



Environmental

Geotechnical

Building Sciences

Construction Testing
& Inspection

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Locations

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October 9, 2024

Town of Petawawa
1111 Victoria Street
Petawawa, ON K8H 2E6

Attn: Trevor Woodtke
Asset/Energy Management Coordinator

Re: Groundwater Monitoring Plan for the Petawawa Net Zero Project
Cambium Reference: 11757-004

Dear Trevor,

Cambium Inc. (Cambium) was retained by the Town of Petawawa (the Client) to prepare a groundwater monitoring plan for the Petawawa Net Zero Project (PNZP), which is situated within the Petawawa Water Pollution Control Plant (WPCP), located at 560 Abbie Lane, Petawawa, Ontario (the Site; Figure 1).

Cambium understands that the PNZP will transform the WPCP by upgrading the plant's existing anaerobic digesters, improving the digestion efficiency of the WPCP sludge, and allowing additional biosolids and organics (from food waste or fats, oils and grease) to be brought into WPCP from the Town and neighbouring wastewater plants as well as other biosolid producers. The resulting biogas production will be used in a Combined Heat and Power (CHP) unit. Upon completion, the PNZP will comprise a Class 3 anaerobic digestion facility that will receive, temporarily store, and process a maximum of 36,135 tonnes of liquid organic waste and generate a maximum of 200 kW of electricity per year.

A condition of Renewable Energy Approval Number 5211-CM3MB6 is the preparation of a groundwater monitoring plan that will identify any leaks in the partially below-ground Anaerobic Digesters and Digestate Storage Tanks.

The following sections provide the details of the baseline and ongoing monitoring and sampling plan for the Site, including the locations and construction of monitoring points, monitoring frequency and parameters, and contingency actions.



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SUBSURFACE CONDITIONS

Cambium completed a borehole investigation at the Site on May 17 to 18, 2021 (Cambium, 2021). Seven boreholes were advanced to depths ranging from 2 to 6.5 metres below ground surface (mbgs) or refusal. All borehole locations are shown in Figure 1. Four of the boreholes (BH) were completed as monitoring wells (MW) to allow for the ongoing measurement of groundwater elevations and water quality (see Figure 1).

Due to the variable nature of the soils onsite, subsurface conditions for the subject site have been separated into three areas, as shown on Figure 1. Table 1, below, shows each area with the corresponding boreholes advanced within the area.

Table 1 Areas of Investigation

	Area 1		Area 2	Area 3				
Borehole/ Monitoring Well	MW101 -21	BH105 -21	MW102 -21	MW103 -21	BH104 -21	BH106 -21	BH107 -21	MW10 8-21

Area 1 is located at the southeast side of the site where the buffer tank, slurry tank, and truck reception pad are to be located. Area 2 is located in the northern area of the Site where the gas conditioning and CHP area is to be located. Area 3 is located in the northern area of the Site where the dewatering building and digester upgrades are to be located.

The footprint of the treatment plant appeared to be built up approximately 1 meter higher than the surrounding area. This is likely due to the swampy, saturated nature of the area which was evident by the standing surface water observed surrounding the treatment plant footprint during the July 2021 field work.

Site conditions generally consist of up to 150 mm of topsoil overlying fill material mixed with sands, gravels, and rock. Beneath the fill material stratigraphy includes sand with varying amounts of gravel, underlain by finer grained sands and occasional silt or clay matrices (Cambium, 2021). Difficult drilling conditions were encountered within the fill material which may have included blasted rock



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fill. This material may have been placed previously to fill in low lying areas or bridge soft, weaker materials.

Native subgrade soils encountered at the Site are variable but generally consist of sands to sandy silty clays overlying glaciofluvial deposits predominately consisting of sands with varying amounts of gravel, silt, and clay.

GROUNDWATER FLOW CONDITIONS

Four of the boreholes advanced during the geotechnical investigation were instrumented with monitoring wells (Figure 2). Monitoring wells MW101-21, MW102-21, and MW108-21 are screened between 0.91 and 3.91 mbgs. As groundwater was encountered almost near surface in MW103-21, the monitoring well was screened from 0.91 to 3.0 mbgs (Cambium, 2021).

Piezometric elevations measured in the four monitoring wells were on July 26, 2021, were used to estimate groundwater flow direction (Figure 2). Groundwater flow was to the northeast, toward the Ottawa River, with MW103-21 and BH108-21 located upgradient of the digester, and MW101-21 and MW102-21 located downgradient. Horizontal hydraulic gradients ranged from approximately 0.008 to 0.02 during the 2021 monitoring event.

Hydraulic conductivity of soils was estimated via single well hydraulic testing (slug tests). Results ranged over three orders of magnitude, from 4.89×10^{-7} to 1.27×10^{-5} m/s.

Monitoring Well	Hydraulic Conductivity (m/s)
MW101-21	4.89×10^{-7}
MW102-21	1.27×10^{-5}
MW103-21	8.24×10^{-6}
MW108-21	3.81×10^{-5}

Assuming a soil porosity between 0.15 and 0.30, average linear groundwater velocities during the 2021 monitoring event were between 0.4 and 54 m per year.



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GROUNDWATER MONITORING PROGRAM

Three of the four monitoring wells installed during the geotechnical investigation remain operational and will be used during the baseline and ongoing monitoring (MW101-21, MW103-21, and MW108-21, see Figure 1). A fourth monitoring well will be installed outside the footprint of the physical plant and bunding to provide a second downgradient monitoring point following the decommissioning of MW102-21.

Based on the groundwater flow directions measured during the July 2021, the recommended location of the replacement monitoring well is between Area 1 and Area 2, in the centreline of groundwater flow downgradient from the digestate storage tanks, as shown on Figure 2 and the attached draft site grading plan.

Initial Monitoring

To identify any seasonal trends in groundwater elevations, flow direction, or quality, and to establish baseline conditions, groundwater elevations in all four monitoring wells will be manually measured quarterly (every three months) for the first year of the program. Water levels will be measured manually during the quarterly events using an electronic water level meter.

During the first monitoring event, a pressure transducer data logger will be installed in the nearest downgradient monitoring well to enable ongoing, high-resolution (twice-daily) measurements of water levels and temperature. A barometric data logger will also be installed to compensate for changes in atmospheric pressure.

During the first monitoring event, all monitoring wells will be developed by mechanically surging the screened portion using a surge block and HDPE tubing. During all events, static water levels will first be measured, then each well will be purged of a minimum of three well volumes or until water runs clear and the following field parameters stabilize:

pH, temperature, electrical conductivity, dissolved oxygen, oxygen reduction potential.



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Following well purging, groundwater samples will be taken from all monitoring wells during each quarterly monitoring event and analyzed at the project laboratory for the following physical and geochemical indicators of potential impacts from the PNZP operations:

pH	total dissolved solids	total coliform, E. coli.	total Kjeldahl nitrogen
alkalinity	dissolved metals	total ammonia nitrogen	chemical oxygen demand
chloride	total organic carbon	nitrate	biological oxygen demand
potassium	total dissolved phosphorus	nitrite	dissolved methane

Samples will be collected in laboratory-provided containers, stored between 0 and 10°C, and be submitted under chain-of-custody to a CALA-certified laboratory for analysis within 24 hours of collection.

Blind duplicate samples will be collected at a rate of approximately 1:10 and analysed for the analytical suite listed above.

Ongoing Monitoring

A datalogger will remain installed and operational in the downgradient well for the duration of the monitoring program. Given the estimated groundwater flow rates at the Site, monitoring frequency will be reduced to semi-annually (twice yearly, during the spring and autumn) in the second and all subsequent years of the program.

Groundwater elevations in all four monitoring wells will be manually measured and samples will be taken from all monitoring wells during each monitoring event for the physical and geochemical indicators of potential impacts from the PNZP operations collected during the baseline events.

MONITORING RESPONSE PLAN

Trend Analysis

Water levels, and the physical and chemical indicator measurements will be evaluated immediately upon completion of analysis for abrupt shifts at a specific point in time (step trend) and for gradual changes over time that are consistent in direction (monotonic trend).



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A step change will be considered abrupt if any parameter:

1. which did not exceed the applicable Provincial Water Quality Objectives (PWQO) or O.Reg. 153/04 criteria during the baseline period is determined to subsequently exceed the corresponding criteria.
2. is less than the applicable criteria but is greater than three times the maximum baseline concentration if >5 times the laboratory limit of reporting, or five times the maximum baseline concentration if < 5 times the limit of reporting.

Monotonic trends will be evaluated using the Mann-Kendall or seasonal Kendall procedures, depending on the significance of seasonal changes measured during the baseline monitoring period. An increasing monotonic trend will be followed up if, over three consecutive monitoring events, there is:

1. sustained parameter concentrations of more than three times the maximum baseline concentration (for laboratory analyses)
2. sustained measurement of field parameters more than 10% greater than the maximum baseline results

Response Plan

The Client or their representative will promptly notify the MECP District Officer should any parameter exceed the applicable criteria at the Site, or if an abrupt shift or gradual changes indicate leakage from the facility to groundwater

If an abrupt step change or increasing monotonic trend is observed, the relevant wells will be promptly resampled to verify the result(s).

Should results be confirmed, monitoring frequency will be increased to quarterly, and the Client will coordinate an inspection of the PNZP and associated plant to determine the potential cause(s) of the observation.

Additional tasks that may be undertaken will depend on the nature of the observed changes and may include: additional analyses for a broader range of chemical indicators; further subsurface investigation; and/or detailed hydrogeological assessment of the Site.



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The response will continue until such time as the cause of the change(s) is determined and resolved, and it can be demonstrated the PNZP operations are consistent with the requirements of the REA for the facility.

CLOSING

We trust that the information in this submission meets your current requirements. If you have any questions regarding the contents of this plan, please contact the undersigned.

Respectfully submitted,

Cambium Inc.

Signed by:

A84A949C3B4C4B4...

Kyle Horner, Ph.D., P.Geo.

Senior Hydrogeologist – Senior Project Manager

KNH/knh

Encl. *Cambium Qualifications & Limitations*
 Figure 1 Borehole Location Plan
 Figure 2 Groundwater Configuration Plan
 Grading Plan

\\cambiumincstorage.file.core.windows.net\projects\11700 to 11799\11757-004 Twn-Petawawa - PNZP GW Mntmg - 560 Abbie Ln\Deliverables\REPORT - Monitoring Plan\Final\2024-10-09 RPT PNZP GW Monitoring Plan.docx

Signed by:



2024-10-09



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A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

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Personal Liability




The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.





**GROUNDWATER
MONITORING PLAN**
TOWN OF PETAWAWA
560 Abbie Lane
Petawawa, Ontario

LEGEND

-  Borehole
-  Monitoring Well
-  Area of Interest

Notes:
- Aerial Imagery obtained from the Maxar (WV02) image captured on Jul 1, 2023 as shown in the 2024-03-28 version of the World Imagery map.
- This document contains information licensed under the Open Government License - Ontario.
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.



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BOREHOLE LOCATION PLAN

Project No.: 11757-004		Date: August 2024	
Scale: 1:1,200		Projection: NAD 1983 UTM Zone 18N	
Created by: LD	Checked by: KH	Figure: 1	



**GROUNDWATER
MONITORING PLAN**
TOWN OF PETAWAWA
560 Abbie Lane
Petawawa, Ontario

LEGEND

- Borehole
- Monitoring Well
- Proposed Monitoring Well
- Decommissioned Monitoring Well
- (196.71)** Groundwater Elevation (July, 2021)
- Groundwater Contour (0.2m Interval)
- Groundwater Flow Direction (July, 2021)

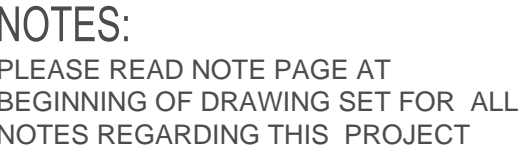
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**GROUNDWATER
CONFIGURATION PLAN**

Project No.: 11757-004		Date: October 2024	
Scale: 1:1,200		Rev.: NAD 1983 UTM Zone 18N	
Created by: LD	Checked by: KH	Figure: 2	



 PROPERTY LINE
 BUILDING
 FENCE LINE
 STORM SEWER
 SANITARY SEWER
 WATER SERVICE
 STUDY AREA

DRAFT - NOT FOR CONSTRUCTION



STONECREST
ENGINEERING INC.
EST. 1995

440 Wright Blvd Unit #2, Stratford, ON, N4Z 1H3
519-625-8025 ~ info@stonecrestengineering.com

CLIENT:	ANAERGIA
LOCATION:	560 ABBIE LANE, PETAWAWA, ON
PROJECT TYPE:	SECONDARY STORAGE AND STORMWATER DESIGN
PROJECT STATUS AND VERSION:	SITE GRADING

G1