

Capital Line SLRT Extension



Environmental Traffic Noise

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Topics for Discussion

- **Decibel Scale**
- **City of Edmonton Criteria**
- **Noise and Vibration Measurements & Monitoring**
- **Noise Barriers (How do they work?)**

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- **Noise is measured using a Decibel (dB) scale**
- **The dB Scale is a base-10 logarithm scale (similar to the Richter Scale)**
 - **A reduction of 1 – 2 dB = Threshold for subjective change**
 - **A reduction of 3 dB = Barely perceptible subjective change**
 - **A reduction of 5 dB = Strongly perceptible subjective change**
 - **A reduction of 10 dB = Approximately ½ as loud**

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Traffic (20,000 vehicles/day) at 100 m away = 55 dB



x2 Traffic (40,000 vehicles/day) at 100 m away = 58 dB



x4 Traffic (80,000 vehicles/day) at 100 m away = 61 dB

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Assessment Criteria

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City of Edmonton Urban Traffic Noise Policy (UTNP) C506A (2013)

UTNP (C506A)



“The City of Edmonton will seek to achieve a projected attenuated noise level below 65 dBA Leq24 or as low as technically, administratively, and economically practicable, where any urban transportation facility (arterial roadways, light rail transit) is proposed to be built or upgraded through or adjacent to a developed residential area where private back yards will abut the transportation facility. Funding for noise attenuation, where appropriate, and subject to availability, is considered in the cost of the project.”

“The City of Edmonton will seek to minimize the impact of operational noise associated with the Light Rail Transit (LRT) system on adjacent noise-sensitive land uses while balancing the need for safety and security of road users and patrons at stations, including pedestrians at intersecting roadways.

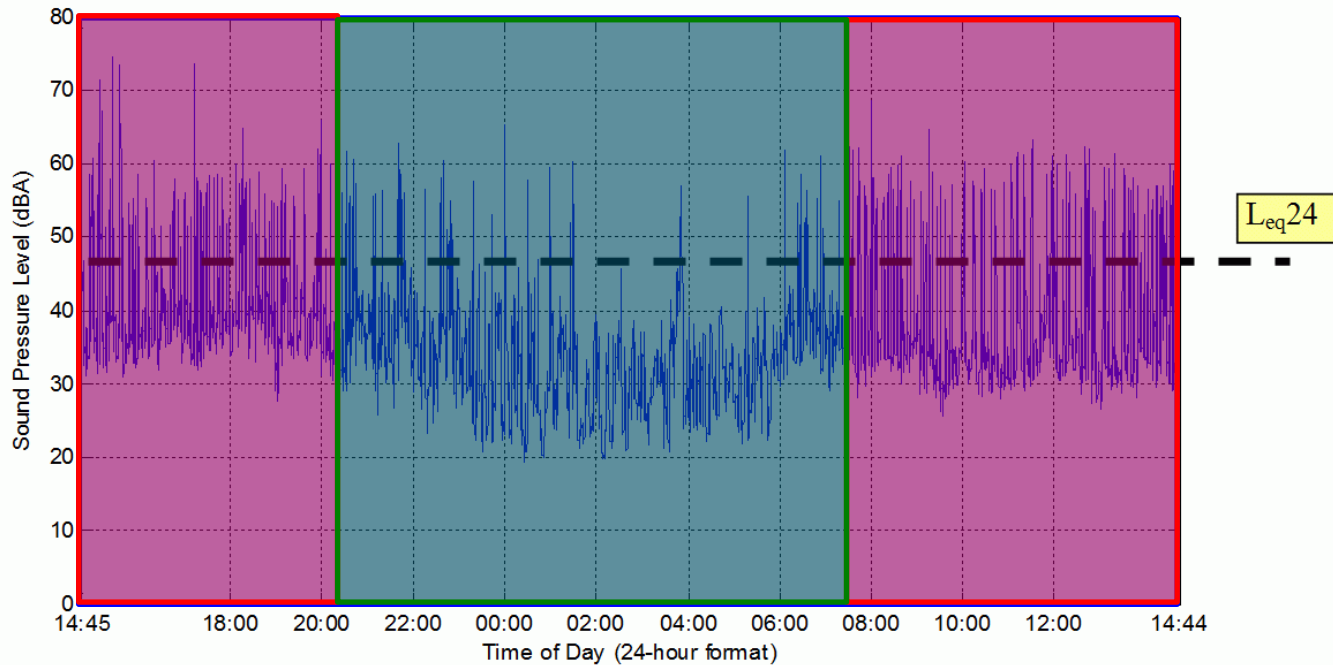
UTNP (C506A)



• L_{eq24} = 24 Hours

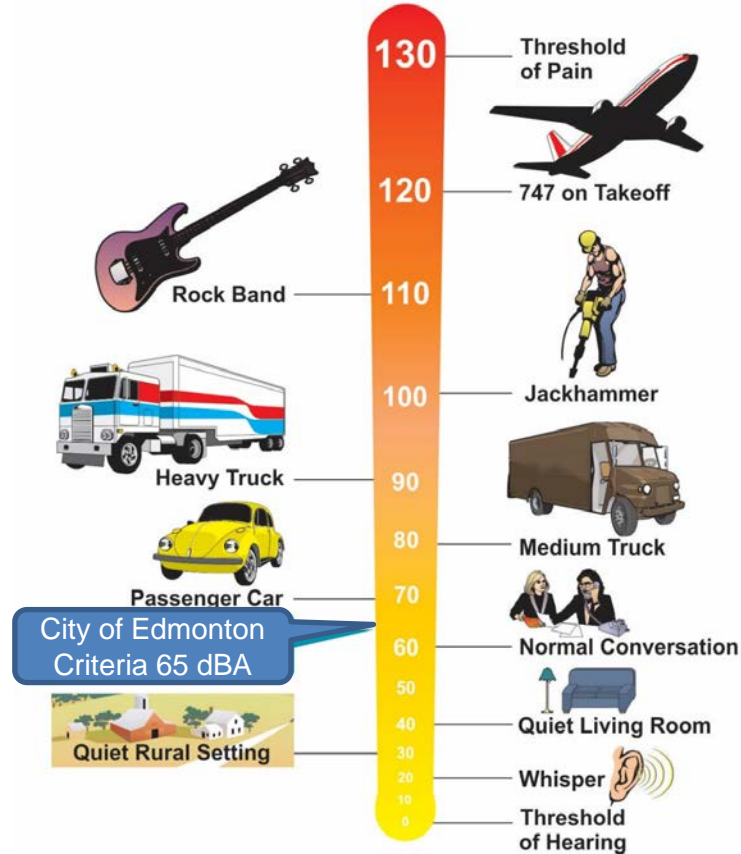
L_{eqDay} = 07:00 – 22:00,

$L_{eqNight}$ = 22:00 – 07:00



$L_{eq24} = 48.9$ dBA, $L_{eqDay} = 50.7$ dBA, $L_{eqNight} = 41.3$ dBA

What is Sound?



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Vibration

- **Human Perceptibility : U.S. Department of Transportation = 0.14 mm/s RMS**
- **Structures: Studies conducted by ACI and the City of Edmonton = 10 mm/s**

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Review and Discussion of Previous Studies

Noise & Vibration Impact Assessment



Two Major Components of noise & vibration impact assessments (NIA & VIA, respectively) include:

- 1. Monitoring & Measurements**
- 2. Modeling(NIA) & Calculations (VIA)**

Monitoring

(Noise and Vibration)



- **ACI uses very specialized noise and vibration monitors to perform measurements from 24 - 48 hours.**
- **Noise: SLM & Omni-directional microphone**
- **Vibration: Tri-axial accelerometer**
- **Conditions for Monitoring:**
 - **Wind speeds are below 15 km/hr,**
 - **Monitor is downwind or crosswind from source,**
 - **No precipitation**
 - **Only performed from Monday to Friday.**
 - **Performed from April to October (no snow)**



Monitoring (Noise and Vibration)



In 2009

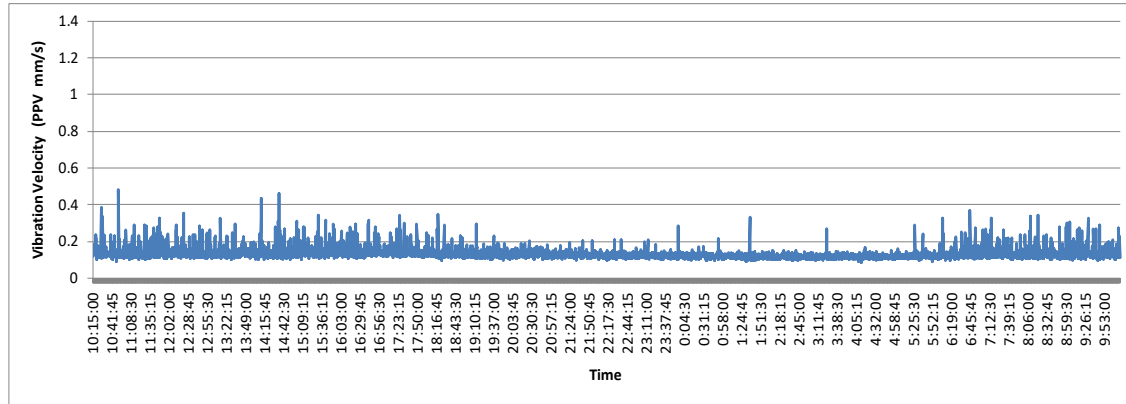
- **ACI conducted 8 Noise Monitorings:**
 - 1 on public land,
 - 7 in residential backyards.
- **ACI conducted 3 Vibration Monitorings:**
 - All 3 were on public land.



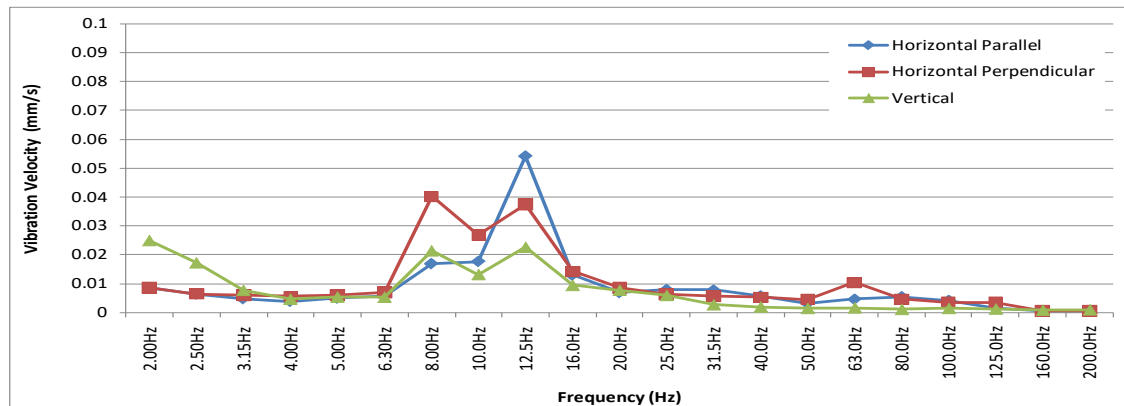
Monitoring (Vibration Monitoring)



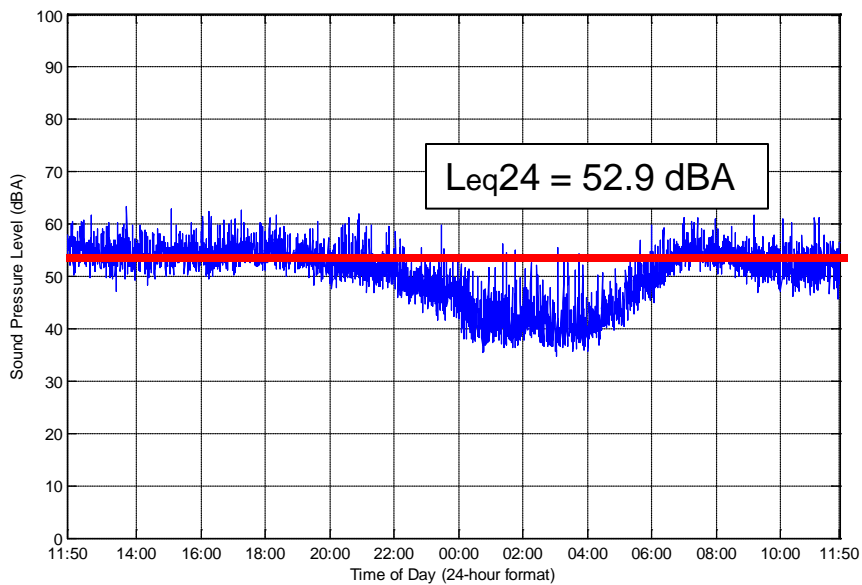
24-Hour PPV



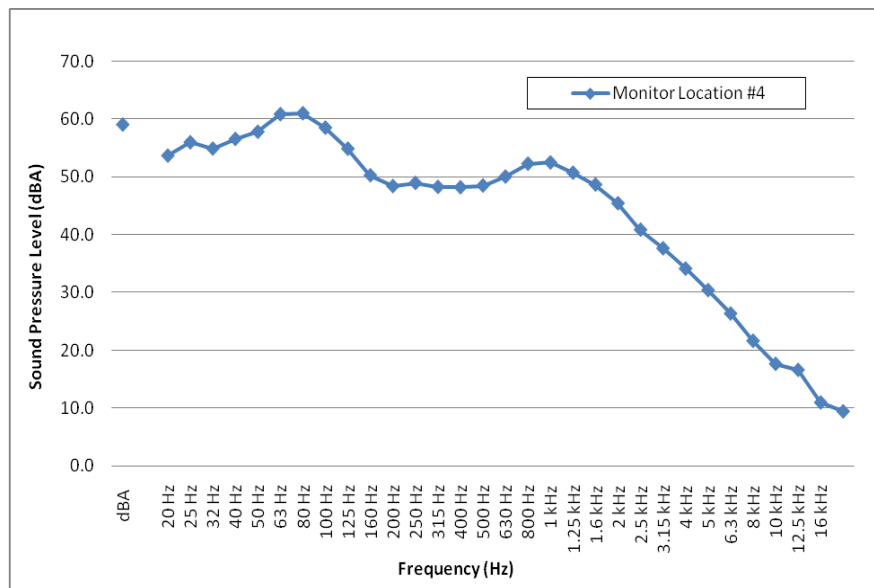
**24-Hour
1/3 Octave
Maximum
Vibration Levels**



Monitoring (Noise Results)



24-Hour Broadband A-Weighted L_{eq} Sound Levels



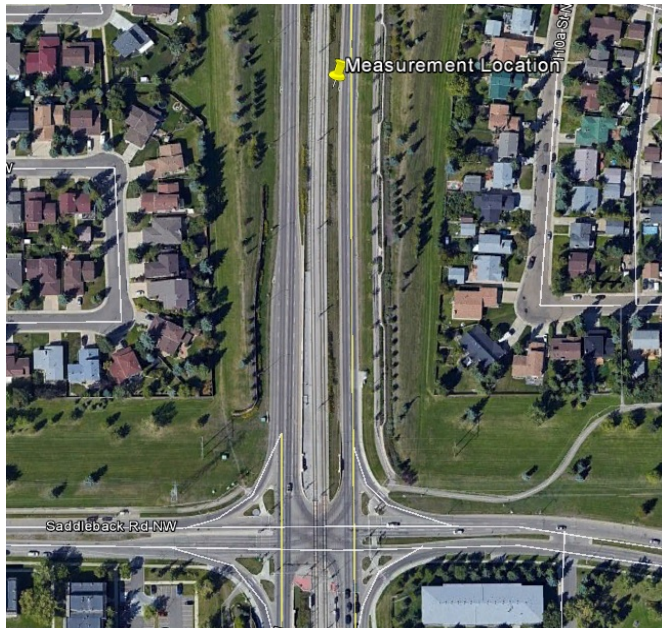
24-Hour 1/3 Octave Band L_{eq} Sound Levels

Measurements

(May 2018)



- Noise and Vibration measurements conducted in May 2018



Vibration (Conclusions)



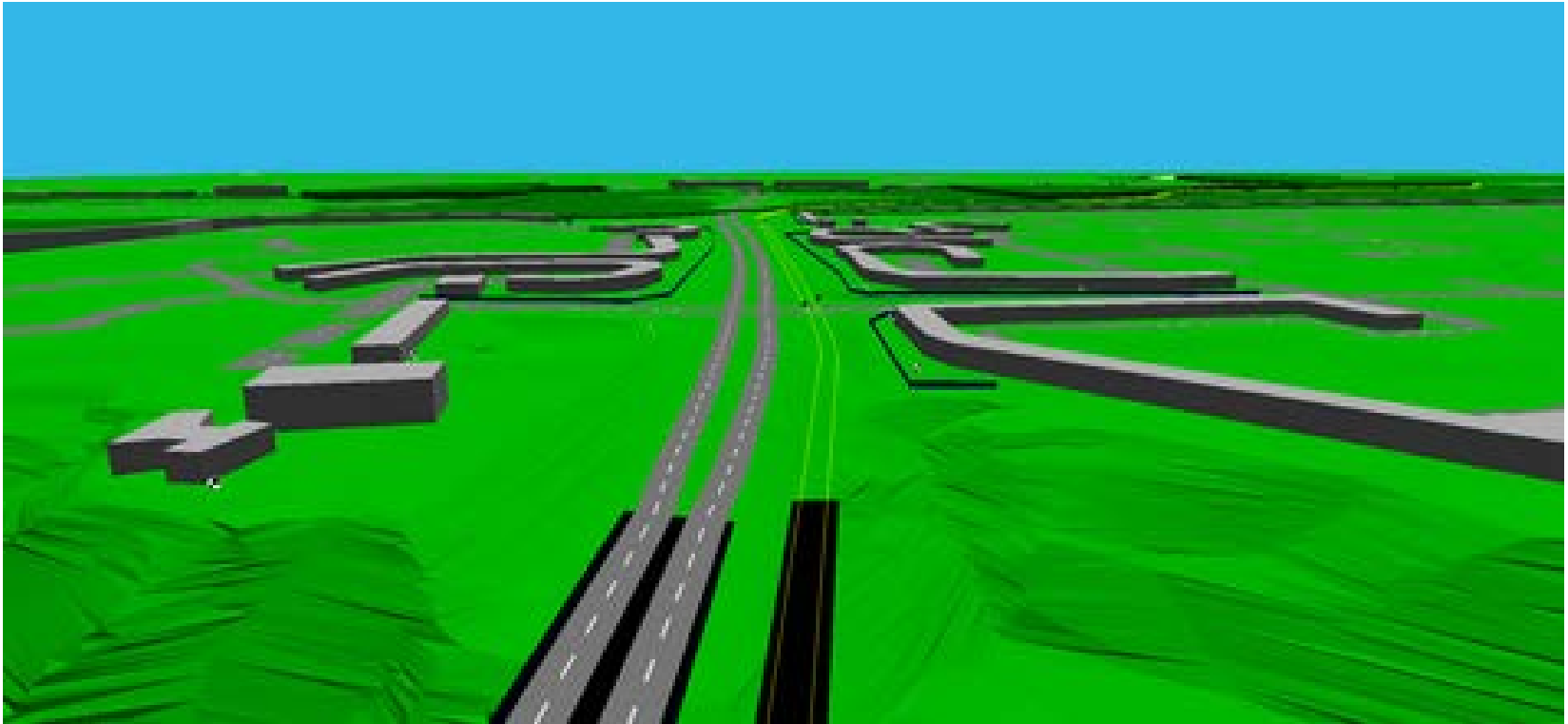
- **Projected vibration levels from vehicle traffic and SLRT Extension Trains will also be under the 0.1 mm/s RMS criteria.**
- **PPV values are well below the 10 mm/s criteria for structural integrity.**

Modeling (Noise)

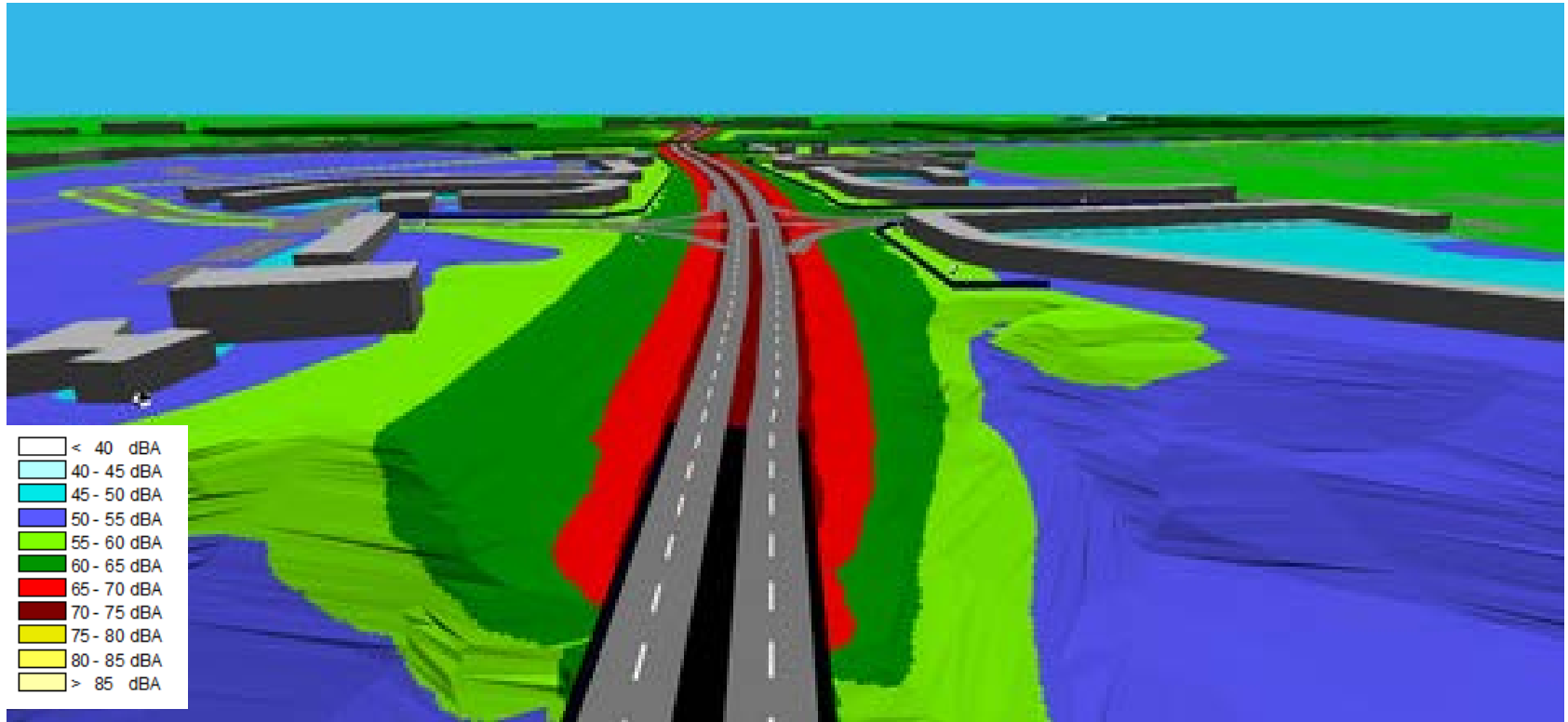


- **CadnaA Noise Modeling Software**
- **ISO 9613-2 1996 – Acoustics – Attenuation of sound during propagation outdoors**
- **Ability to add:**
 1. **Topographical features such as:**
 - **Elevation Contours, Vegetation, etc.**
 2. **Meteorological Conditions such as:**
 - **Temperature, Relative Humidity, Wind-Speed and Wind-Direction**
- **Noise Sources**
 - **Traffic = RLS – 90 German Standard (vehicles/hr, % heavy, speed limit).**
 - **LRT = Empirical measurements (Completed in May 2018)**

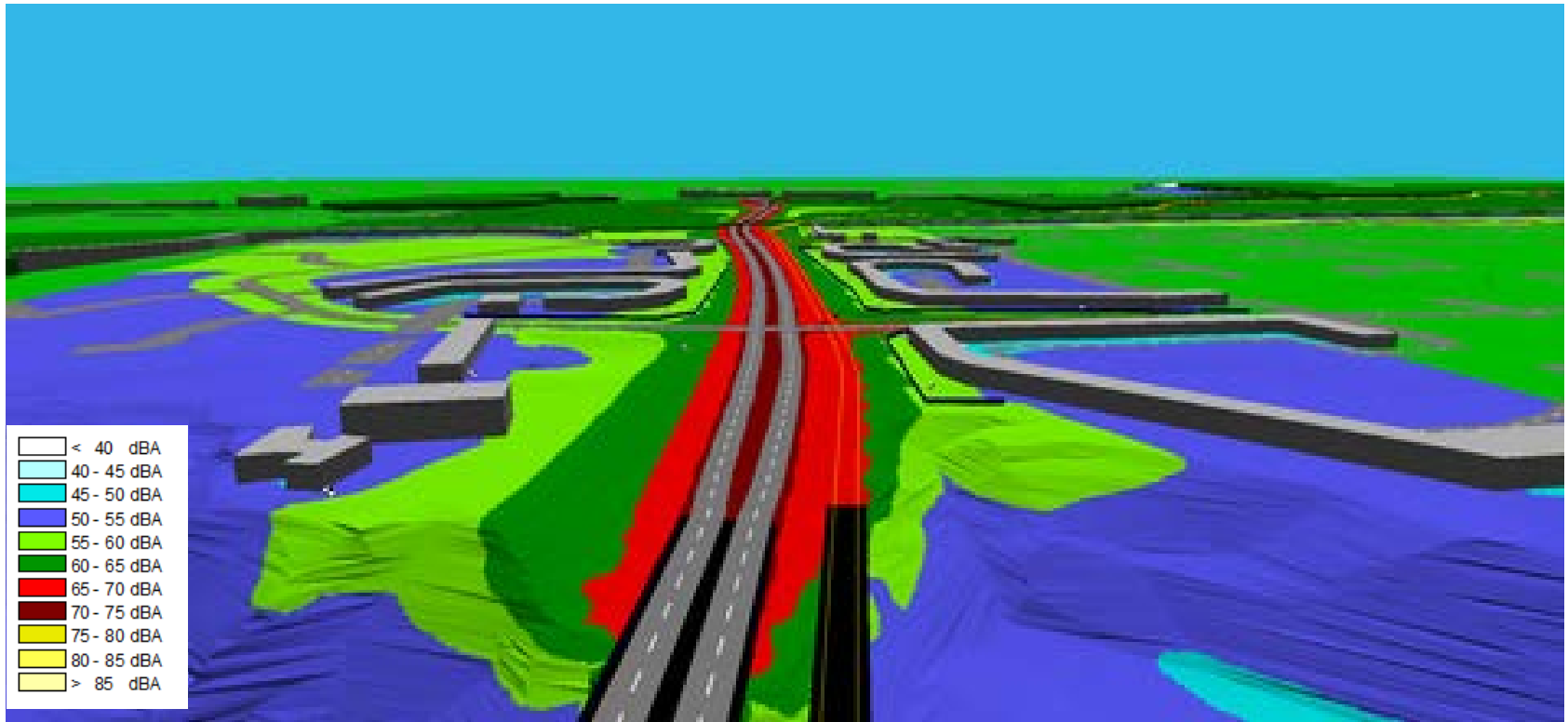
Modeling (Noise)



Modeling (Current)



Modeling (Future + LRT)



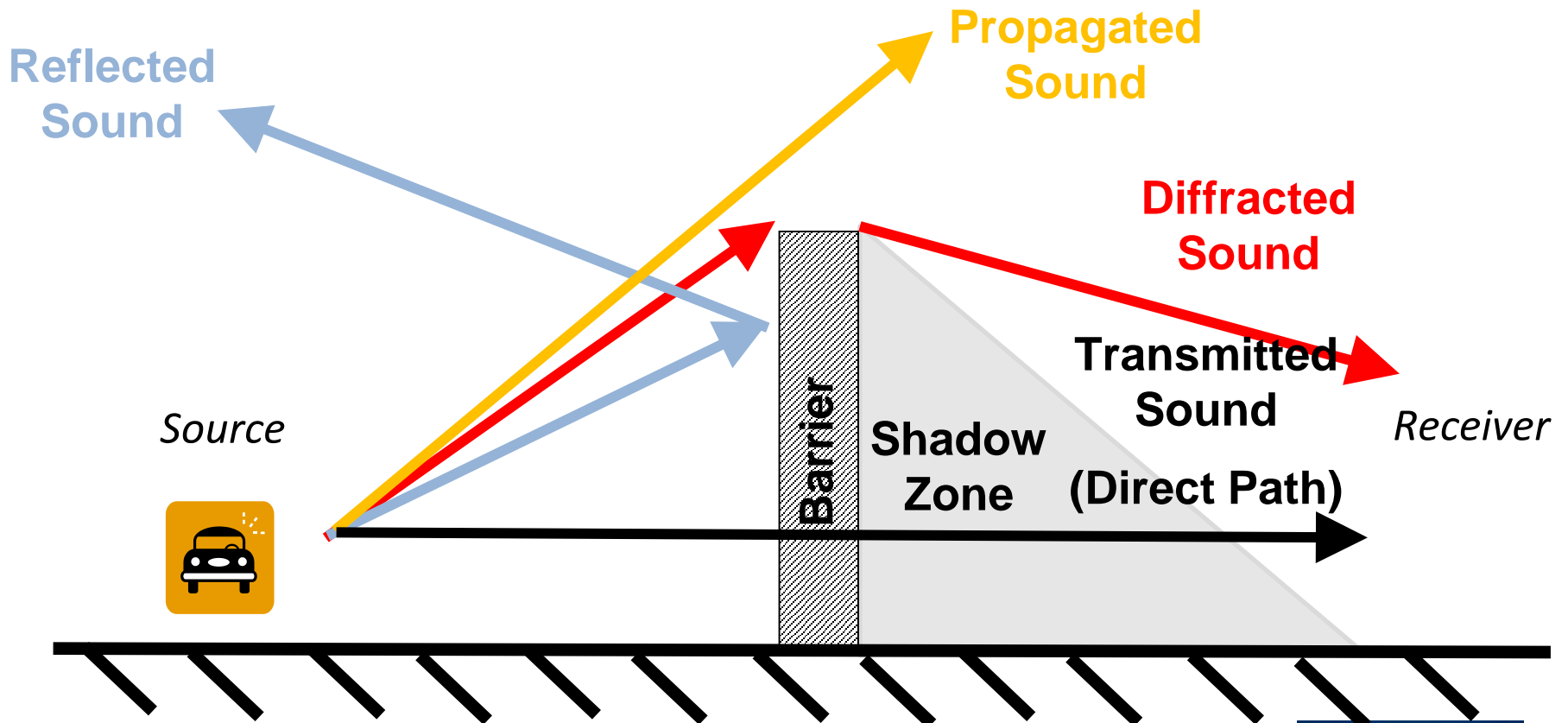
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Noise Mitigation Options

Noise Barriers

(General)



Noise Barriers

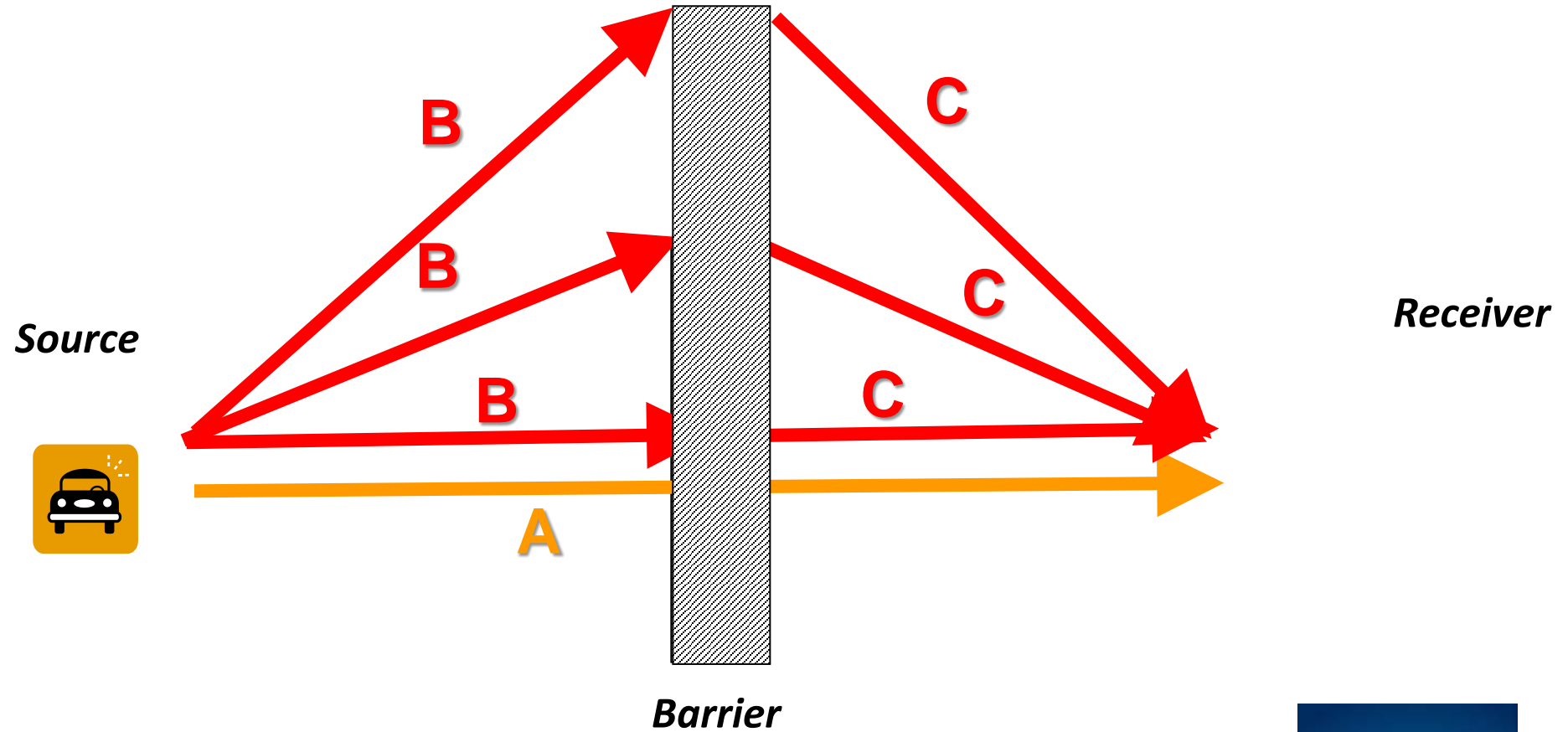
(General)



- **Sound transmitted through barrier must be at least 10 dBA less than sound diffracted over barrier**
- **Mass, Mass, MASS**
- **At least 20 kg/m² (minimum double board fence)**
- **No gaps in between or at bottom**
- **Double Boarded Wood or Masonry materials are preferred**
- **Need to consider maintenance, longevity, visual appeal**
- **There is such a thing as “overkill”**

Noise Barriers

(Path Length Difference)



$$PLD = (B + C) - A \gg 0$$

Noise Barriers

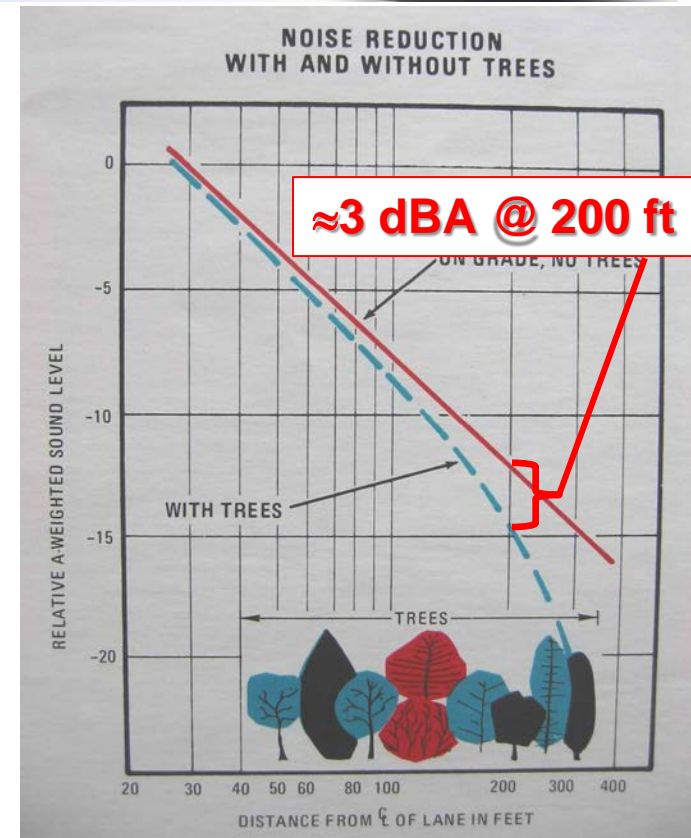
(Trees)



Myth: “Let’s just put in some trees to block the noise.”

Reality: Trees/bushes are a very ineffective means of noise mitigation.

Trees act as an acoustical placebo: ‘out of sight – out of mind’



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Field Work for 2018

- **Noise and Vibration measurements were conducted on existing Capital Line trains in May 2018.**
- **The results of these measurements will be incorporated into the updated noise model and in the vibration calculations.**