APPENDIX E
CULTURAL RESOURCE MANAGEMENT REPORT LETTER
(Nova Scotia Communities, Culture and Heritage, 2024)

Environmental Assessment Registration Document:
New Annan Quarry Expansion
East New Annan, Colchester County
Nova Scotia

NOVA SCOTIA
Communities, Culture and Heritage
Culture and Heritage Development

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June 6, 2024

Roderick Petersen
Cultural Resource Management Group Limited
Ten Mile House
1519 Bedford Highway
Bedford, Nova Scotia
B4A 1E3

Dear Roderick Petersen:

RE: Heritage Research Permit Report
A2023NS210 – New Annan Quarry Expansion

We have received and reviewed the final report on work conducted under the terms of Heritage Research Permit A2023NS210 – New Annan Quarry Expansion Project in Colchester County, Nova Scotia in 2023.

Dexter Construction Company Limited (Dexter) is conducting an expansion of the existing pit in East New Annan, Colchester County. Situated along the Truro and within PID 20098935, the proposed development area occupies an approximate area of 23.9 ha. Dexter retained Cultural Resource Management Group Limited (CRM Group) to conduct an archaeological resource impact assessment (ARIA) for the proposed development area. This ARIA involved Mi'kmaq engagement, an historic background study, field reconnaissance, and limited subsurface testing.

The Mi'kmaq have called Mi'kma'ki / Nova Scotia home for millennia, long prior to the arrival of Europeans. European explorers have been in Nova Scotia since at least the 16th century. Mi'kmaq engagement, background study, and historic research did not indicate any intensified use of the study area until the 20th century. The nearest registered archaeological site is located approximately 4.9 km to the southeast. Field reconnaissance showed the proposed development area to be comprised of generally sloped and undulating terrain, terminating at a existing gravel pit. Within the existing pit, all cultural layers have been removed. The eastern portion of the study area shows undisturbed and sloping terrain with swampy sections and thin soil layers. The western portion exhibited evidence of clearcutting, with previously constructed logging roads, multiple examples of slash piles, and pools of standing water throughout. A single subsurface test was excavated in the southeastern section of the study area, where there was a rise on undisturbed terrain. The single test terminated at 30 cm dbs and was negative for cultural materials. No areas of moderate to high archaeological potential were identified within the proposed development area. No archaeological features or cultural materials were identified. The proposed development area was ascribed low archaeological potential.

Based on the above, CRM Group offered the following recommendations:

1. Due to the elimination of archaeological potential from construction-related ground disturbance within the previously developed gravel pit, and the steep slope, swampy conditions, distance from navigable watercourses, and lack of recorded evidence of activity within undisturbed portions, it is recommended that the Study Area, as depicted on Figure 10, be cleared of the requirement for any further archaeological investigations.

2. It is recommended that any adjustment of the New Annan Pit Expansion be subjected to an Archaeological Resource Impact Assessment.

3. If archaeological deposits or human remains are encountered during construction activity within the Study Area, all work in the associated area(s) should be halted and immediate contact made with the Special Places Program (John Cormier: 902-424-4542).

Staff at CCTH have reviewed the final report and find it acceptable as submitted. Please do not hesitate to contact me with any questions or concerns.

Sincerely,

John Cormier
Coordinator, Special Places

APPENDIX F
WATER BALANCE ASSESSMENT
(Consulting Hydrogeologist J. Fraser, 2024)

Environmental Assessment Registration Document:
New Annan Quarry Expansion
East New Annan, Colchester County
Nova Scotia

PROPOSED NEW ANNAN QUARRY EXPANSION

WATER BALANCE ASSESSMENT

Prepared by Mr. Jim Fraser, M.A.SC, P. Geo,

Date: August 1, 2024

1.0 INTRODUCTION

This document outlines the Water Balance Assessment undertaken for the proposed New Annan Quarry Expansion Project, located in New Annan, Colchester County, Nova Scotia. Dexter Construction Company Limited (Dexter) operates a Nova Scotia Environment and Climate Change (NSECC) approved pit of less than 4 hectares. The existing pit serves as a strategic source of construction aggregate to support local construction and roadwork, as well as Nova Scotia Department of Public Works projects in the area. The existing 3.99-hecatre pit is proposed to be expanded by 14.0-hectares to a maximum of 18.0-hectares and transition to a quarry. The proposed quarry expansion is intended to provide additional aggregate reserves to support the long-term sustainability of the site. It is anticipated that the rate of quarry development will progress gradually, at a rate consistent with aggregate demand in the area and growth of the local market.

The water balance presented herein is an assessment of the estimated effects on surrounding surface water features resulting from the proposed quarry expansion. The methodology used for this water balance assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

For this water balance assessment three (3) site conditions were analyzed; existing (baseline) conditions, quarry full development conditions, and reclaimed quarry conditions. Existing conditions include a gravel covered Pit area of approximately 3.99-hectares, which includes the highwall and crusher set-up and stockpile areas. Quarry full development conditions consider the quarry at 18.0-hectares. Reclamation conditions are representative of the site upon removal of all construction equipment and buildings, after re-contouring, and following the re-introduction of vegetative cover over the quarry areas.

Progressive reclamation will occur throughout the development and operation phases of the quarry, as per the established Reclamation Plan for the site. As the site is developed and aggregate reserves are depleted, disturbed areas no longer required for aggregate production or site related activities will be progressively rehabilitated. This includes using grubbing material originating onsite for site grading, slope construction, and re-vegetation efforts. Temporarily stockpiling and then re-use of overburden as a growing medium for the establishment of vegetation is anticipated to simulate pre-development conditions. Areas that have been progressively rehabilitated would be expected to have reduced surface water runoff and increased infiltration, reflective of natural conditions in the area. This water balance assessment does not account for progressive reclamation, so the development scenarios presented represent the worst-case for each scenario with respect to runoff quantity.

Due to the range of infiltration rates possible, the water balance was completed for two (2) infiltration scenarios. The two infiltration scenarios represent the range of possible outcomes from existing/natural infiltration (most likely) to 100% impervious (worst case, no infiltration).

1.1 Data Collection

1.1.1 Topographic Data

The New Annan Pit and associated study area are in the Cobequid Hills. The general area is characterized by gently rolling hills to steeply-sloped terrain and soils which provide good to moderate drainage. Elevations are generally 200 to 300 m above sea level, including one of the highest points in mainland

Nova Scotia, Nuttby Mountain at 360.6 m located approximately 6.4 km southeast of the quarry. Topography at the site is comparatively level, sloping gradually (approximately 3-6% slope) from northwest to the south and southeast within the study area. In the southeast corner of the property, slope is south to north.

The proposed quarry expansion area contains a single (1) Catchment Area (A), within the watershed which encompasses 90.1 hectares. The soil in the area consists of sandy loam. Mixed forests form the predominant cover, however recent logging has created numerous areas of clear cut.

A LiDAR digital elevation model (DEM) was prepared using available LiDAR data from the province. The catchment area was manually determined using a 5-meter contour interval from the LiDAR DEM. A 2-meter contour interval from the LiDAR DEM was then used to validate and confirm the catchment area.

1.1.2 Climate Data

Precipitation and temperature data were collected from the Debert Climate Station (1991-2020), which is located approximately 20 kilometers (km) from the quarry. Monthly lake evaporation data was obtained from the Environment Canada Truro Station (1981-2010). The Truro station is the closest climate station to the Project Site that collects lake evaporation data and is located approximately 55 km away from the quarry. Monthly potential evapotranspiration data was calculated using the Hamon equation (1961) (Lu, et al., 2005). The Hamon equation requires monthly average hours of daylight and monthly average temperature as input. Monthly average hours of daylight were calculated for the site using the Sunrise and Sunset Calculator (https://www.timeanddate.com/sun/, last accessed on July 17, 2024.

Table 1 -Climate Normal Data

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
Temperature[1] (°C)	-6.7	-6.2	-2.0	4.0	9.9	14.8	18.9	18.3	14.2	8.3	3.2	-2.7	-
Precipitation[1] (mm)	91.0	77.1	81.4	90.4	89.3	98.7	87.5	91.9	118.9	117.5	113.7	121.3	1,179
Lake Evaporation[2] (mm)	0.0	0.0	0.0	0.0	89.9	102.0	117.8	96.1	69.0	40.3	0.0	0.0	515
PET[3] (mm)	0.0	0.0	0.0	35.3	56.8	80.4	100.5	89.7	62.8	38.1	24.0	0.0	488

[1] Values obtained from the Debert Climate Station

[2] Values obtained from the Truro Climate Station

[3] Potential Evapotranspiration was calculated using the Hamon equation (1961), Lu, et al., 2005) Average Daylight Hours from https://www.timeand.com/ (New Annan, NS)

2.0 METHODOLOGY

The water balance assessment for the New Annan Quarry was prepared to assess predicted changes in local flow characteristics during an average year for the three site conditions (existing/full development/reclaimed quarry) and two infiltration scenarios (pervious/impervious). The methodology used for this water balance assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

2.1 Watershed Delineation

Pre and post development catchment areas were established at select points of interest around the proposed New Annan Quarry Expansion. Since the existing pit and future quarry are/will both be located within the same Catchment Area there will be no change from the Pre to Post Development.

The area potentially affected by the proposed quarry expansion involves one individual catchment; that is Catchment Area A, defined as the "New Annan Quarry Catchment Area". This catchment area encompasses a total of 90.1 ha. The disturbed area associated with the existing pit which is approximately 3.99 ha is contained within Catchment Area A. The proposed expansion area totals 18.0 ha and is also within the New Annan Quarry Catchment Area.

The catchment area delineation, boundary of existing pit operations, and the proposed quarry expansion area is presented on **Figure 1**.

2.2 Evaporation and Evapotranspiration Potential

Evaporation (E) describes the process of the return of moisture to the atmosphere from open water and land surfaces. Evaporation from plant surfaces is referred to as evapotranspiration (ET). The magnitude of evaporation and evapotranspiration over time is a function of the climate, soil, and vegetation in the area. Evaporation rates tend to peak in the summer months when temperatures are the highest, daylight hours are the longest, sun intensity is greatest, and the growing season is at its peak.

Lake evaporation (LE) is the amount of evaporation from an open body of water. In Atlantic Canada, the lake evaporation rate is greater than the standard evaporation rate because of the constant availability of water. Based on aerial photos and available wetland mapping it is noted that open water sources and/or identified wetlands within the quarry Catchment Area is 9,460m^2 and the total land area is 891,540m^2. So, for this water balance assessment lake evaporation has been determined to be 1.06% of available water for Catchment Area B (9,460m^2/891,540m^2).

Evapotranspiration rates were calculated using the Hamon equation (1961), which is based on average monthly temperatures and daylight hours. Potential evapotranspiration rates for the 4 months of January through March and December were set to zero due to low temperatures resulting in minimal potential for evapotranspiration. The total potential evapotranspiration used for this water balance is 515 mm/year. July represents the month with the highest PET at 100.5 mm. **Table 1** includes a summary of the potential evapotranspiration rates used as a water loss parameter in the water balance assessment.

2.3 Infiltration Factor

Water storage/infiltration has been estimated using the infiltration factors taken from Table 3.1 of the Ontario Ministry of Environment, Conservation and Parks (OMECP) Stormwater Management Planning and Design Manual (2003). Calculations using the OMECP Table 3.1 account for slope, soil types and vegetation cover when estimating the water holding capacity for an area. The slope, soil type, and vegetative cover within the quarry catchment area was used to determine the appropriate infiltration factor. Using this procedure, as outlined in Appendix 1 – Quarry Water Balance Factors, the quarry catchment area was determined to be hilly (0.1), with partial woodland (0.15) and sandy loam soil (0.15).

Two scenarios were assessed for the infiltration conditions during existing and quarry full development conditions; (1) an impervious quarry floor where no infiltration occurred through the floor of the quarry; and (2) a pervious quarry floor consisting of similar infiltration capabilities as existing surficial soils (sandy loam). Due to the nature of the surficial soils and the presence of bedrock near the ground surface, it is unlikely the soil will have greater infiltration at the floor of the quarry than the existing surface. In this regard therefore, these two scenarios represent the maximum and minimum values for expected infiltration in the quarry. These two scenarios provide a range of potential outcomes resulting from quarry development. New infiltration factors for these scenarios were calculated using an area-ratio method.

Reclamation conditions were expected to be similar to pre-development conditions, with the exception of Flat Land (0.3) in the area where the quarry was located. An area-ratio method was applied to determine the appropriate infiltration factor for the slope and land use in the quarry catchment area.

Runoff volumes for this water balance were assumed to equal the total precipitation less the potential evapotranspiration, lake evaporation, and infiltration. Infiltration includes groundwater recharge and groundwater that contributes to surface water resources as baseflow. This Water Balance Assessment does not distinguish between the two, and as such groundwater recharge was not included in this water balance assessment. The proposed quarry expansion is not planned to enter the deep bedrock groundwater table, and overall is not anticipated to significantly impact or alter groundwater. If future quarry operations are required to enter the water table, a hydrological study will be prepared to assess potential impacts to groundwater, and prior approval from NSECC will be obtained.

3.0 WATER BALANCE ANALYSIS

3.1 New Annan Quarry Catchment Area

The existing conditions include a 3.99-hectare pit fully located within Catchment Area A. The existing Quarry is proposed to be expanded to a maximum 18.0-ha. Surface water runoff from the existing quarry and proposed expansion area will follow the local topography, ultimately discharging north to an unnamed tributary to Fourmile Brook. **Table 3** summarizes the details of the Water Balance Assessment for the quarry catchment area under the three development scenarios considered (existing/full development/reclaimed quarry) and two infiltration (pervious/impervious) scenarios.

Table 3 – Water Balance – New Annan Quarry Catchment Area

Quarry Catchment Area B	Area *(ha)*	Available Water *(m^3)*	Lake Evaporation *(m^3)*	PET *(m^3)*	Infiltration *(m^3)*	Runoff *(m^3)*	Change in Infiltration from Existing Conditions	Change in Runoff from Existing Conditions
Existing Conditions: Impervious Quarry Floor	90.1	1,060,009	4,873	434,808	275,903	346,424	-	-
Quarry Full Development: Impervious Quarry Floor	90.1	1,060,009	3,657	435,959	261,463	360,956	-5.2%	4.2%
Existing Conditions: Pervious Quarry Floor	90.1	1,060,009	4,873	434,808	280,047	342,280	-	-
Quarry Full Development: Pervious Quarry Floor	90.1	1,062,009	3,657	435,959	280,076	342,316	0.0%	0.0%
Quarry Reclamation: Pervious Quarry Floor	90.1	1,062,009	3,657	435,959	280,076	342,316	0.0%	0.0%

Based on the results of the water balance assessment it is estimated that the change in infiltration for Catchment Area A from Existing Conditions ranges between -5.2% (Full Development, Impervious Quarry Floor) to 0.0% (Full Development/Reclamation, Pervious Quarry Floor).

It is estimated that the change in runoff for Catchment Area A from Existing Conditions ranges from 4.2% (Full Development, Impervious Quarry Floor) to 0.0% (Full Development/Reclamation, Pervious Quarry Floor).

4.0 SUMMARY

The New Annan Quarry water balance assessment was prepared to estimate potential changes in surface water flow and assess the potential impact of the proposed quarry expansion on the local hydrological regime. The methodology used for this water balance assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

Based on the results of the water balance assessment it is estimated that the change in infiltration for Catchment Area A from Existing Conditions ranges between -5.2% (Full Development, Impervious Quarry Floor) to 0.0% (Full Development/Reclamation, Pervious Quarry Floor).

It is estimated that the change in runoff for Catchment Area A from Existing Conditions ranges from 4.2% (Full Development, Impervious Quarry Floor) to 0.0% (Full Development/Reclamation, Pervious Quarry Floor).

It is noted that the quarry is only operated on an as-needed basis to supply aggregate for local construction projects. The continued development and expansion of the site is expected to be gradual, with rock incrementally removed from the highwall as needed. The estimated changes in infiltration and runoff would slowly occur over the next several decades, which will allow for field data to be collected to measure any actual changes and provide the local environment an opportunity to adapt to any changes.

The results of the water balance analysis will be used to form the basis of further analysis and design of surface water management infrastructure at the quarry in the future. It is anticipated that conditions of any Environmental Assessment approval issued for the proposed quarry expansion will require a detailed surface water monitoring plan, groundwater monitoring plan, and erosion and sediment control plan. These items will be developed following Environmental Assessment approval for the project, as part of the subsequent Industrial Approval amendment process. The water management and monitoring plans will be used to validate the findings of the water balance assessment.

5.0 CONCLUSION

The New Annan Quarry water balance assessment was prepared to estimate changes in surface water flow and assess the potential impact of the proposed quarry expansion on the local hydrological regime. The methodology used for this water balance assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

Water management and monitoring plans will be implemented as part of the Industrial Approval process to validate the findings of the water balance assessment.

6.0 REFERENCES

Lu et al. (2005). “A Comparison of Six Potential Evapotranspiration Methods for Regional Use in the Southeastern United States”. Journal of the American Water Resources Association, 41, 621-633.

Ontario Ministry of the Environment. (2003). Stormwater Management Planning and Design Manual.

Climate Normal Data (Data taken from Debert and Truro Environment Canada Stations).