Tracks & Fields:

Quantifying the Benefits of Transit-Oriented Communities in Metro Vancouver

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Disclaimer

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This project was conducted under the mentorship of TransLink staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of TransLink or the University of British Columbia.

Territorial Acknowledgement

I respectfully acknowledge that the work for this project took place on the traditional, ancestral, and unceded lands of the xʷməθkʷəy̓əm (Musqueam) and Halkomelem-speaking peoples. The case study areas featured in this report are also situated on the shared territories of 10 local First Nations: qi̓c̓əy̓ (Katzie), qʷɑ:nƛ̓ən̓ (Kwantlen), kʷikʷəƛ̓əm (Kwikwetlem), máthxwi (Matsqui), xʷməθkʷəy̓əm (Musqueam), qiqéyt (Qayqayt), se'mya'me (Semiahmoo), Sḵwx̱wú7mesh Úxwumixw (Squamish), scəw̓aθən məsteyəxʷ (Tsawwassen) and səlilwətaɬ (Tsleil-Waututh).

These Nations are the original stewards of this land, and it is imperative to recognize the colonial context through which these lands were historically developed and are currently being developed. This understanding necessitates future sustainable development to not only preserve as much of the natural environment as possible, but to also honour the deep-rooted cultural heritage of these territories and the enduring relationships that Indigenous peoples have with them.

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Executive Summary

Metro Vancouver is projected to welcome over one million new residents by 2050, necessitating a sustainable approach to urban expansion in the region. Planning for population growth requires careful efforts to protect environmentally sensitive lands, promote sustainable transportation options, and address the high cost of living. Transit-Oriented Communities (TOCs) are central to this approach, as they concentrate high-density, mixed-use development around frequent transit stops and stations, supporting compact, car-free lifestyles (TransLink, 2012). In contrast, greenfield developments typically involve converting previously undeveloped or lightly developed land into low-density, auto-dependent residential suburbs – a long-standing default in Canada that upholds the need for dispersed, auto-oriented regional infrastructure.

This report quantitatively evaluates the benefits of TOCs in achieving sustainable outcomes compared to greenfields, with the goal of building regional support for livable, resilient communities. A literature review of planning documents and research studies identifies key metrics to quantify the environmental, social, and economic benefits of TOCs. In addition, this report presents case studies from across Metro Vancouver – three TOCs and three greenfields – that characterize these development typologies. Their differences are quantified using metrics that provide a descriptive analysis of the current sustainable transportation conditions between the two typologies.

Several key differences between the development typologies emerged:

- TOCs feature significantly higher population densities and require less than half the acreage that greenfields need to accommodate the same number of people, increasing efficiency in land preservation and service provision. By intensifying growth in urban areas connected by transit (i.e., integrating land use and transportation), TOCs reduce sprawl and support preservation of agricultural, rural, and undeveloped land.
- TOCs generally have fewer people per household, lower property values, lower household incomes, and a significantly higher percentage of households in core housing need compared to greenfields and the regional averages across Metro Vancouver. This indicates that TOCs serve populations with greater needs, and who may rely more on transit and affordable housing options.
- Residents in TOCs and greenfields exhibit different commuting patterns depending on the accessibility of sustainable transit modes in each area. In TOCs, where accessibility scores for transit, walking, and cycling are strong, 37.7% of residents use sustainable modes when commuting to work, compared to 9.7% of residents in greenfields.

- Significantly higher rates of motor vehicle collisions occurred in TOCs, including a greater proportion of severe collisions. This highlights a need for improved road safety infrastructure near transit hubs to ensure a safer environment for users of sustainable transit modes.

Future studies may consider using a more comprehensive selection of metrics to monitor the evolution of TOCs over time and assess how transit network expansion can further enhance their benefits. This would help determine the ideal balance between urban intensification and sustainable transportation needed to support future population growth and Metro Vancouver's long-term vision for sustainable, livable, and resilient communities.

Part 1: Introduction

1.1 Rationale, context, & objectives

Rationale

For over half a century, the Metro Vancouver region has planned for population growth through closely coordinated land use and transportation planning among regional partners. With over one million new residents expected by 2050, planning efforts are focused on protecting agricultural, rural, and environmentally sensitive lands, supporting sustainable transportation options, and addressing the high cost of living. Transit-Oriented Communities (TOCs), where development is centered around transit and active travel, are an important tool connecting land use and transportation. TOCs support compact, car-free lifestyles, and will be crucial to the region's success in adopting a sustainable approach to urban expansion.

Another approach to urban expansion is greenfield development, where previously undeveloped or lightly developed agricultural or rural land is converted into a typical post-war pattern of primarily residential suburbs, a long-standing default development in Canada. This type of development disperses neighbourhood destinations and services at low densities, increasing land consumption and dependence on private motor vehicles for transportation. Quantifying the benefits of TOCs – compared to the default approach of greenfield development – is an important way to demonstrate the benefits of TOCs, build regional support, and achieve climate-friendly outcomes.

Today, the Metro Vancouver region is one of the fastest-growing regions in Canada, presenting both a challenge and an opportunity for planning a more sustainable and affordable future. The current regional growth and transportation strategies identify major goals around sustainable transportation and compact urban development. When considered holistically, TOCs can support these shared goals by reducing urban sprawl and improving affordability, among other environmental, economic, and social benefits. With plans for significant transit expansion and a rapidly growing population, TOCs are particularly important for Metro Vancouver's future.

Context

The regional federation of Metro Vancouver is comprised of 21 municipalities, one Electoral Area, and one Treaty First Nation. It is responsible for planning the regional growth strategy for over 2.78 million residents[1], with *Metro 2050* being the latest plan (Metro Vancouver Regional District (MVRD) Regional Planning Committee, 2024; MVRD, 2022). As the regional transportation authority, TransLink manages the transportation system and has developed the latest regional transportation strategy, *Transport 2050*, to align with the growth strategy (TransLink, 2022).

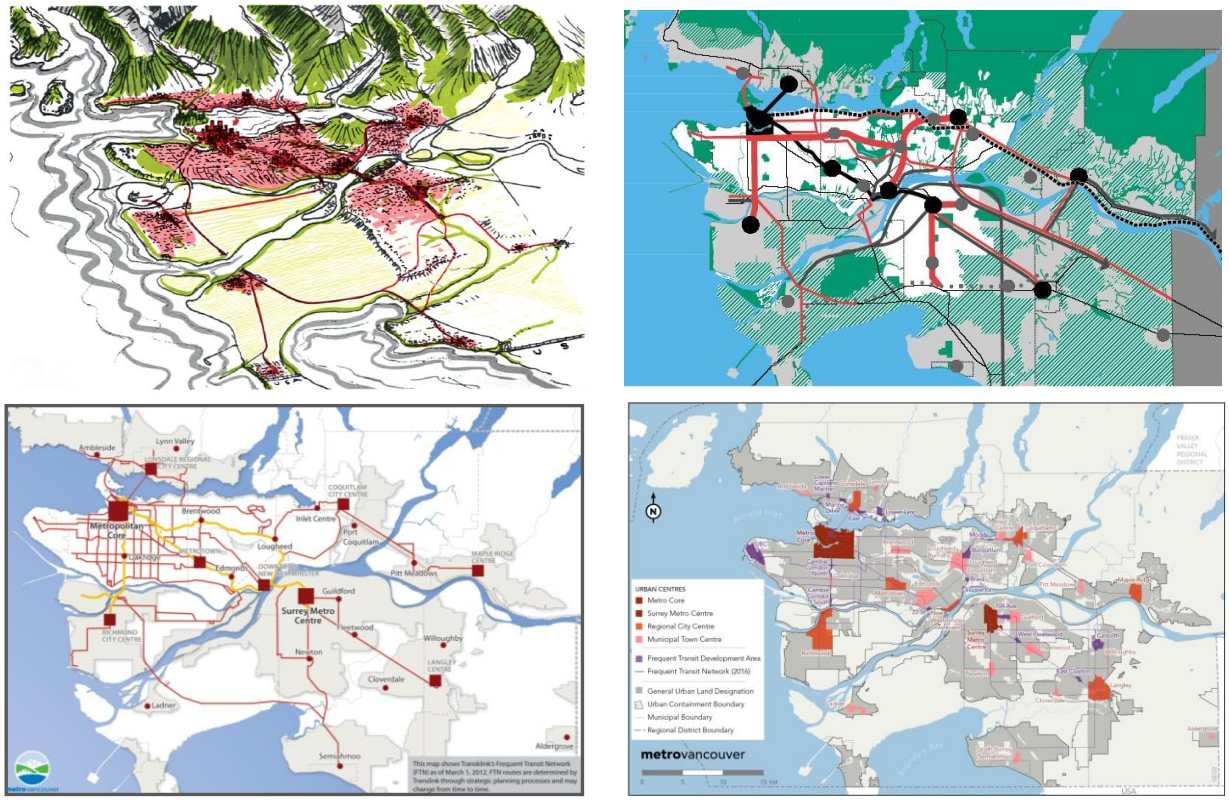
Since the 1970s, regional planning in Metro Vancouver has envisioned future growth to be directed to urban centres connected by major transit corridors (Figure 1). Specifically, the *Livable Region Plan* released in 1975 imagined "livable cities in a sea of green", where travel around the region depends on the public transportation system (Greater Vancouver Regional District (GVRD), 1975). This historical alignment of land use and transportation strategies has created a regional growth pattern where destinations are closer together and easier to access, and has established the foundation for transit and SkyTrain expansion over the years.

Metro 2050 outlines specific goals for concentrating growth inside a compact urban area defined by an Urban Containment Boundary, and aims to create a compact, transit-oriented urban form that supports a range of sustainable transportation choices. The plan also identifies several benefits that are linked with this transit-oriented growth pattern, including: reduced greenhouse gas emissions, formation of complete, compact communities, promoting physical activity and improved health, lower transportation costs, and a more resilient economy with better access to job opportunities, diverse and affordable housing, and community amenities.

While *Metro 2050* provides the land use framework for regional service planning, local governments provide municipal land use planning and zoning regulations. *Transport 2050* correspondingly identifies land use management as a key policy tool in realizing an equitable and resilient transportation system. Since land use influences the distances needed to reach different destinations – and in turn, mode choices – compact land use aims to reduce urban sprawl, promote sustainable modes of transportation, and reduce levels of motor vehicle ownership and use.

[1] As of 2021.

Figure 1. “Livable cities in a sea of green”, connected by transit.



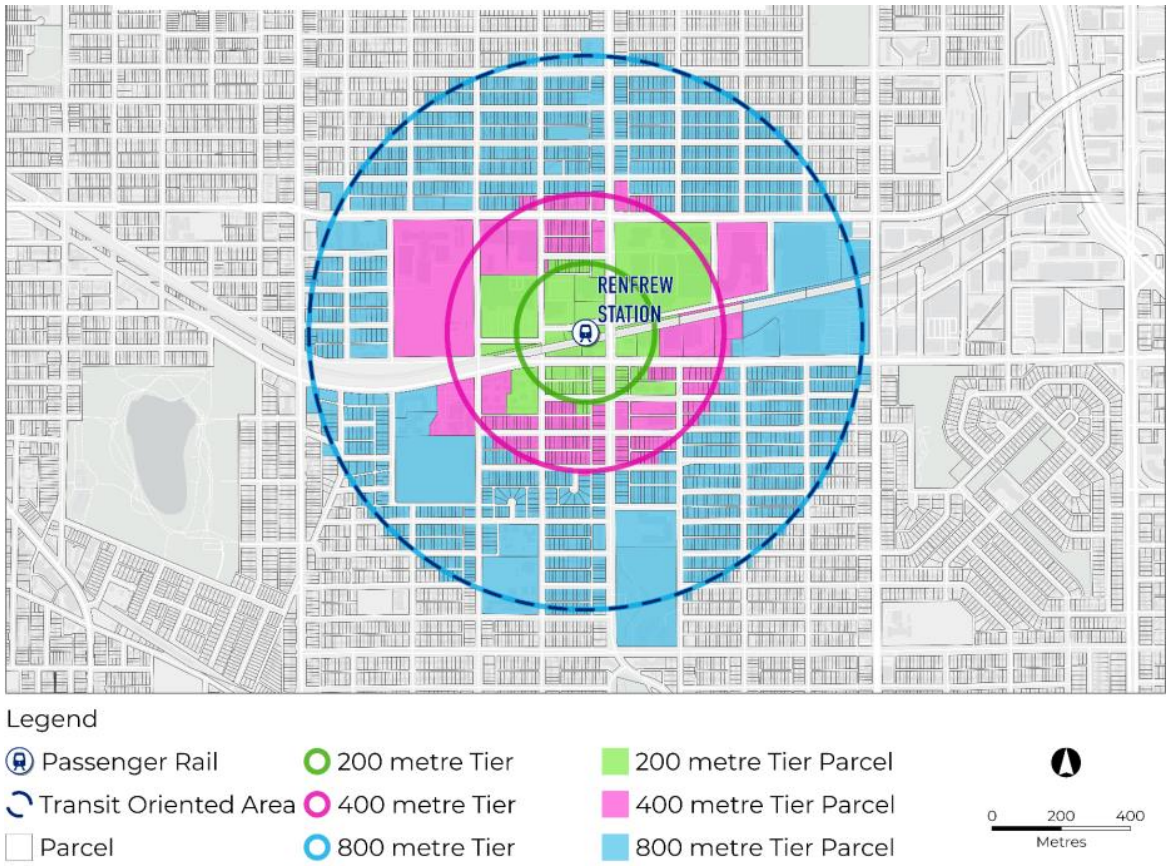
Sources (clockwise from top left): Livable Region Plan (1975), Livable Region Strategic Plan (1996), Metro Vancouver 2040 Shaping Our Future (2011), Metro 2050 Regional Growth Strategy (2022).

Transport 2050 also envisions significant future transit expansion in the region, including the doubling of bus service, additional RapidBus and new bus rapid transit (BRT) routes, and SkyTrain expansion. Ensuring complementary land use and community design for these major transit investments is essential. Supportive neighbourhood design around transit makes it efficient and cost-effective to operate transit service, since land use and built environment characteristics can shape transit demand by increasing ridership. Considering that a key shared goal of land use and transportation plans in Metro Vancouver is to concentrate growth around frequent transit, developing TOCs can facilitate this relationship.

Recently, the Province of British Columbia has adopted legislation requiring some municipalities to designate Transit-Oriented Development Areas (TOD Areas) near transit hubs (Figure 2) (Legislative Assembly of British Columbia, 2023). This legislation aims to simultaneously address several provincial challenges, including increasing housing supply, integrating transportation and land use, providing real alternatives to private vehicle travel, investing in economically sustainable infrastructure, and promoting climate change

resilience (Province of British Columbia, 2024). Creating denser, more complete communities around transit hubs is ultimately a solution-based approach to population growth in the region.

Figure 2. Example catchment area for a municipally-designated Transit-Oriented Area.



Source: Provincial Policy Manual: Transit-Oriented Areas (2024).

Study objectives

As local governments and regional partners plan for a more sustainable future, a clear understanding of how TOCs benefit the region and its residents is crucial. Using TransLink's Transit-Oriented Communities Design Guidelines (TOCDGs) as a conceptual framework, TOCs and greenfields across Metro Vancouver were selected and assessed as case study areas. Quantitative metrics that reflect these design guidelines and the benefits of TOCs were used to compare these development typologies. This project aims to develop and apply a quantitative approach for comparing outcomes between TOCs and greenfields, which can inform future best practices in regional planning.

1.3 Methods

Literature review

A literature review was conducted to explore what is known about TOCs and their characteristics, and if or how they have been applied by other peer regions. Peer regions to Metro Vancouver included those with similar historical urban contexts, governance structures, existing and/or planned rapid transit systems, land costs, and approximate regional sizes. Peer regions were identified in Canada (Toronto, Calgary, Edmonton), the United States (Seattle, Portland, Denver, San Diego, Minneapolis), Australia (Sydney, Melbourne), and New Zealand (Auckland).

A general online search was performed through Google Scholar, PubMed, Transport Research International Documentation (TRID) databases, and reference lists of relevant publications. Data sources included peer-reviewed studies and publicly available regional and municipal planning reports, guidelines, and policies. Included publications were selected based on relevance to the Metro Vancouver regional urban planning context.

Case studies & descriptive analysis

Three TOCs and three greenfields in Metro Vancouver were identified as case study areas using a set of selection criteria (Section 3.1). Case study areas were evaluated to assess similarities and differences between development typologies. This was accomplished in a variety of ways: exploring historical maps and records of how the area developed, assessing elements of the municipal plans that shape the area, estimating commute time and walkability scenarios, identifying transit service and availability within the area, and evaluating the six major design attributes as outlined in TransLink's TOC Design Guidelines. General profiles for each development typology were summarized based on aggregated characteristics across the case studies.

Exact geographical boundaries for the case study areas were determined based on the boundaries of the 2021 Census of Population Dissemination Areas (DA). DAs were selected to represent as close of an overlap as possible with the municipal plan areas and are similarly sized across all case study areas.

For the descriptive analysis, indicators representing the characteristics and benefits of TOCs were identified based on previous research, and metrics to quantitatively measure these indicators were selected based on data availability and accessibility. Data sources included demographic and commute data from the Census of Population (2021), transit stop usage data from TransLink's Transit Service Performance Review (2022 & 2023), data

on collisions involving motor vehicles from TransLink's Regional Road Performance Monitoring Dashboard (2020), and data on accessibility to amenities from WalkScore.com.

Data on 21 metrics were extracted for each case study area. Since each case study area was comprised of multiple DAs, population-weighted values were calculated to represent the entire case study site as needed. Metrics were then aggregated to represent average values for typical TOC and greenfield typologies, and a descriptive analysis was conducted at this aggregated level to compare the similarities and differences between development typologies.

Part 2: Conceptual framework & background

2.1 TOC Design Guidelines

TransLink defines transit-oriented communities (TOCs) as places that, by their design, allow people to drive less and walk, cycle, and take transit more (TransLink, 2012). In practice, this means concentrating higher-density, mixed-use development around frequent transit stops and stations, while maintaining human-scale frontages for pedestrians. The purpose of TransLink's Transit-Oriented Community Design Guidelines (TOCDGs) is to aid in the development of transit-oriented land use plans and projects, and to provide guidance for community planning and design in the areas surrounding transit passenger facilities.

One way that the TOCDGs are applied is through Supportive Policies Agreements (SPAs), wherein commitments for land use and transportation actions by TransLink and a host municipality are required for major transit expansion projects, such as SkyTrain. The TOCDGs act as a framework for developing performance indicators to monitor the initiatives and related outcomes of each project.

The TOCDGs include six design guidelines, known as the 6 D's: destinations, distance, design, density, diversity, and demand management (Figure 3). Each guideline can be measured, although some are more straightforward to quantify than others. For example, population density can be measured by the number of residents within walking distance of a transit corridor per hectare. In contrast, less directly quantifiable guidelines like "people-friendly design" may require multiple or proxy metrics, such as the presence of sidewalks on both sides of the street, building orientation, and/or the placement of parking spaces.

Figure 3. The 6 D's of Transit-Oriented Communities.

Source: Transit Service Guidelines (2018).

2.2 Literature review

This section summarizes key findings from the literature review, based on relevant peer-reviewed studies and planning documents across Metro Vancouver peer regions.

TOC definitions & background

Transit-oriented communities (TOCs) are places that facilitate a decreased reliance on motor vehicles by concentrating higher-density, mixed-use, pedestrian-friendly development around frequent transit. The term transit-oriented community differs slightly from transit-oriented development (TOD), which refers to specific individual buildings or development projects that are fundamentally shaped by their proximity to frequent transit. Similar terms that reflect the overarching concept of a compact, mixed-use, multimodal urban form include: transit-oriented areas, transit villages, smart growth, walkable neighbourhoods, 15-minutes cities, complete streets, and/or complete communities.

Concepts relating to TOCs have historical origins dating back to the Industrial Revolution, where the advent of railroads contributed to increased population density around railway stations (Alvarez et al., 2013). Development patterns around Metro Vancouver's own interurban railway network, in operation from 1891 to 1958, enabled families with modest incomes to move to outlying areas where land was more affordable (Pabillano, 2009). This led to the creation of new communities around the stations, as exemplified by the historical development of the Richmond-Brighouse TOC described in Section 3.1.

Another example of historical TOC development is the Garden City Movement of the late 19th century, which aimed to create self-contained communities surrounded by greenbelt. The amenities of urban life were located in a compact area, discouraging the encroachment of the town upon the rural belt (Encyclopaedia Britannica, 1998). While post-war suburbanization led to an increased dependence on automobiles and shifted travel patterns from fixed routes to individualized travel, modern-day urban planning has revived historical strategies that promote development around transit hubs.

The Metro Vancouver Regional District was first incorporated in 1967 and has long supported a transit-oriented land use approach, from envisioning a region composed of compact urban centres connected by frequent transit in the *1975 Livable Region Plan*, to maintaining this vision in *Metro 2050* (Province of British Columbia, 1967). This strategy aims to accommodate growth in a sustainable way, by addressing challenges and opportunities relating to supporting economic prosperity, protecting the environment, and advancing social equity.

Several peer regions to Metro Vancouver have also adopted TOC-focused guidelines in their respective municipal and regional growth and transportation strategies. While regions adopt varying definitions and plans for implementing these guidelines, integrating transportation and land use policies is a common first step in creating TOCs.

For example, the City of Edmonton defines TOD as "urban development that is planned and integrated with a transit station at its core. [...] housing, shopping and employment are concentrated along a network of walkable and bikeable streets within 400 meters of the transit station" (City of Edmonton, 2012, p. 59). They further define the 200m around a transit station as a station hub, 400m as a station neighbourhood, and 800m as an area of influence. Similarly, the *2040 Growth Concept* for the Portland metropolitan area defines "station communities" as "nodes of development centered around a light-rail or high-capacity transit station that feature a high-quality pedestrian environment [and] provide for the highest density outside centres", which encompass an area of approximately ½ mile (0.8km) around a station stop (Metro Council, 2011, p. 4).

Many municipalities adopt node-and-corridor approach to planning, where housing and employment growth is encouraged in nodes with good transport connections, and corridors of urban streets that provide connections between nodes and serve as destinations themselves. Notably, the Sydney *City Plan 2036* proposes a polycentric model of multiple urban centres connected by transit, with centres prioritizing a mix of uses in the immediate areas around transit stations (i.e., within a 400m radius) (City of Sydney, 2020). Similar node and corridor plans have been developed in Edmonton, Calgary, Toronto, and Portland.

TOC characteristics

The overarching characteristics that distinguish TOCs from other development typologies are reflected in the six design guidelines referenced in Section 2.1. Multiple peer region plans have outlined these TOC guidelines in their policies in some form, including both municipal plans (Calgary's *Municipal Development Plan* (2020), *Minneapolis 2040: The City's Comprehensive Plan* (2019), San Deigo's *General Plan* (2024)) and broader regional plans (*Thrive MSP 2040: Metropolitan Development Guide* for Minneapolis–Saint Paul (2014), *2023 Regional Transportation Plan* for the Greater Portland Region (2023), *2021 Regional Plan* for San Diego (2021), *Sound Transit 3: The Regional Transit System Plan* for Central Puget Sound (2016)).

Additional TOC-related policies are described in *Minneapolis 2040: The City's Comprehensive Plan*, including requiring a minimum level of development near Metro stations to ensure that land is used efficiently, allowing and encouraging a dense mix of housing, employment, and commercial goods and services near Metro stations, prohibiting the establishment of auto-oriented uses near Metro stations, breaking up large blocks into small, walkable blocks, and orienting buildings to the sidewalk (City of Minneapolis, 2019). Additionally, the Minneapolis City Council amended regulations to

eliminate minimum off-street parking requirements and lower maximum parking allowances city-wide (Minneapolis City Council, 2021).

Other peer regions outline different TOC characteristics based on their unique contexts. For example, the *Toronto Official Plan* emphasizes the importance of a high-quality public realm in contributing to the city's cultural heritage and unique character (City of Toronto, 2024). The Plan outlines numerous policies to provide direction for public realm expansion and enhancement through development review and capital projects, involving consultation and collaboration with city partners. The policies aim to support the creation of complete communities in areas well-served by transit, featuring public squares and parks, community gardens, public art, and a comfortable environment for pedestrians and cyclists (City of Toronto, 2024).

Regions like San Diego specifically plan to integrate nature and natural systems with TOCs to promote personal wellness and ecosystem health. In San Diego, focusing growth in "Mobility Hub Areas" is intended to help preserve the region's natural habitat areas and natural resources (SANDAG, 2021). A parallel vision for regional habitat conservation includes "hubs" of protected natural lands that are connected by wildlife movement corridors (SANDAG, 2021). Protecting these areas provides a dual benefit: they are often environmentally sensitive and are important for conservation, and they can have higher development costs and increased long-term vulnerabilities due to their environmental conditions (e.g., slopes, water flow, etc.). Building communities that are resilient to climate and environmental changes is highly emphasized in this plan.

From an equity standpoint, it is imperative that policies increase housing density without compromising opportunities for affordable housing near frequent transit and commercial areas. Municipal plans for Portland, Minneapolis, and Seattle, and regional plans for King County all promote mixed-income communities around transit stations. In Minneapolis, new housing developments have mostly been located in amenity-rich areas with access to transportation choices, jobs, goods, services, and recreation, but the cost of these homes is often unaffordable for those earning the city's median household income (Metropolitan Council, 2014). As the Metropolitan Council for the Minneapolis–Saint Paul region invests in transit, it aims to preserve a mix of affordable housing along transit corridors (Metropolitan Council, 2014). It plans to protect housing options for low-income residents by expanding the supply of affordable housing at all income levels and investing in a variety of housing types and price points to attract and retain residents.

Improving accessibility for seniors and persons with disabilities is also necessary to ensure transit is accessible for everyone, as outlined in the Portland's *2023 Regional Transportation Plan* (Metro Council, 2023). Additionally, creating a development pattern conducive to face-to-face community interaction is a unique TOC feature described in the

2040 Growth Concept for Portland (Metro Council, 2011). Higher-density employment and housing areas can promote social capital by acting as social gathering places and community centers with a "small-town atmosphere" (Metro Council, 2011).

Further, the *Regional Public Transport Plan* for Auckland envisions vibrant and inclusive places that reflect local character and Indigenous identity (Auckland Transport, 2023). Rather than making it a specific goal, Auckland Transport has incorporated considerations for Māori outcomes throughout the plan. Specific considerations include service provision connecting communities with places of cultural significance, working with partners to investigate employment and business development opportunities through social procurement, and considering the percent of the Māori population affected when looking at performance outcomes or targets (Auckland Transport, 2023).

Indicators of TOC benefits

Based on extensive research and experience in practice, TOCs have been shown to offer a wide range of benefits, as outlined in TransLink's Transit-Oriented Community Design Guidelines (TransLink, 2012):

1. Increased livability: TOCs aim to create better urban environments with safe and enjoyable spaces for walking, cycling, and outdoor activities. TOCs are livable, support healthy lifestyles and better quality of life, reduce rates of chronic diseases, and increase safety and security for sustainable transit users.
2. Improved sustainability:
    a. *Environmental benefits:* TOCs promote reduced energy consumption and greenhouse gas emissions due to fewer and shorter motor vehicle trips, which reduces exposure to pollutants and improves air quality. Energy efficient transportation and reduction in paved surfaces supports habitat preservation and climate change resilience.
    b. *Social benefits:* TOCs ensure transportation choices for people of all ages and abilities, and equitably serve marginalized communities and people with varying levels of mobility. TOCs can foster a stronger sense of community by promoting social interactions between residents and enhancing neighbourhood character.
    c. *Economic benefits:* TOCs promote a strong economy by providing residents and workers with convenient access to jobs, shopping, and other activities, which reduces costs and barriers to being mobile. Reducing the need for and usage of automobiles can lower household transportation costs and overall cost of living. TOCs support infrastructure investment in walking,

cycling, and transit, which is more cost-effective than other approaches such as widening roads or building new parking facilities.

3. Enhanced resiliency: TOCs create a network of intensification opportunities where mass transit and urban development are integrated across geographic areas. This makes TOCs adaptable and resilient in the face of changing demographics and fluctuating energy prices, and helps retain their value as desirable places to live, work, and visit.

Regional authorities and researchers alike have recognized the positive impacts of TOCs in promoting increased livability, sustainability, and resiliency. Given the complexities of measuring sustainability, scholars have historically used indicators to organize and measure information relating to sustainable development (Bossel, 1999). One example of a framework that evaluates transportation sustainability is the Transportation Index for Sustainable Places (TISP). Initially developed by Nichols et al. (2009) and later refined by Zheng et al. (2011), the TISP is a hierarchical system designed to integrate indicators into a practical set of performance metrics. It outlines the three overarching domains of sustainability, four fundamental elements within each domain, and specific indicators that represent said elements (Table 1).

Table 1. The Transportation Index for Sustainable Places (TISP).

	Elements	Indicators
Environmental	1 Minimize consumption of non-renewable resources for transportation	1a Energy consumption 1b Infrastructure and vehicle materials consumption
	2 Transportation and placemaking system designed to maximize land use efficiency	2 Land use
	3 Minimize transportation and placemaking system's impact on ecological systems	3a Ecological systems 3b Greenhouse gas emissions
	4 Limit transportation related pollution and wastes	4a Pollution 4b Waste production
Social	5 Transportation meets access needs while consistent with human health and safety	5a Health 5b Traffic safety
	6 Planning and management of transportation incorporates government and community input	6a Government interoperability 6b Community involvement
	7 Transportation and placemaking system promotes social equity	7 Social equity
	8 Transportation and placemaking system meets basic access needs of all individuals	8 Accessibility

	Elements	Indicators
Economic	9 Transportation is affordable for individuals	9 Affordability
	10 Transportation is financed in an equitable manner	10 Finance equity
	11 Transportation provides efficient movement of people and goods for economic growth	11 Efficient mobility
	12 Transportation is resilient to economic fluctuations	12 Resiliency

Adapted from Zheng et al. (2011) and Marshall (2013).

Metrics to evaluate TOC benefits

Under the TISP framework, metrics are intended to serve as proxy measures to holistically understand the transportation sustainability of an area, which allows for a variety of possible metrics to measure each indicator. For example, a study by Marshall (2013) applied the TISP framework to a case study of TOCs in the Denver metropolitan region and selected specific metrics for this purpose. Additionally, some peer region plans established key performance indicators to evaluate and monitor the success of TOC-related goals over time. The metrics listed in Table 2 build on the set applied by Marshall (2013) and include additional metrics commonly used for performance measurement in municipal and regional plans, as well as metrics used in other research studies identified in the literature review.

Table 2. Example metrics used to evaluate transportation sustainability at the TOC level.

	Indicators	Metrics
Environmental	1 Energy consumption	Home energy use Fuel used per person per day Gross vehicle kilometers travelled Daily minutes of private vehicle use per capita
	2 Land use	% mix of land use % open space within 1 mile of station Floor area ratio for employment uses Cumulative building area for ground floor retail Street network Pavement within 1 mile of station
	3a Ecological systems 3b Greenhouse gas emissions	Area designated for natural protection Gross population density per hectare Gross greenhouse gas emissions
	4a Pollution 4b Waste production	Transportation-related CO_2 emitted per person per day Recycled solid waste

	Indicators	Metrics
Social	5a Health 5b Traffic safety	% active transportation mode share Fatal or injury crashes per year Pedestrian/ bicycle risk index Violent crimes per year
	6a Government interoperability 6b Community involvement	Civic engagement
	7 Social equity	Mixed income Mixed race Social capital
	8 Accessibility	Access to groceries, schools, other amenities Walkability index
Economic	9 Affordability	% income spent on housing + transportation Average residential property value Land allocated for affordable housing # of affordable housing units created
	10 Finance equity	-
	11 Efficient mobility	Gross job density per hectare Gross dwelling units per hectare Household size % pedestrian shed Transit score, transit service per hour, transit ridership Automobile congestion Traffic volumes
	12 Resiliency	Regional access to jobs by transit within 55 minutes Resiliency to $2/gallon transportation cost increase

Costs to transportation sustainability are marked in green and benefits are marked in red. Adapted from: Marshall (2013).

As seen in Table 2, not all indicators are perfectly quantifiable (e.g., whether transportation is equitably financed) and some metrics serve as proxy measures to multiple indicators (e.g., a high population density could represent preservation of ecological systems, as well as efficient mobility provided by the transportation system).

In the literature, five studies were identified as the most relevant for quantifying the features and benefits of TOCs, though this was not an exhaustive search. Various methodologies have been used to measure these benefits, including analyzing travel survey data, modelling of demographics, mode use, and regional transportation and travel demand, as well as estimating corresponding health impacts of future development scenarios.

For example, Mudigonda et al. (2014) evaluated several sites in New Jersey to compare the costs of driving versus using rail transit to major employment destinations. They found that transit-oriented development near train stations induces shifts from driving to transit, resulting in financial benefits for users and the transportation system. Additionally, Nahlik & Chester (2014) employed a life-cycle environmental and economic assessment to evaluate the impacts of transit-oriented development near new light rail and bus rapid transit in Los Angeles, which showed significant reductions in greenhouse gas emissions, respiratory health impacts, and user costs.

The body of literature on quantitative methods for modeling TOC indicators is moderate and has gradually expanded over the past 10 years. However, the selection of evaluative metrics varies widely based on data availability and the specific context of each location. The absence of a standardized approach to quantifying the characteristics and benefits of TOCs allows future research to utilize a wide range of potential data sources tailored to areas of interest.

Overall, TOC-related concepts are incorporated in almost all peer region growth and transportation plans. Metro Vancouver, like these other growing regions, faces similar challenges such as land constraints, high living costs, and significant projected population growth. With substantial plans for transit expansion to address these challenges, there is a pressing need to evaluate the benefits and challenges facing TOCs in Metro Vancouver, and to understand the impacts of different development typologies.

Part 3: Analysis

3.1 Community case studies

Selection criteria

The land use designations and regional overlays established in *Metro 2050* provided the basis for defining land use matters of regional significance. These informed the selection of case study areas by ensuring that the selected areas align with the regional land use framework. The designations and overlays relevant to this report include the following, as outlined in *Metro 2050* (MVRD, 2022):

- Urban Containment Boundary: A stable, long-term, regionally-defined area for urban development that protects Agricultural, Conservation and Recreation, and

Rural lands from developments requiring utility infrastructure and from auto-oriented, dispersed development patterns.

- General Urban lands: Lands intended for residential neighbourhoods and centres, and supported by shopping, services, institutions, recreational facilities, and parks. Within General Urban lands, commercial, employment, and residential development should be focused in Urban Centres and Frequent Transit Development Areas.
- Urban Centres: The region's primary focal points for concentrated growth and transit service. Priority locations for employment and services, higher density forms, mixed residential tenures, affordable housing options, and commercial, cultural, entertainment, institutional, and mixed uses. Intended to promote transit-oriented communities where transit, multiple-occupancy vehicles, cycling, walking, and rolling are the preferred modes of transportation.
- Frequent Transit Development Areas (FTDAs): Additional priority locations to accommodate concentrated growth in higher density forms of residential, commercial, and mixed-use development. May contain community, cultural, and institutional uses.

The following criteria were developed to inform the selection of case study areas across Metro Vancouver (Table 3).

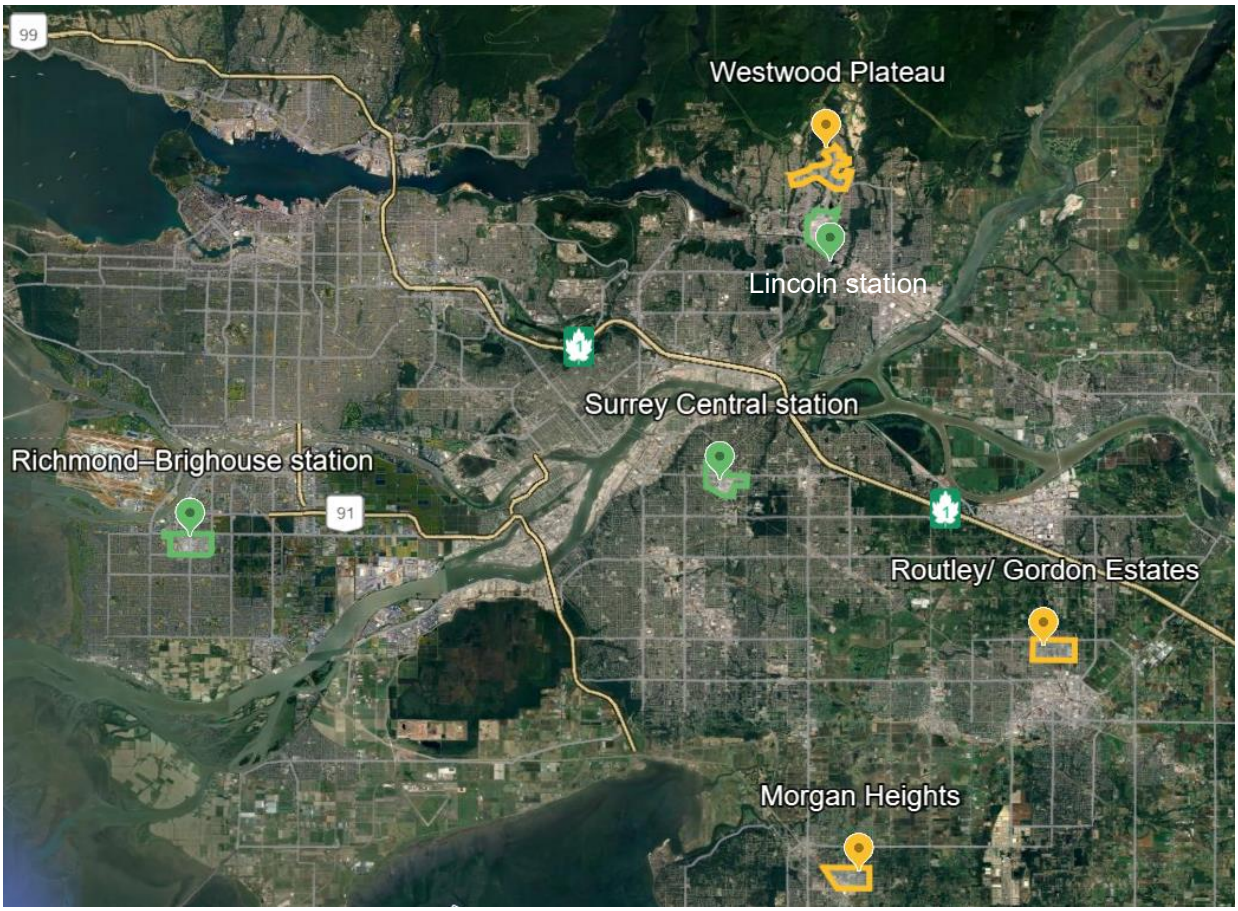
Table 3. Selection criteria for case study areas.

Greenfield selection criteria	TOC selection criteria
• Area not anchored by rapid transit • Designated for General Urban land use in *Metro 2050*, but not part of an Urban Centre or Frequent Transit Development Area • Is a "mature" area with a relatively high degree of development prior to 2021 • Has experienced significant change in land use in the last 10-15 years (i.e., rural land to suburb) • Limited diversity in land uses; either single-use or segregated land uses	• Centered around rapid transit; area within an approximate 800m radius of a SkyTrain station • Designated for General Urban land use in *Metro 2050*, and part of an Urban Centre or Frequent Transit Development Area • Is a "mature" area with significant investment and development of TOC-related projects • Reflects regional policy planning efforts of the last 50 years towards more sustainable development practices

Case study areas

Based on the application of the selection criteria, the following greenfields were selected as case study areas: Morgan Heights (Surrey), Routley/Gordon Estates (Township of Langley), and Westwood Plateau (Coquitlam). These greenfields are all found at the edges of the Urban Containment Boundary, or just outside designated Urban Centres. Additionally, the following TOCs were selected: Surrey Central station (Surrey), Richmond-Brighouse station (Richmond), and Lincoln station (Coquitlam). These TOCs are all located within Urban Centres and anchored by SkyTrain stations along the three rail lines of the rapid transit system. The selected case study areas are identified on a regional map of Metro Vancouver (Figure 4).

Figure 4. Case study areas within Metro Vancouver.



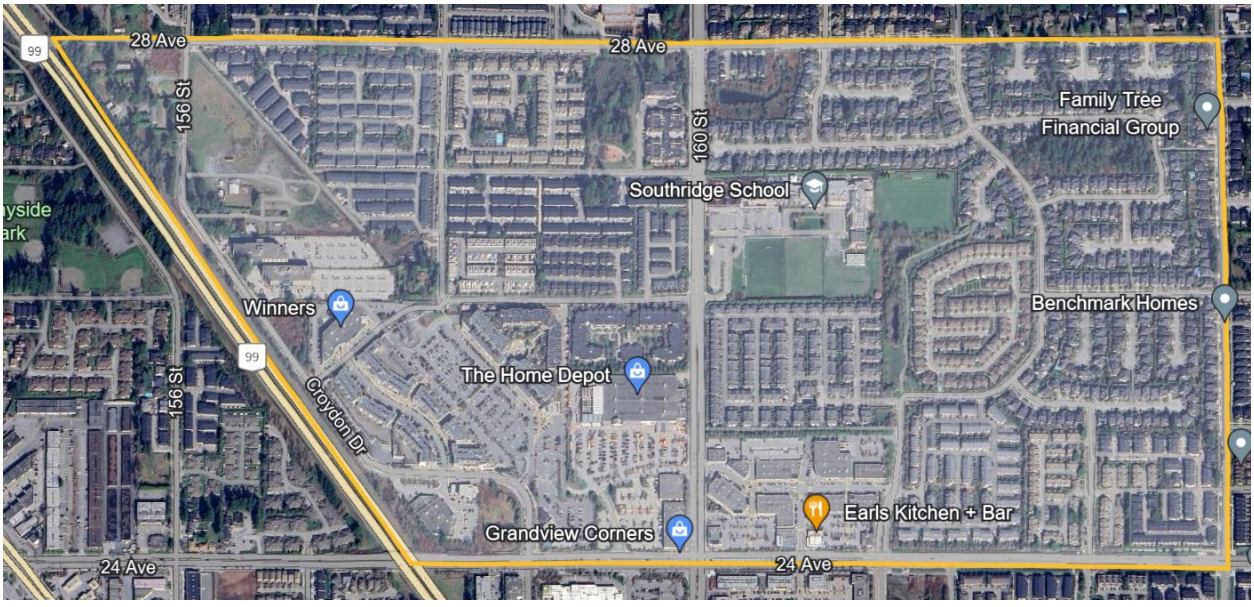
Greenfields are marked in yellow and TOCs are marked in green. Source: Google Earth.

Greenfield case study #1: Morgan Heights (Surrey)

Context: Morgan Heights is a neighbourhood in the northwestern area of Grandview Heights, a suburban community in south Surrey (Figure 5). Bordered by Highway 99 to the west, 28 Ave to the north, 24 Ave to the south, and 164 St to the east, the area is designated as General Urban in *Metro 2050* and was deemed suitable to provide new housing opportunities in south Surrey in the context of developing a complete Grandview Heights community. The area was historically rural; large estates sprawled along the roadsides were surrounded by open fields and patches of dense wooded areas.

The *Grandview Heights General Land Use Plan* (2005) and the *Highway 99 Corridor Local Area Plan (LAP)* (2004) preceded the *Morgan Heights Neighbourhood Concept Plan (NCP)* (2005), which proposed a mix of housing types with three new parks, centered around Southridge Private School. Following the implementation of the NCP, the area underwent significant land clearing for development between 2006-2008 and has now been largely built out as of 2014, with approximately 2,350 residential units. The neighbourhood's character-defining elements rest mainly in the sloped natural landscape, with views to the north across the flat delta plain of the Nicomekl River.

Figure 5. Morgan Heights case study area.



Source: Google Earth.

Transportation: Most commute trips from Morgan Heights are made by car, with up to 89% of residents getting to work by private vehicle (Statistics Canada, 2021). Based on a Google Maps commute scenario, estimated commute times at peak hours are variable when driving but are still significantly faster than the equivalent transit options. On a given Monday at 8am, it would take between 35m—1h to commute by car from a major intersection in Morgan Heights (24 Ave/160 St) to a proximate office complex (Metrotown), and up to 1h45m by transit (Google, n.d.). Further, pedestrian connectivity is rather indirect from the residential areas to the bus stops at this intersection. For a given resident living in the Highland Park townhouse complex (400m northeast of 24 Ave/160 St as the crow flies), it would take them around 10 minutes to walk to the bus stops (an indirect 650m route along sidewalks) (Google, n.d.).

There were no transit services in the Grandview Heights area at the time of the NCP approval; however, this has changed in recent years as the neighbourhood has developed. While not part of Metro Vancouver's Frequent Transit Network (FTN), the current transit service in Morgan Heights includes the 531 route (standard bus with standard service) along 24 Ave, and the 363 and 354 routes (mini-bus with standard service and standard bus with peak only service, respectively) along 160 Ave (TransLink, 2023).

TOCDG evaluation

1. Destinations: Key destinations in Morgan Heights include Southridge Private School, two major shopping centres (The Shops @ Morgan Crossing and Grandview Corners), three public parks, and an assisted living facility. There are transit stops near each destination except for the Grandview Corners stores south of 24 Ave, since the bus routes along 160 St turn west on 24 Ave. Transit users must cross large surface parking lots and smaller roads to reach certain storefronts (e.g. The Home Depot, Indigo, Real Canadian Superstore, etc.) from the bus stops.
2. Distance: The subdivision pattern includes rural grid roads (28 Ave, 24 Ave, 160 St, and 164 St), cul-de-sacs, and a variety of lot sizes and configurations, including long, thin parcels and smaller one-acre parcels fronting the roads. Enclosed townhouse complexes have limited points of access and narrow dead-end sections and an absence of sidewalks, where walking paths connecting residences to arterial streets served by transit exist but are provided arbitrarily (Figure 6). There are bike lanes along 24 Ave, 28 Ave, and 164 St; however, the infrastructure does not form a complete, protected network, given that some sections of 160 St are shared-use with motorists – until a separated multi-use pathway begins near Southridge School – and the bike lane on 164 St abruptly ends north of 28 Ave.

Figure 6. Typical streetscape in Morgan Heights.

Source: RE/MAX.

3. Design: Considering the NCP calls for "pedestrian-friendly design", most local streets have sidewalks on both sides, and there are some multi-use pathways along the arterial roads. However, the commercial node around the 24 Ave/160 St intersection is more auto-oriented, with parking lots and parking spaces placed between the street and the storefronts, and cycling infrastructure that is "comfortable for few" in this area (Regional Roads, n.d.). The design of the commercial area varies at each corner; the large-format Walmart on the southwest corner is visually permeable and accessible from the street, while the storefront entrances on the southeast corner face inwards toward the parking lot and do not have many windows on the street side. Further, the smaller neighbourhood-scale retailers on the northeast corner serve as a transition to the surrounding residential area, and Main Street within The Shops @ Morgan Crossing on the northwest corner provides a pocket of pedestrian-scaled urban realm, with active ground-floor retail uses and traffic calming measures.
4. Density: The Morgan Heights land use map outlines a mix of residential densities, from low-density single-family and duplex homes (6-10 units per acre (UPA)) transitioning to higher-density multiple housing (up to 30-45 UPA) closer to the commercial node along the Highway 99 corridor. The medium-density multiple housing is allocated to small lots, townhouses, and row houses, and higher-density townhouses and mid-rise condos occupy the high-density zone adjacent to The Shops @ Morgan Crossing.

5. Diversity: The *Morgan Heights NCP* calls for single-use areas; zones are either residential or open public park space. However, the Highway 99 Corridor LAP, which encompasses the commercial node, outlines a mixed-use residential and commercial area at The Shops @ Morgan Crossing, and a segregated commercial-only zone at Grandview Corners.
6. Demand Management: This neighbourhood is well-supplied by parking; most townhouses and row houses have attached ground-level garages with shared driveways through the enclosed residential areas, as well as free parking on the local streets. Surface parking within the commercial node is vast and free of charge, with a considerable provision of 3 spaces per 100m^2 of gross floor area, as specified in the *Highway 99 Corridor LAP*. Comparatively, the minimal bus stop design – often a simple signpost and garbage can, and rarely a bench or shelter – contributes to making driving a more appealing choice than taking transit.

Figure 7. Streetscape in The Shops @ Morgan Crossing.

Source: Apartments.com.

Unique feature: Although retail developments in Morgan Heights incorporate design elements typical of traditional strip malls and retail power centres, the area features a distinctive urban-style retail node called The Shops @ Morgan Crossing (Figure 7). Developed by Salthill Capital, this property is located in a mixed-use residential and commercial zone, which is unique for the area. It includes ground-level retail spaces with 457 strata condominium units situated on the three floors above (Salthill Capital, n.d.).

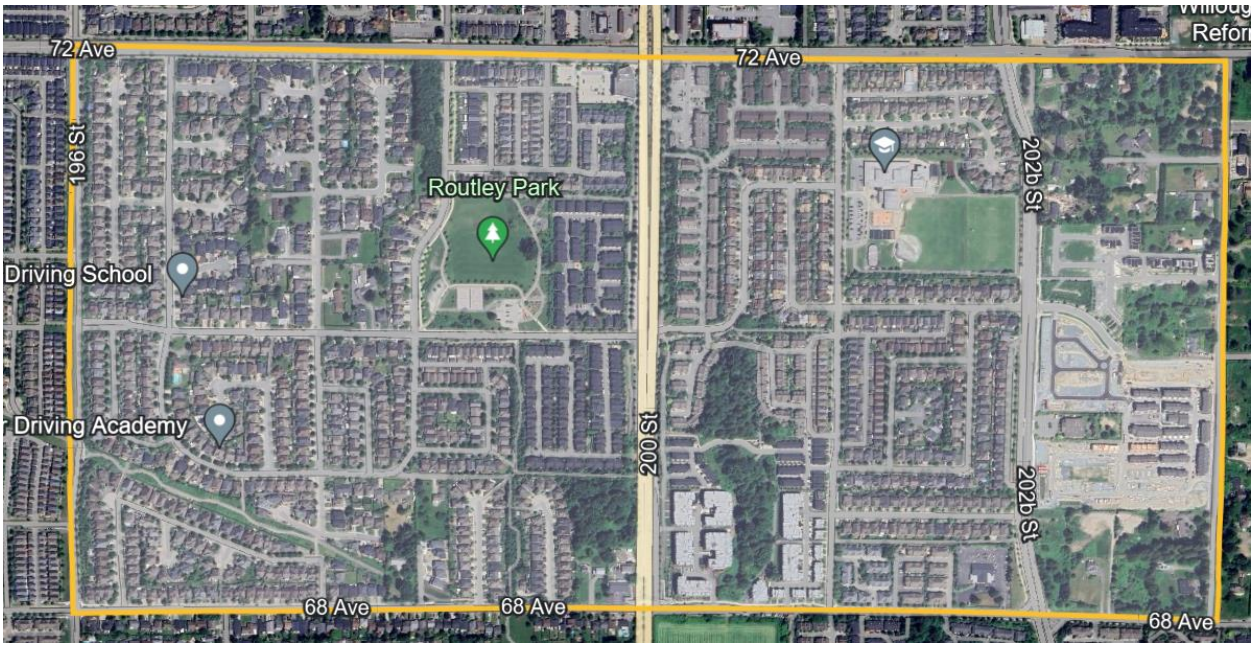
The area is bound by Highway 99 and a surface parking lot, making it only accessible by transit via the two bus stops at 24 Ave/Croydon Dr. This is a busy intersection, with 6 lanes of traffic running along 24 Ave and only one sidewalk along Croydon Dr leading towards the shops. However, after arrival, many design elements contribute to a comfortable pedestrian environment, including a semi-covered pedestrian path through the parking lot, a narrow street with a speed bump and multiple pedestrian crossings, as well as a small courtyard with umbrellas, benches, and plants.

Greenfield case study #2: Routley/ Gordon Estates (Township of Langley)

Context: Routley, Southwest Gordon Estate, and Central Gordon Estate are all neighbourhoods in the southwest area of Willoughby, a community located within the Township of Langley (Figure 8). This case study area includes the majority of Routley and small portions of Southwest and Central Gordon Estates, with 68 Ave to the south, 196 St to the west, and 72 Ave to the north, and 204 St to the east. The area is designated General Urban in *Metro 2050* and is located just outside Langley Urban Centre. This area was historically characterized by rural residential development with estate-type homes, larger lot farms, various institutional uses, and extensive areas of woodlots and pastures.

The *Routley Neighbourhood Plan (NP)* (2001) proposed new residential land uses given the neighbourhood's proximity to amenities and services in Langley City, as well as the creation of a greenway system as an attractive entryway into Langley Town Centre, and Routley Park as a community focal point. Land uses in the *Southwest Gordon Estate Neighbourhood Plan* (2000) were predominantly single-family residential, with two small commercial nodes, and an elementary school. More recently, the *Central Gordon Estate Neighbourhood Plan* (2012) planned for townhouses, some low-density apartments, and a small mixed-use node at 70 Ave/204 St for the rural land between 202A St and 204 St, which is currently being developed. Initial land clearing and residential development began in 2003 and continued incrementally until 2017. Despite recent development, the area still contains numerous clusters of trees and vegetation, and the east-west sloping escarpment provides views of the valley.

Figure 8. Routley/ Gordon Estates case study area.



Source: Google Earth.

Transportation: Almost all commute trips from the Routley/ Gordon Estates area are made by car, with up to 94% of residents getting to work by private vehicle – the highest proportion out of all the case study areas (Statistics Canada, 2021). On a given Monday at 8am, the estimated commute time from a major intersection (72 Ave/200 St) to a proximate employment centre (Surrey Central City Office Tower) takes 18—45m by car, and 1h by transit on the 501 bus route (Google, n.d.). Additionally, pedestrian connectivity to the bus stops at this intersection is quite direct, with high-quality pedestrian infrastructure that is moderately consistent throughout the area. For a given resident living on the corner of 70a Ave/200b St (400m southeast of 72 Ave/200 St as the crow flies), it would take them around 7 minutes to walk to the stops (Google, n.d.). This 550m route follows a walking path that cuts through the residential blocks but also crosses a busy surface parking lot.

Currently, the closest and only connection to the FTN is at Langley Centre; however, 200 St has been identified as one of the first three lines to receive Bus Rapid Transit (BRT) service in the coming years (TransLink, 2022; Freeman & Ross, 2023). Three lower-frequency bus routes serve the area: the 501 route (standard bus with peak frequent service) and the 595 route (standard bus with standard service) along 200 St connect Langley Centre with Surrey Central Station and Maple Meadows Station, respectively, and the 372 route (mini-bus with standard service) runs along 72 St and turns south down 202b St (TransLink, 2023).

TOCDG evaluation

1. Destinations: The small commercial node at 72 Ave/200 St is a key destination for the area, with two gas stations, fast food chains, some smaller shops and community facilities (e.g., dentist, Taekwondo academy), and a low-rise corporate centre. Other sites include two churches, the R.C. Garnett Elementary School, and four daycare centres. Routley Park offers many amenities: playground, baseball diamond, soccer field, tennis and basketball courts, a community garden, and an off-leash dog area. R.C. Garnett Park is adjacent to the school, and the Jeffries Brook Greenway pocket park has a small playground and multi-use path. Bus stops serve the commercial node at 72 Ave/200 St, but access from the bus stop to the school is slightly inconvenient as students must cross a large field.
2. Distance: The area is organized by arterial roads (196 St, 202b St, and 72 Ave), with 204 St and roads between cul-de-sacs serving as collector roads, and 200 St as a major road bisecting the neighbourhood. There is mostly a cul-de-sac subdivision of single-family homes (Figure 9), and compact lots of duplexes and townhouses, with narrow shared driveways and dead-end streets. However, some distinct one-acre lots with large yards and estate-type dwellings remain. Despite this non-grid-like organization, walking routes are continuous and connected. At the end of most dead-end streets, paths connect pedestrians and cyclists to the adjacent residential area or road via a greenway network. This greenway network provides adequate walking and cycling connectivity through off-street shared-use trails and a pedestrian overpass to cross the 200 St/68 Ave intersection. Along the

streets, there are painted bike lanes along 72 Ave and down 200 St, but they abruptly end south of 70 Ave.

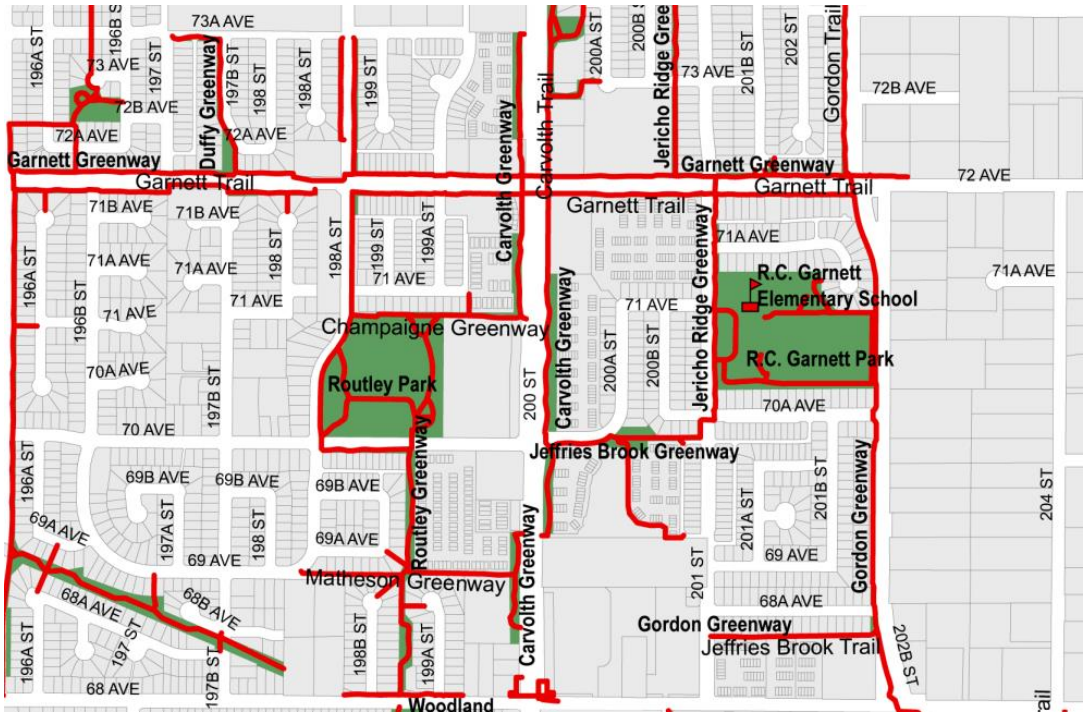
Figure 9. Typical streetscape in Routley/ Gordon Estates.

Source: Google Maps.

3. Design: Most streets have sidewalks on both sides except 204 St, which is a rural road with no pedestrian infrastructure. This contrasts with the safe crossing of 200 St at 68 Ave, which benefits from a recently constructed pedestrian overpass. The commercial node has auto-oriented drive-throughs and strip-mall-type buildings where foot traffic must cross surface parking lots to enter the storefronts. Despite this, human-scale entrances to the Circle K convenience store and the Corporate Centre are directly accessible from the street and are visually appealing. Additional design elements contribute to making the greenways noticeable and inviting, including signage and small bollards.
4. Density: All three NPs have outlined a variety of ground-oriented housing types with a base density of 6 UPA. West of 200 St, low-density (6-10 UPA) residences are comprised of traditional single-family lots and compact lots with duplexes and townhouses, with two areas identified for potential infill development. East of 200 St is mostly single-family homes, but also has an area of higher density along 68 Ave with low-density apartments (1.4 Floor Area Ratio (FAR)) and townhouses (20 UPA). The new development between 202b and 204 St is planned mostly for townhouses (15-20 UPA), with two lots for low-density apartments (1.4 FAR).

5. Diversity: The land use in the area is largely segregated, with mostly residential zones, one commercial node, a few public parks, and some institutional sites, including churches. The *Central Gordon Estate NP* proposes future low-density mixed-use buildings at 204 St/70 Ave to create a main focal point for the neighbourhood core; however, this intersection is currently not served by any bus routes.
6. Demand management: Free 2-hour parking is available behind the Corporate Centre, and there is free unlimited surface parking in the commercial node. The low-density apartment complex at 200 St/68 Ave has underground parking, and the *Central Gordon Estate NP* offers an incentive for developers to provide shared underground or structured parking by allowing an increase in density from 15 UPA to 40 UPA for newly built townhouses. Bus stops in the area are often only a signpost and a bench, but there are shelters at the stops along 72 Ave that provide relatively easy access to the commercial node.

Figure 10. Greenway connections in Routley/ Gordon Estates.



Source: Routley Neighbourhood Plan (2001).

Unique feature: A unique feature of the area is its network of greenway connections (Figure 10). The greenways are made up of mixed-use paths that include signage and pedestrian bollards, and help retain and link the natural clusters of vegetation in the area. The main greenway serves as a green buffer along the 200 St corridor, while smaller greenways and paths are integrated within the neighbourhood.

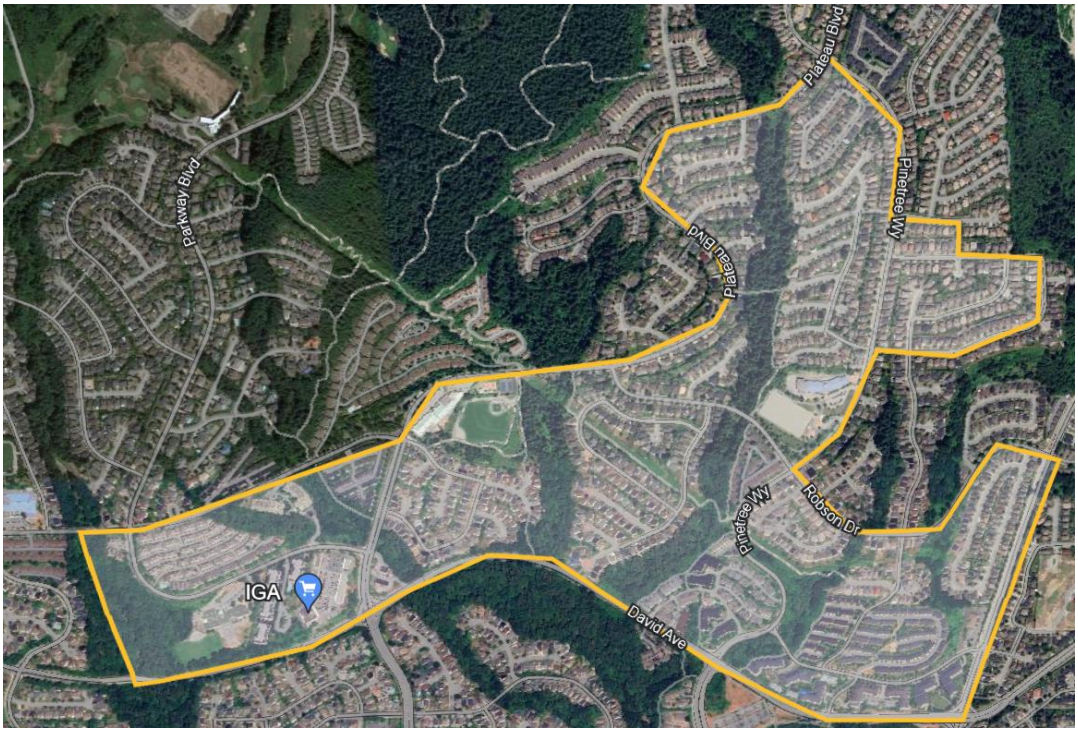
For example, mid-block pedestrian connections from the residential area to the 200 St greenway facilitate access to the bus stops on that street. This network creates a dedicated corridor for commuter and recreational cyclists and incorporates elements of a grid layout that promotes a pedestrian-friendly environment within an area typically designed to favour cars, enhancing overall livability for residents.

Greenfield case study #3: Westwood Plateau (Coquitlam)

Context: Westwood Plateau is a neighbourhood in the northwest region of Coquitlam (Figure 11). This case study area focuses on the southeast part of the neighbourhood, which is generally bounded by David Ave to the south, the Scott Creek Ravine to the west, Panorama Dr/ Plateau Blvd to the north, and Pinetree Wy/ Pipeline Rd to the east. The area is located just outside the Coquitlam Urban Centre and on the edge of the Urban Containment Boundary, including the southern slopes of Eagle Mountain. In *Metro 2050*, both General Urban and Conservation and Recreation land uses are designated within Westwood Plateau. The area is named after the Westwood Racing Circuit, which operated on the plateau before the community was built, between 1957 and 1990 (City of Coquitlam, n.d.). The park was closed to make way for housing development and a golf course.

The *Northwest Coquitlam Area Plan* (2002) planned for a residential community of about 15,000 people, with most of the housing proposed as single-family residential, and the remainder as cluster housing, townhouses, and multi-family apartments. The Plan identified the central hub of the community to be at the intersection of Johnson St/David Ave (Westwood Plateau Village), with three smaller village centres serving as focal points for other parts of the area. Since 2011, the area has been built out, with no significant new development occurring since then. The neighbourhood's character is defined by its extensive green spaces, which include neighbourhood parks, golf courses, and backcountry trails.

Figure 11. Westwood Plateau case study area.



Source: Google Earth.

Transportation: Most commute trips from Westwood Plateau are made by car, with up to 83% of residents taking a private vehicle to work (Statistics Canada, 2021). On a given Monday at 8am, the estimated commute time from the community hub (Johnson St/David Ave) to a proximate office complex (Metrotown) takes 30m—1h by car, and 1h5m by transit via two busses and the Millennium SkyTrain Line (Google, n.d.). When evaluating pedestrian connectivity from a residence at the intersection of Meadowvista Pl/Valleyvista Dr (400m northeast of the community hub as the crow flies), it would take a resident around 10 minutes to reach the hub on foot, via the 650m route along the sidewalks of the winding local streets (Google, n.d.).

At the time of the Area Plan approval, bus services were impeded by rush-hour congestion on regional routes and the area's transportation needs were not being met. As of 2016, the Evergreen extension of the Millennium Line has been operational, connecting the Coquitlam Urban Centre to the FTN. However, the closest SkyTrain station at Lafarge-Lake Douglas is still a 28-minute walk from Westwood Plateau Village (Google, n.d.). The current transit service in Westwood Plateau includes the 186 and 187 routes (mini-buses with peak frequent service) that meander through the local streets and connect to Coquitlam Central station (TransLink, 2023). Additionally, the 183 and 188 routes (standard buses with peak frequent service) run north along Pinetree Wy and connect Coquitlam Central station with Moody Centre and Port Coquitlam station, respectively. Lastly, the 191 route (standard bus with standard service) runs along Pinetree Wy and turns east on David Ave towards Princeton Ave (TransLink, 2023).

TOCDG evaluation

1. Destinations: The community hub at Westwood Plateau Village is a key destination for the area, including an IGA grocery store, a CIBC branch, a few small restaurants and cafes, and other commercial uses (e.g., dollar store, pharmacy, liquor store, hair salon). Other destinations within the case study area include a gas station, three schools with adjacent parks, several daycare centres, and a religious hall. A smaller commercial hub with a physiotherapy clinic and convenience store market is located at Pinetree Wy/Robson Dr. Notably, the Summit Community Centre located on the west side of Summit Middle School offers various drop-in and registered programs in basketball and volleyball for both children and adults. There are three bus stops along Parkway Blvd that serve the area around the main commercial hub and community centre, but each stop is located somewhat down the road from each destination, and there are no direct walking paths leading to the entrances.
2. Distance: Arterial roads include Pipeline Rd, Pinetree Wy, Johnson St, and the east-west David Ave. The collector street system is designed as a series of loops with winding local streets, which create a layout of cul-de-sacs following the natural topography of each subdivision. Some townhouse complexes are fenced off entirely from the collector streets and have gated entrances, while others are lined with tall hedges and have gates for pedestrian access from the street. The Area Plan outlined the need to provide walkways to facilitate pedestrian circulation to

schools, transit stops, and recreational trails. While the area has walking routes that connect some cul-de-sacs and dead-end streets with each other and with collector roads, these connections are not comprehensive. However, a network of hiking trails that aligns with the parks runs between the residential areas (City of Coquitlam, n.d.). There are no Major Bikeway Network routes in the area due to the steep inclines across much of the street system.

Figure 12. Single-family homes in Westwood Plateau.

Source: Westwood Plateau Community Profile (2019).

3. Design: Westwood Plateau Village has an auto-oriented strip-mall design with a large surface parking lot, and only three pedestrian access points from the main roads. Nearly all collector streets are very wide and have sidewalks on both sides, but most local streets within the compact housing areas have only one sidewalk or none at all. Many three-way intersections lack safe pedestrian crossings, but the infrastructure significantly improves closer to school zones. These zones have pedestrian-activated crossing lights, street narrowing with bollards, and clear signage to enhance safety.

4. Density: The Area Plan outlines a range of housing densities, from acreage lots to medium-density apartments. Although the target housing mix for the area historically favoured large single-family homes (Figure 12), the Area Plan introduces cluster housing at a density of 6-10 UPA. This aims to bridge the market gap between traditional single-family homes and townhouses, which have a density of 12 UPA. The highest densities in the form of multi-family apartments are clustered around the commercial hub, which serves as the community focal point.
5. Diversity: Lands within Westwood Plateau are designated for single uses, with zones allocated for residential, general commercial, local commercial, school, open space, or parks and recreation. Since the neighbourhood is primarily residential, the only active uses in proximity to the bus stops are found near the two commercial areas.
6. Demand management: To accommodate the parking area for Westwood Plateau Village, the Area Plan allocated a substantial site of 4 hectares for cut-and-fill slopes. This surface parking lot – like the one at the smaller local commercial site – is free and unlimited, making driving a convenient way to access the shops. The neighbourhood is well-supplied by private garages, driveways, and free on-street parking as well. While some bus stops along David Ave and Johnson St are sheltered, most bus stops in the area are marked by modest signposts that offer minimal comfort or visibility, encouraging driving as the primary mode of transport.

Figure 13. Typical residential subdivision in Westwood Plateau.

Source: OverflightStock.

Unique feature: Westwood Plateau's distinctive character is preserved though a thoughtful approach to land use and development, which maintains the area's natural landscapes while providing practical and recreational benefits for residents. Unlike the flatter greenfields in southeast Metro Vancouver, this neighbourhood is defined by its steep, curving roads and the plateau's unique topography. The Area Plan emphasizes the importance of integrating the natural landscape into the community's design, setting goals to minimize conflict between residential and resource uses of the land.

Specifically, the Area Plan proposes that significant watercourses are protected for fisheries, and that a gravel mining site remains dedicated to resource use. Additionally, preserving the area's rich tree and vegetation cover not only enhances its aesthetic appeal, but also prevents development from encroaching on environmentally sensitive areas outside the Urban Containment Boundary. Residents have direct access to nature through several neighbourhood parks and a network of hiking trails, including the Coquitlam Crunch Trail, which connects to backcountry trails on Eagle Mountain just outside the case study area (City of Coquitlam, n.d.).

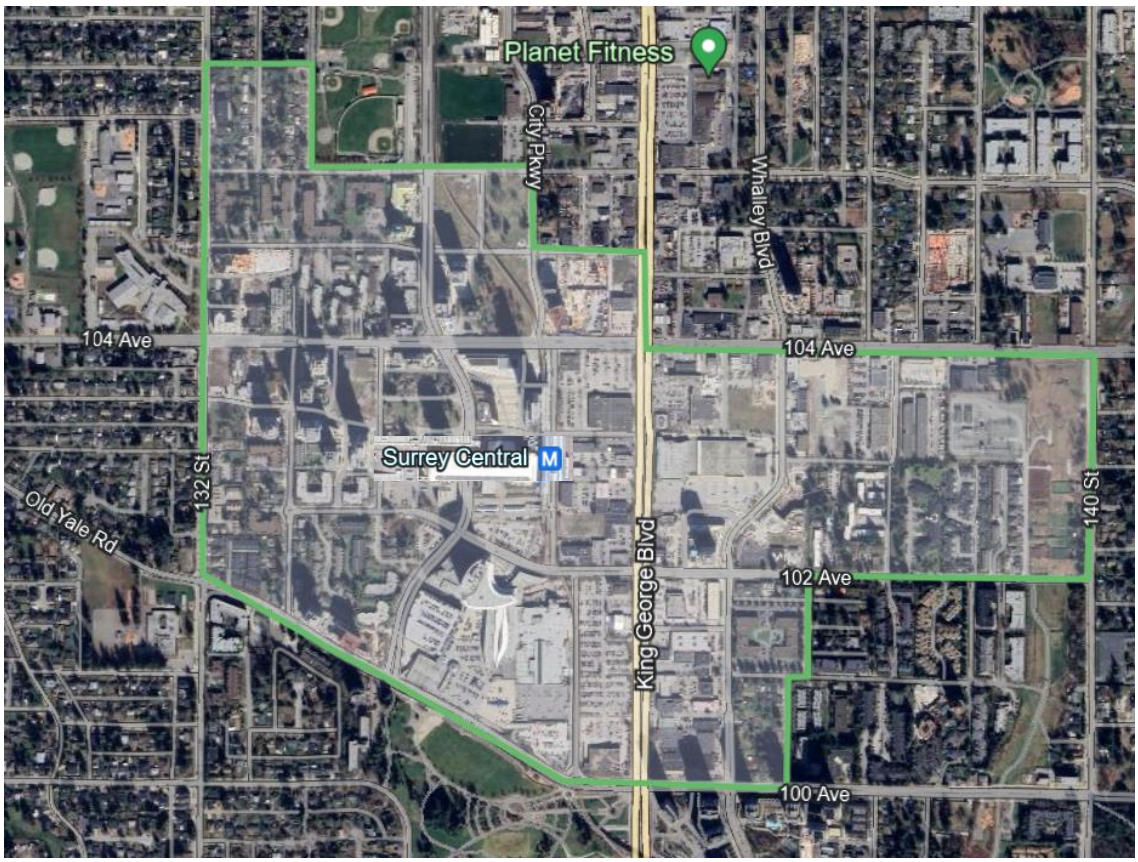
TOC case study #1: Surrey Central station (Surrey)

Context: The transit-oriented community around Surrey Central station is in the Central Downtown district of Surrey City Centre, within the greater community of Whalley (Figure 14). The area is generally bounded by 132 St to the west, 105 Ave to the north, 140 St to the east, and 100 Ave (Old Yale Rd) to the south, with King George Blvd bisecting the area. Surrey City Centre is designated as "Surrey Metro Core" in *Metro 2050* and has been undergoing significant transformation into becoming a compact and identifiable downtown core for the region south of the Fraser River. It was once a suburban town centre, with a shopping mall, recreation centre, small retail buildings, and large surface parking lots along King George Blvd, and low- to medium-density housing along the outskirts (City of Surrey, 2017). Several factors drove the need to plan for a development pattern that would encourage growth and density around existing transportation and services: namely, the SkyTrain extension to King George Station in 1994, a significant population influx to Surrey during the 1980s and 1990s, and the redevelopment of the mall site into a mixed-use high-rise building in 2000.

The *Whalley Enhancement Strategy* (2003) first outlined the vision of transit-oriented development at Surrey Central Station (Surrey City Manager, 2003). In due course, the *City Centre Plan* (2017) proposed high densities for the Central Downtown district, with a focus on civic, educational, entertainment, and cultural activity in a compact, highly walkable area (City of Surrey, 2017). This vision attracted significant public and private sector investment as the area continues to grow today; construction on a 52-storey mixed-use tower was recently completed and several other redevelopment projects are being planned. While most of the City Centre's heritage resources are in the Historic District just north of 105 Ave, the Round Up Cafe on King George Blvd is a notable heritage site in Central Downtown. Built in 1949, its large neon sign and single-storey form represent the auto-oriented development type that historically defined the area's character (City of Surrey, 2017).

Transportation: Residents living within the Surrey Central TOC report the highest usage of sustainable commute modes across all other case study areas, with a considerable 42% of the population taking public transit, walking, or cycling to work (Statistics Canada, 2021). On a given Monday at 8am, Google Maps estimates that it would take between 40m—1h25m to commute by car from the station into Downtown Vancouver, and only 38m by transit on the direct Expo Line (Google, n.d.). The station area itself is includes a rentable bike locker facility and is accessible to the surrounding residences on foot or by bike. For a given resident living at the Evolve apartment building (400m northwest of Surrey Central station as the crow flies), it would take them around 8 minutes to walk to the station (a 600m route via the sidewalks).

Figure 14. Surrey Central station case study area.



Source: Google Earth.

Surrey Central station is a crossover point for three major transit corridors on Metro Vancouver's FTN: the Expo Line high-frequency rail service, the R1 RapidBus service with limited stops and transit priority, and bus routes along the Fraser Highway corridor with service every 15 minutes or better. In addition, the Surrey Central Exchange bus loop facilitates transit connections to over 20 bus routes that serve various areas of Surrey, White Rock, North Delta, and Langley. Within the TOC area, the local bus service includes the 320 and 502 routes (standard buses with all-day frequent service) along 104 Ave and King George Blvd, respectively, as well as other routes with varying service frequency that connect the surrounding districts to the terminus at Surrey Central station (TransLink, 2023). At the time of the *City Centre Plan*, the intent was to introduce a light rail transit (LRT) station next to Surrey Central station, with planned LRT corridors along 104 Ave, King George Blvd, and Fraser Highway. Currently, the R1 RapidBus services this demand, and the ongoing need for transit connecting Surrey City Centre to Langley Centre supports the future Surrey-Langley SkyTrain extension (Government of British Columbia, n.d.).

TOCDG evaluation

1. Destinations: Key sites include City Hall, City Centre Library, Civic Plaza, 3-Civic Plaza (a mixed-use development including Civic Hotel and Kwantlen Polytechnic University (KPU) Civic Plaza Campus), 3 buildings of the Simon Fraser University (SFU) – Surrey Campus, and Central City (a mixed-use development including Central City Mall, an SFU building, and Central City Office Tower). All destinations are within 400m of the station; however, the bus loop, a large surface parking lot, and the North Surrey Recreation Centre create a physical barrier between the civic buildings to the north and the mall/university/office buildings to the south.
2. Distance: The street network is defined by a wide grid of arterial roads (104, 102, and 100 Avenues, 132 and 140 Streets, and University, King George, and Whalley Boulevards), with discontinuous connector roads within. Currently, the neighbourhood blocks are large (up to 400m in length) and irregularly spaced, especially those served by local streets in the peripheral residential areas. The Plan sets a guiding vision to reduce block sizes by introducing a finer-grained road network, aiming for block sizes between 80 and 100m. This would increase connectivity between amenities and provide a variety of routes that increase mobility options. Some enclosed townhouse complexes and local streets – like those in Morgan Heights – lack sidewalks entirely, and the existing sidewalks leading to and from the station cross wide streets. Further, there is a direct cycling route to the station along City Pkwy, but the painted bike lane ends abruptly just south of 104 Ave before reaching the station entrance.

Figure 15. Surrey Central TOC.

Source: Flickr.

3. Design: The older, auto-oriented arterial roads in the area, like King George Blvd, are lined with large-format, highway-style retail and commercial developments, fronted by street-facing parking lots. Most arterial roads have sidewalks on both sides, while 140 St has a sidewalk on one side. Even with ample sidewalks, pedestrians encounter high volumes of fast-moving motor vehicle traffic, limited crossing opportunities, and long traffic signal timings, making the area difficult to navigate on foot. Additionally, large development sites, wide streets, and the fenced bus loop and parking lots around the station hinder pedestrian movement, despite the proximity of key destinations. The quality of bicycle infrastructure varies significantly, ranging from being "comfortable for most" on the multi-use path along 100 Ave to "comfortable for very few" on City Pkwy (Regional Roads, n.d.). The area around the station also has limited greenery and landscaping, prompting the Plan to call for "humanizing King George Blvd" with enhanced plantings and greenways.
4. Density: The range of densities in the Central Downtown district reflects its transition into a concentrated downtown core, with the highest densities centered around the SkyTrain station (Figure 15). West of King George Blvd, the district features high-rise buildings with a FAR of 7.5. Lower densities are found east of King George Blvd and further away from the station, where mixed-use and residential buildings with a FAR of 3.5 line the outer boundaries. Transitions between densities are ongoing, as seen by brand-new high-rise condos with a FAR of 5.5 emerging across the street from older single-family homes on 133a St. However, some low-rise apartment buildings and low- to medium-density townhouses serve as a buffer between the single-family homes south of 102a Ave and the higher-density developments.
5. Diversity: The Plan proposes mixed-use designations along frequent transit corridors and around transit station areas. Surrey Central station is the highest-density and largest mixed-use node in the City Centre, featuring developments that integrate major civic, employment, residential, institutional, and retail uses on the same sites. Medium-scale mixed-use commercial corridors are planned for King George Blvd and 104 Ave, while segregated residential uses are situated away from these major streets. Additional designations include parks and a plaza.
6. Demand management: A large supply of off-street surface parking facilities support the existing big-box land uses – often providing more parking than needed – and occupy a substantial portion of land in the City Centre. For example, the Central City Shopping Centre features several parking options such as surface parking, underground parking, and a multi-level parking facility. To manage parking, strategies include a 20% relaxation of standard parking requirements in the City Centre, pay parking in off-street lots, and limited on-street pay parking around the station. Although SkyTrain offers easy access to destinations like downtown Vancouver, there are limited transit connections to workplaces and destinations in the South of Fraser area, maintaining driving as the preferrable commute choice.

Figure 16. Civic Plaza near Surrey Central station.

Source: Civic Hotel.

Unique feature: Civic Plaza is a key space in defining the heart of Surrey City Centre (Figure 16). Steps away from Surrey Central station, it is surrounded by several destinations including City Hall, City Centre Library, and the Civic Plaza Campus of KPU. The plaza provides dedicated open space for various community events and large public gatherings, including the Surrey Urban Farmers Market and Surrey's Christmas Tree Lighting Festival. The flexibility of this programmable space is crucial for fostering social interaction and activity within the community.

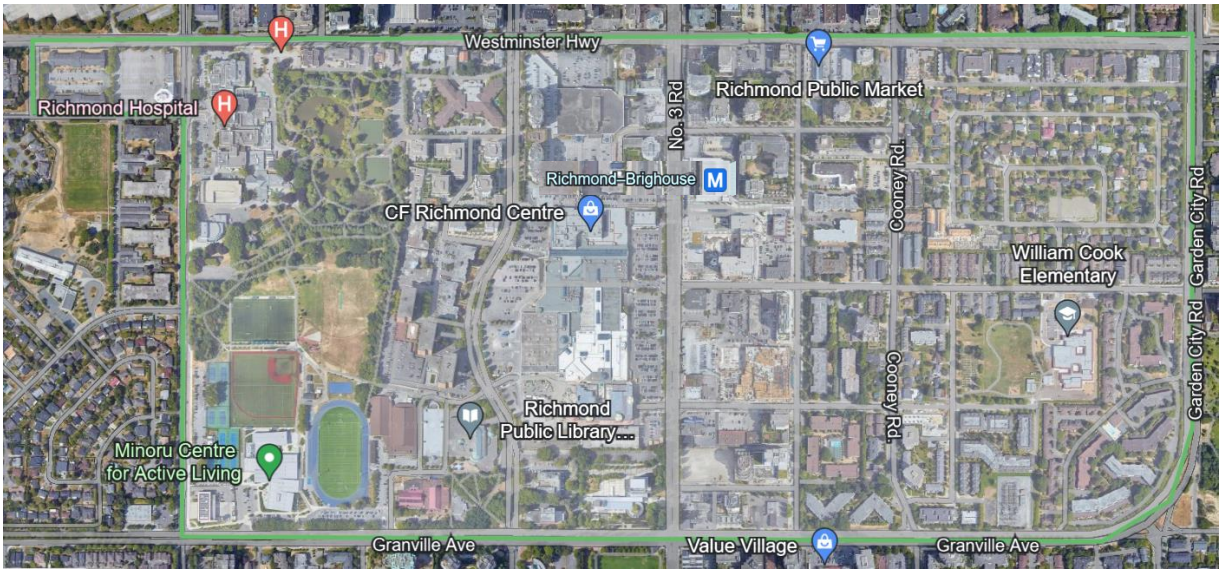
The public realm is well-designed, with cafés and a restaurant on the ground levels of the high-density buildings, potted and planted greenery, unique public art, and illumination at nighttime. The proximity to Surrey Central station highlights Civic Plaza as a focal point for multimodal transportation and community activity. A future extension of the plaza is envisioned in order to create a network of plazas connecting this area with Central City and SFU to the south, and to enhance the pedestrian realm in the downtown core.

TOC case study #2: Richmond-Brighouse station (Richmond)

Context: The transit-oriented community around Richmond-Brighouse station is located within Richmond City Centre, which is a designated Urban Centre in *Metro 2050* (Figure 17). The area is bound by Granville Ave to the south, Gilbert Rd to the west, Westminster Hwy to the north, and Garden City Rd to the east, with No. 3 Rd bisecting the area. The intersection of No. 3 Rd/Granville Ave has long been a hub of activity centered around transit. In the early 1900s, a cluster of shops, a town hall, and a racetrack were located nearby, and the interurban tram running from Marpole to Steveston provided a focus for the community (City of Richmond, 2009). The construction of the Oak St Bridge in 1955 prompted significant residential development that altered the community's early rural character, and a modern town centre complex was built shortly after (City of Richmond, 2009). Since then, the City Centre has grown into a rapidly densifying high-amenity area, featuring a growing commercial hub, proximity to the Vancouver International Airport, and the addition of the SkyTrain Canada Line along No. 3 Rd in 2009.

The *City Centre Area Plan (CCAP)* concept explicitly outlines plans for developing a set of "urban villages" based on the principles of transit-oriented development, with "major" villages around Canada Line SkyTrain stations and "minor" villages around local transit nodes linked to SkyTrain stations via buses (City of Richmond, 2007). Brighouse village is one of the major villages that are proposed, encompassing the area within a 5–10-minute walk (800m) of Richmond-Brighouse station. This area is also municipally designated as a Transit-Oriented Development Area (TOD Area) by the City of Richmond, in line with provincial regulations (Government of BC, 2023, 2024). The special precinct guidelines for Brighouse Village further outline specific land use, density, and design guidelines for this area, with a focus on civic and mixed uses (City of Richmond, 2009).

Figure 17. Richmond-Brighouse station case study area.



Source: Google Earth.

Transportation: A notable 38% of residents living within the Richmond-Brighouse TOC commute to work using sustainable modes, either by transit, walking, or cycling (Statistics Canada, 2021). On a given Monday at 8am, Google Maps estimates that it would take between 22m—1h to commute by car from the station into Downtown Vancouver, depending on traffic conditions, and only 27m by transit on the direct Canada Line (Google, n.d.). The station includes a first come first served bike locker facility and a newly built bus exchange steps away from the station entrance. Pedestrian connectivity from residences to the station is direct; from the Park Village apartment building (400m southeast of Richmond-Brighouse station as the crow flies), it would take a resident around 7 minutes to walk to the station (a 550m route via the sidewalks) (Google, n.d.).

Richmond-Brighouse is one of the terminus stations of the high-frequency rail Canada Line and connects to the FTN with bus corridors that run to Steveston and Delta, providing service every 15 minutes or better. The adjacent bus exchange enables convenient transfer to many bus routes that serve the area. From Richmond-Brighouse station, the 406 and 410 bus routes (standard buses with all day frequent service) operate at FTN levels, connecting to Steveston and New Westminster, respectively (TransLink, 2023). Additionally, the 403 and 430 routes (standard buses with peak frequent service) connect to Riverport and Metrotown, as well as other routes with varying service frequency that connect to local areas within Richmond (TransLink, 2023).

TOCDG evaluation

1. Destinations: Major destinations include Richmond Centre shopping mall, Richmond City Hall, Richmond Art Gallery, Richmond Public Library, Gateway Theatre, Richmond Hospital, Minoru Park, and Minoru Centre for Active Living. These key sites are within an 800m radius of the station and are all accessible via a short walk. However, destinations to the west of No. 3 Rd require crossing through or around the large surface parking lot surrounding the shopping centre.
2. Distance: The street network is comprised of large, discontinuous blocks (over 200m in length) and there is a lack of major throughfares that provide alternative routes for vehicular movement. The CCAP outlines policies on creating a tighter cross-street network to provide more direct access for users of sustainable transit modes. The residential area around Spires Rd is only accessible via two “gate” roads, and lacks both sidewalks and paths for pedestrian connectivity to the surrounding local roads. The Major Bikeway Network runs along No. 3 Rd, but bike lanes only begin north of Cook Rd (Figure 18); the lanes are physically separated from traffic in the immediate area surrounding the station and transition into painted lanes further north beyond the station.

Figure 18. Streetscape at No. 3 Rd and Cook Rd near Richmond-Brighouse station.

Source: LoopNet.

3. Design: An incomplete sidewalk network and large setbacks of some retail sites from the sidewalk hinder the walkability within the case study area, especially along No. 3 Rd. However, the immediate station area features public art and thoughtful greenery and landscaping. Additionally, all connector roads have sidewalks on both sides and the mid-rise buildings along Buswell St have street-facing building fronts. Meanwhile, highway interchanges and intersections with high traffic volumes pose challenges for safe cycling. Cycling along No. 3 Rd is "comfortable for few" and cycling along Gilbert Rd is "comfortable for very few" (Regional Roads, n.d.).
4. Density: Densities and land uses are outlined according to Urban Transect Zones (City of Richmond, 2007). The highest densities are centered around the SkyTrain station and along No. 3 Rd, with high-rise buildings of 3.0 FAR and above. Mixed-use and residential mid-rise buildings (2.0-3.0 FAR) surround the urban core on either side, and only a small general urban area (1.2-2.0 FAR) is designated in the eastern section of the case study area, with primarily low-rise apartment buildings and some single-family homes.
5. Diversity: The CCAP designates the predominant land uses to be mixed commercial-residential, including stand-alone buildings with affordable housing. The urban core zone around the station incorporates several uses, including

business, shopping, hospitality, entertainment, civic, education, recreation, cultural, and residential uses (City of Richmond, 2009). The general urban areas closer to the outer boundaries of the case study area are also mixed-use but are primarily for urban residential uses (e.g., row houses, stacked townhouses, and low- to mid-rise apartment buildings). Other land use designations include parks and a school.

6. Demand management: The vast surface parking lot surrounding the Richmond Centre shopping mall is the most visually impactful parking facility, and makes driving convenient since parking is free. Explicit transportation demand management (TDM) measures are outlined in the CCAP, including incentives to reduce driving (e.g., car-share programs), workplace measures (e.g., free/discounted transit passes), and parking land use management (e.g., tightening parking bylaw requirements). Even though many destinations in this area are accessible by sustainable travel modes, challenges to implementation involve existing lifestyles and attitudes towards new travel options. For future development projects, proposed strategies include reducing parking supply requirements and encouraging optional parking spaces rather than mandatory spaces for residential units.

Figure 19. Residential outdoor amenity space in the Richmond-Brighouse TOC.

Source: City Centre Area Plan – 2.6 Parks & Open Space (2009).

Unique feature: Residential outdoor amenity spaces are a unique contribution towards the open space and recreation areas within the Richmond-Brighouse TOC. Several mid-rise residential or residential-commercial buildings east of No. 3 Rd are positioned near the street, leaving room for on-site amenity space for the shared use of residents. These areas are composed of trees, plants, shrubs, and urban agriculture, and provide space for garden plots, active/passive recreation, and pet recreation, among other uses.

Specifically, the CCAP proposes a strategy to increase the provision of landscaped outdoor amenity space, by encouraging the provision of an additional (minimum) 10% of net development site area for this use (City of Richmond, 2009). These spaces enhance livability, especially in denser areas, where they provide respite from the urban environment, opportunities for children's play and social interaction in a secure setting, and space for activities that may not be easily accommodated elsewhere.

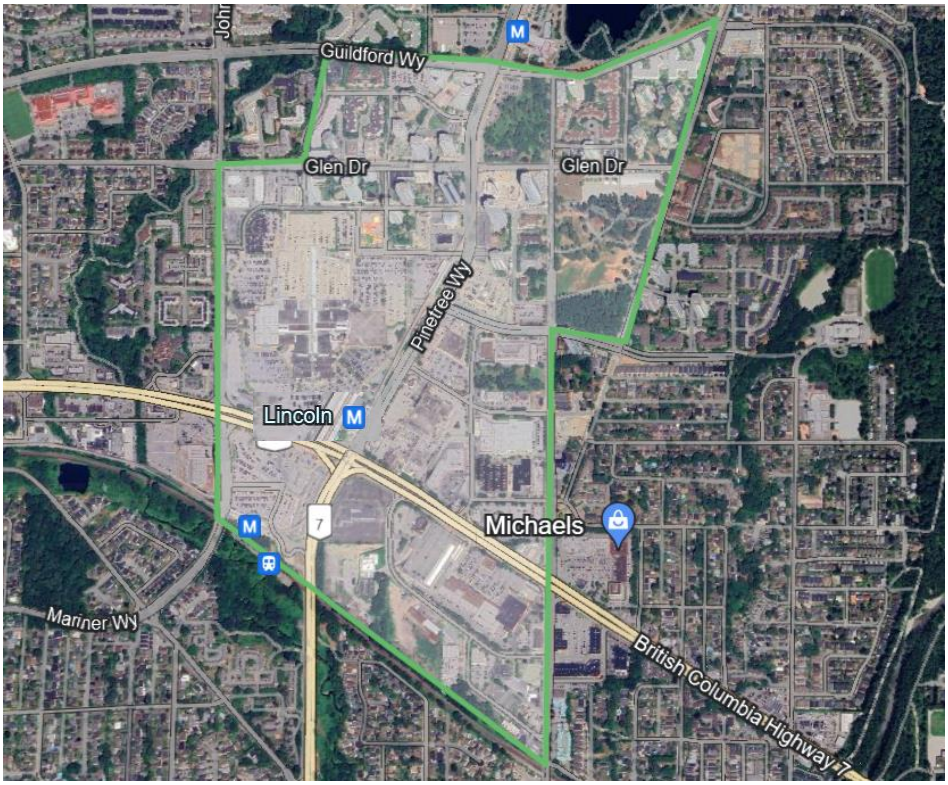
TOC case study #3: Lincoln station (Coquitlam)

Context: The transit-oriented community around Lincoln station is located within Coquitlam Town Centre, which is also a designated Urban Centre in *Metro 2050* (Figure 20). The area is generally bound by the West Coast Express train tracks to the south, Johnson St to the west, Guildford Wy to the north, and Pipeline Rd/ Westwood St to the east, with Pinetree Wy and Barnet Hwy bisecting the area. The Coquitlam Town Centre is a newer community; at the time of the first Town Centre Plan in 1976, only a few homes and a small neighbourhood centre occupied the area (City of Coquitlam, n.d.). Shortly after, Lafarge Lake was created from a former gravel pit and the Coquitlam Centre Mall opened (City of Coquitlam, 2020). With the addition of several civic and community facilities, and the recent extension of the SkyTrain Millennium Line in 2016, the Town Centre has since grown into a major commercial hub and focal point for civic use, community activities, and recreation.

The recent *Coquitlam City Centre Area Plan (CCAP)* (2020) focuses explicitly on transit-oriented development and integrates TransLink's TOC Design Guidelines throughout the plan, with the goal of creating a vibrant transit-supportive downtown (City of Coquitlam, 2020). Specifically, Lincoln station is situated in the heart of the downtown core and is envisioned as a central hub of activity with plazas, offices, shopping, entertainment, and residences. The Lincoln Precinct encompasses the area within a 400m radius of the station and overlaps with the Transit-Oriented Development Area (TOD Area) designated by the City of Coquitlam, in line with provincial regulations (Government of BC, 2023, 2024). Policies for the Lincoln Precinct focus on creating an office business district as well as an entertainment district in proximity to the station.

Transportation: 33% of residents living within the Lincoln TOC commute to work by sustainable modes, either by transit, walking, or cycling (Statistics Canada, 2021). This is the lowest proportion of sustainable commute mode share out of the included TOC case study areas; however, it is still over double the proportion of sustainable commute mode users than the closest greenfield. On a given Monday at 8am, Google Maps estimates that it would take between 28m—1h to commute by car from the station into Metrotown (a proximate office complex), and 47m by transit via the Millennium and Expo Lines (Google, n.d.). The station includes a rentable bike locker facility and bus stops on either side of the partitioned Pinetree Wy. For a given resident living at the Parc Laurent apartment building (400m northeast of Lincoln station as the crow flies), it would take them around 8 minutes to walk to the station (a 550m route via the sidewalks) (Google, n.d.).

Figure 20. Lincoln station case study area.



Source: Google Earth.

Lincoln is the penultimate station of the Evergreen extension to the Millennium SkyTrain Line, and connects to the FTN via bus corridors that run towards Port Moody, SFU, and Lougheed every 15 minutes or better. The bus stops at Lincoln station include the 160 route (standard bus with all day frequent service) to Kootenay, the 183 and 186 routes (standard bus and mini-bus with peak frequent service) through Westwood Plateau, and the 188 route (standard bus with peak frequent service) to Port Coquitlam (TransLink, 2023). Connections to additional bus routes and the R3 RapidBus towards Maple Ridge are one stop away at the Coquitlam Central SkyTrain station.

TOCDG evaluation

1. Destinations: Key destinations within the Lincoln TOC include Coquitlam Centre shopping mall, Henderson Place Mall, Coquitlam City Hall, Buchanan Square, Coquitlam Public Library, the Glen Pine Pavilion community centre, a Service Canada branch, and other big-box retail stores (e.g., Real Canadian Superstore, Rona, Save-on-Foods, etc.). These sites are within an a 5—10-minute walk from the station; however, most destinations along Pinetree Wy and south of Barnett Hwy require crossing through or around large surface parking lots that surround the retail sites.

2. Distance: The street network is defined by high-volume arterial roads that are part of the Major Road Network (Pinetree Wy, Barnet Hwy, Guildford Wy), creating very large and irregularly shaped blocks. The Coquitlam Centre site is over 540m in length, extending from Barnet Hwy to Atlantic Ave, and creates a barrier between the station and the residential areas to the west of the mall, as pedestrian linkages are limited. Most of the pedestrian and micro-mobility paths follow the paths of the existing street network rather than creating short-cuts. However, multi-use pathways under the SkyTrain guideway and along Johnson St provide high-quality connections to the station. The station entrance is accessible on foot or by bike if arriving from the north end; however, the large block size and partitioned traffic lanes do not allow for mid-block crossings to the bus stop on the opposite side (Figure 21). The CCAP calls for a more pedestrian-friendly block pattern to improve connectivity and shorten travel distances by sustainable modes.

Figure 21. Lincoln station viewed from the southeast.

Source: Greg Salter on Wikimedia Commons.

3. Design: Sidewalks are provided on both sides of the street on all arterial and collector roads, but crossings frequently occur at large intersections. Notably, the intersection of Pinetree Wy and Barnet Hwy has crosswalks and pedestrian-activated traffic signals; however, there are 5-7 lanes of motor vehicle traffic coming from each direction as well as right-turn bypass lanes. Most retail sites have traditional auto-oriented power center and strip mall designs, with large

setbacks and entrances facing away from the street. By contrast, the residential buildings in the northern part of the case study area have multiple direct entrances at the street level. Cycling is "comfortable for most" on streets with multi-use paths, and "comfortable for some" on streets with painted bike lanes (Regional Roads, n.d.)

4. Density: The majority of the Lincoln TOC is comprised of the downtown core, which is characterized by high-density mixed-use buildings. Residential buildings are mostly high-density apartments with small-scale neighbourhood commercial uses located closer to Lincoln station. There is also one medium-density residential area with mid-rise apartments between 3-8 storeys on the edge of the case study area.
5. Diversity: The downtown core designation includes mixed-use developments with a high concentration of employment-generating commercial uses, which are mostly located between the downtown core and the residential-only land use areas (City of Coquitlam, 2020). There are general commercial and business enterprise designations in the southeastern part of the case study area, as well as civic and major institutional uses for sites like Coquitlam City Hall. Another use includes a service commercial designation for a gas station.

Figure 22. Coquitlam Centre shopping mall near Lincoln station.

Source: Edgar Bullon on iStock.

6. Demand management: The auto-oriented design of the off-street parking facilities takes up a considerable amount of space within the overall downtown core. There is a large supply of unlimited free parking in front of each retail site, facilitating private vehicle use for driving between destinations. The CCAP outlines some TDM policies, including reducing minimum parking requirements for new developments that provide TDM measures, providing subsidized transit passes for residents and employees, and encouraging carpooling by providing carshare memberships and driving credits. Providing greater pedestrian connectivity will be key in promoting transit accessibility and sustainable mode choice in the area.

Unique feature: Interestingly, the original plans for the Evergreen SkyTrain extension did not include Lincoln station. A unique funding partnership between the City of Coquitlam, the owners of the Coquitlam Centre Mall, and Public-Private Partnerships (PPP) Canada supported its construction (Partnerships British Columbia, 2013).

Initially, Coquitlam Central station was considered sufficiently close to serve the nearby shopping centres and amenities. However, situating an additional station in the center of a rapidly expanding commercial and residential area would serve the mall, as well as numerous existing and planned residential and retail developments within walking distance of the proposed station (Partnerships British Columbia, 2013). Recognizing the value of including the station, this initiative aligned with the City of Coquitlam's Official Community Plan, which aims to transform the City Centre into a sustainable, high-density urban core.

3.2 Quantified differences between development typologies

Development typology

After evaluating each case study area, commonalities emerged in the characteristics defining each development typology. These typical characteristics are summarized below (Table 4).

Table 4. Typical characteristics of development typologies.

Development type	Characteristics
Greenfield	• Key destinations at the intersection of arterial roads, beyond favourable walkable distance from most residences but accessible by car • Large block sizes with arterial roads on the periphery and local streets within • Auto-friendly design, including ample parking options • Highest densities closest to major roads • Segregated land uses, commonly lower-density residential zones and separate commercial areas • Promotes driving as primary transit mode • Static, plateaued development once built out
Transit-oriented community	• Key destinations around rapid transit stations, including both local (e.g., grocery store) and regional destinations (e.g., hospital) • Finer-grained road network facilitating pedestrian connectivity • Design of urban realm is human scale • Highest densities closest to rapid transit stations • Mixed land uses, commonly medium- to high-rises with active ground floor uses • Promotes sustainable transit modes • Active, ongoing development and investment

Metric selection, sources, & definitions

Using the frameworks of the Transportation Index for Sustainable Places (TISP) and the TOC Design Guidelines (TOCDGs), metrics that serve as direct or proxy measures for the characteristics of the two development typologies were selected based on data availability.

Metrics for each case study area were extracted from the following sources: Canadian Census of Population (2021), TransLink's Transit Service Performance Review (2022 & 2023), TransLink's Regional Road Performance Monitoring Dashboard (2020 – based on Insurance Corporation of British Columbia (ICBC) data from 2013-2017), and WalkScore.com. The selected metrics and their definitions are presented below (Table 5).

Table 5. Metrics used in the comparative analysis.

Metric	Data source	Definition
Population	Census	Count of population in case study area
Land area (km^2)	Census	Land area (in km^2) of case study area
Environmental indicators		
Population density per km^2 *	Census, derived	Population per km^2 within case study area
Acreage required for 1,000 people	Census, derived	Land area (in acres) required to house 1,000 people at the population density of a case study area
Main mode of commuting *	Census, derived	Proportion of the employed labour force whose main mode of commuting is by car, truck, or van, or by sustainable modes (public transit, walking, and cycling)
Commuting duration (minutes) *	Census, derived	Proportion of the employed labour force whose commuting duration is either less than 29 minutes, or 30 minutes and over
Social indicators		
Age *	Census	Average age of the population
Transit score	WalkScore	Index score measuring transit accessibility based on distance to closest stop on each route and route frequency and type; measured at the central hub of activity within a case study site
Walk score	WalkScore	Index score measuring walkability based on walking routes to destinations (e.g., grocery stores, schools, parks, restaurants, retail); measured at the central hub of activity within a case study site
Bike score	WalkScore	Index score measuring bike accessibility based on bike infrastructure, topography, destinations, and road connectivity; measured at the central hub of activity within a case study site

Metric	Data source	Definition
Collisions	RRPM	Count of all motor vehicle crashes per year in case study area, over a 5-year period
Collision rate per 100 people (%)	RRPM, derived	Rate of collisions per 100 people per year in case study area, over a 5-year period
Severe collisions	RRPM	Count of motor vehicle crashes resulting in an injury or fatality per year in case study area, over a 5-year period
Severe collision rate per 100 people (%)	RRPM, derived	Rate of severe collisions per 100 people per year in case study area, over a 5-year period
Economic indicators		
Private dwellings	Census	Count of dwellings in case study area
Household size *	Census	Average household size
Total household income ($) *	Census	Average total income of household in 2020
Value of dwellings ($) *	Census	Average property value
Households in core housing need (%) *	Census	Proportion of owner and tenant households whose housing falls below at least one of the indicator thresholds for housing adequacy, affordability, or suitability
Weekday bus stop usage	TSPR, derived	Sum of average daily boardings and alightings per bus stop in case study area, on a weekday
Weekday bus stop usage per capita	TSPR, derived	Average daily bus stop usage per person in case study area, on a weekday

Abbreviations: TSPR (Transit Service Performance Review), RRPM (Regional Road Performance Monitoring Dashboard).

**Data for these metrics were extracted at the Census Dissemination Area (DA) level. Population-weighted metrics were calculated for the DAs within an entire case study area.*

3.3 Comparative analysis results

For the purpose of this descriptive analysis, data on the metrics listed above were extracted for each case study area, then aggregated to represent average values for greenfield and TOC typologies. For example, aggregated population sizes of Morgan Heights, Routley/ Gordon Estates, and Westwood Plateau represent an average population size for a typical greenfield. Results for each metric are presented below for comparison. To provide additional context, data for some metrics were extracted at the Census Metropolitan Area (CMA) level to represent Metro Vancouver regional averages.

Population characteristics

Table 6. Population characteristics of a typical greenfield and a typical TOC.

Metric	Typical greenfield	Typical TOC
Population count	7,468	10,718.33
Land area (km²)	1.42	1.33
Population density per km²	6,466.97	13,870.67
Acreage required for 1,000 people (acres)	38.21	17.81
Private dwelling count	2,732.67	5,542.67
Average age	38.28	42.40

Figure 23. Acreage required to house 1,000 residents.

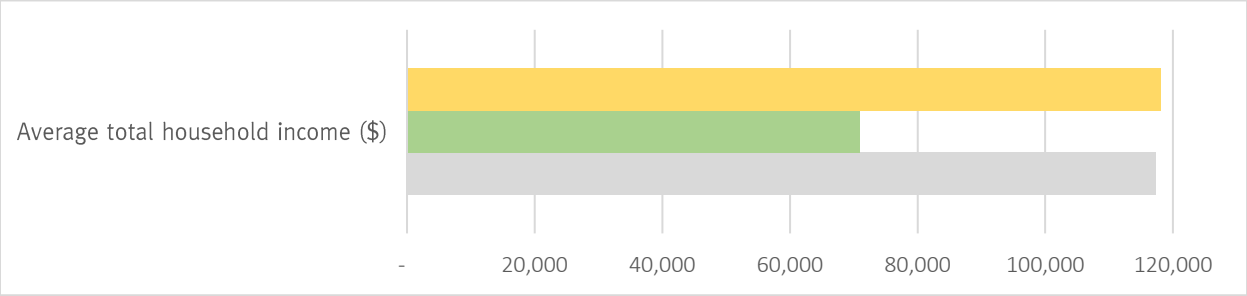
Typical TOCs in Metro Vancouver can accommodate more residents and dwellings at higher densities, reflected by the higher-density forms of development located around frequent transit stops and stations. Notably, the population density per square kilometer in a typical TOC is more than double that of a typical greenfield (Table 6). At this density, for every 1,000 residents, a greenfield requires 38.21 acres of land, whereas a TOC requires only 17.81 acres. This shows how TOCs are a more compact type of development, using less than half the acreage compared to greenfields to accommodate the same number of people (Figure 23).

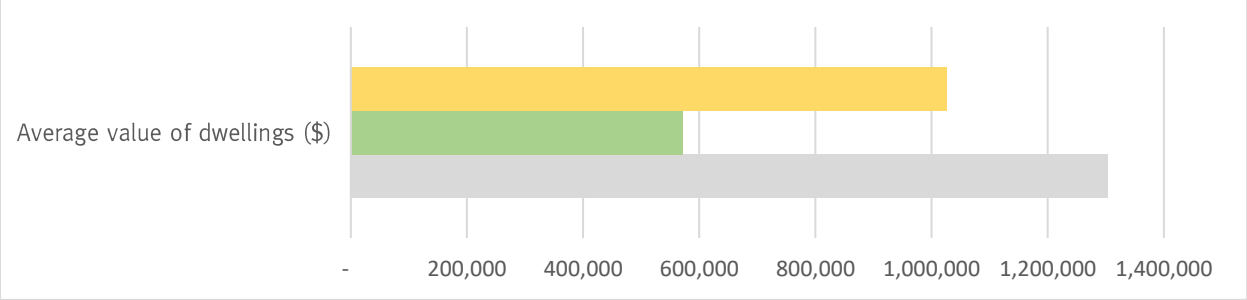
Household characteristics

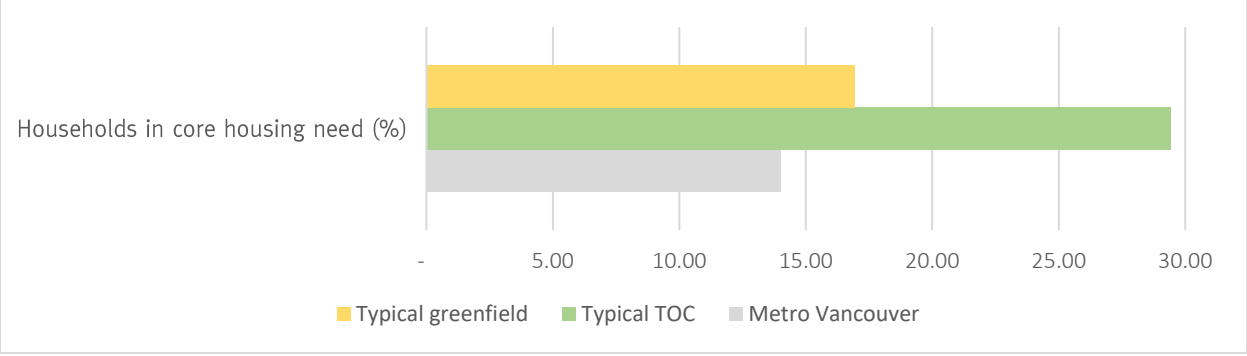
Table 7. Household characteristics compared to Metro Vancouver regional averages.

Metric	Typical greenfield	Typical TOC	Metro Vancouver
Average household size	2.80	2.02	2.50
Average total household income ($)	118,030	70,863	117,300
Average value of dwellings ($)	1,026,341	571,038	1,304,000
Households in core housing need (%)	14.00	29.43	16.93

Figure 24. Indicators of equity and affordability between development typologies and Metro Vancouver regional averages.







Overall, TOCs tend to have fewer people per household compared to greenfields and the Metro Vancouver regional average, as well as significantly lower average household incomes (Table 7). Even though the average dwelling value in a TOC is less than half the value of the regional average – suggesting potentially more affordable housing options – a strikingly high percentage of households in TOCs are in core housing need (Figure 24). This indicates greater challenges for households in TOCs that are living in unsuitable, inadequate, or unaffordable dwellings, and that cannot afford alternative housing in their community. However, TOCs may be more conducive to serving populations with greater needs, and who may rely on transit to reduce household transportation costs.

Commuting characteristics

Table 8. Commuting characteristics and bus stop usage.

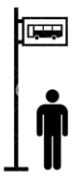
Metric	Typical greenfield	Typical TOC	Metro Vancouver
Weekday bus stop usage *			
Daily usage	87.33	782.33	-
Daily usage per capita	0.01	0.08	-
Main mode of commuting **			
Car, truck, or van (%)	88.62	60.23	74.72
Sustainable modes (%)	9.66	37.68	23.17
Commuting duration			
Less than 29 min (%)	53.22	48.63	55.59
30 min and over (%)	47.12	51.17	44.41

**Daily usage = total average boardings and alightings per bus stop.*

***Totals do not equal 100% since "Other Method" category was excluded.*

Figure 25. Daily bus stop usage per person on a weekday.

Typical greenfield (0.01 uses)



Typical TOC (0.08 uses)

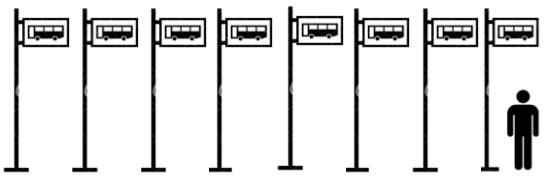


Figure 26. Main mode of commuting in a typical greenfield and a typical TOC.

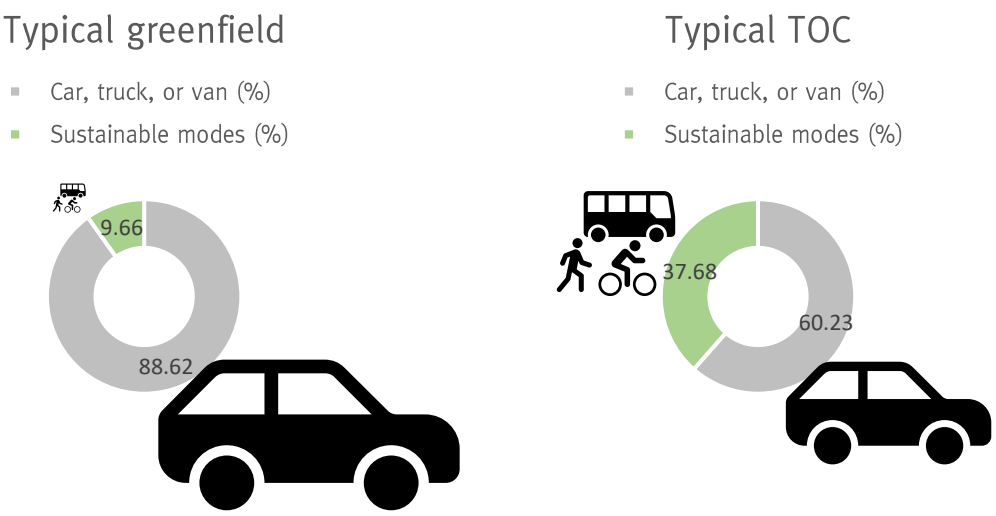
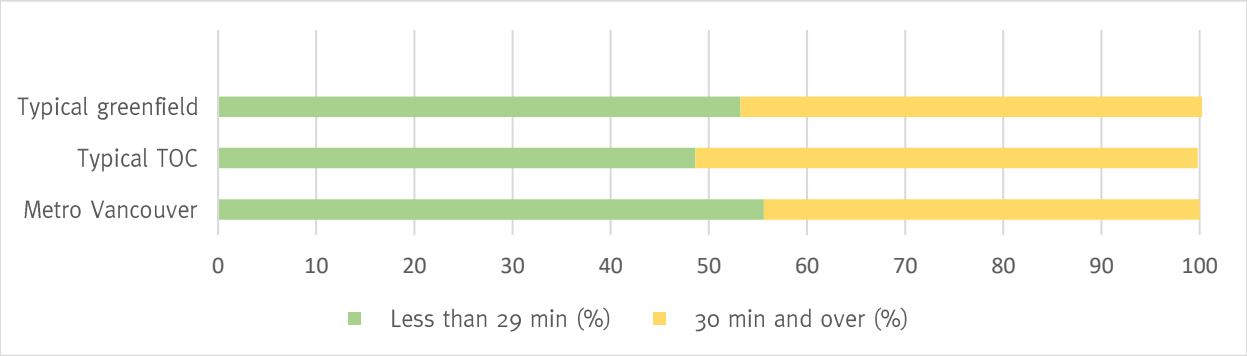


Figure 27. Commuting duration between development typologies and regional proportions in Metro Vancouver.



There are notable differences in commuting patterns between residents of greenfields and TOCs (Table 8). In a typical greenfield, a predominant majority of commuters rely on cars, trucks, or vans to get to work (either as a driver or as a passenger) and a relatively infrequent usage of bus stops on weekdays indicates less reliance on public transit (Figures 25, 26). Conversely, in a typical TOC, there is a substantial reduction in the use of private motor vehicles and a highly frequent usage of bus stops. This indicates a shift towards using public transit, walking, or cycling to reach daily destinations and reflects the influence of transportation demand management – there is an uptake in sustainable mode use when the design and infrastructure of the community is conducive to it.

In Metro Vancouver, the regional proportions of sustainable commuting fall between those of typical greenfields and TOCs, suggesting a moderate reliance on private motor vehicles as a regional standard, but with a promising mix of sustainable commuting options. Additionally, the proportion of short and long commute times is relatively similar between development typologies, but TOCs tend to have a slightly higher percentage of longer commutes in TOCs compared to greenfields (Figure 27).

Safety characteristics

Table 9. Regional road safety characteristics between development typologies.

Metric	Typical greenfield	Typical TOC
Annual collisions *		
Collision count	136	704
Collision rate per 100 people (%)	1.82	6.69
Annual severe collisions *		
Severe collision count	61	291
Severe collision rate per 100 people (%)	0.82	2.82

**Average annual frequencies and rates, over a 5-year period.*

Figure 28. Number of collisions per year in a typical greenfield and a typical TOC.

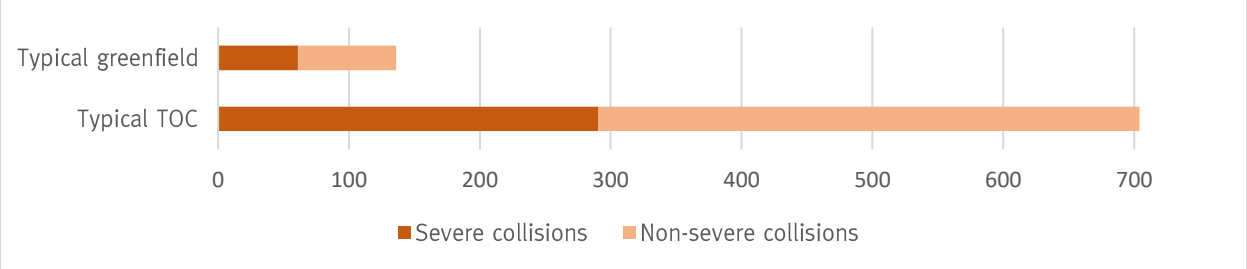
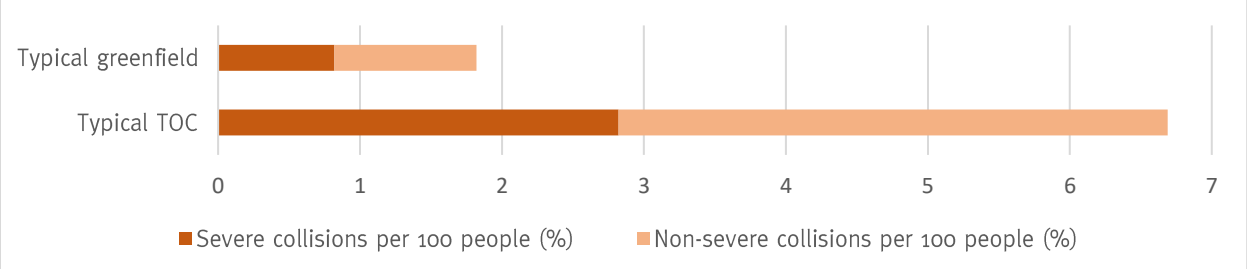


Figure 29. Collision rate per 100 people per year in a typical greenfield and a typical TOC.



In terms of collision frequency, more than five times the number of collisions per year occur in TOCs compared to greenfields (Table 9). A typical TOC also exhibits higher rates of collisions; on average, for every 100 people living in a TOC, 6.69% of residents experience a collision each year (Figure 29). More frequent accidents in TOCs could potentially be due to increased population and traffic densities, higher pedestrian activity, or other factors associated with higher use of sustainable transit modes. In terms of collision severity, a higher proportion of people experience severe collisions – those resulting in an injury or fatality – in TOCs than in greenfields (Figures 28, 29). This indicates a need for improved road safety measures to better accommodate increased activity near transit hubs.

Accessibility characteristics

Table 10. Accessibility of sustainable transit modes in a typical greenfield and a typical TOC.

Metric	Typical greenfield	Typical TOC
Accessibility at case study centrepoint *		
Transit score	42	84
Walk score	71	95
Bike score	64	78

**Case study centrepoint is defined as the central hub of activity within a case study area.*

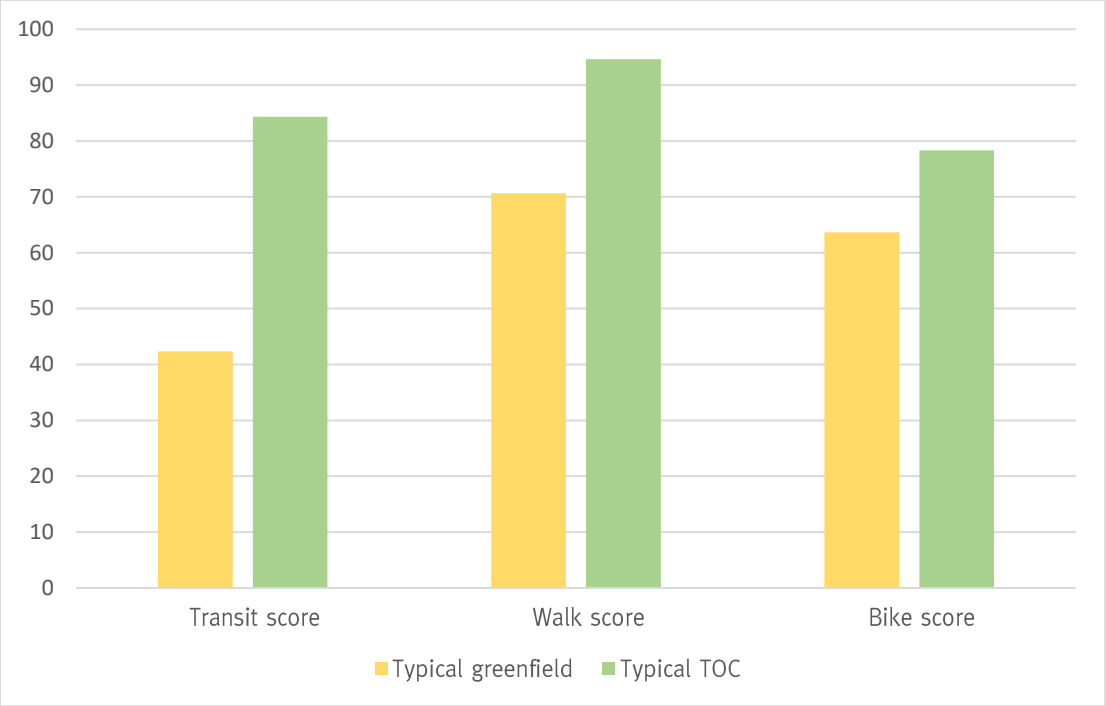
Transit score index: 0-49 minimal transit; 50-69 good transit; 70-89 excellent transit; 90-100 rider's paradise.

Walk score index: 0-49 car-dependent; 50-69 somewhat walkable; 70-89 very walkable; 90-100 walker's paradise.

Bike score index: 0-49 somewhat bikeable; 50-69 bikeable; 70-89 very bikeable; 90-100 biker's paradise.

Overall, the typical TOC outperforms the typical greenfield in all three metrics of accessibility to sustainable transit modes – especially the transit score, as to be expected (Table 10). Greenfields tend to be "very walkable", "bikeable", and have access to "some transit", while TOCs tend to be a "walker's paradise", "very bikeable", and offer "excellent transit" (Figure 30). These scores suggest that TOCs have better walking routes to key destinations so that errands can be accomplished on foot, closer proximity to frequent and reliable public transit routes, and more developed bike infrastructure and road connectivity that make cycling a convenient transportation choice.

Figure 30. Transit accessibility, walkability, and bike accessibility between development typologies.



Part 4: Conclusions

4.1 Discussion

Several key differences emerged between the development typologies. Firstly, TOCs have significantly higher population densities compared to greenfields, and require less than half the acreage to accommodate the same number of people. This compact development approach has embedded efficiencies in land preservation and reducing service provision costs. Concentrating growth in already urbanized areas protects agricultural, conservation and recreation, and rural lands from sprawl, and potentially lowers costs to local governments in providing utility infrastructure (Sense Partners, 2024). This also has implications for prioritizing new development areas; intensifying growth within TOCs may be more advantageous than building out new greenfields, which could lead to static, underutilized land.

Next, TOCs typically have fewer people per household, lower household incomes, and a significantly higher percentage of households in core housing need compared to greenfields and the Metro Vancouver regional average. This suggests that TOCs serve populations with greater needs, who may rely more heavily on transit and who seek more affordable housing options without the financial burden of owning a car – options that may be harder to find elsewhere in the region.

Additionally, residents in TOCs and greenfields exhibit distinct commuting patterns, largely influenced by the accessibility of sustainable transit modes in each typology. In greenfields, most commuters rely on private motor vehicles with relatively infrequent use of public transit. Given the poor transit accessibility scores in these areas, a negative feedback loop is created where driving continues to be the more convenient and preferred choice for daily trips. Conversely, the high accessibility of transit, walking, and cycling in TOCs is more conducive to using sustainable modes to reach daily destinations.

Significantly higher rates of motor vehicle collisions occurred in TOCs, including a greater proportion of severe collisions. Although multiple factors could potentially explain this outcome, it particularly underscores the need for improved road safety infrastructure near transit hubs. Improving safety measures in areas where there is increased activity would ensure a more comfortable environment for users of sustainable transportation modes.

4.2 Directions for future research

This report evaluated the benefits of transit-oriented communities (TOCs) in achieving sustainable outcomes across Metro Vancouver, by quantitatively comparing greenfield and TOC development typologies. These exploratory findings are based on a small sample of case study areas at a single point in time, and focus on select metrics representing the broad environmental, social, and economic domains of sustainable transportation.

Future research could improve the understanding of the strengths and weaknesses of TOCs and the built environment by analyzing a more comprehensive selection of metrics over time. Longitudinal analyses would be particularly valuable for assessing how TOCs evolve, how expanding the transit network enhances their benefits, and which underlying factors contribute to sustainable outcomes. This research would help determine the ideal balance between urban intensification and sustainable transportation, ultimately supporting Metro Vancouver's long-term vision for sustainable growth and livable, resilient communities.

References

Alvarez, E., Franch, X., & Martí-Henneberg, J. (2013). Evolution of the Territorial Coverage of the Railway Network and its Influence on Population Growth: The Case of England and Wales, 1871–1931. Historical Methods: A Journal of Quantitative and Interdisciplinary History, 46(3), 175–191. https://doi.org/10.1080/01615440.2013.804788

Auckland Transport. (2023). Regional Public Transport Plan. https://at.govt.nz/media/1992063/17-at-regional-public-transport-plan-2023-2031_draft.pdf

Bossel, H. (1999). Indicators for Sustainable Development: Theory, Method, Applications. http://iisd.ca/about/prodcat/ordering.htm

City of Calgary. (2020). Municipal Development Plan. https://www.calgary.ca/planning/municipal-development-plan.html

City of Coquitlam. (n.d.-a). City Profile. Retrieved August 13, 2024, from https://web.archive.org/web/20090223002859/http:/www.coquitlam.ca/Residents/About+Coquitlam/City+Profile/default.htm

City of Coquitlam. (n.d.-b). Start Your Engines! Westwood Racing Circuit, 1959-1990 | Coquitlam, BC. Retrieved August 13, 2024, from https://www.coquitlam.ca/713/Westwood-Racing-Circuit-1959-to-1990

City of Coquitlam. (n.d.-c). Westwood Plateau Parks and Trails. Retrieved August 13, 2024, from https://www.walkbc.ca/sites/default/files/trail/Coquitlam_-_Westwod_Plateau_Map.pdf

City of Coquitlam. (2002). Northwest Coquitlam Area Plan. https://www.coquitlam.ca/DocumentCenter/View/916/Northwest-Coquitlam-Area-Plan-PDF

City of Coquitlam. (2019). Westwood Plateau Community Profile. https://www.coquitlam.ca/DocumentCenter/View/214/2019-Westwood-Plateau-PDF?bidId=

City of Coquitlam. (2020a). City Centre Area Plan. https://www.coquitlam.ca/DocumentCenter/View/985/City-Centre-Area-Plan-PDF

City of Coquitlam. (2020b). Land use designations. https://www.coquitlam.ca/DocumentCenter/View/984/Schedule-A---Land-Use-Designations-PDF

City of Edmonton - Sustainable Development and Transportation Services Departments. (2012). Transit Oriented Development Guidelines.

City of Minneapolis. (2019). Minneapolis 2040: The City's Comprehensive Plan. https://minneapolis2040.com/overview/

City of Richmond. (2007). City Centre Area Plan Concept. https://citycouncil.richmond.ca/__shared/assets/020607_item716441.pdf

City of Richmond. (2009a). City Centre Area Plan. https://www.richmond.ca/__shared/assets/10_overview23835.pdf

City of Richmond. (2009b). City Centre Area Plan - 2.6 Parks & Open Space. https://www.richmond.ca/__shared/assets/26_parks23842.pdf

City of Richmond. (2009c). City Centre Area Plan - 3.3 Special Precinct Guidelines. https://www.richmond.ca/__shared/assets/SpecialPrecinctGuidelines56916.pdf

City of Richmond. (2009d). Specific Land Use Map: Brighouse Village. https://www.richmond.ca/__shared/assets/specific_map_transect_brighouse23858.pdf

City of San Diego. (2024). Blueprint SD: General Plan 2024. https://www.sandiego.gov/blueprint-sd

City of Surrey. (2004). Highway 99 Corridor Local Area Plan. https://www.surrey.ca/renovating-building-development/land-planning-development/land-use-planning/south-surrey-land-use-plans/highway-99-corridor-local-area-plan

City of Surrey. (2005a). Grandview Heights General Land Use Plan. In 2005. https://www.surrey.ca/renovating-building-development/land-planning-development/land-use-planning/south-surrey-land-use-plans/grandview-heights-general-land-use-plan

City of Surrey. (2017). City Centre Plan. https://www.surrey.ca/renovating-building-development/land-planning-development/land-use-planning/whalley-land-use-plans/city-centre-plan

City of Surrey. (2005b). Morgan Heights Neighbourhood Concept Plan. https://www.surrey.ca/renovating-building-development/land-planning-development/land-use-planning/south-surrey-land-use-plans/morgan-heights-ncp

City of Sydney. (2020). City Plan 2036: Local strategic planning statement. https://www.cityofsydney.nsw.gov.au/strategic-land-use-plans/city-plan-2036

City of Toronto. (2024). Toronto Official Plan - Chapter 3. https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/official-plan/chapters-1-5/

Encyclopaedia Britannica. (1998). Garden city | Sustainable Urban Development. https://www.britannica.com/topic/garden-city-urban-planning

Google. (n.d.). Google Maps. Retrieved August 13, 2024, from https://www.google.ca/maps

Government of British Columbia. (n.d.-a). Surrey Langley Skytrain Project. Retrieved August 17, 2024, from https://surreylangleyskytrain.gov.bc.ca/

Government of British Columbia. (n.d.-b). Transit oriented development areas. 2024. Retrieved August 13, 2024, from https://www2.gov.bc.ca/gov/content/housing-tenancy/local-governments-and-housing/housing-initiatives/transit-oriented-development-areas

Government of British Columbia. (2023a). Lincoln Station (City of Coquitlam / City of Port Coquitlam). https://www2.gov.bc.ca/assets/gov/housing-and-tenancy/tools-for-government/local-governments-and-housing/maps/coquitlam__port_coquitlam_lincoln_station_toa_map_day_1.pdf

Government of British Columbia. (2023b). Richmond-Brighouse Station (City of Richmond). https://www2.gov.bc.ca/assets/gov/housing-and-tenancy/tools-for-government/local-governments-and-housing/maps/richmond_richmond-brighouse_station_toa_map_day_1.pdf

Greater Vancouver Regional District. (1975). The Livable Region 1976/1986: Proposals to manage the growth of Greater Vancouver.

Greater Vancouver Regional District. (1996). Livable Region Strategic Plan.

Greater Vancouver Regional District. (2010). Metro Vancouver 2040 Shaping Our Future.

Legislative Assembly of British Columbia. (2023). Bill 47 – 2023: Housing Statutes (Transit-Oriented Areas) Amendment Act. https://www.bclaws.gov.bc.ca/civix/document/id/bills/billsprevious/4th42nd:gov47-1

Marshall, W. E. (2013). An evaluation of livability in creating transit-enriched communities for improved regional benefits. Research in Transportation Business & Management, 7, 54–68. https://doi.org/10.1016/J.RTBM.2013.01.002

Metro Council. (2011). Regional Framework Plan: Summary of 2040 Growth Concept. https://www.oregonmetro.gov/sites/default/files/2014/04/18/01132011_regional_framework_plan_2011_update_summary_of_2040_growth_concept.pdf

Metro Council. (2023). 2023 Regional Transportation Plan. https://www.oregonmetro.gov/regional-transportation-plan

Metro Vancouver Regional District. (2022). Metro 2050 Regional Growth Strategy.

Metro Vancouver Regional District Regional Planning Committee. (2024). Metro Vancouver Population Projections.

Metropolitan Council. (2014). Thrive MSP 2040. https://metrocouncil.org/Planning/Thrive-2040/Thrive-MSP-2040-Plan.aspx?source=child

Parking, Loading, and Mobility Regulations, (2021). https://lims.minneapolismn.gov/file/2020-00704

Mudigonda, S., Ozbay, K., Ozturk, O., Iyer, S., & Noland, R. B. (2014). Quantifying Transportation Benefits of Transit-Oriented Development in New Jersey. Https://Doi.Org/10.3141/2417-12, 2417, 111–120. https://doi.org/10.3141/2417-12

Nahlik, M. J., & Chester, M. v. (2014). Transit-oriented smart growth can reduce life-cycle environmental impacts and household costs in Los Angeles. Transport Policy, 35, 21–30. https://doi.org/10.1016/J.TRANPOL.2014.05.004

Nichols, J., Garrick, N., & Atkinson-Palombo, C. (2009). Framework for Developing Indicators of Sustainability for Transportation Planning.

Pabillano, J. (2009). A short history of interurbans in the Lower Mainland. The Buzzer Blog. https://buzzer.translink.ca/2009/03/a-short-history-of-interurbans-in-the-lower-mainland/

Partnerships British Columbia. (2013). Evergreen Line Rapid Transit Project. https://www.infrastructurebc.com/files-4/documents/PBCEvergreen.pdf

Order in Council 1873/1968, (1967). https://www.bclaws.gov.bc.ca/civix/document/id/oic/arc_oic/1873_1968/search/CIVIX_DOCUMENT_ROOT_STEM:(Greater%20Vancouver%20regional%20district)%20AND%20CIVIX_DOCUMENT_ANCESTORS:arc_oic?28#hit1

Provincial Policy Manual: Transit-Oriented Areas, (2024).

Regional Roads. (n.d.). 2025 BICCS & WITT Eligibility. Retrieved August 13, 2024, from https://regionalroads.com/biccswitteligibility

Ross, S., & Freeman, D. (2023). Bus Rapid Transit (BRT) Action Plan. https://www.translink.ca/-/media/translink/documents/about-translink/governance-and-board/council-minutes-and-reports/2023/october/brt_project_report_mayors_council_oct_23.pdf

Salthill Capital. (n.d.). The Shops At Morgan Crossing | Surrey. Retrieved August 13, 2024, from https://www.salthillcapital.com/portfolio/the-shops-at-morgan-crossing

SANDAG. (2021). 2021 Regional Plan. https://www.sandag.org/-/media/SANDAG/Documents/PDF/regional-plan/2021-regional-plan/final-2021-regional-plan/final-2021-regional-plan-flipbook.pdf

Sense Partners. (2024). Infrastructure costs and urban form: A proof-of-concept model. https://www.gw.govt.nz/assets/Documents/2024/05/Comparative-cost-of-urban-form.pdf

Sound Transit. (2016). Sound Transit 3: The Regional Transit System Plan for Central Puget Sound. https://www.soundtransit.org/get-to-know-us/documents-reports/sound-transit-3

Statistics Canada. (2021). Census Profile, 2021 Census of Population. https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

Surrey City Manager. (2003). Update on the Whalley Enhancement Strategy.

Township of Langley. (2000). Southwest Gordon Estate Neighbourhood Plan. https://www.tol.ca/en/services/resources/bylaw-services/bylaws/Neighbourhood-Plan-Bylaws/South-West-Gordon-Neighbourhood-Plan-(No.-3911).pdf

Township of Langley. (2001). Routley Neighbourhood Plan. https://www.tol.ca/en/services/resources/bylaw-services/bylaws/Neighbourhood-Plan-Bylaws/Routley-Neighbourhood-Plan-(No.-4013).pdf

Township of Langley. (2012). Central Gordon Estate Neighbourhood Plan. https://www.tol.ca/en/services/resources/bylaw-services/bylaws/Neighbourhood-Plan-Bylaws/Central-Gordon-Estate-Neighbourhood-Plan-(No.-4924).pdf

TransLink. (2012). Transit-Oriented Communities Design Guidelines.

TransLink. (2018). Transit Service Guidelines.

TransLink. (2022a). Access For Everyone (Transport 2050: 10-year Priorities). https://www.translink.ca/-/media/translink/documents/plans-and-projects/regional-transportation-strategy/transport-2050/t2050_10yr-priorities.pdf#view=fitH

TransLink. (2022b). Transport 2050 Regional Transportation Strategy.

TransLink. (2022c). Transport 2050: Regional Transportation Strategy.

TransLink. (2023). 2023 Transit Service Performance Review - Bus/SeaBus Summaries. Tableau Public. https://public.tableau.com/app/profile/translink/viz/2023TSPR-BusSeaBusSummaries/TheWorkbook

Zheng, J., Atkinson-Palombo, C., McCahill, C., O'Hara, R., & Garrick, N. W. (2011). Quantifying the Economic Domain of Transportation Sustainability. Https://Doi.Org/10.3141/2242-03, 2242, 19–28. https://doi.org/10.3141/2242-03