

Report Prepared
for
Austin Powder Company

Blasting Impacts at New Shine Quarry, WA.



September 2011.



Blastotechnology #101102



EXECUTIVE SUMMARY

Blastotechnology and Austin Powder Company have undertaken a review of the likely impact of vibration, air overpressure, and flyrock from blasting operations at the New Shine Quarry near Port Ludlow in Jefferson County, WA. The review was undertaken to help authorities and local residents put potential impacts into the perspective of standards used nationally throughout the United States to regulate blasting, and also into the perspective of likely perception and exposures to these effects.

The area around the quarry is considered remote in relation to many other quarry locations in the United States. The nearest existing residential structure is located southeast of the quarry site, approximately 4,000 feet from the nearest edge of the proposed blasting operations (Phase 1A of the proposed quarry development), with a second structure located approximately 6000 feet. The nearest portion of the Port Ludlow Master Planned Resort (MPR) is an area of unplatted land zoned for residential use approximately 2,000 feet from the nearest Phase 2 blasting. However, the closest platted lot in the MPR is located approximately 6,600 feet from any quarry operations area. The closest portion of the Port Ludlow Golf Course is approximately 3,200 feet from the nearest point of blasting in the Phase 2 mining area. A portion of the Timberton Loop Trail, which is maintained by the Port Ludlow MPR, but is located outside its boundaries, is approximately 1,500 feet from the proposed Phase 2 blasting areas.

Production blasting is expected to occur no more frequently than twice a month. The duration of blasts will typically be less than 1 second, with blast vibrations probably persisting for a period not exceeding 2 seconds for each blast.

The review of blasting impacts with regard to the Port Ludlow community shows that the expected levels of both ground vibration and overpressure measured at distances 4,000 feet and greater from the area of quarry operations are expected to be in the range “barely perceptible” to “imperceptible,” and close to the bottom limits of detection of modern seismic monitoring equipment. The areas of the MPR greater than 4,000 feet from quarry operations include all existing residences and platted lots and a majority of the Port Ludlow Golf Course. At distances between 3,000 feet and 4,000 feet from the quarry, the blasting vibration and overpressure levels are expected to be only slightly higher than “barely perceptible.” The areas of the MPR between 3,000 and 4,000 feet from quarry operations include Holes 3, 4, and 5 of the Port Ludlow Golf Course’s Timber Course, land preserved as MPR open space, and part of undeveloped residentially-zoned land at the MPR’s southwest corner for which no plans to subdivide or develop have been submitted. At distances between 1,500 feet and 3,000 feet from the area of operations, levels of both vibration and overpressure will be distinctly perceptible, but less than one third of the levels considered safe by the guidelines used throughout the United States to ensure that no significant damage will occur

to structures (though no structures currently exist in this area). The area 1,500 feet to 3,000 feet from quarry operations includes undeveloped forest land owned by Pope Resources and part of the undeveloped residentially-zoned land at the southwest corner of the MPR. These estimates have been made based on the proposed scale of blasting at the quarry, and on the results of trial blasting conducted on 16 February 2011.

Blasts are not expected to produce rock projections greater than approximately 100 feet from the “free-face” area of any blast, and no rock projections are expected beyond the quarry boundaries. All blasts will be video recorded to ensure that tight control is always maintained over rock projections.

The vibration and overpressure impacts from blasting are expected to comfortably comply with the guidelines for safe blasting in the United States Bureau of Mines Reports of Investigations RI 8507 (vibration) and RI 8485 (overpressure) for all structures more than approximately 1,500 ft from blasting operations.

Report prepared for Austin Powder Company
On behalf of IMQ, New Shine Quarry WA.

Blasting Impacts at New Shine Quarry, WA.

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Blasting Impacts from New Shine Quarry, WA.

1. BACKGROUND

On 16 February, 2011, Austin Powder fired two single hole test blasts at the proposed New Shine Quarry near Port Ludlow in Jefferson County, WA, in order to measure vibration impacts in the close vicinity. The charges used in the study were 140 lb and 163 lbs. Each test shot was monitored at two locations approximately 1,000 ft from the test charges, and the data recorded has been used to estimate impacts from future blasting operations at the quarry. Additional monitoring of each test charge was undertaken at the edge of the Port Ludlow Golf Course at Hole 4 of the Timber Course, the closest golf course area to the proposed quarry operations.

Known sensitive areas in the vicinity of the quarry include the Port Ludlow Master Planned Resort (MPR) and Golf Course and existing single family homes. Other surrounding land area is generally undeveloped and used for natural resource extraction activities such as mining and commercial forestry.

The closest point of the MPR is its southwest corner, an undeveloped residentially zoned area approximately 2,000 feet from the proposed Phase 2 mining operations and approximately 3,300 feet from the proposed Phase 1A mining operations. The nearest point of the Port Ludlow Golf Course is approximately 3,200 feet from the nearest point of blasting in Phase 2 and 4,400 feet from the nearest point of blasting within Phase 1A. As mentioned above, the nearest areas of the Golf Course are Holes 3, 4, and 5 of the Timber Course, which are within 3,000 to 4,000 feet of quarry operations and blasting. The remainder of the golf course is greater than 4,000 feet from any proposed mining area.

The project area and vicinity are illustrated in the Google Earth image of Figure 1, from which the golf course is visible, together with the location of the test holes and monitoring locations. Figure 1 depicts the quarry site, nearest existing residence and future residential lots, the blasting and rock extraction areas for the proposed future quarry, and the distances from the nearest mining area to sensitive land uses.

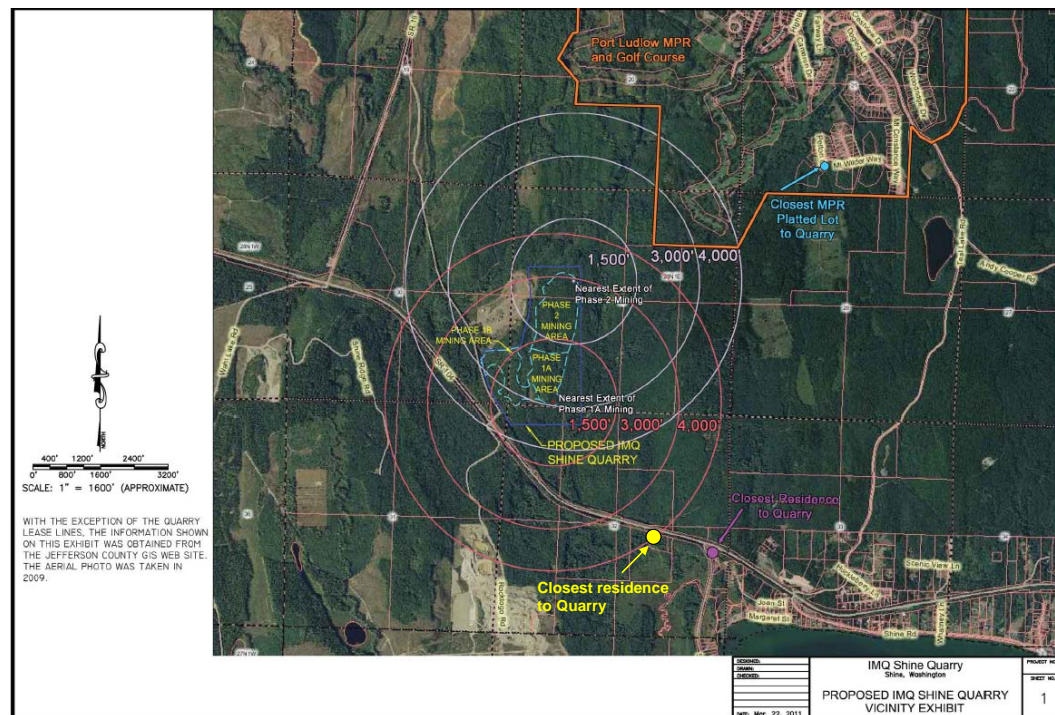


Figure 1. Aerial view of proposed extraction phases, nearby land uses, and distances from the nearest blasting areas. The closest residence to the quarry is located approximately 4000 feet away, and the closest platted MPR lot to the quarry is located 6000 feet away. See attached full-sized image at end of report.

2. PROPOSED SCALE OF BLASTING

Production blasting will occur no more frequently than twice a month. Blasting operations at the New Shine Quarry will utilize 6½ inch holes and benches of approximately 35 feet high. Depending on phase and location of blasting, each hole will contain 1 or 2 decks of pumped emulsion explosive (Hydromite), and blasts will generally contain between 40 and 45 holes, producing around 16,500 cubic yards (approximately 36,000 tons) of broken rock. Blasts will be fired using electronic initiation enabling vibration and overpressure impacts to be minimized. The duration of blasts will typically be less than 1 second, with blast vibrations probably persisting for a period not exceeding 2 seconds after each blast. Due to the greater separation distance from sensitive receiving locations of blasting operations in the Phase 1A and 1B mining areas, these blasts will contain single explosive decks of approximately 500 pounds per bore hole. If needed to reduce impacts to future residential structures, some sections of the Phase 2 mining area may contain 2 explosive decks per bore hole, with each deck having a weight not exceeding 200 pounds. Figure 2 presents the RI 8507 “Safe Blasting Levels” which can be used to place the anticipated vibrations at New Shine in a national perspective.

3. ESTIMATED VIBRATION IMPACTS

Models utilizing the vibration data recorded from the 16 February test shots indicate that vibration levels from 500 pound charges at a distance of 1,500 feet from the blast will be approximately 0.27 inches per second. This impact is approximately one half of the levels considered safe and is incapable of causing even cosmetic damage (e.g. cracking of paint and drywall joints) to structures. Still, it is recommended that if residential structures are ever built in the southwest corner of the MPR and if blasting occurs within 2,000 feet of these structures, the quarry should utilize 2 independently delayed decks of no more than 200 pounds in each deck, This practice will ensure that vibration levels do not exceed 0.18 inches per second, or approximately one third of the safe levels, at any protected structure.

At 2,000 feet and greater distance from the blast, single deck blasting is recommended and induced vibration levels will be approximately 0.18 inches per second. Once distances exceed 3,000 feet from a blast, levels will fall to approximately 0.10 in/s, and at 4,000 feet, levels will fall to approximately 0.06 inches per second. Beyond 5,000 feet, blasting impacts will approach imperceptible levels for both monitoring equipment and occupants of residences. The first test shot failed to trigger the seismic monitor located at Hole 4 of the Port Ludlow Golf Course's Timber Course, which was placed at a distance of 5,700 feet – from the blast site. The vibrations generated by the 140 pound charge were imperceptible at that distance even to the sensitive monitoring equipment.

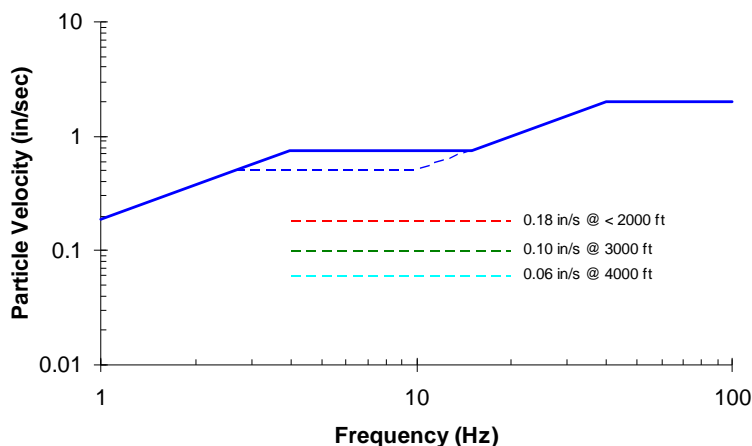


Figure 2. RI 8507 Safe Blasting Levels and expected vibration levels from blasting at the New Shine Quarry, WA (for distances less than 2,000 feet, the use of 2 decks per hole has been assumed).

In addition, studies of human perception have been undertaken and are also reported in the RI 8507 blasting guidelines. Studies undertaken by Wiss & Parmelee¹ show that for vibration of duration in the interval 1 to 2 seconds, the following levels of perception can be assigned to the estimated vibration levels:

- 0.5 in/s – Distinctly perceptible
- 0.17 in/s – Perceptible
- 0.06 in/s – Barely perceptible

It must therefore be concluded that, for all existing houses located more than approximately 4000 ft from blasting operations, vibration will be either imperceptible, or barely perceptible to occupants. This includes the two existing residences on SR 104 located at 4000 feet and 6000 feet from the nearest point of blasting. To place these levels in an everyday context, measurements of vibration² made inside a wood-framed house show that vibration from walking on a wooden floor can generate vibration in the range 0.07 to 0.29 in/s. A vibration level of 0.2 inches per second is expected to resemble the effects of hammering nails in a wooden floor in a remote part of a house, though the vibration effects from blasting are not expected to persist for more than approximately 2 seconds for any production blast, - and occur no more frequently than twice a month.

4. ESTIMATED OVERPRESSURE IMPACTS

Overpressure is a measurement of the air-borne vibration impact from blasting, and differs from “noise” in that it includes all frequencies of induced disturbance from around 2 Hz to at least 200 Hz. Overpressure from blasting is measured in decibels, with the units dBL indicating a linear weighting of the frequencies, or no filtering or removal of low frequency components. Audible noise, on the other hand, is expressed in units of dBA which indicates an “A” weighting of frequencies, or the removal of those frequencies which are inaudible to the human ear (i.e. frequencies less than 20 Hz). Overpressure levels in units of dBL are therefore always considerably greater than noise levels in units of dBA, and cannot be directly compared with an audible noise expression.

Models³ used to estimate peak overpressure levels produced by blasting under conditions of “Normal Confinement” indicate that peak overpressure levels generated by the New Shine Quarry will comply with the safe levels of overpressure according to RI 84854, which recommends levels be maintained below 133 dBL. The quarry has proposed the use of a stemming column of 12 feet for a 6½ inch blasthole and with a pumped emulsion explosive – a quantity which is expected to produce an excellent degree of charge confinement and to result in a high degree of control of induced overpressure levels.

Overpressure levels at a distance of 1,500 ft from the blast are therefore expected to be approximately 119 dBL. At 3,000 feet the levels will fall to approximately 115 dBL, at 4,000 feet, the closest point of blasting to the golf course and to the nearest residence, levels will fall to approximately 113 dBL, and beyond 5,000 feet levels will be less than 110 dBL. Since the decibel is a logarithmic scale, the anticipated maximum overpressure level of 119 decibels is less than one quarter of the maximum permissible level, and 113 decibels is approximately one tenth of

the maximum permissible levels, and unlikely to be noticed in the course of normal daily activities. Overpressure levels of 115 dBL are produced by a light breeze.

It is considered that a level of 120 dBL, with a duration of less than 2 seconds induced from blasting at the proposed quarry, will be perceived as either a thunder clap or a thunder roll from a lightning strike at a distance of around 5 miles from the observer. It will sometimes be perceived as a single event (like a thunder clap), and sometimes as a quickly repeated rolling event (like a thunder roll), though the duration of the event will not exceed 2 seconds.

The effectiveness of explosives to loosen rock for commercial blasting operations is highly dependent upon containing the available explosive energy within the blast, and not letting it escape into the air where it is useless for mining and creates perceivable noise. The overpressures created from professional, well contained blast operations is a result of the mass movement of the blasted material, not from explosives detonating like a bomb on or above the ground surface as this is as useless to the mining operation as it is disturbing to the surroundings.

5. FLYROCK ISSUES

Flyrock is controlled by carefully controlling the depth of burial of the charge, and by using high quality screened aggregate material. Very good guidelines are available to ensure that rock fragments will not be projected beyond the quarry boundaries.

Austin Powder advises that holes at the New Shine Quarry would be charged with approximately 28 feet, or approximately 500 pounds, of explosive, and then capped with 12 feet of inert gravel stemming. The stemming is added to prevent high pressure gases and rock fragments from being ejected from the blasthole collars. Normal projection distances will be in the vicinity of approximately 100 feet from the perimeter of a blast, or within the quarry boundary. Under extreme circumstances, rock projections may travel up to a maximum of 600 feet. At no time will the production blasting activities be capable in terms of proximity and energy to project fly rock beyond the quarry boundary. The photograph of Figure 3 shows a normal blast in progress, in similar material and with a similar charge configuration to that proposed for the New Shine Quarry. It is clear from the photograph that there are no uncontrolled ejections occurring from any point within this blast. In order to gain maximum use of the explosive energy, and operational efficiencies, blasts are specifically designed to avoid forceful ejections and to ensure that rock fragments are not projected beyond the quarry boundaries. All blasts fired by Austin Powder are video recorded with the specific objective of maintaining a constant vigilance over flyrock, and ensuring maximum utilization of explosive energy.

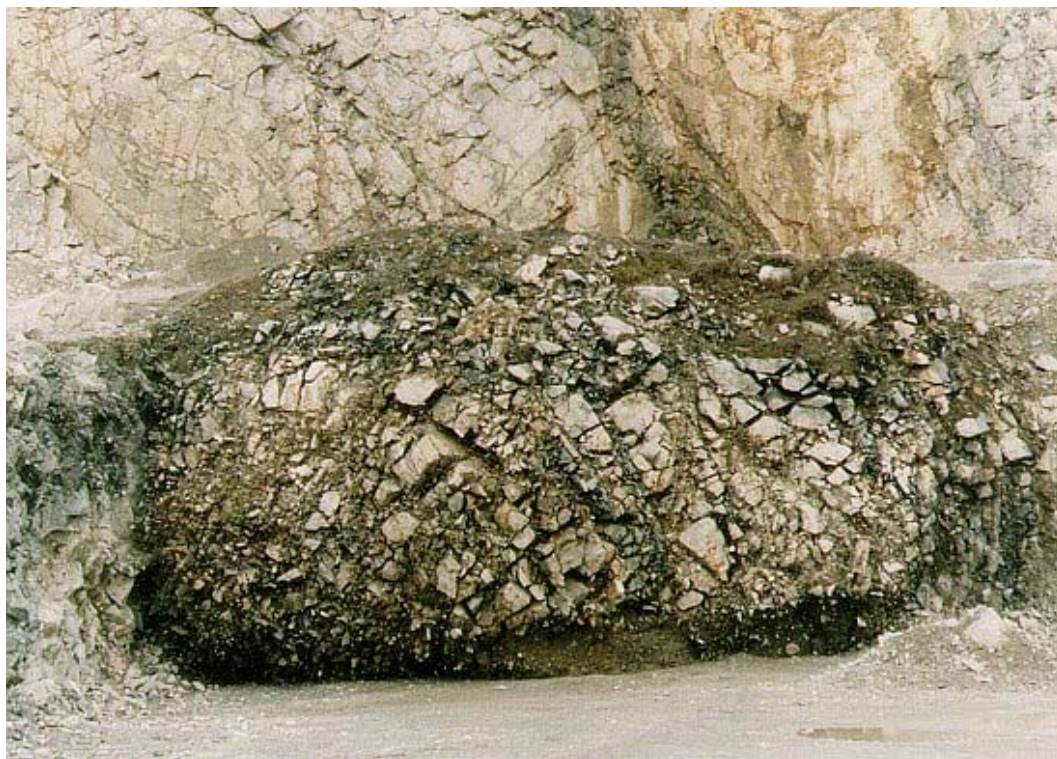


Figure 3. A normal, well-controlled blast in progress with similar charge design to that proposed at New Shine, in which no forceful rock projections occur from any part of the blast.

Flyrock projections under normal blasting conditions are expected to travel no more than 100 feet. Therefore, rock fragments are unlikely to leave the quarry boundaries. Under extremely rare circumstances, flyrock projections could travel up to 600 feet. There are no structures or public spaces within 600 feet of any blasting area.

6. CONCLUSIONS

On the basis of the test blasts fired on 16 February at the proposed New Shine Quarry, it is unlikely that the effects of either ground vibration or air overpressure will be more than “barely perceptible” to all existing residences and all other land uses located more than 4,000 feet from the blasting operations, including the two existing residences on SR 104. For those using the golf course, recreating, or working within 1,500 ft and 4,000 feet of a blast are likely to perceive the effects as “perceptible”, but levels will be well below compliance levels with respect to RI 8507 and RI 8485, and the effects are not expected to be more noticeable than everyday events such as distant thunder claps, moderate wind gusts, and vibration produced by children running on a wooden floor. Control over rock projection and flyrock is achieved by the use of high quality screened aggregate material, and a

minimum stemming length of 12 feet, and the performance of all blasts will be monitored using video cameras to confirm proper levels of control. Fly rock from blasting is not and will not be capable of reaching any areas of the MPR or nearby structures.