DUNTROON EXPANSION QUARRY

ADAPTIVE MANAGEMENT PLAN SUMMARY REPORT 2019

WALKER AGGREGATES INC.

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April 30, 2020

WALKER AGGREGATES INC.
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Attention: **Mr. Matt McMahon**

Dear Mr. McMahon:

WSP Canada Inc. is pleased to present the enclosed Adaptive Management Plan Annual Summary Report for the Duntroon Expansion Quarry. This report documents the monitoring data collected for the performance indicator trigger monitoring program, the long term trend groundwater and surface water monitoring program, the long term trend ecological monitoring program and the ecological enhancement and mitigation monitoring program.

This summary report is for the period of January 1, 2019 through December 31, 2019. Historical data, where available, have been included to provide context to the observed values in 2019. It is noted that the data and reporting conducted to satisfy the long term trend ecological monitoring program and the ecological enhancement and mitigation monitoring program was completed by Stantec Inc.

We trust that the information provided is sufficient for your needs at this time. Please contact the undersigned if you have any questions or comments.

Yours sincerely,

Kevin Fitzpatrick, P.Eng.
Senior Project Engineer, Environment

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The Adaptive Management Plan (AMP) annual summary report is a requirement of the Aggregate Resources Act licensing of the Duntroon expansion quarry. The licensed property of the existing quarry operates in accordance with Aggregate Resource Act (ARA) license number 3514. The expansion quarry is licenced to WAI under ARA licence number 607841, issued August 6, 2014.

Walker Aggregates environmental commitment is to manage its lands so that in the long term, the ecology is not only maintained but also enhanced beyond its current condition. This will be accomplished through environmental initiatives detailed on the ARA Site Plans and the AMP to ensure that protection, mitigation, and enhancement measures sustain local environmental resource features and functions for future generations.

Aggregate extraction in Phase 1 of the expansion quarry began in late June 2016 and was the first year of reporting for the Adaptive Management Plan. The potential impacts for each phase of Quarry operations are outlined in the AMP with details on specific protection and monitoring measures. This annual summary report focuses on quarry operations in Phase 1 and the associated monitoring measures that were completed in support of the AMP in 2019.

Given the extraction that has occurred in the existing quarry, extraction in Phase 1 of the expansion quarry is not expected to result in negative impacts to off-site water resources and/or ecological features and functions. Therefore, the monitoring and mitigation requirements during this phase of extraction are such that the response of the natural environment system will be monitored by means of the groundwater, surface water and wetland monitoring network, and results compared to predictions.

The AMP consists of four monitoring programs:

- the Performance Indicator Trigger Monitoring program (PITM),
- the Long Term Trend Groundwater and Surface Water Monitoring program (LTT),
- the Long Term Trend Ecological Monitoring program (LTTEM), and
- the Ecological Enhancement and Mitigation Monitoring program (EEMM).

The AMP annual summary report is a consolidated summary report documenting the observations from each of the monitoring programs.

Key findings of the PITM and LTT indicate that climate conditions in 2019 resulted in some surface water flows and/or temperatures that did not meet the monthly interim PITM trigger levels at specific locations. However, since the PITM trigger periods do not come into effect until after Phase 1 (Table 3.2 in the AMP), mitigation action was not required. Based on the findings found from PITM program it is recommended that the trigger levels are adjusted to include the monitoring results found in Phase 1.

Key findings from the LTT found that the monitoring wells closest to the expansion quarry have experienced increasing drawdown effects as the quarry continues to expand within the Phase 1 extraction footprint. As monitoring has progressed certain wells have become no longer accessible (BH02-3 CLF1, OW1-6, OW3-1 and NW2). It is recommended that these wells be removed from the monitoring.

Key findings from the LTTEM found that the habitat at each survey Station was suitable for amphibians and, when comparing 2019 data to previous years' surveys, amphibian communities were similar in diversity and abundance at each Station.

Key findings from the EEMM found that the cumulative mortality incurred up to July 2019 has been 5.4%, which translates to a survival rate of 94.6%. Adding in the replacements, which outnumber the mortality, survivability is currently greater than 100% surpassing the project target.

1 INTRODUCTION

The Duntroon Expansion Quarry is located on County Road 91, west of the village of Duntroon on Lot 25, Concession XII in the Township of Clearview, County of Simcoe. The existing quarry property is located south of County Road 91 and the expansion quarry is located north of County Road 91. The expansion quarry property is located adjacent to the approved MAQ Aggregates Inc. (MAQ) Highland Quarry, an independent third party. The locations of these quarry properties and of other lands owned by Walker Aggregates are shown on ***Figure 1***.

The Duntroon Quarry has been in operation on the south side of County Road 91 (existing quarry) since the early 1960s. Since 1995 the quarry has been operated by Walker Aggregates Inc. (WAI). The existing quarry property operates in accordance with Aggregate Resource Act (ARA) license number 3514. The expansion quarry operates under ARA licence number 607841, issued August 6, 2014.

The Adaptive Management Plan (AMP) annual summary report is a requirement of the ARA licensing of the expansion quarry. Throughout this summary report, the original AMP, created in December 2013, is referenced for specific details on AMP requirements. The original AMP provides an in-depth review of the monitoring planned during each Phase until final rehabilitation of the site. Additional background information pertaining to the site, contact information and monitoring requirements are found in ***Appendix A***. The quarry phasing is detailed on the ARA Site Plan (#2B of 4 Operational Plan). Phase 1, Phase 2a and Phase 2b of operations are identified on ***Figure 2a – Site Sketch.*** This site sketch is based on quarry conditions as of October 2019.

This report provides a summary of the monitoring completed in 2019 for the AMP. The monitoring components consist of four categories:

- **Performance Indicator Trigger Monitoring (PITM**): Focuses on the quarry's impact on an annual basis comparing monitoring to historical values to ensure the facility is not having an adverse impact on surrounding ecological features.
- **Long Term Groundwater and Surface Water Monitoring Program (LTT**): Reviews monitoring results as well as past data and analyzes to confirm that the data match forecasted trends. This monitoring also makes note should unexpected trends in the data be observed.
- **Long Term Trend Ecological Monitoring (LTTEM**): Compares current data collected on surrounding ecological features with historic observations to confirm that the quarry's activity is not causing unacceptable impacts to plants or to wildlife.
- Ecological Enhancement and Mitigation Monitoring (EEMM):This monitoring confirms that steps are taken, throughout the quarry's life to ensure that upon rehabilitation, the property is left in an improved ecological condition than prior to quarrying.

Currently, extraction is ongoing within Phase 1 of the expansion property. This extraction during Phase 1 is not expected to result in any negative impacts to off-site water resources or ecological features due to the proximity of the existing quarry. This Phase of the AMP monitoring program will be used as input to establish baseline ecological features that will be compared to later phases as the quarry expands.

Trigger monitoring criteria for water flows, water temperature and wetland water levels will apply during their respective trigger periods when extraction proceeds beyond Phase 1. Groundwater and surface water monitoring data will be used to further update interim triggers as well as build statistically valid relationships between monitoring locations and control points. Since June 2018, the field monitoring is completed by Walker Industries staff.

2 CLIMATE DATA

Historically, climate data from the Thornbury Slama Station were used to assess annual water budget components as part of the monitoring programs at Duntroon Quarry. Operation of the Thornbury Slama station was cancelled in May 2005. After a detailed assessment of nearby climate stations, the Shanty Bay Climate Station, located on Lake Simcoe approximately 60 km east of the Duntroon Quarry, was assessed and provided a reasonable correlation with the climate data from the Thornbury Slama climate station.

The combination of historical climate data and annual weather station data can be used to analyze the impact of deviation from climate norms and their corresponding impact on the surrounding local hydrology and ecosystems.

In 2008, WAI established, an automatic weather station (the WAI station) in the vicinity of Duntroon quarry which provides the following local climate data:

- Wind speed and direction;
- Average hourly air temperature (°C); and
- Total hourly precipitation (mm)

There have been no operational concerns with the Duntroon station since 2015.

For the purpose of this annual report, both the Shanty Bay and the WAI climate station data have been evaluated. Once a more consistent record of local climate conditions has been established, the local and regional climate data will be used to prepare seasonal and annual water budget assessments based on the Thornthwaite-Mather method, as used by Environment Canada. The information from the WAI Duntroonclimate station can be used to compile seasonal and annual water surplus/deficit amounts for consideration in surface water runoff and groundwater recharge evaluations and for comparison against quarry discharge volumes.

The 30-Year Climate Normal data and a calculated water budget for the Thornbury Slama Station are provided in ***Appendix A***, on Table A-1. The Shanty Bay climate data and the calculated water budget from 2015 though 2019 are provided in Tables A-2, A-3, A-5, A-7 and A-9. The Duntroon WAI climate station data and the calculated water budgets for 2016 through 2019 are provided in Table A-4, A-6, A-8 and A-10. ***Figures A-1*** through ***A-9*** provide a plot of the monthly precipitation and water surplus with the data for the 30-Year Climate Normal provided for comparison.

The 2019 climate data at the Shanty Bay station reports a higher amount of precipitation than the WAI Duntroon station (949 mm vs. 660 mm), although historically, the WAI station has often recorded lower precipitation levels. In 2019, the WAI climate station reported roughly 20 to 30 mm less precipitation than the Shanty Bay station on a per month basis. The mean monthly temperature at the Shanty Bay station is also warmer than the mean monthly temperature reported at the WAI station (6.5°C vs. 4.8°C). The mean monthly temperature for the Shanty Bay and WAI climate stations are plotted with the 30-Year normal mean monthly temperature in ***Figure A-10***. The total monthly precipitation for the Shanty Bay and WAI climate stations are plotted with the 30-Year normal total monthly precipitation in ***Figure A-10***.

2.1 AIR TEMPERATURE

At the Shanty Bay climate station, the monthly mean temperature in 2019 was 6.5°C, 0.3°C lower than the 30-Year Climate Normal value of 6.8°C. The monthly average temperatures in January, March, and November were between 1.4°C to 3.4°C lower than normal. The month of July was 2.3 °C warmer than normal. The months of February, April, May, June, August, September, October and December were within +/-1°C of the normal.

At the WAI climate station, the mean monthly temperature in 2019 was 4.8°C, 2.0°C cooler than the 30-Year Climate Normal value of 6.8°C. The months of January, February, March, April, May, June, August, October and November were within 1.1°C to 5.3°C colder than normal. July, September and December were within +/- 1°C of the normal monthly temperature for their respective month. It should also be noted that five out of the twelve months recorded below zero monthly temperature averages.

The below average temperatures contributed to an extended winter resulting in flows that deviated from the historical values at both the beginning and end of the year.

2.2 PRECIPITATION

At the Shanty Bay climate station in 2019, the total amount of precipitation received was 949 mm, or 17 mm (1.8 %)more than the calculated 30-Year Climate Normal (1971-2000) of 966 mm. The months of February, April, May, October and December received between 11% and 69%more precipitation than normal, while the months of January, July, August, September and November received between 20% and 53% less precipitation than normal. The months of March and June received a normal amount of precipitation (within 10% of the Normal).

At the WAI climate station in 2019, the total amount of precipitation received was 660 mm, or 306 mm (32%) less than the calculated 30-Year Climate Normal (1971-2000) of 966 mm. The months of April, May and October received between 10% and 105%more precipitation than normal respectively. The months of January, February, March, June, July, August, September, November and December received between 22% and 80% less precipitation than normal. The second half of the year (July through December) received only 295 mm of precipitation, compared to a normal amount of 536 mm, a difference of 241 mm and a reduction of 45%.

The distribution of precipitation over the late summer months and through the end of the year contributed to drier than normal conditions and resulted in lower than normal measured flow rates at several surface water monitoring stations.

2.3 ANNUAL WATER BUDGET

The climate data from the Shanty Bay and WAI stations (temperature and precipitation) are used to calculate a general water budget for the area that provides a measure of water losses to evaporation. The difference between the monthly precipitation and the monthly evaporation (adjusted for daylight hours) yields the estimated water surplus (or deficit). The estimated evaporation is based on the method developed by Thornthwaite, and incorporates a water holding capacity for the soil. The annual water surplus is a measure of the amount of water that is available for surface runoff and groundwater recharge. Results of the water balance are summarized in Table 2-1. Shanty Bay and the Duntroon WAI stations are both included in the analysis for 2019.

Table 2-1 2019 Water Balance

PARAMETER	THORNBURY SLAMA (30-YEAR NORMAL)	SHANTY BAY 2019	DUNTROON WAI 2019
Annual Precipitation (mm)	966	949	660
Potential Water Surplus (mm)	368	368	120
Actual Water Surplus (mm)	395	410	234

In 2019, the actual water surplus based on the data obtained from the Shanty Bay climate station was 410 mm; 15 mm (4%) greater than the 30-year average. When the water surplus calculated using WAI's weather station data (234 mm) is compared to the 30-year average it is found to be 161 mm (41%) less than the historical average. These values represent the amount of water that is available for infiltration into the ground surface to recharge the groundwater flow system and for surface runoff. The amount of water that is divided into these two components based on site specific conditions such as topography and various ground infiltration variables. The MECP has provided estimates of infiltration factors for various types of slope, soil and vegetation cover in their land development guidelines (MOE, 1996). For the general conditions present across the Duntroon Quarry and the surrounding area, the infiltration factor is estimated and presented on Table 2-2.

Table 2-2 Duntroon Quarry and Surrounding Area Infiltration Factor

FEATURE (RANGE OF INFILTRATION FACTORS)	SITE CHARACTERISTICS	CORRESPONDING INFILTRATION FACTOR
Slope (0.1-0.4)	Hilly land to rolling land	0.1 to 0.2
Soil Type (0.1-0.4)	Medium combinations of clay and loam to exposed fractured bedrock	0.2 to 0.4
Vegetation Cover (0.1-0.2)	Cultivated lands to woodland	0.1 to 0.2
OVERALL INFILTRATION FACTOR RANGE		**0.4 to 0.8**

Based on the overall infiltration factor range, an estimated range of groundwater recharge and surface runoff components can be separated as seen in Table 2-3.

Table 2-3 Groundwater Recharge and Surface Water Runoff

ANNUAL SURPLUS	GROUNDWATER RECHARGE	SURFACE WATER RUNOFF
30 Year Normals (395 mm)	158 to 316 mm per year 0.050 to 0.100 L/s/ha	237 to 79 mm per year 0.075 to 0.025 L/s/ha
2019 Shanty Bay Data (503 mm)	164 to 328 mm/year	246 to 82 mm/year
2019 WAI Data (308 mm)	94 to 187 mm/year	140 to 47 mm/year

The infiltration values used are based on average characteristics of the site and actual values may vary based on specific location. In 2019, the calculated water surplus at the WAI climate station is zero for the months of June, July, August, September, October, November and December.

3 PERFORMANCE INDICATOR TRIGGER MONITORING PROGRAM

3.1 METHODS

The Performance Indicator Trigger Monitoring (PITM) program is the regulatory compliance component of the AMP with respect to water-related issues.

The PITM program's purpose is to monitor the effects of quarry operations on water resources with respect to water levels, flows and temperatures, and to initiate any actions necessary to adapt quarry operations so that the values of each of these parameters remain within their normal patterns of seasonal variation. Any long term changes in prevailing climatic conditions will be incorporated into the AMP by developing statistical relationships between key AMP monitoring stations and two surface water flow and temperature control stations that are located in the Pretty River and Batteaux Creek drainage basins. These two control stations are situated beyond any possible influence of quarry operations or significant water users.

The PITM program provides for the monitoring of water resources that support natural heritage features. These are the features outside of the limit of extraction that are potentially sensitive to fluctuations in water regimes, such as provincially significant wetlands and fisheries.

These locations are monitored so that appropriate actions may be taken to modify routine quarry operations and/or implement contingency mitigation measures, to ensure that quarry operations do not negatively impact water resources which directly support natural heritage features, namely:

- Springs that discharge at the Niagara Escarpment east of the expansion quarry. These springs help to sustain surface water flow and fish habitat below the brow of the Niagara Escarpment in tributary streams of the Pretty River and Batteaux Creek;
- Surface water flows that support fish habitat in the Beaver River west of the expansion quarry; and
- Surface water levels and flows and groundwater levels that support wetland features and functions.

It is recognized that, in some instances, there may be factors, such as atypical climate conditions, which have no connection to quarry operations that could affect flow and/or temperature conditions at some monitoring locations. The monitoring programs in the AMP are designed to assist in identifying cause and effect relationships. In order to incorporate any effects that long-term trends in regional climatic conditions (i.e. climate change) have on local groundwater springs and/or surface water level and flow conditions that are monitored as part of the PITM, monitoring.

For Phase 1 quarry operations, the potential for off-site water-related effects to any of the provincially significant wetlands and/or Escarpment springs is considered low.

During Phase 1, interim trigger values are based on historic monthly measurements at each monitoring location and are updated annually and as part of the 5-year review of the AMP. Data collected in 2019, as part of the PITM monitoring program, is used to update the interim trigger values and to help incorporate any longer term trends in

regional climate on the groundwater springs and/or surface water levels. It is noted that PITM trigger periods do not come into effect until Phase 1 of quarrying is completed.

A description of the PITM regulatory monitoring stations is included in Table 3.3 of the 2013 AMP document. ***Figure 4*** shows monitoring station locations.

During the months of July and August, bi-weekly monitoring is completed at the surface water Escarpment springs (SW10, SW11, SW11A-E, SW21C, SW24A and SW77). Monthly monitoring is conducted at other times of the year. Monitoring includes temperature and an assessment of flow conditions through either the use of an electromagnetic flow meter or by visual assessment.

Water pumped and discharged at the quarry is monitored under a Permit to Take Water and an Environmental Compliance Approval. The quarry discharges into the RR6 wetland, west of the existing quarry. Pumping rates and the metered flow of the quarry discharge are regulated under the site's Permit to Take Water and Environmental Compliance Approval for Industrial Discharge.

Temperature and surface water channel flows are e monitored hourly at selected PITM surface water stations. PITM surface water monitoring stations include locations in three separate watersheds:

- The Pretty River tributary system: SW16, SW17, SW17A, SW18 and PR Control,
- The Batteaux Creek tributary system: SW9, SW14, SW15 and BC Control, and
- The Beaver River tributary system: SW1, SW2, SW0-2, SW3, SW6A and SW3B ('RR3 Karst')

Pressure transducers and a staff gauge have been installed at stations: SW1, SW2, SW0-2, SW3, SW6A, SW9, SW15, SW16 and SW18. Staff gauges have been installed at stations: SW14, SW17, SW17A, RR3 Karst, PR Control and BC Control; these stations are real-time logger to web stations. Flow measurements are collected with an electromagnetic flow velocity meter or manually. Field chemistry parameters (temperature, pH, dissolved oxygen and conductivity) are recorded monthly.

During the months of May, June and July drivepoint monitors in the wetlands are monitored bi-weekly and monthly for the remainder of the year. Monitoring includes measurements of groundwater level, ponded water depth and water temperature. The drivepoints are located in the following wetlands:

- ANSI A wetland: DP6 (vernal pool)
- ANSI B wetland: Bridson DP and DP9
- RR2 wetland: DP5 (vernal pool) and DP7 (vernal pool)
- RR3 wetland: DP10
- RR6 wetland: DP2, DP4 and DP8

During Phase 1 quarry operations, a reference wetland station will be established in either the Nottawasaga Lookout Provincial Park or the Pretty River Provincial Park with input from the Ministry of Natural Resources and Forestry (MNRF) and the Nottawasaga Valley Conservation Authority (NVCA). Additional information regarding this reference wetland is discussed in Section 3.2.3.6.

3.2 MONITORING RESULTS

The results of the AMP performance indicator trigger monitoring program in 2019 are presented in the following section.

As stated in the AMP, trigger monitoring criteria for water flows, water temperature and wetland water levels will apply during their respective trigger periods when aggregate extraction proceeds beyond Phase 1. In 2019, extraction remained within Phase 1 of the expansion property. Interim trigger values have been developed for water flows and water temperature using historical monitoring data and are updated as monitoring data become available.

3.2.1 SURFACE WATER FLOW

The interim red trigger value is set as the historic lowest monthly value recorded at a specific location for stream flows and/or flow at Escarpment springs. The interim yellow trigger value is calculated either by increasing the red value by 15%, or by using the third-lowest monthly flow value over the historic period of record, whichever is the higher value. Green interim trigger values are set above the yellow interim trigger value.

Interim flow trigger values are outlined in Table 3.5, Appendix B of the 2013 AMP document. Monitoring locations are shown on ***Figure 3***.

3.2.1.1 STREAM FLOW

Observations on the 2019 stream flow monitoring results are presented in Table 3-1, below:

Table 3-1 Surface Water Monitoring Stations - Results

MONITORING STATION	FIGURE	OBSERVATIONS
Pretty River Tributary System		
SW16	B-28	Surface water flows generally within previously reported range.
SW17	B-29	Surface water flows generally within previously reported range.
SW17A	B-30	Surface water flows generally within previously reported range.
SW18	B-32	Surface water flows generally within previously reported range.
PR Control	B-56	Surface water flows generally within previously reported range; April 2019 stream flow was marginally above the historic range.
Batteaux Creek Tributary System		
SW9	B-15	Surface water flows generally within previously reported range.
SW14	B-26	Surface water flows generally within previously reported range; April 2019 stream flow was marginally above the historic range.
SW15	B-27	Surface water flows generally within previously reported range.
BC Control	B-57	Surface water flows generally within previously reported range.
Beaver River Tributary System		
SW1	B-1	Surface water flows generally within previously reported range.

SW2	B-2	Surface water flows generally within previously reported range.
SW0-2	B-4	Surface water flows generally within previously reported range.
SW3	B-7	Surface water flows generally within previously reported range.
SW6A	B-12	Surface water flows generally within previously reported range.
SW3B ('RR3 Karst')	B-55	Surface water flows generally within previously reported range.

3.2.1.2 ESCARPMENT SPRINGS

The results of the 2019 AMP monitoring program at the Escarpment spring monitoring stations are summarized in Table 3-2, below.

Table 3-2 Escarpment Springs Monitoring Stations - Results

MONITORING STATION	FIGURE	OBSERVATIONS
SW10	B-16	Surface water flows generally within previously reported range.
SW11	B-17	Surface water flows generally within previously reported range.
SW11A	B-18	Surface water flows generally within previously reported range.
SW11B	B-19	Surface water flows generally within previously reported range.
SW11C	B-20	Surface water flows generally within previously reported range.
SW11D	B-21	Surface water flows generally within previously reported range.
SW11E	B-22	Surface water flows generally within previously reported range.
SW21C	B-38	Surface water flows generally within previously reported range.
SW24A	B-46	Surface water flows generally within previously reported range.
SW77	B-53	Surface water flows generally within previously reported range.

3.2.1.3 CONTROL STATIONS

During Phase 1 of quarry operations, the likelihood of quarry-related water effects off-site is considered low. WAI is currently in the process of developing statistically valid relationships for flow and temperature conditions between specified key AMP monitoring locations and control stations in the Pretty River sub-catchment drainage basin and in the Batteaux Creek sub-catchment drainage basin. Larger sample sizes generally lead to increased precision when developing relationships. The statistical validity of the relationships between flow and temperature conditions between the specified AMP monitoring locations and the control stations is expected to increase as data collection progresses.

The key monitoring locations for the Pretty River sub-catchment drainage basin are SW17, SW17A and SW18. In the Batteaux Creek sub-catchment drainage basin, the key monitoring location is SW14.

The control stations have been established at the following locations:

— Batteaux Creek Sub-watershed Station ("BC Control") – surface water control station located at the north side of the road culvert on 21/22 Sideroad, Clearview Township, approximately 1350 m east of Concession 10.

– Pretty River Sub-watershed Station ("PR Control") – surface water control station located at the north side of the road culvert on 30/31 Sideroad, Town of the Blue Mountains, approximately 390 m west of the boundary line between Clearview Township and Town of Blue Mountains.

Photo 1 - Batteaux Creek sub-watershed control station

Photo 2 – Pretty River sub-watershed control station

In addition to the two control locations, long term gauging stations at the Mad River station at Avening and the Pretty River station at Collingwood were selected for comparison. Statistical relationships between key monitoring locations and the long term gauging stations will be created and used as a supplementary trigger to replace the initial triggers based on the data collected throughout Phase 1 extraction .

The long term regional flow data for the Mad River and the Pretty River stations are presented in ***Appendix A*** as ***Figures A-12*** and ***A-13***. The data for these figures was obtained from the Government of Canada real-time hydrometric data web-site (https://wateroffice.en.gc.ca). Historical data for the Mad River station (02ED015) is available from 1988 through 2018. Historical data for the Pretty River station (02ED031) is available from 2006 through 2018. The average daily surface water flow data for both stations in 2019 was obtained from the real-time data set.

3.2.1.4 TRIGGER EXCEEDANCES

As stated in Table 3.2 of the AMP, trigger monitoring criteria for water flows, water temperature and wetland water levels will apply during their respective trigger periods as soon as extraction proceeds beyond Phase 1. Interim trigger values have been developed for water flows and water temperature using historical monitoring data. These interim trigger values will be updated as further monitoring data becomes available during Phase 1.

Exceedances of the interim trigger values for stream flow are discussed below in chronological order. Monthly summary tables including measured stream flow and temperature values are included in ***Appendix B*** (Tables B7 – B30).

JANUARY 2019

Surface water flow rates and temperatures at the Escarpment springs and the surface water monitoring stations were collected during the January monthly monitoring event (January 18-19, 2019).

- Green zone stream flow measured at: SW21C, SW6A, SW17 and SW18A.
- Yellow zone stream flow interim triggers measured at: SW11.
- Red zone stream flow interim triggers measured at: SW 2 and SW24A.

In addition, SW77, SW1, SW0-2, SW3, SW14, SW16 and SW18 were frozen and were unable to be measured. In the two weeks prior to measuring surface water flows, Duntroon had received approximately 21 mm of precipitation and the average temperature over that time period was minus 5.9 degrees Celsius. The low amount of precipitation and freezing temperatures recorded prior to monitoring are most likely the cause of the trigger exceedances. Additionally, ice blockages upstream of the measurement stations may have limited flow.

FEBRUARY 2019

Surface water flow and temperatures at the Escarpment springs and the surface water monitoring stations were collected during the February monthly monitoring event (February 26 and 28, 2019).

- Green zone stream flow measured at: SW11.

It is noted that numerous surface water monitoring stations were frozen and unable to be measured in February 2019.

MARCH 2019

Surface water flow and temperature data at the Escarpment springs and the surface water stations were collected during the March monthly monitoring event (March 15 and 19, 2019).

- Green zone stream flow measured at: SW10, SW11, SW21C, SW24A, SW77, SW14, SW17 and SW17A
- Yellow zone stream flow interim triggers measured at: SW18.

In addition, SW1, SW2, SW0-2, SW3, SW6A, SW9 and SW16, were frozen and SW15 was buried. As such, these stations were unable to be measured.

Temperatures lower than the 30 year average were recorded in February and March which may have resulted in less melt flowing into the surface water course and, as such, a flow rate at SW18 that was marginally lower than the yellow trigger value. Additionally, debris observed within the water course downstream of SW18 may have caused a reduction in flow.

APRIL 2019

Surface water flow and temperature data at the Escarpment springs and the surface water stations were collected during the April monthly monitoring event (April 24-25, 2019).

— Green zone stream flow measured at all surface water stations and Escarpment springs.

It is noted that SW18 was not measured due to the high amount of flow at this location during the April monitoring event; WAI staff deemed that it was unsafe to attempt flow measurements. Based on the visual observations of higher than normally observed flows, it is inferred that the flow rates would satisfy trigger levels.

MAY 2019

Surface water flows and water temperature data were collected at the Escarpment springs and the surface water monitoring stations during the May monthly monitoring event (May 23 and 27, 2019).

— Green zone stream flow measured at all surface water stations and Escarpment springs stations

JUNE 2019

The surface water flow and temperature data were collected from the Escarpment springs and the surface water monitoring locations during the June monthly monitoring event (June 18 and 21, 2019).

— Green zone stream flow measured at all surface water stations and Escarpment springs stations

JULY 2019

Surface water flow and temperature data were collected bi-weekly at the Escarpment springs in July 2019, as stipulated by the PITM. Monitoring events were completed on July 5, 2019 and during the July monthly monitoring event on July 29-30, 2019. Surface water monitoring stations were measured during the monthly event only.

Biweekly Event (Escarpment springs only)

— Green zone stream flow measured at all Escarpment springs, except SW24A
— Red zone stream flow interim triggers measured at SW24A

Monthly Event

— Green zone stream flow measured at: SW10, SW11, SW21C, SW24A, SW77, SW14, SW16, SW17, SW17A and SW18.
— Yellow zone stream flow interim triggers measured at: SW 15.
— Red zone stream flow interim triggers measured at: SW77, SW1, SW2, SW0-2 and SW6A

The precipitation received throughout June and July was below the 30-year historical average, which contributed to the surface water stations not meeting the trigger levels. In addition, beaver dams observed near the culvert at SW1 likely contributed to the red triggers at SW1 and SW 0-2.

AUGUST 2019

Surface water flow and temperature data were collected bi-weekly at the Escarpment springs in August 2019, as stipulated by the PITM. Monitoring events were completed on August 8,2019 and during the August monthly monitoring event on August 29-30, 2019. Surface water monitoring stations were measured during the monthly event only.

Biweekly Event (Escarpment springs only)

- Green zone stream flow measured at: SW21C
- Yellow zone stream flow measured at: SW10, SW11 and SW77
- Red zone stream flow measured at: SW24A

Monthly Event

- Green zone stream flow measured at: SW11, SW24A, SW2, SW6A, SW14, SW16, SW17 and SW18
- Yellow zone stream flow interim triggers measured at: SW10 and SW 17a.
- Red zone stream flow interim triggers measured at: SW21C, SW77, SW1, SW 0-2 and SW15.

It is noted that PITM trigger station SW10 was observed to be dry during the August biweekly monitoring event. Additionally, PITM trigger stations SW21C and SW15 were observed to be dry during the August monthly monitoring event. The precipitation received throughout June, July and August was below the 30-year historical average, which contributed to many of the surface water stations not meeting the trigger levels or being recorded as dry. In addition, beaver dams observed near the culvert at SW1 likely contributed to the below average flows at SW1 and SW 0-2. There was also construction in the vicinity of SW21C, which may have impacted the flows at some of the stations.

SEPTEMBER 2019

Surface water flow measurements and water temperature data were collected at the Escarpment springs and the surface water monitoring stations during the September monthly monitoring event (September 26-27, 2019).

- Green zone stream flow measured at: SW10, SW11, SW24A, SW0-2, SW6A, SW14, SW16, SW17, SW17A and SW18
- Yellow zone stream flow interim triggers measured at: SW2
- Red zone stream flow interim triggers measured at: SW21C, SW77 and SW15.

It is noted that trigger stations SW21C, SW77 and SW 15 were observed to be dry during the September monitoring event. The precipitation recorded for the month of September, as well as the previous three months, was less than the 30 year average and that may have contributed trigger exceedances observed in September.

OCTOBER 2019

Surface water flow measurements and water temperature at the Escarpment springs and the surface water monitoring stations were collected during the October monthly monitoring event (October 22-23, 2018, 2019).

- Green zone stream flow measured at: all Escarpment spring stations and all surface water monitoring stations, with the exception of SW21C, SW77, SW15 and SW18.
- Yellow zone stream flow interim triggers measured at SW15 and SW18
- Red zone stream flow interim triggers measured at SW21C and SW77.

It is noted that trigger stations SW21C, SW77 and SW 15 were observed to be dry during the October monitoring event. Precipitation levels from June to September were below the 30 year normal. This may have contributed to the trigger exceedances that were observed in October.

NOVEMBER 2019

Surface water flow measurements and air temperature data were recorded at the Escarpment springs and the surface water monitoring stations during the November monthly monitoring event (November 21-22, 2019).

- Green zone stream flow measured at: all Escarpment spring stations and all surface water monitoring stations, with the exception of SW18.
- Red zone stream flow interim triggers measured at: SW18.

Additionally, it is noted that the average temperature in November was below the 30 year normal and, as such, many Escarpment spring stations and surface water monitoring stations were frozen and unable to be measured.

DECEMBER 2019

Surface water flow measurements and water temperature data were collected at the Escarpment springs and most of the surface water monitoring stations during the December monthly monitoring event (December 20, 2019).

Green zone stream flow measured at: all Escarpment springs stations and all surface water monitoring stations. Due to freezing temperatures and heavy snowfall that occurred for two days prior to sampling, several of the stream flows were observed to be frozen.

3.2.1.5 MITIGATION MEASURES UNDERTAKEN

There were no mitigation measures recommended for 2019. Mitigation measures are not anticipated to be required in Phase 1, since extraction during Phase 1 is not expected to result in negative impacts to off-site water resources and/or ecological features and functions.

An overview of the proposed future mitigation measures that may be implemented if necessary, is outlined in Section 2.3 of the 2013 AMP document.

ROUTINE WATER MANAGEMENT MEASURES

In addition to the Site Plans, and this AMP Summary Report, routine water management and mitigation are regulated by approvals under the Ontario Water Resources Act (PTTW No. 7725-AACS54, dated September 22, 2016) and the Environmental Protection Act (ECA No. 1521-A4VJ4X, dated October 17th, 2016). These measures have, to the extent possible, been aligned with the monitoring requirements that exist under the AMP.

The AMP mitigation objectives are based on the release of the required volumes of water to the landscape in the vicinity of the wetlands without negatively affecting the surrounding environment. The initial discharge volumes, if required, will be based proportionately on the respective sizes of the surface drainage catchment areas extracted from the respective watersheds (Beaver River or Batteaux Creek), in each Phase.

The proportionate discharge to each watershed/wetland can be adjusted, as necessary, based on the results of the AMP Performance Indicator Trigger Monitoring Program. Discharge into the wetlands will be managed by adjusting pumping rates and/or by means of flow restrictor valves in discharge lines, as required. Discharge into individual wetlands will be adjusted as necessary to maintain target hydrographs in each wetland/watercourse.

For more information on the proposed discharge points and designs that will be implemented progressively during the excavation of the Phases of the expansion quarry, please see Section 2.3 of the 2013 AMP document.

Routine water management activities are expected to keep quarry operations in compliance with the AMP trigger criteria, and protect the surrounding natural environment and water resources.

In the event that the routine water management activities described above do not fully achieve the objectives of the AMP, contingency measures will be implemented.

CONTINGENCY MITIGATION MEASURES

Contingency mitigation measures were not required to be implemented during the 2019 monitoring period. As previously noted, the extraction of Phase 1 of the expansion Quarry is not expected to result in negative impacts to off-site water resources and/or ecological features and functions.

An overview of the proposed future contingency measures that may be implemented if necessary, is outlined in Section 2.4 of the 2013 AMP document.

3.2.2 SURFACE WATER TEMPERATURE

For water temperature in streams and/or Escarpment springs, monthly interim trigger values are established for the months of June through September to reflect the period when warm surface water temperatures have the potential to affect sensitive fish habitat areas that are present downstream, below the Escarpment brow. The trigger values are based on historic recorded temperatures with red triggers consisting of the highest monthly temperature recorded. The interim yellow zone trigger value is set at 10% below the interim red zone trigger value. The interim green zone trigger value is anything that is below the yellow zone trigger value.

Interim temperature trigger values are outlined in Table 3.6, ***Appendix B*** of the 2013 AMP document.

3.2.2.1 SURFACE WATER COURSES

The surface water monitoring stations (Table 3-1 and 3-2) are monitored once a month during the months of June through September and the surface water temperature is recorded and compared to the interim trigger values developed specifically for each surface water station.

3.2.2.2 ESCARPMENT SPRINGS

The Escarpment spring monitoring stations are monitored once a month during the months of June and September and bi-weekly in July and August. Surface water temperature is recorded and compared to the interim trigger values developed specifically for each Escarpment spring monitoring station.

3.2.2.3 CONTROL STATIONS

The Batteaux Creek (BC Control) and Pretty River (PR Control) control stations provide context to the recorded surface water temperature data. The control stations are discussed in section 3.2.1.3, above.

3.2.2.4 TRIGGER EXCEEDANCES

As outlined in Table 3.2 of the 2013 AMP, trigger monitoring criteria for water flows, water temperature and wetland water levels will apply during their respective trigger periods as soon as extraction activities proceed

beyond Phase 1. In 2019, extraction was within the Phase 1 area of the expansion property. Interim trigger values have been developed for water flows and water temperature using historical monitoring data. These interim trigger values will be updated as further monitoring data become available during Phase 1.

Exceedances of the interim trigger values for water temperature are discussed below in chronological order. Monthly monitoring summary tables are included in ***Appendix B*** (Tables B7 - B30).

JUNE 2019

Surface water temperature data were collected from the Escarpment springs and the surface water monitoring stations during the June monthly monitoring event (June 18 and 21, 2019).

- Green zone temperature measured at all Escarpment spring stations and all surface water monitoring stations.

JULY 2019

Surface water flow and temperature data were collected from the Escarpment springs only during the biweekly monitoring event (July 5, 2019) and from the Escarpment springs and the surface water monitoring locations during the July monthly monitoring event (July 29-30, 2019).

Biweekly Event (Escarpment Springs only)

- Green zone temperature measured at all Escarpment springs.

Monthly Event

- Green zone temperature measured at: all Escarpment springs, and at all surface water stations, with the exception of SW6A and SW17.
- Yellow zone temperature interim triggers measured at: SW6A and SW17.

The mean monthly atmospheric temperature in July was greater than the 30 year normal and that may have contributed to the trigger exceedances observed at SW6A and SW17.

AUGUST 2019

Surface water flow and temperature data were collected bi-weekly at the Escarpment springs in August 2019, as stipulated by the PITM. Monitoring events were completed on August 8, 2019 and during the August monthly monitoring event on August 29-30, 2019. Surface water monitoring stations were measured during the monthly event only.

Biweekly Event (Escarpment springs only)

- Yellow zone temperature measured at: SW11 and SW21C.
- Red zone temperature interim triggers measured at: SW10, SW24A and SW77.

Monthly Event

Green zone temperature measured at: all surface water monitoring stations with the exception of SW24A, SW77 and SW16.

- Red zone temperature interim triggers measured at: SW24A, SW77 and SW16.

Due to a lack of precipitation that contributed to the shallow water levels and low flows, the temperatures recorded at certain stations were found to exceed the trigger levels in August.

SEPTEMBER 2019

Surface water flow measurements and water temperature data were collected at the Escarpment springs and the surface water monitoring stations during the September monthly monitoring event (September 26-27, 2019).

- Green zone temperature measured at: SW10, SW2 and SW0-2.
- Yellow zone temperature interim triggers measured at: SW11, SW6A, SW14, SW17 and SW18
- Red zone temperature interim triggers measured at: SW24A, SW16, SW17A.

The yellow and red zone temperature interim triggers recorded in September 2019 are attributed to the warm air temperature and reduced stream flows in the period leading up to, and during the monitoring events.

3.2.2.5 MITIGATION MEASURES UNDERTAKEN

Mitigation measures are not expected to be required in Phase 1, since extraction during Phase 1 is not expected to result in negative impacts to off-site water resources and/or ecological features and functions. No mitigation measures were required for 2019.

An overview of the proposed future mitigation measures that may be implemented if necessary, is outlined in Section 2.3 of the 2013 AMP document.

ROUTINE WATER MANAGEMENT MEASURES

Routine water management measures are provided in Section 2.1.5.

CONTINGENCY MITIGATION MEASURES

Contingency mitigation measures were not required to be implemented during the 2019 monitoring period. As previously noted, the extraction of Phase 1 of the expansion Quarry is not expected to result in negative impacts to off-site water resources and/or ecological features and functions.

An overview of the proposed future contingency measures that may be implemented if necessary, is outlined in Section 2.4 the 2013 AMP document.

3.2.3 WETLAND WATER LEVEL

The wetlands function by the retention of water within the majority of their catchment areas, such that nearby wetland features will continue to receive direct precipitation, as well as snowmelt and storm-event surface runoff from the lands to the north and east. In the case of Rob Roy Swamp Wetland Complex (unit RR2 wetland), it will receive runoff from the American Hart's-Tongue Fern and Butternut protection areas to the south.

When required, wetland water levels will be managed during the active extraction phases of the quarry through to final rehabilitation by discharging quarry water into the wetlands in an effort to maintain the seasonal hydro-periods and surface water outflows. Discharge water quality is regulated by approvals under the ECA for discharge.

Design and pumping rates will be refined in consultation with the MNRF, MECP and Conservation Authority staff through the Phase I extraction period as the monitoring database expands. Preliminary target hydrographs have been developed for the three major wetland types and include target ranges for wet, average and dry conditions. These conditions will be based on weather data provided by the WAI climate station and will be updated seasonally.

The data collected throughout Phase 1 will be used to update the preliminary hydrographs. The wetland target refinement process will be verified through the long-term ecological monitoring of wetlands to obtain data on the trends in amphibian habitat conditions, wetland plant species diversity and percent cover, and other ecological indicators of healthy, functional wetlands.

During Phase 1 of quarry operations, a reference wetland station will be established in either the Nottawasaga Lookout Provincial Park or the Pretty River Provincial Park with input from MNRF and the Nottawasaga Valley Conservation Authority. This Reference Wetland selection process is discussed in Section 3.2.3.6.

Drivepoint water level and ponded water depth were recorded during the following monitoring events, as outlined in the PITM:

- May bi-weekly event (May 6, 2019)
- May monthly monitoring event (May 22, 2019)
- June biweekly event (June 6, 2019)
- June monthly monitoring event (June 19, 2019)
- July biweekly event (July 5, 2019)
- July monthly monitoring event (July 19, 2019)

Data from these events is included in Table B-31, ***Appendix B***.

Hydrographs for the drivepoint monitors are presented in ***Appendix C (Figures C-63 through C-73)*** and include the water levels inside the drivepoint as well as the elevation of the surface water that is ponded around the drivepoint, where it is present. Table C-8 in ***Appendix C*** includes water level elevations at the drivepoint locations. During the winter and summer months, drivepoints can become unmeasurable when the surrounding water freezes or dries up. These events are noted in Table C-8 where they were observed during the monitoring event. Drivepoint and wetland locations are provided on ***Figure 3 – Monitoring Locations***.

Trends and observations for drivepoint monitoring stations are outlined in Table 3-3, below.

Table 3-3 Drivepoint Monitoring Stations - Results

MONITORING STATION	FIGURE	OBSERVATIONS
Bridson DP	C-73	Seasonal variation within previously reported values.
DP2	C-64	Water levels stable since 2010-2011.
DP4	C-66	Seasonal variation within previously reported values.
DP5	C-67	Water levels drop to new minimum since 2007 in October.
DP6	C-68	Seasonal variation within previously reported values.
DP7	C-69	Limited data set.
DP8	C-70	Limited data set.

DP9	C-71	Limited data set.
DP10	C-72	Limited data set.

3.2.3.1 VERNAL BREEDING POOLS WATER LEVELS

Drivepoints DP5 and DP7 are located north of the expansion quarry in vernal pools that are part of Rob Roy PSW #2. DP5 was installed in the summer of 2007 and has been monitored monthly, when accessible, since then. Water levels at DP5 in 2019 reflect the atypically dry conditions of the summer of 2019. The water level recorded at DP5 in October 2019 was the lowest recorded value since 2007. DP5 had previously been dry during the year 2007, nine years prior to the initiation of AMP monitoring (as seen in hydrograph ***Figure C-67***). DP7 was installed in the summer of 2014 and water level monitoring has been completed monthly since the end of 2015. Water levels at DP7 in 2019 show seasonal variation, with peak water levels recorded in May.

The ANSI A wetland is located north of the expansion lands (***Figure 3***). Drivepoint DP6 is located in a vernal pool in the ANSI A wetland. Water levels at DP6 have been monitored on a monthly frequency since the end of 2007 and show typical seasonal variation. Peak water elevations are reported in the spring months. DP6 is often reported as "dry" over the summer months, represented as gaps in the hydrograph between the recorded data points.

3.2.3.2 SOIL GROUNDWATER TABLE LEVELS

Multiple drivepoints are installed within Rob Roy PSW#6, located west of the existing quarry, where the quarry sump discharge is directed. DP2 is located directly north of the quarry discharge. This monitoring location was installed in the fall of 1999 and has shown little seasonal variation since 2011. DP2 water levels in 2019 showed a slight increase over previously recorded water levels, which could be attributed to the presence of the new secondary storage pond that was added east of the existing main storage pond, in the existing quarry in 2018 *(*Figure ***2c)***. DP4 is located downstream of the quarry discharge and west of SW1. DP4 has been monitored since the fall of 1999 and remained relatively consistent until 2017. DP4 water levels dropped in 2018 but remained within previously observed seasonal variations. In November 2019, the water level in DP4 rebounded to pre-2018 levels. Further monitoring is recommended to determine if these water levels were anomalous. DP8 is located south of SW2 and was installed in 2014. The water levels at DP8 have shown little seasonal variation and appear to show a slight upward trend.

Rob Roy PSW#3 is adjacent to PSW#2 and can be found north of the MAQ quarry property (Figure 3). DP10 was installed in the wetland at the end of 2015. In 2019, water levels in DP10 were relatively consistent and showed little seasonal variation.

Bridson DP, located on the former Bridson property, was installed to monitor ANSI B (Figure 3). Water levels at Bridson DP show seasonal fluctuation, with a seasonal low typically observed in the late summer or early fall.

Drivepoint DP9 was installed in 2014 and is located north-east of the expansion quarry footprint, in the ANSI B buffer lands owned by WAI. In 2019, the seasonal variations observed at DP9 were similar to previous years.

3.2.3.3 REFERENCE WETLANDS

During Phase 1 of quarry extraction, a reference wetland is to be established in the Nottawasaga Lookout Provincial Park or the Pretty River Provincial Park with input from the Ministry of Natural Resources and Forestry and the Nottawasaga Valley Conservation Authority. This wetland will be designated as Reference Wetland 1.

From May until late August of 2019, wetlands mapped in the Nottawasaga Lookout Provincial Park Reserve and adjacent public lands were investigated by staff from Stantec and Walker. Much of the area mapped as wetland was in fact upland forest. The majority of wetlands encountered were on the lower bench of the escarpment and were seepage-dominated without substantial vernal pools. No wetlands that had a similar physiographic location or community composition to the Rob Roy Swamp PSW Complex or ANSI wetlands A and B were encountered. The search will continue in 2020 in the Pretty River watershed with an emphasis on private lands where long term access agreements can be negotiated

3.2.3.4 TRIGGER EXCEEDANCES

As per Table 3.2 in the AMP, the trigger period for the wetland water levels is spring and early summer (June/July) as soon as extraction proceeds beyond Phase 1. In 2019, extraction was within Phase 1 of the expansion property. There are no interim triggers for the wetland water levels. Trigger levels based on wetland vegetation and amphibian habitat will be developed and refined through the Phase 1 extraction period as the monitoring database expands and with input from agency staff.

3.2.3.5 MITIGATION MEASURES UNDERTAKEN

Mitigation measures are not expected to be required in Phase 1, since extraction during Phase 1 is not expected to result in negative impacts to off-site water resources and/or ecological features and functions. There were no mitigation measures undertaken in the year 2019.

An overview of the proposed future mitigation measures that may be implemented if necessary, is outlined in Section 2.3 of the 2013 AMP document.

ROUTINE WATER MANAGEMENT MEASURES

See section 3.2.1.5 for routine water management measures.

CONTINGENCY MITIGATION MEASURES

Contingency mitigation measures were not required to be implemented during the 2019 monitoring period. As previously noted, the extraction of Phase 1 of the expansion Quarry is not expected to result in negative impacts to off-site water resources and/or ecological features and functions

An overview of the proposed future contingency measures that may be implemented if necessary, is outlined in Section 2.4 of the 2013 AMP document.

3.3 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the 2019 performance indicator trigger monitoring program the following conclusions and recommendations are made:

- Certain deficiencies that were apparent with the implementation of the program in 2016, including the flow and temperature interim trigger level values that were adopted for the PITM Escarpment spring and surface water monitoring stations, continued to be evident in the 2019 program. The performance indicator interim triggers for surface water flow and surface water temperature should be re-evaluated to incorporate the conditions

observed in 2016 through 2019. The values recorded as having exceeded a specific seasonal maximum or minimum interim "trigger" value occurred as a result of climatic conditions, and not as a result of quarry operations in Phase 1.

- Surface water stations SW21C, SW24A and SW77 show sensitivity to high air temperatures due to their low flow and shallow nature. These high surface water temperatures are interpreted to be due to climate conditions and are not related to the active extraction in the quarry. The potential for off-site water-related effects to any of the provincially significant wetlands and/or Escarpment springs during Phase 1 is considered to be low.
- During Phase 1 of quarry extraction, a reference wetland is to be established in the Nottawasaga Lookout Provincial Park or the Pretty River Provincial Park with input from the Ministry of Natural Resources and Forestry and the Nottawasaga Valley Conservation Authority. The search for the reference wetland will continue in 2020 through examining the Pretty River Provincial Park and accessible private lands . This wetland will be designated as Reference Wetland 1.

For PITM monitoring in 2020, previous data should be included when creating interim triggers for both flows and temperature. As Phase 1 is unlikely to cause adverse impacts to off-site water resources, the data from the years 2016 to 2019 will help account for more recent local climate trends .

4 LONG-TERM GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

The Long Term Trend (LTT) groundwater and surface water monitoring program is used to track seasonal and year-over-year natural variations in the groundwater and surface water systems, as well as the progressive response of those systems as the existing quarry becomes depleted and extraction at the expansion quarry continues over the next few decades followed by several decades of rehabilitation to lakes. The LTT monitoring program will provide data that will update the environmental baseline conditions, and identify short-term and long-term trends.

4.1 METHODS

The surface water drainage areas, local catchment areas and monitoring stations for the Pretty River, Batteaux Creek, Beaver River and Mad River systems are provided on Figure 3. The LTT includes selected PITM stations with additional LTT surface water and groundwater stations to help assess the long term trends of the surrounding hydrology.

The LTT monitoring program for the groundwater monitoring stations includes monthly manual groundwater level measurements and a network of pressure transducers that record hourly or twice daily water levels at selected groundwater monitoring wells.

Long term trend monitoring stations are listed, along with a description, in Table 4.1 of the 2013 AMP document. A summary of the well information is included in Table C-1 in Appendix C. LTT monitoring stations include groundwater monitoring wells in the following locations:

- Existing quarry: 98-8, 98-9, 98-12 and PW99-1;
- Expansion quarry (injection wells): IW1, IW2, IW3 and IW4;
- Expansion quarry (monitoring wells): BH02-1, BH02-2, BH02-3, BH02-4, BH02-5 nest, BH02-6, BH03-7 nest, BH03-8, BH08-1, BH08-2, BH08-3, NW1-9, NW10 nest, BH03-9, TW04-1, TW04-2 and TW04-3;
- Osprey quarry property: 101-B, 102-C, 103-D, 104-A, OW1-4, OW3-1 (not accessible), OW5-2 and OW6-3;
- Carmarthen Lake Farms property: CLF1 (not accessible), CLF2, CLF3, CLF4 and CLF5.

On the Osprey Quarry property, monitoring wells OW1-6 and OW3-1 are no longer accessible, as noted in prior annual reports. On Carmarthen Lakes Farms access to CLF1 has been blocked and the well can no longer be monitored. The removal of these wells from the monitoring program does not affect the overall integrity of the program.

On the Expansion property, BH02-3 is recommended to be removed from the program as the well casing has been compromised and surrounding fill has breached the well. Due to BH02-3's close proximity to the quarry face and with BH02-4 existing approximately 20 meters north of its' location, it is recommended that this borehole be removed from the monitoring program. NW2 was excavated at the end of May as the quarry face approached its' location.

There are several private domestic water wells located around the periphery of the predicted drawdown zone of influence of the expansion quarry (Jagger Hims, 2007). Locations of the private domestic wells are identified on Figure 3 as 'RW' (residential wells). Selected monitoring wells are monitored in the AMP under the Long Term Trend Groundwater and Surface Water Monitoring Program:

- East of existing and expansion quarry: RW1, RW2 (since new ownership we haven't received written consent to enter property), RW5, RW6, RW7, RW8, RW16 (owned by WAI), RW18 (owned by WAI, to be removed before extraction) and RW19 (owned by WAI, to be removed before extraction).
- North of expansion quarry: RW3, RW4 (owners have asked us to no longer monitor their well), RW17.
- West of expansion quarry: RW9 (MAQ Aggregates property).

The owners of the RW4 property have requested a temporary stop to monitoring activities.

Electronic pressure transducers were installed at residential wells in close proximity to the quarry and record hourly or twice daily groundwater levels. In addition to the pressure transducers, manual groundwater levels are obtained monthly. A limited number of residential wells are also sampled annually for general chemistry, major and minor ion constituents, nutrients, total petroleum and hydrocarbons, BTEX, total suspended solids and bacteriological parameters.

Some historical wells that were originally monitored are not part of the Long Term Trend monitoring program. These wells are RW10, RW11, RW12, RW13, RW14, RW15 and RW20. RW12 and RW13 are currently included in the routine monitoring but are not part of the Long Term Trend monitoring program. RW14 and RW15 are wells that were historically part of the monitoring network at the existing quarry, but have been decommissioned.

The LTT monitoring program also includes drivepoints that are located in the following wetlands:

- ANSI A: DP6 (vernal pool)
- ANSI B: Bridson DP, DP9
- RR2: DP5 (vernal pool), DP7 (vernal pool), Staff Gauge 1 and Staff Gauge 2 (BH03-7 SG1/ SG2)

- RR3: DP11
- RR6: DP1, DP2, DP4, DP8
- CLF wetland: DP3

The groundwater depth, ponded water depth (where available) and surface water temperature are measured monthly at the drivepoints. The surface water depth is recorded monthly at the staff gauges. Selected drivepoint monitors also have pressure transducers installed which record twice daily groundwater levels.

The surface water monitoring program under the LTT monitoring program includes monthly stream flow and temperature measurements at the surface water monitoring stations. Pressure transducers are installed at selected surface water stations to record hourly water level stage. Annual measurement of field chemistry parameters (temperature, pH, conductivity and dissolved oxygen) and water quality sampling also occurs at selected surface water stations.

The LTT surface water monitoring program includes monitoring stations located in the following watersheds:

- The Pretty River tributary system: SW20
- The Batteaux Creek tributary system: SW7, SW8, SW10, SW11E, SW13, SW19, SW21 series, SW22, SW22A and SW22C
- The Beaver River tributary system: SW3C ('RR3 Out')
- Existing quarry floor: QFSW2 and dewatering sump

The additional surface water stations with data included in this AMP summary report that are not required under the PITM or LTT monitoring stations are the following: SWB-1, QFSW1, SW3A, SW4, SW5, SW6, SW12, SW12A, SW17B, SW21D, SW22B, SW23, SW24, SW24B, SW24C, SW25, SW26, SW26A, and SW27. The data for these additional stations is included in the report to provide context to the monitoring results for 2019 and to provide a historical record of the data collected in support of the Duntroon Quarry expansion. A description of each surface water monitoring station is provided in Table B-1, Appendix B.

It is noted that is has become difficult to get an accurate surface water flow measurement due to woody growth at the SW12A location.

4.2 NEW MONITORS INSTALLED

Groundwater monitoring wells and drivepoints were last installed in 2014, as required by the Site Plan for the expansion quarry. No new monitors were installed in 2019.

4.3 MONITORING RESULTS

4.3.1 GROUNDWATER LEVELS

4.3.1.1 SEASONAL VARIATION

Typically, groundwater levels achieve seasonal high elevations in the spring following the freshet with progressive declines throughout the summer months due to higher evapotranspiration (ET) rates. In the fall, the balance between precipitation rates and lower evapotranspiration rates can result in a rise in groundwater levels. In the winter months, when precipitation is bound up in the snow pack and the shallow ground surface is frozen, groundwater levels tend to decline until the freshet, when the cycle repeats.

The magnitude of seasonal variation is generally the greatest at the topographically high groundwater recharge areas, with less seasonal variation occurring in the topographically lower lying lands and adjacent to surface water courses and/or lakes that serve as groundwater discharge areas.

WETLANDS

Wetland water levels displayed the effects of seasonal variation to different degrees. Wetland water levels are discussed in more detail in section 2.2.3, above.

BEDROCK

Groundwater monitoring wells in the long term trend monitoring network showed a varying degree of influence due to seasonal climate conditions. The seasonal variation of groundwater levels in the bedrock is discussed in more detail in the following section, where it applies to selected monitors.

4.3.1.2 EXISTING QUARRY PROPERTY

Table 5-1 outlines the observations made in 2019 at the groundwater monitoring wells that are part of the Long Term Trend groundwater monitoring network on the Existing Quarry property.

Table 4-1 Existing Quarry - Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
98-8	Stable water levels throughout 2019. Water levels have gradually increased at monitoring well 98-8 over time, remaining stable since 2015, with the operation of the main reservoir at the west end of the Existing Quarry.	C-2
98-9	Approximately 11 m of historical impact from aggregate extraction. Stable groundwater variations since 2003 with water levels showing seasonal fluctuations comparable to previous monitoring years. Water levels in 2019 may be showing influence from the recent tunnel construction.	C-3
98-12	Approximately 14 m of historical impact from aggregate extraction. Stable water levels with seasonal variation observed since 2008.	C-4

PW99-1	Stable water levels throughout 2019. The operation of the main reservoir helps to buffer water levels at PW99-1.	C-5

Monitoring data from groundwater monitoring well MW6 (Figure C-1) has also been included in Appendix C to supplement the AMP data set, although this monitor is not included in the LTT monitoring program.

A number of historical groundwater monitors on the Existing Quarry property have been removed as part of normal aggregate extraction activities. The previously mentioned groundwater hydrographs (RW14, RW15 and RW 20) for monitoring wells that were not accessed in 2019 have not been included in this report.

4.3.1.3 OSPREY QUARRY PROPERTY

The following table summarizes the observations made in 2019 at the groundwater monitoring wells that are part of the Long Term Trend groundwater monitoring network on the Osprey Property.

The two groundwater monitoring wells mentioned prior (OW1-6 and OW3-1) were not monitored this year. A groundwater hydrograph with data up until November 2015 has been provided in Appendix C.

Table 4-2 Osprey Quarry - Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
101-B	Water levels within previously recorded seasonal variations.	C-35
102-C	Water levels within previously recorded seasonal variations.	C-36
103-D	Water levels within previously recorded seasonal variations.	C-37
104-A	Water levels within previously recorded seasonal variations.	C-38
OW1-4	Water levels within previously recorded seasonal variations.	C-39
OW3-1	No water level data recorded since 2015.	C-40
OW5-2	Water levels within previously recorded seasonal variations.	C-41
OW6-3	Water levels within previously recorded seasonal variations.	C-42

Groundwater levels on the Osprey Property in 2019 were within previously recorded seasonal variations.

4.3.1.4 EXPANSION QUARRY PROPERTY

The following tables summarize the observations made in 2019 at the groundwater monitoring wells that are part of the Long Term Trend groundwater monitoring network on the expansion quarry property.

Table 4-3 Expansion Quarry Injection Wells – Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
IW1	Water levels within previously recorded seasonal variations. Approximately 9 m difference between peak and low water levels. Historic high water level observed in April.	C-6

IW2	The water level dropped by approximately 15 m to a historic low in July 2019 then rebounded by approximately 5 m and remained stable for the remainder of the year. The cause of this decline is unknown, on-going monitoring is recommended	C-7
IW3	Less than 9 m difference between peak and low water levels.	C-8
IW4	Water levels show fluctuations related to seasonal climate variations. A historic high water level was measured in April while a historic low water level was measured in November.	C-9

Water levels at the injection wells show fluctuations related to seasonal climate variation in 2019. Due to the limited period of record for the injection wells, further monitoring is required before more conclusions can be reached with respect to long term trends at these wells.

Table 4-4 Expansion Quarry Monitoring Wells - Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
BH02-1	Historically this monitor has shown drawdown impacts. Approximately 2 m of additional decline in water level since 2011. Seasonal variation in water levels at this monitor is slightly above 10 m. New minimum groundwater level set in October.	C-10
BH02-2	Groundwater level shows a general decline since 2016 as the quarry face moves northeast towards the monitoring location. New minimum groundwater level set in November.	C-11
BH02-3	Monitor is reported as dry in 2019.	C-12
BH02-4	Water levels declining after August 2016. New water level minimum set in October 2018. This monitor is in close proximity to the extraction activities occurring in Phase 1 of the expansion quarry. A new maximum groundwater level was reported in March 2019. Further monitoring will determine if this reading is anomalous.	C-13
BH02-5 nest	Water levels within previously recorded seasonal variations.	C-14
BH02-6	Monitor is adjacent to the sinking cut made for tunnel construction (Tunnel construction began in October 2015).	C-15
BH03-7 nest	Water levels within previously recorded seasonal variations.	C-16
BH03-8	Water levels within previously recorded seasonal variations.	C-17
BH08-1	Water levels within previously recorded seasonal variations.	C-18
BH08-2	Water levels within previously recorded seasonal variations.	C-19
BH08-3	Water levels within previously recorded seasonal variations.	C-20
NW1	Water levels declining after July 2016. New historic low water level recorded in August 2019.	C-21
NW2	Monitoring ceased in June 2018 due to extraction progression.	C-22
NW3	Water levels in 2019 were within the previously reported range with the exception of a historic low water level measured in October 2019. An overall marginal decline in the water level is being observed at this location.	C-23
NW4	Water levels within previously recorded seasonal variations.	C-24
NW5	Water levels have shown an overall decline since 2016 New historic low level recorded in August 2019.	C-25

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
NW6	Water levels within previously recorded seasonal variations.	C-26
NW7	The water level rose to a new historic high elevation set in July 2019 and stayed elevated for the remainder of the year. The cause of this is unknown	C-27
NW8	The water level declined to a historic low level in September 2019 then rebounded to within the previous range of elevations by December.	C-28
NW9	Water levels within previously recorded seasonal variations.	C-29
NW10 nest	DP water levels remain relatively constant. NW10 shallow and deep monitoring well water levels show variation due to seasonal climatic influence.	C-30
BH03-9	Monitor began showing seasonal variations in 2016. New minimum water elevation reported in October 2019 due to dry conditions.	C-31
TW04-1	Water levels showing similar seasonal variations to 2017 and 2018. New historic low elevations set from September to November 2019.	C-32
TW04-2	Water levels showing similar seasonal variations to 2017 and 2018. New historic low elevations set from September to November 2019.	C-33
TW04-3	Water levels showing similar seasonal variations to 2017 and 2018. New historic low elevations set from August to October 2019.	C-34

Groundwater levels on the expansion quarry property in 2019 display the influence of seasonal variation, as well as influence at some locations from the tunnel excavation and aggregate extraction activities. The influence of the tunnel excavation and aggregate extraction activities are limited to local influence at monitoring wells BH02-6 (immediately next to the tunnel excavation) BH02-4, BH02-1, NW1 and NW4 which are in close proximity to the active aggregate extraction area. The influence of the quarry activities on the groundwater levels at those wells that are in in the footprint of Phase 1 and in the vicinity of the current extraction activities was within anticipated levels.

Groundwater levels at the monitors on the expansion quarry property will continue to be monitored as part of the Long Term Trend monitoring program.

4.3.1.5 CARMARTHEN LAKE FARM PROPERTIES

Table 4-5 summarizes the observations made in 2019 at the groundwater monitoring wells that are part of the Long Term Trend groundwater monitoring network on the Carmarthen Lake Farms property.

As noted previously, monitoring well CLF1 is no longer accessible to obtain water levels. The water levels at CLF2, which is in close proximity to CLF1, have historically shown similar trends to the water levels at CLF1. The historical groundwater hydrograph for CLF1 is included in ***Appendix C*** as ***Figure C-43.***

Table 4-5 Carmarthen Lake Farm Properties - Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
CLF2	Water levels within previously recorded seasonal variations.	C-44
CLF3	Water levels within previously recorded seasonal variations.	C-45

CLF4	Water levels within previously recorded seasonal variations.	C-46
CLF5	Water levels within previously recorded seasonal variations.	C-47

4.3.1.6 RESIDENTIAL WELLS

Table 4-6 Residential Wells - Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
RW1	Water levels within previously recorded seasonal variations.	C-48
RW2	Access was not granted by new home owners in 2018. In 2019, water levels were within previously recorded seasonal variations.	C-49
RW3	Water levels within previously recorded seasonal variations.	C-50
RW4	At home owners' request in November 2018, the well is no longer monitored.	C-51
RW5	Water levels within previously recorded seasonal variations.	C-52
RW6	Water levels within previously recorded seasonal variations.	C-53
RW7	Water levels within previously recorded seasonal variations.	C-54
RW8	RW8 is located on a local topographical high north of the existing and expansion quarries and outside of their influence. Water levels within previously recorded seasonal variations.	C-55
RW9	RW9 is located on the CBM quarry property and has not been accessed for monitoring since September 2014.	C-56
RW16 (Bridson)	Water levels within previously recorded seasonal variations.	C-59
RW17 (owned by WAI)	Water levels within previously recorded seasonal variations.	C-60
RW18 (owned by WAI)	Water levels within previously recorded seasonal variations.	C-61
RW19 (owned by WAI)	Indications of influence due to quarry activities were observed in 2019.This well is located on expansion quarry property in close proximity to the active quarry face. New water level minimum set in November 2019.	C-62

Residential wells that are currently monitored but that are not part of the Long Term Trend monitoring program include: RW12 ***(Figure C-57)*** and RW13 ***(Figure C-58)*** have been included to supplement the 2019 AMP summary report.

As the excavation has continued to expand in a north east direction, some drawdown effects have been observed at RW 19 in 2019.

4.3.1.7 DRIVEPOINTS

A majority of the drivepoint monitors are included in the PITM program and 2019 trends were discussed in Section 3, above. Drivepoints that are exclusively part of the Long Term Trend monitoring program include DP1, DP3, DP11 and the staff gauges at BH03-7.

Table 4-7 Drivepoint Monitoring - Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
DP1	Water levels within previously recorded seasonal variations and have been exhibiting a marginal increase since 2015.	C-63
DP3	Water levels within previously recorded seasonal variations.	C-65
DP11	Monitored by Highland Quarry	N/A
BH03-7 SG1 / SG2	Minimal staff gauge readings (multiple records of station being "dry" or "buried in snow")	C-74

Water levels at the drivepoints that are exclusively monitored under the Long Term Trend monitoring program were within previously recorded seasonal variations. DP11 is monitored under the joint monitoring agreement that WAI holds with the owner of the adjacent quarry (MAQ Highland Quarry).

The staff gauges at BH03-7 are monitored on a monthly frequency, as outlined in the AMP, but there is minimal water elevation data due to the stations being reported as "dry" or "buried in snow".

Drivepoint water elevation data is presented in Table C-8 in ***Appendix C***.

4.3.1.8 GROUNDWATER CONFIGURATION

The borehole monitors and the residential water wells are constructed as open-holes that extend into and sometimes through the dolostone rock strata of the Amabel Formation and the Fossil Hill Formation. The exceptions are BH03-7-I, BH03-7-II, BH02-5 (mid) and NW10 (mid) on the expansion lands which are shallow monitoring wells. Information on each monitoring well is found in Table C-1, ***Appendix C***.

In the open-hole monitors, the overburden soil, where present, is cased off with metal casing that is seated into the bedrock. The water levels that are obtained in the monitors and water wells provide a blended measure of the water table and groundwater conditions through the rock column, rather than the piezometric pressure head at a specific elevation. Since the open holes extend above and below the groundwater table, the water levels in these boreholes represent general water table conditions within the rock.

Groundwater level elevations at the monitors were contoured for April 2018 ***(Figure 4)***, October 2018 ***(Figure 5)***, April 2019 ***(Figure 6)*** and October 2019 ***(Figure 7)***. April contours represent spring conditions and October contours represent fall conditions. The groundwater contours are presented to illustrate the local groundwater configuration and general flow directions within the Amabel aquifer. These figures illustrate that the groundwater configuration and flow pattern remain similar exclusive of the change in groundwater levels associated with seasonal climatic conditions.

The interpreted groundwater configuration beneath the expansion quarry exhibits an elliptical pattern that is centred upon the areas of higher ground formed by local bedrock hills. A groundwater divide is present in the expansion property. The groundwater movement beneath the eastern section of the quarry expansion lands is towards the Escarpment and generally to the Batteaux Creek sub-catchment. Beneath the western part of the quarry expansion property, the groundwater movement is to the north, generally towards the Pretty River sub-catchment, and to the west, contributing to the Beaver River sub-catchment. A southerly component of groundwater flow towards the existing quarry is also present in the vicinity of BH02-6. The presence of the tunnel beneath County Road 91 and

the extraction area in the expansion quarry (floor elevation approximately 501 m ASL) lowers the groundwater levels in the rock adjacent to the extraction area.

South of the existing quarry, groundwater movement is interpreted to be radially away from the higher ground and towards Edward Lake. Edward Lake is interpreted to be a local groundwater discharge area, as well as a collection area for local surface water run-off.

4.3.1.9 QUANTIFICATION OF DRAWDOWN INFLUENCE ZONE

In order to estimate the magnitude and the lateral extent of the zone of influence, and the distance drawdown effects of the existing quarry, expansion quarry and the MAQ Highland Quarry on the local groundwater system, the historical and recent groundwater level data obtained from the long term trend groundwater monitoring network have been evaluated.

Figure 8 provides a summary of the distance-drawdown relationships obtained at individual monitoring well locations. The figure illustrates a lower boundary influence envelope and an upper boundary influence envelope which identify the interpreted minimum and maximum extent of the distance-drawdown relationship.

EXISTING QUARRY

Within the extraction area of the existing quarry there has been a progressive drawdown influence of 12 m to 20 m on the local water table. As the size of the extracted area has increased, so has the zone of influence of the existing quarry on the local groundwater system. The magnitude of the drawdown influence is greatest within the extraction area at the existing quarry, and decreases relatively quickly with distance away from the extraction faces. The magnitude and lateral extent of the drawdown zone of influence is also variable around the quarry due to the variable hydraulic conductivity in the rock mass.

EXPANSION QUARRY

Select monitors on the expansion lands have shown influence from tunnel construction and extraction activities that were initiated in 2016. Groundwater monitors NW1, NW4 and NW7 have been included on ***Figure 8*** to update the distance-drawdown figure for 2019. These monitoring wells are located on property owned by WAI and the observed drawdown effects at these on-site monitors due to quarrying was within anticipated levels. NW4 is showing approximately 5 m of drawdown at a distance of approximately 100 m from the quarry face.

MAQ HIGHLAND QUARRY

The distance-drawdown effects of the MAQ Highland Quarry on the groundwater monitors on the expansion lands is still being developed. The groundwater monitoring wells along the south-west corner of the expansion property showed slower than usual recovery in the fall of 2016, but the water levels recovered by the spring of 2017. Since then water levels have been mostly within seasonal variations. During the late summer and early fall new minimum water elevation levels were set but recovered back to normal levels by December. Ongoing monitoring of the groundwater levels at NW9 and TW04-1, 2 and 3 is recommended in 2020.

4.3.1.10 GROUNDWATER QUALITY

Annual sampling for the following parameters is required under the Long Term Trend Monitoring Program for two selected residential wells, RW1 and RW2:

- General chemistry,
- Major and minor ion constituents and nutrients,
- Total petroleum hydrocarbons and BTEX,
- Total suspended solids, and
- Bacteriological (E.coli, total coliform, heterotrophic plate count).

The samples from the groundwater monitoring locations were obtained from the two residential properties adjacent (RW1) and downgradient (RW2) from the existing and expansion properties on June 6, 2019. The samples were collected from outside taps at each property to try and bypass the water treatment systems. Field chemistry parameters (temperature, pH, conductivity and dissolved oxygen) were recorded at the time of sampling and observations on the appearance of the sampled groundwater were noted. Water quality samples were placed in a cooler with loose ice and shipped to an accredited laboratory for analysis (Bureau Veritas Laboratories). The groundwater quality results are presented in Table C-10, ***Appendix C***.

The analytical results from the groundwater quality sampling are compared to the Ontario Drinking Water Quality Standards, Objectives and Guidelines (ODWQS, June 2006) and meet this guideline, with the exception of the following:

- The total coliform counts in the sample obtained from RW2 was elevated compared to the ODWQS; which is consistent with historic results. The home-owner was notified by phone once the sample results were received from the lab. A resample collected on June 19, 2019 confirmed the results.
- The sodium concentration in the samples obtained from RW2 did not meet the aesthetic guideline range specified in the ODWQS; which is consistent with historic results. Sodium has an aesthetic objective of 200 mg/L and a suggested maximum concentration of 20 mg/L under the ODWQS. The water quality at RW2 is interpreted to be representative of local groundwater quality, which is naturally hard.
- The hardness in the samples obtained from RW1 and RW2 did not meet the aesthetic or operating guideline ranges specified in the ODWQS; which is consistent with historic results. Hardness has an operating guideline range of 80-100 mg/L indicated in the ODWQS. The water quality at RW2 is interpreted to be representative of local groundwater quality, which is naturally hard.

The ODWQS exceedances for sodium, and hardness are not health related. Operational guidelines in the case of hardness exceedances are established for parameters that, if not controlled, may negatively affect the efficient and effective treatment, disinfection and distribution of the water.

The concentration of sodium at RW2 (130 mg/L) exceeds maximum suggested concentration of 20 mg/L. This result is not related to Quarrying activities.

Residential well sampling at RW1 and RW2 will be completed annually as part of the Long Term Trend monitoring program under the AMP.

4.3.2 SURFACE WATER SETTING

4.3.2.1 SURFACE WATER CHARACTERISTICS

The following sections outline the observations and monitoring results collected in 2019 at the surface water stations that are included in the Long Term Trend monitoring program.

Surface water monitoring data are presented in ***Appendix B***, which includes: PITM triggers, surface water hydrographs, field chemistry parameters and laboratory analysis results.

SURFACE WATER MONITORING STATIONS

Table 4-8 Surface Water Monitoring - Results

MONITORING STATION	OBSERVATIONS IN 2019	FIGURE
QFSW2 & Dewatering Sump(s)	Flows are within previously recorded seasonal variations. QFSW2 flows into the main sump (Sump 1). Excess water from the expansion quarry is being directed to the sumps in the existing quarry.	B-6
SW7	Station reported as “Dry” in 2019 except for April and May.	B-13
SW8	Station reported as “Dry” in 2019.	B-14
SW10	Flows are within previously recorded seasonal variations.	B-16
SW11E	Flows are within previously recorded seasonal variations.	B-22
SW13	Flows are within previously recorded seasonal variations.	B-25
SW19	Flows are within previously recorded seasonal variations.	B-33
SW20	Flows are within previously recorded seasonal variations.	B-34
SW21	Flows are within previously recorded seasonal variations.	B-35
SW21A	Flows are within previously recorded seasonal variations.	B-36
SW21B	Flows are within previously recorded seasonal variations.	B-37
SW21C	Flows are within previously recorded seasonal variations.	B-38
SW22	Flows are within previously recorded seasonal variations, with the exception of a historic high flow measured in September 2019.	B-40
SW22A	Flows are within previously recorded seasonal variations.	B-41
SW22C	Flows are within previously recorded seasonal variations.	B-43
SW3C (‘RR3 OUT’)	Flows are within previously recorded seasonal variations.	B-54

Table B-4 in ***Appendix B*** summarizes the high, low and seasonal flows for all of the surface water stations (PITM and LTT), for 2019 and, where available, includes historical data.

Table B-5, ***Appendix B***, tabulates the field chemistry parameters that were collected during each stream flow monitoring event in 2019 as well as the historical data at each monitoring location.

Overall, the results of the Long Term Trend monitoring program in 2019 were consistent with previously measured results for both surface water flow and water temperature.

BEAVER RIVER SUBCATCHMENT

The Beaver River Tributary North is an intermittent watercourse in the vicinity of the expansion property. The Beaver River Tributary South is a perennial watercourse downstream (west) of Grey County Road 31. Flows to the Beaver River north and south tributary systems are continued through maintenance of wetland hydrology and associated discharge flow from Rob Roy Swamp PSW Complex units RR2 and RR6, respectively, including the

pumping of excess quarry water during quarry operation and in the future by rehabilitation lake overflow (expansion quarry and existing quarry, respectively) after quarry closure. The Beaver River sub-catchment is identified on ***Figure 3.***

BATTEAUX CREEK SUBCATCHMENT

Tributaries of the Batteaux Creek that arise from springs below the Escarpment brow also support fisheries within approximately 1 km of their emergence (i.e. 1800 m to 2000 m southeast of the approved expansion quarry extraction area). Constructed online ponds and a golf course occur between the springs and the main areas of known fish habitat. Spatial separation and the presence of online ponds, including water withdrawal for irrigation occurring from the Batteaux Creek on-line ponds at the golf course, limit any potential impact of minor changes to flows from these springs on downstream fish habitat arising from quarry operations. The Batteaux Creek sub-catchment is identified on ***Figure 3.***

PRETTY RIVER SUBCATCHMENT

The lands between the quarry extraction area and the brow of the Escarpment continue to receive direct precipitation that contributes a substantial part of the recharge to the groundwater system in the dolostone aquifer that sustains local water supplies at residential wells and the seasonal flows at the Escarpment springs. This will continue throughout the extraction period and through to final rehabilitation.

Tributaries of the Pretty River that arise from springs below the Escarpment brow support fisheries within 300 m to 500 m of their emergence (approximately 1300 m to 1500 m northeast of the approved expansion quarry extraction area). A constructed pond occurs between some of the springs and the fish habitat in the Pretty River system.

The Pretty River sub-catchment is identified on **Figure 3**.

MAD RIVER SUBCATCHMENT

The Mad River sub-catchment is located south of the existing quarry and is identified, along with all previously mentioned sub-catchments, on ***Figure 3***. The Mad River sub-catchment does not overlap the expansion quarry property.

4.3.2.2 SURFACE WATER QUALITY

DEWATERING SUMPS

Surface water stations QFSW2 and the Dewatering Sump (Sump 1 and Sump 2, proposed Sump 3) are sampled quarterly for water quality. In 2019, the sampling for QFSW2 was included as the results for Sump 1 (QFSW2 flows into Sump 1). Sump 3 is planned for the quarry floor in the expansion quarry and will be included in the water quality sampling program when it is completed.

Field parameters are collected during the sampling event and are recorded in the dedicated project field book. Surface water quality samples are collected in dedicated, pre-labelled containers, placed in coolers filled with loose ice and then shipped to an accredited laboratory for the following analysis:

- General chemistry,
- Major and minor ion constituents and nutrients,
- Total petroleum hydrocarbons and BTEX,
- Total suspended solids, and

— Bacteriological (E.coli, total coliform, heterotrophic plate count).

Water quality samples were obtained from Sump 1, in the Existing Quarry, on March 9, May 10, September 4 and December 19, 2019 and Sump 2, in the existing quarry, on May 17 and December 19, 2019. It is noted that Sump 2 was frozen during the March sampling event and no sample was obtained during the December sampling event. The results of the quarterly water quality sampling at the dewatering sumps are included in Table B-6, ***Appendix B***.

The water quality samples obtained in the first, second, third and fourth quarter at Sump 1 and Sump 2 met the Provincial Water Quality Objectives, with the exception of phenols at Sump 1 in September.

The relative percent difference (RPD) was calculated for the duplicate results taken during each monitoring event. The RPD was within 20% for all of the parameters suggesting the water quality results are considered acceptable in terms of quality assurance and controls.

Bacteriological results for the water quality analysis at Sump 1 and Sump 2 in 2019 indicate that there were total coliform present in the dewatering sumps. E.coli was present in Sump 1 during all four sampling events and Sump 2 in the May sampling event. The presence of bacteriological parameters in the sumps is expected, since the sumps exist as natural surface water ponds in the bottom of the existing quarry and as such are subject to surface water runoff from the quarry floor and are subject to use as temporary waypoints for waterfowl. There is no specific objective for bacteriological parameters under the PWQO.

The water sampled from the dewatering sumps on the Existing Quarry floor has hardness concentrations ranging from 230 - 350 mg/L, which is expected since a portion of the water collected in the sumps is from groundwater inflow to the quarry floor.

SURFACE WATER STATIONS

The AMP monitoring program stipulates that annual sampling be completed at the Escarpment springs and the surface water monitoring stations as listed in Tables 3.3 and 4.2 of the 2013 AMP document. The samples are to be analyzed for the following groups of parameters:

— General chemistry,
— Major and minor ion constituents and nutrients,
— Total petroleum hydrocarbons and BTEX and
— Total suspended solids.

The following Escarpment spring monitoring stations SW10, SW11A, SW11B, SW11C, SW11D, SW11E and SW21C also require laboratory analysis for bacteriological parameters (E.coli, total coliform, heterotrophic plate count).

Samples are to be obtained using standard surface water sampling procedures and then sent to an accredited laboratory for analysis.

The annual water quality sampling event was completed for the surface water monitoring stations on May 14, 2019.

The surface water samples were obtained using standard surface water sampling procedures. Duplicate samples were obtained at SW3 and SW17A. Field chemistry parameters (temperature, pH, conductivity and dissolved oxygen) were recorded at the time of sampling and observations on the flow volume and appearance of the surface

water station were noted. Water quality samples were placed in a cooler with loose ice and shipped to an accredited laboratory for analysis (Caduceon Laboratories).

The relative percent difference (RPD) was calculated for the duplicate results obtained at SW3 and SW1A. The RPD was within 20% for a majority of the parameters with the exception of total phosphorus at SW3 and aluminum at SW17A. Neither the original nor the duplicate results exceeded the PWQO values. Based on the RPD values, the aforementioned parameters are interpreted with caution; however, the majority of the water quality results are considered acceptable in terms of quality assurance and controls.

Surface water quality analytical results are compared to the Provincial Water Quality Objectives (PWQO, July 1994). The water quality samples obtained in the fourth quarter at the designated surface water stations met the PWQO with the exception of the following:

- The concentration of total phosphorus in the sample obtained at SW0-2, SW11 and SW15.
- The concentration of iron in the sample obtained at SW15

4.4 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the 2019 long term trend monitoring program the following conclusions and recommendations are made:

- Localized drawdown effects are occurring at groundwater monitors BH02-6, BH02-4 and BH02-1 as well as NW1 and NW4. Localized drawdown within the expansion quarry property was anticipated.
- Remove wells BH02-3 CLF1, OW1-6, OW3-1 and NW2 in Long Term Trend Monitoring from monitoring program since we no longer have access to them.
- Long Term Trend monitoring will continue in 2020 with no adjustments other than no longer monitoring wells previously mentioned

5 LONG-TERM TREND ECOLOGICAL MONITORING PROGRAM

Ecological monitoring, including wetland monitoring, is a component of the Walker Aggregates Inc. Duntroon Expansion Quarry Adaptive Management Plan (AMP; Stantec and Hims Geoenvironmental 2013). The Long Term Trend Ecological Monitoring (LTTEM) program was developed to supplement the information from the Long Term Trend Water Monitoring (LTTWM) program with information about the healh and functioning of the natural heritage features in the vicinity of the Expansion Quarry.

The wetland component of the LTTEM focuses on amphibian vernal breeding pools and ensuring hydroperiods are suitable for continued hydrophytic plant growth in the surrounding wetland zones. Wetland water level monitoring is conducted as part of the Performance Indicator Trigger Monitoring (PITM) and the LTTWM programs and will be interpreted from a natural heritage perspective. Ecological monitoring to complement the water level monitoring includes two components: amphibian monitoring and wetland vegetation monitoring.

The ecological monitoring components were completed by Stantec Consulting Ltd. (Stantec).

5.1 AMPHIBIAN MONITORING PROGRAM

Wildlife monitoring in wetlands is focused on amphibians (Anura: frogs and toads and Urodela: salamanders). Amphibians are excellent indicators of the health of the wetland area and water regime trends that could be affecting wetland function. Wildlife monitoring was initiated in 2018 and continued in 2019. The 2019 monitoring program, including methodology and results, is summarized in the *Amphibian Monitoring Program, 2019 Annual Monitoring Report* prepared by Stantec (Appendix D).

The 2019 Amphibian Monitoring Program was completed and reported successfully, fulfilling the requirement of the Adaptive Management Plan. Data of amphibian habitat, egg mass occurrence, incidental observation and breeding calls at each survey Station were collected, providing monitoring data for amphibian community and abundance in the Study Site. Habitat at each survey Station was suitable for amphibians and, when comparing 2019 data to previous years' surveys, amphibian communities were similar in diversity and abundance at each Station

5.2 WETLAND VEGETATION MONITORING

Vegetation monitoring was initiated in 2019 at wetlands within the Rob Roy Swamp PSW Complex (RR2 and RR6) and ANSI wetlands A & B. The summary report, *Wetland Vegetation Monitoring* 2019 prepared by Stantec (Appendix D), describes the methods and results from 2019 (baseline) surveys and will be updated annually as part of the AMP reporting schedule.

The 2019 report represents the baseline (first) year of terrestrial monitoring on the Subject Lands. Future years of monitoring will provide opportunities to observe any changes in vegetation composition of the wetland transects.

6 ECOLOGICAL ENHANCEMENT AND MITIGATION MONITROING PROGRAM

The ecological enhancement and mitigation measures monitoring (EEMM) program includes mitigation and enhancement measures not directly related to the day to day operation of the quarry. The EEMM program is designed to make sure the ecological mitigation measures are properly implemented (e.g. appropriate number and species of trees are planted, amphibian habitat is self-sustaining) and that the resulting features are managed and adapted with changing conditions and trends (e.g. replanting for dead trees, controlling pest damage, control / allowing public access, etc.)

The EEMM program includes the Woodland Program, the Millar Pond relocation, the Bridson Pond enhancement and Butternut tree plantings incorporated into the Woodland Program.

The Woodland Program has been initiated. The Millar Pond was relocated in 2019. The remaining EEMM tasks required no action in 2019.

6.1 WOODLAND PROGRAM

The Woodland Program was initiated in 2015, with tree planting and other enhancement measures undertaken over three years from 2015 to 2017. Reforestation efforts were divided between areas of active reforestation and areas of natural regeneration, which were delineated in the field based on site conditions. Active reforestation lands included sodded fields, fallow fields, and worked fields which were treated with techniques including the planting and maintenance of varying sizes and species of trees. Natural regeneration lands consisted of areas of shallow soils, primary succession woodlots and naturalizing, disturbed areas. Grading to create variable microtopography was utilized in both natural regeneration areas and at the margins of active regeneration sites where the physical dimensions or site conditions were not feasible for active regeneration planting techniques.

The Duntroon Quarry Reforestation Plan and planting quantities table are included in Appendix E. These documents track what species of tree have been planted and identifies which areas have been planted in what year.

The proposed planting was completed in 2017 and ongoing monitoring indicates that the materials planted in 2015 and 2016 have acceptable survival rates. The monitoring and maintenance of materials planted in 2016 will wrap up in 2018 and material planted in 2017 will be monitored until 2019.

6.1.1 MONITORING

Mortality monitoring was conducted by the contractor each spring for two years following planting (i.e. spring 2016 to 2019), with Stantec completing a warranty inspection in early summer of the same year. Mortality replacements were planted annually, typically in the fall. Replacements were provided as species-for-species except where quality stock was not available, when the planting window was sub-optimal to transplant a certain species, or where it was believed that another species would survive better given the environmental conditions. Three new species were introduced as a part of the replacement planting process: *Fraxinus americana*, *Fraxinus pennsylvanica*, and *Quercus alba*.

The final warranty inspection of the 2017 plantings was conducted in the spring of 2019. This inspection concluded the warranty period for the project. A summary of mortality monitoring from 2015 – 2019 is provided in Table 6-1 below.

The cumulative mortality incurred up to July 2019 has been 5.4%, which translates to a survival rate of 94.6%. Adding in the replacements, which outnumber the mortality, survivability is currently greater than 100% surpassing the project target.

Table 6-1 Tree Mortality Rates

BOTANICAL SPECIES	**PLANTED TOTAL**	**2015 MORTALITY**	**2015 REPLACEMENT**	**2016 MORTALITY**	**2016 REPLACEMENT**	**2017 MORTALITY**	**2017 REPLACEMENT**	**2018 MORTALITY**	**2019 REPLACEMENT**
Abies balsamea	1,890	0	10	0	0	0	0	0	10
Acer rubrum	1,925	0	0	0	680	0	0	0	200
Acer saccharum	5,485	33	74	4	266	34	0	34	34

BOTANICAL SPECIES	PLANTED TOTAL	2015 MORTALITY	2015 REPLACEMENT	2016 MORTALITY	2016 REPLACEMENT	2017 MORTALITY	2017 REPLACEMENT	2018 MORTALITY	2019 REPLACEMENT
Betula allegheniensis	611	0	10	0	0	0	0	0	0
Betula papyrifera	1,995	56	71	32	40	14	0	14	0
Carya cordiformis	1,180	0	10	0	65	0	0	0	0
Fagus grandifolia	121	0	0	28	0	0	0	0	0
Fraxinus americana	0	0	0	0	20	0	0	0	0
Fraxinus pennsylvanica	0	0	0	0	35	0	0	0	0
Juglans nigra	1,040	84	51	206	64	22	0	22	0
Larix laricina	1,750	73	45	7	25	17	0	17	20
Picea glauca	2,925	14	54	8	50	11	0	11	25
Pinus resinosa	1,100	269	0	13	0	0	0	0	0
Pinus strobus	3,100	0	62	0	104	13	0	13	10
Populus tremuloides	2,205	146	112	42	270	51	0	51	0
Prunus serotina	1,330	40	0	55	0	14	0	24	0
Quercus alba	0	0	0	0	20	0	0	0	0
Quercus macrocarpa	1,210	0	0	0	0	0	0	0	0
Quercus rubra	2,132	188	0	12	30	43	0	43	0
Thuja occidentalis	1,755	0	10	12	190	8	0	8	26
Tilia americana	1,640	42	97	16	25	12	0	12	0
Tsuga canadensis	1,500	12	0	0	0	0	0	0	10
Ulmus americana	1,010	0	0	0	0	0	0	0	0
Total	**35,904**	**957**	**606**	**435**	**1,884**	**239**	**0**	**283**	**335**
								Total Mortality	**1,948**
								Total Replacement	**2,825**

6.2 MILLAR POND RELOCATION

In the fall of 2019, the new Millar Pond was excavated as per the EEEM Program. Planting and ecological monitoring at the new Millar Pond will commence in the spring of 2020 with results presented in the 2020 AMP Summary Report.

7 OPERATIONS IMPROVEMENT WORKSHOP FOR 2019

The operations improvement workshop was completed on July 12, 2019.

As part of its commitment to working with the community, Walker Aggregates will hold an Annual Operations Improvement Workshop for neighbours and other interested stakeholders again in 2020. The 2019 AMP Summary Report will be an agenda item at the Workshop.

8 SUMMARY CONCLUSIONS AND RECOMMENDATIONS

Based on our review of the monitoring data collected to support the Adaptive Management Plan groundwater and surface water monitoring program in 2019, we offer the following conclusions:

- No adverse impact to the surrounding off-site water resources were found in 2019. Trigger events observed at the surface water stations were attributed to climatic conditions and are not related to quarry activities. The potential for off-site water-related effects to any of the provincially significant wetlands and/or Escarpment springs during Phase 1 is considered to be very low
- The habitat at each survey Station was suitable for amphibians and, when comparing 2019 data to previous years' surveys, amphibian communities were similar in diversity and abundance at each Station.
- Wetland vegetation monitoring, including installing transects and plots for monitoring purposes, was initiated in 2019. The monitoring represents the baseline (first) year of terrestrial monitoring on the Subject Lands.
- The cumulative mortality incurred up to July 2019 has been 5.4%, which translates to a survival rate of 94.6%. Adding in the replacements, which outnumber the mortality, survivability is currently greater than 100% surpassing the project target.
- The new Millar Pond was excavated and planted in the fall of 2019.

Based on our review of the monitoring data collected to support the Adaptive Management Plan groundwater and surface water monitoring program in 2019, the following recommendations are made :

- Certain deficiencies that were apparent with the implementation of the program in 2016, including the flow and temperature interim trigger level values that were adopted for the PITM Escarpment spring and surface water monitoring stations, continued to be evident in the 2019 program. The performance indicator interim triggers for surface water flow and surface water temperature should be re-evaluated to incorporate the conditions observed in 2016 through2019. The values recorded as having exceeded a specific seasonal maximum or minimum interim "trigger" value occurred as a result of atypical climatic conditions, and not as a result of quarry operations in Phase 1.
- It is recommended that the groundwater stations BH02-3 CLF1, OW1-6, OW3-1 and NW2 should be removed as they are no longer accessible.
- During Phase 1 of quarry extraction, reference wetlands are to be established in the Nottawasaga Lookout Provincial Park or the Pretty River Provincial Park with input from the Ministry of Natural Resources and Forestry and the Nottawasaga Valley Conservation Authority. The search for the reference wetland will continue in 2020 through examining the Pretty River Provincial Park. This wetland will be designated as Reference Wetland 1.
- Ecological monitoring at the new Millar Pond will commence in the spring of 2020.

Certain inconsistencies between the 2013 AMP document and the Site Plan should be resolved through consultation with the MNRF. These include certain aspects of wetland monitoring, annual reporting dates and the requirement of monthly reporting during Phase 1, when no adverse influences are expected. These should be addressed prior to the 5-year report.

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