January 7, 2022

Ashley Taylor, MCIP, RPP, M.Pl.
Planner - Planning & Development
Haldimand County Administration Building
53 Thorburn St. S., Cayuga, ON N0A 1E0

Dear Ashley:

RE: Lafarge Canada Inc. Comments on Smith Farm Lands (Gardens Communities (Hagersville) Inc.) Draft Plan of Subdivision and Zoning Amendment - PL28T-2020-196 and PLZ-HA-2021-009, Haldimand County
OUR FILE 9526HX

On behalf of our client, Lafarge Canada Inc. ("Lafarge"), we are providing the following additional comments on the applications for Draft Plan of Subdivision and Zoning By-law Amendment for the proposed development of the Smith Farm lands in Hagersville.

Lafarge previously submitted comments on these applications on June 3, 2021, and has outlined its concerns with proposed sensitive uses occurring next to their licensed Hagersville Quarry (Aggregate Resources Act Licence # 4443) throughout the County's Official Plan review process in 2021.

Lafarge acknowledges that the Smith Farm lands are located within the urban area of Hagersville as a result of the County's 2021 Official Plan review process, and despite the concerns expressed by Lafarge during that process. However, Lafarge is of the opinion that compatibility issues between the existing quarry and proposed sensitive uses have not been satisfactorily addressed.

The applicant's technical studies have essentially concluded that development can occur beyond a 300 m "quarry setback line" without precluding or hindering the existing quarry. It should be noted that this "quarry setback line" is approximately **190 m from the licensed boundary** of the quarry at its closest point. There are more than 100 residential units proposed within 300 m of the licensed boundary of the quarry (please see enclosed map which overlays the updated draft plan of subdivision on an airphoto with the licensed boundary of the quarry).

In addition, the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) and Ministry of Environment, Conservation and Parks (MECP) have previously taken the position that any setbacks for sensitive land uses should be measured from the licensed boundary of the quarry.

Lafarge specifically has concerns with proposed development occurring within 300 m of the licensed boundary of the quarry, and objects to the introduction of sensitive uses within this area.

Lafarge's view is that the County should be undertaking a robust peer review of the technical studies in support of the subdivision application. However, given the fact that the County has not, to our knowledge, undertaken such a peer review, Lafarge retained HGC Engineering (HGC) and DST Consulting Engineers (DST) to review the Haldimand Gardens AQ-Noise-Vibration Report (RWDI) and Blasting Compatibility Analysis Report (Explotech), respectively. Please find enclosed the technical reviews completed by HGC and DST.

HGC found that the RWDI Study recommends noise control measures that would significantly restrict Lafarge's existing operation including limited operating hours and considerable acoustic shielding of processing equipment and drills to accommodate the proposed sensitive use. Such mitigation measures should be borne by the proponent of new sensitive land uses, not an existing industrial operation. Any recommendations for noise or vibration control measures should be limited to the lands within the proponent's application.

HGC also concluded that the RWDI Study lacks sufficient technical rigor and detail to conclusively demonstrate that MECP noise limits can be met by the proposed subdivision based on current and future sound levels from the licensed quarry.

The Explotech Study identified the closest existing structure to the quarry being a townhouse 245 m west of the quarry. In DST's review, they question how the presence of this townhouse can act as justification for the proposed development of 114 new sensitive receptors within 300 m of the **licensed boundary** south of the quarry. DST concluded that the proposed development of sensitive uses within 300 m of the **licensed boundary** of the quarry cannot coexist with the existing quarry operations under their existing drilling and blasting procedures, and that a section of the remaining licensed aggregate reserves would potentially be sterilized and not mineable.

Accordingly, it is our opinion that the applications will preclude or hinder the continued use of the Hagersville Quarry and is therefore not consistent with the Provincial Policy Statement (e.g. 1.2.6 & 2.5.2.4) and does not conform with the County's Official Plan (e.g. 3.A.2.3 & 3.A.2.5).

The site-specific policy applicable to the Smith Farm lands as approved through the County's Official Plan (HCOP-62) does not relieve the applicant from the requirement to establish consistency with PPS 1.2.6 or 2.5.2.4 nor would it be appropriate to conclude that it automatically results in compatibility for any new sensitive development proposed on the Smith Farm lands.

The County's Official Plan states that all development within 500 m of existing aggregate operations shall be assessed on a case by case basis and appropriate development setbacks shall be established in consultation with appropriate agencies (Section 3.A.2.5). This policy remains in effect and was not changed through the County's 2021 Official Plan. There are approximately 450 new residential units proposed within 500 m of the quarry.

Please confirm whether the NDMNRF or MECP have been consulted on the proposed applications which involve substantial development within 500 m of an existing licensed quarry, and a proposed setback which is not measured from the licensed boundary.

In summary, Lafarge is of the opinion that compatibility issues between the existing quarry and proposed sensitive uses have not been satisfactorily addressed. Lafarge objects to the introduction of sensitive uses

within 300 m of the **licensed boundary** of the quarry. The County should not proceed with a decision on the applications until the following have been completed, at a minimum:

1. A robust peer review of the technical studies in support of the subdivision application specifically the compatibility assessments regarding noise, vibration and blasting.
2. Confirmation that NDMNRF and MECP have been directly consulted on this application and that they are in support of the proposed setback distance from a licensed quarry.
3. Confirmation that the lands removed the subdivision application closest to the quarry will remain zoned Agricultural, and that any development on these lands will be subject to future planning approvals.

Thank you for the opportunity to submit comments on these applications. Lafarge reserves the right to make further comments as it deems necessary. Please notify us in advance of the future public meeting to be scheduled.

Yours truly,

MHBC

Neal DeRuyter, BES, MCIP, RPP

cc. *Chris McGuckin, Lafarge*
Carol Siemiginowski, Lafarge
David Bazargan, Lafarge
Kim Mullin, Wood Bull LLP
Mike Evers, Haldimand County
Shannon VanDalen, Haldimand County
Alisha Cull, Haldimand County
Al Murray, NDMNRF
Karina Cerniavskaja, NDMNRF
Stephen Burt, MECP
Michael Durst, MECP

Encl.

Proposed Plan of Subdivision and Hagersville Quarry

Lafarge Canada Inc.
Hagersville Quarry
Haldimand County

Legend

- Licensed Boundary (Licence #4443)
- Limit of Extraction (Licence #4443)
- 300m from Licensed Boundary
- 300m Quarry Setback Line (as shown on Draft Plan of Subdivision)

Base Map Sources:
Imagery: Google Earth 2018
Draft Plan of Subdivision: WSP Canada Group Ltd. (Sept.14, 2021)
Licensed Boundary: Ontario Geohub/Land Information Ontario
(Information licensed under the Open Government Licence – Ontario)

DATE: January 7, 2022
SCALE: 1:3,000 (11x17)
FILE: 9526 HX
DRAWN: DGS

north

K:\9526HX-Lafarge-Hagersville\RPT\Hagersville Quarry and Proposed Subdivision January2022.dwg

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200-540 BINGEMANS CENTRE DR. KITCHENER, ON, N2B 3X9
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HGC ENGINEERING

Howe Gastmeier Chapnik Limited
2000 Argentia Road, Plaza One, Suite 203
Mississauga, Ontario, Canada L5N 1P7
t: 905.826.4044

January 5, 2022

David Bazargan, Carol Siemiginowski
Lafarge Canada Inc.
6509 Airport Road
Mississauga, Ontario
L4V 1S7

Re: Review of Noise/Vibration Letters Prepared by RWDI Addressing the Hagersville Quarry in Support of Planning Applications for an Adjacent Residential Development – Garden Communities (Hagersville) Inc. (Smith Farms)

David, Carol,

As requested, we have reviewed two letters prepared by RWDI entitled "Haldimand Gardens AQ-Noise Vibration", dated April 30 and November 14, 2018. We understand the letters were prepared in support of an official plan amendment, a zoning by-law amendment, and an approval of a draft plan of subdivision for the Haldimand Gardens residential development in Haldimand County.

The development is proposed to abut the southern boundary of the Lafarge quarry in Hagersville, Ontario. As the letter titles suggest, RWDI aimed to predictively assess the potential noise/vibration (and air quality) impacts of the Hagersville Quarry on the proposed development, and to provide recommendations for mitigation measures that would result in sound levels from the Lafarge operations that comply with limits stipulated in MECP guideline NPC-300.

Our review was supplemented by the operational plan for the Hagersville Quarry, satellite imagery of the area, and our experience in assessing noise/vibration from numerous similar quarries for Lafarge and other operators.

We offer the following general comments and recommendations for your consideration:

1. In general, the letters appropriately reference MECP noise assessment guideline NPC-300 and uses industry standard acoustical modelling software.

2. Although the letters include the term "vibration" in their titles, there is no mention of vibration within the body of or attachments to either letter. Similarly, the letters acknowledge that blasting takes place at the quarry, but there is no further discussion or assessment of the potential noise or vibration impacts from blasting.

3. In the section entitled "Overview of Lafarge Operations", RWDI acknowledges that the quarry plans (for licence 4443) permit 24-hour operation (except for blasting, which is limited to between 08:00 and 18:00) and processing/stockpiling within a designated area, with seasonal operation of processing equipment at the active face. The latter scenario requires a minimum separation distance of 90 metres from the licence boundary abutting land zoned for residential purposes; it is our understanding that the Haldimand Gardens lands are not currently zoned for residential purposes, such that this

separation distance would not apply along the abutting licence boundary. There is a 15 m extraction setback adjacent to the Haldimand Gardens lands.

4. In the section entitled "Lafarge's Air Quality and Noise Regulatory Obligations", RWDI asserts "If Lafarge intends to operate a[n aggregate processing] plant at this site for more than 60 days per year, then it must have an appropriate ECA" (Environmental Compliance Approval). However, in the preceding sentence, RWDI acknowledges that such mobile equipment is exempt from requiring an ECA when operated below grade in a pit or quarry (per Ontario Regulation 524/98, which is not specifically cited by RWDI), as is the case for the processing equipment at the Hagersville Quarry.

5. The following comments are provided regarding technical aspects of the RWDI letters.

   5.1. Predictive acoustical modelling of the quarry considered only processing equipment, which was assumed to consist of "multiple crushers and screens powered by a single diesel engine." The letters include no explicit reference to modelling noise emissions from drills, mobile equipment at the working face(s), equipment used to transport materials from the working face to the processing equipment (where applicable), or shipping activities.

   5.2. The processing equipment was represented in predictive modelling as a single point source comprising the sum-total sound emissions of the processing equipment, assuming "several possible processing plant locations". It is unclear where the processing equipment was assumed to operate, or where the most potentially impacted receptors on the development site are located, in each assumed location of the processing equipment.

   5.3. The processing equipment considered was assumed to be located on the quarry floor. However, Lafarge simultaneously operates other equipment at the site (i.e. drills, mobile equipment, etc.), across various elevations on the site, which was not considered.

   5.4. Based on predictions of noise impacts from the processing equipment alone, the letters provide conceptual recommendations for noise control which include administratively limiting the hours of operations of the equipment to daytime hours only, installing 11-13 metre stockpiles around the processing plant, and installing perimeter berms. However:

      i. The letters indicate that noise control is recommended for the Hagersville Quarry in order for the operation to comply with the applicable limits at existing points of reception. However, no information is included to suggest that any field measurements were conducted to confirm any such exceedances.

      ii. The practicality of the recommended noise control measures is not discussed, nor is acknowledgement that Lafarge would have to agree to such measures to accommodate the proposed development.

      iii. Without explicit consideration of other potential noise sources within the quarry, as noted in 5.3, the recommendations may not be representative of the degree of noise control required in order for all operations within the quarry to comply with the applicable sound level limits on the development lands.

6. Further to 5.4, the letters include no details regarding the predicted sound levels (or sound level reductions by various propagation attenuation mechanisms) of the quarry operations at any offsite locations, either without or with the recommended noise control.

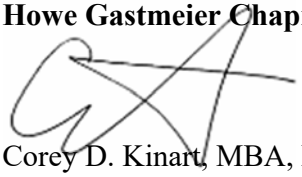
The RWDI letters are of a technical rigor typical of a noise impact feasibility study prepared in support of an early-stage land use planning approval, not a rezoning application or draft plan of subdivision approval. Such feasibility studies typically rely on assumptions regarding the proposed new land use, but can be specific regarding existing land uses since they can be observed, measured, etc. However, in this case, we understand amendments to the official plan and zoning by-law are being sought, along with approval of a draft plan of subdivision. At such an advanced stage of planning, supporting noise impact studies typically include considerably more detail than do the RWDI letters.

Regardless of the detail provided by RWDI, the letters recommend noise control measures that would significantly restrict Lafarge's operations, including limited operating hours and quantities of processing equipment, and considerable acoustical shielding of processing equipment and drills that could severely limit the mobility of such equipment and may be infeasible for drills. However, when a feasibility study concludes requirements for noise control, such measures are typically specified to not encumber the existing land uses i.e. the control measures are borne by the proponent of the land use change. Reason being, the scope of the planning approval process is generally limited to the lands for which the approval is sought, as would be any conditions required to ensure compliance with applicable noise criteria. The RWDI letters demonstrate that the Hagersville Quarry will be precluded or hindered, as evidenced by the recommended operational changes to the existing quarry. Based on MHBC's planning opinion, this is inconsistent with the Provincial Policy Statement (e.g. PPS 1.2.6.1 and 2.5.2.4) and does not reflect contemporary planning practices or policies. Therefore, recommendations for noise control should be limited to the Haldimand Gardens lands and be clearly identified as an integral component of the proponent's application.

In conclusion, the RWDI letters lack sufficient technical rigor and detail to conclusively demonstrate that MECP noise limits can be met by the proposed Haldimand Gardens subdivision based on current and future sound levels from the licenced Hagersville Quarry.

We trust that this satisfies your current requirements. If you have any questions or require any clarification, please don't hesitate to give us a call.

Best Regards,
Howe Gastmeier Chapnik Limited



Corey D. Kinart, MBA, PEng

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December 8, 2021

DST File No.: 02108205

Lafarge Canada Inc.
6509 Airport Road
Mississauga, ON L4V 1S7

Via e-mail: david.bazargan@lafargeholcim.com,
carol.siemiginowski@lafargeholcim.com

Attention: David Bazargan, MES
Carol Siemiginowski, P.Eng.

Subject: Technical Opinion Memo on Desktop Peer Review of Explotech's Blasting Compatibility Analysis Report – Proposed Gardens Communities Subdivision, Hagersville, Ontario.

Disclaimer: This commentary report was prepared for the sole use by Lafarge Canada Inc. (Lafarge). The use of this report or reliance on them by any third party is the responsibility of such third party. The report is subject to Limitations presented in Appendix A.

DST Consulting Engineers Inc., a division of Englobe (DST) was retained by Lafarge Canada Inc. (Lafarge) to conduct a desktop technical peer review of the report titled "Blasting Compatibility Analysis – Final Revision 1, Gardens Communities Subdivision Land Use Compatibility with Lafarge Canada Hagersville Quarry, Hagersville, Ontario" dated April 30, 2018, and "Appendix D – Blasting Impact Analysis to include Newly Acquired Lands" dated August 27, 2018 (the Report) prepared by Explotech Engineering Limited (Explotech). Copy of the Report is attached in Appendix B.

DST has now completed the desktop peer review of the Report and presents the following as its technical opinion memo.

BACKGROUND

Explotech was retained by the IBI Group of Waterloo, Ontario to conduct a Land Use Compatibility Study to determine the viability of the proposed Garden Communities Subdivision (the Development) to coexist with the existing Lafarge Hagersville Quarry located to the north of the proposed subdivision (the Quarry).

The closest existing third-party sensitive receptor is presently located at a standoff distance of 245 m west of the licensed boundary of the Quarry. The Development includes up to 507 units south of the Quarry with dwellings as close as 210 m from the licensed boundary of the Quarry. Note that a copy of the revised application was shared with DST as part of this desktop peer review.

The Report assesses the impact of blasting operations under ASSUMED blast design parameters on existing sensitive receptors and compares the impact on the Development's additional sensitive receptors, should Lafarge carry out the assumed operations under their current licence and site plan. Furthermore, the Report provides alternative blasting parameters and viability of blasting under the above proposed conditions.

DISCUSSION

The Ministry of Natural Resources and Forestry (MNRF) is the provincial body that regulates all mineral aggregate licences or permits for pits and quarries. The Aggregate Resources Act (ARA) is the primary legislative framework, which oversees mineral aggregate operations, sets reporting deadlines and compliance standards, and provides guidance or direction for existing and new sites. The MNRF sets a standard for these activities and measures noise or vibration effects from the licensed boundary of a quarry, which is compared against the applicable limits for compliance as per Ministry of the Environment Conservation and Parks (MECP).

The Report uses an accepted industry standard blast impact assessment approach to determine the impact of vibration and overpressure levels induced by the blasting operations under existing conditions using ASSUMED current blasting practices at the Quarry in accordance with the MECP. In its assessment, the Report uses an in-house regression formula based on 16 data points (Appendix E of the Report) for arriving at the predicted vibration levels, for both existing ASSUMED blasting practices and proposed alternative blast design parameters.

The Report outlines permissible explosives quantities per delay period for various standoff distances from typical quarry blasting operations. Explotech uses calculations that are based on in-house historical vibration data, and not published data. This approach is common practice in the industry in the absence of available site-specific vibration and overpressure data. With the absence of such data, the Report acts as a feasibility study, instead of the appropriate analysis that would be required to support the proposed Development.

Therefore, DST concludes that the Explotech Report is lacking in the following criteria:

- Calculations should be based on actual existing drilling and blasting designed parameters

presently employed at the existing quarry; and

- Vibration and overpressure level attenuation formulas be based on published data and models such as those recommended by the International Society of Explosive Engineers (ISEE) commonly used by blasting consultants and the industry specialists rather than in-house data.

We understand that Lafarge, under their current licence and site plan, expects to complete the extraction of the remaining mineral aggregate deposit within the existing extraction limit. Currently, the closest existing sensitive receptor, namely the townhouse located at 44 Cedar Street, west of the extraction zone is located at a standoff distance of 245 m. The proposed Development includes new sensitive receptors within a standoff distance of approximately 210 m south of the Quarry. Based on a review of the Report, we are not sure how the presence of a single townhouse located at a standoff distance of 245 m can act as justification for the proposed Development of 114 new sensitive receptors within 300 m of the licensed boundary of the Quarry. Such sensitive uses within close proximity to industrial facilities has the potential to experience adverse impacts. To prevent or minimize the encroachment of a new sensitive use on existing industrial facilities, the MECP recommends that appropriate separation distances and mitigation measures be established based on criteria found within the D-6 Guideline. Any reduction to the existing standoff distance will create compatibility issues for any sensitive uses proposed by the Development.

As stated in the Report, changes to an approximate separation distance of 300 m between the licensed boundary of the Quarry and new sensitive uses associated with the proposed Development could preclude or hinder the ability of the Quarry to function. **We concur with Explotech's statement that, due to the proposed Development a section of the remaining mineral deposit will be sterilized and not mineable for safety reasons.**

In conclusion, DST is of the opinion that the proposed Development of an additional 114 new sensitive uses located within 300 m of the licensed boundary cannot coexist with the existing Lafarge quarry operations under their existing drilling and blasting procedures.

We trust the foregoing will satisfy your present requirements. Should you require further assistance or wish to discuss any of the above points, please contact the undersigned.

A copy of the writer's resume is included in Appendix C for your records.

Yours truly,

DST Consulting Engineers Inc., a division of Englobe

Ray Jambakhsh, M.A.Sc, P. Eng.
Subject Matter Expert, Explosive, Blasting and Vibrations

Append.

Appendix A

- **Limitations of Liability and Third-Party Reliance**

This information, conclusions and recommendations herein are specific to this project and this client only; and for the scope of the work described herein. This report may not be relied upon, in whole or in part, by other parties for any purposes whatsoever. Any use which a third party makes of this report, or any part thereof, or any reliance on or decisions made based on it, are the responsibility of such third parties. DST does not accept responsibility for damages, if any, suffered by any third party due to decisions or actions made based on this report.

Appendix B

- **Explotech's Report**

EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

Blasting Compatibility Analysis – Final Revision 1
Gardens Communities Subdivision Land Use Compatibility with Lafarge Canada Hagersville Quarry
Hagersville, Ontario

Submitted to:

IBI Group
410 Albert Street, Suite 101
Waterloo, Ontario
N2L 3V3

Prepared by:

Explotech Engineering Ltd.

April 30, 2018

EXECUTIVE SUMMARY

Explotech Engineering Ltd. was retained in October 2017 to provide a Blast Compatibility Analysis for the proposed Gardens Communities Subdivision Development located on Part of Lot 30, Range East of Plank Road and Part of Lot 26, Registrar's Complied Plan 73 (Geographic Township of Oneida), Town of Hagersville, Haldimand County. Specifically, this study was undertaken to identify land use compatibility issues between the proposed residential development and the existing blasting operations ongoing at Lafarge Canada's Hagersville Quarry located to the North of the proposed subdivision.

Vibration levels assessed in this report are based on the Ministry of Environment and Climate Change Model Municipal Noise Control By-law (NPC119) with regard to guidelines for blasting in Mines and Quarries. We have assessed the area surrounding the proposed license area, including the proposed subdivision development, with regard to potential damage from blasting operations and compliance with the aforementioned by-law document.

On November 11, 2017, Explotech Engineering Ltd. completed a site visit of the development area and reviewed all available site maps and operational plans provided by Empire Communities. Our analysis of the predictable derivatives associated with the blasting concluded that the planned subdivision development can coexist with the adjacent mineral extraction operations at Lafarge Canada's Hagersville Quarry in a safe manner and within MOECC guidelines. Notwithstanding, the development of the residential subdivision may impose the need for operational changes at the Lafarge Hagersville Quarry, depending on the specific location of future blasting.

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EXPLOTECH

INTRODUCTION

The proposed Gardens Communities Subdivision is located on Part of Lot 30, Range East of Plank Road and Part of Lot 26, Registrar's Complied Plan 73 (Geographic Township of Oneida), Town of Hagersville, Haldimand County (refer to Appendix A). Lafarge Hagersville Quarry limits used in this report are based on quarry operations plans received from Empire Communities. The quarry property is located on Part of Lots 28 and 29, Range E of Plank Road, Geographic Township of Oneida, County of Haldimand.

This Blast Compatibility Analysis has been prepared to assess the potential for the Gardens Communities Subdivision to coexist with the adjacent Lafarge Hagersville Quarry in accordance with requirements stipulated under the Ministry of the Environment and Climate Change (MOECC) Model Municipal Noise Control By-law (NPC 119) with regard to Guidelines for Blasting in Mines and Quarries. Additionally, we have investigated the need for any special provisions or operational changes required at either property in order to permit or maintain reasonable use.

Limited information is available with regards to current blasting practice at the Lafarge Hagersville Quarry. As such, our analysis applied typical blasting parameters at quarry operations similar to Lafarge Hagersville to assess the impacts of the blasting on both the existing and proposed residences (ie. closest existing home to the blasting at 44 Cedar Street versus Block 20 or Block 21 on Phase II of the proposed Gardens Communities Subdivision Development). Additionally, our review analyzed whether the introduction of the proposed homes would impose the need for any adjustments to the Lafarge operations or result in the sterilization of areas of the quarry where extraction would no longer be feasible.

EXPLOTECH

EXISTING AND FUTURE BLASTING CONDITIONS

The Lafarge Canada Hagersville Quarry encompasses approximately 232 Acres (94 Hectares). The property is bounded by Haldimand Road 9 with farm fields and sparse residential properties to the East, Main Street N and dense residential and commercial properties to the West, First Line Road with farm fields and sparse residential and commercial properties to the North, and the proposed Gardens Communities (Hagersville) Subdivision along with existing dense residential properties to the South.

The Lafarge Hagersville Quarry Lands lie approximately 60m from the closest home on the proposed Gardens Communities Subdivision Development (refer to Appendix A). The closest existing structure to the quarry operation is located at 44 Cedar Street at a distance of 245m due West of the quarry (refer to Appendix B). The closest existing receptors surrounding the Hagersville Quarry include the following:

Table 1: Closest Existing Sensitive Receptors to Lafarge Hagersville Quarry

Sensitive Receptor	Closest Straight Line Distance to Receptor (m)	Direction from Quarry
1 Athens Street	278	West
3 Athens Street	270	West
5 Athens Street	258	West
12 Athens Street	298	West
14 Athens Street	285	West
16 Carrick Street	415	West
18 Carrick Street	392	West
20 Carrick Street	380	West
21 Carrick Street	400	West
22 Carrick Street	350	West
23 Carrick Street	385	West
24 Carrick Street	335	West
25 Carrick Street	375	West
26 Carrick Street	315	West
27 Carrick Street	355	West

EXPLOTECH

29 Carrick Street	350	West
9 Cedar Street	390	West
10 Cedar Street	353	West
12 Cedar Street	350	West
13 Cedar Street	375	West
14 Cedar Street	342	West
16 Cedar Street	337	West
17 Cedar Street	363	West
18 Cedar Street	330	West
20 Cedar Street	325	West
21 Cedar Street	348	West
22 Cedar Street	315	West
24 Cedar Street	307	West
25 Cedar Street	337	West
26 Cedar Street	303	West
28 Cedar Street	296	West
29 Cedar Street	325	West
30 Cedar Street	291	West
32 Cedar Street	285	West
33 Cedar Street	310	West
34 Cedar Street	275	West
36 Cedar Street	270	West
38 Cedar Street	264	West
40 Cedar Street	257	West
42 Cedar Street	250	West
44 Cedar Street	245	West

EXPLOTECH

BLAST VIBRATION AND OVERPRESSURE LIMITS

The Ontario MOECC guidelines for blasting in quarries are among the most stringent in North America.

Recent studies by the U.S. Bureau of Mines have shown that normal temperature and humidity changes can cause more damage to residences than blast vibrations and overpressure in the range permitted by the MOECC. The limits suggested by the MOECC are as follows.

Vibration	12.5mm/sec	Peak Particle Velocity (PPV)
Overpressure	128dB	Peak Sound Pressure Level (PSPL)

The above guidelines apply when blasts are being monitored. Cautionary levels are slightly lower and apply when blasts are not monitored on a routine basis. The guideline limits apply at the location of sensitive receptors which includes residential homes.

EXPLOTECH

BLAST MECHANICS AND DERIVATIVES

The detonation of explosives within a borehole results in the development of very high gas and shock pressures. This energy is transmitted to the surrounding rock mass, crushing the rock immediately surrounding the borehole (approximately 1 borehole radius) and permanently distorts the rock to several borehole diameters (5-25, depending on the rock type, prevalence of joint sets, etc).

The intensity of this stress wave decays quickly so that there is no further permanent deformation of the rock mass. The remaining energy from the detonation travels through the unbroken material in the form of a pressure wave or shock front which, although it causes no plastic deformation of the rock mass, is transmitted in the form of vibrations.

Particle velocity is the descriptor of choice when dealing with vibrations because of its superior correlation with the appearance of cosmetic cracking. As such, for the purposes this report, ground vibration units have been listed in mm/s.

In addition to the ground vibrations, overpressure, or air vibrations, are generated through the direct action of the explosive venting through cracks in the rock or through the indirect action of the rock movement. In either case, the result is a pressure wave which travels though the air, measured in linear decibels (or dBL) for the purposes of this report.

EXPLOTECH

VIBRATION AND OVERPRESSURE THEORY

Transmission and decay of vibrations and overpressure can be estimated by the development of attenuation relations. These relations utilize empirical data relating measured velocities at specific separation distances from the vibration source to predict particle velocities at variable distances from the source. While the resultant prediction equations are reliable, divergence of data occurs as a result of a wide variety of variables, most notably site-specific geological conditions and blast geometry and design for ground vibrations and local prevailing climatic conditions for overpressure.

In order to circumvent this scatter and improve confidence in forecast vibration levels, probabilistic and statistical modeling is employed to increase conservatism built into prediction models, usually by the application of 95% confidence lines to attenuation data.

The attenuation relations are not designed to conclusively predict vibration levels at a specific location as a result of a specific blast design, application of this probabilistic model creates confidence that for any given scaled distance, 95% of the resultant velocities will fall below the calculated 95% regression line.

While the data still provides insight into probable vibration intensities, attenuation relations for overpressure tends to be less reliable and precise than results for ground vibrations. This is due primarily to wider variations in variables outside of the influence of the blast design which impact propagation of the vibrations. Atmospheric factors such as temperature gradients and prevailing as well as local topography can all serve to significantly alter overpressure attenuation characteristics.

Our experience and analysis demonstrates that blast overpressure is greatest when blasting toward residences, and blast vibrations are greatest when retreating towards the residences.

We are of the understanding that Empire Communities intends to elevate the development site by approximately 1.3m using fill material from a nearby construction site to accommodate the installation of underground services. Assuming competent fill material is used, we do not anticipate any significant impact on ground vibrations or overpressures due to the presence of the fill or the marginally higher elevation.

We were unfortunately not provided any details of current blast practices at the Lafarge Hagersville operations. As such, for the purposes of our analysis, we have assumed a baseline blast design comprised of 114mm (4 ½") diameter hole, 3.35m x 3.35m (11' x 11') square pattern, 10m bench, 7.5m bulk emulsion column with a density of 1.2g/cc and a 2.5m collar. Bench height was limited to 10m given that the closest rock to the proposed subdivision is currently at elevation 207MASL and final quarry floor elevation is 197MASL.

The blasting parameters described above represents one of several designs which we have noted being used at other limestone quarries in the province that are similar in nature to the Lafarge Hagersville Quarry. Given that we are currently unaware as to the exact location of the ongoing blasting within the quarry, Explotech cannot make any additional comments or recommendations beyond the assumed blast design described above.

EXPLOTECH

VIBRATION LEVELS AT THE NEAREST SENSITIVE RECEPTOR

The most commonly used formula for predicting PPV is known as the Bureau of Mines (BOM) prediction formula or Propagation Law.

$$PPV = k\left(\frac{d}{\sqrt{w}}\right)^{e}$$

Where, PPV = the predicted peak particle velocity (mm/s)

K, e = site factors

d = distance from receptor (m)

w = maximum explosive charge per delay (kg)

The value of “K” and “e” are variable and influenced by many factors (i.e. rock type, geology, thickness of overburden, etc.). Based on monitoring performed at similar Ontario rock quarries with comparable material characteristics, our initial estimates for “e” will be set at -1.85 and “K” will be set at 7025 (refer to Appendix E).

EXISTING CONDITIONS

It is our understanding that the approved site plans for the Hagersville Quarry permit Lafarge to remove one remaining bench in the Western most portion of the Hagersville Quarry, making this area the closest point to the majority of the sensitive receptors. This bench would be approximately 10m in depth. We have assumed that the initial blast will be approximately 395m removed from the closest existing sensitive receptor, namely 44 Cedar Street. For a distance of 395m and a maximum explosive load per delay of 92kg per delay (assumed 114mm (4 ½”) diameter hole, 3.35m x 3.35m (11’ x 11’) square pattern, 10m bench, 7.5m bulk emulsion column with a density of 1.2g/cc and a 2.5m collar), we can calculate the maximum PPV at the closest existing sensitive receptor for the initial quarry operations as follows:

$$ppv = 7025\left(\frac{395}{\sqrt{92}}\right)^{-1.85} = 7.24\ mm/s$$

As discussed in previous sections, the MOECC guideline for blast-induced vibration is 12.5 mm/s (0.5 in/s). The calculated predicted PPV (based on the proposed blasting data discussed above) would be 7.24mm/s.
Under current conditions, the closest separation distance between a sensitive receptor and any blast over the life of the quarry would be approximately 245m (44 Cedar Street). Applying the same blast parameters as above to this reduced separation distance yields a calculated vibration of 17.51mm/s suggesting the need for design modifications as the distance to existing receptors decreases. In order to maintain compliance at a separation distance of 245m, maximum load per delay would have to be reduced to 64kg. While this reduced load would result in elevated drill and blast costs, the extraction of the rock would remain economically feasible based on current market conditions.

PROPOSED CONDITIONS

With the introduction of the proposed subdivision, the separation distance to the closest receptor for the initial blast in the Western quadrant of the quarry would decrease from 395m to 220m (Residences in Block 21). Applying the same blast parameters as above, the calculated vibration level at the closest proposed receptor for the initial blast would be 21.36mm/s, again necessitating the need for design modifications in the event that the residential structures are built prior to the blasting in this area. In order to maintain compliance at a separation distance of 220m, maximum load per delay would have to be reduced to 52kg. Once again, while this reduced load would result in elevated drill and blast costs, the extraction of the rock would remain economically feasible based on current market conditions.

The closest separation distance between the blasting and a sensitive receptor in the proposed subdivision over the life of the quarry is approximately 60m (Residences in Block 21). While technically feasible, given current blasting technology and techniques, blasting at the separation distance of 60m would not be economically feasible as maximum loads per delay would be in the 4kg range.

EXPLOTECH

OVERPRESSURE LEVELS AT THE NEAREST SENSITIVE RECEPTOR

It is unusual for overpressure to reach damaging levels, and when it does, the evidence is immediate and obvious in the form of broken windows in the area. However, overpressure remains of interest due to its ability to travel further distances as well as cause audible sounds and excitation in windows and walls.

Air overpressure decays in a known manner in a uniform atmosphere; however, a uniform atmosphere is not a normal condition. As such, air overpressure attenuation is far more variable due to its intimate relationship with environmental influences. Air vibrations decay slower than ground vibrations with an average decay rate of 6dBL for every doubling of distance.

Air overpressure predictive formulas employ cube root scaling based on the following equation:

$$PSPL = k\left(\frac{d}{\sqrt[3]{w}}\right)^{e}$$

Where, PSPL = the peak sound pressure level particle velocity (dBL)
K, e = site factors
d = distance from receptor (m)
w = maximum explosive charge per delay (kg)

Research performed by the United States Bureau of Mines (USBM RI8485) established the following 95% regression equation for peak sound pressure level in front of a quarry blast. The values for "e" and “K” have been established at -0.966 and 1.317 respectively based on the collected empirical data.

$$PSPL = 1.317\left(\frac{D}{\sqrt[3]{W}}\right)^{-0.966}$$

As previously stated in this report, the closest existing sensitive receptor to initial blasting in the remaining Western portion of the quarry will be 395m. This receptor is positioned behind the blast and hence overpressures will be significantly reduced. Research conducted by the USBM has produced a predictive equation for a typical quarry blast in which the receptor is behind the blast.

Based on the data collected, the values for "e" and “K” have been established at -0.515 and 0.056 respectively:

$$PSPL = 0.056\left(\frac{D}{\sqrt[3]{W}}\right)^{-0.515}$$

EXISTING CONDITIONS

Lot 22 on King Street East is the closest existing structure which lies in front of the blast. At a separation distance of 550m (i.e. the closest standoff distance to the existing structure in front of the initial blasting in the remaining Western portion of the quarry) and a maximum explosive weight of 92kg per delay (assumed 114mm (4 ½”) diameter hole, 3.35m x 3.35m (11’ x 11’) square pattern, 10m bench, 7.5m bulk emulsion column with a density of 1.2g/cc and a 2.5m collar), we calculate the PSPL at the nearest receptor in front to be 125.1dBL.

For a distance of 395 m (i.e. the standoff distance to the closest existing structure behind the commencement of blasting in the remaining Western portion of the quarry, namely 44 Cedar Street) and a maximum explosive weight of 92kg per delay (assumed 114mm (4 ½”) diameter hole, 3.35m x 3.35m (11’ x 11’) square pattern, 10m bench, 7.5m bulk emulsion column with a density of 1.2g/cc and a 2.5m collar), we calculate the PSPL at the nearest receptor to be 121.1dBL.

The closest separation distance between the blasting and an existing sensitive receptor in front of a blast over the lifetime of the quarry is approximately 420m, namely Lot 22 on King Street East. Using a maximum explosive weight of 92kg per delay (assumed 114mm (4 ½”) diameter hole, 3.35m x 3.35m (11’ x 11’) square pattern, 10m bench, 7.5m bulk emulsion column with a density of 1.2g/cc and a 2.5m collar), we calculate the PSPL at the nearest receptor to be 127.4dBL.

With regards to the closest existing sensitive receptor behind a blast over the lifetime of the quarry, namely 44 Cedar Street, we have calculated the closest blast to be approximately 245m. Utilizing the same blasting parameters as above, we can calculate the PSPL at this address to be 123.7dBL.

Given the calculations above, the anticipated overpressure levels at the existing receptors would remain within MOECC guidelines, however, actual PSPL amplitudes will be determined by the on-site monitoring program.

EXPLOTECH

PROPOSED CONDITIONS

With the introduction of the proposed subdivision, the separation distance to the closest receptor in front for the initial blast in the Western quadrant of the quarry would decrease from 550m to 215m. Applying the same blast parameters as above, the calculated overpressure level at the closest proposed receptor for the initial blast would be 133.0dBL, again necessitating the need for design modifications in the event that the residential structures are built prior to the blasting in this area. In order to maintain overpressure compliance at a separation distance of 215m in front of the blast, maximum load per delay would have to be reduced to 16kg. Once again, while this reduced load would result in elevated drill and blast costs, the extraction of the rock would likely remain economically feasible based on current market conditions.

For the initial blast in the Western quadrant, the closest sensitive receptor behind the blast will remain 44 Cedar Street and as such, the existing sensitive receptor will govern design.

The closest separation distance between the blasting and a sensitive receptor in front of a blast in the proposed subdivision over the life of the quarry is approximately 85m. As maximum loads per delay would be below 1kg to maintain compliance with MOECC guidelines, the rock in this area is likely to be sterilized.

The closest separation distance between the blasting and a sensitive receptor behind a blast in the proposed subdivision over the life of the quarry is approximately 60m. Utilizing the same blasting parameters as above, the calculated overpressure at this distance is approximately 130.0dBL.

EXPLOTECH

COMPLIANCE AT SENSITIVE RECEPTOR SETBACK DISTANCES

With plans to develop the proposed subdivision, the setback distances from the blasting operations to the closest sensitive receptor will decrease. Table 2 below provides a guide to maximum loads per delay based on various separation distances in order to ensure compliance with MOECC NPC 119 guidelines. The following maximum loads per delay are derived from the ground vibration attenuation equation and are based on an intensity of 12.5mm/s:

TABLE 2 – Maximum Permissible Load per Delay to Maintain 12.5mm/s at each Respective Setback Distances

Setback Range from Blasting Limits (m)	Maximum Permissible Load Per Delay (kg/delay)
60 – 75	3.75 – 6.0
75 – 100	6.0 – 10.50
100 – 125	10.50 – 16.50
125 – 150	16.50 – 23.75
150 – 175	23.75 – 32.50
175 – 200	32.50 – 42.50
200 – 250	42.50 – 66.50
250 – 300	66.50 – 95.50
300 – 400	95.50 – 170.0
400 – 450	170.0 – 215.0
450+	215.0+

Given that the quarry will be extracted from 207masl to 197masl in the Western part of the site and closest to the sensitive receptors, Table 3 below lists feasible blasting parameters that would effectively fragment the rock for removal based on the setback distance from the nearest sensitive receptor(s). These setback distances from the perspective of the Hagersville Quarry are shown visually in the aerial overview contained in Appendix C. These same distances were also calculated from the perspective of the subdivision to illustrate the encroachment on blasting operations as the development expands and can be shown in the aerial overview contained in Appendix D.

We do note that the yellow line on the Appendix D overview denoting the Lafarge blasting limit has been provided by Empire Communities in reference to the Subdivision Draft Plan 28T 89002 Condition 16 that reads as follows:

“That the owner shall agree to provide a 300 metre minimum separation distance between the point of blasting on the adjacent quarry to the property line of the proposed plan of subdivision, to the satisfaction of the Ministry of the Environment and the Ministry of Natural Resources.”

We are unaware as to what time period this condition was implemented for the development, however, based on conversations with Armstrong Planning personnel, it is estimated that this condition was implemented into the site plan in 1989.

Explotech does make reference to small portions of rock remaining in the Western most area of the quarry that falls within the aforementioned 300m separation distance. Based on the blasting limit established in 1989, it is assumed that this limit will be respected and no blasting is to occur South of blasting limit line noted in Appendix D.

Note that the listed designs below represent a select few of many possible designs which could be implemented on site.

TABLE 3 – Typical Blasting Parameters within Maximum Permissible Load per Delays

Setback Distance from Blasting Limits to Nearest Sensitive Receptor(s) (m)	Maximum Permissible Load Per Delay (kg/delay)	Typical Blasting Parameters

60 – 75	3.75 – 6.0	• 76mm (3”) Hole Diameter
		• 1.2m x 1.2m (4’ x 4’) Pattern
		• 5m Bench
		• Two (2) Decks of Explosives
		  o 3.5 Sticks of Emulsion (50x400)
		  o 0.9m Stemming Deck
		• 1.3m Surface Collar
		• 1.0 Powder Factor

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75 – 100	6.0 – 10.50	• 76mm (3”) Hole Diameter
		• 1.5m x 1.5m (5’ x 5’) Pattern
		• 10m Bench
		• Four (4) Decks of Explosives
		  o 4 Sticks of Emulsion (65x400) per Deck
		  o 0.6m Stemming Deck
		• 1.7m Surface Collar
		• 1.1 Powder Factor

100 - 125	10.50 – 16.50	• 76mm (3”) Hole Diameter
		• 1.8m x 1.8m (6’ x 6’) Pattern
		• 10m Bench
		• Three (3) Decks of Bulk Explosives
		  o Three 2m explosive decks
		  o 1.0m Stemming Deck
		• 2.0m Surface Collar
		• 1.0 Powder Factor

125 – 150	16.50 – 23.75	• 89mm (3 ½”) Hole Diameter
		• 2.1m x 2.1m (7’ x 7’) Pattern
		• 10m Bench
		• Three (3) Decks of Bulk Explosives
		  o Three 2m Explosive Decks
		  o 1.0m Stemming Decks
		• 2.0m Surface Collar
		• 1.0 Powder Factor

150 – 175	23.75 – 32.50	• 101mm (4”) Hole Diameter
		• 2.4m x 2.4m (8’ x 8’) Pattern
		• 10m Bench
		• Three (3) Decks of Bulk Explosives
		  o Three 2m Explosive Decks
		  o 1.0m Stemming Deck
		• 2.0m Surface Collar
		• 1.0 Powder Factor

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175 - 200	32.50 – 42.50	• 101mm (4”) Hole Diameter
		• 2.7m x 2.7m (9’ x 9’) Pattern
		• 10m Bench
		• Two (2) Decks of Bulk Explosives
		  o Two 3.5m Explosive Decks
		  o 1.0m Stemming Deck
		• 2.0m Surface Collar
		• 0.94 Powder Factor

200 - 250	42.50 – 66.50	• 114mm (4 ½”) Hole Diameter
		• 3m x 3m (10’ x 10’) Pattern
		• 10m Bench
		• Two (2) Decks of Bulk Explosives
		  o Two 3.5m Explosive Decks
		  o 1.0m Stemming Deck
		• 2.0m Surface Collar
		• 0.92 Powder Factor

250 - 300	66.50 – 95.50	• 114mm (4 ½”) Hole Diameter
		• 3m x 3m (10’ x 10’) Pattern
		• 10m Bench
		• Two (2) Decks of Bulk Explosives
		  o Two 3.5m Explosive Decks
		  o 1.0m Stemming Deck
		• 2.0m Surface Collar
		• 0.92 Powder Factor

300 - 400	95.50 – 170.0	• 114mm (4 ½”) Hole Diameter • 3.4m x 3.4m (11’ x 11’) Pattern • 10m Bench • 8m Bulk Explosive Column Load • 2.0m Collar • 0.84 Powder Factor
400 - 450	170.0 – 215.0	• 152mm (6”) Hole Diameter • 4.6m x 4.6m (15’ x 15’) Pattern • 10m Bench • 7.5m of Bulk Emulsion (1.2g/cc) (163kg) and Booster (0.45kg) • 2.5m Collar • 0.77 Powder Factor

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450+	215.0+	• 178mm (7”) Hole Diameter • 4.9m x 4.9m (16’ x 16’) Pattern • 10m Bench • 7m of Bulk Emulsion (1.2g/cc) (209kg) and Booster (0.45kg) • 3m Collar • 0.87 Powder Factor

While the above blasting parameters provide technically feasible ways of remaining within MOECC guidelines at the nearest receptors, the economic efficiency of such parameters will differ with each given separation distance.

Based on the above calculations and baseline blast design assumed (114mm (4 ½”) diameter hole, 3.35m x 3.35m (11’ x 11’) square pattern, 10m bench, 7.5m bulk emulsion column with a density of 1.2g/cc and a 2.5m collar), the development of the subdivision will impact drill and blast costs to a separation distance of approximately 300m. The extent of these additional costs will naturally reduce as the separation distance increases. The majority of the cost escalation is associated with increases in the cost of drilling. As an example, decreasing hole diameter from 114mm (4 ½”) to 89mm (3 ½”) increases drill costs in the order of 40% as a result of the necessity for additional holes. Blast costs will still increase with decreased hole diameters as a result for the need for additional supplies (caps and boosters) and labour, however, these escalations are far less than those associated with the drilling portion of the operation.

For rock lying within the 60m to 100m radius from the closest unit in the proposed subdivision, this area is likely to be sterilized for economic reasons. Due to the significantly elevated costs associated with blast designs at this separation distance, the costs associated with blasting to compliance at this distance would remain economically impractical based on today’s market conditions.

Beyond approximately a 100m separation distance, drilling and blasting could be economically feasible, however, costs associated with the drill and blast program will be significantly elevated. As previously noted, these cost escalations would systematically reduce as separation distances increase to the point where they are eliminated at a separation distance of approximately 300m. We note that several existing properties adjacent to the Hagersville Quarry currently reside closer that 300m. As such, it is likely Lafarge would be aware of the anticipated alterations in their blasting parameters required in order to remain compliant at these existing properties.

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CONCLUSION

Based on the predicted and measured peak particle velocities and overpressures at the Lafarge Hagersville Quarry, it is the opinion of Explotech Engineering Ltd. that the planned development of the Gardens Communities Subdivision can coexist with the Lafarge mineral extraction operations, within the requirements stipulated under the Ministry of the Environment and Climate Change (MOECC) Model Municipal Noise Control By-law (NPC 119) with regard to Guidelines for Blasting in Mines and Quarries. However, while the above information holds true, the development of residential structures as close as 60 meters to the Hagersville Quarry will require dramatic alterations to blasting parameters and subsequent increase in blasting costs to remain in compliance with MOECC guidelines at this distance.

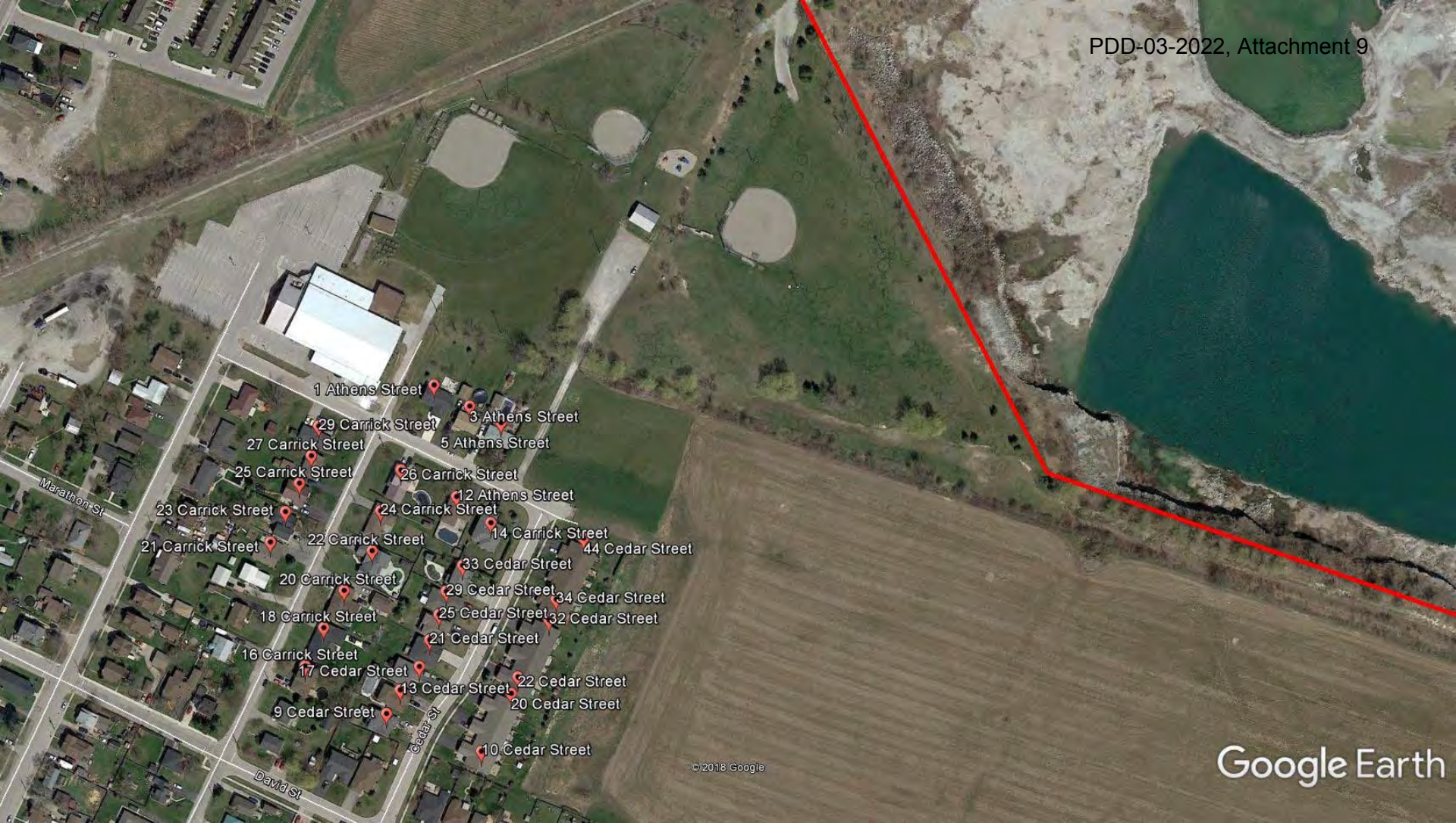
Appendix A

Proposed Sensitive Receptor Overview


EXTRACTIVE INDUSTRY
STREET H
STREET I
ATHENS STREET EXTENSION
Block 43
Park
0.37 ha
Block 42
Max. 9 units
@ min. 8.0m
0.24 ha
Block 21
Max. 44 units @ min. 8.0m
1.19 ha
Block 20
Max. 53 units @ min. 8.0m
1.43 ha
Block 23
Max. 16 units @ min. 8.0m
0.38 ha
Block 24
Max. 17 units @ min. 8.0m
0.39 ha
Block 18
Max. 17 units @ min. 8.0m
0.40 ha
Block 17
Max. 17 units @ min. 8.0m
0.44 ha
Block 39
Max. 6 units
@ min. 8.0m
0.16 ha
Block 36
Max. 5 units
@ min. 8.0m
0.15 ha
STREET A
STREET B
STREET C
STREET D
STREET E
STREET F
STREET G
Phase Two
Phase One
Block 44
Park
1.12 ha
Block 45
Future Development
© 2018 Google
Google Earth

Appendix B

Existing Sensitive Receptor Overview


1 Athens Street
3 Athens Street
29 Carrick Street
5 Athens Street
27 Carrick Street
25 Carrick Street
26 Carrick Street
12 Athens Street
Marathon St
23 Carrick Street
24 Carrick Street
14 Carrick Street
21 Carrick Street
22 Carrick Street
44 Cedar Street
33 Cedar Street
20 Carrick Street
29 Cedar Street
34 Cedar Street
18 Carrick Street
25 Cedar Street
32 Cedar Street
21 Cedar Street
16 Carrick Street
17 Cedar Street
22 Cedar Street
13 Cedar Street
20 Cedar Street
9 Cedar Street
Cedar St
10 Cedar Street
David St
© 2018 Google
Google Earth

Appendix C

Quarry Setback Distance Overview

PDD-03-2022, Attachment 9

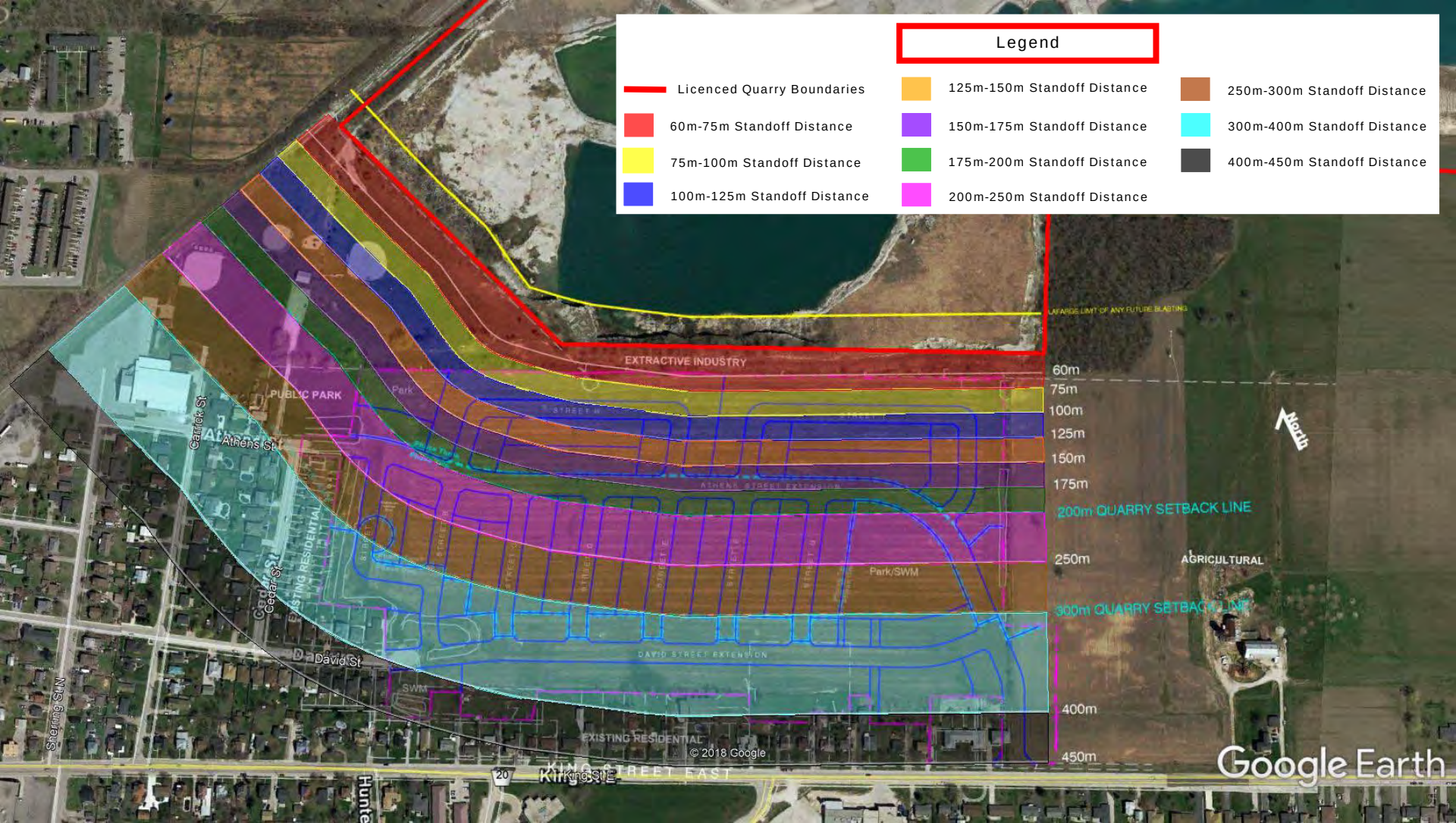
Legend

- Licenced Quarry Boundaries
- 60m-75m Standoff Distance
- 75m-100m Standoff Distance
- 100m-125m Standoff Distance
- 125m-150m Standoff Distance
- 150m-175m Standoff Distance
- 175m-200m Standoff Distance
- 200m-250m Standoff Distance
- 250m-300m Standoff Distance
- 300m-400m Standoff Distance
- 400m-450m Standoff Distance
- 450m+ Standoff Distance

Google Earth

Appendix D

Subdivision Setback Distance Overview


Legend
Licenced Quarry Boundaries
60m-75m Standoff Distance
75m-100m Standoff Distance
100m-125m Standoff Distance
125m-150m Standoff Distance
150m-175m Standoff Distance
175m-200m Standoff Distance
200m-250m Standoff Distance
250m-300m Standoff Distance
300m-400m Standoff Distance
400m-450m Standoff Distance
LAFARGE LIMIT OF ANY FUTURE BLASTING
EXTRACTIVE INDUSTRY
60m
75m
100m
125m
150m
175m
200m QUARRY SETBACK LINE
250m
300m QUARRY SETBACK LINE
400m
450m
North
AGRICULTURAL
PUBLIC PARK
Park
Park/SWM
SWM
EXISTING RESIDENTIAL
EXISTING RESIDENTIAL
Carrick St
Athens St
Cedar St
David St
ATHENS STREET EXTENSION
DAVID STREET EXTENSION
Spring St N
Hunter St
20
KINGSTREET EAST
© 2018 Google
Google Earth

Appendix E

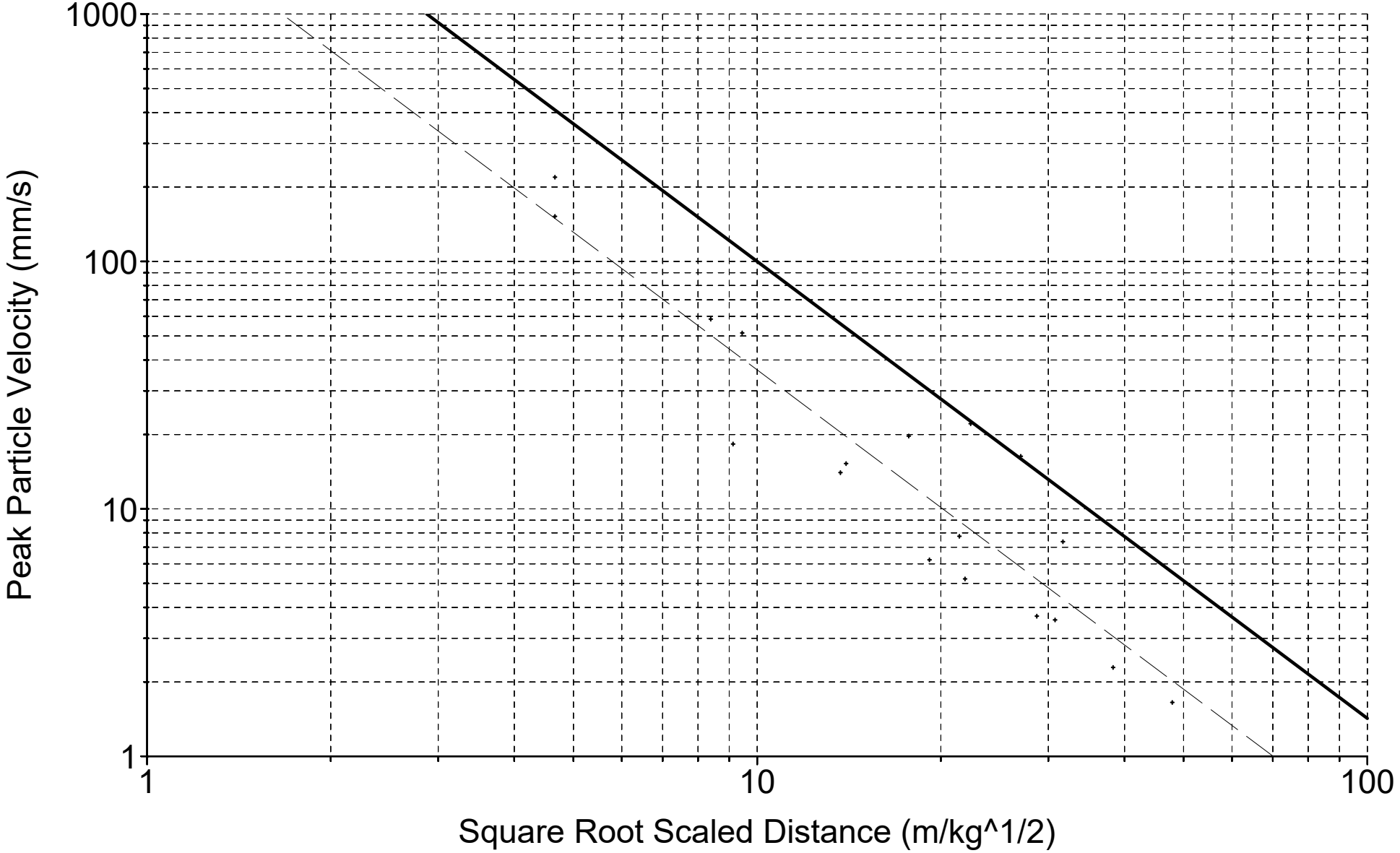
Regression Line for Calculated Quarry Blasts

Regression Behind the shot

Regression Line For M3932A AECON 2003 BEHIND.SDF

95% Line Equation: V = 7025.0 * (SD)^(-1.847)

Coefficient of Determination = 0.854 Standard Deviation = 0.219



Appendix F

Curriculum Vita of Report Writers

EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

Robert J. Cyr, P. Eng.

Principal, Explotech Engineering Ltd.

EDUCATION

Bachelor of Applied Science,
Civil Engineering, Queen's University

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers of Ontario (APEO)
Association of Professional Engineers and Geoscientists of BC (APEG)
Association of Professional Engineers, Geologists and Geophysicists of Alberta
Association of Professional Engineers and Geoscientists of New Brunswick
Association of Professional Engineers of Nova Scotia
Association of Professional Engineers and Geoscientists Manitoba
Professional Engineers and Geoscientists Newfoundland and Labrador
International Society of Explosives Engineers (ISEE)
Aggregate Producers Association of Ontario (APAO)
Surface Blaster Ontario Licence 450109

SUMMARY OF EXPERIENCE

Over thirty years experience in many facets of the construction and mining industry has provided the expertise and experience required to efficiently and accurately address a comprehensive range of engineering and construction conditions. Sound technical training is reinforced by formidable practical experience providing the tools necessary for accurate, comprehensive analysis and application of feasible solutions. Recent focus on vibration analysis, blast monitoring, blast design, damage complaint investigation for explosives consumers and specialized consulting to various consulting engineering firms.

PROFESSIONAL RECORD

2001 – Present	-Principal, Explotech Engineering Ltd.
1996 – 2001	-Leo Alarie & Sons Limited - Project Engineer/Manager
1993 – 1996	-Rideau Oxford Developments Inc. – Project Manager
1982 – 1993:	-Alphe Cyr Ltd. – Project Coordinator/Manager

Matt Morling

Explotech Engineering Ltd.

EDUCATION

Police Foundations,
Algonquin College

Human Resources Management,
Algonquin College

PROFESSIONAL AFFILIATIONS

International Society of Explosives Engineers (ISEE)

SUMMARY OF EXPERIENCE

Hard-working and motivated, Matt holds multiple diplomas from Algonquin College. Strong leadership skills who works well in a team oriented environment and excels in communication. Matt has the ability to manage projects and thrive under various pressure intensive situations. Recent projects have focused on vibration analysis, job estimation, blast monitoring and damage complaint investigations.

PROFESSIONAL RECORD

2013 – Present - Technician, Explotech Engineering Ltd.

APPENDIX D

Blast Impact Analysis to Include Newly Acquired Lands, prepared by Explotech dated August 27, 2018

EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

August 27, 2018

IBI Group
410 Albert Street, Suite 101
Waterloo, Ontario
N2L 3V3

Attention: Mr. David Sisco

Re: Gardens Communities Subdivision Land Use Compatibility Study
Report Amendment – Blast Impact Analysis to Include Newly Acquired Lands

EXECUTIVE SUMMARY

Explotech Engineering Ltd. was retained in October 2017 to provide a Blast Compatibility Analysis for the proposed Gardens Communities Subdivision Development located on Part of Lot 30, Range East of Plank Road and Part of Lot 26, Registrar's Complied Plan 73 (Geographic Township of Oneida), Town of Hagersville, Haldimand County. Specifically, this study was undertaken to identify land use compatibility issues between the proposed residential development and the existing blasting operations ongoing at Lafarge Canada's Hagersville Quarry located to the North of the proposed subdivision.

On November 11, 2017, Explotech Engineering Ltd. completed a site visit of the development area and reviewed all available site maps and operational plans provided by Empire Communities. Our analysis of the predictable derivatives associated with the blasting concluded that the planned subdivision development can coexist with the adjacent mineral extraction operations at Lafarge Canada's Hagersville Quarry in a safe manner and within Ministry of the Environment, Conservation and Parks (MEPC) guidelines. Notwithstanding, Explotech did make note that the development of the residential subdivision may impose the need for operational changes at the Lafarge Hagersville Quarry, depending on the specific location of future blasting and standard blasting practices at the quarry.

On August 21, 2018, Explotech was advised that additional lands had been purchased by Gardens Communities (Hagersville) Ltd. for the purpose of increasing the size of the originally planned subdivision. The newly acquired land is located directly to the East of Phases 1 and 2 of the proposed subdivision and is bound by the Lafarge Hagersville Quarry to the North, King Street East to the South and open farm land and sparse residential homes to the East (refer to Appendix A). In light of this, Explotech has again been retained to discuss the impacts of the newly acquired land on the existing Lafarge Canada Hagersville Quarry and on the proposed subdivision development. This brief report summarizes our findings.

EXPLOTECH

INTRODUCTION

The comments contained within this report are supplemental to those provided in the Phase 1 and 2 study and report titled *Hagersville Subdivision Land Compatibility Study – Final Revision 1* submitted by Explotech on April 30, 2018. New land has been acquired by the developer for the purpose of constructing additional residential properties in the vicinity of the adjacent Lafarge Hagersville Quarry. This newly acquired land is situated directly to the East of Phases 1 and 2 of the original subdivision development and directly to the South of the Lafarge Hagersville Quarry.

This brief Blast Compatibility Analysis has been prepared to assess the potential for the newly acquired Gardens Communities Subdivision lands to coexist with the adjacent Lafarge Hagersville Quarry in accordance with requirements stipulated under the MEPC NPC 119 with regard to Guidelines for Blasting in Mines and Quarries. Additionally, we have investigated the need for any special provisions or operational changes required at either property in order to permit or maintain reasonable use.

IMPACTS OF NEWLY ACQUIRED LAND AREA

With this latest land purchase, the Gardens Communities Subdivision property now fronts onto the entirety of the Southern boundary of the Hagersville Quarry. Unfortunately to date, Explotech has not received current blasting parameters or specific locations of ongoing blasting operations at the quarry. As such, for the purposes of both reports, a maximum permissible load table and typical blasting parameters for given setback distances was developed to account for any given location at which blasting is currently being conducted. The setback distances as noted in the report from the perspective of the Hagersville Quarry can be found in Appendix C of the April 30, 2018 report. These same setback distances were also calculated from the perspective of the subdivision to illustrate the encroachment on blasting operations as the development expands and can be shown in Appendix D of the aforementioned report. The inclusion of the newly acquired land area has necessitated the need for a revised setback distance overview from the perspective of both the Hagersville Quarry and Gardens Communities Subdivision. These revised aerial overviews can be found attached to this report in Appendix B and C respectively.

At this time, Explotech is not in possession of any construction drawings relating to the exact location of the construction of residential properties in the newly acquired land area. As such, we have assumed that the approximate setback distances from the newly constructed homes to the Hagersville Quarry is the same as the drawings for Phase 2 of the originally proposed development. This would dictate that the closest point of blasting operations would be in the order of 60m from the closest proposed sensitive receptor (i.e. new residence). In light of this, ground vibration and air overpressure calculations remain the same as noted in the April 30, 2018 report.

We do note that in the previously submitted report, Explotech made mention of the escalation in drill and blast costs associated with the construction of Phase 2 of the proposed subdivision encroaching on the adjacent Hagersville Quarry. The development of residential properties on the newly acquired land will further increase these costs as maximum allowable loads will require reduction over a significantly greater footprint area as blasting operations progress across the quarry. To reiterate, any rock situated from 60m to 100m from the closest sensitive receptor in both proposed areas of the subdivision is likely to be sterilized due to economic reasons. Any excavation beyond a 100m setback distance is likely to remain economically feasible. However, costs associated with the drill and blast program are likely to be significantly elevated. Once again, the inclusion of the newly acquired lands for the Gardens Communities Subdivision significantly increases the surface area over which these escalated costs and sterilized rock factor into the Lafarge drill and blast program.

CONCLUSION

Based on the predicted peak particle velocities and overpressures at the Lafarge Hagersville Quarry as concluded in the *Hagersville Subdivision Land Compatibility Study – Final Revision 1* and the same assumed setback distances, it is the opinion of Explotech Engineering Ltd. that the planned development on the newly acquired Gardens Communities Subdivision lands can coexist with the Lafarge mineral extraction operations, within the requirements stipulated under the Ministry of the Environment, Conservation and Parks (MEPC) Model Municipal Noise Control By-law (NPC 119) with regard to Guidelines for Blasting in Mines and Quarries. However, while the above information holds true, the development of additional residential structures in the newly acquired area will cause to effect alterations to blasting parameters and subsequent increase in blasting costs over a significantly greater footprint area within the quarry to remain in compliance with MEPC guidelines than noted in the original April 30, 2018 report.

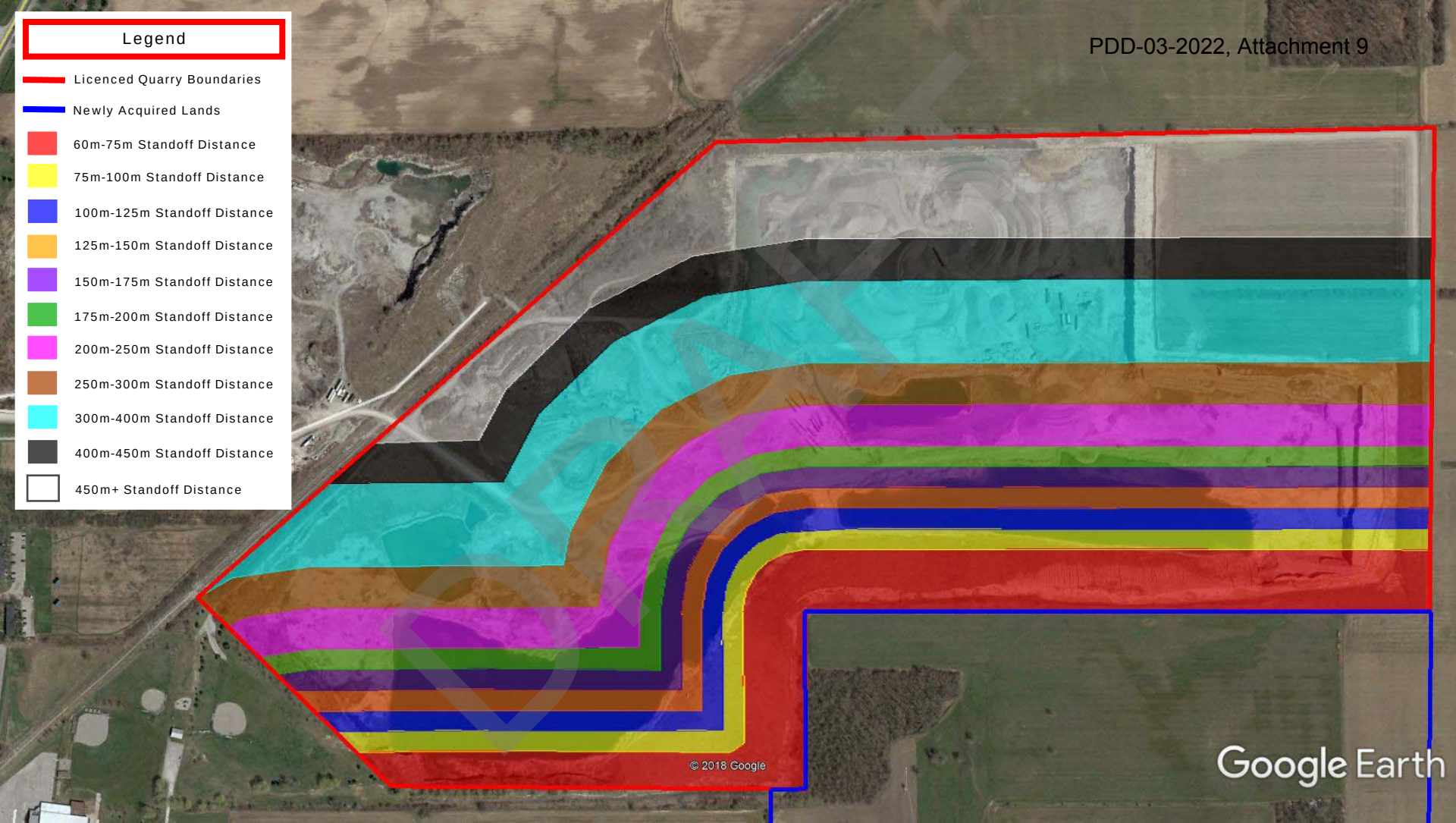
Appendix A

Newly Acquired Land Area


PDD-
Legend
Licenced Quarry Boundaries
Newly Acquired Lands
Athens St
Cedar St
David St
20
King St E
© 2018 Google
Google Earth

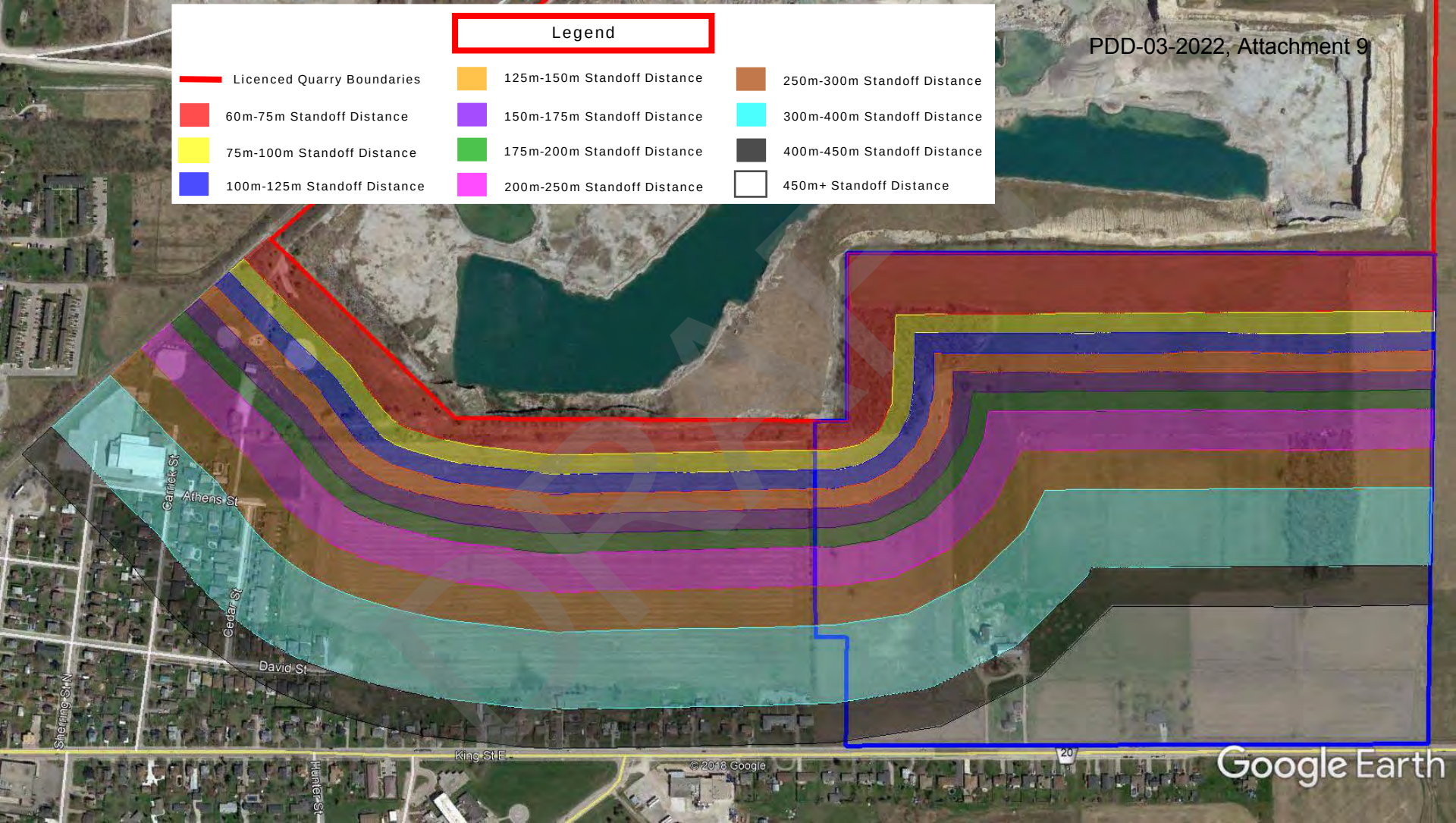
Appendix B

Hagersville Quarry Blasting Setback Distance Overview


Legend
Licenced Quarry Boundaries
Newly Acquired Lands
60m-75m Standoff Distance
75m-100m Standoff Distance
100m-125m Standoff Distance
125m-150m Standoff Distance
150m-175m Standoff Distance
175m-200m Standoff Distance
200m-250m Standoff Distance
250m-300m Standoff Distance
300m-400m Standoff Distance
400m-450m Standoff Distance
450m+ Standoff Distance
© 2018 Google
Google Earth

Appendix C

Subdivision Setback Distance Overview


Legend
Licenced Quarry Boundaries
60m-75m Standoff Distance
75m-100m Standoff Distance
100m-125m Standoff Distance
125m-150m Standoff Distance
150m-175m Standoff Distance
175m-200m Standoff Distance
200m-250m Standoff Distance
250m-300m Standoff Distance
300m-400m Standoff Distance
400m-450m Standoff Distance
450m+ Standoff Distance
PDD-03-2022, Attachment 9
Carrick St
Athens St
Cedar St
David St
Sherring St N
King St E
Hunter St
20
©2018 Google
Google Earth

Appendix C

- **Writer's Resume**

Ray Jambakhsh, M.Sc., P.Eng.

Subject Matter Expert, Explosives, Blasting & Vibrations

Education & Training

B.Sc. Civil/Mining Engineering, Laurentian University, Sudbury, Ontario. (1984)

M.Sc. Applied Physics, Laurentian University, Sudbury, Ontario. (1990)

MIT Executive Management - Pending

Memberships:

- Association of Professional Engineers of Ontario (PEO)
- Association of Professional Engineers and Geoscientists of New Brunswick (APEGNB)
- Designated Consultant by PEO
- International Society of Explosives Engineers (ISEE)
- Licensed Surface Blaster in the Province of Ontario
- Licensed Surface Blaster in the Province of Alberta
- Licensed Surface Blaster in the Province of New Brunswick

Roles:

Ray Jambakhsh has underground and surface mining experience and has been involved in numerical modeling as a rock mechanics engineer for a major Canadian mining firm. He has also been instrumental in design, introduction, and implementation of electric and non-electric sequential blasting techniques for underground (VCR/VRM), open pit and quarry applications, building demolition by blasting, pipeline blasting, marine blasting, and highway blasting projects. He has handled blast vibration monitoring, vibration risk analysis, vibration and noise impact analysis, blasting audits, foundation failure assessments and damage complaints for insurance companies, law firms, government agencies, and contractors. Ray specializes in explosives, explosives demolition, explosion impact analysis, rock fragmentation, rock-face stability, rock blasting and vibrations.

Selected Professional Experience

DST Consulting Engineers Inc., Sudbury ON 2004 to Present

Role: Senior Principal and Senior Rock & Blasting Engineer

Responsibilities: Recognised both nationally and internationally for his blasting expertise, with over 20 years of experience. Responsible for senior review, project management and delivery of blasting and vibration services to the construction, demolition, mining, pipeline, energy and public service sectors, including: blast design; modelling, control and monitoring, vibration and overpressure monitoring, locally and remotely; damage criteria development for vibration; overpressure and flyrock; pre-blast and post-blast surveys; blast damage claim investigation; expert testimony; blast design to optimise fragmentation; dilution and environmental impact; vibration signature analysis and diagnostics; blast performance evaluation and optimization; fragmentation analysis; rock-face stabilization analysis; environmental impact analysis; blast safety and general blast information, training; blast demolition design.

Ray-Tech Engineering Limited, Sudbury ON 2003 to 2004

Role: President – Blasting Services to the Underground and Surface Mining Industries

Responsibilities: Rock mechanics engineering including numerical modelling. Instrumental in the design, introduction and implementation of electric and non-electric sequential blasting techniques for underground (VCR/VRM) open pit and quarry applications, building demolition, blasting, pipeline blasting, marine blasting and highway blasting projects. Blast monitoring, risk analysis, vibration and noise impact analysis, blasting audits and blast damage complaints investigation for major blasting consultants, insurance companies, law firms, and contractors. Specialties include explosives, explosives demolition,

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Subject Matter Expert, Explosives, Blasting & Vibrations

explosion impact, blasting and vibrations. Responsible for business development and project acquisition. Technical responsibility for blast design and review, sequencing, charge placement and blasting on demolition projects, drilling and blasting operations, blast design, vibration control and wall control, seismic monitoring and blasting safety advice, blast consulting services, impact analysis, pre-blast surveys, impact attenuation design and vibration impact prediction to a variety of industry sectors. Extensive project experience with mining and exploration companies, highway construction, and site preparation for private industry.

Other Professional Experience 1986 to 2003:

- *Golder Associates Limited*, Senior Blasting Engineer
- *Explotech Engineering Ltd.,* General Manager
- *Explotech Engineering Ltd.,* Project Engineer
- *B.H.M Consultants Limited*, Field Engineer
- *Kidd Creek Mines Limited,* Engineer in Training
- *Centre in Mining and Mineral Exploration Research,* Researcher

Selected Project Experience

Key Demolition Projects:

- Client – Budget Demolition/Rakowski – Demolition of Vale Stobie #9 Concrete Headframe by blasting – Site blasting engineer and blaster-in-charge responsible for design, implementation and supervision of the demolition by blasting, December 10, 2020.
- Client – Demolition Plus/Rakowski – Nutrien Penobsquis Mine Headframe and Ore-bin Structures - Site blasting engineer and blaster-in-charge responsible for design, implementation and supervision of the demolition by blasting, October 18-20, 2019.
- Client – Demolition Plus – Demolition of stack at Graphic Packaging International Plant, Jonquiere, Quebec. Site blasting engineer responsible for design, implementation and supervision of the demolition by blasting, October 8, 2019.
- Client – Delsan-A.I.M./Rakowski Cartage & Wrecking Limited – Demolition Boiler Building Complex at Nanticoke OPG GS plant, Nanticoke, Ontario. Site blasting engineer and blaster-in-charge responsible for design, implementation and supervision of the demolition by blasting, August 22, 2019.
- Client – Delsan-A.I.M./Rakowski Cartage & Wrecking Limited – Demolition of supper stacks at Nanticoke OPG GS plant, Nanticoke, Ontario. Site blasting engineer and blaster-in-charge responsible for design, implementation and supervision of the demolition by blasting, February 28, 2018.
- Client – Rakowski Cartage & Wrecking Limited – Demolition of Robertson Headframe Building, Yellowknife, Northwest Territories. Site blasting engineer responsible for design, implementation and supervision of the demolition by blasting, October 29, 2016.
- Client – Cambrian Blasting Co. Ltd. – Demolition CP Rail Transcona Smokestack, Winnipeg, Manitoba. Site blasting engineer responsible for design, implementation and supervision of the demolition by blasting, October 23, 2016.

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- Client – Rakowski Cartage & Wrecking Limited – Demolition of Traffic Bridge, Saskatoon, Saskatchewan. Site blasting engineer and blaster-in-charge responsible for design, implementation and supervision of the demolition by blasting, January 10, 2016.
- Client – Rakowski Cartage & Wrecking Limited – Demolition of P&H Grain Elevator, Saskatoon, Saskatchewan. Site blasting engineer and blaster-in-charge responsible for design, implementation and supervision of the demolition by blasting, June 24, 2015.
- Client – Quantum Murray LP – Demolition of PCS Potash Cassidy Lake Dry-mill & Load-out Buildings in New Brunswick by blasting. Site blasting engineer responsible for the explosive demolition of the structures, April 23, 2015.
- Client – JMX Demolition Contractors - Demolition of the 150' Stack at the North Bay Psychiatric Hospital. Site blasting Engineer in charge of blast design, explosives loading, blasting and vibration monitoring, February 23, 2013.
- Client – Rakowski Cartage & Wrecking Limited - Demolition of St. Jean Baptist Bridge over Red River, St. Jean Baptist, Manitoba. Site blasting engineer responsible for design, implementation, vibration monitoring and pre-blast survey, February 16, 2013.
- Client – Delsan-AIM Demolition Group – Demolition of the 250' Stack at the New Brunswick Power Grand Lake GS. Site blasting Engineer in charge of blast design, explosives loading, blasting, vibration monitoring and pre-construction surveys, April 20, 2012.
- Client – Rakowski Cartage & Wrecking Limited - Demolition of Cargill Grain Elevator, Calgary, Alberta. Site blasting engineer and blaster-in-charge responsible for design, implementation and supervision of the demolition by blasting, October 16, 2011.
- Client – Goldcorp – Paymaster Mine Head Frame demolition by blasting. Responsible for design, sequencing preparation, charge placement and blasting. Timmins, Ontario, May 27, 2011.
- Client – Goldcorp – Old Hollinger Mine Head Frame demolition by blasting. Responsible for design, sequencing preparation, charge placement and blasting. Timmins, Ontario, February 20, 2011.
- Client – Rakowski Cartage & Wrecking Limited - Demolition of North Main Head Frame, Hudson Bay Mining & Smelting Company, Flin Flon, Manitoba. Site blasting engineer responsible for design, implementation and supervision of the demolition by blasting, December 5, 2010.
- Client – Goldcorp – Broulan Head Frame demolition by blasting. Responsible for design, sequencing preparation, charge placement and blasting. Timmins, Ontario, December 22, 2009.
- Client – Rakowski Cartage & Wrecking Limited – Demolition of South Main Head Frame, Hudson Bay Mining & Smelting Company, Flin Flon, Manitoba. Site blasting engineer responsible for design, implementation and supervision of the demolition by blasting, July 27, 2009.
- Client – Delsan - AIM Demolition and Environnemental Services – Xstrata Gaspe Mine Site, Murdochville, Quebec. Responsible for design, sequencing, charge placement and blasting of steel ore bin building, December 9, 2008.
- Client - City of Ottawa – Frank Clair Stadium Demolition by Blasting – Responsible for specification writing, site supervision and blasting safety, July 16, 2008.
- Client – Delsan - AIM Demolition and Environmental Services – Abitibi Stephenville Paper Mill Site, Newfoundland. Responsible for design, sequencing, charge placement and blasting of multiple structures on site, June 3, 2008.
- Client – B. Curry & Sons Limited – Phalen Mine Rotary Crusher Building demolition by blasting, Sydney, Nova Scotia. Responsible for design, sequencing, charge placement and blasting, June 18, 2007.
- Client – Rakowski Cartage & Wrecking Limited – Winnipeg Arena demolition by blasting, Winnipeg, Manitoba. Responsible for design review, sequencing, charge placement and blasting, March 26, 2006.

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Subject Matter Expert, Explosives, Blasting & Vibrations

- Client – Lac des Iles Mines Limited – Old Mill Transfer House Building demolition by blasting, Thunder Bay, Ontario. Responsible for design, sequencing, charge placement and blasting, June 16, 2005.
- Client - Rakowski Cartage & Wrecking Limited – AGPRO Grain Storage Building demolition by blasting, Winnipeg, Manitoba, June 12, 2005.
- Client – Noranda Inc. – Noranda Inc. Gaspe Site, Murdochville, Quebec. A 550-foot Smoke Stack demolition by blasting. Responsible for design, sequencing, charge placement and blasting, October 13, 2003.
- Client - Aim Waste Management Group – London Health Science Centre Incinerator Stack demolition by blasting, London, Ontario. Responsible for design, sequencing, charge placement and blasting, May 10, 2003.
- Client - Denison Environmental Services –Inco's Shebandowan # 2 Shaft Head-frame demolition by blasting, Shebandowan, Ontario. Responsible for design, sequencing, charge placement and blasting, August 18, 2001.
- Client - Cambrian Blasting Limited – Lafarge Twin-Stack demolition by blasting, Winnipeg, Manitoba. Responsible for design, sequencing, charge placement and blasting, June 10, 2001.
- Client - Rakowski Cartage & Wrecking Limited - Canada Packers Building demolition by blasting, Winnipeg Manitoba. Responsible for design, sequencing, charge placement and blasting, March 4, 2001.
- Client - Rakowski Cartage & Wrecking Limited – Centragas Steel Propane Storage Tank demolition by blasting, Winnipeg Manitoba. Responsible for design review, sequencing, charge placement and blasting, October 22, 2000.
- Client - Maceron Limited – Inco's Little Stobie Mine, Reinforced Concrete Head Frame demolition by blasting, Sudbury, Ontario. Responsible for design, loading, sequencing and blasting, December 1999.
- Client - Techplode Limited – Robie Street Water Reservoir Dome demolition by blasting, Halifax, Nova Scotia. Responsible for design review, approval, loading, sequencing and blasting, October 1999.
- Client - A & E Enterprises – Demolition of the Proctor & Gamble Building by means of blasting, Hamilton, Ontario. Designated site blasting engineer and consultant, responsible for the blast design review, approvals, and site supervision, October 1999.
- Client - LebRun Northern Contracting Limited – Ontario Hydro's 110 m Smoke Stack demolition by blasting, Mission Island, Thunder Bay, Ontario. Responsible for blast design review, pre-blast survey, seismic monitoring, impact attenuation design and vibration impact prediction, September 1998.
- Client - Stanley Buildings and Alberta Public Works Commission – Bow Valley Centre (Calgary General Hospital) demolition by blasting, Calgary Alberta. Responsible for blast design review, blast impact analysis, safety review and seismic monitoring, October 1998.
- Client - Abitibi Consolidated, Fort William Division – Triple Tower Acid Silo demolition by blasting, Thunder Bay, Ontario. Responsible for blast design, explosives loading, blasting sequence, seismic monitoring and blasting safety, December 1998.
- Client - Corona Inc. – Denison Mine Pebble Bin and Ore Silo demolition by blasting, Elliot Lake, Ontario. Responsible for blast design, explosives loading, blasting sequence, seismic monitoring and blasting safety, September 1995.
- Client - Matthews Group – Portage Dam demolition by blasting, Dokis, Ontario. Responsible for blast design, explosives loading, blasting sequence, seismic monitoring and blasting safety, November 1992.
- Client - Various Contractors – St. Lawrence Seaway (Welland Canal) demolition by blasting, St. Catharines, Ontario. Site blasting engineer in charge of blast design implementation, explosives loading, blasting sequence, seismic monitoring and blasting safety, January 1990, 1991, 1992/

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KEY CIVIL PROJECTS

- Client – Various Quarry Operators – Blast Impact Analysis and Assessment, various quarries in Ontario, 1999 to present.
- Client – Various Contractors – MTO 400 Series Highway Constructions – Consulting on rock blasting and rock-face stability, various MTO contracts along old Hwy 69, 17, and 11, 2002 to present.
- Client – Kiewit-Alarie, A Partnership (KAP) – Blast Consulting Services at the Hound Chute and Sandy Falls Hydro Electric Project – September 2008.
- Client – Consbec Inc., Leo Alarie and Sons Limited, SNC Lavalin – Blast Consulting Services at the Ear Falls OPG new hydro dam construction, 2004.
- Client – Consbec Inc. – Blast Consulting Services at the Wuskwatim GS, Manitoba Hydro, Thompson, Manitoba, June – November 2008.
- Client - Union Gas – Installation of Lateral and Distribution Gas Lines, various locations in Ontario. Blasting consultant responsible for blast design review, approvals, pre-blast surveys, vibration monitoring and blasting safety, 1997 – present.
- Client – Laurentian University and Dennis Consultants – Site preparation blasting for Laurentian Health Science Centre. Responsible for preparing blasting specifications, blast vibration monitoring audit and site risk assessment on several contracts. 2003 – 2005.
- Client - Castonguay Blasting Limited - Proposed Highway 400 Four Lane Project, various MTO contracts. Blast consulting engineer responsible for risk analysis, blast design approvals, vibration monitoring, and pre-blast survey requirements. 2003- 2010.
- Client - Belanger Construction Limited – Laurentian Hospital Expansion Project. Blast consulting engineer responsible for blast design, vibration monitoring and site supervision during rock excavation phase of the project. 1999 – 2007.
- Client - Interpaving Limited – Dynamic Earth Project in Sudbury Ontario. Responsible for blast design, vibration control and wall control. Summer 2001.
- Client - Home Depot – Responsible for the drilling and blasting operations for site preparation of the Home Depot building in Sudbury, Ontario, August – November, 2000.
- Client - Castonguay Blasting Limited – Proposed Highway 400 Four Lane Project, Parry Sound, Ontario. Blast consulting engineer responsible for risk analysis of drilling and blasting operations, November 2000 – 2002.
- Client - Dyna-Con Explosive Technologies – Proposed Highway 400 Four Lane Project, Parry Sound, Ontario. Blast consulting engineer responsible for all aspects of drilling and blasting operations, November 1999 – 2003.
- Client - TransCanada PipeLines Limited (TCPL) – High Pressure Gas Line Installation, along TCPL's right-of-way, in Ontario and Manitoba. Associate consulting engineer responsible for blast design review, approvals, blasting safety, vibration monitoring and public relations, 1990 – 1999.
- Client - Lindsey Morden Limited and representing MTO – Traffic Vibration Impact Analysis, Northern Ontario. Analysis of vibrations induced by vehicular traffic on residential buildings, 1997.
- Client - Peter Kiewit Sons Company Limited – Ontario Hydro's Matabitchuan Power Station Rehabilitation Project, North Cobalt, Ontario. Consulting engineer responsible for, blast design review, approvals, pre-blast survey, vibration monitoring and blast supervision, September 1995.
- Client - John Bianchi Limited – South Falls Power Generating Station, Heron Bay, Ontario. Consulting engineer responsible for, blast design review, approvals, pre-blast survey, vibration monitoring and blast supervision, October 1995.

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- Client - Arcam Engineering – E.B.Eddy Power Plant Installation, Espanola, Ontario. Consulting engineer responsible for, blast design review, approvals, pre-blast survey, vibration monitoring and blast supervision, 1993.
- Client - Bruce Evans Limited – Ontario Hydro's Big Chute Hydroelectric Generating Station, Port Severn, Ontario. Consulting engineer responsible for, blast design review, approvals, pre-blast survey, vibration monitoring, and blast supervision, May – December 1992.
- Client - International Pipeline Engineering Limited (IPEL) – Bell Canada Fiber Optics Transmission Project, along Trans-Canada Highway, Ontario. Site blasting engineer responsible for implementation of blast design, blasting safety, vibration monitoring and explosives loading, 1987 – 1989.
- Client - Matthews Group – Sturgeon Falls Water Treatment Plant, Sturgeon Falls, Ontario. Site blasting engineer responsible for blast design, excavation sequence, supervision of explosives loading, pre-blast survey, vibration monitoring and blasting safety, May 1985.

KEY MARINE PROJECTS

- Client - TransCanada Pipelines Limited – Lake and River Crossings, various locations in Ontario and Manitoba. Associate consulting engineer responsible for blast design review, approvals, blasting safety, underwater blast over-pressure and vibration monitoring and public relations, 1990 – 1999.
- Client - Ontario Hydro – Dear Lake Powerhouse Project, Dear Lake, Ontario. Blast consulting engineer responsible for determination of explosive quantities used in marine blasting operation, March 1998.
- Client - Ontario Trap Rock Limited – Shipping Dock Construction, Bruce Mines, Ontario. Blast consulting engineer responsible for blast design, ice blasting, explosives loading, underwater blast over-pressure and seismic monitoring, blasting safety and blast data logging, 1995.
- Client - Peter Kiewit and Sons Company Limited – Little Chute Channel Expansion Project, Port Severn, Ontario. Blast consulting engineer responsible for blast design, blast design implementation, application of sequential blasting techniques, underwater blast over-pressure and seismic monitoring, blasting safety and blast data logging, 1993.
- Client - Hugh Cole Limited – Port Colborne Bridge Pier Blasting, Port Colborne, Ontario. Site engineer responsible for blast design, explosive selection and loading, blast supervision, underwater blast over-pressure and seismic monitoring, blasting safety and blast data logging, September 1992.
- Client - Peter Kiewit and Sons Company Limited – Lemieux Island Development Project, Ottawa, Ontario. Site blasting engineer responsible for implementation of blast design, explosives loading, sequential sequencing, vibration monitoring, blast tie-up, and execution, October 1990.

KEY MINING PROJECTS

- Client – Vale Canada Limited – Blast consulting services provided on a special project for the development of a service tunnel under the Garson Mine Shaft Bottom, August, 2011 to present.
- Client – BH Martin Consultants Limited – Blast impact analysis and risk Assessment for proposed reopening of gold mines in the Timmins area mining properties, 2007.
- Client – Superior Aggregate Company – Blast Impact Analysis and Risk Assessment, 2003 to 2008.
- Client – Inco Limited – Underground VRM Blasting Audits and Special Projects, 2003 – 2007.
- Client - Goldcorp Incorporated – Red Lake Mining Division, Balmertown, Ontario. Blast consulting specialist responsible for drilling and blasting operations for crown pillar remediation projects, September 2003.

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- Client – Vale Canada (Inco Limited) – Blast Vibration Monitoring Program, Ontario Division, Sudbury, Ontario. Blast consulting engineer responsible for implementation of third-party blast induced vibration-monitoring program, 1990 to present.
- Client - Goldcorp Incorporated – Red Lake Grinding Complex construction, Balmertown, Ontario. Blast consulting engineer responsible for drilling and blasting operations for expansion and installation of new grinding complex, 1999.
- Client - Rainbow Concrete Industries Limited – Hick's Quarry, Sudbury Division, Sudbury, Ontario. Blast consulting engineer responsible for all aspects of drilling and blasting operations, 1996 – 2003.
- Client - Rainbow Concrete Industries Limited – Sudbury, Ontario. Blast consulting engineer responsible for all aspects of drilling and blasting operations in their quarries, 1990 - 2011.
- Client - Placer Dome Limited – Timmins Super Pit Development, South Porcupine, Ontario. Consulting engineers responsible for establishing vibration attenuation curves, recommending blast parameters affecting mining operations, seismic monitoring and blast impact analysis, January 1994.
- Client - Monenco – Sudbury Neutrino Observatory (SNO) Project, Creighton Mine, Sudbury, Ontario. Consulting engineer responsible for blasting operations required for the SNO cavity development, 1993 – 1994.
- Client - Inco Limited – Pillar Recovery at Sudbury Area Mines, Sudbury, Ontario. Instrumental in design, introduction and implementation of combined electric/non-electric sequential blasting techniques in underground Vertical Retreat Mining (VRM) stopes, 1989 – 1995
- Client - Inco Limited – Long Hole Blind Slot Raise Development, Sudbury Area Mines, Sudbury, Ontario. Responsible for design and introduction of blind inverted raises. Development of raises 18 meters long with production holes in the same blast was achieved. This technique is now being widely implemented as a mining method, 1989 - 1990
- Client - Inco Limited – Inco Garson Ore/waste Segregation Project, Garson, Ontario. Responsible for introduction of sequential blasting techniques at the open pit mine. Segregation of ore from waste was achieved within the blasting operations, 1988 – 1989.

RESEARCH AND DEVELOPMENT

- Evaluation of methods to control flyrock in quarry and open pit mining operations.
- Evaluation of prototype electronic detonators in underground mining applications. Analyses of time domain and frequency domain vibrations induced by blasting using electronic detonators. Research conducted at Inco's Sudbury area mines.
- Timing evaluation of prototype non-electric detonators for Ensign-Bickford Limited at several underground mine sites.
- Velocity of Detonation (VOD) measurements of explosive products for quality control purposes in production and controlled test blasting sites, 1999.
- Research in modification of new high-frequency geophones for near-field blast monitoring applications. 1997
- Research in development of high-pressure sensors for determining in-situ rock properties in mining applications, 1996.
- Research on rock fragmentation fatigue using ultra-sonic cyclic loading techniques, 1986 –1987.

TRAINING AND TEACHING

- Lecturing and training of drillers and blasters for Sudbury area blasting companies, 2003 to present.

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Subject Matter Expert, Explosives, Blasting & Vibrations

- Lecturing and field training for the Surface Blaster Apprenticeship and Licensing Program, Sir Sandford Fleming Collage, Lindsey, Ontario. Training blasters and new candidates on specialized blasting techniques, 1997 – 1999.
- Lecturing and training the TransCanada Pipeline Blasting Inspectors in all aspects of pipeline drilling and blasting operations, 1999.
- Annual lecturing and training the Union Gas Blasting Inspectors in all aspects of drilling and blasting operations, 1999 - 2016.
- Lecturing and training engineers at the Inco Thompson Mine for all aspects of advanced drilling, blasting, vibration monitoring, vibration waveform analysis, and blast diagnostics procedures, 1997.
- Lecturer, post diploma program in ground control, sponsored by the Mining Research Directorate (MRD) at the Ontario Centre for Ground Control Training, Sudbury, Ontario. Provided hands on training in the application of new technology in explosives, rock fragmentation by blasting and controlled blasting techniques to engineers and planner from Northern Ontario mines, 1997.
- Lecturing and field training of candidates for drilling and blasting course sponsored by the Corporation of the Town of Nickel Centre in Sudbury, Ontario, 1994.

PUBLICATIONS

- Bourget, G., Jambakhsh, R.M., “Ontario Hydro T.G.S. Chimney Demolition, Thunder Bay, Ontario, Canada”, Proceedings of the Twenty Sixth Annual Conference on Explosives and Blasting Technique, International Society of Explosive Engineers, Anaheim, California, 2000.
- Jambakhsh, R.M., Copping, C., “Improved Methods of Blasting Concrete for Welland Canal Rehabilitation”, Proceedings of the Twentieth Annual Conference on Explosives and Blasting Technique, International Society of Explosive Engineers, Austin, Texas, 1994.
- Jambakhsh, R.M., Okell, J., “Blast Vibrations and Overpressure Control Using Sequential Blasting Techniques at Inco’s McCreedy West Mine”, Proceedings of the Nineteenth Annual Conference on Explosives and Blasting Technique, International Society of Explosive Engineers, San Diego, California, 1993.
- Jambakhsh, R.M., Cameron, E.A., Richardson, S., “Development of Upper Blind Raises By Long hole Carbide Drilling (LCD) Methods”, Proceedings of the Eighteenth Annual Conference on Explosives and Blasting Technique, International Society of Explosive Engineers, Orlando, Florida, 1992.
- Jambakhsh, R.M., Stephen, G., Muzzeral, B., Hamill, D., “Blast Design and Vibration Analysis in Trench Blasting for Bell Canada’s Fibre Optics Line Project across Ontario”, An Internal Publication, May 1989.