

June 18, 2021

**Joe Nethery**  
**Halton Region**  
**Manager, Priority Development Projects**  
**Legislative & Planning Services**  
1151 Bronte Road  
Oakville, Ontario L6M 3L1

Dear Mr. Nethery:

**RE: Burlington Quarry Extension – Nelson Response to JART Blasting Comments**  
**OUR FILE 9135D**

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On behalf of Nelson Aggregate Co., MHBC is pleased to provide the Joint Agency Review Team (JART) with the blasting response prepared by Explotech dated June 16, 2021.

In accordance with the updated Blast Impact Assessment, MHBC commits to update the April 2021 Site Plans to include the additional recommendations.

We trust the enclosed addresses the comments provided by JART. If there are any outstanding issues or clarification needed, Nelson would be pleased to meet with JART to discuss.

Yours truly,

**MHBC**



Brian Zeman, BES, MCIP, RPP  
President

cc. Gina Ali, Region of Halton  
Janice Hogg, Region of Halton  
Betty Pakulski, Region of Halton  
Kyle Plas, City of Burlington  
Gordon Dickson, City of Burlington  
John Stuart, NEC  
Jessica Bester, Halton Region Conservation Authority  
Quinn Moyer, Nelson Aggregate Co.  
Peter Graham, Nelson Aggregate Co.  
Tecia White, Whitewater Hydrogeology Ltd.  
Kevin Powers, Project Advocacy Inc.  
Mike Tobin, Explotech  
Mark Morelli, Explotech



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

June 16, 2021

Nelson Aggregates  
2433 NO 2 Side Road  
Burlington, ON  
L7P 0G8

**Attention: Ms. Tecia White**

**Subject: Burlington Quarry Expansion Blast Impact Analysis  
Response to DST Consulting Engineers Peer Review**

Dear Ms. White,

In response to the peer review performed by DST Consulting Engineers (DST) on the Burlington Quarry application Blast Impact Analysis prepared by Explotech Engineering Ltd. (Explotech), we present the following clarifications.

The DST peer review identifies that written conditions recommended by the blast impact analysis be included in the site plans notes. Explotech has reviewed the updated April 2021 site plans which have been provided to JART by MHBC and Explotech confirms that all of the required recommendations (barring the recommendations made below in this report) have been included. Explotech confirms that MHBC has committed to including the recommendations contained herein will be adopted on the site plan notes.

The DST peer review states that the Golder Associates vibration attenuation study referred to in the blast impact analysis be provided for ease of technical review and cross reference. The peer review also requests that the source for the vibration and air attenuation curves be identified. To address the above comments Explotech has updated the report to include the Golder Associates Blast Impact Assessment dated April 2006 in Appendix C.



The DST peer review requests that the rationale behind why the attenuation formula established by Golder in 2004 was used while the historical data obtained during the 2014-2019 blasting campaigns was not included in the attenuation analysis. To address this comment Explotech provides the following commentary:

Attenuation equations are typically developed using a linear array of seismographs located at carefully measured distances both in front and behind the blast(s). Taking precise distance measurements ensures that the data used to develop the attenuation equations leads to a more reliable model to predict ground vibrations and air overpressures. While compliance data is available from the 2014-2019 blast reports, its inclusion in the attenuation equation would be inappropriate as the majority of the data is lacking critical information regarding the location of the blasts and/or the location of the seismographs. Inclusion of this data into the attenuation equation would result in a less reliable model for predicting ground vibrations and air overpressures.

The DST peer review also requests that a recommendation be added to include that the vibration and overpressure data collected in the first 12 months of the proposed quarry extensions be incorporated in the attenuation data base to develop a more reliable and new site specific attenuation formula. To address this concern Explotech has added the following recommendation to the updated blast impact analysis report:

Vibration and overpressure data collected during the first 12 months of extraction in the proposed quarry extension lands will be used to calibrate and update the 2004 Golder Associates attenuation equation. The proponent shall ensure information collected includes all relevant blast and monitoring details to permit and facilitate inclusion of the data in the attenuation data and resultant equation.

# EXPLOTECH

The DST peer review states that fish bearing waterbodies within 120m of the proposed extensions should be addressed in the blast impact analysis. This issue was addressed in a supplemental technical memorandum addressing fish bearing waterbodies in direct vicinity of the Burlington Quarry dated January 19, 2021. For greater continuity, Explotech has revised the Blast Impact Analysis report to include a section titled *“Blast Impact on Adjacent Fish Habitats”*.

The DST peer review states that considering the blasting operations will approach a standoff distance of 12.8m to the Sun Canadian Pipeline corridor, all requirements of their blasting specification outlined in *“Appendix 2, section 8.3 to 8.5”* under the heading *“Vibration and Blasting Control”* be implemented: Explotech agrees with this comment and has added the following recommendation to the updated Blast Impact Analysis report:

All blasting operations encroaching the Sun Canadian High Pressure Oil Pipeline will follow all requirements in the Sun Canadian Guidelines outlined in Section 8.3 to 8.5 under the heading *“Vibration and Blasting Control.”* and any requirements specified in later revisions of the Sun Canadian guidelines

Attached please find a copy of the updated Blast Impact Analysis for the Burlington Quarry, dated June 16, 2021. We trust the foregoing addresses the comments raised in the DST Consulting Engineers peer review with regards to the Burlington Quarry. We remain available to expand on the comments made as required.

Best regards,



Michael Tobin, B.A.Sc.

## Proposed Burlington Quarry Expansion JART COMMENT SUMMARY TABLE – Blast Impact Analysis (BIA)

Please accept the following as feedback from the Burlington Quarry Joint Agency Review Team (JART). Fully addressing each comment below will help expedite the potential for resolutions of the consolidated JART objections and individual agency objections. **Additional, new comments may be provided once a response has been prepared to the comments raised below and additional information provided.**

|                                                                                | JART Comments (January 2021)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Reference                                 | Source of Comment             | Applicant Response (June 2021)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | JART Response |
|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>Report/Date: Blast Impact Analysis, March 24, 2020 &amp; April 23, 2020</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Author: Explotech Engineering Ltd.</b> |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |
| 1.                                                                             | The introduction recommends that a vibration monitoring program be continued and maintained for the duration of all blasting activities. Is this a requirement of the MECP Certificate of Approval? Are there securities or other legal assurances that the monitoring will take place? Is it possible for the language of the Official Plan Designation to include this recommendation?                                                                                                                                                                                                                                                                                                           | General                                   | City of Burlington            | The MNRF Provincial Standards require that all new licences monitor all blasts for ground vibration and blasts over pressure to ensure compliance with provincial guidelines. It is our understanding that provided the requirement for vibration and overpressure monitoring is included as a site plan condition, this requirement becomes legally binding. It is further our understanding that the recommendations of the Blast Impact Analysis (Pages 32 – 33) will be fully transcribed onto the final site plans thereby providing a vehicle for enforcement. |               |
| 2.                                                                             | In the BIA report no mention is made regarding presence of any identified water body within the proposed extraction areas or within 500.0 metre stand off distance outside the extraction areas. There are water bodies in the area.                                                                                                                                                                                                                                                                                                                                                                                                                                                               | General                                   | DST Consulting Engineers Inc. | Please refer to the supplemental technical memorandum addressing fish bearing waterbodies in direct vicinity of the Burlington Quarry dated January 19, 2021 based on additional information provided by project biologists. In response, Explotech has revised the Blast Impact Analysis. Refer to revised BIA dated June 16, 2021                                                                                                                                                                                                                                  |               |
| 3.                                                                             | It is noted that the version of site plan drawings appended to BIA is missing the “Note” section. The same version of site plan drawings provided to the retained consultant by Halton includes “Notes” on the drawings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | General                                   | DST Consulting Engineers Inc. | In response, Explotech has revised the Blast Impact Analysis to include the newest version of site plans dated April 2021. Refer to revised BIA dated June 16, 2021                                                                                                                                                                                                                                                                                                                                                                                                  |               |
| 4.                                                                             | The impact of blasting in the context of production of vibration and overpressure and their effect on neighbouring sensitive receptors located at various standoff distance are considered by the BIA report. The BIA report identifies a number of these receptors to be owned by the applicant, and hence considers them as non-sensitive receptors for the purpose of predictive vibration and overpressure impact calculations. Should these be considered as sensitive receptors given current use and design?                                                                                                                                                                                | General                                   | DST Consulting Engineers Inc. | Nelson Aggregates has advised that upon commencement of extraction in the extension lands, the owned properties will be non-sensitive either as a result of their demolition, conversion into commercial space, or suspension of active use. As such, these properties would be exempt from the guidelines set out in NPC 119. For informational purposes, Explotech has included the vibration calculations anticipated at these properties as part of the BIA report.                                                                                              |               |
| 5.                                                                             | In order to mitigate the potential vibration and overpressure on surrounding existing sensitive receptors, the BIA uses a well-known predictive model, namely the Bureau of Mines (BOM) prediction formula or Propagation law. The BIA states that this model has been used by Golder Associates (Golder) to develop a site-specific attenuation formula based on a study carried out at the existing Burlington Quarry in 2006. However, the attenuation curves referred to in the Appendix C of the report are dated 2004. The BIA solely relies on the site-specific attenuation curves established by Golder for the existing Burlington Quarry for their assessment of the impact of blasting | General                                   | DST Consulting Engineers Inc. | The attenuation study referenced in the Explotech BIA incorporates information gained through the attenuation study undertaken by Golder Associates in 2004 as part of an unrelated study at that time. Given the fact that this analytical effort was previously undertaken and there has been no change in material characteristics or blasting practices, it was determined that undertaking a duplicate study                                                                                                                                                    |               |

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|    | on surrounding sensitive receptors in the proposed Burlington Quarry Extension area with no new data added, even though the new data is available.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                                                 | would provide no new information or insight. While compliance monitoring data is available for the period from 2014-2019, the majority of the data is lacking critical information regarding the location of the blasts and/or the location of the seismographs relative to the blast which is necessary to accurately append the data to the earlier attenuation study. Inclusion of this data into the attenuation equation would result in a less reliable model for predicting ground vibrations and air overpressures.                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 6. | The BIA report under the heading “EXISTING CONDITIONS” identifies seventy-eight (78) sensitive receptors with respective standoff distance from the extraction zones comprising of residential dwellings and a Golf Course known as Camisle Golf Course. The civic addresses and the land use of these properties are also identified in the BIA report. Of the seventy-eight sensitive receptors, eleven (11) dwellings are presently owned by the proponent and may be converted to offices, in which case will be eliminated from the list of sensitive receptors. The properties owned by the proponent are amongst the closest to the proposed extraction areas. The BIA identifies Buildings located at 2280 No. 2 Side Road presently owned by the proponent as structures classified as “culturally significant” and will be vacant at the time of extraction, and thus will not be considered as sensitive receptors. Should all of these building be considered as sensitive receptors given current use and design? | Existing Conditions | DST Consulting Engineers Inc. and Halton Region | Please refer to the answer in question 4. Additionally, the heritage structure located at 2280 No. 2 Side Road was given special consideration in the BIA due to its heritage status regardless of its status as a receptor. Specifically, the BIA recommends that “In order to safeguard the structural integrity of the structures located at 2280 No 2 Side Road, ground vibrations shall be maintained below 50mm/s (>40Hz) in accordance with research performed by the United States Bureau of Mines (USBM RI8507). The closest structure located at 2280 No 2 Side Road shall be monitored for ground vibration and overpressure when vibration calculations suggest vibrations in excess of 35mm/s”. This recommendation is based on the understanding that the building need not be subject to the MECP nuisance criteria as it will be vacant but should be subject to the damage criteria so as to prevent any adverse impacts on the structure(s). |  |
| 7. | Page 7 recommends that vibrations at 2280 No. 2 Side Road be maintained below 50.0 millimetres/second, and the closest structure on the property shall be monitored for ground vibration and over pressure when vibration calculations suggest vibrations in excess of 35.0 millimetres/second. Page 8 indicates Nelson Quarry is the owner of the property, please confirm that the vibration monitoring equipment will be or has been installed and monitored                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Page 7              | City of Burlington                              | The BIA prepared by Explotech recommends that all blasts shall be monitored for both ground vibration and overpressure at the closest privately owned sensitive receptors adjacent the site, or closer, with a minimum of two (2) instruments – one installed in front of the blast and one installed behind the blast. Additionally, it is recommended that the ...structure located at 2280 No 2 Side Road shall be monitored for ground vibration and overpressure when vibration calculations suggest vibrations in excess of 35mm/s. Provided this recommendation is included on site-plans, this will be a condition of site plan approval in the extension lands. Monitoring practices at the existing licence can be confirmed by others.                                                                                                                                                                                                              |  |
| 8. | Page 10 provides recommendations on blast monitoring, please provide confirmation on where the vibration monitors will be (or are currently) installed (municipal address, and location on property) and if necessary (for non-owned properties) provide written confirmation from landowners that they have given permission for the vibration monitors to be installed on their property.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Page 10             | City of Burlington                              | The BIA prepared by Explotech recommends that all blasts shall be monitored for both ground vibration and overpressure at the closest privately owned sensitive receptors adjacent the site, or closer, with a minimum of two (2) instruments – one installed in front of the blast                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |

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|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |                               | and one installed behind the blast. Specific installation locations can only be determined at the field level in response to each individual blast locations and orientation. Location of seismographs provided in the 2014 - 2019 blast documentation are provided on Page 26 of the BIA.                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| 9.  | Page 20 references the Sun Canada Pipeline. The BIA report provides a detailed assessment of the impact of blasting on the Sun Canadian High Pressure Oil Pipeline and recommendation on changes in the blast design parameters to protect the pipeline based on the Sun Canadian vibration limit policy. GIS mapping indicates there is also an Enbridge Pipeline and Imperial Oil Pipe line south of the south expansion, have any of those agencies been contacted to see if there are any precautions or requirements for blasting in proximity to the pipelines?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Page 20                                     | City of Burlington            | The Enbridge specification "Third Party Requirements in the Vicinity of Natural Gas Facilities" states that Enbridge must be notified of blasting operations if they are undertaken within 300m of the pipeline. Similarly, Imperial Oil requires notification of blasting operations if they encroach within 300m of the pipeline. Given the approximate 430m from the closest point of the southern extraction area to both the Enbridge and Imperial Oil Pipelines these agencies are not required to be contacted. Additionally, both pipelines fall further removed than the Sun Canadian Pipeline and hence the Sun Pipeline will govern from both a compliance and blast design perspective.                               |  |
| 10. | The BIA report under the heading "REVIEW OF HISTORICAL BURLINGTON QUARRY DATA" states that vibration and overpressure data has been collected in recent years for all blasts conducted at the Nelson Aggregate Burlington Quarry (for 2014 through 2019) and provided to Explotech as part of their analysis. The historical vibration and overpressure data are included in Appendix C of the report. As part of their analysis, the BIA further confirms that the data reveals occurrence of 18 exceedances over the period from 2014 to 2019. List of exceedance occurrences, their location, exceedance level, date and time are presented in Table 5 of the BIA report. Although the data has been reviewed, it is not used in the BOM model prediction model for predicting expected vibration and overpressure levels for the quarry extension. If the prediction formula established by Golder is used for calculation of predicted vibration and overpressure levels for the new extension, then the data collected from actual quarry blasting during the period of 2014 to 2019 should have been incorporated in the model. | Review of Historical Burlington Quarry Data | DST Consulting Engineers Inc. | Please refer to the answer in question 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| 11. | The Recommendations section (pages 28/29) does not address warning clauses, are there any warning clauses recommended for surrounding residential properties and/or to be included in the Official Plan Designation?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Pages 28-29                                 | City of Burlington            | At this time Explotech is not aware of any warning clauses recommended for surrounding residential properties.<br><br>MHBC advises that for new or expanded mineral aggregate operations, warning clauses are not put in place on surrounding residential properties and it is the applicant's responsibility to operate in compliance with provincial guidelines to ensure no adverse impacts to surrounding properties. When the subdivisions were approved in the area (Paletta, Illingsworth and Bunkowsky), as part of that approval, the Owners were required to include in all Offers of Purchase, Agreements of Purchase and Sale, or Lease and Reservation Agreements a warning clause regarding Nelson's operation. The |  |

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|     |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |                               | <p>following is the excerpt from the Paletta subdivision. The other approvals included a similar warning clause:</p> <p><i>"Purchasers are advised that Nelson Aggregate Company ("Nelson") is the owners of lands located in Lots 1 and 2, Concession 2 and 3, N.S., City of Burlington, in the Regional Municipality of Halton and which lands are in proximity to those lands being developed for residential purposes by Paletta International Corporation.</i></p> <p><i>The Nelson lands are presently licensed and operated for aggregate extraction industrial purposes and it is the intention of Nelson, through its licensees, agents, successors and assigns, to use the lands for the purpose of extraction, processing, manufacturing and transportation of aggregates.</i></p> <p><i>(i) Purchasers are also advised and acknowledge that noise, vibrations, dust, visual unsightliness, large equipment, maneuvering and permitted working hours are all incidental to the lawful operation of aggregate extraction site and the lawful operation of heavy vehicles on the public roads.</i></p> <p><i>(j) Purchasers are further advised that even though noise and vibration control features may be incorporated within the development area, noise and vibration levels may be of potential concern."</i></p> |  |
| 12. | <p>The BIA report under the heading "RECOMMENDATIONS" provides nine (9) recommendations as the condition of blasting in the proposed Nelson Aggregates Burlington Quarry Extension areas. The following need to be addressed:</p> <ul style="list-style-type: none"> <li>• Critical conditions recommended by the BIA be included in the site plan notes.</li> </ul>                                                                       | Recommendations | DST Consulting Engineers Inc. | <p>Explotech has reviewed the site plans and all required conditions are included and MHBC will be further updating the site plans to include the additional recommendations found in the revised BIA dated June 16, 2021</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| 13. | <p>The BIA report under the heading "RECOMMENDATIONS" provides nine (9) recommendations as the condition of blasting in the proposed Nelson Aggregates Burlington Quarry Extension areas. The following need to be addressed:</p> <ul style="list-style-type: none"> <li>• The Golder Associates vibration attenuation study report referred to in the BIA report be provided for ease of technical review and cross reference.</li> </ul> | Recommendations | DST Consulting Engineers Inc. | <p>In response, Explotech has revised the Blast Impact Analysis. Refer to revised BIA dated June 16, 2021</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| 14. | <p>The BIA report under the heading "RECOMMENDATIONS" provides nine (9) recommendations as the condition of blasting in the proposed Nelson Aggregates Burlington Quarry Extension areas. The following need to be addressed:</p> <ul style="list-style-type: none"> <li>• The source of the Nelson Quarry vibration and Air Attenuation Curves included in Appendix C (Figures 5 and 6) of the BIA report be identified.</li> </ul>       | Recommendations | DST Consulting Engineers Inc. | <p>In response, Explotech has revised the Blast Impact Analysis. Refer to revised BIA dated June 16, 2021</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |

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| 15. | <p>The BIA report under the heading “RECOMMENDATIONS” provides nine (9) recommendations as the condition of blasting in the proposed Nelson Aggregates Burlington Quarry Extension areas. The following need to be addressed:</p> <ul style="list-style-type: none"> <li>Vibration and overpressure data collected in the first 12 months of the proposed quarry extensions be incorporated in the data attenuation data base to develop a more reliable and new site-specific attenuation formula.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Recommendations | DST Consulting Engineers Inc. | <p>In response, Explotech has revised the Blast Impact Analysis to include the following recommendation:<br/>Vibration and overpressure data collected during the first 12 months of extraction in the proposed quarry extension lands will be used to calibrate and update the 2004 Golder Associates attenuation equation. The proponent shall ensure information collected includes all relevant blast and monitoring details to permit and facilitate inclusion of the data in the attenuation data and resultant equation.</p> |  |
| 16. | <p>The BIA report under the heading “RECOMMENDATIONS” provides nine (9) recommendations as the condition of blasting in the proposed Nelson Aggregates Burlington Quarry Extension areas. The following need to be addressed:</p> <ul style="list-style-type: none"> <li>Provide the rationale why the attenuation formula established by Golder in 2004 was used, but the historical vibration and overpressure data from the same site was not incorporated in formula.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Recommendations | DST Consulting Engineers Inc. | Please refer to the answer in question 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| 17. | <p>The BIA report under the heading “RECOMMENDATIONS” provides nine (9) recommendations as the condition of blasting in the proposed Nelson Aggregates Burlington Quarry Extension areas. The following need to be addressed:</p> <ul style="list-style-type: none"> <li>According to the “Level 1 and Level 2 Natural Environment Technical Report, April 2020, page 60, Fish Habitat Summary” conducted by SAVANTA, there are potential direct fish habitat within 120.0 metres of the adjacent lands, and no fish habitat within the extraction areas.</li> </ul> <p>A review of historical supporting information and current Level 1 and Level 2 Natural Heritage Reports provided by the applicant was also carried out by the Halton Region Environmental Consultants Matrix Solutions Inc. (MSI). “This review provides the following overview of fish habitat within 500.0 metres of the proposed Burlington Quarry Extension areas:</p> <ul style="list-style-type: none"> <li>West Arm of the West Branch of Mount Nemo Tributary of Grindstone Creek</li> <li>East Arm of the West Branch of Mount Nemo Tributary of Grindstone Creek</li> <li>Willoughby Tributary of Bronte Creek</li> </ul> <p>In addition to these, there are waters containing fish within the existing quarry and proposed extension areas. Within the existing quarry, it can be assumed that all pond features contain fish. In historical reports prepared by ESG International (October 2000) the following features were noted:</p> <ul style="list-style-type: none"> <li>Pond 1 – support a largemouth bass population</li> <li>Pond 2 – supports a stickleback and pumpkinseed population</li> <li>Pond 3 – supports a largemouth bass population</li> <li>Pond 4 – supports largemouth bass, pumpkinseed and stickleback population</li> </ul> <p>Although there are fish within these features, earlier reports do not classify these as “fish habitat” due to the isolation of these watercourses. According to MSI, the applicant has been requested to provide DFO concurrence that this is the case.</p> | Recommendations | DST Consulting Engineers Inc. | Please refer to the technical memorandum dated January 19, 2021 addressing fish bearing waterbodies in direct vicinity of the Burlington Quarry based on additional information provided by project biologists. In response and for continuity, Explotech has revised the Blast Impact Analysis to include the details of this technical memorandum. Refer to revised BIA dated June 16, 2021                                                                                                                                       |  |

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|     | <p>Within the West Extension area, largemouth bass is present in all of the irrigation ponds within the golf course. Although the fish are present within these watercourses, they are currently not viewed as “fish habitat” by the applicant. These irrigation ponds are hydrologically connected to Willoughby Creek Tributary. The applicant has been requested to provide DFO concurrence that this is not fish habitat”.</p> <p>In the case that DFO confirms that the above noted features are considered as “fish habitat”, the applicant’s blasting consultant should revise their BIA to include a section addressing the impact of blasting on these features and recommend mitigation measures to address the potential impact on the fish habitat in accordance with the “Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters”. The document can be sourced online at <a href="https://www.racerocks.ca/wp-content/uploads/2015/09/DND-explosive-guidelines.pdf">https://www.racerocks.ca/wp-content/uploads/2015/09/DND-explosive-guidelines.pdf</a>.</p> <p>The potential impact of blasting may be insignificant on the fish habitat within 120.0 metres of the adjacent lands considering the proposed blasting parameters. However, the potential impact should have been addressed by the BIA. The Location of these water bodies are also shown in the site plan drawings and described as “Water Features”.</p> |                 |                               |                                                                                                                                                                                                                                                                                                                |  |
| 18. | <p>The BIA report under the heading “RECOMMENDATIONS” provides nine (9) recommendations as the condition of blasting in the proposed Nelson Aggregates Burlington Quarry Extension areas. The following need to be addressed:</p> <ul style="list-style-type: none"> <li>Considering that the proposed blasting operations at one point will approach a standoff distance of 12.8 metres from Sun Canadian Pipeline corridor, all requirements of their blasting specifications outlined in Appendix 2, section 8.3 to 8.5 under the heading “Vibration and Blasting Control” be implemented (copy attached for reference).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Recommendations | DST Consulting Engineers Inc. | In response, Explotech has revised the Blast Impact Analysis. Refer to revised BIA dated June 16, 2021. Blast Impact Analysis now includes recommendations to follow the blasting specifications outlined in Appendix 2, Section 8.3 to 8.5 under the heading “Vibration and Blasting Control” be implemented. |  |



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

## MEMORANDUM

**Re:** Nelson Aggregate Burlington Quarry Extension – Blast Vibration and Water Overpressure at Adjacent Waterbodies

**Date:** January 19, 2021

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Explotech Engineering Ltd. (Explotech) has been requested by Nelson Aggregates to provide commentary on the potential impact of blasting activities from the proposed Burlington Quarry Extension on adjacent fish habitats. This technical memorandum should be reviewed in conjunction with the previously submitted “*Blast Impact Analysis, Burlington Quarry Extension*” report dated April 23, 2020.

The detonation of explosives in or near water can produce compressive shock waves which initiate damage to the internal organs of fish in close proximity, ultimately resulting in the death of the organism. Additionally, ground vibrations imparted on active spawning beds have the ability to adversely impact the incubating eggs and spawning activity. In an effort to alleviate adverse impacts on fish populations as a result of blasting, the Department of Fisheries and Oceans (DFO) developed the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (1998). This publication establishes limits for water overpressure and ground vibrations which are intended to mitigate impacts on aquatic organisms while providing sufficient flexibility for blasting to proceed. Specifically, water overpressures are to be limited to 100kPa and, in the presence of active spawning beds, ground vibrations at the bed are to be limited to 13mm/s.

Current information suggests the presence of three waterbodies that have been classified as potential fish habitats located in close proximity to the proposed license areas. Specifically, these waterbodies are the Unnamed Tributary of Willoughby Creek located North of the proposed West extension along Colling Road, the Unnamed Tributary of Lake Medad located Southeast of the West extension along No. 2 Side Road and the East and West Arms of the West Branch of the Mount Nemo Tributary of Grindstone Creek located to Northeast and Southwest of the South extension area.

# EXPLOTECH

The operational plan shows an approximate minimum extraction setback distance of 55m to the Unnamed Tributary of Willoughby Creek, 130m to the Unnamed Tributary of Lake Medad and 85m to the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. Based on these separation distances, it is anticipated that alterations to blast designs will be necessary when blasting in close proximity to the identified waterbodies to maintain compliance with DFO water overpressure guidelines of 100kPa. A review of available topographic maps identifies elevations in the extraction areas closest to the above noted waterbodies ranging from 271-281masl, which will require blasting hole depths of up to 20m in some areas to reach the design quarry floor. The utilization of shallower blast holes, decks, smaller hole diameters and/or changes in blasting patterns may be necessary to maintain compliance with DFO Guidelines.

In the event that blast designs for any given blast are scheduled to exceed maximum loads per delay as specified in the DFO “*Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (1998)*” publication Table 1, we recommend that a hydrophone sensor be installed in the closest point of the waterbody to verify water overpressure levels, provided water depth is a minimum of 1m. The DFO Table 1 load restrictions are reproduced in part in Table 1 below for continuity.

| <b>Separation distance between possible fish bearing waterbody and closest borehole (meters)</b> | <b>Maximum recommended explosive load per delay (Kilograms)</b> |
|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| 150                                                                                              | 887                                                             |
| 125                                                                                              | 616                                                             |
| 100                                                                                              | 394                                                             |
| 90                                                                                               | 319                                                             |
| 80                                                                                               | 252                                                             |
| 70                                                                                               | 193                                                             |
| 60                                                                                               | 142                                                             |
| 50                                                                                               | 98.7                                                            |
| 40                                                                                               | 63.1                                                            |
| 30                                                                                               | 35.5                                                            |

**Table 1: Maximum Loads per Delay to Maintain 100kPa at Various Separation Distances**

Active spring spawning beds (March 15 – July 15) are assumed to be present in all three (3) waterbodies listed above. During the spawning season, these waterbodies are subject to a vibration limit of 13mm/s recorded at the shoreline of the closest spawning



location to the blast. Vibration monitoring will be required in order to confirm compliance with DFO limits for ground vibration.

Table 2 below is provided as initial guidance demonstrating maximum permissible loads per delay based on various separation distances from spawning beds. The following maximum loads per delay are derived from the equation for ground vibrations listed in the “*Blast Impact Analysis, Burlington Quarry Extension*” report dated April 23, 2020 and are based on a maximum vibration intensity of 13.0mm/s as experienced at the active spawning habitat:

| <b>Separation distance between possible spawning bed and closest borehole (meters)</b> | <b>Maximum recommended explosive load per delay (Kilograms)</b> |
|----------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| 500                                                                                    | 410                                                             |
| 450                                                                                    | 332                                                             |
| 400                                                                                    | 262                                                             |
| 350                                                                                    | 200                                                             |
| 300                                                                                    | 147                                                             |
| 250                                                                                    | 102                                                             |
| 200                                                                                    | 65.5                                                            |
| 150                                                                                    | 36.8                                                            |
| 100                                                                                    | 16.4                                                            |
| 75                                                                                     | 9.2                                                             |
| 50                                                                                     | 4.1                                                             |
| 30                                                                                     | 1.5                                                             |

**Table 2: Maximum Loads per Delay to Maintain 13.0mm/s at Various Separation Distances**

Should blasting operations take place outside of the active spawning window (March 15 – July 15), the above 13mm/s vibration limit would not apply.

# EXPLOTECH

Should you require any additional information or clarification with regards to the information provided in this brief report, please do not hesitate to contact the undersigned at your leisure.

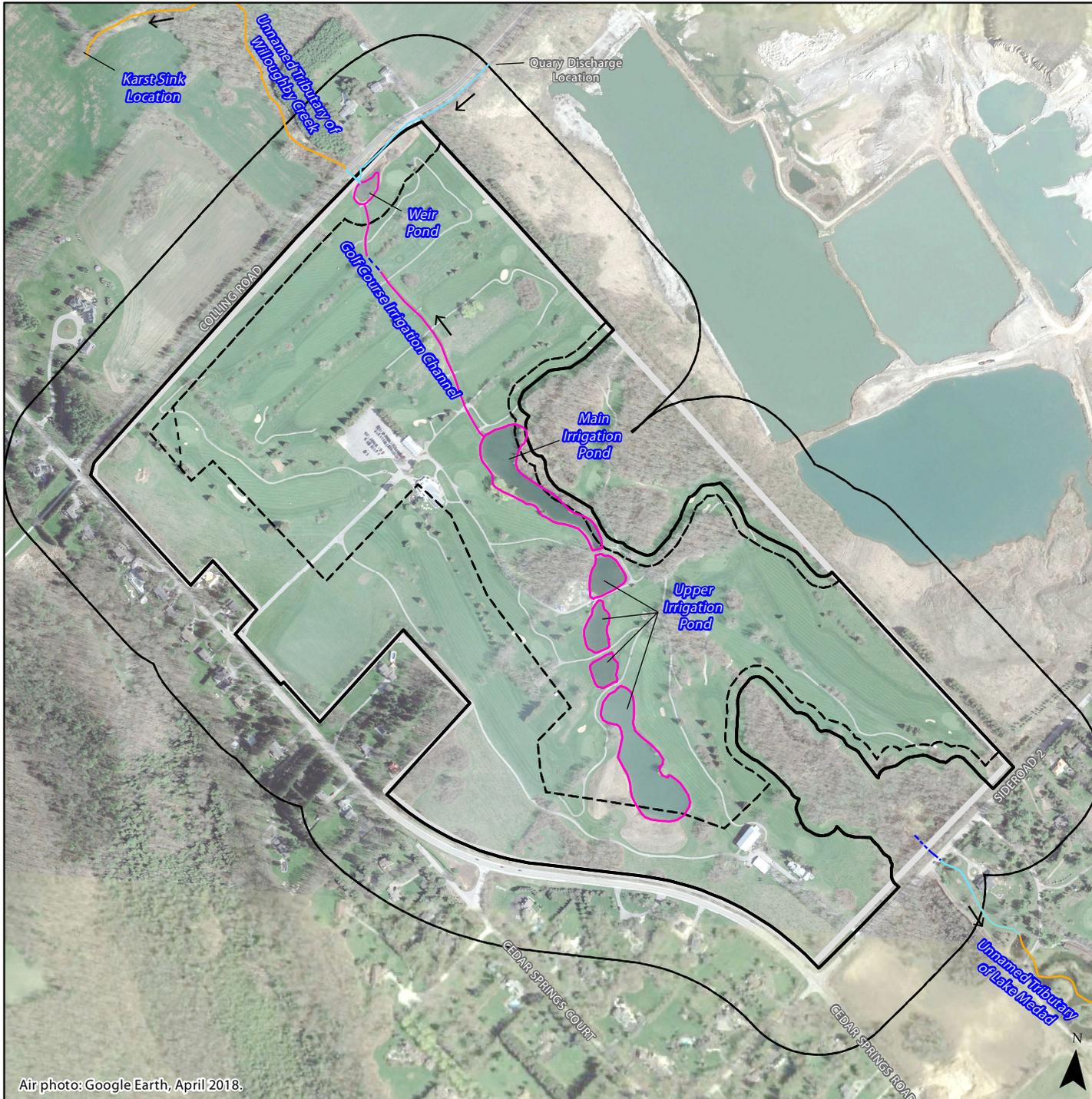
Kindest regards,



Michael Tobin, B.A.Sc.



Rob Cyr, P. Eng.



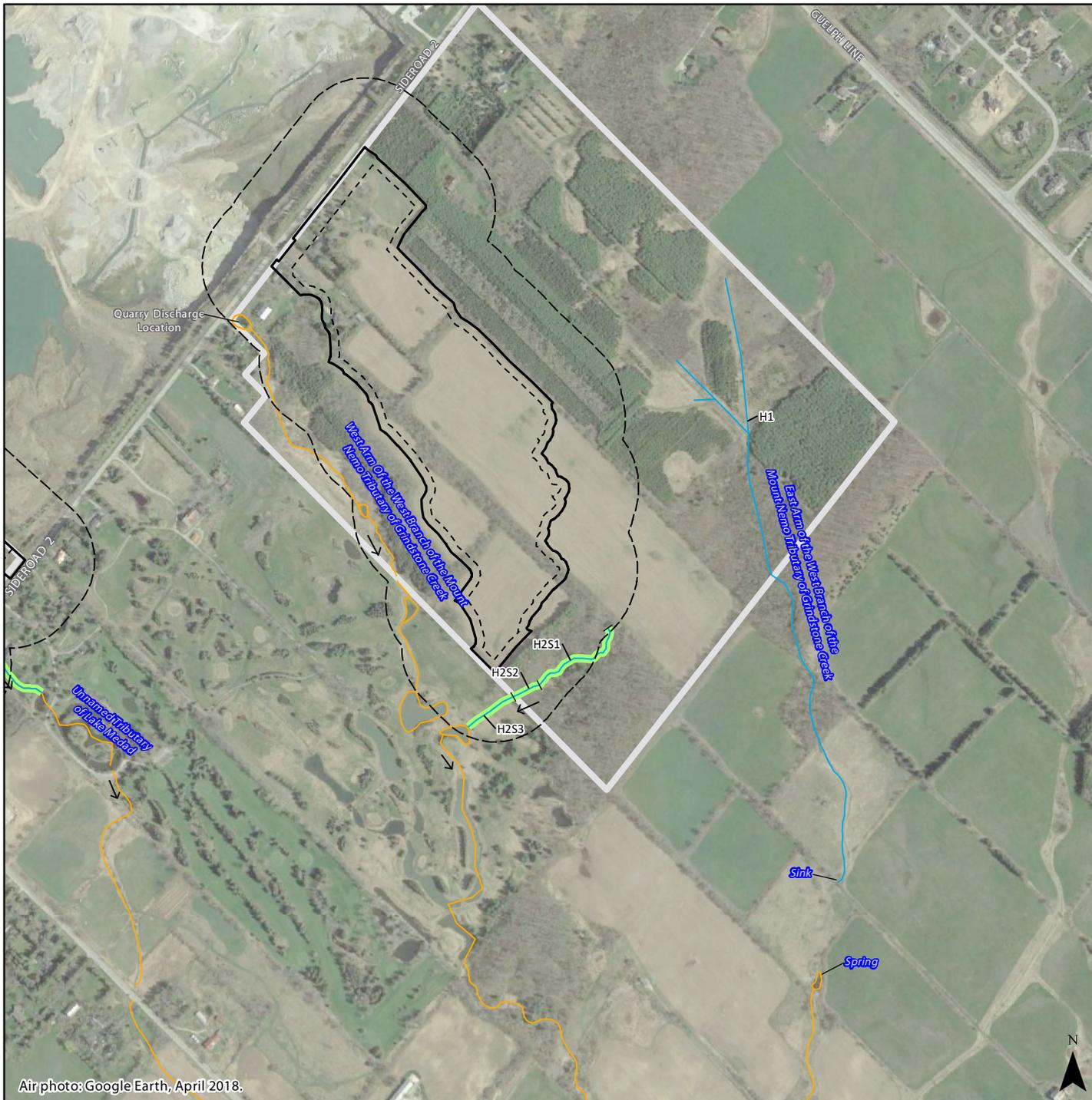
-  Licensed Boundary
-  Limit of Extraction
-  120 m Adjacent Lands
-  Subject Lands
-  Watercourse Buried Reach
-  Historical Drainage Feature
-  Drainage Feature (Not Fish Habitat)
-  Indirect Fish Habitat
-  Direct Fish Habitat

Figure 9a  
Fish Habitat  
WEST EXTENSION

0 100 M  
1:8,000

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A GEI Company

Air photo: Google Earth, April 2018.



- Licensed Boundary
- Limit of Extraction
- 120 m Adjacent Lands
- Subject Lands
- Headwater Drainage Feature
- Indirect Fish Habitat
- Direct Fish Habitat

Figure 9b  
 Fish Habitat  
 SOUTH EXTENSION

0 100 M  
 1:10,000

**SAVANTA**  
 A GEI Company

Air photo: Google Earth, April 2018.

# **Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters**

D.G. Wright and G.E. Hopky

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1998

**Canadian Technical Report of  
Fisheries and Aquatic Sciences 2107**

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## ABSTRACT

Wright, D.G., and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can. Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p.

The federal *Fisheries Act* includes provisions for the protection of fish, shellfish, crustaceans, marine mammals and their habitats. The detonation of explosives in or adjacent to fish habitat has been demonstrated to cause disturbance, injury and/or death to fish and marine mammals, and/or the harmful alteration, disruption or destruction of their habitats, sometimes at a considerable distance from the point of detonation.

Within the context of the guidelines and procedures outlined in this report, an explosive is defined as a chemical compound which, when detonated, creates a compressional wave having an almost instantaneous rise time to a very high peak pressure followed by a decay to below ambient pressure by either rapid oxidation or the breaking of high-energy chemical bonds.

The purpose of this report is to provide information to proponents who are proposing works or undertakings that involve the use of confined or unconfined explosives in or near Canadian fisheries waters, and to which the *Fisheries Act*, Sections 32 and 35 in particular, may apply. Guidelines are provided on methods and practices for the conservation and protection of fish, marine mammals, and fish habitat from impacts arising from the destructive forces of explosives. The report describes the suggested application and review procedures and processes for proponents whose use of explosives may result in the destruction of fish, or the harmful alteration, disruption or destruction of fish habitat.

## RÉSUMÉ ANALYTIQUE

Wright, D.G. et G.E. Hopky. *Lignes directrices concernant l'utilisation d'explosifs à l'intérieur ou à proximité des eaux de pêche canadiennes*, rapport technique canadien des sciences halieutiques et aquatiques 2107, 1998, iv + 34 p.

La *Loi sur les pêches* fédérale renferme des dispositions relatives à la protection du poisson, des mollusques, des crustacés, des mammifères marins et de leur habitat. Il a été prouvé que la détonation d'explosifs dans l'habitat du poisson ou à proximité perturbe, blesse ou tue des poissons et des mammifères marins ou encore entraîne la détérioration, la destruction ou la perturbation de leur habitat. Il arrive parfois que les dommages se fassent sentir à une distance considérable du point de détonation.

Aux fins des lignes directrices et des procédures énoncées dans le présent rapport, on entend par explosif un composé chimique qui, lorsqu'il explose, crée une vague de compression entraînant presque instantanément un pic de pression extrêmement élevé suivi d'une décroissance sous la pression ambiante soit par oxydation rapide ou par la rupture des liaisons chimiques à haute énergie.

Le présent rapport a pour but de fournir de l'information aux promoteurs qui proposent des ouvrages ou des entreprises nécessitant l'utilisation d'explosifs confinés ou non confinés à l'intérieur ou à proximité des eaux de pêche canadiennes et auxquels la *Loi sur les pêches*, plus précisément les articles 32 et 35, pourraient s'appliquer. Il renferme des lignes directrices concernant les méthodes et pratiques de conservation et de protection du poisson, des mammifères marins et de leur habitat contre les effets découlant de la force destructrice des explosifs. On y décrit les procédures de présentation des demandes et d'examen pour les promoteurs qui prévoient l'utilisation d'explosifs de nature à entraîner la destruction du poisson ou la détérioration, la perturbation ou la destruction de son habitat.

## SCOPE AND RATIONALE

The federal *Fisheries Act* includes provisions for the protection of fish, shellfish, crustaceans, marine mammals and their habitats. The detonation of explosives in or adjacent to fish habitat has been demonstrated to cause disturbance, injury and/or death to fish and marine mammals, and/or the harmful alteration, disruption or destruction of their habitats, sometimes at a considerable distance from the point of detonation. Therefore, the Department of Fisheries and Oceans (DFO) has prepared this document to provide information to proponents on the conservation and protection of fish, marine mammals, and their habitat from impacts arising from the use of confined or unconfined explosives in or near Canadian fisheries waters. The guidelines, and application and review procedures and processes outlined in this document apply in the context of the legislative and policy framework summarized below.

## APPLICABLE LEGISLATION AND POLICY

### **Fisheries Act**

A number of sections of the *Fisheries Act* and its attendant regulations are applicable to the conservation and protection of fish and fish habitat from the destructive forces of explosives.

- Section 2 defines "Canadian fisheries waters" as meaning all waters in the fishing zones of Canada, all waters in the territorial sea of Canada and all internal waters of Canada.
- Section 2 defines "fish" as including shellfish, crustaceans, marine animals and the eggs, sperm, spawn, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.
- Section 32 prohibits the destruction of fish by any means other than fishing, except as authorized by the Minister of Fisheries and Oceans or under regulations made by the Governor in Council under the *Fisheries Act*.
- Subsection 34(1) defines "fish habitat" as meaning spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.
- Subsection 35(1) prohibits any person from carrying on any work or undertaking that results in the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat.
- Subsection 35(2) provides for the alteration, disruption or destruction of fish habitat by any means or under any conditions authorized by the Minister of Fisheries and Oceans or under regulations made by the Governor in Council under the *Fisheries Act*.

- Subsection 36(3) prohibits the deposit of a deleterious substance into waters frequented by fish, unless otherwise permitted by regulation.
- Subsection 58(1) of the *Fishery (General) Regulations* provides for anyone proposing to carry on any work or undertaking likely to result in the HADD of fish habitat, to apply to have the means or conditions of that work or undertaking authorized by the Minister under Subsection 35(2) of the *Fisheries Act*, using the form set out in Schedule VI. Schedule VI includes a section for the applicant to provide details on the proposed use of explosives.
- Subsection 58(2) of the *Fishery (General) Regulations* provides the means for the Department of Fisheries and Oceans to issue Authorizations under Subsection 35(2) of the *Fisheries Act*, using the form set out in Schedule VII.
- Section 7 of the *Marine Mammal Regulations* prohibits disturbance of marine mammals except when fishing for them.

In addition, the Department of Fisheries and Oceans has developed a policy framework to assist in the interpretation and application of the applicable legislation. The most relevant documents are as follows:

- The **Policy for the Management of Fish Habitat** (1986) provides policy direction for interpreting the broad powers mandated in the *Fisheries Act* in a way that is consistent with the concept of sustainable development. To achieve the Policy's goal of fish habitat conservation when reviewing project proposals with the potential to affect fish habitat, DFO's habitat managers apply the No Net Loss (NNL) guiding principle. Under this principle, the Department strives to maintain the existing productive capacity of fish habitats, such that the fish habitat is able to sustain the production of fish suitable for fisheries purposes.

In summary, in order to meet the NNL guiding principle, the habitat manager's first preference is to avoid or reduce the project's potential for a HADD of fish habitat through the application of appropriate mitigation measures. Avoidance measures, such as project relocation or redesign, can be effectively applied at the project design stage. Failing that, impacts may be further reduced by application of specific mitigation measures, such as use of timing windows during the construction phase. If a HADD is still expected to occur, unavoidable - i.e. residual - losses in habitat productive capacity may be compensated on a case-by-case basis if the manager concludes that compensation is acceptable and feasible.

- The **Directive on the Issuance of Subsection 35(2) Authorizations** (1995) clarifies the circumstances when an Authorization under Subsection 35(2) may be issued, and on providing proponents with letters of advice suggesting means of avoiding HADD of fish habitat.

- The **Habitat Conservation and Protection Guidelines** (1998) is a document for use by DFO's staff in administering the habitat provisions of the *Fisheries Act*. It outlines a standard approach to habitat conservation and protection through the application of the NNL guiding principle.

### **Canadian Environmental Assessment Act**

A decision to issue an Authorization under Section 32 or Subsection 35(2) of the *Fisheries Act* triggers an environmental assessment under the *Canadian Environmental Assessment Act* (CEAA).

### **IMPACTS**

The use of explosives may result in a number of adverse impacts on fish and marine mammals, and their habitats.

#### **Effects on Fish**

The detonation of explosives in or near water produces post-detonation compressive shock waves characterized by a rapid rise to a high peak pressure followed by a rapid decay to below ambient hydrostatic pressure. The latter pressure deficit causes most impacts on fish.

The primary site of damage in finfish is the swimbladder, the gas-filled organ that permits most pelagic fish to maintain neutral buoyancy. The kidney, liver, spleen, and sinus venous also may rupture and haemorrhage. Fish eggs and larvae also may be killed or damaged (Wright 1982).

Studies (Wright 1982) show that an overpressure in excess of 100 kPa will result in these effects. The degree of damage is related to type of explosive, size and pattern of the charge(s), method of detonation, distance from the point of detonation, water depth, and species, size and life stage of fish.

Vibrations from the detonation of explosives may cause damage to incubating eggs (Wright 1982, Wright in prep.). Sublethal effects, such as changes in behaviour of fish, have been observed on several occasions as a result of noise produced by explosives. The effects may be intensified in the presence of ice and in areas of hard substrate (Wright 1982, Wright in prep.).

The detonation of explosives may be lethal to marine mammals and may cause auditory damage under certain conditions. The detonation of explosives in the proximity of marine mammals also has been demonstrated to induce changes in behaviour (Wright in prep.).

The number of shellfish and crustaceans killed by the detonation of explosives is believed to be negligible, however, few data are available. Sublethal effects of explosives on

shellfish and crustaceans including behavioural modifications are little known or understood (Wright 1982, Wright in prep.).

### **Effects on Fish Habitat**

The use of explosives in and near fish habitat may also result in the physical and/or chemical alteration of that habitat. For example, sedimentation resulting from the use of explosives may cover spawning areas or may reduce or eliminate bottom-dwelling life forms that fish use for food. By-products from the detonation of explosives may include ammonia or similar compounds and may be toxic to fish and other aquatic biota (Wright in prep.).

## **GUIDELINES, AND APPLICATION AND REVIEW PROCESSES**

The following sections have been prepared to guide proponents proposing works or undertakings that involve the use of confined or unconfined explosives in or near Canadian fisheries waters, and to which the *Fisheries Act*, Sections 32 and 35 in particular, may apply. Confined explosives are those that would be used within a substrate, including ice, while unconfined explosives are those that would be used in open water, or not within a substrate.

Note that the information and guidance provided in these sections pertains to the conservation and protection of fish and fish habitat in the context of the *Fisheries Act*, and to the CEAA requirements that may result. There is no intent to relieve the proponent of responsibilities under any other federal, provincial or municipal legislation. Proponents are encouraged to contact other appropriate regulatory agencies to ensure that the proposed work or undertaking is carried out according to their requirements.

### **GUIDELINES**

This section provides guidelines on methods and practices which, if incorporated into a project proposal, are intended to prevent or avoid the destruction of fish, or any potentially harmful effects to fish habitat that could result from the use of explosives. Implementation of these measures, for this purpose, is at the discretion of the proponent. Use of these guidelines should not be taken to imply approval of the proposed project in accordance with the *Fisheries Act*. Note that should the proponent proceed with the project and the use of explosives results in the destruction of fish and/or the HADD of fish habitat as a result of a change in plans, or failure to implement the measures, contravention of Section 32 and/or Subsection 35(1) of the *Fisheries Act* could occur.

1. Proponents considering the use of explosives are encouraged to consult the appropriate DFO Regional/Area authorities (Appendix I) as early as possible in their planning process to identify possible alternatives to the use of explosives, the biological resources and their habitats at risk, and/or effective mitigation measures.

2. Where provincial or territorial resource management agencies, or aboriginal resource management boards undertake the administration of fisheries, the proponent is encouraged to consult with the relevant authorities.
3. The use of confined or, in particular, unconfined explosives in or near Canadian fisheries waters is discouraged, and proponents are encouraged to utilize other potentially less destructive methods wherever possible.
4. No use of ammonium nitrate-fuel oil mixtures occurs in or near water due to the production of toxic by-products (ammonia).

Note:

- The deposit of deleterious substances into waters frequented by fish is prohibited under Section 36(3) of the *Fisheries Act*, unless otherwise permitted by regulation. There is no regulation pursuant to the *Fisheries Act* that permits the deposit of by-products resulting from the use of ammonium nitrate-fuel oil mixtures.
5. After loading a charge in a hole, the hole is to be back-filled (stemmed) with angular gravel to the level of the substrate/water interface or the hole collapsed to confine the force of the explosion to the formation being fractured. The angular gravel is to have a particle size of approximately 1/12th the diameter of the borehole.
  6. All "shock-tubes" and detonation wires are to be recovered and removed after each blast.
  7. No explosive is to be knowingly detonated within 500 m of any marine mammal (or no visual contact from an observer using 7x35-power binocular).

Note:

- Upon review of a proposal, the DFO Regional/Area authority may impose a greater avoidance distance, depending on the size of the charge or other project specific or fishery resource conditions.
8. No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa (14.5 psi) in the swimbladder of a fish.

Notes:

- For confined explosives, setback distances from the land-water interface (e.g., the shoreline), or burial depths from fish habitat (e.g., from under the riverbed) that will ensure that explosive charges meet the 100 kPa overpressure

guideline are shown in Table 1. Equations to derive these relationships have been adapted from Nicholls et al. (1971) and Anon (1980). The equations are described in Appendix II, and should be used for weights of explosives not covered in Table 1. Sample calculations and examples are illustrated in Appendix III.

- If a confined explosive is to be detonated close to the substrate-water interface (such as in trenching or demolition), the set-back distance closely approximates the theoretical lethal range within which 50% of the fish may be killed or injured. Consequently, the 100 kPa guideline is not likely to be met in those situations where, because of the design constraint's of the project, it is also likely not possible or practical to 'adjust' the setback distance as a means to meet the 100 kPa guideline. For example, preparation of a trench for a pipeline crossing typically requires no more than a below grade burial depth of about 2m. Therefore, the weight of explosive charge per delay will have to be adjusted in an effort to meet the 100 kPa guideline. A sample calculation to illustrate a trenching example is given in Appendix III.
  - For unconfined explosives, proponents are encouraged to contact the appropriate DFO Regional/Area authorities (Appendix I) for further guidance.
9. No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity greater than  $13 \text{ mm}\cdot\text{s}^{-1}$  in a spawning bed during the period of egg incubation.

Note:

- For confined explosives, setback distances or burial depths from spawning beds that will ensure that explosive charges meet the  $13 \text{ mm}\cdot\text{s}^{-1}$  guideline criteria are shown in Table 2. Equations to derive these relationships have been adapted from Nicholls et al. (1971) and Anon (1980) and are described in Appendix II. Sample calculations and examples are illustrated in Appendix III.
- For unconfined explosives, proponents are encouraged to contact the appropriate DFO Regional/Area authorities (Appendix I) for further guidance.

## APPLICATION AND REVIEW PROCESSES

Proponents planning to use an explosive that is likely to destroy fish and/or cause a HADD of fish habitat are subject to certain legal obligations under the *Fisheries Act*, as identified in the preceding 'Applicable Legislation and Policy' section. This section discusses these obligations with respect to the proposed use of explosives, and suggests to proponents how to fulfil them.

Proponents should contact the DFO Regional/Area authorities (Appendix I) as early as possible in their planning process. The purpose is to find out whether the proposed use of

explosives is likely to affect a Canadian fisheries water and whether its use is likely to destroy fish and/or cause a HADD of fish habitat. Depending on the outcome, DFO may also discuss potential issues, specific information requirements, or the next steps and possible outcomes in a further review of the proposal. For example, as summarized in the subsequent 'Review and Decision-making Process' section, possible next steps could include a request for further information, or a recommendation that the proponent seek an authorization pursuant to Section 32 and/or Subsection 35(2). Possible outcomes may include the provision of written advice, the issuance of (an) authorization(s) subject to completion of a CEEA review, or, refusal to issue (an) authorization(s).

Proponents should contact DFO before irrevocable commitments (such as contracts for equipment/services) are made, in order to avoid any unnecessary delays in the application and review process. Note that DFO may become aware of your proposed project through its participation in co-operative arrangements with other governments, agencies, boards, etc.

The following 'Application Procedures' section provides information to assist the proponent in deciding if it should seek Authorization to destroy fish by means other than fishing, and/or Authorization to harmfully alter, disrupt or destroy fish habitat, through the use of explosives and, if so, provides information on procedures for filing, etc.

Note that application for Authorization under Section 32 and/or Subsection 35(2) is voluntary. Proponents are not prohibited from going ahead with their use of explosives without Authorization. But, if as a result of the use of explosives, fish are destroyed and/or there is a HADD of fish habitat, contravention of Section 32 and/or Subsection 35(1) of the *Fisheries Act* could occur and the proponent is liable to prosecution.

### **Application Procedures**

1. Proponents unable to meet the overpressure or peak particle velocity guideline values identified, respectively, in measures 8 or 9 of the preceding 'Guidelines' section, should complete and submit an application for Authorization under Section 32 of the *Fisheries Act*, to destroy fish by means other than fishing. The recommended application form is shown in Appendix IV. However, the proponent should contact the appropriate DFO Regional/Area authority (Appendix I) to verify that this is the appropriate application form to use and/or to identify information requirements.
2. Proponents who wish to file for Authorization under Subsection 35(2) of the *Fisheries Act* should complete and submit a separate application in accordance with the form prescribed pursuant to Subsection 58(1) of the *Fishery (General) Regulations* (Appendix V). Assistance on filing the application form, and related procedures, may be obtained by contacting the appropriate DFO Regional/Area authorities (Appendix I).

3. Proponents seeking Authorization under both Section 32 and Subsection 35(2) should complete and submit both Section 32 (Appendix IV) and Subsection 35(2) (Appendix V) applications. However, to minimize duplication, the proponent may choose to cross-reference those sections that are the same in each application form, and is expected to only submit one set of the documents requested in the forms, unless otherwise requested by the DFO Regional/Area authority. Contact the appropriate DFO Regional/Area authorities (Appendix I) for further information and assistance.
4. In seeking Authorization, the proponent will be expected to provide the information requested in the application forms. Doing so will expedite the review process.

In general, the proponent is expected to provide all plans, specifications, studies, procedures, samples or other information required to permit an assessment of the potential impact of the proposed use of explosives on fish and fish habitat, and the mitigation and/or compensation measures proposed to alleviate impacts and/or to compensate for any loss of productive capacity of habitat to produce fish. Typically, the fish and/or fish habitat information requirements include, but may not necessarily be limited to the items summarized below:

- a) A description of the project and the expected effects resulting from the use of explosives on the fisheries resources (including marine mammals) and/or fish habitat, including:
  - i) A description of fish and marine mammal species and their habitats likely to be affected by the detonation;
  - ii) A description of whether the fish, marine mammals and their habitats contribute, or have the potential to contribute, directly or indirectly, to a fishery - subsistence, commercial or recreational;
  - iii) The timing of any seasonal migration of fish and marine mammals;
  - iv) The theoretical lethal range (i.e., the range, or distance, over which the overpressure exceeds 100 kPa) of the explosives to be used (from equations provided in Appendix II);
  - v) An assessment of potential impacts arising from the proposed use of explosives and a description of proposed mitigation and/or compensation measures; and
  - vi) Other matters, such as the proposed contingency plan and monitoring and follow-up program.
- b) The proponent's mitigation plan should include discussion of the following measures that are particularly relevant to alleviating the potential impacts of explosives:
  - i) The work or undertaking should be undertaken at the time of least biological activity or biological sensitivity. Proponents should consult with DFO Regional/Area authorities to determine the appropriate timing;

- ii) If multiple charges are required, time-delay detonation initiators (blasting caps) should be used to reduce the overall detonation to a series of discrete explosions. Time delays for discrete explosions should be greater than 25 ms; and,
- iii) If possible, large charges should be subdivided into a series of smaller discrete detonations or explosions using time-delay detonation initiators (a procedure known as decking) to reduce the overall detonation to a series of smaller discrete detonations or explosions.

In addition to these measures, the proponent should also consider additional mitigation measures including, but not limited to the following:

- iv) Deployment of bubble curtains/air curtains to disrupt the shock wave;
  - v) Deployment of noise generating devices, such as an air compressor discharge line, to scare fish away from the site; or,
  - vi) Removal or exclusion of fish from the work area before the blast occurs.
5. Proponents should be aware that subsequent to filing the application, DFO may request additional information concerning fish and fish habitat, the mitigation and/or compensation plans, the contingency and monitoring and follow-up programs, and other matters as required to complete the *Fisheries Act* review. If the appropriate information is not already available, it is the proponent's responsibility to provide it and, also, to assure DFO that the proposed mitigation and/or compensation measures will be effective. Should it be necessary to conduct an environmental assessment of the project pursuant to the CEEA, then additional information will be required in order to meet the requirements of the CEEA.
  6. The Department of Fisheries and Oceans will undertake to: respond to requests for review, or to referrals, of project proposals or activities; issue Authorizations or provide advice; and/or complete environmental assessments in a manner consistent with Departmental service standards. Generally, DFO will respond to requests for review or to referrals within 30 working days of notification. Timeframes required for the issuance of Authorizations or advice will be discussed with proponents. Proponents should be aware that the length of time required to complete a review can vary greatly, often depending on the type and complexity of project proposed, the fish and fish habitat issues involved, and whether or not an environmental assessment under the CEEA is required. Once again, proponents are encouraged to contact the appropriate DFO Regional/Area authorities (Appendix I) to discuss these issues.
  7. If an unforeseen need to use explosives arises, Departmental service standards may be waived and a review completed as expeditiously as possible so as not to unduly delay a project. Further, Departmental service standards are waived in the event of an emergency where lives and/or property are threatened. In such cases, the amount of information required may be reduced due to the urgency of the

situation. Any verbal request for an emergency Authorization will be accepted only on the condition that it is followed by a written confirmation of the project details.

8. If applicable, proponents may be required by the Department of Fisheries and Oceans, Canadian Coast Guard, to issue a "Notice to Mariners" and/or a "Notice to Fishers". The appropriate DFO Area/Regional authorities (Appendix I) are prepared to assist the proponent with contacting the Canadian Coast Guard.
9. Resource management agencies of other governments, departments, or boards that have been established under some aboriginal land claim settlements, may have aquatic resource review requirements and service standards that are different than those described in this document. Proponents should contact those agencies to ensure compliance with any requirements they may have.

### **Review and Decision-making Process**

This section summarizes the approach taken by the Department of Fisheries and Oceans in the review of referrals and of applications for Authorization. Included is a description of the key decisions possible from a review, and the criteria used in making decisions. There is also a brief summary of the linkage between Section 32 and/or Subsection 35(2) Authorizations and the responsibilities of the Department of Fisheries and Oceans to undertake environmental assessments pursuant to the *Canadian Environmental Assessment Act* (CEAA).

#### *Fisheries Act*

DFO will review the proponent's application in accordance with the *Fisheries Act* and its supporting policy framework, including this document. Upon receipt of information, notice, a referral, or application for Authorization concerning works or undertakings where the use of explosives is proposed, DFO will normally take the following steps in its review of the proposal:

1. Determine the adequacy of the information provided by the proponent.
2. Using the information provided, assess the extent of risk or potential damage to fish and marine mammals and/or fish habitat and the acceptability of this level of damage in context with the level of protection required.
3. Determine the probable success of proposed mitigation and/or compensation measures and, as appropriate the acceptability of any residual impacts.
4. Where relevant, consult with the appropriate provincial or territorial resource management agencies, and/or aboriginal resource management boards.
5. Note that prior to finalizing its review of the proposal DFO may, among other matters, advise the proponent of the need for more information, re-assess a revised project proposal, suggest that the proponent seek authorization, etc. The

review of a proposal is often an iterative process depending on a number of factors, such as the type of referral received by DFO, its completeness, its potential impacts on fish and/or fish habitat and the potential to mitigate and/or compensate for such impacts. Proponents should discuss this and related aspects of the review process with the relevant DFO/Regional area authority (Appendix I).

6. After examination of the proposal, DFO will make a decision regarding the proponent's application.

- **With respect to Section 32, DFO will either,**

⇒ upon determining that implementation of mitigation measures by the proponent is expected to prevent or avoid the destruction of fish, advise the proponent by letter that if such measures are incorporated into the project, Section 32 is not expected to be contravened. A letter of advice should not be taken to imply approval of the project pursuant to the habitat provisions of the *Fisheries Act*, or any other legislation. Note, if the destruction of fish occurs as a result of a change in the plans for the proposed project, or failure to implement the measures identified in the letter of advice, contravention of Section 32 of the *Fisheries Act* could occur.

**OR**

⇒ upon determining that even with the implementation of mitigation measures the destruction of fish is still expected to occur **and**, because this mortality is acceptable within the context of the fisheries resource, issue a Section 32 Authorization using a letter format.

**OR**

⇒ upon determining that even with the implementation of mitigation measures the destruction of fish is still expected to occur **but**, because this mortality is not acceptable within the context of the fisheries resource, reject the proposal, and notify the proponent that DFO will not issue a Section 32 Authorization and that a contravention of the *Fisheries Act* could occur should the proponent still choose to proceed as proposed.

- **With respect to Section 35, DFO will either,**

⇒ upon determining that implementation of mitigation measures by the proponent is expected to prevent or avoid a HADD of fish habitat, advise the proponent by letter that if such measures are incorporated into the project, Subsection 35(1) is not expected to be contravened. A letter of advice should not be taken to imply approval of the project pursuant to the habitat provisions of the *Fisheries Act*, or any other legislation. Note, if a

HADD of fish habitat occurs as a result of a change in the plans for the proposed project, or failure to implement the measures identified in the letter of advice, contravention of Subsection 35(1) of the *Fisheries Act* could occur.

**OR**

⇒ upon determining that even with the implementation of mitigation measures a HADD of fish habitat is still expected to occur **and**, because the proposed compensation for the unavoidable net loss of productive capacity of fish habitat is acceptable to DFO, issue a Subsection 35(2) authorization using the form provided in Schedule VII of Subsection 58(2) of the *Fishery (General) Regulations*.

**OR**

⇒ upon determining that even with the implementation of mitigation measures a HADD of fish habitat is still expected to occur **but**, because the proposed compensation for the unavoidable net loss of fish habitat productive capacity is not acceptable, reject the proposal, and notify the proponent that DFO will not issue a Subsection 35(2) Authorization and that a violation of the *Fisheries Act* could occur should the proponent still choose to proceed as proposed.

Notes:

- The Department of Fisheries and Oceans, in arriving at one of the above noted determinations, will also consider the following criteria:
  - Whether the use of explosives is the only technically feasible means by which to attain the desired objective; and
  - Whether the use of explosives is required to alleviate an emergency situation threatening human safety and/or property.
- Section 32 and/or Subsection 35(2) authorizations come with conditions attached, which among others may include:
  - The proponent may be required to develop, undertake and report on a monitoring program at its expense, typically, to monitor compliance and evaluate effectiveness of the mitigation and/or compensation measures.
  - If, during the course of the works or undertakings, the adverse effects of the explosives were significantly greater than anticipated, the proponent may be required to immediately cease all further use of explosives,

pending review of the situation with Department of Fisheries and Oceans personnel.

- Additional, site-specific terms and conditions as may be required in order to satisfy fishery resource and/or fish habitat protection requirements. For example, the conditions may be more stringent than the measures identified in the preceding 'Guidelines' section.

#### Canadian Environmental Assessment Act

Section 32 and Subsection 35(2) are included in the *Law List Regulation* of the *Canadian Environmental Assessment Act* (CEAA). Consequently, the Department of Fisheries and Oceans as the Responsible Authority must conduct an environmental assessment of the relevant proposed works or undertakings before an Authorization can be issued. If the result of the environmental assessment is that the work or undertaking will, after taking into account the appropriate measures, not likely result in significant impact that cannot be justified, then authorization(s) will normally be issued pursuant to Section 32 and/or Subsection 35(2) of the *Fisheries Act*. Procedures for coordinating the CEAA review with provincial and aboriginal government review processes vary. Proponents are strongly advised to contact the DFO Regional/Area authorities (Appendix I) to obtain additional information on environmental assessment procedures and requirements.

### **UPDATING**

These guidelines will be reviewed and updated as necessary.

### **ACKNOWLEDGEMENTS**

Many individuals and governmental and non-governmental organizations were consulted in the development of these guidelines. We gratefully acknowledge their interest and contributions. In particular, input from D. Haché, K. Fisher, K. Broughton and R. Drolet, from DFO, and L. Macanuf (Golder-VME) and R. Morin (Explotec Engineering Ltd) is appreciated.

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Wright, D.G. 1982. A discussion paper on the effects of explosives on fish and marine mammals in the waters of the Northwest Territories. Can. Tech. Rep. Fish. Aquat. Sci. 1052: v + 16 p.

Wright, D.G., in prep. The effects of the use of explosives on fish and marine mammals, including models to predict their impact and mitigation strategies to reduce the effect on fish and marine mammals. Can. Tech. Rep. Fish. Aquat. Sci. xxxx: xx + xx p.

Table 1. Setback distance (m) from centre of detonation of a confined explosive to fish habitat to achieve 100 kPa guideline criteria for various substrates.

The data in this table is incorrect and should not be used.

| Substrate Type   | Weight of Explosive Charge (kg) |     |     |      |      |      |      |      |
|------------------|---------------------------------|-----|-----|------|------|------|------|------|
|                  | 0.5                             | 1   | 2   | 5    | 10   | 25   | 50   | 100  |
| Rock             | 3.6                             | 5.0 | 7.1 | 11.0 | 15.9 | 25.0 | 35.6 | 50.3 |
| Frozen Soil      | 2.3                             | 3.2 | 4.5 | 7.2  | 14.3 | 16   | 22.6 | 32   |
| Ice              | 1.5                             | 2.1 | 3.0 | 4.7  | 6.6  | 10.5 | 14.8 | 21   |
| Saturated Soil   | 1.5                             | 2.1 | 3.0 | 4.8  | 6.7  | 10.0 | 15.1 | 21.3 |
| Unsaturated Soil | 0.7                             | 1.0 | 1.4 | 2.2  | 3.1  | 4.9  | 6.9  | 9.8  |

Erratum:

Wright, D.G., and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p.

Page 15: Table 1 should be replaced by the following Table:

Table 1. Setback distance (m) from centre of detonation of a confined explosive to fish habitat to achieve 100 kPa guideline criteria for various substrates.

| Substrate Type   | Weight of Explosive Charge (kg) |     |     |      |      |      |      |      |
|------------------|---------------------------------|-----|-----|------|------|------|------|------|
|                  | 0.5                             | 1   | 2   | 5    | 10   | 25   | 50   | 100  |
| Rock             | 3.6                             | 5.0 | 7.1 | 11.0 | 15.9 | 25.0 | 35.6 | 50.3 |
| Frozen Soil      | 3.3                             | 4.7 | 6.5 | 10.4 | 14.7 | 23.2 | 32.9 | 46.5 |
| Ice              | 3.0                             | 4.2 | 5.9 | 9.3  | 3.2  | 20.9 | 29.5 | 41.8 |
| Saturated Soil   | 3.0                             | 4.2 | 5.9 | 9.3  | 13.2 | 20.9 | 29.5 | 41.8 |
| Unsaturated Soil | 2.0                             | 2.9 | 4.1 | 6.5  | 9.2  | 14.5 | 20.5 | 29.0 |

Table 2. Setback distance (m) from centre of detonation of a confined explosive to spawning habitat to achieve  $13 \text{ mm} \cdot \text{sec}^{-1}$  guideline criteria for all types of substrate.

|                      | Weight of Explosive Charge (kg) |      |      |      |      |       |       |
|----------------------|---------------------------------|------|------|------|------|-------|-------|
|                      | 0.5                             | 1    | 5    | 10   | 25   | 50    | 100   |
| Setback distance (m) | 10.7                            | 15.1 | 33.7 | 47.8 | 75.5 | 106.7 | 150.9 |

## Appendix I DFO Regional/Area Authorities

### **Newfoundland Region**

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Fisheries and Habitat Management Branch  
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St. John's, NF A1C 5X1  
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### **Central and Arctic Region**

#### Ontario

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**Appendix I (concluded)**  
**DFO Regional/Area Authorities**

**Central and Arctic Region (continued)**

Nunavut

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Western Arctic

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North Coast

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**Appendix II**  
**General Equations to Determine Setback Distance for Confined**  
**Explosives to Meet Guideline Criteria of 100 kPa**

## Equation (A)

Equation (A) describes the transfer of shock pressure from the substrate to the water.

$$P_W = \frac{2(Z_W / Z_R)P_R}{1 + (Z_W / Z_R)}$$

where:

|       |   |                                 |
|-------|---|---------------------------------|
| $P_W$ | = | pressure (kPa) in water         |
| $P_R$ | = | pressure (kPa) in substrate     |
| $Z_W$ | = | acoustic impedance of water     |
| $Z_R$ | = | acoustic impedance of substrate |

## Equation (B)

Equation (B) describes the relationship between acoustic impedance and the density and velocity of the medium through which the compressional wave travels.

$$Z_W/Z_R = \frac{D_W C_W}{D_R C_R}$$

where:

|       |   |                                                |
|-------|---|------------------------------------------------|
| $D_W$ | = | density of water = 1 g•cm <sup>-3</sup>        |
| $D_R$ | = | density of the substrate in g•cm <sup>-3</sup> |
| $C_W$ | = | compressional wave velocity in water           |
|       | = | 146,300 cm•s <sup>-1</sup>                     |
| $C_R$ | = | compressional wave velocity in substrate       |
|       | = | in cm•s <sup>-1</sup>                          |

**Appendix II (concluded)**  
**General Equations to Determine Setback Distance for Confined**  
**Explosives to Meet Guideline Criteria of 100 kPa**

Equation (B) (continued):

The following values are used for  $D_R$  and  $C_R$  for various substrates:

| Substrate        | $D_R$ ( $\text{g}\cdot\text{cm}^{-3}$ ) | $C_R$ ( $\text{cm}\cdot\text{s}^{-1}$ ) |
|------------------|-----------------------------------------|-----------------------------------------|
| Rock             | 2.64                                    | 457,200                                 |
| Frozen Soil      | 1.92                                    | 304,800                                 |
| Ice              | 0.98                                    | 304,800                                 |
| Saturated soil   | 2.08                                    | 146,300                                 |
| Unsaturated soil | 1.92                                    | 45,700                                  |

Equation (C)

Equation (C) describes the relationship between the peak particle velocity ( $V_R$ ) and the pressure, density and compressional wave velocity in the substrate.

$$V_R = \frac{2P_R}{D_R C_R}$$

Equation (D)

Equation (D) represents the scaled distance relationship and is used to equate the peak particle velocity to charge weight and distance.

$$V_R = 100 (R/W^{.5})^{-1.6}$$

where:

|       |   |                                                         |
|-------|---|---------------------------------------------------------|
| $V_R$ | = | peak particle velocity in $\text{cm}\cdot\text{s}^{-1}$ |
| $R$   | = | distance to the detonation point in m                   |
| $W$   | = | charge weight per delay in kg                           |

### Appendix III Sample Calculations and Examples for Confined Explosives

#### SAMPLE CALCULATIONS

#### Sample Calculation 1: Calculation of Setback Distance Required for a 100 kg Charge Set in Rock to Meet the 100 kPa Guideline.

1. From Equation (B):

$$\begin{aligned} Z_W/Z_R &= \frac{D_W C_W}{D_R C_R} \\ &= \frac{(1\text{g}\cdot\text{cm}^{-3})(146,300\text{cm}\cdot\text{s}^{-1})}{(2.64\text{g}\cdot\text{cm}^{-3})(457,200\text{cm}\cdot\text{s}^{-1})} \\ &= 0.1212 \end{aligned}$$

2. From Equation (A):

$$P_W = \frac{2(Z_W / Z_R)P_R}{1+(Z_W / Z_R)}$$

$$P_W = \frac{2(0.1212)P_R}{1+(0.1212)}$$

$$P_W = 0.22 P_R$$

3. To limit  $P_W$  to 100 kPa ( $\text{kg}\cdot\text{m}\cdot\text{s}^{-2}\cdot\text{m}^{-2}$ ):

$$P_R = \frac{P_W}{0.22}$$

$$P_R = \frac{100 \text{ kPa}}{0.22}$$

$$P_R = 455 \text{ kPa}$$

$$P_R = 4.55 \times 10^2 \text{ kPa}$$

**Appendix III (continued)**  
**Sample Calculations and Examples for Confined Explosives**

4. Convert kPa to dynes ( $\text{g}\cdot\text{cm}\cdot\text{s}^{-2}$ ):

$$\text{dynes} = \text{kPa} \times 10^4$$

$$P_R = 4.55 \times 10^2 \times 10^4$$

$$P_R = 4.55 \times 10^6 \text{ dynes } (\text{g}\cdot\text{cm}\cdot\text{s}^{-2})$$

5. From Equation (C):

$$V_R = \frac{2P_R}{D_R C_R}$$

$$V_R = \frac{(2) (4.55 \cdot 10^6 \text{ g}\cdot\text{cm}\cdot\text{s}^{-2})}{(2.64 \text{ g}\cdot\text{cm}^{-3})(457,200 \text{ cm}\cdot\text{s}^{-1})}$$

$$V_R = 7.54 \text{ cm}\cdot\text{s}^{-1}$$

6. From Equation (D):

$$V_R = 100(R/W^{.5})^{-1.6}$$

$$R = (W^{.5})(V_R/100)^{-0.625}$$

$$R = (100\text{kg})^{.5}(7.54\text{cm}\cdot\text{s}^{-1}/100\text{kg}\cdot\text{cm}\cdot\text{s}^{-1}\cdot\text{m})^{-0.625}$$

$$R = 50.3 \text{ m}$$

Therefore, a 100 kg charge of explosives detonated in rock requires a setback of 50.3 m from fish habitat in order to reduce the overpressure produced by the detonation to less than 100 kPa.

Now, the calculation of the set-back distance required for a 100 kg charge set in rock to meet the peak particle velocity guideline of  $13 \text{ mm}\cdot\text{sec}^{-1}$  is as follows:

**Appendix III (continued)**  
**Sample Calculations and Examples for Confined Explosives**

From Equation (D):

$$R = (W^{.5})(V_R/100)^{-0.625}$$

When

$$V_R = 13 \text{ mm}\cdot\text{sec}^{-1} = 1.3 \text{ cm}\cdot\text{sec}^{-1}$$

and  $W = 100 \text{ kg}$

$$R = (100^{.5})(1.3/100)^{-0.625}$$

$$R = 150.9 \text{ m}$$

Therefore, a 100 kg charge of explosives detonated in rock requires a setback of 150.9 m from a spawning area in order to reduce the peak particle velocity produced by the detonation to less than 13 mm•sec<sup>-1</sup>.

**Sample Calculation 2: Simplified Calculation of Setback Distance from Fish Habitat.**

The calculations to determine the required setback distance to meet the 100 kPa guideline may be simplified. Since the weight of the charge and the distance from the charge to fish habitat are the only variables in the equations, a factor can be developed for substitution in Equation (D).

From Equation (D):

$$V_R = 100(R/W^{.5})^{-1.6}$$

$$R = (W^{.5})(V_R/100)^{-0.625}$$

Therefore:

$$R = W^{.5}(K)$$

By working through the equations of Appendix II and solving for  $V_R$  for each substrate

**Appendix III (continued)**  
**Sample Calculations and Examples for Confined Explosives**

type, the following results are obtained:

| SUBSTRATE TYPE   | K    |
|------------------|------|
| Rock             | 5.03 |
| Frozen Soil      | 3.2  |
| Ice              | 2.1  |
| Saturated Soil   | 2.13 |
| Unsaturated Soil | 0.98 |

Therefore, to determine the setback distance required to meet the peak pressure guideline of 100 kPa, multiply the square root of the charge weight by the appropriate “K” factor.

**Sample Calculation 3: Simplified Calculation of Setback Distance from Fish Spawning Habitat.**

Similarly, to determine the set-back distance required to meet the peak particle velocity ( $V_R$ ) guideline of  $13 \text{ mm}\cdot\text{sec}^{-1}$ , a constant can be developed for substitution in Equation (D):

From Equation (D):

$$V_R = 100(R/W^5)^{-1.6}$$

$$R = (W^5)(V_R/100)^{-0.625}$$

where:

$$V_R = 13 \text{ mm}\cdot\text{sec}^{-1} = 1.3 \text{ cm}\cdot\text{sec}^{-1}$$

$$R = (W^5)(1.3/100)^{-0.625}$$

$$R = (W^5)(15.09)$$

Therefore, to determine the setback distance required to meet the peak particle velocity ( $V_R$ ) guideline of  $13 \text{ mm}\cdot\text{sec}^{-1}$ , multiply the square root of the charge weight by a factor of 15.09.

**Appendix III (continued)**  
**Sample Calculations and Examples for Confined Explosives**

**EXAMPLES**

**Example 1: On-shore Setback Distance from Fish Habitat.**

A proponent wishes to use explosives to break rock in a quarry near a stream. What is the minimum setback distance from the stream required in order to limit the overpressure in the stream to less than 100 kPa?

Calculate the required set back distance for a 35 kg charges set in rock.

$$\begin{aligned}
 W &= 35 \text{ kg} \\
 K_{(\text{rock})} &= 6.75 \\
 R &= (W^{-5})(K) \\
 R &= (35^{-5})(5.03) \\
 R &= 29.8 \text{ m}
 \end{aligned}$$

Note: It is assumed that the rock formation being quarried extends under the stream. Therefore the K factor for rock is used.

Therefore, the proponent would be required to maintain a set back distance of at least 29.8 m in order to meet the DFO guideline criteria of 100 kPa.

**Example 2: Buried Charges for Geophysical Exploration.**

A proponent wishes to conduct a geophysical survey beneath a shallow lake. Because of the shallow depth of the lake, it is not possible to use an air gun or other similar non-explosive energy source. To what depth must explosive charges (5 kg) be buried in order to limit the overpressure to less than 100 kPa?

$$\begin{aligned}
 W &= 5 \text{ kg} \\
 K_{(\text{sat. soil})} &= 2.13 \\
 R &= (W^{-5})(K) \\
 R &= (5^{-5})(2.13) \\
 R &= 4.8 \text{ m}
 \end{aligned}$$

Note: It is assumed that the charges are buried in un-consolidated sediments. Therefore the K factor for saturated soil is used.

Therefore the proponent would be required to bury the charges to a depth of at least 4.8 m below the substrate-water interface in order to limit the overpressure at the interface to less than 100 kPa.

**Appendix III (continued)**  
**Sample Calculations and Examples for Confined Explosives**

**Example 3: In-stream Trench Excavation.**

A proponent wishes to use explosives to assist in the excavation of a trench for a pipeline across a trout stream. The right-of-way is located in a cobble bottom riffle area that is used as a feeding area. There is a potential spawning bed located 75 m upstream of the right-of-way. The explosives' parameters are as follows:

|                               |       |
|-------------------------------|-------|
| Weight of individual charges: | 15 kg |
| # of holes detonated/delay:   | 5     |
| Weight of charge/delay:       | 75 kg |

Does the proposal meet the DFO guideline criteria for overpressure and peak particle velocity?

**a) For the Overpressure Criteria:**

$$\begin{aligned}
 W &= 75 \text{ kg} \\
 K_{(\text{rock})} &= 5.03 \\
 R &= (W^{.5})(K) \\
 R &= (75^{.5})(5.03) \\
 R &= 43.6 \text{ m}
 \end{aligned}$$

Note: Since explosives must be used to excavate the trench, it is assumed that the substrate consists of rock or strongly consolidated sediments. Therefore the K factor for rock is used.

Therefore the detonation of 75 kg of explosives could kill or injure fish within a radius of 43.6 m of the right-of-way.

**b) For the Peak Particle Velocity Criteria:**

To determine the setback distance required to meet the peak particle velocity ( $V_R$ ) guideline of  $13 \text{ mm} \cdot \text{sec}^{-1}$  in a spawning area, multiply the square root of the charge weight by a factor of 15.09.

$$\begin{aligned}
 R &= (W^{.5})(15.09) \\
 R &= (75^{.5})(15.09) \\
 R &= 130.7 \text{ m}
 \end{aligned}$$

Therefore, the detonation of 75 kg of explosives would exceed the DFO Guideline for peak particle velocity of  $13 \text{ mm} \cdot \text{sec}^{-1}$  in a spawning bed.

**Appendix III (concluded)**  
**Sample Calculations and Examples for Confined Explosives**

Therefore, the application for an authorization to use explosives would be denied and major changes in the explosives program would be required in order for the project to be acceptable to DFO.

For example:

If the weight of explosive/delay were reduced to 5 kg by increasing the number of holes in the pattern and detonating each hole separately with 25 msec delays between each hole, the zone of overpressure exceeding 100 kPa would be:

$$\begin{aligned}
 W &= 5 \text{ kg} \\
 K_{(\text{rock})} &= 5.03 \\
 R &= (W^{-5})(K) \\
 R &= (5^{-5})(5.03) \\
 R &= 11.2 \text{ m}
 \end{aligned}$$

Similarly, the distance at which the peak particle velocity in the substrate would not exceed  $13 \text{ mm} \cdot \text{sec}^{-1}$  would be:

$$\begin{aligned}
 R &= (W^{-5})(15.09) \\
 R &= (5^{-5})(15.09) \\
 R &= 33.7 \text{ m}
 \end{aligned}$$

Therefore, if the weight of explosives per delay were reduced to 5 kg, the spawning area would be protected, as it is further than 33.7m from the detonation area. However, the detonation would still produce over-pressures exceeding 100 kPa to a distance of 11.2 m. Additional mitigation such as undertaking the project at a time of least fish activity or by removing/excluding fish from the area by either physical exclusion or scare tactics may be required.









## APPENDIX V

## Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat

SCHEDULE VI / ANNEXE VI  
(Subsection 58(1)/paragraphe 58(1))

Fisheries and Oceans



Pêches et Océans

Page 1

Application No./N° de la demande

**APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON**

I, the undersigned, hereby request authorization to carry out the works or undertakings described on this application form. I understand that the approval of this application, if granted, is from the Minister of Fisheries and Oceans standpoint only and does not release me from my obligation to obtain permission from other concerned regulatory agencies.

Je soussigné, demande par les présentes l'autorisation d'exploiter les ouvrages ou entreprises décrits dans la formule. Je comprends que l'approbation de cette demande, le cas échéant, porte sur ce qui relève du ministre des Pêches et des Océans et ne me dispense pas d'obtenir la permission d'autres organismes réglementaires concernés.

If an authorization is granted as a result of this application, I hereby agree to carry out all activities relating to the project within the designated time frames and conditions specified in the authorization.

Si la demande est approuvée, je consens par les présentes à exécuter tous les travaux relatifs à ce projet selon les modalités et dans le laps de temps prescrits dans l'autorisation.

Applicant's Name (Please Print) \_\_\_\_\_ Nom du requérant (lettres moulées)

Applicant's Business Address \_\_\_\_\_ Adresse d'affaires du requérant  
\_\_\_\_\_  
\_\_\_\_\_

Applicant's Telephone No./ N° de téléphone du requérant \_\_\_\_\_ Date \_\_\_\_\_

I solemnly declare that the information provided and facts set out in this application are true, complete and correct, and I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath. This declaration applies to all material submitted as part of this application.

Je déclare solennellement que les renseignements fournis et les faits énoncés dans cette demande sont véridiques, complets et exacts, et je fais cette déclaration solennelle, la croyant consciencieusement vraie et sachant qu'elle a la même force et le même effet que si elle était faite sous serment. Cette déclaration s'applique à tout document qui est présenté dans le cadre de cette demande.

\_\_\_\_\_  
Applicant's Signature (and corporate seal)

\_\_\_\_\_  
Signature du requérant (et sceau de la société)

Name of watercourse or waterbody (give coordinates)  
Cours d'eau ou plan d'eau (donner les coordonnées) \_\_\_\_\_

This watercourse is a tributary of (where applicable)  
Cours d'eau tributaire de (le cas échéant)  
\_\_\_\_\_

Nearest community  
Localité la plus proche

County  
Comté

Province  
Province

**APPENDIX V**

**Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat (continued)**

SCHEDULE VI-Continued/ANNEXE VI (suite)

Fisheries and Oceans



Pêches et Océans

Application No./N° de la demande

**APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON**

**Type of Activity/Genre d'activité**

- |                                                                        |                                                                             |                                                                                                    |                                                                      |
|------------------------------------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| <input type="checkbox"/> Bridge<br>Pont                                | <input type="checkbox"/> Stream Realignment<br>Alignement de cours<br>d'eau | <input type="checkbox"/> Gravel Removal<br>Enlèvement du gravier                                   | <input type="checkbox"/> Stream Traverse<br>Traversée de cours d'eau |
| <input type="checkbox"/> Culvert<br>Ponceau                            | <input type="checkbox"/> Channelization<br>Canalisation                     | <input type="checkbox"/> Obstruction Removal - Bypass<br>Enlèvement ou contournement<br>d'obstacle | <input type="checkbox"/> Seismic Survey<br>Levé sismique             |
| <input type="checkbox"/> Dam<br>Barrage                                | <input type="checkbox"/> Wharf - Break water<br>Quai - Brise-lames          | <input type="checkbox"/> Stream Utilization - Recreation<br>Utilisation récréative du cours d'eau  | <input type="checkbox"/> Agriculture                                 |
| <input type="checkbox"/> Stream Diversion<br>Dérivation de cours d'eau | <input type="checkbox"/> Dewatering<br>Assèchement                          | <input type="checkbox"/> Erosion Control<br>Lutte contre l'érosion                                 | <input type="checkbox"/> Other (specify)<br>Autres (préciser)        |
| <input type="checkbox"/> Mining<br>Activité minière                    | <input type="checkbox"/> Aquaculture                                        | <input type="checkbox"/> Flood Protection<br>Protection contre les inondations                     |                                                                      |

**List of Agencies (Federal, Provincial or Municipal) contacted or notified, or who have initiated contact with the applicant.**

**Liste des organismes (fédéraux, provinciaux ou municipaux) contactés ou qui ont pris contact avec le requérant.**

**PROVIDE DETAILS OF PROPOSED ACTIVITY INCLUDING REASONS FOR THE PROJECT AND TYPES OF EQUIPMENT TO BE USED  
DONNER DES PRÉCISIONS SUR LES TRAVAUX PROJÉTÉS Y COMPRIS LA JUSTIFICATION DU PROJET ET  
LE TYPE D'ÉQUIPEMENT À UTILISER**

Blank lines for providing details of proposed activity and equipment.

## APPENDIX V

## Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat (continued)

SCHEDULE VI-Continued/ANNEXE VI (suite)

Fisheries and Oceans



Pêches et Océans

Page 3

Application No./N° de la demande

APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON

## SCHEDULE/CALENDRIER

|                                                                                                                                                                                                                     | D/J   | MM    | Y/A   |      | D/J   | MM    | Y/A   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|------|-------|-------|-------|
| Proposed Starting Date<br>Date prévue du début des travaux                                                                                                                                                          | _____ | _____ | _____ |      | _____ | _____ | _____ |
| Proposed Completion Date<br>Date prévue de l'achèvement des travaux                                                                                                                                                 | _____ | _____ | _____ |      | _____ | _____ | _____ |
| Approximate Timing of Work in shoreline, foreshore, tidal zone, or underwater areas.<br>Période approximative des travaux sur le rivage et les estrans ainsi que dans les zones à marées et les zones sous-marines. |       |       |       |      |       |       |       |
|                                                                                                                                                                                                                     | D/J   | MM    | Y/A   | To/A | D/J   | MM    | Y/A   |
| From/De                                                                                                                                                                                                             | _____ | _____ | _____ |      | _____ | _____ | _____ |

The following documents will assist in assessing your application and help expedite its approval. Please check which documents you have attached.

Les documents suivants faciliteront l'évaluation de votre demande et permettront d'accélérer son approbation. Veuillez cocher les documents vous avez joints à votre demande.

|                                                              |                          |                                                                               |
|--------------------------------------------------------------|--------------------------|-------------------------------------------------------------------------------|
| Map indicating location of project                           | <input type="checkbox"/> | Carte indiquant l'emplacement du projet                                       |
| Engineering Specifications                                   | <input type="checkbox"/> | Spécifications techniques                                                     |
| Scale Drawings                                               | <input type="checkbox"/> | Dessins à l'échelle                                                           |
| Dimensional Drawings                                         | <input type="checkbox"/> | Plans cotés                                                                   |
| Assessment of Existing Fish Habitat Characteristics          | <input type="checkbox"/> | Évaluation des caractéristiques existantes de l'habitat du poisson            |
| Assessment of Potential Effects of Project on Fish Habitat   | <input type="checkbox"/> | Évaluation des répercussions possibles sur l'habitat du poisson               |
| Measures Proposed to Offset Potential Damage to Fish Habitat | <input type="checkbox"/> | Mesures proposées pour compenser les ventuels dommages à l'habitat du poisson |
| Other                                                        | <input type="checkbox"/> | Autres                                                                        |

ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS  
CONSIDERATIONSCONSIDÉRATIONS CONCERNANT LE PROCESSUS  
D'ÉVALUATION ET D'EXAMEN EN MATIÈRE  
D'ENVIRONNEMENT

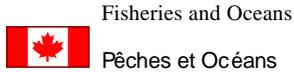
NOTE: All applications pursuant to section 35 of the Fisheries Act will be assessed in accordance with applicable federal environmental assessment requirements.

REMARQUE : Toute demande en vertu l'article 35 de la Loi sur les pêches sera soumise aux exigences fédérales applicables à l'évaluation environnementale.

## APPENDIX V

## Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat (concluded)

SCHEDULE VI-Concluded/ANNEXE VI (fin)



Page 4

Application No./N° de la demande

**APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON**

COMPLETE ONLY IF USE OF EXPLOSIVES IS INTENDED  
A REMPLIR SEULEMENT EN CAS D'UTILISATION D'EXPLOSIFS

EXPLOSIVES CONTRACTOR (IF DIFFERENT FROM APPLICANT)/RESPONSABLE DES EXPLOSIFS (SI AUTRE QUE LE REQUIRANT)

Name/Nom : \_\_\_\_\_

Address/Adresse : \_\_\_\_\_

Telephone No./N° de téléphone : \_\_\_\_\_

|                                  | D/J   | M/M   | Y/A   |                   | D/J   | M/M   | Y/Y   |
|----------------------------------|-------|-------|-------|-------------------|-------|-------|-------|
| Anticipated Starting Date        |       |       |       | Completion Date   |       |       |       |
| Date prévue du début des travaux | _____ | _____ | _____ | Date d'achèvement | _____ | _____ | _____ |

**DETAILS OF EXPLOSIVES/PRÉCISIONS SUR LES EXPLOSIFS**

Type (including trade name) \_\_\_\_\_  
Genre (y compris la marque) \_\_\_\_\_

Weight and configuration (where applicable) \_\_\_\_\_  
Poids et forme (le cas échéant) \_\_\_\_\_

Weight of individual shots and shot pattern where multiple charges are used  
Poids des coups individuels et déploiement des coups, en cas de charges multiples

Detonation depth (in the rock; note also the depth of water, if applicable)  
Profondeur de détonation (dans le roc; indiquer aussi, la profondeur de l'eau, s'il y a lieu)

Method of detonation \_\_\_\_\_  
Méthode de détonation \_\_\_\_\_



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

Blast Impact Analysis  
Burlington Quarry Extension  
Concession 2, Part Lot 1,2,17 &18  
Township of Burlington

Submitted to:

Nelson Aggregate  
2433 No. 2 Side Road  
Burlington, ON  
L7P 0G8



Prepared by

Explotech Engineering Ltd.  
58 Antares Drive, Unit 5  
Ottawa, Ontario  
K2E 7W6

June 16, 2021



## **EXECUTIVE SUMMARY**

ExploTech Engineering Ltd. was retained in November 2018 to provide a Blast Impact Analysis for the proposed Nelson Aggregate – Burlington Quarry Extension operation located on Concession 2, Part Lot 1,2,17 and 18 – geographical City of Burlington, Ontario.

Vibration levels assessed in this report are based on the Ministry of the Environment, Conservation and Parks Model Municipal Noise Control By-law (NPC 119) with regard to guidelines for blasting in Mines and Quarries. We have assessed the area surrounding the proposed license area with regard to potential damage from blasting operations and compliance with the aforementioned by-law document. In addition, we have reviewed blast and/or vibration reports collected at the existing licenced quarry for the 2014 - 2019 blasting campaigns.

Golder Associates undertook a vibration attenuation study at the existing Burlington Quarry in 2004. The resultant data was analyzed in order to develop site specific vibration attenuation characteristics and equations.

We have inspected the site and reviewed the available site plans. ExploTech Engineering Ltd. is of the opinion that the planned mineral extraction extension on the site can be carried out safely and within Ministry of the Environment, Conservation and Parks guidelines as set out in NPC 119 of the By-Law.

Recommendations are included in this report for blasting operations to be carried out in a safe and productive manner and to suitably manage and mitigate the possibility of damage to any buildings, wells, structures or residences surrounding the property.



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1. Golder Blast Impact Assessment\_April 2006



## **INTRODUCTION**

The proposed Nelson Aggregate – Burlington Quarry Extension operation is separated into two areas. The Burlington Quarry South Extension is located on the Southeast side of the existing licensed and operating Burlington Quarry (Licence 5499) while the Burlington Quarry West Extension is located along the Southwest face of the existing quarry. The legal description for the proposed licence is Concession 2, Part Lot 1,2,17 and 18 – geographical City of Burlington, Ontario.

This Blast Impact Analysis is based on the Ministry of the Environment, Conservation and Parks (MECP) Model Municipal Noise Control By-law (NPC 119) with regard to guidelines for blasting in mines and quarries. We have additionally assessed the area surrounding the proposed license with regard to potential damage from blasting operations. It is a recommendation of this report that a vibration monitoring program be continued on the existing licenced site as well as on the proposed Burlington Quarry extension lands and that this monitoring program be maintained for the duration of all blasting activities to permit timely adjustment to blast parameters as required.

While not specifically required as part of the required scope of the Blast Impact Analysis under the Aggregate Resources Act, this report reviews the topics of flyrock and residential water wells. Exhaustive details related to residential water wells are addressed in the hydrogeological report while specific flyrock control is addressed at the operational level given significant influences related to blast design, geology and field accuracy.

Recommendations are included in this report for blasting operations to be carried out in a safe and productive manner and to suitably manage and mitigate the possibility of damage to any buildings, wells, structures or residences surrounding the property.



## **EXISTING CONDITIONS**

The current operating licensed area for the Nelson Aggregate Burlington Quarry (Licence 5499) is described as Concession 2, Lot 1 and 2 and Concession 3, Part Lot 1 and 2 – geographic City of Burlington. This property is bound by Colling Road to the Northeast, No. 2 Side Road to the Southeast, Burlington Springs Golf Club property to the Southwest and Guelph Line to the Northeast. The lands immediately surrounding the licence are sparsely populated with the areas of densest development lying to the Southwest.

The proposed Burlington Quarry extension is separated into two (2) areas designated as the South and West Extension Areas. The Burlington Quarry South Extension is legally described as Concession 2, Part Lot 17 and 18 and is located immediately Southeast of the existing licence separated by No. 2 Side Road. The Burlington Quarry South extension lands are bound by vacant lands to the Northeast and Southeast, No. 2 Side Road and the existing Burlington Quarry to the Northwest and residential properties located along No. 2 Side Road as well as the Camisle Golf Course to the Southwest. The South Extension lands are generally highest towards the Northeast boundary of the extension lands. The maximum elevations are in the order of 282MASL. The land drops in the South corner of the South extension lands to an elevation of approximately 274MASL.

The Burlington Quarry West Extension is legally described as Concession 2, Part Lot 1 & 2 and lies Southwest of the existing licence. The West Extension lands are bound by the existing quarry and Colling Road to the North, Cedar Springs Road and residential properties along Cedar Springs Road to the West, residential properties located along No. 2 Side Road and Cedar Springs Road to the South and East. The West Extension lands are generally highest towards the Northeast and South boundaries of the extension lands. The maximum elevations are in the order of 275MASL. The existing topography drops along the West boundary of the West Extension lands to an elevation of approximately 262MASL.

The licenced area for the proposed Burlington Quarry extension lands encompasses a total area of approximately 78.4HA. The associated extraction area is approximately 50.2HA when allowing for setbacks and sterilized areas.

The closest sensitive receptors located to the existing Burlington Quarry licence boundary and the proposed Burlington Quarry Extension extraction boundaries are listed in Table 1 below as well as on the Sensitive Receptor Overviews contained in Appendix A:

# EXPLOTECH

| Sensitive Receptor    | Straight Line Distance from Existing Burlington Quarry Boundary to Receptor (m) | Straight Line Distance from proposed Burlington Quarry Extension Extraction Boundary to Receptor (m) | Extension Area Closest to Sensitive Receptor |
|-----------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------|
| 2196 No. 2 Side Road  | 158                                                                             | 284                                                                                                  | South                                        |
| *2226 No. 2 Side Road | 53                                                                              | 208                                                                                                  | South                                        |
| *2244 No. 2 Side Road | 47                                                                              | 129                                                                                                  | South                                        |
| *2280 No. 2 Side Road | 28                                                                              | 15                                                                                                   | South                                        |
| *2292 No. 2 Side Road | 153                                                                             | N/A                                                                                                  | South                                        |
| *2300 No. 2 Side Road | 52                                                                              | N/A                                                                                                  | South                                        |
| *2416 No. 2 Side Road | 116                                                                             | 278                                                                                                  | South                                        |
| *2433 No 2 Side Road  | 69                                                                              | 280                                                                                                  | South                                        |
| 2450 No. 2 Side Road  | 50                                                                              | 387                                                                                                  | South                                        |
| 2462 No. 2 Side Road  | 60                                                                              | 423                                                                                                  | South                                        |
| 2470 No. 2 Side Road  | 48                                                                              | 462                                                                                                  | South                                        |
| *2473 No. 2 Side Road | 12                                                                              | 493                                                                                                  | South                                        |
| *2479 No. 2 Side Road | 41                                                                              | 521                                                                                                  | South                                        |
| 2485 No. 2 Side Road  | 75                                                                              | 549                                                                                                  | South                                        |
| 2495 No. 2 Side Road  | 74                                                                              | 612                                                                                                  | South                                        |
| 2496 No. 2 Side Road  | 449                                                                             | 636                                                                                                  | South                                        |
| 2509 No. 2 Side Road  | 78                                                                              | 644                                                                                                  | South                                        |
| 2519 No. 2 Side Road  | 118                                                                             | 664                                                                                                  | South                                        |
| 4366 Guelph Line      | 613                                                                             | 740                                                                                                  | South                                        |
| 4420 Guelph Line      | 380                                                                             | 517                                                                                                  | South                                        |
| 4448 Guelph Line      | 349                                                                             | 663                                                                                                  | South                                        |
| 4472 Guelph Line      | 312                                                                             | 674                                                                                                  | South                                        |
| 4480 Guelph Line      | 288                                                                             | 669                                                                                                  | South                                        |
| 4486 Guelph Line      | 183                                                                             | 535                                                                                                  | South                                        |
| 4487 Guelph Line      | 329                                                                             | 672                                                                                                  | South                                        |
| 4496 Guelph Line      | 282                                                                             | 668                                                                                                  | South                                        |
| 5030 Guelph Line      | 35                                                                              | 697                                                                                                  | South                                        |
| 1385 No. 2 Side Road  | 560                                                                             | 285                                                                                                  | West                                         |
| 1405 No. 2 Side Road  | 500                                                                             | 239                                                                                                  | West                                         |
| 1425 No. 2 Side Road  | 453                                                                             | 202                                                                                                  | West                                         |
| *2015 No. 2 Side Road | 307                                                                             | 95                                                                                                   | West                                         |

# EXPLOTECH

| Sensitive Receptor       | Straight Line Distance from Existing Burlington Quarry Boundary to Receptor (m) | Straight Line Distance from proposed Burlington Quarry Extension Extraction Boundary to Receptor (m) | Extension Area Closest to Sensitive Receptor |
|--------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------|
| 2080 No. 2 Side Road     | 144                                                                             | 143                                                                                                  | West                                         |
| 2090 No. 2 Side Road     | 249                                                                             | 268                                                                                                  | West                                         |
| 2102 No. 2 Side Road     | 90                                                                              | 118                                                                                                  | West                                         |
| 2116 No. 2 Side Road     | 36                                                                              | 77                                                                                                   | West                                         |
| 2126 No. 2 Side Road     | 39                                                                              | 100                                                                                                  | West                                         |
| 2136 No. 2 Side Road     | 46                                                                              | 140                                                                                                  | West                                         |
| 2170 No. 2 Side Road     | 167                                                                             | 298                                                                                                  | West                                         |
| 5050 Cedar Springs Road  | 478                                                                             | 146                                                                                                  | West                                         |
| 5070 Cedar Springs Road  | 523                                                                             | 154                                                                                                  | West                                         |
| 5029 Cedar Springs Court | 634                                                                             | 326                                                                                                  | West                                         |
| 5059 Cedar Springs Court | 620                                                                             | 279                                                                                                  | West                                         |
| 5069 Cedar Springs Court | 615                                                                             | 226                                                                                                  | West                                         |
| 5079 Cedar Springs Court | 610                                                                             | 188                                                                                                  | West                                         |
| 5089 Cedar Springs Court | 615                                                                             | 150                                                                                                  | West                                         |
| 5106 Cedar Springs Court | 735                                                                             | 237                                                                                                  | West                                         |
| 5116 Cedar Springs Court | 731                                                                             | 220                                                                                                  | West                                         |
| 5132 Cedar Springs Court | 738                                                                             | 245                                                                                                  | West                                         |
| 5140 Cedar Springs Court | 717                                                                             | 233                                                                                                  | West                                         |
| 5158 Cedar Springs Road  | 707                                                                             | 237                                                                                                  | West                                         |
| 5164 Cedar Springs Road  | 717                                                                             | 259                                                                                                  | West                                         |
| 5165 Cedar Springs Road  | 625                                                                             | 189                                                                                                  | West                                         |
| 5168 Cedar Springs Road  | 728                                                                             | 296                                                                                                  | West                                         |
| 5172 Cedar Springs Road  | 729                                                                             | 266                                                                                                  | West                                         |
| 5179 Cedar Springs Road  | 636                                                                             | 222                                                                                                  | West                                         |
| 5191 Cedar Springs Road  | 542                                                                             | 139                                                                                                  | West                                         |
| 5206 Cedar Springs Road  | 727                                                                             | 231                                                                                                  | West                                         |
| 5214 Cedar Springs Road  | 747                                                                             | 234                                                                                                  | West                                         |
| 5224 Cedar Springs Road  | 720                                                                             | 196                                                                                                  | West                                         |
| 5234 Cedar Springs Road  | 712                                                                             | 184                                                                                                  | West                                         |
| *5235 Cedar Springs Road | 327                                                                             | N/A                                                                                                  | West                                         |
| 5244 Cedar Springs Road  | 716                                                                             | 184                                                                                                  | West                                         |
| 5245 Cedar Springs Road  | 642                                                                             | 110                                                                                                  | West                                         |
| 5248 Cedar Springs Road  | 716                                                                             | 184                                                                                                  | West                                         |

# EXPLOTECH

| Sensitive Receptor      | Straight Line Distance from Existing Burlington Quarry Boundary to Receptor (m) | Straight Line Distance from proposed Burlington Quarry Extension Extraction Boundary to Receptor (m) | Extension Area Closest to Sensitive Receptor |
|-------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------|
| 5254 Cedar Springs Road | 713                                                                             | 173                                                                                                  | West                                         |
| 5255 Cedar Springs Road | 637                                                                             | 103                                                                                                  | West                                         |
| 5258 Cedar Springs Road | 704                                                                             | 152                                                                                                  | West                                         |
| 5264 Cedar Springs Road | 705                                                                             | 138                                                                                                  | West                                         |
| 5268 Cedar Springs Road | 705                                                                             | 131                                                                                                  | West                                         |
| 5300 Cedar Springs Road | 721                                                                             | 146                                                                                                  | West                                         |
| 5318 Cedar Springs Road | 717                                                                             | 140                                                                                                  | West                                         |
| 5336 Cedar Springs Road | 710                                                                             | 163                                                                                                  | West                                         |
| 5352 Cedar Springs Road | 721                                                                             | 225                                                                                                  | West                                         |
| 5353 Cedar Springs Road | 524                                                                             | 149                                                                                                  | West                                         |
| 5360 Cedar Springs Road | 725                                                                             | 235                                                                                                  | West                                         |
| 5380 Cedar Springs Road | 752                                                                             | 312                                                                                                  | West                                         |
| 2129 Colling Road       | 94                                                                              | 114                                                                                                  | West                                         |
| 2139 Colling Road       | 67                                                                              | 103                                                                                                  | West                                         |

\* Denotes properties owned by the proponent. If these properties are unoccupied at the time of blasting operations or their use has changed (eg converted to offices) they will no longer be considered sensitive receptors and are thereby exempt from the MECP Guideline vibration and overpressure limits.

The structures located at 2280 No 2 Side Road located directly adjacent the proposed south expansion license are classified as culturally significant and will be vacant at the time of extraction. In this instance, 2280 No 2 Side Road would not qualify as a sensitive receptor as defined by the MECP (refer to Appendix E for Definitions). In order to safeguard the structural integrity of these structures, we recommend that vibrations at the 2280 No 2 Side Road property be maintained below 50mm/s (>40Hz) in accordance with research performed by the United States Bureau of Mines (USBM RI8507). The closest structure on the property shall be monitored for ground vibration and overpressure when vibration calculations suggest vibrations in excess of 35mm/s.



## **PROPOSED MINERAL EXTRACTION**

As per the April 2020 Extraction Plan (Refer to Appendix A), the proposed initial quarry operations will commence with a sinking cut at the North corner of the Burlington Quarry South extension area. The South Extension Area will be extracted in three (3) phases designated as Phase 1a, Phase 1b and Phase 2. Retreat of the face will progress in a general Southeast direction.

Initial blasting for the South Extension lands will be located approximately 410m from the closest sensitive receptor not owned by the proponent outside of the proposed limits of extraction, namely 2450 No. 2 Side Road. (Note: The property located at 2280 No. 2 Sideroad is located approximately 205m from the initial blasting. This property is owned by the proponent and will be vacant upon commencement of extraction operations in which case it would be exempt from NPC 119 guideline limits. In the event that the property is being used a residence upon commencement of blasting, the NPC 119 limits would be applicable at this property). As operations progress during the South Extension, quarry faces along the Southwest limits of extraction will come as close as 15m removed from the closest receptor (namely 2280 No.2 Side Road) owned by the proponent or approximately 300m (namely 2196 No. 2 Side Road) to the closest privately owned sensitive receptor.

The Burlington Quarry West Extension will be extracted in four (4) phases designated as Phases 3 through 6 (Refer to Appendix A). The West Extension area will leverage the existing Southwest face of the Burlington Quarry in Phases 3 and 5 with a general East to West face retreat in Phase 3, 4 and 5. The Phase 6 face will retreat in a general North to South direction leveraging the face created by the Phase 5 progress.

As operations progress during the Burlington Quarry West Extension, quarry faces along the East limits of extraction will come as close as 77m removed from the properties located on No. 2 Side Road. Table 2 denotes relevant extraction details as they pertain to each individual phase.

| <p style="text-align: center;"><b>TABLE 2</b><br/> <b>Details for Extraction for Each Individual Phase of the Burlington Quarry Extension</b></p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Phase 1a                                                                                                                                          | <ul style="list-style-type: none"> <li>• Phase 1a will commence with a sinking cut in the Northeast corner of the Burlington Quarry South Extension lands</li> <li>• Extracted to a depth of 271MASL</li> <li>• Retreat in a general Southeasterly direction</li> <li>• Likely extracted in 1-2 benches</li> </ul>                                                                                                                                                                                                          |
| Phase 1b                                                                                                                                          | <ul style="list-style-type: none"> <li>• Initial operations for Phase 1b will leverage the existing face of Phase 1a thereby initially eliminating the need for a sinking cut.</li> <li>• Extracted to a depth of 270MASL</li> <li>• Retreat in a general Southeasterly direction</li> <li>• Extracted in 1 bench</li> </ul>                                                                                                                                                                                                |
| Phase 2                                                                                                                                           | <ul style="list-style-type: none"> <li>• Initial operations of Phase 2 will leverage the existing face of Phase 1b thereby initially eliminating the need for a sinking cut.</li> <li>• Once operations reach the quarry floor elevation achieved in Phase 1b a sinking cut will be required to extract rock to the Phase 2 final floor elevation of 252.5MASL.</li> <li>• Extracted to a depth of 252.5MASL</li> <li>• Retreat in a general Southeasterly direction.</li> <li>• Likely extracted in 1-2 benches</li> </ul> |
| Phase 3                                                                                                                                           | <ul style="list-style-type: none"> <li>• Phase 3 will commence along the Southeast corner of the Burlington Quarry West Extension lands</li> <li>• Phase 3 will leverage the existing face of the Burlington Quarry thereby eliminating the need for a sinking cut.</li> <li>• Extracted to a depth of 252.5MASL</li> <li>• Retreat in a general Westerly direction</li> <li>• Likely extracted in 2-3 benches</li> </ul>                                                                                                   |
| Phase 4                                                                                                                                           | <ul style="list-style-type: none"> <li>• Phase 4 will leverage the face of the previously excavated Phase 3 therefore eliminating the need for a sinking cut.</li> <li>• Extracted to a depth of 252.5MASL</li> <li>• Retreat in a general Westerly and Southerly direction</li> <li>• Likely extracted in 2-3 benches</li> </ul>                                                                                                                                                                                           |
| Phase 5                                                                                                                                           | <ul style="list-style-type: none"> <li>• Phase 5 will leverage the existing West face of the Burlington Quarry therefore eliminating the need for a sinking cut.</li> <li>• Extracted to a depth of 252.5MASL</li> <li>• Retreat in a general Westerly direction</li> <li>• Likely extracted in 2-3 benches</li> </ul>                                                                                                                                                                                                      |

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|         |                                                                                                                                                                                                                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Phase 6 | <ul style="list-style-type: none"><li>• Phase 6 will leverage the face of the previously excavated Phase 5 thereby eliminating the need for a sinking cut.</li><li>• Extracted to a depth of 252.5MASL</li><li>• Retreat in a general Southerly direction</li><li>• Likely extracted in 2-3 benches</li></ul> |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Current practice at the Nelson Aggregate Burlington Quarry operation employs 102-152mm diameter blast holes with a typical load per delay of between 10kg and 400kg per period. Calculations contained within this report suggest modifications to current blast designs will be necessary as operations progress towards adjacent receptors.

It is a recommendation of this report that all blasts shall, as a minimum, be monitored at the nearest sensitive receptors, or closer, in front and behind any given blast in order to ensure constant compliance with MECP guideline limits and to permit timely adjustment to blast designs as required.



## **BLAST VIBRATION AND OVERPRESSURE LIMITS**

The Ontario MECP 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 MECP. The limits suggested by the MECP are as follows.

**Vibration**\_\_\_\_\_ 12.5mm/s            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. It is a recommendation of this report that all blasts at the operation be monitored to quantify and record ground vibration and overpressure levels employing a minimum of two (2) digital seismographs, one installed at the closest receptor behind the blast, or closer, and one installed at the closest receptor in front of the blast, or closer.



## **BLAST MECHANICS AND DERIVATIVES**

The detonation of explosives within a blast hole 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 through the air, measured in linear decibels (or dBL) for the purposes of this report.



## **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 winds (refer to Appendix B) 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 towards receptors, and blast vibrations are greatest when retreating towards the receptors.



## 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. We have used this formula to predict the PPV's at the closest house for the initial operations.

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

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 is variable and is influenced by many factors (i.e. rock type, geology, thickness of overburden, blast parameters, etc.). Based on the data collected from the previous attenuation study prepared by Golder Associates, the values for "e" and "K" have been established at -1.32 and 896 respectively (refer to Appendix C).

An **example** of this calculation is as follows:

For a distance of 410m (i.e. the closest standoff distance to the nearest existing structure outside of the extraction limits for the initial blasting of **Phase 1a** not owned by the proponent, namely 2450 No. 2 Sideroad) and a maximum explosive weight of 80kg (10m deep, 102mm blast hole, 2.4m collar, single hole per period), we can calculate the maximum PPV at the nearest receptor as follows:

$$ppv = 896 \left( \frac{410}{\sqrt{80}} \right)^{-1.32} = 5.75 \text{ mm / s}$$

As discussed in previous sections, the MECP guideline for blast-induced vibration is 12.5 mm/s (0.5 in/s). The calculated PPV based on the design parameters above would remain compliant at a calculated value of 5.75mm/s.

As noted previously, In the event that the proponent owned unit located at 2280 No. 2 Side Road qualifies as a sensitive receptor at the

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commencement of blasting, the above theoretical design would need to be adjusted to ensure compliance with MECP guidelines (i.e. at a separation distance of 205m and a load of 80kg per delay, the above calculation results in a calculated vibration level of 14.35mm/s).

For the Phase 3 area in the West Extension lands it is recommended that the initial blasting take place in the North corner of the common boundary between the extension lands and the existing quarry. At a separation distance of 350m (i.e. the closest standoff distance to the nearest existing structure outside of the extraction limits for the initial blasting of **Phase 3** not owned by the proponent, namely 2116 No. 2 Side Road, and a maximum explosive load per delay of 85kg (20m deep, 102mm blast hole, 2.5m surface collar, 2 explosive decks, single deck per period), we can calculate the maximum PPV at the nearest receptor to be 7.37mm/s.

Based on the data collected from the previous attenuation study, Table 3 below denotes the theoretical maximum charge per delay that can be used given the standoff distance to the nearest sensitive receptor:

| TABLE 3<br>Maximum Load per Delay based on varied Stand-off Distance from Sensitive Receptors to Maintain 12.5mm/s Vibration Limit |                             |
|------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Distance from Sensitive Receptor (m)                                                                                               | Maximum Load per Delay (kg) |
| 100                                                                                                                                | 15.5                        |
| 125                                                                                                                                | 24.1                        |
| 150                                                                                                                                | 34.8                        |
| 175                                                                                                                                | 47.3                        |
| 200                                                                                                                                | 61.8                        |
| 225                                                                                                                                | 78.2                        |
| 250                                                                                                                                | 96.5                        |
| 275                                                                                                                                | 116.8                       |
| 300                                                                                                                                | 139.0                       |

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As the separation distance between the blast and closest receptor decreases, it will be necessary to adjust blast parameters to ensure continued compliance with the guideline limit. Fortunately, a variety of blast design alternatives are available to accomplish this including but not limited to reductions in blast hole diameter, change in explosives types, adjustment in bench heights and decking of holes. Given the planned phasing of the extension, vibration data will be continually collected and analyzed as the adjacent receptors are approached in order to confirm the requirement for any design modifications.

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## 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 6dB for every doubling of distance.

As part of the attenuation study performed on site, air overpressure levels were measured and analyzed using 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 (dB)

K, e = site factors

d = distance from receptor (m)

w = maximum explosive charge per delay (kg)

The collection of points gathered in the linear arrays emanating from each blast vibration were again analyzed and used to develop the following 95% regression equation (refer to Appendix C). Based on the data collected from the previous attenuation study prepared by Golder Associates, the values for "e" and "K" have been established at -0.0867 and 181 respectively (refer Appendix C).

$$PSPL = 181 \left( \frac{D}{\sqrt[3]{W}} \right)^{-0.0867}$$

As discussed in previous sections, the MECP guideline for blast-induced overpressure is 128dB. For a separation distance of

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410m (i.e. the standoff distance to the closest existing structure located outside of the extraction limits in front of the blast for initial blasting for **Phase 1a** not owned by the proponent, namely 2450 No. 2 Sideroad) and a maximum explosive weight of 80kg per delay (10m deep, 102mm blast hole, 2.4m collar, single hole per period delay), we can calculate the PSPL at the nearest receptor as follows:

$$PSPL = 181 \left( \frac{410}{\sqrt[3]{80}} \right)^{-0.0867} = 121.94dB(L)$$

As discussed in previous sections, the MECP guideline for blast-induced overpressure is 128dB(L). The calculated overpressure based on the above blast parameters would remain compliant at a calculated value of 121.94dB(L).

In the event that the proponent owned unit located at 2280 No. 2 Sideroad qualifies as a sensitive receptor at the commencement of blasting, the above theoretical design would need to be adjusted to ensure compliance with MECP guidelines (i.e. at a separation distance of 205m and a load of 80kg per delay, the above calculation results in a calculated overpressure level of 129.5dB(L)).

For the Phase 3 area in the West Extension lands, we again assume initial blasting will take place in the North corner of the common boundary between the extension lands and the existing quarry. At a separation distance of 350m (i.e. the closest standoff distance to the nearest existing structure outside of the extraction limits for the proposed initial blasting of **Phase 3** not owned by the proponent, namely 2116 No 2 Side Road and a maximum explosive load per delay of 85kg (20m deep, 102mm blast hole, 2.5m surface collar, 2 explosive decks, single deck per period), we can calculate the maximum overpressure at the nearest receptor to be 123.84dB(L).

We reiterate that air overpressure attenuation is far more variable due to its intimate relationship with environmental influences and as such, the equation employed is less reliable than that developed for ground vibration. Overpressure monitoring performed on site shall be used to guide blast design as it pertains to the control of blast overpressures. Given the intimate correlation between overpressure and environmental conditions, care must be taken to avoid blasting on days when weather patterns are less favourable.



## ADDITIONAL CONSIDERATIONS OUTSIDE OF THE BLAST IMPACT ANALYSIS SCOPE

The following headings are addressed for general information purposes and are not strictly required as part of the scope of the Blast Impact Analysis as required under the ARA to ensure compliance with MECP NPC-119 guidelines. The hydrogeological study prepared by EarthFX and Azimuth Environmental Consulting as part of the licence application will address residential water wells in detail. Flyrock control is addressed at the operational level given significant influences related to blast design, geology and field accuracy which render concrete recommendations related to control inappropriate at the licencing phase.

### SUN CANADIAN HIGH PRESSURE OIL PIPELINE

A Sun Canadian High Pressure Oil Pipeline runs parallel to Colling Road adjacent to Phase 5 of the of the proposed West expansion quarry limits (refer to Appendix A). The MECP guideline for blast-induced vibration (12.5mm/s) does not apply to pipelines as they are not classified as sensitive receptors. Sun Canadian Policy employs a 50mm/s vibration limit for welded steel pipelines. For the Phase 5 area in the West Extension lands it is recommended that the initial blasting take place in the South corner of the common boundary between the extension lands of Phase 5 and the existing quarry. Initial blasting operations will take place approximately 370m from the subject pipeline if they are initiated at the South corner, however, will reach as close as 12.8m throughout the course of the Phase 5 extraction.

Applying the equation from Predicated Vibration Limits at the Nearest Sensitive Receptor, for a distance of 370m (the conservative standoff distance to the pipeline for the initial blasting in **Phase 5**) and a maximum explosives load per delay of 177kg (20m deep, 102mm blast hole, 2.5m collar, single hole per period), we can calculate the maximum PPV at the pipeline as follows for the initial blast:

$$ppv = 896 \left( \frac{370}{\sqrt{177}} \right)^{-1.32} = 11.12 \text{ mm/s}$$

The calculated 95% predicted PPV (based on the proposed blasting data discussed above) would be 11.12mm/s, well below the

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Sun Canadian limit of 50mm/s for a steel welded pipeline located adjacent to the proposed quarry. While this initial value resides below the required threshold, it is anticipated that design modifications will be necessary to maintain compliance as the separation distance to the pipeline decreases and column loads increase. Fortunately, a variety of blast design alternatives are available to accomplish this including but not limited to reductions in blast hole diameter, change in explosives types, adjustment in bench heights and decking of holes.

We do note that the Sun Canadian Blasting Specification requires the presence of a vibration monitoring program conducted by an independent third party engineer when blasting operations are to be conducted within 60m of a pipeline. The proposed Operational Plan dictates that blasting is to encroach within approximately 12.8m of the ROW and as such, it remains a recommendation of this report that an independent third party firm be retained to conduct vibration monitoring on this pipeline when separation encroaches within 60m of the pipeline or when calculations suggest ground vibrations in excess of 35mm/s as measured at the pipeline are anticipated. The results of this monitoring program will determine what alterations shall be necessary as the separation distance to the subject pipeline decreases.

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## FLYROCK

Flyrock is the term used to define rocks which are propelled from the blast area by the force of the explosion. This action is a predictable and necessary component of a blast and requires that every blast have an exclusion zone established within which no persons or property which may be harmed are permitted.

Government regulations strictly prohibit the ejection of flyrock off of a quarry property. The regulations regarding flyrock are enforced by the Ministries of Natural Resources and Forestry, Environment, Conservation and Parks and Labour. In the event of an incident where flyrock does leave a site, the punitive measures include suspension / revocation of licences and fines to both the blaster and quarry owner / operator. Fortunately, flyrock incidents are extremely rare due to the possible serious consequences of such an event. It is in the best interest of all, stakeholders and non-stakeholders, to ensure that dangerous flyrock does not occur. Through proper blast planning and design, it is possible to control and mitigate the possibility for flyrock.

## THEORETICAL HORIZONTAL FLYROCK CALCULATIONS

Flyrock occurs when explosives in a hole are poorly confined by the stemming or rock mass and the high pressure gas breaks out of confinement and launches rock fragments into the air. The three primary sources of fly rock are as follows:

- **Face burst:** Lack of confinement by the rock mass in front of the blast hole results in fly rock in front of the face.
- **Cratering:** Insufficient stemming height or weakened collar rock results in a crater being formed around the hole collar with rock projected in any direction.
- **Stemming Ejection:** Poor stemming practice can result in a high angle throw of the stemming material and loose rocks in the blasthole wall and collar.

The horizontal distance flyrock can be thrown ( $L_H$ ) from a blast hole is determined using the expression:

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$$L_H = \frac{V_o^2 \sin 2\theta_0}{g} \quad [1]$$

where:

$V_o$  = launch velocity (m/s)

$\theta_0$  = launch angle (degrees)

$g$  = gravitational constant (9.8 m/s<sup>2</sup>)

The theoretical maximum horizontal distance fly rock will travel occurs when  $\theta_0 = 45$  degrees, thereby yielding the equation:

$$L_{H \max} = \frac{V_o^2}{g} \quad [2]$$

The normal range of launch velocity for blasting is between 10m/s - 30m/s. To calculate the launch velocity of a blast the following formula is used:

$$V_o = k \left( \frac{\sqrt{m}}{B} \right)^{1.3} \quad [3]$$

where:

$k$  = a constant

$m$  = charge mass per meter (kg/m)

$B$  = burden (m)

By combining equations 2 and 3 and taking into account the different sources of fly rock, the following equations can be used to calculate the maximum fly rock thrown from a blast:

Face burst: 
$$L_{H \max} = \frac{k^2}{g} * \left( \frac{\sqrt{m}}{B} \right)^{2.6}$$

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Cratering: 
$$L_{H \max} = \frac{k^2}{g} * \left( \frac{\sqrt{m}}{SH} \right)^{2.6}$$

Stemming Ejection: 
$$L_{H \max} = \frac{k^2}{g} * \left( \frac{\sqrt{m}}{SH} \right)^{2.6} \sin 2\theta$$

where:  $\theta$  = drill hole angle  
 $L_{h\max}$  = maximum flyrock throw (m)  
 $m$  = charge mass per meter (kg/m)  
 $B$  = burden (m)  
 $SH$  = stemming height (m)  
 $g$  = gravitational constant  
 $k$  = a constant

For flyrock calculation purposes, we have applied the current blasting parameters used in the Burlington Quarry which utilize 102mm (4") diameter holes on a 3.5m x 3.5m (11.5'x 11.5') pattern, with total depths of up to 24m (80') and a collar length of 2m (8').

The range for the constant  $k$  is 13.5 for soft rocks and 27 for hard rocks. Given the proposed licence area is predominantly dolostone, we have applied a  $k$  value of 20. The explosive density is assigned to be 1.2 g/cc for emulsion products and the drill hole angles are assumed to be 90 degrees (i.e. vertical).

The following does not apply to the sinking cut which will require highly specialized designs and additional considerations for flyrock. Based on a free face blast, maximum anticipated horizontal flyrock projection distances are calculated as follows in Table 4:

| <b>Table 4 – Maximum Flyrock Horizontal</b> |                                        |                                                             |
|---------------------------------------------|----------------------------------------|-------------------------------------------------------------|
| <b>Collar Lengths</b><br>(m)                | <b>Maximum Throw Face Burst</b><br>(m) | <b>Maximum Throw Cratering and Stemming Ejection</b><br>(m) |
| 1.5                                         | 30                                     | 274                                                         |
| 2.0                                         | 30                                     | 129                                                         |
| 2.5                                         | 30                                     | 72                                                          |
| 3.0                                         | 30                                     | 45                                                          |
| 3.5                                         | 30                                     | 30                                                          |

Different collar lengths are displayed in the table above to account for over or under loaded holes. As demonstrated with these various collar lengths, any deviation, no matter how slight, can greatly affect these maximum values. Blast mats or sand can be placed on top of the shot to further reduce the distance for potential flyrock.

Through proper blast design and diligence in inspecting the geology before every blast, flyrock can readily be maintained within the quarry limits. It may be necessary to increase collars and adjust designs accordingly when blasting along the perimeter to accommodate the reduced distance to receptors and to ensure flyrock remains within the property limit.



## **BLAST IMPACT ON ADJACENT FISH HABITATS**

The detonation of explosives in or near water can produce compressive shock waves which initiate damage to the internal organs of fish in close proximity, ultimately resulting in the death of the organism. Additionally, ground vibrations imparted on active spawning beds have the ability to adversely impact the incubating eggs and spawning activity. In an effort to alleviate adverse impacts on fish populations as a result of blasting, the Department of Fisheries and Oceans (DFO) developed the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (1998). This publication establishes limits for water overpressure and ground vibrations which are intended to mitigate impacts on aquatic organisms while providing sufficient flexibility for blasting to proceed. Specifically, water overpressures are to be limited to 100kPa and, in the presence of active spawning beds, ground vibrations at the bed are to be limited to 13mm/s.

Current information suggests the presence of three waterbodies that have been classified as potential fish habitats located in close proximity to the proposed license areas. Specifically, these waterbodies are the Unnamed Tributary of Willoughby Creek located North of the proposed West extension along Colling Road, the Unnamed Tributary of Lake Medad located Southeast of the West extension along No. 2 Side Road and the East and West Arms of the West Branch of the Mount Nemo Tributary of Grindstone Creek located to Northeast and Southwest of the South extension area.

The operational plan shows an approximate minimum extraction setback distance of 55m to the Unnamed Tributary of Willoughby Creek, 130m to the Unnamed Tributary of Lake Medad and 85m to the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. Based on these separation distances, it is anticipated that alterations to blast designs will be necessary when blasting in close proximity to the identified waterbodies to maintain compliance with DFO water overpressure guidelines of 100kPa. A review of available topographic maps identifies elevations in the extraction areas closest to the above noted waterbodies ranging from 271-281masl, which will require blasting hole depths of up to 20m in some areas to reach the design quarry floor. The utilization of shallower blast holes, decks, smaller hole diameters and/or

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changes in blasting patterns may be necessary to maintain compliance with DFO Guidelines.

In the event that blast designs for any given blast are scheduled to exceed maximum loads per delay as specified in the DFO “*Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (1998)*” publication Table 1, we recommend that a hydrophone sensor be installed in the closest point of the waterbody to verify water overpressure levels, provided water depth is a minimum of 1m. The DFO Table 1 load restrictions are reproduced in part in Table 5 below for continuity.

| Separation distance between possible fish bearing waterbody and closest borehole (meters) | Maximum recommended explosive load per delay (Kilograms) |
|-------------------------------------------------------------------------------------------|----------------------------------------------------------|
| 150                                                                                       | 887                                                      |
| 125                                                                                       | 616                                                      |
| 100                                                                                       | 394                                                      |
| 90                                                                                        | 319                                                      |
| 80                                                                                        | 252                                                      |
| 70                                                                                        | 193                                                      |
| 60                                                                                        | 142                                                      |
| 50                                                                                        | 98.7                                                     |
| 40                                                                                        | 63.1                                                     |
| 30                                                                                        | 35.5                                                     |

**Table 5: Maximum Loads per Delay to Maintain 100kPa at Various Separation Distances**

Active spring spawning beds (March 15 – July 15) are assumed to be present in all three (3) waterbodies listed above. During the spawning season, these waterbodies are subject to a vibration limit of 13mm/s recorded at the shoreline of the closest spawning location to the blast. Vibration monitoring will be required in order to confirm compliance with DFO limits for ground vibration.

Table 6 below is provided as initial guidance demonstrating maximum permissible loads per delay based on various separation distances from spawning beds. The following maximum loads per

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delay are derived from the equation for ground vibrations listed earlier in this report and are based on a maximum vibration intensity of 13.0mm/s as experienced at the active spawning habitat:

| <b>Separation distance between possible spawning bed and closest borehole (meters)</b> | <b>Maximum recommended explosive load per delay (Kilograms)</b> |
|----------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| 500                                                                                    | 410                                                             |
| 450                                                                                    | 332                                                             |
| 400                                                                                    | 262                                                             |
| 350                                                                                    | 200                                                             |
| 300                                                                                    | 147                                                             |
| 250                                                                                    | 102                                                             |
| 200                                                                                    | 65.5                                                            |
| 150                                                                                    | 36.8                                                            |
| 100                                                                                    | 16.4                                                            |
| 75                                                                                     | 9.2                                                             |
| 50                                                                                     | 4.1                                                             |
| 30                                                                                     | 1.5                                                             |

**Table 6: Maximum Loads per Delay to Maintain 13.0mm/s at Various Separation Distances**

Should blasting operations take place outside of the active spawning window (March 15 – July 15), the above 13mm/s vibration limit would not apply.

It is a recommendation of this report that all blasts shall, as a minimum, be monitored for ground vibrations at the closest active spawning bed from March 15 – July 15 to ensure compliance with DFO guidelines when calculations suggest vibrations in excess of 75% of the DFO vibration limit may be reached at the location of a potential active spawning habitat.



## **RESIDENTIAL WATER WELLS**

Possible impacts to the water quality and production capacity of groundwater supply wells is a common concern for residents near blasting operations. Complaints related to changes in water quality often include the appearance of turbidity, water discolouration and changes in water. Complaints regarding water production most often involve loss of quantity production, air in water and damage to well screens and casings. A review of research and common causes of these problems indicates that most of these concerns are not related to blasting and can be shown to be the direct impact of environmental factors and poor well construction and maintenance.

There is an intuitive belief that blasting operations have dramatic and disastrous impacts on residential water wells for large distances around such operations. Unfortunately, there is no scientific basis for such claims. Outside of the immediate radius of approximately 20-25 blasthole diameters from a loaded hole, there is no permanent ground displacement. As such, barring blasting activity within several meters of an existing well, the probability of damage to residential wells is essentially non-existent.

Despite the scientific support for the above conclusion, numerous studies have been performed to verify the validity of this statement. These studies have investigated the effects of blasting on varied well configurations and in varied geological mediums to ensure results could be readily extrapolated to all blasting operations. The conclusion of these studies has confirmed that with the exception of possible temporary increases in turbidity, blasting operations did not result in any permanent impact on wells outside of the immediate blast zone of the blast until vibrations levels reached exceedingly high intensities. Applying universally accepted threshold levels for ground vibrations eliminates the possibility for any long term adverse effects on wells in the vicinity of blasting operations.

In a study by Froedge (1983), blast vibration levels of up to 32.3mm/s were recorded at the bottom of a shallow well located at a distance of 60 meters (200 feet) from an open pit blast. There was no report of visible damage to the well nor was there any change in the water pumping flow rate. This study concluded that the commonly accepted limit of 50mm/s PPV level is adequate to protect wells from any damage. We reiterate, the current guideline limit for vibrations from quarry and mining operations is 12.5mm/s.



## **REVIEW OF HISTORICAL BURLINGTON QUARRY DATA**

A vibration and overpressure monitoring program has been in place for all blasts conducted at the Nelson Aggregate Burlington Quarry in recent years. As part of this analysis, Nelson Aggregates has provided copies of vibration data summaries collected for 2014 through 2019 inclusive. For continuity, summaries of the historical data collected and supplied by Nelson Aggregate are included in Appendix C to this report.

### **2014-2019 DATA**

Vibration monitoring conducted during 2014 – 2019 has included the installation of seismographs at the following locations:

- 2479 No. 2 Side Road
- 2470 No. 2 Side Road
- 2450 No. 2 Side Road
- 2582 No. 2 Side Road
- Southwest Corner of the Quarry property along No. 2 Side Road (N 43.39339, W 79.88880)
- Colling Road and Blind Line Intersection (N 43.40605, W 79.89400)
- Northwest Corner of the Quarry Property along Colling Road
- Gas Line (N 43.40466, W 79.88098)

All vibration monitoring was performed by either the blasting contractor or the quarry owner. A review of the data supplied confirms that for 2014 through 2019 inclusive, two (2) blasts exceeded the MECP guideline limit of 12.5mm/s set for ground vibrations, while sixteen (16) blasts exceeded the MECP guideline limit of 128dB for overpressure. Table 7 below lists the blasts that exceeded these limits:



| <b>Table 7: Exceedances of NPC 119 Recorded During 2014-2019 Blasting Operations</b> |             |                                           |                       |                            |
|--------------------------------------------------------------------------------------|-------------|-------------------------------------------|-----------------------|----------------------------|
| <b>Date</b>                                                                          | <b>Time</b> | <b>Location</b>                           | <b>Limit Exceeded</b> | <b>Value of Exceedance</b> |
| August 25, 2014                                                                      | 13:52       | *SW Corner                                | >128dB(L)             | 132.2dB(L)                 |
| September 16, 2014                                                                   | 12:12       | *Colling Road and Blind Line Intersection | >128dB(L)             | 134.6dB(L)                 |
| October 2, 2014                                                                      | 13:40       | *2479 # 2 Side Road                       | >128dB(L)             | 131.8dB(L)                 |
| October 22, 2014                                                                     | 12:02       | *SW Corner                                | >128dB(L)             | 128.4dB(L)                 |
| November 11, 2014                                                                    | 12:00       | *2479 # 2 Side Road                       | >128dB(L)             | 130.6dB(L)                 |
| November 24, 2014                                                                    | 12:08       | *2479 # 2 Side Road                       | >128dB(L)             | 128.7dB(L)                 |
| December 2, 2014                                                                     | 11:57       | *Colling Road and Blind Line Intersection | >128dB(L)             | 132.8 dB(L)                |
| June 12, 2015                                                                        | 12:18       | *SW Corner                                | >128dB(L)             | 133.0 dB(L)                |
| June 17, 2015                                                                        | 12:03       | *Colling Road and Blind Line Intersection | >128dB(L)             | 130.7 dB(L)                |
| July 13, 2015                                                                        | 12:02       | *Colling Road and Blind Line Intersection | >128dB(L)             | 129.2 dB(L)                |
| July 30, 2015                                                                        | 12:00       | *2479 # 2 Side Road                       | >128dB(L)             | 130.7 dB(L)                |
| September 1, 2015                                                                    | 12:01       | *2479 # 2 Side Road                       | >128dB(L)             | 130.5 dB(L)                |
| October 21, 2015                                                                     | 12:03       | *2479 # 2 Side Road                       | >128dB(L)             | 134.3 dB(L)                |
| May 4 , 2016                                                                         | 12:00       | SW Corner                                 | >12.5mm/s             | 12.8 mm/s                  |
| May 9 , 2016                                                                         | 12:00       | Colling Road                              | >128dB(L)             | 129.5 dB(L)                |
| July 5, 2016                                                                         | 12:00       | Colling Road                              | >128dB(L)             | 128.3 dB(L)                |
| August 30, 2016                                                                      | 12:00       | Colling Road                              | >128dB(L)             | 128.8 dB(L)                |
| April 11, 2017                                                                       | 11:56       | SW Corner                                 | >12.5mm/s             | 15.6 mm/s                  |

\* These locations are assumed but cannot be verified due to insufficient information being recorded during the 2014 and 2015 blasting campaigns.

Although the above table denotes exceedances of the MECP guidelines, given the heavy conservatism inherent to the guideline, the risk of damage associated with these vibrations and overpressures remain extremely low.



## **RECOMMENDATIONS**

It is recommended that the following conditions be applied for all blasting operations at the proposed Nelson Aggregates – Burlington Quarry Extension areas:

1. All blasts shall be monitored for both ground vibration and overpressure at the closest privately owned sensitive receptors adjacent the site, or closer, with a minimum of two (2) instruments – one installed in front of the blast and one installed behind the blast.
2. Vibration and overpressure data collected during the first 12 months of extraction in the proposed quarry extension lands will be used to calibrate and update the 2004 Golder Associates attenuation equation. The proponent shall ensure information collected includes all relevant blast and monitoring details to permit and facilitate inclusion of the data in the attenuation data and resultant equation.
3. In order to safeguard the structural integrity of the structures located at 2280 No 2 Side Road, ground vibrations shall be maintained below 50mm/s (>40Hz) in accordance with research performed by the United States Bureau of Mines (USBM R18507). The closest structure located at 2280 No 2 Side Road shall be monitored for ground vibration and overpressure when vibration calculations suggest vibrations in excess of 35mm/s.
4. All blasts within 60m of the adjacent Sun-Canadian High Pressure Oil Pipeline will be designed and monitored by a registered engineer, licensed in the province of Ontario or any distance specified in later revisions of the Sun-Canadian guidelines or when vibration calculations suggest vibrations in excess of 35mm/s at the pipeline.
5. To protect adjacent fish habitat, the Department of Fisheries and Oceans (DFO) has established limits for water overpressure and ground vibrations. Water overpressures are to be limited to 100kPa (year round), and in the presence of active spawning beds (March 15 – July 15), ground vibrations at the bed are to be limited to 13mm/s. Fish habitat and assumed spawning beds are present in the Unnamed Tributary of Willoughby Creek, the Unnamed Tributary of Lake Medad and the East and West Arms of the West Branch of the Mount Nemo Tributary of Grindstone Creek. The utilization of shallower blast holes, decks, smaller hole diameters and/or changes in blasting

# EXPLOTECH

patterns may be necessary when blasting adjacent to fish habitat at any time of year. These mitigation measures would also apply, when adjacent to spawning beds from March 15 – July 15.

6. From March 15 – July 15 of any year, blasts shall be designed to maintain vibrations below 13mm/s at the closest point of any spawning habitat to the blast. One (1) additional seismograph shall be installed on the shoreline adjacent the closest spawning habitat to any blast performed between March 15 and July 15 when calculations suggest vibrations in excess of 75% of the DFO vibration limit may be reached at the location of a potential active spawning habitat.
7. All blasting operations encroaching the Sun Canadian High Pressure Oil Pipeline will follow all requirements in the Sun Canadian Guidelines outlined in Section 8.3 to 8.5 under the heading “Vibration and Blasting Control” and any requirements specified in later revisions of the Sun Canadian guidelines.
8. The guideline limits for vibration and overpressure shall adhere to standards as outlined in the MECP Model Municipal Noise Control By-law publication NPC 119 (1978) or any such document, regulation or guideline which supersedes this standard.
9. In the event of an exceedance of NPC 119 limits or any such document, regulation or guideline which supersedes this standard, blast designs and protocol shall be reviewed prior to any subsequent blasts and revised accordingly in order to return the operations to compliant levels.
10. Orientation of the aggregate extraction operation will be designed and maintained so that the direction of the overpressure propagation will be away from structures as much as possible.
11. Blast designs shall be continually reviewed with respect to fragmentation, ground vibration and overpressure. Blast designs shall be modified as required to ensure compliance with current applicable guidelines and regulations.
12. Blasting procedures such as drilling and loading shall be reviewed on a yearly basis and modified as required to ensure compliance with industry standards.



13. Detailed blast records shall be maintained in accordance with current industry best practices

The blast parameters described within this report are supported by the modeling in the attached appendices. As the quarry progresses and as site-specific data is collected from the on-going operation, the blast parameters can be refined, as necessary, to ensure continual compliance with MECP Guidelines.



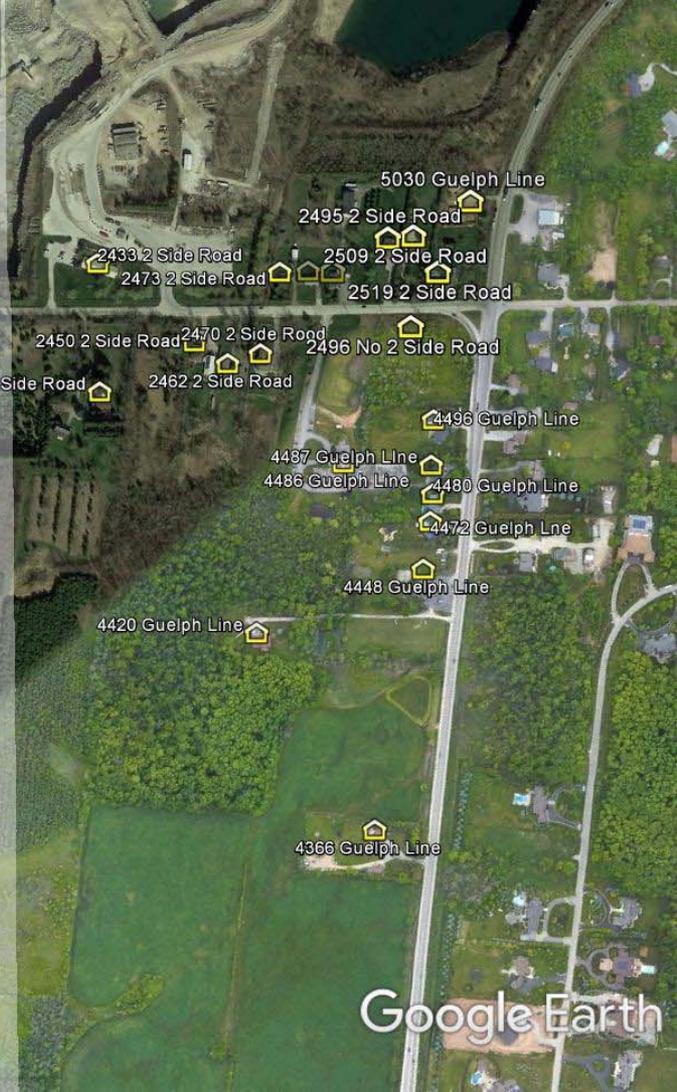
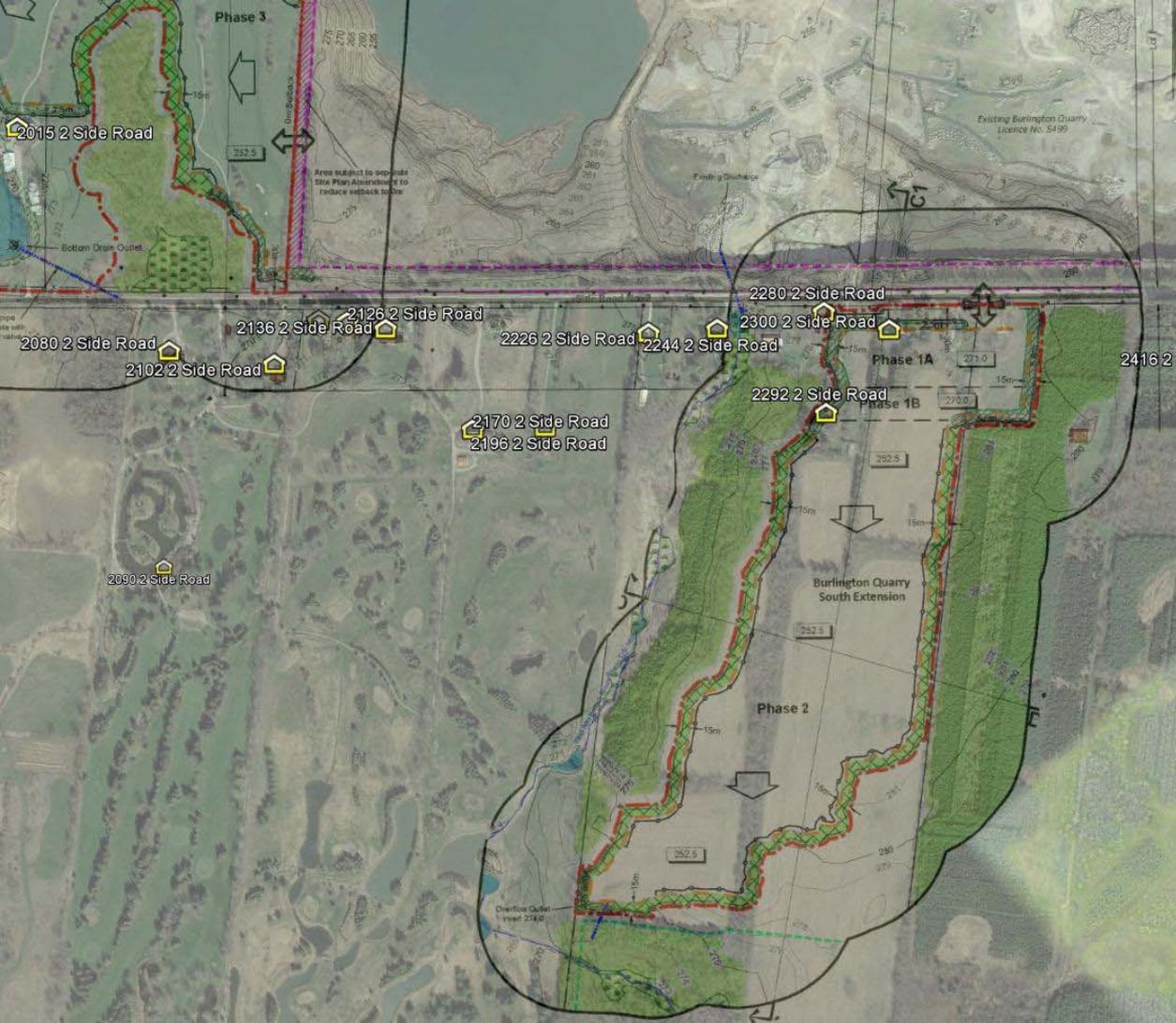
## **CONCLUSION**

Blasting operations required for mineral extraction at the proposed Nelson Aggregates – Burlington Quarry Extension lands can be carried out safely and within governing guidelines set by the Ministry of the Environment, Conservation and Parks.

Modern blasting techniques will permit blasting to take place with explosives charges below allowable charge weights ensuring that blast vibrations and overpressure will remain minimal at the nearest receptors.

# Appendix A

5380 Cedar Spring Road  
5353 Cedar Spring Road  
5352 Cedar Spring Road  
5318 Cedar Springs Road  
5300 Cedar Springs Road  
5264 Cedar Springs Road  
5255 Cedar Spring Road  
5248 Cedar Springs Road  
5245 Cedar Spring Road  
5244 Cedar Springs Road  
5214 Cedar Springs Road  
5235 Cedar Springs Road  
5191 Cedar Springs Road  
5186 Cedar Springs Road  
5168 Cedar Springs Road  
5158 Cedar Springs Road  
5140 Cedar Springs Court  
5132 Cedar Springs Court  
5116 Cedar Springs Court  
5106 Cedar Springs Court  
5089 Cedar Springs Court  
5069 Cedar Springs Court  
5059 Cedar Springs Court  
5050 Cedar Springs Road  
2015 2 Side Road  
1405 2 Side Road  
1425 2 Side Road  
2136 2 Side Road  
2280 2 Side Road  
2473 2 Side Road  
2433 2 Side Road  
2519 2 Side Road  
2496 No 2 Side Road  
2080 2 Side Road  
2102 2 Side Road  
2226 2 Side Road  
2300 2 Side Road  
2292 2 Side Road  
2450 2 Side Road  
2170 2 Side Road  
2196 2 Side Road  
2090 2 Side Road  
2509 2 Side Road  
2487 Guelph Line  
4480 Guelph Line  
4486 Guelph Line  
4472 Guelph Line  
4420 Guelph Line  
4448 Guelph Line  
4366 Guelph Line



5380 Cedar Spring Road

5353 Cedar Spring Road

5360 Cedar Spring Road 5352 Cedar Spring Road

2129 Colling Road 2139 Colling Road

5336 Cedar Spring Road

5328 Cedar Spring Road

5318 Cedar Springs Road

5300 Cedar Springs Road

5268 Cedar Springs Road

5264 Cedar Springs Road

5255 Cedar Spring Road

5254 Cedar Springs Road

5248 Cedar Springs Road

5245 Cedar Spring Road

5234 Cedar Springs Road

5244 Cedar Springs Road

5224 Cedar Springs Road

5214 Cedar Springs Road

5235 Cedar Springs Road

5206 Cedar Springs Road

5191 Cedar Springs Road

5172 Cedar Springs Road

5186 Cedar Springs Road

5179 Cedar Springs Road

5165 Cedar Springs Road

5140 Cedar Springs Court

5132 Cedar Springs Court

5116 Cedar Springs Court

5106 Cedar Springs Court

5089 Cedar Springs Court

5079 Cedar Springs Court

5069 Cedar Springs Court

5070 Cedar Springs Road

5059 Cedar Springs Court

2015 2 Side Road

5029 Cedar Springs Court

5050 Cedar Springs Road

1385 2 Side Road

1405 2 Side Road

1425 2 Side Road

2080 2 Side Road

2136 2 Side Road

2126 2 Side Road

2226 2 Side Road

2300 2 Side Road

2244 2 Side Road

2102 2 Side Road

2170 2 Side Road

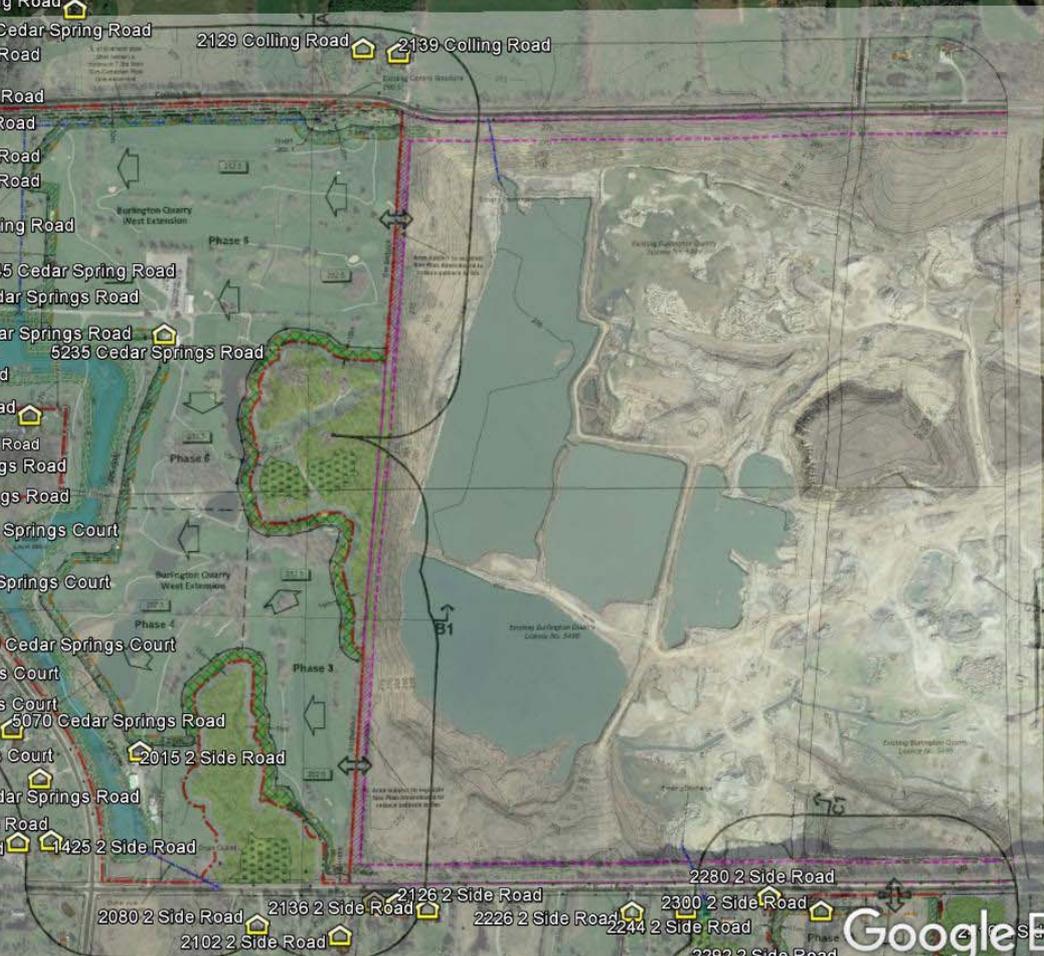
2196 2 Side Road

2280 2 Side Road

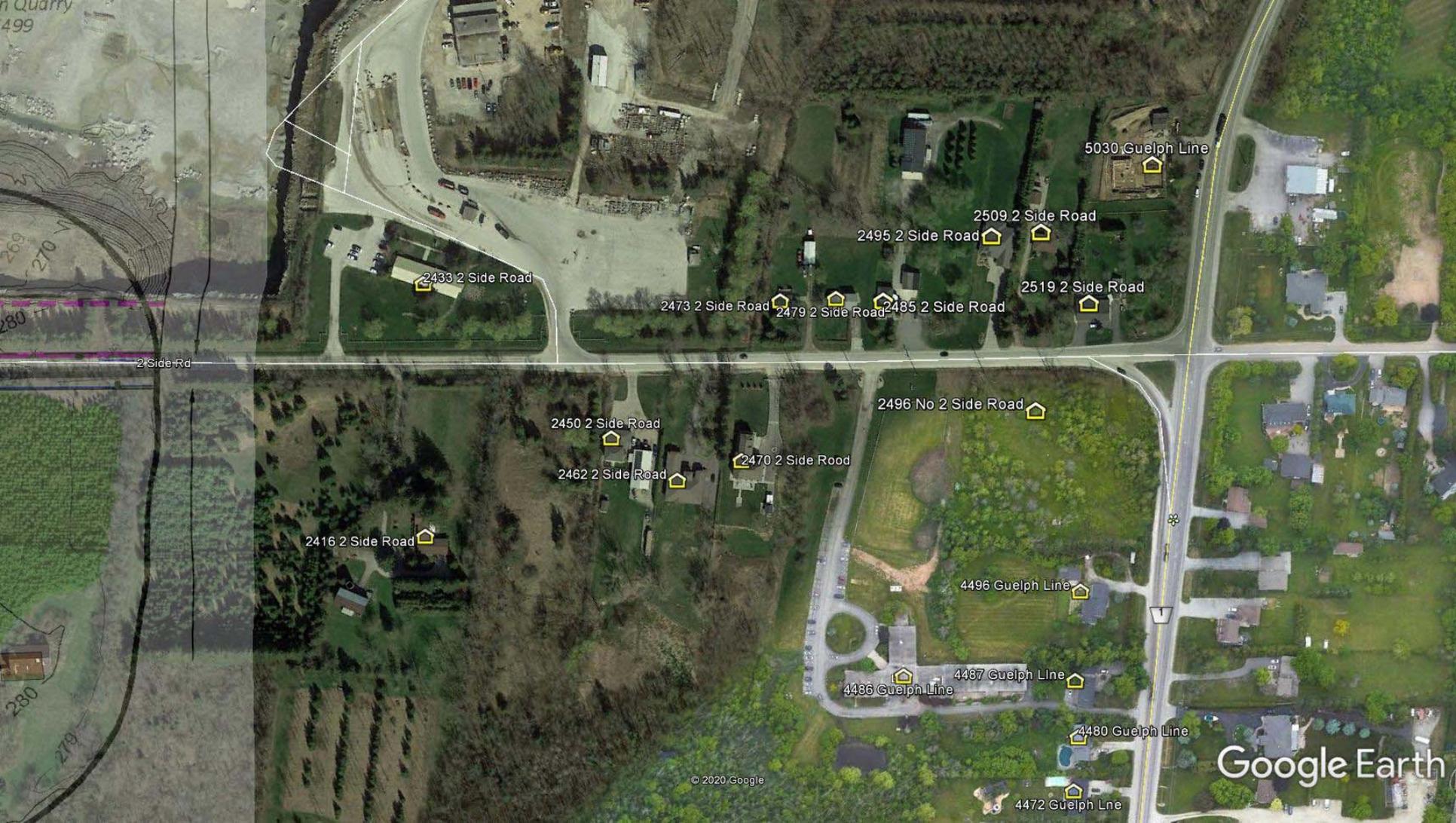
2292 2 Side Road

2433

Google Earth







Quarry  
499

269  
270  
280

2 Side Rd

280  
270

5030 Guelph Line

2509 2 Side Road

2495 2 Side Road

2433 2 Side Road

2473 2 Side Road

2479 2 Side Road

2485 2 Side Road

2519 2 Side Road

2450 2 Side Road

2462 2 Side Road

2416 2 Side Road

2470 2 Side Road

2496 No 2 Side Road

4496 Guelph Line

4436 Guelph Line

4487 Guelph Line

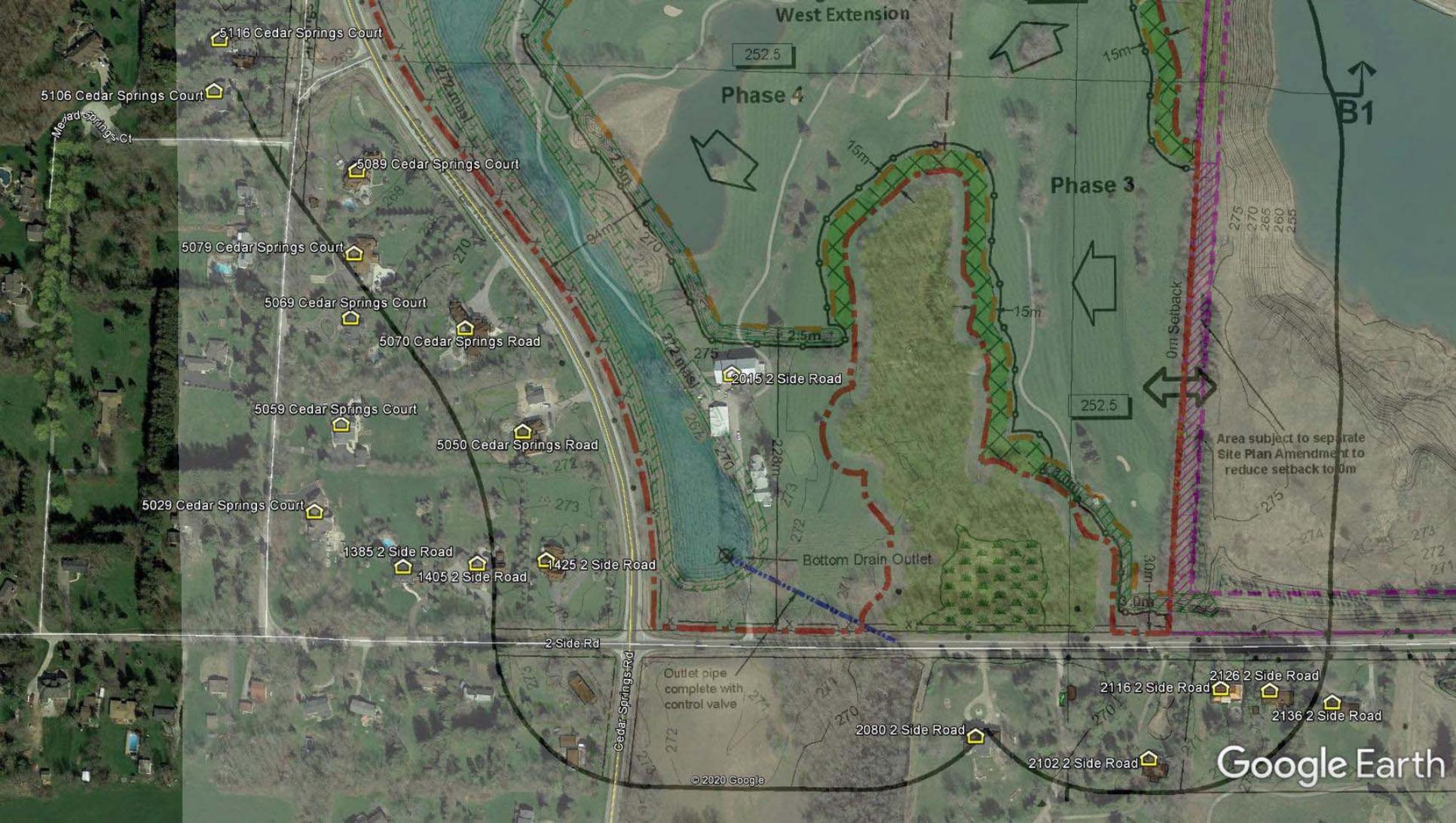
4480 Guelph Line

4472 Guelph Lne

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Google Earth





5116 Cedar Springs Court

5106 Cedar Springs Court

5089 Cedar Springs Court

5079 Cedar Springs Court

5069 Cedar Springs Court

5070 Cedar Springs Road

5059 Cedar Springs Court

5050 Cedar Springs Road

5029 Cedar Springs Court

1385 2 Side Road

1405 2 Side Road

1425 2 Side Road

2 Side Rd

Cedar Springs Rd

Outlet pipe complete with control valve

2080 2 Side Road

2102 2 Side Road

2116 2 Side Road

2126 2 Side Road

2136 2 Side Road

Phase 4

Phase 3

West Extension

B1

Area subject to separate Site Plan Amendment to reduce setback to 0m

Google Earth

© 2020 Google



5248 Cedar Springs Road

5245 Cedar Spring Road

5244 Cedar Springs Road

5234 Cedar Springs Road

5224 Cedar Springs Road

5214 Cedar Springs Road

5206 Cedar Springs Road

5172 Cedar Springs Road

5168 Cedar Springs Road

5164 Cedar Springs Road

5165 Cedar Springs Road

5158 Cedar Springs Road

5140 Cedar Springs Court

5132 Cedar Springs Court

5116 Cedar Springs Court

Invert  
269.1

143m

2.5m

272 masl

5235 Cedar Springs Road

5191 Cedar Springs Road

5179 Cedar Springs Road

110m

Water Level  
269.5

2.5m

252.5

252.5

252.5

Phase 6

Burlington Quarry  
West Extension

252.5

252.5

Google Earth

© 2020 Google

5380 Cedar Spring Road

5353 Cedar Spring Road

5360 Cedar Spring Road

5352 Cedar Spring Road

☐ of diversion pipe shall remain a minimum 7.0m from Sun-Canadian Pipe Line easement

2129 Colling Road

2139 Colling Road

5336 Cedar Spring Road

Existing Control S

Colling Rd

Colling Road

269.5

5318 Cedar Springs Road

Invert 269.1

5300 Cedar Springs Road

30m

30m

5268 Cedar Springs Road

98m

252.5

5264 Cedar Springs Road

Burlington Quarry West Extension

5258 Cedar Springs Road

Phase 5

Google Earth

5254 Cedar Springs Road

5255 Cedar Spring Road

96m

© 2020 Google

Setb

Area sub  
Site Pla



5353 Cedar Spring Road

of diversion pipe shall remain a minimum 7.0m from Sun-Canadian Pipe Line easement

2129 Colling Road

2139 Colling Road

Existing Control Structure 269.5

Colling Road

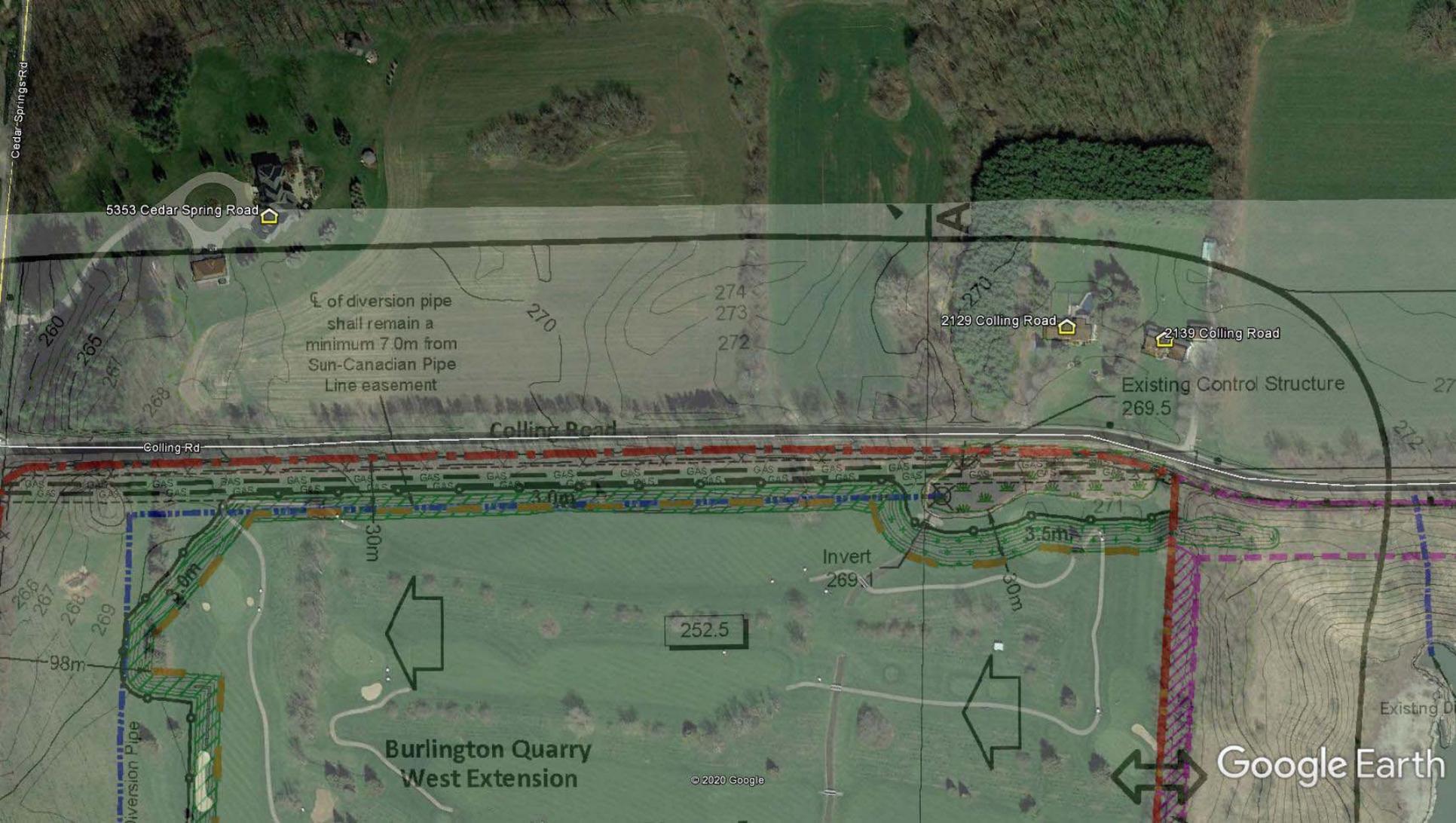
Colling Rd

Invert 269.1

252.5

Burlington Quarry West Extension

Google Earth



**Seismograph Location Overview**

**Seismograph Location for  
Blasting Operations  
(2014-2019)**

Colling Road and Blind Line



Southwest Corner of Quarry Property



Gas Line



2450 No 2 Side Road



2470 No 2 Side Road



2582 No 2 Side Road



**Legend**

|  |                                                          |  |                                                                                                         |
|--|----------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------|
|  | Licence Boundary                                         |  | 120m Offset From Licence Boundary                                                                       |
|  | Limit of Extraction                                      |  | Existing Licence<br>Existing Licence Boundary (solid line)<br>Existing Line of Extraction (dashed line) |
|  | Contours with Elevation<br>Metres above sea level (MASL) |  | Parcel Fabric                                                                                           |
|  | Public Road                                              |  | Diversion or Discharge Pipe<br>Existing - Single Dash                                                   |
|  | Fence<br>1.2m post & wire fence unless otherwise noted   |  | Discharge Location                                                                                      |
|  | Water Feature                                            |  | Jefferson Salamander Regulatory Boundary                                                                |
|  | Irrigation Pond                                          |  | Fish Habitat<br>Direct - solid<br>Indirect - dash                                                       |
|  | Significant Woodlands                                    |  | Sun-Canadian Pipe Line<br>Pipe line location and easement                                               |
|  | Woodlands                                                |  | Entrance / Exit<br>Existing                                                                             |
|  | Wooded Feature                                           |  | Direction of Surface Drainage                                                                           |
|  | Wetland<br>Savanna                                       |  | Building/Structure                                                                                      |
|  | Wetland<br>MNRP - Provincially Significant               |  | Cross Sections<br>A1                                                                                    |
|  | Wetland<br>MNRP - Unvaluated                             |  |                                                                                                         |

**Significant Wildlife Habitat**

|  |                               |  |                           |
|--|-------------------------------|--|---------------------------|
|  | Amphibian Breeding (Woodland) |  | Unicorn Clubtail          |
|  | Bat Maternity Colony          |  | Eastern Wood-pewee        |
|  | Rare Vegetation Community     |  | Large Toothwort Community |

**Species at Risk**

|  |                                                          |
|--|----------------------------------------------------------|
|  | Butternut Category 1                                     |
|  | Butternut Category 2                                     |
|  | Bobolink                                                 |
|  | Barn Swallow Nest Observation                            |
|  | Bat Habitat<br>(Little Brown Myotis and Tricoloured Bat) |

**Site Plan Amendments**

| No. | Date | Description | By |
|-----|------|-------------|----|
|     |      |             |    |
|     |      |             |    |
|     |      |             |    |

**Site Plan Revisions (Pre-Licensing)**

| No. | Date           | Description                                                                                                                                         | By  |
|-----|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1   | September 2020 | Update date of Archaeological Assessment Report in Section H                                                                                        | CAP |
| 2   | April 2021     | Included MNRP wetlands for South Extension. Added Significant Wildlife Habitat, Species of Conservation Concern and Species at Risk. Update legend. | CAP |

**MHBC**  
 PLANNING  
 URBAN DESIGN  
 & LANDSCAPE  
 ARCHITECTURE  
 113 COLUER STREET, BARRE, ON, CANADA L4R 1H2 | P: 705.728.0404 F: 705.728.2010 | WWW.MHBCPLAN.COM

MNR Approval Stamp: **DRAFT**

Applicant: **NELSON AGGREGATE CO.**  
 2433 No. 2 St. Road  
 P.O. Box 1070, Burlington, Ont. L7R 4L8  
 phone: (905) 335-5250

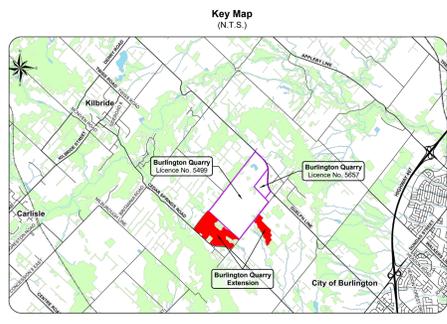
Project: **Burlington Quarry Extension**

MNR Licence Reference No.: 626477  
 Pre-approval review: April 2021

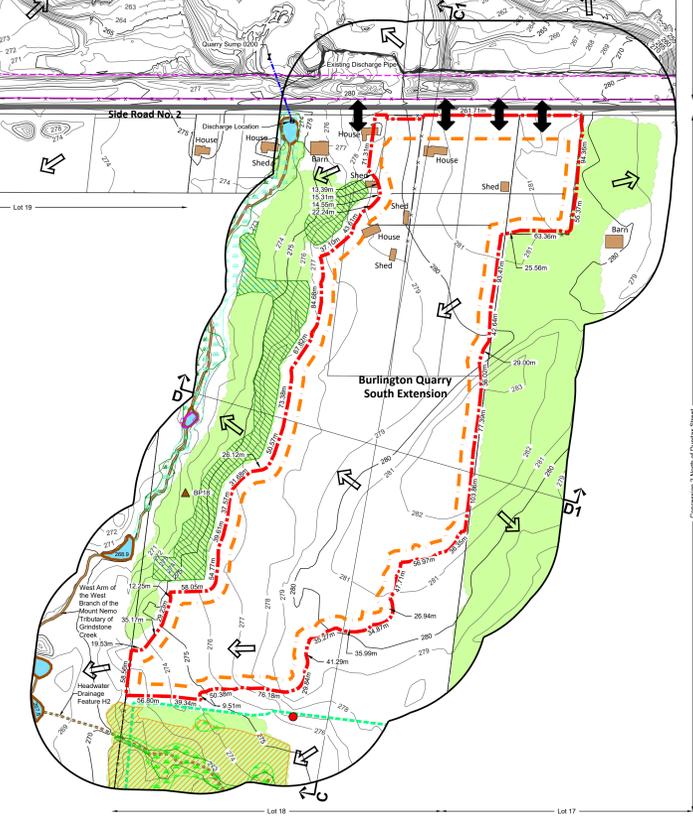
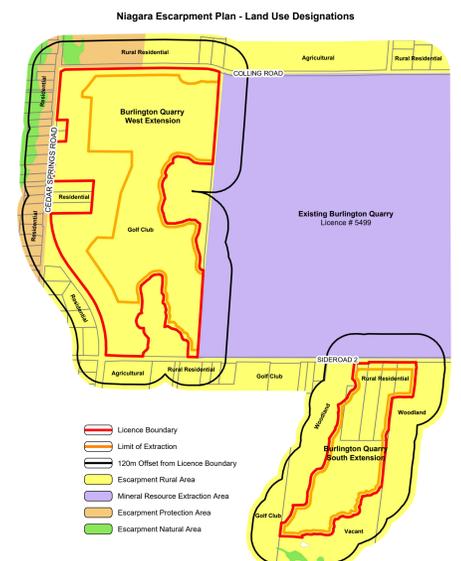
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 Date: April 2021  
 Drawn By: C.P. File No.: 9135D  
 Checked By: B.Z.

File Name: **Existing Features**

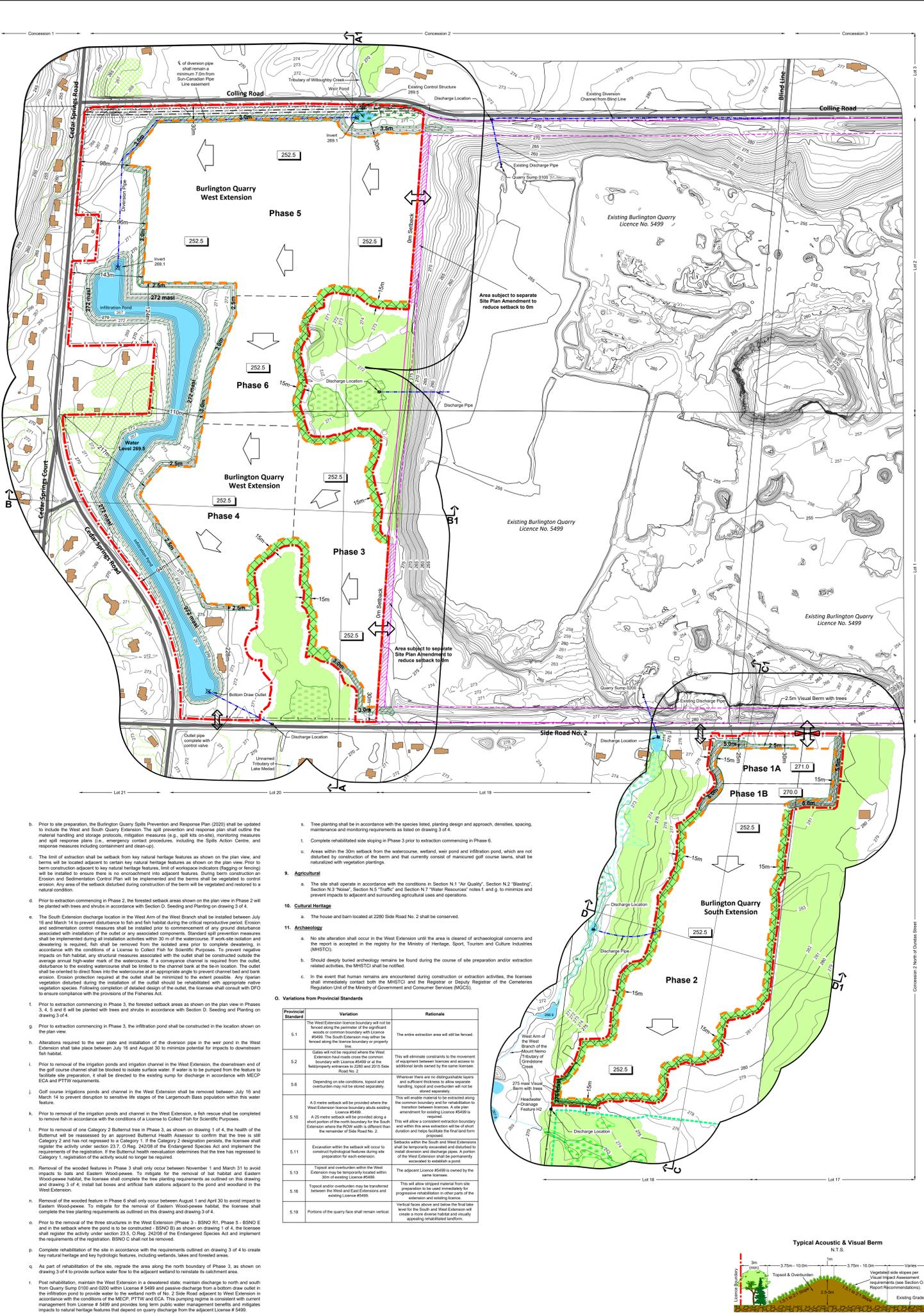
Drawing No.: **1 of 4**



- A. General**
- This site plan is prepared under the Aggregate Resources Act (ARA) for a Class 'A' Licence, Category 2.
  - Area Calculations:
    - Licence Area (total): 78.4 ha
    - South Extension: 18.3 ha
    - West Extension: 60.1 ha
- B. References**
- Contours were obtained from the City of Burlington's Open Data Catalogue based on 2017 data and are displayed in one metre intervals. Elevations shown are in metres above sea level (masl).
  - Topographic information was obtained from numerous sources including Ontario GeoHub (Land Information Ontario), City of Burlington's Open Data Catalogue, Google Earth Pro aerial photography captured on May 7, 2018 and field investigations for technical reports.
  - All topographic features and structures are shown to scale in Universal Transverse Mercator (UTM) with North American Datum 1983 (NAD83), Zone 17 (metre), Central Meridian 81 degrees west coordinate system.
  - The licence boundaries were established using Municipal Property Assessment Corporation (MPAC) parcel fabric data. Distances are approximate and for reference purposes only.
  - Land use designations on and within 120 metres of the licences are from the Niagara Escarpment Plan, Map 3 - Regional Municipality of Halton, approved June 1, 2017. The Burlington Quarry Extension lands are designated Escarpment Rural Area.
  - Land use information and structures identified on or within 120 metres of the licence boundaries were determined using Google Earth Pro aerial photography captured on May 7, 2018.
- C. Drainage**
- Surface drainage on and within 120 metres of the licence boundaries are by overland flow in the directions shown by arrows on the plan view, or by infiltration.
- D. Groundwater**
- The established groundwater table varies between 264 masl to 273 masl in the South Extension and 263 masl to 265 masl in the West Extension (EarthFX 2020).
- E. Site Access and Fencing**
- There are four existing site accesses on Side Road No. 2 and a single existing site access on Cedar Springs Road.
  - Post and wire fencing (unless noted otherwise) exists in the locations shown on the plan view.
- F. Aggregate Related Site Features**
- There are no existing aggregate operations or features on either Extension such as internal haul roads, processing stockpiles, scrap, fuel storage, berms or excavation faces.
- G. Cross Sections**
- See drawing 4 of 4.
- H. Technical Reports - References**
- Adaptive Management Plan, Proposed Burlington Quarry Extension, EarthFX Inc., Savanta and Tatham Engineering, April 2020.
  - Agricultural Impact Assessment, Nelson Aggregate Co., Burlington Quarry Extension, BCK Environmental Consulting, March 2020.
  - Air Quality Study for Nelson Aggregate Co., Burlington Quarry Extension, BCK Environmental Consulting, March 2020.
  - Archaeological Assessment (Stages 1, 2 & 3), Nelson Aggregates Quarry Expansion, Archaeologic Inc., August 2003.
  - Archaeological Assessment (Stage 4), Nelson Aggregates Quarry Expansion, Archaeologic Inc., August 2004.
  - Stage 1-2 Archaeological Assessment, Proposed West Extension of the Burlington Quarry, Götter Associates, September 2020.
  - Blind Impact Analysis, Burlington Quarry Extension, Epitech Engineering Ltd., April 23, 2020.
  - Cultural Heritage Impact Assessment Report, Burlington Quarry Extension, MacNaughton Hermsen Britton Clarkson Planning Limited (MHBC), April 2020.
  - Financial Impact Study, Proposed Burlington Quarry Extension, Nelson Aggregates Co., April 2020.
  - Level 1 and 2 Hydrogeological and Hydrological Impact Assessment Report, Proposed Burlington Quarry Extension, EarthFX Incorporated, April 2020.
  - Level 1 and 2 Natural Environment Technical Report, Proposed Burlington Quarry Extension, Savanta, April 2020.
  - Noise Impact Assessment, Nelson Aggregate Quarry Extension, Howe Gastmeier Chapnik Limited, April 22, 2020.
  - Nelson Aggregate Company, Burlington Quarry Extension Traffic Report, Paradigm Transportation Solutions Limited, February 2020.
  - Surface Water Assessment, Burlington Quarry Extension, Tatham Engineering, April 2020.
  - Visual Impact Assessment Report, Proposed Extension of the Burlington Quarry, MacNaughton Hermsen Britton Clarkson Planning Limited (MHBC), April 2020.



- A. General**
- Area Calculations:
    - License Area (total) **76.4 ha**
      - South Extension 18.3 ha
      - West Extension 60.1 ha
    - Limit of Extraction (total) **90.2 ha**
      - South Extension 14.5 ha
      - West Extension 75.7 ha
  - The maximum annual forage is 2,000,000.
  - The existing golf course use in the West Extension may continue to operate until site preparation for that Extension commences.
- B. Hours of Operation**
- Hours of operation are Monday to Friday from 7:00am to 7:00pm excluding statutory holidays.
  - Blasting is permitted Monday to Friday between 8:00am to 6:00pm excluding statutory holidays. Blasting will typically occur once per week but may occur more often based on operational needs.
- C. Site Access and Erection**
- Prior to extraction within the South or West Extension, post and wire fencing (at least 1.2 metres in height) shall be erected and maintained for the life of the extension works. The licence boundary of the West Extension licence boundary shall be exempt from this requirement (see Section O. Variations from Provincial Standards). Where the licence boundary is not fenced, the licensee shall erect and maintain a fence.
  - A new operational antiseptic for this requirement shall be established in the location shown on the plan view (see Section N. Report Recommendations for additional details under Traffic). Material being transferred from the South Extension to existing Licence #5499 (see Section O. Variations from Provincial Standards) shall occur through an at grade roadway crossing at Side Road No. 2 in this location.
  - A gate shall be installed at the operational antiseptic of the West Extension on Side Road No. 2, kept closed during hours of non-operation, and maintained throughout the life of that Extension.
  - A gate shall not be required for the fireprotection access located at 2280 and 2015 Side Road No. 2 (see Section O. Variations from Provincial Standards).
  - The West Extension shall be accessed through the common licence boundary with existing Licence #5499 in Phases 3 and 5. The locations shown on the plan view are approximate only.
- D. Drainage and Erosion Control**
- Drainage of undisturbed areas will continue in the directions shown on drawing 1 of 4.
  - Prior to site preparation, an Erosion and Sedimentation Control (ESC) Plan shall be prepared and implemented to minimize the erosion and sedimentation from the operation of the quarry (see Section N. Report Recommendations - Natural Environment note "r").
  - Prior to extraction in the West Extension, the infiltration pond located in the west setback (including the diversion/discharge pipe and bottom draw outlet) shall be constructed. The pond shall be excavated to an elevation of 252.7 mast into bedrock. For the portions of the pond which are not excavated, 2.1 slopes shall be established. The purpose of the diversion pipe is to collect water from the west pond to the infiltration pond in the west setback and to provide the discharge in the northwest corner of the site.
  - Within the West Extension, the diversion and discharge pipes shall be placed in the locations shown on the plan view (see Section N. Report Recommendations - Natural Environment note "r") for to install the diversion pipe within the west pond). The centreline of the diversion pipe along the north boundary of Phase 5 shall maintain a minimum of 7.0 metres from the Sun-Canadian Pipe Line easement and be installed prior to constructing the berm in this vicinity.
  - Prior to removal of the irrigation ponds and irrigation channel in the West Extension, the downstream end of the golf course channel shall be blocked to isolate surface water. If water is to be pumped from the channel to facilitate site preparation, it shall be directed to the existing sump for discharge in accordance with MECP, ECA and PTTW requirements.
- E. Site Preparation**
- All existing structures within the South Extension (including the house and barn located at 2280 Side Road No. 2) and West Extension (including the house and barn located at 2015 Side Road No. 2) shall be demolished prior to extraction in each Extension, in accordance with applicable regulations (see Section N. Report Recommendations - Natural Environment note "r" regarding removal of three structures within the West Extension that contain Barn Swallow habitat).
  - No new buildings are proposed for other Extension.
  - Timber resources (if any) will be salvaged for use as saw logs, fence posts and fuel wood where appropriate. Stumps, trees, shrubs and brush removal will be used for rehabilitation of this site and Licence #5499 to provide coarse and the wood debris to enhance soils and create habitats during site rehabilitation.
  - Topsoil and overburden shall be stripped and stored separately where feasible (see Section O. Variations from Provincial Standards).
  - Topsoil and overburden shall be placed in perimeter agricultural/woodlands, pond construction or used immediately for progressive rehabilitation in either Extension or existing Licence #5499 (see Section O. Variations from Provincial Standards).
  - Excess topsoil and overburden not required for immediate use in berms or rehabilitation may be temporarily stockpiled on the quarry floor. Topsoil and overburden stockpiles shall be located within the limit of extraction and remain a minimum of 30 metres from the licence boundary except where the West Extension quarry abuts existing Licence #5499 and 10 metres from a property with a residential use (see Section O. Variations from Provincial Standards).
  - Temporary topsoil and overburden stockpiles which remain for more than one year shall have their slopes vegetated to control erosion.
- F. Berms and Screening**
- Acoustic and visual berms shall be constructed to the heights or elevations specified in the locations shown on the plan view. See Section N. Report Recommendations - Visual Impact Assessment notes and the Typical Acoustic & Visual Berm detail on this drawing for additional information.
  - Berm side slopes shall not exceed the following maximums:
    - South Extension
      - Northwest, north and northeast setback + 1:5.1
      - Southeast setback + 2:1
    - West Extension
      - North and west setback + 2:1
      - Southeast setback + 1:5.1
  - Berms in the South Extension shall be constructed prior to extraction in that extension.
  - Berms in the West Extension shall be constructed prior to extraction in that extension.
  - The north foot of the perimeter berm in the West Extension shall not be located within 1 metre of the Sun-Canadian Pipe Line easement.
  - Berms shall be vegetated with a native mix of wildflowers and grasses to stabilize slopes and minimize mowing and maintenance. The vegetation on the berms shall be maintained until the berms are removed for rehabilitation.
  - Existing vegetation within the setbacks shall be maintained except where acoustic berms, visual berms, ponds or diversion/discharge pipes are required (see Section O. Variations from Provincial Standards). Berms, berms, ponds or diversion/discharge pipes shall be installed in accordance with applicable regulations (see Section N. Report Recommendations - Natural Environment note "r") for to install the diversion pipe within the west pond). The centreline of the diversion pipe along the north boundary of Phase 5 shall maintain a minimum of 7.0 metres from the Sun-Canadian Pipe Line easement and be installed prior to constructing the berm in this vicinity.
  - Subsides identified as forested setbacks on the plan view shall be forested (see Section N. Report Recommendations - Natural Environment notes "r" and "t" for additional information).
- G. Site Detailing**
- During the initial stages of extraction within the South Extension, a temporary setting pond will be constructed within the extraction area (see Phase 2). Once sufficient extraction has occurred in Phase 2, the sump and setting pond will be constructed on the quarry floor. See Adaptive Management Plan for additional details.
  - The discharge location for the South Quarry Extension shall be constructed in accordance with Section N. Report Recommendations - Natural Environment note "r".
  - For the West Extension, the water will be diverted to existing Licence #5499 and discharged from the existing sump and discharge location.
  - The licensee shall operate in accordance with Environmental Compliance Approval (ECA) and Permit to Take Water (PTTW) requirements.
- H. Extraction Sequence**
- Phase 1
    - Prepare Phase 1 (South Extension) for extraction and ensure all requirements pertaining to the Extension in Sections C through G of this drawing are met.
    - Strip Phase 1 and construct perimeter berms. Should there be insufficient topsoil to construct berms in Phase 1 to construct berms, only the amount of material required to complete the perimeter berms and the temporary setting pond may be stripped from Phase 1.
    - Create sinking cut.
    - Construct extraction in a southerly direction and complete a noise audit to ensure the site is meeting NPC 300 Noise Guidelines at the nearest sensitive receptors.
    - Phase 1A may be extracted to a maximum depth of 252.5 mast.
    - Phase 1B may be extracted to a maximum depth of 270 mast.
    - Prepare Phase 2 for extraction.
  - Phase 2
    - Strip Phase 2 in sequence as extraction progresses in a southerly direction.
    - Extract Phase 2 in a southerly direction from Phase 1 and complete a noise audit to ensure the site is meeting NPC 300 Noise Guidelines at the nearest sensitive receptors.
    - Phase 2 may be extracted to a maximum depth of 252.5 mast.
    - As extraction advances, complete progressive rehabilitation of Phase 2.
    - Prepare Phase 3 (West Extension) for extraction and ensure all requirements pertaining to the Extension in Sections C through G and Archaeology notes "r", under Section N. Report Recommendations, of this drawing are met.
    - Remove wooded features in Phase 3 (see Section N. Report Recommendations - Natural Environment note "r").
  - Phase 3
    - Strip Phase 3 and a portion of Phase 4 (if required) to construct perimeter berms in West Extension.
    - Extract Phase 3 by commencing at the common boundary with existing Licence #5499 and proceeding westerly before heading in a northerly direction. At the commencement of extraction, complete a noise audit to ensure the site is meeting NPC 300 Noise Guidelines at the nearest sensitive receptors.
    - Phase 3 may be extracted to a maximum depth of 252.5 mast.
    - Complete progressive and final rehabilitation in Phases 1 and 2.
    - Prepare Phase 4 for extraction.
  - Phase 4
    - Strip Phase 4 and use the material for progressive rehabilitation in Phase 3 and existing Licence #5499.
    - Extract Phase 4 in a westerly and southerly direction from Phase 3. At the commencement of extraction, complete a noise audit to ensure the site is meeting NPC 300 Noise Guidelines at the nearest sensitive receptors.
    - Phase 4 may be extracted to a maximum depth of 252.5 mast.
    - Prepare Phase 5 for extraction.
  - Phase 5
    - Strip Phase 5 and use the material for progressive rehabilitation in Phase 4 and existing Licence #5499.
    - Continue progressive rehabilitation in Phases 4 and 5.
    - Extract Phase 5 by commencing at the common boundary with existing Licence #5499 and proceeding in a westerly direction. At the commencement of extraction, complete a noise audit to ensure the site is meeting NPC 300 Noise Guidelines at the nearest sensitive receptors.
    - Refer to Section N. Report Recommendations - Blasting for additional requirements regarding the NPC 300 Noise Guidelines at the nearest sensitive receptors.
    - The well contractor will contact the resident with the supply issue and rectify the problem as expeditiously as possible, provided the landowner gives authorization for the work. If the issue raised by the landowner is related to loss of water supply, the licensee will have a consultant/determiner determine the likely causes of the loss of water supply, which can result in a number of factors, including pump failure (owner's responsibility), extended overuse of the well (owner's responsibility) or lowering of the water level in the well from potential quarry interference (licensee expense). This assessment process would be carried out at the expense of the licensee and the results provided to the homeowner.
    - d. If it has been determined that the quarry caused a water supply interference, the quarry shall continue to supply water at the licensee's expense until the problem is rectified. The following mitigation measures shall be considered and the appropriate measure(s) implemented at the expense of the licensee:
      - adjust pump pressure;
      - lowering of the pump to take advantage of existing water storage within the well;
      - deepening of the well to increase the available water column;
      - relocation of the well to another area on the property;
      - only at the request of a landowner would a cistern be installed.
- I. Extraction Details**
- The maximum height of a lift shall be 25 metres.
  - The maximum depth of extraction for the South Extension is 29.5 metres. Phase 1 shall be extracted in one lift and Phase 2 shall be extracted in a maximum of two lifts.
  - The maximum depth of extraction for the West Extension is 23.5 metres and the maximum number of lifts is two.
  - Extraction shall be permitted in two Phases simultaneously to allow for transition between Phases.
  - Internal haul road locations will vary as extraction progresses and will be located on the quarry floor with the exception of the at grade roadway crossing between the South Extension and existing Licence #5499.
  - Blasted aggregate will be transported back to existing Licence #5499 for processing and shipping.
  - Berms that encroach within the limit of extraction shall be removed, and the underlying aggregate may be extracted, as part of final extraction for each Extension.
- J. Equipment and Processing**
- Equipment used for site preparation, extraction, pond construction, and site rehabilitation includes drills, front-end loaders, graders, bulldozers, backhoes, conveyors, water trucks, fuel trucks and haul trucks. See Section N. Report Recommendations for additional details on the noise register regarding equipment.
  - No processing shall occur in the South or West Extension. Aggregate extracted in the South and West Extension shall be hauled to existing Licence #5499 for processing.



**Legal Description**  
Part Lot 1 & 2, Concession 2 and Part Lot 17 & 18, Concession 2 NDS (former geographic Township of Nelson)  
City of Burlington  
Region of Halton

**Legend**

- License Boundary
- Limit of Extraction
- Contours with Elevation
- Public Road
- Fence
- Jefferson Salamander Regulatory Boundary
- Water Feature
- Significant Woodlands
- Woodlands
- Wooded Feature
- Wetland
- Wetland (MNP - Provincially Significant)
- Wetland (MNP - Unrated)
- Forested Setbacks
- 120m Offset From Licence Boundary
- Existing Licence
- Parcel Fabric
- Diversion or Discharge Pipe
- Discharge Location
- Sun-Canadian Pipe Line
- Entrance / Exit
- Gate
- General Direction of Excavation & Boundary
- Berm - Acoustic
- Berm - Hydrologic
- Berm - Visual
- Building/Structure
- Quarry Floor
- Cross Sections

**Tree Protection Plan Detail**

- The Tree Protection Zone (TPZ) for woodlands extends the length of the woodland stripline of significant woodlands.
- Prior to site preparation in each Phase, tree fencing shall be erected along the fence line between the source boundary and the strip line of the significant woodlands in a TPZ. The TPZ to prevent damage and soil compaction with the TPZ.
- Fencing material shall consist of orange plastic, white snow fencing and/or page wire fencing with reflective tape.
- Fencing material shall be installed a minimum 1.2 metres height above grade.
- Storage shall be located in visible locations along the perimeter of each TPZ fence and be a minimum 25m x 30m. Each site shall clearly state the lot provided to the right.
- The TPZ must remain fully intact and shall not be used for temporary storage of fill, topsoil, building materials, equipment storage, loading of equipment, or dumping of any construction materials.
- Where appropriate, the TPZ is necessary to facilitate construction of the discharge pipe, tree removal shall be kept to a minimum and the disturbed soil shall be restored with weed-free topsoil. In this location a walk will be maintained to provide access to the discharge location.

**Site Plan Amendments**

| No. | Date           | Description                                                                                                                                                                  | By  |
|-----|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1   | September 2020 | Adjust pond adjacent to dwelling in the southwest corner of the West Extension.                                                                                              | CAP |
| 2   | April 2021     | Update notes per MNP feedback. Added discharge water storage to plan view. Updated legend to include Tree Protection Plan detail. Included MNP wetlands for South Extension. | CAP |

**Site Plan Revisions (Pre-Licensing)**

| No. | Date           | Description                                                                                                                                                                  | By  |
|-----|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1   | September 2020 | Adjust pond adjacent to dwelling in the southwest corner of the West Extension.                                                                                              | CAP |
| 2   | April 2021     | Update notes per MNP feedback. Added discharge water storage to plan view. Updated legend to include Tree Protection Plan detail. Included MNP wetlands for South Extension. | CAP |

**MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE**  
113 COLEBRIER STREET, BARRE, ON, L4M 1H2 | P: 705.720.0435 | F: 705.720.0431 | WWW.MHBCAN.COM

**MNRF Approval Stamp**      **MHBC Stamp**

**DRAFT**

**Applcant**      **NELSON AGGREGATE CO.**  
2435 No. 2 Street  
Burlington, Ontario L7R 4L8  
phone: (905) 335-2520

**Project**      **Burlington Quarry Extension**

**MNRF Licence Reference No.**      **Pre-approval review:**  
626477      **Date**      **File No.**  
**Drawn By**      **Checked By**  
C.P.      B.Z.

**Plan Scale:** 1:3000 (A3/E)      **Date**      **File No.**  
0      100      200      **Drawn By**      **Checked By**  
Meters      C.P.      B.Z.

**File Name**      **Operational Plan**

**Drawing No.**      **2 of 4**

**File Path**      N:\Bentley\3D\Nelson - Project\Drawings\Drawing\ARA Site Plan\Operational Site Plan\CAD\9135D - Site Plan - Backdrop - April 19, 2021.dwg

**Legend**

|  |                                                          |  |                                                                             |
|--|----------------------------------------------------------|--|-----------------------------------------------------------------------------|
|  | Licence Boundary                                         |  | 120m Offset From Licence Boundary                                           |
|  | Limit of Extraction                                      |  | Existing Licence (solid line)<br>Existing Limit of Extraction (dashed line) |
|  | Contours with Elevation<br>Meters above sea level (MASL) |  | Parcel Fabric                                                               |
|  | Public Road                                              |  | Diversion or Discharge Pipe<br>Proposed - Double Dash                       |
|  | Fence<br>1.2m post & wire fence unless otherwise noted   |  | Discharge Location                                                          |
|  | Water Feature                                            |  | Sun-Canadian Pipe Line<br>Pipe location and easement                        |
|  | Lake / Pond<br>Licence # 5499                            |  | Jefferson Salamander<br>Regulatory Boundary                                 |
|  | Significant Woodlands                                    |  | Entrance / Exit<br>Field / Property                                         |
|  | Woodlands                                                |  | Gate                                                                        |
|  | Wooded Feature                                           |  | Building/Structure                                                          |
|  | Wetland<br>Savanna                                       |  | Proposed Final Grade<br>and Slope                                           |
|  | Wetland<br>MNRP - Provincially Significant               |  | Final Elevation<br>of Land and Lake (MASL)                                  |
|  | Wetland<br>MNRP - Unvaluated                             |  | Cross Sections                                                              |

**Site Plan Amendments**

| No. | Date | Description | By |
|-----|------|-------------|----|
|     |      |             |    |
|     |      |             |    |
|     |      |             |    |
|     |      |             |    |

**Site Plan Revisions (Pre-Licensing)**

| No. | Date           | Description                                                                                  | By  |
|-----|----------------|----------------------------------------------------------------------------------------------|-----|
| 1.  | September 2020 | Adjust pond adjacent to dwelling in the southwest corner of the West Extension.              | CAP |
| 2.  | April 2021     | Included MNRP wetlands for South Extension. Updated notes per MNRP feedback. Located herein. | CAP |
|     |                |                                                                                              |     |
|     |                |                                                                                              |     |

**Site Plan Revisions**

| No. | Date | Description | By |
|-----|------|-------------|----|
|     |      |             |    |
|     |      |             |    |
|     |      |             |    |
|     |      |             |    |

**Table 1: Rehabilitation Plant List Recommendations**

| Location                                      | LATIN NAME | COMMON NAME | Coefficient of Conservation | Wetness Index | OWES Wetland Species | PROVINCIAL STATUS (RANK) | LOCAL STATUS (RANK) |
|-----------------------------------------------|------------|-------------|-----------------------------|---------------|----------------------|--------------------------|---------------------|
| Pond/Wetland (PW)                             |            |             |                             |               |                      |                          |                     |
| Gradual Grade/Side Slope with Trees (GG)      |            |             |                             |               |                      |                          |                     |
| Forested Setback During Operation (FSO)       |            |             |                             |               |                      |                          |                     |
| Forested Setback Post-Berm (FSB)              |            |             |                             |               |                      |                          |                     |
| Restored to Existing Grade and Forested (REG) |            |             |                             |               |                      |                          |                     |

**MHBC**  
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 ARCHITECTURE  
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**MNRP Approval Stamp**      **MHBC Stamp**

**DRAFT**

**NELSON AGGREGATE CO.**  
 2432 No. 2 Street  
 P.O. Box 1077 Burlington, ON L7R 4J8  
 phone: (905) 335-5250

**Project**  
**Burlington Quarry Extension**

**MNRP Licence Reference No.**  
 626477

**Pre-approval review:**  
 Date: April 2021  
 Drawn By: C.P.  
 Checked By: B.Z.  
**9135D**

**Plan Scale:** 1:3000 (Arch E)

**File Name**  
**Rehabilitation Plan**

**Drawing No.**  
**3 of 4**

**File Path**  
 N:\Bids\9135D-Nelson - Project\Sidway\Drawings\AIA Site Plan\Concession Site Plan\CA091550 - Site Plan - Backdrop - April 19 2021.dwg

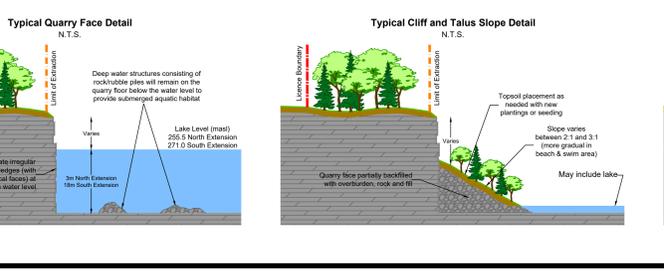


- Progressive Rehabilitation**
- A. General**
- Area Calculations:
    - To be extracted (total): 50.2 ha
      - South Extension: 14.0 ha
      - West Extension: 36.2 ha
    - To be rehabilitated (total): 50.2 ha
      - South Extension: 14.0 ha
      - West Extension: 36.2 ha
- B. Phasing**
- An excavation reaches the limit of extraction or maximum depth, progressive rehabilitation shall commence.
  - Progressive rehabilitation shall follow the direction and sequence of extraction identified on the plan view and described in the notes on drawing 2 of 4.
  - Prior to extraction commencing in Phase 6, side sloping within Phase 3 shall be completed.
- C. Slopes and Grading**
- Progressive rehabilitation will utilize a variety of rehabilitation techniques including:
    - Backfilling extraction faces and quarry floors;
    - Partially backfilling extraction faces to create a cliff with talus slope; or
    - Leaving extraction faces vertical.
  - Excess soil, in accordance with MECP "Excess Soil Regulation" (O. Reg. 406/19), as may be amended from time to time, may be imported to facilitate the establishment of 3:1 and 2:1 (horizontal) vertical slopes on the quarry faces and/or applied to the quarry floors to achieve the final contour elevations shown on the plan view. The licensee must ensure that the material is leached at the source, before it is deposited on-site, to ensure that the material meets the MECP's criteria under Table 1 of MECP's Soils, Ground Water and Sediment Standards for use under Part 1 of the Environmental Protection Act. Sampling results will be provided to the MNRP upon request.
  - Notwithstanding Condition 1, where the imported material is not being placed within 1.0 metres of the surface, the criteria under Table 1 for sodium absorption ratio and electrical conductivity do not have to be met.
  - The final rehabilitated landforms established in the South and/or West Extension using the rehabilitation techniques will consist of lakes, islands, shoreline wetlands, vernal pools, beach, pond, woodlands, gradually sloping grades, 2:1 and 3:1 side slopes, cliff with talus slopes, and vertical faces as shown on the plan view.
  - Beach sand may be imported to establish the beach area in the South Extension.
  - As part of rehabilitation of the site, regrade the area along the north boundary of Phase 3, as shown on this drawing to provide surface water flow to the adjacent wetland to reestablish its catchment area.
- D. Seeding and Planting**
- The side slopes and backfilled portions of the quarry floor will be seeded with the Ministry of Transportation's (MTO) Ontario Roadside Seed Mix (Cheeping Fescue, Kentucky Bluegrass, Perennial Ryegrass and White Clover) or equivalent.
  - Forbs, wetlands, and tree plantings as identified in the plan view shall be planted in accordance with Table 1: Rehabilitation Plant List Recommendations on this drawing.
  - The planting design and approach will be guided by the Conservation Halton Landscaping and Tree Preservation Guidelines (2010).
  - Planting densities shall be determined based on the restoration objectives and presence/balance of existing natural features. For example, planting densities will be higher where the objective is to restore/establish a woodland, and meet the definition of woodland under the Forestry Act, but may be reduced (where objective is to establish a buffer adjacent to a rehabilitated area). The type of species planted will also be dependent on adjacent habitat (e.g., greater reliance on shrub plantings when restoration occurs adjacent to a meadow, and tree plantings when planting next to woodland).
  - Where the restoration objective is the establishment of a woodland, trees will be planted at a minimum density of 10 trees per 100 m<sup>2</sup> in order to account for competition, stress or wildlife damage and to meet the definition of woodland under the Forestry Act. Within this area, the ratio to tree ratio will be 5:1, with trees planted no closer than 2.0 m on centre and shrubs planted between 0.75 m and 1.5 m apart.
  - Where the restoration objective is the establishment of a setback adjacent to a natural feature, planting densities will be dependent on the features they abut (e.g., densities will be higher when planting next to an existing forest relative to the densities when planting next to an anthropogenic or cultural feature). The planting design of a natural feature will follow a 3-band approach, where woody planting densities will be highest within Band 1 (closest to the existing adjacent feature) and reduced in Band 2. No woody species will be planted in Band 3, which will be seeded with a soil and moisture-appropriate native mix. Where trees will be planted, the following planting densities will be applied: Band 1 - five trees per 100 m<sup>2</sup>. Where shrubs are also being proposed, these will be planted at a shrub to tree ratio of 5:1. Band 2 - three trees per 100 m<sup>2</sup>. Where shrubs are also being proposed, these will be planted at a shrub to tree ratio of 5:1.
  - Competing herbaceous vegetation will be controlled by placing mulch around each planted tree or shrub (50 cm radius of mulch around each planting). Rodent protection will be installed as necessary. Where access permits, planting will be watered during periods of drought (defined as a 30 day period between May and September with less than 50mm of precipitation) until establishment has occurred.
  - For planting in areas not extracted, plantings shall be monitored at least annually until "free-to-grow" conditions have been achieved. "Free-to-grow" is a condition in which the plantings are considered established based on a minimum stocking standard, a minimum height and freedom from competition that could impede growth. At the "free-to-grow" condition, the survival (stocking standard) of planted trees shall be a minimum of 1000 trees per hectare. If survival is less than 1000 "free-to-grow" condition trees per hectare, additional planting will take place.
  - For plantings in areas extracted, plantings shall be monitored at least annually until "free-to-grow" conditions have been achieved. "Free-to-grow" is considered established based on a minimum stocking standard, a minimum height and freedom from competition that could impede growth. At the "free-to-grow" condition, the survival (stocking standard) of planted trees shall be a minimum of 1000 trees per hectare. If survival is less than 1000 "free-to-grow" condition trees per hectare, additional planting will take place.
- E. Drainage**
- Final surface drainage will follow the rehabilitated contours and directional arrows shown on the plan view.
  - Once the South Extension is depleted, pumping will cease and portions of the site below the ground water table will fill with water.
  - Runoff within the South Extension will drain into the lake.
  - Construct overflow outlet in the southwest corner of the South Extension.
  - Once the West Extension is depleted, the West Extension will remain in a dewatered state. Runoff within the West Extension will either drain north towards the lake or southeast into existing Licence #5499.
  - During rehabilitation the licensee shall maintain discharge to fish habitat to the north and south from Quarry Sump 0100 and 0200 with Licence #5499 and passive discharge from Licence #5499 to provide long-term public water management benefits and mitigate impacts on natural heritage features which depend on quarry discharge from the adjacent Licence #5499.
  - During rehabilitation the licensee shall operate in accordance with the conditions of the MECP, PTTW and EGA for the ongoing dewatering of the site. This pumping regime is consistent with current management from Licence #5499 and provides long term public water management benefits and mitigates impacts to natural heritage features that depend on quarry discharge from the adjacent Licence #5499.
  - The licensee has committed to conveying the site into public ownership and to maintain the West Extension in a dewatered state by maintaining the pumping regime from Licence #5499 to provide long-term public water management benefits and mitigate impacts on natural heritage features which depend on quarry discharge from the adjacent Licence #5499.
- F. Adaptive Management Plan**
- During progressive rehabilitation, until surrendering the licence, the licensee is required to operate in accordance with the Adaptive Management Plan, prepared by Earth Inc., Savaris and Tatham Engineering, dated April 2020, as may be amended from time to time with approval from MNRP, in consultation with NEC, Region of Halton, City of Burlington and Conservation Halton.

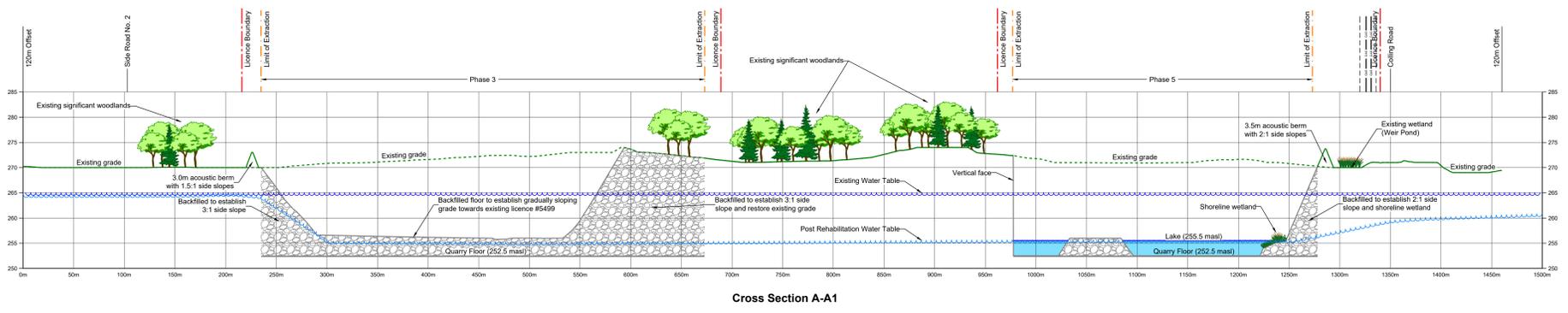
- Final Rehabilitation**
- A. General**
- All equipment shall be removed from the South and West Extension.
  - No internal haul roads shall remain in either Extension.
  - The residence and barn at 2280 Side Road No. 2 in the South Extension shall remain.
  - The residence and barn located at 2015 Side Road No. 2 in the southwest corner of the West Extension shall remain.
  - A field property access entrance shall remain to access the residence and barn located at 2280 and 2015 Side Road No. 2.
  - The groundwater table post rehabilitation varies between 263.5 msl to 271 msl in the South Extension and 265.5 msl to 268 msl in the West Extension (MNRP 2020) or 420 msl if the West Extension is not maintained in a dewatered state.
  - The licensee, prior to the surrender of the licence, shall complete a Record of Site Condition for the Extensions in accordance with the Environmental Protection Act.
  - Prior to the surrender of the Aggregate Resource Act Licence, the licensee shall define the transition of the site to another party and the pre-requisite for licence surrender to the satisfaction of the MNRP.

**Table 1: Rehabilitation Plant List Recommendations**

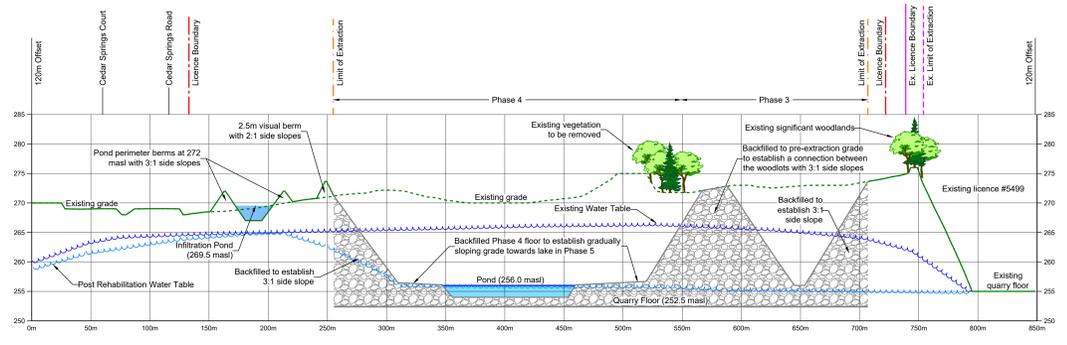
| Location                                      | LATIN NAME | COMMON NAME | Coefficient of Conservation | Wetness Index | OWES Wetland Species | PROVINCIAL STATUS (RANK) | LOCAL STATUS (RANK) |
|-----------------------------------------------|------------|-------------|-----------------------------|---------------|----------------------|--------------------------|---------------------|
| Pond/Wetland (PW)                             |            |             |                             |               |                      |                          |                     |
| Gradual Grade/Side Slope with Trees (GG)      |            |             |                             |               |                      |                          |                     |
| Forested Setback During Operation (FSO)       |            |             |                             |               |                      |                          |                     |
| Forested Setback Post-Berm (FSB)              |            |             |                             |               |                      |                          |                     |
| Restored to Existing Grade and Forested (REG) |            |             |                             |               |                      |                          |                     |



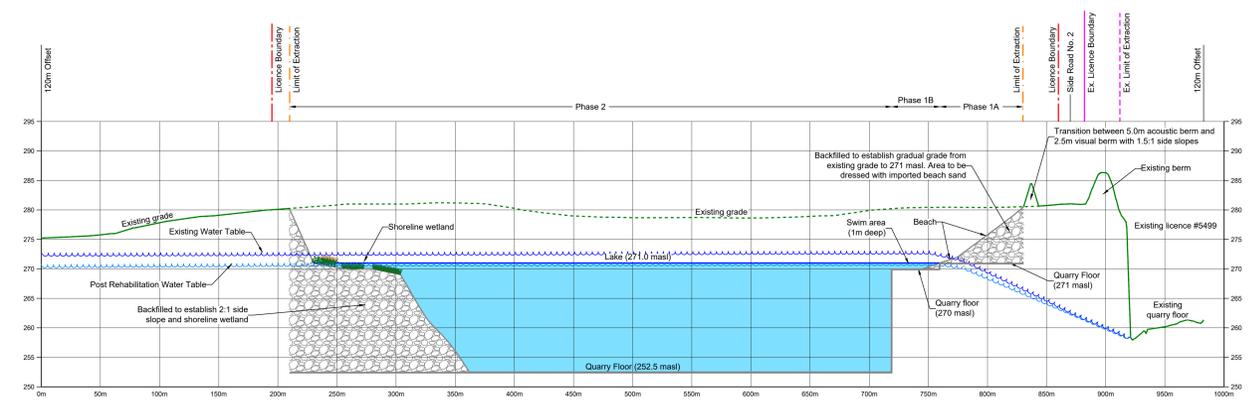
- Legend**
- Licence Boundary
  - Limit of Extraction
  - Existing Licence
  - Existing Limit of Extraction
  - 120m Offset From Licence Boundary
  - Existing Grade - Removed / Altered
  - Existing Grade - Undisturbed
  - Quarry Floor / Face
  - Berm
  - Existing Water Table
  - Post Rehabilitation Water Table
  - Backfilled
  - Lake or Pond



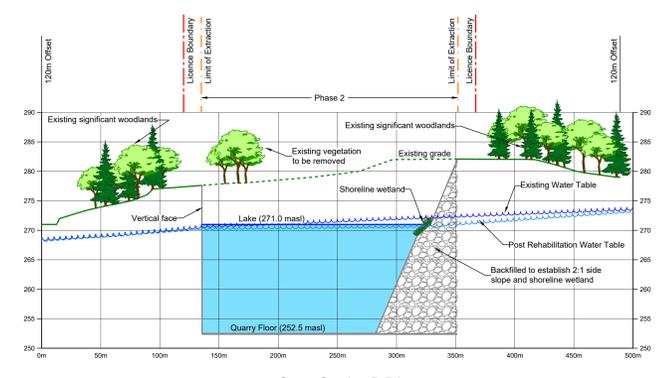
Cross Section A-A1



Cross Section B-B1

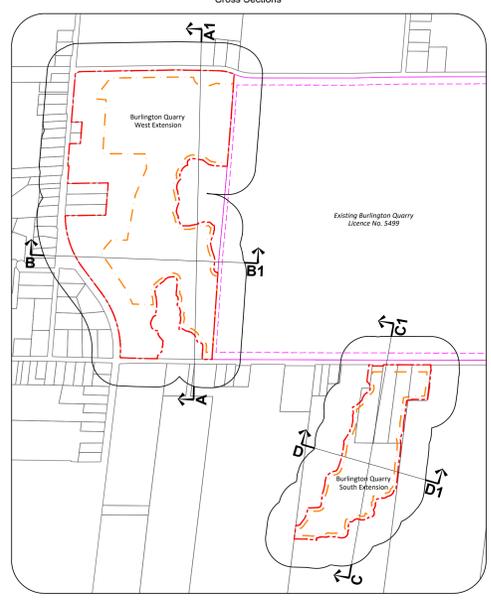


Cross Section C-C1



Cross Section D-D1

**Key Map**  
 Cross Sections



**Site Plan Amendments**

| No. | Date | Description | By |
|-----|------|-------------|----|
|     |      |             |    |

**Site Plan Revisions (Pre-Licensing)**

| No. | Date       | Description                                       | By  |
|-----|------------|---------------------------------------------------|-----|
| 1   | April 2021 | Added additional cross section labels for clarity | CAP |

**MHBC**  
 PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE  
 113 COLUER STREET, BARRE, ON, L4M 1H2 | P: 705.728.0405 F: 705.728.2010 | WWW.MHBCPLAN.COM

MNRF Approval Stamp: **DRAFT**

Applicant: **NELSON AGGREGATE CO.**  
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 phone: (905) 335-5250

Project: **Burlington Quarry Extension**

|                                      |                      |
|--------------------------------------|----------------------|
| MNRF Licence Reference No.<br>626477 | Pre-approval review: |
|--------------------------------------|----------------------|

|                                                    |                    |
|----------------------------------------------------|--------------------|
| Plan Scale:<br>Horizontal 1:2000<br>Vertical 1:400 | Date<br>April 2021 |
| Drawn By<br>C.P.                                   | File No.<br>9135D  |
| Checked By<br>B.Z.                                 |                    |

File Name: **Cross Sections**

Drawing No.: **4 of 4**

# Appendix B

# Burlington Quarry Extension

## PREVAILING METEOROLOGICAL CONDITIONS

Medians provided by Environment Canada  
Canadian Climate Normals 1981-2010  
Hamilton – Municipal Airport

| Date      | Wind Direction | Wind Velocity<br>Km/h | Temperature<br>(Deg Celsius) |
|-----------|----------------|-----------------------|------------------------------|
| January   | SW             | 19.5                  | -5.5                         |
| February  | W              | 18.6                  | -4.6                         |
| March     | W              | 18.5                  | -0.1                         |
| April     | NE             | 15.9                  | 6.7                          |
| May       | NE             | 14.0                  | 12.8                         |
| June      | SW             | 14.0                  | 18.3                         |
| July      | W              | 12.6                  | 20.9                         |
| August    | SW             | 11.8                  | 20.0                         |
| September | SW             | 13.1                  | 15.8                         |
| October   | SW             | 15.6                  | 9.3                          |
| November  | W              | 17.4                  | 3.7                          |
| December  | SW             | 18.7                  | -2.3                         |

# Appendix C

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**REPORT ON**

**BLASTING IMPACT ASSESSMENT  
PROPOSED NELSON AGGREGATE  
NELSON QUARRY EXTENSION**

Submitted to:

Nelson Aggregate Co.  
P.O. Box 1070  
Burlington, Ont. L7R 4L8

**DISTRIBUTION:**

20 Copies - Nelson Aggregate Co.  
2 Copies - Golder Associates Ltd.

April 2006

021-1238



## EXECUTIVE SUMMARY

Blasting operations within the proposed extension of the Nelson quarry may be readily carried out in compliance with existing provincial environmental guideline limits with respect to ground and air vibrations. These effects are subject to recommended limits of 12.5 mm/s and 128 dBL respectively, as established by the Ontario Ministry of the Environment and outlined in Noise Pollution Control (NPC) publication 119 of the Model Municipal Noise Control By-Law, for operations where monitoring of these effects is carried out as a matter of routine.

Ground and air vibration attenuation characteristics were monitored and assessed from a number of routine production blasts within the existing Nelson quarry. The results indicate that the majority of the proposed extension may be excavated using the blast parameters currently being used in the existing quarry. These would include reducing the borehole diameter, reducing the bench height and reducing the explosive weight per delay period. The Nelson quarry would continue monitoring all blasts during extraction within the proposed extension area. The blasting operations within the proposed extension would have no impact on the integrity of adjacent water wells.

By ensuring that the ground and air vibration levels produced during blasting operations at the Nelson quarry continue to remain within the recommended provincial guideline limits, there would not be any noticeable cumulative effect on adjacent structures associated with the blasting operations within the proposed extension.

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## 1.0 INTRODUCTION

Golder Associates was retained by Nelson Aggregate Co. to carry out an impact assessment of the environmental effects from future blasting operations within the proposed extension of the existing licensed area of the Nelson Quarry Company quarry. The proposed extension would be located immediately south of No. 2 Sideroad on Part Lots 17 and 18, Concession 2 in the City of Burlington. The impact assessment specifically addresses whether the applicable Ontario Ministry of Environment guidelines with respect to ground and air vibration effects could be met at the residential properties closest to the proposed extension.

The investigation included monitoring a number of regularly scheduled production blasts at various receptor points around the blast site to assess site-specific ground and air vibration decay characteristics.

This report addresses the following topics:

- reviews existing provincial and federal guidelines for the assessment of environmental impacts from blasting,
- provides recommendations for the continued control of ground and air vibration effects,
- evaluates the potential impact of the blasting operations on bedrock strata and adjacent water wells,
- evaluates the long term impact of the blasting operations on surrounding structures.

## **2.0 EXISTING CONDITIONS**

### **2.1 Site Description**

The existing licensed Nelson Quarry Co. quarry (Nelson) is situated immediately north of No. 2 Sideroad and south of Colling Road between Guelph Line and Cedar Springs Road in the City of Burlington, Ontario in the Region of Halton (see Figure 1). The proposed extension area would encompass an area of approximately 82.3 Hectares immediately south of the existing quarry and No. 2 Sideroad, as seen in Figure 2.

As shown in Figures 2 and 4, the closest residential properties to the proposed extension consist of those residences to the east and west on the south side of No. 2 Sideroad. Compared to the existing quarry location, the proposed extension is relatively remote from the existing neighbouring properties. The closest residential receptors have been identified as the residences along No. 2 Sideroad (see Appendix B). The topography of the area generally consists of gently rolling hills.

### **2.2 Quarry Blasting Operations**

The Nelson quarry currently operates a single bench which varies in height from approximately 19 to 26 m. Typical blast design details for the existing quarry are given in Table 1 while common quarry blasting terms and procedures are illustrated in Figure 3.

All blasting at the Nelson quarry is monitored for ground and air vibration effects. Monitoring is routinely being carried out at three locations along the south side of No. 2 Sideroad and occasionally within Mount Nemo Court, east of Guelph Line.

Blasting procedures within the proposed extension would be carried out in a manner similar to those currently being carried out for the existing Nelson quarry, as shown in Table 1.

### **3.0 PROPOSED EXTRACTION OF EXTENSION AREA**

The proposed sequence of extraction for the extension is illustrated in Figure 4. Extraction within the proposed extension area would commence with the crossing of No. 2 Sideroad west of the existing office. Extraction of Phase 1 would see an approximately 100 m wide working face advanced in a westerly direction along the north side of the proposed extension, as shown in Figure 4. Phases 2 and 3 would see the entire west side of the extension extracted in a southerly direction before proceeding east along the south boundary.

Extraction of Phase 4 would be carried out in a northerly direction which would complete extraction of the west half of the proposed extension. Phases 5a and 5b would be carried out in an easterly direction in the southeast corner of the extension while the remainder of the property would be extracted as Phase 6 in a northerly direction, as seen in Figure 4.

## 4.0 IMPACT IDENTIFICATION

The environmental effects most often associated with blasting operations are ground vibrations and air concussion.

The intensity of ground vibrations, which is an elastic effect measured in units of peak particle velocity, is defined as the speed of excitation of particles within the ground resulting from vibratory motion. For the purposes of this report, peak particle velocity is measured in mm/s.

While ground vibration is an elastic effect, one must also consider the plastic or non-elastic effect produced locally by each detonation when assessing the effects on the bedrock strata and local water wells. The detonation of an explosive produces a very rapid and dramatic increase in volume due to the conversion of the explosive from a solid to a gaseous state. When this occurs within the confines of a borehole it has the following effect:

- The bedrock in the area immediately adjacent to the explosive product is crushed.
- As the energy from the detonation radiates outward from the borehole, the bedrock between the borehole and quarried face becomes fragmented and is displaced while the bedrock behind the borehole is fractured.
- Energy not used in the fracturing and displacement of the bedrock dissipates in the form of ground vibrations, sound and airblast. This energy attenuates rapidly from the blast site due to geometric spreading and natural damping.

Air concussion, or air vibrations, is a pressure wave traveling through the air produced by the direct action of the explosive on air or the indirect action of a confining material subjected to explosive loading. Air vibrations from surface blasting operations consist primarily of acoustic energy below 20 Hz, where human hearing is less acute (Siskind et al., 1980), while noise is that portion of the spectrum of the air vibration lying within the audible range from 20 to 2000 Hz. It is the lower frequency component (below 20 Hz) of air concussion, that which is less audible, that is of interest as it is often the source of secondary rattling and shaking within a structure. For the purposes of this report, air vibration is measured as decibels in the Linear or Unweighted mode (dBL). This differs from noise (above 20 Hz) which is measured in dBA.

Both ground and air vibration effects produced at private structures adjacent to surface or underground mining operations are subject to guidelines contained in Noise Pollution Control (NPC) publication 119 of the Model Municipal Noise Control By-Law, dated August, 1978, published by the Ontario Ministry of Environment. Under conditions where monitoring of the blasting operations is routinely carried out, as it is at the Nelson Quarry, the recommended ground and air vibration limitations at the nearest private structure would be 12.5 mm/s and 128 dBL respectively. A copy of Publication NPC 119 is reproduced in Appendix A.

## 5.0 QUARRY BLAST MONITORING

As part of this study, peak ground and air vibration levels were monitored during several typical quarry production blasts in the existing quarry at progressively increasing distances from the blast site. The blasts occurred both on the south and east faces of the quarry. Instrumentation consisted of Instantel DS-077 Minimates, Minimate Pluses and DS-477 Blastmates. These instruments measure and record ground vibration velocities in each of three orthogonal directions, as well as simultaneously recording air vibration levels. Instrumentation was generally set up in a line at distances ranging from about 100 to 600 m from the blast site. Specific instrument and blast locations were established using a Garmin GPS electronic navigation aid (NAVAID) to determine accurate distances between the blast and receptors.

### 5.1 Attenuation Characteristics

The rate at which ground vibrations attenuate or decrease with increased distance from a blast source depends on a variety of conditions, including the type and condition of the bedrock being blasted, depth and composition of the earth covering deposits (soil), and the general topography. Air vibration effects are less affected by these factors, being more influenced by the prevailing weather conditions at the time of the blast.

The following relationships were established from the blast monitoring results.

#### 5.1.1 Ground Vibrations

The ground vibration attenuation characteristics established for the Nelson Quarry is presented in Figure 5 as a plot of the peak particle velocity against the Scaled Distance. Scaled Distance is defined as:

$$\text{Scaled Distance (SD)} = D/\sqrt{W}$$

where D = distance (m) between the blast and receptor

W = maximum weight of explosive (kg) detonated per delay period

As seen in Figure 5 the collection of points defining the rate of decay for the ground vibrations exhibits a degree of scatter that is inherent in all Scaled Distance plots. Factors responsible for these variations include the geologic conditions of the bedrock (type and structure), different wave types, errors in blast initiation timing, differences between types of explosives, degree of confinement, and differences in blast efficiencies.

The equation for the 95% regression line developed in Figure 5 can be expressed as:

$$PPV = 896(SD)^{-1.32}$$

where PPV = Peak Particle Velocity (mm/s)  
SD = Scaled Distance (m/(kg<sup>0.5</sup>))

The calculated Scaled Distance for a peak ground vibration level of 12.5 mm/s would equal 25.5 m/(kg<sup>0.5</sup>). The purpose of this equation is not so much to predict what a given vibration level would be at a particular location for a given blast, but to indicate the probability that the peak vibration would fall below the level indicated by the equation for a given distance and maximum explosive weight. The equation is therefore a useful blast design tool in establishing maximum explosive charge weights per delay for various distances from a blast site for a given maximum ground vibration level.

### 5.1.2 Air Vibrations

Cube root scaling was used in establishing the air vibration decay characteristics as given in the following relationship:

$$\text{Scaled Distance (SD)} = D/\sqrt[3]{W}, \quad \text{where } D \text{ and } W \text{ are defined as previously described.}$$

Figure 6 shows the Scaled Distance air vibration plot, which exhibits considerably more scatter and has a typically poorer correlation than that seen with the ground vibration results. This is primarily due to variable weather conditions during each blast, which are entirely independent of the blasting operations. Other factors influencing air vibration distribution from a blast include the length of collar and type of stemming material used, differences in explosive types and variations in burden distance.

The 95% regression curve given in Figure 6 can be expressed as:

$$APL = 181(SD)^{-0.0867}$$

where SD = as defined above  
APL = air pressure level (dBL)

The calculated Scaled Distance for a peak air vibration level of 128 dBL would equal 53.0 m/(kg<sup>0.33</sup>). The variability in the plot suggests that it is less reliable as a tool for guiding blast design.

Site specific Scaled Distance plots are commonly used as a blast design tool since peak vibration levels can be reasonably predicted at specified distances from a blast site. Based on the 95%

regression equations given in Figures 5 and 6, Table 2 shows the maximum suggested explosive loads for various distances from the blast site based on the provincial guideline limits of 12.5 mm/s and 128 dBL discussed previously. It can be seen that the ground vibration limit of 12.5 mm/s becomes the more restrictive guideline when determining maximum explosive loads beyond a distance of about 225 m for the quarry's blasting operations.

## **6.0 IMPACT ASSESSMENT**

### **6.1 Compliance with NPC 119**

It is evident from the regression equations discussed in Section 5 that the distance between the blast and the receptor and the amount of explosive detonated per delay period are the principal parameters in controlling ground and air vibration effects. The maximum explosive loads given in Table 2 for limiting peak ground and air vibration levels to 12.5 mm/s and 128 dBL respectively, indicate that the provincial guidelines may be complied with for all blasting beyond a distance of about 200 m from adjacent private residential properties. This represents a majority of the proposed extension and is based on a maximum explosive weight per delay of about 60 kg. When blasting approaches to within about 200 m of adjacent private residences, it may become necessary to reduce the maximum explosive weight detonated per delay period within the blast. Any one or combination of the following operations would achieve this:

1. Reducing the borehole diameter with a corresponding reduction in the drill pattern.
2. Introduce additional decked charges within each borehole, as illustrated on Figure 3.
3. Reduce the borehole length (depth) by reducing the bench height.

For example, a reduction in the borehole diameter from 127 mm to 76 mm would effectively reduce the explosive column weight per hole by about 65%. Decking the explosive column could further reduce the explosive column weight by an additional 50%. Additional decking and reductions in bench heights, as identified above, could achieve further reductions in maximum explosive weights.

As it is the intention of the Nelson quarry to continue monitoring all blasting operations, the attenuation curves discussed previously would be used in conjunction with the monitoring data collected at adjacent properties to dictate when changes to the blast procedure become necessary within the proposed extension. Although a reduction in the maximum instantaneous explosive load is anticipated as blasting approaches the residences to the east and west, the ground and air vibration guideline limits contained within NPC 119 would continue to be maintained.

### **6.2 Repeated Vibration Effects on Structures**

Blast vibrations characteristically produce temporary transient strains within the various materials that makeup a residential structure. These strains would typically have durations of no more than one or two seconds for each blast as the vibration passed the structure. In addition to these temporary strains, Table 3 shows the strain levels produced in a household by changes in temperature and humidity (environmental changes), as well as those produced by regular household activities (Dowding, 1985), which occur on a recurring and often frequent basis. These strain levels are compared to equivalent levels of ground vibration produced from blasting

operations. It is evident from Table 3 that routine household activities and environmental changes can at times produce strains within a structure that are well in excess of those produced by blasting.

Several studies have also been carried out to look at the long-term effects of repeated blasting on structures (Stagg et al, 1984, Siskind et al, 1980). These studies concluded that repeated blasting over several decades, producing peak vibration levels well in excess of the provincial guideline limit, were required to cause cosmetic threshold cracking to occur. By ensuring that blasting continues to remain within the provincial guideline limits, there would not be any noticeable cumulative effect associated with the blasting operations within the extension area.

### **6.3 Effects on Bedrock and Water Wells**

As discussed previously, under typical blasting conditions stresses introduced into the bedrock by the explosive detonation and the accompanying gas pressures create and extend fractures within the bedrock around each borehole. Fracture development is usually limited to the equivalent distance of about 20 times the borehole diameter. In the case of the blast procedures expected for the proposed extension, this would equate to about two to three metres for a 114 mm diameter hole. The gas pressures within the hole may extend micro-cracks or existing natural discontinuities within the bedrock, such as joints or bedding planes, beyond this distance.

Studies on crack development within bedrock from blast detonations (Keil et al., 1977) indicate that peak ground vibration levels of 300 to 600 mm/s are required to create micro-cracks or open existing discontinuities. Our own experience within the limestone of Southern Ontario indicates that such values would not be anticipated beyond a distance of about 10 to 20 m from the blast site, depending on such parameters as drill hole diameter and the type of explosive product. It is evident therefore that the creation or extension of fractures within the bedrock would remain confined to an area immediately around the blast site.

Several studies have been carried out to investigate the effects of blasting on ground water wells (Froedge, 1983). These studies have concluded that:

1. When blast induced ground vibrations are less than about 25 mm/s maximum resultant particle velocity, the response of the well is limited to a slight temporary variation in water level on the order of 3 to 6 cm either up or down. The specific capacity of the water well is unchanged based on drawdown tests.
2. Vibration measurements made at the surface and at the bottom of the observation wells indicate the vibration levels are always lower at the bottom of the well.
3. All of the data collected indicates that a ground vibration limit of 50 mm/s peak particle velocity is adequate to protect the wells from any significant damage. There is a possibility that temporary turbidity may be caused at lower levels periodically, although not at any constant threshold level.

The research consistently indicates that blast vibrations below 25 mm/s should have no adverse effects on nearby wells. As the maximum provincial guideline vibration limitation at the nearest residence is only half of this value, at 12.5 mm/s, the ground vibrations produced from the quarry's blasting operations within the proposed extension area would have no effect on the integrity of neighbouring water wells.

## 7.0 CONCLUSIONS

Based on the foregoing considerations, it is our opinion that blasting operations may be readily performed within the limits of the proposed extension of Nelson Quarry Company quarry in compliance with the current quarry blasting guidelines published by the Ministry of Environment. All blasting and blast monitoring would occur in accordance with the Aggregate Resources Act prescribed conditions in order to ensure compliance with the provincial guidelines.

### **GOLDER ASSOCIATES LTD.**



Marcus V. van Bers, P. Eng.  
Associate

MVVB/AC/ms/co

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Stagg, M. S., Siskind, D. E., Stevens, M. G., Dowding, C. H., *Effects of Repeated Blasting on a Wood-Frame House*, U.S.B.M. Report RI8896, 1984.

**TABLES**

**TABLE 1**  
**Existing Blast Details for Nelson Quarry Company**

| PARAMETER                                         | NELSON QUARRY                      |
|---------------------------------------------------|------------------------------------|
| Bench (face) height (m)                           | 19 - 26                            |
| Drill hole pattern (m)                            | 2.4 x 2.4 – 4.3 x 4.3              |
| Drill hole diameter (mm)                          | 76 – 114                           |
| Sub-drill depth (m)                               | 0.6                                |
| Collar length (m)                                 | 1.7 – 3.0                          |
| Holes per blast                                   | 7 – 40                             |
| Explosive product(s) used                         | Emulsion/ANFO blend                |
| Initiation system                                 | Electric, Electronic               |
| Delay timing (ms)                                 | 25ms (electric), 13ms (electronic) |
| Maximum explosive weight<br>per delay period (kg) | 30 – 279                           |

*Note:* See Figure 3 for a description of blasting terms.

**TABLE 2**  
**Maximum Explosive Loads vs Distance**  
**for 12.5 mm/s and 128 dBL**

| Distance (m) | PPV = 12.5 mm/s<br>SD = 25.5 kg/m <sup>0.5</sup> | INL = 128 dBL<br>SD = 53.0 kg/m <sup>0.33</sup> |
|--------------|--------------------------------------------------|-------------------------------------------------|
| 100          | 15                                               | 7                                               |
| 150          | 35                                               | 23                                              |
| 200          | 61                                               | 54                                              |
| 250          | 96                                               | 105                                             |
| 300          | 138                                              | 181                                             |
| 400          | 246                                              | 429                                             |
| 500          | 384                                              | 838                                             |
| 600          | 553                                              | 1449                                            |

*Note:* See Section 5 of accompanying report.

TABLE 3

## Strain Levels Induced by Household Activities, Environmental Changes and Blasting

| Loading Phenomena           | Site <sup>a</sup> | Microstrain Induced by Phenomena ( $\mu\text{in.in.}$ ) | Corresponding Blast Vibration Level <sup>b</sup> (mm/s) |
|-----------------------------|-------------------|---------------------------------------------------------|---------------------------------------------------------|
| Daily environmental changes | K <sub>1</sub>    | 149                                                     | 30.0                                                    |
|                             | K <sub>2</sub>    | 385                                                     | 76.0                                                    |
| Household activities:       |                   |                                                         |                                                         |
| 1. Walking                  | S <sub>2</sub>    | 9.1                                                     | 0.8                                                     |
| 2. Heel drops               | S <sub>2</sub>    | 16.0                                                    | 0.8                                                     |
| 3. Jumping                  | S <sub>2</sub>    | 37.3                                                    | 7.1                                                     |
| 4. Door slams               | S <sub>1</sub>    | 48.8                                                    | 12.7                                                    |
| 5. Pounding nails           | S <sub>12</sub>   | 88.7                                                    | 22.4                                                    |

<sup>a</sup>K<sub>1</sub> and K<sub>2</sub> were placed across a taped joint between two sheets of gypsum wallboard.

<sup>b</sup>Blast equivalent based on envelope line of strain vs ground vibration.

Source: Dowding (1985)

**FIGURES**

# KEY LOCATION PLAN NELSON QUARRY

FIGURE 1



**Existing Nelson  
Burlington  
Quarry**

**REFERENCE:**  
THIS FIGURE WAS CREATED FROM A MAPART  
MAP TITLED "HAMILTON" 2003 EDITION.

Date: **SEPTEMBER 2004**

Drawn: **RJ**

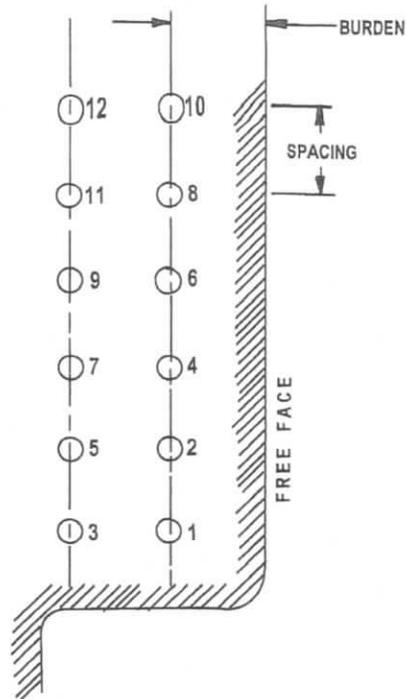
Project: **021-1238**

**Golder Associates**

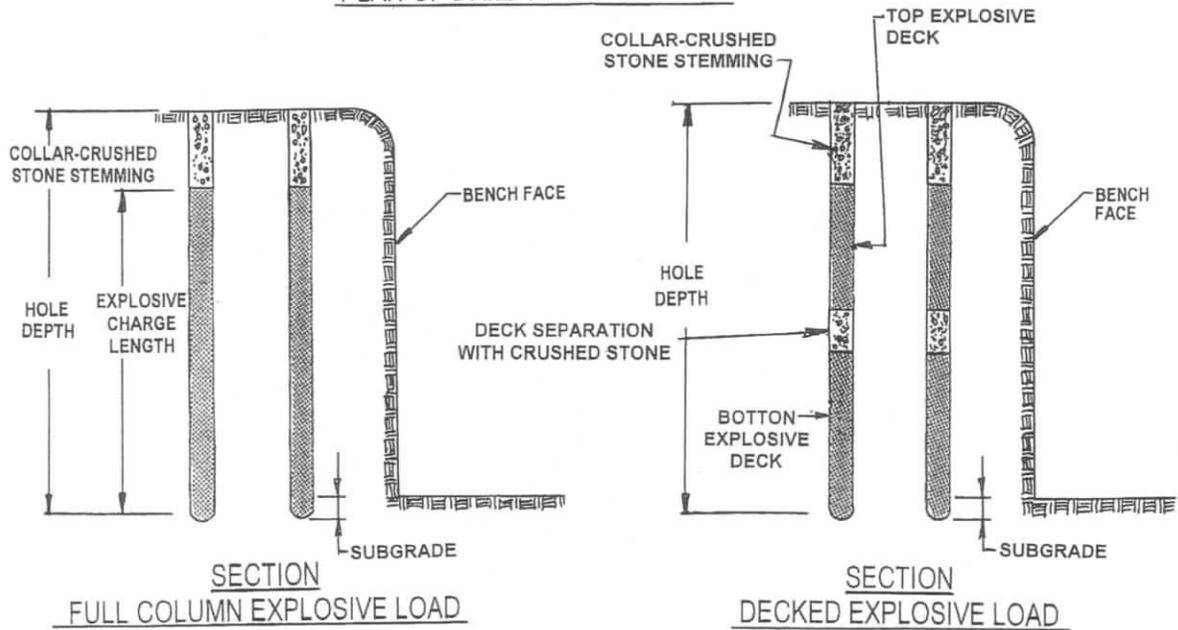
Chkd: \_\_\_\_\_

0211238FIG01.cdr

| NUMBERS SHOW SHORT PERIOD DELAY | EXAMPLE OF FIRING TIMES (MILLISECONDS) |
|---------------------------------|----------------------------------------|
| PERIOD 1                        | 25                                     |
| PERIOD 2                        | 50                                     |
| PERIOD 3                        | 75                                     |
| PERIOD 4                        | 100                                    |
| PERIOD 5                        | 125                                    |



PLAN OF DRILL HOLE PATTERN



SECTION FULL COLUMN EXPLOSIVE LOAD

SECTION DECKED EXPLOSIVE LOAD

0211238F IG03.cdr

Date: SEPTEMBER 2004

Project: 021-1238

Golder Associates

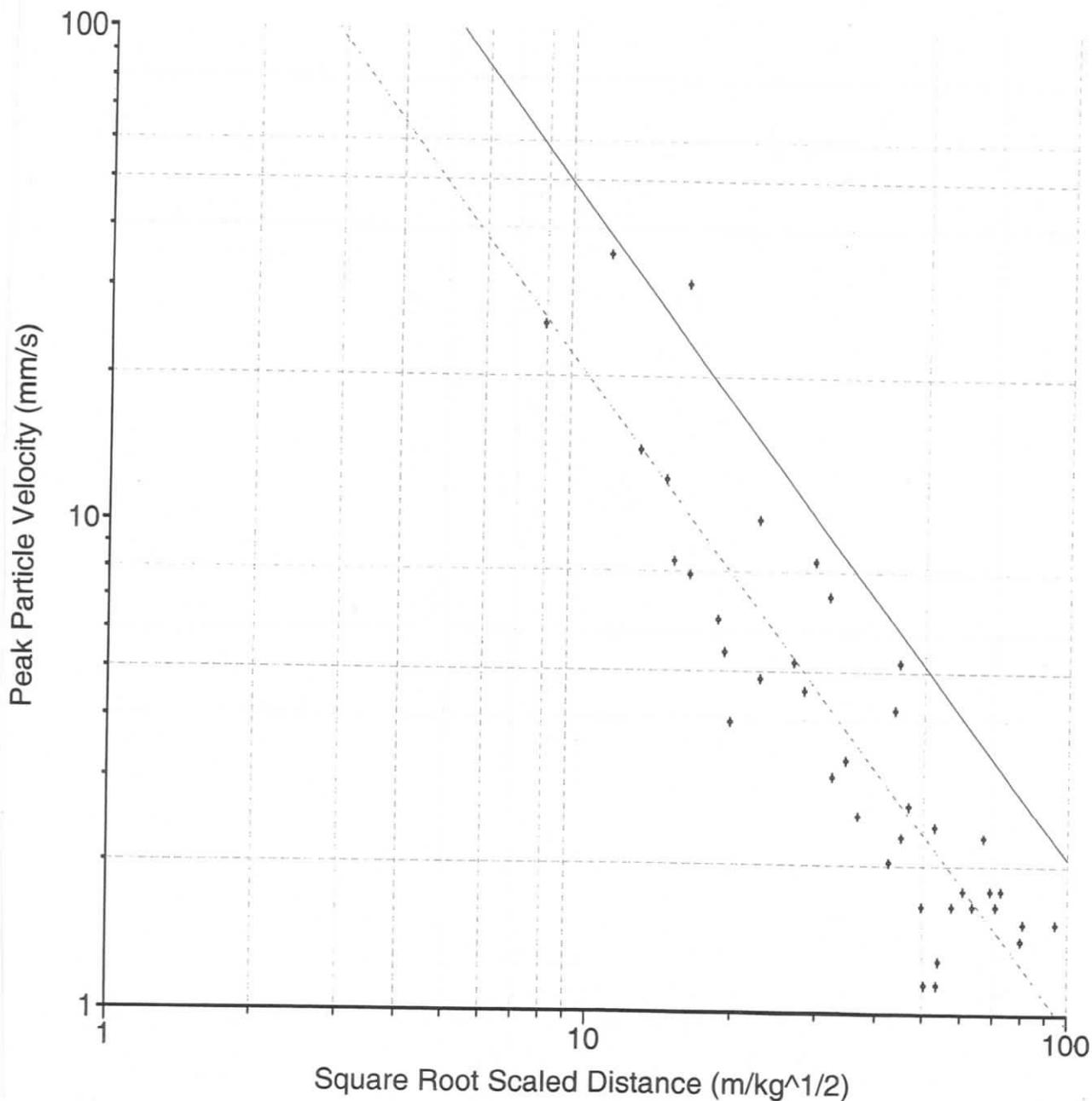
Drawn: RJ

Chkd:

NELSON QUARRY GROUND VIBRATION  
ATTENUATION CURVE

FIGURE 5

Coefficient of Determination = 0.811 Standard Deviation = 0.172



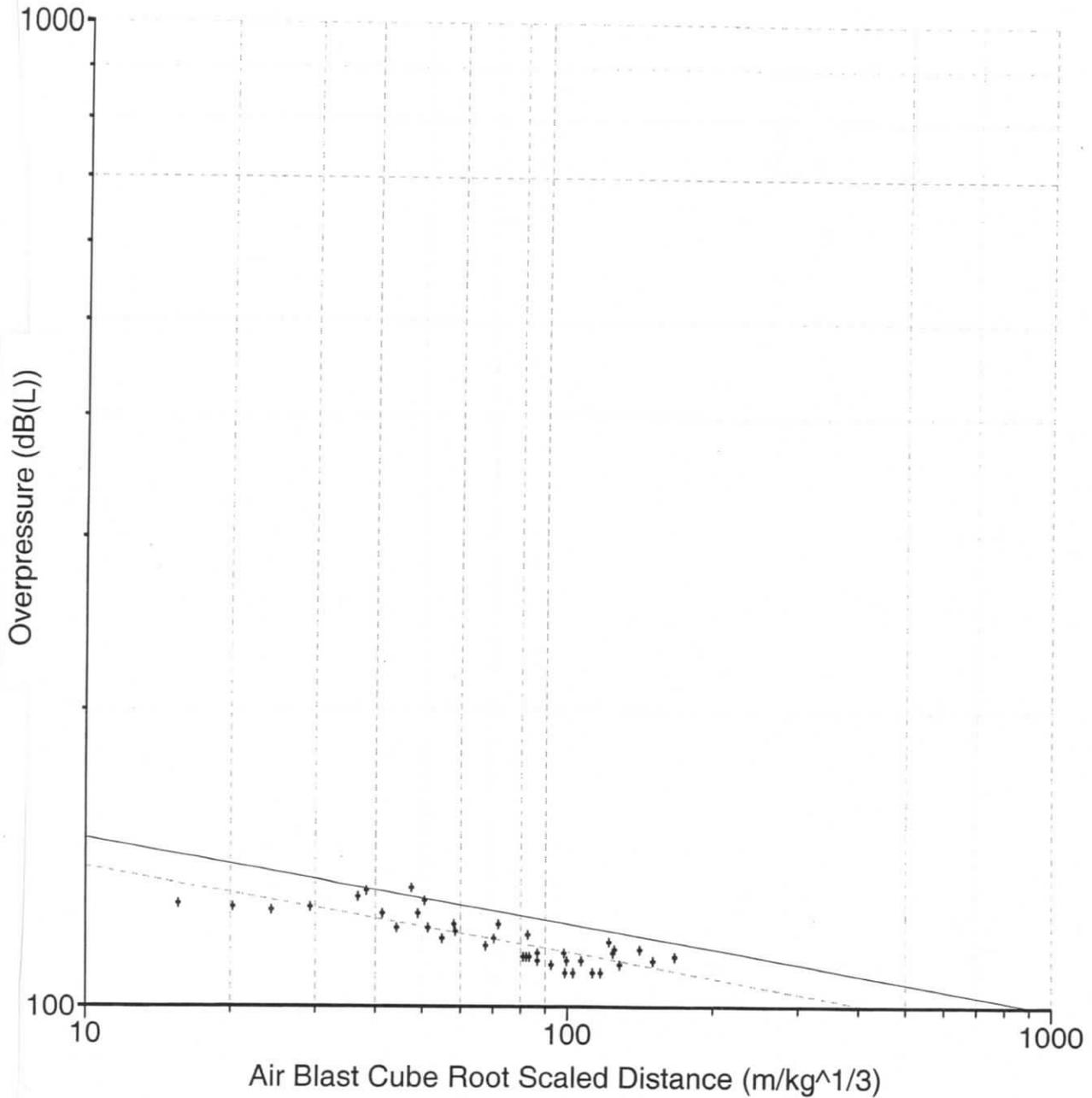
Date.....Aug 29/04.....  
Project...021-1238.....

Drawn.....*AMB*.....  
Chkd.....*AMB*.....

NELSON QUARRY AIR VIBRATION  
ATTENUATION CURVE

FIGURE 6

Coefficient of Determination = 0.677 Standard Deviation = 0.0145



Date.....Aug 29/04.....  
Project...021-1238.....

Drawn.....*MMB*.....  
Chkd.....*MMB*.....

**APPENDIX A**  
**PUBLICATION NPC 119**

## **PUBLICATION NPC-119**

### **Blasting**

#### **Scope**

This Publication refers to limits on sound (concussion) and vibration due to blasting operations.

#### **Technical Definitions**

The technical terms used in this Publication are defined in Publication NPC-101 – Technical Definitions.

#### **Measurement Procedures**

All measurements of peak pressure level and vibration velocity shall be made in accordance with the “Procedure for Measurement of Sound and Vibration due to Blasting Operations” set out in Publication NPC-103 – Procedures, section 5.

#### **Concussion – Cautionary Limit**

Subject to section 5 the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 120 dB.

#### **Concussion – Peak Pressure Level Limit**

If the person in charge of a blasting operation carries out routine monitoring of the peak pressure level, the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 128 dB.

#### **Vibration – Cautionary Limit**

Subject to section 7, the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.00 cm/s.

#### **Vibration – Peak Particle Velocity Limit**

If the person in charge of a blasting operation carries out routine monitoring of the vibration the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.25 cm/s.

**APPENDIX B**  
**NEW RESIDENCE RECEPTOR LOCATION**

**Golder Associates Ltd.**

2390 Argentia Road  
Mississauga, Ontario, Canada L5N 5Z7  
Telephone 905-567-4444  
Fax 905-567-6561



December 13, 2004

021-1238

Nelson Aggregate Co.  
P.O. Box 1070  
Burlington, Ontario  
L7R 4L8

Attention: Mr. Tom Palko  
Property Manager

**RE: BLASTING IMPACT ASSESSMENT PROPOSED NELSON AGGREGATE  
NELSON QUARRY EXTENSION NEW RESIDENCE RECEPTOR LOCATION**

Dear Mr. Palko:

Further to our report entitled "Blasting Impact Assessment Proposed Nelson Aggregate Nelson Quarry Extension" dated September, 2004, it is our understanding that the closest residential receptor to the proposed Nelson Aggregate Nelson quarry extension has now been identified as the residence at 2416 No. 2 Sideroad, located in the northeast corner of the proposed extraction area. The residence and ancillary buildings at 2416 No. 2 Sideroad are located a minimum of 290 m from the Phase 1 extraction area and 370 m from the Phase 5B extraction area.

As stated in Section 6.0 Impact Assessment of the report identified above, the recommended Ontario provincial ground and air vibration guideline limits of 12.5 mm/s and 128 dBL respectively, may be complied with for all blasting beyond a distance of about 200 m. This indicates that the extraction of Phases 1 through 5B and part of Phase 6 may be carried out without any changes to the quarry's existing blasting procedures.



It is our opinion that blasting operations may be carried out within the proposed extension area in compliance with the current quarry blasting guidelines while the residence at 2416 No. 2 Sideroad is occupied. If you have any additional questions please do not hesitate to contact me.

Yours truly,

**GOLDER ASSOCIATES LTD.**

Marcus V. van Bers, P.Eng.  
Associate

MVB/co

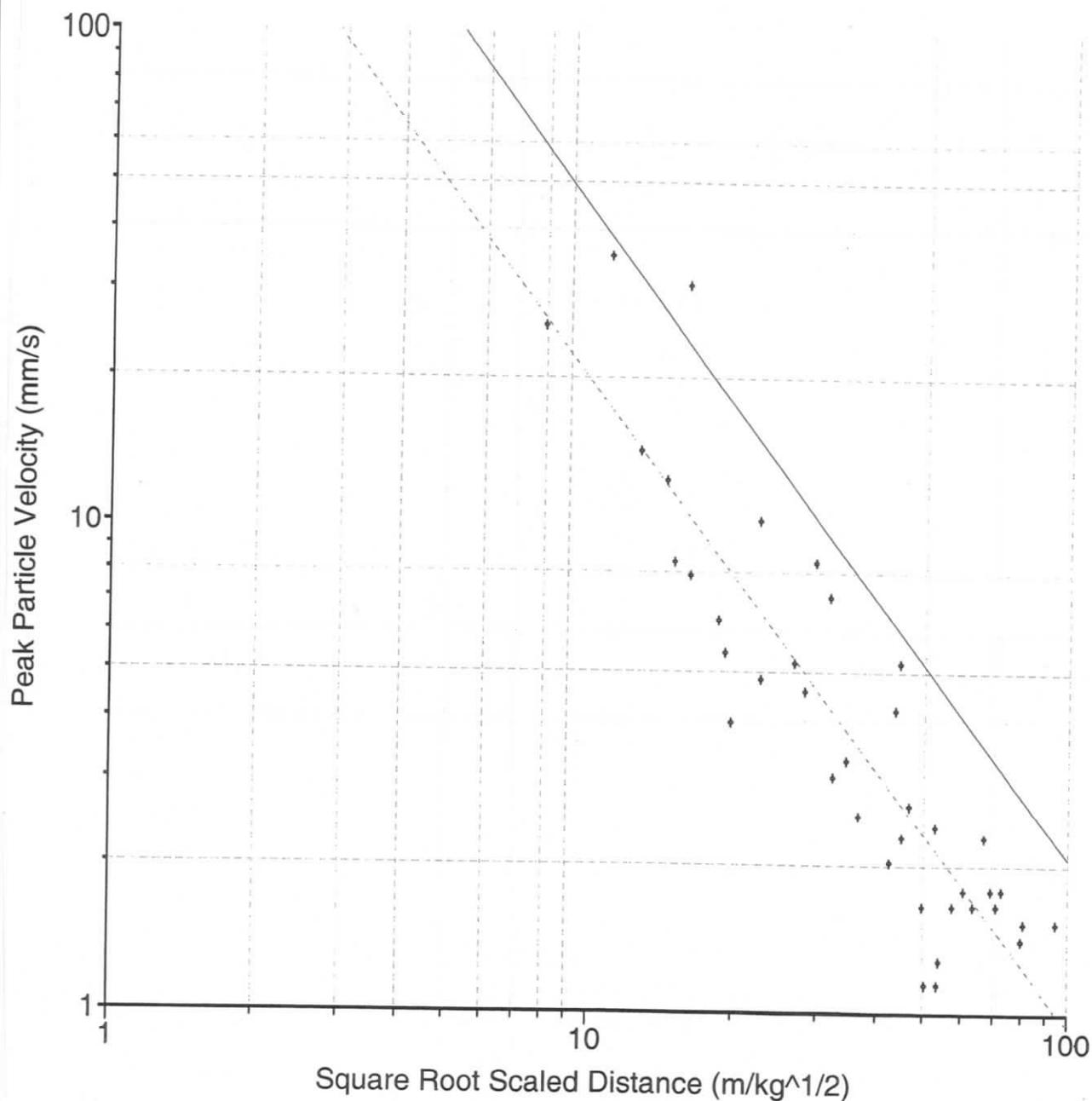
cc: Mr. Brian Zeman, MHBC Planning

n:\active\2002\1200\021-1238 - nelson aggreg-extension-burlington\reports\021-1238 ltr 04dec13 blasting impact assess-amendment.doc

NELSON QUARRY GROUND VIBRATION  
ATTENUATION CURVE

FIGURE 5

Coefficient of Determination = 0.811 Standard Deviation = 0.172



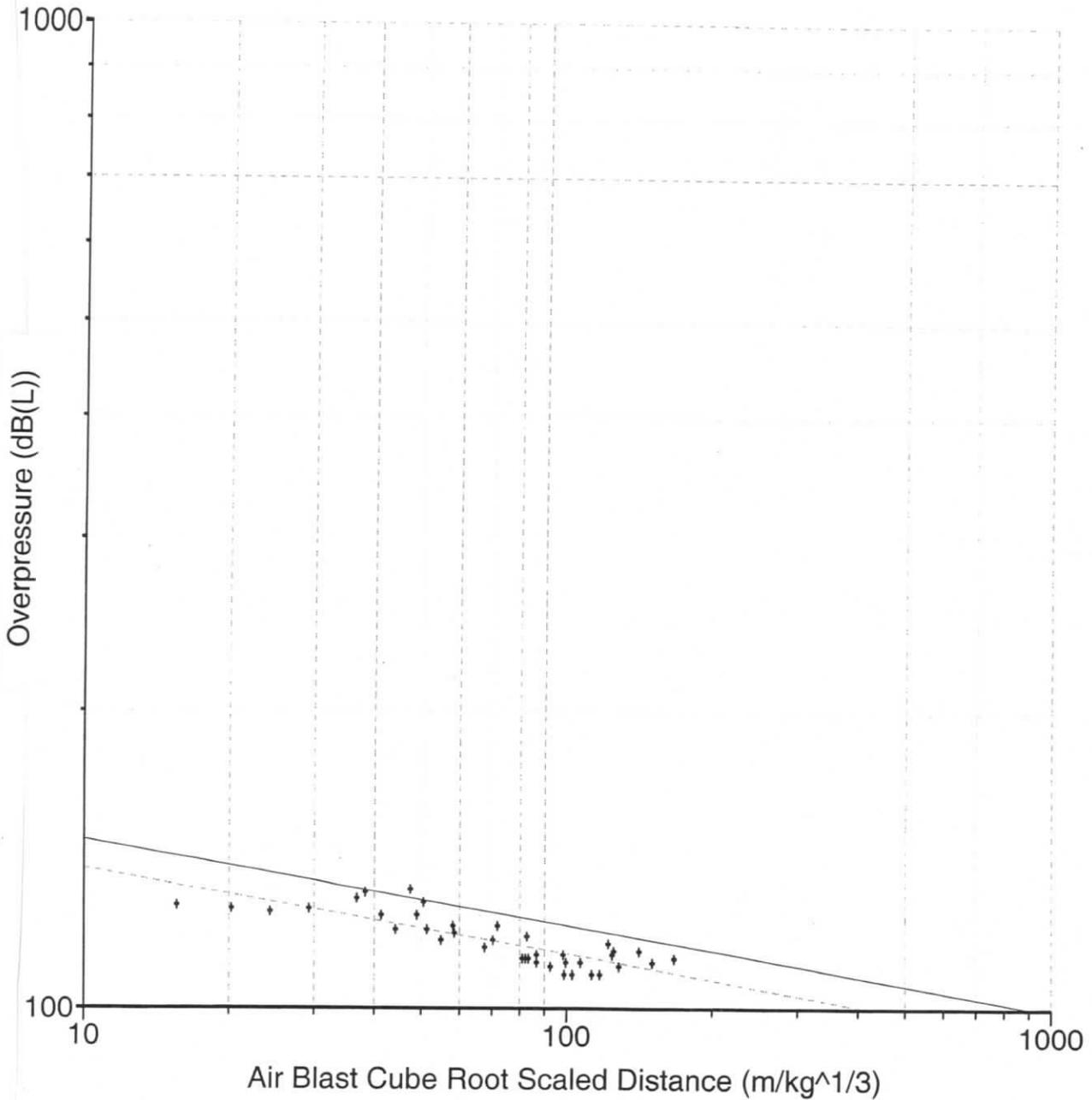
Date.....Aug 29/04.....  
Project...021-1238.....

Drawn.....*AMB*.....  
Chkd.....*AMB*.....

NELSON QUARRY AIR VIBRATION  
ATTENUATION CURVE

FIGURE 6

Coefficient of Determination = 0.677 Standard Deviation = 0.0145



Date.....Aug 29/04.....  
Project...021-1238.....

Drawn.....*MMB*.....  
Chkd.....*MMB*.....



# SEISMIC REPORT

Date: APRIL 11/17 Time: 11:56 AM Shot # 01-17  
OVERCAST

Weather: 20°C Terrain: UNEVEN Wind From: SW Wind Velocity: 20 KPH

Location of Blast: BULIDGE, #2 SIDE RD.

Seismic Setup By: B. WHITE, NELSON Max. Kg/Delay: 92.15

Detonator System:  Electric  Non-Electric  Electronic

Toe Load Product: CENTRA GOLD Column Load Product: CENTRA GOLD

Hole Dia. 4 in. Pattern: Spacing 11 ft. x Burden 11 ft.

# of Decks 2 # of Rows 5 # of Holes 46

Time Between: Decks 13 ms., Holes 26 ms., Rows 136 ms.

Subdrill 2 ft. Ave. Water 60.37 ft. Ave. Hole Depth 68.25 ft. Total Tons 26417.9

Max. Vibration = 12.5 mm/sec, Max Airblast = 128.0 dbI

|                  |                                                             |
|------------------|-------------------------------------------------------------|
| <b>Monitor 1</b> |                                                             |
| Location:        | <u>2450 #2 SIDE RD.</u>                                     |
| Vibration:       | <u>2.53</u> mm/s      Airblast: <u>111.5</u> dbI.           |
| <b>Monitor 2</b> |                                                             |
| Location:        | <u>COLLING RD, BLIND LINE INTERSECTION, NELSON PROPERTY</u> |
| Vibration:       | <u>N/R</u> mm/s      Airblast: <u>N/R.</u> dbI.             |
| <b>Monitor 3</b> |                                                             |
| Location:        | <u>SOUTH WEST CORNER, CAMISLE</u>                           |
| Vibration:       | <u>15.6</u> mm/s      Airblast: <u>113.1</u> dbI.           |
| <b>Monitor 4</b> |                                                             |
| Location:        | <u>NOT USED</u>                                             |
| Vibration:       | _____ mm/s      Airblast: _____ dbI.                        |

Prepared by: M. Nelson



# SEISMIC REPORT

Date: APRIL 18/17 Time: 11:53 AM Shot # 02-17

Weather: CLEAR 10° Terrain: FLAT, Wind From: EAST Wind Velocity: 15 MPH

Location of Blast: HIGH WALL OLD SUB STATION

Seismic Setup By: B. WHITE, NELSON Max. Kg/Delay: 222.95

Detonator System:  Electric  Non-Electric  Electronic

Toe Load Product: CENTRA GOLD Column Load Product: CENTRA GOLD

Hole Dia. 4 in. Pattern: Spacing 10 1/2 ft. x Burden 11 1/2 ft.

# of Decks 1 # of Rows 3 # of Holes 27

Time Between: Decks 0 ms., Holes 13 ms., Rows 58 ms.

Subdrill 2 ft. Ave. Water 72.82 ft. Ave. Hole Depth 80.5 ft. Total Tons 21384.4

Max. Vibration = 12.5 mm/sec, Max Airblast = 128.0 dbi

### Monitor 1

Location: NOT USED

Vibration: \_\_\_\_\_ mm/s Airblast: \_\_\_\_\_ dbi

### Monitor 2

Location: SOUTH WEST CORNER, CAMISLE

Vibration: 0.176 mm/s Airblast: 124.1 dbi

### Monitor 3

Location: 2450 #2 SIDE ROAD

Vibration: 3.66 mm/s Airblast: 125.0 dbi

### Monitor 4

Location: NOT USED

Vibration: \_\_\_\_\_ mm/s Airblast: \_\_\_\_\_ dbi

Prepared by:

M. Wilson



# SEISMIC REPORT

Date: APRIL 21/17 Time: 11:53 AM Shot # 03-17  
 Weather: RAIN, 10° Terrain: FLAT Wind From: WEST Wind Velocity: 22 KPH  
 Location of Blast: LOW BENCH  
 Seismic Setup By: B. WHITE, NELSON Max. Kg/Delay: 173.13  
 Detonator System:  Electric  Non-Electric  Electronic  
 Toe Load Product: CENTRA GOLD Column Load Product: CENTRA GOLD  
 Hole Dia. 450 4" 12 1/2 in. Pattern: Spacing 10 1/2 ft. x Burden 11 1/2 ft.  
 # of Decks 1 # of Rows 3 # of Holes 50  
 Time Between: Decks 8 ms., Holes 13 ms., Rows ROW 1: 2 19ms ms. ROW 2: 3 91ms  
 Subdrill 2 ft. Ave. Water 39.38 ft. Ave. Hole Depth 44.76 ft. Total Tons 21133.9

Max. Vibration = 12.5 mm/sec, Max Airblast = 128.0 dbi

### Monitor 1

Location: COLLING RD BLIND LINE INTERSECTION, NELSON PROPERTY  
 Vibration: N/R mm/s Airblast: N/R dbi.

### Monitor 2

Location: 2450<sup>th</sup> 2 SIDE ROAD  
 Vibration: 3.56 mm/s Airblast: 122.9 dbi.

### Monitor 3

Location: SOUTH WEST CORNER, CAMISLE  
 Vibration: 1.02 mm/s Airblast: 116.7 dbi.

### Monitor 4

Location: NOT USED  
 Vibration: \_\_\_\_\_ mm/s Airblast: \_\_\_\_\_ dbi.

Prepared by: M. Baker



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-05-01**

Blast Number: **17-004**  
 Orica Order #: **2179557**  
 Blast Time: **11:51 AM**

page 1

Blaster-in-charge: **Kevin Toplis** (Print Name)

Blast Location: **South Wall** (Bench / Face)

GPS Coordinates: **43.39784** °N Latitude **79.88487** °W Longitude  
 Centre of Blast Centre of Blast

Wind from the: **E** at **15** kph Temperature: **6 to 10** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **185** m

- Drilling Information -

Angle from Vertical **0**° Nominal Bit Diameter:

Primary Bit diam: **101.6** mm # Holes: **32** = 2,230.4 ft ( 4 " diam)  
 Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
 Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

| Bulk Explosives:      | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>27,020</b> | <b>20,900</b> | 6,120 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                        | kg / unit | # used    | kg   |
|----------------------------------|-----------|-----------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>95</b> | 32.3 |

total explosives weight in Blast (kg): **6,152**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators:              | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 15M</b> |          |    | <b>31</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>63</b> |

| Cord & Accessories:                     | U of M | # used    |
|-----------------------------------------|--------|-----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b>  |
| <b>SPIDER STEMMING PLUG 8"</b>          | units  | <b>25</b> |

| Resource Deployment:            |  |          |
|---------------------------------|--|----------|
| # of Blasts today (this Quarry) |  | <b>1</b> |
| # of Blasters (this Blast)      |  | <b>1</b> |
| # of Helpers (this Blast)       |  | <b>1</b> |
| # of MMU's (this Blast)         |  | <b>1</b> |

| Services:                   | Line Item (Hourly Rate)   |             |
|-----------------------------|---------------------------|-------------|
| GPS LAYOUT                  |                           | <b>1</b>    |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg       | <b>1</b>    |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast) | <b>1</b>    |
| SEISMOGRAPH RENTAL          | Line Item (Fee per Blast) | <b>1</b>    |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled  |             |
| BORETRACK                   | Enter "1" if Boretraked   |             |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour)  | <b>16.0</b> |

tonnes Blasted: **17,585** te **6,763** m<sup>3</sup>

Total tonnes per day: te

Total Holes Loaded: **32** holes

... including: Dead Holes

... and: Helper Holes

Helper Hole Collar: ft avg

# Rows Blasted: **3** rows

- Pattern (Front Row)-

Burden: **10.5** ft avg

Spacing: **10.5** ft avg

# Holes: **10** front row

Burden: **10.5** ft avg

Spacing: **10.5** ft avg

# Holes: **22**

Bench Height: **67.7** ft avg

Sub-drill: **2.0** ft avg

Hole Depth: **69.7** ft avg

- Stone Decking -

Front Row: **4.0** ft avg

Main Body: **4.0** ft avg

**# Stone Decks: 31** per blast

- Collar Stemming -

Front Row: **7.0** ft avg

Main Body: **7.0** ft avg

Material used: **.75 clear**

- Charge Length -

Front Row: **58.7** ft avg

Main Body: **58.7** ft avg

- Charge Weight -

Front Row: **171.2** kg/hole

Main Body: **171.2** kg/hole

Max. per delay: **128.0** kg/delay

SD () Equation: **622.8** kg/delay

Total kg Loaded: **6,152** kg

Rock Density: **2.60** g/cc = te/m<sup>3</sup>

- Powder Factor -

Yield PF: **0.350** kg/te (actual)

Front row: **0.311** kg/te (theoretical)

Main Body: **0.311** kg/te (theoretical)

"KPI" PF: **0.000** kg/te (theoretical)

Theoretical PF: (Based on a single hole):

Yield Powder Factor (kg Loaded / te Blasted)

Cost Reduction Notes (this Blast) - change in Bit . B. S. Expl or IS from previous Blast:

There is no video for this blast

All holes got 88kg on the bottom and then adjusted loads for the tops. A1 was only too to 50ft.

16 hours split between 1 blaster and 2 helper



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:   
 Blast Date: **2017-05-01**

Blast Number: **17-004**  
 Orica Order #: **2179557**  
 Blast Time: **11:51 AM**

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radlans | (W) Radlans |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.39783       | 79.88548        | 0.757435    | 1.394265    |
| Front Row Corner          | 43.39795       | 79.88469        | 0.757437    | 1.394251    |
| Back Row Corner           | 43.39775       | 79.88443        | 0.757434    | 1.394246    |
| Average (Centre of Blast) | 43.39784       | 79.88487        | 0.757435    | 1.394254    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.    | Enter ° W Long. | (N) Radlans | (W) Radlans                                          |
|-------------------------------------------|-------------------|-----------------|-------------|------------------------------------------------------|
| 1st Reading                               | 43.40246          | 79.87814        | 0.757516    | 1.394137                                             |
| 2nd Reading                               |                   |                 |             |                                                      |
| Average                                   | 43.40246          | 79.87814        | 0.757516    | 1.394137                                             |
| Distance (1st Seis. From Centre of Blast) | 748.7             | m               |             |                                                      |
| Post Blast Data:                          | ppV:              | 2.6             | mm/s        | Trigger set at: 2.0                                  |
|                                           | frequency:        | 41.0            | Hz          | V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: | 121.0           | dB          | Trigger set at: 115                                  |

2nd concession (orica monitor)

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.    | Enter ° W Long. | (N) Radlans | (W) Radlans                                          |
|-------------------------------------------|-------------------|-----------------|-------------|------------------------------------------------------|
| 1st Reading                               | 43.71939          | 80.38847        | 0.763047    | 1.403043                                             |
| 2nd Reading                               |                   |                 |             |                                                      |
| Average                                   | 43.71939          | 80.38847        | 0.763047    | 1.403043                                             |
| Distance (2nd Seis. From Centre of Blast) | 0.0               | m               |             |                                                      |
| Post Blast Data:                          | ppV:              | 3.1             | mm/s        | Trigger set at: 2.0                                  |
|                                           | frequency:        | 43.0            | Hz          | V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: | 108.0           | dB          | Trigger set at: 115                                  |

2450 2nd concession (Nelson monitor)

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.    | Enter ° W Long. | (N) Radlans | (W) Radlans                                          |
|-------------------------------------------|-------------------|-----------------|-------------|------------------------------------------------------|
| 1st Reading                               |                   |                 |             |                                                      |
| 2nd Reading                               |                   |                 |             |                                                      |
| Average                                   | 0.00000           | 0.00000         | 0.000000    | 0.000000                                             |
| Distance (3rd Seis. From Centre of Blast) | 0.0               | m               |             |                                                      |
| Post Blast Data:                          | ppV:              |                 | mm/s        | Trigger set at: 2.0                                  |
|                                           | frequency:        |                 | Hz          | V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: |                 | dB          | Trigger set at: 115                                  |

Enter description of seismograph location

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting;

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(748.7)^2}{30^2} \text{ kg}$$

$$= \frac{560,552}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **623** kg

Orica  
 Blaster-in-charge:

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate



Customer: **Nelsons**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-05-15**

Blast Number: **17-005**  
 Orica Order #: **2185675**  
 Blast Time: **12:35PM**

|                                                                                              |                                                        |                                                               |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------|
| <b>page 1</b>                                                                                | blaster-in-charge: <b>Mitch Ossington</b> (Print Name) | tonnes Blasted: <b>21,062 te</b>   <b>8,101 m<sup>3</sup></b> |
| Blast Location: <b>South face</b> (Bench / Face)                                             | Total tonnes per day: <b>21,062 te</b> TBA Rate Code   | Total Holes Loaded: <b>34 holes</b>                           |
| GPS Coordinates: <b>43.39788 °N Latitude</b> <b>79.88447 °W Longitude</b><br>Centre of Blast | ... including: <b>0 Dead Holes</b>                     | ... and: <b>0 Helper Holes</b>                                |
| Wind from the: <b>NW</b> at <b>10 kph</b>                                                    | Helper Hole Collar: <b>0.0 ft avg</b>                  | # Rows Blasted: <b>3 rows</b>                                 |
| Temperature: <b>16 to 20 °C</b>                                                              | - Pattern (Front Row) -                                | Burden: <b>10.5 ft avg</b>                                    |
| Clear: <b>X</b> Rain: Overcast:                                                              | # Rows Blasted: <b>3 rows</b>                          | Spacing: <b>11.6 ft avg</b>                                   |
| Partly Cloudy: Snow: Inversion: Ceiling: <b>30000ft m</b>                                    | - Pattern (Front Row) -                                | # Holes: <b>11 front row</b>                                  |

**- Drilling Information -**

|                                   |                                |                    |                                                     |
|-----------------------------------|--------------------------------|--------------------|-----------------------------------------------------|
| Primary Bit diam: <b>101.6 mm</b> | Angle from Vertical: <b>0°</b> | # Holes: <b>34</b> | Nominal Bit Diameter: <b>2,516.0 ft ( 4 " diam)</b> |
| Secondary Bit diam: <b>mm</b>     | Angle from Vertical: <b>0°</b> | # Holes: <b>=</b>  | <b>0.0 ft ( " diam)</b>                             |
| Tertiary Bit diam: <b>mm</b>      | Angle from Vertical: <b>0°</b> | # Holes: <b>=</b>  | <b>0.0 ft ( " diam)</b>                             |

|                         |               |               |              |
|-------------------------|---------------|---------------|--------------|
| <b>Bulk Explosives:</b> | in (kg)       | out (kg)      | kg           |
| <b>CENTRA GOLD 70</b>   | <b>27,020</b> | <b>19,900</b> | <b>7,120</b> |

|                             |            |             |    |
|-----------------------------|------------|-------------|----|
| <b>Packaged Explosives:</b> | cs shipped | cs returned | kg |
|-----------------------------|------------|-------------|----|

|                                  |             |            |             |
|----------------------------------|-------------|------------|-------------|
| <b>Boosters:</b>                 | kg / unit   | # usec     | kg          |
| <b>PENTEX 12 (OR EQUIVALENT)</b> | <b>0.34</b> | <b>103</b> | <b>35.0</b> |

total explosives weight in Blast (kg): **7,155**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

|                          |          |    |           |
|--------------------------|----------|----|-----------|
| <b>Detonators:</b>       | case #'s | ms | # used    |
| <b>UNITRONIC 600 15M</b> |          |    | <b>34</b> |
| <b>UNITRONIC 600 20M</b> |          |    | <b>32</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>37</b> |

|                                         |        |           |
|-----------------------------------------|--------|-----------|
| <b>Cord &amp; Accessories:</b>          | U of M | # used    |
| <b>HARNES WIRE DUPLEX (8 PACK) 400M</b> | units  | <b>1</b>  |
| <b>STEMMING PLUG MINI</b>               | units  | <b>12</b> |

|                                 |          |
|---------------------------------|----------|
| Resource Deployment:            |          |
| # of Blasts today (this Quarry) | <b>1</b> |
| # of Blasters (this Blast)      | <b>1</b> |
| # of Helpers (this Blast)       | <b>1</b> |
| # of MMU's (this Blast)         | <b>1</b> |

|                             |                                    |
|-----------------------------|------------------------------------|
| <b>Services:</b>            |                                    |
| GPS LAYOUT                  | Line Item (Hourly Rate) <b>1</b>   |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg <b>1</b>       |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast) <b>1</b> |
| SEISMOGRAPH RENTAL          | * 1 unit In Shot Service Fee       |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled           |
| BORETRACK                   | Enter "1" If Boretraked            |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized             |

|                                                   |
|---------------------------------------------------|
| Burden: <b>10.0 ft avg</b>                        |
| Spacing: <b>11.5 ft avg</b>                       |
| # Holes: <b>23</b>                                |
| Bench Height: <b>72.0 ft avg</b>                  |
| Sub-drill: <b>2.0 ft avg</b>                      |
| Hole Depth: <b>74.0 ft avg</b>                    |
| - Stone Decking -                                 |
| Front Row: <b>4.0 ft avg</b>                      |
| Main Body: <b>4.0 ft avg</b>                      |
| # Stone Decks: <b>33 per blast</b>                |
| - Collar Stemming -                               |
| Front Row: <b>7.0 ft avg</b>                      |
| Main Body: <b>7.0 ft avg</b>                      |
| Material used: <b>1/2" crush</b>                  |
| - Charge Length -                                 |
| Front Row: <b>63.0 ft avg</b>                     |
| Main Body: <b>63.0 ft avg</b>                     |
| - Charge Weight -                                 |
| Front Row: <b>183.7 kg/hole</b>                   |
| Main Body: <b>183.7 kg/hole</b>                   |
| Max. per delay: <b>110.0 kg/delay</b>             |
| SD () Equation: <b>kg/delay</b>                   |
| Total kg Loaded: <b>7,155 kg</b>                  |
| Rock Density: <b>2.60 g/cc = te/m<sup>3</sup></b> |
| - Powder Factor -                                 |
| Yield PF: <b>0.340 kg/te (actual)</b>             |
| Front row: <b>0.287 kg/te (theoretical)</b>       |
| Main Body: <b>0.301 kg/te (theoretical)</b>       |
| "KPI" PF: <b>#DIV/0! kg/te (theoretical)</b>      |

Cost Reduction Notes (this Blast) - change in Blt , B. S. Expl or IS from previous Blast:

- 3D laser profile = 0.5hrs
- Blaster hours = 6.5hrs
- Helper hours = 6
- All Nelsons seismographs used.
- Salesman will have to provide a rate code.



Customer: **Nelsons**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-05-15**

Blast Number: **17-005**  
 Orica Order #: **2185675**  
 Blast Time: **12:35PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. |
|---------------------------|-----------------|-----------------|
| Mid Blast                 | <b>43.39805</b> | <b>79.88465</b> |
| Front Row Corner          | <b>43.39790</b> | <b>79.88446</b> |
| Back Row Corner           | <b>43.39770</b> | <b>79.88439</b> |
| Average (Centre of Blast) | <b>43.39788</b> | <b>79.88447</b> |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757439    | 1.394248    |
| 0.757436    | 1.394247    |
| 0.757433    | 1.394246    |
| 0.757436    | 1.394247    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.  | Enter ° W Long. |
|-------------------------------------------|-----------------|-----------------|
| 1st Reading                               |                 |                 |
| 2nd Reading                               |                 |                 |
| Average                                   | 0.00000         | 0.00000         |
| Distance (1st Seis. From Centre of Blast) | <b>0.0</b>      | m               |
| Post Blast Data:                          | ppV: <b>0.1</b> | mm/s            |
| frequency:                                |                 | Hz              |
| air overpressure:                         | <b>88.0</b>     | dB              |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

Colling Rd

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.  | Enter ° W Long. |
|-------------------------------------------|-----------------|-----------------|
| 1st Reading                               |                 |                 |
| 2nd Reading                               |                 |                 |
| Average                                   | 0.00000         | 0.00000         |
| Distance (2nd Seis. From Centre of Blast) | <b>0.0</b>      | m               |
| Post Blast Data:                          | ppV: <b>3.8</b> | mm/s            |
| frequency:                                |                 | Hz              |
| air overpressure:                         | <b>111.5</b>    | dB              |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

2450 #2 sideroad

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.  | Enter ° W Long. |
|-------------------------------------------|-----------------|-----------------|
| 1st Reading                               |                 |                 |
| 2nd Reading                               |                 |                 |
| Average                                   | 0.00000         | 0.00000         |
| Distance (3rd Seis. From Centre of Blast) | <b>0.0</b>      | m               |
| Post Blast Data:                          | ppV: <b>3.3</b> | mm/s            |
| frequency:                                |                 | Hz              |
| air overpressure:                         | <b>95.9</b>     | dB              |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

Camisle

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:

$$W = \frac{D^2}{2}$$

$$= \frac{(0)^2}{2} \text{ kg}$$

$$= \frac{0}{0} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mitch Ossington*

Signature required, indicating that  
 Blast Report is Complete & Accurate



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-05-17**

Blast Number: **17-006**  
 Orica Order #: **2187001**  
 Blast Time: **11:53 AM**

page 1 Master-in-charge: **Kevin Topllis** (Print Name)

Blast Location: **Lower middle bench** (Bench / Face)

GPS Coordinates: **43.40414** °N Latitude **79.88442** °W Longitude  
 Centre of Blast Centre of Blast

Wind from the: **SW** at **40** kph Temperature: **26 to 30** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **9,144** m

tonnes Blasted: **15,010** te **5,773** m<sup>3</sup>

Total tonnes per day: **15,010** te **5,773** m<sup>3</sup>

Total Holes Loaded: **42** holes

... including: Dead Holes  
 ... and: Helper Holes

Helper Hole Collar: ft avg

# Rows Blasted: **2** rows

- Pattern (Front Row) -

Burden: **10.5** ft avg

Spacing: **11.5** ft avg

# Holes: **22** front row

- Drilling Information -

|                                     | Angle from Vertical           | Nominal Bit Diameter:     |
|-------------------------------------|-------------------------------|---------------------------|
| Primary Bit diam: <b>101.6</b> mm   | <b>0</b> ° # Holes: <b>41</b> | = 1,689.2 ft ( 4 " diam)  |
| Secondary Bit diam: <b>114.3</b> mm | " # Holes: <b>1</b>           | = 41.2 ft ( 4 1/2 " diam) |
| Tertiary Bit diam: mm               | "° # Holes:                   | = 0.0 ft ( " diam)        |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg           |
|-----------------------|---------------|---------------|--------------|
| <b>CENTRA GOLD 70</b> | <b>27,060</b> | <b>22,200</b> | <b>4,860</b> |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used    | kg          |
|----------------------------------|-----------|-----------|-------------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>84</b> | <b>28.6</b> |

total explosives weight in Blast (kg): **4,889**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 6M</b>  |          |    | <b>41</b> |
| <b>UNITRONIC 600 15M</b> |          |    | <b>43</b> |

**Cord & Accessories:**

|                                         | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |
| <b>SPIDER STEMMING PLUG 8"</b>          | units  | <b>3</b> |

Resource Deployment:

|                                 |                         |
|---------------------------------|-------------------------|
| # of Blasts today (this Quarry) | <b>1</b>                |
| # of Blasters (this Blast)      | <b>1</b>                |
| # of Helpers (this Blast)       | Note Exception <b>2</b> |
| # of MMU's (this Blast)         | <b>1</b>                |

**Services:**

| Line Item (Hourly Rate)     | #                                    |
|-----------------------------|--------------------------------------|
| GPS LAYOUT                  | <b>1</b>                             |
| BULK TRUCK CHARGE           | >=2,000kg <5,000kg <b>1</b>          |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast) <b>1</b>   |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee         |
| 3D LASER PROFILE            | Line Item (Hourly Rate) <b>1</b>     |
| BORETRACK                   | Enter "1" if Boretraked              |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour) <b>16.0</b> |

Burden: **10.5** ft avg

Spacing: **11.5** ft avg

# Holes: **20**

Bench Height: **40.2** ft avg

Sub-drill: **1.0** ft avg

Hole Depth: **41.2** ft avg

- Stone Decking -

Front Row: ft avg

Main Body: ft avg

# Stone Decks: **0** per blast

- Collar Stemming -

Front Row: **7.0** ft avg

Main Body: **7.0** ft avg

Material used: **.75** clear

- Charge Length -

Front Row: **34.2** ft avg

Main Body: **34.2** ft avg

- Charge Weight -

Front Row: **99.7** kg/hole

Main Body: **99.7** kg/hole

Max. per delay: **140.0** kg/delay

SD () Equation: **325.6** kg/delay

Total kg Loaded: **4,889** kg

Rock Density: **2.60** g/cc = te/m<sup>3</sup>

- Powder Factor -

Yield PF: **0.326** kg/te (actual)

Front row: **0.279** kg/te (theoretical)

Main Body: **0.279** kg/te (theoretical)

"KPI" PF: **0.000** kg/te (theoretical)

Cost Reduction Notes (this Blast) : change in Bit B. S. Expl or IS from previous Blast:

Hole B2 is a 4 1/2"

Hole B1 slumped to 18ft, a 15m uni was used instead of a 6m uni. The hole was plugged 10ft.

Hole collars adjusted: A22 10ft, A21-19 10ft, A18-14 8ft.

There was no Orica seismograph used.

Labour hours is 16 split between 1 blaster and 2 helpers



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:   
 Blast Date: **2017-05-17**

Blast Number: **17-006**  
 Orica Order #: **2187001**  
 Blast Time: **11:53 AM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.40414</b> | <b>79.88444</b> | 0.757545    | 1.394246    |
| Front Row Corner          | 43.40388        | 79.88413        | 0.757541    | 1.394241    |
| Back Row Corner           | 43.40440        | 79.88469        | 0.757550    | 1.394251    |
| Average (Centre of Blast) | 43.40414        | 79.88442        | 0.757545    | 1.394246    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.                   | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|----------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               | 43.40246                         | 79.87814        | 0.757516                   | 1.394137                               |
| 2nd Reading                               |                                  |                 |                            |                                        |
| Average                                   | 43.40246                         | 79.87814        | 0.757516                   | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | <b>541.3</b>                     | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>DID</b>                  | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency: <b>NOT</b>            | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>TRIGGER</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| 2nd concession (Nelson monitor)           |                                  |                 |                            |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.                 | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|--------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               | 43.71939                       | 80.38847        | 0.763047                   | 1.403043                               |
| 2nd Reading                               |                                |                 |                            |                                        |
| Average                                   | 43.71939                       | 80.38847        | 0.763047                   | 1.403043                               |
| Distance (2nd Seis. From Centre of Blast) | <b>0.0</b>                     | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>1.1</b>                | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency:                     | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>111.8</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| 2450 2nd concession (Nelson monitor)      |                                |                 |                            |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.    | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|-------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                   |                 |                            |                                        |
| 2nd Reading                               |                   |                 |                            |                                        |
| Average                                   | 0.00000           | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | <b>0.0</b>        | m               |                            |                                        |
| Post Blast Data:                          | ppV:              | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency:        | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: | dB              | Trigger set at: <b>115</b> | dB                                     |
| Enter description of seismograph location |                   |                 |                            |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(541.3)^2}{30^2} \text{ kg} \\
 &= \frac{293,006}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay = **326** kg

Orica  
 Blaster-in-charge:

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate



Customer: **Nelsons**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-05-29**

Blast Number: **17-007**  
 Orica Order #: **2191786**  
 Blast Time: **12:00PM**

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Blaster-in-charge: **Mitch Ossington** (Print Name)  
 Blast Location: **South face** (Bench / Face)  
 GPS Coordinates: **43.39805** °N Latitude **79.88433** °W Longitude  
 Centre of Blast Centre of Blast  
 Wind from the: **SE** at **5** kph Temperature: **21 to 25** °C  
 Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **30000ft** m

tonnes Blasted: **20,898** te **7,886** m<sup>3</sup>  
 Total tonnes per day: **20,898** te TBA Rate Code  
 Total Holes Loaded: **30** holes  
 ... including: **0** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **3** rows  
 - Pattern (Front Row) -  
 Burden: **10.5** ft avg  
 Spacing: **11.5** ft avg  
 # Holes: **10** front row

- Drilling Information -

|                                   | Angle from Vertical           | Nominal Bit Diameter:           |
|-----------------------------------|-------------------------------|---------------------------------|
| Primary Bit diam: <b>101.6</b> mm | <b>0</b> ° # Holes: <b>30</b> | = 2,442.0 ft ( <b>4</b> " diam) |
| Secondary Bit diam: mm            | <b>0</b> ° # Holes:           | = 0.0 ft ( " diam)              |
| Tertiary Bit diam: mm             | " # Holes:                    | = 0.0 ft ( " diam)              |

Burden: **10.0** ft avg  
 Spacing: **11.5** ft avg  
 # Holes: **20**  
 Bench Height: **79.4** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: **81.4** ft avg  
 - Stone Decking -  
 Front Row: **4.0** ft avg  
 Main Body: **4.0** ft avg  
**# Stone Decks: 29** per blast  
 - Collar Stemming -  
 Front Row: **10.0** ft avg  
 Main Body: **7.0** ft avg  
 Material used: **1/2" crush**  
 - Charge Length -  
 Front Row: **67.4** ft avg  
 Main Body: **70.4** ft avg  
 - Charge Weight -  
 Front Row: **196.5** kg/hole  
 Main Body: **205.3** kg/hole  
 Max. per delay: **130.0** kg/delay  
 SD () Equation: **0.0** kg/delay  
 Total kg Loaded: **6,860** kg  
 Rock Density: **2.65** g/cc = te/m<sup>3</sup>

| Bulk Explosives:      | in (kg)       | out (kg)      | kg           |
|-----------------------|---------------|---------------|--------------|
| <b>CENTRA GOLD 70</b> | <b>33,530</b> | <b>26,710</b> | <b>6,820</b> |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                        | kg / unit   | # usec     | kg          |
|----------------------------------|-------------|------------|-------------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | <b>0.34</b> | <b>118</b> | <b>40.1</b> |

total explosives weight in Blast (kg): **6,860**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators:              | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 800 6M</b>  |          |    | <b>29</b> |
| <b>UNITRONIC 800 20M</b> |          |    | <b>29</b> |
| <b>UNITRONIC 800 30M</b> |          |    | <b>60</b> |

| Cord & Accessories:                     | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |
|                                         | units  |          |
|                                         | units  |          |

| Resource Deployment:            |                         |
|---------------------------------|-------------------------|
| # of Blasts today (this Quarry) | <b>1</b>                |
| # of Blasters (this Blast)      | <b>1</b>                |
| # of Helpers (this Blast)       | Note Exception <b>2</b> |
| # of MMU's (this Blast)         | <b>1</b>                |

| Services:                   |                                       |
|-----------------------------|---------------------------------------|
| GPS LAYOUT                  | Line Item (Hourly Rate) <b>1</b>      |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg <b>1</b>          |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast) <b>1</b>    |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee <b>0</b> |
| 3D LASER PROFILE            | Line Item (Hourly Rate) <b>1</b>      |
| BORETRACK                   | Enter "1" if Boretraked <b>0</b>      |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized                |

Theoretical PF (based on a single hole)  
 1,466 lb/yd<sup>3</sup>  
 1,220 lb/yd<sup>3</sup>  
 1,338 lb/yd<sup>3</sup>  
 ##### lb/yd<sup>3</sup>  
 "KPI" PF: #DIV/0! kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast  
 salesman will provide a rate code.

Blaster Hours= 6hrs  
 Helper Hours= 10hrs



Customer: **Nelsons**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-05-29**

Blast Number: **17-007**  
 Orica Order #: **2191786**  
 Blast Time: **12:00PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.39814</b> | <b>79.88442</b> | 0.757440    | 1.394246    |
| Front Row Corner          | <b>43.39803</b> | <b>79.88434</b> | 0.757439    | 1.394245    |
| Back Row Corner           | <b>43.39798</b> | <b>79.88423</b> | 0.757438    | 1.394243    |
| Average (Centre of Blast) | <b>43.39805</b> | <b>79.88433</b> | 0.757439    | 1.394245    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.               | Enter ° W Long. | (N) Radians                | (W) Radians                                     |
|-------------------------------------------|------------------------------|-----------------|----------------------------|-------------------------------------------------|
| 1st Reading                               |                              |                 |                            |                                                 |
| 2nd Reading                               |                              |                 |                            |                                                 |
| Average                                   | 0.00000                      | 0.00000         | 0.000000                   | 0.000000                                        |
| Distance (1st Sels. From Centre of Blast) | <b>0.0</b>                   | m               |                            |                                                 |
| Post Blast Data:                          | ppV: <b>DNT</b>              | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                            |
|                                           | frequency: <b>DNT</b>        | Hz              | V / T / L                  | <b>T</b> (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>DNT</b> | dB              | Trigger set at: <b>115</b> | dB                                              |
| Colling Rd                                |                              |                 |                            |                                                 |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                                     |
|-------------------------------------------|-------------------------------|-----------------|----------------------------|-------------------------------------------------|
| 1st Reading                               |                               |                 |                            |                                                 |
| 2nd Reading                               |                               |                 |                            |                                                 |
| Average                                   | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                                        |
| Distance (2nd Sels. From Centre of Blast) | <b>0.0</b>                    | m               |                            |                                                 |
| Post Blast Data:                          | ppV: <b>3.3</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                            |
|                                           | frequency: <b>DNT</b>         | Hz              | V / T / L                  | <b>?</b> (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>94.0</b> | dB              | Trigger set at: <b>115</b> | dB                                              |
| 2450 #2 sideroad                          |                               |                 |                            |                                                 |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                                     |
|-------------------------------------------|-------------------------------|-----------------|----------------------------|-------------------------------------------------|
| 1st Reading                               |                               |                 |                            |                                                 |
| 2nd Reading                               |                               |                 |                            |                                                 |
| Average                                   | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                                        |
| Distance (3rd Sels. From Centre of Blast) | <b>0.0</b>                    | m               |                            |                                                 |
| Post Blast Data:                          | ppV: <b>2.4</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                            |
|                                           | frequency: <b>DNT</b>         | Hz              | V / T / L                  | <b>?</b> (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                              |
| Camisle                                   |                               |                 |                            |                                                 |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mitch Ossington*

Signature required, indicating that  
 Blast Report is Complete & Accurate



Customer: **Nelson**  
**Blast Report**

Quarry: Burlington  
P.O. #: n/a  
Blast Date: 2017-06-01

Blast Number: 17-008  
Orica Order #: 2194148  
Blast Time: 2:38 PM

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Blaster-in-charge: Ken George

Blast Location: East Middle

GPS Coordinates: 0 00000 °N Latitude 0 00000 °W Longitude

Wind from the: SW at 25 kph

Temperature: -16 to -20 °C

Clear: X  
Partly Cloudy:

Rain:  
Snow:

Overcast:  
Inversion:

Ceiling: m

tonnes Blasted: 29,085 te 10,976 m<sup>3</sup>  
Total tonnes per day: te Rate Code  
Total Holes Loaded: 86 holes  
Including: 0 Dead Holes  
and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 4 rows  
Burden: 10.5 ft avg  
Spacing: 11.5 ft avg  
# Holes: 27

Nominal Bit Diameter:  
Primary Bit diam: 101.6 mm 0 # Holes: 86 = 3,382.0 ft ( 4 " diam)  
Secondary Bit diam: mm 0 # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm ° # Holes: = 0.0 ft ( " diam)

Burden: 10.5 ft avg  
Spacing: 11.5 ft avg  
Bench Height: 37.3 ft avg  
Sub-drill: 2.0 ft avg  
Hole Depth: 39.3 ft avg  
Front Row: 0.0 ft avg  
Main Body: 0.0 ft avg  
# Stone Decks: 0 per blast

**Bulk Explosives:** in (kg) out (kg) kg  
CENTRA GOLD 70 26,860 17,350 9,510

**Packaged Explosives:** cs shipped cs returned kg

**Boosters:** kg / unit # usec kg  
PENTEX 12 (OR EQUIVALENT) 0 34 174 59.2

total explosives weight in Blast (kg): 9,569  
Pkgd Prod (0 kg) % of Total kg: 0 0%

**Detonators:** case #'s ms # used  
UNITRONIC 600 6M 84  
UNITRONIC 600 15M 90

**Cord & Accessories:** U of M # used  
HARNESS WIRE DUPLEX (6 PACK) 400M units 1  
units  
units

1.470 lb/yd<sup>3</sup>

Yield PF: 0.329 kg/te (actual)

##### lb/yd<sup>3</sup>

"KPI" PF: #DIV/0! kg/te (theoretical)

1

1

3 Angled holes drill underneath concrete tunnel

2

MMU ran out of ammonium nitrate, 100% emulsion blend used to load last 9 holes

1

**Services:**

GPS LAYOUT Line Item (Hourly Rate) 1  
BULK TRUCK CHARGE >=5,000kg <10,000kg 1  
SHOT SERVICE FEE \* Line Item (Fee per Blast) 1  
SEISMOGRAPH RENTAL \* 1 unit in Shot Service Fee  
3D LASER PROFILE Line Item (Hourly Rate) 1  
BORETRACK Line Item (Hourly Rate) 1



Customer: **Nelson**  
**Blast Design**

Quarry: Burlington  
 P.O #: n/a  
 Blast Date: 2017-06-01

Blast Number: 17-008  
 Orica Order #: 2194148  
 Blast Time: 2:38 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 |                |                 |             |             |
| Front Row Corner          |                |                 |             |             |
| Back Row Corner           |                |                 |             |             |
| Average (Centre of Blast) | 0.00000        | 0.00000         | 0.000000    | 0.000000    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                               |                |                 |             |             |
| 2nd Reading                               |                |                 |             |             |
| Average                                   | 0.00000        | 0.00000         | 0.000000    | 0.000000    |
| Distance (1st Seis. From Centre of Blast) |                | m               |             |             |
| Post Blast Data: ppV:                     | 5.8            | mm/s            | 2.0         |             |
| frequency:                                |                | Hz              | T           |             |
| air overpressure:                         | 101.0          | dB              | 115         |             |
| 2450 #2 Side Rd                           |                |                 |             |             |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                               |                |                 |             |             |
| 2nd Reading                               |                |                 |             |             |
| Average                                   | 0.00000        | 0.00000         | 0.000000    | 0.000000    |
| Distance (2nd Seis. From Centre of Blast) |                | m               |             |             |
| Post Blast Data: ppV:                     | 3.8            | mm/s            | 2.0         |             |
| frequency:                                |                | Hz              | ?           |             |
| air overpressure:                         | 91.5           | dB              | 115         |             |
| Northwest                                 |                |                 |             |             |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                               |                |                 |             |             |
| 2nd Reading                               |                |                 |             |             |
| Average                                   | 0.00000        | 0.00000         | 0.000000    | 0.000000    |
| Distance (3rd Seis. From Centre of Blast) |                | m               |             |             |
| Post Blast Data: ppV:                     | 1.5            | mm/s            | 2.0         |             |
| frequency:                                |                | Hz              | ?           |             |
| air overpressure:                         | 88.0           | dB              | 115         |             |
| Southwest                                 |                |                 |             |             |

Scaling Factor denotes the degree of Blast confinement  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:

$$W = \frac{D^2}{2}$$

$$= \frac{(0)^2}{2} \text{ kg}$$

$$= \frac{0}{0} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Ken George*



Customer: **Nelsons**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-06-08**

Blast Number: **17-009**  
 Orica Order #: **2191786**  
 Blast Time: **12:00PM**

page 1 Blaster-in-charge: **Mitch Ossington** (Print Name)

Blast Location: **South face** (Bench / Face)

GPS Coordinates: **43.39805** °N Latitude **79.88433** °W Longitude  
 Centre of Blast Centre of Blast

Wind from the: **SE** at **5** kph Temperature: **21 to 25** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **30000** m

- Drilling Information -

|                                             | Angle from Vertical  | Nominal Bit Diameter:                            |
|---------------------------------------------|----------------------|--------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm           | <b>0</b>             | # Holes: <b>30</b> = 2,442.0 ft ( 4 " diam)      |
| Secondary Bit diam: <input type="text"/> mm | <input type="text"/> | # Holes: <input type="text"/> = 0.0 ft ( " diam) |
| Tertiary Bit diam: <input type="text"/> mm  | <input type="text"/> | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

| Bulk Explosives:      | in (kg)       | out (kg)      | kg           |
|-----------------------|---------------|---------------|--------------|
| <b>CENTRA GOLD 70</b> | <b>33,530</b> | <b>26,710</b> | <b>6,820</b> |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                        | kg / unit | # used     | kg   |
|----------------------------------|-----------|------------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>118</b> | 40.1 |

total explosives weight in Blast (kg): **6,860**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators:              | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 6M</b>  |          |    | <b>29</b> |
| <b>UNITRONIC 600 20M</b> |          |    | <b>29</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>60</b> |

| Cord & Accessories:                     | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

Services:

|                             |                              |          |
|-----------------------------|------------------------------|----------|
| GPS LAYOUT                  | Line Item (Hourly Rate)      | <b>1</b> |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b> |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b> |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee | <b>0</b> |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | <b>1</b> |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b> |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |          |

|                       |                       |                             |
|-----------------------|-----------------------|-----------------------------|
| tonnes Blasted:       | <b>20,898</b> te      | <b>7,886</b> m <sup>3</sup> |
| Total tonnes per day: | <b>20,898</b> te      | <b>TBA</b> Rate Cube        |
| Total Holes Loaded:   | <b>30</b> holes       |                             |
| ... including:        | <b>0</b> Dead Holes   |                             |
| ... and:              | <b>0</b> Helper Holes |                             |
| Helper Hole Collar:   | <b>0.0</b> ft avg     |                             |
| # Rows Blasted:       | <b>3</b> rows         |                             |

- Pattern (Front Row) -

|          |                     |
|----------|---------------------|
| Burden:  | <b>10.5</b> ft avg  |
| Spacing: | <b>11.5</b> ft avg  |
| # Holes: | <b>10</b> front row |

|               |                    |
|---------------|--------------------|
| Burden:       | <b>10.0</b> ft avg |
| Spacing:      | <b>11.5</b> ft avg |
| # Holes:      | <b>20</b>          |
| Bench Height: | <b>79.4</b> ft avg |
| Sub-drill:    | <b>2.0</b> ft avg  |
| Hole Depth:   | <b>81.4</b> ft avg |

- Stone Decking -

|                |                     |
|----------------|---------------------|
| Front Row:     | <b>4.0</b> ft avg   |
| Main Body:     | <b>4.0</b> ft avg   |
| # Stone Decks: | <b>29</b> per blast |

- Collar Stemming -

|                |                    |
|----------------|--------------------|
| Front Row:     | <b>10.0</b> ft avg |
| Main Body:     | <b>7.0</b> ft avg  |
| Material used: | <b>1/2" crush</b>  |

- Charge Length -

|            |                    |
|------------|--------------------|
| Front Row: | <b>67.4</b> ft avg |
| Main Body: | <b>70.4</b> ft avg |

- Charge Weight -

|                  |                                      |
|------------------|--------------------------------------|
| Front Row:       | <b>196.5</b> kg/hole                 |
| Main Body:       | <b>205.3</b> kg/hole                 |
| Max. per delay:  | <b>130.0</b> kg/delay                |
| SD () Equation:  | <b>0.0</b> kg/delay                  |
| Total kg Loaded: | <b>6,860</b> kg                      |
| Rock Density:    | <b>2.65</b> g/cc = te/m <sup>3</sup> |

- Powder Factor -

|            |                                    |
|------------|------------------------------------|
| Yield PF:  | <b>0.328</b> kg/te (actual)        |
| Front row: | <b>0.273</b> kg/te (theoretical)   |
| Main Body: | <b>0.300</b> kg/te (theoretical)   |
| "KPI" PF:  | <b>#DIV/0!</b> kg/te (theoretical) |

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastoc)

Cost Reduction Notes (this Blast) - change in Bl, S, Expl or IS from previous Blast:  
 salemann will provide a rate code.

Blaster Hours= 6hrs  
 Helper Hours= 10hrs



Customer: **Nelsons**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-06-08**

Blast Number: **17-009**  
 Orica Order #: **2191786**  
 Blast Time: **12:00PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radlans | (W) Radlans |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.39814       | 79.88442        | 0.757440    | 1.394246    |
| Front Row Corner          | 43.39803       | 79.88434        | 0.757439    | 1.394245    |
| Back Row Corner           | 43.39798       | 79.88423        | 0.757438    | 1.394243    |
| Average (Centre of Blast) | 43.39805       | 79.88433        | 0.757439    | 1.394245    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.               | Enter ° W Long. | (N) Radlans                | (W) Radlans                            |
|-------------------------------------------|------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                              |                 |                            |                                        |
| 2nd Reading                               |                              |                 |                            |                                        |
| Average                                   | 0.00000                      | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast) | 0.0                          | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>DNT</b>              | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency: <b>DNT</b>        | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>DNT</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| Colling Rd                                |                              |                 |                            |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.                | Enter ° W Long. | (N) Radlans                | (W) Radlans                            |
|-------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                               |                 |                            |                                        |
| 2nd Reading                               |                               |                 |                            |                                        |
| Average                                   | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (2nd Seis. From Centre of Blast) | 0.0                           | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>3.3</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency: <b>DNT</b>         | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>94.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| 2450 #2 sideroad                          |                               |                 |                            |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.                | Enter ° W Long. | (N) Radlans                | (W) Radlans                            |
|-------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                               |                 |                            |                                        |
| 2nd Reading                               |                               |                 |                            |                                        |
| Average                                   | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | 0.0                           | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>2.4</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency: <b>DNT</b>         | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| Camisle                                   |                               |                 |                            |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(0)^2}{30^2} \text{ kg} \\
 &= \frac{0}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

*Mitch Ossington*

Signature required, indicating that  
 Blast Report is Complete & Accurate



Customer: **Nelsons**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-06-21**

Blast Number: **17-010**  
 Orica Order #: **2202619**  
 Blast Time: **12:35PM**

page 1  
 Blaster-in-charge: **Mitch Ossington**  
 Blast Location: **Lower Middle**  
 GPS Coordinates: **43.40406 °N Latitude 79.88412 °W Longitude**  
 Wind from the: **W** at **10** kph Temperature: **21 to 25 °C**  
 Clear: Rain: Overcast:  
 Partly Cloudy: **X** Snow: Inversion: Ceiling: **30000m**

tonnes Blasted: **25,680** te **9,690** m<sup>3</sup>  
 Total tonnes per day: **25,680** te TBA Rate Code  
 Total Holes Loaded: **84** holes  
 ... including: **0** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **3** rows  
 Burden: **12.0** ft avg  
 Spacing: **10.5** ft avg  
 # Holes: **28**

Nominal Bit Diameter:  
 Primary Bit diam: **101.6** mm **0"** # Holes: **78** = **3,182.4** ft ( **4** " diam)  
 Secondary Bit diam: **114.3** mm **0"** # Holes: **6** = **244.8** ft ( **4 1/2** " diam)  
 Tertiary Bit diam: mm " # Holes: = **0.0** ft ( " diam)

Burden: **9.0** ft avg  
 Spacing: **10.5** ft avg  
 Bench Height: **38.8** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: **40.8** ft avg  
 Front Row: **10.0** ft avg  
 Main Body: **0.0** ft avg  
**# Stone Decks:** **1** per blast  
 Front Row: **8.0** ft avg  
 Main Body: **7.0** ft avg  
 Material used: **1/2"** crush  
 Front Row: **22.8** ft avg  
 Main Body: **33.8** ft avg  
 Front Row: **66.5** kg/hole  
 Main Body: **98.6** kg/hole  
 Max. per delay: **117.0** kg/delay  
 SD ( ) Equation: **0.0** kg/delay  
 Total kg Loaded: **8,482** kg  
 Rock Density: **2.65** g/cc = **te/m<sup>3</sup>**

| Bulk Explosives: | in (kg) | out (kg) | kg    |
|------------------|---------|----------|-------|
| CENTRA GOLD 70   | 27,170  | 18,720   | 8,450 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                 | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 95     | 32.3 |

total explosives weight in Blast (kg): **8,482**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators:       | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 15M |          |    | 91     |
| UNITRONIC 600 6M  |          |    | 4      |

| Cord & Accessories:              | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| STEMMING PLUG MINI               | units  | 5      |

| Resource Deployment:            |  |   |
|---------------------------------|--|---|
| # of Blasts today (this Quarry) |  | 1 |
| # of Blasts (this Blast)        |  | 1 |
| # of helpers this Blast         |  | 2 |
| # of HMO's this Blast           |  | 1 |

| Services:                   | Line Item (Hourly Rate)      |   |
|-----------------------------|------------------------------|---|
| GPS LAYOUT                  |                              | 1 |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | 1 |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | 1 |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee | 0 |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | 1 |
| BORETRACK                   | Enter "1" if Boretraked      | 0 |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |   |

1.475 lb/yd<sup>3</sup> Yield PF: 0.330 kg/te (actual)  
 Front row 0.181 kg/te (theoretical)  
 Main Body 0.358 kg/te (theoretical)  
 "KPI" PF: #DIV/0! kg/te (theoretical)

Customer wants to try higher collars in back row to try to break the top better on the middle bench.



Customer: **Nelsons**  
**Blast Design**

Quarry: Burlington  
 P.O. #: NA  
 Blast Date: 2017-06-21

Blast Number: 17-010  
 Orica Order #: 2202619  
 Blast Time: 12:35PM

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| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.40401       | 79.88408        |
| Front Row Corner          | 43.40370       | 79.88380        |
| Back Row Corner           | 43.40447       | 79.88447        |
| Average (Centre of Blast) | 43.40406       | 79.88412        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757543    | 1.394240    |
| 0.757537    | 1.394235    |
| 0.757551    | 1.394247    |
| 0.757544    | 1.394241    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.        | Enter ° W Long. |
|-------------------------------------------|-----------------------|-----------------|
| 1st Reading                               |                       |                 |
| 2nd Reading                               |                       |                 |
| Average                                   | 0.00000               | 0.00000         |
| Distance (1st Seis. From Centre of Blast) | 0.0                   | m               |
| Post Blast Data:                          | ppV: DNT              | mm/s            |
|                                           | frequency: DNT        | Hz              |
|                                           | air overpressure: DNT | dB              |

Colling Rd

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.        | Enter ° W Long. |
|-------------------------------------------|-----------------------|-----------------|
| 1st Reading                               |                       |                 |
| 2nd Reading                               |                       |                 |
| Average                                   | 0.00000               | 0.00000         |
| Distance (2nd Seis. From Centre of Blast) | 0.0                   | m               |
| Post Blast Data:                          | ppV: DNT              | mm/s            |
|                                           | frequency: DNT        | Hz              |
|                                           | air overpressure: DNT | dB              |

2450 #2 sideroad

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.        | Enter ° W Long. |
|-------------------------------------------|-----------------------|-----------------|
| 1st Reading                               |                       |                 |
| 2nd Reading                               |                       |                 |
| Average                                   | 0.00000               | 0.00000         |
| Distance (3rd Seis. From Centre of Blast) | 0.0                   | m               |
| Post Blast Data:                          | ppV: DNT              | mm/s            |
|                                           | frequency: DNT        | Hz              |
|                                           | air overpressure: DNT | dB              |

Camisle

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mitch Ossington*



Customer: **Nelsons**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-06-20**

Blast Number: **17-011**  
 Orica Order #: **2201920**  
 Blast Time: **12:02PM**

page 1

Blaster-in-charge: **Mitch Ossington** (Print Name)

Blast Location: **South Wall** (Bench / Face)  
 GPS Coordinates: **43.39816** °N Latitude **79.88425** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **SW** at **10** kph Temperature: **21 to 25** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **2540ft** m

tonnes Blasted: **23,583** te **8,899** m<sup>3</sup>  
 Total tonnes per day: **23,583** te **TBA** Rate Code  
 Total Holes Loaded: **36** holes  
 ... including: **0** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **3** rows  
 - Pattern (Front Row) -  
 Burden: **18.0** ft avg  
 Spacing: **6.0** ft avg  
 # Holes: **16** front row

- Drilling Information -

Primary Bit diam: **101.6** mm **0**° # Holes: **36** = **3,027.6** ft ( **4** " diam)  
 Secondary Bit diam: **mm** **0**° # Holes: **=** **0.0** ft ( " diam)  
 Tertiary Bit diam: **mm** ° # Holes: **=** **0.0** ft ( " diam)

Burden: **10.0** ft avg  
 Spacing: **10.5** ft avg  
 # Holes: **20**  
 Bench Height: **82.1** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: **84.1** ft avg  
 - Stone Decking -  
 Front Row: **4.0** ft avg  
 Main Body: **4.0** ft avg  
**# Stone Decks: 35** per blast

| Bulk Explosives: | in (kg) | out (kg) | kg    |
|------------------|---------|----------|-------|
| CENTRA GOLD 70   | 30,240  | 21,910   | 8,330 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                 | kg / unit | # usec | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 143    | 48.6 |

total explosives weight in Blast (kg): **8,379**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators:       | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 9M  |          |    | 35     |
| UNITRONIC 600 15M |          |    | 36     |
| UNITRONIC 600 30M |          |    | 72     |

| Cord & Accessories:              | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

Services:

|                             |                              |   |
|-----------------------------|------------------------------|---|
| GPS LAYOUT                  | Line Item (Hourly Rate)      | 1 |
| BULK TRUCK CHARGE           | >/=5,000kg <10,000kg         | 1 |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | 1 |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee | 0 |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | 1 |
| BORETRACK                   | Enter "1" if Boretraked      | 0 |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |   |

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / lbs Blasted)

1.587 lb/yd<sup>3</sup> Yield PF: **0.355** kg/te (actual)  
 1.411 lb/yd<sup>3</sup> Front row 0.316 kg/te (theoretical)  
 1.472 lb/yd<sup>3</sup> Main Body: 0.330 kg/te (theoretical)  
 ##### lb/yd<sup>3</sup> "KPI" PF: **#DIV/0!** kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast

Hole A8 bottom dets would not pull so a 15m unitronic was used as a safety.  
 Hole A4 collapsed at collar, no top deck.

Blaster Hours= 6.5  
 Helper Hours= 11



Customer: **Nelsons**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-06-20**

Blast Number: **17-011**  
 Orica Order #: **2201920**  
 Blast Time: **12:02PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.39823       | 79.88432        |
| Front Row Corner          | 43.39816       | 79.88428        |
| Back Row Corner           | 43.39810       | 79.88415        |
| Average (Centre of Blast) | 43.39816       | 79.88425        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757442    | 1.394244    |
| 0.757441    | 1.394244    |
| 0.757440    | 1.394241    |
| 0.757441    | 1.394243    |

1st

| Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. |
|--------------------------|----------------|-----------------|
| 1st Reading              |                |                 |
| 2nd Reading              |                |                 |
| Average                  | 0.00000        | 0.00000         |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

Distance (1st Seis. From Centre of Blast) **0.0** m  
**Post Blast Data:** ppV: **DNT** mm/s Trigger set at: **2.0** mm/s  
 frequency: **DNT** Hz V / T / L : **T** (Vertical, Transverse or Longitudinal)  
 air overpressure: **DNT** dB Trigger set at: **115** dB  
 Colling Rd

2nd

| Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. |
|--------------------------|----------------|-----------------|
| 1st Reading              |                |                 |
| 2nd Reading              |                |                 |
| Average                  | 0.00000        | 0.00000         |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

Distance (2nd Seis. From Centre of Blast) **0.0** m  
**Post Blast Data:** ppV: **2.0** mm/s Trigger set at: **2.0** mm/s  
 frequency: Hz V / T / L : **?** (Vertical, Transverse or Longitudinal)  
 air overpressure: **108.4** dB Trigger set at: **115** dB  
 2450 #2 sideroad

3rd

| Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. |
|--------------------------|----------------|-----------------|
| 1st Reading              |                |                 |
| 2nd Reading              |                |                 |
| Average                  | 0.00000        | 0.00000         |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.000000    | 0.000000    |

Distance (3rd Seis. From Centre of Blast) **0.0** m  
**Post Blast Data:** ppV: **2.4** mm/s Trigger set at: **2.0** mm/s  
 frequency: Hz V / T / L : **?** (Vertical, Transverse or Longitudinal)  
 air overpressure: **101.9** dB Trigger set at: **115** dB  
 Camisle

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

*Mitch Ossington*

Signature required indicating that  
 blast design is complete & accurate.



Customer: **Nelsons**

# Blast Design

Quarry: **Burlington**  
P.O. #: **NA**  
Design Date: **2017-06-20**

Blast Number: **17-011**  
Orica Order #:

page 1

Master-in-charge: **Mitch Ossington** (Print Name)

Blast Location: **South Face** (Bench / Face)  
GPS Coordinates: **43.39805** °N Latitude **79.88433** °W Longitude  
Centre of Blast

Design to Blasted: **23,583** te  
Total Holes Loaded: **36** holes  
... including: **0** Dead Holes  
... and: **0** Helper Holes  
Helper Hole Collar: **0.0** ft avg  
# Rows Blasted: **3** rows

### - Drilling Information -

Primary Bit diam: **101.6** mm **0**° Angle from Vertical **# Holes: 36** = **3,027.6** ft ( **4** " diam)  
Secondary Bit diam: **mm** **0**° **# Holes:** = **0.0** ft ( " diam)  
Tertiary Bit diam: **mm** **0**° **# Holes:** = **0.0** ft ( " diam)

*12:02 pm  
22°C P. Cloudy  
7km/h SW  
2540'*

### - Design Pattern (Front Row) -

Burden: **18.0** ft avg  
Spacing: **6.0** ft avg  
# Holes: **16** front row

### - Design Pattern (Main Body) -

Burden: **10.0** ft avg  
Spacing: **10.5** ft avg  
# Holes: **20** main body  
Bench Height: **82.1** ft avg  
Sub-drill: **2.0** ft avg  
Hole Depth: **84.1** ft avg

### - Design Stone Decking -

Front Row: **4.0** ft avg  
Main Body: **4.0** ft avg

### - Design Collar Stemming -

Front Row: **7.0** ft avg  
Main Body: **7.0** ft avg

Material used: **1/2" crush**

### - Design Charge Length -

Front Row: **73.1** ft avg  
Main Body: **73.1** ft avg

### - Design Charge Weight -

Front Row: **213.2** kg/hole  
Main Body: **213.2** kg/hole  
Max Chge Wt / delay: ~~130.0~~ **130** kg/delay

Required kg Loaded: **8,565** kg  
Rock Density: **2.65** g/cc = **te/m<sup>3</sup>**

### - Design Powder Factor -

Expected Yield PF: **0.363** kg/te (actual)  
Front row: **0.320** kg/te (theoretical)  
Main Body: **0.330** kg/te (theoretical)  
"KPI" PF: **0.326** kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Blt., B., S., Expl or IS from previous Blast:

*Hole A8 bottom dets would not pull, put in a 15m qs safety.  
Hole A4 collapsed at collar, no top deck.*

| Bulk Explosives Req'd: | ChargeWt.exe | kg           |
|------------------------|--------------|--------------|
| CENTRA GOLD 70         |              | <b>8,500</b> |

| Pkgd Explosives Req'd: |  | kg |
|------------------------|--|----|
|                        |  |    |
|                        |  |    |
|                        |  |    |

| Boosters Req'd:           | kg/u # used     | kg          |
|---------------------------|-----------------|-------------|
| PENTEX 16 (OR EQUIVALENT) | 0.45 <b>144</b> | <b>65.4</b> |

total explosives weight in Blast (kg): **8,565**  
Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators Req'd:                       | ms | # req'd   |
|-----------------------------------------|----|-----------|
| UNITRONIC 600 30M                       |    | <b>72</b> |
| UNITRONIC 600 <del>45M</del> <b>20m</b> |    | <b>36</b> |
| UNITRONIC 600 9M                        |    | <b>36</b> |

| Cord & Access. Req'd:    | U of M | # req'd  |
|--------------------------|--------|----------|
| IRE DUPLEX (6 PACK) 400M | units  | <b>1</b> |
| STEMMING PLUG MINI       | units  |          |

### Resource Deployment

|                                 |                 |          |
|---------------------------------|-----------------|----------|
| # of Blasts today (this Quarry) |                 | <b>1</b> |
| # of Blasters (this Blast)      |                 | <b>1</b> |
| # of Helpers (this Blast)       | Note: Exception | <b>2</b> |
| # of MML's (this Blast)         |                 | <b>1</b> |

### Services Req'd:

|                                                    |                              |          |
|----------------------------------------------------|------------------------------|----------|
| BULK TRUCK CHARGE                                  | >=5,000kg <10,000kg          | <b>1</b> |
| SHOT SERVICE FEE *                                 | Line Item (Fee per Blast)    | <b>1</b> |
| SEISMOGRAPH RENTAL                                 | * 1 unit in Shot Service Fee |          |
| 3D LASER PROFILE                                   | Line Item (Fee per Blast)    | <b>1</b> |
| BORETRACK                                          | Enter "1" if Boretraced      |          |
| LABOUR CHARGE (enter HOURS Must be pre-authorized) |                              |          |



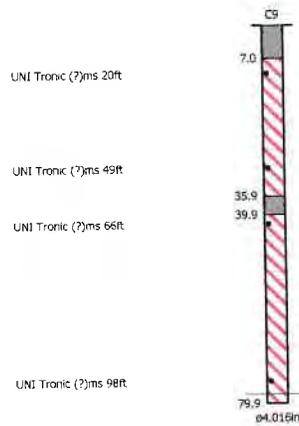
Customer: **Nelsons**  
**Blast Design**

Quarry: Burlington  
P.O. #:  
Blast Date: ~~2017-08-21~~  
2017/06/20

Blast Number: 17-011  
~~17-007~~  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

*Mitch Ossington*

#

Quarry Manager:

Signature required, indicating sign off on Blast Design



**Orica Canada Inc.**  
 GRAND VALLEY  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE  
 CONSIGNATAIRE

**NELSON AGGREGATE COMPANY**  
 BURLINGTON ON  
 CA L7R 4L8

**Bill of Lading / Connaissance**

*BLASTER MITCH  
 HELP KEITH  
 BRAD*

|                                |                                   |
|--------------------------------|-----------------------------------|
| GROSS / BRUT                   |                                   |
| TARE                           |                                   |
| NET                            |                                   |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE          |
| 700                            | 1230                              |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSEMENT |
| 2201920                        | 85682632                          |

REPRINT

PAGE 2

|                               |                                          |                                            |                                                    |
|-------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 20 Jun 2017                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   | n/a                                                |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR       | VEHICLE NO.<br>N° DE VÉHICULE                      |
| 20 Jun 2017                   | FOB Dest'n, Own Truck                    | F-73289                                    | 15001                                              |

|                          |                       |                               |
|--------------------------|-----------------------|-------------------------------|
| SHIP VIA<br>TRANSPORTEUR | ROUTING<br>ITINÉRAIRE | MAG. LIC. NO.<br>N° DE PERMIS |
| Orica Truck              | STANDARD              |                               |

| QTY.<br>QTE.                                                                                                                                                                                                                          | UM | DG<br>MD | QTY. RET'D<br>QTE. RET. | QTY. SOLD<br>QTE. FACT | DESCRIPTION                          | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|------------------------|--------------------------------------|--------------------|-------------------|
| 196                                                                                                                                                                                                                                   | PC | X        | 53                      | 143                    | PENTEX BC 340 (49/CS)                | 4                  | 71.540            |
| 2                                                                                                                                                                                                                                     | PC |          | 1                       | 1                      | Harness Wire Duplex (6 pack) 400m    | 1                  | 5.840             |
| 60                                                                                                                                                                                                                                    | PC | X        | 25                      | 35                     | *uni tronic 600-09.0M CU/ZC(30')60PC | 1                  | 5.880             |
| 66                                                                                                                                                                                                                                    | PC | X        | 30                      | 36                     | *uni tronic 600-15M C/Z SPL(50')66PC | 1                  | 11.286            |
| 108                                                                                                                                                                                                                                   | PC | X        | 36                      | 72                     | *uni tronic 600-30M C/Z SPL(100')36P | 3                  | 31.752            |
| 100                                                                                                                                                                                                                                   | PC |          | 100                     | 0                      | MINI STEM PLUGS - PART #6015         |                    | 0.700             |
| 1                                                                                                                                                                                                                                     | PC |          |                         |                        | LICENSED BLASTER                     |                    |                   |
| 1.0                                                                                                                                                                                                                                   | HR |          |                         |                        | LABOUR CHARGE                        |                    |                   |
| 1                                                                                                                                                                                                                                     | PC |          |                         |                        | ROG (ROCK ON GROUND)                 |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                                                                                                                    |    |          |                         |                        |                                      |                    | 126.998 KG        |
| **** TOTAL PACKAGES ****                                                                                                                                                                                                              |    |          |                         |                        |                                      | 10                 |                   |
| GHS/WHMIS SDS documents available<br>Website: <a href="http://www.oricaminingservices.com">www.oricaminingservices.com</a><br>Email: <a href="mailto:sds.na@orica.com">sds.na@orica.com</a><br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                        |                                      |                    |                   |

24 HOUR TECHNICAL INFORMATION: 1-613-996-6666

|                                                    |                                                                             |                                    |
|----------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------|
| PALLETS USED / PALETTES UTILISÉES                  | PALLETS RETURNED / PALETTES RETOURNÉES                                      | BAGS USED / SACS UTILISÉS          |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE | EMERGENCY RESPONSE NO/24 HOUR NUMBER<br>TELEPHONE D'URGENCE/24 HEURE NUMERO | PLACARDS OFFERED / PLACARDS OFFERT |
| ERAP 2-1510                                        | 1-877-561-3636                                                              | YES / OUI NO / NON                 |

THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.  
 NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÈGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS.

DECLARED VALUE OF SHIPMENT  
 VALEUR DÉCLARÉE \$

NETTE No. CONV  
 PRESSAGE  
 WT AGREEMENT NO.

FORWARD INVOICE FOR PREPAID FREIGHT  
 QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE  
 FOUR EXPÉDITION PORT PAYÉ EN RÉFÉRENT À  
 Orica Canada Inc.

301 rue hotel de ville  
 Brownsburg-Chatham, QC  
 J8G 3B5

|                                                                          |                                                                       |                                                      |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------|
| CONSIGNEUR / EXPÉDITEUR<br>GRAND VALLEY                                  | CARRIER / TRANSPORTEUR<br>Orica Truck                                 | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br><i>Brad Hutchins</i> | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br><i>B Hutchins</i> | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br><i>Brad Hutchins</i>                                        | SIGNATURE<br><i>B Hutchins</i>                                        | SIGNATURE                                            |
| DATE<br>20 JUN 17                                                        | DATE<br>20 JUN 17                                                     | DATE                                                 |

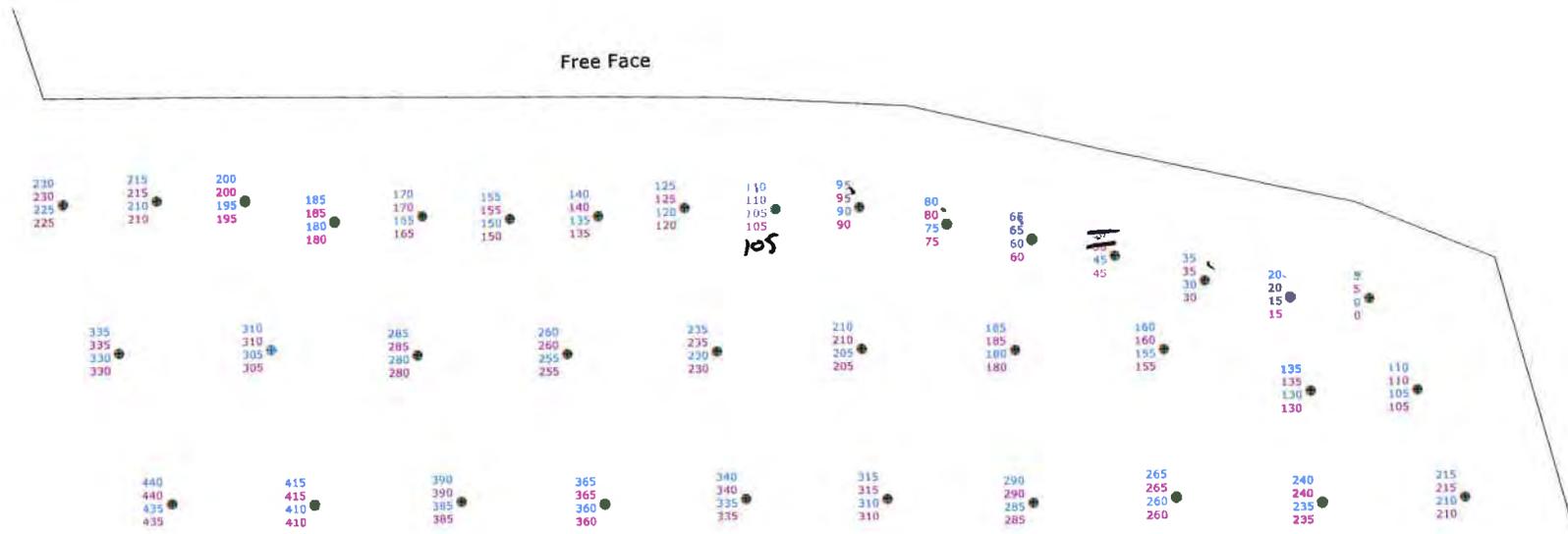
# SHOTPlus 5 Plan

## Blast Summary Data

Burden: 10.0ft  
 1st row burden: 18.0ft  
 Total drilled: 3030.6ft

Spacing: 10.5ft  
 Hole Diameter: 4.0in  
 Number of holes: 36

Stemming: 7.0ft  
 Hole angle: 0.0°



Scale 1:150

|                  |                                   |
|------------------|-----------------------------------|
| SHOTPlus 5.6.2.7 | 20/06/2017                        |
| Mine             |                                   |
| Location         |                                   |
| Title/author     | 17-011 South Face Final G. Palcso |
| Filename         | 17-011 South Face Final (2).spf   |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 10.0ft

Spacing: 10.5ft

Subdrill: 2.0ft

Stemming: 7.0ft

1st row burden: 18.0ft

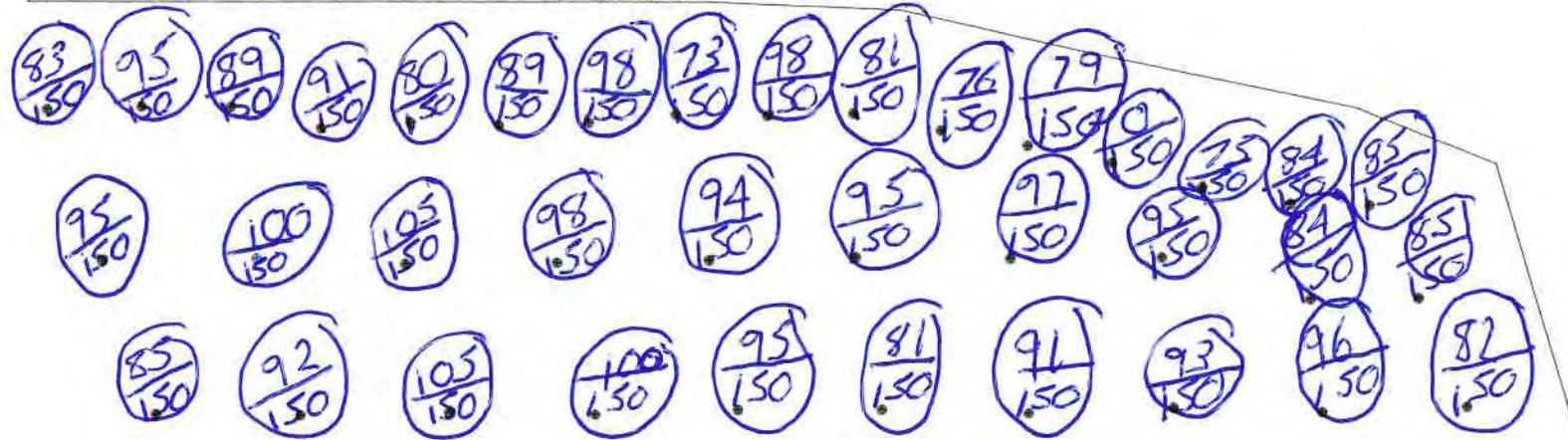
Hole Diameter: 4.0in

Number of holes: 36

Hole angle: 0.0°

Total drilled: 3030.6ft

Free Face



\* 150 kg in all bottom decks:

SHOTPlus 5.6.2.7

20/06/2017

Mine

Location

Title/author 17-011 South Face Final G. Palcso

Filename 17-011 South Face Final.spf

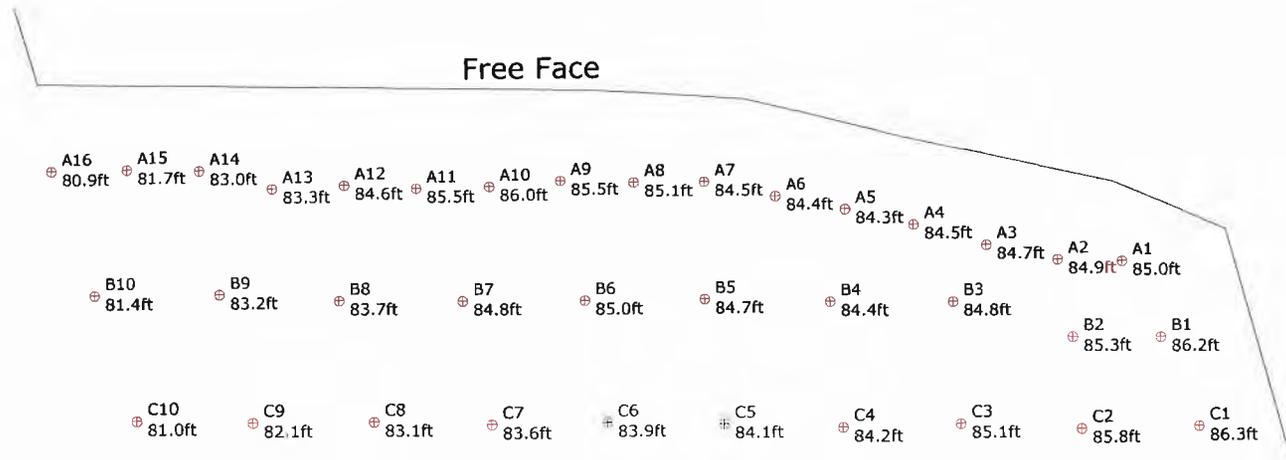


Scale 1:150

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 10.0ft          | Spacing: 10.5ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 18.0ft  | Hole Diameter: 4.0in | Number of holes: 36 | Hole angle: 0.0° |
| Total drilled: 3030.8ft |                      |                     |                  |



17-011 South Face Final  
 Front Row - 18' X 6' - Body - 10' X 10.5' - 4" Bit  
 248.5 + .6 Sub



Not to scale

|                    |                                   |
|--------------------|-----------------------------------|
| ShotPlus5 5.2.29.0 | 12/06/2017                        |
| Mine               |                                   |
| Location           |                                   |
| Title/author       | 17-011 South Face Final G. Palcso |
| Filename           | 17-011 South Face Final.spf       |



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **n/a**  
 Blast Date: **2017-06-26**

Blast Number: **17-012**  
 Orica Order #: **2204495**  
 Blast Time: **1:14 PM**

page 1

Master-in-charge: **Ken George**

Blast Location: **Floor**  
 GPS Coordinates: **43.40250 °N Latitude 79.88614 °W Longitude**  
 Wind from the: **SW at 15 kph** Temperature: **21 to 25 °C**  
 Clear: Rain: Overcast:  
 Partly Cloudy: **X** Snow: Inversion: Ceiling: **30000 m**

tonnes Blasted: **40,014 te** 15,099 m<sup>3</sup>  
 Total tonnes per day: **40,014 te** Rate Code  
 Total Holes Loaded: **252 holes**  
 ... including: **0 Dead Holes**  
 ... and: **0 Helper Holes**  
 Helper Hole Collar: **0.0 ft avg**  
 # Rows Blasted: **12 rows**  
 Burden: **11.5 ft avg**  
 Spacing: **11.5 ft avg**  
 # Holes: **17**

Nominal Bit Diameter:  
 Primary Bit diam: **101.6 mm** 0 # Holes: **252** = **4,032.0 ft ( 4 " diam)**  
 Secondary Bit diam: **mm** 0 # Holes: = **0.0 ft ( " diam)**  
 Tertiary Bit diam: **mm** " # Holes: = **0.0 ft ( " diam)**

Burden: **11.5 ft avg**  
 Spacing: **11.5 ft avg**  
 Bench Height: **16.0 ft avg**  
 Sub-drill: **0.0 ft avg**  
 Hole Depth: **16.0 ft avg**

**Bulk Explosives:** in (kg) out (kg) kg  
 CENTRA GOLD 70 34,290 27,570 6,720

**Packaged Explosives:** cs shipped cs returned kg

**Boosters:** kg / unit # usec kg  
 PENTEX 12 (OR EQUIVALENT) 0.34 252 85.7

total explosives weight in Blast (kg): **6,806**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

**Detonators:** case #'s ms # used  
 EXEL HANDIDET 12m 25/500 252  
 CONNECTADET 12M 42 ms 18  
 UNITRONIC 600 6M 1

**Cord & Accessories:** U of M # used  
 HARNESS WIRE DUPLEX (6 PACK) 400M units 1  
 units  
 units

Front Row: **0.0 ft avg**  
 Main Body: **0.0 ft avg**  
 # Stone Decks: **0 per blast**

Front Row: **7.0 ft avg**  
 Main Body: **7.0 ft avg**  
 Material used: **3/4 Clear**

Front Row: **9.0 ft avg**  
 Main Body: **9.0 ft avg**

Front Row: **26.2 kg/hole**  
 Main Body: **26.2 kg/hole**  
 Max. per delay: **45.0 kg/delay**  
 SD ( ) Equation: **kg/delay**

Total kg Loaded: **6,806 kg**  
 Rock Density: **2.65 g/cc = te/m<sup>3</sup>**

0.760 lb/yd<sup>3</sup> Yield PF: **0.170 kg/te (actual)**

##### lb/yd<sup>3</sup> "KPI" PF: #DIV/0! kg/te (theoretical)

**Services:**

GPS LAYOUT Line Item (Hourly Rate) 1  
 BULK TRUCK CHARGE >/=5,000kg <10,000kg 1  
 SHOT SERVICE FEE \* Line Item (Fee per Blast) 1  
 SEISMOGRAPH RENTAL \* 1 unit in Shot Service Fee  
 3D LASER PROFILE Enter "1" if 3D Profiled  
 BORETRACK Enter "1" if Boretraked



Customer: **Nelson**  
**Blast Design**

Quarry: Burlington  
 P.O. #: n/a  
 Blast Date: 2017-06-26

Blast Number: 17-012  
 Orica Order #: 2204495  
 Blast Time: 1:14 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40254       | 79.88612        | 0.757517    | 1.394276    |
| Front Row Corner          | 43.40207       | 79.88607        | 0.757509    | 1.394275    |
| Back Row Corner           | 43.40288       | 79.88623        | 0.757523    | 1.394278    |
| Average (Centre of Blast) | 43.40250       | 79.88614        | 0.757516    | 1.394276    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.    | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|-------------------|-----------------|-------------|-------------|
| 1st Reading                               |                   |                 |             |             |
| 2nd Reading                               |                   |                 |             |             |
| Average                                   | 0.00000           | 0.00000         | 0.000000    | 0.000000    |
| Distance (1st Seis. From Centre of Blast) | 0.0               | m               |             |             |
| Post Blast Data:                          | ppV:              | 6.2             | mm/s        | 2.0         |
|                                           | frequency:        |                 | Hz          | T           |
|                                           | air overpressure: | 91.5            | dB          | 115         |
| 2450 #2 Side Rd                           |                   |                 |             |             |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.    | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|-------------------|-----------------|-------------|-------------|
| 1st Reading                               |                   |                 |             |             |
| 2nd Reading                               |                   |                 |             |             |
| Average                                   | 0.00000           | 0.00000         | 0.000000    | 0.000000    |
| Distance (2nd Seis. From Centre of Blast) | 0.0               | m               |             |             |
| Post Blast Data:                          | ppV:              | DNT             | mm/s        | 2.0         |
|                                           | frequency:        |                 | Hz          | ?           |
|                                           | air overpressure: | DNT             | dB          | 115         |
| Northwest                                 |                   |                 |             |             |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.    | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|-------------------|-----------------|-------------|-------------|
| 1st Reading                               |                   |                 |             |             |
| 2nd Reading                               |                   |                 |             |             |
| Average                                   | 0.00000           | 0.00000         | 0.000000    | 0.000000    |
| Distance (3rd Seis. From Centre of Blast) | 0.0               | m               |             |             |
| Post Blast Data:                          | ppV:              | 1.8             | mm/s        | 2.0         |
|                                           | frequency:        |                 | Hz          | ?           |
|                                           | air overpressure: | 88.0            | dB          | 115         |
| Southwest                                 |                   |                 |             |             |

Scaling Factor denotes the degree of Blast confinement.

The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:

$$W = \frac{D^2}{7}$$

$$= \frac{(0)^2}{7} \text{ kg}$$

$$= \frac{0}{7} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Ken George*

Customer: **Nelson****Blast Report**Quarry: **Burlington**

P.O. #:

Blast Date: **2017-07-10**Blast Number: **17-013**Orica Order #: **2210809**Blast Time: **1:40 PM**

page 1

Blaster-in-charge: **Kevin Toplis** (Print Name)Blast Location: **Floor** (Bench / Face)GPS Coordinates: **43.40152** °N Latitude **79.88959** °W Longitude  
Centre of Blast Centre of BlastWind from the: **SW** at **10** kph Temperature: **21 to 25** °CClear:  Rain:  Overcast: Partly Cloudy:  Snow:  Inversion:  Ceiling: **2.804** m**- Drilling Information -**

|                                                 | Angle from Vertical        | Nominal Bit Diameter:                                |
|-------------------------------------------------|----------------------------|------------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm               | <b>0</b> °                 | # Holes: <b>299</b> = 5,980.0 ft ( 4 " diam)         |
| Secondary Bit diam: <input type="checkbox"/> mm | <input type="checkbox"/> ° | # Holes: <input type="checkbox"/> = 0.0 ft ( " diam) |
| Tertiary Bit diam: <input type="checkbox"/> mm  | <input type="checkbox"/> ° | # Holes: <input type="checkbox"/> = 0.0 ft ( " diam) |

| Bulk Explosives:      | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>34,150</b> | <b>25,680</b> | 8,470 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                        | kg / unit | # used     | kg    |
|----------------------------------|-----------|------------|-------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>300</b> | 102.0 |

total explosives weight in Blast (kg): 8,572  
Pkgd Prod (0 kg) % of Total kg: 0.0%

| Detonators:              | case #'s | ms            | # used     |
|--------------------------|----------|---------------|------------|
| <b>EXEL HANDIDET 12m</b> |          | <b>25/500</b> | <b>300</b> |
| <b>CONNECTADET 12M</b>   |          | <b>42 ms</b>  | <b>21</b>  |
| <b>UNITRONIC 600 6M</b>  |          |               | <b>1</b>   |

| Cord & Accessories:                     | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

**Resource Deployment:**

|                                 |                         |
|---------------------------------|-------------------------|
| # of Blasts today (this Quarry) | <b>1</b>                |
| # of Blasters (this Blast)      | <b>1</b>                |
| # of Helpers (this Blast)       | Note Exception <b>2</b> |
| # of MMU's (this Blast)         | <b>1</b>                |

**Services:**

|                             |                              |             |
|-----------------------------|------------------------------|-------------|
| GPS LAYOUT                  | Enter "1" if Layout by GPS   | <b>0</b>    |
| BULK TRUCK CHARGE           | >/=5,000kg <10,000kg         | <b>1</b>    |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b>    |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee |             |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled     | <b>0</b>    |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b>    |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour)     | <b>16.0</b> |

|                               |                       |                       |
|-------------------------------|-----------------------|-----------------------|
| tonnes Blasted:               | <b>58,552</b> te      | 22,095 m <sup>3</sup> |
| Total tonnes per day:         | <b>58,552</b> te      | Rate Code             |
| Total Holes Loaded:           | <b>295</b> holes      |                       |
| ... including:                | <b>0</b> Dead Holes   |                       |
| ... and:                      | <b>0</b> Helper Holes |                       |
| Helper Hole Collar:           | <b>0.0</b> ft avg     |                       |
| # Rows Blasted:               | <b>11</b> rows        |                       |
| <b>- Pattern (Front Row)-</b> |                       |                       |
| Burden:                       | <b>11.5</b> ft avg    |                       |
| Spacing:                      | <b>11.5</b> ft avg    |                       |
| # Holes:                      | <b>28</b> front row   |                       |

|                          |                    |
|--------------------------|--------------------|
| Burden:                  | <b>11.5</b> ft avg |
| Spacing:                 | <b>11.5</b> ft avg |
| # Holes:                 | <b>58,524</b>      |
| Bench Height:            | <b>20.0</b> ft avg |
| Sub-drill:               | <b>0.0</b> ft avg  |
| Hole Depth:              | <b>20.0</b> ft avg |
| <b>- Stone Decking -</b> |                    |
| Front Row:               | <b>0.0</b> ft avg  |
| Main Body:               | <b>0.0</b> ft avg  |
| <b># Stone Decks:</b>    | <b>0</b> per blast |

|                            |                    |
|----------------------------|--------------------|
| <b>- Collar Stemming -</b> |                    |
| Front Row:                 | <b>7.0</b> ft avg  |
| Main Body:                 | <b>7.0</b> ft avg  |
| Material used:             | <b>3/4 Clear</b>   |
| <b>- Charge Length -</b>   |                    |
| Front Row:                 | <b>13.0</b> ft avg |
| Main Body:                 | <b>13.0</b> ft avg |

|                          |                                      |
|--------------------------|--------------------------------------|
| <b>- Charge Weight -</b> |                                      |
| Front Row:               | <b>37.9</b> kg/hole                  |
| Main Body:               | <b>37.9</b> kg/hole                  |
| Max. per delay:          | <b>46.0</b> kg/delay                 |
| SD () Equation:          | <b>0.0</b> kg/delay                  |
| Total kg Loaded:         | <b>8,572</b> kg                      |
| Rock Density:            | <b>2.65</b> g/cc = te/m <sup>3</sup> |

|                          |                                    |
|--------------------------|------------------------------------|
| <b>- Powder Factor -</b> |                                    |
| Yield PF:                | <b>0.146</b> kg/te (actual)        |
| Front row:               | <b>0.191</b> kg/te (theoretical)   |
| Main Body:               | <b>0.191</b> kg/te (theoretical)   |
| "KPI" PF:                | <b>#DIV/0!</b> kg/te (theoretical) |

**Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:**

Holes A1,2,3- B1,2- C1 where not drilled.  
Holes A24, C24 where not loaded, but primed. They both where at 8ft.  
Holes, K17, I15 det did not pull, a safety was used.  
Holes, G28, H28 did not get loaded, do to both only being 3ft.

Blaster hours: **8.5**  
Helper hours: **7.5**



Customer: **Nelson**

## Blast Design

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-07-10**

Blast Number: **17-013**  
 Orica Order #: **2210809**  
 Blast Time: **1:40 PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.40144</b> | <b>79.88941</b> | 0.757498    | 1.394333    |
| Front Row Corner          | <b>43.40125</b> | <b>79.89002</b> | 0.757495    | 1.394344    |
| Back Row Corner           | <b>43.40186</b> | <b>79.88933</b> | 0.757505    | 1.394332    |
| Average (Centre of Blast) | 43.40152        | 79.88959        | 0.757499    | 1.394336    |

**1st Seismograph Co-ordinates**

| Enter ° N Lat. | Enter ° W Long. | (N) Radians     | (W) Radians |          |
|----------------|-----------------|-----------------|-------------|----------|
| 1st Reading    | <b>43.71939</b> | <b>80.38847</b> | 0.763047    | 1.403043 |
| 2nd Reading    |                 |                 |             |          |
| Average        | 43.71939        | 80.38847        | 0.763047    | 1.403043 |

Distance (1st Seis. From Centre of Blast) **0.0** m

**Post Blast Data:** ppV: **2.2** mm/s Trigger set at: **2.0** mm/s  
 frequency: Hz V / T / L : **T** (Vertical, Transverse or Longitudinal)  
 air overpressure: **91.5** dB Trigger set at: **115** dB

**2450 #2 Side Rd (Nelson monitor)**

**2nd Seismograph Co-ordinates**

| Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |          |
|----------------|-----------------|-------------|-------------|----------|
| 1st Reading    |                 |             |             |          |
| 2nd Reading    |                 |             |             |          |
| Average        | 0.00000         | 0.00000     | 0.000000    | 0.000000 |

Distance (2nd Seis. From Centre of Blast) **0.0** m

**Post Blast Data:** ppV: **1.0** mm/s Trigger set at: **2.0** mm/s  
 frequency: Hz V / T / L : **?** (Vertical, Transverse or Longitudinal)  
 air overpressure: **104.2** dB Trigger set at: **115** dB

**Northwest (Nelson monitor)**

**3rd Seismograph Co-ordinates**

| Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |          |
|----------------|-----------------|-------------|-------------|----------|
| 1st Reading    |                 |             |             |          |
| 2nd Reading    |                 |             |             |          |
| Average        | 0.00000         | 0.00000     | 0.000000    | 0.000000 |

Distance (3rd Seis. From Centre of Blast) **0.0** m

**Post Blast Data:** ppV: **4.2** mm/s Trigger set at: **2.0** mm/s  
 frequency: Hz V / T / L : **?** (Vertical, Transverse or Longitudinal)  
 air overpressure: **88.0** dB Trigger set at: **115** dB

**Southwest (Nelson monitor)**

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

jim bray

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

SHOTPlus 5 Plan

Blast Summary Data

Burden: 11.5ft      Spacing: 11.5ft      Subdrill: 0.0ft      Stemming: 7.0ft  
 1st row burden: 11.5ft      Hole Diameter: 4.0in      Number of holes: 305      Hole angle: 0.0°  
 Total drilled: 6100.0ft

Free Face

.16 .22 .16 .16 x .20 .15 .15 .22 .22 .16 .22 .22 .22 .24 .29 .27 .21 .32 .29 .22 .35 .26 .34 .26 x x  
 .8 .19 .22 .16 .14 .16 .13 .18 .26 .21 .22 .22 .24 .27 .26 .32 .32 .29 .34 .32 .32 .37 .35 .34 .34 .42 x x  
 .13 .22 .22 .16 x .19 .16 .22 .22 .22 .22 .26 .27 .27 .29 .32 .32 .35 .34 .35 .38 .37 .37 .37 .38 .42 .38 x  
 .16 .16 .18 .22 .14 .19 .22 .24 .26 .22 .22 .21 .22 .30 .30 .32 .30 .30 .32 .37 .38 .39 .37 .34 .35 .42 .42 .34  
 .16 .16 .19 .16 .19 .21 .22 .27 .22 .22 .22 .21 .22 .29 .29 .32 .24 .32 .32 .34 .38 .38 .38 .38 .37 .42 .42 .42  
 .29 .16 .19 .13 .16 .21 .22 .24 .22 .22 .22 .16 .22 .30 .30 .32 .32 .29 .34 .37 .38 .38 .37 .38 .38 .42 .42 .42  
 .16 .29 .29 .13 .16 .16 .22 .22 .19 .19 .24 .26 .26 .26 .29 .26 .32 .26 .29 .34 .38 .42 .35 .35 .38 .42 .42 .42  
 .19 .14 .22 .12 .16 .16 .20 .22 .19 .19 .26 .26 .29 .29 .29 .32 .30 .29 .32 .37 .35 .35 .27 .38 .38 .42 .42 .42  
 x .16 .13 .19 .20 .19 .22 .19 .24 .26 .26 .29 .27 .22 .29 .32 .32 .35 .38 .38 .27 .38 .38 .42 .42 .38 .45  
~~.16~~ .16 .20 .20 .22 .20 .22 .22 .19 .26 .26 .29 .29 .22 .29 .32 .37 .35 .42 .42 .40 .43 .42 .46 .45 .38 .45  
 .19 .19 .22 .19 .19 .19 .22 .18 .22 .29 .29 .29 .26 .29 .32 .32 .34 .34 .29 .38 .42 .42 .45 .38 .45 .45 .45

17-013 Floor Blast - 11.5' X 11.5' - 4" Bit - Drill to shale

8497



Not to scale

|                  |                              |            |
|------------------|------------------------------|------------|
| SHOTPlus 5.6.3.6 |                              | 07/07/2017 |
| Mine             | Burlington                   |            |
| Location         |                              |            |
| Title/author     | 17-013 Floor Blast G. Palcso |            |
| Filename         | 17-013_Floor_Blast_Final.spf |            |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 11.5ft      Spacing: 11.5ft      Subdrill: 0.0ft      Stemming: 7.0ft  
 1st row burden: 11.5ft      Hole Diameter: 4.0in      Number of holes: 305      Hole angle: 0.0°  
 Total drilled: 6100.0ft

*Timing*

Free Face



17-013 Floor Blast - 11.5' X 11.5' - 4" Bit - Drill to shale



Not to scale

|                                             |            |
|---------------------------------------------|------------|
| SHOTPlus 5.6.4.3                            | 10/07/2017 |
| Mine Burlington                             |            |
| Location                                    |            |
| Title/author 17-013 Floor Blast             | G. Palcso  |
| Filename 17-013_Floor_Blast_Final Timing Op |            |

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                      |                  |
|-------------------------|----------------------|----------------------|------------------|
| Burden: 11.5ft          | Spacing: 11.5ft      | Subdrill: 0.0ft      | Stemming: 7.0ft  |
| 1st row burden: 11.5ft  | Hole Diameter: 4.0in | Number of holes: 305 | Hole angle: 0.0° |
| Total drilled: 4575.0ft |                      |                      |                  |

Free Face

A28 15.0ft A27 15.0ft A26 15.0ft A25 15.0ft A24 15.0ft A23 15.0ft A22 15.0ft A21 15.0ft A20 15.0ft A19 15.0ft A18 15.0ft A17 15.0ft A16 15.0ft A15 15.0ft A14 15.0ft A13 15.0ft A12 15.0ft A11 15.0ft A10 15.0ft A9 15.0ft A8 15.0ft A7 15.0ft A6 15.0ft A5 15.0ft A4 15.0ft A3 15.0ft A2 15.0ft A1 15.0ft  
 B28 15.0ft B27 15.0ft B26 15.0ft B25 15.0ft B24 15.0ft B23 15.0ft B22 15.0ft B21 15.0ft B20 15.0ft B19 15.0ft B18 15.0ft B17 15.0ft B16 15.0ft B15 15.0ft B14 15.0ft B13 15.0ft B12 15.0ft B11 15.0ft B10 15.0ft B9 15.0ft B8 15.0ft B7 15.0ft B6 15.0ft B5 15.0ft B4 15.0ft B3 15.0ft B2 15.0ft B1 15.0ft  
 C28 15.0ft C27 15.0ft C26 15.0ft C25 15.0ft C24 15.0ft C23 15.0ft C22 15.0ft C21 15.0ft C20 15.0ft C19 15.0ft C18 15.0ft C17 15.0ft C16 15.0ft C15 15.0ft C14 15.0ft C13 15.0ft C12 15.0ft C11 15.0ft C10 15.0ft C9 15.0ft C8 15.0ft C7 15.0ft C6 15.0ft C5 15.0ft C4 15.0ft C3 15.0ft C2 15.0ft C1 15.0ft  
 D28 15.0ft D27 15.0ft D26 15.0ft D25 15.0ft D24 15.0ft D23 15.0ft D22 15.0ft D21 15.0ft D20 15.0ft D19 15.0ft D18 15.0ft D17 15.0ft D16 15.0ft D15 15.0ft D14 15.0ft D13 15.0ft D12 15.0ft D11 15.0ft D10 15.0ft D9 15.0ft D8 15.0ft D7 15.0ft D6 15.0ft D5 15.0ft D4 15.0ft D3 15.0ft D2 15.0ft D1 15.0ft  
 E28 15.0ft E27 15.0ft E26 15.0ft E25 15.0ft E24 15.0ft E23 15.0ft E22 15.0ft E21 15.0ft E20 15.0ft E19 15.0ft E18 15.0ft E17 15.0ft E16 15.0ft E15 15.0ft E14 15.0ft E13 15.0ft E12 15.0ft E11 15.0ft E10 15.0ft E9 15.0ft E8 15.0ft E7 15.0ft E6 15.0ft E5 15.0ft E4 15.0ft E3 15.0ft E2 15.0ft E1 15.0ft  
 F28 15.0ft F27 15.0ft F26 15.0ft F25 15.0ft F24 15.0ft F23 15.0ft F22 15.0ft F21 15.0ft F20 15.0ft F19 15.0ft F18 15.0ft F17 15.0ft F16 15.0ft F15 15.0ft F14 15.0ft F13 15.0ft F12 15.0ft F11 15.0ft F10 15.0ft F9 15.0ft F8 15.0ft F7 15.0ft F6 15.0ft F5 15.0ft F4 15.0ft F3 15.0ft F2 15.0ft F1 15.0ft  
 G28 15.0ft G27 15.0ft G26 15.0ft G25 15.0ft G24 15.0ft G23 15.0ft G22 15.0ft G21 15.0ft G20 15.0ft G19 15.0ft G18 15.0ft G17 15.0ft G16 15.0ft G15 15.0ft G14 15.0ft G13 15.0ft G12 15.0ft G11 15.0ft G10 15.0ft G9 15.0ft G8 15.0ft G7 15.0ft G6 15.0ft G5 15.0ft G4 15.0ft G3 15.0ft G2 15.0ft G1 15.0ft  
 H28 15.0ft H27 15.0ft H26 15.0ft H25 15.0ft H24 15.0ft H23 15.0ft H22 15.0ft H21 15.0ft H20 15.0ft H19 15.0ft H18 15.0ft H17 15.0ft H16 15.0ft H15 15.0ft H14 15.0ft H13 15.0ft H12 15.0ft H11 15.0ft H10 15.0ft H9 15.0ft H8 15.0ft H7 15.0ft H6 15.0ft H5 15.0ft H4 15.0ft H3 15.0ft H2 15.0ft H1 15.0ft  
 I27 15.0ft I26 15.0ft I25 15.0ft I24 15.0ft I23 15.0ft I22 15.0ft I21 15.0ft I20 15.0ft I19 15.0ft I18 15.0ft I17 15.0ft I16 15.0ft I15 15.0ft I14 15.0ft I13 15.0ft I12 15.0ft I11 15.0ft I10 15.0ft I9 15.0ft I8 15.0ft I7 15.0ft I6 15.0ft I5 15.0ft I4 15.0ft I3 15.0ft I2 15.0ft I1 15.0ft  
 J27 15.0ft J26 15.0ft J25 15.0ft J24 15.0ft J23 15.0ft J22 15.0ft J21 15.0ft J20 15.0ft J19 15.0ft J18 15.0ft J17 15.0ft J16 15.0ft J15 15.0ft J14 15.0ft J13 15.0ft J12 15.0ft J11 15.0ft J10 15.0ft J9 15.0ft J8 15.0ft J7 15.0ft J6 15.0ft J5 15.0ft J4 15.0ft J3 15.0ft J2 15.0ft J1 15.0ft  
 K27 15.0ft K26 15.0ft K25 15.0ft K24 15.0ft K23 15.0ft K22 15.0ft K21 15.0ft K20 15.0ft K19 15.0ft K18 15.0ft K17 15.0ft K16 15.0ft K15 15.0ft K14 15.0ft K13 15.0ft K12 15.0ft K11 15.0ft K10 15.0ft K9 15.0ft K8 15.0ft K7 15.0ft K6 15.0ft K5 15.0ft K4 15.0ft K3 15.0ft K2 15.0ft K1 15.0ft

17-013 Floor Blast - 11.5' X 11.5' - 4" Bit - Drill to shale



Not to scale

|                    |                              |
|--------------------|------------------------------|
| ShotPlus5 5.2.29.0 | 16/06/2017                   |
| Mine               | Burlington                   |
| Location           |                              |
| Title/author       | 17-013 Floor Blast G. Palcso |
| Filename           | 17-013 Floor Blast Final.spf |



Customer: **Nelson**

# Blast Design

Quarry: **Burlington**  
P.O. #:  
Design Date: **2017-07-07**

Blast Number: **17-013**  
Orica Order #:

page 1

Master-in-charge: **Kevin Toplis** (Print Name)

Blast Location: **Floor** (Bench / Level)  
GPS Coordinates: **0.00000** °N Latitude **0.00000** °W Longitude  
Centre of Blast Centre of Blast

Design to Blasted: **60,536** te  
Total Holes Loaded: **305** holes  
... including: **0** Dead Holes  
... and: **0** Helper Holes  
Helper Hole Collar: **0.0** ft avg  
# Rows Blasted: **11** rows

### - Drilling Information -

Angle from Vertical: **0°** Nominal Bit Diameter: **6,100.0** ft ( **4** " diam)  
Primary Bit diam: **101.6** mm # Holes: **305** =  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### - Design Pattern (Front Row) -

Burden: **11.5** ft avg  
Spacing: **11.5** ft avg  
# Holes: **28** front row

### - Design Pattern (Main Body) -

Burden: **11.5** ft avg  
Spacing: **11.5** ft avg  
# Holes: **277** main body  
Bench Height: **20.0** ft avg  
Sub-drill: **0.0** ft avg  
Hole Depth: **20.0** ft avg

### - Design Stone Decking -

Front Row: **0.0** ft avg  
Main Body: **0.0** ft avg

### - Design Collar Stemming -

Front Row: **7.0** ft avg  
Main Body: **7.0** ft avg

Material used: **3/4 Clear**

### - Design Charge Length -

Front Row: **13.0** ft avg  
Main Body: **13.0** ft avg

### - Design Charge Weight -

Front Row: **37.9** kg/hole  
Main Body: **37.9** kg/hole  
Max Chge Wt / delay: **30.0** kg/delay

Required kg Loaded: **7,912** kg  
Rock Density: **2.65** g/cc = te/m<sup>3</sup>

### - Design Powder Factor -

Expected Yield PF: **0.131** kg/te (actual)  
Front row: **0.191** kg/te (theoretical)  
Main Body: **0.191** kg/te (theoretical)  
"KPI" PF: **0.191** kg/te (theoretical)

0.853 lb/yd<sup>3</sup>  
0.853 lb/yd<sup>3</sup>  
0.853 lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

### Bulk Explosives Req'd:

|                       | ChargeWt.exe | kg |
|-----------------------|--------------|----|
| <b>CENTRA GOLD 70</b> | <b>7,808</b> |    |

### Pkgd Explosives Req'd:

|  |  | kg |
|--|--|----|
|  |  |    |
|  |  |    |

### Boosters Req'd:

|                                  | kg/u        | # used     | kg           |
|----------------------------------|-------------|------------|--------------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | <b>0.34</b> | <b>305</b> | <b>103.7</b> |

total explosives weight in Blast (kg): **7,912**  
Pkgd Prod (0 kg) % of Total kg: **0.0%**

### Detonators Req'd:

|                          | ms            | # req'd    |
|--------------------------|---------------|------------|
| <b>EXEL HANDIDET 12m</b> | <b>25/500</b> | <b>305</b> |
| <b>CONNECTADET 12M</b>   | <b>42 ms</b>  | <b>11</b>  |
| <b>UNITRONIC 600 6M</b>  |               | <b>1</b>   |

### Cord & Access. Req'd:

|                                 | U of M       | # req'd  |
|---------------------------------|--------------|----------|
| <b>IRE DUPLEX (6 PACK) 400M</b> | <b>units</b> | <b>1</b> |
|                                 | <b>units</b> |          |
|                                 | <b>units</b> |          |

### Resource Deployment

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

### Services Req'd:

|                                                    |                              |          |
|----------------------------------------------------|------------------------------|----------|
| BULK TRUCK CHARGE                                  | >=5,000kg <10,000kg          | <b>1</b> |
| SHOT SERVICE FEE *                                 | Line Item (Fee per Blast)    | <b>1</b> |
| SEISMOGRAPH RENTAL                                 | * 1 unit in Shot Service Fee |          |
| 3D LASER PROFILE                                   | Enter "1" if 3D Profiled     | <b>0</b> |
| BORETRACK                                          | Enter "1" if Boretraked      | <b>0</b> |
| LABOUR CHARGE (enter HOURS Must be pre-authorized) |                              |          |



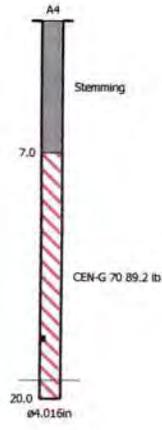
Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
P.O. #:  
Blast Date: **2017-07-10**

Blast Number: **17-013**  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica  
Blaster-in-charge:

*Kevin Toplis*

#  
Quarry Manager:

Signature required, indicating sign-off on Blast Design.

1085980

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.



Bill of Lading / Connaissancement

CONSIGNOR EXPÉDITEUR GRAND VALLEY 033411 SIDE ROAD 21-22 GRAND VALLEY ON CA L9W 7G1

blaster Kevin  
Herd - Neil  
Keith

CONSIGNEE CONSIGNATAIRE NELSON AGGREGATE COMPANY BURLINGTON ON CA L7R 4L8

Table with columns: GROSS / BRUT, TARE, NET, TIME IN HEURE D'ENTRÉE, TIME OUT HEURE SORTIE, ORDER NUMBER N° DE COMMANDE, B/L NUMBER N° DE CONNAISSEMENT. Values: 6:45, 14:00, 2210809, 85701951

PAGE 2

Table with columns: DATE REQUIRED DATE REQUISE, TIME REQUIRED HEURE REQUISE, INVOICE TO / BUYER FACTURÉ À / ACHETEUR, CUSTOMER REFERENCE NO. N° DE COMMANDE DU CLIENT. Values: 10 Jul 2017, 00:00:00, NELSON AGGREGATE COMPANY, n/a

Table with columns: DATE SHIPPED EXPÉDIÉ LE, FREIGHT TERMS CONDITIONS DE LIVRAISON, SHIP. MAG. LIC. PERMIS EXPÉDITEUR, VEHICLE NO. N° DE VÉHICULE. Values: 10 Jul 2017, FOB Dest'n, Own Truck, F-73289, PT115013

Table with columns: SHIP VIA TRANSPORTEUR, ROUTING ITINÉRAIRE, MAG. LIC. NO. N° DE PERMIS. Values: Orica Truck, STANDARD

Main table with columns: QTY. QTÉ., UM, DG MD, QTY. RET'D QTÉ. RET., QTY. SOLD QTÉ. FACT., DESCRIPTION, # OF / DE PKGS., AMOUNT MONTANT. Includes items like PENTEX BC 340, EXEL HANDIDET, EXEL Connectadet, etc.

24 HOUR TECHNICAL INFORMATION: 1-613-996-6666

Table with columns: EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE, EMERGENCY RESPONSE NO./24 HOUR NUMBER, PLACARDS OFFERED / PLACARDS OFFERT, FORWARD INVOICE FOR PREPAID FREIGHT. Values: ERAP 2-1510, 1-877-561-3636, YES / OUI, NO / NON

THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION...

Table with columns: CONSIGNOR / EXPÉDITEUR, CARRIER / TRANSPORTEUR, CONSIGNEE / DESTINATAIRE, SHIPPER'S NAME, DRIVER'S NAME, RECEIVER'S NAME, SIGNATURE, DATE. Values: GRAND VALLEY, Orica Truck, NELSON AGGREGATE COMPANY, Kevin Platt, Kevin Platt, Nelson Aggregate Company

2 SHIPPING ORDER BON D'EXPÉDITION

(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO \*\*\*\* PAGE 2 OF 3 \*\*\*\*



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-07-04**

Blast Number: **17-014 A**  
 Orica Order #: **2207581**  
 Blast Time: **12:46 PM**

page 1

blaster-in-charge: **Kevin Topplis** (Print Name)

Blast Location: **Lower middle bench** (Bench / Face)  
 GPS Coordinates: **43.40390** °N Latitude **79.88386** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **SE** at **10** kph Temperature: **21 to 25** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **9,144** m

- Drilling Information -

|                                            | Angle from Vertical    | Nominal Bit Diameter:                            |
|--------------------------------------------|------------------------|--------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm          | <b>0</b> °             | # Holes: <b>36</b> = 1,497.6 ft ( 4 " diam)      |
| Secondary Bit diam: <b>114.3</b> mm        | <b>0</b> °             | # Holes: <b>7</b> = 291.2 ft ( 4 1/2 " diam)     |
| Tertiary Bit diam: <input type="text"/> mm | <input type="text"/> ° | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>34,050</b> | <b>29,193</b> | 4,857 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used    | kg   |
|----------------------------------|-----------|-----------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>86</b> | 29.2 |

total explosives weight in Blast (kg): 4,886

Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 6M</b>  |          |    | <b>43</b> |
| <b>UNITRONIC 600 15M</b> |          |    | <b>43</b> |

**Cord & Accessories:**

|                                         | U of M | # used    |
|-----------------------------------------|--------|-----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b>  |
| <b>SPIDER STEMMING PLUG 8"</b>          | units  | <b>20</b> |

Resource Deployment:

|                                 | Note Exception |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>2</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services:**

|                             | Line Item (Hourly Rate)      |             |
|-----------------------------|------------------------------|-------------|
| GPS LAYOUT                  |                              | <b>1</b>    |
| BULK TRUCK CHARGE           | >=2,000kg <5,000kg           | <b>1</b>    |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1/2</b>  |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee |             |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | <b>1</b>    |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b>    |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour)     | <b>14.0</b> |

|                         |                                      |                             |
|-------------------------|--------------------------------------|-----------------------------|
| tonnes Blasted:         | <b>11,970</b> te                     | <b>4,517</b> m <sup>3</sup> |
| Total tonnes per day:   | <b>33,601</b> te                     | <b>TBA</b> Rate Code        |
| Total Holes Loaded:     | <b>43</b> holes                      |                             |
| ... including:          | <b>0</b> Dead Holes                  |                             |
| ... and:                | <b>4</b> Helper Holes                |                             |
| Helper Hole Collar:     | <b>10.0</b> ft avg                   |                             |
| # Rows Blasted:         | <b>3</b> rows                        |                             |
| - Pattern (Front Row)-  |                                      |                             |
| Burden:                 | <b>12.0</b> ft avg                   |                             |
| Spacing:                | <b>10.5</b> ft avg                   |                             |
| # Holes:                | <b>12</b> front row                  |                             |
| - Pattern (Main Body) - |                                      |                             |
| Burden:                 | <b>9.0</b> ft avg                    |                             |
| Spacing:                | <b>10.5</b> ft avg                   |                             |
| # Holes:                | <b>31</b> main body                  |                             |
| Bench Height:           | <b>39.6</b> ft avg                   |                             |
| Sub-drill:              | <b>2.0</b> ft avg                    |                             |
| Hole Depth:             | <b>41.6</b> ft avg                   |                             |
| - Stone Decking -       |                                      |                             |
| Front Row:              | <b>0.0</b> ft avg                    |                             |
| Main Body:              | <b>0.0</b> ft avg                    |                             |
| <b># Stone Decks:</b>   | <b>0</b> per blast                   |                             |
| - Collar Stemming -     |                                      |                             |
| Front Row:              | <b>7.0</b> ft avg                    |                             |
| Main Body:              | <b>7.0</b> ft avg                    |                             |
| Material used:          | <b>.75</b> clear                     |                             |
| - Charge Length -       |                                      |                             |
| Front Row:              | <b>34.6</b> ft avg                   |                             |
| Main Body:              | <b>34.6</b> ft avg                   |                             |
| - Charge Weight -       |                                      |                             |
| Front Row:              | <b>100.9</b> kg/hole                 |                             |
| Main Body:              | <b>100.9</b> kg/hole                 |                             |
| Max. per delay:         | <b>125.0</b> kg/delay                |                             |
| SD () Equation:         | <b>0.0</b> kg/delay                  |                             |
| Total kg Loaded:        | <b>4,886</b> kg                      |                             |
| Rock Density:           | <b>2.65</b> g/cc = te/m <sup>3</sup> |                             |
| - Powder Factor -       |                                      |                             |
| Yield PF:               | <b>0.408</b> kg/te (actual)          |                             |
| Front row:              | <b>0.269</b> kg/te (theoretical)     |                             |
| Main Body:              | <b>0.359</b> kg/te (theoretical)     |                             |
| "KPI" PF:               | <b>0.350</b> kg/te (theoretical)     |                             |

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blasted)

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

blaster hours: **7.5**  
 helper hours: **6.5**  
 This blast was shot with 17-014 B, with a 5 second delay  
 Holes A1, X1, X2 got 10ft collars. Holes B1, X3, X4, C1 got 12ft collars.



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-07-04**

Blast Number: **17-014 A**  
 Orica Order #: **2207581**  
 Blast Time: **12:46 PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.40388</b> | <b>79.88387</b> | 0.757541    | 1.394236    |
| Front Row Corner          | <b>43.40375</b> | <b>79.88372</b> | 0.757538    | 1.394234    |
| Back Row Corner           | <b>43.40406</b> | <b>79.88399</b> | 0.757544    | 1.394239    |
| Average (Centre of Blast) | 43.40390        | 79.88386        | 0.757541    | 1.394236    |

1st

| Seismograph Co-ordinates                                | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|---------------------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                             |                               |                 |                            |                                        |
| 2nd Reading                                             |                               |                 |                            |                                        |
| Average                                                 | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast)               | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                                        | ppV: <b>1.3</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                                         | frequency:                    | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                                         | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <a href="#">northwest- colling rd. (Nelson monitor)</a> |                               |                 |                            |                                        |

2nd

| Seismograph Co-ordinates                             | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|------------------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                          | <b>43.71939</b>               | <b>80.38847</b> | 0.763047                   | 1.403043                               |
| 2nd Reading                                          |                               |                 |                            |                                        |
| Average                                              | 43.71939                      | 80.38847        | 0.763047                   | 1.403043                               |
| Distance (2nd Seis. From Centre of Blast)            | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                                     | ppV: <b>12.2</b>              | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                                      | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                                      | air overpressure: <b>95.9</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <a href="#">2450 2nd concession (Nelson monitor)</a> |                               |                 |                            |                                        |

3rd

| Seismograph Co-ordinates                            | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-----------------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                         |                               |                 |                            |                                        |
| 2nd Reading                                         |                               |                 |                            |                                        |
| Average                                             | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast)           | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                                    | ppV: <b>4.2</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                                     | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                                     | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <a href="#">southwest- Camisle (Nelson Monitor)</a> |                               |                 |                            |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(0)^2}{30^2} \text{ kg} \\
 &= \frac{0}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

SHOTPlus 5 Plan

Blast Summary Data

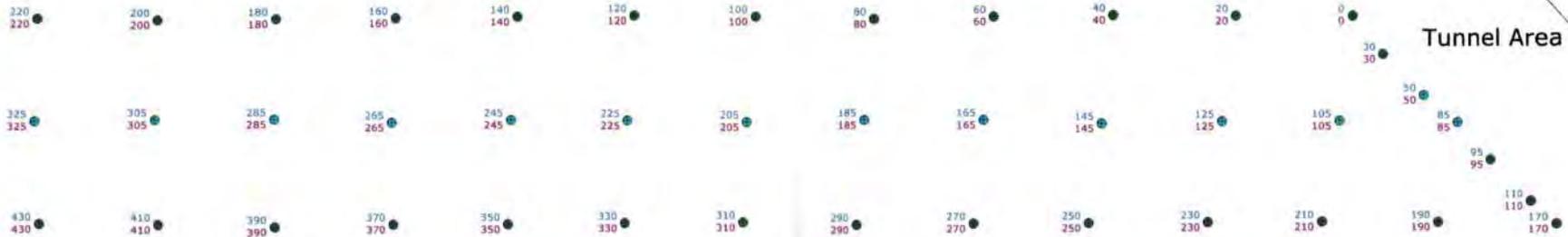
|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.5ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 43 | Hole angle: 0.0° |
| Total drilled: 1793.4ft |                      |                     |                  |

Holes A1,B1,C1, X1,X2,X3,X4 are 4.5" Diameter Marked with Green Paint



open face

timing



Lower Middle 17-014 Part A  
 12x10.5 Front Row, 9x10.5 Body  
 4" Hole Diameter  
 250m Floor Elevation + 0.6m Subdrill



Not to scale

|                  |                                      |
|------------------|--------------------------------------|
| SHOTPlus 5.6.3.6 | 03/07/2017                           |
| Mine             | Burlington                           |
| Location         | Lower Middle                         |
| Title/author     | Blast 17-014 Design Ken George       |
| Filename         | Blast 17-014 Lower Middle Design.spf |

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.5ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 43 | Hole angle: 0.0° |
| Total drilled: 1793.4ft |                      |                     |                  |

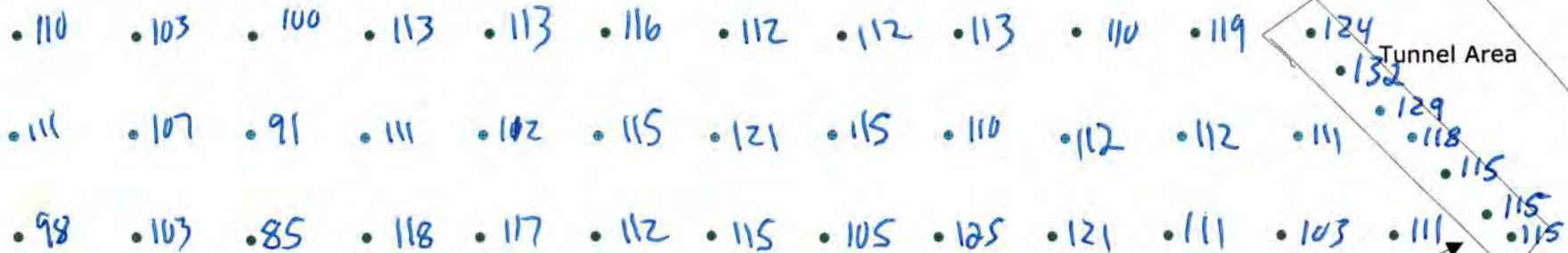
Holes A1,B1,C1, X1,X2,X3,X4 are 4.5" Diameter Marked with Green Paint

load sheet

open face

pc counter

max load: 140kg



Lower Middle 17-014 Part A  
 12x10.5 Front Row, 9x10.5 Body  
 4" Hole Diameter  
 250m Floor Elevation + 0.6m Subdrill

4.5" holes

4811



Not to scale

|                  |                                      |            |
|------------------|--------------------------------------|------------|
| SHOTPlus 5.6.3.6 |                                      | 03/07/2017 |
| Mine             | Burlington                           |            |
| Location         | Lower Middle                         |            |
| Title/author     | Blast 17-014 Design Ken George       |            |
| Filename         | Blast 17-014 Lower Middle Design.spf |            |

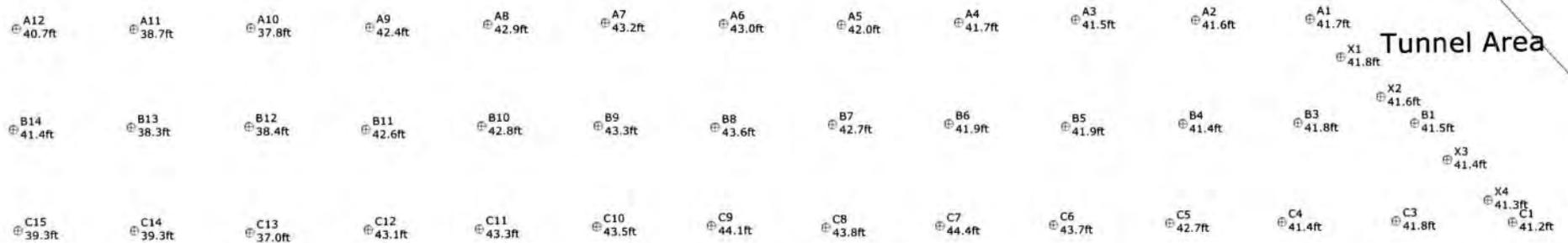
SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.5ft      Subdrill: 2.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 43      Hole angle: 0.0°  
 Total drilled: 1793.4ft

Holes A1,B1,C1, X1,X2,X3,X4 are 4.5" Diameter Marked with Green Paint

open face



Tunnel Area

Lower Middle 17-014 Part A  
 12x10.5 Front Row, 9x10.5 Body  
 4" Hole Diameter  
 250m Floor Elevation + 0.6m Subdrill

|                  |                                     |
|------------------|-------------------------------------|
| SHOTPlus 5.6.4.3 | 22/06/2017                          |
| Mine             | Burlington                          |
| Location         | Lower Middle                        |
| Title/author     | Blast 17-014 Design Ken George      |
| Filename         | Blast 17-014 Lower Middle Design.sp |



Not to scale

Customer: **Nelson**Quarry: **Burlington**Blast Number: **17-014 A****Blast Design**

P.O. #:

Orica Order #:

Design Date: **2017-07-04**

page 1

Blaster-in-charge: **Kevin Toplis** (Print Name)Blast Location: **Lower middle bench** (Bench / Face)GPS Coordinates: **43.40390** °N Latitude **79.88386** °W Longitude  
Centre of Blast Centre of BlastDesign te Blasted: **12,949** te  
Total Holes Loaded: **43** holes  
... including: **0** Dead Holes  
... and: **4** Helper Holes  
Helper Hole Collar: **7.0** ft avg  
# Rows Blasted: **3** rows*- Drilling Information -*

|                                     |                     |                    |                            |
|-------------------------------------|---------------------|--------------------|----------------------------|
|                                     | Angle from Vertical |                    | Nominal Bit Diameter:      |
| Primary Bit diam: <b>101.6</b> mm   | <b>0</b> °          | # Holes: <b>36</b> | = 1,497.6 ft ( 4 " diam)   |
| Secondary Bit diam: <b>114.3</b> mm | <b>0</b> °          | # Holes: <b>7</b>  | = 291.2 ft ( 4 1/2 " diam) |
| Tertiary Bit diam: <b>  </b> mm     | <b>0</b> °          | # Holes: <b>  </b> | = 0.0 ft ( " diam)         |

*- Design Pattern (Front Row) -*Burden: **12.0** ft avg  
Spacing: **10.5** ft avg  
# Holes: **12** front row*- Design Pattern (Main Body) -*Burden: **9.0** ft avg  
Spacing: **10.5** ft avg  
# Holes: **31** main bodyBench Height: **39.6** ft avgSub-drill: **2.0** ft avgHole Depth: **41.6** ft avg*- Design Stone Decking -*Front Row: **0.0** ft avg  
Main Body: **0.0** ft avg*- Design Collar Stemming -*Front Row: **7.0** ft avg  
Main Body: **7.0** ft avgMaterial used: **.75 clear***- Design Charge Length -*Front Row: **34.6** ft avg  
Main Body: **34.6** ft avg*- Design Charge Weight -*Front Row: **100.9** kg/hole  
Main Body: **100.9** kg/hole  
Max Chge Wt / delay: **140.0** kg/delayRequired kg Loaded: **4,920** kg  
Rock Density: **2.60** g/cc = te/m<sup>3</sup>*- Design Powder Factor -*Expected Yield PF: **0.380** kg/te (actual)  
Front row: **0.275** kg/te (theoretical)  
Main Body: **0.366** kg/te (theoretical)  
"KPI" PF: **0.336** kg/te (theoretical)1.204 lb/yd<sup>3</sup>1.605 lb/yd<sup>3</sup>1.471 lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Bit - B S Expl or IS from previous Blast

| Bulk Explosives Req'd:      | kg    |
|-----------------------------|-------|
| CENTRA GOLD 70 ChargeWt.exe | 4,891 |

| Pkgd Explosives Req'd: | kg |
|------------------------|----|
|                        |    |
|                        |    |
|                        |    |

| Boosters Req'd:           | kg/u | # used | kg   |
|---------------------------|------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34 | 86     | 29.2 |

total explosives weight in Blast (kg): **4,920**  
Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators Req'd: | ms | # req'd |
|-------------------|----|---------|
| UNITRONIC 600 15M |    | 43      |
| UNITRONIC 600 9M  |    | 43      |

| Cord & Access. Req'd:    | U of M | # req'd |
|--------------------------|--------|---------|
| IRE DUPLEX (6 PACK) 400M | units  | 1       |
|                          | units  |         |
|                          | units  |         |

## Resource Deployment

| # of Blasts today (this Quarry) | Note Exception |   |
|---------------------------------|----------------|---|
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

## Services Req'd:

|                             |                              |     |
|-----------------------------|------------------------------|-----|
| BULK TRUCK CHARGE           | >=2,000kg <5,000kg           | 1   |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | 1/2 |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee | 0   |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled     | 0   |
| BORETRACK                   | Enter "1" if Boretraked      | 0   |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |     |



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
P.O. #:   
Blast Date: **2017-07-04**

Blast Number: **17-014 A**  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:

UNI Tronic (7)ms 20ft  
PENTEX BC 12 \* 340 x1

UNI Tronic (7)ms 49ft  
PENTEX BC 12 \* 340 x1



**Orica**

Blaster-in-charge:

*Kevin Toplis*

#

Quarry Manager:

Signature required, indicating  
sign-off on Blast Design.

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.



Orica Canada Inc.
GRAND VALLEY
033411 SIDE ROAD 21-22
GRAND VALLEY ON
CA L9W 7G1

Bill of Lading / Connaissancement

Table with 4 columns: GROSS / BRUT, TARE, NET, TIME IN HEURE D'ENTRÉE, TIME OUT HEURE SORTIE, ORDER NUMBER N° DE COMMANDE, B/L NUMBER N° DE CONNAISSEMENT.

CONSIGNEE
CONSIGNATAIRE
NELSON AGGREGATE COMPANY
BURLINGTON ON
CA L7R 4L8

Table with 4 columns: DATE REQUIRED DATE REQUISE, TIME REQUIRED HEURE REQUISE, INVOICE TO / BUYER FACTURÉ À / ACHETEUR, CUSTOMER REFERENCE NO. N° DE COMMANDE DU CLIENT.

Table with 3 columns: SHIP VIA TRANSPORTEUR, ROUTING ITINÉRAIRE, MAG. LIC. NO. N° DE PERMIS.

Main table with 8 columns: QTY. QTÉ., UM, DG MD, QTY. RET'D QTÉ. RET., QTY. SOLD QTÉ. FACT, DESCRIPTION, # OF / DE PKGS., AMOUNT MONTANT.

24 HOUR TECHNICAL INFORMATION: 1-613-996-6666

Table with 4 columns: EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE, EMERGENCY RESPONSE NO.24 HOUR NUMBER TELEPHONE D'URGENCE/24 HEURE NUMERO, PLACARDS OFFERED / PLACARDS OFFERT, FORWARD INVOICE FOR PREPAID FREIGHT QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À NO. DE CONNAISSEMENT D'ORICA :

THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.

Table with 3 columns: CONSIGNOR / EXPÉDITEUR, CARRIER / TRANSPORTEUR, CONSIGNEE / DESTINATAIRE.

Table with 3 columns: SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR, DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR, RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR.

Table with 4 columns: SIGNATURE, DATE, SIGNATURE, DATE.



(THIS BILL OF LADING-EXPRESS SHIPPING CONTRACT IS TO BE SIGNED BY THE SHIPPER AND CARRIER) (CE CONNAISSEMENT-CONTRAT D'EXPÉDITION PAR MESSAGERIES DOIT ÊTRE SIGNÉ PAR L'EXPÉDITEUR ET LE TRANSPORTEUR)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO \*\*\*\* PAGE 2 OF 2 \*\*\*\* D.F.G. S772



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-07-04**

Blast Number: **17-014 B**  
 Orica Order #: **2207581**  
 Blast Time: **12:46 PM**

page 1

blaster-in-charge: **Kevin Topplis** (Print Name)

Blast Location: **Lower middle bench** (Bench / Face)  
 GPS Coordinates: **43.40347** °N Latitude **79.88363** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **SE** at **10** kph Temperature: **21 to 25** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **9,144** m

- Drilling Information -

Angle from Vertical Nominal Bit Diameter:  
 Primary Bit diam: **101.6** mm **0**° # Holes: **36** = 2,840.4 ft ( 4 " diam)  
 Secondary Bit diam: mm ° # Holes: = 0.0 ft ( " diam)  
 Tertiary Bit diam: mm ° # Holes: = 0.0 ft ( " diam)

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>29,193</b> | <b>20,540</b> | 8,653 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used    | kg   |
|----------------------------------|-----------|-----------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>74</b> | 25.2 |

total explosives weight in Blast (kg): 8,678

Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 6M</b>  |          |    | <b>36</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>38</b> |

**Cord & Accessories:**

|                                         | U of M | # used    |
|-----------------------------------------|--------|-----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b>  |
| <b>SPIDER STEMMING PLUG 8"</b>          | units  | <b>20</b> |

Resource Deployment:

|                                 | Note Exception |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>2</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services:**

|                             | Line Item (Hourly Rate)      |             |
|-----------------------------|------------------------------|-------------|
| GPS LAYOUT                  |                              | <b>1</b>    |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b>    |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1/2</b>  |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee |             |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | <b>1</b>    |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b>    |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour)     | <b>14.0</b> |

tonnes Blasted: **21,631** te **8,163** m<sup>3</sup>  
 Total tonnes per day: **33,601** te **TBA** Rate Code  
 Total Holes Loaded: **36** holes  
 ... including: **0** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **3** rows

- Pattern (Front Row)-

Burden: **12.0** ft avg

Spacing: **10.5** ft avg

# Holes: **11** front row

Burden: **9.0** ft avg

Spacing: **10.5** ft avg

# Holes: **25**

Bench Height: **76.9** ft avg

Sub-drill: **2.0** ft avg

Hole Depth: **78.9** ft avg

- Stone Decking -

Front Row: **15.0** ft avg

Main Body: **0.0** ft avg

# Stone Decks: **1** per blast

- Collar Stemming -

Front Row: **8.0** ft avg

Main Body: **7.0** ft avg

Material used: **.75 clear**

- Charge Length -

Front Row: **55.9** ft avg

Main Body: **71.9** ft avg

- Charge Weight -

Front Row: **163.0** kg/hole

Main Body: **209.7** kg/hole

Max. per delay: **250.0** kg/delay

SD () Equation: **0.0** kg/delay

Total kg Loaded: **8,678** kg

Rock Density: **2.65** g/cc = te/m<sup>3</sup>

- Powder Factor -

Yield PF: **0.401** kg/te (actual)

Front row: **0.224** kg/te (theoretical)

Main Body: **0.384** kg/te (theoretical)

"KPI" PF: **#DIV/0!** kg/te (theoretical)

1.792 lb/yd<sup>3</sup>

1.001 lb/yd<sup>3</sup>

1.717 lb/yd<sup>3</sup>

##### lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blasted)

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

blaster hours: **7.5**

helper hours: **6.5**

This shot was fired with 17-014 A, with a 5 second delay.

Hole A11 was loaded to 65ft, stone deck to 41ft.

Hola A10 got a 14ft collar, Hole A1 got a 10ft collar, Holes, A4+5 got 14ft collar.



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-07-04**

Blast Number: **17-014 B**  
 Orica Order #: **2207581**  
 Blast Time: **12:46 PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.40345</b> | <b>79.88364</b> | 0.757533    | 1.394232    |
| Front Row Corner          | <b>43.40335</b> | <b>79.88349</b> | 0.757531    | 1.394230    |
| Back Row Corner           | <b>43.40362</b> | <b>79.88376</b> | 0.757536    | 1.394235    |
| Average (Centre of Blast) | 43.40347        | 79.88363        | 0.757533    | 1.394232    |

**1st**

| Seismograph Co-ordinates                      | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-----------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                   |                               |                 |                            |                                        |
| 2nd Reading                                   |                               |                 |                            |                                        |
| Average                                       | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast)     | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                              | ppV: <b>1.3</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                               | frequency:                    | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                               | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Northwest- colling rd (Nelson monitor)</b> |                               |                 |                            |                                        |

**2nd**

| Seismograph Co-ordinates                    | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|---------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                 | <b>43.71939</b>               | <b>80.38847</b> | 0.763047                   | 1.403043                               |
| 2nd Reading                                 |                               |                 |                            |                                        |
| Average                                     | 43.71939                      | 80.38847        | 0.763047                   | 1.403043                               |
| Distance (2nd Seis. From Centre of Blast)   | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                            | ppV: <b>12.2</b>              | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                             | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                             | air overpressure: <b>95.9</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>2450 2nd concession (Nelson monitor)</b> |                               |                 |                            |                                        |

**3rd**

| Seismograph Co-ordinates                   | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|--------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                |                               |                 |                            |                                        |
| 2nd Reading                                |                               |                 |                            |                                        |
| Average                                    | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast)  | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                           | ppV: <b>4.2</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                            | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                            | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Southwest- Camisle (Nelson monitor)</b> |                               |                 |                            |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(0)^2}{30^2} \text{ kg} \\
 &= \frac{0}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay = **0** kg

**Orica**  
 Blaster-in-charge:

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

*jim bray*

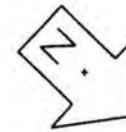


SHOTPlus 5 Plan

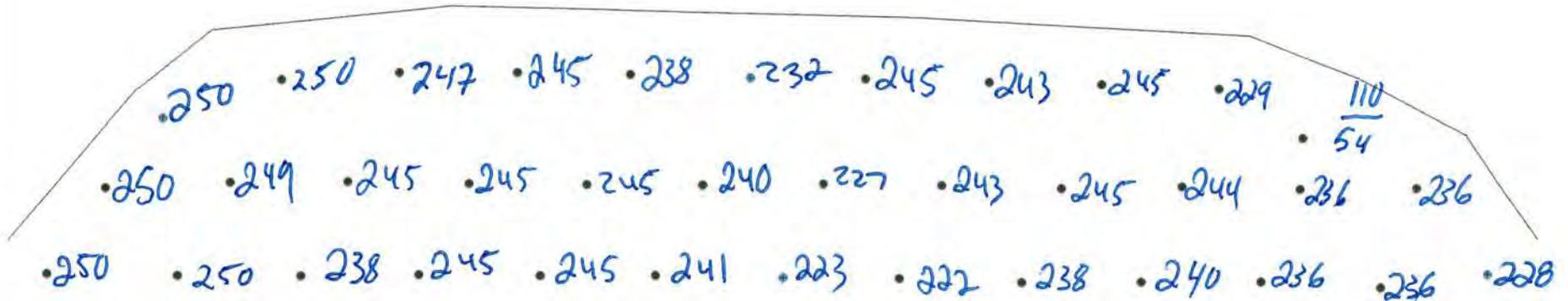
Blast Summary Data

|                        |                         |                            |                  |
|------------------------|-------------------------|----------------------------|------------------|
| Burden: 9.0ft          | Spacing: 10.5ft         | Subdrill: 2.0ft            | Stemming: 7.0ft  |
| 1st row burden: 12.0ft | Hole Diameter: 4.0in    | Number of holes: 36        | Hole angle: 0.0° |
| Rock density: 2.65g/cc | Total drilled: 2841.9ft | Blasted tonnage: 20,509S/T |                  |

load sheet  
pc counter:  
max load 233kg



open face



Lower Middle 17-014 Part B  
12x10.5 Front Row, 9x10.5 Body  
4" Hole Diameter  
250m Elevation + 0.6m subdrill

8570



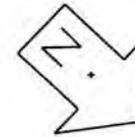
Not to scale

|                  |                                           |
|------------------|-------------------------------------------|
| SHOTPlus 5.6.3.6 | 03/07/2017                                |
| Mine             | Burlington                                |
| Location         | Lower Middle Bench                        |
| Title/author     | Lower Middle 17-014 Part B Ken George     |
| Filename         | Blast_17-014_Lower_Middle_Design_Part_B.s |

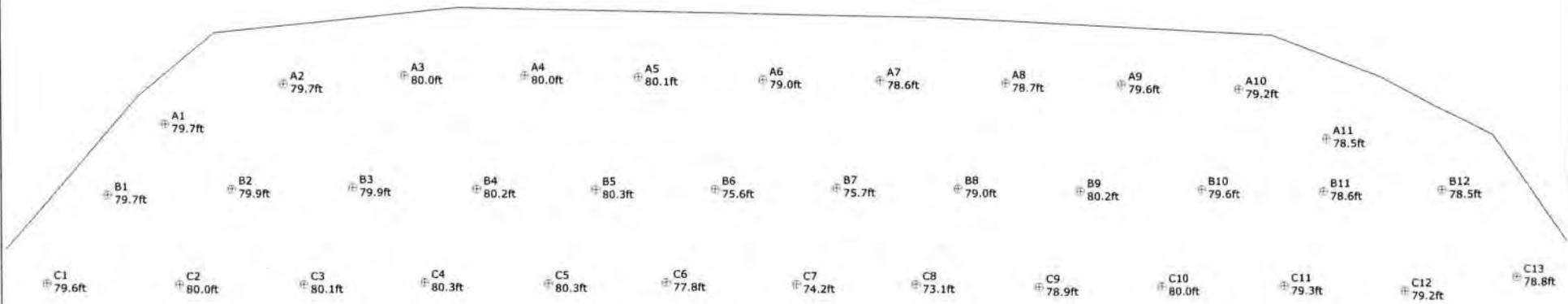
SHOTPlus 5 Plan

Blast Summary Data

|                        |                         |                            |                  |
|------------------------|-------------------------|----------------------------|------------------|
| Burden: 9.0ft          | Spacing: 10.5ft         | Subdrill: 2.0ft            | Stemming: 7.0ft  |
| 1st row burden: 12.0ft | Hole Diameter: 4.0in    | Number of holes: 36        | Hole angle: 0.0° |
| Rock density: 2.65g/cc | Total drilled: 2841.9ft | Blasted tonnage: 20,509S/T |                  |



open face



Lower Middle 17-014 Part B  
 12x10.5 Front Row, 9x10.5 Body  
 4" Hole Diameter  
 250m Elevation + 0.6m subdrill



Not to scale

|                  |                                     |
|------------------|-------------------------------------|
| SHOTPlus 5.6.4.3 | 22/06/2017                          |
| Mine             | Burlington                          |
| Location         | Lower Middle Bench                  |
| Title/author     | Lower Middle 17-014 Part B Ken Ge   |
| Filename         | Blast 17-014 Lower Middle Design Pa |

Customer: **Nelson**Quarry: **Burlington**Blast Number: **17-014 B****Blast Design**

P.O. #:

Orica Order #:

Design Date: **2017-07-04**

page 1

Blaster-in-charge: **Kevin Toplis** (Print Name)Blast Location: **Lower middle bench** (Bench / Face)GPS Coordinates: **43.40347** °N Latitude **79.88363** °W Longitude  
Centre of Blast Centre of Blast

Design te Blasted: **21,631** te  
 Total Holes Loaded: **36** holes  
 ... including: **0** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **3** rows

*- Drilling information -*

Angle from Vertical

Primary Bit diam: **101.6** mm **0**° # Holes: **36** = 2,840.4 ft ( **4** " diam)  
 Secondary Bit diam: mm **0**° # Holes: = 0.0 ft ( " diam)  
 Tertiary Bit diam: mm **0**° # Holes: = 0.0 ft ( " diam)

Nominal Bit Diameter:

*- Design Pattern (Front Row) -*

Burden: **12.0** ft avg  
 Spacing: **10.5** ft avg  
 # Holes: **11** front row

*- Design Pattern (Main Body) -*

Burden: **9.0** ft avg  
 Spacing: **10.5** ft avg  
 # holes: **25** main body

Bench Height: **76.9** ft avgSub-drill: **2.0** ft avgHole Depth: **78.9** ft avg*- Design Stone Decking -*Front Row: **0.0** ft avgMain Body: **0.0** ft avg*- Design Collar Stemming -*Front Row: **7.0** ft avgMain Body: **7.0** ft avgMaterial used: **.75** clear*- Design Charge Length -*Front Row: **71.9** ft avgMain Body: **71.9** ft avg*- Design Charge Weight -*Front Row: **209.7** kg/holeMain Body: **209.7** kg/holeMax Chge Wt / delay: **230.0** kg/delayRequired kg Loaded: **8,318** kgRock Density: **2.65** g/cc = te/m<sup>3</sup>*- Design Powder Factor -*Expected Yield PF: **0.385** kg/te (actual)Front row: **0.288** kg/te (theoretical)Main Body: **0.384** kg/te (theoretical)"KPI" PF: **0.352** kg/te (theoretical)1.288 lb/yd<sup>3</sup>1.717 lb/yd<sup>3</sup>1.574 lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Blt B, S, Expl or IS from previous Blast

**Bulk Explosives Req'd:**

kg

|                       |              |              |
|-----------------------|--------------|--------------|
| <b>CENTRA GOLD 70</b> | ChargeWt.exe | <b>8,294</b> |
|-----------------------|--------------|--------------|

**Pkgd Explosives Req'd:**

kg

**Boosters Req'd:**

kg/u # used kg

|                                  |      |           |             |
|----------------------------------|------|-----------|-------------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34 | <b>72</b> | <b>24.5</b> |
|----------------------------------|------|-----------|-------------|

total explosives weight in Blast (kg): **8,318**Pkgd Prod (0 kg) % of Total kg: **0.0%****Detonators Req'd:**

ms # req'd

|                          |  |           |
|--------------------------|--|-----------|
| <b>UNITRONIC 600 30M</b> |  | <b>36</b> |
|--------------------------|--|-----------|

|                         |  |           |
|-------------------------|--|-----------|
| <b>UNITRONIC 600 9M</b> |  | <b>36</b> |
|-------------------------|--|-----------|

**Cord & Access. Req'd:**

U of M # req'd

|                                 |       |          |
|---------------------------------|-------|----------|
| <b>IRE DUPLEX (6 PACK) 400M</b> | units | <b>1</b> |
|---------------------------------|-------|----------|

|  |       |  |
|--|-------|--|
|  | units |  |
|--|-------|--|

|  |       |  |
|--|-------|--|
|  | units |  |
|--|-------|--|

## Resource Deployment

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) | Note Exception | <b>2</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services Req'd:**

|                                                           |                              |            |
|-----------------------------------------------------------|------------------------------|------------|
| <b>BULK TRUCK CHARGE</b>                                  | >/=5,000kg <10,000kg         | <b>1</b>   |
| <b>SHOT SERVICE FEE *</b>                                 | Line Item (Fee per Blast)    | <b>1/2</b> |
| <b>SEISMOGRAPH RENTAL</b>                                 | * 1 unit in Shot Service Fee | <b>0</b>   |
| <b>3D LASER PROFILE</b>                                   | Enter "1" if 3D Profiled     | <b>0</b>   |
| <b>BORETRACK</b>                                          | Enter "1" if Boretraked      | <b>0</b>   |
| <b>LABOUR CHARGE (enter HOURS Must be pre-authorized)</b> |                              |            |



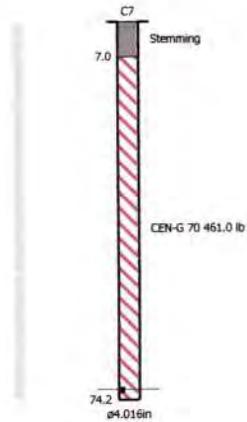
Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
P.O. #:  
Blast Date: **2017-07-04**

Blast Number: **17-014B**  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

*Kevin Toplis*

#

Quarry Manager:

Signature required, indicating  
sign off on Blast Design.



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-07-25**

Blast Number: **17-015**  
 Orica Order #: **2216725**  
 Blast Time: **11:57 AM**

page 1 blaster-in-charge: **Kevin Topplis** (Print Name)

Blast Location: **Lower middle bench** (Bench / Face)

GPS Coordinates: **43.40395** °N Latitude **79.88376** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **NE** at **5** kph Temperature: **16 to 20** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **9,144** m

- Drilling Information -

|                                             | Angle from Vertical    | Nominal Bit Diameter:                            |
|---------------------------------------------|------------------------|--------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm           | <b>0</b> °             | # Holes: <b>52</b> = 2,184.0 ft ( 4 " diam)      |
| Secondary Bit diam: <input type="text"/> mm | <input type="text"/> ° | # Holes: <input type="text"/> = 0.0 ft ( " diam) |
| Tertiary Bit diam: <input type="text"/> mm  | <input type="text"/> ° | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>27,100</b> | <b>21,270</b> | 5,830 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used    | kg   |
|----------------------------------|-----------|-----------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>52</b> | 17.7 |

total explosives weight in Blast (kg): 5,848

Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 15M</b> |          |    | <b>52</b> |

**Cord & Accessories:**

|                                         | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services:**

|                             | Line Item (Hourly Rate)      |             |
|-----------------------------|------------------------------|-------------|
| GPS LAYOUT                  |                              | <b>1</b>    |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b>    |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b>    |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee |             |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled     | <b>0</b>    |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b>    |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour)     | <b>12.0</b> |

|                        |                                      |                             |
|------------------------|--------------------------------------|-----------------------------|
| tonnes Blasted:        | <b>15,057</b> te                     | <b>5,682</b> m <sup>3</sup> |
| Total tonnes per day:  | <b>15,057</b> te                     | <b>TBA</b> Rate Code        |
| Total Holes Loaded:    | <b>52</b> holes                      |                             |
| ... including:         | <b>3</b> Dead Holes                  |                             |
| ... and:               | <b>0</b> Helper Holes                |                             |
| Helper Hole Collar:    | <b>0.0</b> ft avg                    |                             |
| # Rows Blasted:        | <b>4</b> rows                        |                             |
| - Pattern (Front Row)- |                                      |                             |
| Burden:                | <b>12.0</b> ft avg                   |                             |
| Spacing:               | <b>10.5</b> ft avg                   |                             |
| # Holes:               | <b>13</b> front row                  |                             |
| Burden:                | <b>9.0</b> ft avg                    |                             |
| Spacing:               | <b>10.5</b> ft avg                   |                             |
| # Holes:               | <b>39</b>                            |                             |
| Bench Height:          | <b>40.0</b> ft avg                   |                             |
| Sub-drill:             | <b>2.0</b> ft avg                    |                             |
| Hole Depth:            | <b>42.0</b> ft avg                   |                             |
| - Stone Decking -      |                                      |                             |
| Front Row:             | <b>0.0</b> ft avg                    |                             |
| Main Body:             | <b>0.0</b> ft avg                    |                             |
| # Stone Decks:         | <b>0</b> per blast                   |                             |
| - Collar Stemming -    |                                      |                             |
| Front Row:             | <b>9.0</b> ft avg                    |                             |
| Main Body:             | <b>7.0</b> ft avg                    |                             |
| Material used:         | <b>.75</b> clear                     |                             |
| - Charge Length -      |                                      |                             |
| Front Row:             | <b>33.0</b> ft avg                   |                             |
| Main Body:             | <b>35.0</b> ft avg                   |                             |
| - Charge Weight -      |                                      |                             |
| Front Row:             | <b>96.2</b> kg/hole                  |                             |
| Main Body:             | <b>102.1</b> kg/hole                 |                             |
| Max. per delay:        | <b>125.0</b> kg/delay                |                             |
| SD () Equation:        | <b>0.0</b> kg/delay                  |                             |
| Total kg Loaded:       | <b>5,848</b> kg                      |                             |
| Rock Density:          | <b>2.65</b> g/cc = te/m <sup>3</sup> |                             |
| - Powder Factor -      |                                      |                             |
| Yield PF:              | <b>0.388</b> kg/te (actual)          |                             |
| Front row:             | <b>0.254</b> kg/te (theoretical)     |                             |
| Main Body:             | <b>0.360</b> kg/te (theoretical)     |                             |
| "KPI" PF:              | <b>#DIV/0!</b> kg/te (theoretical)   |                             |

1.735 lb/yd<sup>3</sup>  
 1.136 lb/yd<sup>3</sup>  
 1.607 lb/yd<sup>3</sup>  
 ##### lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

blaster hours: **6.5**  
 helper hours: **5.5**  
 Tech hours: **GPS 1hr**  
 adjusted collars to holes: **A1,3,4-10ft +O21:AA54A7,8-11ft A9,10,11-10ft A12-12ft A13-B1, C1, D1-10ft X1-20ft X2-12ft X3-10ft**



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-07-25**

Blast Number: **17-015**  
 Orica Order #: **2216725**  
 Blast Time: **11:57 AM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.40393</b> | <b>79.88378</b> | 0.757542    | 1.394235    |
| Front Row Corner          | <b>43.40406</b> | <b>79.88393</b> | 0.757544    | 1.394238    |
| Back Row Corner           | <b>43.40385</b> | <b>79.88356</b> | 0.757540    | 1.394231    |
| Average (Centre of Blast) | 43.40395        | 79.88376        | 0.757542    | 1.394235    |

1st

| Seismograph Co-ordinates                      | Enter ° N Lat.                 | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-----------------------------------------------|--------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                   |                                |                 |                            |                                        |
| 2nd Reading                                   |                                |                 |                            |                                        |
| Average                                       | 0.00000                        | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast)     | <b>0.0</b>                     | m               |                            |                                        |
| Post Blast Data:                              | ppV: <b>1.1</b>                | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                               | frequency:                     | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                               | air overpressure: <b>112.8</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Northwest- colling rd (Nelson monitor)</b> |                                |                 |                            |                                        |

2nd

| Seismograph Co-ordinates                    | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|---------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                 | <b>43.71939</b>               | <b>80.38847</b> | 0.763047                   | 1.403043                               |
| 2nd Reading                                 |                               |                 |                            |                                        |
| Average                                     | 43.71939                      | 80.38847        | 0.763047                   | 1.403043                               |
| Distance (2nd Seis. From Centre of Blast)   | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                            | ppV: <b>3.6</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                             | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                             | air overpressure: <b>91.5</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>2450 2nd concession (Nelson monitor)</b> |                               |                 |                            |                                        |

3rd

| Seismograph Co-ordinates                   | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|--------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                |                               |                 |                            |                                        |
| 2nd Reading                                |                               |                 |                            |                                        |
| Average                                    | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast)  | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                           | ppV: <b>2.2</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                            | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                            | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Southwest- Camisle (Nelson monitor)</b> |                               |                 |                            |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

*Kevin Toplis*

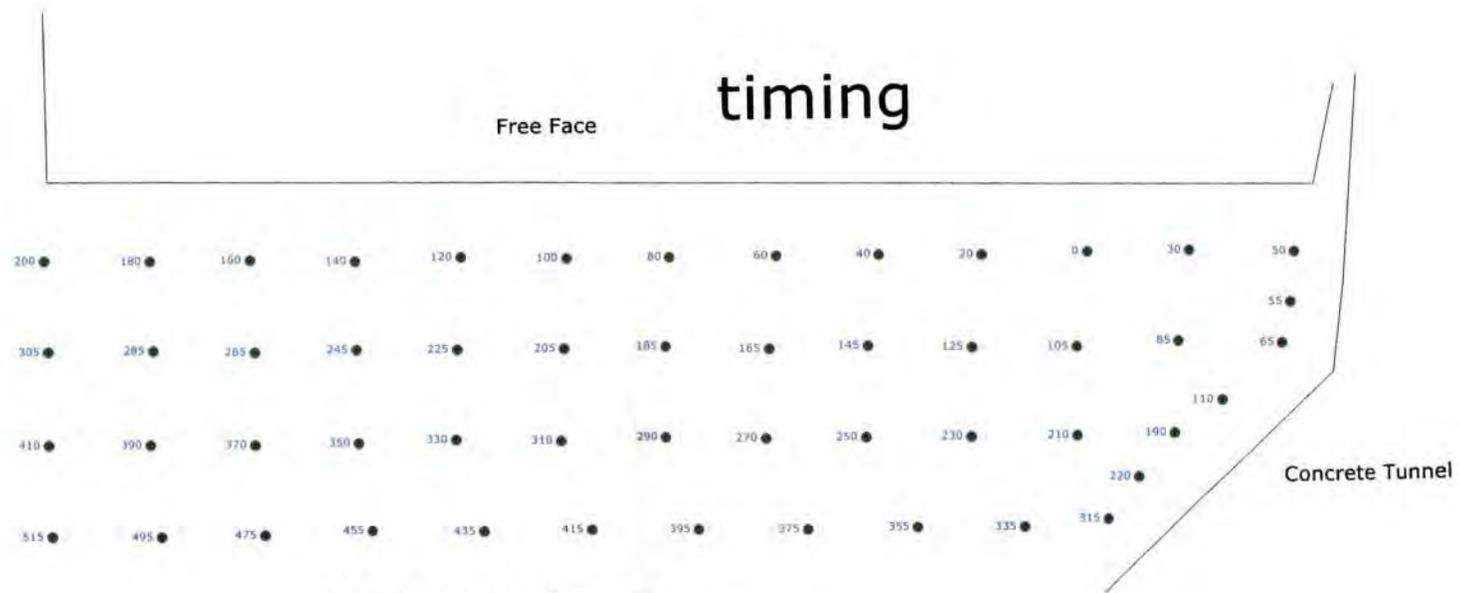
Signature required, indicating that  
 Blast Report is Complete & Accurate.

jim bray

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.5ft      Subdrill: 2.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 52      Hole angle: 0.0°  
 Total drilled: 2188.5ft



17-015 Lower Middle Bench  
 12' X 10.5' Front Row - 9' X 10.5' Body  
 4" Drill Bit  
 250 Floor Elevation + .6 Sub



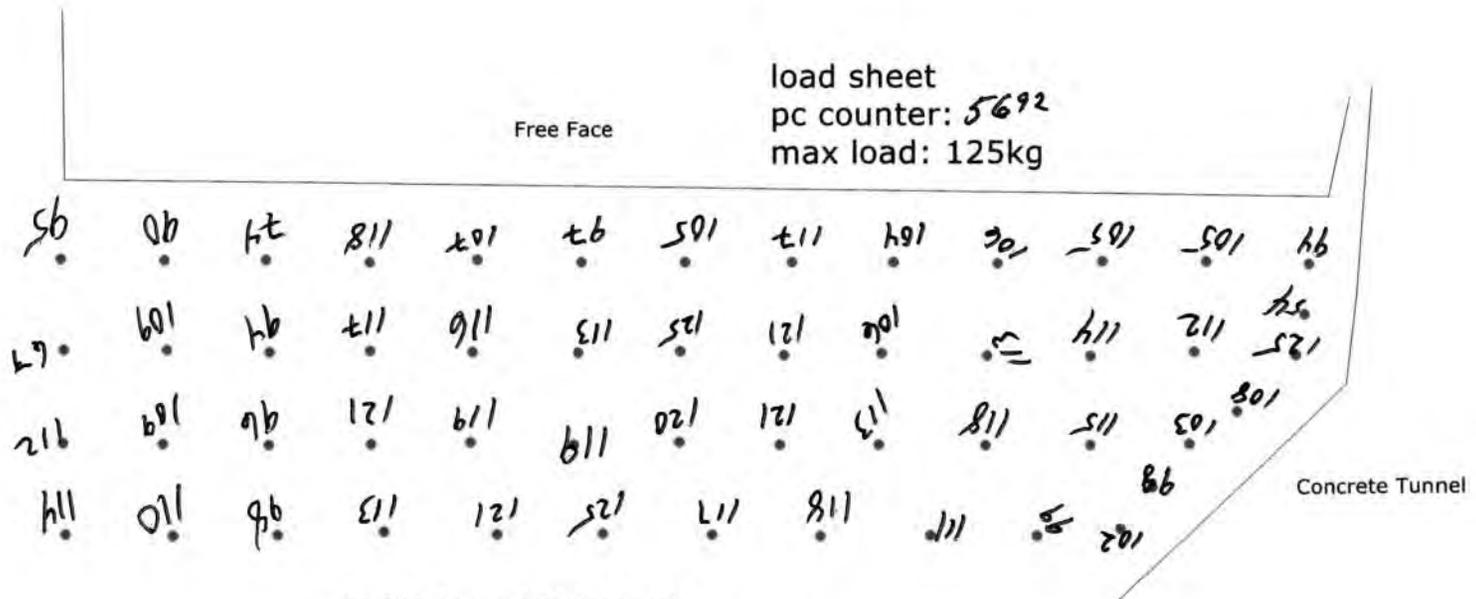
Not to scale

|                  |                                     |
|------------------|-------------------------------------|
| SHOTPlus 5.6.3.6 | 24/07/2017                          |
| Mine             | Burlington                          |
| Location         |                                     |
| Title/author     | 17-015 Lower Middle Bench G. Palcso |
| Filename         | 17-015_Lower_Middle_Bench_Final.spf |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.5ft      Subdrill: 2.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 52      Hole angle: 0.0°  
 Total drilled: 2188.5ft



17-015 Lower Middle Bench  
 12' X 10.5' Front Row - 9' X 10.5' Body  
 4" Drill Bit  
 250 Floor Elevation + .6 Sub

|                  |                                     |
|------------------|-------------------------------------|
| SHOTPlus 5.6.3.6 | 24/07/2017                          |
| Mine             | Burlington                          |
| Location         |                                     |
| Title/author     | 17-015 Lower Middle Bench G. Palcso |
| Filename         | 17-015_Lower_Middle_Bench_Final.spf |

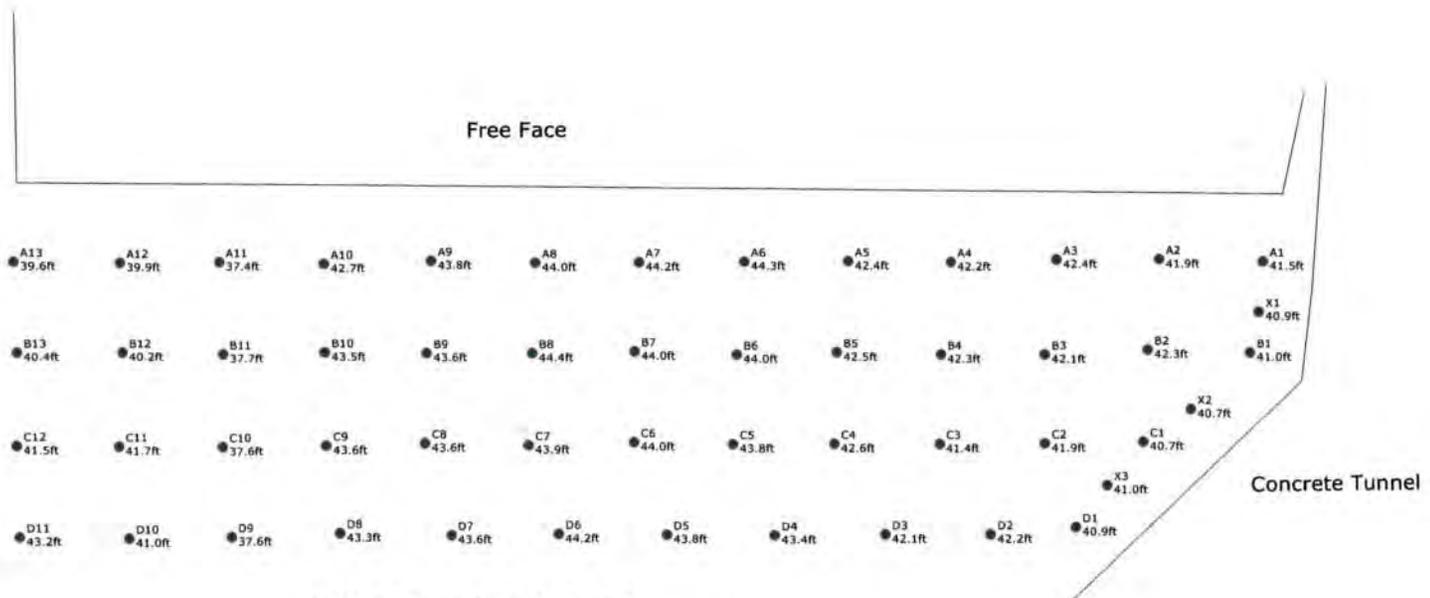


Not to scale

### SHOTPlus 5 Plan

#### Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.5ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 52 | Hole angle: 0.0° |
| Total drilled: 2188.5ft |                      |                     |                  |



17-015 Lower Middle Bench  
 12' X 10.5' Front Row - 9' X 10.5' Body  
 4" Drill Bit  
 250 Floor Elevation + .6 Sub

|                  |                                     |            |
|------------------|-------------------------------------|------------|
| SHOTPlus 5.6.3.6 |                                     | 24/07/2017 |
| Mine             | Burlington                          |            |
| Location         |                                     |            |
| Title/author     | 17-015 Lower Middle Bench G. Palcso |            |
| Filename         | 17-015_Lower_Middle_Bench_Final.spf |            |



Not to scale

Customer: **Nelson**Quarry: **Burlington**Blast Number: **17-015****Blast Design**

P.O. #:

Orica Order #:

Design Date: **2017-07-25**

page 1

Master-in-charge: **Kevin Toplis** (Print Name)Blast Location: **Lower middle bench** (Bench / Face)GPS Coordinates: **43.40395** °N Latitude **79.88376** °W Longitude  
Centre of Blast Centre of Blast

Design te Blasted: **15,057** te  
 Total Holes Loaded: **52** holes  
 ... including: **3** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **4** rows

*- Drilling Information -*

Angle from Vertical  
 Primary Bit diam: **101.6** mm **0**° # Holes: **52** = 2,184.0 ft ( **4** " diam)  
 Secondary Bit diam: mm **0**° # Holes: = 0.0 ft ( " diam)  
 Tertiary Bit diam: mm **0**° # Holes: = 0.0 ft ( " diam)

Nominal Bit Diameter:

*- Design Pattern (Front Row) -*

Burden: **12.0** ft avg  
 Spacing: **10.5** ft avg  
 # Holes: **13** (front row)

*- Design Pattern (Main Body) -*

Burden: **9.0** ft avg  
 Spacing: **10.5** ft avg  
 # Holes: **39** main body  
 Bench Height: **40.0** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: **42.0** ft avg

*- Design Stang Decking -*

Front Row: **0.0** ft avg  
 Main Body: **0.0** ft avg

*- Design Collar Stemming -*

Front Row: **8.0** ft avg  
 Main Body: **7.0** ft avg

Material used: **.75** clear*- Design Charge Length -*

Front Row: **34.0** ft avg  
 Main Body: **35.0** ft avg

*- Design Charge Weight -*

Front Row: **99.1** kg/hole  
 Main Body: **102.1** kg/hole  
 Max Chge Wt / delay: **115.0** kg/delay

Required kg Loaded: **5,842** kg  
 Rock Density: **2.65** g/cc = te/m<sup>3</sup>

*- Design Powder Factor -*

Expected Yield PF: **0.388** kg/te (actual)  
 Front row: **0.262** kg/te (theoretical)  
 Main Body: **0.360** kg/te (theoretical)  
 "KPI" PF: **0.335** kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Blt. B, S, Expl or IS from previous Blast

**Bulk Explosives Req'd:** kg  
 CENTRA GOLD 70 ChargeWt.exe **5,824**

**Pkgd Explosives Req'd:** kg

**Boosters Req'd:** kg/u # used kg  
 PENTEX 12 (OR EQUIVALENT) 0.34 **52** 17.7

total explosives weight in Blast (kg): **5,842**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

**Detonators Req'd:** ms # req'd  
 UNITRONIC 600 15M **52**

**Cord & Access. Req'd:** U of M # req'd  
 IRE DUPLEX (6 PACK) 400M units **1**

## Resource Deployment

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services Req'd:**

|                             |                              |          |
|-----------------------------|------------------------------|----------|
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b> |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b> |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee | <b>0</b> |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled     | <b>0</b> |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b> |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |          |



Bill of Lading / Connaissance

CONSIGNOR  
EXPÉDITEUR  
**GRAND VALLEY**  
033411 SIDE ROAD 21-22  
GRAND VALLEY ON  
CA L9W 7G1

CONSIGNEE  
CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
BURLINGTON ON  
CA L7R 4L8

|                                           |                                               |
|-------------------------------------------|-----------------------------------------------|
| GROSS / BRUT                              |                                               |
| TARE                                      |                                               |
| NET                                       |                                               |
| TIME IN<br>HEURE D'ENTRÉE<br>16:50        | TIME OUT<br>HEURE SORTIE                      |
| ORDER NUMBER<br>N° DE COMMANDE<br>2216725 | B/L NUMBER<br>N° DE CONNAISSEMENT<br>85716915 |

|                                              |                                                                   |                                                                        |                                                           |
|----------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE<br>25 Jul 2017 | TIME REQUIRED<br>HEURE REQUISE<br>00:00:00                        | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR<br>NELSON AGGREGATE COMPANY | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT<br>N/A |
| DATE SHIPPED<br>EXPÉDIÉ LE<br>25 Jul 2017    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON<br>FOB Dest'n, Own Truck | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR<br>F-73289                        | VEHICLE NO.<br>N° DE VÉHICULE<br>16055                    |

| QTY.<br>QTÉ.                                                                                                                                    | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT. | DESCRIPTION                          | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|-------------------------|--------------------------------------|--------------------|-------------------|
| 98                                                                                                                                              | PC | X        | 46                      | 52                      | PENTEX BC 340 (49/CS)                | 2                  | 35.770            |
| 2                                                                                                                                               | PC |          | 1                       | 1                       | Harness Wire Duplex (6 pack) 400m    | 1                  | 5.840             |
| 80                                                                                                                                              | PC | X        | 80                      | 0                       | *uni tronic 600-06.0M CU/ZC(20')80PC | 1                  | 5.840             |
| 132                                                                                                                                             | PC | X        | 80                      | 52                      | *uni tronic 600-15M C/Z SPL(50')66PC | 2                  | 22.572            |
| 100                                                                                                                                             | PC |          | 100                     | 0                       | MINI STEM PLUGS - PART #6015         |                    | 0.700             |
| 1                                                                                                                                               | PC |          |                         |                         | LICENSED BLASTER                     |                    |                   |
| 1.0                                                                                                                                             | HR |          |                         |                         | LABOUR CHARGE                        |                    |                   |
| 1                                                                                                                                               | PC |          |                         |                         | ROG (ROCK ON GROUND)                 |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                              |    |          |                         |                         |                                      |                    | 70.722 KG         |
| **** TOTAL PACKAGES ****                                                                                                                        |    |          |                         |                         |                                      | 6                  |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingsservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                         |                                      |                    |                   |

PALETTES USED / PALETTES UTILISÉES      PALETTES RETURNED / PALETTES RETOURNÉES      BAGS USED / SACS UTILISÉS

|                                                                          |                                                                                                       |                                                               |                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br><b>ERAP 2-1510</b> | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TÉLÉPHONE D'URGENCE/24 HEURE NUMÉRO<br><b>1-877-561-2626</b> | PLACARDS OFFERED / PLACARDS OFFERT<br>YES / OUI      NO / NON | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSEMENT D'ORICA :<br>Orica Canada Inc.<br>301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5 |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                       |                                                                       |                                                             |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br><b>GRAND VALLEY</b>                         | CARRIER / TRANSPORTEUR<br><b>Orica Truck</b>                          | CONSIGNEE / DESTINATAIRE<br><b>NELSON AGGREGATE COMPANY</b> |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br><i>Neil Kwart</i> | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br><i>Neil Kwart</i> | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR            |
| SIGNATURE<br><i>17/17</i>                                             | DATE<br>25 07 17<br>D/J M/M Y/A                                       | SIGNATURE<br><i>17/17</i>                                   |
|                                                                       | DATE<br>25 07 17<br>D/J M/M Y/A                                       | DATE<br>D/J M/M Y/A                                         |

**2 SHIPPING ORDER  
BON D'EXPÉDITION**

(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
(L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRES AVOIR SIGNÉ LA COPIE ORIGINALE (1) DU CONNAISSEMENT CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO



Customer: **Nelsons**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-08-30**

Blast Number: **17-016**  
 Orica Order #: **2232326**  
 Blast Time: **12:01 PM**

page 1

Blaster-in-charge: **Mitch Ossington** (Print Name)

Blast Location: **South face** (Bench / Face)  
 GPS Coordinates: **43.39837** °N Latitude **79.88412** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **SW** at **5** kph Temperature: **21 to 25** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **3000ft** m

*- Drilling Information -*

|                                             | Angle from Vertical    | Nominal Bit Diameter:                            |
|---------------------------------------------|------------------------|--------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm           | <b>0</b> °             | # Holes: <b>28</b> = 2,360.4 ft ( 4 " diam)      |
| Secondary Bit diam: <input type="text"/> mm | <b>0</b> °             | # Holes: <input type="text"/> = 0.0 ft ( " diam) |
| Tertiary Bit diam: <input type="text"/> mm  | <input type="text"/> ° | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>27,280</b> | <b>20,510</b> | 6,770 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used     | kg   |
|----------------------------------|-----------|------------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>112</b> | 38.1 |

total explosives weight in Blast (kg): **6,808**

Pkgd Prod (0 kg) % of Total kg: **0.0%**

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 6M</b>  |          |    | <b>28</b> |
| <b>UNITRONIC 600 20M</b> |          |    | <b>28</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>56</b> |

**Cord & Accessories:**

|                                         | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services:**

| GPS LAYOUT                  | Line Item (Hourly Rate)      |          |
|-----------------------------|------------------------------|----------|
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b> |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b> |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee | <b>0</b> |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | <b>1</b> |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b> |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |          |

|                                |                                      |                             |
|--------------------------------|--------------------------------------|-----------------------------|
| tonnes Blasted:                | <b>16,211</b> te                     | <b>6,118</b> m <sup>3</sup> |
| Total tonnes per day:          | <b>16,211</b> te                     | <b>TBA</b> Rate Code        |
| Total Holes Loaded:            | <b>28</b> holes                      |                             |
| ... including:                 | <b>0</b> Dead Holes                  |                             |
| ... and:                       | <b>3</b> Helper Holes                |                             |
| Helper Hole Collar:            | <b>7.0</b> ft avg                    |                             |
| # Rows Blasted:                | <b>3</b> rows                        |                             |
| <i>- Pattern (Front Row)-</i>  |                                      |                             |
| Burden:                        | <b>10.0</b> ft avg                   |                             |
| Spacing:                       | <b>10.5</b> ft avg                   |                             |
| # Holes:                       | <b>14</b> front row                  |                             |
| <i>- Pattern (Main Body) -</i> |                                      |                             |
| Burden:                        | <b>10.0</b> ft avg                   |                             |
| Spacing:                       | <b>10.5</b> ft avg                   |                             |
| # Holes:                       | <b>14</b> main body                  |                             |
| Bench Height:                  | <b>82.3</b> ft avg                   |                             |
| Sub-drill:                     | <b>2.0</b> ft avg                    |                             |
| Hole Depth:                    | <b>84.3</b> ft avg                   |                             |
| <i>- Stone Decking -</i>       |                                      |                             |
| Front Row:                     | <b>4.0</b> ft avg                    |                             |
| Main Body:                     | <b>4.0</b> ft avg                    |                             |
| <b># Stone Decks:</b>          | <b>28</b> per blast                  |                             |
| <i>- Collar Stemming -</i>     |                                      |                             |
| Front Row:                     | <b>10.0</b> ft avg                   |                             |
| Main Body:                     | <b>7.0</b> ft avg                    |                             |
| Material used:                 | <b>1/2" crush</b>                    |                             |
| <i>- Charge Length -</i>       |                                      |                             |
| Front Row:                     | <b>70.3</b> ft avg                   |                             |
| Main Body:                     | <b>73.3</b> ft avg                   |                             |
| <i>- Charge Weight -</i>       |                                      |                             |
| Front Row:                     | <b>205.0</b> kg/hole                 |                             |
| Main Body:                     | <b>213.7</b> kg/hole                 |                             |
| Max. per delay:                | <b>150.0</b> kg/delay                |                             |
| SD () Equation:                | <b>0.0</b> kg/delay                  |                             |
| Total kg Loaded:               | <b>6,808</b> kg                      |                             |
| Rock Density:                  | <b>2.65</b> g/cc = te/m <sup>3</sup> |                             |
| <i>- Powder Factor -</i>       |                                      |                             |
| Yield PF:                      | <b>0.420</b> kg/te (actual)          |                             |
| Front row:                     | <b>0.316</b> kg/te (theoretical)     |                             |
| Main Body:                     | <b>0.330</b> kg/te (theoretical)     |                             |
| "KPI" PF:                      | <b>0.328</b> kg/te (theoretical)     |                             |

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blasted)

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

Blaster Hours= 6hr  
 Helper Hours= 10hrs



Customer: **Nelsons**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-08-30**

Blast Number: **17-016**  
 Orica Order #: **2232326**  
 Blast Time: **12:01 PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.39827</b> | <b>79.88426</b> | 0.757443    | 1.394243    |
| Front Row Corner          | <b>43.39837</b> | <b>79.88413</b> | 0.757444    | 1.394241    |
| Back Row Corner           | <b>43.39847</b> | <b>79.88398</b> | 0.757446    | 1.394238    |
| Average (Centre of Blast) | <b>43.39837</b> | <b>79.88412</b> | 0.757444    | 1.394241    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.                 | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|--------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                                |                 |                            |                                        |
| 2nd Reading                               |                                |                 |                            |                                        |
| Average                                   | 0.00000                        | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast) | <b>0.0</b>                     | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>1.1</b>                | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency:                     | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>107.5</b> | dB              | Trigger set at: <b>115</b> | dB                                     |

**Colling Rd**

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                               |                 |                            |                                        |
| 2nd Reading                               |                               |                 |                            |                                        |
| Average                                   | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (2nd Seis. From Centre of Blast) | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>1.5</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>91.5</b> | dB              | Trigger set at: <b>115</b> | dB                                     |

**2450 #2 sideroad**

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                               |                 |                            |                                        |
| 2nd Reading                               |                               |                 |                            |                                        |
| Average                                   | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>1.5</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |

**Camisle**

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(0)^2}{30^2} \text{ kg} \\
 &= \frac{0}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

*Mitch Ossington*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

Customer: **Nelsons**Quarry: **Burlington**Blast Number: **17-016****Blast Design**P.O. #: **NA**

Orica Order #:

Design Date: **2017-08-30**

page 1

Master-in-charge: **Mitch Ossington** (Print Name)Blast Location: **South Face** (Bench / Face)GPS Coordinates: **43.39805** °N Latitude **79.88433** °W Longitude  
Centre of Blast Centre of Blast

Design to Blasted: **18,157** te  
 Total Holes Loaded: **28** holes  
 ... including: **0** Dead Holes  
 ... and: **3** Helper Holes  
 Helper Hole Collar: **7.0** ft avg  
 # Rows Blasted: **3** rows

**- Drilling Information -**

Angle from Vertical  
 Primary Bit diam: **101.6** mm **0'** # Holes: **28** = 2,360.4 ft ( 4 " diam)  
 Secondary Bit diam: mm **0'** # Holes: = 0.0 ft ( " diam)  
 Tertiary Bit diam: mm **0'** # Holes: = 0.0 ft ( " diam)

Nominal Bit Diameter:

**- Design Pattern (Front Row) -**

Burden: **10.0** ft avg  
 Spacing: **10.5** ft avg  
 # Holes: **14** front row

**- Design Pattern (Main Body) -**

Burden: **10.0** ft avg  
 Spacing: **10.5** ft avg  
 # Holes: 14 main body  
 Bench Height: **82.3** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: **84.3** ft avg

**- Design Stone Decking -**

Front Row: **4.0** ft avg  
 Main Body: **4.0** ft avg

**- Design Collar Stemming -**

Front Row: **7.0** ft avg  
 Main Body: **7.0** ft avg  
 Material used: **1/2" crush**

**- Design Charge Length -**

Front Row: **73.3** ft avg  
 Main Body: **73.3** ft avg

**- Design Charge Weight -**

Front Row: **213.7** kg/hole  
 Main Body: **213.7** kg/hole  
 Max Chge Wt / delay: **130.0** kg/delay

Required kg Loaded: **6,551** kg  
 Rock Density: **2.65** g/cc = te/m<sup>3</sup>

**- Design Powder Factor -**

Expected Yield PF: **0.361** kg/te (actual)  
 Front row: **0.330** kg/te (theoretical)  
 Main Body: **0.330** kg/te (theoretical)  
 "KPI" PF: **0.330** kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast

**130 kg in bottom deck. Bob the top deck to collar.****Bulk Explosives Req'd:**

|                       | ChargeWt.exe | kg           |
|-----------------------|--------------|--------------|
| <b>CENTRA GOLD 70</b> |              | <b>6,500</b> |

**Pkgd Explosives Req'd:**

|  |  | kg |
|--|--|----|
|  |  |    |

**Boosters Req'd:**

|                                  | kg/u        | # used     | kg          |
|----------------------------------|-------------|------------|-------------|
| <b>PENTEX 16 (OR EQUIVALENT)</b> | <b>0.45</b> | <b>112</b> | <b>50.8</b> |

total explosives weight in Blast (kg): **6,551**Pkgd Prod (0 kg) % of Total kg: **0.0%****Detonators Req'd:**

|                          | ms | # req'd   |
|--------------------------|----|-----------|
| <b>UNITRONIC 600 30M</b> |    | <b>56</b> |
| <b>UNITRONIC 600 20M</b> |    | <b>28</b> |
| <b>UNITRONIC 600 9M</b>  |    | <b>28</b> |

**Cord & Access. Req'd:**

|                                 | U of M | # req'd  |
|---------------------------------|--------|----------|
| <b>IRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |
| <b>STEMMING PLUG MINI</b>       | units  |          |

**Resource Deployment**

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services Req'd:**

|                                    |                              |          |
|------------------------------------|------------------------------|----------|
| <b>BULK TRUCK CHARGE</b>           | >=5,000kg <10,000kg          | <b>1</b> |
| <b>SHOT SERVICE FEE *</b>          | Line Item (Fee per Blast)    | <b>1</b> |
| <b>SEISMOGRAPH RENTAL</b>          | * 1 unit in Shot Service Fee |          |
| <b>3D LASER PROFILE</b>            | Line Item (Fee per Blast)    | <b>1</b> |
| <b>BORETRACK</b>                   | Enter "1" if Boretraked      |          |
| <b>LABOUR CHARGE (enter HOURS)</b> | Must be pre-authorized       |          |



Customer: **Nelsons**

# Blast Design

Quarry: **Burlington**

P.O. #:

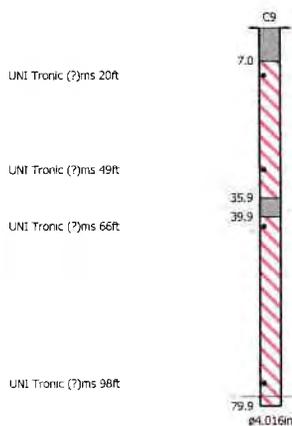
Blast Date: **2017-08-30**

Blast Number: **17-019**

Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mitch Ossington*

#

Quarry Manager:

Signature required, indicating  
sign off on Blast Design

1086863

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissancement



CONSIGNOR  
EXPÉDITEUR  
**GRAND VALLEY**  
033411 SIDE ROAD 21-22  
GRAND VALLEY ON  
CA L9W 7G1

CONSIGNEE  
CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
BURLINGTON ON  
CA L7R 4L8

|                                           |                                               |
|-------------------------------------------|-----------------------------------------------|
| GROSS / BRUT                              |                                               |
| TARE                                      |                                               |
| NET                                       |                                               |
| TIME IN<br>HEURE D'ENTRÉE<br>8:45         | TIME OUT<br>HEURE SORTIE<br>12:30             |
| ORDER NUMBER<br>N° DE COMMANDE<br>2232326 | B/L NUMBER<br>N° DE CONNAISSEMENT<br>85752392 |

|                                              |                                                                   |                                                                        |                                                           |
|----------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE<br>30 Aug 2017 | TIME REQUIRED<br>HEURE REQUISE<br>00:00:00                        | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR<br>NELSON AGGREGATE COMPANY | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT<br>n/a |
| DATE SHIPPED<br>EXPÉDIÉ LE<br>30 Aug 2017    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON<br>FOB Dest'n, Own Truck | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR<br>F-73289                        | VEHICLE NO.<br>N° DE VÉHICULE                             |
| SHIP VIA<br>TRANSPORTEUR<br>Orica Truck      |                                                                   | ROUTING<br>ITINÉRAIRE<br>STANDARD                                      | MAG. LIC. NO.<br>N° DE PERMIS                             |

| QTY.<br>QTÉ.                                                                                                                                                                                                                          | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT. | DESCRIPTION                           | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|-------------------------|---------------------------------------|--------------------|-------------------|
| 196                                                                                                                                                                                                                                   | PC | X        | 84                      | 112                     | PENTEX BC 340 (49/CS)                 | 4                  | 71.540            |
| 2                                                                                                                                                                                                                                     | PC |          | 1                       | 1                       | Harness Wire Duplex (6 pack) 400m     | 1                  | 5.840             |
| 80                                                                                                                                                                                                                                    | PC | X        | 52                      | 28                      | *uni tronic 600-06.0M CU/ZC(20')80PC  | 1                  | 5.840             |
| 66                                                                                                                                                                                                                                    | PC | X        | 38                      | 28                      | *uni tronic 600-20M CU/ZC SPL(65')66P | 1                  | 13.464            |
| 72                                                                                                                                                                                                                                    | PC | X        | 16                      | 56                      | *uni tronic 600-30M C/Z SPL(100')36P  | 2                  | 21.168            |
| 100                                                                                                                                                                                                                                   | PC |          | 100                     | 0                       | MINI STEM PLUGS - PART #6015          |                    | 0.700             |
| 1                                                                                                                                                                                                                                     | PC |          |                         |                         | LICENSED BLASTER                      |                    |                   |
| 1.0                                                                                                                                                                                                                                   | HR |          |                         |                         | LABOUR CHARGE                         |                    |                   |
| 1                                                                                                                                                                                                                                     | PC |          |                         |                         | ROG (ROCK ON GROUND)                  |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                                                                                                                    |    |          |                         |                         |                                       |                    | 118.552 KG        |
| **** TOTAL PACKAGES ****                                                                                                                                                                                                              |    |          |                         |                         |                                       | 9                  |                   |
| GHS/WHMIS SDS documents available<br>Website: <a href="http://www.oricaminingservices.com">www.oricaminingservices.com</a><br>Email: <a href="mailto:sds.na@orica.com">sds.na@orica.com</a><br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                         |                                       |                    |                   |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                                |  |                                                                 |  |                                                                                                                                                                                                                                                   |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br>FRAP 2-1510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TELEPHONE D'URGENCE/24 HEURE NUMERO<br>1-877-561-3636 |  | PLACARDS OFFERED / PLACARDS OFFERT<br>YES / OUI NO / NON        |  | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSEMENT D'ORICA:<br>Orica Canada Inc.<br>301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J0G 3B5 |  |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |  |                                                                                                |  | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE<br>\$             |  | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                                                                                                                    |  |
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | CARRIER / TRANSPORTEUR<br>Orica Truck                                                          |  | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY            |  |                                                                                                                                                                                                                                                   |  |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>B. Williams                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>B. Williams                                |  | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR<br>B. Williams |  |                                                                                                                                                                                                                                                   |  |
| SIGNATURE<br>B. Williams                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  | SIGNATURE<br>B. Williams                                                                       |  | DATE<br>30 Aug 17                                               |  | DATE<br>30 Aug 17                                                                                                                                                                                                                                 |  |

**3 MEMORANDUM**  
MEMORANDUM  
(THIS BILL OF LADING-EXPRESS SHIPPING CONTRACT IS TO BE SIGNED BY THE SHIPPER AND CARRIER)  
(CE CONNAISSEMENT-CONTRAT D'EXPÉDITION PAR MESSAGERIES DOIT ÊTRE SIGNÉ PAR L'EXPÉDITEUR ET LE TRANSPORTEUR)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO  
\*\*\*\* PAGE 2 OF 2 \*\*\*\*  
D.F.G. S772

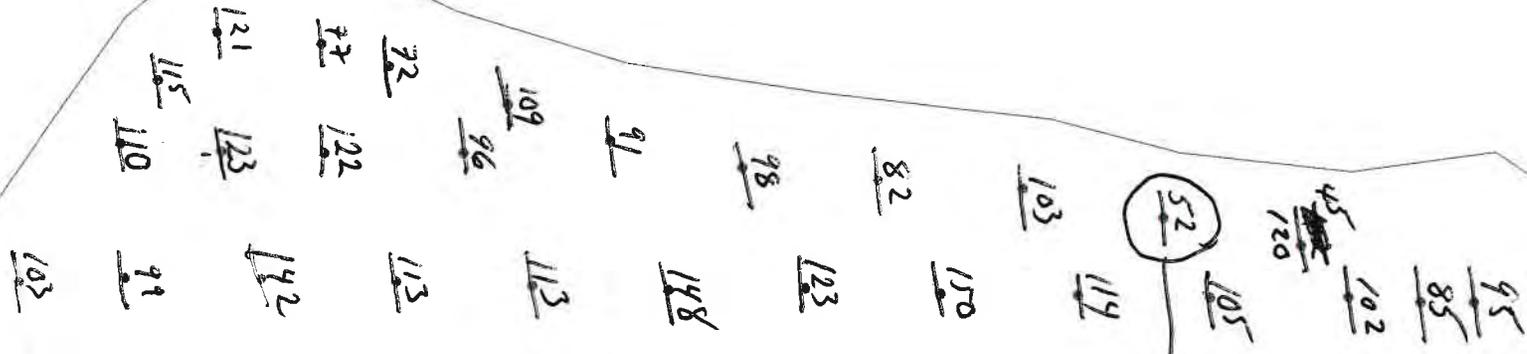
SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 10.0ft          | Spacing: 10.5ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 10.0ft  | Hole Diameter: 4.0in | Number of holes: 28 | Hole angle: 0.0° |
| Total drilled: 2362.0ft |                      |                     |                  |

Free Face

Free Face



17-016 South Wall Final  
 10' X 10.5' - 4" Bit  
 248.5 Floor Elevation + .6 Sub

ALL BOTTOM DECKS  
 TOOK 130 Kg UNLESS  
 MARKED.

|                  |                                    |
|------------------|------------------------------------|
| SHOTPlus 5.6.2.7 | 29/08/2017                         |
| Mine             | Burlington                         |
| Location         |                                    |
| Title/author     | 17-016 South Wall Final G. Palcso  |
| Filename         | 17-016 South Wall Final Timing.spf |



Scale 1:175

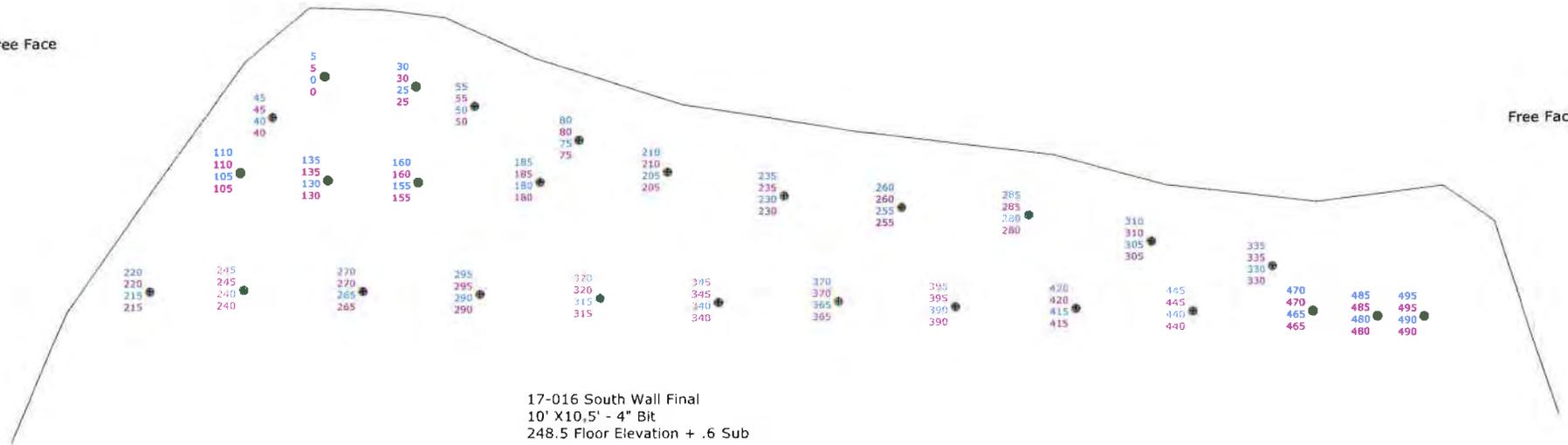
# SHOTPlus 5 Plan

## Blast Summary Data

Burden: 10.0ft      Spacing: 10.5ft      Subdrill: 2.0ft      Stemming: 7.0ft  
 1st row burden: 10.0ft      Hole Diameter: 4.0in      Number of holes: 28      Hole angle: 0.0°  
 Total drilled: 2362.0ft

Free Face

Free Face



Scale 1:175

|                  |                                    |
|------------------|------------------------------------|
| SHOTPlus 5.6.2.7 | 29/08/2017                         |
| Mine             | Burlington                         |
| Location         |                                    |
| Title/author     | 17-016 South Wall Final G. Palcso  |
| Filename         | 17-016 South Wall Final Timing.spf |

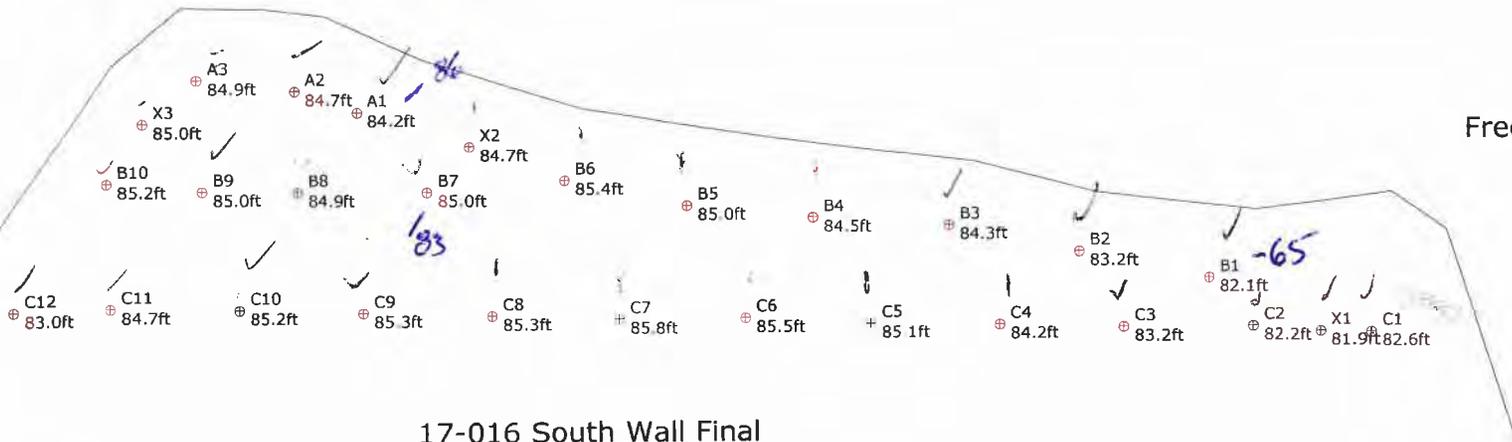
SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 10.0ft          | Spacing: 10.5ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 10.0ft  | Hole Diameter: 4.0in | Number of holes: 28 | Hole angle: 0.0° |
| Total drilled: 2362.1ft |                      |                     |                  |

Free Face

Free Face



17-016 South Wall Final  
 10' X10.5' - 4" Bit  
 248.5 Floor Elevation + .6 Sub



*over drilled 2' needs to be back filled.*



Not to scale

|                    |                                   |
|--------------------|-----------------------------------|
| ShotPlus5 5.2.29.0 | 13/07/2017                        |
| Mine               | Burlington                        |
| Location           |                                   |
| Title/author       | 17-016 South Wall Final G. Palcso |
| Filename           | 17-016 South Wall Final.spf       |



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-08-03**

Blast Number: **17-017**  
 Orica Order #: **2220757**  
 Blast Time: **12:41 PM**

page 1 Blaster-in-charge: **Kevin Topplis** (Print Name)

Blast Location: **Upper middle bench** (Bench / Face)  
 GPS Coordinates: **43.40358** °N Latitude **79.88363** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **N** at **0** kph Temperature: **26 to 30** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **9,144** m

**- Drilling Information -**

|                                     | Angle from Vertical          | Nominal Bit Diameter:      |
|-------------------------------------|------------------------------|----------------------------|
| Primary Bit diam: <b>101.6</b> mm   | <b>0</b> ° # Holes: <b>7</b> | = 539.7 ft ( 4 " diam)     |
| Secondary Bit diam: <b>114.3</b> mm | ° # Holes: <b>6</b>          | = 462.6 ft ( 4 1/2 " diam) |
| Tertiary Bit diam: <b>127.0</b> mm  | ° # Holes: <b>8</b>          | = 616.8 ft ( 5 " diam)     |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>31,090</b> | <b>25,230</b> | 5,860 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used    | kg   |
|----------------------------------|-----------|-----------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>46</b> | 15.6 |

total explosives weight in Blast (kg): 5,876

Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 30M</b> |          |    | <b>26</b> |
| <b>UNITRONIC 600 9M</b>  |          |    | <b>20</b> |

**Cord & Accessories:**

|                                         | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |
| <b>SPIDER STEMMING PLUG 8"</b>          | units  | <b>2</b> |

**Resource Deployment:**

|                                 |          |
|---------------------------------|----------|
| # of Blasts today (this Quarry) | <b>1</b> |
| # of Blasters (this Blast)      | <b>1</b> |
| # of Helpers (this Blast)       | <b>1</b> |
| # of MMU's (this Blast)         | <b>1</b> |

**Services:**

| GPS LAYOUT                  | Line Item (Hourly Rate)      |             |
|-----------------------------|------------------------------|-------------|
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b>    |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b>    |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee |             |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | <b>1</b>    |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b>    |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour)     | <b>13.0</b> |

|                               |                                      |                      |
|-------------------------------|--------------------------------------|----------------------|
| tonnes Blasted:               | <b>11,832</b> te                     | 4,465 m <sup>3</sup> |
| Total tonnes per day:         | <b>11,832</b> te                     | TBA Rate Code        |
| Total Holes Loaded:           | <b>23</b> holes                      |                      |
| ... including:                | <b>2</b> Dead Holes                  |                      |
| ... and:                      | <b>0</b> Helper Holes                |                      |
| Helper Hole Collar:           | <b>0.0</b> ft avg                    |                      |
| # Rows Blasted:               | <b>4</b> rows                        |                      |
| <b>- Pattern (Front Row)-</b> |                                      |                      |
| Burden:                       | <b>12.0</b> ft avg                   |                      |
| Spacing:                      | <b>10.5</b> ft avg                   |                      |
| # Holes:                      | <b>4</b> front row                   |                      |
| Burden:                       | <b>9.0</b> ft avg                    |                      |
| Spacing:                      | <b>10.5</b> ft avg                   |                      |
| # Holes:                      | <b>19</b>                            |                      |
| Bench Height:                 | <b>75.1</b> ft avg                   |                      |
| Sub-drill:                    | <b>2.0</b> ft avg                    |                      |
| Hole Depth:                   | <b>77.1</b> ft avg                   |                      |
| <b>- Stone Decking -</b>      |                                      |                      |
| Front Row:                    | <b>0.0</b> ft avg                    |                      |
| Main Body:                    | <b>0.0</b> ft avg                    |                      |
| <b># Stone Decks:</b>         | <b>0</b> per blast                   |                      |
| <b>- Collar Stemming -</b>    |                                      |                      |
| Front Row:                    | <b>9.0</b> ft avg                    |                      |
| Main Body:                    | <b>8.0</b> ft avg                    |                      |
| Material used:                | <b>.75</b> clear                     |                      |
| <b>- Charge Length -</b>      |                                      |                      |
| Front Row:                    | <b>68.1</b> ft avg                   |                      |
| Main Body:                    | <b>69.1</b> ft avg                   |                      |
| <b>- Charge Weight -</b>      |                                      |                      |
| Front Row:                    | <b>198.6</b> kg/hole                 |                      |
| Main Body:                    | <b>201.5</b> kg/hole                 |                      |
| Max. per delay:               | <b>393.0</b> kg/delay                |                      |
| SD () Equation:               | <b>0.0</b> kg/delay                  |                      |
| Total kg Loaded:              | <b>5,876</b> kg                      |                      |
| Rock Density:                 | <b>2.65</b> g/cc = te/m <sup>3</sup> |                      |
| <b>- Powder Factor -</b>      |                                      |                      |
| Yield PF:                     | <b>0.497</b> kg/te (actual)          |                      |
| Front row:                    | <b>0.280</b> kg/te (theoretical)     |                      |
| Main Body:                    | <b>0.378</b> kg/te (theoretical)     |                      |
| "KPI" PF:                     | <b>#DIV/0!</b> kg/te (theoretical)   |                      |

2.218 lb/yd<sup>3</sup>  
 1.249 lb/yd<sup>3</sup>  
 1.690 lb/yd<sup>3</sup>  
 ##### lb/yd<sup>3</sup>

**Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:**

Blaster hours: **7**  
 helper hours: **6**  
 B1 and X1 are 6"  
 Adjusted collars to holes: A1-23ft, A2-16ft, A3-14ft, A4-16ft, A5-20ft, B1-20ft, C1-15ft  
 C6-load to 63ft 10ft collar, D1-20ft, D7-12ft, D8-12ft, X1 load to 35ft 10ft collar, X2-28ft  
 Holes C6, X1 and X2 got 2 30m uni,



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-08-03**

Blast Number: **17-017**  
 Orica Order #: **2220757**  
 Blast Time: **12:41 PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.40358</b> | <b>79.88365</b> | 0.757535    | 1.394233    |
| Front Row Corner          | <b>43.40365</b> | <b>79.88370</b> | 0.757537    | 1.394234    |
| Back Row Corner           | <b>43.40350</b> | <b>79.88355</b> | 0.757534    | 1.394231    |
| Average (Centre of Blast) | 43.40358        | 79.88363        | 0.757535    | 1.394232    |

**1st**

| Seismograph Co-ordinates                      | Enter ° N Lat.                   | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-----------------------------------------------|----------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                   |                                  |                 |                            |                                        |
| 2nd Reading                                   |                                  |                 |                            |                                        |
| Average                                       | 0.00000                          | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast)     | <b>0.0</b>                       | m               |                            |                                        |
| Post Blast Data:                              | ppV: <b>did</b>                  | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                               | frequency: <b>not</b>            | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                               | air overpressure: <b>trigger</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Northwest- colling rd (Nelson monitor)</b> |                                  |                 |                            |                                        |

**2nd**

| Seismograph Co-ordinates                    | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|---------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                 | <b>43.71939</b>               | <b>80.38847</b> | 0.763047                   | 1.403043                               |
| 2nd Reading                                 |                               |                 |                            |                                        |
| Average                                     | 43.71939                      | 80.38847        | 0.763047                   | 1.403043                               |
| Distance (2nd Seis. From Centre of Blast)   | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                            | ppV: <b>2.9</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                             | frequency: <b>?</b>           | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                             | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>2450 2nd concession (Nelson monitor)</b> |                               |                 |                            |                                        |

**3rd**

| Seismograph Co-ordinates                   | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|--------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                |                               |                 |                            |                                        |
| 2nd Reading                                |                               |                 |                            |                                        |
| Average                                    | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast)  | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                           | ppV: <b>1.3</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                            | frequency: <b>?</b>           | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                            | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Southwest- Camisle (Nelson monitor)</b> |                               |                 |                            |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **0** kg

**Orica**  
 Blaster-in-charge:

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

*jim bray*

SHOTPlus 5 Plan

Blast Summary Data

|                        |                         |                            |                  |
|------------------------|-------------------------|----------------------------|------------------|
| Burden: 9.0ft          | Spacing: 10.5ft         | Subdrill: 2.0ft            | Stemming: 7.0ft  |
| 1st row burden: 12.0ft | Hole Diameter: 4.0in    | Number of holes: 23        | Hole angle: 0.0° |
| Rock density: 2.65g/cc | Total drilled: 1775.1ft | Blasted tonnage: 18,453S/T |                  |

Timing

A2, A3, B4, B5, D7, and D8 are 4.5" Diameter  
 A1, B1, C1, D1, X1, X2, B6, and C6 are 5" Diameter  
 all other holes drill 4" Diameter

open face



Upper Middle 17-017 Final  
 12x10.5 9x10.5 Pattern  
 4" - 4.5" - 5" Hole Diameter  
 250m Elevation + 0.6m Subdrill

|                  |                                       |
|------------------|---------------------------------------|
| SHOTPlus 5.6.3.6 | 03/08/2017                            |
| Mine             |                                       |
| Location         |                                       |
| Title/author     | Middle/ Upper 17-015 Design G. Palcso |
| Filename         | 17-017_Upper_Middle_Final.spf         |



Not to scale

Blast Summary Data

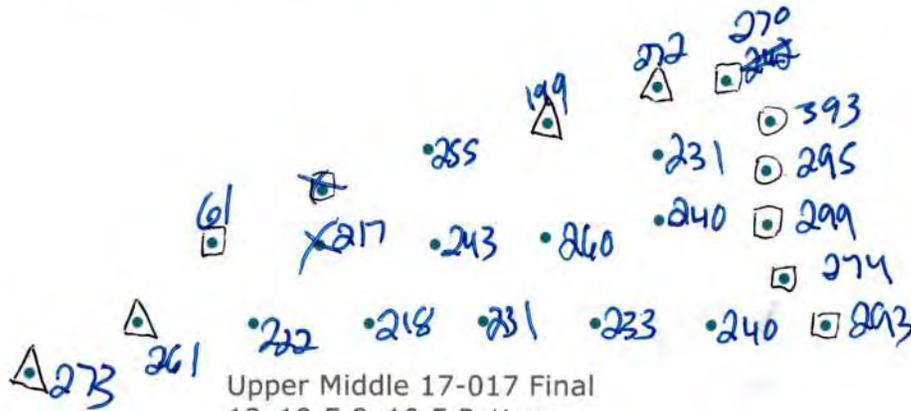
|                        |                         |                            |                  |
|------------------------|-------------------------|----------------------------|------------------|
| Burden: 9.0ft          | Spacing: 10.5ft         | Subdrill: 2.0ft            | Stemming: 7.0ft  |
| 1st row burden: 12.0ft | Hole Diameter: 4.0in    | Number of holes: 23        | Hole angle: 0.0° |
| Rock density: 2.65g/cc | Total drilled: 1775.1ft | Blasted tonnage: 14,442S/T |                  |

○-6"  
 □-5"  
 △-4.5"

A2, A3, B4, B5, D7, and D8 are 4.5" Diameter  
 A1, B1, C1, D1, X1, X2, B6, and C6 are 5" Diameter  
 all other holes drill 4" Diameter

# load sheet pc counter:

open face



Upper Middle 17-017 Final  
 12x10.5 9x10.5 Pattern  
 4" - 4.5" - 5" Hole Diameter  
 250m Elevation + 0.6m Subdrill

5731 kg/s



Not to scale

|                  |                                       |
|------------------|---------------------------------------|
| SHOTPlus 5.6.3.6 | 03/08/2017                            |
| Mine             |                                       |
| Location         |                                       |
| Title/author     | Middle/ Upper 17-015 Design G. Palcso |
| Filename         | 17-017_Upper_Middle_Final.spf         |

*[Handwritten signature]*



Customer: **Nelson**

# Blast Design

Quarry: **Burlington**  
P.O. #:  
Design Date: **2017-08-03**

Blast Number: **17-017**  
Orica Order #: **2220757**

page 1

Blaster-in-charge: **Kevin Toplis** (Print Name)

Blast Location: **Upper middle bench** (Bench / Face)  
GPS Coordinates: **43.40358** °N Latitude **79.88363** °W Longitude  
Centre of Blast      Centre of Blast

Design te Blasted: **11,670** te  
Total Holes Loaded: **23** holes  
... including: **2** Dead Holes  
... and: **0** Helper Holes  
Helper Hole Collar: **0.0** ft avg  
# Rows Blasted: **4** rows

### Drilling Information

|                                     | Angle from Vertical |                     | Nominal Bit Diameter:           |
|-------------------------------------|---------------------|---------------------|---------------------------------|
| Primary Bit diam: <b>101.6</b> mm   | <b>0</b>            | # Holes: <b>9</b> = | 693.9 ft ( <b>4</b> " diam)     |
| Secondary Bit diam: <b>114.3</b> mm | <b>0</b>            | # Holes: <b>6</b> = | 462.6 ft ( <b>4 1/2</b> " diam) |
| Tertiary Bit diam: <b>127.0</b> mm  | <b>0</b>            | # Holes: <b>8</b> = | 616.8 ft ( <b>5</b> " diam)     |

### Design Pattern (Front Row)

Burden: **12.0** ft avg  
Spacing: **10.5** ft avg  
# Holes: **3** front row

### Design Pattern (Main Body)

Burden: **9.0** ft avg  
Spacing: **10.5** ft avg  
# Holes: **20** main body

Bench Height: **75.1** ft avg  
Sub-drill: **2.0** ft avg  
Hole Depth: **77.1** ft avg

### Design Stone Charging

Front Row: **0.0** ft avg  
Main Body: **0.0** ft avg

### Design Collar Stemming

Front Row: **8.0** ft avg  
Main Body: **7.0** ft avg

Material used: **.75** clear

### Design Charge Length

Front Row: **69.1** ft avg  
Main Body: **70.1** ft avg

### Design Charge Weight

Front Row: **201.5** kg/hole  
Main Body: **204.4** kg/hole

Max Chge Wt / delay: **kg/delay**

Required kg Loaded: **18** kg

Rock Density: **2.65** g/cc = te/m<sup>3</sup>

### Design Powder Factor

Expected Yield PF: **0.002** kg/te (actual)  
Front row: **0.284** kg/te (theoretical)  
Main Body: **0.384** kg/te (theoretical)  
"KPI" PF: **0.359** kg/te (theoretical)

1.267 lb/yd<sup>3</sup>

1.714 lb/yd<sup>3</sup>

1.603 lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Bl, S, Expl or IS from previous Blast

### Bulk Explosives Req'd: kg

| CENTRA GOLD 70 | ChargeWt.exe |  |
|----------------|--------------|--|
|                |              |  |

### Pkgd Explosives Req'd: kg



### Boosters Req'd: kg/u # used kg

| PENTEX 12 (OR EQUIVALENT) | 0.34 | 52 | 17.7 |
|---------------------------|------|----|------|
|                           |      |    |      |

total explosives weight in Blast (kg): **18**

Pkgd Prod (0 kg) % of Total kg: **0.0%**

### Detonators Req'd: ms # req'd

| UNITRONIC 600 30M |  | 23 |
|-------------------|--|----|
|                   |  |    |

### Cord & Access. Req'd: U of M # req'd

| IRE DUPLEX (6 PACK) 400M | units | 1 |
|--------------------------|-------|---|
|                          |       |   |

### Resource Deployment

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

### Services Req'd:

|                                                    |                              |          |
|----------------------------------------------------|------------------------------|----------|
| BULK TRUCK CHARGE                                  | <2,000kg                     |          |
| SHOT SERVICE FEE *                                 | Line Item (Fee per Blast)    | <b>1</b> |
| SEISMOGRAPH RENTAL                                 | * 1 unit in Shot Service Fee | <b>0</b> |
| 3D LASER PROFILE                                   | Enter "1" if 3D Profiled     | <b>0</b> |
| BORETRACK                                          | Enter "1" if Boretraked      | <b>0</b> |
| LABOUR CHARGE (enter HOURS Must be pre-authorized) |                              |          |



Customer: **Nelson**

# Blast Design

Quarry: **Burlington**

P.O. #:

Blast Date: **2017-08-03**

Blast Number: **17-017**

Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle



Orica

Blaster-in-charge:

*Kevin Toplis*

#

Quarry Manager:

Signature required, indicating sign-off on Blast Design

SHOTPlus 5 Plan

Blast Summary Data

|                        |                         |                            |                  |
|------------------------|-------------------------|----------------------------|------------------|
| Burden: 9.0ft          | Spacing: 10.5ft         | Subdrill: 2.0ft            | Stemming: 7.0ft  |
| 1st row burden: 12.0ft | Hole Diameter: 4.0in    | Number of holes: 23        | Hole angle: 0.0° |
| Rock density: 2.65g/cc | Total drilled: 1775.1ft | Blasted tonnage: 14,442S/T |                  |

A2, A3, B4, B5, D7, and D8 are 4.5" Diameter  
 A1, B1, C1, D1, X1, X2, B6, and C6 are 5" Diameter  
 all other holes drill 4" Diameter

open face



Upper Middle 17-017 Final  
 12x10.5 9x10.5 Pattern  
 4" - 4.5" - 5" Hole Diameter  
 250m Elevation + 0.6m Subdrill



Not to scale

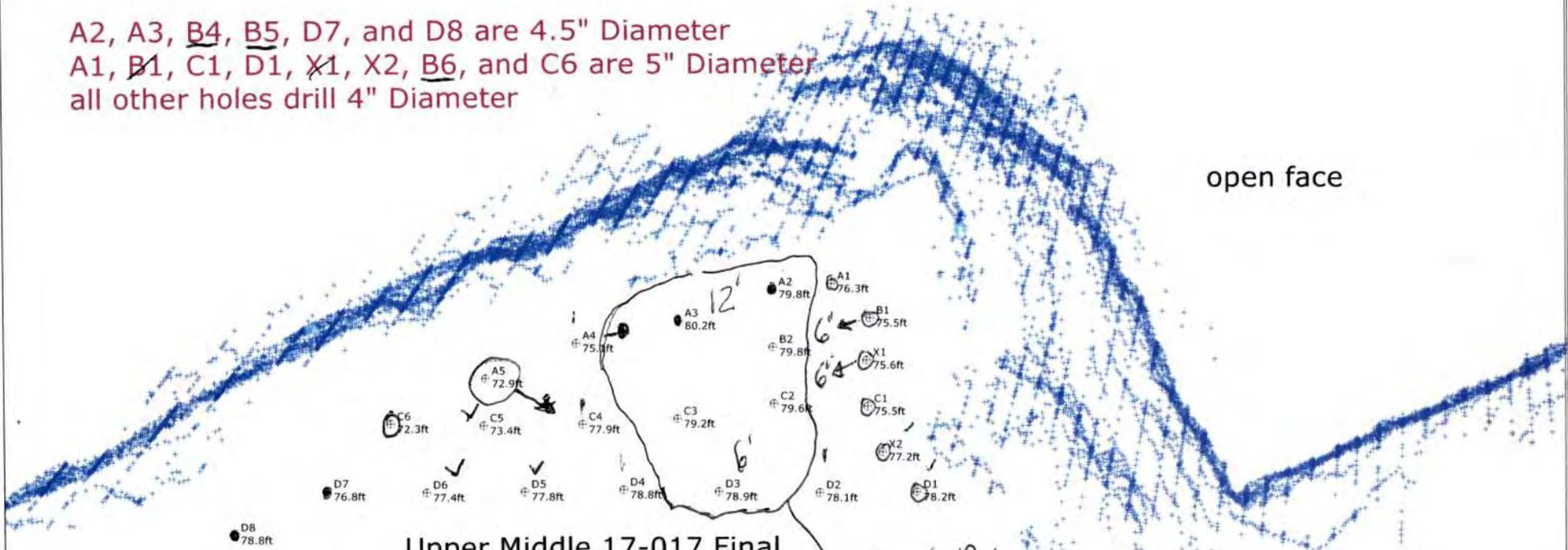
|                  |                                       |
|------------------|---------------------------------------|
| SHOTPlus 5.6.3.6 | 03/08/2017                            |
| Mine             |                                       |
| Location         |                                       |
| Title/author     | Middle/ Upper 17-015 Design G. Palcso |
| Filename         | 17-017_Upper_Middle_Final.spf         |

SHOTPlus 5 Plan

Blast Summary Data

|                        |                         |                            |                  |
|------------------------|-------------------------|----------------------------|------------------|
| Burden: 9.0ft          | Spacing: 10.5ft         | Subdrill: 2.0ft            | Stemming: 7.0ft  |
| 1st row burden: 12.0ft | Hole Diameter: 4.0in    | Number of holes: 23        | Hole angle: 0.0° |
| Rock density: 2.65g/cc | Total drilled: 1775.1ft | Blasted tonnage: 14,442S/T |                  |

A2, A3, B4, B5, D7, and D8 are 4.5" Diameter  
 A1, B1, C1, D1, X1, X2, B6, and C6 are 5" Diameter  
 all other holes drill 4" Diameter



open face

Upper Middle 17-017 Final  
 12x10.5 9x10.5 Pattern  
 4" - 4.5" - 5" Hole Diameter  
 250m Elevation + 0.6m Subdrill

*Top shelf loose  
 layered rock 12' front - 6' back*

*holes overdrilled need to be back filled*



Not to scale

## INDEMNITY & RELEASE AGREEMENT

|                      |                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Orica</b>         | <b>Orica Canada Inc.</b> , a Canadian corporation with its principal place of business at 301 Hotel de Ville, Brownsburg, Quebec J8G 3B5 ("Orica")                              |
| <b>Customer</b>      | <b>Cox Construction Limited</b> , with a place of business at 965 York Road, Guelph, Ontario Canada.                                                                            |
| <b>Date</b>          | June 1, 2017                                                                                                                                                                    |
| <b>Site</b>          | Nelson Aggregates, Burlington Quarry                                                                                                                                            |
| <b>Blasting Plan</b> | Crushing production requires that a the crushing plant and other equipment and property be left in the designated blast area during the blast. Crusher is 64 meters from blast. |

Subject to the terms and conditions of this Indemnity & Release Agreement (this "Agreement"), Orica has agreed to perform certain blasting services (the "Services") for Customer in accordance with the Blasting Plan. Customer recognizes and acknowledges that the performance of the Services in accordance with the Blasting Plan, despite the use of best practices, subjects Orica and Customer to increased risks (a) that the intended blasting results will not be obtained, and (b) of injury and/or death to persons and damage and/or destruction to real and personal property, including without limitation, any property listed above in the Blasting Plan.

Customer, for itself and its parent companies, subsidiaries, shareholders, affiliates and each of their respective agents, representatives, managers, members, directors, officers, employees, heirs, executors, successors and assigns (the "Customer Parties"), shall forever release, discharge, defend and indemnify Orica, its direct and indirect shareholders, subsidiaries, affiliates and parent companies, and each of their respective agents, representatives, managers, members, directors, officers, employees, successors and assigns (collectively, the "Orica Parties"), of, from and against each and every claim made, asserted or threatened and any and all disputes, suits, losses, demands, actions, causes of action, damages, compensation, costs, fees, expenses, interest, awards, judgment, diminution in value, fines, contracts, covenants, obligations, liens, debts and liabilities of every kind and nature whatsoever, presently known or unknown, that the Customer Parties or any third party may now or in the future claim, assert or have, whether in tort, contract, law, equity or otherwise, against the Orica Parties, resulting from, arising out of or relating in any way to the performance of the Services in accordance with the Blasting Plan.

This Agreement constitutes the entire agreement between Customer and Orica with respect to all matters referred to herein and there is no other understanding, agreement, warranty or representation whether express or implied (whether by statute or otherwise) in any way extending, defining or otherwise relating to this Agreement. This Agreement may only be varied or amended by an agreement in writing between Orica and Customer. This Agreement shall be governed and construed in accordance with the laws of the Province of Ontario, without reference to its rules regarding conflicts of laws. This Agreement may be executed by electronic signature and in one or more counterparts.

### **Cox Constuction Limited**

By: Bill White  
Name: Bill White  
Title: Super

1086458

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissance

**Orica Canada Inc.**

CONSIGNOR  
EXPÉDITEUR  
**GRAND VALLEY**  
033411 SIDE ROAD 21-22  
GRAND VALLEY ON  
CA L9W 7G1

CONSIGNEE  
CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
BURLINGTON ON  
CA L7R 4L8

|                                                  |                                                      |
|--------------------------------------------------|------------------------------------------------------|
| GROSS / BRUT                                     |                                                      |
| TARE                                             |                                                      |
| NET                                              |                                                      |
| TIME IN<br>HEURE D'ENTRÉE<br><b>7:00</b>         | TIME OUT<br>HEURE SORTIE<br><b>1:00</b>              |
| ORDER NUMBER<br>N° DE COMMANDE<br><b>2220757</b> | B/L NUMBER<br>N° DE CONNAISSEMENT<br><b>85726282</b> |

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|                                                     |                                                                          |                                                                               |                                                                  |
|-----------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE<br><b>03 Aug 2017</b> | TIME REQUIRED<br>HEURE REQUISE<br><b>00:00:00</b>                        | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR<br><b>NELSON AGGREGATE COMPANY</b> | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT<br><b>n/a</b> |
| DATE SHIPPED<br>EXPÉDIÉ LE<br><b>03 Aug 2017</b>    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON<br><b>FOB Dest'n, Own Truck</b> | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR<br><b>F-73289</b>                        | VEHICLE NO.<br>N° DE VÉHICULE<br><b>DT-15001</b>                 |
| SHIP VIA<br>TRANSPORTEUR<br><b>Orica Truck</b>      |                                                                          | ROUTING<br>ITINÉRAIRE<br><b>STANDARD</b>                                      | MAG. LIC. NO.<br>N° DE PERMIS                                    |

| QTY.<br>QTE.                                                                                                                                                                                                                          | UM | DG<br>MD | QTY. RET'D<br>QTE. RET. | QTY. SOLD<br>QTE. FACT | DESCRIPTION                          | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|------------------------|--------------------------------------|--------------------|-------------------|
| 147                                                                                                                                                                                                                                   | PC | X        | 101                     | 46                     | PENTEX BC 340 (49/CS)                | 3                  | 53.655            |
| 2                                                                                                                                                                                                                                     | PC |          | 1                       | 1                      | Harness Wire Duplex (6 pack) 400m    | 1                  | 5.840             |
| 60                                                                                                                                                                                                                                    | PC | X        | 40                      | 20                     | *uni tronic 600-09.0M CU/ZC(30')60PC | 1                  | 5.880             |
| 66                                                                                                                                                                                                                                    | PC | X        | 66                      | 0                      | *uni tronic 600-15M C/Z SPL(50')66PC | 1                  | 11.286            |
| 72                                                                                                                                                                                                                                    | PC | X        | 46                      | 26                     | *uni tronic 600-30M C/Z SPL(100')36P | 2                  | 21.168            |
| 100                                                                                                                                                                                                                                   | PC |          | 98                      | 2                      | MINI STEM PLUGS - PART #6015         |                    | 0.700             |
| 1                                                                                                                                                                                                                                     | PC |          |                         |                        | LICENSED BLASTER                     |                    |                   |
| 1.0                                                                                                                                                                                                                                   | HR |          |                         |                        | LABOUR CHARGE                        |                    |                   |
| 1                                                                                                                                                                                                                                     | PC |          |                         |                        | ROG (ROCK ON GROUND)                 |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                                                                                                                    |    |          |                         |                        |                                      |                    | 98.529 KG         |
| **** TOTAL PACKAGES ****                                                                                                                                                                                                              |    |          |                         |                        |                                      | 8                  |                   |
| GHS/WHMIS SDS documents available<br>Website: <a href="http://www.oricaminingservices.com">www.oricaminingservices.com</a><br>Email: <a href="mailto:sds.na@orica.com">sds.na@orica.com</a><br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                        |                                      |                    |                   |

|                                                                                                                       |                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24 HOUR TECHNICAL INFORMATION / LETS (24 HEURES) / 619-996-6666                                                       | BAGS USED / SACS UTILISÉS                                                                                                                            |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br><b>BRAP 2-1510</b>                                              | EMERGENCY RESPONSE NO./24 HOUR NUMBER / TÉLÉPHONE D'URGENCE/24 HEURE NUMÉRO<br><b>1-877-561-2636</b>                                                 |
| PLACARDS OFFERED / PLACARDS OFFERT<br><input checked="" type="checkbox"/> YES / OUI <input type="checkbox"/> NO / NON | FORWARD INVOICE FOR PREPAID FREIGHT QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À NO DE CONNAISSEMENT D'ORICA: |

THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.  
NOUS CERTIFIONS QU'É LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS.

|                                                                          |                                                                          |                                                             |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br><b>GRAND VALLEY</b>                            | CARRIER / TRANSPORTEUR<br><b>Orica Truck</b>                             | CONSIGNEE / DESTINATAIRE<br><b>NELSON AGGREGATE COMPANY</b> |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br><b>Tristan Neely</b> | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br><b>Tristan Neely</b> | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR            |
| SIGNATURE<br>                                                            | DATE<br><b>3 8 17</b><br>D/J M/M Y/A                                     | SIGNATURE<br>                                               |
|                                                                          | DATE<br><b>3 8 17</b><br>D/J M/M Y/A                                     | DATE<br><b>3 8 17</b><br>D/J M/M Y/A                        |



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:   
 Blast Date: **2017-08-28**

Blast Number: **17-018**  
 Orica Order #: **2230835**  
 Blast Time: **12:32 PM**

page 1 Blaster-in-charge: **Kevin Toplis** (Print Name)

Blast Location: **Floor** (Bench / Face)

GPS Coordinates: **43.37370** °N Latitude **79.92779** °W Longitude  
 Centre of Blast Centre of Blast

Wind from the: **W** at **5** kph Temperature: **21 to 25** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **9.144** m

tonnes Blasted: **26,351** te **9,944** m<sup>3</sup>  
 Total tonnes per day: **26,351** te **tba** Rate Code  
 Total Holes Loaded: **167** holes  
 ... including: **8** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **8** rows  
 - Pattern (Front Row) -  
 Burden: **11.5** ft avg  
 Spacing: **11.5** ft avg  
 # Holes: **26** front row

- Drilling Information -

Angle from Vertical

Primary Bit diam: **101.6** mm **0**° # Holes: **188** = 3,327.6 ft ( 4 " diam)  
 Secondary Bit diam:  mm **0**° # Holes:  = 0.0 ft ( " diam)  
 Tertiary Bit diam:  mm \* # Holes:  = 0.0 ft ( " diam)

Nominal Bit Diameter:

| Bulk Explosives:      | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>27,130</b> | <b>21,910</b> | 5,220 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                        | kg / unit | # used     | kg   |
|----------------------------------|-----------|------------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>167</b> | 56.8 |

total explosives weight in Blast (kg): **5,277**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators:              | case #'s | ms            | # used     |
|--------------------------|----------|---------------|------------|
| <b>EXEL HANDIDET 12m</b> |          | <b>25/500</b> | <b>167</b> |
| <b>CONNECTADET 12M</b>   |          | <b>42 ms</b>  | <b>31</b>  |
| <b>UNITRONIC 600 6M</b>  |          |               | <b>1</b>   |
| <b>CONNECTADET 9M</b>    |          | <b>25 ms</b>  | <b>3</b>   |

| Cord & Accessories:                     | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

Services:

|                             |                              |             |
|-----------------------------|------------------------------|-------------|
| GPS LAYOUT                  | Enter "1" if Layout by GPS   | <b>0</b>    |
| BULK TRUCK CHARGE           | >/=5,000kg <10,000kg         | <b>1</b>    |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b>    |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee |             |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled     | <b>0</b>    |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b>    |
| LABOUR CHARGE (enter HOURS) | Line Item (Fee per Hour)     | <b>12.0</b> |

Burden: **11.5** ft avg  
 Spacing: **11.5** ft avg  
 # Holes: **26,325**  
 Bench Height: **16.7** ft avg  
 Sub-drill: **1.0** ft avg  
 Hole Depth: **17.7** ft avg  
 - Stone Decking -  
 Front Row: **0.0** ft avg  
 Main Body: **0.0** ft avg  
 # Stone Decks: **0** per blast  
 - Collar Stemming -  
 Front Row: **7.0** ft avg  
 Main Body: **7.0** ft avg  
 Material used: **3/4 Clear**  
 - Charge Length -  
 Front Row: **10.7** ft avg  
 Main Body: **10.7** ft avg  
 - Charge Weight  
 Front Row: **31.2** kg/hole  
 Main Body: **31.2** kg/hole  
 Max. per delay: **45.0** kg/delay  
 SD () Equation: **0.0** kg/delay  
 Total kg Loaded: **5,277** kg  
 Rock Density: **2.65** g/cc = te/m<sup>3</sup>

Theoretical PF (Based on a single tchler)

Theoretical Powder Factor (kg Loaded/te Blast)

- Powder Factor -  
 Yield PF: **0.200** kg/te (actual)  
 Front row: **0.188** kg/te (theoretical)  
 Main Body: **0.188** kg/te (theoretical)  
 #DIV/0! PF: **#DIV/0!** kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

Holes F1, 16, 21, 22, 23, G18,19,20,21 H9, 11, 17,18,19 D24, 25 E20,21,22,23,24,25 where left out of the shot, due to not being drilled, or to short on depth.

Blaster hours: **7**  
 Helper hours: **5**



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-08-28**

Blast Number: **17-018**  
 Orica Order #: **2230835**  
 Blast Time: **12:32 PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.31765       | 80.00309        | 0.756036    | 1.396317    |
| Front Row Corner          | 43.40165       | 79.88986        | 0.757502    | 1.394341    |
| Back Row Corner           | 43.40179       | 79.89043        | 0.757504    | 1.394351    |
| Average (Centre of Blast) | 43.37370       | 79.92779        | 0.757014    | 1.395003    |

1st

| Selsmograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.71939                | 80.38847        | 0.763047            | 1.403043                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.71939                | 80.38847        | 0.763047            | 1.403043                               |
| Distance (1st Seis. From Centre of Blast) | 0.0                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: 4.7                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency:              | Hz              | V / T / L: T        | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 104.9 | dB              | Trigger set at: 115 | dB                                     |
| 2450 #2 Side Rd (Nelson monitor)          |                         |                 |                     |                                        |

2nd

| Selsmograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               |                         |                 |                     |                                        |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 0.00000                 | 0.00000         | 0.000000            | 0.000000                               |
| Distance (2nd Seis. From Centre of Blast) | 0.0                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: 1.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency:              | Hz              | V / T / L: ?        | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 107.5 | dB              | Trigger set at: 115 | dB                                     |
| Northwest (Nelson monitor)                |                         |                 |                     |                                        |

3rd

| Selsmograph Co-ordinates                  | Enter ° N Lat.         | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               |                        |                 |                     |                                        |
| 2nd Reading                               |                        |                 |                     |                                        |
| Average                                   | 0.00000                | 0.00000         | 0.000000            | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | 0.0                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: 3.3               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency:             | Hz              | V / T / L: ?        | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 88.0 | dB              | Trigger set at: 115 | dB                                     |
| Southwest (Nelson monitor)                |                        |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting.

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(0)^2}{30^2} \text{ kg} \\
 &= \frac{0}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate



Customer: **Nelson**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2017-09-12**

Blast Number: **17-019**  
 Orica Order #: **2237955**  
 Blast Time: **11:49 AM**

page 1 | blaster-in-charge: **Kevin Topplis** (Print Name)

Blast Location: **Lower middle bench-north** (Bench / Face)

GPS Coordinates: **43.40436** °N Latitude **79.88425** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **SE** at **10** kph Temperature: **21 to 25** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **9,144** m

- Drilling Information -

|                                             | Angle from Vertical    | Nominal Bit Diameter:                            |
|---------------------------------------------|------------------------|--------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm           | <b>0</b> °             | # Holes: <b>37</b> = 1,513.3 ft ( 4 " diam)      |
| Secondary Bit diam: <input type="text"/> mm | <input type="text"/> ° | # Holes: <input type="text"/> = 0.0 ft ( " diam) |
| Tertiary Bit diam: <input type="text"/> mm  | <input type="text"/> ° | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>30,317</b> | <b>24,940</b> | 5,377 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used    | kg   |
|----------------------------------|-----------|-----------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>41</b> | 13.9 |

total explosives weight in Blast (kg): **5,391**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 15M</b> |          |    | <b>39</b> |
| <b>UNITRONIC 600 9M</b>  |          |    | <b>2</b>  |

**Cord & Accessories:**

|                                         | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |
| <b>SPIDER STEMMING PLUG 8"</b>          | units  | <b>6</b> |

Resource Deployment:

|                                 | Note Exception |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>2</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services:**

| GPS LAYOUT                  | Line Item (Hourly Rate)      |            |
|-----------------------------|------------------------------|------------|
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b>   |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1/2</b> |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee |            |
| 3D LASER PROFILE            | Enter "1" if 3D Profiled     | <b>0</b>   |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b>   |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |            |

|                        |                                      |                             |
|------------------------|--------------------------------------|-----------------------------|
| tonnes Blasted:        | <b>10,087</b> te                     | <b>3,806</b> m <sup>3</sup> |
| Total tonnes per day:  | <b>21,101</b> te                     | <b>TBA</b> Rate Code        |
| Total Holes Loaded:    | <b>37</b> holes                      |                             |
| ... including:         | <b>3</b> Dead Holes                  |                             |
| ... and:               | <b>1</b> Helper Holes                |                             |
| Helper Hole Collar:    | <b>0.0</b> ft avg                    |                             |
| # Rows Blasted:        | <b>3</b> rows                        |                             |
| - Pattern (Front Row)- |                                      |                             |
| Burden:                | <b>12.0</b> ft avg                   |                             |
| Spacing:               | <b>10.5</b> ft avg                   |                             |
| # Holes:               | <b>12</b> front row                  |                             |
| Burden:                | <b>9.0</b> ft avg                    |                             |
| Spacing:               | <b>10.5</b> ft avg                   |                             |
| # Holes:               | <b>25</b>                            |                             |
| Bench Height:          | <b>38.9</b> ft avg                   |                             |
| Sub-drill:             | <b>2.0</b> ft avg                    |                             |
| Hole Depth:            | <b>40.9</b> ft avg                   |                             |
| - Stone Decking -      |                                      |                             |
| Front Row:             | <b>4.0</b> ft avg                    |                             |
| Main Body:             | <b>4.0</b> ft avg                    |                             |
| # Stone Decks:         | <b>2</b> per blast                   |                             |
| - Collar Stemming -    |                                      |                             |
| Front Row:             | <b>8.0</b> ft avg                    |                             |
| Main Body:             | <b>7.0</b> ft avg                    |                             |
| Material used:         | <b>.75</b> clear                     |                             |
| - Charge Length -      |                                      |                             |
| Front Row:             | <b>28.9</b> ft avg                   |                             |
| Main Body:             | <b>29.9</b> ft avg                   |                             |
| - Charge Weight -      |                                      |                             |
| Front Row:             | <b>84.3</b> kg/hole                  |                             |
| Main Body:             | <b>87.2</b> kg/hole                  |                             |
| Max. per delay:        | <b>140.0</b> kg/delay                |                             |
| SD () Equation:        | <b>0.0</b> kg/delay                  |                             |
| Total kg Loaded:       | <b>5,391</b> kg                      |                             |
| Rock Density:          | <b>2.65</b> g/cc = te/m <sup>3</sup> |                             |
| - Powder Factor -      |                                      |                             |
| Yield PF:              | <b>0.534</b> kg/te (actual)          |                             |
| Front row:             | <b>0.229</b> kg/te (theoretical)     |                             |
| Main Body:             | <b>0.316</b> kg/te (theoretical)     |                             |
| "KPI" PF:              | <b>#DIV/0!</b> kg/te (theoretical)   |                             |

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blasted)

2.387 lb/yd<sup>3</sup>  
 1.023 lb/yd<sup>3</sup>  
 1.412 lb/yd<sup>3</sup>  
 ##### lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

total labour charge, see blast report 17-021  
 4ft stone decks where used in holes A1 and B8  
 This blast was shot with 17-021, 6 second delay, this shot going first  
 adjusted collars to following holes: A1 12ft, A4 13ft, A9 14ft A12 15ft



Customer: **Nelson**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:   
 Blast Date: **2017-09-12**

Blast Number: **17-019**  
 Orica Order #: **2237955**  
 Blast Time: **11:49 AM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.40436</b> | <b>79.88428</b> | 0.757549    | 1.394244    |
| Front Row Corner          | <b>43.40423</b> | <b>79.88413</b> | 0.757547    | 1.394241    |
| Back Row Corner           | <b>43.40450</b> | <b>79.88436</b> | 0.757551    | 1.394245    |
| Average (Centre of Blast) | 43.40436        | 79.88425        | 0.757549    | 1.394243    |

**1st**

| Seismograph Co-ordinates                      | Enter ° N Lat.                 | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-----------------------------------------------|--------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                   |                                |                 |                            |                                        |
| 2nd Reading                                   |                                |                 |                            |                                        |
| Average                                       | 0.00000                        | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast)     | <b>0.0</b>                     | m               |                            |                                        |
| Post Blast Data:                              | ppV: <b>1.0</b>                | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                               | frequency:                     | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                               | air overpressure: <b>114.6</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Northwest- colling rd (Nelson monitor)</b> |                                |                 |                            |                                        |

**2nd**

| Seismograph Co-ordinates                    | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|---------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                 | <b>43.71939</b>               | <b>80.38847</b> | 0.763047                   | 1.403043                               |
| 2nd Reading                                 |                               |                 |                            |                                        |
| Average                                     | 43.71939                      | 80.38847        | 0.763047                   | 1.403043                               |
| Distance (2nd Seis. From Centre of Blast)   | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                            | ppV: <b>2.9</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                             | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                             | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>2450 2nd concession (Nelson monitor)</b> |                               |                 |                            |                                        |

**3rd**

| Seismograph Co-ordinates                   | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|--------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                                |                               |                 |                            |                                        |
| 2nd Reading                                |                               |                 |                            |                                        |
| Average                                    | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast)  | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                           | ppV: <b>1.9</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                            | frequency:                    | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                            | air overpressure: <b>94.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |
| <b>Southwest- Camisle (Nelson monitor)</b> |                               |                 |                            |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **0** kg

**Orica**  
 Blaster-in-charge:

*Kevin Toplis*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

*jim bray*

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft

Spacing: 10.5ft

Subdrill: 2.0ft

Stemming: 7.0ft

1st row burden: 12.0ft

Hole Diameter: 4.0in

Number of holes: 37

Hole angle: 0.0°

Total drilled: 1515.0ft

Free Face

timing



17-019 Lower Middle North Final - 12' X 10.5' - 9' X 10.5' - 4" Bit  
250 + .6m Sub



Not to scale

|                  |                                           |
|------------------|-------------------------------------------|
| SHOTPlus 5.6.3.6 | 11/09/2017                                |
| Mine             | Burlington                                |
| Location         |                                           |
| Title/author     | 17-019 Lower Middle North Final G. Palcso |
| Filename         | 17-019_Lower_Middle_North_Final.spf       |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.5ft      Subdrill: 2.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 37      Hole angle: 0.0°  
 Total drilled: 1515.0ft

Free Face

load sheet  
 pc counter:  
 max load: 115kg

|     |     |     |     |                  |     |     |     |     |     |     |                 |
|-----|-----|-----|-----|------------------|-----|-----|-----|-----|-----|-----|-----------------|
| 83  | 109 | 112 | 89  | 105              | 105 | 109 | 106 | 94  | 106 | 104 | $\frac{30}{88}$ |
| 108 | 122 | 111 | 110 | $\frac{37}{103}$ | 105 | 102 | 110 | 106 | 104 | 69  | 105             |
| 61  |     |     |     |                  |     |     |     |     |     |     |                 |
| 111 | 111 | 106 | 113 | 107              | 118 | 114 | 114 | 107 | 107 | 98  | 111             |

17-019 Lower Middle North Final - 12' X 10.5' - 9' X 10.5' - 4" Bit  
 250 + .6m Sub

8148



Not to scale

|                  |                                           |
|------------------|-------------------------------------------|
| SHOTPlus 5.6.3.6 | 11/09/2017                                |
| Mine             | Burlington                                |
| Location         |                                           |
| Title/author     | 17-019 Lower Middle North Final G. Palcso |
| Filename         | 17-019_Lower_Middle_North_Final.spf       |



Customer: Nelson

# Blast Design

Quarry: Burlington

P.O. #:

Design Date: 2017-09-12

Blast Number: 17-019

Orica Order #:

page 1

Blaster-in-charge: Kevin Toplis

Blast Location: Lower middle bench-north  
GPS Coordinates: 43.40436 °N Latitude 79.88425 °W Longitude

Design to Blasted: 10,393 te  
Total Holes Loaded: 37 holes  
... including: 3 Dead Holes  
... and: 1 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 3 rows

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                |
|----------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm | 0'                  | # Holes: 37 = 1,513.3 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0'                  | # Holes: = 0.0 ft ( " diam)          |
| Tertiary Bit diam: mm      | 0'                  | # Holes: = 0.0 ft ( " diam)          |

### - Design Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.5 ft avg  
# Holes: 12 front row

### - Design Pattern (Main Body) -

Burden: 9.0 ft avg  
Spacing: 10.5 ft avg  
# Holes: 25 main body  
Bench Height: 38.9 ft avg  
Sub-drill: 2.0 ft avg  
Hole Depth: 40.9 ft avg

### - Design Stone Decking -

Front Row: 0.0 ft avg  
Main Body: 0.0 ft avg

### - Design Collar Stamping -

Front Row: 8.0 ft avg  
Main Body: 7.0 ft avg

Material used: .75 clear

### - Design Charge Length -

Front Row: 32.9 ft avg  
Main Body: 33.9 ft avg

### - Design Charge Weight -

Front Row: 95.9 kg/hole  
Main Body: 98.8 kg/hole  
Max Chge Wt / delay: 115.0 kg/delay

Required kg Loaded: 4,038 kg  
Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Design Powder Factor -

Expected Yield PF: 0.388 kg/te (actual)  
Front row: 0.261 kg/te (theoretical)  
Main Body: 0.358 kg/te (theoretical)  
"KPI" PF: 0.326 kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast

| Bulk Explosives Req'd: | ChargeWt.exe | kg    |
|------------------------|--------------|-------|
| CENTRA GOLD 70         |              | 4,025 |

| Pkgd Explosives Req'd: |  | kg |
|------------------------|--|----|
|                        |  |    |
|                        |  |    |
|                        |  |    |

| Boosters Req'd:           | kg/u | # used | kg   |
|---------------------------|------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34 | 37     | 12.6 |

total explosives weight in Blast (kg): 4,038  
Pkgd Prod (0 kg) % of Total kg: 0.0%

| Detonators Req'd: | ms | # req'd |
|-------------------|----|---------|
| UNITRONIC 600 15M |    | 37      |

| Cord & Access. Req'd:    | U of M | # req'd |
|--------------------------|--------|---------|
| IRE DUPLEX (6 PACK) 400M | units  | 1       |

### Resource Deployment

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) | Note Exception | 2 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services Req'd:

|                                                    |                              |     |
|----------------------------------------------------|------------------------------|-----|
| BULK TRUCK CHARGE                                  | >=2,000kg <5,000kg           | 1   |
| SHOT SERVICE FEE *                                 | Line Item (Fee per Blast)    | 1/2 |
| SEISMOGRAPH RENTAL                                 | * 1 unit in Shot Service Fee | 0   |
| 3D LASER PROFILE                                   | Enter "1" if 3D Profiled     | 0   |
| BORETRACK                                          | Enter "1" if Boretraked      | 0   |
| LABOUR CHARGE (enter HOURS Must be pre-authorized) |                              |     |



Customer: **Nelson**

# Blast Design

Quarry: **Burlington**

P.O. #:

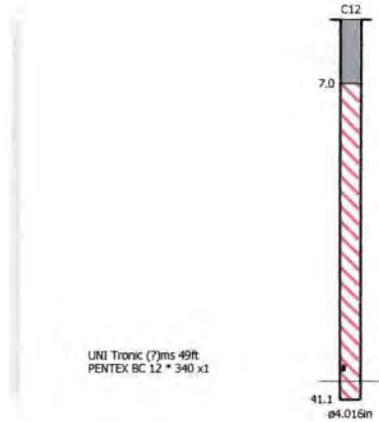
Blast Date: **2017-09-12**

Blast Number: **17-019**

Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Kevin Toplis*

#

Quarry Manager:

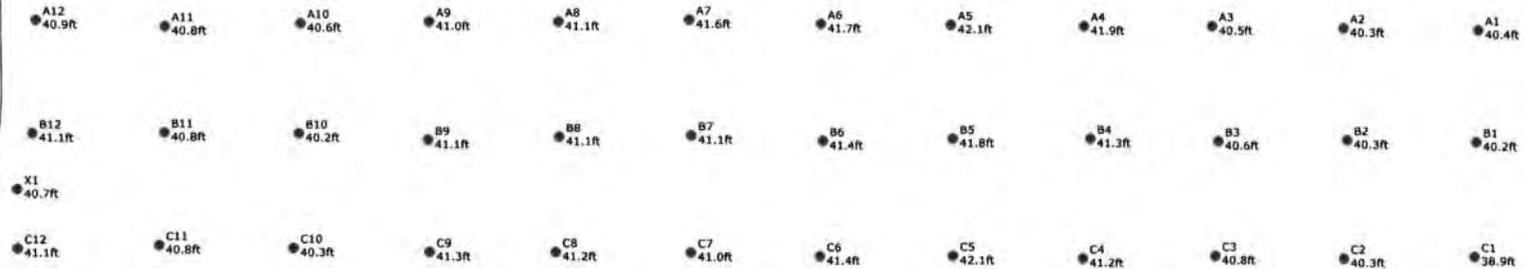
Signature required, indicating sign-off on Blast Design.

### SHOTPlus 5 Plan

#### Blast Summary Data

Burden: 9.0ft      Spacing: 10.5ft      Subdrill: 2.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 37      Hole angle: 0.0°  
 Total drilled: 1515.0ft

Free Face



17-019 Lower Middle North Final - 12' X 10.5' - 9' X 10.5' - 4" Bit  
250 + .6m Sub



Not to scale

|                  |                                           |
|------------------|-------------------------------------------|
| SHOTPlus 5.6.3.6 | 11/09/2017                                |
| Mine             | Burlington                                |
| Location         |                                           |
| Title/author     | 17-019 Lower Middle North Final G. Palcso |
| Filename         | 17-019_Lower_Middle_North_Final.spf       |

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
 FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES  
 SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissance



CONSIGNOR  
 EXPÉDITEUR  
 GRAND VALLEY  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE  
 CONSIGNATAIRE  
 NELSON AGGREGATE COMPANY  
 BURLINGTON ON  
 CA L7R 4L8

|                                |                                   |
|--------------------------------|-----------------------------------|
| GROSS / BRUT                   |                                   |
| TARE                           |                                   |
| NET                            |                                   |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE          |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSEMENT |
| 2237955                        | 85765597                          |

|                               |                                          |                                            |                                                    |
|-------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURÉ À / ACHÉTEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 12 Sep 2017                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   | n/a                                                |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR       | VEHICLE NO.<br>N° DE VÉHICULE                      |
| 12 Sep 2017                   | FOB Dest'n, Own Truck                    | F-73289                                    | 16055                                              |
| SHIP VIA<br>TRANSPORTEUR      |                                          | ROUTING<br>ITINÉRAIRE                      | MAG. LIC. NO.<br>N° DE PERMIS                      |
| Orica Truck                   |                                          | STANDARD                                   |                                                    |

| QTY.<br>QTÉ.                                                                                                                                   | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT. | DESCRIPTION                          | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|-------------------------|--------------------------------------|--------------------|-------------------|
| 98                                                                                                                                             | PC | X        | 19                      | 79                      | PENTEX BC 340 (49/CS)                | 2                  | 35.770            |
| 2                                                                                                                                              | PC |          | 1                       | 1                       | Harness Wire Duplex (6 pack) 400m    | 1                  | 5.840             |
| 60                                                                                                                                             | PC | X        | 36                      | 4                       | *uni tronic 600-09.0M CU/ZC(30')60PC | 1                  | 5.880             |
| 132                                                                                                                                            | PC | X        | 57                      | 75                      | *uni tronic 600-15M C/Z SPL(50')66PC | 2                  | 22.572            |
| 100                                                                                                                                            | PC |          | 88                      | 12                      | MINI STEM PLUGS - PART #6015         |                    | 0.700             |
| 1                                                                                                                                              | PC |          |                         |                         | LICENSED BLASTER                     |                    |                   |
| 1.0                                                                                                                                            | HR |          |                         |                         | LABOUR CHARGE                        |                    |                   |
| 1                                                                                                                                              | PC |          |                         |                         | ROG (ROCK ON GROUND)                 |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                             |    |          |                         |                         |                                      |                    | 70.762 KG         |
| **** TOTAL PACKAGES ****                                                                                                                       |    |          |                         |                         |                                      | 6                  |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                         |                                      |                    |                   |

24 HOUR TECHNICAL INFORMATION

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              |                                                                   |                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TÉLÉPHONE D'URGENCE/24 HEURE NUMÉRO | PLACARDS OFFERED / PLACARDS OFFERT                                | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSEMENT D'ORICA: |
| ERAP 2-1510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1-877-561-3636                                                               | YES / OUI NO / NON                                                | Orica Canada Inc.<br>301 rue hotel de ville<br>Browsburg-Chatham, QC<br>J8G 3B5                                                                               |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                                              | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE                     | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                                |
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                              | CARRIER / TRANSPORTEUR<br>Orica Truck                             | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY                                                                                                          |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>BRAD HUTCHINS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                              | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>BRAD HUTCHINS | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR                                                                                                              |
| SIGNATURE<br>[Signature]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | DATE<br>12/9/17                                                              | SIGNATURE<br>[Signature]                                          | DATE<br>12/9/17                                                                                                                                               |



(THIS BILL OF LADING-EXPRESS SHIPPING CONTRACT IS TO BE SIGNED BY THE SHIPPER AND CARRIER)  
 (CE CONNAISSEMENT-CONTRAT D'EXPÉDITION PAR MESSAGERIES DOIT ÊTRE SIGNÉ PAR L'EXPÉDITEUR ET LE TRANSPORTEUR)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
 SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO



Customer: **Nelsons**  
**Blast Report**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-09-27**

Blast Number: **17-020**  
 Orica Order #: **2244865**  
 Blast Time: **12:01 PM**

page 1

Blaster-in-charge: **Mitch Ossington** (Print Name)

Blast Location: **South face** (Bench / Face)  
 GPS Coordinates: **43.39828** °N Latitude **79.88401** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **W** at **10** kph Temperature: **26 to 30** °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **3000ft** m

- Drilling Information -

|                                            | Angle from Vertical    | Nominal Bit Diameter:                            |
|--------------------------------------------|------------------------|--------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm          | <b>0</b> °             | # Holes: <b>34</b> = 2,852.6 ft ( 4 " diam)      |
| Secondary Bit diam: <b>114.3</b> mm        | <b>0</b> °             | # Holes: <b>6</b> = 503.4 ft ( 4 1/2 " diam)     |
| Tertiary Bit diam: <input type="text"/> mm | <input type="text"/> ° | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>34,070</b> | <b>24,600</b> | 9,470 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used     | kg   |
|----------------------------------|-----------|------------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>157</b> | 53.4 |

total explosives weight in Blast (kg): 9,523

Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 6M</b>  |          |    | <b>36</b> |
| <b>UNITRONIC 600 20M</b> |          |    | <b>41</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>80</b> |

**Cord & Accessories:**

|                                         | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |
| <b>STEMMING PLUG MINI</b>               | units  | <b>2</b> |

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services:**

|                             | Line Item (Hourly Rate)      |          |
|-----------------------------|------------------------------|----------|
| GPS LAYOUT                  |                              | <b>1</b> |
| BULK TRUCK CHARGE           | >=5,000kg <10,000kg          | <b>1</b> |
| SHOT SERVICE FEE *          | Line Item (Fee per Blast)    | <b>1</b> |
| SEISMOGRAPH RENTAL          | * 1 unit in Shot Service Fee | <b>0</b> |
| 3D LASER PROFILE            | Line Item (Hourly Rate)      | <b>1</b> |
| BORETRACK                   | Enter "1" if Boretraked      | <b>0</b> |
| LABOUR CHARGE (enter HOURS) | Must be pre-authorized       |          |

tonnes Blasted: **27,877** te **10,520** m<sup>3</sup>  
 Total tonnes per day: **27,877** te **TBA** Rate Code  
 Total Holes Loaded: **40** holes  
 ... including: **0** Dead Holes  
 ... and: **0** Helper Holes  
 Helper Hole Collar: **0.0** ft avg  
 # Rows Blasted: **3** rows

- Pattern (Front Row)-

Burden: **12.0** ft avg

Spacing: **10.5** ft avg

# Holes: **16** front row

Burden: **10.0** ft avg

Spacing: **10.5** ft avg

# Holes: **24**

Bench Height: **81.9** ft avg

Sub-drill: **2.0** ft avg

Hole Depth: **83.9** ft avg

- Stone Decking -

Front Row: **6.0** ft avg

Main Body: **6.0** ft avg

# Stone Decks: **40** per blast

- Collar Stemming -

Front Row: **10.0** ft avg

Main Body: **7.0** ft avg

Material used: **1/2" crush**

- Charge Length -

Front Row: **67.9** ft avg

Main Body: **70.9** ft avg

- Charge Weight -

Front Row: **198.0** kg/hole

Main Body: **206.7** kg/hole

Max. per delay: **150.0** kg/delay

SD () Equation: **0.0** kg/delay

Total kg Loaded: **9,523** kg

Rock Density: **2.65** g/cc = te/m<sup>3</sup>

- Powder Factor -

Yield PF: **0.342** kg/te (actual)

Front row: **0.256** kg/te (theoretical)

Main Body: **0.320** kg/te (theoretical)

"KPI" PF: **#DIV/0!** kg/te (theoretical)

1.526 lb/yd<sup>3</sup>

1.142 lb/yd<sup>3</sup>

1.431 lb/yd<sup>3</sup>

##### lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blasted)

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

Deck height varied if deck was in a void.

Blaster Hours= 6hr

Helper Hours= 11hrs



Customer: **Nelsons**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #: **NA**  
 Blast Date: **2017-09-27**

Blast Number: **17-020**  
 Orica Order #: **2244865**  
 Blast Time: **12:01 PM**

page 2

| Blast Co-ordinates        | Enter ° N Lat.  | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|-----------------|-----------------|-------------|-------------|
| Mid Blast                 | <b>43.39844</b> | <b>79.88387</b> | 0.757446    | 1.394237    |
| Front Row Corner          | <b>43.39826</b> | <b>79.88401</b> | 0.757443    | 1.394239    |
| Back Row Corner           | <b>43.39813</b> | <b>79.88414</b> | 0.757440    | 1.394241    |
| Average (Centre of Blast) | <b>43.39828</b> | <b>79.88401</b> | 0.757443    | 1.394239    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.               | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                              |                 |                            |                                        |
| 2nd Reading                               |                              |                 |                            |                                        |
| Average                                   | 0.00000                      | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (1st Seis. From Centre of Blast) | <b>0.0</b>                   | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>DNT</b>              | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency: <b>DNT</b>        | Hz              | V / T / L : <b>T</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>DNT</b> | dB              | Trigger set at: <b>115</b> | dB                                     |

**Colling Rd**

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.                 | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|--------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                                |                 |                            |                                        |
| 2nd Reading                               |                                |                 |                            |                                        |
| Average                                   | 0.00000                        | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (2nd Seis. From Centre of Blast) | <b>0.0</b>                     | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>2.5</b>                | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency: <b>?</b>            | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>103.5</b> | dB              | Trigger set at: <b>115</b> | dB                                     |

**2450 #2 sideroad**

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.                | Enter ° W Long. | (N) Radians                | (W) Radians                            |
|-------------------------------------------|-------------------------------|-----------------|----------------------------|----------------------------------------|
| 1st Reading                               |                               |                 |                            |                                        |
| 2nd Reading                               |                               |                 |                            |                                        |
| Average                                   | 0.00000                       | 0.00000         | 0.000000                   | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | <b>0.0</b>                    | m               |                            |                                        |
| Post Blast Data:                          | ppV: <b>3.2</b>               | mm/s            | Trigger set at: <b>2.0</b> | mm/s                                   |
|                                           | frequency: <b>?</b>           | Hz              | V / T / L : <b>?</b>       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: <b>88.0</b> | dB              | Trigger set at: <b>115</b> | dB                                     |

**Camisle**

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(0)^2}{30^2} \text{ kg}$$

$$= \frac{0}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **0** kg

Orica  
 Blaster-in-charge:

*Mitch Ossington*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



Customer: **Nelsons**

Quarry: **Burlington**

Blast Number: **17-020**

# Blast Design

P.O. #: **NA**

Orica Order #:

Design Date: **2017-09-27**

page 1

Blaster-in-charge: **Mitch Ossington** (Print Name)

Blast Location: **South Face** (Bench / Face)

GPS Coordinates: **0.00000** °N Latitude **0.00000** °W Longitude  
Centre of Blast Centre of Blast

|                     |                |
|---------------------|----------------|
| Design te Blasted:  | 27,877 te      |
| Total Holes Loaded: | 40 holes       |
| ... including:      | 0 Dead Holes   |
| ... and:            | 3 Helper Holes |
| Helper Hole Collar: | 0.0 ft avg     |
| # Rows Blasted:     | 3 rows         |

### - Drilling Information -

|  | Primary Bit diam: | Secondary Bit diam: | Tertiary Bit diam: | Angle from Vertical | # Holes: | Nominal Bit Diameter:  |
|--|-------------------|---------------------|--------------------|---------------------|----------|------------------------|
|  | 101.6 mm          |                     |                    | 0'                  | 40       | 3,356.0 ft ( 4 " diam) |
|  |                   |                     |                    | 0'                  |          | 0.0 ft ( " diam)       |
|  |                   |                     |                    | 0'                  |          | 0.0 ft ( " diam)       |

### - Design Pattern (Front Row) -

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.5 ft avg  |
| # Holes: | 16 front row |

### - Design Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 10.0 ft avg  |
| Spacing: | 10.5 ft avg  |
| # Holes: | 24 main body |

|               |             |
|---------------|-------------|
| Bench Height: | 81.9 ft avg |
| Sub-drill:    | 2.0 ft avg  |
| Hole Depth:   | 83.9 ft avg |

### - Design Stone Decking -

|            |            |
|------------|------------|
| Front Row: | 4.0 ft avg |
| Main Body: | 4.0 ft avg |

### - Design Collar Stemming -

|            |            |
|------------|------------|
| Front Row: | 7.0 ft avg |
| Main Body: | 7.0 ft avg |

Material used: 1/2" crush

### - Design Charge Length -

|            |             |
|------------|-------------|
| Front Row: | 72.9 ft avg |
| Main Body: | 72.9 ft avg |

### - Design Charge Weight -

|                      |                |
|----------------------|----------------|
| Front Row:           | 212.6 kg/hole  |
| Main Body:           | 212.6 kg/hole  |
| Max Chge Wt / delay: | 150.0 kg/delay |

|                     |                               |
|---------------------|-------------------------------|
| Required kg Loaded: | 9,554 kg                      |
| Rock Density:       | 2.65 g/cc = te/m <sup>3</sup> |

### - Design Powder Factor -

|                    |                           |
|--------------------|---------------------------|
| Expected Yield PF: | 0.343 kg/te (actual)      |
| Front row:         | 0.275 kg/te (theoretical) |
| Main Body:         | 0.329 kg/te (theoretical) |
| "KPI" PF:          | 0.311 kg/te (theoretical) |

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast

12:01 pm  
28c fanclouds  
11km/h W  
30,000 ft

| Bulk Explosives Req'd: | ChargeWt exe | kg |
|------------------------|--------------|----|
| CENTRA GOLD 70         | 9,500        |    |

| Pkgd Explosives Req'd: | kg |
|------------------------|----|
|                        |    |
|                        |    |
|                        |    |

| Boosters Req'd:           | kg/u | # used | kg   |
|---------------------------|------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34 | 160    | 54.4 |

|                                        |       |
|----------------------------------------|-------|
| total explosives weight in Blast (kg): | 9,554 |
| Pkgd Prod (0 kg) % of Total kg:        | 0.0%  |

| Detonators Req'd: | ms | # req'd |
|-------------------|----|---------|
| UNITRONIC 600 30M |    | 80      |
| UNITRONIC 600 20M |    | 40      |
| UNITRONIC 600 9M  |    | 40      |

| Cord & Access. Req'd:    | U of M | # req'd |
|--------------------------|--------|---------|
| IRE DUPLEX (6 PACK) 400M | units  | 1       |
| STEMMING PLUG MINI       | units  |         |
|                          | units  |         |

### Resource Deployment

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services Req'd:

|                                                    |                              |   |
|----------------------------------------------------|------------------------------|---|
| BULK TRUCK CHARGE                                  | >/=5,000kg <10,000kg         | 1 |
| SHOT SERVICE FEE *                                 | Line Item (Fee per Blast)    | 1 |
| SEISMOGRAPH RENTAL                                 | * 1 unit in Shot Service Fee |   |
| 3D LASER PROFILE                                   | Line Item (Fee per Blast)    | 1 |
| BORETRACK                                          | Enter "1" if Boretraked      |   |
| LABOUR CHARGE (enter HOURS Must be pre-authorized) |                              |   |



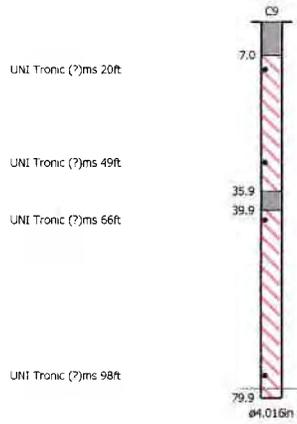
Customer: **Nelsons**  
**Blast Design**

Quarry: **Burlington**  
P.O. #:  
Blast Date: **2017-09-27**

Blast Number: **17-020**  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mitch Ossington*

#

Quarry Manager:

Signature required, indicating  
sign off on Blast Design

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
 FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSANCEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES  
 SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.



Bill of Lading / Connaissancement

CONSIGNOR  
 EXPÉDITEUR  
**GRAND VALLEY**  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE  
 CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
 BURLINGTON ON  
 CA L7R 4L8

*Blaster Milton  
 Taylor Nelson*

|                                |                                      |
|--------------------------------|--------------------------------------|
| GROSS / BRUT                   |                                      |
| TARE                           |                                      |
| NET                            |                                      |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE             |
| 6:30                           |                                      |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSANCEMENT |
| 2244865                        | 85781592                             |

|                               |                                          |                                            |                                                    |
|-------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 27 Sep 2017                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   | n/a                                                |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR       | VEHICLE NO.<br>N° DE VÉHICULE                      |
| 27 Sep 2017                   | FOB Dest'n, Own Truck                    | E-73289                                    | DT-15001                                           |
| SHIP VIA<br>TRANSPORTEUR      |                                          | ROUTING<br>ITINÉRAIRE                      | MAG. LIC. NO.<br>N° DE PERMIS                      |
| Orica Truck                   |                                          | STANDARD                                   |                                                    |

| QTY.<br>QTE.                                                                                                                                   | UM | DG<br>MD | QTY. RET'D<br>QTE. RET. | QTY. SOLD<br>QTE. FACT. | DESCRIPTION                           | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|-------------------------|---------------------------------------|--------------------|-------------------|
| 196                                                                                                                                            | PC | X        | 34                      | 157                     | PENTEX BC 340 (49/CS)                 | 4                  | 71.540            |
| 2                                                                                                                                              | PC |          | 2                       | 0                       | Harness Wire Duplex (6 pack) 400m     | 1                  | 5.840             |
| 60                                                                                                                                             | PC | X        | 24                      | 36                      | *uni tronic 600-09.0M CU/ZC(30')60PC  | 1                  | 5.880             |
| 66                                                                                                                                             | PC | X        | 25                      | 41                      | *uni tronic 600-20M CU/ZC SPL(65')66P | 1                  | 13.464            |
| 140                                                                                                                                            | PC | X        | 64                      | 80                      | *uni tronic 600-30M C/Z SPL(100')36P  | 4                  | 35.280 42.75      |
| 75                                                                                                                                             | PC |          | 73                      | 2                       | MINI STEM PLUGS - PART #6015          |                    | 0.525             |
| 1                                                                                                                                              | PC |          |                         |                         | LICENSED BLASTER                      |                    |                   |
| 1.0                                                                                                                                            | HR |          |                         |                         | LABOUR CHARGE                         |                    |                   |
| 1                                                                                                                                              | PC |          |                         |                         | ROG (ROCK ON GROUND)                  |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                             |    |          |                         |                         |                                       |                    | 132.529 KG        |
| **** TOTAL PACKAGES ****                                                                                                                       |    |          |                         |                         |                                       | 11                 |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                         |                                       |                    |                   |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                |                                                                              |                                |                                                      |                     |                                                                                                                                                                   |                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------------------------------------------------------------|--------------------------------|------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TELEPHONE D'URGENCE/24 HEURE NUMERO |                                | PLAGARDS OFFERED / PLACARDS OFFERT                   |                     | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSANCEMENT D'ORICA : |                     |
| ERAP 2-1510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                | 1-877-561-3636                                                               |                                | YES / OUI NO / NON                                   |                     | Orica Canada Inc.<br>301 rue hotel de ville<br>Browsburg-Chatham, QC<br>J8G 3B5                                                                                   |                     |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                |                                                                              |                                | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE        |                     | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                                    |                     |
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                | CARRIER / TRANSPORTEUR<br>Orica Truck                                        |                                | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |                     |                                                                                                                                                                   |                     |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>Taylor Neely                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>Taylor Neely             |                                | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |                     |                                                                                                                                                                   |                     |
| SIGNATURE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | DATE<br>27 9 17<br>D/J M/M Y/A | SIGNATURE                                                                    | DATE<br>27 9 17<br>D/J M/M Y/A | SIGNATURE                                            | DATE<br>D/J M/M Y/A | SIGNATURE                                                                                                                                                         | DATE<br>D/J M/M Y/A |

**3** MEMORANDUM  
 MEMORANDUM

(THIS BILL OF LADING-EXPRESS SHIPPING CONTRACT IS TO BE SIGNED BY THE SHIPPER AND CARRIER)  
 (CE CONNAISSANCEMENT-CONTRAT D'EXPÉDITION PAR MESSAGERIES DOIT ÊTRE SIGNÉ PAR L'EXPÉDITEUR ET LE TRANSPORTEUR)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
 SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO

SHOTPlus 5 Plan

Blast Summary Data

Burden: 12.0ft

Spacing: 10.5ft

Subdrill: 2.0ft

Stemming: 7.0ft

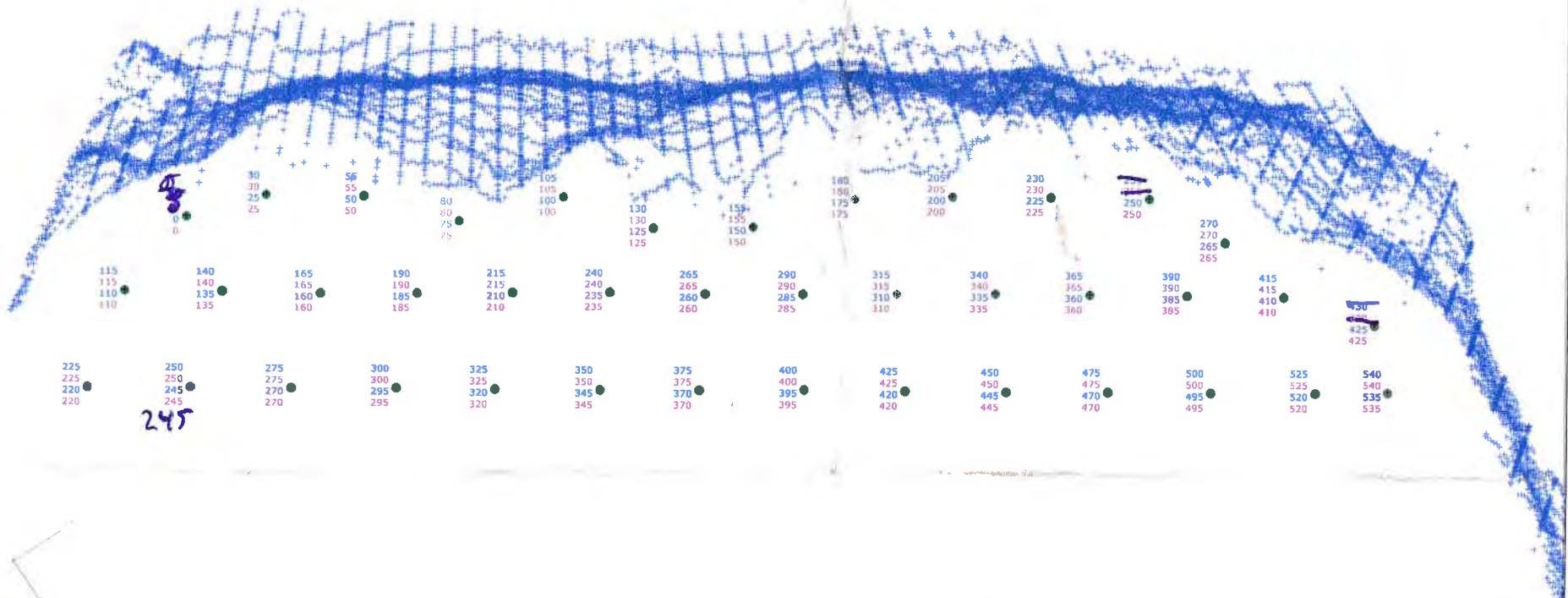
1st row burden: 10.0ft

Hole Diameter: 4.0in

Number of holes: 40

Hole angle: 0.0°

Total drilled: 3358.0ft



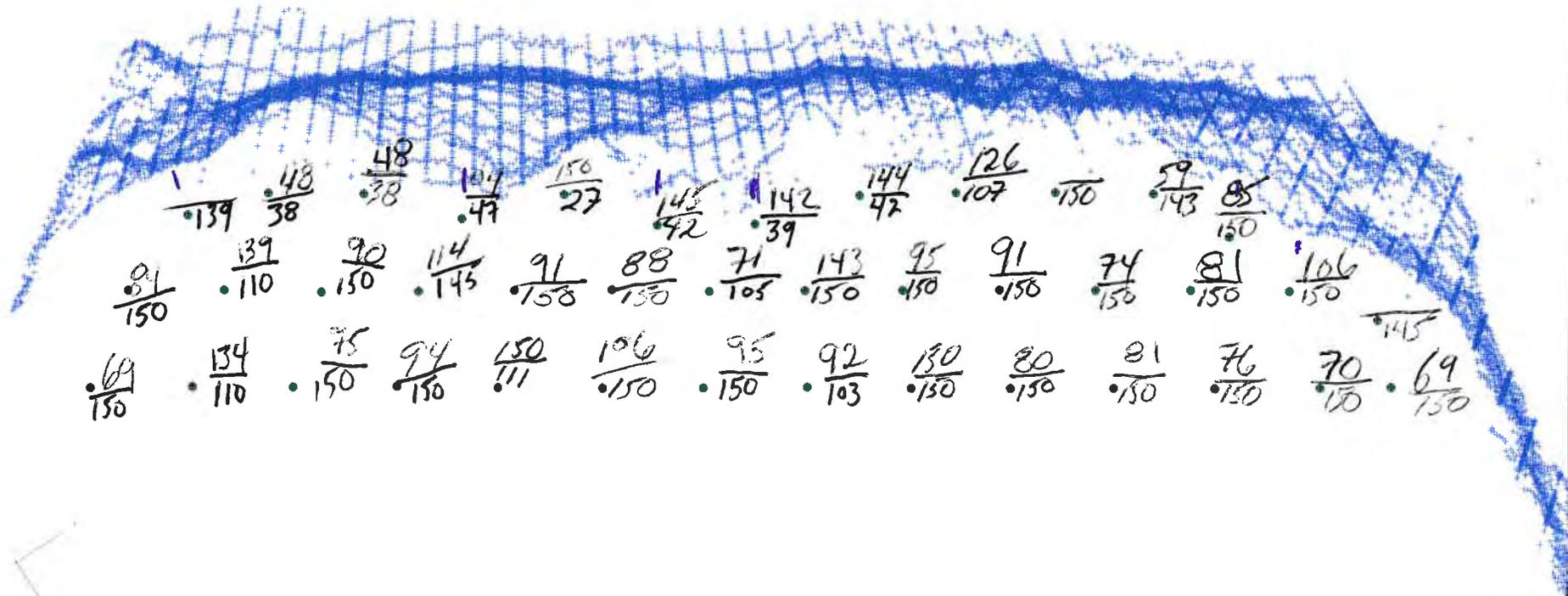
Scale 1:200

|                  |                                   |
|------------------|-----------------------------------|
| SHOTPlus 5.6.2.7 | 27/09/2017                        |
| Mine             | Burlington                        |
| Location         |                                   |
| Title/author     | 17-016 South Wall Final G. Palcso |
| Filename         | 17-020_South_Wall_Final.spf       |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 12.0ft      Spacing: 10.5ft      Subdrill: 2.0ft      Stemming: 7.0ft  
 1st row burden: 10.0ft      Hole Diameter: 4.0in      Number of holes: 40      Hole angle: 0.0°  
 Total drilled: 3358.0ft



Scale 1:200

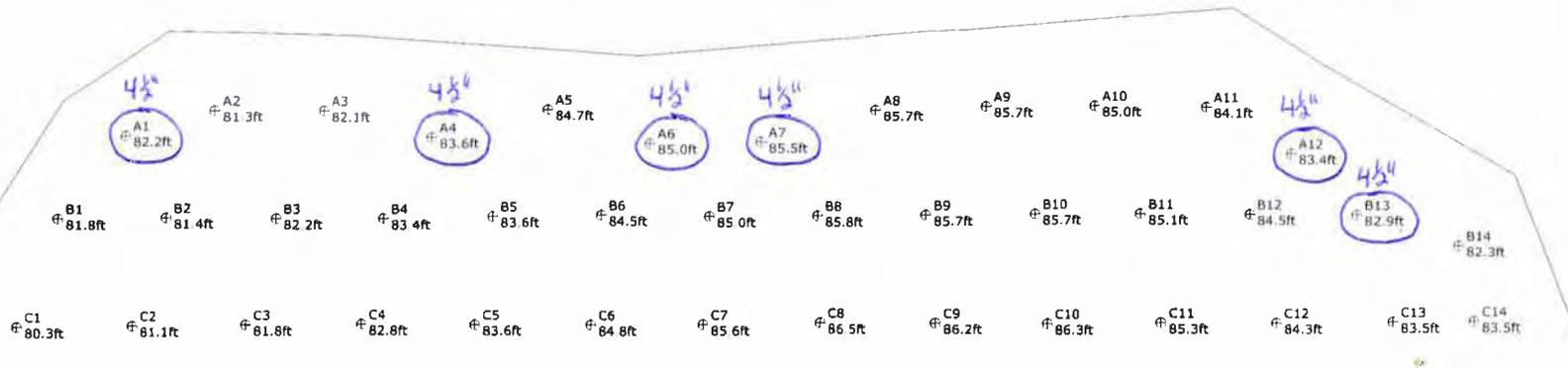
|                  |                                   |
|------------------|-----------------------------------|
| SHOTPlus 5.6.2.7 | 27/09/2017                        |
| Mine             | Burlington                        |
| Location         |                                   |
| Title/author     | 17-016 South Wall Final G. Palcso |
| Filename         | 17-020_South_Wall_Final.spf       |

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 12.0ft          | Spacing: 10.5ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 10.0ft  | Hole Diameter: 4.0in | Number of holes: 40 | Hole angle: 0.0° |
| Total drilled: 3358.0ft |                      |                     |                  |

Hole A1, A4, A6, A7, A12 and B13 are 4.5 Hole Diameter  
 Marked in Green

open face



South Face 17-020  
 12x10.5 Front Row - 10x10.5 Body  
 4" Hole Diameter  
 248.5m Floor Elevation + 0.6m Sub



Not to scale

Customer: **Nelson Aggregat****Blast Report**Quarry: **Burlington**

P.O. #:

Blast Date: **2018-04-09**Blast Number: **18-001**Orica Order #: **2322201**Blast Time: **11:56 AM**

page 1

Blaster-in-charge: **Mike Derkinderen** (Print Name)Blast Location: **Upper Middle** (Bench / Face)GPS Coordinates: **43.40358** °N Latitude **79.88337** °W Longitude  
Centre of Blast Centre of BlastWind from the: **SE** at **5** kph Temperature: **1 to 5** °CClear:  Rain:  Overcast:   
Partly Cloudy:  Snow:  Inversion: **30000****- Drilling Information -**

|                                             |                     |                                                  |
|---------------------------------------------|---------------------|--------------------------------------------------|
|                                             | Angle from Vertical | Nominal Bit Diameter:                            |
| Primary Bit diam: <b>101.6</b> mm           | <b>0</b>            | # Holes: <b>49</b> = 3,797.5 ft ( 4 " diam)      |
| Secondary Bit diam: <input type="text"/> mm | <b>0</b>            | # Holes: <input type="text"/> = 0.0 ft ( " diam) |
| Tertiary Bit diam: <input type="text"/> mm  | <b>0</b>            | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg     |
|-----------------------|---------------|---------------|--------|
| <b>CENTRA GOLD 70</b> | <b>34,030</b> | <b>21,700</b> | 12,330 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used     | kg   |
|----------------------------------|-----------|------------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>102</b> | 34.7 |

total explosives weight in Blast (kg): 12,365

Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 9M</b>  |          |    | <b>48</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>52</b> |

**Cord & Accessories:**

|                                         | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

**Resource Deployment:**

|                                 | # req'd                              |
|---------------------------------|--------------------------------------|
| # of Blasts today (this Quarry) | <b>1</b>                             |
| # of Blasters (this Blast)      | <b>1</b> <b>6</b> hr                 |
| # of Helpers (this Blast)       | Note Exceptior <b>2</b> <b>12</b> hr |
| # of MMU's (this Blast)         | <b>1</b>                             |

**Services:**

|                       |                                |          |
|-----------------------|--------------------------------|----------|
| ADVANCED BLAST DESIGN | Enter "1" if Advance Blast Des |          |
| BULK TRUCK CHARGE     | As per agreement               | <b>1</b> |
| SHOT SERVICE FEE *    | As per agreement               | <b>1</b> |
| BORETRACK             | Enter "1" if Boretraked        | <b>0</b> |
| SEISMOGRAPH RENTAL    | Enter # of Seismographs Use    | <b>0</b> |

|                        |                       |                              |
|------------------------|-----------------------|------------------------------|
| tonnes Blasted:        | <b>27,194</b> te      | <b>10,262</b> m <sup>3</sup> |
| <b># Holes Loaded:</b> | <b>49</b> holes       |                              |
| ... including:         | <b>0</b> Dead Holes   |                              |
| ... and:               | <b>3</b> Helper Holes |                              |
| Helper Hole Collar:    | <b>8.0</b> ft avg     |                              |
| # Rows Blasted:        | <b>3</b> rows         |                              |

**- Pattern (Front Row)-**Burden: **12.0** ft avgSpacing: **10.0** ft avg# Holes: **13** front row**- Pattern (Main Body) -**Burden: **9.0** ft avgSpacing: **10.0** ft avg

# Holes: 36 main body

Bench Height: **75.5** ft avgSub-drill: **2.0** ft avg

Hole Depth: 77.5 ft avg

**- Stone Decking -**Front Row: **0.0** ft avgMain Body: **0.0** ft avg**# Stone Decks:** **0** per blast**- Collar Stemming -**Front Row: **7.0** ft avgMain Body: **7.0** ft avgMaterial used: **.75 clear****- Charge Length -**

Front Row: 70.5 ft avg

Main Body: 70.5 ft avg

**- Charge Weight -**

Front Row: 205.6 kg/hole

Main Body: 205.6 kg/hole

Max. per delay: **256.0** kg/delay

SD () Equation: #NUM! kg/delay

Total kg Loaded: 12,365 kg

Rock Density: **2.65** g/cc = te/m<sup>3</sup>**- Powder Factor -**2.031 lb/yd<sup>3</sup> Yield PF: **0.455** kg/te (actual)1.351 lb/yd<sup>3</sup> Front row: 0.302 kg/te (theoretical)1.801 lb/yd<sup>3</sup> Main Body: 0.403 kg/te (theoretical)1.651 lb/yd<sup>3</sup> "KPI" PF: 0.370 kg/te (theoretical)**NOTES:**

Hole A-10 Received A stone deck from 50'-32' due to lean burden

Hole X-3 Received A stone deck from 60'-50' due to lean burden

Hole X-1 Received a toe load to 55'

Hole X-2 was plugged at 24'

Rate Code TBA by sale representative

6 Blaster hours

6 Helper hours times 2 Helpers



Customer: **Nelson Aggregat**  
**Blast Design**

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2018-04-09**

Blast Number: **18-001**  
 Orica Order #: **2322201**  
 Blast Time: **11:56 AM**

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40358       | 79.88339        | 0.757535    | 1.394228    |
| Front Row Corner          | 43.40343       | 79.88334        | 0.757533    | 1.394227    |
| Back Row Corner           | 43.40374       | 79.88338        | 0.757538    | 1.394228    |
| Average (Centre of Blast) | 43.40358       | 79.88337        | 0.757535    | 1.394228    |

1st

| Selsmograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 441.3                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 3.6                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 7.3          | Hz              | V / T / L: ?        | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 115.3 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

2nd

| Selsmograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 902.8                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.4                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 7.4          | Hz              | V / T / L: ?        | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 121.9 | dB              | Trigger set at: 115 | dB                                     |

Colling Road & Blind line Bruce Trail

3rd

| Selsmograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | #NUM!                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 1.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 7.3          | Hz              | V / T / L: ?        | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 119.7 | dB              | Trigger set at: 115 | dB                                     |

South West Corner Of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{\#NUM!}{30^2} \text{ kg}$$

$$= \frac{\#NUM!}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **#NUM!** kg

Orica  
 Blaster-in-charge:

*Mike Derkinderen*

Jim Gray

Signature required, indicating that  
 Blast Report is Complete & Accurate

Customer: **Jelson Aggregat****Blast Report**Quarry: **Burlington**

P.O. #:

Blast Date: **2018-04-11**Blast Number: **18-002**Orica Order #: **2323512**Blast Time: **11:16 AM**

page 1

Blaster-in-charge: **Mike Derkinderen** (Print Name)Blast Location: **Floor** (Bench / Face)GPS Coordinates: **43.40235** °N Latitude **79.88634** °W Longitude  
Centre of Blast Centre of BlastWind from the: **SW** at **10** kph Temperature: **1 to 5** °CClear:  Rain:  Overcast:   
Partly Cloudy:  Snow:  Inversion:  **30000****- Drilling Information -**

|                     | Angle from Vertical        | Nominal Bit Diameter:                        |
|---------------------|----------------------------|----------------------------------------------|
| Primary Bit diam:   | <b>101.6</b> mm <b>0</b> ° | # Holes: <b>180</b> = 1,980.0 ft ( 4 " diam) |
| Secondary Bit diam: | mm <b>0</b> °              | # Holes: = 0.0 ft ( " diam)                  |
| Tertiary Bit diam:  | mm <b>0</b> °              | # Holes: = 0.0 ft ( " diam)                  |

| Bulk Explosives:      | in (kg)       | out (kg)      | kg    |
|-----------------------|---------------|---------------|-------|
| <b>CENTRA GOLD 70</b> | <b>30,150</b> | <b>27,630</b> | 2,520 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                        | kg / unit | # used     | kg   |
|----------------------------------|-----------|------------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>182</b> | 61.9 |

total explosives weight in Blast (kg): 2,582  
Pkgd Prod (0 kg) % of Total kg: 0.0%

| Detonators:              | case #s | ms            | # used     |
|--------------------------|---------|---------------|------------|
| <b>UNITRONIC 600 6M</b>  |         |               | <b>1</b>   |
| <b>EXEL HANDIDET 12m</b> |         | <b>25/500</b> | <b>182</b> |
| <b>CONNECTADET 9M</b>    |         | <b>25 ms</b>  | <b>3</b>   |
| <b>CONNECTADET 9M</b>    |         | <b>42 ms</b>  | <b>30</b>  |

| Cord & Accessories:                     | U of M | # used   |
|-----------------------------------------|--------|----------|
| <b>HARNES WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

| Resource Deployment:            | # req'd                              |
|---------------------------------|--------------------------------------|
| # of Blasts today (this Quarry) | Enter # <b>1</b>                     |
| # of Blasters (this Blast)      | <b>1</b> <b>7</b> hr                 |
| # of Helpers (this Blast)       | Note Exception <b>2</b> <b>10</b> hr |
| # of MMU's (this Blast)         | <b>1</b>                             |

| Services:             |                                       |
|-----------------------|---------------------------------------|
| ADVANCED BLAST DESIGN | Enter "1" if Advance Blast Des        |
| BULK TRUCK CHARGE     | As per agreement <b>1</b>             |
| SHOT SERVICE FEE *    | As per agreement #DIV/0!              |
| BORETRACK             | Enter "1" if Boretraked <b>0</b>      |
| SEISMOGRAPH RENTAL    | Enter # of Seismographs Used <b>0</b> |

tonnes Blasted: **19,279** te **7,415** m<sup>3</sup>

**# Holes Loaded:** **180** holes  
... including: **0** Dead Holes  
... and: **0** Helper Holes  
Helper Hole Collar: **0.0** ft avg  
# Rows Blasted: **9** rows

**- Pattern (Front Row) -**

Burden: **11.5** ft avg  
Spacing: **11.5** ft avg  
# Holes: **28** front row

**- Pattern (Main Body) -**

Burden: **11.5** ft avg  
Spacing: **11.5** ft avg  
# Holes: 152 main body

Bench Height: **11.0** ft avg  
Sub-drill: **0.0** ft avg  
Hole Depth: 11.0 ft avg

**- Stone Decking -**

Front Row: **0.0** ft avg  
Main Body: **0.0** ft avg

**# Stone Decks:** **0** per blast**- Collar Stemming -**

Front Row: **7.0** ft avg  
Main Body: **7.0** ft avg  
Material used: **.75** clear

**- Charge Length -**

Front Row: 4.0 ft avg  
Main Body: 4.0 ft avg

**- Charge Weight -**

Front Row: 11.7 kg/hole  
Main Body: 11.7 kg/hole  
Max. per delay: **14.0** kg/delay  
SD () Equation: #NUM! kg/delay  
Total kg Loaded: 2,582 kg

Rock Density: **2.60** g/cc = te/m<sup>3</sup>**- Powder Factor -**

Yield PF: 0.134 kg/te (actual)  
Front row: 0.109 kg/te (theoretical)  
Main Body: 0.109 kg/te (theoretical)  
"KPI" PF: 0.109 kg/te (theoretical)

**NOTES:**

5 Holes in the pattern had caved in when we measured the shot the morning of, we were unable to load those 5 holes



Customer: **Nelson Aggregat**  
**Blast Design**

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2018-04-11

Blast Number: 18-002  
 Orica Order #: 2323512  
 Blast Time: 11:16 AM

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| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40230       | 79.88635        | 0.757513    | 1.394280    |
| Front Row Corner          | 43.40209       | 79.88602        | 0.757509    | 1.394274    |
| Back Row Corner           | 43.40267       | 79.88664        | 0.757519    | 1.394285    |
| Average (Centre of Blast) | 43.40235       | 79.88634        | 0.757514    | 1.394280    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.    | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245          | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                   |                 |                     |                                        |
| Average                                   | 43.40245          | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 663.1             | m               |                     |                                        |
| Post Blast Data:                          | ppV:              | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency:        | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line Did not set up for this blast ( as per bill)

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 744.0                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

Colling Rd & Blind Line Bruce Trail

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.         | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339               | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                        |                 |                     |                                        |
| Average                                   | 43.39339               | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | #NUM!                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 2.0               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 3.3         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 88.4 | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor: **30** Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{\#NUM!}{30^2} \text{ kg}$$

$$= \frac{\#NUM!}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay = **#NUM!** kg

Orica  
 Blaster-in-charge:

*Mike Derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

jim bray



# Blast Report

Quarry:  
P.O. #:  
Blast Date: 2018-04-18

Blast Number: 18-003  
Orica Order #: 2326529  
Blast Time: 10:54 AM

page 1

Blaster-in-charge: Mike der Kinderen

Blast Location: Lower Middle  
GPS Coordinates: 43.40418 °N Latitude 79.88352 °W Longitude

Wind from the: W at 10 kph Temperature: 1 to 5 °C

Clear: Rain: Overcast: X  
Partly Cloudy: Snow: Inversion: Ceiling: 30 000 ft

Tonnes Blasted: 11,087 te 4,184 m<sup>3</sup>  
Total tonnes per day: 11,087 te TBA Rate Code  
Total Holes Loaded: 39 holes  
... including: 0 Dead Holes  
... and: 1 Helper Holes  
Helper Hole Collar: 7.0 ft avg  
# Rows Blasted: 4 rows

Range: Front Row:  
Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 9

Range: Main Body:  
Burden: 9.0 ft avg  
Spacing: 10.0 ft avg

# Holes: 30 main body  
Bench Height: 40.1 ft avg  
Sub-drill: 2.0 ft avg  
Hole Depth: 42.1 ft avg

Stone Decking:  
Front Row: 8.0 ft avg  
Main Body: 0.0 ft avg  
# Decks: 1 per blast

Collar Stemming:  
Front Row: 7.0 ft avg  
Main Body: 7.0 ft avg  
Material used: 3/4 Stone

Charge Length:  
Front Row: 27.1 ft avg  
Main Body: 35.1 ft avg

Charge Delay:  
Front Row: 79.1 kg/hole  
Main Body: 102.4 kg/hole  
Max. per delay: 129.0 kg/delay  
SD () Equation: 251.0 kg/delay  
Total kg Loaded: 4,817 kg  
Rock Density: 2.65 g/cc = te/m<sup>3</sup>

Explosive Weight:  
Yield PF: 0.434 kg/te (actual)  
Front row: 0.219 kg/te (theoretical)  
Main Body: 0.378 kg/te (theoretical)  
"KPI" PF: 0.338 kg/te (theoretical)

### Drilling Information

|                            | Angle from Vertical | Nominal Bit Diameter:    |
|----------------------------|---------------------|--------------------------|
| Primary Bit diam: 101.6 mm | 0° # Holes: 39      | = 1,642.4 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0° # Holes: =       | 0.0 ft ( " diam)         |
| Tertiary Bit diam: mm      | 0° # Holes: =       | 0.0 ft ( " diam)         |

| Bulk Explosives: | in (kg) | out (kg) | kg    |
|------------------|---------|----------|-------|
| CENTRA GOLD 70   | 29,810  | 25,070   | 4,740 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
| FORTEL PRO 75X400    | 6          | 4           | 50 |

| Boosters:                 | kg / unit | # usec | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 78     | 26.5 |

total explosives weight in Blast (kg): 4,817  
Pkgd Prod (50 kg) % of Total kg: 1.0%

| Detonators:       | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 39     |
| UNITRONIC 600 15M |          |    | 39     |

| Cord & Accessories:              | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
|                                  | units  |        |
|                                  | units  |        |

| Resource Deployment:            |                   |
|---------------------------------|-------------------|
| # of Blasts today (this Quarry) | 1                 |
| # of Blasts (this Blast)        | 1                 |
| # of Helpers (this Blast)       | Note Exception: 2 |
| # of BMA's (this Blast)         | 1                 |

| Services:              |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=2,000kg <5,000kg           | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 6.0  |
| HELPER HOURS           | Enter total Helper man-hours | 10.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 4.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

1.941 lb/yd<sup>3</sup>  
0.978 lb/yd<sup>3</sup>  
1.588 lb/yd<sup>3</sup>  
1.511 lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Bit B-3 expl or (S) from previous Blast  
Holes D-1 D-2 D-3 Had either caved in or were to short to load  
Hole B-1 Was loaded to 18' then package was used on the top  
A-7 Received a stone deck from 16'-24' due to a void identified on the drill log  
Please contact our sales rep for Rate code



# Blast Report

Quarry:  
P.O. #:  
Blast Date: 2018-04-18

Blast Number: 18-003  
Orica Order #: 2326529  
Blast Time: 10:54 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.40418       | 79.88317        |
| Front Row Corner          | 43.40423       | 79.88351        |
| Back Row Corner           | 43.40412       | 79.88387        |
| Average (Centre of Blast) | 43.40418       | 79.88352        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757546    | 1.394224    |
| 0.757547    | 1.394230    |
| 0.757545    | 1.394236    |
| 0.757546    | 1.394230    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. |
|-------------------------------------------|-------------------------|-----------------|
| 1st Reading                               | 43.40245                | 79.87814        |
| 2nd Reading                               |                         |                 |
| Average                                   | 43.40245                | 79.87814        |
| Distance (1st Seis. From Centre of Blast) | 476.3                   | m               |
| Post Blast Data:                          | ppV: 2.7                | mm/s            |
|                                           | frequency: 43.0         | Hz              |
|                                           | air overpressure: 119.7 | dB              |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757516    | 1.394137    |
| 0.757516    | 1.394137    |

2450 2nd Line

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. |
|-------------------------------------------|---------------------------|-----------------|
| 1st Reading                               | 43.40605                  | 79.89400        |
| 2nd Reading                               |                           |                 |
| Average                                   | 43.40605                  | 79.89400        |
| Distance (2nd Seis. From Centre of Blast) | 673.3                     | m               |
| Post Blast Data:                          | ppV: DID                  | mm/s            |
|                                           | frequency: NOT            | Hz              |
|                                           | air overpressure: TRIGGER | dB              |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757578    | 1.394413    |
| 0.757578    | 1.394413    |

Colling Road & Blind Line Bruce Trail

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. |
|-------------------------------------------|---------------------------|-----------------|
| 1st Reading                               | 43.39339                  | 79.88880        |
| 2nd Reading                               |                           |                 |
| Average                                   | 43.39339                  | 79.88880        |
| Distance (3rd Seis. From Centre of Blast) | 1274.5                    | m               |
| Post Blast Data:                          | ppV: DID                  | mm/s            |
|                                           | frequency: NOT            | Hz              |
|                                           | air overpressure: TRIGGER | dB              |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757358    | 1.394323    |
| 0.757358    | 1.394323    |

South West Corner of Property

Scaling Factor denotes the degree of Blast confinement.

The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(476.3)^2}{30^2} \text{ kg}$$

$$= \frac{225,910}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der kinderen*



# Blast Report

## Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-05-22

Blast Number: 18-004  
Orica Order #: 2339509  
Blast Time: 12:02 PM

page 1

Blaster-in-charge: Mike der Kinderen

Blast Location: Upper Middle  
GPS Coordinates: 43.40364 °N Latitude 79.88324 °W Longitude

Wind from the: SE at 5 kph Temperature: 11 to 15 °C

Clear: Rain: Overcast: x  
Partly Cloudy: Snow: Inversion: Ceiling: 1062 ft

Tonnes Blasted: 26,332 te 9,937 m<sup>3</sup>  
Total tonnes per day: 26,332 te NB80-01 Rate Code  
Total Holes Loaded: 49 holes  
... including: 0 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 3 rows  
Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 8

Primary Bit diam: 101.6 mm 0° # Holes: 40 = 3,098.6 ft ( 4 " diam)  
Secondary Bit diam: 114.3 mm 0° # Holes: 9 = 697.2 ft ( 4 1/2 " diam)  
Tertiary Bit diam: mm 0° # Holes: = 0.0 ft ( " diam)

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
Bench Height: 75.5 ft avg  
Sub-drill: 2.0 ft avg  
Hole Depth: 77.5 ft avg

**Bulk Explosives:** In (kg) out (kg) kg  
CENTRA GOLD 70 33,680 21,760 11,920

**Packaged Explosives:** cs shipped cs returned kg

**Boosters:** kg / unit # used kg  
PENTEX 12 (OR EQUIVALENT) 0.34 98 33.3

total explosives weight in Blast (kg): 11,953  
Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators:** case #'s ms # used  
UNITRONIC 600 9M 49  
UNITRONIC 600 25M 14  
UNITRONIC 600 30M 35

**Cord & Accessories:** U of M # used  
HARNES WIRE DUPLEX (6 PACK) 400M units 1

Resource Deployment  
# of Blasts today (this Quarry): 1  
# of Blasts (this Blast): 1  
# of Helpers (this Blast): 1  
# of MMU's (this Blast): 1

**Services:**  
GPS LAYOUT Enter hours 0.0  
BULK TRUCK CHARGE >=10,000 kg 1  
BLASTER HOURS Enter Blaster hours 7.0  
HELPER HOURS Enter total Helper man-hours 5.5  
SEISMOGRAPH RENTAL Enter # Orica Seismographs 2  
3D LASER PROFILE Enter hours 0.0  
BORETRACK Enter hours 0.0  
TECHNICAL BLAST DESIGN (per day) Enter # of days 0.0

2.028 lb/yd<sup>3</sup>  
1.651 lb/yd<sup>3</sup>  
Yield PF: 0.454 kg/te (actual)  
Front row: 3,302 kg/te (theoretical)  
Main Body: 0,403 kg/te (theoretical)  
"KPI" PF: 0.370 kg/te (theoretical)

Cast Residual Water (this Blast): orange in B1 B2 B3 (value is from previous Blast)  
It was extremely foggy during the blast



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #: 2018-05-22  
 Blast Date: 2018-05-22

Blast Number: 18-004  
 Orica Order #: 2339509  
 Blast Time: 12:02 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40362       | 79.88325        | 0.757536    | 1.394226    |
| Front Row Corner          | 43.40349       | 79.88326        | 0.757534    | 1.394226    |
| Back Row Corner           | 43.40382       | 79.88322        | 0.757540    | 1.394225    |
| Average (Centre of Blast) | 43.40364       | 79.88324        | 0.757536    | 1.394226    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.    | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|-------------------|-----------------|-------------|-------------|
| 1st Reading                               | 43.40245          | 79.87814        | 0.757516    | 1.394137    |
| 2nd Reading                               |                   |                 |             |             |
| Average                                   | 43.40245          | 79.87814        | 0.757516    | 1.394137    |
| Distance (1st Seis. From Centre of Blast) | 433.6             | m               |             |             |
| Post Blast Data:                          | ppV:              | 3.3 mm/s        |             |             |
|                                           | frequency:        | 8.1 Hz          |             |             |
|                                           | air overpressure: | 124.3 dB        |             |             |

2450 2nd Line

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.    | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|-------------------|-----------------|-------------|-------------|
| 1st Reading                               | 43.40605          | 79.89400        | 0.757578    | 1.394413    |
| 2nd Reading                               |                   |                 |             |             |
| Average                                   | 43.40605          | 79.89400        | 0.757578    | 1.394413    |
| Distance (2nd Seis. From Centre of Blast) | 910.4             | m               |             |             |
| Post Blast Data:                          | ppV:              | 0.3 mm/s        |             |             |
|                                           | frequency:        | 8.9 Hz          |             |             |
|                                           | air overpressure: | 123.1 dB        |             |             |

Colling Rd & Blind Line Bruce Trail

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.    | Enter ° W Long. | (N) Radians | (W) Radians |
|-------------------------------------------|-------------------|-----------------|-------------|-------------|
| 1st Reading                               | 43.39339          | 79.88880        | 0.757358    | 1.394323    |
| 2nd Reading                               |                   |                 |             |             |
| Average                                   | 43.39339          | 79.88880        | 0.757358    | 1.394323    |
| Distance (3rd Seis. From Centre of Blast) | 1228.7            | m               |             |             |
| Post Blast Data:                          | ppV:              | 0.3 mm/s        |             |             |
|                                           | frequency:        | 100.0 Hz        |             |             |
|                                           | air overpressure: | 39.1 dB         |             |             |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.

The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(433.6)^2}{30^2} \text{ kg} \\
 &= \frac{188,009}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike der Kinderen*



# Blast Report

## Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2018-06-04

Blast Number: 18-005  
 Orica Order #: 2345753  
 Blast Time: 11:50 AM

page 1

Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Lower Middle South (Bench / Face)  
 GPS Coordinates: 43.40398 °N Latitude 79.88319 °W Longitude  
Centre of Blast (Cent) of Blast

Wind from the: W at 15 kph Temperature: 16 to 20 °C

Clear:  Rain:  Overcast:   
 Partly Cloudy:  Snow:  Inversion:  Ceiling: 2.563 ft

*- Drilling Information -*

Primary Bit diam: 101.6 mm 0° # Holes: 67 = 2,963.5 ft ( 4 " diam)  
Angle from Vertical  
 Secondary Bit diam:      mm 0° # Holes:      = 0.0 ft ( " diam)  
 Tertiary Bit diam:      mm 0° # Holes:      = 0.0 ft ( " diam)  
 Nominal Bit Diameter:

| Bulk Explosives: | in (kg) | out (kg) | kg    |
|------------------|---------|----------|-------|
| CENTRA GOLD 70   | 33,890  | 25,710   | 8,180 |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |
|                      |            |             |    |
|                      |            |             |    |

| Boosters:                 | kg / unit | # usec | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 138    | 46.9 |

total explosives weight in Blast (kg): 8,227  
 Pkgd Prod (0 kg) % of Total kg: 0.0%

| Detonators:       | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 69     |
| UNITRONIC 600 15M |          |    | 69     |

| Cord & Accessories:              | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
|                                  | units  |        |
|                                  | units  |        |

Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >/=5,000kg <10,000kg         | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 11.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

Tonnes Blasted: 20,811 te 7,853 <sup>m3</sup>  
 Total tonnes per day: 20,811 te NB40-07 <sup>Rate Code</sup>  
 Total Holes Loaded: 67 holes  
 ... including:      Dead Holes  
 ... and:      Helper Holes  
 Helper Hole Collar:      ft avg  
 # Rows Blasted: 8 rows  
*- Pattern (Front Row)-*  
 Burden: 12.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 8 front row  
*- Pattern (Main Body) -*  
 Burden: 9.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 59 main body  
 Bench Height: 44.2 ft avg  
 Sub-drill: 0.0 ft avg  
 Hole Depth: 44.2 ft avg  
*- Stone Decking -*  
 Front Row: 0.0 ft avg  
 Main Body: 5.0 ft avg  
 # Decks: 2 per blast  
*- Collar Stemming -*  
 Front Row: 7.0 ft avg  
 Main Body: 7.0 ft avg  
 Material used: .75" stone  
*- Charge Length -*  
 Front Row: 37.2 ft avg  
 Main Body: 32.2 ft avg  
*- Charge Weight -*  
 Front Row: 108.6 kg/hole  
 Main Body: 94.0 kg/hole  
 Max. per delay: 132.0 kg/delay  
 SD () Equation: 217.6 kg/delay  
 Total kg Loaded: 8,227 kg  
 Rock Density: 2.65 g/cc = te/m<sup>3</sup>

Theoretical PF: (based on 1 single hole)

Yield Powder Factor (kg powder) / (te Blasted)

*- Powder Factor -*  
 1.766 lb/yd<sup>3</sup> Yield PF: 0.395 kg/te (actual)  
 1.218 lb/yd<sup>3</sup> Front row: 0.273 kg/te (theoretical)  
 1.405 lb/yd<sup>3</sup> Main Body: 0.315 kg/te (theoretical)  
 1.382 lb/yd<sup>3</sup> "KPI" PF: 0.309 kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast

Stone decks were required at E-7 & F-7 due to voids identified on drill log

Hole H-5 was at 38'

1st seismograph was set to trigger at 100db and when I went to pick it up the memory was full truck traffic going by.



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-06-04

Blast Number: 18-005  
Orica Order #: 2345753  
Blast Time: 11:50 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40399       | 79.88318        | 0.757542    | 1.394225    |
| Front Row Corner          | 43.40400       | 79.88336        | 0.757543    | 1.394228    |
| Back Row Corner           | 43.40396       | 79.88302        | 0.757542    | 1.394222    |
| Average (Centre of Blast) | 43.40398       | 79.88319        | 0.757542    | 1.394225    |

| 1st Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                  | 43.40245       | 79.87814        | 0.757516    | 1.394137    |
| 2nd Reading                  |                |                 |             |             |
| Average                      | 43.40245       | 79.87814        | 0.757516    | 1.394137    |

Distance (1st Seis. From Centre of Blast) **442.5** m

Post Blast Data: ppV: **Memory** mm/s Trigger set at: 2.0 mm/s  
 frequency: **Was** Hz V / T / L ? (Vertical, Transverse or Longitudinal)  
 air overpressure: **Full** dB Trigger set at: 100 dB

2450 2nd Line

| 2nd Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                  | 43.40605       | 79.89400        | 0.757578    | 1.394413    |
| 2nd Reading                  |                |                 |             |             |
| Average                      | 43.40605       | 79.89400        | 0.757578    | 1.394413    |

Distance (2nd Seis. From Centre of Blast) **904.3** m

Post Blast Data: ppV: **Did** mm/s Trigger set at: 2.0 mm/s  
 frequency: **Not** Hz V / T / L ? (Vertical, Transverse or Longitudinal)  
 air overpressure: **Trigger** dB Trigger set at: 115 dB

Colling Rd & Blind Line Bruce Trail

| 3rd Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                  | 43.39339       | 79.88880        | 0.757358    | 1.394323    |
| 2nd Reading                  |                |                 |             |             |
| Average                      | 43.39339       | 79.88880        | 0.757358    | 1.394323    |

Distance (3rd Seis. From Centre of Blast) **1263.7** m

Post Blast Data: ppV: **Did** mm/s Trigger set at: 2.0 mm/s  
 frequency: **Not** Hz V / T / L ? (Vertical, Transverse or Longitudinal)  
 air overpressure: **Trigger** dB Trigger set at: 115 dB

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(442.5)^2}{30^2} \text{ kg}$$

$$= \frac{195,806}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



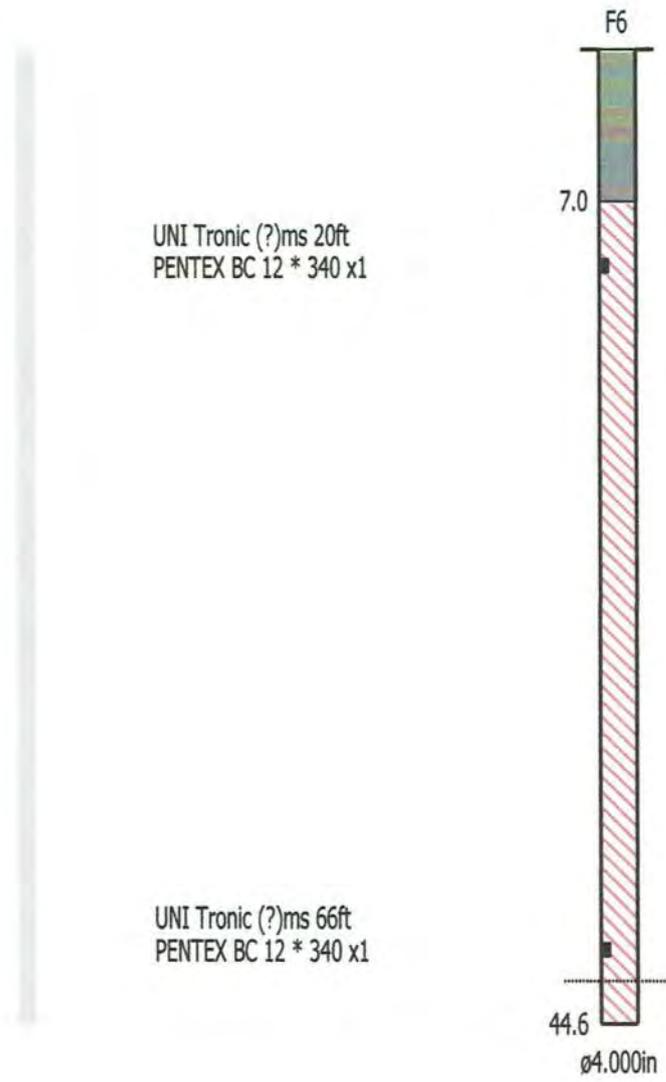
**Blast Design**  
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 6/4/2018

Blast Number: 18-005  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

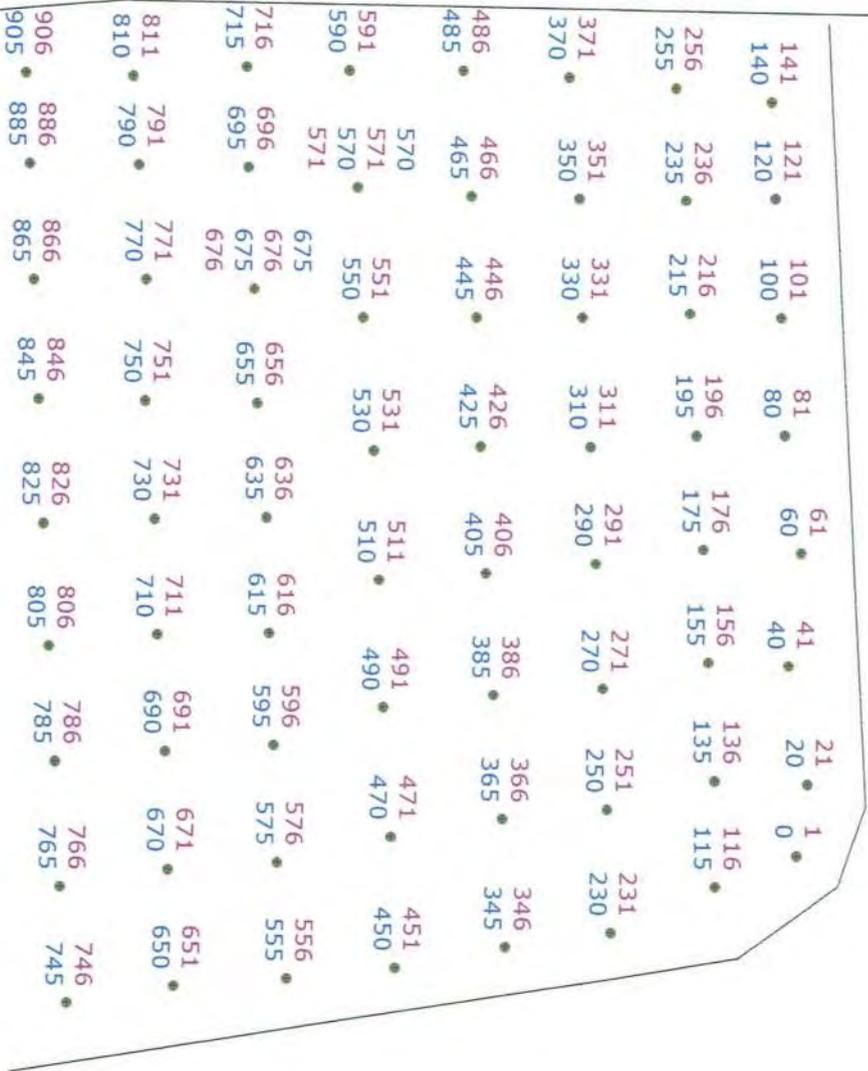
*Mike der Kinderen*

Quarry Manager:

*Bill White*

Signature required, indicating sign off on Blast Design.

# Timing



Not to scale



|                  |                                       |          |
|------------------|---------------------------------------|----------|
| SHOTPlus 5.7.1.1 |                                       | 6/4/2018 |
| Mine             | Burlington                            |          |
| Location         |                                       |          |
| Title/author     | 18-005 Bottom Middle South I. Deemert |          |
| Filename         | 2018-06-04 18-005 Lower Middle.spf    |          |

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Subdrill: 0.0ft      Stemming: 6.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 67      Hole angle: 0.0°  
 Rock density: 2.65g/cc      Total drilled: 2963.6ft      Blasted tonnage: 21,880S/T

# Load Sheet 132kg MAX

Highwall

- 74 • 108 • 92 • 117 • 114 • 116 • 114 • ~~112~~ 112
- 114 • 116 • 108 • 121 • 113 • 113 • 131 • ~~107~~ 97
- 118 • 114 • 118 • 116 • 117 • 126 • 119 • 112
- 124 • 124 • 122 • 132 • 123 • 116 • 106 • 109
- 119 •  $\frac{15}{124}$  • 121 • 123 • 125 • 124 • 109 • 116
- 123 • 126 •  $\frac{7}{132}$  • 119 • 122 • 107 • 119 • 111 • 97
- 131 • 104 • 128 • 121 • 119 • 94 • 115 • 129 • 121
- 129 • 129 • 132 • 123 • 99 • 121 • 121 • 120 • 107



Not to scale

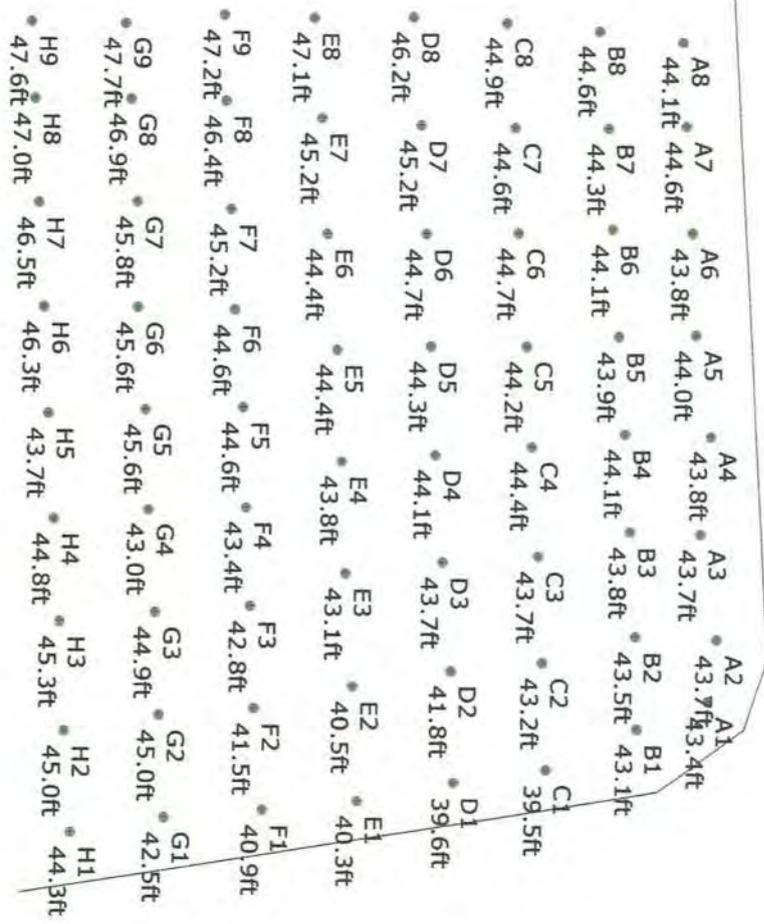
|                  |                                       |           |
|------------------|---------------------------------------|-----------|
| SHOTPlus 5.7.1.1 |                                       | 5/30/2018 |
| Mine             | Burlington                            |           |
| Location         |                                       |           |
| Title/author     | 18-005 Bottom Middle South I. Deenert |           |
| Filename         | 2018-06-04 18-005 Lower Middle.spf    |           |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Subdrill: 0.0ft Stemming: 6.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 67 Hole angle: 0.0°  
 Rock density: 2.65g/cc Total drilled: 2963.6ft Blasted tonnage: 21,8805/T

Highwall



|                  |                                       |           |
|------------------|---------------------------------------|-----------|
| SHOTPlus 5.7.1.1 |                                       | 5/30/2018 |
| Mine             | Burlington                            |           |
| Location         |                                       |           |
| Title/author     | 18-005 Bottom Middle South I. Deemert |           |
| Filename         | 2018-06-04 18-005 Lower Middle.spf    |           |



Not to scale

1089712

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
 FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSANCE NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.



Bill of Lading / Connaissance

CONSIGNOR EXPÉDITEUR  
**GRAND VALLEY**  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
 BURLINGTON ON  
 CA L7R 4L8

*BLASTER: MIKE D  
 HCLP: MIKE A  
 KEITH  
 BULK: JEFF*

|                                        |                                            |
|----------------------------------------|--------------------------------------------|
| GROSS / BRUT                           |                                            |
| TARE                                   |                                            |
| NET                                    |                                            |
| TIME IN HEURE D'ENTRÉE<br><i>6:50</i>  | TIME OUT HEURE SORTIE                      |
| ORDER NUMBER N° DE COMMANDE<br>2345753 | B/L NUMBER N° DE CONNAISSEMENT<br>86028794 |

|                                           |                                                                |                                                                     |                                                        |
|-------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------|
| DATE REQUIRED DATE REQUISE<br>04 Jun 2018 | TIME REQUIRED HEURE REQUISE<br>00:00:00                        | INVOICE TO / BUYER FACTURÉ À / ACHETEUR<br>NELSON AGGREGATE COMPANY | CUSTOMER REFERENCE NO. N° DE COMMANDE DU CLIENT<br>n/a |
| DATE SHIPPED EXPÉDIÉ LE<br>04 Jun 2018    | FREIGHT TERMS CONDITIONS DE LIVRAISON<br>FOB Dest'n, Own Truck | SHIP. MAG. LIC. PERMIS EXPÉDITEUR<br>F-73289                        | VEHICLE NO. N° DE VÉHICULE<br>15013                    |
| SHIP VIA TRANSPORTEUR<br>Orica Truck      |                                                                | ROUTING ITINÉRAIRE<br>STANDARD                                      | MAG. LIC. NO. N° DE PERMIS                             |

| QTY. QTÉ.                                                                                                                                                                                                                             | UM | DG MD | QTY. RET'D QTÉ. RET. | QTY. SOLD QTÉ. FACT. | DESCRIPTION                           | # OF / DE PKGS. | AMOUNT MONTANT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-------|----------------------|----------------------|---------------------------------------|-----------------|----------------|
| 196                                                                                                                                                                                                                                   | PC | X     | 58                   | 138                  | PENTEX BC 340 (49/CS)                 | 4               | 71.540         |
| 2                                                                                                                                                                                                                                     | PC |       | 1                    | 1                    | Harness Wire Duplex (6 pack) 400m     | 1               | 5.840          |
| 80                                                                                                                                                                                                                                    | PC | X     | 11                   | 69                   | *uni tronic 600-06.0M CU/ZC(20')30PC  | 1               | 5.840          |
| 132                                                                                                                                                                                                                                   | PC | X     | 63                   | 69                   | *uni tronic 600-15M C/Z SPL(50')66PC  | 2               | 22.572         |
| 66                                                                                                                                                                                                                                    | PC | X     | 66                   | 0                    | *uni tronic 600-20M CU/ZC SPL(65')66P | 1               | 13.464         |
| 100                                                                                                                                                                                                                                   | PC |       | 95                   | 5                    | MINI STEM PLUGS - PART #74853         |                 | 0.700          |
| 1                                                                                                                                                                                                                                     | PC |       |                      |                      | LICENSED BLASTER                      |                 |                |
| 1.0                                                                                                                                                                                                                                   | HR |       |                      |                      | LABOUR CHARGE                         |                 |                |
| 1                                                                                                                                                                                                                                     | PC |       |                      |                      | ROG (ROCK ON GROUND)                  |                 |                |
| TOTAL GROSS WEIGHT                                                                                                                                                                                                                    |    |       |                      |                      |                                       |                 | 119.956 KG     |
| **** TOTAL PACKAGES ****                                                                                                                                                                                                              |    |       |                      |                      |                                       | 9               |                |
| GHS/WHMIS SDS documents available<br>Website: <a href="http://www.oricaminingservices.com">www.oricaminingservices.com</a><br>Email: <a href="mailto:sds.na@orica.com">sds.na@orica.com</a><br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |       |                      |                      |                                       |                 |                |

24 HOUR TECHNICAL INFORMATION: 1-613-996-6666

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                         |                                                          |                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br>ERAP 2-1510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>1-877-561-3636 | PLACARDS OFFERED / PLACARDS OFFERT<br>YES / OUI NO / NON | FORWARD INVOICE FOR PREPAID FREIGHT QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À NO DE CONNAISSANCE D'ORICA:<br>Orica Canada Inc.<br>301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5 |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORT AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÈGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                         | DECLARED VALUE OF SHIPMENT VALEUR DÉCLARÉE<br>\$         | NETTE No. CONV PRESSAGE WT AGREEMENT NO.                                                                                                                                                                                                |

|                                                                     |                                                                     |                                                      |
|---------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                              | CARRIER / TRANSPORTEUR<br>Orica Truck                               | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br><i>K. PLATT</i> | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br><i>K. PLATT</i> | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br><i>K. Platt</i>                                        | SIGNATURE<br><i>K. Platt</i>                                        | SIGNATURE                                            |
| DATE<br>4 6 18<br>D/J M/M Y/A                                       | DATE<br>4 6 18<br>D/J M/M Y/A                                       | DATE                                                 |

2 SHIPPING ORDER BON D'EXPÉDITION

(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
 (L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRES AVOIR SIGNE LA COPIE ORIGINALE (1) DU CONNAISSANCE CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
 SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO

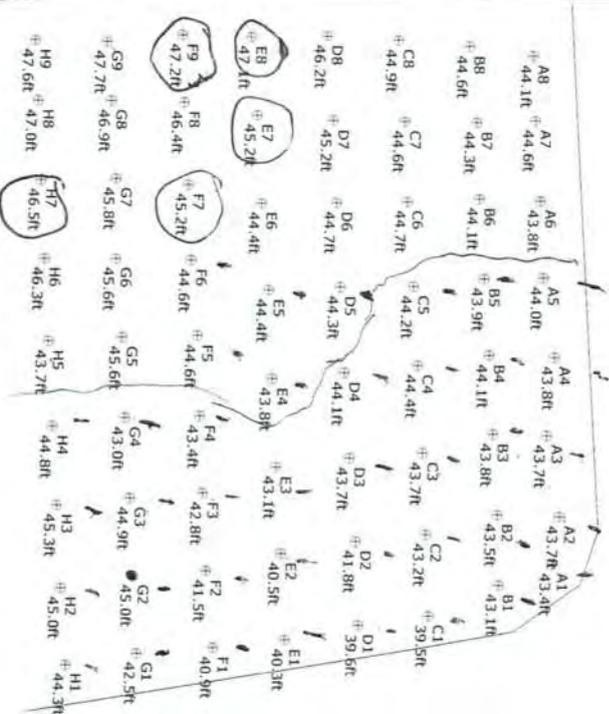
Blast Summary Data

Burden : 9.0ft      Spacing: 10.0ft      Subdrill: 0.0ft      Stemming: 6.0ft  
 1st row burden : 12.0ft      Hole Diameter: 4.0in      Number of holes : 67      Hole angle: 0.0°  
 Rock density: 2.65g/cc      Total drilled : 2963.6ft      Blasted tonnage: 21,8805/T

Open Face

Bottom Middle South 18-005  
 12x10 Front Row 9x10 Body  
 4" Hole Diameter  
 250m Floor Elevation + 0.6m Su

Highwall



Not to scale

|                                                |            |
|------------------------------------------------|------------|
| SHOTPlus 5.7.2.1                               | 02/05/2018 |
| Mine Burlington                                |            |
| Location                                       |            |
| Title/author 18-005 Bottom Middle South I. Dee |            |
| Filename 18-005 Design Final.spf               |            |



# Blast Report

## Nelson Aggregate

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2018-06-06**

Blast Number: **18-006**  
 Orica Order #: **2346925**  
 Blast Time: **12:10 PM**

page 1 Blaster-in-charge: **Mike der Kinderen** (Print Name)

Blast Location: **Lower Bench** (Bench / Face)  
 GPS Coordinates: **43.40428** °N Latitude **79.88387** °W Longitude  
Centre of Blast Centre of Blast

Wind from the: **W** at **5** kph Temperature: **11 to 15** °C

Clear:  Rain:  Overcast:  X  
 Partly Cloudy:  Snow:  Inversion:  Ceiling: **3,116** ft

*- Drilling Information -*

Primary Bit diam: **101.6** mm Angle from Vertical **0**° # Holes: **61** = **2,668.2** ft ( **4** " diam)  
 Secondary Bit diam: **mm** **0**° # Holes: = **0.0** ft ( " diam)  
 Tertiary Bit diam: **mm** **0**° # Holes: = **0.0** ft ( " diam)  
 Nominal Bit Diameter:

| Bulk Explosives: | in (kg)       | out (kg)      | kg           |
|------------------|---------------|---------------|--------------|
| CENTRA GOLD 70   | <b>26,650</b> | <b>19,410</b> | <b>7,240</b> |

| Packaged Explosives: | cs shipped | cs returned | kg |
|----------------------|------------|-------------|----|
|                      |            |             |    |

| Boosters:                | kg / unit | # usec      | kg         |
|--------------------------|-----------|-------------|------------|
| PENTEX 8 (OR EQUIVALENT) |           | <b>0.23</b> | <b>130</b> |
|                          |           |             |            |

total explosives weight in Blast (kg): **7,270**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

| Detonators:       | case #'s | ms | # used    |
|-------------------|----------|----|-----------|
| UNITRONIC 600 6M  |          |    | <b>59</b> |
| UNITRONIC 600 15M |          |    | <b>71</b> |

| Cord & Accessories:              | U of M | # used   |
|----------------------------------|--------|----------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | <b>1</b> |
| MINI STEM PLUGS - 6015 (4")      | units  | <b>8</b> |

| Resource Deployment:            |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

| Services:              |                              |             |
|------------------------|------------------------------|-------------|
| GPS LAYOUT             | Enter hours                  | <b>0.0</b>  |
| BULK TRUCK CHARGE      | >=5,000kg <10,000kg          | <b>1</b>    |
| BLASTER HOURS          | Enter Blaster hours          | <b>7.0</b>  |
| HELPER HOURS           | Enter total Helper man-hours | <b>11.0</b> |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | <b>0</b>    |
| 3D LASER PROFILE       | Enter hours                  | <b>0.0</b>  |
| BORETRACK              | Enter hours                  | <b>0.0</b>  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | <b>0.0</b>  |

Tonnes Blasted: **17,948** te **6,773** m<sup>3</sup>  
 Total tonnes per day: **17,948** te NB40-08 Rate Code  
 Total Holes Loaded: **61** holes  
 ... including: **Dead Holes**  
 ... and: **Helper Holes**  
 Helper Hole Collar: **ft** avg  
 # Rows Blasted: **11** rows  
*- Pattern (Front Row) -*  
 Burden: **12.0** ft avg  
 Spacing: **10.0** ft avg  
 # Holes: **8** front row  
*- Pattern (Main Body) -*  
 Burden: **9.0** ft avg  
 Spacing: **10.0** ft avg  
 # Holes: **53** main body  
 Bench Height: **41.7** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: **43.7** ft avg  
*- Stone Decking -*  
 Front Row: **7.0** ft avg  
 Main Body: **5.0** ft avg  
 # Decks: **6** per blast  
*- Collar Stemming -*  
 Front Row: **7.0** ft avg  
 Main Body: **7.0** ft avg  
 Material used: **.75"** stone  
*- Charge Length -*  
 Front Row: **29.7** ft avg  
 Main Body: **31.7** ft avg  
*- Charge Weight -*  
 Front Row: **86.7** kg/hole  
 Main Body: **92.6** kg/hole  
 Max. per delay: **145.0** kg/delay  
 SD () Equation: **284.6** kg/delay  
 Total kg Loaded: **7,270** kg  
 Rock Density: **2.65** g/cc = te/m<sup>3</sup>

Theoretical PF (Based on a single row)

Yield Powder Factor (kt Loaded / in Blast)

*- Powder Factor -*  
 Yield PF: **0.405** kg/te (actual)  
 Front row: **0.231** kg/te (theoretical)  
 Main Body: **0.328** kg/te (theoretical)  
 "KPI" PF: **0.319** kg/te (theoretical)

*Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or iS from previous Blast:*  
 Due to voids identified on drill log and found while loading we had to put in 6 stone decks rang from 5'-7'  
 Every front row hole had lean burden, therefore we used toe loads and stem plugs  
 See load adjustment sheet in report



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-06-06

Blast Number: 18-006  
Orica Order #: 2346925  
Blast Time: 12:10 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40427       | 79.88388        | 0.757547    | 1.394237    |
| Front Row Corner          | 43.40428       | 79.88368        | 0.757548    | 1.394233    |
| Back Row Corner           | 43.40428       | 79.88405        | 0.757548    | 1.394240    |
| Average (Centre of Blast) | 43.40428       | 79.88387        | 0.757548    | 1.394237    |

| 1st Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                  | 43.40245       | 79.87814        | 0.757516    | 1.394137    |
| 2nd Reading                  |                |                 |             |             |
| Average                      | 43.40245       | 79.87814        | 0.757516    | 1.394137    |

|                                           |                           |                                                        |
|-------------------------------------------|---------------------------|--------------------------------------------------------|
| Distance (1st Seis. From Centre of Blast) | 506.1                     | m                                                      |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0 mm/s                          |
|                                           | frequency: Not            | Hz V / T / L: ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 120 dB                              |
| 2450 2nd Line                             |                           |                                                        |

| 2nd Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                  | 43.40605       | 79.89400        | 0.757578    | 1.394413    |
| 2nd Reading                  |                |                 |             |             |
| Average                      | 43.40605       | 79.89400        | 0.757578    | 1.394413    |

|                                           |                           |                                                        |
|-------------------------------------------|---------------------------|--------------------------------------------------------|
| Distance (2nd Seis. From Centre of Blast) | 842.9                     | m                                                      |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0 mm/s                          |
|                                           | frequency: Not            | Hz V / T / L: ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115 dB                              |
| Colling Rd & Blind Line Bruce Trail       |                           |                                                        |

| 3rd Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|------------------------------|----------------|-----------------|-------------|-------------|
| 1st Reading                  | 43.39339       | 79.88880        | 0.757358    | 1.394323    |
| 2nd Reading                  |                |                 |             |             |
| Average                      | 43.39339       | 79.88880        | 0.757358    | 1.394323    |

|                                           |                           |                                                        |
|-------------------------------------------|---------------------------|--------------------------------------------------------|
| Distance (3rd Seis. From Centre of Blast) | 1276.3                    | m                                                      |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0 mm/s                          |
|                                           | frequency: Not            | Hz V / T / L: ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115 dB                              |
| SouthWest Corner of Property              |                           |                                                        |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(506.1)^2}{30^2} \text{ kg} \\
 &= \frac{256,137}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that Blast Report is Complete & Accurate.



# Blast Design

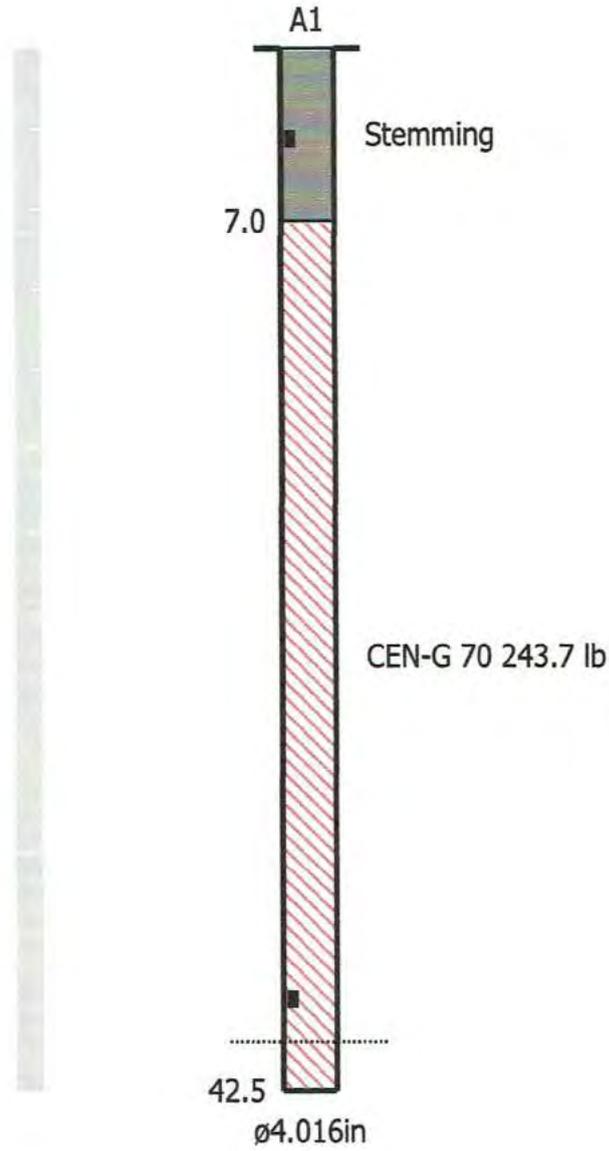
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 6/6/2018

Blast Number: 18-006  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Bill White*

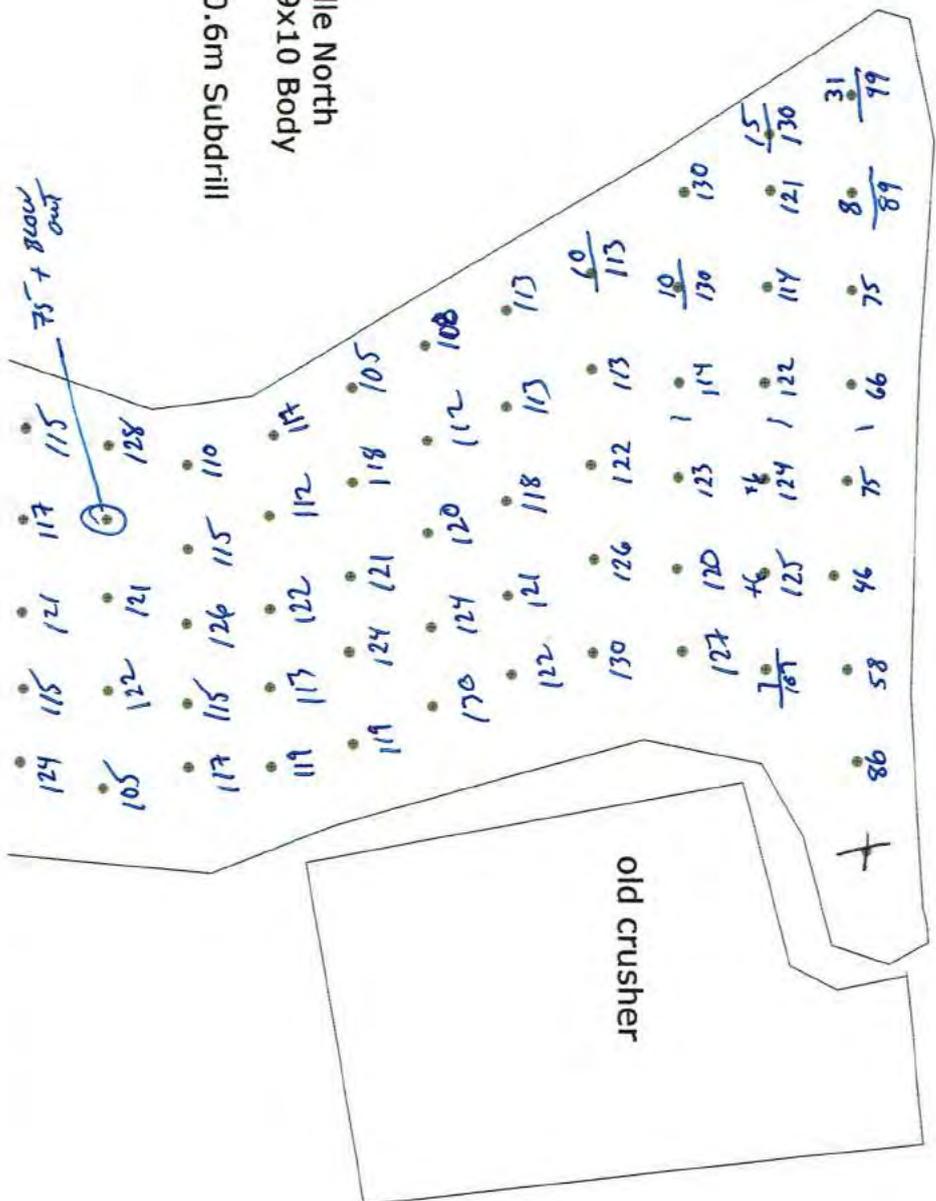
Signature required, indicating sign off on Blast Design.



Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Subdrill: 2.0ft      Stemming: 6.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 62      Hole angle: 0.0°  
 Total drilled: 2588.0ft

# Load Sheet 130kg MAX



open face

18-006 Lower Middle North  
 12x10 Front Row, 9x10 Body  
 4" Hole Diameter  
 250m Elevation + 0.6m Subdrill



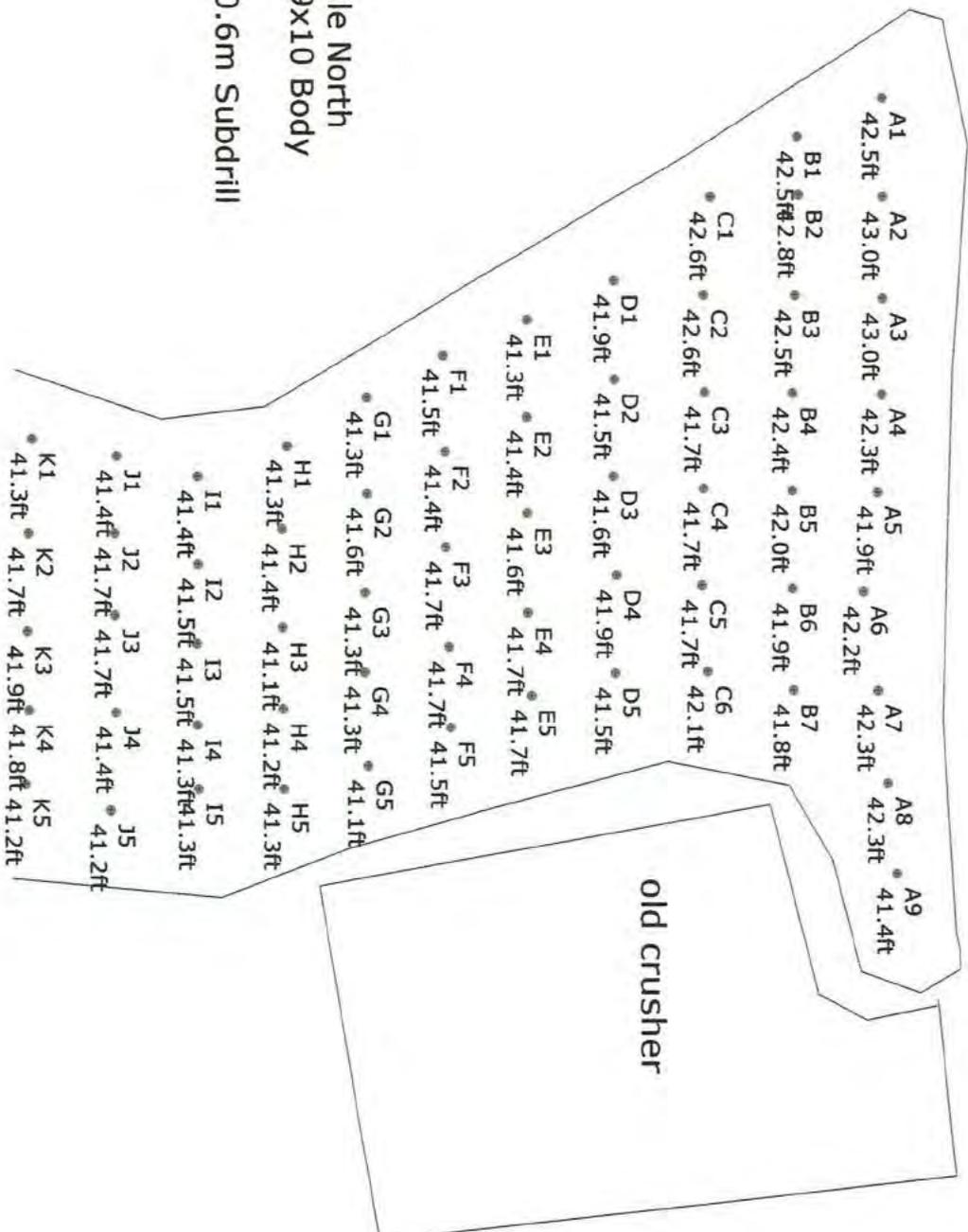
Not to scale

|                  |                       |
|------------------|-----------------------|
| SHOTPlus 5.7.1.1 | 6/4/2018              |
| Mine             | Burlington            |
| Location         |                       |
| Title/author     | 18-006 K. George      |
| Filename         | 2018-06-06 18-006.spf |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Subdrill: 2.0ft      Stemming: 6.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 62      Hole angle: 0.0°  
 Total drilled: 2588.0ft



open face

18-006 Lower Middle North  
 12X10 Front Row, 9X10 Body  
 4" Hole Diameter  
 250m Elevation + 0.6m Subdrill

old crusher



Not to scale

|                  |                       |
|------------------|-----------------------|
| SHOTPlus 5.7.1.1 | 6/4/2018              |
| Mine             | Burlington            |
| Location         |                       |
| Title/author     | 18-006 K. George      |
| Filename         | 2018-06-06 18-006.spf |

1089736

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.

Bill of Lading / Connaissancement



Orica Canada Inc.

CONSIGNOR EXPÉDITEUR

GRAND VALLEY
033411 SIDE ROAD 21-22
GRAND VALLEY ON
CA L9W 7G1

Blaster - Mike
Helpers - Dylan
Ken

CONSIGNEE CONSIGNATAIRE

NELSON AGGREGATE COMPANY
BURLINGTON ON
CA L7R 4L8

Table with 4 columns: GROSS / BRUT, TARE, NET, TIME IN HEURE D'ENTRÉE, TIME OUT HEURE SORTIE, ORDER NUMBER N° DE COMMANDE, B/L NUMBER N° DE CONNAISSEMENT. Values: 2346925, 86032192.

Table with 4 main sections: DATE REQUIRED / DATE REQUISE, TIME REQUIRED / HEURE REQUISE, INVOICE TO / BUYER FACTURÉ À / ACHETEUR, CUSTOMER REFERENCE NO. N° DE COMMANDE DU CLIENT. Values: 06 Jun 2018, 00:00:00, NELSON AGGREGATE COMPANY, n/a.

Main table with columns: QTY. QTÉ, UM, DG MD, QTY. RET'D QTÉ. RET., QTY. SOLD QTÉ. FACT, DESCRIPTION, # OF / DE PKGS., AMOUNT MONTANT. Includes items like PENTEX BC 340, Harness Wire Duplex, etc.

24 HOUR TECHNICAL INFORMATION: 1-613-996-6666

Table with 4 columns: EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE, EMERGENCY RESPONSE NO.24 HOUR NUMBER, PLACARDS OFFERED / PLACARDS OFFERT, FORWARD INVOICE FOR PREPAID FREIGHT. Values: ERAP 2-1510, 1-877-561-3636, YES/OUI NO/NON.

Table with 4 columns: CONSIGNOR / EXPÉDITEUR, CARRIER / TRANSPORTEUR, CONSIGNEE / DESTINATAIRE, SHIPPER'S NAME, DRIVER'S NAME, RECEIVER'S NAME. Values: GRAND VALLEY, Orica Truck, NELSON AGGREGATE COMPANY, Dylan Tratt, Dylan Tratt.

2 SHIPPING ORDER BON D'EXPÉDITION

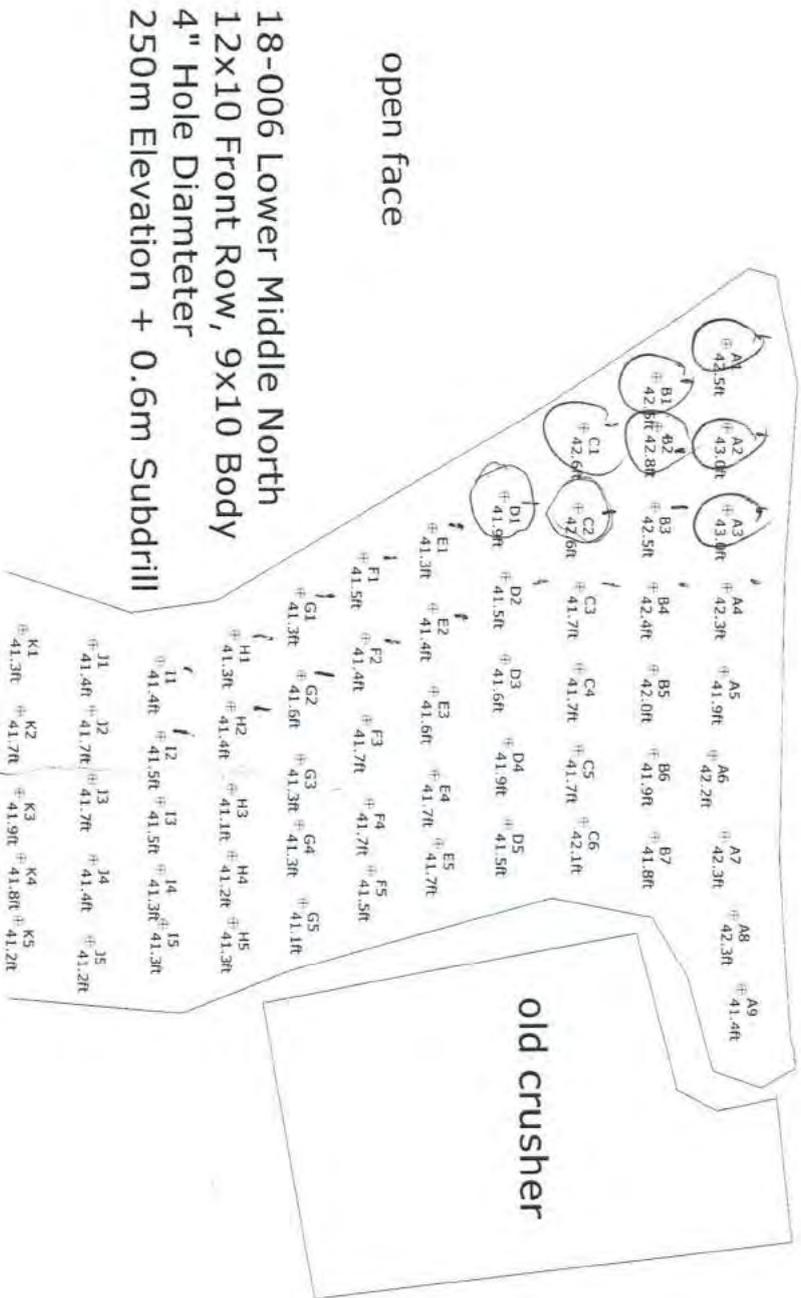
(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Subdrill: 2.0ft Stemming: 6.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 62 Hole angle: 0.0°  
 Total drilled: 2588.0ft

0



open face

18-006 Lower Middle North  
 12X10 Front Row, 9X10 Body  
 4" Hole Diameter  
 250m Elevation + 0.6m Subdrill

Not to scale



|                  |                         |
|------------------|-------------------------|
| SHOTPlus 5.7.2.1 | 02/05/2018              |
| Mine             | Burlington              |
| Location         |                         |
| Title/author     | 18-006 K. George        |
| Filename         | 18-006 Lower Middle.spf |



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:  
Blast Date: 2018-06-11

Blast Number: 18-007  
Orica Order #: 2348563  
Blast Time: 11:56 AM

page 1

Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40368 °N Latitude 79.88315 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: E at 15 kph Temperature: 21 to 25 °C

Clear: Partly Cloudy: X Rain: Overcast: Snow: Inversion: Ceiling 30,000 ft

### - Drilling Information -

|                              | Angle from Vertical | Nominal Bit Diameter:                |
|------------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm   | 0°                  | # Holes: 54 = 4,055.1 ft ( 4 " diam) |
| Secondary Bit diam: 101.6 mm | 0°                  | # Holes: 1 = 75.1 ft ( 4 " diam)     |
| Tertiary Bit diam: mm        | 0°                  | # Holes: = 0.0 ft ( " diam)          |

### Bulk Explosives:

|  | in (kg) | out (kg) | kg     |
|--|---------|----------|--------|
|  | 33,850  | 21,090   | 12,760 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 110    | 37.4 |

total explosives weight in Blast (kg): 12,797  
Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 54     |
| UNITRONIC 600 15M |          |    | 1      |
| UNITRONIC 600 25M |          |    | 55     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 10     |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |     |
|------------------------|------------------------------|-----|
| GPS LAYOUT             | Enter hours                  | 0.0 |
| BULK TRUCK CHARGE      | >=10,000 kg                  | 1   |
| BLASTER HOURS          | Enter Blaster hours          | 0.0 |
| HELPER HOURS           | Enter total Helper man-hours | 0.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0   |
| 3D LASER PROFILE       | Enter hours                  | 0.0 |
| BORETRACK              | Enter hours                  | 0.0 |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0 |

Tonnes Blasted: 28,467 te 10,742 m<sup>3</sup>  
Total tonnes per day: 28,467 te NB80-01 Rate Code  
Total Holes Loaded: 55 holes  
... including: Dead Holes  
... and: Helper Holes  
Helper Hole Collar: ft avg  
# Rows Blasted: 4 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 8 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 47 main body

Bench Height: 73.1 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 75.1 ft avg

### - Stone Decking -

Front Row: ft avg  
Main Body: ft avg  
# Decks: per blast

### - Collar Stemming -

Front Row: 7.0 ft avg  
Main Body: 7.0 ft avg  
Material used: .75" Stone

### - Charge Length -

Front Row: 68.1 ft avg  
Main Body: 68.1 ft avg

### - Charge Weight -

Front Row: 198.6 kg/hole  
Main Body: 198.6 kg/hole  
Max. per delay: 261.0 kg/delay  
SD () Equation: 202.9 kg/delay  
Total kg Loaded: 12,797 kg  
Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.450 kg/te (actual)  
Front row: 0.302 kg/te (theoretical)  
Main Body: 0.402 kg/te (theoretical)  
"KPI" PF: 0.377 kg/te (theoretical)

2.008 lb/yd<sup>3</sup>  
1.347 lb/yd<sup>3</sup>  
1.797 lb/yd<sup>3</sup>  
1.684 lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

Cost Reduction Notes (this Blast) - change in Bit , B , S , Expl or IS from previous Blast:

Some holes received an 8' or 9' collar due to broken rock on top or lean burden at the crest



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-06-11

Blast Number: 18-007  
Orica Order #: 2348563  
Blast Time: 11:56 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40364       | 79.88314        | 0.757536    | 1.394224    |
| Front Row Corner          | 43.40353       | 79.88317        | 0.757535    | 1.394224    |
| Back Row Corner           | 43.40386       | 79.88312        | 0.757540    | 1.394223    |
| Average (Centre of Blast) | 43.40368       | 79.88315        | 0.757537    | 1.394224    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 427.3                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 2.7                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 12.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 116.9 | dB              | Trigger set at: 115 | dB                                     |
| 2450 2nd Line                             |                         |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 916.8                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 10.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 120.2 | dB              | Trigger set at: 115 | dB                                     |
| Colling Rd & Blind Line Bruce Trail       |                         |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1233.5                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 0.0          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 119.6 | dB              | Trigger set at: 115 | dB                                     |
| SouthWest Corner of Property              |                         |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(427.3)^2}{30^2} \text{ kg}$$

$$= \frac{182,585}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



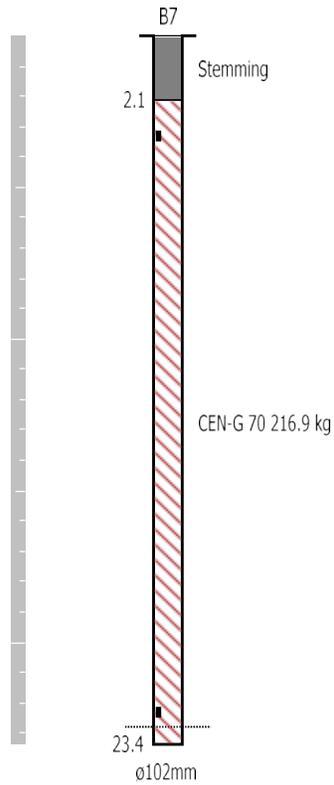
**Blast Design**  
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 6/11/2018

Blast Number: 18-007  
Orica Order #: 2348563

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Bill White*

Signature required, indicating  
sign off on Blast Design.

SHOTPlus 5 Plan

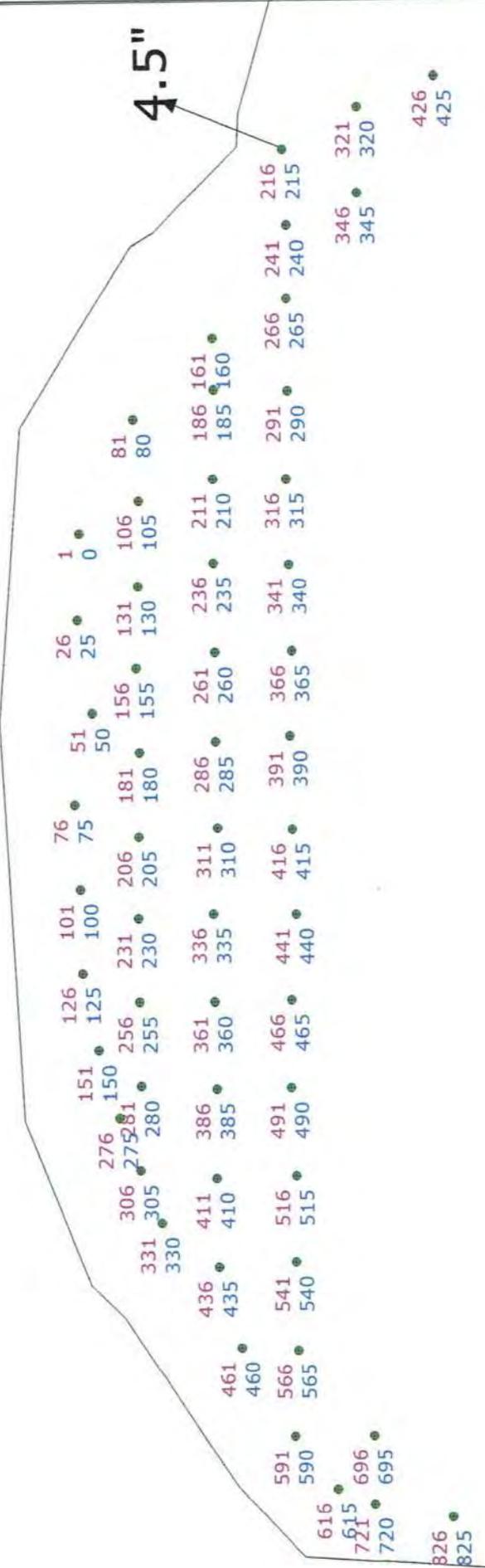
Blast Summary Data

Burden: 2.7m Spacing: 3.0m Stemming: 2.1m  
 1st row burden: 3.7m Hole Diameter: 102.0mm Number of holes: 55 Hole angle: 0.0°  
 Rock density: 2.65g/cc Total drilled: 1292.0m Blasted tonnage: 29,020tne



open face

4.5"



|                  |                               |            |
|------------------|-------------------------------|------------|
| SHOTPlus 5.7.1.1 |                               | 6/11/2018  |
| Mine             | Burlington                    |            |
| Location         | Upper Middle Bench            |            |
| Title/author     | 18-007 Upper Middle Design    | Ken George |
| Filename         | 18-007_Upper_Middle_Final.spf |            |

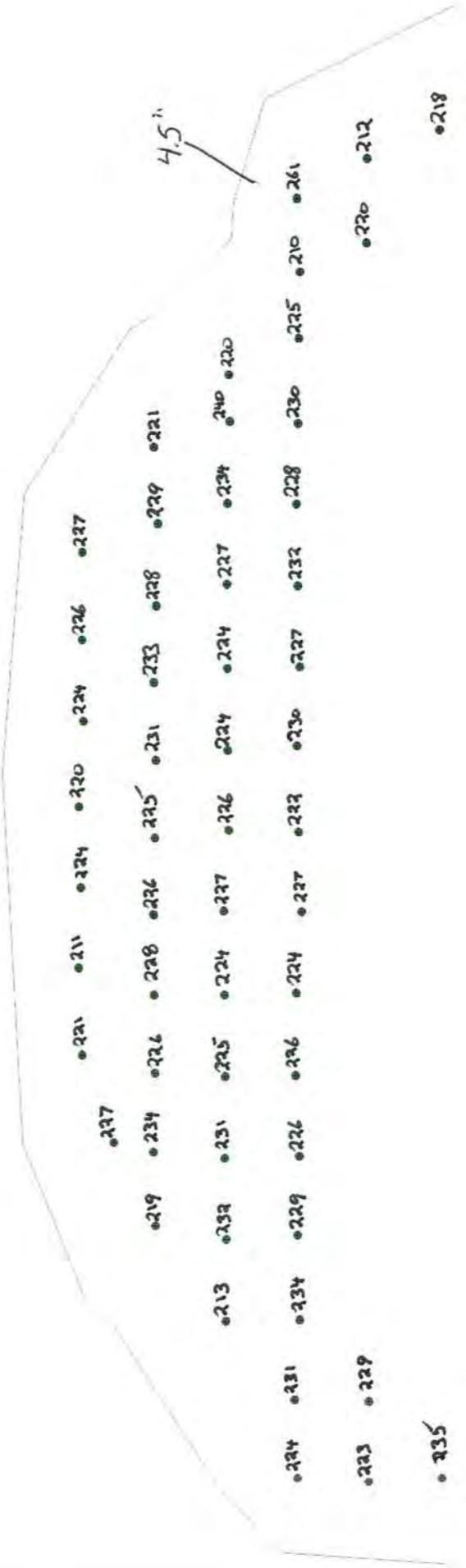


Not to scale

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 55      Hole angle: 0.0°  
 Rock density: 2.65g/cc      Total drilled: 4130.2ft      Blasted tonnage: 25,592S/T

# Load Sheet Max Load 240kg



|                  |                                       |
|------------------|---------------------------------------|
| SHOTPlus 5.7.1.1 | 6/7/2018                              |
| Mine             | Burlington                            |
| Location         | Upper Middle Bench                    |
| Title/author     | 18-007 Upper Middle Design Ken George |
| Filename         | 18-007_Upper_Middle_Final.spf         |

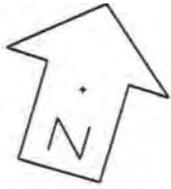


Not to scale

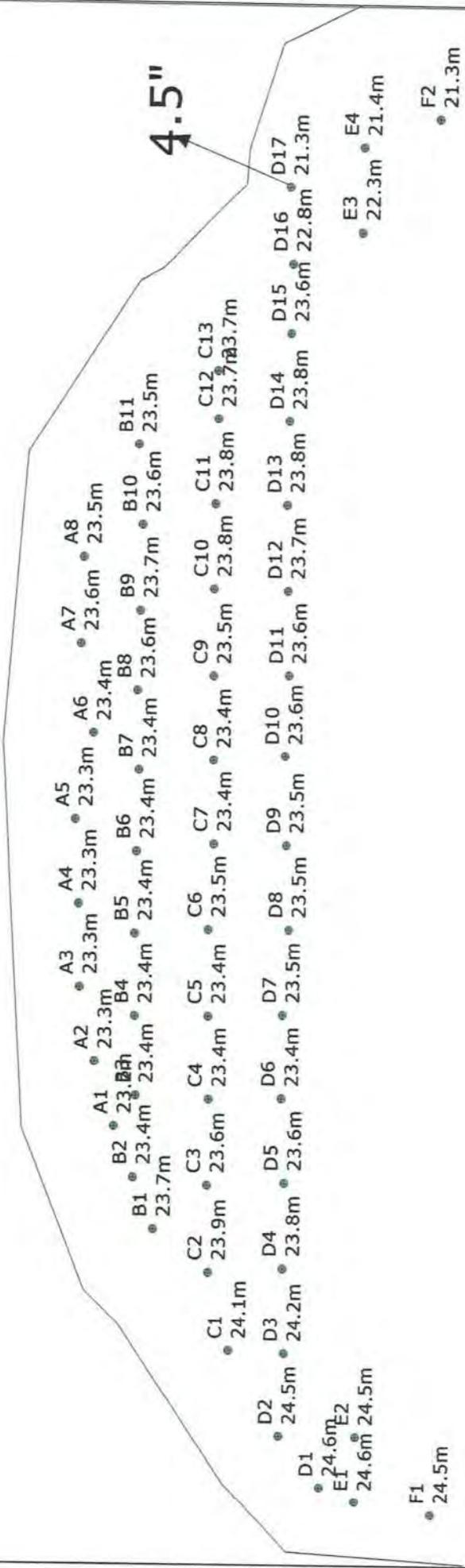
SHOTPlus 5 Plan

Blast Summary Data

Burden: 2.7m Spacing: 3.0m Stemming: 2.1m  
 1st row burden: 3.7m Hole Diameter: 102.0mm Number of holes: 55 Hole angle: 0.0°  
 Rock density: 2.65g/cc Total drilled: 1292.0m Blasted tonnage: 29,020tne



open face



|                  |                                       |           |
|------------------|---------------------------------------|-----------|
| SHOTPlus 5.7.1.1 |                                       | 6/11/2018 |
| Mine             | Burlington                            |           |
| Location         | Upper Middle Bench                    |           |
| Title/author     | 18-007 Upper Middle Design Ken George |           |
| Filename         | 18-007_Upper_Middle_Final.spf         |           |



Not to scale

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
 FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSANCE NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES  
 SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissance

**Orica Canada Inc.**  
 GRAND VALLEY  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE  
 CONSIGNATAIRE  
 NELSON AGGREGATE COMPANY  
 BURLINGTON ON  
 CA L7R 4L8

|                                |                                   |
|--------------------------------|-----------------------------------|
| GROSS / BRUT                   |                                   |
| TARE                           |                                   |
| NET                            |                                   |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE          |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSEMENT |
| 2348563                        | 86036212                          |

|                               |                                |                                            |                                                    |
|-------------------------------|--------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 11 Jun 2018                   | 00:00:00                       | NELSON AGGREGATE COMPANY                   | n/a                                                |

|                            |                                          |                                      |                               |
|----------------------------|------------------------------------------|--------------------------------------|-------------------------------|
| DATE SHIPPED<br>EXPÉDIÉ LE | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR | VEHICLE NO.<br>N° DE VÉHICULE |
| 11 Jun 2018                | FOB Dest'n, Own Truck                    | F-73289                              | PT 15013                      |

|                          |                       |                               |
|--------------------------|-----------------------|-------------------------------|
| SHIP VIA<br>TRANSPORTEUR | ROUTING<br>ITINÉRAIRE | MAG. LIC. NO.<br>N° DE PERMIS |
| Orica Truck              | STANDARD              |                               |

| QTY.<br>QTÉ.                                                                                                                                   | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                           | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|------------------------|---------------------------------------|--------------------|-------------------|
| 147                                                                                                                                            | PC | X        | 37                      | 110                    | PENTEX BC 340 (49/CS)                 | 3                  | 53.655            |
| 2                                                                                                                                              | PC |          | 1                       | 1                      | Harness Wire Duplex (6 pack) 400m     | 1                  | 5.840             |
| 80                                                                                                                                             | PC | X        | 26                      | 54                     | *uni tronic 600-06.0M CU/ZC(20')80PC  | 1                  | 5.840             |
| 66                                                                                                                                             | PC | X        | 65                      | 1                      | *uni tronic 600-15M C/Z SPL(50')66PC  | 1                  | 11.286            |
| 108                                                                                                                                            | PC | X        | 53                      | 55                     | *uni tronic 600-25M CU/ZC SPL(80')54P | 2                  | 26.352            |
| 100                                                                                                                                            | PC |          | 90                      | 10                     | MINI STEM PLUGS - PART #74853         |                    | 0.700             |
| 1                                                                                                                                              | PC |          |                         |                        | LICENSED BLASTER                      |                    |                   |
| 1.0                                                                                                                                            | HR |          |                         |                        | LABOUR CHARGE                         |                    |                   |
| 1                                                                                                                                              | PC |          |                         |                        | ROG (ROCK ON GROUND)                  |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                             |    |          |                         |                        |                                       |                    | 103.673 KG        |
| **** TOTAL PACKAGES ****                                                                                                                       |    |          |                         |                        |                                       | 8                  |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                        |                                       |                    |                   |

24 HOUR TECHNICAL INFORMATION: 1-613-996-6666

|                                                    |                                                                              |                                    |
|----------------------------------------------------|------------------------------------------------------------------------------|------------------------------------|
| PALLETS USED / PALETTES UTILISÉES                  | PALLETS RETURNED / PALETTES RETOURNÉES                                       | BAGS USED / SACS UTILISÉS          |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TÉLÉPHONE D'URGENCE/24 HEURE NUMERO | PLACARDS OFFERED / PLACARDS OFFERT |
| BRAP 2-1510                                        | 1-877-561-3636                                                               | YES / OUI NO / NON                 |

THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.  
 NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS.

DECLARED VALUE OF SHIPMENT / VALEUR DÉCLARÉE \$

NETTE No. CONV PRESSAGE WT AGREEMENT NO.

301 rue hotel de ville  
 Brownsburg-Chatham, QC  
 J8G 3B5

|                                                                 |                                                                 |                                                      |
|-----------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                          | CARRIER / TRANSPORTEUR<br>Orica Truck                           | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>Ryan Behnam | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>Ryan Behnam | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE                                                       | DATE<br>11 06 18                                                | SIGNATURE                                            |
|                                                                 | D/J M/M Y/A                                                     | DATE<br>11 06 18                                     |
|                                                                 |                                                                 | D/J M/M Y/A                                          |



# Blast Design

## Nelson Aggregate

Quarry: **Burlington**  
 P.O. #:   
 Design Date: **2018-06-11**

Blast Number: **18-007**  
 Orica Order #:

page 1

Blaster-in-charge: **Mike der Kinderen** (Print Name)

Blast Location: **Upper Middle** (Bench / Face)  
 GPS Coordinates: **43.40368** °N Latitude **79.88315** °W Longitude  
Centre of Blast Centre of Blast

Design to Blasted: **27,150** te  
 Total Holes Loaded: **55** holes  
 ... including:  Dead Holes  
 ... and:  Helper Holes  
 Helper Hole Collar:  ft avg  
 # Rows Blasted: **4** rows

- Drilling Information -

Angle from Vertical

|                     |                 |          |          |           |   |                        |
|---------------------|-----------------|----------|----------|-----------|---|------------------------|
| Primary Bit diam:   | <b>101.6</b> mm | <b>0</b> | # Holes: | <b>55</b> | = | 4,130.2 ft ( 4 " diam) |
| Secondary Bit diam: | mm              | <b>0</b> | # Holes: |           | = | 0.0 ft ( " diam)       |
| Tertiary Bit diam:  | mm              | <b>0</b> | # Holes: |           | = | 0.0 ft ( " diam)       |

Nominal Bit Diameter:

- Design Pattern (Front Row) -

Burden: **12.0** ft avg  
 Spacing: **10.0** ft avg  
 # Holes:  front row

- Design Pattern (Main Body) -

Burden: **9.0** ft avg  
 Spacing: **10.0** ft avg  
 # Holes: **55** main body

Bench Height: **73.1** ft avg

Sub-drill: **2.0** ft avg

Hole Depth: **75.1** ft avg

- Design Stone Decking -

Front Row:  ft avg

Main Body:  ft avg

- Design Collar Stemming -

Front Row: **7.0** ft avg

Main Body: **7.0** ft avg

Material used: **.75" Stone**

- Design Charge Length -

Front Row: **68.1** ft avg

Main Body: **68.1** ft avg

- Design Charge Weight -

Front Row: **198.6** kg/hole

Main Body: **198.6** kg/hole

Max Chge Wt / delay: **240.0** kg/delay

Required kg Loaded: **13,237** kg

Rock Density: **2.65** g/cc = te/m<sup>3</sup>

- Design Powder Factor -

Expected Yield PF: **0.488** kg/te (actual)

Front row: **0.302** kg/te (theoretical)

Main Body: **0.402** kg/te (theoretical)

"KPI" PF: **0.377** kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit B.S. Expl or IS from previous Blast

A-3 (9)  
 C-1 (8)  
 D-17 2-20 P(8)

**Bulk Expl. Required:**

|                       | kg            |
|-----------------------|---------------|
| <b>CENTRA GOLD 70</b> | <b>13,200</b> |

**Pkgd Expl. Required:**

|  | kg |
|--|----|
|  |    |
|  |    |
|  |    |

**Boosters Required:**

|                                  | kg/u        | # usec     | kg          |
|----------------------------------|-------------|------------|-------------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | <b>0.34</b> | <b>110</b> | <b>37.4</b> |

total explosives weight in Blast (kg): **13,237**

Pkgd Prod (0 kg) % of Total kg: **0.0%**

**Detonators Required:**

|                          | ms | # req'd   |
|--------------------------|----|-----------|
| <b>UNITRONIC 600 6M</b>  |    | <b>55</b> |
| <b>UNITRONIC 600 25M</b> |    | <b>55</b> |

**Cord & Access. Req'd:**

|                                  | U of M | # req'd  |
|----------------------------------|--------|----------|
| <b>WIRE DUPLEX (6 PACK) 400M</b> | units  | <b>1</b> |

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services Req'd:**

|                        |                              |            |
|------------------------|------------------------------|------------|
| GPS LAYOUT             | Enter hours                  | <b>0.0</b> |
| BULK TRUCK CHARGE      | <2,000kg                     |            |
| BLASTER HOURS          | Enter Blaster hours          | <b>0.0</b> |
| HELPER HOURS           | Enter total Helper man-hours | <b>0.0</b> |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | <b>0</b>   |
| 3D LASER PROFILE       | Enter hours                  | <b>0</b>   |
| BORETRACK              | Enter hours                  | <b>0</b>   |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | <b>0.0</b> |

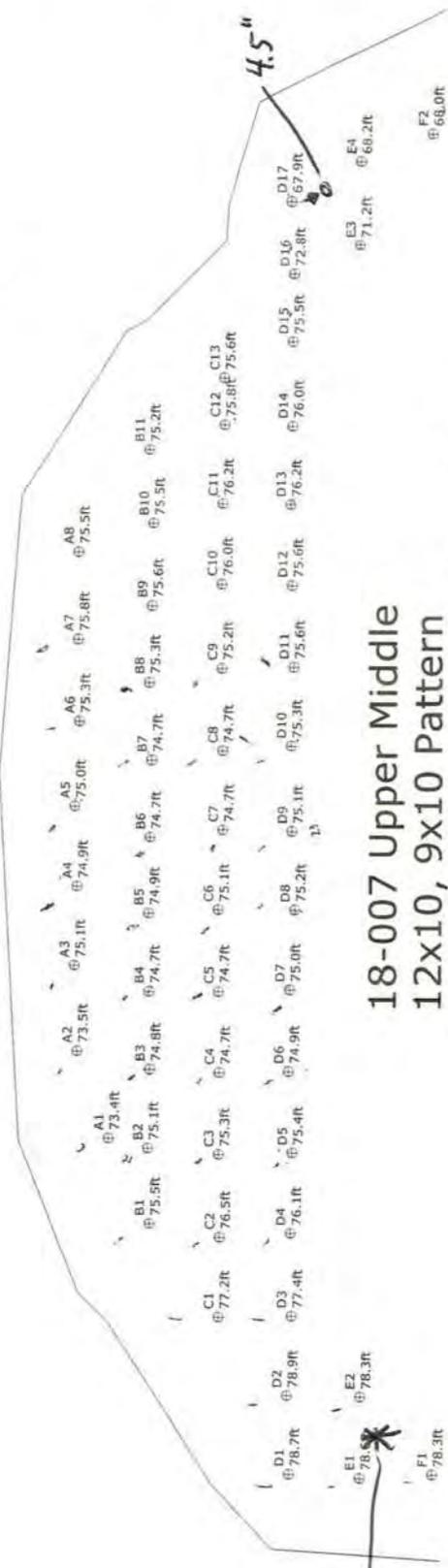
SHOTPlus 5 Plan

| Blast Summary Data     |                         |                            |
|------------------------|-------------------------|----------------------------|
| Burden: 9.0ft          | Spacing: 10.0ft         | Stemming: 7.0ft            |
| 1st row burden: 12.0ft | Hole Diameter: 4.0in    | Hole angle: 0.0°           |
| Rock density: 2.65g/cc | Total drilled: 4130.2ft | Blasted tonnage: 25,8625/T |
|                        |                         | Number of holes: 55        |
|                        |                         | Subdrill: 0.6ft            |

A1-A8  
B1  
C1  
D1  
E1



open face



18-007 Upper Middle  
12x10, 9x10 Pattern  
4" Hole Unless otherwise noted  
250m + 0.6m Subdrill



Not to scale

|                                               |            |
|-----------------------------------------------|------------|
| SHOTPlus5Beta 5.7.3.9                         | 04/06/2018 |
| Mine Burlington                               |            |
| Location Upper Middle Bench                   |            |
| Title/author 18-004 Upper Middle Design Ken G |            |
| Filename 18-007 Upper Middle Final.spf        |            |

**Date/Time** Long at 11:56:25 June 11, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.5 Volts  
**Unit Calibration** May 3, 2017 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 2nd Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada  
 General: N.43.40245 W.79.87814

**Extended Notes**

Sand Bagged

**Microphone** Linear Weighting

**PSPL** 116.9 dB(L) at 1.206 sec

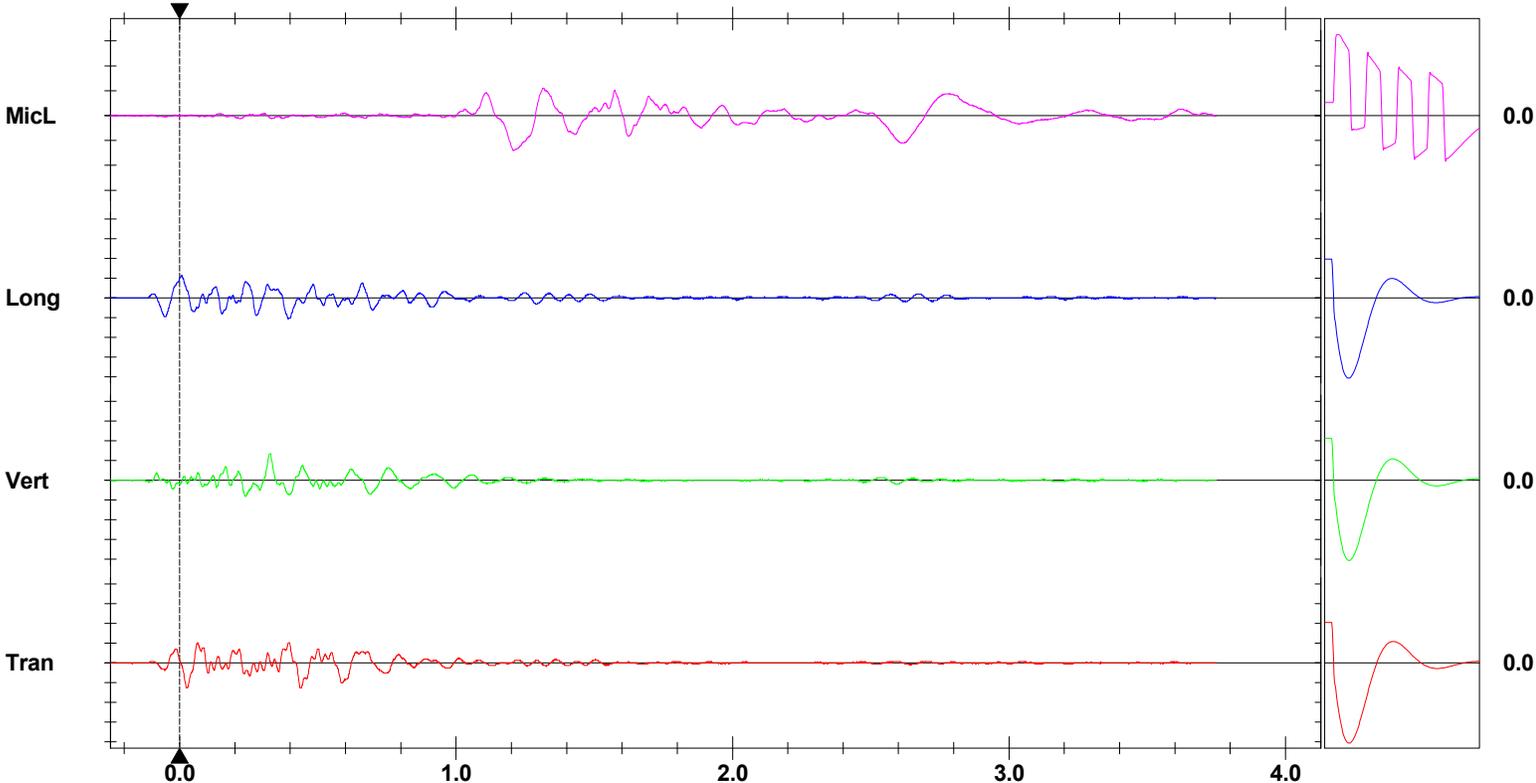
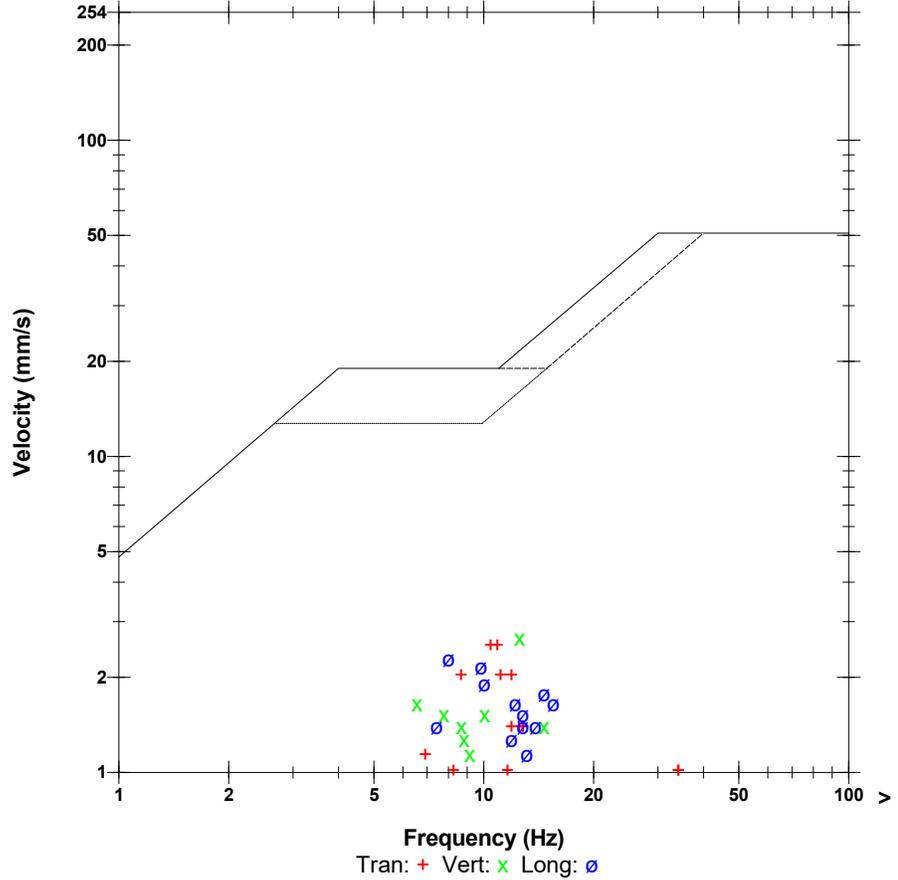
**ZC Freq** 3.5 Hz

**Channel Test** Passed (Freq = 20.1 Hz Amp = 693 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 2.540  | 2.667  | 2.286  | mm/s |
| ZC Freq             | 11     | 12     | 8.0    | Hz   |
| Time (Rel. to Trig) | 0.024  | 0.324  | 0.006  | sec  |
| Peak Acceleration   | 0.040  | 0.027  | 0.040  | g    |
| Peak Displacement   | 0.038  | 0.031  | 0.042  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.4    | 7.4    | Hz   |
| Overswing Ratio     | 3.8    | 3.8    | 4.2    |      |

**Peak Vector Sum** 3.277 mm/s at 0.393 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 11:56:27 June 11, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.107 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/BURLINGTON.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.5 Volts  
**Unit Calibration** February 14, 2018 by Instantel  
**File Name** \_\_TEMP.EVT

**Notes**

**Location:** COLLING RD & BLINDLINE  
**Client:** NELSON AGGREGATES  
**User Name:** ORICA CANADA  
**General:**

**Extended Notes**

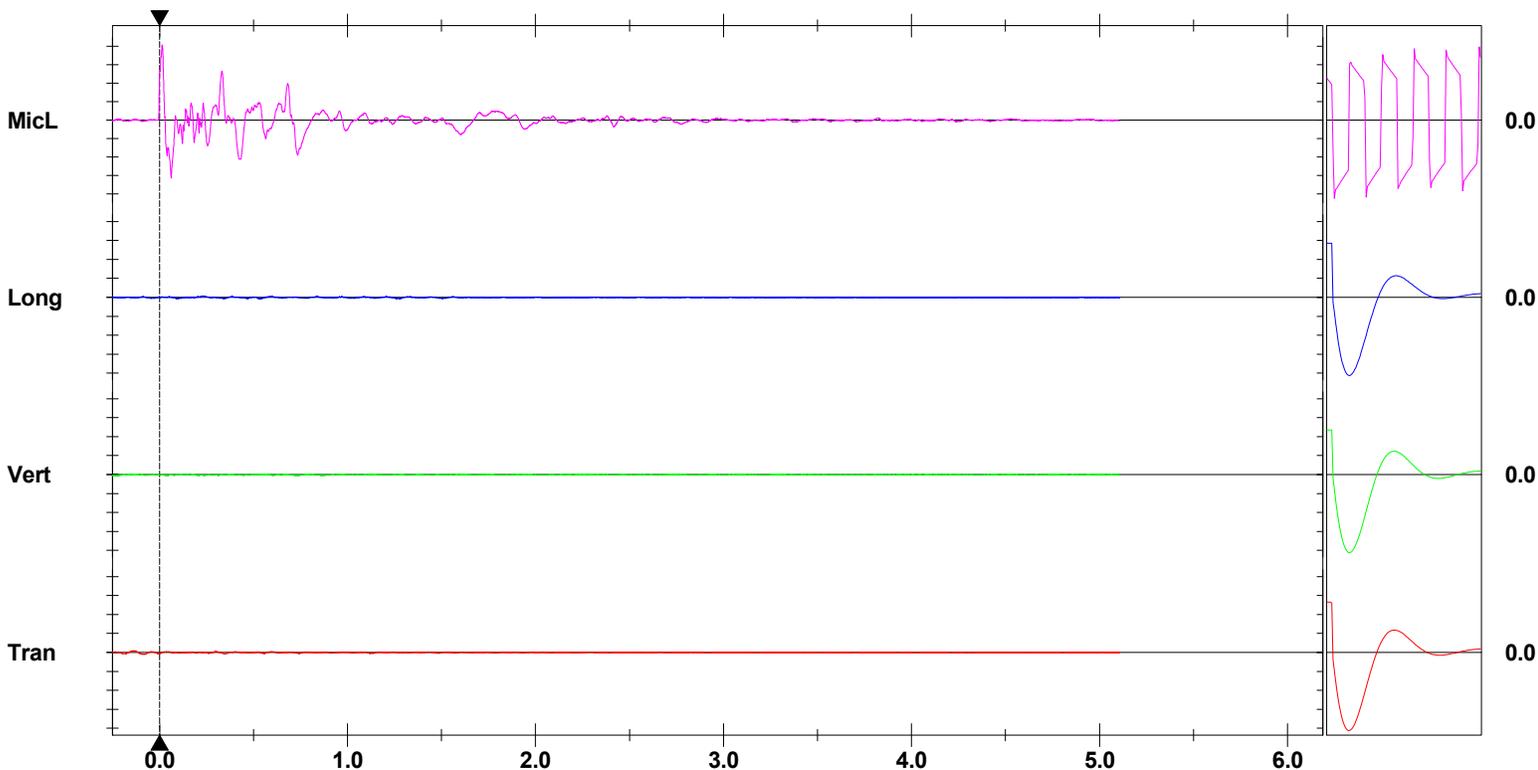
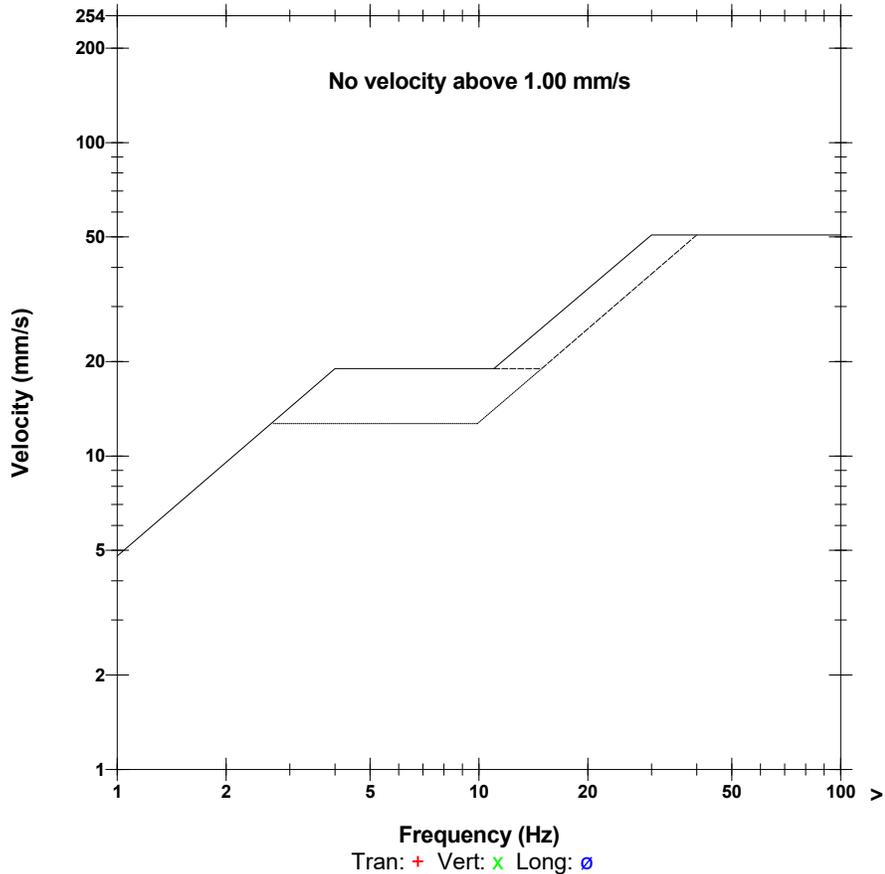
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 120.2 dB(L) at 0.015 sec  
**ZC Freq** 13.0 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1331 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.213  | 0.126  | 0.158  | mm/s |
| ZC Freq             | 9.7    | 9.3    | 10.0   | Hz   |
| Time (Rel. to Trig) | -0.085 | -0.241 | 0.533  | sec  |
| Peak Acceleration   | 0.010  | 0.010  | 0.010  | g    |
| Peak Displacement   | 0.004  | 0.004  | 0.003  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.5    | 3.3    | 3.6    |      |

**Peak Vector Sum** 0.227 mm/s at -0.084 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 11:56:29 June 11, 2018  
**Trigger Source** Geo: 1.500 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 1024 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** November 3, 2017 by InstanTel  
**File Name** \_\_TEMP.EVT  
**Scaled Distance** 3879.2 (1226.7 m, 0.1 kg)

**Notes**

**Location:** South West Corner of Property  
**Client:** Nelson Aggregates Burlington Quarry  
**User Name:** ORICA CANADA INC.  
**General:**

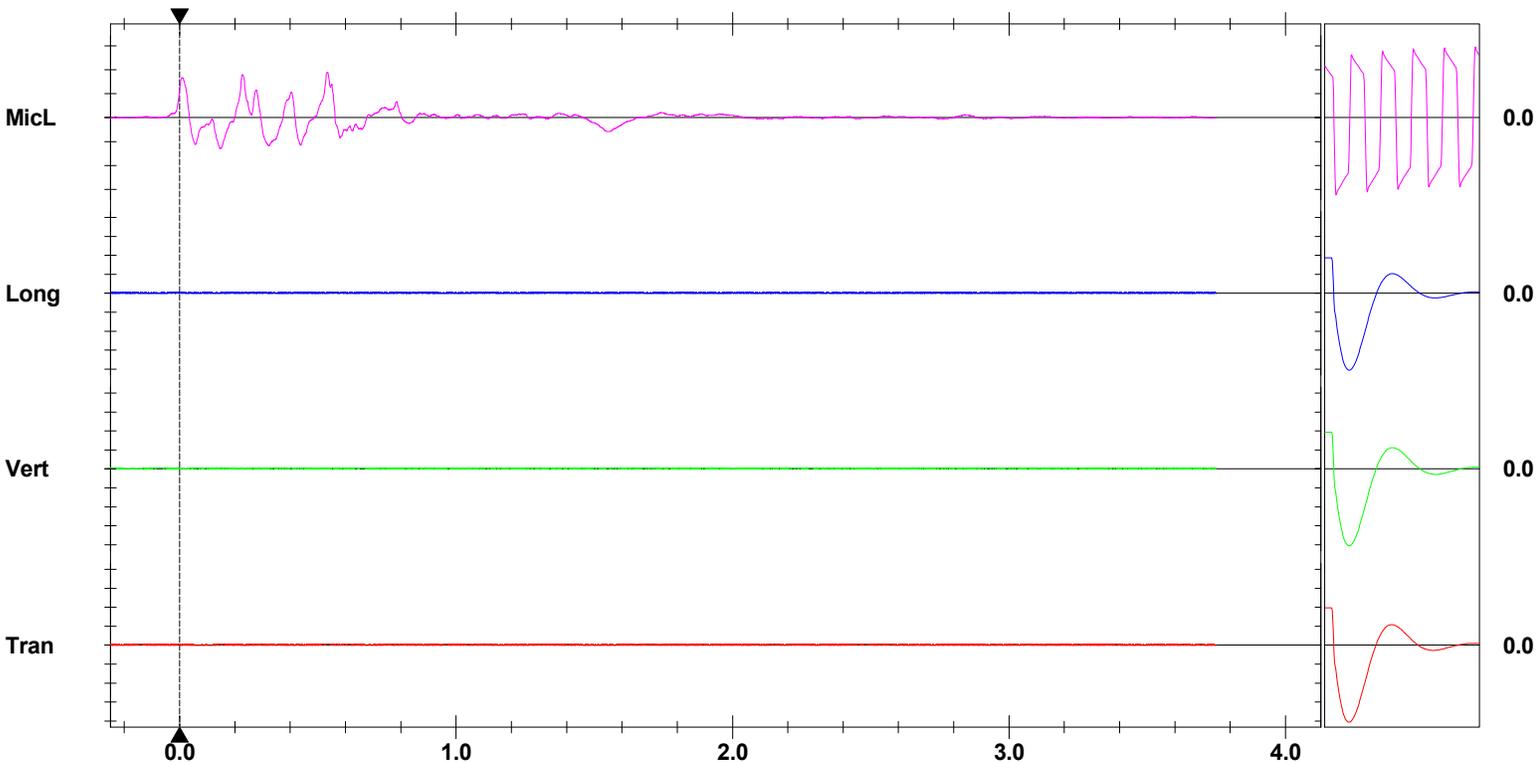
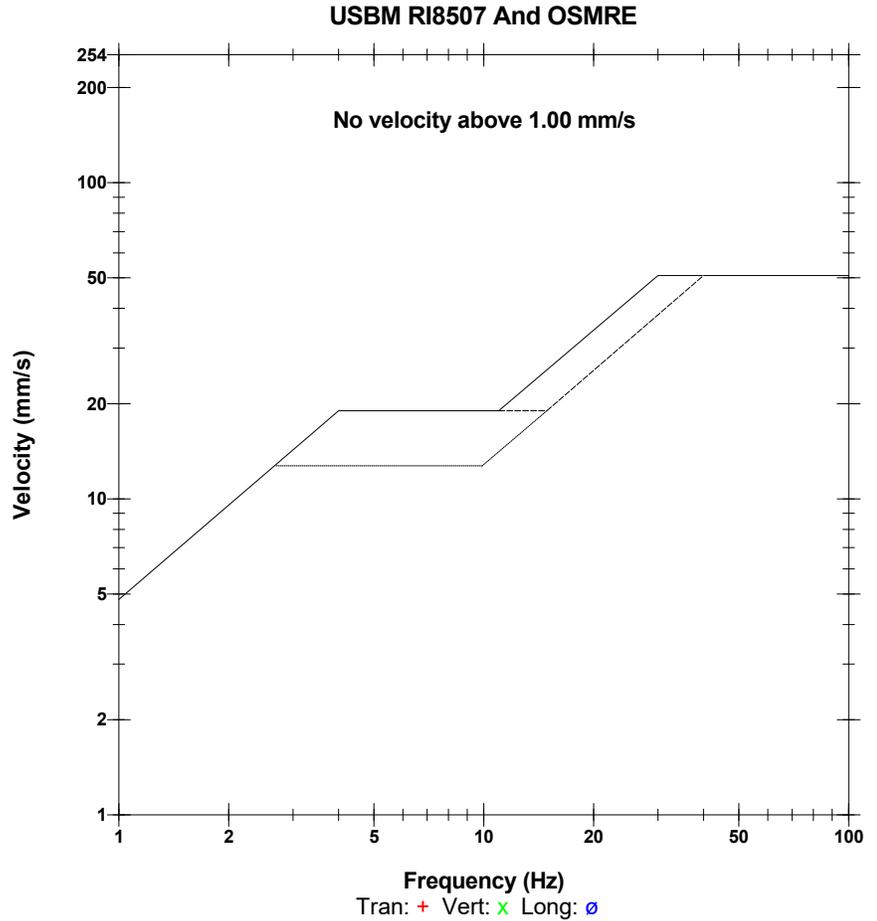
**Extended Notes**

43.39339 ,79.88880

**Microphone** Linear Weighting  
**PSPL** 119.6 dB(L) at 0.533 sec  
**ZC Freq** 6.8 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 618 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.127  | 0.127  | 0.127  | mm/s |
| ZC Freq             | N/A    | N/A    | >100   | Hz   |
| Time (Rel. to Trig) | -0.250 | -0.250 | -0.246 | sec  |
| Peak Acceleration   | 0.013  | 0.013  | 0.013  | g    |
| Peak Displacement   | 0.000  | 0.000  | 0.000  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.4    | 7.3    | Hz   |
| Overswing Ratio     | 3.8    | 3.7    | 4.0    |      |

**Peak Vector Sum** 0.220 mm/s at -0.244 sec  
**N/A: Not Applicable**



**Time Scale:** 0.20 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-06-13

Blast Number: 18-008

Orica Order #: 2349625

Blast Time: 11:52 AM

page 1

Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Lower Middle (Bench / Face)

GPS Coordinates: 43.40407 °N Latitude 79.88289 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 10 kph Temperature: 21 to 25 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 2,554 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                |
|----------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm | 0°                  | # Holes: 89 = 4,450.9 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0°                  | # Holes: = 0.0 ft ( " diam)          |
| Tertiary Bit diam: mm      | 0°                  | # Holes: = 0.0 ft ( " diam)          |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,790  | 20,940   | 12,850 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 3          | 2           | 25 |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 187    | 63.6 |

total explosives weight in Blast (kg): 12,939

Pkgd Prod (25 kg) % of Total kg: 0.2%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 87     |
| UNITRONIC 600 15M |          |    | 8      |
| UNITRONIC 600 20M |          |    | 92     |

### Cord & Accessories:

|                                   | U of M | # used |
|-----------------------------------|--------|--------|
| HARNESS WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=10,000 kg                  | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 10.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 28,929 te      | 10,917 m <sup>3</sup> |
| Total tonnes per day: | 28,929 te      | NB40-06 Rate Code     |
| Total Holes Loaded:   | 89 holes       |                       |
| ... including:        | Dead Holes     |                       |
| ... and:              | 3 Helper Holes |                       |
| Helper Hole Collar:   | 9.0 ft avg     |                       |
| # Rows Blasted:       | 7 rows         |                       |

### - Pattern (Front Row) -

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 10 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 79 main body |

Bench Height: 48.0 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 50.0 ft avg

### - Stone Decking -

Front Row: 5.0 ft avg

Main Body: 5.0 ft avg

# Decks: 8 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: .75" Stone

### - Charge Length -

Front Row: 38.0 ft avg

Main Body: 38.0 ft avg

### - Charge Weight -

Front Row: 110.8 kg/hole

Main Body: 110.8 kg/hole

Max. per delay: 157.0 kg/delay

SD () Equation: 200.0 kg/delay

Total kg Loaded: 12,939 kg

Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.447 kg/te (actual)

Front row: 0.256 kg/te (theoretical)

Main Body: 0.342 kg/te (theoretical)

"KPI" PF: 0.330 kg/te (theoretical)

1.998 lb/yd<sup>3</sup>

1.145 lb/yd<sup>3</sup>

1.527 lb/yd<sup>3</sup>

1.472 lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

Hole X-3 & G9 Could not be found once loading had been started

A-8,C-4,B-8,C-12,C-7,C-8,F-4,F-10 All Received a 5' stone deck due to incompetent rock

See Attached Load Adjustment sheet for any more Changes



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-06-13

Blast Number: 18-008  
Orica Order #: 2349625  
Blast Time: 11:52 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.40407       | 79.88286        |
| Front Row Corner          | 43.40417       | 79.88310        |
| Back Row Corner           | 43.40397       | 79.88271        |
| Average (Centre of Blast) | 43.40407       | 79.88289        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757544    | 1.394219    |
| 0.757546    | 1.394223    |
| 0.757542    | 1.394216    |
| 0.757544    | 1.394219    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long.                                         |
|-------------------------------------------|-------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814                                                |
| 2nd Reading                               |                         |                                                         |
| Average                                   | 43.40245                | 79.87814                                                |
| Distance (1st Seis. From Centre of Blast) | 424.3                   | m                                                       |
| Post Blast Data:                          | ppV: 1.0                | mm/s Trigger set at: 2.0                                |
|                                           | frequency: 15.0         | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 120.6 | dB Trigger set at: 115                                  |

2450 2nd Line

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757516    | 1.394137    |
| 0.757516    | 1.394137    |

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long.                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400                                                |
| 2nd Reading                               |                           |                                                         |
| Average                                   | 43.40605                  | 79.89400                                                |
| Distance (2nd Seis. From Centre of Blast) | 925.3                     | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |

Colling Rd & Blind Line Bruce Trail

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757578    | 1.394413    |
| 0.757578    | 1.394413    |

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long.                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880                                                |
| 2nd Reading                               |                           |                                                         |
| Average                                   | 43.39339                  | 79.88880                                                |
| Distance (3rd Seis. From Centre of Blast) | 1281.4                    | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |

SouthWest Corner of Property

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757358    | 1.394323    |
| 0.757358    | 1.394323    |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(424.3)^2}{30^2} \text{ kg}$$

$$= \frac{180,030}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

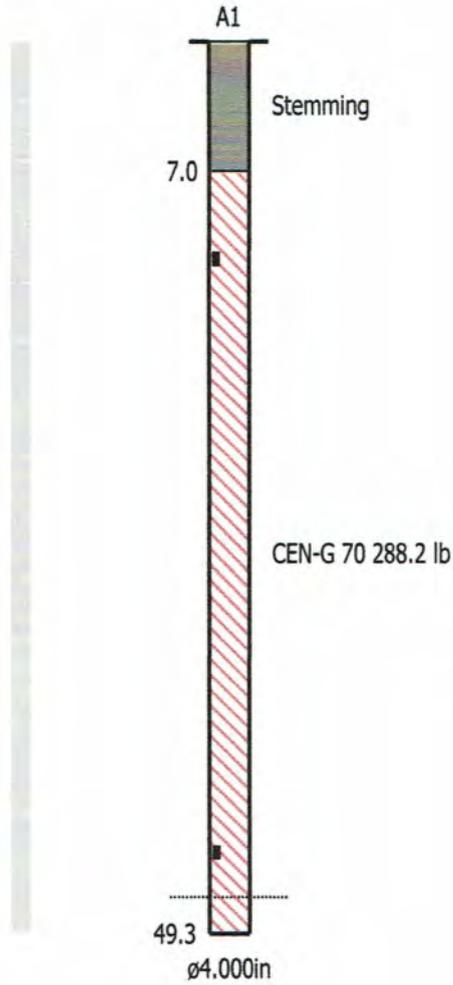
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 6/13/2018

Blast Number: 18-008  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

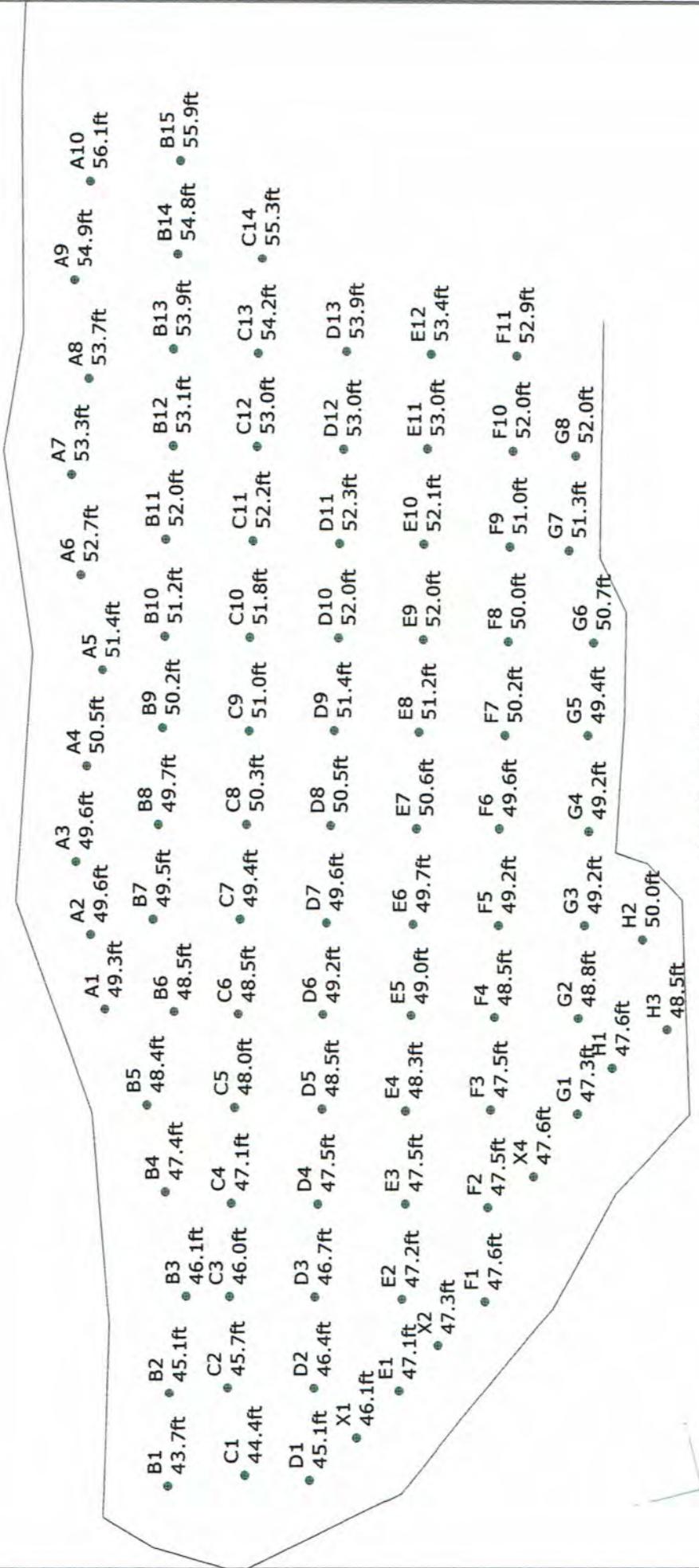
*Bill White*

Signature required, indicating sign off on Blast Design.

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Subdrill: 2.0ft Stemming: 6.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 89 Hole angle: 0.0°  
 Rock density: 2.65g/cc Total drilled: 4446.2ft Blasted tonnage: 33,192S/T



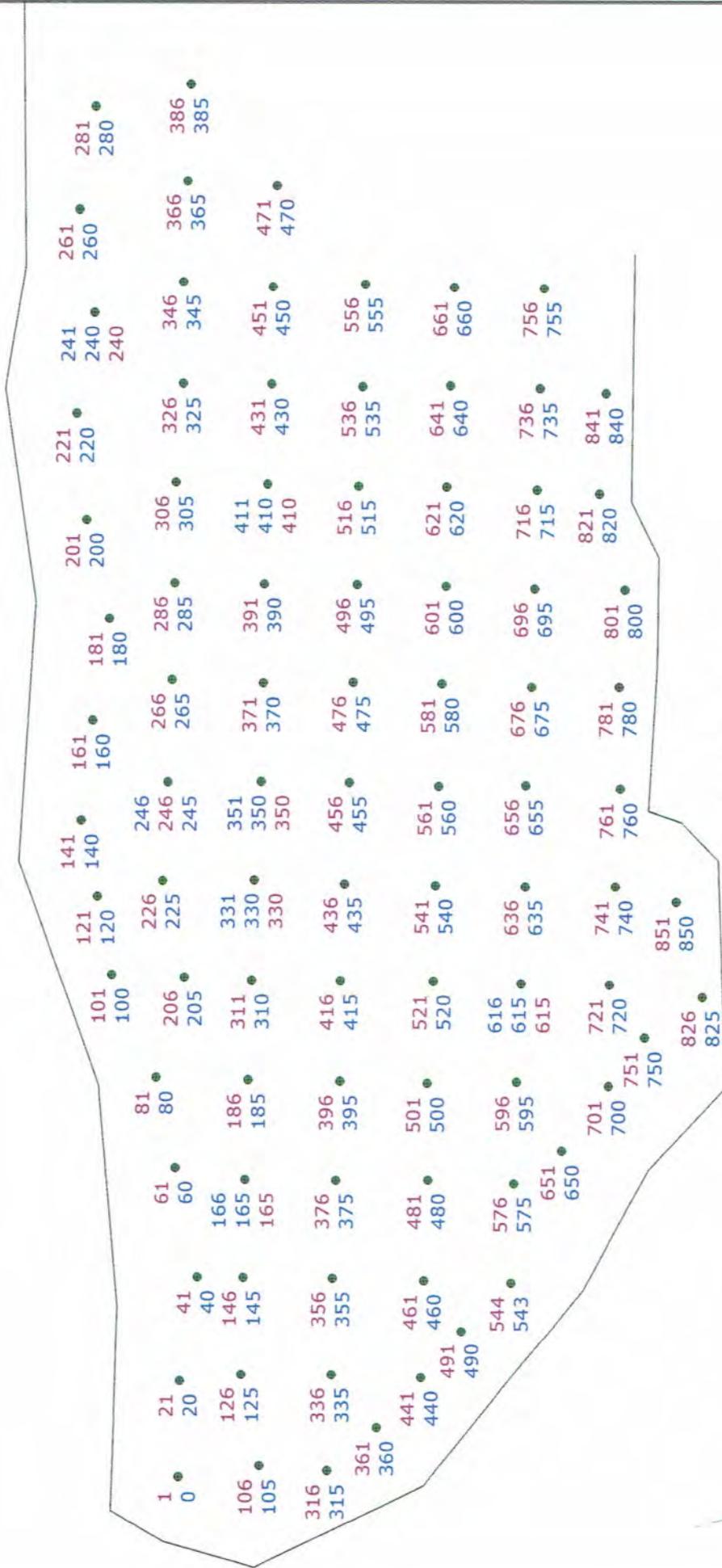
high wall

|                  |                                     |
|------------------|-------------------------------------|
| SHOTPlus 5.7.1.1 | 6/13/2018                           |
| Mine             | Burlington                          |
| Location         |                                     |
| Title/author     | 18-008 Bottom Middle South K George |
| Filename         | 2018-06-13 18-008 Lower Middle.spf  |



Not to scale

# Timing



Not to scale

|                  |                                     |
|------------------|-------------------------------------|
| SHOTPlus 5.7.1.1 | 6/13/2018                           |
| Mine             | Burlington                          |
| Location         |                                     |
| Title/author     | 18-008 Bottom Middle South K George |
| Filename         | 2018-06-13 18-008 Lower Middle.spf  |

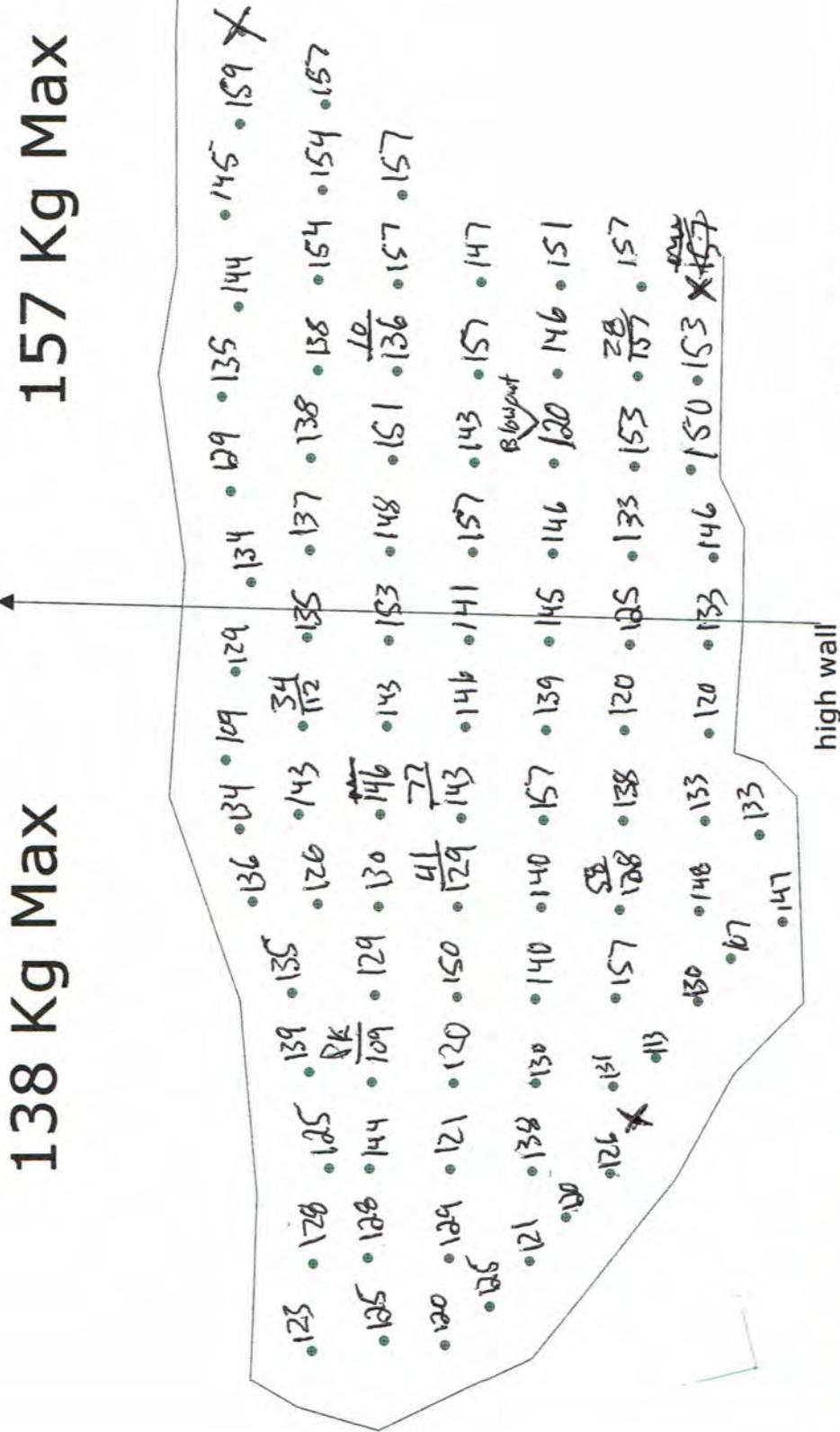
53

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 6.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 92      Hole angle: 0.0°  
 Rock density: 2.65g/cc      Total drilled: 4601.0ft      Blasted tonnage: 34,239S/T

# Load Sheet



|                  |                                     |
|------------------|-------------------------------------|
| SHOTPlus 5.7.1.1 | 6/11/2018                           |
| Mine             | Burlington                          |
| Location         |                                     |
| Title/author     | 18-008 Bottom Middle South K George |
| Filename         | 2018-06-13 18-008 Lower Middle.spr  |



Not to scale

1089815

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
 FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES  
 SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissance



CONSIGNOR  
 EXPÉDITEUR  
**GRAND VALLEY**  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE  
 CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
 BURLINGTON ON  
 CA L7R 4L8

|                                |                                   |
|--------------------------------|-----------------------------------|
| GROSS / BRUT                   |                                   |
| TARE                           |                                   |
| NET                            |                                   |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE          |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSEMENT |
| 2349625                        | 86039399                          |

|                               |                                          |                                            |                                                    |
|-------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURE À / ACHETEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 13 Jun 2018                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   | n/a                                                |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR       | VEHICLE NO.<br>N° DE VÉHICULE                      |
| 13 Jun 2018                   | FOB Dest'n, Own Truck                    | F-73289                                    | PT 1515013                                         |
| SHIP VIA<br>TRANSPORTEUR      |                                          | ROUTING<br>ITINÉRAIRE                      | MAG. LIC. NO.<br>N° DE PERMIS                      |
| Orica Truck                   |                                          | STANDARD                                   |                                                    |

| QTY.<br>QTÉ.             | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                           | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|--------------------------|----|----------|-------------------------|------------------------|---------------------------------------|--------------------|-------------------|
| 3                        | CS | X        | 2                       | 1                      | FORTEL PRO 75X400 (3X16)              | 3                  | 78.900            |
| 294                      | PC | X        | 107                     | 187                    | PENTEX BC 340 (49/CS)                 | 6                  | 107.310           |
| 2                        | PC |          | 1                       | 1                      | Harness Wire Duplex (6 pack) 400m     | 1                  | 5.840             |
| 160                      | PC | X        | 73                      | 87                     | *uni tronic 600-06.0M CU/ZC(20')80PC  | 2                  | 11.680            |
| 66                       | PC | X        | 58                      | 8                      | *uni tronic 600-15M C/Z SPL(50')66PC  | 1                  | 11.286            |
| 132                      | PC | X        | 40                      | 92                     | *uni tronic 600-20M CU/ZC SPL(65')66P | 2                  | 26.928            |
| 100                      | PC |          | 94                      | 6                      | MINI STEM PLUGS - PART #74853         |                    | 0.700             |
| 1                        | PC |          |                         |                        | LICENSED BLASTER                      |                    |                   |
| 1.0                      | HR |          |                         |                        | LABOUR CHARGE                         |                    |                   |
| 1                        | PC |          |                         |                        | ROG (ROCK ON GROUND)                  |                    |                   |
| TOTAL GROSS WEIGHT       |    |          |                         |                        |                                       |                    | 242.644 KG        |
| **** TOTAL PACKAGES **** |    |          |                         |                        |                                       | 15                 |                   |

24 HOUR TECHNICAL INFORMATION: 1-613-996-6666

|                                                    |                                                                             |                                    |                                                                                                                                                                                    |
|----------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE | EMERGENCY RESPONSE NO.24 HOUR NUMBER<br>TÉLÉPHONE D'URGENCE/24 HEURE NUMERO | PLACARDS OFFERED / PLACARDS OFFERT | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSEMENT D'ORICA:<br>Orica Canada Inc. |
| ERAP 2-1510                                        | 1-877-561-3636                                                              | YES / OUI NO / NON                 | 301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5                                                                                                                        |

|                                                                 |                                                                 |                                                      |
|-----------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                          | CARRIER / TRANSPORTEUR<br>Orica Truck                           | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>Ryan Benham | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>Ryan Benham | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br><i>[Signature]</i>                                 | SIGNATURE<br><i>[Signature]</i>                                 | SIGNATURE                                            |
| DATE<br>03 06 18<br>D/J M/M Y/A                                 | DATE<br>13 06 18<br>D/J M/M Y/A                                 | DATE                                                 |

**Date/Time** MicL at 11:52:09 June 13, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.25 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.4 Volts  
**Unit Calibration** May 3, 2017 by InstanTel  
**File Name** \_TEMP.EVT

**Notes**  
 Location: 2450 2nd Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada  
 General: N.43.40245 W.79.87814

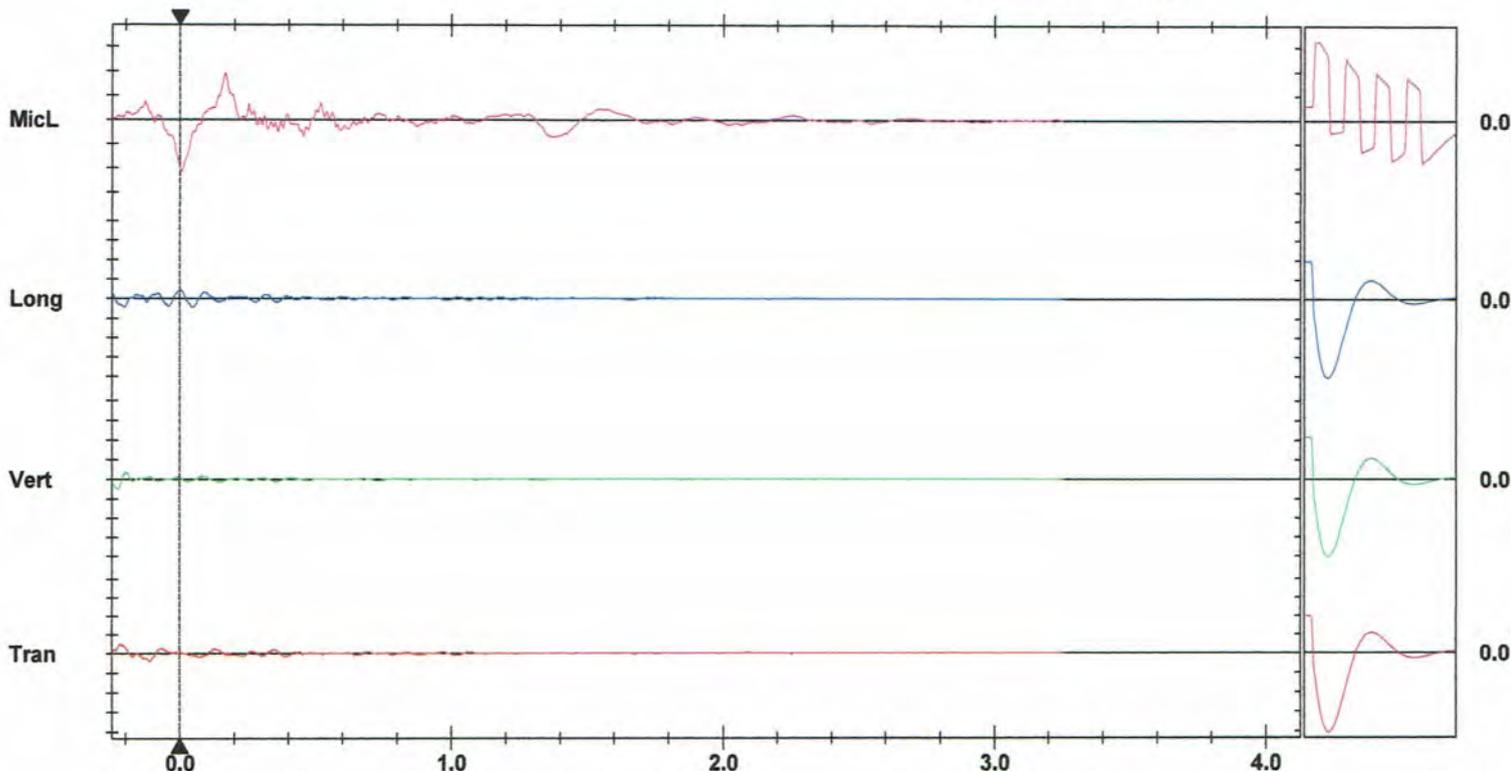
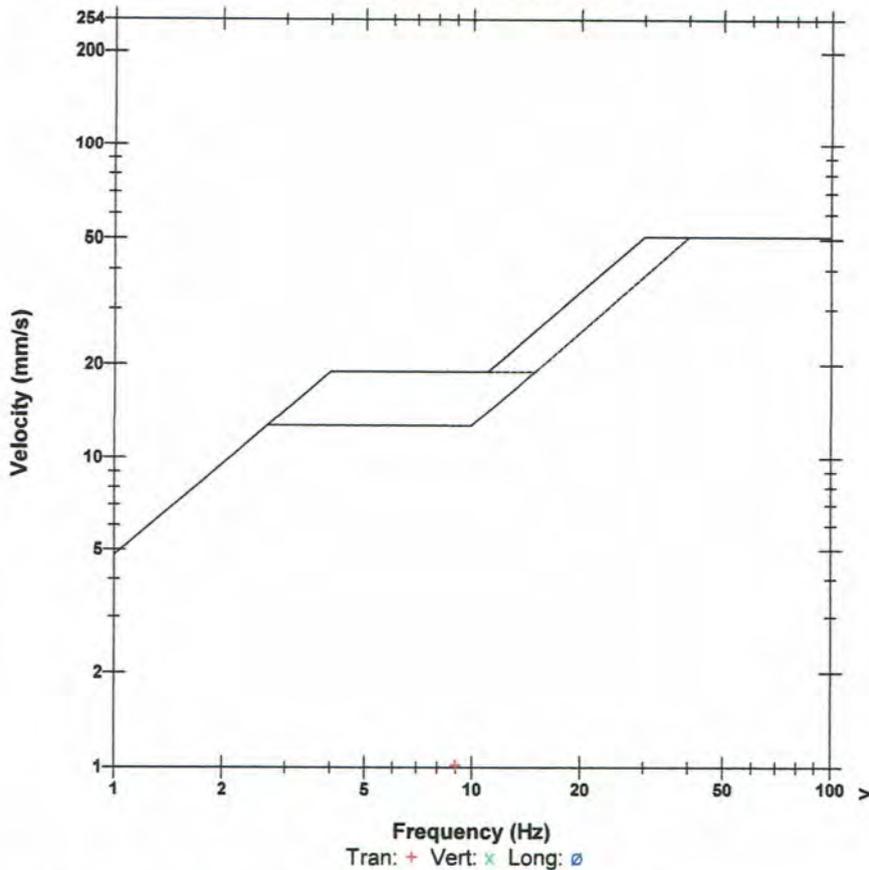
**Extended Notes**  
 Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 120.6 dB(L) at 0.004 sec  
**ZC Freq** 3.4 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 615 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 1.016  | 1.016  | 0.889  | mm/s |
| ZC Freq             | 9.0    | 15     | 10     | Hz   |
| Time (Rel. to Trig) | -0.223 | -0.228 | -0.208 | sec  |
| Peak Acceleration   | 0.013  | 0.013  | 0.027  | g    |
| Peak Displacement   | 0.017  | 0.012  | 0.014  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.4    | 7.4    | Hz   |
| Overswing Ratio     | 3.8    | 3.8    | 4.2    |      |

**Peak Vector Sum** 1.420 mm/s at -0.228 sec

**USBM RI8507 And OSMRE**



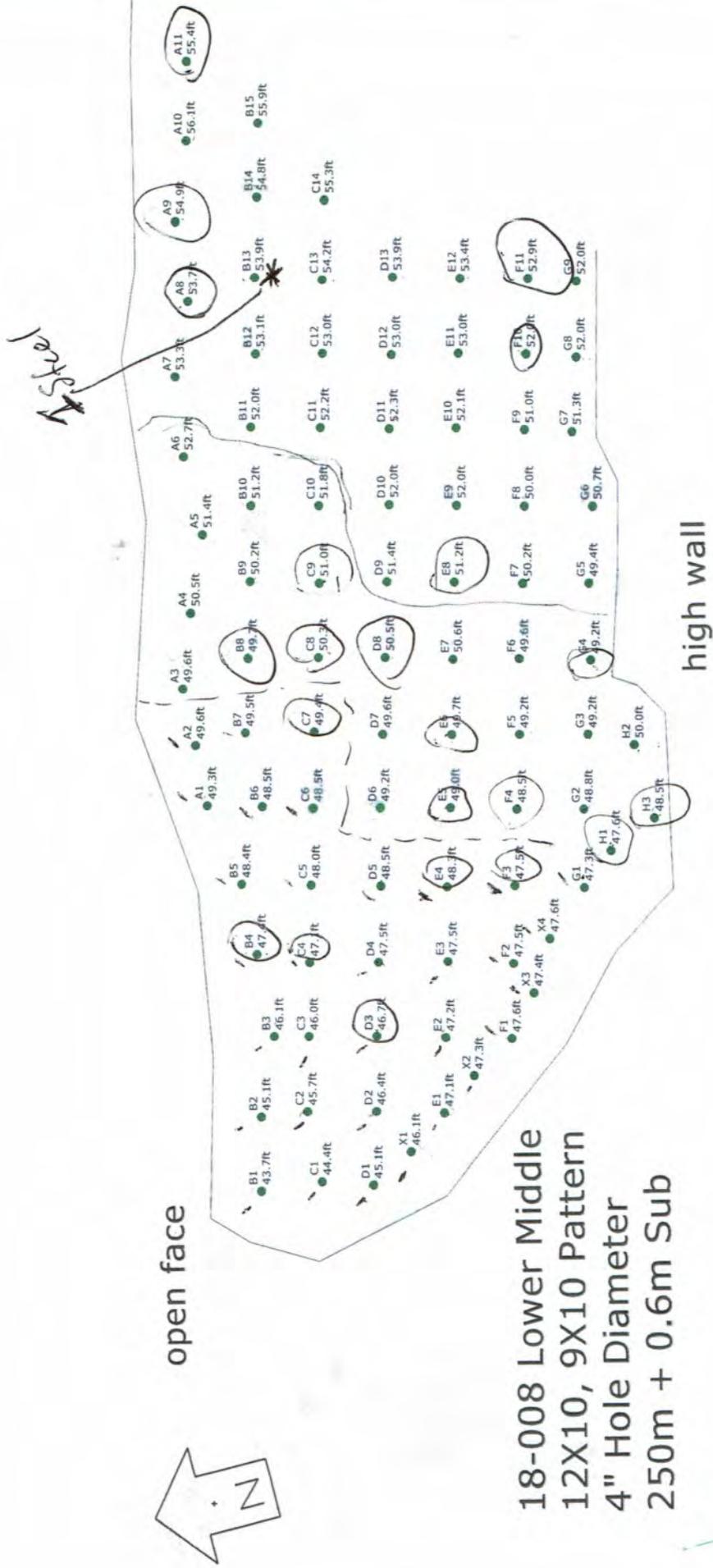
**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

613 305 0454

SHOTPlus 5 Plan

**Blast Summary Data**  
 Burden: 9.0ft      Spacing: 10.0ft      Stemming: 6.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 92      Hole angle: 0.0°  
 Rock density: 2.65g/cc      Total drilled: 4601.0ft      Blasted tonnage: 34,239S/T



18-008 Lower Middle  
 12X10, 9X10 Pattern  
 4" Hole Diameter  
 250m + 0.6m Sub

|                       |                                    |
|-----------------------|------------------------------------|
| SHOTPlus5Beta 5.7.3.9 | 06/06/2018                         |
| Mine                  | Burlington                         |
| Location              |                                    |
| Title/author          | 18-005 Bottom Middle South I. Dee  |
| Filename              | 18-008 Lower Middle South Design F |

Not to scale





# Blast Design

## Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Design Date: 2018-06-13

Blast Number: 18-008  
 Orica Order #:

page 1

Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Lower Middle (Bench / Face)

GPS Coordinates: 43.40407 °N Latitude 79.88289 °W Longitude  
Centre of Blast Centre of Blast

Design te Blasted: 29,670 te  
 Total Holes Loaded: 97 holes  
 ... including:  Dead Holes  
 ... and: 4 Helper Holes  
 Helper Hole Collar:  ft avg  
 # Rows Blasted: 8 rows

- Drilling Information -

Angle from Vertical: 0°  
 Nominal Bit Diameter: 4,600.9 ft ( 4 " diam)  
 Primary Bit diam: 101.6 mm 0' # Holes: 92 = 4,600.9 ft ( 4 " diam)  
 Secondary Bit diam:  mm 0' # Holes:  = 0.0 ft ( " diam)  
 Tertiary Bit diam:  mm 0' # Holes:  = 0.0 ft ( " diam)

- Design Pattern (Front Row) -

Burden: 12.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 11 front row

- Design Pattern (Main Body) -

Burden: 9.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 81 main body  
 Bench Height: 48.0 ft avg  
 Sub-drill: 2.0 ft avg  
 Hole Depth: 50.0 ft avg

- Design Stone Decking -

Front Row:  ft avg  
 Main Body:  ft avg

- Design Collar Stemming -

Front Row: 7.0 ft avg  
 Main Body: 7.0 ft avg

Material used: .75" Stone

- Design Charge Length -

Front Row: 43.0 ft avg  
 Main Body: 43.0 ft avg

- Design Charge Weight -

Front Row: 125.4 kg/hole  
 Main Body: 125.4 kg/hole  
 Max Chge Wt / delay: 170.0 kg/delay

Required kg Loaded: 12,875 kg  
 Rock Density: 2.65 g/cc = te/m<sup>3</sup>

- Design Powder Factor -

Expected Yield PF: 0.434 kg/te (actual)  
 Front row: 0.290 kg/te (theoretical)  
 Main Body: 0.387 kg/te (theoretical)  
 "KPI" PF: 0.375 kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

**Bulk Expl. Required:** kg

|  |  |               |
|--|--|---------------|
|  |  | <u>12,700</u> |
|--|--|---------------|

**Pkgd Expl. Required:** kg

|                          |          |           |
|--------------------------|----------|-----------|
| <b>FORTEL PRO 75X400</b> | <u>3</u> | <u>75</u> |
|--------------------------|----------|-----------|

**Boosters Required:** kg/u # used kg

|                                  |             |            |              |
|----------------------------------|-------------|------------|--------------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | <u>0.34</u> | <u>294</u> | <u>100.0</u> |
|----------------------------------|-------------|------------|--------------|

total explosives weight in Blast (kg): 12,875

Pkgd Prod (75 kg) % of Total kg: 0.6%

**Detonators Required:** ms # req'd

|                          |  |            |
|--------------------------|--|------------|
| <b>UNITRONIC 600 6M</b>  |  | <u>160</u> |
| <b>UNITRONIC 600 15M</b> |  | <u>66</u>  |
| <b>UNITRONIC 600 20M</b> |  | <u>132</u> |

**Cord & Access. Req'd:** U of M # req'd

|                                  |       |          |
|----------------------------------|-------|----------|
| <b>WIRE DUPLEX (6 PACK) 400M</b> | units | <u>1</u> |
|----------------------------------|-------|----------|

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <u>1</u> |
| # of Blasters (this Blast)      |                | <u>1</u> |
| # of Helpers (this Blast)       | Note Exception | <u>2</u> |
| # of MMU's (this Blast)         |                | <u>1</u> |

**Services Req'd:**

|                        |                              |            |
|------------------------|------------------------------|------------|
| GPS LAYOUT             | Enter hours                  | <u>0.0</u> |
| BULK TRUCK CHARGE      | <2,000kg                     |            |
| BLASTER HOURS          | Enter Blaster hours          | <u>0.0</u> |
| HELPER HOURS           | Enter total Helper man-hours | <u>0.0</u> |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | <u>0</u>   |
| 3D LASER PROFILE       | Enter hours                  | <u>0</u>   |
| BORETRACK              | Enter hours                  | <u>0</u>   |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | <u>0.0</u> |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-06-25

Blast Number: 18-009

Orica Order #: 2354121

Blast Time: 12:01 PM

page 1

Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Lower Middle (Bench / Face)

GPS Coordinates: 43.40451 °N Latitude 79.88425 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: SE at 10 kph Temperature: 16 to 20 °C

Clear: X

Rain: X

Overcast: X

Partly Cloudy:

Snow:

Inversion:

Ceiling: 30,000 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                |
|----------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm | 0°                  | # Holes: 99 = 3,692.3 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0°                  | # Holes: = 0.0 ft ( " diam)          |
| Tertiary Bit diam: mm      | 0°                  | # Holes: = 0.0 ft ( " diam)          |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 27,280  | 17,620   | 9,660 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 3          | 0           | 75 |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 200    | 68.0 |

total explosives weight in Blast (kg): 9,803

Pkgd Prod (75 kg) % of Total kg: 0.8%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 98     |
| UNITRONIC 600 15M |          |    | 102    |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=5,000kg <10,000kg          | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 11.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

|                       |              |                      |
|-----------------------|--------------|----------------------|
| Tonnes Blasted:       | 25,983 te    | 9,805 m <sup>3</sup> |
| Total tonnes per day: | 25,893 te    | NB40-07 Rate Code    |
| Total Holes Loaded:   | 99 holes     |                      |
| ... including:        | Dead Holes   |                      |
| ... and:              | Helper Holes |                      |
| Helper Hole Collar:   | ft avg       |                      |
| # Rows Blasted:       | 13 rows      |                      |

### - Pattern (Front Row) -

Burden: 12.0 ft avg

Spacing: 10.0 ft avg

# Holes: 30 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg

Spacing: 10.0 ft avg

# Holes: 69 main body

Bench Height: 35.3 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 37.3 ft avg

### - Stone Decking -

Front Row: 5.0 ft avg

Main Body: 5.0 ft avg

# Decks: 2 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: .75" Stone

### - Charge Length -

Front Row: 25.3 ft avg

Main Body: 25.3 ft avg

### - Charge Weight -

Front Row: 73.8 kg/hole

Main Body: 73.8 kg/hole

Max. per delay: 118.0 kg/delay

SD () Equation: 329.8 kg/delay

Total kg Loaded: 9,803 kg

Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.377 kg/te (actual)

Front row: 0.232 kg/te (theoretical)

Main Body: 0.309 kg/te (theoretical)

"KPI" PF: 0.303 kg/te (theoretical)

1.685 lb/yd<sup>3</sup>

1.037 lb/yd<sup>3</sup>

1.382 lb/yd<sup>3</sup>

1.356 lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

Hole B-1 and B-2 Reviewed stone decks due to voids found while loading

Hole N-5 to N-11 were not loaded because we ran out of product in our MMU



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-06-25

Blast Number: 18-009  
Orica Order #: 2354121  
Blast Time: 12:01 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.40452       | 79.88424        |
| Front Row Corner          | 43.40442       | 79.88402        |
| Back Row Corner           | 43.40458       | 79.88449        |
| Average (Centre of Blast) | 43.40451       | 79.88425        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757552    | 1.394243    |
| 0.757550    | 1.394239    |
| 0.757553    | 1.394247    |
| 0.757552    | 1.394243    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long.                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.40245                  | 79.87814                                                |
| 2nd Reading                               |                           |                                                         |
| Average                                   | 43.40245                  | 79.87814                                                |
| Distance (1st Seis. From Centre of Blast) | 544.8                     | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |

2450 2nd Line

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757516    | 1.394137    |
| 0.757516    | 1.394137    |

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long.                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400                                                |
| 2nd Reading                               |                           |                                                         |
| Average                                   | 43.40605                  | 79.89400                                                |
| Distance (2nd Seis. From Centre of Blast) | 807.0                     | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |

Colling Rd & Blind Line Bruce Trail

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757578    | 1.394413    |
| 0.757578    | 1.394413    |

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long.                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880                                                |
| 2nd Reading                               |                           |                                                         |
| Average                                   | 43.39339                  | 79.88880                                                |
| Distance (3rd Seis. From Centre of Blast) | 1291.1                    | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |

SouthWest Corner of Property

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757358    | 1.394323    |
| 0.757358    | 1.394323    |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(544.8)^2}{30^2} \text{ kg}$$

$$= \frac{296,807}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-07-05

Blast Number: 18-010

Orica Order #: 2359087

Blast Time: 11:51 AM

page 1

Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40369 °N Latitude 79.88327 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: SW at 5 kph Temperature: 26 to 30 °C

Clear: X

Rain: X

Overcast: X

Partly Cloudy:

Snow:

Inversion:

Ceiling 30,000 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                |
|----------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm | 0°                  | # Holes: 53 = 4,133.5 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0°                  | # Holes: = 0.0 ft ( " diam)          |
| Tertiary Bit diam: mm      | 0°                  | # Holes: = 0.0 ft ( " diam)          |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,780  | 21,100   | 12,680 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 118    | 40.1 |

total explosives weight in Blast (kg): 12,720

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 53     |
| UNITRONIC 600 25M |          |    | 16     |
| UNITRONIC 600 30M |          |    | 49     |

### Cord & Accessories:

|                                   | U of M | # used |
|-----------------------------------|--------|--------|
| HARNESS WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=10,000 kg                  | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 10.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

|                       |              |                       |
|-----------------------|--------------|-----------------------|
| Tonnes Blasted:       | 30,963 te    | 11,684 m <sup>3</sup> |
| Total tonnes per day: | 30,963 te    | NB80-01 Rate Code     |
| Total Holes Loaded:   | 53 holes     |                       |
| ... including:        | Dead Holes   |                       |
| ... and:              | Helper Holes |                       |
| Helper Hole Collar:   | ft avg       |                       |
| # Rows Blasted:       | 3 rows       |                       |

### - Pattern (Front Row)-

Burden: 12.0 ft avg

Spacing: 10.0 ft avg

# Holes: 22 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg

Spacing: 10.0 ft avg

# Holes: 31 main body

Bench Height: 76.0 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 78.0 ft avg

### - Stone Decking -

Front Row: 0.0 ft avg

Main Body: 15.0 ft avg

# Decks: 6 per blast

### - Collar Stemming -

Front Row: 8.0 ft avg

Main Body: 7.0 ft avg

Material used: .75" Stone

### - Charge Length -

Front Row: 70.0 ft avg

Main Body: 56.0 ft avg

### - Charge Weight -

Front Row: 204.1 kg/hole

Main Body: 163.3 kg/hole

Max. per delay: 250.0 kg/delay

SD () Equation: 212.6 kg/delay

Total kg Loaded: 12,720 kg

Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.411 kg/te (actual)

Front row: 0.298 kg/te (theoretical)

Main Body: 0.318 kg/te (theoretical)

"KPI" PF: 0.311 kg/te (theoretical)

1.835 lb/yd<sup>3</sup>

1.332 lb/yd<sup>3</sup>

1.421 lb/yd<sup>3</sup>

1.391 lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### Cost Reduction Notes (this Blast) - change in Bit , B , S , Expl or IS from previous Blast:

While measuring the blast we discovered Hole B-4 was only at a depth of 59' (19'short of the v  
I told Bill White from Nelson Aggregates and he told us to proceed with loading.

Attached is a load adjustment sheet showing all the deck that were added due to voids and se



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-07-05

Blast Number: 18-010  
Orica Order #: 2359087  
Blast Time: 11:51 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.40367       | 79.88381        |
| Front Row Corner          | 43.40348       | 79.88299        |
| Back Row Corner           | 43.40391       | 79.88301        |
| Average (Centre of Blast) | 43.40369       | 79.88327        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757537    | 1.394235    |
| 0.757534    | 1.394221    |
| 0.757541    | 1.394222    |
| 0.757537    | 1.394226    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. |
|-------------------------------------------|-------------------------|-----------------|
| 1st Reading                               | 43.40245                | 79.87814        |
| 2nd Reading                               |                         |                 |
| Average                                   | 43.40245                | 79.87814        |
| Distance (1st Seis. From Centre of Blast) | 437.4                   | m               |
| Post Blast Data:                          | ppV: 2.3                | mm/s            |
|                                           | frequency: 9.5          | Hz              |
|                                           | air overpressure: 115.9 | dB              |

2450 2nd Line

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757516    | 1.394137    |
| 0.757516    | 1.394137    |

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. |
|-------------------------------------------|---------------------------|-----------------|
| 1st Reading                               | 43.40605                  | 79.89400        |
| 2nd Reading                               |                           |                 |
| Average                                   | 43.40605                  | 79.89400        |
| Distance (2nd Seis. From Centre of Blast) | 906.7                     | m               |
| Post Blast Data:                          | ppV: Did                  | mm/s            |
|                                           | frequency: Not            | Hz              |
|                                           | air overpressure: Trigger | dB              |

Colling Rd & Blind Line Bruce Trail

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757578    | 1.394413    |
| 0.757578    | 1.394413    |

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. |
|-------------------------------------------|---------------------------|-----------------|
| 1st Reading                               | 43.39339                  | 79.88880        |
| 2nd Reading                               |                           |                 |
| Average                                   | 43.39339                  | 79.88880        |
| Distance (3rd Seis. From Centre of Blast) | 1230.8                    | m               |
| Post Blast Data:                          | ppV: Did                  | mm/s            |
|                                           | frequency: Not            | Hz              |
|                                           | air overpressure: Trigger | dB              |

SouthWest Corner of Property

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757358    | 1.394323    |
| 0.757358    | 1.394323    |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(437.4)^2}{30^2} \text{ kg}$$

$$= \frac{191,319}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

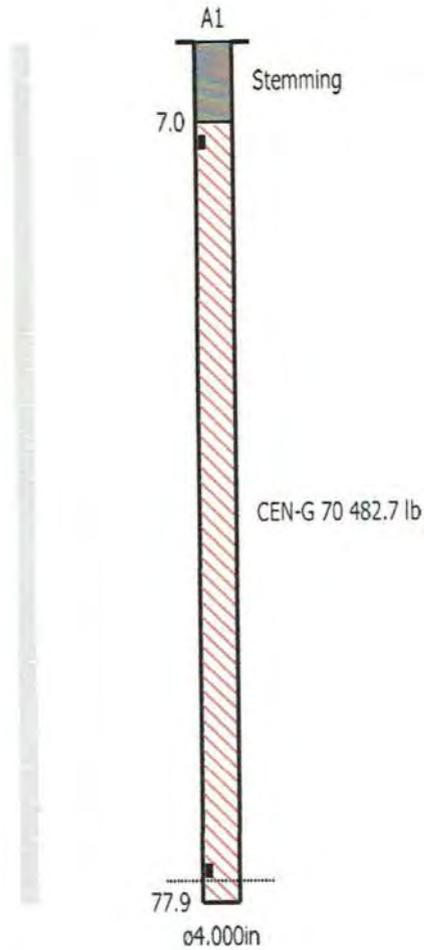
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 7/5/2018

Blast Number: 18-010  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

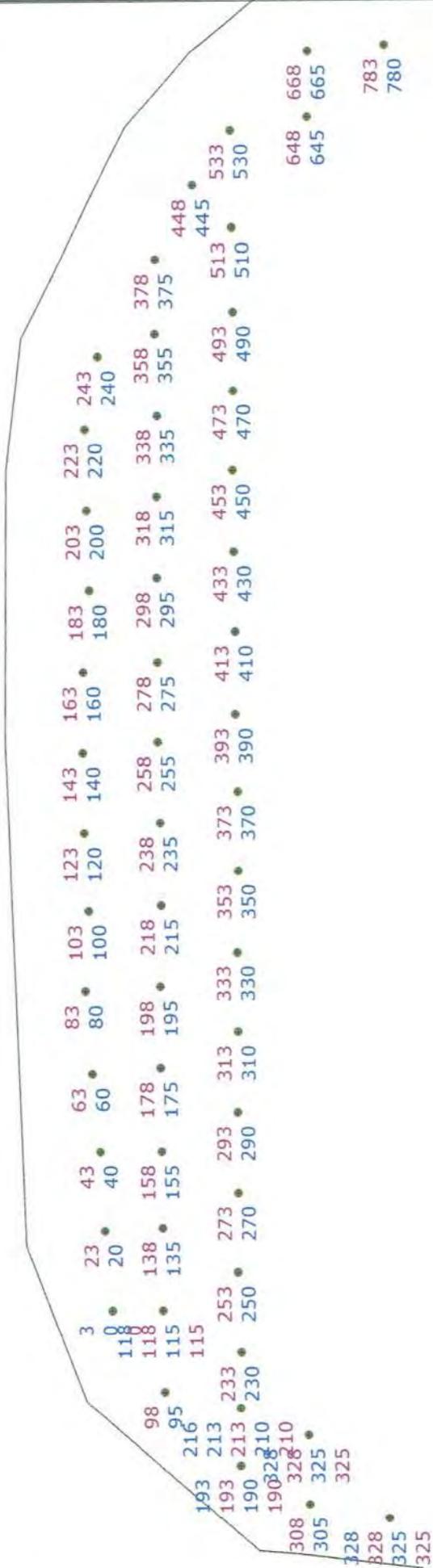
*Bill White*

Signature required, indicating sign off on Blast Design.

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Hole angle: 0.0°  
 Total drilled: 4133.5ft      Number of holes: 53



Not to scale

|                  |                                    |          |
|------------------|------------------------------------|----------|
| SHOTPlus 5.7.1.1 |                                    | 7/6/2018 |
| Mine             | Burlington                         |          |
| Location         |                                    |          |
| Title/author     | 18-010 Upper Middle Final          |          |
| Filename         | 2018-07-05 18-010 Upper Middle.spf |          |

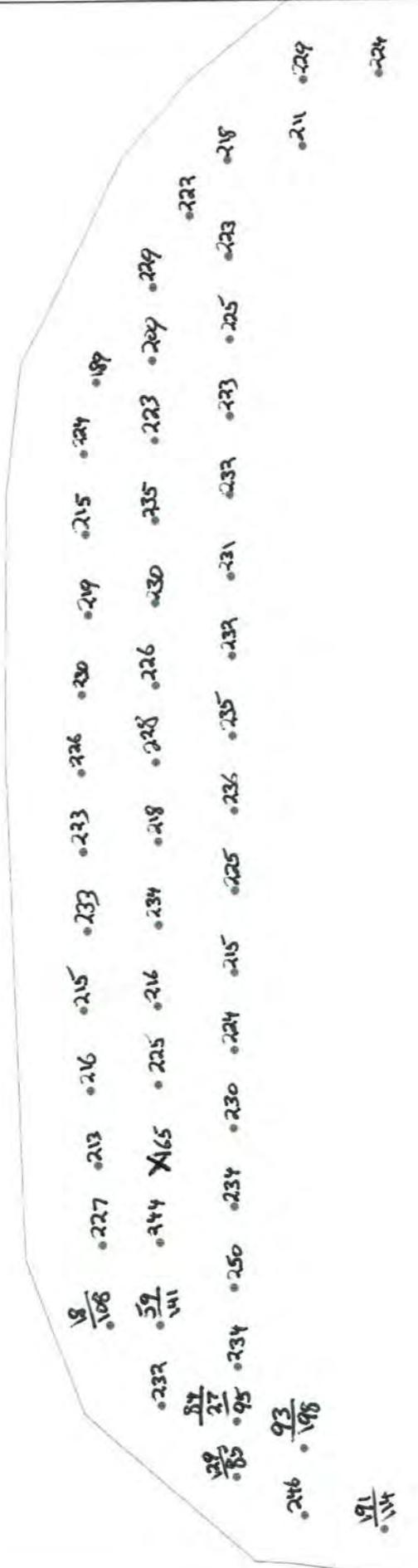
SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 4133.5ft  
 Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Subdrill: 2.0ft  
 Number of holes: 53  
 Stemming: 7.0ft  
 Hole angle: 0.0°

# Load Sheet 250 Kg Max

Free Face



6426  
 = 4'  
 4035

|                  |                               |
|------------------|-------------------------------|
| SHOTPlus 5.7.1.1 | 6/27/2018                     |
| Mine             | Burlington                    |
| Location         |                               |
| Title/author     | 18-010 Upper Middle Final     |
| Filename         | 18-010_Upper_Middle_Final.spf |

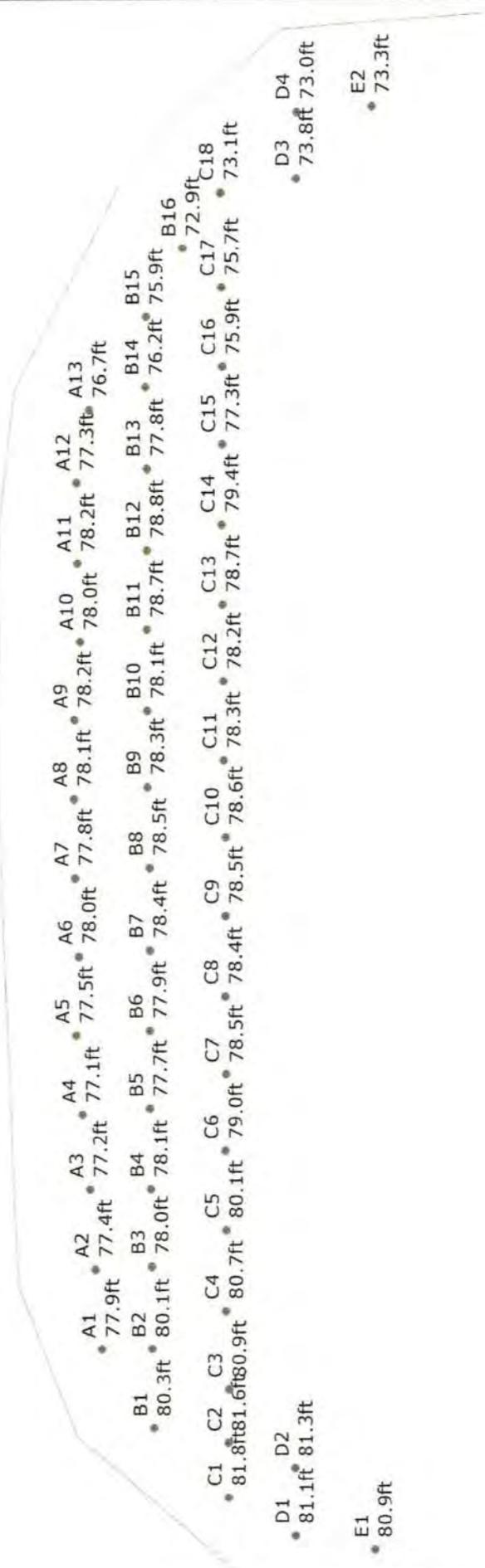


Not to scale

**SHOTPlus 5 Plan**

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 4133.5ft      Hole Diameter: 4.0in      Number of holes: 53



|                  |                                    |          |
|------------------|------------------------------------|----------|
| SHOTPlus 5.7.1.1 |                                    | 7/4/2018 |
| Mine             | Burlington                         |          |
| Location         |                                    |          |
| Title/author     | 18-010 Upper Middle Final          |          |
| Filename         | 2018-07-05 18-010 Upper Middle.spf |          |



Not to scale

1089976

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY. FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissance



Orica Canada Inc.

CONSIGNOR EXPÉDITEUR GRAND VALLEY 033411 SIDE ROAD 21-22 GRAND VALLEY ON CA L9W 7G1

CONSIGNEE CONSIGNATAIRE NELSON AGGREGATE COMPANY 118 49053 BURLINGTON ON CA L7R 4L8

Table with fields: GROSS / BRUT, TARE, NET, TIME IN HEURE D'ENTRÉE (6.45), TIME OUT HEURE SORTIE, ORDER NUMBER (2359087), B/L NUMBER (86063385)

Table with 4 columns: DATE REQUIRED, TIME REQUIRED, INVOICE TO / BUYER, CUSTOMER REFERENCE NO. Includes handwritten 'n/a' and '9712103'.

Main table with columns: QTY., UM, DG MD, QTY. RET'D, QTY. SOLD, DESCRIPTION, # OF / DE PKGS., AMOUNT MONTANT. Lists items like PENTEX BC 340, uni tronic, MINI STEM PLUGS, LABOUR CHARGE, ROG, Harness Wire Duplex.

Table with 4 columns: EMERGENCY RESPONSE PLAN, EMERGENCY RESPONSE NO./24 HOUR NUMBER, PLACARDS OFFERED, FORWARD INVOICE FOR PREPAID FREIGHT. Includes ERAP 2-1510 and 1-877-561-3636.

THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION...

Table with 4 columns: CONSIGNOR / EXPÉDITEUR, CARRIER / TRANSPORTEUR, CONSIGNEE / DESTINATAIRE, SHIPPER'S NAME, DRIVER'S NAME, RECEIVER'S NAME. Includes signatures and dates.

**Date/Time** Long at 11:51:55 July 5, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.25 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.5 Volts  
**Unit Calibration** May 3, 2017 by InstanTel  
**File Name** \_TEMP.EVT

**Notes**

Location: 2450 2nd Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada  
 General: N.43.40245 W.79.87814

**Extended Notes**

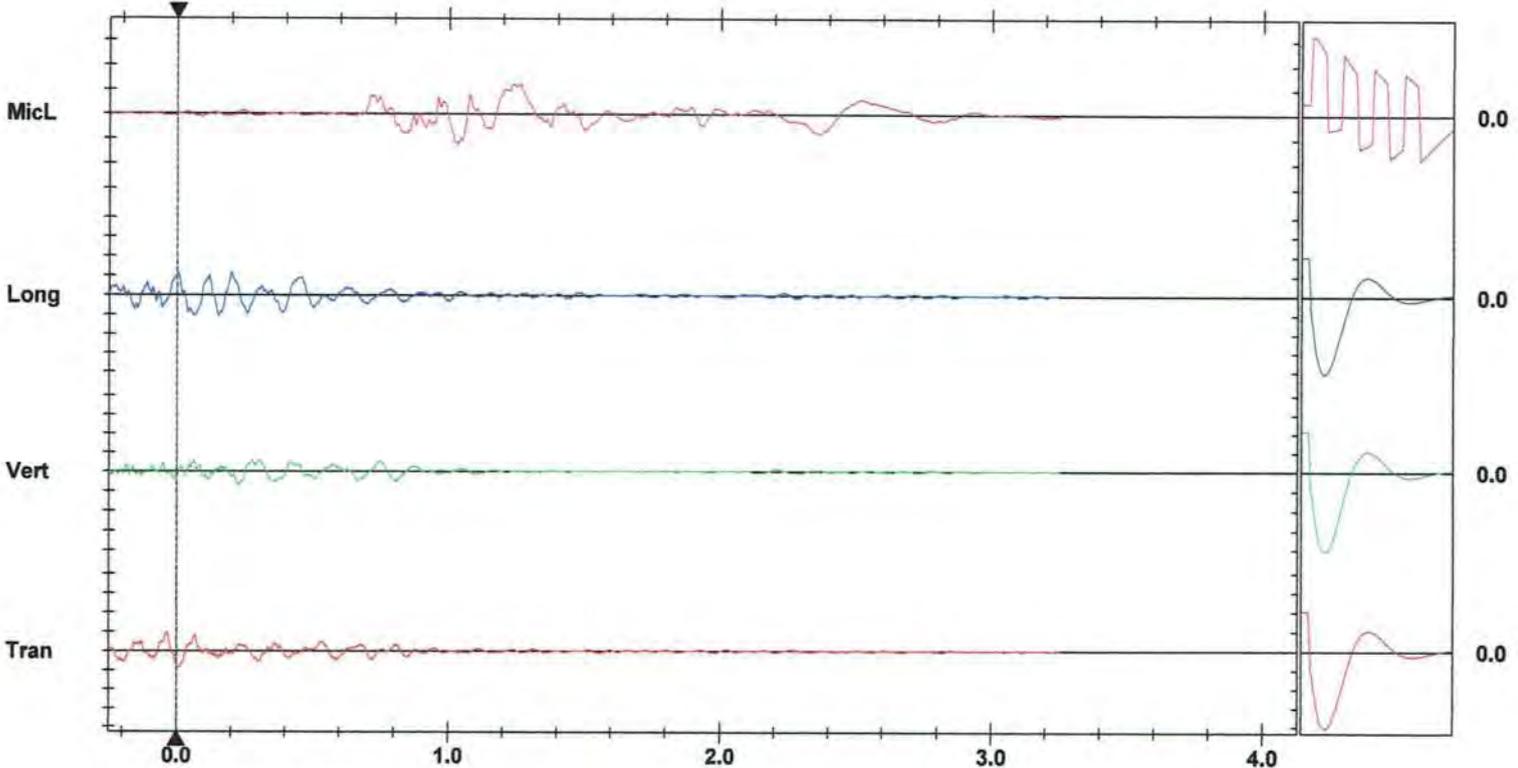
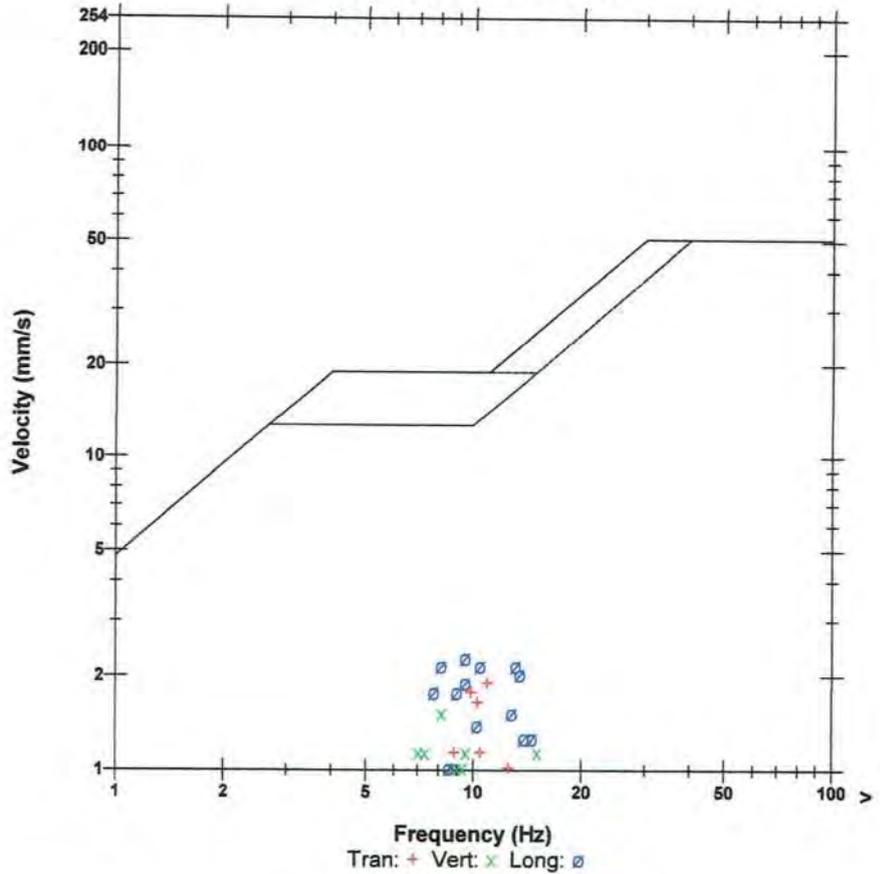
Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 115.9 dB(L) at 1.240 sec  
**ZC Freq** 3.6 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 673 mv)

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 1.905  | 1.524  | 2.286  | mm/s |
| ZC Freq             | 11     | 8.1    | 9.5    | Hz   |
| Time (Rel. to Trig) | -0.037 | 0.226  | 0.198  | sec  |
| Peak Acceleration   | 0.027  | 0.027  | 0.040  | g    |
| Peak Displacement   | 0.028  | 0.029  | 0.046  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.2    | 7.4    | 7.5    | Hz   |
| Overswing Ratio     | 3.8    | 3.7    | 4.1    |      |

Peak Vector Sum 2.823 mm/s at 0.003 sec

**USBM RI8507 And OSMRE**



Time Scale: 0.20 sec/div Amplitude Scale: Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
 Trigger =

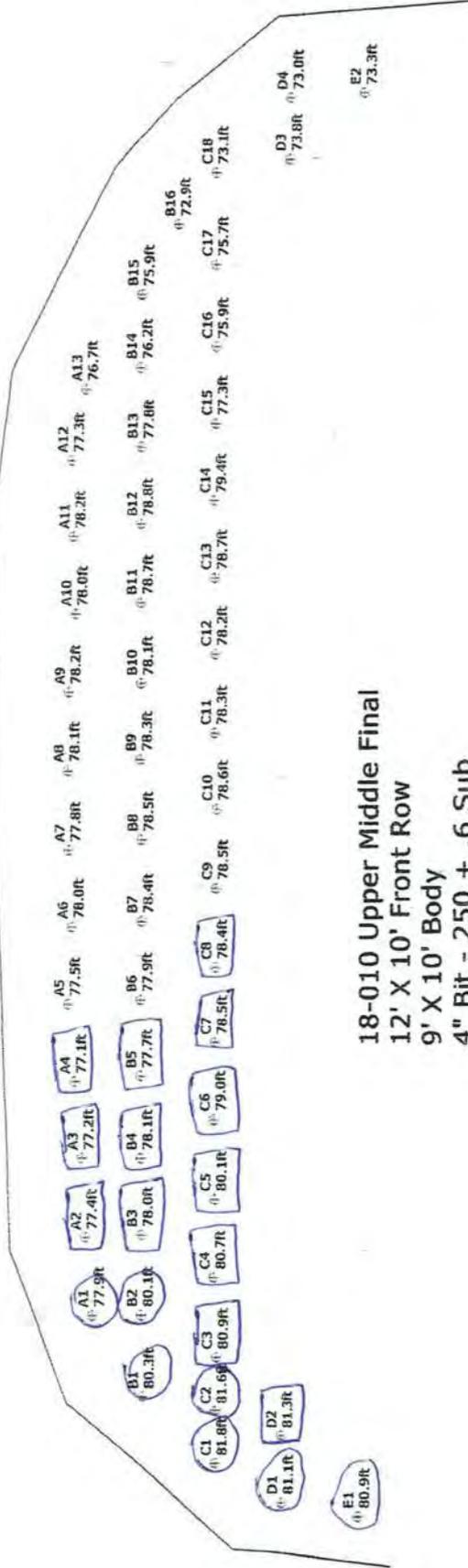
Sensor Check

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Subdrill: 2.0ft Hole angle: 0.0°  
 Hole Diameter: 4.0in Number of holes: 53  
 Total drilled: 4133.5ft

Free Face



18-010 Upper Middle Final  
 12' X 10' Front Row  
 9' X 10' Body  
 4" Bit - 250 + .6 Sub

|                                        |            |
|----------------------------------------|------------|
| SHOTPlus 5.7.2.1                       | 12/06/2018 |
| Mine Burlington                        |            |
| Location                               |            |
| Title/author 18-010 Upper Middle Final |            |
| Filename 18-010 Upper Middle Final.spf |            |

Not to scale

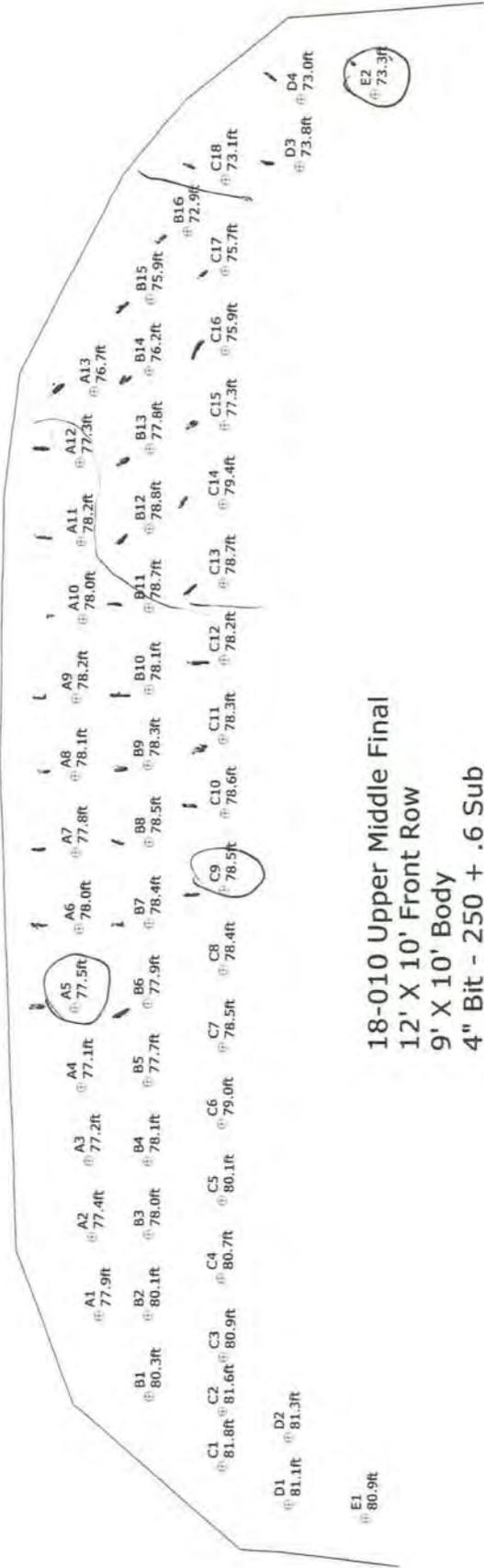


SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 4133.5ft  
 Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Subdrill: 2.0ft  
 Number of holes: 53  
 Stemming: 7.0ft  
 Hole angle: 0.0°

Free Face



18-010 Upper Middle Final  
 12' X 10' Front Row  
 9' X 10' Body  
 4" Bit - 250 + .6 Sub

SHOTPlus 5.7.2.1 12/06/2018

Mine Burlington

Location

Title/author 18-010 Upper Middle Final

Filename 18-010 Upper Middle Final.spf



Not to scale





# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-06-20

Blast Number: 18-011

Orica Order #: 2367871

Blast Time: 11:59 AM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Lower Middle (Bench / Face)

GPS Coordinates: 43.40486 °N Latitude 79.88449 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: E at 5 kph Temperature: 21 to 25 °C

Clear: Partly Cloudy: X Rain: Snow: Inversion: X Ceiling: 30,000 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                 |
|----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm | 0°                  | # Holes: 125 = 3,500.0 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0°                  | # Holes: = 0.0 ft ( " diam)           |
| Tertiary Bit diam: mm      | 0°                  | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 34,090  | 25,800   | 8,290 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 270    | 91.8 |

total explosives weight in Blast (kg): 8,382  
Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 123    |
| UNITRONIC 600 9M  |          |    | 51     |
| UNITRONIC 600 15M |          |    | 96     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 3      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >/=5,000kg <10,000kg         | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 12.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

|                       |              |                      |
|-----------------------|--------------|----------------------|
| Tonnes Blasted:       | 24,173 te    | 9,122 m <sup>3</sup> |
| Total tonnes per day: | te           | NB40-07 Rate Code    |
| Total Holes Loaded:   | 125 holes    |                      |
| ... including:        | Dead Holes   |                      |
| ... and:              | Helper Holes |                      |
| Helper Hole Collar:   | ft avg       |                      |
| # Rows Blasted:       | 15 rows      |                      |

### - Pattern (Front Row) -

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 38 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 87 main body |

Bench Height: 26.0 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 28.0 ft avg

### - Stone Decking -

|            |              |
|------------|--------------|
| Front Row: | 5.0 ft avg   |
| Main Body: | 6.0 ft avg   |
| # Decks:   | 10 per blast |

### - Collar Stemming -

|                |            |
|----------------|------------|
| Front Row:     | 7.0 ft avg |
| Main Body:     | 7.0 ft avg |
| Material used: | .75" Stone |

### - Charge Length -

|            |             |
|------------|-------------|
| Front Row: | 16.0 ft avg |
| Main Body: | 15.0 ft avg |

### - Charge Weight -

|                  |                               |
|------------------|-------------------------------|
| Front Row:       | 46.7 kg/hole                  |
| Main Body:       | 43.7 kg/hole                  |
| Max. per delay:  | 90.0 kg/delay                 |
| SD ( ) Equation: | 372.7 kg/delay                |
| Total kg Loaded: | 8,382 kg                      |
| Rock Density:    | 2.65 g/cc = te/m <sup>3</sup> |

### - Powder Factor -

|            |                           |
|------------|---------------------------|
| Yield PF:  | 0.347 kg/te (actual)      |
| Front row: | 0.199 kg/te (theoretical) |
| Main Body: | 0.249 kg/te (theoretical) |
| "KPI" PF:  | 0.246 kg/te (theoretical) |

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

10 Stone decks were added to this blast due to the drill logs showing voids

The timing sheet identifies where they are as well as the drill log and load sheet.

Attached is a load adjustment sheet



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-06-20

Blast Number: 18-011  
Orica Order #: 2367871  
Blast Time: 11:59 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40487       | 79.88448        | 0.757558    | 1.394247    |
| Front Row Corner          | 43.40462       | 79.88452        | 0.757554    | 1.394248    |
| Back Row Corner           | 43.40508       | 79.88446        | 0.757562    | 1.394247    |
| Average (Centre of Blast) | 43.40486       | 79.88449        | 0.757558    | 1.394247    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 579.2                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |
| 2450 2nd Line                             |                           |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 780.7                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |
| Colling Rd & Blind Line Bruce Trail       |                           |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1323.3                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |
| SouthWest Corner of Property              |                           |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(579.2)^2}{30^2} \text{ kg}$$

$$= \frac{335,473}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

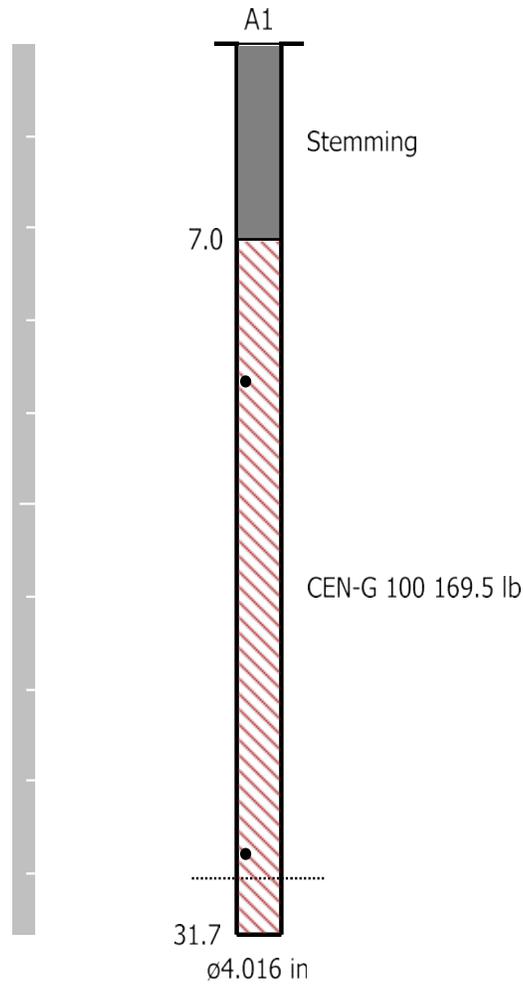
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 7/30/2018

Blast Number: 18-011  
Orica Order #: 2367871

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

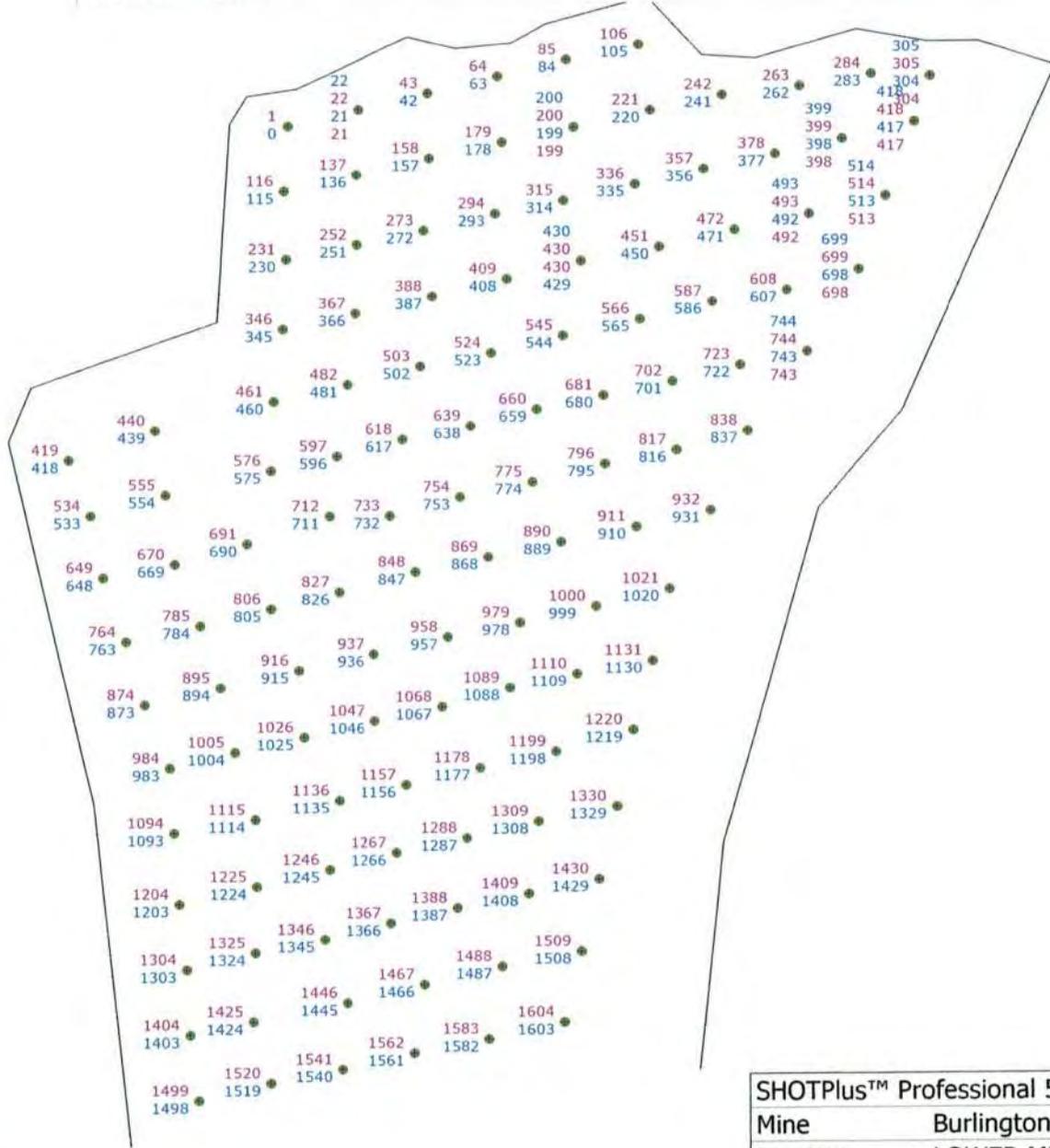
*Bill White*

Signature required, indicating sign off on Blast Design.

### SHOTPlus 5 Plan

#### Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Subdrill: 2.0ft      Stemming: 5.9ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 125      Hole angle: 0.0°  
 Total drilled: 3500.1ft



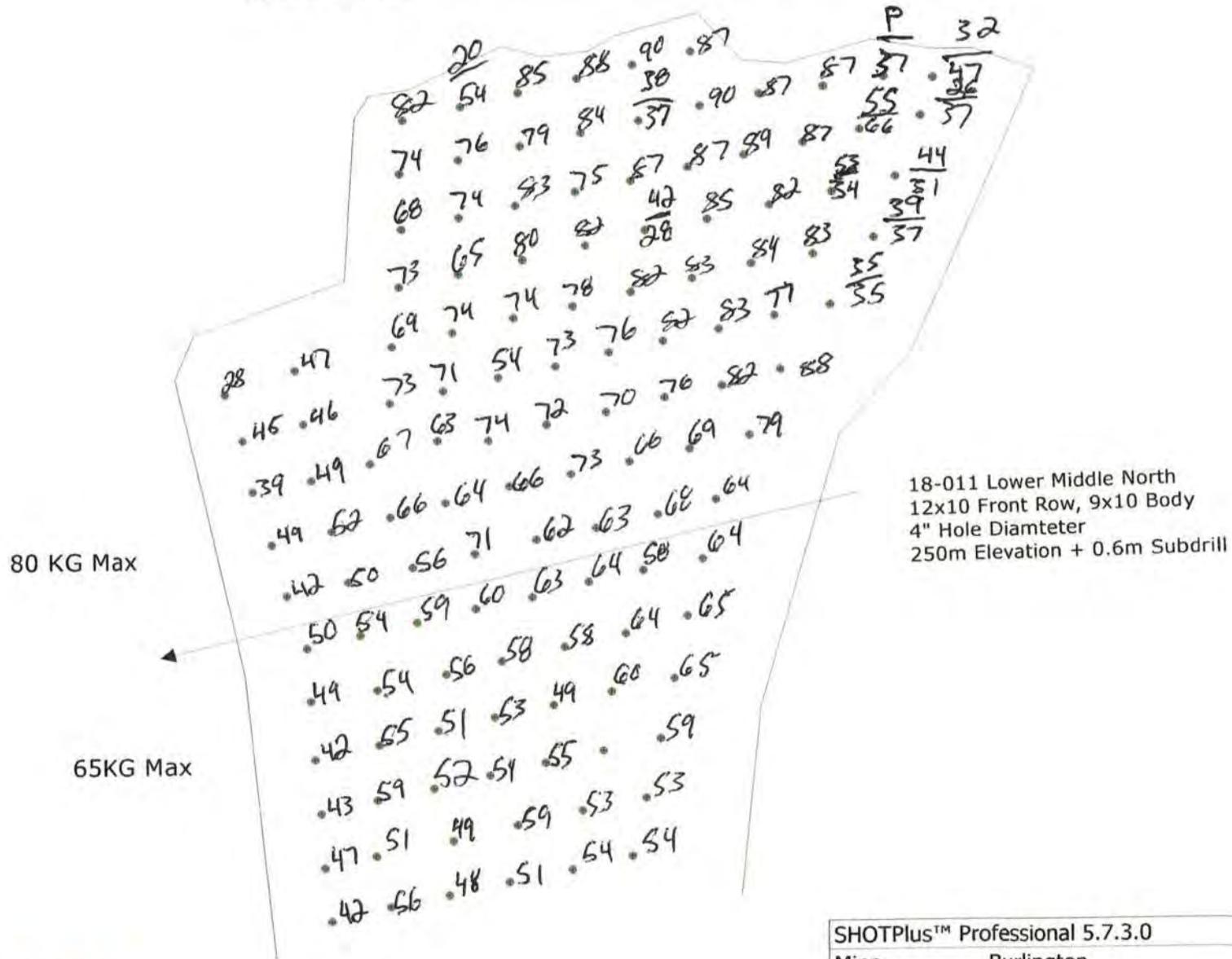
Not to scale

|                                |                            |           |
|--------------------------------|----------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                            | 7/30/2018 |
| Mine                           | Burlington                 |           |
| Location                       | LOWER MIDDLE               |           |
| Title/author                   | DESIGN 18-011 LOWER MIDDLE |           |
| Filename                       | Timing from A-1.spf        |           |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Subdrill: 2.0ft      Stemming: 5.9ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 125      Hole angle: 0.0°  
 Total drilled: 3500.1ft



|                                |                               |           |
|--------------------------------|-------------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                               | 7/27/2018 |
| Mine                           | Burlington                    |           |
| Location                       | LOWER MIDDLE                  |           |
| Title/author                   | DESIGN 18-011 LOWER MIDDLE    |           |
| Filename                       | Blast_18-011_Lower_Middle.spf |           |

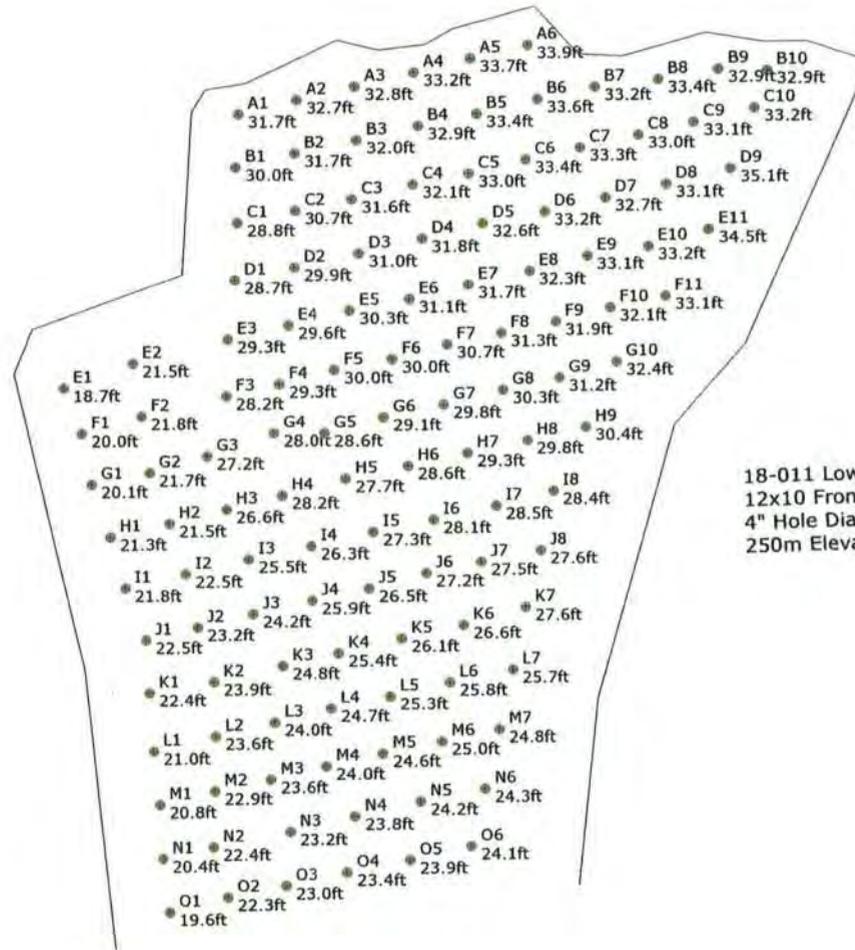


Not to scale

### SHOTPlus 5 Plan

#### Blast Summary Data

|                         |                      |                      |                  |
|-------------------------|----------------------|----------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft      | Stemming: 5.9ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 125 | Hole angle: 0.0° |
| Total drilled: 3500.1ft |                      |                      |                  |



18-011 Lower Middle North  
 12x10 Front Row, 9x10 Body  
 4" Hole Diameter  
 250m Elevation + 0.6m Subdrill



Not to scale

|                                |                                    |           |
|--------------------------------|------------------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                                    | 7/30/2018 |
| Mine                           | Burlington                         |           |
| Location                       | LOWER MIDDLE                       |           |
| Title/author                   | DESIGN 18-011 LOWER MIDDLE         |           |
| Filename                       | 2018-07-30 18-011 Lower Middle.spf |           |

1090217

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSANCE NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissance



**Orica Canada Inc.**

GRAND VALLEY

033411 SIDE ROAD 21-22

GRAND VALLEY ON  
CA L9W 7G1

CONSIGNOR  
EXPÉDITEUR

CONSIGNEE  
CONSIGNATAIRE

NELSON AGGREGATE COMPANY

BURLINGTON ON  
CA L7R 4L8

|                                           |                                               |
|-------------------------------------------|-----------------------------------------------|
| GROSS / BRUT                              |                                               |
| TARE                                      |                                               |
| NET                                       |                                               |
| TIME IN<br>HEURE D'ENTRÉE<br>6:55         | TIME OUT<br>HEURE SORTIE                      |
| ORDER NUMBER<br>N° DE COMMANDE<br>2367871 | B/L NUMBER<br>N° DE CONNAISSEMENT<br>86087520 |

PAGE 2

|                                              |                                                                   |                                                                        |                                                           |
|----------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE<br>30 Jul 2018 | TIME REQUIRED<br>HEURE REQUISE<br>00:00:00                        | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR<br>NELSON AGGREGATE COMPANY | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT<br>n/a |
| DATE SHIPPED<br>EXPÉDIÉ LE<br>30 Jul 2018    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON<br>FOB Dest'n, Own Truck | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR<br>F-73289                        | VEHICLE NO.<br>N° DE VÉHICULE<br>18230                    |
| SHIP VIA<br>TRANSPORTEUR<br>Orica Truck      |                                                                   | ROUTING<br>ITINÉRAIRE<br>STANDARD                                      | MAG. LIC. NO.<br>N° DE PERMIS                             |

| QTY.<br>QTÉ.                                                                                                                                   | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                           | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|------------------------|---------------------------------------|--------------------|-------------------|
| 294                                                                                                                                            | PC | X        | 24                      | 270                    | PENTEX BC 340 (49/CS)                 | 6                  | 107.310           |
| 2                                                                                                                                              | PC |          | 1                       | 1                      | Harness Wire Duplex (6 pack) 400m     | 1                  | 5.840             |
| 184                                                                                                                                            | PC | X        | 61                      | 123                    | *uni tronic 600-06.0M CU/ZC(20')80PC  | 3                  | 13.432            |
| 60                                                                                                                                             | PC | X        | 9                       | 51                     | *uni tronic 600-09.0M CU/ZC(30')60PC  | 1                  | 5.880             |
| 102                                                                                                                                            | PC | X        | 6                       | 96                     | *uni tronic 600-15M C/Z SPL(50')66PC  | 2                  | 17.442            |
| 131                                                                                                                                            | PC | X        | 131                     | 0                      | *uni tronic 600-20M CU/ZC SPL(65')66P | 2                  | 26.724            |
| 100                                                                                                                                            | PC |          | 97                      | 3                      | MINI STEM PLUGS - PART #74853         |                    | 0.700             |
| 1                                                                                                                                              | PC |          |                         |                        | LICENSED BLASTER                      |                    |                   |
| 1.0                                                                                                                                            | HR |          |                         |                        | LABOUR CHARGE                         |                    |                   |
| 1                                                                                                                                              | PC |          |                         |                        | ROG (ROCK ON GROUND)                  |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                             |    |          |                         |                        |                                       |                    | 177.328 KG        |
| **** TOTAL PACKAGES ****                                                                                                                       |    |          |                         |                        |                                       | 15                 |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                        |                                       |                    |                   |

24-HOUR NUMBER: 1-613-996-6666

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                       |                                                          |                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PALLETS USED / PALETTES UTILISÉES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | PALLETS RETURNED / PALETTES RETOURNÉES                                                                | BAGS USED / SACS UTILISÉS                                | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRENT À<br>B/L DE CONNAISSANCE ORICA: |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br><b>ERAP 2-1510</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TÉLÉPHONE D'URGENCE/24 HEURE NUMERO<br><b>1-877-561-3636</b> | PLACARDS OFFERED / PLACARDS OFFERT<br>YES / OUI NO / NON | 301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5                                                                                                 |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES S'USMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                                                                       | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE<br>\$      | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                              |

|                                                              |                                                               |                                                      |
|--------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                       | CARRIER / TRANSPORTEUR<br>Orica Truck                         | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>K. Kaban | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>K. Patten | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br>K. Kaban                                        | SIGNATURE<br>K. Patten                                        | SIGNATURE                                            |
| DATE<br>30 7 18<br>D/J M/M Y/A                               | DATE<br>30 7 18<br>D/J M/M Y/A                                | DATE                                                 |

**2 SHIPPING ORDER  
BON D'EXPÉDITION**

(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
(L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRÈS AVOIR SIGNÉ LA COPIE ORIGINALE (1) DU CONNAISSANCE CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO  
\*\*\*\* PAGE 2 OF 2 \*\*\*\*  
D.F.G. S7772



# SHOTPlus 5 Plan

## Blast Summary Data

Burden: 9.0ft

Spacing: 10.0ft

Subdrill: 2.0ft

Stemming: 5.9ft

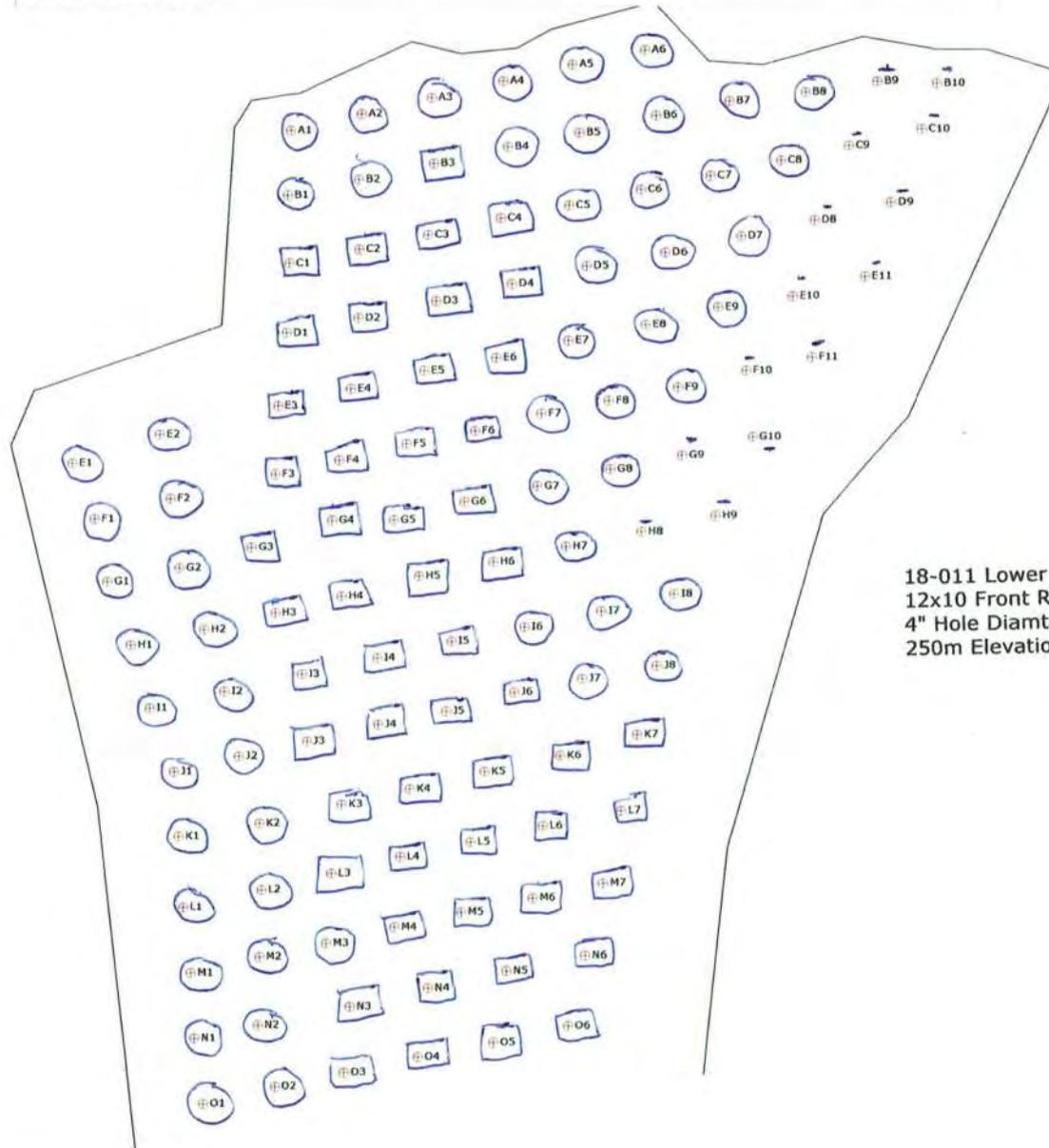
1st row burden: 12.0ft

Hole Diameter: 4.0in

Number of holes: 125

Hole angle: 0.0°

Total drilled: 3500.1ft



18-011 Lower Middle North  
12x10 Front Row, 9x10 Body  
4" Hole Diameter  
250m Elevation + 0.6m Subdrill



Not to scale



# Blast Report

## Nelson Aggregate

Quarry: **Burlington**  
 P.O. #:  
 Blast Date: **2018-08-03**

Blast Number: **18-012**  
 Orica Order #: **2370307**  
 Blast Time: **11:52 AM**

page 1

Blaster-in-charge: **Mike derkinderen** (Print Name)

Blast Location: **Upper Middle** (Bench / Face)

GPS Coordinates: **43.40371** °N Latitude **79.88291** °W Longitude  
Centre of Blast Centre of Blast

Wind from the:  at  **0** kph Temperature: **16 to 20** °C

Clear:  Rain:  Overcast:  X  
 Partly Cloudy:  Snow:  Inversion:  Ceiling **24,791** ft

**- Drilling Information -**

|                                            | Angle from Vertical  | Nominal Bit Diameter:                            |
|--------------------------------------------|----------------------|--------------------------------------------------|
| Primary Bit diam: <b>101.6</b> mm          | <b>0</b>             | # Holes: <b>46</b> = 3,606.6 ft ( 4 " diam)      |
| Secondary Bit diam: <b>127.0</b> mm        | <b>0</b>             | # Holes: <b>1</b> = 78.4 ft ( 5 " diam)          |
| Tertiary Bit diam: <input type="text"/> mm | <input type="text"/> | # Holes: <input type="text"/> = 0.0 ft ( " diam) |

**Bulk Explosives:**

|                       | in (kg)       | out (kg)      | kg     |
|-----------------------|---------------|---------------|--------|
| <b>CENTRA GOLD 70</b> | <b>33,800</b> | <b>22,760</b> | 11,040 |

**Packaged Explosives:**

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

**Boosters:**

|                                  | kg / unit | # used     | kg   |
|----------------------------------|-----------|------------|------|
| <b>PENTEX 12 (OR EQUIVALENT)</b> | 0.34      | <b>106</b> | 36.0 |

total explosives weight in Blast (kg): **11,076**  
 Pkgd Prod (0 kg) % of Total kg: **0.0%**

**Detonators:**

|                          | case #'s | ms | # used    |
|--------------------------|----------|----|-----------|
| <b>UNITRONIC 600 9M</b>  |          |    | <b>45</b> |
| <b>UNITRONIC 600 25M</b> |          |    | <b>25</b> |
| <b>UNITRONIC 600 30M</b> |          |    | <b>36</b> |

**Cord & Accessories:**

|                                    | U of M | # used    |
|------------------------------------|--------|-----------|
| <b>MINI STEM PLUGS - 6015 (4")</b> | units  | <b>12</b> |

**Resource Deployment:**

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <b>1</b> |
| # of Blasters (this Blast)      |                | <b>1</b> |
| # of Helpers (this Blast)       | Note Exception | <b>2</b> |
| # of MMU's (this Blast)         |                | <b>1</b> |

**Services:**

|                        |                              |             |
|------------------------|------------------------------|-------------|
| GPS LAYOUT             | Enter hours                  | <b>0.0</b>  |
| BULK TRUCK CHARGE      | >=10,000 kg                  | <b>1</b>    |
| BLASTER HOURS          | Enter Blaster hours          | <b>6.0</b>  |
| HELPER HOURS           | Enter total Helper man-hours | <b>11.0</b> |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | <b>0</b>    |
| 3D LASER PROFILE       | Enter hours                  | <b>0.0</b>  |
| BORETRACK              | Enter hours                  | <b>0.0</b>  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | <b>0.0</b>  |

Tonnes Blasted: **27,176** te **10,255** m<sup>3</sup>  
 Total tonnes per day: **27,176** te **NB80-01** Rate Code  
 Total Holes Loaded: **47** holes  
 ... including: Dead Holes  
 ... and: Helper Holes  
 Helper Hole Collar:  ft avg  
 # Rows Blasted: **3** rows

**- Pattern (Front Row) -**

Burden: **12.0** ft avg  
 Spacing: **10.0** ft avg  
 # Holes: **17** front row

**- Pattern (Main Body) -**

Burden: **9.0** ft avg  
 Spacing: **10.0** ft avg  
 # Holes: **30** main body

Bench Height: **76.4** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: **78.4** ft avg

**- Stone Decking -**

Front Row: **10.0** ft avg  
 Main Body: **10.0** ft avg  
 # Decks: **6** per blast

**- Collar Stemming -**

Front Row: **7.0** ft avg  
 Main Body: **7.0** ft avg  
 Material used: **.75" Stone**

**- Charge Length -**

Front Row: **61.4** ft avg  
 Main Body: **61.4** ft avg

**- Charge Weight -**

Front Row: **179.0** kg/hole  
 Main Body: **179.0** kg/hole  
 Max. per delay: **265.0** kg/delay  
 SD ( ) Equation: **187.2** kg/delay  
 Total kg Loaded: **11,076** kg  
 Rock Density: **2.65** g/cc = te/m<sup>3</sup>

**- Powder Factor -**

1.820 lb/yd<sup>3</sup> Yield PF: **0.408** kg/te (actual)  
 1.162 lb/yd<sup>3</sup> Front row: **0.260** kg/te (theoretical)  
 1.550 lb/yd<sup>3</sup> Main Body: **0.347** kg/te (theoretical)  
 1.421 lb/yd<sup>3</sup> "KPI" PF: **0.318** kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

Cost Reduction Notes (this Blast) - change in Bit , B , S , Expl or IS from previous Blast:

**3 Siesmographs set up**

**Holes D-1,D2 and E1 were not loaded due to lean burden on profiles**



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-08-03

Blast Number: 18-012  
Orica Order #: 2370307  
Blast Time: 11:52 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40369       | 79.88291        | 0.757537    | 1.394220    |
| Front Row Corner          | 43.40351       | 79.88288        | 0.757534    | 1.394219    |
| Back Row Corner           | 43.40392       | 79.88295        | 0.757541    | 1.394220    |
| Average (Centre of Blast) | 43.40371       | 79.88291        | 0.757538    | 1.394220    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 410.5                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 2.4                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 7.2          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 115.0 | dB              | Trigger set at: 115 | dB                                     |
| 2450 2nd Line                             |                         |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 934.1                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 7.1          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 116.4 | dB              | Trigger set at: 115 | dB                                     |
| Colling Rd & Blind Line Bruce Trail       |                         |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1243.6                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 7.4          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 117.1 | dB              | Trigger set at: 115 | dB                                     |
| SouthWest Corner of Property              |                         |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(410.5)^2}{30^2} \text{ kg}$$

$$= \frac{168,510}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-08-14

Blast Number: 18-013

Orica Order #: 2374191

Blast Time: 10:54 AM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Floor (Bench / Face)

GPS Coordinates: 43.40146 °N Latitude 79.88807 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: S at 5 kph Temperature: 21 to 25 °C

Clear: Partly Cloudy: X Rain: Snow: Inversion: Ceiling: 30,420 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                 |
|----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm | 0°                  | # Holes: 182 = 1,820.0 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0°                  | # Holes: = 0.0 ft ( " diam)           |
| Tertiary Bit diam: mm      | 0°                  | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 27,500  | 26,290   | 1,210 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 182    | 61.9 |

total explosives weight in Blast (kg): 1,272  
Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                  | case #'s | ms     | # used |
|------------------|----------|--------|--------|
| UNITRONIC 600 6M |          |        | 2      |
| EXEL HANDIDET 9m |          | 25/500 | 182    |
| CONNECTADET 9M   |          | 25 ms  | 4      |
| CONNECTADET 12M  |          | 42 ms  | 44     |

### Cord & Accessories:

|                                   | U of M | # used |
|-----------------------------------|--------|--------|
| HARNESS WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |     |
|------------------------|------------------------------|-----|
| GPS LAYOUT             | Enter hours                  | 0.0 |
| BULK TRUCK CHARGE      | <2,000kg                     | 1   |
| BLASTER HOURS          | Enter Blaster hours          | 0.0 |
| HELPER HOURS           | Enter total Helper man-hours | 0.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0   |
| 3D LASER PROFILE       | Enter hours                  | 0.0 |
| BORETRACK              | Enter hours                  | 0.0 |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0 |

|                       |               |                      |
|-----------------------|---------------|----------------------|
| Tonnes Blasted:       | 17,069 te     | 6,441 m <sup>3</sup> |
| Total tonnes per day: | 17,069 te     | NF-15 Rate Code      |
| Total Holes Loaded:   | 182 holes     |                      |
| ... including:        | 10 Dead Holes |                      |
| ... and:              | Helper Holes  |                      |
| Helper Hole Collar:   | ft avg        |                      |
| # Rows Blasted:       | 11 rows       |                      |

### - Pattern (Front Row)-

|          |              |
|----------|--------------|
| Burden:  | 11.5 ft avg  |
| Spacing: | 11.5 ft avg  |
| # Holes: | 18 front row |

### - Pattern (Main Body) -

|          |               |
|----------|---------------|
| Burden:  | 11.5 ft avg   |
| Spacing: | 11.5 ft avg   |
| # Holes: | 164 main body |

Bench Height: 10.0 ft avg

Sub-drill: 0.0 ft avg

Hole Depth: 10.0 ft avg

### - Stone Decking -

|            |           |
|------------|-----------|
| Front Row: | ft avg    |
| Main Body: | ft avg    |
| # Decks:   | per blast |

### - Collar Stemming -

|                |            |
|----------------|------------|
| Front Row:     | 7.0 ft avg |
| Main Body:     | 7.0 ft avg |
| Material used: | .75" Stone |

### - Charge Length -

|            |            |
|------------|------------|
| Front Row: | 3.0 ft avg |
| Main Body: | 3.0 ft avg |

### - Charge Weight -

|                  |                               |
|------------------|-------------------------------|
| Front Row:       | 8.7 kg/hole                   |
| Main Body:       | 8.7 kg/hole                   |
| Max. per delay:  | 16.0 kg/delay                 |
| SD () Equation:  | 545.1 kg/delay                |
| Total kg Loaded: | 1,272 kg                      |
| Rock Density:    | 2.65 g/cc = te/m <sup>3</sup> |

### - Powder Factor -

|            |                           |
|------------|---------------------------|
| Yield PF:  | 0.075 kg/te (actual)      |
| Front row: | 0.088 kg/te (theoretical) |
| Main Body: | 0.088 kg/te (theoretical) |
| "KPI" PF:  | 0.088 kg/te (theoretical) |

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-08-14

Blast Number: 18-013  
Orica Order #: 2374191  
Blast Time: 10:54 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.40115       | 79.88796        |
| Front Row Corner          | 43.40147       | 79.88808        |
| Back Row Corner           | 43.40176       | 79.88818        |
| Average (Centre of Blast) | 43.40146       | 79.88807        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757493    | 1.394308    |
| 0.757499    | 1.394310    |
| 0.757504    | 1.394312    |
| 0.757498    | 1.394310    |

1st

| Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. |
|--------------------------|----------------|-----------------|
| 1st Reading              | 43.40245       | 79.87814        |
| 2nd Reading              |                |                 |
| Average                  | 43.40245       | 79.87814        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757516    | 1.394137    |
|             |             |
| 0.757516    | 1.394137    |

|                                           |                           |                                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| Distance (1st Seis. From Centre of Blast) | 811.0                     | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |
| 2450 2nd Line                             |                           |                                                         |

2nd

| Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. |
|--------------------------|----------------|-----------------|
| 1st Reading              | 43.40605       | 79.89400        |
| 2nd Reading              |                |                 |
| Average                  | 43.40605       | 79.89400        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757578    | 1.394413    |
|             |             |
| 0.757578    | 1.394413    |

|                                           |                           |                                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| Distance (2nd Seis. From Centre of Blast) | 700.4                     | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |
| Colling Rd & Blind Line Bruce Trail       |                           |                                                         |

3rd

| Seismograph Co-ordinates | Enter ° N Lat. | Enter ° W Long. |
|--------------------------|----------------|-----------------|
| 1st Reading              | 43.39339       | 79.88880        |
| 2nd Reading              |                |                 |
| Average                  | 43.39339       | 79.88880        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757358    | 1.394323    |
|             |             |
| 0.757358    | 1.394323    |

|                                           |                           |                                                         |
|-------------------------------------------|---------------------------|---------------------------------------------------------|
| Distance (3rd Seis. From Centre of Blast) | 900.7                     | m                                                       |
| Post Blast Data:                          | ppV: Did                  | mm/s Trigger set at: 2.0                                |
|                                           | frequency: Not            | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB Trigger set at: 115                                  |
| SouthWest Corner of Property              |                           |                                                         |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(700.4)^2}{30^2} \text{ kg}$$

$$= \frac{490,560}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

|             |            |
|-------------|------------|
| Quarry:     | Burlington |
| P.O. #:     |            |
| Blast Date: | 8/9/2018   |

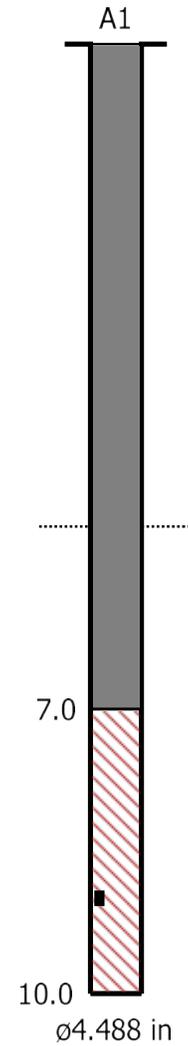
|                |         |
|----------------|---------|
| Blast Number:  | 18-013  |
| Orica Order #: | 2374191 |

page 2

Paste ShotPlus Diagram inside Rectangle:



HANDIDET 500ms 16ft  
PENTEX BC 12 \* 340 x1



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Bill White*

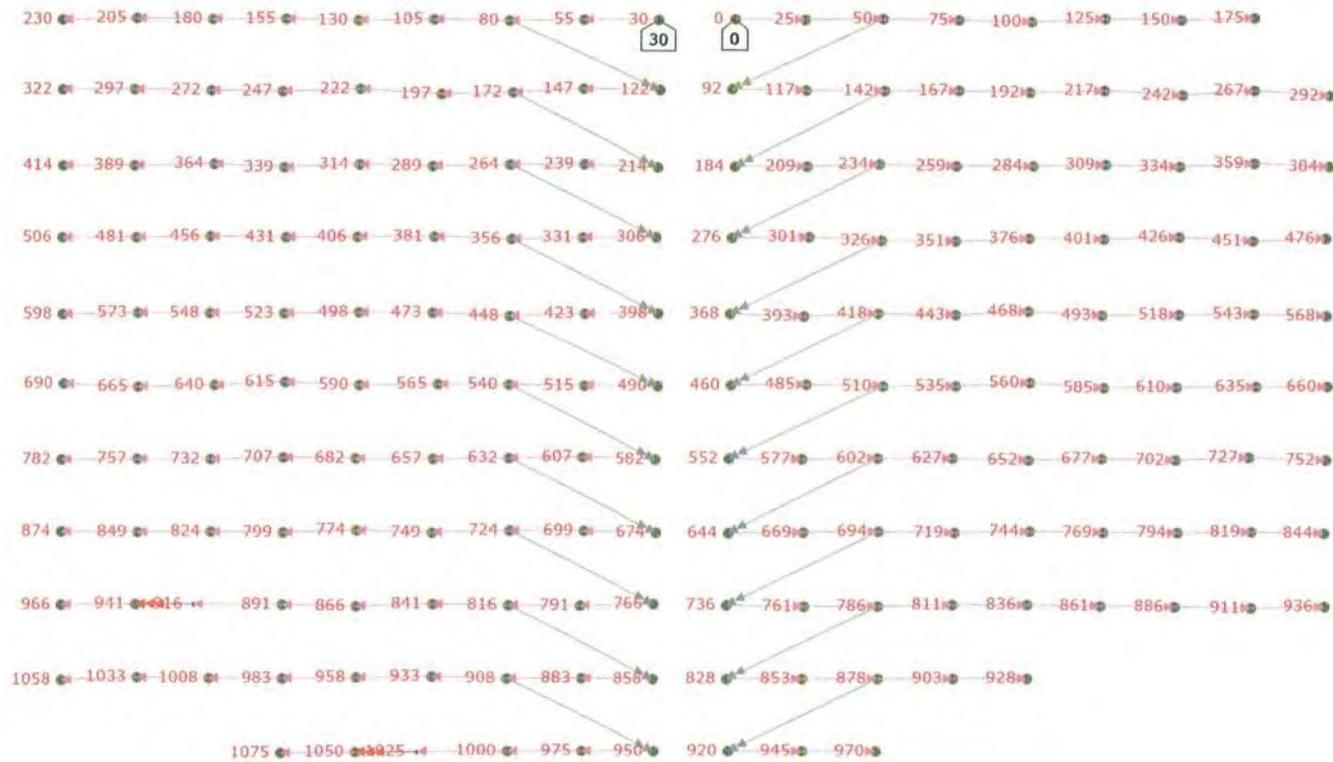
Signature required, indicating sign off on Blast Design.

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                      |                  |
|-------------------------|----------------------|----------------------|------------------|
| Burden: 11.5ft          | Spacing: 11.5ft      | Subdrill: 0.0ft      | Stemming: 8.2ft  |
| 1st row burden: 11.5ft  | Hole Diameter: 4.0in | Number of holes: 182 | Hole angle: 0.0° |
| Total drilled: 1819.9ft |                      |                      |                  |

## Blasted and Backfilled



**Blast 18-013 Floor**  
**4" Hole**  
**11.5 X 11.5**

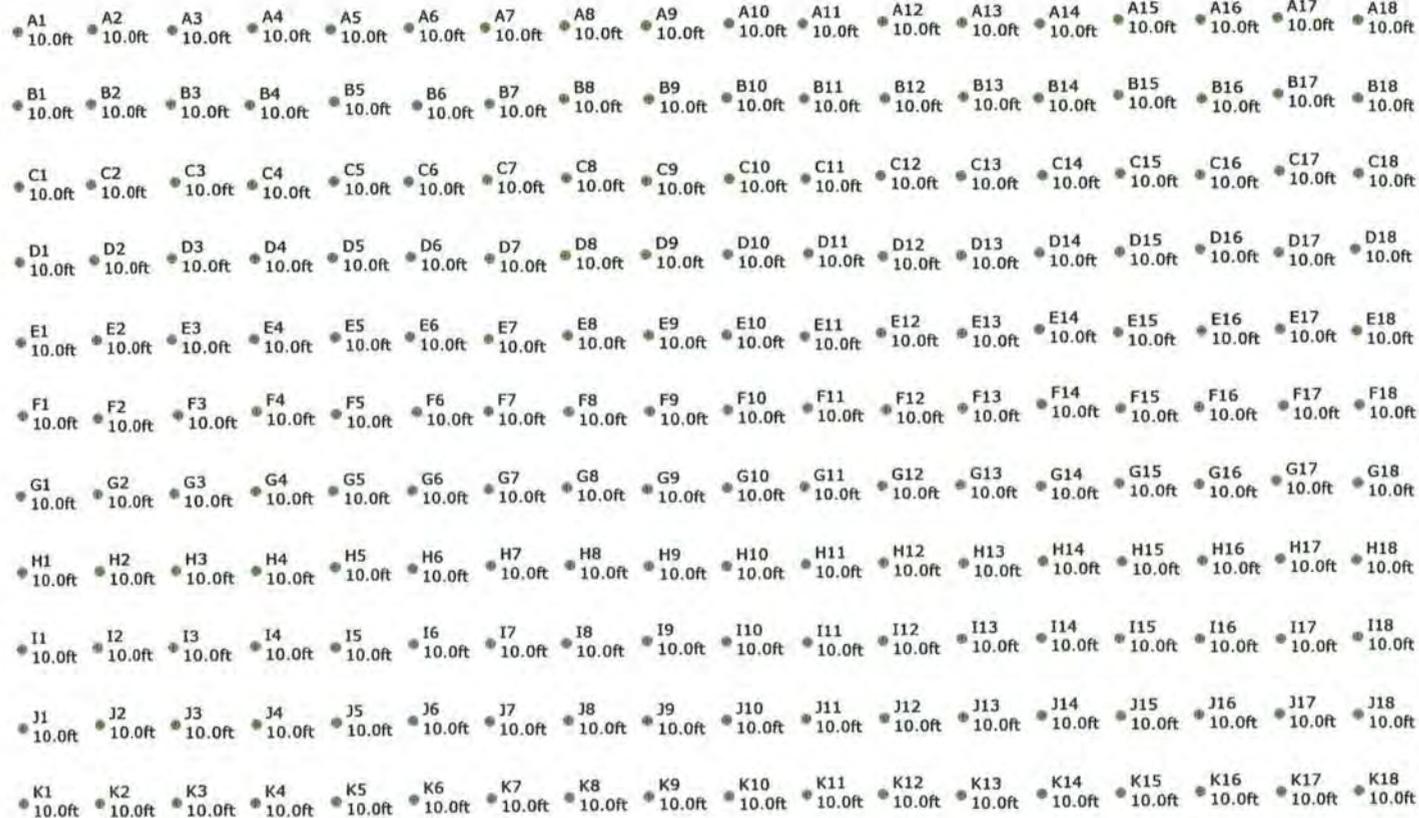


Not to scale

|                                |                             |           |
|--------------------------------|-----------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                             | 8/14/2018 |
| Mine                           | Burlington                  |           |
| Location                       |                             |           |
| Title/author                   | 18-013 Floor                |           |
| Filename                       | 2018-08-14 18-013 Floor.spf |           |



# Blasted and Backfilled



Blast 18-013 Floor  
 4" Hole  
 11.5 X 11.5



Not to scale

|                                |              |
|--------------------------------|--------------|
| SHOTPlus™ Professional 5.7.3.0 | 8/7/2018     |
| Mine                           | Burlington   |
| Location                       |              |
| Title/author                   | 18-013 Floor |
| Filename                       | Timing.spf   |



**Orica Canada Inc.**

CONSIGNOR  
EXPÉDITEUR  
GRAND VALLEY  
033411 SIDE ROAD 21-22  
GRAND VALLEY ON  
CA L9W 7G1

**Bill of Lading / Connaissance**

|                                |                                  |
|--------------------------------|----------------------------------|
| GROSS / BRUT                   |                                  |
| TARE                           |                                  |
| NET                            |                                  |
| 7 TIME IN<br>HEURE D'ENTRÉE    | TIME OUT<br>HEURE SORTIE         |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSANCE |
| 2374191                        | 86102967                         |

CONSIGNEE  
CONSIGNATAIRE  
NELSON AGGREGATE COMPANY  
BURLINGTON ON  
CA L7R 4L8

|                               |                                          |                                            |                                      |                                                    |                                         |                    |                   |
|-------------------------------|------------------------------------------|--------------------------------------------|--------------------------------------|----------------------------------------------------|-----------------------------------------|--------------------|-------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR |                                      | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |                                         |                    |                   |
| 14 Aug 2018                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   |                                      | n/a                                                |                                         |                    |                   |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON |                                            | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR | VEHICLE NO.<br>N° DE VÉHICULE                      |                                         |                    |                   |
| 14 Aug 2018                   | FOB Dest'n, Own Truck                    |                                            | F-73289                              | 1387                                               |                                         |                    |                   |
| SHIP VIA<br>TRANSPORTEUR      |                                          | ROUTING<br>ITINÉRAIRE                      |                                      | MAG. LIC. NO.<br>N° DE PERMIS                      |                                         |                    |                   |
| Orica Truck                   |                                          | STANDARD                                   |                                      |                                                    |                                         |                    |                   |
| QTY.<br>QTÉ.                  | UM                                       | DG<br>MD                                   | QTY. RET'D<br>QTÉ. RET.              | QTY. SOLD<br>QTÉ. FACT.                            | DESCRIPTION                             | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|                               |                                          |                                            | NET EXPLOSIVES QUANTITY:             |                                                    | 83.718 KG                               |                    |                   |
| 245                           | PC                                       | X                                          | 63                                   | 182                                                | PENTEX BC 340 (49/CS)                   | 5                  | 89.425            |
| 2                             | PC                                       |                                            | 1                                    | 1                                                  | Harness Wire Duplex (6 pack) 400m       | 1                  | 5.840             |
| 18                            | PC                                       | X                                          | 16                                   | 2                                                  | *uni tronic 600-06.0M CU/ZC(20')80PC    | 1                  | 1.314             |
| 100                           | PC                                       |                                            | 100                                  | 0                                                  | MINI STEM PLUGS - PART #74853           |                    | 0.700             |
| 260                           | PC                                       | X                                          | 78                                   | 182                                                | EXEL HANDIDET 9M 25/500(30') 65/CS      | 4                  | 26.260            |
| 50                            | PC                                       | X                                          | 50                                   | 0                                                  | EXEL HANDIDET 12M 25/500(40') 50/CS     | 1                  | 6.150             |
| 27                            | PC                                       | X                                          | 23                                   | 4                                                  | EXEL Connectadet 9M 25MS (30 FT) 65/CS  | 1                  | 2.619             |
| 50                            | PC                                       | X                                          | 6                                    | 44                                                 | EXEL Connectadet 12M 42MS (40 FT) 50/CS | 1                  | 6                 |
| 1                             | PC                                       |                                            |                                      |                                                    | LICENSED BLASTER                        |                    |                   |
| 1.0                           | HR                                       |                                            |                                      |                                                    | LABOUR CHARGE                           |                    |                   |
| 1                             | PC                                       |                                            |                                      |                                                    | ROG (ROCK ON GROUND)                    |                    |                   |
| TOTAL GROSS WEIGHT            |                                          |                                            |                                      |                                                    |                                         |                    | 138.308 KG        |
| **** TOTAL PACKAGES ****      |                                          |                                            |                                      |                                                    |                                         | 14                 |                   |

24-HOUR NUMBER: 1-613-996-6666

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              |                                               |                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PALLETS USED / PALETTES UTILISÉES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PALLETS RETURNED / PALETTES RETOURNÉES                                       | BAGS USED / SACS UTILISÉS                     | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSANCE D'ORICA: |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TÉLÉPHONE D'URGENCE/24 HEURE NUMERO | PLACARDS OFFERED / PLACARDS OFFERT            |                                                                                                                                                              |
| ERAP 2-1510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1-877-561-3636                                                               | YES / OUI NO / NON                            | 301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5                                                                                                  |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                                              | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              | \$                                            |                                                                                                                                                              |

|                                                                |                                                                |                                                      |
|----------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                         | CARRIER / TRANSPORTEUR<br>Orica Truck                          | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>Neil Kwast | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>Neil Kwast | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br><i>Neil Kwast</i>                                 | DATE<br>14 08 18<br>D/J M/M Y/A                                | SIGNATURE<br><i>Neil Kwast</i>                       |
|                                                                | DATE<br>14 08 18<br>D/J M/M Y/A                                | DATE<br>D/J M/M Y/A                                  |

**2 SHIPPING ORDER  
BON D'EXPÉDITION**

(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
(L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRES AVOIR SIGNÉ LA COPIE ORIGINALE (1) DU CONNAISSANCE CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO





# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-08-30

Blast Number: 18-014

Orica Order #: 2380811

Blast Time: 11:55 AM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40372 °N Latitude 79.88278 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: NE at 5 kph Temperature: 16 to 20 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

|                              | Angle from Vertical | Nominal Bit Diameter:                |
|------------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm   | 0°                  | # Holes: 50 = 3,859.1 ft ( 4 " diam) |
| Secondary Bit diam: 127.0 mm | 0°                  | # Holes: 8 = 617.4 ft ( 5 " diam)    |
| Tertiary Bit diam: mm        | 0°                  | # Holes: = 0.0 ft ( " diam)          |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,770  | 20,690   | 13,080 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 154    | 52.4 |

total explosives weight in Blast (kg): 13,132

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 50     |
| UNITRONIC 600 9M  |          |    | 4      |
| UNITRONIC 600 20M |          |    | 22     |
| UNITRONIC 600 25M |          |    | 6      |
| UNITRONIC 600 30M |          |    | 72     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
|                                  | units  |        |
|                                  | units  |        |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 3 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=10,000 kg                  | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 6.0  |
| HELPER HOURS           | Enter total Helper man-hours | 15.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   |      |
| 3D LASER PROFILE       | Enter hours                  |      |
| BORETRACK              | Enter hours                  |      |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    |      |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 31,778 te      | 11,992 m <sup>3</sup> |
| Total tonnes per day: | 31,778 te      | NB80-01 Rate Code     |
| Total Holes Loaded:   | 58 holes       |                       |
| ... including:        | Dead Holes     |                       |
| ... and:              | 3 Helper Holes |                       |
| Helper Hole Collar:   | 60.0 ft avg    |                       |
| # Rows Blasted:       | 3 rows         |                       |

### - Pattern (Front Row)-

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 24 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 34 main body |

Bench Height: 75.2 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 77.2 ft avg

### - Stone Decking -

|            |              |
|------------|--------------|
| Front Row: | 8.4 ft avg   |
| Main Body: | 9.8 ft avg   |
| # Decks:   | 19 per blast |

### - Collar Stemming -

|                |            |
|----------------|------------|
| Front Row:     | 7.0 ft avg |
| Main Body:     | 7.0 ft avg |
| Material used: | .75" Stone |

### - Charge Length -

|            |             |
|------------|-------------|
| Front Row: | 61.8 ft avg |
| Main Body: | 60.4 ft avg |

### - Charge Weight -

|                  |                |
|------------------|----------------|
| Front Row:       | 180.1 kg/hole  |
| Main Body:       | 176.1 kg/hole  |
| Max. per delay:  | 307.0 kg/delay |
| SD () Equation:  | 178.7 kg/delay |
| Total kg Loaded: | 13,132 kg      |

Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

|            |                           |
|------------|---------------------------|
| Yield PF:  | 0.413 kg/te (actual)      |
| Front row: | 0.266 kg/te (theoretical) |
| Main Body: | 0.347 kg/te (theoretical) |
| "KPI" PF:  | 0.320 kg/te (theoretical) |

1.846 lb/yd<sup>3</sup>  
1.189 lb/yd<sup>3</sup>  
1.549 lb/yd<sup>3</sup>  
1.429 lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### Cost Reduction Notes (this Blast) - change in Bit , B , S , Expl or IS from previous Blast:

3 Helpers requested due to the amount of voids located on drill log and stone decking require Holes A3,A7,B5,B8,C8,C12 All measured short in depth by an average of 12'.

Bill White from Nelson Burlington said we have to blast it, the drill wont be back until Sept.4, 2

3 Siesmographs supplied and set-up



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-08-30

Blast Number: 18-014  
Orica Order #: 2380811  
Blast Time: 11:55 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40374       | 79.88277        | 0.757538    | 1.394217    |
| Front Row Corner          | 43.40351       | 79.88279        | 0.757534    | 1.394218    |
| Back Row Corner           | 43.40392       | 79.88277        | 0.757541    | 1.394217    |
| Average (Centre of Blast) | 43.40372       | 79.88278        | 0.757538    | 1.394217    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 401.0                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 3.7                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 12.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 113.3 | dB              | Trigger set at: 115 | dB                                     |
| 2450 2nd Line                             |                         |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 943.9                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |
| Colling Rd & Blind Line Bruce Trail       |                           |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.         | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339               | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                        |                 |                     |                                        |
| Average                                   | 43.39339               | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1249.2                 | m               |                     |                                        |
| Post Blast Data:                          | ppV: 2.0               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 2.5         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 93.2 | dB              | Trigger set at: 115 | dB                                     |
| SouthWest Corner of Property              |                        |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.

The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(401)^2}{30^2} \text{ kg}$$

$$= \frac{160,801}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

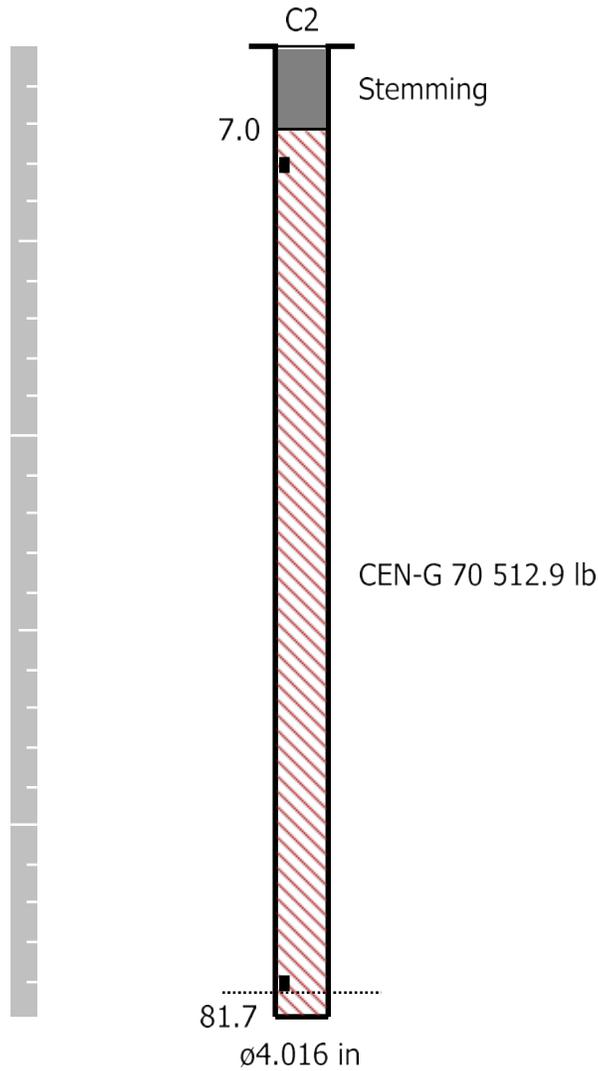
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 8/30/2018

Blast Number: 18-014  
Orica Order #: 2380811

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

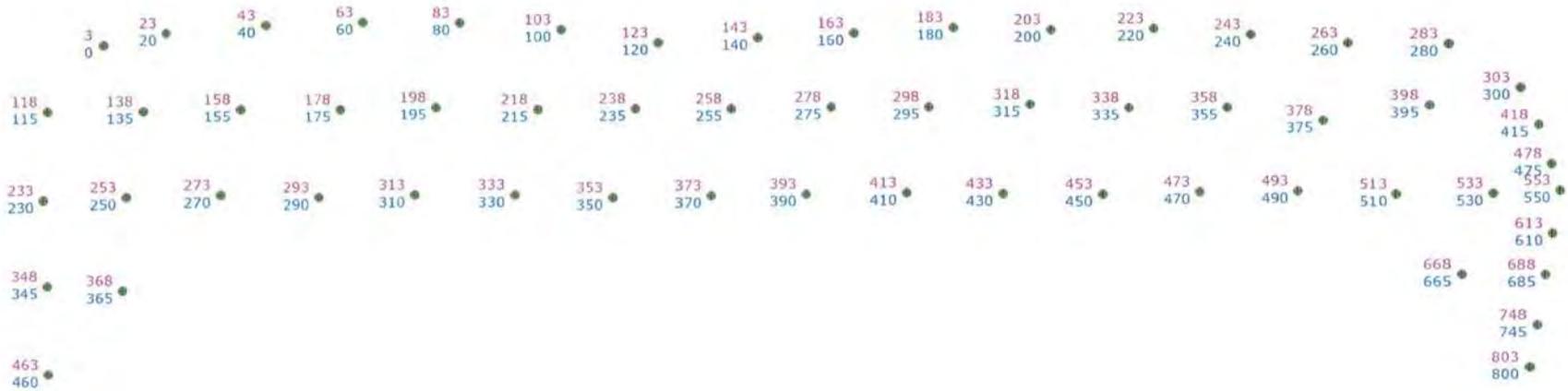
*Bill White*

Signature required, indicating sign off on Blast Design.

### SHOTPlus 5 Plan

#### Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.2ft           | Spacing: 10.2ft      | Subdrill: 2.0ft     | Stemming: 6.9ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 58 | Hole angle: 0.0° |
| Total drilled: 4476.5ft |                      |                     |                  |



Not to scale

|                                |                                          |           |
|--------------------------------|------------------------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                                          | 8/16/2018 |
| Mine                           | Burlington                               |           |
| Location                       | UPPER MIDDLE                             |           |
| Title/author                   | Design 18-013 UPPER MIDDLE Partial Final |           |
| Filename                       | Design_18-014_UPPER_MIDDLE_Final.spf     |           |

SHOTPlus 5 Plan

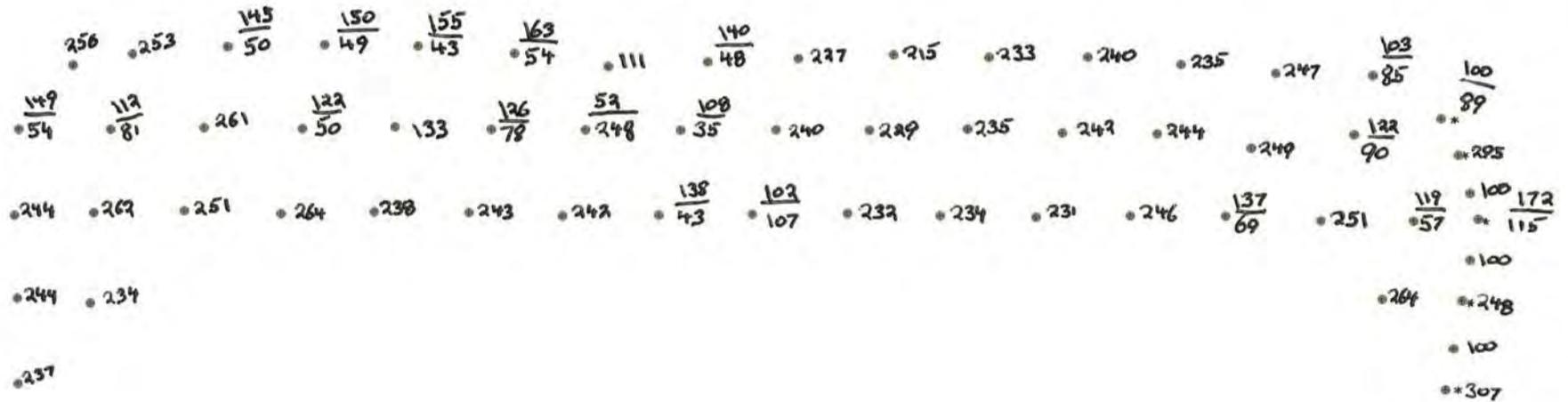
Blast Summary Data

Burden: 9.2ft      Spacing: 10.2ft      Subdrill: 2.0ft      Stemming: 6.9ft  
 1st row burden: 12.1ft      Hole Diameter: 4.0in      Number of holes: 58      Hole angle: 0.0°  
 Total drilled: 4476.5ft

# Load Sheet

## 4" 270kg Max

## 5" 350Kg Max



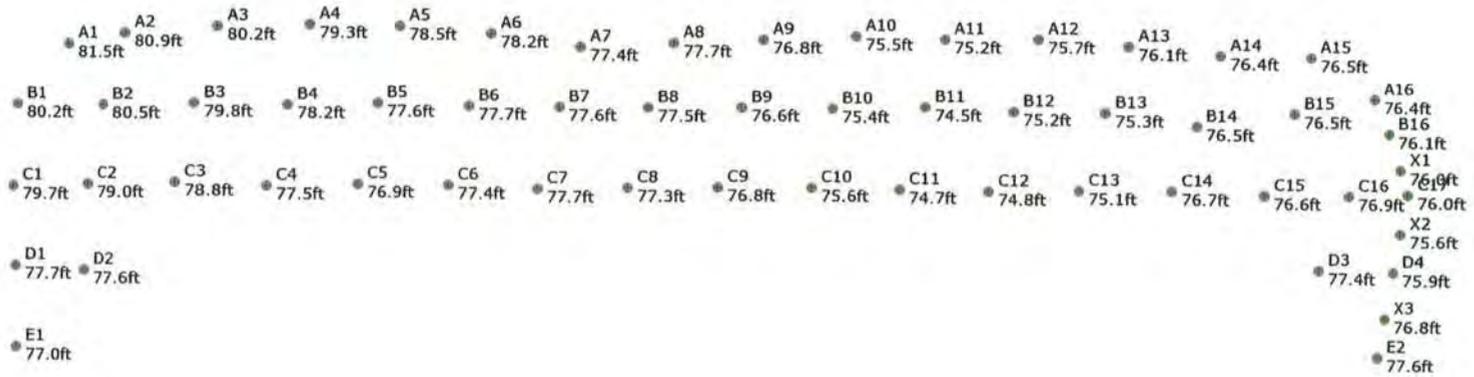
Not to scale

|                                |                                          |
|--------------------------------|------------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 8/29/2018                                |
| Mine                           | Burlington                               |
| Location                       | UPPER MIDDLE                             |
| Title/author                   | Design 18-013 UPPER MIDDLE Partial Final |
| Filename                       | 2018-08-00 18-014 Upper Middle.spf       |

# SHOTPlus 5 Plan

## Blast Summary Data

Burden: 9.2ft      Spacing: 10.2ft      Subdrill: 2.0ft      Stemming: 6.9ft  
 1st row burden: 12.1ft      Hole Diameter: 4.0in      Number of holes: 58      Hole angle: 0.0°  
 Total drilled: 4476.5ft



Not to scale

|                                |                                          |
|--------------------------------|------------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 8/29/2018                                |
| Mine                           | Burlington                               |
| Location                       | UPPER MIDDLE                             |
| Title/author                   | Design 18-013 UPPER MIDDLE Partial Final |
| Filename                       | 2018-08-00 18-014 Upper Middle.spf       |

1090563

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissance



CONSIGNOR  
EXPÉDITEUR

GRAND VALLEY  
033411 SIDE ROAD 21-22  
GRAND VALLEY ON  
CA L9W 7G1

CONSIGNEE  
CONSIGNATAIRE

NELSON AGGREGATE COMPANY  
BURLINGTON ON  
CA L7R 4L8

|                                           |                                               |
|-------------------------------------------|-----------------------------------------------|
| GROSS / BRUT                              |                                               |
| TARE                                      |                                               |
| NET                                       |                                               |
| TIME IN<br>HEURE D'ENTRÉE<br>6:45 AM      | TIME OUT<br>HEURE SORTIE<br>12:30 PM          |
| ORDER NUMBER<br>N° DE COMMANDE<br>2380811 | B/L NUMBER<br>N° DE CONNAISSEMENT<br>86120203 |

PAGE 2

|                                              |                                                                   |                                                                        |                                                           |
|----------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE<br>30 Aug 2018 | TIME REQUIRED<br>HEURE REQUISE<br>00:00:00                        | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR<br>NELSON AGGREGATE COMPANY | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT<br>n/a |
| DATE SHIPPED<br>EXPÉDIÉ LE<br>30 Aug 2018    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON<br>FOB Dest'n, Own Truck | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR<br>F-73289                        | VEHICLE NO.<br>N° DE VÉHICULE<br>PT 15013                 |
| SHIP VIA<br>TRANSPORTEUR<br>Orica Truck      |                                                                   | ROUTING<br>ITINÉRAIRE<br>STANDARD                                      | MAG. LIC. NO.<br>N° DE PERMIS                             |

| QTY.<br>QTÉ.                                                                                                                                   | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                           | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|------------------------|---------------------------------------|--------------------|-------------------|
| 245                                                                                                                                            | PC | X        | 91                      | 154                    | PENTEX BC 340 (49/CS)                 | 5                  | 89.425            |
| 2                                                                                                                                              | PC |          | 1                       | 1                      | Harness Wire Duplex (6 pack) 400m     | 1                  | 5.840             |
| 80                                                                                                                                             | PC | X        | 30                      | 50                     | *uni tronic 600-06.0M CU/ZC(20')80PC  | 1                  | 5.840             |
| 60                                                                                                                                             | PC | X        | 56                      | 4                      | *uni tronic 600-09.0M CU/ZC(30')60PC  | 1                  | 5.880             |
| 66                                                                                                                                             | PC | X        | 44                      | 22                     | *uni tronic 600-20M CU/ZC SPL(65')66P | 1                  | 13.464            |
| 54                                                                                                                                             | PC | X        | 48                      | 6                      | *uni tronic 600-25M CU/ZC SPL(80')54P | 1                  | 13.176            |
| 72                                                                                                                                             | PC | X        | 0                       | 72                     | *uni tronic 600-30M C/Z SPL(100')36P  | 2                  | 21.168            |
| 100                                                                                                                                            | PC |          | 90                      | 10                     | MINI STEM PLUGS - PART #74853         |                    | 0.700             |
| 1                                                                                                                                              | PC |          |                         |                        | LICENSED BLASTER                      |                    |                   |
| 1.0                                                                                                                                            | HR |          |                         |                        | LABOUR CHARGE                         |                    |                   |
| 1                                                                                                                                              | PC |          |                         |                        | ROG (ROCK ON GROUND)                  |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                             |    |          |                         |                        |                                       |                    | 155.493 KG        |
| **** TOTAL PACKAGES ****                                                                                                                       |    |          |                         |                        |                                       | 12                 |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                        |                                       |                    |                   |

24-HOUR NUMBER: 1-613-996-6666

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                               |                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| PALLETS USED / PALETTES UTILISÉES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PALLETS RETURNED / PALETTES RETOURNÉES                                                        | BAGS USED / SACS UTILISÉS                                         |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br>ERAP 2-1510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EMERGENCY RESPONSE NO.24 HOUR NUMBER<br>TELEPHONE D'URGENCE/24 HEURE NUMERO<br>1-877-561-3636 | PLACARDS OFFERED / PLACARDS OFFERT<br>YES / OUI NO / NON          |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÈGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                                                               | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE<br>\$               |
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                               | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY              |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>Ryan Benjamin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                               | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>Ryan Benjamin |
| SIGNATURE<br>[Signature]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               | DATE<br>30 08 18                                                  |
| DATE<br>30 08 18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                               | SIGNATURE<br>[Signature]                                          |
| DATE<br>D/J M/M Y/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                               | DATE<br>D/J M/M Y/A                                               |

|                                                                                                                                                                                                                                                   |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSEMENT D'ORICA:<br>Orica Canada Inc.<br>301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5 |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Date/Time** Tran at 12:17:50 August 30, 2018  
**Trigger Source** Geo: 1.500 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.758 sec (Auto=4Sec) at 2048 sps  
**Operator/Setup:** Operator/Nelson Agg.mmb

**Serial Number** UM6859 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** December 22, 2017 by Instantel  
**File Name** UM6859\_20180830121750.IDFW

**Notes**

**Location:** SouthWest Corner Of Property  
**Client:** Nelson Aggregates  
**User Name:** Orica Canada  
**General:** Burlington

**Extended Notes**

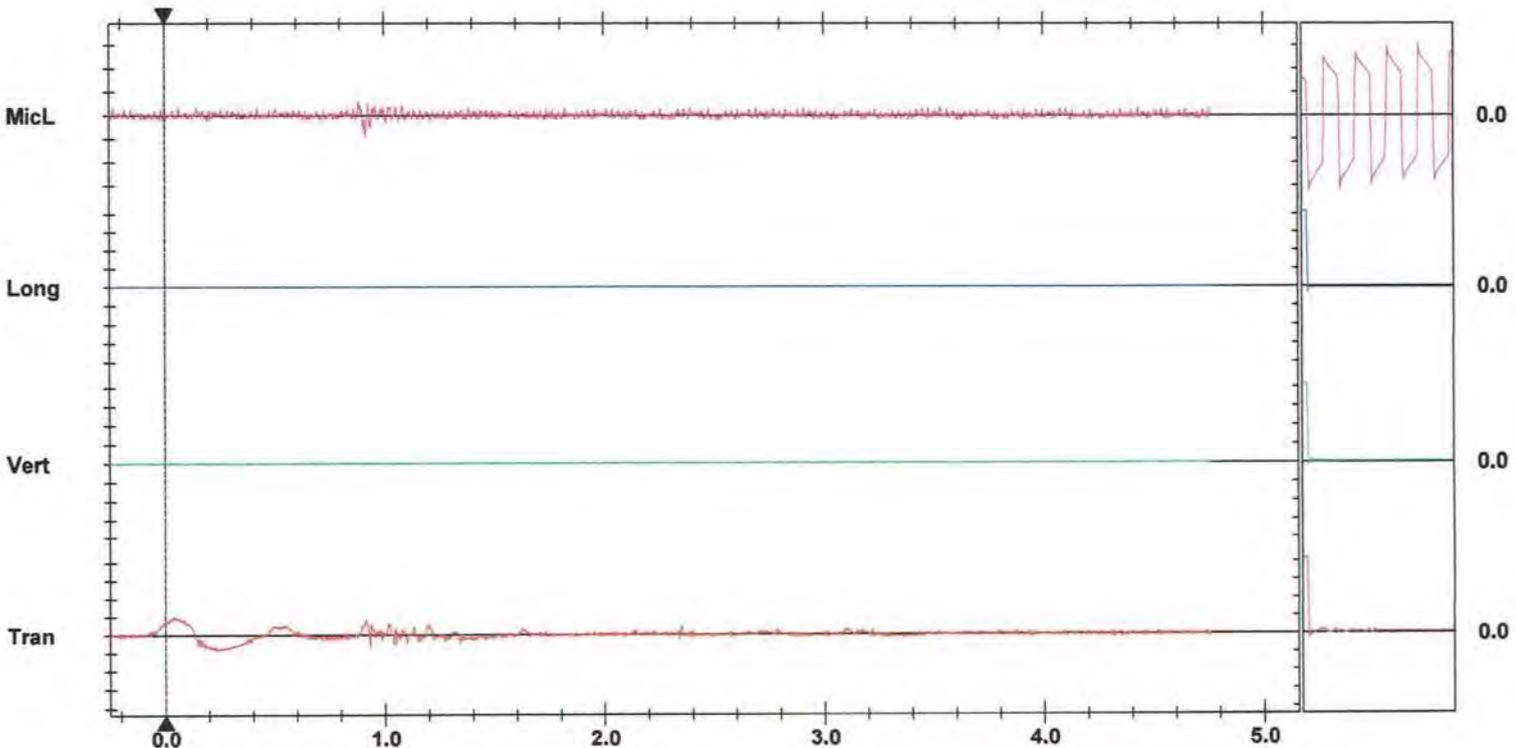
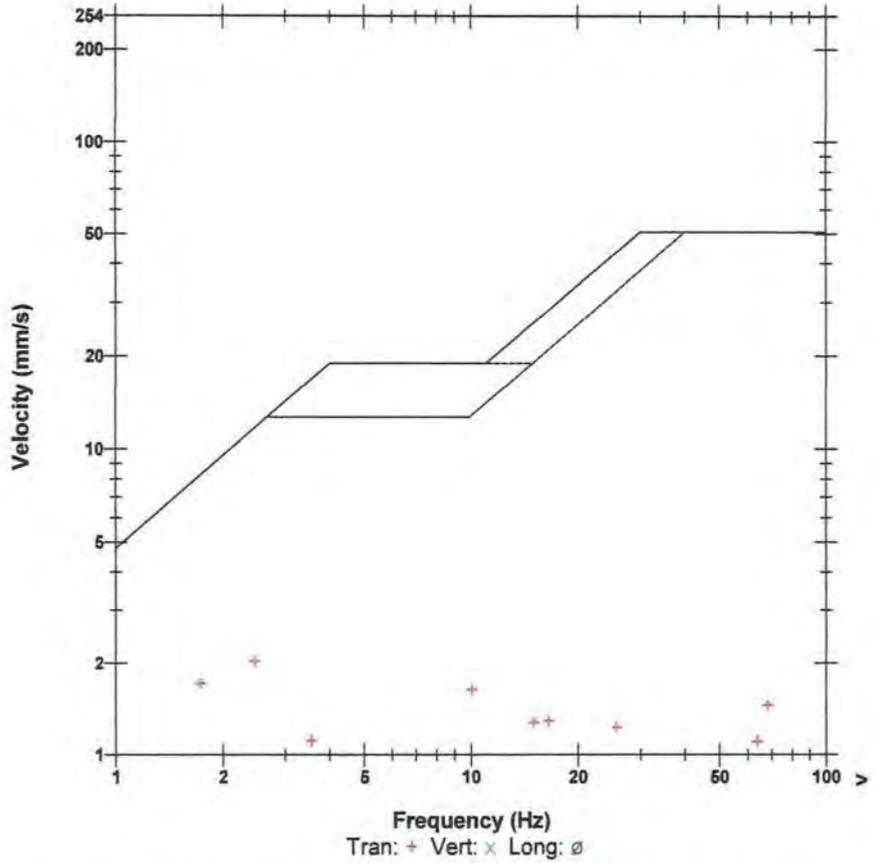
Sand Bagged  
 43.39339-79.88880

**Microphone** Linear Weighting  
**PSPL** 93.2 dB(L) at 0.916 sec  
**ZC Freq** 22 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1334 mv )

|                     | Tran  | Vert   | Long   |      |
|---------------------|-------|--------|--------|------|
| PPV                 | 2.041 | 0.110  | 0.055  | mm/s |
| ZC Freq             | 2.5   | 68     | >200   | Hz   |
| Time (Rel. to Trig) | 0.044 | 0.822  | 4.283  | sec  |
| Peak Acceleration   | 0.142 | 0.012  | 0.008  | g    |
| Peak Displacement   | 0.152 | 0.000  | 0.000  | mm   |
| Sensor Check        | Check | Check  | Check  |      |
| Frequency           | 20.9  | 1024.0 | 1024.0 | Hz   |
| Overswing Ratio     | 1.2   | 0.0    | 0.0    |      |

Peak Vector Sum 2.041 mm/s at 0.044 sec

**USBM RI8507 And OSMRE**



Time Scale: 0.20 sec/div Amplitude Scale: Geo: 2.000 mm/s/div Mic: 1.000 pa.(L)/div  
 Trigger =

Sensor Check

**Date/Time** Tran at 11:55:00 August 30, 2018  
**Trigger Source** Geo: 1.500 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.25 sec (Auto=3Sec) at 1024 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.1 Volts  
**Unit Calibration** November 3, 2017 by InstanTel  
**File Name** \_\_TEMP.EVT  
**Scaled Distance** 5850.2 (1850.0 m, 0.1 kg)

**Notes**

**Location:** 2450 2nd Line  
**Client:** Nelson Aggregate  
**User Name:** Orica Canada  
**General:** Burlington

**Extended Notes**

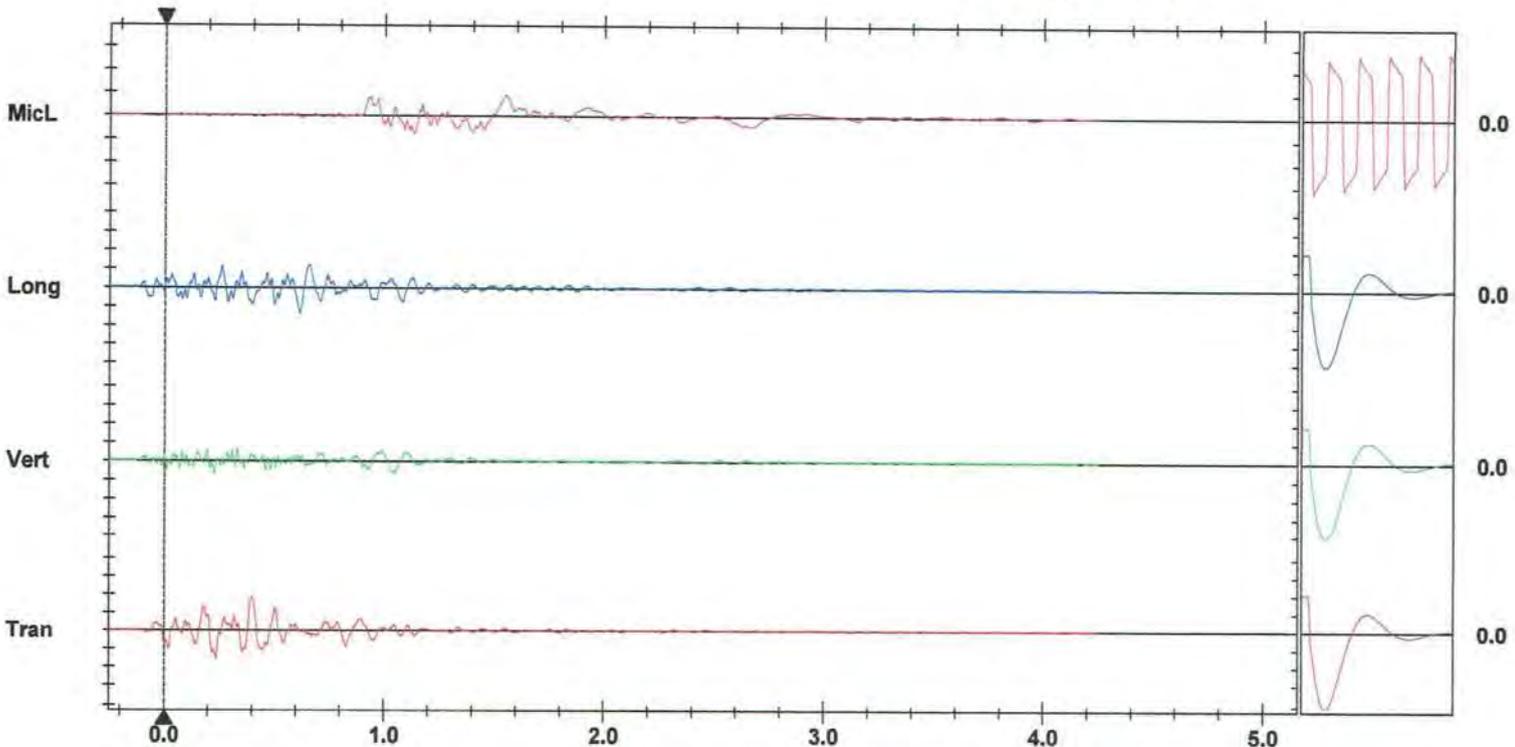
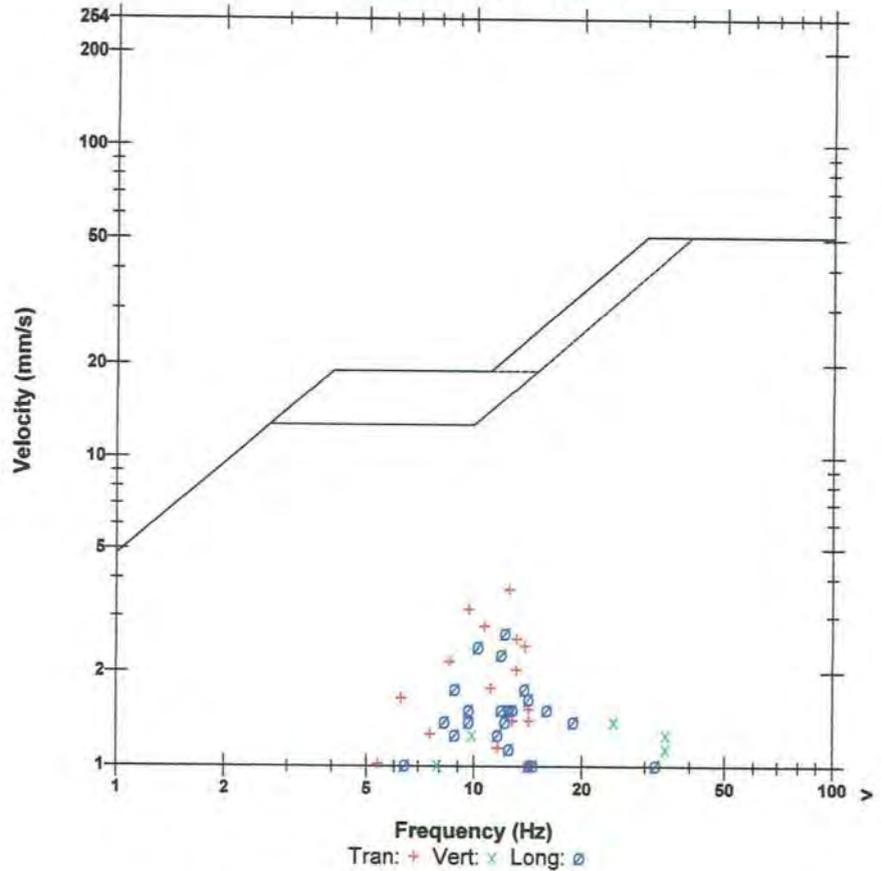
Sand Bagged  
 43.40245-79.87814

**Microphone** Linear Weighting  
**PSPL** 113.3 dB(L) at 1.545 sec  
**ZC Freq** 3.0 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 558 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 3.683  | 1.397  | 2.667  | mm/s |
| ZC Freq             | 12     | 24     | 12     | Hz   |
| Time (Rel. to Trig) | 0.395  | 0.229  | 0.614  | sec  |
| Peak Acceleration   | 0.053  | 0.040  | 0.040  | g    |
| Peak Displacement   | 0.050  | 0.022  | 0.037  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.4    | 7.3    | Hz   |
| Overswing Ratio     | 3.8    | 3.6    | 4.0    |      |

Peak Vector Sum 4.139 mm/s at 0.396 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.2ft

Spacing: 10.2ft

Subdrill: 2.0ft

Stemming: 6.9ft

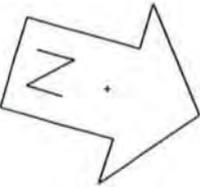
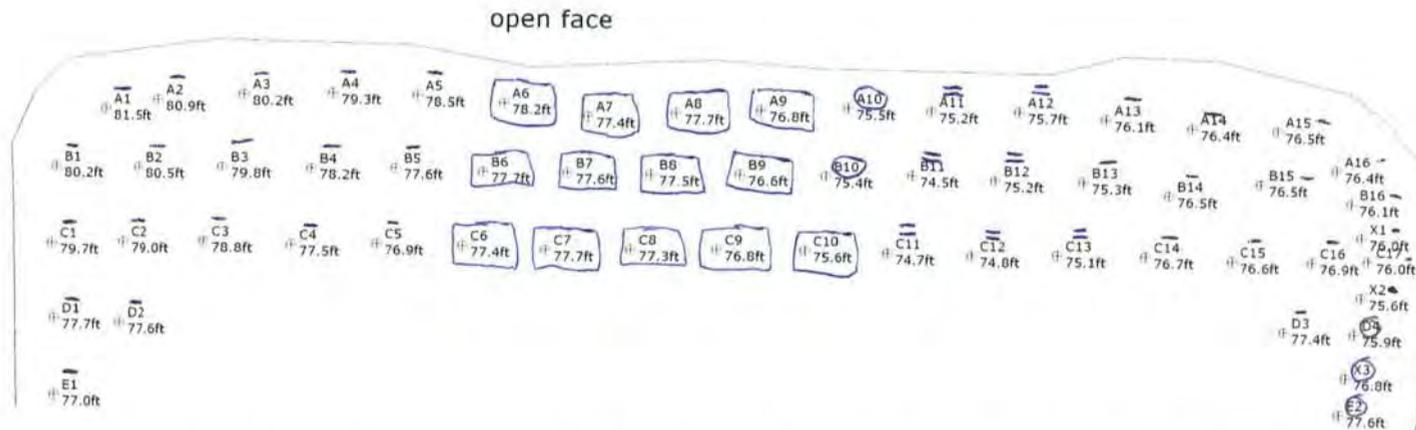
1st row burden: 12.1ft

Hole Diameter: 4.0in

Number of holes: 58

Hole angle: 0.0°

Total drilled: 4476.5ft



- 5" HOLES IN GREEN
- A16
  - B16
  - C17
  - D4
  - E2
  - X1 X2 X3

Design 18-013 UPPER MIDDLE Final- 4" Blast Hole 12x10 9x10 274 and 250 + .6 SUB ELEV



Scale 1:275

|                  |                                          |
|------------------|------------------------------------------|
| SHOTPlus 5.7.0.8 | 8/7/2018                                 |
| Mine             | Burlington                               |
| Location         | UPPER MIDDLE                             |
| Title/author     | Design 18-013 UPPER MIDDLE Partial Final |
| Filename         | Design 18-013 UPPER MIDDLE Partial.spf   |



# Blast Design

## Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Design Date: 2018-08-30

Blast Number: 18-014  
 Orica Order #:

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Pitize)  
 GPS Coordinates: 43.40372 °N Latitude 79.88278 °W Longitude  
Centre of Blast Centre of Blast

Design te Blasted: 31,778 te  
 Total Holes Loaded: 58 holes  
 ... including: Dead Holes  
 ... and: 3 Helper Holes  
 Helper Hole Collar: ft avg  
 # Rows Blasted: 3 rows

- Drilling Information -

|                     |                     |    |                       |                             |
|---------------------|---------------------|----|-----------------------|-----------------------------|
|                     | Angle from Vertical |    | Nominal Bit Diameter: |                             |
| Primary Bit diam:   | 101.6 mm            | 0° | # Holes:              | 50 = 3,859.1 ft ( 4 " diam) |
| Secondary Bit diam: | 127.0 mm            | 0° | # Holes:              | 8 = 617.4 ft ( 5 " diam)    |
| Tertiary Bit diam:  | mm                  | 0° | # Holes:              | = 0.0 ft ( " diam)          |

- Design Pattern (Front Row) -

Burden: 12.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 24 front row

- Design Pattern (Main Body) -

Burden: 9.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 34 main body  
 Bench Height: 75.2 ft avg  
 Sub-drill: 2.0 ft avg  
 Hole Depth: 77.2 ft avg

- Design Stone Decking -

Front Row: 5.0 ft avg  
 Main Body: ft avg

- Design Collar Stemming -

Front Row: 7.0 ft avg  
 Main Body: 7.0 ft avg

Material used: .75" Stone

- Design Charge Length -

Front Row: 65.2 ft avg  
 Main Body: 70.2 ft avg

- Design Charge Weight -

Front Row: 190.1 kg/hole  
 Main Body: 204.6 kg/hole  
 Max Chge Wt / delay: 240.0 kg/delay

Required kg Loaded: 13,539 kg  
 Rock Density: 2.65 g/cc = te/m<sup>3</sup>

- Design Powder Factor -

Expected Yield PF: 0.426 kg/te (actual)  
 Front row: 0.281 kg/te (theoretical)  
 Main Body: 0.403 kg/te (theoretical)  
 "KPI" PF: 0.362 kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast.

3 Helpers

**Bulk Expl. Required:** kg  
 CENTRA GOLD 70 13,500

**Pkgd Expl. Required:** kg

**Boosters Required:** kg/u # used kg  
 PENTEX 12 (OR EQUIVALENT) 0.34 116 39.4

total explosives weight in Blast (kg): 13,539  
 Pkgd Prod (0 kg) % of Total kg: 0.0%

**Detonators Required:** ms # req'd  
 UNITRONIC 600 6M 58  
 UNITRONIC 600 15M  
 UNITRONIC 600 30M 58

**Cord & Access. Req'd:** U of M # req'd  
 WIRE DUPLEX (6 PACK) 400M units 1

Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 3 |
| # of MMU's (this Blast)         |                | 1 |

**Services Req'd:**

|                        |                              |     |
|------------------------|------------------------------|-----|
| GPS LAYOUT             | Enter hours                  | 0.0 |
| BULK TRUCK CHARGE      | <2,000kg                     |     |
| BLASTER HOURS          | Enter Blaster hours          | 0.0 |
| HELPER HOURS           | Enter total Helper man-hours | 0.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0   |
| 3D LASER PROFILE       | Enter hours                  | 0   |
| BORETRACK              | Enter hours                  | 0   |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0 |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-09-10

Blast Number: 18-015

Orica Order #: 2384839

Blast Time: 11:49 AM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Floor (Bench / Face)

GPS Coordinates: 43.40084 °N Latitude 79.88808 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: E at 15 kph Temperature: 11 to 15 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 1,324 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 204 = 2,244.0 ft ( 4 " diam)  
Secondary Bit diam: mm Angle from Vertical: 0° # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm Angle from Vertical: 0° # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 31,670  | 29,370   | 2,300 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 235    | 79.9 |

total explosives weight in Blast (kg): 2,380

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                  | case #'s | ms     | # used |
|------------------|----------|--------|--------|
| UNITRONIC 600 6M |          |        | 2      |
| EXEL HANDIDET 9m |          | 25/500 | 235    |
| CONNECTADET 9M   |          | 25 ms  | 11 X   |
| CONNECTADET 9M   |          | 42 ms  | 34     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 3 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=2,000kg <5,000kg           | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 16.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

Tonnes Blasted: 22,269 te 8,404 m<sup>3</sup>  
Total tonnes per day: 22,269 te NF-15 Rate Code  
Total Holes Loaded: 204 holes  
... including: Dead Holes  
... and: Helper Holes  
Helper Hole Collar: ft avg  
# Rows Blasted: 9 rows

### - Pattern (Front Row) -

Burden: 11.5 ft avg  
Spacing: 11.5 ft avg  
# Holes: 20 front row

### - Pattern (Main Body) -

Burden: 11.5 ft avg  
Spacing: 11.5 ft avg  
# Holes: 184 main body

Bench Height: 11.0 ft avg

Sub-drill: 0.0 ft avg

Hole Depth: 11.0 ft avg

### - Stone Decking -

Front Row: ft avg  
Main Body: ft avg  
# Decks: per blast

### - Collar Stemming -

Front Row: 7.0 ft avg  
Main Body: 7.0 ft avg  
Material used: .75" Stone

### - Charge Length -

Front Row: 4.0 ft avg  
Main Body: 4.0 ft avg

### - Charge Weight -

Front Row: 11.7 kg/hole  
Main Body: 11.7 kg/hole  
Max. per delay: 30.0 kg/delay  
SD () Equation: 629.5 kg/delay  
Total kg Loaded: 2,380 kg

Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

0.477 lb/yd<sup>3</sup> Yield PF: 0.107 kg/te (actual)  
0.477 lb/yd<sup>3</sup> Front row: 0.107 kg/te (theoretical)  
0.477 lb/yd<sup>3</sup> Main Body: 0.107 kg/te (theoretical)  
0.477 lb/yd<sup>3</sup> "KPI" PF: 0.107 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

3 Helpers needed due to the number of holes and conditions  
31 additional primers were needed because the primary was stuck and would not pull into product.



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-09-10

Blast Number: 18-015  
Orica Order #: 2384839  
Blast Time: 11:49 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40083       | 79.88805        | 0.757487    | 1.394310    |
| Front Row Corner          | 43.40067       | 79.88858        | 0.757485    | 1.394319    |
| Back Row Corner           | 43.40102       | 79.88760        | 0.757491    | 1.394302    |
| Average (Centre of Blast) | 43.40084       | 79.88808        | 0.757487    | 1.394310    |

| 1st Seismograph Co-ordinates                                         | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|----------------------------------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                                                          | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                                                          |                           |                 |                     |                                        |
| Average                                                              | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast)                            | 823.6                     | m               |                     |                                        |
| Post Blast Data:                                                     | ppV: Did                  | mm/s            | Trigger set at: 1.5 | mm/s                                   |
|                                                                      | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                                                      | air overpressure: Trigger | dB              | Trigger set at: 124 | dB                                     |
| 2450 2nd Line (set to 124DB trigger due to continuous truck traffic) |                           |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 752.7                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 7.5          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 118.0 | dB              | Trigger set at: 115 | dB                                     |
| Colling Rd & Blind Line Bruce Trail       |                         |                 |                     |                                        |

| 3rd Seismograph Co-ordinates                                                 | Enter ° N Lat.       | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|------------------------------------------------------------------------------|----------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                                                                  | 43.39339             | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                                                                  |                      |                 |                     |                                        |
| Average                                                                      | 43.39339             | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast)                                    | 831.0                | m               |                     |                                        |
| Post Blast Data:                                                             | ppV: Not             | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                                                              | frequency: Set       | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                                                              | air overpressure: Up | dB              | Trigger set at: 115 | dB                                     |
| SouthWest Corner of Property ( Only require 2 Siesmographs for floor blasts) |                      |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(752.7)^2}{30^2} \text{ kg}$$

$$= \frac{566,557}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



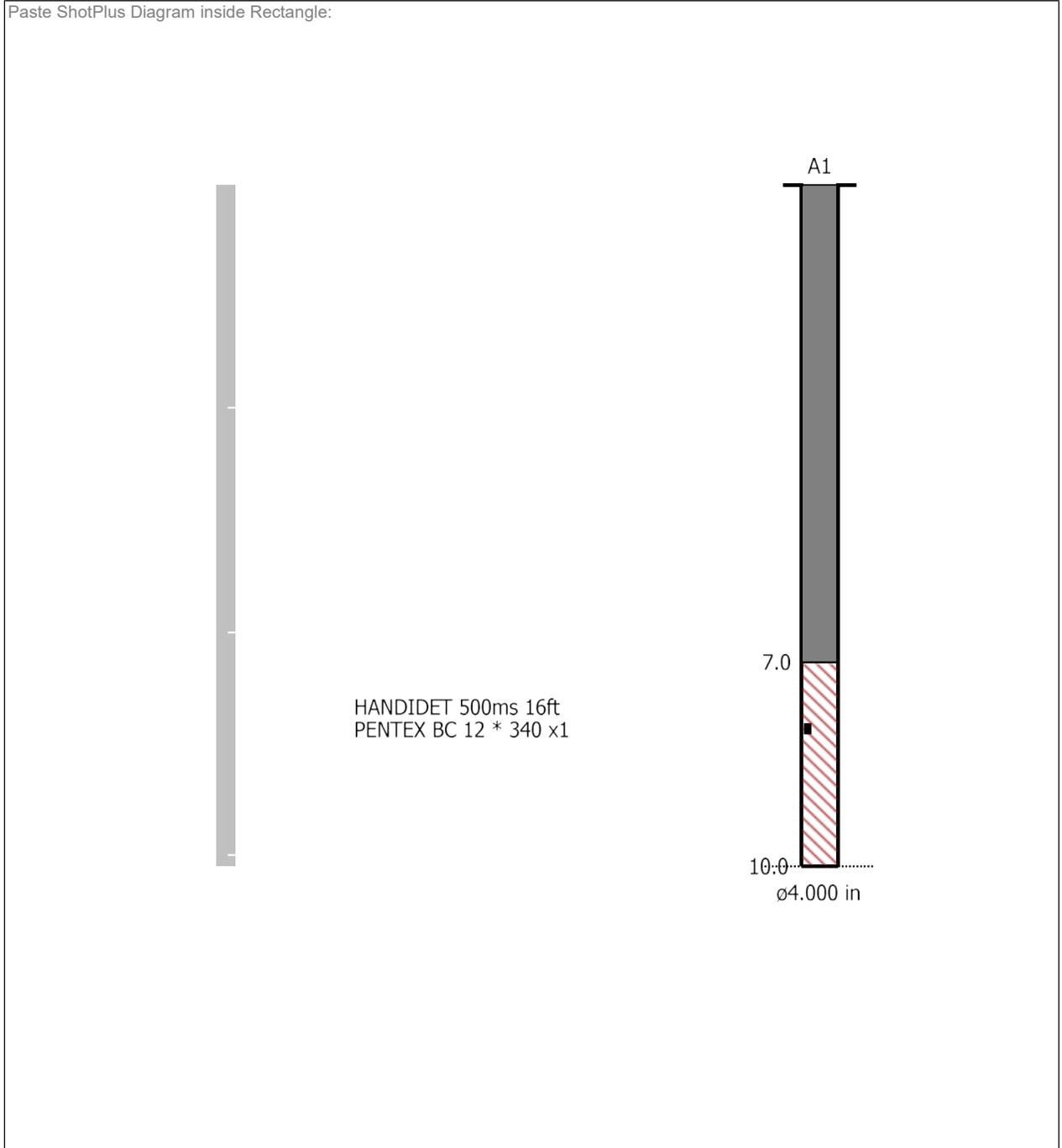
**Blast Design**  
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 9/10/2018

Blast Number: 18-015  
Orica Order #: 2384839

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Bill White*

Signature required, indicating  
sign off on Blast Design.

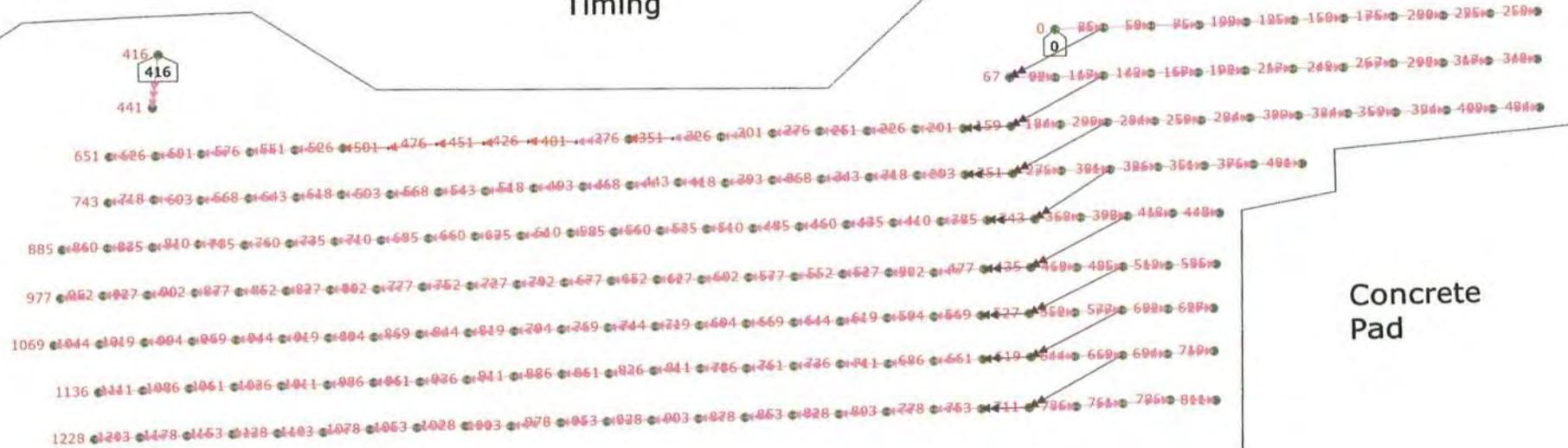
SHOTPlus 5 Plan

Blast Summary Data

Burden: 3.5m      Spacing: 3.5m      Subdrill: 0.0m      Stemming: 2.5m  
 1st row burden: 3.5m      Hole Diameter: 101.6mm      Number of holes: 204      Hole angle: 0.0°  
 Total drilled: 673.2m

-013  
 Floor  
 Previous Blast

Timing



Concrete  
 Pad



Not to scale

|                                |                                  |           |
|--------------------------------|----------------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                                  | 9/10/2018 |
| Mine                           | Burlington                       |           |
| Location                       |                                  |           |
| Title/author                   | 18-013 Floor                     |           |
| Filename                       | 18-015 Floor Final Not timed.spf |           |



**Date/Time** MicL at 11:49:28 September 10, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.03 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/BURLINGTON.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.6 Volts  
**Unit Calibration** February 14, 2018 by InstanTEL  
**File Name** UM6857\_20180910114928.IDFW

**Notes**  
 Location: COLLING RD & BLINDLINE  
 Client: NELSON AGGREGATES  
 User Name: ORICA CANADA  
 General:

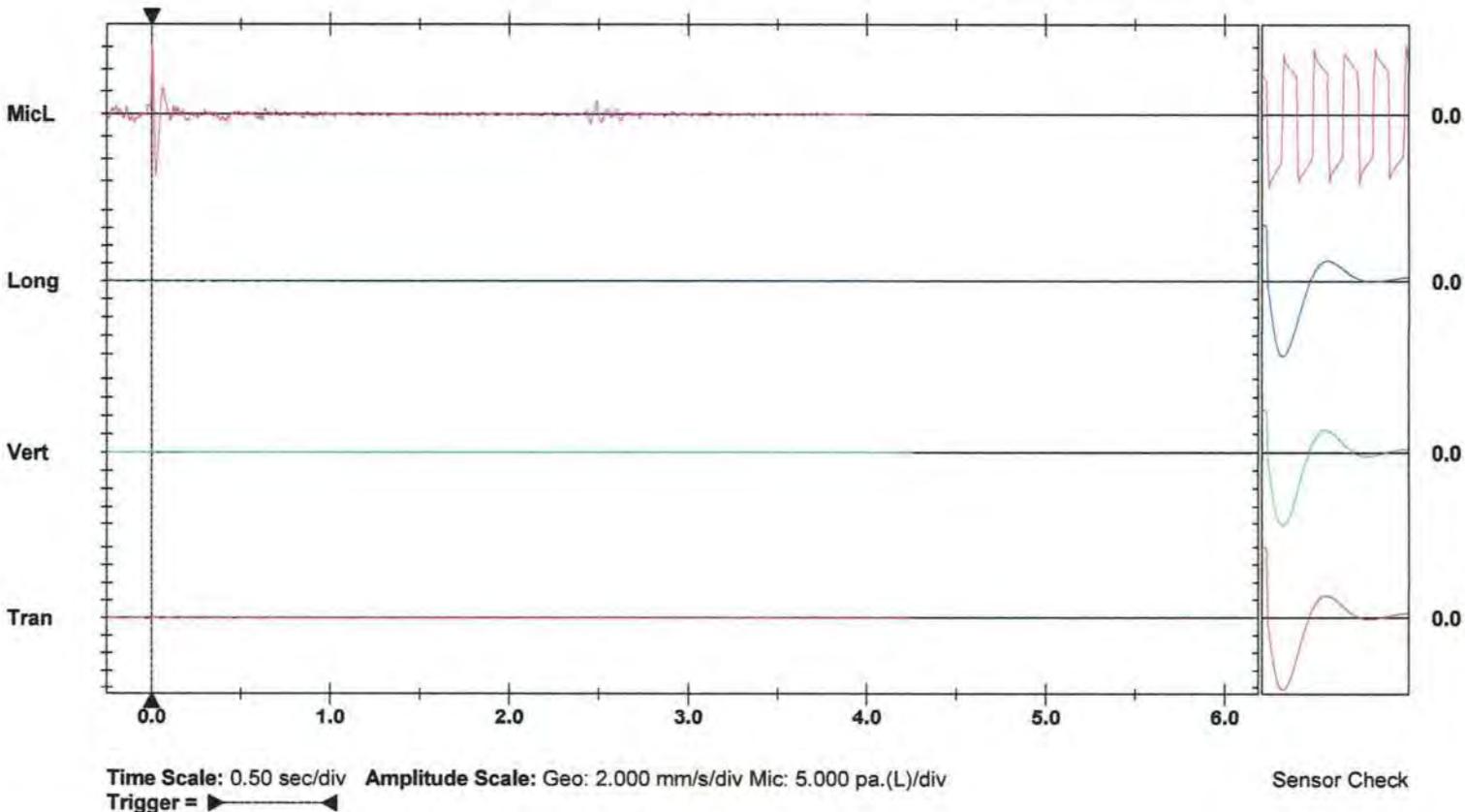
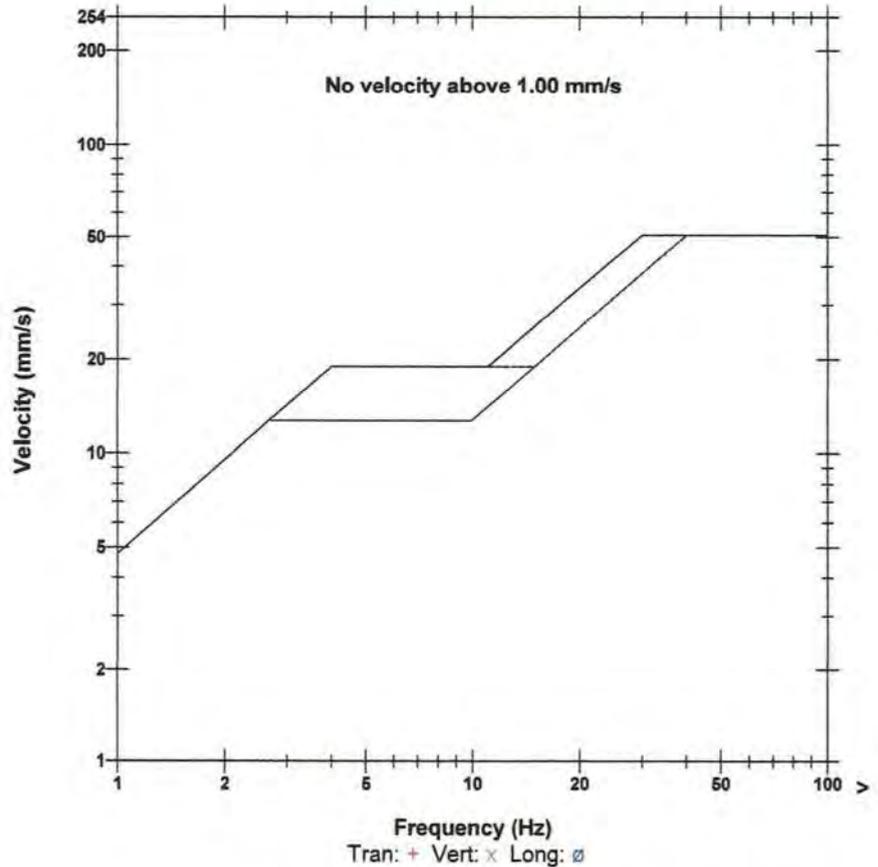
**Extended Notes**  
 N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 118.0 dB(L) at 0.001 sec  
**ZC Freq** 11.1 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 1457 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.110  | 0.110  | 0.110  | mm/s |
| ZC Freq             | 11.6   | 27     | 16.0   | Hz   |
| Time (Rel. to Trig) | -0.020 | 0.049  | 0.026  | sec  |
| Peak Acceleration   | 0.010  | 0.010  | 0.012  | g    |
| Peak Displacement   | 0.001  | 0.001  | 0.010  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.5    | 7.5    | 7.3    | Hz   |
| Overswing Ratio     | 3.3    | 3.4    | 3.6    |      |

**Peak Vector Sum** 0.136 mm/s at 0.049 sec

**USBM RI8507 And OSMRE**



1090658



Bill of Lading / Connaissance

CONSIGNOR  
EXPÉDITEUR  
**Orica Canada Inc.**  
**GRAND VALLEY**  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE  
CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
 BURLINGTON ON  
 CA L7R 4L8

|                                                  |                                                      |
|--------------------------------------------------|------------------------------------------------------|
| GROSS / BRUT                                     |                                                      |
| TARE                                             |                                                      |
| NET                                              |                                                      |
| TIME IN<br>HEURE D'ENTRÉE<br><b>6 45 AM</b>      | TIME OUT<br>HEURE SORTIE                             |
| ORDER NUMBER<br>N° DE COMMANDE<br><b>2384839</b> | B/L NUMBER<br>N° DE CONNAISSEMENT<br><b>86129828</b> |

PAGE 2

| DATE REQUIRED<br>DATE REQUISE<br><b>10 Sep 2018</b> | TIME REQUIRED<br>HEURE REQUISE<br><b>00:00:00</b>                        | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR<br><b>NELSON AGGREGATE COMPANY</b> | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT<br><b>n/a</b> |                        |                                         |                    |                   |
|-----------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------|-----------------------------------------|--------------------|-------------------|
| DATE SHIPPED<br>EXPÉDIE LE<br><b>10 Sep 2018</b>    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON<br><b>FOB Dest'n, Own Truck</b> | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR<br><b>F-73289</b>                        | VEHICLE NO.<br>N° DE VÉHICULE<br><b>AT15013</b>                  |                        |                                         |                    |                   |
| SHIP VIA<br>TRANSPORTEUR<br><b>Orica Truck</b>      |                                                                          | ROUTING<br>ITINÉRAIRE<br><b>STANDARD</b>                                      | MAG. LIC. NO.<br>N° DE PERMIS                                    |                        |                                         |                    |                   |
| QTY.<br>QTÉ.                                        | UM                                                                       | DG<br>MD                                                                      | QTY. RET'D<br>QTÉ. RET.                                          | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                             | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
| <b>NET EXPLOSIVES QUANTITY:</b>                     |                                                                          |                                                                               |                                                                  |                        |                                         | <b>100.426 KG</b>  |                   |
| 294                                                 | PC                                                                       | X                                                                             | 59                                                               | 235                    | PENTEX BC 340 (49/CS)                   | 6                  | 107.310           |
| 12                                                  | PC                                                                       |                                                                               | 0                                                                | 1                      | Harness Wire Duplex (6 pack) 400m       | 1                  | 5.840             |
| 30                                                  | PC                                                                       | X                                                                             | 28                                                               | 2                      | *uni tronic 600-06.0M CU/ZC(20')80PC    | 1                  | 2.190             |
| 100                                                 | PC                                                                       |                                                                               | 100                                                              | 6                      | MINI STEM PLUGS - PART #74853           |                    | 0.700             |
| 325                                                 | PC                                                                       | X                                                                             | 90                                                               | 235                    | EXEL HANDIDET 9M 25/500(30') 65/CS      | 5                  | 32.825            |
| 65                                                  | PC                                                                       | X                                                                             | 59                                                               | 6                      | EXEL Connectadet 9M 25MS (30 FT) 65/CS  | 1                  | 6.305             |
| 65                                                  | PC                                                                       | X                                                                             | 31                                                               | 34                     | EXEL Connectadet 9M 42MS (30 FT) 65/CS  | 1                  | 6.370             |
| 108                                                 | PC                                                                       | X                                                                             | 10                                                               | 4                      | EXEL Connectadet 12M 42MS (40 FT) 50/CS | 1                  | 1.080             |
| 1                                                   | PC                                                                       |                                                                               |                                                                  |                        | LICENSED BLASTER                        |                    |                   |
| 1.0                                                 | HR                                                                       |                                                                               |                                                                  |                        | LABOUR CHARGE                           |                    |                   |
| 1                                                   | PC                                                                       |                                                                               |                                                                  |                        | ROG (ROCK ON GROUND)                    |                    |                   |
| <b>TOTAL GROSS WEIGHT</b>                           |                                                                          |                                                                               |                                                                  |                        |                                         | <b>162.620 KG</b>  |                   |
| <b>**** TOTAL PACKAGES ****</b>                     |                                                                          |                                                                               |                                                                  |                        |                                         | <b>16</b>          |                   |

24-HOUR NUMBER: 1-613-996-6666

PALLETS USED / PALETTES UTILISÉES

PALLETS RETURNED / PALETTES RETOURNÉES

BAGS USED / SACS UTILISÉS

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                       |                                                                                                                       |                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br><b>ERAP 2-1510</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TELEPHONE D'URGENCE/24 HEURE NUMERO<br><b>1-877-561-3636</b> | PLACARDS OFFERED / PLACARDS OFFERT<br><input checked="" type="checkbox"/> YES / OUI <input type="checkbox"/> NO / NON | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>N° DE CONNAISSEMENT ORICA:<br><b>301 rue hotel de ville<br/>Brownsburg-Chatham, QC<br/>J8G 3B5</b> |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SONT MENTIONNÉS DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÈGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                                                                       | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE<br>\$                                                                   | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                                                                                                      |

|                                                                     |                                                                     |                                                             |
|---------------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br><b>GRAND VALLEY</b>                       | CARRIER / TRANSPORTEUR<br><b>Orica Truck</b>                        | CONSIGNEE / DESTINATAIRE<br><b>NELSON AGGREGATE COMPANY</b> |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br><b>K. PLATT</b> | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br><b>K. PLATT</b> | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR            |
| SIGNATURE<br><b>K. Platt</b>                                        | DATE<br><b>10 9 18</b><br>D/J M/M Y/A                               | SIGNATURE<br><b>K. Platt</b>                                |
|                                                                     | DATE<br><b>10 9 18</b><br>D/J M/M Y/A                               | SIGNATURE                                                   |
|                                                                     |                                                                     | DATE<br>D/J M/M Y/A                                         |

**2 SHIPPING ORDER BON D'EXPÉDITION**  
 (AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
 (L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRES AVOIR SIGNÉ LA COPIE ORIGINALE (1) DU CONNAISSEMENT CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
 SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO  
 \*\*\*\* PAGE 2 OF 3 \*\*\*\*  
 D.F.G. S772



SHOTPlus 5 Plan

Blast Summary Data

Burden: 3.5m

Spacing: 3.5m

Subdrill: 0.0m

Stemming: 2.5m

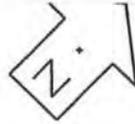
1st row burden: 3.5m

Hole Diameter: 101.6mm

Number of holes: 259

Hole angle: 0.0°

Total drilled: 789.4m

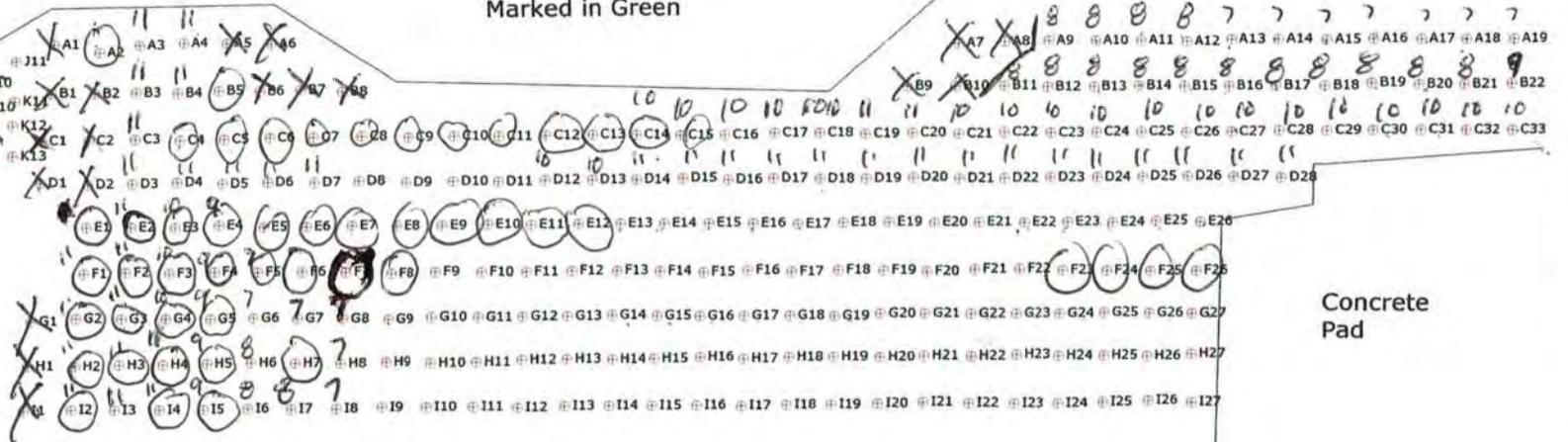


18-013  
Floor  
Previous Blast

Blast 18-015 Floor  
4" Hole  
11.5 X 11.5

3.5" Hole  
9 X 9.5  
Marked in Green

Ramp



Concrete  
Pad

DRILL TO SHALE



Not to scale



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-09-21

Blast Number: 18-018  
Orica Order #: 2390035  
Blast Time: 12:34 PM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Floor (Bench / Face)

GPS Coordinates: 43.40052 °N Latitude 79.88765 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: SW at 15 kph Temperature: 26 to 30 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                 |
|----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm | 0°                  | # Holes: 345 = 3,877.8 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0°                  | # Holes: = 0.0 ft ( " diam)           |
| Tertiary Bit diam: mm      | 0°                  | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 30,490  | 26,640   | 3,850 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg    |
|---------------------------|-----------|--------|-------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 349    | 118.7 |

total explosives weight in Blast (kg): 3,969  
Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                  | case #'s | ms | # used |
|------------------|----------|----|--------|
| UNITRONIC 600 6M |          |    | 349    |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 2      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 3 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=2,000kg <5,000kg           | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 18.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

Tonnes Blasted: 38,483 te 14,522 m3  
Total tonnes per day: 38,483 te NF-14 Rate Code  
Total Holes Loaded: 345 holes  
... including: Dead Holes  
... and: Helper Holes  
Helper Hole Collar: ft avg  
# Rows Blasted: 21 rows

### - Pattern (Front Row) -

Burden: 11.5 ft avg  
Spacing: 11.5 ft avg  
# Holes: 26 front row

### - Pattern (Main Body) -

Burden: 11.5 ft avg  
Spacing: 11.5 ft avg  
# Holes: 319 main body

Bench Height: 11.2 ft avg  
Sub-drill: 0.0 ft avg  
Hole Depth: 11.2 ft avg

### - Stone Decking -

Front Row: ft avg  
Main Body: ft avg  
# Decks: per blast

### - Collar Stemming -

Front Row: 7.0 ft avg  
Main Body: 7.0 ft avg  
Material used: .75" Stone

### - Charge Length -

Front Row: 4.2 ft avg  
Main Body: 4.2 ft avg

### - Charge Weight -

Front Row: 12.4 kg/hole  
Main Body: 12.4 kg/hole  
Max. per delay: 30.0 kg/delay  
SD () Equation: 709.0 kg/delay  
Total kg Loaded: 3,969 kg  
Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.103 kg/te (actual)  
Front row: 0.111 kg/te (theoretical)  
Main Body: 0.111 kg/te (theoretical)  
"KPI" PF: 0.111 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

Cost Reduction Notes (this Blast) - change in Bit , B, S, Expl or IS from previous Blast:

Unitronic detonators were used due to a shortage of non-electronic detonators.

The rate code will show use of non-electronic detonators, therefore no additional cost will be incurred by the customer

4 holes received a secondary primers because the bottom primer was stuck additional helper due to number of hole and difficulty of blast



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-09-21

Blast Number: 18-018  
Orica Order #: 2390035  
Blast Time: 12:34 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40053       | 79.88773        | 0.757482    | 1.394304    |
| Front Row Corner          | 43.40099       | 79.88756        | 0.757490    | 1.394301    |
| Back Row Corner           | 43.40004       | 79.88767        | 0.757474    | 1.394303    |
| Average (Centre of Blast) | 43.40052       | 79.88765        | 0.757482    | 1.394303    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 798.8                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 1.5 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 124 | dB                                     |
| 2450 2nd Line                             |                           |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 801.6                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |
| Colling Rd & Blind Line Bruce Trail       |                           |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.           | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|--------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                 | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                          |                 |                     |                                        |
| Average                                   | 43.39339                 | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 799.3                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                 | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not           | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Set-up | dB              | Trigger set at: 115 | dB                                     |
| SouthWest Corner of Property              |                          |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.

The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(798.8)^2}{30^2} \text{ kg}$$

$$= \frac{638,081}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



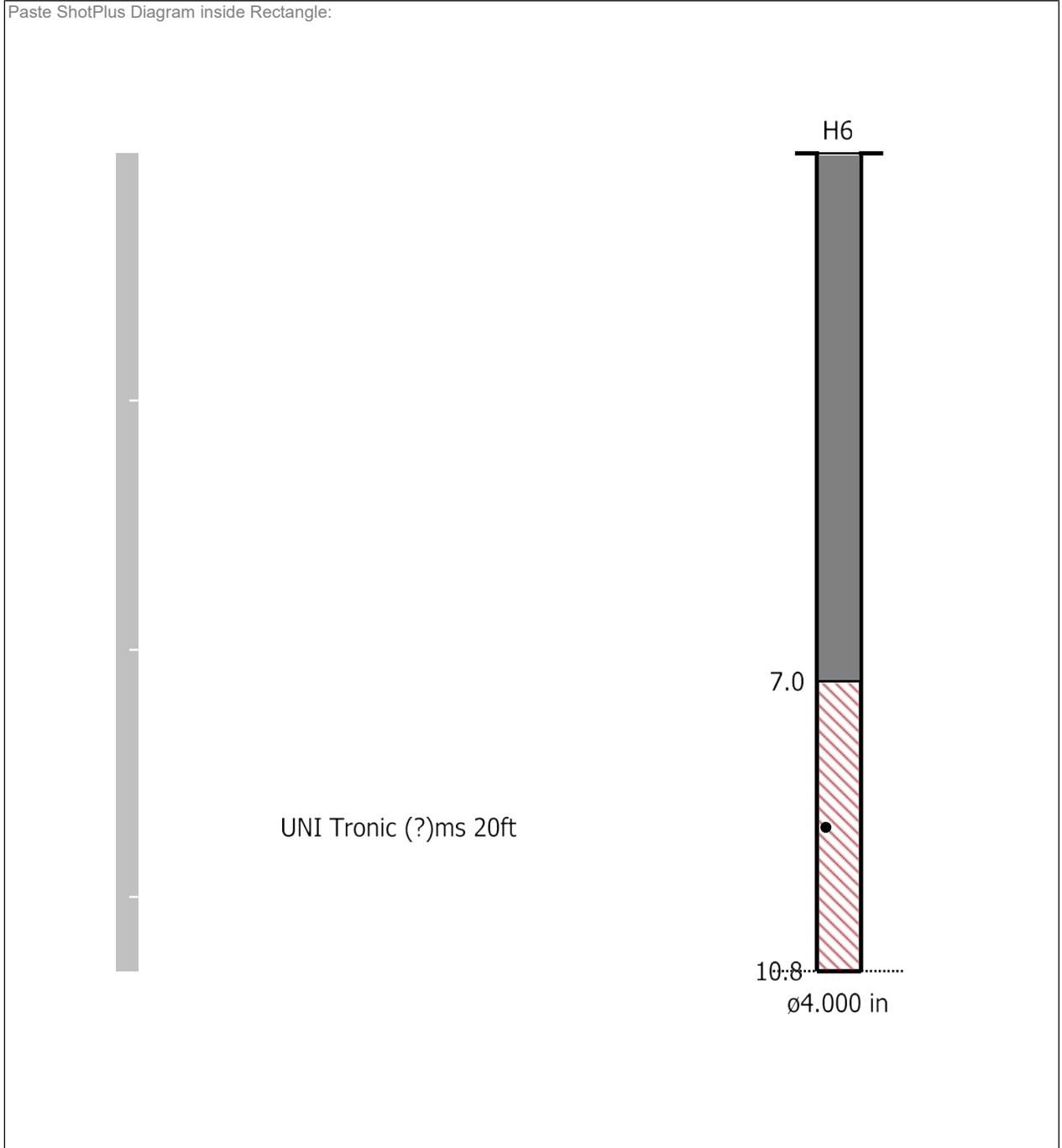
**Blast Design**  
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 9/21/2018

Blast Number: 18-018  
Orica Order #: 2390035

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Bill White*

Signature required, indicating  
sign off on Blast Design.

240 \* 220 \* 200 \* 180 \* 160 \* 140 \* 120 \* 100 \* 80 \* 60 \* 40 \* 20 \* 0 \* 29 \* 49 \* 69 \* 89 \* 109 \* 129 \* 149 \* 169 \* 189 \* 209 \* 229 \* 249 \* 269 \*  
 355 \* 335 \* 315 \* 295 \* 275 \* 255 \* 235 \* 215 \* 195 \* 175 \* 155 \* 135 \* 115 \* 144 \* 164 \* 184 \* 204 \* 224 \* 244 \* 264 \* 284 \* 304 \* 324 \* 344 \* 364 \* 384 \*  
 470 \* 450 \* 430 \* 410 \* 390 \* 370 \* 350 \* 330 \* 310 \* 290 \* 270 \* 250 \* 230 \* 259 \* 279 \* 299 \* 319 \* 339 \* 359 \* 379 \* 399 \* 419 \* 439 \* 459 \* 479 \* 499 \*  
 585 \* 565 \* 545 \* 525 \* 505 \* 485 \* 465 \* 445 \* 425 \* 405 \* 385 \* 365 \* 345 \* 374 \* 394 \* 414 \* 434 \* 454 \* 474 \* 494 \* 514 \* 534 \* 554 \* 574 \* 594 \* 614 \*  
 700 \* 680 \* 660 \* 640 \* 620 \* 600 \* 580 \* 560 \* 540 \* 520 \* 500 \* 480 \* 460 \* 489 \* 509 \* 529 \* 549 \* 569 \* 589 \* 609 \* 629 \* 649 \* 669 \* 689 \* 709 \* 729 \*  
 795 \* 775 \* 755 \* 735 \* 715 \* 695 \* 675 \* 655 \* 635 \* 615 \* 595 \* 575 \* 604 \* 624 \* 644 \* 664 \* 684 \* 704 \* 724 \* 744 \* 764 \* 784 \* 804 \* 824 \* 844 \*  
 910 \* 890 \* 870 \* 850 \* 830 \* 810 \* 790 \* 770 \* 750 \* 730 \* 710 \* 690 \* 719 \* 739 \* 759 \* 779 \* 799 \* 819 \* 839 \* 859 \* 879 \* 899 \* 919 \* 939 \* 959 \*  
 1025 \* 1005 \* 985 \* 965 \* 945 \* 925 \* 905 \* 885 \* 865 \* 845 \* 825 \* 805 \* 834 \* 854 \* 874 \* 894 \* 914 \* 934 \* 954 \* 974 \* 994 \* 1014 \* 1034 \* 1054 \* 1074 \*  
 1140 \* 1120 \* 1100 \* 1080 \* 1060 \* 1040 \* 1020 \* 1000 \* 980 \* 960 \* 940 \* 920 \* 949 \* 969 \* 989 \* 1009 \* 1029 \* 1049 \* 1069 \* 1089 \* 1109 \*  
 1255 \* 1235 \* 1215 \* 1195 \* 1175 \* 1155 \* 1135 \* 1115 \* 1095 \* 1075 \* 1055 \* 1035 \* 1064 \* 1084 \* 1104 \* 1124 \* 1144 \* 1164 \* 1184 \* 1204 \*  
 1350 \* 1330 \* 1310 \* 1290 \* 1270 \* 1250 \* 1230 \* 1210 \* 1190 \* 1170 \* 1150 \* 1179 \* 1199 \* 1219 \* 1239 \* 1259 \* 1279 \* 1299 \*  
 1465 \* 1445 \* 1425 \* 1405 \* 1385 \* 1365 \* 1345 \* 1325 \* 1305 \* 1285 \* 1265 \* 1294 \* 1314 \* 1334 \* 1354 \* 1374 \* 1394 \*  
 1580 \* 1560 \* 1540 \* 1520 \* 1500 \* 1480 \* 1460 \* 1440 \* 1420 \* 1400 \* 1380 \* 1409 \* 1429 \* 1449 \* 1469 \*  
 1695 \* 1675 \* 1655 \* 1635 \* 1615 \* 1595 \* 1575 \* 1555 \* 1535 \* 1515 \* 1495 \* 1524 \* 1544 \*  
 1810 \* 1790 \* 1770 \* 1750 \* 1730 \* 1710 \* 1690 \* 1670 \* 1650 \* 1630 \* 1610 \*  
 1935 \* 1915 \* 1895 \* 1875 \* 1855 \* 1835 \* 1815 \* 1795 \* 1775 \*  
 2050 \* 2030 \* 2010 \* 1990 \* 1970 \* 1950 \* 1930 \*  
 2165 \* 2145 \* 2125 \* 2105 \* 2085 \* 2065 \*  
 2280 \* 2260 \* 2240 \* 2220 \*  
 2395 \* 2375 \* 2355 \*  
 2510 \* 2490 \*

X = HOLE UNLOADABLE  
 O = DOUBLE PRIMED



Not to scale

|                                |                               |           |
|--------------------------------|-------------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                               | 9/20/2018 |
| Mine                           | Burlington                    |           |
| Location                       |                               |           |
| Title/author                   | 18-018 Floor I. Deemert       |           |
| Filename                       | 18-018_Floor_Design_Final.spf |           |

1090791

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
 FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissancement



CONSIGNOR / EXPÉDITEUR  
**GRAND VALLEY**  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE / CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
 BURLINGTON ON  
 CA L7R 4L8

|                                |                                   |
|--------------------------------|-----------------------------------|
| GROSS / BRUT                   |                                   |
| TARE                           |                                   |
| NET                            |                                   |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE          |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSEMENT |
| 2390035                        | 86143198                          |

|                               |                                          |                                            |                                                    |
|-------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURE À / ACHETEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 21 Sep 2018                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   | n/a                                                |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR       | VEHICLE NO.<br>N° DE VÉHICULE                      |
| 21 Sep 2018                   | FOB Dest'n, Own Truck                    | F-73289                                    | 18230                                              |
| SHIP VIA<br>TRANSPORTEUR      |                                          | ROUTING<br>ITINÉRAIRE                      | MAG. LIC. NO.<br>N° DE PERMIS                      |
| Orica Truck                   |                                          | STANDARD                                   |                                                    |

| QTY.<br>QTÉ.                                                                                                                                   | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                          | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|------------------------|--------------------------------------|--------------------|-------------------|
| 392                                                                                                                                            | PC | X        | 43                      | 349                    | PENTEX BC 340 (49/CS)                | 8                  | 143.080           |
| 3                                                                                                                                              | PC |          | 1                       | 2                      | Harness Wire Duplex (6 pack) 400m    | 1                  | 8.760             |
| 400                                                                                                                                            | PC | X        | 51                      | 349                    | *uni tronic 600-06.0M CU/ZC(20')80PC | 5                  | 29.200            |
| 60                                                                                                                                             | PC | X        | 60                      | 0                      | *uni tronic 600-09.0M CU/ZC(30')60PC | 1                  | 5.880             |
| 100                                                                                                                                            | PC |          | 100                     | 0                      | MINI STEM PLUGS - PART #74853        |                    | 0.700             |
| 1                                                                                                                                              | PC |          |                         |                        | LICENSED BLASTER                     |                    |                   |
| 1.0                                                                                                                                            | HR |          |                         |                        | LABOUR CHARGE                        |                    |                   |
| 1                                                                                                                                              | PC |          |                         |                        | ROG (ROCK ON GROUND)                 |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                             |    |          |                         |                        |                                      |                    | 187.620 KG        |
| **** TOTAL PACKAGES ****                                                                                                                       |    |          |                         |                        |                                      | 15                 |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                        |                                      |                    |                   |

24-HOUR NUMBER: 1-613-996-6666

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              |                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PALLETS USED / PALETTES UTILISÉES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PALLETS RETURNED / PALETTES RETOURNÉES                                       | BAGS USED / SACS UTILISÉS                                                                                                                                                                                                                         |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TÉLÉPHONE D'URGENCE/24 HEURE NUMERO | PLACARDS OFFERED / PLACARDS OFFERT                                                                                                                                                                                                                |
| ERAP 2-1510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1-877-561-3636                                                               | YES / OUI NO / NON                                                                                                                                                                                                                                |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                                              | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE                                                                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                              | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>NO DE CONNAISSEMENT D'ORICA:<br>Orica Canada Inc.<br>301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5 |

|                                                              |                                                              |                                                      |
|--------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                       | CARRIER / TRANSPORTEUR<br>Orica Truck                        | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>K. Platt | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>K. Platt | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br>K. Platt                                        | DATE<br>21 9 18<br>D/J M/M Y/A                               | SIGNATURE<br>K. Platt                                |
|                                                              | DATE<br>21 9 18<br>D/J M/M Y/A                               | DATE<br>D/J M/M Y/A                                  |

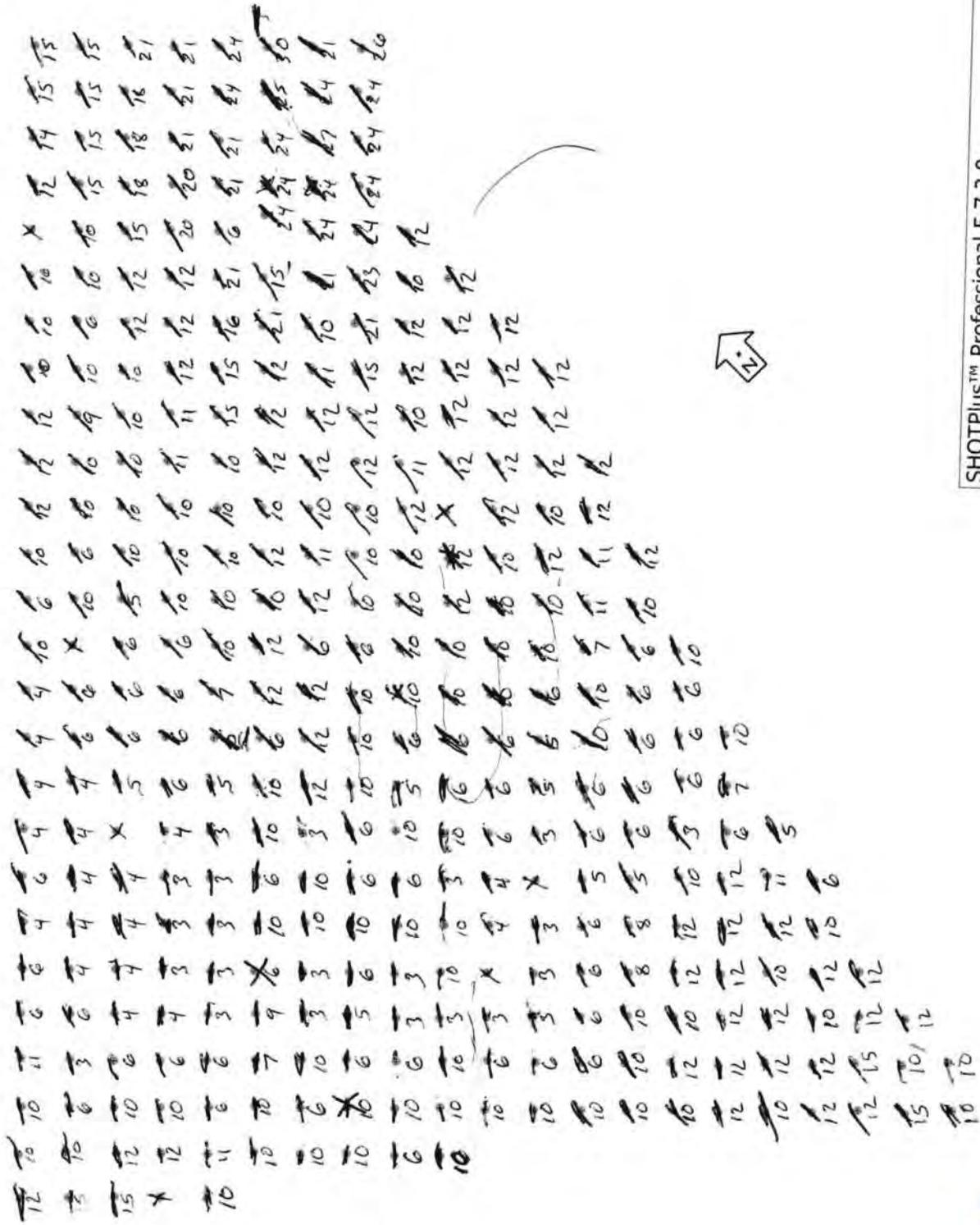
**2 SHIPPING ORDER / BON D'EXPÉDITION**  
 (AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
 (L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRÈS AVOIR SIGNÉ LA COPIE ORIGINALE (1) DU CONNAISSEMENT CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
 SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO  
 \*\*\*\* PAGE 2 OF 2 \*\*\*\*  
 D.F.G. 57772

Open Face

Load Sheet 16 Kg Max

Previous Blast

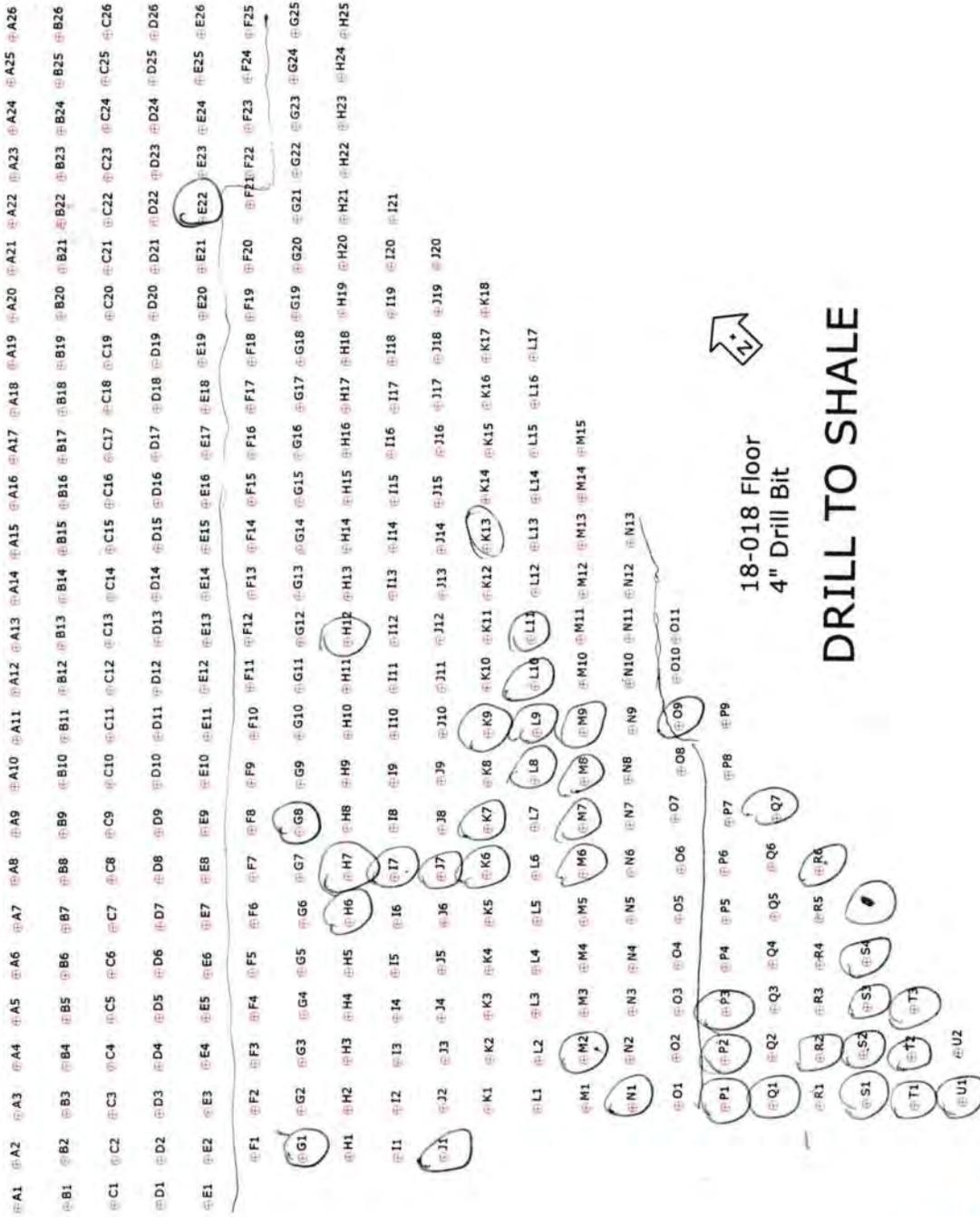


Not to scale

|                                |                               |
|--------------------------------|-------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 9/20/2018                     |
| Mine                           | Burlington                    |
| Location                       |                               |
| Title/author                   | 18-018 Floor I. Deemert       |
| Filename                       | 18-018_Floor_Design_Final.spf |

Blast 18-015 Floor  
Previous Blast

Open Face



18-018 Floor  
4" Drill Bit

DRILL TO SHALE



Not to scale

~~F5-6 4.5' OB~~ F4-7' OB  
~~Q4-7' OB~~ F4-6' OB

F5-7' OB F6-7' OB  
~~Q2-7' OB~~

# GODRILLING

## SHOT DIAMETER

Client:

Job:

Date:

Driller:

Blast Num:

Employee:

1 foot into the Shale  
 134 holes Footage - 1531'  
 in shot so far

~~776' OB~~  
 574.5' OB  
 559' OB  
 569' OB  
 584.5' OB

| GPS Coordinates |  | GPS LF:              | GPS RF:              | GPS LR:              | GPS RR:              | Total Cubic Meters:  |                      | Total Tonnes:        |                      | Total Footage:       |                      |
|-----------------|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                 |  | <input type="text"/> |
| 1               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 2               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 3               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 4               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 5               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 6               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 7               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 8               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 9               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 10              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 11              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 12              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 13              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 14              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 15              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 16              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 17              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 18              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 19              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 20              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 21              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 22              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 23              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 24              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 25              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 26              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 27              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 28              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 29              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 30              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 31              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 32              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 33              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 34              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| 35              |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| A               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| B               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| C               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| D               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| E               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| F               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| G               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| H               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| I               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| J               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| K               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| L               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| M               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| N               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| O               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| P               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Q               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| R               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| S               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| T               |  |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |

Burden:  Spacing:  Average Hole Depth:  Total Holes:

Shot Notes: F23-9-15 - Fractured  
 F4-6' OB  
 F4-7' OB  
 F5-7' OB  
 F6-7' OB  
 F7-7' OB  
 F8-7' OB  
 F9-7' OB  
 F10-7' OB  
 F11-7' OB  
 F12-7' OB  
 F13-7' OB  
 F14-7' OB  
 F15-7' OB  
 F16-7' OB  
 F17-7' OB  
 F18-7' OB  
 F19-7' OB  
 F20-7' OB  
 F21-7' OB  
 F22-7' OB  
 F23-7' OB  
 F24-7' OB  
 F25-7' OB  
 F26-7' OB  
 F27-7' OB  
 F28-7' OB  
 F29-7' OB  
 F30-7' OB  
 F31-7' OB  
 F32-7' OB  
 F33-7' OB  
 F34-7' OB  
 F35-7' OB

Shot Notes: F23-9-15 - Fractured  
 F4-6' OB  
 F4-7' OB  
 F5-7' OB  
 F6-7' OB  
 F7-7' OB  
 F8-7' OB  
 F9-7' OB  
 F10-7' OB  
 F11-7' OB  
 F12-7' OB  
 F13-7' OB  
 F14-7' OB  
 F15-7' OB  
 F16-7' OB  
 F17-7' OB  
 F18-7' OB  
 F19-7' OB  
 F20-7' OB  
 F21-7' OB  
 F22-7' OB  
 F23-7' OB  
 F24-7' OB  
 F25-7' OB  
 F26-7' OB  
 F27-7' OB  
 F28-7' OB  
 F29-7' OB  
 F30-7' OB  
 F31-7' OB  
 F32-7' OB  
 F33-7' OB  
 F34-7' OB  
 F35-7' OB



# Blast Design

## Nelson Aggregate

Quarry: Burlington  
 P.O. #: \_\_\_\_\_  
 Design Date: 2018-09-21

Blast Number: 18-018  
 Orica Order #: \_\_\_\_\_

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Floor (Bench / Party)  
 GPS Coordinates: enter data on p2 °N Latitude enter data on p2 °W Longitude  
Centre of Blast      Centre of Blast

Design to Blasted: 39,153 te  
 Total Holes Loaded: 351 holes  
 ... including:          Dead Holes  
 ... and:          Helper Holes  
 Helper Hole Collar:          ft avg  
 # Rows Blasted: 21 rows

*- Drilling Information -*

Nominal Bit Diameter: \_\_\_\_\_

|                     |                 |                                 |          |            |   |                               |
|---------------------|-----------------|---------------------------------|----------|------------|---|-------------------------------|
| Primary Bit diam:   | <u>101.6</u> mm | Angle from Vertical: <u>0</u> ° | # Holes: | <u>351</u> | = | 3,945.2 ft ( <u>4</u> " diam) |
| Secondary Bit diam: | _____ mm        | <u>0</u> °                      | # Holes: | _____      | = | 0.0 ft ( _____ " diam)        |
| Tertiary Bit diam:  | _____ mm        | <u>0</u> °                      | # Holes: | _____      | = | 0.0 ft ( _____ " diam)        |

*- Design Pattern (Front Row) -*

Burden: 11.5 ft avg  
 Spacing: 11.5 ft avg  
 # Holes: 26 front row

*- Design Pattern (Main Body) -*

Burden: 11.5 ft avg  
 Spacing: 11.5 ft avg  
 # Holes: 325 main body  
 Bench Height: 11.2 ft avg  
 Sub-drill: 0.0 ft avg  
 Hole Depth: 11.2 ft avg

*- Design Stone Decking -*

Front Row: \_\_\_\_\_ ft avg  
 Main Body: \_\_\_\_\_ ft avg

*- Design Collar Stemming -*

Front Row: 7.0 ft avg  
 Main Body: 7.0 ft avg

Material used: .75" Stone

*- Design Charge Length -*

Front Row: 4.2 ft avg  
 Main Body: 4.2 ft avg

*- Design Charge Weight -*

Front Row: 12.4 kg/hole  
 Main Body: 12.4 kg/hole  
 Max Chge Wt / delay: 16.0 kg/delay

Required kg Loaded: 10,119 kg  
 Rock Density: 2.65 g/cc = te/m<sup>3</sup>

*- Design Powder Factor -*

Expected Yield PF: 0.258 kg/te (actual)  
 Front row: 0.111 kg/te (theoretical)  
 Main Body: 0.111 kg/te (theoretical)  
 "KPI" PF: 0.111 kg/te (theoretical)

Cost Reduction Notes (this Blast) - change in Blr, B, S, Expl or IS from previous Blast:

| Bulk Expl. Required: | kg            |
|----------------------|---------------|
| CENTRA GOLD 70       | <u>10,000</u> |

| Pkgd Expl. Required: | kg |
|----------------------|----|
|                      |    |
|                      |    |
|                      |    |

| Boosters Required:        | kg/u        | # used     | kg           |
|---------------------------|-------------|------------|--------------|
| PENTEX 12 (OR EQUIVALENT) | <u>0.34</u> | <u>351</u> | <u>119.3</u> |

total explosives weight in Blast (kg): 10,119  
 Pkgd Prod (0 kg) % of Total kg: 0.0%

| Detonators Required: | ms | # req'd    |
|----------------------|----|------------|
| UNITRONIC 600 6M     |    | <u>351</u> |

| Cord & Access. Req'd:     | U of M | # req'd  |
|---------------------------|--------|----------|
| WIRE DUPLEX (6 PACK) 400M | units  | <u>1</u> |

Resource Deployment:

|                                 |                         |
|---------------------------------|-------------------------|
| # of Blasts today (this Quarry) | <u>1</u>                |
| # of Blasters (this Blast)      | <u>1</u>                |
| # of Helpers (this Blast)       | Note Exception <u>3</u> |
| # of MMU's (this Blast)         | <u>1</u>                |

Services Req'd:

|                        |                              |            |
|------------------------|------------------------------|------------|
| GPS LAYOUT             | Enter hours                  | <u>0.0</u> |
| BULK TRUCK CHARGE      | <2,000kg                     |            |
| BLASTER HOURS          | Enter Blaster hours          | <u>0.0</u> |
| HELPER HOURS           | Enter total Helper man-hours | <u>0.0</u> |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | <u>0</u>   |
| 3D LASER PROFILE       | Enter hours                  | <u>0</u>   |
| BORETRACK              | Enter hours                  | <u>0</u>   |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | <u>0.0</u> |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-10-02

Blast Number: 18-017

Orica Order #: 2394470

Blast Time: 12:02 PM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40374 °N Latitude 79.88268 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: SW at 5 kph Temperature: 11 to 15 °C

Clear:  Rain:  Overcast:  Snow:  Inversion:  Ceiling: 751 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 48 = 3,763.4 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,740  | 22,350   | 11,390 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 108    | 36.7 |

total explosives weight in Blast (kg): 11,427

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 45     |
| UNITRONIC 600 25M |          |    | 26     |
| UNITRONIC 600 30M |          |    | 36     |
| UNITRONIC 600 15M |          |    | 1      |

### Cord & Accessories:

|                                   | U of M | # used |
|-----------------------------------|--------|--------|
| HARNESS WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 0.0  |
| BULK TRUCK CHARGE      | >=10,000 kg                  | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 11.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

Tonnes Blasted: 26,868 te 10,139 m<sup>3</sup>  
Total tonnes per day: 26,868 te NB80-01 Rate Code  
Total Holes Loaded: 48 holes  
... including: Dead Holes  
... and: 2 Helper Holes  
Helper Hole Collar: 50.0 ft avg  
# Rows Blasted: 3 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 19 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 29 main body

Bench Height: 76.4 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 78.4 ft avg

### - Stone Decking -

Front Row: 10.0 ft avg

Main Body: 10.0 ft avg

# Decks: 6 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: .75" Stone

### - Charge Length -

Front Row: 61.4 ft avg

Main Body: 61.4 ft avg

### - Charge Weight -

Front Row: 179.0 kg/hole

Main Body: 179.0 kg/hole

Max. per delay: 265.0 kg/delay

SD () Equation: 172.7 kg/delay

Total kg Loaded: 11,427 kg

Rock Density: 2.65 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.425 kg/te (actual)

Front row: 0.260 kg/te (theoretical)

Main Body: 0.347 kg/te (theoretical)

"KPI" PF: 0.318 kg/te (theoretical)

1.900 lb/yd<sup>3</sup>  
1.162 lb/yd<sup>3</sup>  
1.550 lb/yd<sup>3</sup>  
1.421 lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

3 Siesmographs set up



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-10-02

Blast Number: 18-017  
Orica Order #: 2394470  
Blast Time: 12:02 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. |
|---------------------------|----------------|-----------------|
| Mid Blast                 | 43.40371       | 79.88267        |
| Front Row Corner          | 43.40358       | 79.88266        |
| Back Row Corner           | 43.40393       | 79.88271        |
| Average (Centre of Blast) | 43.40374       | 79.88268        |

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757538    | 1.394216    |
| 0.757535    | 1.394215    |
| 0.757541    | 1.394216    |
| 0.757538    | 1.394216    |

1st

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long.                                         |
|-------------------------------------------|-------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814                                                |
| 2nd Reading                               |                         |                                                         |
| Average                                   | 43.40245                | 79.87814                                                |
| Distance (1st Seis. From Centre of Blast) | 394.2                   | m                                                       |
| Post Blast Data:                          | ppV: 5.3                | mm/s Trigger set at: 2.0                                |
|                                           | frequency: 7.6          | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 114.2 | dB Trigger set at: 124                                  |

2450 2nd Line

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757516    | 1.394137    |
| 0.757516    | 1.394137    |

2nd

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long.                                         |
|-------------------------------------------|-------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400                                                |
| 2nd Reading                               |                         |                                                         |
| Average                                   | 43.40605                | 79.89400                                                |
| Distance (2nd Seis. From Centre of Blast) | 951.1                   | m                                                       |
| Post Blast Data:                          | ppV: 0.2                | mm/s Trigger set at: 2.0                                |
|                                           | frequency: 7.1          | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 121.6 | dB Trigger set at: 115                                  |

Colling Rd & Blind Line Bruce Trail

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757578    | 1.394413    |
| 0.757578    | 1.394413    |

3rd

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long.                                         |
|-------------------------------------------|-------------------------|---------------------------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880                                                |
| 2nd Reading                               |                         |                                                         |
| Average                                   | 43.39339                | 79.88880                                                |
| Distance (3rd Seis. From Centre of Blast) | 1253.8                  | m                                                       |
| Post Blast Data:                          | ppV: 0.5                | mm/s Trigger set at: 2.0                                |
|                                           | frequency: 7.3          | Hz V / T / L : ? (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 123.5 | dB Trigger set at: 115                                  |

SouthWest Corner of Property

| (N) Radians | (W) Radians |
|-------------|-------------|
| 0.757358    | 1.394323    |
| 0.757358    | 1.394323    |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(394.2)^2}{30^2} \text{ kg}$$

$$= \frac{155,394}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

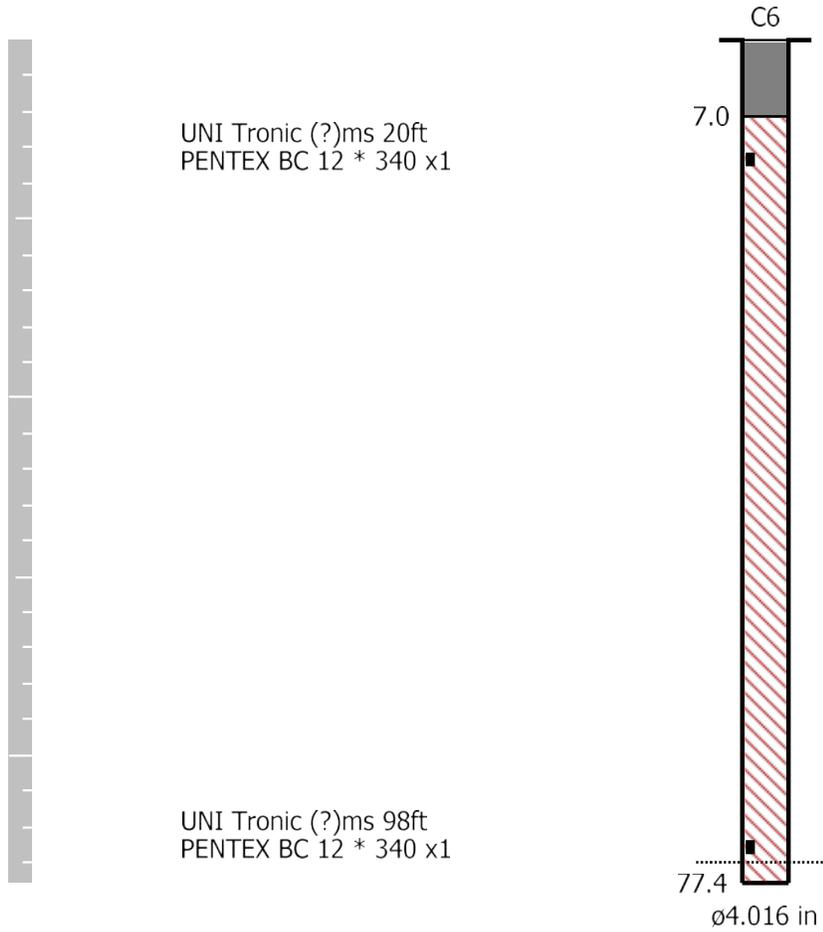
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 10/2/2018

Blast Number: 18-017  
Orica Order #: 2394470

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Bill White*

Signature required, indicating  
sign off on Blast Design.

### SHOTPlus 5 Plan

#### Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 6.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 49 | Hole angle: 0.0° |
| Total drilled: 3733.8ft |                      |                     |                  |

open face



TRY C17A 4" FIRST POSITION IF UNSUC  
 TRY C17B 5" SECOND POSITION  
 NO ROUNDING DUE TO RAMP



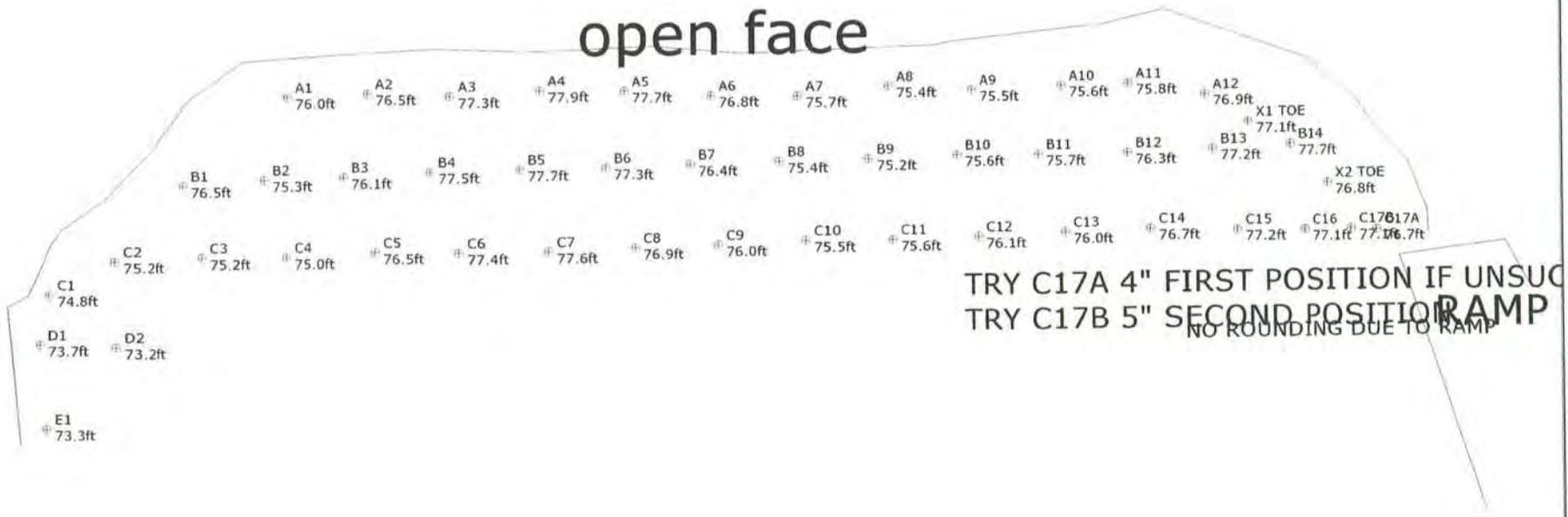
Not to scale

|                                |                                    |
|--------------------------------|------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 10/1/2018                          |
| Mine                           | Burlington                         |
| Location                       | UPPER MIDDLE NO ROUNDING ON NORTH  |
| Title/author                   | Design 18-017 UPPER MIDDLE         |
| Filename                       | 2018-10-02 18-017 Upper Middle.spf |

### SHOTPlus 5 Plan

#### Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 6.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 49 | Hole angle: 0.0° |
| Total drilled: 3733.8ft |                      |                     |                  |



**TRY C17A 4" FIRST POSITION IF UNSUC**  
**TRY C17B 5" SECOND POSITION**  
 NO ROUNDING DUE TO RAMP

|                                |                                    |
|--------------------------------|------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 9/17/2018                          |
| Mine                           | Burlington                         |
| Location                       | UPPER MIDDLE NO ROUNDING ON NORTH  |
| Title/author                   | Design 18-017 UPPER MIDDLE         |
| Filename                       | Design_18-017_UPPER_MIDDLE_Fnl.spf |



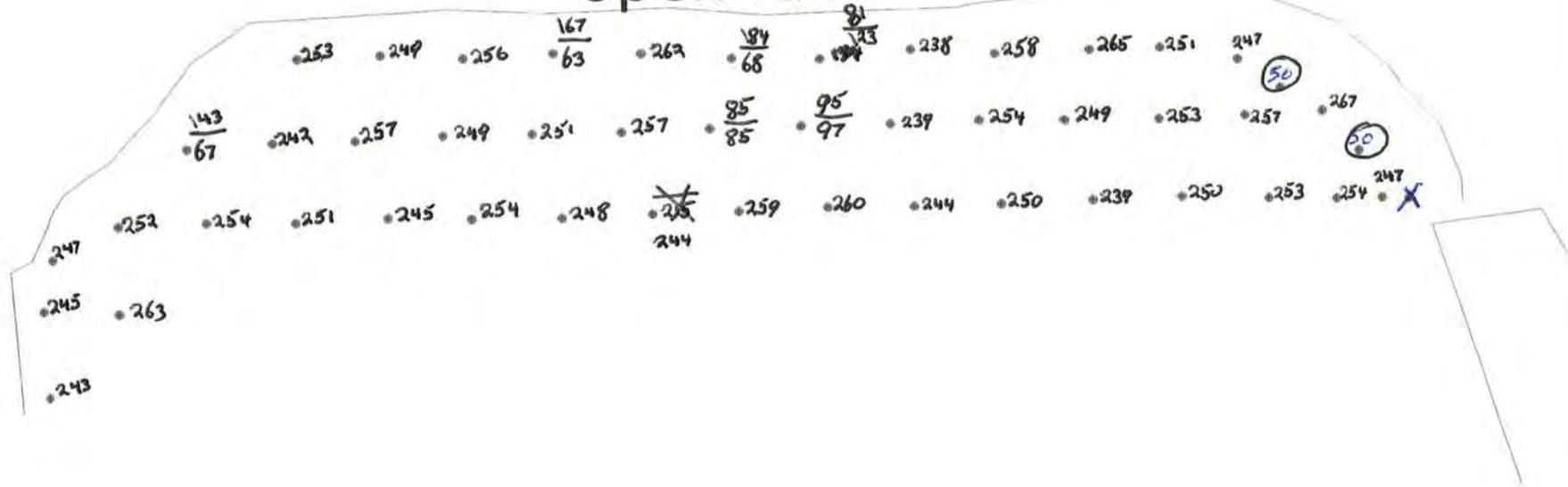
Not to scale

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 6.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 49 | Hole angle: 0.0° |
| Total drilled: 3733.8ft |                      |                     |                  |

# Load Sheet 240 Kg Max open face



Not to scale

|                                |                                    |
|--------------------------------|------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 9/28/2018                          |
| Mine                           | Burlington                         |
| Location                       | UPPER MIDDLE NO ROUNDING ON NORTH  |
| Title/author                   | Design 18-017 UPPER MIDDLE         |
| Filename                       | Design_18-017_UPPER_MIDDLE_Fnl.spf |

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
 FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES  
 SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.

Bill of Lading / Connaissancement

**Orica Canada Inc.**  
 GRAND VALLEY  
 033411 SIDE ROAD 21-22  
 GRAND VALLEY ON  
 CA L9W 7G1

CONSIGNEE  
 CONSIGNATAIRE  
**NELSON AGGREGATE COMPANY**  
 BURLINGTON ON  
 CA L7R 4L8

|                                |                                  |
|--------------------------------|----------------------------------|
| GROSS / BRUT                   |                                  |
| TARE                           |                                  |
| NET                            |                                  |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE         |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSMENT |
| 2394470                        | 86154431                         |

|                               |                                          |                                            |                                                    |
|-------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 02 Oct 2018                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   | n/a                                                |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR       | VEHICLE NO.<br>N° DE VÉHICULE                      |
| 02 Oct 2018                   | FOB Dest'n, Own Truck                    | F-73289                                    | PT 18230                                           |
| SHIP VIA<br>TRANSPORTEUR      | ROUTING<br>ITINÉRAIRE                    | MAG. LIC. NO.<br>N° DE PERMIS              |                                                    |
| Orica Truck                   | STANDARD                                 |                                            |                                                    |

| QTY.<br>QTÉ.                                                                                                                                   | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                           | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|-------------------------|------------------------|---------------------------------------|--------------------|-------------------|
| 147                                                                                                                                            | PC | X        | 39                      | 108                    | PENTEX BC 340 (49/CS)                 | 3                  | 53.655            |
| 2                                                                                                                                              | PC |          | 1                       | 1                      | Harness Wire Duplex (6 pack) 400m     | 1                  | 5.840             |
| 80                                                                                                                                             | PC | X        | 35                      | 45                     | *uni tronic 600-06.0M CU/ZC(20')80PC  | 1                  | 5.840             |
| 66                                                                                                                                             | PC | X        | 65                      | 1                      | *uni tronic 600-15M C/Z SPL(50')66PC  | 1                  | 11.286            |
| 54                                                                                                                                             | PC | X        | 28                      | 26                     | *uni tronic 600-25M CU/ZC SPL(80')54P | 1                  | 13.176            |
| 36                                                                                                                                             | PC | X        | 0                       | 36                     | *uni tronic 600-30M C/Z SPL(100')36P  | 1                  | 8.820             |
| 100                                                                                                                                            | PC |          |                         |                        | MINI STEM PLUGS - PART #74853         |                    | 0.700             |
| 1                                                                                                                                              | PC |          |                         |                        | LICENSED BLASTER                      |                    |                   |
| 1.0                                                                                                                                            | HR |          |                         |                        | LABOUR CHARGE                         |                    |                   |
| 1                                                                                                                                              | PC |          |                         |                        | ROG (ROCK ON GROUND)                  |                    |                   |
| TOTAL GROSS WEIGHT                                                                                                                             |    |          |                         |                        |                                       |                    | 99.317 KG         |
| **** TOTAL PACKAGES ****                                                                                                                       |    |          |                         |                        |                                       | 8                  |                   |
| GHS/WHMIS SDS documents available<br>Website: www.oricaminingservices.com<br>Email: sds.na@orica.com<br>Phone: 1-855-26-ORICA (1-855-266-7422) |    |          |                         |                        |                                       |                    |                   |

24-HOUR NUMBER: 1-613-996-6666

|                                                    |                                                                              |                                    |                                                                                                                                                              |
|----------------------------------------------------|------------------------------------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TELEPHONE D'URGENCE/24 HEURE NUMERO | PLACARDS OFFERED / PLACARDS OFFERT | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>N° DE CONNAISSMENT D'ORICA: |
| ERAP 2-1510                                        | 1-877-561-3636                                                               | YES / OUI NO / NON                 | Orica Canada Inc.                                                                                                                                            |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                               |                                                |                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|-------------------------------------------------------------|
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QU'É LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QU'É LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE | NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO. | 301 rue hotel de ville<br>Brownsburg-Chatham, QC<br>J8G 3B5 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|-------------------------------------------------------------|

|                                                                  |                                                                  |                                                      |
|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                           | CARRIER / TRANSPORTEUR<br>Orica Truck                            | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>Jeff Norwood | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>Jeff Norwood | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br>[Signature]                                         | DATE<br>2-10-18                                                  | SIGNATURE<br>[Signature]                             |
|                                                                  | DATE<br>2-10-18                                                  | DATE                                                 |

2 SHIPPING ORDER  
BON D'EXPÉDITION

(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
 (L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRES AVOIR SIGNE LA COPIE ORIGINALE (1) DU CONNAISSMENT CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
 SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO

**Date/Time** MicL at 12:02:29 October 2, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.308 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/BURLINGTON.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.6 Volts  
**Unit Calibration** February 14, 2018 by Instantel  
**File Name** UM6857\_20181002120229.IDFW

**Notes**

**Location:** COLLING RD & BLINDLINE  
**Client:** NELSON AGGREGATES  
**User Name:** ORICA CANADA  
**General:**

**Extended Notes**

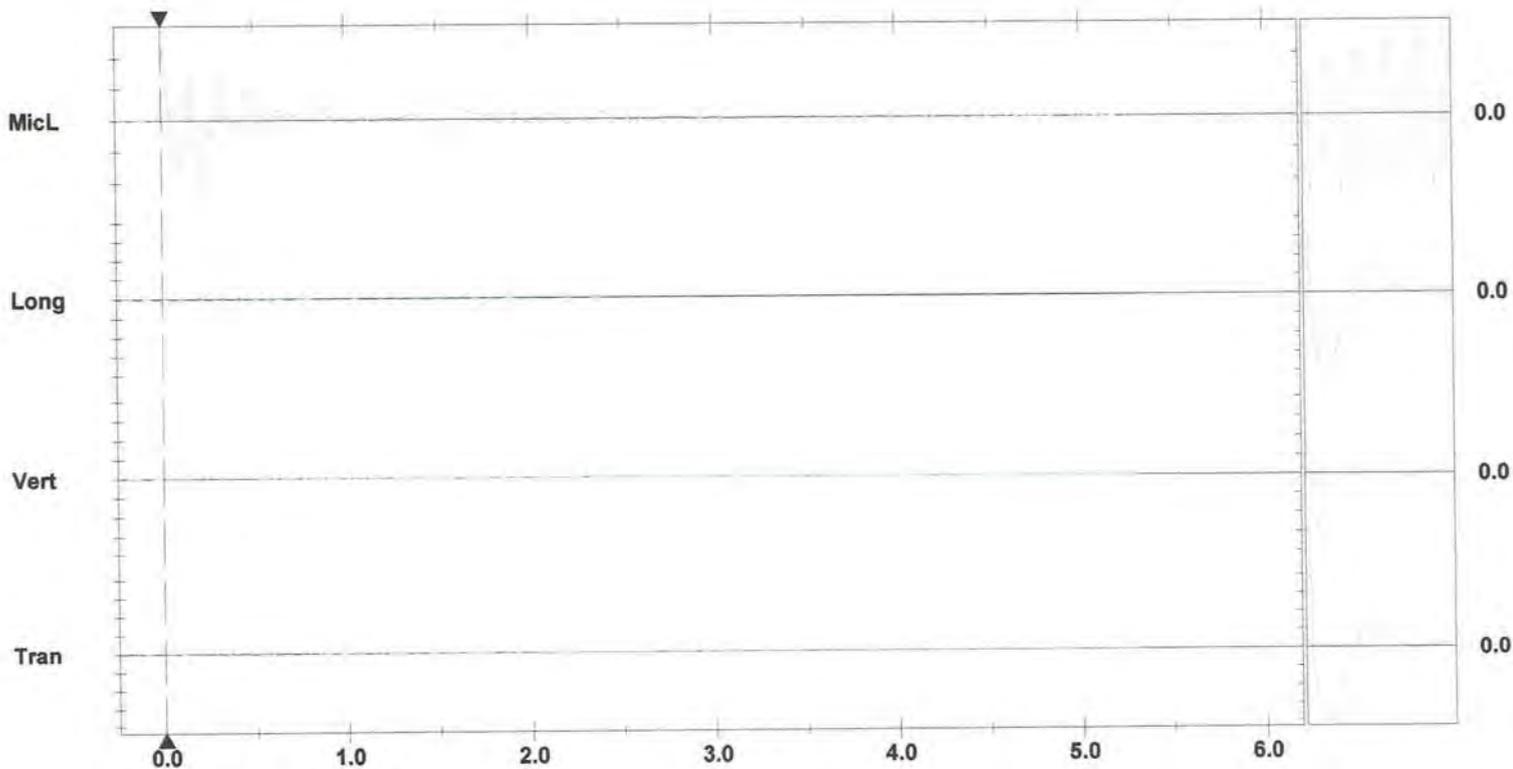
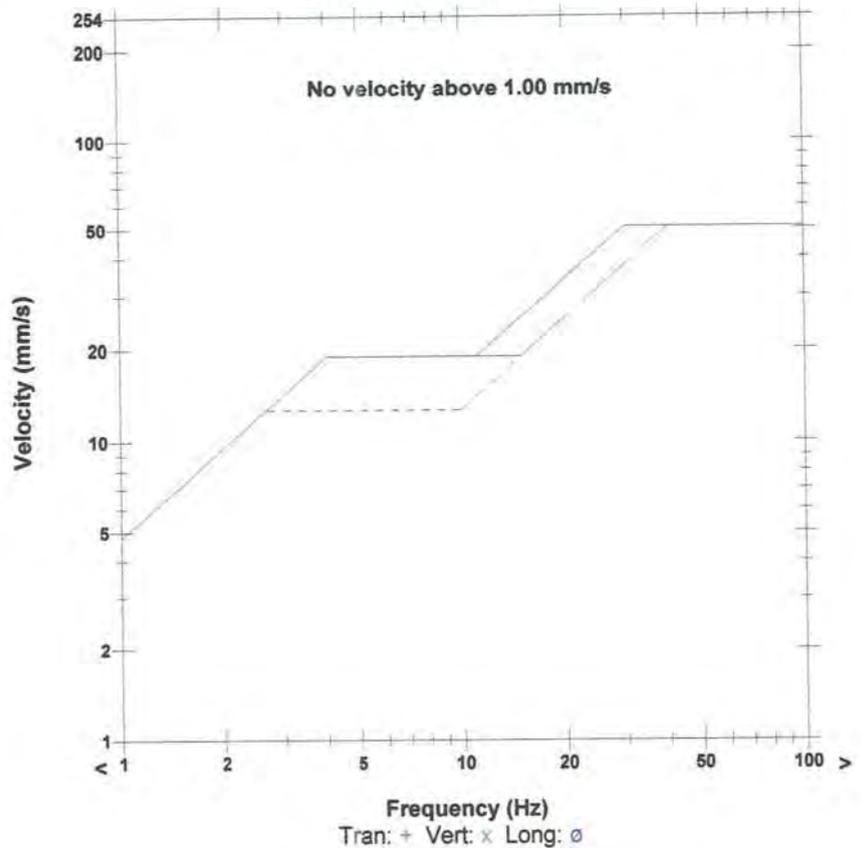
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 121.6 dB(L) at 0.202 sec  
**ZC Freq** 4.3 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1470 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.150  | 0.189  | 0.205  | mm/s |
| ZC Freq             | 16.5   | 17.1   | 7.9    | Hz   |
| Time (Rel. to Trig) | 0.407  | 0.215  | 0.388  | sec  |
| Peak Acceleration   | 0.010  | 0.010  | 0.010  | g    |
| Peak Displacement   | 0.002  | 0.002  | 0.013  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.3    | 3.4    | 3.6    |      |

**Peak Vector Sum** 0.214 mm/s at 0.394 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Long at 12:02:24 October 2, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.3 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_TEMP.EVT

**Notes**  
 Location: 2450 2nd Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada  
 General: N.43.40245 W.79.87814

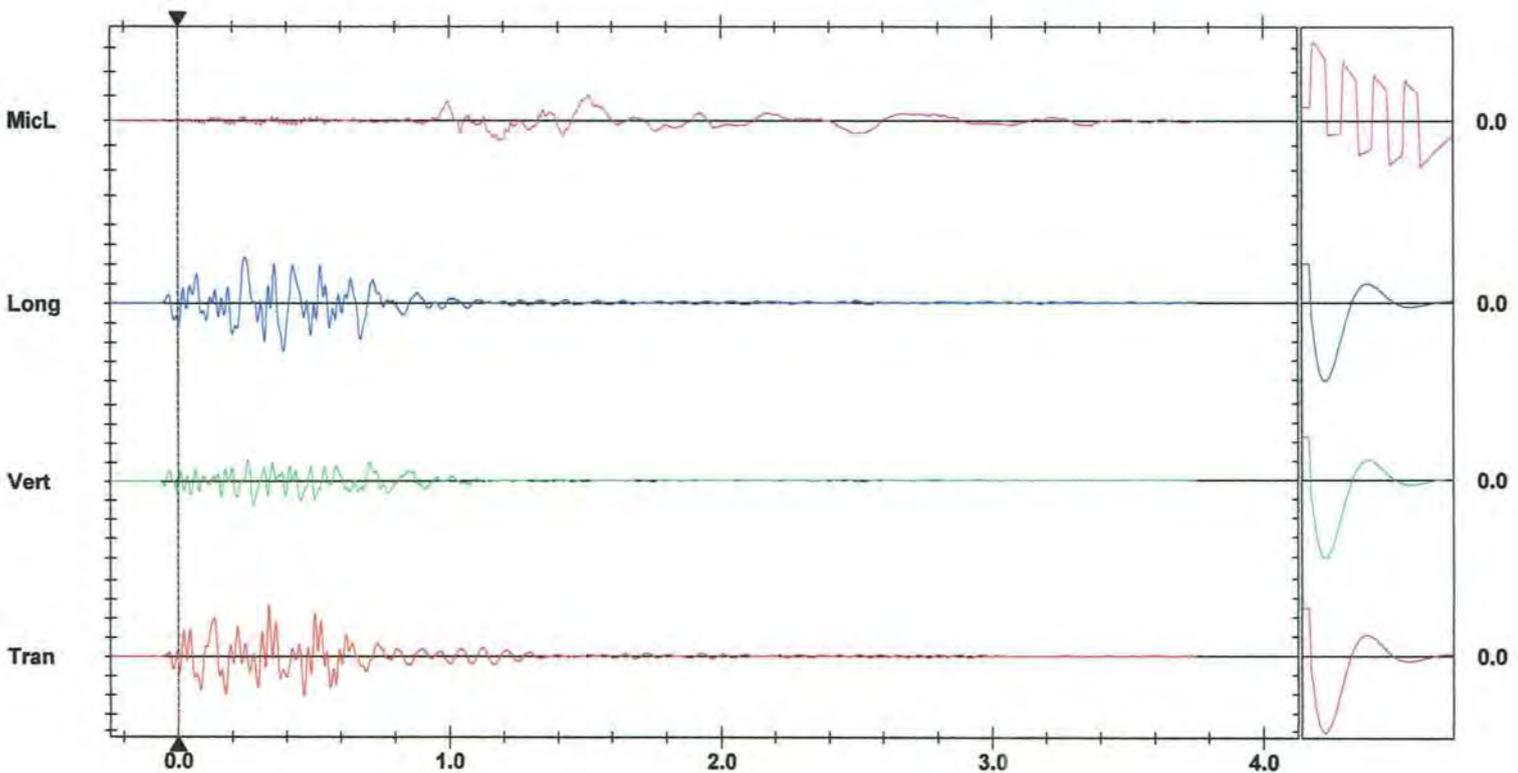
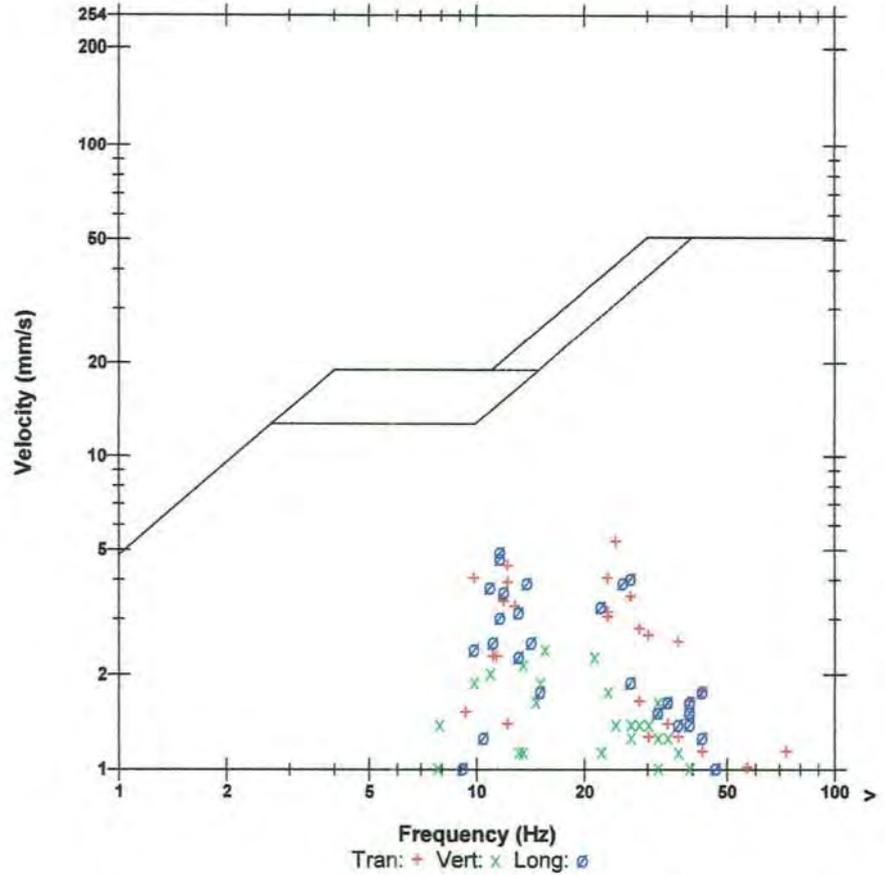
**Extended Notes**  
 Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 114.2 dB(L) at 1.513 sec  
**ZC Freq** 3.5 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 692 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 5.334  | 2.413  | 4.953  | mm/s |
| ZC Freq             | 24     | 16     | 12     | Hz   |
| Time (Rel. to Trig) | 0.334  | 0.275  | 0.388  | sec  |
| Peak Acceleration   | 0.093  | 0.053  | 0.066  | g    |
| Peak Displacement   | 0.056  | 0.027  | 0.066  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.6    | 7.4    | 7.4    | Hz   |
| Overswing Ratio     | 3.7    | 3.9    | 4.2    |      |

Peak Vector Sum 5.677 mm/s at 0.333 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 12:02:29 October 2, 2018  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.25 sec (Auto=3Sec) at 1024 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.2 Volts  
**Unit Calibration** November 3, 2017 by Instantel  
**File Name** \_TEMP.EVT  
**Scaled Distance** 5850.2 (1850.0 m, 0.1 kg)

**Notes**

**Location:** SouthWest Corner of property  
**Client:** Nelson Aggregates  
**User Name:** Orica Canada  
**General:** N. 44.39585; W-80.25085

**Extended Notes**

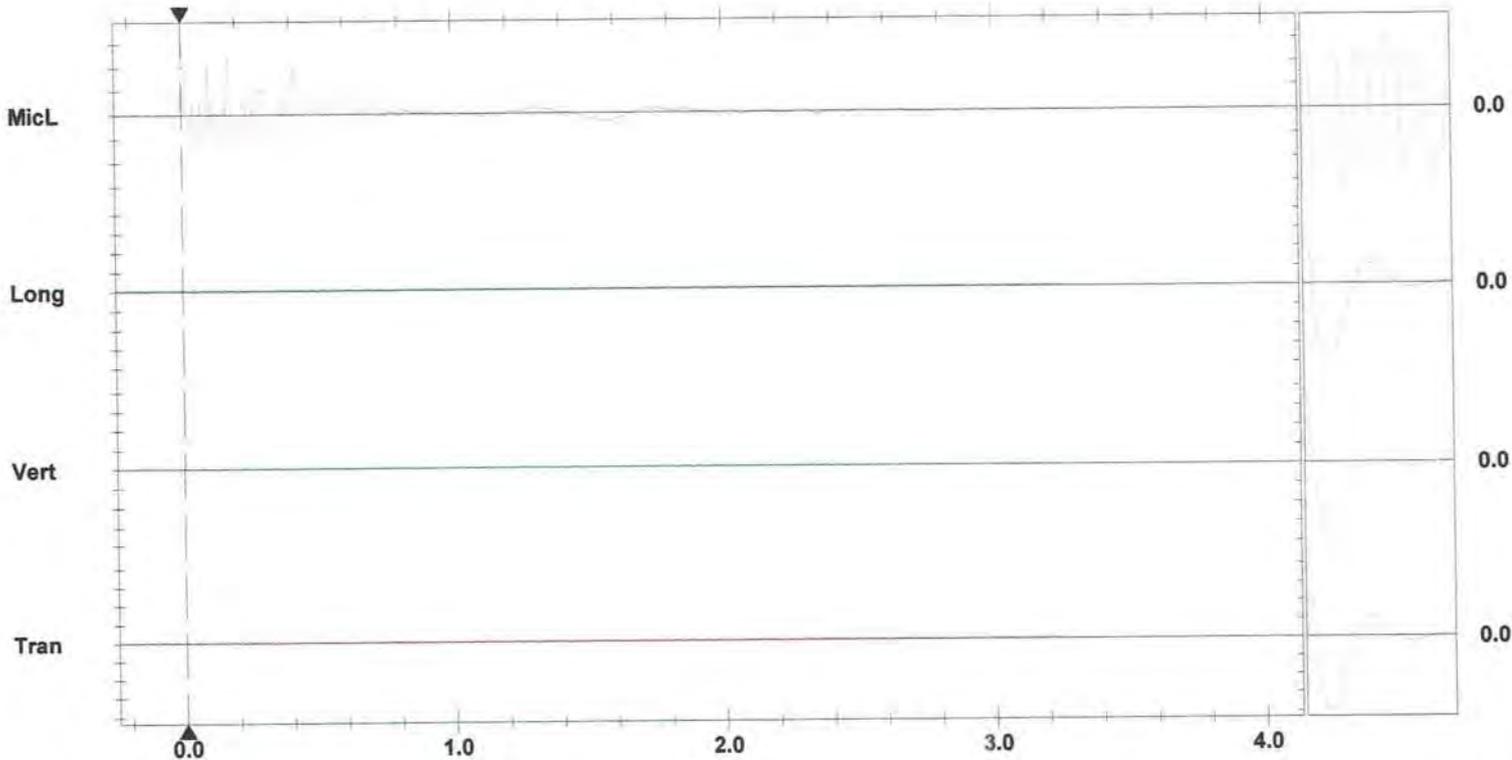
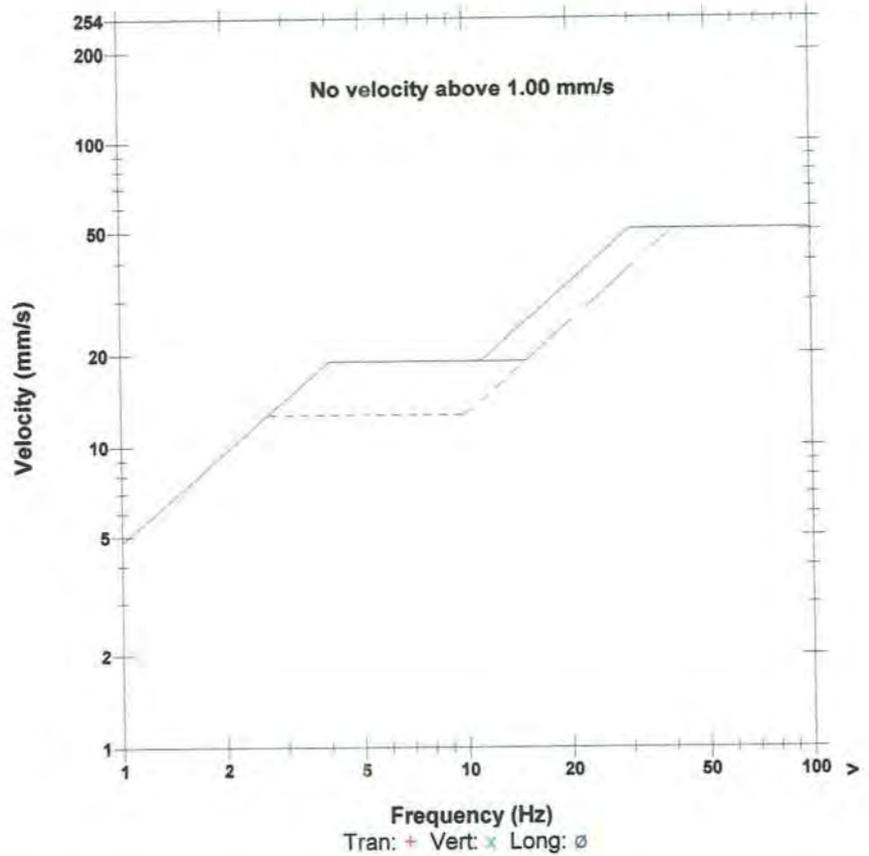
Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 123.5 dB(L) at 0.004 sec  
**ZC Freq** 20 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 584 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.254  | 0.508  | 0.254  | mm/s |
| ZC Freq             | >100   | 47     | 73     | Hz   |
| Time (Rel. to Trig) | 0.032  | 0.197  | 0.037  | sec  |
| Peak Acceleration   | 0.013  | 0.013  | 0.027  | g    |
| Peak Displacement   | 0.001  | 0.002  | 0.001  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.3    | Hz   |
| Overswing Ratio     | 3.9    | 3.7    | 4.1    |      |

**Peak Vector Sum** 0.568 mm/s at 0.197 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check



# Blast Design

## Nelson Aggregate

Quarry: Burlington  
 P.O. #:                       
 Design Date: 2018-10-02

Blast Number: 18-017  
 Orica Order #:                     

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)  
 GPS Coordinates: 43.40374 °N Latitude 79.88268 °W Longitude  
Centre of Blast Centre of Blast

Design to Blasted: 26,093 te  
 Total Holes Loaded: 48 holes  
 ... including:            Dead Holes  
 ... and: 2 Helper Holes  
 Helper Hole Collar: 60.0 ft avg  
 # Rows Blasted: 4 rows

*- Drilling Information -*

|                     |                                 |                            |                                 |
|---------------------|---------------------------------|----------------------------|---------------------------------|
|                     | Angle from Vertical             |                            | Nominal Bit Diameter:           |
| Primary Bit diam:   | <u>101.6</u> mm <u>0</u> °      | # Holes: <u>48</u>         | = 3,657.6 ft ( <u>4</u> " diam) |
| Secondary Bit diam: | <u>          </u> mm <u>0</u> ° | # Holes: <u>          </u> | = 0.0 ft ( " diam)              |
| Tertiary Bit diam:  | <u>          </u> mm <u>0</u> ° | # Holes: <u>          </u> | = 0.0 ft ( " diam)              |

*- Design Pattern (Front Row) -*

Burden: 12.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 19 front row

*- Design Pattern (Main Body) -*

Burden: 9.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 29 main body

Bench Height: 74.2 ft avg  
 Sub-drill: 2.0 ft avg  
 Hole Depth: 76.2 ft avg

*- Design Stone Decking -*

Front Row:            ft avg  
 Main Body:            ft avg

*- Design Collar Stemming -*

Front Row: 7.0 ft avg  
 Main Body: 7.0 ft avg

Material used: .75" Stone

*- Design Charge Length -*

Front Row: 69.2 ft avg  
 Main Body: 69.2 ft avg

*- Design Charge Weight -*

Front Row: 201.8 kg/hole  
 Main Body: 201.8 kg/hole  
 Max Chge Wt / delay: 250.0 kg/delay

Required kg Loaded: 12,533 kg  
 Rock Density: 2.65 g/cc = te/m<sup>3</sup>

*- Design Powder Factor -*

Expected Yield PF: 0.480 kg/te (actual)  
 Front row: 0.302 kg/te (theoretical)  
 Main Body: 0.403 kg/te (theoretical)  
 "KPI" PF: 0.377 kg/te (theoretical)

1.349 lb/yd<sup>3</sup>

1.799 lb/yd<sup>3</sup>

1.686 lb/yd<sup>3</sup>

Cost Reduction Notes (this Blast) - change in Bit , B , S , Expl or IS from previous Blast:

| Bulk Expl. Required: | kg            |
|----------------------|---------------|
| CENTRA GOLD 70       | <u>12,500</u> |

| Pkgd Expl. Required: | kg |
|----------------------|----|
|                      |    |
|                      |    |
|                      |    |

| Boosters Required:        | kg/u # used           | kg          |
|---------------------------|-----------------------|-------------|
| PENTEX 12 (OR EQUIVALENT) | <u>0.34</u> <u>98</u> | <u>33.3</u> |

total explosives weight in Blast (kg): 12,533  
 Pkgd Prod (0 kg) % of Total kg: 0.0%

| Detonators Required: | ms | # req'd   |
|----------------------|----|-----------|
| UNITRONIC 600 6M     |    | <u>80</u> |
| UNITRONIC 600 15M    |    | <u>66</u> |
| UNITRONIC 600 25M    |    | <u>54</u> |
| UNITRONIC 600 30M    |    | <u>36</u> |

| Cord & Access. Req'd:     | U of M | # req'd  |
|---------------------------|--------|----------|
| WIRE DUPLEX (6 PACK) 400M | units  | <u>1</u> |
|                           | units  |          |
|                           | units  |          |

Resource Deployment:

|                                 |                |          |
|---------------------------------|----------------|----------|
| # of Blasts today (this Quarry) |                | <u>1</u> |
| # of Blasters (this Blast)      |                | <u>1</u> |
| # of Helpers (this Blast)       | Note Exception | <u>2</u> |
| # of MMU's (this Blast)         |                | <u>1</u> |

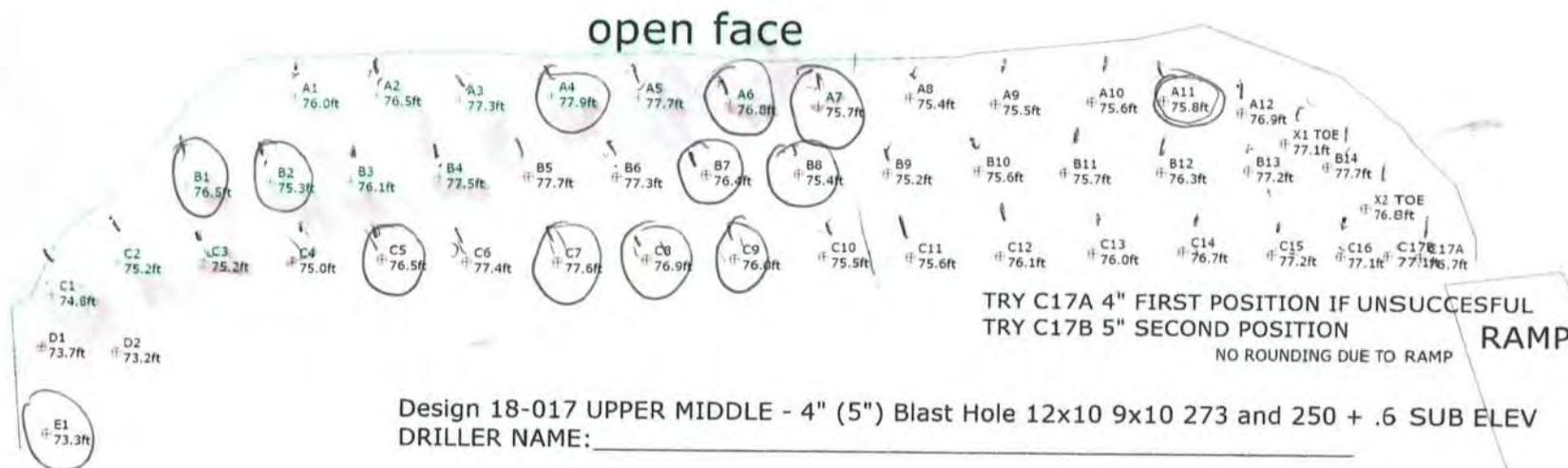
Services Req'd:

|                        |                              |            |
|------------------------|------------------------------|------------|
| GPS LAYOUT             | Enter hours                  | <u>0.0</u> |
| BULK TRUCK CHARGE      | <2,000kg                     |            |
| BLASTER HOURS          | Enter Blaster hours          |            |
| HELPER HOURS           | Enter total Helper man-hours |            |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | <u>0</u>   |
| 3D LASER PROFILE       | Enter hours                  | <u>0</u>   |
| BORETRACK              | Enter hours                  | <u>0</u>   |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | <u>0.0</u> |

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 6.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 49 | Hole angle: 0.0° |
| Total drilled: 3733.8ft |                      |                     |                  |



Scale 1:250

|                  |                                   |
|------------------|-----------------------------------|
| SHOTPlus 5.7.0.8 | 9/5/2018                          |
| Mine             | Burlington                        |
| Location         | UPPER MIDDLE NO ROUNDING ON NORTH |
| Title/author     | Design 18-017 UPPER MIDDLE        |
| Filename         |                                   |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-11-01

Blast Number: 18-019

Orica Order #: 2407202

Blast Time: 11:57 AM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40371 °N Latitude 79.88251 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: at 0 kph Temperature: 6 to 10 °C

Clear: Partly Cloudy: Rain: X Snow: Overcast: Inversion: Ceiling 7.842 ft

### - Drilling Information -

|                              | Angle from Vertical | Nominal Bit Diameter:                 |
|------------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm   | 0°                  | # Holes: 44 = 3,319.4 ft ( 4 " diam)  |
| Secondary Bit diam: 114.3 mm | 0°                  | # Holes: 6 = 452.6 ft ( 4 1/2 " diam) |
| Tertiary Bit diam: mm        | 0°                  | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,970  | 22,720   | 11,250 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 132    | 44.9 |

total explosives weight in Blast (kg): 11,295  
Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 49     |
| UNITRONIC 600 15M |          |    | 10     |
| UNITRONIC 600 20M |          |    | 7      |
| UNITRONIC 600 25M |          |    | 66     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 5      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 3 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 1.0  |
| BULK TRUCK CHARGE      | >=10,000 kg                  | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 15.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 1.0  |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 27,342 te      | 10,516 m <sup>3</sup> |
| Total tonnes per day: | 27,342 te      | NB80-01 Rate Code     |
| Total Holes Loaded:   | 50 holes       |                       |
| ... including:        | Dead Holes     |                       |
| ... and:              | 1 Helper Holes |                       |
| Helper Hole Collar:   | 60.0 ft avg    |                       |
| # Rows Blasted:       | 5 rows         |                       |

### - Pattern (Front Row) -

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 22 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 28 main body |

Bench Height: 73.4 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 75.4 ft avg

### - Stone Decking -

|            |              |
|------------|--------------|
| Front Row: | 8.0 ft avg   |
| Main Body: | 8.0 ft avg   |
| # Decks:   | 16 per blast |

### - Collar Stemming -

|                |            |
|----------------|------------|
| Front Row:     | 7.0 ft avg |
| Main Body:     | 7.0 ft avg |
| Material used: | .75' Stone |

### - Charge Length -

|            |             |
|------------|-------------|
| Front Row: | 60.4 ft avg |
| Main Body: | 60.4 ft avg |

### - Charge Weight -

|                  |                               |
|------------------|-------------------------------|
| Front Row:       | 176.2 kg/hole                 |
| Main Body:       | 176.2 kg/hole                 |
| Max. per delay:  | 288.0 kg/delay                |
| SD () Equation:  | 160.6 kg/delay                |
| Total kg Loaded: | 11,295 kg                     |
| Rock Density:    | 2.60 g/cc = te/m <sup>3</sup> |

### - Powder Factor -

|            |                           |
|------------|---------------------------|
| Yield PF:  | 0.413 kg/te (actual)      |
| Front row: | 0.272 kg/te (theoretical) |
| Main Body: | 0.362 kg/te (theoretical) |
| "KPI" PF:  | 0.344 kg/te (theoretical) |

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

3 Helper due to the amount of voids found on the drill log.

16 Stone decks in total



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-11-01

Blast Number: 18-019  
Orica Order #: 2407202  
Blast Time: 11:57 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40371       | 79.88251        | 0.757538    | 1.394213    |
| Front Row Corner          | 43.40391       | 79.88264        | 0.757541    | 1.394215    |
| Back Row Corner           | 43.40352       | 79.88237        | 0.757534    | 1.394210    |
| Average (Centre of Blast) | 43.40371       | 79.88251        | 0.757538    | 1.394213    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 380.2                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 5.7                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 11.3         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 116.3 | dB              | Trigger set at: 124 | dB                                     |
| 2450 2nd Line                             |                         |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 965.3                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.3                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 12.2         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 118.8 | dB              | Trigger set at: 120 | dB                                     |
| Coling rd & Blind Line ( Bruce Trail)     |                         |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1257.1                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 1.8                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 41.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 114.2 | dB              | Trigger set at: 120 | dB                                     |
| South West Corner of Property             |                         |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(380.2)^2}{30^2} \text{ kg}$$

$$= \frac{144,552}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

|             |            |
|-------------|------------|
| Quarry:     | Burlington |
| P.O. #:     |            |
| Blast Date: | 10/23/2018 |

|                |         |
|----------------|---------|
| Blast Number:  | 18-019  |
| Orica Order #: | 2407202 |

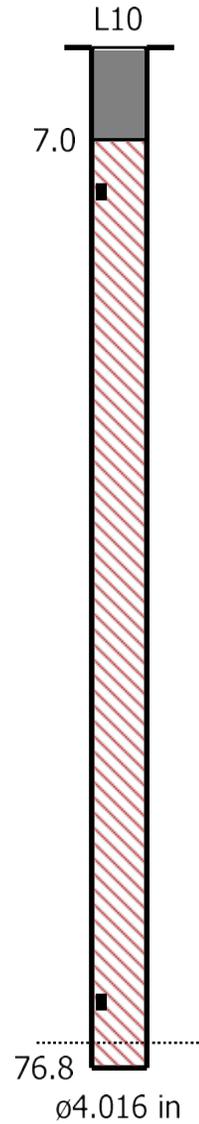
page 2

Paste ShotPlus Diagram inside Rectangle:



UNI Tronic (?)ms 20ft  
PENTEX BC 12 \* 340 x1

UNI Tronic (?)ms 98ft  
PENTEX BC 12 \* 340 x1



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Bill White*

Signature required, indicating sign off on Blast Design.

**Date/Time** MicL at 11:57:30 November 1, 2018  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.357 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/COLLING RD\_BURLINGTO.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.6 Volts  
**Unit Calibration** February 14, 2018 by InstanTEL  
**File Name** UM6857\_20181101115730.IDFW

**Notes**

**Location:** COLLING RD & BLINDLINE  
**Client:** NELSON AGGREGATES  
**User Name:** ORICA CANADA  
**General:**

**Extended Notes**

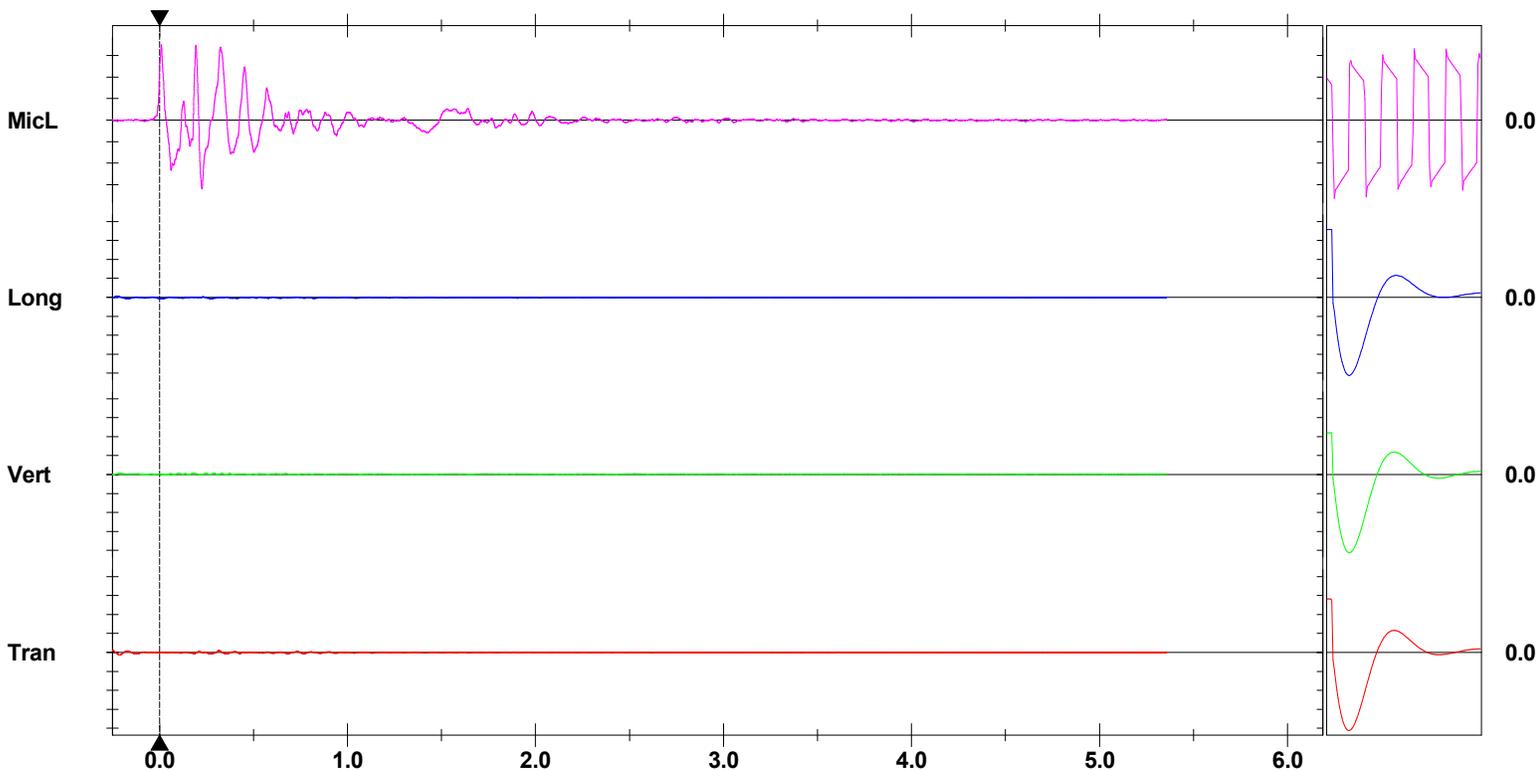
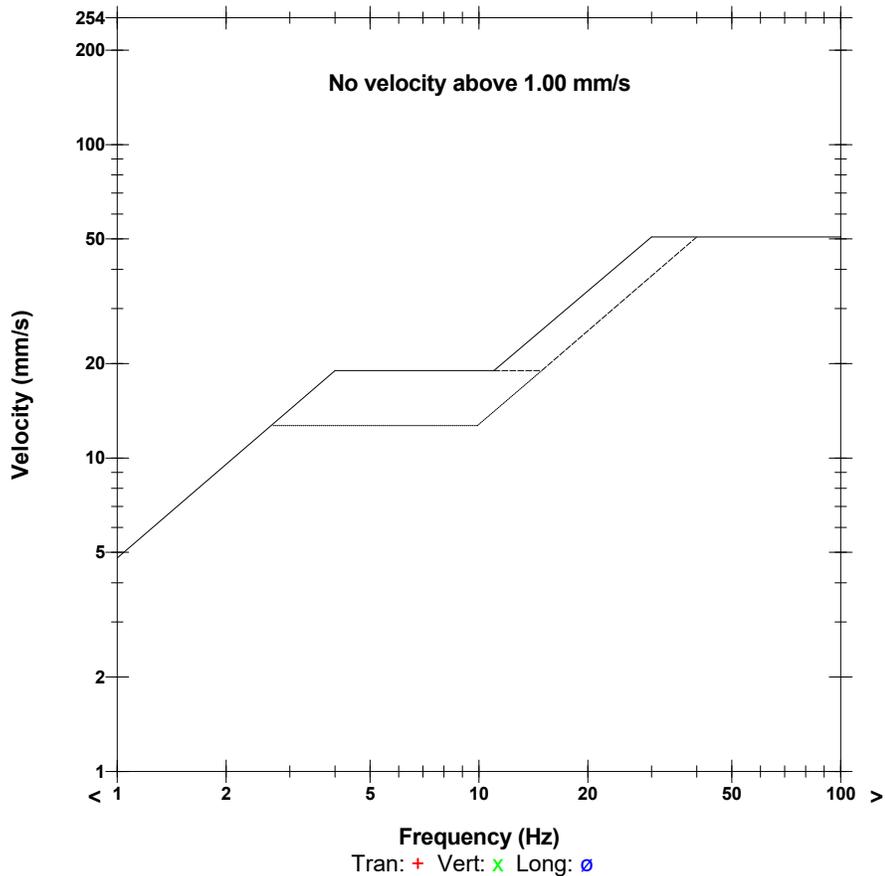
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 118.8 dB(L) at 0.010 sec  
**ZC Freq** 5.7 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1551 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.284  | 0.166  | 0.181  | mm/s |
| ZC Freq             | 12.2   | 17.7   | 7.5    | Hz   |
| Time (Rel. to Trig) | -0.209 | 0.292  | 0.275  | sec  |
| Peak Acceleration   | 0.010  | 0.010  | 0.010  | g    |
| Peak Displacement   | 0.004  | 0.023  | 0.018  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.5    | 3.5    | 3.5    |      |

**Peak Vector Sum** 0.299 mm/s at -0.209 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Long at 11:57:29 November 1, 2018  
**Trigger Source** Geo: 1.500 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.0 sec at 2048 sps  
**Operator/Setup:** ORICA CANADA/Nelson 2450 2nd.MMB

**Serial Number** UM9119 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** December 7, 2017 by InstanTel  
**File Name** UM9119\_20181101115729.IDFW

**Notes**

Location: 2450 2nd Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

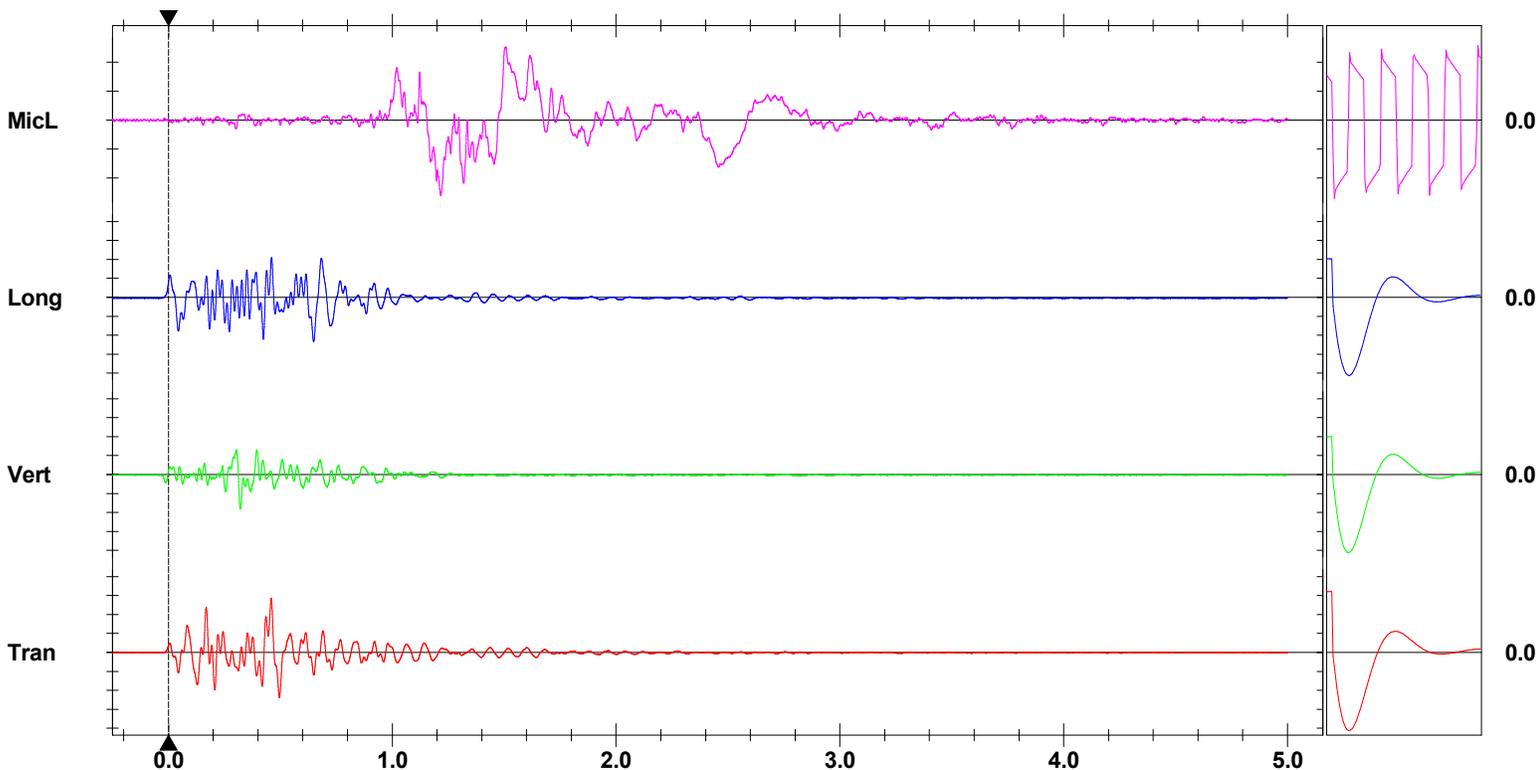
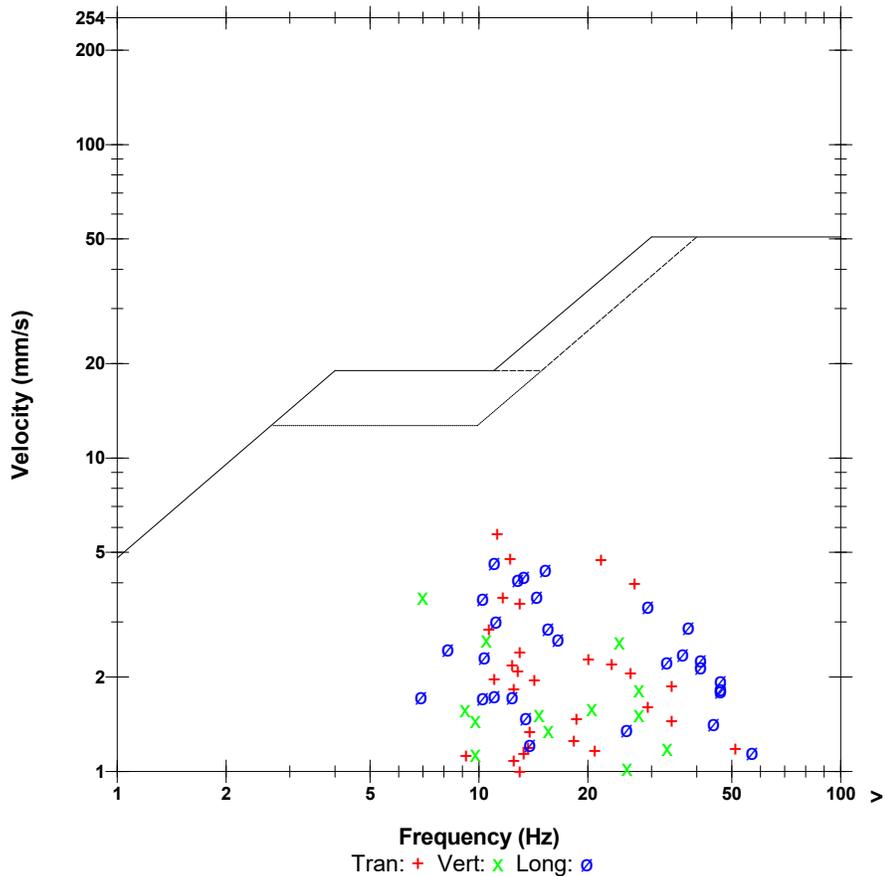
43.40245,-79.87814  
 Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 116.3 dB(L) at 1.216 sec  
**ZC Freq** 4.1 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 1547 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 5.714  | 3.618  | 4.658  | mm/s |
| ZC Freq             | 11.3   | 7.0    | 11.0   | Hz   |
| Time (Rel. to Trig) | 0.459  | 0.321  | 0.648  | sec  |
| Peak Acceleration   | 0.092  | 0.066  | 0.123  | g    |
| Peak Displacement   | 0.068  | 0.049  | 0.055  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.1    | 7.5    | 7.3    | Hz   |
| Overswing Ratio     | 3.7    | 3.8    | 3.8    |      |

**Peak Vector Sum** 7.029 mm/s at 0.460 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Long at 11:57:29 November 1, 2018  
**Trigger Source** Geo: 1.500 mm/s, Mic: 121.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.024 sec (Auto=4Sec) at 2048 sps  
**Operator/Setup:** Operator/Nelsons SW.mmb

**Serial Number** UM6859 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** December 22, 2017 by InstanTel  
**File Name** UM6859\_20181101115729.IDFW

**Notes**

**Location:** SouthWest Corner of Quarry  
**Client:** Nelsons Burlington  
**User Name:** Orica Canada Inc.  
**General:** Monitoring Vibration and Airblast

**Extended Notes**

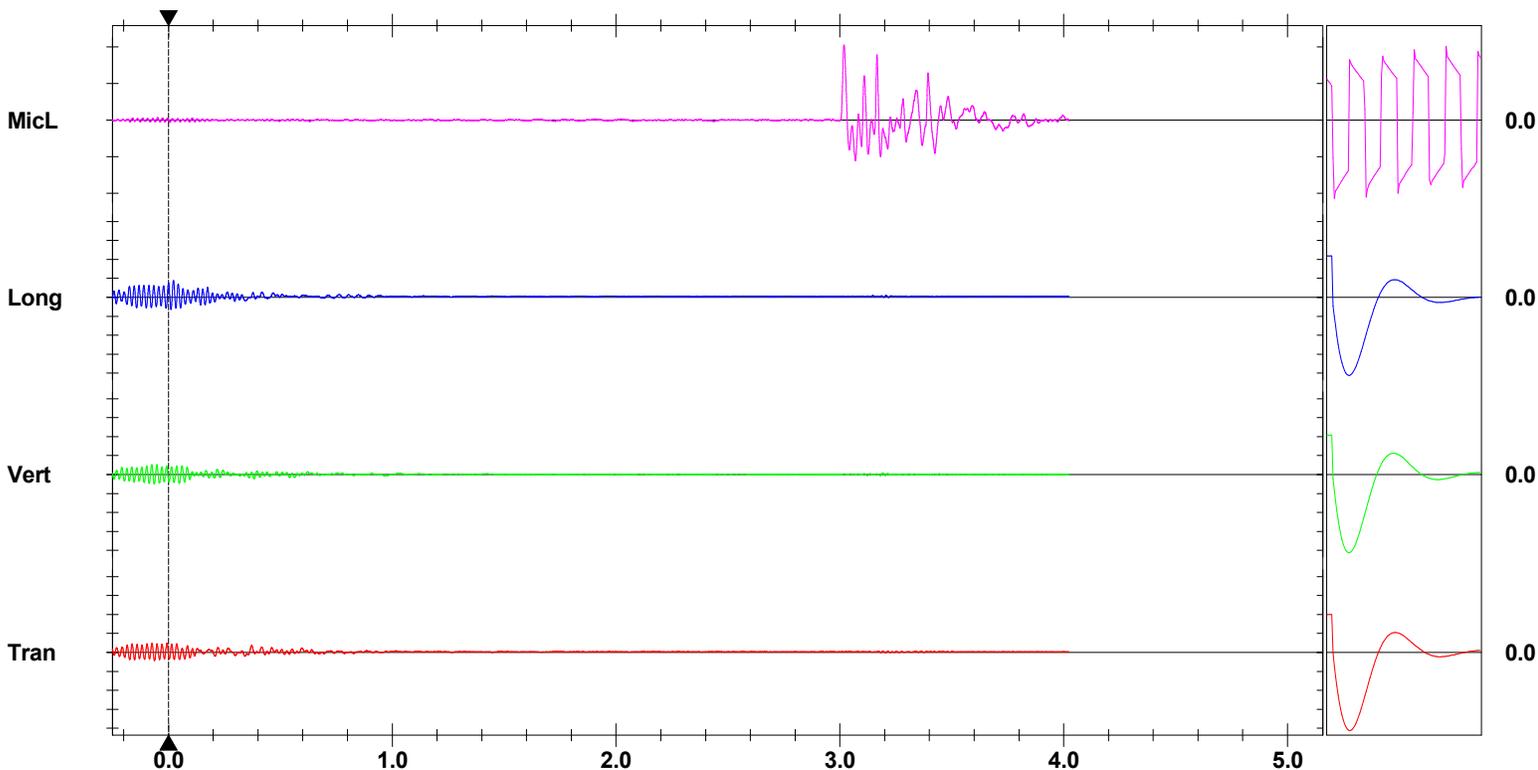
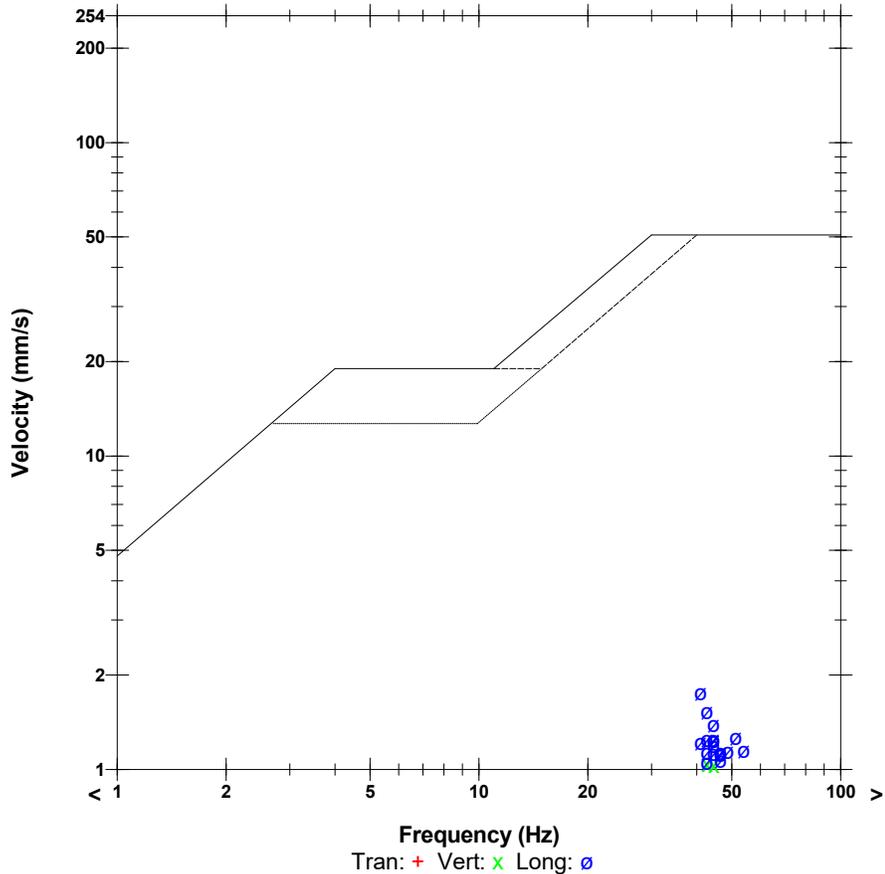
N 43.39339  
 W 79.88880

**Microphone** Linear Weighting  
**PSPL** 114.2 dB(L) at 3.019 sec  
**ZC Freq** 17.1 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1525 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.977  | 1.040  | 1.766  | mm/s |
| ZC Freq             | 43     | 43     | 41     | Hz   |
| Time (Rel. to Trig) | -0.007 | -0.052 | 0.022  | sec  |
| Peak Acceleration   | 0.031  | 0.038  | 0.048  | g    |
| Peak Displacement   | 0.060  | 0.004  | 0.105  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.1    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.9    | 3.6    | 4.4    |      |

**Peak Vector Sum** 1.938 mm/s at 0.023 sec

**USBM R18507 And OSMRE**



**Time Scale:** 0.20 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

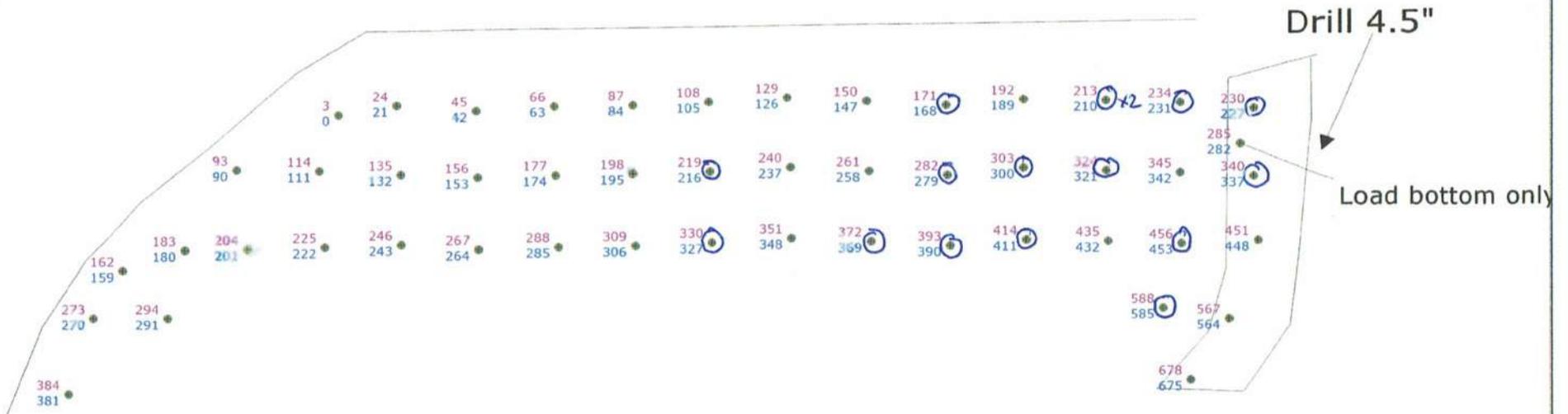
Sensor Check

### SHOTPlus 5 Plan

#### Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.3ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 50 | Hole angle: 0.0° |
| Total drilled: 3772.9ft |                      |                     |                  |

○ = DECK

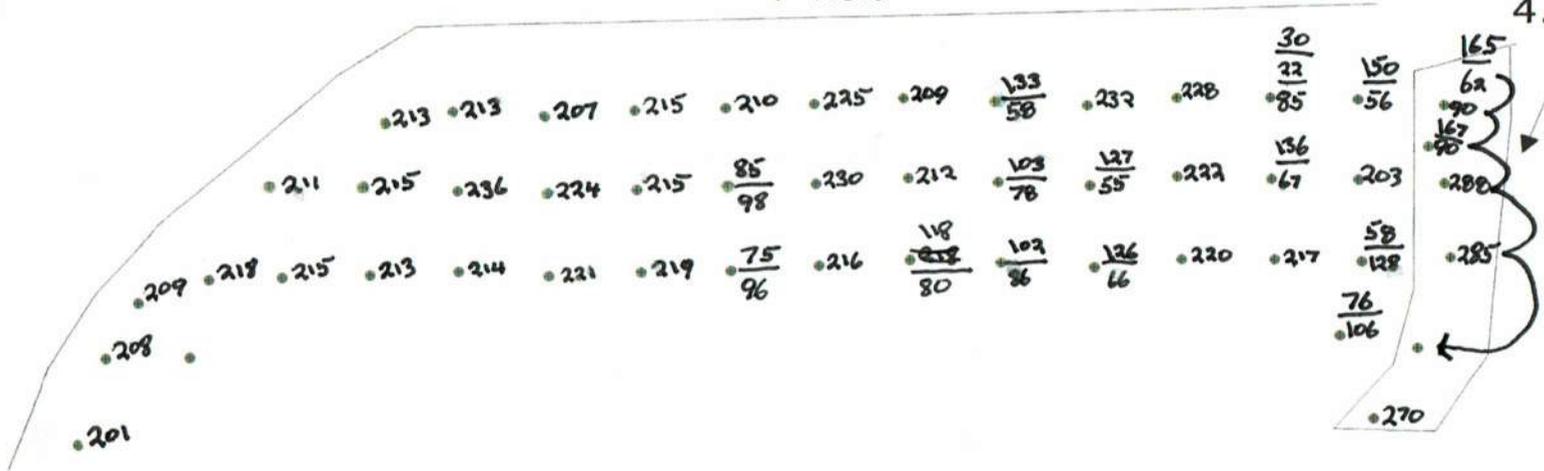


Not to scale

|                                |                                            |
|--------------------------------|--------------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 10/31/2018                                 |
| Mine                           | Burlington                                 |
| Location                       | UPPER MIDDLE SOUTH FACE SCAN Design        |
| Title/author                   | Design 18-019 UPPER MIDDLE Partial Fnl     |
| Filename                       | 2018-11-02 18-019 Revised Timing Upper Mid |

Load Sheet  
250 Kg  
4" Hole

320 Kg  
4.5" Hole



|                                |                                            |
|--------------------------------|--------------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 10/29/2018                                 |
| Mine                           | Burlington                                 |
| Location                       | UPPER MIDDLE SOUTH FACE SCAN Design        |
| Title/author                   | Design 18-019 UPPER MIDDLE Partial Fnl     |
| Filename                       | Dessign_18-019_Upper_Middle_Partial_Fnl tm |

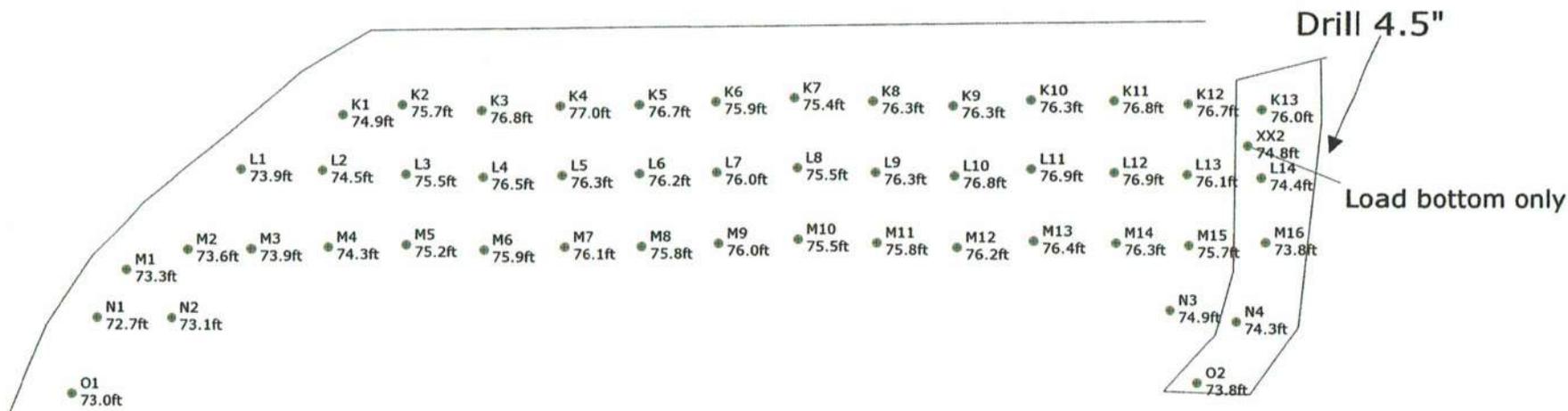


Not to scale

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.3ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 50 | Hole angle: 0.0° |
| Total drilled: 3772.9ft |                      |                     |                  |



Not to scale

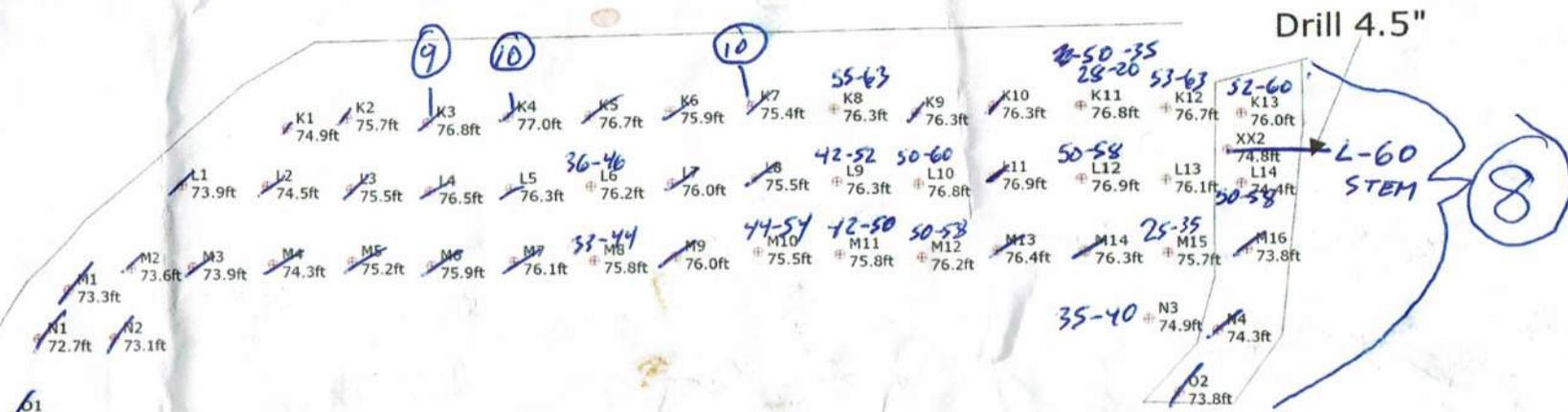
|                                |                                            |           |
|--------------------------------|--------------------------------------------|-----------|
| SHOTPlus™ Professional 5.7.3.0 |                                            | 11/1/2018 |
| Mine                           | Burlington                                 |           |
| Location                       | UPPER MIDDLE SOUTH FACE SCAN Design        |           |
| Title/author                   | Design 18-019 UPPER MIDDLE Partial Fnl     |           |
| Filename                       | 2018-11-02 18-019 Revised Timing Upper Mid |           |

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.3ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 50 | Hole angle: 0.0° |
| Total drilled: 3772.9ft |                      |                     |                  |

16 DECKS



Design 18-019 UPPER MIDDLE Partial Fnl - 4" Blast Hole 12x10 9x10 274 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_



Not to scale

|                                |                                            |
|--------------------------------|--------------------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 10/23/2018                                 |
| Mine                           | Burlington                                 |
| Location                       | UPPER MIDDLE SOUTH FACE SCAN Design        |
| Title/author                   | Design 18-019 UPPER MIDDLE Partial Fnl     |
| Filename                       | Dessign_18-019_Upper_Middle_Partial_Fnl.sp |

1091137

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.

Bill of Lading / Connaissancement



CONSIGNOR EXPÉDITEUR GRAND VALLEY 033411 SIDE ROAD 21-22 GRAND VALLEY ON CA L9W 7G1

CONSIGNEE CONSIGNATAIRE NELSON AGGREGATE COMPANY BURLINGTON ON CA L7R 4L8

Table with fields: GROSS / BRUT, TARE, NET, TIME IN HEURE D'ENTRÉE, TIME OUT HEURE SORTIE, ORDER NUMBER N° DE COMMANDE, B/L NUMBER N° DE CONNAISSEMENT. Includes handwritten values: 6:45am, 2407202, 86185300.

REPRINT

PAGE 2

Table with 4 columns: DATE REQUIRED / DATE REQUISE, TIME REQUIRED / HEURE REQUISE, INVOICE TO / BUYER / FACTURÉ À / ACHETEUR, CUSTOMER REFERENCE NO. / N° DE COMMANDE DU CLIENT. Includes handwritten values: 01 Nov 2018, 00:00:00, NELSON AGGREGATE COMPANY, n/a, PT 15013.

Orica Truck

Main table with columns: QTY. QTE, UM, DG MD, QTY. RET'D QTE. RET., QTY. SOLD QTE. FACT, DESCRIPTION, # OF / DE PKGS., AMOUNT MONTANT. Lists items like PENTEX BC 340, Harness Wire Duplex, etc. Includes handwritten corrections and totals.

24 HOUR NUMBER 1-613-996-6666

Table with 4 columns: EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE, EMERGENCY RESPONSE NO./24 HOUR NUMBER / TÉLÉPHONE D'URGENCE/24 HEURE NUMERO, PLACARDS OFFERED / PLACARDS OFFERT, FORWARD INVOICE FOR PREPAID FREIGHT QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À NO DE CONNAISSEMENT D'ORICA: Orica Canada Inc. 301 rue hotel de ville Brownsburg-Chatham, QC J8G 3B5

Table with 3 columns: CONSIGNOR / EXPÉDITEUR (GRAND VALLEY), CARRIER / TRANSPORTEUR (Orica Truck), CONSIGNEE / DESTINATAIRE (NELSON AGGREGATE COMPANY). Includes signature and date fields for shipper, driver, and receiver.

2 SHIPPING ORDER BON D'EXPÉDITION (AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)

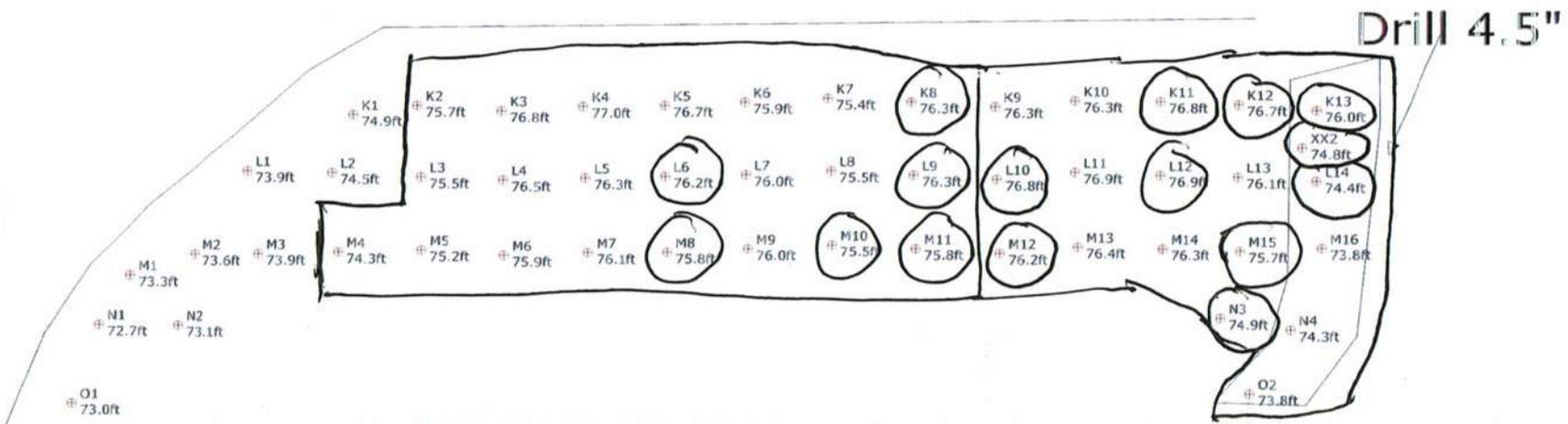
SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO



Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.3ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.1ft  | Hole Diameter: 4.0in | Number of holes: 50 | Hole angle: 0.0° |
| Total drilled: 3772.9ft |                      |                     |                  |

4" dia = 3326"  
 4½" dia = 4471"



Design 18-019 UPPER MIDDLE Partial Fnl - 4" Blast Hole 12x10 9x10 274 and 250 +  
 DRILLER NAME: \_\_\_\_\_



Not to scale

|                                 |                                    |
|---------------------------------|------------------------------------|
| SHOTPlus™ Professional 5.7.4.19 | 11/10/2018                         |
| Mine                            | Burlington                         |
| Location                        | UPPER MIDDLE SOUTH FACE SCAN I     |
| Title/author                    | Design 18-019 UPPER MIDDLE Partia  |
| Filename                        | Dessign_18-019_Upper_Middle_Partia |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2018-11-08

Blast Number: 18-020

Orica Order #: 2410149

Blast Time: 11:57 AM

page 1

Blaster-in-charge: Mike derkinderen (Print Name)

Blast Location: Floor (Bench / Face)

GPS Coordinates: 43.40437 °N Latitude 79.88535 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 5 kph Temperature: 1 to 5 °C

Clear:  Rain:  Overcast:  X  
Partly Cloudy:  Snow:  Inversion:  X Ceiling: 3,758 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 251 = 2,756.0 ft ( 4 " diam)  
Secondary Bit diam: mm Angle from Vertical: 0° # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm Angle from Vertical: 0° # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 25,140  | 22,650   | 2,490 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 251    | 85.3 |

total explosives weight in Blast (kg): 2,575

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                  | case #'s | ms     | # used |
|------------------|----------|--------|--------|
| EXEL HANDIDET 9m |          | 25/500 | 251    |
| CONNECTADET 9M   |          | 25 ms  | 18     |
| CONNECTADET 9M   |          | 42 ms  | 23     |
| UNITRONIC 600 6M |          |        | 2      |

### Cord & Accessories:

|                                   | U of M | # used |
|-----------------------------------|--------|--------|
| HARNESS WIRE DUPLEX (6 PACK) 400M | units  | 0      |
|                                   | units  |        |
|                                   | units  |        |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 3 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                        |                              |      |
|------------------------|------------------------------|------|
| GPS LAYOUT             | Enter hours                  | 2.5  |
| BULK TRUCK CHARGE      | >=2,000kg <5,000kg           | 1    |
| BLASTER HOURS          | Enter Blaster hours          | 7.0  |
| HELPER HOURS           | Enter total Helper man-hours | 18.0 |
| SEISMOGRAPH RENTAL     | Enter # Orica Seismographs   | 0    |
| 3D LASER PROFILE       | Enter hours                  | 0.0  |
| BORETRACK              | Enter hours                  | 0.0  |
| TECHNICAL BLAST DESIGN | (per day) Enter # of days    | 0.0  |

Tonnes Blasted: 24,552 te 9,443 m<sup>3</sup>  
Total tonnes per day: 24,552 te NF-14 Rate Code  
Total Holes Loaded: 251 holes  
... including: Dead Holes  
... and: Helper Holes  
Helper Hole Collar: ft avg  
# Rows Blasted: 12 rows

### - Pattern (Front Row) -

Burden: 11.0 ft avg  
Spacing: 11.0 ft avg  
# Holes: 21 front row

### - Pattern (Main Body) -

Burden: 11.0 ft avg  
Spacing: 11.0 ft avg  
# Holes: 230 main body

Bench Height: 11.0 ft avg

Sub-drill: 0.0 ft avg

Hole Depth: 11.0 ft avg

### - Stone Decking -

Front Row: ft avg  
Main Body: ft avg  
# Decks: per blast

### - Collar Stemming -

Front Row: 7.0 ft avg  
Main Body: 7.0 ft avg  
Material used: .75" Stone

### - Charge Length -

Front Row: 4.0 ft avg  
Main Body: 4.0 ft avg

### - Charge Weight -

Front Row: 11.6 kg/hole  
Main Body: 11.6 kg/hole  
Max. per delay: 21.0 kg/delay  
SD () Equation: 429.0 kg/delay  
Total kg Loaded: 2,575 kg  
Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.105 kg/te (actual)  
Front row: 0.119 kg/te (theoretical)  
Main Body: 0.119 kg/te (theoretical)  
"KPI" PF: 0.119 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### Cost Reduction Notes (this Blast) - change in Bit, B, S, Expl or IS from previous Blast:

1 Extra helper due to the number of holes

1 Advanced Blast design



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 2018-11-08

Blast Number: 18-020  
Orica Order #: 2410149  
Blast Time: 11:57 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40442       | 79.88533        | 0.757550    | 1.394262    |
| Front Row Corner          | 43.40454       | 79.88495        | 0.757552    | 1.394255    |
| Back Row Corner           | 43.40417       | 79.88577        | 0.757546    | 1.394270    |
| Average (Centre of Blast) | 43.40437       | 79.88535        | 0.757549    | 1.394262    |

| 1st Seismograph Co-ordinates                         | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|------------------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                                          | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                                          |                         |                 |                     |                                        |
| Average                                              | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast)            | 621.4                   | m               |                     |                                        |
| Post Blast Data:                                     | ppV: 2.0                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                                      | frequency: 43.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                                      | air overpressure: 110.4 | dB              | Trigger set at: 115 | dB                                     |
| 2450 2nd Line ( Beside cut tree stump in front yard) |                         |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1254.2                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |
| South West Corner of Property             |                           |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.        | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-----------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               |                       |                 |                     |                                        |
| 2nd Reading                               |                       |                 |                     |                                        |
| Average                                   | 0.00000               | 0.00000         | 0.000000            | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | 0.0                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.0              | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 0.0        | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 0.0 | dB              | Trigger set at: 115 | dB                                     |

Scaling Factor denotes the degree of Blast confinement. The higher the SF, the more confined the Blast.

A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$W = \frac{D^2}{30^2}$$

$$= \frac{(621.4)^2}{30^2} \text{ kg}$$

$$= \frac{386,138}{900} \text{ kg}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that Blast Report is Complete & Accurate.



# Blast Design

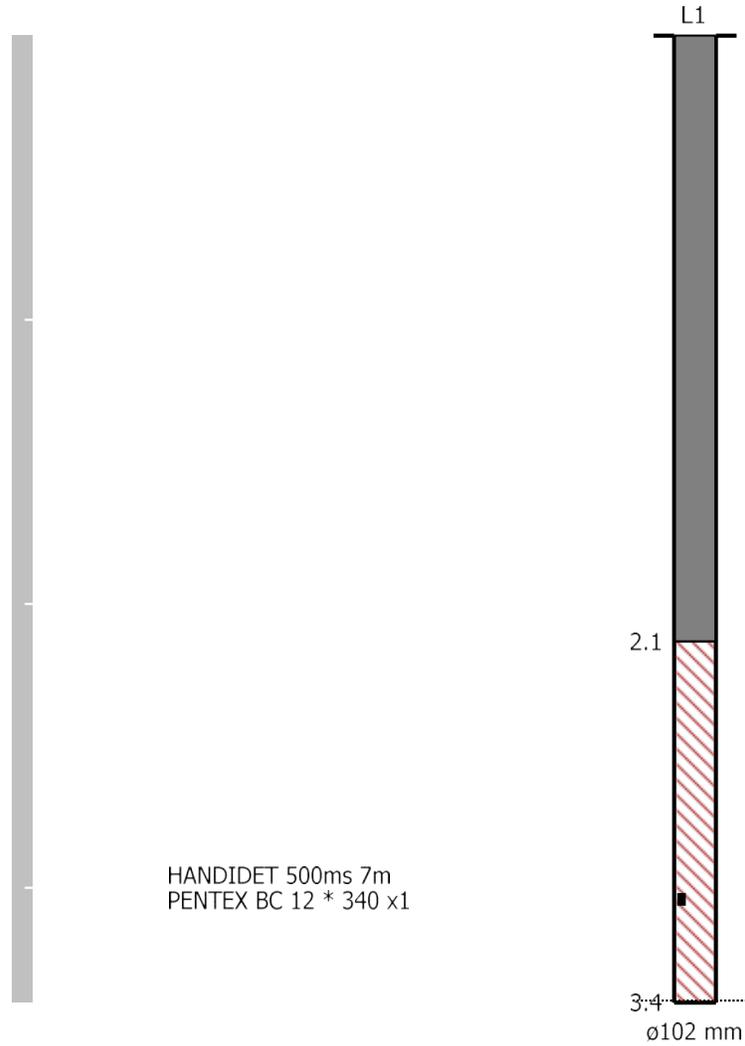
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 11/8/2018

Blast Number: 18-020  
Orica Order #: 2410149

page 2

Paste ShotPlus Diagram inside Rectangle:



HANDIDET 500ms 7m  
PENTEX BC 12 \* 340 x1

**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

Signature required, indicating  
sign off on Blast Design.

**Date/Time** Vert at 12:57:15 November 8, 2018  
**Trigger Source** Geo: 1.500 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.0 sec at 2048 sps  
**Operator/Setup:** ORICA CANADA/Nelson 2450 2nd.mmb

**Serial Number** UM9119 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** December 7, 2017 by InstanTEL  
**File Name** UM9119\_20181108125715.IDFW

**Notes**

**Location:** 2450 2nd Line  
**Client:** Nelson Aggregates  
**User Name:** Orica Canada Inc.  
**General:** Burlington

**Extended Notes**

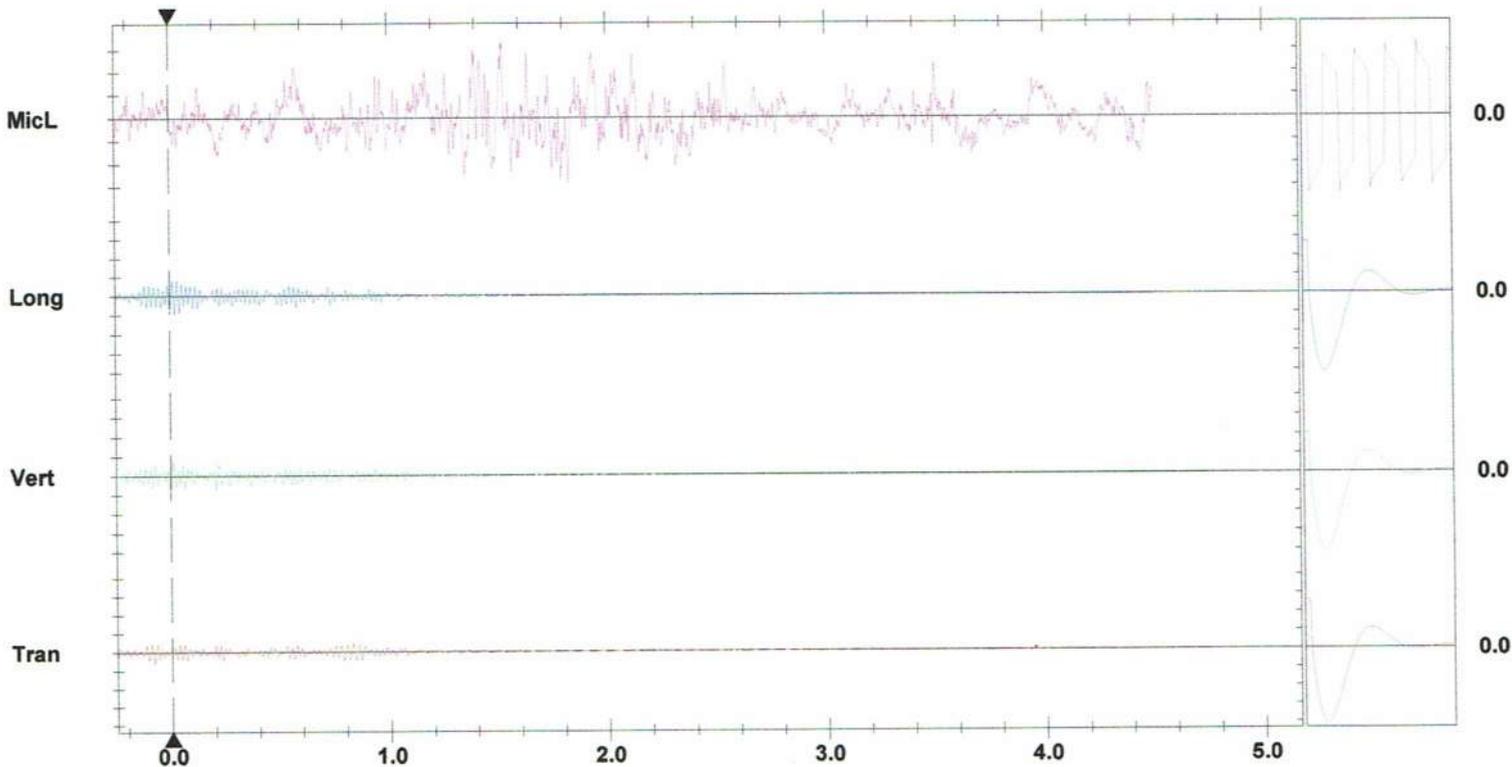
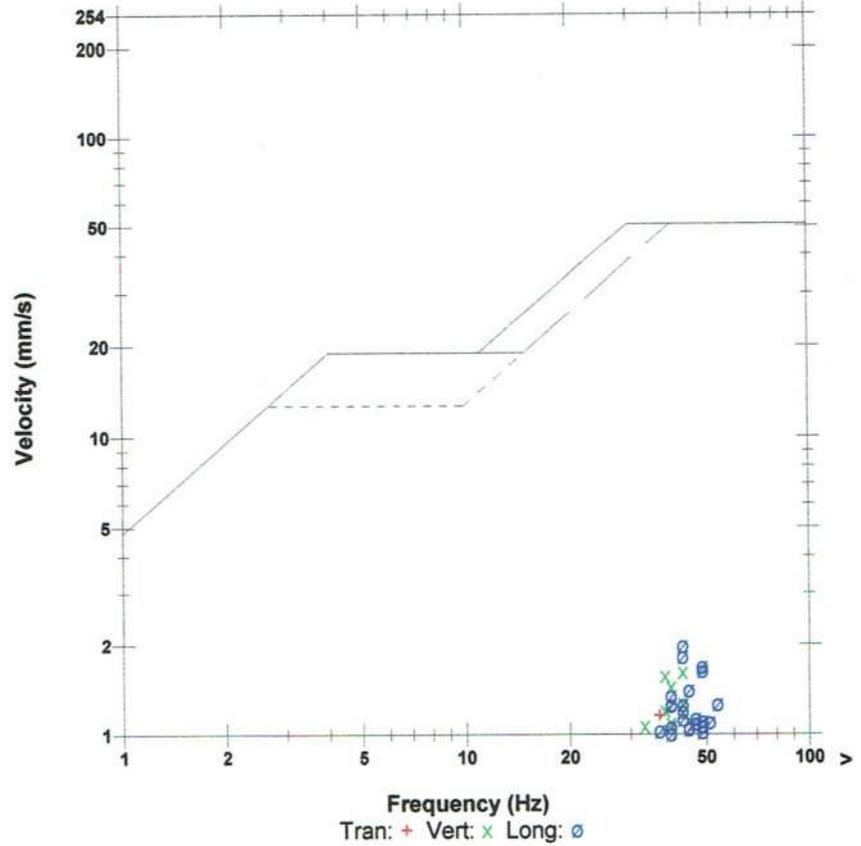
43.40245,-79.87814  
 Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 110.4 dB(L) at 1.525 sec  
**ZC Freq** 14.2 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1585 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 1.151  | 1.616  | 1.978  | mm/s |
| ZC Freq             | 37     | 43     | 43     | Hz   |
| Time (Rel. to Trig) | -0.081 | 0.013  | 0.022  | sec  |
| Peak Acceleration   | 0.031  | 0.046  | 0.089  | g    |
| Peak Displacement   | 0.005  | 0.008  | 0.018  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.1    | 7.3    | 7.3    | Hz   |
| Overswing Ratio     | 3.9    | 3.9    | 3.9    |      |

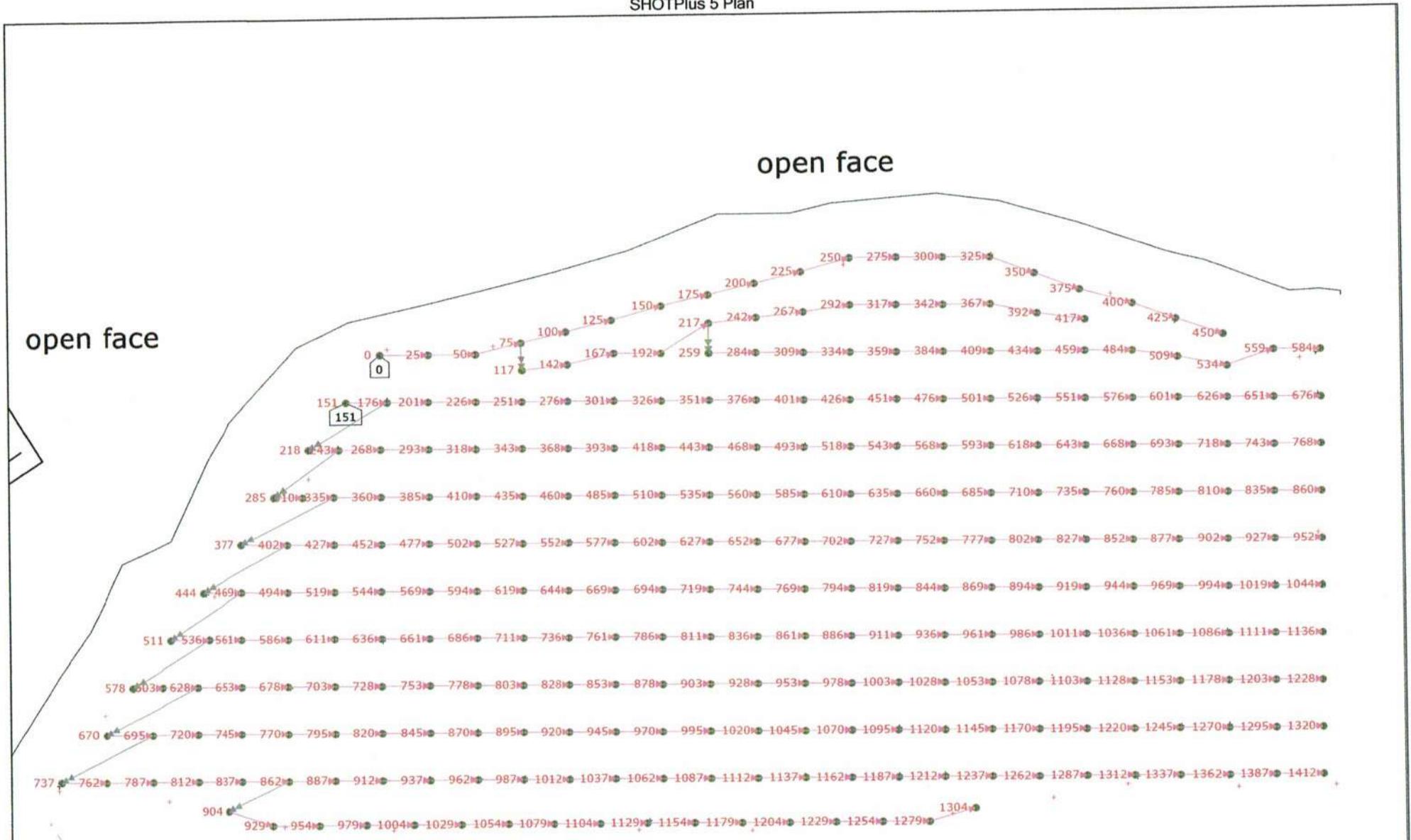
**Peak Vector Sum** 2.305 mm/s at 0.023 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 2.000 pa.(L)/div  
**Trigger =**

Sensor Check



ARMOUR STONE ROW

ARMOUR STONE ROW

ARMOUR STONE ROW

Design 18-020 FLOOR Fnl - 4" Blast Hole 11.5x11.5 253 and 249.6 ELEV

SHOTPlus™ Professional 5.7.4.4 11/8/2018

Mine Burlington

Location FLOOR

Title/author Design 18-020 FLOOR

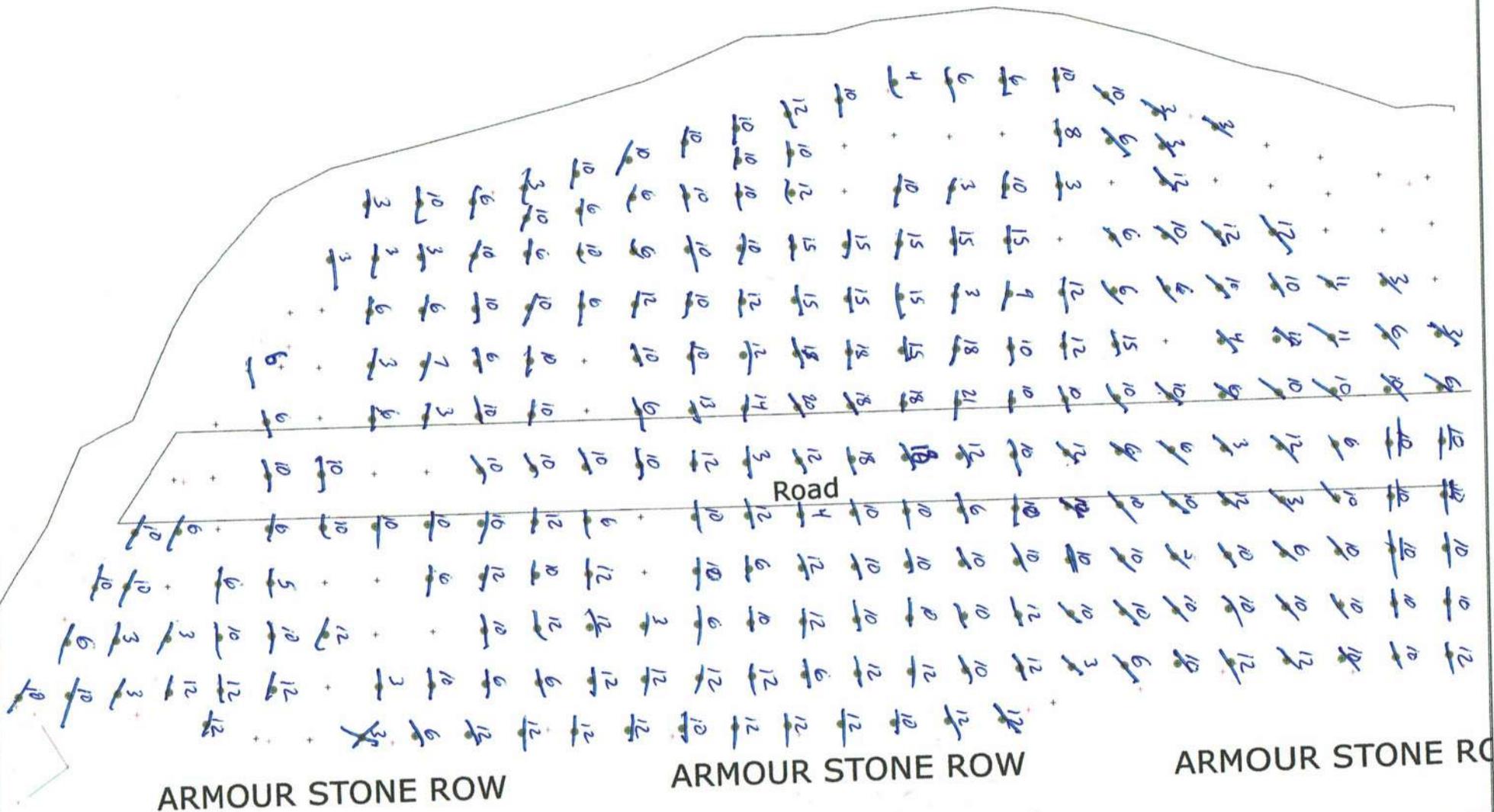
Filename Design\_18-020\_FLOOR\_Final R1.spf



**DRILL TO SHALE**

Not to scale

Load sheet  
Max Load 21Kg



Not to scale

|                                |                               |           |
|--------------------------------|-------------------------------|-----------|
| SHOTPlus™ Professional 5.7.4.4 |                               | 11/7/2018 |
| Mine                           | Burlington                    |           |
| Location                       | FLOOR                         |           |
| Title/author                   | Design 18-020 FLOOR           |           |
| Filename                       | Design_18-020_FLOOR_Final.spf |           |

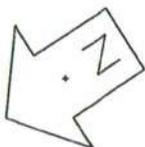
SHOTPlus 5 Plan

Blast Summary Data

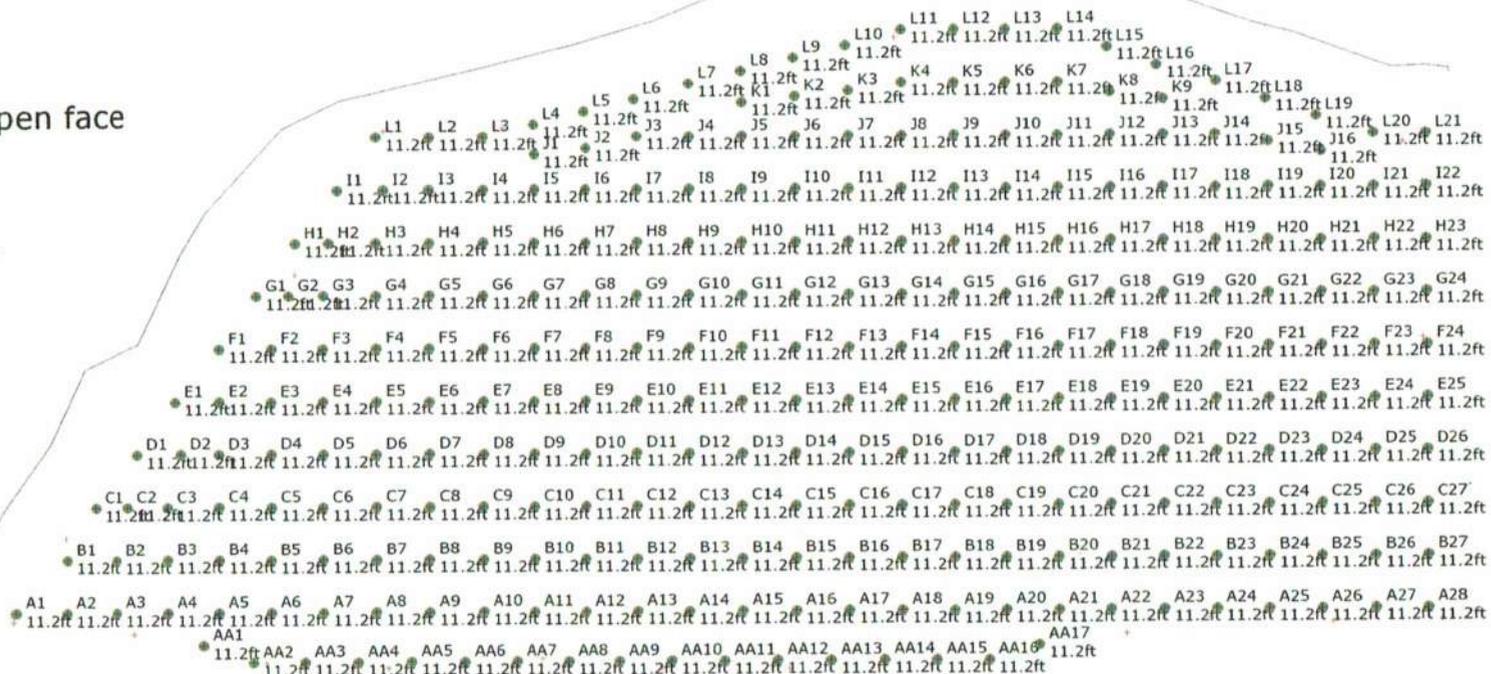
|                         |                      |                      |                  |
|-------------------------|----------------------|----------------------|------------------|
| Burden: 11.8ft          | Spacing: 11.8ft      | Subdrill: 0.0ft      | Stemming: 5.6ft  |
| 1st row burden: 11.8ft  | Hole Diameter: 4.0in | Number of holes: 289 | Hole angle: 0.0° |
| Total drilled: 3228.3ft |                      |                      |                  |

open face

open face



= BILL'S  
MARKI  
STONES



ARMOUR STONE ROW                      ARMOUR STONE ROW                      ARMOUR STONE ROW

Design 18-020 FLOOR Fnl - 4" Blast Hole 11.5x11.5 253 and 249.6 ELEV



DRILL TO SHALE

Not to scale

|                                |                               |
|--------------------------------|-------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 11/1/2018                     |
| Mine                           | Burlington                    |
| Location                       | FLOOR                         |
| Title/author                   | Design 18-020 FLOOR           |
| Filename                       | Design_18-020_FLOOR_Final.spf |

1091195

COMBINATION SHORT FORM STRAIGHT BILL OF LADING-EXPRESS SHIPPING CONTRACT ADOPTED BY RAIL FREIGHT AND EXPRESS CARRIERS SUBJECT TO THE JURISDICTION OF THE NATIONAL TRANSPORT AGENCY.  
FORMULE COMBINÉE ET ABRÉGÉE DE CONNAISSEMENT NOMINATIF ET CONTRAT DE TRANSPORT DE MESSAGERIES  
SOUS RÉSERVE DE LA JURISDICTION DE L'OFFICE DES TRANSPORTS.



**Orica Canada Inc.**

GRAND VALLEY

CONSIGNOR  
EXPÉDITEUR  
033411 SIDE ROAD 21-22  
GRAND VALLEY ON  
CA L9W 7G1

**Bill of Lading / Connaissance**

|                                |                                   |
|--------------------------------|-----------------------------------|
| GROSS / BRUT                   |                                   |
| TARE                           |                                   |
| NET                            |                                   |
| TIME IN<br>HEURE D'ENTRÉE      | TIME OUT<br>HEURE SORTIE          |
| ORDER NUMBER<br>N° DE COMMANDE | B/L NUMBER<br>N° DE CONNAISSEMENT |
| 2410149                        | 86192440                          |

CONSIGNEE  
CONSIGNATAIRE  
NELSON AGGREGATE COMPANY  
BURLINGTON ON  
CA L7R 4L8

|                               |                                          |                                            |                                                    |
|-------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------|
| DATE REQUIRED<br>DATE REQUISE | TIME REQUIRED<br>HEURE REQUISE           | INVOICE TO / BUYER<br>FACTURÉ À / ACHETEUR | CUSTOMER REFERENCE NO.<br>N° DE COMMANDE DU CLIENT |
| 08 Nov 2018                   | 00:00:00                                 | NELSON AGGREGATE COMPANY                   | n/a                                                |
| DATE SHIPPED<br>EXPÉDIÉ LE    | FREIGHT TERMS<br>CONDITIONS DE LIVRAISON | SHIP. MAG. LIC.<br>PERMIS EXPÉDITEUR       | VEHICLE NO.<br>N° DE VÉHICULE                      |
| 08 Nov 2018                   | FOB Dest'n, Own Truck                    | F-73289                                    | PT18230                                            |
| SHIP VIA<br>TRANSPORTEUR      | ROUTING<br>ITINÉRAIRE                    | MAG. LIC. NO.<br>N° DE PERMIS              |                                                    |
| Orica Truck                   | STANDARD                                 |                                            |                                                    |

| QTY.<br>QTÉ.                    | UM | DG<br>MD | QTY. RET'D<br>QTÉ. RET. | QTY. SOLD<br>QTÉ. FACT | DESCRIPTION                            | # OF / DE<br>PKGS. | AMOUNT<br>MONTANT |
|---------------------------------|----|----------|-------------------------|------------------------|----------------------------------------|--------------------|-------------------|
| <b>NET EXPLOSIVES QUANTITY:</b> |    |          |                         |                        | <b>117.137 KG</b>                      |                    |                   |
| 343                             | PC | X        | 92                      | 251                    | PENTEX BC 340 (49/CS)                  | 7                  | 125.195           |
| 1                               | PC |          | 1                       | 0                      | Harness Wire Duplex (6 pack) 400m      | 1                  | 2.920             |
| 5                               | PC | X        | 3                       | 2                      | *uni tronic 600-06.0M CU/ZC(20')80PC   | 1                  | 0.365             |
| 100                             | PC |          | 100                     | 0                      | MINI STEM PLUGS - PART #74853          |                    | 0.700             |
| 390                             | PC | X        | 139                     | 251                    | EXEL HANDIDET 9M 25/500(30') 65/CS     | 6                  | 39.390            |
| 65                              | PC | X        | 47                      | 18                     | EXEL Connectadet 9M 25MS (30 FT) 65/CS | 1                  | 6.305             |
| 65                              | PC | X        | 42                      | 23                     | EXEL Connectadet 9M 42MS (30 FT) 65/CS | 1                  | 6.370             |
| 1                               | PC |          |                         |                        | LICENSED BLASTER                       |                    |                   |
| 1.0                             | HR |          |                         |                        | LABOUR CHARGE                          |                    |                   |
| 1                               | PC |          |                         |                        | ROG (ROCK ON GROUND)                   |                    |                   |
| <b>TOTAL GROSS WEIGHT</b>       |    |          |                         |                        |                                        |                    | <b>181.245 KG</b> |
| **** TOTAL PACKAGES ****        |    |          |                         |                        |                                        | 17                 |                   |

24-HOUR NUMBER: 1-613-996-6666

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                       |                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PALLETS USED / PALETTES UTILISÉES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PALLETS RETURNED / PALETTES RETOURNÉES                                                                | BAGS USED / SACS UTILISÉS                                                                                                                                                                                                             |
| EMERGENCY RESPONSE PLAN / RÉSUMÉ DE PLAN D'URGENCE<br><b>ERAP 2-1510</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | EMERGENCY RESPONSE NO./24 HOUR NUMBER<br>TELEPHONE D'URGENCE/24 HEURE NUMERO<br><b>1-877-561-3636</b> | PLACARDS OFFERED / PLACARDS OFFERT<br><input checked="" type="checkbox"/> YES / OUI <input type="checkbox"/> NO / NON                                                                                                                 |
| THIS IS TO CERTIFY THAT THE ABOVE NAMED ARTICLES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELLED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE NATIONAL TRANSPORTATION AGENCY AND THE DEPARTMENT OF TRANSPORT.<br>NOUS CERTIFIONS QUE LA CLASSE, LA DESCRIPTION, L'EMBALLAGE, LE MARQUAGE ET L'ÉTIQUETAGE DES MARCHANDISES SUSMENTIONNÉES DE MÊME QUE LES CONDITIONS DE TRANSPORT SONT CONFORMES À LA RÉALITÉ ET AUX RÉGLEMENTS DE L'OFFICE NATIONAL DES TRANSPORTS ET DU MINISTÈRE DES TRANSPORTS. |                                                                                                       | DECLARED VALUE OF SHIPMENT<br>VALEUR DÉCLARÉE \$                                                                                                                                                                                      |
| NETTE No. CONV<br>PRESSAGE<br>WT AGREEMENT NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                       | FORWARD INVOICE FOR PREPAID FREIGHT<br>QUOTING ORICA B/L TO / FAIRE SUIVRE FACTURE<br>POUR EXPÉDITION PORT PAYÉ EN RÉFÉRANT À<br>N° DE CONNAISSEMENT D'ORICA:<br><b>301 rus hotel de ville<br/>Brownsburg-Chatham, QC<br/>J6G 3B5</b> |

|                                                              |                                                              |                                                      |
|--------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------|
| CONSIGNOR / EXPÉDITEUR<br>GRAND VALLEY                       | CARRIER / TRANSPORTEUR<br>Orica Truck                        | CONSIGNEE / DESTINATAIRE<br>NELSON AGGREGATE COMPANY |
| SHIPPER'S NAME (PLEASE PRINT) / NOM D'EXPÉDITEUR<br>K. Platt | DRIVER'S NAME (PLEASE PRINT) / NOM DU CAMIONNEUR<br>K. Platt | RECEIVER'S NAME (PLEASE PRINT) / NOM DU RECEVEUR     |
| SIGNATURE<br>K. Platt                                        | DATE<br>8 11 18<br>D/J M/M Y/A                               | SIGNATURE<br>K. Platt                                |
|                                                              | DATE<br>8 11 18<br>D/J M/M Y/A                               | DATE<br>D/J M/M Y/A                                  |

**2 SHIPPING ORDER BON D'EXPÉDITION**  
(AGENT MUST DETACH AND RETAIN THIS SHIPPING ORDER AND MUST SIGN THE ORIGINAL BILL OF LADING-EXPRESS SHIPPING CONTRACT)  
(L'AGENT DOIT DETACHER ET GARDER CETTE COPIE APRES AVOIR SIGNE LA COPIE ORIGINALE (1) DU CONNAISSEMENT CONTRAT D'EXPÉDITION PAR MESSAGERIES)

SUBJECT TO ALL THE TERMS AND CONDITIONS ON THE BACK  
SOUS RÉSERVE DES CONDITIONS ET RESTRICTIONS ÉNUMÉRÉS AU VERSO  
\*\*\*\* PAGE 2 OF 3 \*\*\*\*  
D.F.G. 5772

SHOTPlus 5 Plan

Blast Summary Data

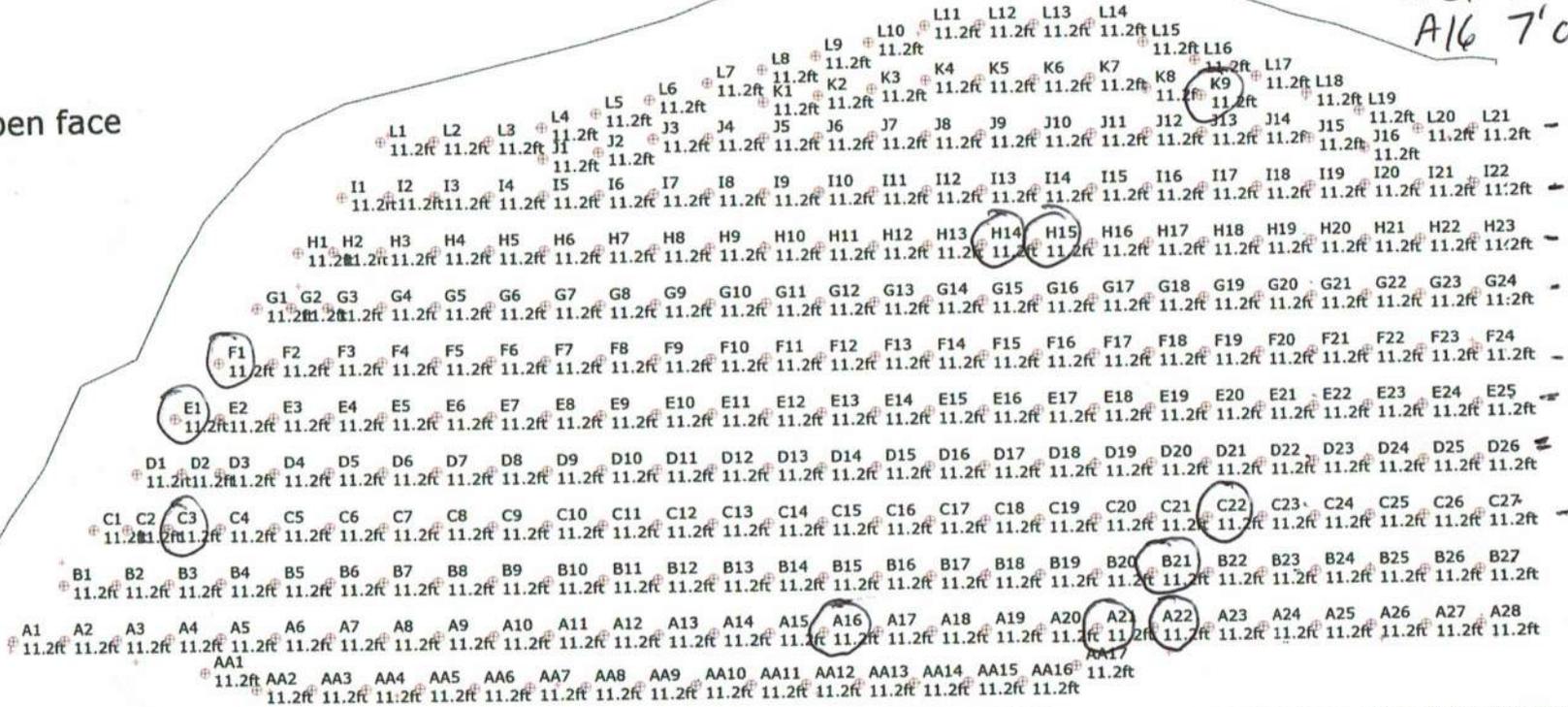
|                         |                      |                      |                  |
|-------------------------|----------------------|----------------------|------------------|
| Burden: 11.8ft          | Spacing: 11.8ft      | Subdrill: 0.0ft      | Stemming: 5.6ft  |
| 1st row burden: 11.8ft  | Hole Diameter: 4.0in | Number of holes: 289 | Hole angle: 0.0° |
| Total drilled: 3228.3ft |                      |                      |                  |

4'-5' Broken material over all holes

H15 6'0B  
 H14 6'0B  
 K9 VOID 7-7.5'  
 C22 VOID 7.5-8'  
 C3 NO ROCK  
 B21 VOID 7-7.5  
 A22 VOID 7-7.5  
 A21 NO ROCK  
 A16 7'0B

open face

open face



= BILL'S  
 MARKI  
 STONE

F1 NO ROCK  
 E1 NO ROCK

ARMOUR STONE ROW

ARMOUR STONE ROW

ARMOUR STONE ROW

Design 18-020 FLOOR Fnl - 4" Blast Hole 11.5x11.5 253 and 249.6 ELEV

DRILL TO SHALE



Not to scale

|                                |                               |
|--------------------------------|-------------------------------|
| SHOTPlus™ Professional 5.7.3.0 | 11/1/2018                     |
| Mine                           | Burlington                    |
| Location                       | FLOOR                         |
| Title/author                   | Design 18-020 FLOOR           |
| Filename                       | Design_18-020_FLOOR_Final.spf |







## SIEMIC REPORT SUMMARY

| Shot # | Date        | Time    | Max<br>Kg/Delay | Hole          | Pattern          | # Of<br>Decks | # Of<br>Rows | # Of<br>Holes | Time Between (ms.) |       |       | Sub<br>Drill | Ave.<br>Water | Ave Hole<br>Depth | Total<br>Tons | Monitor 1 |        | Monitor 2 |        | Monitor 3 |        | Monitor 4 |        |
|--------|-------------|---------|-----------------|---------------|------------------|---------------|--------------|---------------|--------------------|-------|-------|--------------|---------------|-------------------|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|        |             |         |                 | Dia.<br>(in.) | Spacing<br>(ft.) |               |              |               | Burden<br>(ft.)    | Decks | Holes |              |               |                   |               | Rows      | (mm/s) | (dbl.)    | (mm/s) | (dbl.)    | (mm/s) | (dbl.)    | (mm/s) |
| 01-14  | Mar. 5/14   | 11:21AM | 130.80          | 4             | 11.5             | 11.5          | 1            | 8             | 117                | 0     | 25    | 67           | 0             | N/A               | 17.00         | 21800.0   | 1.02   | 103.5     | 2.05   | 104.2     | 1.78   | 115.2     |        |
| 02-14  | Mar. 31/14  | 11:58AM | 75.80           | 4             | 11.5             | 11.5          | 1            | 6             | 102                | 0     | 25    | 67           | 0             | N/A               | 18.75         | 20609.0   | N/R    | N/R       | 2.52   | 103.5     | 1.78   | 115.2     |        |
| 03-14  | Apr. 9/14   | 12:42PM | 54.0            | 4             | 12               | 12            | 1            | 6             | 186                | 0     | 25    | 134          | 0             | N/A               | 13.00         | 28371.2   | 2.03   | 104.9     | 1.02   | 108.0     | 1.02   | 100.0     |        |
| 04-14  | Apr. 21/14  | 12:00PM | 240.79          | 4             | 11               | 11            | 1            | 2             | 37                 | 0     | 13    | 110          | 2             | 73.38             | 81.00         | 29548.2   | 2.79   | 126.7     | N/R    | N/R       | N/R    | N/R       |        |
| 05-14  | Apr. 30/14  | 11:57AM | 107.02          | 4             | 11.5             | 11.5          | 1            | 9             | 138                | 0     | 25    | 67           | 0             | N/A               | 18.00         | 26726.4   | 1.78   | 106.0     | N/R    | N/R       | 1.27   | 101.0     |        |
| 06-14  | May 7/14    | 11:59AM | 44.59           | 4             | 11.5             | 11.5          | 1            | 7             | 162                | 0     | 25    | 67           | 0             | N/A               | 11.00         | 19202.7   | 2.16   | 105.5     | N/R    | N/R       | 1.02   | 104.9     |        |
| 07-14  | May 16/14   | 12:01PM | 80.06           | 4             | 11.5             | 11.5          | 1            | 9             | 125                | 0     | 25    | 67           | 0             | N/A               | 15.50         | 23884.8   | 2.67   | 101.9     | 1.48   | 97.5      | 3.17   | 110.6     |        |
| 08-14  | May 27/14   | 01:08PM | 234.84          | 4             | 11               | 11            | 1            | 2             | 40                 | 0     | 13    | 58           | 2             | 71.56             | 82.25         | 32437.0   | 3.56   | 120.4     | N/R    | N/R       | 1.90   | 125.5     |        |
| 09-14  | Jun. 2/14   | 11:10AM | 89.19           | 4             | 11.5             | 11.5          | 1            | 10            | 116                | 0     | 25    | 67           | 0             | N/A               | 16.00         | 21379.4   | N/R    | N/R       | N/R    | N/R       | N/R    | N/R       |        |
| 10-14  | Jun. 11/14  | 12:00PM | 89.18           | 4             | 11.5             | 11.5          | 1            | 8             | 155                | 0     | 25    | 67           | 0             | N/A               | 13.50         | 26185.5   | N/R    | N/R       | 1.78   | 88.0      | 3.43   | 111.5     |        |
| 11-14  | Jun. 17/14  | 12:07PM | 237.42          | 4             | 11               | 11            | 1            | 2             | 43                 | 0     | 13    | 110          | 2             | 76.29             | 82.50         | 34975.7   | 3.05   | 114.9     | 2.16   | 118.6     | N/R    | N/R       |        |
| 12-14  | Jun. 24/14  | 11:11AM | 65.25           | 4             | 11.5             | 11.5          | 1            | 14            | 164                | 0     | 25    | 67           | 0             | N/A               | 13.50         | 24294.3   | N/R    | N/R       | N/R    | N/R       | 3.05   | 111.2     |        |
| 13-14  | Jul. 7/14   | 12:18PM | 240.79          | 4             | 11               | 11            | 1            | 1             | 34                 | 0     | 13    | 0            | 2             | 70.83             | 80.50         | 26984.8   | 2.92   | 116.9     | N/R    | N/R       | 1.78   | 124.1     |        |
| 14-14  | Jul. 15/14  | 11:57AM | 55.74           | 4             | 11.5             | 11.5          | 1            | 8             | 210                | 0     | 25    | 67           | 0             | N/A               | 11.25         | 25458.1   | N/R    | N/R       | N/R    | N/R       | N/R    | N/R       |        |
| 15-14  | Jul. 21/14  | 12:07PM | 240.79          | 4             | 11               | 11            | 1            | 1             | 35                 | 0     | 13    | 0            | 2             | 77.04             | 83.50         | 28813.7   | 4.57   | 123.4     | 1.02   | 124.2     | N/R    | N/R       |        |
| 16-14  | Aug. 1/14   | 12:02PM | 240.79          | 4             | 11               | 11            | 1            | 1             | 29                 | 0     | 13    | 0            | 2             | 78.28             | 82.75         | 23659.8   | 3.68   | 126.6     | N/R    | N/R       | 1.90   | 127.0     |        |
| 17-14  | Aug. 14/14  | 11:34AM | 77.29           | 4             | 11.5             | 11.5          | 1            | 7             | 155                | 0     | 25    | 84           | 0             | N/A               | 12.50         | 20878.4   | 1.78   | 106.0     | 1.27   | 104.2     | 1.02   | 100.0     |        |
| 18-14  | Aug. 20/14  | 11:55AM | 49.05           | 4             | 11.5             | 11.5          | 1            | 9             | 166                | 0     | 25    | 67           | 0             | N/A               | 11.50         | 23669.3   | N/R    | N/R       | 1.02   | 88.0      | N/R    | N/R       |        |
| 19-14  | Aug. 25/14  | 1:52PM  | 204.67          | 4             | 11               | 11            | 1            | 1             | 35                 | 0     | 13    | 0            | 2             | 76.73             | 85.00         | 29331.3   | 3.30   | 129.4     | 2.16   | 132.2     | N/R    | N/R       |        |
| 20-14  | Aug. 28/14  | 12:15PM | 77.29           | 4             | 11.5             | 11.5          | 1            | 9             | 190                | 0     | 25    | 84           | 0             | N/A               | 12.50         | 25592.8   | N/R    | N/R       | 1.40   | 103.5     | 1.02   | 101.0     |        |
| 21-14  | Sept. 4/14  | 12:11PM | 62.43           | 4             | 11.5             | 11.5          | 1            | 17            | 187                | 0     | 25    | 67           | 0             | N/A               | 13.00         | 26336.4   | N/R    | N/R       | N/R    | N/R       | 5.08   | 111.8     |        |
| 22-14  | Sept. 10/14 | 12:47PM | 176.58          | 4             | 11.5             | 11.5          | 1            | 14            | 186                | 0     | 25    | 67           | 0             | N/A               | 12.75         | 25555.1   | N/R    | N/R       | 1.02   | 94.0      | 8.64   | 127.9     |        |
| 23-14  | Sept. 16/14 | 12:12PM | 204.14          | 4             | 11.5             | 11.5          | 1            | 2             | 37                 | 0     | 13    | 97           | 2             | 71.70             | 83.50         | 33292.2   | 5.21   | 128.4     | 1.40   | 133.4     | 1.40   | 134.6     |        |
| 24-14  | Sept. 24/14 | 11:59AM | 40.13           | 4             | 11.5             | 11.5          | 1            | 9             | 141                | 0     | 25    | 84           | 0             | N/A               | 12.75         | 19509.8   | N/R    | N/R       | N/R    | N/R       | 2.92   | 107.0     |        |
| 25-14  | Sept. 24/14 | 12:10PM | 62.43           | 4             | 11.5             | 11.5          | 1            | 7             | 73                 | 0     | 25    | 67           | 0             | N/A               | 13.00         | 10226.3   | N/R    | N/R       | N/R    | N/R       | 10.70  | 113.3     |        |
| 26-14  | Oct. 2/14   | 1:40PM  | 240.79          | 4             | 11.5             | 11.5          | 1            | 2             | 60                 | 0     | 13    | 97           | 2             | 74.93             | 85.25         | 55107.0   | 4.32   | 131.8     | 1.65   | 124.2     | 1.27   | 128.6     |        |
| 27-14  | Oct. 7/14   | 12:23PM | 60.20           | 4             | 11.5             | 11.5          | 1            | 10            | 172                | 0     | 25    | 67           | 0             | N/A               | 12.75         | 23631.6   |        |           |        |           | 6.86   | 116.4     |        |
| 28-14  | Oct. 22/14  | 11:54AM | 255.65          | 4             | 11.5             | 11.5          | 1            | 2             | 31                 | 0     | 13    | 97           | 2             | 73.73             | 87.75         | 29313.2   | 6.22   | 128.0     | 2.03   | 128.4     | 1.40   | 119.2     |        |
| 29-14  | Oct. 31/14  | 12:02PM | 62.43           | 4             | 11.5             | 11.5          | 1            | 9             | 231                | 0     | 25    | 67           | 0             | N/A               | 13.00         | 33340.7   | N/R    | N/R       | 3.17   | 104.9     | 3.68   | 112.3     |        |
| 30-14  | Nov. 5/14   | 12:02PM | 246.74          | 4             | 11.5             | 11.5          | 1            | 2             | 35                 | 0     | 13    | 97           | 2             | 74.69             | 87.00         | 32812.7   | 4.57   | 118.6     | 1.02   | 127.1     | 1.65   | 126.7     |        |
| 31-14  | Nov. 11/14  | 12:00PM | 237.82          | 4             | 11.5             | 11.5          | 1            | 2             | 28                 | 0     | 13    | 110          | 2             | 72.85             | 81.75         | 24666.1   | 3.56   | 130.6     | N/R    | N/R       | N/R    | N/R       |        |
| 32-14  | Nov. 24/14  | 12:08PM | 246.74          | 4             | 11.5             | 11.5          | 1            | 2             | 26                 | 0     | 13    | 97           | 2             | 74.88             | 88.75         | 24865.5   | 3.81   | 128.7     | 1.02   | 98.8      | 1.90   | 101.0     |        |
| 33-14  | Nov 27/14   | 11:55AM | 71.34           | 4             | 11.5             | 11.5          | 1            | 7             | 232                | 0     | 24    | 84           | 0             | N/A               | 14.00         | 35000.2   | N/R    | N/R       | 3.56   | 94.0      | 4.83   | 115.9     |        |



## SEISMIC REPORT SUMMARY

| Shot # | Date      | Time    | Max<br>Kg/Delay | Hole          |                  | Pattern         |               |              | Time Between (ms.) |       |       | Sub<br>Drill | Ave.<br>Water | Ave Hole<br>Depth | Total<br>Tons | Monitor 1 |        | Monitor 2 |        | Monitor 3 |        | Monitor 4 |        |
|--------|-----------|---------|-----------------|---------------|------------------|-----------------|---------------|--------------|--------------------|-------|-------|--------------|---------------|-------------------|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|        |           |         |                 | Dia.<br>(in.) | Spacing<br>(ft.) | Burden<br>(ft.) | # Of<br>Decks | # Of<br>Rows | # Of<br>Holes      | Decks | Holes |              |               |                   |               | Rows      | (mm/s) | (dbl.)    | (mm/s) | (dbl.)    | (mm/s) | (dbl.)    | (mm/s) |
| 34-14  | Dec. 2/14 | 11:57AM | 246.74          | 4             | 11.5             | 11.5            | 1             | 2            | 59                 | 0     | 13    | 97           | 2             | 71.46             | 83.75         | 52344.1   | 4.83   | 129.6     | 2.03   | 127.5     | 1.40   | 132.8     |        |
| 35-14  | Dec. 9/14 | 11:50AM | 89.60           | 4             | 11.5             | 11.5            | 1             | 9            | 179                | 0     | 25    | 67,84        | 0             | N/A               | 13.00         | 25215.7   | 1.14   | 104.9     | 2.16   | 88.0      | 4.83   | 116.7     |        |



## SIEMIC REPORT SUMMARY

| Shot # | Date        | Time    | Max<br>Kg/Delay | Hole          |                  | Pattern         |               |              | Time Between (ms.) |       |       | Sub<br>Drill | Ave.<br>Water | Ave Hole<br>Depth | Total<br>Tons | Monitor 1 |        | Monitor 2 |        | Monitor 3 |        | Monitor 4 |        |
|--------|-------------|---------|-----------------|---------------|------------------|-----------------|---------------|--------------|--------------------|-------|-------|--------------|---------------|-------------------|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|        |             |         |                 | Dia.<br>(in.) | Spacing<br>(ft.) | Burden<br>(ft.) | # Of<br>Decks | # Of<br>Rows | # Of<br>Holes      | Decks | Holes |              |               |                   |               | Rows      | (mm/s) | (dbl.)    | (mm/s) | (dbl.)    | (mm/s) | (dbl.)    | (mm/s) |
| 01-15  | Apr. 2/15   | 12:00PM | 225.93          | 4             | 11.5             | 11.5            | 1             | 2            | 24                 | 0     | 13    | 84           | 2             | 73.37             | 82.00         | 21207.0   | 2.41   | 115.6     | 1.52   | 94.0      | 2.29   | 125.6     |        |
| 02-15  | Apr. 9/15   | 11:57AM | 35.67           | 4             | 11.5             | 11.5            | 1             | 19           | 121                | 0     | 25    | 84           | 0             | N/A               | 12.00         | 17198.4   | 1.27   | 117.1     | 2.16   | 88.0      | 2.16   | 126.7     |        |
| 03-15  | Apr. 21/15  | 12:05PM | 11.9            | 4             | 11.5             | 11.5            | 1             | 20           | 114                | 0     | 25    | 84           | 0             | N/A               | 10.00         | 14763.0   | 11.78  | 104.2     | 1.02   | 98.8      | N/R    | N/R       |        |
| 04-15  | Apr. 23/15  | 12:03PM | 225.93          | 4             | 11.5             | 11.5            | 1             | 2            | 23                 | 0     | 13    | 123          | 2             | 75.04             | 81.00         | 20075.5   | 4.06   | 123.2     | 1.78   | 122.4     | 2.79   | 124.8     |        |
| 07-15  | May. 15/15  | 11:54AM | 49.05           | 4             | 11.5             | 11.5            | 1             | 19           | 159                | 0     | 25    | 67           | 0             | N/A               | 14.25         | 25644.0   | 1.78   | 103.5     | 1.4    | 103.5     | N/R    | N/R       |        |
| 08-15  | May. 22/15  | 11:51AM | 120.39          | 4             | 11.5             | 11.5            | 1             | 12           | 153                | 0     | 25    | 67           | 0             | N/A               | 19.50         | 32150.0   | 1.02   | 104.9     | 1.27   | 105.5     | 1.52   | 101.9     |        |
| 09-15  | May 28 2015 | 12:02PM | 222.95          | 4             | 11.5             | 11.5            | 1             | 2            | 28                 | 0     | 13    | 110          | 2             | 70.42             | 28.00         | 23534.6   | 3.81   | 116.6     | N/R    | N/R       | 1.02   | 122.3     |        |
| 10-15  | June 2 2015 | 12:01PM | 246.74          | 4             | 11.5             | 11.5            | 1             | 1            | 15                 | 0     | 13    | 0            | 2             | 80.27             | 92.75         | 14992.0   | 3.3    | 122.9     | 1.02   | 95.9      | 1.78   | 125       |        |
| 11-15  | June 10/15  | 11:50AM | 225.92          | 4             | 11.5             | 11.5            | 1             | 2            | 30                 | 0     | 13    | 110          | 2             | 70.86             | 77.25         | 24793.2   | 4.32   | 119.8     | 1.02   | 114.2     | 2.79   | 123.4     |        |
| 12-15  | June 12/15  | 12:18PM | 98.1            | 4             | 11.5             | 11.5            | 1             | 13           | 254                | 0     | 25    | 67           | 0             | N/A               | 17.00         | 47629.6   | 1.78   | 125.5     | 3.81   | 133.0     | 1.40   | 128.2     |        |
| 13-15  | June 17/15  | 12:03PM | 255.65          | 4             | 11.5             | 11.5            | 1             | 2            | 35                 | 0     | 13    | 130          | 2             | 83.00             | 92.00         | 34698.5   | 4.83   | 125.3     | 1.27   | 122       | 11.52  | 130.7     |        |
| 14-15  | July 8/15   | 12:02PM | 214.04          | 4             | 11.5             | 11.5            | 1             | 2            | 29                 | 0     | 13    | 123          | 2             | 71.64             | 77.00         | 24062.6   | 3.17   | 117.2     | N/R    | N/R       | 2.67   | 124.1     |        |
| 15-15  | July 13/15  | 12:02PM | 275.20          | 4             | 11.5             | 11.5            | 1             | 2            | 38                 | 0     | 13    | 38           | 2             | 77.87             | 88.50         | 36239.4   | 4.32   | 124.3     | N/R    | N/R       | 1.40   | 129.2     |        |
| 16-15  | July 30/15  | 12:00PM | 214.04          | 4             | 11.5             | 11.5            | 1             | 6            | 29                 | 0     | 13    | 29           | 2             | 75.38             | 77.75         | 24297.0   | 2.29   | 130.7     | N/R    | N/R       | 2.92   | 112.6     |        |
| 17-15  | Aug 19/15   | 12:02PM | 246.74          | 4             | 11.5             | 11.5            | 1             | 2            | 44                 | 0     | 13    | 182          | 2             | 75.75             | 86.25         | 39827.8   | 3.68   | 126.3     | 1.4    | 126.9     | N/R    | N/R       |        |
| 18-15  | Aug 26/15   | 12:01PM | 120.49          | 4             | 11.5             | 11.5            | 1             | 9            | 242                | 0     | 25    | 84           | 0             | N/A               | 19.50         | 51061.7   | 1.27   | 107       | 2.03   | 108.4     | N/R    | N/R       |        |
| 19-15  | Sept 1/15   | 12:01PM | 217.01          | 4             | 11.5             | 11.5            | 1             | 3            | 34                 | 0     | 13    | 68           | 2             | 70.87             | 78.50         | 28761.0   | 4.19   | 130.5     | 1.02   | 91.5      | N/R    | N/R       |        |
| 20-15  | Sept10/15   | 11:19AM | 115.94          | 4             | 11.5             | 11.5            | 1             | 9            | 153                | 0     | 25    | 67           | 0             | N/A               | 19.00         | 31325.6   | N/R    | N/R       | 1.40   | 106.0     | N/R    | N/R       |        |
| 21-15  | Oct 6/15    | 12:03PM | 237.82          | 4             | 11.5             | 11.5            | 1             | 3            | 25                 | 0     | 13    | 45           | 2             | 72.72             | 82.50         | 22225.4   | 5.08   | 121.1     | 1.78   | 88        | 1.02   | 123.0     |        |
| 22-15  | Oct 21/15   | 12:03PM | 225.93          | 4             | 11.5             | 11.5            | 1             | 5            | 32                 | 0     | 13    | 45           | 2             | 73.28             | 80.50         | 27758.7   | 6.6    | 134.3     | 1.78   | 91.5      | 3.94   | 130.9     |        |



**BLAST REPORT SUMMARY**

| Blast # | Date        | Time    | Blast            |                   | Wind From | Wind Velocity | Terrain   | Hole Dia (in.) | # Of Rows | # Of Holes | Ave. Water | Ave Hole Depth | Total Tons     | Monitor 1              |                        | Monitor 2              |           | Monitor 3 |                |            |       |       |
|---------|-------------|---------|------------------|-------------------|-----------|---------------|-----------|----------------|-----------|------------|------------|----------------|----------------|------------------------|------------------------|------------------------|-----------|-----------|----------------|------------|-------|-------|
|         |             |         | Location         | Weather           |           |               |           |                |           |            |            |                |                | Location (mm/s) (dbl.) | Location (mm/s) (dbl.) | Location (mm/s) (dbl.) |           |           |                |            |       |       |
| 01-16   | Apr. 8/16   | 1:01PM  | Bulge #2 Side Rd |                   |           |               | 4         | 2              | 40        | 55.25      | 70.00      | 27605.9        | 2479 #2 Side R | N/R                    | N/R                    | SW Corner              | N/R       | N/R       | 2450 #2 Side R | 2.29       | 113.5 |       |
| 02-16   | Apr. 19/16  | 12:28PM | NE Face          |                   |           |               | 4         | 2              | 27        | 69.37      | 81.00      | 23567.0        | 2470 #2 Side R | N/R                    | N/R                    | SW Corner              | 1.65      | 97.5      | Colling Rd     | 1.14       | 123.1 |       |
| 03-16   | May 4/16    | 12:00PM | Bulge #2 Side Rd |                   |           |               | 4         | 2              | 42        | 51.86      | 67.75      | 28054.0        | 2470 #2 Side R | 1.40                   | 112.0                  | SW Corner              | 12.80     | 118.1     | Colling Rd     | 2.41       | 116.6 |       |
| 04-16   | May 9/16    | 12:00PM | NE Face          | Partly Cloudy 14c | East      | 5 KPH         | Rough     | 4,4.5          | 2         | 26,1       | 75.35      | 84.25          | 23604.7        | 2450 #2 Side R         | 3.43                   | 118.8                  | SW Corner | 1.65      | 91.5           | Colling Rd | 3.17  | 129.5 |
| 05-16   | May 18/16   | 12:06PM | Pit Floor        | Clear 15c         | East      | 10 KPH        | Flat      | 4              | 16        | 272        | N/A        | 15.00          | 43965.8        | 2450 #2 Side R         | N/R                    | N/R                    | SW Corner | 2.92      | 105.5          | Colling Rd | 1.65  | 111.5 |
| 06-16   | May 24/16   | 12:01PM | Pit Floor        | Clear 27c         | West      | 15 KPH        | Flat      | 4              | 14        | 152        | N/A        | 16.50          | 27026.0        | 2450 #2 Side R         | 1.02                   | 109.5                  | SW Corner | 2.41      | 95.9           | Colling Rd | 3.81  | 106.0 |
| 07-16   | May 30/16   | 2:41PM  | NE Face          | Partly Cloudy 25c | West      | 10 KPH        | Uneven    | 4,4.5          | 3         | 46,3       | 70.40      | 79.50          | 41977.6        | 2450 #2 Side R         | 3.94                   | 124.9                  | SW Corner | 1.14      | 125.0          | Colling Rd | 2.67  | 124.6 |
| 08-16   | Jun 3/16    | 12:00PM | Bulge #2 Side Rd | Partly Cloudy 23c | East      | 10 KPH        | Slope     | 4              | 2         | 43         | 50.39      | 63.75          | 27026.7        | 2450 #2 Side R         | 1.52                   | 113.3                  | SW Corner | 5.71      | 114.8          | Colling Rd | 1.90  | 115.9 |
| 16-09   | Jul 5/16    | 12:00PM | N Face           | Partly Cloudy 31  | West      | 15KPH         | Flat      | 4              | 3         | 20         | 74.74      | 83.00          | 17888.0        | 2450 #2 Side R         | 2.79                   | 123.6                  | SW corner | N/R       | N/R            | Colling Rd | N/R   | N/R   |
| 16-10   | Jul 5/16    | 12:01PM | NE Face          | Partly Cloudy 31  | West      | 15kKPH        | Flat      | 4              | 1         | 10         | 62.20      | 74.25          | 8001.1         | 2450 #2 Side R         | 4.06                   | 122.1                  | SW Corner | N/R       | N/R            | Colling Rd | 1.90  | 128.3 |
| 16-11   | Jul 12/16   | 12:38PM | Pit Floor        | Clear 32          | Southwest | 15KPH         | Flat      | 4              | 14        | 248        | N/A        | 19.00          | 50776.2        | NOT USED               |                        |                        | SW Corner | 1.02      | 106            | Colling Rd | 4.06  | 105.5 |
| 16-12   | Jul 15/16   | 12:00PM | Bulge#2 Side Rd  | Partly Cloudy 27  | West      | 25KPH         | Flat      | 4              | 3         | 31         | 45.40      | 57.75          | 17650.5        | 2450 #2 Side R         | 1.14                   | 88                     | SW Corner | 4.44      | 117.4          | Colling Rd | 1.52  | 110.9 |
| 16-13   | Jul 20/16   | 11:55PM | Pit Floor        | Clear 29          | West      | 10KPH         | Flat      | 4.5            | 14        | 202        | N/A        | 17.50          | 39035.8        | 2450 #2 Side R         | N/R                    | N/R                    | SW Corner | 2.54      | 103.5          | Colling Rd | 2.41  | 106   |
| 16-14   | Jul 22/16   | 12:00PM | N Face           | Partly Cloudy 33  | Northwest | 25KPH         | Flat      | 4              | 3         | 21         | 61.50      | 73.50          | 16632.6        | 2450 #2 Side R         | 2.92                   | 118.1                  | SW Corner | N/R       | N/R            | Colling Rd | 1.40  | 124.5 |
| 16-15   | Aug 4/16    | 12:00PM | Bulge#2 Side Rd  | Clear 31          | Southwest | 10KPH         | Flat      | 4              | 3         | 35         | 43.85      | 58.00          | 20014.3        | 2450 #2 Side R         | 1.40                   | 108.8                  | SW Corner | 3.05      | 117.9          | Colling Rd | 1.02  | 113.8 |
| 16-16   | Aug 9/16    | 12:00PM | N Face           | Partly Cloudy 31  | South     | 15KPH         | Uneven    | 4,4.5          | 3         | 45         | 66.05      | 77.50          | 37581.0        | 2450 #2 Side R         | 2.29                   | 115.7                  | SW Corner | 1.4       | 118.8          | Colling Rd | 2.16  | 127.5 |
| 16-17   | Aug 30/16   | 12:00PM | N Face           | Clear             | West      | 15KPH         | Uneven    | 4              | 3         | 41         | 64.95      | 80.00          | 35345.0        | 2450 #2 Side R         | 3.05                   | 120.0                  | SW Corner | N/R       | N/R            | Colling Rd | 1.78  | 128.8 |
| 16-18   | Sep 20/16   | 12:01PM | NE Face          | Clear             | Northwest | 10KPH         | Flat      | 4,4.5          | 3         | 47         | 41.90      | 47.50          | 24057.3        | 2450 #2 Side R         | 2.52                   | 127.2                  | SW Corner | N/R       | N/R            | Colling Rd | 1.78  | 117.4 |
| 16-19   | Oct 6/16    | 11:55AM | N Face           | Clear             | South     | 10KPH         | Flat      | 4,4.5          | 2         | 41         | 38.78      | 45.75          | 20212.9        | 2450 #2 Side R         | 2.67                   | 124.3                  | SW Corner | 2.29      | 91.5           | Colling Rd | 1.65  | 114.4 |
| 16-20   | Oct 12/16   | 11:47AM | NE Face          | Clear             | South     | 20KPH         | Downslope | 4,4.5          | 6         | 27         | 60.00      | 71.75          | 20872.3        | 2450 #2 Side R         | 4.57                   | 122.1                  | SW Corner | 1.52      | 88             | Colling Rd | 2.03  | 122.9 |
| 16-21   | Oct 24/16   | 11:59AM | Bulge#2 Side Rd  | Partly Cloudy 11  | Northwest | 25KPH         | Uneven    | 4              | 4         | 29         | 45.68      | 59.25          | 16940.7        | 2450 #2 Side R         | 3.05                   | 111.2                  | SW Corner | 4.06      | 123.4          | Colling Rd | 2.41  | 109.9 |
| 17-01   | Apr 11/17   | 11:56AM | Bulge#2 Side Rd  | Partly Cloudy 20  | Southwest | 20KPH         | Uneven    | 4              | 5         | 26         | 50.33      | 58.25          | 26417.9        | 2450 #2 Side R         | 2.55                   | 111.5                  | SW Corner | N/R       | N/R            | Colling Rd | N/R   | N/R   |
| 17-02   | Apr 18/17   | 11:53AM | N Face           | Clear             | East      | 15KPH         | Flat      | 4              | 3         | 13         | 72.82      | 80.50          | 21384.4        | 2450 #2 Side R         | 3.56                   | 125.0                  | SW Corner | 0.18      | 124.1          | Colling Rd | N/R   | N/R   |
| 17-03   | April 21/17 | 11:53AM | Low Bench        | Rain              | West      | 22KPH         | Flat      | 4,4.5          | 3         | 50         | 39.38      | 44.75          | 21133.9        | 2450 #2 Side R         | 3.56                   | 122.9                  | SW Corner | 1.02      | 116.7          | Colling Rd | N/R   | N/R   |
| 17-04   | May 1/17    | 11:52AM | Bulge#2 Side Rd  | Rain              | East      | 15KPH         | Downslope | 4              | 3         | 32         | N/A        | 69.70          | 17585.0        | 2450 #2 Side R         | 3.05                   | 108.0                  | SW Corner | 2.03      | 88             | Colling Rd | N/R   | N/R   |
| 17-05   | May 15/17   | 12:35PM | Bulge#2 Side Rd  | Clear             | Northwest | 10KPH         | Downslope | 4              | 3         | 34         | N/A        | 74.00          | 21062.0        | 2450 #2 Side R         | 3.82                   | 111.5                  | SW Corner | 3.30      | 95.9           | Colling Rd | 0.13  | 88.0  |
| 17-06   | May 17/17   | 11:53AM | Low Bench        | Cloudy26          | Southwest | 40KPH         | Flat      | 4,4.5          | 2         | 42         | N/A        | 41.20          | 15010.0        | 2450 #2 Side R         | N/R                    | N/R                    | SW Corner | N/R       | N/R            | Colling Rd | 1.14  | 111.8 |
| 17-07   | May 29/17   | 12:00PM | Bulge#2 Side Rd  | Cloudy23          | West      | 10KPH         | Flat      | 4              | 3         | 32         | N/A        | 72.00          | 21440.0        | 2450 #2 Side R         | 1.42                   | 98.8                   | SW Corner | 1.52      | 88             | Colling Rd | 6.10  | 91.5  |
| 17-08   | Jun 1/17    | 2:30PM  | Low Bench        | Clear             | Southwest | 25KPH         | Flat      | 4              | 4         | 86         | N/A        | 37.30          | 29085          | 2450 #2 Side R         | 5.84                   | 101.0                  | SW Corner | N/R       | N/R            | Colling Rd | 3.81  | 91.5  |
| 17-09   | June 8/17   | 11:55PM | Bulge#2 Side Rd  | Clear             | Southeast | 5KPH          | Flat      | 4              | 3         | 30         | N/A        | 79.40          | 20898          | 2450 #2 Side R         | 3.30                   | 94.0                   | SW Corner | 2.41      | 88             | Colling Rd | N/R   | N/R   |



**BLAST REPORT SUMMARY**

| Blast # | Date            | Time    | Blast           |               | Wind From | Wind Velocity | Terrain | Hole Dia  | # Of  | # Of  | Ave.  | Ave Hole | Total | Monitor 1 |                | Monitor 2 |          | Monitor 3 |        |          |            |         |       |
|---------|-----------------|---------|-----------------|---------------|-----------|---------------|---------|-----------|-------|-------|-------|----------|-------|-----------|----------------|-----------|----------|-----------|--------|----------|------------|---------|-------|
|         |                 |         | Location        | Weather       |           |               |         | (in.)     | Rows  | Holes | Water | Depth    | Tons  | Location  | (mm/s)         | (dbl.)    | Location | (mm/s)    | (dbl.) | Location | (mm/s)     | (dbl.)  |       |
| 17-01   | April 11/17     | 11:56AM | Bulge#2 Side Rd | Part Cloudy   | 20        | Southwest     | 20KPH   | Uneven    | 4     | 5     | 26    | 50.33    | 58.25 | 26417.9   | 2450#2 Side R  | 2.55      | 111.5    | SW Corner | N/R    | N/R      | Colling Rd | N/R     | N/R   |
| 17-02   | April 18/17     | 11:53AM | North Face      | Clear         |           | East          | 15KPH   | Flat      | 4     | 3     | 13    | 72.82    | 80.50 | 21384.4   | 2450#2 Side R  | 3.56      | 125      | SW Corner | 0.18   | 124.1    | Colling Rd | N/R     | N/R   |
| 17-03   | April 21/17     | 11:53AM | Low bench       | Rain          |           | West          | 22KPH   | Flat      | 4,4.5 | 3     | 50    | 39.38    | 44.75 | 21133.9   | 2450#2 Side R  | 3.56      | 122.9    | SW Corner | 1.02   | 116.7    | Colling Rd | N/R     | N/R   |
| 17-04   | May 1/17        | 11:52AM | Bulge#2 Side Rd | Rain          |           | East          | 15KPH   | Downslope | 4     | 3     | 32    | N/A      | 69.70 | 17585.0   | 2450 #2 Side R | 3.05      | 108      | SW Corner | 2.03   | 88       | Colling Rd | N/R     | N/R   |
| 17-05   | May 15/17       | 12:35PM | Bulge#2 Side Rd | Clear         |           | Northwest     | 10KPH   | Downslope | 4     | 3     | 34    | N/A      | 74.00 | 21062.0   | 2450#2 Side R  | 3.82      | 111.5    | SW Corner | 3.3    | 95.9     | Colling Rd | 0.13    | 88.0  |
| 17-06   | May 17/17       | 11:53AM | Low bench       | Cloudy        | 26        | Southwest     | 40KPH   | Flat      | 4,4.5 | 2     | 42    | N/A      | 41.20 | 15010.0   | 2450#2 Side R  | N/R       | N/R      | SW Corner | N/R    | N/R      | Colling Rd | 1.14    | 111.8 |
| 17-07   | May 29/17       | 12:00PM | Bulge#2 Side Rd | Cloudy        | 23        | West          | 10KPH   | Flat      | 4     | 3     | 32    | N/A      | 72.00 | 21440.0   | 2450#2 Side R  | 1.42      | 98.8     | SW Corner | 1.52   | 88.0     | Colling Rd | 6.10    | 91.5  |
| 17-08   | June 1/17       | 2:30PM  | Low bench       | Clear         |           | Southwest     | 25KPH   | Flat      | 4     | 4     | 86    | N/A      | 37.30 | 29085.0   | 2450#2 Side R  | 5.84      | 101      | SW Corner | N/R    | N/R      | Colling Rd | 3.81    | 91.5  |
| 17-09   | June 8/17       | 11:55AM | Bulge#2 Side Rd | Clear         |           | Southeast     | 5KPH    | Flat      | 4     | 3     | 30    | N/A      | 79.40 | 20898.0   | 2450#2 Side R  | 3.3       | 94       | SW Corner | 2.41   | 88       | Colling Rd | N/R     | N/R   |
| 17-11   | June 20/17      | 12:02PM | Bulge#2 Side Rd | Part Cloudy   | 22        | Southwest     | 10KPH   | Flat      | 4     | 3     | 36    | N/A      | 84.10 | 23583.0   | 2450#2 Side R  | 2.03      | 108.4    | SW Corner | 2.41   | 101.9    | Colling Rd | N/R     | N/R   |
| 17-10   | June 21/17      | 12:35PM | Low bench       | Part Cloudy   | 21        | West          | 10KPH   | Flat      | 4,4.5 | 3     | 84    | N/A      | 40.80 | 25680.0   | 2450#2 Side R  | N/R       | N/R      | SW Corner | N/R    | N/R      | Colling Rd | did not | use   |
| 17-12   | June 26/17      | 1:00PM  | Floor           | Part Cloudy   |           | Southwest     | 15KPH   | Flat      | 4     | 12    | 252   | N/A      | 16.00 | 40014.0   | 2450#2 Side R  | 6.22      | 91.5     | SW Corner | 1.78   | 88       | Colling Rd | N/R     | N/R   |
| 17-14   | July 4/17       | 12:46PM | North Face      | Part Cloudy   |           | Southeast     | 10KPH   | Flat      | 4,4.5 | 3     | 36    | N/A      | 57.95 | 33601.0   | 2450#2 Side R  | 12.20     | 95.9     | SW Corner | 4.19   | 88.0     | Colling Rd | 1.27    | 88    |
| 17-13   | July 10/17      | 1:40PM  | Floor           | Part Cloudy   |           | Southwest     | 10KPH   | Flat      | 4     | 11    | 295   | N/A      | 16.70 | 48920.0   | 2450#2 Side R  | 2.16      | 91.5     | SW Corner | 4.22   | 88.0     | Colling Rd | 1.02    | 104.2 |
| 17-15   | July 25/17      | 11:57AM | Low Bench       | Part Cloudy   |           | NorthEast     | 5KPH    | Flat      | 4     | 4     | 52    | N/A      | 42.00 | 15057.0   | 2450#2 Side R  | 3.56      | 91.5     | SW Corner | 2.16   | 88       | Colling Rd | 1.14    | 112.8 |
| 17-17   | August 3/17     | 12:41PM | North Face      | Part Cloudy   |           | North         | 0.00    | Flat      | 4,5   | 4     | 23    | N/A      | 77.10 | 11832.0   | 2450#2 Side R  | 2.92      | 88       | SW Corner | 1.27   | 88       | Colling Rd | N/R     | N/R   |
| 17-18   | August 28/17    | 12:32PM | Floor           | Partly Cloudy |           | West          | 5KPH    | Flat      | 4     | 8     | 188   | N/A      | 17.70 | 26351.0   | 2450 #2 Side R | 4.70      | 104.9    | SW Corner | 3.3    | 88       | Colling Rd | 1.14    | 107.5 |
| 17-16   | August 30/17    | 12:01PM | Bulge#2 Side Rd | Partly Cloudy |           | Southwest     | 5KPH    | Flat      | 4     | 3     | 28    | N/A      | 84.30 | 16211.0   | 2450 #2 Side R | 1.52      | 91.5     | SW Corner | 1.52   | 92.0     | Colling Rd | N/R     | N/R   |
| 17-19   | September 12/17 | 11:49AM | Low bench       | Partly Cloudy |           | Southeast     | 10KPH   | Flat      | 4     | 3     | 37    | N/A      | 38.90 | 21101.0   | 2450 #2 Side R | 2.92      | 88.0     | SW Corner | 1.90   | 94       | Colling Rd | 1.02    | 114.6 |
| 17-22   | September 26/17 | 11:56AM | Low bench       | Partly Cloudy |           | South         | 5KPH    | Flat      | 4     | 5     | 62    | N/A      | 38.80 | 19349.0   | 2450 #2 Side R | 1.65      | 88.0     | SW Corner | 1.65   | 88       | Colling Rd | 1.14    | 115.6 |
| 17-20   | September 27/17 | 12:01PM | Bulge#2 Side Rd | Partly Cloudy |           | West          | 10KPH   | Flat      | 4,4.5 | 3     | 40    | N/A      | 81.90 | 27877.0   | 2450 #2 Side R | 2.54      | 103.5    | SW Corner | 3.17   | 88       | Colling Rd | N/R     | N/R   |
| 17-23   | October 6/17    | 11:53AM | Upper Middle    | Partly Cloudy |           | North         | 10KPH   | Flat      | 4,4.5 | 3     | 34    | N/A      | 77.20 | 21365.0   | 2450 #2 Side R | 3.43      | 95.9     | SW Corner | 3.05   | 94       | Colling Rd | 1.27    | 88.0  |
| 17-24   | October 11/17   | 12:41PM | Bulge#2 Side Rd | Rain          |           | East          | 20KPH   | Flat      | 4,4.5 | 3     | 45    | N/A      | 81.70 | 30695.0   | 2450 #2 Side R | 0.38      | 91.5     | SW Corner | 4.95   | 122.4    | Colling Rd | N/R     | N/R   |
| 17-25   | October 30/17   | 11:55AM | Low bench       | Partly Cloudy |           | West          | 35KPH   | Flat      | 4     | 9     | 41    | N/A      | 39.10 | 11407.0   | 2450#2 Side R  | 1.14      | 122.8    | SW Corner | N/R    | N/R      | Colling Rd | N/R     | N/R   |



**BLAST REPORT SUMMARY**

| Blast# | Date       | Time     | Blast        |             | Wind From | Wind Velocity | Terrain | Hole Dia | # Of  | # Of  | Ave. | Ave Hole | Total   | Monitor 1     |          | Monitor 2 |           | Monitor 3 |        |            |      |       |
|--------|------------|----------|--------------|-------------|-----------|---------------|---------|----------|-------|-------|------|----------|---------|---------------|----------|-----------|-----------|-----------|--------|------------|------|-------|
|        |            |          | (in.)        | Rows        |           |               |         | Holes    | Water | Depth | Tons | Location | (mm/s)  | (dbl.)        | Location | (mm/s)    | (dbl.)    | Location  | (mm/s) | (dbl.)     |      |       |
| 18-001 | Apr 9/18   | 11:56 AM | Upper Middle | Part Cloudy | Southeast | 5KPH          | Flat    | 4        | 3     | 49    | N/A  | 75.50    | 27194.0 | 2450#2 Side R | 3.60     | 115.3     | SW Corner | 1.2       | 119.7  | Colling Rd | 0.4  | 121.9 |
| 18-002 | Apr 11/18  | 11:16AM  | Floor        | Overcast    | Southwest | 10KPH         | Flat    | 4        | 9     | 180   | N/A  | 10.00    | 19279.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | 2         | 88.4   | Colling Rd | N/A  | N/A   |
| 18-003 | Apr 18/18  | 10:54    | Lower middle | Overcast    | West      | 10KPH         | Flat    | 4        | 4     | 39    | N/A  | 40.10    | 11087.0 | 2450#2 Side R | 2.70     | 119.7     | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-004 | May 22/18  | 12:02PM  | Upper Middle | Overcast    | SouthEast | 5KPH          | Flat    | 4,4.5    | 3     | 49    | N/A  | 75.50    | 26332.0 | 2450#2 Side R | 3.3      | 124.3     | SW Corner | 0.3       | 39.1   | Colling Rd | 0.30 | 123.1 |
| 18-005 | June 4/18  | 11:50AM  | Lower middle | Overcast    | West      | 15KPH         | Flat    | 4        | 8     | 67    | N/A  | 44.20    | 20811.0 | 2450#2 Side R | N/R      | N/R       | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-006 | June 6/18  | 12:10PM  | Lower middle | Overcast    | West      | 5KPH          | Flat    | 4        | 11    | 61    | N/A  | 41.70    | 17948.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-007 | June 11/18 | 11:56AM  | Upper Middle | Part Cloudy | East      | 15KPH         | Flat    | 4,4.5    | 4     | 55    | N/A  | 73.10    | 28467.0 | 2450#2 Side R | 2.70     | 116.9     | SW Corner | 0.10      | 119.6  | Colling Rd | 0.20 | 120.2 |
| 18-008 | June 13/18 | 11:52AM  | Lower middle | Part Cloudy | West      | 10KPH         | Sloped  | 4        | 7     | 89    | N/A  | 50.00    | 28929.0 | 2450#2 Side R | 1        | 120.6     | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-009 | June 25/18 | 12:01PM  | Lower middle | Clear       | Southeast | 10KPH         | Flat    | 4        | 13    | 99    | N/A  | 35.30    | 25983.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-010 | July 5/18  | 11:51AM  | Upper Middle | Clear       | Southwest | 5KPH          | Flat    | 4        | 3     | 53    | N/A  | 76.00    | 30963.0 | 2450#2 Side R | 2.30     | 115.9     | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-011 | 20-Jul     | 11:59AM  | Lower middle | Part Cloudy | East      | 5KPH          | Flat    | 4        | 15    | 125   | N/A  | 26.00    | 24173.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-012 | Aug 3/18   | 11:52AM  | Upper Middle | Part Cloudy | none      | 0             | Flat    | 4,5      | 3     | 46    | N/A  | 76.40    | 27176.0 | 2450#2 Side R | 2.4      | 115       | SW Corner | 0.01      | 117.1  | Colling Rd | 0.01 | 116.4 |
| 18-013 | Aug 14/18  | 10:54AM  | Floor        | Part Cloudy | South     | 5.00          | Flat    | 4        | 11    | 182   | N/A  | 10.00    | 17069.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-014 | Aug 30/18  | 11:55AM  | Upper Middle | Part Cloudy | NorthEast | 5KPH          | Flat    | 4,5      | 3     | 58    | N/A  | 75.20    | 31778.0 | 2450#2 Side R | 3.7      | 113.3     | SW Corner | 2.00      | 93.2   | Colling Rd | DNT  | DNT   |
| 18-015 | Sept 10/18 | 11:49AM  | Floor        | Rain        | East      | 15KPH         | Flat    | 4        | 9     | 204   | N/A  | 11.50    | 22269.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | NSU       | NSU    | Colling Rd | 0.1  | 118   |
| 18-018 | Sept 21/18 | 12:34PM  | Floor        | Part Cloudy | Southwest | 15KPH         | Flat    | 4        | 21    | 345   | N/A  | 11.20    | 38483.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | NSU       | NSU    | Colling Rd | DNT  | DNT   |
| 18-017 | Oct 2/18   | 12:02PM  | Upper Middle | Rain        | Sourhwest | 5KPH          | Flat    | 4        | 3     | 48    | N/A  | 76.40    | 26868.0 | 2450#2 Side R | 5.30     | 114.2     | SW Corner | 0.5       | 123.5  | Colling Rd | 0.20 | 121.6 |
| 18-016 | Oct 10/18  | 12:24PM  | Lower middle | Part Cloudy | East      | 5KPH          | Flat    | 4        | 5     | 100   | N/A  | 61.80    | 44223.0 | 2450#2 Side R | DNT      | DNT       | SW Corner | DNT       | DNT    | Colling Rd | DNT  | DNT   |
| 18-019 | Nov 1/18   | 11:57AM  | Upper Middle | Rain        | None      | 0.00          | Flat    | 4,4.5    | 5     | 50    | N/A  | 73.40    | 27342.0 | 2450#2 Side R | 5.70     | 116.3     | SW Corner | 1.80      | 114.2  | Colling Rd | 0.30 | 118.8 |
| 18-020 | Nov11/18   | 11:57AM  | Floor        | Cloudy      | West      | 5KPH          | Flat    | 4        | 12    | 251   | N/A  | 11.00    | 24552.0 | 2450#2 Side R | 2.00     | 110.4     | SW Corner | DNT       | DNT    | Colling Rd | 0.00 | 0.0   |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-05-28

Blast Number: 19-006

Orica Order #: 2487394

Blast Time: 11:09 AM

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Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Upper Middle North East (Bench / Face)

GPS Coordinates: 43.40506 °N Latitude 79.88187 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: NE at 10 kph Temperature: 6 to 10 °C

Clear:  Rain:  Overcast:  X  
Partly Cloudy:  Snow:  Inversion:  Ceiling 591 ft

### - Drilling Information -

Angle from Vertical Nominal Bit Diameter:  
Primary Bit diam: 101.6 mm 0° # Holes: 43 = 2,739.9 ft ( 4 " diam)  
Secondary Bit diam: 92.1 mm 0° # Holes: 4 = 254.9 ft ( 3 5/8 " diam)  
Tertiary Bit diam: mm 0° # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 33,740  | 25,080   | 8,660 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 1           | 25 |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 8 (OR EQUIVALENT)  | 0.23      | 47     | 10.7 |
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 47     | 16.0 |

total explosives weight in Blast (kg): 8,712

Pkgd Prod (25 kg) % of Total kg: 0.3%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 47     |
| UNITRONIC 600 25M |          |    | 47     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 2      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 5.0  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 1.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 18,760 te 7,215 m<sup>3</sup>  
Total tonnes per day: 18,760 te NB60-08 Rate Code  
Total Holes Loaded: 47 holes  
... including: 5 Dead Holes  
... and: Helper Holes  
Helper Hole Collar: ft avg  
# Rows Blasted: 4 rows

### - Pattern (Front Row)-

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 13 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 34 main body

Bench Height: 61.7 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 63.7 ft avg

### - Stone Decking -

Front Row: 0.0 ft avg  
Main Body: 0.0 ft avg  
# Decks: 0 per blast

### - Collar Stemming -

Front Row: 8.0 ft avg  
Main Body: 8.0 ft avg  
Material used: 3/4" Clear

### - Charge Length -

Front Row: 55.7 ft avg  
Main Body: 55.7 ft avg

### - Charge Weight -

Front Row: 162.5 kg/hole  
Main Body: 162.5 kg/hole  
Max. per delay: 197.0 kg/delay  
SD ( ) Equation: 195.0 kg/delay  
Total kg Loaded: 8,712 kg  
Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.464 kg/te (actual)  
Front row: 0.298 kg/te (theoretical)  
Main Body: 0.397 kg/te (theoretical)  
"KPI" PF: 0.372 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):

Hole D7 Recived packaged product to load though small seam from 15'-9'  
We were unable to locate the drill log.  
After speaking with the driller we felt confidant to continue and load the blast



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-05-28

Blast Number: 19-006  
 Orica Order #: 2487394  
 Blast Time: 11:09 AM

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| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40510       | 79.88190        | 0.757562    | 1.394202    |
| Front Row Corner          | 43.40488       | 79.88179        | 0.757558    | 1.394200    |
| Back Row Corner           | 43.40519       | 79.88193        | 0.757563    | 1.394203    |
| Average (Centre of Blast) | 43.40506       | 79.88187        | 0.757561    | 1.394202    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 418.9                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 4.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 10.7         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 119.6 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 987.1                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 8.8          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 118.9 | dB              | Trigger set at: 115 | dB                                     |

Colling Rd & Blind Line Bruce Trail

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1414.7                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(418.9)^2}{30^2} \text{ kg} \\
 &= \frac{175,477}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike der Kinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

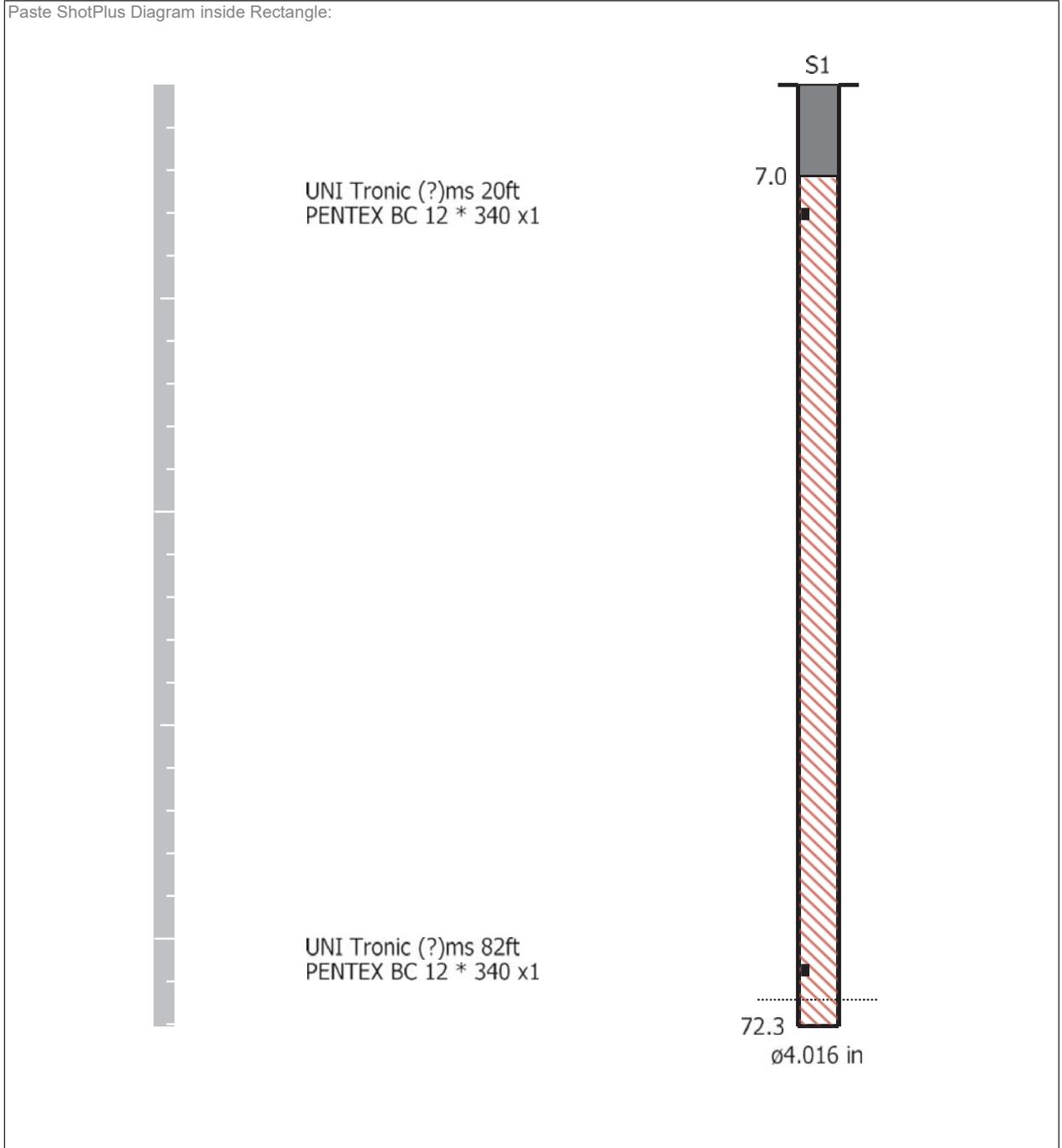
Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 5/28/2019

Blast Number: 19-006  
 Orica Order #: 2487394

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nick Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 11:09:14 May 28, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.2 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 Line 2  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

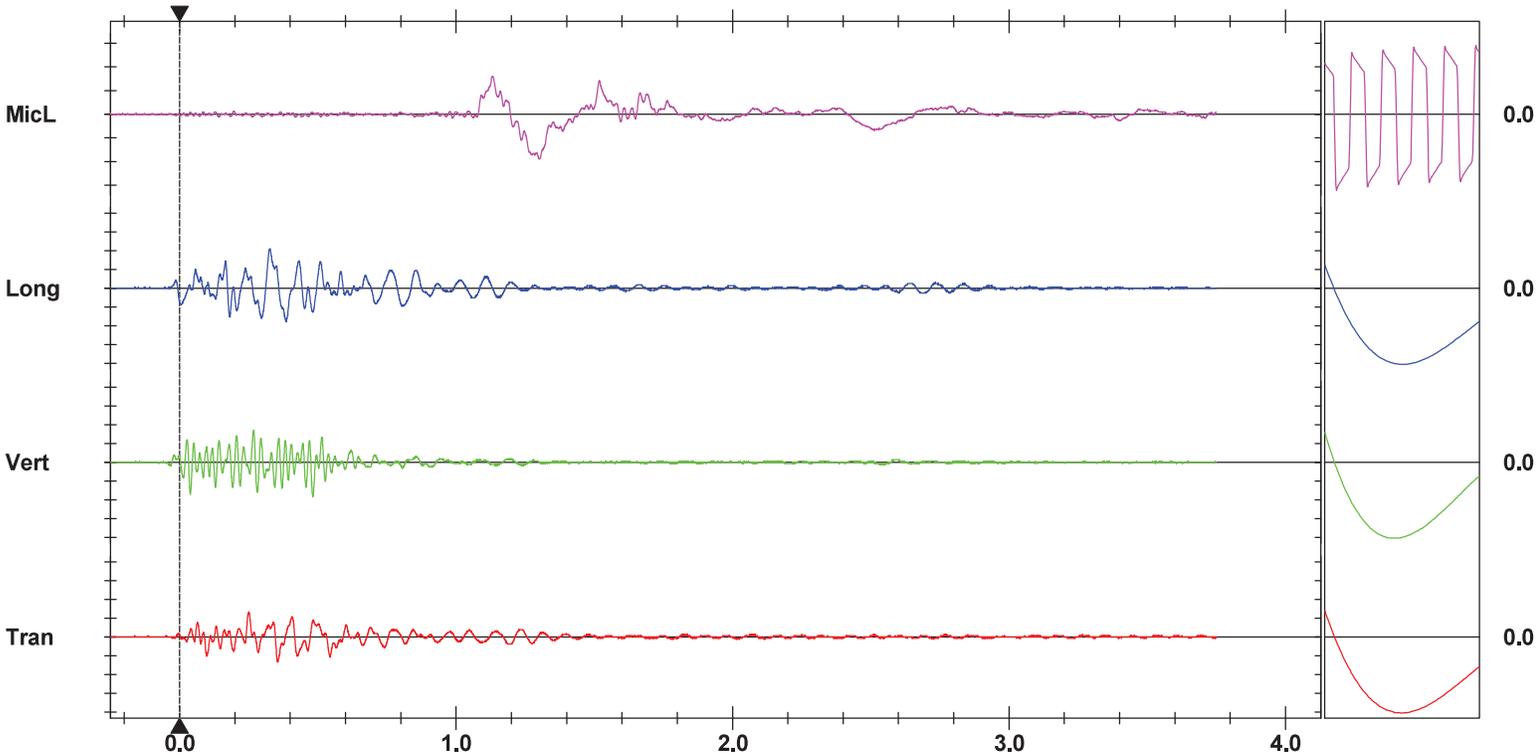
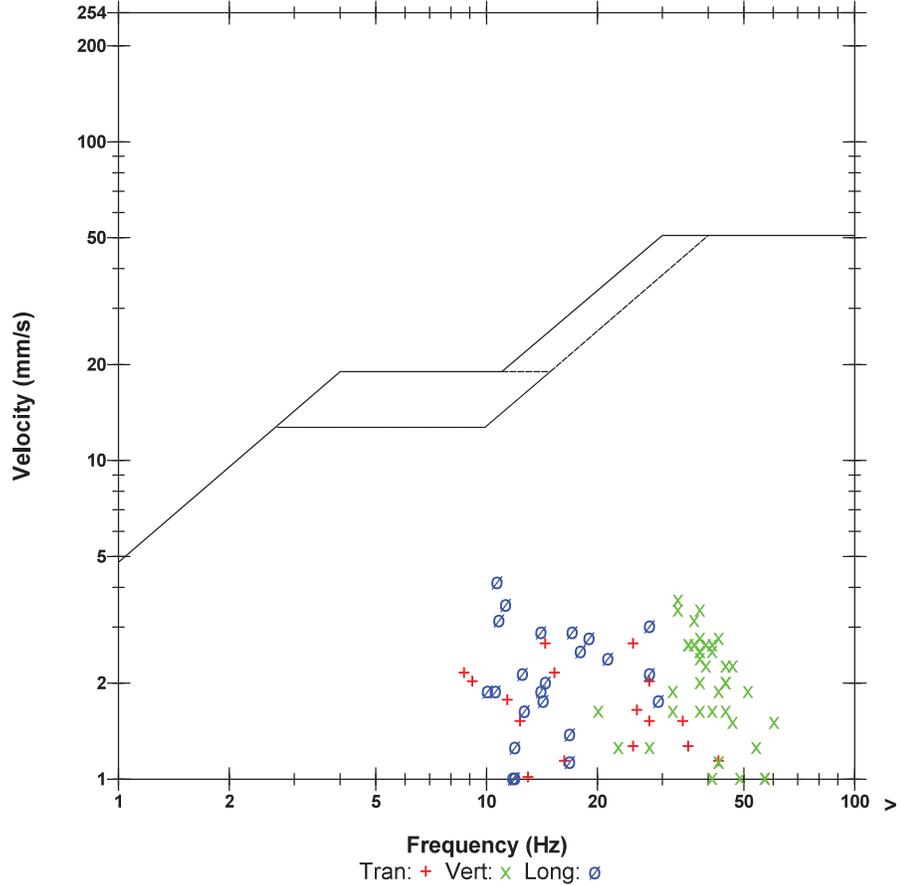
In front Yard by tree stump  
 N-43.40245, W-79.87814

**Microphone** Linear Weighting  
**PSPL** 119.6 dB(L) at 1.301 sec  
**ZC Freq** 2.0 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 562 mv )

|                     | Tran  | Vert  | Long  |      |
|---------------------|-------|-------|-------|------|
| PPV                 | 2.667 | 3.683 | 4.191 | mm/s |
| ZC Freq             | 25    | 33    | 10.7  | Hz   |
| Time (Rel. to Trig) | 0.250 | 0.482 | 0.325 | sec  |
| Peak Acceleration   | 0.053 | 0.106 | 0.106 | g    |
| Peak Displacement   | 0.030 | 0.018 | 0.057 | mm   |
| Sensor Check        | Check | Check | Check |      |
| Frequency           | 2.2   | 2.2   | 2.2   | Hz   |
| Overswing Ratio     | 226.0 | 174.0 | 247.0 |      |

Peak Vector Sum 4.814 mm/s at 0.482 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 11:09:17 May 28, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.117 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL,MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.8 Volts  
**Unit Calibration** January 15, 2019 by InstanTEL  
**File Name** UM6857\_20190528110917.IDFW

**Notes**

**Location:** COLLING RD & BLINDLINE  
**Client:** NELSON AGGREGATES  
**User Name:** ORICA CANADA  
**General:**

**Extended Notes**

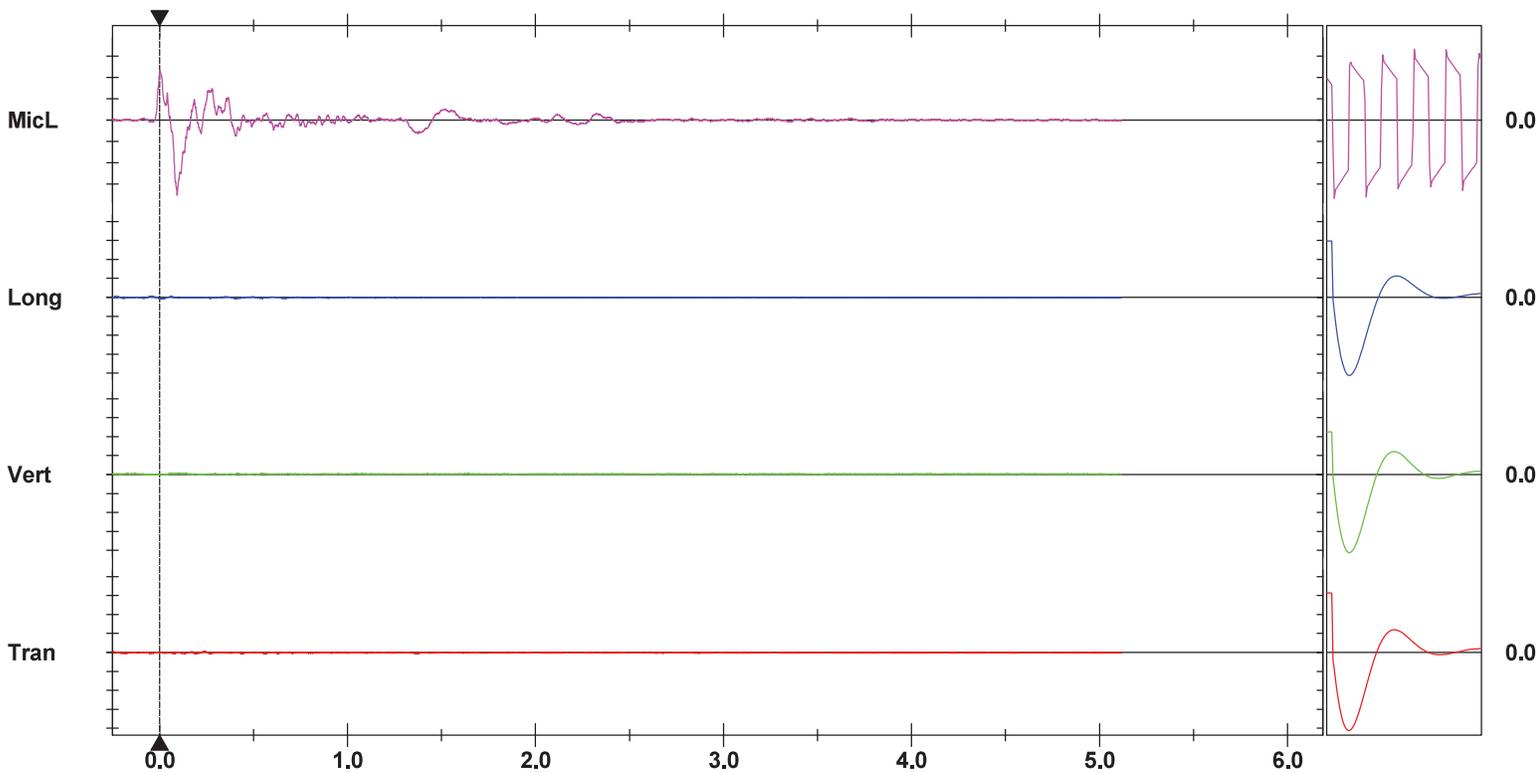
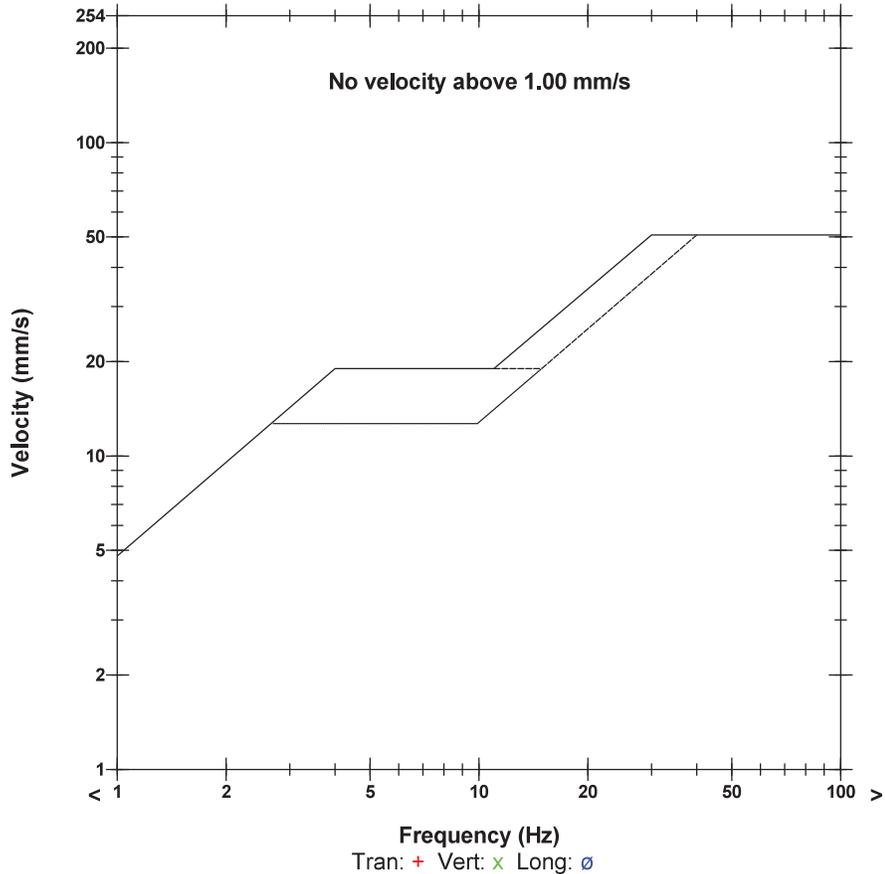
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 118.9 dB(L) at 0.093 sec  
**ZC Freq** 4.7 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1541 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.142  | 0.166  | 0.197  | mm/s |
| ZC Freq             | 9.6    | 3.0    | 8.8    | Hz   |
| Time (Rel. to Trig) | 0.124  | 0.103  | 0.008  | sec  |
| Peak Acceleration   | 0.012  | 0.010  | 0.015  | g    |
| Peak Displacement   | 0.026  | 0.034  | 0.003  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.4    | 3.4    | 3.6    |      |

**Peak Vector Sum** 0.202 mm/s at 0.008 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Nelson Aggregate  
Across rod from 2102 Road 2  
Burlington 2019-05-28 Blast 19-005**

**Event Report: Monitor Log - Micromate ISEE # UM6859-Compliance**

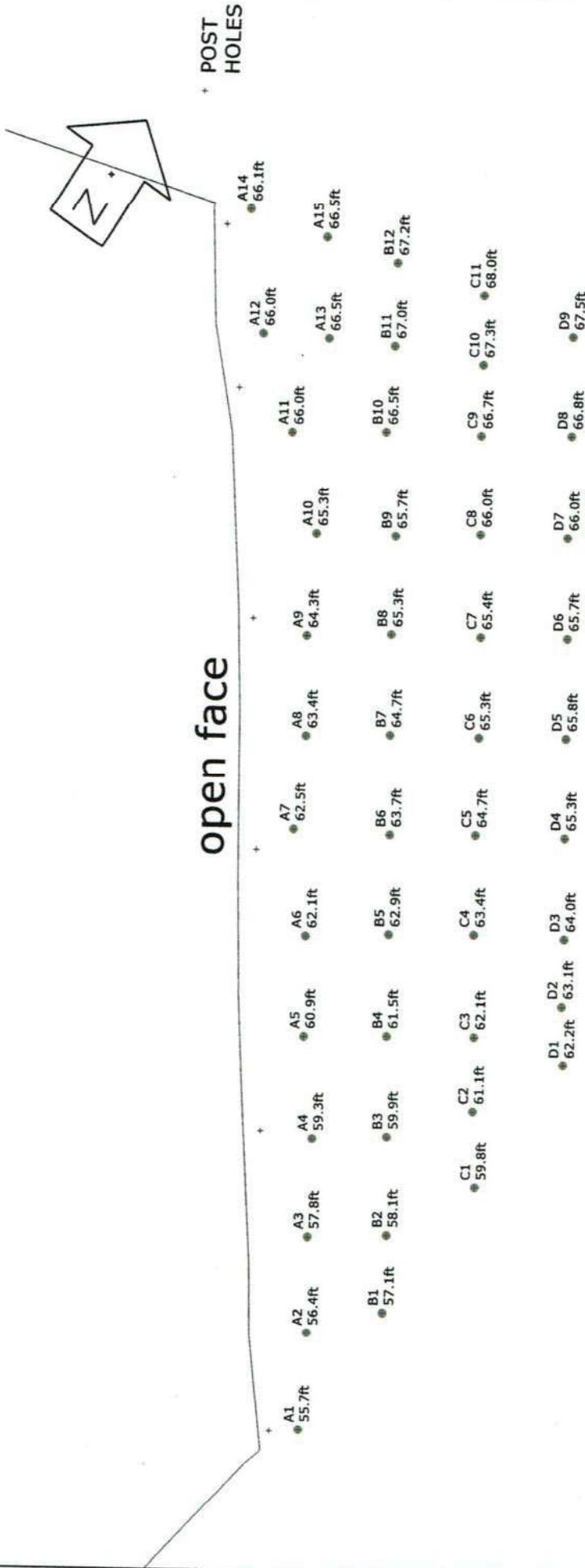
| Start Time                   | End Time                     | Status                                                                          |
|------------------------------|------------------------------|---------------------------------------------------------------------------------|
| -----<br>May 28 /19 05:53:15 | -----<br>May 28 /19 05:53:15 | SERIAL NUMBER: UM6859<br>Start Monitoring Waveform Geo: 1.50 mm/s Mic: 121.0 dB |
| May 28 /19 05:53:15          | May 28 /19 11:40:31          | No events recorded. (Keyboard Exit) Waveform Geo: 1.50 mm/s Mic:                |



SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 47 Hole angle: 0.0°  
 Total drilled: 2994.8ft



9NECRNR005 Design Fnl -3.625 and 4" Blast Holes 12x10 9x10 270.25 a  
 DRILLER NAME:

GREEN MARKER STONES 3.625" Blast Holes



Not to scale

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 5/27/2019                                    |
| Mine                           | Burlington                                   |
| Location                       | N E CRNR NEXT TO UPPER MIDDLE                |
| Title/author                   | 9NECRNR005 Design Partial                    |
| Filename                       | Burlington 2019-05-28 Blast 19-005 Upper Mic |

SHOTPlus 5 Plan

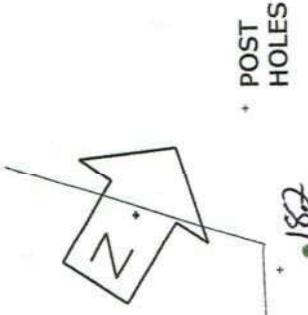
Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 2994.8ft  
 Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Stemming: 7.0ft  
 Hole angle: 0.0°  
 Subdrill: 2.0ft  
 Number of holes: 47

# Load Sheet 215Kg Max

open face

$\phi = 3 \frac{5}{8}''$



POST HOLES

- 159 • 173 • 181 • 156 • 161 • 180 • 184 • 185 • 190 • 197 • 195 • 190 • 182
- 176 • 160 • 163 • 179 • 184 • 191 • 196 • 194 • 192 • 191 • 192 • 189 • 152 • 144
- 168 • 187 • 186 • 190 • 197 • 187 • 190 • 192 • 146 • 193
- 181 • 140 • 184 • 194 • 179 • 193 • 193 • 185

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 5/27/2019                                    |
| Mine                           | Burlington                                   |
| Location                       | N E CRNR NEXT TO UPPER MIDDLE                |
| Title/author                   | 9NECRNR005 Design Partial                    |
| Filename                       | Burlington 2019-05-28 Blast 19-005 Upper Mic |



Not to scale



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-05-10

Blast Number: 19-007

Orica Order #: 2480529

Blast Time: 12:55 PM

page 1

Blaster-in-charge: Kevin Toplis (Print Name)

Blast Location: Floor (Bench / Face)

GPS Coordinates: 43.40368 °N Latitude 79.88238 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 30 kph Temperature: 11 to 15 °C

Clear:  Rain:  Overcast:  X  
Partly Cloudy:  Snow:  Inversion:  Ceiling: 2,434 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                 |
|----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm | 0                   | # Holes: 283 = 4,188.4 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0                   | # Holes: = 0.0 ft ( " diam)           |
| Tertiary Bit diam: mm      | 0                   | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 34,110  | 27,740   | 6,370 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 5          | 5           | 0  |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 280    | 95.2 |

total explosives weight in Blast (kg): 6,465

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                  | case #'s | ms     | # used |
|------------------|----------|--------|--------|
| UNITRONIC 600 6M |          |        | 1      |
| EXEL HANDIDET 9m |          | 25/500 | 280    |
| CONNECTADET 9M   |          | 25 ms  | 1      |
| CONNECTADET 9M   |          | 42 ms  | 26     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 7.5  |
| HELPER HOURS          | Enter total Helper man-hours | 13.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 1.0  |
| BORETRACK             | Enter hours                  | 0.0  |

|                       |              |                       |
|-----------------------|--------------|-----------------------|
| Tonnes Blasted:       | 40,349 te    | 15,519 m <sup>3</sup> |
| Total tonnes per day: | 40,349 te    | NF-02 Rate Code       |
| Total Holes Loaded:   | 280 holes    |                       |
| ... including:        | Dead Holes   |                       |
| ... and:              | Helper Holes |                       |
| Helper Hole Collar:   | ft avg       |                       |
| # Rows Blasted:       | 13 rows      |                       |

### - Pattern (Front Row) -

Burden: 11.5 ft avg

Spacing: 11.5 ft avg

# Holes: 4 front row

### - Pattern (Main Body) -

Burden: 11.5 ft avg

Spacing: 11.5 ft avg

# Holes: 276 main body

Bench Height: 14.8 ft avg

Sub-drill: 0.0 ft avg

Hole Depth: 14.8 ft avg

### - Stone Decking -

Front Row: ft avg

Main Body: ft avg

# Decks: 0 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: 3/4" Stone

### - Charge Length -

Front Row: 7.8 ft avg

Main Body: 7.8 ft avg

### - Charge Weight -

Front Row: 22.7 kg/hole

Main Body: 22.7 kg/hole

Max. per delay: 42.0 kg/delay

SD () Equation: 151.3 kg/delay

Total kg Loaded: 6,465 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.160 kg/te (actual)

Front row: 0.158 kg/te (theoretical)

Main Body: 0.158 kg/te (theoretical)

"KPI" PF: 0.158 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

0.702 lb/yd<sup>3</sup>  
0.692 lb/yd<sup>3</sup>  
0.692 lb/yd<sup>3</sup>  
0.692 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

Holes B7, B8, B9, where taken out of the shot due to being caved in before loading.

helper hours: 6.5 hours x 2



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-05-10

Blast Number: 19-007  
 Orica Order #: 2480529  
 Blast Time: 12:55 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40368       | 79.88241        | 0.757537    | 1.394211    |
| Front Row Corner          | 43.40387       | 79.88250        | 0.757540    | 1.394213    |
| Back Row Corner           | 43.40348       | 79.88223        | 0.757534    | 1.394208    |
| Average (Centre of Blast) | 43.40368       | 79.88238        | 0.757537    | 1.394211    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 369.0                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: trigger | dB              | Trigger set at: 115 | dB                                     |
| 2450 2nd Line                             |                           |                 |                     |                                        |

| 2nd Seismograph Co-ordinates              | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 976.5                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: trigger | dB              | Trigger set at: 115 | dB                                     |
| Colling Rd & Blind Line Bruce Trail       |                           |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.        | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-----------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               |                       |                 |                     |                                        |
| 2nd Reading                               |                       |                 |                     |                                        |
| Average                                   | 0.00000               | 0.00000         | 0.000000            | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | 0.0                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.0              | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 0.0        | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 0.0 | dB              | Trigger set at: 115 | dB                                     |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(369)^2}{30^2} \text{ kg} \\
 &= \frac{136,161}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Kevin Toplis*

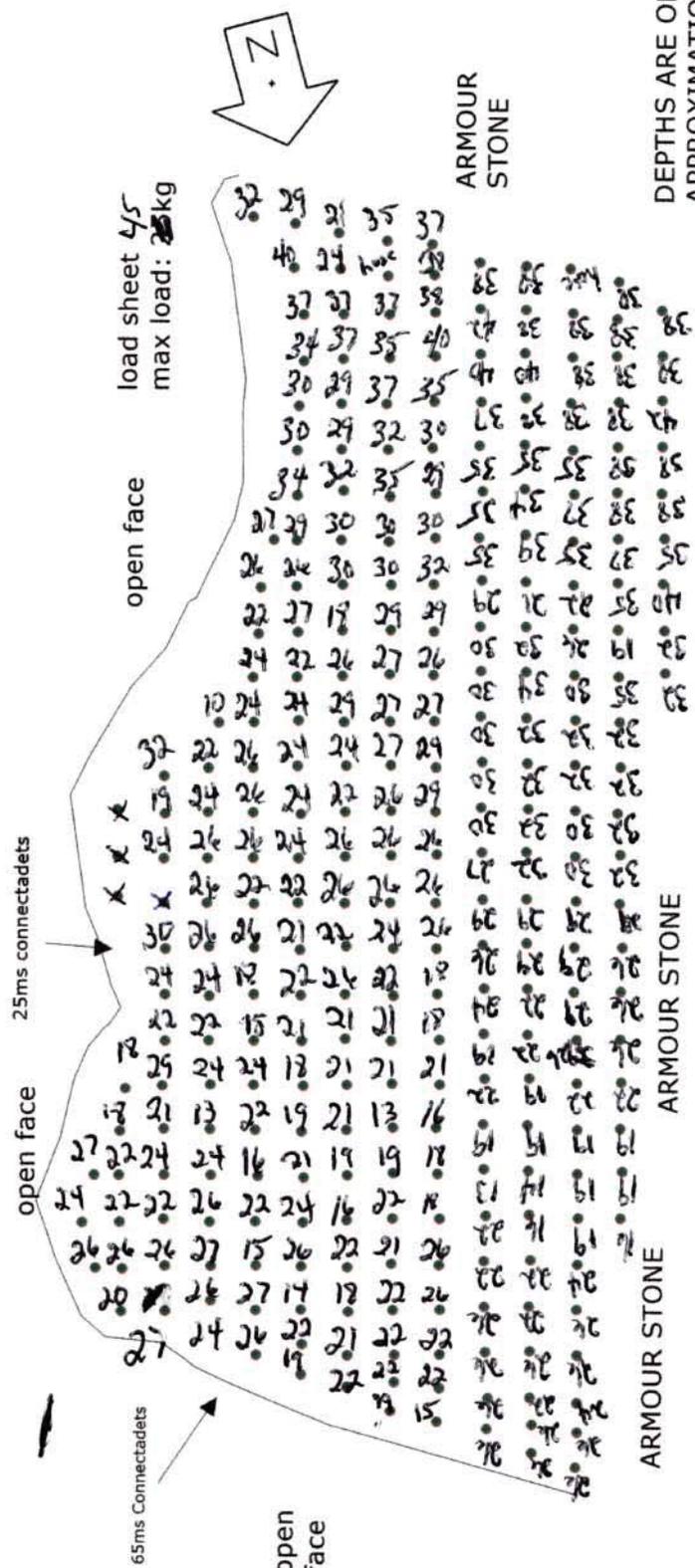
Signature required, indicating that  
 Blast Report is Complete & Accurate.



SHOTPlus Plan

Blast Summary Data

Burden: 11.5ft Spacing: 11.5ft Subdrill: 0.0ft Stemming: 5.5ft  
 1st row burden: 11.5ft Hole Diameter: 4.0in Number of holes: 283 Hole angle: 0.0°  
 Total drilled: 4211.9ft



9FLR007 Design Partial Fnl - 4" Blast Hole 11.5 x 11.5 253 and 248.6 ELEV  
 DRILLER NAME:

**DRILL TO SHALE**

DEPTHS ARE ONLY APPROXIMATIONS

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.6.1 | 5/9/2019                                     |
| Mine                           | Burlington                                   |
| Location                       | FLOOR SHOT NEXT TO 9FLR004                   |
| Title/author                   | 9FLR007 Partial Design Fnl                   |
| Filename                       | Burlington 2019-05-10 Blast 19-007 Floor.spf |

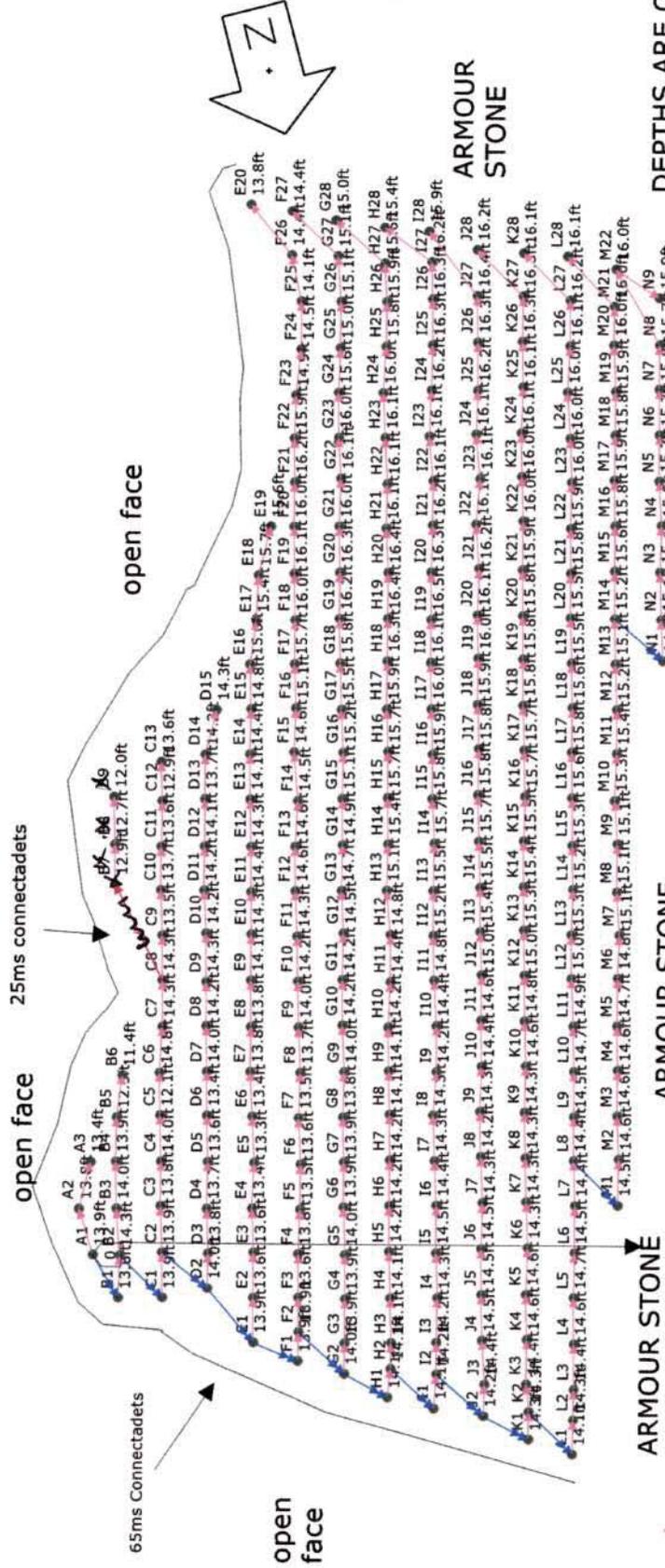


Not to scale

SHOTPlus Plan

Blast Summary Data

Burden: 11.5ft Spacing: 11.5ft Subdrill: 0.0ft Stemming: 5.5ft  
 1st row burden: 11.5ft Hole Diameter: 4.0in Number of holes: 283 Hole angle: 0.0°  
 Total drilled: 4211.9ft



ARMOUR STONE  
 DEPTHS ARE ONLY APPROXIMATIONS

ARMOUR STONE

9FLR007 Design Partial Fnl - 4" Blast Hole 11.5 x 11.5 253 and 248.6 ELEV  
 DRILLER NAME:

**DRILL TO SHALE**



Not to scale

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.6.1 | 5/9/2019                                     |
| Mine                           | Burlington                                   |
| Location                       | FLOOR SHOT NEXT TO 9FLR004                   |
| Title/author                   | 9FLR007 Partial Design Fnl                   |
| Filename                       | Burlington 2019-05-10 Blast 19-007 Floor.spf |



# Blast Design

## Nelson Aggregate

Quarry: **Burlington**  
 P.O. #:  
 Design Date: **2019-05-10**

Blast Number: **19-007**  
 Orica Order #:

page 1

Blaster-in-charge: **Kevin Toplis** (Print Name)

Blast Location: **Floor** (Bench / Face)

GPS Coordinates: **43.40368** °N Latitude **79.88238** °W Longitude  
Centre of Blast Centre of Blast

Design to Blasted: **35,821** te  
 Total Holes Loaded: **283** holes  
 ... including: Dead Holes  
 ... and: Helper Holes  
 Helper Hole Collar: ft avg  
 # Rows Blasted: **13** rows

- Drilling Information -

Angle from Vertical  
 Primary Bit diam: **101.6** mm **0**° # Holes: **283** = 4,245.0 ft ( 4 " diam)  
 Secondary Bit diam: mm **0**° # Holes: = 0.0 ft ( " diam)  
 Tertiary Bit diam: mm **0**° # Holes: = 0.0 ft ( " diam)  
 Nominal Bit Diameter:

- Design Pattern (Front Row)-

Burden: **11.5** ft avg  
 Spacing: **11.5** ft avg  
 # Holes: **7** front row

- Design Pattern (Main Body) -

Burden: **11.5** ft avg  
 Spacing: **11.5** ft avg  
 # Holes: 276 main body  
 Bench Height: **13.0** ft avg  
 Sub-drill: **2.0** ft avg  
 Hole Depth: 15.0 ft avg

- Design Stone Decking -

Front Row: ft avg  
 Main Body: ft avg

- Design Collar Stemming -

Front Row: **7.0** ft avg  
 Main Body: **7.0** ft avg

Material used: **3/4" Clear**

- Design Charge Length -

Front Row: 8.0 ft avg  
 Main Body: 8.0 ft avg

- Design Charge Weight -

Front Row: 23.3 kg/hole  
 Main Body: 23.3 kg/hole  
 Max Chge Wt / delay: **25.0** kg/delay

Required kg Loaded: 8,096 kg  
 Rock Density: **2.60** g/cc = te/m<sup>3</sup>

- Design Powder Factor -

Expected Yield PF: 0.226 kg/te (actual)  
 Front row: 0.184 kg/te (theoretical)  
 Main Body: 0.184 kg/te (theoretical)  
 "KPI" PF: 0.184 kg/te (theoretical)

0.808 lb/yd<sup>3</sup>  
 0.808 lb/yd<sup>3</sup>  
 0.808 lb/yd<sup>3</sup>

NOTES (ANY VARIATION FROM STANDARD):

| Bulk Expl. Required: | kg    |
|----------------------|-------|
| CENTRA GOLD 70       | 8,000 |

| Pkgd Expl. Required: | kg |
|----------------------|----|
|                      |    |
|                      |    |
|                      |    |

| Boosters Required:                     | kg/u | # used | kg    |
|----------------------------------------|------|--------|-------|
| PENTEX 12 (OR EQUIVALENT)              | 0.34 | 283    | 96.2  |
| total explosives weight in Blast (kg): |      |        | 8,096 |
| Pkgd Prod (0 kg) % of Total kg:        |      |        | 0.0%  |

| Detonators Required: | ms    | # req'd |
|----------------------|-------|---------|
| EXEL HANDIDET 9m     |       | 283     |
| UNITRONIC 600 6M     |       | 1       |
| CONNECTADET 9M       | 65 ms | 27      |

| Cord & Access. Req'd:     | U of M | # req'd |
|---------------------------|--------|---------|
| WIRE DUPLEX (6 PACK) 400M | units  | 1       |
|                           | units  |         |
|                           | units  |         |

| Resource Deployment:            |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

| Services Req'd:       |                              |     |
|-----------------------|------------------------------|-----|
| BULK TRUCK CHARGE     |                              | 1.0 |
| BLASTER HOURS         | Enter Blaster hours          | 0.0 |
| HELPER HOURS          | Enter total Helper man-hours | 0.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0 |
| ADVANCED BLAST DESIGN | Enter hours                  | 1.0 |
| BORETRACK             | Enter hours                  | 0.0 |



**Blast Design**  
Nelson Aggregate

Quarry: Burlington  
P.O. #:  
Blast Date: 5/10/2019

Blast Number: 19-007  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



D10

7.0

14.2

ø4.000 in

HANDIDET 500ms 23ft  
PENTEX BC 12 \* 340 x1

Orica

Blaster-in-charge:

*Kevin Toplis*

Quarry Manager:

*Nick Heap*

Signature required, indicating  
sign off on Blast Design.



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-05-30

Blast Number: 19-008

Orica Order #: 2488743

Blast Time: 11:55 AM

page 1

Blaster-in-charge: Mike der Kinderen (Print Name)

Blast Location: Floor (Bench / Face)

GPS Coordinates: 43.40286 °N Latitude 79.88663 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 10 kph Temperature: 16 to 20 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 23,061 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 229 = 4,243.8 ft ( 4 " diam)  
Secondary Bit diam: mm Angle from Vertical: 0° # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm Angle from Vertical: 0° # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 26,810  | 19,270   | 7,540 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 2           | 0  |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 227    | 77.2 |

total explosives weight in Blast (kg): 7,617

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                  | case #'s | ms     | # used |
|------------------|----------|--------|--------|
| UNITRONIC 600 6M |          |        | 1      |
| EXEL HANDIDET 9m |          | 25/500 | 227    |
| CONNECTADET 9M   |          | 65 ms  | 18     |

### Cord & Accessories:

|  | U of M | # used |
|--|--------|--------|
|  | units  |        |
|  | units  |        |
|  | units  |        |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |     |
|-----------------------|------------------------------|-----|
| BULK TRUCK CHARGE     |                              | 1.0 |
| BLASTER HOURS         | Enter Blaster hours          | 0.0 |
| HELPER HOURS          | Enter total Helper man-hours | 0.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0 |
| ADVANCED BLAST DESIGN | Enter hours                  | 1.0 |
| BORETRACK             | Enter hours                  | 0.0 |

Tonnes Blasted: 40,960 te 15,754 m<sup>3</sup>  
Total tonnes per day: 40,960 te NF-02 Rate Code  
Total Holes Loaded: 227 holes  
... including: 0 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 18 rows

### - Pattern (Front Row) -

Burden: 11.5 ft avg  
Spacing: 11.5 ft avg  
# Holes: 20 front row

### - Pattern (Main Body) -

Burden: 11.5 ft avg  
Spacing: 11.5 ft avg  
# Holes: 207 main body

Bench Height: 18.5 ft avg

Sub-drill: 0.0 ft avg

Hole Depth: 18.5 ft avg

### - Stone Decking -

Front Row: ft avg  
Main Body: ft avg  
# Decks: per blast

### - Collar Stemming -

Front Row: 8.0 ft avg  
Main Body: 8.0 ft avg  
Material used: 1/2" Clear

### - Charge Length -

Front Row: 10.5 ft avg  
Main Body: 10.5 ft avg

### - Charge Weight -

Front Row: 30.7 kg/hole  
Main Body: 30.7 kg/hole  
Max. per delay: 45.0 kg/delay  
SD () Equation: 526.2 kg/delay  
Total kg Loaded: 7,617 kg  
Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.186 kg/te (actual)  
Front row: 0.170 kg/te (theoretical)  
Main Body: 0.170 kg/te (theoretical)  
"KPI" PF: 0.170 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 2019-05-30

Blast Number: 19-008  
 Orica Order #: 2488743  
 Blast Time: 11:55 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40292       | 79.88668        | 0.757524    | 1.394286    |
| Front Row Corner          | 43.40298       | 79.88617        | 0.757525    | 1.394277    |
| Back Row Corner           | 43.40269       | 79.88704        | 0.757520    | 1.394292    |
| Average (Centre of Blast) | 43.40286       | 79.88663        | 0.757523    | 1.394285    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 688.2                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 1.3                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 35.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 104.2 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1068.8                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.        | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-----------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               |                       |                 |                     |                                        |
| 2nd Reading                               |                       |                 |                     |                                        |
| Average                                   | 0.00000               | 0.00000         | 0.000000            | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | 0.0                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.0              | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 0.0        | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 0.0 | dB              | Trigger set at: 115 | dB                                     |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(688.2)^2}{30^2} \text{ kg} \\
 &= \frac{473,619}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

jim bray

Orica  
 Blaster-in-charge:

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington

P.O. #:

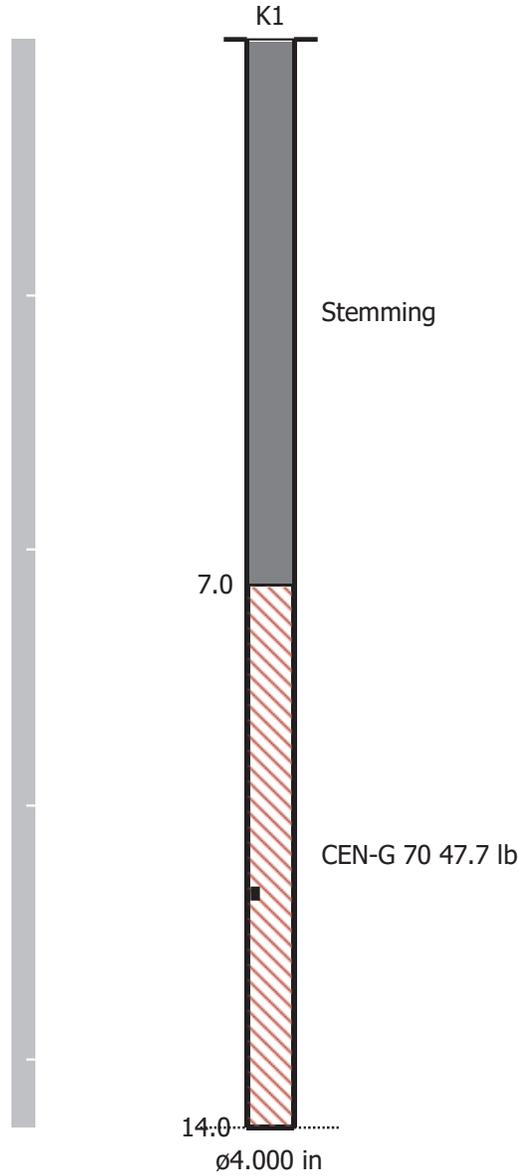
Blast Date: 5/30/2019

Blast Number: 19-008

Orica Order #: 2488743

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nick Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 11:55:15 May 30, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.0 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTEL  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 Line 2  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

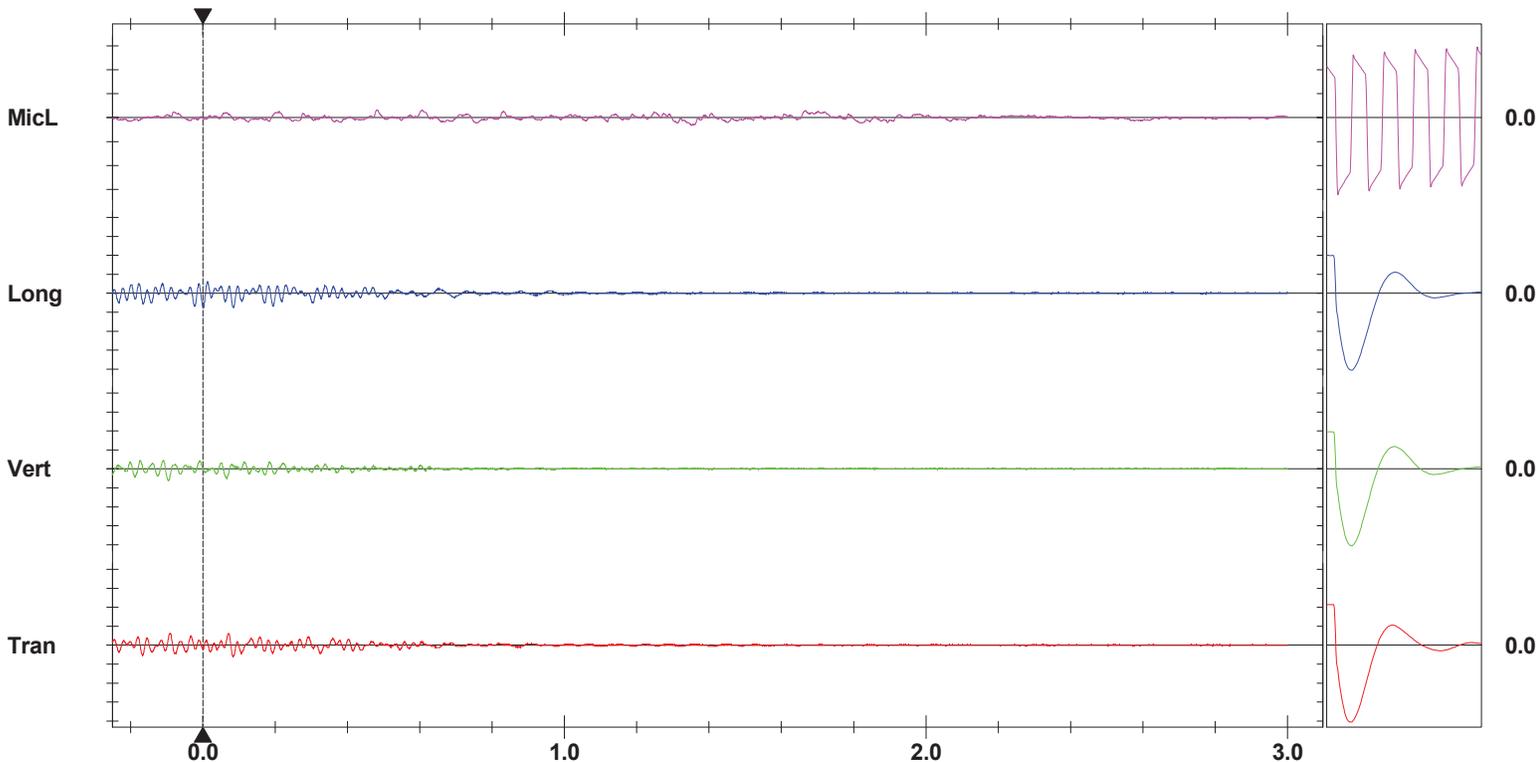
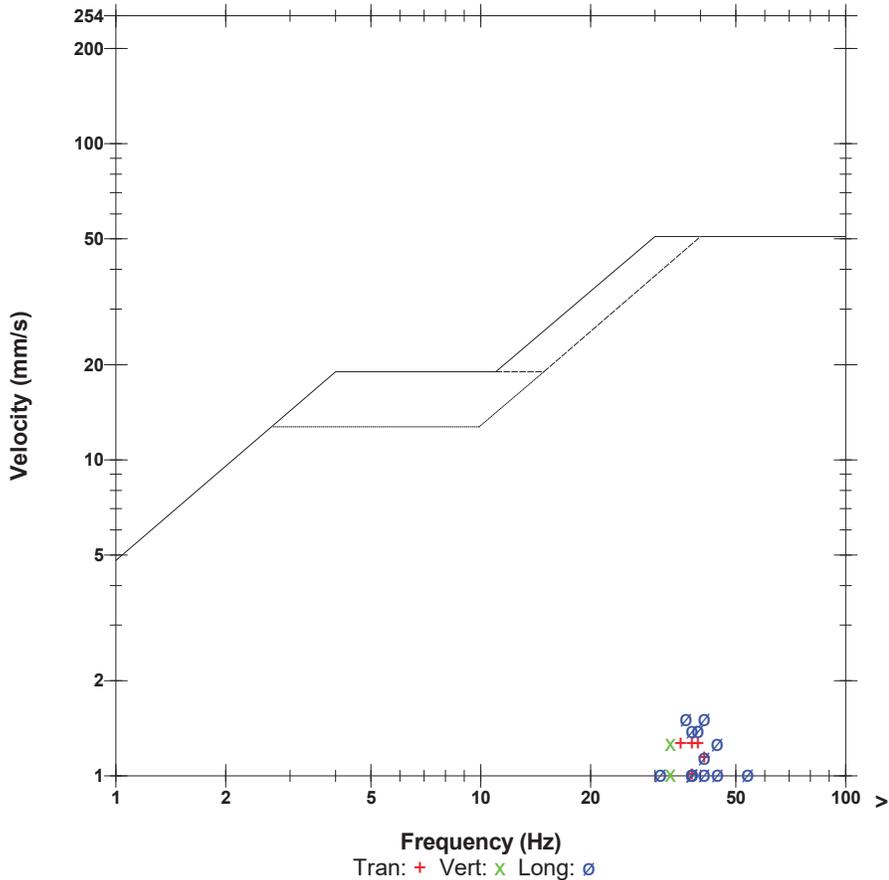
In front Yard by tree stump  
 N-43.40245, W-79.87814

**Microphone** Linear Weighting  
**PSPL** 104.2 dB(L) at 0.481 sec  
**ZC Freq** 20 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 566 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 1.270  | 1.270  | 1.524  | mm/s |
| ZC Freq             | 35     | 33     | 41     | Hz   |
| Time (Rel. to Trig) | -0.092 | -0.096 | 0.000  | sec  |
| Peak Acceleration   | 0.053  | 0.053  | 0.053  | g    |
| Peak Displacement   | 0.006  | 0.006  | 0.007  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.5    | 7.4    | 7.3    | Hz   |
| Overswing Ratio     | 3.9    | 3.5    | 3.7    |      |

**Peak Vector Sum** 2.020 mm/s at 0.083 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Nelson Aggregate  
Across rod from 2102 Road 2  
Burlington 2019-05-30 Blast 19-008 Floor**

**Event Report: Monitor Log - Micromate ISEE # UM6859-Compliance**

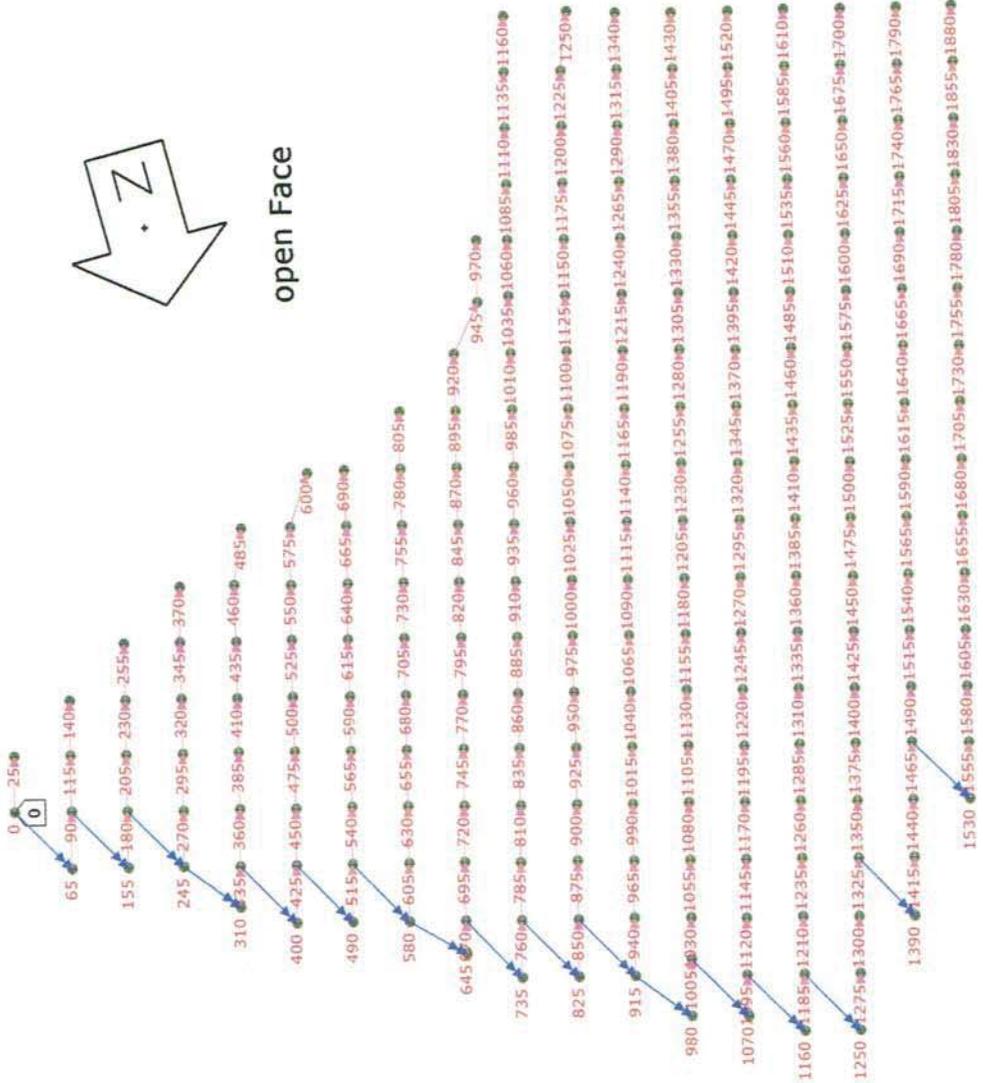
| Start Time                   | End Time                     | Status                                                                          |
|------------------------------|------------------------------|---------------------------------------------------------------------------------|
| -----<br>May 30 /19 05:22:36 | -----<br>May 30 /19 05:22:36 | SERIAL NUMBER: UM6859<br>Start Monitoring Waveform Geo: 1.50 mm/s Mic: 121.0 dB |
| May 30 /19 05:22:36          | May 30 /19 12:21:22          | No events recorded. (Keyboard Exit) Waveform Geo: 1.50 mm/s Mic:                |

SHOTPlus 5 Plan

Blast Summary Data

Burden: 11.5ft Spacing: 11.5ft Subdrill: 0.0ft Stemming: 5.5ft  
 1st row burden: 11.5ft Hole Diameter: 4.0in Number of holes: 229 Hole angle: 0.0°  
 Total drilled: 3206.0ft

Ramp



Road

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 5/29/2019                                    |
| Mine                           | Burlington                                   |
| Location                       |                                              |
| Title/author                   | 9FLR008 Final                                |
| Filename                       | Burlington 2019-05-30 Blast 19-008 Floor.spf |



Not to scale

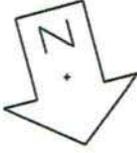
SHOTPlus 5 Plan

Blast Summary Data

Burden: 11.5ft Spacing: 11.5ft Stemming: 5.5ft  
 1st row burden: 11.5ft Hole Diameter: 4.0in Subdrill: 0.0ft Hole angle: 0.0°  
 Total drilled: 3206.0ft Number of holes: 229

Ramp

- R1 R2 14.0ft 14.0ft
- Q1 Q2 Q3 Q4 14.0ft 14.0ft 14.0ft 14.0ft
- P1 P2 P3 P4 P5 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft
- O1 O2 O3 O4 O5 O6 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft
- N1 N2 N3 N4 N5 N6 N7 N8 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft
- M1 M2 M3 M4 M5 M6 M7 M8 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft
- L1 L2 L3 L4 L5 L6 L7 L8 L9 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft
- K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft 14.0ft
- J1 J2 J3 J4 J5 J6 J7 J8 J9 J10 J11 J12 14.0ft 14.0ft
- I1 I2 I3 I4 I5 I6 I7 I8 I9 I10 I11 I12 I13 I14 I15 I16 I17 I18 14.0ft 14.0ft
- H1 H2 H3 H4 H5 H6 H7 H8 H9 H10 H11 H12 H13 H14 H15 H16 H17 H18 14.0ft 14.0ft
- G1 G2 G3 G4 G5 G6 G7 G8 G9 G10 G11 G12 G13 G14 G15 G16 G17 G18 14.0ft 14.0ft
- F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 14.0ft 14.0ft
- E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 14.0ft 14.0ft
- D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18 D19 14.0ft 14.0ft
- C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 14.0ft 14.0ft
- B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 14.0ft 14.0ft
- A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 14.0ft 14.0ft



9FLR008 Final  
 4" Blasthole  
 11.5 X 11.5' Pattern

DRILL TO SHALE

Road



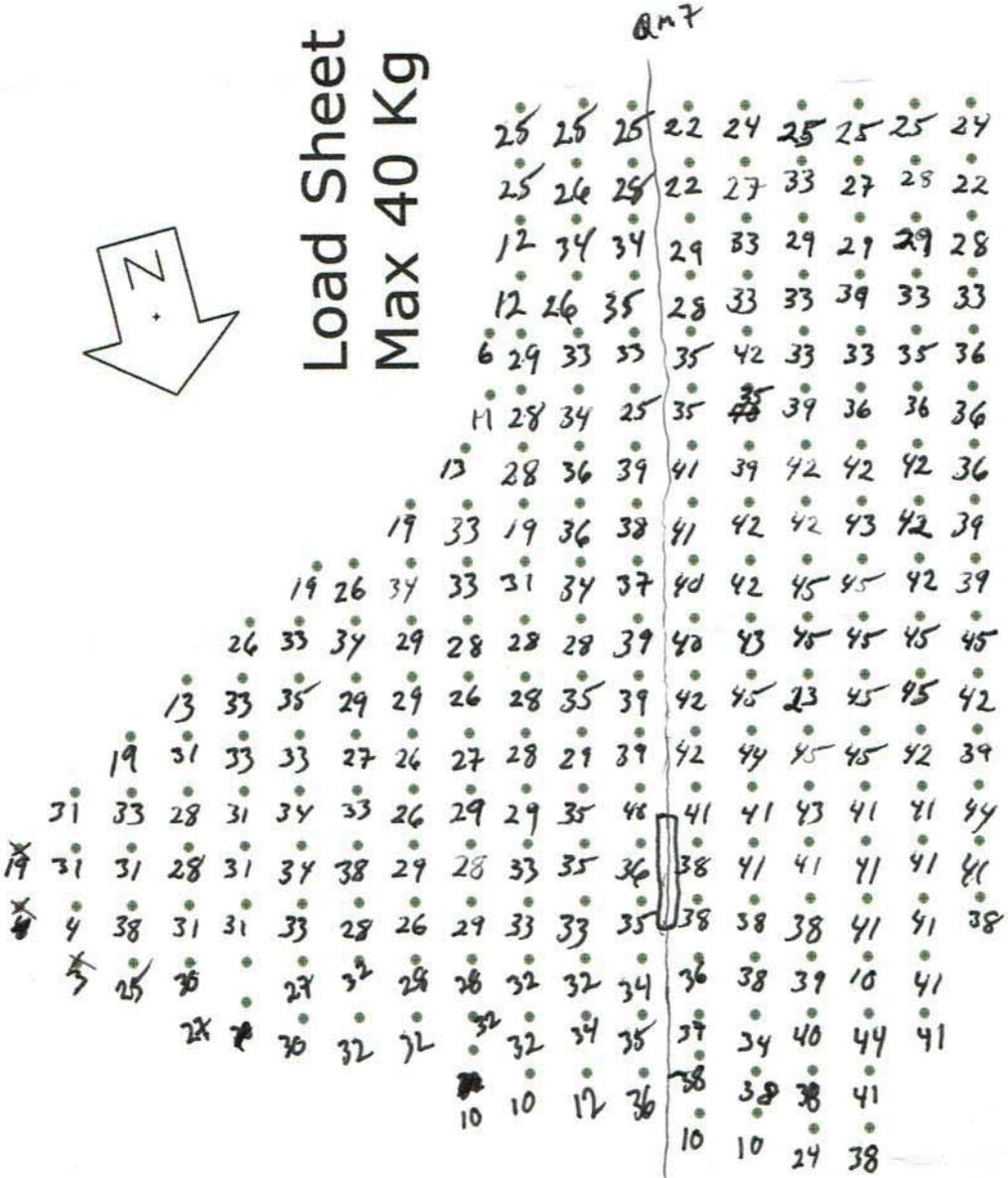
Not to scale

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 5/29/2019                                    |
| Mine                           | Burlington                                   |
| Location                       |                                              |
| Title/author                   | 9FLR008 Final                                |
| Filename                       | Burlington 2019-05-30 Blast 19-008 Floor.spf |

SHOTPlus 5 Plan

Blast Summary Data  
 Burden: 11.5ft Spacing: 11.5ft Stemming: 5.5ft  
 1st row burden: 11.5ft Hole Diameter: 4.0in Subdrill: 0.0ft Hole angle: 0.0°  
 Total drilled: 3206.0ft Number of holes: 229

Ramp



Road

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 5/29/2019                                    |
| Mine                           | Burlington                                   |
| Location                       |                                              |
| Title/author                   | 9FLR008 Final                                |
| Filename                       | Burlington 2019-05-30 Blast 19-008 Floor.spf |



Not to scale



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-06-06

Blast Number: 19-009

Orica Order #: 2491485

Blast Time: 12:07 PM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40361 °N Latitude 79.88191 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: S at kph Temperature: 16 to 20 °C

Clear: Partly Cloudy: X Rain: Snow: Inversion: Ceiling 3,169 ft

### - Drilling Information -

|                             | Angle from Vertical | Nominal Bit Diameter:                |
|-----------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm  | 0                   | # Holes: 52 = 3,754.9 ft ( 4 " diam) |
| Secondary Bit diam: 92.1 mm | 0                   | # Holes: 1 = 72.2 ft ( 3 5/8 " diam) |
| Tertiary Bit diam: mm       | 0                   | # Holes: = 0.0 ft ( " diam)          |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,970  | 22,050   | 11,920 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 2           | 0  |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 8 (OR EQUIVALENT)  | 0.23      | 55     | 12.5 |
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 55     | 18.7 |

total explosives weight in Blast (kg): 11,951  
Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 53     |
| UNITRONIC 600 20M |          |    | 2      |
| UNITRONIC 600 25M |          |    | 55     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 5      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |     |
|-----------------------|------------------------------|-----|
| BULK TRUCK CHARGE     |                              | 1.0 |
| BLASTER HOURS         | Enter Blaster hours          | 6.0 |
| HELPER HOURS          | Enter total Helper man-hours | 5.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0 |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0 |
| BORETRACK             | Enter hours                  | 0.0 |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 27,603 te      | 10,616 m <sup>3</sup> |
| Total tonnes per day: | 27,603 te      | NB80-01 Rate Code     |
| Total Holes Loaded:   | 53 holes       |                       |
| ... including:        | 0 Dead Holes   |                       |
| ... and:              | 0 Helper Holes |                       |
| Helper Hole Collar:   | 0.0 ft avg     |                       |
| # Rows Blasted:       | 3 rows         |                       |

### - Pattern (Front Row) -

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 19 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 34 main body |

Bench Height: 70.2 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 72.2 ft avg

### - Stone Decking -

Front Row: 8.0 ft avg

Main Body: 0.0 ft avg

# Decks: 2 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 57.2 ft avg

Main Body: 65.2 ft avg

### - Charge Weight -

Front Row: 166.8 kg/hole

Main Body: 190.1 kg/hole

Max. per delay: 230.0 kg/delay

SD () Equation: 122.0 kg/delay

Total kg Loaded: 11,951 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.433 kg/te (actual)

Front row: 0.269 kg/te (theoretical)

Main Body: 0.409 kg/te (theoretical)

"KPI" PF: 0.362 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.897 lb/yd<sup>3</sup>  
1.179 lb/yd<sup>3</sup>  
1.791 lb/yd<sup>3</sup>  
1.587 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

2 Stone decks were added due to voids identified on drill log



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-06-06

Blast Number: 19-009  
 Orica Order #: 2491485  
 Blast Time: 12:07 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40362       | 79.88191        | 0.757536    | 1.394202    |
| Front Row Corner          | 43.40341       | 79.88199        | 0.757532    | 1.394204    |
| Back Row Corner           | 43.40381       | 79.88183        | 0.757539    | 1.394201    |
| Average (Centre of Blast) | 43.40361       | 79.88191        | 0.757536    | 1.394202    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 331.4                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 9.7                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 11.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 116.9 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 1014.8                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 15.5         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 121.7 | dB              | Trigger set at: 115 | dB                                     |

Colling Rd & Blind Line Bruce Trail

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1267.4                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(331.4)^2}{30^2} \text{ kg} \\
 &= \frac{109,826}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.

**Date/Time** Long at 12:07:12 June 6, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

### Notes

**Location:** 2450 #2 Sideroad  
**Client:** Nelson Aggregate  
**User Name:** Orica Canada Inc.  
**General:** Burlington

### Extended Notes

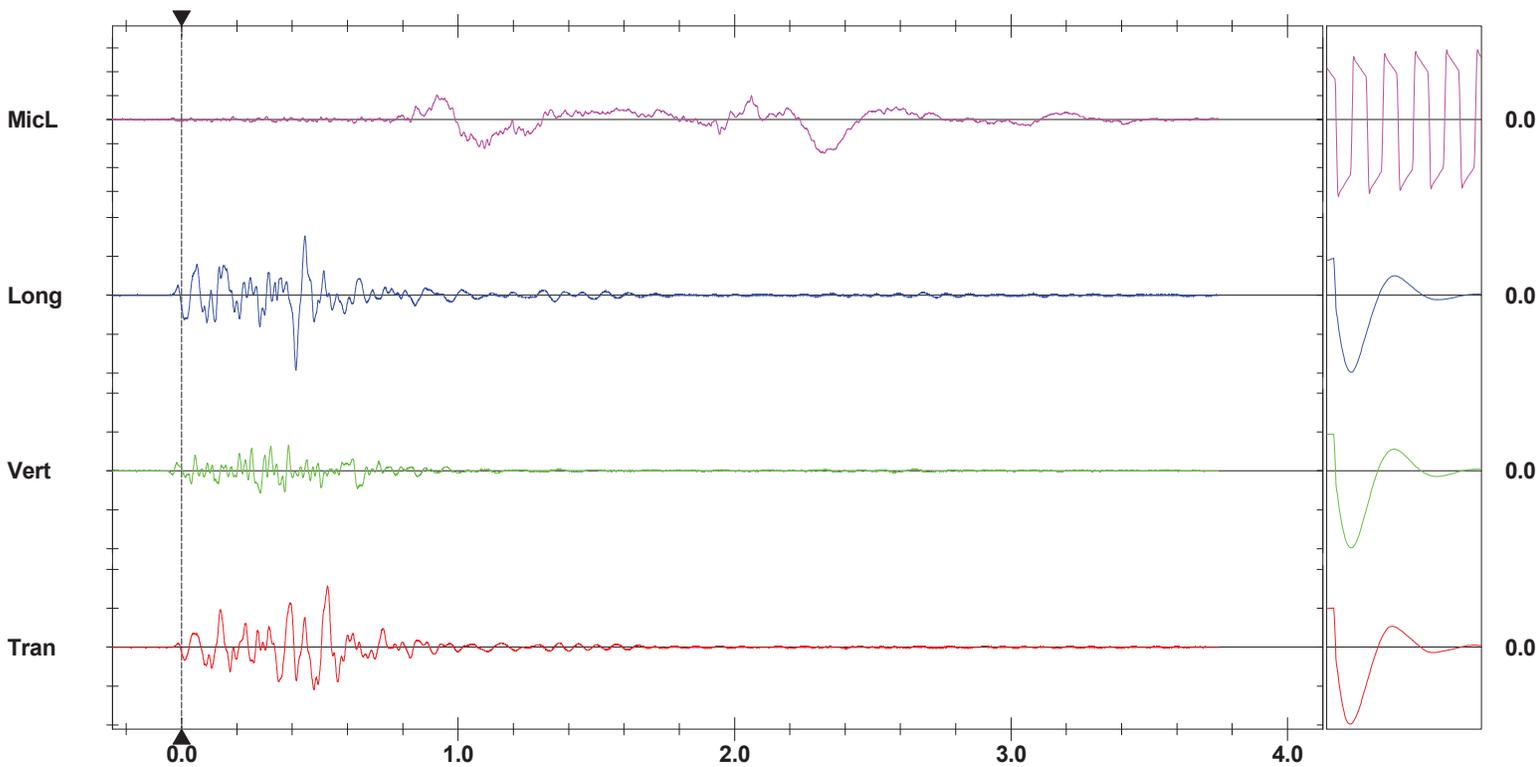
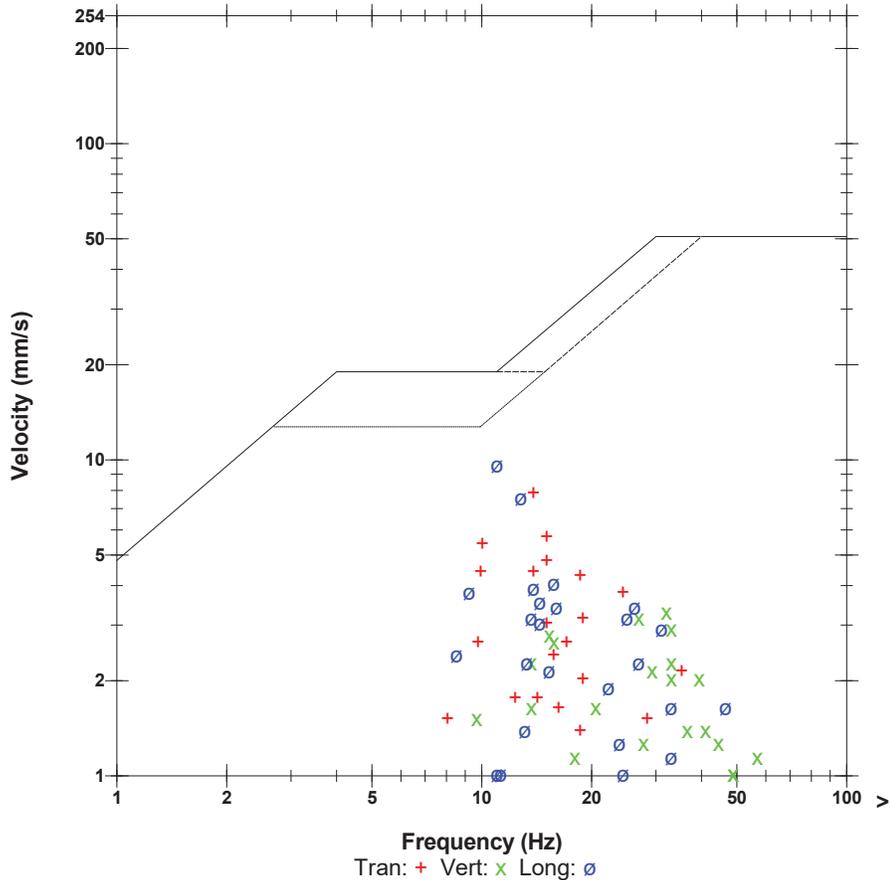
43.40245 -79.87814  
 Beside tree stump in front yard

**Microphone** Linear Weighting  
**PSPL** 116.9 dB(L) at 2.322 sec  
**ZC Freq** 2.3 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 571 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 7.874  | 3.302  | 9.652  | mm/s |
| ZC Freq             | 13.8   | 32     | 11.0   | Hz   |
| Time (Rel. to Trig) | 0.527  | 0.386  | 0.413  | sec  |
| Peak Acceleration   | 0.106  | 0.080  | 0.106  | g    |
| Peak Displacement   | 0.089  | 0.029  | 0.089  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.5    | 7.3    | Hz   |
| Overswing Ratio     | 3.8    | 3.6    | 4.0    |      |

**Peak Vector Sum** 10.53 mm/s at 0.414 sec

### USBM RI8507 And OSMRE



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 5.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 12:07:14 June 6, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.353 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** January 15, 2019 by InstanTEL  
**File Name** UM6857\_20190606120714.IDFW

**Notes**

Location: COLLING RD & BLINDLINE  
 Client: NELSON AGGREGATES  
 User Name: ORICA CANADA  
 General:

**Extended Notes**

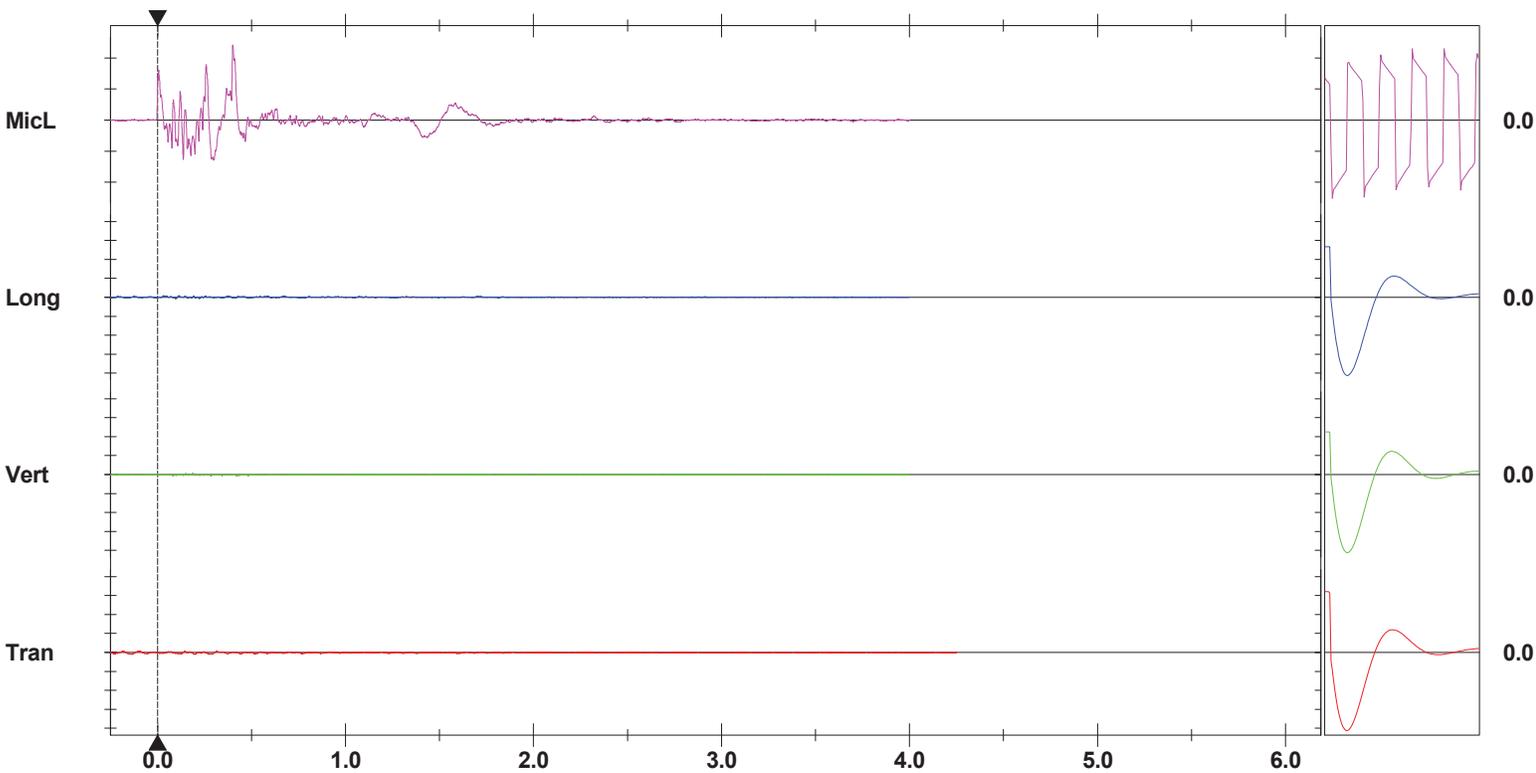
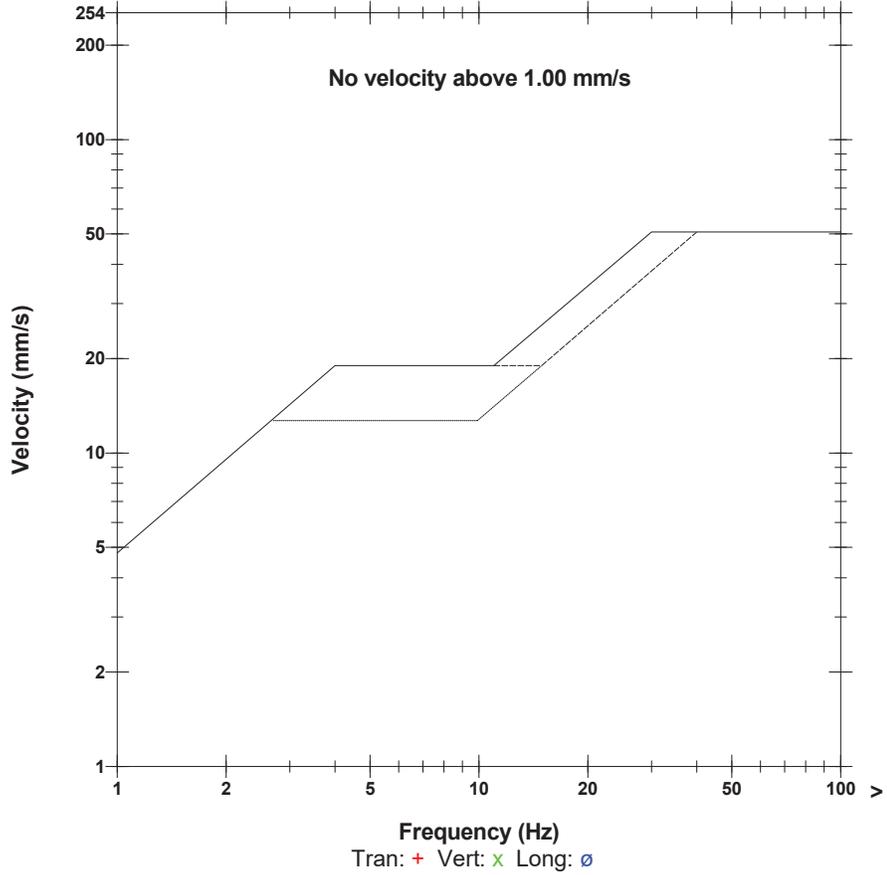
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 121.7 dB(L) at 0.400 sec  
**ZC Freq** 5.6 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1345 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.213  | 0.126  | 0.173  | mm/s |
| ZC Freq             | 15.5   | 14.4   | 25     | Hz   |
| Time (Rel. to Trig) | 0.200  | 0.081  | 0.114  | sec  |
| Peak Acceleration   | 0.010  | 0.012  | 0.016  | g    |
| Peak Displacement   | 0.009  | 0.002  | 0.002  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.4    | 3.4    | 3.7    |      |

Peak Vector Sum 0.232 mm/s at 0.200 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Nelson Aggregate  
SW Corner of Property  
Burlington 2019-06-06 Blast 19-009 Upper Middle**

**Event Report: Monitor Log - Micromate ISEE # UM6859-Compliance**

| Start Time         | End Time           | Status                                                                |
|--------------------|--------------------|-----------------------------------------------------------------------|
| -----              | -----              | SERIAL NUMBER: UM6859                                                 |
| Jun 6 /19 05:55:30 |                    | Start Monitoring Waveform Geo: 1.50 mm/s Mic: 121.0 dB                |
| Jun 6 /19 12:29:39 | Jun 6 /19 12:29:41 | Event recorded. Trigger Level Long: 1.50 mm/s                         |
| Jun 6 /19 12:29:41 | Jun 6 /19 12:29:49 | Event recorded. (Keyboard Exit) Waveform Geo: 1.50 mm/s Mic: 121.0 dB |

SHOTPlus 5 Plan

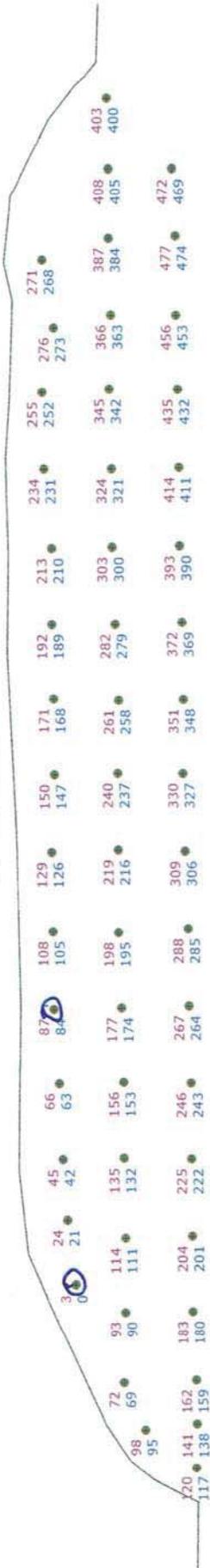
Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 3827.1ft      Hole Diameter: 4.0in      Number of holes: 53

*O = Deck*



open face



**C2 3.625" DIA HOLE**



Not to scale

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 6/5/2019                                     |
| Mine                           | Burlington                                   |
| Location                       | UPPER MIDDLE                                 |
| Title/author                   | 9UPMD009 Design Fnl                          |
| Filename                       | Burlington 2019-06-06 Blast 19-009 Upper Mig |

SHOTPlus 5 Plan

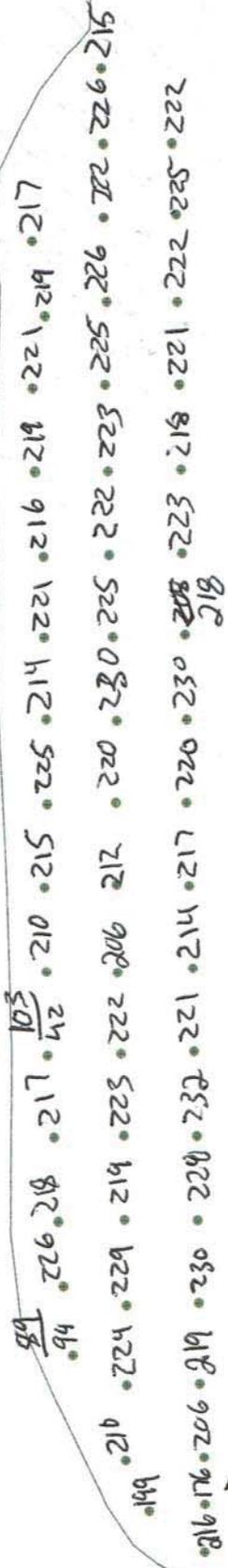
Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 3827.1ft      Hole Diameter: 4.0in      Number of holes: 53

Load Sheet  
 Max 230 Kg



open face



C2 3.625" DIA HOLE



Not to scale

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 6/5/2019                                     |
| Mine                           | Burlington                                   |
| Location                       | UPPER MIDDLE                                 |
| Title/author                   | 9UPMD009 Design Fnl                          |
| Filename                       | Burlington 2019-06-06 Blast 19-009 Upper Mic |

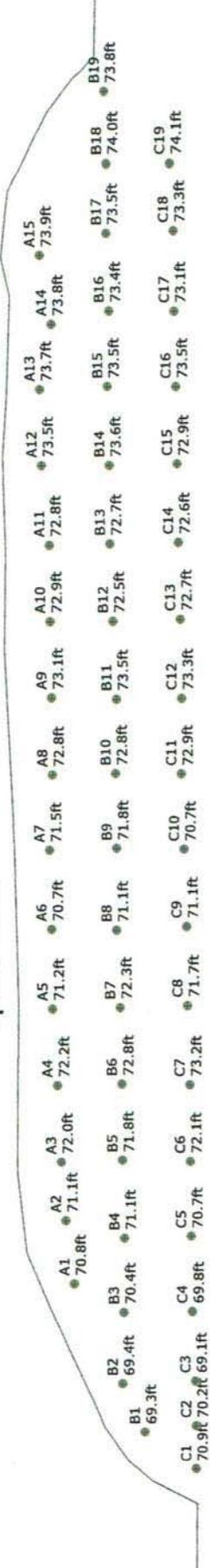
SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Subdrill: 2.0ft Hole angle: 0.0°  
 Total drilled: 3827.1ft Hole Diameter: 4.0in Number of holes: 53



open face



9UPMD009 Design Fnl - 3.625" and 4" Blast Holes 12x10 9x10 272 and 250 + .6 S  
 DRILLER NAME: \_\_\_\_\_

**C2 3.625" DIA HOLE**



Not to scale

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 6/5/2019                                     |
| Mine                           | Burlington                                   |
| Location                       | UPPER MIDDLE                                 |
| Title/author                   | 9UPMD009 Design Fnl                          |
| Filename                       | Burlington 2019-06-06 Blast 19-009 Upper Mid |



# Blast Design

## Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Design Date: 2019-06-06

Blast Number: 19-009  
 Orica Order #:

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)  
 GPS Coordinates: 43.40361 °N Latitude 79.88191 °W Longitude  
Centre of Blast Centre of Blast

Design to Blasted: 27,603 te  
 Total Holes Loaded: 53 holes  
 ... including:          Dead Holes  
 ... and:          Helper Holes  
 Helper Hole Collar:          ft avg  
 # Rows Blasted: 3 rows

- Drilling Information -

|                     |                     |            |                            |                                  |
|---------------------|---------------------|------------|----------------------------|----------------------------------|
|                     | Angle from Vertical |            |                            | Nominal Bit Diameter:            |
| Primary Bit diam:   | <u>101.6</u> mm     | <u>0</u> ° | # Holes: <u>52</u> =       | 3,754.9 ft ( <u>4</u> " diam)    |
| Secondary Bit diam: | <u>92.1</u> mm      | <u>0</u> ° | # Holes: <u>1</u> =        | 72.2 ft ( <u>3 5/8</u> " diam)   |
| Tertiary Bit diam:  | <u>        </u> mm  | <u>0</u> ° | # Holes: <u>        </u> = | 0.0 ft ( <u>        </u> " diam) |

- Design Pattern (Front Row) -

Burden: 12.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 19 front row

- Design Pattern (Main Body) -

Burden: 9.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 34 main body  
 Bench Height: 70.2 ft avg  
 Sub-drill: 2.0 ft avg  
 Hole Depth: 72.2 ft avg

- Design Stone Decking -

Front Row: 0.0 ft avg  
 Main Body: 0.0 ft avg

- Design Collar Stemming -

Front Row: 7.0 ft avg  
 Main Body: 7.0 ft avg  
 Material used: .75" Clear

- Design Charge Length -

Front Row: 65.2 ft avg  
 Main Body: 65.2 ft avg

- Design Charge Weight -

Front Row: 190.1 kg/hole  
 Main Body: 190.1 kg/hole  
 Max Chge Wt / delay: 230.0 kg/delay

Required kg Loaded: 12,550 kg  
 Rock Density: 2.60 g/cc = te/m<sup>3</sup>

- Design Powder Factor -

Expected Yield PF: 0.455 kg/te (actual)  
 Front row: 0.307 kg/te (theoretical)  
 Main Body: 0.409 kg/te (theoretical)  
 "KPI" PF: 0.375 kg/te (theoretical)

1.343 lb/yd<sup>3</sup>  
 1.791 lb/yd<sup>3</sup>  
 1.642 lb/yd<sup>3</sup>

NOTES (ANY VARIATION FROM STANDARD):

|                             |               |
|-----------------------------|---------------|
| <b>Bulk Expl. Required:</b> | kg            |
| CENTRA GOLD 70              | <u>12,500</u> |

|                             |             |
|-----------------------------|-------------|
| <b>Pkgd Expl. Required:</b> | kg          |
| FORTEL PRO 75X400           | <u>2</u> 50 |

|                           |      |        |    |
|---------------------------|------|--------|----|
| <b>Boosters Required:</b> | kg/u | # used | kg |
| PENTEX 8 (OR EQUIVALENT)  | 0.23 |        |    |
| PENTEX 12 (OR EQUIVALENT) | 0.34 |        |    |

total explosives weight in Blast (kg): 12,550  
 Pkgd Prod (50 kg) % of Total kg: 0.4%

|                             |    |         |
|-----------------------------|----|---------|
| <b>Detonators Required:</b> | ms | # req'd |
| UNITRONIC 600 6M            |    |         |
| UNITRONIC 600 25M           |    |         |

|                                  |        |          |
|----------------------------------|--------|----------|
| <b>Cord &amp; Access. Req'd:</b> | U of M | # req'd  |
| WIRE DUPLEX (6 PACK) 400M        | units  | <u>1</u> |

|                                 |          |
|---------------------------------|----------|
| Resource Deployment:            |          |
| # of Blasts today (this Quarry) | <u>1</u> |
| # of Blasters (this Blast)      | <u>1</u> |
| # of Helpers (this Blast)       | <u>1</u> |
| # of MMU's (this Blast)         | <u>1</u> |

|                        |                              |            |
|------------------------|------------------------------|------------|
| <b>Services Req'd:</b> |                              |            |
| BULK TRUCK CHARGE      |                              | <u>1.0</u> |
| BLASTER HOURS          | Enter Blaster hours          | <u>0.0</u> |
| HELPER HOURS           | Enter total Helper man-hours | <u>0.0</u> |
| SHOT LAYOUT FEE        | Enter # trips extra beyond 1 | <u>0.0</u> |
| ADVANCED BLAST DESIGN  | Enter hours                  | <u>0.0</u> |
| BORETRACK              | Enter hours                  | <u>0.0</u> |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-06-20

Blast Number: 19-010

Orica Order #: 2496865

Blast Time: 12:11 PM

page 1

Blaster-in-charge: Kevin Toplis (Print Name)

Blast Location: Floor 011 (Bench / Face)

GPS Coordinates: 43.40226 °N Latitude 79.88668 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: N at 5 kph Temperature: 16 to 20 °C

Clear:  Rain:  Overcast:  X  
Partly Cloudy:  Snow:  Inversion:  Ceiling 30,000 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                 |
|----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm | 0                   | # Holes: 272 = 4,678.4 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0                   | # Holes: = 0.0 ft ( " diam)           |
| Tertiary Bit diam: mm      | 0                   | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 35,630  | 29,410   | 6,220 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 2           | 0  |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 272    | 92.5 |

total explosives weight in Blast (kg): 6,312

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms     | # used |
|-------------------|----------|--------|--------|
| UNITRONIC 600 6M  |          |        | 1      |
| EXEL HANDIDET 12m |          | 25/500 | 24     |
| CONNECTADET 9M    |          | 25 ms  | 11     |
| CONNECTADET 9M    |          | 33 ms  | 2      |
| CONNECTADET 9M    |          | 65 ms  | 36     |
| EXEL HANDIDET 9m  |          | 25/500 | 248    |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
|                                  | units  |        |
|                                  | units  |        |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.5  |
| HELPER HOURS          | Enter total Helper man-hours | 12.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 45,552 te      | 17,520 m <sup>3</sup> |
| Total tonnes per day: | 45,552 te      | NF-02 Rate Code       |
| Total Holes Loaded:   | 272 holes      |                       |
| ... including:        | 0 Dead Holes   |                       |
| ... and:              | 0 Helper Holes |                       |
| Helper Hole Collar:   | ft avg         |                       |
| # Rows Blasted:       | 17 rows        |                       |

### - Pattern (Front Row)-

|          |              |
|----------|--------------|
| Burden:  | 11.5 ft avg  |
| Spacing: | 11.5 ft avg  |
| # Holes: | 40 front row |

### - Pattern (Main Body) -

|          |               |
|----------|---------------|
| Burden:  | 11.5 ft avg   |
| Spacing: | 11.5 ft avg   |
| # Holes: | 232 main body |

Bench Height: 17.2 ft avg

Sub-drill: 0.0 ft avg

Hole Depth: 17.2 ft avg

### - Stone Decking -

Front Row: ft avg

Main Body: ft avg

# Decks: 0 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: 1/2" Clear

### - Charge Length -

Front Row: 10.2 ft avg

Main Body: 10.2 ft avg

### - Charge Weight -

Front Row: 29.7 kg/hole

Main Body: 29.7 kg/hole

Max. per delay: 32.0 kg/delay

SD () Equation: 530.4 kg/delay

Total kg Loaded: 6,312 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.139 kg/te (actual)

Front row: 0.178 kg/te (theoretical)

Main Body: 0.178 kg/te (theoretical)

"KPI" PF: 0.178 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):

helper hours 2x6=12hrs



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-06-20

Blast Number: 19-010  
 Orica Order #: 2496865  
 Blast Time: 12:11 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40226       | 79.88684        | 0.757512    | 1.394288    |
| Front Row Corner          | 43.40197       | 79.88588        | 0.757507    | 1.394272    |
| Back Row Corner           | 43.40255       | 79.88732        | 0.757517    | 1.394297    |
| Average (Centre of Blast) | 43.40226       | 79.88668        | 0.757512    | 1.394286    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40245                  | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 690.9                     | m               |                     |                                        |
| Post Blast Data:                          | ppV: did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: trigger | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1002.0                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.        | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-----------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               |                       |                 |                     |                                        |
| 2nd Reading                               |                       |                 |                     |                                        |
| Average                                   | 0.00000               | 0.00000         | 0.000000            | 0.000000                               |
| Distance (3rd Seis. From Centre of Blast) | 0.0                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.0              | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 0.0        | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 0.0 | dB              | Trigger set at: 115 | dB                                     |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(690.9)^2}{30^2} \text{ kg} \\
 &= \frac{477,343}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

jim bray

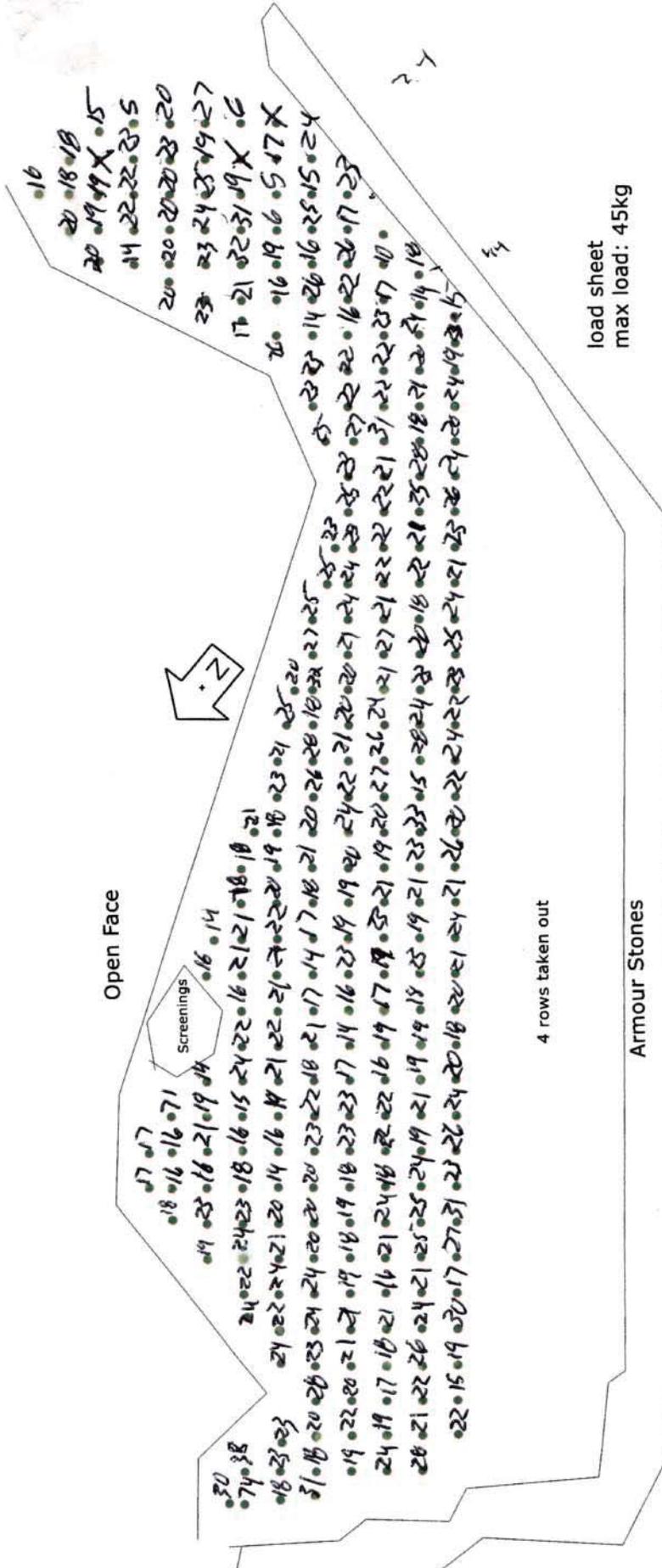
Kevin Toplis

Signature required, indicating that  
 Blast Report is Complete & Accurate.

SHOTPlus Plan

Blast Summary Data

Burden: 11.5ft Spacing: 11.5ft Stemming: 5.5ft  
 1st row burden: 11.5ft Hole Diameter: 4.0in Subdrill: 0.0ft Hole angle: 0.0°  
 Total drilled: 4368.0ft Number of holes: 273



load sheet  
max load: 45kg

9FLR11 Design  
4" Blasthole  
11.5' X 11.5' Pattern  
DRILL TO SHALE

|                                |                                              |
|--------------------------------|----------------------------------------------|
| SHOTPlus™ Professional 5.7.7.8 | 6/19/2019                                    |
| Mine                           | Burlington                                   |
| Location                       |                                              |
| Title/author                   | 9FLR11 Design                                |
| Filename                       | Burlington 2019-06-20 Blast 19-010 Floor.spf |



Not to scale









# Blast Design

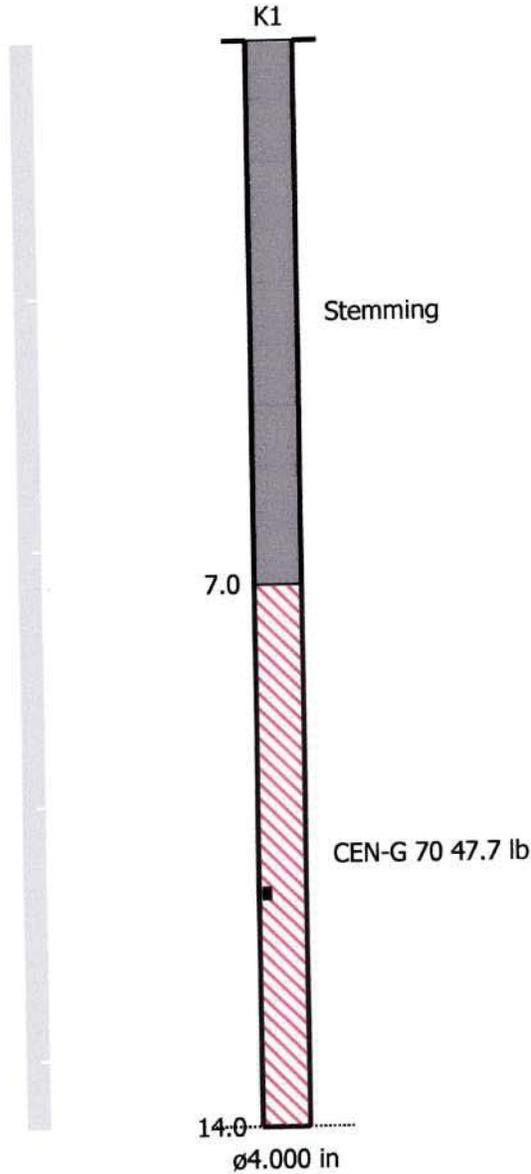
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 6/20/2019

Blast Number: 19-010  
Orica Order #:

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

*Kevin Toplis*

Quarry Manager:

*Nick Heap*

Signature required, indicating  
sign off on Blast Design.



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-07-04

Blast Number: 19-011

Orica Order #: 2503180

Blast Time: 11:04 AM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle North (Bench / Face)

GPS Coordinates: 43.40499 °N Latitude 79.88175 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: SE at 10 kph Temperature: 26 to 30 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

|                             | Angle from Vertical | Nominal Bit Diameter:                 |
|-----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm  | 0°                  | # Holes: 53 = 3,205.4 ft ( 4 " diam)  |
| Secondary Bit diam: 92.1 mm | 0°                  | # Holes: 4 = 241.9 ft ( 3 5/8 " diam) |
| Tertiary Bit diam: mm       | 0°                  | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 27,440  | 19,700   | 7,740 |
| CENTRA GOLD 70 | 34,450  | 32,820   | 1,630 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 2           | 0  |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 8 (OR EQUIVALENT)  | 0.23      | 57     | 12.9 |
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 57     | 19.4 |

total explosives weight in Blast (kg): 9,402

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 57     |
| UNITRONIC 600 20M |          |    | 25     |
| UNITRONIC 600 25M |          |    | 32     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 5      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.0  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

|                       |                |                      |
|-----------------------|----------------|----------------------|
| Tonnes Blasted:       | 23,372 te      | 8,989 m <sup>3</sup> |
| Total tonnes per day: | 23,372 te      | NB60-07 Rate Code    |
| Total Holes Loaded:   | 57 holes       |                      |
| ... including:        | 3 Dead Holes   |                      |
| ... and:              | 0 Helper Holes |                      |
| Helper Hole Collar:   | 0.0 ft avg     |                      |
| # Rows Blasted:       | 3 rows         |                      |

### - Pattern (Front Row)-

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 20 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 37 main body |

Bench Height: 58.5 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 60.5 ft avg

### - Stone Decking -

Front Row: 0.0 ft avg

Main Body: 0.0 ft avg

# Decks: 0 per blast

### - Collar Stemming -

Front Row: 8.0 ft avg

Main Body: 8.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 52.5 ft avg

Main Body: 52.5 ft avg

### - Charge Weight -

Front Row: 153.0 kg/hole

Main Body: 153.0 kg/hole

Max. per delay: 187.0 kg/delay

SD () Equation: 183.3 kg/delay

Total kg Loaded: 9,402 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.402 kg/te (actual)

Front row: 0.296 kg/te (theoretical)

Main Body: 0.395 kg/te (theoretical)

"KPI" PF: 0.362 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.763 lb/yd<sup>3</sup>

1.298 lb/yd<sup>3</sup>

1.731 lb/yd<sup>3</sup>

1.586 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

F-16 Was measured at 61' the morning of the blast and brought to Nick Heap's attention

8' Collars were used due to excessive over burden



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 2019-07-04

Blast Number: 19-011  
 Orica Order #: 2503180  
 Blast Time: 11:04 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40505       | 79.88168        | 0.757561    | 1.394198    |
| Front Row Corner          | 43.40470       | 79.88175        | 0.757555    | 1.394200    |
| Back Row Corner           | 43.40521       | 79.88182        | 0.757564    | 1.394201    |
| Average (Centre of Blast) | 43.40499       | 79.88175        | 0.757560    | 1.394199    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 406.2                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 3.3                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 20.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 113.5 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 998.1                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 9.1          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 115.3 | dB              | Trigger set at: 115 | dB                                     |

Colling Rd & Blind Line Bruce Trail

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1411.7                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(406.2)^2}{30^2} \text{ kg} \\
 &= \frac{164,998}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 7/4/2019

Blast Number: 19-011  
 Orica Order #: 2503180

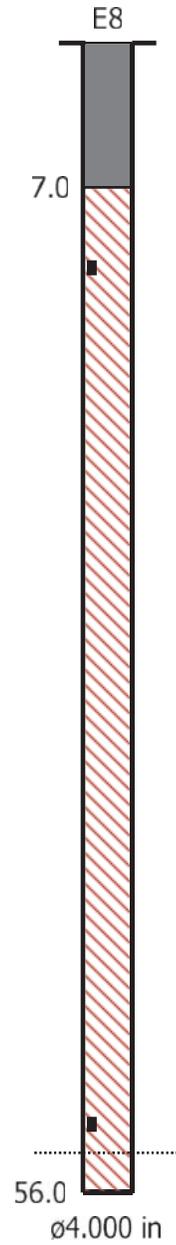
page 2

Paste ShotPlus Diagram inside Rectangle:



UNI Tronic (?)ms 20ft  
 PENTEX BC 7 \* 200 x1

UNI Tronic (?)ms 66ft  
 PENTEX BC 12 \* 340 x1



**Orica**

Blaster-in-charge:

*Mike derkinderen*

Quarry Manager:

*Nick Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 11:04:45 July 4, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.4 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

### Notes

**Location:** 2450 #2 Road  
**Client:** Nelson Aggregate  
**User Name:** Orica Canada Inc.  
**General:** Burlington

### Extended Notes

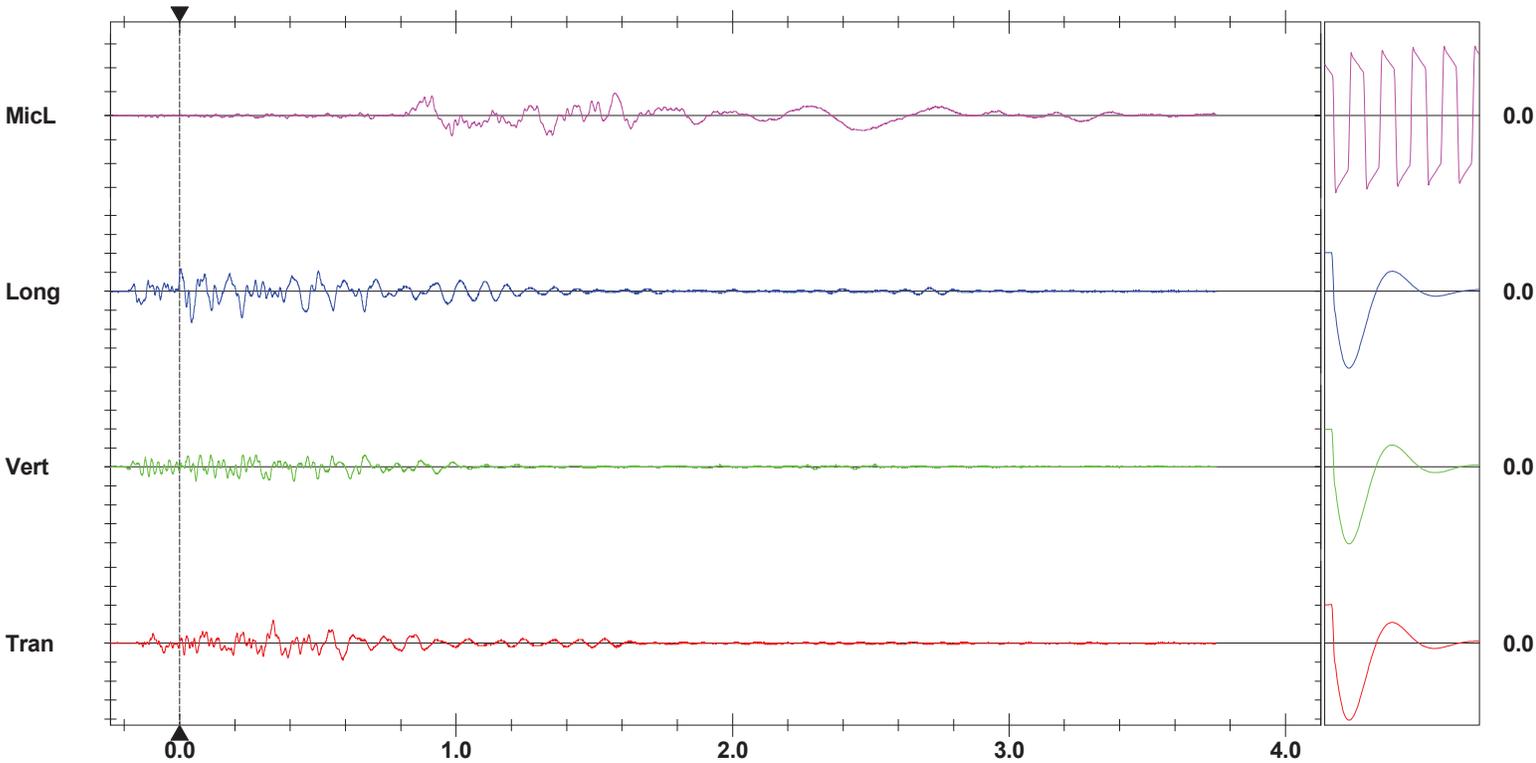
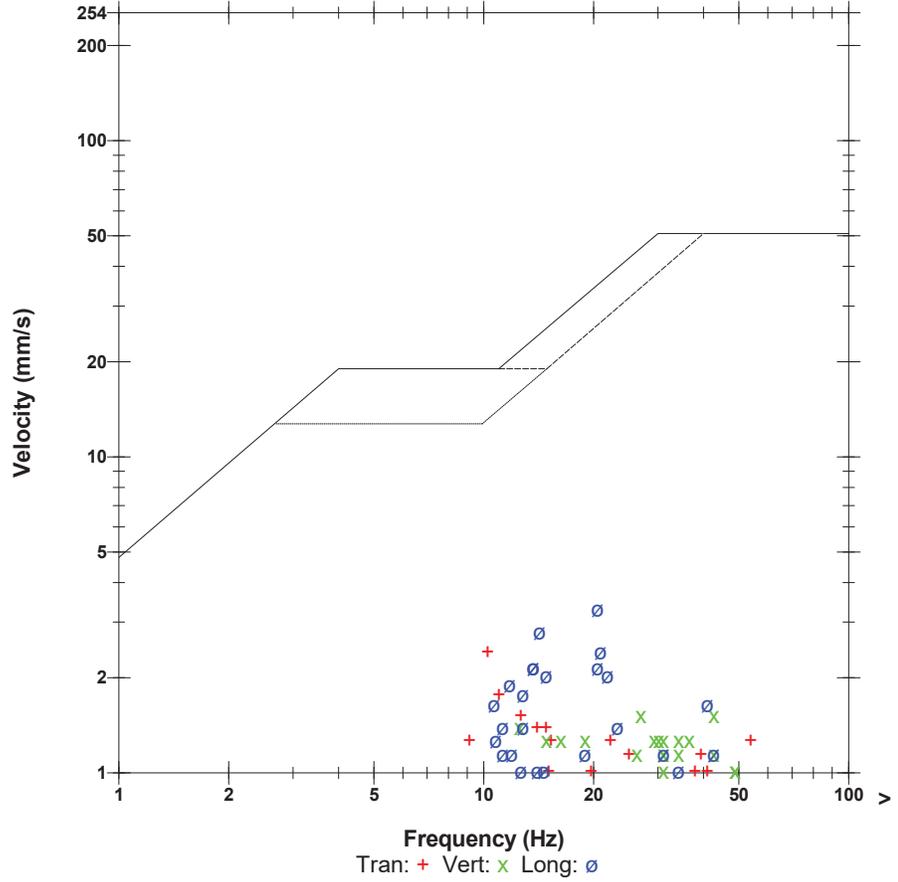
N43.40245;W-79.87814

**Microphone** Linear Weighting  
**PSPL** 113.5 dB(L) at 1.575 sec  
**ZC Freq** 9.1 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 514 mv )

|                            | Tran   | Vert   | Long   |      |
|----------------------------|--------|--------|--------|------|
| <b>PPV</b>                 | 2.413  | 1.524  | 3.302  | mm/s |
| <b>ZC Freq</b>             | 10.2   | 43     | 20     | Hz   |
| <b>Time (Rel. to Trig)</b> | 0.338  | 0.059  | 0.042  | sec  |
| <b>Peak Acceleration</b>   | 0.053  | 0.053  | 0.080  | g    |
| <b>Peak Displacement</b>   | 0.026  | 0.019  | 0.029  | mm   |
| <b>Sensor Check</b>        | Passed | Passed | Passed |      |
| <b>Frequency</b>           | 7.4    | 7.4    | 7.4    | Hz   |
| <b>Overswing Ratio</b>     | 3.8    | 3.6    | 3.9    |      |

**Peak Vector Sum** 3.326 mm/s at 0.042 sec

### USBM RI8507 And OSMRE



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 11:04:45 July 4, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.009 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** January 15, 2019 by InstanTEL  
**File Name** UM6857\_20190704110445.IDFW

**Notes**

**Location:** COLLING RD & BLINDLINE  
**Client:** NELSON AGGREGATES  
**User Name:** ORICA CANADA  
**General:**

**Extended Notes**

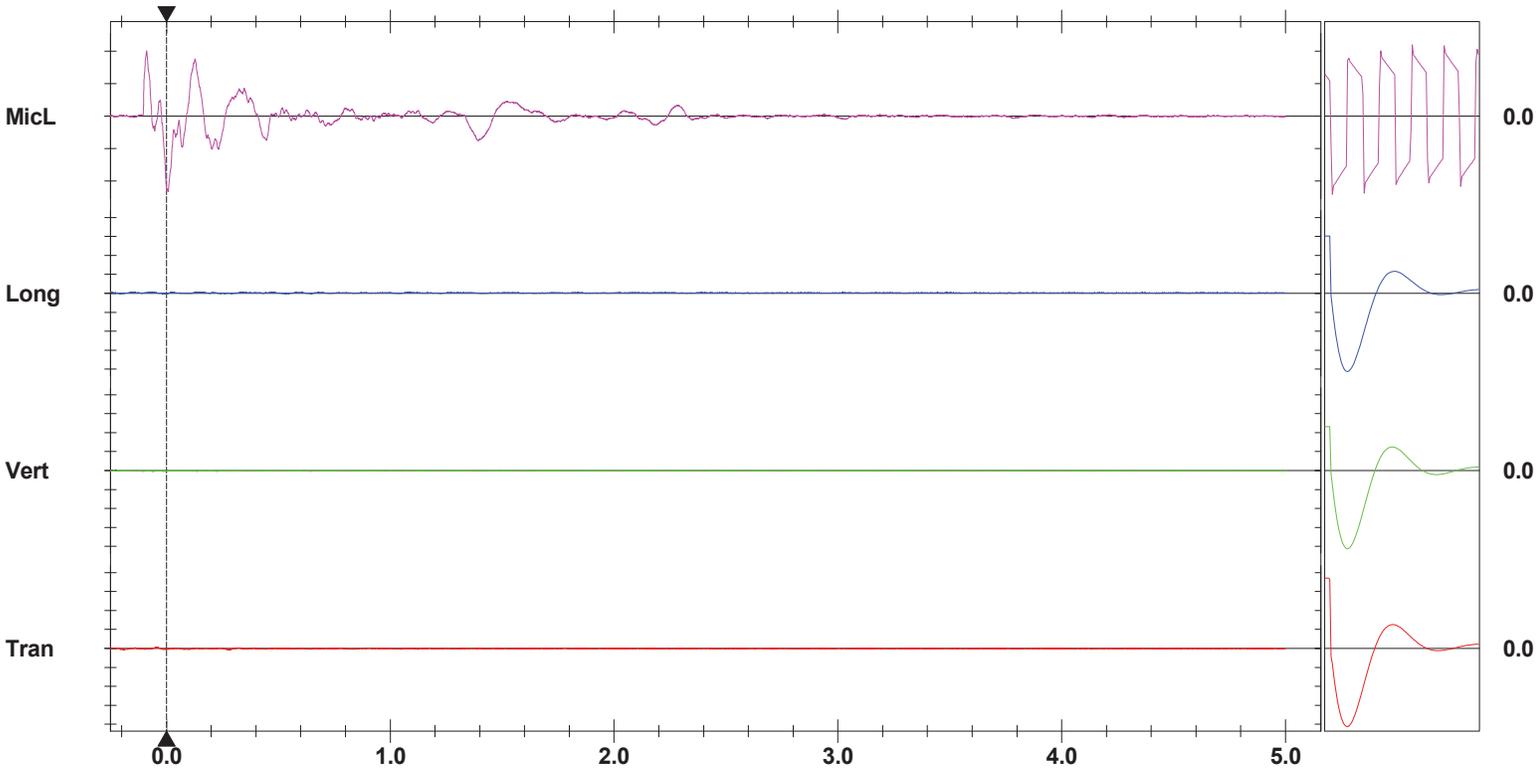
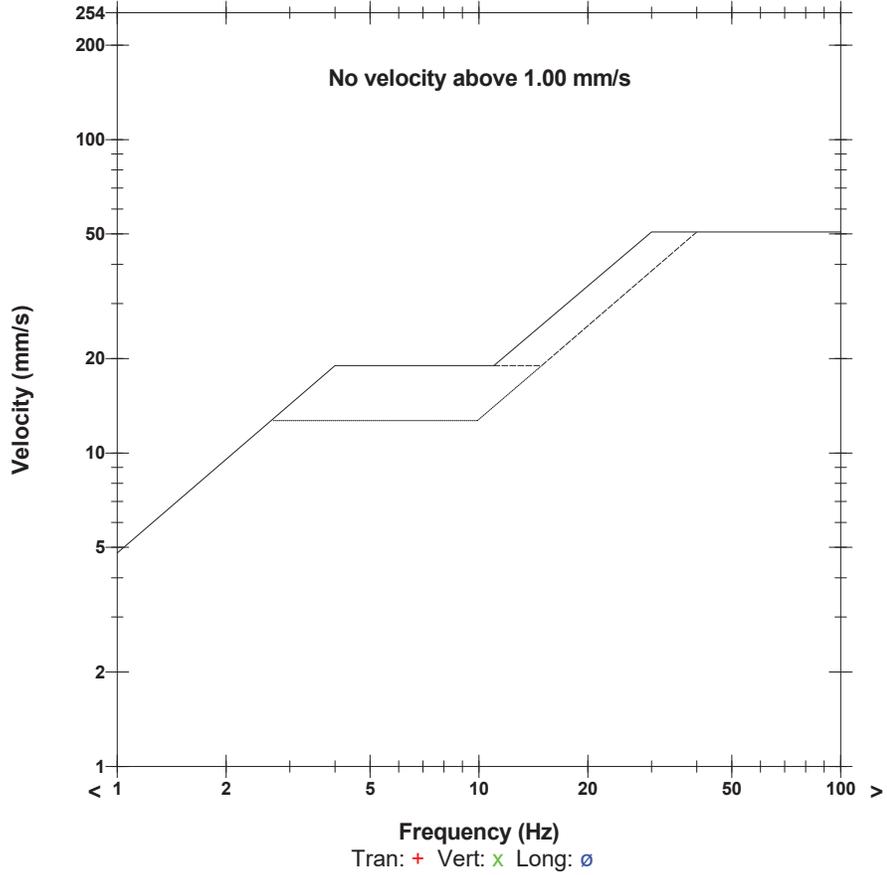
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 115.3 dB(L) at 0.007 sec  
**ZC Freq** 4.5 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1273 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.150  | 0.102  | 0.150  | mm/s |
| ZC Freq             | 9.1    | 4.9    | 7.2    | Hz   |
| Time (Rel. to Trig) | -0.188 | -0.104 | 0.141  | sec  |
| Peak Acceleration   | 0.010  | 0.012  | 0.012  | g    |
| Peak Displacement   | 0.003  | 0.016  | 0.012  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.3    | 3.3    | 3.5    |      |

**Peak Vector Sum** 0.166 mm/s at -0.060 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

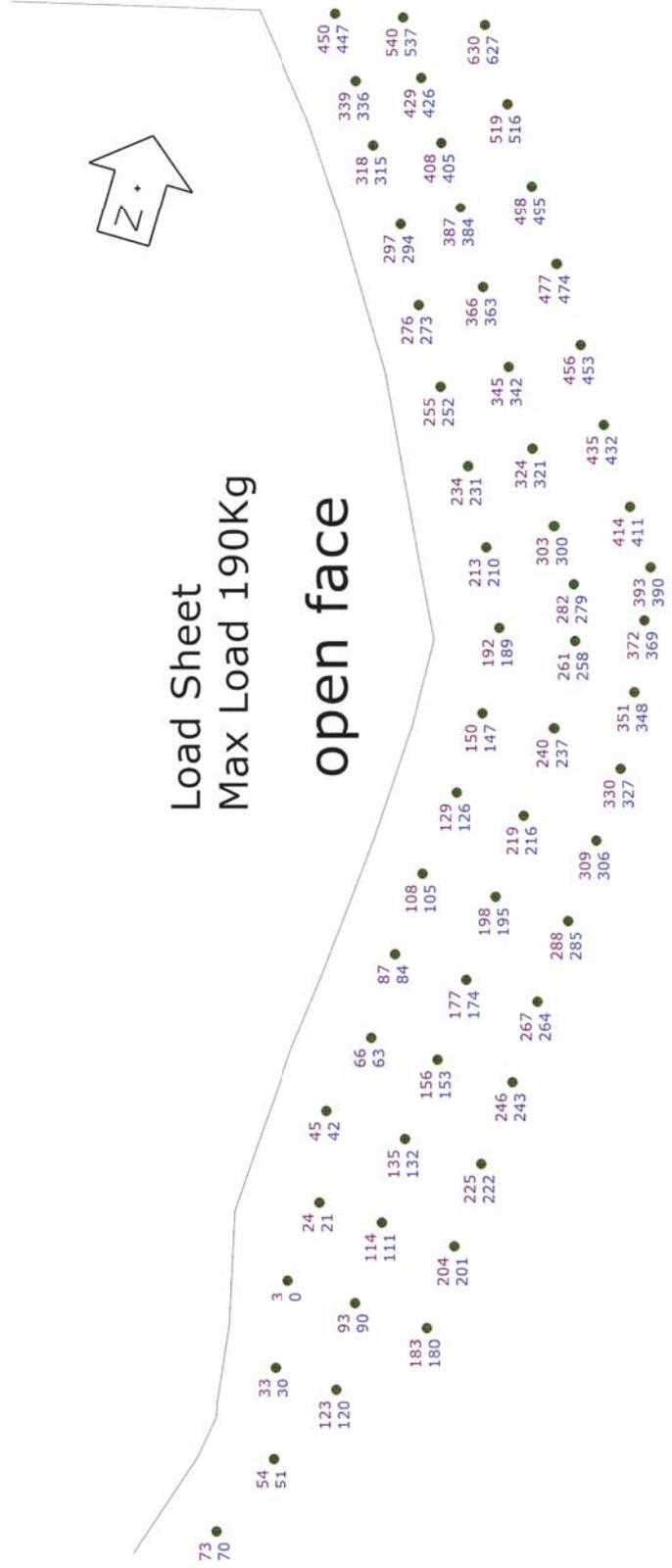
Sensor Check

**Southwest Corner of property  
Nelson Aggregate  
Burlington 2019-07-04 Blast 19-011 Upper Middle**

**Event Report: Monitor Log - Micromate ISEE # UM6859-Compliance**

| Start Time         | End Time           | Status                                                                    |
|--------------------|--------------------|---------------------------------------------------------------------------|
| -----              | -----              | SERIAL NUMBER: UM6859                                                     |
| Jul 4 /19 10:13:22 |                    | Start Monitoring Waveform Geo: 1.50 mm/s Mic: 121.0 dB                    |
| Jul 4 /19 10:13:22 | Jul 4 /19 11:37:50 | No events recorded. (Keyboard Exit) Waveform Geo: 1.50 mm/s Mic: 121.0 dB |

| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 57 | Hole angle: 0.0° |
| Total drilled: 3447.4ft |                      |                     |                  |



9NECRNR010 Design FnI- 3.625" and 4" Blast Holes 12x10 9x10 266 and 2  
**E19 F11 F18 G10 G11 are 3.625" DIA HOLES  
PAINTED PINK MARKER STONES**

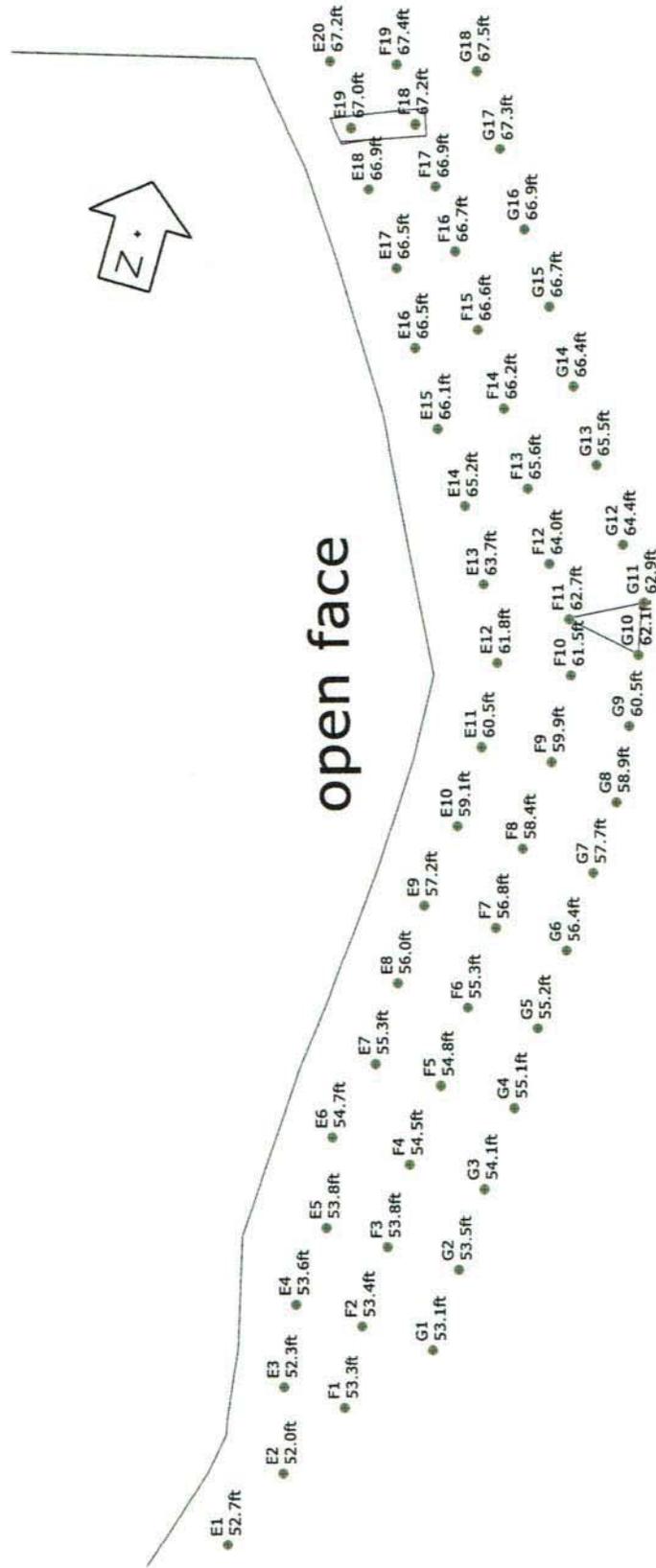


Not to scale

SHOTPlus 5 Plan

Blast Summary Data

|                         |                      |                     |
|-------------------------|----------------------|---------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Stemming: 7.0ft     |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Hole angle: 0.0°    |
| Total drilled: 3447.4ft | Subdrill: 2.0ft      | Number of holes: 57 |



E19 F11 F18 G10 G11 are 3.625" DIA HOLES  
PAINTED PINK MARKER STONES

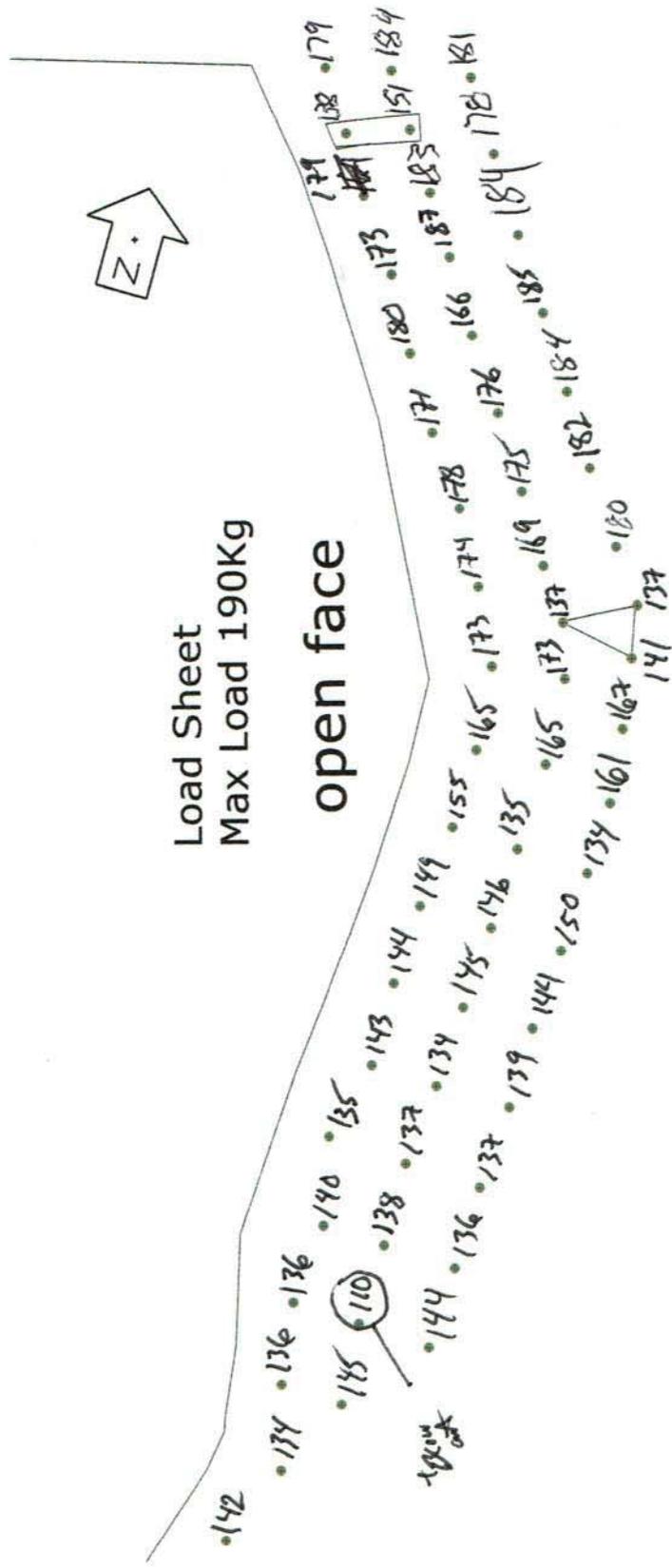


Not to scale

SHOTPLUS 5 Plan

Blast Summary Data

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 57 | Hole angle: 0.0° |
| Total drilled: 3447.4ft |                      |                     |                  |



E19 F11 F18 G10 G11 are 3.625" DIA HOLES  
PAINTED PINK MARKER STONES

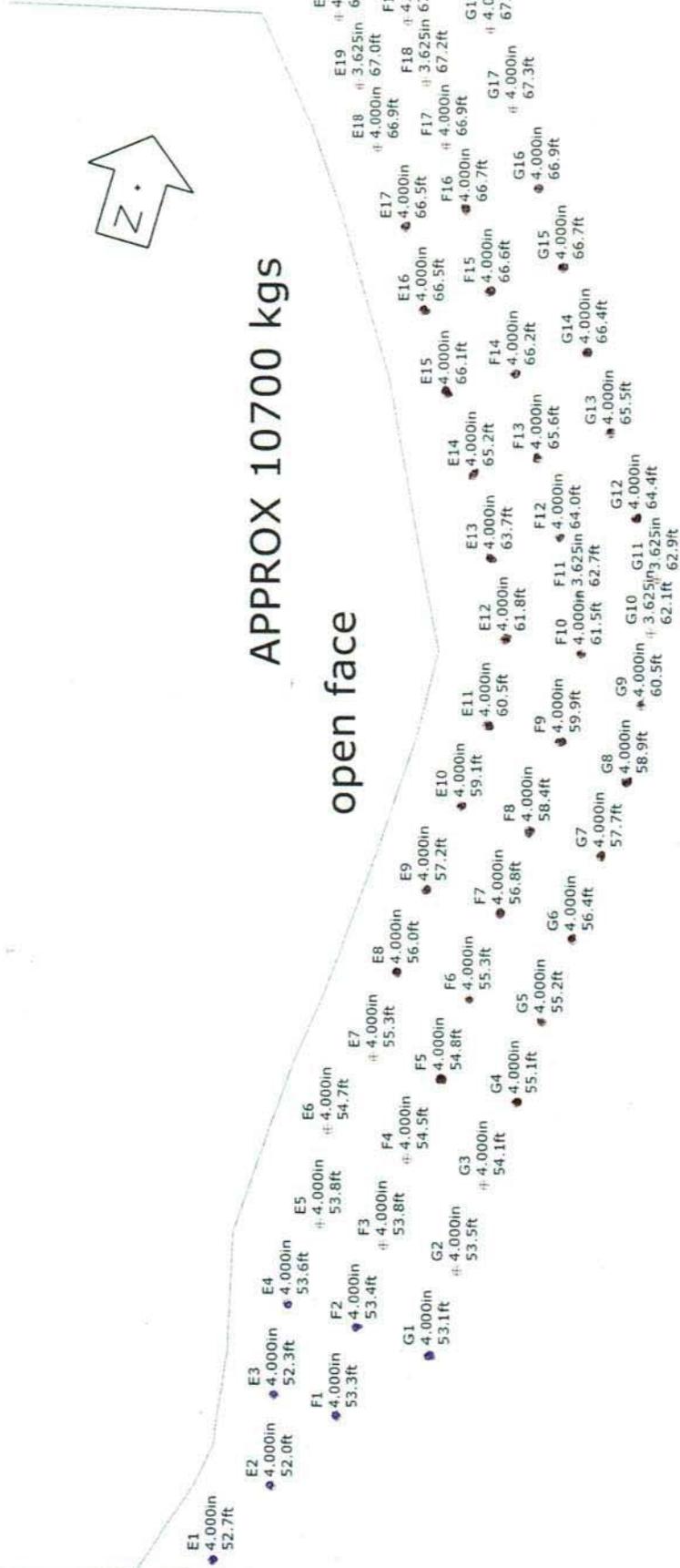


Not to scale

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Subdrill: 2.0ft Hole angle: 0.0°  
 Total drilled: 3447.4ft Hole Diameter: 4.0in Number of holes: 57



APPROX 10700 kgs  
 open face

9NECRNR010 Design Fnl- 3.625" and 4" Blast Holes 12x10 9x10 266 and 250 + .6 SUB ELEV

E19 F11 F18 G10 G11 are 3.625" DIA HOLES  
 PAINTED PINK MARKER STONES

|                                |                            |           |
|--------------------------------|----------------------------|-----------|
| SHOTPlus™ Professional 5.7.4.4 |                            | 6/12/2019 |
| Mine                           | Burlington                 |           |
| Location                       | N E Corner along haul road |           |
| Title/author                   | 9NECRNR010 Design Fnl      |           |
| Filename                       |                            |           |



Scale 1:250



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-07-11

Blast Number: 19-012

Orica Order #: 2505549

Blast Time: 11:01 AM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40358 °N Latitude 79.88181 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: SW at 5 kph Temperature: 26 to 30 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 29,209 ft

### - Drilling Information -

|                            | Angle from Vertical | Nominal Bit Diameter:                |
|----------------------------|---------------------|--------------------------------------|
| Primary Bit diam: 101.6 mm | 0°                  | # Holes: 51 = 3,662.6 ft ( 4 " diam) |
| Secondary Bit diam: mm     | 0°                  | # Holes: = 0.0 ft ( " diam)          |
| Tertiary Bit diam: mm      | 0°                  | # Holes: = 0.0 ft ( " diam)          |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,890  | 22,660   | 11,230 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 2           | 0  |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 8 (OR EQUIVALENT)  | 0.23      | 52     | 11.8 |
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 53     | 18.0 |

total explosives weight in Blast (kg): 11,260

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 48     |
| UNITRONIC 600 15M |          |    | 4      |
| UNITRONIC 600 25M |          |    | 53     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 5      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.0  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 24,817 te 9,545 m<sup>3</sup>  
 Total tonnes per day: 24,817 te NB80-02 Rate Code  
 Total Holes Loaded: 51 holes  
 ... including: 3 Dead Holes  
 ... and: 0 Helper Holes  
 Helper Hole Collar: 0.0 ft avg  
 # Rows Blasted: 3 rows

### - Pattern (Front Row)-

Burden: 12.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 18 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg  
 Spacing: 10.0 ft avg  
 # Holes: 33 main body

Bench Height: 69.8 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 71.8 ft avg

### - Stone Decking -

Front Row: 4.0 ft avg

Main Body: 4.0 ft avg

# Decks: 3 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 60.8 ft avg

Main Body: 60.8 ft avg

### - Charge Weight -

Front Row: 177.3 kg/hole

Main Body: 177.3 kg/hole

Max. per delay: 242.0 kg/delay

SD () Equation: 115.2 kg/delay

Total kg Loaded: 11,260 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.454 kg/te (actual)

Front row: 0.287 kg/te (theoretical)

Main Body: 0.383 kg/te (theoretical)

"KPI" PF: 0.351 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.988 lb/yd<sup>3</sup>  
 1.260 lb/yd<sup>3</sup>  
 1.680 lb/yd<sup>3</sup>  
 1.540 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

Hole E18's top detonator showed an error at blast time (NCO) All holes are double primed so we continued to fire the blast.



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-07-11

Blast Number: 19-012  
 Orica Order #: 2505549  
 Blast Time: 11:01 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40361       | 79.88180        | 0.757536    | 1.394200    |
| Front Row Corner          | 43.40336       | 79.88190        | 0.757532    | 1.394202    |
| Back Row Corner           | 43.40377       | 79.88172        | 0.757539    | 1.394199    |
| Average (Centre of Blast) | 43.40358       | 79.88181        | 0.757535    | 1.394201    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 322.0                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 7.9                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 13.1         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 119.7 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 1024.0                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.3                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 10.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 120.3 | dB              | Trigger set at: 115 | dB                                     |

Colling Rd & Blind Line Bruce Trail

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1267.6                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(322)^2}{30^2} \text{ kg} \\
 &= \frac{103,684}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

jim bray

Orica  
 Blaster-in-charge:

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

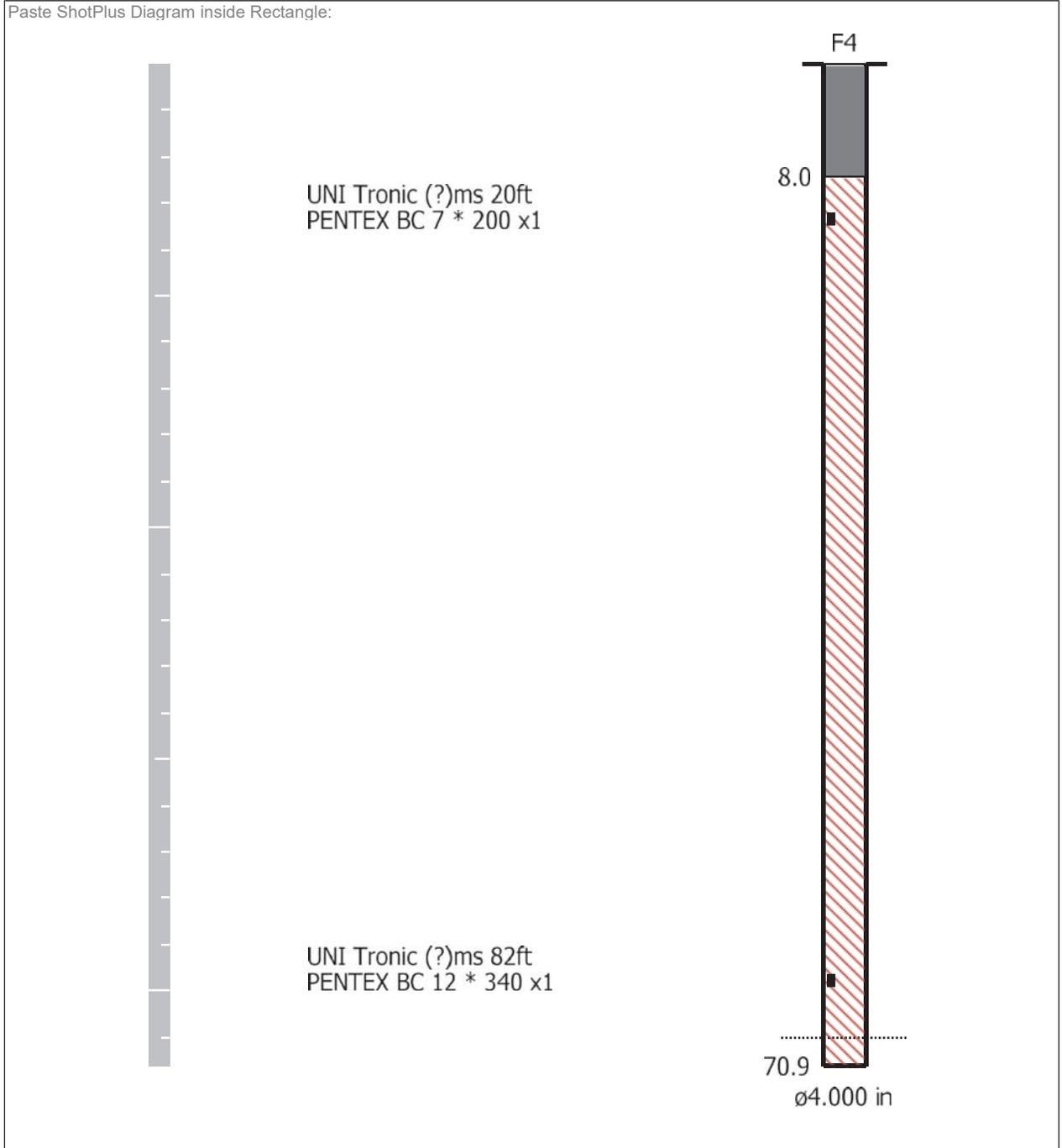
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date:

Blast Number: 19-012  
Orica Order #: 2505549

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 11:01:03 July 11, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.0 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 #2 Road  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

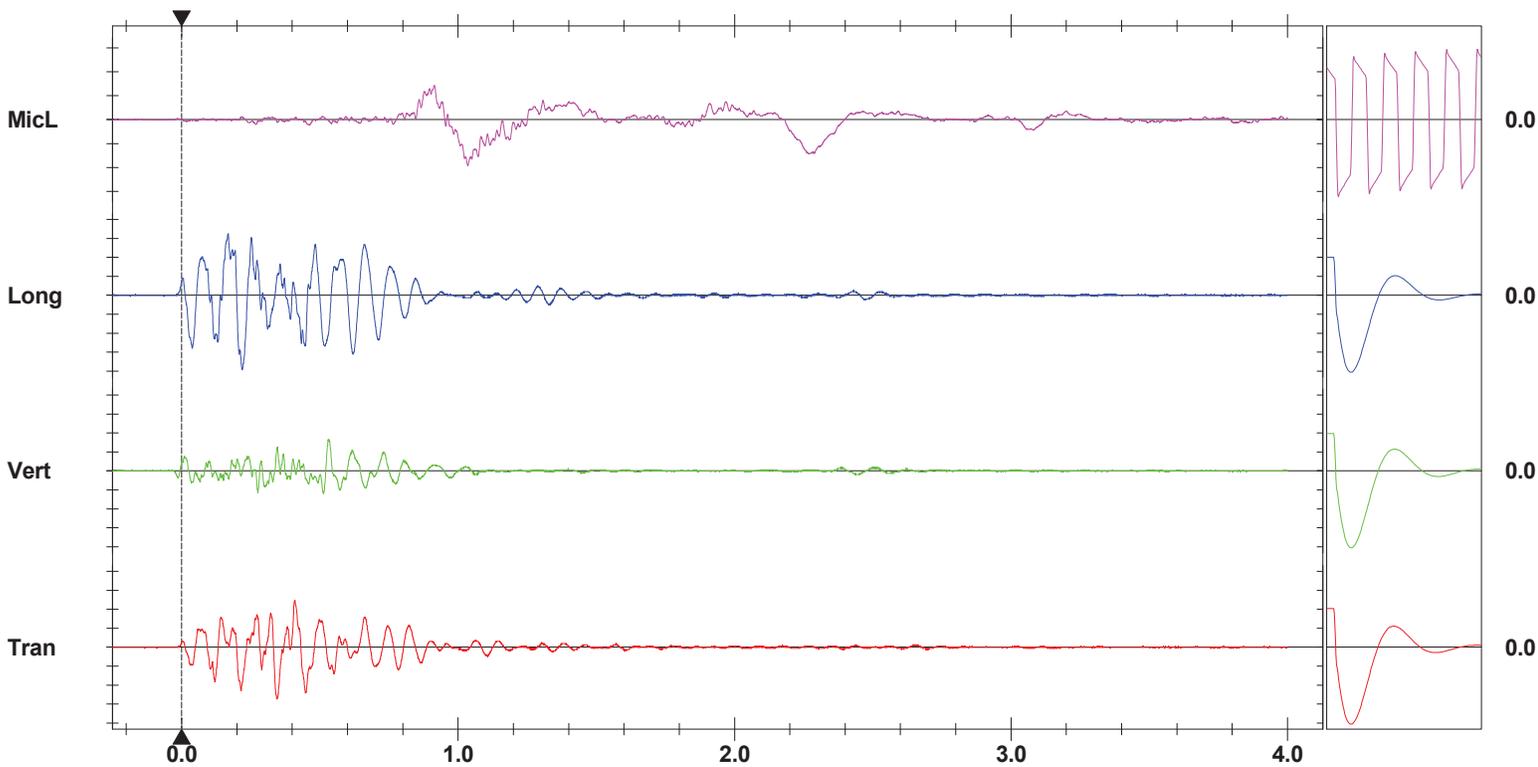
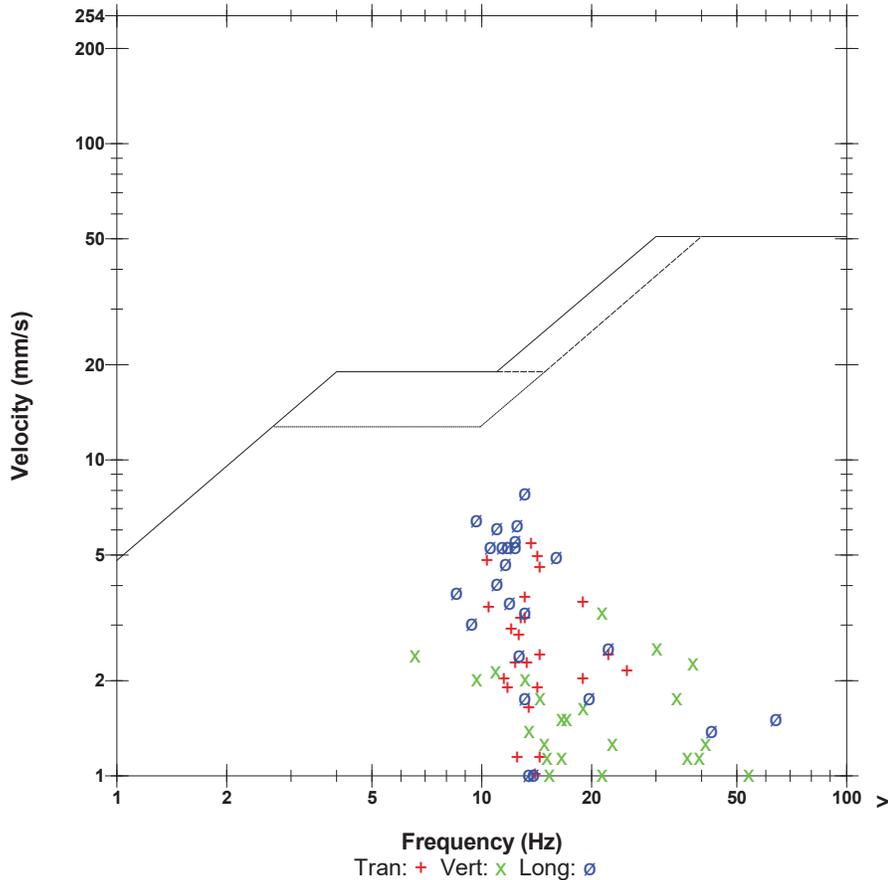
N43.40245;W-79.87814

**Microphone** Linear Weighting  
**PSPL** 119.7 dB(L) at 1.034 sec  
**ZC Freq** 1.9 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 543 mv )

|                            | Tran   | Vert   | Long   |      |
|----------------------------|--------|--------|--------|------|
| <b>PPV</b>                 | 5.461  | 3.302  | 7.874  | mm/s |
| <b>ZC Freq</b>             | 13.7   | 21     | 13.1   | Hz   |
| <b>Time (Rel. to Trig)</b> | 0.344  | 0.530  | 0.218  | sec  |
| <b>Peak Acceleration</b>   | 0.080  | 0.080  | 0.133  | g    |
| <b>Peak Displacement</b>   | 0.063  | 0.037  | 0.111  | mm   |
| <b>Sensor Check</b>        | Passed | Passed | Passed |      |
| <b>Frequency</b>           | 7.4    | 7.4    | 7.3    | Hz   |
| <b>Overswing Ratio</b>     | 3.7    | 3.6    | 4.0    |      |

**Peak Vector Sum** 8.807 mm/s at 0.218 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 11:01:04 July 11, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.133 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.6 Volts  
**Unit Calibration** January 15, 2019 by InstanTel  
**File Name** UM6857\_20190711110104.IDFW

**Notes**

Location: COLLING RD & BLINDLINE  
 Client: NELSON AGGREGATES  
 User Name: ORICA CANADA  
 General:

**Extended Notes**

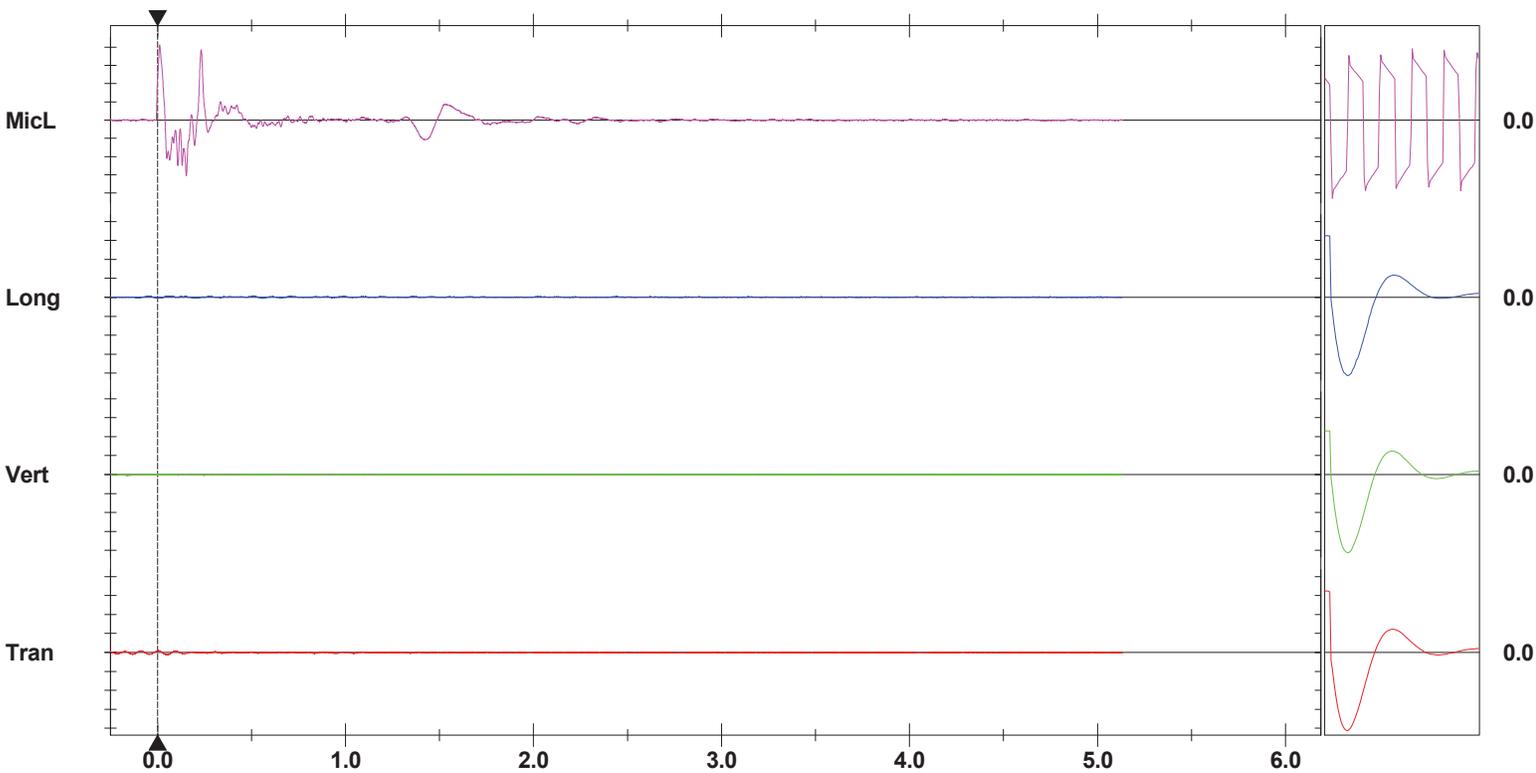
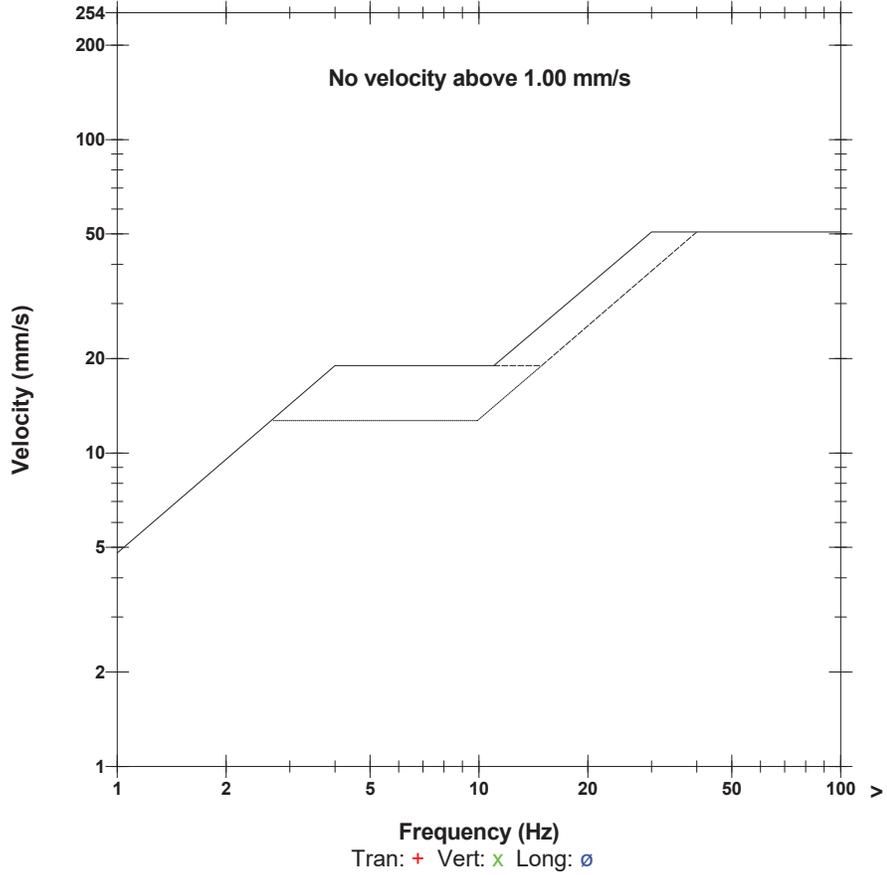
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 120.3 dB(L) at 0.011 sec  
**ZC Freq** 10.6 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1329 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.252  | 0.102  | 0.158  | mm/s |
| ZC Freq             | 10.0   | 6.4    | 9.0    | Hz   |
| Time (Rel. to Trig) | 0.046  | -0.164 | 0.511  | sec  |
| Peak Acceleration   | 0.010  | 0.010  | 0.012  | g    |
| Peak Displacement   | 0.004  | 0.002  | 0.003  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.4    | 3.3    | 3.5    |      |

**Peak Vector Sum** 0.275 mm/s at 0.053 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Southwest Corner of property  
Nelson Aggregate  
Burlington 2019-07-11 Blast 19-12 Upper Middle**

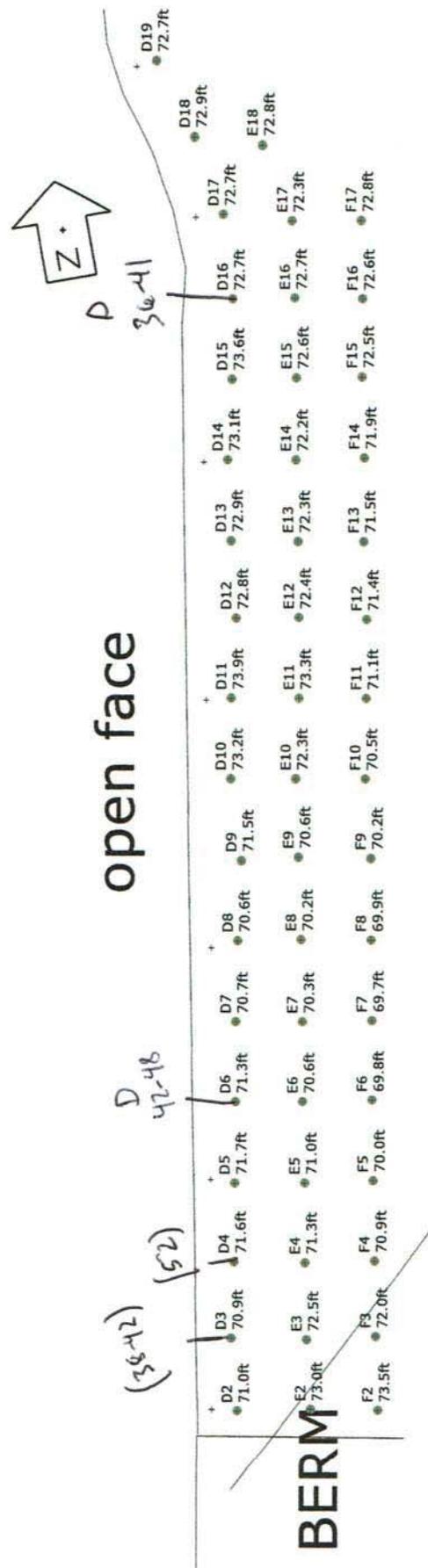
**Event Report: Monitor Log - Micromate ISEE # UM6859-Compliance**

| Start Time          | End Time            | Status                                                                    |
|---------------------|---------------------|---------------------------------------------------------------------------|
| -----               | -----               | SERIAL NUMBER: UM6859                                                     |
| Jul 11 /19 06:21:03 |                     | Start Monitoring Waveform Geo: 1.50 mm/s Mic: 121.0 dB                    |
| Jul 11 /19 06:21:02 | Jul 11 /19 11:33:15 | No events recorded. (Keyboard Exit) Waveform Geo: 1.50 mm/s Mic: 121.0 dB |

SHOTPLUS 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Subdrill: 2.0ft Hole angle: 0.0°  
 Total drilled: 3662.6ft Hole Diameter: 4.0in Number of holes: 51



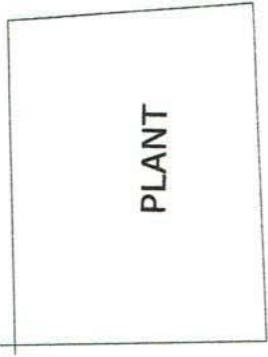
Not to scale

SHOTPlus 5 Plan

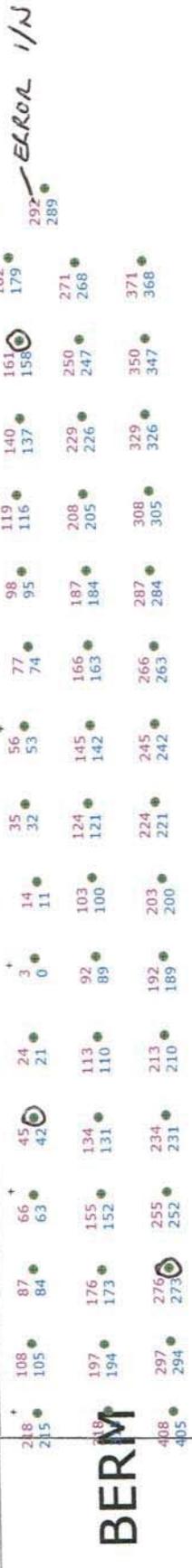
Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 3662.6ft      Hole Diameter: 4.0in      Number of holes: 51

*O = Deck*



open face



Not to scale

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 3662.6ft      Hole Diameter: 4.0in      Number of holes: 51

Load Sheet 245  
 Max Load 230Kg  
 open face



118  
 230 230 235 229 227 229 222 226 229 229 220 223 225 100 150  
 227 230 228 224 232 221 222 226 222 232 227 226 222 219 221 222 228  
 230 225 219 217 219 223 220 216 217 211 211 230 225 216 220  
 242 219 217 219 223 220 216 217 211 211 230 225 216 220

BERM



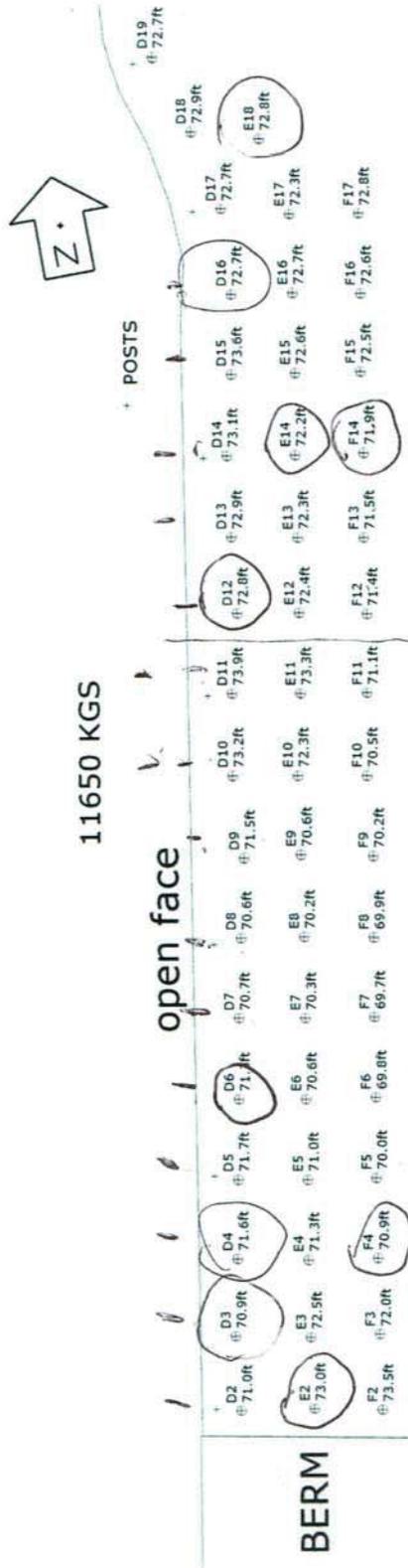
Not to scale

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 3662.6ft      Hole Diameter: 4.0in      Number of holes: 51

11650 KGS



9UPMD012 Design Fnl - 4" Blast Hole 12x10 9x10 271.5 and 250 + .6 SUB ELEV  
 DRILLER NAME:



Scale 1:300

|                                |                                     |
|--------------------------------|-------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 7/5/2019                            |
| Mine                           | Burlington                          |
| Location                       | UPPER MIDDLE NEXT TO OLD WHEEL WASH |
| Title/author                   | 9UPMD012 Design Fnl                 |
| Filename                       |                                     |



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:  
Blast Date: 2019-07-30

Blast Number: 19-014  
Orica Order #: 2512320  
Blast Time: 12:20 PM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40355 °N Latitude 79.88169 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 5 kph Temperature: 26 to 30 °C

Clear:  Rain:  Overcast:   
Partly Cloudy:  Snow:  Inversion:  Ceiling: 2,552 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 45 = 3,113.3 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 36,290  | 26,610   | 9,680 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 1           | 25 |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 8 (OR EQUIVALENT)  | 0.23      | 46     | 10.4 |
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 46     | 15.6 |

total explosives weight in Blast (kg): 9,731

Pkgd Prod (25 kg) % of Total kg: 0.3%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 45     |
| UNITRONIC 600 15M |          |    | 2      |
| UNITRONIC 600 25M |          |    | 45     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  |        |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 7.0  |
| HELPER HOURS          | Enter total Helper man-hours | 11.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 21,052 te 8,097 m<sup>3</sup>  
Total tonnes per day: 21,052 te NB60-07 Rate Code  
Total Holes Loaded: 45 holes  
... including: 3 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 3 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 17 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 28 main body

Bench Height: 67.2 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 69.2 ft avg

### - Stone Decking -

Front Row: 0.0 ft avg  
Main Body: 5.0 ft avg  
# Decks: 1 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg  
Main Body: 7.0 ft avg  
Material used: 3/4" Clear

### - Charge Length -

Front Row: 62.2 ft avg  
Main Body: 57.2 ft avg

### - Charge Weight -

Front Row: 181.3 kg/hole  
Main Body: 166.7 kg/hole  
Max. per delay: 209.0 kg/delay  
SD ( ) Equation: 108.4 kg/delay  
Total kg Loaded: 9,731 kg  
Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.462 kg/te (actual)  
Front row: 0.305 kg/te (theoretical)  
Main Body: 0.375 kg/te (theoretical)  
"KPI" PF: 0.352 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):

Hole I5 received a 5' stone deck due to void identified while loading



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-07-30

Blast Number: 19-014  
 Orica Order #: 2512320  
 Blast Time: 12:20 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40354       | 79.88170        | 0.757535    | 1.394199    |
| Front Row Corner          | 43.40376       | 79.88168        | 0.757539    | 1.394198    |
| Back Row Corner           | 43.40336       | 79.88170        | 0.757532    | 1.394199    |
| Average (Centre of Blast) | 43.40355       | 79.88169        | 0.757535    | 1.394199    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 312.4                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 7.7                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 12.8         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 120.7 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40605                | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 1033.6                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 8.9          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 120.5 | dB              | Trigger set at: 115 | dB                                     |

Colling Rd & Blind Line Bruce Trail

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (3rd Seis. From Centre of Blast) | 1269.2                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(312.4)^2}{30^2} \text{ kg} \\
 &= \frac{97,594}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

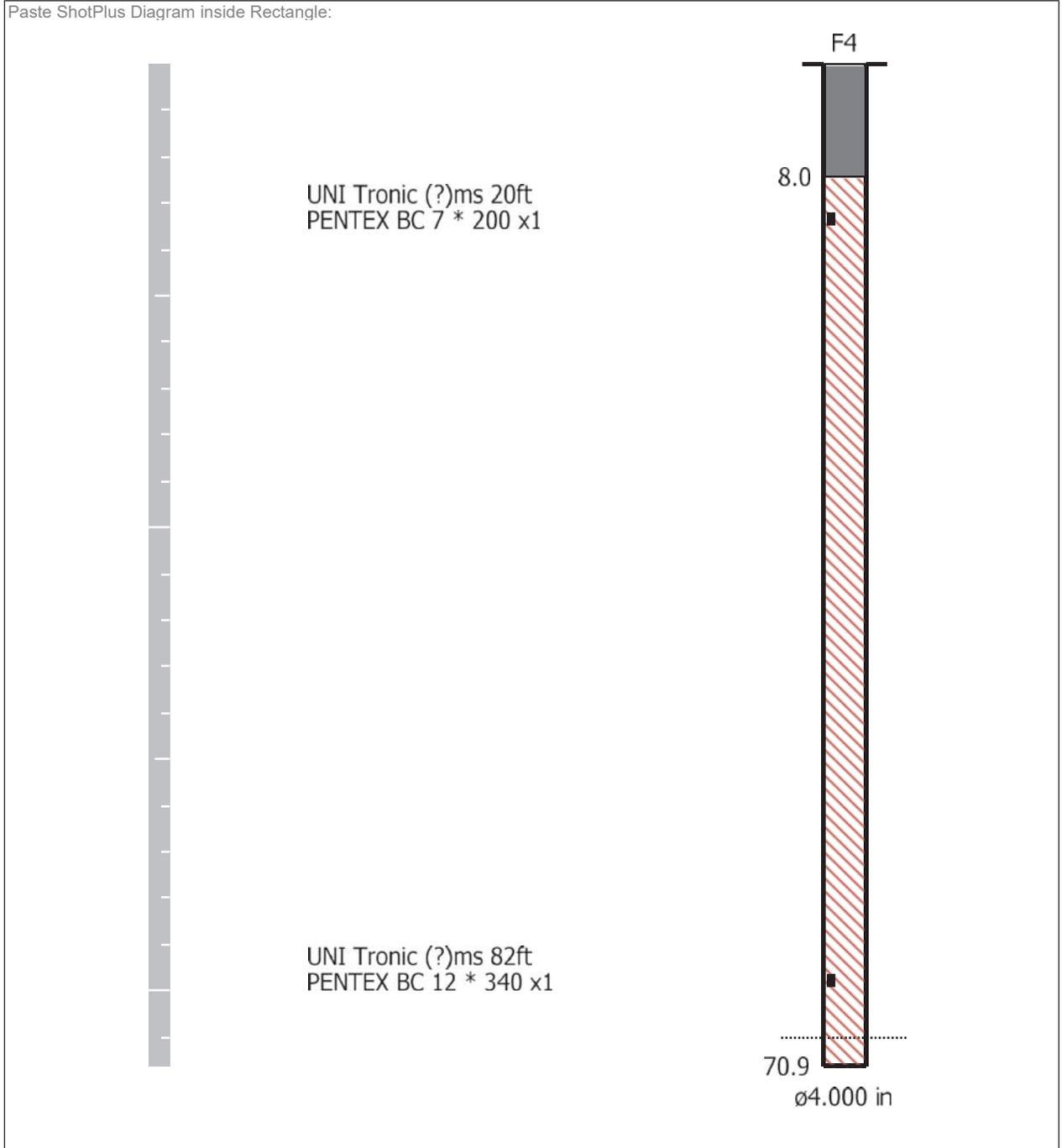
Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 7/30/2019

Blast Number: 19-014  
 Orica Order #: 2512320

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 12:20:36 July 30, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.0 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 #2 Sideroad  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

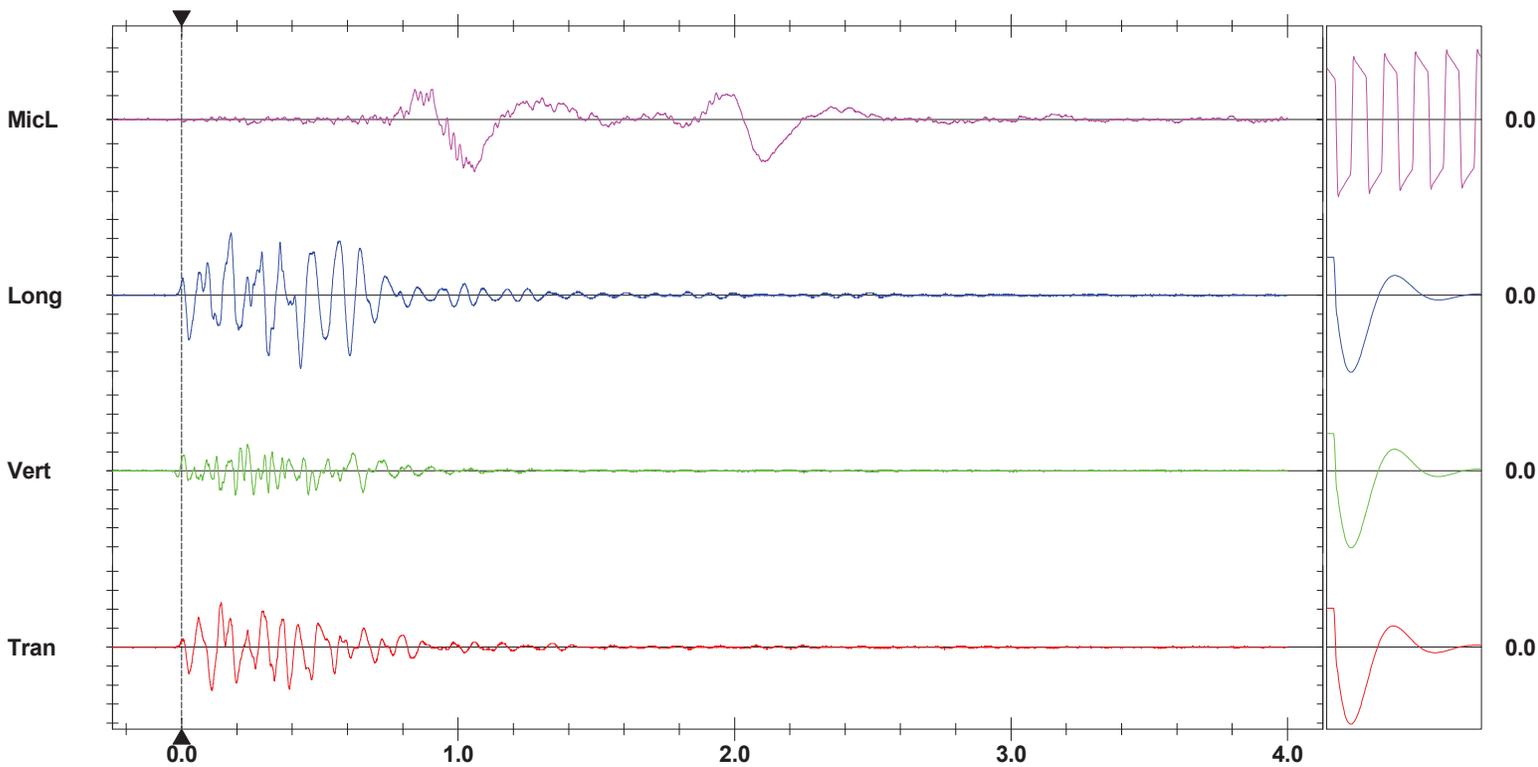
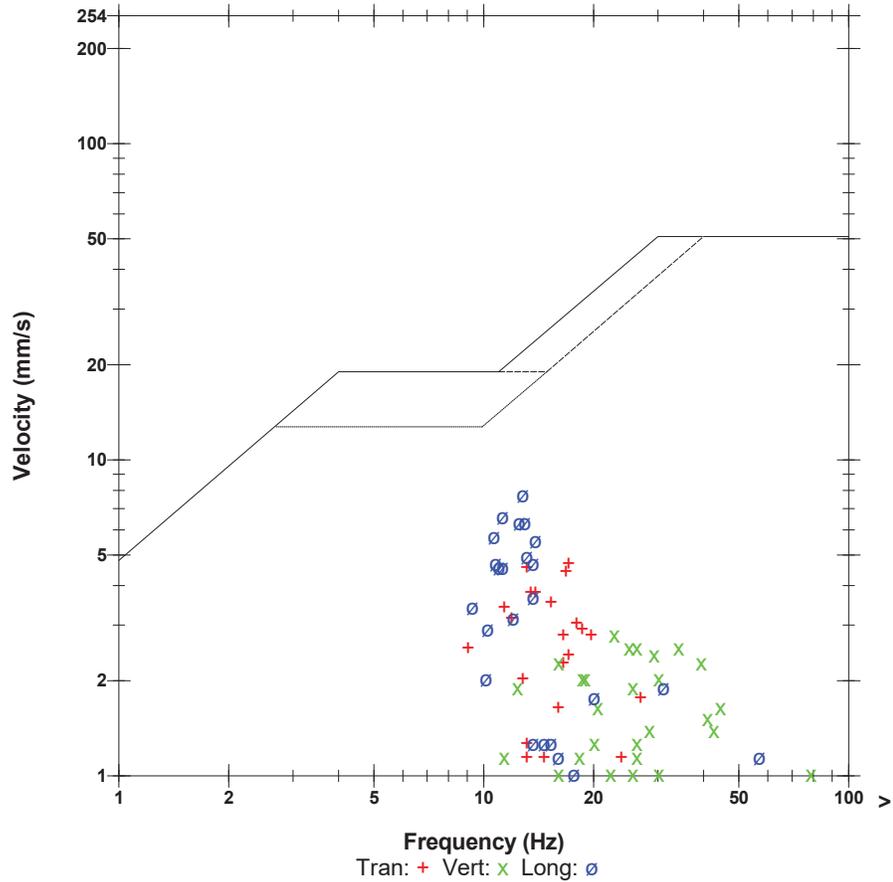
Sand Bagged  
 N43.40245W-79.87814

**Microphone** Linear Weighting  
**PSPL** 120.7 dB(L) at 1.059 sec  
**ZC Freq** 2.7 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 556 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 4.699  | 2.794  | 7.747  | mm/s |
| ZC Freq             | 17.1   | 23     | 12.8   | Hz   |
| Time (Rel. to Trig) | 0.143  | 0.237  | 0.430  | sec  |
| Peak Acceleration   | 0.080  | 0.080  | 0.106  | g    |
| Peak Displacement   | 0.049  | 0.023  | 0.091  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.5    | 7.4    | 7.3    | Hz   |
| Overswing Ratio     | 3.7    | 3.6    | 4.0    |      |

**Peak Vector Sum** 7.832 mm/s at 0.430 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 12:20:37 July 30, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.147 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.5 Volts  
**Unit Calibration** January 15, 2019 by InstanTEL  
**File Name** UM6857\_20190730122037.IDFW

**Notes**

Location: COLLING RD & BLINDLINE  
 Client: NELSON AGGREGATES  
 User Name: ORICA CANADA  
 General:

**Extended Notes**

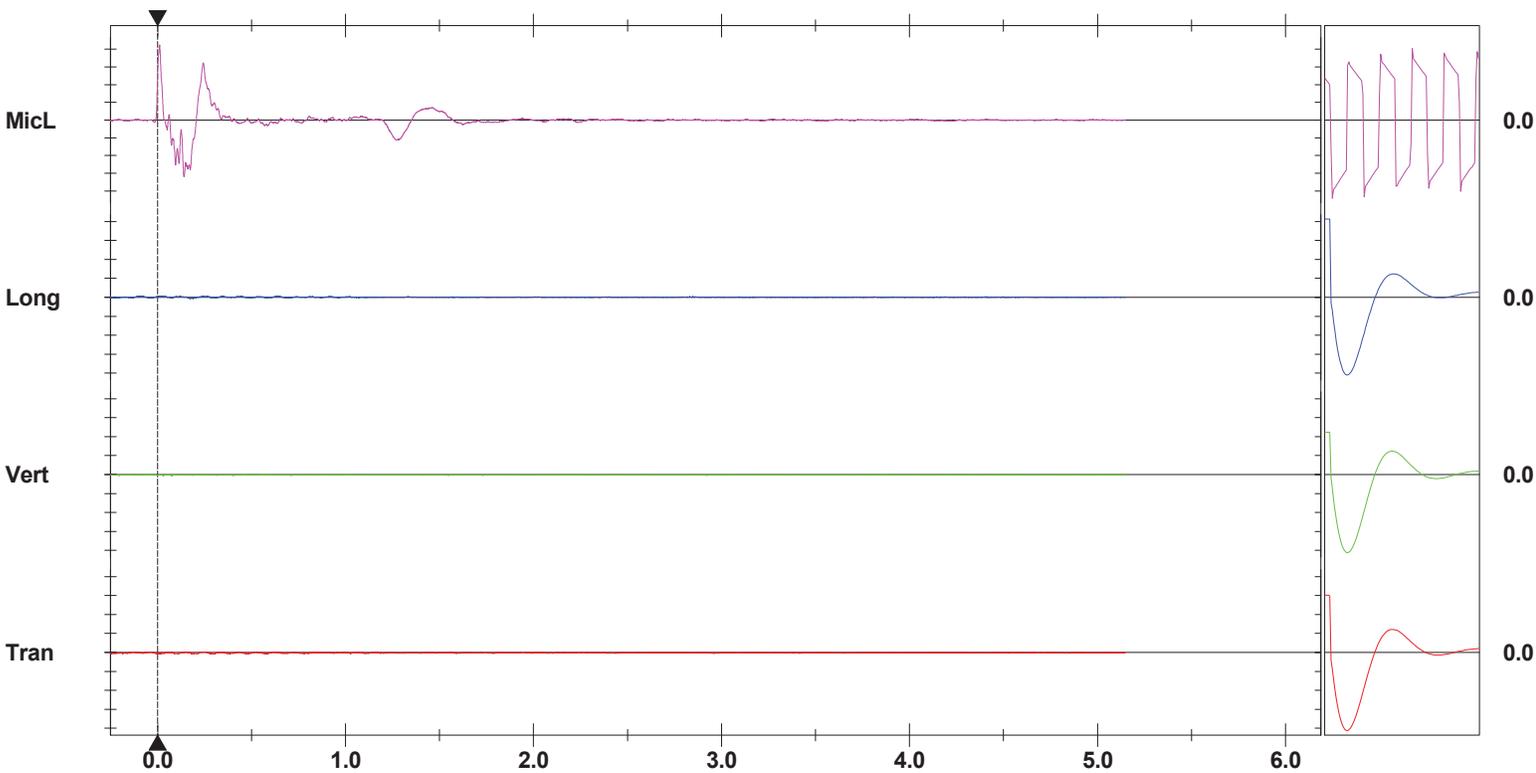
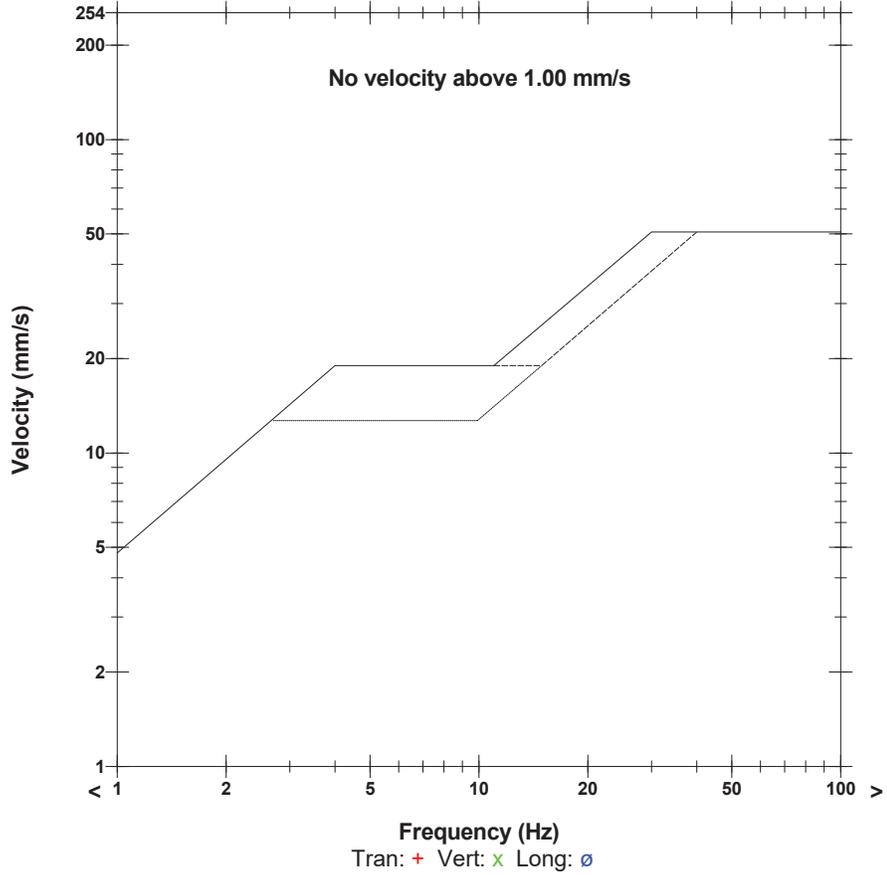
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 120.5 dB(L) at 0.011 sec  
**ZC Freq** 11.0 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1301 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.166  | 0.102  | 0.150  | mm/s |
| ZC Freq             | 8.9    | 5.4    | 8.1    | Hz   |
| Time (Rel. to Trig) | 0.185  | -0.232 | 0.012  | sec  |
| Peak Acceleration   | 0.010  | 0.010  | 0.013  | g    |
| Peak Displacement   | 0.018  | 0.044  | 0.003  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.3    | Hz   |
| Overswing Ratio     | 3.4    | 3.3    | 3.3    |      |

Peak Vector Sum 0.209 mm/s at 0.185 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**South west corner of property(N43.39339W-79.88880)  
Nelson Aggregate  
Burlington 2019-07-30 Blast 19-014**

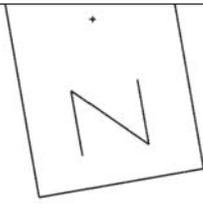
**Event Report: Monitor Log - Micromate ISEE # UM6859-Compliance**

| Start Time          | End Time            | Status                                                             |
|---------------------|---------------------|--------------------------------------------------------------------|
| -----               | -----               | SERIAL NUMBER: UM6859                                              |
| Jul 30 /19 05:43:58 |                     | Start Monitoring Waveform Geo: 1.50 mm/s Mic: 121.0 dB             |
| Jul 30 /19 11:20:23 | Jul 30 /19 11:20:26 | Event recorded. Trigger Level Long: 1.50 mm/s                      |
| Jul 30 /19 12:43:42 | Jul 30 /19 12:43:46 | Event recorded. Trigger Level Tran: 1.50 mm/s                      |
| Jul 30 /19 12:43:46 | Jul 30 /19 12:43:53 | Event recorded. (Keyboard Exit) Waveform Geo: 1.50 mm/s Mic: 121.0 |

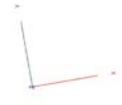
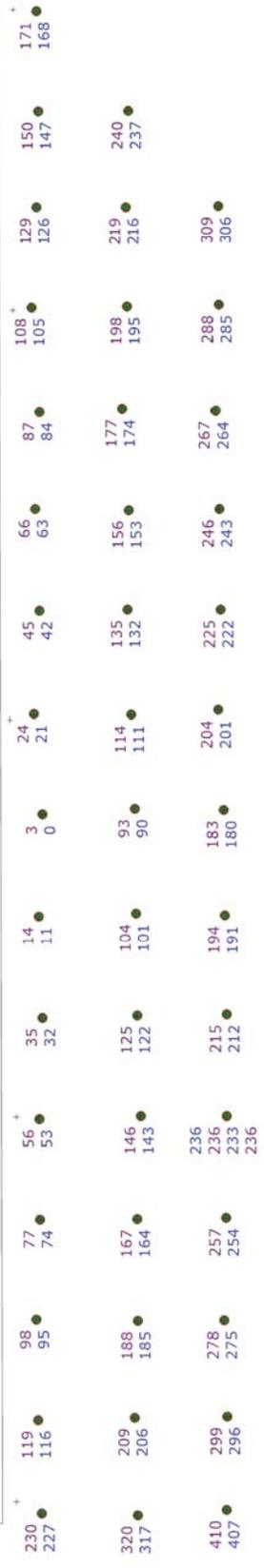
SHOTPlus Plan

**Blast Summary Data**

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 45 | Hole angle: 0.0° |
| Total drilled: 3113.3ft |                      |                     |                  |



open face



Not to scale

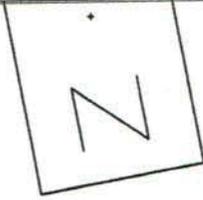
SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 3113.3ft

Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Number of holes: 45

Stemming: 7.0ft  
 Hole angle: 0.0°



open face

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| G1     | G2     | G3     | G4     | G5     | G6     | G7     | G8     | G9     | G10    | G11    | G12    | G13    | G14    | G15    | G16    |
| 71.8ft | 71.3ft | 70.4ft | 69.7ft | 69.2ft | 69.0ft | 69.4ft | 69.7ft | 70.2ft | 70.5ft | 70.7ft | 70.7ft | 71.0ft | 71.2ft | 70.6ft | 70.2ft |
| H1     | H2     | H3     | H4     | H5     | H6     | H7     | H8     | H9     | H10    | H11    | H12    | H13    | H14    | H15    |        |
| 71.0ft | 70.3ft | 69.1ft | 67.8ft | 67.0ft | 67.4ft | 68.4ft | 68.5ft | 67.9ft | 67.3ft | 68.3ft | 69.0ft | 70.3ft | 70.8ft | 70.6ft |        |
| I1     | I2     | I3     | I4     | I5     | I6     | I7     | I8     | I9     | I10    | I11    | I12    | I13    | I14    |        |        |
| 69.9ft | 69.5ft | 68.0ft | 67.5ft | 66.9ft | 67.2ft | 67.7ft | 67.2ft | 66.4ft | 66.9ft | 67.9ft | 68.3ft | 70.0ft | 70.7ft |        |        |

9UPMD015 Design Fnl - 4" Blast Hole 12x10 9x10 270 and  
 DRILLER NAME:

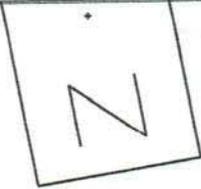


Not to scale

SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 3113.3ft  
 Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Subdrill: 2.0ft  
 Number of holes: 45  
 Stemming: 7.0ft  
 Hole angle: 0.0°



# Load Sheet 230Kg Max open face

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 214 | 203 | 211 | 207 | 197 | 197 | 307 | 244 | 203 | 196 | 203 | 197 | 181 | 202 | 198  |
| 210 | 206 | 212 | 180 | 184 | 203 | 196 | 192 | 196 | 197 | 198 | 203 | 207 | 203 |      |
| 204 | 180 | 200 | 198 | 198 | 196 | 205 | 196 | 187 | 187 | 198 | 211 | 175 | +   | Blow |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |

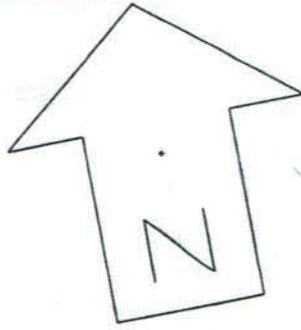


Not to scale

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft  
 Spacing: 10.0ft  
 Stemming: 7.0ft  
 1st row burden: 12.0ft  
 Subdrill: 2.0ft  
 Hole angle: 0.0°  
 Hole Diameter: 4.0in  
 Number of holes: 45  
 Total drilled: 3113.3ft



APPROX 10000 KGS

POSTS

open face

|                |                |                |                |                |                |                |                |                |                 |                 |                 |                 |                 |                 |                 |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| G1<br># 71.8ft | G2<br># 71.3ft | G3<br># 70.4ft | G4<br># 69.7ft | G5<br># 69.2ft | G6<br># 69.0ft | G7<br># 69.4ft | G8<br># 69.7ft | G9<br># 70.2ft | G10<br># 70.5ft | G11<br># 70.7ft | G12<br># 70.7ft | G13<br># 71.0ft | G14<br># 71.2ft | G15<br># 70.6ft | G16<br># 70.2ft |
| H1<br># 71.0ft | H2<br># 70.3ft | H3<br># 69.1ft | H4<br># 67.8ft | H5<br># 67.0ft | H6<br># 67.4ft | H7<br># 68.4ft | H8<br># 68.5ft | H9<br># 67.9ft | H10<br># 67.3ft | H11<br># 68.3ft | H12<br># 69.0ft | H13<br># 70.3ft | H14<br># 70.8ft | H15<br># 70.6ft |                 |
| I1<br># 69.9ft | I2<br># 69.5ft | I3<br># 68.0ft | I4<br># 67.5ft | I5<br># 66.9ft | I6<br># 67.2ft | I7<br># 67.7ft | I8<br># 67.2ft | I9<br># 66.4ft | I10<br># 66.9ft | I11<br># 67.9ft | I12<br># 68.3ft | I13<br># 70.0ft | I14<br># 70.7ft |                 |                 |

9UPMD015 Design Fnl - 4" Blast Hole 12x10 9x10 270 and 250 + .6 SUB ELEV

DRILLER NAME: *Mike Keller*

*Start July 25/19*

*Finish July 29/19*



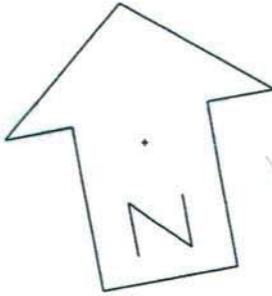
Scale 1:250

|                                |                         |
|--------------------------------|-------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 7/29/2019               |
| Mine                           | Burlington              |
| Location                       |                         |
| Title/author                   | 9UPMD015 Design Partial |
| Filename                       | 9UPMD015 Design Fnl.spf |

SHOTPlus 5 Plan

Blast Summary Data

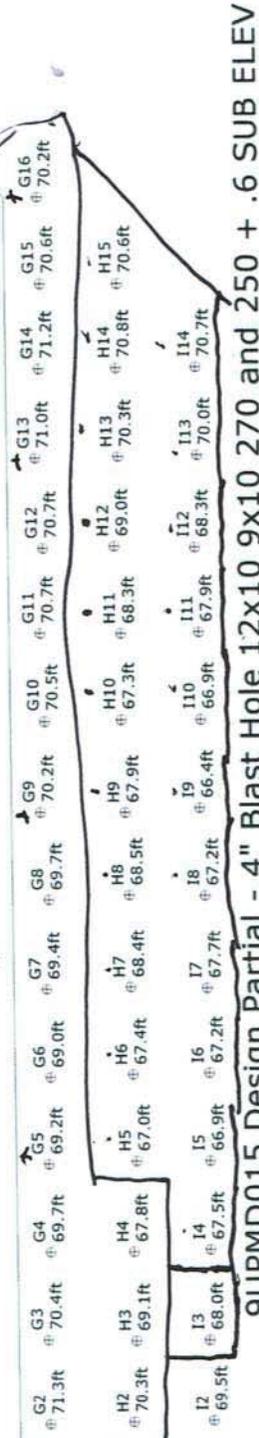
Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 42 Hole angle: 0.0°  
 Total drilled: 2900.7ft



APPROX 10000 KGS

+ Posts

open face



9UPMD015 Design Partial - 4" Blast Hole 12x10 9x10 270 and 250 + .6 SUB ELEV

DRILLER NAME:

NOT MARKED

BERM STRIPPING  
 REQ'D BEFORE  
 LAYING OUT  
 G1 H1 I1 I2

|                                |                                 |
|--------------------------------|---------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 7/26/2019                       |
| Mine                           | Burlington                      |
| Location                       |                                 |
| Title/author                   | 9UPMD015 Design Partial         |
| Filename                       | 9UPMD015 Design Partial Fnl.spf |

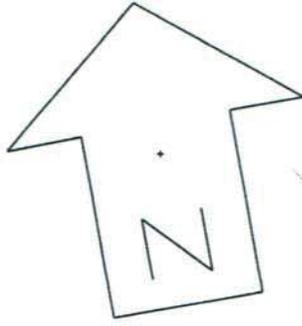


Scale 1:275

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Subdrill: 2.0ft Hole angle: 0.0°  
 Total drilled: 2016.5ft Number of holes: 29



*G1 to G16  
 to be drilled  
 after*

open face

|        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| G2     | G3     | G4     | G5     | G6     | G7     | G8     | G9     | G10    | G11    | G12    | G13    | G14    | G15    | G16    |
| 70.3ft | 70.4ft | 69.7ft | 69.2ft | 69.0ft | 69.4ft | 69.7ft | 70.2ft | 70.5ft | 70.7ft | 70.7ft | 71.0ft | 71.2ft | 70.6ft | 70.2ft |
| H2     | H3     | H4     | H5     | H6     | H7     | H8     | H9     | H10    | H11    | H12    | H13    | H14    | H15    |        |
| 70.3ft | 69.1ft | 67.8ft | 67.0ft | 67.4ft | 68.4ft | 68.5ft | 67.9ft | 67.3ft | 68.3ft | 69.0ft | 70.3ft | 70.8ft | 70.6ft |        |

9UPMD015 Design Partial - 4" Blast Hole 12x10 9x10 270 and 250 + .6 SUB ELEV

DRILLER NAME: Michael Keller

*Start July 25/19*



Scale 1:250

|                                |                         |
|--------------------------------|-------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 7/25/2019               |
| Mine                           | Burlington              |
| Location                       |                         |
| Title/author                   | 9UPMD015 Design Partial |
| Filename                       |                         |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-08-12

Blast Number: 19-015

Orica Order #: 2517100

Blast Time: 12:10 PM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40432 °N Latitude 79.88176 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: N at 0 kph Temperature: 21 to 25 °C

Clear:  Rain:  Overcast:   
Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

|                             | Angle from Vertical | Nominal Bit Diameter:                 |
|-----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm  | 0                   | # Holes: 64 = 3,799.9 ft ( 4 " diam)  |
| Secondary Bit diam: 92.1 mm | 0                   | # Holes: 2 = 118.7 ft ( 3 5/8 " diam) |
| Tertiary Bit diam: mm       | 0                   | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,850  | 22,690   | 11,160 |

### Packaged Explosives:

|  | cs shipped | cs returned | kg |
|--|------------|-------------|----|
|  |            |             |    |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 8 (OR EQUIVALENT)  | 0.23      | 69     | 15.7 |
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 69     | 23.5 |

total explosives weight in Blast (kg): 11,199

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 65     |
| UNITRONIC 600 20M |          |    | 43     |
| UNITRONIC 600 25M |          |    | 30     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 2      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.0  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 28,893 te      | 11,113 m <sup>3</sup> |
| Total tonnes per day: | 28,893 te      | NB60-06 Rate Code     |
| Total Holes Loaded:   | 66 holes       |                       |
| ... including:        | 0 Dead Holes   |                       |
| ... and:              | 0 Helper Holes |                       |
| Helper Hole Collar:   | 0.0 ft avg     |                       |
| # Rows Blasted:       | 3 rows         |                       |

### - Pattern (Front Row) -

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 30 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 36 main body |

Bench Height: 57.4 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 59.4 ft avg

### - Stone Decking -

Front Row: 8.0 ft avg

Main Body: 0.0 ft avg

# Decks: 3 per blast

### - Collar Stemming -

Front Row: 8.0 ft avg

Main Body: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 43.4 ft avg

Main Body: 52.4 ft avg

### - Charge Weight -

Front Row: 126.5 kg/hole

Main Body: 152.7 kg/hole

Max. per delay: 238.0 kg/delay

SD () Equation: 143.8 kg/delay

Total kg Loaded: 11,199 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.388 kg/te (actual)

Front row: 0.250 kg/te (theoretical)

Main Body: 0.402 kg/te (theoretical)

"KPI" PF: 0.351 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):

3 Stone decks were added due to voids identified by driller on the drill log.



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-08-12

Blast Number: 19-015  
 Orica Order #: 2517100  
 Blast Time: 12:10 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40437       | 79.88178        | 0.757549    | 1.394200    |
| Front Row Corner          | 43.40390       | 79.88181        | 0.757541    | 1.394201    |
| Back Row Corner           | 43.40470       | 79.88170        | 0.757555    | 1.394199    |
| Average (Centre of Blast) | 43.40432       | 79.88176        | 0.757548    | 1.394200    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 359.7                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 3.9                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 11.6         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 112.8 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.40605                  | 79.89400        | 0.757578            | 1.394413                               |
| Distance (2nd Seis. From Centre of Blast) | 1008.2                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

Colling Rd & Blind Line Bruce Trail

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39329                  | 79.88868        | 0.757356            | 1.394321                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39329                  | 79.88868        | 0.757356            | 1.394321                               |
| Distance (3rd Seis. From Centre of Blast) | 1349.6                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

SouthWest Corner of Property

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(359.7)^2}{30^2} \text{ kg} \\
 &= \frac{129,384}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica

Blaster-in-charge:

Signature required, indicating that  
 Blast Report is Complete & Accurate.

jim bray



# Blast Design

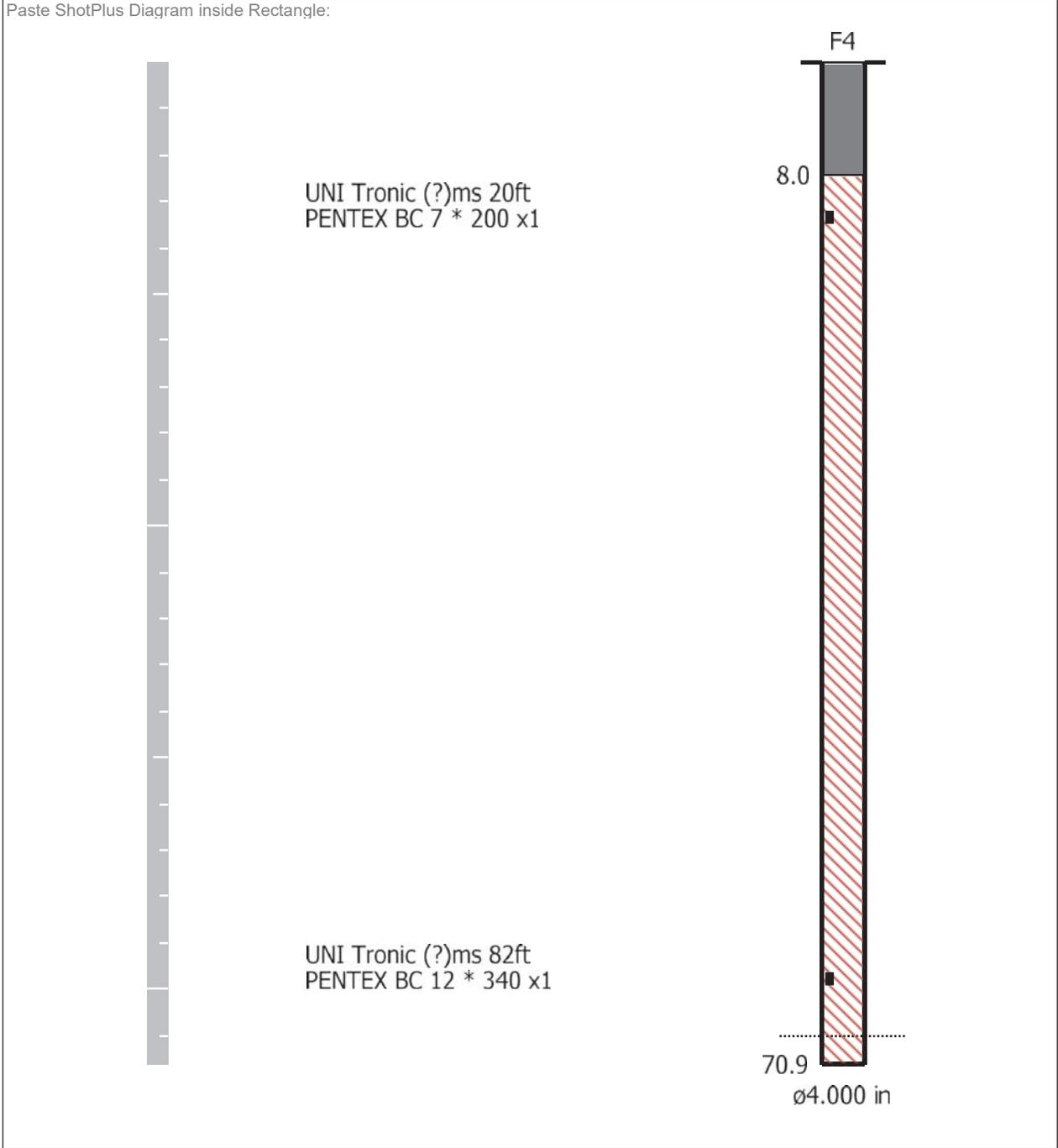
Nelson Aggregate

|             |            |
|-------------|------------|
| Quarry:     | Burlington |
| P.O. #:     |            |
| Blast Date: | 8/12/2019  |

|                |         |
|----------------|---------|
| Blast Number:  | 19-015  |
| Orica Order #: | 2517100 |

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 12:10:05 August 12, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.25 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 2nd Line, Burlington, On  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

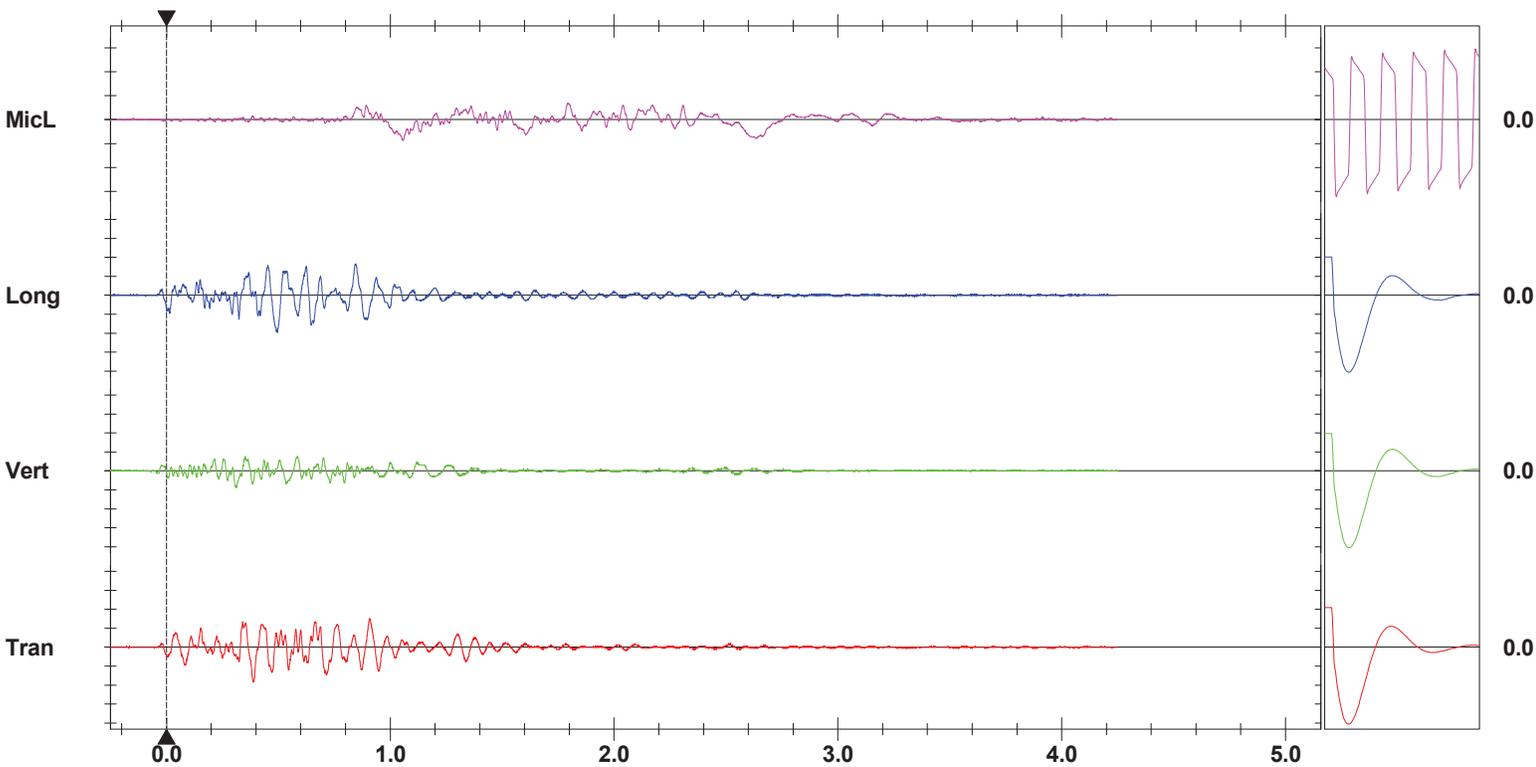
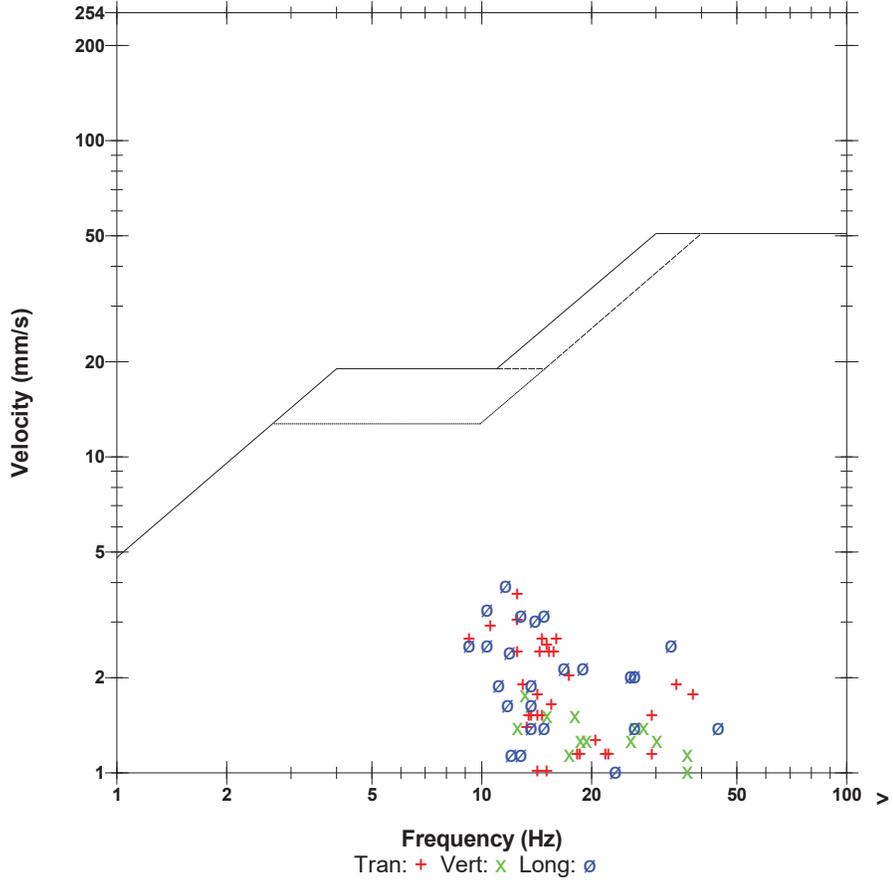
Sand Bagged  
 N43.40245:W-79.87814

**Microphone** Linear Weighting  
**PSPL** 112.8 dB(L) at 1.056 sec  
**ZC Freq** 2.4 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 533 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 3.683  | 1.778  | 3.937  | mm/s |
| ZC Freq             | 12.5   | 13.1   | 11.6   | Hz   |
| Time (Rel. to Trig) | 0.388  | 0.312  | 0.494  | sec  |
| Peak Acceleration   | 0.053  | 0.053  | 0.080  | g    |
| Peak Displacement   | 0.044  | 0.018  | 0.052  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.5    | 7.4    | 7.4    | Hz   |
| Overswing Ratio     | 3.8    | 3.6    | 4.0    |      |

Peak Vector Sum 4.111 mm/s at 0.491 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Coling rd & Blind Line ( Bruce Trail)  
Nelson Aggregate  
Burlington 2019-08-12 Blast 19-015 Upper Middle**

**Event Report: Monitor Log - Micromate ISEE # UM6857-Compliance**

| Start Time          | End Time            | Status                                                           |
|---------------------|---------------------|------------------------------------------------------------------|
| -----               | -----               | SERIAL NUMBER: UM6857                                            |
| Aug 12 /19 06:04:45 |                     | Start Monitoring Waveform Geo: 2.00 mm/s Mic: 115.0 dB           |
| Aug 12 /19 06:04:45 | Aug 12 /19 12:42:41 | No events recorded. (Keyboard Exit) Waveform Geo: 2.00 mm/s Mic: |

**SW Corner of Property  
Nelson Aggregate  
Burlington 2019-08-12 Blast 19-015 Upper Middle**

**Event Report: Monitor Log - Micromate ISEE # UM6859-Compliance**

| Start Time          | End Time            | Status                                                           |
|---------------------|---------------------|------------------------------------------------------------------|
| -----               | -----               | SERIAL NUMBER: UM6859                                            |
| Aug 12 /19 06:09:14 |                     | Start Monitoring Waveform Geo: 1.50 mm/s Mic: 115.0 dB           |
| Aug 12 /19 06:09:14 | Aug 12 /19 12:38:37 | No events recorded. (Keyboard Exit) Waveform Geo: 1.50 mm/s Mic: |

SHOTPlus Plan

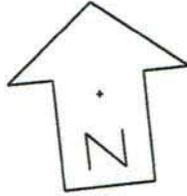
Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 3918.7ft

Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Number of holes: 66

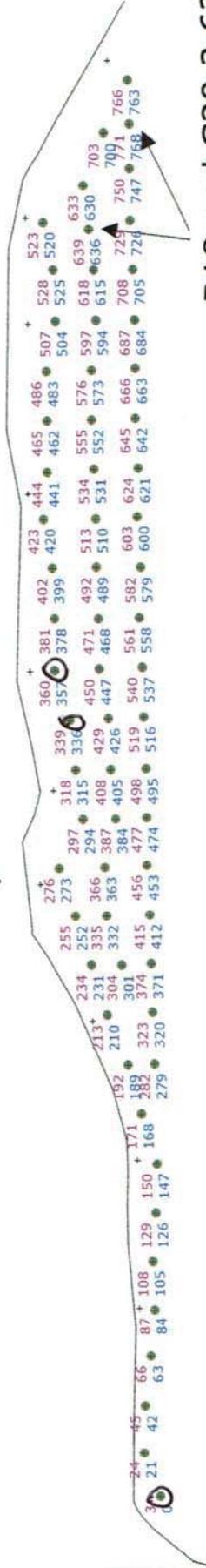
Stemming: 7.0ft  
 Hole angle: 0.0°

*D = Deck*



Load Sheet  
 Max 75 Kg

open face



B18 and C29 3.625" DIA



Not to scale

SHOTPLUS Plan

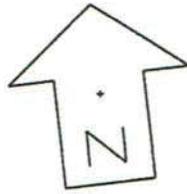
Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 3918.7ft

Spacing: 10.0ft  
 Subdrill: 2.0ft  
 Number of holes: 66

Hole Diameter: 4.0in  
 Stemming: 7.0ft  
 Hole angle: 0.0°

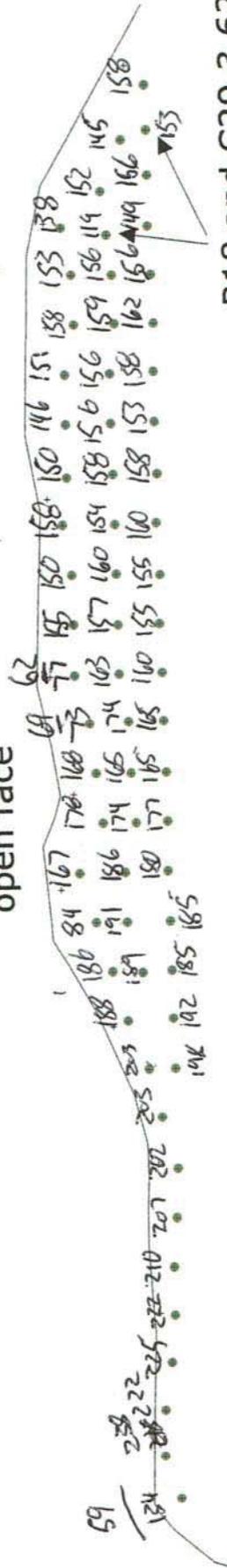
240  
 150  
 2  
 60



310

Load Sheet  
 Max 75-Kg

open face



B18 and C29 3.625" DIA.

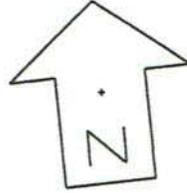


Not to scale

SHOTPlus Plan

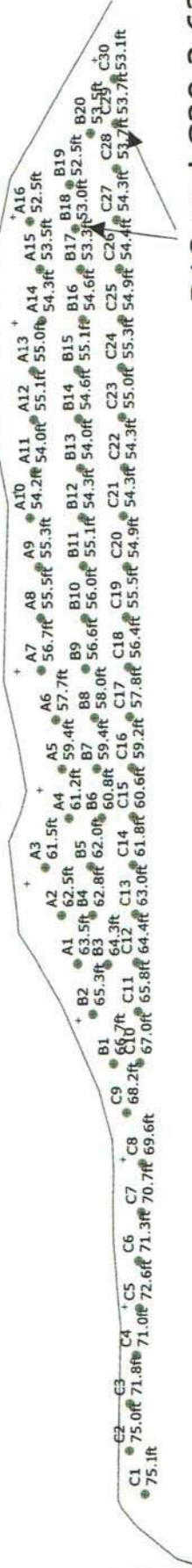
Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 3918.7ft      Hole Diameter: 4.0in      Number of holes: 66



+ POSTS

open face



B18 and C29 3.625" DIA.



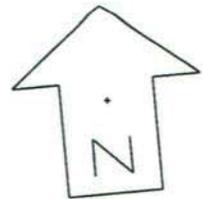
Not to scale

SHOTPlus 5 Plan

Blast Summary Data

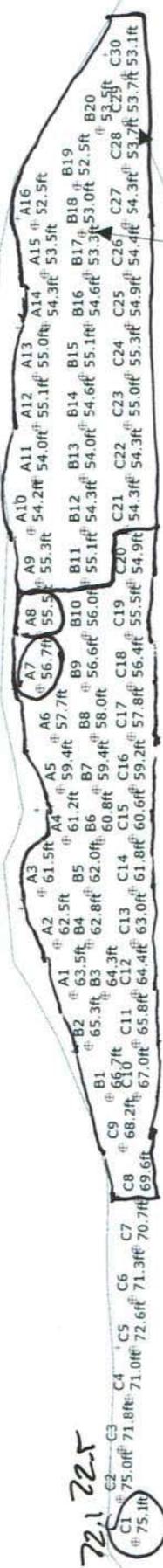
Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Subdrill: 2.0ft Hole angle: 0.0°  
 Total drilled: 3918.7ft Hole Diameter: 4.0in Number of holes: 66

- 5.5'  
 3918.7'



12165 KGS

open face POSTS



B18 and C29 3.625" DIA.

9MID014 Design Partial - 3.625 and 4" Blast Hole 12x10 9x10 270 and 250 + .6 SUB ELEV  
 DRILLER NAME: Michael Kelle

Start July 29/19

Finish July 31/19

O = void  
 see log



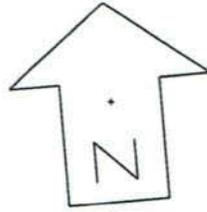
Scale 1:400

|                                |                                |
|--------------------------------|--------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 7/29/2019                      |
| Mine                           | Burlington                     |
| Location                       | MID BETWEEN NECRNR AND UPMD    |
| Title/author                   | 9MID014 Partial Design Fnl     |
| Filename                       | 9MID014 Partial Design Fnl.spf |

SHOTPlus 5 Plan

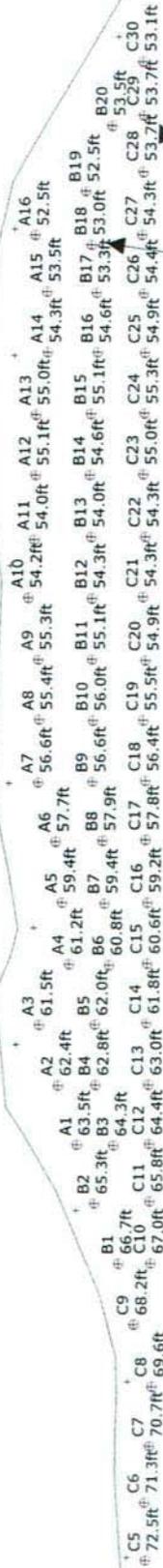
Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 3624.7ft      Hole Diameter: 4.0in      Number of holes: 62



POSTS

open face



cleanup  
requ'd

B18 and C29 3.625" DIA.

9MID014 Design Partial - 3.625 and 4" Blast Hole 12x10 9x10 270 and 250 + .6 SUB ELEV  
 DRILLER NAME:



Scale 1:375

|                                |                             |
|--------------------------------|-----------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 7/29/2019                   |
| Mine                           | Burlington                  |
| Location                       | MID BETWEEN NECRNR AND UPMD |
| Title/author                   | 9MID014 Partial Design Fnl  |
| Filename                       |                             |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-08-22

Blast Number: 19-016

Orica Order #: 2521575

Blast Time: 12:04 PM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40434 °N Latitude 79.88168 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: NW at 15 kph Temperature: 21 to 25 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 9,144 ft

### - Drilling Information -

|                              | Angle from Vertical | Nominal Bit Diameter:                 |
|------------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm   | 0°                  | # Holes: 66 = 3,937.6 ft ( 4 " diam)  |
| Secondary Bit diam: 114.3 mm | 0°                  | # Holes: 4 = 238.6 ft ( 4 1/2 " diam) |
| Tertiary Bit diam: mm        | 0°                  | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,930  | 22,980   | 10,950 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 1           | 25 |

### Boosters:

|                            | kg / unit | # used | kg   |
|----------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT)  | 0.34      | 68     | 23.1 |
| PENTEX DUO (OR EQUIVALENT) | 0.45      | 70     | 31.8 |

total explosives weight in Blast (kg): 11,030

Pkgd Prod (25 kg) % of Total kg: 0.2%

### Detonators:

|                   | case #'s | ms    | # used |
|-------------------|----------|-------|--------|
| UNITRONIC 600 9M  |          |       | 23     |
| UNITRONIC 600 15M |          |       | 45     |
| UNITRONIC 600 20M |          |       | 18     |
| UNITRONIC 600 25M |          |       | 52     |
| EXEL MS 18m       |          | 25 ms | 25     |
| EXEL MS 25m       |          | 25 ms | 45     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.0  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 30,187 te      | 11,610 m <sup>3</sup> |
| Total tonnes per day: | 30,187 te      | TBD                   |
| Total Holes Loaded:   | 70 holes       |                       |
| ... including:        | 0 Dead Holes   |                       |
| ... and:              | 2 Helper Holes |                       |
| Helper Hole Collar:   | 35.0 ft avg    |                       |
| # Rows Blasted:       | 2 rows         |                       |

### - Pattern (Front Row) -

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 34 front row |

### - Pattern (Back Row) -

|          |             |
|----------|-------------|
| Burden:  | 9.0 ft avg  |
| Spacing: | 10.0 ft avg |
| # Holes: | 36 back row |

Bench Height: 57.7 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 59.7 ft avg

### - Stone Decking -

Front Row: 4.0 ft avg

Back Row: 4.0 ft avg

# Decks: 68 per blast

### - Collar Stemming -

Front Row: 8.0 ft avg

Back Row: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 47.7 ft avg

Back Row: 48.7 ft avg

### - Charge Weight -

Front Row: 139.0 kg/hole

Back Row: 141.9 kg/hole

Max. per delay: 130.0 kg/delay

SD () Equation: 5.0 kg/delay

Total kg Loaded: 11,030 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.365 kg/te (actual)

Front row: 0.273 kg/te (theoretical)

Main Body: 0.371 kg/te (theoretical)

"KPI" PF: 0.322 kg/te (theoretical)

1.601 lb/yd<sup>3</sup>

1.196 lb/yd<sup>3</sup>

1.628 lb/yd<sup>3</sup>

1.412 lb/yd<sup>3</sup>

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):

Package was used to bring up collars

Rate code to be determined by sale rep.



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 2019-08-22

Blast Number: 19-016  
 Orica Order #: 2521575  
 Blast Time: 12:04 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40439       | 79.88167        | 0.757549    | 1.394198    |
| Front Row Corner          | 43.40387       | 79.88176        | 0.757540    | 1.394200    |
| Back Row Corner           | 43.40478       | 79.88161        | 0.757556    | 1.394197    |
| Average (Centre of Blast) | 43.40434       | 79.88168        | 0.757549    | 1.394198    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 355.8                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 7.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 12.5         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 116.7 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1348.6                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 1.5                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 41.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 111.3 | dB              | Trigger set at: 115 | dB                                     |

South West Corner of property

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 67.1                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: 48.64              | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 30           | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 128.3 | dB              | Trigger set at: 115 | dB                                     |

Gas Line

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(67.1)^2}{30^2} \text{ kg} \\
 &= \frac{4,502}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date:

Blast Number: 19-016

Orica Order #: 2521575

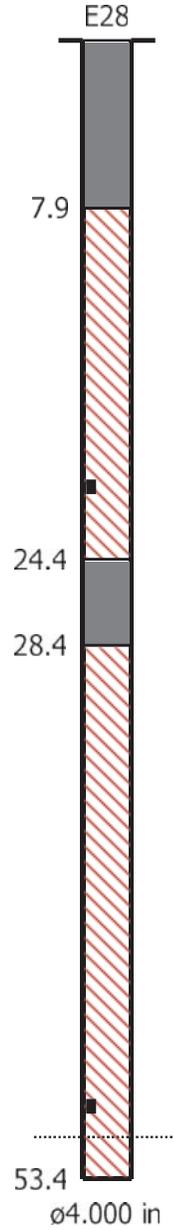
page 2

Paste ShotPlus Diagram inside Rectangle:



UNI Tronic (?)ms 33ft  
PENTEX BC 12 \* 340 x1

UNI Tronic (?)ms 66ft  
Pentex DUO 16 \* 454 x1



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 12:05:01 August 22, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.25 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 2nd Line  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

Sand Bagged  
 N43.40245,W-79.87814

**Microphone** Linear Weighting

**PSPL** 116.7 dB(L) at 2.612 sec

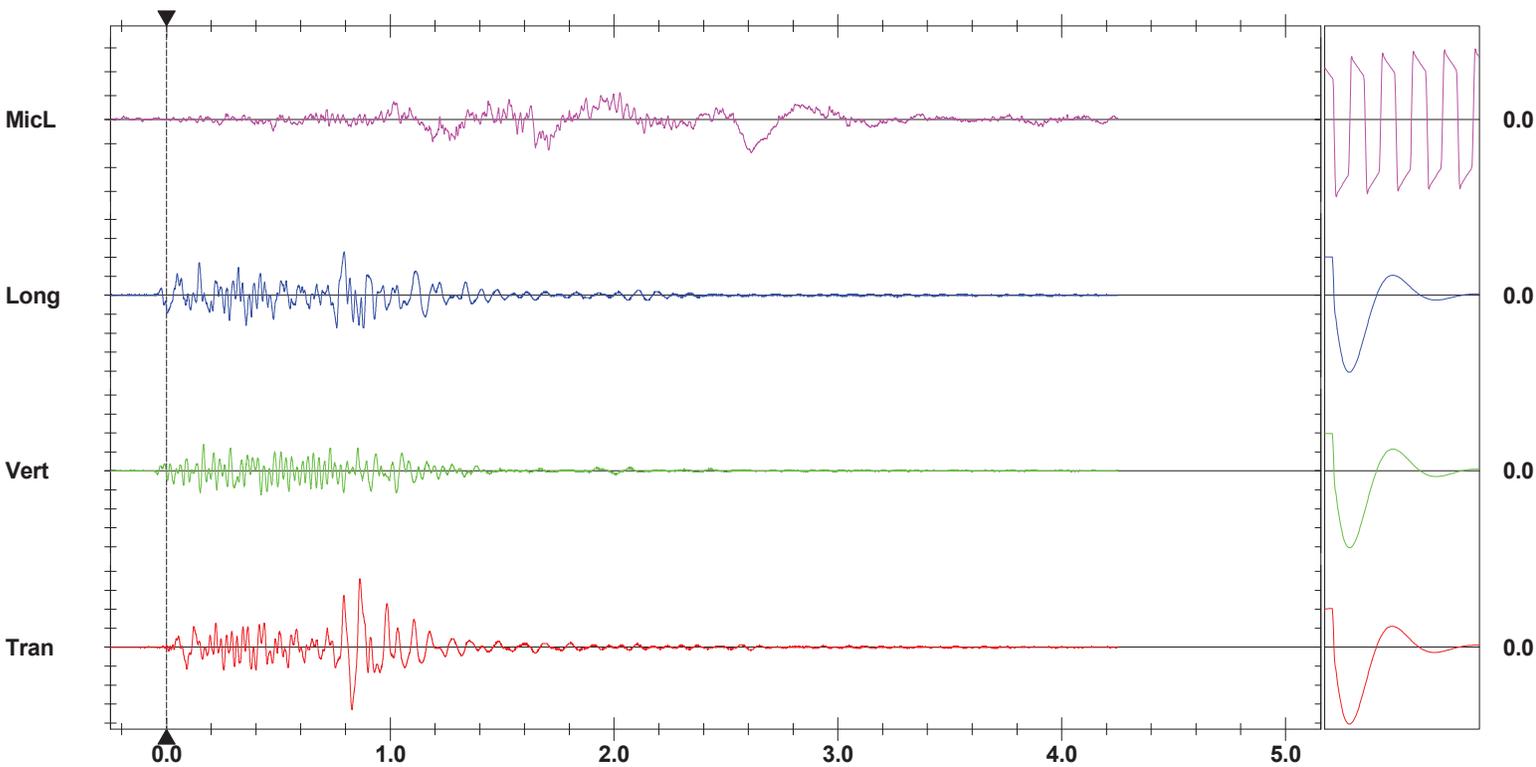
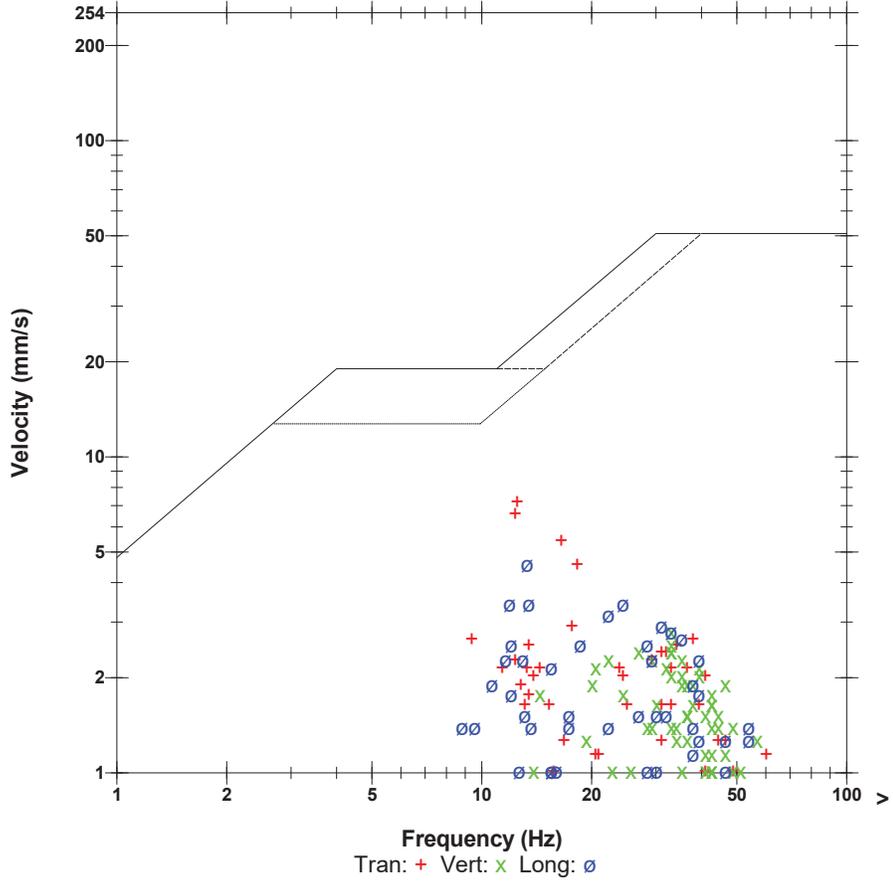
**ZC Freq** 2.6 Hz

**Channel Test** Passed (Freq = 20.1 Hz Amp = 530 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 7.239  | 2.794  | 4.572  | mm/s |
| ZC Freq             | 12.5   | 33     | 13.3   | Hz   |
| Time (Rel. to Trig) | 0.864  | 0.165  | 0.793  | sec  |
| Peak Acceleration   | 0.106  | 0.080  | 0.080  | g    |
| Peak Displacement   | 0.079  | 0.019  | 0.050  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.4    | 7.3    | Hz   |
| Overswing Ratio     | 3.8    | 3.6    | 3.9    |      |

**Peak Vector Sum** 7.523 mm/s at 0.864 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Long at 12:04:56 August 22, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 121.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.0 sec (Auto=4Sec) at 2048 sps  
**Operator/Setup:** Mike der Kinderen/Burlington SW.MMB

**Serial Number** UM6859 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** December 24, 2018 by InstanTel  
**File Name** UM6859\_20190822120456.IDFW

**Notes**

**Location:** SouthWest Corner of Quarry  
**Client:** Nelsons Burlington  
**User Name:** Orica Canada Inc.  
**General:** Monitoring Vibration and Airblast

**Extended Notes**

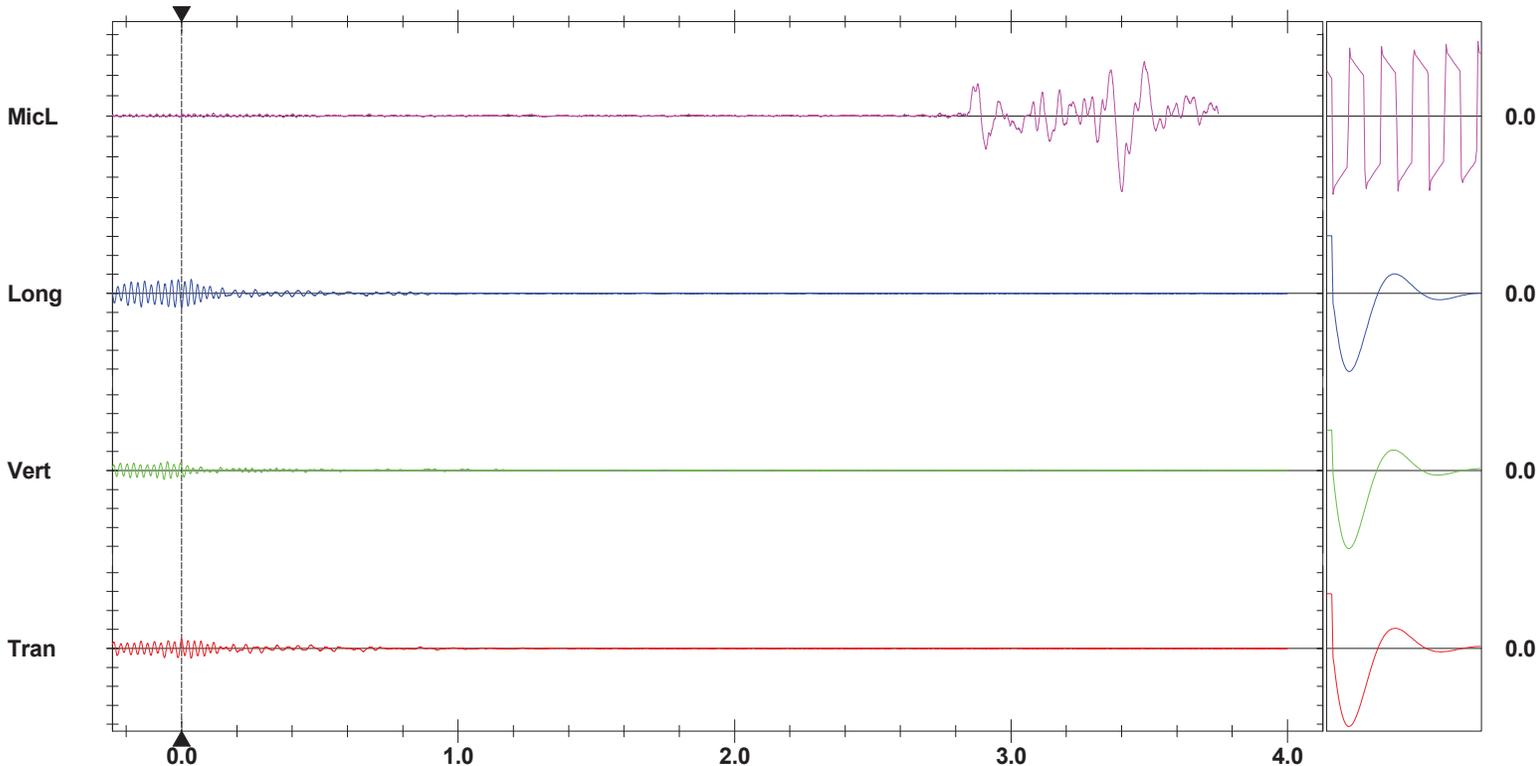
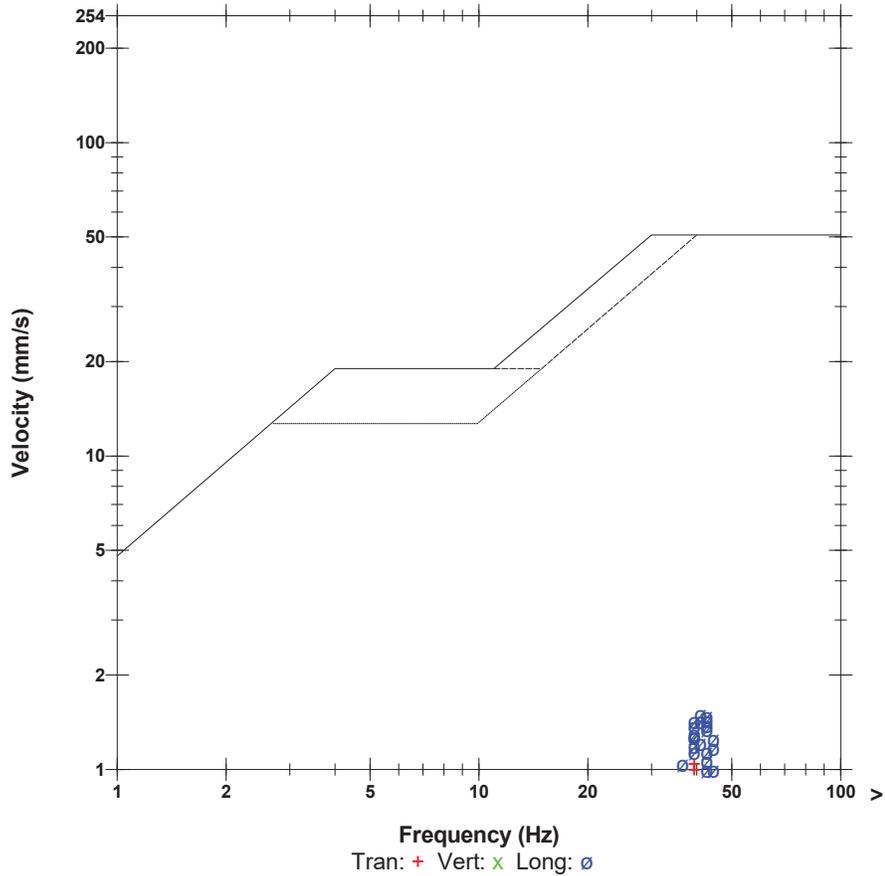
N 43.39339  
 W 79.88880

**Microphone** Linear Weighting  
**PSPL** 111.3 dB(L) at 3.400 sec  
**ZC Freq** 7.7 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 1355 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 1.040  | 0.938  | 1.498  | mm/s |
| ZC Freq             | 39     | 43     | 41     | Hz   |
| Time (Rel. to Trig) | 0.035  | -0.063 | 0.000  | sec  |
| Peak Acceleration   | 0.028  | 0.033  | 0.064  | g    |
| Peak Displacement   | 0.004  | 0.004  | 0.006  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.1    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.9    | 3.8    | 4.0    |      |

**Peak Vector Sum** 1.884 mm/s at 0.000 sec

**USBM R18507 And OSMRE**



**Time Scale:** 0.20 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 2.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Vert at 12:05:00 August 22, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.25 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.3 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_TEMP.EVT

### Notes

**Location:** Gas Line 52 Meters Behind Blast  
**Client:** Nelson Aggregates  
**User Name:** Orica Canada  
**General:** 43.40466,-79.88098

### Extended Notes

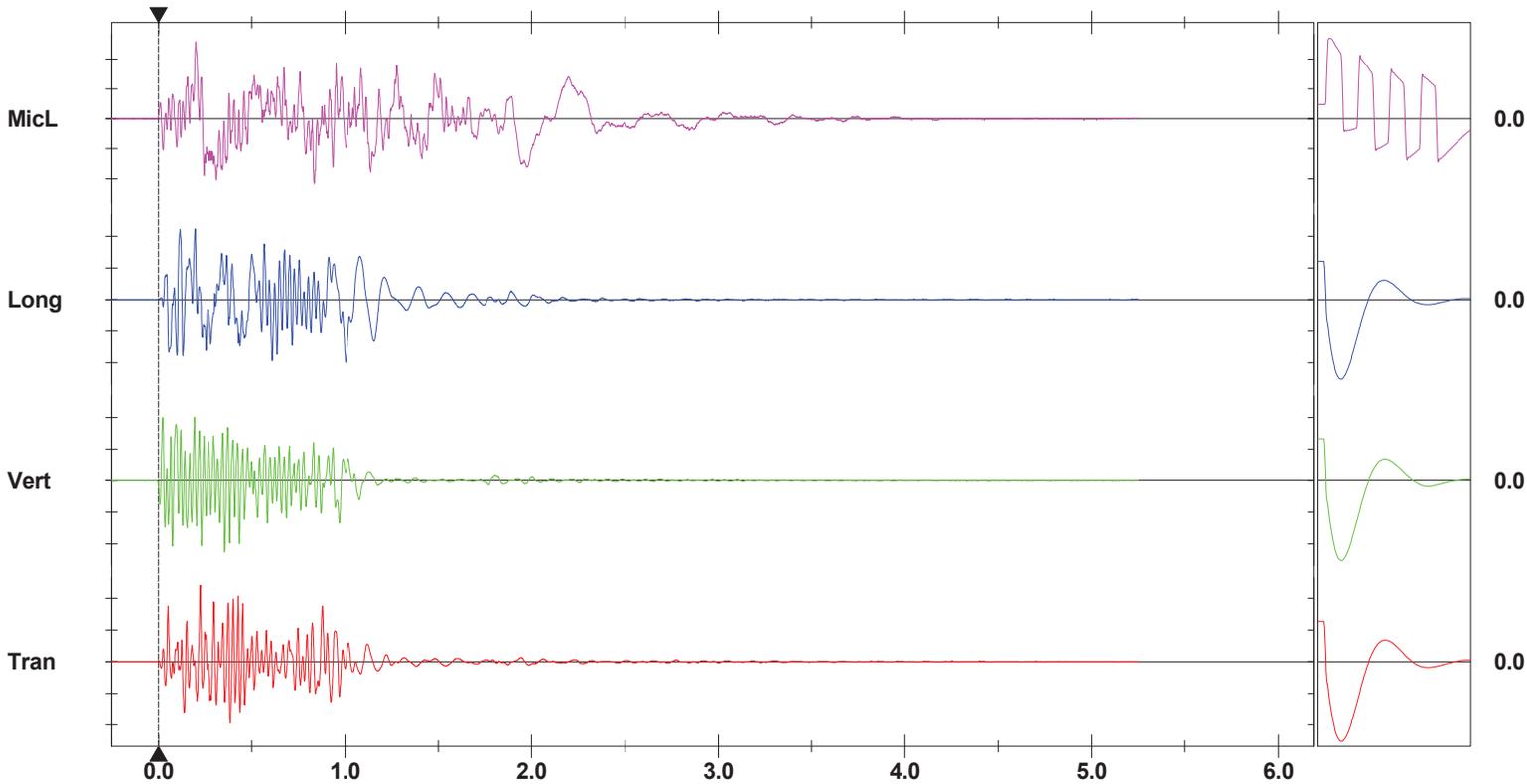
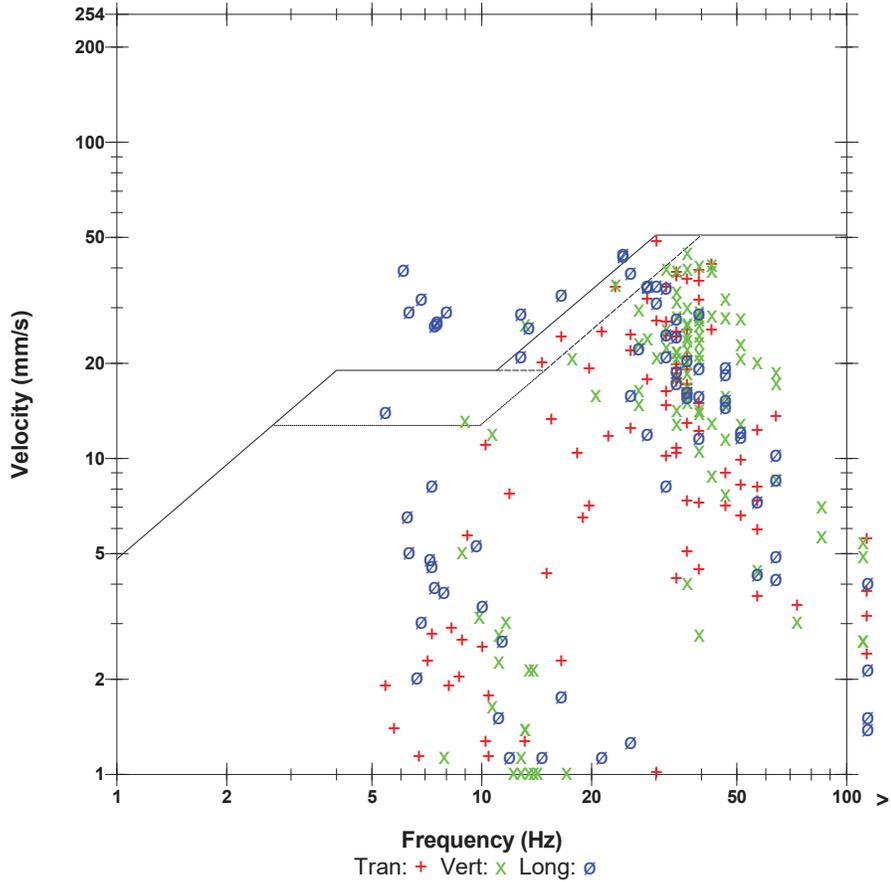
Sand Bagged at gas line

**Microphone** Linear Weighting  
**PSPL** 128.3 dB(L) at 0.199 sec  
**ZC Freq** 10 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 683 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 48.64  | 45.08  | 44.58  | mm/s |
| ZC Freq             | 30     | 37     | 24     | Hz   |
| Time (Rel. to Trig) | 0.224  | 0.355  | 0.196  | sec  |
| Peak Acceleration   | 1.644  | 1.591  | 1.259  | g    |
| Peak Displacement   | 0.227  | 0.301  | 0.675  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.4    | Hz   |
| Overswing Ratio     | 3.7    | 3.9    | 4.1    |      |

**Peak Vector Sum** 56.13 mm/s at 0.194 sec

### USBM RI8507 And OSMRE



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 20.00 mm/s/div Mic: 20.00 pa.(L)/div  
**Trigger =**

Sensor Check

**Blind line & Colling rd  
Nelson Aggregate  
Burlington 2019-08-22 Blast 19-016Middle**

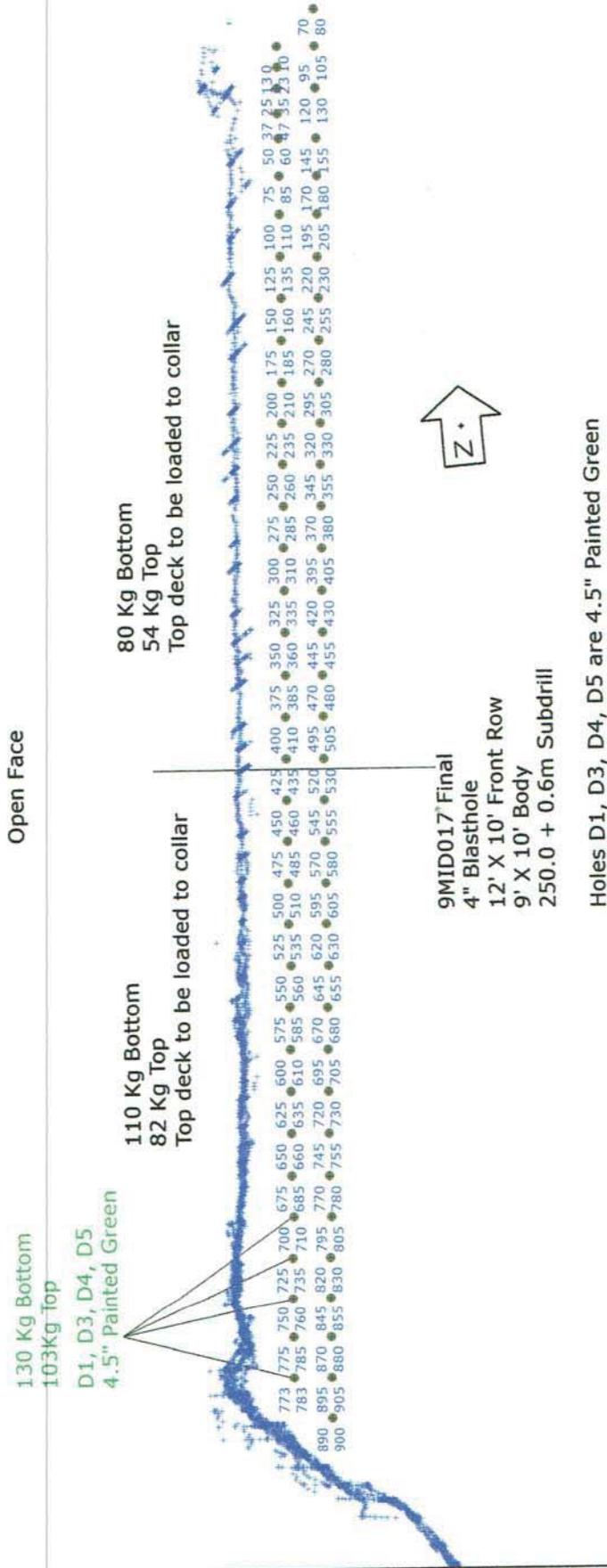
**Event Report: Monitor Log - Micromate ISEE # UM6857-Compliance**

| Start Time                   | End Time                     | Status                                                                                                                                              |
|------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| -----<br>Aug 22 /19 11:20:47 | -----<br>Aug 22 /19 12:41:21 | SERIAL NUMBER: UM6857<br>Start Monitoring Waveform Geo: 2.00 mm/s Mic: 115.0 dB<br>No events recorded. (Keyboard Exit) Waveform Geo: 2.00 mm/s Mic: |

**SHOTPlus Plan**

**Blast Summary Data**

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 8.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Hole angle: 0.0°  
 Total drilled: 4176.3ft      Subdrill: 2.0ft      Number of holes: 70



Not to scale

SHOTPLUS Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 8.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Hole Diameter: 4.0in      Number of holes: 70  
 Total drilled: 4176.3ft

Load Sheet  
Open Face

130 Kg Bottom  
103Kg Top

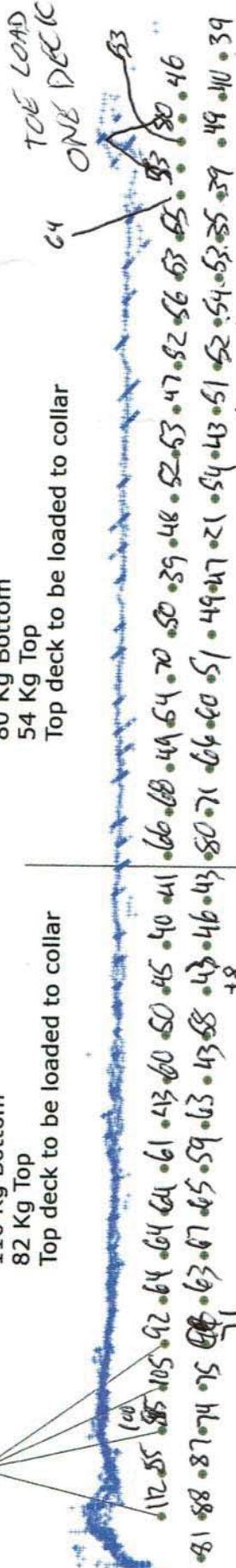
D1, D3, D4, D5  
4.5" Painted Green

110 Kg Bottom  
82 Kg Top

Top deck to be loaded to collar

80 Kg Bottom  
54 Kg Top

Top deck to be loaded to collar



Not to scale

**SHOTPlus Plan**

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 8.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 4176.3ft      Hole Diameter: 4.0in      Number of holes: 70

Open Face

130 Kg Bottom  
 103Kg Top  
 D1, D3, D4, D5  
 4.5" Painted Green

110 Kg Bottom  
 82 Kg Top  
 Top deck to be loaded to collar

80 Kg Bottom  
 54 Kg Top  
 Top deck to be loaded to collar



9MID017 Final  
 4" Blasthole  
 12' X 10' Front Row  
 9' X 10' Body  
 250.0 + 0.6m Subdrill

Holes D1, D3, D4, D5 are 4.5" Painted Green



Not to scale

SHOTPLUS Plan

Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 4069.7ft  
 Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Subdrill: 2.0ft  
 Number of holes: 68  
 Stemming: 8.0ft  
 Hole angle: 0.0°

Open Face

D1, D3, D4, D5  
 4.5" Painted Green

HEZ ADZ  
 XYZ  
 PT.



- 9MID017 Final
- 4" Blasthole
- 12' X 10' Front Row
- 9' X 10' Body
- 250.0 + 0.6m Subdrill

Holes D1, D3, D4, D5 are 4.5" Painted Green



Not to scale



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-08-28

Blast Number: 19-017

Orica Order #: 2523993

Blast Time: 10:59 AM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40346 °N Latitude 79.88160 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 5 kph Temperature: 21 to 25 °C

Clear:  Rain:  Overcast:   
Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 36 = 2,383.1 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 34,180  | 27,010   | 7,170 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 2           | 0  |

### Boosters:

|                           | kg / unit | # used | kg   |
|---------------------------|-----------|--------|------|
| PENTEX 8 (OR EQUIVALENT)  | 0.23      | 35     | 7.9  |
| PENTEX 12 (OR EQUIVALENT) | 0.34      | 36     | 12.2 |

total explosives weight in Blast (kg): 7,190

Pkgd Prod (0 kg) % of Total kg: 0.0%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 35     |
| UNITRONIC 600 25M |          |    | 36     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 5.5  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 15,727 te 6,049 m<sup>3</sup>  
Total tonnes per day: 15,727 te NB60-08 Rate Code  
Total Holes Loaded: 36 holes  
... including: 3 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 2 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 13 front row

### - Pattern (Back Row) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 23 back row

Bench Height: 64.2 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 66.2 ft avg

### - Stone Decking -

Front Row: 0.0 ft avg

Back Row: 0.0 ft avg

# Decks: 0 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Back Row: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 59.2 ft avg

Back Row: 59.2 ft avg

### - Charge Weight -

Front Row: 172.6 kg/hole

Back Row: 172.6 kg/hole

Max. per delay: 237.0 kg/delay

SD () Equation: 22.5 kg/delay

Total kg Loaded: 7,190 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.457 kg/te (actual)

Front row: 0.304 kg/te (theoretical)

Main Body: 0.406 kg/te (theoretical)

"KPI" PF: 0.355 kg/te (theoretical)

Theoretical PF (Based on a single hole)  
2.004 lb/yd<sup>3</sup>  
1.334 lb/yd<sup>3</sup>  
1.778 lb/yd<sup>3</sup>  
1.556 lb/yd<sup>3</sup>

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):

J-9 Only received a bottom primer due to hole bridging while retracting the hose



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-08-28

Blast Number: 19-017  
 Orica Order #: 2523993  
 Blast Time: 10:59 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40346       | 79.88160        | 0.757533    | 1.394197    |
| Front Row Corner          | 43.40333       | 79.88167        | 0.757531    | 1.394198    |
| Back Row Corner           | 43.40360       | 79.88153        | 0.757536    | 1.394196    |
| Average (Centre of Blast) | 43.40346       | 79.88160        | 0.757533    | 1.394197    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 301.5                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 7.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 12.3         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 119.1 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1263.8                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 10.1         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 117.4 | dB              | Trigger set at: 115 | dB                                     |

Blind Line and Colling Road (Bruce Trail Entrance)

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 142.4                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 34.4               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 30.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 131.6 | dB              | Trigger set at: 115 | dB                                     |

Gas Line

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(142.4)^2}{30^2} \text{ kg} \\
 &= \frac{20,278}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 8/28/2019

Blast Number: 19-017  
 Orica Order #: 2523993

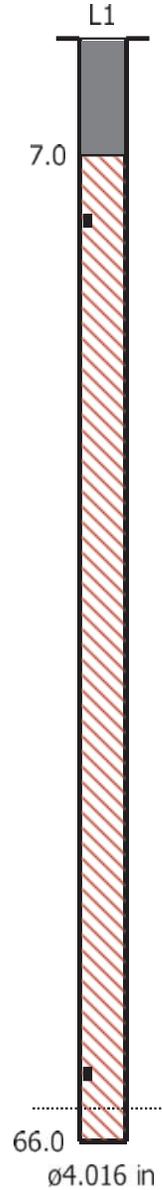
page 2

Paste ShotPlus Diagram inside Rectangle:



UNI Tronic (?)ms 20ft  
 PENTEX CD 8 \* 227 x1

UNI Tronic (?)ms 82ft  
 PENTEX BC 12 \* 340 x1



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Vert at 10:59:42 August 28, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.2 Volts  
**Unit Calibration** December 4, 2018 by InstanTEL  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 2nd Line  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

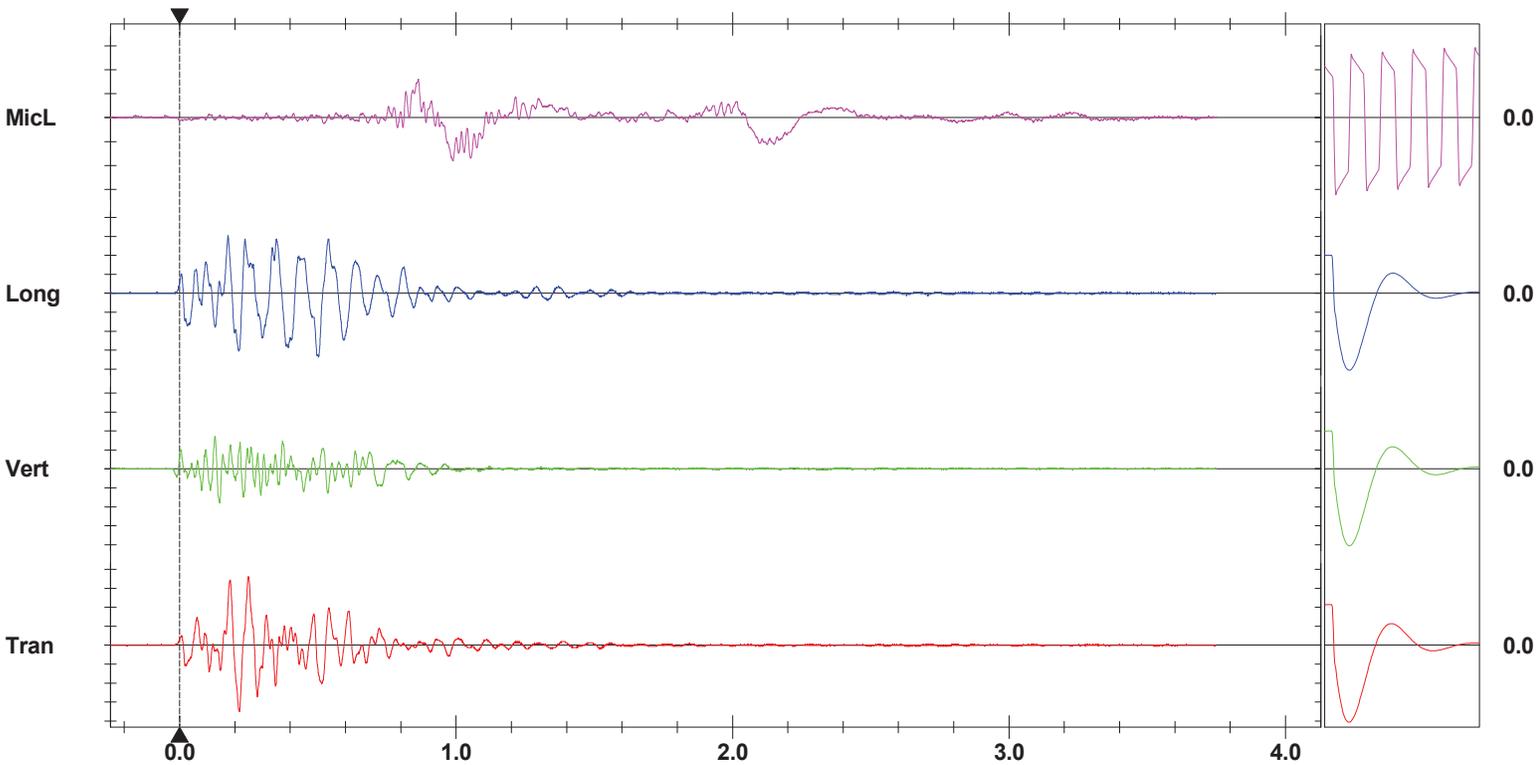
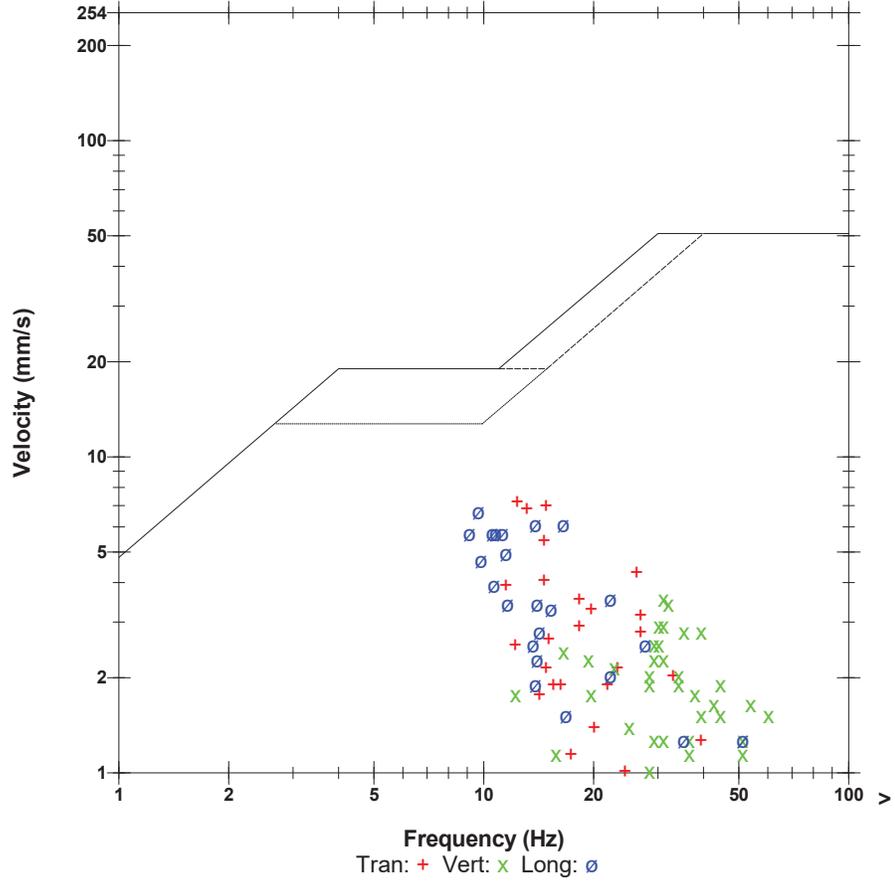
Sand Bagged  
 N43.40245,W-79.87814

**Microphone** Linear Weighting  
**PSPL** 119.1 dB(L) at 0.987 sec  
**ZC Freq** 3.0 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 520 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 7.239  | 3.556  | 6.731  | mm/s |
| ZC Freq             | 12.3   | 31     | 9.7    | Hz   |
| Time (Rel. to Trig) | 0.248  | 0.144  | 0.502  | sec  |
| Peak Acceleration   | 0.106  | 0.106  | 0.106  | g    |
| Peak Displacement   | 0.073  | 0.027  | 0.094  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.5    | 7.4    | 7.3    | Hz   |
| Overswing Ratio     | 3.6    | 3.5    | 3.9    |      |

**Peak Vector Sum** 9.410 mm/s at 0.216 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 10:59:42 August 28, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.088 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.5 Volts  
**Unit Calibration** January 15, 2019 by InstanTel  
**File Name** UM6857\_20190828105942.IDFW

**Notes**

Location: COLLING RD & BLINDLINE  
 Client: NELSON AGGREGATES  
 User Name: ORICA CANADA  
 General:

**Extended Notes**

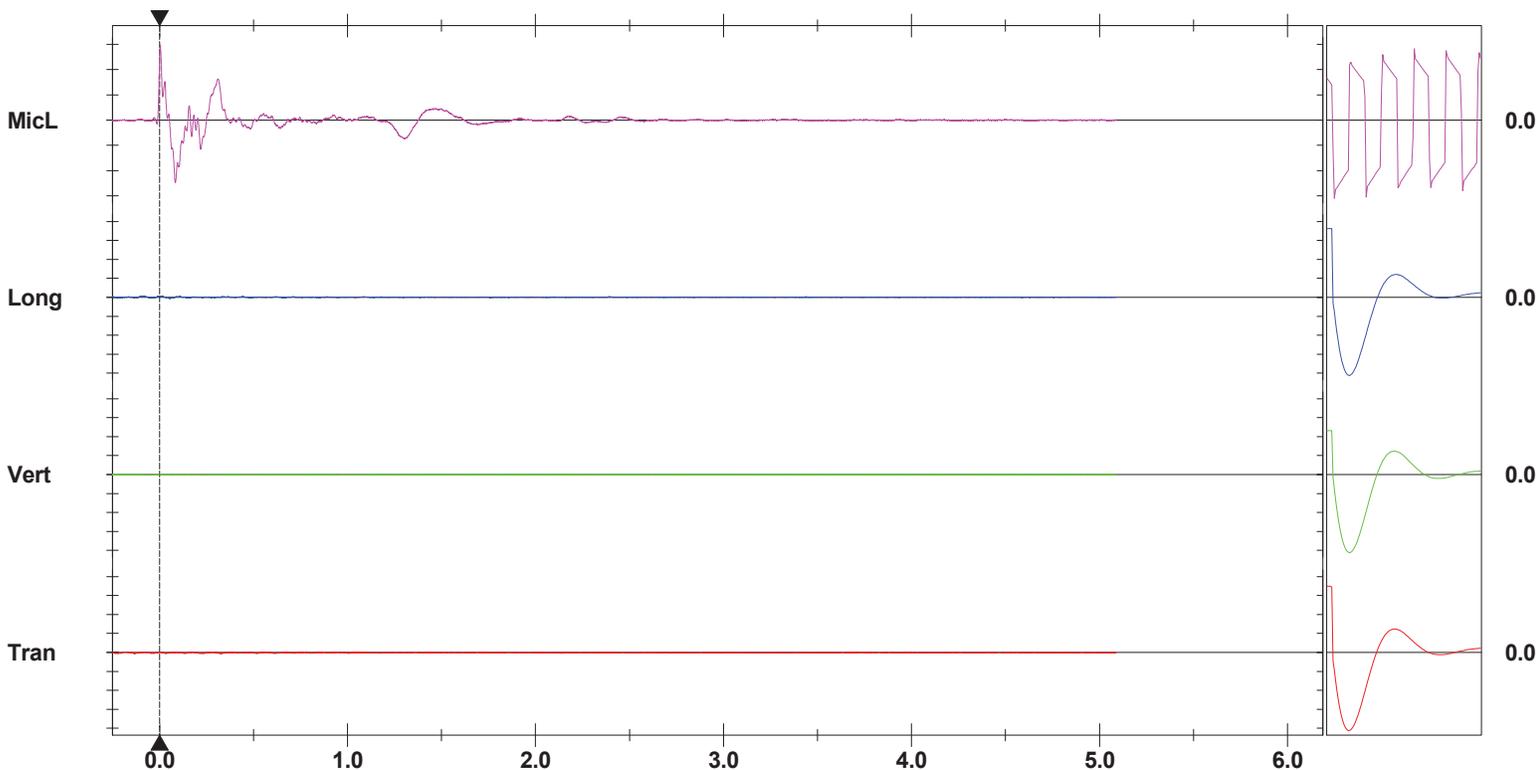
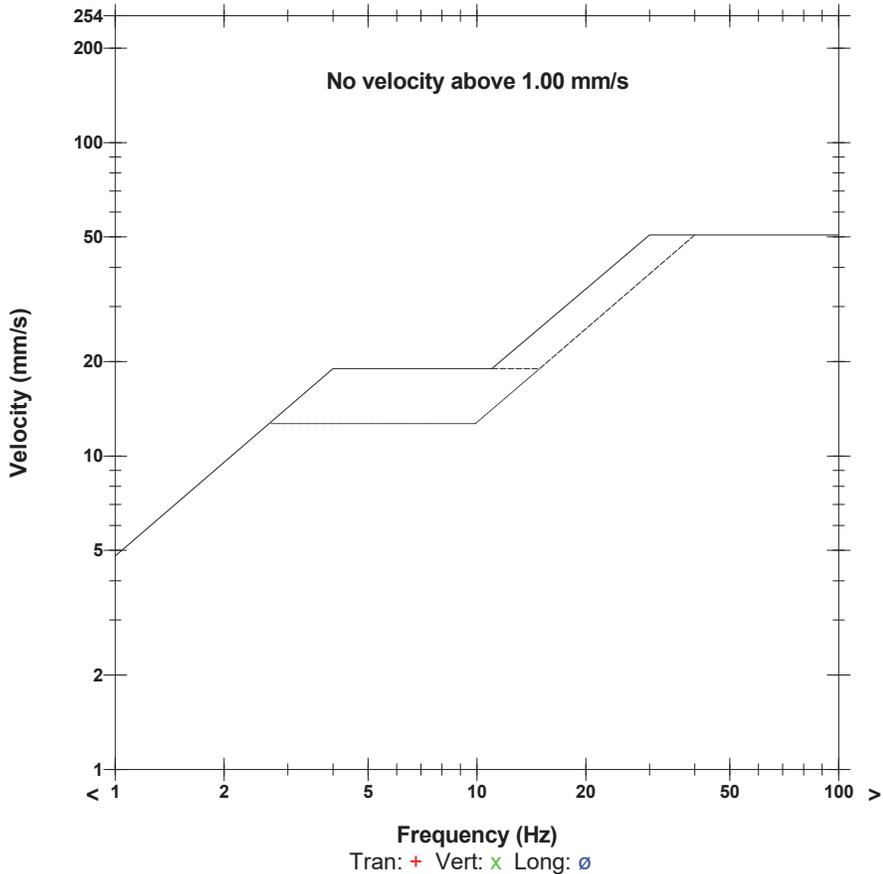
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 117.4 dB(L) at 0.004 sec  
**ZC Freq** 8.0 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1338 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.126  | 0.079  | 0.134  | mm/s |
| ZC Freq             | 9.5    | 6.6    | 10.1   | Hz   |
| Time (Rel. to Trig) | -0.219 | -0.071 | -0.093 | sec  |
| Peak Acceleration   | 0.008  | 0.010  | 0.010  | g    |
| Peak Displacement   | 0.017  | 0.002  | 0.002  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.3    | Hz   |
| Overswing Ratio     | 3.3    | 3.3    | 3.4    |      |

Peak Vector Sum 0.146 mm/s at -0.088 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Vert at 10:59:42 August 28, 2019  
**Trigger Source** Geo: 10.000 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.4 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: Gas Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada  
 General: 43.40466,-79.88098

**Extended Notes**

Sand Bagged at gas line

**Microphone** Linear Weighting

**PSPL** 131.6 dB(L) at 0.717 sec

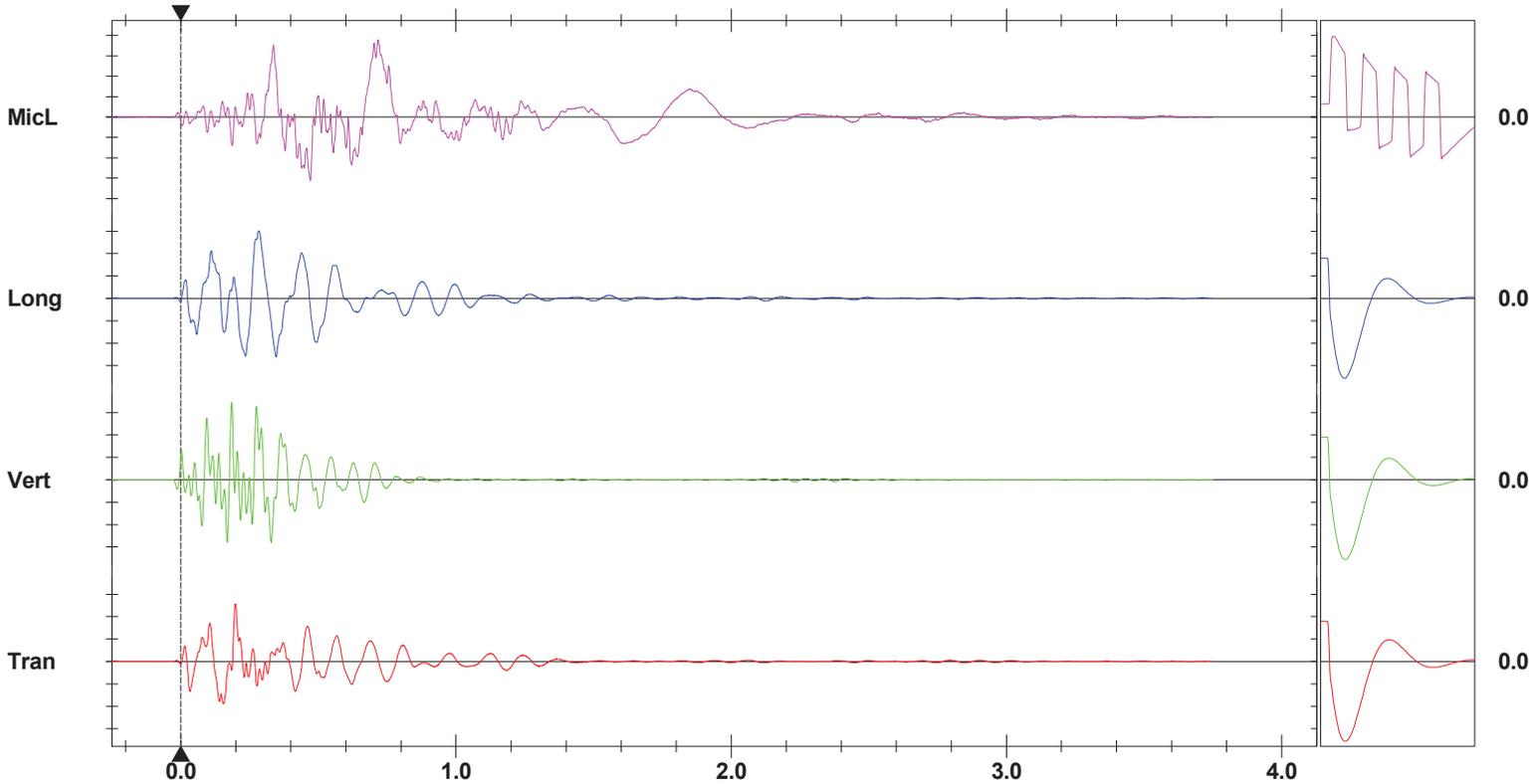
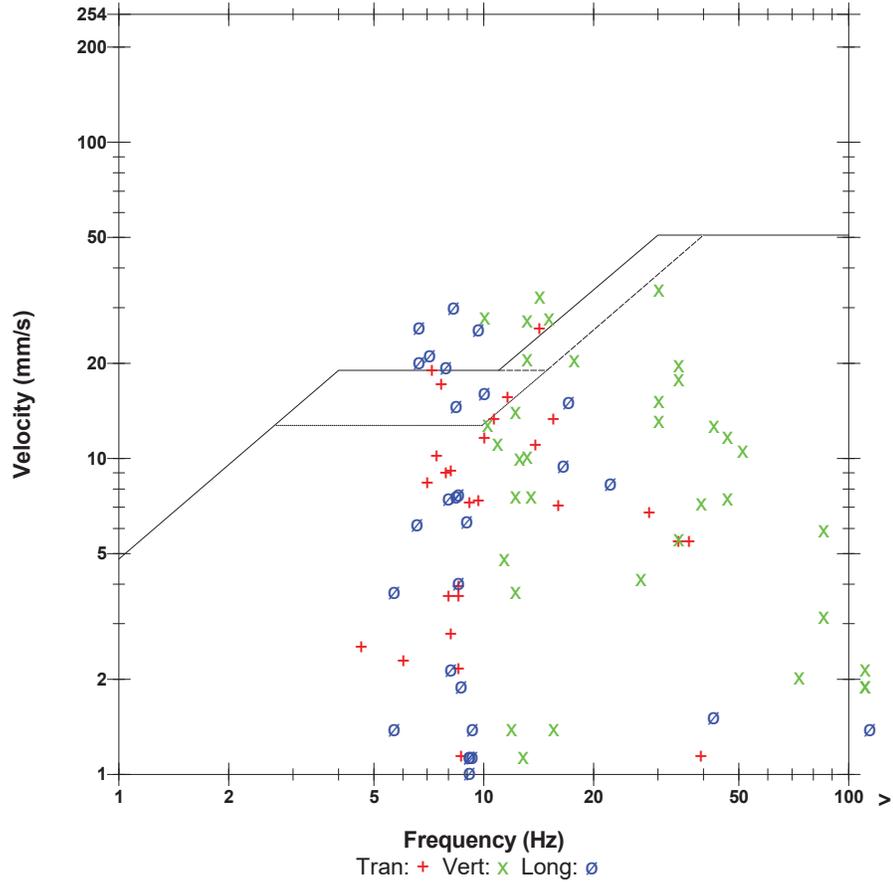
**ZC Freq** 4.1 Hz

**Channel Test** Passed (Freq = 20.1 Hz Amp = 695 mv)

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 25.65  | 34.42  | 30.10  | mm/s |
| ZC Freq             | 14     | 30     | 8.3    | Hz   |
| Time (Rel. to Trig) | 0.198  | 0.186  | 0.282  | sec  |
| Peak Acceleration   | 0.424  | 0.663  | 0.278  | g    |
| Peak Displacement   | 0.333  | 0.340  | 0.556  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.2    | 7.3    | 7.5    | Hz   |
| Overswing Ratio     | 3.7    | 3.7    | 4.0    |      |

**Peak Vector Sum** 43.35 mm/s at 0.275 sec

**USBM RI8507 And OSMRE**



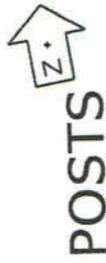
**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 10.000 mm/s/div Mic: 20.00 pa.(L)/div  
**Trigger =**

Sensor Check

SHOTPlus Plan

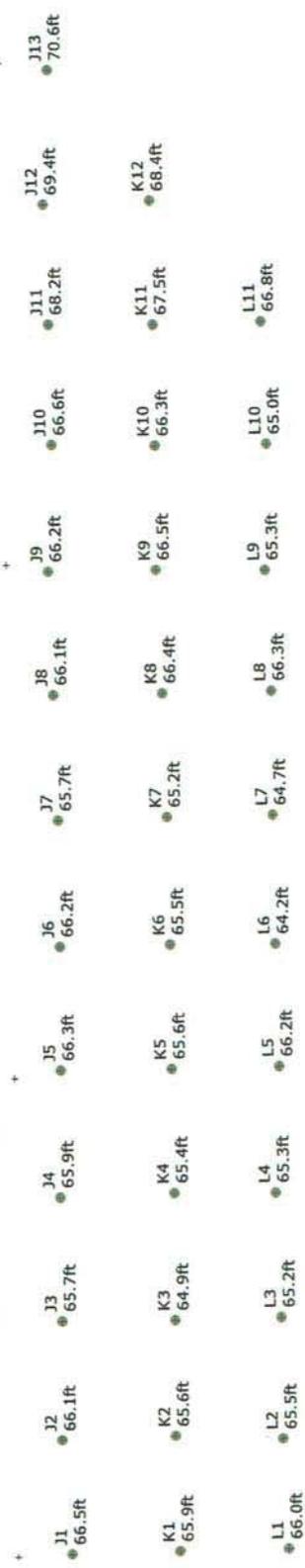
Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Subdrill: 2.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 36 Hole angle: 0.0°  
 Total drilled: 2383.1ft



POSTS

open face



9UPMD016 Design Fnl - 4" Blast Hole 12x10 9x10 271 and 250 +  
 DRILLER NAME: \_\_\_\_\_

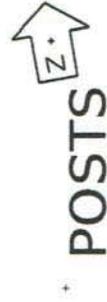


Not to scale

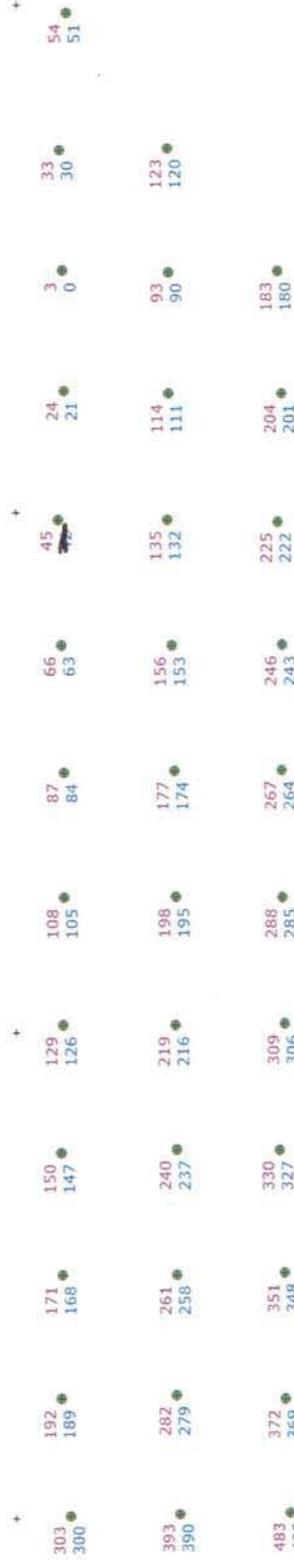
SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 36      Hole angle: 0.0°  
 Total drilled: 2383.1ft



open face



9UPMD016 Design Fnl - 4" Blast Hole 12x10 9x10 271 and 250 +  
 DRILLER NAME: \_\_\_\_\_



Not to scale

SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft  
Spacing: 10.0ft  
Stemming: 7.0ft  
Hole angle: 0.0°  
1st row burden: 12.0ft  
Subdrill: 2.0ft  
Hole Diameter: 4.0in  
Number of holes: 36  
Total drilled: 2383.1ft

Load Sheet  
Max 225 Kg  
open face



Not to scale

SHOTPlus 5 Plan

Blast Summary Data

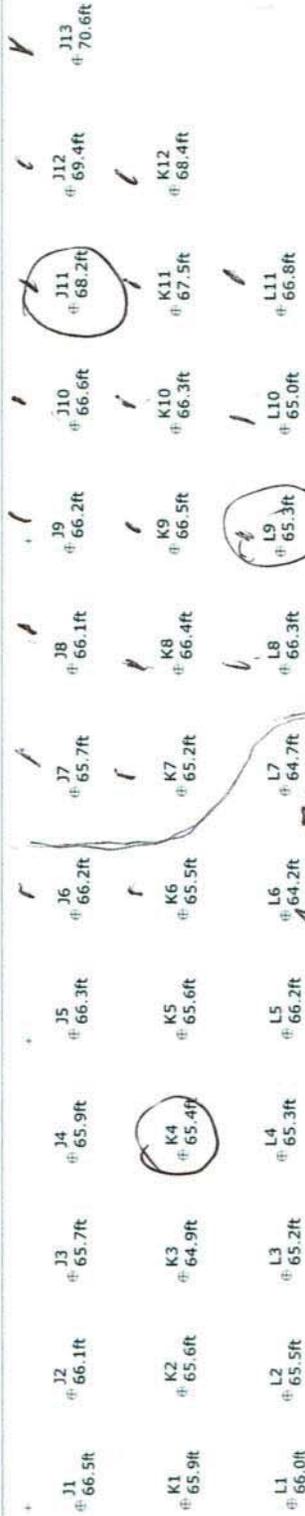
Burden: 9.0ft Spacing: 10.0ft Subdrill: 2.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 36 Hole angle: 0.0°  
 Total drilled: 2383.1ft



POSTS

7500 KGS

open face



9UPMD016 Design Fnl - 4" Blast Hole 12x10 9x10 271 and 250 + .6 SUB ELEV  
 DRILLER NAME:

|                                |                                      |
|--------------------------------|--------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 8/19/2019                            |
| Mine                           | Burlington                           |
| Location                       | UPPER MIDDLE SLOT NEXT TO OLD WHLWAS |
| Title/author                   | 9UPMD016 Design Fnl                  |
| Filename                       |                                      |



Scale 1:200



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-09-09

Blast Number: 19-018

Orica Order #: 2528633

Blast Time: 12:37 PM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Middle (Bench / Face)

GPS Coordinates: 43.40434 °N Latitude 79.88160 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: NE at 15 kph Temperature: 16 to 20 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 2,400 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 78 = 4,680.9 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 33,710  | 22,210   | 11,500 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 1           | 25 |

### Boosters:

|                            | kg / unit | # used | kg   |
|----------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT)  | 0.34      | 79     | 26.9 |
| PENTEX DUO (OR EQUIVALENT) | 0.45      | 97     | 44.0 |

total explosives weight in Blast (kg): 11,596

Pkgd Prod (25 kg) % of Total kg: 0.2%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 9M  |          |    | 20     |
| UNITRONIC 600 15M |          |    | 78     |
| UNITRONIC 600 20M |          |    | 39     |
| UNITRONIC 600 25M |          |    | 54     |
| EXEL MS 15m       |          |    | 19     |
| EXEL MS 18m       |          |    | 39     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |
| MINI STEM PLUGS - 6015 (4")      | units  | 4      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 7.0  |
| HELPER HOURS          | Enter total Helper man-hours | 12.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 35,108 te 13,503 m<sup>3</sup>  
Total tonnes per day: 35,108 te NB60-16 Rate Code  
Total Holes Loaded: 78 holes  
... including: 0 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 2 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 40 front row

### - Pattern (Back Row) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 38 back row

Bench Height: 58.0 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 60.0 ft avg

### - Stone Decking -

Front Row: 4.0 ft avg

Back Row: 4.0 ft avg

# Decks: 97 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Back Row: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 49.0 ft avg

Back Row: 49.0 ft avg

### - Charge Weight -

Front Row: 142.9 kg/hole

Back Row: 142.9 kg/hole

Max. per delay: 110.0 kg/delay

SD () Equation: 4.2 kg/delay

Total kg Loaded: 11,596 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.330 kg/te (actual)

Front row: 0.279 kg/te (theoretical)

Main Body: 0.372 kg/te (theoretical)

"KPI" PF: 0.325 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.447 lb/yd<sup>3</sup>

1.222 lb/yd<sup>3</sup>

1.629 lb/yd<sup>3</sup>

1.426 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

The first 19 Holes at the north end of the blast received 3 emulsion decks, the rest of the blast received 2 emulsion decks to control vibrations at the gas line and the near by shop.

Rate Code NB60-16 (19 decks in addition to the 78 built into the rate code)

Excel MS 25M 25ms---24 Used

15 additional 25M Unitronics were used instead of 25M ms because of limited stock

No additional charge should be added



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 2019-09-09

Blast Number: 19-018  
 Orica Order #: 2528633  
 Blast Time: 12:37 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40436       | 79.88159        | 0.757549    | 1.394197    |
| Front Row Corner          | 43.40381       | 79.88168        | 0.757539    | 1.394198    |
| Back Row Corner           | 43.40486       | 79.88152        | 0.757558    | 1.394196    |
| Average (Centre of Blast) | 43.40434       | 79.88160        | 0.757549    | 1.394197    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 349.9                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 4.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 10.9         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 117.4 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1351.1                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.1                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 14.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 116.4 | dB              | Trigger set at: 115 | dB                                     |

Blind Line and Colling Road (Bruce Trail Entrance)

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 61.5                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: 29.3               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 20.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 128.2 | dB              | Trigger set at: 115 | dB                                     |

Gas Line

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(61.5)^2}{30^2} \text{ kg} \\
 &= \frac{3,782}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington

P.O. #:

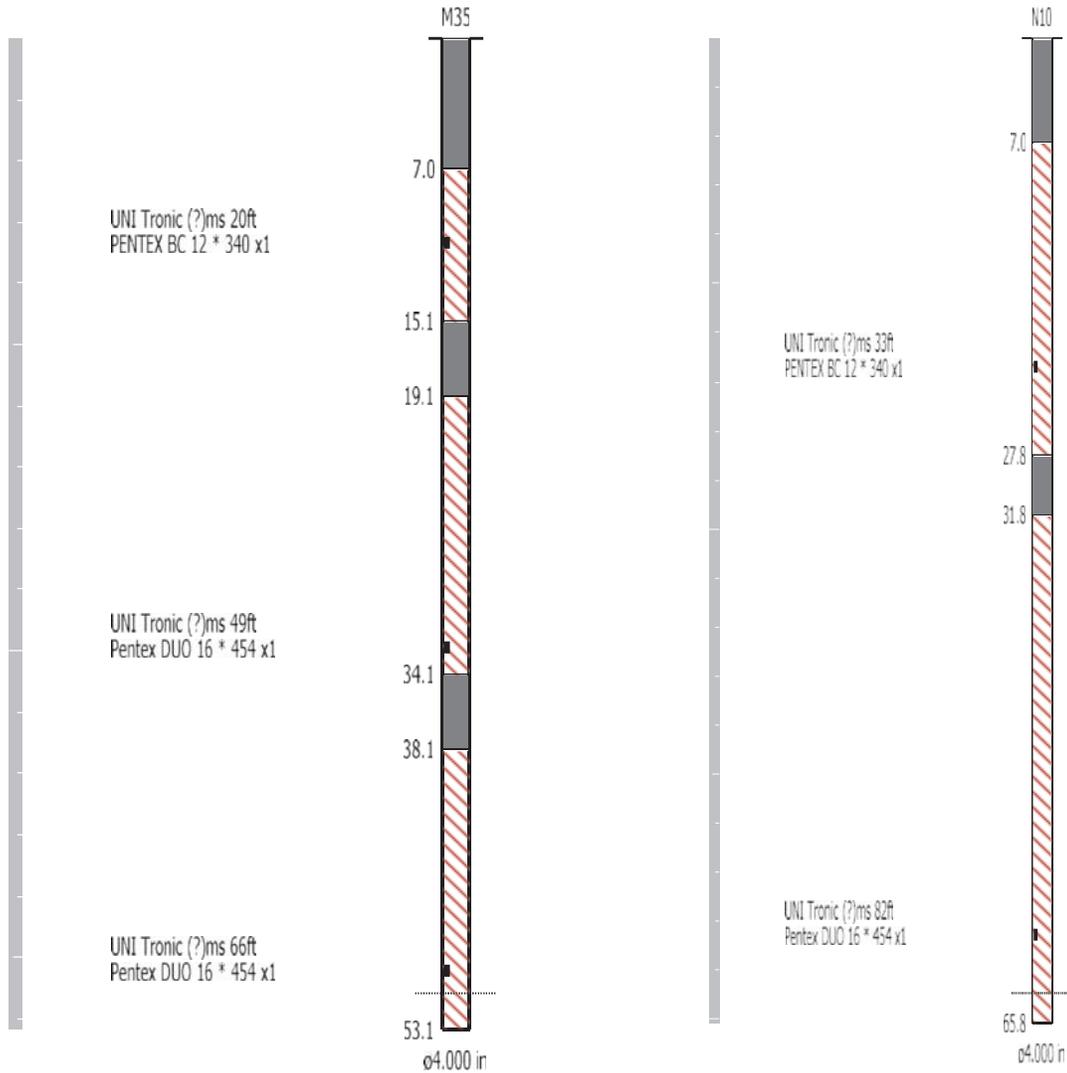
Blast Date: 9/9/2019

Blast Number: 19-018

Orica Order #: 2528633

page 2

Paste ShotPlus Diagram inside Rectangle:



Orica

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 12:37:13 September 9, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.0 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.2 Volts  
**Unit Calibration** December 4, 2018 by InstanTEL  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 #2 Road Burlington  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

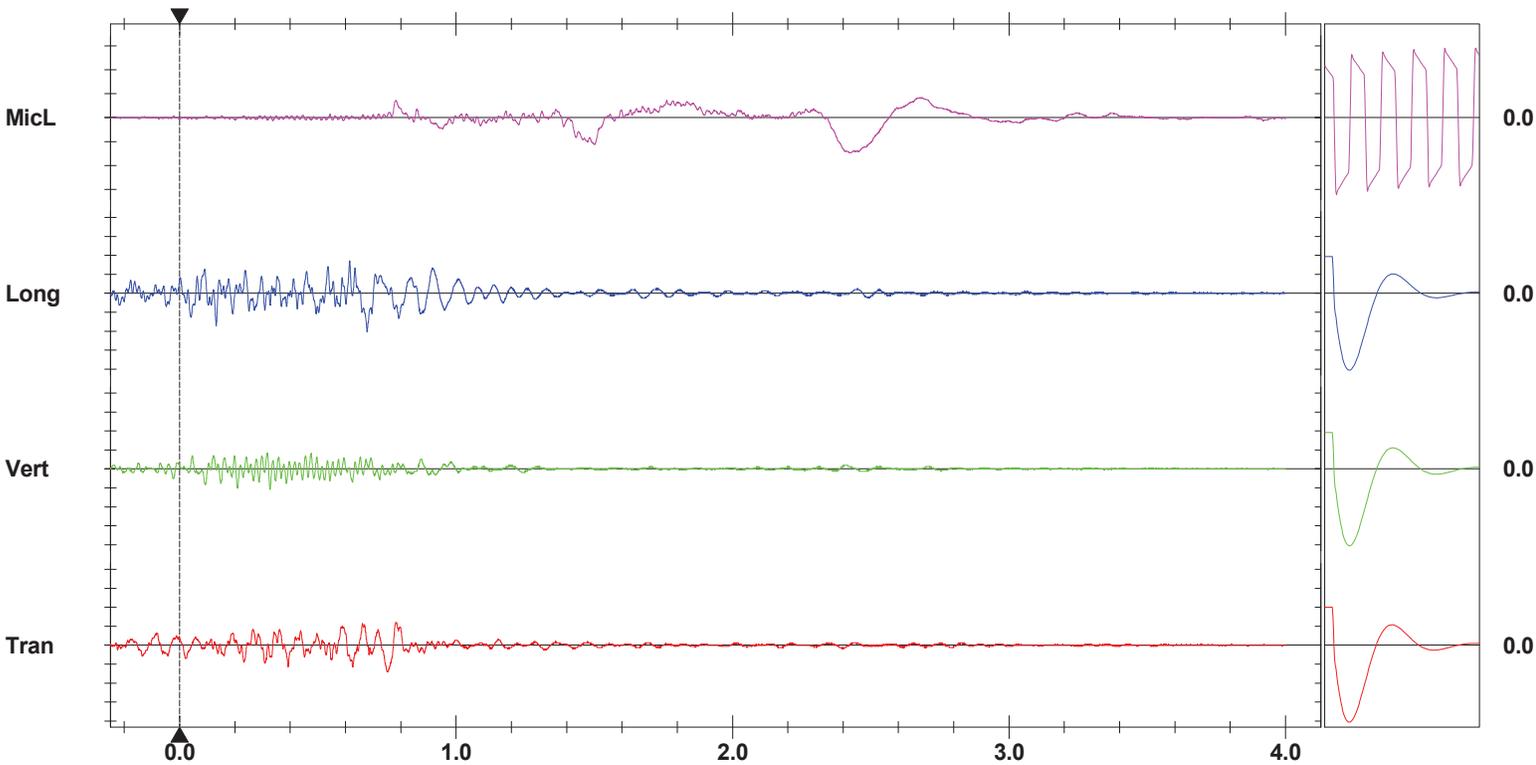
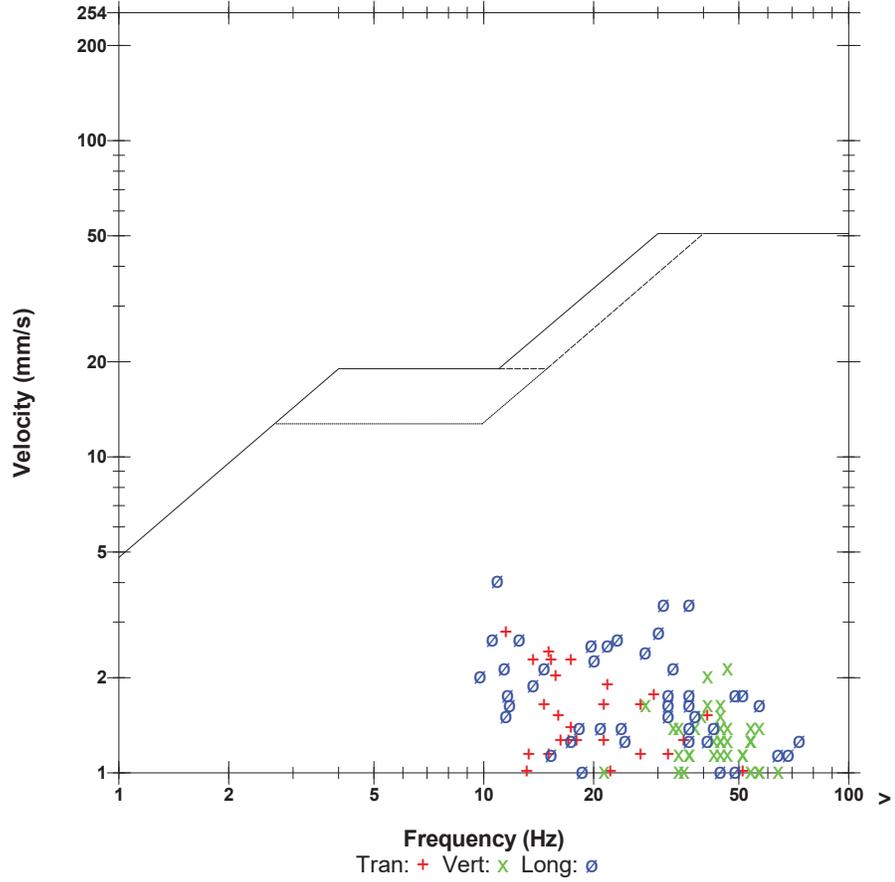
Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 117.4 dB(L) at 2.425 sec  
**ZC Freq** 2.3 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 599 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 2.794  | 2.159  | 4.064  | mm/s |
| ZC Freq             | 11.5   | 47     | 10.9   | Hz   |
| Time (Rel. to Trig) | 0.750  | 0.326  | 0.678  | sec  |
| Peak Acceleration   | 0.053  | 0.080  | 0.106  | g    |
| Peak Displacement   | 0.036  | 0.010  | 0.048  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.5    | 7.3    | 7.2    | Hz   |
| Overswing Ratio     | 3.8    | 3.7    | 4.1    |      |

**Peak Vector Sum** 4.098 mm/s at 0.678 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 12:37:15 September 9, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.012 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.7 Volts  
**Unit Calibration** January 15, 2019 by InstanTEL  
**File Name** UM6857\_20190909123715.IDFW

**Notes**

Location: COLLING RD & BLINDLINE  
 Client: NELSON AGGREGATES  
 User Name: ORICA CANADA  
 General:

**Extended Notes**

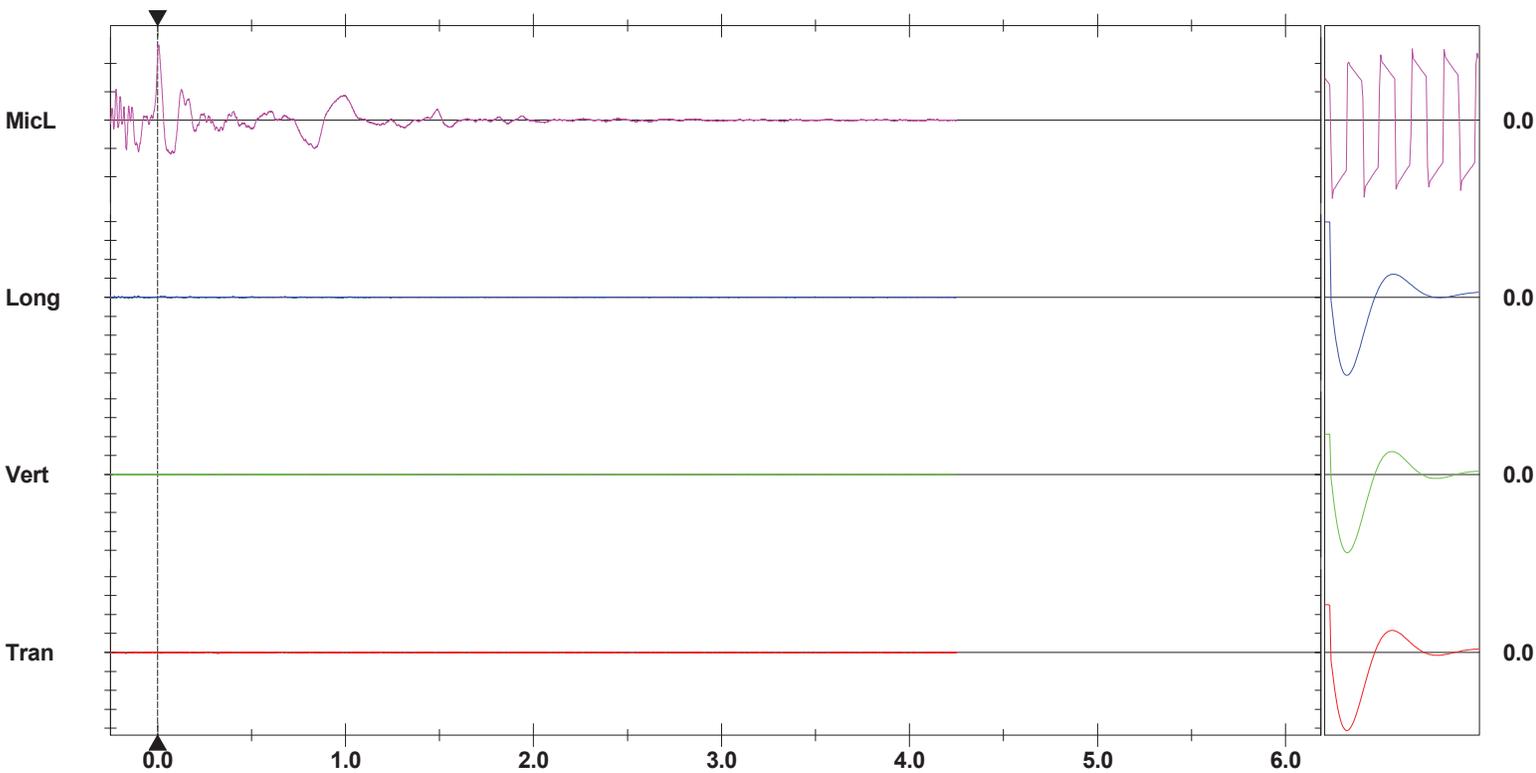
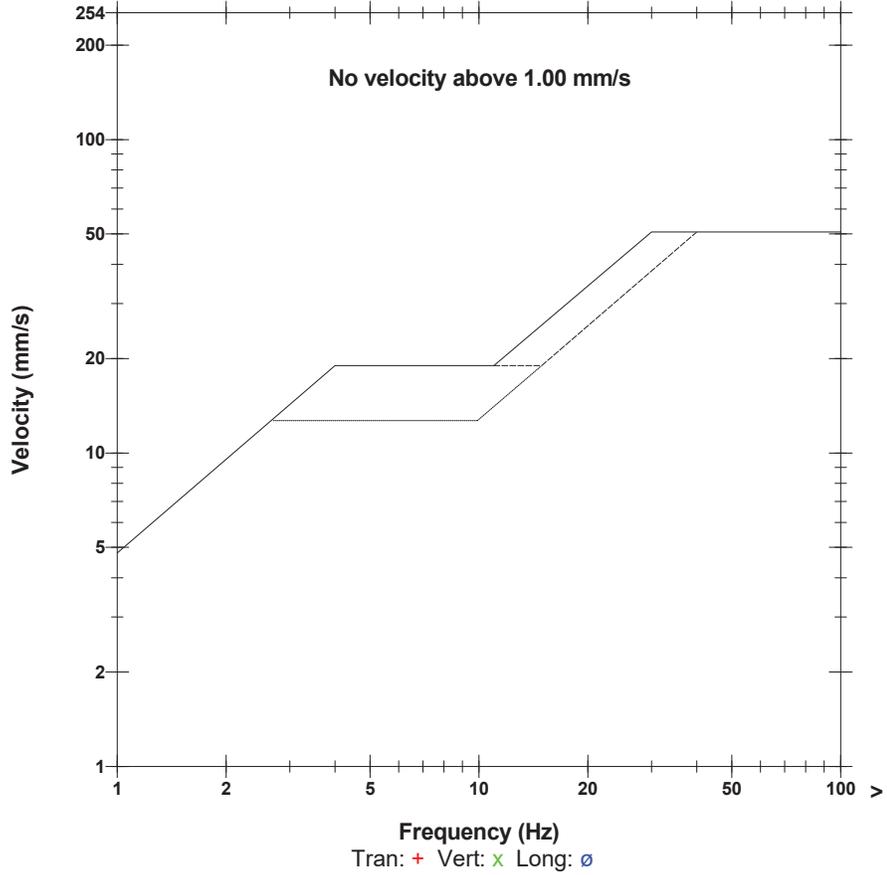
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 116.4 dB(L) at 0.007 sec  
**ZC Freq** 7.0 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1392 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.102  | 0.071  | 0.142  | mm/s |
| ZC Freq             | 9.1    | 20     | 14.0   | Hz   |
| Time (Rel. to Trig) | -0.167 | -0.214 | -0.104 | sec  |
| Peak Acceleration   | 0.010  | 0.010  | 0.010  | g    |
| Peak Displacement   | 0.003  | 0.000  | 0.001  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.3    | Hz   |
| Overswing Ratio     | 3.6    | 3.4    | 3.4    |      |

Peak Vector Sum 0.151 mm/s at -0.104 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Vert at 12:35:20 September 9, 2019  
**Trigger Source** Geo: 10.000 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.25 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.4 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: Gas Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada  
 General: 43.40466,-79.88098

**Extended Notes**

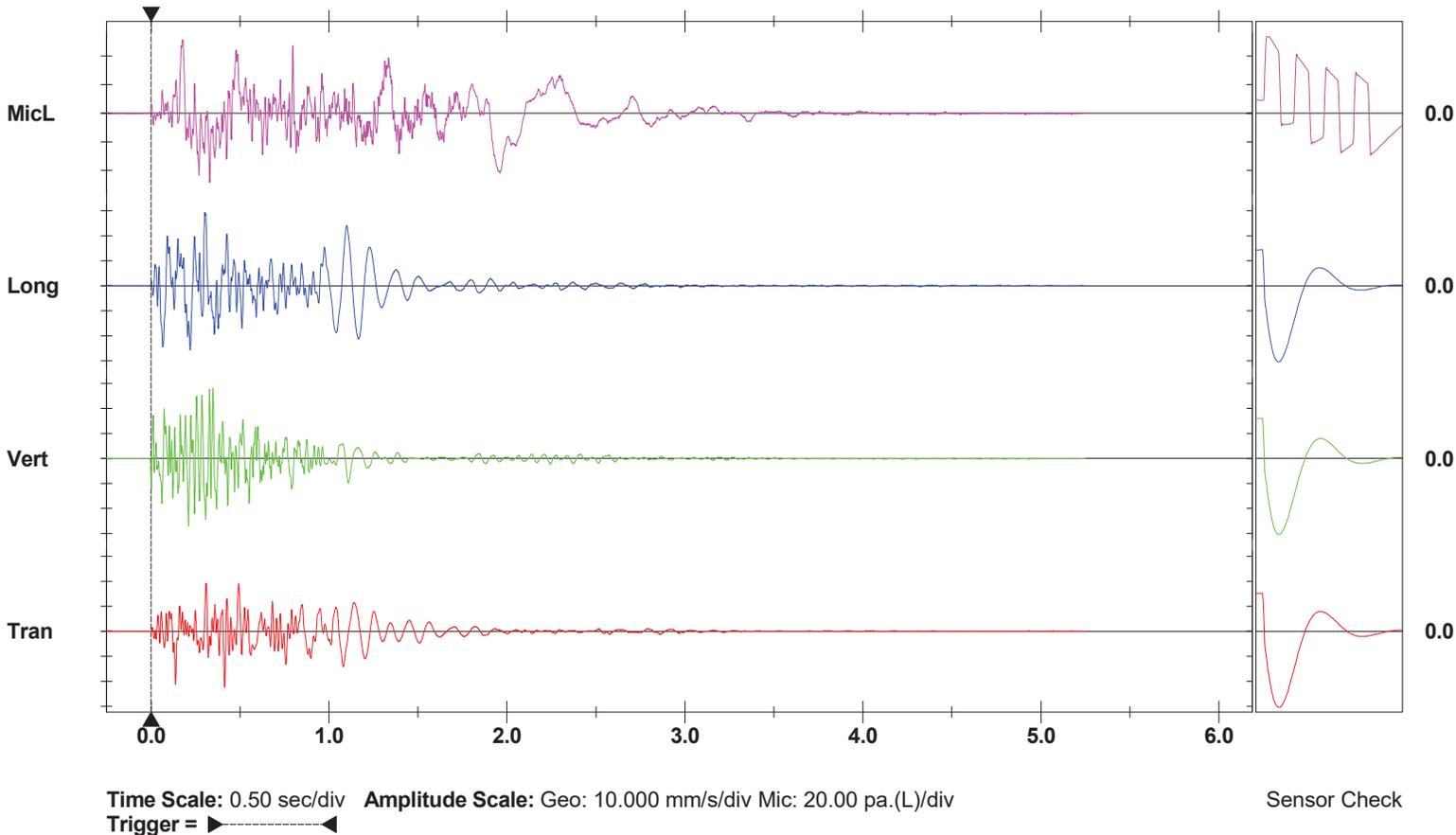
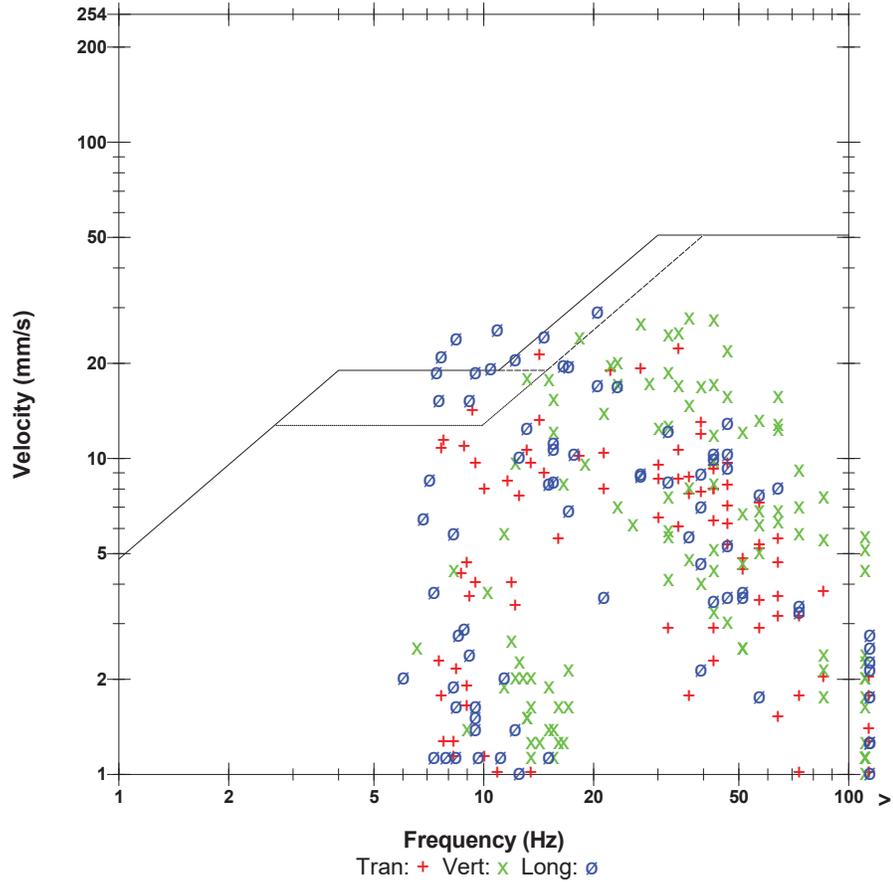
Sand Bagged at gas line

**Microphone** Linear Weighting  
**PSPL** 128.2 dB(L) at 0.177 sec  
**ZC Freq** 16 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 624 mv)

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 22.35  | 28.07  | 29.34  | mm/s |
| ZC Freq             | 34     | 37     | 20     | Hz   |
| Time (Rel. to Trig) | 0.414  | 0.349  | 0.303  | sec  |
| Peak Acceleration   | 0.464  | 0.862  | 0.583  | g    |
| Peak Displacement   | 0.224  | 0.195  | 0.444  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.4    | Hz   |
| Overswing Ratio     | 3.9    | 3.9    | 4.2    |      |

**Peak Vector Sum** 41.10 mm/s at 0.308 sec

**USBM RI8507 And OSMRE**



SHOTPlus Plan

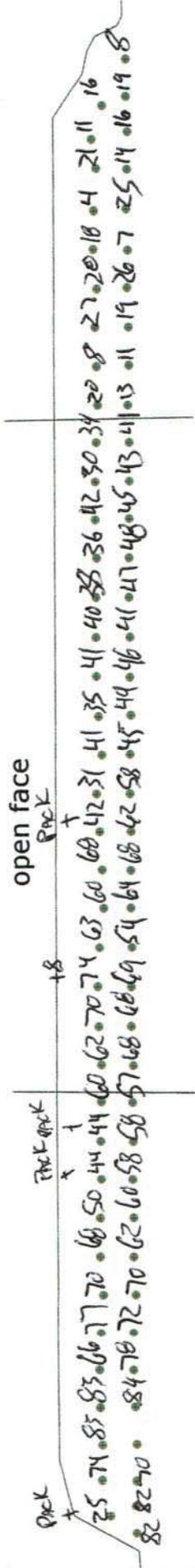
Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 8.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Hole angle: 0.0°  
 Total drilled: 4681.0ft      Subdrill: 2.0ft      Number of holes: 78

2 decks  
 78Kg  
 110kg

2 decks  
 68Kg  
 85kg

3 decks  
 32Kg  
 48Kg  
 48Kg



SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 4681.0ft

Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Number of holes: 78

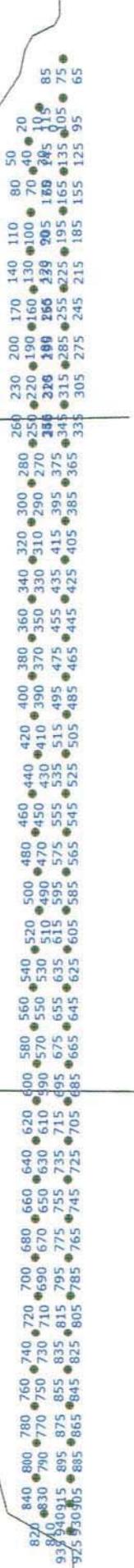
Stemming: 8.0ft  
 Hole angle: 0.0°

2 decks  
 78Kg  
 110kg

2 decks  
 68Kg  
 85kg

3 decks  
 32Kg  
 48Kg  
 48Kg

open face



9MID018 Design Fnl -  
 4" Blast Hole  
 12x10 9x10 271.25 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_



Not to scale

SHOTPLUS Plan

Blast Summary Data  
 Burden: 9.0ft Spacing: 10.0ft Stemming: 8.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 78 Hole angle: 0.0°  
 Total drilled: 4681.0ft

2 decks  
 78Kg  
 110kg

2 decks  
 68Kg  
 85kg

3 decks  
 32Kg  
 48Kg  
 48Kg

open face



9MID018 Design Fnl -  
 4" Blast Hole  
 12x10 9x10 271.25 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_



Not to scale



SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 8.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Hole angle: 0.0°  
 Total drilled: 4681.0ft      Subdrill: 2.0ft      Number of holes: 78

open face



9MID018 Design Fnl - 4" Blast Hole 12x10 9x10 271.25 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_



Scale 1:325

|                                |                    |
|--------------------------------|--------------------|
| SHOTPlus™ Professional 5.7.4.4 | 8/29/2019          |
| Mine                           | Burlington         |
| Location                       | 2 ROW MID WALL     |
| Title/author                   | 9MID018 Design Fnl |
| Filename                       |                    |





# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-09-24

Blast Number: 19-019

Orica Order #: 2534945

Blast Time: 12:05 PM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Middle (Bench / Face)

GPS Coordinates: 43.40405 °N Latitude 79.88154 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 10 kph Temperature: 21 to 25 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 72 = 4,700.4 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg     |
|----------------|---------|----------|--------|
| CENTRA GOLD 70 | 36,500  | 23,730   | 12,770 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 1           | 25 |

### Boosters:

|                            | kg / unit | # used | kg   |
|----------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT)  | 0.34      | 74     | 25.2 |
| PENTEX DUO (OR EQUIVALENT) | 0.45      | 72     | 32.7 |

total explosives weight in Blast (kg): 12,853  
Pkgd Prod (25 kg) % of Total kg: 0.2%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 2      |
| UNITRONIC 600 15M |          |    | 72     |
| UNITRONIC 600 20M |          |    | 54     |
| UNITRONIC 600 25M |          |    | 90     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 7.0  |
| HELPER HOURS          | Enter total Helper man-hours | 13.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 32,416 te 12,468 m<sup>3</sup>  
Total tonnes per day: 32,416 te NB60-16 Rate Code  
Total Holes Loaded: 72 holes  
... including: 3 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 3 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 26 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 46 main body

Bench Height: 63.3 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 65.3 ft avg

### - Stone Decking -

Front Row: 4.0 ft avg

Main Body: 4.0 ft avg

# Decks: 72 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 54.3 ft avg

Main Body: 54.3 ft avg

### - Charge Weight -

Front Row: 158.3 kg/hole

Main Body: 158.3 kg/hole

Max. per delay: 110.0 kg/delay

SD () Equation: 7.5 kg/delay

Total kg Loaded: 12,853 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.396 kg/te (actual)

Front row: 0.283 kg/te (theoretical)

Main Body: 0.377 kg/te (theoretical)

"KPI" PF: 0.346 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.738 lb/yd<sup>3</sup>  
1.241 lb/yd<sup>3</sup>  
1.654 lb/yd<sup>3</sup>  
1.516 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

We had to use 2 unitronics per dou booster due to shortage of 25M Excel ms 25ms



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 2019-09-24

Blast Number: 19-019  
 Orica Order #: 2534945  
 Blast Time: 12:05 PM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40407       | 79.88154        | 0.757544    | 1.394196    |
| Front Row Corner          | 43.40376       | 79.88161        | 0.757538    | 1.394197    |
| Back Row Corner           | 43.40432       | 79.88148        | 0.757548    | 1.394195    |
| Average (Centre of Blast) | 43.40405       | 79.88154        | 0.757544    | 1.394196    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 327.9                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 6.7                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 16.5         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 116.7 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                           |                 |                     |                                        |
| Average                                   | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1324.1                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |

Blind Line and Colling Road (Bruce Trail Entrance)

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 81.9                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: 37.3               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 30.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 131.9 | dB              | Trigger set at: 115 | dB                                     |

Gas Line

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(81.9)^2}{30^2} \text{ kg} \\
 &= \frac{6,708}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

jim bray

Signature required, indicating that  
 Blast Report is Complete & Accurate.



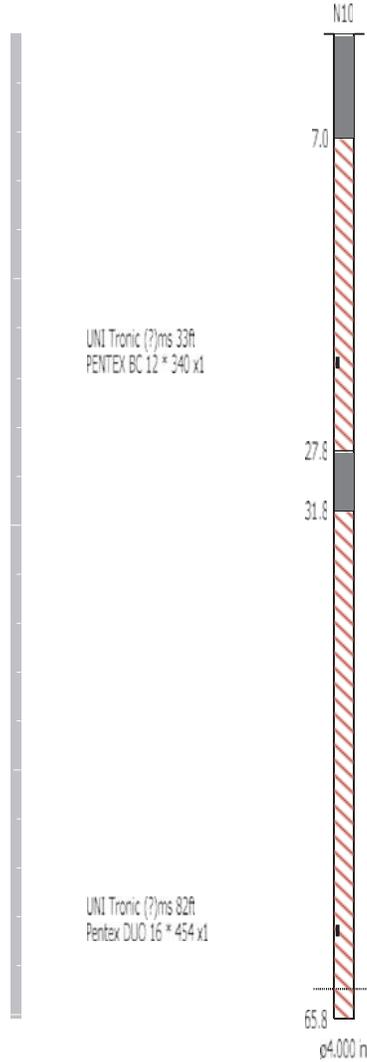
**Blast Design**  
Nelson Aggregate

Quarry: Burlington  
P.O. #:   
Blast Date: 9/9/2019

Blast Number: 19-019  
Orica Order #: 2534945

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**  
Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 12:06:02 September 24, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.0 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 #2 road, Burlington  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

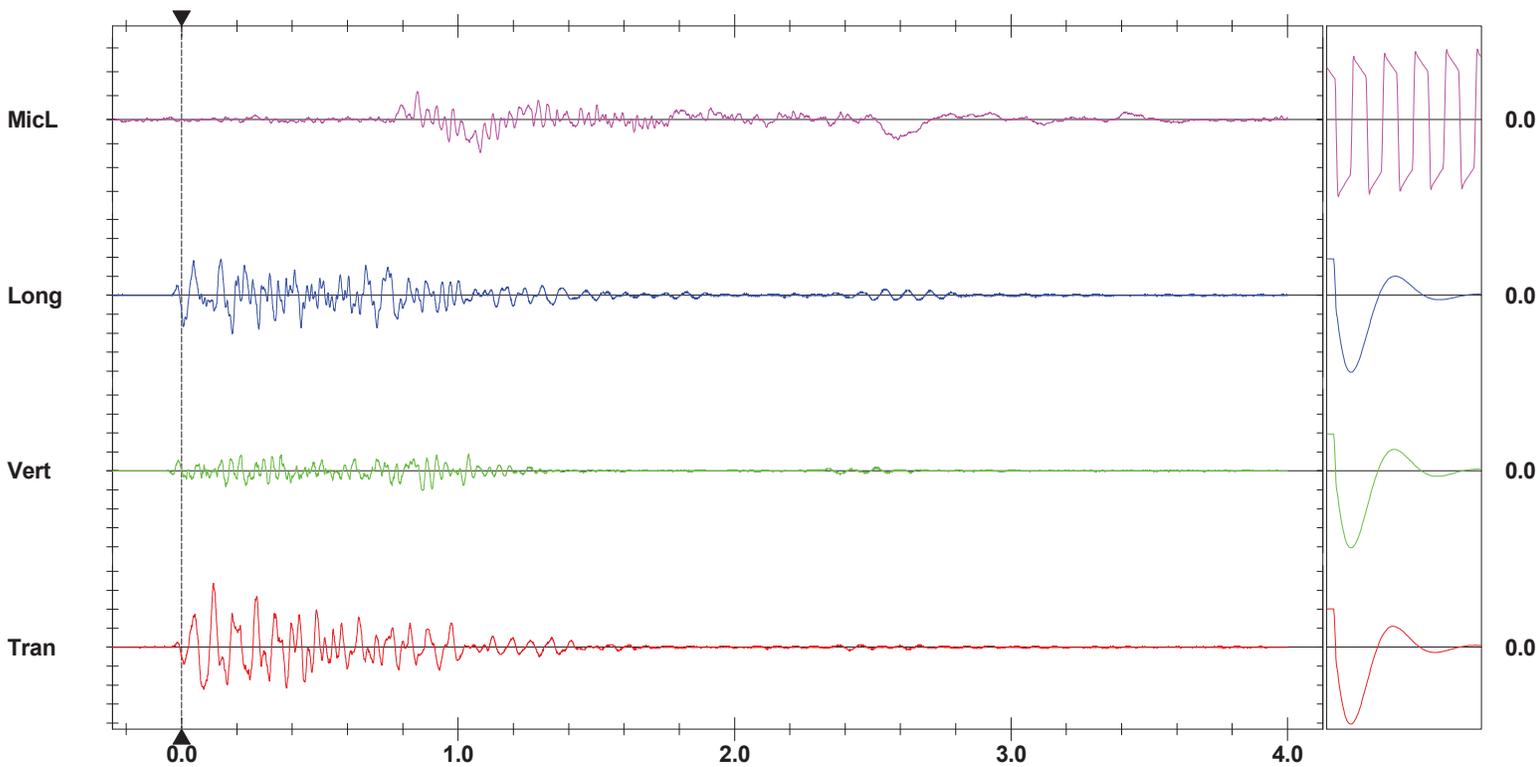
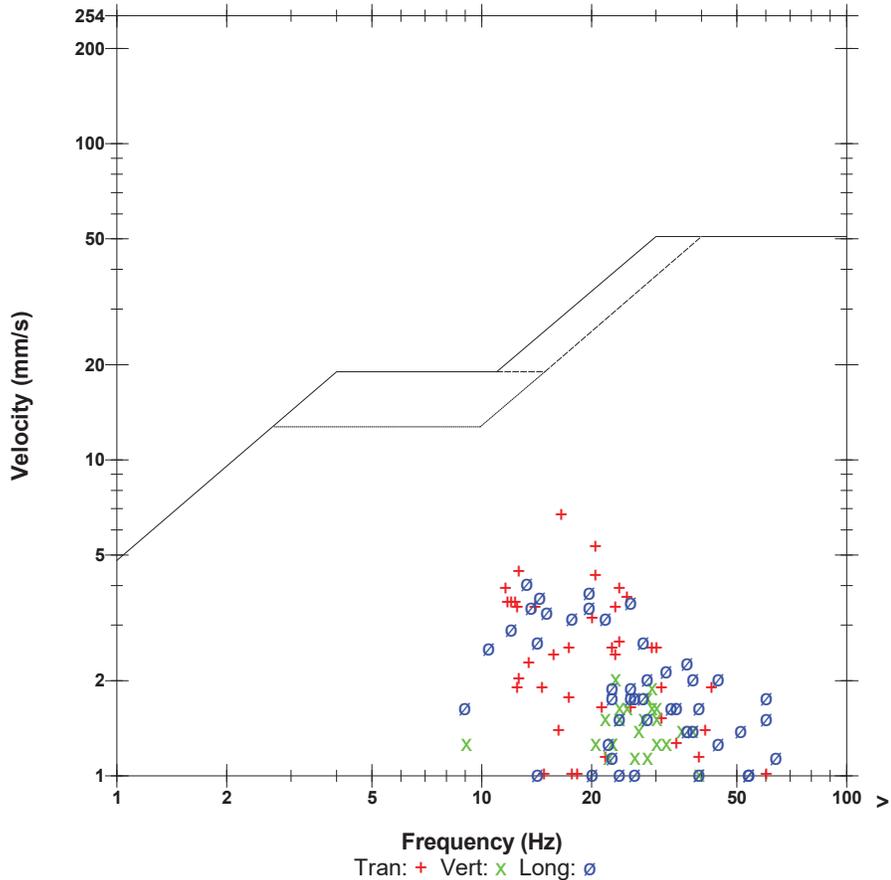
Sand Bagged  
 N43.40245 W-79.87814

**Microphone** Linear Weighting  
**PSPL** 116.7 dB(L) at 1.080 sec  
**ZC Freq** 3.8 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 570 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 6.731  | 2.032  | 4.064  | mm/s |
| ZC Freq             | 16.5   | 23     | 13.3   | Hz   |
| Time (Rel. to Trig) | 0.114  | 0.869  | 0.184  | sec  |
| Peak Acceleration   | 0.106  | 0.080  | 0.106  | g    |
| Peak Displacement   | 0.063  | 0.018  | 0.039  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.5    | 7.4    | 7.2    | Hz   |
| Overswing Ratio     | 3.8    | 3.7    | 4.1    |      |

**Peak Vector Sum** 6.901 mm/s at 0.116 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Blind Line & Colling rd  
Nelson Aggregate  
Burlington 2019-09-24 Blast 19-019 Middle**

**Event Report: Monitor Log - Micromate ISEE # UM6857-Compliance**

| Start Time                   | End Time                     | Status                                                                                                                                              |
|------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| -----<br>Sep 24 /19 06:03:57 | -----<br>Sep 24 /19 13:17:31 | SERIAL NUMBER: UM6857<br>Start Monitoring Waveform Geo: 2.00 mm/s Mic: 115.0 dB<br>No events recorded. (Keyboard Exit) Waveform Geo: 2.00 mm/s Mic: |

**Date/Time** Long at 12:06:01 September 24, 2019  
**Trigger Source** Geo: 10.000 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.25 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.3 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

**Location:** Gas Line  
**Client:** Nelson Aggregates  
**User Name:** Orica Canada  
**General:** 43.40466,-79.88098

**Extended Notes**

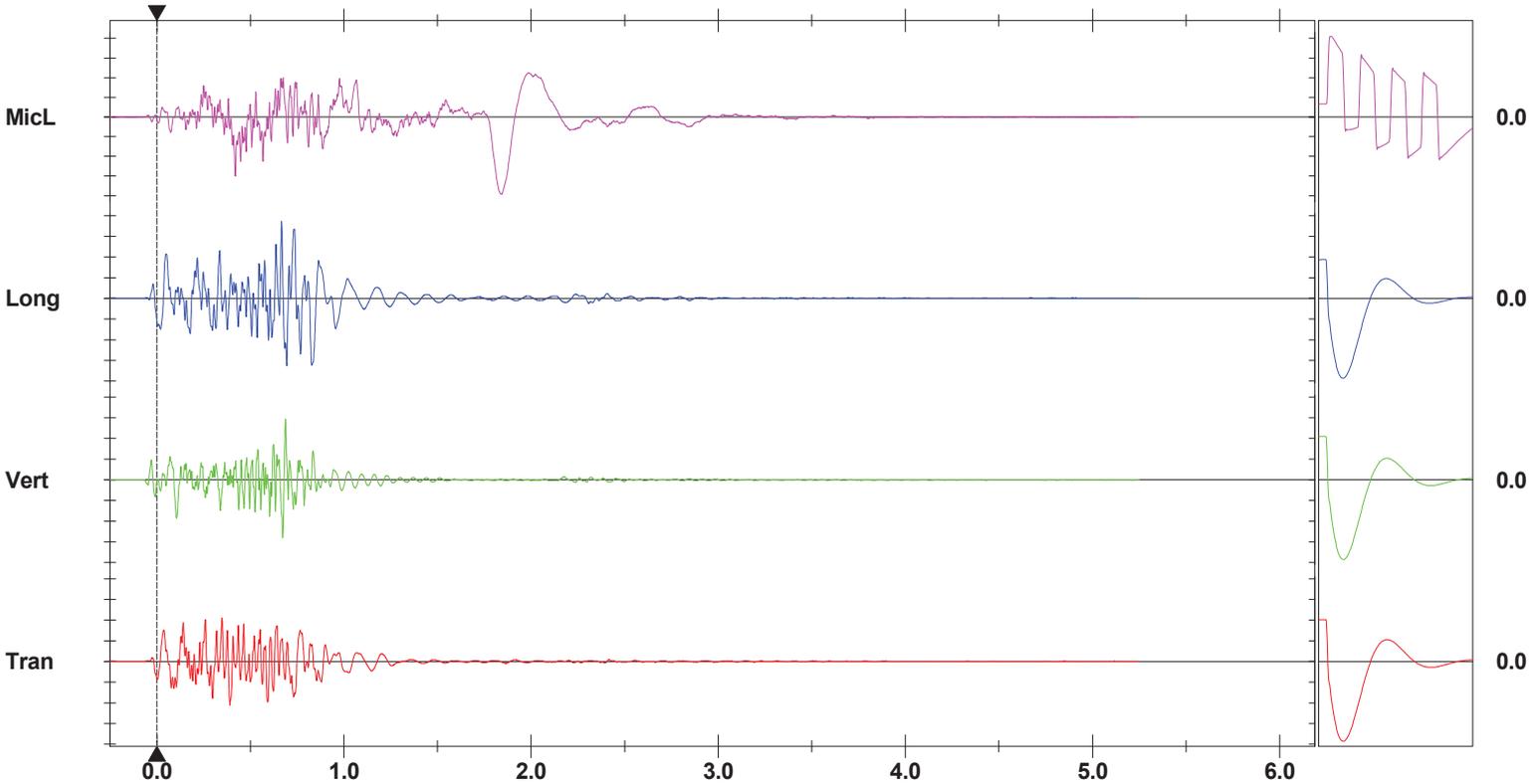
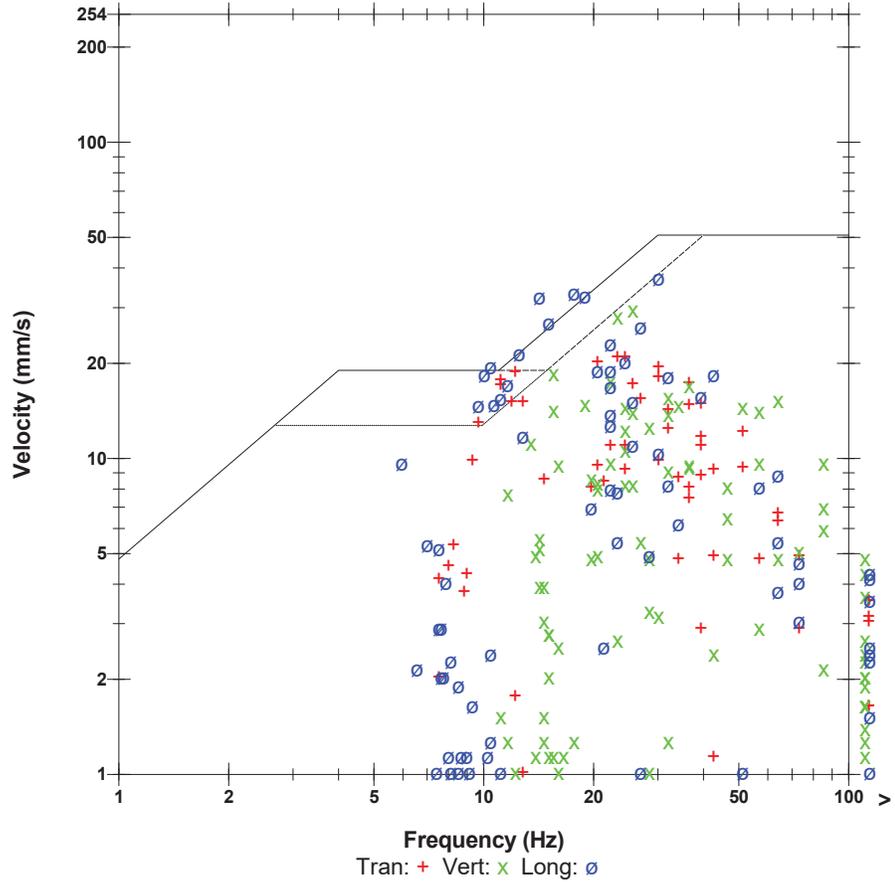
Sand Bagged at gas line

**Microphone** Linear Weighting  
**PSPL** 131.9 dB(L) at 1.840 sec  
**ZC Freq** 3.5 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 611 mv)

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 21.08  | 29.46  | 37.34  | mm/s |
| ZC Freq             | 24     | 26     | 30     | Hz   |
| Time (Rel. to Trig) | 0.349  | 0.688  | 0.667  | sec  |
| Peak Acceleration   | 0.490  | 0.742  | 0.623  | g    |
| Peak Displacement   | 0.235  | 0.167  | 0.378  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.3    | Hz   |
| Overswing Ratio     | 3.7    | 3.7    | 4.1    |      |

**Peak Vector Sum** 42.02 mm/s at 0.667 sec

**USBM RI8507 And OSMRE**



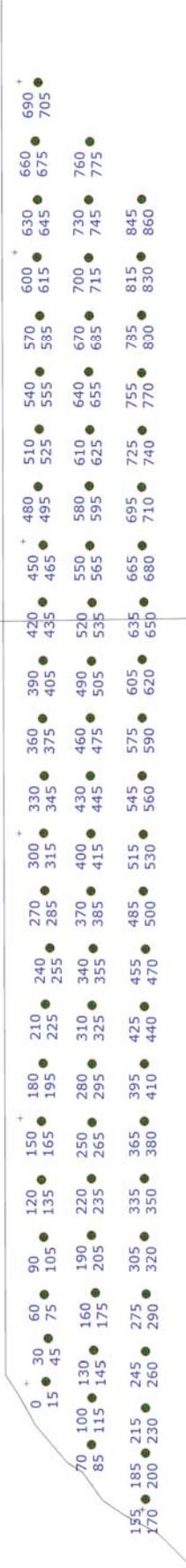
**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 10.000 mm/s/div Mic: 20.00 pa.(L)/div  
**Trigger =**

Sensor Check

SHOTPlus Plan

Blast Summary Data  
 Burden: 9.0ft Spacing: 10.0ft Subdrill: 2.0ft Stemming: 8.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 72 Hole angle: 0.0°  
 Total drilled: 4700.5ft

82Kg/delay 25M/25M 20M/18M,ms  
 110Kg/delay 15M/15M,ms 15M/15M,ms  
 open face 85Kg/Delay 85Kg/Delay



9MID019 Design Fnl - 4" Blast Hole 12x10 9x10 271 266 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_



Not to scale

SHOTPlus Plan

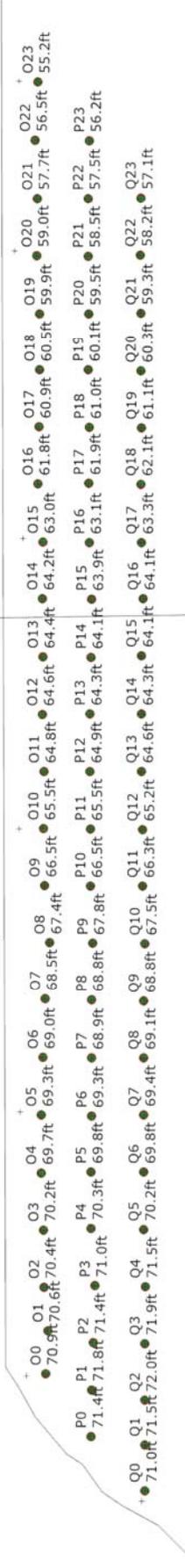
| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 8.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 72 | Hole angle: 0.0° |
| Total drilled: 4700.5ft |                      |                     |                  |

82Kg/delay  
110Kg/delay

25M/25M  
15M/15M,ms  
open face

85Kg/Delay  
85Kg/Delay

20M/18M,ms  
15M/15M,ms



9MID019 Design Fnl - 4" Blast Hole 12x10 9x10 271 266 and 250 + .6 SUB ELEV  
DRILLER NAME: \_\_\_\_\_



Not to scale



Not to scale



85kg/Delay  
85kg/Delay

open face  
82kg/delay  
110kg/delay

SHOTPlus Plan  
Blast Summary Data

|                        |                         |                      |                     |                 |                  |
|------------------------|-------------------------|----------------------|---------------------|-----------------|------------------|
| Burden: 9.0ft          | Spacing: 10.0ft         | Hole Diameter: 4.0in | Subdrill: 2.0ft     | Stemming: 8.0ft | Hole angle: 0.0° |
| 1st row burden: 12.0ft | Total drilled: 4700.5ft |                      | Number of holes: 72 |                 |                  |





# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-09-30

Blast Number: 19-020

Orica Order #: 2537318

Blast Time: 11:56 AM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Middle (Bench / Face)

GPS Coordinates: 43.40469 °N Latitude 79.88146 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: NE at 15 kph Temperature: 16 to 20 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 64 = 3,370.0 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 27,320  | 20,030   | 7,290 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 0           | 50 |

### Boosters:

|                            | kg / unit | # used | kg   |
|----------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT)  | 0.34      | 65     | 22.1 |
| PENTEX DUO (OR EQUIVALENT) | 0.45      | 64     | 29.1 |

total explosives weight in Blast (kg): 7,391

Pkgd Prod (50 kg) % of Total kg: 0.7%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 6M  |          |    | 1      |
| UNITRONIC 600 9M  |          |    | 64     |
| UNITRONIC 600 15M |          |    | 64     |
| UNITRONIC 600 20M |          |    | 64     |
| EXEL MS 15m       |          |    | 64     |
| EXEL MS 18m       |          |    | 64     |

### Cord & Accessories:

|  | U of M | # used |
|--|--------|--------|
|  | units  |        |
|  | units  |        |
|  | units  |        |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.0  |
| HELPER HOURS          | Enter total Helper man-hours | 12.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 24,167 te 9,295 m<sup>3</sup>  
Total tonnes per day: 24,167 te NB60-17 Rate Code  
Total Holes Loaded: 64 holes  
... including: 0 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 3 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 24 front row

### - Pattern (Main Body) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 40 main body

Bench Height: 50.7 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 52.7 ft avg

### - Stone Decking -

Front Row: 4.0 ft avg

Main Body: 4.0 ft avg

# Decks: 128 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 41.7 ft avg

Main Body: 41.7 ft avg

### - Charge Weight -

Front Row: 121.5 kg/hole

Main Body: 121.5 kg/hole

Max. per delay: 40.0 kg/delay

SD () Equation: 1.7 kg/delay

Total kg Loaded: 7,391 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.306 kg/te (actual)

Front row: 0.271 kg/te (theoretical)

Main Body: 0.362 kg/te (theoretical)

"KPI" PF: 0.332 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.340 lb/yd<sup>3</sup>

1.189 lb/yd<sup>3</sup>

1.586 lb/yd<sup>3</sup>

1.454 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

64 Addition decks on top of rate code



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 2019-09-30

Blast Number: 19-020  
 Orica Order #: 2537318  
 Blast Time: 11:56 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40469       | 79.88146        | 0.757555    | 1.394195    |
| Front Row Corner          | 43.40444       | 79.88153        | 0.757550    | 1.394196    |
| Back Row Corner           | 43.40493       | 79.88140        | 0.757559    | 1.394193    |
| Average (Centre of Blast) | 43.40469       | 79.88146        | 0.757555    | 1.394195    |

| 1st Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 366.2                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 2.8                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 26.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 111.8 | dB              | Trigger set at: 115 | dB                                     |
| 2450 2nd Line                             |                         |                 |                     |                                        |

| 2nd Seismograph Co-ordinates                       | Enter ° N Lat.            | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|----------------------------------------------------|---------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                                        | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                                        |                           |                 |                     |                                        |
| Average                                            | 43.39339                  | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast)          | 1390.6                    | m               |                     |                                        |
| Post Blast Data:                                   | ppV: Did                  | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                                    | frequency: Not            | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                                    | air overpressure: Trigger | dB              | Trigger set at: 115 | dB                                     |
| Blind Line and Colling Road (Bruce Trail Entrance) |                           |                 |                     |                                        |

| 3rd Seismograph Co-ordinates              | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 39.3                    | m               |                     |                                        |
| Post Blast Data:                          | ppV: 30.4               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 20.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 129.9 | dB              | Trigger set at: 115 | dB                                     |
| Gas Line                                  |                         |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(39.3)^2}{30^2} \text{ kg} \\
 &= \frac{1,544}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington

P.O. #:

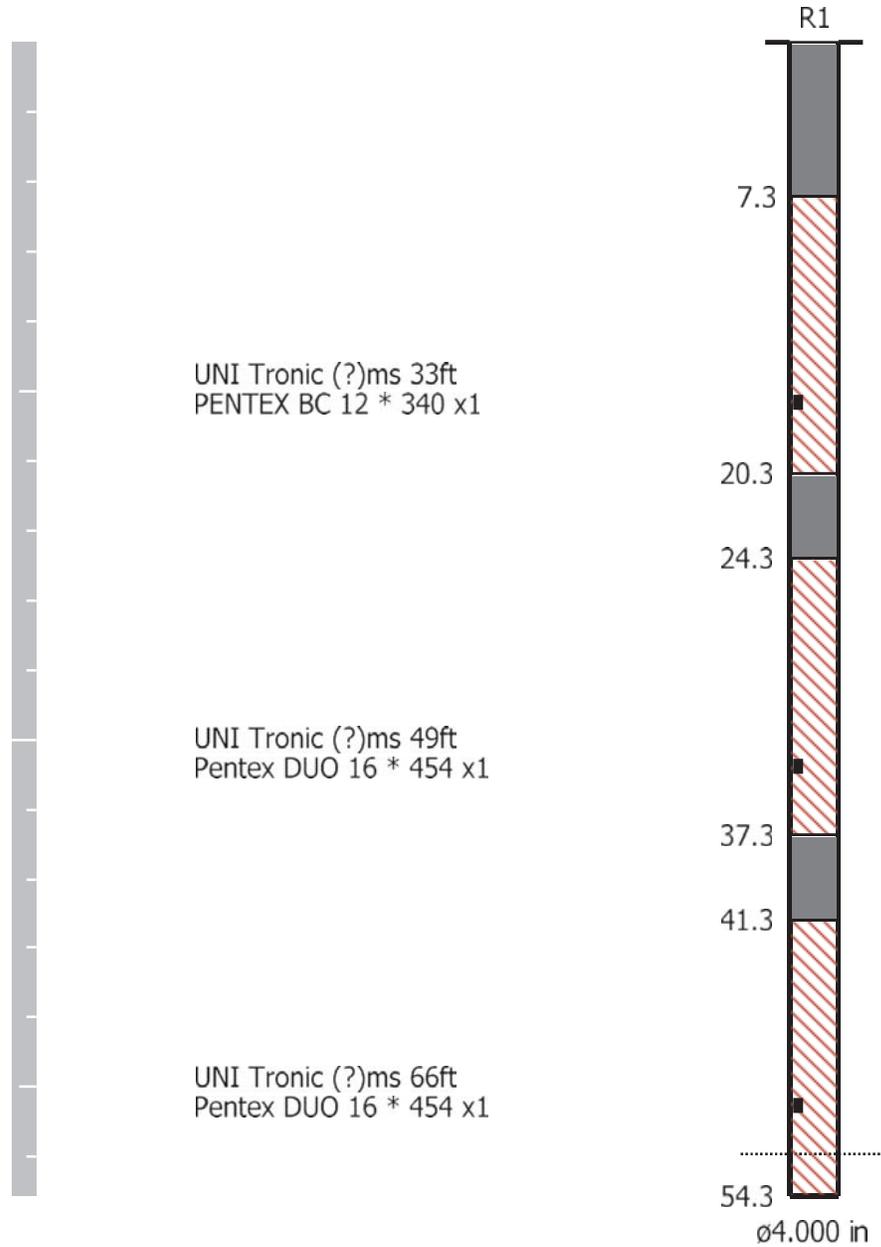
Blast Date: 9/30/2019

Blast Number: 19-020

Orica Order #: 2537318

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Vert at 11:56:54 September 30, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.0 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.2 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 #2 road, Burlington  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

Sand Bagged  
 N43.40245 W-79.87814

**Microphone** Linear Weighting

**PSPL** 111.8 dB(L) at 0.757 sec

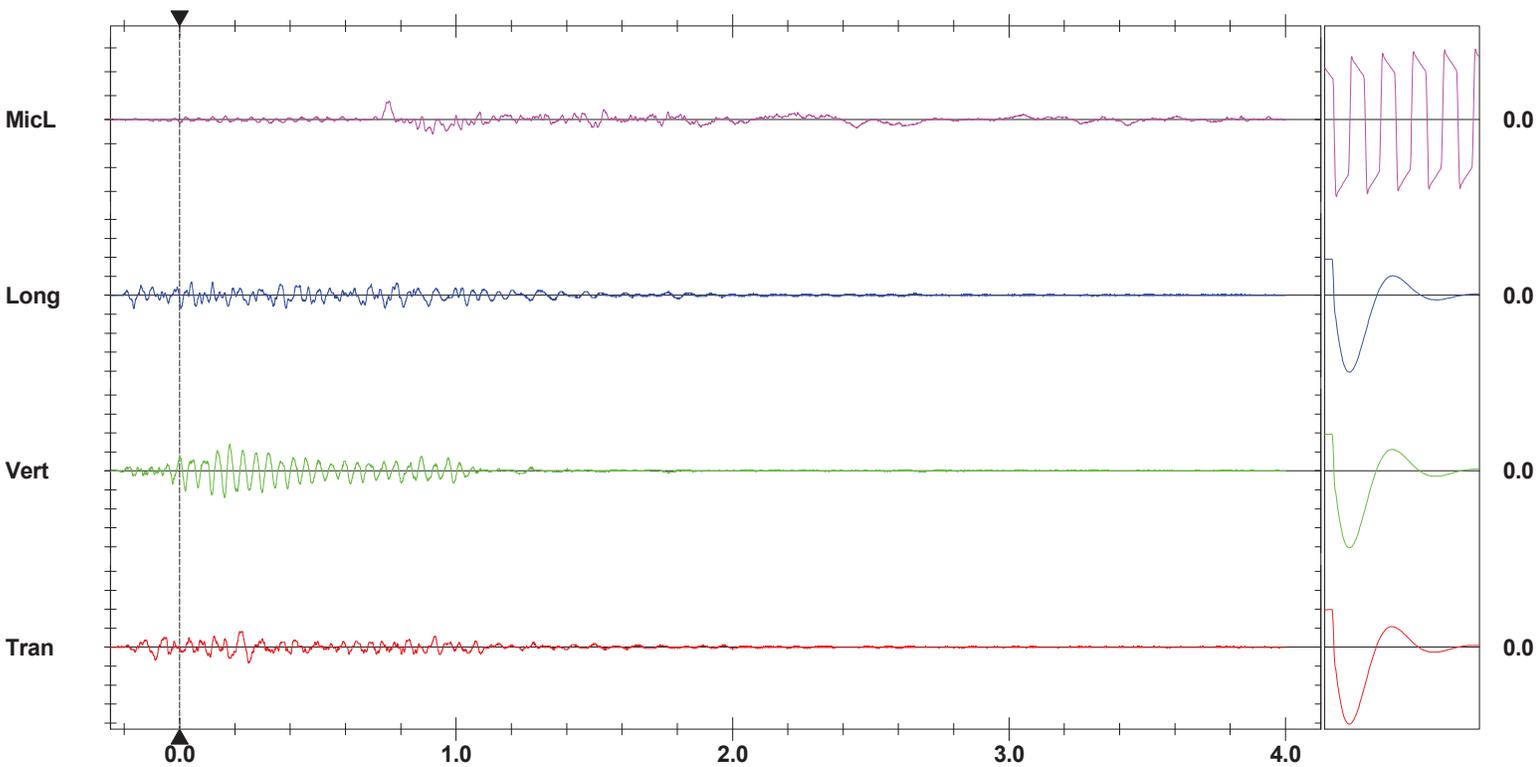
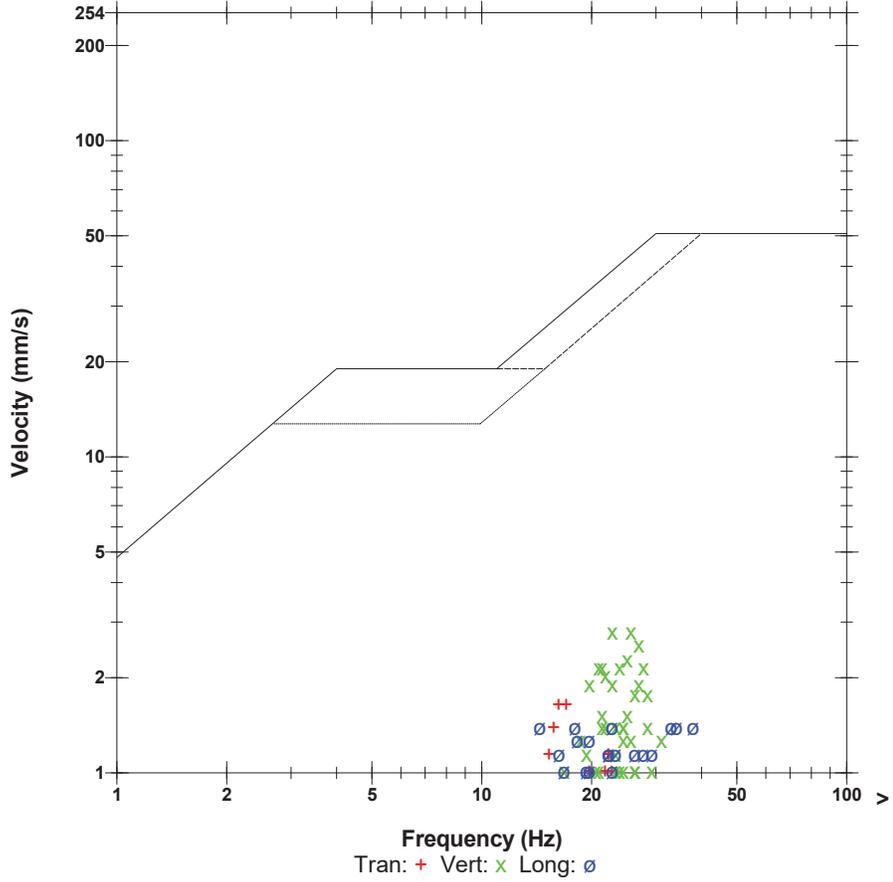
**ZC Freq** 10.8 Hz

**Channel Test** Passed (Freq = 20.1 Hz Amp = 574 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 1.651  | 2.794  | 1.397  | mm/s |
| ZC Freq             | 16.3   | 26     | 18.0   | Hz   |
| Time (Rel. to Trig) | 0.216  | 0.161  | -0.167 | sec  |
| Peak Acceleration   | 0.053  | 0.080  | 0.053  | g    |
| Peak Displacement   | 0.018  | 0.019  | 0.012  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.4    | 7.3    | Hz   |
| Overswing Ratio     | 3.8    | 3.7    | 4.0    |      |

**Peak Vector Sum** 3.113 mm/s at 0.181 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Blind Line & Colling road  
Burlington  
Burlington 2019-09-30 Blast 19-020 Middle**

**Event Report: Monitor Log - Micromate ISEE # UM6857-Compliance**

| Start Time                   | End Time            | Status                                                                          |
|------------------------------|---------------------|---------------------------------------------------------------------------------|
| -----<br>Sep 30 /19 06:17:01 | -----               | SERIAL NUMBER: UM6857<br>Start Monitoring Waveform Geo: 2.00 mm/s Mic: 115.0 dB |
| Sep 30 /19 10:16:29          | Sep 30 /19 10:16:34 | Event recorded. Trigger Level MicL: 115.0 dB                                    |
| Sep 30 /19 10:16:34          | Sep 30 /19 12:25:24 | Event recorded. (Keyboard Exit) Waveform Geo: 2.00 mm/s Mic: 115.               |

**Date/Time** Vert at 11:56:52 September 30, 2019  
**Trigger Source** Geo: 10.000 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.25 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.3 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_TEMP.EVT

### Notes

**Location:** Gas Line  
**Client:** Nelson Aggregates  
**User Name:** Orica Canada  
**General:** 43.40466,-79.88098

### Extended Notes

Sand Bagged at gas line

**Microphone** Linear Weighting

**PSPL** 129.9 dB(L) at 0.182 sec

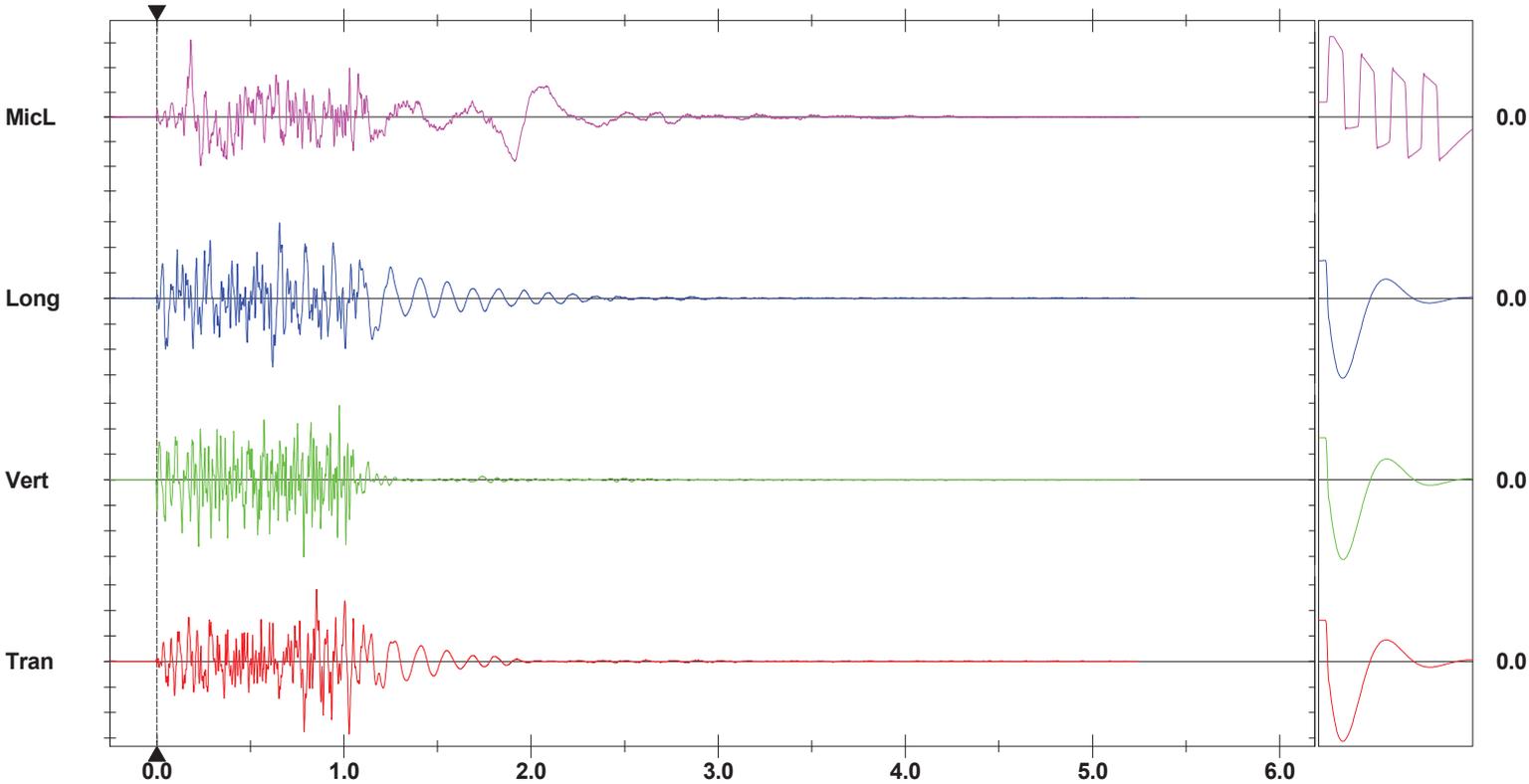
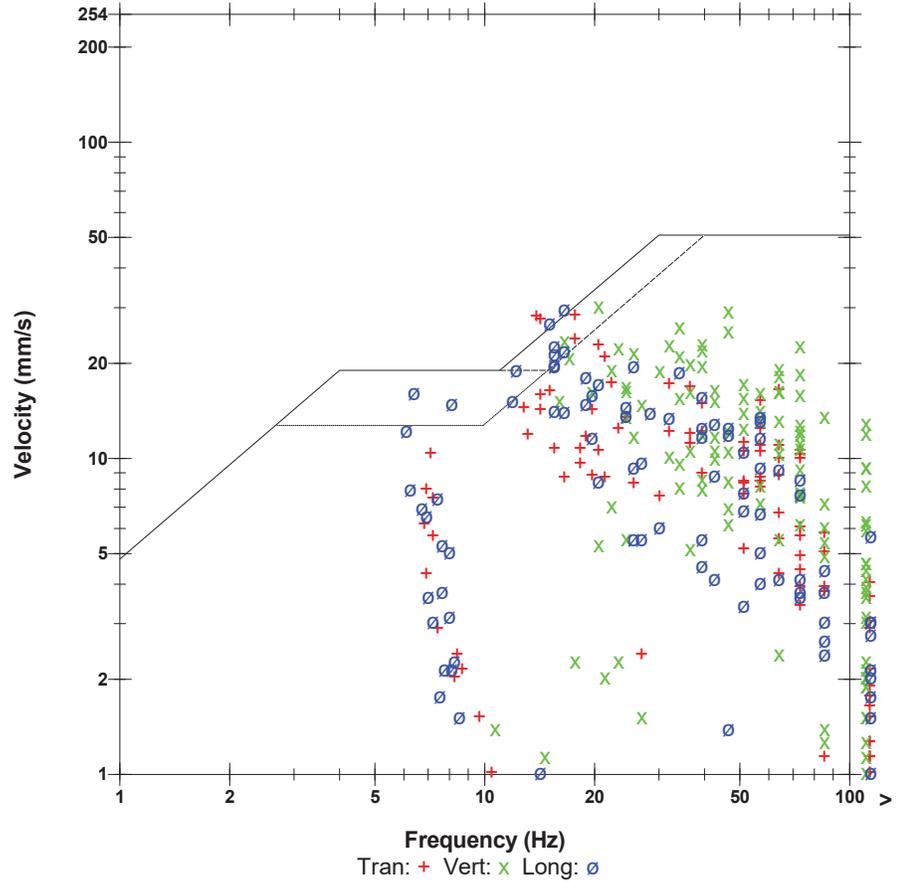
**ZC Freq** 10 Hz

**Channel Test** Passed (Freq = 20.1 Hz Amp = 644 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 28.57  | 30.35  | 29.72  | mm/s |
| ZC Freq             | 18     | 20     | 17     | Hz   |
| Time (Rel. to Trig) | 1.027  | 0.785  | 0.656  | sec  |
| Peak Acceleration   | 0.610  | 1.418  | 0.663  | g    |
| Peak Displacement   | 0.246  | 0.144  | 0.403  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.3    | 7.3    | Hz   |
| Overswing Ratio     | 3.7    | 3.9    | 4.2    |      |

**Peak Vector Sum** 40.18 mm/s at 0.787 sec

### USBM RI8507 And OSMRE

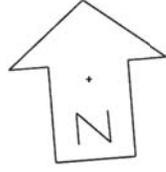


**Time Scale:** 0.50 sec/div    **Amplitude Scale:** Geo: 10.000 mm/s/div Mic: 20.00 pa.(L)/div  
**Trigger =**

Sensor Check

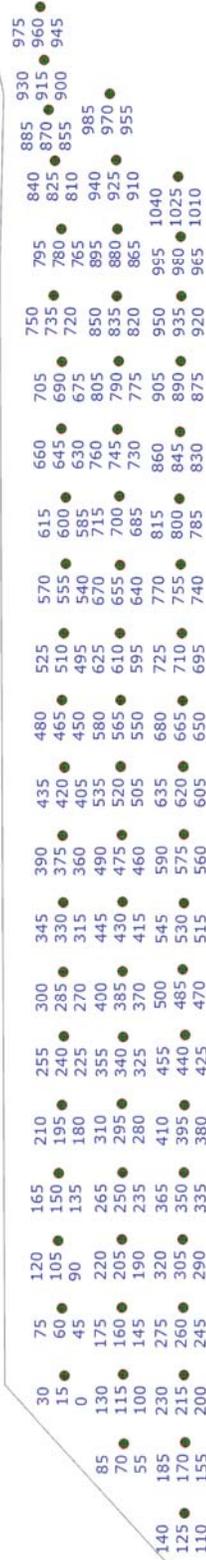
SHOTPLUS Plan

| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 8.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 73 | Hole angle: 0.0° |
| Total drilled: 4105.8ft |                      |                     |                  |



POSTS

open face



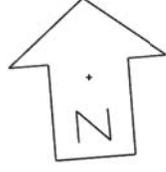
9MID020 Design Fnl - 4" Blast Hole 12x10 9x10 266 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_



Not to scale

SHOTPlus Plan

| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 8.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 73 | Hole angle: 0.0° |
| Total drilled: 4105.8ft |                      |                     |                  |

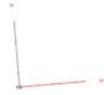


open face

POSTS

- R1 ● 52.3ft ● R2 ● 52.3ft ● R3 ● 52.1ft ● R4 ● 52.1ft ● R5 ● 51.7ft ● R6 ● 51.7ft ● R7 ● 51.6ft ● R8 ● 51.8ft ● R9 ● 51.8ft ● R10 ● 51.8ft ● R11 ● 51.7ft ● R12 ● 52.1ft ● R13 ● 52.2ft ● R14 ● 52.5ft ● R15 ● 52.5ft ● R16 ● 53.2ft ● R17 ● 53.2ft ● R18 ● 53.3ft ● R19 ● 53.5ft ● R20 ● 54.0ft ● R21 ● 54.9ft ● R22 ● 54.7ft
- S1 ● 52.7ft ● S2 ● 52.3ft ● S3 ● 51.9ft ● S4 ● 51.5ft ● S5 ● 51.4ft ● S6 ● 51.7ft ● S7 ● 52.3ft ● S8 ● 52.6ft ● S9 ● 52.3ft ● S10 ● 51.8ft ● S11 ● 51.8ft ● S12 ● 52.0ft ● S13 ● 52.2ft ● S14 ● 52.4ft ● S15 ● 52.5ft ● S16 ● 52.6ft ● S17 ● 53.0ft ● S18 ● 53.6ft ● S19 ● 53.8ft ● S20 ● 53.3ft ● S21 ● 55.1ft
- T1 ● 53.5ft ● T2 ● 52.6ft ● T3 ● 52.2ft ● T4 ● 51.9ft ● T5 ● 51.3ft ● T6 ● 51.7ft ● T7 ● 52.1ft ● T8 ● 52.8ft ● T9 ● 52.6ft ● T10 ● 52.2ft ● T11 ● 51.7ft ● T12 ● 51.6ft ● T13 ● 52.0ft ● T14 ● 52.2ft ● T15 ● 52.3ft ● T16 ● 52.2ft ● T17 ● 52.5ft ● T18 ● 53.3ft ● T19 ● 54.0ft ● T20 ● 53.6ft ● T21 ● 53.3ft

9MID020 Design Fnl - 4" Blast Hole 12x10 9x10 266 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_



Not to scale



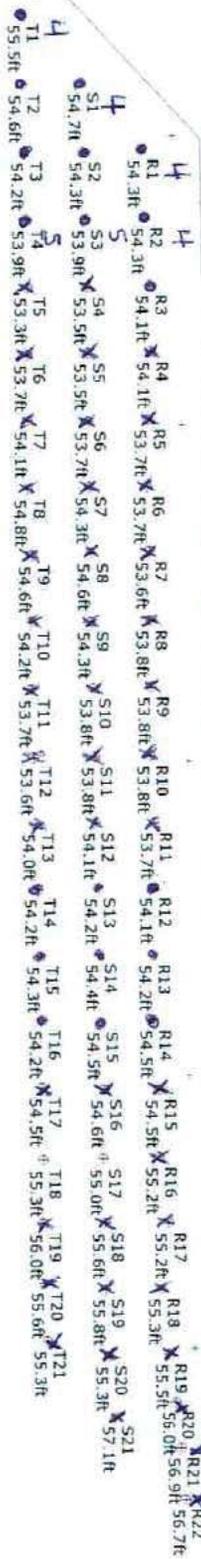
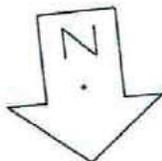
SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 8.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 64      Hole angle: 0.0°  
 Total drilled: 3489.7ft

open face

POSTS



9MID020 Design Fnl - 4" Blast Hole 12x10 9x10 266 and 250 + .6 SUB ELEV  
 DRILLER NAME: \_\_\_\_\_

10-543,8



Scale 1:350

|                                |                    |
|--------------------------------|--------------------|
| SHOTPlus™ Professional 5.7.4.4 | 9/11/2019          |
| Mine                           | Burlington         |
| Location                       | NORTH CLOSED END   |
| Title/author                   | 9MID020 Design Fnl |
| Filename                       |                    |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-10-15

Blast Number: 19-021

Orica Order #: 2543361

Blast Time: 11:55 AM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40362 °N Latitude 79.88148 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: S at 5 kph Temperature: 11 to 15 °C

Clear:  Rain:  Overcast:   
Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

|                             | Angle from Vertical | Nominal Bit Diameter:                 |
|-----------------------------|---------------------|---------------------------------------|
| Primary Bit diam: 101.6 mm  | 0°                  | # Holes: 56 = 3,832.6 ft ( 4 " diam)  |
| Secondary Bit diam: 92.1 mm |                     | # Holes: 3 = 205.3 ft ( 3 5/8 " diam) |
| Tertiary Bit diam: mm       |                     | # Holes: = 0.0 ft ( " diam)           |

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 33,740  | 24,140   | 9,600 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 1           | 25 |

### Boosters:

|                            | kg / unit | # used | kg   |
|----------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT)  | 0.34      | 56     | 19.0 |
| PENTEX DUO (OR EQUIVALENT) | 0.45      | 54     | 24.5 |

total explosives weight in Blast (kg): 9,669

Pkgd Prod (25 kg) % of Total kg: 0.3%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 15M |          |    | 54     |
| UNITRONIC 600 25M |          |    | 54     |
| EXEL MS 25m       |          |    | 54     |
| UNITRONIC 600 6M  |          |    | 2      |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.5  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

|                       |                |                       |
|-----------------------|----------------|-----------------------|
| Tonnes Blasted:       | 26,561 te      | 10,216 m <sup>3</sup> |
| Total tonnes per day: | 26,561 te      | NB60-17 Rate Code     |
| Total Holes Loaded:   | 53 holes       |                       |
| ... including:        | 0 Dead Holes   |                       |
| ... and:              | 0 Helper Holes |                       |
| Helper Hole Collar:   | 0.0 ft avg     |                       |
| # Rows Blasted:       | 3 rows         |                       |

### - Pattern (Front Row)-

|          |              |
|----------|--------------|
| Burden:  | 12.0 ft avg  |
| Spacing: | 10.0 ft avg  |
| # Holes: | 22 front row |

### - Pattern (Main Body) -

|          |              |
|----------|--------------|
| Burden:  | 9.0 ft avg   |
| Spacing: | 10.0 ft avg  |
| # Holes: | 31 main body |

Bench Height: 66.4 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 68.4 ft avg

### - Stone Decking -

Front Row: 8.0 ft avg

Main Body: 0.0 ft avg

# Decks: 2 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Main Body: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 53.4 ft avg

Main Body: 61.4 ft avg

### - Charge Weight -

Front Row: 155.8 kg/hole

Main Body: 179.2 kg/hole

Max. per delay: 107.0 kg/delay

SD () Equation: 16.7 kg/delay

Total kg Loaded: 9,669 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.364 kg/te (actual)

Front row: 0.265 kg/te (theoretical)

Main Body: 0.407 kg/te (theoretical)

"KPI" PF: 0.360 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

### NOTES (ANY VARIATION FROM STANDARD):

Nick Heap and I decided it was best to cut 6 holes off to the south due to a hole that was 20' short in depth.

Package was use to load through lean burden



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:  
 Blast Date: 2019-10-15

Blast Number: 19-021  
 Orica Order #: 2543361  
 Blast Time: 11:55 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40365       | 79.88148        | 0.757537    | 1.394195    |
| Front Row Corner          | 43.40332       | 79.88155        | 0.757531    | 1.394196    |
| Back Row Corner           | 43.40390       | 79.88141        | 0.757541    | 1.394194    |
| Average (Centre of Blast) | 43.40362       | 79.88148        | 0.757536    | 1.394195    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 300.1                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 6.0                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 14.6         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 112.8 | dB              | Trigger set at: 115 | dB                                     |

2450 2nd Line

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.39339                | 79.88880        | 0.757358            | 1.394323                               |
| Distance (2nd Seis. From Centre of Blast) | 1283.8                  | m               |                     |                                        |
| Post Blast Data:                          | ppV: 0.2                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 9.1          | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 117.0 | dB              | Trigger set at: 115 | dB                                     |

Blind Line and Colling Road (Bruce Trail Entrance)

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 122.6                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 18.8               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 15.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 129.7 | dB              | Trigger set at: 115 | dB                                     |

Gas Line

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(122.6)^2}{30^2} \text{ kg} \\
 &= \frac{15,031}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington

P.O. #:

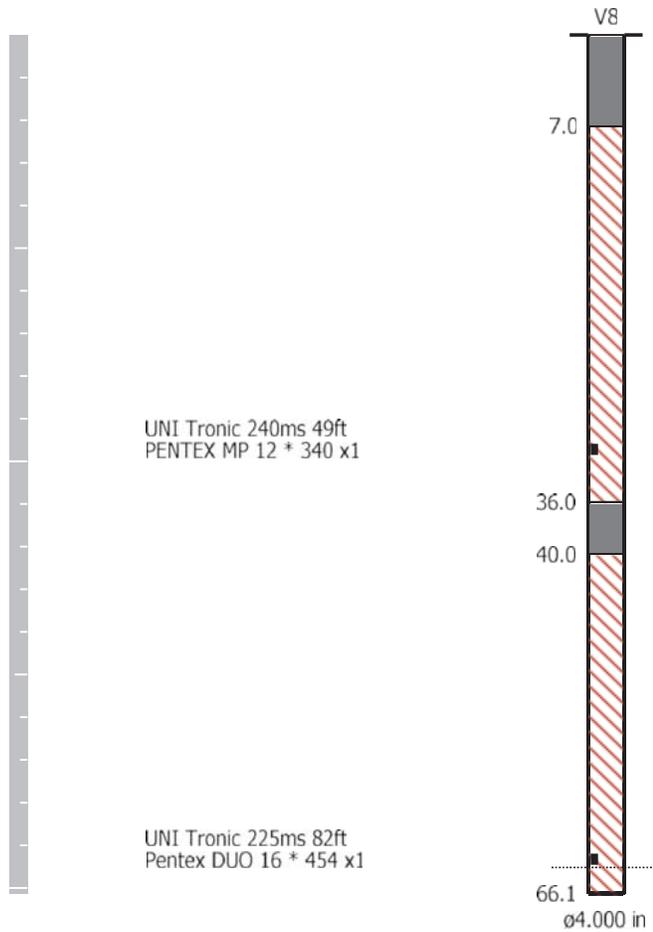
Blast Date: 10/15/2019

Blast Number: 19-021

Orica Order #: 2543361

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Vert at 11:55:04 October 15, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.25 sec (Auto=3Sec) at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.3 Volts  
**Unit Calibration** December 4, 2018 by InstanTEL  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 #2 road, Burlington  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington, On

**Extended Notes**

Sand Bagged  
 43.40245 -79.87814

**Microphone** Linear Weighting

**PSPL** 112.8 dB(L) at 1.290 sec

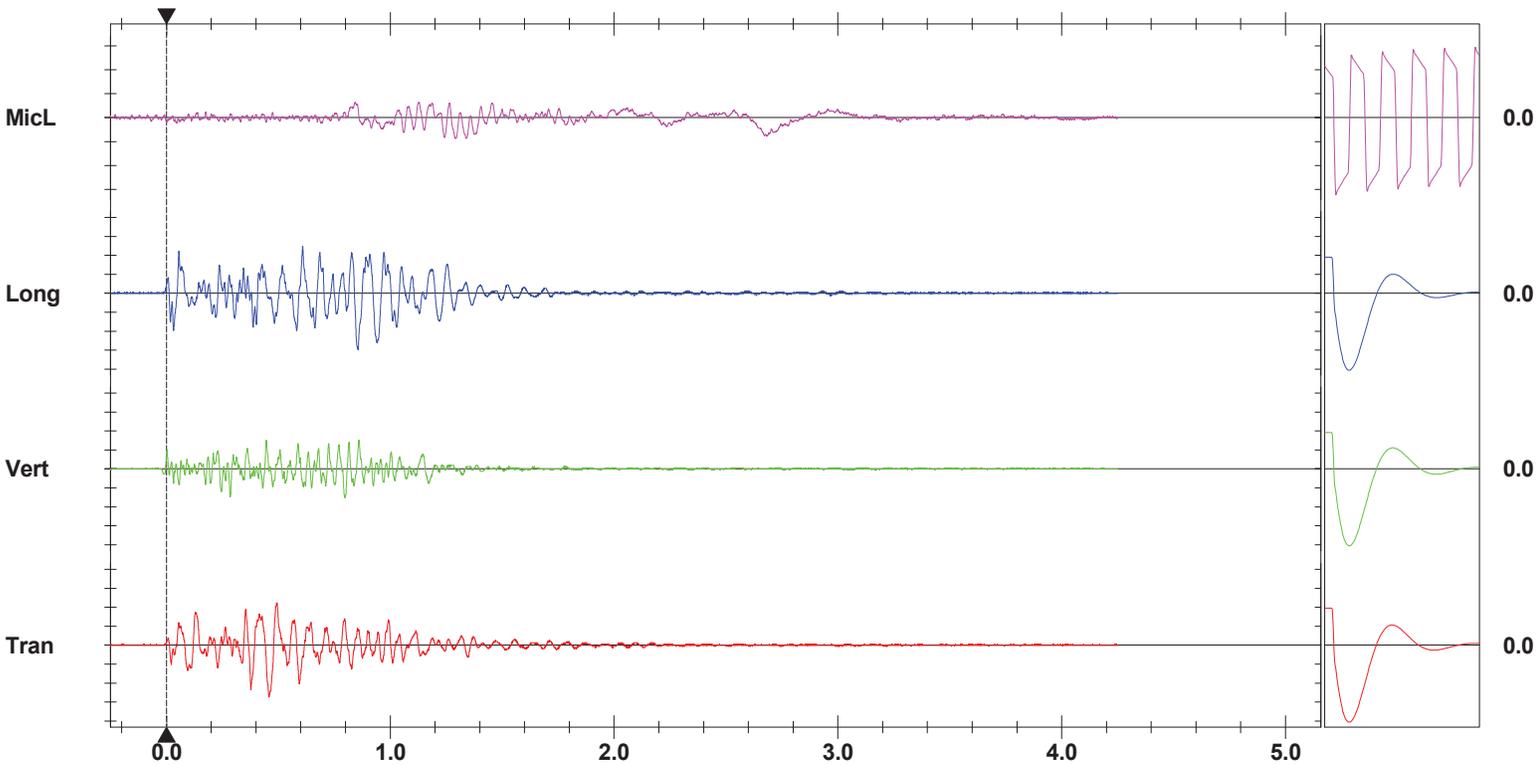
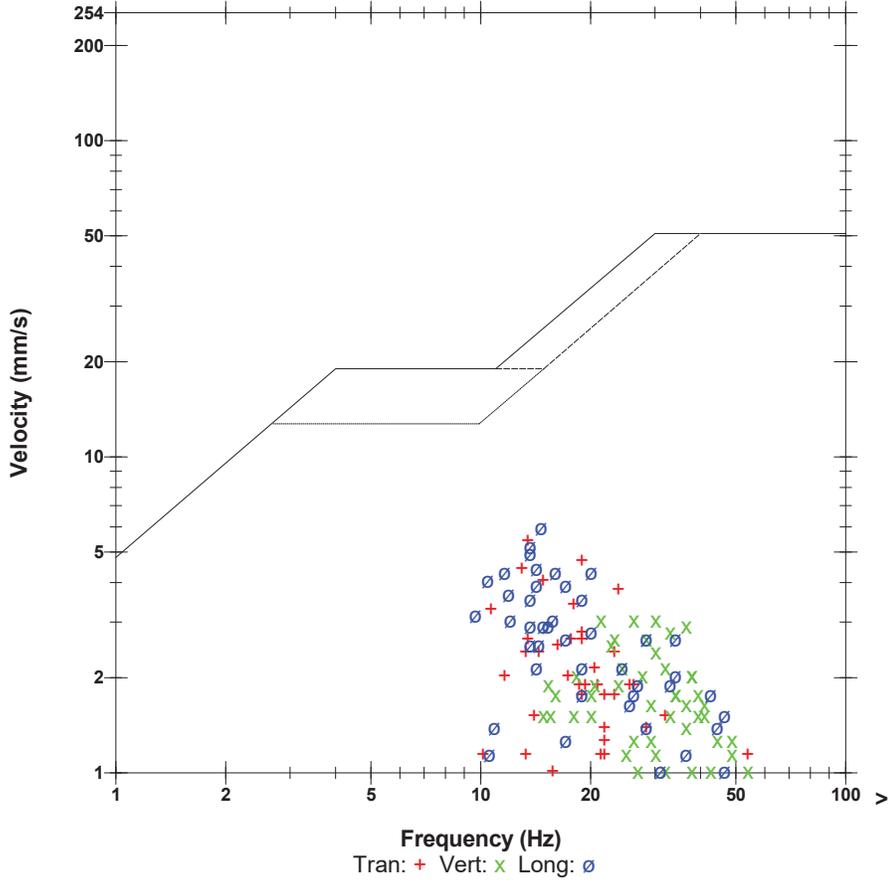
**ZC Freq** 15.3 Hz

**Channel Test** Passed (Freq = 20.5 Hz Amp = 627 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 5.461  | 3.048  | 5.969  | mm/s |
| ZC Freq             | 13.5   | 30     | 14.6   | Hz   |
| Time (Rel. to Trig) | 0.458  | 0.446  | 0.855  | sec  |
| Peak Acceleration   | 0.080  | 0.080  | 0.106  | g    |
| Peak Displacement   | 0.064  | 0.019  | 0.065  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.3    | 7.2    | Hz   |
| Overswing Ratio     | 3.9    | 3.7    | 4.1    |      |

**Peak Vector Sum** 6.571 mm/s at 0.856 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div    **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** MicL at 11:55:03 October 15, 2019  
**Trigger Source** Geo: 2.000 mm/s, Mic: 115.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.054 sec (Auto=5Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington Bruce TRL.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.6 Volts  
**Unit Calibration** January 15, 2019 by InstanTEL  
**File Name** UM6857\_20191015115503.IDFW

**Notes**

Location: COLLING RD & BLINDLINE  
 Client: NELSON AGGREGATES  
 User Name: ORICA CANADA  
 General:

**Extended Notes**

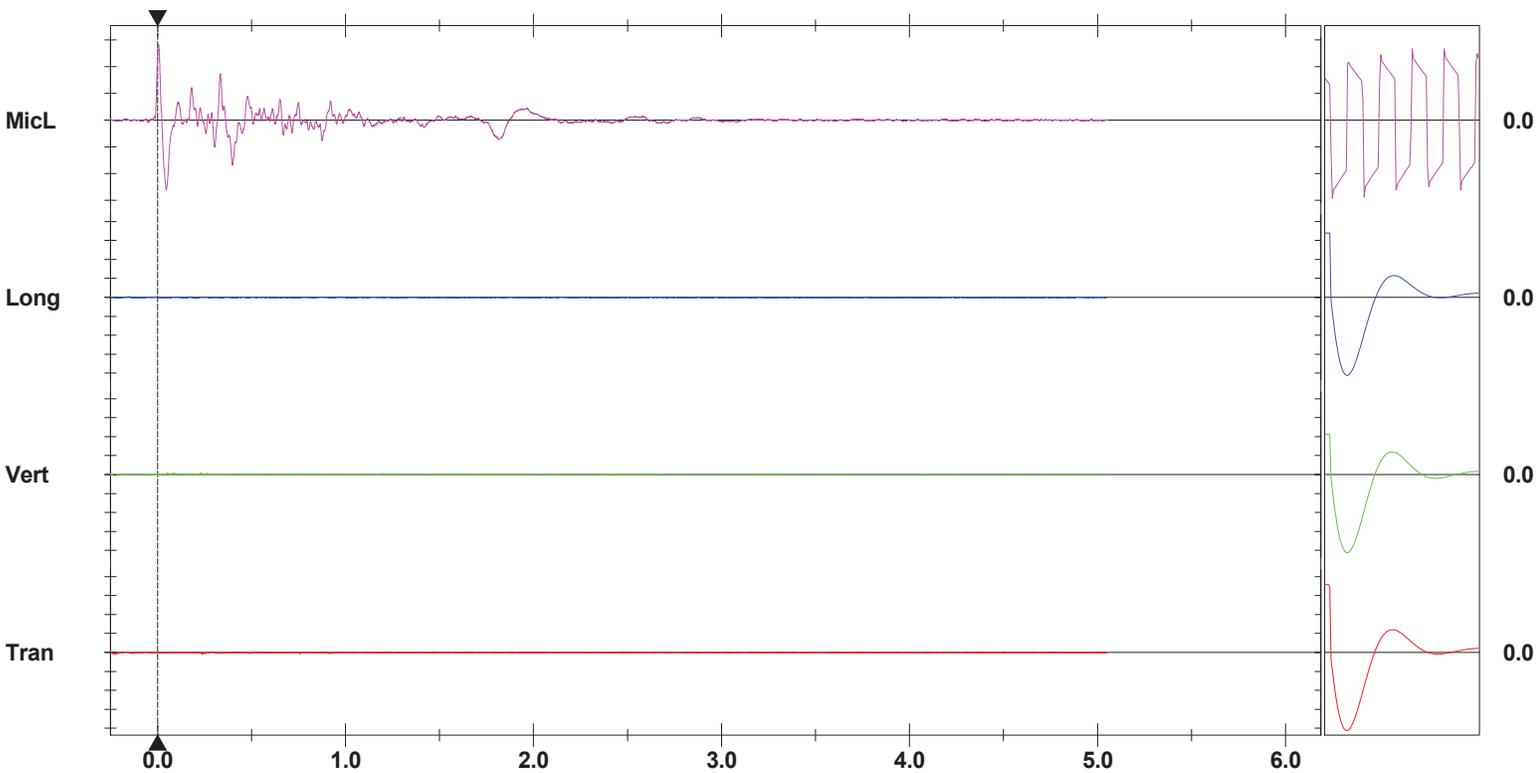
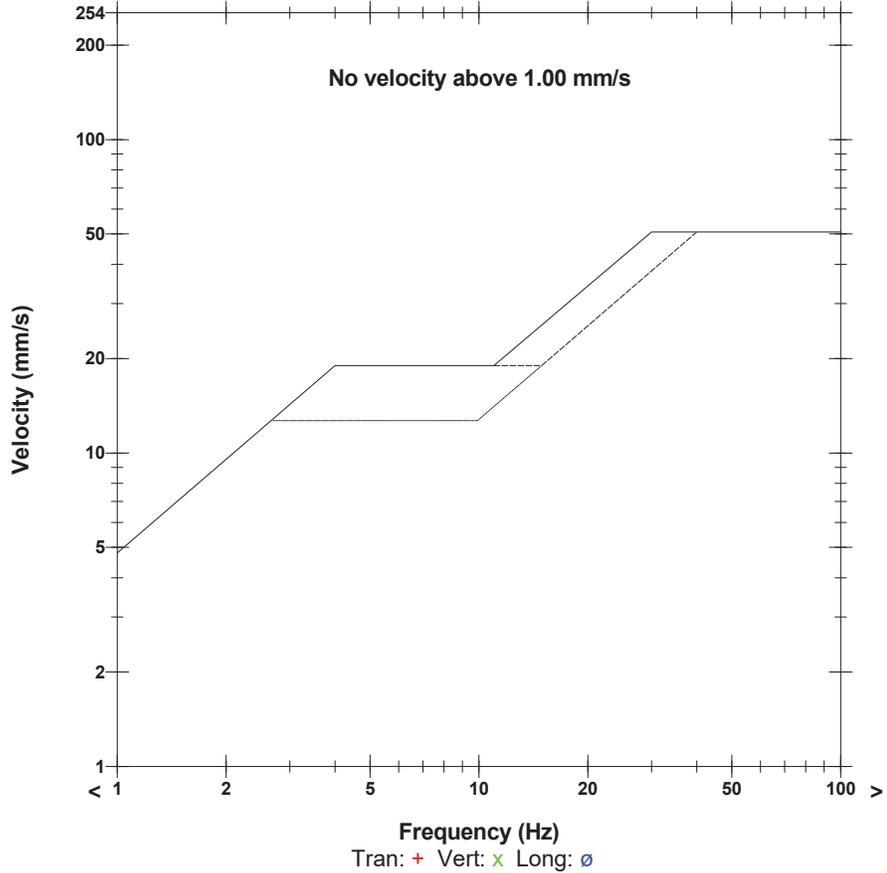
N 43.31617  
 W 80.02664

**Microphone** Linear Weighting  
**PSPL** 117.0 dB(L) at 0.006 sec  
**ZC Freq** 10.0 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1474 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 0.166  | 0.110  | 0.102  | mm/s |
| ZC Freq             | 9.1    | 4.0    | 13.7   | Hz   |
| Time (Rel. to Trig) | -0.229 | 0.056  | 0.206  | sec  |
| Peak Acceleration   | 0.008  | 0.010  | 0.012  | g    |
| Peak Displacement   | 0.005  | 0.013  | 0.002  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.4    | 3.4    | 3.6    |      |

Peak Vector Sum 0.177 mm/s at -0.229 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 5.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Tran at 11:52:41 October 15, 2019  
**Trigger Source** Geo: 10.000 mm/s, Mic: 124.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 5.25 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.3 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_TEMP.EVT

**Notes**

Location: Gas Line  
 Client: Nelson Aggregates  
 User Name: Orica Canada  
 General: 43.40466,-79.88098

**Extended Notes**

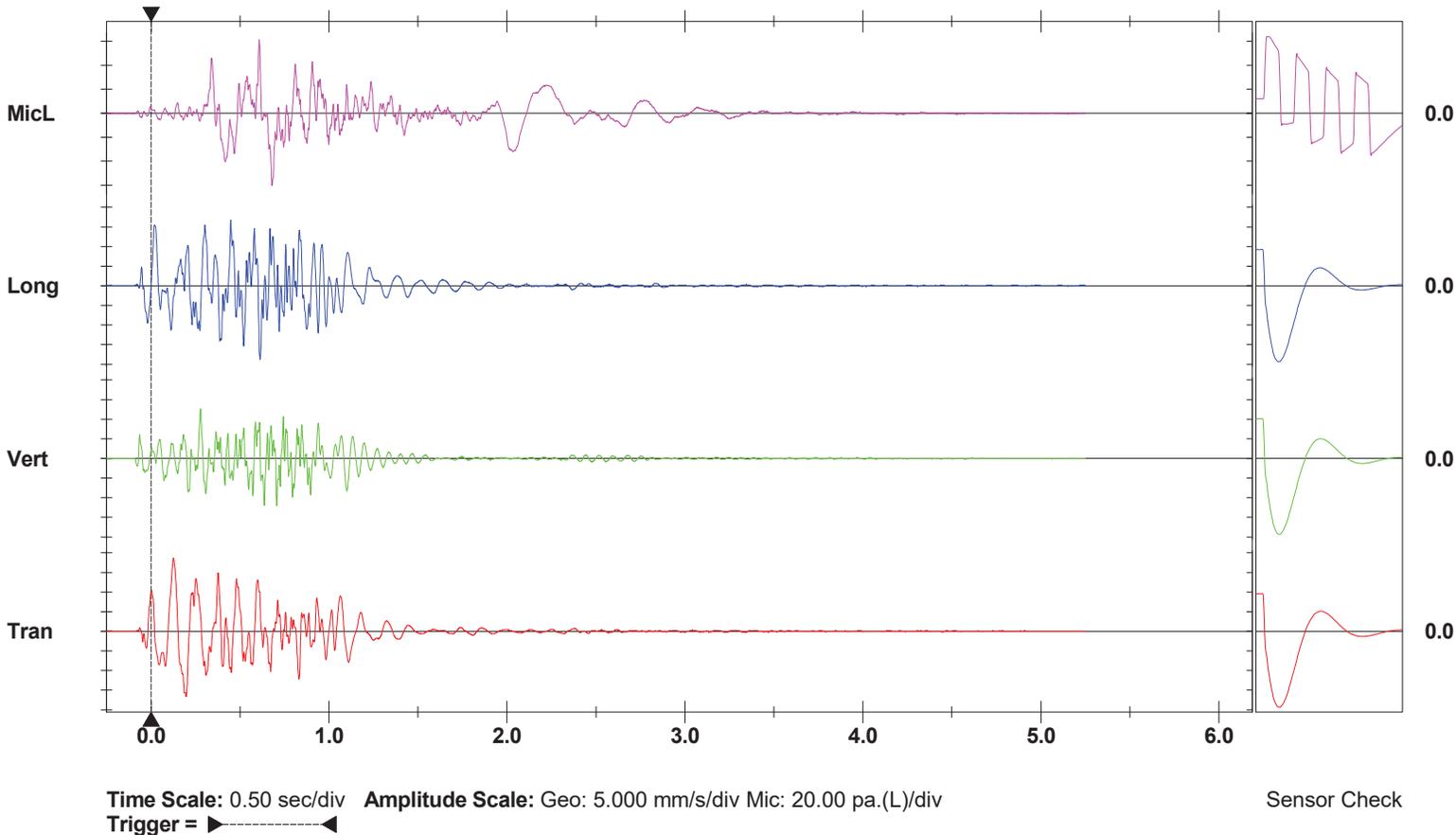
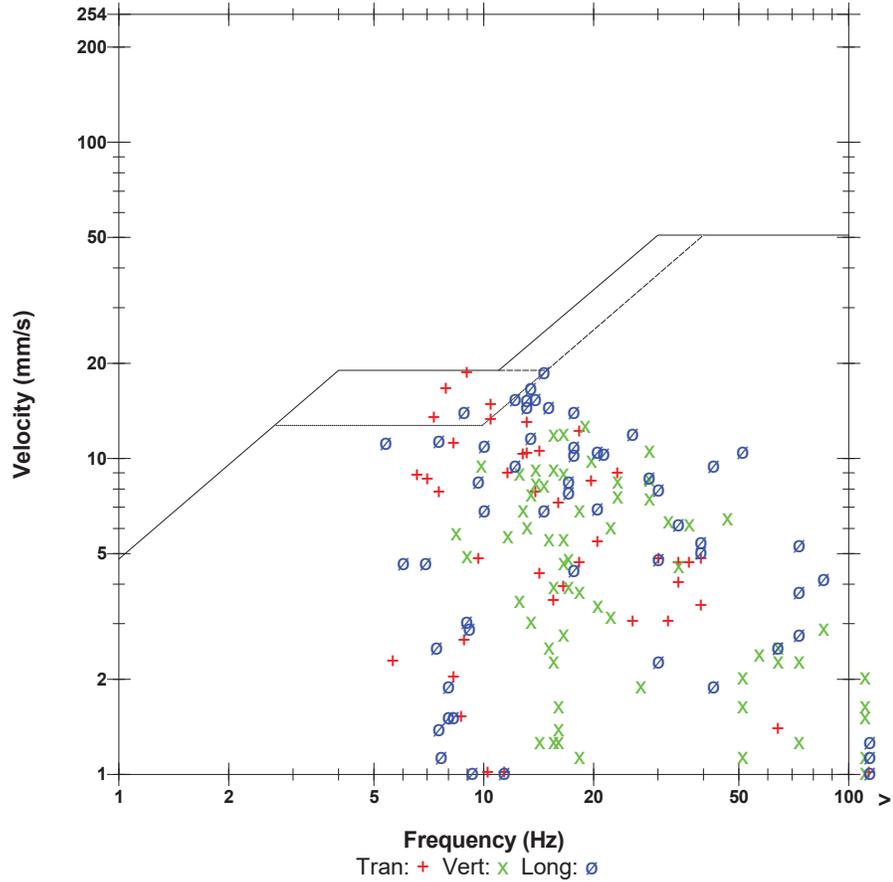
Sand Bagged at gas line

**Microphone** Linear Weighting  
**PSPL** 129.7 dB(L) at 0.607 sec  
**ZC Freq** 16 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 627 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 18.67  | 12.70  | 18.80  | mm/s |
| ZC Freq             | 9.0    | 19     | 15     | Hz   |
| Time (Rel. to Trig) | 0.125  | 0.278  | 0.613  | sec  |
| Peak Acceleration   | 0.199  | 0.318  | 0.318  | g    |
| Peak Displacement   | 0.323  | 0.112  | 0.234  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.4    | Hz   |
| Overswing Ratio     | 3.8    | 3.9    | 4.2    |      |

**Peak Vector Sum** 22.37 mm/s at 0.610 sec

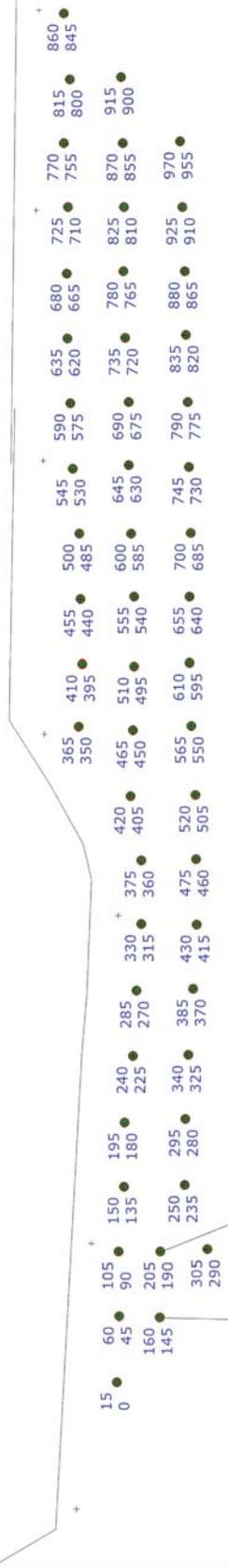
**USBM RI8507 And OSMRE**



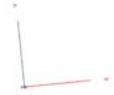
SHOTPLUS Plan

| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 53 | Hole angle: 0.0° |
| Total drilled: 3634.7ft |                      |                     |                  |

open face



W2 W3 W4 3.625" DIA

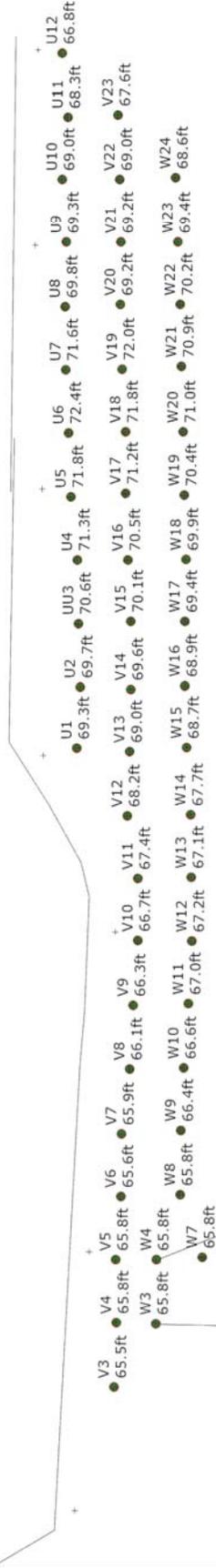


Not to scale

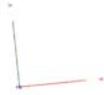
SHOTPlus Plan

| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 53 | Hole angle: 0.0° |
| Total drilled: 3634.7ft |                      |                     |                  |

open face  
 Load Sheet  
 100 Kg Max  
 95Kg Bottom Deck



**W2 W3 W4 3.625" DIA**



Not to scale

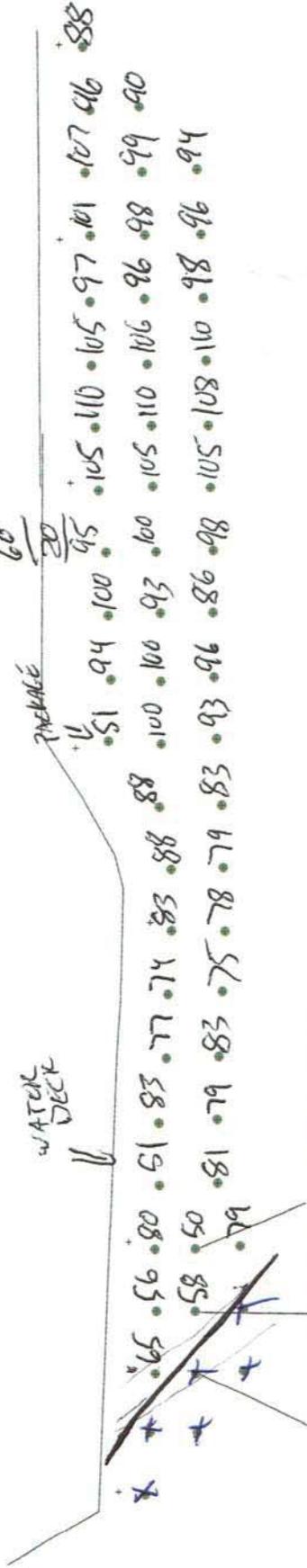
SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Subdrill: 2.0ft      Hole angle: 0.0°  
 Total drilled: 4029.6ft      Hole Diameter: 4.0in      Number of holes: 59

open face  
 Load Sheet  
 100 Kg Max  
 95Kg Bottom Deck

31 / 60



W2 W3 W4 3.625" DIA



Not to scale

SHOTPlus 5 Plan

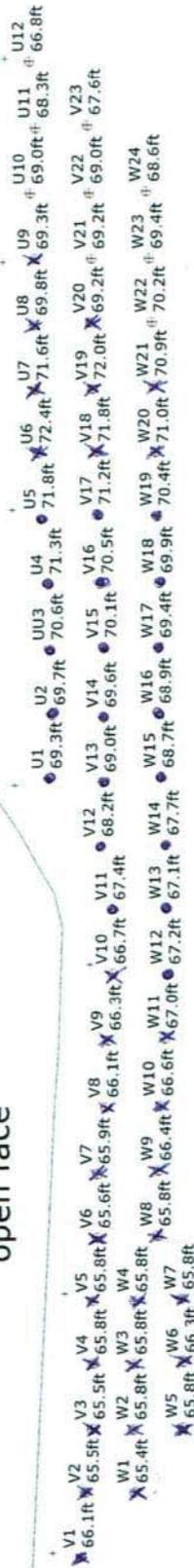
Blast Summary Data

Burden: 9.0ft Spacing: 10.0ft Stemming: 7.0ft  
 1st row burden: 12.0ft Hole Diameter: 4.0in Number of holes: 59 Hole angle: 0.0°  
 Total drilled: 4029.6ft

APPROX 12300 KGS WITH NO DECKS

POSTS

open face



W2 W3 W4 3.625" DIA

9MID021 Design Fnl - 3.625 and 4" Blast Holes 12x10 9x10 271 and 250 + .6 SUB ELEV

DRILL TO DEPTH OR SHALE + 2 FEET

|                                |                                      |
|--------------------------------|--------------------------------------|
| SHOTPlus™ Professional 5.7.4.4 | 9/25/2019                            |
| Mine                           | Burlington                           |
| Location                       | SOUTH WALL TO MID NEXT TO OLD WHL WS |
| Title/author                   | 9MID021 Design Partial Fnl           |
| Filename                       | 9MID021 Design Partial Fnl.spf       |



Scale 1:350



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-10-23

Blast Number: 19-022

Orica Order #: 2547256

Blast Time: 11:59 AM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Middle (Bench / Face)

GPS Coordinates: 43.40443 °N Latitude 79.88139 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: W at 15 kph Temperature: 11 to 15 °C

Clear:  Rain:  Overcast:  Partly Cloudy:  Snow:  Inversion:  Ceiling: 30,000 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 64 = 3,527.0 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 33,760  | 24,820   | 8,940 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 0           | 50 |

### Boosters:

|                            | kg / unit | # used | kg   |
|----------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT)  | 0.34      | 66     | 22.4 |
| PENTEX DUO (OR EQUIVALENT) | 0.45      | 64     | 29.1 |

total explosives weight in Blast (kg): 9,041

Pkgd Prod (50 kg) % of Total kg: 0.6%

### Detonators:

|                   | case #'s | ms    | # used |
|-------------------|----------|-------|--------|
| UNITRONIC 600 6M  |          |       | 1      |
| UNITRONIC 600 15M |          |       | 64     |
| UNITRONIC 600 20M |          |       | 36     |
| UNITRONIC 600 25M |          |       | 29     |
| EXEL MS 18m       |          | 25 ms | 36     |
| EXEL MS 25m       |          | 25 ms | 28     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 6.0  |
| HELPER HOURS          | Enter total Helper man-hours | 12.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 26,393 te 10,151 m<sup>3</sup>  
Total tonnes per day: 26,393 te NB60-17 Rate Code  
Total Holes Loaded: 64 holes  
... including: 0 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 2 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 33 front row

### - Pattern (Back Row) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 31 back row

Bench Height: 53.1 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 55.1 ft avg

### - Stone Decking -

Front Row: 4.0 ft avg

Back Row: ft avg

# Decks: 64 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Back Row: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 44.1 ft avg

Back Row: 48.1 ft avg

### - Charge Weight -

Front Row: 128.6 kg/hole

Back Row: 140.3 kg/hole

Max. per delay: 85.0 kg/delay

SD () Equation: 2.0 kg/delay

Total kg Loaded: 9,041 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.343 kg/te (actual)

Front row: 0.274 kg/te (theoretical)

Main Body: 0.399 kg/te (theoretical)

"KPI" PF: 0.336 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.501 lb/yd<sup>3</sup>

1.201 lb/yd<sup>3</sup>

1.747 lb/yd<sup>3</sup>

1.474 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

Drilled to dept od shale + 2'

2 Cases of package were used for X1 due to lean burden from 30' to collar



# Blast Report

Nelson Aggregate

Quarry: Burlington  
 P.O. #:   
 Blast Date: 2019-10-23

Blast Number: 19-022  
 Orica Order #: 2547256  
 Blast Time: 11:59 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40443       | 79.88138        | 0.757550    | 1.394193    |
| Front Row Corner          | 43.40401       | 79.88147        | 0.757543    | 1.394195    |
| Back Row Corner           | 43.40485       | 79.88133        | 0.757557    | 1.394192    |
| Average (Centre of Blast) | 43.40443       | 79.88139        | 0.757550    | 1.394193    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.                   | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|----------------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                         | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                                  |                 |                     |                                        |
| Average                                   | 43.40245                         | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 343.1                            | m               |                     |                                        |
| Post Blast Data:                          | ppV: Memory                      | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: was full              | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: from high wind | dB              | Trigger set at: 115 | dB                                     |
| 2450 #2 Sideroad, Burlington, On          |                                  |                 |                     |                                        |

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40614                | 79.87455        | 0.757580            | 1.394074                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40614                | 79.87455        | 0.757580            | 1.394074                               |
| Distance (2nd Seis. From Centre of Blast) | 585.1                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 3.3                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 43.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 104.6 | dB              | Trigger set at: 115 | dB                                     |
| 2582 #2 Sideroad, Burlington, On          |                         |                 |                     |                                        |

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.                   | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|----------------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                         | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                                  |                 |                     |                                        |
| Average                                   | 43.40466                         | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 42.2                             | m               |                     |                                        |
| Post Blast Data:                          | ppV: Memory                      | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: was full              | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: from high wind | dB              | Trigger set at: 115 | dB                                     |
| Gas Line                                  |                                  |                 |                     |                                        |

Scaling Factor denotes the degree of Blast confinement.  
 The higher the SF, the more confined the Blast.  
 A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(42.2)^2}{30^2} \text{ kg} \\
 &= \frac{1,781}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
 Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
 Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington

P.O. #:

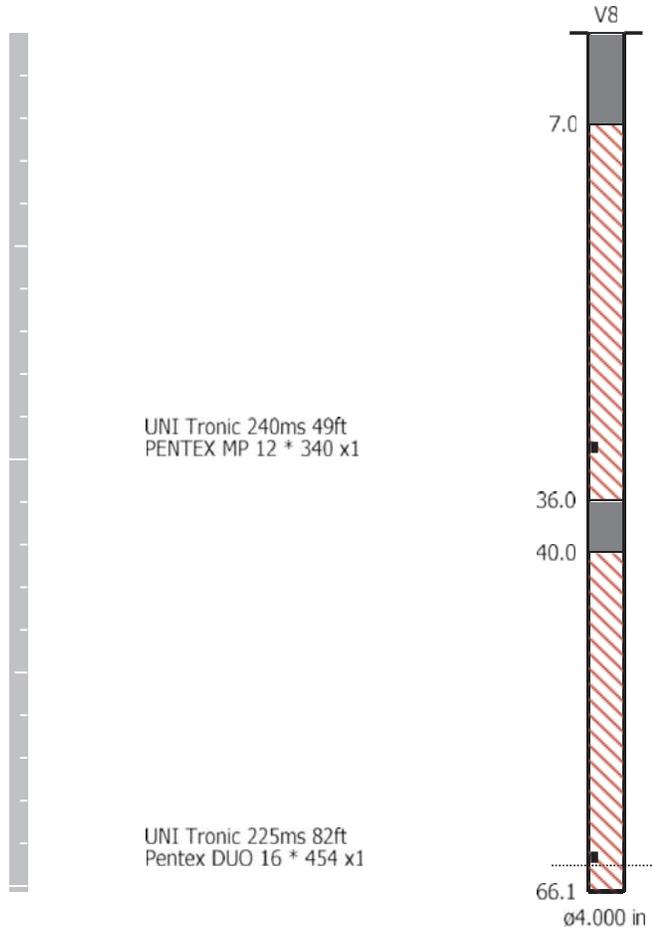
Blast Date: 10/23/2019

Blast Number: 19-022

Orica Order #: 2547256

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Long at 11:59:19 October 23, 2019  
**Trigger Source** Geo: 1.500 mm/s, Mic: 120.0 dB(L)  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.875 sec (Auto=4Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington 2582.mmb

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.8 Volts  
**Unit Calibration** January 15, 2019 by InstanTEL  
**File Name** UM6857\_20191023115919.IDFW

**Notes**

Location: 2582 #2 Sideroad, Mount Nemo, On  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Monitoring Vibration and Airblast

**Extended Notes**

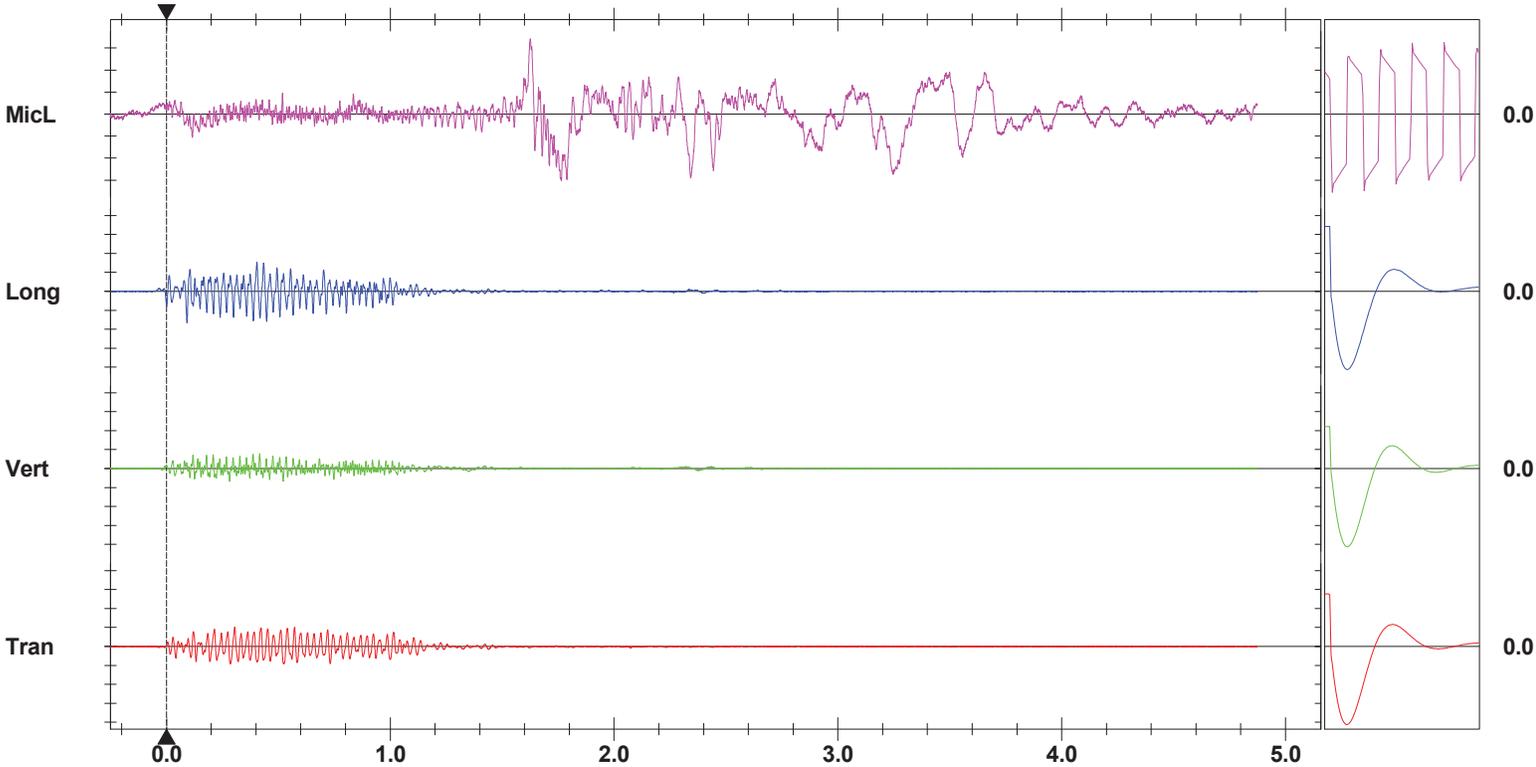
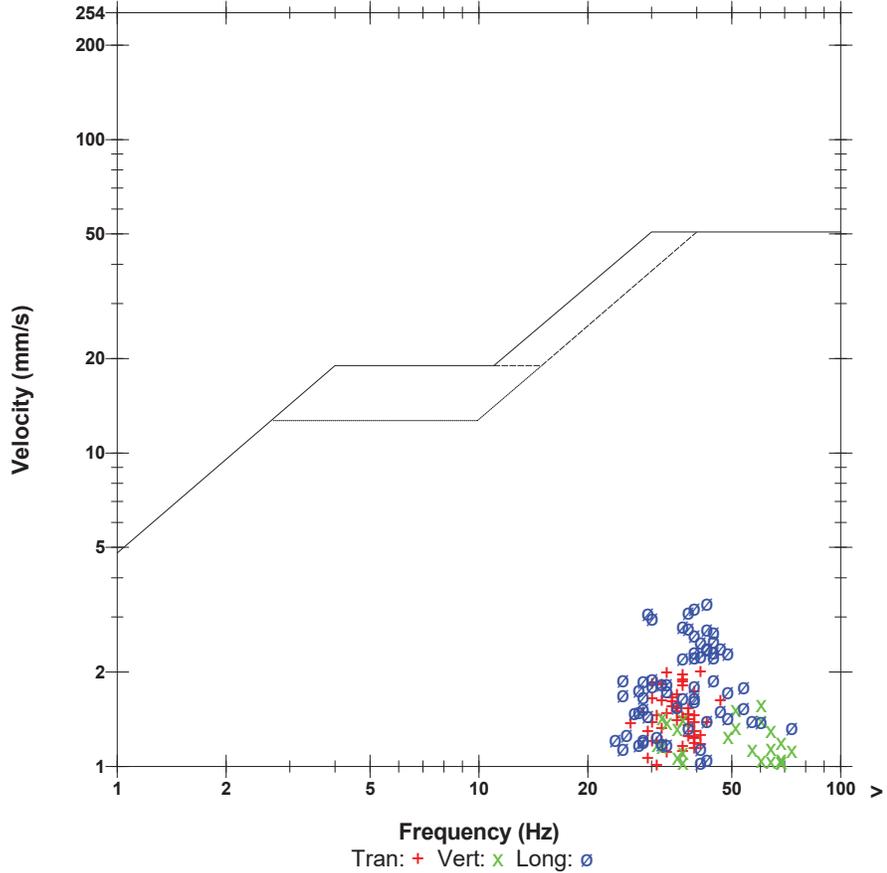
Sand Bagged  
 N43.40614,W-79.87455

**Microphone** Linear Weighting  
**PSPL** 104.6 dB(L) at 1.625 sec  
**ZC Freq** 5.9 Hz  
**Channel Test** Passed (Freq = 19.7 Hz Amp = 1484 mv )

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 2.018  | 1.576  | 3.334  | mm/s |
| ZC Freq             | 41     | 60     | 43     | Hz   |
| Time (Rel. to Trig) | 0.572  | 0.417  | 0.091  | sec  |
| Peak Acceleration   | 0.064  | 0.077  | 0.145  | g    |
| Peak Displacement   | 0.011  | 0.005  | 0.013  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.3    | 7.3    | 7.1    | Hz   |
| Overswing Ratio     | 3.5    | 3.4    | 3.6    |      |

**Peak Vector Sum** 3.595 mm/s at 0.388 sec

**USBM RI8507 And OSMRE**

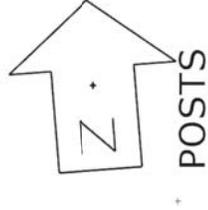


**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 1.000 pa.(L)/div  
**Trigger =**

Sensor Check

# SHOTPLUS Plan

| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 7.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 63 | Hole angle: 0.0° |
| Total drilled: 3628.0ft |                      |                     |                  |



open face



Not to scale



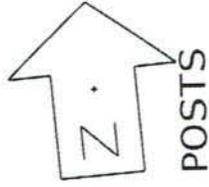
SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 63      Hole angle: 0.0°  
 Total drilled: 3628.0ft

Load Sheet  
 85 Kg / Top Deck  
 75 Kg / Bottom Deck

open face



85 85 82 73 75 64 76 45 58 56 61 75 51 47 64 48 52 53 59 57 69 55 75 70 62 53 67 59 53 57  
 85 83 83 75 67 66 63 62 75 68 52 38 36 43 48 41 35 40 51 61 61 18 46 54 69 51 56 50 53 60  
 46 54 69 51 56 50 53 60



Not to scale

SHOTPlus 5 Plan

Blast Summary Data

Burden: 9.0ft      Spacing: 10.0ft      Stemming: 7.0ft  
 1st row burden: 12.0ft      Hole Diameter: 4.0in      Number of holes: 64      Hole angle: 0.0°  
 Total drilled: 3684.3ft



open face



9MID022 Design Fnl - 4" Blast Hole 12x10 9x10 268 266.5 and 250 + .6 SUB ELEV  
 DRILLER NAME:



Scale 1:500

|                                |                          |           |
|--------------------------------|--------------------------|-----------|
| SHOTPlus™ Professional 5.7.4.4 |                          | 10/1/2019 |
| Mine                           | Burlington               |           |
| Location                       | MID TO NORTH WALL DESIGN |           |
| Title/author                   | 9MID022 Design Fnl       |           |
| Filename                       |                          |           |



# Blast Report

Nelson Aggregate

Quarry: Burlington

P.O. #:

Blast Date: 2019-10-31

Blast Number: 19-023

Orica Order #: 2550103

Blast Time: 10:56 AM

page 1

Blaster-in-charge: Mike Derkinderen (Print Name)

Blast Location: Upper Middle (Bench / Face)

GPS Coordinates: 43.40370 °N Latitude 79.88137 °W Longitude  
Centre of Blast Centre of Blast

Wind from the: E at 5 kph Temperature: 6 to 10 °C

Clear:  Rain:  Overcast:  X  
Partly Cloudy:  Snow:  Inversion:  X Ceiling: 18,000 ft

### - Drilling Information -

Primary Bit diam: 101.6 mm Angle from Vertical: 0° # Holes: 41 = 2,753.0 ft ( 4 " diam)  
Secondary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Tertiary Bit diam: mm # Holes: = 0.0 ft ( " diam)  
Nominal Bit Diameter:

### Bulk Explosives:

|                | in (kg) | out (kg) | kg    |
|----------------|---------|----------|-------|
| CENTRA GOLD 70 | 33,440  | 25,960   | 7,480 |

### Packaged Explosives:

|                   | cs shipped | cs returned | kg |
|-------------------|------------|-------------|----|
| FORTEL PRO 75X400 | 2          | 0           | 50 |

### Boosters:

|                            | kg / unit | # used | kg   |
|----------------------------|-----------|--------|------|
| PENTEX 12 (OR EQUIVALENT)  | 0.34      | 41     | 13.9 |
| PENTEX DUO (OR EQUIVALENT) | 0.45      | 41     | 18.6 |

total explosives weight in Blast (kg): 7,563

Pkgd Prod (50 kg) % of Total kg: 0.7%

### Detonators:

|                   | case #'s | ms | # used |
|-------------------|----------|----|--------|
| UNITRONIC 600 15M |          |    | 41     |
| UNITRONIC 600 25M |          |    | 82     |

### Cord & Accessories:

|                                  | U of M | # used |
|----------------------------------|--------|--------|
| HARNES WIRE DUPLEX (6 PACK) 400M | units  | 1      |

### Resource Deployment:

|                                 |                |   |
|---------------------------------|----------------|---|
| # of Blasts today (this Quarry) |                | 1 |
| # of Blasters (this Blast)      |                | 1 |
| # of Helpers (this Blast)       | Note Exception | 2 |
| # of MMU's (this Blast)         |                | 1 |

### Services:

|                       |                              |      |
|-----------------------|------------------------------|------|
| BULK TRUCK CHARGE     |                              | 1.0  |
| BLASTER HOURS         | Enter Blaster hours          | 5.0  |
| HELPER HOURS          | Enter total Helper man-hours | 10.0 |
| SHOT LAYOUT FEE       | Enter # trips extra beyond 1 | 0.0  |
| ADVANCED BLAST DESIGN | Enter hours                  | 0.0  |
| BORETRACK             | Enter hours                  | 0.0  |

Tonnes Blasted: 19,709 te 7,580 m<sup>3</sup>  
Total tonnes per day: 19,709 te NB60-18 Rate Code  
Total Holes Loaded: 41 holes  
... including: 2 Dead Holes  
... and: 0 Helper Holes  
Helper Hole Collar: 0.0 ft avg  
# Rows Blasted: 2 rows

### - Pattern (Front Row) -

Burden: 12.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 21 front row

### - Pattern (Back Row) -

Burden: 9.0 ft avg  
Spacing: 10.0 ft avg  
# Holes: 20 back row

Bench Height: 65.1 ft avg

Sub-drill: 2.0 ft avg

Hole Depth: 67.1 ft avg

### - Stone Decking -

Front Row: 4.0 ft avg

Back Row: ft avg

# Decks: 41 per blast

### - Collar Stemming -

Front Row: 7.0 ft avg

Back Row: 7.0 ft avg

Material used: 3/4" Clear

### - Charge Length -

Front Row: 56.1 ft avg

Back Row: 60.1 ft avg

### - Charge Weight -

Front Row: 163.7 kg/hole

Back Row: 175.4 kg/hole

Max. per delay: kg/delay

SD () Equation: 13.9 kg/delay

Total kg Loaded: 7,563 kg

Rock Density: 2.60 g/cc = te/m<sup>3</sup>

### - Powder Factor -

Yield PF: 0.384 kg/te (actual)

Front row: 0.284 kg/te (theoretical)

Main Body: 0.406 kg/te (theoretical)

"KPI" PF: 0.345 kg/te (theoretical)

Theoretical PF (Based on a single hole)

Yield Powder Factor (kg Loaded / te Blastec

1.682 lb/yd<sup>3</sup>  
1.247 lb/yd<sup>3</sup>  
1.781 lb/yd<sup>3</sup>  
1.514 lb/yd<sup>3</sup>

### NOTES (ANY VARIATION FROM STANDARD):

Unitronics were used instead of 25ms Excel MS in bottom deck due to an error on Orica.



# Blast Report

Nelson Aggregate

Quarry: Burlington  
P.O. #:  
Blast Date: 2019-10-31

Blast Number: 19-023  
Orica Order #: 2550103  
Blast Time: 10:56 AM

page 2

| Blast Co-ordinates        | Enter ° N Lat. | Enter ° W Long. | (N) Radians | (W) Radians |
|---------------------------|----------------|-----------------|-------------|-------------|
| Mid Blast                 | 43.40370       | 79.88136        | 0.757537    | 1.394193    |
| Front Row Corner          | 43.40345       | 79.88143        | 0.757533    | 1.394194    |
| Back Row Corner           | 43.40395       | 79.88133        | 0.757542    | 1.394192    |
| Average (Centre of Blast) | 43.40370       | 79.88137        | 0.757537    | 1.394193    |

**1st**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40245                | 79.87814        | 0.757516            | 1.394137                               |
| Distance (1st Seis. From Centre of Blast) | 296.0                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 8.6                | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 20.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 115.7 | dB              | Trigger set at: 115 | dB                                     |

2450 #2 Sideroad, Burlington, On

**2nd**

| Seismograph Co-ordinates                  | Enter ° N Lat.                       | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|--------------------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40614                             | 79.87455        | 0.757580            | 1.394074                               |
| 2nd Reading                               |                                      |                 |                     |                                        |
| Average                                   | 43.40614                             | 79.87455        | 0.757580            | 1.394074                               |
| Distance (2nd Seis. From Centre of Blast) | 615.0                                | m               |                     |                                        |
| Post Blast Data:                          | ppV: 3.3                             | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 28.0                      | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: Set to not trigger | dB              | Trigger set at: n/a | dB                                     |

2582 #2 Sideroad, Burlington, On

**3rd**

| Seismograph Co-ordinates                  | Enter ° N Lat.          | Enter ° W Long. | (N) Radians         | (W) Radians                            |
|-------------------------------------------|-------------------------|-----------------|---------------------|----------------------------------------|
| 1st Reading                               | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| 2nd Reading                               |                         |                 |                     |                                        |
| Average                                   | 43.40466                | 79.88098        | 0.757554            | 1.394186                               |
| Distance (3rd Seis. From Centre of Blast) | 111.8                   | m               |                     |                                        |
| Post Blast Data:                          | ppV: 36.2               | mm/s            | Trigger set at: 2.0 | mm/s                                   |
|                                           | frequency: 26.0         | Hz              | V / T / L : ?       | (Vertical, Transverse or Longitudinal) |
|                                           | air overpressure: 130.5 | dB              | Trigger set at: 115 | dB                                     |

Gas Line

Scaling Factor denotes the degree of Blast confinement.  
The higher the SF, the more confined the Blast.  
A Scaling Factor of 30 is commonly used in the Scaled Distance formula for Quarry Bench Blasting:

Enter a scaling Factor:  Quarry Bench Blasting - 2 Free Faces

$$\begin{aligned}
 W &= \frac{D^2}{30^2} \\
 &= \frac{(111.8)^2}{30^2} \text{ kg} \\
 &= \frac{12,499}{900} \text{ kg}
 \end{aligned}$$

Maximum Indicated Charge Weight per Delay =  kg

Orica  
Blaster-in-charge:

*Mike derkinderen*

Signature required, indicating that  
Blast Report is Complete & Accurate.



# Blast Design

Nelson Aggregate

Quarry: Burlington

P.O. #:

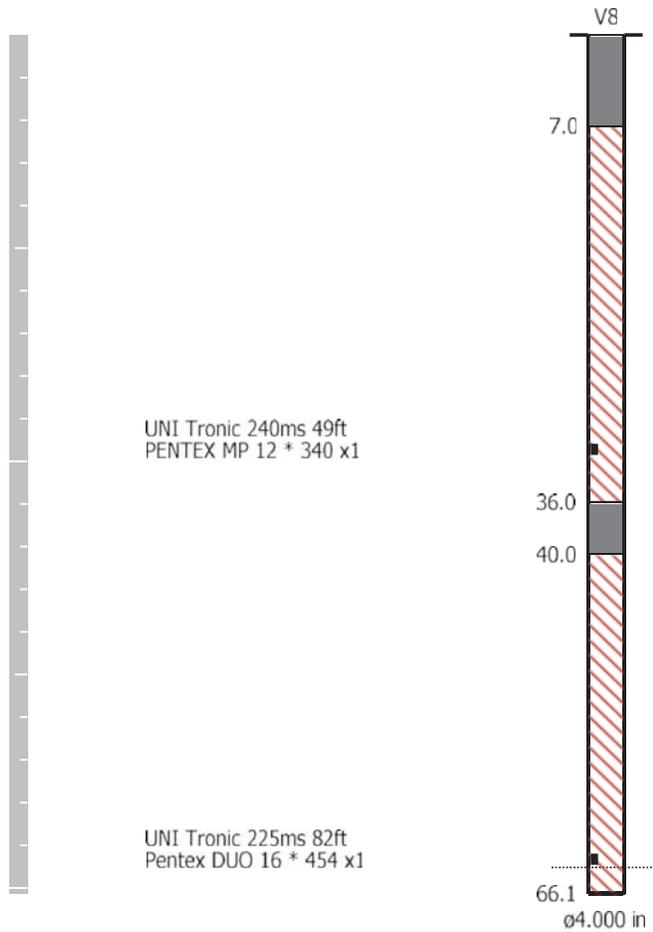
Blast Date: 10/31/2019

Blast Number: 19-023

Orica Order #: 2550103

page 2

Paste ShotPlus Diagram inside Rectangle:



**Orica**

Blaster-in-charge:

*Mike der Kinderen*

Quarry Manager:

*Nich Heap*

Signature required, indicating sign off on Blast Design.

**Date/Time** Vert at 10:56:06 October 30, 2019  
**Trigger Source** Geo: 1.500 mm/s  
**Range** Geo: 254.0 mm/s  
**Record Time** 1.0 sec at 2048 sps  
**Job Number:** 1

**Serial Number** BE12877 V 10.72-1.1 Minimate Blaster  
**Battery Level** 6.1 Volts  
**Unit Calibration** December 4, 2018 by InstanTel  
**File Name** \_\_TEMP.EVT

**Notes**

Location: 2450 #2 Road, Burlington, On  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Burlington

**Extended Notes**

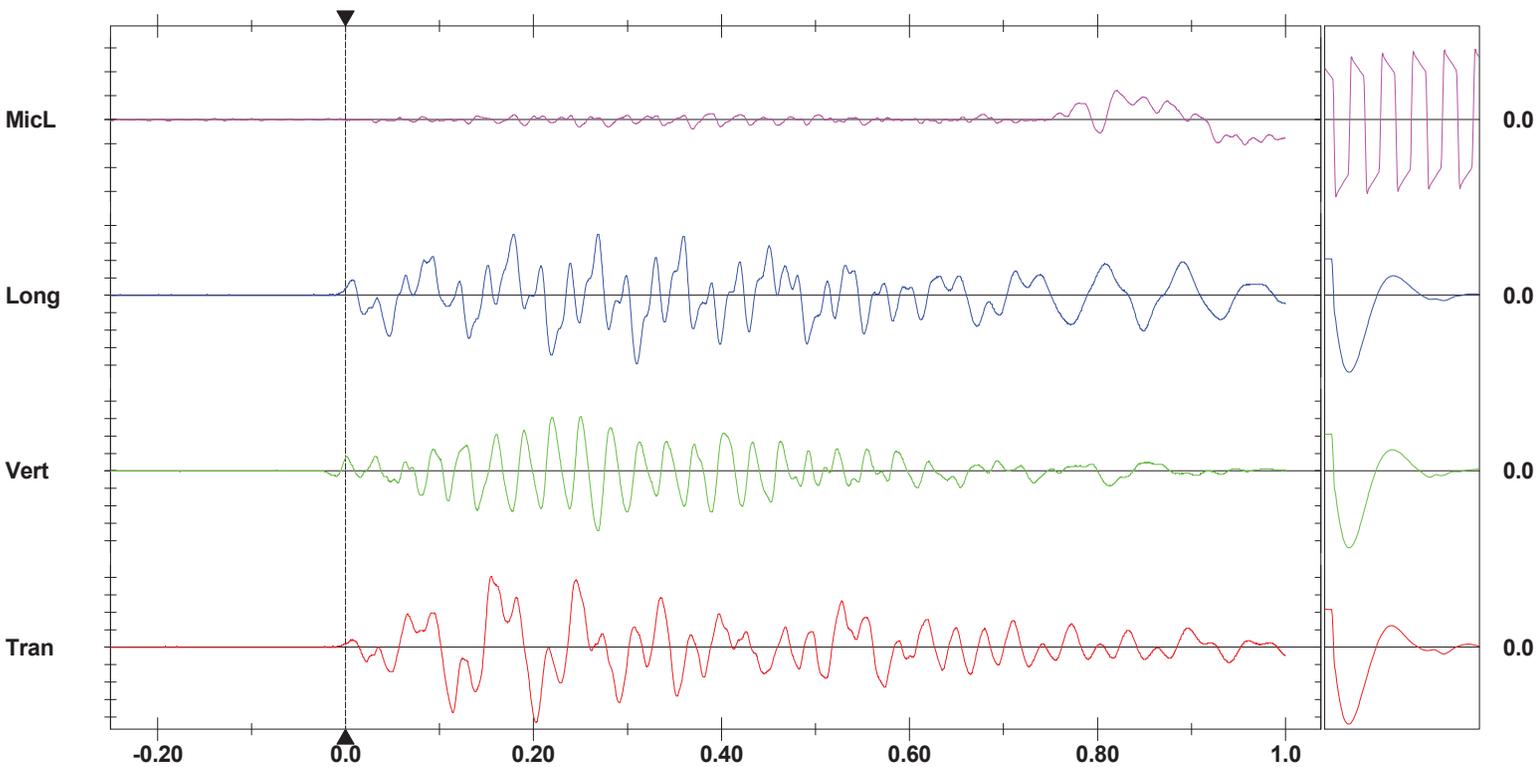
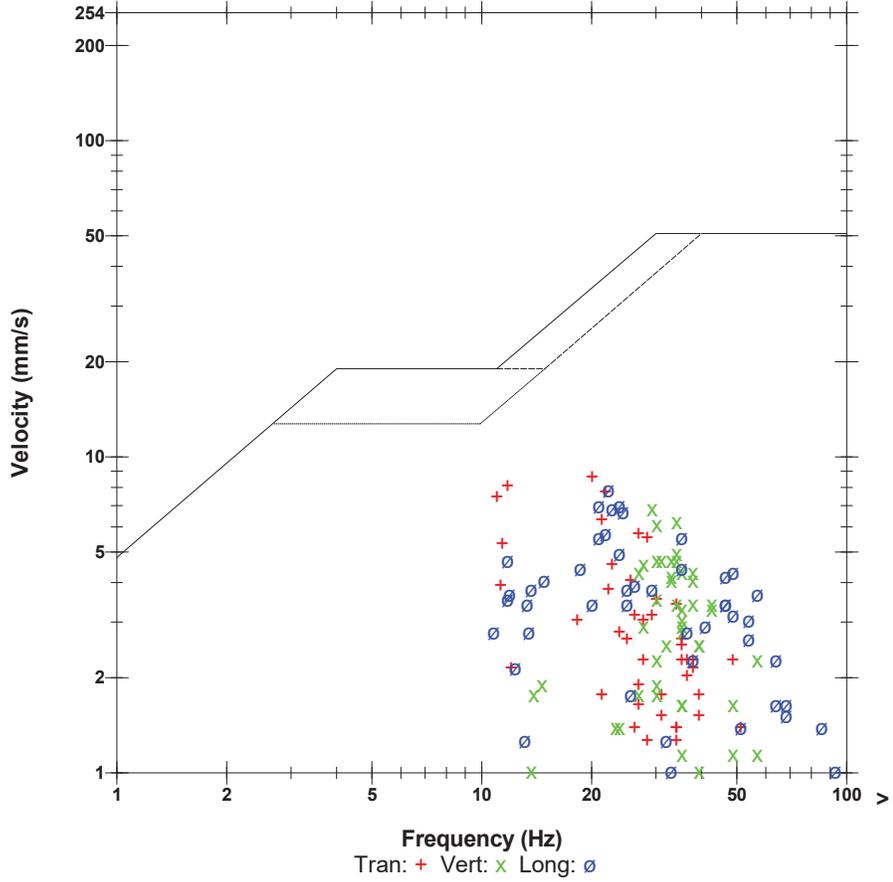
Sand Bagged

**Microphone** Linear Weighting  
**PSPL** 115.7 dB(L) at 0.821 sec  
**ZC Freq** 6.0 Hz  
**Channel Test** Passed (Freq = 20.5 Hz Amp = 612 mv )

|                            | Tran   | Vert   | Long   |      |
|----------------------------|--------|--------|--------|------|
| <b>PPV</b>                 | 8.636  | 6.858  | 7.874  | mm/s |
| <b>ZC Freq</b>             | 20     | 29     | 22     | Hz   |
| <b>Time (Rel. to Trig)</b> | 0.202  | 0.268  | 0.310  | sec  |
| <b>Peak Acceleration</b>   | 0.159  | 0.159  | 0.186  | g    |
| <b>Peak Displacement</b>   | 0.102  | 0.037  | 0.048  | mm   |
| <b>Sensor Check</b>        | Passed | Passed | Passed |      |
| <b>Frequency</b>           | 7.4    | 7.4    | 7.2    | Hz   |
| <b>Overswing Ratio</b>     | 3.7    | 3.7    | 4.0    |      |

**Peak Vector Sum** 9.809 mm/s at 0.269 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.10 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div  
**Trigger =**

Sensor Check

**Date/Time** Long at 10:56:07 October 30, 2019  
**Trigger Source** Geo: 1.500 mm/s  
**Range** Geo: 254.0 mm/s  
**Record Time** 4.756 sec (Auto=4Sec) at 2048 sps  
**Operator/Setup:** MIKE DERKNDEREN/Burlington 2582.MMB

**Serial Number** UM6857 V 10-89 Micromate ISEE  
**Battery Level** 3.8 Volts  
**Unit Calibration** January 15, 2019 by InstanTel  
**File Name** UM6857\_20191030105607.IDFW

**Notes**

Location: 2582 #2 Sideroad, Mount Nemo, On  
 Client: Nelson Aggregate  
 User Name: Orica Canada Inc.  
 General: Monitoring Vibration and Airblast

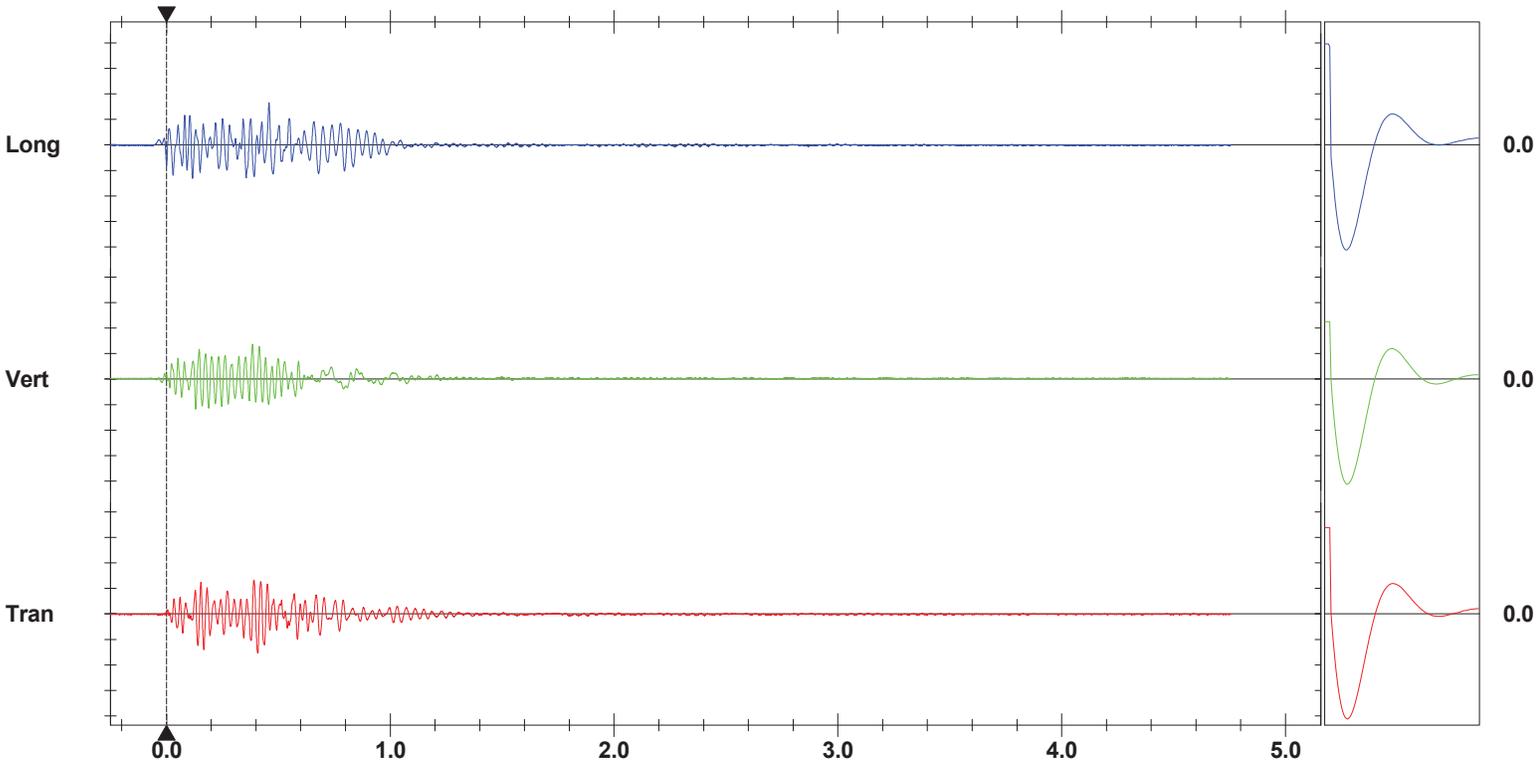
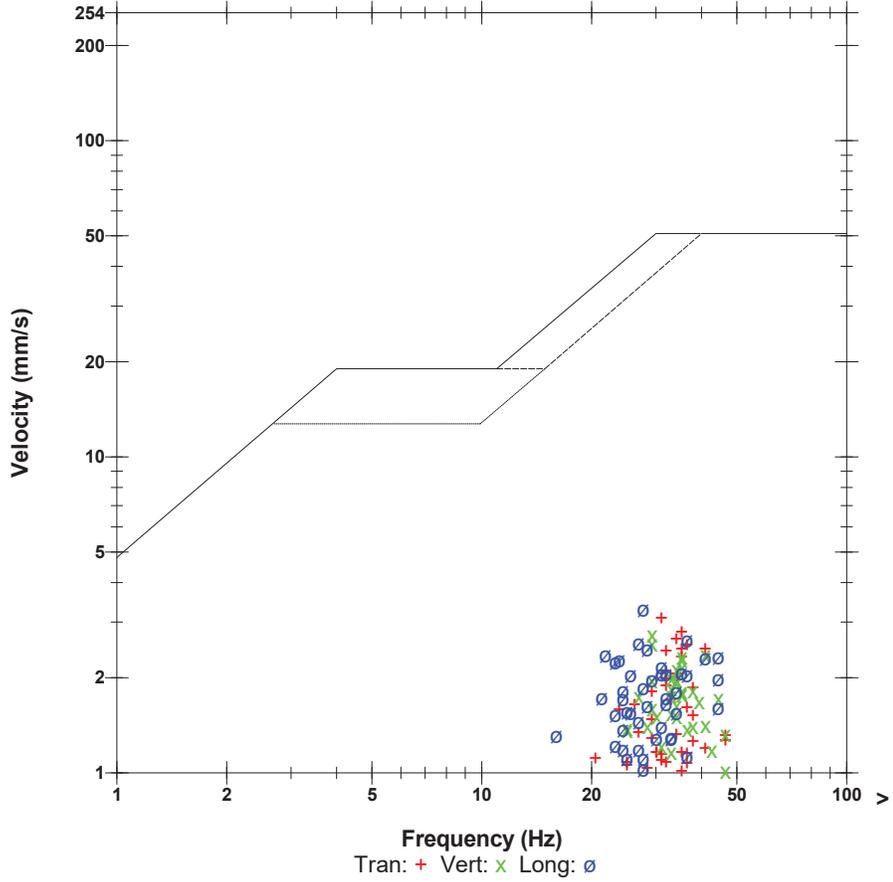
**Extended Notes**

Sand Bagged  
 N43.40614,W-79.87455

|                            | Tran   | Vert   | Long   |      |
|----------------------------|--------|--------|--------|------|
| <b>PPV</b>                 | 3.090  | 2.743  | 3.302  | mm/s |
| <b>ZC Freq</b>             | 31     | 29     | 28     | Hz   |
| <b>Time (Rel. to Trig)</b> | 0.408  | 0.384  | 0.458  | sec  |
| <b>Peak Acceleration</b>   | 0.081  | 0.114  | 0.102  | g    |
| <b>Peak Displacement</b>   | 0.016  | 0.017  | 0.016  | mm   |
| <b>Sensor Check</b>        | Passed | Passed | Passed |      |
| <b>Frequency</b>           | 7.3    | 7.3    | 7.5    | Hz   |
| <b>Overswing Ratio</b>     | 3.5    | 3.4    | 3.4    |      |

**Peak Vector Sum** 3.783 mm/s at 0.458 sec

**USBM RI8507 And OSMRE**



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div  
**Trigger =**

Sensor Check

**Date/Time** Tran at 10:56:05 October 30, 2019  
**Trigger Source** Geo: 10.000 mm/s  
**Range** Geo: 254.0 mm/s  
**Record Time** 3.75 sec (Auto=3Sec) at 1024 sps

**Serial Number** BE19461 V 10.72-8.17 MiniMate Plus  
**Battery Level** 6.3 Volts  
**Unit Calibration** August 31, 2018 by InstanTel  
**File Name** \_TEMP.EVT

### Notes

**Location:** Gas Line  
**Client:** Nelson Aggregates  
**User Name:** Orica Canada  
**General:** 43.40466,-79.88098

### Extended Notes

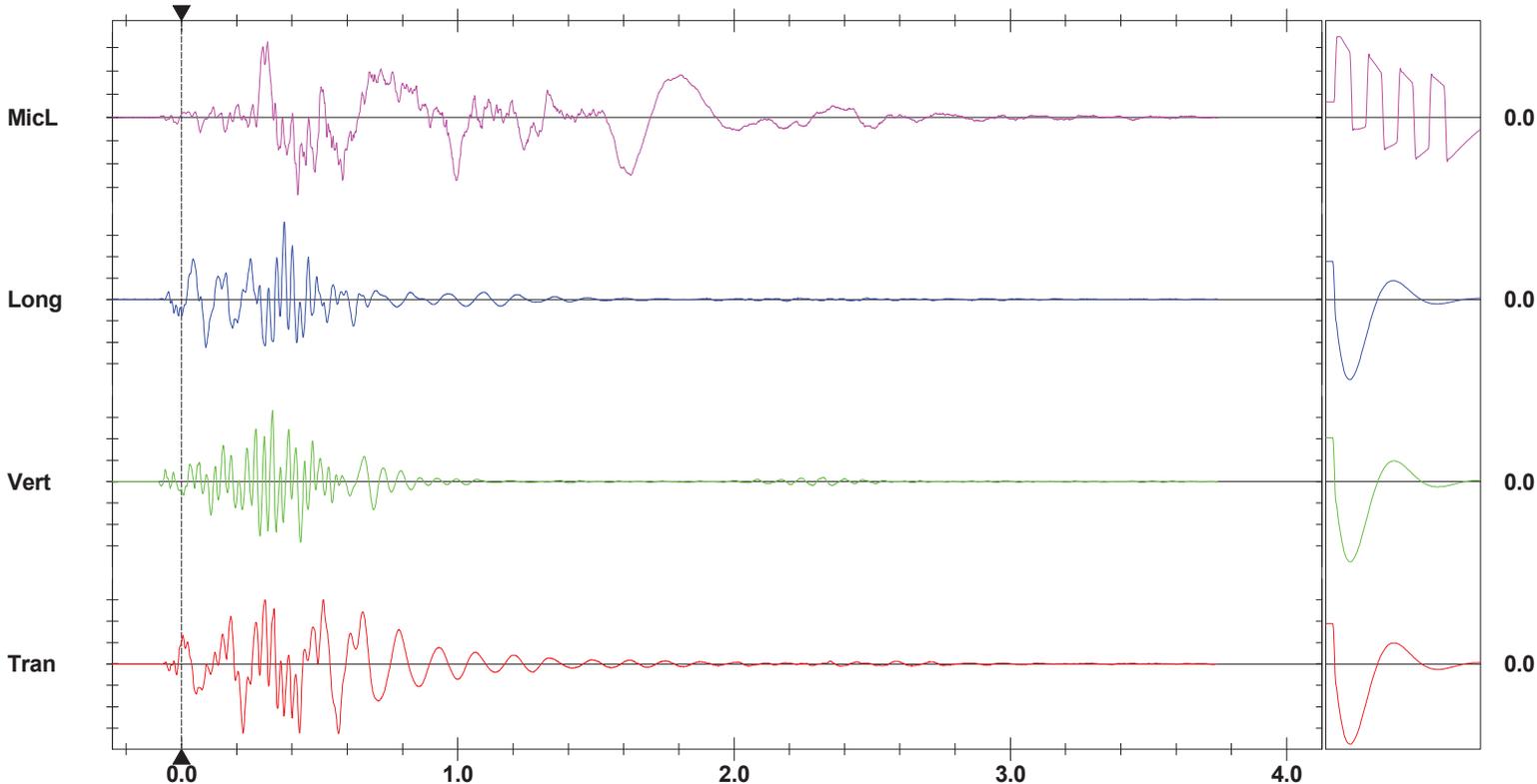
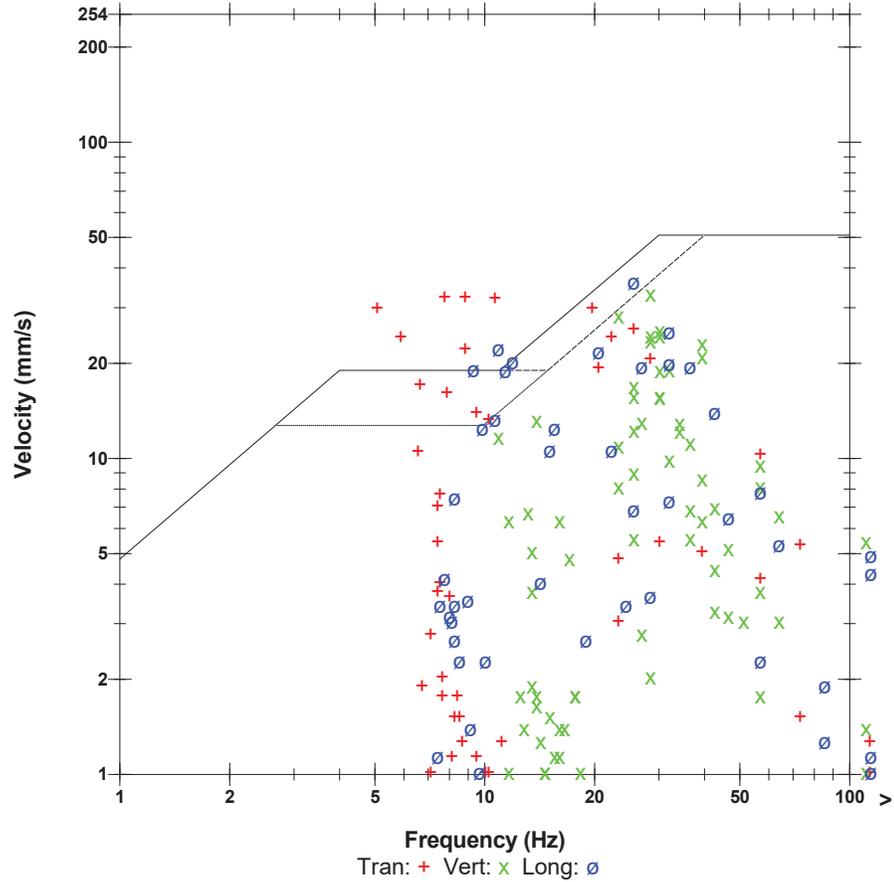
Sand Bagged at gas line

**Microphone** Linear Weighting  
**PSPL** 130.5 dB(L) at 0.421 sec  
**ZC Freq** 9.0 Hz  
**Channel Test** Passed (Freq = 20.1 Hz Amp = 658 mv)

|                     | Tran   | Vert   | Long   |      |
|---------------------|--------|--------|--------|------|
| PPV                 | 32.51  | 33.27  | 36.19  | mm/s |
| ZC Freq             | 8.8    | 28     | 26     | Hz   |
| Time (Rel. to Trig) | 0.568  | 0.329  | 0.372  | sec  |
| Peak Acceleration   | 0.610  | 0.848  | 0.623  | g    |
| Peak Displacement   | 0.579  | 0.182  | 0.257  | mm   |
| Sensor Check        | Passed | Passed | Passed |      |
| Frequency           | 7.4    | 7.3    | 7.4    | Hz   |
| Overswing Ratio     | 3.8    | 3.9    | 4.3    |      |

**Peak Vector Sum** 45.51 mm/s at 0.371 sec

### USBM RI8507 And OSMRE



**Time Scale:** 0.20 sec/div **Amplitude Scale:** Geo: 10.000 mm/s/div Mic: 20.00 pa.(L)/div  
**Trigger =**

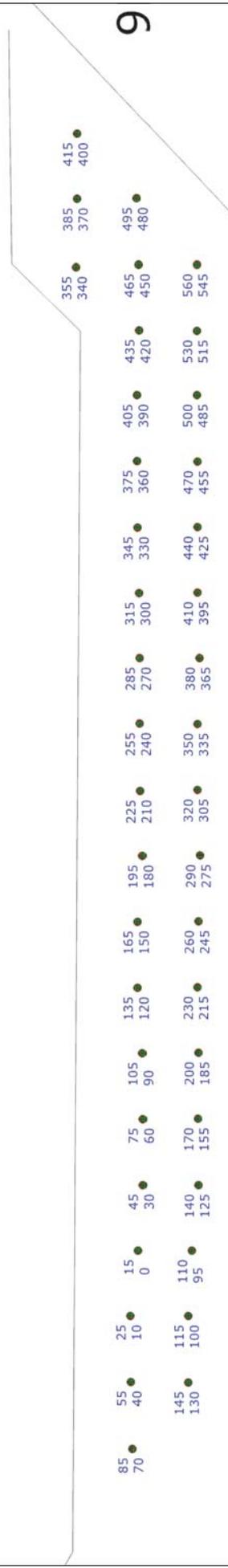
Sensor Check

SHOTPlus Plan

**Blast Summary Data**

|                         |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 8.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 41 | Hole angle: 0.0° |
| Total drilled: 2774.7ft |                      |                     |                  |

# Open Face



9

9MID023 Final  
 4" Blasthole  
 12 X 10, 9 X 10 Pattern  
 250 + 0.6m Subdrill  
**DRILL TO DEPTH OR SHALE + 2 FEET**

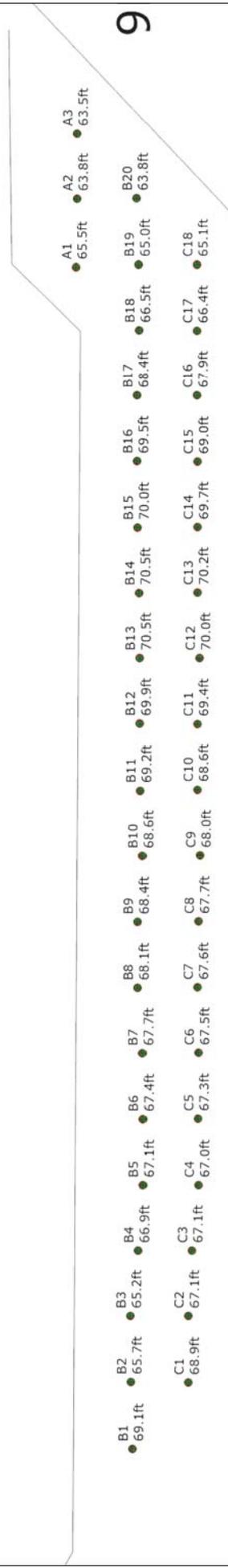


Not to scale

SHOTPlus Plan

| Blast Summary Data      |                      |                     |                  |
|-------------------------|----------------------|---------------------|------------------|
| Burden: 9.0ft           | Spacing: 10.0ft      | Subdrill: 2.0ft     | Stemming: 8.0ft  |
| 1st row burden: 12.0ft  | Hole Diameter: 4.0in | Number of holes: 41 | Hole angle: 0.0° |
| Total drilled: 2774.7ft |                      |                     |                  |

# Open Face



9MID023 Final  
4" Blasthole  
12 X 10, 9 X 10 Pattern  
250 + 0.6m Subdrill

**DRILL TO DEPTH OR SHALE + 2 FEET**



Not to scale

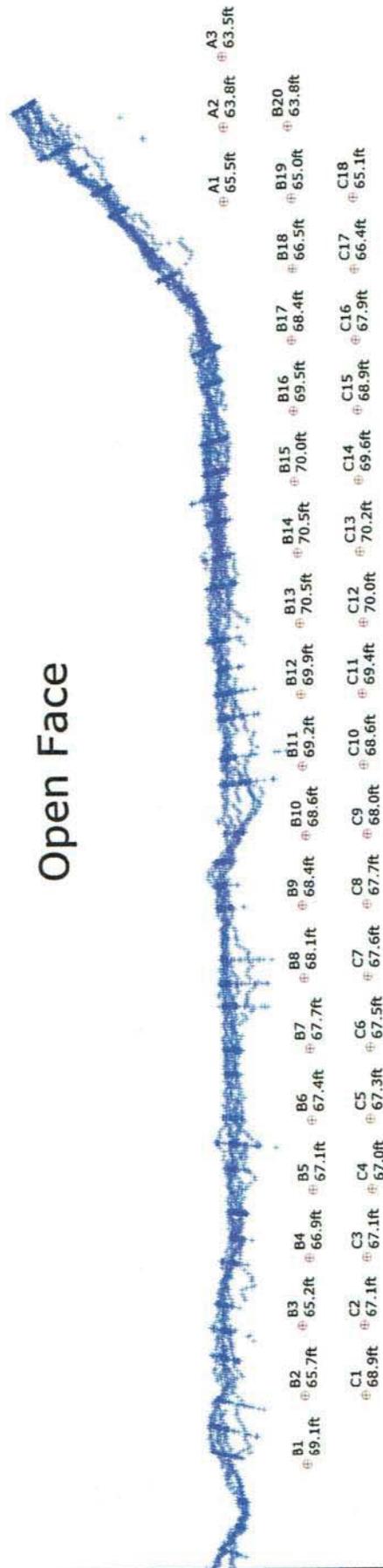


SHOTPlus Plan

Blast Summary Data

Burden: 9.0ft  
 1st row burden: 12.0ft  
 Total drilled: 2774.6ft  
 Spacing: 10.0ft  
 Hole Diameter: 4.0in  
 Subdrill: 2.0ft  
 Number of holes: 41  
 Stemming: 8.0ft  
 Hole angle: 0.0°

Open Face



9MID023 Final  
 4" Blasthole  
 12 X 10, 9 X 10 Pattern  
 250.0 + 0.6m Subdrill



DRILL TO DEPTH OR SHALE + 2 FEET

Not to scale

# Appendix D



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  
Northwest Territories and Nunavut Association of Professional Engineers (NAPEG)  
International Society of Explosives Engineers (ISEE)  
Ontario Stone Sand & Gravel Association (OSSGA)  
Surface Blaster Ontario Licence 450109

## SUMMARY OF EXPERIENCE

Over thirty five 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         |

---

**EXPLOTECH ENGINEERING LTD.**

**Ottawa ♦ Sudbury ♦ Toronto ♦ Halifax**

**WWW.EXPLOTECH.COM**

**1-866-EXPLOTECH**



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

**Mitch Malcomson, P.Eng.**  
Consulting Engineer, Explotech Engineering Ltd.

## **EDUCATION**

Bachelor of Engineering,  
Civil Engineering with Concentration in Business Management,  
Carleton University

## **PROFESSIONAL AFFILIATIONS**

Association of Professional Engineers of Ontario (APEO)  
Association of Professional Engineers and Geoscientists of BC (APEG)  
International Society of Explosives Engineers (ISEE)  
Ontario Stone Sand and Gravel Association (OSSGA)

## **SUMMARY OF EXPERIENCE**

A Consulting Engineer and Project Manager for Explotech Engineering Ltd., Mitch holds a Bachelor of Engineering degree from Carleton University in Civil Engineering with a Concentration in Business Management. Mitch has strong analytical, technical, business and leadership skills. As a Project Manager, Mitch is responsible for operational strategies, scheduling and contract procurement. As a Consulting Engineer, the technical responsibilities include detailed blast designs, blast investigations and reviews, implementation of vibration monitoring programs, development of monitoring equipment/ technologies and building assessments for construction and the drilling and blasting portions of mining, quarrying and construction projects across Canada.

## **PROFESSIONAL RECORD**

2008 – Present - Consulting Engineer / Project Manager, Explotech Engineering Ltd.



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

Mark Morelli, B.Eng.

Explotech Engineering Ltd.

## EDUCATION

Bachelor of Engineering,  
Civil Engineering, Carleton University

## PROFESSIONAL AFFILIATIONS

International Society of Explosives Engineers (ISEE)

## SUMMARY OF EXPERIENCE

A technician working for Explotech Engineering Ltd., Mark holds a Bachelor of Engineering degree in Civil Engineering and has strong technical, leadership, interpersonal, communication, and presentation skills. Recent focus on blast monitoring, data management, scheduling, job estimations, vibration analysis, damage complaint investigation and attenuation analysis.

## PROFESSIONAL RECORD

- 2006 – Present - Technician, Explotech Engineering Ltd.
- 2003 – 2004 - Labourer, Hydracorp Canada Ltd.
- 2002 – 2003 - Labourer, Quad Construction



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

Michael Tobin, B.A.Sc.

Explotech Engineering Ltd.

## EDUCATION

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

## PROFESSIONAL AFFILIATIONS

International Society of Explosives Engineers (ISEE)

## SUMMARY OF EXPERIENCE

A technician working for Explotech Engineering Ltd., Michael holds a Bachelor of Applied Science degree from Queen's University in Geological Engineering. Michael has strong analytical, technical, and interpersonal skills. Recent projects have focused on blast monitoring, vibration analysis, job estimation, damage complaint investigation and equipment maintenance and repair.

## PROFESSIONAL RECORD

2017 – Present - Technician, Explotech Engineering Ltd.

# Appendix E



## Blasting Terminology

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ANFO:                   | Ammonium Nitrate and Fuel Oil – explosive product                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| ANFO WR:                | Water resistant ANFO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Blast Pattern:          | Array of blast holes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Body hole:              | Those blast holes behind the first row of holes (Face Holes)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Burden:                 | Distance between the blast hole and a free face                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Column:                 | That portion of the blast hole above the required grade                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Column Load:            | The portion of the explosive loaded above grade                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Collar:                 | That portion of the blast hole above the explosive column, filled with inert material, preferably clean crushed stone                                                                                                                                                                                                                                                                                                                                                                                                             |
| Face Hole:              | The blast holes nearest the free face                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Overpressure:           | A compressional wave in air caused by the direct action of the unconfined explosive or the direct action of confining material subjected to explosive loading.                                                                                                                                                                                                                                                                                                                                                                    |
| Peak Particle Velocity: | The rate of change of amplitude, usually measured in mm/s or in/s. This is the velocity or excitation of the particles in the ground resulting from vibratory motion.                                                                                                                                                                                                                                                                                                                                                             |
| Scaled distance:        | An equation relating separation distance between a blast and receptor to the energy (usually expressed as explosive weight) released at any given instant in time.                                                                                                                                                                                                                                                                                                                                                                |
| Sensitive Receptor:     | Sensitive land use may include recreational uses which are deemed by the municipality or provincial agency to be sensitive; and/or any building or associated amenity area (i.e. may be indoor or outdoor space) which is not directly associated with the industrial use, where humans or the natural environment may be adversely affected by emissions generated by the operation of a nearby industrial facility. For example, the building or amenity area may be associated with residences, senior citizen homes, schools, |

# EXPLOTECH

day care facilities, hospitals, churches and other similar institutional uses, or campgrounds.

|            |                                                                                                                                                            |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spacing:   | Distance between blast holes                                                                                                                               |
| Stemming:  | Inert material, preferably clean crushed stone applied into the blast hole from the surface of the rock to the surface of the explosive in the blast hole. |
| Sub-grade: | That portion of the blast hole drilled and loaded below the required grade                                                                                 |
| Toe Load:  | The portion of explosive loaded below grade                                                                                                                |



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# Appendix F

**Golder Associates Ltd.**

2390 Argenta Road  
Mississauga, Ontario, Canada L5N 5Z7  
Telephone 905-567-4444  
Fax 905-567-6561



**REPORT ON**

**BLASTING IMPACT ASSESSMENT  
PROPOSED NELSON AGGREGATE  
NELSON QUARRY EXTENSION**

Submitted to:

Nelson Aggregate Co.  
P.O. Box 1070  
Burlington, Ont. L7R 4L8

**DISTRIBUTION:**

20 Copies - Nelson Aggregate Co.  
2 Copies - Golder Associates Ltd.

April 2006

021-1238



## EXECUTIVE SUMMARY

Blasting operations within the proposed extension of the Nelson quarry may be readily carried out in compliance with existing provincial environmental guideline limits with respect to ground and air vibrations. These effects are subject to recommended limits of 12.5 mm/s and 128 dBL respectively, as established by the Ontario Ministry of the Environment and outlined in Noise Pollution Control (NPC) publication 119 of the Model Municipal Noise Control By-Law, for operations where monitoring of these effects is carried out as a matter of routine.

Ground and air vibration attenuation characteristics were monitored and assessed from a number of routine production blasts within the existing Nelson quarry. The results indicate that the majority of the proposed extension may be excavated using the blast parameters currently being used in the existing quarry. These would include reducing the borehole diameter, reducing the bench height and reducing the explosive weight per delay period. The Nelson quarry would continue monitoring all blasts during extraction within the proposed extension area. The blasting operations within the proposed extension would have no impact on the integrity of adjacent water wells.

By ensuring that the ground and air vibration levels produced during blasting operations at the Nelson quarry continue to remain within the recommended provincial guideline limits, there would not be any noticeable cumulative effect on adjacent structures associated with the blasting operations within the proposed extension.

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## 1.0 INTRODUCTION

Golder Associates was retained by Nelson Aggregate Co. to carry out an impact assessment of the environmental effects from future blasting operations within the proposed extension of the existing licensed area of the Nelson Quarry Company quarry. The proposed extension would be located immediately south of No. 2 Sideroad on Part Lots 17 and 18, Concession 2 in the City of Burlington. The impact assessment specifically addresses whether the applicable Ontario Ministry of Environment guidelines with respect to ground and air vibration effects could be met at the residential properties closest to the proposed extension.

The investigation included monitoring a number of regularly scheduled production blasts at various receptor points around the blast site to assess site-specific ground and air vibration decay characteristics.

This report addresses the following topics:

- reviews existing provincial and federal guidelines for the assessment of environmental impacts from blasting,
- provides recommendations for the continued control of ground and air vibration effects,
- evaluates the potential impact of the blasting operations on bedrock strata and adjacent water wells,
- evaluates the long term impact of the blasting operations on surrounding structures.

## **2.0 EXISTING CONDITIONS**

### **2.1 Site Description**

The existing licensed Nelson Quarry Co. quarry (Nelson) is situated immediately north of No. 2 Sideroad and south of Colling Road between Guelph Line and Cedar Springs Road in the City of Burlington, Ontario in the Region of Halton (see Figure 1). The proposed extension area would encompass an area of approximately 82.3 Hectares immediately south of the existing quarry and No. 2 Sideroad, as seen in Figure 2.

As shown in Figures 2 and 4, the closest residential properties to the proposed extension consist of those residences to the east and west on the south side of No. 2 Sideroad. Compared to the existing quarry location, the proposed extension is relatively remote from the existing neighbouring properties. The closest residential receptors have been identified as the residences along No. 2 Sideroad (see Appendix B). The topography of the area generally consists of gently rolling hills.

### **2.2 Quarry Blasting Operations**

The Nelson quarry currently operates a single bench which varies in height from approximately 19 to 26 m. Typical blast design details for the existing quarry are given in Table 1 while common quarry blasting terms and procedures are illustrated in Figure 3.

All blasting at the Nelson quarry is monitored for ground and air vibration effects. Monitoring is routinely being carried out at three locations along the south side of No. 2 Sideroad and occasionally within Mount Nemo Court, east of Guelph Line.

Blasting procedures within the proposed extension would be carried out in a manner similar to those currently being carried out for the existing Nelson quarry, as shown in Table 1.

### **3.0 PROPOSED EXTRACTION OF EXTENSION AREA**

The proposed sequence of extraction for the extension is illustrated in Figure 4. Extraction within the proposed extension area would commence with the crossing of No. 2 Sideroad west of the existing office. Extraction of Phase 1 would see an approximately 100 m wide working face advanced in a westerly direction along the north side of the proposed extension, as shown in Figure 4. Phases 2 and 3 would see the entire west side of the extension extracted in a southerly direction before proceeding east along the south boundary.

Extraction of Phase 4 would be carried out in a northerly direction which would complete extraction of the west half of the proposed extension. Phases 5a and 5b would be carried out in an easterly direction in the southeast corner of the extension while the remainder of the property would be extracted as Phase 6 in a northerly direction, as seen in Figure 4.

## 4.0 IMPACT IDENTIFICATION

The environmental effects most often associated with blasting operations are ground vibrations and air concussion.

The intensity of ground vibrations, which is an elastic effect measured in units of peak particle velocity, is defined as the speed of excitation of particles within the ground resulting from vibratory motion. For the purposes of this report, peak particle velocity is measured in mm/s.

While ground vibration is an elastic effect, one must also consider the plastic or non-elastic effect produced locally by each detonation when assessing the effects on the bedrock strata and local water wells. The detonation of an explosive produces a very rapid and dramatic increase in volume due to the conversion of the explosive from a solid to a gaseous state. When this occurs within the confines of a borehole it has the following effect:

- The bedrock in the area immediately adjacent to the explosive product is crushed.
- As the energy from the detonation radiates outward from the borehole, the bedrock between the borehole and quarried face becomes fragmented and is displaced while the bedrock behind the borehole is fractured.
- Energy not used in the fracturing and displacement of the bedrock dissipates in the form of ground vibrations, sound and airblast. This energy attenuates rapidly from the blast site due to geometric spreading and natural damping.

Air concussion, or air vibrations, is a pressure wave traveling through the air produced by the direct action of the explosive on air or the indirect action of a confining material subjected to explosive loading. Air vibrations from surface blasting operations consist primarily of acoustic energy below 20 Hz, where human hearing is less acute (Siskind et al., 1980), while noise is that portion of the spectrum of the air vibration lying within the audible range from 20 to 2000 Hz. It is the lower frequency component (below 20 Hz) of air concussion, that which is less audible, that is of interest as it is often the source of secondary rattling and shaking within a structure. For the purposes of this report, air vibration is measured as decibels in the Linear or Unweighted mode (dBL). This differs from noise (above 20 Hz) which is measured in dBA.

Both ground and air vibration effects produced at private structures adjacent to surface or underground mining operations are subject to guidelines contained in Noise Pollution Control (NPC) publication 119 of the Model Municipal Noise Control By-Law, dated August, 1978, published by the Ontario Ministry of Environment. Under conditions where monitoring of the blasting operations is routinely carried out, as it is at the Nelson Quarry, the recommended ground and air vibration limitations at the nearest private structure would be 12.5 mm/s and 128 dBL respectively. A copy of Publication NPC 119 is reproduced in Appendix A.

## 5.0 QUARRY BLAST MONITORING

As part of this study, peak ground and air vibration levels were monitored during several typical quarry production blasts in the existing quarry at progressively increasing distances from the blast site. The blasts occurred both on the south and east faces of the quarry. Instrumentation consisted of Instantel DS-077 Minimates, Minimate Pluses and DS-477 Blastmates. These instruments measure and record ground vibration velocities in each of three orthogonal directions, as well as simultaneously recording air vibration levels. Instrumentation was generally set up in a line at distances ranging from about 100 to 600 m from the blast site. Specific instrument and blast locations were established using a Garmin GPS electronic navigation aid (NAVAID) to determine accurate distances between the blast and receptors.

### 5.1 Attenuation Characteristics

The rate at which ground vibrations attenuate or decrease with increased distance from a blast source depends on a variety of conditions, including the type and condition of the bedrock being blasted, depth and composition of the earth covering deposits (soil), and the general topography. Air vibration effects are less affected by these factors, being more influenced by the prevailing weather conditions at the time of the blast.

The following relationships were established from the blast monitoring results.

#### 5.1.1 Ground Vibrations

The ground vibration attenuation characteristics established for the Nelson Quarry is presented in Figure 5 as a plot of the peak particle velocity against the Scaled Distance. Scaled Distance is defined as:

$$\text{Scaled Distance (SD)} = D/\sqrt{W}$$

where D = distance (m) between the blast and receptor

W = maximum weight of explosive (kg) detonated per delay period

As seen in Figure 5 the collection of points defining the rate of decay for the ground vibrations exhibits a degree of scatter that is inherent in all Scaled Distance plots. Factors responsible for these variations include the geologic conditions of the bedrock (type and structure), different wave types, errors in blast initiation timing, differences between types of explosives, degree of confinement, and differences in blast efficiencies.

The equation for the 95% regression line developed in Figure 5 can be expressed as:

$$PPV = 896(SD)^{-1.32}$$

where PPV = Peak Particle Velocity (mm/s)  
SD = Scaled Distance (m/(kg<sup>0.5</sup>))

The calculated Scaled Distance for a peak ground vibration level of 12.5 mm/s would equal 25.5 m/(kg<sup>0.5</sup>). The purpose of this equation is not so much to predict what a given vibration level would be at a particular location for a given blast, but to indicate the probability that the peak vibration would fall below the level indicated by the equation for a given distance and maximum explosive weight. The equation is therefore a useful blast design tool in establishing maximum explosive charge weights per delay for various distances from a blast site for a given maximum ground vibration level.

### 5.1.2 Air Vibrations

Cube root scaling was used in establishing the air vibration decay characteristics as given in the following relationship:

$$\text{Scaled Distance (SD)} = D/\sqrt[3]{W}, \quad \text{where D and W are defined as previously described.}$$

Figure 6 shows the Scaled Distance air vibration plot, which exhibits considerably more scatter and has a typically poorer correlation than that seen with the ground vibration results. This is primarily due to variable weather conditions during each blast, which are entirely independent of the blasting operations. Other factors influencing air vibration distribution from a blast include the length of collar and type of stemming material used, differences in explosive types and variations in burden distance.

The 95% regression curve given in Figure 6 can be expressed as:

$$APL = 181(SD)^{-0.0867}$$

where SD = as defined above  
APL = air pressure level (dBL)

The calculated Scaled Distance for a peak air vibration level of 128 dBL would equal 53.0 m/(kg<sup>0.33</sup>). The variability in the plot suggests that it is less reliable as a tool for guiding blast design.

Site specific Scaled Distance plots are commonly used as a blast design tool since peak vibration levels can be reasonably predicted at specified distances from a blast site. Based on the 95%

regression equations given in Figures 5 and 6, Table 2 shows the maximum suggested explosive loads for various distances from the blast site based on the provincial guideline limits of 12.5 mm/s and 128 dBL discussed previously. It can be seen that the ground vibration limit of 12.5 mm/s becomes the more restrictive guideline when determining maximum explosive loads beyond a distance of about 225 m for the quarry's blasting operations.

## **6.0 IMPACT ASSESSMENT**

### **6.1 Compliance with NPC 119**

It is evident from the regression equations discussed in Section 5 that the distance between the blast and the receptor and the amount of explosive detonated per delay period are the principal parameters in controlling ground and air vibration effects. The maximum explosive loads given in Table 2 for limiting peak ground and air vibration levels to 12.5 mm/s and 128 dBL respectively, indicate that the provincial guidelines may be complied with for all blasting beyond a distance of about 200 m from adjacent private residential properties. This represents a majority of the proposed extension and is based on a maximum explosive weight per delay of about 60 kg. When blasting approaches to within about 200 m of adjacent private residences, it may become necessary to reduce the maximum explosive weight detonated per delay period within the blast. Any one or combination of the following operations would achieve this:

1. Reducing the borehole diameter with a corresponding reduction in the drill pattern.
2. Introduce additional decked charges within each borehole, as illustrated on Figure 3.
3. Reduce the borehole length (depth) by reducing the bench height.

For example, a reduction in the borehole diameter from 127 mm to 76 mm would effectively reduce the explosive column weight per hole by about 65%. Decking the explosive column could further reduce the explosive column weight by an additional 50%. Additional decking and reductions in bench heights, as identified above, could achieve further reductions in maximum explosive weights.

As it is the intention of the Nelson quarry to continue monitoring all blasting operations, the attenuation curves discussed previously would be used in conjunction with the monitoring data collected at adjacent properties to dictate when changes to the blast procedure become necessary within the proposed extension. Although a reduction in the maximum instantaneous explosive load is anticipated as blasting approaches the residences to the east and west, the ground and air vibration guideline limits contained within NPC 119 would continue to be maintained.

### **6.2 Repeated Vibration Effects on Structures**

Blast vibrations characteristically produce temporary transient strains within the various materials that makeup a residential structure. These strains would typically have durations of no more than one or two seconds for each blast as the vibration passed the structure. In addition to these temporary strains, Table 3 shows the strain levels produced in a household by changes in temperature and humidity (environmental changes), as well as those produced by regular household activities (Dowding, 1985), which occur on a recurring and often frequent basis. These strain levels are compared to equivalent levels of ground vibration produced from blasting

operations. It is evident from Table 3 that routine household activities and environmental changes can at times produce strains within a structure that are well in excess of those produced by blasting.

Several studies have also been carried out to look at the long-term effects of repeated blasting on structures (Stagg et al, 1984, Siskind et al, 1980). These studies concluded that repeated blasting over several decades, producing peak vibration levels well in excess of the provincial guideline limit, were required to cause cosmetic threshold cracking to occur. By ensuring that blasting continues to remain within the provincial guideline limits, there would not be any noticeable cumulative effect associated with the blasting operations within the extension area.

### **6.3 Effects on Bedrock and Water Wells**

As discussed previously, under typical blasting conditions stresses introduced into the bedrock by the explosive detonation and the accompanying gas pressures create and extend fractures within the bedrock around each borehole. Fracture development is usually limited to the equivalent distance of about 20 times the borehole diameter. In the case of the blast procedures expected for the proposed extension, this would equate to about two to three metres for a 114 mm diameter hole. The gas pressures within the hole may extend micro-cracks or existing natural discontinuities within the bedrock, such as joints or bedding planes, beyond this distance.

Studies on crack development within bedrock from blast detonations (Keil et al., 1977) indicate that peak ground vibration levels of 300 to 600 mm/s are required to create micro-cracks or open existing discontinuities. Our own experience within the limestone of Southern Ontario indicates that such values would not be anticipated beyond a distance of about 10 to 20 m from the blast site, depending on such parameters as drill hole diameter and the type of explosive product. It is evident therefore that the creation or extension of fractures within the bedrock would remain confined to an area immediately around the blast site.

Several studies have been carried out to investigate the effects of blasting on ground water wells (Froedge, 1983). These studies have concluded that:

1. When blast induced ground vibrations are less than about 25 mm/s maximum resultant particle velocity, the response of the well is limited to a slight temporary variation in water level on the order of 3 to 6 cm either up or down. The specific capacity of the water well is unchanged based on drawdown tests.
2. Vibration measurements made at the surface and at the bottom of the observation wells indicate the vibration levels are always lower at the bottom of the well.
3. All of the data collected indicates that a ground vibration limit of 50 mm/s peak particle velocity is adequate to protect the wells from any significant damage. There is a possibility that temporary turbidity may be caused at lower levels periodically, although not at any constant threshold level.

The research consistently indicates that blast vibrations below 25 mm/s should have no adverse effects on nearby wells. As the maximum provincial guideline vibration limitation at the nearest residence is only half of this value, at 12.5 mm/s, the ground vibrations produced from the quarry's blasting operations within the proposed extension area would have no effect on the integrity of neighbouring water wells.

## 7.0 CONCLUSIONS

Based on the foregoing considerations, it is our opinion that blasting operations may be readily performed within the limits of the proposed extension of Nelson Quarry Company quarry in compliance with the current quarry blasting guidelines published by the Ministry of Environment. All blasting and blast monitoring would occur in accordance with the Aggregate Resources Act prescribed conditions in order to ensure compliance with the provincial guidelines.

### **GOLDER ASSOCIATES LTD.**



Marcus V. van Bers, P. Eng.  
Associate

MVVB/AC/ms/co

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**TABLES**

**TABLE 1**  
**Existing Blast Details for Nelson Quarry Company**

| PARAMETER                                      | NELSON QUARRY                      |
|------------------------------------------------|------------------------------------|
| Bench (face) height (m)                        | 19 - 26                            |
| Drill hole pattern (m)                         | 2.4 x 2.4 – 4.3 x 4.3              |
| Drill hole diameter (mm)                       | 76 – 114                           |
| Sub-drill depth (m)                            | 0.6                                |
| Collar length (m)                              | 1.7 – 3.0                          |
| Holes per blast                                | 7 – 40                             |
| Explosive product(s) used                      | Emulsion/ANFO blend                |
| Initiation system                              | Electric, Electronic               |
| Delay timing (ms)                              | 25ms (electric), 13ms (electronic) |
| Maximum explosive weight per delay period (kg) | 30 – 279                           |

*Note:* See Figure 3 for a description of blasting terms.

**TABLE 2**  
**Maximum Explosive Loads vs Distance**  
**for 12.5 mm/s and 128 dBL**

| Distance (m) | PPV = 12.5 mm/s<br>SD = 25.5 kg/m <sup>0.5</sup> | INL = 128 dBL<br>SD = 53.0 kg/m <sup>0.33</sup> |
|--------------|--------------------------------------------------|-------------------------------------------------|
| 100          | 15                                               | 7                                               |
| 150          | 35                                               | 23                                              |
| 200          | 61                                               | 54                                              |
| 250          | 96                                               | 105                                             |
| 300          | 138                                              | 181                                             |
| 400          | 246                                              | 429                                             |
| 500          | 384                                              | 838                                             |
| 600          | 553                                              | 1449                                            |

*Note:* See Section 5 of accompanying report.

TABLE 3

## Strain Levels Induced by Household Activities, Environmental Changes and Blasting

| Loading Phenomena           | Site <sup>a</sup> | Microstrain Induced by Phenomena ( $\mu\text{in.in.}$ ) | Corresponding Blast Vibration Level <sup>b</sup> (mm/s) |
|-----------------------------|-------------------|---------------------------------------------------------|---------------------------------------------------------|
| Daily environmental changes | K <sub>1</sub>    | 149                                                     | 30.0                                                    |
|                             | K <sub>2</sub>    | 385                                                     | 76.0                                                    |
| Household activities:       |                   |                                                         |                                                         |
| 1. Walking                  | S <sub>2</sub>    | 9.1                                                     | 0.8                                                     |
| 2. Heel drops               | S <sub>2</sub>    | 16.0                                                    | 0.8                                                     |
| 3. Jumping                  | S <sub>2</sub>    | 37.3                                                    | 7.1                                                     |
| 4. Door slams               | S <sub>1</sub>    | 48.8                                                    | 12.7                                                    |
| 5. Pounding nails           | S <sub>12</sub>   | 88.7                                                    | 22.4                                                    |

<sup>a</sup>K<sub>1</sub> and K<sub>2</sub> were placed across a taped joint between two sheets of gypsum wallboard.

<sup>b</sup>Blast equivalent based on envelope line of strain vs ground vibration.

Source: Dowding (1985)

**FIGURES**

# KEY LOCATION PLAN NELSON QUARRY

FIGURE 1



**Existing Nelson  
Burlington  
Quarry**

**REFERENCE:**  
THIS FIGURE WAS CREATED FROM A MAPART  
MAP TITLED "HAMILTON" 2003 EDITION.

Date: **SEPTEMBER 2004**

Drawn: **RJ**

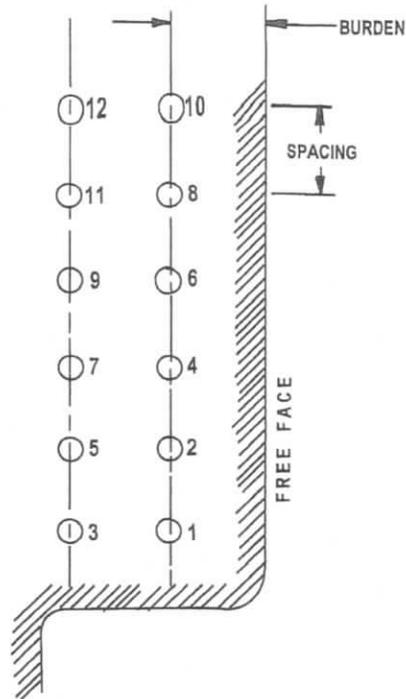
Project: **021-1238**

**Golder Associates**

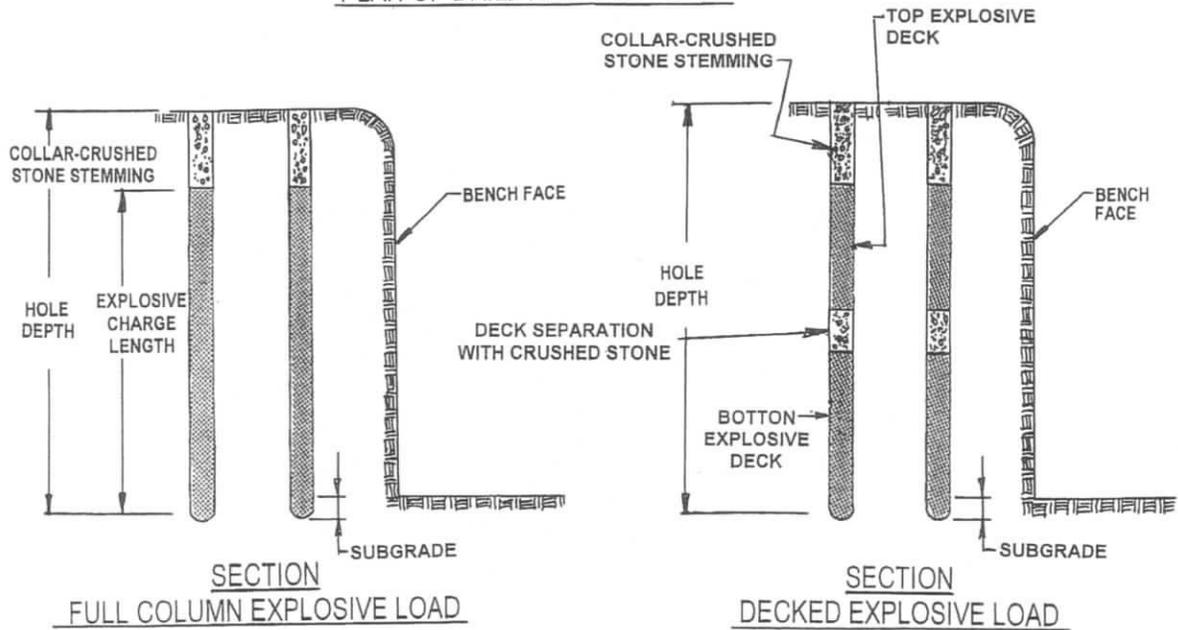
Chkd: \_\_\_\_\_

0211238FIG01.cdr

| NUMBERS SHOW SHORT PERIOD DELAY | EXAMPLE OF FIRING TIMES (MILLISECONDS) |
|---------------------------------|----------------------------------------|
| PERIOD 1                        | 25                                     |
| PERIOD 2                        | 50                                     |
| PERIOD 3                        | 75                                     |
| PERIOD 4                        | 100                                    |
| PERIOD 5                        | 125                                    |



PLAN OF DRILL HOLE PATTERN



SECTION FULL COLUMN EXPLOSIVE LOAD

SECTION DECKED EXPLOSIVE LOAD

0211238F IG03.cdr

Date: SEPTEMBER 2004

Project: 021-1238

Golder Associates

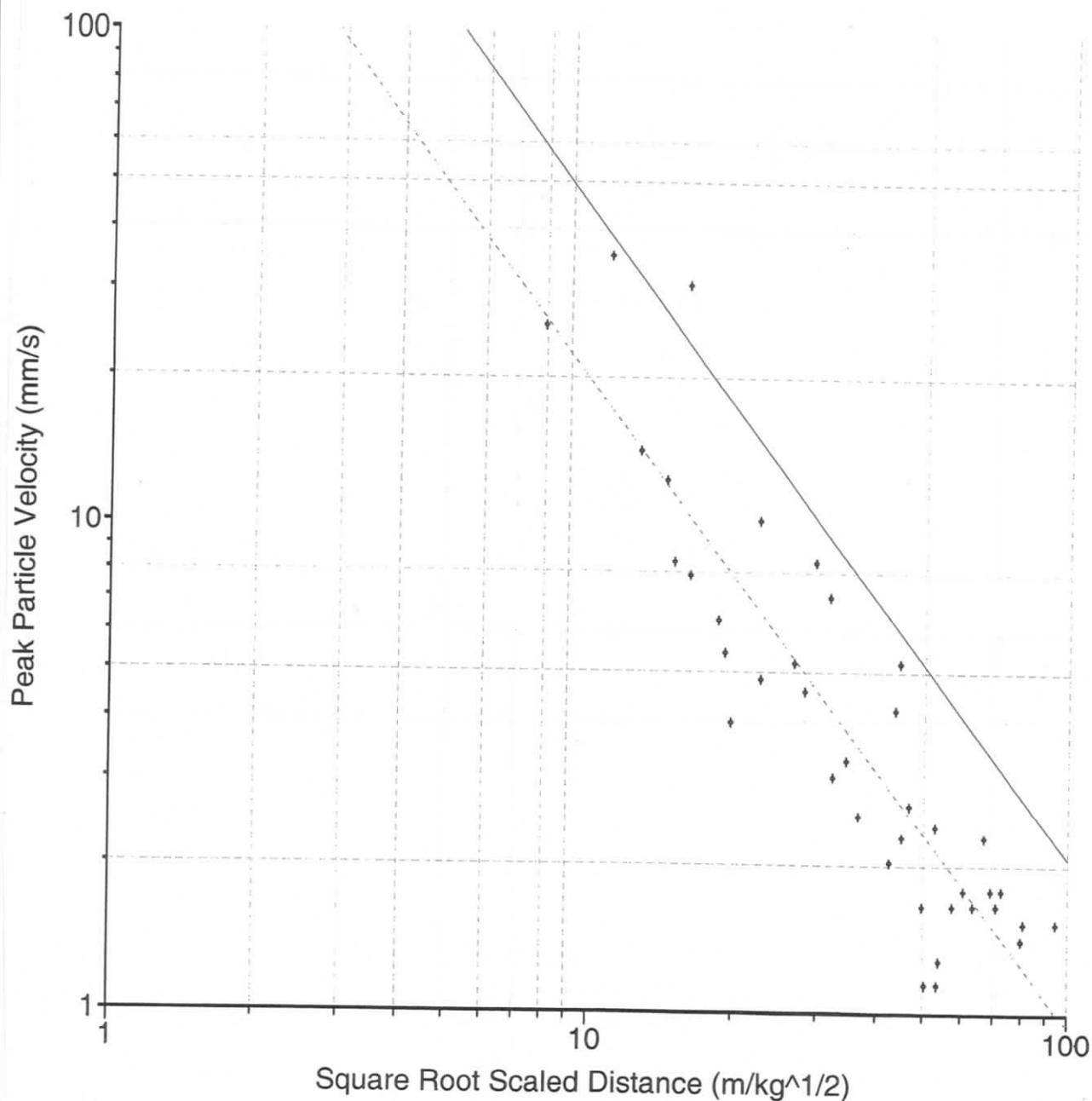
Drawn: RJ

Chkd:

NELSON QUARRY GROUND VIBRATION  
ATTENUATION CURVE

FIGURE 5

Coefficient of Determination = 0.811 Standard Deviation = 0.172



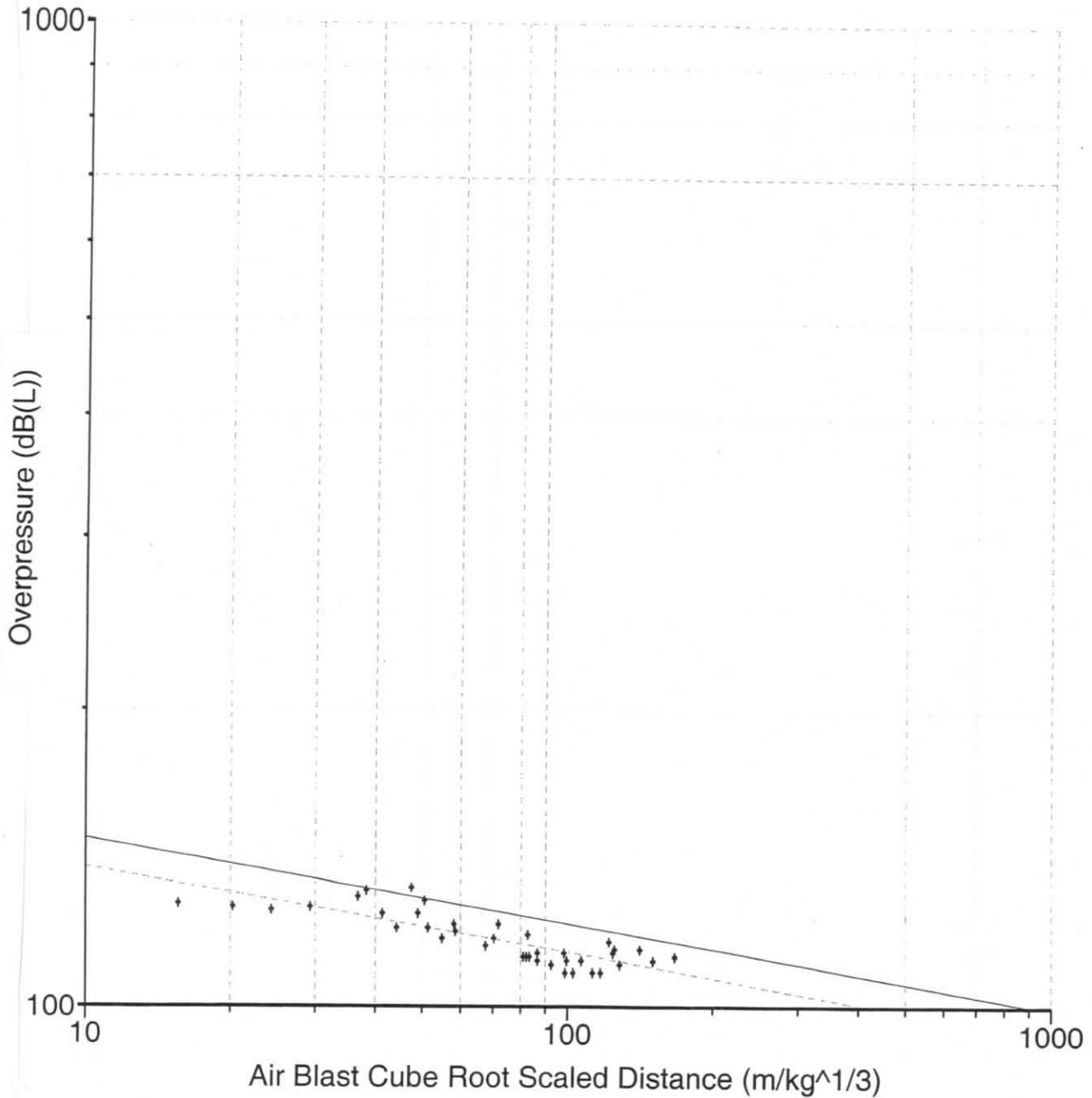
Date.....Aug 29/04.....  
Project...021-1238.....

Drawn.....*AMB*.....  
Chkd.....*AMB*.....

NELSON QUARRY AIR VIBRATION  
ATTENUATION CURVE

FIGURE 6

Coefficient of Determination = 0.677 Standard Deviation = 0.0145



Date.....Aug 29/04.....  
Project...021-1238.....

Drawn.....*MMB*.....  
Chkd.....*MMB*.....

**APPENDIX A**  
**PUBLICATION NPC 119**

## **PUBLICATION NPC-119**

### **Blasting**

#### **Scope**

This Publication refers to limits on sound (concussion) and vibration due to blasting operations.

#### **Technical Definitions**

The technical terms used in this Publication are defined in Publication NPC-101 – Technical Definitions.

#### **Measurement Procedures**

All measurements of peak pressure level and vibration velocity shall be made in accordance with the “Procedure for Measurement of Sound and Vibration due to Blasting Operations” set out in Publication NPC-103 – Procedures, section 5.

#### **Concussion – Cautionary Limit**

Subject to section 5 the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 120 dB.

#### **Concussion – Peak Pressure Level Limit**

If the person in charge of a blasting operation carries out routine monitoring of the peak pressure level, the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 128 dB.

#### **Vibration – Cautionary Limit**

Subject to section 7, the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.00 cm/s.

#### **Vibration – Peak Particle Velocity Limit**

If the person in charge of a blasting operation carries out routine monitoring of the vibration the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.25 cm/s.

**APPENDIX B**  
**NEW RESIDENCE RECEPTOR LOCATION**

**Golder Associates Ltd.**

2390 Argentia Road  
Mississauga, Ontario, Canada L5N 5Z7  
Telephone 905-567-4444  
Fax 905-567-6561



December 13, 2004

021-1238

Nelson Aggregate Co.  
P.O. Box 1070  
Burlington, Ontario  
L7R 4L8

Attention: Mr. Tom Palko  
Property Manager

**RE: BLASTING IMPACT ASSESSMENT PROPOSED NELSON AGGREGATE  
NELSON QUARRY EXTENSION NEW RESIDENCE RECEPTOR LOCATION**

Dear Mr. Palko:

Further to our report entitled "Blasting Impact Assessment Proposed Nelson Aggregate Nelson Quarry Extension" dated September, 2004, it is our understanding that the closest residential receptor to the proposed Nelson Aggregate Nelson quarry extension has now been identified as the residence at 2416 No. 2 Sideroad, located in the northeast corner of the proposed extraction area. The residence and ancillary buildings at 2416 No. 2 Sideroad are located a minimum of 290 m from the Phase 1 extraction area and 370 m from the Phase 5B extraction area.

As stated in Section 6.0 Impact Assessment of the report identified above, the recommended Ontario provincial ground and air vibration guideline limits of 12.5 mm/s and 128 dBL respectively, may be complied with for all blasting beyond a distance of about 200 m. This indicates that the extraction of Phases 1 through 5B and part of Phase 6 may be carried out without any changes to the quarry's existing blasting procedures.



It is our opinion that blasting operations may be carried out within the proposed extension area in compliance with the current quarry blasting guidelines while the residence at 2416 No. 2 Sideroad is occupied. If you have any additional questions please do not hesitate to contact me.

Yours truly,

**GOLDER ASSOCIATES LTD.**

Marcus V. van Bers, P.Eng.  
Associate

MVB/co

cc: Mr. Brian Zeman, MHBC Planning

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