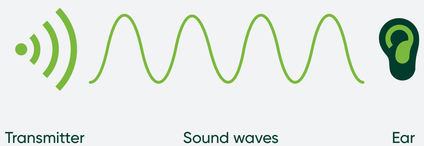
What is noise?

Definition of noise

A term used to describe everything we hear.
It includes the sound elements present in the environment.

Overview

Noise is the energy produced by vibrations that propagate in the form of waves, like a stone thrown in water.

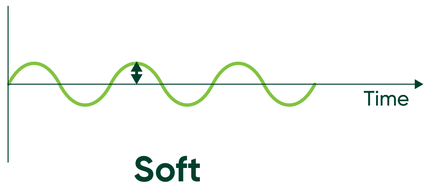


Amplitude, or sound volume

The power of noise is determined by the amplitude of the sound wave, i.e. its height, which is measured in decibels (dB).

This measurement can be adjusted to take account of the way the human ear hears sounds. This is known as decibel “A” (dBA).

The greater the amplitude, the greater the number of decibels.

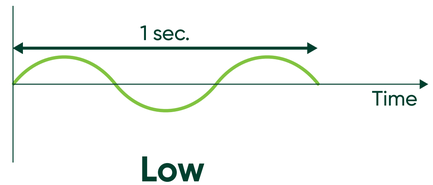


Frequency, from high to low

A wave’s frequency determines whether the sound is perceptible to humans, who generally pick up midrange frequencies.

Wave frequency is calculated in hertz (Hz), which corresponds to the repetition of the wave in one second.

The more ripples, the higher-pitched the sound. The fewer the ripples, the lower the sound.



What sounds can we hear?

Not all sounds are audible to the human ear. Here are the three categories of sound, according to the frequency of the waves generated by a noise source:

Low frequencies or infrasound

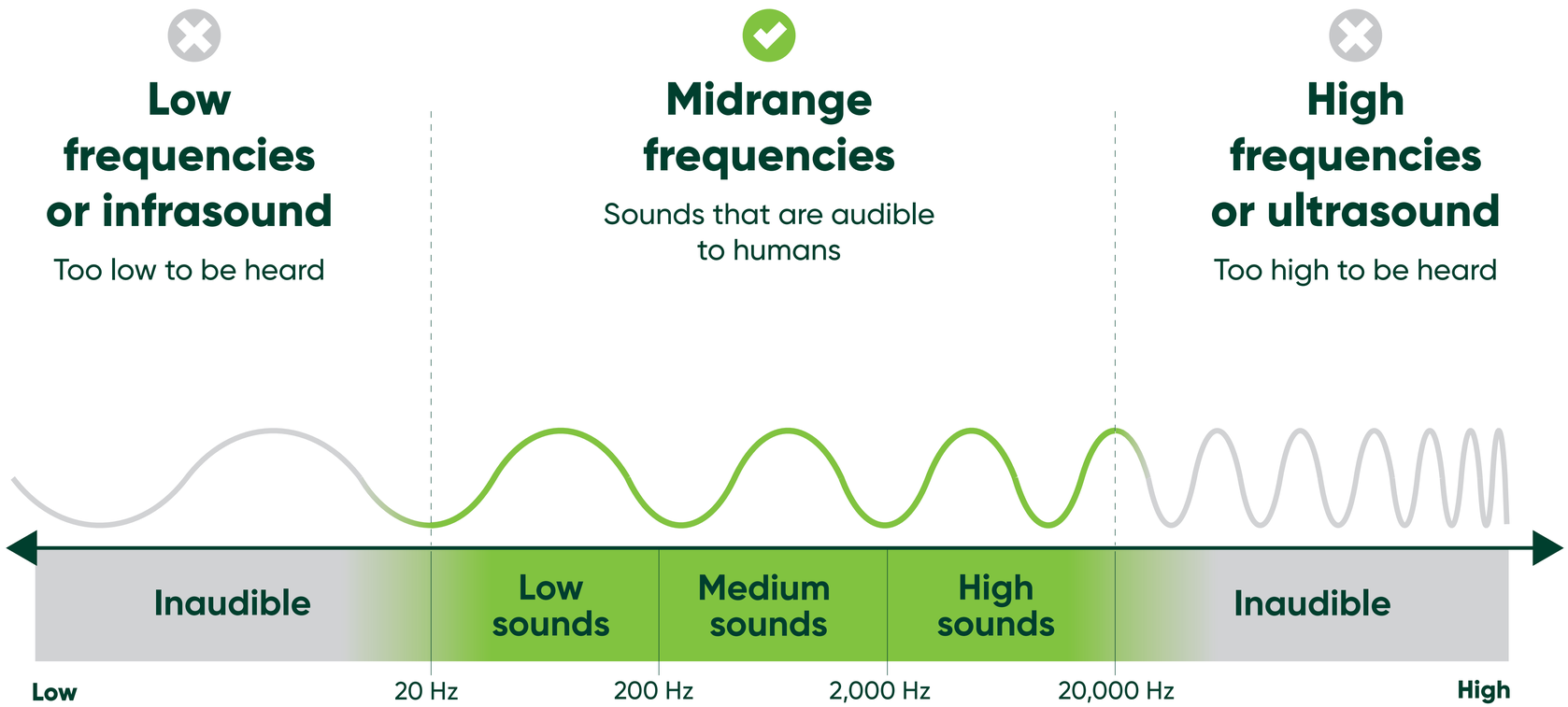
Too low to be heard

Midrange frequencies

Sounds that are audible to humans

High frequencies or ultrasound

Too high to be heard



Sound perception varies:

From one person to another, depending on age and sensitivity,

From one environment to another, depending on the surrounding noise level.

Sound level meter

Definition

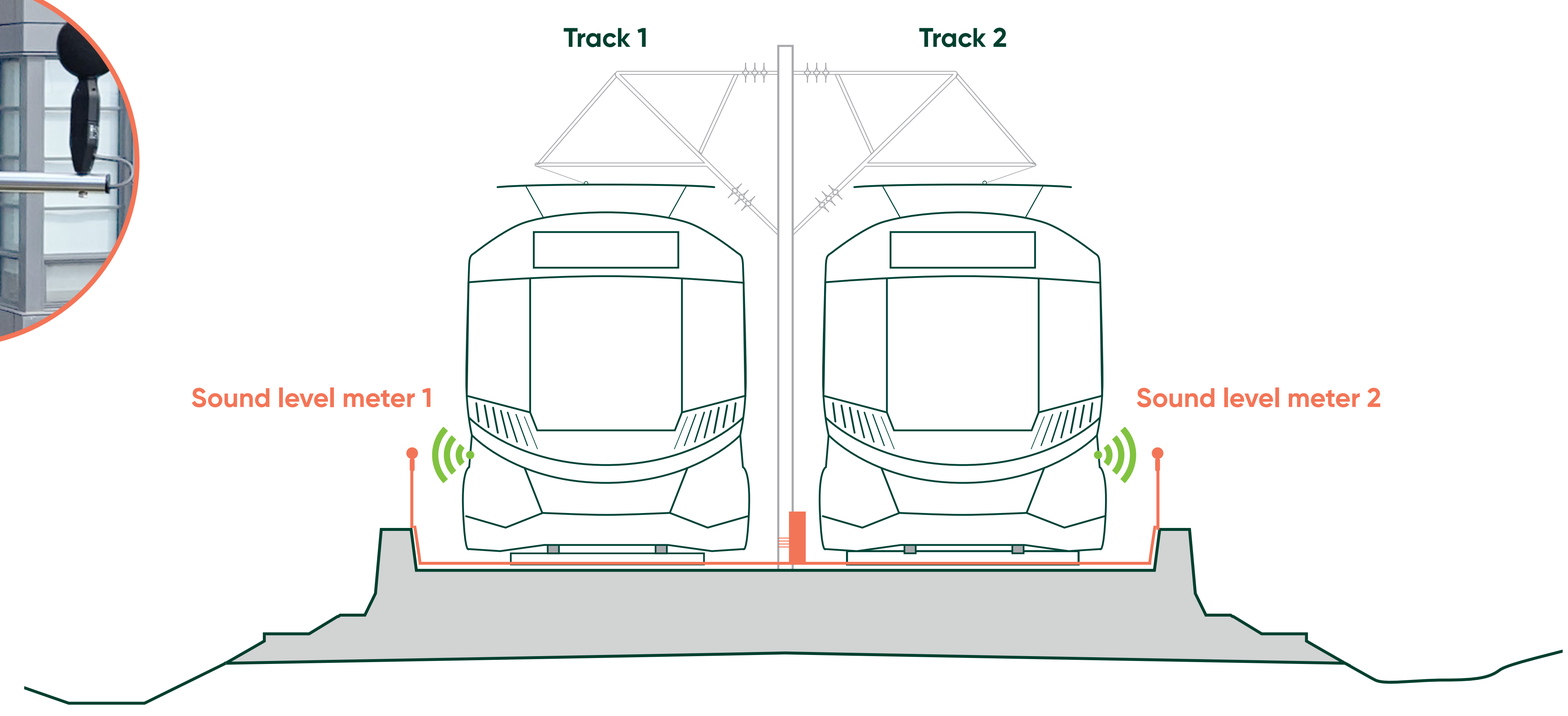
Tool used to measure decibel levels. Its microphone measures the number of particles in the air that are “displaced” and which we perceive as sound.

How does it work?

The sound level meter is placed close to the noise source you want to measure, called measuring noise at source. This ensures that the noise measurement is as unpolluted as possible by other surrounding noises.

Noise levels are influenced by distance from the noise source

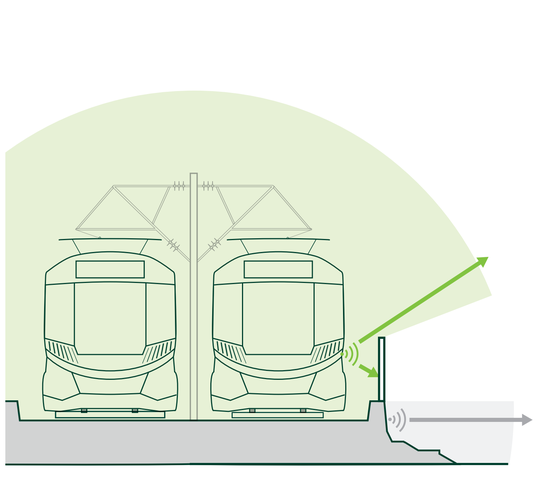
The further away we are from it, the quieter the sound.



Sound propagation

Sound waves behave differently depending on the obstacles encountered and the configuration of the space.

Behaviour of noise



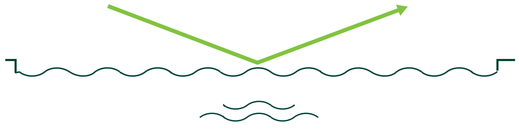
Ballasted tracks on embankments and on the ground

Noise levels are influenced by distance from the noise source

The further away we are from it, the quieter the sound.

Physical objects
(sheds, houses, walls)

Deviation



Presence of water bodies
(river, lake)

Ricochet

Weather conditions
(snow, rain)

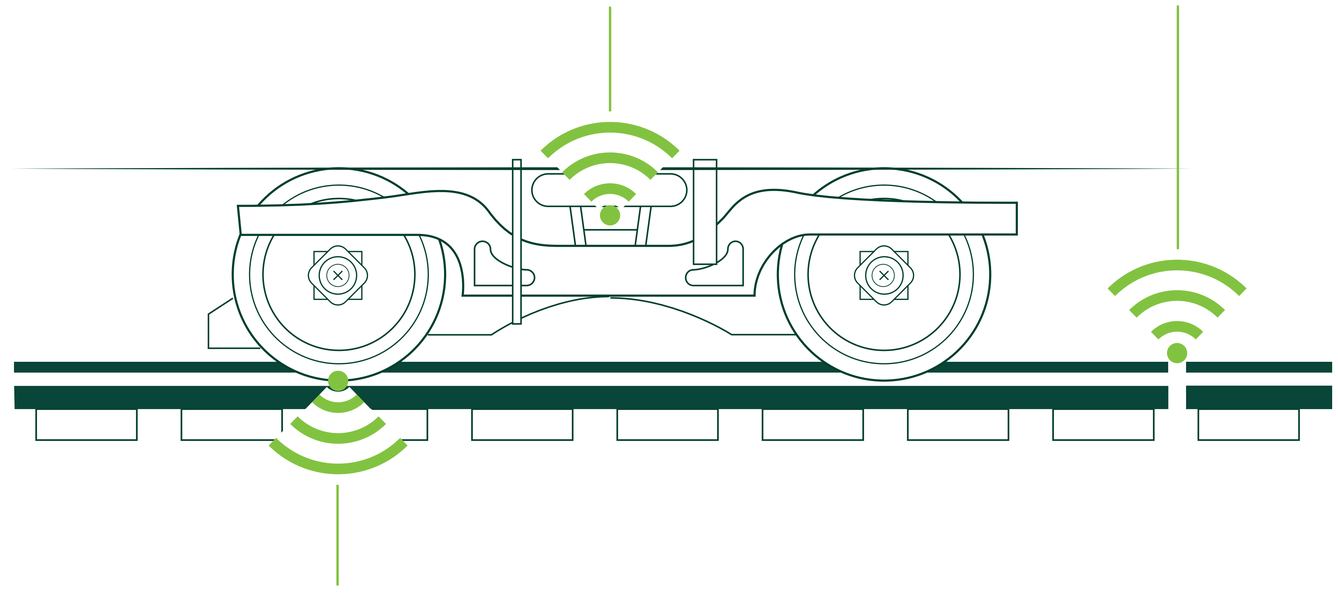
Absorption

Sources of noise

Railway noise is made up of different types of noise, such as:

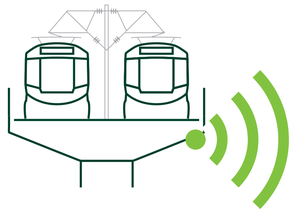
Traction noise
Produced by the motor and transmission systems.

Impact noise
Produced by the impact of wheels on the rail junction.



Rolling noise
Produced by contact between wheel and rail.

Squealing noise
Produced by passing cars on curves.



Rumbling noise
Characterized by low frequencies (low noise), produced by the spread of vibrations through a structure.

Auxiliary noise
Station noise produced by ventilation and heating systems.

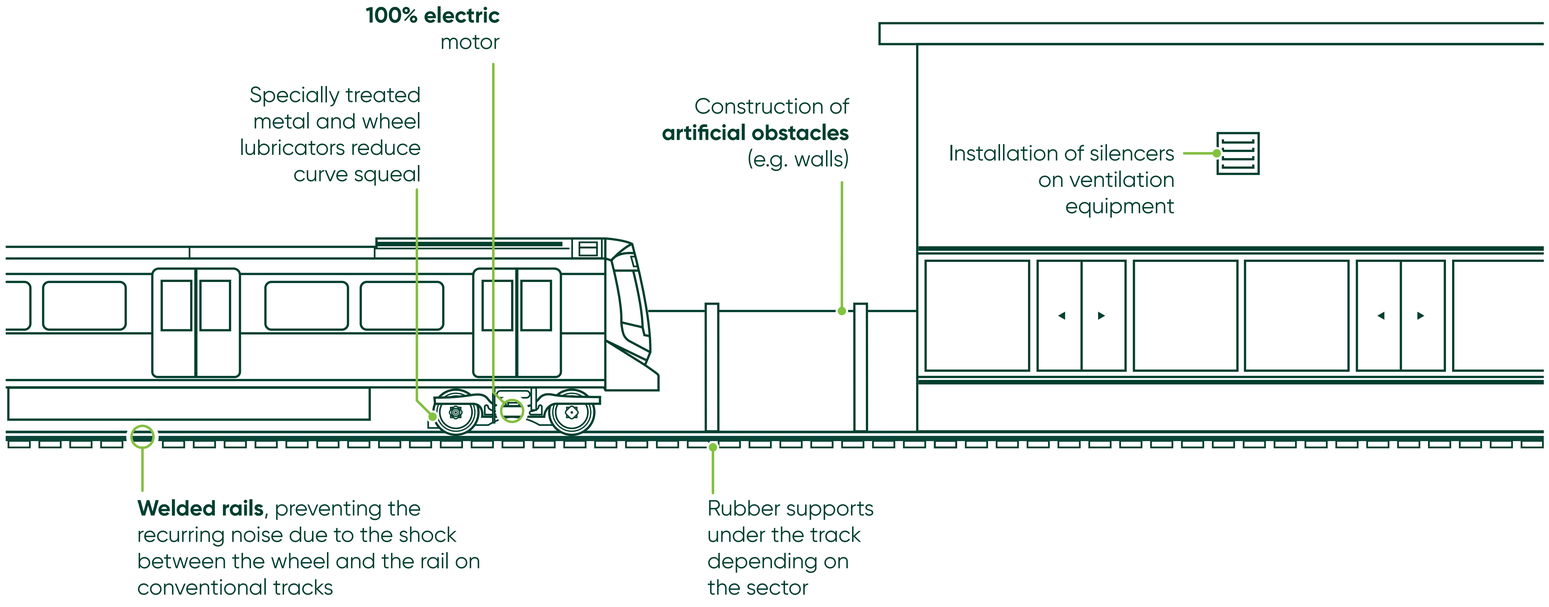
Mitigation measures

At-source measures

The cars have features that help reduce the noise caused by their circulation.

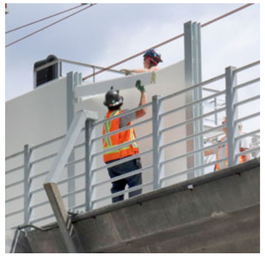
The tracks have been designed to avoid certain noises generated by contact between the rails and car wheels.

The stations' design incorporates mitigation measures (choice of equipment, installation of silencers, etc.).



Complementary measures

Additional precautions are taken to reduce the impact of noise generated by the REM. They are adapted to the characteristics of each sector.



Noise barriers

Panels containing acoustic insulation to absorb sound.

Image: Poly Corp

Dynamic absorbers

Devices for damping vibrations transmitted to rails and structures.

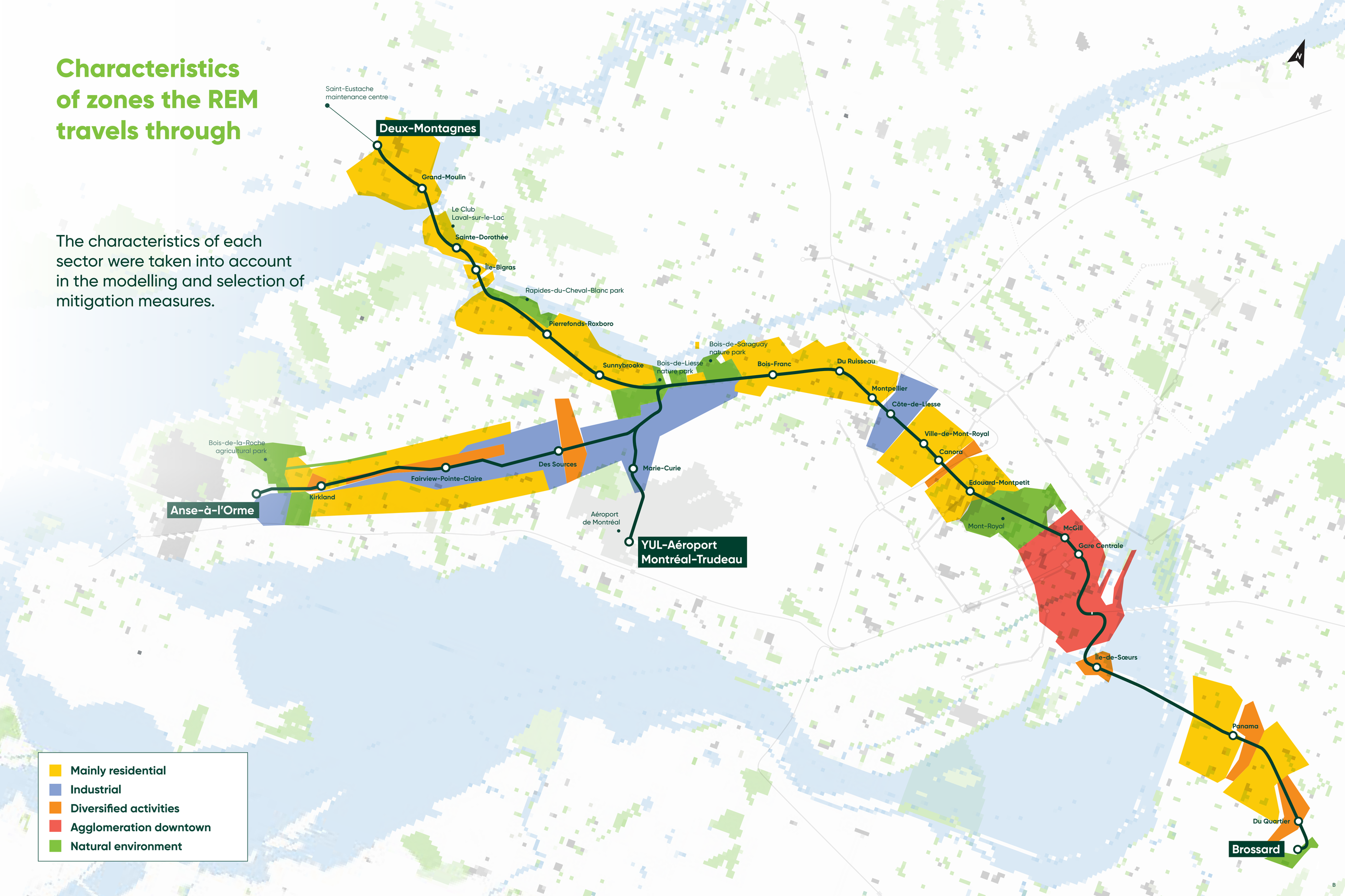
Image: Vossloh

Track and rolling stock maintenance program

Track grinding and wheel reprofiling operations to reduce friction.

Characteristics of zones the REM travels through

The characteristics of each sector were taken into account in the modelling and selection of mitigation measures.



Current status

Circulation of first cars

Early 2024

Two trips between Saint-Eustache maintenance centre and Sainte-Dorothée station.

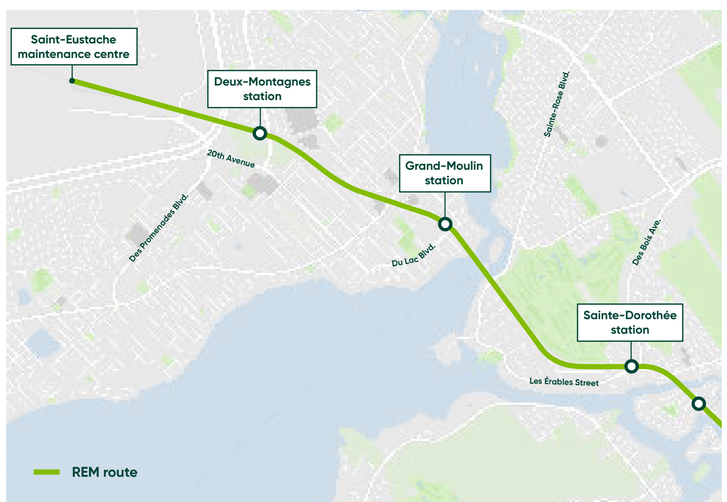
First real data collected for the Deux-Montagnes and Laval sector.

Start of dynamic testing

Mid-June 2024

Additional real data collection in these sectors.

Increased frequency of REM car circulation to test all systems, up to simulating the REM in operation.



What about the rest of the network?

What's next

These car circulation and dynamic tests will gradually be carried out for the other sectors.

The noise analyses carried out in Deux-Montagnes and Laval will provide sufficient information for comparison with the modelling results of the other sectors.

Phases of dynamic testing

1.
Start of dynamic testing between Saint-Eustache and Sainte-Dorothée

These tests will be used to test all components and systems

- ✔ cars and stations
- ✔ electrical substations
- ✔ screen doors
- ✔ and everything that powers the REM

2.
Gradual extension of test area

The dynamic tests will have to be repeated for the other segments of the Deux-Montagnes and Anse-à-l'Orme branches.

3.
Connection of all segments

Integration of segments in test phase with South Shore branch

4.
Test runs

Cars simulate regular service without passengers

5.
Commissioning

Meeting reliability and safety criteria

Test segments

- Saint-Eustache / Sainte-Dorothée
- Sainte-Dorothée / Du Ruisseau
- Anse-à-l'Orme
- Du Ruisseau / Canora
- Canora / Central Station

The order of the test segments is for information purposes only

Segment in service

- Central Station / Brossard

A supervised approach

Regulatory framework set by the Québec government

Pre-REM sound analysis

Measurement of environmental noise levels without the REM.

Sound modelling

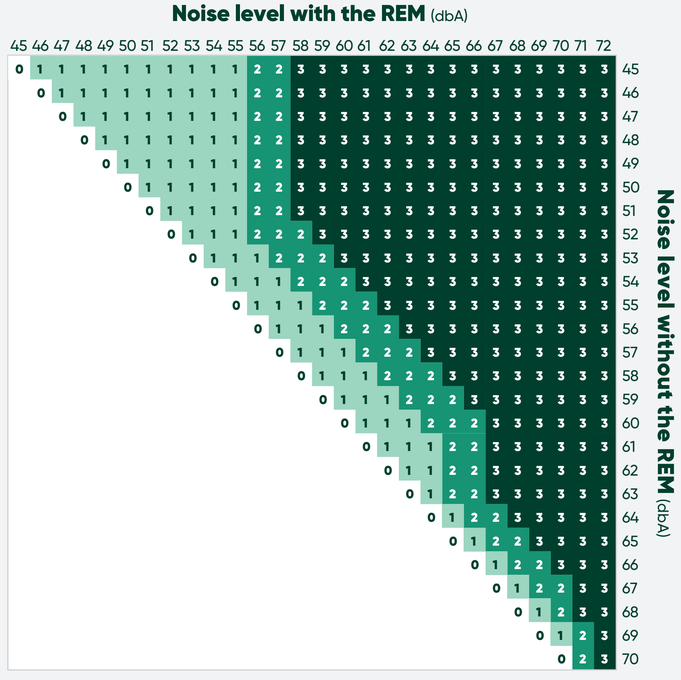
Environmental noise level prediction with the REM.

Noise impact matrix

Comparing before-and-after measurements on the noise impact matrix gives an indication of the impact level.

Impact level

- **0** No impact
- **1** Low impact
- **2** Moderate impact
- **3** Strong impact



Mitigation measures

The regulatory framework requires the addition of mitigation measures when the impact is moderate or high, to reduce it to low or zero.

Sound level monitoring

Sound monitoring must be carried out regularly once the REM is commissioned, to ensure that its impact remains low or zero.

From theory to practice

Environment without the REM

Sound analysis

Pre-REM measurement of environmental noise levels

Sound modelling

Estimated noise levels with REM traffic

Mitigation measures

Addition of mitigation measures according to the characteristics of the sector and degree of impact obtained by modelling to achieve a low or zero impact level

REM car traffic

Sound analysis

Measurement of actual noise levels with REM traffic and comparison with modelling results

Mitigation measures

Adjustment of mitigation measures as required, depending on the degree of impact and the characteristics of the sector, to achieve a low or zero level

The REM in operation

Regular sound monitoring

Once the REM is commissioned, then renewed periodically