

# Environmental Ground-Borne Vibrations from Train Operations in the US 36 Corridor (Denver-Boulder, CO)

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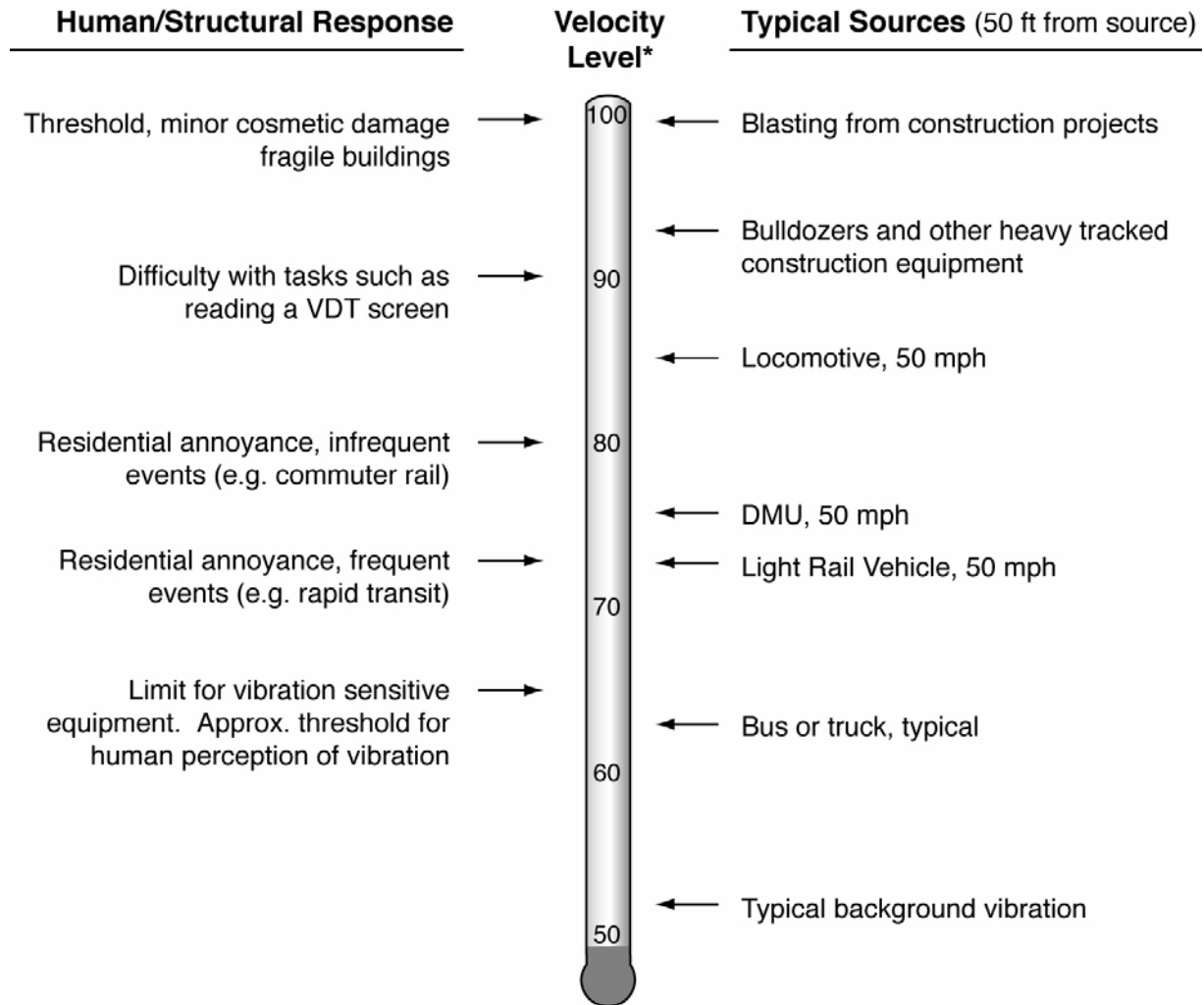
# Description of Project

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- **Sponsored by U.S. FHWA and FTA in cooperation with CDOT and RTD for Denver Metro Region**
- **Purpose: To identify multi-modal transportation improvements between Denver & Boulder, CO**
- **Alternatives include Commuter Rail service along an existing 48-km long BNSF freight rail line**
- **Rail alignment goes through residential areas with many homes as close as 15-30 m**
- **Ground-borne vibration effects were investigated as part of the Environmental Impact Study**



# Assessment of Ground-Borne Vibration

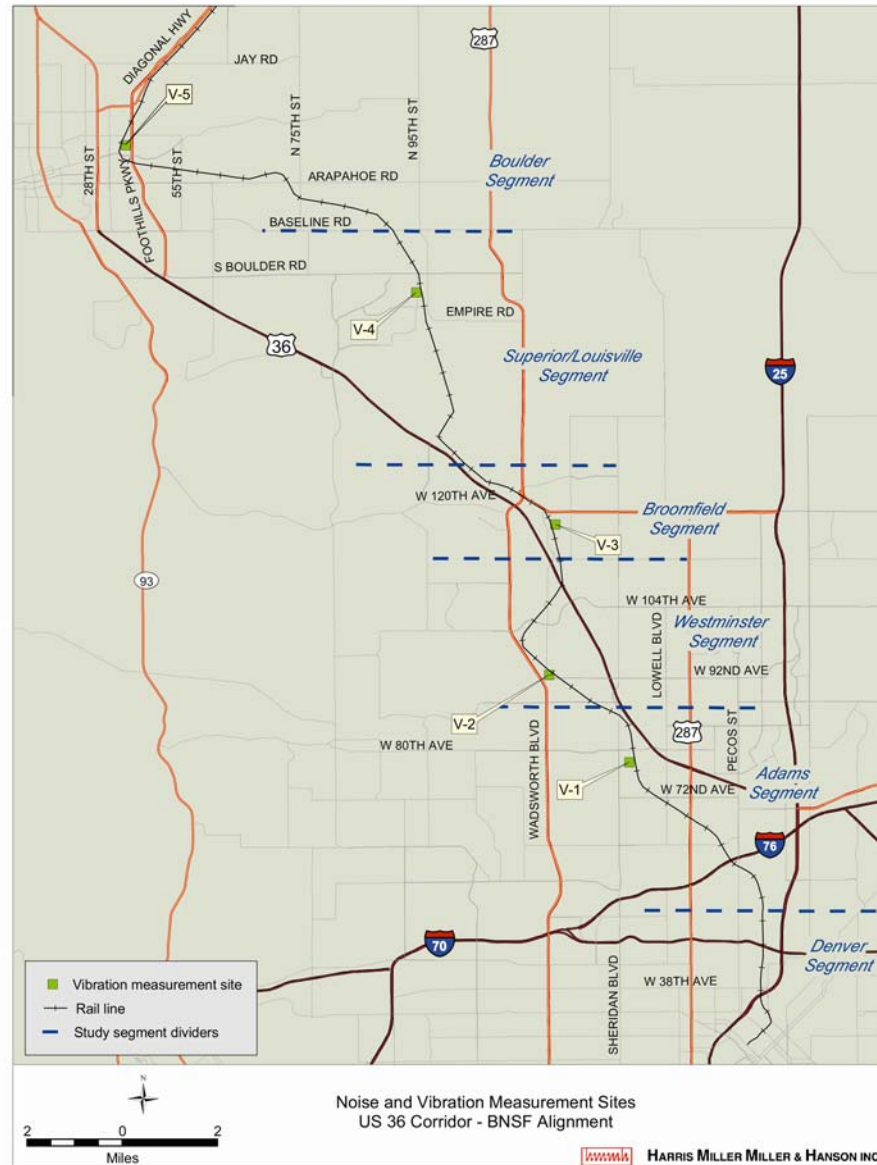


\* RMS Vibration Velocity Level in VdB relative to  $10^{-6}$  inches/second



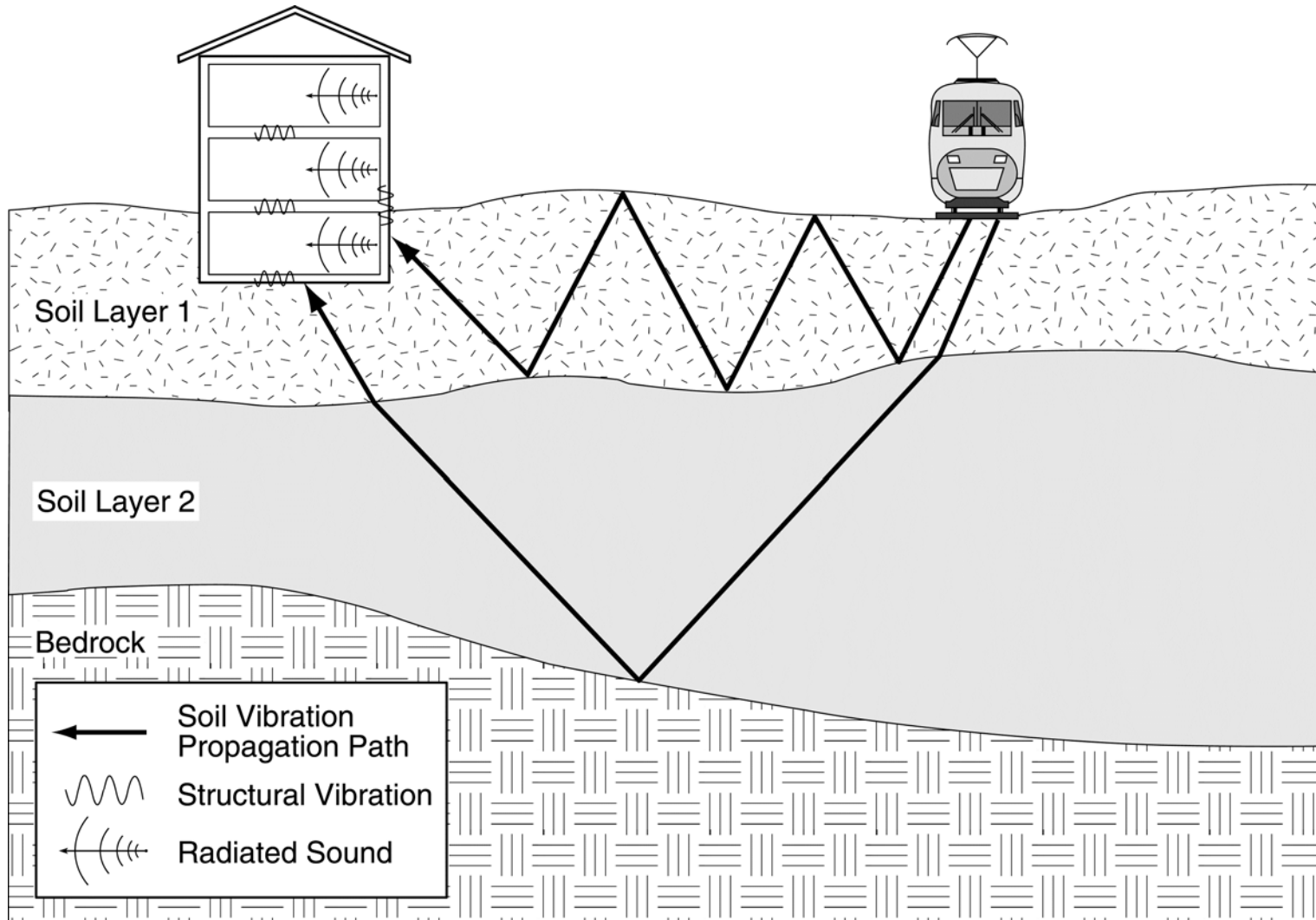
# Ground Vibration Measurement Locations

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# Ground-Borne Vibration Propagation from Trains

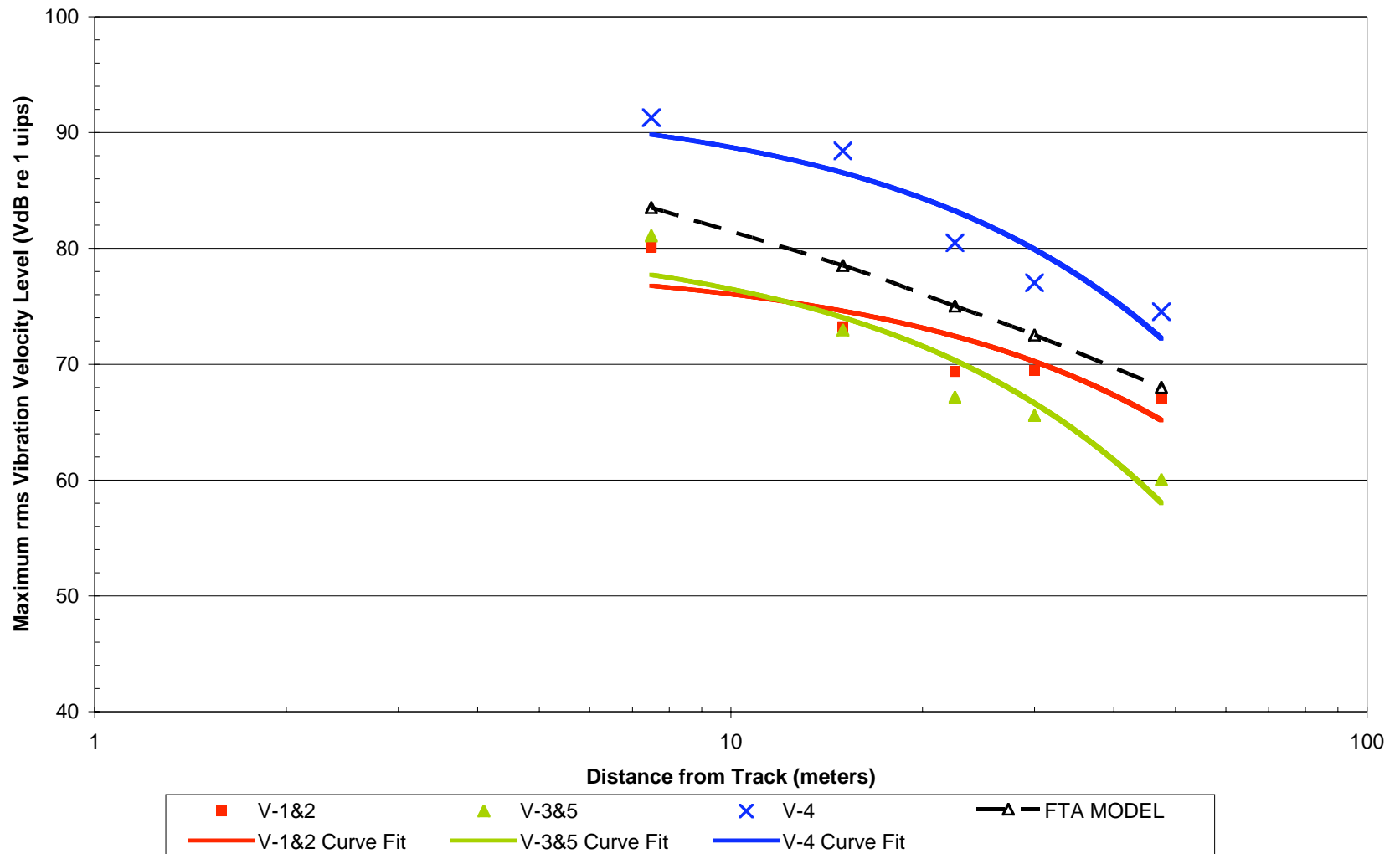
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# Ground Vibration from Existing Freight Trains

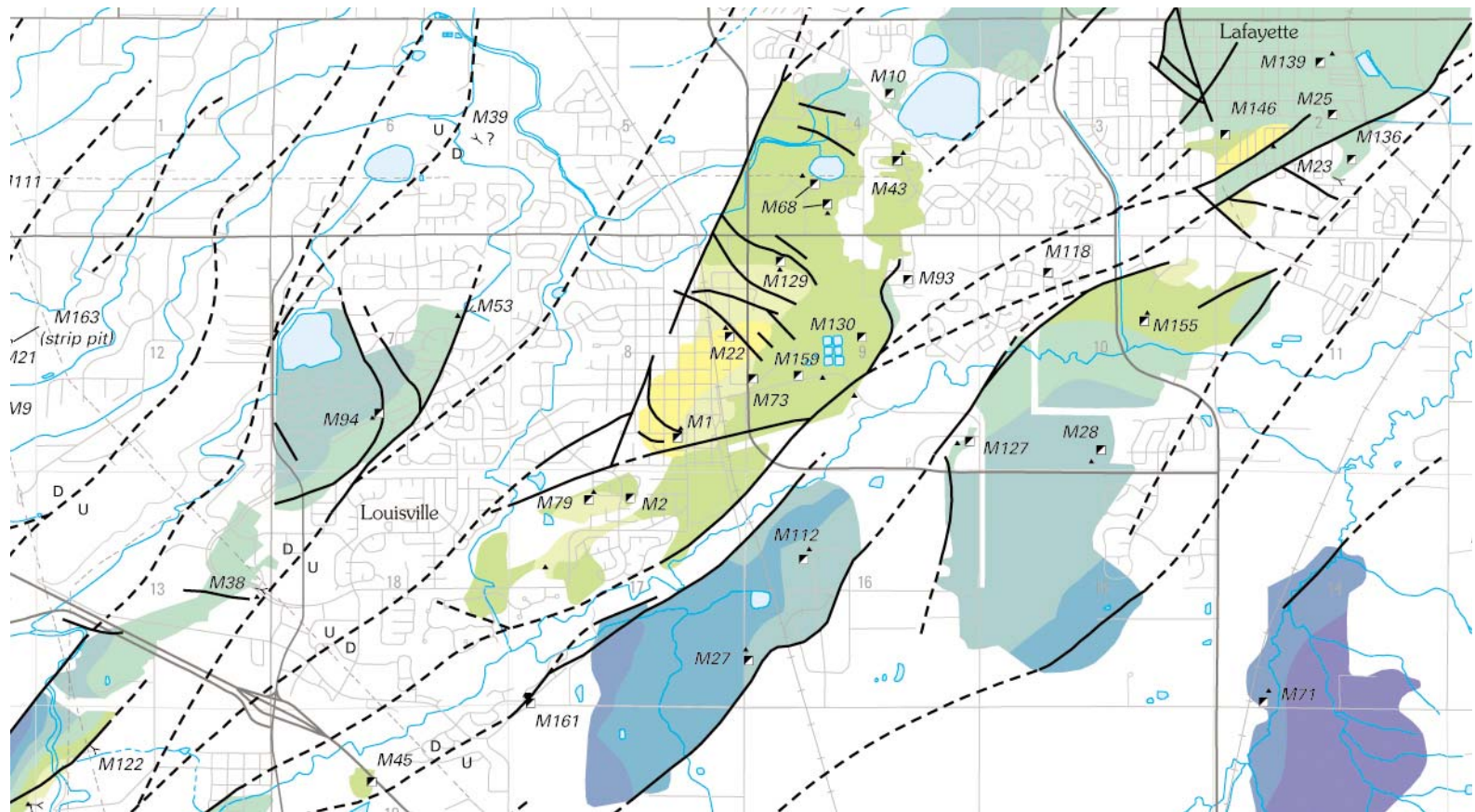
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Ground Vibration from Freight Trains on BNSF Corridor  
(Modeled by Site Area, Normalized to 40 km/hr Train Speed)



# Depth of Cover over Abandoned Coal Mines

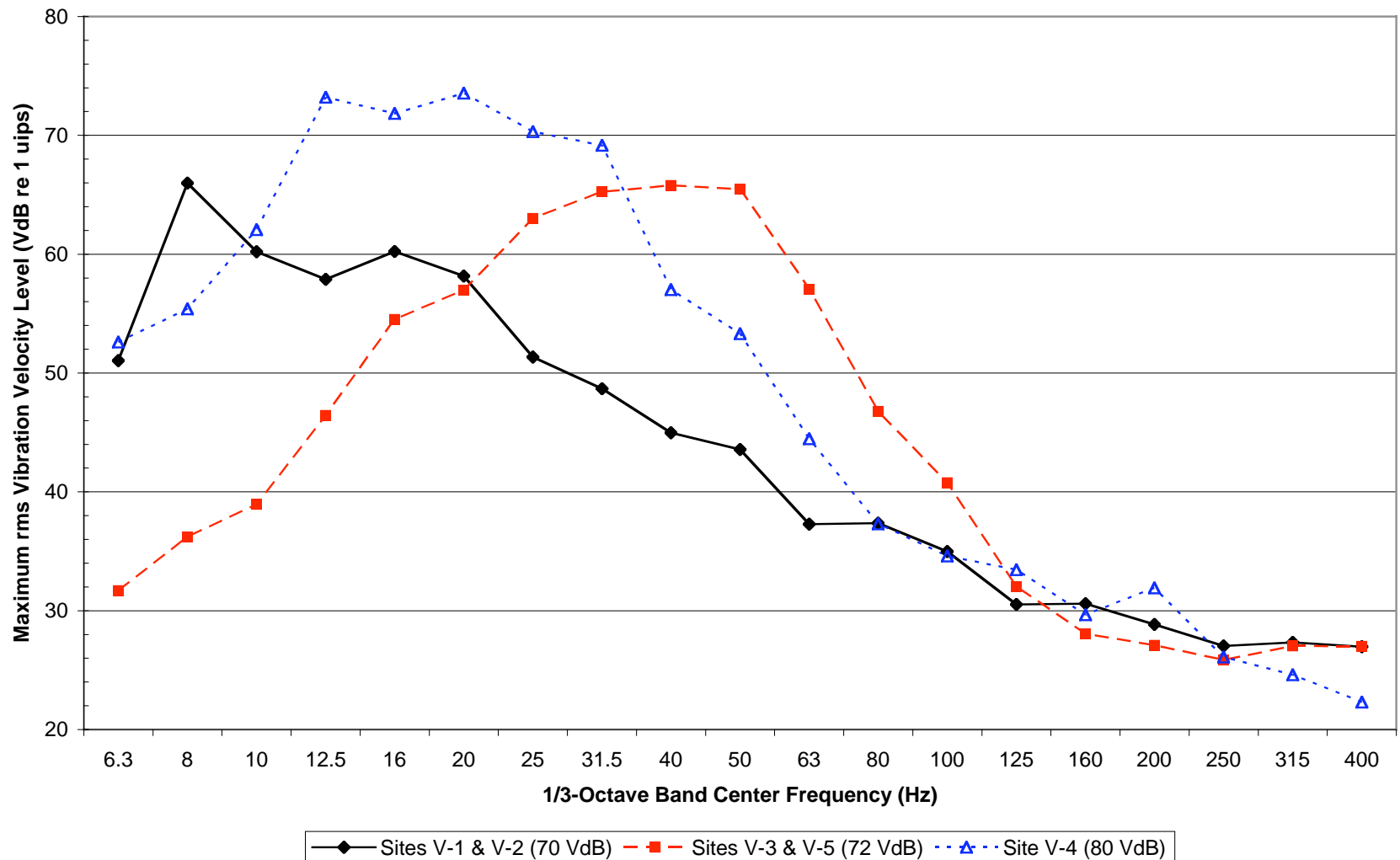
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# Average Ground-Borne Train Vibration Spectra

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AVERAGE GROUND-BORNE TRAIN VIBRATION SPECTRA AT 22.5 M FROM TRACK

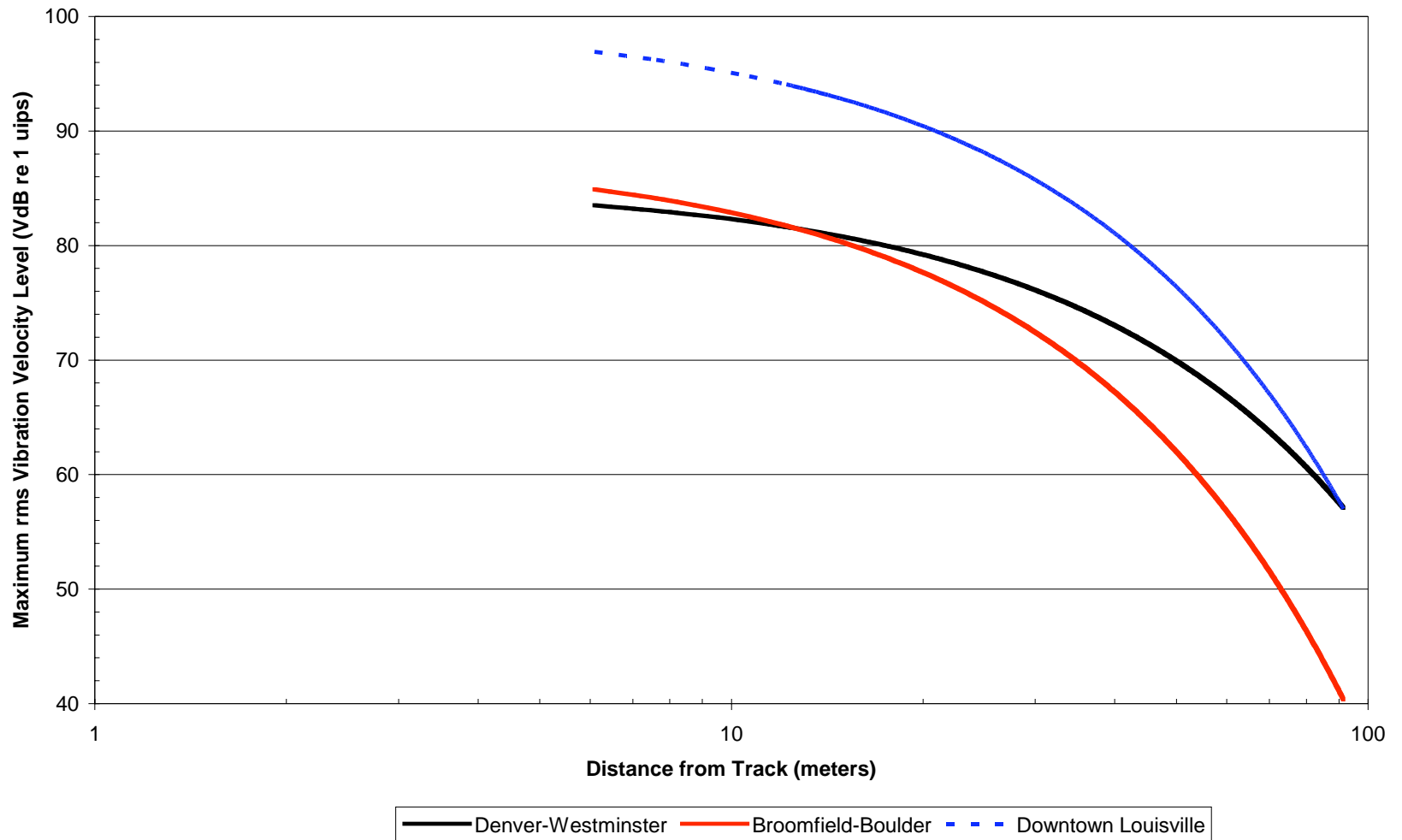




# Projected Commuter Rail Ground-Borne Vibration

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Projected Commuter Rail Ground-Borne Vibration Levels at 80 km/hr



# CONCLUSIONS

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- **Projected train vibration levels using FTA General Assessment Method represented average conditions along the US 36 Corridor**
- **Significant variations in vibration propagation due to area-specific ground characteristics**
- **Refined analysis is needed to determine types and locations of vibration mitigation measures**
- **Analysis should include site-specific tests, spectral analysis and review of geology**

