ONTARIO MUNICIPAL BOARD

In the matter of a PROCEEDING COMMENCED UNDER subsection 34(11) of the *Planning Act*, R.S.O. 1990, c. P. 13, as amended

Appellant:	James Dick Construction Limited
Subject:	Application to amend Zoning By-law No. 57/1999 - Refusal or neglect of Township of Guelph/Eramosa to make a decision
Existing Zoning:	Agriculture (A) and Hazard (H)
Proposed Zoning:	Extractive Industrial (M3) and Hazard (H)
Municipality:	Guelph Eramosa
Municipality File No.:	ZBA 09/12
OMB Case No.:	**PL150494**
OMB File No.:	**PL150494**
OMB Case Name:	James Dick Construction Limited v. Guelph/Eramosa (Township)
Hearing Date:	May 21, 2019

PROCEEDING COMMENCED UNDER subsection 11(5) of the *Aggregate Resources Act,* R.S.O. 1990, c. A.8, as amended

Referred by:	Jane Ireland
Objector:	Shirley Allen
Objector:	Ron & Debbie Brennen
Objector:	John & Ann Brophy
Objector:	Dennis & Laura Campbell; and others
Applicant:	James Dick Construction Limited
Subject:	Application for a Class A Licence for the removal of aggregate
Property Address/ Description:	Part Lot 6, Concession 1
Municipality:	Guelph Eramosa
OMB Case No.:	PL150494
OMB File No.:	PL150494

WITNESS STATEMENT
OF
GARRY T. HUNTER, M.A.Sc., P.Eng.

BACKGROUND AND QUALIFICATIONS

1. This witness statement has been prepared by:

GARRY T. HUNTER, M.A.Sc., P.Eng.
Principal
Hunter and Associates / Hunter GIS
Environmental Systems Planner and Engineer
Environmental and Engineering & Geographic Information Systems Consultants

2285 Dunwin Drive, Unit 18
Mississauga, ON L5L 3S3
T: 905 607- 4120
E: ghunter@hunter-gis.com

2. I am a member of the Association of Professional Engineers of Ontario. I have over 45 years of professional consulting experience as a civil engineer and related environmental disciplines and have been qualified by the Ontario Municipal Board ("OMB" or "Board"), on numerous occasions, as an expert witness. My current Curriculum Vitae together with a signed acknowledgement of expert's duty form is attached. I will review my curriculum vitae as part of my oral evidence.

3. I have been specifically recognized by the Ontario Municipal Board and/or the Ontario Superior Court of Justice as qualified to give opinion evidence as a Civil Engineer and in the fields of airphoto interpretation, geology, hydrogeology, hydro-geochemistry, the collection and mining of geographic data for hydrogeological purposes, stormwater management, and solar shadowing.

4. I am qualified and experienced in the preparation of Site Plans and Updates under the Aggregate Resources Act of Ontario and obtaining Permits to Take Water. I am experienced at undertaking Aggregate Pit and Quarry Site Selection studies for the Industry. I have undertaken a number of Aggregate Licencing Peer Reviews on behalf of ratepayer groups and municipalities.

5. I have made submissions on behalf of a number of clients on the Provincial Policy Statement 2014 update, Aggregate Resources Act Review (2012), A Blueprint for Change (2015): A Proposal to Modernize and Strengthen the Aggregate Resources Act Policy Framework, and the Provincial Plan Reviews 2015/2016.

6. I have experience with geographic information systems technology; groundwater modelling, municipal, environmental and infrastructure assessments; preparation and peer review of Master Environmental Servicing Plans (MESPs); and preliminary designs and approvals leading to subdivision design and construction.

7. As part of my routine consulting work, I integrate geotechnical, groundwater, flood analysis, noise, blasting, traffic, aquatic and fisheries biology, natural heritage and other resource studies as part of environmental assessments and functional engineering planning. While I have experience in these other areas of expertise which are necessary to understand how an aggregate operation works, for the purposes of expert opinion evidence I am seeking qualification as a hydrogeologist and civil engineer.

8. I have recently (2018) completed a comprehensive review of the Township of Centre Wellington urban communities of Elora and Fergus production well history for the period from the 1930s to 2018. Work also included water supply demand projections to 2041 and beyond, selection of future candidate potable water supply sites (wells) and preparation of a water supply implementation plan to 2041.

9. In preparing this Witness Statement, I have reviewed and may refer to the following documents prepared by others:

    - Applicant Evidence Books 1 to 35
    - Applicant Site Plan plot versions dated February 19, 2019 and March 5, 2019
    - Various communications of the review agencies and their consultants

10. This Witness Statement mainly relies on the following Applicant and Agency Reports:

    - The Harden 2012 Report Appendices, including Borehole Logs and Water Quality Summary
    - The Aercoustics Updated Noise Report of May 24, 2013 and Addendum #1 Report of August 10, 2015 with regard to pit floor elevation assumptions for noise calculations.
    - The Burnside Peer Review Documents prepared for Guelph / Eramosa Township
    - The Harden January 14, 2014 Letter on Nitrogen Balance for the Proposed Hidden Quarry
    - The Burnside May 28, 2015 New Rockwood Well 4 PTTW Application Report
    - The Grand River Source Protection Area Approved Assessment Report, November 2015
    - The Harden January 11, 2016 Memo on the Hidden Quarry Wash Plant

- The Worthington Groundwater November 23, 2016 Memorandum on Fracture Apertures between Hidden Quarry and Brydson Springs
- The Kent S. Novakowski March 9, 2017 Fractured Rock Heat Transport Analysis Letter
- The Harden September 2017 Modelling Update Report, including additional Borehole Logs and Water Quality information
- The City of Guelph and Township of Guelph/Eramosa Tier 3 Water Budget and Local Area Risk Assessment Wellhead Protection and Drawdown Scenario Figures, November 2017
- The Explotech Blast Impact Analysis revised February 12, 2019 with regard to Fly Rock and Fish Protection
- The Flood Hazard Assessment for Brydson Creek Tributary 'B' by CC Tatham & Associates Ltd, Feb 25, 2019
- The Applicant Aggregate Resource Site Plans dated March 5, 2019
- Additional piecemeal 2016 to 2019 Groundwater Monitoring Summary Data, Water Quality, Borehole, Pump Test and reverse particle tracking Data as received directly from Harden over the period January to March 2019

11. In preparing this Witness Statement, I may refer to the following documents prepared by myself and with technical assistance from my staff:

- Hunter May 15, 2015 Letter to Ms. Kim Wingrove, CAO, Township of Guelph/Eramosa re: Peer Review on behalf of the Concerned Residents Coalition, Proposed Hidden Quarry Zoning By-law Amendment and Aggregate Resources Application, Pt W½ Lot 1, Con 6 (Eramosa), Guelph/Eramosa Township
- Hunter September 25, 2015 Letter to Mayor Chris White, Township of Guelph/Eramosa re: Howson Planning Report (September 2, 2015), Comments and Addendum to May 15, 2015 Hunter Hidden Quarry Peer Review (HPR)
- Hunter March 3, 2017 Letter to Mr. Doug Tripp, Concerned Residents Coalition, CRC Rockwood Inc re: Proposed County of Wellington Official Plan Amendment and Zoning By-law Amendment Application ZBA 06/16 – 8532 Highway 7
- Hunter February 28, 2018 Letter Report to Mr. Doug Tripp, President, CRC Rockwood Inc re: Technical Review of Harden September 14, 2017 Groundwater model Report, March 28, 2017 GRCA (Matrix) Tier 3 Groundwater Model Report and Other Recent Applicant Reports
- Hunter February 27, 2018 Letter Report to Mr. Doug Tripp, President, CRC Rockwood Inc, Concerned Residents Coalition re: Scoped Review of GRCA Comments of December 12, 2017 and Harden Response Letter of February 9, 2018 (received February 16, 2018)

- Hunter February 27, 2018 Letter Report to Mr. Doug Tripp, President, CRC Rockwood Inc, Concerned Residents Coalition re: Hidden Quarry Tributary B and Northwest Wetland Provisional Flood Elevations and Limits

12. This Witness Statement takes precedence over the above documents in para 11 and my prior June 30, 2016 Witness Statement.

13. I have produced supporting graphics and reviewed the Report prepared by Dr. Emil Frind, PhD, P.Eng titled "Review of Hidden Quarry Groundwater Modelling issues – Update' dated February 28, 2018.

14. I provided pre-survey line selection and technical support to Global GPR Services for the November 8, 2018 Ground Penetration Radar Investigations of the De Grandis Pond Area which interpreted overburden thickness and bedrock fracture zone locations.

15. I provided technical support to Dr. Karl Schiefer in preparation of his Report dated January 2015 "Aquatic Habitat and Fish Survey of Brydson Creek".

16. I have walked the area including the Allen Wetland, the Allan Springs, the De Grandis Ponds and parts of Brydson Creek Tributary A, B and C corridors with the Hydrogeology Experts, Dr. Karl Schiefer, Ministry of Environment staff, neighbouring land owners and CRC members at different times and locations.

17. The following Tables are appended to this Witness Statement:

- Table A: Selected Review Agency Comments
- Table B: Comparison of Applicant 2012 Model vs 2017 Replacement Model
- Table C: Water Quality at the Proposed Hidden Quarry Site Area and the Existing Guelph Dolime Quarry

18. Visual illustrative Figures have been appended to this Witness Statement for reference. An index is provided with the Figures.

RETAINER - Concerned Residents Coalition – CRC Rockwood Inc.

19. In April 2014, I was retained by CRC Rockwood Inc. of the Township of Guelph/Eramosa and Town of Milton to peer review the proposed Hidden Quarry Application Documents prepared for James Dick Construction Limited.

NATURE OF EVIDENCE

20. This Witness Statement has been prepared in support of opinion evidence to the Board that the Zoning By-law Amendment and the approval of a Class 'A' Licence Category 2 for quarrying of Aggregates below the water table should not be approved because:

21. The Applicant's groundwater monitoring system is deficient beyond the Quarry boundaries to support reliable environmental assessment. The Application does not meet a number of the required water resource statutory tests in the Aggregate Resources Act (2018), the Provincial Policy Statement (2014) and the Wellington Official Plan (2018) as detailed in this Witness Statement. The following principal reasons are stated:

    - The instability of existing designated Wellhead Protection Areas with the proposed Hidden Quarry in place.
    - The Applicant's incorrect determination of Site Plan Post-Quarry lake levels.
    - The Applicant's Groundwater Model understates predicted water level drawdowns on the upgradient Quarry perimeter and beyond into the Paris Moraine and understates the related flow increase to Brydson Creek.
    - The Applicant has not acknowledged quantity and/or quality impacts due to Quarry interference with Rockwood Municipal Wells PW3 and PW4 and nearby private water wells.
    - The Applicant has not sufficiently protected the Allen Springs, De Grandis Springs and various Ponds and the Allen Wetlands in the Paris Moraine from adverse effects of passive quarry water table drawdowns or proposed appropriate mitigation.
    - The Applicant has not included provisions for protection and enhancement of the Brydson Creek Springs groundwater source quality.
    - The Applicant has not integrated the Flood Hazard Assessment into its Site Plans.
    - The Applicant's Site Plans are incomplete and conflicted.

22. The Applicant has been producing new research and descriptive documents from about September 2012 to as recently as March 2019. Many of the Applicant older documents and resource interpretations are no longer relevant.

23. Agencies who 'signed off' prior to about September 2017 based their conclusions on a deficient onsite groundwater monitoring program and the flawed Harden (2012) Model. Agencies who signed off prior to about February 2018 had improved onsite groundwater monitor information and modelling in the Highway 7 and Brydson Creek Area. None of the agencies reviewed the 2017 to 2019 Water Quality Monitoring at Brydson Springs. With the exception of Brydson Springs there is no formal offsite groundwater monitoring.

24. This piecemeal release of information by the Applicant has resulted in an evolution of my analysis, reviews and reporting.

RESPONSE TO ISSUES LIST

25. My summation opinions on the Procedural Order Issues List are included beginning about page 29 of this Witness Statement. My Conclusions are at about page 57.

26. This Witness Statement deals primarily with Water Resource, Hydrogeology and Site Plan Issues beginning with a series of related overview and background questions as follows.

OVERVIEW AND BACKGROUND QUESTIONS

A) Will the City of Guelph and Township of Guelph/Eramosa Wellfield Pumping affect Hidden Quarry water levels?

27. The City of Guelph and Guelph / Eramosa Wellfield Pumping will affect Hidden Quarry water levels and similarly the Hidden Quarry 'passive' upgradient drawdowns will impact the Rockwood PW3 and PW4 Municipal Wells.

28. The Grand River Conservation Authority (GRCA) Tier 3 March 27, 2017 Water Budget despite being aware of the submission of the Hidden Quarry Application in year 2012 did not include the Hidden Quarry and its 7 m (23 ft) upgradient drawdowns in its later model scenarios (G6.2 and G6.3). It is my opinion that inclusion of the proposed quarry would result in a modification of the Source Water Protection area for the Rockwood Municipal Wells.

29. The Hidden Quarry Applicant and the Grand River Conservation Authority reviews to date have not addressed the implication of combined City of Guelph and Township of Guelph / Eramosa pumping wellfields and the proposed Hidden Quarry water level change interference perhaps due to the Memorandum of Understanding with the Municipalities (Fig G.1.1, G.1.2 and G.1.3).

30. The Tier 3 Modelling is based on the predicted 2026 Rockwood populations and on build out of the existing available designated development lands. No growth is predicted for Rockwood through 2031 to 2041. The City of Guelph wellfield modelling is based on predicted 2031 Populations. City of Guelph groundwater production to supply 2041 populations may be anticipated to produce even more extensive drawdowns unless other water supply sources are identified that do not increase groundwater takings and / or further significant water conservation measures are introduced.

31. The GRCA (2017) Tier 3 Water Budget Report confirms that the combined pumping of the City of Guelph and the Guelph / Eramosa Township (Rockwood) regional wellfields will produce drawdowns at the Proposed Hidden Quarry Site prior to Planning Year 2031 and the midlife of the proposed Quarry extraction. The Applicant has not directly addressed this issue in its Quarry water level change predictions. The Review Agencies have also not identified this regional wellfield drawdown issue and the widespread combined impacts on wetlands, ponds, springs and shallow wells.

32. The Tier 3 Main Report Fig 5-1 and Fig 5-7 WHPA-Q1 indicates the simulated drawdown was greatest and extended furthest in the production aquifer and thus it was used to delineate the selected 2.0 m drawdown contour of the WHPA-Q1 areas (Fig G.1.2 and 1.3). The production zone of the middle Gasport Formation is the target municipal supply aquifer in the Rockwood Area.

33. The 2017 GRCA Tier 3 Study shows drawdowns in the bedrock aquifer (Gasport) at the Quarry site at 0.5 m to 1.0 m due to the City of Guelph and Guelph/Eramosa Township municipal and other wellfields based on the City and Township population growth forecasts to 2031 (Fig G.1.3). These drawdowns are likely to further increase by Year 2041 coincidental with the present anticipated 20 to 25 year life of the proposed Hidden Quarry extraction activity.

34. Tier 3 Fig 5-1 and Fig 5-7 demonstrates that the City of Guelph and Township of Guelph/Eramosa wellfield 0.5 to 1.0 drawdown zone extends to Brydson Springs and the Hidden Quarry Site and the Allen and De Grandis farmsteads (Fig G.1.2 and G.1.3). The drawdowns from the Rockwood Municipal Production Wellfields locally merges with that from the City of Guelph Wellfields.

35. The local up to 7 m drawdown and passive water taking effects (Fig G6.2 and G6.3) of the proposed Hidden Quarry operation is not included in Fig 5-1 and Fig 5-7 of the Tier 3 Assessment (Fig G1.2 and G1.3). This Tier 3 Assessment represents average steady state for municipal wellfield pumping and other water takings. Drought drawdown scenarios have not been provided. These shorter term drought interference scenarios are more significant for the nearby Rockwood municipal wells, the proposed Quarry, Brydson Spring, Allen Spring and Ponds and the De Grandis Springs, Ponds and shallow dug well (Fig G3.8).

36. The Tier 3 wellfield predicted groundwater interference and wellfield drawdowns makes prediction of longer term operational Quarry water levels even more difficult. The Quarry operator will not be directly in control of water levels.

37. A robust off-site buffer zone multi-level groundwater monitoring program is required together with an adaptive management mitigation plan to respond and adapt to unanticipated water quantity and quality changes and adverse effects and to allocate responsibility for adverse effects. This would also include the Rockwood Municipal Wells in particular Well Zone 4.

38. There should also be an adaptive management plan for the onsite northwest wetland.

B) Are the designated Official Plan Rockwood Well Protection Areas stable?

39. The Wellhead Protection Areas designated in Map 7-42 in the Grand River Source Protection Area Approved Assessment Report and included in the County of Wellington Official Plan will alter as City of Guelph and Guelph/Eramosa Township water takings drawdowns continue to expand and the proposed Hidden Quarry extraction operational drawdowns come into effect (Fig G1.1, G1.2, G1.3 and G1.4).

40. Other sources of instability are new data, new modelling concepts, new software and new modellers.

C) Does the Harden (2017) Model improve the Harden (2012) Model?

41. The replacement Harden (2017) groundwater model at face value appears to be improved due to incorporation of the additional November 2016 on-site monitor wells, use of selected Tier 3 model layers, improved water balance and provision of a transient mode in the Highway 7 area of the Quarry. However, the Applicant's work is not transparent and cannot be independently audited without access to the actual model input files and the opportunity (resources) to generate a range of appropriate alternative scenarios (see also Dr. Frind's report of February 28, 2018). Therefore it is not possible to demonstrate that the statutory tests of the Aggregate Resources Act, the Provincial Policy Statement and the County Official Plan have been met to permit approval of the application.

42. The following model deficiencies continue to be apparent with respect to impact assessment and Site Plan preparation (also see appended Table B).

- The model is based on only one multi-level bedrock monitor (M15) with assessment of layer hydraulic parameters.

- The model underestimates upgradient drawdowns and flow capture due to expanded groundwater capture zones and underestimates water level rise at the south quarry lake limits and related flow increases at Brydson Creek.

- There are no sentry groundwater monitor wells with geodetic surveyed water levels in the key water level change buffer areas 500 to 700 m from the proposed Quarry Extraction footprint.

- The Brydson Spring and Brydson Creek water levels were estimated in the Harden (2017) Model. Geodetic elevations, at my request, were not provided until Mar 15, 2018.

- The Applicant continues to speculate on geological and hydrostratigraphic conditions in the Quarry buffer zones including Allen Springs and the De Grandis springs, pond and farmstead areas versus installing formal geological boreholes and groundwater monitors.

- The model does not recognize the upward bedrock hydraulic gradients reported at monitor wells M20S/ M20D in the Harden September 24, 2017 Report and upward gradients (upwelling) apparent in the De Grandis and Allen Springs areas. The model incorrectly predicts downward gradients – overburden water levels above bedrock water levels in these areas.

- No observed (measured) spring flows are provided for either De Grandis or Allen Springs to validate model predictions.

- The model does not directly incorporate the City of Guelph and Township of Guelph/ Eramosa Wellfield pumping influences as identified in the recent Tier 3 Study (Fig G1.2 and G1.3).

- Model scenarios are not presented for the Quarry with and without the Rockwood municipal production wells (PW3 and PW4) or for the municipal wells without the Quarry (Compare Fig G3.3 and G3.4).

- Model scenarios are not provided for long-term PW3 and PW4 pumping rates versus peak daily pumping rates (Compare Fig G3.3 and G3.4).

43. The modelled drawdown contours are frequently ‘broken’ instead of smooth outside of the Quarry limits indicating problems with model input parameter assumptions (Fig G3.2).

44. The model appears to calibrate reasonably well with transient observational data along the Highway 7 side of the Quarry upgradient from Brydson Springs (Fig G6.1) however, this information is not consistent with Fig G3.2.

D) How does the Harden (2017) Modelled Drawdown compare to Tier 3 and Reality?

45. The Tier 3 (2017) integrated surface and groundwater model is considered to be the 'model of record' for the City of Guelph and Guelph Eramosa Township regional area. The Harden (2012), Hunter (2016) and Harden (2017) models are local models. The expectation is that the local model will reasonably conform to the regional model if similar input data is employed. All models are deficient in areas relying solely on the Provincial Water Well Database. Outside the Hidden Quarry perimeters, wells may be sparsely distributed and frequently have outlier static water level errors of up to ± 5 m as geodetic elevation control and precise geographic coordinates are not available.

46. Unless there is a distributed network of high quality vertically controlled monitor wells, it is not possible to predict water level changes in the range of ± 1 m beyond the Quarry limits. This and higher accuracy is required to analyze impact on springs, wetlands, pond and shallow dug wells. Without these predictions, the statutory tests cannot be meaningfully addressed beyond the Quarry perimeters. The following discussion compares the 'fit' of the model virtual surfaces to the best known water levels as a measure of validation.

47. The assumptions are not stated but the Harden Tier 3 comparison appears to be to Fig 4-3 (Matrix 2017) and to Fig 4-5 (Matrix 2017) not to Fig 3-11 and 3-15 as specified in the footnote to Harden Table 12 (Sept 14, 2017). **Comparison Location 2 elevations are different near the De Grandis Ponds the Tier 3 Overburden Water Level at 365 m asl versus the Harden Overburden Water Level is at 364 m asl. The Tier 3 Bedrock (Gasport) water level is at 362 m asl versus Harden at 361.5 m asl (Fig G2.3, G2.4 and G4.1).**

48. Coincidental with the Tier 3 and Harden Gasport bedrock levels, the De Grandis Pond and dug well water levels on December 12, 2014 were estimated at 362 m asl as referenced to the TRCA 2011 DEM (Hunter Table 1 at Question L). However, the vertical gradient in the ice free area of the De Grandis central pond spring area is upwards similar to that at M20D (Fig G4.1).

49. The winter ice free areas in the De Grandis Pond are interpreted to be warm upwelling bedrock springs (Fig G4.1 and G4.5). Hunter Fig G2.2 Top of Bedrock contours based on water wells and the GRCA 2011 DEM shows the bedrock surface to be at 360 to 361 m asl in the De Grandis pond

area (Fig G2.2). Ground Penetrating Radar Surveys interpret the bedrock to be a similar 1 to 2 m thick in the De Grandis Pond Area (Fig G4.3 and G4.5).

50. When compared to the Topographic Relief mapping generated from the Grand River Conservation Authority DEM (2011), **the overburden water level potential at the De Grandis Ponds is about 2 m above the De Grandis Pond levels indicating an unacceptable model fit to actual water levels**. However, geodetic referenced water level elevations should be provided by the Applicant for the De Grandis Pond, and new sentry monitor wells installed to improve the model calibration and/or validation.

51. The Brydson Spring (SW15) and Pond levels at approximately 344.5 m asl and Brydson Creek (SW16) at about 342.3 m asl water levels (Fig G5.2 and Fig G6.2) were surveyed after the Harden (2017) Model Run. Harden shows the Bedrock Potentials at 344 m asl at SW15 at about 342 m asl (Fig G3.1) which is reasonable measure of model validation at Brydson Pond and Springs. However the Harden (2017) model understates the flow increase at Brydson Spring.

E) Has the Applicant adequately defined its hydraulic modelling parameters upgradient of the Quarry? (see Harden September 2017 Figs 4, 5, 6, 7: Layers 1 to 4 Hydraulic Conductivity)

52. Harden fails to provide justification for the abrupt changes of the hydraulic conductivity in these layers (Fig G3.7). The selected location of these abrupt changes influences the location and magnitude of the simulated drawdown contours in the key Quarry perimeter and buffer area. Variation in model parameter assumptions determines the propagation distance, magnitude of the water level changes and the geographic location of the drawdown contours. The Applicant has no subsurface data beyond the Quarry perimeters to support his parameter (hydraulic conductivity) selection. Therefore, the statutory tests cannot be meaningfully applied.

- In Fig 4 (Harden, September 2017) there are no equivalent surface soil changes as displayed on the March 2017 Tier 3 Appendix C Fig 2-4 and 2-8. These Figures show Till Moraine and Ice Contact stratified drift deposits. The Wellington County Soils Report (1963) maps Dumfries Stoney Sandy Loam Till in the Quarry area, Muck and Parkhill Loam north of the Quarry in the Allen Wetland area and Fox Sandy Loam in the De Grandis farmstead area (see Hunter February 28, 2018 Report Item 42, 43 and 44).

- Fig 5 (Harden, September 2017) Layer 2 Lower Layer of Overburden does not provide justification for the location of the abrupt three orders of magnitude hydraulic conductivity change between the De Grandis farmstead and the proposed Quarry.

- Fig 6 (Harden, September 2017) does not provide justification for its Layer 3 Bedrock (Contact Aquifer) abrupt order of magnitude change in Hydraulic Connectivity south of the De Grandis farmstead and ponds to the north of the proposed Quarry.

- Fig 7 (Harden, September 2017) in Layer 4 Upper Gasport (Quarry Depth) does not provide justification for termination of the 32 m/day hydraulic conductivity at the exact northwest Quarry boundary under the Allen Wetland and for the abrupt changes in Hydraulic Conductivity within the Quarry.

53. These abrupt changes selected at the discretion of the modeller determine the geographic location and magnitude of drawdowns and often prevent the formation of smooth drawdown contours by the Modelling software resulting in broken lines and artifacts (Fig G3.2). I do not have confidence in the location and magnitude of these abrupt changes.

F) Will there be quantity interference between the Rockwood Wellfield and the proposed Hidden Quarry?

54. There will be quantity interference between the Rockwood Well Field specifically PW3 and PW4 and the proposed Hidden Quarry (Fig 3.4 and 3.5). The Applicant's available modelling (Fig 3.2) is inadequate to undertake meaningful statutory tests.

55. Based on its 2012 Groundwater Modelling, Harden concluded that the Quarry would become an active recharge boundary providing storage for the pumping well. This conclusion is contradicted by Harden September 2017 Fig 34 which shows quarry drawdowns at PW4 propagated across a soft groundwater divide subject to collapse under different modelling scenarios.

56. The Burnside Monitor Well hydrographs on the proposed Hidden Quarry site and to the north demonstrate measurable interference during the 72-hour Rockwood Well No. 4 Pump Test, notwithstanding Burnside's conclusion that the Quarry monitoring wells were not affected. The GRCA 2017 Tier 3 simulations in Appendix E also show small but measurable drawdowns at the included Quarry pump test monitor wells indicating pumping influences from PW4.

57. My 2016 Model Runs (Fig G3.4) with both PW3 and PW4 pumping at maximum rates and a no Quarry scenario demonstrates similar local results to Tier 3 (Fig G1.2).

58. The Tier 3 Model does not show a 'divide' between the Quarry and Rockwood Well 4 (Fig G1.2 and G1.3). It is not clear, if alternative model scenarios were run, when the soft divide shown in Harden (2017) Fig 34 would collapse or vanish (see also Frind February 28, 2018, s4.2).

59. My experience after a comprehensive recent review of the production well history (1930s to 2018) for the Elora and Fergus communities in the Township of Centre Wellington is that Production Wells in the Gasport Aquifers need to be separated by about two kilometres to avoid significant quantity interference. Both Elora and Fergus have decommissioned historical deep wells spaced at closer intervals.

60. This experience is further confirmed by Rockwood Production Wells PW3 and PW4 which interfere with each other when pumped at higher rates (Fig G3.4 and G3.5). Similarly, there will be interference between the Production Wells PW3 and PW4 and the proposed Quarry passive drawdowns which acts as a large well. PW4 is only about 1,100 m distant from M14D at the proposed Quarry. PW3 and PW4 are separated by about 1,300 m.

G) Does the Applicant have sufficient Groundwater Water Level Control in the Proposed Quarry Buffer Zone?

61. The Applicant's virtual model is not adequate to predict potential impacts to the wetlands, ponds and shallow dug wells of the Quarry resulting from the estimated 7 m (23 ft) drawdowns on the upgradient side of the Quarry (Township Lot 1 / Lot 2 boundary) (Fig G6.3). The model is a poor substitute for a buffer zone baseline groundwater monitoring network and does not permit meaningful assessment for the statutory tests.

62. The Applicant model inadequacy is primarily related to the complete absence of geodetic surveyed bedrock and overburden water levels in the offsite 1,000 m buffer zone beyond the Site Plan perimeters to provide for accurate model calibration in the proposed Quarry perimeter buffer zone.

63. To compensate for this model uncertainty and inadequacy, I have recommended a robust buffer zone monitor well system to provide actual baseline and routine monitoring of water levels and water quality (Fig G7.3).

64. The Hunter recommended pre-extraction Quarry Buffer Zone Groundwater Monitor Network is an essential component for establishing pre-extraction baseline quantity and quality and for evaluating future water level changes due to proposed Quarry activities and regional wellfield pumping interference. This baseline data is important for future fair and equitable complaint dispute resolution.

65. The Applicant has not accepted Hunter's previously proposed buffer zone sentry monitor wells M22 (De Grandis), M23 (Allen), M25 (Brydson Spring), M26 (7th Line Eramosa) and M27 (5th Line Nassagaweya) as shown on Fig G7.3. These non-pumping sentry wells provide for actual bedrock

water level baseline establishment and change monitoring approximately 500 to 700 m distant from the proposed Quarry limits versus reliance on a conceptualized, poorly controlled, non-unique and questioned groundwater model.

H) Should the GRCA Tier 3 Model be re-run with the proposed Quarry incorporated?

66. To perform the necessary statutory tests in a meaningful way, the GRCA Tier 3 Model of Record needs to be re-run including the Hidden Quarry on-site baseline, new Quarry buffer zone vertically controlled water levels, two years of transient water level data prior to extraction and quarry drawdown information (Fig G6.3). Revised Wellhead Protection Areas (quantity and quality) and updated Official Plan designations need to be considered based on the Tier 3 official model of record with the Hidden Quarry integrated.

I) How does the Harden (2017) Modelled Drawdown in the Bedrock Gasport Aquifer compare to Observed Data?

67. The Harden 2017 Model understates the drawdowns on the upgradient Quarry Lake perimeters compared to drawdowns estimated from elevation controlled observed onsite water levels. Therefore the necessary statutory tests cannot be accurately applied.

68. The modelled 0.0 m (no change line) on Harden Fig 28 (Fig G3.2) is coincidental with the 348 m asl contour when compared to Harden Fig 20. The overburden 0.0 m (no change line) (Harden Fig 27) is also coincidental with the same 348 m asl contour on Harden Fig 19 (Fig G3.2). This 'Gasport Bedrock Aquifer' Drawdown Figure 28 shows an anomalous unexplained 1.0 m + rise (blue colour) at the southeast corner of the west Quarry cell. However, this water level information is contradicted by the Harden Fig 32 (Fig G6.1) for the high hydraulic conductivity zone along Highway 7 and the downgradient quarry edge.

69. The modelled drawdown at the northwest corner of the west Quarry cell is 4 m (13 ft) and at the northeast corner of the east Quarry cell is about 5 m (16 ft) (Fig 3.2). Again the modelled drawdowns are averaged downwards in Harden Fig 20 compared to the observational data. The key impacted Brydson Springs, Allen Springs, the De Grandis springs and ponds locations have been added by Hunter. Harden Fig 20 data is contradicted by the 7 m drawdown in Fig G6.3 based on the Harden Post-Quarry Simulated Water Level Range in Fig G6.1.

70. The 'Gasport Aquifer' drawdown at the De Grandis farmstead is predicted by Harden to be about 0.5 m (Fig G3.2). The overburden drawdown is also predicted to be about 0.5 m. These drawdown alone subtracted from the Harden observed October 5, 2012 water level in the De

Grandis well would result in a 'dry' De Grandis well regardless of Harden's contention that Quarry drawdowns will be within the seasonal range. (see Questions K and L in this Witness Statement) The post Quarry seasonal range will be at lower absolute elevations.

71. Furthermore, a factor of safety of at least 2x should be applied to the Harden (September 2017) drawdowns to reflect the inherent Harden model uncertainty at the upgradient Quarry edges and in the proposed Quarry buffer zone. Additional regional wellfield drawdown is estimated at about 0.5 to 1.0 m in Year 2031 (fig G1.2 and 1.3).

72. At Brydson Spring, the Harden (2017) Groundwater Model is predicting no change (0.0 m) due to the proposed Quarry (Fig G3.2). Acceptance of the Harden 2017 model means the Tier 3 Year 2031 regional wellfield pumping will create about 0.5 to 1.0 m of local drawdown which will adversely affect the spring.

73. This no change prediction is contradictory to Harden Fig 32 (Fig G6.1) which implies a favourable dry season rise in water levels (and flows) at Brydson Creek. It also contradicts Harden Fig 2 Simulated Pre and Post Quarry Groundwater Discharge (L/s) to Brydson Creek (Harden Feb 9, 2018 correspondence to GRCA)

J) Does the Harden (2017) Model adequately represent the Allen Wetland?

74. The Harden (2017) Model does not adequately represent the Allen Wetland. Therefore the statutory tests cannot be meaningfully applied.

75. The Harden (September 2017) Fig 31 cross section through the Allen Wetland is not consistent with the observational pre-Quarry water levels for MW20S at 353.70 m asl on May 4, 2017 and 352.81 m asl on March 20, 2017 (Fig G3.8).

76. The higher Pre-Quarry bedrock water potential at 354.42 m asl for M20D on May 4, 2017 (Fig G2.4) should also be shown on this cross section together with the Post-Quarry levels. Harden does not discuss the upward discharge potential at M20D (bedrock) vs M20S (overburden) and at the De Grandis Central Pond Springs and at the Allen Springs.

77. Harden (Fig 31) has no geodetic referenced elevations, hydrostratigraphic and model calibration data (borehole, overburden depth and water levels) upgradient of M20S (left hand side) on this Allen Wetland cross section **and is simply inappropriately extrapolating data beyond the proposed Quarry site. The regular layer information shown is speculative and not based on borehole investigations**. The steep water table gradients shown at about 80 to 130 m distance from the left graph axis are simply an artificial artifact of Harden's model layer hydraulic

conductivity boundary geographic location selection and poor quality or absence of actual data input. These model artifacts are also apparent in the Harden (September 2017) Fig 27 'Drawdown in Overburden' in the De Grandis farmstead area (Fig G3.2).

78. Harden (Fig 31) overestimates the overburden thickness at the De Grandis ponds and also overestimates the post Quarry water level (Fig G3.8). The best estimate of overburden thickness is about 2 m at the De Grandis Pond (0 Distance) and the Post Quarry Lake Level will be about 346.6 m asl just south of M20S. This cross-section is misleading.

K. Has the Applicant adequately described the De Grandis Farmstead geology / hydrogeology?

79. The Applicant has not adequately described the De Grandis farmstead / hydrogeology. I have consistently requested a deep groundwater monitor (M22 on Fig G7.3) throughout my reviews to assist with assessment of the hydrostratigraphy and hydraulic characteristics. This Groundwater Monitor is required to address the necessary statutory tests.

80. My current geological / hydrogeological interpretation of the De Grandis Farmstead and Pond conditions concludes that the farmstead area sits on a bedrock platform with shallow permeable overburden mantle. This is based on:

- The presence of frequent large dolostone boulders along the shoreline and northwest of the De Grandis Pond as surface float is indicative of the presence of shallow bedrock (Fig G4.1 and G4.2).
- The original excavation depth of the De Grandis ponds was reported to be limited by extensive ledge rock. The contractor reported that blasting would be required for further pond deepening (De Grandis pers comm).
- The presence of shallow bedrock at water wells W32 (67-03695) and W50 (67-11476) east of the De Grandis farmstead on the 7th Line. There may be a bedrock elevation step (low escarpment) just south of the De Grandis Pond limits.
- Hunter bedrock contour mapping show bedrock at shallow depths in the De Grandis Pond Area (Fig G2.2).
- The interpretation of 1 to 2 m thickness of overburden and bedrock fracture locations from the Ground Penetrating Radar Surveys of November 8, 2018 (Fig G4.3 and G4.4).
- Groundwater discharge into the De Grandis Ponds mainly from warm bedrock springs as evidenced by ice-free areas on winter photos (Fig G4.1 and G4.5).

- Similar to the Applicant M20S/D, the upwelling groundwater in the De Grandis pond is at a higher hydraulic head than the ambient pond surface level. This pond upwelling area is interpreted to be fed via the underlying bedrock fractures from the connected upgradient Paris Moraine recharge area (Fig G2.1).

- The De Grandis farmstead nearby stony pasture fields are well drained except where the water table is intersected in low lying areas (Fig G4.2).

- Seasonal spring discharge also occurs to the northwest of the De Grandis farmstead at the base of the steep Paris Moraine slope (Fig 4.2).

- The Paris Moraine springs on the De Grandis Farm are the important water contributors to the Allen Wetlands. These wetlands are recharge features.

81. In summary, from the evidence available, the De Grandis pond and dug well, directly and indirectly, are connected to the bedrock aquifers.

L) Has the Applicant sufficiently investigated the De Grandis Pond and Well and Allen Springs Water Levels? (see Fig 2: De Grandis Pond and De Grandis Well (W31))

82. The Applicant has not sufficiently investigated the De Grandis Pond and Dug Well water levels. The De Grandis dug well has limited depth of water above the pump intake. This limited depth of water is less than even the Applicant's understated drawdowns (Fig G3.2). The Applicant has not supplied a geodetic water level elevation for the De Grandis Well and Ponds and for the Allen Spring. The statutory tests are clearly negative even based on the Applicant deficient investigations.

83. Shallow backhoe investigations as previously proposed by the Applicant are not adequate to define the local De Grandis Farm hydrogeological conditions and this offer has been refused at my advisement. Overburden backhoe exploratory excavations would simply duplicate the already known farmstead dug well and dug pond low gradient water table conditions. A full depth borehole and multi-level piezometer (M22) installation to the Middle Gasport production aquifer is required to establish the overburden and bedrock baseline hydrostratigraphy and hydraulics in the De Grandis pond southeast area (Fig G7.3).

84. A similar investigation is required adjacent to Allen Springs (Proposed Groundwater Monitor M23 on Fig G7.3).

85. These subsurface investigations are the responsibility of the Applicant, not the potentially impacted neighbour.

86. Harden (September 2017) Fig 2 shows very low pre-Quarry and pre-Rockwood Municipal Well No. 4 water levels in the De Grandis Pond on September 25 and October 5, 2012 (Fig G3.8). These low levels were coincidental with low pumping levels in the bedrock aquifers at Rockwood Well No. 1, 2 and 3 (see March 2017 Tier 3 Appendix B Chart C3-2 and C3-3). Hunter Fig G4.1 and G4.5 show the more typical normal water levels of the De Grandis Pond.

87. The Harden September 25, 2012 photographs (Fig G3.8) taken during drought conditions are typical of routine conditions to be anticipated when the proposed Quarry is operational and drawdowns are in effect. Ponds will be completely dry during extreme climate events.

88. Harden in its Well Survey Memorandum of January 8, 2015 reported the De Grandis Well (W31) as a 3.8 m dug well with a static water level at 3.11 m depth on October 5, 2012. Harden did not report the pump intake depth on this date. The pump intake was later surveyed by Hunter to be 0.30 m above the well bottom indicating **available pumping drawdown depth of only 0.39 m on October 5, 2012. This dug well available drawdown is less than the questioned and understated Harden 2012 and 2017 predicted groundwater modelling drawdowns without even considering additive regional wellfield pumping drawdowns (Fig G1.2 and G1.3).**

89. The De Grandis Well W31 (Item 38) and the adjacent De Grandis pond level was surveyed on December 12, 2014 by B. Hietkamp, P.Geo (Licenced Water Well Technician) and G. Hunter, M.A.Sc., P.Eng. with the following findings:

Table 1: De Grandis Well W31 and Adjacent Pond Surveyed December 12, 2014

	m	**m asl**
Ground Elevation (estimated from GRCA 2011 DEM)		364.4
Measuring Point (Stick Up) above ground level	0.45	364.85
Static Water Level (BMP)	2.95	**361.90**
Pump Intake Depth (BMP)	4.10	360.75
Depth of Water Above Pump Intake (BMP)	1.15	
Well Depth (BMP)	4.40	360.45
Pump Intake above well base (m)	0.30	
Surveyed Nearby Pond Water Level (BMP)	3.07	**361.78**

90. Water in the dug well was very ‘clear’ with temperature at 8.5 °C and pH (field) at 7.76 on December 12, 2014.

91. The water level in the dug well on December 12, 2014 was only 0.12 m above that in the ponds to the south indicating hydraulic connection and low gradients.

92. **The Applicant's proposed contingency plan on January 8, 2015 for the first time included drilling a new De Grandis well despite the De Grandis site exceeding the Applicant's arbitrary selected 500 m distance limit from the Quarry boundary**. The Applicant prior to this date denied any responsibility for this well. However, this 'contingency' is not included on the March 19, 2015 Site Plan and later versions and therefore is not enforceable directly through the Site Plans.

93. **The Applicant has not proposed any pond water level mitigation for the De Grandis and Allen properties**.

94. A new replacement well to the Middle Gasport (M15-2 equivalent) aquifer should be installed prior to any pit (overburden) or Quarry (bedrock) preparation and excavation, especially as the Applicant has not proposed any contingency for De Grandis farm livestock watering and fire protection in the event of loss of well and pond source water due to quarry induced and other regional drawdowns.

95. **During dry seasons (late summer to early winter) under Quarry drawdown conditions other local springs on this farm may be dry and not be available as an alternative farm water supply source for the De Grandis cattle herd (60+ head) plus other livestock, household needs and fire protection**.

96. The Applicant's Fig 2 (Harden, September 2017) may be indicative of the future 'normal' condition of the De Grandis Pond after Quarry drawdowns are imposed along the north upgradient side of the Quarry (Fig G3.8). Regional and local wellfield pumping, climate change and periodic draughts will further adversely affect water levels and completely dry out these farm ponds.

M) Did the Applicant Model properly represent the proposed bedrock extraction limits?

97. The Applicant groundwater model appears to be based on an unknown bedrock extraction limit not identified on the Site Plans despite a related note on pg 2 of 6 to see pgs 3-5. To address the statutory tests, a knowledge of the full extent of the bedrock extraction limit is required.

98. The Applicant has run a transient model and simulated post- and pre-Quarry groundwater levels at M19 (Fig 32). M19 is outside of the designated bedrock extraction footprint (Mar 5, 2019 Site Plan version (pg 2 of 6)). However the Mar 5, 2019 Site Plan version pg 3 of 6 Quarry Phasing includes a note:

> *"Drilling and blasting will not occur within a distance of approximately 165 m to the adjacent sensitive receptor(s). Should the blasting pattern be revised, extraction may occur within this setback with MNRF approval".*

99. The relaxation of the specified 165 m setbacks and/or the acquisition of Receptor R12 residential lot by the Quarry operator would permit the extraction footprint to embrace the M16 and M19 groundwater monitor sites within the proposed Aggregate Licence Limit subject to Natural Heritage limitations. The groundwater model should include this possible expanded extraction footprint. Alternatively, the Site Plan Note should be deleted.

100. These conservative assumptions should be employed for the groundwater modelling analysis, therefore the M19 Post-Quarry water level simulation (Harden September 2017 Fig 32) is indicative of the final Quarry lake levels not those reported on the Mar 5, 2019 Site Plans (Fig G6.1). On this basis bedrock drawdowns in the Phase 1 area near the Northwest Wetland and the northeastern Phase 2 part of the proposed Quarry will approach 7 m (23 ft) as the Quarry lakes expand due to continuing extraction (Fig G6.3 and G6.4).

N) Does the Applicant Model fit Observational Data along the Highway 7 Side of the Quarry?

101. The water levels at the upgradient side of the quarry are not suitable to predict quarry lake levels. Quarry lake levels will be controlled at the downgradient (Hwy 7) edge of the quarry by the combination of groundwater flow and hydraulic conductivities. The Applicant Model in my opinion fits the Applicant's two years of data logger observational groundwater levels along Highway 7 (Fig G5.1). This provides a reasonable conservative base line for more accurate Post-Quarry analytical (not model) drawdown predictions at the upgradient limits of the Post-Quarry lakes. This baseline provides information, in part, meaningful to the application of the statutory tests.

102. However not with standing the above comment the under statement of the drawdowns upgradient of the quarry and related under statement of the extent of the capture zone of the quarry means that quarry flow through is underestimated and water level rise at the south edge of the quarry is underestimated. Flow to Brydson Springs will also be underestimated.

103. The Applicants (Fig G5.1) 2016 to 2018 data logger hydrographs demonstrate remarkable consistency and low gradients in the M16D, M4, M19D and W1 area. This means that the locations of these monitor wells are 'agnostic', in other words the monitor locations may be transposed to the local downgradient bedrock extraction limit.

104. The Applicant in its September 14, 2017 Modelling Report (Fig 32) at M9 for the period May 2005 to October 2010 simulated the seasonal transient Post-Quarry water levels ranging from about **346.2 to 346.9 m asl with an average of about 346.6 m asl (Fig G6.1).** This value may also be transposed to the southern edge of the post quarry lakes but recognizing these are low estimates

of the water level rise for reasons stated above.

105. These predicted lower Post-Quarry water levels are consistent with the high hydraulic conductivities and low hydraulic gradients in the M4, M19D, W1 and M16D Groundwater Monitor Areas as represented in the Harden (2017) model Layer 4 (Fig G3.7). Additional supporting field data was provided in March 2019 by Harden (Fig G5.1).

106. The haul route passive drainage of the Phase 1 overburden water tables to about 350 m asl with recharge in the Phase 3 Quarry area as proposed by the Applicant may also raise water levels in the Pit Processing Area during Phase 1 initial pit development (Fig G2.5 and G2.6). The proposed wash pond site shown on the Mar 5, 2019 Site Plans – Operations Plan (pg 2 of 6) will also locally raise water levels at M4 due to infiltration.

O) Is the Applicant Comparison of Hidden Quarry to Dolime Quarry as a Water Quality Analogue appropriate?

107. The Applicant's comparison of the Hidden Quarry Environment to the Dolime Quarry environment as an analogue is not appropriate or relevant to the administration of the statutory tests.

108. The Applicant has previously compared the proposed Hidden Quarry blasting water quality to the Dolime Quarry in the City of Guelph. This comparison is not valid due to the 10x greater flow through at Dolime and as the effluent discharge from Dolime is pumped to waste to the nearby Speed River and not used as a Drinking Water Source.

109. The Dolime Quarry Discharge is about 10,000 m^3/day or the equivalent of about eight Rockwood PW4 Municipal Wells pumping at the Maximum Permitted Level.

110. The future termination of water takings for dewatering at Dolime Quarry would, in part, offset regional wellfield drawdowns.

P) Is there a risk of Pathogen Contamination of Private Wells downgradient of the proposed Quarry?

111. There is a risk of pathogen contamination of private wells downgradient of the proposed Quarry Evaluation and satisfactory mitigation of this risk is part of the administration of the statutory tests.

112. Burnside commented as follows on October 6, 2014:

> *"It is Burnside's opinion that it is preferable for residents to refrain from the need to use water treatment systems if possible.* ***As a result, Burnside recommends that the condition of the closest downgradient wells be investigated as part of the ongoing studies in support of the quarry application.*** *The assessment should include detailed documentation of the surface condition of the well, the depth of the pump, a brief pumping test to quantify the well yield and collection of water quality samples. The potential to deepen the well to access the deeper fracture system below 327 m asl should be evaluated. The survey should also identify the repairs needed in order to bring all wells in compliance to O.Reg. 903. Compliance with O.Reg 903 decreases the chances that water quality impairment is being caused by the condition of the well which will make future evaluation of water quality easier.* ***If the quarry application is approved, then the necessary repairs/retrofits to these wells should be undertaken within one month of license approval.***"

113. The Novakowski (2017) and Worthington (2016) Technical Submissions with conclusions of rapid groundwater bedrock fracture transport between the proposed Hidden Quarry and Brydson Springs emphasizes the need to replace nearby open hole private wells within the Quarry extraction interval (349 to 327 m asl) with new wells isolated to the deeper Middle Gasport municipal aquifer interval similar to Rockwood PW4 to reduce the risk of (but not eliminate) pathogen contamination.

114. Allen et al (June 2017) on the basis of a groundwater sampling program conducted in Wellington County and in the general area of the proposed Quarry found that viruses can spread rapidly in a fractured rock medium while retaining their ability to infect a host. If the Quarry lakes were contaminated with viruses, the viruses could be expected to show up in downgradient private wells. Similarly, dissolved solvents, petrochemicals and other Quarry operational contaminants may travel quickly in rock fractures (see Frind February 28, 2018 s4.8).

115. The Harden October 4, 2018 Water Quality Sampling at Tributary B (SW4) at the entrance to the proposed Quarry site reported Background at 73,000 CFU/100 mL, Total Coliforms at 7,900 CFU/100 mL and Escherichia coli at 960 CFU/100 mL. Repeat sampling on November 8, 2018 at SW4 indicated much lower values with E. coli at 5 CFU/100 mL. On March 15, 2019 E. Coli was observed at 1,500 mg/L. The flowing Tributary B surface water at SW4 recharges into the proposed Quarry environment. Total Coliforms and E. Coli should be non-detectible in Drinking Water.

116. This work confirms that Water Treatment Systems (disinfection) also will be required for those replaced private wells in proximity to the proposed Quarry (Fig G7.3). Many of these downgradient wells are in the Town of Milton, Halton Region.

117. **A more appropriate safer remedial solution would be to supply piped treated water from the Rockwood municipal water supply system to Sixth Line (Eramosa) and Highway 7 neighbours.**

Q) Has the Applicant adequately set Private Water Well Alerts considering the ambient groundwater quality in the proposed Quarry?

118. The Applicant has not set private water well and surface water alerts based on the ambient groundwater and surface water quality conditions as well as the Ontario Drinking Water Standards, Objectives and Guidelines (2006), the Canadian Water Quality Guidelines for the Protection of Aquatic Life (2012) and the Ontario Policies and Guidelines for Provincial Water Quality Objectives (February 1999). These criteria are necessary to administer the statutory tests.

119. I do not agree with the Applicant's assumption that it can monopolize the full Ontario Drinking Water Standards for the proposed Hidden Quarry aquifers or above the 95th Percentile (January 14, 2014 Applicant Letter pg 16). There may be other adverse upgradient water quality trends (agriculture) and downgradient home owner site conditions that may already adversely affect the local drinking water source aquifer environments.

120. The following selected recommended adaptive management alerts for private wells are based on applicable Standards, Objectives, Guidelines and Policies and consideration of ambient groundwater conditions in the Hidden Quarry environment as summarized in Appended Table C.

Microbiology/Pathogens

121. For Wellhead Protection a 100 m pathogen protective zone is typically designated around each wellhead. This may not be sufficient distance considering the open bedrock fracture network along Highway 7. The Applicant should exercise appropriate cautions in an equivalent buffer zone around the Quarry. The microbiological quality of drinking water is most important because of its association with waterborne diseases. For Escherichia Coli (E. Coli) and for Total Coliforms:

Amber Alert	Detectible
Red Alert	Detectible

Thermal

122. Source Groundwater for private wells will be maintained in the following range:

	Upper	**Lower**
Amber Alert	11 °C	8 °C
Red Alert	13 °C	6 °C

123. The Harden letter of April 4, 2016 concluded quarry thermal effects may be anticipated to extend a minimum of 100 m downgradient of the Quarry.

124. Warmer waters may increase biological and chemical reactions. Colder waters (winter) may increase the incidence of residential water pipe freezing.

Sodium

125. The following trigger Level for Sodium in wells downgradient of the Quarry is recommended for deeper wells with existing Sodium below 10 mg/L. These trigger levels, reflecting existing ambient conditions, are lower than the ODWS (2006) Medical Advisory of 20 mg/L.

Amber Alert	12 mg/L
Red Alert	15 mg/L

126. Sodium levels however may also be increased in downgradient wells and surface water by Highway 7 road salting.

Iron

127. Elevated iron was observed in the Applicant 1996 Monitor well samples. Based on existing ambient conditions, the following trigger alerts for Iron are recommended:

Amber Alert	0.15 mg/L
Red Alert	0.20 mg/L

Manganese

128. Based on existing ambient conditions, the following trigger alerts for Manganese are recommended:

Amber Alert	0.15 mg/L
Red Alert	0.03 mg/L

Hardness

129. Hardness in excess of 500 mg/L in drinking water is unacceptable for most domestic purposes. The following Hardness Trigger Alerts are recommended, based on local ambient groundwater conditions.

Amber Alert	420 mg/L
Red Alert	450 mg/L

Total Dissolved Solids (TDS)

130. Active subaqueous quarrying activity may contribute to increased TDS and Turbidity levels in the downgradient private wells. Based on existing ambient conditions, the following trigger alerts are recommended:

Amber Alert	450 mg/L
Red Alert	475 mg/L

Turbidity

131. The following alerts are recommended for Turbidity:

Amber Alert	3.0 NTU
Red Alert	4.0 NTU

Benzene

132. Measurable Benzene was observed at Guelph Limestone Quarry quarry pond samples. The proposed trigger alerts for Hidden Quarry are:

Amber Alert	Detectible
Red Alert	Detectible

Nitrate-Nitrogen

133. Considering the existing ambient Nitrate (N) conditions, the following Alerts are recommended for Nitrate (NO3-N) concentrations in the quarry lakes and in groundwater monitors on the downgradient side of the quarry (Fig G2.7).

Amber Alert	2.0 mg/L
Red Alert	2.5 mg/L

Phosphorus

134. The following alerts are proposed for Phosphorus in the quarry lakes.

Amber Alert	0.005 mg/L
Red Alert	0.01 mg/L

Organic Nitrogen

135. The following trigger values, are recommended for Organic Nitrogen at the monitors and at private wells downgradient of the proposed Quarry.

Amber Alert	0.12 mg/L
Red Alert	0.15 mg/L

Hydrocarbons / Oil and Grease

136. Hydrocarbon and Oil and Grease should be absent from downgradient monitor and private wells. Water quality monitoring is required. Measured values (detectible) in downgradient monitor wells above method detection limits should be considered Amber and Red Alerts.

Amber Alert	Detectible
Red Alert	Detectible

Zinc

137. Reflecting existing ambient conditions, the operational trigger values proposed for the quarry lakes based are:

Amber Alert	0.02 mg/L
Red Alert	0.03 mg/L

R) Has the Applicant sufficiently protected the Brydson Springs aquatic habitat (quantity and quality) and the coldwater brook trout fishery through its operational Site Plans?

138. The operational Site Plans are silent on protection of Brydson Creek aquatic habitat quality. The Applicant has not recognized the sensitivity of the Brydson Springs aquatic ecosystems to eutrophic conditions as confirmed by recently released March 2019 water quality data for SW15 and SW16. The Applicant has not met the required statutory tests.

139. Groundwater Nitrate (N) levels are elevated north of the Quarry from long standing agriculture activities and practices including livestock barnyards, mushroom farms, septic fields, waterfowl habitat ponds and/or widespread intensive commercial agriculture field crop production. These activities preceded the proposed Quarry by many decades (Fig G2.7).

140. Brydson Springs waters already exceed a water quality target limits for eutrophication and exceed the 'Nitrate-N' trigger level of 3.0 mg/L **for protection of amphibians, fish and aquatic life**. Un-

ionized Ammonia has not yet been analyzed at Brydson Springs. There is no remaining Reasonable Use Capacity for the proposed Quarry to increase 'nitrate loading' at Brydson Springs including from onsite blasting, rehabilitation and other contributors or by induced groundwater flow from upgradient nitrate enriched agriculture source areas (Fig G2.7).

141. If the application is approved the quarry operator may have to implement upgradient groundwater quality improvement (nitrate reduction) compensation offsets to reduce quarry groundwater nutrient loading and reduce Nitrate (N) levels in the Quarry Lakes and at Brydson Springs. The operator has not done so.

142. The proposed northern well monitors (M22, M23 and M26) together with a multi-level sentry well at M25 upgradient of Brydson Springs (HPR Fig 2.1) will allow further assessment of potential quarry induced Nitrate (N) increases. These monitors will also provide a much improved picture of aquifer Nitrate (N) contamination closer to the assumed agricultural source areas.

S) Has the Applicant provided Adequate Water Quality Alerts for the Quarry Lakes and Brydson Springs?

143. The Applicant has not provided adequate water quality alerts for the Quarry Lakes and Brydson Springs. These alerts are required to administer the required statutory tests. The following alerts are proposed.

Nitrate (as N)

144. The recommended Water Quality Alert for Nitrate (as N) in the quarry lakes, at the downgradient quarry monitors and at Brydson Springs reflects a reduction from ambient conditions.

Amber Alert	2.0 mg/L
Red Alert	2.5 mg/L

145. A future amber alert management objective for Brydson Springs of 1.0 mg/L is encouraged and recommended.

Un-ionized Ammonia

146. The Applicant has not observed Un-ionized Ammonia at the Brydson Springs. The following alerts are proposed based on Surface Water Quality Objectives:

Amber Alert	0.15 mg/L
Red Alert	0.20 mg/L

T) Has the Applicant set Water Quality Alerts for Rockwood Well No. 4?

147. The Applicant has not set Water Quality Alerts for Rockwood Well No. 4. In view of the elevated Nitrate (N) in the quarry environment an observed increase in Nitrate (N) at PW 4 may be an indication of quarry water influence. Setting of Alerts will assist in administration of statutory tests.

148. An increase in Nitrate (N) at Rockwood Well No. 4 may be a direct indication of Hidden Quarry water influence.

149. An Amber Alert for Nitrate (N) is proposed at 2 mg/L and a Red Alert at 3 mg/L for PW4.

CONSOLIDATED ISSUES LIST

Issue 1: Have the implications of the underlying karst geology been properly taken into account in designing the Quarry and modelling its potential impacts? (CRC, Halton/Halton Hills)

150. The Applicant recent Monitoring data provided for January to March 2019 indicates that in the Highway 7 area of the proposed Quarry water flows and equilibrates rapidly via a bedrock fracture network, perhaps with karst enhancement (Fig G5.1). This determination significantly facilitates the administration of the statutory tests. (see also Question 'N' Responses in this Witness Statement).

151. The Applicant during March 2019, for the first time, provided two years of continuous water level data for Groundwater Monitor Wells M4, M19, W1 and M16 along the Highway 7 side of the proposed Quarry. WI is a residential pumping well. These pre-Quarry Hydrograph Plots near Highway 7 are very similar each with about 2 m amplitude (see Fig G5.1).

152. The seasonal highs on Fig G5.1 represent recharge both from losing stream Tributary B and directly from the proposed Quarry environs. These wet season recharge effects are quickly dissipated before the dry season. There is no evidence of groundwater mounding in the Tributary B Highway 7 corridor.

153. The similarity of these hydrographs and the low gradients demonstrate high uniform hydraulic conductivity consistent with an interconnected bedrock fracture network, perhaps with karstic enhancement. There may be a slight flow convergence evidence toward Well W1 which may indicate a preferential flow zone (karstic conduits) towards Brydson Creek springs. Alternatively, this may be residual drawdown induced by frequent residential pumping (see Fig G5.1).

154. The low water level rises along Highway 7 compared to the Harden (2012) and the Hunter (2016) modelling efforts are the result of Harden's incorporation of a high hydraulic conductivity zone in the Brydson Creek Tributary B corridor of its 2017 Model (see Harden Hydraulic Conductivity Test Data provided March 2019 and Fig 3.7).

155. **In my opinion, it will not be possible to raise water levels in the high hydraulic conductivity Highway 7 corridor by 2 m as implied by the Applicant's Site Plans.**

Issue 2: Has it been demonstrated that there will be no adverse impacts on surface water or groundwater resources, including private and municipal wells as a result of the proposed quarry and removal of the moraine overburden and bedrock? (CRC, Halton/Halton Hills)

156. The Applicant has not demonstrated that there will be no adverse impacts on the surface water and groundwater resources as a result of the proposed Quarry. The Applicant places far too much faith on the accuracy of its 2017 model in predicting precise quantity impacts (see also Dr. Frind's February 28, 2018 Report and Witness Statement). Conformance with the statutory tests off-site from the Quarry is not possible with this model.

157. The Applicant advocates providing downgradient private well owners with water quality treatment systems in the event of proven poor water quality originating from the proposed Quarry site and well replacement in the event of proven drawdowns as determined at the Applicant's investigative discretion. I recommend on a precautionary basis replacement of existing downgradient wells with deep wells isolated through the quarry bedrock interval subject to owner consent. Water treatment for pathogens will still be required.

158. Upgradient wells W5, W7 and W31, subject to owner consent, should be replaced with deep wells as a precautionary measure due to quarry induced drawdowns that will be greater than currently estimated by the Applicant (Fig G3.2 and 6.3). Well W31 is further discussed in Question K of this Witness Statement. The applicant reports that owner declined replacement of Well 7. W5 (67-128214) has limited depth with open hole base at 341.1 m asl compared to existing water level at about 353.4 m asl and predicted low quarry lake level at 346.2 m asl.

159. **Alternatively, the Applicant should extend municipal treated piped water from the Rockwood municipal water supply system to service downgradient wells on lots fronting the 6th Line Eramosa and on Highway 7.**

Issue 3: Has appropriate stormwater management been undertaken including protection of the Brydson Creek floodplain and design of internal quarry road floodplain crossings? (CRC)

160. In February 2019, the Applicant completed an appropriate analysis of the Regulatory Floodlines with the exception of incorporation of the internal quarry road crossing design into the analysis (Fig G7.1). Therefore upstream backwater effects have not been determined on the Allen Wetlands. The Applicant also has not incorporated the GRCA 5 m buffer to determine the Regulated Flood Limit. A site Plan Update is required to adjust the proposed Site Plan excavation limit in the easterly part of Phase 1 area. These adjustments are required to satisfy Issue 3.

161. The Tributary B limits on the February 19, 2019 Site Plan version were determined by the Applicant and GRCA (GWS, September 16, 2013). However, there is no evidence that this limit was incorporated into the legal property Survey framework or the field staking is still recoverable.

162. The Applicant's February 2019 Floodplain mapping report is generally appropriate (Fig G7.1). The Applicant modelled regulatory flood elevations (Tatham Dwg FM-1) are very similar to my February 27, 2018 provisional estimated flood elevations as shown on my Item 26 in that report. However the following variances are noted in the Tatham Report:

- Tributary C is not included the analysis. Tributary B and C at Regional Flood levels are linked south of the De Grandis property and immediately north of Highway 7.
- The regulatory flood limits are not correct above Highway 7 at the Tributary C confluence.
- The flood line is understated between Sta 570 and 601 and should be extended to the west based on flood and ground elevations with a contingency.
- The GRCA required 5 m buffer limit has not been included on the Applicants mapping Dwg FM-1 (GRCA O.Reg 150/06 Oct 23, 2015).
- Backwater from the internal quarry road causeway across Tributary B floodplain has not been considered. No recommendations for culvert / bridge opening cross section has been included to minimize unnatural upstream flooding of the Allen Wetlands.
- The Regulated Flood Limit is generally within the February 19, 2019 Site Plan excavation footprint with the exception of the area between Section 508 to 668 shown in Fig G7.1 and G7.2.
- The Applicant's proposal to construct berms to contain and exclude the Tributary B flood flows from the proposed excavation footprint as contemplated by Dwg FM-1 and the February 19, 2019 Site Plans is not consistent with GRCA O.Reg 150/06.
- The Tributary B valley and/or regulatory flood plain corridor subject to the above adjustments including the additional 5 m setback must be located and staked in the field and referenced to

the property legal survey and the Site Plans by an Ontario Land Surveyor.

- This adjusted valley/floodplain corridor will be the new limit of excavation adjacent to Tributary B.
- The Site Plans will have to be updated as shown on Fig G7.1 and G7.2. Note the February 19, 2019 Site Plan version (pg 2 of 6) used in Fig G7.2 is consistent with the Applicant Fig G7.1 and the improved graphic quality of this version.

163. My Floodplain mapping of February 27, 2018 applies the Flood Elevations to the GRCA 2011 Topographic Mapping whereas the Applicant Mapping is based on more accurate on site ground Topographic Surveys.

Issue 4: Has the Applicant established appropriate water level and quality trigger levels, and adequate contingency and mitigation measures to ensure no adverse impacts on water quantity and quality in private wells upgradient and downgradient of the quarry site, municipal wells, springs, ponds and wetlands due to the quarry including independent review of same? Have appropriate procedures been established to provide this data to the Township, and any Public Liaison Committee that may be established? If so, has the requirement for this program been appropriately secured? (CRC, Halton/Halton Hills, Township)

164. The Applicant has not established appropriate water level and quantity trigger levels in the Quarry environment. The Applicant has not provided for access to the data by any Public Liaison Committee or provided appropriate securement. The Applicant cannot meet the statutory tests without this information.

165. **The Applicant will not be directly in control of water levels in the proposed Quarry.** Water levels will be determined by the increased flow through due to the upgradient capture zone expansion and the downgradient high hydraulic conductivity along Highway 7 and further influenced by climate variability, climate change and increased regional wellfield pumping (Guelph/Eramosa Township and City of Guelph) as well as by progressive Hidden Quarry extraction activity.

166. As result of extraction activities and the quarry lake levelling effect, water levels may be anticipated to rise at the down gradient side of the Quarry and decline at the up gradient side of the Quarry. Flow through the Quarry to Brydson Creek will increase due to the expanded up gradient drawdown catchment into the Paris Moraine. The Paris Moraine will be the source of this increased flow (Fig G2.1).

167. The most important water levels to maintain are at the Applicant's Brydson Spring monitor SW15 and at the downgradient M4 and M19 monitor wells along Highway 7 and M16 at the southern extent of Phase 2.

168. **Based on the Applicant's two years of data logger groundwater monitoring made available in 2019, recommended Amber and Red trigger levels at SW15 are 344.45 and 344.60 m asl respectively. Recommended Amber and Red trigger levels at M4 and M19 are 345.95 and 345.61 m asl (Fig G6.1).**

169. An upper level operational Amber and Red Alert is proposed at M4/M19 at 348.5 and 349.0 m asl respectively to recognize flooding in the Phase 3 Processing Area during overburden excavation and haul route water drainage from Phase 1 with recharge in the Site Plan designated Processing Area specified at 351 m asl on the Site Plans.

170. The M4, M16 and M19 Amber and Red Alert Triggers in effect are the water level control for the entire proposed operating Quarry area because of the upgradient leveling effect of the expanding Quarry lakes. If the Quarry is approved the Site Plans will in effect permit drawdowns to approach this downgradient water level control at M4 and M19. **Adverse effects of upgradient drawdowns will have to be mitigated if this Quarry application is approved.**

171. **The Applicant's logic for establishing independent upgradient trigger levels at groundwater monitors is unexplained, flawed and likely not achievable if set much higher than M4/M19 trigger levels proposed herein. Upgradient water levels including those in Ministry permitted wash water supply ponds and opening 'sinking cuts' should not be allowed to fall below the M4/M19 Amber Alert Levels.**

Proximal Private Well Replacement

172. The Applicant has not acknowledged Hunter's prior recommendations to replace (or deepen) private wells W5, W7, W10, W11, W16, W17, W18, W19, W20, W21, W22, W23 and W31 cased into and isolated to the Middle Gasport production aquifer subject to owner consent as shown on Hunter Fig G7.3 enclosed.

Private Well Surveys Not Required

173. The installation of buffer zone sentry wells and selected replacement private wells, except for downgradient of the Quarry, removes the need for routine private well surveys and privacy issues related to reporting and public sharing of monitoring results for independent analysis (Fig G7.3).

174. Water quality surveys at formal on-site and buffer zone sentry ground water monitors will provide an improved more accurate representation of ambient groundwater quality and water levels for

administration of the statutory tests and for future fair and equitable independent assessment of water quantity and quality change.

Issue 5: Has it been demonstrated that pre-quarrying water levels and water quality will be maintained in the wetlands and in on-site and off-site surface water features? (CRC, Halton/Halton Hills, Township)

175. It has not been demonstrated that pre-quarrying water levels will be maintained in the Allen Wetlands. The De Grandis spring flows will be reduced, the overburden and bedrock aquifers on the upgradient side of the Quarry will be drawdown. The Applicant does not meet the statutory tests.

176. The current upward vertical leakage (discharge) at M20D to M20S adjacent to the Allen Wetland will be converted to downward leakage stressing the wetlands when the overburden and bedrock water levels are drawndown by the proposed adjacent Quarry (Fig G6.3). Mitigation has not been proposed by the Applicant.

177. The Applicant's groundwater model is flawed upgradient of the proposed Quarry due to absence of reliable water level calibration data.

178. The Applicant will not be able to meet its proposed Mar 5, 2019 Site Plan trigger flows in Tributary B at SW4 due to reduced flow of upgradient springs and increased recharge in the wetland (Site Plan pg 6 of 6 s2.3).

Issue 6: If so, has a sufficient monitoring and mitigation program including independent review of same been established for these features? If so, has the requirement for this program been appropriately secured? (CRC, Halton/Halton Hills, Township)

179. Sufficient monitoring and mitigation and independent review has not been established to meet the statutory tests. See Issue 11 discussion.

Issue 7: Are existing and proposed on-site wells constructed at appropriate depths and is the frequency of water level and water quality monitoring sufficient to provide reliable data on water level and quality, (including pre-extraction ground water monitoring) and have appropriate procedures been established to provide this data to the Township, and any Public Liaison Committee that may be established? Is the monitoring program able to confirm that predicted water level and water quality changes are accurate? (CRC,

Halton/Halton Hills, Township)

180. The Applicant in November 2016, with the addition of three new on-site boreholes, finally provided an adequate distribution of bedrock groundwater monitors and static water levels to determine the shape of the on-site existing bedrock water level contours. The Applicant can meet the statutory tests within the Quarry footprint with respect to number of monitors to define existing bedrock water levels.

181. The additional (2016 to 2019) on-site monitoring for the first time illustrates the convergence of flow through the north-central area of the proposed Quarry towards Highway 7 which should have been reasonably expected since the original Harden 2012 Report (Fig G2.2 and G2.4). Much of the water flow through the Quarry discharges at Brydson Springs (Fig G3.3 and G3.6).

182. Monitor Wells M13-D and M14-D with top of screens at 350.43 and 348.56 m asl may also be dry with the anticipated low Post-Quarry lake levels (Fig G6.1). New adjacent monitor wells will be required to 327 m asl depth. The Applicant has no deep borehole monitor in this key area.

183. M1D base of piezometer screen is at 348.05 m asl which is above the lower range of predicted post Quarry Lake water levels (Fig G6.1). This monitor well needs to be replaced or deepened to 327 m asl.

184. Similarly, M3 in the Tributary 'B' corridor needs to be replaced with a deeper monitor well (M21) to 327 m asl (Fig G7.3).

185. New Monitor Well M18 is required in proximity to the 6th Line and Highway 7 corner of the Quarry site to 327 m asl depth. New M17 proposed by the Applicant appears redundant.

Issue 8: Will Nitrates-N and Nitrates be added by quarry blasting activities and if so, will they impact the quality of surface and ground water features? (CRC, Halton/Halton Hills)

186. Nitrate-N will be added by quarry blasting activities and will impact the water quality. See Issue 12 Discussion. The Applicant does not meet the statutory water quality tests.

Issue 9: The revised site plan illustrates a wash pond which has not been documented or detailed. Has the design and function of this wash pond, including the source and volume of the water, been appropriately studied to evaluate its potential impacts on the quality and quantity of water resources? How will the wash pond be incorporated into the monitoring program? (CRC)

187. No, the wash pond has not been appropriately studied to evaluate its impact on the quantity and quality of water resources and the relation to statutory tests.

188. The Harden January 11, 2016 Memo (Tab 23) states washwater silt (and turbidity) will be contained in a closed loop system and silt recovered and sold as a product.

189. However, Mar 5, 2019 Site Plans notes (pg 4 of 6) state that for Quarry Lake areas screening piles may be returned into the Quarry or left in the bottom of the Quarry.

190. Water levels in the wash pond or pumping wells should not be drawndown below the proposed M4/M19 water level alerts.

191. The Site Plans pg 2 of 6 should contain the following notes to reduce lake water turbidity:

'Screenings, washwater silt and turbid water will not be disposed in quarry lakes.'

'Fine textured overburden excavated on-site will not be disposed in quarry lakes.'

Issue 10: Does the 2017 groundwater model adequately demonstrate that the proposed quarry will meet the applicable tests and standards for ground and surface water protection? In particular, have modelling uncertainties in the 2017 groundwater model, and the implications of these uncertainties with respect to predicted quarry operating water levels and related adverse effects on springs, ponds, wetlands and shallow wells due to the quarry, been adequately recognized and investigated by means of sensitivity analyses? This includes uncertainties in:

- **the conceptual model,**
- **the boundary conditions,**
- **the recharge,**
- **the distribution of the parameters (zoning),**
- **the parameter values,**
- **the data (both within and outside the quarry area),**
- **the model results. (CRC, Halton/Halton Hills, Township)**

192. See Dr. Emil Frind's Report of February 28, 2018 and his current Witness Statement. Also see my discussion at Question 'E'. The Quarry Application does not meet the required statutory tests.

Issue 11: With respect to section 4.9.7 (Paris and Galt Moraine Policy Area) of the County of Wellington Official Plan:

a. Has it been demonstrated that pre-quarrying water levels and water quality will be maintained in the wetland and surface water features on in the vicinity of the subject property?

b. Are the monitoring programs, and the trigger levels and contingency measures for water levels and water quality, adequate to ensure the protection of private water supply wells, wetlands and surface water features and associated fish habitat on, and in the vicinity of the subject property? (County of Wellington)

193. The Paris Moraine encompasses the Hidden Quarry site and the related surface and groundwater catchments (Fig G1.4) with the De Grandis and Allen Springs and Ponds. Pre-Quarry water levels will not be maintained in these wetlands and ponds.

194. The monitoring programs, trigger levels for water levels and quantities are not adequate to ensure the protection of private water supply wells, wetlands and surface water features and associated fish habitat (including Halton Region) in the vicinity of the subject property.

195. See also Dr. Emil Frind's Report of February 28, 2018 and current Witness Statement.

196. The Applicant has not provided any baseline vertical geodetically controlled off-site bedrock and overburden water levels in the buffer zone around the Quarry. Existing baseline water level data in the Quarry buffer zone is very sparse, inadequate in distribution and without geodetic horizontal position and vertical survey control.

197. Due to the presence of springs, ponds and shallow dug wells, precise transient water levels within the 1,000 m buffer zone are required to support accurate groundwater model calibration, prediction and validation.

198. Hunter has recommended a 500 to 700 m buffer zone external groundwater monitoring network independent of existing private wells (Fig G7.3) if the application is approved. This buffer zone network will provide for actual baseline and water level change monitoring. The Applicant has not yet supported this proposal and incorporated these recommendations into its work and Site Plans.

Issue 12: Has it been demonstrated that the downstream brook trout habitat will be protected from water quality and quantity adverse effects, and that all legislative and regulatory

requirements will be met? (CRC, Halton/Halton Hills)

199. The downstream brook trout habitat already has adverse water quality as confirmed by the Applicant's very recent water quality monitoring provided during March 2019 (Fig G2.7 and Table A). Quarry blasting is anticipated to further increase Nitrate (N) levels in the brook trout habitat. The water quality (Nitrate-N) exceeds the Canadian Water Quality Guidelines of 3 mg/L Nitrate (N) for the Protection of Aquatic Life (2012). The Applicant cannot meet the required statutory tests.

200. Explosive activities for quarry extraction are expected to adversely increase these already elevated Nitrate (N) levels. The Canadian Water Quality Guidelines (20212) also identified mining (explosives) as a source of Nitrogen.

201. The Applicant has not provided the existing concentration of Un-ionized Ammonia in Tributary B seasonal surface flow at Brydson Spring to complete this assessment.

202. **On March 16, 2017 the Applicant observed Nitrate (N) at SW3 (Highway 7) and SW4 (North Quarry Boundary) at 10.7 and 10.5 respectively at more than 3x the Guideline.**

203. On May 4, 2017 Nitrate (N) at SW4 was observed at 6.70 mg/L and 4.82 mg/L.

204. On June 2, 2017, the Applicant reported Nitrate (N) at 4.25 mg/L at SW3, **4.08 mg/L at SW15 (Brydson Spring) and 3.47 mg/L at SW16 (Brydson Creek).**

205. **On April 4, 2018 the Applicant observed Nitrate (N) at SW15 (Brydson Spring), at SW16 (Brydson Creek) and at SW4 (Tributary B) at 4.21, 2.02 and 4.40 mg/L respectively.**

206. **On March 15, 2019 the Nitrate (N) was observed by Harden at 3.85 mg/L at SW15 and at 0.92 mg/L at SW16.**

207. **These Nitrate (N) values are excessive in the Quarry site environment and need to be reduced (Fig G2.7 and Table A).**

208. The Applicant has reported Nitrogen compounds to average 4.38 mg/L in the groundwater entering the north boundary of the proposed Hidden Quarry (Harden, April 9 and June 14, 2014) and **predicted Nitrogen compounds to be 4.54 mg/L at the south boundary of the Quarry. According to the Applicant, explosives contributed 1.91 mg/L of this predicted Nitrogen at the South Quarry Boundary**.

209. By comparison, Harden (January 14, 2014) Table 1 estimated the loss of Total Nitrogen for explosives at the Gamebridge Quarry varied from 3.1 to 6.72 mg/L over the period 2009 to 2013

(average 4.9 mg/L). The Nitrogen in the influent water averaged 1.4 mg/L**. Therefore the contribution from explosives at Gamebridge Quarry was 3.5 mg/L.** No diluting flow through water information was provided.

210. Reasonable Use indicates a 5 mg/L loading of Nitrate-N may be acceptable as a Drinking Water Source objective for Hidden Quarry. However this is a reportable level to the Ministry for a Municipal Water Supply System.

211. The Reasonable Use objective with respect to Brydson Springs would be about 2 mg/L. The Applicant has not made any proposals as to how the existing and future Nitrate-N levels within the Quarry and at Brydson Springs will be mitigated and enhanced.

212. **The Applicant's 2016 to 2019 Water Quality Sampling on June 2, 2017 reported Total Phosphorus at 0.019 mg/L at SW3 (Brydson Creek Highway 7) compared to the Ontario Surface Water Quality Criteria at 0.01 mg/L. On April 4, 2018 at SW16 (Brydson Creek) Total Phosphorus was reported at 0.023 mg/L. Total phosphorus was also elevated on May 15, 2019 at RS1 (Tributary A), SW4 (Tributary B) SW15 (Brydson Spring) and SW16 (Brydson Creek) at 0.072, 0.28, 0.34 and 0.17 mg/L respectively.**

213. **On April 4, 2018, zinc was elevated above criteria (0.03 mg/L) with SW15, SW16 and SW4 concentrations at 0.038, 0.035 and 0.038 mg/L respectively. On March 15, 2019, zinc was elevated above criteria at SW4, SW15 and SW16 at 0.057, 0.048 and 0.050 mg/L respectively.**

214. The elevated Nitrate (N) levels in the Hidden Quarry Area are the result of agricultural field, mushroom farm, farm barnyard and/or pond waterfowl activities upgradient of the Quarry (Fig G2.7, Fig G4.5 and Table C).

215. The proposed Hidden Quarry will further aggravate the adverse water quality effects on Brook Trout and aquatic habitat and on local drinking water supplies. The Applicant cannot meet the required statutory tests.

Issue 14: Is an adaptive management plan in place to monitor and mitigate potential impacts on natural heritage system? If not, is it appropriate to approve the proposal without an approved adaptive management plan? (CRC, Halton/Halton Hills, Township)

216. No adaptive management plan has been proposed by the Applicant. An adaptive management plan is required due to the uncertainty with the Applicant's virtual groundwater model as a result of understated drawdowns and absence of quarry buffer zone quantity and quality groundwater monitoring for model calibration (Fig G2.5 and G7.3).

217. Ongoing potential adaptive management issues include but are not limited to:

- Operational and Post-Quarry Water Levels at variance with model predictions.
- Upgradient drawdowns at variance with model predictions.
- Quantity and Quality Interference with Rockwood Municipal Wells 3 and 4.
- Quantity and Quality Interference with nearby private wells.
- Quantity and Quality interference with Brydson Creek Brook Trout Habitat.
- Quantity Interference with Allen Wetlands and Paris Moraine Springs and Ponds.
- Quantity Interference with the Northwest Wetland.

Issue 16: Are the rehabilitation plans suitable taking into consideration the existing natural heritage features in the area? (CRC, Township)

218. The Mar 5, 2019 Rehabilitation Site Plans (pg 4 of 6) are based on technically unsupported and incorrect Post-Quarry closure water levels of 348.5 ± 0.5 m **versus the Applicant modelled water levels (Harden, September 2017 Fig 32) at about 346.6 m asl ± 0.4 m (Fig G6.1).** The Applicant Site Plans do not meet the statutory tests.

219. This Post-Quarry water level is about 3 m below the overburden bedrock. The execution of the Applicant's Site Plan Rehabilitation Plan leaving bedrock unextracted under the proposed shore platforms is not identified on the Site Plans by a clearly designated Bedrock Extraction Limit.

Issue 20: Does the proposal meet the 'no negative impacts' test with respect to natural heritage features and functions, including those in Halton Region? (Halton/Halton Hills)

220. The proposal does not meet the 'no negative impacts' test due to the uncertainty of the magnitude of offsite groundwater drawdown (quantity) impacts on ponds, springs, and stream natural heritage features in the County of Wellington.

221. The Quarry proposal has not addressed downgradient water quality issues with respect to eutrophication of Brydson Creek and protection of Brook Trout and Aquatic Habitat in Halton Region (see Issue 12).

Issue 30: Are sufficient mitigation, monitoring and enforcement measures in place to ensure noise and vibration levels, and other impacts from the operation of the quarry, including impact on water quality from blasting materials, are maintained at acceptable levels? (CRC, Halton/Halton Hills, Township)

222. There are not sufficient mitigation measures proposed for nutrient reduction including Nitrogen from blasting operation considering the existing adversely impacted ambient groundwater quality at the proposed Quarry site (Fig G2.7). See also Issue 12 discussion.

Issue 31: Are appropriate protocols in place for the provision of this data, including blasting records and acoustical monitoring to the Township and its peer review consultant, and any Public Liaison Committee that may be established? (CRC, Township)

223. There are no proposals to provide monitoring information to Public Liaison Committees. The Site Plan focus on private well monitoring outside the Quarry limits, which in most cases precludes public sharing of data without private owner consent, which may not be forthcoming.

Issue 46: Is the proposal consistent with the Provincial Policy Statement (2014)? Township, CRC, Halton/Halton Hills

Provincial Policy Statement 2014
Part IV; Part V - 1.1.1 c), h); 1.1.3; 1.1.4; 1.1.4 f); 1.1.5.1; 1.1.5.2; 1.1.5.6; ; 1.2.1 ; 1.2.6; 1.3.1; 1.3.2; 1.6.8.3; 1.7.1 b), d), f); 2.1.2; 2.2.1; 2.2.2; 2.3; 2.3.6.1 a); 2.5; 2.6.3; 3.1; 3.2.1;

224. ***1.2 Coordination***

1.2.1 A coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, across lower, single and/or upper-tier municipal boundaries, and with other orders of government, agencies and boards including:

c) managing natural heritage, water, agricultural, mineral, and cultural heritage and archaeological resources;

225. The Applicant has not proposed a coordinated, integrated and comprehensive approach for management of the Paris Moraine and Brydson Creek water resources across the Upper Tier (Wellington County and Halton Region) and Lower Tier Municipal Boundaries (Guelph/Eramosa Township and Town of Milton).

226. ***1.2.6 Land Use Compatibility***

1.2.6.1 Major facilities and sensitive land uses should be planned to ensure they are appropriately designed, buffered and/or separated from each other to prevent or mitigate adverse effects from odour, noise and other contaminants, minimize risk to public health and safety, and to ensure the long-term viability of major facilities

227. The Applicant has not ensured that the private residences on Highway 7 and 6th Line (Eramosa) are appropriately buffered from quarry water contaminants minimizing risks to public health and safety.

228. ***2.1 Natural Heritage***

2.1.1 Natural features and areas shall be protected for the long term.

2.1.2 The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.

229. The Applicant has not sufficiently defined the groundwater characteristics in the quarry buffer (influence) zone to permit recognition of linkages between and among groundwater and natural heritage features.

230. ***2.2 Water***

2.2.1 Planning authorities shall protect, improve or restore the quality and quantity of water by:

a) using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development.

231. The watershed as meaningful for integrated long-term planning and as the foundation for considering cumulative impacts of development may be considered the Brydson Creek Tributary A and B from the Paris Moraine to Blue Springs Creek. The Applicant has not embraced this watershed planning concept.

232. *b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;*

233. The Applicant has not minimized cross-jurisdictional potential negative impacts on Brydson Creek in Halton Region and cross watershed impacts in the Paris Moraine in Wellington County due to groundwater catchment expansion.

234. *c) identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which*

are necessary for the ecological and hydrological integrity of the watershed.

d) maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;

235. The Applicant has not recognized impacts on upgradient springs and groundwater fed ponds necessary for the ecological and hydrological integrity of the watershed.

236. *e) implementing necessary restrictions on development and site alteration to:*
1. protect all municipal drinking water supplies and designated vulnerable areas; and

237. The Applicant has not implemented any restrictions on development or taken precautionary measures to protect both municipal and private water supplies. **The Applicant has pursued an approach of impact first and mitigate second** as described on pg 6 of 6 of the Mar 5, 2019 Site Plans.

238. *2. protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions;*

239. The Applicant has not pursued protection, improvement and restoration of the vulnerable and sensitive Brydson Creek Springs and the hydrological function in maintenance of aquatic habitat.

240. *f) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality*

241. The Applicant has not introduced necessary measures for sustaining water quality.

242. *2.2.2 Development and site alteration shall be restricted in or near sensitive surface water features and sensitive groundwater features such that these features and their related hydrologic functions will be protected, improved or restored.*

Mitigative measures and/or alternative development approaches may be required in order to protect, improve or restore sensitive surface water features, sensitive ground water features, and their hydrologic functions.

243. **The Applicant has not demonstrated how the Brydson Creek Springs Water Quality and their related sensitive hydrologic functions will be protected, improved or restored.**

244. ***3.1 Natural Hazards***
3.1.1 Development shall generally be directed to areas outside of:

b) hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards and/or erosion hazards;

245. The Applicant has not fully excluded development from flood hazard lands (see Fig G7.1 and G7.2).

246. With respect to adjacent lands, the Applicant Site Plan typically uses a 120 m surface feature distance in accordance with the Aggregate Resource Act and the Provincial Standards. However, the Provincial Standards use buffer distances of up to 500 m for other analyses. The Standards are silent on the adjacent area buffer for assessment of groundwater related impacts. The groundwater adjacent area needs to be determined by facts.

247. The adjacent lands that are likely to experience negative groundwater impacts at Hidden Quarry are up to 1,000 m distant from the proposed Quarry licence boundary.

Issue 47: Will the proposal conform to the applicable policies of the County of Wellington Official Plan, specifically (CRC, Halton/Halton Hills, Township)

Part 3, 4.2.5, 4.3, 4.6.1,-4.6.2, 4.9.3, 4.9.4, 4.9.5, 4.9.5.2-4.9.5.4, 4.9.5.9, 4.9.7.1-2, 5.1-5.6, 6.1-6.6

248. The following section provides a summary in part of my opinion with respect to whether the Applicant has met the tests set out in the County Official Plan with respect to ground and surface water.

249. *4.9.3 Groundwater*

Groundwater resources occur throughout the County and are not confined to the Greenlands system. Groundwater needs to be protected to promote public health, and as an essential resource for urban and rural water supplies, agricultural production and the maintenance of the Greenland system. It is the intent of this Plan that all development and site alteration shall be subject to the following policies to ensure water quality and quantity are not negatively affected. Specifically, it is the County's intent that the development of public and private uses will not:

- *Impair groundwater or surface water quality*
- *Negatively impact municipal groundwater supply.*

250. The Applicant has not demonstrated that it will not negatively impair groundwater and surface water quality and not negatively impact municipal groundwater supply (quantity and quality).

251. *4.9.4 Policy Direction*

Wellington County commits to pursuing the following directions relating to water resources:

a) ensure that land use planning contributes to the protection, maintenance and enhancement of water and related resources and aquatic systems on an integrated watershed management basis;

b) protect surface and groundwater quality and quantity through the use of regulatory and voluntary means of prohibiting, restricting or influencing land uses and activities within vulnerable areas, communal well policy areas, and underlying vulnerable aquifers;

c) ensure that development meets provincial water quality objectives;

252. The Applicant has not demonstrated that it will protect, maintain and enhance water quantity and quality in vulnerable aquifers, in communal well policy areas and at Brydson Creek Springs.

253. *h) protect the hydrogeological functions of the moraine systems in the County;*

i) ensure the base flow needed to protect streams, fisheries and wetlands are maintained;

m) protect or enhance the function of sensitive groundwater recharge areas, discharge areas, aquifers and headwaters.

254. The Applicant has not demonstrated that it will protect the Paris Moraine headwater catchments, springs, intermittent streams, ponds and wetlands as well as shallow private wells upgradient of the proposed Quarry.

255. *4.9.5 Source Water Protection*

The Clean Water Act, 2006 is intended to ensure the protection of drinking water supplies by setting out a risk-based process on watershed basis to identify vulnerable areas and associated drinking water threats and issues through the preparation of Assessment Reports; and develop policies and programs to eliminate or reduce the risks posed by identified drinking water threats through the preparation of Source Protection Plans. This process is otherwise known as Source Protection Planning.

The science-based Assessment Report is the technical basis upon which a Source Protection Plan is prepared. The Source Protection Plan contains policies to address the drinking water threats identified in the Assessment Report.

256. I am not aware that the Applicant has prepared a risk and science based Assessment Report which documents the potential associated drinking water threats, increased Aquifer Vulnerability and the proposed Quarry as an Anthropogenic Transport Pathway and Issue Contributing Area that would result in the degradation of the quality of the local groundwater (Fig G2.7).

257. The GRCA has not updated its designated Wellhead Protection Areas to incorporate the 2017 Tier 3 Model to address the proposed Hidden Quarry influence on the location of the Rockwood Wellhead Protection Area designations and to address designation uncertainty.

258. As has been experienced in Halton Region (Kelso wellfields) Wellhead Protection Areas may undergo dramatic revisions when new data and new modelling software become available. The proposed Hidden Quarry excavation with its 7 m (23 ft) upgradient drawdowns (Fig G6.3) will interfere with Rockwood PW3 and PW4 and alter the current Tier 3 and County of Wellington Official Plan designated Wellhead Protection Areas (Fig G1.1, G1.4, G3.4 and G3.5).

259. 4.9.5.2 Prescribed Drinking Water Threats

The prescribed drinking water threats in the upgradient expanded catchment areas as result of both the Quarry passive drawdowns and the Municipal Production Wells active drawdowns may include but not be limited to:

3. The Application of Agricultural Source Material to Land
4. The storage of Agriculture Source Material
8. The Application of Commercial Fertilizer to Land
15. The Handling and Storage of Fuel (and other petroleum fluids, coolants, degreasers and solvents)
21. The Use of Land as Livestock Grazing or Pasturing Land, an Outdoor Confinement Area or Farm Animal Yard.

260. A non-prescribed drinking water threat is the addition of blasting nitrogen residues to the open Quarry Lake waters at Hidden Quarry. However, blasting is a threat at the proposed Hidden Quarry due to the already existing elevated Nitrate (N) concentrations in the site environment (Fig G2.7).

261. *4.9.5.3 Land Use & Activity Prohibitions, Regulations and Restrictions within Vulnerable Areas*

b) An application for development, redevelopment or site alteration within a Wellhead Protection Area, Intake Protection Zone, or Issue Contributing Area where a drinking water threat could be significant shall only be deemed complete under the Planning Act if submitted with a Section 59 Notice issued by the Risk Management Official, in accordance with the Clean Water Act, 2006, where applicable in accordance with the relevant Source Protection Plan.

262. I am not aware that a Section 59 Notice has been issued by the County Risk Management Official considering the proposed Quarry altered 'Wellhead Protection Areas', the 'Anthropogenic Transport Pathway' and 'Issue Contributing Areas' where a drinking water threat (Nitrate-N) may be significant (Fig G2.7).

263. *e) Existing land use activities involving prescribed drinking water threats are as defined by the respective Source Protection Plans in Section 4.9.5.5.*

264. *4.9.5.4 Drinking Water Threat Disclosure Reports*

The submission of a Drinking Water Threat Disclosure Report will be required as part of a complete application under the Planning Act for development, redevelopment or site alteration of non-residential uses within a Wellhead Protection Area, Intake Protection Zone or Issue Contributing Area. The report shall disclose whether any of the prescribed drinking water threats identified in subsection 4.9.5.2 are expected to occur on the property, as well as the handling and storage of any other chemicals, fuel and wastes, and related volumes, types, storage, handling, disposal, etc. The report shall also disclose the proposed management programs associated with the use of chemicals at the site, including risk management/reduction measure, emergency response plans, spill response/prevention plans, employee awareness training, best management practices and monitoring programs.

265. I am not aware that the Applicant has prepared a Drinking Water Threat Disclosure Report including consideration of the Quarry Anthropogenic Transport Pathways, Issue Contributing Areas and potential Wellhead Protection Area designation alterations due to Quarry development.

266. *4.9.5.9 Mineral Aggregate Resources*

To the extent that the aquifer vulnerability is changed as a result of a new or expanding extraction operation, the potential for overland flow of surface water originating from adjacent lands onto the excavated area must be minimized such that it does not pose additional risk to groundwater quality.

267. The Applicant proposed Quarry together with the nearby Municipal Production Wells and the combined additive active and passive upgradient drawdowns have the effect of increasing recharge of poor quality overland surface flow into the shallow groundwater systems which discharge into the Quarry ponds posing additional risk to water quality in the Issue Contributing Area.

268. The Applicant has not addressed this issue.

269. *4.9.5.9 Mineral Aggregate Resources*

Any new or existing mineral aggregate extraction operations will be encouraged to adopt best management practices (BMPs) to reduce the risk of potential impacts on aquifer water quality and/or municipal supplies. Specifically, BMPs shall be adopted for the storage and dispensing of fuels and oils for the operation of aggregate extraction and processing equipment, including containment, spills prevention measures, and clean-up protocols.

270. The Applicant Site Plans have implemented BMPs for fuels and oils. However, BMPs have not been documented on the Site Plans for Blasting materials and other nutrient contributions.

Issue 48: Would approval of the proposed quarry conform to section 4.9.7 (Paris and Galt Moraine Policy Area) of the County of Wellington Official Plan? (CRC, Halton/Halton Hills, Wellington)

271. As described in this Witness Statement, the Applicant has not met the tests set out in the County Official Plan with respect to ground and surface water and management of drinking water threats.

272. *4.9.7.1 Objectives: Paris Moraine*

The Paris and Galt Moraine policies are intended to:

- *Protect moraine processes and features in order to maintain and where possible restore and enhance groundwater and surface water resources; and*
- *Promote stewardship activities on the moraine that maintain, restore or enhance groundwater and surface water resources.*

273. *4.9.7.2 Policy Direction*

On lands in the Paris and Galt Moraines Policy Area on Schedule 'B' that lie outside of Wellhead Protection Area, the following shall apply:

a) Large scale development proposals including intensive recreation, mineral aggregate operations, new rural employment area designations, and urban boundary expansions will be required to demonstrate that ground and surface water functions will be maintained, and where possible, restored and enhanced.

274. The Applicant (and the Township) have imposed upgradient groundwater catchment expansion and increased capture (undetermined area and quantity) from the headwater sources of the Paris Moraine (Fig G1.4 and G2.1). There is limited assessment of impacts on the Moraine surface headwaters due to drawdown recharge stresses and how these headwaters function including springs, intermittent streams, ponds and wetlands (and shallow wells) will be maintained and where possible restored and enhanced.

275. **Downgradient the Applicant has not demonstrated that existing water quality in Brydson Creek will be maintained and where possible restored and enhanced by the proposed Quarry operation.**

276. *5.4.3 Hazard Lands*

Development and site alteration will not be permitted in the floodway of a river or stream unless a Special Policy Area has been approved or it is permitted elsewhere in this Plan. In most parts of the County, a one-zone floodplain management concept applies and the floodway encompasses the entire floodplain.

277. The Applicant has undertaken Regional Storm Flood Hydrological Analyses to determine the Regulatory Floodway Limits and the limit of development. However, corresponding adjustments to the Site Plans have not been made (Fig G7.1 and G7.2). Backwater from the proposed Haul Route crossing of the Tributary B regulated flood limit has not been determined and the related impact on Allen Wetlands has not been assessed (Mar 5, 2019 Site Plans, pg 2 of 6).

278. *5.6.3 Adjacent Lands*

For the purposes of this section of the Plan, adjacent lands are considered to be:

a) lands within 120 metres of provincially significant wetlands, provincially significant Life Science Areas of Natural and Scientific Interest, significant habitat of endangered and threatened species, fish habitat, significant wildlife habitat, significant valleylands, and significant woodlands.

279. The Applicant Site Plans do not show Provincially Significant Wetlands (PSW) and the appropriate setbacks (Fig G7.2).

280. See also Provincial Standards Adjacent Lands discussion under Issue 46 Provincial Policy Statement (2014) in this Witness Statement.

281. *6.6.5 New Mineral Aggregate Operations*

New or expanded mineral aggregate operations shall only be established through amendment to Mineral Aggregate Area shown on Schedule 'A' of this Plan. New or expanded mineral aggregate operations also require appropriate rezoning and licensing. Rezoning applications to allow mineral aggregate operations are subject to all relevant policies of this Plan. In considering proposals to establish new aggregate operations, the following matters will be considered:

a) the impact on adjacent land uses and residents and public health and safety;
b) the impact on the physical (including natural) environment;
e) existing and potential municipal water supply resources are protected in accordance with Sections 4.9.5 and 4.9.5.9 of this Plan and the applicable Source Protection Plan.
f) the possible effect on the water table or surface drainage patterns.
g) the manner in which the operation will be carried out;

282. The Applicant has not adequately addressed the possible effects on the public health (private wells), the existing and potential municipal water supply resources and the possible effect on the water table for the proposed Quarry operation and therefore does not conform to this policy.

Issue 55: Does the operational plan demonstrate that potential impacts from the proposed quarry will be satisfactorily mitigated and minimized? If not, should the application be approved? (CRC, Halton/Halton Hills)

283. The Applicant has not demonstrated that potential impacts from the proposed Quarry will be satisfactorily mitigated and minimized.

284. The Applicant does not address how quantity and quality impacts on the Brydson Creek Brook Trout Fish and Aquatic Habitat will be satisfactorily mitigated and minimized (see Issue 12 Discussion).

285. The Applicant has not used a precautionary approach to mitigation of private water well quantity and quality impacts. **The applicant approach is impact first, mitigate second.**

286. The Applicant has not taken a precautionary approach to quantity and quality mitigation at Rockwood Municipal Wells PW3 and PW4.

287. This application should not be approved.

Issue 56: If Board does approve the proposal, what is the appropriate form of the zoning by-law, licence and site plans and what conditions of approval are appropriate? (CRC, Halton/Halton Hills, Township)

288. The Applicant Site Plans require updating to reflect my Issue 60 Response including pg 6 of 6 alternative Monitoring Recommendations in this Witness Statement.

Issue 57: In terms of whether the licence under the Aggregate Resource Act ("ARA") should be issued (CRC, Halton/Halton Hills, Township):

Aggregate Resources Act R.S.O., 1990 Chapt A.8
Consolidation Period from April 3, 2018

289. *Matters to be considered by the Minister:*
12(1) In considering whether a licence should be issued or refused, the Minister or the Local Planning Appeal Tribunal, as the case may be, shall have regard to,
(a) the effect of the operation of the pit or quarry on the environment

290. The Operation of the Quarry as proposed by the Applicant will have an adverse effect on Brydson Creek and the Paris Moraine.

291. *(d) the suitability of the progressive rehabilitation and final rehabilitation plans for the site;*

292. The Rehabilitation Plan is not credible or executable in the absence of a formal designated bedrock extraction limit. Furthermore, the rehabilitation plans are based on arbitrary unsupported quarry lake levels.

293. *(e) any possible effects on ground and surface water resources including on drinking water sources.*

294. The operation of the Quarry as proposed by the Applicant will have an adverse effect on ground and surface water resources including downstream quality impacts and upgradient drawdowns with possible effects (quantity and quality) on private and municipal drinking water resources.

295. This application should not be approved.

Issue 58: Are the Site Plans, Boundaries, Extraction Setbacks and Creek Corridor based on precise legal surveys? (CRC)

296. The Mar 5, 2019 Site Plans, Boundaries, Extraction Setbacks and Creek (Tributary B) corridors are not based on precise legal surveys (Fig G7.2).

297. The Mar 5, 2019 Site Plans are an approximation to the Legal Survey boundary framework deposited December 13, 2018.

298. There is a misfit when the Operations Plan (pg 2 of 6) is overlaid on the Legal Survey and Orthophoto base. This misfit confirms that the Site Plans were not constructed within the Legal Survey framework prepared at a later date (Fig G7.2).

299. The Tributary B Corridor limits of excavation were apparently staked by the Applicant and GRCA in June 2013, about six years ago. There is no evidence that these stakes still exist or were surveyed by an Ontario Land Surveyor in order that the stake positions may be recovered.

300. The Regional Flood Line and 5 m Buffer designations have also not been incorporated into the legal survey framework and the excavation setback. All setbacks must be surveyed from the property boundaries as applicable (Fig G7.2).

Issue 59: Do the Site Plans notes permit bedrock extraction outside the designated bedrock extraction limits? CRC

301. The Site Plans do not include a formal designated bedrock extraction limit, only a surface

excavation limit.

302. The Mar 5, 2019 versions of the Site Plans on pg 3 of 6 in the Quarry operation notes states:

> *"Drilling and blasting will not occur within a distance of approximately 165 m to the adjacent sensitive receptor(s). Should the blasting pattern be revised, extraction may occur within this setback with MNRF approval."*

303. James Dick Construction Limited has previously advised Halton Region (December 11, 2018) that:

> *"There are many operational measures that can be taken to reduce blasting noise and vibration. These include, managing the weight of charge per delay, decking, reducing hole diameters close to the property line, and reduction in quarry depth close to receptors."*

Therefore the Quarry operator is not excluded from mining the blasting setbacks by the Site Plan sketch designations except by an administrative approval.

304. This Site Plan note should be deleted or alternatively, the Applicant's groundwater modelling should be expanded to the designated Excavation Limit.

Issue 60: Have the Site Plans adequately incorporated the recommendations of the Applicant's own expert component studies into the Notes? (CRC, Halton/Halton Hills, Township)

305. There are disconnects between the Applicant Technical Reports and Site Plan authors. This following discussion is based on the Mar 5, 2019 Site Plan versions.

Page 1 of 6: Existing Features

306. c) The 120 m Buffer Zone is not adequate for analysis of Quarry drawdown effects. Considering associated groundwater drawdowns, a 1,000 m buffer is more appropriate for Hidden Quarry.

- No off-site multi-level bedrock sentry groundwater Monitors are provided to permit observation of actual groundwater quantity and quality changes in the quarry buffer zone.
- Rockwood Production Well No. 4 is not referenced (1,100 m distant).
- Brydson Creek tributaries 'B' and 'C' are not 'named'.
- A number of references are no longer up-to-date and contain incorrect, misleading information. Other more recent and relevant references are omitted.

Page 2 of 6: Operations Plan

307. In the Phase 2 Area, the top of bedrock elevation at M16D is 349.2 m asl, at M19D 346.54 m asl and at M20D at 351.0 m asl according to the Harden borehole logs. The Mar 5, 2019 Site Plans require updating to reflect these new top of bedrock elevations (Fig G2.2).

- Similarly, the 2019 Blasting Impact Assessment Report assumptions need to be updated to reflect the updated actual top of bedrock and the updated predicted post quarry water level elevations.
- The maximum depth of bedrock extraction is therefore about 24 m in Phase 2 area.
- Remove Technical Recommendation to Hidden Quarry Monitoring Program and Contingency Measures dated July 28, 2016. This information is updated to February 6, 2019 as included on Site Plan pg 6 of 6.
- The existing groundwater table ranges from 346 to 356 m asl (update Note 15)
- Add Notes:
  '***To accommodate drainage percolation and possibly recycle materials, the quarry will not be operated when water tables in the Central Processing area are less than two (2) m below the central processing area floor as specified by Aercoustics at maximum elevation 351 m asl or lower as constructed.'***

  'Screenings, washwater silt and turbid water will not be disposed in quarry ponds.'

  'Fine textured overburden excavated on-site will not be disposed in quarry ponds.'
- The Hydraulic Barrier at the Northwest Wetland needs to be completed prior to introduction of passive drawdowns from the processing area and overburden and deeper to facilitate overburden drainage. Below water table construction will be required (Fig 2.5 and 2.6).
- An upper water level barrier overflow is not shown on the Site Plans as specified by Harden Feb 9, 2018 on pg 9.
- Revise Note: ***The hydraulic barrier will be constructed prior to the overburden excavation of the access haul road trench from the Processing Area to Phase 1.***
- No contingency is provided if Silt Till is not found continuously under the Northwest Hydraulic Barrier.
- Legend - ***Blasting Line should also reference receptor R3, R12 and R19 in addition to R16 or alternatively replace 'R16' with generic 'receptor' terminology.***
- Location of referenced PSW not shown.
- Location of Allen Wetland PSW, intrusion into 120 m adjacent area and connectivity with Tributary B riparian wetlands not shown (Fig G7.2).
- Setbacks from Allen Wetland PSW not shown and integrated into Site Plans.
- The Applicant might consider initial mining in the designated Phase 2 area rather than Phase 1 due to the lower dry season water tables mainly below the top of bedrock (Fig 2.5 and 2.6).

Page 3 of 6: Quarry Phasing

308. The limits of bedrock extraction are not shown as contemplated on pg 2 of 6.

- The depth of dolostone extraction in Phase 2 is anticipated to be 22 to 24 m (not 23 to 28 m).
- The Phase 2 dolostone elevation 354 m asl is incorrect (see Borehole logs for M20D, M16 and M3).

Page 4 of 6: Progressive Rehabilitation and Final Rehabilitation

309. The limits of bedrock extraction are not shown as contemplated on pg 2 of 6.

- The specified post-quarry lake elevations of 348.5 ± 0.5 m asl are unsupported by the Applicant Hydrogeological studies.
- Best current applicant information is that post extraction quarry pond levels will average about 346.6 ± 0.4 m asl (Fig G6.1).
- The entire shoreline will be about 3 m below the top of bedrock unless bedrock shore platforms remain unextracted.
- Shoreline rehabilitation plans and proposed wetland floor elevations need to accommodate this lower elevation range. This will leave unextracted bedrock resource within the Limit of Excavation Area.
- Rehabilitated lake depth will be about 19 to 20 m based on a 327 m asl quarry floor elevation (Revise Note).

Page 5 of 6: Cross Sections

310. The limits of bedrock extraction are not shown as contemplated on pg 2 of 6.

311. The Cross Sections need to reflect the lower range of quarry lake water levels at 346.6 ± 0.4 m asl.

Page 6 of 6: On-Site and Off-Site Surface and Groundwater Program

312. The Applicant's On Site and Off Site Surface and Groundwater Monitoring Program although obviously well intended is problematic, technically complex, difficult to understand, costly to execute and administer, and presents significant barriers to expedient public information access.

313. **Many of the Applicant's trigger notes simply recommend further monitoring and investigation delays without meaningful operations penalty.**

314. The implementation of Off Site Sentry Well monitoring should reduce the requirements for

Private Well Monitoring. Water resource changes at and beyond the Quarry perimeter are of primary concern to the neighbours, not internal changes in the Site Plan Area. The sentry wells will allow more objective documentation of water level and quality changes independent of private well pumping circumstances.

315. The Applicant and Site Plan Notes do not recognize that water level change may be the result of external factors such as City of Guelph and Guelph/Eramosa Township Wellfield Pumping. **The off-site monitoring recommended herein is key to equitably allocate responsibilities for quantity and quality complaint dispute resolution.**

316. My alternative below includes a simplification to the proposed on-site water resource monitoring program and comprehensive off-site sentry monitoring in the Quarry buffer zone. My comments do not address the Northwest Wetland monitoring as specified by others.

317. As an alternative to Site Plan pg 6 of 6 Surface Water and Groundwater Monitoring, I recommend the following simplified program.

318. Groundwater Monitoring

- Establishment of sentry groundwater monitoring wells in the buffer zone 500 to 700 distant from the proposed Quarry. These wells to include M22, M23, M25, M26 and M27 as shown on Fig G7.3 enclosed. Wells to be cased through the overburden and open through the bedrock to 327 m asl elevation or multilevel as appropriate (Fig G7.3).

- Addition of on-site monitoring Wells M18, M24 (replaces MID) and M21 (replaces M3). Wells M13D and M14D will also need to be deepened or adjacent deep wells constructed. Wells to be cased through the overburden and open through the bedrock to 327 m asl or multilevel as appropriate. The Applicant proposed monitor well M17 appears redundant (Fig G7.3).

319. Private Well Replacement

- Private Water Supply Wells W10, W11, W16, W17, W18, W19, W20, W21 and W23 downgradient to be replaced and W5, W7 and W31 upgradient of the proposed Quarry Wells to be cased (isolated) above 327 m asl and open hole through the deeper municipal aquifer zone. Drinking water treatment to be provided for downgradient private wells (Fig G7.3).

- Private Wells to be replaced prior to overburden excavation and drainage of Phase 1 Area.

- **Alternatively, the above designated private water supply wells fronting on 6th Line and Highway 7 may be supplied with municipal water through piped extension of the Rockwood municipal water supply system.**

320. Water Level Data Loggers

- Continuous Water Level Data Loggers to be installed and/or maintained in on-site wells M2, M4, M13D, M14S, M14D, M16, M18, M19, M20S, M20D, M21, M24 and M27 (Fig G7.3).

- Continuous Water Level Data Loggers to be installed in all sentry wells and a minimum of two years of data be acquired prior to initiation of overburden drainage and excavation in Phase 1.

- Continuous data loggers to be maintained in Brydson Creek SW15 and SW16 Wells (Fig G7.3).

- Continuous data logger to be installed in a shallow piezometer at or near SW4 at the north Quarry boundary to act as a surrogate for seasonal flow measurements.

321. Tier 3 Model Update

- After installation of additional on-site and groundwater monitoring wells, rerun the GRCA Tier 3 model to include the proposed Hidden Quarry scenario.

322. Water Quality Monitoring

- Water Quality samples to be collected from all wells with specified water level data loggers and individual quarry lakes in early May and early October of each year (Comprehensive and Microbiology).

- Reduction of Nitrate (N) concentrations in the quarry lakes downgradient quarry monitors to 2 mg/L (Amber Alert) and 2.5 mg/L (Red Alert).

- Maintenance of Total Dissolved Solids in the downgradient quarry monitors to 400 mg/L (Amber Alert) and 450 mg/L (Red Alert).

- Maintenance of Phosphorus in Quarry lakes to 0.005 mg/L (Amber Alert) and 0.01 mg/L (Red Alert).

323. Amber and Red Alerts

- The additional adoption of the Amber and Red Quality Alerts as contained in this Witness Statement in Overview Section Q.

- **Amber Alert means investigate quantity and quality change. Red Alert means shutdown quarry activities resulting in water quantity and quality change.**

324. This pre-excavation work and monitoring will require about 2 to 3 years to complete.

325. Annual monitoring reports should be circulated to CRC Rockwood Inc as a Public Liaison Agency as well as the agencies by March 31 for the preceding calendar year.

326. If the Quarry licence should be approved, there will need to be an adaptive management plan and an operational agreement between the Grand River Conservation Authority, City of Guelph and Guelph/Eramosa Township and the Applicant to determine how water level change impact responsibilities will be allocated within the 1,000 m Quarry buffer zone.

CONCLUSION

327. **My conclusion is that this proposed Quarry Application as submitted does not and cannot meet the statutory tests as required by the Aggregate Resources Act (2018), the Provincial Policy Statement (2014) and County of Wellington Official Plan (2018) with respect to water and groundwater resources. This Application for an Aggregate Licence should not be approved.**

Dated: April 11, 2019

Garry T. Hunter, M.A.Sc., P.Eng.

Garry T. Hunter, M.A.Sc., P.Eng.

Environmental Systems Planner and Civil Engineer

HUNTER and ASSOCIATES
Environmental and Engineering Consultants

Specialist in systems analyses, cumulative impact assessment and integration of development with the environment

---

Mr. Hunter has more than 40 years of experience in Canada's Environmental, Engineering and Resource consulting industry. He has participated in more than 500 individual professional assignments in Canada and overseas since he began his consulting career in 1968 after graduating with Honours in Applied Science from University of Toronto.

Mr. Hunter received his Master of Applied Science degree (Civil Engineering) from the University of Toronto (and Purdue University, Indiana) in 1969 and is a registered member of the Association of Professional Engineers of Ontario.

> *Mr. Hunter has been specifically recognized by the Ontario Municipal Board and/or the Ontario Superior Court of Justice as an expert in law and qualified to give opinion evidence as a Civil Engineer and in the fields of airphoto interpretation, geology, hydrogeology, hydro-geochemistry, the collection and mining of geographic data for hydrogeological purposes, stormwater management and solar shadowing.*
>
> *During Ontario Superior Court of Justice proceedings (Feb 8 and 9, 2001), the Ministry of Municipal Affairs and Housing stated: "Mr. Hunter brings a unique ability to explain interdisciplinary co-relations and a unique experience with the area (Oak Ridges Moraine) under consideration" - Ontario (Ministry of Municipal Affairs and Housing) v. Ontario (Municipal Board).*

EDUCATION

M.A.Sc.
Master of Applied Science (Civil Engineering)
University of Toronto, 1969 (Airphoto Interpretation, Engineering Geology, Micrometereology)

Purdue University, 1969 (Materials and Engineering Problems of North America, Airphoto Interpretation of Soils and Rocks, Geophysical Exploration for Engineers, Remote Sensing Methods, Engineering Site Selection, Theoretical Soil Mechanics)

B.A.Sc.
Bachelor of Applied Science (Civil Engineering)
University of Toronto (Honours), 1968

Other

- Ontario Land Surveyor Scholarship (1967)
- Urban Stormwater Management Seminars (1976, 1977) (Canada-Ontario Agreement for Great Lakes Water Quality)
- Fundamentals of Groundwater Quality Protection Seminar, Geraghty & Miller Inc., Pittsburgh (1980)
- Offshore Electronic Positioning Workshop, Toronto (1983)
- International Conference on Coastal and Port Engineering, Sri Lanka (1983)
- Planning and Design for Environmentally Sensitive Projects, University of Toronto (1984)
- Water Quality Seminar, Mann Aqua Laboratories Ltd. (1989)
- Forest Resources Systems Institute, Seventh Annual Meeting. Computer Technology for the 1990's: Integrated Forest Management, Washington, D.C., July 29, 1990
- First Prize GIS Poster Display - MNR/CISM, 1991
- Alternative Septic Systems for Ontario, Waterloo Centre for Groundwater Research, June 1992
- Ontario Ministry of Environment and Energy, Stormwater Management Practices, Planning and Design Manual Seminar, Aurora, July 1994
- Wastewater Nutrient Removal Technologies and Onsite Management Districts, Waterloo Centre for Groundwater Research, June 1994
- Symposium on Groundwater Protection, Waterloo Centre for Groundwater Research, June 1994
- NRC/IRAP Seminar - Biofiltration: "New Solutions to On-Site Sewage Treatment", University of Waterloo, March 1997
- Biofiltration III CRESTech/NRC - IRAP, February 2000
- Smart Systems for Water Resource Management Workshop, CRESTech March 2000
- Homelands Security Initiatives, Autodesk Inc., San Rafael, California, June 2002
- Internet site developed for United Counties of Prescott and Russell selected as an Industry Canada success story, October 2002

- Ohio State University, Overholt Drainage School, Agricultural Controlled Drainage and Subirrigation Methodology, March 12-16, 2007.
- Regular attendance at monthly International Association of Hydrogeologists (IAH) seminars at Waterloo Region and Toronto, Ontario since 2007
- Curious Minds - Canadian Oil Sands Excursion Sept 10-12, 2013. Briefing on Keystone, Transmountain Expansion and Northern Gateway Pipeline Projects. Ground tour of Suncor Oil Sands operations and helicopter tour of Oil Sands region.
- The Canadian Geotechnical Society, Toronto Group. Regular attendance at evening seminars.

PROFESSIONAL AFFILIATIONS
(Current and Past)

AM/FM International (Automated Mapping/Facilities Management)
American Society of Photogrammetry and Remote Sensing - Member International Advisory Council (1995)
Association of Professional Engineers of Ontario (Registered since 1970)
Canadian Association of Aerial Surveyors (Director 1986 to 1989)
Canadian Association of Hydrographic and Ocean Survey Industries - Vice President (1981/82)
Canadian Association on Water Pollution Research and Control (CAWPRC)
Canadian Environmental Industry Association (CEIA)
Canadian Institute of Geomatics
The Canadian Institute of Surveying and Mapping
Canadian Hydrographic Association
Canadian Parks and Wilderness Society
Geospatial Information and Technology Association (GITA)
International Association of Hydrogeologists (IAH)
International Society for Reef Studies
Municipal Information Systems Association (MISA)
Ontario Association for Impact Assessment (OAIA)
Ontario Association of Remote Sensing (OARS)
Ontario Good Roads Association (OGRA)
Ontario Ground Water Association (OGWA)
Ontario Natural Gas Association (ONGA)
Ontario Society for Environmental Management (OSEM) - Councillor (1998/00)
Supervisory Control and Data Acquisition (SCADA) Forum
The Federation of Ontario Naturalists (FON)
The International Society for Environmental Development
Urban and Regional Information Systems Association (URISA) - Member Policy and Planning Committee (1995/96)
Water Environment Association of Ontario

AFFILIATIONS AND EMPLOYMENT EXPERIENCE

HUNTER and ASSOCIATES (1977 to Present)
President and founder of the firm HUNTER and ASSOCIATES providing professional services in environmental and engineering consulting. Projects have been undertaken in Canada, United States, the Caribbean and South East Asia. International participation with World Bank, Asian Development Bank, Inter-American Development Bank and Export Development Corporation, Canada.

Hunter GIS (1987 to Present)
President of a geographic information systems software development group, originally in Charlotte, North Carolina. Installation of Geographic Information and Forensic Image Processing Systems in North America and South East Asia. Business assets and technology transferred to Canada in 1991. Consultant on a wide variety of user GIS applications.

Autodesk Inc., San Rafael, California
(1997 to Present)
Corporate Member of Autodesk Developer Network. Participation in Autodesk University, One Team, technology seminars and webcasts.

Esri Canada
(2007 to Present)
Corporate Member of Esri Developer Network.

Aquarius Flight Inc. (1984 to 1989)
Founding Director of an aerial photographic survey firm providing services to resource mapping and development industry in Canada and overseas.

Managing Director domestic activities and Vice President and Secretary Treasurer to 1989. Director of Central Canada aerial survey industry consortium 1987 (5 firms). Co-Project Director for World Bank SUAT V and TRANSMIGRATION V Aerial

Photography Project in Indonesia. Management participation for projects in Papua New Guinea, Indonesia and Malaysia.

Airphoto Analysis Associates Consultants Ltd.
(1967 to 1976)
Principal undertaking a variety of environmental, recreational and tourism planning and engineering projects. Specialist in airphoto interpretation and remote sensing.

Purdue University, Indiana, 1969
County engineering soil surveys in the State of Indiana.

Department of Highways, Ontario 1967
Highway construction surveys.

Township of Mulmur, 1966
Recreation sports centre (arena) construction (Honeywood).

Agriculture, 1960 to 1987
Commercial agriculture and farming activities in Mulmur and Melancthon Townships, Dufferin County, Ontario. Practical applications of crop and animal science, agricultural economics, and engineering design. Potato growing and livestock experience.

CONSULTING PROJECTS

Since entering the consulting field in 1968, Mr. Hunter has undertaken a wide variety of environmental and engineering feasibility assignments for government and private sector clients. Most assignments have involved the use of airphoto interpretation techniques for organization and co-ordination of geological, hydrogeological and ecological research, environmental impact assessment, engineering feasibility, design and infrastructure management programs. The comparative interpretation of historical aerial photographs, coastal diagnostics, erosion and coastal zone management is a developed specialty.

For the past forty years, Mr. Hunter has coordinated staff research, development and application of computer geographic information system, infrastructure and work management solutions in support of his consulting activities.

Many projects have involved public participation and expert witness testimony. The following selected projects of which he has been either manager, principal investigator or advisor, are representative of his experience. Projects range from a few weeks to a number of years in duration.

Parks, Recreation and Tourism Planning Studies

- Hotel Site Analysis, Island of Vitii Levu, Fiji
- Hotel Site Analysis, Island of Tobago
- Master Plan Preparation for Parlee Beach Provincial Park, New Brunswick
- Master Plan Preparation for Melmerby Beach, Sand Hills Beach and Dominion Beach, Nova Scotia
- Visitor Centre Site Studies, Gros Morne National Park, Newfoundland
- Golf Course Site Feasibility, Terra Nova National Park, Newfoundland
- Visitor Centre Development Concept, Pukaskwa National Park
- Mode Access Feasibility Study for Visitor Viewing the Kaskawulsh Glacier, Kluane National Park, Yukon
- Park Land Acquisition Studies, Heron Island, New Brunswick
- Resort Hotel Development Feasibility, Whistler Mountain, British Columbia
- Tourism Industry Development Plan, Fundy Isles, New Brunswick
- Recreation Land Acquisition Study, Northumberland Strait, New Brunswick
- Tourism Economic Impact Study, Parlee Beach, New Brunswick
- Highway Camper Survey, Trans Canada Highway, Newfoundland
- Tourism Industry Development Strategy, Newfoundland
- Hotel Site Selection, Upper Canada Village, Ontario

Land Use Planning Studies

- Rural Estate Residential and Official Plan Policy Preparation, Town of Caledon, Ontario
- Allocation of Lands for Urban Expansion, Town of Alliston, Ontario
- Agricultural Land Capability Assessment, Dufferin County, Ontario
- Land Capability for Urban Expansion, Port Hawkesbury, Nova Scotia
- Rural Retirement Community, Palgrave, Ontario
- Auto Mall, Barrie, Ontario

- Concrete Batch Plant, Bolton, Ontario
- Oil Pumping Station and Tank Farm Expansion, Flamborough Township, Ontario
- Oak Ridges Moraine Conservation Plan Conformity Assessments
- Springwood Lot of Record, Oak Ridges Moraine, Town of Caledon
- Specialty Crop Assessments, Melancthon and Mulmur Townships and Grey Highlands
- Various Provincial Plan Review (2015) Submissions

Route Selection and Site Evaluation

- Slims/Kaskawulsh and Mush Lake Corridors, Kluane National Park, Yukon
- Mine Access, North-west River to Michelin, Labrador
- Coastal Parkway and Design Concepts, Gros Morne National Park, Newfoundland
- Access Road and Visitor Service Centre, Pukaska National Park, Newfoundland
- Access Road, Coral Harbour, Northwest Territories
- Antigonish Trans Canada Highway Bypass, Nova Scotia
- Re-routing of Provincial Trunk 7, Eastern Shore, Nova Scotia
- Electrical Transmission Tower Locations, Wawa to Aubrey Falls, Ontario
- Gas Pipeline (1200 km), Gas East Project, New Brunswick and Nova Scotia
- Gas Pipeline Lateral, Parry Sound to Huntsville, Ontario
- Gas Pipeline Lateral, Sault Ste. Marie to Elliot Lake to Sudbury, Ontario
- Gas Pipeline Lateral, Bruce Mines to Red Lake, Ontario
- Gas Pipeline Laterals to Schreiber, Terrace Bay, Marathon, Hemlo, Manitouwadge and White River, Ontario

Aggregate Resource Assessment

- Granular Aggregates Search, Belledune, New Brunswick
- Granular Aggregates Search, Algonquin Provincial Park, Ontario
- Granular Aggregates Searches at a number of Northern Ontario sites
- Environmental and Site Plan Peer Review of Application for Cheltenham Brickworks, Town of Caledon
- Preparation of comprehensive Licence Applications and Site Plans under the Pits and Quarries Control Act, Ontario, in Puslinch and Pilkington Townships. Licences issued without Board Hearings
- Review of Underground Aggregate Mining Proposals in Southern Ontario
- Preparation of Site Replacement Plans for Franceschini Pits Nos. 1, 2 and 3 in the Town of Caledon
- Comprehensive Quarry Aggregate Strategy for Major Producer in Regional Municipality of Ottawa-Carleton (4 years)
- Site Plan Approvals, Environmental Permitting and Licensing for Aggregate Quarry, Township of Osgoode, Ottawa
- Quarry Aggregate Reserve Assessment in Niagara Escarpment and Ottawa Areas of Ontario
- New Quarry Site Selection Studies Hamilton-Wentworth, Halton and Peel Regions on behalf of an industry producer
- Hydrogeological Review of all Granular Pit Operations within the Oak Ridges Moraine
- Geographic Naming Application for an Extraction Pond, Township of Uxbridge
- Environmental Peer Review of proposed Greenfield Quarry, Flamborough, City of Hamilton
- Environmental Peer Review for Permit to Take Water Application, Adjala Pit, Town of Tecumseth
- Environmental, Hydrogeological and Site Plan Review, Shelter Valley Aggregates, Grafton, Ontario
- Site Plan, Hydrogeological, Recirculation and Hydraulic Barrier Design Review, Rockfort Quarry
- Review of McCook Reservoir dolomite grout curtain history with U.S. Corp of Engineers, Chicago
- Environmental, Hydrogeological and Site Plan Peer Review, Seabright Granite Quarry
- Environmental, Hydrogeological, Site Plan and Agricultural Impact Review of proposed Melancthon Mega Quarry, Ontario on behalf of rate payers (5 years)
- Hydrogeological Review of Duntroon existing and proposed new expansion quarry
- Environmental Review of existing and proposed new Keppel Quarries, Owen Sound
- Aggregate Resources Act Review Submission (2012)
- Aggregate Resources Act Policy Framework Blueprint for Change (2015) Submission

Engineering Geology, Geomorphology and Environmental Management

- Erosion and riverbank stabilization, Metropolitan Toronto
- Analysis of Hydroelectric Reservoir Landslide Potential in the Marine Clays of the Lower Churchill River Valley, Muskrat Falls, Labrador

- Investigation of Fatal Landslides, Fort Smith, Northwest Territories
- Terrain Evaluations and Site Selection for First Nation Lands in South-Western, North-Central and Northern Ontario (more than 20 different Reserve areas)
- Site Evaluation, Clendenning Dam, Thornbury, Ontario
- Watershed Erosion, Sedimentation and Drainage Study, Willow Creek, Ontario
- Preliminary Engineering, Geological and Hydrogeological Evaluations for the Proposed Des Joachims Nuclear Generator Site, Ontario
- Soil Mapping for 2,000 Acre Development Parcel in Mississauga
- Shoreline Erosion Assessment, Caledon Lake, Town of Caledon, Ontario
- Comparative Assessment of Beaver Pond Dynamics and Wetland Shore Positions 1927 to 1977, Gravenhurst
- Sixteen Mile Creek Valley Erosion and Geomorphology Study, Town of Oakville, Ontario
- Humber River Valley Erosion and Geomorphology Study, Woodbridge, Ontario
- Bank Erosion and Permafrost Thawing at York Factory Cemetery, Northern Manitoba, Parks Canada

Hydrogeology / Hydrogeochemistry

- Hydrogeology Evaluation for Kitts-Michelin Mine Site and Tailings Disposal Area, Labrador
- Soil and Hydrogeological Evaluation of a number of sites for Disposal of Septic Effluents, Ontario
- Groundwater Nitrate Contaminants Model, Palgrave Estates Area, Town of Caledon
- Hydrogeological Peer Reviews of Applications for Granular Resource Extraction Sites, including Reagan Graham Ltd., Presswood Pit, Petch Pit, Caledon Sand and Gravel Inc., Armbro Pinchin Pit and Gormley Sand and Gravel Inc., Town of Caledon, Ontario
- USGS Modflow GIS Integration including Particle Tracking, Town of Caledon
- Review of Rural Estate Development Proposals, Town of Caledon
- Review, Caledon East Village Settlement, Town of Caledon
- Devils Pulpit Golf Course Review, Town of Caledon, Ontario
- Devils Link Golf Course Review, Town of Caledon, Ontario
- Caledonian Golf and Country Club Review, Town of Caledon, Ontario
- Restaurant/Motel Nitrate Loading and Hydrogeological Investigation, Caledon, Ontario
- Hydrogeology Studies for Pit and Quarry Licence Applications, Puslinch, Pilkington and Osgoode Townships
- Osprey Valley Resort, Mixed Use Residential and Golf Course Development Review, Town of Caledon
- Hydrogeology and Groundwater Circulation Cell Studies in the Barbados Coastal Zone
- Rural Service Centres Expansions, Hydrogeological Study, Town of Caledon - Alton, Caledon Village, Mono Mills, Inglewood and Cheltenham
- Manager, Oak Ridges Moraine Hydrogeological Study, Region of Peel, York and Durham, Ontario (4 years)
- Water Well Management System, Oak Ridges Moraine, Ontario Ministry of the Environment
- Hydrogeological (Peer) Review of North Richmond Hill, Oak Ridges Moraine Urbanization Proposals
- Hydrology and Hydrogeological Evaluation, Cruickston Charitable Research Reserve, Cambridge
- Stokrest Estates, Draft Plan Application, Campbellville, Ontario
- Domestic Water Well planning, construction supervision, monitoring and proving for Drinking Water Quality and Quantity, Bridlewood Estates, Campbellville
- Participant in North Richmond Hill 'Like Hydrogeologists' meetings, preparation of common expert evidence for Board Hearing
- Observation well database development and profiling solutions, Town of Richmond Hill
- Participant in North Leslie 'Like Hydrogeologists' meetings, preparation of common expert evidence for Board Hearing
- Review of York Region 9th Line/16th Avenue Sewer Construction Dewatering Impacts, presented at Policy and Finance Committee, City of Toronto
- Historical image interpretation, landuse history, hydrology, hydrogeology and municipal servicing review (MESP), David Dunlap Observatory property, Richmond Hill
- Monitoring of Aquifer Recovery after York Region 9th Line/16th Avenue Sewer Construction Dewatering in Town of Whitchurch-Stouffville and adjacent Town of Markham (10 years)
- Analysis of groundwater quality degradation and methane contamination at Dickson Hill (Markham) as a result of York Region 9th Line/16th Avenue Sewer construction dewatering (10 years)
- Assessment of ratepayer storm drainage / high water table basement flooding issues, Caledon Village
- Hydrogeological Review of Keppel Existing and New Quarry

- Hydrogeological review, groundwater modelling, proposed Hidden Quarry, Rockwood, Ontario
- Hydrogeological Report for Worden property, north Richmond Hill, Ontario.
- Hydrogeological Report for Harwood Estates Residential Development, Caledon, Ontario.
- Hydrogeological review of Municipal Production Well 7 and water level recovery after introduction of Georgian Bay water pipeline.
- Hydrogeological review and preparation of Groundwater Supply Plan to support future growth, Fergus and Elora (three years).

Remote Sensing / Image Interpretation

- Aerial Photography Project Management throughout Canada
- Co-project Director Aerial Photography Program Kalimantan, Sumatra; Irian Jaya and Papua New Guinea Border - Indonesia (36 months)
- Development of Remote Sensing Techniques for Shallow-Water Bathymetry, Project Sites on the East Coast of Vancouver Island; Northwest Territories; and Lake Huron, Ontario
- Infrared Colour Photography, Analysis of Surface Water Ponding on Runways and recommendations for drainage at Montreal Dorval Airport
- Development of a Plant Material Inventory System for a Southern Ontario Nursery
- Infrared Colour Photography for Analysis of Spruce Budworm Damage, Sault Ste. Marie, Ontario
- Infrared Colour Photography for Landslide Analysis, Fort Smith, Northwest Territories
- Colour Aerial Photography for Shallow-Water Bathymetry, Sable Island, Nova Scotia
- Development of Large Scale Photo Sampling and Analytical Photogrammetric Mensuration Techniques for Environmental Resource Surveys
- Video Surveys, Image Analysis for Ice Studies, Lachine Rapids, Quebec
- Time Lapse Video for Environmental Monitoring of Humber River Estuary Turbidity Plumes, Lake Ontario
- Interpretation of Historical Process Plant Piping Photography, Syncrude, Ft. McMurry, Alberta
- Participant in Eastern Ontario DRAPE 2008, 2014 and 2019 orthophoto projects
- Historical airphoto studies, City of Elliot Lake
- Bornish Wind Farm - Mapping of Tile Drainage History in proposed turbine and cable facilities areas

Environmental Assessment and Ecological Land Surveys

- Vegetation Re-inventory (Ecological Survey), Pukaskwa National Park
- Ecological Land Survey, Seaside Adjunct (Woods Property), Kejimkujik National Park
- Ecological Database, Cape Breton Highlands National Park
- Peat Inventories in Northern Ontario
- Sault Ste. Marie Canal, Ontario
- Gros Morne National Park, Newfoundland
- Terra Nova National Park, Newfoundland
- Kitts-Michelin Uranium Mine, Labrador
- Lower Churchill River (Gull Island and Muskrat Falls), Hydroelectric Project, Labrador
- East Central Labrador (50,000 sq. km.)
- Six Nations Bridge, Ontario
- Prairie Siding Bridge, Ontario
- Estate Residential Development Projects (15+), Palgrave, Ontario
- Upper Salmon/Cat Arm Hydro-electric Environmental Assessment, Newfoundland
- Existing Timber Flooded Reservoir, Hynds Lake, Newfoundland
- North Shore Pipeline, Sault Ste Marie to Elliot Lake, Ontario
- Osprey Valley Golf Project, Town of Caledon
- Interprovincial Pipelines, Westover Tank Farm
- Killarney Farm Wetland (Peatland) Rehabilitation, Town of Caledon
- Southeast Collector Trunk Sewer (EA Review Comments), York and Durham Regions, Ontario
- Comprehensive Peer Review, proposed Mansions of King and Bushland Heights Subdivisions, King City

Coastal Zone Research and Management

Barbados

- Manager Diagnostic Component Coastal Conservation Study (18 months)
- Advisor Prefeasibility Component Coastal Conservation Study

Quebec

- Ice Studies Lachine Rapids

Newfoundland

- Marine Algae Resource Inventory
- Marine Intertidal Ecology Study, Terra Nova National Park

- Marine Inventory and Park Potential, Terra Nova National Park
- Delineation of Territorial Sea Baseline, Northern Labrador

New Brunswick

- Coastal Zone Process and Management Study, Bay of Fundy Coast
- Coastal Zone Process and Management Study, Eastern New Brunswick
- Comparative Shoreline Analysis, 1837-1974, Miramichi Channel
- Master Plan Preparation, Parlee Beach Provincial Park
- Beach Park Restoration, Parlee Beach Provincial Park
- Recreation Land Acquisition Study, Northumberland Strait
- Castalia, The Anchorage, Grand Manan
- Marina Feasibility Study, Shediac
- Comparative Shoreline Analysis, Val Comeau Beach Park

Nova Scotia

- Evaluation of Dredging Activities on the Beaches of Halifax Harbour
- Resource Analysis Management, Melmerby Beach, Sand Hills Beach and Dominion Beach Provincial Parks
- Coastal Environmental Assessment, Martinique Beach
- Development Critique, Risser's Beach Provincial Park
- Resource Analysis, Clam Harbour Provincial Park
- Sable Island, Shallow Water Bathymetric Mapping

Prince Edward Island

- Comparative Shoreline Assessment (1935 to 1973) and Coastal Process Study, Prince Edward Island National Park

Ontario

- Bruce Peninsula, Lake Huron
- North Channel, Lake Huron
- Humber Bay Nearshore Circulation, Lake Ontario
- Coastal Studies Pukaskwa National Park
- Coastal Studies Georgian Bay Islands National Park
- Caledon Lake, Ontario
- Natural pre-flooding shoreline delineation and post-construction flooding land lost quantity estimates (4 years), Trent Severn Waterway - First Nations/Canada
- Delineation of prospective Trent Severn Waterway - jurisdictional boundaries as a basis for Canada / Ontario negotiations

Canadian Arctic

- Simpson Strait, Northwest Passage, Shallow Water Bathymetric Mapping

Geographic and Infrastructure Information Systems Consulting

- Forest Resource Inventory, (Spruce Falls and McChesney Lumber) Northern Ontario
- Municipal, Parcel, Taxation, Development Tracking and Planning Database, Caledon, Ontario
- Mined Lands Reclamation Division, Department of Natural Resources, Colorado
- Observation well and Hydrogeochemistry GIS Data Base, Town of Caledon and Oak Ridges Moraine
- Water Well Records Processing, Ministry of Environment, Waterloo, Halton, Peel, York, Durham and Ottawa-Carleton Regions, United Counties of Prescott and Russell, Ontario
- Parcel Database Preparation, Town of Milton, Flamborough, Halton Hills, Regional Municipality of Ottawa-Carleton, Ontario
- Road Information Management System (RIMS), Town of Lindsay
- Property Database, Reedy Creek Improvement Corporation (Disney World), Florida
- Conversion and Adjustment of Great Lakes Non-Datum Hydrographic Charts to NAD 83 Datum
- Preparation of Electrical Utilities Models Database, Newcastle Hydro and Ajax Hydro Electrical Commission
- Gas, Water, Electrical, Sewer, Roads and Parcel Databases Creation for Kingston Public Utilities Commission (6 years)
- Gas Pipe Network modelling, load forecasting, and identification of unbilled accounts, Kingston Public Utilities Commission (3 years)
- Parcel Tax Assessment Implementation, Town of Caledon, Cities of Kingston, Barrie, Sault Ste. Marie, United Counties of Prescott and Russell
- Web 911 Implementation, United Counties of Prescott and Russell
- City of Barrie Web GIS Implementation
- Web-based applications, City of Jacksonville, Florida
- Municipal Web-based GIS implementation support, City of Dublin, Ohio
- Municipal Web Solutions and Maintenance, United Counties of Prescott and Russell (8 years)

- Web-hosting of Planning, Permitting and Infrastructure Data, City of Pembroke, Ontario (15+ years)
- Web Based Geological Solutions, Pacific Region, Geological Survey of Canada
- Water Distribution System Information Management, City of Indianapolis, Indiana (3 years)
- Building Facilities Management Solutions, South Trust Bank, Alabama
- Building Facilities Management Solutions, Brookfield LePage Johnson Controls (BLJC)
- Proposed Hydro Electric Generating Stations, Manitoba Hydro
- Web-based Applications for Snertill, Iceland
- Building Facilities Management Systems, Atomic Energy of Canada Limited, Ontario
- Water and Sewer Information Management, Washington Suburban Sanitary Commission, Maryland
- Waste Water Flow Demand (Intensification) Solutions, City of Ottawa (multiple projects - 8 years)
- Water Pipe Network Modelling Solutions including EPA Module Integration, City of Pembroke
- Remote tracking of geophysical survey equipment, Kamchatka Peninsula
- Tracking of Milk Transports for rate review, Ontario Milk Transport Association
- Community Development Tracking, Government of Nunavut
- Stormwater Catchment Analysis, City of Ottawa (3 years)
- Mapping of agricultural controlled drainage/subirrigation potential for 36 Southern Ontario Counties (OMAFRA, LICO and Agriculture Canada)
- Enterprise GIS Solution Implementation, Carmel Indiana
- Municipal DataWorks (MDW) Web Services Integration
- Web platform hosting and proof of concept for City of Windsor legacy City Information Management software replacement
- Upgrade of City of Windsor Environmental Information System Technology utilized daily by 400 staff.
- Comprehensive Zoning By-Law, City of Markham (in progress)
- Dangerous Goods GIS Supply Chain Analysis for Toxic and Flammable Gases and Flammable Liquids throughout Canada (in progress).

Environmental, Engineering Design and Landscape Pre-feasibility/Design/Implementation

- Parlee Beach Restoration Project, New Brunswick (5 years)
- Beach Protection, Site Planning, Access Road and Parking Lot Design and Construction Monitoring, Parlee Beach
- Coverdale Urban Development, Moncton, New Brunswick (3 years)
- Dominion Beach Restoration, Nova Scotia
- Reservoir Preparation Strategy and Cost Estimates, Cat Arm Reservoir, Newfoundland
- Engineering Feasibility Study for 35 km Visitor Park Access, Kluane National Park
- Erosion Remedial Measures, York Factory National Historic Site
- Golf Course Feasibility, Terra Nova National Park, Newfoundland
- Rural Residential Estate Development Site Planning and Design (15+) including Stormwater Management, Town of Caledon, Ontario (35 years)
- Sault Ste. Marie to Elliot Lake Gas Pipeline
- Sunshine Estates, Town of Caledon
- New Fire Hall Candidate Site and Response Time Evaluation, Pembroke, Ontario
- Bridlewood Estates, Design and Construction of Lots, Streets and Storm Water Management, (Campbellville) Town of Milton
- Participatory support in small diameter gravity sewer/low pressure design alternatives for King City
- Harwood Estates, Town of Caledon
- Spina Estates, Town of Caledon
- Residence Site Plan, Erin
- Residence Site Plan Oak Ridges Moraine , Caledon
- Condominium Development (140 acres), Town of Aurora
- Four Hundred Unit Condominium Development, Town of Richmond Hill (in progress)
- Municipal Sewer and Pumping Station Overflow and Basement Flooding Review Kalar Rd, Shriners Creek, City of Niagara Falls
- Potable groundwater source and demand analysis 2018 to 2041 for the communities of Fergus and Elora, Ontario

Expert Witness, Preparation of Technical Evidence, Attendance at Board and Judicial Hearings

- Ontario Municipal Board Hearing, Barrie Annexation, Ontario
- Coastal Park Land Acquisition Studies, Heron Island, New Brunswick

- Shoreline Erosion Assessment, Caledon Lake, Ontario
- Shoreline Erosion, Mud Lake, Gravenhurst, Ontario
- Ontario Municipal Board Hearing, Proposed Roseneath Resort, Lake Muskoka (Advisor)
- Supreme Court of Ontario, Drainage Dispute, Cayuga
- Ontario Municipal Board, Proposed Landfill, Southwest Oxford (Advisor)
- Ontario Energy Board, North Shore Pipeline (Sault Ste. Marie to Elliot Lake)
- Ontario Municipal Board Hearings for Reagan-Graham and Presswood Pit Applications, Town of Caledon
- Ontario Municipal Board Hearings, Official Plan and Aggregate Industry Issues, Township of Puslinch (observer, 200 day hearing)
- Lower Churchill Hydro Electric Development, Labrador (Federal Environmental Assessment and Review Panel)
- Quarry Expropriation, Regional Municipality of Ottawa-Carleton (Advisor)
- Syncrude Refinery Fire Litigation, Fort McMurray, Alberta (Settled)
- Supreme Court of Ontario, Tree Nursery/Golf Course Drainage Dispute, Whitby, Ontario
- Ontario Municipal Board, Proposed Aggregate Extraction (Pinchin Pit), Town of Caledon (Advisor)
- Ontario Municipal Board, Estate Residential Policy Interpretation, Town of Caledon (Advisor)
- Tree Removal Litigation, Bradford, Ontario (Settled)
- Ontario Municipal Board Hearing, Matchet Property, Town of Caledon
- Ontario Municipal Board, King City Official Plan Hearing
- North Richmond Hill Yonge East and Yonge West Oak Ridges Moraine Ontario Municipal Board Hearing (12 months)
- Ontario Municipal Board, Ballycroy Golf Course and Resort (Mediated Settlement)
- Ontario Superior Court of Justice, King City Sewer, Township of King/Region of York (settled)
- Ontario Superior Court of Justice, Riparian Dispute, Grey County
- First Nations/Canada Flooding Specific Claims Resolution, Trent Severn Waterway (Expert Witness 5 years), Claim ratified by First Nations
- Ontario Municipal Board North Leslie Secondary Plan, Richmond Hill
- Ontario Municipal Board Shelter Valley Aggregates, Northumberland County (settled)
- Conservation Review Board, David Dunlap Observatory, Richmond Hill (Expert Witness on Development Limits)
- Preparation of appeals for residents adversely impacted by York Region 9th Line/16th Avenue Sewer dewatering
- Review of York Durham Sanitary Sewer Boundary Meter Wastewater Flows and Estimate of Inflow/Infiltration Quantities for Peak and Average Flow conditions, for City of Pickering vs York Region (settled)
- Quantity Estimates for York Region Trunk Sewer Intrabasin Water Transfer from Lake Simcoe to Lake Ontario, for City of Pickering vs York Region (settled)
- Ontario Municipal Board Rockfort Quarry Hearing, evidence review, periodic attendance and advisor to ratepayer solicitor
- Ontario Municipal Board Duntroon Quarry Expansion Hearing, evidence review, statement preparation, periodic attendance and advisor to ratepayers
- Ontario Municipal Board - Analysis of hydrology, hydro-geological, stormwater and solar/shadow impacts due to proposed 6-storey condominium on Glen Davis Ravine, Toronto.
- Niagara Escarpment Hearing Office, Expert participation in Facilitation Process, Keppel New Quarry (settled)
- Niagara Escarpment Hearing Office - re-configuration and re-location of the existing Keppel Quarry discharge effluent release (settled).
- Dufferin Wind / Black Farms - Lease Participant Arbitration
- Ontario Municipal Board, David Dunlap Observatory Lands (2 Hearings)
- Ontario Municipal Board, Northwest Niagara Falls proposed urban expansion (advisor to ratepayer participant)
- Ontario Municipal Board, West Gormley Secondary Plan and Master Environmental Servicing Plan, Town of Richmond Hill
- Proposed Hidden Quarry, Rockwood, Review and Witness Statement Preparation
- Town of Alliston Production Well 7 Impacts on adjacent farm lands. Expert Report preparation (settled).

GUEST LECTURES - ACADEMIC POSITIONS

- Geological Survey of Canada Workshop on Groundwater Resources within the Oak Ridges Moraine. "The MNR Oak Ridges Moraine Hydrogeology Study - A Progress Report", 1993.

- Large scale photo sampling presentations (invited) to Great Lakes Forest Research Institute, Petawawa National Forest Institute and Thunder Bay District, Ministry of Natural Resources, 1984.
- Lectures in Large Scale Photo Sampling, Ryerson Institute of Technology, 1981.
- Lectures in Rural Estate Residential Planning, Faculty of Environmental Studies, University of Waterloo, 1980.
- Lectures in Airphoto Interpretation, Department of Earth Sciences, University of Waterloo, 1978.
- Lectures in Urban Environmental Assessment, School of Architecture, University of Toronto, 1977.
- Lectures in Airphoto Interpretation, Department of Civil Engineering, University of Toronto, 1973.
- "Data Collection by Remote Sensing", Panelist, UNESCO/IGU, Second Symposium on Geographic Information Systems, 1972.
- "Agriculture and Geography", Working group member, Earth Resources Technical Satellites and Remote Airborne Sensing (ERTS), 1972.
- Instructor in Airphoto Interpretation, Department of Civil Engineering, University of Toronto, 1968.

PUBLICATIONS, PAPERS (OTHER THAN CONSULTING REPORTS), PRESENTATIONS

- "MapGuide Application Toolkit v2.0". Presented at Autodesk MapGuide Bootcamp '99, Evian, France, Mar. 2-5, 1999.
- "Resource Management in the ORM". Presented at a one day session on Water Resource Investigations of the Oak Ridges Moraine: Geology and Hydrogeology, Newmarket, Ontario, Oct. 29, 1997.
- "Georeferencing Quality Control of Ontario's Water Well Data Base for the Greater Toronto and Oak Ridges Moraine Areas of Southern Ontario". Kenny, F.M.[1], Hunter, G.[2] and Chan, P.[3]. [1]Ontario Ministry of Natural Resources, [2]Hunter GIS, [3]Metro Toronto Conservation Authority. Presented at the International Symposium: Geomatics in the Era of Radarsat, Ottawa, May 28, 1997.
- "Quaternary Geology and Hydrogeology of the Oak Ridges Moraine Area". Sharpe, D.R., Barnett, P.J., Dyke, L.D., Howard, K.W.F., Hunter, G.T., Gerber, R.E., Paterson, J. and Pullan, S.E. Presented at the Geological Association of Canada and Mineralogical Association of Canada Joint Annual Meeting, 1994, Waterloo, Ontario.
- "The Palgrave Estate Residential Policy Area, Town of Caledon: A Potential Environmental Planning Model for the Oak Ridges Moraine Complex (A Case Example)". Presented at the seminar "Out of Control": Development of the Oak Ridges Moraine at York University, May 1990. Invited by Metro Toronto Conservation Authority.
- "Erosion of the Barbados Coast". Lawson, D.E.[1], Hunter, G.T.[2], and Hooper, R.[3]. [1]University of Waterloo, [2]Hunter and Associates, Toronto, [3] Memorial University. Presented at the 12th Caribbean Geological Conference, St. Croix, U.S. Virgin Islands, August 7-11, 1989.
- "Sediment Transport Along the Barbados Coast". Lawson, D.E.[1], Hunter, G.T.[2]. [1]University of Waterloo, [2]Hunter and Associates, Toronto. Presented at the 12th Caribbean Geological Conference, St. Croix, U.S. Virgin Islands, August 7-11, 1989.
- "Environmental Impacts and Coral Degradation, Barbados Coast". Hunter, G.T.[1], Hooper, R.[2] and Lawson, D.E.[3]. [1]Hunter and Associates, Toronto, [2]Memorial University, [3]University of Waterloo. Presented at the 12th Caribbean Geological Conference, St. Croix, U.S. Virgin Islands, August 7-11, 1989.
- "Application of Fixed Base Simultaneous Large Scale Stereo Photography to Precision Measurement of Caribou Individuals, Buchans Herd, Newfoundland", with David W. Smith (unpublished, December 1982).
- "Fixed Base Simultaneous Photo Bathymetry". Presented to the Canadian Institute of Surveying, Ottawa, April 1982.
- "Preliminary Environmental Impact Assessment, Upper Salmon/Cat Arm Watersheds, a Case Study". Presented to the Association of Consulting Engineers of Canada, Montreal, 1976.
- "Landforms and Landscapes of Canada". J.D. Mollard (Fifth Edition). Review and revisions of airphoto annotations for Eastern Canada, 1974.
- "Critical Pavement Analysis". Montréal-Dorval International Airport (now Montréal-Pierre Elliott Trudeau International Airport). Presented at the annual convention of the American Society of Photogrammetry and American Congress of Surveying and Mapping, Washington, D.C., March 1971.

- "Critical Terrain Analysis". Garry T. Hunter and S.J. Glenn Bird, Photogrammetric Engineering. Also presented at Washington D.C., March 1970.
- "Postglacial Uplift at Fort Albany, James Bay". Canadian Journal of Earth Sciences, Vol. 7(2), Pt. 1, 1970, pp. 547-548.
- "Infrared (Thermal) Scanning for Terrain Data Acquisition". M.A.Sc. Thesis, University of Toronto, 1969.
- "Airphoto Interpretation in the Sub-Arctic". (For Department of Indian Affairs and Northern Development). B.A.Sc. Thesis, University of Toronto, 1968.

Ontario
Local Planning Appeal Tribunal
Tribunal d'appel de l'aménagement local

ACKNOWLEDGMENT OF EXPERT'S DUTY

Case Number	Municipality
PL150494	Guelph Eramosa

1. My name is……*Garry T. Hunter* ……(*name*)
   I live at the …… *City of Mississauga*……..(*municipality*)
   in the……*Region of Peel*……..(*county or region*)
   in the ……..…… *Province of Ontario*……..(*province*)

2. I have been engaged by or on behalf of…....*CRC Rockwood Inc*……(*name of party/parties*) to provide evidence in relation to the above-noted LPAT proceeding.

3. I acknowledge that it is my duty to provide evidence in relation to this proceeding as follows:

   a. to provide opinion evidence that is fair, objective and non-partisan;

   b. to provide opinion evidence that is related only to matters that are within my area of expertise; and

   c. to provide such additional assistance as the LPAT may reasonably require, to determine a matter in issue.

4. I acknowledge that the duty referred to above prevails over any obligation which I may owe to any party by whom or on whose behalf I am engaged.

Date…April 5, 2019…… ……
Signature