To support development of the Regional Transportation Strategy, TransLink prepared the following working paper on Transportation & Health:

**Summary:** This document covers both Global (A) and Local (B) health issues related to transportation. Based on leading and promising practices from across North America and abroad, this report identifies opportunities and provides recommendations on how TransLink can incorporate health into the transportation planning process and begin to consider the health impacts of transportation-related administrative, procedural, programmatic, fiscal and regulatory decisions. As the transportation sector’s desire to facilitate healthy communities increases, so does the commitment of public health agencies to healthy community design through land use planning and transportation.
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CONTENTS

Executive Summary ....................................................................................................................................... 1

1. Introduction .......................................................................................................................................... 4
   1.1. The Regional Transportation Strategy (RTS) ................................................................................. 4
   1.2. Purpose & Scope of This Report ................................................................................................... 4

2. Why is Health of Increasing Importance within Transportation Planning & Decision Making? .......... 6
   2.1. Provincial and Regional Health Challenges ................................................................................... 7
   2.2. An Aging Population ...................................................................................................................... 9
   2.3. Travel Behaviour and Chronic Disease ........................................................................................ 10
   2.4. The Health Imperative for Transportation Planning ................................................................... 10

3. Transportation & Health – the Linkages ............................................................................................. 12
   3.1. The Built Environment and Travel Behaviour Link ...................................................................... 12
   3.2. A1: Travel Behaviour & Physical Activity Link ............................................................................. 14
   3.3. A1: Travel Behaviour & Diet Link ................................................................................................ 15
   3.4. A2: Physical Activity & Chronic Disease Link ............................................................................... 16
   3.5. A3: Physical Activity & Body Mass Index Link ............................................................................. 17
   3.6. A4: Body Mass Index & Chronic Disease Link ............................................................................. 17
   3.7. B1: Vehicular Travel, Volume & Emissions Link .......................................................................... 18
   3.9. B3: Volume & Speed and Health Outcomes Link ........................................................................ 22
   3.10. B4: Land use / Transportation Investments and Mental Health Link ....................................... 23
   3.11. C: Health Outcomes & Health Care Cost Link ..................................................................... 25
   3.12. Conclusion ........................................................................................................................... 25

4. Approaches to Incorporate Health within the Transportation Planning Process ............................... 27
   4.1 Policy Development ...................................................................................................................... 27
   4.2 Evaluation ..................................................................................................................................... 29
      4.2.1 Multi-criteria analysis ........................................................................................................ 30
      4.2.2 Rating Systems .................................................................................................................. 30
      4.2.3 Economic Analysis ............................................................................................................. 31
      4.2.4 Scenario Planning ............................................................................................................... 32
      4.2.5 Health Impact Assessment ................................................................................................ 35
   4.3 Monitoring & Reassessment ......................................................................................................... 37
4.4 Public Engagement, Partnership & Collaboration ................................................................. 40
  4.4.1. Public Engagement ...................................................................................................... 40
  4.4.2. Partnerships & Collaboration .................................................................................... 41
4.5 Conclusion .......................................................................................................................... 45
5. Case Studies .............................................................................................................................. 46
  5.1. Nashville Area MPO 2035 Regional Transportation Plan - Impacts of Transportation Policy on
      Prevention and Health ........................................................................................................ 46
  5.2. NSW Premier’s Council for Active Living - Development of a cost benefit framework to
evaluate active transport decisions incorporating health benefits ........................................ 49
  5.3. Pilot Testing the Health Impact Assessment Scenario Testing Tool in Toronto, Ontario ....... 52
6. Conclusions & Recommendations ......................................................................................... 56
  6.1. Key Findings .................................................................................................................... 56
  6.2. Recommendations ......................................................................................................... 56
APPENDIX 1 – Policy Language ................................................................................................. 59
APPENDIX 2- Indicators ............................................................................................................... 67
EXECUTIVE SUMMARY

TransLink is updating its 30-year regional transportation strategy (RTS) as part the renewal of its strategic framework. This report is one of several background documents that TransLink has commissioned on a variety of regional transportation issues. The purpose of this report is to provide TransLink with a greater understanding of the linkages between public health and transportation, and to describe the means by which health can be integrated into transportation planning and decision making.

Based on promising practices from across North America and abroad, this report identifies opportunities and provides recommendations on how TransLink can incorporate health into the transportation planning process and begin to consider the health impacts of transportation-related administrative, procedural, programmatic, fiscal and regulatory decisions.

The need to explore transportation impacts on health is becoming increasingly urgent. Health care costs are rising rapidly and already constitute 41% of the annual provincial budget. A significant portion of this budget is related to preventable chronic conditions, including obesity, which currently produce more than $860 million in direct and indirect health care costs in each year. As a further complicating factor, the rise in rates of chronic disease is expected to accelerate as BC makes the demographic transition to an older population over the next 25 years.

Chronic diseases rarely have a single, identifiable cause, but rather are a result of a number of factors, including the behaviours in which individuals engage. Travel behaviours influence how physically active or sedentary people are, both of which are key determinants for many of today’s most prevalent chronic health problems. Several strategies are available to transportation and land use planners that promote increased physical activity and reduce obesity levels, which in turn can prevent illness and reduce health care costs. Thus, investment in infrastructure supporting active transportation is preventive medicine. Conversely, reliance upon sedentary modes of travel can exacerbate health risks.

Transportation decisions impact health outcomes through two paths: one is by affecting travel behaviour (and therefore, activity levels) and the other is by exposing us to harmful substances or stressors. These two pathways are depicted in the figure below. In addition, this figure illustrates the various links through which the built environment ultimately affects health outcomes. Several key links are highlighted in Figure 1 below.¹

¹Further details and references are provided in Chapter 3.
Figure 1 - Built Environment & Health Linkages

By collecting data corresponding to these pathways, agencies can predict how transportation policies relate to health care costs and savings. Such information can then be used to inform transportation policies at different stages in the decision making process (see Figure 2 below).

Figure 2 - Conceptual Model of Transportation Decision Making

One of the first actions that can be taken is to integrate health into the language of transportation planning. By including health values and goals into transportation plans, health becomes an outcome. Health related policy language provides an effective starting point to make health part of the
conversation when setting priorities. However, while incorporating health values and goals into policy documents is necessary, it may not be sufficient to effectively translate into results on the ground. A more concrete means is by directly linking funding to health-related outcomes – perhaps through a performance-based funding approach.

Another major objective is to establish programs to make health a regular part of planning. Many evaluation tools currently used in planning may be adapted to incorporate health into transportation planning. These include the following:

- Multi Criteria Analysis
- Economic Analysis
- Health Impact Assessment
- Rating Systems
- Scenario Planning

As important as visioning new public policies and taking steps to implement them is, it is also crucial to develop a means to monitor such initiatives. Monitoring is employed to assess consistency between adopted policy and action, to provide feedback on progress towards desired outcomes, and to inform future visioning and policy development exercises. Because health outcomes linked to transportation are primarily chronic in nature, long-term monitoring is generally required to demonstrate health impacts of planning decisions. Typically, indicators of determinants of health cannot show presence or absence of ill health, but instead show those external, community-level factors that are known to impact it. Mapping and integrated GIS-based information databases are powerful means to communicate these data within agencies and with stakeholders.

As with any other planning initiative, addressing public health requires robust public engagement. Essentially, the same public engagement tools used in transportation planning are also used to plan for healthy communities. However, the stakeholders that are involved in the process will likely include health practitioners, public health experts, and vulnerable populations. Likewise, the type of information brought forward will need to reflect a health focus as will the questions and input from the public.

This report presents a range of opportunities for TransLink to consider when incorporating health into transportation planning processes. These include adopting transportation plans that emphasize active transportation, evaluating transportation decisions in terms of health benefits and risks, and developing health-based decision support tools. The case studies presented in Chapter 5 outline many strengths, opportunities, and challenges with implementation. Even though these initiatives are still in their nascent stages, they nonetheless represent excellent models for future consideration in the Metro Vancouver region.
1. INTRODUCTION

1.1. THE REGIONAL TRANSPORTATION STRATEGY (RTS)

In order to support the development of more evidence-based plans, policies, and strategies – including an update to the Regional Transportation Strategy in 2013 – TransLink has commissioned a series of working papers. The papers are designed to help illuminate and explore key issues from a global context (A-series papers) and from the local context of Metro Vancouver (B-series papers).

This paper sets both the global and regional context for health.

1.2. PURPOSE & SCOPE OF THIS REPORT

TransLink is updating its 30-year regional transportation strategy and this report is one of several background documents that TransLink has commissioned on a variety of regional transportation issues. The purpose of this report is to provide TransLink with a greater understanding of the linkages between public health and transportation, and describe the means by which health considerations can be integrated into transportation planning and decision making processes. The contents of this report will inform discussions and consultations surrounding the development of the RTS.

Based on leading and promising practices from across North America and abroad, this report identifies opportunities and provides recommendations on how TransLink can incorporate health into the transportation planning process and begin to consider the health impacts of transportation-related administrative, procedural, programmatic, fiscal and regulatory decisions. As the transportation sector’s desire to facilitate healthy communities increases, so does the commitment of public health agencies to healthy community design through land use planning and transportation. Vancouver Coastal Health, one of the region’s health authorities, is a partner in the production of this document. This report builds on the content of the October 6th, 2011, Symposium on Integrating Active Transportation and Health into Transportation Planning, a Walk 21 post-event co-hosted by the University of British Columbia’s Health & Community Design Lab, the City of Vancouver, and TransLink. A working group of the City of Vancouver, Metro Vancouver, Fraser Health Authority, the Ministry of Health, and the Ministry of Transportation have also provided valuable inputs into this research paper.

The main objectives of this report are to:

1) Improve policymakers’ and transportation practitioners’ understanding of the state of the evidence on the connections between transportation, public health and quality of life;
2) Provide an overview of the current state of knowledge of transportation planning practice implications on public health;
3) Identify and review promising strategies from across the globe for integrating health impacts into the transportation planning and decision making process;

2 Additional information at http://health-design.spph.ubc.ca/events/health-transportationplanning/
4) Provide recommendations to TransLink on the near and longer term opportunities and strategies the agency can take to begin to consider the health impacts of transportation-related decisions;

5) Identify key gaps in the evidence base to support the ability to understand how transportation impacts health, ways in which these impacts can be monetized, and steps to fills these gaps;

6) Present some alternative approaches to developing partnerships with the range of health stakeholders.
2. WHY IS HEALTH OF INCREASING IMPORTANCE WITHIN TRANSPORTATION PLANNING & DECISION MAKING?

Health care costs are rising rapidly and already constitute 41% of the annual provincial budget. Most of these costs are associated with chronic disease, much of which can be prevented or mitigated through active living and healthy eating. Walking and biking between destinations—as opposed to doing so solely for leisure or recreation—are key components of active living. Transportation and land use planning also impact the relative ease with which we can access healthy food and avoid or minimize the amount of driving, a sedentary behaviour.

Several strategies are available to transportation and land use planners that promote increased physical activity and reduce obesity levels, which in turn can prevent illness and reduce health care costs. Evidence makes it clear that physical activity in the form of active transportation\(^3\) is enabled and promoted through investments in pedestrian and bike infrastructure,\(^4\) and through transit investment and use.\(^5\) Transit trips typically include some walking, such as to or from stops, which may support physically active lifestyles.\(^6\) Thus, investment in infrastructure supporting active transportation and transit is preventive medicine.\(^7\)

This view is a shift from the popular conception of the origins of chronic disease being individual. With advances in biology, genetics, and impact of lifestyle on chronic disease, the medical community has in the past moved away from environmental and population level explanations for disease. Given the importance placed on behaviour and genetics, population health prevention focused on screening and education.\(^8\) Public health efforts provided the information needed to make healthy decisions, without addressing the role that environment plays in exposure and opportunity structures. Even now, many transportation planners would acknowledge health concerns as valid, but outside of their mandate or unrelated to their task of planning for efficient and equitable transportation options. Likewise, many public health authorities may see plans for transportation systems as outside their mandate or being of

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\(^3\) Active transportation refers to any form of human-powered transportation – walking, cycling, using a wheelchair, in-line skating or skateboarding. There are many ways to engage in active transportation, whether it is walking to the bus stop, or cycling to school/work. Public Health Agency of Canada. Retrieved from http://www.phac-aspc.gc.ca/hp-ps/hl-mvs/pa-ap/at-ta-eng.php


\(^7\) It is important to note that the potential health care savings that may result from investments in healthy built environments are realized at the provincial and federal levels (the level at which health care is funded), whereas the costs for these investments are typically made at the regional and municipal levels.

little consequence to their field. However, an understanding of the linkages between the two fields and
the changing nature of health care provision demonstrates the need to consider the benefits of
incorporating health concerns into transportation decision making frameworks.

Transportation systems affect large-scale regional growth patterns and land use as well as individual
travel decisions and lifestyles. Decisions about where to live, work, and how to get from point A to point
B exert large cumulative effects on the environment and on our health. Location choice and travel
decisions affect prosperity, community relationships, the costs of infrastructure, and overall population
health. As this report will detail, the health impacts of transportation decisions—both on the individual
and population level—have generally been hidden or neglected.9

2.1. PROVINCIAL AND REGIONAL HEALTH CHALLENGES

The past two hundred years have seen the dominant health challenge in our society change from acute,
short-term illness often in the form of communicable disease to chronic longer term, often preventable,
illness.10 These changes have been accompanied by steady increases in health care spending, and new
concerns for public health. While Canada has the highest percent (7.3% in 2007) of total health care
expenditure going towards prevention among OECD countries11, the vast majority of health related
expenditures goes towards acute treatment. Health care costs account for 41% of the 2012/2013
provincial budget, by far the government’s largest expense category. These costs are projected to
continue to climb, increasing by more than $1.5 Billion over the next 2-3 years.12 As health care costs
increase, the proportion of provincial funds available to dedicate to other priority areas, including
transportation is reduced. Figure 313 shows the current distribution of provincial expenditures.

from http://www.apha.org/NR/rdonlyres/F8464OFD-13CF-47EA-8267-
E767A1099239/0/HiddenHealthCostsofTransportationShortFinal.pdf
11Sustainable Governance Indicators 2011. “Prevention accounts for what percentage of current health care
network.org/index.php?page=indicator_quant&indicator=S10_4
http://www.bcbudget.gov.bc.ca/2012/highlights/2012_Highlights.pdf
13Ibid.
A significant portion of health care costs are related to preventable chronic conditions including obesity and overweight which currently produce more than $860 million in direct and indirect health care costs in BC\textsuperscript{14} each year. Rates of Type 2 or “adult onset” diabetes are rising in children and adults alike and are tied directly to obesity. Figure 4 displays the actual and predicted rise in both types of diabetes in BC between 2000 and 2020.\textsuperscript{15} Because the majority of all diabetes diagnoses are Type 2, and because Type 1 diabetes is related to genetic predisposition, we can assume that most of the increase will be a result of Type 2 diabetes diagnoses. Over the same period, the combined direct and indirect cost of diabetes is expected to rise from $776 million to $1.9 billion.\textsuperscript{16} In comparison, health complications related to air pollution cost the provincial economy approximately $1 billion each year.\textsuperscript{17} Diabetes is such an expensive disease because severe complications require costly medical intervention. For example, a combination of Diabetic Peripheral Neuropathy—which damages nerves in the extremities—and increased susceptibility to infection can turn small foot injuries like blisters or cracks into a situation that requires full foot amputation. Other potential issues include eye surgery for diabetics, who develop


\textsuperscript{16} Ibid. Cost estimates in 2009 dollars.

cataracts or glaucoma earlier and more frequently, and surgery or long-term treatment for complications of heart disease such as stroke and heart attack.\textsuperscript{18}

\textbf{Figure 4: Diabetes in British Columbia}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{diabetes_bcg.png}
\caption{Diabetes in British Columbia: 2000 to 2020}
\end{figure}

It is important to note that health care costs are not the only costs compounded as a result of chronic disease. Chronic disease involves more time spent infirm or in hospital visits, a risk of premature death and longer time incapacitated at end of life. This translates to a loss of human potential throughout the life course and at end of life—in productivity that could be directed towards work, learning, or caring for family.\textsuperscript{19} Not only is absenteeism from work and other obligations of concern, but productivity impairment while at work—termed ‘presenteeism’—is as well.

\subsection*{2.2. An Aging Population}

The rise in rates of chronic disease is expected to accelerate as BC makes the demographic transition to an older population. Over the next 25 years, the proportion of the population over 65 will increase


dramatically and, presently the fastest growing segment of our population is people over age 80.\textsuperscript{20} In 2009, the 20\% of BC residents over 60 consumed 47.5\% of health care expenditures.\textsuperscript{21} Older adults are more likely to develop chronic conditions, which come with considerable costs, and the proportion of BC’s population over 65 is projected to grow from 15\% in 2010 to 23.7\% in 2036.\textsuperscript{22} The aging population, coupled with high per-capita health care spending for seniors suggests major impacts on the allocation of government resources for the foreseeable future. Even without accounting for health, an aging population with mobility limitations presents new challenges for transportation.\textsuperscript{23}

2.3. **Travel Behaviour and Chronic Disease**

Chronic diseases rarely have a single, identifiable cause, but rather are a result of a number of factors, including the behaviours that individuals engage in and the substances they are exposed to. Travel behaviours influence how physically active or sedentary people are, both of which are key determinants for many of today’s most prevalent chronic health problems. Active transportation presents the possibility of prevention or treatment through increased routine physical activity. Ensuring accessible travel facilities and encouraging people with chronic disease to use them could help to stabilize, slow down, or even reverse disease processes. Furthermore, travel behaviour on an aggregate level influences exposure to air pollutants and noise, which also have consequences for health. Therefore, the transportation investment decisions that determine what travel behaviours are convenient and practical have an effect on health and on the health care system. The linkages between transportation and health are the subject of Chapter 3.

2.4. **The Health Imperative for Transportation Planning**

Changing demographics, fiscal concerns and an improved understanding of the effects of transportation on health create the opportunity for transportation and public health decision makers to find common ground: to broaden planning objectives to include creating a healthy and functional built environment for all. The looming health care crisis, as well as the new evidence linking transportation and health, makes this the ideal time to integrate health outcomes into transportation planning. Furthermore, planning for healthy cities can also assist in addressing other emerging goals such as adaptation for climate change, reductions in greenhouse gas emissions and fossil-fuel dependence, as well as classic transportation issues such as congestion and pollution. For instance, transportation strategies to mitigate GHG emission also strongly support active transportation. In forecast modelling scenarios in the

\textsuperscript{20}BCMA. “Charting the Course: Designing BC’s health care system for the next 25 years” (2012). Retrieved from https://www.bcma.org/files/Charting_the_Course_Final.pdf
cities of London (UK) and New Delhi (India), a reduction in carbon dioxide emissions through strategies aimed at shifting trips from vehicles to active transportation forms also had substantial health benefits. Important health gains and reductions in CO2 emissions can therefore be achieved through the development of a safe urban environment for active transportation.\textsuperscript{24} Many current transportation planning strategies such as creating bike lanes and improving transit service already offer potential health benefits. By explicitly addressing health concerns in transportation plans, further gains can be made.

3. TRANSPORTATION & HEALTH – THE LINKAGES

Transportation decisions impact health outcomes through two paths: one is by affecting travel behaviour (encouraging us to behave in ways that affect health) and the other is by exposing us to harmful substances and stressors (e.g. noise). These two pathways are depicted in Figure 5. The linkages identified in Figure 5 are not exhaustive, but reflect the objectives listed in Section 1.2. Linkages that TransLink has a greater capacity to influence are also addressed in greater depth.

Figure 5: Built Environment & Health Linkages

3.1. THE BUILT ENVIRONMENT AND TRAVEL BEHAVIOUR LINK

Types of transportation options available are largely influenced by both land use patterns and the transport investments made. The relationship between land use and transport is iterative; land use patterns can shape the required transport infrastructure and service, whilst new transportation investments can establish the framework for land use decisions. Therefore creating automobile infrastructure induces automobile travel by making driving more competitive relative to other modes.25 Likewise, research has shown that creating pedestrian infrastructure, for example, encourages both

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utilitarian and recreational pedestrian travel. While some of the strongest predictors of utilitarian walking are connected to land use (e.g. density and proximity), factors such as the presence of sidewalks, the street design and traffic safety also play roles. Creating walkable environments does more than just attract people who want to walk, it encourages walking for all people in those environments.

Figure 6 reveals that highly walkable areas are not the norm for Metro Vancouver. Rather, many of the neighbourhoods in the region have been built with characteristics that discourage walking. These are:

- sprawling development patterns
- low residential density (mostly single-detached houses)
- commercial developments set far back from streets in large parking lots

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• separated land uses
• poor street connectivity (large blocks, cul-de-sacs)\(^{30}\)

Given varying built environments and socio-demographic contexts within Metro Vancouver, transportation planning that integrates health considerations may take a variety of forms. Policies and programs to support active transportation should be specific to differences in geography as well as other factors such as demographics, resources, and current and projected infrastructure. For example, efforts in newer suburban areas in the region may focus on the design of new subdivisions and transit orientated development, whereas efforts in more urban areas may emphasize retrofits to existing infrastructure.

The following sections are labeled and correspond to linkages identified in Figure 5.

3.2. **A1: TRAVEL BEHAVIOUR & PHYSICAL ACTIVITY LINK**

“17% of Canadian men and 14% of Canadian women accumulate the recommended 150 minutes per week of moderate-to-vigorous physical activity. Only 5% of these accumulate at least 30 minutes on at least 5 days of the week.”\(^{31}\)

An individual’s travel behaviour is one of the most telling indicators of physical activity levels given that different travel modes inherently require different amounts of physical activity. Driving requires very little physical activity, save for the few steps to and from the car, while walking and cycling require some effort ranging in intensity from light to vigorous activity.\(^{32}\) Transit occupies a middle ground. The amount of effort required depends on a number of factors including the distance between transit access points and the origin and destination for each trip, but it has been shown to be a significant source of incidental physical activity for many of its users.\(^{33}\) One study found that frequent transit commuters accumulated approximately eight more minutes of moderate physical activity per day than those who did not commute by transit.\(^{34}\)

\(^{30}\)Ibid.
Just as more walking and cycling result in higher physical activity levels, increases in driving are associated with decreases in physical activity and increases in sedentary time, since driving is a sedentary activity. Sedentary time is high among Canadians in part because of reliance on vehicular travel and in part because of increased participation in sedentary leisure activities and limited time for active recreation. When people do not have time for, or the inclination to, exercise active transportation becomes an even more important source of physical activity.

Consider the effects that active transportation can have on health outcomes. People who incorporate walking (or other forms of active transportation, such as cycling) into their daily travel routines engage in approximately 70 more minutes of moderate to vigorous physical activity per week, or almost half of the recommended amount. Over the course of a year, this amount of activity yields about 15,000 kilocalories of energy expenditure for a 68-kilogram person, which, if not offset by caloric intake, could result in almost 1.8 kilograms of weight loss. While not everyone will participate in sports or attend a gym, nearly everyone travels to work, school or shops. Therefore, the potential for meeting physical activity standards is readily achievable if active transportation modes are used to fulfill these daily tasks. This is especially true for the 83% of total trips which usually occur close to home, such as non work utilitarian trips.

3.3. A1: TRAVEL BEHAVIOUR & DIET LINK

Travel patterns, the location of food retail and services and time spent driving also affect how and what one eats. Individuals living in neighbourhoods with good access to healthy food options have a lower average Body Mass Index (BMI). More time spent commuting is associated with higher BMI, increased consumption of low quality food or fast-food and increased stress, which is linked to

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39 Ibid.


unhealthy eating. In sum, travel behaviour affects both the amount of physical activity engaged in and nutritional choices.

3.4. **A2: PHYSICAL ACTIVITY & CHRONIC DISEASE LINK**

“The majority—69%—of Canadian adults’ waking hours are spent in sedentary pursuits.”

The health benefits of physical activity are numerous and well documented – a recent review on its effects on coronary heart disease alone initially identified over three thousand studies. Such studies have confirmed the importance of physical activity in the prevention of the chronic diseases that are most prevalent in society. In fact, being fit or active reduces the risk of death from cardiovascular disease by half, as well as reducing the incidence and severity of other chronic diseases significantly. Just as important, the benefits of physical activity accrue even at low levels and increase with more activity, meaning that even small changes to lifestyle can have a significant impact on health. This low threshold makes environmental changes for health practical and feasible.

Low levels of physical activity and a sedentary lifestyle increase the risk of developing a plethora of health problems, including coronary heart disease, hypertension, Type 2 diabetes, osteoporosis, colon cancer, anxiety and depression. Sedentary behaviour denotes activities that do not increase energy expenditure significantly above a resting rate. Using the example of driving as sedentary behaviour, it is possible for an otherwise physically active individual to incur adverse impacts of a sedentary daily commute. Driving has been linked to increased incidence of Type 2 diabetes and indicators of metabolic risk. Often, developing these chronic diseases is preceded by weight gain and obesity, but studies have found increased risk of chronic disease because of low physical activity regardless of unhealthy

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51 Christine M. Hoehner, Carolyn E. Barlow, Peg Allen, Mario Schootman, “Commuting Distance, Cardiorespiratory Fitness, and Metabolic Risk,” American Journal of Preventive Medicine, 42.6 (2012) 571-578.
weight. The increasingly common combination of overweight and inactivity, however, is the most pernicious to health. Thus, the behavioural effects of transportation decisions, especially those affecting physical activity and sedentary time, impact health and the types of health conditions which prevail in society.

3.5. **A3: PHYSICAL ACTIVITY & BODY MASS INDEX LINK**

"From 2003 to 2010, obesity [BMI 30+] among men rose from 16.0% to 19.8%, and among women, from 14.5% to 16.5%. When those who were overweight [BMI 25-29.9] were included, 60.9% of Canadian men and 43.7% of women had an increased health risk because of excess weight."53

Physical activity and healthy diet are the two main components of maintaining a healthy weight. A Calgary study connected BMI to transportation more directly, showing that persons who drive more are less likely to be physically active and more likely to be overweight even when they were sufficiently active.54 A study in Atlanta found that “each additional hour spent in a car per day was associated with a 6% increase in the likelihood of obesity [while] each additional kilometer walked per day was associated with a 4.8% reduction in the likelihood of obesity.”55 While it is difficult to determine how much of the obesity problem is caused by physical inactivity alone, it is generally understood that it is, along with diet, a primary agent in unhealthy weight.56 In addition, without regular physical activity, overweight persons are unlikely to achieve significant weight loss, even with a reduced calorie intake.57

3.6. **A4: BODY MASS INDEX & CHRONIC DISEASE LINK**

“Overall, [in Canada] in 2004, 45% of hypertension, 39% of type II diabetes, 35% of gallbladder disease, 23% of coronary artery diseases, 19% of osteoarthritis, 11% of stroke, 22% of endometrial cancer, 12% of postmenopausal breast cancer, and 10% of colon cancer could be attributed to obesity. In 2004, 8,414 (95% CI: 6,881-9,927) deaths were attributable to obesity.”58

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Considering data from 2008, one quarter of Canadian adults are obese—over a 2% increase from the measured rate in 2004. Severity of obesity is increasing as well, with rates for class I (BMI: 30-34.9), class II (BMI: 35-39), and class III (BMI: 40) increasing by one third, doubling, and tripling, respectively, between 1978 and 2004. Obesity is a serious public health concern, largely because it contributes to the incidence of many chronic diseases. Research has linked obesity (usually measured using BMI) to higher risk of cardiovascular disease, respiratory illness, Type 2 diabetes, arthritis, certain forms of cancer and mental health problems. High BMI in childhood has been consistently linked with overweight and obese status among adults, in addition to earlier onset of the previously mentioned chronic diseases. Furthermore, obese persons are three times more likely and overweight persons one and a half times more likely to undergo joint replacement surgery than persons with a healthy weight, and obese persons require more and longer hospital stays.

3.7. **B1: VEHICULAR TRAVEL, VOLUME & EMISSIONS LINK**

“Greenhouse gas emissions from private vehicle operation [in Canada] reached 70,774 kilotonnes of CO2 equivalent in 2007, an increase of 3% from the 2006 level. Compared to the 1990 emissions level of 52,256 kilotonnes, emissions in 2007 have gone up 35%, almost twice the growth rate of population (19%) during the same period.”

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Increases in automobile use are generally accompanied by increases in air pollution and noise from vehicle traffic. Advancements in emissions technology and engine insulation have significantly reduced the air and noise pollution produced by each individual vehicle, but these gains have been at least partially offset by real increases in total distance traveled.\textsuperscript{70} For instance, Table 1 illustrates the increase in the total Vehicle Kilometers Travelled (VKT) throughout the Metro Vancouver and Fraser Valley Regional District between 1990 and 2000.\textsuperscript{71} It is important to note that even though the total kilometers travelled per personal vehicle has actually decreased between 1995 and 2000 in Metro Vancouver; the increase in the number of vehicles on the road serves to keep the total VKT on the rise.\textsuperscript{72} Average vehicles per capita in Metro Vancouver has grown from 61 per 100 persons in 2003 to 64.1 per 100 persons in 2009.\textsuperscript{73}

| Table 1 - Total Vehicle Kilometers Travelled (VKT) Across the Lower Fraser Valley |
|---------------------------------|---------|---------|
| 1990                            | 1995    | 2000    |
| Auto                            | 13,821,815,861 | 16,040,005,340 | 17,379,438,867 |
| Light Truck                     | 306,706,774   | 358,249,477   | 388,165,387   |
| Heavy Truck                     | 266,418,601   | 309,174,701   | 334,992,582   |
| Bus                             | 48,258,391    | 56,003,123    | 60,679,708    |
| TOTAL                           | 14,446,199,627 | 16,763,432,640 | 18,163,276,545 |

Air pollutants can originate from a variety of sources, which include both mobile and point sources. Figure 7 illustrates the emissions profile of the Metro Vancouver region in 2005. As can be seen, the largest share of emissions originates from on-road motor vehicles.\textsuperscript{74} When considering motor vehicles, emissions depend on a number of factors, including ambient temperature, travel speed, fuel quality and the characteristics of the pollutant.\textsuperscript{75} Furthermore, actual population exposure to air pollution is complicated by urban form issues such as proximity to traffic, intersection density and physical

\textsuperscript{70} Giles, et al. “From good intentions to proven interventions: effectiveness of actions to reduce the health impacts of air pollution.” \textit{Environmental Health Perspectives} 199.1 (2011).


\textsuperscript{74} Metro Vancouver. \textit{Regional Growth Strategy: Climate change as a Driver for the draft Regional Growth Strategy}. Retrieved from \url{http://www.metrovancouver.org/planning/development/strategy/RGSBackgrounderClimateChange.pdf}

These interactions mean that some neighbourhoods and populations are more exposed to health risks from pollutants than others, and that efforts to reduce exposure to one pollutant can increase exposure to another. For example, a 2009 study of Metro Vancouver air pollution trends found that improved neighbourhood walkability was associated with reduced exposure to ozone, but increased exposure to nitric oxide. The study further found that certain upwind walkable neighbourhoods had low levels of both pollutants, but that often more central walkable areas had higher levels of particulates and lower levels of ozone. Outlying auto-dependent neighbourhoods typically had higher levels of ozone, but lower levels of particulates. The “sweet spots”, where walkability is high and air pollution is low, were all found to be in high-income areas, while the “sour spots”, with low walkability and high air pollution, were middle-income areas, indicating an important equity dimension of air pollution exposure. Figure 8 identifies these areas in Metro Vancouver.

![Figure 7: 2005 Metro Vancouver GHG Emissions by Source](image)


78 Ibid.
3.8. **B2: EMISSIONS & NOISE AND HEALTH OUTCOMES LINK**

*Health Canada estimates that air pollution causes 5,900 excess deaths per year in Canada.*

The most common vehicle pollutants are small particulates, along with volatile organic compounds (VOC) and nitric oxide (NOx), which together form ground-level ozone. While each of these has unique

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properties, all are connected to chronic health problems, such as respiratory and heart diseases,\(^8\) and increased dependence on respiratory medication.\(^2\) This dependence is the result of increased incidence of asthma attacks, decreased lung function, bronchitis, and other respiratory issues related to acute or short-term exposure. Long term exposure is linked to permanent decreased lung function, chronic bronchitis, and premature death.\(^3\) Air pollution is known to increase the risk of acute cardiovascular problems such as heart attacks as well as the overall incidence of heart disease.\(^4\)

Because air pollution exposure is a function of concentration of pollutants and duration, travel mode and route choice are of concern. Encouraging mode shifts to walking and biking along road corridors with high vehicle volumes can result in higher levels of personal exposure, creating a trade-off between increased physical activity and increased pollutant exposure. However, improvements to walking and biking infrastructure may reduce VKT and therefore improve air quality. In addition, these improvements may also be designed to shorten trip length for pedestrians and cyclists, and therefore reduce exposure time, minimizing potential negative impacts.\(^5\)

There is also mounting evidence that cardiovascular health is harmed by exposure to traffic noise.\(^6\) Loud noises produced by typical traffic sounds have been shown to contribute to general irritation throughout the day, having impacts extending even as far as contributing to the loss of sleep and exacerbating hypertensive conditions. In addition, loud noises can engage many other senses through synergistic action with vibration. The effects of vibration make sound more acutely perceived and have been shown to act upon diastolic blood pressure.\(^7\)

### 3.9. B3: VOLUME & SPEED AND HEALTH OUTCOMES LINK

Vehicle collisions also cause serious health concerns and impose significant social costs. In 2007, the Insurance Corporation of British Columbia reports that there were 47,870 traffic collisions resulting in

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27,556 injuries and 417 fatalities Province wide.88 A federal government report estimates that transportation accidents cost over 1.5 percent of Canada’s GDP.89 Many strategies have been implemented to reduce collisions and improve roadway safety, including a graduated license program, seatbelt laws and enhanced vehicle safety features, but these advances have also been partially offset by overall increases in VKT. Roadway safety can also be enhanced by providing safe active transportation infrastructure such as traffic calming90 and purpose-built bicycle specific facilities.91 Further research on road safety is presented in RTS Working Papers 1.400A and 1.400B.

3.10. B4: LAND USE / TRANSPORTATION INVESTMENTS AND MENTAL HEALTH LINK

Poor accessibility can also affect mental health by isolating those with mobility challenges. For example, the health and vision impairments that often accompany advanced age make many seniors unfit or unwilling to drive, despite living in areas where a car is a necessity for accomplishing daily tasks. In the absence of strong family support, these people may experience social isolation and its accompanying health concern, depression, as their mobility is reduced.92 A 2005 Statistics Canada report found that access to transportation significantly affected the social opportunities of seniors in Canada.93 Mobility has been shown to have an impact on mental health in the general population as well, with the evidence that limited activity space—the physical space within which a person travels in their daily activities—serves as a risk factor for depression among those living in otherwise deprived neighbourhoods.94 Further indicating the importance of activity space, walkability and safety was shown as a predictor of self-rated mental health in an Australian sample. In the same study, traffic and noise also proved to be a successful predictor.95

The mental health impact of engaging in forms of active transportation is less known. In one study of physical activity by purpose, active transport for leisure and walking to work showed no significant effect, whereas voluntary sports participation had a positive impact. Biking to work increased stress among blue collar workers, leading the authors to posit that in cases where biking is viewed as

necessary, its utility mitigates potential positive effects. However, research demonstrates that physical activity more broadly has positive impacts on mental health and psychological well-being. Further, simulations comparing stress in children walking or being driven to school suggest that walking to school may reduce cardiovascular and stressful reactions to challenges during the ensuing school day.

Road traffic noise can impact mental health through a variety of mechanisms. Noise annoyance is a term that refers to the displeasure or irritation resulting from negative noise exposures—both in terms of sound level and frequency of noise events. Noise annoyance can weaken an individual’s ability to adapt to stressors and increase negative moods or attitudes. Nocturnal noise has been shown to result in tiredness and other physical manifestations that contribute to depressed social orientation, extroversion and overall mood or well-being.

In addition to these potential hazards to mental health, the mere act of driving can also have deleterious mental health effects, acting as a stressor over both prolonged driving time, and acutely over relatively short trips. The somatic responses to driving have long been studied and understood with numerous studies in the US, Europe, and the UK all indicating that even the most casual driving over familiar routes can cause an elevated heart rate and self-reported feelings of anxiety. Under more difficult driving conditions such as coming to sudden stops and passing, drivers were shown to display considerably more harmful effects such a myocardial stress and indications of ischemia (inadequate blood flow to the heart).

It is well understood that sprawl often necessitates the use of a personal vehicle, the most prevalent and common use being the twice daily drive of the typical suburban commute. Studies researching the link between commuting and stress have shown that aspects of driving such as traffic jams, road construction, and long trips combine to produce physiological "stress" which can translate into psychological "strain" in drivers. This strain can manifest itself through feelings of anxiety, fear, uncertainty, frustration, and even aggression. Over the course of time, the overall effects of driving stress have been shown to decrease job satisfaction and commitment, lead to lost days of work, and compound external life stresses. Though a seemingly innocuous and ubiquitous part of life for most people, the act of driving can have substantial impacts on mental health.

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3.11. C: HEALTH OUTCOMES & HEALTH CARE COST LINK

“People with chronic conditions represent about 34% of the BC population, but they make up approximately 67% of health care costs.”

These health outcomes incur real costs on society and strain the capacity of the health care system. Cardiovascular disease, cancers, chronic obstructive pulmonary disease, and diabetes account for nearly three-quarters of all deaths in Canada, with cardiovascular disease alone claiming 35% of total deaths. This produces an estimated direct health care cost of $38.9 billion and indirect productivity losses of $54.4 billion (2002 dollars). Further a recent assessment found that the estimated direct health care cost of physical inactivity in Canada was $2.4 billion in 2009. This assessment looked at costs of seven major physical inactivity-related diseases—coronary artery disease, stroke, hypertension, colon cancer, breast cancer, Type 2 diabetes, and osteoporosis—based on their relative risk estimates for physical inactivity. The report found that total (direct and indirect) costs were $6.8 billion (2009 dollars). As mentioned in Section 2.1, chronic illness also affects individuals by reducing potential productivity, both throughout the life-course and by increasing the risk of lengthy incapacitation approaching end of life. A reduction in chronic disease not only decreases health care costs for acute treatments and procedures, but lengthens the healthy lifespan overall—meaning the time during which an individual draws on the medical system at end of life may be shortened. Transportation networks and systems can affect these costs. A meta-analysis of the effects of walking on coronary heart disease found that if the inactive population of Australia engaged in 30 minutes of walking 5 to 7 days a week, the direct health costs of coronary heart disease would be reduced by 12% and that these savings would double to 24% if the same population walked for 60 minutes 5 to 7 days a week. These estimated savings were only calculated for the direct costs of heart disease, but physical activity is known to reduce the risk of the four most common chronic diseases in Canada, so the savings of such a change could be much greater overall. Furthermore, a healthier workforce provides economic benefits in terms of fewer sick days and higher productivity.

3.12. CONCLUSION

Calculating the health and related economic impacts of transportation decisions requires an understanding of the multiple pathways of influence via behaviour change and exposure to

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105 Ibid.
environmental characteristics. By collecting data corresponding to these pathways, agencies can predict changes in active transportation, emissions, and traffic accidents resulting from a policy, and use this information to link activity levels to health care costs and savings. A number of approaches can be used to monetize the costs of ill-health, including the “value of statistical life” (VSL) method, the “cost of illness” method, the “years of life lost (or gained)” method and the “quality-adjusted life years” method, depending on the intended audience. Specific schemes for the incorporation of health metrics within transportation planning processes are discussed in the following chapter.

4. APPROACHES TO INCORPORATE HEALTH WITHIN THE TRANSPORTATION PLANNING PROCESS

This chapter reviews a range of strategies, approaches and tools to incorporate health into transportation decision making processes. Figure 9 below presents a generalized conception of the decision making process to provide the context for the approaches discussed in this chapter. As conceptualized here, the decision making process begins with the establishment of a broad vision and more concrete goals. These in turn provide the basis for the development of policy, a key aspect of which is the evaluation of alternatives. Policy implementation occurs through programs, which may be monitored using a variety of indicators to provide insights that feed back into how to design more effective policy. Monitoring results may also point towards the more fundamental need to reassess the vision and goals. Opportunities for public engagement, partnership and collaboration exist throughout the decision making process. Within this framework, the focus of this chapter is on the processes leading up to program implementation, with an emphasis on policy development, evaluation, monitoring and reassessment, and public engagement, partnership and collaboration.

**Figure 9: Conceptual model of Transportation Decision Making**

4.1 POLICY DEVELOPMENT

The goal in bringing health into transportation planning is making the implicit, explicit. There is an underlying awareness of the health costs of transportation-related noise, emissions, and sedentary
behaviour—and conversely, an awareness of the health benefits of active transportation and transit solutions. By incorporating health-related values and goals in transportation plans, health becomes an outcome. Health related policy language provides an effective starting point to make health part of the conversation when setting priorities.

Language choices surrounding this process are varied, and framing is important. The simplest method of integrating health into transportation planning is by linking it to sustainability. While interactions between the preservation of the environment and human health are complex, their discourse pairs well. Interventions such as fostering safe walking or cycling environments benefit both causes. Given pressing concerns about the impact of a sedentary lifestyle on chronic disease, health language can also carry a comparable level of urgency. As with green urbanism, incorporating health into planning represents a progressive stance. A series of examples of health concepts and policies in current transportation plans is outlined in Appendix 1.

An alternative to marrying health and environmental sustainability is to focus on the human aspect. Health interventions embedded in planning can be framed as an investment in community. Incorporating health objectives as a route to more complete, livable communities with healthier residents fosters a positive public perception of associated plans. Policies can also be used to address the health concerns of specific populations such as children, the elderly, low-income households, and those with mobility challenges. Here, social justice, equity, and a sense of civic pride or responsibility can be called on as support.

While incorporating health goals into policy documents is necessary, it may not be sufficient to effectively translate into results on the ground. A more concrete means to this end is directly linking funding to health related outcomes. For example, the 1991 U.S. Clean Air Act Amendments were enacted to link federal transportation funding to the ability of a region to uphold the health based National Ambient Air Quality Standards (NAAQS). However, behavioural considerations such as physical activity, dietary patterns and resulting obesity levels are newer and becoming more common considerations in some parts of North America. These policy considerations are taking place at national, state/provincial, regional and municipal levels.

Locally, Smart Growth planning principles have been used extensively in British Columbia and support health and transportation linkages by promoting compact communities, transit priority, and cycling and pedestrian infrastructure. In May of 2011, the British Columbia Ministry of Health launched a provincial strategy that aims to improve the health and wellbeing of the province’s population and one of the key areas of focus is “Healthy Communities.” This component of the strategy includes built

environment linkages with health, such as walking and bicycle-friendly neighbourhoods. It is not yet known how this strategy will be implemented throughout the province, but it is anticipated that the program will support efforts to better address built environment and transportation impacts on public health. The Provincial Health Services Authority (PHSA) in BC has also been involved in addressing healthy built environments, mainly through developing resources and workshops on the topic.

Also at the State/Provincial level, the State of California established the Health in All Policies (HiAP) Task Force “to collaborate with existing SGC [Strategic Growth Council] working groups to identify priority programs, policies, and strategies to improve the health of Californians while advancing the SGC’s goals of improving air and water quality, protecting natural resources and agricultural lands, increasing the availability of affordable housing, improving infrastructure systems, promoting public health, planning sustainable communities, and meeting the state’s climate change goals.” This action indicates recognition of the public health consequences of decisions taking place in agencies without an explicit health mandate and supports efforts at state as well as regional levels to identify and account for public health outcomes in decision making.

Transportation policies that make explicit mention of health are becoming more common at the regional and local levels. Examples discussed throughout this document are from Nashville, Tennessee; Portland, Oregon; and the Puget Sound Region of Washington. Appendix 1, referenced above, provides examples of these regional and municipal policies. The following sections outline two additional critical elements of policy development: evaluation of alternatives, and monitoring and reassessment.

### 4.2 EVALUATION

Many evaluation tools currently used in planning may be adapted to incorporate health into transportation planning. This section presents several examples of the use of these tools in evidence based decision support:

- Multi-Criteria Analysis,
- Rating Systems,
- Economic Analysis,
- Scenario Planning, and
- Health Impact Assessment.

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4.2.1 Multi-criteria analysis

Opportunities exist to incorporate health and equity objectives more explicitly into project evaluation criteria. In implementing their Transportation 2040 plan, the Puget Sound Regional Council established a working group that includes representation from health and provides information and recommendations to aid in the development of an improved prioritization process for transportation decisions. While still under development, the prioritization process will involve an advisory committee of experts using scorecards to rate potential projects on a series of prioritization measures, each with a series of evaluation questions, and augmented with cost-benefit information. Of note, is the inclusion of health and equity related measures in the scoring process:

- Does the project increase opportunities for physical activity? (active living)
- Does the project result in specific benefits to minority or low-income population groups?
- Does the project avoid negative impacts on minority and low-income residents?
- Does the project mitigate or eliminate a previous negative impact on a minority or low-income community?

4.2.2 Rating Systems

Rating systems, such as Leadership in Energy and Environmental Design, are popular for evaluating the design, construction and operation of buildings, homes and neighbourhoods, but are not as common in transportation planning. Since 2008, the Portland Bureau of Transportation and North American Sustainable Transportation Council (STC) have been developing a set of tools under the name STARS (Sustainable Transportation Analysis & Rating System). Throughout STARS, there is a focus on improved access—a pairing of mobility and land use—rather than just mobility. Thus far, three STARS tools have been produced: STARS-Project; STARS-Plan; and Safety, Health, and Equity Credits.

STARS-Project is a manual aimed at helping stakeholders in a position to influence transportation projects—planners, elected officials, the public—make decisions that improve short- and long-term outcomes while improving sustainability. STARS-Project considers cost-effectiveness and focuses on strategies that improve projects in as many facets as possible while making strides in sustainability. STARS-Plan provides a framework to establish sustainable goals and objectives as well as ways to measure them—with a focus on interventions that achieve multiple goals. STARS-Plan is three-phase, and at this point only the first phase has been developed. This involved establishing goals, objectives, and measures while the second and third phase focus on requirements for meeting those goals and

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creating certification processes, respectively. Ultimately, STARS-Plan will be a formal process for rating the sustainability of plans.

STARS incorporates health and related issues into their framework through the document titled “Safety, Health and Equity Credits.” The report focuses on incorporating these three credit categories into project planning. The Health category includes three goals, each with one objective, which speak to active transportation, air quality, and traffic noise exposure. As the STARS toolkit is further developed, adherence to and documentation of its goals and objectives could be beneficial in certifying the sustainable and health-promoting nature of transportation plans and projects.

4.2.3 Economic Analysis

Economic analysis, such as cost-benefit analysis (CBA), is commonly utilized to assess major transportation investments, but the full range of health benefits and risks of projects are typically not quantified in mainstream transport CBAs, especially for alternative modes of transport development. “CBA that does not fully account for induced travel and the land-use impacts of transport projects tends to ignore many important transport-related health impacts, and to favour car-oriented transport planning over non-motorized travel.” However, there is growing interest in developing economic appraisal methodologies that can incorporate these considerations.

Over the past several years, the World Health Organization coordinated two projects that culminated in the development of a health economic assessment tool (HEAT) for cycling and walking. This web-based calculation tool enables an economic assessment of the health benefits of walking or cycling by estimating the value of reduced mortality that results from specified amounts of walking or cycling. The tool is designed to be applied in a variety of contexts, such as when planning a new piece of cycling or walking infrastructure or to provide input into a health impact assessment or other economic assessment. The tool has been applied in several countries within Europe and elsewhere to evaluate specific infrastructure projects or to estimate annual saving from a specified change in mode share. By attaching a value to the estimated level of walking or cycling that will result from a new infrastructure investment, a benefit-cost ratio can be calculated that factors health into the transportation decision making process.

“HEAT for cycling was also used to evaluate the possibility of adding cycling and pedestrian facilities to the Auckland Harbour Bridge, the major bridge connecting Central Auckland with the North Shore that currently only provides access to cars, trucks and buses. Based on hypotheses for the number of adults that would use the Bridge for regular commuting, the average distance they would cycle and the frequency of use, the mortality benefits and

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123 Ibid.
The New South Wales Premier’s Council for Active Living in Australia has initiated projects to prepare for incorporating the health benefits of walking into transport appraisal methodologies. Recognizing that increased walking can impact mortality (death), morbidity (illnesses or disease burden) and ailments related to physical inactivity, it is expected that health care costs will be reduced with improved health outcomes. A methodology has been developed to enable the application of CBA to walking initiatives. It provides a set of appraisal parameters to be consistently applied when examining the costs and benefits of walking initiatives. This type of approach can aid policy and decision makers when deciding how to allocate transportation funds. A hypothetical case study application of the methodology evaluated the benefits of achieving a 5% switch and a 10% switch in the proportion of private vehicle trips under one kilometre to walk trips. The results of this case study are discussed further in Chapter 5.

While methodologies for incorporating health costs and benefits into cost-benefit analysis are in their early stages, the HEAT tool and Australian approach represent promising examples of the potential for these types of methodologies in transportation planning.

4.2.4 Scenario Planning

Scenario planning tools enable the objective evaluation and comparison of several alternative land use and transportation alternatives. One example of such a tool is I-PLACE3S, a web-based modeling platform for scenario planning. This tool can be used to evaluate alternative land use and development scenarios or transportation investments using indicators to assess transportation patterns, energy use, cost efficiency, and climate change. Another scenario planning tool, the Integrated Transport and Health Impacts Model (ITHIM), enables the analysis of transport policies and scenarios with regard to changes in physical activity, road traffic injury risk, and urban air pollution. Inputs for the tool include results from models of travel demand, vehicle emissions, and air pollution, along with traffic collision, vital statistics, and health survey data. The tool relates physical activity, air pollution, and travel behaviours to specific health outcomes available in the literature. These outcomes include heart and respiratory disease; stroke; diabetes; cancers of the breast, colon, and lung; dementia; and depression. The California Department of Public Health, the Metropolitan Transportation Commission, the Bay Area Air Quality Management District, and the developers of the ITHIM recently tested the model with scenarios

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of active transport and low carbon driving in the San Francisco Bay Area. Using a scenario with active transportation representing 15% of miles traveled relative to the business as usual case of 2%, the model predicted the following: 13% fewer premature deaths, 15% fewer years of life lost due to cardiovascular disease and diabetes, and 10% fewer deaths and life years lost from dementia.\textsuperscript{128}

Recently, the widely used software platform known as CommunityViz has been used to model health impacts of alternative approaches to land use and transportation within the San Diego\textsuperscript{129} and Toronto regions.\textsuperscript{130} CommunityViz has a robust user interface and is an effective visual tool. These tools allow citizens to become more informed about the types of transportation investments required to meet desired health outcomes. They incorporate detailed parcel level land use and other built environment data with travel survey, demographic, and health outcome data from the California Health Interview Survey and Canadian Community Health Survey respectively. Users are able to program in detailed parcel level land use, transportation system, and accessibility characteristics of alternative development scenarios as inputs to these tools. The software then predicts the impacts of these characteristics on a range of health indicators including utilitarian physical activity (minutes of walking and biking), minutes of sedentary transportation, minutes of leisure physical activity, body mass index, overweight/obesity, diabetes, cardiovascular disease, high blood pressure, asthma, and risk of pedestrian/cyclist collisions with automobiles.\textsuperscript{131}

In San Diego, CommunityViz was used to create a template for the San Diego Association of Governments (SANDAG) and other local jurisdiction partners to evaluate potential health impacts of planning decisions as part of the SANDAG Healthy Works project. Two case study sites, both areas planned for future intensification and transportation improvements, were used as templates: the Palomar Gateway area in Chula Vista, and the site of SANDAG’s South Bay Bus Rapid Transit (BRT) project. Results from these case studies highlight the utility of the tool in visioning alternative development impacts. For example, the findings of the BRT case study indicate that planned built environment changes result in adults experiencing consistent health benefits, as demonstrated by physical activity, body weight, chronic disease, and general health indicators. Beyond demonstrating this overall positive result, the tool was also used to highlight substantial variation in health outcomes between project subareas, due to large differences in urban form and forecasted land use changes.\textsuperscript{132}

While discussed in greater depth in a case study (Chapter 5), the tool developed for the Toronto region was used to assess the outcomes of the redevelopment of the West Don Lands neighbourhood from industrial lands into a sustainable, mixed-use, pedestrian-friendly, riverside community.\textsuperscript{133} Table \textsuperscript{134}

\textsuperscript{128}Ibid.
\textsuperscript{129}www.sandag.org/?projectid=381&fuseaction=projects.detail
\textsuperscript{130}www.toronto.ca/health/hphe/built_environment.htm
\textsuperscript{134}Daily energy expenditure, expressed in kcal/kg/day (PACDTLE), was derived by Statistics Canada based on participant responses to several activity questions. It is calculated by combining the time each participant spent engaging in leisure (e.g. walking, cycling, sports) and transportation (e.g. walking/cycling to work) activities in the
compares the physical activity, travel, and health outcomes of the redevelopment in the West Don Lands relative to existing conditions in that neighbourhood and the city as a whole. Results indicate positive estimated impacts across all outcomes of interest. It is estimated that the planned development will generate 6,000 new active trips per day (nearly 0.5 daily active trips per resident), over 200,000 new exercise walking trips per month, and approximately 145,000 new walking trips to work or school per month.\textsuperscript{135}

Table 2: Estimated Outcomes for Study Area (West Don Lands-WDL)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>City Level (Existing Conditions)**</th>
<th>WDL Existing Conditions*</th>
<th>Change Scenario 1: WDL Plan*</th>
<th>Percentage Change Scenario 1: WDL Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>average active trips/person/day</td>
<td>0.14</td>
<td>0.23</td>
<td>0.48</td>
<td>106.8%</td>
</tr>
<tr>
<td>average transit trips/person/day</td>
<td>0.49</td>
<td>0.60</td>
<td>0.79</td>
<td>31.7%</td>
</tr>
<tr>
<td>average automobile trips/person/day</td>
<td>1.33</td>
<td>1.00</td>
<td>0.52</td>
<td>-47.5%</td>
</tr>
<tr>
<td>average trip kilometers/person/day</td>
<td>22.58</td>
<td>18.17</td>
<td>15.43</td>
<td>-15.1%</td>
</tr>
<tr>
<td>average CO2 generated from vehicles (kg/HH/day)</td>
<td>4.21</td>
<td>3.38</td>
<td>2.39</td>
<td>-29.3%</td>
</tr>
<tr>
<td>walking for exercise monthly freq.</td>
<td>10.12</td>
<td>14.25</td>
<td>15.57</td>
<td>9.2%</td>
</tr>
<tr>
<td>walk to work/school monthly freq.</td>
<td>5.58</td>
<td>7.79</td>
<td>10.94</td>
<td>40.4%</td>
</tr>
<tr>
<td>bicycle for exercise monthly freq.</td>
<td>0.63</td>
<td>1.08</td>
<td>1.53</td>
<td>41.6%</td>
</tr>
<tr>
<td>bicycle to work/school monthly freq.</td>
<td>0.25</td>
<td>0.80</td>
<td>2.71</td>
<td>238.7%</td>
</tr>
<tr>
<td>daily energy expenditure (kcal/kg/day)</td>
<td>2.04</td>
<td>2.28</td>
<td>2.73</td>
<td>19.7%</td>
</tr>
<tr>
<td>body mass index</td>
<td>24.64</td>
<td>24.31</td>
<td>24.14</td>
<td>-0.7%</td>
</tr>
<tr>
<td>high blood pressure (likelihood)</td>
<td>7.38%</td>
<td>9.58%</td>
<td>9.11%</td>
<td>-4.9%</td>
</tr>
</tbody>
</table>

*Unweighted average of postal code values
** Population weighted average of postal code values

The Toronto tool was also piloted in the Surrey, BC, as a means of evaluating its potential for application in other parts of Canada. The Central Station area, as part of the Surrey City Centre, is expected to undergo substantial built environment and transportation infrastructure changes as part of plans to develop into a regional downtown for the South Fraser Region.\textsuperscript{136} Comparing the proposed change scenario to existing conditions, results indicate benefits to activity levels and health outcomes, with

last three months. The total calories burned during all activities was calculated and converted into a daily value based on the participant’s weight. Respondents are classified as follows: 3.0 kcal/kg/day or more = physically active; 1.5 to 2.9 kcal/kg/day = moderately active; less than 1.5 kcal/kg/day = inactive. Source: Canadian Community Health Survey (CCHS): 2008 (Annual component) and 2007-2008, Derived Variable (DV) Specifications, Master and share file. http://www.statcan.gc.ca/imdb-bmdi/document/3226_D2_T9_V6-eng.pdf


\textsuperscript{136} Ibid.
cycling trips to work or school estimated to double and daily vehicles trips estimated to decrease by nearly 50 percent.\(^\text{137,138}\)

In contrast to such complex map-based models, some scenario testing tools have been designed for relatively high level comparisons. As one example, Calthorpe Associates developed a spreadsheet based scenario planning tool called the ‘Rapid Fire Model’ to evaluate a range of metrics corresponding to alternative land use and transportation infrastructure investment policies. This model was designed to be scalable to the state, region or county levels.\(^\text{139}\) Metrics evaluated using the Rapid Fire Model include several health related variables such as the incidences of respiratory and cardiovascular diseases. The model has been used as part of the Vision California project to analyze a set of statewide growth scenarios. In this application, model results demonstrated substantial reductions of health incidences and health costs corresponding to transit oriented, compact growth scenarios ($3.1 Billion annually by 2035).\(^\text{140}\)

4.2.5 Health Impact Assessment

HIA is a multidisciplinary process that incorporates quantitative, qualitative and participatory techniques in a decision making framework.\(^\text{141}\) For projects, plans and policies in non-health sectors, such as transportation and land use, HIA provides a structured method for assessing and improving health outcomes. HIA is used extensively in Europe, Australia, New Zealand and elsewhere. It has also been applied in Canada, often as a component of environmental assessments, and is gaining momentum in the United States.

While a variety of methods and approaches exist, HIA typically follows the main steps outlined in Figure 10:\(^\text{142,143}\)

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\(^\text{137}\) Scenario Descriptions for Surrey Central Station (SCS): **Existing conditions:** The area surrounding the Surrey Central Skytrain station, which currently contains largely single family development, some multi-use, higher density development, and the Simon Fraser University Surrey Campus. **SCS Plan (Change Scenario):** This scenario was designed to match the pre-existing development plans for the SCS as closely as possible, adding over 11,000 residential units, 100,000 square feet of mixed use, commercial and retail development, a public plaza, and a finer grained street grid. New bicycle lanes and full sidewalk coverage were also added to the Change Scenario.


HIA can be valuable in transportation planning because it provides evidence about the health impacts of a project. The process of conducting an HIA can bring about increased awareness and understanding of the health consequences of transportation policies and decisions. HIAs are intended to be multi-disciplinary and participatory so they are also a means to engage stakeholders and improve interagency collaboration. HIA is flexible: it can be applied to policies, programs, project and plans at a variety of scales (e.g. local, regional, national). However, there are some challenges and limitations associated with conducting health impact assessment:

- lack of agreed upon methods for HIA
- gaps in the evidence base for health impacts
- difficulties with quantifying health impacts (reduces accuracy of models)
- lack of capacity to conduct the assessment (few professionals trained in this area)
- lack of time and resources
- lack of political support (context dependent)

In order to address these challenges, Canada could consider a policy change that merges or pairs Health Impact Assessment with already-mandatory environmental assessments. The Canadian Environmental

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145 HIA has been applied to variety of transportation policies, programs and projects, including at the community, regional, and state level. Case studies are available at: [http://www.hiaguide.org/hias?page=2&term=&pathway=All&sector=369&method=All&heffect=All&x=41&y=12](http://www.hiaguide.org/hias?page=2&term=&pathway=All&sector=369&method=All&heffect=All&x=41&y=12) and [http://www.cdc.gov/healthyplaces/transportation/case_studies.htm#more](http://www.cdc.gov/healthyplaces/transportation/case_studies.htm#more)


Assessment Act of 2012 (CEAA 2012) requires an environmental assessment to take place when there is potential for a project to adversely impact certain habitats and land types. This evaluation looks at environmental effects of development, but not at the human health impact. Were a similar act to be instituted related to HIA, or were CEAA 2012 modified to include aspects of HIA, the process would become standardized and gain strength.

HIA is increasingly being applied to transportation policies and projects and a number of case studies are available to date. For example, the Healthy Transportation Compact, adopted by the Massachusetts legislature in 2009, requires the Massachusetts Department of Transportation to establish methods to implement Health Impact Assessments (HIAs) on transportation projects. This interagency initiative is intended to “facilitate transportation decisions that balance the needs of all users, expand mobility, improve public health, support a cleaner environment and create stronger communities.” A recent analysis of 27 transportation HIAs taking place in the US between the years 2004-2011 showed that HIA can be applied in a variety of contexts including corridor redevelopments, road and bridge redevelopments, transit projects, trails and greenways, and community transportation plans. Some of the documented outcomes of this process include increased awareness of health issues, health professional inclusion in decision making teams, and endorsement for projects and policies that are health-promoting.

4.3 MONITORING & REASSESSMENT

Monitoring is employed to assess consistency between adopted policy and action, and as illustrated in Figure 7, to provide feedback on progress towards desired outcomes to inform future visioning and policy development exercises. Individual indicators assessed through monitoring exercises may be analyzed on their own to assess trends over time; or in conjunction with other indicators to assess relationships between measures such as those between land use and transportation investments, and health outcomes; or to feed back into evaluation exercises (as discussed above, 4.2).

A first step in creating a system for monitoring and reassessment is to establish a framework for selection of indicators that captures all relevant categories of indicators. The framework developed by the Strategies for Metropolitan Atlanta’s Transportation and Air Quality (SMARTRAQ) project offers an example of one such approach. Figure 11 highlights this four-tiered framework for developing and grouping performance measures for monitoring. It outlines how transportation investment and land use

149 Case studies are available at: http://www.hiaguide.org/hias?page=2&term=&pathway=All&sector=369&method=All&heffect=All&x=41&y=12 and http://www.cdc.gov/healthyplaces/transportation/case_studies.htm#more
actions affect the built environment, which in turn impacts travel choices, environment, health and quality of life. This scheme closely parallels the Built Environment & Health Linkages Model introduced in Chapter 3, which could potentially be used as a more comprehensive indicator framework. The advantage of the SMARTRAQ framework is that it provides a clear, simplified model that could be easily communicated to non-technical audiences. In this model, transportation agencies play a critical role in forming the basis of this pyramid and decisions at this level ultimately affect the tiers above.

Figure 11: Performance Pyramid

While transportation performance measures are relatively well developed, the incorporation of health related indicators into transportation plans, processes and evaluations is in a relatively nascent stage. Health outcome indicators are population rates of individual-level disease or wellness. Indicators of determinants of health cannot show presence or absence of ill health, but instead show those external, community-level factors that are known to impact it. Other health related indicators include measures of health behaviours (e.g. minutes of Moderate to Vigorous Physical Activity per day), and health related anthropomorphic measures such as Body Mass Index (Figure 5). Examples of indicators are included in Appendix 2.

Beyond examining trends in individual health related indicators over time, bivariate and multivariate relationships between these indicators and other indicators may also be assessed to provide more concrete insight into the effectiveness of planning policies in influencing health outcomes. Such analyses are however complicated because it is difficult to show causality due to myriad confounders and multiple pathways through which the environment can influence health. To help address this, transportation agencies can also incorporate demographic and health related statistics into planning and decision making in order to better understand the populations they serve and target interventions effectively. These measures may also be incorporated into statistical analyses to assess relationships...
between environment and health while controlling for individual characteristics, or to assess moderating effects of these characteristics on the relationships.

Because health outcomes linked to transportation are primarily chronic in nature, long-term monitoring is generally required to demonstrate the health impacts of planning decisions. However, in the short-term, progress can be demonstrated using indicators of determinants of health. One way to measure how supportive an environment is of non-motorized transportation is to consider the infrastructure dedicated to it. While such indicators do not show any health effect, they gauge the presence or extent of health promoting structures, and when supported by well documented relationships established in other jurisdictions (Chapter 3), may provide moderate support for health related built environment interventions. Short term research can also be conducted to evaluate behaviour changes before and after the implementation of active transportation projects. Such natural experiments may be used to better demonstrate causal relationships between the built environment and behaviour than can be gauged through more conventional cross-sectional designs.\textsuperscript{153}

Mapping is also a powerful means to communicate these data (e.g. at risk populations) within agencies and with stakeholders. A Healthy Communities Atlas has recently been developed for the San Diego region. The Atlas presents a series of maps that depict built environment and health conditions that impact San Diego residents, providing an overview of the region’s health landscape. The indicators (e.g. transit accessibility, low mobility areas, pedestrian safety, access to healthy food, air pollution, etc.) are compiled at a consistent geography (Census block groups) which enables comparison between indicators. Furthermore, a companion Geographic Information System (GIS) tool can be used by regional health and planning agencies to conduct unique queries and geographic analyses. Ultimately, the Atlas and GIS tool can be used to identify areas in the region that could better support health through investments in infrastructure, programs, and /or policies. Finally, mapping and analysis can be combined to produce highly visual models of how built environment interventions might influence health across geographic regions (e.g. as part of scenario planning, discussed above).

4.4 PUBLIC ENGAGEMENT, PARTNERSHIP & COLLABORATION

4.4.1. Public Engagement

As with any other planning initiative, addressing public health requires robust public engagement. Essentially, the same public engagement tools used in transportation planning are also used to plan for healthy communities. However, the stakeholders that are involved in the process will likely expand to include health practitioners, public health experts and vulnerable populations. Likewise, the type of information brought forward will need to reflect a health focus as will the questions and input from the public.

**Strategies**

Below are some planning examples to illustrate strong engagement processes for health and transportation.

Nashville, Tennessee’s Metropolitan Planning Organization (MPO) consulted extensively with the public to create a new direction for transportation planning in the Nashville area. Among other changes, now 60% of the criteria for funding transportation projects are related to health, and safety.¹⁵⁴ To arrive at these changes, the MPO used a robust Public Participation Plan that included a number of strategies to reach different segments of the population. These included traditional engagement strategies such as advertisements and information in minority and community newspapers and local television, a website, well-promoted public meetings, and exhibits at community events. Additional engagement strategies included tagging on to other public meetings, conducting surveys and focus groups, and contacting people through a mailing list.

The Nashville MPO also used enhanced outreach methods to engage with marginalized groups. They partnered with organizations that represent some of these groups, such as the Hispanic Chamber of Commerce and the 100 Black Men of Nashville. They held meetings in accessible locations and sought donations from local businesses to provide incentives (such as light food and transit passes) for participation. They used a variety of communication devices including straightforward language, photos, renderings and charts to connect with more people.¹⁵⁵ Public demand for walkable communities spurred the reserve of 15% of the funding from the MPO’s largest pot of money (traditionally funds for urban highways) to be used for active transportation projects.

**Tools**

Because transportation and health as a combined area of interest is relatively new and largely unrecognized by the public, effective engagement will likely require an information strategy to explain the issues and connections. Planning for transportation systems with positive health

¹⁵⁵ See [http://www.nashvillempo.org/docs/PPP/PPP_Adopted_071807.pdf](http://www.nashvillempo.org/docs/PPP/PPP_Adopted_071807.pdf)
outcomes will therefore need to begin by explaining the health implications of transportation decisions before discussing projects that are underway, brainstorming ideas and setting priorities. This is what was done for the trail network plan in the Don Valley area of Toronto as well as the active transportation plan for the Township of Georgian Bay in Ontario. By using this workshop structure, these plans were able to inform stakeholders of the issues as well as generate feedback and determine priorities. Workshop effectiveness can be augmented by employing a variety of communicative devices, including interactive mapping, drawings, presentations and physical or virtual tours. This variety is especially important for engaging groups with lower rates of literacy or English proficiency.

Transportation and planning authorities that have incorporated health concerns into their projects do not need to reinvent the public engagement process. Many of the strategies they are currently using to engage with the public will be applicable to health-related content. However, because transportation and public health have long been construed as separate and unrelated fields, many stakeholders will require help bridging the gap between them. Engagement strategies should recognize this divide and modify their approach accordingly.

### 4.4.2. Partnerships & Collaboration

Efforts to identify and implement strategies for integrating health into transportation planning can be enhanced by the development of partnerships with health focused agencies and organizations at the local, regional, provincial and national levels. Furthermore, successful implementation of environmental and policy interventions to support health often requires new skills and non-traditional partnerships with organizations not working directly in public health.\(^{156}\)

Recognizing that decisions that affect public health often take place outside the jurisdiction of health agencies, public health professionals are interested in offering a health lens to planning processes and developments that affect transportation and land use. Medical Health Officers have a legislated role to protect the public from harmful health risks under the Public Health Act. They are advocates for addressing the broad determinants of health, such as healthy community design and transportation, bringing an evidenced based, non-partisan voice on behalf of the health of all residents in their communities. More broadly, health agencies can be valuable members of partnerships and are positioned well to make a variety of contributions within a collaborative setting.\(^{157}\)

1) **Evidence to make the case for change:** Public health professionals can present data and the evidence base showing the connections between transportation and health, such as data on the connection between transit use and physical activity. This evidence, presented at the board or council level, can help garner support for strategies from those in a leadership capacity. In

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\(^{157}\) Informed by personal communications with Kadie Bell, Public Health – Seattle & King County; Jennifer Moore, Multnomah County Health Department; Kate Rube, Active Design Program, City of New York; and Carol Haywood, City of Austin. March, 2012.
addition, communicating this type of evidence can also help build public support for policies and programs.

2) **Health and equity expertise:** Public health professionals can provide a health lens to planning processes and plans. If involved from the early stages of a planning process, health representatives can help to ensure that health and equity issues are addressed throughout a plan. Furthermore, public health professionals can evaluate the potential health impacts of an agency’s current policies and programs to help identify areas where health concepts and goals could be better integrated.

3) **Education and outreach:** Health agencies can help to educate the public about the connections between the built environment and health outcomes. Health agencies work closely with other agencies and community organizations, particularly those that work with vulnerable populations. Health agencies can provide information, such as a health brief, to these community groups and agencies about the plans, policies and initiatives its partners are working on. Furthermore, health professionals are well positioned to advocate for vulnerable populations in the planning process.

4) **Health data:** Health agencies can provide health related data on, for example trends in obesity or chronic disease. This data can help justify the need for policy change in a region or city. Health data can also be used for monitoring and evaluation purposes, such as before and after a transportation infrastructure investment. Data from health agencies can also be used in decision making processes to inform the prioritization of transportation projects and initiatives. For example, health agencies can map where vulnerable populations are concentrated and this information can aid decision makers in selecting projects that reduce inequities.

5) **Access to funds:** Working together, health and transportation agencies may be able to access new sources of funding to undertake research or support the implementation of transportation projects that are anticipated to improve health outcomes.158

6) **Project support:** Health agencies can endorse transportation projects that would foster positive health outcomes. For example, at a council or Board meeting when a preferred alternative is being selected, public health representatives can promote the option with the most desirable potential health benefits.

**Examples of Effective Partnerships:**

Partnerships between health and both land use and transportation planning are emerging at municipal, regional and provincial/state levels across North America. The US Centers for Disease Control and

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158 A greater proportion of healthcare funding will likely need to be committed to preventive care in order to support funding partnerships for healthy built environments between transportation and health agencies.
Prevention’s program Communities Putting Prevention to Work (CPPW)\textsuperscript{159} provided funding to fifty health departments across the US to support prevention strategies around tobacco use and obesity. Many of the obesity prevention strategies had a built environment element and have served as a catalyst to forge stronger connections between the sectors of health, planning and transportation. North Carolina’s Healthy Environment’s Collaborative (HEC), composed of the Departments of Health and Health Services, Transportation (DOT), Commerce, and Environment and Natural Resources, is a partnership of state departments with a mission “to integrate and align departmental efforts to improve the health of North Carolina’s people, economy and environments.” Working with the University of North Carolina Chapel Hill the HEC undertook an extensive analysis of policies, regulations, and guidelines that affect the built environment and physical activity. Once reviewed and prioritized by the members of the HEC, each department identified two to five key action items to pursue. The Department of Transportation examined the work they were already doing and identified areas where they could incorporate health language and messages. The DOT is currently preparing a policy on public health for the Board of Transportation and developing a state wide bicycle and pedestrian master plan that incorporates steps of HIA and includes health related performance measures.\textsuperscript{160}

Through the collaborative actions of thirty organizations, the Partnership for Active Communities in Sacramento California strengthened support for walking and cycling in school programs, land use development, and transportation infrastructure. Over the five year project, the partnership developed a focus on transportation infrastructure, specifically Complete Streets. The main achievements of this collaborative include establishing Complete Streets policies in Sacramento’s largest jurisdiction and Sacramento Regional Transit District incorporating Complete Streets as a cornerstone policy of its transit master plan.\textsuperscript{161}

The Columbus Healthy Places (CHP) program in Ohio was established to prevent obesity through built environment change and it promotes active transportation in community design. Initiated by the local public health department, the CHP created successful partnerships with a number of agencies within local government. The CHP strategy was to review city development rezoning applications. A key outcome of this partnership has been that 64% of development applications adopted active transportation components specifically recommended by the CHP review in 2009, prior to which only 7% of development application in Columbus included active transportation components.\textsuperscript{162}

In British Columbia, the Healthy Families BC health promotion program looks to enable healthy choices. Its Healthy Communities program partners with BC communities to start grassroots initiatives focused


\textsuperscript{160}Personal communications with Lori Rhew, North Carolina Department of Health and Human Services; James Emory, University of North Carolina – Chapel Hill; and Julie Hunkins, North Carolina Department of Transportation – March 29, 2012.


on making healthier cities and towns.\textsuperscript{163} The Provincial Health Services Authority supports a cross-sector alliance of BC organizations called the Healthy Built Environment Alliance, which improves links between public health and design professionals.\textsuperscript{164} Other initiatives address the interests of specific populations: Seniors BC’s Age-Friendly BC program advocates for communities conducive to all-age access,\textsuperscript{165} and the Social Planning and Research Council of BC produced the Accessible Communities Bylaws Guide to establish a set of best practices for writing policies that enhance neighbourhood accessibility for those with disabilities.\textsuperscript{166}

In the lower mainland, efforts to build partnerships among health, planning and transportation are gaining momentum. Vancouver Coastal Health entered into a formal partnership with the District of North Vancouver around the development of their Official Community Plan. Vancouver Coastal Health participated in the planning process by supplying health data, providing feedback on draft plans, participating in public meetings, and circulating a health brief to community groups committed to health promotion explaining why they support the approval of the plan.\textsuperscript{167} Established in 2010, the Health and Community Design Collaborative (HCDC) aims to enable, support, and maintain the development of healthy, low-carbon and equitable communities across British Columbia’s Lower Mainland. Its members currently include staff representatives from the regional government (Metro Vancouver), the regional transportation authority (TransLink), the region’s health authorities (Fraser Health and Vancouver Coastal Health), the University of British Columbia (Health & Community Design Lab), and has occasionally also had representation from local municipalities.\textsuperscript{168} The attendance and feedback from the October 2011 event “Integrating Active Transportation and Health into Municipal and Regional Transportation Planning”, co-hosted by the Health & Community Design Lab, the City of Vancouver and TransLink, indicates that agencies in the region are receptive to enhancing efforts to incorporate health into transportation planning. In light of this interest, many opportunities exist for transportation agencies and departments to engage more closely in partnerships with health agencies and organizations in developing plans, projects and initiatives in the region.

\textsuperscript{167} The Corporation of the City of North Vancouver – Community Development Department. Memorandum of Understanding Regarding the Participation of Vancouver Coastal Health in the OCP CityShaping Process. File No 6480-01-2011 (September 28, 2011).
\textsuperscript{168} Health & Community Design Lab: http://health-design.spph.ubc.ca/partnerships/
4.5 CONCLUSION

Many opportunities exist for incorporating health into the policy making process, whether through the use of tools such as scenario planning for evaluating alternatives, or through the use of health indicators within a broader monitoring strategy, or through the strategic incorporation of health language into policy documents. The most effective of these approaches are however likely to be those in which a transportation agency implements mechanisms to directly tie funding, programming decisions and project prioritization to health considerations. This includes performance based funding such as that enabled by the 1991 U.S. Clean Air Act Amendments. Efforts to involve health agencies in collaborative transportation planning (as in the development of the ITHIM model discussed above) are also instrumental for building institutional awareness of long-term public health benefits. Such efforts can in turn contribute towards bridging the current disconnect between transportation planning and health care costs. The case studies in the following chapter provide more detailed examples of how various agencies are working towards implementation.
5. CASE STUDIES

This chapter introduces three unique case studies that demonstrate a range of approaches to integrating health into transportation planning: (1) Regional Transportation Plan, Nashville Area MPO; (2) Cost Benefit Framework, Premier’s Council for Active Living, New South Wales; and (3) Health Impact Assessment Scenario Testing Tool, Toronto.

5.1. NASHVILLE AREA MPO 2035 REGIONAL TRANSPORTATION PLAN - IMPACTS OF TRANSPORTATION POLICY ON PREVENTION AND HEALTH

Description of the Issue
With Tennessee ranked fourth in the US for obesity rates, the Nashville Area MPO is pursuing infrastructure policies that reflect a desire for healthier options to get around communities— including safer, more convenient means to walk or bicycle for routine trips.

Institutional Context
The Nashville Area MPO is the transportation planning organization for the greater Nashville region—serving 1.3 million residents in twenty-two city and county governments—and is responsible for programming federal transportation dollars for projects that help to increase efficient movement and accommodate future growth throughout the region.

Approach
In December of 2010, the MPO adopted its 2035 Regional Transportation Plan, which marks a significant shift in increasing the support for active transportation projects. Transportation projects are scored based on positive outcomes for air quality, provision of active transportation facilities, injury reduction for all modes, improvement to personal health, and equity of transportation facilities in underserved areas.

Resources

Contact: Leslie Meehan, AICP – Director of Healthy Communities, meehan@nashvillempo.org
As seen below (Table 3), ten of the total possible 100 points in the scoring criteria are given for potential to improve health and environment, and negative points are assigned in cases where there are potential adverse consequences. In addition, another possible ten points is allocated to safety and security, making health and related environmental concerns directly responsible for 1/5 of the total potential score.

Table 3: Nashville Area MPO Project Evaluation Criteria, Health and Environment Section

<table>
<thead>
<tr>
<th>HEALTH &amp; ENVIRONMENT</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td>Project Improves Health &amp; Environment</td>
<td></td>
</tr>
<tr>
<td>Project Provides Increased Accessibility for Low-Income &amp; Minority Communities</td>
<td>+</td>
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<tr>
<td>Project Corrects ADA Non-Compliance</td>
<td>+</td>
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<tr>
<td>Project Provides Transportation Choices for the Disabled</td>
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<tr>
<td>Project Provides Transportation Choices for Aging Population</td>
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<tr>
<td>Project Provides Transportation Choices in Health Impact Areas</td>
<td>+</td>
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<tr>
<td>Project Promotes Physical Activity</td>
<td>+</td>
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<tr>
<td>Project Reduces VHT/VMT</td>
<td>+</td>
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<tr>
<td>Project Reduces Vehicle Emissions</td>
<td>+</td>
</tr>
<tr>
<td>Project Has Potential Consequences for Health &amp; Environment</td>
<td>-</td>
</tr>
<tr>
<td>Project Located Close to Natural Resources/Environmental Constraints</td>
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<tr>
<td>Project Located Close to Socio-Cultural Resources</td>
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The MPO also evaluates submitted transportation projects based on proximity to grocery stores, farmers markets and emergency food sources. Although this evaluation is not part of the official scoring criteria, it was part of the staff evaluation report for each project, which plays a role in the determination of which projects receive funding.

In addition, the MPO Executive Board endorsed a funding strategy which reserves 15% of Federal Surface Transportation Program (STP) funds, the largest federal funding source for roadways in the MPO region, exclusively for active transportation infrastructure and education. The total funding available over the next two decades is estimated to be $115 million. The 15% funding set-aside is separate from the funding for projects that were ranked on the scoring criteria. The national average of federal transportation dollars spent on bicycle and pedestrian infrastructure is around 1%, so the 15% reserved amount demonstrates a significant commitment to active transportation. The 15% may be used for infrastructure projects such as crosswalks, greenways and sidewalks; or education and promotional activities, such as Safe Routes to School Programs, maps of bicycle and pedestrian facilities, and education of law enforcement and the public on bicycle and pedestrian laws.

The MPO also reserved 10% of STP funds to be flexed to federal transit funds received by the MPO from the Federal Transit Administration. Combined with the funding for the criteria-ranked projects and the 15% Active Transportation funds, the MPO is spending a significant portion of federal funding on active transportation infrastructure and education.

Outcomes

The outcomes of the initiative are adopted regional transportation policies and dedicated funding for active transportation facilities that will impact a large number of people over the next several decades. The MPO has taken steps to prioritize these facilities so that underserved areas are addressed first. Over time, the positive impacts of the policies may include improved air quality, increased opportunities for
physical activity, decreased traffic crashes for all modes, and increased active transportation facilities for populations with higher rates of health disparities.

Following the adoption of the 2035 Regional Transportation Plan, five hundred transportation projects were submitted for the plan and were scored using the new criteria. MPO staff saw a significant shift in the type of transportation projects submitted for the estimated $6 billion dollars, with 75% of the submitted projects including an active transportation element such as a bikeway, sidewalk or greenway. The 2035 plan document showed that 70% of the adopted roadway projects have active transportation infrastructure, up significantly from the estimated 2% of projects in the 2030 plan.

Challenges and Lessons Learned
A key lesson for the MPO was the need to insert health into every stage of the planning process. Putting health-related language into a plan is the first step, adopting policy to support the language is the second step, creating funding to support the policy is the third step, and the fourth step is collecting baseline data to measure the impact of the policies over time. One of the challenges faced by the MPO was a lack of data on populations with health disparities and high rates of chronic diseases, such as asthma, diabetes and heart disease, at a sub-regional level. In order to address this data gap, the MPO will be collecting health data as part of a regional travel survey effort described below.

Next Steps
The MPO is currently conducting the Middle Tennessee Transportation and Health Study that is surveying 6,000 households on travel behaviour, overall health, and healthy habits of household members. The study includes a subset of 600 participants who wear GPS units and accelerometers to collect data on trips and physical activity rates. These participants will also fill out a survey, which asks questions about food security, physical activity rates, and prevalence of chronic diseases among household members. The study is collecting data that is integral to illustrating the relationship between transportation, physical activity, and overall health. This data will be used in the next update of the MPO Regional Transportation Plan to shape additional tools and policies on health outcomes in the regional transportation planning process.
5.2. **NSW Premier’s Council for Active Living - Development of a Cost Benefit Framework to Evaluate Active Transport Decisions Incorporating Health Benefits**

**Description of the Issue**
Australian transport planning and appraisal guidelines have traditionally described walking and cycling in qualitative terms with detailed discussion and guidance reserved for motorised modes. There has been less understanding of the potential role of these ‘active travel’ modes in promoting positive transport, health and social outcomes. The lack of an appropriate framework to quantitatively articulate the role of active travel options has meant the costs and benefits of these modes could not be measured in as rigorous a manner as motorised modes of transport.

Recent work in Australia and New Zealand has seen the development and refinement of walking and cycling economic appraisal frameworks and parameter values addressing the co-benefits of active travel modes including a range of health benefits. This has facilitated the theoretically rigorous estimation of benefits and costs of these modes consistent with cost benefit analysis frameworks adopted for other forms of transport.

**Institutional Context**
In New South Wales (NSW), the Premier’s Council for Active Living (PCAL) [www.pcal.nsw.gov.au](http://www.pcal.nsw.gov.au) is an Australian interagency group that aims to strengthen physical and social environments to increase participation in physical activity including active transport. The Council comprises senior representatives from government (linking infrastructure and service delivery agencies), industry and the non-government sectors.

PCAL was asked to prepare a number of background studies to inform the development of a state-wide walking strategy. Initial data analysis indicated that walking for short trips had been increasing over the last decade in the Sydney Metropolitan area. PCAL and the NSW Office for Environment and Heritage engaged PricewaterhouseCoopers to assist in developing a robust methodology to estimate the potential financial savings to the NSW Government of increasing the conversion of regular short car trips to walking.

**Approach**
A methodology was developed to establish an easy to adopt set of appraisal parameters to examine the costs and benefits of walking initiatives. A review of current international best practice was undertaken.

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**Resources**
- A number of walking related background studies including the walking methodology papers discussed in the case study are available on the PCAL website at [www.pcal.nsw.gov.au/draft_nsw_walking_strategy](http://www.pcal.nsw.gov.au/draft_nsw_walking_strategy)
and procedures adapted to ensure consistency with Australian transport cost benefit analysis frameworks used by NSW Treasury. The methodology incorporated a range of quantifiable benefits that have been identified from research as directly attributable to walking schemes including decongestion, reduced vehicle operating costs, avoided infrastructure provision, reduced environmental costs, and health benefits. Health benefit parameter values were derived by quantifying reduced mortality (death) and reduced morbidity (illness or disease burden). Both direct and indirect health benefits were calculated to generate an indirect cost per insufficiently active individual per annum. No comparable evaluation of bicycle use was conducted.

**Outcomes**

The methodology developed was utilised to quantify the financial benefits that would accrue from switching 1% of short car journeys (of less than one kilometre) within the Sydney Metropolitan area to walking trips over five and ten years. This was done by setting up parameters for the dollars per kilometre that would be generated in economic benefits for each benefit category, and does not account for contextual differences in trips or specify which trips qualify for conversion. Monetary values for specific influencing factors are taken from previous studies to create those parameters, and address such topics as health-related walking benefits in sedentary vs. active participants, cycling benefits, and health benefits of increased activity resulting from planning decisions.

Previous analysis of NSW walking data had indicated that a 1% annual shift towards walking for short trips (less than one kilometre) would be slightly higher than existing trends. Estimated benefits of $134 million and $214 million over five and ten years respectively were determined as a result of a switch to walking for short trips.

The estimated health benefits of walking are a significant proportion of the quantifiable benefits. Figure 12 provides an indication of the potential distribution of benefits emerging from walking policy implementation that focuses on short trip conversion as estimated by the proposed methodology. It shows the estimated distribution of benefits, but because the context of each project varies, the actual proportion of each category is likely to change and is not shown. The distribution of benefits between categories may change but the benefits from improved health in most cases will contribute the greatest share, followed by decongestion and environmental benefits.

The estimated financial benefits were also used to successfully advocate for the inclusion of walking specific targets within the new NSW Government’s overarching State Plan, and government funding will be allocated accordingly. The quantification of the conversion of short car trips to walking provided the financial case to help justify an increased focus on walking promotion.

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173These walking targets were 1) more than double the mode share of bicycle trips made in the Greater Sydney
Challenges and Lessons Learned
While quantification of the costs and benefits of walking and cycling has progressed, further comprehensive data is required to more rigorously quantify the health effects of active travel. Evaluations to date for example have typically included a limited range of health benefits, primarily utilising measures of mortality or disability adjusted life years (DALY) and excluding quantification of morbidity. There is very little empirical data available on the number and purpose of trips that would be generated through a walking project and sparse measures of current walking travel has also limited the ability to forecast demand. While the short trip definition used in this project did not account for contextual differences—and therefore whether or not conversion to walking was possible—this weakness in analysis is being addressed in current work, so future data will have greater depth. In addition, it is difficult to quantify the interaction between the health category—which only incorporated physical activity and sedentary behaviour—and other categories that would also impact health such as decongestion, noise reduction, and environmental benefits. As an evolving area of cost benefit analysis, the methodology needed to be viewed as a reflection of current international best practice adapted to ensure consistency with local transport CBA frameworks.

Within Australia, three key areas exist where evidence indicates that more comprehensive incorporation of active travel appraisal into established cost benefit frameworks is now feasible and desirable to ensure informed policy decisions including: the incorporation of active transport within option development and appraisal of transport initiatives (policies, plans, and projects), the inclusion of active

transport methodology and parameter values within future appraisal frameworks, and further investigation of the relationship between transport choices and health costs and benefits. This is bolstered by evidence that the largest proportion of quantified benefits relate to health, showing that health benefits would be significant. An immediate opportunity exists to incorporate a robust quantification of walking benefits into existing multimodal transport appraisals. Currently, multimodal demand modelling and economic quantification only capture the perceived user costs of walking.

**Next Steps**
Given their success in advocating for walking targets in the NSW State plan, the authors are proposing a methodology to help quantify demand in addition to mortality and morbidity changes associated with active travel related infrastructure projects. They are working with state and federal officials alike to incorporate these 'health parameter recommendations' as standard practice.

**5.3. Pilot Testing the Health Impact Assessment Scenario Testing Tool in Toronto, Ontario**

**Description of the Issue**
Chronic conditions such as asthma, diabetes, cancer, high blood pressure and heart disease are among the most common health problems affecting people in Toronto. Approximately 30% of residents aged 12 and older reported having been diagnosed with one or more common chronic conditions in 2008. About 40% of adults and 20% of teenagers were overweight and only 40% met the recommended level of physical activity for good health. Toronto Public Health has revitalized its ‘Healthy Cities’ approach as a useful conceptual and implementation framework to stimulate policy change in the built environment at the municipal level.

**Institutional Context**
Toronto Public Health (TPH) is the largest health unit in Canada and is responsible for protecting and promoting the health of approximately 2.6 million residents in the City of Toronto, and thousands more people who come to the city to visit or work. The Ontario Ministry of Health and Long Term Care requires that health units in Ontario, including TPH, work with their respective municipalities and regions to support the development of healthy public policies and create supportive built environments. One of TPH’s strategic priorities is to champion public policy using whole of government approaches and cross-sectoral collaboration, including municipal/regional government...

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174 The Ontario Public Health Standards 2008 are guidelines pursuant to Section 7 of the 1990 Health Protection and Promotion Act. Under the requirements for Health Hazard Prevention and Management, the Health Promotion and Policy Development section states that:

"The board of health shall assist community partners to develop healthy policies related to reducing exposure to health hazards. Topics may include, but are not limited to: Indoor air quality; Outdoor air quality; Extreme weather; and built environments."

departments and agencies, elected officials, and non-governmental organizations to improve the built environment and related health outcomes.

Given this mandate, TPH became a partner in the Healthy Canada by Design initiative funded by the Canadian Partnership Against Cancer (CPAC) through its Coalitions Linking Action and Science for Prevention (CLASP) program. The Heart and Stroke Foundation was the lead agency that co-ordinated all the specific CLASP projects. CPAC funding enabled TPH to retain Dr. Larry Frank and colleagues at Urban Design for Health (UD4H) to create a customized health-based decision support tool to enable public health, transportation and land use planners to assess key impacts of urban design scenarios.

Approach
TPH consolidated a wide range of new projects on the built environment through its Healthy Toronto by Design initiative. All projects included collaboration with policy advisors, technical experts and stakeholders within and beyond City government. Of key importance was engagement with opinion leaders and non-governmental organizations so as to understand community concerns, build mutually supportive relationships, and share knowledge.

TPH chose to pilot a health-based decision support tool as a part of the initiative. This tool can be applied at multiple scales, but was used at a neighbourhood level in this context. It uses local data to evaluate activity, health, and greenhouse gas (GHG) outcomes in the context of built environment decisions. TPH worked with UD4H to develop the following criteria for selecting the case study site:

- There is potential for dense/mixed use development
- The planned development would result in significant changes in the built environment
- New transit is planned for the area
- Support for the pilot is likely

Several different candidates for the pilot study were examined. The case study chosen was the proposed redevelopment of the West Don Lands, which was evaluated retrospectively. The West Don Land neighbourhood is a good example of the ways in which a former industrial area can be re-developed into a walkable and transit-supportive neighbourhood.

Located at the original mouth of the Don River, the West Don Lands neighbourhood is being transformed from former industrial lands into a sustainable, mixed-use, pedestrian-friendly, riverside community through re-development (Figure 13). The West Don Lands will accommodate a mix of housing, office space, retail/restaurants and staging areas, all just a 15 minute walk to downtown Toronto. The 32 hectare (80 acres) area will feature:

1. 6,000 residential units (20% of which will be affordable rental housing);
2. Up to 1 million square feet of employment, institutional and retail space;
3. At least one elementary school, and two child-care centres;
4. All surrounded by about 9.3 hectares of parks and public spaces.

The streets in the neighbourhood will enhance north south connections to adjacent neighbourhoods and lead to Don River Park. The scale of building heights is in keeping with that of surrounding communities. The West Don Lands will feature a mixture of mid-rise buildings and higher tower
buildings in strategic locations. Historical buildings will be preserved and incorporated in new developments.

Figure 13: West Don Lands Redevelopment

An innovative street design, called woonerfs, or living streets, will be used for some of the area’s local streets. Woonerfs, a concept originally developed in the Netherlands, are pedestrian-oriented streets that erase the boundary between sidewalk and street and provide a common public space shared by pedestrians, cyclists and low-speed motor vehicles.

The West Don Lands will also have new transit available within five minutes of residents and businesses. Streetcars will travel in their own transit corridor on the east side of Cherry and Sumach streets beside the eastern sidewalk. The street design prioritizes transit users and pedestrians. The idea is to create the street as an urban place, not simply a corridor for movement.

Outcomes
The software tool was used to model health-related outcomes for the planned high-density, mixed use West Don Lands development scenario in relation to three other scenarios: 1) no change to existing land use, 2) medium density, single use development, 3) comparison to an existing low-density single use residential neighbourhood. The outcomes examined included active transportation uptake (including walking, biking, and bus trips); carbon dioxide; and, health indicators such as energy expenditure, BMI, and blood pressure. The software tool demonstrated the clear health benefits associated with the West Don Lands scenario. These included higher physical activity levels through active transportation and reduced reliance on vehicle travel, more walking, cycling and transit use, fewer vehicle trips and reduced vehicle travel distances, and reduced CO2 emissions. These changes are expected to translate to significant health benefits for future residents at this new development compared with a more traditional development approach, and in comparison to the situation for the City as a whole.
The pilot provided evidence that the software tool is a helpful adjunct to understanding the potential health impacts associated with diverse development scenarios. While more qualitative health impact assessment approaches are important, the value of the software tool is that it can quantify and provide comparative data on key health-based outcomes. It can also help community and other stakeholders to better understand and visualize how diverse development scenarios are anticipated to affect the health of future residents and those living in the adjacent area.

Challenges and Lessons Learned
Given that the software tool is a new application in the Canadian context, it represents quite a departure from more traditional planning and health assessment approaches. The biggest challenge is demonstrating that the tool has value above and beyond traditional approaches, that it is based on a rigorous evidence-informed method, and that as such it provides a defensible assessment of development options, especially when there is resistance to adopting the healthiest design scenario. Other challenges include populating the model with local data, and providing sufficient training and support to health and planning staff on how to use the tool for maximum benefit.

The key lesson learned is that it takes time to build support for using new approaches and new tools. Knowledge transfer happens slowly at the outset of any new innovative initiative, and accelerates quickly with use and time. One way to accelerate knowledge transfer and support is to pilot test the tool in other regions.

Next Steps
Development of the West Don Lands neighbourhood is underway, with an expected start-date for occupancy in 2013 and a completion date of July 2015 for at least one portion of the neighbourhood dubbed the Athlete’s Village, which will host competitors for the 2015 Pan Am games.
6. CONCLUSIONS & RECOMMENDATIONS

6.1. KEY FINDINGS

The need to integrate health into transportation planning is becoming increasingly urgent. Health care costs are rising rapidly and already constitute 41% of the annual provincial budget. A significant portion of this budget is related to preventable chronic conditions including obesity, which currently produce more than $860 million in direct and indirect health care costs in each year. Exacerbating this situation, the rise in rates of chronic disease is expected to accelerate as BC makes the demographic transition to an older population over the next 25 years. Shaping travel behaviours through transportation planning represents a critical opportunity for reversing trends in rising health care costs because travel behaviour influences how physically active or sedentary people are, both of which are key determinants for many of today’s most prevalent chronic health problems. Furthermore, many opportunities exist for incorporating health into the policy making process, and various agencies are working towards implementation. These include adopting transportation plans that emphasize active transportation, evaluating transportation decisions in terms of health benefits, and developing health based decision support tools.

TransLink’s Regional Transportation Strategy provides an opportunity to embed public health concerns into the strategic goals of the agency and facilitates further work which integrates health outcomes into policy development and program delivery.

6.2. RECOMMENDATIONS

Recommendations have been categorized according to three major elements of the transportation planning process: Policy and Implementation, Public Involvement, and Partnerships. These recommendations highlight both initiatives that may be relatively easily implemented in the short term (e.g. reviewing existing surveillance tools to identify key indicators to monitor) and those requiring more substantial, longer term commitments (e.g. the integration of health into fundamental training and ongoing professional development of transportation engineers). Several of the recommendations are also partly contingent on the implementation of other recommendations. The distinction between recommendations 1 and 2 (building the evidence base, and using evidence to inform policy) reflects this contingency. Where relevant, specific stakeholders involved with implementation have been identified.

Policy & Implementation

1. **Build the evidence base**
   
   1.1 Establish a monitoring framework to identify categories of indicators necessary to understand the multiple pathways of influence on health via behaviour change and exposure (Figure 1)
   
   1.2 Review existing data sources and surveillance tools from both the health and transportation sectors to identify:
   
   • key indicators to monitor, and
   
   • available data that can be used for baseline or historic assessment
1.3 Institute policies to capture data on the chosen indicators
   • see also recommendation 6

2 Use evidence to inform transportation planning policy
   2.1 Identify reduction in chronic disease and injuries as a goal in high level transportation policy, providing a rationale for collaboration and for development of more concrete policies
   2.2 Develop concrete policies to link health and transportation, informed by local data when available, but also drawing on the rapidly expanding body of evidence from other jurisdictions
      2.2.1 Monetize health costs associated with specific transportation investments using methods such as the value of statistical life or cost of illness
      2.2.2 Explicitly link the evaluation and funding of transportation infrastructure to health via:
         • methods such as Cost Benefit Analysis, HIAs, and scenario planning
         • performance based transportation funding

3 Develop policies to foster institutional environments supportive of health-transportation integration
   3.1 Consider including expertise in public health or liaising with health practitioners as qualifications in job descriptions
   3.2 Work with professional organizations such as the Transportation Association of Canada and Institute of Transportation Engineers to further integrate health into fundamental training and ongoing professional development of transportation engineers, building on the current emphasis on safety
   3.3 Work with the Canadian Engineering Accreditation Board to amend national criteria and procedures to include health outcomes of transportation in the curriculum of accredited engineering programs in post-secondary institutions

Public Involvement
4 Use communications and engagement strategies to emphasize and build public knowledge of the connections between health and transportation choices
   4.1 Adapt existing community engagement tools to incorporate public health outcomes associated with transportation more explicitly
   4.2 Consider new approaches to demonstrate public health outcomes of transportation choices, such as HIAs and scenario planning
   4.3 Link health information to daily travel choices through tools such as the Trip Planner to help people better understand the impacts of these choices on their health

Partnerships
5 Continue collaboration with Regional Health Authorities, The Ministry of Transportation and The Ministry of Health
   5.1 Build relationships through activities such as:
      • hosting presentations and other forums to explore areas of common purpose and joint interest and to understand the opportunities and limitations of partnerships
      • developing and signing an MOU with health authorities to promote partnership work
• identifying key liaison positions
• ensuring health representation in advisory roles, for example, including public health professionals in presentations to the TransLink Board and high level management on health and transportation linkages

5.2 Work with regional health authorities to ensure that different geographic contexts are understood and considered in healthy transportation planning

5.3 Engage with the Provincial Government in discussions to address the disconnect between health care funding and health costs associated with transportation

6  Continue collaborations with academic partners to further develop the evidence base to inform policy

7  Strengthen partnerships by engaging health in defined, small-scale projects or plans as a starting point to build trust, with limited commitment
APPENDIX 1 – POLICY LANGUAGE

The integration of health into transportation planning is becoming more explicit, and many recent plans provide useful examples. Each organization has different motivations or priorities, and the policy language that they use reflects this. Listed below are examples of policy language used by plans to discuss 1) Active Transportation, 2) Air Quality and Noise Pollution, 3) Equity and Vulnerable Populations, 4) Sustainability, 5) Land Use, 6) Costs and Monetization, and 7) other miscellaneous topics. Following that, a second table lists examples of health-related goals and objectives.

### General Policy Language Examples

#### 1. Active Transportation

- Active transportation is self-powered or human-powered transportation that engages people in healthy physical activity while they accomplish the task of traveling from place to place. When an active transportation trip—walking or bicycling—replaces a motor vehicle trip, there is the added benefit of reduced congestion and harmful emissions, and improvements in quality of life.
  - *Transportation and Health*, Safe Transportation Research & Education Center (p. 2-1)

- Incentivizing automobile travel, whether by creating an artificially low cost for users or prioritizing auto infrastructure over other modes, will result in fewer people walking, biking, or using transit. A transportation system that encourages the use of active transportation modes, such as walking, biking, and taking public transportation, provides many health benefits for individuals and for communities by promoting physical activity.
  - *Health Equity & the Transportation System Plan*, City of Portland Bureau of Transportation (p. ii)

- There are three main components to the plan: ... To improve and expand upon active transportation choices and walkable communities; creating safe, scenic pathways connecting people to places while fostering healthy activity[.]
  - *2035 Nashville Area Regional Transportation Plan*, Nashville Area Metropolitan Planning Organization (p. vi)

- [T]hree major transportation policy initiatives: #2: Support Active Transportation and the Development of Walkable Communities to improve connectivity between people and places within the urbanizing area of the region, foster healthier activity for the region’s citizens, and to serve as the backbone of investments in mass transit.
  - *2035 Nashville Area Regional Transportation Plan*, Nashville Area Metropolitan Planning Organization (p. 1)

- Investing in accessible walking and biking networks and open space will provide residents increased opportunities for outdoor exercise as part of their daily routines.
  - *Imagine Austin*, City Planning Commission (p. 190)

- [G]etting physical activity as part of a transportation trip is an affordable and time-saving way to get physical activity. ... Taking a portion of these trips out of a car and transferring them into transit, walking or bicycling trips not only helps to improve congestion and air quality, but helps people get their daily physical activity.
  - *2035 Nashville Area Regional Transportation Plan*, Nashville Area Metropolitan Planning Organization (p. 10)

- [P]erhaps the most significant reason for the recent emergence of active transportation
initiatives relates more directly to personal health, and more specifically, the increasing costs to
the nation associated with an overall decline in public health, of which a share of the blame can
be attributed current and former public policies for transportation infrastructure that have
shaped the built environment.

- 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning
  Organization (p. 117)

- The opportunity to get physical activity as part of travel is available through facilities such as
  sidewalks, bike lanes, greenways and transit. These facilities have no membership fees or hours
  of operation, and combine the purposes of traveling and getting physical activity.

- 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning
  Organization (p. 201)

- Well-planned facilities for bicycle and pedestrian travel have been shown to have positive
  impacts on accessibility of destinations, air quality, congestion, health, local economies,
  personal savings, road maintenance and safety.

- CAMPO 2035 Regional Transportation Plan, Capital Area Metro Planning Organization
  (p. 38)

- Providing incentives to encourage changes in travel behavior, including adopting new behavior
  such as walking and bicycling, will help replace some motor vehicle trips with transit, walking, or
  bicycling, or by combining trips or changing the time when they are made.

- Transportation and Health, Safe Transportation Research & Education Center (p. ES-2)

- Public transit enables personal mobility for all people. There is enormous potential in the role
  that public transit can play in amplifying the practicality of walking and bicycling trips.

- Transportation and Health, Safe Transportation Research & Education Center (p. ES-4)

- Examining a few elements of this package of design approaches suggests there are beneficial
  effects. Adequate lighting is a top facilitator for walking. Continuous bike lanes or trails are some
  of the top facilitators for cycling and give pedestrians a buffer from traffic. Bicyclists choose
  routes based on bicycle facilities rather than travel distance.

- Transportation and Health, Safe Transportation Research & Education Center (p. 2-16)

2. Air Quality and Noise Pollution

- Additional costs of congestion include impacts to personal and environmental health. A study
  conducted in Atlanta during the 1996 Olympics found a significant decrease in hospital
  admissions related to asthma during the two-week period when the ADT on the regional
  roadways was down significantly. Studies such as this one provide insight into health concerns
  that may be related to air quality. New research indicates that severity of damage due to heart
  disease worsens as air quality deteriorates.

- 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning
  Organization (p. 45)

- The health effects of mobile source pollution are a growing hazard for people across America.
  According to the U.S. EPA, asthma accounts for more than 2 million emergency room visits,
  5,000 deaths, and costs the nation more than $14 billion per year.

- 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning
  Organization (p. 80)

- Ozone is the primary local air pollutant of concern in Central Texas. It is a serious public health
High levels of ozone are particularly problematic for vulnerable populations such as children, seniors and people who suffer from respiratory illnesses.
- CAMPO 2035 Regional Transportation Plan, Capital Area Metro Planning Organization (p. 57)
- The Nashville region is expected to be designated by the EPA as non-attainment for ozone levels by 2011 – indicating a growing health hazard for residents.
- 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 80)
- Tailpipe emissions, which are the by-products of fuel combustion, and emissions from electricity-generating sources (in the case of electric-powered vehicles) have a direct impact on the environment and human health. Their health effects are well-documented—higher incidences of: respiratory disease (such as asthma and chronic obstructive pulmonary disease), cardiovascular disease, and adverse pregnancy outcomes. Pregnant women, children, and the elderly are the most vulnerable.
- Transportation and Health, Safe Transportation Research & Education Center (p. ES-2)
- ... reducing the negative effects of transportation-related emissions. This can be accomplished through two approaches: reducing the amount of emissions that are generated and reducing exposure to these emissions when they do occur.
- Transportation and Health, Safe Transportation Research & Education Center (p. 1-1)

### 3. Equity and Vulnerable Populations

- Each federal agency is required to identify any disproportionately high and adverse health or environmental effects of its programs on minority and low-income populations.
  - 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 191)
- Particulate exposure has been directly associated with decreases in lung function in older adults already suffering from chronic obstructive pulmonary disease and in children with asthma. Generally, children and infants are the most susceptible to air pollutants because of their increased levels of physical activity and the fact that their lungs are still developing. Financially disadvantaged populations and minorities are disproportionately impacted by air pollution because they are more likely to live in areas with worse air quality.
  - Transportation and Health, Safe Transportation Research & Education Center (p. 1-6)
- [W]hile transportation investments have improved day-to-day life for some residents, many communities are not well served and the burdens of these investments have disproportionately impacted those who have historically been underserved including communities of color, people experiencing poverty, people with disabilities, and people experiencing language barriers. This burden further exacerbates high rates of negative health outcomes such as obesity, diabetes, and asthma, among others, in these communities.
  - Health Equity & the Transportation System Plan, City of Portland Bureau of Transportation (p. vii)

### 4. Sustainability

- If transportation programs and projects are to support social and economic activity, they must also contribute to the health and vitality of human and natural environments.
  - VISION 2040, Puget Sound Regional Council (p.77)
- Guiding Principle #2: Sustainability - Strive to support growth and prosperity without sacrificing the health, environment, natural and socio-cultural resources, or financial stability of this or
Greenhouse gases in the atmosphere trap heat and contribute to rising surface temperatures. This can trigger a multitude of mechanisms—including weather patterns and sea level rise—that can have adverse environmental health effects.

### 5. Land Use

- Land use and development patterns have created community environments in which many Americans never walk to destinations and have come to depend on motor vehicle travel. More than one-third of Americans reported having taken no walking trips in the previous week, in part because destinations are so spread out, or routes are not safe or welcoming.
  - *Transportation and Health*, Safe Transportation Research & Education Center (p. ES-3)
- Locating shops, offices, and services near homes, and ensuring that transportation infrastructure is well-connected and provides for a variety of transportation types, can promote walking, bicycling, transit use and greatly contribute to improved accessibility and mobility.
  - *Transportation 2040*, Puget Sound Regional Council (p. 7)
- Station area planning should consider the fine-grained issues and opportunities that help transit-oriented communities function well, such as attractive and functional walking and bicycling.
  - *Transportation 2040*, Puget Sound Regional Council (p. 11)
- Through improved land use, transportation, and urban design, Austin’s places can contribute to healthy lifestyles by encouraging walkable communities, parks and open space, and recreation and by reducing air pollution.
  - *Imagine Austin*, City Planning Commission (p. 173)
- Locating key destinations close to the populations they serve is associated with a high degree of walking as a regular transport mode. Increasing the mix of utilitarian destinations in neighborhoods encourages inactive individuals to make purpose-driven walking trips and encourages higher levels of active travel among already-active individuals.
  - *Transportation and Health*, Safe Transportation Research & Education Center (p. 2-8)

### 6. Costs/Monetization

- According to an article in the October 14, 2009 American Bicyclist Update, the U.S. government spends approximately $60 billion per year on transportation infrastructure. This outlay is dwarfed by the costs to the country resulting from the negative health impacts of transportation. Americans spend $168 billion a year on obesity, $76 billion a year on health care costs related to physical inactivity, partly because many individuals cannot safely walk, bicycle, or access public transit; $164 billion a year on health care costs associated with traffic injuries and deaths; and between $40 and $64 billion a year on health care costs associated with asthma and other health conditions related to high rates of air pollution.
  - *2035 Nashville Area Regional Transportation Plan*, Nashville Area Metropolitan Planning Organization (p. 202)
- Looking at the numbers, for every $1 the United States spends on transportation infrastructure, $5 is spent treating diseases like obesity related to physical inactivity. Perhaps our goal should be to reverse those numbers and create more walkable, bikeable and transit-oriented communities so that for every $5 spent on transportation infrastructure, only $1 was needed to
treated diseases related to physical inactivity.

- 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 202)

- Yearly costs of treating related diseases and those incurred by premature deaths associated with exposure to these emissions are high, as are the costs of the associated losses in productivity.
  - Transportation and Health, Safe Transportation Research & Education Center (p. ES-2)

- The monetized value of the public health impacts of particulate matter exposure is estimated to be in the tens of billions of dollars annually, which is significant enough to make its reduction a consideration in setting transportation policy.
  - Transportation and Health, Safe Transportation Research & Education Center (p. 1-9)

- Economic Indicators ...
  - They only measure market goods and so overlook other factors that contribute to wellbeing such as health, friendship, community, pride, environmental quality, etc.
  - These indicators give a positive value to destructive activities that reduce people’s health and self-reliance, and therefore increase consumption of medical services, purchased rather than home-produced foods, and motorized transport.
  - Well Measured, Victoria Transport Policy Initiative (p. 20)

- As much as possible, nonmarket impacts (such as environmental assets and human health damages) be measured and monetized (measured in monetary units) so that they can be incorporated into standard accounts.
  - Well Measured, Victoria Transport Policy Initiative (p. 25)

### 7. Miscellaneous

- **Access to food:** “Food deserts are areas in which the population is typically low income, the rate of personal vehicle ownership is low, there is a lack of a full-service grocery store that offers fresh fruits and vegetables, and there is no direct transit route to access the closest full-service store.”
  - 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 10)

- **Climate Change:** “[L]arge fluctuations in temperature and rainfall can cause vector-borne and water-borne disease epidemics, heat exhaustion, hypothermia, and related respiratory and cardiovascular disease. Sea-level rise can cause flooding and economic dislocation, including the destruction of food crops.
  - Transportation and Health, Safe Transportation Research & Education Center (p. 1-13)

- **Congestion:** “The MPO is aware that these hidden costs of congestion exist, and that congestion has significant impacts on health in addition to fuel consumption and time lost.”
  - 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 45)

- **Freight:** Freight is an important component to many health outcomes such as jobs, accessible and affordable goods and services, road safety, and air quality.
  - Health Equity & the Transportation System Plan, City of Portland Bureau of Transportation (p. 27)

- **Measurement:** “For example, reductions in vehicle-mile emission rates can reduce ambient pollutants and human health damages; it may be useful to track each of these factors, but it would be wrong to add them up as if they reflect different types of impacts.”
  - Well Measured, Victoria Transport Policy Initiative (p. 14)
Plan development: “The 2012/2013 Transportation System Plan (TSP) update provides an opportunity to address these health impacts by explicitly supporting transportation policy that promotes positive health outcomes and ensuring that the transportation system minimizes negative impacts, particularly to Portland’s most vulnerable residents.”
- *Health Equity and the Transportation System Plan, Portland*

Prioritization: “Factors in Evaluating Projects for the 2035 Regional Transportation Plan … 8. Health & Environment …
  d. How well does the project support efforts to improve air and water quality?
  e. Does the project include facilities that provide opportunities for active transportation/physical activity?
  f. Does the project aid/harm the advancement of social justice and equal opportunity to destinations throughout the region?
  g. How can the project be scoped to mitigate any negative impacts to predominately low income or minority communities or persons with a disability?”
- *2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (Appendix B, p. 4)*

Travel Demand Management: “A demand management approach to transportation also has the potential to deliver better environmental outcomes and improved public health as many TDM strategies focus on the increased use of ridesharing, bicycling, walking, and public transportation.”
- *2035 Regional Transportation Plan Update, Madison Transportation Area Planning Board*

Objective/Goal Examples

1. Active Transportation

- **MPP-T-7:** Develop a transportation system that minimizes negative impacts to human health.
- **MPP-T-15:** Improve local street patterns — including their design and how they are used — for walking, bicycling, and transit use to enhance communities, connectivity, and physical activity.
- **MPP-T-25:** Ensure mobility choices for people with special transportation needs, including persons with disabilities, the elderly, the young, and low-income populations. (p. 85, section discusses aging population)
  - *VISION 2040, Puget Sound Regional Council (p.81)*
- **Goal # 4:** Protect the Region’s Health & Environment.
- **Objective #10:** Invest in the development of walkable communities that offer citizens the ability to access residences, jobs, retail, recreation, and other community amenities without the need to rely on an automobile.
- **Objective:** The MPO will program at least 15 percent of its future allocation of Urbanized Area Surface Transportation Program funding to projects that proactively address goals for walkable communities and increased active transportation choices to respond to mounting challenges related to energy costs, health and environmental concerns, and the efficient use of land resources. (p. 184)
  - *2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 24)*
- **Put pedestrians and transit first:** Recognizes that every trip begins and ends with pedestrian links. Design transport systems to promote and active living and community wellbeing.
Portland’s transportation system will support residents’ health by prioritizing walking, biking, and taking transit over using personal vehicles; supporting projects and programs that reduce air pollution through VMT reduction and/or technology; and increasing real and perceived safety through engineering and design improvements.

Health Equity & the Transportation System Plan, City of Portland Bureau of Transportation (p. vi)

2. Air Quality and Noise Pollution

- **Principle 6: Pollution Prevention:** Transportation needs must be met without generating emissions that threaten public health, global climate, biological diversity or the integrity of essential ecological processes.
  - Well Measured, Victoria Transport Policy Initiative (p. 29)

3. Equity and Vulnerable Populations

- **Value communities and neighborhoods:** Enhance the unique characteristics of all communities by investing in healthy, safe, and walkable neighborhoods—rural, urban, or suburban.
  - U.S. Interagency Partnership for Sustainable Communities (HUD-DOT-EPA 2010)
- **Goal #6:** Offer Meaningful Transportation Choices for a Diverse Population including the Aging
  - 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 24)
- **Provide access and mobility for everyone:** Ensure that all residents (especially those with lower incomes, disabilities, recent immigrants, youth and the elderly) have barrier-free, reliable and affordable access
  - Transportation Master Plan, York Region
- **Principle 3: Health and Safety:** Transportation systems should be designed and operated in a way that protects the health (physical, mental and social well-being) and safety of all people, and enhances the quality of life in communities.
  - Well Measured, Victoria Transport Policy Initiative (p. 28)
- **Goal 6, Transportation:** Develop a balanced, equitable, and efficient transportation system that provides a range of transportation choices; reinforces the livability of neighborhoods; supports a strong and diverse economy; reduces air, noise, and water pollution; and lessens reliance on the automobile while maintaining accessibility.
  - 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 25)
- Portland’s transportation system strives to be equitably built, maintained, and improved in a manner focused on reducing the burdens of historically disadvantaged populations: communities of color, people experiencing poverty, people with disabilities, and people experiencing language barriers.
  - Health Equity & the Transportation System Plan, City of Portland Bureau of Transportation (p. vi)

4. Sustainability

- **Goal #4:** Protect the Region’s Health & Environment.
- **Objective #9:** Consider how transportation policies, programs, and investment strategies affect the overall health of people and the environment including air quality, physical activity, biodiversity, and the natural resources.
  - 2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization (p. 25)
5. Land Use

- **Integrate transportation and land use planning**: Integrate transport planning with other urban development practices to create an urban form that is compact, mixed and supports a sense of community.
  
  - *Transportation Master Plan, York Region*
APPENDIX 2- INDICATORS

In order to fully incorporate health into transportation planning, it must be measurable. Current and suggested indicators for measuring and monitoring health in relation to planning decisions are listed below. These include indicators of a health-promoting environment as well as population rates of health-promoting behaviours and health outcomes.

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<thead>
<tr>
<th>CATEGORY</th>
<th>INDICATOR</th>
<th>DOCUMENT</th>
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<tbody>
<tr>
<td>Active Transportation</td>
<td>Physical Fitness</td>
<td>• Well Measured, Victoria Transport Policy Initiative</td>
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<td></td>
<td>Portion of population that walks and cycles sufficient for fitness and health (15 minutes or more daily)</td>
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<td></td>
<td>Rates of overweight/obese status</td>
<td>• Imagine Austin, City Planning Commission</td>
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<tr>
<td>Mode Split</td>
<td>Mode split (portion of trips by transportation mode: walking/biking/public transit/private vehicle)</td>
<td>• Transportation Master Plan, York Region</td>
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<tr>
<td></td>
<td>Pedestrian mode share compared with peer communities</td>
<td>• The Healthy Development Measurement Tool, San Francisco Department of Public Health</td>
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<td></td>
<td>Travel by non-motorized modes in urban areas</td>
<td>• Sustainable Transportation Performance Indicators (STPI), Centre for Sustainable Transportation</td>
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<td></td>
<td>Transit ridership/annual trips per capita</td>
<td>• Imagine Austin, City Planning Commission</td>
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<td></td>
<td>Average vehicle/bike/walking miles/kilometres traveled per day or per capita</td>
<td>• The Healthy Development Measurement Tool, San Francisco Department of Public Health</td>
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<tr>
<td>Supportive Structures</td>
<td>Miles/kilometres of walking/biking trails</td>
<td>• Imagine Austin, City Planning Commission</td>
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<td>Sidewalk availability/density</td>
<td>• The Healthy Development Measurement Tool, San Francisco Department of Public Health</td>
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### Air Quality and Noise Pollution

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<tr>
<td><strong>Air Quality</strong></td>
<td>Frequency of air pollution standard violations.</td>
<td>• Well Measured, Victoria Transport Policy Initiative</td>
</tr>
<tr>
<td></td>
<td>Number of unhealthy air days</td>
<td>• VISION 2040, Puget Sound Regional Council</td>
</tr>
<tr>
<td></td>
<td>Per capita emissions of “conventional” air pollutants (CO, VOC, NOx, particulates, etc.)</td>
<td>• Well Measured, Victoria Transport Policy Initiative</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Project Evaluation Criteria:</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Project Includes Transit Capacity (e.g., dedicated lanes, signal priority, HOV)</td>
</tr>
<tr>
<td></td>
<td>• Project Includes Sidewalk Improvements</td>
</tr>
<tr>
<td></td>
<td>• Project Includes Bicycle Facility Improvements</td>
</tr>
<tr>
<td></td>
<td>• Project Includes Multi Modal Treatments (e.g., crosswalks, pullouts, shelters, etc)</td>
</tr>
<tr>
<td></td>
<td><strong>2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization</strong></td>
</tr>
<tr>
<td>Priority areas</td>
<td>Health Impact Areas:</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Equity and Vulnerable Populations</td>
<td>Have a higher than average rate of poverty, minority populations, and zero-car households</td>
</tr>
<tr>
<td></td>
<td>Areas within 2-Miles of Schools</td>
</tr>
<tr>
<td></td>
<td>Areas within 1-Mile of Grocery Stores</td>
</tr>
<tr>
<td></td>
<td>Have at least 50 percent of the population earning less than 80 percent of the county median family income; and/or</td>
</tr>
<tr>
<td></td>
<td>Have the income of at least 25 percent of the population falling below the federal poverty level for a family of 3</td>
</tr>
<tr>
<td></td>
<td>“Minority” TAZs have less than 50% of the population identifying themselves as “White, non-Hispanic.”</td>
</tr>
<tr>
<td></td>
<td>Degree of Disadvantaged: The number of sensitive groups in each census tract</td>
</tr>
<tr>
<td></td>
<td>Project Evaluation Criteria:</td>
</tr>
<tr>
<td></td>
<td>Project Provides Alternative Transportation Choices for Traditionally Underserved Groups</td>
</tr>
<tr>
<td></td>
<td>Project Provide Multi Modal Options Near Schools</td>
</tr>
<tr>
<td></td>
<td>Public Participation</td>
</tr>
<tr>
<td></td>
<td>Substantial involvement of affected people, with special efforts to insure that disadvantaged and vulnerable groups are involved.</td>
</tr>
<tr>
<td></td>
<td>Disability and Quality of transport facilities and services for</td>
</tr>
<tr>
<td>Old Age</td>
<td>disabled people.</td>
</tr>
<tr>
<td>---------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>Senior Pedestrian Focus Areas (SPFAs) based on top senior pedestrian crashes</td>
</tr>
</tbody>
</table>

| Children | Portion of [children’s] travel to school and other local destinations by walking and cycling. | Well Measured, Victoria Transport Policy Initiative |

**Sustainability**

<table>
<thead>
<tr>
<th></th>
<th>Greenhouse gas emissions for all transport. (See related air quality indicators)</th>
<th>Sustainable Transportation Performance Indicators (STPI), Centre for Sustainable Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of parking placards/permits</td>
<td>Sustainable Streets, NYC Dept. of Transportation</td>
</tr>
<tr>
<td></td>
<td>Proximity of infrastructure to sensitive areas and ecosystem fragmentation.</td>
<td>Sustainable Transportation Performance Indicators (STPI), Centre for Sustainable Transportation</td>
</tr>
</tbody>
</table>

**Land Use**

<table>
<thead>
<tr>
<th>Job/Housing Balance</th>
<th>Jobs within walking distance of homes (jobs/housing balance)</th>
<th>Transportation Master Plan, York Region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residents/jobs within station catchment</td>
<td>“New Approaches to Strategic Urban Transport Assessment,” Hale (2011)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sustainable Transportation Performance Indicators (STPI), Centre for Sustainable Transportation</td>
</tr>
<tr>
<td></td>
<td>Project Evaluation Criteria:</td>
<td>2035 Nashville Area Regional Transportation Plan, Nashville Area Metropolitan Planning Organization</td>
</tr>
<tr>
<td></td>
<td>• Project Improves Accessibility and/or Connectivity to Existing Residential Population</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Project Improves Accessibility and/or Connectivity to Existing Jobs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Project Located ENTIRELY within Existing or Planned Mixed Use or Employment Centers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Project Located PARTIALLY within Existing or Planned Mixed Use or Employment Centers</td>
<td></td>
</tr>
</tbody>
</table>

| Environmental Impact | Proximity of infrastructure to sensitive areas and ecosystem fragmentation. | Sustainable Transportation Performance Indicators (STPI), Centre for Sustainable Transportation |