



Tilcon New Jersey – Pompton Lakes Quarry

Blast Monitoring Review

Prepared by Vibra-Tech Engineers, Inc.

May 19, 2022

USBM RI-8507

“Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting”

In this study ground vibration produced structure response and damage in 76 residences for 219 production blasts from surface-mine production blasting. This data along with damage data from nine additional studies were combined yielding 624 data points of which 234 (37.5%) produced damage and 390 (62.5%) no damage was observed.

USBM RI-8507

“The Blasting Data”

The RI-8507 data contained a total of 241 blasts. The distribution was 168 (70%) from coal, 20 (8%) from quarry, 20 (8%) from iron, and 33 (14%) from construction blasting. Peak ground velocities ranged from 0.01 to 10.58 in/sec. Scaled distances ranged from 3.3 to 788 ft./lb.^{1/2}

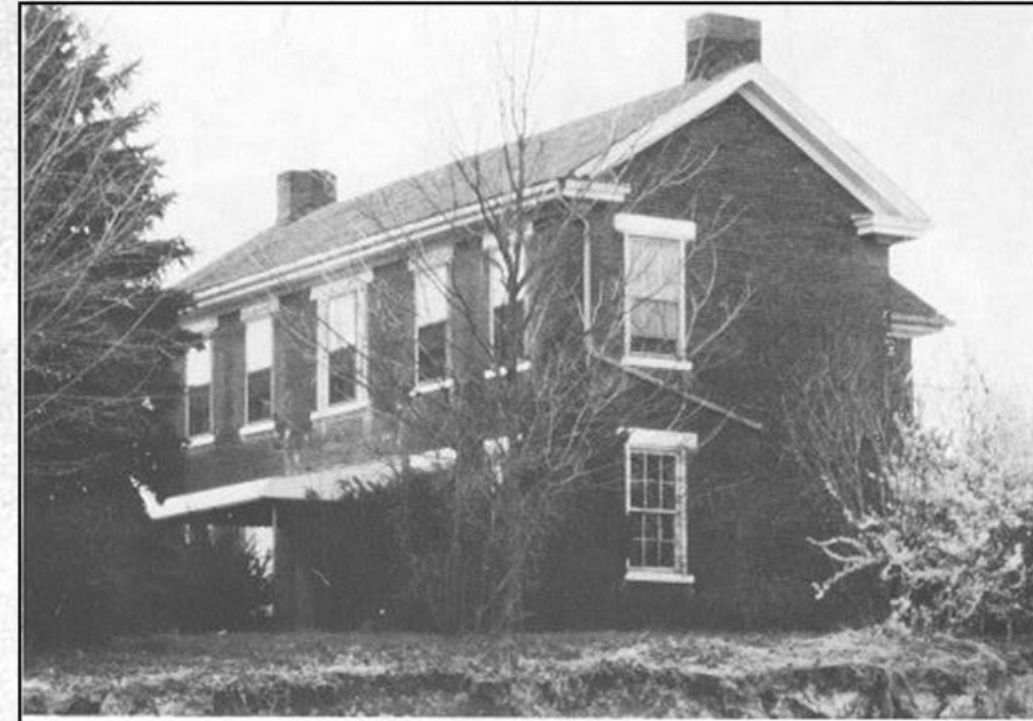
USBM RI-8507

“The Structures”

The RI-8507 ground vibration and structure response measurements were made on 76 structures. 42 were single story, 17 were 1 1/2 story, and 17 were 2 story. The interiors of these structures were finished with gypsum wallboard (48), plaster-on-lath (12), paneling (11), or a combination of materials (5). 31 of the structures had a full basements, 20 had a partial basement or crawlspace, 9 were built on concrete slabs, 7 had concrete or concrete block foundations, 6 had continuous concrete footings. 2 wooden pier foundations and 1 had no foundation.

Structures from USBM RI-8507

Older Plaster-on-Lath Interiors



2 Story Brick



1 Story Wood Frame

Structures from USBM RI-8507

Modern Gypsum Wallboard Interiors



1 Story Wood Frame

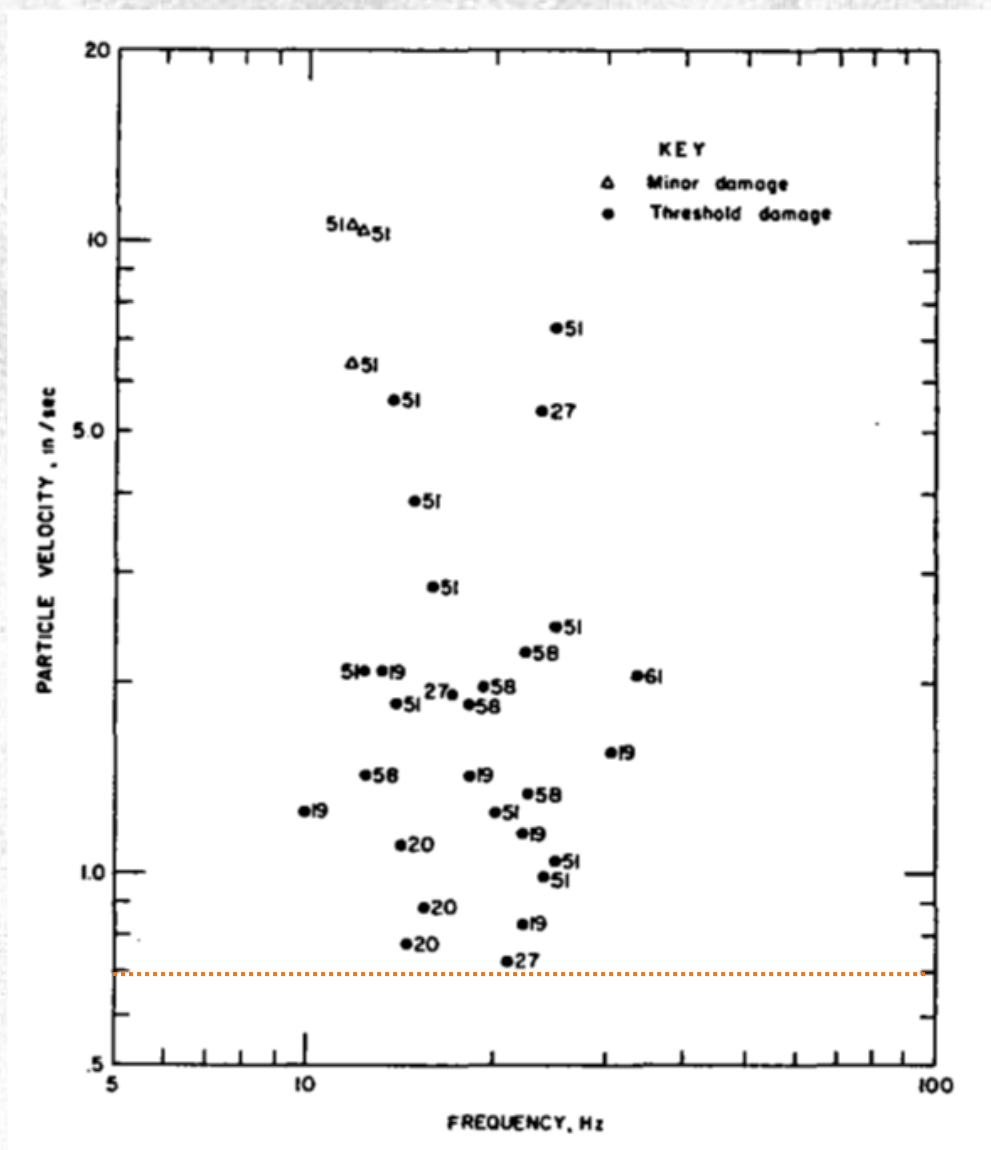


1 1/2 Story Wood Frame

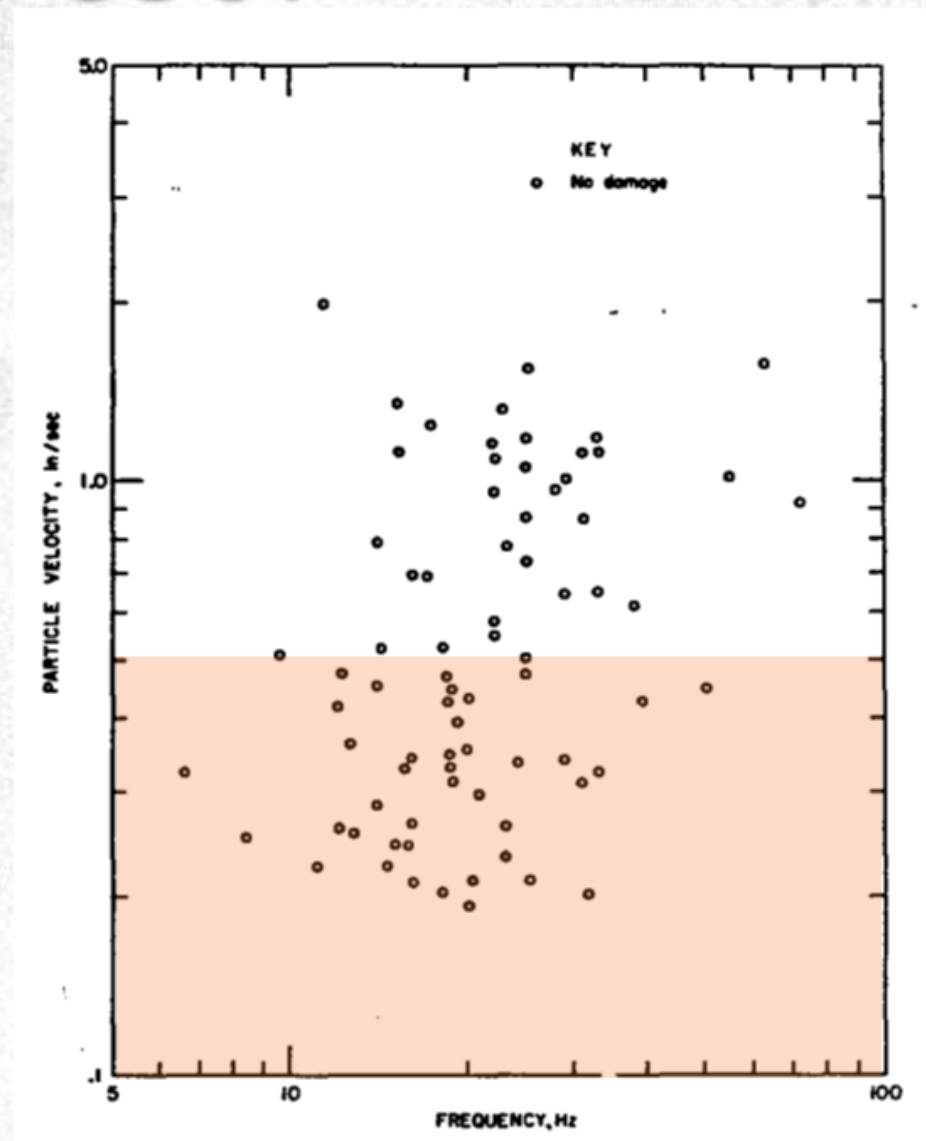


2 Story Wood
Frame

Damage and Non-damage Observations From RI-8507

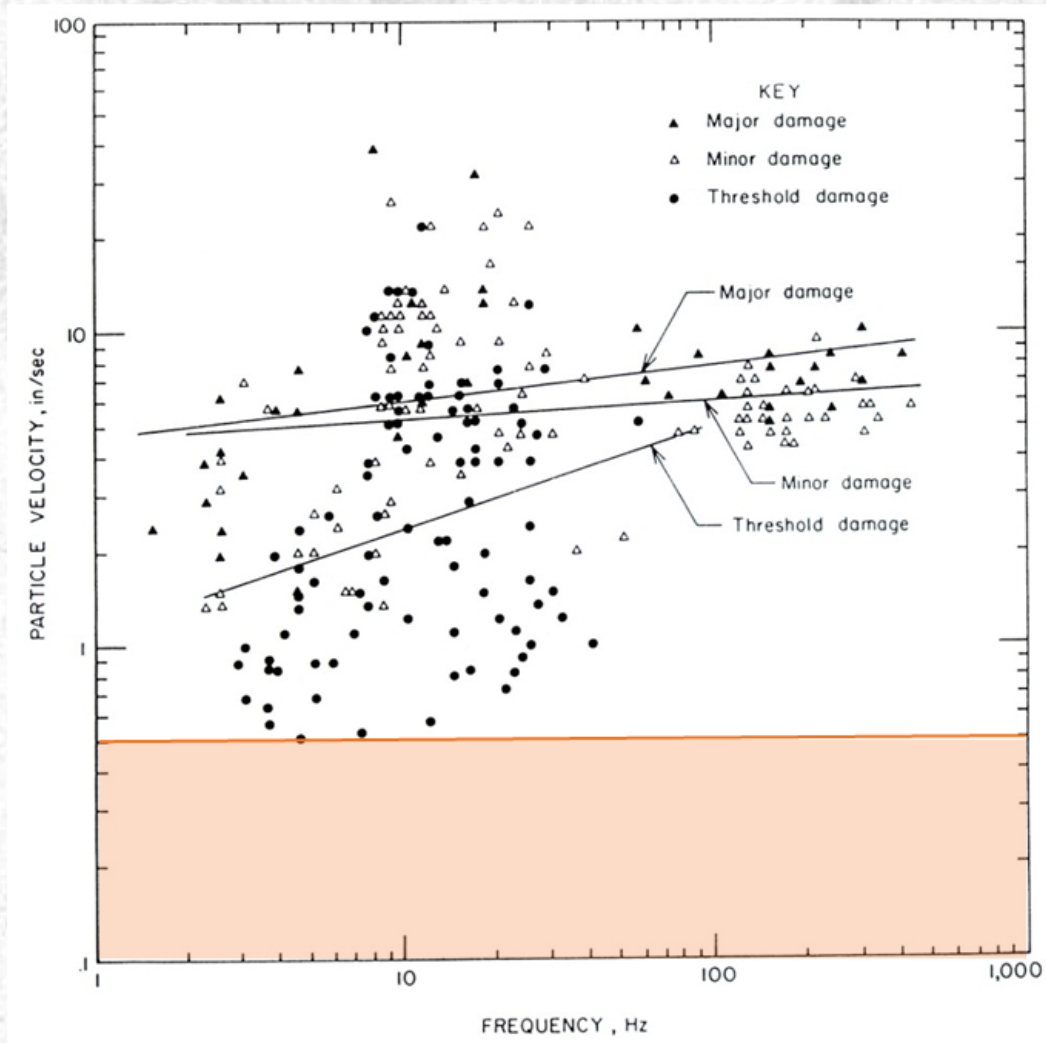


Damage Observations



Non-damage Observations

Types of Damage Observed (From RI-8507)



Threshold Damage - minor plaster cracks at construction joints, loosening of paint, lengthening of old cracks

Minor Damage - loosening & falling of plaster, cracks in masonry joints around openings, hairfine to 3 mm

Major Damage - cracks of several mm in walls, falling masonry, structural damage & weakening

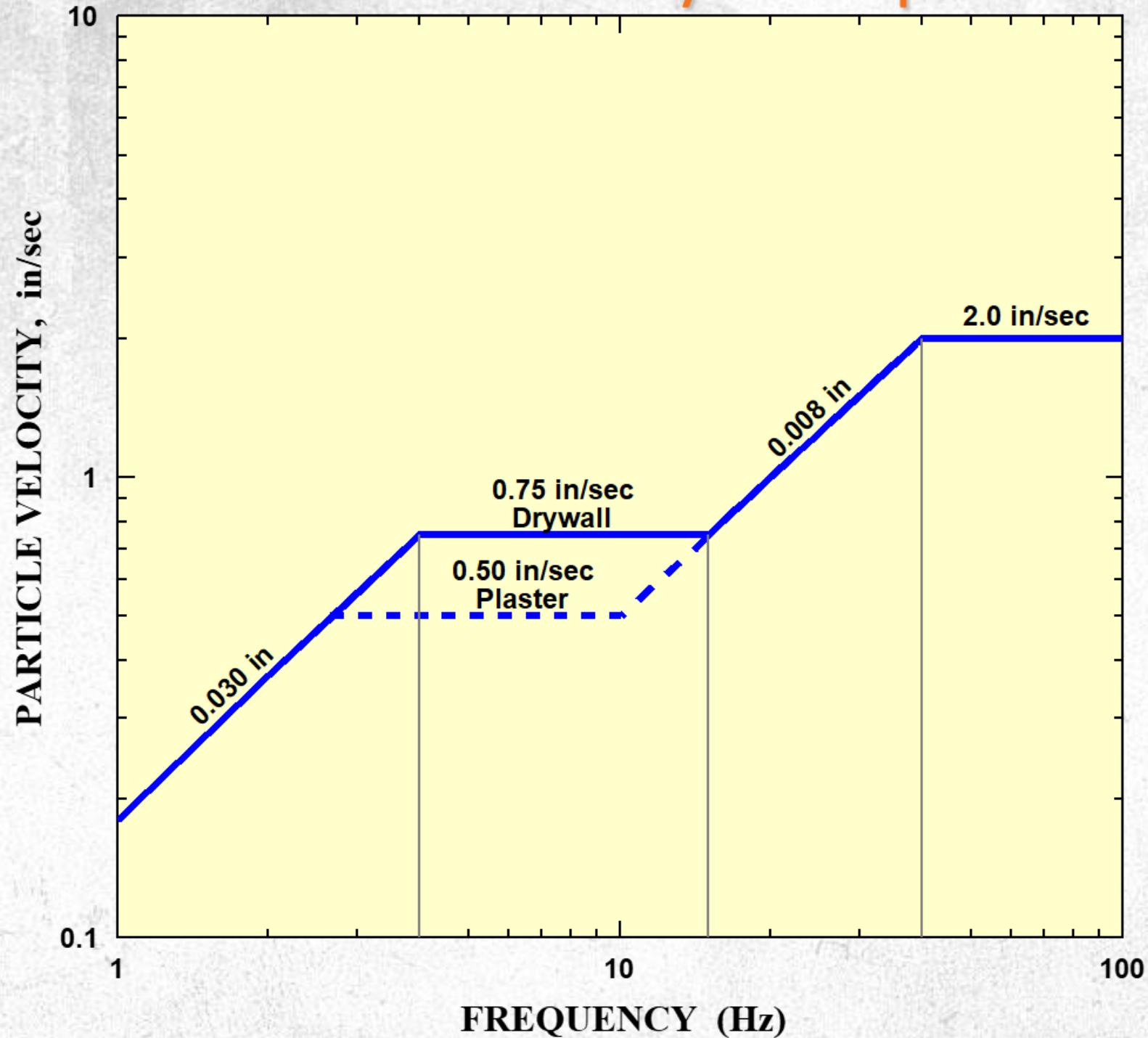
Conclusions From USBM RI-8507

- Particle velocity is still the best single descriptor of ground motion.
- All homes eventually crack because of a variety of environmental stresses.
- Damage potentials for low frequency blasts (<40 Hz) are considerably higher than those for high frequency blasts (>40 Hz).
- Home construction is a factor in the minimum expected damage levels.

Conclusions From USBM RI-8507

- The practical and safe criteria for blasts that generate low frequency ground vibrations are **0.75 in/sec** for modern Drywall interiors and **0.50 in/sec** for plaster-on-lath interiors. For frequencies above 40 Hz, a safe particle velocity maximum of 2.0 in/sec is recommended for all houses.

Safe Levels of Blasting Vibrations for Houses Using a Combination of Velocity & Displacement



USBM RI-8485

“Structure Response and Damage Produced by Airblast from Surface Mining”

In this report the Bureau of Mines studied airblast from surface mining to assess its damage and annoyance potential. Outside ground vibration and airblast measurements were made, in addition to corner and midwall responses of the structure for each shot. This data was used to evaluate airblast-produced structure response and damage. A total of 56 different structures were studied for 196 blasts from surface-mine production blasting. Only 17 had significant and identifiable levels of airblast response.

USBM RI-8485

“The Blasting Data”

The RI-8485 data contained a total of 253 blasts. The distribution was 162 (64%) from coal, 75 (30%) from quarry, and 16 (6%) from the iron range. Peak air overpressures ranged from 105 to 154 dB. Scaled distances ranged from 2.0 to 842 ft./lb.^{1/2}

USBM RI-8485

“The Structures”

The RI-8485 airblast-produced structure response measurements were made on 56 structures. 28 were single story, 17 were 1 1/2 story, and 11 were 2 story. The interiors of these structures were finished with gypsum wallboard (33), plaster-on-lath (10), paneling (8), or a combination of materials (5). 33 of the structures had a full basements, 15 had a partial basement or crawlspace, 6 were built on concrete slabs, 1 had wooden pillars founded in dirt and 1 had no foundation.

USBM RI-8485

“Structure Response and Damage Produced by Airblast from Surface Mining”

Airblast criteria were developed from comparisons of airblast responses and ground vibration responses with equivalent damage risks. Airblast levels equivalent to 0.5 in/s in terms of whole structure response were 134 dB (0.1 Hz), 133 dB (2 Hz.), 129 dB (6 Hz.), and 105 dB (C-slow). These levels correspond to essentially zero (<1 % probability of damage) in typical residential structures.

Recommended Air Overpressure Limits From USBM RI-8485

Lower Frequency Limit of Measuring system in Hz.	Maximum Level in dB
1 Hz or lower – flat response.....	134 peak
2 Hz or lower – flat response.....	133 peak
6 Hz or lower – flat response.....	129 peak
C-weighted – slow response.....	105 peak dBC

Concrete Vibration Criteria

Block and Mortar Walls

- USBM noted localized cracks at interfaces of mortar joints of bricks or concrete blocks at peak ground vibrations of 3.4 in/sec.
- Canadian Building Research Council also found block walls always failed along mortar joints, due to failure of the bond between the mortar and the blocks. This failure was observed at a particle velocity around 3.0 in/sec.

Concrete Vibration Criteria

Poured Concrete Walls

- In the Canadian study, poured concrete walls were found to be much stronger than concrete block. Poured concrete walls showed no visible signs of damage until particle velocity approached 10.0 in/sec. Failure was sudden and consisted of large cracks originating at the junction of two walls.

Concrete Vibration Criteria

Poured Concrete Slabs

- None of the USBM, Swedish, Canadian or U.K. blasting studies found cases of slab or pavement cracking.
- Vibration levels in these studies ranged from 5.0 to 10.0 in/sec.
- Cracks in mass concrete generally require vibration amplitudes of >100 in/sec.



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Blast Monitoring Data

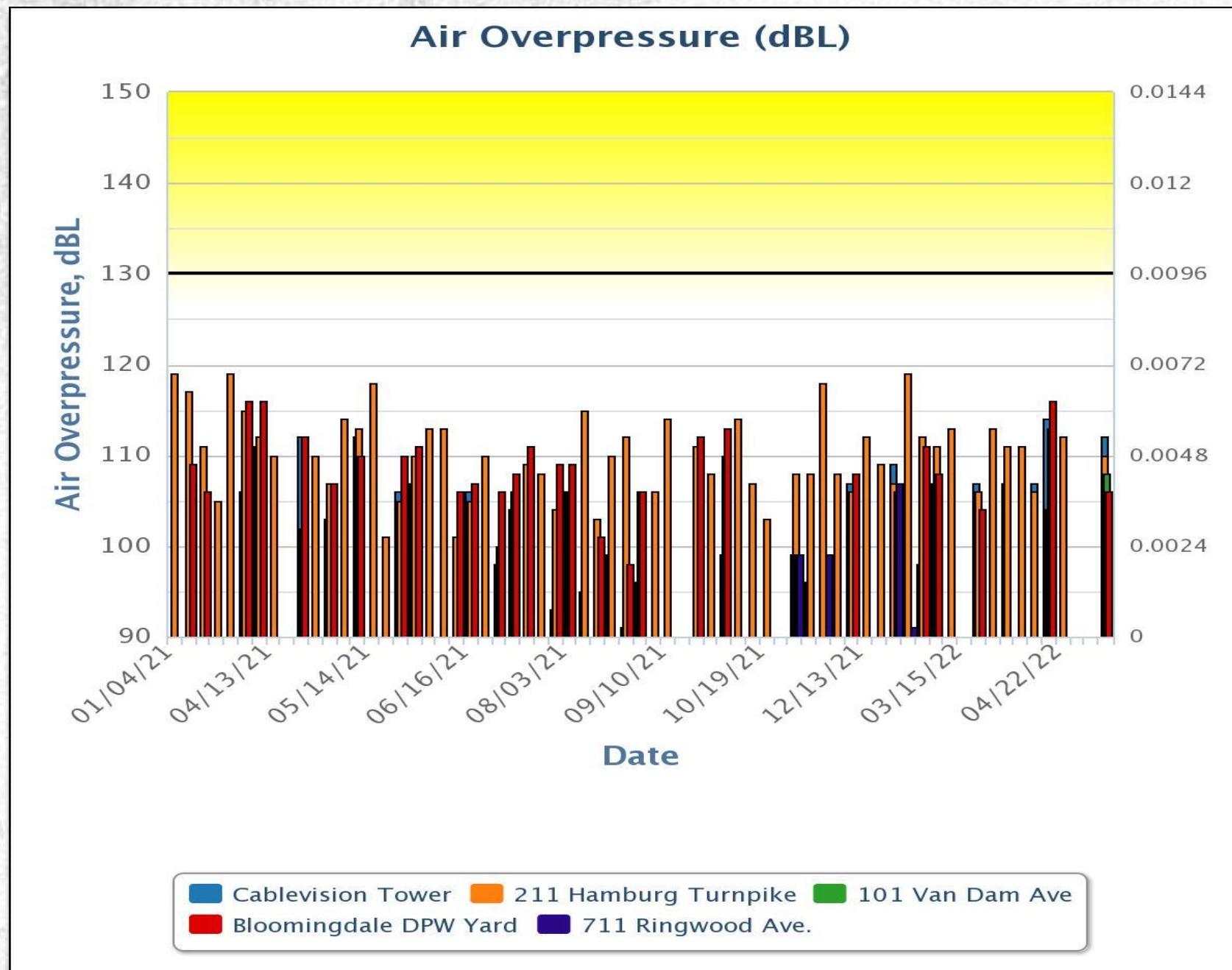
01-04-2021 – 05-11-2022



Prompton Lakes Quarry

Recorded Air Overpressures

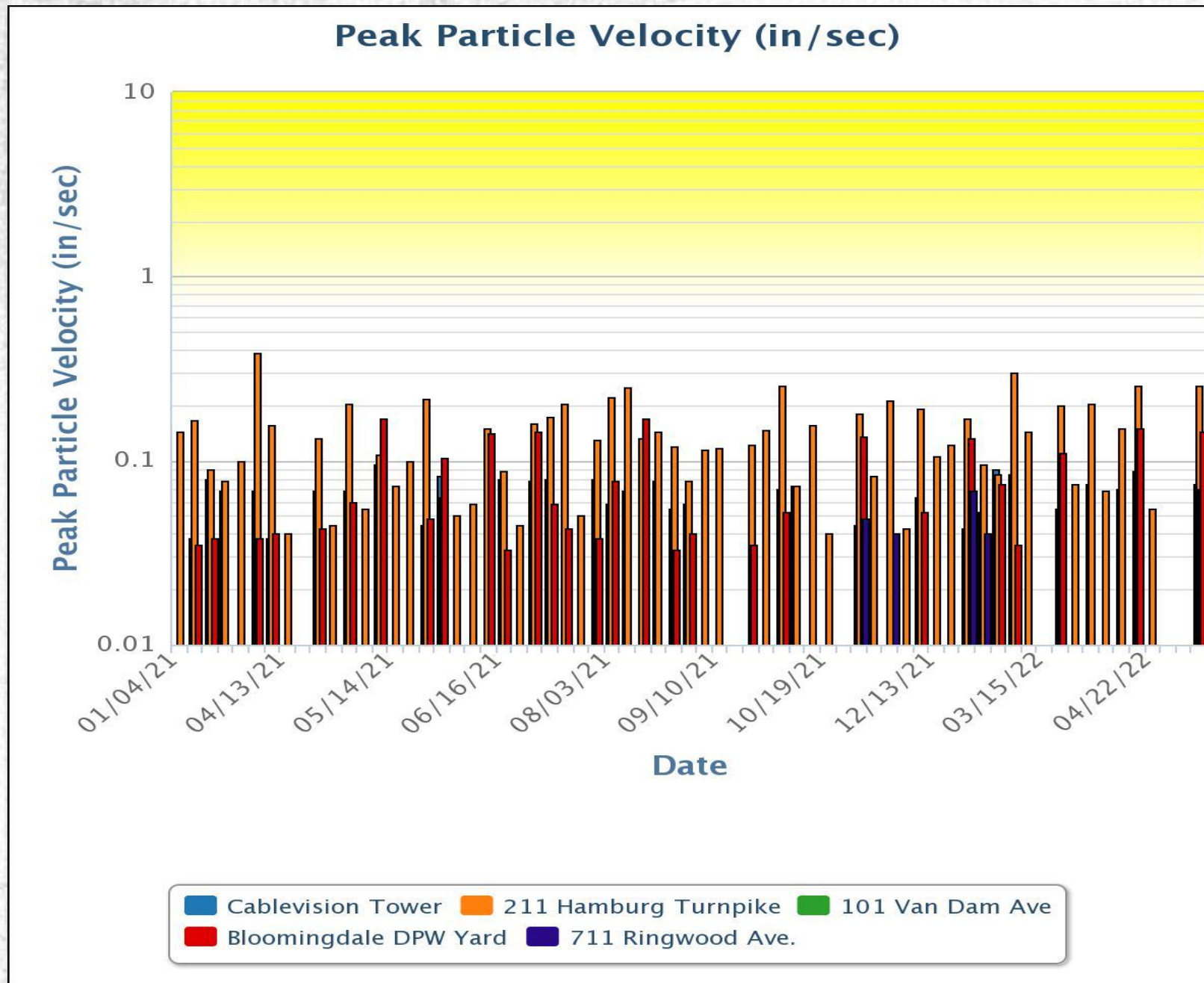
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Prompton Lakes Quarry

Peak Particle Velocity vs. Date

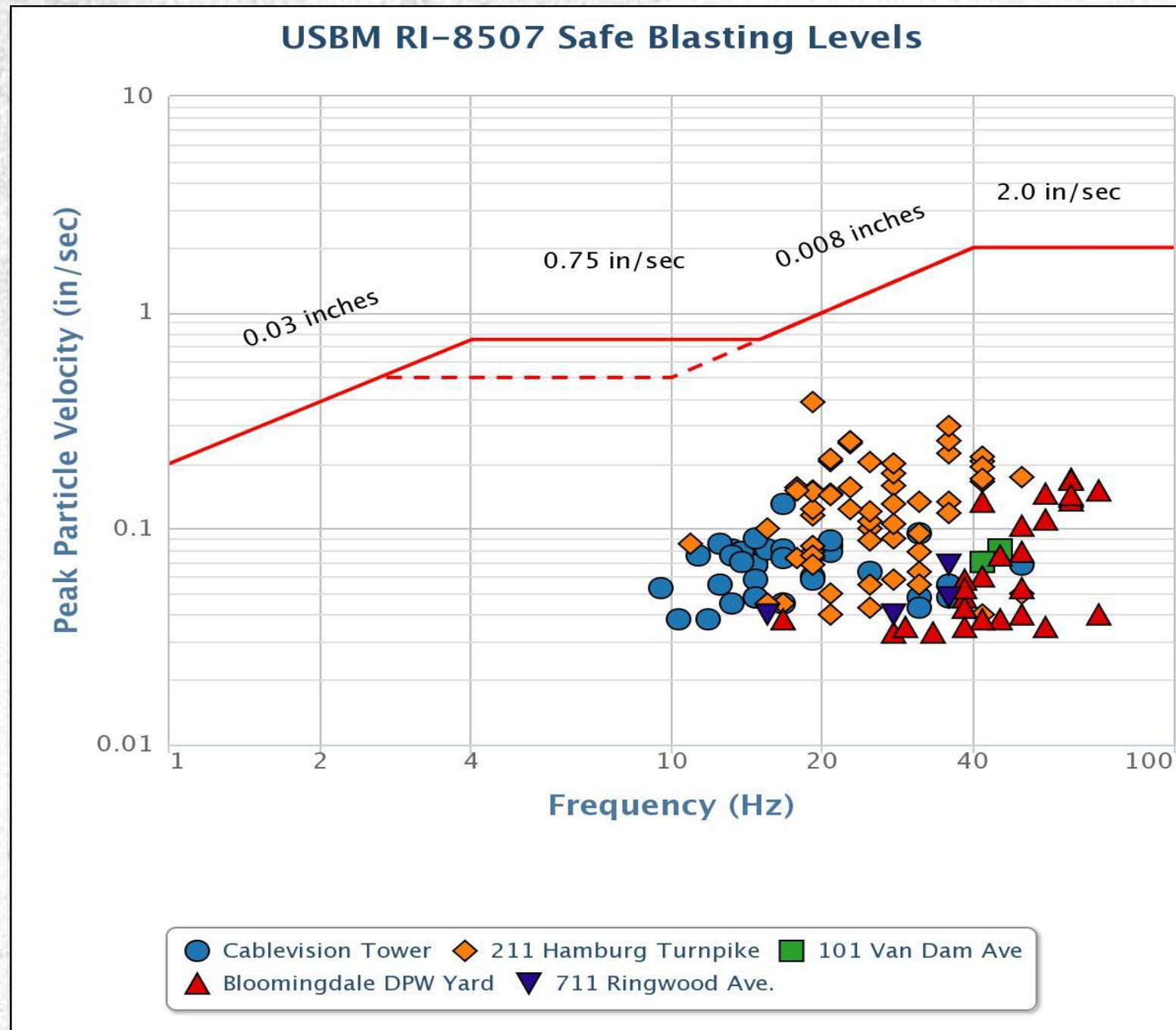
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Pompton Lakes Quarry

Recorded Ground Vibrations

01-04-2021 – 05-11-2022



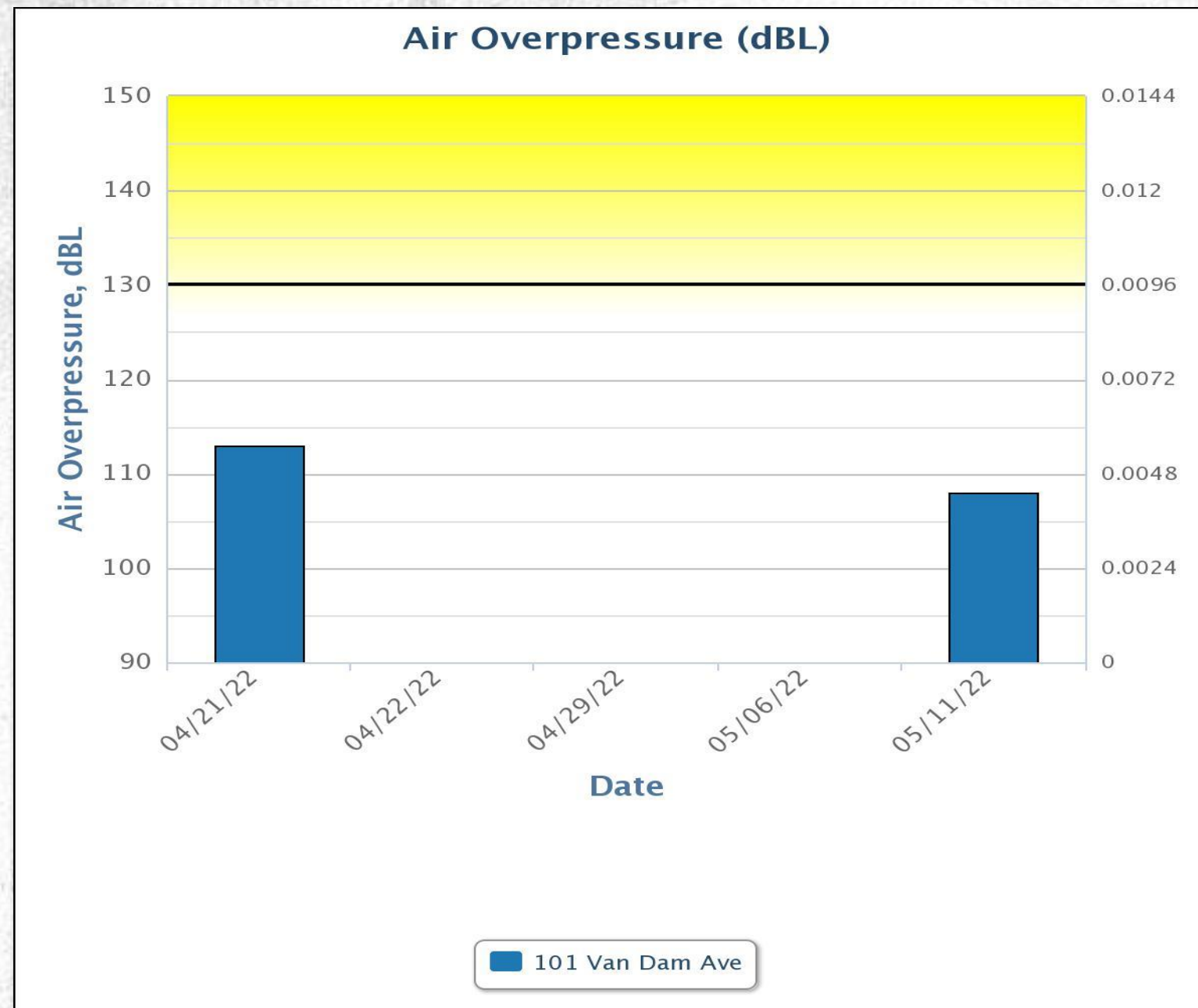
101 Van Dam Ave.



Prompton Lakes Quarry

Recorded Air Overpressures – 101 Van Dam Ave.

04-21-2022 - 05-11-2022

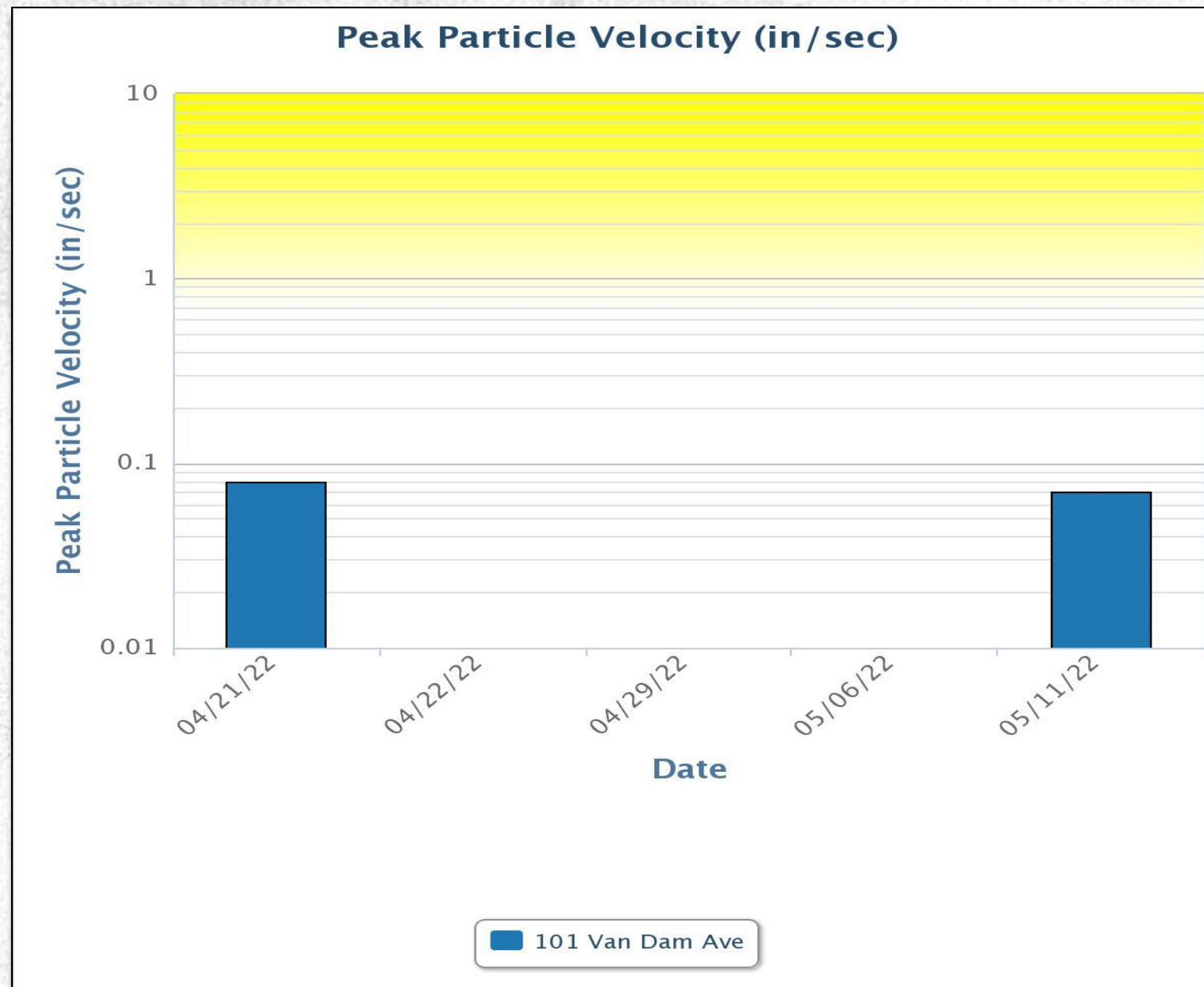


AOP Trigger Level: 125 dB

Prompton Lakes Quarry

Peak Particle Velocity vs. Date – 101 Van Dam Ave.

04-21-2022 - 05-11-2022

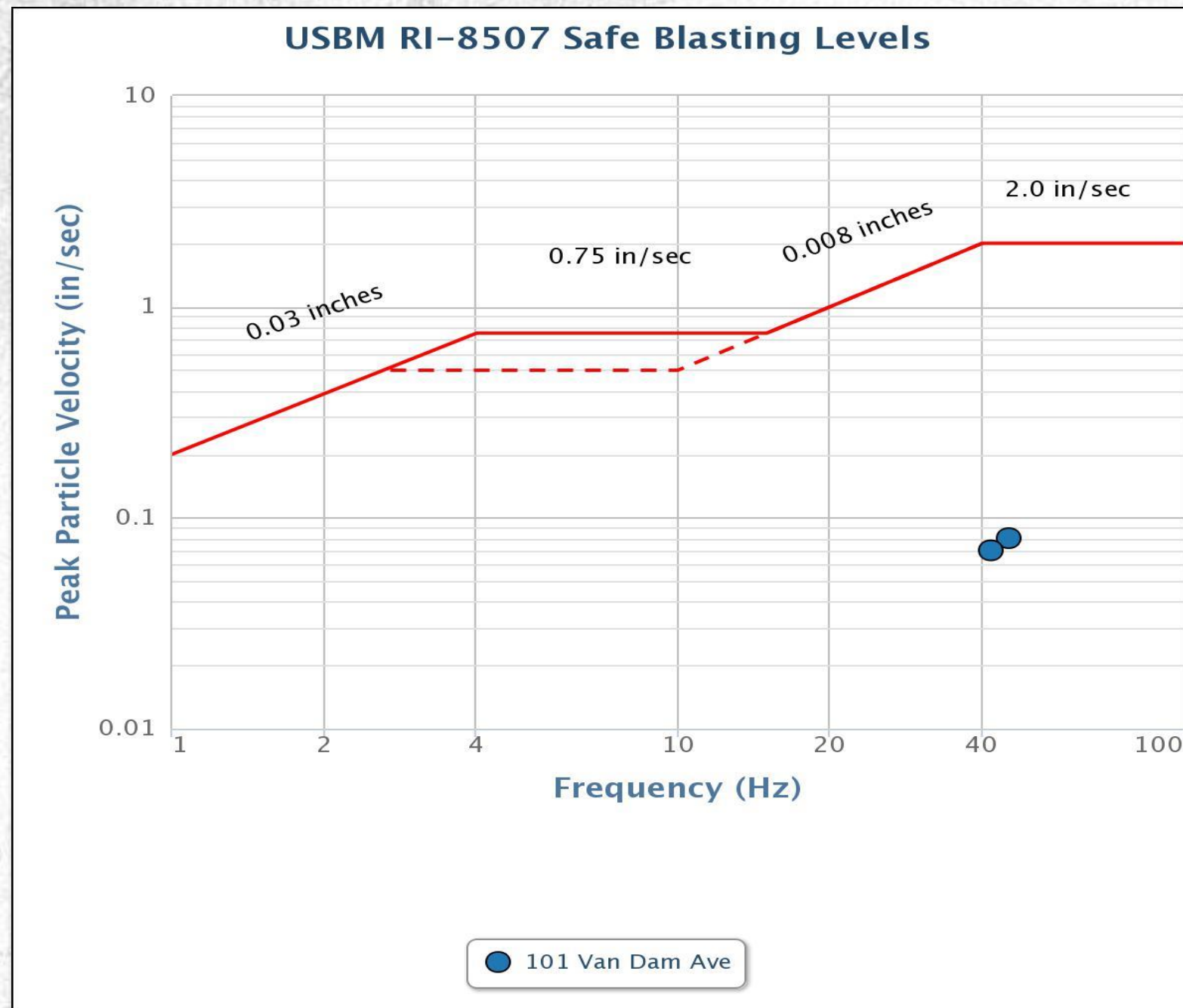


Ground Vibration Trigger Level: 0.03 in/sec

Pompton Lakes Quarry

Recorded Ground Vibrations – 101 Van Dam Ave.

04-21-2022 - 05-11-2022



Questions?