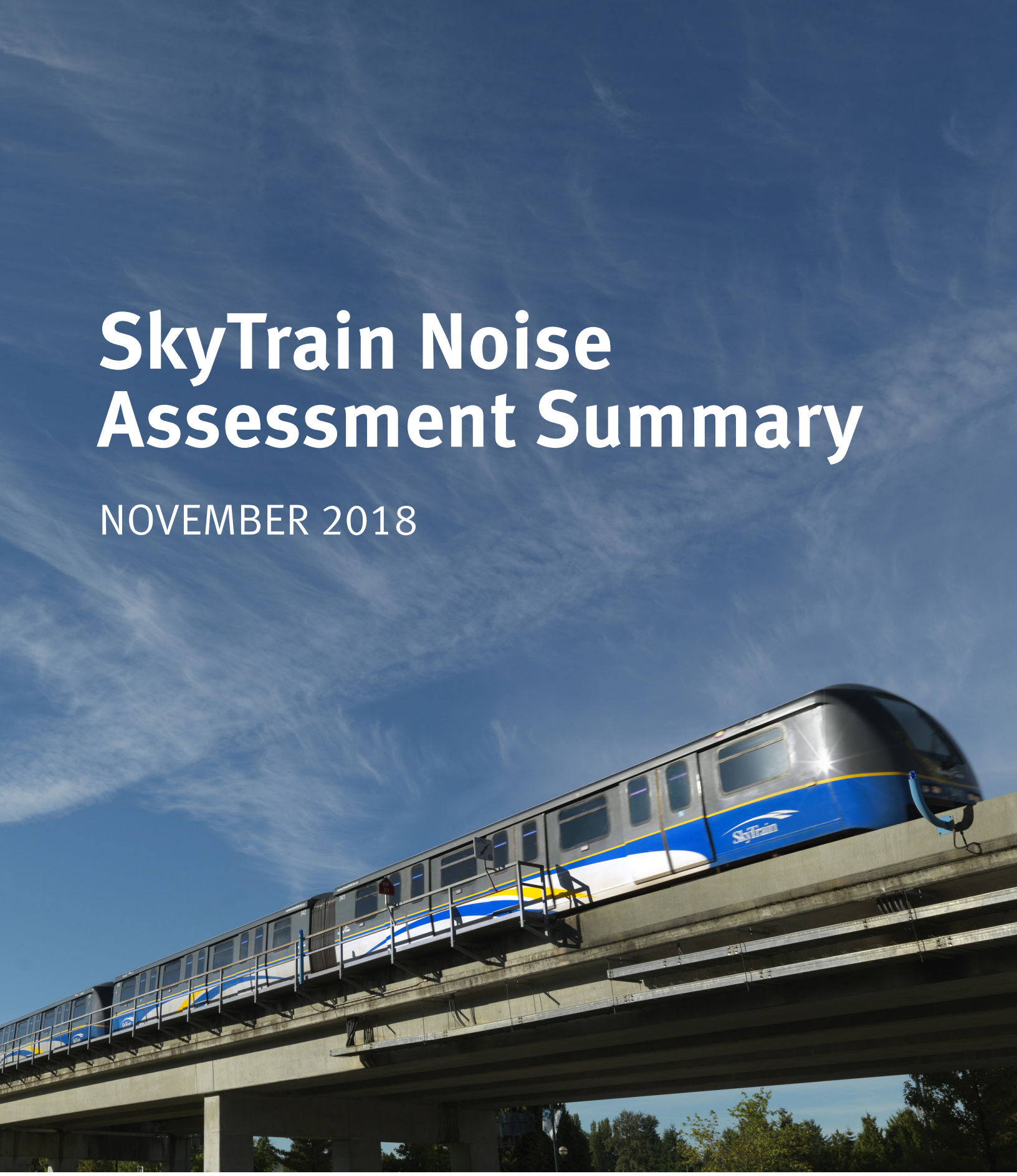
SkyTrain Noise Assessment Summary

NOVEMBER 2018



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SkyTrain Noise Summary

ASSESSMENT

INTRODUCTION

In response to noise concerns from residents, TransLink completed a SkyTrain Noise Study to assess current noise levels along the SkyTrain system and to evaluate possible noise-mitigation options. Noise levels were assessed through extensive measurements in 10 study areas along the Expo and Millennium lines. The results were used to create a detailed sound model, which highlighted sources of noise that exist in the SkyTrain system and areas most in need of noise-mitigation measures. The results show that there is relatively little difference in noise levels between train types and that track condition is the main contributor to noise rising to levels above desired thresholds, which is further amplified with higher train speeds.

TransLink contracted the services of SLR Consulting to lead the SkyTrain noise analyses. SLR is an environmental consultancy with expertise in transportation noise and vibration impact assessments and noise control design. SLR has conducted assessments for all forms of rail systems and their past projects include work with many transit agencies from around the world.

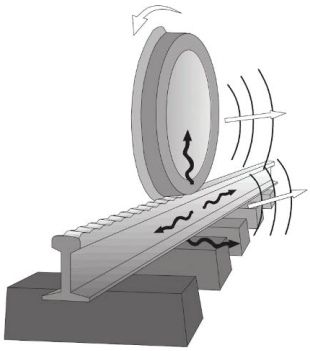
BACKGROUND

There are many sources of noise that exist in the urban environment, such as sirens, airports, and construction noise. Some noises are more tolerable than others due to aspects such as the time of day we are exposed to the noise, the frequencies and pitch of the noise, or how intermittently the noise is heard. A key indicator of noise impacting community liveability is its potential to cause sleep disturbance. The SkyTrain noise study has adopted a passby noise goal of 75 decibels (dBA) at residential facades. This level is considered to be a reasonable balance between the adverse effects of noise and other benefits of rail transit systems to communities.

dBA	Example	
130	Threshold of pain	Intolerable Extremely Noisy
120	Heavy rock concert	
110	Grinding on steel	Very noisy
100	Loud car horn at 3 am	
90	Construction pneumatic hammering	Loud
80	Curbside of busy street	
70	Loud radio or television	Moderate to quiet
60	Department store	
50	General Office	Quiet to very quiet
40	Inside private office	
30	Inside bedroom	Almost silent
20	Recording studio	

What is dBA? Decibels, or dB, is a unit for measuring the relative loudness of sounds; dBA is a variant of dB, which is tuned to represent sound volumes as perceived by the human ear – technically dB and dBA are measurements of sound pressure level (think of it like measuring the psi of a tire, but for sound volume). For reference, the chart above shows real-world noise examples and their typical dBA measurements.

NOISE SOURCES



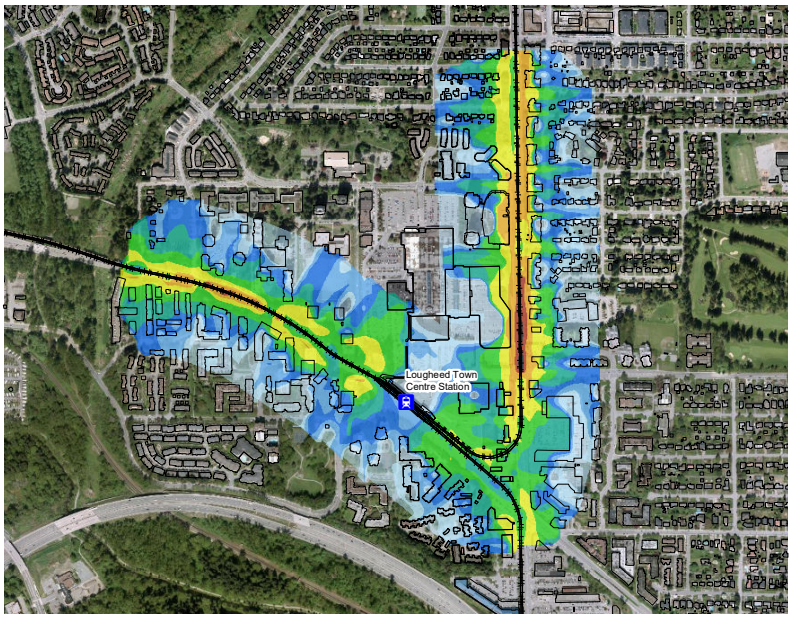
One of the primary sources of noise in the SkyTrain system is worn tracks and the presence of switches, expansion joints, and rail defects. These minor breaks or tiny gaps cause vibrations in the wheels, rails, and track components, which are heard as noise. Even smooth wheels and rails produce sound due to microscopic roughness, but rail condition can worsen, resulting in higher noise levels. Rail corrugation is an issue caused by the repetition of similar vibrations which build upon repeating, wave-like wear patterns. Highly corrugated sections of track can produce the loud roaring noise heard along some sections of the SkyTrain system.

NOISE EXPOSURE

Sound decreases with distance, so exposure is reduced for residents further from the SkyTrain system. Additionally, buildings, the SkyTrain guideway, trees, elevation changes, and other features of the urban landscape can reflect and/or absorb sound (think of the echoes in a large empty room compared to the deadened sound of a full room – walls reflect sound and people absorb sound). Residents with direct line of sight to the tracks will experience higher noise exposure than those living in areas where various sound barriers are present.

NOISE MODELING

For each study area, it is only possible to take noise measurements for a sample of locations. However, a noise model can be used to 'fill in the blanks' and estimate noise levels throughout the study areas. The noise models developed in this study included variables to account for building locations/heights, track elevation/ location, and terrain. Additionally, known relationships between sound and the effect of distance and interactions with physical objects were used to create maps of varying sound intensity. The results and visualizations offer a snapshot of current noise levels in the study areas and help us understand specific sources of noise and where SkyTrain noise may impact community liveability.



SkyTrain Noise Summary

NEXT STEPS

INTRODUCTION

Building on the SkyTrain Noise Assessment, TransLink reviewed several noise-mitigation options identified as feasible and potentially effective for SkyTrain infrastructure. Individual sources of noise generation were reviewed in more detail to determine targeted noise-mitigation treatments and strategies to consider for reducing overall noise. Rail noise was identified as the highest source of noise, however, changes to wheel design can affect the behaviour of the rail. Both aspects are reviewed in the mitigation options.

The following noise-mitigation options are currently under review and are listed by highest potential effectiveness and highest feasibility. An additional initiative includes the development of noise-mitigation guidelines for future residential developments near the SkyTrain system.

1. MAINTENANCE OF SWITCHES

Rail switches allow SkyTrain cars to change lines at rail junctions. These switches wear over time and cause increased noise levels as the transitions from the switch to the rail become less aligned with one another. This can be mitigated by improved maintenance.

2. HARDER RAIL

Development of rail corrugation can be reduced by using harder types of steels in the rails. The original SkyTrain lines used relatively soft rail steel, harder rail has been used in some sections of the SkyTrain network and are currently implemented as part of rail replacement programs. This provides the opportunity to compare and validate harder rail's effectiveness at preventing corrugation development compared to standard rail.

3. TOP OF RAIL FRICTION MODIFIERS

Friction modifiers are products which can be applied either as a liquid to specific sections of track or in the form of solid "sticks" pushed against the wheel treads, and hence transferred to the rails. This treatment can reduce rail wear and slow down the growth of rail corrugation. To get the most benefit from friction modifiers, rail grinding to remove corrugations is also required.

4. ACOUSTIC RAIL GRINDING

Rail grinding is already used to remove corrugations and can be effective at reducing noise. For SkyTrain, in the limited maintenance time available it is always a challenge to remove all the corrugation and leave a smooth surface, without residual roughness. This mitigation measure aims to modify grinding techniques to improve the rail surface finish after grinding and hence reduce noise.

5. RAIL DAMPERS

Rail dampers are bolted to the sides of the track and are made of flexible materials which absorb vibrations that would otherwise be emitted as noise. Rail dampers are an expensive option, but require very little maintenance and can be applied to worn or unworn track.

6. GUIDELINES FOR NEW RESIDENTIAL DEVELOPMENTS

Noise exposure and sleep disturbance can also be reduced through improvements to residential developments. Use of higher quality windows and other building materials can reflect or absorb higher noise levels, while improvements to ventilation systems can allow residents to keep windows closed at nighttime. TransLink will develop a set of guidelines to assist developers and planning authorities in the region to deliver residential units with appropriate noise-mitigation measures, when adjacent to the SkyTrain system.

NEXT STEPS

Over the coming months, TransLink will investigate the feasibility of a variety of noise mitigation measures to address the complexity of SkyTrain noise and develop noise guidelines for residential developments. Thorough pilot programs and further studies are needed to understand the effectiveness, costs, and operational considerations for each noise-mitigation option. These findings will inform priorities for future investments with the intent of reducing noise levels and improving the liveability of communities near the SkyTrain system.

For more information, please visit the project website at:
www.translink.ca/noisestudy

To view the original technical report, please visit:
https://www.translink.ca/-/media/Documents/plans_and_projects/noise_study/SkyTrain-Noise-Report-20181128.pdf