

## UNDERSTANDING Vibration

### BACKGROUND

The B&P Tunnel project's preferred alternative, Alternative 3B, includes construction of new tunnels under several historic West Baltimore neighborhoods. To construct the tunnels, tunnel boring machines (TBMs) would be used to grind through rock and other earth material deep underground, creating four round bores within which the track and electrical and communications equipment would be installed. This project would also require the construction of ventilation plants located on the surface and connected to the underground tunnels to provide air circulation and an exit for passengers and crews in the event of an emergency.

The construction would create vibrations through the earth, which has raised concerns from property owners. In response to these concerns, and with the understanding that humans are sensitive to vibration, the B&P Tunnel Study team has included an estimate of the nature and magnitude of vibration for this project. To estimate vibration from construction, project engineers considered the types of soil and rock along the path of the tunnel, the depth of the tunnel, and likely tunnel construction techniques.

### VIBRATION DURING CONSTRUCTION

#### Sources of Vibration

Construction vibration can be caused by the operation of TBMs, the excavation of the ventilation shaft, and the excavation of connections between the tunnels. For the purpose of the environmental evaluation, the vibration from each source was considered separately.

- **Vibration from TBMs.** New tunnels would be bored through dense soil and rock, both of which can transmit vibration. The vibration diminishes with distance, and is generally not detectable at more than 160 feet. The tunnel will vary in depth from 50 to 150 feet so the area where vibration would be felt is limited. The TBMs are expected to advance at a rate of about 30 feet per day, which means the vibration source will move rapidly away from any given location.



*Example of a tunnel boring machine*

- **Vibration from Cross Passages.** The new tunnels would include passageways between them to allow maintenance or evacuation during emergencies. Once the TBM work is complete, cross passages would be dug using a "drill and blast" technique. Drill and blast construction produces vibration from both the blast and from the pressure of the blast travelling through the air. Unlike TBM vibration, which is steady, blasting will be felt as quick pulses lasting for several seconds several times each day. Vibration from the blasts would be barely perceptible and not enough to damage structures. Air pressure would be controlled with a temporary shaft cover.
- **Vibration from Ventilation Shaft Construction.** The ventilation shaft would be constructed from the surface to a depth of about 100 feet. Slurry walls or secant piles could be used in construction. The vibration produced from these construction techniques is great enough to be felt by people in the area, but would not be enough to damage buildings.

Based upon the professional analysis of the project team, vibration from mining, drilling and blasting may be temporarily perceived by people in the area during construction, but would not be significant enough to damage homes or other buildings.

**Construction Monitoring**

Once funds are secured for final design and construction, the contracting team will work with property owners to monitor the impact of construction activity on the surrounding built environment. These activities will be managed by the team assigned by Amtrak or their designee in cooperation with property owners.

**VIBRATION DURING TRAIN OPERATIONS**

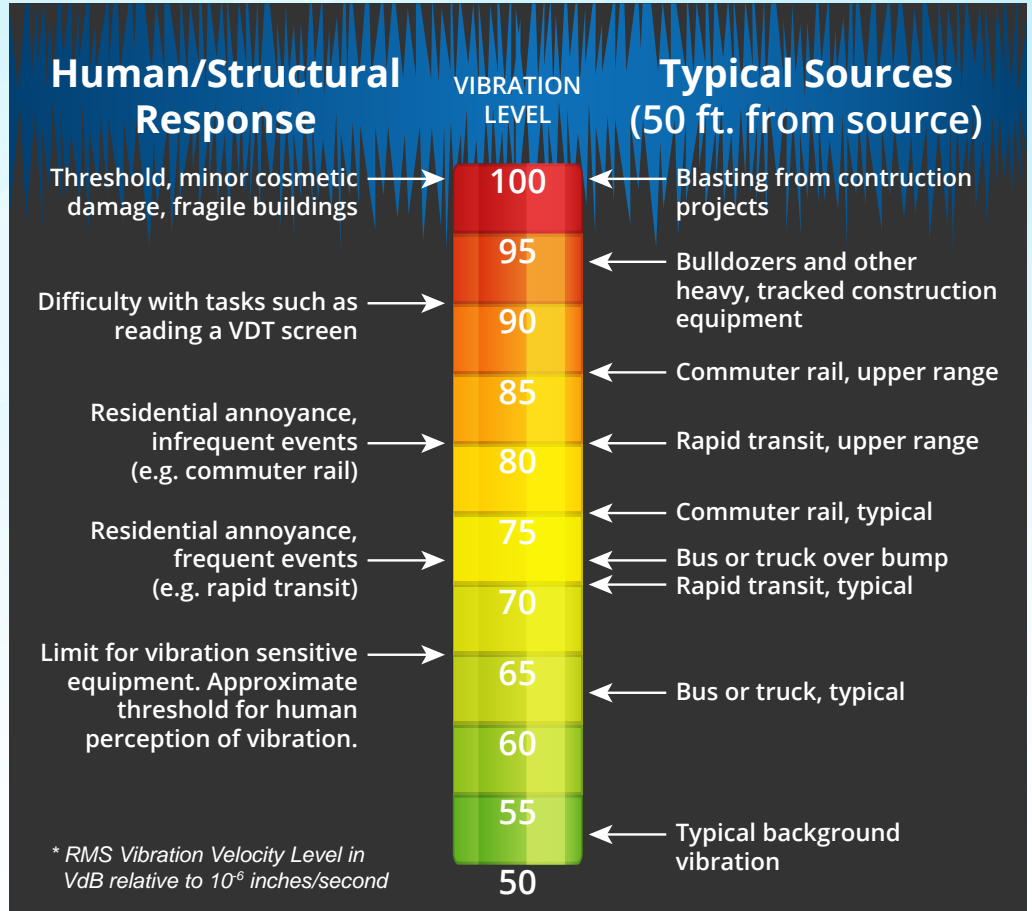
Operational vibration originates at the track bed, where train wheels rolling on the rails create vibration energy. This energy is transmitted into the adjacent ground and emanates through soil and rock to the foundations of nearby buildings.

Ground-borne noise is the noise radiated from the motion of room surfaces. When buildings vibrate, they can emit a noise or rumble which may be perceptible to people inside them. Ground-borne noise impacts are determined using a separate vibration threshold.

**Impacts of Operational Vibration and Ground-Borne Noise**

The Federal Transit Administration (FTA) has developed Impact Criteria which are used to estimate ground-borne noise and vibration levels that are expected to result in human annoyance for frequent events.

- Typical background vibration in residential areas rarely exceeds 50 velocity decibels (VdB).
- Humans can sense vibration at approximately 65 VdB.



- Areas within approximately 500 feet of the proposed alignment may experience vibration levels just approaching the level of human perception at 65 VdB. A smaller area immediately adjacent to the proposed south portal approaches and existing Northeast Corridor tracks may experience vibration levels between 65 and 72 VdB, which is slightly perceptible to humans. No vibration impacts exceeding FTA Impact Criteria of 72 VdB would occur.
- An estimated 449 ground-borne noise impacts above the FTA Impact Criteria would occur. Mitigation measures will be incorporated into the final design to reduce these impacts.
- No vibration levels high enough to damage fragile buildings are estimated from operations.



**To request more information**

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