceptable declines in water levels be observed in most of the wells monitored during the Phase 1 phase, then additional restrictions and conditions on water use in Phase 1 wells will be implemented and Phase 2 of the development will not proceed.

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3. Phase 2 Development

Phase 2 of the development can proceed as planned, if no groundwater triggers are exceeded through the first Tri-Annual Post-Development Monitoring Report, as describe above.

The length of the proposed post-construction monitoring program (12 years) is based on the inferred travel time through the unsaturated zone and underlying aquifer of potential nitrates from the residential septic systems and road salt chemicals through to downgradient monitoring points. Other potential impacts to groundwater quantity, such as groundwater interference, are expected to develop much faster.

If development Phase 2 is given approval to proceed, the monitoring program should continue through construction and post-construction of Phase 2 to Year 12 of the overall post-construction monitoring. If nitrate and/or chloride impacts are identified in later years of this Phase Two post-construction monitoring program, water treatment measures (e.g., reverse osmosis) will be implemented. This would be a warning clause to be enforced and implemented through the Subdivision Agreement.

4. Signatures

We trust that this information is sufficient for your current purposes. Should you require anything further, please do not hesitate to contact us.

Prepared by:

IBI GROUP



Aron Zhao, P. Eng.
Environmental Engineer



Steve Davies, M.Sc., P. Geo.
Senior Geoscientist

Attachment A: Revised Site Plan Showing Phase 1

Attachment B: Proposed Location of the Monitoring Stations

TOWN OF CALEDON
PLANNING
RECEIVED
Jul 12, 2021

IBI GROUP TECHNICAL MEMORANDUM

Environmental Management Plan (EMP)
Manors of Belfountain, Caledon, Ontario

Attachment A

Revised Site Plan Showing Phase 1

JUL 12, 2021



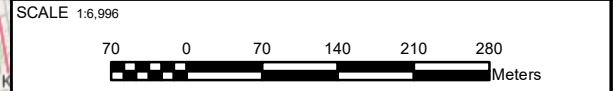
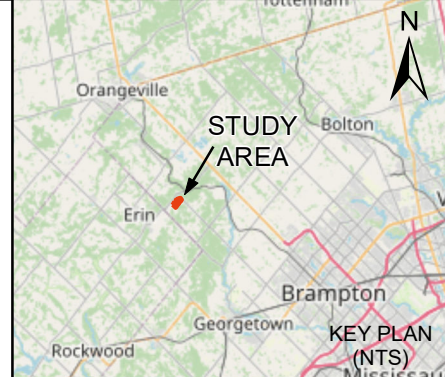
578547 579047 579547 580047
COORDINATES: UTM NAD 1983 CSRS ZONE 17.

LEGEND

- | | |
|--------------------|----------------------|
| Phases | Proposed Lots |
| — Proposed Phase 1 | - - Proposed Lots |
| — Proposed Phase 2 | |

REFERENCE

Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Terraprobe (2013) Borehole data sourced from Region of Peel's 2014 EA



PROJECT
Hydrogeological Investigation
Manors of Belfountain
Caledon, ON

TITLE
Phase 1 Lot and Layout Plan

[BI]	04/25/2021		2017-0646
	GIS	A.Z.	04/25/2021
	DESIGN		
	CHECK	S.D.	04/25/2021
FIGURE 1			

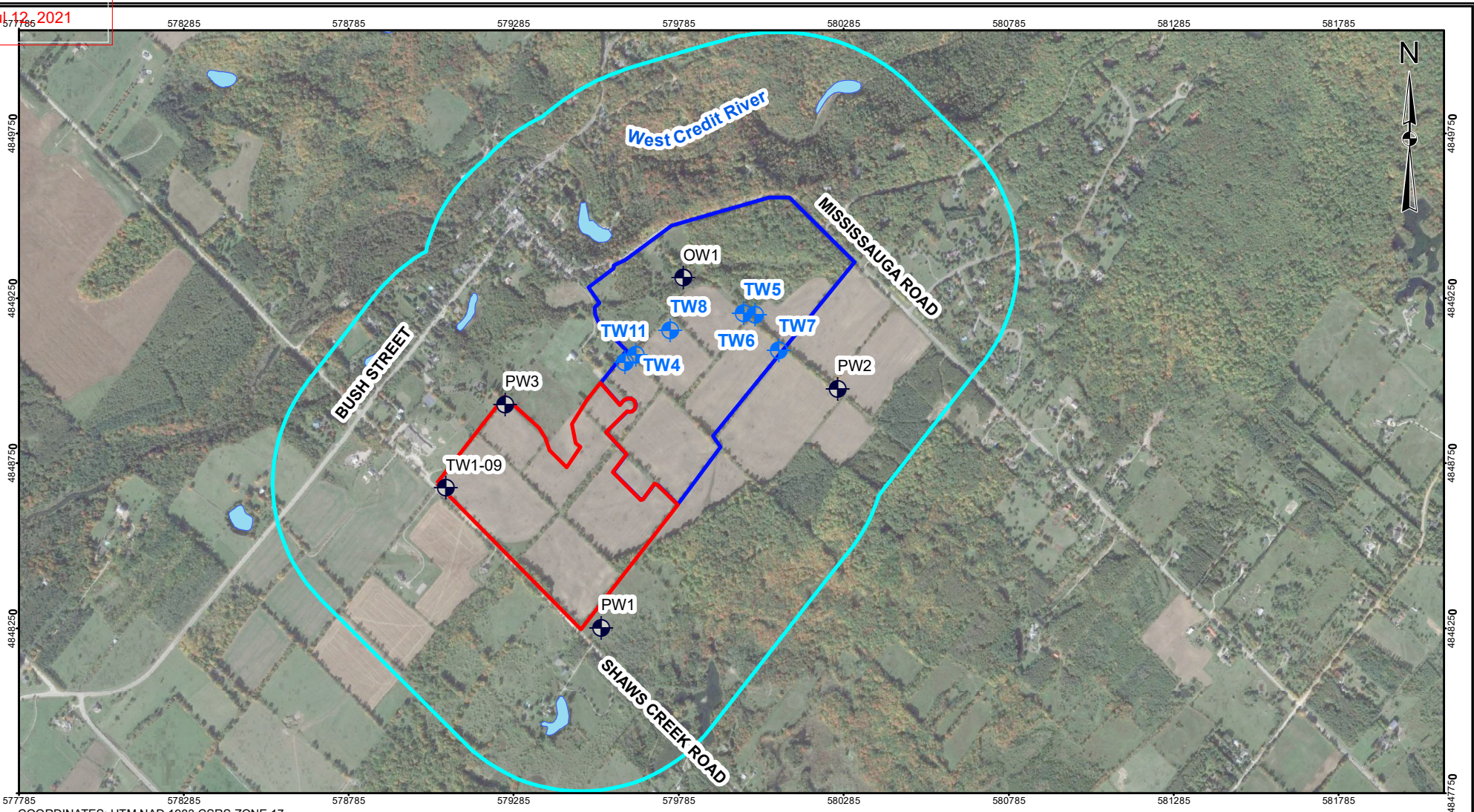
IBI GROUP TECHNICAL MEMORANDUM

Environmental Management Plan (EMP)
Manors of Belfountain, Caledon, Ontario

Attachment B

Proposed Location of the Monitoring Stations

Jul 12, 2021



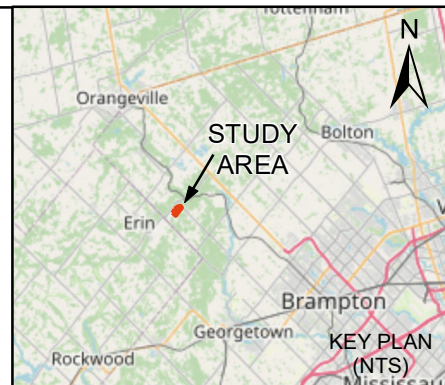
COORDINATES: UTM NAD 1983 CSRS ZONE 17.

LEGEND

- 500m Buffer
- + Test Wells
- Proposed Phase 1
- Proposed Phase 2
- Monitoring Stations

REFERENCE

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 Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 Terraprobe (2013) Borehole data sourced from Region of Peel's 2014 EA



SCALE 1:17,000

170 0 170 340 510 680 Meters

PROJECT Hydrogeological Investigation
Manors of Belfountain
Caledon, ON

TITLE **Phasing and Monitoring Plan**

[BI]	04/25/2021		2017-0646
	GIS	A.Z.	04/25/2021
	DESIGN		
	CHECK	S.D.	04/25/2021
FIGURE 2			REV. 1.0