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VibraTechinc.com

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Mr. Scott Martino
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**RE: Predicted Ground Vibration and Air Overpressure
Proposed Prospect Hill, NC Location**

Dear Mr. Martino:

Per your request, Vibra-Tech, Inc. offers the following vibration and air overpressure predictions based on loading information provided by Carolina Sunrock and Orica USA.

Methods:

The International Society of Explosives Engineers Blaster's Handbook, 18th Edition provides **Equations 1 & 2** below that predict the peak particle velocity of a blast given the distance from the blast in question and the amount of explosives detonated per 8ms delay. **Equation 2** represents a general industry prediction. According to Carolina Sunrock, blasting practices and geology will be similar to projected operations at the Prospect Hill site. Historical data, recorded at the Carolina Sunrock Kittrell Quarry, was used to determine **Equation 3** for vibration prediction at the Prospect Hill site.

$$\text{Scaled Distance} = \frac{\text{Distance}}{\sqrt{\text{max. lbs. per delay}}} \quad [1]$$

$$\text{Peak Particle Velocity} = 160 \times (\text{Scaled Distance})^{-1.6} \quad [2]$$

$$\text{Peak Particle Velocity} = 112 \times (\text{Scaled Distance})^{-1.71} \quad [3]$$

The ISEE Blaster's handbook, 18th Edition also provides **Equations 4 - 7** below as methods to predict peak air overpressure of a blast given the distance to the blast in question and the amount of explosives detonated per 8ms delay. **Equation 5** represents air overpressure from a typical construction blast, whereas **Equation 6** represents air overpressure from a typical quarry face:

$$\text{Cubed Root Scaled Distance} = \left(\frac{\text{distance}}{\sqrt[3]{\frac{\text{max lbs}}{\text{delay}}}} \right) \quad [4]$$

$$\text{Peak Air Overpressure (psi)} = 1 * (\text{CRSD})^{-1.1} \quad [5]$$

$$\text{Peak Air Overpressure (psi)} = 1.32 * (\text{CRSD})^{-0.97} \quad [6]$$

$$\text{Convert psi to dB(L)} = 20 * \log \frac{\text{psi}}{0.000000029} \quad [7]$$

Given Parameters:

Hole Diameter – 5.5 in

Hole Depth – 50 ft

Maximum Explosive Product Density – 73.04 lbs/ft³

Given the variability in explosive product density, the maximum yield is considered when calculating the Peak Particle Velocity and Peak Air Overpressure. The following are the predicted values for Prospect Hill, using these equations and information provided by Carolina Sunrock and Orica USA. These predictions consider the closest point of pit development to the structure(s) in the surrounding area:

Peak Particle Velocity (Pit A):

Address	Distance from Blast (ft)	Calculated Peak Particle Velocity Equation 2 (in/sec)	Calculated Peak Particle Velocity Equation 3 (in/sec)
28 HENRY DANIELS RD	1128	0.305	0.139
206 BEAVER FALLS DR	1350	0.229	0.102
971 GOOSE CREEK RD	1526	0.188	0.083
115 BEAVER FALLS DR	1675	0.162	0.071
200 HENRY DANIELS RD	1784	0.147	0.064
950 GOOSE CREEK RD	1890	0.134	0.058
1238 WRENN RD	4053	0.039	0.016
2856 RIDGEVILLE RD	4058	0.039	0.016
2611 RIDGEVILLE RD	4263	0.036	0.014
2372 RIDGEVILLE RD	4275	0.036	0.014
2760 RIDGEVILLE RD	4292	0.036	0.014
3247 RIDGEVILLE RD	4305	0.036	0.014
2685 RIDGEVILLE RD	4379	0.035	0.014
2461 RIDGEVILLE RD	4400	0.035	0.014
2541 RIDGEVILLE RD	4400	0.035	0.014
3015 RIDGEVILLE RD	4417	0.034	0.013
2711 RIDGEVILLE RD	4442	0.034	0.013
2859 RIDGEVILLE RD	4560	0.033	0.013
2278 RIDGEVILLE RD	4572	0.033	0.013
2377 RIDGEVILLE RD	4650	0.032	0.012
2188 RIDGEVILLE RD	4917	0.029	0.011
2233 RIDGEVILLE RD	5000	0.028	0.011
2132 RIDGEVILLE RD	5140	0.027	0.010
4231 JOHN OAKLEY RD	5458	0.025	0.009
2592 WRENN RD	5478	0.024	0.009
2721 RIDGEVILLE RD	5701	0.023	0.009
1893 RIDGEVILLE RD	6385	0.019	0.007

Peak Particle Velocity (Pit B):

Address	Distance from Blast (ft)	Calculated Peak Particle Velocity Equation 2 (in/sec)	Calculated Peak Particle Velocity Equation 3 (in/sec)
971 GOOSE CREEK RD	790	0.817	0.256
950 GOOSE CREEK RD	1430	0.316	0.093
2592 WRENN RD	2346	0.143	0.040
28 HENRY DANIELS RD	3150	0.089	0.024
200 HENRY DANIELS RD	3181	0.088	0.024
206 BEAVER FALLS DR	4077	0.059	0.015
115 BEAVER FALLS DR	4373	0.053	0.014
1238 WRENN RD	5095	0.041	0.011
2372 RIDGEVILLE RD	5203	0.040	0.010
2278 RIDGEVILLE RD	5290	0.039	0.010
2188 RIDGEVILLE RD	5376	0.038	0.010
2132 RIDGEVILLE RD	5500	0.037	0.009
2611 RIDGEVILLE RD	5560	0.036	0.009
2461 RIDGEVILLE RD	5633	0.035	0.009
2541 RIDGEVILLE RD	5633	0.035	0.009
2377 RIDGEVILLE RD	5645	0.035	0.009
2233 RIDGEVILLE RD	5645	0.035	0.009
2856 RIDGEVILLE RD	5740	0.034	0.009
2760 RIDGEVILLE RD	5744	0.034	0.009
2685 RIDGEVILLE RD	5747	0.034	0.009
2711 RIDGEVILLE RD	5817	0.033	0.008
2859 RIDGEVILLE RD	6192	0.030	0.008
3015 RIDGEVILLE RD	6436	0.028	0.007
1893 RIDGEVILLE RD	6444	0.028	0.007
3247 RIDGEVILLE RD	6800	0.026	0.006
2721 RIDGEVILLE RD	6897	0.025	0.006
4231 JOHN OAKLEY RD	7489	0.022	0.005

Peak Air Overpressure (Pit A):

Address	Distance from Blast (ft)	Calculated Peak Air Overpressure Equation 5 (dBL)	Calculated Peak Air Overpressure Equation 6 (dBL)
28 HENRY DANIELS RD	1128	123.4	131.4
206 BEAVER FALLS DR	1350	121.7	129.9
971 GOOSE CREEK RD	1526	120.6	128.9
115 BEAVER FALLS DR	1675	119.7	128.1
200 HENRY DANIELS RD	1784	119.1	127.6
950 GOOSE CREEK RD	1890	118.5	127.1
1238 WRENN RD	4053	111.2	120.7
2856 RIDGEVILLE RD	4058	111.2	120.7
2611 RIDGEVILLE RD	4263	110.7	120.2
2372 RIDGEVILLE RD	4275	110.7	120.2
2760 RIDGEVILLE RD	4292	110.7	120.2
3247 RIDGEVILLE RD	4305	110.6	120.2
2685 RIDGEVILLE RD	4379	110.5	120.0
2461 RIDGEVILLE RD	4400	110.4	120.0
2541 RIDGEVILLE RD	4400	110.4	120.0
3015 RIDGEVILLE RD	4417	110.4	119.9
2711 RIDGEVILLE RD	4442	110.3	119.9
2859 RIDGEVILLE RD	4560	110.1	119.7
2278 RIDGEVILLE RD	4572	110.1	119.7
2377 RIDGEVILLE RD	4650	109.9	119.5
2188 RIDGEVILLE RD	4917	109.4	119.0
2233 RIDGEVILLE RD	5000	109.2	118.9
2132 RIDGEVILLE RD	5140	109.0	118.7
4231 JOHN OAKLEY RD	5458	108.4	118.2
2592 WRENN RD	5478	108.3	118.1
2721 RIDGEVILLE RD	5701	108.0	117.8
1893 RIDGEVILLE RD	6385	106.9	116.8

Peak Air Overpressure (Pit B):

Address	Distance from Blast (ft)	Calculated Peak Air Overpressure Equation 5 (dBL)	Calculated Peak Air Overpressure Equation 6 (dBL)
971 GOOSE CREEK RD	790	126.8	134.4
950 GOOSE CREEK RD	1430	121.2	129.4
2592 WRENN RD	2346	116.4	125.3
28 HENRY DANIELS RD	3150	113.6	122.8
200 HENRY DANIELS RD	3181	113.5	122.7
206 BEAVER FALLS DR	4077	111.2	120.6
115 BEAVER FALLS DR	4373	110.5	120.0
1238 WRENN RD	5095	109.0	118.7
2372 RIDGEVILLE RD	5203	108.8	118.6
2278 RIDGEVILLE RD	5290	108.7	118.4
2188 RIDGEVILLE RD	5376	108.5	118.3
2132 RIDGEVILLE RD	5500	108.3	118.1
2611 RIDGEVILLE RD	5560	108.2	118.0
2461 RIDGEVILLE RD	5633	108.1	117.9
2541 RIDGEVILLE RD	5633	108.1	117.9
2377 RIDGEVILLE RD	5645	108.1	117.9
2233 RIDGEVILLE RD	5645	108.1	117.9
2856 RIDGEVILLE RD	5740	107.9	117.7
2760 RIDGEVILLE RD	5744	107.9	117.7
2685 RIDGEVILLE RD	5747	107.9	117.7
2711 RIDGEVILLE RD	5817	107.8	117.6
2859 RIDGEVILLE RD	6192	107.2	117.1
3015 RIDGEVILLE RD	6436	106.8	116.8
1893 RIDGEVILLE RD	6444	106.8	116.8
3247 RIDGEVILLE RD	6800	106.3	116.3
2721 RIDGEVILLE RD	6897	106.1	116.2
4231 JOHN OAKLEY RD	7489	105.4	115.5

Appendix A displays the suggested locations for vibration monitoring at the Prospect Hill location. These locations consist of a combination of permanent monitoring stations and portable seismographs. In addition to the proposed monitoring locations, Vibra-Tech recommends an additional floating portable seismograph to follow pit development to ensure coverage of any nearby structures.

If you have any questions regarding this matter, please do not hesitate to contact our office.

Respectfully submitted,

VIBRA-TECH, INC.®



Andrew Coil
Operations Manager, SC



Chuck Jaworski
Area Manager, TN

Vibra-Tech, Inc., shall not be liable for any claims of tangible property damage where such damage is not solely, directly, and physically caused by Vibra-Tech, Inc. Additionally, Vibra-Tech, Inc., shall not be liable, in whole or in part, for any claims of tangible property damage brought by or on behalf of third-party claimants.

Appendix A

Map of Carolina Sunrock's proposed Prospect Hill Site. Includes surrounding nearby addresses, suggested seismograph placements, pit boundaries, initial blasting zone, and distance scaling from pit boundaries.

Carolina Sunrock
Prospect Hill Site

- Pit Boundaries
- Initial Blasting Activities
- Half Mile
- Mile

