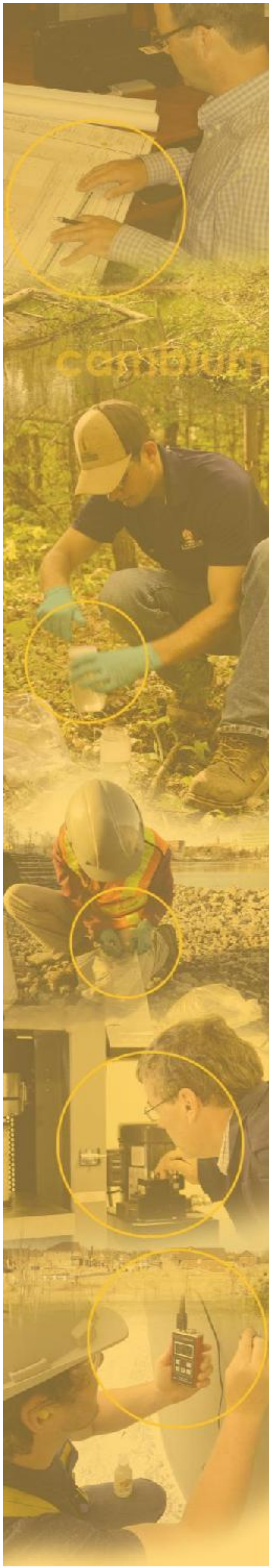

2018 Performance Report McClintock Septage Lagoon

Environmental Compliance Approval No.: 3746-8RRM8C

Cambium Reference No.: 7206-007

March 25, 2019

Prepared for: The Corporation of the Township of Algonquin Highlands

Cambium Inc.

P.O. Box 325
52 Hunter Street East, Peterborough
Ontario, K9H 1G5

Telephone: (866) 217.7900
Facsimile: (705) 742.7907

cambium-inc.com

Table of Contents

List of Embedded Tables

List of Appended Figures

List of Appended Tables

List of Appendices

1.0 Introduction

The Corporation of the Township of Algonquin Highlands (Township) retained Cambium Inc. (Cambium) to complete the 2018 annual monitoring program and prepare a performance report for the hauled sewage disposal site, known as the McClintock Septage Lagoon (Site). The McClintock Septage Lagoon is in the geographic Township of McClintock, Township of Algonquin Highlands, County of Haliburton.

The Site operates under amended Ontario Ministry of the Environment, Conservation and Parks (Ministry) Environmental Compliance Approval (ECA) No. 3746-8RRM8C (Appendix A), which came into effect on March 14, 2012 (Appendix A). As per the ECA, the existing septage treatment lagoon is capable of handling a maximum septage volume of 2,470 m^3 and has an exfiltration rate of 3,000 m^3, in a given year. The ECA also includes an allowance for a concrete screening box with a design capacity of 3.4 m^3.

An annual performance report must be prepared to satisfy Condition 7 (3) of the ECA, which requires the Site owner to prepare and submit a performance report on an annual basis within ninety (90) days following the end of the period being reported upon. This Performance Report is specific to the period from January 1, 2018 to December 31, 2018.

1.1 Site Location

The Site is on Part 1, Plan 19R-4134 and Parts 1 & 2, Plan 19R-7214, known as Part of Lots 14 & 15, Concession 2, in the geographic Township of McClintock, Township of Algonquin Highlands, County of Haliburton, approximately 8.2 km northeast of the Hamlet of Dorset (Figure 1). Access is gained to the Site from 1068 Wes Clarke Trail, which is approximately 400 m east of McClintock Road (Figure 2). The Site property is approximately 3.33 ha in area. The Universal Transverse Mercator (UTM) coordinates for the Site entrance are Zone 17, 669178m east, 5018619m north.

1.2 Scope of Work

The scope of work completed in 2018 as required by the ECA included:

- groundwater and surface water monitoring twice annually (spring and autumn) at established sampling locations identified on Figure 2
- analysis of the quality of the raw septage during unloading on a bi-monthly basis
- preparation of an annual performance report containing annual environmental monitoring information, as well as operational information related to Site activities

Volumes of septage received and placed in the lagoon during the reporting period, as well as analytical results for the septage received at the Site, are included within this 2018 Performance Report. Results of the groundwater and surface water sampling program are presented and discussed in Section 4.0 and a detailed account of 2018 Site Operations is included in Section 5.0.

In addition, this report addresses comments and recommendations made by Dana Cruikshank, Surface Water Specialist, Eastern Region Technical Support Section, dated December 10, 2018, following his review of the *2017 Performance Report* (Cambium, 2018); refer to Appendix B for a copy of the correspondence.

1.3 Description of Operation

The McClintock Sewage Lagoon was established to receive hauled liquid waste from local septic and sewage holding tanks. The liquid is received into a single exfiltration lagoon cell directly from haulage trucks, after passing through a concrete screening box. The approved screening box measures 3.86 m x 2.13 m with a depth of 0.65 m and a design capacity of 3.4 m^3. It is comprised of a gravity drained concrete tank with two compartments divided by a steel bar screen to prevent non-sewage waste from entering the lagoon. Details of the lagoon are included in Section 5.0.

Discharge of effluent from the lagoon cell occurs by percolation into the sandy overburden below the cell and by evaporation. Solids settle to the bottom of the lagoon and, over time, fill the voids in the underlying sandy soils. The solids are periodically re-distributed to allow further percolation into the overburden. There is no direct removal of supernatant or sludge from the lagoon for disposal purposes.

Embedded Table 1 Lagoon Details

Dimensions (m)	36.5 x 30.5
Area (m²)	1,113.25
Depth (m)	2.4
Minimum Freeboard Required (m)	0.3
Operating Depth (m)	1.0
Maximum Allowable Septage Volume per year (m³)	2,470
Exfiltration Rate (m³/yr)	3,000
2018 Septage Volume Received (m³)	1,582.5
Dates Septage Received	May to November

According to Trow Associates Inc. (Trow, 2010), the Township installed two Geotubes® at the Site in October/November 2009 to allow for passive dewatering of the lagoon sludge. The Geotube® dewatering system was designed to remove and dewater a maximum of 35 dry tons of sludge from the lagoon. The Geotube® process was initiated to restore the full capacity of the lagoon and to improve infiltration rates to avoid closures of the Site which had started to become more frequent. The basic process of Geotube® dewatering is as follows: lagoon contents are agitated to lift solids off the flow of the lagoon; contents are pumped into Geotubes® (textile like bags) which allow supernatant to drain through and back into the lagoon while solids are retained. Once the Geotubes® have filled with solids to design capacity, which may allow for multiple lagoon contents processing, the tubes are opened and the solids disposed of off-site.

The location of the Geotubes® is illustrated on Figure 2. The existing drainage area accommodates 2 - 13.7 m circumference x 17.4 m long Geotubes® which are laid on top of a gravel drainage area to promote dewatering. Overall, the drainage area may be described as follows:

- One geotextile and gravel drainage area of approximately 18.5 m x 22.0 m is used to accommodate both Geotubes®.

- The bottom of the drainage area is sloped at approximately 1% to drain directly into the lagoon.
- Each existing Geotube® has a calculated input capacity of approximately 2,445 m^3 of liquid septage at an estimated 1.2% solids which is sufficient to accommodate one year of the currently approved septage input to the lagoon.
- The two Geotubes®, which are accommodated by the existing drainage area, offer approximately two years of operational life based on design.
- After dewatering to approximately 18% solids, each Geotube® will produce approximately 163 m^3 of dewatered sludge for removal and disposal.

No septage was transferred to the Geotubes® in 2018. Presently, the Geotubes® have been dewatered, but have remaining capacity available; therefore, the Geotubes® will be left on-site for future operational use, if required. The status of the Geotubes® will be reported on within each annual Performance Report until the tubes are no longer in use at the Site.

1.4 Proposed Site Expansion

The Township is currently in the process of completing the studies required to expand the existing Site. One option for the expansion that is being considered is to include a number of dewatering trenches constructed adjacent (south) the existing lagoon. Some items that have been completed to date for this project include:

- One public consultation event
- First Nations Consultation, by way of Notice of Project Commencement
- Hydrogeological Assessment
- Natural Heritage Study
- Archaeological Study

Draft reports have been prepared. The reports will be submitted to the Ministry for review and comment prior to finalizing as part of the pre-consultation process.

The existing Site is not large enough to support an expansion and all adjacent lands are owned by the Crown (Ministry of the Natural Resources and Forestry (MNRF)). The MNRF has agreed, in principle, to\ transfer the lands to the Township, pending the results of a Resource Stewardship and Facility Development Class EA.

2.0 Methodology

The work program completed in 2018 was to maintain compliance with the Site ECA and Ministry policies. Field tasks were completed following Cambium's Standard Operating Procedures developed from recognized standard procedures such as the Ministry document *Guidance on Sampling and Analytical Methods for use at Contaminated Sites in Ontario* (MOEE, 1996). A health and safety program was developed for Site specific conditions and all Cambium personnel working on the project were familiarized and required to follow the identified protocol.

All field work was completed by Cambium field personnel. Groundwater and surface water samples were collected using standard field sampling protocols at the locations and frequencies shown in Table 1. All collected surface water and groundwater samples were stored in coolers with freezer packs and maintained less than 10°C after collection and during transport to the Caduceon Environmental Laboratories in Kingston, Ontario (Caduceon). Caduceon is accredited by the *Canadian Associations for Laboratory Accreditation Inc*. (CALA) for specific environmental tests listed in the scope of accreditation approved by the CALA.

2.1 Groundwater Monitoring Program

Groundwater sampling and monitoring was completed on May 1 and September 27, 2018. Groundwater samples were collected by Cambium in accordance with the approved monitoring program, from the following monitoring wells:

- MW1
- MW2
- MW3
- MW4B
- MW5B
- MW6

In addition, water levels are also collected during each sampling event at monitoring well MW4.

The following exceptions were noted:

- No samples were analyzed for total mercury in May due to a bottle error.

- Although a sample was collected from monitor MW1 in May, the bottles were misplaced and did not reach the lab for analysis.
- Monitoring wells MW3 and MW6 were observed to be dry during the October event and samples could not be collected.
- There were no other deviations from the groundwater monitoring program summarized in Table 1.

The following tasks were completed as part of the monitoring program:

- Prior to sampling, water levels were measured at each monitoring well using an electronic water level tape.
- Each groundwater monitoring well to be sampled was purged of approximately three well bore volumes. Where wells were observed to go dry, only one well volume was purged. The volume of groundwater to be purged was calculated on-site during each monitoring event using the measured water level and the well diameter. Purged water was disposed of on-site, down-gradient of each respective monitor.
- Samples were collected using dedicated polyethylene tubing equipped with inertial-lift footvalves.
- Where required (i.e., groundwater for metals analysis), samples were field-filtered.
- Field measurements were collected including: pH, conductivity, temperature, dissolved oxygen (DO), and oxygen reduction potential (ORP).
- The weather conditions prior to and during each field sampling event were recorded.

Results are discussed in Section 4.1 and analytical data is presented in Table 2 through Table 4.

The locations of the monitoring wells are illustrated on Figure 2 and a description of each monitor is included in Embedded Table 10. The laboratory Certificates of Analysis provided by Caduceon are in Appendix C, photographs of the sampling location are in Appendix D, and field data sheets are in Appendix E.

The following blind duplicate groundwater samples were collected as part of the Quality Assurance/Quality Control (QA/QC) program. In addition to these samples, the laboratory completes internal QA/QC. As this represents at least 10 percent of the samples taken, this program is considered sufficient. The results of the QA/QC program are presented in Section 4.1.

- May and September: MW5B

2.2 Surface Water Monitoring Program

Cambium conducted the surface water sampling events concurrently with the groundwater sampling events on May 1 and September 27, 2018. The following five surface water sampling stations are currently included in the monitoring program:

- MCSW1
- MCSW2
- MCSW3B
- MCSW4
- MCSW5

The following exceptions to sampling were noted:

- Station MCSW1 was observed to be dry during the September sampling event and samples could not be collected.
- Station MCSW5 Culvert 2 was not measured for depth, flow velocity, and discharge in September due to a beaver dam obstructing the culvert. Refer to Appendix D for photo.
- There were no other deviations from the surface water monitoring program outlined in Table 1.

The following tasks were completed as part of the monitoring program:

- Surface water samples were collected by immersing the sample container into the water body.
- Where sample bottles were prefilled with preservatives, a clean bottle was used to collect and decant the water directly into the sample bottle.
- Field measurements were collected including: pH, conductivity, temperature, DO, and ORP.

- Where possible, the following measurements were collected at each surface water location: depth, width, and flow velocity measurements.
- The weather conditions prior to and during the field sampling event were recorded.

The results of the surface water monitoring program are discussed in Section 4.2 and analytical results are summarized in Table 5.

The locations of the sampling stations are illustrated on Figure 2 and a description of the surface water sampling locations is in Embedded Table 2. The laboratory Certificates of Analysis provided by Caduceon are in Appendix C, photographs of the surface water sampling stations are in Appendix D, and the surface water field data sheets are in Appendix E.

The following blind duplicate surface water samples were collected as part of the QA/QC program. In addition to these samples, the laboratory completes internal QA/QC. As this represents at least 10 percent of the samples taken, this program is considered sufficient. The results of the QA/QC program are presented in Section 4.2.

- May and September: MCSW5

3.0 Geological and Hydrogeological Context

3.1 Topography and Drainage

The Site is in the northeast portion of the Muskoka River watershed. The headwaters of the watershed span from Algonquin Provincial Park and drain southwesterly into Georgian Bay. The Muskoka River watershed receives above average precipitation when compared to the rest of Ontario and is integral for cold water fish species and wildlife diversity (MHF, 2012). Tourism is predominant in the watershed and is used primarily for recreational uses, such as seasonal residents, whitewater kayaking, and fishing. There are no provincially significant wetlands within 500 m of the Site.

The Site is located in a low-lying area, relative to the hilly landscape of the surrounding topography which is characteristic of the Haliburton Highlands. Surface drainage is primarily to the north and northeast, toward a tributary to Harvey Lake Creek, identified as ‘Tributary Stream’ on appended Figure 2. Harvey Lake Creek is 435 m directly east of the Site and the tributary stream is approximately 250 m northeast of the Site. These watercourses are the closest permanent watercourses to the Site and both flow into Kawagama Lake, into the bay locally known as Fletcher Bay.

There are currently five surface water sampling locations included in the monitoring program for the Site; locations are on Figure 2 and details of each location are in Embedded Table 2. Surface water flows and discharge rates were determined and are summarized in Embedded Table 3; additional details are provided in Appendix E.

Embedded Table 2 Surface Water Sample Location Descriptions

Sampling Station	UTM (Zone 17)	Description
Tributary Stream		
MCSW1 (Background)	669843 5019267	Upstream of septage lagoon on McClintock Road
MCSW4	670302 5018827	100 m west of the confluence of Harvey Lake Creek and the Tributary Stream
Harvey Lake Creek		
MCSW2 (Background)	670277 5018597	Approximately 100 m south (upstream) of Wes Clarke Trail
MCSW5	670264 5018681	Culverts on south (upstream) side of the crossing of Wes Clarke Trail
MCSW3B	670302 5018827	North (downstream) of confluence of Harvey Lake Creek and Tributary Stream, approximately 150 m north of Wes Clarke Trail in the centre of the waterway. It is noted, monitoring station MCSW3 was moved from the wetland area on the eastern shore of Fletcher Bay into the open water of Fletcher Bay in October 2012; the monitoring station was renamed MCSW3B to reflect this change.

Embedded Table 3 Surface Water Sampling Observations

Location	May		September	
	Velocity (m/s)	Discharge (m^3/s)	Velocity (m/s)	Discharge (m^3/s)
MCSW1	0.70	0.028	Dry	
MCSW2	Too wide and too deep to measure		Too wide and too deep to measure	
MCSW3B	Too wide and too deep to measure		Too wide and too deep to measure	
MCSW4	0.35	0.315	0.10	0.019
MCSW5[1]	1.30	0.311	0.50	0.310

Note:

1. *Measured at two culverts in May; September discharge was estimated based on measurements at one culvert and extrapolated discharge at the second culvert..*

Based on these measurements, discharge values for the Tributary Stream (MCSW4) and Harvey Lake Creek (MCSW5) to Fletcher Bay were calculated for the 2018 monitoring program. Discharge values are summarized in Embedded Table 4 for comparison to historical data.

Embedded Table 4 Summary of Discharge to Fletcher Bay (Kawagama Lake)

Year	Daily Discharge m^3/day		
	Spring	Autumn	Average
2011	NA	19,872	NA
2012	NA	7,776	NA
2013	45,792	55,642	50,717
2014	35,597	103,162	69,379
2015	18,921	864[2]	NA[3]
2016	20,736	6,912[2]	NA[3]
2017	16,070	6,480[2]	NA[3]
2018	54,086	28,426	41,256

Note:

1. *NA indicates discharge values were not available for the sampling period.*
2. *Discharge based on influx from one location only.*
3. *Average discharge could not be accurately calculated based on lack of flow data at one or both locations.*

Based on the above, the discharges into Fletcher Bay over the entire year were average. During the May sampling event, the discharges from the Tributary Stream and Harvey Lake Creek were approximately equal. During the autumn, there was limited discharge from the Tributary Stream into Fletcher Bay opposed to Harvey Lake Creek which was approximately the same discharge observed in May.

3.1.1 Effects of Climate on Site Operation

There are three weather stations in the general proximity of the McClintock lagoons. Where available, data is compared between the 2018 precipitation records, climate normals (1981-2010), and data recorded at the Site. This information is used to estimate the total contribution to the lagoon from precipitation and evaporation (surplus). Refer to Embedded Table 5 for a summary of the information collected on the adjacent weather stations. It is noted, due to issues with the rain gauge in 2018, on-site precipitation data could only be relied on for May to September.

Embedded Table 5 Annual Precipitation Data

Station	Location	Distance from Site	Years Data Available	Annual Average Precipitation [1] (May to October only)	2018 Total Precipitation (May to October only)
Sprucedale	Sprucedale	55 km northwest	2003 – current	NA	1042.4 mm (540.9 mm)
Haliburton 3	Haliburton	38 km south	1987 – current	1073.5 mm (544 mm)	1102.8 mm (526.8 mm)
Algonquin East Gate	Whitney	50 km east	2004 – current	NA	884.5 mm (447.6 mm)
McClintock Site	-	on-site	-	-	(412.0 mm)[2]

Notes:

1. *1981-2010 Climate Normals, as obtained from Environment Canada (Government of Canada, 2015).*
2. *Total precipitation data from May to September*

Embedded Table 6 May to October Monthly Station Precipitation Data (mm)

2018	On-site	Algonquin East Gate	Sprucedale	Haliburton 3	Normals
May	41.7	56.4	83.2	79.4	93.3
June	47.5	31.5	43.0	61.0	81.2
July	86.4	72.3	15.6	63.6	90.1
August	155.4	113.8	225.8	149.4	79.0
September	81.0	81.3	75.6	79.6	100.2
October	-	92.3	97.7	93.8	100.2
Total	*412.0*	*447.6*	*540.9*	*526.8*	*544.0*

From Embedded Table 5 and Embedded Table 6, it can be seen that the 2018 precipitation data indicated that the area received normal precipitation depths, with the exception of Algonquin East Gate which reported less-than-normal precipitation. As some data was missing from the on-site rain gauge and the Algonquin East Gate (AEG) station best mirrored the precipitation received from May to September on-site, the annual precipitation data from AEG was used to determine the inputs to the lagoon in 2018.

A review of the 2018 precipitation data at the AEG in comparison to the precipitation normals for Haliburton County (1981 to 2010; (Government of Canada, 2015)), indicated that overall precipitation in 2018 was less than normal. The sampling months saw less-than-normal precipitation and the months of April and August saw nearly 50% more than the normal precipitation. Precipitation data for April, May, and September have been included in Appendix E. Monthly precipitation data and the amount of precipitation received during and within three days of each sampling event is included in Embedded Table 7.

Embedded Table 7 Historical and 2018 Precipitation Data

Sampling Date	Average Monthly Precipitation (mm) (1981-2010)	2018 Precipitation (mm)	Precipitation During and Prior to Sampling (mm)
May 1, 2018	93.3	56.4	0.7
September 27, 2018	100.2	81.3	7.5

In historical reports, lagoon inputs considered total precipitation when determining the annual inputs for the lagoon. In some cases, the lagoon was perceived to be nearing the exfiltration limit of 3,000 m^3/year; however, a more accurate determination of the annual input volume takes into account the potential evaporation occurring in the lagoon during warmer periods of the year. Therefore, the lagoon surplus (precipitation – evaporation) was calculated and applied to establish the lagoon inputs in 2018; refer to Embedded Table 8.

Embedded Table 8 2018 Precipitation Surplus Data (mm)

2018	AEG Precipitation	Potential Evaporation	Surplus
January	56.9	0	56.9
February	64.5	0	64.5
March	35.5	0	35.5
April	105.5	0	105.5
May	56.4	65.8	-9.4
June	31.5	85.3	-53.8
July	72.3	107.8	-35.5
August	113.8	94.1	19.7
September	81.3	62.0	19.3
October	92.3	31.0	61.3
November	103.1	0	103.1
December	71.4	0	71.4
Totals	*884.5*	*446.0*	*438.5*

Embedded Table 9 provides the calculations used to determine the inputs to the lagoon from precipitation (i.e., surplus) in 2018.

Embedded Table 9 Precipitation Inputs, 2018

		Lagoon Inputs
Total Precipitation (mm)	884.5	
Total Surplus (mm)	438.5	
Surface Area of Lagoon (m²)	1,113.3	
Geotubes® Area (m²)	407.0	
Surplus Contribution, Lagoon (m³)	488.2	
Surplus Contribution, Geotubes® (m³) [1]	178.5	
Surplus Contribution, Total (m³)		*666.6*

Notes:

1. It is assumed all precipitation that falls on the Geotubes will enter the lagoon (no evaporation).

3.2 Hydrogeological Setting

The Site is in a rolling upland area characteristic of this region of Ontario. According to available mapping, the Site and surrounding area are characterized by a bedrock region composed of felsic igneous granodiorite, tonalite, monzonite, derived gneisses, granite and syenite (OGS, 2011).

Based on existing information available from borehole logs (Appendix F) for the monitoring wells installed on-site, the overburden soil composition generally consists of sandy silt topsoil layer overlying a layer of fine sand with some silt; however, areas of loose medium sand and medium to coarse sand with some pebbles and trace gravel were observed (i.e., glacio-fluvial deposit). Depth to bedrock is at least 10.1 m below ground surface (mbgs), as documented at monitoring well MW6.

Five overburden monitoring wells (MW1, MW2, MW3, MW4, and MW5) were constructed in the vicinity of the lagoon facility between 1996 and 1997; no bedrock wells have been constructed at the Site to date. Monitoring wells MW4 and MW5 were replaced with monitoring wells MW4B and MW5B in 2006, due to sedimentation issues and damage, respectively. Monitoring well MW6 was constructed in 2010. Monitoring well details are included in Embedded Table 10; refer to Appendix F for complete borehole logs.

Embedded Table 10 Monitoring Well Descriptions

Monitoring Well	UTM (Zone 17)	Description
MW1	669770 5018563	30 m east of lagoon cell to a depth of 5.0 m into course sand overburden
MW2	669668 5018605	Northwest corner of lagoon cell to a depth of 5.9 m into sand/silt overburden
MW3	669636 5018637	20 m northwest of monitoring well MW2 to a depth of 4.5 m into course sand overburden
MW4 (water elevations only)	669824 5018586	85 m east of lagoon to a depth of 5.5 m into sand overburden. No longer sampled due to sedimentation.
MW4B	669823 501585	75 m east of the lagoon to a depth of 6.7 m into the fine sand with silt overburden
MW5B	669695 5018679	70 m north of lagoon near property boundary to a depth of 9.7 m in the fine sand with silt overburden
MW6	669763 5018655	85 m northeast of the lagoon near property boundary to a depth of 10.1 m at presumed bedrock – overlying strata composed of coarse to medium grained sand with gravel, some cobbles and boulders

3.2.1 Groundwater Flow

By monitoring the static water levels in all on-site monitoring wells, the groundwater flow direction in the vicinity of the Site can be determined. Groundwater elevations obtained from the monitoring wells are in Table 2, groundwater configurations for the spring and autumn are on Figure 3, and historical groundwater elevation trends are illustrated on Figure 4.

Water table elevation in the immediate vicinity of the lagoon cell varies. At monitors MW2, MW5B, and MW6, located adjacent and north of the lagoon, the depth to the water table is observed between 1.6 and 8.2 mbgs. At the monitors located west and east of the lagoon, groundwater is observed to be much shallower below ground, observed between surface and 3.5 mbgs. This is generally attributed to the undulating terrain observed at the Site.

Water elevations observed in 2018, as shown on Figure 4, were generally consistent with historical ranges and trends with the exception of well MW5B. The groundwater elevation at monitoring well MW5B was significantly lower in May compared to historical trends. Generally, groundwater elevations at the Site have exhibited an overall decreasing trend since 2013.

Natural variations due to climate change have likely influenced this trend, and are further discussed in Section 4.1.1.

Historically, hydraulic flows within the unconfined overburden aquifer have been observed to flow toward the low-lying swampy area to the north of the Site and Fletcher Bay to the northeast of the Site. Water level measurements and the topography of the area have indicated that the overall direction of groundwater flow should be towards the north and northeast, with a component of easterly flow. In 2018, groundwater flows were documented to be towards the northeast with a component to the north at wells MW5B and MW6, as expected. The 2018 horizontal hydraulic gradients observed were 0.085 in May and 0.075 in September (Figure 3).

4.0 Results and Discussion

Water quality analytical results from the monitoring program are used to assess the existence, extent, and intensity of impacts to the surface water and groundwater environments related to operation of the Site. This section presents the results of the 2018 monitoring program. Comparisons are drawn to available historical data, and observed trends in the groundwater and surface water quality are discussed.

4.1 Groundwater Quality

Analytical results for the groundwater samples collected in 2018 are provided in Table 3; historical analytical results (i.e. 2002 to 2010) have been included digitally with the report package. The 2018 results were compared against the historical data for the Site and compliance was assessed with the Ministry Reasonable Use Policy, which pertains specifically to groundwater (MOE, 1994).

Results from the analyses completed on the blind duplicate groundwater samples obtained from monitoring well MW5B in May and September, as part of the QA/QC program were evaluated. Parameter concentrations were considered to be significantly different if the relative percent difference (RPD) between the duplicate and the original samples was greater than 30RPD when both analytical results were greater than five times the reported detection limit (RDL).

In general, the data for duplicate groundwater samples were similar to the regular sample collected with the exception of those parameters outlined in Embedded Table 11. Concentrations of all identified parameters were observed to be within compliance criteria and historical concentration ranges. This was taken into consideration when interpreting the groundwater quality data at the Site in 2018.

Given that the groundwater samples at the Site are persistently observed to be opaque with sediment, it was inferred the discrepancies observed were related to the quality of the sample and the difficulty getting a true duplicate sample, particularly given the discrepancies noted for total suspended solids (TSS).

Embedded Table 11 Groundwater QA/QC Evaluation

Monitoring Well	Sampling Event	Parameter	Relative Percent Difference
MW5B	May	TSS	64%
		Total Kjeldahl Nitrogen (TKN)	33%
		Total Phosphorus	99%
MW5B	September	TSS	54%
		Total Volatile Solids	43%
		Total Phosphorus	73%
		Total Chromium	91%
		Total Cobalt	33%
		Total Lead	66%

In addition to the above, parent/duplicate samples with only one measurable concentration were assessed qualitatively. If the measurable concentration was close to the RDL, the sample results were considered valid and the measurable concentration was accepted. Evaluation of these parent/duplicate samples did not identify significant data quality issues.

Despite the variances noted, the groundwater data was considered suitable for its intended use, which was to identify changes in water quality and analyzed parameters present at concentrations greater than the applicable standards. As such, the groundwater analytical results were interpreted with confidence while caution was used in interpreting the parameters noted.

4.1.1 Cross-gradient Water Quality

Overburden groundwater quality is assessed at monitoring wells MW1, MW3, and MW4B; these wells are interpreted to represent water quality not impacted by the Site. Monitor MW4B was installed in 2006 to replace monitor MW4 due to sedimentation issues.

- Groundwater quality at monitor MW1 is characterized as having generally low concentrations of most parameters sampled, with the exception of an acidic pH and occasional elevated concentrations observed for dissolved aluminum. Nutrient concentrations at monitoring well MW1 are at or near the detection limit with the exception of low and stable concentrations of nitrate, indicating no evidence of impact from Site operations. Water quality indicated that the majority of the ammonia concentration consists of TKN. Figure 5 through Figure 7 show the concentrations of nitrogen parameters over time.

- In 2018, most parameter concentrations were consistent with historical results; however, an elevated concentration of TSS was documented in September 2018. Given the variations noted in the QA/QC data in October and the significant sediment observed in the sample, this was not unexpected.
- Groundwater obtained from monitor MW4B typically exhibits elevated concentrations of TSS, volatile solids, total phosphorus, and many total metals concentrations; however, generally low concentrations of most other parameters including dissolved metals and nutrients. That being said, concentrations of some dissolved metals have been sporadically elevated, such as iron and aluminum, and an acidic pH is often observed, consistent with monitor MW1.
- In 2018, water quality was generally consistent with historical results with the exception of elevated concentrations of TSS, dissolved organic carbon (DOC), chemical oxygen demand (COD), hardness, ammonia, and TKN, documented during one or both sampling events in 2017 and/or 2018. Given the issues with sedimentation in this well, the fluctuation parameters were likely due to natural variations. That being said, given the location of this monitor and the potential for a component of northeast groundwater flow, the elevated concentrations could have been reflective of a seasonal, albeit, marginal impact from the lagoon.
- Groundwater quality observed at monitor MW3 is consistent with that observed at locations MW1 and MW4B with the exception of a persistently acidic pH.
- In 2018, water quality was generally consistent with historical results with the exception of elevated concentrations of TSS, DOC, COD, hardness, and TKN, similar to well MW4B. In addition, copper and lead were observed to be elevated. The elevated copper and lead concentrations were attributed to the variations noted in the QA/QC data in 2018. The remaining parameters should continue to be monitored closely, as they could be

representative of a marginal impact at this location; however, were attributed to natural variations at this time.

Although annual precipitation was less than normals in 2018, month-to-month precipitation varied significantly. In general, climate has experienced a shift from steady, predictable wet periods of the year to long periods of dryness followed by significant precipitation events. Additionally, groundwater elevations at the Site have exhibited an overall decreasing trend since 2013.

Elevated concentrations of TSS and other solids are consistent with field observations that the water is opaque and brown at these locations and may indicate excessive sedimentation, consistent with conditions that led to the removal of well MW4 from the sampling program. Regardless, given the locations of monitoring wells MW1, MW3, and MW4B, groundwater quality is not interpreted to be impacted by the lagoon at these locations, with notable exceedances attributable to background water quality and/or substrate conditions. As such, elevated concentrations in down-gradient monitors in 2018 were interpreted with caution, and were not necessarily attributed to the Site.

4.1.2 Down-gradient Water Quality

Down-gradient water quality is assessed at monitors MW2, MW5B, and MW6. Monitor MW5B replaced monitor MW5 in 2006 as MW5 was destroyed; monitor MW6 was added in 2010 to assess water quality northeast of the Site.

- Monitor MW2 has been observed to have low water volumes, particularly during the autumn sampling event. Concentrations of many parameters (i.e., general water chemistry, dissolved metals, etc.) have been observed to be elevated at this location, including key nutrient parameters ammonia and TKN, compared to the background water quality at monitors MW1, MW3, and MW4B. Nitrate concentrations are typically reported at the RDL at this location. Ammonia, after entering the groundwater and subsurface soil environment, is broken down by natural chemical and biological processes to nitrate; this process does not appear to occur immediately adjacent the lagoon and likely occurs down-gradient.

- In 2018, an acidic pH and elevated concentration of TDS were observed and concentrations of nutrient parameters were generally observed to be low, following the decreasing trend since 2011, with exception of an exceedance in the nitrate concentration in May. It is believed the concentration of May was anomalous or in error (23.1 mg/L); the maximum concentration of nitrate observed on-site to date has been 1.44 mg/L. Refer to Figure 5 through Figure 7 for concentration trends over time for nitrogen parameters. Based on interpretation of the analytical results for this location, it is apparent that the groundwater immediately adjacent to the lagoon has been impacted by the lagoon contents, which is expected given the proximity to the exfiltration lagoon.
- Water quality at monitoring wells MW5B and MW6 located north and northeast of the lagoon, respectively, are observed to be consistent with water quality observed at cross-gradient monitors, including sporadically elevated concentrations of aluminum and an acidic pH. Nutrient parameters are documented at low concentrations, with ammonia, nitrite, and nitrate present in concentrations at or near the detection limit and consistent with concentration ranges observed at the cross-gradient monitors. TKN and phosphorus have been elevated but consistent with water quality at background monitors. The groundwater data at these locations have not been interpreted to be adversely impacted by Site activities.
- In 2018, the parameter concentrations at monitors MW5B and MW6 were generally within historical ranges observed at each respective location and continued to be consistent with the cross-gradient (background) monitors.

  While water quality at monitor MW5B was observed to mirror that at monitor MW1, monitor MW6 seemed to mirror monitors MW3 and MW4B. This is apparent through the elevated concentrations of hardness, TKN, DOC, and TSS observed at monitor MW6, and lack thereof at monitor MW5B. This correlation may suggest marginal impacts from the peripherals of the impacted groundwater plume at monitors MW3, MW4B, and MW6, as well as the attenuation of the plume prior to reaching monitor MW1 to MW5B. This correlation may however be related to the geological materials and variations in the water quality surrounding the site (i.e., saturated organic soils in the low lying wet areas vs. sandy soils).

Overall, the water quality data at these monitoring well locations remained stable and continued to be un-impacted by the Site in 2018.

4.1.3 Volatile Organic Compound Assessment

The assessment of volatile organic compounds (VOCs) was added to the monitoring program in 2010 at the request of the Ministry to track the potential contamination of groundwater and surface water by certain parameters documented at high concentrations in the septage samples, such as acetone, methyl chloride, and toluene. The analytical results for VOC samples collected from 2011 to 2018 are summarized in Table 4; 2010 results are attached to the report package digitally.

No VOCs were detected in the groundwater at the Site in 2018. Historically, acetone and toluene have been documented at monitoring well MW2. No other VOCs have been detected in groundwater samples at the Site since sample collection began in 2011.

4.1.4 Compliance Assessment

To ensure appropriate recognition and response to potential degradation in groundwater quality beyond an acceptable concentration, Site specific triggers and contingency plans have been developed for the Site. These are based on the Ministry Reasonable Use Concept (RUC) values for groundwater (MOE, 1994). The Ministry Reasonable Use Policy states that, in accordance with the appropriate criteria for particular uses, a change in quality of the groundwater on an adjacent property will be accepted only as follows:

The quality cannot be degraded by an amount in excess of 50% of the difference between background and the Ontario Drinking Water Standards (ODWQS) for non-health related parameters and in excess of 25% of the difference between background and the ODWQS for health related parameters. Background is considered to be the quality of the groundwater prior to any man made contamination.

Ministry Procedure B-7-1. (MOE, 1994)

The maximum concentration of a particular contaminant that is considered acceptable in the groundwater beneath an adjacent property is calculated in accordance with the following relationship:

$$C_m = C_b + x \cdot (C_r - C_b)$$

Where: C_m = maximum concentration accepted

C_b = background concentration

C_r = Maximum concentration permitted in accordance with the Ontario Drinking Water Standards

x = a constant that reduces the contamination to a level that is considered by the Ministry to have a negligible effect on water use.
i.e. 0.5 for non-health related parameters
0.25 for health related parameters.

The RUC values were calculated for all leachate indicator parameters using the median value of the background concentration (C_b) from a minimum of the previous five sampling events. The maximum allowable concentration (C_m) of any particular parameter may be calculated using the background concentration of that parameter from a monitor up-gradient of the Site, the designated ODWQS value for that parameter, and a constant that reflects whether the parameter is health or aesthetic-related as defined by the ODWQS. Where background concentrations were less than the laboratory method detection limit, the method detection limit was used as the background value. The calculated C_m values for the site were set as the RUC values. Where a background value exceeded the ODWQS value, the C_b value was set as the RUC value.

As per Condition 4 (1) of the ECA, the Site performance objective is to operate the Site such that the daily concentrations of the parameters named in Table 2 of the ECA at the designated sampling locations meet the RUC criteria. As such, the RUC criteria were calculated for all parameters included in the monitoring program which have an ODWQS criteria using the background water quality from monitoring wells MW1, MW3, and MW4B.

Although all parameters included in the monitoring program were assessed, a specific assessment of nitrate was also completed. Liquid sewage waste contains relatively high concentrations of ammonia, which, after entering the groundwater and subsurface soil environment, is broken down by natural chemical and biological processes to nitrate. As such, the presence of high concentrations of nitrate is a good indicator that liquid sewage waste has potentially impacted groundwater quality. The lack of elevated concentrations of nitrate at a location down-gradient of a potential sewage source would indicate that either there was no introduction of sewage to the groundwater, or that the sewage has had time to be naturally attenuated before reaching that particular location.

The down-gradient monitoring wells used to evaluate compliance with the RUC included monitoring wells MW5B to the north of the lagoon and monitoring well MW6 along the northeastern property boundary.

An assessment of groundwater quality at down-gradient monitoring wells indicated that the only exceedances of the RUC in 2018 was for pH (low) at monitor MW5B in May and September, and for both pH (field, low), DOC, and hardness at monitor MW6 in May. A review of the background water quality revealed elevated concentrations for each of these parameters, greater than those observed at monitors MW5B and MW6; therefore, the RUC exceedances observed were not attributed to the Site.

As noted herein, a detailed assessment of nitrate was also completed, given the significance of this parameter related to the disposal of septage. Figure 5 shows nitrate concentrations at the Site overtime and Embedded Table 12 includes the average, maximum, minimum, and 75th percentile concentrations of nitrate observed at all monitoring wells on-site.

Embedded Table 12 Detailed Nitrate Analysis, 2018

Concentrations (2011 to 2018, mg/L)				
Well	**Average**	**Max**	**Min**	**75th percentile**
MW1	0.51	0.88	0.21	0.63
MW2	3.38	23.10	0.05	0.12
MW3	0.24	0.46	0.15	0.29
MW4B	0.49	0.89	0.10	0.66
MW5B	0.64	1.44	0.26	0.72
MW6	0.16	0.50	0.06	0.17

From this graph and table, it can be seen that the greatest nitrate concentrations observed at the Site are observed at monitors MW2 and MW5B. In May 2018, monitor MW2 experienced a spike in its nitrate concentration; however, this monitor has historically exhibited the lowest concentrations of nitrate on-site and this value was thought to be anomalous. Monitor MW2 is located directly adjacent to the septage lagoon, whereas the other monitors (MW5B and MW6) are located further down-gradient and are generally in line with concentrations observed at background monitors MW1 and MW4B. This suggests that although some elevated nitrate concentrations are attributed to the Site, nitrate is also naturally-occurring to some degree in the organic soils surrounding the Site.

Regardless of the source, nitrate concentrations are generally observed to be stable over time at all wells on-site and concentrations observed at the most down-gradient property boundary are an order of magnitude less than the RUC criteria (2.8 mg/L).

Based on the analytical results obtained during the 2018 groundwater monitoring program, the Site is in compliance with the RUP and the Performance Objectives (Section 4(1)) of the ECA.

4.2 Surface Water Quality

Surface water quality is assessed at five sampling stations located in the vicinity of the Site, as described in Embedded Table 2. Analytical results are included as Table 5; historical analytical results are included digitally with the report package. The 2018 results were compared against the historical data for the Site and compliance was assessed with the Provincial Water Quality Objectives (PWQO; (MOEE, 1999)).

As discussed in Section 3.1, two watercourses are adjacent to the Site including the tributary stream to the north of the Site and Harvey Lake Creek to the east. Stations MCSW1 (upstream) and MCSW4 assess the tributary. Stations MCSW2 (upstream), MCSW5, and MCSW3B assess Harvey Lake Creek, and station MCSW3B is at the discharge location of both watercourses into Fletcher Bay on Kawagama Lake.

Results from the analyses completed on the blind duplicate surface water samples obtained from sampling stations MCSW5 in May and September, as part of the QA/QC program, were evaluated. Parameter concentrations were considered to be significantly different if the RPD between the duplicate and the original samples was greater than 30RPD when both analytical results were greater than five times the RDL.

In general, the data for duplicate surface water samples were similar to the regular sample collected with the exception of those parameters outlined in Embedded Table 13. All concentrations of iron were observed to exceed compliance criteria for the September sampling event.

Embedded Table 13   Surface Water QA/QC Evaluation

Sampling location	Sampling Event	Parameter	Relative Percent Difference
MCSW5	September	Iron	32%

In addition to the above, parent/duplicate samples with only one measurable concentration were assessed qualitatively. If the measurable concentration was close to the RDL, the sample results were considered valid and the measurable concentration was accepted. Evaluation of these parent/duplicate samples did not identify significant data quality issues.

Given the variances noted were minimal, the surface water data was considered suitable for its intended use, which was to identify changes in water quality and analyzed parameters present at concentrations greater than the applicable standards. As such, the surface water analytical results were interpreted with confidence.

4.2.1 Tributary Stream Surface Water Quality

Sampling station MCSW1 is north of the Site, on the downstream side of a culvert passing beneath McClintock Road. Station MCSW1 is representative of background water quality for the tributary stream north of the Site. Water quality at sampling station MCSW1 has been monitored regularly since May 2009. Since that time, water quality has remained relatively consistent across sampling events including persistent exceedances of the PWQO for aluminum and occasional exceedances of iron, copper, total phosphorus, and pH. Nitrogen parameters have been documented in concentrations at or near the RDL.

In 2018, water quality data was generally observed to be consistent with historical results, including the concentration of aluminum not meeting the PWQO.

Downstream water quality in the tributary stream is assessed at sampling station MCSW4, which is approximately 100 m west and upstream of the confluence with Harvey Lake Creek. Similar to the water quality at station MCSW1, concentrations of aluminium regularly do not meet the PWQO and concentrations of iron, total phosphorus, and pH occasionally do not meet the PWQO.

In 2018, water quality data at surface water sampling station MCSW4 were observed to be within historical concentration ranges and were observed to have concentrations similar to or less than those observed at station MCSW1. Aluminum, iron, and pH (lab, low) were observed to not meet the PWQO during one or more sampling events, consistent with historical results here and at the background location MWSW1. Based on the analytical results available to date, the tributary stream has not been impacted by the Site and this remained the case in 2018. The surface water reviewer agreed with this assessment in his comments dated December 10, 2018 (Appendix B).

4.2.2 Harvey Lake Creek Surface Water Quality

Surface water station MCSW2 is east and cross-gradient of the Site, approximately 100 m upstream and south of Wes Clarke Trail. This location is interpreted to represent the background water quality for Harvey Lake Creek. Surface water quality data at station MCSW2 have generally been consistent with the other background station MCSW1 including concentrations of aluminium, iron, total phosphorus, pH, and DO not meeting the PWQO on some occasions; however, concentrations of aluminum are notably less. All nitrogen parameters have been documented in concentrations at or near the RDL.

In September 2018, concentrations of zinc were observed to be greater than historical results and exceeded the PWQO. For all other parameters, water quality data was observed to be consistent with historical results, including an acidic pH (lab and field) and the concentration of iron not meeting the PWQO for one or more sampling event.

Water quality downstream of the Site in Harvey Lake Creek, upstream of Wes Clarke Trail, is monitored by sampling station MCSW5. Water quality at the discharge of Harvey Lake Creek into Fletcher Bay, north and downstream of the confluence of the tributary stream is monitored at station MCSW3B. Water quality at both of these locations is generally consistent with the quality observed at the upstream locations MCSW2 and MCSW1. Both locations are typified by a slightly acidic pH and occasional concentration of aluminum, iron, total phosphorus, pH, and DO (MCSW3B) not meeting the PWQO. Nutrient parameters have been documented at concentrations less than or near to the RDL at both locations.

In 2018, water quality at sampling stations MCSW5 and MCSW3B was observed to be stable and similar to background concentrations, including PWQO exceedances of pH, aluminum, and iron.

Based on the analytical results available to date, Harvey Lake Creek and Fletcher Bay have not been impacted by the Site. The surface water reviewer agreed with this assessment in his comments dated December 10, 2018 (Appendix B).

4.2.3 Compliance Assessment

According to Ministry PWQO Policies, the following two policies must be met:

1. In areas which have water quality better than the PWQO, water quality shall be maintained at, or above the PWQO.

2. Water quality which presently does not meet the PWQO shall not be degraded further and all practical measure taken to upgrade the water quality to the PWQO.

In 2018, concentrations of parameters were generally observed to be consistent with historical results and/or the background water quality at the Site, with very few exceedances of the PWQO. Where PWQO exceedances were observed, these exceedances were consistent with background concentrations observed historically and/or in 2018. Based on this assessment, the Site is considered to be in compliance with the Ministry PWQO Policies outlined above.

In comments provided by Dana Cruikshank, Surface Water Specialist, Eastern Region Technical Support Section, following his review of the *2017 Performance Report* (Cambium, 2018), Mr. Cruikshank concurred with the surface water assessment (Appendix B). His recommendations to the monitoring program are discussed in Section 4.4.

4.3 Septage Quality

Septage accepted at the Site is intended to be sampled by the Township Operations Manager, or his delegate, on a bi-monthly basis as the material is discharged to the lagoon. The ECA specifies that grab samples for raw septage shall be collected during unloading of hauled septage into the lagoon at a bi-monthly frequency and analyzed for the parameters listed in Table 1. Historically, there have been three haulers that typically hauled septage to the Site; therefore, the Ministry had suggested that each hauler should be sampled twice annually if possible, to ensure that the samples collected over the year are representative of the overall quality of material entering the lagoon (Cambium, 2013). Notwithstanding, it remains necessary to collect septage samples on a roughly bi-monthly basis from the various haulers using the Site, as the material is being released to the lagoon.

In 2018, there were two haulers that deposited septage into the lagoon (Dorset Sanitation and Thomas Contracting); samples were collected by the Township on six occasions (June (two samples), July, and October (three samples)). All septage was received between May and November. Certificates of analysis for the raw septage samples are included as Appendix G.

Historically, the septage quality has been documented to vary considerably between haulers with concentrations of many parameters documented in excess of the PWQO. The following parameters have been documented in elevated concentrations in the raw septage samples in past years:

- aluminum
- cadmium
- chromium
- cobalt
- unionized NH3
- copper
- iron
- phosphorus
- lead
- dichloromethane
- silver
- toluene
- acetone
- zinc
- methyl chloride

In correspondence received from the Ministry, a recommendation was made to begin sampling the septage from the lagoon in order to determine elevated parameters and provide a comparison point for surface and groundwater parameter concentrations (Cambium, 2016). Sampling of the septage from the lagoon has been included since the 2015 monitoring program; samples were collected during both sampling events in 2018. Analytical results are presented in Table 6 and Table 7.

The following parameters were documented to exceed the PWQO criteria in 2018 in samples obtained from the surface of the lagoon:

- May: copper, total phosphorus, zinc, DO (low)
- September: un-ionized ammonia, aluminum, chromium, cobalt, copper, iron, lead, total phosphorus, zinc, and DO (low)

Greater concentrations of all nutrient parameters were documented in September, which reflects the change in lagoon water quality after septage was actively received throughout the summer and autumn seasons in 2018. Analytical results on May 1, which present lower concentrations for all parameters, reflect lagoon quality prior to use of the lagoon resuming later in May. This information, in combination with the lack of impact in down-gradient and downstream monitoring locations, indicates the Site is functioning as it should and remaining in compliance with the Site ECA and provincial legislation.

4.4 Adequacy of Monitoring Program

In an effort to have a refined and concise monitoring program at the Site, the existing monitoring program is reviewed annually to determine if it sufficiently monitors impacts at the Site. The monitoring program implemented in 2018 continues to effectively characterize Site conditions, groundwater and any groundwater discharges from the Site, and surface water conditions, and includes data that relates to upstream/background and downstream receiving water conditions. At the Site:

- All monitoring wells are confirmed to be in good condition and secure.
- All fieldwork for groundwater and surface water investigations was done in accordance with the standard operating procedures as established/outlined per the standard operating procedures (including internal/external QA/QC).
- Groundwater and surface water sampling for the monitoring period was successfully completed in accordance with the ECA, with those exceptions noted in Section 2.0.
- The Site has an adequate buffer, contaminant attenuation zone (CAZ), and contingency plan in place.
- Design and operational measures, including size and configuration of any CAZ are adequate to prevent potential human health impacts and impairments of the environment.
- The Site generally meets compliance and assessment criteria.

Following an assessment of the monitoring program in 2018, consideration of comments provided by Dana Cruikshank dated December 10, 2018 (Appendix B), and the requirements of the ECA (Appendix A), the following recommendations were made for the monitoring program at the Site:

- A new surface water station downstream of the outlet of the wetland between sampling stations MCSW1 and MCSW4 should be considered to determine if the wetland is influencing water quality at MCSW4, which is poorer than upstream. This will be investigated during the spring sampling event in 2019; the proposed location for the station is shown on Figure 2.

- The watercourse between sampling station MCSW1 and the wetland inlet should be investigated to determine if there is a more suitable sampling station for background station MCSW1, away from the McClintock Road, near the inlet of the defined channel into the wetland area. Should a suitable location be found, the location may be more permanent, will be less influenced from the adjacent road, and the un-impacted wetland water quality will be more accurately characterized.

No other changes were recommended following the 2018 assessment.

5.0 Site Operations

A detailed summary of Site Operations is completed on an annual basis on behalf of the Township.

Operations at the Site were completed in accordance with the requirements of the ECA (Appendix A). The Site is approved to handle a maximum septage volume of 2,470 m^3/year and has an estimated exfiltration rate of 3000 m^3/year.

The Site is operated in accordance with By-Law 2014-39, including Schedule 'A' Hauled Sewage Program; a copy of the By-law is included digitally with the report package. This By-law and associated Program were developed to provide procedures and regulations for the Site, including a fee structure for disposal. As per the By-law, the lagoon facility accepts hauled sewage generated within the Township of Algonquin Highlands which is deposited at the Site by registered haulers.

A solar-powered cardlock system was installed at the Site in 2014, allowing approved haulers access to the Site without the presence of Township staff. Haulers are required to register with the Township on an annual basis, free of charge. The use of the Site decreased significantly in 2012, with no septage received in 2013 or 2014. Use of the Site resumed in 2015 and has continued through 2018. Septage was deposited at the Site between May and November in 2018; Embedded Table 14 provides a summary of the septage deposited at the Site in 2018 by each hauler.

Embedded Table 14 Summary of Septage Deposited in 2018

Month	Dorset Sanitation		Thomas Contracting		Total
	# of loads	Volume (m³)		Volume (m³)	Volume (m³)
May	3	15.0	28	236.4	251.4
June	2	10.0	36	323.0	333.0
July	4	38.2	39	306.4	344.5
August	5	56.4	21	94.5	150.9
September	0	0.0	28	282.3	282.3
October	1	4.5	26	174.1	178.6
November	0	0.0	7	41.8	41.8
Total	*15*	*124.1*	*185*	*1,458.4*	*1,582.5*

Using the surplus inputs outlined in Section 3.1.1, the inputs to lagoon in 2018 were determined; refer to Embedded Table 15.

Embedded Table 15 Total Lagoon Inputs

Year	Surplus Input (m³)	Septage (m³)	Total Volume (m³)
2015	475.8	290.9	*766.7*
2016	623.3	337.7	*961.0*
2017	1,150.8	1,112.3	*2,263.1*
2018	666.6	1,582.5	*2,249.1*

Based on the above, the lagoon inputs were less than the design exfiltration rate of 3,000 m³.

In historical reports, the volume inputs into the lagoon considered total precipitation opposed to surplus. As such, the input volumes reported were overestimated. Embedded Table 15 has been updated to include the input volumes to the lagoon considering surplus opposed to total precipitation for the years from 2015 to 2018.

Some historical reports considered the lagoon to be out of compliance if the total precipitation and septage volumes combined exceeded 2,470 m^3. As outlined in the ECA, the Site is approved to accept 2,470 m^3 of septage annually; however, the lagoon is able to effectively exfiltrate a volume of 3,000 m^3. The exfiltration volume accounts for inputs from precipitation (surplus), in combination with the 2,470 m^3 of septage. Furthermore, Condition 5 (5) requires a minimum freeboard of 0.3 m. As such, for the lagoon to be operated in compliance with the ECA, the following conditions related to volumes must be met:

- The maximum volume of septage received annual is 2,470 m^3
- The maximum volume of inputs into the lagoon (septage + precipitation – evaporation) must not exceed the exfiltration capacity of the lagoon of 3,000 m^3
- The minimum freeboard of 0.3 m must not be exceeded

As outlined herein and in Section 5.1 (minimum freeboard observed was 0.61 m), the Site was operated in compliance with these conditions in 2018.

5.1 Site Inspections

The Site is inspected on a monthly basis by Township staff for general Site conditions and to measure cell freeboard. No operating problems were encountered during this reporting period. A minimum of 0.3 m of freeboard is required in the lagoon at all times, as per Condition 5 (5) of the ECA; the freeboard was measured monthly from May to December; refer to Embedded Table 16.

Embedded Table 16 Measured Freeboard, 2018

Month	Measured Freeboard (m)
May	0.84
June	0.97
July	0.84
August	0.79
September	0.71
October	0.64
November	0.64
December	0.61

5.2 Complaints

According to the Township, two complaints were received with respect to the Site in June 23 and August 21, 2018. Both complaints came from the same resident reporting a strong sewage odour in the area of the lagoon as they were driving by the Site. Following correspondence from Aaron Gordon, Senior Environmental Officer of the Ministry's Eastern Region, notifying the Township of the initial complaint received, Township staff immediately investigated and found no significant odour in the area and the Site to be in order. Similarly, when the resident provided the complaint to the Township in August, Township staff investigated the Site and found no significant odour in the area and Site to be in order.

There was regular haulage into the Site during this period and haulers had deposited sewage into the lagoon on June 22 and August 21, 2018. The Township confirmed with the respective hauler that there was no unusual activity, no spills, and nothing unusual about the waste at the time. Furthermore, freeboard was inspected at the time of each complaint and found to be well above the allowable limit of 0.3 m (0.81 m on June 23 and 0.66 m on August 21).

5.3 Maintenance

As per the ECA, a concrete screening box was installed at the Site in 2012. The screening box measures 3.86 m by 2.13 m with a depth of 0.65 m and a design capacity of 3.4 m^3. Routine maintenance of the steel bar screen is undertaken by the haulers and Township on an as-needed basis.

Commencing in 2011, the Township treated the lagoon with Bio-Dissolve; treatments were administered periodically from 2011 through 2013. According to MTS Environmental Products, the manufacturers of the Bio-Dissolve treatment, Bio-Dissolve is intended to reduce toxins and chemicals in wastewater, assist in the breakdown of phosphates, oils, fats and organics, reduce solids in wastewater by up to 35% based on volume, and reduce *E.Coli* concentrations. The Bio-Dissolve maintains or improves wastewater quality while enhancing the digestion of solids to reduce the accumulation of solids at the bottom of the lagoon. MTS Environmental completed an assessment of the lagoon in May and August 2012 and prepared an assessment report outlining the findings. Based on the assessment report, the depth of total solids in the lagoon had decreased by approximately 16% at the time that the report was written in 2012 (MTS, 2012). At that time, observations of the composition and consistency of the material in the lagoon were interpreted by MTS to indicate that the bio-digestion of the solids was accelerated by the application of Bio-Dissolve and the accumulation in the lagoon had begun to digest and be reduced. There were no applications of Bio-Dissolve from 2014 through 2018.

No maintenance activities were performed on the lagoon system in 2018.

Although a formal inspection of the McClintock site was not completed by the Ministry in 2018, Chris Johnston, Senior Environmental Officer visited the Site on October 17, 2018, accompanied by the Township and Cambium. This visit was undertaken such the Mr. Johnston could familiarize himself with the Site given the pending EA. The following comments were provided from Mr. Johnston following his visit.

- *Fencing. The Ministry recommends that the site/lagoon be properly fenced to keep people out of the lagoon. The Ministry recommends that fencing be installed around the lagoon and that signage also be upgraded in an attempt to keep people out of the site. I also note that Condition 5.4 of the ECA states: "(4) The Works shall remain locked at all times except while in use and access to the Works shall be provided only to those authorized by the Owner." This condition suggests to me that the site should be properly fenced.*

- *Brush – A significant amount of the brush has grown up on the berms of the lagoon. As discussed brush should be removed on a regular basis to ensure the integrity of the berms and for easy inspection of the berms.*

The Township intends to address these concerns in the coming year.

5.4 Monitoring Well Security

All monitoring wells at the Site were inspected by Cambium personnel in 2018 and were observed to be in compliance with Ontario Regulation (O. Reg.) 903.

5.5 Site Compliance

The Township operated the Site in compliance with the ECA in 2018.

6.0 Conclusions and Recommendations

Based on the 2018 monitoring program, Cambium makes the following conclusions regarding the Township of Algonquin Highlands McClintock Septage Lagoon facility:

- Groundwater flow direction was confirmed to be towards the north and northeast in 2018.
- Groundwater analytical results to date indicated that there are some impacts from the lagoon occurring at the Site; however, the impacts do not extend much beyond the lagoon itself.
- An assessment of groundwater quality at down-gradient monitoring wells indicated that the only exceedances of the RUC in 2018 was for pH (low) at monitor MW5B in May and September, and for pH (field, low), DOC, and hardness at monitor MW6 in May. A review of the background water quality revealed elevated concentrations for each of these parameters, greater than those observed at monitors MW5B and MW6; therefore, the RUC exceedances observed were not attributed to the Site. Furthermore, as the only nitrate exceedance observed was at well MW2, adjacent the lagoon and reported to be anomalous, the Site was in compliance with the RUC and the Performance Objectives (Section 4 (1)) of the ECA.
- Surface water quality results obtained in 2018 were generally consistent with results obtained in previous years in the tributary stream and Harvey Lake Creek watercourses, and Fletcher Bay. The surface water bodies surrounding the lagoon remained un-impacted by the Site.
- The lagoon facility was open to receive sewage/septage generated in the Township from May to November 2018. Septage was received at the Site from two haulers (Dorset Sanitation and Thomas Contracting) between May and November 2018.
- Surplus inputs to the lagoon in 2018 were estimated to be 666.6 m^3 and septage inputs were reported to be 1,582.5 m^3; therefore, the total input into the lagoon in 2018 from

septage and precipitation sources was 2,249.1 m^3. This was less than the exfiltration rate of 3,000 m^3 per year.

- The freeboard was measured monthly at the Site from May to December. The measured freeboard was between 0.61 and 0.97 m, well within the required freeboard of 0.3 m.
- Samples of septage from within the lagoon were collected by Cambium during both monitoring events in 2018. Samples of septage quality were obtained from the haulers at the time of deposit on six occasions in 2018.
- The Township operated the Site in compliance with the ECA in 2018.

Based on the results of the 2018 monitoring program, Cambium recommends the following:

- The monitoring program should continue in 2019 as was completed in 2018.
- A new surface water station should be investigated downstream of the outlet of the wetland between sampling stations MCSW1 and MCSW4, and a new location for station MCSW1 should be investigated further downstream, to determine if the wetland is influencing water quality at MCSW4.
- It remains necessary to collect six samples of received septage per year on a bi-monthly basis, if possible.
- The status of the Geotubes® should continue to be documented annually.
- As per comments from the Ministry, the Township should consider installing fencing (or similar) to deter people from accessing the Site. In addition, the brush that has established on the berms should be removed.

7.0 Closing

This report was prepared on the behalf of the Corporation of the Township of Algonquin Highlands to summarize the 2018 performance of the hauled sewage disposal site, known as the McClintock Septage Lagoon (Site). This report was prepared to satisfy Condition 7 (3) of the ECA, which requires the Site owner to prepare and submit a performance report on an annual basis within ninety (90) days following the end of the period being reported upon. This Performance Report is specific to the period from January 1, 2018 to December 31, 2018.

Respectfully submitted by:

Cambium Inc.

PROFESSIONAL GEOSCIENTIST
Mar 25/19
STEPHANIE REEDER
PRACTISING MEMBER
2516
ONTARIO

Carmen Staunton, EIT	Stephanie Reeder, P.Geo, C.E.T.
Environmental Technician	Project Manager

P:\7200 to 7299\7206-007 TAH - McClintock Lagoons Landfill AMP 2018\Deliverables\AMR\Final\2019-03-25 RPT 2018 Performance Report McClintock.docx

References

Cambium. (2013). *2012 Performance Report, McClintock Septage Lagoon.* Cambium Environmental Inc.

Cambium. (2016). *2015 Performance Report, McClintock Septage Lagoon.* Peterborough: Cambium Inc.

Cambium. (2018). *2017 Performance Report McClintock Septage Lagoon.* Peterborough: Cambium Inc.

Government of Canada. (2015). *Canadian Climate Normals & Averages 1981-2010*. Retrieved October 30, 2015, from Canadian Climate Normals: http://climate.weather.gc.ca/climate_normals/index_e.html

MHF. (2012). *Muskoka Watershed Council*. (Muskoka Heritage Foundation) Retrieved March 5, 2012, from Muskoka River Watershed: http://www.muskokaheritage.org/mwc/watersheds/muskoka-river-watershed/

MOE. (1994, April). *Guideline B-7: Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities.* Ontario Ministry of the Environment Program Development Branch: Ontario Ministry of the Environment.

MOE. (1994, April). *Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities.*

MOEE. (1996). *Guidance on Sampling and Analytical Methods for Use at Contaminated Site in Ontario* (1.1 ed.). Ontario Ministry of the Environment and Energy Standards Development Branch.

MOEE. (1999). *Water Management - Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of the Environment and Energy.* Ontario Ministry of the Environment and Energy.

MTS. (2012). *Bio-Desolve - McClintock Septage Treatment Lagoon Assessment Report.* Centralia, Ontario: MTS Environmental Inc.

OGS. (2011). *Bedrock Geology of Ontario, Miscellaneous Release Data 126-Revision.* Ontario Geological Survey.

Trow. (2010). *Township of Algonquin Highlands McClintock Lagoon, 2009 Annual Performance & Water Quality Monitoring Report.* Trow Associates Inc.

Abbreviations

RFP	Request For Proposal	**µS**	microSiemens
MOE	Ontario Ministry of the Environment	**ODWQS**	Ontario Drinking Water Quality Standards
MNR	Ontario Ministry of Natural Resources	**PWQO**	Provincial Water Quality Objectives
PCofA	Provisional Certificate of Approval	**TOC**	Total Organic Carbon
EPA	Environmental Protection Act	**VOC**	Volatile Organic Compound
EAA	Environmental Assessment Act	**BTU**	British Thermal Unit
MW	monitoring well	**°C**	temperature in degrees Celsius
masl	metres above sea level	**N/A**	not available
kg	kilogram	**%**	percent
mm	millimetres	**cfm**	cubic feet per minute
m	metres	**ppmdv**	part per million by dry volume
km	kilometres	**ppmv**	part per million by volume
ha	hectare	**ppm**	part per million
m^3	cubic metres	**min**	minimum
m^2	square metres	**max**	maximum
mg/l	milligrams per litre		

Units of Measurement and Conversions

Length

1 metre (m)	=	3.28 feet
1 millimetre (mm)	=	0.039 inches
1 kilometre (km)	=	0.621 miles

Area

1 hectare (ha)	=	2.47 acres
1 square metre (m^2)	=	10.76 square feet

Volume

1 cubic metre(m^3)	=	35.29 cubic feet
1 litre(L)	=	0.220 gallons

Mass

1 metric ton (tonne)	=	1.10 Imperial tons
1 kilogram (kg)	=	2.20 lbs
pound (lb)	=	453.6 g
gram (g)	=	---
milligrams (mg)	=	1×10^{-3} g
microgram (µg)	=	1×10^{-6} g
nanogram (ng)	=	1×10^{-9} g
kilogram (kg)	=	1000 g
picogram (pg)	=	1×10^{12} g
metric tonne (t)	=	1000 kg

Glossary of Terms

Active Face/Area
The portion of the landfill facility where waste is currently being deposited, spread and/or, compacted prior to the placement of cover material.

Adverse Environmental Impact
Any direct or indirect undesirable effect on the environment resulting from an emission or discharge that is caused or likely to be caused by human activity.

Annual Report
Report documenting the results of water quality, environmental quality, and operations monitoring for the year, or for a period as prescribed in the Certificate of Approval.

Approved Design and Operations Plan
The design of a landfill site and its facilities which have been submitted along with the application documents for which formal MOE approval has been issued through the Certificate of Approval.

Approved Site or Facility
A landfill site/facility for which there is an existing and current Certificate of Approval.

Aquifer
A geologic unit (soil or rock) that contains sufficient saturated permeable material to yield measurable quantities of water to wells and springs.

Attenuation
Natural process through which the concentrations of landfill generated contaminants are reduced to safe levels.

Borehole
A hole drilled for soil sampling purposes.

Buffer Area
An area of land situated within the peripheral area surrounding an active filling area, but limited in extent to the property boundary, assigned to provide space for remedial measures, contaminant control measures, and for the reduction or elimination of adverse environmental impact caused by migrating contaminants.

Certificate of Approval
The license or permit issued by the MOE for the operation of a landfill site. Issued to the owner of the site with conditions of compliance stated therein.

Contaminant
A compound, element, or physical parameter, usually resulting from human activity, or found at elevated concentrations that have or may have a harmful effect on public health or the environment.

Contaminant Migration Path
Route by which a contaminant will move from the site into adjacent properties or the natural environment. Usually a route that offers the least resistance to movement.

Contamination Attenuation Zone
The zone beneath the surface, located beyond the landfill site boundary, where contaminants will be naturally attenuated to predetermined levels. Also, see Reasonable Use Policy.

Contingency Plan
A documented plan detailing a co-ordinated course of action to be followed to control and remediate occurrences such as a fire, explosion, or release of contaminants in an uncontrolled manner that could threaten the environment and public health.

Cover Material
Material approved by the MOE that is used to cover compacted solid waste. Usually, a soil with suitable characteristics for specific end-use.

Site Development Plan and Operations Report
Development and Operations Plan or Report is a document detailing the planned sequence of activities through the landfill site's active life, the control systems, site facilities and monitoring systems that are necessary. This document is required for obtaining a Certificate of Approval.

Design Capacity
The maximum amount of waste that is planned to be disposed of at a landfill site.

Detection Limit
Concentration under which a parameter cannot be quantitatively measured.

EAA or EA Act
Environmental Assessment Act, Revised Statutes of Ontario, 1990. One of the primary acts of legislation intended to protect, conserve, and wisely manage Ontario's environment through regulating planning and development.

Environmental Compliance Approval
The license or permit issued by the MOE for the operation of a landfill site. Issued to the owner of the site with conditions of compliance stated therein.

EPA
Environmental Protection Act, Revised Status of Ontario, 1990. EPA is another of the primary pieces of Provincial legislation governing the protection of the natural environment of the Province.

Evapotranspiration
The evaporation of all water from soil, snow, ice, vegetation and other surfaces, including the water absorbed by plants, that is released to the atmosphere as vapour.

Fill Area
The area of a landfill site designed and designated for the disposal of waste.

Final Cover
Soil material or soil in combination with synthetic membranes, overlain by vegetation in a planned landscape, placed over a waste cell that has reached the end of its active life.

Groundwater
Subsurface water that occurs beneath the water table in soils and rocks that are fully saturated.

Hydraulic Conductivity
The rate of flow of water through a cross-section under a specific hydraulic gradient. It is a property of the geologic formation and the fluid, in hydrogeologic applications where the fluid is water (Units of m/day or cm/s).

Hydraulic Gradient
The head drop per unit distance in the direction of flow, the driving force for groundwater flow.

Hydrogeology
The study of subsurface waters and related geologic aspects of surface waters.

Impermeable Fill
Soil material that is placed as filling material that is sufficiently cohesive and fine grained to impede and restrict the flow of water through it.

In situ Testing
Testing done on-site, in the field, of material or naturally occurring substances in their original state.

Landfill Gas
Combustible gas (primarily methane and carbon dioxide) generated by the decomposition of organic waste materials.

Landfill Site
A parcel of land where solid waste is disposed of in or on land for the purposes of waste management.

Leachate
Water or other liquid that has been contaminated by dissolved or suspended particles due to contact with solid waste.

Leachate Breakout
Location where leachate comes to the ground surfaces; a seep or spring.

Limit of Filling
The outermost limit at which waste has been disposed of, or approved or proposed for disposal at a landfill.

MOE
Ontario Ministry of the Environment.

Monitoring
Regular or spontaneous procedures used to methodically inspect and collect data on the performance of a landfill site relating to environmental quality (i.e., air, leachate, gas, ground or surface water, unsaturated soils, etc.).

Monitoring Well
The constructed unit of casing (riser and screen) installed in a borehole.

Multi-Level Monitoring Well
More than one monitoring well installed at a given test well location.

Native Soil
Soil material occurring naturally in the ground at a location.

Natural Attenuation
Where contaminants are reduced to acceptable concentration levels by natural mechanisms (dilution, absorption onto the soil matrix, etc.), biological action, and chemical interaction.

Occupational Health and Safety Act
The primary act of legislation enacted by Ontario Ministry of Labour to regulate and control the safety in the workplace; also Occupational Health and Safety Act, Revised Statutes of Ontario, 1990.

Odour Control
Minimizing or eliminating the nuisance and undesirable impact of objectionable or unpleasant odours arising from waste disposal operations.

Open Burning
Burning any matter whereby the resultant combustion products are emitted directly to the atmosphere without passing through an adequate stack, duct, or chimney.

Operations Plan
A document detailing the waste disposal operations in a planned, and if necessary, a staged manner, that ensure compliance with regulatory provisions concerning the operations of a landfill site.

Operator (Site Operator)/Attendant
The individual or organization who, through ownership or under contract, manages and operates a landfill site for the purpose of waste disposal.

Owner
A person, persons, organization, or municipal authority who own a landfill facility or part of a landfill facility, and in whose name the Certificate of Approval for the site is issued.

Percolation
The movement of infiltrating water through soil.

Permeability
Often used interchangeable with hydraulic conductivity, but not strictly correct. Permeability is a property of the porous media only. Dependent upon media properties that affect flow, diameter, sphericity, roundness, and packing of the grains.

Piezometer
A well that intersects a confined aquifer.

Provisional Certificate of Approval (Provisional C of A)
Same as Certificate of Approval.

Reasonable Use Policy
A policy developed by the Ministry to stipulate limits to the level of groundwater quality impairment that may be permitted to occur at site property boundaries, to allow the reasonable use of adjacent properties or land without adversely affecting public health and the environment.

Recharge Zone
An area where precipitation or surface run-off infiltrates into the ground and then, through natural percolation enters an aquifer.

Recycling
Sorting, collecting or processing waste materials that can be used as a substitute for the raw materials in a process or activity for the production of (the same or other) goods. For example, the "Blue Box" system, in-plant scrap handling, or raw material recovery systems. Recycling is also the marketing of products made from recycled or recycled materials.

Reduction (of waste or component of 3Rs program)
Those actions, practices, or processes that result in the production or generation of less waste.

Remedial Action
Corrective action taken to clean-up or remedy a spill, an uncontrolled discharge of a contaminant, or a breach in a facility or its operations, in order to minimize the consequent threat to public health and the environment.

Representative Sample
A small portion of soil, water, etc. which can be subjected to testing and analysis, that is expected to yield results that will reliably represent the identical characteristics of the source of the material or of a larger body of material.

Reuse (component of 3Rs program)
The use of an item again in its original form, for a similar purpose as originally intended, or to fulfil a different function.

Run-off
The part of precipitation (rainwater, snowmelt) that flows overland and does not infiltrate the surface material (soil or rock).

Saturated Zone
The zone of a subsurface soil where all voids are filled with water.

Sedimentation
The deposition of fine grained soil in an undesirable location, caused by the scouring, erosion and transportation of earth materials by surface run-off.

Sensitive Land Use
A land use where humans or the natural environment may experience an adverse environmental impact.

Settlement
The subsidence of the top surface and underlying waste of a landfill or waste cell as a result of densification under its own weight.

Site Capacity
The maximum amount of waste that is planned to be disposed (design capacity) or that has been disposed of at a landfill site.

Site Closure
The planned and approved cessation or termination of landfilling activities at a landfill site upon reaching its site capacity.

Site Life
The period from its inception through active period of waste disposal, to the time when a landfill site reaches its' site capacity, when it ceases to receive any further waste, including and up to closure.

Solid Waste
Any waste matter that cannot be characterized by its physical properties as a liquid waste product.

Solid Waste Disposal Site or Facility
A site or facility such as a landfill site where solid waste is disposed of.

Source Separation
The separation of various wastes at their point of generation for the purposes of recycling or further processing.

Standpipe
A monitoring well that intersects the water table aquifer.

Storm water
Run-off that occurs as a direct result of a storm event or thaw.

Storm water Detention
Control of storm water by the construction of impoundments of structures for the purpose of regulating storm water flows during high intensity rainfall events that would otherwise transport excessive amounts of sediment, cause soil erosion or cause flooding.

Stratigraphy
The geologic sub-structuring, usually layered with different distribution, deposition and age.

Surface Run-off (Drainage)
See Run-off.

Surface Water
Water that occurs at the earth's surface (ponds, streams, rivers, lakes, oceans).

Sub-Soil
Soil horizons below the topsoil.

Test hole
A hole drilled for soil sampling purposes.

Topsoil
The uppermost layer of the soil containing appreciable organic materials in mineral soils. Adequate fertility to support plant growth.

Unsaturated Zone
The zone (also vadose zone) in a porous sub-soil, where the voids are not completely water-filled, but contain some air-filled voids. Limited above by the land surface and below by the water table.

Vector
A disease carrier and transmitter; usually an insect or rodent.

VOC
Volatile organic compounds are those compounds that will readily volatilize (convert from liquid to gas phase) at conditions normally found in the environment.

Waste
Ashes, garbage, refuse, domestic waste, industrial waste, or municipal refuse and other used products as are designated or interpreted by the provisions of the Environmental Protection Act.

Waste Disposal Site (Facility)
Any land or land covered by water upon, into, in or through which, or building or structure in which, waste is deposited or processed and any machinery or equipment or operation required for the treatment or disposal of waste.

Waste Management System
All facilities, equipment and operations for the complete management of waste, including the collection, handling, transportation, storage, processing and disposal thereof, and may include one or more waste disposal sites.

Water Table
The water level attained in a monitoring well, which screens the surficial unconfined aquifer.

Water Balance
Amounts of water to various components in a system so that water entering the system equals the amount of water contained within and discharged out of a system.

Water Level
The level of water in a well.

Well Casing
The pipe that is used to construct a well.

Well Screen
A filtering device used to keep sediment from entering a well.

Wetlands
Areas where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrolytic vegetation, and which have soils indicative of wet conditions.