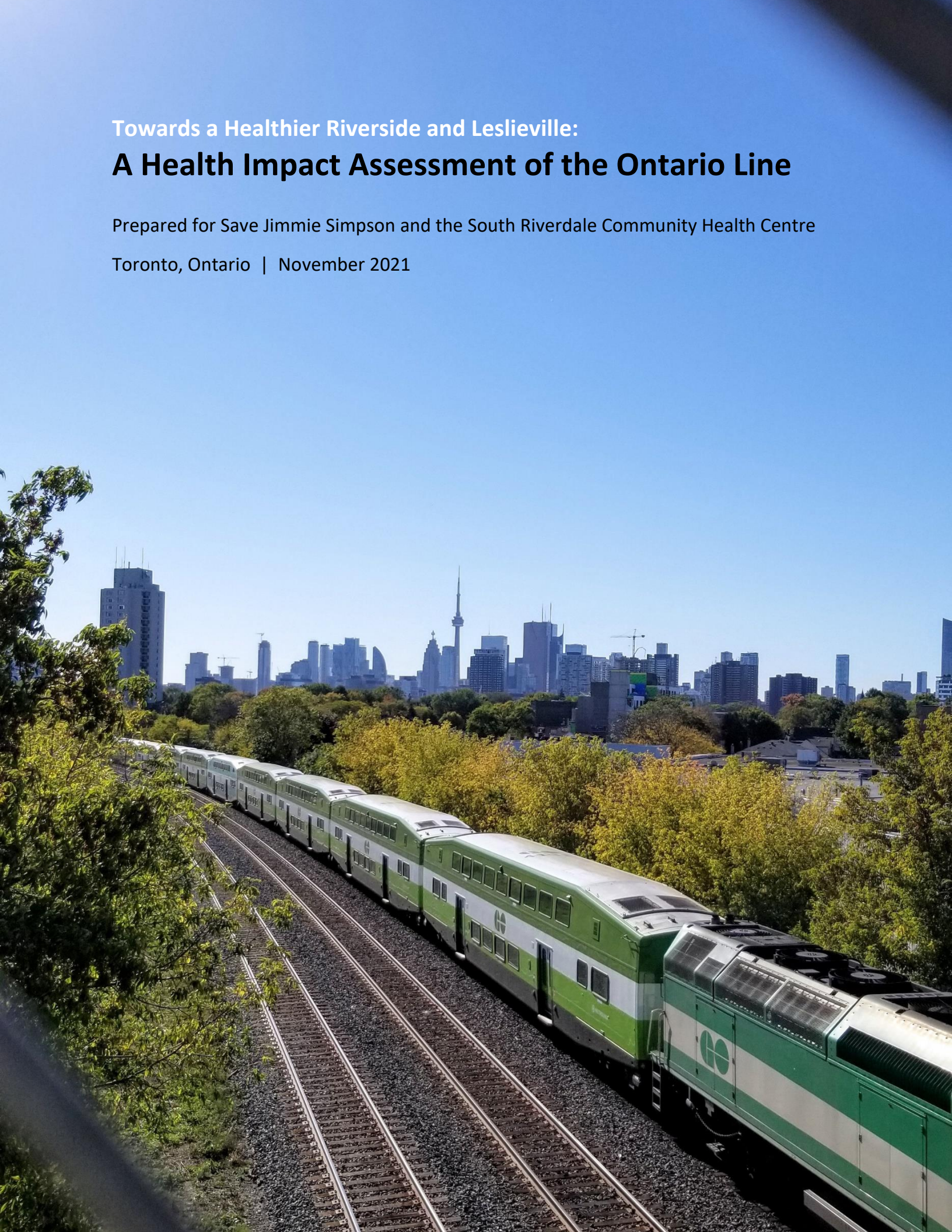
Towards a Healthier Riverside and Leslieville:

A Health Impact Assessment of the Ontario Line

Prepared for Save Jimmie Simpson and the South Riverdale Community Health Centre

Toronto, Ontario | November 2021



Acknowledgements

This work could not have been possible without the input of many people:

- The South Riverdale Community Health Centre, Save Jimmie Simpson and community members who donated to fund this project
- Project advisors
    - Maggi Redmonds
    - Eon Song
    - Paul Young
- The participants at the workshops on September 23rd and 24th, 2021, and
- All others who provided comments and insights at different points along the way

Ronald Macfarlane

Table of Contents

Summary and Conclusions **1**
Conclusions 1
Summary of the results 6
1. Introduction **11**
What is an HIA? 11
Why do an HIA? 12
Limitations 13
The Ontario Line proposal 13
The Joint Corridor 14
The community-supported underground proposal 17
The changing face of South Riverdale 17
2. Health factors assessed **19**
2.1 Transport 19
Health benefits of improved transit 19
The proposal 20
Advantages of an underground alignment 20
Transport – underground compared to overground rail 20
2.2 Noise 21
Noise in Toronto 21
Noise and health 22
Measures to mitigate noise 23
Proposed noise mitigation 24
Noise – underground compared to overground rail 25
2.3 Vibration 26
Vibrations from trains 26
Vibration and health 27
Measures to mitigate vibration 30
Vibration – underground compared to overground rail 30
2.4 Green space 31
Green space in Toronto 31
Green space and health 33
Green space and climate 34
Green space and noise 34
Ontario Line – impact on green space and proposed mitigation 36
Green space – underground compared to overground rail 37
2.5 Recreation/Leisure 37
Health benefits of recreation and leisure 37
Recreation and leisure – underground compared to overground rail 38
2.6 Air quality 39

Air pollution and health 39
Ontario Line – impact on air quality 39
Air quality – underground compared to overground rail 40
2.7 Health & social services 40
2.8 Social equity 40
Vulnerable groups living in South Riverdale 41
Indigenous populations 41
People living on low-income 42
Language and cultural diversity 42
Seniors 43
Children 44
2.9 Community design 44
Transit-oriented communities 46
Community design and health 47
Transit-oriented communities and social capital 48
Transit-oriented communities and noise 48
Transit-oriented communities and climate change 48
Building complete communities 49
East Harbour – proposed transit-oriented community 49
Riverside/Leslieville and Gerrard Stations 51
Community design – underground compared to overground rail 52
Transport-oriented development – underground compared to overground rail 53
2.10 Gentrification 54
Little Portugal – a case study of gentrification 56
Gentrification and employment 56
Gentrification and health 57
Gentrification – underground compared to overground rail 58
Minimising adverse health equity impacts 58
3. Impacts of construction 59
Early works 59
Noise and vibration impacts 62
Air quality impacts 62
Impacts on green space 63
Community disruption 63
Principles of engagement 63
Construction – underground compared to overground rail 64
4. References 65
Appendix 78
Ontario environmental noise guidelines 78
Health Canada's noise guidance 78
World Health Organization guidelines 79
Vibration guidelines 81
Population characteristics of South Riverdale compared to that of Toronto 82
Factors to consider when planning healthy transit and transit-oriented communities. 83

Recommendations to maximise the health-related benefits of transit-oriented communities 84

Summary and Conclusions

Save Jimmie Simpson, in conjunction with the South Riverdale Community Health Centre, commissioned a health impact assessment (HIA) to better understand the health impacts that the proposed Ontario Line could have on the residents of Riverside and Leslieville and to compare them to the impacts of an underground option. This document provides background information on the impacts of new transit lines on communities they run through as well as the transit-oriented development that is encouraged around stations. The HIA fills a gap in the current process to design and build the Ontario Line and the East Harbour transit-oriented community.

The HIA is a qualitative assessment of the potential impacts of an overground and underground alignment for the Ontario Line through Riverside and Leslieville. It was constrained by the lack of a complete environmental assessment by Metrolinx that compares various options including an underground alignment. Also missing is a cumulative assessment of the three undertakings affecting the neighbourhood: the Ontario Line, GO rail service expansion and rail electrification.

Many factors, referred to as determinants of health, influence a person's health. An HIA considers all of them and highlights sub-populations who are more likely to experience either the benefits or adverse effects of a proposal. The Toronto Public Health screening list was used to identify factors relevant to the Ontario Line proposal and refined for this project with input from members of Save Jimmie Simpson and the South Riverdale Community Health Centre staff. Seventeen factors plus construction were selected. Two workshops were held in September to get input from community stakeholders. Participants highlighted what was most important to them and what they thought was missing. These observations were used to revise the draft report.

Conclusions

The Ontario Line provides benefits to residents and businesses of Toronto. However, people who live near the proposed line and stations experience more of the potential negative effects that come with this new development. This HIA concludes that when it comes to health, the underground alignment is the better option (Table 1).

Input received during the workshop indicated that overall, environmental factors were of most concern to the community, especially noise, vibration and green space. Second in importance were impacts due to construction, including impacts on business viability, noise, vibration, air quality and access to green space.

While an aboveground alignment is often chosen because of its lower construction cost, to ensure the right decision is made, it is important to accurately include the long-term economic, social and environmental benefits that accrue from an underground option as these benefits are important contributors to health. Available evidence suggests that an underground alignment would have fewer negative impacts on health. The underground option would:

- Cause less disturbance to the current urban fabric as well as various homes, schools and businesses adjacent to the line
- Have negligible impact on the tree canopy, parks and other green spaces

- Result in less exposure to noise for people living near the line
- Have less impact on the quality of spaces used for recreation and leisure, making them more attractive to users
- Have fewer negative impacts on children, seniors, people living on low income, and people who do not speak either of the official languages, and
- With the use of tunnelling equipment for the line and mining techniques for stations, cause less disruption to both residents and businesses during construction.

Three factors are anticipated to have a positive impact on health. One of them is greenhouse gas emissions; there is likely no difference between the two options for this factor. When it come to the other two, air quality and transport, the underground option is likely to have greater benefits.

There are several factors where the negative impacts of both options are likely to be the same. Many are related to the differential impacts of gentrification that a new transit line and transit-oriented development will encourage. While both the Ontario Line and the East Harbour development will increase access to employment overall, experience elsewhere shows that people on low-income and minority populations are not as likely to benefit from these new opportunities and may even experience a loss of income.

The evidence from other cities suggests that people on low income and equity-deserving groups, including Indigenous peoples, who currently live in Riverside and Leslieville are likely to benefit less from the opportunities that arise from this transit improvement and investment in East Harbour. In addition, they are more likely to experience negative impacts related to increased rents and cost of living, displacement, social isolation, and a loss of belonging. While these factors are independent of the choice made for the alignment they must not be ignored. To create a healthy city for all, the potential for these factors to increase health risks for people who already experience poorer health must be addressed.

An important limitation of this HIA is the lack of a completed rigorous environmental assessment that compares various options. A reliable environmental assessment would compare options, integrate a health impact assessment, include meaningful community engagement, and be completed before work starts. Nevertheless, the conclusion of this HIA is that the underground line is the best option when it comes to promoting the health of residents and businesses in Riverside and Leslieville.

Table 1 summarises the impacts of the two options on the determinants included in this report, and indicates whether these are negative, positive or neutral.

Table 1. Summary of the differences in health impact between the overground and underground alignment for the Ontario Line.

Legend:

Determinant	Overground alignment	Underground alignment
Environmental factors		
1. Noise	Potential for increase in annoyance and sleep disturbance from noise exposure	Least noise exposure
2. Vibration	Potential for annoyance from vibrations	Unlikely to result in annoyance due to vibration
3. Green space	Greater loss of green space and/or tree canopy along the whole corridor and related to construction	Possible loss of green space and/or tree canopy around stations or related to construction
4. Air quality	Small difference between options Some improvement as more people use transit or active travel Potential for higher release of toxic metals into the ambient environment	Small difference between options. Some improvement as more people use transit or active travel Release of toxic metals would occur inside the tunnel
5. Greenhouse gas emissions	No significant difference between options Some reduction as more people use transit or active travel	No significant difference between options Some improvement as more people use transit or active travel

Determinant	Overground alignment	Underground alignment
6. Community design	▼▼ More impact on land-uses adjacent to the line	▼ Potential impact on land-use only along East Harbour
7. Transit-oriented development	▼ Potential positive overall impact on health Negative due to gentrification pressures on neighbouring community	▼ Potential overall positive impact on health Negative due to gentrification pressures on neighbouring community
Access to services		
8. Transport	▲ Health benefits from improved access to employment, services, and recreation and increase physical activity due to taking transit Transfer at Riverside/Leslieville station to the Queen Street streetcar only	▲▲ Health benefits from improved access to employment, services, and recreation and increase physical activity due to taking transit Station at Queen and Carlaw offers transfer to multiple surface transit lines
9. Recreation/ Leisure	▼▼ Greater impact on green space affecting the quality and desirability of space used for recreation, leisure and as playgrounds	😐 Minimal impact on green space and the quality and desirability of space used for recreation, leisure and as playgrounds
10. Health & social services	▼ Likely no difference between options Some potential negative impacts related to gentrification	▼ Likely no difference between options Some potential negative impacts related to gentrification
Social equity		
11. Indigenous populations	▼▼ Insufficient information to assess, but likely negative	▼▼ Insufficient information to assess, but likely negative

Determinant	Overground alignment	Underground alignment
12. People living on low-income	▼▼ Potential negative impact including displacement due to rising rents and taxes More likely to be adversely impacted by loss of green space, noise and vibration	▼ Potential negative impact including displacement due to rising rents and taxes
13. Language and cultural diversity	▼▼ Likely larger negative impacts on social capital due to greater disruption during construction	▼ Possible negative impacts on social capital
14. Seniors	▼▼ Greater disruption during construction and larger impact on green space and potentially higher exposure to noise likely to result in more negative impacts on support networks	▼ Displacement could result in negative impacts on support networks
15. Children	▼▼ Exposure to noise and air pollution and reduced access to green space during construction is especially of concern.	▼ Potential for localised impacts due to noise and air pollution during construction
16. Gentrification	▼ Potential differential negative impacts on low-income and minority populations	▼ Potential differential negative impacts on low-income and minority populations
17. Employment	▼ Increased access to employment but potential negative differential impacts on low-income and minority populations	▼ Increased access to employment but potential negative differential impacts on low-income and minority populations
Construction		

Determinant	Overground alignment	Underground alignment
18. Community impacts during construction	▼▼ Greater disruption to the community during construction, affecting viability of businesses and increasing the risk of displacement. Higher degree of annoyance from disruption caused by construction including work happening overnight.	▼ Tunnelling and the use of mining techniques for the building of stations will reduce disruption to the community during construction

Summary of the results

When comparing the proposed Ontario Line surface alignment to an underground alternative, the results of this HIA are as follows:

Environmental factors

1. **Noise**: Noise can cause annoyance and sleep disturbance, both of which are detrimental to health and well-being. While the noise modelling completed for the joint rail corridor suggests that, with noise barriers installed, some residences would experience less noise in future compared to today, there are other residences where noise levels are expected to increase. Overall, an underground option is expected to result in lower exposure to noise, including less noise at night.

2. **Vibration**: Vibration can cause annoyance and sleep disturbance, both of which are detrimental to health and well-being. Data from the vibration assessment for the joint-corridor identifies properties that could be adversely affected by vibrations. While the assessment suggests that mitigation measures are available to reduce these, there is a higher likelihood of vibration impacts from the overground alignment as compared to an underground option.

3. **Green space**: Living in an area close to a park or with green space including trees is associated with better health, including lower risk of dying from heart and lung disease. Green space reduces stress, improves mental health and is linked to increased physical activity. Green space has been found to reduce exposure to air pollution. It also increases resilience to climate change by reducing the urban heat island effect, lowering the risk of flooding, and acting as a carbon sink.

   The overground option will be removing most of the existing tree canopy along the rail corridor. This will reduce the health benefits associated with trees and have negative consequences for climate. Even if trees are replanted, it will take many years before they

mature and provide the same climate benefits as the existing ones both as a carbon sink and reduction of the urban heat island effect. Given that an underground option can be expected to have less impact on current green space in this neighbourhood, from the point of view of health, an underground alignment is preferred.

4. **Air quality**: Both short- and long-term exposure to air pollution can lead to adverse health outcomes. It contributes to many different adverse health outcomes, including various lung and heart diseases, cancer, adverse birth outcomes, neurodevelopmental issues, reduced cognitive function, dementia, and diabetes. If more people opt for travel by transit rather than car, an overall reduction in air pollution can be expected.

   The community has expressed concerns about impacts on air quality. While GO Transit will increase train frequency and continue to use some diesel-powered trains, the Ontario Line will use electric ones. Ontario Line air pollution impacts would be more regional and related to the source of the electricity. There are some releases of metals and other pollutants from the friction between moving parts, brakes, and contact between the wheel and the rail. If state-of the-art technology and station design are used, one would not expect a significant difference of exposure to these pollutants between options, although the overground option could result in dispersion of some toxic elements into the ambient environment.

5. **Greenhouse gas emissions**: If fewer people opt for travel by transit rather than car, an overall reduction in greenhouse gas emissions can be expected for Toronto as a whole. The Ontario Line will use electric trains. Greenhouse gas emissions would depend on the source of electricity. With potential expansion of gas-powered generation, this would increase the carbon footprint of electricity generation in Ontario. Overall though, there is likely no difference between the options when it comes to greenhouse gas emissions.

6. **Community design**: Urban design refers to the look and feel – form, shape, and character – of a group of buildings or a neighbourhood which is the result of the layout of buildings, public spaces, roads, amenities and services. Certain design aspects are known to increase the likelihood of people walking, cycling and taking transit. This helps reduce the use of motor vehicles and their associated pollution, including greenhouse gas emissions. It also contributes to health due to increased physical activity and reduced exposure to air pollution.

   When it comes to community design, the most important difference between the options is the impact on land-use adjacent to the line. The overground option will have more impact on the existing community along the whole portion of the corridor starting from the portal just south of the Pape Avenue Junior Public School at the corner of Riverdale and Pape Avenues to East Harbour. Whereas, the underground alignment proposed by the community would only affect a section south of Eastern Avenue near the proposed East Harbour development. Not only does the underground option reduce the extent of impact on the community, since East Harbour is still at the design stage, any negative impact can more easily be mitigated.

7. **Transit-oriented development (TOD)**: TODs that are appropriately designed can encourage people to walk, cycle and take transit more; thus, they have a positive impact on health due

to more physical activity and lower pollution. While studies show that TODs can have positive impacts overall, people on low-income, seniors, and other vulnerable populations may not share in the benefits equally and may be adversely affected due to displacement. While there are likely no differences between the options, impacts are identified as negative because of the potential adverse impact to groups who are already more vulnerable to poor health outcomes.

There is a proposal to add residential buildings in the East Harbour development. As proposed, this would increase the building density by about one third (33%). If approved, this can be expected to result in even greater gentrification pressures in the areas around this site. As well, there is a concern that allowing residential development on this site would have negative repercussions on other employment lands in Toronto, and thus access to employment in the city over the long run.

Access to services:

8. **Transport**: Both options provide improved access to employment, services, and recreation in the community and further afield. They also have a potential to result in increased physical activity related to greater use of transit. These factors contribute to better health from lower emissions of pollutants and greenhouse gases, increased active travel, and improved employment options.

   The underground alignment as proposed by the community would see a station at the intersection of Queen Street and Carlaw Avenue, which is a transfer point to surface transit that runs on both of these streets. In comparison, the overground alignment places a station at Queen St and De Grassi Street which would provide an easy transfer only to the Queen Street streetcar.

   Most cities that have opted for an underground alignment for transit near and adjacent to the city centre do not regret making that choice. This suggests that an underground alignment would provide more benefit overall.

9. **Recreation/Leisure**: Recreation is known to confer physical and mental health benefits. The combined health and social benefits make parks and recreation facilities one of the most cost-effective public services.

   The Ontario Line will improve access to recreation and leisure activities that are outside of the community, which will benefit residents who can afford to take part in these activities. The overground alignment will have greater impact on tree cover and green spaces in the neighbourhood compared to the underground option. As well, it is likely to result in higher exposure to noise and possibly also vibration from trains in the joint corridor. These factors will reduce the quality of spaces used as for recreation, leisure, and as playgrounds. The underground alignment is therefore preferred.

10. **Health & social services**: Transit improves access to health and social services, especially for people on low income or who do not drive. These services help maintain health, prevent disease, restore function, and improve well-being.

    There is likely no difference between the overground and underground options on access to health and social services in the neighbourhood. However, as described in the gentrification section, displacement of businesses could decrease access to services that cater to existing residents, especially people who have less facility in speaking English.

Social Equity:

The impacts described under social equity can affect anyone in the neighbourhood. However, the purpose of this section is to highlight the impacts that disproportionately affect people who are already at risk to poor health due to various social factors.

11. **Indigenous populations**: There is insufficient information to assess the impact of the Ontario Line on Indigenous residents in the study area. However, given that a high prevalence of people with low-income in Indigenous populations, they will face similar risks as others on low income, but likely exacerbated by the trauma related to systemic influences such as historical oppression and marginalization. There is likely no difference in the impact of the two options.

12. **People living on low-income**: People on low income have poorer health than the rest of the population. Improved transit has a positive impact on access to employment, education, and other services for people living on low income. Negative impacts are mostly related to gentrification (see below). In the case of the overground alignment, due to the number of people living in non-profit apartment buildings within metres of the railway line, seniors and people living on lower income may be disproportionately affected by increased noise and vibration as well as loss of green space.

13. **Language and cultural diversity**: Compared to Toronto as a whole, the proportion of people who speak neither official language is higher in South Riverdale. The transformation of the neighbourhood can result in the displacement of people and businesses that cater to their needs. This increases the risk of social isolation and related health consequences.

    Greater neighbourhood disruption is expected to occur during the construction of an overground alignment. This is likely to result in larger negative impact on the viability of small businesses that serve the local community. This would compound the risk of social isolation among equity deserving groups living in the neighbourhood.

14. **Seniors**: 30% of seniors in South Riverdale live alone. This increases the risk of social isolation. Socially isolated seniors are at more likely to experience poorer health and earlier death.

    There are 3 seniors apartment buildings close to the existing rail line. In addition to potential noise and vibration impacts, greater disruption to the neighbourhood from the construction of the overground option could result in negative impacts on the viability of businesses and

contribute to a higher level of displacement. This could affect access to services used by older adults in the neighbourhood and lead to increased social isolation.

An overground option would also have greater negative impact on the quality of public and private green spaces, which are regularly used by older adults. By making these spaces less attractive this could result in a higher risk of social isolation and decrease in physical activity among this population.

15. **Children**: Children are often more vulnerable to environmental stressors. Exposure to noise and air pollution and reduced access to green space during construction is especially of concern.

16. **Gentrification**: The impacts of gentrification are mixed. On a macro level, gentrification is associated with positive economic and social impacts. However, the benefits are not equally shared. People living on low income and equity seeking groups are more likely to be adversely affected by the higher cost of living, displacement and a loss of belonging. Small independent businesses are also more at risk of displacement.

    Both options are likely to lead to similar gentrification pressures, with a negative impact on groups that are more at risk of ill health. The best way to minimise inequitable outcomes is to engage with the populations likely to be negatively impacted and give careful consideration to these concerns at the planning stage of either a new transit line or transit-oriented community.

17. **Employment**: There is likely no difference between the two options on access to employment opportunities. Improved transit facilitates travel to employment without needing to rely on a car, which reduces the cost of travel. People who are less skilled and have a lower income are not as likely to benefit from the quality employment opportunities that may occur in new development that accompanies better transit. Service employment in restaurants and retail may be available, but possibly at a lower wage than previous employment. Due to this differential negative impact on more susceptible populations, the impact is rated as negative for health.

18. **Construction**: Long-term disruptions can affect the viability of local businesses and result in either displacement or closure, with detrimental impact on the community and the health of those most affected. Evidence available suggests that the underground alignment (as proposed by the community) is likely to have the least disruption during construction. In addition, the underground option is expected have less impact on health due to reduced exposure to noise and air pollution and less disturbance of green space, especially if state-of-the-art construction methods are used. It is important to accurately include the long-term social and environmental benefits in the assessment of impacts before deciding on the preferred option.

1. Introduction

Prompted by the absence of a completed environmental assessment (EA) of the Ontario Line, including consideration of possible alternatives, Save Jimmie Simpson and South Riverdale Community Health Centre commissioned this health impact assessment (HIA) to better understand the impacts the proposed Ontario Line could have on the health of residents of Riverside and Leslieville. In particular, they wanted to compare the proposed alignment along the existing rail lines to an underground one as had been the plan for the Relief Line which the Ontario Line replaces.

As Dalhousie University professor Ingrid Waldron said: "Consultation has to be done in a culturally specific way. In the Indigenous way of thinking, when you desecrate our land, you harm me, you harm my body, my community and my nation" (Keung 2021).

As well, Save Jimmie Simpson noted the absence of meaningful community consultation in the design process and that the commencement of early works construction before a study of the alternatives has been completed. Generally speaking, this can undermine support for transit projects.

> "Without local support built through meaningful engagement and transparent responses to concerns, transit projects may not move forward" *(*Wiginton 2017).

What is an HIA?

A health impact assessment is a process that studies a proposal to better understand its potential positive and negative effects on health of a community, including the distribution of these impacts on various groups within society (Health Impact Project 2019; WHO 2005).

Health impact assessments are often conceptualised as a process similar to an environmental assessment with a screening phase, scoping phase, assessment phase, reporting phase that includes making recommendations, and finally a monitoring and evaluation phase (Health Impact Project 2021). However, there is no one way to conduct an HIA and they can use different methods or approaches (WHO 2005).

Health impact assessments also come in different degrees of depth or detail. There are rapid HIAs that can be conducted in a matter of days or weeks. Desktop HIAs rely on existing information to highlight potential impacts. In-depth or comprehensive HIAs will often include the gathering of project-specific data. The choice of the approach is influenced by several factors including: time and resources available; complexity of the proposal; potential degree of harm; level of controversy; and regulatory requirements (WHO 2005).

Community involvement can strengthen HIAs. An inclusive process helps build trust and can ensure that the recommendations are broadly supported and implemented (Health Impact Project 2019, 2021). Involvement can occur in different ways. HIAs can be community led or led by project teams that include representatives of the different stakeholders. Another way is to hold workshops where the project is discussed, concerns identified, and recommendations developed. These workshops could be attended by experts, stakeholders, community members, or a mix of these. It is also possible to get feedback through expert review or public consultation.

A person's health is influenced by many different factors called the determinants of health (Braveman & Gottlieb; WHO 2005).[1] Health impact assessments consider how a proposal will affect all relevant determinants. It pays particular attention to people who are most at risk of adverse impact due to socio-economic factors, existing health conditions or belonging to an equity-deserving group.

Why do an HIA?

Health impact assessments bring health evidence up front in the decision-making process. They identify the potential health effects of a decision on different groups and highlight the potential health outcomes including how these may affect different groups disproportionately. The findings of the HIA are then used to make recommendations that will enhance the benefits of the proposal and minimise potential adverse effects, such as chronic disease and injuries. They encourage a collaborative process between communities and decision-makers to ensure the best possible outcome (Health Impact Project 2019; WHO 2005). When conducted well, an HIA process increases stakeholders' understanding of how a project may impact health and equity, ensures those affected have a say in the decision, and promotes the necessary systemic change that will improve health for all (Health Impact Project 2019). Further, meaningful engagement in decisions has a positive health impact in and of itself as outlined in the Canadian Index of Wellbeing (University of Waterloo 2014).[2]

How was this HIA conducted?

This HIA is a desktop assessment. Using the screening tool developed by Toronto Public Health (2014), The scope of the HIA was refined in collaboration with members of Save Jimmie Simpson and staff of the South Riverdale Community Health Centre. Information on the proposed Ontario Line and East Harbour transit-oriented community was consulted and an internet search was performed to identify literature on the health impacts of introducing a new transit line to a community and the building of transit-oriented developments (TODs). With guidance from the project advisory group, this report was written as a background document to inform residents of Riverside and Leslieville and help them make recommendations on the option for the Ontario Line that would result in the least harm to health and the most benefit to their community. Save Jimmie Simpson and the South Riverdale Community Health Centre held two workshops in September to obtain input from community residents and stakeholders which included health professionals and academics. This input was used to revise the draft report.

Study Area

The focus of this health impact assessment (HIA) is the section along the Lakeshore East rail corridor from Gerrard Street East at Carlaw Avenue to the Don River. The study area of this HIA is bounded to the north by Riverdale Avenue, to the east by Jones Avenue, to the south by Lakeshore Boulevard East and

[1] Health Canada has identified the following determinants of health: Income and social status; Employment and working conditions; Education and literacy; Childhood experiences; Physical environments; Social supports and coping skills; Healthy behaviours; Access to health services; Biology and genetic endowment; Gender; Culture; and Race/Racism. https://www.canada.ca/en/public-health/services/health-promotion/population-health/what-determines-health.html (Accessed 2021-08-08)

[2] The Canadian Index of Wellbeing states, "Wellbeing is supported when. . . governments build relationships, trust, shared responsibility and participation opportunities with citizens; and democratic values are sustained by citizens, government and civil society at a local, national and global level."

to the West by the Don Valley Parkway. This area corresponds closely to the area known as South Riverdale. Depending on the context, this report also uses the historical and recently adopted names of Riverside/Leslieville.

Limitations

There are several limitations to this HIA. Due to time and resource constraints, it was not possible to make this a fully community-driven assessment nor to involve experts on the various topics addressed. The largest constraint was the absence of a completed environmental assessment (EA) for the Ontario Line and associated transit-oriented communities, including the assessment of possible alternatives and of cumulative impacts of the Ontario Line, GO service expansion, and GO electrification. EAs provide baseline information and model potential impacts and are an ideal source of site-specific information that can be used to evaluate the impact of the proposal on health. Because of this, integration of HIAs into EAs is a recommended practice (Bhatia & Wernham 2008; Health Impact Project 2021; Mahboubi et al. 2015).

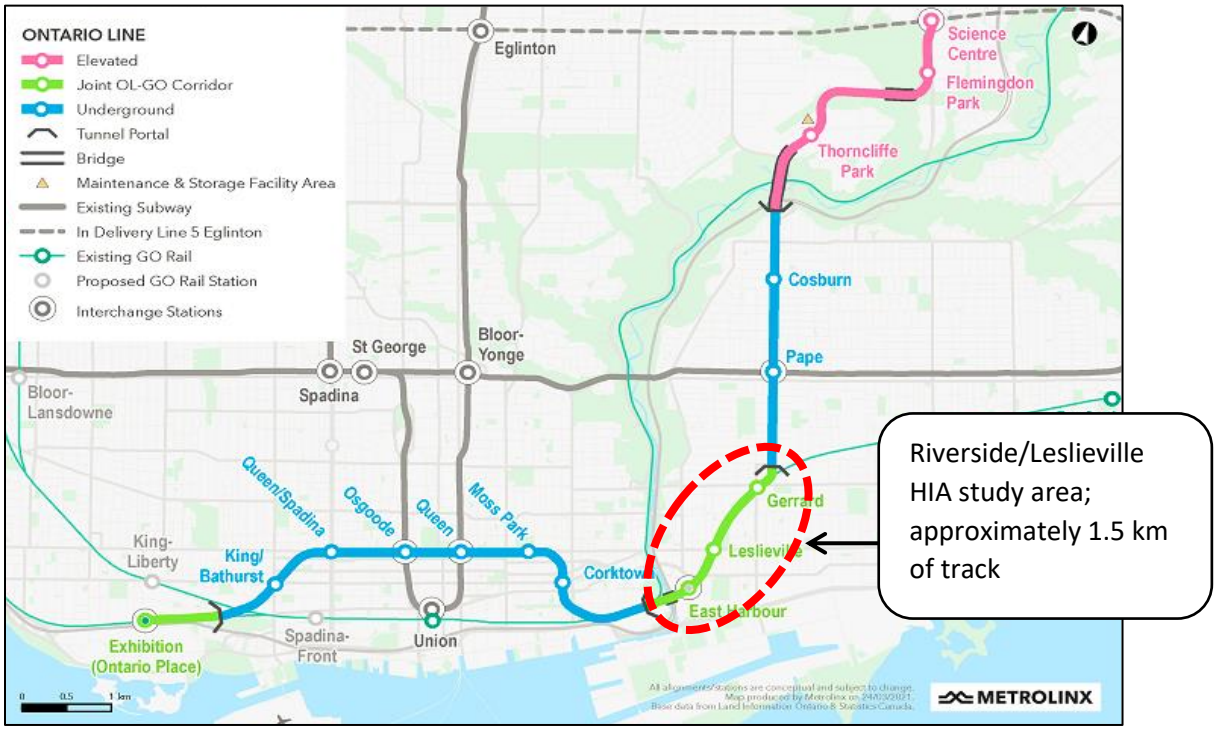
This HIA focussed on the longer-term impacts of the Ontario Line on the community. There will be impacts on the community during construction, and these have been identified as a high concern by residents and businesses. These impacts – such as disrupting access to services, and noise and vibration from construction equipment – are important but require a separate assessment and have not been included in detail.

The Ontario Line proposal

On April 10, 2019, the government of Ontario announced that it would build a new transit line called the Ontario Line (See Figure 1-1). This new line would run from the Ontario Science Centre, south through Thorncliffe Park (shown in pink) and then south under Pape Avenue (shown in blue). The line would then emerge to the surface through a portal near Pape Avenue School to run above ground for about 1.5 km south to the East Harbour development site (the former Unilever factory) along the existing train tracks (in green). The Line would then go back underground and continue west to Ontario Place (in green and blue). There are 15 stations proposed along the route. The projected number of trains is 912 per day in 2030, and 1,130 by 2060 (Munro 2021a).[3]

[3] https://stevemunro.ca/category/transit/a-grand-plan/subways/downtown-relief-ontario-line/

Figure 1-1: Alignment of the Ontario Line as proposed by Metrolinx running between the Ontario Science Centre and Exhibition Station (Ontario Place).



The Ontario Line replaces and extends the previously approved Relief Line which was to run underground from Pape Station to Queen and Osgoode Stations.

The Joint Corridor

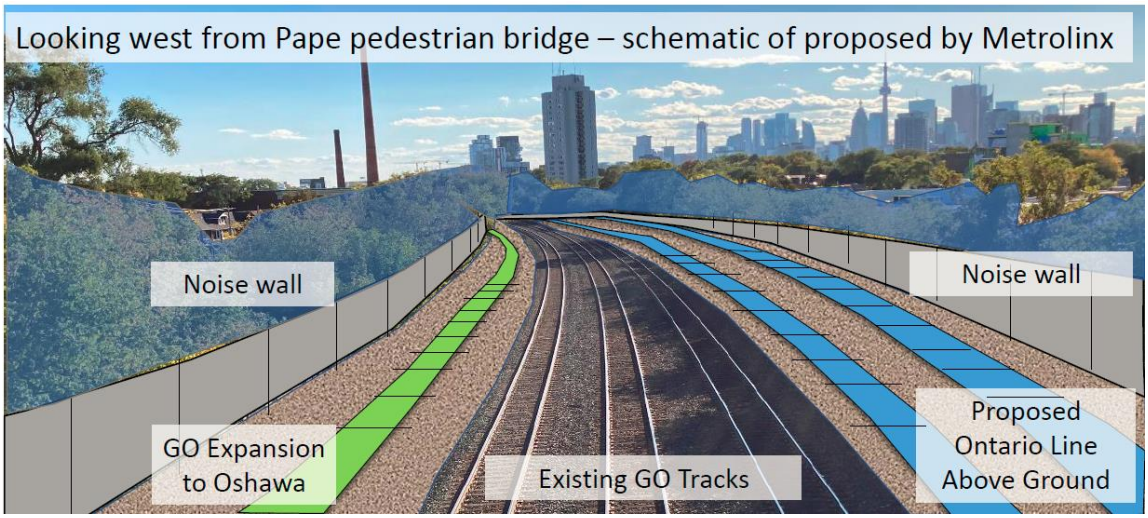
Two other Metrolinx projects are occurring – the GO service expansion and GO rail network electrification. The Lakeshore East GO train expansion, between Toronto and Oshawa includes electrification of the tracks and the installation of a fourth track. The GO expansion will see an increase in rail volumes in the corridor from 169 (GO and other trains) today to 593 at full expansion. In Riverside/Leslieville, the Ontario Line is proposed to join the other trains within the same corridor, creating a section with a total of six tracks (Figure 1-2). This means a total of 1505 or more daily trains could travel along this portion of the Lakeshore East rail corridor. Figure 1-3 shows the existing corridor as seen from the pedestrian bridge near Gerrard Street East and Pape Avenue, and Figure 1-4 illustrates the widening of the rail bed that will need to occur to accommodate the three extra tracks, which will require retaining walls along the edge of the railway corridor. Figure 1-5 shows a cross section of the line at Queen Street - note the tracks would be raised by about 1.5 metres to clear the roadways below.

Figure 1-2: **Overview of the Metrolinx proposed Ontario Line along the current GO tracks emerging around Pape and Riverdale Avenues and continuing across the Don River to Corktown**

Note: Figure 1-2 shows the addition of north and south-bound Ontario Lines (yellow) and the GO line (green). At the top middle of the map, the Ontario Line emerges from a portal just south of Pape Avenue School. Jimmie Simpson Park is in the upper middle. The yellow circles show the approximate location of the planned stations. The station at East Harbour would serve both the Ontario Line and GO train service.

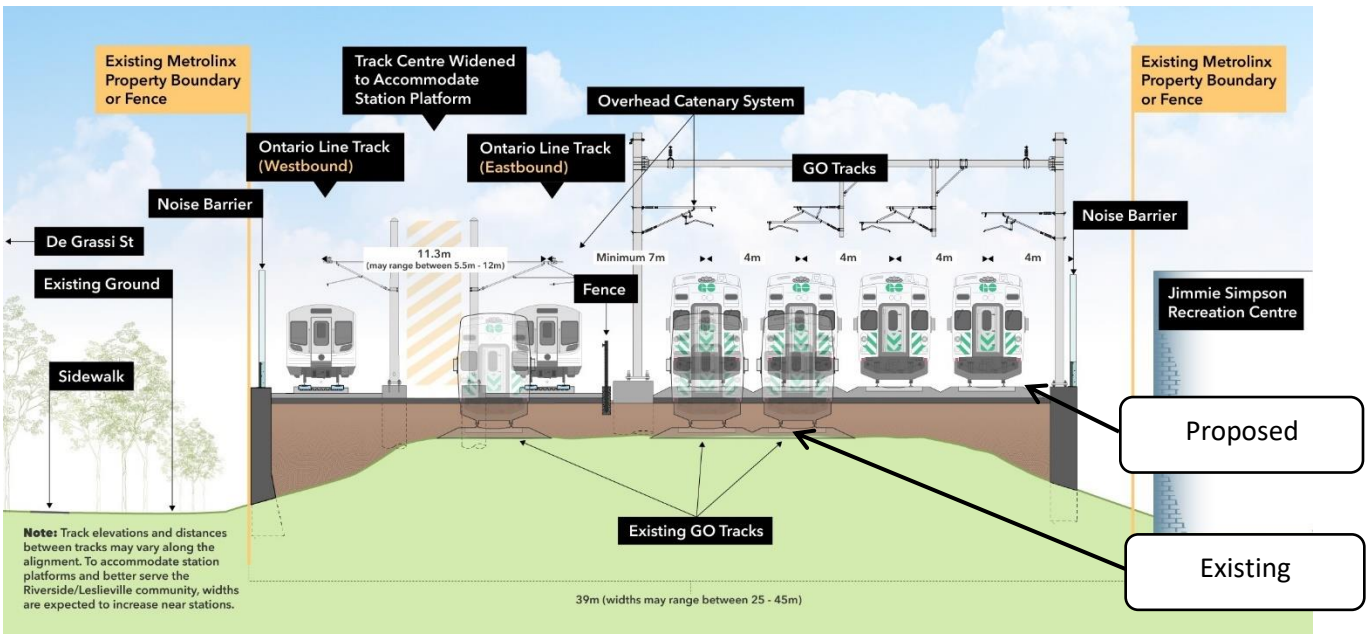
Figure 1-3: The existing track bed running through Leslieville/Riverside as seen looking west from the Pape Avenue pedestrian bridge near Gerrard Street East and Pape Avenue

Figure 1-4: What the joint corridor could look like when the fourth GO rail and two Ontario Line rails are added.



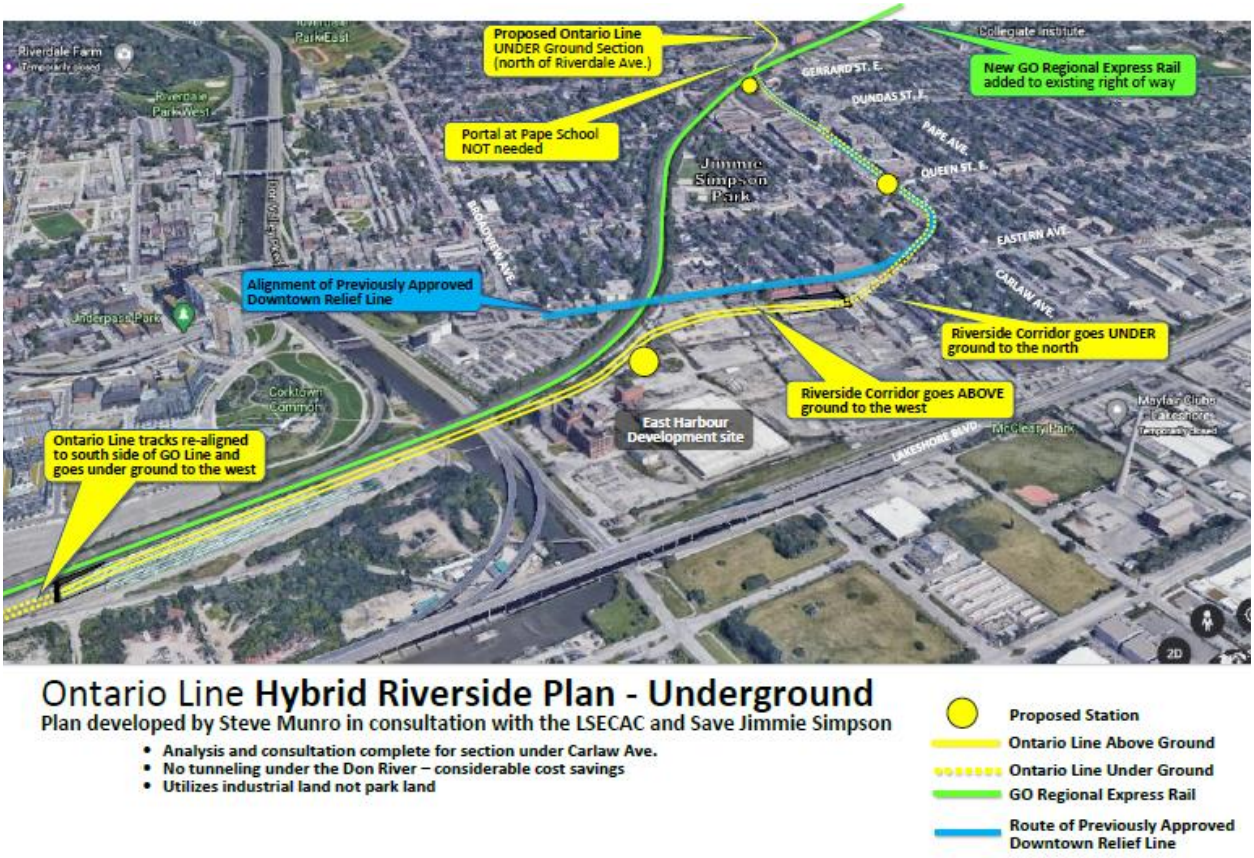
Note: Ontario Lines will split and widen further at proposed station locations.

Figure 1-5: Conceptual drawing of the cross section of the joint corridor north of Queen Street with noise barriers.



Note: The track bed is to be raised approximately 1.5 m (Source: Metrolinx, accessed 2021-06-19)

Figure 1-6: An alternative underground alignment for the Ontario Line as proposed by the Riverside and Leslieville communities



The community-supported underground proposal

On February 2, 2021, Toronto City Council reiterated its support for a below ground subway in the segment of the former Relief Line from Pape to the Don Yards (City of Toronto 2021c). Save Jimmie Simpson worked with the Lakeshore East Community Advisory Committee and transit advocate Steve Munro to develop a viable alternate underground plan (Figure 1-6). Similar to the Relief Line, this alignment would continue underground under Carlaw Avenue to Queen Street. After that point it would veer west and emerge south of Eastern Avenue before reaching East Harbour at grade on the south side of the GO tracks.

The changing face of South Riverdale

Riverdale was annexed to the City of Toronto in 1884, which resulted in rapid development of the area. By 1923 the area was essentially built out. Development in North Riverdale targeted more to middle to high income families, while South Riverdale had a greater concentration of working-class households, whose members were employed in the industries that established themselves in the area due to the proximity to the port. Between 1945 and 1970, few changes occurred. South Riverdale continued to be characterised as a predominantly working-class neighbourhood, with lower income and higher unemployment than other parts of Toronto. There was however a high degree of home ownership, that

contributed to the stability of the neighbourhood which remained predominantly of Anglo-Saxon descent (Walks & August 2008).

The working-class residents of South Riverdale were considered a vestige of the past, and not considered as part of the neighbourhood's future. As such the area was affected by the slum clearance and urban renewal craze of the 1960s. The first redevelopment occurred east of Broadview Avenue and south of Dundas Street. Work on a new housing project the Don Mount Court begun in 1965.[4] The plan was to extend this initiative, which would have seen 800 homes demolished and replaced by 10,000 high-rise housing units (Walks & August 2008).

The Riverdale Community Organisation (RCO) was created to fight further "slum clearance." It empowered the working-class community and helped form the vision for South Riverdale: "strengthen the residential character of the area" and "to protect the industrial function of the area" (City of Toronto Planning Board, 1977, as cited in Walks & August 2008).

In 1968, a few Chinese businesses were established in the neighbourhood, which started to grow quickly as a cheaper alternative to the Chinatown in downtown Toronto. The first immigrants were from Hong Kong, followed by Chinese from Vietnam, and then from the Chinese mainland. By 2001, people of Chinese ancestry made up a quarter of the population of South Riverdale. The Chinese became part of the social fabric holding a large proportion of the housing stock and establishing businesses and institutions catering to members of their community (Walks & August 2008).

In the 1970s, escalating house prices on the west side of the Don Valley in the community now known as Cabbagetown put pressure on prices in Riverdale. In 1974 and 1975 a developer bought about 40 houses on three streets in the centre of the South Riverdale. These were renovated and sold for a good profit. However, South Riverdale did not experience the degree of gentrification that occurred in North Riverdale, likely due to the presence of heavy industry and related environmental concerns (The South Riverdale Community Health Centre 2020). As prices rose in North Riverdale, in the 1980's the business interests promoted South Riverdale as a cheaper alternative and local improvements were made along Queen Street East. which became known as Queen Broadview Village. The improvements included the cleaning of 40 historical facades (Walks & August 2008).

Starting in the 1980s, incomes of North Riverdale residents started to increase while those in South Riverdale remained more stable. This is likely because North Riverdale attracted an influx of higher income households. The discovery of termites in South Riverdale, followed by identification of widespread lead contamination, and the proposal for a new incinerator meant that the neighbourhood was less attractive as a place to invest or buy homes. This resulted in South Riverdale remaining quite stable between 1981 and 2001 (Walks & August 2008). Since then, South Riverdale has become an attractive community due to its greater affordability. A 2014 survey of residents indicated that people living on a low income were concerned about gentrification of their neighbourhood, as expensive shops replaced more affordable ones. This change has eliminated places where they could socialise, and there is now a need to travel out of the neighbourhood to find more affordable options (Planning South Riverdale 2014).

[4] Don Mount Court was redeveloped in the 2000s and is now Rivertowne.

2. Health factors assessed

2.1 Transport

Riverside and Leslieville are already very walkable with good access to transit. Walk Score® ranks South Riverdale as the 14th most walkable neighbourhood in Toronto with a Walk Score of 87 (very walkable, most errands can be accomplished on foot), Transit Score of 93 (rider's paradise, world-class public transportation), and Bike Score of 91 (biker's paradise, daily errands can be accomplished on a bicycle) (Walkscore.com**,** accessed 2021-07-05).

Health benefits of improved transit

Improving public transit is a cost-effective way to improve health, and these improvements are one of the largest benefits of transit investments (Litman 2020).

Public transit, including the subway system, contributes to better health in many ways. In addition to reducing traffic-related injuries, improved transit results in increased walking and cycling to work, school and other activities such as shopping. This increase in physical activity helps prevent premature deaths and various chronic diseases such as diabetes. Transit also improves social connectivity and mental health. It contributes to improved equity by offering better access to employment, schooling and social/community services for people with low income and an aging population. And there are also the benefits that come with lower traffic-related air pollution and fewer greenhouse gas emissions (Mowatt et al 2014; TPH 2019b).

Transit offers mobility at lower cost than travel by private automobile. This reduces household transportation-related costs. The lower amount of income devoted to paying for transportation means more resources can go to pay housing, food, health and other essential services. Improved access is especially important for people on low income, with disabilities or who are not able to drive (Litman 2020; TPH 2013).

Good transit has many health benefits. Transit improves access to opportunities and services that contribute to health (for example, employment, education, health services, food, and recreation/social activities). Because transit improves access to economic, social and recreational opportunities, it contributes to mental health. Not only does employment provide a source of income, it contributes to a sense of identity and gives structure to daily life, which in turn promotes mental health. Being able to access health services also allows people to prevent illness and to improve their health and well-being (TPH, 2013).

Poor diets are linked to chronic illnesses such as heart disease, diabetes, high blood pressure, and poor self-rated health. Transit has an important role in improving access to healthy foods, especially for people who do not have access to a car. In addition, participation in recreation and cultural activities promotes social relationships and contributes to positive mental health (TPH 2013).

Transit also contributes to increased physical activity which is critical to good health. People who use transit walk and cycle more, not only to get to transit, but also for doing errands and getting to and from other activities. Compared to non-transit users, people who travel by transit are more likely to meet recommended physical activity guidelines (Litman 2020). Physical activity can lower the risk of chronic

health conditions such as cardiovascular disease, stroke, hypertension, diabetes, colon cancer, breast cancer, and osteoporosis (TPH, 2013).

Transit, especially when it is electrified, reduces both traffic-related pollution and greenhouse gas emissions as fewer people travel in private vehicles than otherwise would be the case. Studies have shown lower per capita traffic-related injuries and deaths in communities with better transit: transit has about one-twentieth the passenger fatality rate of automobile travel. As well, many commuters report they find traveling by transit less stressful than driving (Litman 2020).

The proposal

The proposal (Metrolinx accessed 2021-07-19) envisages the Ontario Line as a faster and easier way for people to travel to and from Leslieville, Riverside and Riverdale: It will mean shorter travel times for people travelling to the Exhibition, downtown, the Danforth and the Ontario Science Centre. In addition, the Line will make it easier for people to get to community spaces like the Jimmie Simpson Park and recreation centre as well as the unique shops and restaurants in the area. Three stations are planned, one at Gerrard and Carlaw, a second at Queen and De Grassi (Leslieville/Riverside), and a third south of Eastern Avenue (East Harbour). By 2041 these stations will serve approximately 27,000 people living within walking distance of these stations.

Advantages of an underground alignment

"Aboveground or underground" is not a simple choice. It involves the consideration of many factors including planning, urban design, engineering, construction, economic and social aspects. There is a balance of advantage that may differ between the urban core and more suburban areas of a city. The environmental and social benefits of an underground line need to be considered when making the choice, rather than focussing primarily on upfront cost of construction (ITA 2004).

While there may be little difference in ridership potential between an overground and underground alignment, social, aesthetic and environmental considerations generally favour an underground system in city centres. In terms of noise, underground alignments result in less noise as compared to either an at-grade or elevated route. Though the costs and benefits may be hard to quantify, when long-term benefits are taken into account, this generally favours an underground alignment in dense urban areas. Most cities that have opted for an underground alignment for transit near and adjacent to the city centre do not regret making that choice (ITA 2004).

Transport – underground compared to overground rail

Metrolinx (2021c) notes that an underground line would result in stations deep underground that could add four to five minutes to travel time and discourage people from using the Ontario Line. It also suggests that an underground alignment would require the permanent closure of either Eastern Avenue or Queen Street.

As noted above, the Lakeshore East Community Advisory Committee and Save Jimmie Simpson have endorsed a revised alignment which would see the Ontario line continue underground beneath Carlaw Avenue and emerge south of Eastern Avenue just before East Harbour (see figure 1-6 above). This option would not require tunnelling under the Don River, and it would impinge on industrial land rather than park land or residential properties. The consultation and analysis for the portion under Carlaw has

already been completed (Steve Munro, accessed 2021-07-21). It also would not require the permanent closure of either Queen Street or Eastern Avenue. The underground option as proposed by the community would have a station at the intersection of Queen Street and Carlaw Avenue, which would provide a better transfer point to other transit routes, compared to a stop at De Grassi Street in the overground alignment.

Improved transit provides many health benefits. Overall, there is likely little difference between the underground and overground rail options when it comes to improving access to jobs, education, food, recreation and various services that contribute to health and well-being. While an underground option could be more expensive to build, it would minimise impact on the character of the neighbourhood, including green space and heritage.

2.2 Noise

Noise in Toronto[5]

In 2017 Toronto Public Health released a study on noise in Toronto (TPH 2017b). The results of the noise monitoring showed the overall average noise levels in Toronto were 64.1 dBA during the day (7:00 am – 11:00 pm) and 57.5 dBA (11:00 pm – 7:00 am) at night. These differed by location with daytime levels ranging from 51.6 to 79.5 dBA and nighttime levels from 42.6 to 74.4 dBA (Oiamo 2017). Noise levels were higher during the week than the weekend. Presence of railways is a predictor of total noise levels and has a small but significant contribution to measured noise levels (Oiamo et al. 2017)

Noise measurements taken as part of the preparation of the Ontario Line Environmental Conditions Report (AECOM 2020) indicate that existing average daytime, evening, and night-time noise levels in the vicinity of the proposed alignment to be as follows:

- Daytime (7 AM to 7 PM) Leq (1hr): 48 dBA to 73 dBA;
- Evening (7 PM to 11 PM) Leq (1hr): 48 dBA to 71 dBA;
- Night-time (11 PM to 7 AM) Leq (1hr): 43 dBA to 70 dBA;
- Daytime (7 AM to 11 PM) Leq (16hr): 53 dBA to 67 dBA; and

[5] Sound levels are reported in decibels (**dB**) or A-weighted decibels (**dBA**) which take into account the human perceptions of loudness to different frequencies. The loudness of sound (L) may be expressed in different ways:

- **Leq:** The equivalent continuous level, which is the average level of sound over a period of time (for example hour, day, or year)
- **Leq 24:** The equivalent continuous level, which is the average level of sound over a period of 24 hours
- **Ldn:** the average equivalent sound level over a 24-hour period with a penalty added for noise during the night-time hours
- **Lden:** the average equivalent sound level over a 24-hour period with a penalty added for noise during the evening and night-time hours
- **Lmax**: the maximum level of sound that occurs in a period of time
- **Lnight:** average level during the night (usually 8-hours, for example 11pm to 7 am)

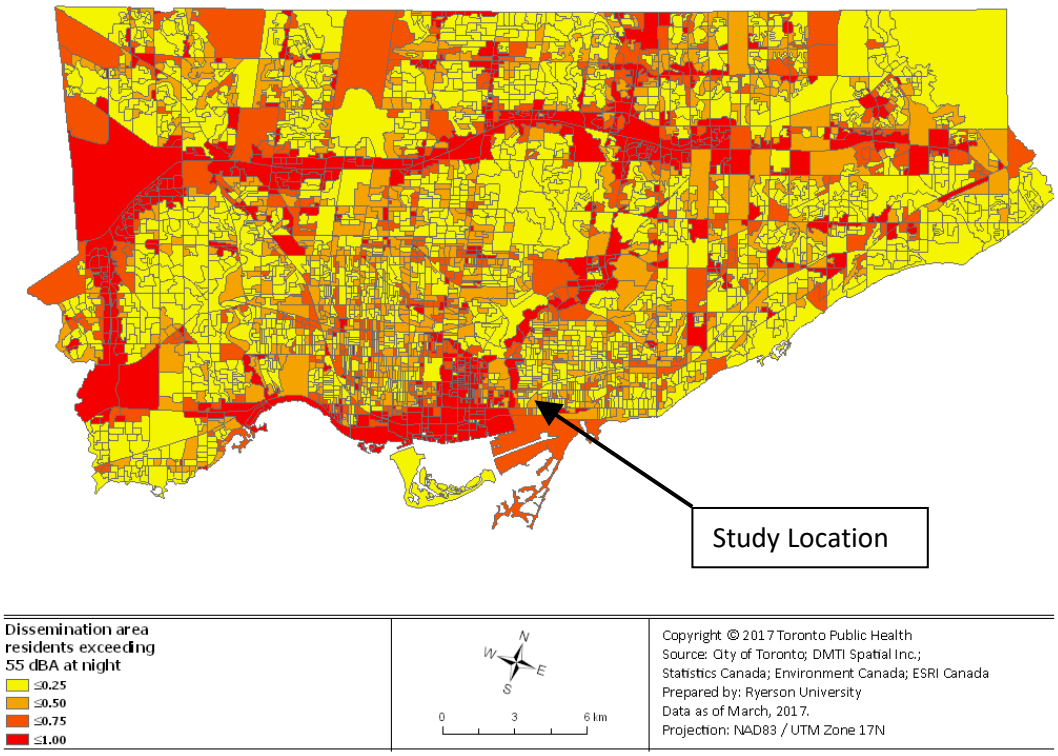
Other terms**: Plane** of door or of window is the centre of an exterior window or door opening in a building; **SEL** is the sound exposure level measured over one second.

- Night-time (11 PM to 7 AM) Leq (8hr): 49 dBA to 62 dBA.

Noise was measured at two locations in the study area: one at Pape/Riverdale Avenues and the other on Wardell Street south of Dundas St. These showed a daytime average level of noise of 64 dBA (16-hr Leq) and night-time average of 55-56 dBA (8-hr Leq) (AECOM 2020). No indoor noise measurements have been made in properties near the rail corridor to document the current exposures in people's homes.

While levels of noise in Toronto are typical of large cities, they are higher than the World Health Organization (WHO) guidelines for community noise – 55 dBA Leq daytime average and 40 dBA nighttime average – as well as the Ontario noise thresholds for sensitive land uses near transportation sources – 55 dBA Leq daytime and 50 dBA nighttime (TPH 2017b). A large proportion of the population is exposed to average levels of above 55 dB at night (Figure 2-1). This points to the need to make efforts to reduce exposure to noise in Toronto, which means it is essential that new undertakings do not result in increased exposure to noise.

Figure 2-1: Percentage of residents exceeding 55 dBA at night (11 AM to 7 AM) by census track
(Source: Oiamo et al. 2017)



Noise and health

The available evidence shows that exposure to levels of environmental noise commonly experienced in urban environments can impact cognition, result in sleep disturbance, affect mental health and contribute to cardiovascular illness. These health impacts can occur when outdoor levels are between 42 and 60 dBA (TPH 2017b). The biological effects of traffic noise have been observed in laboratory studies, field investigations and epidemiological research. "Effects range from acute reactions to short-term loud noise, occurring within seconds or minutes from the initiation of a noise stimulus, to chronic

effects of long-term exposure to more moderate noise levels, which may develop over years of exposure" (Eriksson & Pershagen 2018). There is evidence to suggest that risk to health increases when people are exposed to multiple sources of noise (Pyko 2018).

Most studies that have looked at the relationship between environmental noise and health have looked at noise from road traffic (Clark & Paunovic 2018). Fewer studies have looked at railway noise. Studies that have looked at annoyance[6] have found differences in the response to noise depending on the source (Schreckenberg 2018). There is no threshold for annoyance as it increases steadily with noise level (Fields 1979). In residential areas, reports of annoyance are more often related to noise from through-trains, maintenance activities and vibration. At the same noise levels, electrified trains appear to be less annoying than diesel ones. However, the degree of annoyance experienced is likely underestimated when the effects of vibration and all the various sources of railway noise are not taken into account (Janssen & Hong 2017).

In urban areas, the noise from the interaction between the rotating wheel and the rail (rolling noise) dominates (Kouroussis et al. 2021). A study of railway noise (Gidlöf-Gunnarsson et al. 2012) found that level of annoyance was related not only to the level of noise but also to the number of trains and presence of ground-borne vibrations. To compensate for this effect, noise levels would need to be kept 5-7 dB lower in areas with ground-borne vibrations and large number of trains. The researchers also found that residents in dwellings with a balcony or patio oriented towards the railway were twice as likely to report being annoyed; annoyance among residents with bedroom windows facing the railway as opposed to the quiet facade was 1.5 times higher.

The World Health Organization (WHO 2018) considers annoyance and self-reported sleep disturbance as health outcomes due to the evidence that these factors are possible causal pathways of noise-induced cardiovascular and metabolic diseases. Maximum sound pressure levels (SPLs) as low as 33 dBA have been shown to induce physiological reactions during sleep (Basner & McGuire 2018). Hahad and colleagues (2018) found an association between railway noise annoyance during sleep and atrial fibrillation, which can increase the risk of stroke, heart failure and other heart-related complications. While noise guidelines usually set exposure limits on the average sound level (Leq), the number and characteristic of noise events during the night are a better predictor of sleep disturbance (Basner & McGuire 2018).

Measures to mitigate noise

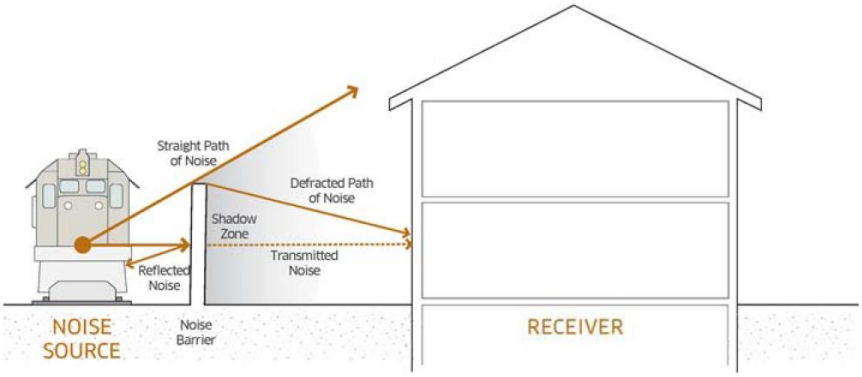
Many available measures to reduce noise are most feasible during the development of new railway tracks. Rail pads, bi-bloc sleepers, small noise barriers and tunnels, cuttings or earthwork barriers can be used. Other interventions include acoustic rail grinding, noise barriers built alongside the tracks, construction of quieter locomotives and railcars, and replacement of brakes on freight trains (WHO 2018).

A noise barrier can provide noise reduction of up 15 dBA when it blocks the line of sight between the train and the receiver, although it is typically less than that (FCM & RAC 2013). However, as can be

[6] Annoyance is linked to adverse health effects. The World Health Organization (2018) defines annoyance as a feeling of displeasure, nuisance, disturbance or irritation caused by a specific sound or vibration. Studies use self-reported annoyance from surveys or number of reports of complaints.

deduced from Figure 2-2, sound barriers may not be effective in reducing noise impacts on upper floors of multi-storey buildings near the rail line. Underground trains are the quietest option especially when track isolation measures are used (ITA 2004).

Figure 2-2: Effect of a noise barrier on the path of noise (Source: FCM & RAC 2013)



Proposed noise mitigation

The Ontario Line environmental assessment is to study the combined noise impacts from the GO trains and Ontario Line operations along the segment of the rail corridor from East Harbour to Carlaw Avenue (Metrolinx 2021a). Appendix C of the Draft Early Works Report for the Lakeshore East Joint Corridor Early Works (AECOM 2021) provides the results of the noise assessment. Metrolinx followed the 1994 GO protocol with the Ontario Ministry of the Environment and Energy (now, Ministry of the Environment Conservation and Parks) for Noise and Vibration Assessment, the 1993 Ministry-TTC protocol, and the US Federal Transit Administration Manual (AECOM 2020, Appendix 3). The reference exposure limits Metrolinx used in its assessment are shown in Table 2-1.

Table 2-1: Rail Noise Limits for Residences used by Metrolinx (Metrolinx 2020)

Parameter	Measure	Exposure Criterion*
Airborne Noise	Daytime Adjusted Noise Impact (16-hour average, 7 a.m. to 11 p.m.)	5 dB relative to the higher of pre-project sound levels or 55 dBA
Airborne Noise	Night-time Adjusted Noise Impact (8-hour average, 11 p.m. to 7 a.m.)	5 dB relative to the higher of pre-project sound levels or 50 dBA
Airborne Noise	Subway vehicle L_{passby}**	80 dBA
Ground-borne Noise	Subway vehicle L_{passby}	35 dBA

* Limits apply outside building, except for ground borne noise

** L_{passby} The allowable noise level associated with a train passing by

Metrolinx has proposed noise walls along the existing GO rail corridor through the Riverside and Leslieville areas (Figure 2-3). Other noise mitigation approaches are being considered such as rail dampers, continuously-welded rail, ballast mats, floating slabs, resiliently supported rail ties and highly resilient fasteners. “Once the trains are running, there will be continual track and vehicle maintenance, combined with timely monitoring and inspections (Winterburn 2020).”

Figure 2-3: Recommended noise walls and vibration mitigation for GO service expansion between Greenwood and the Don Valley (Source: GO Expansion Program Public Consultation Meeting 3rd Round November-December 2020, accessed 2021-06-19)

Noise – underground compared to overground rail

Available evidence shows when it comes to noise, underground trains cause less disturbance than either elevated or at grade alignments (ITA 2004; US FTA 2018).

A noise impact assessment was done for the underground Relief Line (IEC 2018). The potential sources of operational noise identified were 1) subway stations 2) traction power substations 3) tunnel ventilation and 4) emergency exit buildings. These stationary sources of noise are readily mitigated. The plan was to assess these at the final design stage when seeking an Environmental Compliance Approval, which would ensure they comply with the Ontario noise guidelines for stationary sources.

The Early Works report (AECOM 2021) provides an assessment of the noise impact of the expanded GO service and the Ontario Line. The main contributor to noise exposures are the GO trains. With noise barriers the modelling suggests that noise levels at many of the selected receptors would be lower than it is today (between 0.4 and 10 dBA less). A predicted increase in noise levels was noted for five high-rise buildings (327 and 345 Carlaw Avenue, 1189 Dundas Street E., 444 Logan Avenue and 369 Pape Avenue). These were estimated to be below 5 dBA, which are characterised as being either noticeable or negligible in the Ontario noise guidelines and do not require mitigation measures. Station-related noise was not assessed.

The community is very concerned about the impact of the planned service and large increase in frequency of trains on the level of noise residents along the railway corridor will experience. Agincourt Village Community Association reports that residents were devastated by the removal of mature trees that used to form both an acoustic and aesthetic barrier. They note that the noise barriers that were installed have not been effective at reducing exposure to noise. Residents continue to be disturbed by engine, brake, and whistle sounds (Potter 2021). Given the experience of the Agincourt community,

residents of Riverside and Leslieville question the effectiveness of the proposed mitigation measures and how well the noise assessment takes into account deflected and refracted noise.

While proposed mitigation measures would meet Ontario noise guidelines, it is worth noting that there are several limitations to these guidelines from a point of view of health.

The Ontario (2013) guidelines set 50 dBA L_{night} as the acceptable outdoor noise limit at night. This is higher than the recommended limit of 44 dBA L_{night} for railway noise established by the WHO (2018). WHO's limit is based on adverse effects on sleep and corresponds to levels at which 3% of people reported to be highly disturbed by railway noise. This criterion is consistent with Health Canada (2017)'s guidance, which considers the change in percent highly annoyed (%HA) an appropriate indicator of noise-induced human health effects from exposure to noise during the operational phase of a project. Health Canada also indicates that noise levels for susceptible populations in particular not exceed the WHO outdoor annual average 40 dBA L_{night}. Further, Health Canada suggests that WHO's ideal background noise level of 35 dBA be used as a reference level to determine the potential impact and the need for mitigation in the event of potential impacts on schools.

While guideline levels are set using equivalent noise levels (Leq), other characteristics of the noise, including peak noise, multiple sources of noise and simultaneous occurrence of vibration are known to influence perception of noise, annoyance, sleep and well-being (Basner & McGuire 2018; Cerletti et al.2020; Guski et al. 2017; Lercher et al. 2017).

Another consideration is that when existing outdoor levels are above the guideline levels of 55 dBA L_{day} or 55 dBA L_{night}, the Ontario guidelines allow for an increase in noise of up to 5 dBA above current levels before mitigation is required. This 5 dBA threshold is based on perception – that is a person is unlikely to notice a difference in sound levels. It is not a health-based criterion. It in effect allows background noise to increase. As indicated above, background noise levels in Toronto, including in this neighbourhood, are already at levels associated with adverse health impacts.

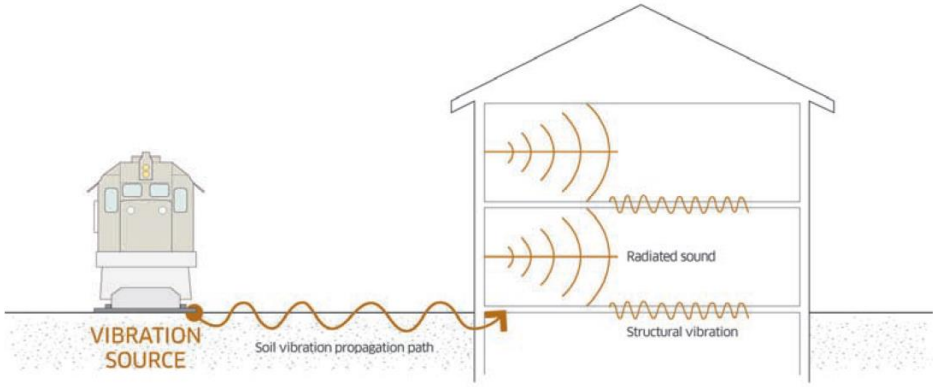
The available evidence therefore indicates that, from a point of view of health, the underground alignment is preferred as it would minimise any additional exposure to noise for people living near the rail corridor in this neighbourhood.

2.3 Vibration

Vibrations from trains

Vibration travels from the source through the transit structure and excites the adjacent ground, creating vibration waves that travel through the layers of soil and rock to the foundations of nearby buildings (Figure 2-4). The vibration then spreads from the foundation throughout the remainder of the building structure. Soil and subsurface conditions influence the levels of ground-borne vibration. The effects of ground-borne vibration can include perceptible movement of floors in buildings, rattling of windows, shaking of items on shelves or hanging on walls, and low-frequency noise (ground-borne noise). The vibration of the building structure and room surfaces can emit a low-frequency rumble called ground-borne noise (US FTA 2018).

Figure 2-4: Ground-borne vibration propagation (Source: FCM & RAC 2013)



The major sources of vibration from moving trains are 1) the moving load effect,[7] 2) track unevenness, 3) defects on the rail surface, and 4) defects on the wheel surface (Kouroussis et al. 2021). Of the factors that contribute to ground-borne vibration and noise from rail, the most important one is the track support system. Special vibration control systems such as resilient fasteners, ballast mats, and floating slabs are effective in reducing vibrations. Heavier transit structures will lower vibration levels. Higher train speed will increase vibration, with a doubling speed resulting in an increase in approximately 4 to 6 VdB. Wheel flats and wheel roughness are major sources of vibration from steel wheel/steel rail systems. Rough tracks contribute to vibration, therefore maintaining a smooth surface is important. Stiff suspension systems will also contribute to higher vibration levels (US FTA 2018). Airborne noise at low frequencies (such as those caused by locomotives) can also induce vibration in lightweight elements of a building and can be perceived as ground-borne vibration (FCM & RAC 2013).

Vibration and health[8]

Vibration is perceived through complex physiological mechanisms. The magnitude, frequency, duration, and temporal characteristics of the vibration affect the way it is perceived. Available data suggest that

[7] The effect of a moving load – in this case the railcar – on a structure.

[8] There are different ways to measure and report vibrations. Ground-borne vibration can be expressed as root-mean square (RMS) velocity either in decibels or mm/sec, and ground-borne noise as A-weighted sound levels (dBA) (US FTA 2018). Another measure is the vibration dose value (VDV).

- **RMS** (m/s): the frequency-weighted root-mean-square velocity measured in metres per second. In the US it is measured in inches per second
- **RMS** (m/s^2): the frequency-weighted root-mean-square acceleration is the preferred measure of vibration in the ISO standard (Peris et al. 2012)
- **RMS W_k** (m/s^2): The root-mean square acceleration for whole-body vertical vibration
- **VdB:** The vibration velocity level expressed in the decibel scale
- **VDV** ($m/s^{1.75}$): the vibration dose value is a measure of the cumulative exposure to vibration during a period or time using two frequency weighting curves for vertical and horizontal vibrations based on the human perception thresholds of vibration. VDV takes into account the number of events, their duration, and their vibration level and RMS takes account of the number of events and their level (Peris et al. 2012). The use of the fourth power method makes VDV more sensitive to peaks in the

people react differently depending on the source of vibration, including the type of train (Waddington et al. 2014). Factors that influence the degree of annoyance include:

- Time of day – lowest annoyance when vibration occurs during the day, higher annoyance during the evening and most annoyance at night
- Visibility – greater annoyance when the source of vibration is visible
- Time spent at home – higher annoyance among people who are at home less than 10 hours a day
- Property damage – people who are concerned about property damage report higher annoyance
- Future expectations – people who anticipate vibrations will get worse in future express more annoyance
- Noise sensitivity – people who describe themselves as noise sensitive report a higher degree of annoyance (Woodcock et al. 2014).

Table 2-2 below summaries the human response to different levels of vibration and accompanying sound.

A study in Sweden found that freight and diesel trains were more annoying than electric passenger trains. A statistically significant increase in annoyance was observed at a distance of up to 200 m for passenger trains (electric), 300 m for diesel trains, and 400 m for freight trains (Maclachlan et al. 2018).

Vibration from trains can reach 0.4mm/sec RMS or occasionally more (FCM & RAC 2013). Typically, humans will not notice vibrations at levels 0.1 mm/s RMS. Strength of vibrations from rail depend on the distance, soil structure, and type of infrastructure. However, the human response to vibration in buildings cannot be explained by the magnitude of the vibration alone. Some complaints are associated with vibration levels lower than the human perception threshold. This is because factors such as ground-borne noise, rattling, movement of hanging objects, and time of day all play a role in how individuals respond to vibration (US FTA 2018). Levels of vibration close to the tracks of rapid transit or light rail are around 70 VdB but can sometimes be more. Vibration levels from the heavier locomotives used on diesel commuter trains are 5 to 10 VdB higher than those from light rail. Experience shows that few complaints occur when vibration levels are below 72 VdB (US FTA 2018).

Ground-borne vibrations contribute to annoyance (Janssen & Hong, 2017). Annoyance has been found to be higher when residents can hear trains every day and when objects in the home rattle (Janssen et al. 2015). People report greater annoyance during the night. A study in England found that with the same vibration exposure [measured as 24-h RMS W_k of 0.004 m/s^2 or vertical vibration dose value (VDV_b) of 0.05 $m/s^{1.75}$] 4% of residents report being highly annoyed during the day, 7% during the evening, and 15% during the night (Peris et al. 2011; Peris et al. 2012). Night-time disturbances were better correlated with horizontal vibration exposure (VDV_d) (Peris et al. 2011). At an average exposure level (from 7:00 a.m. to 7:00 p.m.) of VDV_b of 0.01 $m/s^{1.75}$, about 2% of the respondents reported being

acceleration waveform. VDV accumulates the vibration energy received over the daytime and night-time periods (NSW 2006).

- **VDV_b** ($m/s^{1.75}$): The vibration dose value for vibration in the vertical direction
- **VDV_d** ($m/s^{1.75}$): The vibration dose value for vibration in the horizontal direction

highly annoyed. In the same survey, 50% of 931 respondents reported being able to feel railway induced vibration at exposures of VDV of 0.0082 $m/s^{1.75}$ (Waddington et al. 2014). While vibration standards are usually set as time-weighted averages, the authors note this may not be the best measure to assess annoyance.

Table 2-2: Human Response to Different Levels of Ground-Borne Vibration and Noise (Source: US FTA 2018, p. 120)

Vibration Velocity Level	**Noise Level** Low frequency*	**Noise Level** Mid frequency**	**Human Response**
65 VdB	25 dBA	40 dBA	Approximate threshold of perception for many humans. Low-frequency sound: usually inaudible. Mid-frequency sound: excessive for quiet sleeping areas.
75 VdB***	35 dBA	50 dBA	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find transit vibration at this level annoying. Low-frequency noise: tolerable for sleeping areas. Mid-frequency noise: excessive in most quiet occupied areas.
85 VdB	45 dBA	60 dBA	Vibration tolerable only if there are an infrequent number of events per day. Low-frequency noise: excessive for sleeping areas. Mid-frequency noise: excessive even for infrequent events for some activities.

* Approximate noise level when vibration spectrum peak is near 30 Hz.

** Approximate noise level when vibration spectrum peak is near 60 Hz.

*** Few complaints occur when vibration levels are below 72 VdB

Vibrations impact sleep quality. Vibrations may cause people to wake up in the night or to wake up too early, and to have greater difficulty of going back to sleep. Exposure to vibration results in more reported sleep disturbance. As well, fewer people indicate feeling restored (Woodcock et al. 2014). Vibrations have been found to increase the heart rate and affect sleep structure (for example, reduction in REM sleep, shorter period of time between falling asleep and first awakening, and shorter uninterrupted time in slow wave sleep).

Both noise and vibration affect the natural rhythm of sleep. Evidence indicates sleep disturbance is more likely when noise occurs along with vibrations, such as with railway noise (Basner & McGuire 2018). Smith and colleagues (2013, 2014, 2016, 2017) undertook various experiments simulating exposure to train noise and vibration. Strength of vibration, number of trains and level of noise were found to contribute to the likelihood of sleep disruption. When vibrations were stronger and trains more frequent, sleep was more fragmented (Smith et al. 2013). Stronger vibrations also resulted in an increase in heart rate (Croy et al. 2013; Smith et al. 2013). Given that arousal from sleep is more likely during shallower sleep stages, older adults may be more sensitive to noise and vibration (Smith et al. 2017). As children need more sleep, it is also possible that they are also more vulnerable.

A study in the Netherland found that awakenings were associated with the vertical maximum vibration (Vmax). Increases of Vmax levels from freight trains of 0.1 mm/s were associated with about a 4% increase in reported severe sleep disturbance (Van Kamp et al. 2017). Factors related to higher disturbance included sleeping on a higher floor, with an open window or when vibrations were accompanied with rattling of objects within the home.

Measures to mitigate vibration

Metrolinx uses a vibration velocity of 0.1 mm/s RMS as its benchmark to decide if mitigation measures are needed (Table 2-3). Vibrations from underground trains can be an issue, but low-cost measures are available to reduce these to acceptable levels. A study of annoyance that looked at three rail lines, reported a very low level of annoyance from vibration along the line that had been covered (Janssen et al. 2015).

Many of the measures used to reduce noise are also used to reduce vibration (US FTA 2018). Special track support systems such as floating slabs, resiliently supported ties, high-resilience fasteners, ballast mats and tire-derived aggregates can be used. In addition, preventative maintenance such as rail grinding and wheel truing to remove wheel flats.

Table 2-3: Rail Vibration Limits for Residences used by Metrolinx (Metrolinx 2020)

Parameter	Measure	Exposure criterion outside building
Ground-borne Vibration	Vibration Velocity RMS	0.1 mm/s RMS (equivalent to 72 VdB)

Vibration – underground compared to overground rail

While complaints of ground-borne vibration are more common in underground trains than those at grade, this is not because the vibrations are greater, but because underground rails are often closer to building foundations. As well, since they tend to be of higher frequency, they are more noticeable than those from at-grade tracks (US FTA 2018).

Typically, humans will not notice vibrations at levels 0.1 mm/s. The Relief Line noise and vibration assessment estimated vibrations to be between 12 and 14 percent of the Ministry-TTC protocol criterion of 0.1 mm/s along this segment of the line (IEC 2018). The Early Works report for the joint corridor identified nine receptors where vibration levels were estimated to be between 12 and 128 percent above the Ministry-GO protocol. Metrolinx indicates that further investigation will be needed before determining the required mitigation. In all but one location, the excess vibration was attributed to GO trains. The estimated level of vibration at the other receptors varied between 28 and 92 percent of the Ministry-GO criterion.

Hundreds of homes and apartments are well within 100 metres of the proposed OL and GO lines. This includes 365 properties, three of which are senior's apartment buildings, that are less than 30 metres from the proposed rail lines (Metrolinx 2021). As noted above, complaints can be associated with vibration levels lower than the human perception threshold (US FTA 2018). So, even if the Ministry protocol limits are met, complaints related to vibration may still occur. While the difference between

the options is likely small, the available information suggests that the underground option is likely to result in a lower likelihood of sleep disruption and fewer complaints related to vibration.

2.4 Green space

Green space in Toronto

There are more than 1,500 parks in Toronto with a total area of 8,000 hectares, or about 13% of the land area of Toronto (Toronto 2019a). The degree of access to parks varies across the city (Figure 2-5). As Toronto's population grows and more people live in apartment buildings, the need for park space will increase, including in South Riverdale (Figure 2-6). Toronto's parkland strategy has identified the need for additional parks in the study area, particularly on the north-west side of the existing railway corridor (Figure 2-7). With about 11.5 million trees, Toronto's tree canopy covers about 30% of the city (Toronto 2020). While the tree canopy has increased, it is still below the 40% target set out in Toronto's Strategic Forest Management Plan (Toronto 2013). South Riverdale is one area of the city with the lowest tree canopy (Figure 2-8).

The benefits of Toronto's trees include improving air quality by trapping 1,905 tonnes of air pollutants a year. They also store about 1.1 million tonnes of carbon, the equivalent annual carbon dioxide emissions from 733,000 cars (City of Toronto 2015).

Figure 2-5: Park area per person in Toronto (Source: Toronto 2019a)

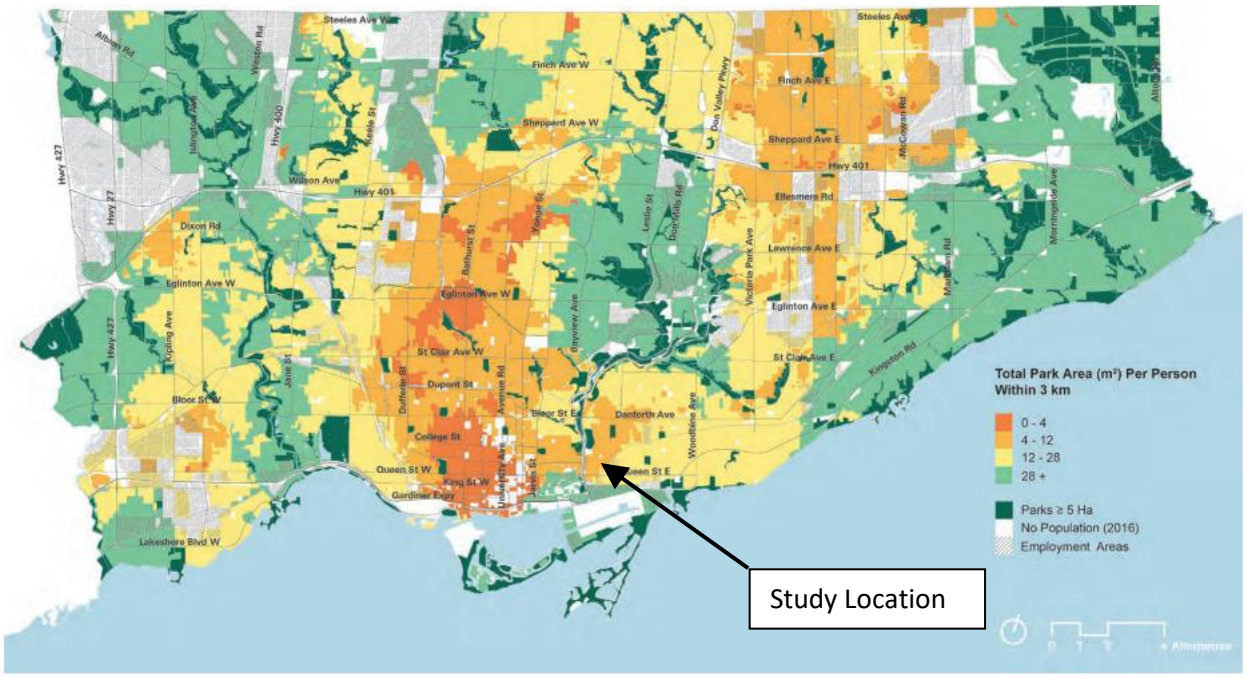


Figure 2-6: Percent change in available parkland supply in Toronto between 2016 and 2033 due to anticipated growth in population (Source: Toronto 2019a)

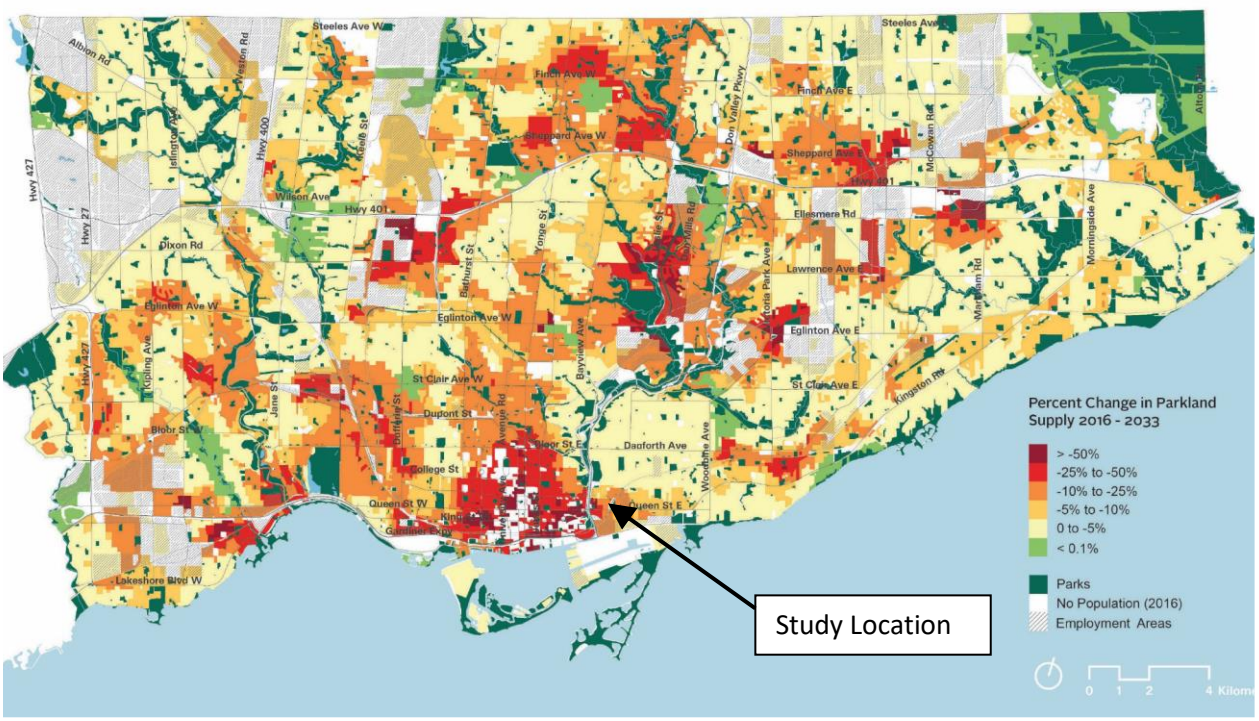


Figure 2-7: Areas of parkland need in Toronto (Source: Toronto 2019a)

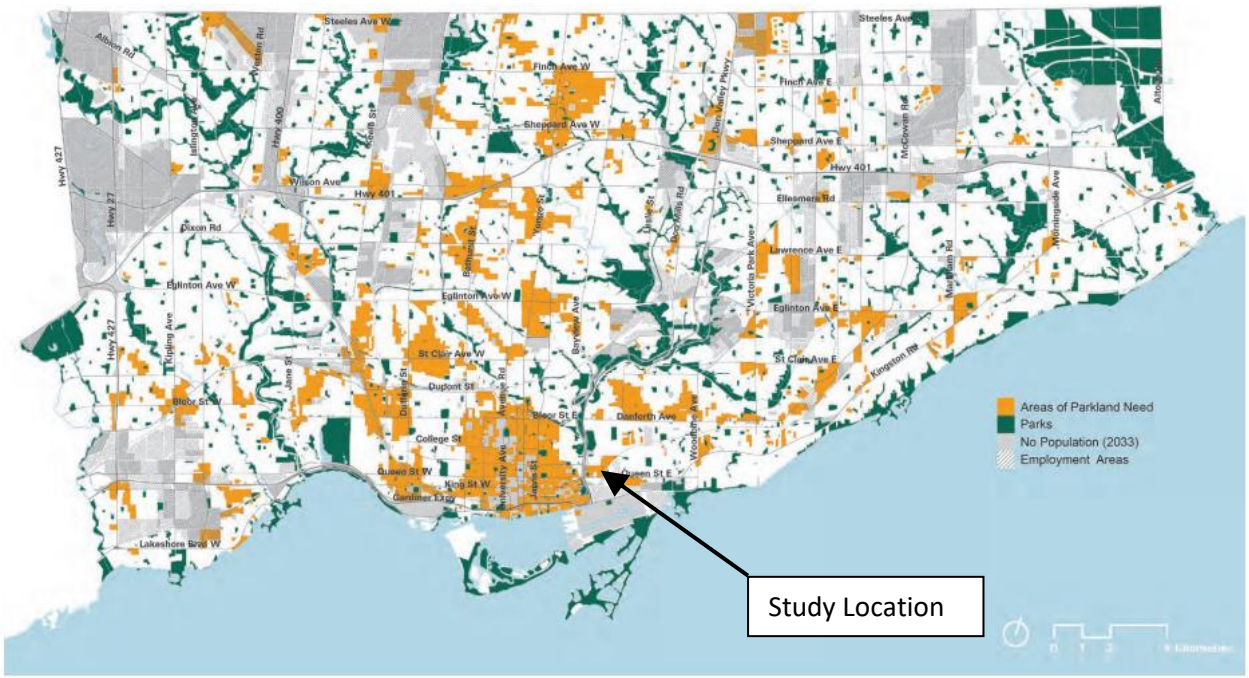
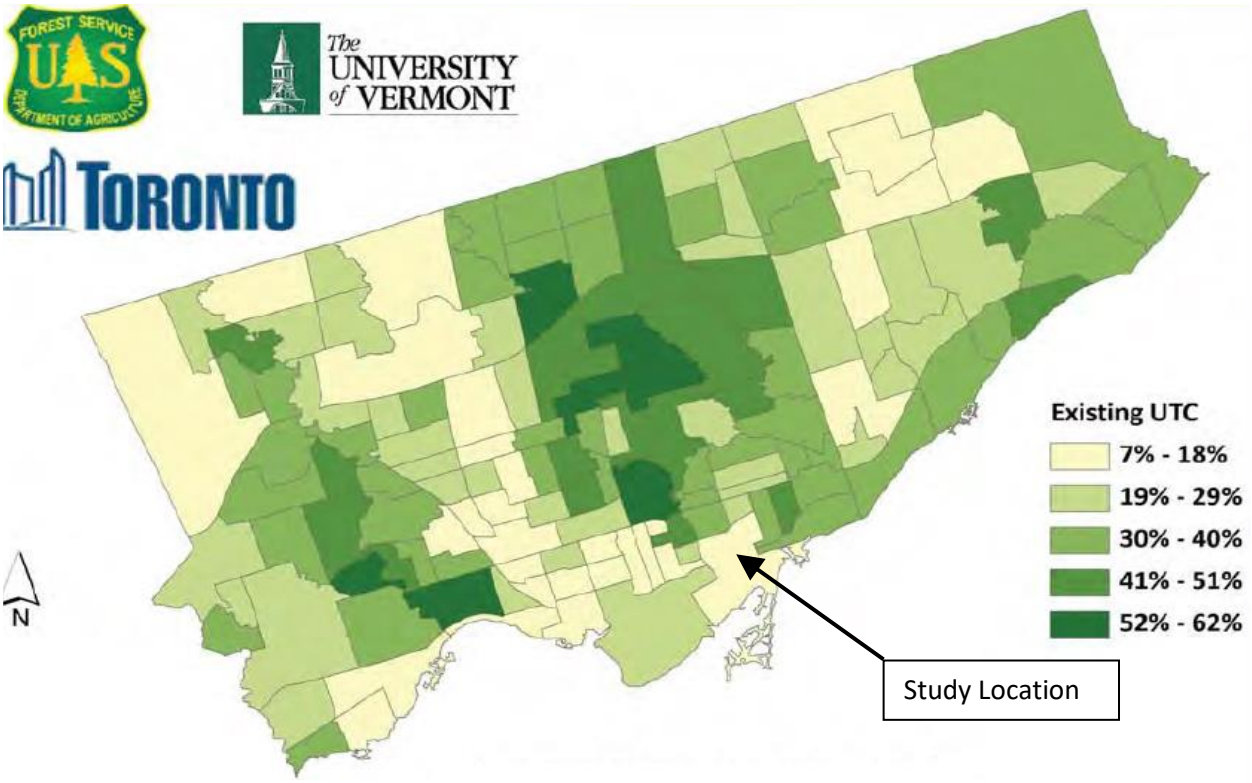


Figure 2-8: Average tree canopy by Toronto neighbourhoods (Source: Toronto 2013)



Green space and health

The contribution of green space to health is being recognised more and more (PHE 2020). In its review of the evidence, Toronto Public Health concluded that green space improves physical health, mental health and well-being of urban residents. It also noted that frequent access to nearby green space is important, especially for children and people living on low-income (TPH 2015a). Studies have found that living in greener communities reduces health disparities. Green space also reduces the negative effects of air pollution, excessive noise, heat and flooding (PHE 2020).

Studies have shown that people who live in greener neighbourhoods and have better access to green spaces have better health outcomes. A study that looked at greenness near a person's home and deaths among Canadian-born residents of 30 cities found that people living in areas with more green space had an 8 to 12% lower risk of dying from heart and lung disease (Crouse et al 2017). A health impact assessment estimated that increasing the tree canopy in Philadelphia from 20% to 30% would lead to a 3% reduction in death (Kondo et al 2020). Greenery helps people recover from illness and managing poor health. Green environments also contribute to improved mental health, including less depression, anxiety, and fatigue. They enhance the quality of life for both children and adults, help bind communities together, reduce loneliness, all of which result in an improved sense of well-being (PHE 2020). Studies have also found higher levels of physical activity among people who have more access to green space (Billings et al 2020; Glazener et al 2021). Green space reduces the urban heat island effect and lowers the levels of pollutants in the air (Zupancic et al, 2015).

The health benefits of green space include decreased risk of many different health outcomes: all-cause mortality, stroke and other cardiovascular diseases, respiratory diseases, premature mortality, stress, anxiety, type-2 diabetes, and high blood pressure. Green space is also associated with improved cognitive function, immune function, sleep patterns, pregnancy outcomes, and self-reported health (Glazener et al 2021). Green space is associated with longer sleep in both adults and children (Billings et al 2020). The more you are exposed to green space, the greater the mental health benefits (Engemann et al 2019). In an increasingly urban society, it is important to provide sufficient access to green spaces to protect children's and adolescents' mental health (Vanaken and Danckaerts 2018). Green spaces also provide a home for birds. A study in Europe found that when an area had a higher number of bird species, people indicted a higher level of life satisfaction, showing the importance of maintaining biodiverse green spaces (Methorst et al 2021).

How green spaces benefit health is still not fully understood. The health benefits could be related to the fact that green spaces encourage exercise, provide spaces for socializing, reduce exposure to heat, noise and air pollution, improve immune function and help to reduce stress. In addition, green spaces contribute to greater climate resiliency. Psychological restoration may be green space's strongest protective mechanism (Engemann et al 2019; Wilson et al 2020).

Green space and climate

Green space provides many benefits when it comes to reducing the impacts of climate change on health. The tree canopy and other greenspaces keep outdoor spaces cooler and reduce the urban heat island effect, which will become more important as Toronto experiences more hot days in a warming climate (Demuzere et al. 2014; Zupancic et al 2015). In addition, trees sequester carbon as they grow. The larger the tree and greater the leaf density, the greater the benefit. Compared to a tree with a 15 cm trunk, a 75 cm tree can store up to 90 times more carbon and adds up to 100 times more leaf area to the tree canopy. Green spaces also have an important role in reducing urban flood risks by reducing run-off and as flood plains next to rivers, streams and other bodies of water (Demuzere et al. 2014; PHE 2020).

Green space and noise

Green spaces mitigate the adverse effects of harmful, transportation-related environmental exposures like noise (Glazener et al 2021). A study that compared the noise levels from trains running on tracks using concrete or wooden rail sleepers in both green and open spaces found that the average noise levels from rail traffic were lower in green areas and when tracks had wooden sleepers (Aleknaite and Grubliauskas 2018). Increasing residential green is associated with reduced road traffic and railway noise annoyance with an equivalent level of 3 dB reduction of railway noise (Schäffer et al 2020).

Figure 2-9: Satellite view of the rail corridor from the Don River to Jones Avenue (Source: Google Maps, accessed 2021-06-19)

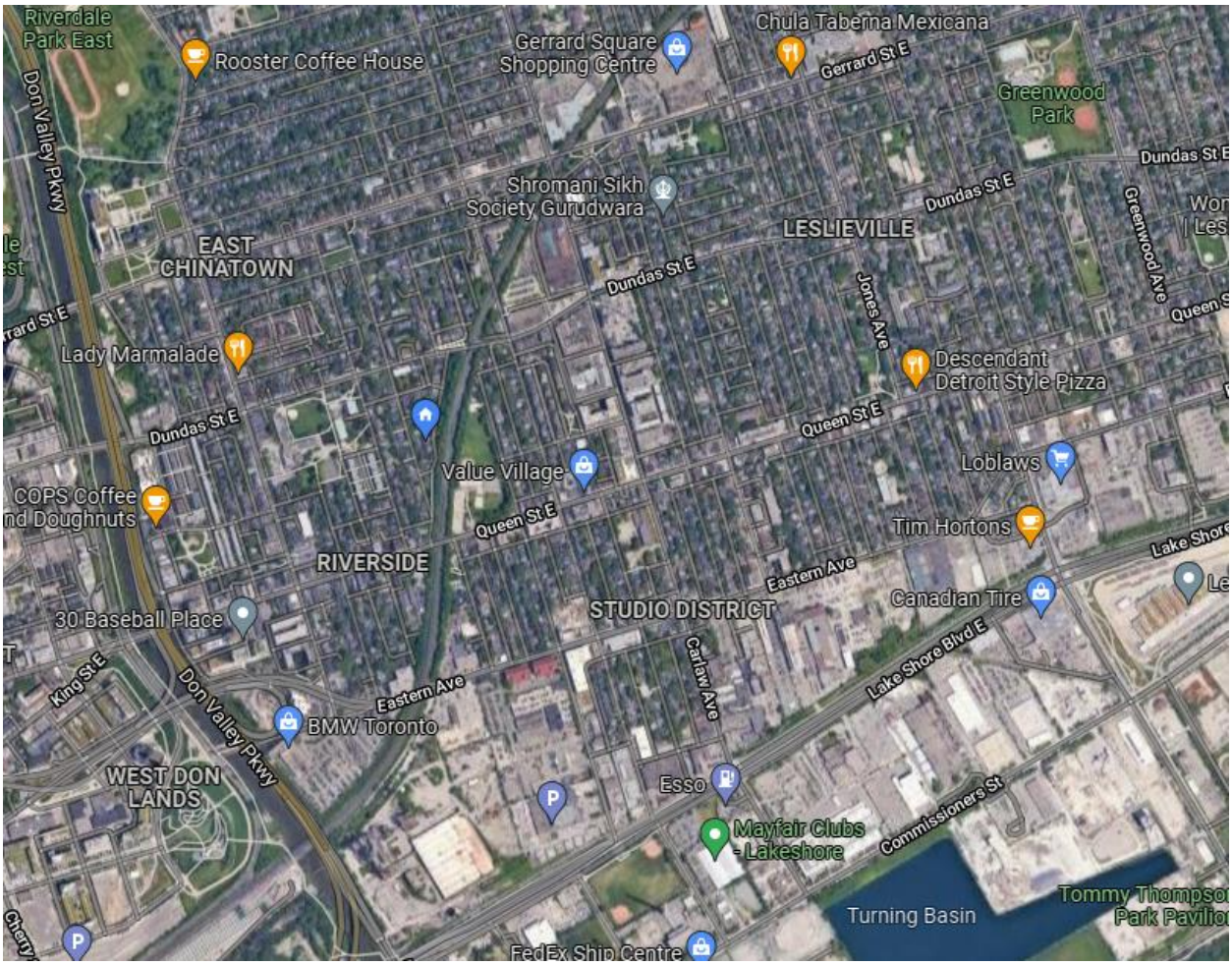


Figure 2-10: Satellite view of the rail corridor showing the potential canopy loss related to tree removal along the rail corridor (view next to the Jimmie Simpson Recreation Centre) (Courtesy of the South Riverdale Community Health Centre, referenced cross section drawing by Metrolinx)

Ontario Line – impact on green space and proposed mitigation

A large portion of the current rail corridor is lined by trees (Figure 2-9). To install additional tracks, Metrolinx will need to remove much of this natural barrier (Figure 2-10). The Early Works report (AECOM 2021) notes Metrolinx will remove vegetation along the existing corridor. An expected 2.24 hectares of woodland, about 0.53 hectares meadow and up to 0.86 hectares of cultural hedgerow are anticipated to be removed. There will also be an impingement on Bruce Mackey Park and the Gerrard-Carlaw Parkette.

Metrolinx has noted that it will consider vegetation, landscaping and streetscaping to enhance noise walls so they fit well with surrounding spaces, like parks (Wilbur 2021). Specifically, Metrolinx has indicated that it will limit impact on green space by building new noise and retaining walls almost entirely within the existing rail corridor. They note that building the walls closer to the tracks than the current fence will allow more land to be accessible to the community. It has also indicated that green space will be added to the four park spaces in the area – Jimmie Simpson Park, Bruce Mackey Park, McCleary Playground and the Gerrard-Carlaw Parkette – increasing the area of park space by nearly 2,600 m^2 or 0.26 hectares (by comparison Jimmie Simpson Park is 2.4 ha in size).

Green space – underground compared to overground rail

South Riverdale is a neighbourhood with lower-than-average tree cover and a park deficiency. Removing the existing trees along the existing rail line will reduce the tree canopy in a neighbourhood where tree cover is well below the city average. It will also remove greenery which contributes to the character of the area and acts as a carbon sink. While Metrolinx has indicated that it will plant trees for every tree removed for the construction of the line, it will take many years for these new trees to achieve the same aesthetic and climate value as the existing mature trees. Still unknown is where these trees will be planted and what will be done to ensure they thrive. The removal of trees in the railway corridor will also eliminate the cooling effect these currently provide the neighbourhoods.

A decrease in green space will be detrimental to health. As of the date of writing, there are insufficient details to accurately assess the impact of an overland alignment on green space, including tree cover along the rail corridor. Some trees may need to be removed as part of the GO rail expansion and electrification, but how much more will need to occur to accommodate the Ontario Line is unclear.

An examination of the maps provided (Winterburn 2021) shows that, except for the addition to 500 square metres to the Gerrard-Carlaw Parkette, much of the additional park space that Metrolinx will make available is within portions of the rail corridor that are already green space. Therefore, it will not result in new green space in the community. As well, with the proximity of the retaining walls and noise barriers, the quality of this space is still unknown (Munro 2021b).

Given that an underground option can be expected to have less impact on current green space in this neighbourhood, from the point of view of health, an underground alignment is preferred.

2.5 Recreation/Leisure

Amenities in the community include:

- Three libraries (Jones, Queen & Saulter, Riverdale)
- Two recreation centres (Matty Eckler Community Recreation Centre, Jimmie Simpson Recreation Centre)
- Twenty parks including parkettes and playgrounds (see Figure 2-11)

A range of sports amenities are located in Jimmie Simpson Park. These include a ball hockey pad/ice rink, an outdoor basketball court, two outdoor tennis courts, and a sports field.

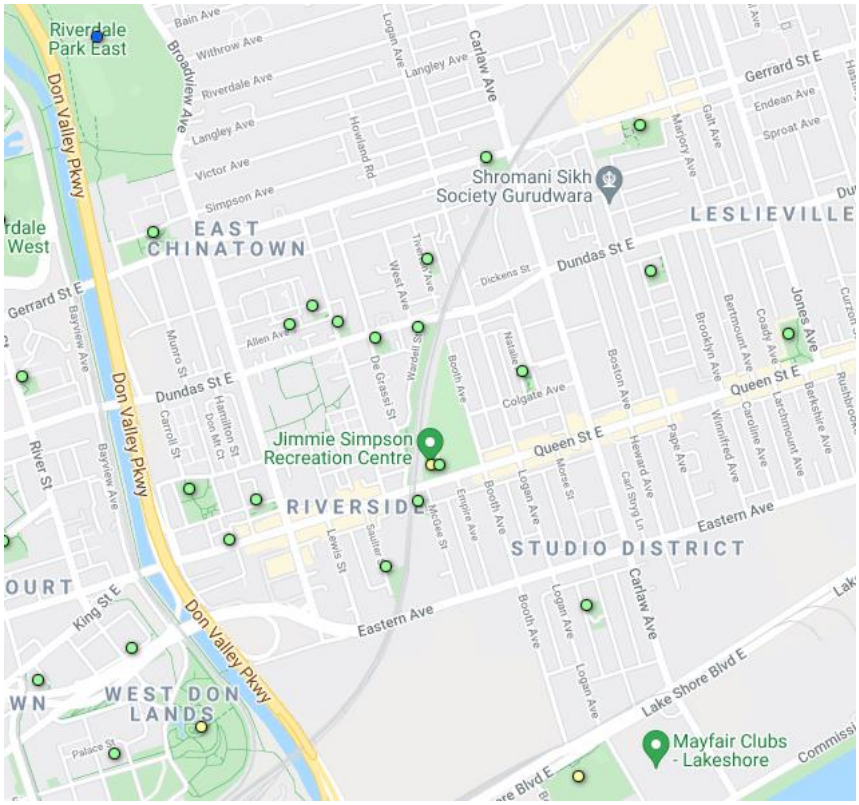
Health benefits of recreation and leisure

The combined health and social benefits make parks and recreation facilities one of the most cost-effective public services (California 2005). Recreation is known to confer physical and mental health benefits. Some of these benefits can be attributed to physical activity which reduces the risk of disease, boosts the immune system, helps maintain a healthy weight and results in overall increase in life expectancy. Access to playgrounds is important for children's health (TPH 2015a).

Recreational activities contribute to quality of life and improved mental health as well as provide social benefits. These include promoting social bonds and strengthening community ties. Youth who are

engaged in recreational activities are less prone to exhibiting negative behaviours and show improved educational outcomes (California 2005). Participants in a consultation undertaken by Planning South Riverdale (2014) noted that "the absence of places where low-income people can meet and socialize was identified as limiting opportunities to connect with friends and neighbours."

Figure 2-11: Locations of park, parkettes, playgrounds in the study area (Source City of Toronto Maps, accessed 2021-07-23)



Park Size: less than 25,000 square metres 25,000 to 75,000 square metres more than 75,000 square metres

Recreation and leisure – underground compared to overground rail

The advantage of an underground alignment compared to an overground one is that it would reduce the impact on surface land-use, include park and recreational spaces.

As mentioned in the section on green space, except for the additional space at the Gerrard-Carlaw Parkette, much of the additional park space that Metrolinx will make available is within portions of the rail corridor that are already green space. Access to recreational amenities is essential for health and well-being. Members of the community have expressed concerns that an over ground Ontario Line would adversely impact the quality of green space both during and after construction in an area that already has a limited supply of parks and recreation facilities. They also noted the particular importance of recreational spaces for children. And, as the population continues to increase, the need for these amenities will become more critical.

2.6 Air quality

There are four air quality monitors in Toronto. The downtown station is the one closest to Riverside/Leslieville. For the 10-year period between 2009 and 2018 the levels of fine particles and ozone in downtown Toronto have remained fairly stable (Table 2-4). During that same period, concentrations of nitrogen dioxide, which comes primarily from the combustion of fossil fuels, have declined about 27 percent. The largest source of air pollution released within Toronto is transportation (City of Toronto 2017).

Table 2-4: Trends in annual average concentrations of selected air pollutants in downtown Toronto between 2009 and 2018. (Source: Air quality in Ontario 2018 report, accessed 2021-06-30)

Pollutant	Concentrations (2009)	Concentrations (2018)	Trend	Canadian Ambient Air Quality Standards (2020)
Fine particles ($PM_{2.5}$)	7.06 ug/m^3 (estimate)	7.94 ug/m^3	None	8.8 µg/m^3
Ozone (O_3)	24.64 ppb	25.8 ppb	None	62 ppb
Nitrogen dioxide (NO_2)	14.36 ppb	10.99 ppb	-27%	17 ppb (NO_2)

Air pollution and health

Both short- and long-term exposure to air pollution can lead to adverse health outcomes. It contributes to various lung and heart diseases. These include the onset and exacerbation of respiratory disease, particularly asthma, wheezing, reduced lung function, hypertension, stroke, and heart attack. Air pollution is also associated with increased risk of childhood cancer, lung cancer, adverse birth outcomes, neurodevelopmental issues, reduced cognitive function, dementia, and diabetes (City of Toronto 2017; Manisalidis et al. 2020).

In Canada, air pollution is a major risk factor for premature death and disability with an estimated economic cost of $120 billion in 2016 or approximately 6% of Canada's real gross domestic product (Health Canada, 2021). In Toronto, air pollution gives rise to around 1,300 premature deaths and 3,550 hospitalizations from respiratory and cardiovascular illness each year (City of Toronto 2017). Particulate matter ($PM_{2.5}$) ozone (O_3) contribute the most to cardiovascular and respiratory ill health, accounting for about 96% of premature death and about 97% of hospitalizations.

Ontario Line – impact on air quality

The Ontario Line will use electric trains. Air pollution and greenhouse gas emissions from running these trains will come from the source of the electricity used – the cleaner the source, the less the pollution. In addition, the friction generated between the brakes and the wheels, the friction between the wheels and the rail, and maintenance activities release particles into the air. These are rich in metals including, barium, chromium, copper, iron, and manganese (TPH 2019b). Lower levels of fine particle matter have

been found in the Montreal metro system compared to those in Toronto and Vancouver. This could be because the trains in Montreal run on rubber wheels and have wooden brake pads (Ryswyk et al. 2017).

The community has raised concern about reduced air quality as the result of the transit expansion that is affecting the neighbourhood. Although this is a legitimate concern, this impact is related to the GO rail service rather than the Ontario Line. Impact on air quality from construction is discussed in the section on impacts of construction below.

Air quality – underground compared to overground rail

The emission profile between an underground and overground Ontario Line is not expected to be significantly different. Where there is a difference is in the release of metals and other particles due to friction. Underground, these are released in a more closed environment, and could result in higher exposure for passengers using the system. The Medical Officer of Health (TPH 2019a) identified various measures, including platform edge doors, as ways that could be used to reduce exposure to particulate matter in Toronto's subway system. Such doors are planned for the Ontario Line. A study conducted in Italy found particulate matter concentrations in a "high-quality" metro system to be lower than the ones measured in "traditional" railways, as well as lower than outdoors (Cartenì & Cascetta 2018). This suggests that, with appropriate measures in place (for example, rubber tires, platform screen doors, advanced ventilation system and a variable slope of the longitudinal profile of the line), an underground option would not result in an increase exposure to pollutants to passengers, but might even result in lower exposure to pollutants than an overground alignment, where these pollutants would be directly released into the wider environment.

2.7 Health & social services

Transit improves access to health and social services, especially for people on low income or who do not drive. These services help maintain health, prevent disease, restore function, and improve well-being (TPH 2013). There is likely no difference between the overground and underground options on access to health and social services in the neighbourhood. However, as described in the gentrification section, displacement of businesses could decrease access to services that cater to existing residents, especially people who have less facility in speaking English.

2.8 Social equity

The social and economic circumstances of Toronto residents, and the area where they live, work, learn and play, influence how healthy they are. A person's social-economic circumstance is the most influential factor. Some people are more likely to experience poor heath or be at higher risk of illness (PAHO 2013; TPH 2015b; WHO 2005). These include:

- Children, older adults, people with a health condition and/or who are socially isolated
- People living on low-income and people who are unemployed or not working due to disability
- People who live in areas with lower access to goods and services, including parks and recreational facilities

- People who face discrimination, including Indigenous Peoples, Black and people of colour, refugees, migrant and undocumented workers, single-parent families, LGBTQ2S+ people, people with a disability, and women
- People with a lower level of formal education, homeless people and those who live in inadequate or unaffordable housing, and people who work in hazardous conditions

The impact of urban development is not equally distributed among the population (Tehrani et al 2019). For this reason, health impact assessments pay particular attention to equity to ensure that people who are already at higher risk of ill health do not experience an even greater burden to their health.

Vulnerable groups living in South Riverdale

Table A-4 in the Appendix summarises a few demographic parameters for South Riverdale, which corresponds closely to the study area (City of Toronto, 2018). When it comes to vulnerable populations, the proportion of the population that identifies as Indigenous is about twice that of Toronto as a whole (1.9% vs 0.9%). While the proportion of people of colour is lower than that of the city as a whole, a higher proportion (8.1%) of the population does do not speak either of the official languages. The rate of poverty (20.7%) and the percentage of households with income less than $20,000 (14%) is similar to that of Toronto as whole. The proportion of single-person households (35.9%) and of seniors living alone (29.1%) is higher than the city average. Compared to Toronto as a whole, a larger proportion of households own their homes, while fewer households live in apartments. The proportion of people living in unsuitable (5.9%) or unaffordable housing (31.1%) is slightly lower than the city average, but when it comes to living in inadequate housing, the proportion (7.7%) is slightly higher than for Toronto as a whole.

Indigenous populations

An estimated 34,000 to 69,000 Indigenous People make Toronto their home, the largest and most diverse Indigenous population in Ontario. Seventy three percent were born outside of Toronto. Compared to the National Health Survey, the results of the *Our Health Counts Toronto* survey of Indigenous Peoples showed a much higher percentage Indigenous Peoples in Toronto live under the low-income cut-off (LICO) – 90% vs 26%. Indigenous Peoples also have a lower formal education attainment – 25% are without a certificate, diploma or college degree. About 16% are homeless (TIHAC 2016).

There is little data on Indigenous People's health in Toronto. However, available data show that they have poorer health compared to non-Indigenous populations (TIHAC 2016). Diseases that occur at increased rates in Indigenous Peoples of Canada include: infectious diseases, cancer, cardiovascular disease, type 2 diabetes, and mental illness (Park et al. undated). Indigenous Peoples experience higher rates of poverty, unemployment, homelessness, involvement with child welfare, food insecurity and challenges within the education system, all factors that contribute to poor health outcomes (TIHAC 2016). There is insufficient information to assess the impact of the Ontario Line on Indigenous residents in the study area. However, given the level of low-income among members of this community, they will face similar risks as other people on low income in general, but likely exacerbated by the trauma related to systemic influences such as historical oppression and marginalization (Park et al. undated).

People living on low-income

While family or household income in South Riverdale is higher than the city average, the number of people on low-income is similar to the city average (City of Toronto 2018). People on lower income are more likely to live in inadequate, substandard or unaffordable housing which is a stressor that contributes to poor health.

There is a well documented gradient between income and health – the higher your income, the better your health (TPH 2015b). An analysis of different indicators showed significant inequities between people living on low-income in Toronto compared to those on high-income. More people in the lowest income bracket (quintile) rated their health as poor or fair. Negative health outcomes included: lower life expectancy; higher premature mortality; as well as higher rates of cardiovascular disease, diabetes, lung cancer, low birth weight, teen pregnancy, and certain sexually transmitted infections in youth. The following risk factors were also more prevalent: lower readiness to learn; less physically activity and higher smoking rates (TPH 2015b). "When compared to the health status of the highest income group:

- Men in the lowest income group are 50% more likely to die before age 75
- Women in the lowest income group are 85% more likely to have diabetes
- Young women aged 15 to 24 in the lowest income group are twice as likely to be reported with chlamydia infection
- Babies in the lowest income group are 40% more likely to be born with a low birth weight" (TPH 2015b).

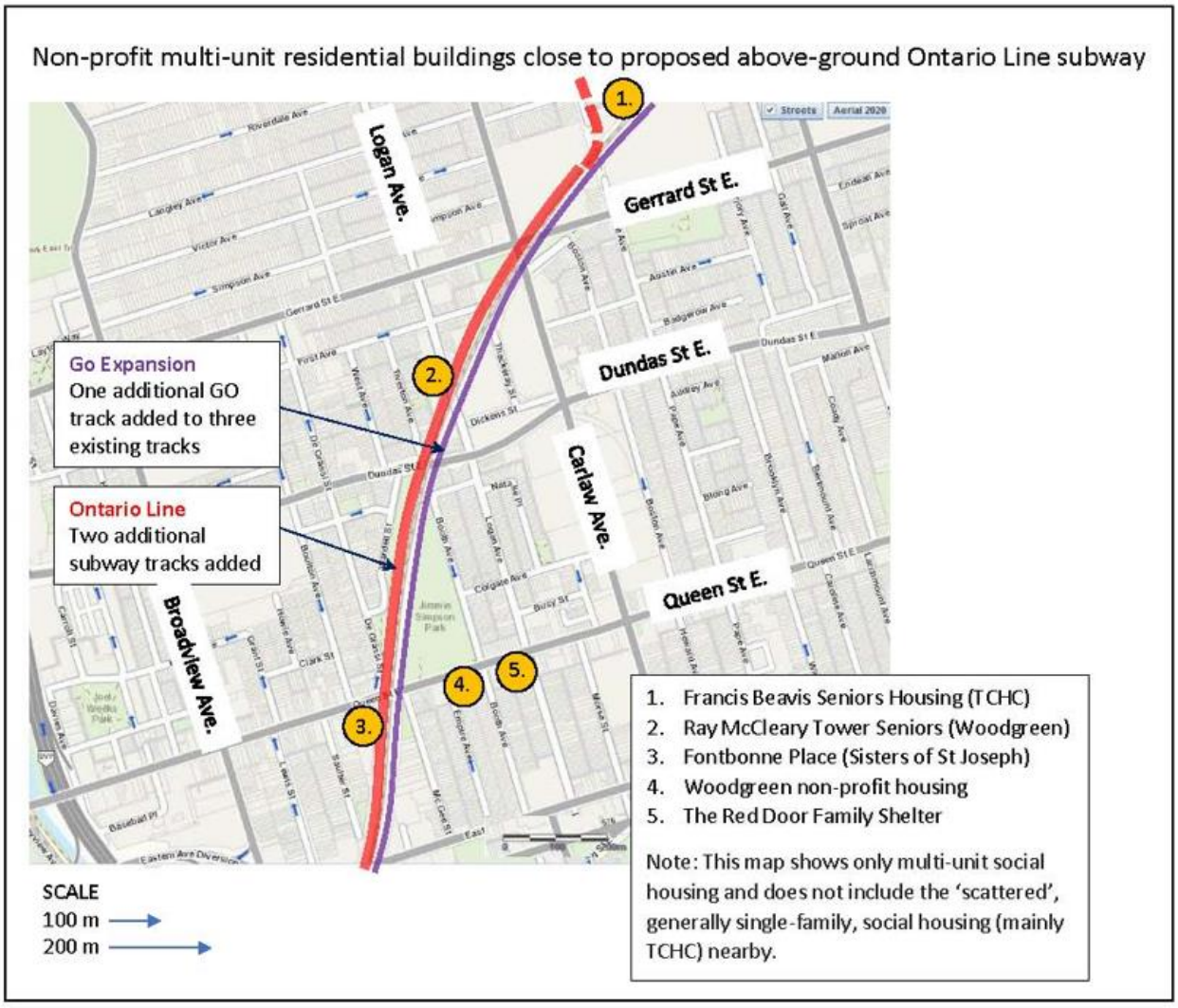
Improved transit has a positive impact on access to employment, education, and other services for people living on low income. Negative impacts are mostly related to gentrification (see section below). There are several buildings housing people with low-income near the proposed overground alignment of the Ontario Line. Three such non-profit residential buildings are immediately adjacent to the corridor (Figure 2-12). People living in these buildings can be expected to experience higher exposure to noise and vibration. It will also reduce the tree canopy near their homes. This will negatively impact the health of people who are already at higher risk of poor health due to their socio-economic status.

Language and cultural diversity

About two thirds of people living in South Riverdale report English as their mother-tongue. Of the 31% who report a non-official mother tongue the top three are Cantonese, Mandarin, and Vietnamese (City of Toronto 2018). While the proportion of people who indicate a non-official language as mother tongue or language spoken at home is lower than Toronto's average, the proportion of people who speak neither official language is higher: 8.1% compared to 4.9% for Toronto as a whole. This increases the risk of social isolation when the community ties are broken as people and businesses that cater to their needs are displaced by gentrification and the transformation of the neighbourhood (Tehrani et al 2019).

Greater disruption to the neighbourhood is expected to occur during the construction of an overground alignment. This is likely to result in larger negative impact on the viability of small businesses that serve the local community. This would compound the risk of social isolation among equity deserving groups living in the neighbourhood.

Figure 2-12: Non-profit multi-unit residential buildings close to the proposed above-ground Ontario Line (Prepared by the South Riverdale Community Health Centre)



Seniors

The number of seniors in Toronto is growing. The 2016 census estimated that 11% of residents of South Riverdale were 65 or over, with nearly 30% of them living alone (City of Toronto 2018). With living alone comes a higher risk of social isolation. Socially isolated seniors are at more likely to be hospitalized. They are also more likely to have poor eating habits, to be less physically active, and more prone to falls and depression. They are at higher risk of death from suicide, heart disease and stroke and may also suffer from elder abuse and neglect (TPH 2017a). Changes in the neighbourhood are more likely to be detrimental to their health and well-being as social ties are affected by outward migration of family, neighbours and local businesses (Tehrani et al 2019).

Greater neighbourhood disruption from the construction of the overground option could result in negative impact on the viability of businesses and contribute to a higher level of displacement. This could affect access to services used by older adults in the neighbourhood and lead to increased social

isolation. An overground option would also have greater negative impact on the quality of public and private green spaces, which are regularly used by older adults. By making these spaces less attractive, this could result in a higher risk of social isolation and decrease in physical activity among this population.

Children

Children are often more vulnerable to environmental stressors. Noise can impact children's ability to learn, contribute to hyperactivity, lead to negative behaviour and affect emotions (TPH 2017; WHO 2018). Children are sensitive to air pollution because: they often spend more time outdoors; their lungs are developing; and they have higher breathing rates (City of Toronto 2017). Having access to green space is also important for children's health. For children, benefits of living near parks and playgrounds includes being more active and having a healthy weight, improved cognitive function, and reduced stress (TPH 2015a). Exposure to noise and air pollution and reduced access to green space during construction is especially of concern.

2.9 Community design

Urban design has been called the art of creating and shaping cities and towns (The Center for Design Excellence, accessed 2021-07-30). It refers to the look and feel – form, shape, and character – of a group of buildings or a neighbourhood which is shaped by the layout of buildings, public spaces, roads, amenities and services.

More compact cities are more sustainable. Higher urban densities are associated with improved health as compared to lower density areas comprised of single-family dwellings on large lots (Connon et al 2018; Kimball et al. 2013; Lehmann 2016; Stevenson et al 2016). Higher densities are associated with more walking, cycling and use of transit. More compact communities reduce the amount of land needed to accommodate the residents living in a city. They also reduce the cost of infrastructure and help preserve natural areas and agricultural lands. In addition, people who live in compact communities tend to emit fewer greenhouse gases, because their homes are more energy efficient and they rely less on the use of private automobiles for transport. South Riverdale is among the most walkable neighbourhoods in Toronto where daily errands can easily be done by bicycle, and easily accessible by transit (Walkscore.com, accessed 2021-07-05).

Complete communities

That said, density by itself is not sufficient to ensure good health (Connon et al 2018; Kent et al. 2011 Lehmann 2016). The urban design elements that, when combined, create a healthy living environment are essential. These elements include: provision of sufficient pedestrian space, safe cycling infrastructure, easy access to transit, landscaping, shade, street trees, green spaces and parks, recreation facilities, open spaces, features that contribute to a sense of place and character or identity for the neighbourhood (Connon et al 2018; Lehmann 2016). Dwellings must be affordable and of sufficient size to prevent overcrowding (Connon et al 2018). They must also minimise exposure to noise that comes from both outside the building and neighbouring apartments (Connon et al 2018; Lehmann 2016).

The City of Toronto has various planning policies in place to promote complete communities and complete streets. Chapter 3 of the Toronto Official Plan (City of Toronto 2021b) outline the elements of a successful city including the public realm, built form, public art, heritage, affordable housing, community services, parks and open spaces, and natural environment. It also recognises the need for a vibrant economy and culture. The City has also various design guidelines to support the creation of healthy neighbourhoods, streets and buildings.[9]

There is no uniform measure of urban density (Towers 2013). A common way to describe it is by the floor area ratio (FAR), calculated by dividing the total area of the built floor space by the area of the land on which it is built. Given the focus on reducing urban sprawl, which is dominated by low-density single-family homes, many studies refer to number of dwellings per hectare or acre.

Various minimum densities which can support transit use and enable access to goods and services within easy walking distance have been suggested. These range from 60 to 120 dwellings per hectare (Connon et al. 2018; Lehmann, 2016). While there are examples of high-density neighbourhoods that have not been successful, no maximum densities have been identified. This is likely because other characteristics of the neighbourhood, including the level of income of the residents, may be more important determinants of health (Connon et al 2018; Haigh et al 2011; Towers 2002).

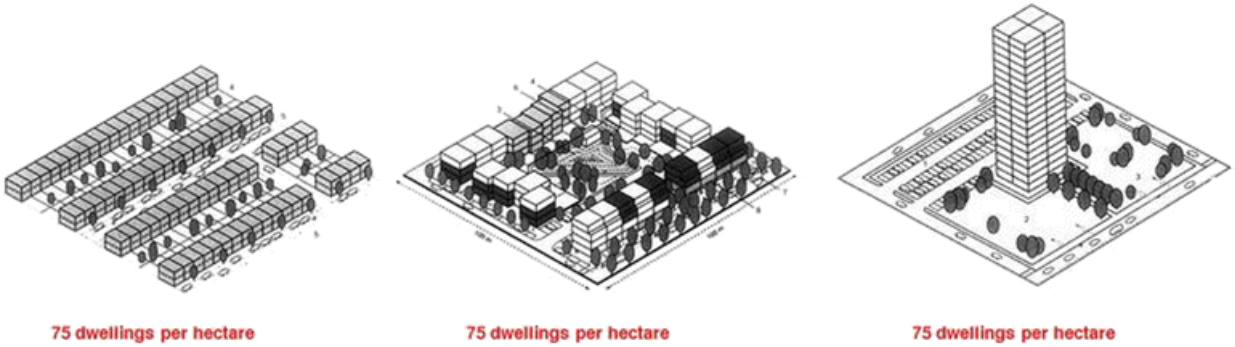
Several authors have suggested that mid-rise perimeter blocks provide an optimal approach to creating healthy density (Lehmann 2016; The Center for Design Excellence, accessed 2021-07-30; Towers, 2002). Such a built form (see the centre illustration in Figure 2-13), which is typical of the older town and city centres in Europe, can achieve densities as high as 6,000 people per square kilometre (Lehmann 2016). The 105 km^2 central core of Paris achieves a density 20,169 people per square kilometre (Lennard, undated). This approach results in a smaller building envelope, which means the building is more energy efficient and due to shared walls, reduces summer heat gain and winter heat loss. This also results in less material being used in the construction, which lowers the amount of embodied energy in the structure (Lehmann 2016). Pomponi and colleagues (2021) looked at the life cycle greenhouse gas emissions of different urban forms and concluded that high-density low-rise development had lowest per-capita energy use compared to high-density high-rise, low-density high-rise and low-density low-rise typologies.

A perimeter block allows for retail at the street level. It is also possible to integrate an office building on one edge of the quadrangle, which could face a main street while having residences facing quieter side streets. Another feature is the inner courtyard, which provides open and green space where residents can socialise and children can play away from traffic.

An example of creating density while still fitting into the surrounding neighbourhood is Canada's first social housing project Riverdale Courts (now Bain Avenue Co-op). Built starting in 1913 and complete in the mid-1920s, it is composed of housing units of 1 to 4 bedrooms around large courtyards. It illustrates how one can increase density and also provide families with an opportunity to live in the city rather than moving to suburbs (Toronto Neighbourhood Walks, 2011).

[9] https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/design-guidelines/

Figure 2-13: Achieving housing density per hectare using low-rise, mid-rise and high-rise building forms (Source: Lehmann 2016)



Transit-oriented communities

Transit-oriented communities (TOCs) or transit-oriented developments (TODs) are specially zoned areas around a major transit node which permit higher building densities than would otherwise be allowed. They are created as a way to increase transit ridership by increasing the number of people living within easy walking distance to a station or transit hub (Noland et al. 2014; Padeiro et al 2019).

Mixed-use developments that are integrated with transit services contribute to a city's "triple bottom line" – providing social, environmental and economic benefits. TODs that create compact and walkable neighbourhoods reduce distances travelled by car, traffic congestion and vehicular emissions. Less car-dependant neighbourhoods also help with climate change mitigation and adaptation (Flannery et al. 2014). However, because station areas attract people, they can also attract cars which then leads to congestion. Reducing the speed of traffic and improving the walking and cycling environment are ways to create a safer environment for pedestrians and cyclists (Noland et al 2014).

Transit-oriented development can reduce the demand for greenfield development that results in sprawl and also helps households minimise their transportation costs. Higher densities and increased land values lead to higher revenues for municipalities and thus offset part of the cost of providing improved transit. The building of transit-oriented communities is an opportunity to create affordable housing and to integrate social services (Flannery et al. 2014). Potential benefits of transit-oriented communities also include:

- Lower dependence on driving
- Allowing residents to live, work, and play in the same area
- Improved access to jobs, services, entertainment and recreational facilities
- Improved local economy, and
- Revitalisation of urban areas (Ali et al. 2021).

Transit-oriented developments aim to attract investment from private developers who will need to recover their costs for the various design elements and amenities required, such as attractive streets and open public spaces. This results in the building of dwellings that will attract higher income groups. In addition, such developments tend to attract one-person households and young professionals because of lifestyle factors, green areas, and attractive public spaces (Padeiro et al. 2019).

A study of eight train stations in New Jersey found that compared to those who lived further away, people who lived closer to the stations were more likely to walk, use transit, and drive less (Noland et al.

2014). The study also found that a denser local street network was associated with greater walking frequency. While population density around the station did not seem to impact the amount of walking, higher employment density was associated with lower frequency of both walking and transit use. People with longer daily commutes were more frequent transit users and also tended to walk more. Vehicle ownership is another factor that influences the degree of walking and transit use, with those who own cars driving more while walking and using transit less frequently than people who do not own a car.

Noland and colleagues (2014) report that residents who live close to a station appreciated the access to transit provided by the TOD, the ability to walk to destinations and the rejuvenation of the neighbourhood. These residents described the area as a good place to live and that their neighbourhood gave them a sense of community. Residents identified a need for more retail stores that would cater to their more day-to-day needs. Pedestrian safety around the stations was also mentioned as a concern.

Overall, Noland and colleagues (2014) concluded that TODs provide many benefits to individuals, municipalities, and transit authorities. TOD increases transit usage and reduces vehicle travel, which means lower commuting costs for new transit users. They also contribute to less congestion, air pollution, accidents, and noise. Living near a station was associated with higher social capital, however, people living in apartments had lower social capital than those living in single-family homes. The actual benefits associated with a TOD depend on their design features (land use, transportation, and walkability) (Vale 2015).

Community design and health

The community you live in influences your health. People who live in neighbourhoods with sustainable transportation options (walking, cycling, transit), affordable housing, fresh foods, good schools, and safe parks report better health and improved quality of life compared to people who lack access to these amenities (Malekafzali and Bergstrom 2011). By creating a community with a larger number of people living close to transit, transit-oriented communities encourage more people to travel by transit. People who take transit tend to walk more. Stations located in highly liveable neighbourhoods are associated with lower rates of obesity, cardiovascular disease, and asthma (Appleyard et al 2019).

When a community is built using Active City principles (including, a mix of land uses, density that supports the provision of local services, retail and transit, short distances to transit, bicycle and pedestrian infrastructure, interesting destinations, attractive streets and public spaces, parks, and recreation facilities), it encourages people to be more physically active by promoting more active travel (walking, cycling) and recreation (sports, running) (Appleyard et al 2019; MAPC 2020; TPH et al. 2014). This contributes to improved mental health, and a decrease in risk of chronic disease.

In their study, Noland and colleagues (2014) were not able determine a relationship between TODs and health. This was due to confounding with age: people who lived in the TODs or near the stations tended to be younger compared to those who lived outside a TOD or further away from a station. They did find areas with higher population densities had a lower incidence of traffic-related injuries and death. The incidence of cycling injuries and deaths were higher near stations, whereas vehicle-related injuries and deaths were higher further from the stations. A higher incidence of pedestrian injuries and deaths near stations was detected, but this association was weak. Several factors are likely at play, including: lower vehicular speeds around stations and in higher density neighbourhoods; and the quality of pedestrian and cycling infrastructure around stations and in the TOD.

In their study of four residential communities in Sydney (Australia), Paine and colleagues (2014) found that positive health outcomes were often related to unplanned co-benefits of other interventions such as green features and other amenities that would attract people to the community. At the same time, when interventions planned to enhance healthy living were poorly implemented, they did not always result in the intended outcomes. The authors indicated a need for ongoing assessment of design, construction and ongoing management of urban areas to evaluate health impacts.

Gentrification and displacement impacts of transit improvements and transit-oriented communities are discussed in section 2.10.

Transit-oriented communities and social capital

While some features of transit-oriented communities promote social capital, the degree to which this happens depends on features of the community. Higher levels of employment in TODs are associated with lower levels of social capital and the perception that the neighbourhood is not the best place to raise children. People living in wealthier areas were more likely to rate their neighbourhood as good place to raise children. While residential densities do not appear to influence the degree of social capital, higher social capital is found in single family housing (Noland et al 2016).

Transit-oriented communities and noise

Noise is often a concern in high density living (Haigh et al. 2011). While there is a mix of evidence, several studies have found TODs to be noisier than single-use residential developments. A study in Dallas-Fort Worth (Texas) found that noise levels in TODs were nearly 9 dB(A) higher compared to non-TOD stations (Yildirim & Arefi 2021). Land uses that are associated with higher noise levels include commercial establishments and nightclubs. Wider streets are also associated with higher noise levels. Human activity in parks, public space and recreational areas can increase exposure to noise. Yet at the same time, trees, landscaping, and water features may attenuate noise; parks and conservation areas can provide respite.

Transit-oriented communities and climate change

Transit oriented communities are promoted as a way to reduce greenhouse gas emissions as they encourage cycling, walking and transit rather than the use of private automobiles for travel (MAPC 2020). Compact communities are generally more energy efficient, which, depending on the energy source, can result in lower climate emissions per person or household (Connon et al 2018; Lehmann 2016).

Temperatures experienced in the dense central core of cities is often hotter than those of greener and less built-up areas (Heaviside et al 2016). There is a danger that the move towards higher housing densities will result in a reduction in the extent of the urban tree canopy, which would lead to a stronger urban heat island (UHI) effect (Brown et al. 2018). A study in Brisbane (Australia) compared heat gain between TOD and non-TOD urban areas and found the UHI effect to be more pronounced in areas classified as TODs (Kamruzzaman et al. 2018). Factors that most influenced heat gain were land use diversity and the proportion of porous land. The authors suggest the use of green roofs and living walls to reduce the UHI in transit-oriented communities.

Extreme weather events can be accompanied by widespread power failures. Without adequate back-up power, heating, air conditioning, and ventilation systems will be affected. This will increase the risk of exposure to excessive heat or cold, as well as food spoilage from lack of refrigeration. This is of particular concern for people who are socially isolated (MAPC 2020).

Building complete communities

Various provincial and municipal policies guide development in Toronto. These include the Provincial Policy Statement (Ontario 2020b) under the Planning Act and A Place to Grow (Ontario 2020a), the growth plan for the Greater Golden Horseshoe. A Place to Grow describes complete communities as "communities that are well designed to meet people's needs for daily living throughout an entire lifetime by providing convenient access to an appropriate mix of jobs, local services, public service facilities, and a full range of housing to accommodate a range of incomes and household sizes."

The Official Plan is the overarching document that guides development in the city. It supports and implements both the provincial policy statement and the growth plan. It guides the creation of an attractive, liveable and safe city and addresses elements such as transportation, land use, housing, employment and the natural environment. It aims to ensure that Toronto grows, improves and realises its full potential (City of Toronto 2021b).

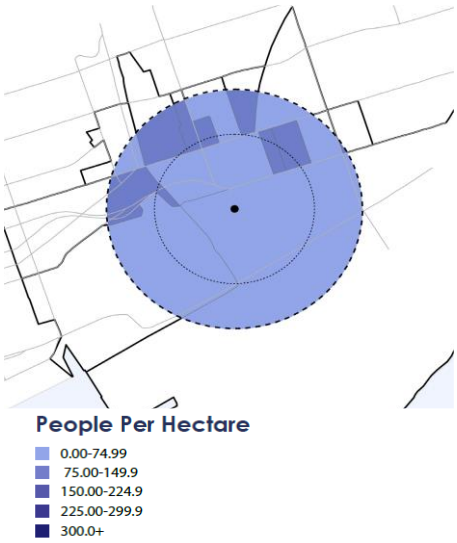
New construction is governed by various tools including Official Plan Amendments, Secondary Plans, Zoning By-laws, urban design guidelines and special area studies such as Avenue Studies. When the portion of an avenue is not subject to another instrument, the Avenues and Mid-Rise Buildings Study stipulates the as-of-right maximum height of a building is the width of the street's right-of way (City of Toronto 2010). Design guidelines have been developed for tall and mid-rise buildings, retail design and complete streets).[10] Adopted in 2020, the Planning for Children in New Vertical Communities Urban Design Guidelines set out objectives for high-rise residential buildings to include a range of unit types and sizes that are suitable for families with children as well as households of different composition and at different life stages. They also provide guidance on ensuring the building itself and the neighbourhood in which it is sited provide a favourable environment.

East Harbour – proposed transit-oriented community

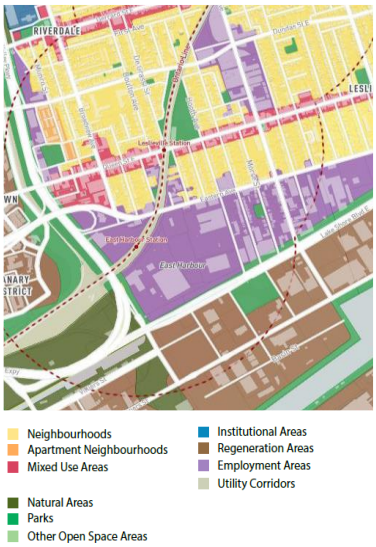
The proposed East Harbour Transit Hub will provide connections between the GO Train service (Lakeshore East and the Markham/Stouffville line), SmartTrack service, future TTC light rail transit (linking the Queens Quay LRT with Broadview Avenue) and the Ontario Line. Figure 2-14 shows the current population density and land-use designations around the new transit station.

[10] https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/design-guidelines/

Figure 2-14: Current density and land use designations around the East Harbour Station



Credit: Smart Density 2021



Credit: Radio City

In 2016, the City of Toronto began a planning study to guide the transformation of the Unilever Precinct. This resulted in the development of the Unilever Precinct Planning Framework, Unilever Precinct Secondary Plan, and the East Harbour Zoning By-laws which were adopted by Toronto City Council in June and July 2018 (City of Toronto, accessed 2021-09-30). These documents set out the parameters for the development of the area, including allowable density, building heights, and types of uses. They also made provisions for parks, public and community spaces and outline community design elements (for example, design of streets and public realm, preservation of cultural heritage, building heights, and transition to lower density neighbours). The study incorporated significant input from members of the community, landowners and stakeholders. Conditions include preservation of listed heritage structures, and cash contribution to be allocated to building affordable rental housing in the immediate area and for the provision of community services and facilities (for example, childcare, multi-purpose community space, and/or improvements to library and recreation facilities) (City of Toronto 2018b).

The majority of land in the Unilever Precinct is currently owned by Cadillac Fairview. Consumers Gas and the City own the remainder (City of Toronto, accessed 2021-09-30). East Harbour is designated as an employment area (City of Toronto 2021a). Cadillac Fairview is now seeking changes in the zoning bylaw to allow for a mix of commercial space, residential space, retail, food, cultural uses and outdoor space. When completely built, this would create employment opportunities for 50,000 people and 4,300 units of housing (Figures 2-15 and 2-16). If approved it will provide about 1.23 million square metres of office, residential and retail space in 18 buildings. Proposed office building heights range from 143 metres (31 storeys) to 214 metres (48 storeys) and residential building heights from 75 metres (23 storeys) to 207 metres (65 storeys). The community is expected to include 15,000 square metres of parks and open spaces. This represents about one third increase in density compared to the approved East Harbour precinct secondary plan and zoning by-law amendment (Urban Strategies 2021).

Figure 2-15: Master Plan of the future East Harbour transit-oriented community (Source: Cadillac Fairview 2021, accessed 2021-07-23)

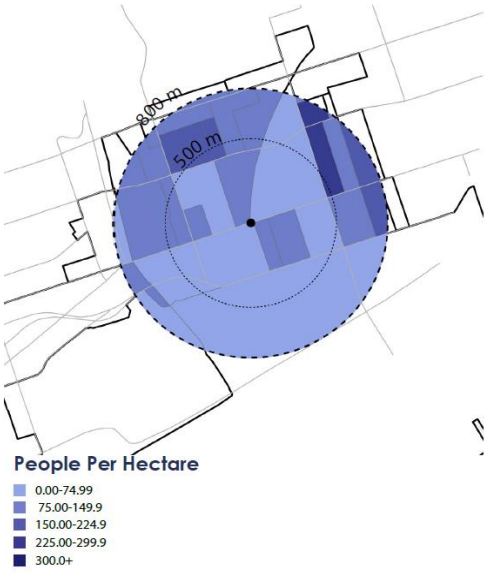
Figure 2-16: Conceptual drawings of the proposed East Harbour transit-oriented community viewed from the west and from the south. Source: Engage East Harbour Virtual Open House #1 (accessed 2021-07-23)

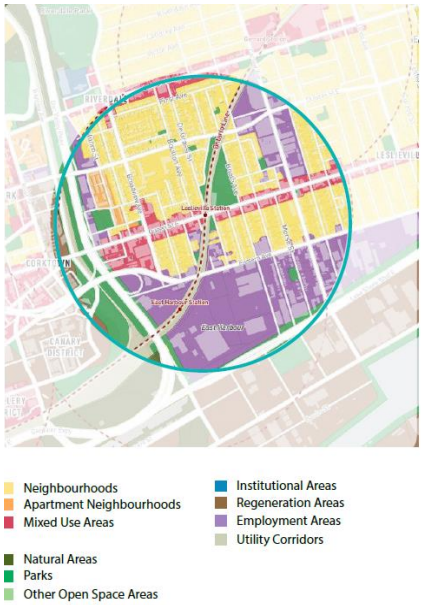
Riverside/Leslieville and Gerrard Stations

The Toronto Official Plan designates Gerrard Street East (from the Don Valley to Jones Avenue) and Queen Street East (from the Don Valley to Neville Park) as Avenues (City of Toronto 2019). The City has developed urban design guidelines for the portion of Queen Street between Jimmie Simpson Park to Leslie Street (City of Toronto 2014a). The Carlaw-Dundas area which roughly bounded by Logan Avenue to the west, the rail line to the north, Boston Avenue to the east, and Queen Street East to the south is designated as an employment area. The character of this area is guided by the Carlaw + Dundas Community Initiative, which updates the 2000 Carlaw/Dundas Neighbourhood Improvement Plan (City of Toronto 2014b). Figures 2-17 and 2-18 show the current population density and land-use mix around

the proposed Riverside/Leslieville and Gerrard stations. How the Ontario Line will affect these two areas is uncertain at this time.

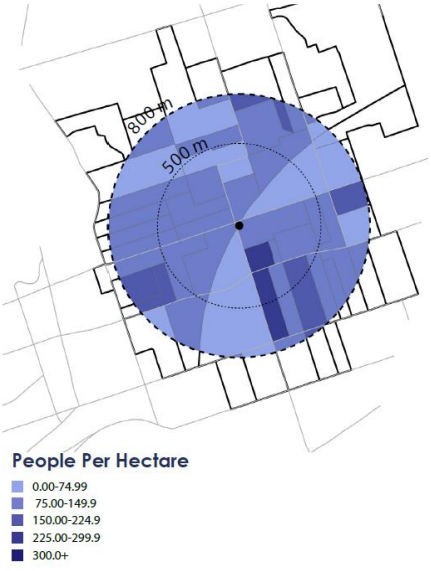
Figure 2-17: Current density and land use designations around the Riverside/Leslieville station

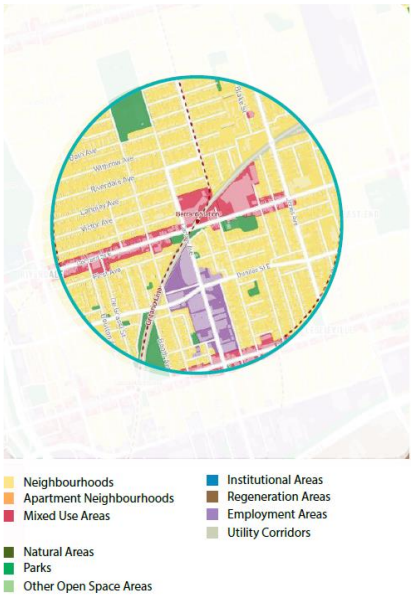




Credit: Smart Density 2021 Credit: Radio City

Figure 2-18: Current density and land use designations around the Gerrard station





Credit: Smart Density 2021 Credit: Radio City

Community design – underground compared to overground rail

The most important difference between the underground and overground options on community design is the impact on land-use adjacent to the line. The underground option, as proposed by the community,

is less disruptive to the community. In this option, the Ontario Line would enter/exit the tunnel at a portal south of Eastern Avenue, which is currently employment land awaiting redevelopment. The line would be on the south side of the current railway tracks. While this could impinge on the development proposal for East Harbour, given that its design is yet to be finalised and construction has not begun, this could be accommodated with less interference to the existing community.

In comparison, under the overland alignment, the portal would occur on the northeast side of the vicinity of Riverdale and Pape Avenues and bring the rails to the north side of the current railway tracks. This would locate the portal near an elementary school and also result in more disturbance to the community as it impacts an existing neighbourhood, including its green space.

Transport-oriented development – underground compared to overground rail

The community has raised concerns around the pressures the Ontario Line would have on the character of the neighbourhood, including gentrification. The new transit service, whether underground or overground, will likely add to the existing forces that are leading to gentrification in Riverside and Leslieville.

Experience shows that improvements in transit infrastructure makes a neighbourhood more attractive and results in an increase in land and property values (Connon et al 2018; Tehrani et al 2019). New residential and commercial space that is built is usually more expensive. As property taxes and rents increase, this makes living less affordable and running a business less viable. This causes the current residents and businesses to move out of the area, weakening their social ties as they disperse to different areas of the city or further away. At the same time, as new businesses that cater to the new residents establish themselves, the character of the neighbourhood can change, and make the existing residents feel out of place (Tehrani et al 2019). Higher land values put pressure on exiting uses and encourages change in land tenure and higher density development. This could particularly impact the areas surrounding the East Harbour development.

The introduction of residential uses in East Harbour could have implications for Toronto as a whole (Engage East Harbour 2021). As part of the downtown planning study (TOCore), the area south of Eastern, which includes East Harbour, is identified as a location that could accommodate projected demand for office and institutional space that would otherwise not find space within the core (Mathew et al 2018). The request to include residential units in East Harbour constitutes a request to convert a designated employment land to residential use. Permitting residential buildings would likely result in increased demand for employment to residential conversions in other parts of the city, which could be detrimental to retaining quality employment in Toronto and ensuring that employment grows along with its population. The Growth Plan and the City's Official Plan contain policies on how to address these requests. The City is also in the midst of a Municipal Comprehensive Review of the Official Plan. A decision on allowing residential uses in East Harbour needs to be done with consideration of city-wide implications (City of Toronto 2021a).

Inclusion of residential areas in East Harbour may have a positive impact on the degree of physical activity and social capital associated with the development, but this will depend on various design factors. These factors include: 1) building layout and design as well as materials that attenuate noise; 2) areas to socialise and encourage social interaction; 3) services such as libraries and health care providers in close proximity; and 4) for families, larger unit sizes, playgrounds close to their home and schools

within walking distance. In addition, East Harbour needs to be evaluated in the context of Toronto as whole.

Not only is the relationship between space and health complex, it is only one of the social and environmental determinants of health (Connon et al 2018). There are many lessons to be learnt from the past (see for example Easthope et al. 2017; Graham 2013; Randolph 2017; Troy et al. 2017). City planning involves taking into account various objectives with the aim of finding an optimal approach. The regular monitoring of quality of life and health of people living and working in the community would help evaluate its functioning as designed and identify any changes needed to achieve the goal of a healthy city for all (Paine et al 2016).

2.10 Gentrification

A thriving neighbourhood needs reinvestment and revitalization. However, this may lead to gentrification where those who live in the community benefit unequally (Qiang et al. 2020). There is ongoing debate about the distributive consequences of this gentrification (Lester & Hartley 2013). On one hand, supporters of gentrification focus on aggregate impact, which appears positive on balance. On the other, people who are concerned focus on the distribution of the negative impacts which fall disproportionately on the poor. Gentrification involves the balancing of modest benefits to many with the significant burden imposed on a smaller number but more vulnerable people (Holland 2016).

Gentrification is a process where investments in a community result in increasing property values and in-migration of people with higher income and education than the residents living in the neighbourhood (Tehrani et al. 2014; Zuk et al. 2017). The renovation and demolition of existing buildings that occurs in this process, and the increase in property values, which often leads to higher rents and taxes, make the area less affordable for people on lower incomes and small independent and family run businesses, who then move out of the neighbourhood.

The economic development impact, increases in property values, and enhanced liveability are considered benefits of transit-oriented development (TOD). As benefits and negative impacts of TODs are not evenly distributed, not all individuals and communities experience gentrification the same way (Tehrani et al. 2019). Gentrification may result in residential displacement, cultural displacement and/or disruption of local community ties.

Teasing out the contribution of gentrification to displacement is made more difficult given the natural rate of moving to a different home (Brummet & Reed 2019). Data from 2018 showed that 34% of Ontario residents moved in the previous 5 years (Statistics Canada 2019). Of these 20% moved within the same municipality, and 12.4% from a different place in Ontario or Canada. There are many reasons people choose to move. Over a 5-year period for example: 9.1% of households move to upgrade to a larger or better-quality dwelling; 4.9% to reduce housing costs; 6.6% to be in a more desirable neighbourhood; and 2.3% because they were forced to move by the landlord, government or financial institution.

Creating a more compact city and investing in transit are important investments in health and can promote equity when it improves access to employment, education, recreation, and services for people living on low-income (Mowatt et al. 2014). However, the benefits of transit improvements are often not equally distributed (Tehrani et al. 2019). These investments can reinforce processes of gentrification and

displacement. The higher land-use intensity and transit accessibility that result from transit investments often encourage people with higher income to move into these areas. This changes the demographic characteristic of the neighbourhood with a change in racial mix and a disproportionate increase of young, well-educated, middle- or high-income professionals and small families (Tehrani et al. 2019). Some authors have concluded that the changes associated with gentrification are mostly due to the change of population mix from in-migration to the area, rather than the result of displacement (Brummet & Reed 2019).

Looking at the period from 2000 until 2013, Richardson and colleagues (2019) found that gentrification and displacement in the US occurred mostly in the largest cities, especially those with vibrant economies. They also found that most low- to moderate-income neighbourhoods did not gentrify or revitalize rather they remained impoverished, untouched by the building booms elsewhere. This supports the hypothesis that a concentration of wealth and wealth-building investment is occurring in only a few areas of the US, while the rest of the country languishes behind.

A study of 100 US metropolitan areas prepared for Federal Reserve Bank of Philadelphia concluded that, overall, gentrification benefits residents (Brummet & Reed 2019). However, renters with lower educational attainment were likely to experience more adverse impacts. No impact was observed on employment, income, and commuting distance. Less-educated residents made up about 25% of the population in neighbourhoods that are at risk of gentrification. Of these 30% of renters and 60% of homeowners chose to remain in the neighbourhood as it gentrified. There was an increase of 4-6% in the numbers of renters with lower educational attainment who moved. This is a small increase over the background moving rates of 70-80% among renters and 40% among homeowners (Brummet and Reed 2019).

Among those people who stayed, exposure to neighbourhood poverty was reduced by 7%. No change was observed among those who moved, suggesting that the move was to a community with similar socioeconomic status. Compared to homeowners who moved away, those who remained experienced a greater increase in the value of their home, an important contributor of their overall wealth. Renters with more education did pay higher rent, but no change was observed among renters with less education (Brummet & Reed 2019). Unlike owners, not only are renters more likely to be displaced, they do not reap the rewards of rising home prices or higher rents (Brummet & Reed 2019; Richardson et al. 2020).

A study in New York City found that residents who lived in public housing next to neighbourhoods with increasing or high incomes also had higher household income (USD 3,000-4,500) compared to people living next to a lower-income neighbourhood. Similarly, children in these housing complexes performed better in school with higher math and reading test scores. At the same time, public housing residents living next to a neighbourhood with increasing income expressed concern that the improvements in the neighbourhood were for the “condo residents” and not for them. Residents that lived next to a high-income area appreciated the amenities that became available, but were concerned about being forced out. While their rents remained affordable, the higher costs of goods and services around them created pressure to move out (Dastrup et al 2015).

A study in Montreal found that over the 10-year period between 1996 and 2006, gentrification was associated with increased collective efficacy – the capacity of community members to coordinate their members to achieve collective goals (Steinmetz-Wood et al. 2017). Neighbourhoods with high levels of

collective efficacy are more likely to work together and mobilise the resources to address community concerns. High collective efficacy is associated with many health benefits including better self-rated health, lower all-cause mortality, as well as lower rates of cardiovascular disease, obesity, sexually transmitted diseases and improved mental health. However, this study does not look at the impact on people who were displaced.

Little Portugal – a case study of gentrification

The experience of the people living in Little Portugal in Toronto highlights how gentrification benefits some, but tends to affect people living on low-income more negatively (Murdie & Teixeira 2011). Portuguese immigration to Toronto began in the early 1950s and peaked in the 1970s. Many made their home in an area that be came known as Little Portugal neighbourhood. By 1981 more than half of residents in the neighbourhood reported Portuguese as their mother tongue. After this, the proportion of Portuguese speaking people started to decline as families moved to other areas of Toronto and beyond, immigrants from other nationalities settled in, and the arrival of middle-class professionals.

Little Portugal became a complete community with the local Catholic Church as focal point. A whole range of Portuguese language retail and services were available: grocery stores, bakeries, restaurants, furniture stores, travel agencies and real estate agencies as examples (Walks & August, 2008). This meant people who had no or limited English could easily meet their day-to-day needs within their neighbourhood. The Portuguese community had low rates of higher education and were predominantly employed in blue-collar occupations. Many would supplement their income through renting out part of their homes – many of which were converted into apartments.

A study carried out in 2006 documented the experience of people of Portuguese descent, British descent and newcomers in and around Little Portugal (Murdie & Teixeira 2011). There was a mix of reaction to the changes happening around them among the Portuguese speaking residents. The rising property values were seen as a benefit to home or business owners who sold, but low-income residents feared they would at some point have no option but to move out as rents or taxes continued to rise. They also noted the diminishing job opportunities for people like them as industrial activity declined in the area. Some appreciated the presence of the professionals who were moving into the neighbourhood as a contribution to the future of the area. Others noted the disappearance of the shops that catered to their needs, as more up-market retailers they could not afford moved in. Some residents described the gentrifiers as an elitist group who formed their own “white-collar world” outside of their Portuguese world, which was a working-class or blue-collar one. Others saw things differently. “It’s positive the arrival of gentrifiers into Little Portugal ... it destroys the ‘ghetto’ that we had for decades.”

Gentrification and employment

Gentrification brings investments to an area, stimulates the local economy and creates new employment opportunities. It is also often accompanied by an influx of highly educated workers. Studies have found that while gentrification increases the number of high-paying jobs in the neighbourhood, it tends to result in a reduction in low and moderate wage employment opportunities, especially jobs in local services and good-producing sectors (Meltzer & Ghorbani 2015; Qiang et al. 2020).

The findings of a Working Paper from the Federal Reserve Bank of Cleveland (Lester & Hartley 2013) point to higher employment growth in gentrifying neighbourhoods compared to non-gentrifying ones.

However, there is a shift in the type of employment with lower-paying jobs in restaurants and retail replacing those in manufacturing. The authors found that, while there was little displacement overall, people with the greatest socio-economic disadvantage were most likely to move. While this move did not seem to make them economically worse off, it did incur moving costs which could be substantial for a low-income household. It also reduced social capital from the loss of proximity to friends, family, and networks.

In contrast, a study of New York City found that while there was an overall increase in jobs, local job loss could be as much as 63% (Meltzer & Ghorbani 2017). Tenants of three New York City Housing Authority developments indicated that they did not get the jobs at the new stores that established themselves in the higher income areas near them. They also said that the former local retail and services were replaced by upscale establishments that they could not afford (Dastrup et al. 2015).

A study of 100 metropolitan areas in the US found that, overall, the original residents of the affected neighbourhoods benefited from gentrification (Brummet & Reed 2019). Many of these residents were able to remain in the neighbourhood and gain from the improvements that occurred. This allowed existing residents to experience decreased neighbourhood poverty and increased education and employment opportunities, factors known to be beneficial to health and to lead to better employment prospects among people living on low income.

A study of the impacts of gentrification in Los Angeles, California (Qiang et al. 2020) found that the negative impacts of gentrification were concentrated among lower-income renters and people of colour. Low-income renters living in the gentrifying neighbourhood were more likely to change jobs, and more likely to earn less when they did. Low-income renters were also more likely to be displaced and tended to move to lower quality neighbourhoods. This move can affect their income due to changes in employment opportunities in the new locality and can also result in longer commutes.

Gentrification and health

Gentrification in urban centres can perpetuate existing health inequalities when the new development caters to single people and those with higher income (Thompson & Paine 2017). While studies have shown an improvement in health in gentrified neighbours, these studies do not necessarily look at the impact on those who were displaced (Tehrani et al. 2019). In contrast to those who have remained in a gentrified neighbourhood, people who have been displaced experience poorer health: lower life expectancy; poorer mental health; and increased rates of cancer, birth defects, infant mortality, asthma, diabetes, and cardiovascular disease (Tehrani et al. 2019).

As the neighbourhood changes and people leave, social ties with neighbours and shop keepers are weakened. This weakens social networks and sense of community, which in turn reduces resilience. As new businesses replace “mom and pop” or small family-owned stores and restaurants that were there previously, long-time residents may feel a diminished sense of place and community, and start feeling unwelcome (Tehrani et al. 2019).

When the change is perceived as negative, it increases stress, leads to unhealthy behaviours, and can impact a person’s mental health (Tehrani et al. 2019). A study in New York City, NY found that loss of cultural and historical asset, racial biases of incoming residents, and police behaviour was associated with higher stress levels among long-time residents who remained in the neighbourhood (Shmool et al.

2015 as cited in Tehrani et al. 2019). Financial and social pressures related to concern about being able to remain in their homes or potential to become homeless, lower access to affordable food and reduced access to medical care can also result in stress and feelings of disenfranchisement (Tehrani et al. 2019).

In children, gentrification has been linked to negative impacts on performance in school children, emotional difficulties; and increased rates of adolescent pregnancy (Tehrani et al 2019). When comparing children who lived in gentrified neighbourhoods, to those in ungentrified neighbourhoods of New York City, Dragan and colleagues (2019) did not find any difference in children's use of the health services, asthma or obesity among those assessed at ages 9–11. They did find an increase in anxiety or depression, particularly among children living in market-rate housing in gentrified neighbourhoods.

Older adults prefer to age in place. As the neighbourhood changes and people move away, this can reduce the sense of belonging, weaken social ties and decrease availability of social supports that are important to healthy ageing. As well, with the change in socioeconomic status of the neighbourhood, long-standing residents can face social or financial barriers to access recreational amenities and other services (Tehrani et al 2019).

Gentrification – underground compared to overground rail

As a large city with a vibrant economy, Toronto is at greater risk of gentrification and associated displacement. Increased access to transit is considered a benefit to people on a low income as it provides better access to employment, goods and services that are too far to reach by walking or cycling. It also alleviates the need for travel by motor vehicle, resulting in lower transportation costs. However, many people living on low-income, equity deserving groups, and seniors will not necessarily benefit and in some cases may be worse off due to the changes in the neighbourhood.

The gentrification pressures of the underground or overground alignments are likely to be similar given that both will improve transit access and make South Riverdale a more attractive place to live and run a business. This will likely result in increasing property prices, higher taxes, pressures for higher densities, and redeveloping the area.

Gentrification is the result of economic and social forces. Socio-economic factors such as income, immigration status, belonging to a racialized group and ability to speak English are important determinants of health. As described in the section on community design, it is possible to create a community that fosters equity, but many other boarder policies and programs are needed to ensure that new transit lines and associated transit-oriented communities do not result in inequitable impacts.

Minimising adverse health equity impacts

There is an opportunity to address equity concerns when careful consideration is given to them at the planning stage of either a new transit line or transit-oriented community. The *Community Health Impact Assessment of Transit-Oriented Development Policy in St Paul MN* (Malekafzali & Bergstrom 2011) identifies factors to consider in order to foster a healthy economy, healthy affordable housing, and safe and sustainable transportation (Appendix, Table A-5).

The Metropolitan Area Planning Council of Massachusetts performed a health impact assessment of TODs and made recommendations to minimise negative health and equity impacts (Appendix, Table A-

6). Some of the policies suggested are already in place in Toronto, which, if adhered to, should contribute to reducing adverse health impacts and enhance positive ones.

3. Impacts of construction

Constructing a new transit line will cause disruption. Long-term disruptions can affect the viability of local businesses and result in either displacement or closure, with detrimental impact on the community and the health of people most affected. It is therefore important to minimise any such disruption.

Experience elsewhere indicates that an underground alignment, which makes use of tunnelling equipment for the tunnel and mining techniques for the stations, is likely to cause the least disruption to a community (ITA 2004). In part, this is because the areas of construction impacts are more localised around specific points such as stations. While in its blog of February 21, 2021 (accessed 2021-09-13), Metrolinx counters the claim that building the Ontario Line underground would be less disruptive. The blog refers to an underground alignment along the current rail corridor, and not the community's proposal that would see the line continue south along Carlaw to Queen Street (as the previously approved design for the Relief Line). Since then, Metrolinx has indicated that in order to accommodate the above ground Ontario Line, it needs to reconfigure the rail corridor. It plans to move an in-use GO track and replace or widen the 5 existing rail bridges along this segment of the line (Metrolinx 2021d). And it will install retaining walls to raise the existing track bed by approximately 1.5 metres. These activities will also cause disruption, and need to be taken into account before making a final decision on the optimal option.

Early works

Assessing the impacts of the construction of the Ontario Line on the neighbourhood is made more difficult due to the lack of a comprehensive overview that considers the three undertakings affecting the corridor (GO expansion, GO electrification and the Ontario Line). For example, for the GO electrification project, Metrolinx is assessing the noise and vibration impacts of the construction phase of infrastructure components at a given location independently of each other (Metrolinx 2021b). The Early Works report (AECOM 2021) outlines the anticipated impacts of the initial phase of construction along the Lakeshore East Joint Corridor between approximately Eastern Avenue and Pape Avenue which does not include the impacts related to the construction of the stations or the portal near Pape Avenue. The stages of the Early Works are outlined as follows:

- reconfiguration of existing GO tracks
- replacement of the existing bridges at Queen Street East, Dundas Street East and Logan Avenue
- construction of two new bridges at Dundas Street East and Logan Avenue
- construction of the foundations for GO Overhead Catenary System poles and supporting infrastructure for the fourth GO track
- construction of retaining walls, and
- construction of noise barriers, including part of the corridor east of Pape Avenue.

Figure 3-1. **Lakeshore East joint corridor early works components** (Source: Metrolinx accessed 2021-10-10)

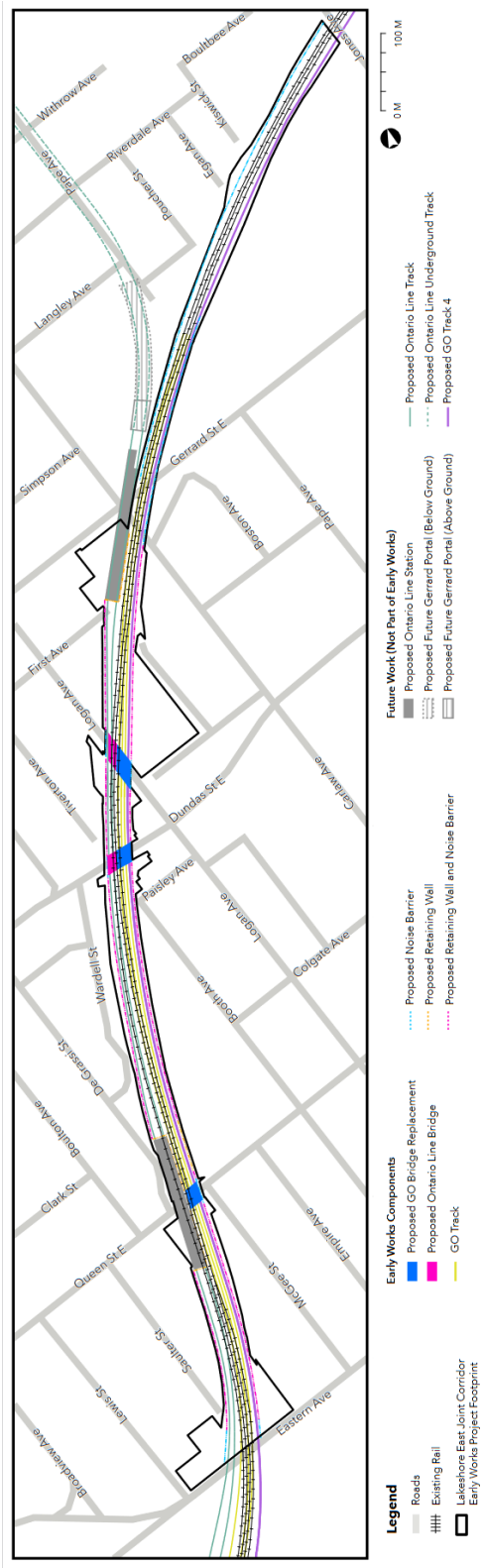


Figure 3-1 shows the footprint of the early works and identifies the location of the retaining walls, noise barrier, stations, portal as well as the project footprint. A timeline for construction of the Early Works in the joint corridor is set out in Table 3-1.

Table 3-1. Proposed timetable for the early works along the Lakeshore East joint corridor (https://hdr.wistia.com/medias/czrk84lfbg accessed 2021-10-09)

Approximate timing	Activity
1. 2022	Existing conditions
2. Mid 2022	Begin Phase 1 track work and grading Begin traffic management at Queen St and Dundas Street bridges
3. Summer 2022	Construct eastern retaining wall from Eastern Avenue to Queen St; Reinforce existing Queen St bridge
4. Fall 2022	Construct eastern retaining wall from Jimmie Simpson Rec Centre to Dundas St
5. Fall 2022	Shift local Go Service lines west
6. December 2022	Begin Phase 2 track work and grading Demolish the eastern portion of existing Dundas St bridge Construct eastern retaining wall Queen St to Jimmie Simpson RC
7. 1st quarter 2023	Demolish eastern portion of existing Queen St Bridge
8. 1st quarter 2023	construct eastern portion of new Queen Street and Dundas St GO bridges
9. 1st quarter 2023	construct easter noise barrier wall (Eastern Avenue to Dundas)
10. Late 2023	Shift local GO service lines east Construct western retaining wall from Eastern Avenue to future Leslieville Station
11. December 2023	Begin Phase 3 track work and grading; demolish western section of Dundas Street Bridge
12. Early 2024	demolish western portion of existing Queen Street bridge
13. Early 2024	Construct western retaining wall from future Leslieville Station to Dundas Street; Construct western portion of new Dundas St GO bridge
14. 1st quarter 2024	Construct western portion of new Queen St bridge
15. 1st quarter 2024	Construct retaining wall at future Leslieville Station; construct new Dundas street Ontaril Line bridge
16. 2nd quarter 2024	Construct western noise barrier wall
17. 3rd quarter 2024	Restart service on GO express line
18. 4th quarter 2024	begin to construct Leslieville Station
19. 2028	Substantial complete Leslieville station
20. Mid 2029	Complete construction on Ontario Line tracks (final conditions)

Noise and vibration impacts

The Early Works assessment found that noise limits could be exceed at some sensitive receptors within the project screening area, particularly at night. Noise mitigation measures have been identified and could be refined. These could include restricted hours of operation, improved hoarding, moveable noise barriers, use of enclosures and/or silencers. AECOM (2021) notes that noise monitoring may be required at some locations.

Vibrations are likely to be felt in a large area around the project footprint (AECOM 2021). There are 29 properties identified where vibration levels could exceed permitted levels and will require mitigation measures. These could include monitoring and pre-construction inspections, using equipment at lower vibration settings and/or the use of alternative construction methods.

The Early Works report does not go into detail of the construction phasing or schedule (AECOM 2021). The report notes that construction work will be done during day-time hours where feasible, but does not describe which work will need to be done outside of those hours. So that existing train service is not disrupted during the construction of the overground Ontario Line, it can be expected that a major portion of the construction work will need to take place at night. Noise from such activities, including movement of machinery and vehicles, will impair people's ability to sleep.

Health Canada's guidance indicates that impacts on sleep should be considered when determining the impact of short-term construction noise (Health Canada 2017). Based on the above schedule, it is possible that some locations could be affected for more than a year. Health Canada's guidance recommends that "construction noise lasting longer than 1 year be assessed as operational noise." While there would be some local impacts, in the case of an underground alignment, most construction could take place during the day or early evening, greatly minimising disturbance, especially at night when a majority of people, including children and seniors, sleep.

Air quality impacts

Current air quality data for Toronto show that the polyaromatic hydrocarbon (PAH) benzo (a) pyrene and benzene are found at levels above Ontario's ambient air quality criteria. Both of these compounds are components of vehicle diesel and gasoline exhaust (AECOM 2021). The draft Early Works report notes that construction activity will result in emissions of dust including silica, fine particles and exhaust from diesel and gasoline equipment and vehicles. The report outlines mitigation measures which reflect current good practice.

However, there are numerous references to study limitations. Due to the lack of precision, the community continues to express concerns about exposure to pollution from construction activities related to an overground alignment which is very close to existing homes. Diesel exhaust is a carcinogen and also contributes to local air pollution. Short-term exposure to air pollution can result in people experiencing breathing difficulties, asthma exacerbation, pneumonia, bronchitis and other effects on the lung as well as contribute to heart disease (Manisalidis et al 2020). People who are more susceptible to air pollution include older adults, children, people with diabetes and others with existing heart or lung disease, especially asthma. The duration of construction is outlined as 8 years assuming no delays (Table 3-1).

Given that South Riverdale was home to a number of heavy industries in the past, the potential for contamination remains a question for residents (TPH, 2005). For example, International Varnish Company, which was located north east of the intersection of Gerrard and Carlaw, sold varnishes and insecticides such as DDT and 2,4-D (Georgiou, undated; MyCo, undated). The possibility of releases of contaminated soil during construction of the proposed portal at this location has not yet been assessed.

Impacts on green space

The project footprint includes the Gerrard-Carlaw Parkette. It is still unclear what impact construction will have on other parks along the corridor. Metrolinx states: "Streamlining Ontario Line construction work with planned GO Expansion work within the existing Metrolinx-owned rail corridor means we can keep mostly within our existing property boundaries and significantly reduce impacts to surrounding neighbourhoods, including park spaces." Without clear demonstration of how this will be achieved, and a comparison to the impacts during construction of the community's preferred underground alignment, there will continue to be concern about what will actually happen to green space.

Community disruption

The potential impact of construction on businesses in the area is of concern. Disruption during construction can have long-term impacts on the community. Many establishments are already struggling from the impact of COVID, and further disruption would make it that much more difficult for them. Potential impacts on programs such as CaféTO (roadside dining), which have been popular and have assisted businesses to remain viable, and on sidewalk circulation need to be taken into account in order to support small businesses.

The Early Works report indicates that temporary lane restrictions/closures, travel time delays, realignment of sidewalks and bike lanes, and rail closures can be expected. A traffic impact assessment will be completed at a later date once detailed construction staging schemes become available to determine the specific mitigation measures that will reduce impacts on vehicle, bicycle and pedestrian travel. However, a thorough analysis that compares the various negative impacts – also referred to as dis-benefits or transitional effects – would help identify the optimal approach to construction (Transportation Economics Committee, undated). If such an analysis were done for both the underground and overground options, this would help in selecting a preferred option.

Principles of engagement

A good community engagement process is essential to effectively address community concerns (Health Impact Project 2019; Health Canada 2017; US FTA 2018; WHO 2005). Involving the community in the identification and selection of options makes residents and business proprietors appreciate the necessary trade-offs as well as increasing community acceptance of the project and the measures taken to minimise adverse impacts during both construction and the operation phase.

While an aboveground alignment is often chosen because of its lower construction cost, to ensure the right decision is made, it is important to accurately include the long-term social and environmental benefits that accrue from an underground option (ITA 2004) as these benefits are also important contributors to good health.

Construction – underground compared to overground rail

Long-term disruptions can affect the viability of local businesses and result in either displacement or closure, with detrimental impact on the community and the health of those most affected. Evidence available suggests that the underground alignment (as proposed by the community) is likely to have the least disruption during construction. While Metrolinx has countered this assertion, it has not presented a comparative analysis to support their view. In addition, the underground option is expected have less impact on health due to reduced exposure to noise and air pollution, traffic disruption, and less disturbance of green space during construction. It is important to accurately include the long-term social and environmental benefits in the assessment of impacts before deciding on the preferred option.

4. References

AECOM (2020) Final Ontario line environmental conditions report. Prepared for Metrolinx, November 2020. https://www.metrolinxengage.com/en/content/ontario-line-final-environmental-conditions-report

AECOM (2020) Final Ontario Line environmental conditions report: Appendix B3. Noise and Vibration Report. Prepared for Metrolinx, November 2020. https://www.metrolinxengage.com/en/content/ontario-line-final-environmental-conditions-report

AECOM (2021) Draft early works report – Ontario Line Lakeshore East Joint Corridor Early Works. Prepared for Metrolinx. https://www.metrolinxengage.com/en/content/ontario-line-early-works-lakeshore-east-joint-corridor

AECOM (2021) Draft early works report – Ontario Line Lakeshore East Joint Corridor Early Works: Appendix C Draft Noise and Vibration Operations Report - Lakeshore East Joint Corridor. Prepared for Metrolinx. https://www.metrolinxengage.com/sites/default/files/rpt_2021-09-22_ol-oncorr_lse_nv_60611173_draft_optimized_locked_0.pdf

Aleknaite M, Grubliauskas R (2018) Assessment and evaluation of railway noise spread dependence on different types of sleepers. Energy Procedia (147): 249-257. https://doi.org/10.1016/j.egypro.2018.07.089

Ali L, Nawaz A, Iqbal S, Basheer MA, Hameed J, Albasher G, Shah SAR, and Bai Y (2021) Dynamics of transit oriented development, role of greenhouse gases and urban environment: a study for management and policy. Sustainability (13): 2536. https://doi.org/10.3390/su13052536

Appleyard BS, Frost AR, Allen C (2019) Are all transit stations equal and equitable? Calculating sustainability, livability, health, & equity performance of smart growth & transit-oriented-development (TOD) Journal of Transport & Health Volume (14): 100584 (Abstract). https://doi.org/10.1016/j.jth.2019.100584

Basner M, McGuire S (2018) WHO environmental noise guidelines for the European region: a systematic review on environmental noise and effects on sleep. International Journal of Environmental Research and Public Health 2018, 15, 519. https://www.mdpi.com/1660-4601/15/3/519

Bhatia R, Wernham A (2008) Integrating Human Health into Environmental Impact Assessment: An Unrealized Opportunity for Environmental Health and Justice. Environmental Health Perspectives (116/8): 991–1000. https://doi.org/10.1289/ehp.11132

Billings ME, Hale L, Johnson DA (2020) Physical and social environment relationship with sleep health and disorders. CHEST (157/5): 1304-1312. https://doi.org/10.1016/j.chest.2019.12.002

Braveman P, Gottlieb L (2014) The social determinants of health: it's time to consider the causes of the causes. Public Health Reports (129/Supplement 2): 19–31. https://doi.org/10.1177/00333549141291s206

Brown H, Proust K, Newell B, Spickett J, Capon T, Bartholomew L (2018) Cool communities—urban density, trees, and health. International Journal of Environmental Research and Public Health (15): 1547 https://doi.org/10.3390/ijerph15071547

Brummet Q, Reed D (2019) The Effects of Gentrification on the Well-Being and Opportunity of Original Resident Adults and Children. The Federal Reserve Bank of Philadelphia Working Paper No. 19-30. http://dx.doi.org/10.21799/frbp.wp.2019.30

Cadillac Fairview (2021) East Harbour mixed use master plan. https://res.cloudinary.com/courbanize-production/image/upload/v1/information_plans/v4cm8citxcioqehzsy7c (Accessed 2021-07-23)

California State Parks (2005). The Health and Social Benefits of Recreation. https://www.parks.ca.gov/pages/795/files/benefits final online v6-1-05.pdf

Cartenì A, Cascetta F (2018). Particulate matter concentrations in a high-quality rubber-tyred metro system: the case study of Turin in Italy. International Journal of Environmental Science and Technology (15): 1921–1930. https://doi.org/10.1007/s13762-017-1566-x

Cerletti P, Eze IC, Schaffner E, Foraster M, Viennau D, Cajochen C, Wunderli J-M, Röösli M. Stolz D, Pons M, Imboden M, Probst-Hensch N (2020) The independent association of source-specific transportation noise exposure, noise annoyance and noise sensitivity with health-related quality of life Environment International (143): 105960. https://doi.org/10.1016/j.envint.2020.105960

City of Toronto (2010) Avenues & mid-rise buildings study. Prepared for the City of Toronto by Brook McIlroy Planning + Urban Design/Pace Architects with E.R.A. Architects, Quadrangle Architects Limited, and Urban Marketing Collaborative. https://www.toronto.ca/wp-content/uploads/2017/09/9039-Avenues-Mid-Rise-Buildings-Study-Part-1.pdf

City of Toronto (2014a) Leslieville urban design guidelines. https://www.toronto.ca/legdocs/mmis/2014/te/bgrd/backgroundfile-70398.pdf

City of Toronto (2014b) Carlaw + Dundas Community Initiative: A public space plan for the Carlaw-Dundas area. https://www.toronto.ca/legdocs/mmis/2014/te/bgrd/backgroundfile-72579.pdf

City of Toronto (2015) Tree Benefits (Sequestration) Information. November 23, 2015 Staff report to the Parks and Environment Committee. https://www.toronto.ca/legdocs/mmis/2015/pe/bgrd/backgroundfile-86019.pdf

City of Toronto (2017) Avoiding the TRAP: Traffic-Related Air Pollution in Toronto and Options for Reducing Exposure. Technical Report. https://www.toronto.ca/legdocs/mmis/2017/hl/bgrd/backgroundfile-108070.pdf

City of Toronto (2018b) Unilever Precinct Planning Study Secondary Plan and Planning Framework, and East Harbour Official Plan and Zoning By-law Amendment Applications - Final Report. Report of the Chief Planner to the Planning and Growth Management Committee considered by City Council on 26 June. http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2018.PG30.5

City of Toronto (2019) Toronto Official Plan: Map 2 – Urban structure. https://www.toronto.ca/wp-content/uploads/2017/11/904f-cp-official-plan-Map-02_OP_UrbanStructure_AODA.pdf

City of Toronto (2021) City of Toronto Maps. https://www.toronto.ca/data/parks/maps/index.html (Accessed 2021-07-23)

City of Toronto (2021a) East Harbour transit oriented communities proposal. Report to the Planning and Housing Committee, June 14, 2021. https://www.toronto.ca/legdocs/mmis/2021/ph/bgrd/backgroundfile-168262.pdf

City of Toronto (2021b) Official Plan. https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/official-plan/chapters-1-5/ (Accessed 2021-09-30)

City of Toronto (2021c) Ontario Line Update. Motion by Councillor Paula Fletcher, seconded by Councillor Joe Cressy, as amended. Toronto City Council (2 February). http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2021.MM28.17

City of Toronto, Social Policy, Analysis & Research (2018) South Riverdale – 2016 neighbourhood profile. https://www.toronto.ca/ext/sdfa/Neighbourhood%20Profiles/pdf/2016/pdf1/cpa70.pdf

Clark C, Paunovic K (2018) WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Quality of Life, Wellbeing and Mental Health. International Journal of Environmental Research and Public Health (15): 2400. https://www.mdpi.com/1660-4601/15/11/2400

Connon ILC, Prior JH, Kent J, Thomas L, Thompson SM, McIntyre E, Adams J, Capon A, Rissel C, Westcott H (2018) Healthy higher density living: A review of the literature. Landcom, Sydney, Australia. https://www.uts.edu.au/sites/default/files/2019-03/Healthy%20Higher%20Density%20Living-%20A%20Review%20of%20the%20Literature.pdf

Crouse DL, Pinault L, Balram A, Hystad P, Peters PA, Chen H, van Donkelaar A, Martin RV, Ménard R, Robichaud A, Villeneuve PJ (2017) Urban greenness and mortality in Canada's largest cities: a national cohort study. Lancet Planetary Health (1): e289–97. https://doi.org/10.1016/s2542-5196(17)30118-3

Croy I, Smith MG, Persson Waye K (2013) Effects of train noise and vibration on human heart rate during sleep: an experimental study. BMJ Open (3/5): e002655. https://bmjopen.bmj.com/content/3/5/e002655

Dastrup S, Ellen I, Jefferson A, Weselcouch M, Schwartz D, Cuenca K (2015) The effects of neighborhood change on New York City Housing Authority residents. Abt Associates with the NYU Furman Center for Real Estate and Urban Policy for the New York City Center for Economic Opportunity. https://www1.nyc.gov/assets/opportunity/pdf/nns_15.pdf

Demuzere M, Orru K, Heidrich O, Olazabal E, Geneletti D, Orru H ,Bhave AG, Mittal N, Feliu E, Faehnle M (2014) Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure. Journal of Environmental Management (146): 107-115. https://doi.org/10.1016/j.jenvman.2014.07.025

Dragan KL, Gould Ellen I, Glied SA (2019) Gentrification and the health of low-income children in New York City. Health Affairs (38/9): 1425-1432. https://doi.org/10.1377/hlthaff.2018.05422

Easthope H, Crommelin L, Troy L (2017) This is why apartment living is different for the poor. The Conversation (August 20, 2017). https://theconversation.com/this-is-why-apartment-living-is-different-for-the-poor-82069 (Accessed 2021-08-05)

Engage East Harbour (2021) Virtual Open House #1. https://courbanize.com/projects/engage-east-harbour/updates (Accessed 2021-07-23)

Engemann K, Pedersen CB, Argef L, Tsirogiannis C, Mortensen PB, Svenning J-C (2019) Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood. PNAS (116/11): 5188-5193. https://doi.org/10.1073/pnas.1807504116

Eriksson C, Pershagen G (2018) Biological mechanisms related to cardiovascular and metabolic effects by environmental noise. Prepared for the World Health Organization Regional Office for Europe. https://www.euro.who.int/__data/assets/pdf_file/0004/378076/review-noise-bio-effects-eng.pdf

Federation of Canadian Municipalities & Railway Association of Canada (2013) Guidelines for new development in proximity to railway operations. Prepared by DIALOG and J.E. Coulter Associates Ltd. https://www.proximityissues.ca/wp-content/uploads/2017/09/2013_05_29_Guidelines_NewDevelopment_E.pdf

Fields JM (1979) Railway noise and vibration annoyance in residential areas. Journal of Sound and Vibration (66/3): 445-458. (Abstract). https://www.sciencedirect.com/science/article/abs/pii/0022460X79908630

Flannery D, Norman B, Sinclair H, Straw V (2014) Transport oriented urban transformation: Contribution to urban futures. CURF Working Paper 3. University of Canberra, Australia. https://apo.org.au/node/54859

Georgiou B (Undated) Scenes From A City: Scenes From Carlaw Avenue. https://scenesto.com/2013/08/24/scenes-from-carlaw-avenue/ (Accessed 2021-10-21)

Gidlöf-Gunnarsson A, Ögren M, Jerson T, Öhrström E (2012) Railway noise annoyance and the importance of number of trains, ground vibration, and building situational factors. Noise & Health (14): 190-201. DOI: 10.4103/1463-1741.99895

Glazener A, Sanchez K, Ramani T, Zietsman J, Nieuwenhuijsen MJ, Mindell JS, Fox M, Khreis H (2021) Fourteen pathways between urban transportation and health: A conceptual model and literature review. Journal of Transport & Health (21): 101070. https://doi.org/10.1016/j.jth.2021.101070

Graham G (2013) Is There an Optimum Housing Density When We Consider Sustainability? House Planning Help. https://www.houseplanninghelp.com/hph031-is-there-an-optimum-housing-density-when-we-consider-sustainability-with-graham-towers/ (Accessed 2021-08-05)

Guski R, Schreckenberg D, Schuemer R (2017) WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance. International Journal of Environmental Research and Public Health (14): 1539. https://doi.org/10.3390/ijerph14121539

Hahad O, Beutel M, Gori T, Schulz A, Blettner M, Pfeiffer N, Rostock T, Lackner K, Sørenseng M, Prochaska JH, Wild PS, Münzel T (2018) Annoyance to different noise sources is associated with atrial

fibrillation in the Gutenberg Health Study. International Journal of Cardiology 264: 79–84. https://www.internationaljournalofcardiology.com/article/S0167-5273(17)37174-7/

Haigh F. Ng Chok H, Harris P (2011) Housing density and health: A review of the literature and Health Impact Assessments. Centre for Health Equity Training, Research and Evaluation. University of New South Wales, Sydney, Australia. https://hiaconnect.edu.au/wp-content/uploads/2013/04/housing_density_HIA_review1.pdf

Health Canada (2017) Guidance for evaluating human health impacts in environmental assessment: Noise. Health Canada, Ottawa. https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-evaluating-human-health-impacts-noise.html

Health Canada (2021) Health impacts of air pollution in Canada – estimates of premature deaths and nonfatal outcomes. https://www.canada.ca/en/health-canada/services/publications/healthy-living/2021-health-effects-indoor-air-pollution.html

Health Impact Project (2019) Do health impact assessments promote healthier decision-making. The Pew Charitable Trusts. https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2019/02/do-health-impact-assessments-promote-healthier-decision-making

Health Impact Project (2021) Health impact assessments, community engagement can promote equitable infrastructure choices. The Pew Charitable Trusts. https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2021/05/health-impact-assessments-community-engagement-can-promote-equitable-infrastructure-choices

Heaviside C, Vardoulakis S, Cai XM (2016) Attribution of mortality to the urban heat island during heatwaves in the West Midlands, UK. Environmental Health (15, Suppl 1): 27. https://doi.org/10.1186/s12940-016-0100-9

Holland S (2016) Gentrification: causes and consequences. Journal of Lutheran Ethics (16/1). https://elca.org/JLE/Articles/1135

Independent Environmental Consultants (2018) Relief Line south. Noise and vibration impact assessment - Appendix 6-4. Prepared for the Toronto Transit Commission.

International Tunnelling Association (2004). Underground or aboveground? Making the choice for urban mass transit. Systems Tunnelling and Underground Space Technology (19): 3–28. https://about.ita-aites.org/publications/wg-publications/content/18-working-group-13-direct-and-indirect-advantages-of-underground-structures

Janssen S, Hong J (2017). Recent progress in the field of community response to noise. 12th ICBEN Congress on Noise as a Public Health Problem, Zurich (18-22 June 2017). http://www.icben.org/2017/ICBEN 2017 Papers/SubjectArea06_Janssen_0601_3983.pdf

Kamruzzaman MD, Deilami K, Yigitcanlar T (2018) Investigating the urban heat island effect of transit oriented development in Brisbane. Journal of Transport Geography (66): 116-124. https://eprints.qut.edu.au/115416/

Kent, J., Thompson, S.M. and Jalaludin, B. (2011) Healthy Built Environments: A review of the literature City Futures Research Centre, University of New South Wales, Sydney (Australia).

https://www.be.unsw.edu.au/sites/default/files/upload/pdf/cf/hbep/publications/attachments/HBEPLiteratureReview_FullDocument.pdf

Keung N (2021) How Canada is moving to end the systemic 'environmental racism' that has been the toxic burden of racialized and Indigenous people for decades. Toronto Star June 6, 2021. https://www.thestar.com/news/canada/2021/06/06/how-canada-is-moving-to-end-the-systemic-environmental-racism-that-has-been-the-toxic-burden-of-racialized-and-indigenous-people-for-decades.html (accessed 2021-08-08)

Kimball M. Chester M, Gino C, Reyna J (2013) Assessing the potential for reducing life-cycle environmental impacts through transit-oriented development infill along existing light rail in Phoenix. Journal of Planning Education and Research (33/4): 395–410. https://doi.org/10.1177/0739456X13507485

Kondo KC, Mueller N, Locke DH, Roman LA, Rojas-Rueda D, Schinasi LH, Gascon M, Nieuwenhuijsen MJ (2020) Health impact assessment of Philadelphia's 2025 tree canopy cover goals. Lancet Planetary Health (4): e149–57. https://doi.org/10.1016/s2542-5196(20)30058-9

Kouroussis G, Zhu S-Y, Vogiatzis K (2021) Noise and vibration from transportation. Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering) (22/1): 1-5. https://doi.org/10.1631/jzus.A20NVT01

Lehmann S (2016) Sustainable urbanism: towards a framework for quality and optimal density? Future Cities and Environment (2): 8. https://doi.org/10.1186/s40984-016-0021-3

Lennard SC (undated) The high density livability question. https://www.livablecities.org/articles/high-density-livability-question (Accessed 2021-08-05)

Lercher P, De Coensel B, Dekonink L, Botteldooren D (2017) Community Response to Multiple Sound Sources: Integrating Acoustic and Contextual Approaches in the Analysis International Journal of Environmental Research and Public Health, 14: 663. https://doi.org/10.3390/ijerph14060663

Lester TW, Hartley DA (2013) The long-term employment impacts of gentrification in the 1990s. *The* Federal Reserve Bank of Cleveland, Working Paper no. 13-07. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2354015

Litman T (2020) Evaluating Public Transportation Health Benefits. The Victoria Transport Policy Institute for the American Public Transportation Association. https://vtpi.org/tran_health.pdf

Maclachlan L, Ögren M, van Kempen E, Hussain-Alkhateeb L, Persson Waye K (2018) Annoyance in response to vibrations from railways. International Journal of Environmental Research and Public Health (15): 1887. https://www.mdpi.com/1660-4601/15/9/1887

Mahboubi P, Parkes MW, Chan HM (2015). Challenges and opportunities of integrating human health into the environmental assessment process. Journal of Environmental Assessment Policy and Management (17/4): 1-32. https://www.jstor.org/stable/enviassepolimana.17.4.04

Malekafzali S, Bergstrom D (2011) Healthy corridor for all: A community health impact assessment of transit-oriented development policy in Saint Paul, Minnesota. Policy Link, Oakland CA, New York NY and

Washington DC.
https://www.policylink.org/sites/default/files/HEALTHYCORRIDOR_SUMMARY_FINAL_20120111.PDF

Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E (2020) Environmental and health impacts of air pollution – a review. Frontiers in Public Health (8):14.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7044178/pdf/fpubh-08-00014.pdf

Meltzer R, Ghorbani P (2017) Does gentrification increase employment opportunities in low-income neighborhoods? Regional Science and Urban Economics (66): 52-73.
https://doi.org/10.1016/j.regsciurbeco.2017.06.002

Methorst J, Rehdanz K, Mueller T, Hansjürgens B, Bonn A, Böhning-Gaese K (2021) The importance of species diversity for human well-being in Europe. Ecological Economics (181): 106917
https://doi.org/10.1016/j.ecolecon.2020.106917

Metrolinx (2020) Noise & Vibration Management Approach (January 2020).
https://www.metrolinxengage.com/sites/default/files/dsg-2019-01-22-ol-noise_and_vibration-info_sheet-v5-60611173.pdf

Metrolinx (2021a) GO rail network electrification final environmental project report addendum (2021-05-17). Prepared by Gannett Fleming and Morrison Hershfield.
https://www.metrolinxengage.com/en/content/go-rail-network-electrification-addendum-important-documents-0

Metrolinx (2021b) Lakeshore East noise and vibration study - Appendix G6, GO rail network electrification project final environmental project report addendum (2021-05-19). Prepared by Gannett Fleming. https://www.metrolinxengage.com/sites/default/files/appendix_g6_-_go_rail_network_electrification_lse_n-v_report_19may21.pdf

Metrolinx (2021c) The most common question from Leslieville and Riverside – Why can't Metrolinx run the Ontario Line underground? Metrolinx News: 2021-02-12.
https://blog.metrolinx.com/2021/02/12/the-most-common-question-from-leslieville-and-riverside-why-cant-metrolinx-run-the-ontario-line-underground/ (Accessed 2021-07-13)

Metrolinx (2021d) The Ontario Line: Neighbourhood Updates – East.
https://www.metrolinxengage.com/en/content/ontario-line-neighbourhood-updates-east (Accessed 2021-07-02, 2021-09-13 and 2021-09-19)

Metropolitan Area Planning Council (2020) Transit-oriented development and health update to the 2013 health impact assessment to inform Healthy Neighborhoods Equity Fund II. MAPC, Boston MA.
https://static1.squarespace.com/static/5f31ae81bcb71e20e39311bb/t/5f875cd50a60aa0a62dc8c6d/1602706674549/HNEF_HIA_update_10_1_2020.pdf

Moore J (2021) Get the facts about Ontario Line plans in Riverside and Leslieville. Metrolinx News (June 2, 2021). https://blog.metrolinx.com/2021/06/02/get-the-facts-about-ontario-line-plans-in-riverside-and-leslieville/

Mowatt D, Gardner C, McKeown D, Tran, N (2014) Improving health by design in the Greater Toronto-Hamilton Area. Peel Region Public Health, Simcoe Muskoka District Health Unit, Toronto Public Health,

and Hamilton Public Health Service. Available at: https://www.simcoemuskokahealth.org/docs/default-source/hu-promo/V2_moh-report.pdf

Munro S (2021a) An Alternative Ontario Line for Riverside? https://stevemunro.ca/2021/03/28/an-alternative-ontario-line-for-riverside/ (Accessed 2021-07-21)

Munro S (2021b) Ontario Line East Segment Update (25 June 2021) https://stevemunro.ca/2021/06/25/ontario-line-east-segment-update/ (Accessed 2021-09-13)

Murdie R, Teixeira C (2011) The impact of gentrification on ethnic neighbourhoods in Toronto: A case study of Little Portugal. Urban Studies 48(1): 61–83. https://www.jstor.org/stable/43081597

MyCo (Undated) Vintage advertising & company histories: International Varnish Company. https://mycompanies.fandom.com/wiki/International_Varnish_Company (Accessed 2021-10-21)

New South Wales Department of Environment and Conservation (2006) Assessing vibration: a technical guideline. https://www.environment.nsw.gov.au/resources/noise/vibrationguide0643.pdf

Noland RB, Ozbay K, DiPetrillo S, Iyer S (2014) Measuring benefits of transit oriented development. Mineta National Transit Research Consortium, San José State University, San José CA. https://rosap.ntl.bts.gov/view/dot/28116

Oiamo TH, Davies H, Rainham D, Rinner C (2017) Environmental noise study in the city of Toronto. Prepared for Toronto Public Health, April 2017. https://www.toronto.ca/wp-content/uploads/2017/11/8f4d-tph-Environmental-Noise-Study-2017.pdf

Ontario (2013) Environmental noise guideline - stationary and transportation sources - approval and planning (NPC-300). https://www.ontario.ca/page/environmental-noise-guideline-stationary-and-transportation-sources-approval-and-planning

Ontario (2020a) A place to grow – growth plan for the Greater Golden Horseshoe. Office Consolidation 2020.

Ontario (2020) Provincial Policy Statement, 2020. https://www.ontario.ca/page/provincial-policy-statement-2020

Padeiro M, Louro A, Marques da Costa N (2019) Transit-oriented development and gentrification: a systematic review. Transport Reviews (39/6): 733-754. https://doi.org/10.1080/01441647.2019.1649316

Paine G, Thompson S, Mitchell E, Judd B, Randolph B (2014) What contributes to a built environment that supports our health? City Futures Research Centre, University of New South Wales, Sydney, Australia. https://cityfutures.be.unsw.edu.au/documents/367/Planning__Building_Healthy_Communities-SUMMATION_REPORT.pdf

Pan American Health Organization (2013) Health Impact Assessment: Concepts and Guidelines for the Americas. PAHO, Washington DC. https://www.paho.org/hq/dmdocuments/2014/health-impact-assessment-concepts-and-guidelines-2013.pdf

Park S (Ed.), Boyle J, Hoyeck P, Jayawardena S, Kilian A, Mikhail M, Mylabathula S, Naguib M (undated) Indigenous Health in Ontario – an introductory guide for medical students. University of Toronto Faculty of Medicine. https://temertymedicine.utoronto.ca/sites/default/files/IndigenousHealthinOntario-compressed.pdf

Planning South Riverdale (2014) Results of consultations about local development issues with marginalized community members. http://spacing.ca/toronto/wp-content/uploads/sites/4/2015/11/PSR-CONSULTATIONS-REPORT.pdf

Pomponi F, Saint R, Arehart JH, Gharavi N, D'Amico B (2021) Decoupling density from tallness in analysing the life cycle greenhouse gas emissions of cities. npj Urban Sustainability (1/33). https://doi.org/10.1038/s42949-021-00034-w

Potter R (2021) Agincourt Village Community Association presentation at TrainWreck (Toronto: 28 January 2021: (45:26). https://www.youtube.com/watch?v=R4FtxPYPdT0

Public Health England (2020) Improving access to greenspace: A new review for 2020. Public Health England (PHE), London.

Pyko A (2018) Long-term exposure to transportation noise in relation to metabolic and cardiovascular outcomes. Karolinska Institute, Stockholm. https://openarchive.ki.se/xmlui/handle/10616/46273

Qiang AJ, Timmins C, Wang W (2020) Displacement and the Consequences of Gentrification. https://sites.duke.edu/wenwang/files/2020/01/Gentrification_and_Displacement_Working_Paper.pdf

Randolph B (2017) Why investor-driven urban density is inevitably linked to disadvantage. The Conservation (August 22, 2017) https://theconversation.com/why-investor-driven-urban-density-is-inevitably-linked-to-disadvantage-82073 (Accessed 2021-08-05)

Richardson J, Mitchell B, Edlebi J (2019) Shifting neighborhoods: Gentrification and cultural displacement in American cities. National Community Reinvestment Coaliton (NCRC), Washington, DC. https://ncrc.org/gentrification/

Richardson J, Mitchell B, Edlebi J (2020) Gentrification and Disinvestment 2020. National Community Reinvestment Coaliton (NCRC), Washington, DC. https://ncrc.org/gentrification20/

Schäffer B, Brink M, Schlatter F, Vienneau D, Wunderli JM (2020) Residential green is associated with reduced annoyance to road traffic and railway noise but increased annoyance to aircraft noise exposure. Environment International (143): 105885. https://doi.org/10.1016/j.envint.2020.105885

Schreckenberg D (2018) Knowledge gaps concerning health impacts of environmental noise. Euronoise 2018, Heraklion, Crete, Greece (27-31 May 2018). https://environmentalnoise.zeusgmbh.de/pdfs/Schreckenberg_2018_KnowledgeGaps_EN18.pdf

Shmool JLC, Yonas MA, Newman OD, Kubzansky LD, Joseph E, Parks A, Callaway C, Chubb LG, Shepard P, Clougherty JE (2015) Identifying perceived neighborhood stressors across diverse communities in New York City. American Journal of Community Psychology (56): 145-155. As cited in Tehrani et al. 2019.

Smart Density (2021) The Ontario Line – Station Profiles & Growth Opportunities. Smart Density, Toronto. Available at: https://smartdensity.com/ontario-line/

Smith MG, Croy I, Hammar O, Ögren M, Persson Waye K (2013) Nocturnal vibration and noise from freight trains impacts sleep. Proceedings of Meetings on Acoustics (19): 040114. http://dx.doi.org/10.1121/1.4800407

Smith MG, Croy I, Hammar O, Persson Waye K (2016) Vibration from freight trains fragments sleep: A polysomnographic study. Scientific Reports (6): 24717. http://dx.doi.org/10.1038/srep24717

Smith MG, Croy I, Ögren M, Hammar O, Lindberg E, Persson Waye K (2017) Physiological effects of railway vibration and noise on sleep. Journal of the Acoustical Society of America (141/5): 3262-3269. http://dx.doi.org/10.1121/1.4983302

Smith MG, Croy I, Ögren M, Hammar O, Persson Waye K (2014) Freight trains, nocturnal vibration and noise, and their physiological effects during sleep. 11th International Congress on Noise as a Public Health Problem (ICBEN) Nara, Japan (1-5 June 2014). https://www.academia.edu/6994369/Freight_trains_nocturnal_vibration_and_noise_and_their_physiological_effects_during_sleep

Statistics Canada (2019) Indicators related to moving – Table 46-10-0044-01. https://doi.org/10.25318/4610004401-eng (Accessed 2021-08-06)

Steinmetz-Wood M, Wasfi R, Parker G, Bornstein L, Caron J, Kestens Y (2017) Is gentrification all bad? Positive association between gentrification and individual's perceived neighborhood collective efficacy in Montreal, Canada. International Journal of Health Geographics (16): 24. http://doi.org/10.1186/s12942-017-0096-6

Stevenson M, Thompson J, Hérick de Sá T, Ewing R, Mohan D, McClure R, Roberts I, Tiwari G, Giles-Corti B, Sun X, Wallace M, Woodcock J (2016) Land use, transport, and population health: estimating the health benefits of compact cities. Lancet (388): 2925-2935. http://dx.doi.org/10.1016/S0140-6736(16)30067-8

Tehrani SO, Wu SJ, Roberts, JD (2019) The color of health: residential segregation, light rail transit developments, and gentrification in the United States. International Journal of Environmental Research and Public Health (16) 3683. http://dx.doi.org/10.3390/ijerph16193683

The Center for Design Excellence (undated) Density: Making great cities with density. http://www.urbandesign.org/density.html (Accessed 2021-07-30)

The South Riverdale Community Health Centre (2020) Setting the Stage: A Profile of the South Riverdale CHC Community. https://www.srchc.ca/wp-content/uploads/2021/02/Setting-the-Stage-A-Profile-of-SRCHC-August-2020.pdf

The University of Waterloo (2014) The Canadian Index of Wellbeing https://uwaterloo.ca/canadian-index-wellbeing/reports/2016-canadian-index-wellbeing-national-report/democratic-engagement

Thompson S, Paine G (2017) What's equity got to do with health in a higher-density city? The Conversation (August 23, 2017). https://theconversation.com/whats-equity-got-to-do-with-health-in-a-higher-density-city-82071 (Accessed 2021-07-29)

Toronto Indigenous Health Advisory Circle (2016) A reclamation of well being: visioning a thriving and healthy urban Indigenous community. Toronto Public Health. https://www.toronto.ca/wp-content/uploads/2018/02/9457-tph-tihac-health-strategy-2016-2021.pdf

Toronto Neighbourhood Walks (2011) Riverdale. https://neighbourhoodwalks.wordpress.com/2011/11/02/riverdale/ **(**Accessed 2021-08-08)

Toronto Parks, Forestry and Recreation (2013) Sustaining and expanding the urban forest: Toronto's strategic forest management plan. City of Toronto, Toronto. https://www.toronto.ca/data/parks/pdf/trees/sustaining-expanding-urban-forest-management-plan.pdf

Toronto Parks, Forestry and Recreation (2019a) Parkland strategy – growing Toronto parkland. Prepared by O2 Planning + Design for City of Toronto, Toronto. https://www.toronto.ca/wp-content/uploads/2019/11/97fb-parkland-strategy-full-report-final.pdf

Toronto Parks, Forestry and Recreation (2020) CanopyTO – the 2018 tree canopy study. City of Toronto, Toronto. https://www.toronto.ca/legdocs/mmis/2020/ie/bgrd/backgroundfile-141367.pdf

Toronto Public Health (2005) Air emissions and health status studies for South Riverdale and The Beaches communities. https://www.toronto.ca/legdocs/2005/agendas/committees/hl/hl050509/it009.pdf

Toronto Public Health (2013) Next Stop Health: Transit Access and Health Inequities in Toronto. https://www.toronto.ca/legdocs/mmis/2013/hl/bgrd/backgroundfile-56681.pdf

Toronto Public Health (2014) Health impact assessment tool (draft). http://www.ncchpp.ca/docs/TorontoPublicHealth-HIAFrameworkScreeningTool.pdf

Toronto Public Health (2015a) Green city - why nature matters to health: an evidence review. City of Toronto, Toronto. https://www.toronto.ca/legdocs/mmis/2015/hl/bgrd/backgroundfile-83421.pdf

Toronto Public Health (2015b) The Unequal City 2015: Income and Health Inequities in Toronto. City of Toronto. https://www.toronto.ca/wp-content/uploads/2017/12/8c61-tph-the-unequal-city-2015-aoda.pdf

Toronto Public Health (2017a) Healthy Aging in Toronto: The Health Status of Seniors. Staff report to the Board of Health. https://www.toronto.ca/legdocs/mmis/2017/hl/bgrd/backgroundfile-102238.pdf

Toronto Public Health (2017b) How loud is too loud? Health impacts of environmental noise in Toronto. https://www.toronto.ca/legdocs/mmis/2017/hl/bgrd/backgroundfile-104525.pdf

Toronto Public Health (2019a) Subway Health Impacts Study. Report from the Medical Officer of Health to the Board of Health. http://www.toronto.ca/legdocs/mmis/2020/hl/bgrd/backgroundfile-141357.pdf

Toronto Public Health (2019b) Toronto subway air quality health impact assessment. Prepared by Wolf Environmental Science and Ollson Environmental Health Management. https://www.toronto.ca/wp-content/uploads/2019/11/99d2-TSAQ-HIA-Final-Report-November-25_2019.pdf

Toronto Public Health, City of Toronto Planning, City of Toronto Transportation Services and Gladki Planning Associates (2014). Active City: Designing for Health. City of Toronto. https://www.toronto.ca/legdocs/mmis/2014/hl/bgrd/backgroundfile-69334.pdf

Towers G (2002) The Implications of Housing Density. In Challenges and Opportunities in Housing: New Concepts, Policies and Initiatives, Marana I and Tsenkova S (eds.). CIB, Rotterdam: 145-152. http://www.irbnet.de/daten/iconda/CIB919.pdf

Transportation Economics Committee (undated) Transportation Benefit-Cost Analysis. http://bca.transportationeconomics.org/ (Accessed 2021-10-09)

Troy L, Easthope H, Crommelin L (2017) It's not just the buildings, high-density neighbourhoods make life worse for the poor. The Conservation (August 21, 2017). https://theconversation.com/its-not-just-the-buildings-high-density-neighbourhoods-make-life-worse-for-the-poor-82070

Urban Strategies (2021) East Harbour master plan update & planning rationale report. Prepared for Cadillac Fairview, Toronto. https://res.cloudinary.com/courbanize-production/image/upload/v1/information_plans/bgncxz4lfosca6kttscc

US Federal Transit Administration (2018) Transit noise and vibration impact assessment manual. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf

Vale DS (2015) Transit-oriented development, integration of land use and transport, and pedestrian accessibility: Combining node-place model with pedestrian shed ratio to evaluate and classify station areas in Lisbon. Journal of Transport Geography (45): 70-80. (Abstract) https://doi.org/10.1016/j.jtrangeo.2015.04.009

Van Ryswyk K, Anastasopolos AT, Evans G, Sun L, Sabaliauskas K, Kulka R, Wallace L, Weichenthal S (2017) Metro commuter exposures to particulate air pollution and PM2.5-associated elements in three Canadian cities: The urban transportation exposure study. Environmental Science & Technology (51): 5713−5720. https://pubs.acs.org/doi/pdf/10.1021/acs.est.6b05775

Vanaken G-J, Danckaerts M (2018) Impact of green space exposure on children's and adolescents' mental health: a systematic review. International Journal of Environmental Research and Public Health (15): 2668. https://doi.org/10.3390/ijerph15122668

Waddington DC, Woodcock JS, Peris E, Condie J, Sica G, Moorhouse AT, Steele, A (2014) Human response to vibration in residential environments. Journal of the Acoustical Society of America (135/1): 182-193. Available at: http://usir.salford.ac.uk/33652/.

Walks A, August M (2008) The factors inhibiting gentrification in areas with little non-market housing: policy lessons from the Toronto experience. Urban Studies 45(12): 2594–2625. https://doi.org/10.1177/0042098008097102

Walkscore.com (2021) Living in South Riverdale Toronto. https://www.walkscore.com/CA-ON/Toronto/South_Riverdale (Accessed 2021-07-05)

Wilbur S (2021) Ontario Line east segment update looks at how noise walls will make communities quieter. Metrolinx News (April 22, 2021). https://blog.metrolinx.com/2021/04/22/ontario-line-east-segment-update-looks-at-how-noise-walls-will-make-communities-quieter/ (accessed 2021-06-18)

Wilson JS, McCutcheon J, Wilson JJ, Taylor A (2020) A conceptual framework to understand the business case for ecohealth in Ontario. Prepared by Green Analytics. https://www.ecohealthontario.ca/resources

Winterburn M (2020) How to avoid rocking the neighbours – The tools Metrolinx experts use to reduce noise and vibration on the Ontario Line. Metrolinx News (June 9, 2020). https://blog.metrolinx.com/2020/06/09/how-to-avoid-rocking-the-neighbours-the-tools-metrolinx-experts-use-to-reduce-noise-and-vibration-on-the-ontario-line/

Winterburn M (2021) Metrolinx announces more park space for Ontario Line east. Metrolinx News: 2021-06-24. https://blog.metrolinx.com/2021/06/24/metrolinx-announces-more-park-space-for-ontario-line-east/ (Accessed 2021-07-02)

Wiginton L (2017) Getting on Board: Learning from planning and engagement around rapid transit projects in Ontario. Pembina Institute https://www.evergreen.ca/downloads/pdfs/2017/Getting_on_Board_Mar13.pdf

World Health Organization (2005) Health Impact Assessment Toolkit for Cities. WHO Regional Office for Europe, Copenhagen. https://www.euro.who.int/__data/assets/pdf_file/0007/101500/HIA_Toolkit_1.pdf

World Health Organization Regional Office for Europe (2005) Health impact assessment toolkit for cities: Background document: concepts, processes, methods. WHO Regional Office for Europe, Copenhagen. https://www.euro.who.int/__data/assets/pdf_file/0007/101500/HIA_Toolkit_1.pdf

World Health Organization Regional Office for Europe (2018) Environmental Noise Guidelines for the European Region. WHO, Copenhagen. https://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2018/environmental-noise-guidelines-for-the-european-region-2018

Yildirim Y, Arefi M (2021) How does mixed-use urbanization affect noise? Empirical research on transit-oriented developments (TODs). Habitat International (107): 102297. https://doi.org/10.1016/j.habitatint.2020.102297

Zuk M, Bierbaum AH, Chapple K, Gorska K, Loukaitou-Sideris A (2017) Gentrification, Displacement, and the Role of Public Investment. Journal of Planning Literature (33/1): 31–44. https://doi.org/10.1177/0885412217716439

Zupancic T, Westmacott C, Bulthuis, M (2015) The impact of green space on heat and air pollution in urban communities: A meta-narrative systematic review. David Suzuki Foundation. https://www.toronto.ca/legdocs/mmis/2015/hl/bgrd/backgroundfile-83422.pdf

Appendix

Ontario environmental noise guidelines

When assessing noise from rail, the Ontario (2013) guidelines indicates that the "sound level should be assessed in an OLA [outdoor living area], such as a rear yard or a patio, and in indoor living areas, such as bedrooms and living rooms, and compared with MOE guidelines. Noise control measures are not required if the sound level estimated in the OLA is 55 dBA or less during the daytime [07:00 – 23:00] and 50 dBA or less in the plane of bedroom windows during daytime or night time…. The outdoor noise impact should be assessed in the OLA during daytime hours, considering a combination of only two sources of rail traffic noise, namely the locomotive and the wheel-rail interaction. Whistle noise is not included in the outdoor noise impact assessment."

"A major characteristic of railway noise is its high pass-by sound level for short periods and a major low frequency component produced by the operation of the diesel locomotive. This special character of the sound should be taken into account, particularly when assessing the indoor sound levels. Consequently, in order to account for the special character of railway sound, the indoor sound level limits for rail noise, Table C-2 [see Table A-1], are 5 dBA lower than the indoor sound level limits for road traffic noise. This difference results in a requirement for acoustically superior architectural components such as windows and walls, for railway noise (Ontario 2013)."

Table A-1: Table C-2 "Indoor Sound Level Limits – Rail" of the Ontario Environmental noise guideline (NPC-300). (Ontario 2013)

Type of Space	Time Period	L_{eq} (dBA) Rail
Living/dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc.	07:00 - 23:00	40
Living/dining, den areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	23:00 - 07:00	40
Sleeping quarters	07:00 - 23:00	40
Sleeping quarters	23:00 - 07:00	35

Note: The specified indoor sound level limits are maxima and apply to the indicated indoor spaces with windows and doors closed.

Health Canada's noise guidance

When evaluating sleep disturbance, Health Canada's Guidance for Evaluating Human Health Impacts in Environmental Assessment – Noise recommends the use of World Health Organization (WHO)'s noise guidelines. Health Canada notes that the WHO guideline levels should not be exceeded for susceptible populations, such as those in hospitals, or convalescent or senior homes (Health Canada 2017). It also recommends that noise levels for susceptible populations in particular not exceed the WHO annual average 40 dBA L_{night} outdoors. It also notes that it is good practice to consult with people running such facilities to determine if there is any potential for sleep disturbance during the day and to take this in consideration in the assessment. While there may be times when the sound levels are above and below 40 dBA, as long as the annual average does not exceed this value, long-term impacts on health are not expected to occur.

When a school could be affected by noise from the project, Health Canada suggests that the EA use WHO's ideal background noise level of 35 dBA in the classroom to determine the potential impact and the need for mitigation.

High annoyance is one way to estimate a community response to noise. Health Canada considers the change in percent highly annoyed (%HA) an appropriate indicator of noise-induced human health effects as the result of exposure to noise during the operational phase of a project. Because the relationship between noise and %HA is non-linear, a relatively small change in the noise level can result in a substantial increase in %HA in areas where the initial baseline noise level is high. Health Canada recommends that %HA be assessed for representative receptors. Mitigation measures should be considered when the calculated %HA at any given receptor location increases by more than 6.5%.

While Ontario's guidelines assume closed windows or doors when evaluating acceptable noise exposures, Health Canada "recognizes that in many cases, people will want to keep windows at least partially open, depending on the season." Therefore, good practice is to assess noise impact with such an assumption. Health Canada does recognise that there may be situations when baseline noise levels would not allow meeting WHO guidelines. In such cases noise mitigation measures should be considered so that project noise is kept at 75 dBA L_{dn} or less.

World Health Organization guidelines

The 2018 Environmental noise guidelines for the European Region outlines several principles including (WHO 2018: p. 105):

> "The **first principle** is to reduce exposure to noise, while conserving quiet areas... existing large quiet outdoor areas should be preserved."
>
> "The **second principle** is to promote interventions to reduce exposure to noise and improve health.… The potential health impacts from environmental noise are significant, especially when considering the widespread exposure to environmental noise across the population and the high baseline rates for various health outcomes associated with environmental noise."

The guidelines set evidence-based guidelines of different source categories of noise including rail. There are limited data available on the impacts of railway noise on health. Using a precautionary approach, recommendations for average exposure to railway noise were based on annoyance studies, since there is supportive evidence of health effects occurring from exposure to other sources of transportation noise.

The WHO (2018) strongly recommends:

- For average noise exposure: Reducing noise levels produced by railway traffic below 54 dB L_{den}[11] as railway noise above this level is associated with adverse health effects. At this level, 10% of people reported that they were highly annoyed by railway noise.

[11] The L_{den} a weighted average equivalent sound level over a 24-hour period with a penalty added for noise occurring during the evening and night-time hours.

- For night noise exposure: Reducing noise levels produced by railway traffic during night time to below 44 dB L_{night}[12] as night-time railway noise above this level is associated with adverse effects on sleep. At this level 3% of people reported to be highly disturbed by railway noise.
- To reduce health effects: Policymakers to implement suitable measures to reduce noise exposure from railways in the population exposed to levels above the guideline values for average and night noise exposure.

[12] The European Noise Directive defines L_{night}, as an equivalent outdoor sound pressure level, measured at the most exposed façade, associated with a particular type of noise source during night time (at least eight hours), calculated over a period of a year.

Vibration guidelines

Few studies have assessed the human response to intermittent vibrations induced by railway corridors. While there is no universally accepted approach, several organisations have developed guidelines, including: International Standard ISO 2631-2 (2003), American Standard ANSI S2.71 (2006) Australian Standard AS 2670-2 (1990), British Standard BS 6472-1 (2008), New Zealand Standard NZS/ISO 2631-2 (1989) and Norwegian Standard NS 8176.E (2005) (FCM & RAC 2013). Australian and US limit values are provided in the Tables A-2 and A-3 below.

Table A-2: Australian acceptable vibration dose values (VDV) for intermittent vibration such as rail traffic measured as m/s$^{1.75}$ (Source: NSW 2006)

Location	Daytime		Night time	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas*	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80

* Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

Table A-3: US indoor impact levels for ground-borne vibration (GBV VdB re 1 micro-inch /sec**) and ground-borne noise (GBN,** dBA re 20 micro-Pascals**) criteria** (Source: US FTA 2018)

Land Use Category	Frequent GBV events	Occasional GBV events	Infrequent GBV Events	Frequent GBN Events	Occasional GBN Events	Infrequent GBN Events
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB	65 VdB	65 VdB	N/A	N/A	N/A
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Notes:

1. "Frequent Events" is defined as more than 70 vibration events of the same source per day.
2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.
3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day.

Table A-4

Population characteristics of South Riverdale compared to that of Toronto

(Source: City of Toronto, 2018)

Demographic Parameter (2016 census)	**South Riverdale**	**Toronto**
Population of South Riverdale	27,876	
Between 2011 and 2016 South Riverdale increased by about twice the rate as Toronto as a whole	8.7%	4.5%
The proportion of the population that identifies as Indigenous is about twice that of Toronto	1.9%	0.9%
There are proportionally more citizens and fewer immigrants than in Toronto	91.5% 30.3%	85.3% 51.2%
The proportion of people of colour (visible minority) is lower than the city as a whole, but a higher proportion of the population does do not speak English or French	41.5% 8.1%	51.5% 4.9%
The median family income in 2015 was higher than for Toronto as a whole	$101,037	$82,859
Based on the market basket measure, the poverty rate in South Riverdale is slightly lower than that for Toronto	20.7%	21.9%
The percentage of households with income less than $20,000 is a little higher than the Toronto average	14%	13%
Compared to the city as whole, more households report an income of greater than $125 000	29%	22%
A higher percentage of people have a university education (bachelor's degree or higher)	48.2%	44.1%
Fewer people are unemployed	6.5%	8.2%
The percentage of single-person households and of seniors living alone is higher than the city average	35.9% 29.1%	32.3% 26.7%
Compared to the city as a whole there are fewer renter households as well as many fewer households living in apartments with five or more storeys	40.1% 17.7%	47.2% 44.3%
A smaller percentage of people are living in unsuitable or unaffordable housing, but slightly more are living in inadequate housing	5.9% 31.1% 7.7%	12.1% 36.6% 7.1%
A similar proportion take public transit to work but fewer commute more than an hour to work	38.6 10.8%	37.0% 16.2%

Table A-5

Factors to consider when planning healthy transit and transit-oriented communities.

(Adapted from Malekafzali & Bergstrom 2011)

To foster a healthy economy:

Objective 1:
High Quality, Healthy Jobs that Increase Wealth, Income, and Equity for All Residents
How will the proposal change the amount and quality of jobs that will be available to residents in the neighborhood?

Objective 2:
Diverse, Local Businesses—Existing and New—Are Developed and Supported
How will the proposal affect small, locally and minority-owned businesses that are located along the corridor?

To foster healthy affordable housing:

Objective 3:
Protect Residents from the Negative Impacts of Gentrification
How will the proposal affect the likelihood of neighbourhood gentrification and the involuntary displacement of current residents?

Objective 4:
Construct and Preserve Affordable and Diverse Housing in Proportion to Demand
How will the proposal impact the cost of housing in the neighborhood and the availability of affordable housing?

To foster safe and sustainable transportation:

Objective 5:
Maintain and Improve Affordable and Accessible Transportation
How will the proposal coordinate with, and affect, affordable and accessible public transportation?

Objective 6:
Safe, Connected Walking Routes to, from, and across Transit Stops
How will the proposal coordinate with, and affect, access to safe and connected routes to, from, and around rail and bus stops

Table A-6

Recommendations to maximise the health-related benefits of transit-oriented communities

Adapted from MAPC 2020.

Health Pathway	Potential Health Impacts	Recommendations
Walkability/Active Transport	Physical activity Mental health Chronic disease Obesity	• Promote density, mixed land-use, availability of destinations and amenities, short distances to transit, bicycle, and pedestrian. • Accommodations, and lower ratios of on- and off-street parking into the development design.
Safety from Traffic	Injury Air quality Real and perceived safety	• Support developments that promote a Complete Streets approach to accommodate safe bicycle, pedestrian, and transit trip-making for the new residential and/or commercial development. • Encourage a context-sensitive approach for proposed roadway improvements so that new or reconstructed roads are designed with narrow travel lanes and for slower vehicular speeds.
Safety from Crime	Injury Physical activity Mental health Real and perceived safety	• Incorporate Crime Prevention through Environmental Design (CPTED) strategies into the development design. • Encourage developers to be aware of internal and external pathways/connections to other destinations, particularly for routes to a transit station.
Economic Opportunity	Economic stability and mobility Mental health	• Require or encourage measures that result in construction-related employment opportunities (part- or full-time) for residents in the impacted neighborhood. • Encourage or create job training components to assist residents to acquire skills that allow them to access job opportunities can offer higher wages and job stability. • Prioritize ground floor commercial space for locally owned, minority owned, and women owned businesses.
Affordable Housing	Economic stability	• Support developments that maintain a diverse housing stock, including affordable deed-restricted housing units for households with low incomes.

Health Pathway	Potential Health Impacts	Recommendations
Moving to Opportunity	Mental health Economic mobility Chronic disease	• Provide housing search and relocation assistance for families with children who desire to move away from the impacted areas to a preferred neighbourhood. • Promote neighbourhood changes that reduce neighbourhood level poverty and include housing, with potential support services, for current residents. • Include programming with new developments that provide opportunities for community building among new residents and current residents, for sharing of cultural and ethnic backgrounds, and that provide opportunities for youth leadership.
Social Cohesion	Mental health Social capital Chronic disease	• Promote developments that seek to enhance the social impact of the public spaces and social and cultural programming of these spaces. • Promote initiatives and programs that value inclusiveness, diversity and health promotion across all ages and backgrounds.
Displacement/Gentrification	Air quality Asthma Other respiratory diseases Cardiovascular disease	• Identify what types of community-level displacement forces, if any, are currently occurring in the area of the proposed development. • Promote the use of anti-displacement strategies and local regulatory changes that support existing residents right to remain and apply policies such as inclusionary zoning, prevent condominium conversion, and one for one affordable housing replacement. • Support initiatives that increase housing stability for existing residents, such as right to counsel, rental assistance, and community wellness staff.
Ownership of Neighbourhood Change	Physical health Mental health	• Document understanding of community vision, reflecting the needs and priorities of current residents, as part of development process. • Promote sharing of decision-making on proposed developments with residents in the impacted neighborhood.

Health Pathway	Potential Health Impacts	Recommendations
Food Access	Mental health Chronic disease Diet	• Encourage expanded access to healthy, affordable food through walking, bicycling and frequent transit connections. • Consider use of mobile markets and farmers market as means to expand access to local, healthy foods.
Green Space	Physical activity Mental health Thermal comfort Social cohesion Respiratory health	• Promote expansion, upkeep, and programming of green spaces. • Promote introduction of vegetation, including trees, low level bushes and shrubs and ground cover plants in public and private spaces. • Design sites to reduce potential for trees to restrict dispersal of air pollutants and to contribute allergens.
Air Quality	Mental health Economic stability Social cohesion	• Encourage air quality analyses associated with increased motor vehicle use. Consider background concentrations. • Monitor air quality during construction and after the development is complete to ensure that air quality levels do not degrade beyond projected levels. • Consider mitigation measures such as reinforcing the bicycle/pedestrian infrastructure and low-emission construction equipment.
Climate Change	Exposure to natural hazards such as heat and extreme rain events Injury	• Assess project vulnerability using a community exposure, sensitivity, and adaptive capacity framework. • Build resiliency in neighborhoods by addressing physical environmental risks and socioeconomic factors that increase vulnerability. • Promote use of building designs that reduce reliance on carbon-based energy sources and minimise utility costs for residents.
Residential Energy Efficiency	Exposure to environmental contaminants Economic stability Mental health Thermal comfort Chronic disease	• Encourage housing that meets the highest energy efficiency standards. • When applicable, retrofit existing homes to meet higher energy efficiency performance.