STUDY REPORT

Central Okanagan Regional Goods Movement Study

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Prepared for:

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and

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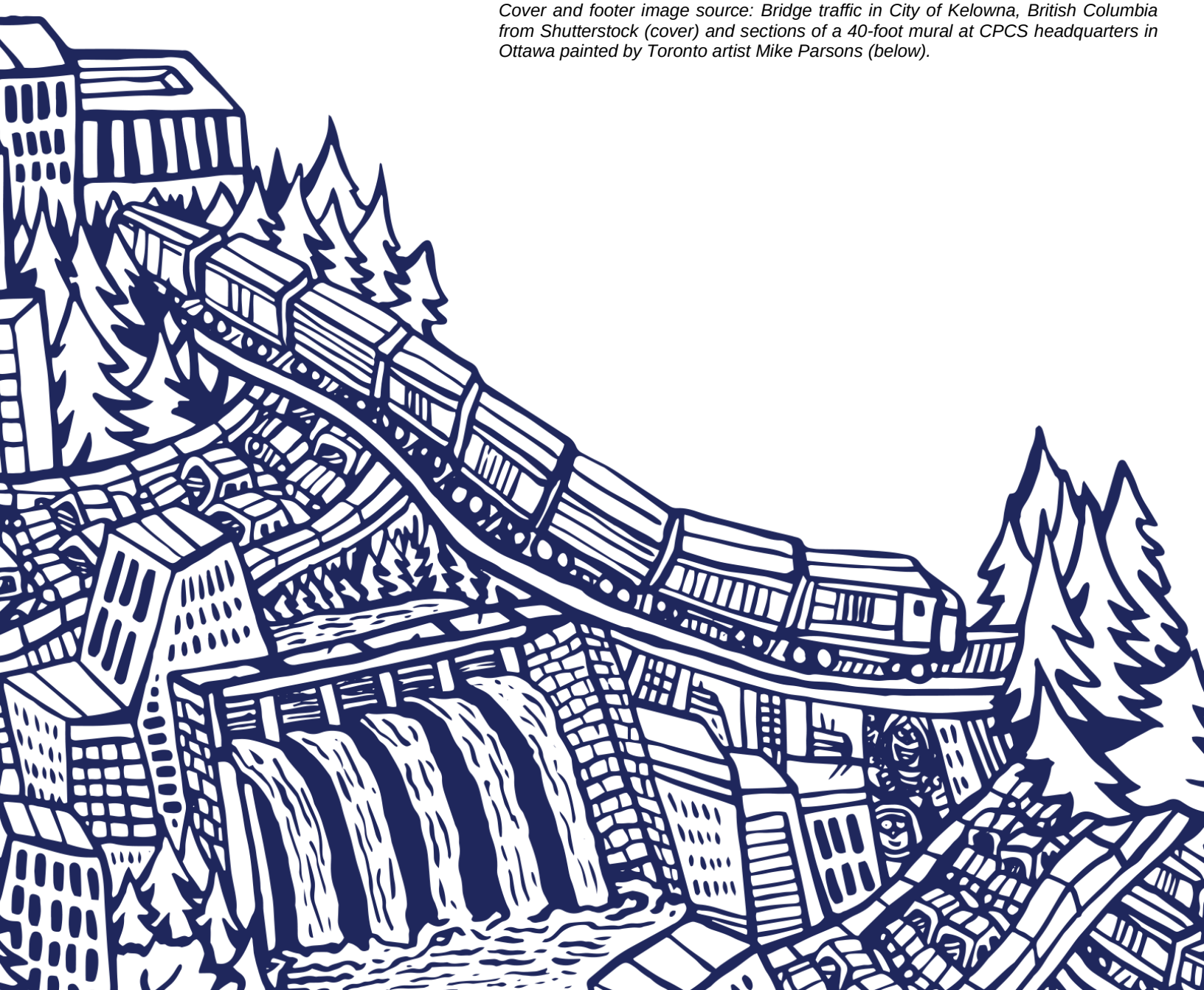

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ACATS	Advanced Connectivity and Automation in the Transportation System Program
ATCS	Adaptive Traffic Control Systems
AZETEC	Alberta Zero Emissions Truck Electrification Collaboration
BC	British Columbia
BC MOTI	British Columbia Ministry of Transportation and Infrastructure
BIA	Business Improvement Associations
C/AV	Connected and Autonomous Vehicles
CAP	Criteria Air Pollutant
CCC	Construction Consolidation Centre
CCP	Comprehensive Community Plans
CLZ	Commercial Loading Zones
CN	Canadian National Railway
CNG	Compressed Natural Gas
COEDC	Central Okanagan Economic Development Commission
COGMS	Central Okanagan Goods Movement Study
CP	Canadian Pacific Railway
CTPS	Cooperative Truck Platooning Systems
DC	Distribution Centre
DDC	Drone Delivery Canada
DOT	Department of Transportation
ELCV	Electric Light Commercial Vehicles
EV	Electric Vehicle
FMGC	Fast Moving Consumer Goods
FQP	Freight Quality Partnership
FSP	Freight Signal Priority
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLOSA	Green Light Optimized Speed Advisory
GLZ	Green Loading Zone
GVW	Gross Vehicle Weight
HOV	High Occupancy Vehicle
HPDI	High-Pressure Direct Injection Engine
IIoT	Industrial Internet of Things
IoT	Internet of Things
ITS	Intelligent Transportation Systems
KCS	Kansas City Southern Railroad
LCV	Long-Combination Vehicles
LNG	Liquefied Natural Gas
NACTO	National Association of City Transportation Officials

NAICS	North American Industry Classification System
NGO	Non-government Organization
OCP	Official Community Plans
OECD	Organisation for Economic Co-operation and Development
OHD	Off-Hours Delivery
OKIB	Okanagan Indian Band
RFID	Radio Frequency Identification
SCOOT	Split Cycle Offset Optimization Technique
TAC	Transportation Association of Canada
TCO	Total Costs of Ownership
TEU	Twenty-Foot Equivalent Unit
TSP	Transit Signal Priority
UAV	Unmanned Aerial Vehicles
UCC	Urban Consolidation Centre
UGV	Unmanned Ground Vehicles
ULEZ	Ultra Low Emission Zone
VFPA	Vancouver Fraser Port Authority
VKT	Vehicle-Kilometres Travelled
VRP	Vehicle Reception Point
YLW	Kelowna International Airport
YVR	Vancouver International Airport
ZEV	Zero-Emission Vehicles
EB	Eastbound
WB	Westbound

Executive summary

Background and objectives

The safe, efficient and sustainable movement of goods helps facilitate economic activity. It also ensures a high quality of life for residents of the Central Okanagan, which is undergoing rapid population growth. However, despite the importance of goods movement, its role is not well understood within the region, in part given limitations on data. In this context, the Central Okanagan Goods Movement Study had the following three purposes:

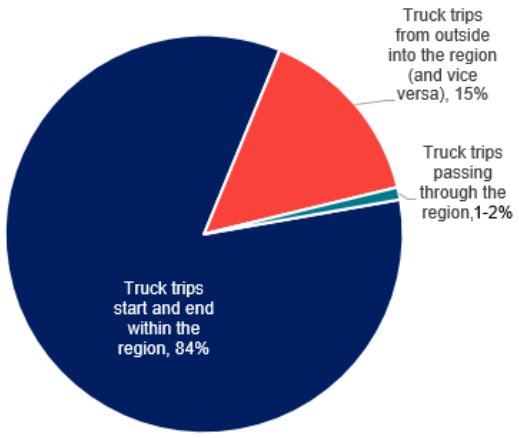
- Better understand existing goods movement to, from, through, and within the Central Okanagan region
- Analyze current and future trends that will influence the movement of goods to, from, through, and within the Central Okanagan region
- Develop strategies, recommendations, and innovative solutions that will support the safe, efficient, and sustainable movement of goods as the region grows

The study was developed through a literature review, data analysis and interviews with goods movement stakeholders. A portrait of goods movement, economic activity and land use was developed through an analysis of data sources, including truck GPS data and business establishment data acquired from third parties, as well as land-use data compiled from municipalities and First Nations in the region. In total, we engaged 23 public- and private-sector stakeholders representing businesses/shippers, truck carriers, infrastructure owners, and municipalities, as well as two First Nations.

Goods movement to, from, through, and within the Central Okanagan

Most goods movement activity in the Central Okanagan is serving the region (Figure ES-1). In other words, trucks are not just passing through the region. The majority of truck trips (84%) are internal trips entirely within the Central Okanagan (i.e., have an origin and destination within the region). Fifteen percent of truck trips are travelling either to or from the region, and an estimated 1-2% of truck trips are travelling entirely through the region (i.e., have both a start and end outside the region).

Figure ES-1: Proportion of truck trips by start/end locations (2019)



Source: CPCS analysis of Geotab data. Note, this graphic assumes 10-minute stop duration to estimate through trips.

Highway 97 is the primary goods movement corridor and is a focal point of policy and planning due to the multimodal people and goods movement needs along and across the corridor. Highway 97 has the highest intensity of truck volumes through the region – orders-of-magnitude higher than other corridors – with the greatest intensity occurring from the WR Bennett Bridge eastward through Kelowna. In addition, most goods generating businesses and

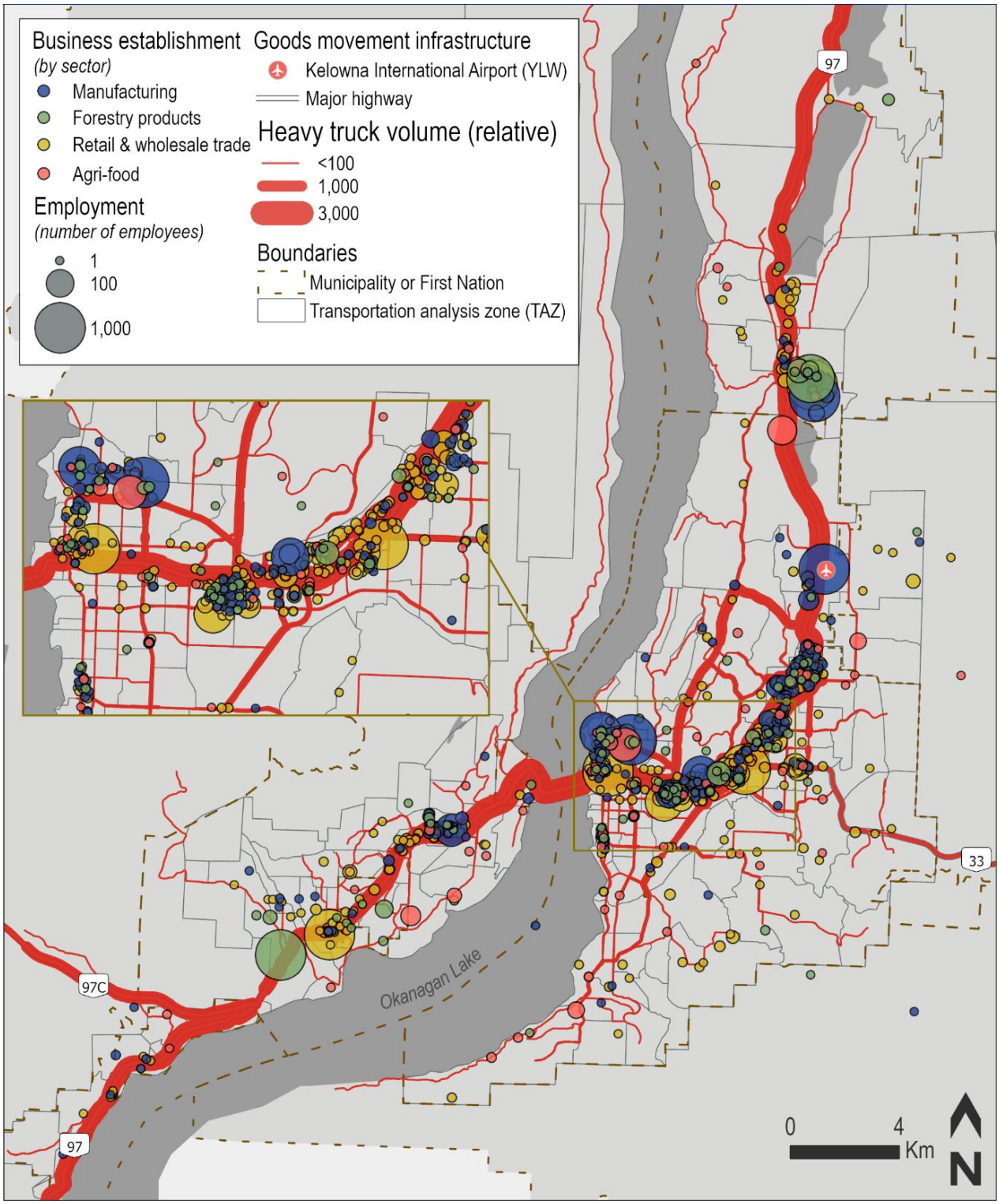
transportation and logistics sector businesses are clustered along Highway 97. The highway is the primary spine for goods movement activity in the region.

Figure ES-2 shows the distribution of goods generating businesses by employment size for four sectors and the relative heavy truck volumes in the Central Okanagan. Weighted by jobs, approximately 70% of the businesses in four important sectors to the Central Okanagan (agriculture/food processing, forestry products, other manufacturing, and wholesale and retail trade) fall within 1 km of Highway 97.

Figure ES-3 shows the region's major business clusters by employment numbers and the transportation and logistics businesses' building footprints. Weighted by jobs, about 87% of transportation and warehousing businesses are within 1 km of Highway 97.

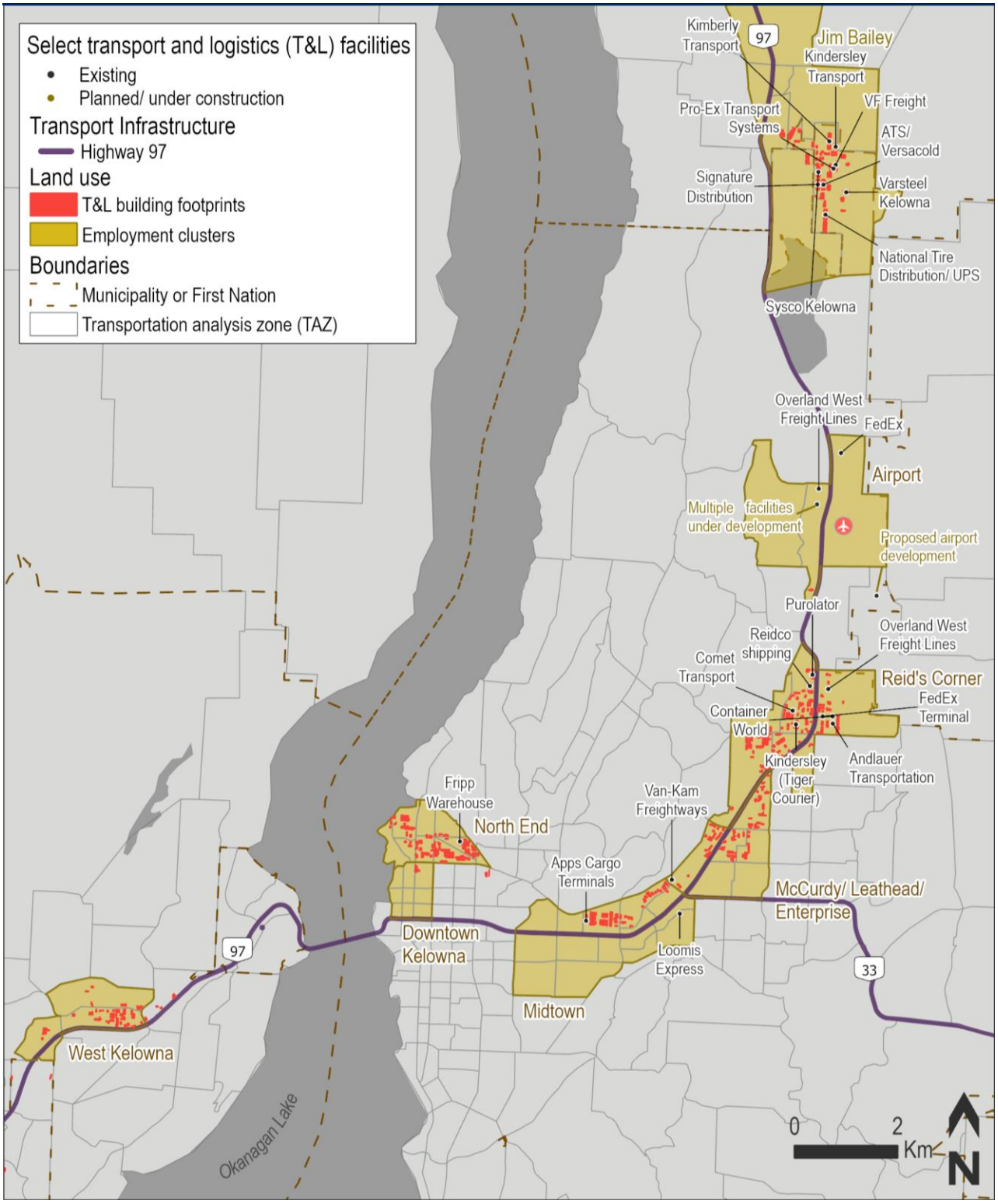
Air transport also serves an important role in a multimodal transportation system. Air cargo is used for transport where a high premium is placed on short transit times, including high-value-to-weight products, perishable products, products that have a quick replenishment cycle, time-sensitive documents, and cargo and live animals. Stakeholders noted that shippers in the Central Okanagan use air cargo primarily through two gateways: Kelowna International Airport (YLW), including via courier companies, and Vancouver International Airport, transporting by truck to/from Vancouver.

Figure ES-2: Businesses in four goods generating sectors (and heavy truck relative volumes)



Source: CPCS analysis of Geotab and Scott's data

Figure ES-3: Major goods generating business clusters by employment numbers correlated with existing and known future transportation and logistics facilities



Source: CPCS analysis of Geotab and Scott's data

Goods movement trends and sustainable goods movement practices

Goods movement and logistics are being shaped by several existing and emerging trends, including disruptors, global logistics trends, technological and operational trends, measures to minimize conflicts between trucks and vulnerable road users, and alternative fuel/propulsion systems for trucks.

Disruptors are overarching trends that are reshaping goods movement and logistics around the world and are being felt in the Central Okanagan. Climate change and supply chain disruptions are front of mind challenges. However, the digitalization of the supply chain has also generated profound changes and opportunities in how goods are moved and delivered. Global transportation and logistics trends, as well as other emerging technological and operational trends, are also relevant to the Central Okanagan.

In the context of these trends, we also identify best practices for sustainable urban goods movement, which were considered in the recommendations. Categories of best practices examined include policies to increase uptake of alternative fuel vehicles, cargo bicycles, strategies to increase efficiency in deliveries, curbside management, Complete Streets, and logistics and land use.

Figure ES-4: A goods movement vehicle with side underrun protection in the UK

Source: CPCS

Mitigating the impact of climate changes (decarbonization of transport) is also a driving factor behind the adoption of alternative fuel vehicles, particular zero-emissions vehicles. Several technologies are being matured, including hybrid-electric, electric, hydrogen fuel cell, and natural gas vehicles. Strategies to encourage uptake of alternative fuel/low-emission/zero-emission vehicles include policies that provide for preferential access to low or zero-emission vehicles (e.g., to certain areas, loading zones or vehicle lanes) as well as financial incentives.

There are several strategies used to increase efficiency in deliveries, as well as consider goods movement within Complete Streets (which promotes corridor designs and operations that provide a safe and attractive environment for all corridor travellers, especially vulnerable road users, e.g., Figure ES-4).

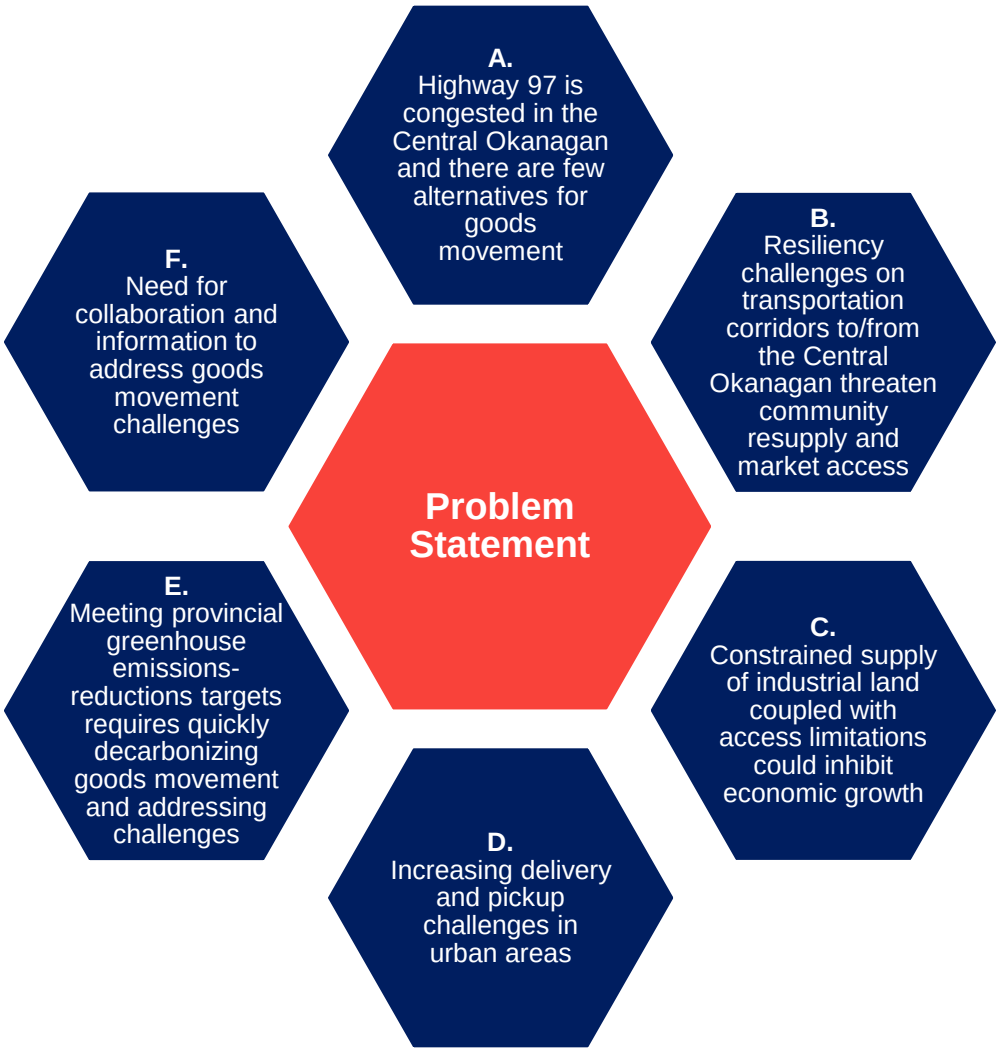
Problem statement: goods movement challenges

Based on the Central Okanagan Goods Movement Study objectives, the issues raised in the stakeholder engagement and our analysis, we have developed a Problem Statement comprised of six Problems (Figure ES-5).

Problems are challenges that are impacting or could impact goods movement. However, they also present opportunities, and were used to develop the strategies, actions and recommendations.

Many of the problems may be driven by similar trends and are interrelated. For example, the Central Okanagan is an attractive place to live and has experienced rapid population growth. Looking ahead, the population of the Central Okanagan region is forecasted to increase by over 36% between 2021 and 2040, and significant growth has already occurred. This trend could lead to increased congestion (Problem A), provide additional constraints on the availability of industrial land (Problem C), and increase challenges with deliveries and pickups (Problem D). Problem A is also related to Problem C as the development of industrial land for goods movement also depends on effective access to Highway 97. Accordingly, while the problems are lettered for ease of reference, the lettering does not correspond to order of importance.

Figure ES-5: Problem Statement



Strategies, actions and recommendations

In response to the Problem Statement, we developed 26 actions with 43 recommendations, grouped in six strategic directions:

- **Strategic Direction A:** Manage congestion on Highway 97 and develop a strategic goods movement network
- **Strategic Direction B:** Increase resiliency of road and air access to/from the Central Okanagan, including support for intermodal (rail-truck) terminals in the BC Interior
- **Strategic Direction C:** Protect industrial land supply and coordinate with transportation infrastructure projects
- **Strategic Direction D:** Plan for goods movement in urban areas
- **Strategic Direction E:** Accelerate adoption of zero-emissions goods movement vehicles and provide supporting infrastructure
- **Strategic Direction F:** Improve public and private sector collaboration on goods movement

Actions and recommendations are listed in Figure ES-6. The lettering of the strategies, actions and recommendations are intended for ease of reference only, and not intended to suggest a priority. In Section 5.2, we present these strategies, actions and recommendations in an Action Plan, which includes information on approximate cost, timing, and leading and supporting organization.

Closing: Goods movement's vital role in achieving policy aspirations

The safe, efficient and sustainable movement of goods is important for supporting economic development, land use, and sustainability goals, but is often overlooked. The Central Okanagan Regional Goods Movement Study recommendations are intended to support goods movement, while also coordinating with plans for moving people - recognizing they often share the same corridors and need to be considered together holistically. The intent is to ensure goods movement is appropriately prioritized and accommodated throughout the region.

Many of the recommendations reflect the disruptors and new technologies that are changing goods movement globally, and many governments and logistics businesses around the world recognize that the need to support decarbonization is paramount. The Central Okanagan's direct experience with the 2021 atmospheric river outages, coupled with rapid growth in e-commerce deliveries and other goods movement practices, have provided an imperative to develop a resilient and advanced goods movement system for the future. These experiences, plus the Central Okanagan's critical mass of population and jobs and its fast growth, provide a unique opportunity for the region to potentially serve as a laboratory to pilot new technologies and logistics practices to make goods movement safer, more efficient and more sustainable.

Figure ES-6: List of strategies, actions and recommendations

#	Recommendation
***Strategic Direction A*: Manage congestion on Highway 97 and develop a strategic goods movement network**	
Action A.1: Continue to improve operations on Highway 97 and major trucking routes	
1	Continue to conduct operational reviews, including signal timing, progressions and phasing improvements with a goods movement lens on Highway 97 and major trucking routes.
2	Investigate the feasibility of smart traffic signals or truck signal priorities that could improve the flow of trucks, transit and other vehicles on Highway 97 and major trucking routes (which can be integrated jointly with transit signal priorities).
Action A.2: Continue to improve and build infrastructure that benefits goods movement	
3	Conduct a review of intersection configurations, especially for truck turns, on Highway 97 and major truck routes to facilitate the efficient movement of trucks that are turning.
4	Improve parallel road infrastructure along Highway 97, including the Clement Avenue extension as recommended in the Regional Transportation Plan, ensuring that design and engineering work consider access connections for goods movement.
5	Advance the longer-term Okanagan Gateway Transportation Study option of intersection improvements at Airport Way / Highway 97.
Action A.3: Ensure goods movement is given appropriate weighting in future corridor planning	
6	Incorporate goods movement metrics more explicitly into MOTI Multiple Account Evaluation (and municipal transportation planning, as applicable), and ensure evaluation guidance is up to date.
7	Designate a strategic goods movement network (SGMN) to inform asset management and capital priorities for upgrading and expanding the road network.
Action A.4: Systematize process to review and update the truck route networks within each of the Central Okanagan governments	
8	Review the Central Okanagan governments' truck route networks and develop a systematic approach for updating the networks, with the eventual aim of developing a consistently defined truck route network across the entire Central Okanagan
Action A.5: Manage travel demand (shift commuters to bike, walk, transit, and promote work from home, etc.)	
9	Ensure robust parallel biking, walking and transit infrastructure is maintained to encourage modal shift away from single-occupancy vehicles.
10	Encourage work from home and other travel demand management strategies to take pressure off roadways needed for goods movement.
11	Investigate sustainable transportation opportunities to serve employees travelling to/from YLW / Gateway and other industrial areas.
Action A.6: Incorporate goods movement into future Highway 97 corridor planning	
12	Incorporate goods movement into future Highway 97 corridor planning to ensure the safe, efficient and sustainable movement of both people and goods.
***Strategic Direction B*: Increase resiliency of road and air access to/from the Central Okanagan, including support for intermodal (rail-truck) terminals in the BC Interior**	
Action B.1: Continue to advance planning and implementation of improvements to highway infrastructure outside of the Central Okanagan to improve resiliency	
13	Support highway infrastructure improvements outside the Central Okanagan.
Action B.2: Support the development of intermodal (rail-truck) infrastructure in the BC Interior	
14	Support intermodal (rail-truck) infrastructure improvements in the BC interior that demonstrate the ability to achieve modal shift, commensurate with the ability to reduce greenhouse gas emissions, reduce highway wear, and free up road and port capacity for truck trips from the Central Okanagan that cannot shift modes.
Action B.3: Plan for Kelowna International Airport's strategic role in goods movement	

#	Recommendation
15	Plan for Kelowna International Airport's strategic role in goods movement (e.g., during highway closures) and develop a climate adaptation plan for the airport.
Action B.4: Formalize and disseminate lessons learned from 2021 outages	
16	Publish and distribute lessons learned from 2021 outages caused by atmospheric river events, and identify further opportunities to improve resiliency working with the Province, Central Okanagan governments, first responders and private sector.
Action B.5: Consider developing digital tools to improve route planning and productivity for truck drivers	
17	Investigate the feasibility of a province-wide truck route map app.
18	Consider opportunities to provide commercial vehicles additional information about their payload before a trip departs the Central Okanagan.
19	Consider developing digital tools and educational material to improve route planning and productivity for truck drivers, as well as to help shippers get their goods to market.
Action B.6: Consider opportunities to improve driver amenities and highway maintenance practices	
20	Review the demand for driver amenities for long-haul truckers, such as parking and rest stops, and as required, implement new or upgrade existing facilities around the Central Okanagan.
21	Monitor winter highway maintenance practices on highways to/from the Central Okanagan, particularly Highway 97C.
***Strategic Direction C*: Protect industrial land supply and coordinate development of these lands with transportation infrastructure projects**	
Action C.1: Protect existing industrial lands in the Central Okanagan	
22	Protect existing industrial land supply for traditional goods-generating sectors and logistics activities (e.g., warehousing and distribution).
23	Ensure that sufficient zoned and designated land is available to accommodate emerging industries in appropriate locations.
24	Consider how new technologies could be deployed to locate and integrate warehouses and distribution centres in denser urban areas.
25	Apply best practices for land-use planning, site design and access.
Action C.2: Protect trade and industrial lands at/around Kelowna International Airport (YLW)	
26	Maintain and apply existing residential densification restriction policies applicable in zones around YLW.
Action C.3: Enhance truck access and manage truck flows to the Jim Bailey Industrial Area	
27	Continue to minimize impacts of truck activity on residents and Duck Lake Reserve.
Action C.4 Implement a process for developing transportation infrastructure projects to support commercial/industrial land development	
28	Implement a process for developing transportation infrastructure projects to support commercial/industrial land development. Develop funding agreements between multiple levels of government to program required infrastructure into municipal capital plans and Development Cost Charge programs.
***Strategic Direction D*: Plan for goods movement in urban areas**	
Action D.1: In existing developed areas, improve the flow of first- and last-kilometre deliveries made on-street	
29	Conduct an urban goods movement operational review, e.g., off-hours delivery, on-street loading.
Action D.2: In new developments limit on-street deliveries	
30	Ensure new developments can accommodate existing and future goods movement practices and minimize demands for on-street delivery.
Action D.3: Prepare for and support emerging sustainable delivery practices	
31	Ensure that municipal policies, regulations and bylaws have language that enables the potential introduction of sustainable goods movement initiatives for first- and last-kilometre delivery.
32	Examine ways to leverage business opportunities for managing first- and last-kilometre deliveries.

#	Recommendation
33	Identify opportunities to right-size goods movement vehicles in urban areas.
Action D.4: Promote safety of goods movement vehicles to reduce impacts on vulnerable road users	
34	Review and as appropriate update provincial legislation, regulations, standards and guidelines to further enhance the safety of goods movement.
***Strategic Direction E*: Accelerate adoption of zero-emissions goods movement vehicles and provide supporting infrastructure**	
Action E.1: Investigate opportunities to green provincial and municipal fleets of medium- and heavy-duty vehicles	
35	Among provincial agencies, investigate opportunities to directly procure or encourage contractors to procure low- or zero-emissions fleet vehicles.
36	Review Kelowna's Green Fleet Strategy (and those of other Central Okanagan governments, as applicable) to ensure they incorporate the latest opportunities to procure zero-emission medium- and heavy-duty vehicles and consider whether fueling/charging facilities could be incorporated into municipal lands.
Action E.2: Set market incentives and implement supportive infrastructure	
37	As a priority, continue to implement a medium- and heavy-duty zero-emissions vehicle provincial sales standard.
38	Investigate the feasibility of incentivizing zero-emissions light- and medium-duty commercial vehicles to utilize HOV lanes, and consider expanding the provincial decal program to facilitate enforcement.
39	Investigate the need for public charging and low/zero-emissions refueling stations to support goods transporters and couriers.
Action E.3: Prepare for other new technologies related to goods movement	
40	Develop provincial planning guidance to help municipalities ensure that roads, intersections and on-street parking can accommodate new technologies, especially autonomous commercial vehicles but also electric vehicles
***Strategic Direction F*: Improve public and private sector collaboration on goods movement**	
Action F.1: Develop a regional freight council	
41	Develop a regional freight council to anticipate, address and act on goods movement needs.
Action F.2: Improve ongoing freight data collection	
42	Establish a data collection initiative for the region.
Action F.3: Promote the importance of goods movement and ways to limit its impact	
43	Work with private-sector stakeholders to develop public-facing evidence-based material that communicates: a. the importance of goods movement to the economy but also peoples' lives b. principles of consumer behaviour that can help lower transportation impacts when using e-commerce.

1 Introduction

Summary

- The safe, efficient and sustainable movement of goods helps facilitate economic activity. It also ensures a high quality of life for residents of the Central Okanagan, which is undergoing rapid population growth. However, despite its importance, the role of goods movement is not well understood within the region. In this context, the Central Okanagan Goods Movement Study (COGMS) had the following three purposes:
  - Better understand existing goods movement to, from, through, and within the Central Okanagan region
  - Analyze current and future trends that will influence the movement of goods to, from, through, and within the Central Okanagan region
  - Develop strategies, recommendations, and innovative solutions that will support the safe, efficient, and sustainable movement of goods as the region grows
- The study was developed through a literature review, data analysis and interviews goods movement stakeholders. A portrait of goods movement, economic activity and land use was developed through an analysis of data sources, including truck GPS data and business establishment data acquired from third parties, as well as land-use data compiled from municipalities and First Nations in the region. In total, we engaged 21 public- and private-sector stakeholders representing businesses/shippers, truck carriers, infrastructure owners, and municipalities, as well as two First Nations.
- Of note, several data sources, including truck GPS data and business establishment data, represent samples of trucks and businesses, respectively. Therefore, these data should be interpreted to provide relative proportions (not absolute values) and are subject to errors introduced by sampling.
- In total, we engaged 21 public- and private-sector stakeholders representing businesses/shippers, truck carriers, infrastructure owners, and municipalities, as well as two First Nations.

1.1 Study background and objectives

1.1.1 Background

Goods movement is about how the products that businesses and residents produce and consume reach their destination. Goods are also sometimes referred to as freight or cargo, and the ways they reach their destination are often called supply chains. These supply chains are facilitated by producers/shippers; transportation, logistics and warehousing providers; and public-infrastructure providers, each of whom retain a wide range of expertise to ensure the efficient movement of goods.

Though only road and air modes of transport reach the Central Okanagan, supply chains to, from and within the Central Okanagan are facilitated by multiple transport modes, including marine, ports, rail, truck, air and pipelines. In addition, goods movement includes the deliveries and pick-ups made in urban areas by truck, vans, cars, bikes and on foot.

Accordingly, the safe, efficient and sustainable goods movement helps facilitate economic activity and ensure a high quality of life for residents of the Central Okanagan, which is undergoing rapid population growth. However, despite its importance, the role of goods movement is not well understood within the region, in part given data limitations. This gap in knowledge is not unique to

the Central Okanagan, but driven by challenges including the wide array of participants involved in goods movement, who are not organized at a regional level, and the limited information on goods movement relative to people movement.

1.1.2 Purpose and objectives

In this context, the COGMS had the following three purposes:

1. Better understand existing goods movement to, from, through, and within the Central Okanagan region
2. Analyze current and future trends that will influence the movement of goods to, from, through, and within the Central Okanagan region
3. Develop strategies, recommendations, and innovative solutions that will support the safe, efficient, and sustainable movement of goods as the region grows

It achieves these purposes through six objectives:

1. Assessing industry access and constraints to/from, through, and within regional, provincial, national, and international markets
2. Assessing the relationship between industry, transportation, land use and economic development
3. Identifying long-term congestion management strategies
4. Identifying sustainable goods movement strategies
5. Reviewing current and future travel and technology trends
6. Assessing the truck route network

1.2 Study outline and purpose of this report

The COGMS was developed in three phases:

- Phase 1 Data gathering, including a background policy review; engagement with industry, municipalities and First Nations; and an analysis of goods movement data
- Phase 2 Analysis of Current and Future Goods Movement Trends
- Phase 3 Strategies and Recommendations

This Study Report is the output of all three phases. It presents a synthesis of the three phases and, framed by a problem statement, provides strategies, recommendations, and innovative solutions that will support the safe, efficient, and sustainable movement of goods as the region grows.

1.3 Methodology

1.3.1 Methodology

The study was developed through a literature review, data analysis and interviews goods movement stakeholders.

A portrait of goods movement, economic activity and land use was developed through an analysis of data sources, including truck GPS data and business establishment data acquired from third parties, as well as land-use data compiled from municipalities and First Nations in the region.

In total, we engaged 23 public- and private-sector stakeholders representing businesses/shippers, truck carriers, infrastructure owners, and municipalities, as well as two First Nations. This engagement occurred through one-on-one interviews or small focus groups. We also received two written responses from a trucking carrier and local business and carried out an online survey facilitated by the Kelowna Chamber of Commerce.

A list of organizations interviewed is found in ***Appendix A: Stakeholders, Central Okanagan governments, and First Nations interviewed***, and a summary of issues raised is found in ***Appendix B: Themes from engagement.***

1.3.2 Limitations

The analysis in this study relies on data sources, including truck GPS data and business establishment data that are samples of all trucks and businesses, respectively at a particular time or time period. Therefore, these data should be interpreted to provide relative proportions (not absolute values) and are subject to errors introduced by sampling, particularly on lower volume corridors.

1.4 Report organization

This report is organized into four additional chapters:

- **Chapter 2: Goods movement to, from, through and within the Central Okanagan**, provides an overview of goods movement-related infrastructure and patterns in the Central Okanagan
- **Chapter 3: Goods movement trends and sustainable goods movement practices,** provides an overview of trends affecting goods movement in the Central Okanagan as well as an overview of practices to transition to a sustainable future for goods movement
- **Chapter 4: Problem statement,** identifies six interrelated problems, which challenge impacting goods movement now or could in the future
- **Chapter 5: Strategies, actions and recommendations** to enhance goods movement in the Central Okanagan, provides recommendations to address the problem statement

2 Goods movement to, from, through, and within the Central Okanagan

Summary

- This chapter provides a portrait of goods movement in the Central Okanagan, including briefly summarizing background studies and policies relevant to goods movement, profiling goods movement infrastructure and travel patterns in the Central Okanagan, highlighting goods generating economic activity, and mapping commercial and industrial land use that supports this activity.
- Most goods movement activity in the Central Okanagan is serving the region. The majority of truck trips (84%) are internal trips entirely within the Central Okanagan (i.e., have an origin and destination within the region). In other words, trucks are not just passing through the region. Fifteen percent of truck trips are travelling either to or from the region, and an estimated approximately 1-2% of truck trips are travelling entirely through the region (i.e., have both a start and end outside the region).
- Highway 97 is a primary goods movement corridor and is a focal point of policy and planning due to the multimodal people and goods movement needs along and across the corridor. Highway 97 has the highest intensity of truck volumes through the corridor – orders-of-magnitude higher than other corridors – with the greatest intensity occurring from the WR Bennett Bridge eastward through Kelowna. In addition, most goods generating businesses and transportation and logistics businesses are clustered along Highway 97. It is a spine for goods movement activity.
- Air transport serves an important role in a multimodal transportation system. Air cargo is used to transport where a high premium is placed on short transit times, including high-value-to-weight products, perishable products, products that have a quick replenishment cycle, time-sensitive documents, and cargo and live animals. Stakeholders noted that shippers in the Central Okanagan use air cargo primarily through two gateways: through Kelowna International Airport (YLW), including via courier companies and through Vancouver International Airport, transporting by truck to/from Vancouver.

2.1 Background study and policy context for goods movement in the Central Okanagan

Goods movement in the Central Okanagan is influenced by provincial and regional policies and is considered by previous studies. This section describes some of the findings and policies relevant to goods movement from these studies and prior plans. The federal government also has a role in goods movement (described in brief in Section 2.1.4).

Provincially, the Government of BC has developed two strategies to foster inclusive economic development (StrongerBC Economic Plan, 2022) and decarbonization (CleanBC Roadmap to 2030, 2021). Both have implications for goods movement, including actions to develop a province-wide Goods Movement Strategy (ongoing) and promote decarbonization of the commercial vehicle sector.

The Province is also developing an integrated planning approach to ensure greater alignment between transportation and land-use planning. The integrated planning approach is intended to

improve the seamless movement of people and goods, enable trade, prepare for future growth, and encourage the development of diverse, affordable, resilient, and connected communities.

Regionally, the present COGMS is occurring in parallel to an ongoing MOTI-led Central Okanagan Integrated Transportation Strategy (CO-ITS). Both studies are considering the work of previous planning studies, notably the Central Okanagan Planning Study (COPS)[1] and Regional Transportation Plan.

In addition, municipal, First Nations and other agencies have expressed policies and plans in their transportation master plans, economic development strategies, Official Community Plans (OCPs) and Comprehensive Community Plans (CCPs). We use the lenses of transportation, economy and land use to briefly summarize the contents of these plans related to goods movement.

2.1.1 Transportation

Highway 97 is a primary goods movement corridor and is a focal point of policy and planning due to the multimodal people and goods movement needs along and across the corridor. It is governed by provincial highway functional classification, service, and design criteria (see box below).

Provincial Highway Functional Classification, Service and Design Classes

Highways 97 is functionally classified as a primary highway. Primary highways provide a continuous, integrated highway network for long-distance international trips and inter/intra-provincial trips between major population centers and other major activity nodes. They carry substantial heavy truck volumes over long distances and provide for high overall travel speeds, with minimum interference to through movements.

“Functional classes” differ from “service classes” and "design classes." Service classification is the grouping of highways/roads into systems according to the type of service they provide to the public. Design classes are a more detailed description of service classes.

Highway 97 has changing service and design classifications through the Central Okanagan.

The City of Kelowna has several policies related to this corridor within their 2040 Transportation Master Plan (TMP, see box below). The City of Kelowna’s 2040 TMP also notes the need to manage curb space and includes several policies related to goods movement as it relates to supporting economic growth in the Gateway area.

[1] COPS and CO-ITS are considered as Phases 1 and 2 of the same MOTI planning initiative.

City of Kelowna, 2040 Transportation Master Plan, Policies related to Highway 97 and goods movement

TMP Policy 1.15 *– Support goods movement in the Gateway by working with the provincial government to find pragmatic ways to increase vehicle capacity and reduce reliance on Highway 97 in the Gateway.*

TMP Policy 3.1 *- Work towards higher-capacity transit on Harvey Avenue by building up existing bus service, directing new residents and jobs near stops, and collaborating with the Ministry of Transportation and Infrastructure.*

TMP Policy 6.1 *– Work with the Province to strengthen Harvey Avenue as a multi-modal transportation corridor that can safely and efficiently move people and goods as the region grows. Seek to integrate Harvey into the surrounding transportation network, with strong bicycle and pedestrian connections to transit, as well as parallel roads to help take local vehicle trips off the highway. (See related TMP Policy 3.1 [above].)*

TMP Policy 6.2 *– Promote safety for all on Harvey Avenue by controlling vehicle speeds, protecting people outside of cars, and incorporating safe crossings.*

Recent studies have been carried out on multiple segments, including through Peachland,[2] along Highway 97 in Kelowna from Sexsmith to Old Vernon Road (known as the Gateway),[3] and through Kelowna, Lake Country and Okanagan Indian Band reserve land.[4] Goods movement access at Highway 97/Beaver Lake Road in Lake Country was also noted as an issue,[5] as it is contributing to goods vehicles using other corridors where non-industrial land uses are prioritized.

Some policy and planning documents, including the City of Kelowna's TMP and the Regional Transportation Plan, note the importance of transitioning to a more sustainable future for all transportation, including goods movement.

In addition to provincial highways, the City of Kelowna has designated truck routes. Peachland designates Princeton Avenue as a truck route.

2.1.2 Economy

Goods movement is derived from other economic activities. Several plans acknowledge the economic role of goods generating sectors, now and in the future.

Goods movement-dependent sectors (wholesale and retail trade, transportation and warehousing, construction, agriculture, manufacturing, forestry, fishing, mining, quarrying, oil and gas, and tourism) collectively make up around 35% of employment in the Central Okanagan. These sectors overlap with several of the Central Okanagan Economic Development Commission's identified key sectors, including agriculture, viticulture, aerospace/manufacturing, and retail trade.

The Okanagan Gateway Study, 2020, focused on ways to support the economic and industrial development of lands in and around Kelowna International Airport (YLW) in the northern part of Kelowna.

[2] MOTI Highway 97 - Peachland Transportation Study
[3] Okanagan Gateway Transportation Study
[4] Multiple studies and agreements, including: a memorandum of understanding between Okanagan Indian Band, City of Kelowna and District of Lake Country, Lake Country Planning Study led by MOTI, ongoing (unpublished) investigation of the design of Commonwealth Road east of Highway 97 by the City of Kelowna
[5] Lake Country 2014 Transportation for Tomorrow

Some municipal plans acknowledge as a goal/objective the desire to support continued economic growth, including noting this growth as being enabled by the movement of goods. As an example, the City of Kelowna's TMP states: "Foster a growing economy: Support the city's growing economy by ensuring the transportation system connects people to jobs and facilitates the efficient movement of goods."

> *"Foster a growing economy: Support the city's growing economy by ensuring the transportation system connects people to jobs and facilitates the efficient movement of goods."*
>
> *-Goal/objective from City of Kelowna's 2040 TMP*

According to COPS, between 2020 and 2040 (both forecast years at the time of the study), employment is expected to grow from 100,000 to 130,000, though this growth does not occur equally across all goods generating sectors.

2.1.3 Land use

Regional and municipal policies and plans vary in how they consider goods movement. However, the management of industrial land, the protection of agricultural land and the transition to mixed use (commercial/residential) development all have bearing on goods movement and were noted in some of the plans reviewed:

- The Kelowna 2040 Official Community Plan notes that "industrial development will be challenged by the lack of land available for low-density industrial projects and the inability for industrial uses to be incorporated into mixed-use projects." Other plans also reference limited industrial land (e.g., Peachland and Westbank First Nation). These plans also note that any such developments should not create nuisances to adjacent uses.

> *"Industrial development will be challenged by the lack of land available for low-density industrial projects and the inability for industrial uses to be incorporated into mixed-use projects."*
>
> *- Kelowna 2040 Official Community Plan*

- Given the limited availability of industrial land in Kelowna, the city's northern boundary of Kelowna with Lake Country and the Okanagan Indian Band serves as an inter-regional focal point for goods-generating industrial land development. Kelowna's 2040 OCP objectives and policies seek to protect or promote industrial and goods movement uses (i.e., centred on Kelowna International Airport), particularly in northeast Kelowna – e.g., Jim Bailey / Beaver Lake Industrial Lands, and Reid's Corner (Highway 97 and Sexsmith/Old Vernon Road). Other significant industrial areas include the large contiguous industrial area north of Highway 97 in West Kelowna, Gorman Brothers Lumber, and portions of Kelowna's North End south of Knox Mountain. A North End Neighbourhood Planning process is underway as of late 2022. In April 2022, the North End Plan released a Vision and Objectives, which included:
  - Retain a core of industrial lands to preserve employment opportunities and much-needed services that support businesses and households
  - Support the evolution of industrial businesses to meet changing market demands and to capitalize on the North End's proximity to Downtown
  - Minimize conflicts and nuisance effects between industrial and residential uses[6]

[6] City of Kelowna, Policy and Planning Department. 2022. North End Plan, Vision and Objectives.

- OCPs of Central Okanagan governments refer to the importance of protecting agricultural land uses. Agriculture's long-standing presence in the region, the need to preserve food security, and the interplay between agricultural and other economic sectors (i.e., tourism) all have an impact on goods movement.
- Kelowna and West Kelowna have identified Urban Centres/Village Centres/neighbourhood centres where mixed use (commercial and residential) uses are to be encouraged (in turn requiring consideration on accommodating goods deliveries). Lake Country identifies Main Street as an area focused on being pedestrian friendly. The relevance is that it is close to the existing access to the Jim Bailey Industrial Park, noted above.
- Some note the significance of the role of aggregate (sand and gravel) extraction (notably Lake Country), which is an important goods generating sector.

2.1.4 Role of the federal government in goods

The federal government also has a significant goods movement role, including regulating interprovincial and international transportation. It influences goods movement in the Central Okanagan by regulating vehicle standards of trucks, as well as regulating connecting modes such as ports, marine, rail and air transportation. Following the findings of a National Supply Chain Task Force, the Government of Canada will be developing a National Supply Chain Strategy.[7] Federal government policies and programs also have financial implications for the goods movement sector, such as funding programs (e.g., National Trade Corridors Fund) as well as taxation policy (e.g., setting accelerated capital cost allowances for zero-emissions vehicles).

2.2 Goods movement infrastructure and travel patterns in the Central Okanagan

2.2.2 Goods movement related infrastructure

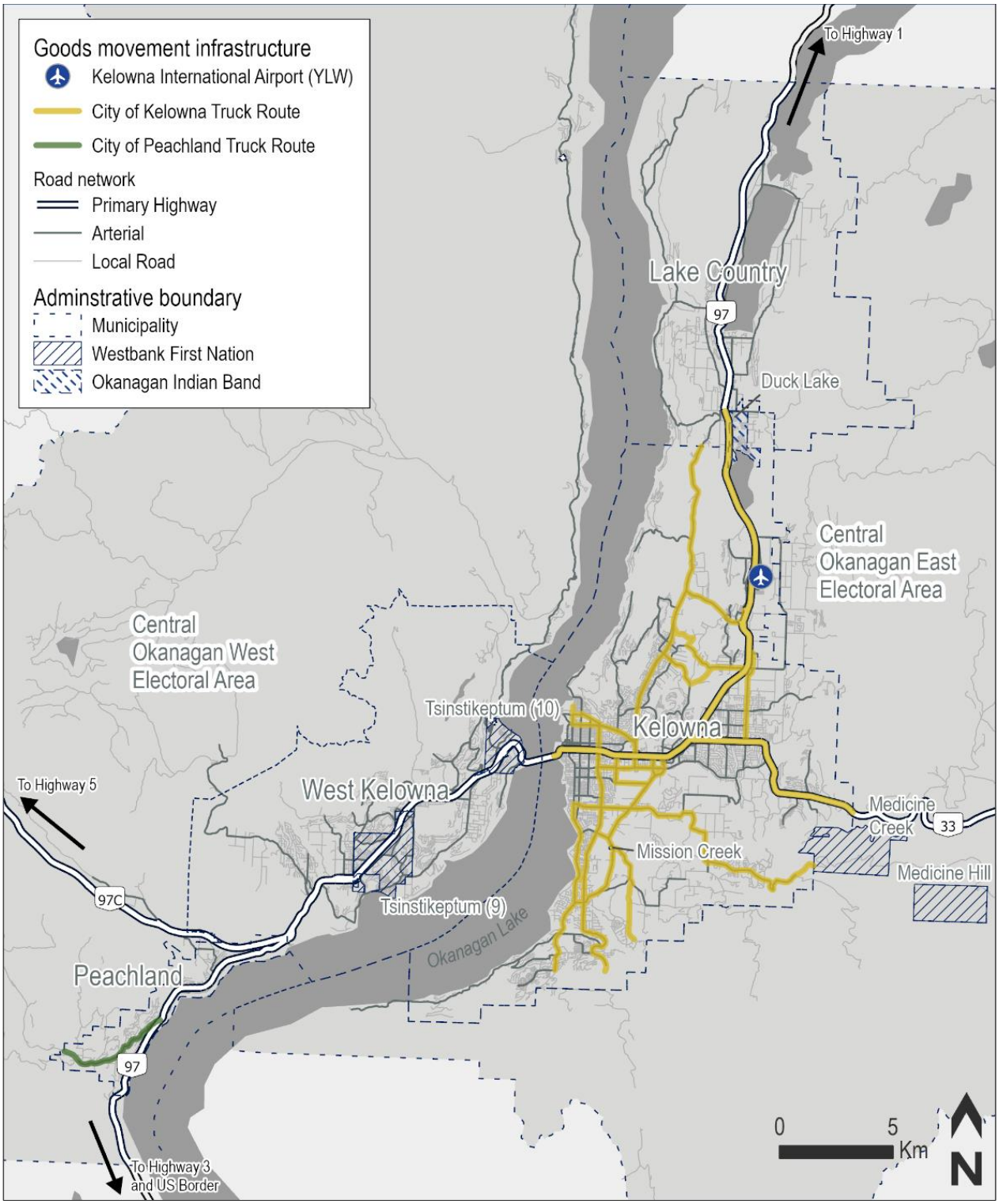
Goods movement supportive infrastructure in Central Okanagan (the study area)[8] consists of a road and highway network, as well as the Kelowna International Airport (YLW), which handles passenger and cargo (Figure 2-1). A rail corridor used to provide service between the north end of Kelowna and Vernon; however, the track has been removed. Within the Central Okanagan, the City of Kelowna has a designated truck route network,[9] some of which is further limited with time-of-day restrictions (i.e., trucks are only permitted to operate at certain times of day, which is not shown in Figure 2-1). The District of Peachland designates Princeton Avenue as a truck route. However, trucks can operate off the truck route from their origin and destination, and goods movement vehicles include a wide range of vehicles from passenger vehicles and courier vans to trucks with one or more trailers.

[7] Transport Canada. 2022. Minister of Transport welcomes final report of the National Supply Chain Task Force. https://www.canada.ca/en/transport-canada/news/2022/10/minister-of-transport-welcomes-final-report-of-the-national-supply-chain-task-force.html

[8] The study area includes the area within the external boundary of the Regional District of Central Okanagan, including municipalities and First Nations therein.

[9] Available graphically here: https://www.kelowna.ca/sites/files/1/docs/b4_truck_overlay.pdf

Figure 2-1: Central Okanagan region goods movement infrastructure



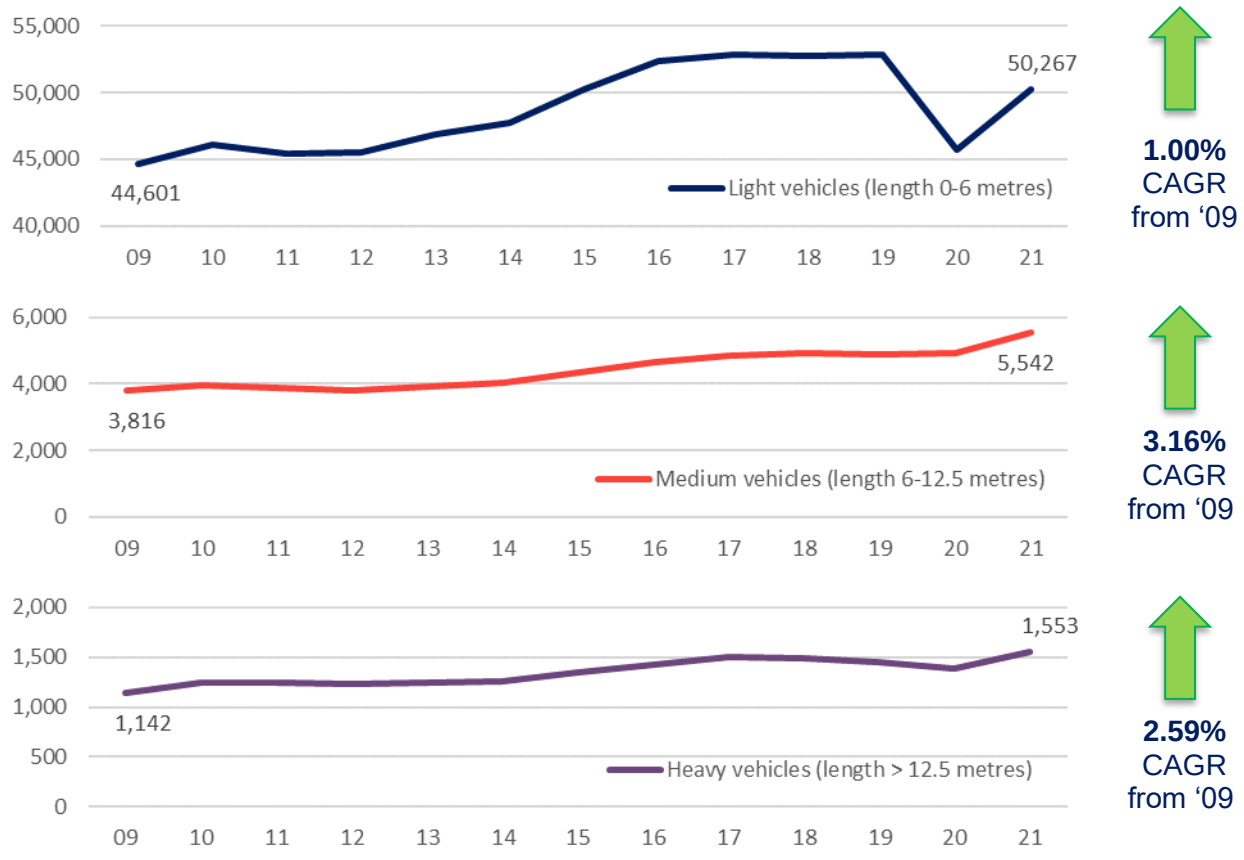
Source: CPCS, based on multiple sources including City of Kelowna truck routes

2.2.3 Goods movement vehicle trends and travel patterns

Overall volume trends

Light vehicles (mainly passenger vehicles) are the majority of traffic. However, medium and heavy vehicle traffic, a large portion of which is commercial vehicles, is growing faster than light vehicle traffic growth (Figure 2-2).[10] Between 2009 and 2022, light vehicles comprised just under 90% of all traffic crossing the bridge. However, medium and heavy vehicle traffic crossing the bridge has grown faster than light vehicle traffic (3.16% and 2.59% CAGR[11] versus 1.00% CAGR respectively). Light vehicle volumes had stabilized before the downward trend during the pandemic, although volumes are now increasing. In contrast, medium and heavy vehicle traffic was stable or increased during the pandemic.

Figure 2-2: Annual Trends in AADT, at WR Bennett Bridge Count Station



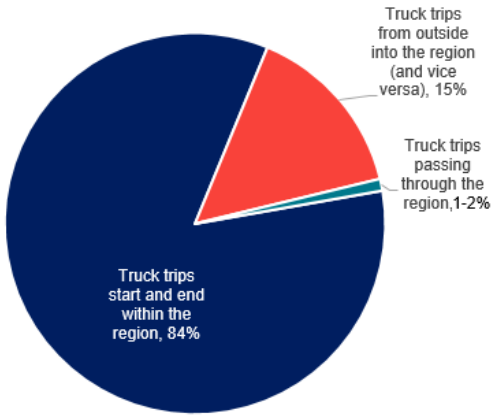
Source: British Columbia Ministry of Transportation and Infrastructure, Traffic Data at Route 97 (west end of WR Bennett Bridge)

[10] Based on analysis of traffic counts at the WR Bennett Bridge,
[11] CAGR is compound annual growth rate

Trip patterns

We used truck GPS data to analyze trip patterns to/from/through/within Central Okanagan (i.e., all trips that touch the Central Okanagan region), including light, medium and heavy trucks. These data represent a sample of trips within the Central Okanagan, so values must be interpreted in a relational sense. Nonetheless, the findings are indicative.

Figure 2-3: Proportion of truck trips by start/end locations (2019)



Source: CPCS analysis of Geotab data. Note, this graphic assumes 10-minute stop duration to estimate through trips.

Most goods movement activity in the Central Okanagan is serving the region (Figure 2-3). In other words, trucks are not just passing through the region. The majority of truck trips (84%) are internal trips entirely within the Central Okanagan (i.e., have an origin and destination within the region). Fifteen percent of truck trips are travelling either to or from the region, and approximately 1-2% of truck trips are travelling entirely through the region (i.e., have both a start and end outside the region). The estimate of through trips is sensitive to the assumed duration of a stop versus a trip end.

Internal trip ends

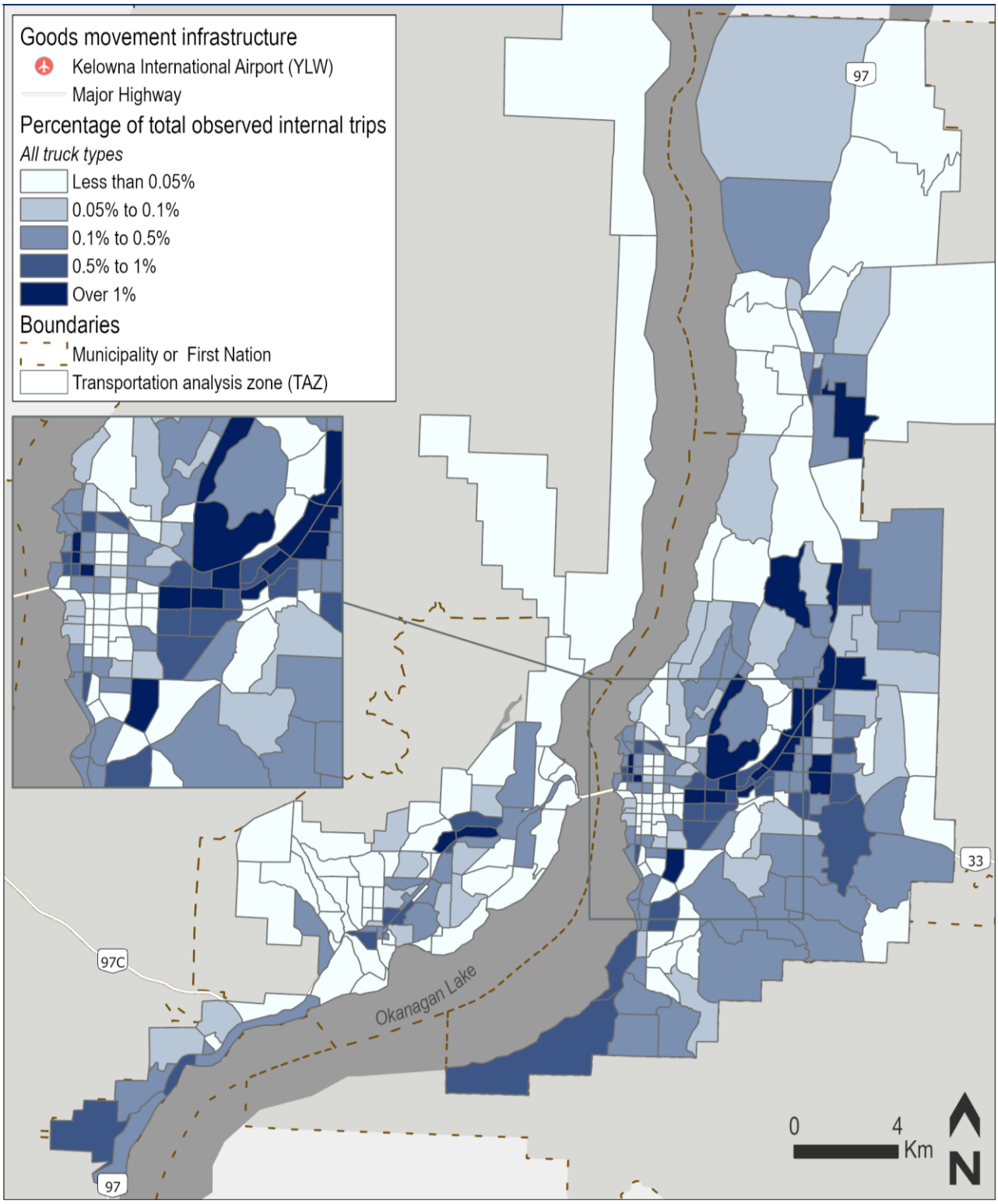
Figure 2-4 shows the distribution of internal trip ends for **all truck types** (light, medium and heavy), within the Central Okanagan. Zones with the highest concentration of internal trip ends are primarily clustered along the Highway 97 corridor, including (from north-to-south):

- Jim Bailey Industrial Park area
- Okanagan Gateway area, including lands around YLW and UBCO (note: in 2019, there was active development-related construction which would be generating additional goods movement activity)
- Commercial and industrial areas from north of Reid's Corner (Highway 97 and Sexsmith/Old Vernon Rd) through Midtown Kelowna to west of Spall Road
- Commercial areas on the Westside

Other areas with high intensities of truck trip ends include:

- Glenmore Landfill
- Dilworth Mountain
- North End Neighbourhood (at the base of Knox Mountain)
- Rutland
- Downtown Kelowna
- Pandosy Urban Centre
- Parts of South Kelowna

Figure 2-4: Internal trip end distribution map, all truck types, 2019



Source: CPCS analysis based on Geotab data

Internal total flows

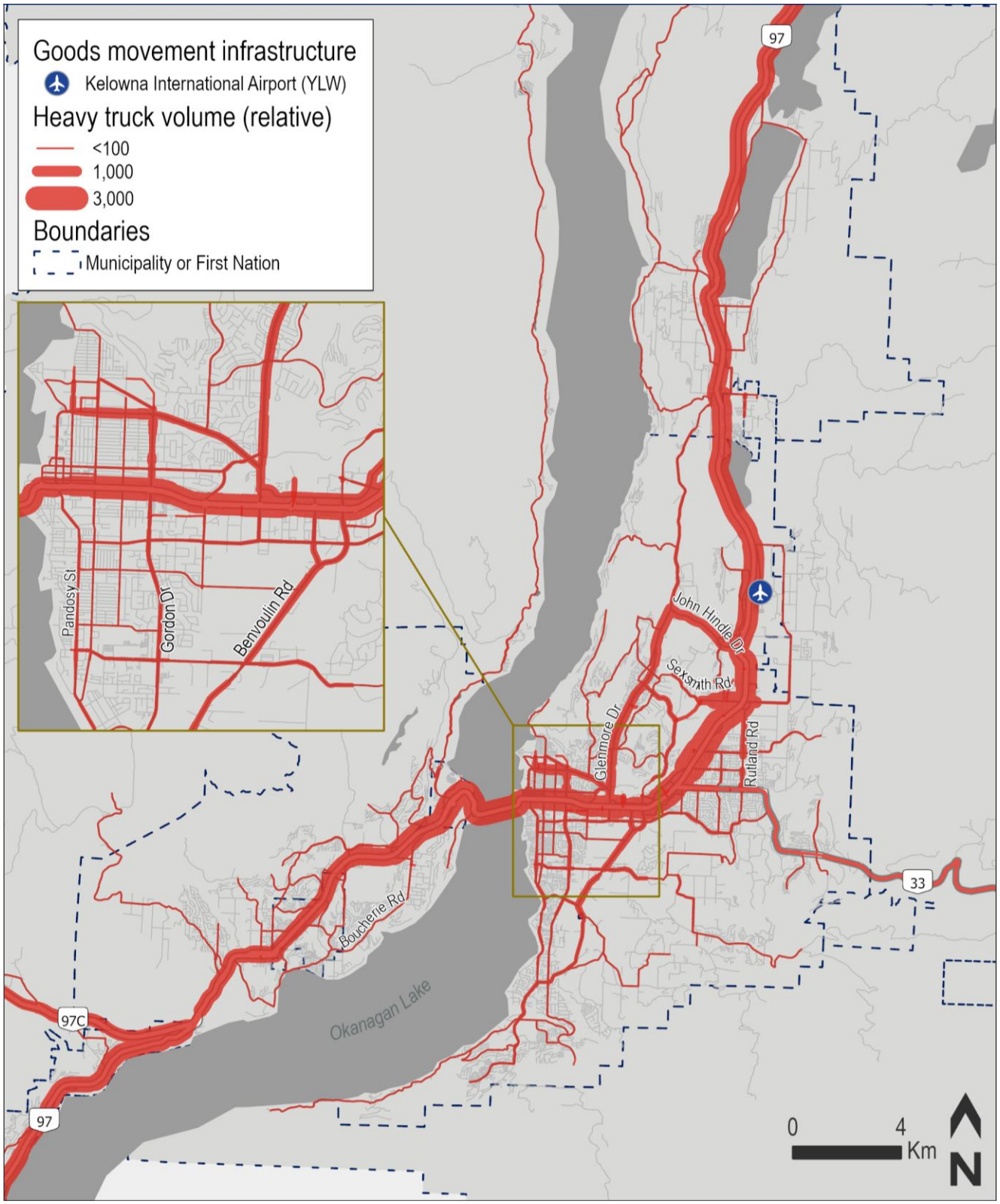
Figure 2-5 shows the intensity of 2019 truck volumes across the Central Okanagan as a heat map considering all trip types. As expected, Highway 97 has the highest intensity of truck volumes in the Central Okanagan – orders-of-magnitude higher than other corridors – with the greatest intensity occurring from the WR Bennett Bridge eastward through Kelowna. Some observations, using volumes and Kelowna's truck routes as a guide, include:

As expected, Highway 97 has the very highest intensity of truck volumes through the corridor – orders-of-magnitude higher than other corridors -- with the greatest intensity occurring from the WR Bennett Bridge eastward through Kelowna

- **To access the North End Neighbourhood in Kelowna**, the highest relative volume of trucks is using Gordon Drive, which would be expected as Gordon Drive is a designated truck route and the north end includes a high concentration of heavy truck volumes. This is also consistent with a stakeholder comment. Trucks are also accessing the area via Clement Avenue, which is also on Kelowna's truck route network.
- **There is a high intensity of truck volumes using corridors directly north of and parallel to Highway 97,** including Enterprise Way (which is **not** on Kelowna's truck route network, but almost entirely flows through a commercial area). A much smaller volume intensity is flowing along Rifle Road and Dilworth Drive to/from Sexsmith Road to access Enterprise Way. This was noted as a route used by at least one stakeholder.
- **A high intensity of trucks is using Glenmore Drive/Road**, including in part likely to access the Glenmore Landfill, as well as connecting to Highway 97 via John Hindle Drive. Glenmore Drive and John Hindle Drive are designated truck routes.
- **A moderate intensity of trucks is using Pandosy Street south of Highway 97** (which is not a truck route and runs along residential and institutional areas), likely in part to access commercial areas in South Pandosy – KLO. Gordon Drive is the nearest designated truck route to this area, but if coming from the west, requires trucks to travel over 1 km further east along Highway 97, then south on Gordon, then back west.
- A moderate volume of trucks is travelling along Benvoulin Road (which is a designated truck route).
- **There is a moderate volume along Rutland Road** between Highway 33 and Highway 97 (which is a designated truck route).
- On the west side, we observe that there is relatively limited volume of off-highway truck traffic, including on the parallel Boucherie Road.

It is important to note that the commentary about high truck volumes on non-truck routes is suggestive, but not conclusive that trucks are not following the truck route network, as these routes might be partially on the most direct path from the truck route to the driver's final destination.

Figure 2-5: Heavy truck flow heat map, 2019



Source: CPCS analysis based on Geotab data

Access to/from the Central Okanagan

Businesses and residents are served by distribution centres primarily in the Lower Mainland and Calgary, and need to be able to access airports, seaports and rail transload facilities around the region. Access to/from the Central Okanagan relies on three primary routes to/from the Lower Mainland: Highways 1, 3 and 5. Most trips (90%) use Highway 5 to travel between the Central Okanagan and Lower Mainland. We did see evidence of changing travel patterns following flooding events in late 2021 (see box).

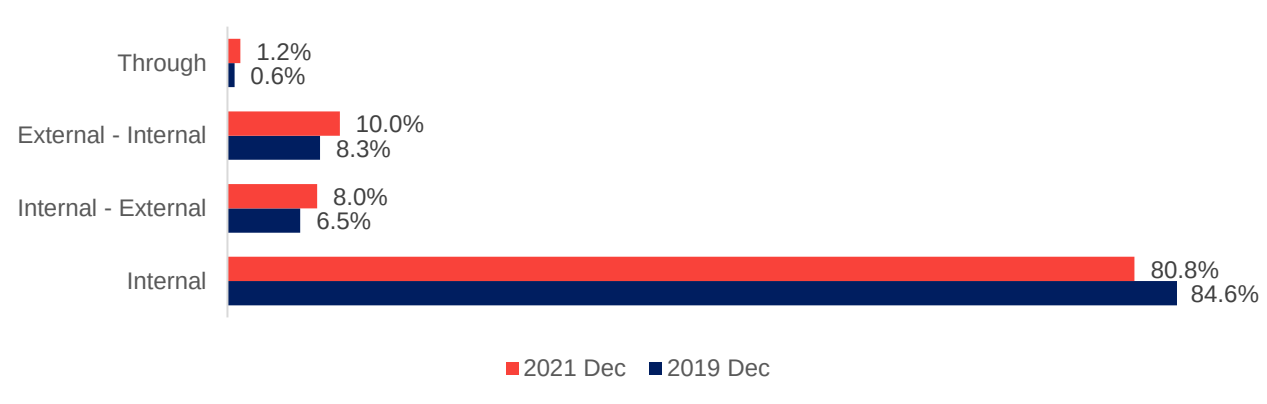
The majority of trips (90%) use Highway 5 to travel between the Central Okanagan and Lower Mainland.

Impact of flooding on interior highways

Highway 5 (the Coquihalla), on the main route for commercial vehicles between the Lower Mainland and Alberta, as well as to/from the Central Okanagan, was closed to commercial traffic between November 14 and December 20, 2021, due to flooding. Highway 3 was also closed due to flooding November 14 but reopened to essential traffic on November 29. Many commercial vehicles used the Highway 3 detour route until Highway 5 reopened on December 20. We wished to assess whether Highway 97 was being used by commercial vehicles to transit between Highway 1 and 3 during the period of the detour on Highway 3.

Figure 2-6 compares the distribution of trip types in December 2019 and December 2021 to assess the impacts of the Highway 5 closure and the Highway 3 detour on traffic volumes through the Central Okanagan. The proportion of trips **through** the Okanagan doubled (from 0.6% to 1.2%), evidence that trips rerouted along Highway 3 were passing through the Central Okanagan. However, it still remains a small proportion of overall trips.

Figure 2-6: Comparison December 2019 versus December 2021



Source: CPCS analysis based on Geotab data

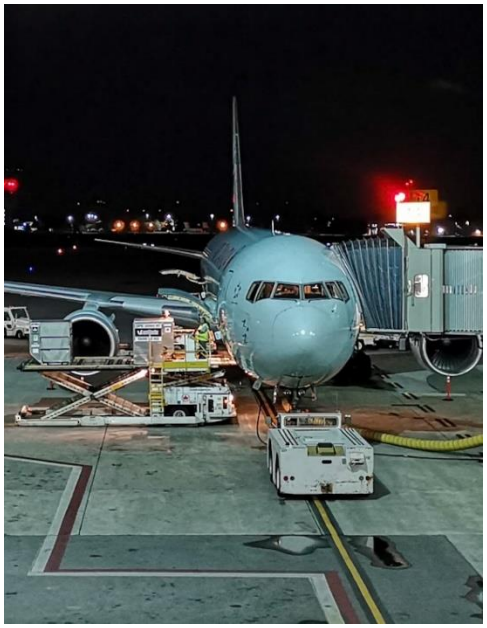
In addition, based on CPCS analysis of MOTI data, the increase in daily heavy vehicle volume between December 2021 versus December 2019 was +23.1%. This increase is about **three-times higher** than the total increase across all months of 2021 versus 2019 (7.3%). This is suggestive that there was rerouting through the Central Okanagan during this time. Roughly, the higher than annual growth experienced in December 2021 amounts to about 160 additional heavy vehicles daily, or about 15% above typical December heavy vehicle volumes.

2.2.4 Air cargo

Air transport serves an important role in a multimodal transportation system. Air cargo is used to transport where a high premium is placed on short travel times, including high-value-to-weight products, perishable products, products that have a quick replenishment cycle, time-sensitive documents, and cargo and live animals.

Air cargo can be handled as belly freight on passenger flights (e.g., Figure 2-7) as well as on dedicated air cargo freighters.

Figure 2-7: Passenger flight being loaded with containers



Source: CPCS

Couriers, such as FedEx, UPS, etc. will operate dedicated freighters as part of a network with a central hub to provide global overnight service and integrate it with ground transport. Some airlines will also operate scheduled freighter service, or they can be chartered. E-commerce companies (e.g., Amazon) now also operate their own fleets (e.g., Prime Air).

Stakeholders noted that shippers in the Central Okanagan use air cargo primarily through two gateways:

- Through Kelowna International Airport (YLW), including by courier companies
- Through Vancouver International Airport (YVR), transporting by truck to/from Vancouver

We did not hear any indication that Calgary was used as a primary gateway; however, some courier flights to/from Kelowna are routed through Calgary. Customs clearance activities also conducted in Calgary for courier cargo originating from/destined to YLW.

Between 2015 and 2020 (the last year of reported data), YLW handled approximately 1,500-1,900 tonnes of air cargo annually, as reported by Statistics Canada (Figure 2-8). The YLW 2045 Master Plan explains the drop in cargo volumes that occurred pre-2015:

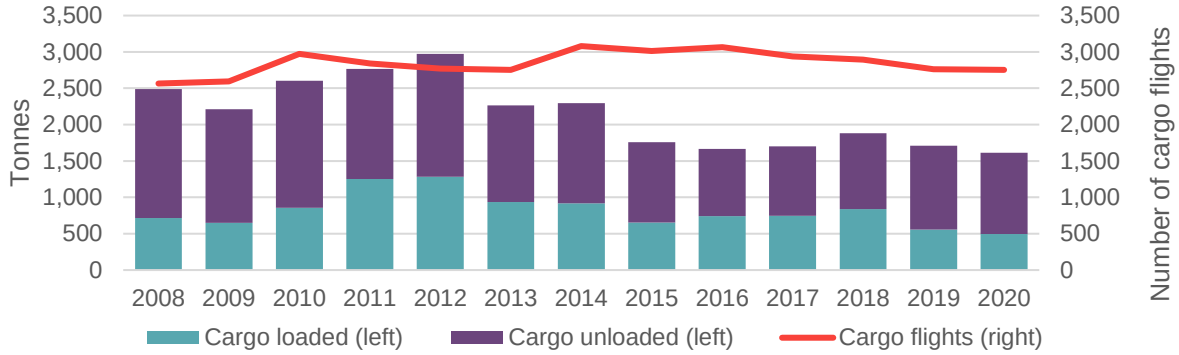
> In 2015, YLW handled 1,757 tonnes of air cargo, 23% less than in 2014, and well below its peak of 2,971 tonnes in 2012. Approximately 60% of the cargo is inbound and unloaded at YLW. Belly hold capacity for cargo shipments out of YLW has been limited over recent years due to the operation of smaller turboprop (Dash-8) aircraft by Air Canada and the limited focus on air cargo activities by WestJet. The drop in traffic in 2015 coincides with the locally based carrier KF Aerospace losing a large contract with Canada Post to transport mail.[12]

By comparison, YVR reported 285,000 tonnes of cargo in 2019,[13] the most recent year before the pandemic, up from about 200,000 tonnes in the early 2010s.

Statistics Canada data are not yet available for 2021. However, stakeholders indicated that an air bridge was established between Vancouver and Kelowna to transport pharmaceuticals during the pandemic.

[12] SNC-Lavalin and YLW. 2016. Kelowna International Airport: Airport Master Plan 2045
[13] CPCS analysis of Statistics Canada data

Figure 2-8: Air cargo volumes handled at YLW, 2008-2020



Source: CPCS analysis of Statistics Canada data

In 2014, the most commonly reported cargo types handled at YLW were wine, fruit, personal effects, company material / aircraft parts, kennelled animals, and general cargo. More recently, stakeholders indicated that there has been the emergence of shipments of pharmaceuticals as well as cannabis. Looking forward, there is interest by YLW in developing markets related to package delivery for e-commerce, as well as produce exports via YLW.

The raw volume of air cargo reported understates YLW's transportation and economic importance to the region in three ways:

1. **Limitations in the data collected by Statistics Canada,** as regional and local carriers do **not** file cargo data, and Statistics Canada's charter survey does **not** include domestic courier cargo or domestic entity cargo flights.[14] Based on consultations, a single large courier company serving the Central Okanagan and surrounding area might have approximately 40-50 ground delivery routes per day, though not all the cargo necessarily arrives/departs by air.

2. **Air cargo has an average value-per-tonne that is over 100-times higher than truck** (based on reported cargo originating in the "Rest of BC" outside of the Vancouver CMA in 2017), an indicator of its economic importance (see Figure 2-9).[15]

3. **Air cargo has a very small shipment size, estimated at about 0.4 tonnes per shipment in Statistics Canada data** (again, Figure 2-9)**.** This estimate is likely high, given the growth that is being experienced in small package delivery for e-commerce (see point 1). In addition, while some shipments arriving or departing by air might be consolidated into a single truck, we also heard that it is not uncommon to hotshot (i.e., send by point-to-point courier) an important piece of equipment directly from a manufacturing facility to the airport, to meet courier cut-offs. We expect that air cargo that is in turn transported by commercial vehicle

[14] Statistics Canada. Airport Activity: Air Carrier Traffic at Canadian Airports, 2019 https://www150.statcan.gc.ca/n1/pub/51-004-x/51-004-x2020005-eng.htm

[15] A midsize air freighter such as a 767-300F can carry 53 tonnes of cargo. Assuming an average value of $185,000 per tonne, the value on board is nearly $10 million. Larger freighters, such as a 747, can carry three times this cargo by weight, and cargo values can vary based on the goods being carried. CPCS based on cargo capacities cited by Boeing and CargoLux and values per tonne estimated from Statistics Canada data.

(truck or van) requires more vehicles, as compared to other cargos handled primarily by truck. These shipments are also more time sensitive.

Figure 2-9: Cargo metrics for shipments originating in the "Rest of BC" (outside of the Vancouver CMA), All commodity types, 2017

Mode	Value per tonne ($/t)	Weight per shipment (tonne / shipment)
Air	$185,000	0.4
Rail	$400	63.0
Truck*	$1,500	18.5

Note: *Trucking includes for hire (contracted) trucking only.
Source: CPCS analysis of Statistics Canada, Canadian Freight Analysis Framework

2.3 Goods generating economic activity

Goods movement is generated by other economic activities, including the inputs and outputs of business activity. In other words, goods movement facilitates other economic activity. Accordingly, the goods movement travel patterns described in the previous section can be further explained by the layout of economic activity in the Central Okanagan. This section briefly describes goods generating economic activity in the Central Okanagan and where it is clustered in the region. In addition, we also describe the factors shippers in different industries will consider in selecting transportation options as part of a supply chain.

2.3.2 Business count and employment profile

CPCS purchased business establishment data from Scott's, a data provider to identify the location of goods movement-generating business clusters.[16] The business establishments are geocoded by address and latitude-longitude, which allow us to map business activity geographically, including to transportation analysis zones (TAZs). The businesses also come coded by industry, in line with the standard North American Industry Classification System (NAICS) framework.

We grouped Scott's business establishment data into four high-level industry categories for those industries considered to be freight-generating. Figure 2-10 shows the four high-level industry categories ranked from highest to lowest based on the magnitude of their freight-generating activity. *Industry* and *transportation and trade* categories are considered "core" freight-generating industry categories. However, all types of businesses can generate freight:

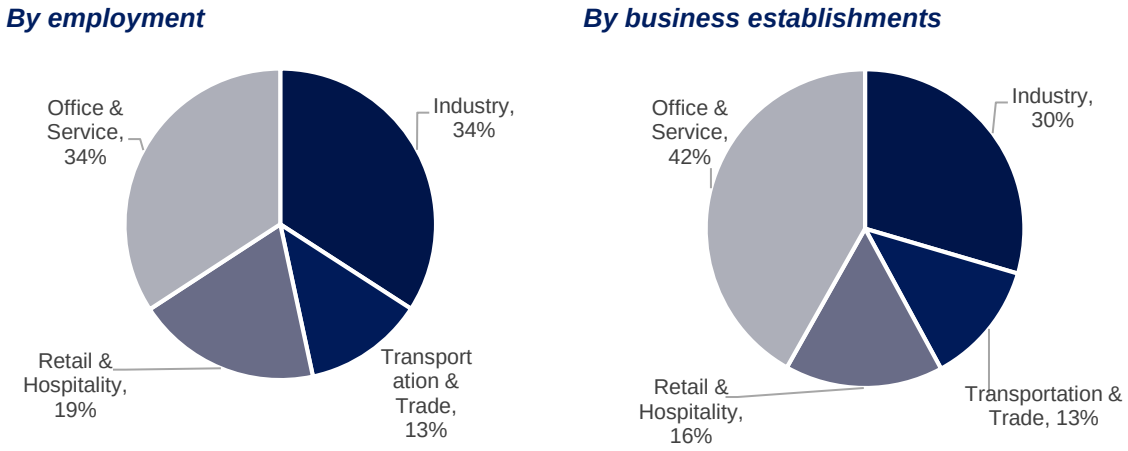
- **Industry** includes businesses that are typically understood to constitute the core shipper base for trucking activity. This includes businesses associated with extraction, manufacturing, and construction. These industries tend to take in physical inputs and generate physical outputs, all of which implies the need for transportation of commodities and materials. These businesses are highly reliant on logistics, freight and transportation for their operations (NAICS 11, 21, 22, 23, 31-33 and 56, as shown in Figure 2-11). *About 34% of employment in the region consists of these types of businesses*.
- **Transportation and Trade** includes businesses that are also considered to be in core freight-related industries. This includes businesses that are involved in shipping or distributing freight, i.e., facilitating trade and the movement of goods (NAICS 41 and 48-49). This category is responsible for a further *13% of employment in the region*.

[16] Scott's Directories provide a sample of businesses, acquired through their own data collection methodology.

- **Retail and Hospitality** is not necessarily considered to be associated with heavy freight, as these industries tend to serve the end user directly (i.e., the general public). However, these businesses are still very much reliant on the flow of goods for inputs, if not for outputs. For example, stores need to receive deliveries of products, while restaurants need to receive deliveries of food and beverages. Hence, these industries are also dependent on effective goods movement. It includes NAICS 44-45, 71 and 72. *They represent another 19% of employment in the region.*
- **Office and Service** sector jobs are typically not considered to be freight-related, as these are largely entities that are in the business of providing services (e.g., financial, legal, technical, healthcare, etc.) rather than producing or distributing goods (NAICS 51, 52, 53, 54, 55, 61, 62, 81 and 91). However, particularly with the rise of business-to-business e-commerce, these businesses will still rely on deliveries from time-to-time, such as deliveries of documents, office supplies, and parcels. In addition, some businesses in this area may operate commercial vehicles that, while not delivering "goods" per se, do impact and rely on the road network in much the same way (for example, technicians, contractors, repair persons, home care, cleaning services, etc.). Hence, although not the top focus of goods movement studies, these types of economic activities should not be ignored either.

As the figures show, the Central Okanagan has a diverse and varied employment base. Nearly half of the businesses in the Central Okanagan (as measured by businesses or employment) are in core freight-generating industries (Industry plus Transportation and Trade categories). The distribution of employment and number of businesses by category is shown in Figure 2-10.

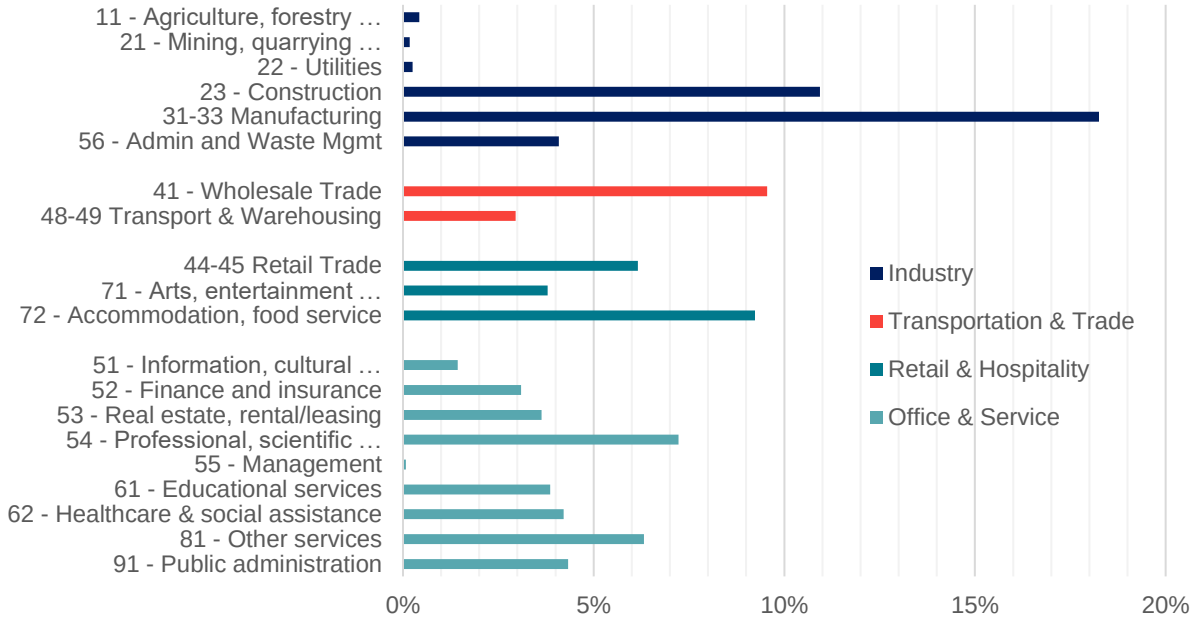
Figure 2-10: Percentage distribution of freight-generating industries by employment and business establishment numbers



Sources: CPCS analysis of Scott's data

Figure 2-11 shows a further breakdown of employment by 2-digit NAICS industry.

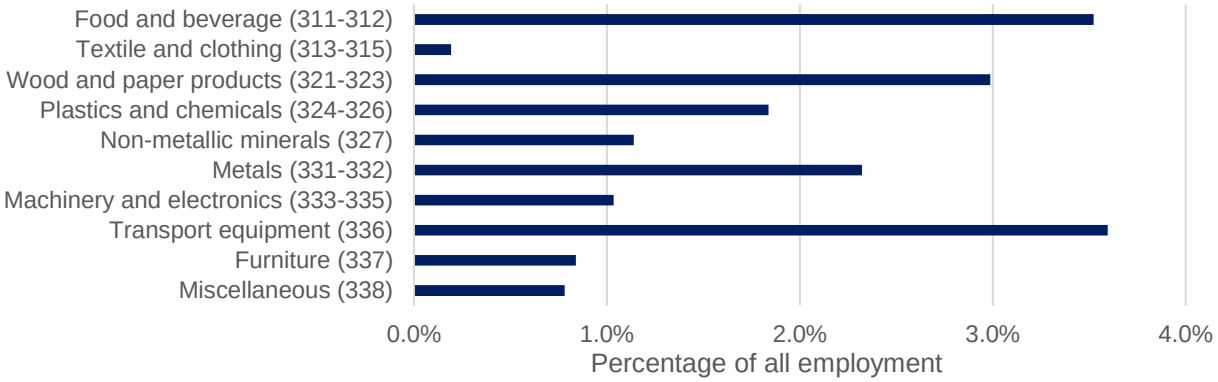
Figure 2-11: Breakdown of employment by 2-digit NAICS industry



Sources: CPCS Analysis of Scott's data

Manufacturing, the top industry (by 2-digit NAICS code), is further broken down in Figure 2-12 below. Important segments within the manufacturing industry include food and beverage manufacturing, wood and paper products manufacturing, and transport equipment manufacturing.

Figure 2-12: Breakdown of manufacturing employment



Sources: CPCS Analysis of Scott's data

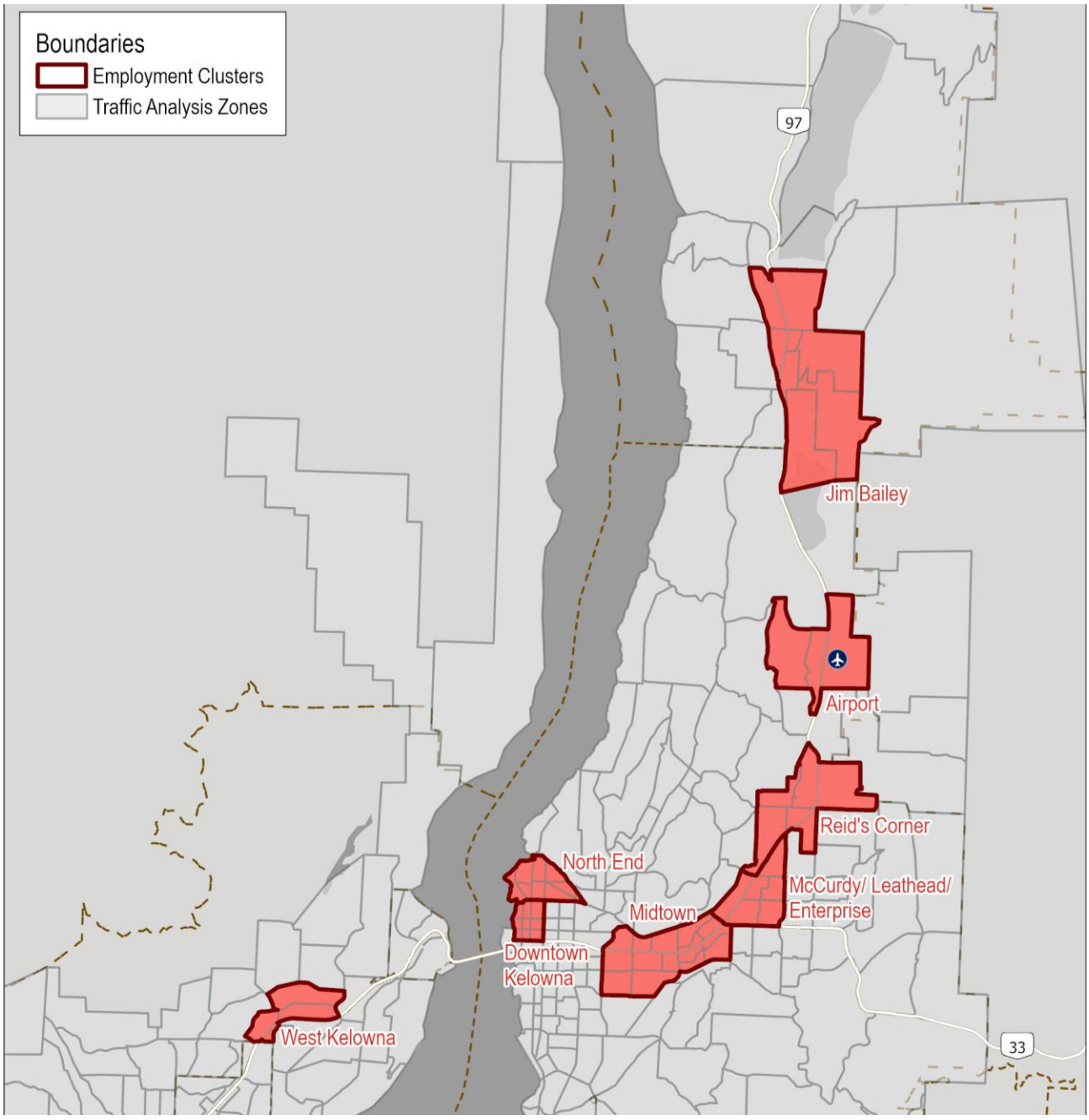
It should be noted that the employment data is based on a sample,[17] rather than a full inventory of all businesses in the region. Nonetheless, it provides some sense of the significance of various types of economic activity that take place in the Central Okanagan.

[17] The Scott's Directory sample used for this analysis included 38,000 employees from 3,519 businesses across all sectors shown in Figure 2-11.

2.3.3 Goods generating business clusters

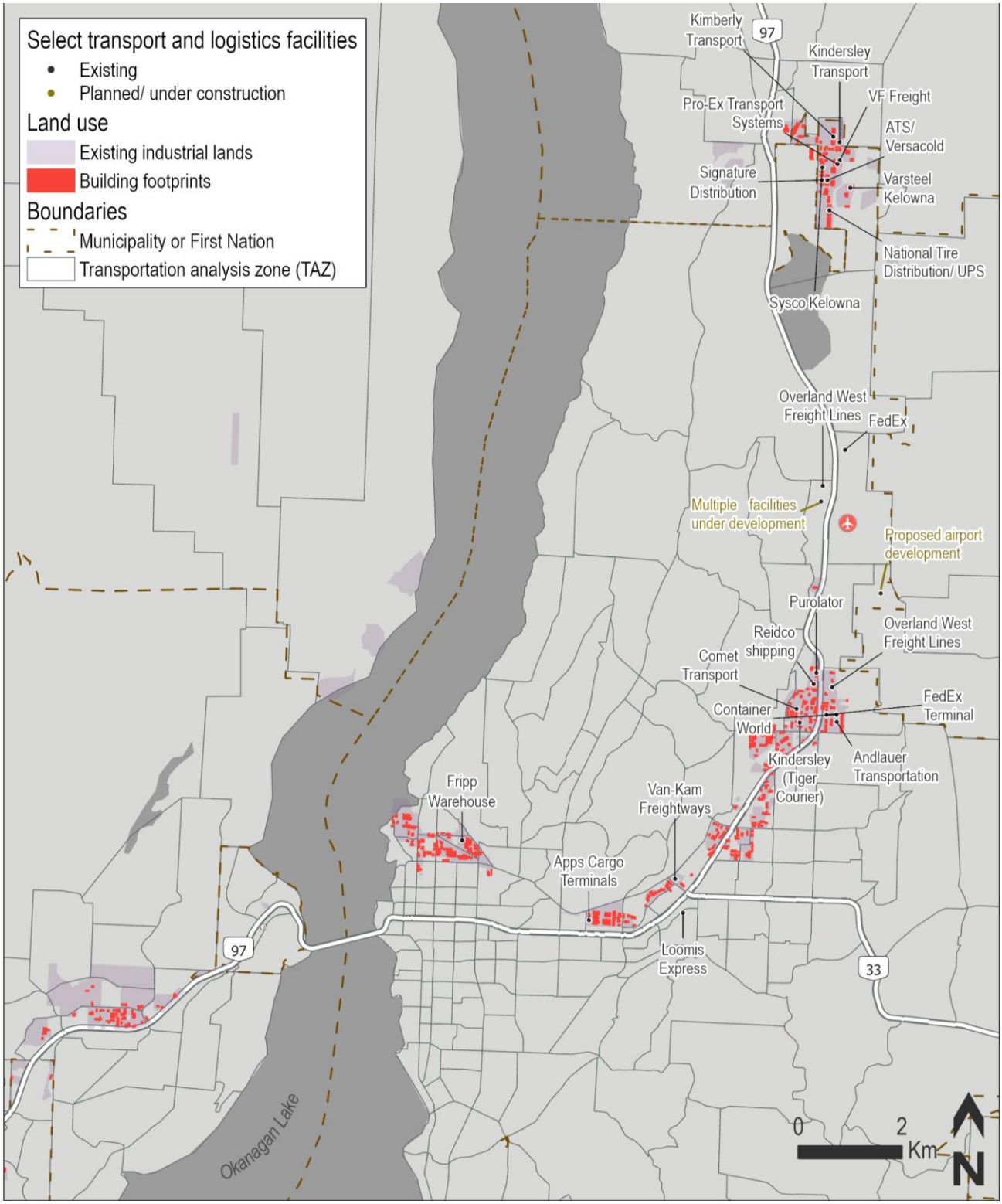
We identified eight primary clusters of businesses by employment numbers (ordered generally from northeast to southwest): Jim Bailey Industrial Area, Kelowna International Airport, Reid's Corner (Highway 97 and Sexsmith/Old Vernon Road), McCurdy / Leathead / Enterprise, Midtown Kelowna, Downtown Kelowna, Kelowna North End Neighbourhood and West Kelowna (Figure 2-13). These clusters are also highly correlated with existing and any future known transportation and logistics facilities in the Central Okanagan (Figure 2-14). A comparison of the GPS truck trips with the business data indicates that light and medium trucks predominantly operate in the service sector. By comparison, heavy trucks predominantly operate in the retail trade and manufacturing sectors. ***Appendix C: Business clusters***, profiles each of the eight clusters.

Figure 2-13: Location of major business clusters within Central Okanagan



Source: CPCS analysis based on Scott's data

Figure 2-14: Existing and known future large manufacturing, warehousing, logistics and transportation facilities in the Central Okanagan



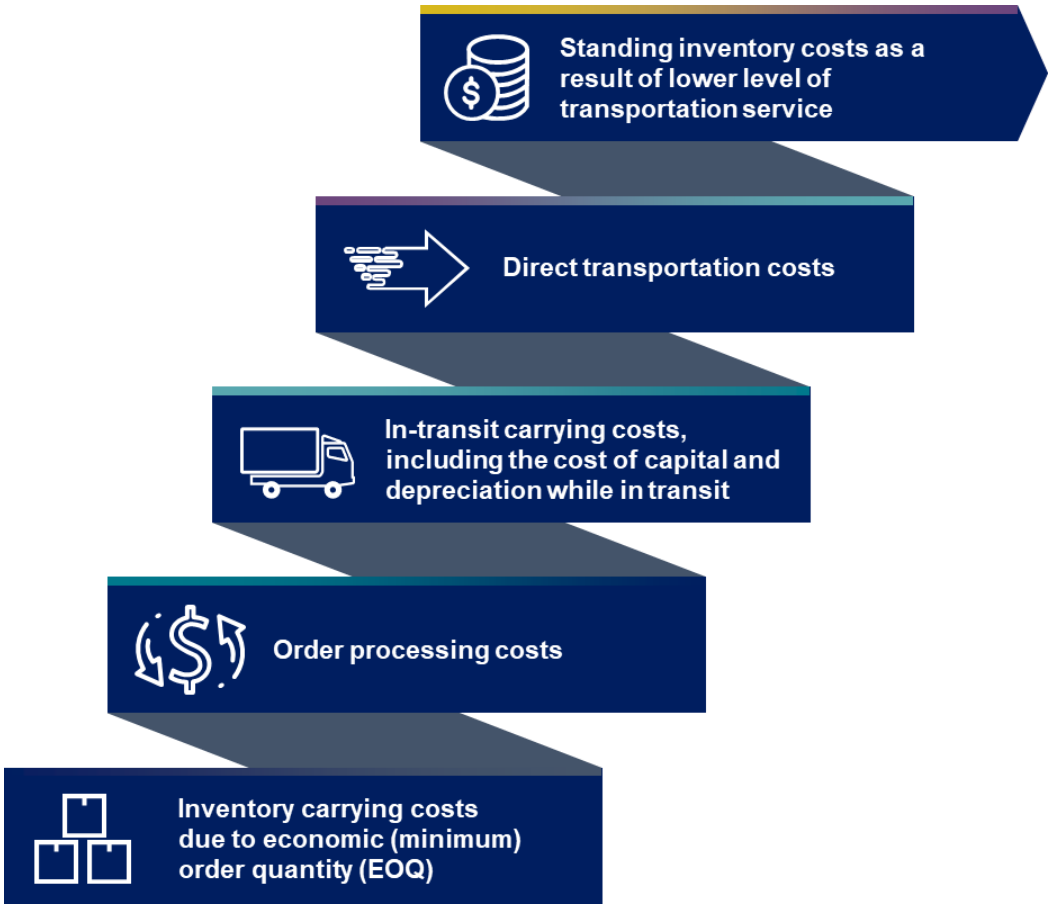
Note: These were identified by mapping facilities with building footprints over 900 m2 (nearly 10,000 square feet) on industrial land.
Source: CPCS analysis of Statistics Canada building footprint data, Scott's Directories data and online searches

2.3.4 Overview of supply chain transportation decision-making factors

When moving goods along supply chains, businesses shipping goods ("shippers," such as those in the clusters above) are faced with a variety of choices and trade-offs as they seek to minimize overall logistics costs while ensuring satisfaction by end users (notably their customers, which includes businesses and consumers). Shippers often attempt to minimize the sum of the logistics costs either implicitly as a result of past business practices or explicitly through logistics cost modeling.[18]

Components of logistics cost models are summarized in Figure 2-15. These models include **direct transportation costs** (i.e., the cost a shipper pays to a transportation carrier[19] to move its goods) as well as other **logistics costs** (e.g., inventory carrying costs, order processing costs, product loss and depreciation ["shrinkage"] costs).

Figure 2-15: Key components of a logistics cost model



Source: CPCS based on the Conference Board of Canada

[18] One stakeholder specifically mentioned how they use an analytical model that accounts for these trade-offs in determining where to establish distribution centres, for example.
[19] The firm that is actually moving the goods for the shipper, such as the shipping line, and/or railway or trucking company. In some cases, the shipper will also transport goods themselves.

Several other choices and trade-offs are possible including, order, frequency, and inventory levels, etc. The most relevant trade-off (for understanding of goods movement) is the choice of transport mode (faster and more expensive or slower and less expensive) and inventory costs (smaller inventory and lower cost or larger inventory and more cost). **The optimal choice seeks to minimize the sum of transportation and inventory costs.**

This is a simplification, as there are several practical industry- or firm-specific needs that need to be satisfied, such as:

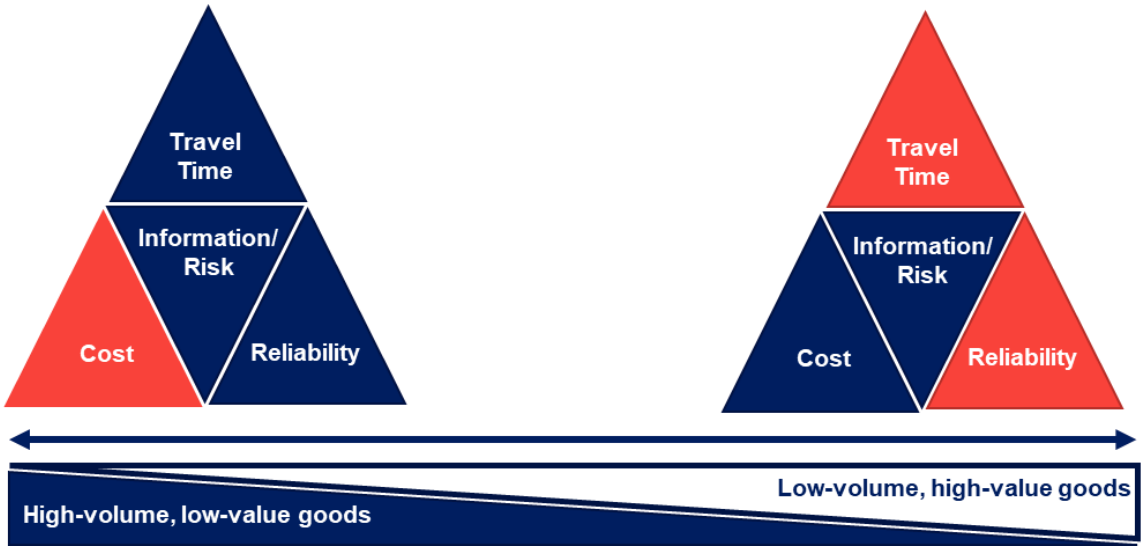
- **Limited storage space onsite:** We heard multiple times that certain firms in the Central Okanagan have constraints on available storage, so have to evacuate product regularly or risk having to shut down production/throughput.
- **Satisfying customer requirements:** Customers in different industries will have varying expectations about the speed at which they expect their product back, which will be influenced by the business realities. For example, an aviation customer awaiting a part to get an aircraft back in service will have a much higher expectation for shorter-return time than a customer handling bulk goods, who has ample storage and simply expects the goods to arrive eventually.

Given these trade-offs and needs, shippers ultimately make decisions based on the trade-offs associated with lowering logistics cost, transit time, or improving quality/reliability and lessening risks. Producers and shippers choose the appropriate transportation mode (e.g., air, truck, road, marine) and/or route depending on these four primary decision factors (see Figure 2-16):

1. **Costs**: the cost they pay to bring their products to their end markets (i.e., the rate they pay to carriers, such as trucking firms)
2. **Travel time**: the time it takes to bring their products from origin to destination
3. **Quality/reliability**: the confidence they have that their products will arrive on time and safely to their end markets as well as the overall quality of transportation services
4. **Information/risk**: the knowledge of the existence of the mode available and the risks it involves

In general, high-volume/low-value goods (e.g., grains, etc.) are more sensitive to transportation costs, so will use modes such as rail or bulk vessel. By comparison, low-volume/high-value goods (such as retail goods) are much more sensitive to shorter and reliable travel times, so will use modes such as containerized vessel, air and trucks. We summarize the supply chains of four industries predominant in the Central Okanagan in ***Appendix D: Examples of supply chains in the Central Okanagan***.

Figure 2-16: Transportation decision factors (red triangles show the factors most likely to drive decision-making at each end of the commodity value and volume spectrum)



Source: CPCS.

It is also important to note that these factors are interrelated and influenced by transportation infrastructure. For example, the cost that shippers pay to carriers is usually correlated with the distance between origin and destination, and in turn travel time of the goods (among other factors). Thus, to the extent that a carrier passes along costs to its shipper customers through rates, lowering travel time will also lower transportation costs.

2.4 Industrial and commercial land use in the Central Okanagan

2.4.2 Approach and overview

Goods movement activity occurs throughout the Central Okanagan. Residential areas generate goods movement activity through pick-ups and deliveries, including waste disposal. In addition, several stakeholders noted the existence of several home-based businesses in the Central Okanagan. However, commercial and industrial areas are primary drivers of goods movement activity, [20] and the availability of industrial and commercial lands is required to support economic activity in goods generating sectors. We map existing and planned future commercial and industrial land use in the Central Okanagan region using GIS files from Official Community Plans/Comprehensive Community Plans (OCPs/CCPs).

2.4.3 Mapping of existing and future land use

Figure 2-17 shows the locations of *existing* commercial and industrial land use in the Central Okanagan region. If superimposed on the map of truck trip ends (from Phase 1), the areas with the highest density of truck trip ends would line up with commercial and industrial areas, notably along Highway 97 and in Kelowna's North End Neighbourhood. This confirms visually and unambiguously the importance of industrial and commercial land uses as key truck generators, and underscores the importance of having adequate truck access to these land uses.

[20] By design, the COGMS is not a truck forecasting exercise, which would require the development of truck forecasts and scenarios in the regional travel demand forecasting model.

Figure 2-18 shows a composite of planned *future* commercial and industrial land uses in the region, as designated through the current OCPs and CCPs. Areas along Highway 97 through Kelowna and the West Side, along with the Kelowna North End Neighbourhood, are planned to remain as commercial and industrial areas. In addition, though the City of Kelowna has reclassified some lands from commercial to mixed-use zones (e.g., Urban Centres and Village Centres), these lands are expected nonetheless to still include goods movement generating commercial activities. Such mixed uses can create new challenges, including ensuring the adequacy of loading zone design and location and minimizing truck-generated conflicts and annoyances (e.g., noise and vibration associated with loading zones).

The supply of zoned industrial land is expected to increase through the region's OCP/CCP planning horizons (Figure 2-19).[21] Based on a GIS-based analysis of OCPs/CCPs,[22] this increase is expected to occur predominantly within the City of Kelowna and District of Lake Country, especially along Highway 97 in the Gateway (some of which has already developed since the issuance of the relevant OCPs), at Jim Bailey Industrial Park and at Glenmore Industrial Area.[23] There is expected to be further industrial use in this area if YLW develops industrial land in its southeast quadrant, which is not shown as it is encompassed under a different land-use designation.

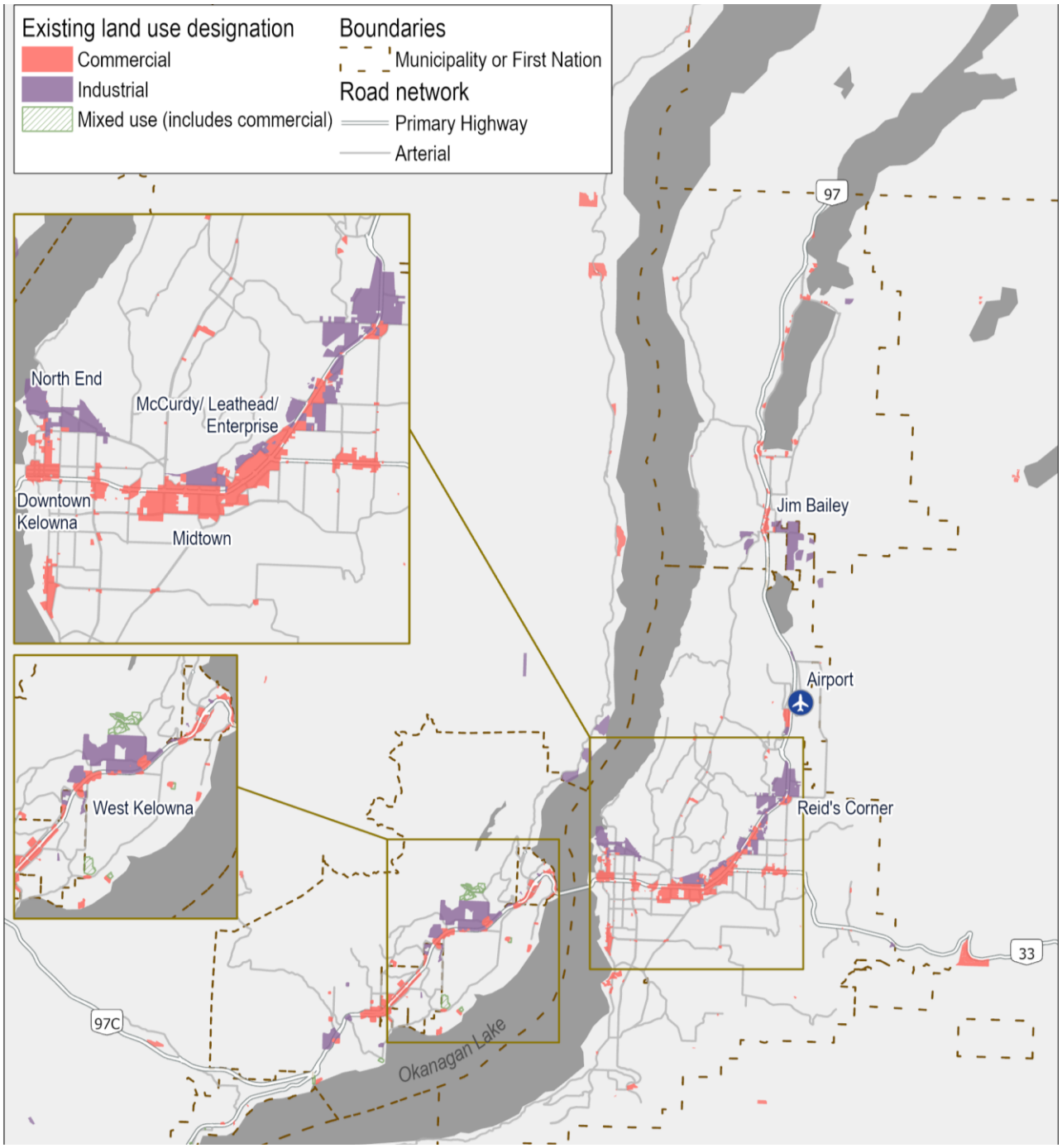
However, as noted in Section 2.1.3, despite the increase in industrial land area per the OCPs and CCPs at time of adoption, the availability of industrial land is an issue. Growth and development pressures will continue to put pressure on industrial lands. It follows that additional goods movement activity can be expected in these areas as these industrial areas develop. Regardless, even outside these goods-generating land uses, goods movement activity would grow as the region's population continues to grow.

[21] This estimate does not include any changes that would result from the City of Kelowna's North End Neighbourhood plan, which is under development. Based on engagement with the City of Kelowna, the overall supply of land is not expected to materially change, but its locations within the neighbourhood and industries may change

[22] As noted in the figure footnote, there are some limitations to this analysis that impact the estimation, including whether the GIS layers included road allowances.

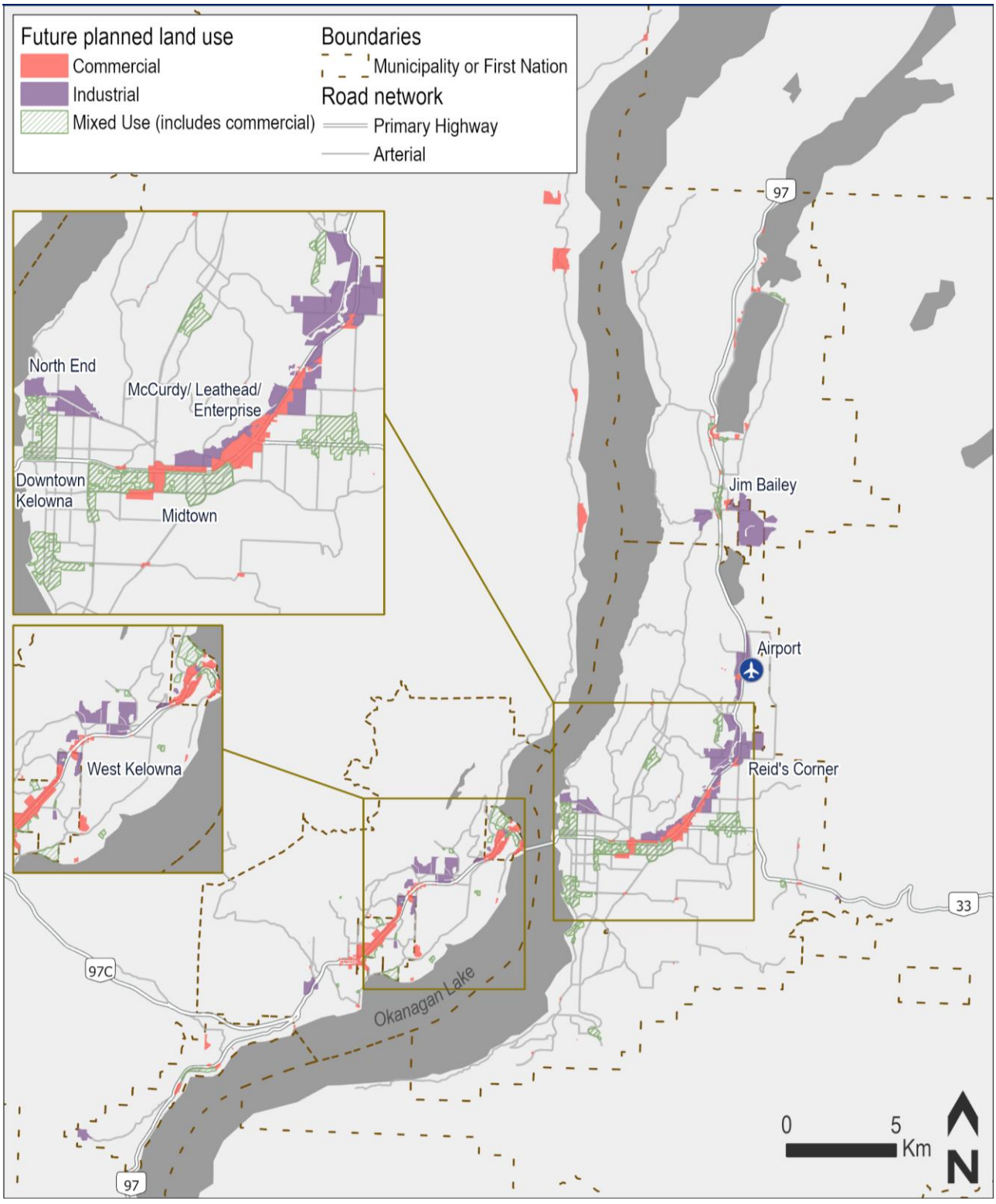
[23] This area was not previously identified. It is located west of Glenmore Road in Lake Country.

Figure 2-17: Existing commercial and industrial land use in the region



Source: CPCS illustration of land use plans: City of Kelowna bylaw No: 8000, City of West Kelowna zoning bylaw 0154, District of Lake Country zoning bylaw 561, District of Peachland zoning bylaw 2100, RDCO land use bylaw 871, RDCO land use bylaw 1195 (Joe Rich rural land use bylaw), Westbank First Nation land use law

Figure 2-18: Future commercial and industrial land use in the region



Note: Mixed-used zones include Urban Centres and Village Centres. Source: CPCS illustration of GIS files associated land-use plans: City of Kelowna OCP 2040, City of West Kelowna OCP, District of Lake Country OCP, District of Peachland OCP, RDCO official community plans, Westbank First Nation CCP

Figure 2-19: Area designated for industrial land use, by municipality or First Nation

Municipality/First Nation	Existing area (km^2)	Future area (km^2)	Change (km^2)
City of Kelowna	5.5	8.0	2.5
City of West Kelowna	2.3	*1.7	-0.6
Lake Country	0.4	1.0	0.6
District of Peachland	0.2	0.2	0.0
Westbank First Nation	0.2	0.2	0.0
Regional District of Central Okanagan	1.2	0.0	-1.2
OKIB	Not available	Not available	Not available
Total	**9.8**	**11.1**	**1.3**

*Note: Industrial area was redesignated into Agriculture, Business Parks and Institutional. Also, the existing land use polygons included transport corridors, while the future land use polygons have cut-offs for the roads passing through, which also accounts for some of this decrease in area. Source: CPCS analysis of GIS-files of OCPs/CCPs: City of Kelowna OCP 2040, City of West Kelowna OCP, District of Lake Country OCP, District of Peachland OCP, RDCO official community plans, Westbank First Nation CCP. This analysis was conducted in Spring 2022.

2.4.4 Composition of future industrial base

The preceding section considered the locations of existing and planned commercial and industrial lands. It is also important to consider *how* these lands will be used, especially if/as Central Okanagan's industrial base changes. This is described in four ways:

- **Existing industrial land base will continue to be important.** A 2018 study describes three generic uses of industrial – i.e., employment – lands: *traditional industries*, whose goods are distributed beyond the immediate region (e.g., agriculture); *city-serving functions*, which serve local residents and businesses (e.g., retail); and *gateway industries* (e.g., related to the airport).[24] All these industries exist today in Central Okanagan, and the profile of goods movement patterns described in Section 2.2 reflect these three industrial uses. One implication is that it is important to recognize that the goods movement needs of these three types of uses can vary as, for example, automation becomes more pervasive in different economic sectors, albeit to varying degrees (same with the shift to more sustainable industrial processes), and more businesses rely on courier deliveries to serve customers directly. A second implication is that each of these three industrial uses likely will continue to be important in a region like Central Okanagan, even if the allocation of these lands among the three uses is difficult to project. The need to preserve the supply of industrial lands in Central Okanagan is paramount.

The need to preserve the supply of industrial lands in Central Okanagan is paramount.

- **Enable transition to the innovation economy.** Another, less apparent, implication is the emergence of the *innovation economy* as a fourth use of industrial lands. These uses include high-tech, cultural, design, communications, and combinations of these industries, among others. They are characterized as 'creative' industries and are growing and changing quickly. Many cities, including Vancouver, have encouraged the repurposing of old, redundant inner-city industrial spaces for these uses.[25] Their goods movement needs could differ from those of the other three industry types in several ways: a reliance on courier (express delivery) but generating relatively small volumes and the need to reach a broad market (national or even global, which heightens

[24] T Hutton and T Barnes, *Metro Vancouver Industrial Lands Report 2018, Industrial Lands and the Innovation Economy*, University of British Columbia, June 8, 2018.
[25] Ibid.

the importance of the airport gateway). An example of a facility that includes elements of this innovation economy (along with traditional industry needs) is Hexagon Purus, which is setting up a battery micro-plant and research facility in the Gateway.[26] Similarly, reliable internet connectivity and power throughout the region would allow people to set up small businesses close to where they live, suggesting some dispersal of jobs throughout the region, with the ensuing need to provide the same levels of delivery service that urban businesses rely on, in cost-effective and sustainable ways but now in remote areas of very low density. It follows that, although many of these land uses are small-scale or even just emerging today, they can be expected to occur as Central Okanagan's economy further develops. One implication is that recommendations should contemplate built-in flexibility to meet the goods movement needs of the innovation economy as they arise. A second, broader, implication is that planning for industrial lands (and, by implication, for its goods movement support) necessarily will be an ongoing process.

- **Industrial land supply must be protected.** Even with a potential transition to innovation economy jobs that make more efficient use of land, there likely will continue to be pressures on Central Okanagan's industrial land supply. This is illustrated by a 2019 study which examined ways to address constraints on industrial space in the Lower Mainland.[27] The profound growth challenges, development pressures and geographical constraints are together unique in scale and breadth to the Lower Mainland. Nonetheless, the Lower Mainland's challenges illustrate the need for other parts of the province to be proactive in maintaining an adequate supply of industrial land to support economic growth. For the Central Okanagan, the challenges lie in (1) its own geographical constraints; (2) the prominence of the agricultural land reserve spatially and as a tourism generator; (3) the desirability of the region as a place to live as evidenced by its very strong growth rate; and (4) the importance of a single highway corridor as the spine for urban and long-haul goods movement. The competition for the limited available space means there will be pressures to use industrial lands in other ways, but as the foregoing discussion explains, the need to accommodate industrial growth will always be present.
- **Lower Mainland and Calgary will continue to be Central Okanagan's primary distribution hubs.** Another outcome of the Lower Mainland experience is that other Western Canadian urban areas have looked at ways to attract industries from the Lower Mainland. Examples are Calgary, which has developed a significant footprint as a Western Canadian distribution hub,[28] and the Ashcroft Terminal inland port. However, the Central Okanagan does not have the connectivity to the transcontinental rail network (needed to handle the large numbers of containers that are involved) and the market size to make the region a likely location for offloading Lower Mainland industrial functions.[29] The implication is that the Central Okanagan will likely remain dependent on the Lower mainland and Calgary as its primary distribution hubs, even if smaller distribution centres are developed to serve local markets. In turn, this emphasizes the importance of maintaining a resilient network of road and air connections to the region's outside suppliers.

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[26] KelownaNow, *$2.4B in contracts for Kelowna truck battery-pack company*, March 1, 2022 https://www.kelownanow.com/watercooler/money/news/Business/2_4B_in_contracts_for_Kelowna_truck_battery_pack_company/

[27] Hemson Consulting Ltd., *Metro Vancouver Regional Industrial Lands Strategy, Draft*, prepared for Metro Vancouver Regional Planning Advisory Committee, November 15, 2019.

[28] *Calgary Goods Movement Strategy*, City of Calgary, December 2018.

[29] The Central Okanagan also does not have large industrial facilities of low-value commodities suitable for rail to anchor traffic, nor large industrial parcels to attract such industries (assuming that were desirable). As one stakeholder mentioned, it is unlikely the Central Okanagan will be able to attract an industrial facility looking for 200 acres of land.

3 Goods movement trends and sustainable goods movement practices

Summary

- This chapter examines current and emerging trends in goods movement and logistics, including disruptors, global logistics trends, technological and operational trends, measures to minimize conflicts between trucks and vulnerable road users, and alternative fuel / propulsion systems for trucks.
- This chapter also identifies examples of best practices associated with sustainable urban goods movement, which were considered in the recommendations. Best practices examined include policies to increase uptake of alternative fuel vehicles, cargo bicycles, strategies to increase efficiency in deliveries, curbside management, Complete Streets, and logistics and land-use.
- Disruptors are trends that are reshaping goods movement and logistics around the world and are being felt in the Central Okanagan. Climate change and supply chain disruptions are front-of mind challenges. However, the digitalization of the supply chain has generated profound changes and opportunities in how goods are moved and delivered. Global transportation and logistics trends, as well as other emerging technological and operational trends are also relevant to the Central Okanagan.
- Mitigating the impact of climate changes (decarbonization of transport) is also a driving factor behind the adoption of alternative fuel vehicles, particularly zero-emissions vehicles. Several technologies are being matured, including hybrid-electric, electric, hydrogen fuel cell, and natural gas vehicles. Several strategies to encourage uptake of alternative fuel/low-emission/zero-emission vehicles include not only financial incentives, but also policies that provide for preferential access to low or zero-emission vehicles (e.g., to certain areas, loading zones or vehicle lanes).
- There are several strategies to increase the efficiency of deliveries and consider goods movement within Complete Streets (which promotes corridor designs and operations that provide a safe and attractive environment for all travellers, especially vulnerable road users).

3.1 Goods movement trends

The global goods movement and logistics community is being influenced by several current and emerging trends (further described in ***Appendix E: Current and future goods movement travel and technology trends***). The analysis grouped these in several ways:

- *Disruptors*, of which *climate change* and *supply chain disruptions* are front-of-mind as critical challenges, especially given the 2021 floods and wildfires that cut off highway and power access to the Central Okanagan region. These events raise the need for infrastructure resilience and redundancy.
- The events also underscore the importance of another disruptor, namely, the *digitalization* of the supply chain. Characterized by rapid advancements in communications and computing, digitalization has enabled the deployment of new technologies, online purchasing and other profound changes. The influence of supply chain digitalization is so fundamental that it must

now be seen as a precursor to the economic development of the Central Okanagan region (as with other urban areas as well). Locally, this suggests that communications infrastructure should be built into roads to allow for the deployment of new traffic control technologies. It also means that Wi-Fi capabilities should be integrated into industrial and commercial developments as part of the servicing package.

- *Global logistics trends* are also relevant to the Central Okanagan. Several capacity constraints and opportunities are of relevance to the Central Okanagan region, including the trend towards use of longer and heavier vehicles (such as long-combination vehicles), and congestion, limited industrial land supply and marine terminal capacity expansion needs at the Port of Vancouver (which impacts where goods bound to the region are sourced from). The repatriation of the supply chain (e.g., "nearshoring"), automation in manufacturing (e.g., 3D printing), and changes in last-kilometre delivery (especially by couriers) and the distribution networks that are needed to meet e-commerce purchases are also shaping how goods are produced, distributed, and delivered to businesses and consumers.
- New *technologies* and *operational practices* are emerging. Some of these are more distant and/or more difficult to influence at a regional level (e.g., connected and autonomous vehicles, uncrewed aerial and ground vehicles). However, others, such as operational and safety practices like ITS-based intersection control, and electronic logging devices to record hours-of-service, are already emerging in the short-term and/or can be influenced at the regional level.
- *Alternative fuel vehicles* are aimed at decarbonizing goods movement. Several technologies are being matured, including hybrid-electric, electric, hydrogen fuel cell, and natural gas vehicles. BC's transition to zero-emission vehicles attracted considerable attention from stakeholders, who are on board with the transition but expressed concerns about how it would work. The current lack of available vehicles and the need to plan now to ensure an adequate charging/refuelling network were front-of-mind (meaning authorities should be working now with utilities to ensure an adequate power supply).

Figure 3-1: Tesla electric semi tractor

Source: Steve Jurvetson/Wikipedia/CC BY 2.0

3.2 Transition to a sustainable future for goods movement

3.2.2 Sustainable goods movement practices

The analysis reviewed several best practices associated with sustainable urban goods movement (further described in ***Appendix F: Best practice review of sustainable urban goods movement***). The discussion covered policies to increase the uptake of alternative fuel vehicles, the deployment of cargo bicycles, strategies to increase the efficiency of last-kilometre deliveries, curbside management, Complete Streets, and logistics and land use. To summarize:

- Strategies to encourage uptake of alternative fuel vehicles, including low and zero-emission vehicles, include not only financial incentives, but also policies that provide for preferential access to low or zero-emission vehicles (e.g., to certain areas, loading zones or vehicle lanes).
- A number of strategies can be used to increase efficiency in last-kilometre deliveries, including pick-up points (Figure 3-2), load utilization, load efficiency/management, and local delivery plans. These are predominantly private sector led, though the public sector can facilitate or encourage by planning for central locations in neighbourhoods or requiring new condos to have sufficient lockers to accommodate online purchases. It is often more financially feasible for the private sector to use some of these practices (e.g., installing a pick-up point) versus adding an additional step in the logistics process (e.g., through additional microhubs).

Figure 3-2: Pick up point

Source: CPCS

- Cargo bicycles are used in cities around the world. High delivery densities are seen as the first factor for a successful commercial application – hence the preponderance of applications in dense city centres. Complementary success factors include regulations (e.g., in which bicycles are permitted access to existing loading areas or to areas that are not available to vehicles, such as pedestrian zones) and pricing incentives such as the avoidance of a parking fee (Figure 3-3).
- Complete Streets promotes corridor designs and operations that provide a safe and attractive environment for all travellers, especially vulnerable road users. Often, they do not consider the need for goods movement, or goods movement is considered as an afterthought. Several strategies to address this concern are identified, but it must be emphasized that the objective of this discussion is not to give priority to trucks on Complete Streets. Rather, the objective is to ensure that goods can still be moved and unloaded in Complete Streets schemes. Accommodating goods movement does not necessarily mean designing infrastructure to primarily benefit trucks.

Figure 3-3: Cargo bike delivery

Source: CPCS

- Urban consolidation centres (UCCs) and microhubs are ways to consolidate shipments. UCCs are commonly located at the periphery of the core and are used as transshipment points where packages can be delivered by small low/zero-emission vehicles for final delivery. However, UCCs require the availability of a convenient parcel of land, which commonly must be supplied by the municipality to make the entity financially attractive to shippers and carriers. Microhubs are small consolidation facilities that supplement large UCCs, and potentially offer the advantage of being mobile (hence land requirements can potentially be avoided).

3.2.3 Considerations for implementation

The discussion draws from best practices in Canada, the United States and Europe. In addition to describing the practices, the discussion considers how the practices could be applied in the Central Okanagan region. To this end, it describes authorities' experiences elsewhere in implementing the

practice, noting success factors, the role of public authorities and situations in which a given practice is best suited.

The practices define a spectrum of measures and policies. No one practice can address all needs. A pervasive underlying theme is that implementation is best achieved through a collaborative, step-by-step approach. A 2020 guide notes that the process is complex, involving many stakeholders, and several steps are needed to achieve buy-in and approvals. The guide refers specifically to the introduction of zero-emission zones but is relevant to the broader array of measures to transition to a more sustainable future for urban goods movement:[30]

- Build trust with stakeholders throughout the broad freight community – "understanding the needs, challenges and interests of the various sub-communities is key to enabling collaboration and devising effective rules and incentives."
- Clarify local and provincial objectives and regulatory powers. Related objectives can include meeting decarbonization targets, reducing pollutants to improve equity and health for disadvantaged communities, lowering congestion and improving efficiency, creating green spaces, developing more livable neighbourhoods, and stimulating the demand for zero-emission vehicles. However, some cities may have limited regulatory powers and may have to work with other levels of government to achieve these objectives.
- Set an ambitious but realistic target and timeline. The timeline should be ambitious, but progressive and realistic to set planning in motion and gain the interest of stakeholders.
- Develop an implementation strategy. These are not 'one-size-fits-all' measures. Rather, they should be seen as a "new way of seeing freight as a system." This can mean combinations of ways to reduce truck trips through improved efficiency, rethinking how goods are transported, choosing the most appropriate mode, and incentives to ensuring that these modes are zero emission. The strategy could also be phased.
- Test and pilot your desired interventions. Pilot tests allow stakeholders to define new collaboration schemes, test procedures and vehicles, and measure initial impacts (positive and otherwise). They can help build stakeholder confidence to invest in solutions and help companies make informed decisions about costs and savings.
- Implement, monitor, fine-tune and embrace. As implementation, monitoring (data collection and information exchange) and enforcement take place, the development of key performance indicators, sharing of information, data on compliance and uptake, and continued stakeholder consultation will help move the initiative forward.

Finally, the guide notes several keys to success, noting that there is a "large ecosystem of regulations, financial incentives, infrastructure investments and other urban, regional, national and international plans and strategies" within which local sustainability initiatives exist. As a result, "factors both within and beyond city limits can significantly influence the success" of any planned initiative. The keys to success are:

- Align policies across different levels of government
- Create incentives and other supporting measures
- Develop supporting infrastructure (e.g., a charging/refuelling network for EVs and natural gas vehicles)
- Obtain the necessary data (evidence-based approach)

[30] *Zero-Emission Zones, Don't Wait to Start With Freight!, How-to-Guide*, Transport Decarbonisation Alliance, C40 Cities and Polis, The Netherlands, December 2020.

4 Problem statement: goods movement challenges

Summary

- This chapter develops a Problem Statement, which is intended to concisely synthesize current and future goods movement challenges and provide the basis for the recommendations.
- Based on the objectives of the COGMS, the issues from stakeholder engagement and our analysis, we have developed a Problem Statement comprised of six interrelated Problems:
  - Problem A: Highway 97 is congested in the Central Okanagan and there are few alternatives for goods movement
  - Problem B: Resiliency challenges on transportation corridors to/from the Central Okanagan threaten community resupply and market access
  - Problem C: Constrained supply of industrial land coupled with access limitations could inhibit economic growth
  - Problem D: Increasing delivery and pickup challenges in urban areas
  - Problem E: Meeting provincial greenhouse emission-reduction targets requires quickly decarbonizing goods movement and addressing challenges
  - Problem F: Need for collaboration and information to address goods movement challenges

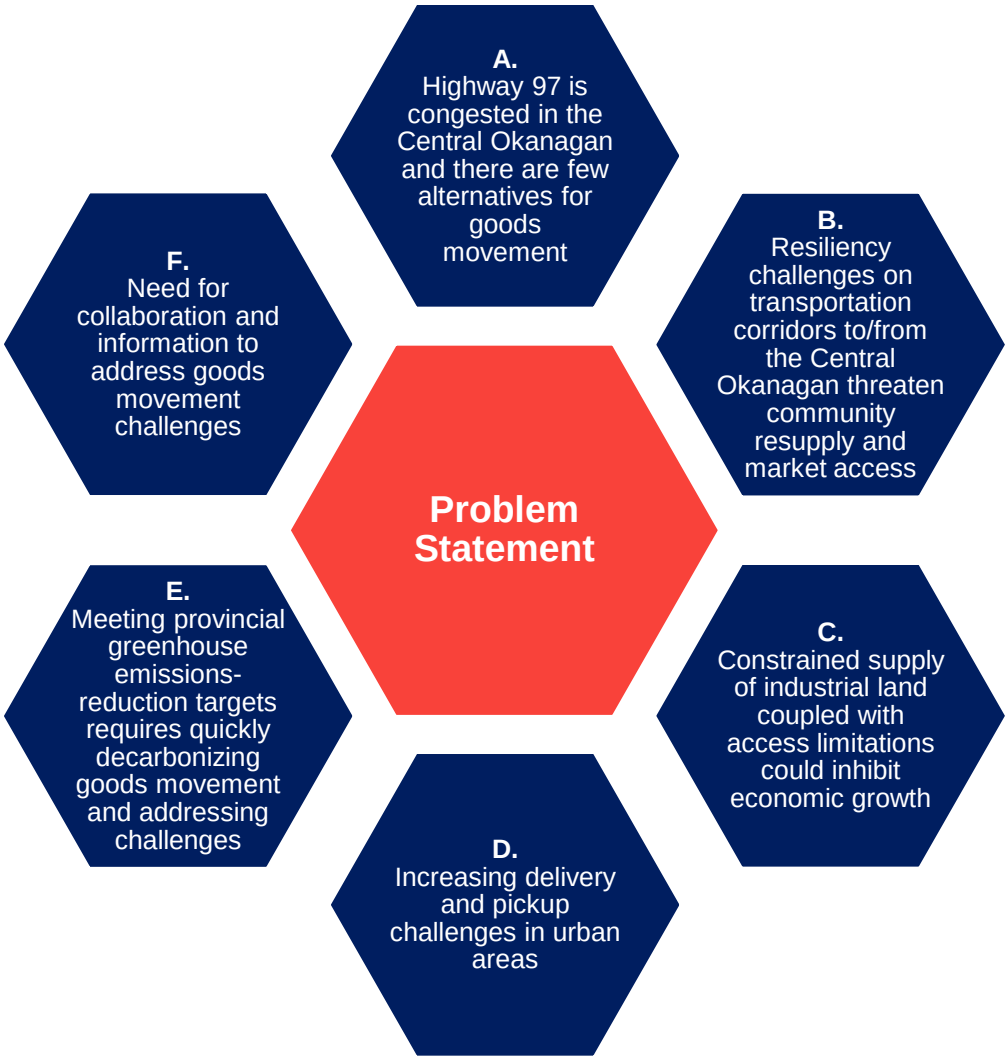
4.1 The Problem Statement

Based on the objectives of the COGMS, the issues from stakeholder engagement (See ***Appendix B: Themes from engagement***) and our analysis, we have developed a Problem Statement comprised of six Problems (Figure 4-1).

Problems are challenges that are impacting or could impact goods movement. However, they also present opportunities and were used to develop the strategies, actions and recommendations.

Many of the problems may be driven by similar trends and are interrelated. For example, the Central Okanagan is an attractive place to live and has experienced rapid population growth. Looking ahead, the population of the Central Okanagan region is forecasted to increase by 36% between 2021 and 2040, and significant growth has already occurred. This trend could lead to increased congestion (Problem A), provide additional constraints on the availability of industrial land (Problem C), and increase challenges with deliveries and pickups (Problem D). Problem A is also related to Problem C as the development of industrial land for goods movement also depends on effective access to Highway 97. Accordingly, while the problems are lettered for ease of reference, the lettering does not correspond to any order of importance.

Figure 4-1: Problem Statement



Problem definition

For each of the six Problems we:

- Describe its **importance**
- Discuss individual **challenges**, grouped into areas of focus

Each problem is described further below.

4.2 Problem A: Highway 97 is congested in the Central Okanagan and there are few alternatives for goods movement

Importance

Producers in the Central Okanagan rely on the ability to quickly and reliably get their goods to market to remain competitive in the markets they serve. Residents and businesses in the Central Okanagan receive the products they use on a daily basis primarily out of distribution centres in the Lower Mainland and Alberta. Congestion can result in longer travel times and contribute to higher transportation costs, as more trucks and drivers are required to serve the same volume of goods. Poor reliability can add costs, such as additional warehousing charges from missed connections, inefficient plant use, product spoilage, etc. This is particularly the case for high-value or perishable products produced in the Central Okanagan that need to make intermodal connections with air, including air-based courier services. Businesses, such a retailers, that bring goods into the Central Okanagan are also impacted by reliability.

Congestion on Highway 97 also impacts truck trips that are internal to the region (the majority of truck trips - 84% - are trips with an origin and destination in the region). For example, an internal trip includes a courier vehicle making a pick-up in downtown Kelowna and delivering a package to a courier depot near the airport. Congestion would impact the cutoff window that a courier must apply to meet connecting flights.[31] There are also internal trips, such as waste pick-ups from businesses and residences or even food delivery, that are also impacted by congestion. In short, congestion in the region can impact all types of trips.

Trucks are also contributing to congestion, though there are currently no alternatives to using trucks to bring goods to the Central Okanagan at scale.

Challenges

a. Congestion along Highway 97

Highway 97 is the primary goods movement corridor in the Central Okanagan, **which is congested. Travel times can be lengthy and variable due to recurring and non-recurring congestion,**[32] particularly through Kelowna, impacting goods movement vehicles. In addition, most goods generating businesses and transportation and logistics sector businesses are also located along or near the Highway 97 corridor (Figure 4-2). Weighted by jobs, approximately 70% of the businesses in four important sectors to the Central Okanagan (agriculture/food processing, forestry products, other manufacturing, and wholesale and retail trade) fall within 1 km of Highway 97.

Weighted by jobs, approximately 70% of the businesses in agriculture/food processing (agri-food), forestry products, other manufacturing, and wholesale and retail trade fall within 1 km of Highway 97. Using a similar approach, about 87% of transportation and warehousing businesses are within 1 km of Highway 97.

[31] In other words, in this analysis, internal corresponds to the vehicle trip, not the overall supply chain associated with the good being transported.

[32] Recurring congestion is the congestion that is generated from daily fluctuations in travel volume, such as the peak commuting periods. Non-recurring congestion refers to the congestion generated from irregular events such as crashes.

An even greater fraction of transportation and warehousing businesses are concentrated along the Highway 97 corridor. Weighted by jobs, about 87% of transportation and warehousing businesses are within 1 km of Highway 97.[33]

This further emphasizes the importance of the corridor for goods movement pick-ups and deliveries.

Multiple stakeholders noted that the worst congestion in the Central Okanagan is not on the WR Bennett Bridge, but on approaches on either side of Lake Okanagan. Our analysis of travel time variability along Highway 97 corroborates this feedback (Figure 4-3). From visual examination, the longest cluster of fair and poor measures of the Truck Travel Time Reliability (TTTR) index occurs east of the WR Bennett Bridge to McCurdy Road.

We estimate the average delay for a truck travelling along Highway 97 between the WR Bennett Bridge and McCurdy Road was between 1.5-4.3 minutes per truck in October 2021. About 1 out of 20 truck trips were delayed by an additional 6.9-9.9 minutes above average travel times due to travel time variability on the corridor.

Congestion on this corridor impacts all trip types (internal, to/from the Central Okanagan, and through trips):

- There is a concentration of goods-generating businesses and transportation and logistics facilities between the WR Bennett Bridge and McCurdy Road (see Figure 2-14, page 23; and Figure 4-2, page 41). In addition, there is a concentration of internal trip ends in the commercial and industrial areas between the WR Bennett Bridge and McCurdy Road (see Figure 2-4, page 12). Accordingly, a large fraction (84%) of internal trips occur to, from and through the most congested part of the Central Okanagan on a daily basis. Other internal trips, such as those travelling the Gateway area to the Westside, will also travel through at least part of this corridor.
- Many of the 15% of truck trips travelling either to or from the region are destined for distribution centres and connecting marine, rail and air modes in the Lower Mainland or Alberta, and must travel through the most congested part of the Highway 97 to reach the commercial and industrial areas noted in the previous bullet.
- The estimated 1-2% of truck trips that pass through the region also travel trough the congested part of Highway 97, WR Bennett Bridge to McCurdy Road.

We examine congestion along the Highway 97 corridor between WR Bennett Bridge to McCurdy Road to illustrate the scale of congestion experienced and its impact on goods movement.

We estimate the *average* delay[34] for a truck travelling along Highway 97 between the WR Bennett Bridge and McCurdy Road was between 1.5 and 4.3 minutes per truck in October

[33] A limitation with this analysis is that not all businesses in the sample report employment. However, we have not reason to suspect a bias associated with the location of the businesses.

[34] Delay is measured as the difference in average travel time experienced during the day (7:00 AM to 6:00 PM) and overnight. The overnight travel speed was factored by 90% to account for the potential of travel speeds being influenced by speeding vehicles, consistent with previous CPCS practice on similar studies. (The truck GPS data do not allow for the removal of individual vehicles from the estimate of travel speed, so it is not possible to cap speeds at the speed limit from individual vehicles when estimating travel times.) October 2021 was selected as it is more representative of an average delay rather than peak delay experienced in the summer.

2021. About 1 in 20 truck trips were delayed by an additional 6.9-9.9 minutes above average travel times due to travel time variability on the corridor.[35]

We estimate that this delay and travel time variability is equivalent to between $1.5 million per year (without including travel time variability impacts) and $10.2 million per year (with an estimate of the value of this variability to goods movement).[36] (See ***Appendix H: Monetization of delay methodology*** for calculation details.) More than 75% of the value of this congestion is estimated to occur during the midday (9:00 AM to 3:00 PM). At 6% discount, the capitalized value is approximately $19-120 million over 25 years.[37]

While congestion has a real cost for the economy, many potential infrastructure expansion solutions are also expensive. (For example, a single interchange can cost $50-$60 million, and the WR Bennett Bridge cost $144 million in 2008.) As always, it will be important to ensure a business case for any major infrastructure solutions that are advanced.

The value of the travel time variability is significant, because it reflects factors including the additional planning time shippers and carriers need to consider in planning their shipments (i.e., to meet delivery schedules, shippers and trucking companies often cannot plan for a trip taking the average travel time),[38] as well as the implications of a late arrival at origin or destination (e.g., a plant shut down because of a stock out, or missing a connecting train or flight and requiring additional storage fees). However, it is important to note that the impacts can be supply chain or even operator specific.

Further, this analysis indicates that the majority of the economic cost of congestion is due to the lack of predictability rather than the average travel time delays experienced. This means that working to make travel times more predictable and reliable will have the most economic benefit compared to simply working to speed up traffic.

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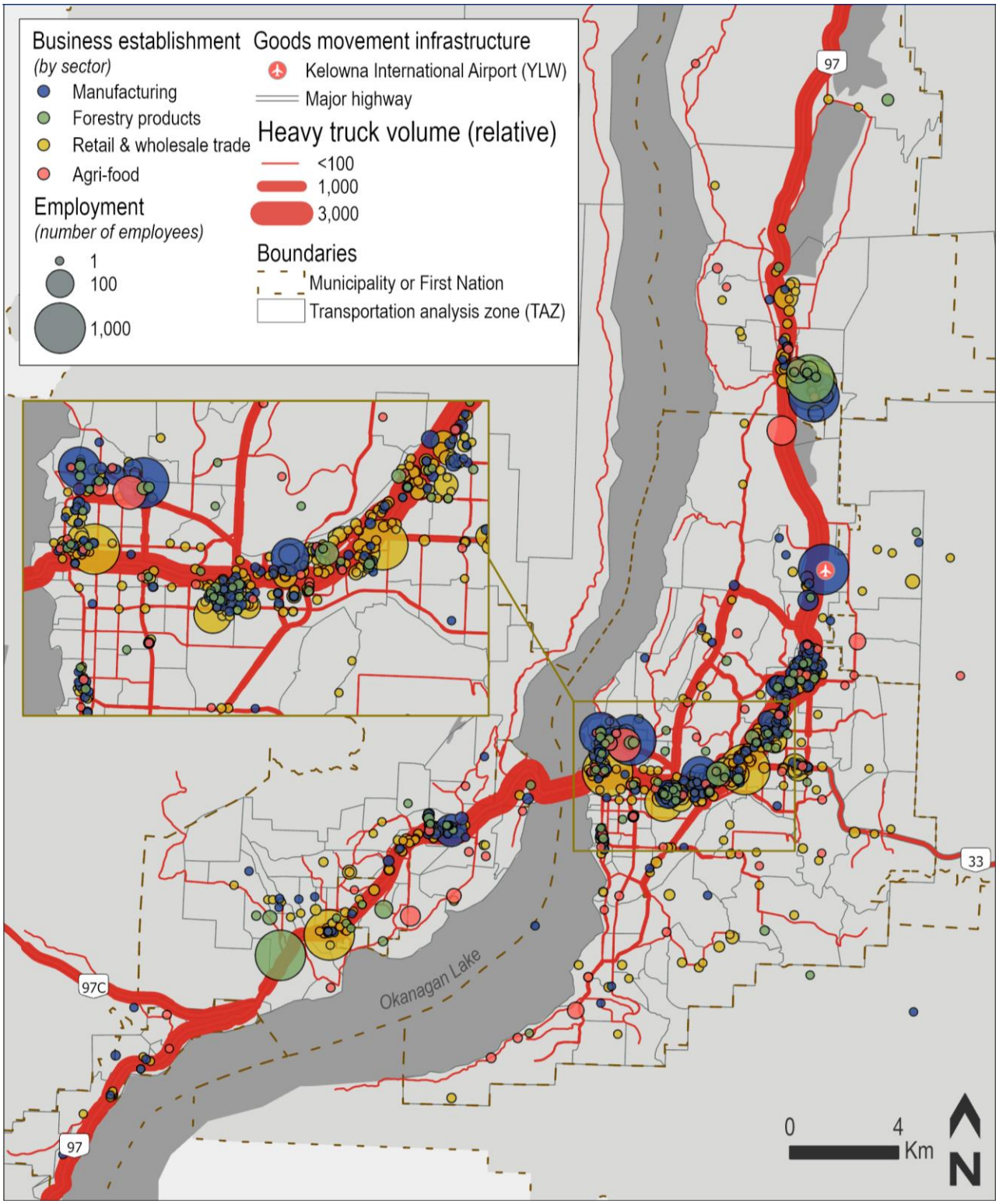
[35] This is measured as the difference between the 95th percentile travel time and the average travel time over the corridor during the given time period. The 95th percentile travel time, which was between 20-27 minutes depending on the time of day, means that about one out of 20 trips take longer than this time to complete. As an analogy to passenger travel, it means that if someone commutes to the office five days a week and plans for the 95th percentile travel time, on average about one day per month they will be late.

[36] See Appendix H for calculation details.

[37] Conservatively, no traffic volume or delay growth is assumed in this calculation.

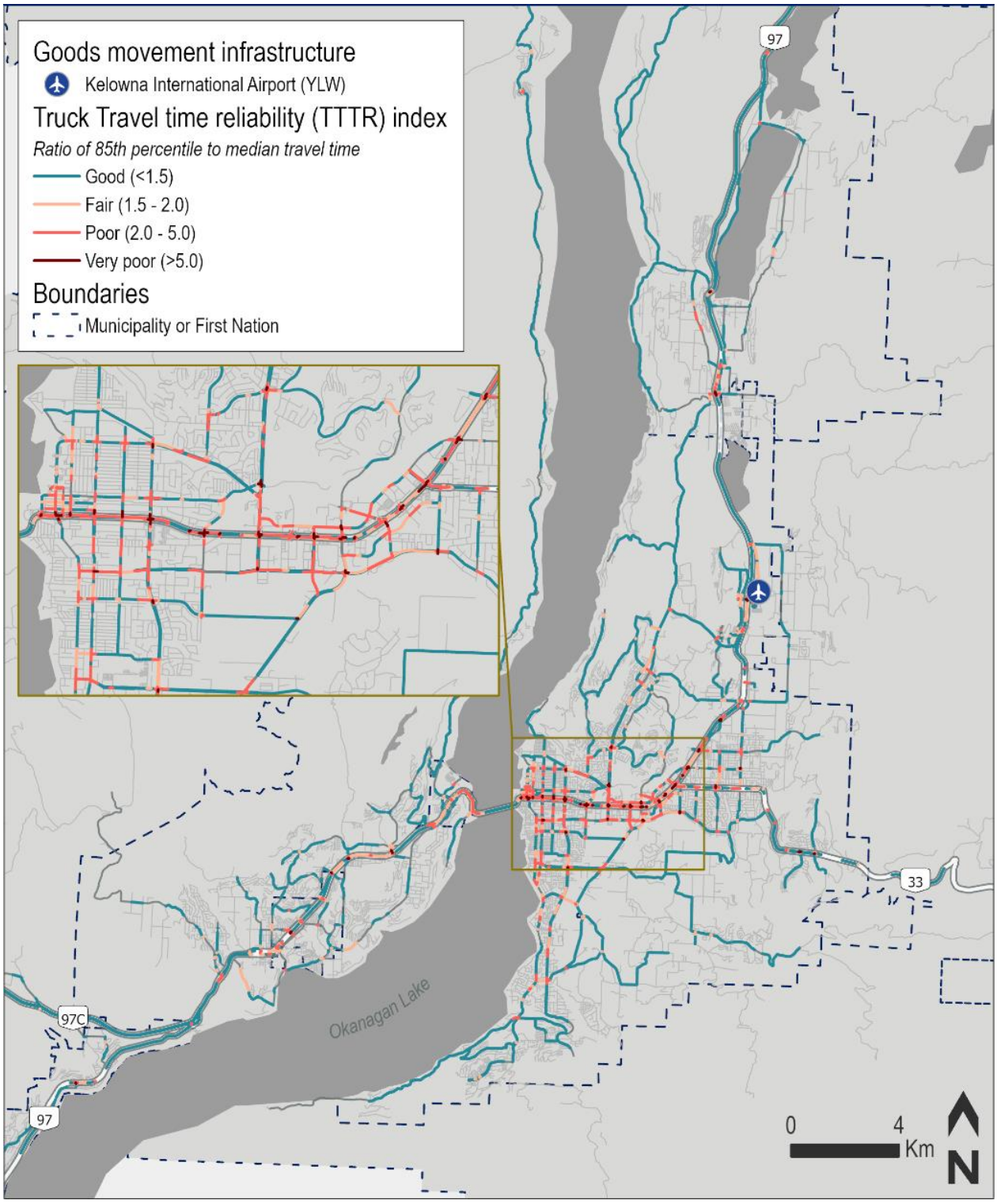
[38] NCHRP Research Report "Estimating the value of truck travel time reliability" cites a study by Hirschman et al. that surveyed shippers and motor carriers on the management of unreliability. This study provided some information on shipper and carrier scheduling practices, including in response to delays. The study found that shippers "most frequently add a buffer time to a shipment's departure schedule." Some shippers (14% of survey respondents) were found to consider delays of as little of one hour to be "unacceptable." Most shippers (74% of respondents) were found to expect a response [from the carrier] to be necessary if a shipment does "does not arrive within 4 hours." (The comment was made in a section on "contingencies and responses," so it is assumed that this should be interpreted as "within 4 hours of the scheduled delivery time.") Most carriers (74% of respondents) also indicated that an operational response was required for delays over 4 hours.
The scheduling practices are industry and location specific. We heard some anecdotes regarding shipper practices in the Central Okanagan. One exporter sending goods to YVR indicated that they typically only had one hour of buffer time for goods to reach YVR by truck. Otherwise, the cargo would miss its flight and have to be rescheduled for a later flight, which requires additional storage fees and carries some reputational risk from customers. One stakeholder mentioned from their experience working in concrete delivery that concrete must be completely poured within four hours of production.

Figure 4-2: Businesses in four goods generating sectors and heavy truck relative volumes



Source: CPCS analysis of Geotab and Scott's data

Figure 4-3: Truck travel time reliability index, 2021



Source: CPCS analysis based on Geotab data

This estimate of congestion costs suggests that there is merit to exploring operational and infrastructure improvements within Kelowna to improve travel times and reliability for goods movement. However, it is not expected nor desirable that all this travel time delay and variability can be addressed. Our estimate of delay used a baseline of 90% of the free-flow speed, which is a clear and easily understood baseline from which to measure delay. In practice, in any thriving economic area, there are competing objectives, including the desire to get the most throughput out of a corridor as well as to ensure access to businesses. In theory, there is a speed associated with maximum throughput, which is generally lower than the free flow-based speed used in this analysis; however, it is not practical to objectively determine this baseline maximum throughput speed on a complex arterial such as Highway 97 through Kelowna. Nonetheless, the estimate of congestion provides an indication of the approximate scale of the impact of congestion on goods movement.

Highway 97 is also the primary corridor in the region for people movement. There is an existing high occupancy vehicle lane adjacent to the curb along Highway 97 through Kelowna, which is the preferred lane for delivery vehicles to enter/exit. In addition, there is interest in developing higher capacity transit in a dedicated lane, which could help address congestion by reducing single-occupancy vehicles and increasing the people-moving capacity of the corridor. However, future analysis would need to consider operational parameters, including truck movements, to ensure potential conflicts are avoided. Effective use of road space for all modes is a consideration.

There are no continuous parallel routes through the region as alternatives to Highway 97. Stakeholders suggested the development of alternative corridors/bypasses/parallel routes, though acknowledged there are physical constraints (namely Lake Okanagan but also the 'hourglass' between Dilworth Mountain and the agricultural land reserve) that limit the feasibility of such alternatives. Additionally, most goods movement trips are in, out and within the region, particularly along Highway 97, so any route would need to consider access to commercial and industrial areas to be effective.

Key findings and implications from truck travel pattern and congestion analysis

- The bottleneck analyzed was along Highway 97 between the WR Bennett Bridge and McCurdy Road, in both directions. Multiple stakeholders noted that the worst congestion in the Central Okanagan is not on the WR Bennett Bridge, but on approaches on either side of Lake Okanagan. Our analysis of travel time variability along Highway 97 corroborates this feedback.
- The estimate of congestion cost is the **total** value of delay and travel time variability associated with goods-movement vehicles. The actual reduction in delay and improvement in reliability that could be achieved through infrastructure and other solutions will be lower than this delay estimate.
- Goods movement vehicles also require access to commercial and industrial areas along Highway 97, as the area along Highway 97 through Kelowna includes several goods movement clusters.
- This analysis points to the need to improve the Highway 97 corridor and parallel road network *within* Kelowna in a fashion that maintains connectivity with industrial areas. Highway 97 will remain an important goods movement corridor as well.

b. Challenges with access to commercial, industrial and agricultural areas

To serve the region efficiently, trucks with 53' trailers and long-combination vehicles (LCVs) need to be able to enter/exit commercial and industrial areas along Highway 97 safely and efficiently. Several of these intersections are not currently identified on the Kelowna truck route network, which does not preclude trucks from using these routes, but is a missed opportunity to have a tool to improve the efficiency and manage conflicts.

Some commercial and industrial areas have access challenges such as circuity and grades. These areas include the Kelowna North End Neighbourhood and Jim Bailey Industrial Park. Alternate accesses to these areas could improve the flow of goods but could create conflicts with non-compatible residential land use.[39]

Agricultural areas are widely dispersed throughout the region. Heavy farm vehicles are required to operate on a wide range of low-density routes and following harvest, products need to be quickly consolidated at receiving/processing facilities without damage.

4.3 Problem B: Resiliency challenges on transportation corridors to/from the Central Okanagan threaten community resupply and market access

Importance

Residents and businesses in the Central Okanagan receive the products they use on a daily basis primarily out of distribution centres in the Lower Mainland and Alberta. Producers in the Central Okanagan likewise require access to seaports, airports and rail transload facilities in these geographic areas, as well as to eastern Washington State, to export their products to customers.

Though there is air service to the Central Okanagan, there is no rail service to/from the region as an alternative to truck transport. The Central Okanagan relies on a few highway corridors and therefore the resiliency (the capacity of a system to maintain performance when stressed) of the provincial highway network is crucial for ensuring community resupply and market access.

Challenges

a. Enhancing the resiliency of highway routes to/from the Central Okanagan

There are four primary highway routes between the Lower Mainland, Alberta, and the Central Okanagan (Highways 1/97, 5/97C, 3/97 and 3/33). Stakeholders noted that access to the region has already significantly improved with the development of Highway 97C, which generally functions well along with Highway 5. However, congestion can occur and delay traffic in the Lower Mainland, and accesses to/from the region can be disrupted by recurring short-duration seasonal closures (e.g., from snow, flooding, wildfires, etc.).[40] Stakeholders noted that there was not enough (or would like to see more) winter road maintenance on corridors to/from the Central Okanagan, with Highway 97C particularly noted. Stakeholders also mentioned that they would prefer to travel by Highway 5

[39] Access to the North End Neighbourhood from Highway 97 for heavy trucks is governed by designating Gordon Drive a truck route. This is intended to limit trucks from passing through Downtown Kelowna to the North End. However, it increases the travel distance and time for trucks arriving from the west and travelling to the North End, particularly locations further west. Stakeholders also expressed concerns over the length and road quality of the eastbound to northbound turning bay on Highway 97 at Gordon Drive.

[40] These outages are disruptive, but some stakeholders noted that they are generally expected and manageable (relative to the longer duration outage).

to Edmonton rather than Highway 1, due to the steeper grades (burning more fuel) and subject to more closures in winter (despite being a shorter route).

The multi-week outage of all three primary corridors between the Lower Mainland and Central Okanagan in autumn 2021 showed the potential for all three routes to be simultaneously impacted and was a serious threat to the ability to resupply the region. For instance, one company rationed its truck capacity to most important facilities (long-term care facilities). There was a momentous effort by public- and private-sector stakeholders to maintain service and recover. However, during the outages, rerouting cargo through the US was not a viable alternative for many carriers[41] and Highway 3 was perceived as less safe (though stakeholders did appreciate that traffic was restricted to essential travel only). There are limited options to develop new infrastructure alternatives. Thus, a challenge is whether the existing corridors to/from the Central Okanagan (and the supply chains that rely on them) can withstand and recover when stressed under similar circumstances.

An issue in defining this problem is that there is no universal definition of supply chain resiliency or meaningful quantifiable metrics (i.e., satisfactory resilience is difficult to define). Metrics are important to enable potential measures, such as continuing to adapt infrastructure to climate change, developing contingency plans,[42] etc., to be prioritized and implemented by public and private sector stakeholders. However, MOTI is at the forefront of quantifying aspects of this issue, including adapting transportation infrastructure to climate change.[43]

b. Attracting truck drivers to serve the Central Okanagan is not easy in an industry with short supply and on a challenging corridor

Several stakeholders noted that the trucking rates paid by shippers has increased 3-4 times since the beginning of COVID on routes to/from the Central Okanagan. While it is beyond the scope of this study to examine all the factors contributing to this issue (and this is a national issue) several Central Okanagan stakeholders noted drivers, especially long-haul drivers, are in short supply and a contributing issue.

Stakeholders noted that it can be challenging to attract drivers to provide service to/from the Central Okanagan, in part because it is a challenging corridor to drive. Stakeholders would like to see improved rest stops, including washrooms to facilitate people of all genders joining the industry, and improved winter maintenance on highway corridors to/from the Central Okanagan. This is also increasingly important in the context of drivers meeting hours of service restrictions to have safe locations to rest.

Some stakeholders expressed that a mandatory brake check along Highway 33 near Joe Rich was not safe.

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[41] Under normal circumstances, there are flows of goods between the Central Okanagan and the US, particularly via Highway 97 and the Lower Mainland. This challenge relates to truck carriers and shipments that would not otherwise have flowed through the US.

[42] One private sector stakeholder noted that they did not originally have a contingency plan for serving the Central Okanagan out of distribution centres in Alberta when the flooding occurred.

[43] BC MOTI. Adapting Transportation Infrastructure to Climate Change. https://www2.gov.bc.ca/gov/content/transportation/transportation-environment/climate-action/adaptation

c. Broadening intermodal connectivity with air

The Kelowna International Airport (YLW) is a strategic goods movement asset for the Central Okanagan. YLW facilitates market access for producers and importers of high-value goods, including via air courier services. The inherent high value of some goods, many of which have rapid replenishment cycles, coupled with the perishability of the fruits that are a key regional economic contributor, make the need for quick connections to far-afield markets critical. In addition, air remains the only alternative to truck in the event of a highway outage to resupply the region.

There is interest in further developing air cargo and logistics uses around the airport, but this requires improved ground access. Other challenges include limited international passenger flights with belly cargo and relatively small cargo volumes to justify an air freighter stop; consolidating cargo volumes in Kelowna would likely be required. Climate change can also impact airport infrastructure and air service, including reducing payloads in a warming region.[44]

4.4 Problem C: Constrained supply of industrial land coupled with access limitations could inhibit economic growth

Importance

Industrial land supply allows for economic growth by allowing for the development of new businesses and industries. The Central Okanagan Economic Development Commission has identified "key industries," including agriculture, viticulture, aerospace/manufacturing, and retail trade, which require efficient goods movement to be competitive and attract investments. In addition, the cost of acquiring and developing land and attracting a skilled labour force (which is influenced by transportation access to the facility) all contribute to the attractiveness of a site for development.

Challenges

a. Improved goods movement access is needed to facilitate industrial land development

There is relatively limited supply of industrial land in the Central Okanagan and those lands have access challenges. As noted in Section 2.1.3, planning documents acknowledge that land for industrial activity is constrained. Some growth in zoned industrial area is expected to occur in the Gateway (including YLW, not shown) and Jim Bailey/Glenmore areas (Figure 4-4). However, existing developments and the agricultural land reserve (shown) surround many of these industrial areas, restricting potential for further growth.

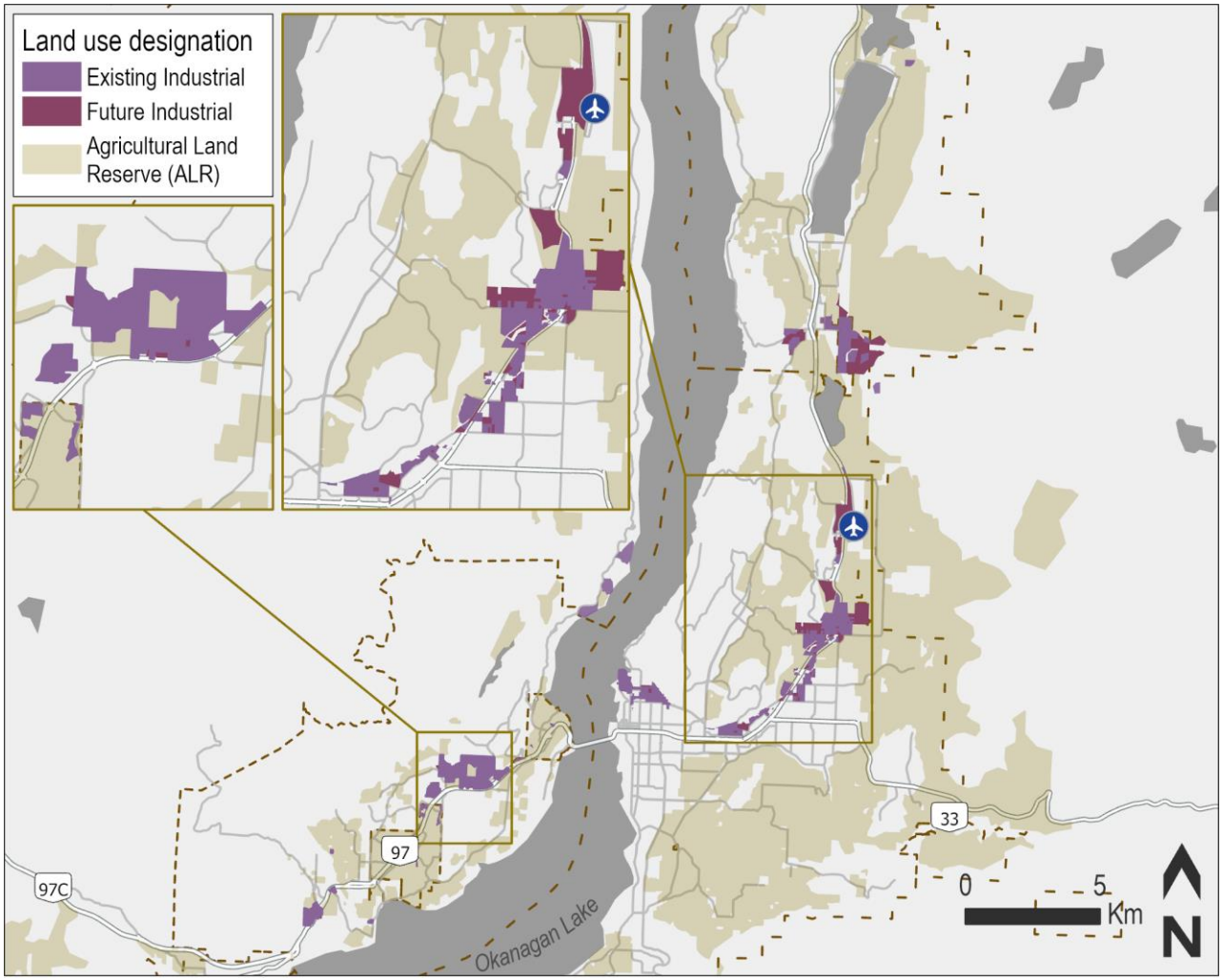
Maintaining, expanding and developing new industrial areas will require improved access on/off Highway 97, notably in the Kelowna North End Neighbourhood, Gateway and Jim Bailey/Glenmore areas. However, as noted in Problem A, enhancing accesses in these areas can create conflicts, and also requires significant investments.

However, one stakeholder also put some bounds around this problem, noting the need to be realistic about the types of industries that the Central Okanagan region can attract. For

[44] Increased air temperature reduces the lift that aircraft wings can generate. For a given length of runway and aircraft, the amount of payload that an aircraft can be lower as temperatures increase. International Civil Aviation Organization. 2020. Effects of Climate Change on Aviation Business and Economics. https://www.icao.int/environmental-protection/Documents/Factsheet%20Business%20and%20Economics%20Final.pdf

example, they noted that they will get inquiries looking for a 200-acre parcel, which is unlikely to be realistically served.

Figure 4-4: Existing and future land designated for industrial use



Source: CPCS analysis of GIS-files of OCPs/CCPs: City of Kelowna bylaw No: 8000, City of West Kelowna zoning bylaw 0154, District of Lake Country zoning bylaw 561, District of Peachland zoning bylaw 2100, RDCO land use bylaw 871, RDCO land use bylaw 1195 (Joe Rich rural land use bylaw), Westbank First Nation land use law

b. Use of industrial lands must be optimized to support an evolving economy, drawing lessons from the Lower Mainland's experience

There are potentially other lessons learned from the Lower Mainland's experience as well to ensure the supply of industrial land, namely the need to anticipate future growth in established industries like agriculture, distribution, retail, and shipping while also providing space for the emerging innovation economy (high-tech, culture, design, communications, etc.). Ensuring the ability of workers to access jobs in the transportation and logistics sector is a related consideration, but providing fixed route transit is challenging due to shift work.

c. Preservation of lands surrounding the Kelowna International Airport (YLW) is needed to support future logistics growth

A future logistics hub can facilitate economic growth and enable market reach. The demand for distribution centres and complementary activities[45] has not yet reached a critical point in the Central Okanagan. Nonetheless, future population growth in the region coupled with broadening e-commerce purchasing, densification and expansion of mixed-use developments, and other emerging logistical trends all mean that adequate, properly accessed lands must be preserved to allow the development of a focused cluster of activities, especially near YLW to take advantage of air connections.

Additionally, preserving industrial land near residential and commercial areas (e.g., the North End Neighbourhood) can ensure there are lands available to sustain servicing adjacent areas, as well as provide employment locations for existing and emerging industries. However, the types of industrial uses allowed need not be the same as those required in other areas, given that the needs would likely differ (e.g., the catchment area for a distribution facility may only be the downtown area) and would need to be compatible with the surrounding land use (e.g., heavy industrial would not be acceptable). Planning to relocate all industrial activity to the Gateway Area would likely increase goods movement challenges in servicing core parts of Kelowna, as well as require the labour force to commute to the area, potentially increasing congestion (absent modal alternatives such as frequent transit).

4.5 Problem D: Increasing delivery and pickup challenges in urban areas

Importance

Given the population growth that is expected in the Central Okanagan, areas of the region are expected to densify with mixed-use developments: while densification can improve the efficiency of deliveries, it can also increase challenges for couriers and other goods movement in finding and accessing legal loading/unloading zones. Some of these challenges already exist in the Central Okanagan. In addition, increased mixed-use development also creates the potential for conflicts (e.g., due to noise from loading zones). The Regional Transportation Plan identifies “quality of life – minimizes noise, visual and community effects while supporting community cohesion” as one of its goals.[46]

Challenges

a. Challenges in first/last-kilometre delivery

In the context of a densifying region, **goods movement stakeholders identified the following challenges making pick-ups and deliveries in the Central Okanagan:**

- Challenges of delivering to addresses located on Harvey Avenue (Highway 97) and entering/exiting the highway via the HOV lane by couriers, given the frequent entries/exits they must make during deliveries.[47]
- Inadequate site design to allow goods movement service in commercial and industrial strip mall-style developments (i.e., issues with off-street courier and other deliveries). Some stakeholders

[45] For example, it is also worth noting that anecdotally some deconsolidation activity (e.g., splitting up trucks with multiple trailers coming from the Lower Mainland) does occur on the Westside, though further industrial land growth appears constrained by terrain and the agricultural land reserve.
[46] HDR for the Sustainable Transportation Partnership of the Central Okanagan (STPCO). 2020. Final Report Regional Transportation Plan. https://www.smarttrips.ca/sites/files/6/docs/related/kelowna_regionaltransportationplan_122120.pdf
[47] They also noted that they perceived the centre lane to be slower than surrounding lanes.

acknowledged that this was likely a result of development pressures to utilize most of the available land for buildings, but also noted that a modest change (such as reversing the direction of a loading zone or shortening a building very slightly) would have been enough to provide more fluid access.

- Limited on-street loading zones in downtown Kelowna (i.e., issues with curbside management)
- Multiple stakeholders mentioned that new residential streets and alleys were very narrow and sometimes do not allow flow through without reversing (e.g., cul-de-sacs), increasing the time spent making deliveries or pick-ups. Sightlines can also be limited when exiting alleyways.
- Limited courier access to some new (gated) residential developments, which means that delivery vehicles must park on the street.
- Some stakeholders noted that off-street loading was not always adequate, forcing them to load / unload on the street.

b. Potential challenges in maintaining safety of all road users, especially vulnerable road users (VRUs) such as people biking and walking

Active transportation infrastructure contributes to quality of life, and can help address congestion and decarbonization through mode shift. The Kelowna Census Metropolitan Area (CMA) has a higher active transportation mode share (7.2%) than the national average and other CMAs (6.9%). It is also important to note that this share is higher in core parts of Kelowna (e.g., downtown, Landmark and Pandosy). It is important that this strength can be maintained while ensuring the efficient movement of goods.

Some stakeholders were concerned with the ability of active transportation users to safely cross Highway 97, particularly if it is expanded through Peachland. This concern is not related only to goods movement, though Highway 97 is a primary goods movement corridor and the comments were made in the context of the COGMS.

In addition, there were concerns regarding conflicts between goods movement vehicles and bicyclists throughout the region. Goods movement stakeholders were also concerned about poor sightlines (e.g., coming out of alley due to adjacent buildings, foliage and poles), particularly at locations crossing active transportation infrastructure. There is increasing use of long-combination vehicles to/from the Central Okanagan, as well. There are challenging trade-offs in designing intersections for fluidity of allowing these vehicles to enter/exit Highway 97 while protecting pedestrians and cyclists.

Initial analysis indicates that heavy vehicles are involved in proportionally fewer crashes with cyclists than all vehicle types. Between 2017 and 2021, the Insurance Corporation of BC[48] reported five crashes involving heavy vehicles[49] and cyclists in the Central Okanagan[50] (four in Kelowna and one in Peachland). All of these crashes involved an injury or fatality. These crashes make up 1.2% of all cyclist-involved crashes (417) and 1.5% of cyclist-involved crashes with a casualty[51] (336) over the same period. Heavy trucks (defined by lengths over 12.5 m) made up 2.7% of vehicles crossing the WR Bennett Bridge in 2021.

[48] Analysis based on information licensed under ICBC's Open Data Licence.
[49] Vehicles with a Gross Vehicle Weight (GVW) of more than 10,900 kg.
[50] CPCS selected Kelowna, West Kelowna, Peachland and Lake Country, the available municipalities in the online data portal: https://public.tableau.com/app/profile/icbc/viz/PublicDataset-ICBCReportedCrashesCyclists/ICBCReportedCrashes-Cyclists
[51] Including an injury or fatality

However, this analysis was not intended to be comprehensive, and further assessment is appropriate. Continued management of existing and future goods movement-active transportation infrastructure conflicts is required to ensure efficient goods movement and safety for all road users. Further discussion of measures to reduce conflicts between trucks and vulnerable road users is included in ***Appendix E – Current and future goods movement travel and technology trends***.

4.6 Problem E: Meeting provincial greenhouse emissions-reduction targets requires quickly decarbonizing goods movement and addressing challenges

Importance

The Province has legislated targets for reducing greenhouse gas emissions to mitigate the impacts of climate change. It has committed to reducing the emissions from transportation by 27-32% (from a 2007 baseline) by 2030 and achieving net zero by 2050.[52]

The CleanBC Roadmap to 2030 sets targets to reduce the energy intensity of goods movement 10% by 2030, 30% by 2040 and 50% by 2050. The CleanBC Roadmap to 2030 identifies five areas of focus relevant to commercial vehicles in achieving these targets: reducing distance travelled; encouraging "mode shifting" to more energy-efficient forms of transport (e.g., marine and rail); accelerating the switch to ZEVs; making commercial transportation more energy efficient; and implementing the BC Hydrogen Strategy. In other words, the Province's objectives and solutions are clear. The challenge is how to implement them.

The challenge for urban goods movement to contribute to decarbonization, particularly in reaching the 2030 target, is even greater, especially given the rapid growth in e-commerce purchases that impose deliveries anytime and anywhere across urban areas. Because urban measures like ZEV delivery trucks and the use of microhubs served by cargo bikes are becoming more pervasive, slower progress in the deployment of decarbonization measures for long-distance transport mean that more reliance could be placed on reducing emissions from urban goods movement to achieve 2030 targets.

Challenges

a. Challenge of decarbonizing goods movement to/from/within the Central Okanagan

There is no alternative lower-carbon intensity ground-based modes serving the Central Okanagan (e.g., rail or marine), so truck service will remain the primary means of goods movement in/out of the region.[53] Accordingly, accelerating the switch to ZEVs and making commercial

[52] Government of BC. Climate action and accountability. https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action

[53] Restoring rail service to the Central Okanagan is an option that could be considered to encourage mode shift, but the market size (relative to the scale needed to justify an intermodal ramp where containers can be transferred between rail and trucks), the circuity of the route (as trucking directly from the Okanagan to the Lower Mainland is shorter than routing through Kamloops by rail) and the potential need to truck containers between intermodal terminals (drayage) in Vancouver or Calgary limit the potential attractiveness and GHG-reduction impact of rail in this region. There is the possibility in the future that some distribution activities could occur from Ashcroft Terminals, which would result in a partial mode shift to rail, but the net impact on GHG for goods movement to/from the Central Okanagan is not known.

transportation more energy efficient will be the primary element of reducing GHG emissions from goods movement to/from/within the Central Okanagan.

Large companies are piloting alternative fuel vehicles to decarbonize their operations, in part to meet environmental, social, and governance objectives. While these pilot tests help prepare the companies, technologies and operations for eventual deployment, supporting measures from government (like recharging networks) may also be needed to enable broad use. Moreover, the costs of pilots may be beyond the capabilities of the many independent operators who typically represent an important proportion of goods movement providers.

There are concerns that small and independent trucking companies, as well as other small-and-medium enterprises that rely on goods movement, will not have the resources to decarbonize, and will not be able to transition to ZEVs, at least without assistance. During consultations, larger corporate entities did indicate that they were piloting new technologies, but this was not the case for smaller and medium enterprises consulted. There are some emerging business models seeking to address the financial concerns with adoption of ZEV's which might be particularly relevant for small- and medium-size firms.[54]

Deploying ZEVs, such as battery electric or fuel-cell trucks will require the deployment of recharging/refuelling/battery-swapping locations by private- and public-sector participants. However, it remains unclear what technology(ies) will be more widely adopted. Further, while public-sector entities could potentially deploy charging infrastructure, a US study found that "none of the interviewed companies expressed interest in public charging."[55] For the widespread adoption, there are also vital but indirect needs related to the power supply of the electrical grid, maintenance and labour force considerations that likely need to be fleshed out, etc.

It is also worth noting that the development of active transportation infrastructure, in addition to supporting mode shift of passengers, can also enable the development of bike cargo services.

b. Challenges in enabling adaptation to or readiness for new technologies

Decarbonizing goods movement will require the widespread deployment of new vehicles, infrastructure and practice, which will also need to be supported by a labour force with additional skills. Financial issues (especially large upfront investments in vehicles and infrastructure, as well as lower utilization due to lower range and reduced cargo-carrying ability) and vehicle availability issues remain challenges to greater adoption, particularly for long-haul trucking.

In addition to decarbonization, a number of other technologies (e.g., connected and autonomous vehicles, drones, digital supply chains, etc.) are being developed and deployed. Though the form and pace of change is uncertain, all of these technologies share the need for ubiquitous and secure communications infrastructure. For some emerging technologies, there will also be a need to ensure that enabling legislation and regulations are in place.

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[54] For 7Gen and Vancouver Community Investment Bank (VCIB) have developed a business model to lease ZEVs to an urban delivery firm as a "turnkey" solution:

> VCIB's $3.2-million loan has paved the way for Vancouver-based Seven Generation Capital (7Gen) to acquire ten electric trucks and the required EV fast chargers that it will then lease to GoBolt, a growth logistics firm that offers secure storage and e-commerce fulfillment to big retailers.

Source: https://vancitycommunityinvestmentbank.ca/electrifying-local-freight-delivery/

[55] Maxner, T; Dalla Chiara, G; and Goodchild, A. 2022. Identifying the challenges to sustainable urban last-mile deliveries: perspectives from public and private stakeholders. *Sustainability*, 2022, 14, 4701.

Some observers assume that trucking and courier fleets will be early adopters of autonomous technologies due to the relatively high costs that only fleet operators could absorb. Some general guidance has been prepared by planning and transportation research organizations. Nonetheless, because the take-up of an autonomous fleet would most likely not be restricted to individual cities, coordinated national and even continental initiatives and guidance is needed.

c. Challenges in enabling innovation

The development of innovative decarbonization technologies and practices often requires significant upfront investments and participation by governments, industry, financiers, researchers, academics and others, resulting in the competition for scarce funds and the need to develop collaborative partnerships that may have objectives that are not fully aligned.

For the private sector, the need to prove the reliability of relatively new emerging technologies, the financial stakes involved in corporate decisions to make necessary changes to their operations, and the need for stakeholder (and public) acceptance to promote new technologies can inhibit the uptake of innovative technologies and practices. The private sector also seeks assurances that new technologies are reliable and available (note the current shortage of electric vehicles), and they also want to understand the implications on operations, resources, and required skill sets– for example, the additional weight of a battery can reduce the payload that an electric vehicle can carry. Additionally, before committing to electrifying its truck fleet, one national retailer spent some effort researching new technologies to see which one(s) would become market dominant – the "VHS versus Betamax" dilemma. In short, the private sector is looking for certainty that they will achieve sufficient financial return on investment in a new technology, including through a clear regulatory environment and supportive policy environment, whereas government will be balancing multiple policy objectives and will often be dealing with limited evidence with which to base their decisions, particularly in the context of new technologies and business models.

4.7 Problem F: Need for collaboration and information to address goods movement challenges

Importance

Efficient goods movement is enabled by a range of public- and private-sector stakeholders. Nearly any opportunity for enhancement will require close collaboration between multiple participants. Collaboration has at least four dimensions; the importance depends on the strategy being deployed:

- Collaboration amongst public sector participants in the region, including municipalities and First Nations (e.g., developing regional truck routes)
- Collaboration with the Province, municipalities and First Nations (e.g., managing the interface between Highway 97 and local roads)
- Public-private sector collaboration (e.g., on the deployment of ZEVs and supporting infrastructure)
- Private sector collaboration (e.g., identification of backhaul opportunities for trucks departing from the region)[56]

[56] Anecdotally, stakeholders indicated that there is more cargo inbound to the Central Okanagan than cargo leaving, meaning that trucks will often depart the region empty.

In addition, as noted by the Transportation Association of Canada's "Understanding Goods Movement in Canada: Trends and Best Practices":

> Despite the significant impact of goods movement on the road system and on the economy, there is a need to raise awareness and understanding of how goods are transported in urban areas and how to best plan for goods movement. There is a widely acknowledged gap in the training and education of urban and transportation planners, engineers, and other professionals on the subject of goods movement.[57]

COGMS helps fill this gap by providing a portrait of goods movement in the Central Okanagan in particular, but further collaboration and information exchange is needed to continue to advance goods movement initiatives.

Finally, deploying many strategies by the public sector will require public input and support. There are also potential roles by individuals to help enhance the efficiency and/or lower the impacts of goods movement (e.g., picking up goods at a drop-off site or asking, when possible, an e-commerce site to consolidate deliveries). However, though the public has much greater awareness of supply chains and goods movement due to COVID-19 and infrastructure outages, there are continued opportunities to promote awareness of goods movement.

Challenges

a. Need for ongoing public- and private-sector cooperation to address goods movement issues

Some public-sector stakeholders noted that intra-regional public-sector collaboration on planning topics has improved over the last 20 years. This study (COGMS) is an example of provincial-municipal collaboration that is specific to goods movement. Addressing goods movement challenges through policy and infrastructure (e.g., the development and updating of a regional truck route network) will require continued collaboration and consistent information gathering by public-sector participants. **There is an opportunity to formalize how this collaboration can continue, specific to goods movement.**

There is also a need to continue collaboration with private-sector stakeholders. We are not aware of any regular forums for public-private-sector collaboration on goods movement in the Central Okanagan. Though greater collaboration might help identify potential opportunities and contribute to deploying solutions, a likely challenge in the Central Okanagan is that many private-sector goods movement stakeholders are not locally based (unlike larger regions such as Vancouver or Calgary). From our experience with urban goods movement strategies elsewhere, the "disaggregated and unorganized" nature of urban goods movement is a common challenge to the deployment of initiatives, and this appears to be the case too in the Central Okanagan.[58]

Information gathering will continue to be important. COGMS has started to address information gaps, notably through stakeholder consultation but also through using GPS-based data to quantify where and when trucks move in the region. However, several data gaps remain, especially concerning light truck activity (which tends to be focused on urban goods movement rather than long-distance trips). Screenline counts could also be augmented at key points, for example along Harvey Avenue, to measure truck activity at greater spatial detail. These activities require the availability of resources to enable them.

[57] WSP Canada for TAC. 2021. Understanding Goods Movement in Canada: Trends and Best Practices.
[58] Maxner, T; Dalla Chiara, G; and Goodchild, A. 2022. Identifying the challenges to sustainable urban last-mile deliveries: perspectives from public and private stakeholders. *Sustainability*, 2022, 14, 4701.

b. Increasing public awareness of the benefits of efficient goods movement to deploy solutions and take individual action

The general public depends on reliable access to goods to live in the Central Okanagan (including necessities such as food). In addition, businesses (employers) in the Central Okanagan rely on goods movement to get their goods to market. Transportation, logistics and warehousing also generates employment in the Central Okanagan and benefits the regional economy. Yet, there is often greater focus on the negative impacts of goods movement (e.g., crashes),[59] relative to its importance to the economy and quality of life. **There is a need to ensure that factual information about the role of goods movement to the Central Okanagan is communicated to the public.**

There is also a need to more widely research and disseminate individual practices to improve the efficiency and/or lower impacts from goods movement. For example, some research has shown that e-commerce can generate fewer GHG emissions than purchasing from brick-and-mortar retailers[60], but it is highly dependent on factors including whether someone owns an electric vehicle or walks/bikes to a shop, bundles packages when shopping online, makes use of online returns, makes multiple trips before purchasing online, etc. There is a potential opportunity for the public (and private sector) to provide evidence of the impact of different e-commerce and in-store shopping practices based on the latest available research.

[59] As an example, a search of “trucks Kelowna” in Google News yields primarily articles about truck crashes.
[60] MIT Real Estate Innovation Lab. 2021. Retail Carbon Footprints: Measuring Impacts from Real Estate and Technology. https://realestateinnovationlab.mit.edu/research_article/retail-carbon-footprints-measuring-impacts-from-real-estate-and-technology/

5 Strategies, actions and recommendations

Summary

- This chapter presents strategies, actions and recommendations to enhance goods movement to, from, through and within the Central Okanagan.
- We suggest 26 actions with 43 recommendations in total, grouped in six strategic directions:
  - Strategic Direction A: Manage congestion on Highway 97 and develop a strategic goods movement network
  - Strategic Direction B: Increase resiliency of road and air access to/from the Central Okanagan, including support for intermodal (rail-truck) terminals in the BC Interior
  - Strategic Direction C: Protect industrial land supply and coordinate with transportation infrastructure projects
  - Strategic Direction D: Plan for goods movement in urban areas
  - Strategic Direction E: Accelerate adoption of zero-emissions goods movement vehicles and provide supporting infrastructure
  - Strategic Direction F: Continue to improve public and private sector collaboration on goods movement

Section 5.1. presents the strategies, actions and recommendations. The lettering of the strategies, actions and recommendations is intended for ease of reference only, and not intended to suggest a priority.

In Section 5.2, we present these strategies, actions and recommendations in an Action Plan, which includes information on approximate cost, timing, and leading and supporting organizations.

5.1 Strategies, actions and recommendations

We recommend that MOTI, the Central Okanagan governments and First Nations work together to pursue the following six strategic directions to enhance goods movement in the region:

- Strategic Direction A: Manage congestion on Highway 97 and develop a strategic goods movement network
- Strategic Direction B: Increase resiliency of road and air access to/from the Central Okanagan, including support for intermodal (rail-truck) terminals in the BC Interior
- Strategic Direction C: Protect industrial land supply and coordinate with transportation infrastructure projects
- Strategic Direction D: Plan for goods movement in urban areas
- Strategic Direction E: Accelerate adoption of zero-emissions goods movement vehicles and provide supporting infrastructure
- Strategic Direction F: Continue to improve public and private sector collaboration on goods movement

Similar to the problem definition, strategic directions can be complementary and are not ordered in importance. For example, Strategic Direction F complements others by providing additional mechanisms and evidence to evaluate and enhance goods movement in the Central Okanagan. However, specific recommendations may only be feasible or have priority in terms of timing, as detailed in Section 5.2.

Strategic Direction A: Manage congestion on Highway 97 and develop a strategic goods movement network

Highway 97 is the primary goods movement route in the Central Okanagan, and there are short-, medium-, and long-term strategies to improve the movement of goods and relieve congestion on Highway 97 (Actions A.1 and A.2). In addition, there are opportunities to ensure goods movement is given appropriate weighting in transportation planning, management and infrastructure development decision-making (Action A.3), as well as to ensure that changes to truck routes that could impact goods movement are considered systematically (Action A.4).

Action A.1: Continue to improve operations on Highway 97 and major trucking routes

Goods movement vehicles are slower to accelerate and decelerate. Some stakeholders anecdotally noted that signal progressions were well timed for passenger cars, but that trucks would often hit sequential lights. *We recommend:*

1. **Continue to conduct operational reviews, including signal timing, progressions and phasing improvements with a goods movement lens on Highway 97 and major trucking routes.**
2. **Investigate the feasibility of smart traffic signals or truck signal priorities that could improve the flow of trucks, transit and other vehicles on Highway 97 and major trucking routes (which can be integrated jointly with transit signal priorities).**

Action A.2: Continue to improve and build infrastructure that benefits goods movement

Ensuring adequacy of intersection configurations can improve the fluidity of heavy truck movements along the corridor. In addition, enhancing the parallel road network to provide access to commercial/industrial areas, including sites to be developed at Kelowna International Airport (YLW), can help relieve Highway 97 and improve and promote economic development opportunities in a region with a constrained industrial land supply. These improvements should be considered in a coordinated fashion to ensure they achieve the intended impact. *We recommend:*

Adaptive (smart) signal control

Adaptive signals, sometimes called smart signals, allows traffic signals to vary timing throughout the day in response to traffic conditions (rather than pre-set timings). Early pilots of the technology have yielded promising results.

For example, in 2021-2022, the City of Peterborough, Ontario conducted a pilot using a 1.75 km of Lansdowne Avenue. Lansdowne Avenue is “a four-lane high-capacity arterial road with a centre left-turn lane (5 lane cross-section) carrying between 23,000 and 29,500 vehicles per day. The posted speed limit on Lansdowne Street is 50 km/h.” During busy conditions, the software prioritizes maximizing throughput on Lansdowne Avenue.

The pilot found that “[d]espite the increased delay at sideroad intersections, with the Adaptive Signal Control system the improved corridor travel time on Lansdowne Street resulted in an estimated reduction in overall user travel time in the pilot study area. When the results of the test period were annualized the travel time savings equated to an estimated $977,000 in reduced user costs over a typical year.”

Source: CPCS based on City of Peterborough report to council “ Smart Signal Pilot Project Update, Report IPSTR22-012,” https://pub-peterborough.escribemeetings.com/filestream.ashx?DocumentId=34402

3. **Conduct a review of intersection configurations, especially for truck turns, on Highway 97 and major truck routes to facilitate the efficient movement of trucks that are turning.**
4. **Improve parallel road infrastructure along Highway 97, including the Clement Avenue extension (as recommended in the Regional Transportation Plan), ensuring that design and engineering work consider access connections for goods movement.**

   When considering the Clement Avenue extension, the design and engineering work should assess this new roadway from a systems perspective recognizing behavioural changes of vehicles as well as developing design criteria and access locations to accommodate goods movement.
5. **Advance the longer-term Okanagan Gateway Transportation Study option of intersection improvements at Airport Way / Highway 97, including:**
   - **a.** Longer term, consider the development of parallel roads that would tie into trade lands at YLW, such as the improvement and extension of Rutland Road North/ Al Horning Way.

Action A.3: Ensure goods movement is given appropriate weighting in future corridor planning

People and goods movement share the same transportation infrastructure. However, given limited data, goods movement is often overlooked in planning activities (see also Action F.3). There are opportunities to ensure that goods movement is taken into account in planning activities, and in turn ensure it is given appropriate weight when infrastructure improvements and asset management activities take place. *We recommend:*

6. **Incorporate goods movement metrics more explicitly into MOTI Multiple Account Evaluation (and municipal transportation planning, as applicable), and ensure evaluation guidance is up to date**.

   For example, ensure that commercial vehicle values of time used in benefit-cost analysis are current, and guidance is provided on incorporating value of goods movement reliability, etc.

7. **Designate a strategic goods movement network (SGMN) to inform asset management and capital priorities for upgrading and expanding the road network.**

   Designating an SGMN with associated policies attached as a planning tool can help ensure goods movement is given appropriate weighting in planning decisions. Once designated, it is not reliant on ongoing data to apply and is intended to be a long-term outlook on important goods movement corridors. The SGMN also serves as the spine of the truck route network – i.e., it does not necessarily need to, and likely should not, include all truck routes. In this way, a core SGMN can meet critical areas of truck activities and serve as the base for eventual extension across some or all other municipalities in the Central Okanagan.

   The following is a suggested process to develop an SGMN:

a. Start with Map 3 in the Regional Transportation Plan (Map 3: Regional Road and Goods Movement Network).

   Draw from the existing City of Kelowna truck routes,[61] and consider adding access truck corridors to/from Highway 97 identified in this report and also potentially permitted long-combination vehicle routes. The former locations are noted in ***Appendix G, Figure G-3, page G-5.*** In this way, a core SGMN can meet critical areas of truck activities and serve as the base for eventual extension across some or all other municipalities in the Central Okanagan.

b. In developing the core SGMN, consult with other Central Okanagan municipalities to develop a framework for consistent regional expansion in the future, using agreed criteria and standards.

c. Consider a hierarchy of goods movement corridors. For example, primary SGMN corridors (like Highway 97) and secondary connectors.

d. Review the current and potential demand for long-combination vehicles (LCVs) and consider whether designated truck routes can support LCV movements, parking, staging and disassembly areas.

e. Consider a special designation on agricultural truck routes.

   Given the importance of agricultural activity in the region, consider a special designation on agricultural truck routes. Consider the movement of slow-moving agricultural vehicles on these routes and give special attention to maintaining the viability of fragile agricultural products.[62]

Accommodating goods movement networks and Complete Streets

The City of Seattle has looked at ways to accommodate cyclists on downtown core streets while also accommodating truck traffic, which must use core streets to access the Port of Seattle. A key part of the solution is to consider the core streets as a system where some streets favour one or the other mode (but still accommodate all modes) to safely maintain overall fluidity and mobility. The City had developed Complete Street guidelines and Major Truck Route guidelines. However, a conflict arose regarding how to set priorities for an important core street. Through consultation with stakeholders, the City recognized that all user needs must be met, and by treating the street as part of a network the City was able to accommodate all needs (meaning that different needs could be prioritized on different parallel streets in the corridor). This was not considered to be an 'ideal' solution (some in the community wanted all downtown streets to be prioritized for cyclists) but this consultation-based compromise did meet the needs. Additional information on Complete Streets and information from Seattle is found in ***Appendix F, page F-22.***

A similar issue has arisen in Winnipeg's 2050 transportation master plan (ongoing), where the existing network configuration funnels a considerable volume of truck traffic through the downtown. While the long-term plan looks at bypass infrastructure to get through traffic out of the core (e.g., completion of a long-planned inner ring road), the City is also examining how to evaluate trade-offs between truck priorities and Complete Street needs in the immediate downtown (which in itself is an important truck trip generator), again considering the downtown street network as a whole.

Other studies have examined guidelines on how to establish priorities between the movement of people and goods for long-term transportation plans. A commonly applied guideline is to avoid having major truck routes and planned rapid transit initiatives sharing the same corridor, meaning that one or the other designation or alignment should shift to the nearest parallel route, where feasible.

[61] An SGMN is similar but distinct from the truck route. The SGMN is a planning tool that is intended to remain relatively static year-over-year, and is intended to identify areas where goods movement is to be afforded some level of prioritization in planning. The truck route network is a regulatory tool designed to manage conflicts between truck activities, and in principle could be subject to change on a more regular basis.

[62] The consultant team conducted a brief literature review and outreach. Several traffic calming guides exist for agricultural roads, but none of these has any specific accommodation for the movement of fragile agricultural products.

f. Develop a network approach for evaluating candidate road segments for implementation of Complete Streets, the SGMN and truck route candidate road segments to establish mode priorities on individual segments within the context of the overall network. Planning should accommodate all road users on the network as a whole and avoid 'either-or' choices on individual road segments.

Action A.4: Systematize process to review and update the truck route networks within each of the Central Okanagan governments

It is common for there to be competing demands from stakeholders to make additions or deletions to the truck route network. Given that the truck routes restricts trucks to designated routes, removing truck routes can extend the length of a trip, though there may be other rationale for doing so. Commonly used criteria for defining truck routes in other Canadian cities are summarized in the text box. In addition, this study considered whether there are any obvious gaps through an assessment of goods movement vehicle volumes (See ***Appendix G: Analysis of truck routes*** for detailed analysis) and identified Enterprise Way, but there may be other reasons not to designate it as a truck route. *We recommend:*

8. **Review the Central Okanagan governments' truck route networks and develop a systematic approach for updating the networks, with the eventual aim of developing a consistently defined truck route network across the entire Central Okanagan:**

    a. Examine the feasibility of adding Enterprise Way to the City of Kelowna's truck route network.

    b. If the Commonwealth extension proceeds, consider designating Commonwealth Road east of Highway 97 as a truck route.

    c. Allow for potential differentiations between vehicle types on truck routes.

        Example: a two-tier system that allows only small- and medium-sized trucks on certain routes.

Possible criteria for truck routes

Criteria for defining truck routes vary among municipalities. However, commonly used criteria include:

- Usage, as measured by truck volumes
- Road classification and function, which can be used to screen ineligible roads from further consideration (e.g., local roads, noting that these are still usable for first- / last-kilometre delivery)
- Continuity (sometimes referred to as connectivity), to ensure that the network is continuous with no gaps, and that all key freight generators are connected to it
- Adequacy of road and intersection capacity, geometries and grades
- Avoidance of conflicts with other users, especially cyclists and pedestrians (e.g., avoidance of roads that have on-pavement bike lanes)
- Minimization of intrusion through residential and other sensitive areas
- Adjacent land uses, avoiding roads with residential frontages, schools and parks

Note that these are guidelines intended to allow flexibility and be used practically as opposed to being tied to specific quantitative or numerical thresholds.

Broader criteria have informed more recent truck route networks. For example, a recent study in Hamilton, Ontario included equity, as measured by the prevalence of low-income households and the proportion of vulnerable (very young and very old) population cohorts living along the corridor.

Some municipalities have implemented regular reviews of their truck route networks. This ensures a systematic network-wide review process is in place to objectively inform political discourse and avoid ad hoc piecemeal decisions.

Reference sources: Goods Movement Study, Final Report, Town of Oakville, Ontario, 2016 and Hamilton Truck Route Master Plan Update, City of Hamilton, Ontario, 2022.

Action A.5: Manage travel demand (shift commuters to bike, walk, transit, and promote work from home, etc.)

9. **Ensure robust parallel biking, walking and transit infrastructure is maintained to encourage modal shift away from single-occupancy vehicles.**

   Where possible, separation from major trucking routes is preferred, to protect people biking and walking from conflicts with trucks.

10. **Encourage work from home and other travel demand management strategies to take pressure off roadways needed for goods movement.**

11. **Investigate sustainable transportation opportunities to serve employees travelling to/from YLW / Gateway and other industrial areas.**

    Examples include demand-responsive transit and working with local employers to promote carpooling. This will help provide modal alternatives to the auto commute, taking pressure off roadways in these car dependent locations.

Action A.6: Incorporate goods movement into future Highway 97 corridor planning

12. **Incorporate goods movement into future Highway 97 corridor planning to ensure the safe, efficient and sustainable movement of both people and goods.**

Strategic Direction B: Increase resiliency of road and air access to/from the Central Okanagan, including support for intermodal (rail-truck) terminals in the BC Interior

We define resiliency as the ability of the transportation system to maintain its performance when stressed. This strategic direction is intended to ensure that goods can continue to flow to and from the Central Okanagan, including as the climate changes and increasing stress is placed on the system through weather-related events. It includes actions to enhance the resiliency of highway infrastructure (Action B.1), support for intermodal (rail-truck) terminals (Action B.2), air infrastructure (Action B.3), as well as to improve driver amenities and safety (Action B.5). It is important to note that the resiliency of the multimodal system throughout the province can affect transportation to and from the Central Okanagan. The province-wide Goods Movement Strategy is underway and will address province-wide issues at greater length.

Action B.1: Continue to advance planning and implementation of improvements to highway infrastructure outside of the Central Okanagan to improve resiliency

MOTI already undertakes several initiatives to adapt transportation infrastructure in a changing climate.[63] *We recommend* continuing these actions, as well as considering the following actions on corridors in BC:

13. **Support highway infrastructure improvements outside the Central Okanagan**:
    a. Continue to advance planning and implementation of highway improvements in the Fraser Valley and on Highway 1 to Calgary that could benefit flows to/from the Central Okanagan
    b. Review opportunities to upgrade Highway 3 to support commercial vehicle traffic as an alternative to Highway 5

[63] An overview of these activities are available here: https://www2.gov.bc.ca/gov/content/transportation/transportation-environment/climate-action/adaptation

Action B.2: Support the development of intermodal (rail-truck) infrastructure in the BC Interior

14. **Support intermodal (rail-truck) infrastructure improvements, such as an inland rail terminal,** that could provide an alternate mode of transport to the BC interior in addition to truck transport. This should be supported if intermodal rail infrastructure can demonstrate the ability to achieve modal shift from truck to rail, reduce greenhouse gas emissions, reduce highway wear, and free up road and port capacity for truck trips from the Central Okanagan that cannot shift modes.

    Examples raised by stakeholders in this study include inland rail terminals and intermodal connections to access Port of Prince Rupert.

Action B.3: Plan for Kelowna International Airport's strategic role in goods movement

15. **Plan for Kelowna International Airport's strategic role** in goods movement (e.g., during highway closures) and develop a climate adaptation plan for the airport.
    a. YLW facilitated an air bridge during the fall 2021 atmospheric river. We recommend including air as a modal alternative during an emergency or outages on the highways, where practical.
    b. Also, consider the impact of a changing climate on the airport infrastructure itself and identify any improvements needed to adapt.

Action B.4: Formalize and disseminate lessons learned from 2021 outages

16. **Publish and distribute lessons learned from the 2021 outages** caused by atmospheric river events, and identify further opportunities to improve resiliency working with the Province, Central Okanagan governments, first responders and the private sector.
    a. Publish and disseminate results to support private sector contingency planning
    b. Continue the strategy of designating "Essential Purposes only" (including goods movement)[64] to manage safety on essential goods movement corridors

Action B.5: Consider developing digital tools to improve route planning and productivity for truck drivers

17. Investigate the feasibility of a province-wide truck route map app to help drivers and dispatchers plan their routes.
    a. Examine the feasibility and transferability of the recently developed MOTI / TransLink Truck Route Planner for the Lower Mainland[65]
    b. Consider the integration of this expanded tool to the existing DriveBC platform to have this be a single source of information
    c. Examine the feasibility of a guidance tool that long-haul drivers can use to find parking areas for rest breaks and servicing
18. **Consider opportunities to provide commercial vehicles with additional information about their payload before a trip departs the Central Okanagan.**

[64] BC MOTI. 2021. Highway route to southern Interior open. https://news.gov.bc.ca/releases/2021TRAN0073-002210
[65] Available here: https://translink.apps.gov.bc.ca/trp/

Examples: Stakeholders suggested a self-weigh scale. However, our opinion is that installing a self-weigh scale is potentially counterproductive to the Weigh2Go program's objective to minimize goods movement vehicle stops. Accordingly, consider whether technology solutions such as a weigh-in-motion scale could provide feedback to drivers. Alternatively, consider whether additional feedback from Weigh2Go program could be provided to commercial vehicles to support their load planning and meeting regulations.

19. **Consider developing digital tools and educational material to improve route planning and productivity for truck drivers, as well as to help shippers get their goods to market.**

Action B.6: Consider opportunities to improve driver amenities and highway maintenance practices

20. **Review the demand for driver amenities for long-haul truckers, such as parking and rest stops, and as required, implement new or upgrade existing facilities around the Central Okanagan**
21. **Monitor winter highway maintenance practices on highways to/from the Central Okanagan, particularly Highway 97C.** While provincial highways are generally reliable, even small closures can have impacts on businesses dependent on goods movement.

    Example: Just in Time (JIT) deliveries depend on transportation infrastructure to reach their destinations in a timely fashion. In this regard, snowstorms, avalanches, and winter highway maintenance can have impacts on goods movement to/from the Central Okanagan.

Trucking industry labour

Trucking industry stakeholders across Canada (and those consulted in this study) have raised concerns about the availability of professional truck drivers, particularly to/from the Central Okanagan. Strategies to address labour shortages are beyond the scope of examination of goods movement to/from/within the Central Okanagan. However, there are nonetheless opportunities to improve conditions for drivers operating on routes serving the Central Okanagan.

Strategic Direction C: Protect industrial land supply and coordinate with transportation infrastructure projects

The region will require sufficient lands to support goods movement, including existing goods generating sectors, logistics activities to support wholesale and retail activities, as well as emerging sectors. The actions within this section are intended to ensure existing industrial lands are continually managed and protected (Action C.1), trade lands around YLW are protected (Action C.2), and access issues at the Jim Bailey Industrial area are addressed (Action C.3). In addition, multiple levels of government should work together on a process for developing transportation infrastructure projects to support commercial/industrial land development (Action C.4).

Action C.1: Protect existing industrial lands in the Central Okanagan

Available, affordable, accessible and right-sized industrial land is essential to economic activity, as well as ensuring transportation and logistics activities can take place in the Central Okanagan. Given the limited areas for development, the protection of existing industrial lands will be essential to preserving industrial land for goods movement activities, while avoiding conflicts with non-compatible activities. *We recommend:*

22. **Protect existing industrial land supply for traditional goods-generating sectors and logistics activities (e.g., warehousing and distribution).** Ensure some lands are protected near urban areas to facilitate consolidation and transition to last-kilometre deliveries.
23. **Ensure that sufficient zoned and designated land is available to accommodate emerging industries in appropriate locations (i.e., in addition to accommodating traditional industries)** and that new technologies like 3D printing and warehouse automation can be accommodated in lot servicing, zoning and site plan approval requirements.
24. **Consider how new technologies could be deployed to locate and integrate warehouses and distribution centres in denser urban areas**

    Examples: re-use older warehousing space or locate distribution centres closer to their customers by using automated warehousing technologies to grow up rather than grow out and minimize disturbances to neighbouring areas.[66] Work completed to date in the Lower Mainland, such as the Metro Vancouver Industrial Intensification Analysis, could provide some further guidance.[67]

    Suggested process: Review existing land use planning policies and industrial zoning rules to ensure they reflect anticipated land, servicing, loading and access requirements to support technological changes and new logistics practices in traditional sectors and also growth in "innovation economy" activities – e.g., high technology – which require an accessible pool of skilled labour and may not present the same nuisances as other traditional industrial activities.
25. **Apply best practices for land-use planning, site design and access.** Including:
    a. avoid leap-frogging of residential and industrial developments site design, and access design such as Ontario Ministry of Transportation's Freight Supportive Guidelines.
    b. clarify and establish MOTI policy and practice for reviewing Official Community Plans submitted for feedback from municipalities with a goods movement/industrial lands preservation lens and consider developing guidelines using these best practices.

Action C.2: Protect trade and industrial lands at/around the Kelowna International Airport (YLW)

Recognizing potential trade lands at YLW as one of the few remaining areas to develop new trade-oriented uses within the Central Okanagan, *we recommend:*

26. **Maintain and apply existing residential densification restriction policies applicable in zones around YLW** as set out in the City of Kelowna's 2040 Official Community Plan "Policy

[66] For example, Ocado in the United Kingdom is constructing automated warehouses, which uses a grid of containers up to 21 containers deep to pick products. The technology is being used in North America by companies such as Kroger and Sobeys. Though not involving technology, a 563-bed student accommodation at 13 St. Pancras Way in London incorporates a retail location for a building supplier at the base.
Prisco, J. 2021. Why online supermarket Ocado wants to take the human touch out of groceries. https://www.cnn.com/2021/04/26/world/ocado-supermarket-robot-warehouse-spc-intl/index.html
Savills. Student Accommodation Case Study – Travis Perkins, St Pancras Way, Camden, London. http://pdf.savills.com/documents/Travis-Perkins-St-Pancras.pdf

[67] Chapter 7 of the following report provides a summary of challenges and opportunities for consideration.
Colliers. Metro Vancouver Industrial Intensification Analysis. http://www.metrovancouver.org/services/regional-planning/PlanningPublications/IndustrialIntensificationAnalysisStudy2021.pdf

7.2.6. Aircraft Noise Impacts" and "Policy 7.2.7. Building Heights Near Airport"[68] to protect the airport's role in serving goods movement, now and in the future.

Action C.3: Enhance truck access and manage truck flows to the Jim Bailey Industrial Area

The Jim Bailey Industrial Park is one of the largest goods generating sites in the Central Okanagan and is the location of a diversified range of goods generating businesses, with potential area for expansion. Protecting access to Highway 97 is critical to ensuring it can function as intended. There are plans to construct an extension of Commonwealth Road to access the Industrial Park. However, this will create truck flows through Duck Lake 7 Indian Reserve, which is developed as a residential area. This routing raises equity issues by the likely impact on the adjacent community and in turn risks impacting access to the Jim Bailey Industrial Park. The following recommendations are intended to mitigate these impacts and ensure that the Jim Bailey Industrial Park can continue to function as an important economic and goods movement generator for the region.

27. **Continue to minimize impacts of freight activity via Commonwealth Road extension on residents and Duck Lake Reserve.**
    a. Should the Commonwealth extension proceed, consider using additional tools to mitigate impacts of truck flows on adjacent residential areas.
    b. Re-examine alternative road on the east side of Duck Lake as a long-term alternative, ensuring that equity and Indigenous reconciliating factors are considered in the evaluation.
    c. Consider over-dimensional loads in the design of infrastructure accessing the Jim Bailey area. Consult with relevant goods movement industry stakeholders during design, where feasible.[69]
    d. Continue to advance implementation of safety, frontage road, and other measures along Highway 97 to improve safety and land access for commercial and industrial enterprises located along the route.

Action C.4: Implement a process for developing transportation infrastructure projects to support commercial/industrial land development

28. **Implement a process for developing transportation infrastructure projects to support commercial/industrial land development.** Develop funding agreements between multiple levels of government to program required infrastructure into municipal capital plans and Development Cost Charge programs.

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[68] Full excerpts:

Policy 7.2.6. Aircraft Noise Impacts.
Prohibit increases in residential density within the NEF 25 contour and above, as illustrated in Map 6.1, to accommodate for growth in aircraft travel from Kelowna International Airport. In addition, new development that falls within the Federal Aviation Zone, as illustrated in Map 6.2, should include upgraded sound proofing and must provide a covenant that saves the City harmless with respect to noise complaints.

Policy 7.2.7. Building Heights Near Airport.
Require that all proposed subdivision, multi-unit, industrial, institutional and commercial development projects within the Federal Aviation Zone, as illustrated in Map 6.2, include consultation with Kelowna International Airport and Transport Canada with respect to building heights as per Airport Zoning Regulations under the authority of the Aeronautics Act.

[69] For example, a manufactured home facility is located in the business park

Strategic Direction D: Plan for goods movement in urban areas

Improving the flow of deliveries sustainably will require a multifaceted approach, including addressing on-street deliveries (Action D.1), while limiting their further growth (Action D.2). In addition, there is an opportunity to prepare for and support emerging sustainable logistics practices within areas of the region that are expected to densify (e.g., downtown Kelowna (Action D.3)). Finally, there is evidence from other jurisdictions that improvements to goods movement vehicles can help improve the safety of vulnerable road users, including bicyclists (Action D.4).

Action D.1: In existing developed areas, improve the flow of first- and last-kilometre deliveries made on-street

In existing developed areas, it is not likely feasible or cost effective to retrofit existing developments to increase off-street deliveries. However, there are sometimes opportunities to improve the flow (and safety) of on-street delivery through changes to regulation and infrastructure. *We recommend:*

29. **Conduct an urban goods movement operational review, e.g., off-hours delivery, on-street loading**, including the following:
    - needs of couriers
    - an inventory of conflict points with goods movement
    - possible opportunities to address in future master planning work, paying particular attention to on- and off-street requirements
    - a small survey of local business delivery and pick-up needs
    - consultation with local academics with complementary research objectives for implementation[70]
    - evidence gathered from this survey may also support recommendations 26 and 27
    - review on-street parking policies, pricing and enforcement procedures for all vehicles, including for trucks and courier vehicles (which are often unmarked), to ensure an adequate supply of on-street loading spaces while also better managing how those spaces are used
    - review municipal practices for street furniture and vegetation to ensure sightlines for turning or exiting alleys are protected.
    - ensure that Complete Streets policies, guidelines and plans explicitly account for truck movement in all environments and for current and anticipated on- and off-street loading requirements

Action D.2: In new developments, limit on-street deliveries

It will be important to ensure that the need for on-street deliveries does not continue to grow. *We* recommend*:*

30. **Ensure new developments can accommodate existing and future goods movement practices and minimize demands for on-street delivery** including:
    a. Ensure that municipal site plan approval and corridor planning can accommodate emerging goods movement technologies and logistics practices.

[70] For example, UBC Okanagan is home to the UBC integrated Transportation Research (UiTR), which has as an aim improve transportation data collection. https://engineering.ok.ubc.ca/2022/11/23/better-understanding-travel-behaviour-will-help-clear-path-to-greener-future/

For example, ensure that new multi-story residential developments have secure courier drop-off areas or by anticipating the need for safe drone landing pads on residential properties.

b. Ensuring that all new non-residential developments can accommodate off-street deliveries. This could include:
    - accommodation for couriers
    - investigating the feasibility of mandating smaller loading bays to encourage the use of smaller trailers
    - ensuring that goods movement vehicles can circulate through the property to load and unload without having to back onto the street
    - ensuring that there is adequate space for off-street truck parking where required to serve the property or to park vehicles overnight
    - for large developments, the preparation of a Delivery Service Plan could be a planning condition.[71]

c. Ensure that gated communities provide for safe and secure courier delivery access.

d. Consider a requirement for property owners and developers to implement construction vehicle management plans for large building projects.

Action D.3: Prepare for and support emerging sustainable delivery practices

As the region grows and densifies, there is an opportunity to implement new forms of sustainable delivery practices. In particular, Kelowna benefits from a defined downtown core and an adjacent light-industrial area. While this is a niche and likely not immediate application, it is important to prepare for these developments now. *We recommend:*

31. **Ensure that municipal policies, regulations and bylaws have language that enables the potential introduction of sustainable goods movement initiatives for first- and last-kilometre delivery**

    For example, enable off-hours deliveries – and also accommodate new business models for delivering these initiatives such as ride-hailing services to deliver parcels

32. **Examine ways to leverage business opportunities for managing first- and last-kilometre deliveries**. For example:
    - identify any City of Kelowna controlled land or facilities (e.g., parking lot) that might be suitable for a microhub and in close proximity to high-density areas.
    - work with courier companies to investigate the feasibility of implementing microhubs to support cycle logistics and, in particular, what the impediments are and how local and provincial authorities can address these.
    - review existing City of Kelowna protected cycle network for suitability of use by cargo bikes, and any guidelines or standards required to ensure safe operation. Provincial regulation limits e-bikes to three wheels, but does not speak to maximum overall dimensions.[72] Or comparison, the City of Vancouver recommends Cargo

[71] The plans are commonly required in the UK, with the objective of encouraging developments to have safe, clean and efficient deliveries. https://content.tfl.gov.uk/delivery-and-servicing-plan-guidance.pdf
[72] *Motor Vehicle Act*, Motor Assisted Cycle Regulation: bclaws.gov.bc.ca/civix/document/id/complete/statreg/151_2002

bikes should not exceed 1 metre in width and 2.7 metres in length.[73] There also larger vehicles that exist (e.g., quadracycles) that also operate elsewhere but not in BC.

- monitor pilot experience elsewhere in BC,[74] and, if appropriate, update municipal, provincial regulations and guidelines to address any lessons learned.

33. **Identify opportunities to right-size goods movement vehicles in urban areas**

    Example: smaller delivery vehicles may be better suited to dense urban areas, such as electric vans or cargo bikes.

Action D.4: Promote safety of goods movement vehicles to reduce impacts on vulnerable road users

While bicycling and pedestrian infrastructure is often seen as at odds with goods movement, promoting active modes of travel will be essential to freeing up road space in a growing region. Crashes involving goods movement vehicles and vulnerable road users can have serious consequences, and other jurisdictions have deployed vehicle retrofits to improve the safety of trucks and vulnerable road users. *We recommend:*

34. **Review and as appropriate update provincial legislation, regulations, standards and guidelines to further enhance the safety of goods movement** by:

    a. Examining the feasibility, costs, benefits and equity considerations of a province-wide mandate to require additional safety devices on medium- and heavy-duty goods vehicles.

       Research: A National Research Council of Canada study for Transport Canada found that "based on data from the EU, the number of deaths and serious injuries for VRUs when involved in an incident with heavy vehicles has been reduced since the introduction of side guards," though acknowledges that it does not address all collisions and that there may be other contributing factors.[75]

       Possible recommendation:

       - Our understanding is the federal government regulates vehicle design, and previously examined this issue, so it may not be feasible to directly implement.
       - If so, our recommendation would be for MOTI to encourage Transport Canada to re-examine the feasibility, costs, benefits and equity considerations of such requirements in light of the current imperative towards decarbonization (including modal shift to active modes) and equity considerations.
       - A pilot project could be undertaken in the Central Okanagan between MOTI and the City of Kelowna to procure vehicles, and/or transportation and construction services from suppliers that include safeguards on heavy goods movement vehicles.[76]

    b. Considering whether the BC Active Transportation Design Guide should be reviewed with a goods movement lens

[73] City of Vancouver. 2022. Cargo Bike Guide for Businesses. https://vancouver.ca/files/cov/cargo-bike-toolkit-for-businesses.pdf
[74] BC Ministry of Transportation and Infrastructure. 2021. B.C. partners with Vancouver on cargo e-bike project
[75] National Research Council of Canada. 2010. Side Guards for Trucks and Trailers Phase 1: Background Investigation. https://www.volpe.dot.gov/sites/volpe.dot.gov/files/docs/side-guards-for-trucks-and-trailers-phase-1-background-investigation-jd-patten-canada.pdf
[76] Halifax and Vancouver have pursued such an approach in Canada.

For example, determine whether a separate discussion is warranted in the next update on planning for cargo bicycles and to revisit the existing guidelines for active transportation infrastructure that crosses provincial highways (protecting active transportation users while managing turning truck movements). See also recommendation 32. Regarding taking a network approach to the implementation of Complete Streets, which could also be incorporated.

Strategic Direction E: Accelerate adoption of zero-emissions goods movement vehicles and provide supporting infrastructure

To reach decarbonization targets, there are opportunities to work on decarbonizing the goods movement and related service fleets they control or influence (Action E.1), as well as incentivizing and supporting decarbonization by others (Action E.2). Urban areas are particularly well-suited to be a focal point for decarbonization given the density of goods movement activity and the shorter distance of operations.

Action E.1: Investigate opportunities to green provincial and municipal fleets of medium- and heavy-duty vehicles

The Province as well as Central Okanagan governments collectively operate their own vehicle fleets and are buyers of goods movement services. The procurement of fleet vehicles and goods movement-related contracts (e.g., courier services) are directly within the control the organization, subject to the availability of fleets.

35. **Among provincial agencies, investigate opportunities to directly procure or encourage contractors to procure low- or zero-emissions fleet vehicles**.

    Opportunities could include courier/delivery contracts or highway maintenance contracts. It is recognized that this may be a medium-term strategy given the availability of vehicles.

36. **Review Kelowna's Green Fleet Strategy (and those of other Central Okanagan governments, as applicable) to ensure they incorporate the latest opportunities to procure zero-emission medium- and heavy-duty vehicles and consider whether fueling/charging facilities could be incorporated into municipal lands.**

Action E.2: Set market incentives and implement supportive infrastructure

The Pembina Institute, which has examined various pathways to decarbonization of the goods movement sector, has found "that the transition to ZEVs can be completed most cost effectively through a ZEV sales standard that employs sales requirements segmented by vehicle type" though other complementary policies will be required.[77] *We recommend:*

37. **As a priority, continue to implement a medium- and heavy-duty zero-emissions vehicle provincial sales standard** as set out in CleanBC[78] and reflecting evolving federal policy[79] as

[77] Pembina Institute. 2022. Strategy for Zero-emission Medium- and Heavy-Duty Vehicles. Draft Recommendations.

[78] CleanBC includes the action "[to develop] new ZEV targets for medium- and heavy-duty vehicles . . . in alignment with California"

[79] Government of Canada, 2030 Emissions Reduction Plan states (p.57): "Launch an integrated strategy to reduce emissions from medium-and heavy-duty vehicles (MHDVs) with the aim of reaching 35% of total MHDV sales being ZEVs by 2030. In addition, the Government will develop a MHDV ZEV regulation to require 100% MHDV sales to be ZEVs by 2040 for a subset of vehicle types based on feasibility, with interim 2030 regulated sales requirements that would vary for different vehicle categories based on feasibility, and explore interim targets for the mid-2020s."

the primary policy to decarbonize the goods movement sector. Engage with the goods movement sector to set the horizons for the sales standards.

38. **Investigate the feasibility of incentivizing zero-emissions light- and medium-duty commercial vehicles to utilize HOV lanes, and consider expanding the provincial decal program to facilitate enforcement.**
39. **Investigate the need for public charging and low/zero-emissions refueling stations to support goods transporters and couriers**, especially the many independents for whom the uptake of new technologies may be financially prohibitive. In addition:
    a. Work with utilities and energy providers to ensure an adequate clean energy supply in the coming years to meet the anticipated demand
    b. Ensure that the supporting legislation and policies are in place to allow for the potential private sector furnishing of this infrastructure

Action E.3: Prepare for other new technologies related to goods movement

40. **Develop provincial planning guidance to help municipalities ensure that roads, intersections and on-street parking can accommodate new technologies,** especially autonomous commercial vehicles but also electric vehicles.

    For example, Chicago and other municipalities have taken advantage of road rehabilitation projects to incorporate basic communications infrastructure along the right-of-way to allow for future deployment of vehicle-to-everything (V2X) communications.

Strategic Direction F: Continue to improve public and private sector collaboration on goods movement

Goods movement initiatives require collaboration (Action F.1) and can be strengthened through improved evidence (Action F.2). In addition, public support is also required to advance goods movement initiatives, and have a role to play in addressing its impacts (Action F.3).

Action F.1: Develop a regional freight council

Acting on goods movement initiatives requires public and private sector collaboration. A freight council (or advisory group, task force, etc.) can provide a venue to drive forward goods movement initiatives (such as the recommendations in this report), as well as provide a forum for the private sector to raise concerns and the public sector to tap into relevant private-sector knowledge. In the Central Okanagan, this council could be comprised of representatives from private industry, the Province, the regional district, local municipalities, and First Nations, among others. However, challenges developing a regional freight council in the Central Okanagan include the limited regional

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In December 2022, the Government of Canada announced that Canada's Action Plan for Clean On-Road Transportation would "aim to reach 35% of total new medium- and heavy-duty vehicle sales being zero-emission vehicles by 2030. In addition, the Government will develop a medium- and heavy-duty zero-emission vehicle regulation to require 100% of new medium- and heavy-duty vehicle sales to be zero-emission vehicles by 2040 for a subset of vehicle types based on feasibility, with interim 2030 regulated sales requirements that would vary for different vehicle categories based on feasibility, and explore interim targets for the mid-2020s."
Transport Canada. 2022. Minister of Transport announces the release of Canada's Action Plan for Clean On-Road Transportation. https://www.canada.ca/en/transport-canada/news/2022/12/minister-of-transport-announces-the-release-of-canadas-action-plan-for-clean-on-road-transportation.html

transportation governance structure,[80] as well as the fact that many goods movement activities are managed by industry based in the Lower Mainland (with the Central Okanagan being one destination of many). Champions of this initiative would be needed, as it will take time to set up and manage. In this context, *we recommend:*

41. **Develop a regional freight council to anticipate, address and act on goods movement needs**.

Action F.2: Improve ongoing freight data collection

Improving freight data collection helps inform evidence-based action to improve the efficiency of goods movement in the Central Okanagan. *We recommend:*

42. **Establish a data collection initiative for the region.**

    For example, focusing on light truck, courier, last kilometre and other goods movement activity (data that are not available from existing data sources), and initiate an ongoing vehicle count program at strategic locations in Central Okanagan (including allowing for 24-hour and seasonal counts at key locations).

Action F.3: Promote the importance of goods movement and ways to limit its impact

Government can play a role, with the private sector, that provides evidence of the role of goods movement. In addition, while the impact of a growing e-commerce sector is not conclusive, there is evidence that certain practices are more or less greenhouse gas intensive. *We recommend:*

43. **Work with private-sector stakeholders to develop public-facing evidence-based material that communicates:**

    a. the importance of goods movement to the economy but also people's lives

       For example, public education on how goods movement policies can impact people individually (restaurant tab, cost of groceries, cost of online shopping deliveries and delivery timeframes).

    b. principles of consumer behaviour that can help lower transportation impacts when using e-commerce.

       Such guidance is not intended to pit e-commerce against traditional brick-and-mortar retail, but rather describe general practices and approaches to lower the impact. We have not seen any public guidance, but reputable sources have proposed approaches, such as the *New York Times Wirecutter*, which suggests:

       - Group your purchases
       - Use online shopping to replace—not supplement—in-store buying
       - Choose slower delivery options[81]

[80] It is important to note that public sector stakeholders did indicate that regional collaboration has improved over the last 20 years.

[81] Heffernan, T. 2021. How to Shop Online More Sustainably. https://www.nytimes.com/wirecutter/blog/shop-online-sustainably/

5.2 Action Plan

The previous section described the strategies, actions and recommendations in some detail. Not all of the 44 identified recommendations could occur at once, and many will require collaboration amongst multiple public- and private-sector stakeholders. Accordingly, we have developed an Action Plan to summarize the recommendations. The table with the Action Plan also

- provides a rough, order-of-magnitude cost to indicate the scale of the recommendation
- proposes a timeline for implementation, reflecting both the level of priority and timeline for implementation
- identifies leading and supporting organization

The box below provides a legend for the table entries regarding costs, timing and leading / supporting organizations.

Legend for Action Plan

Approximate **time** horizon:

- ST – 1-2 years
- MT – 2-5 years
- LT – 5+ years
- Ongoing – i.e., started in the short terms and continued through the long term

Approximate **costs** for implementing organization (rough, order-of-magnitude):

- $ = <$0.5 million – e.g., a small study
- $$ = <$1 million – e.g., a medium study or data collection program
- $$$ = $1-$10 million, e.g., large-scale study/data collection program, operational improvements or small-scale infrastructure improvement
- $$$$ = >$10 million, e.g., infrastructure improvements

For brevity, we also use **Central Okanagan governments** as shorthand for all the regional partners, including District of Peachland, District of Lake Country, City of West Kelowna, City of Kelowna, Westbank First Nation, and the Regional District of Central Okanagan. We have identified these organizations where appropriate, though the relevance of a recommendation to each community might differ. Where a recommendation is specifically intended for City of Kelowna as well as other Central Okanagan governments, both are identified.

Strategic Direction A: Manage congestion on Highway 97 and develop a strategic goods movement network

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action A.1: Continue to improve operations on Highway 97 and major trucking routes				
1	Continue to conduct operational reviews, including signal timing, progressions and phasing improvements with a goods movement lens on Highway 97 and major trucking routes	$$$	ST-MT	MOTI with the City of Kelowna
2	Investigate the feasibility of smart traffic signals or truck signal priorities that could improve the flow of trucks, transit and other vehicles on Highway 97 and major trucking routes (which can be integrated jointly with transit signal priorities)	$	ST-MT	MOTI with City of Kelowna
Action A.2: Continue to improve and build infrastructure that benefits goods movement				
3	Conduct a review of intersection configurations, especially for truck turns, on Highway 97 and major truck routes to facilitate the efficient movement of trucks that are turning.	$	ST-MT	MOTI with City of Kelowna
4	Improve parallel road infrastructure along Highway 97, including the Clement Avenue extension, ensuring that design and engineering work consider access connections for goods movement	$$$$	LT	City of Kelowna with MOTI
5	Advance the longer-term Okanagan Gateway Transportation Study option of intersection improvements at Airport Way / Highway 97	$$$$	LT	MOTI with City of Kelowna
Action A.3: Ensure goods movement is given appropriate weighting in future corridor planning				
6	Incorporate goods movement metrics more explicitly into MOTI Multiple Account Evaluation (and municipal transportation planning, as applicable), and ensure evaluation guidance is up to date	$$	ST	MOTI (Central Okanagan governments, as applicable)
7	Designate a strategic goods movement network (SGMN) to inform asset management and capital priorities for upgrading and expanding the road network	$	ST	MOTI, City of Kelowna, and other Central Okanagan governments, as required
Action A.4: Systematize process to review and update the truck route networks within each of the Central Okanagan governments				
8	Review the Central Okanagan governments' truck route networks and develop a systematic approach for updating the networks, with the eventual aim of developing a consistently defined truck route network across the entire Central Okanagan	$	ST	City of Kelowna, with other Central Okanagan governments, as required

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action A.5: Manage travel demand (shift commuters to bike, walk, transit, and promote work from home, etc.)				
9	Ensure robust parallel biking, walking and transit infrastructure is maintained to encourage modal shift away from single-occupancy vehicles	$$$$	Ongoing	City of Kelowna and other Central Okanagan governments, as required, BC Transit
10	Encourage work from home and other travel demand management strategies to take pressure off roadways needed for goods movement	$	Ongoing	City of Kelowna, MOTI and other Central Okanagan governments, as required
11	Investigate sustainable transportation opportunities to serve employees travelling to/from YLW / Gateway and other industrial areas	$	ST	City of Kelowna (including YLW) with BC Transit, UBCO and other gateway landowners
Action A.6: Incorporate goods movement into future Highway 97 corridor planning				
12	Incorporate goods movement into future Highway 97 corridor planning to ensure the safe, efficient and sustainable movement of both people and goods	$	Ongoing	MOTI with City of Kelowna, adjacent landowners and other Central Okanagan governments, as required

Strategic Direction B: Increase resiliency of road and air access to/from the Central Okanagan, including support for intermodal (rail-truck) terminals in the BC Interior

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action B.1: Continue to advance planning and implementation of improvements to highway infrastructure outside of the Central Okanagan to improve resiliency				
13	Support highway infrastructure improvements outside the Central Okanagan	$$$$	MT-LT	MOTI
Action B.2: Support the development of intermodal (rail-truck) infrastructure in the BC Interior				
14	Support intermodal (rail-truck) infrastructure improvements, such as an inland rail terminal, that could provide an alternate mode of transport to the BC interior in addition to truck transport. This should be supported if intermodal rail infrastructure can demonstrate the ability to achieve modal shift from truck to rail, reduce greenhouse gas emissions, reduce highway wear, and free up road and port capacity for truck trips from the Central Okanagan that cannot shift modes	$$-$$$$[82]	ST-LT	MOTI with infrastructure developers

[82] Level of support could vary, but should be commensurate with benefits to be achieved.

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action B.3: Plan for Kelowna International Airport's strategic role in goods movement				
15	Plan for Kelowna International Airport's strategic role in goods movement (e.g., during highway closures) and develop a climate adaptation plan for the airport	$	Ongoing	City of Kelowna (including YLW)
Action B.4: Formalize and disseminate lessons learned from 2021 outages				
16	Publish and distribute lessons learned from 2021 outages caused by atmospheric river events, and identify further opportunities to improve resiliency working with the Province, Central Okanagan governments, first responders and private sector	$	ST	MOTI, with other ministries, RCMP
Action B.5: Consider developing digital tools to improve route planning and productivity for truck drivers				
17	Investigate the feasibility of a province-wide truck route map app	$	ST	MOTI with BCTA
18	Consider opportunities to provide commercial vehicles additional information about their payload before a trip departs the Central Okanagan	$$$	MT	MOTI
19	Consider developing digital tools and educational material to improve route planning and productivity for truck drivers, as well as to help shippers get their goods to market	$	ST	MOTI with BCTA, producers in the Central Okanagan
Action B.6: Consider opportunities to improve driver amenities and highway maintenance practices				
20	Review the demand for driver amenities for long-haul truckers, such as parking and rest stops, and as required, implement new or upgrade existing facilities around the Central Okanagan	$$$	MT	MOTI with Central Okanagan governments, as appropriate
21	Monitor winter highway maintenance practices on highways to/from the Central Okanagan, particularly Highway 97C	$$	MT	MOTI

Strategic Direction C: Protect industrial land supply and coordinate with transportation infrastructure projects

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action C.1: Protect existing industrial lands in the Central Okanagan				
22	Protect existing industrial land supply for traditional goods-generating sectors and logistics activities (e.g., warehousing and distribution)	$$$	Ongoing	Central Okanagan governments

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
23	Ensure that sufficient zoned and designated land is available to accommodate emerging industries in appropriate locations	$	Ongoing	Central Okanagan governments
24	Consider how new technologies could be deployed to locate and integrate warehouses and distribution centres in denser urban areas	$	Ongoing	Central Okanagan governments
25	Apply best practices for land-use planning, site design and access	$$	Ongoing	MOTI and Central Okanagan governments
Action C.2: Protect trade lands at the Kelowna International Airport (YLW)				
26	Maintain and apply existing residential densification restriction policies applicable in zones around YLW	$	Ongoing	City of Kelowna
Action C.3: Enhance truck access and manage truck flows to the Jim Bailey Industrial Area				
27	Continue to minimize impacts of truck activity on Duck Lake Reserve.	$$$	ST-MT	MOTI, City of Kelowna, District of Lake Country, OKIB
Action C.4: Implement a process for developing transportation infrastructure projects to support commercial/industrial land development				
28	Implement a process for developing transportation infrastructure projects to support commercial/industrial land development. Develop funding agreements between multiple levels of government to program required infrastructure into municipal capital plans and Development Cost Charge programs	$	Ongoing	MOTI, City of Kelowna and Central Okanagan governments

Strategic Direction D: Plan for goods movement in urban areas

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action D.1: In existing developed areas, improve the flow of first- and last-kilometre deliveries made on-street				
29	Conduct an urban goods movement operational review, e.g., off-hours delivery, on-street loading	$	ST-MT	City of Kelowna, other Central Okanagan governments as applicable, and MOTI
Action D.2: In new developments, limit on-street deliveries				
30	Ensure new developments can accommodate existing and future goods movement practices and minimize demands for on-street delivery	$$$	Ongoing	City of Kelowna, other Central Okanagan governments as applicable, with developers

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action D.3: Prepare for and support emerging sustainable delivery practices				
31	Ensure that municipal policies, regulations and bylaws have language that enables the potential introduction of sustainable goods movement initiatives for first- and last-kilometre delivery	$	ST	City of Kelowna, other Central Okanagan governments as applicable
32	Examine ways to leverage business opportunities for managing first- and last-kilometre deliveries	$$$	MT	City of Kelowna, with local businesses and delivery companies; MOTI for provincial guidance
33	Identify opportunities to right-size goods movement vehicles in urban areas	$	ST	City of Kelowna, with local businesses and delivery companies; MOTI for provincial guidance
Action D.4: Promote safety of goods movement vehicles to reduce impacts on vulnerable road users				
34	Review and as appropriate update provincial legislation, regulations, standards and guidelines to further enhance the safety of goods movement	$$$	MT	MOTI and City of Kelowna

Strategic Direction E: Accelerate adoption of zero-emissions goods movement vehicles and provide supporting infrastructure

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action E.1: Investigate opportunities to green provincial and municipal fleets of medium- and heavy-duty vehicles				
35	Among provincial agencies, investigate opportunities to directly procure or encourage contractors to procure low- or zero-emissions fleet vehicles	$$	ST	MOTI
36	Review Kelowna's Green Fleet Strategy (and those of other Central Okanagan governments, as applicable) to ensure they incorporate the latest opportunities to procure zero-emission medium- and heavy-duty vehicles and consider whether fueling/charging facilities could be incorporated into municipal lands	$$	ST	City of Kelowna (and other Central Okanagan governments)
Action E.2: Set market incentives and implement supportive infrastructure				
37	As a priority, continue to implement a medium- and heavy-duty zero-emissions vehicle provincial sales standard	$$	ST	MOTI

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
38	Investigate the feasibility of incentivizing zero-emissions light- and medium-duty commercial vehicles to utilize HOV lanes, and consider expanding the provincial decal program to facilitate enforcement	$	ST	MOTI
39	Investigate the need for public charging and low/zero-emissions refueling stations to support goods transporters and couriers	$$	MT	MOTI, Central Okanagan governments, with BC Hydro, Fortis BC, private EV infrastructure suppliers/operations
Action E.3: Prepare for other new technologies related to goods movement				
40	Develop provincial planning guidance to help municipalities ensure that roads, intersections and on-street parking can accommodate new technologies, especially autonomous commercial vehicles but also electric vehicles	$	ST	MOTI

Strategic Direction F: Continue to improve public and private sector collaboration on goods movement

#	Recommendation	Approximate Cost	Approximate Timing	Lead / support
Action F.1: Develop a regional freight council				
41	Develop a regional freight council to anticipate, address and act on goods movement needs	$	MT	Central Okanagan governments with local business groups, economic development associations and agricultural associations
Action F.2: Improve ongoing freight data collection				
42	Establish a data collection initiative for the region	$$$	MT	City of Kelowna with MOTI
Action F.3: Promote the importance of goods movement and ways to limit its impact				
43	Work with private-sector stakeholders to develop public-facing evidence-based material that communicates: a. the importance of goods movement to the economy but also people's lives b. principles of consumer behaviour that can help lower transportation impacts when using e-commerce.	$	ST	MOTI and City of Kelowna, with BCTA, goods movement business associations

Appendix A Stakeholders, Central Okanagan governments, and First Nations interviewed

Organization
007 Group
A large courier company
AEM
BC Tree Fruits Cooperative
BC Trucking Association
Canadian Tire
Central Okanagan Economic Development Commission
City of Kelowna (as part of a focus group)
City of West Kelowna (as part of a focus group)
Costco
DCT Chambers
District of Lake Country (as part of a focus group)
District of Peachland (as part of a focus group)
Environmental 360 Solutions (E360S)
Gordon Food Services
Gorman Brothers Lumber
Jealous Fruits
Kelowna Chamber of Commerce (as part of a focus group)
Kelowna International Airport
Okanagan Indian Band
Regional District of the Central Okanagan (as part of a focus group)
Save-on-Foods
Van-Kam Freightways
Westbank First Nation
Westside Board of Trade (as part of a focus group)

Appendix B Themes from engagement

Issues and constraints from stakeholder engagement

We engaged with 23 public- and private-sector stakeholders representing businesses/shippers, truck carriers, infrastructure owners, municipalities, and First Nations (Appendix A). This engagement occurred through one-on-one interviews or small focus groups. We also received two written responses, from a trucking carrier and local business. We themed the following 10 issues and constraints (below), as well as opportunities, solutions and existing actions working well.

Lengthy and variable travel time along Highway 97 due to congestion and traffic signals

Many stakeholders cited the lengths duration of travel times along the Highway 97 corridor through the Westside and Kelowna as their top concern or was the first issue raised.

Congestion on Highway 97 is a top concern for most stakeholders involved in moving goods into/out of/around/through the region. Many stakeholders cited the lengthy duration of travel times along the Highway 97 corridor through the Westside and Kelowna as their top concern or was the first issue raised. This included stakeholders who had goods movement patterns coming into, out of, around or internal to the goods the area. Without implying representativeness, one stakeholder mentioned for example that it often takes them 30 minutes to travel from their office near Highway 97 at Sexsmith Road to downtown Kelowna, a distance of only 10 km (i.e., 20 km/h) along Highway 97.[83]

Many highlighted that the issue was caused by the volume of non-goods movement vehicles. It often came up in the context of a discussion that congestion was historically only significant in the summer tourist seasons, but now seems to be spreading across all months of the year. One characterized it that the summer congestion was “brutal,” but that now it seems to occur all the time.

Many stakeholders cited the many at-grade signalized intersections along the Highway 97 corridor from the Westside through Kelowna as a primary cause of lengthy travel times. One stakeholder mentioned that they perceived efforts at creating a “green wave” for passenger vehicles, i.e., when adjacent signals are timed to allow vehicles to progress through multiple successive green lights. However, the same stakeholder, as well as at least one other, mentioned that because heavy goods movement vehicles (i.e., trucks) have slower acceleration, these vehicles can get stopped at repeated lights (and in some cases, at the same light through multiple cycles). Anecdotally, one stakeholder mentioned that their driver counted 20 minutes stopped at red lights between the WR Bennett Bridge to Sexsmith Road (about 10 km) as measured using its electronic logging system. The stakeholder noted that because trucks are slow to accelerate, their drivers will often hit consecutive red lights. One goods movement stakeholder explicitly said they do **not** experience a green wave in their goods movement vehicles.

It is worth noting that none of the stakeholders thought that the extended travel times was due to the WR Bennett Bridge itself, and several noted that they understood the issue relates to the signalized intersections on either side. In fact, one discussion suggested that “everyone” knows that

[83] For comparison, Google Maps provides an estimated travel time of between about 12-35 minutes if departing around 4:30 PM.

the bridge is not the issue causing congestion. (There were, however, concerns about the alternatives to the bridge if it becomes unavailable or congested, for example from a crash.)

Beyond overall volumes and signal timing, the following concerns noted to be contributing to congestion along the corridor and impacting goods movement:

- **"Surprising" business accesses along Highway 97:** Multiple stakeholders mentioned that there are multiple accesses on/off the Highway 97 that impede the flow of traffic. One stakeholder mentioned that there are "surprising" business accesses along Highway 97. The stakeholder mentioned the access to Orchard Park Shopping Centre, though there appear to be multiple along this corridor. Another stakeholder mentioned that there is a challenge of permitting access to businesses along this corridor to enable their continued business activity, while enabling efficiency of the overall corridor.
- **High occupancy vehicle (HOV) lanes impact on goods movement:** HOV lanes run through Kelowna along Highway 97 between Water Street to Highway 33 and are in effect between 7:00 AM to 7:00 PM.[84] A courier stakeholder mentioned that because they need to frequently turn right to deliver to businesses, they have to use the middle lane, which they perceive to move slower than other lanes. Other stakeholders mentioned that they are concerned that the rules respecting the HOV lanes are not being enforced, so question the value of them (particularly if it is deleterious to overall traffic flow). Another suggested using the HOV lanes for goods movement vehicles.

One stakeholder also mentioned that because of the congestion, all it takes is one incident to back up traffic on Highway 97. In other words, the reliability of travel time can also be poor. It was noted that the normal trip that the stakeholder could take would be 20 minutes during free flow (i.e., overnight), but takes an hour during peak times.

Congestion through Vernon was also raised by some stakeholders, but it was not further explored as it is outside of the study area. By comparison, it was noted that south of Peachland on Highway 97 the highway bypasses communities, so congestion was less of an issue.

Some stakeholders did acknowledge that alternatives to Highway 97 do exist, but they are circuitous depending on the origin/destination. Alternate routings, while much longer, are possible via Westside Road, Highway 3 to 33, Highway 5A to 5. Also, the Forest Service Road 201 has been activated in the past to provide additional emergency alternate route.

Some of the implications of this issue are described in the box on the next page.

[84] BC MOTI. HOV Kelowna. https://www2.gov.bc.ca/gov/content/transportation/driving-and-cycling/traveller-information/routes-and-driving-conditions/hov-lanes/hov-kelowna

Implications

- Congestion is a top concern for the people and businesses involved in moving goods and services around the region.
- Increased travel times and reduced reliability of those travel times can increase not only the cost of transportation but can also increase the cost of logistics. Some illustrations of this include:
    - **For all types of goods (perishable or nonperishable), stakeholders argued that extended travel times increase cost of transportation**, because it requires additional time by the driver and trucks (i.e., can reduce the number of round trips by the truck within driver hours of service limits). In turn, these costs may be passed along to the shipper (i.e., business), who in turn could pass it along to customers. To support this argument, one stakeholder argued that trucking is a "cost-plus" business. Because of the competitive nature of the industry, any incremental cost such as tolls is ultimately passed along to businesses.
    - Produce can only be stored/transported without refrigeration for a couple of hours after harvesting. **Therefore, companies have to construct receiving facilities throughout the Central Okanagan or invest in refrigeration at the farm to stay within that time window for transport.**
    - A stakeholder with experience in concrete delivery mentioned there have been occasions when, in his direct industry experience (of about one year), concrete trucks had to be returned to the plant because they could not be unloaded in time. Concrete has a four-hour perishability window between when it is produced and when placement needs to be completed. He also heard indirectly of experiences when concrete had hardened in trucks.
- These impacts can, in turn, reduce the competitiveness of businesses relative to their competitors elsewhere, and have different implications depending on the industry. For example, a high-tech sector can tolerate additional cost of air courier service but cannot tolerate shipments being regularly late from the Central Okanagan due to congestion on Highway 97. In the extreme, it can lead to a business shutting down or not being attracted to a region, in turn having an economic impact for the region as a whole.
- **Carriers will bypass the Central Okanagan if it is not essential for them to travel through,** even if the bypass route is longer. For example, drivers heading from the Okanagan Valley south of the Central Okanagan to Edmonton prefer to bypass via Highway 97C and Highway 5, even though they burn more fuel (order of 10 litres) than running through the Central Okanagan. Another company with a depot in Vernon mentioned their drivers will travel through Kamloops and Highway 5 to reach Vancouver, despite it being about 30 km longer (according to Google Maps). One company, with locations throughout BC, indicated none of their trucks do a pure through move through the Central Okanagan.
- For courier-dependent shippers, one mentioned that the cut-off window is earlier the further from the airport area (where courier depots are located). For example, cut-off window is one hour earlier near downtown than areas around Midtown. Several stakeholders noted that the courier windows in Kelowna are already fairly early relative to larger urban areas (i.e., 1:00 or 2:00 PM), which we understand is because packages from Kelowna will have to transit via Calgary or Vancouver. One business indicated that they will pay a premium to hotshot (direct courier) packages to the depots around the airport and pay premiums for faster courier service, as on-time deliveries are essential for their industry.
- There were concerns that the commercial vehicle traffic/congestion contributes to noise and air pollution in the Highway 97.

Constraints in access to/from Central Okanagan: Limited alternatives for truck routes between Vancouver and the region, insufficient winter maintenance, and insufficient rest stops between Central Okanagan and Vancouver

Many stakeholders noted that the Coquihalla (Highway 5) is the primary highway used to access the Central Okanagan by truck from distribution centres (DCs) in the Lower Mainland. Many noted that the highway itself is excellent, with the exception perhaps of one steep section. One stakeholder mentioned the Highway 97C connector has been great for the region (in terms of economic development).

However, a number of concerns were raised about the availability, redundancy and resiliency of road access to/from the Central Okanagan, as well as to/from the Lower Mainland to the rest of Canada). Stakeholders noted that alternative routes exist, i.e., Highway 1 and 3. However, one stakeholder perceived Highway 1 is subject to more slides and multiple noted Highway 3 as dangerous/less safe, particularly as a high-volume truck route and in the winter.[85] They had drivers who refused to drive on Highway 3 during the flooding event when it was the sole route to the Central Okanagan.

The implications of this context were illustrated using two categories of issues:

1. **The reoccurring short-duration seasonal closures and rerouting on corridors serving the Central Okanagan:** Stakeholders noted that it is not uncommon for there to be closures and re-rerouting during the summer and winter, including due to fires, crashes, slides and snow. It was also noted these events can also strand drivers along the corridor. One stakeholder mentioned that it is not uncommon to have all three access roads closed to the Central Okanagan during a winter, though usually one route is open within 24 hours.

Figure B-1: Highway 5 during closure

Source: DriveBC Screenshot

2. **The impact of a major multi-week outages across all three corridors serving the Central Okanagan, as illustrated by flooding event in November and December 2021:** Some stakeholders noted that an event of this impact was not considered in their contingency planning (i.e., they had not envisioned having to serve the Central Okanagan out of their Calgary DC). It would also be fair to say that the implications of this outage were much more threatening to the region in terms of being able to resupply their needs, as well as export products to market (see box on implications).

It would also be important to note the role of this corridor as an alternative to rail service, as well as its role in resupplying DCs in the Lower Mainland (see box below).

[85] The context for these discussions around Highway 3 was the rerouting that occurred during flooding in fall/winter 2021, when weather conditions were poor and truck volumes were high. In normal conditions, Highway 3 is used for access to the Central Okanagan. One stakeholder noted it is used when a truck is making deliveries along Highway 3 before travelling to the Central Okanagan.

Impact of rail outages on the Central Okanagan and dual importance of highways serving the Central Okanagan

Some of the discussions drew a connection between rail service through BC and serving Central Okanagan. Most shippers serve the Central Okanagan out of DCs in the Lower Mainland. Many of these companies ship goods from Eastern Canada in containers loaded on railcars to these distribution centres. Thus, when there are rail service outages in BC, more goods need to be transported by truck between terminals and distribution centres in Alberta east. One stakeholder mentioned that following the Lytton Fire when rail was out of service, major shippers had to use all available trucking capacity to provide a land bridge between BC and Alberta.

Thus, highways in Central BC serve dual purposes related to goods movement to/from the Central Okanagan: (1) to directly resupply businesses in the Central Okanagan and (2) as an alternative to rail for goods coming from east of BC, which are in turn destined to the Central Okanagan. Stakeholders noted that Highway 1 is a challenging route to drive due to the grades and winter conditions, though it is being improved (see figure below). Stakeholders also noted winter conditions on Highway 5 and 97C as being challenging to drive.

Construction of Highway 1 east of Golden with goods movement vehicles in view, summer 2021

Source: CPCS

The number and maintenance quality of rest stops and facilities between Kelowna and the Coast was identified as concern. One carrier mentioned chaining up is very difficult in the wet snow experienced in the corridor. Multiple stakeholders also noted insufficient road maintenance and plowing of the highway during the winter months, including not enough plows to keep up with the snow. One stakeholder mentioned that when they personally drive the route it is “hit and miss” whether those roads are being worked enough and they would like to see better maintenance during

the winter. One company mentioned that they would never send a tractor or a bare chassis on the roads in the winter between BC and Alberta, as it is too dangerous.

When raised, using routes via the US as an alternative did not appear to be a feasible alternative during the flooding. Some stakeholders noted that there were government efforts made to allow trucks to move through the US (Washington State). However, this took requisite permissions from US government, bonding, etc., which takes time and effort by private-sector companies to acquire as well as the requisite permissions from the US government agencies. It was not feasible in the short-term to do so.

Implications

- **Regarding issues related to reoccurring seasonal closures, stakeholders mentioned that they work to operate safely.** As evidence, one shipper stakeholder mentioned that they rarely, if ever, get reports that there has been lost cargo along the route between the Lower Mainland and Central Okanagan. Another stakeholder mentioned that they have rarely been disrupted by these closures. However, the seasonal outages do slow down the movement of cargo and it is a concern. Stakeholders mentioned that it is also difficult to attract drivers to serve between the Lower Mainland and Central Okanagan, noting that it is a long and difficult drive particularly during the winter.
- **The impact of the multi-week outage was much more severe** in terms of implications for the Central Okanagan.
    - Outages threatened the ability of local manufacturing and agricultural/viniculture to get products to market. In addition, one business that provided waste management services ran out of storage capacity during the flooding because they were unable to ship out product. In turn, additional land needed to be located for storage during the outage.
    - Multiple retailers mentioned that they were able to pivot to serving their stores and customers in the Central Okanagan out of Alberta-based DCs, but that they lost capacity because of the longer truck cycle times. This meant that in some cases they had to prioritize the customers they served, because they did not have sufficient capacity to serve both well (e.g., prioritizing long-term care facilities versus fast food restaurants). The corridor Highway 1 corridor between Alberta and BC is also very challenging to operate on (even more so than Highway 5) due to grades and winter disruptions.
    - Many of the sectors essential to the Central Okanagan's economy and quality of life (e.g., hospitality and food service, healthcare, grocery stores, etc.) rely on just-in-time delivery. One food service delivery business mentioned that their customers can place their orders up to late afternoon the day before the delivery (which is shipped out of a warehouse in the Lower Mainland the same evening). Thus, even a less than one-day outage can impact the resupply of facilities in the region.

Concerns about access to commercial and industrial areas along Highway 97

Adequacy of left-hand turn bays

Some stakeholders mentioned that the length of the turning bay (and in some cases, possibly the length of the protected phase) may not be adequate to allow vehicles (including goods movement vehicles) to turn left into commercial areas off Highway 97. Two distinct locations/areas were noted:

- **Left-hand turn from Highway 97 eastbound to Gordon Avenue northbound** had too short of bay and light timing (despite the closure of the Tolko Mill lessening truck volumes, per

stakeholder comments). This location was noted as being the primary truck route access to commercial and industrial areas in North Kelowna, because trucks are not permitted travel along the parallel Ellis Avenue through downtown. Gordon Avenue is the truck route through the area. Stakeholders also mentioned there were pavement quality issues in this area.

- Left-hand turn bays along Highway 97 northbound through Midtown Kelowna (including at Dilworth Drive, Cooper Road, Leckie Road and Banks Road) were not perceived to be adequate by one stakeholder, noting that there is a lot of volume of goods and non-goods movement vehicles going into commercial areas on either side of Highway 97

Areas where improved left-hand turn access is desired

In addition, some stakeholders noted the need to improve left-hand access on/off of Highway 97, including at:

- Old Vernon Road and Highway 97, north of YLW, to facilitate industrial park development
- The area on either side of Highway 97 in the vicinity of the Jim Bailey Industrial Park to facilitate goods and people movement to businesses in the area and improve safety. Highway 97 at Glenmore Road was noted as not being suitable for larger trucks.

Other intersections or access corridors identified

In the interest of completeness and being explicit about stakeholder feedback, the following additional intersections or access corridors were noted with issues:

- Highway 97 and Glenmore intersection is not suited for bigger trucks
- Congestion at intersections south of the airport along Highway 97: Sexsmith Road, McCurdy, Highway 33, Edwards to industrial lands, Leathead/Enterprise
- Congestion at Highway 97 and Westside Road interchange
- Traffic issues on Pandosy and Richter Streets in Kelowna
- Congestion at Highway 97 and Campbell Road; on-ramp very short with no room for expansion
- Traffic issues at Hwy 97 and Boucherie interchange
- Congestion at multiple at-grade intersections in Kelowna and Westside; limited land available for multi-level interchanges
- Traffic issues in East Kelowna on Benvoulin Road
- Unable to drive semi-trucks on East Kelowna Road at Mission Creek
- Highway 97 and 33 are not well synced during the busiest parts of the day for traffic and goods and concern about the intersection at Highway 33 and Rutland Road N, ultimately leading to logging trucks using Rutland Road N towards Sexsmith Road

Impact of HOV on access

In addition, stakeholders mentioned they have to cross over these lanes to access businesses for deliveries.

Trend towards greater use of long-combination vehicles (LCVs) and implications (as commented by MOTI)[86]

In the Central Okanagan, Commercial Vehicle Safety and Enforcement (CVSE), MOTI, is receiving more frequent LCV requests for both Turnpike Double (TPD) and shorter Rocky Mountain Double combinations to help carrier operational efficiency in the transport of consumer goods. Factors quoted as part of recent requests include fuel costs and driver shortages.

There are approximately 5 TPD operators in the Kelowna area. TPD operators typically run up to 4 round trips a day from each end of an approved route which is the equivalent of 8 single trips, for a total of 40 TPD trips per day in the Kelowna area, an increase from zero in 2008.

Highway designs do not consider TPDs as a typical design vehicle. Smaller vehicles such at the I-Bus or WB-20 or B-Train are considered typical design vehicles. TPDs can typically stay within designated travel lane on provincial standard highway designs; however, turns on/off the provincial highway are a challenge. Infrastructure is designed to accommodate smaller design vehicles, so TPDs may have to use multiple lanes of traffic to make a turn (i.e., not just going from the rightmost lane to the perpendicular rightmost lane).

An example of a challenging location in the Central Okanagan that has had more recent TPD requests is Highway 97 at Airport Way in the City of Kelowna. Use of multiple lanes is required for TPDs to turn on/off Highway 97 at Airport Way and it is difficult to further optimize signal timing to allow for additional time and gaps for TPDs (and/or general traffic) to turn on/off Highway 97. It is not uncommon for general traffic to wait multiple cycles at the Hwy 97/Airport Way signal while a TPD is making its turn.

Implications

- The adequacy of left-hand turn bays may be contributing to delays of trucks accessing the North End of Kelowna
- One business north of the airport mentioned that they did not believe they could expand into retail and e-commerce until safe access was provided into their property, as it is currently unsafe to make a left turn off of Highway 97 heading northbound absent a signalized left-hand turn lane at or near their property
- The lack of left-hand turn access off of Old Vernon Road (north of YLW) onto Highway 97 would constrain industrial development along Old Vernon Road on the east side of YLW

Concerns about the availability and cost of serviced industrial land supply and buildings

This was an issue primarily raised by business groups, noting work has been done by the City of Kelowna. The City of Kelowna's 2040 OCP:

> … projects a significant increase in industrial development over the next twenty years. Over this time, it is expected that Kelowna's manufacturing sector will continue to decrease, but growing demand for storage, distribution, warehousing, cannabis and other uses will drive demand for industrial space. The shift away from manufacturing and heavy industrial activity reflects Kelowna's ongoing transformation to a regional service centre and the growth of knowledge-based employment.

[86] This section is based on information provided by MOTI.

> Over the last several years, Kelowna has seen a severe shortage of affordable, serviced industrial space as a result of speculation on industrial land for more valuable commercial uses, such as hotels and retail. From 2017 to 2019, the City has witnessed extremely low industrial vacancy rates (1-3 per cent), highlighting the strong demand for industrial space.
>
> By 2040 the OCP projects roughly 323,000 square metres of new industrial space with the greatest demand from 2031 to 2040. Industrial development will be challenged by the lack of land available for low-density industrial projects and the inability for industrial uses to be incorporated into mixed-use projects. Overall, the 2040 OCP projects the need for approximately 95 hectares of land to meet the demand for industrial businesses as well as retail businesses using industrial space over the next 20 years . . .

Another stakeholder also echoed that the vacancy rate for industrial land use is low. Many stakeholders noted that there is a lack of affordable industrial land, with anecdotal findings from the stakeholder engagement include:

- One business noted that they explored locating around the airport (which would be more suitable for courier access), but the area did not have sufficiently large buildings that would suit their business. It is also less desirable location to attract a skilled workforce due to the distance from residential areas.
- Another stakeholder provided examples that the availability of commercial and industrial land is limited, and cost is high. They noted that one company they are familiar with purchased an industrial parcel for storage in the Lake Country area for $1 million. They also noted that another person they are familiar with is looking to purchase a commercial lot with frontage and access onto Highway 97, but cannot find anything under $10 million for a single parcel.
- Multiple stakeholders cited asking prices of $1 million/acre or similar costs for land development.

One possible reason for the high cost of land noted by the stakeholders was the various constraints, including the lakes as well as the preservation of agricultural lands. We also heard that better access to Highway 97 would be needed to unlock industrial land development (or the highest use of an existing facility to provide mixed services, such as retail).[87] This is because the existing accesses could not safely accommodate left turns onto/off Highway 97.

Though not framed quite as such by stakeholders, several comments highlighted the challenge of systematically incorporating economic development opportunities (i.e., industrial land development) within planning processes:

- One stakeholder mentioned that they had designed their facility to accommodate a frontage road. The stakeholder asked what they could do to continue to advocate for the development of a frontage road, noting that they have opportunities to expand and the facility would benefit only them.
- In another location, an existing transportation plan did not contemplate upgrading the left turn onto Highway 97 to a potential industrial site development. The stakeholder involved in the development noted that at the time of the study, they had not identified an anchor tenant, so the development was speculative.

These locations were north of the airport.

[87] Absent improved access, the stakeholder noted that they did not feel comfortable offering retail, as it would require a left-hand turn off of Highway 97

It is also worth noting that there are fewer guidelines for commercial and industrial development in the RDCO. While this could allow for additional commercial and industrial developments, it also creates the potential for conflicts with non-compatible land uses and related goods movement, which would not support related goals of sustainability and livability.

Implications

- One stakeholder mentioned the need to be realistic about the types of industries that the Central Okanagan region can attract. For example, they noted that they will get inquiries looking for a 200-acre parcel. The stakeholder noted that something like this realistically cannot be served in the Central Okanagan.
- One stakeholder noted that they are unable to grow their business into a more retail operation without adequate road access.
- Another stakeholder noted that they would not be able to develop industrial land without road access off of Highway 97.

Cost and supply of trucking

Stakeholders mentioned that the cost and availability of trucking at multiple points of the supply chain was a challenge.

First, there was the high and cumulative cost of truck drayage between port terminals, rail terminals, transload facility and storage locations in the Lower Mainland. When a marine container arrives in the Lower Mainland, multiple trucking moves are required before it is transported inland, which is known as drayage. One stakeholder noted the high cost of drayage activities in the Lower Mainland, including rates for each move and $50 for port terminal truck gate reservations.[88] The same stakeholder also mentioned that they employ a small team of analysts to make the truck reservations at port container terminal reservations.

This first issue was raised as an ongoing issue (not necessarily brought on by the pandemic and related supply chain challenges). The second issue described below was described in the context of the pandemic.

Several shippers consulted noted that the availability and pricing of trucking capacity into/out of the Central Okanagan region has increased to a point that it is not sustainable. Most consulted cited that the trucking rates have **tripled or quadrupled** during the pandemic. One stakeholder noted it went from about $2000 per load, to about $8000 per load (i.e., 53-foot trailer). (Fuel prices have increased by 30% as a component of trucking costs.)

Some stakeholders first contextualized that because there are not any ground-based alternative modes into/out of the Central Okanagan, the vast majority of goods are moved into and out of the region are by truck. (Even if goods are sent by air, they will also be sent by a goods movement vehicle such as a truck to its final destination.)

Several stakeholders raised a separate but related concern about the availability of drivers, including noting that the average age of drivers continues to increase. Barriers to attracting new drivers was particularly cited as a concern, including limited recent immigration, inability to start attracting drivers in high school (due to the graduated licensing system and lack of trade designation for trucking),

[88] This fee is charged during certain periods of the day.

cargo insurance-imposed requirements that drivers need to have a minimum of two years of experience, and driver preference for short-haul versus long-haul trucking.

Some carriers consulted indicated that their adherence to government rules and more stringent standards puts them at a competitive disadvantage in attracting drivers. For example, some companies still do not use e-logs, enabling drivers to work longer than permitted; those using e-logs have difficulty attracting drivers and longer routes are impacted. Some trucking companies also limit speed on trucks. Drivers gravitate to smaller companies that offer higher mileage rates and single trip contracts in lieu of benefits such as RRSP contributions and health benefits or new equipment.

Implications

- We heard from one business that was planning to close its plant in the Central Okanagan at least in part due to supply chain issues. It noted that it has manufacturing plants around the world and the cost to move products to the ultimate markets made it difficult to manufacture and export in Western Canada. The stakeholder noted that supply chain disruption inbound on materials was also a contributing factor to the decision to close, but less so than outbound finished goods.
- Some stakeholders noted that they were able to source sufficient truck drivers to establish a road land bridge during the November-December 2021 flooding, but noted that large companies likely used all available trucking capacity.
- Following the implementation of the federal requirement for cross-border truck drivers to be vaccinated, one company noted that they had to reduce their cross-border operations and focus on intra-US movements. It was also a contributing factor to being unable to re-route through the US during the November-December 2021, as they did not have sufficient supply of drivers to make the longer trip.
- An online survey response noted that consolidation opportunities have increased in response to rising fuel and transport costs

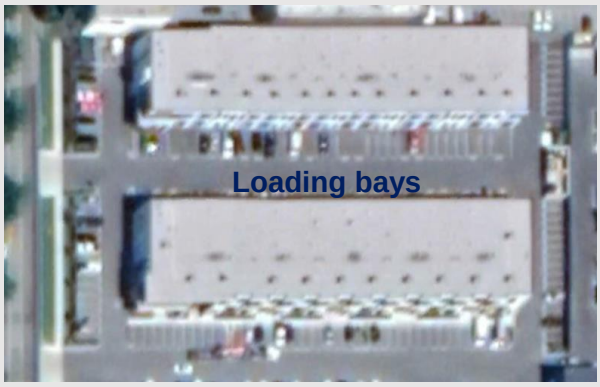
Challenges with deliveries and preparing for continuing to supply residences and businesses in a densifying urban core, including challenges with parking and alleyways

Stakeholders identified several challenges making pick-up and deliveries in commercial and residential areas in the Central Okanagan:

- **Inadequate site design to allow goods movement service in commercial and industrial strip mall-style developments:** In Kelowna, there are a lot of industrial and retail strip malls which were constructed without freight access in mind, including having only one access point (requiring a careful multi-point turn or to back onto the street) or having the building constructed slightly too large to allow flow through around the building. In some cases, this means the company serving the business needs to use a smaller vehicle. In other cases, the carrier will still use a large truck, but then park in the street. One stakeholder perceives the underlying issue that the City has not assessed the ability of vehicles to access the property during permitting.
- **Limited on-street loading zones in downtown Kelowna:** Multiple delivery companies mentioned that they get parking tickets regularly, as they cannot find adequate loading space. Stakeholders noted that back alleys are not generally an option for delivery as they are skinny, have low wires,[89] store owners park in the alley, and there are garbage bins. This stakeholder mentioned that they are usually using a five-tonne straight truck for delivery downtown.
- Multiple stakeholders mentioned that new residential streets and alleys were very narrow and sometimes do not allow flow through: While residential areas are typically less significant goods generators, they do require service for deliveries (including home-based businesses, which are allowed in the area) as well as pick-ups

Examples of site access cited

One stakeholder noted site challenges at some new developments in the Dilworth Area. They noted some buildings were designed to allow access around the buildings, but the building is probably 10 feet too long to get around the building with a 40-foot trailer. The stakeholder did not cite any specific buildings, though the figure below shows a possible illustration. Loading bays appear to be located along the north side of the south building. Depending on whether vehicles are parked, it is likely not possible to turn around within the channel, nor necessarily circulate around the building.



Source: CPCS, adapted from Google Earth/Maxar Technologies.

One stakeholder mentioned that they observe multiple car carriers (see example figure) unloading in the middle of the street on a daily basis along Enterprise Way. They noted there is not room within the property to unload and has observed a car hitting the unloading car carrier.

Source: Jim.henderson/Wikipedia/ CC BY-SA 4.0

[89] The stakeholder perceived that as these were upgraded, wires were being removed and buried.

like garbage and recycling. One stakeholder mentioned that the streets are so narrow that, with parking allowed, it is difficult to flow through a corridor let alone safely park to allow for delivery. Another mentioned that because some residential streets are narrow and dead-end, they have often have to back-in to serve the same area.

- **Bike lanes can slow down goods movement:** One stakeholder mentioned they have to move slower when merging from alleys onto roads like Richter, where there are bike facilities.

Building on these concerns, stakeholders, looking forward at the growth to be expected in Kelowna and drawing on experience from other jurisdictions, recommended that the City of Kelowna, as well as other governments in the Central Okanagan, ensure that residences and businesses in central business districts can continue to be resupplied as the region densifies (see e.g., photo of Vancouver in Figure B-2).

Figure B-2: Alley deliveries in downtown Vancouver

Source: CPCS

Tourism was also noted as a big local industry. Multiple discussions highlighted that while service sectors such as restaurants, hospitality and healthcare are not typically regarded as “goods generating,” getting goods to/from these locations is essential to support tourism as well as quality of life. These sectors rely on the resupply of food, medical supplies, among other products.

In the context of this issue, stakeholders also highlighted the need to ensure affordable housing in close proximity to workplaces for workers in the hospitability and goods movement sector, which is typically lower wage. One stakeholder argued that if these workers are forced to live farther away (by challenges affording accommodation close to their work), that it further contributes to the challenges of congestion that the region experience.

Implications

- Stakeholders across sectors mentioned that in some cases they *can* use smaller trucks and vans, but because a smaller vehicle holds less cargo, they need to use more vehicles and make more trips for the same volume of goods. While the upfront cost of the vehicle is lower, they lose productivity in the vehicle and driver, in part as there is unproductive time spent going to/from the depot to their first delivery. This in turn means that the cost of providing service increases, which is ultimately passed along to the consumer.
- Stakeholders raised safety concerns with the need to often park on the streets to serve businesses and residences in the area.
- Goods movement stakeholders noted the inadequacy of loading zones means they will receive parking tickets when making deliveries.

Challenges pursuing decarbonization of goods movement vehicles

This issue was not raised top of mind by any stakeholders, though multiple indicated that they were exploring or piloting alternative fuel vehicles, including to meet Environmental, Social, and Governance (ESG) expectations of investors. They were also candid about some of the issues that they are facing, including:

- **With respect to federal and provincial governments emissions reduction targets** Companies are concerned that they will not be able to obtain zero-emission commercial vehicles to meet provincial ZEV fleet targets by 2030; and federal and provincial emissions reduction requirements are easier for larger firms to implement, and may result in SMEs being shut out of the market, with larger shippers and carriers unable to use their services because of ESG requirements.
- **The availability of alternative fuel goods movement vehicles:** Some stakeholders mentioned that while they have received vehicles for pilots, they still have vehicles on order, and the availability of vehicles is expected to be an issue in the short-term. One stakeholder mentioned that they have been waiting for a year to receive non-electrified goods movement vehicles, likely due to the broader supply chain issues in the auto manufacturing sector (notably chip shortages).
- **The lifecycle cost gap between conventional internal combustion engine (ICE) and alternative fuels, including battery electric vehicles (BEV):** Assuming a company can procure an alternative fuel vehicle for testing, all who spoke to the issue indicated that they expect a higher lifecycle cost. The cost drivers include higher upfront technology costs (e.g., from batteries) and lower asset utilization (from the time required to charge it, during which the truck is not productive).[90] One stakeholder noted that recent high fuel prices have lowered differential, however. Recent applied research has shown that a short-payback period could be

[90] While it is often suggested that "return-to-base" style trucking operations would be suited conversion to BEV (because the trucks can be charged during off peaks), multiple transportation providers operating in the Central Okanagan mentioned that they use some of their tractors used for local delivery for the transfer between their DC (usually in the Lower Mainland) and the Central Okanagan. This means that the tractors are moving nearly constantly. One stakeholder mentioned that out of their six-day delivery window (i.e., 144 hours per week), they are trying to keep their trucks in motion between 110-130 hours. There is potentially time to charge, but it would need to occur in very short increments (e.g., the 30-60 minutes windows when the truck might be stopped for loading) and at specific locations, unless the batteries could be swapped.

achieved through reduction in battery prices (through increased scale of production), provided there is sufficient charging infrastructure to avoid impacts to range.[91]

- **Stakeholders noted that charging infrastructure is not currently adequate:** Related to the issue of utilization, stakeholders noted that charging infrastructure is not sufficient to allow for BEV to maintain the same high utilization as their existing diesel fleet. One stakeholder specifically mentioned the length required for charging as being a primary barrier (see also Footnote 90).
- **Cradle-to-grave impacts of battery production is very high and partially offsets other reductions**: A recent American Trucking Research Institute (ATRI) Report found that the greenhouse gas emissions embodied in the production of a battery electric-powered truck are six times higher than a conventional internal combustion engine (ICE) powered truck and would make up about 20% of the lifecycle emissions of a battery electric vehicle (BEV), on average. BEVs would reduce overall emissions through its lifecycle despite the higher emissions from production.[92] However, lowering the emissions from production would improve the attractiveness of the technology.
- **Industry is assessing the benefits of different alternative fuel types:** Some stakeholders mentioned that it is not clear if BEV, compressed natural gas (CNG), or hydrogen will end up being the alternative fuel of choice for commercial vehicles. One company is using CNG for their fleet would not choose BEV because of the heavy loads.

One stakeholder mentioned that there is still uncertainty about what technology is going to be preferred (notably hydrogen fuel cell electric vehicle [FCEV] or BEV), but in practice thinks that some combination will occur. They mentioned that FCEV could potentially be fuelled using hydrogen produced for forklifts used in warehouses.[93]

Challenges with dual role of Highway 97, safe crossings, and conflicts with vulnerable road users

Stakeholders noted that Highway 97 serves as both a regional highway corridor and local road with accesses to businesses. A number of stakeholders highlighted issues related to these multiple roles of Highway 97, including:

- Some stakeholders noted that through Lake Country and Kelowna (in particular), vehicles are moving at speeds around 80-100 km/h (even sometimes where the posted speed is at 50 km/h).[94] There are safety concerns, as it was described like having a driveway off an expressway.
- The priority to ensure the movement of people, particularly in the context of a tourism-dependent area, and the conflicts it can create. One example of the challenge that can exist was noted in Peachland (but other examples exist along the corridor, including in Kelowna). Upper and Lower Peachland are separated by Highway 97, and there are concerns with how to get people across the highway, including on bikes. There is concern that the Province will four-lane the highway.

[91] International Energy Analysis Department Energy Analysis and Environmental Impacts Division Lawrence Berkeley National Laboratory. 2021. Why Regional and Long-Haul Trucks are Primed for Electrification Now
[92] ATRI. 2022. Understanding the CO2 Impacts of Zero-Emission Trucks: A Comparative Life-Cycle Analysis of Battery Electric, Hydrogen Fuel Cell and Traditional Diesel Trucks
[93] Walmart, for example, has been using fuel-cell forklifts at a DC near Calgary for over 10 years: https://corporate.walmart.com/newsroom/2010/11/15/walmart-canada-opens-its-first-sustainable-distribution-centre
[94] The stakeholder noted that the highway was designed to allow for higher speeds (and so drivers will still drive at higher speeds).

- Some stakeholders noted that Highway 97 operates as a regional highway corridor and as a local road. Because it serves as a local connector, there are multiple accesses on/off the highway. Accesses do not function well considering the volume of traffic. (A stakeholder raised a similar concern that there were several unexpected accesses to businesses along Highway 97, in the context of the efficiency of the corridor.)
- MOTI noted that while bike traffic has been restricted on Highway 97 with options on local road network, there is expected to be more friction experienced where bike lanes have been added to roads without additional right of way. This leads to over narrowing of the roadways and places vulnerable users such as cyclists closer to larger commercial vehicles, in areas that are highly congested. Examples include the road network near Baron and Leckie Road, as well as Ellis Street, Gerstmar/Kneller Road and Banks Road.

Loosely analogous, one stakeholder identified interaction between tourism, residential area and working farms tourism on wine routes or near to wine routes as a challenge. It was noted that when a tourist or new resident arrives in the Central Okanagan, they are expecting an idyllic area. The stakeholder gave the example though of purchasing or renting near a working farm, and the surprise that comes from not being aware of noise and impacts of agricultural production (e.g., cherries being dried with helicopters at 5:30 AM).

Implications

- Stakeholders are concerned about the ability of vulnerable road users to cross Highway 97 safely
- It creates potential tensions in planning priorities. Highway 97 is a critical goods movement corridor, though the issue is not only related to goods movement
- Stakeholders would also like to see more information on highway development plans, particularly in Peachland, in order to consider in its own planning

Other safety concerns

Perception that goods movement vehicles were running red lights

Some stakeholders thought that the constraints posed by hours-of-service limits meant that drivers may be rushing to meet their delivery.

Safety concerns along Highway 97 North of YLW

One stakeholder noted they observed crashes along this stretch of Highway 97, where there is no centre median physical divider. They recommended that MOTI install a median divider in this location, in part to avoid vehicles trying to turn left where it is unsafe to do so.

Intersection sightlines, including coming out of alleys, from trees and new infills

Some stakeholders mentioned that several issues can prevent them from seeing oncoming traffic (including bikes) when approaching an intersection:

- Within the City of Kelowna, there are trees planted in the boulevard within 5-10 feet of an intersection, which creates sightline issues when fully bloomed. This was noted as predominantly in “new areas”

- One stakeholder mentioned that trees can prevent them from seeing along the street when coming out of an alley
- In older residential neighbourhoods that have infilled with four and six-plexes, there can be poor sightlines exiting alleys because the development is constructed nearly up to the property lines

In all cases, stakeholders mentioned that this not only slows them down (because they have to continually inch out), but even if they do so, it creates safety concerns because they often cannot see until they are already out into the road/intersection.

They would like to see better consideration of placement of trees as well as better tree maintenance/trimming during the summer.

Unsafe exit and entry to brake check near Joe Rich along Highway 33

One stakeholder indicated that a relatively new brake check pull-off along Highway 33, west of Big White turnoff near Joe Rich, is unsafe and has led to close calls. Two particular issues were cited:

- Short exit on a downward grade, which is often slippery during winter
- Blind entrance back onto Highway 33

Other

Opportunities to promote back-haul opportunities and load consolidation

Many stakeholders highlighted that there are more goods coming into the region than going out, so many trucks depart with empty trailers. Many stakeholders highlighted some of the entrepreneurial efforts they make to consolidate loads and achieve matchback. (This in turn raises the cost of shipping goods into the region because companies have to cover the round-trip cost of the movement.) Stakeholders were not aware of a formal mechanism for companies to consolidate loads in the region, or a local manufacturing association for convening.

Climate change can also impact air travel

One stakeholder also mentioned that during forest fires there were times when there was a no-fly zone around YLW.

Another stakeholder also mentioned that YLW runways were not likely to be long enough to support large air freighters (and even if they could, there would not be enough volume to consolidate to fill up a freighter load). As a CPCS observation, we note that the YLW 2045 Airport Master Plan bases its maximum takeoff weight calculations (based on runway length), using an air temperature of 27.9 degrees, which “represents the average maximum temperature for the hottest month of the year (July) at YLW according to Environment Canada weather records for the period 1981-2010.” This might not reflect future conditions, which would impact these calculations.

Licensing with alcohol storage and delivery

One online survey response noted that licensing around alcohol storage and delivery poses extra layers of challenge and inefficiency.

Opportunities, solutions and existing actions working well from stakeholder engagement

This section identifies themes from stakeholder engagement regarding opportunities, solutions and existing actions working well.

Improve infrastructure and operations along Highway 97 within the Central Okanagan, including developing parallel road network/bypass

Develop infrastructure before it is needed (be "pre-ready" or "get ahead of the curve")

Many stakeholders noted that the Central Okanagan's population is growing at a fast pace. (As noted in the Chapter 1, the Central Okanagan was expected to grow by over 40% between 2016 and 2040 or 80,000 residents. Another stakeholder noted that 20,000 people have already moved to the region between the 2016-2021 censuses).

In this context, many argued that they would like to see infrastructure put in place sooner to stay on top of this growth. One stakeholder punctuated this argument by mentioning that the current bridge was constructed about 15 years after congestion was an issue.

A related suggestion was to ensure proper forecasting and planning for transportation corridors and that there is a need to ensure that planned growth in industrial activity can be accommodated. Putting in a transportation corridor after an area has been planned was viewed as bad planning and there is need to consider how to move people and goods over the long term.

Plan and construct Kelowna bypass and second crossing, if feasible

Many stakeholders noted that ideally[95] there would be a second crossing of Lake Okanagan as well as a bypass around Kelowna. Many caveated this comment that they recognized there were significant challenges to such a development, including the terrain and road infrastructure on either side of the bridge.

Some of the benefits stakeholders saw in a second crossing, included:

- Shifting passenger movements (notably through movements) off the Highway 97
- Improving redundancy, particularly if there is an issue (e.g., crash) on the bridge, as the only bypass

One stakeholder mentioned that they would like to see planning progress for a second crossing/bypass, particularly in the context of the North End planning. While the stakeholder observed that trends like autonomous vehicles, drones, etc. that could mitigate need for additional transportation infrastructure in the future, these technologies are not expected soon and planning for additional infrastructure capacity should progress in the meantime.

However, in some cases, stakeholders noted that a second crossing/alternative does not directly benefit their operations (except to the extent it can free up capacity) because their depot is within Kelowna. (As described in Chapters 2 and 4, the many goods movements-related businesses are clustered along Highway 97 southeast of Dilworth Mountain, and there is relatively little through traffic, so a bypass to the north would not necessarily result in a shorter travel time. One stakeholder suggested a corridor following the rail trail corridor would be great.)

[95] Though it was one of the more frequent comments, most stakeholders caveated this recommendation by highlighting feasibility considerations. One stakeholder called it a "dream."

Develop parallel road network through Kelowna

One stakeholder suggested there might be independent value of a bypass around Kelowna, even without a second crossing. Few saw the bridge as the bottleneck, which is consistent with the congestion analysis.

Some stakeholders also specifically mentioned that they would see value to developing a parallel road network, such as extending Clement Avenue along the existing rail bed to Leathead, or beyond to the airport.

Four-lane Enterprise Way

One online survey response suggested four-lanning Enterprise Way, noting that Highway 97 and Enterprise Way are packed during the day, making courier deliveries very slow.

Construct overpasses along Highway 97 through West Kelowna and Kelowna

Many stakeholders noted that the WR Bennett Bridge was not the primary congestion issue. In this context, they provided suggestions for how to address signalized intersections along the Highway 97 corridor. Stakeholders suggested constructing overpasses through West Kelowna and Kelowna to reduce signalized intersections along this corridor and improve fluidity for goods movement.

Install adaptive traffic signal lights

One stakeholder suggested installing adaptive signals to try to improve the flow of goods movement vehicles through the corridor. Adaptive traffic signals are lights that can respond more dynamically to traffic conditions. One stakeholder mentioned they had seen examples where a single car on a side street might trigger a traffic signal, for example.

Extend left-hand turn lanes along Highway 97

Stakeholders indicated that consideration should be given to extending left-hand turn lanes at major intersections of Highway 97 that intersect with truck routes (e.g., Gordon Road), as well as on roads that provide access to commercial properties through Midtown Kelowna

Add right-hand turn bays and remove other right-hand accesses off Highway 97

One stakeholder mentioned that while they recognized that Highway 97 could not be widened, they thought there might be locations at intersections (e.g., where there are trees along the boulevard), where a right-hand turn lane could be added to facilitate east-to-west to north-or-south turns. The same stakeholder also suggested reducing the number of midblock accesses off Highway 97. One illustration of this was at Orchard Park Mall, where there is a right-in/right-out. The stakeholder mentioned that is surprising when driving along the corridor.

Re-examine implementation of HOV lanes through Kelowna on Highway 97

Multiple stakeholders did not believe the high-occupancy levels were being enforced. It also meant that for some goods movement stakeholders, they were using the center lane, which they perceived to be slower. They also need to frequently turn right to access properties. (Though not directly tied to this comment, one stakeholder did mention that if transit were implemented, it would need to not be stuck in the same congestion. The HOV lane could be, though not necessarily, a corridor for transit.)

Other comments and suggestions

Other comments that were either raised by only one stakeholder or had lower specificity, include:

- Consider using roundabouts to avoid signalized intersections

Improve access on/off Highway 97

Improve road access on both sides of Highway 97 around Jim Bailey Industrial Park

Desired potential options to improve road access include:

- Construct a frontage road along the west side and east side of Highway 97 south of Commonwealth Road to provide safer access to local businesses and access to new businesses
- Improve the intersection at Glenmore Road and Commonwealth Road and connect with Commonwealth Road on the east side of Highway 97. The objective would be taking volumes off the broader road network. (Glenmore Road and Beaver Lake Road were noted as being congested, which was also noted in the data analysis.)
  - However, if this is done, ensure mitigations (i.e., sound walls) are put in place to avoid impacts to residential areas adjacent to Commonwealth Road along the east side of Highway 97

However, longer term develop road on the east side of Ellison Lake/Duck Lake

To limit the volume growth of goods movement vehicles along Commonwealth Road as the area developments (on which there is residential on both sides), one recommendation was to provide a new road along the east side of Duck Lake/Ellison Lake that would connect in north of the airport.

Do *not* change Beaver Lake Road at Highway 97 to a right-in/right-out

There was in turn concerns that this would result in goods movement vehicles moving down through Commonwealth Road (on which there is residential on both sides).

Review and improve intersection at Old Vernon Road and Highway 97 (north of YLW), to facilitate westbound-to-southbound movements

One stakeholder indicated that to facilitate industrial park development southeast of the Kelowna airport, further upgrades would be required to this intersection to allow westbound to southbound movements off of Old Vernon Road.

Consider interchange at Airport Way

Though not a specific ask, one stakeholder asked if there are plans for an overpass at Airport Way, as it was noted that traffic is rarely flowing.

Improve access to East Kelowna via the north

This was noted as the largest continuous tract of agricultural land in the area. It was noted that semi-trucks cannot cross Mission Creek, so there is potentially opportunity to improve access in this area.

Improve infrastructure improvements for access to/from the Central Okanagan

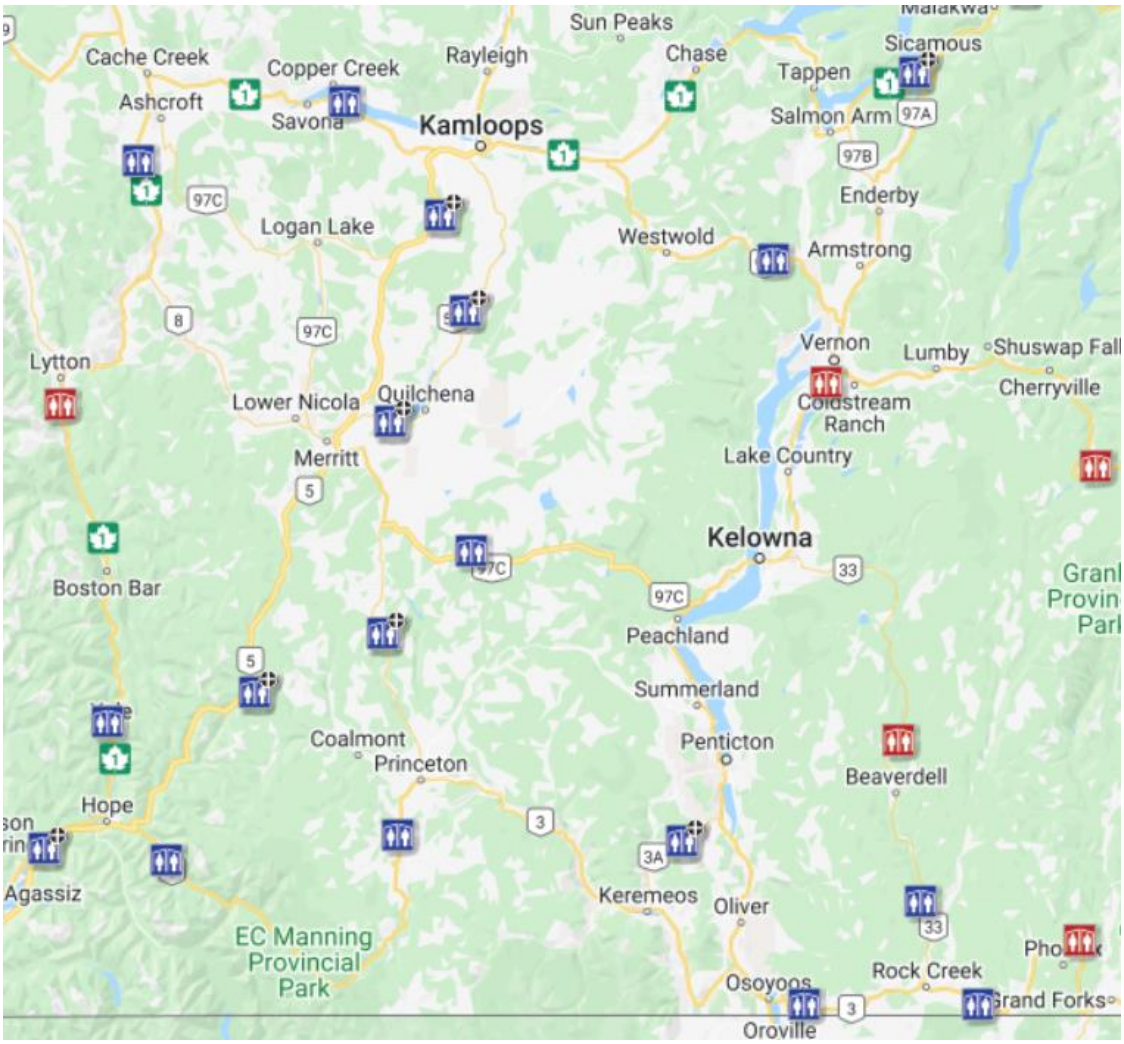
Improve rest stops and winter maintenance on highway corridors

Stakeholders, particularly trucking carriers, would like to see infrastructure and operations improvements to the highway corridors between the Lower Mainland and Central Okanagan.

- Add more truck stops to pull over at lower elevations, particularly on alternative routes Stakeholder implied or stated that that they would like to see more rest areas along the corridor, including on alternative routes (i.e., Highway 3) at lower elevations.
- Improve winter highway maintenance, including plowing of the corridor and rest areas
- Add more bathroom facilities to the corridor, including at brake checks. One stakeholder noted that they are trying to attract women to the profession, and the limited number of bathroom facilities makes for less attractive working conditions
- Add new rest stops in the vicinity of Kelowna, particularly north of Kelowna along Highway 97, noting that trucks cannot simply pull over in parking lots typically reserved for cars. They noted that drivers will often try to find locations within industrial areas. There are no rest stops immediately around the Central Okanagan (Figure B-3), though this image does not show all pull-over points.

These could help make the corridor safer and more attractive for drivers to serve the area.

Figure B-3: Existing rest stops around Central Okanagan



Source: CPCS screenshot of Drive BC. Note: **Red** locations cannot accommodate large commercial vehicles

Ensure that Highway 3 is ready as an alternative

Stakeholders mentioned improving rest stops (see above) and implementing essential travel restrictions should this alternative be required.

Protect industrial land base, learning from Lower Mainland experience

One stakeholder suggested learning from the work that Lower Mainland stakeholders are trying to do now to protect the industrial land base. The stakeholder noted that this is the "number one" impediment to industrial development in the Lower Mainland. A concrete suggestion was to change the nomenclature around industrial lands to "employment" lands. Otherwise, the Metro Vancouver Regional Industrial Land Strategy provides a number of recommendations.[96]

[96] http://www.metrovancouver.org/services/regional-planning/industrial-lands/regional-strategy/Pages/default.aspx

Consider changes to truck regulations and continue enforcement

Support continued (or enhanced) enforcement of truck safety regulations

Multiple trucking carriers advocated for continued if not enhanced enforcement of truck regulations, including hours of service. They argued that trucking companies that try to follow standards will get undercut by companies that they perceive as cutting corners.

One stakeholder noted it is a law in other provinces that trucks are governed at 100 km/h, but not BC. Noted that it is a competitive disadvantage for companies doing this because of safety, because they cannot cycle as quickly and offer as low of rates.

Consider installing a self-weigh scale

One company indicated that they appreciated when there used to be a self-weigh scale in the area, as it allows them to check their loads. This is particularly relevant for cargos that tend to "weigh out," such as beverages or personal articles (e.g., from moving). The stakeholder mentioned that there used to be one in the area. Otherwise, they mentioned that the current configuration of weigh scales in the region seemed appropriate (i.e., one each near Kaleden and Vernon). This is where trucks will be travelling at highway speeds, so risk is greatest, and will not impact local truck movements.

Another suggestion from the online survey was to install a scale at the Kelowna landfill, noting that it could potentially be a source of revenue.

Opportunity to use longer trailers

One stakeholder mentioned that they are piloting using 60-foot containers. For retail goods, these allow the stakeholder to increase efficiency, as they can ship more product as compared a standard 53-foot containers.[97] At the time of engagement, 60-foot containers were not being used to serve the Central Okanagan.

It was noted that BC was cautious in issuing permits relative to other jurisdictions. These are the practices the stakeholder cited in other jurisdictions:

- Ontario: The company has been issued eight permits to use 60' containers and can use them anywhere across the province
- Alberta: Use of the 60' containers is allowed under long-combination vehicle requirements

By comparison, they indicated that BC issues permit on a route-by-route/store-by-store basis.

Create road space for goods movement vehicles through transportation demand management and improved transit

Pursue transportation demand management strategies that lower personal vehicle use

One stakeholder suggested implementing policies to encourage businesses to work flex hours and work from home, etc. (to reduce traffic volumes and peaking). Another public-sector stakeholder noted that they have moved to a hybrid model, which has been successful in terms of business

[97] The amount of retail goods that can be loaded into a single container is usually limited by volume, not weight restrictions. This is known as cubing out (rather than weighing out). A container loaded with retail goods averages about 13 tonnes.

metrics that they track related to customer service. They also echoed that congestion in Kelowna can be sensitive to peaks.

Intensify residential areas, while ensuring affordability and access to nearby services

Some stakeholders remarked that certain areas of Kelowna are densifying with condos, and one stakeholder in particular was supportive of efforts to densify residential areas. They observed that while densification of housing is often viewed as the *cause* of people moving to the area (straining services), it is actually helping lower road use by passenger vehicles. Another stakeholder cautioned that it is important for that new housing to be affordable for people who support the livability of the area (e.g., low-wage hospitality sector employees) and also commented on the need for services like grocery stores to be co-located. Otherwise, it has the potential to increase congestion.

Increase rapid transit along Highway 97, in particular to Gateway Area (YLW and UBCO)

Some stakeholders advocated for improved rapid transit along the Highway 97 corridor to divert single-occupancy vehicles (SOV), in turn allowing more road space for goods movement vehicles. However, another cautioned that it needs to have sufficient transit time advantage over vehicle traffic to make it attractive; if bus passengers are going to sit in the same congestion, it is not going to be attractive.

Multiple stakeholders argued for the need to enhance rapid transit to/from YLW and UBCO, for passengers and for people who work at these locations. However, another stakeholder mentioned that it is important to recognize the potential limitations of the markets that can be served: many employees in the airport area work non-standard shifts, so it is unlikely that fixed route transit will be able to accommodate their schedules. However, there is a potential market for employees who are working more traditional “9-to-5” hours.[98]

Promote awareness of the role of goods movement

Promote awareness about the value of goods movement to the region,

One stakeholder wants to encourage the public to understand and respect the value of goods movement sector workers, particularly as they perceive that larger and longer vehicles are being used.

Promote awareness of the impact of consumer decisions on goods movement

One of the local chambers of commerce mentioned they recently had a campaign encouraging locals to shop locally, and what the benefits are. Multiple stakeholders said that there is the public expectation that someone can purchase something online and get it quickly, but there are consequences to this decision, including:

- Goods will be imported
- Goods will be shipped in multiple packages/deliveries (particularly if consumers do not group their purchases like they would if they went to a retailer).

[98] Client feedback noted that on-demand transit is being examined in the region, though it was not raised as an opportunity in discussions.

Consistent with this comment, while there are not conclusive rules, there is increasing evidence to support the development of consumer awareness principles.[99]

Support the development of inland rail terminals and the Port of Prince Rupert as alternative and complementary facilities to the Port of Vancouver

A couple of stakeholders mentioned that the Province should explore complements and alternatives to developing container handling capacity in Vancouver, including:

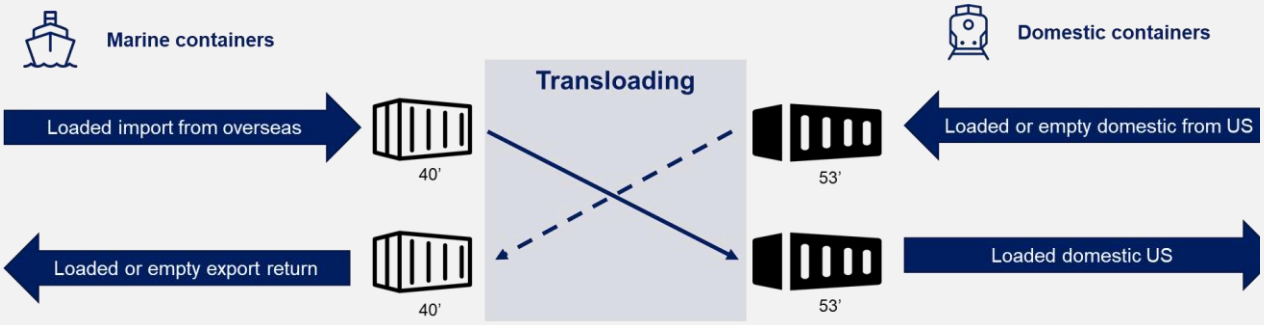
- **Ashcroft Terminal:** Ashcroft Terminal, about 100 km West of Kamloops, is an inland rail terminal adjacent to the CN and CP rail corridors. An objective of the development is to reduce truck movements in the Lower Mainland, which add time and costs to shippers moving goods (see box below). Stakeholder comments highlighted that an inland rail terminal has multiple benefits including, reduced truck movements in the Lower Mainland, reduced GHG emissions, improved cargo handling efficiency, lower trucking costs, improved utilization of port assets, and opportunities to create improved rail car matchback. A stakeholder also mentioned that Ashcroft Terminal could be used as a distribution hub for containers to the Central Okanagan, though no plans to do so at the moment. If goods could be trucked from Ashcroft Terminal to the Central Okanagan, truck trip length for goods distribution could be shortened. The stakeholder highlighted that in addition to lower trucking costs and environmental benefits, shorter trip lengths would address driver preference for short haul driving and would help to address the long-haul driver shortage.
- **Prince Rupert:** One stakeholder suggested that MOTI explore opportunities to further the development of container terminals in Prince Rupert, to reduce congestion in Vancouver. (However, the stakeholder indicated that they would not ship to Prince Rupert, because the distance is longer than to Vancouver.)

Specific approaches to support these initiatives were not mentioned.

[99] See e.g., https://www.nytimes.com/wirecutter/blog/shop-online-sustainably/

Container transloading and truck drayage, in brief

Most goods, including retail goods, arriving in Vancouver by container vessel need to be sent by truck or rail to large markets in eastern Canada and the US. To minimize the amount of space taken up on rail cars (and save shipper costs), some goods arriving by marine containers (typically 40-feet long) will be transferred ("transloaded") into 53-foot domestic containers near port terminals. While conceptually simple (see figure), in the Lower Mainland, this involves multiple truck movements hauling containers between the marine container terminal, transloading facilities, container storage yards and rail intermodal terminals to reposition both the loaded and empty containers.



Source: CPCS

Using Ashcroft Terminal, the chain involves sending marine containers from Vancouver by **rail** and transferring them into domestic containers at that facility. The empty marine containers could then be loaded with products destined for exports, such as forestry products. A number of the truck movements that are involved in the Lower Mainland are confined to the terminal grounds themselves.

Other suggestions and considerations

Recognize that fleet decisions are usually made to minimize costs of shipping and policy-imposed constraints would likely increase the cost of goods movement

One stakeholder made a general comment that it is important to consider the cost implications of any policies that impact the trucking sector. Due to the competitive nature truck carriage, incremental costs are generally passed through to customers (i.e., shippers), which could then impact the cost of the goods sold to consumers. An example given is of a road toll, which would usually be passed along by the truck carrier to customers.

This was often raised in the context of discussion around how the built environmental impacts vehicle selection. One stakeholder tried to make the point that companies are pretty sophisticated in terms of their vehicle selection to minimize costs, and particular, the value of load aggregation: a truck might take up three or four times as much as a cargo van but might be able to hold the 40 times the load, so fewer trips are required. Of course, the stakeholder mentioned that carriers will generally not run a large truck into a cul-de-sac. Other stakeholders mentioned that they can use smaller vehicles, but it comes with a cost.

Consult with goods movement stakeholders during planning and policy making

While many goods movement stakeholder acknowledge that there are competing policy priorities (e.g., densification), they are often left out of the discussion and left to sort out how to serve an area after the fact. In jurisdictions outside of the Central Okanagan, one stakeholder noted that the competing policy priorities have started to leave them at a loss about how they are going to service

the area because of the overlapping restrictions/constraints (i.e., during the day the area is busy with tourist traffic, at night there are noise bylaws, etc.).

They mentioned that consultation with goods movement stakeholders would have avoided issues of varying severity to goods movement, such as intersection design restricting oversize movements, loading zones angled the wrong way, etc.

Related, preserve access for loading and sightlines

While some stakeholders caveated that they understood land values are very high in the Central Okanagan (necessitating densification), they still advocated for having appropriate loading zones and site access. Some of the common vehicle sizes used for delivery around the Central Okanagan included:

- 28- to 40-foot trailers with truck
- Five-tonne straight truck
- Courier vehicles can vary (up to a five-tonne truck)

For safety, one stakeholder noted the challenge of poor sightlines coming out of alleys, so would like to see better tree maintenance and better consideration of siting infrastructure that can block views.

Implement policies that facilitate attraction of young people to the profession

One stakeholder suggested potentially designating truck driving as a trade, as well as potentially allowing for some form of truck driver training/licensing before a driver exits the graduated licensing system (potentially starting with smaller trucks, such as straight trucks that require a Class 3 license to operate). The objective of these suggestions is to lower the age when carriers can start attracting drivers to the profession.

They noted that between the requirements for graduated licensing in BC, which requires a minimum of three years to complete starting at 16 years old, and requirements by carrier cargo insurers (typically requiring two years of truck driving experience), they are not able to start attracting drivers until they are 21 years old. The stakeholder contrasted the experience in trades, which often have programs starting in high school.

Other possible solutions that have challenges

Development of distribution centres (DC)s in the Central Okanagan

There was some discussion with stakeholders about the possibility of locating a DC in the Central Okanagan as a way to add a buffer to supply chains, particularly for retail including food. At least two retailers mentioned or implied that there was not enough volume going into the region to justify a DC in the location.[100] Another stakeholder, which does not have a DC in the area, mentioned it might help buffer in the case of the outage, but the stock would still only last for a couple of days for food.

Expand use of off-peak delivery as a congestion mitigation

The interviewers probed multiple stakeholders on whether there was the possibility of delivering more product in off-peak hours (e.g., evening and overnight) as a way of mitigating the impact of

[100] One of the comments did not relate to the Central Okanagan but mentioned that even having one DC in Western Canada was sufficient for their operations.

congestion on their operations (as well as congestion in the region). Many were already using some form of off-peak delivery. Barriers to conducting more goods movement in the off-peak included: (1) they are already cycling their trucks throughout the day, so it is not possible to always miss a peak period; (2) they have made a conscious choice to ship during the day as a way to attract drivers; (3) their operation would create too much noise. One online survey response noted that some activities (i.e., downtown deliveries) still need to happen during the day.

Existing actions working well

Several actions that are working or had worked well mentioned by stakeholders, included:

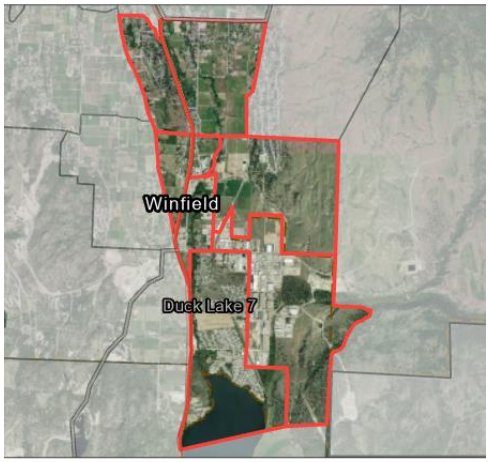
- **Maintaining "essential travel" only restrictions on Highway 3 when it was being used as a diversion:** During the flooding and diversion to Highway 3, one stakeholder appreciated MOTI's decision to keep Highway 3 open to "essential traffic only" in order to maintain safety as much as possible under the circumstances.
- **Improvements to north-south travel in Kelowna:** One stakeholder noted that to be very difficult to travel north/south to/from the south end of Kelowna, but the City of Kelowna has upgraded Gordon Drive. This improved north-south flow, though the stakeholder also caveated that the traffic ultimately still has to funnel onto Highway 97, which is congested.
- **Lake Country:** One stakeholder mentioned that there have been (unspecified) improvements along Highway 97 through Lake Country
- **Regional cooperation among municipalities and First Nations:** One stakeholder framed this that there has been a shift over the last 20 years to a more collaborative approach, and recognition that everything is connected in the region. The comment was also made in the context of issues like climate change.
- **Ensuring that deliveries and truck movements can continue overnight:** Many stakeholders indicated that they attempt to avoid goods movement during the most congested times of the day, including to maintain travel times and to ensure adequate parking for deliveries. Some mentioned that in other jurisdictions have had challenges in delivering at night, because of noise bylaws and conflicts in mixed retail and residential developments. No issues were raised related to the Central Okanagan, and it was implied that this is desirable to continue.
- **Clement Drive west of Spall Road was noted as a well-designed corridor** for goods movement, with businesses up front and parking behind.

In addition, one stakeholder highlighted that the Okanagan Connector (Highway 97C) was a game changer for the region. Truck carriers noted that they will use it to bypass the region, as well.

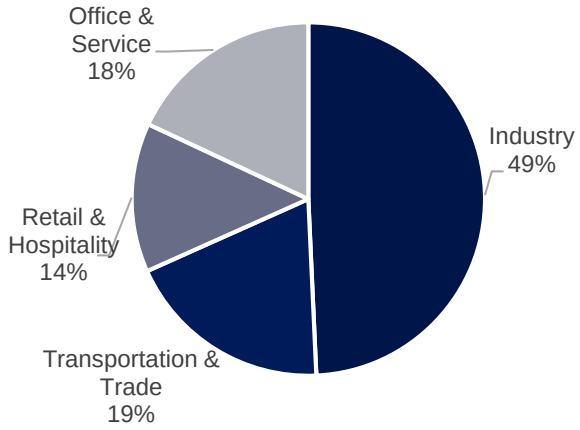
Appendix C Business clusters

Jim Bailey Industrial Area Business Cluster

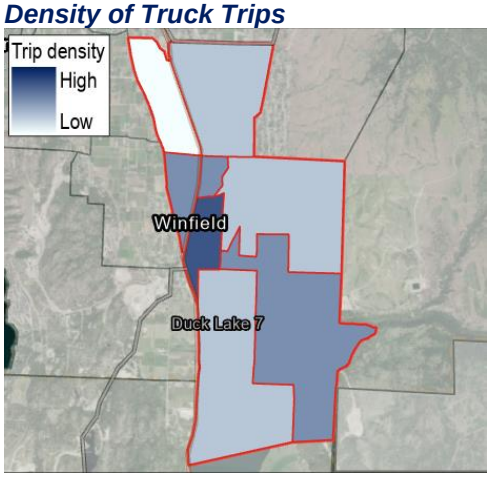
View of Cluster



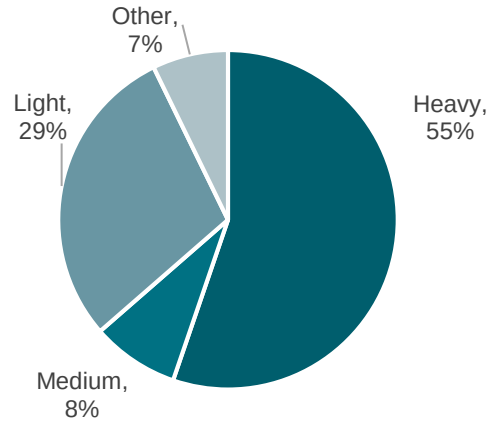
Distribution of Employment



Density of Truck Trips



Commercial Vehicle Type



Examples of Freight-Related Establishments

SRI Homes
- Modular home construction
- Three factories in Western Canada

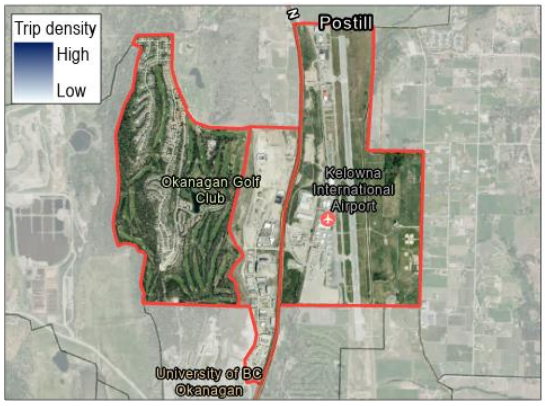
Sysco
- US-based food service distributor for restaurant and institutional customers

BC Tree Fruits Cooperative
- Fruit receiving, packing, storage and distribution

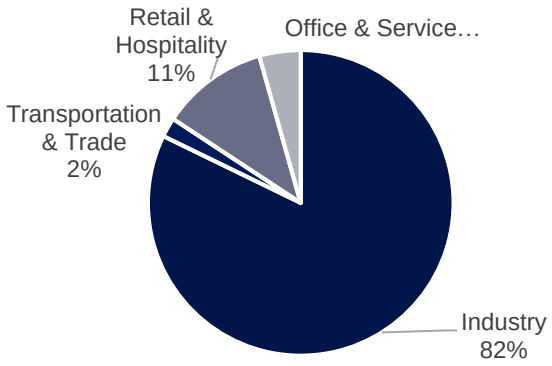
Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

Kelowna International Airport Business Cluster

View of Cluster

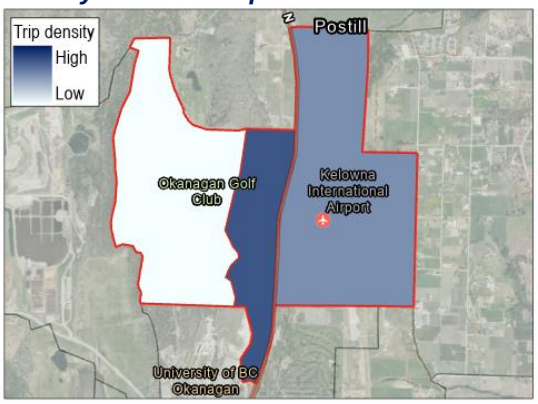


Distribution of Employment

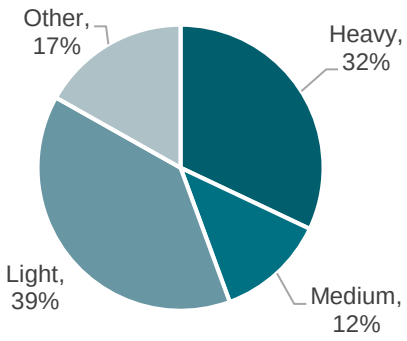


Note: does not appear to reflect institutional use (e.g., UBCO, YLW), in part as the directory focuses on identification of businesses.

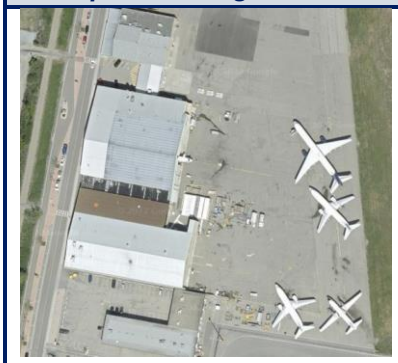
Density of Truck Trips



Commercial Vehicle Type

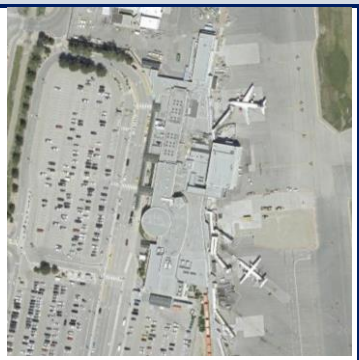


Examples of Freight-Related Establishments



KF Aerospace

- Canada's largest aircraft maintenance, repair & overhaul (MRO) company



Kelowna International Airport

- Airport with service to Northwest US, Canada and sun country

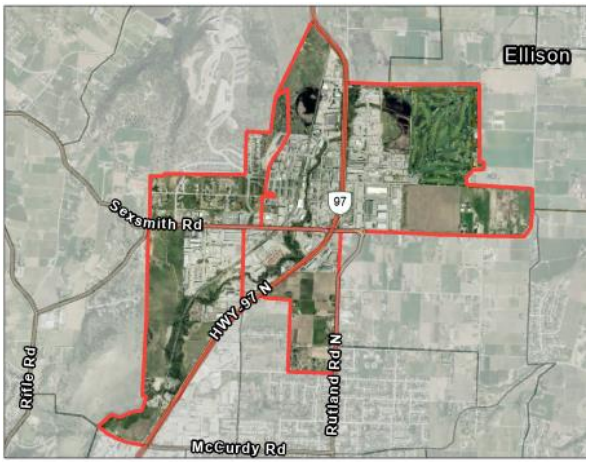
Kon Kast Concrete Products

- Producer of standard and custom concrete products for Western Canadian market

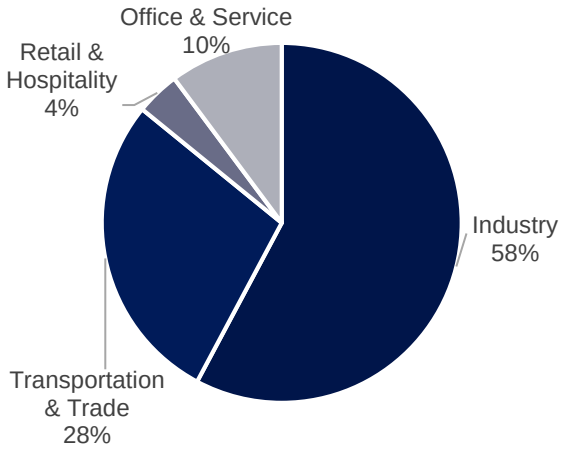
Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

Reid's Corner Business Cluster

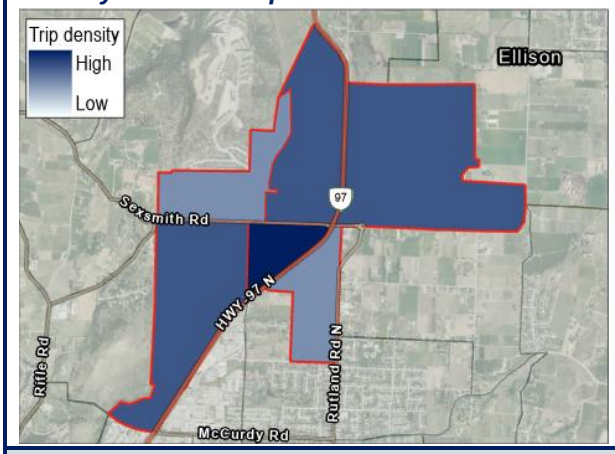
View of Cluster



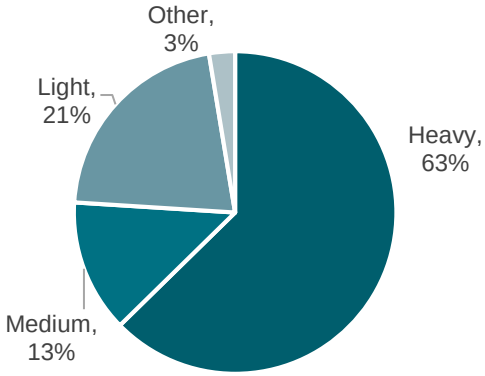
Distribution of Employment



Density of Truck Trips



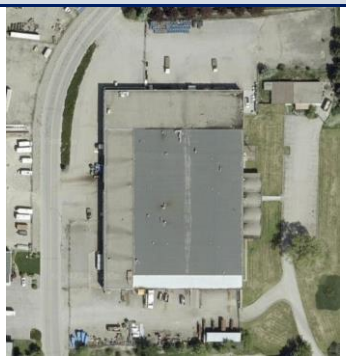
Commercial Vehicle Type



Examples of Freight-Related Establishments

ContainerWorld Forwarding

- BC-based logistics & trucking company serving beverage industry (alcoholic / other)



Levico Lighting

- Locally based lighting manufacturer

Warnaar Steel Tech

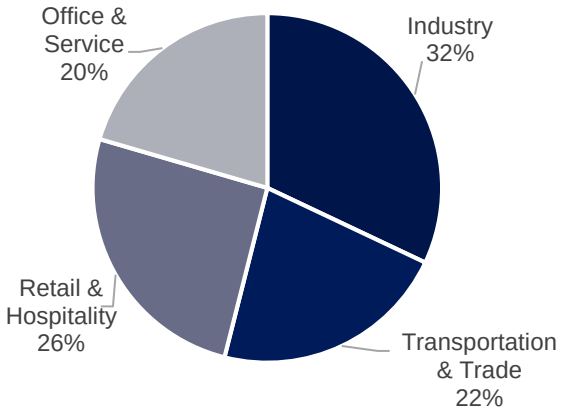
- Structural steel fabricator for industrial, commercial, residential markets

Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

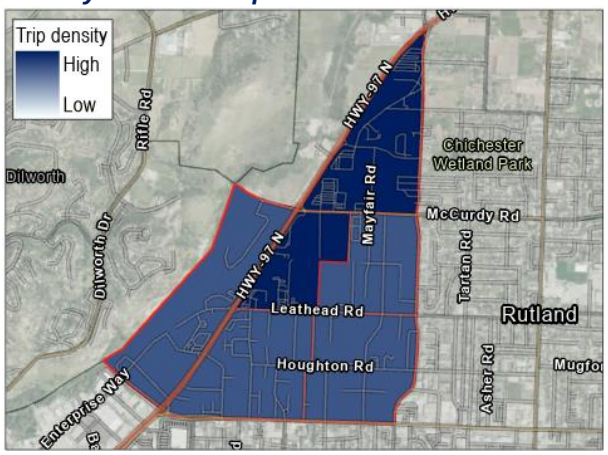
McCurdy/Leathead/Enterprise Business Cluster

View of Cluster

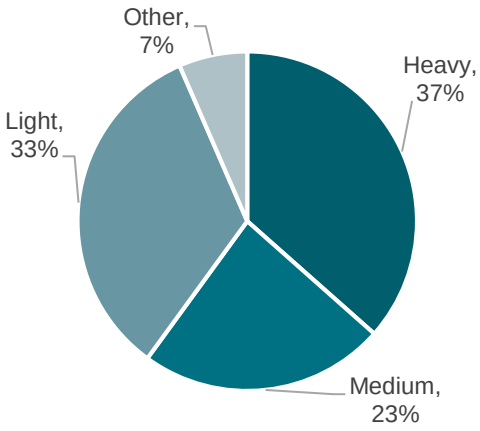
Distribution of Employment



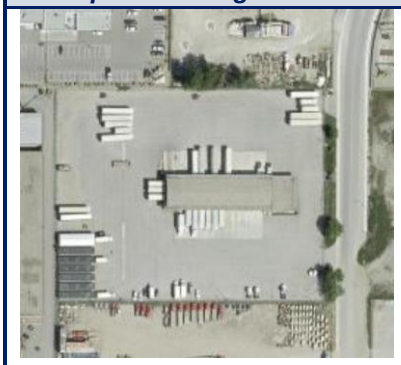
Density of Truck Trips



Commercial Vehicle Type



Examples of Freight-Related Establishments

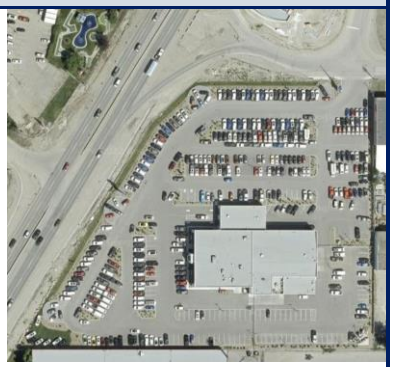


Canadian Freightways

- Less-than-truckload carrier
- Subsidiary of North America-wide trucking company

Precisely Right Moving and Storage

- Residential / commercial moving company



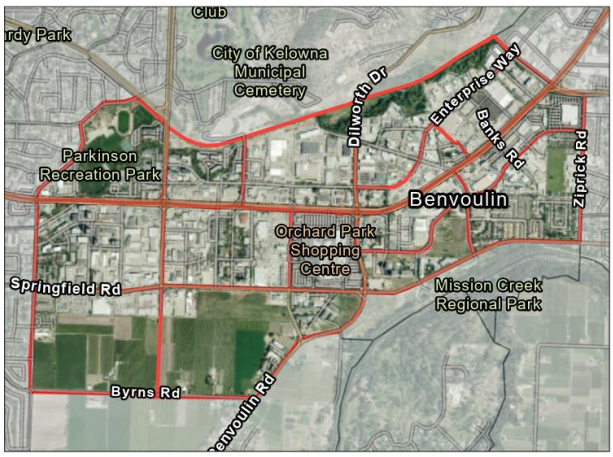
Orchard Ford Sales

- New and used car dealership serving Kelowna and Vernon markets

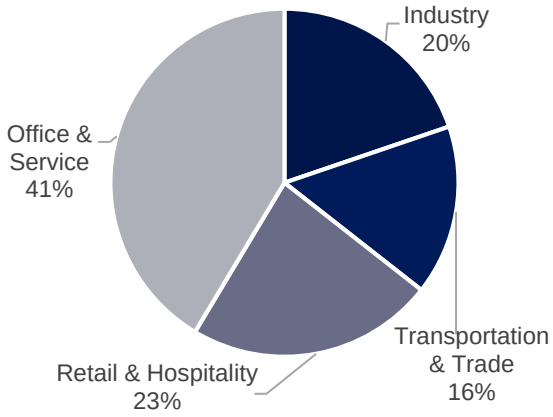
Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

Midtown Kelowna Business Cluster

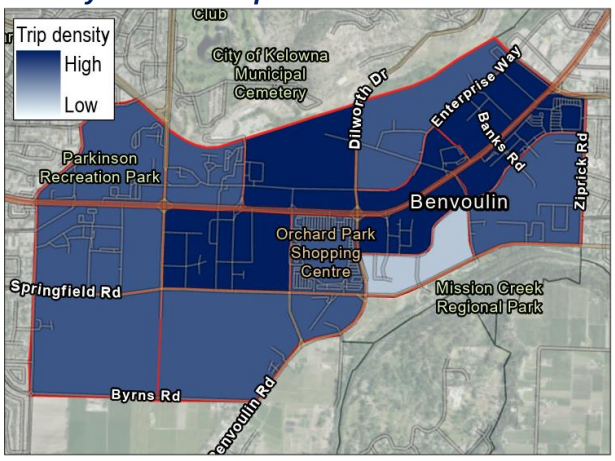
View of Cluster



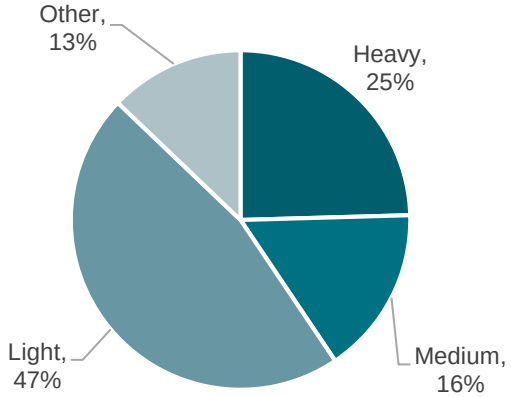
Distribution of Employment



Density of Truck Trips



Commercial Vehicle Type



Examples of Freight-Related Establishments

Orchard Park Shopping Centre

- Over 160 retailers and services
- Largest mall in Okanagan

Westwood Fine Cabinetry

- Kelowna-based wood kitchen cabinet and countertop manufacturer

PepsiCo Beverages

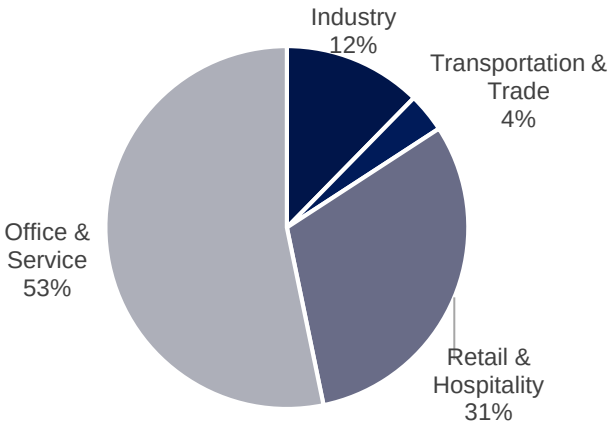
- Regional distribution facility for beverages (soft drinks, water, etc.)

Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

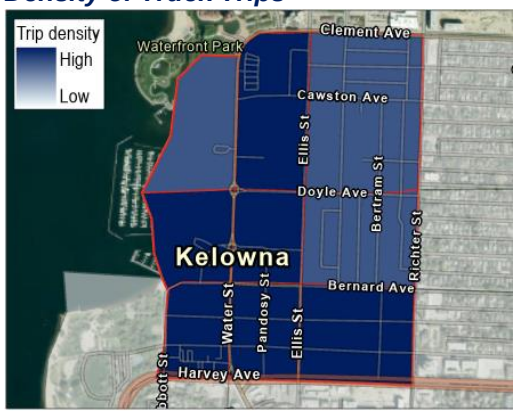
Downtown Kelowna Business Cluster

View of Cluster

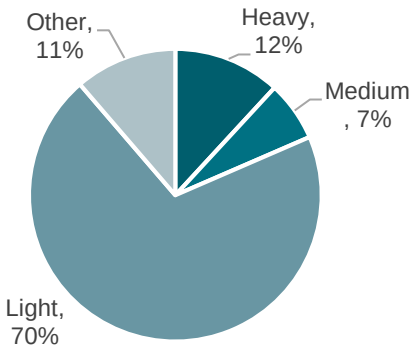
Distribution of Employment



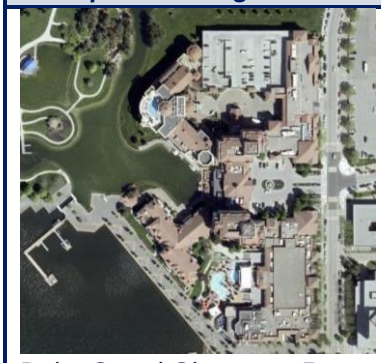
Density of Truck Trips



Commercial Vehicle Type

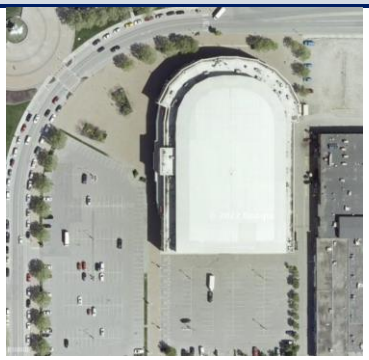


Examples of Freight-Related Establishments



Delta Grand Okanagan Resort

- Lakefront resort, hotel and conference centre



Prospera Place

- Multipurpose arena hosting hockey/sports, concerts, events

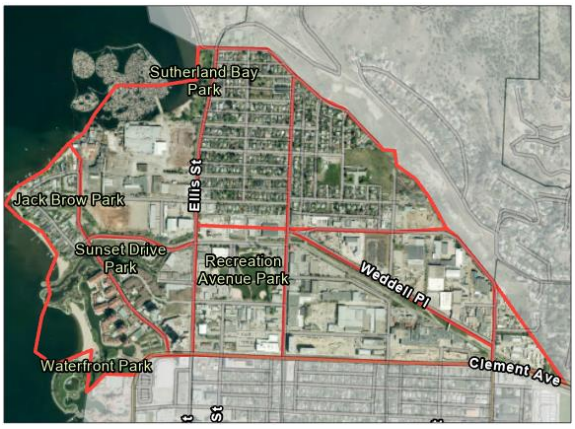
Offices and Restaurants

- Businesses, offices, pubs, restaurants receiving deliveries

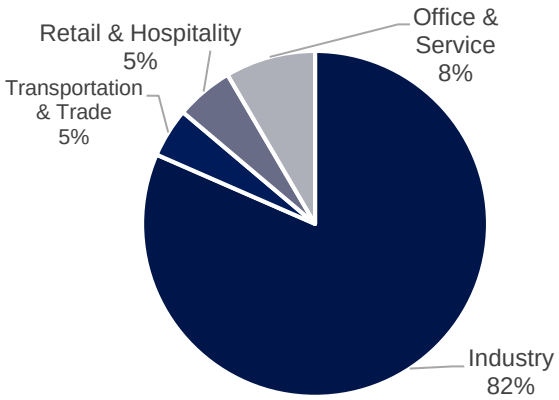
Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

North End Business Cluster

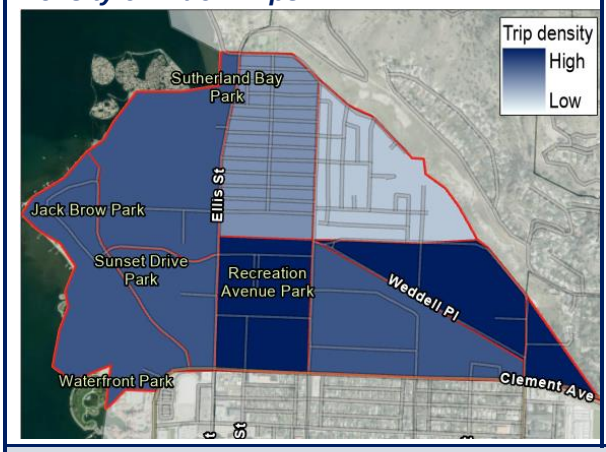
View of Cluster



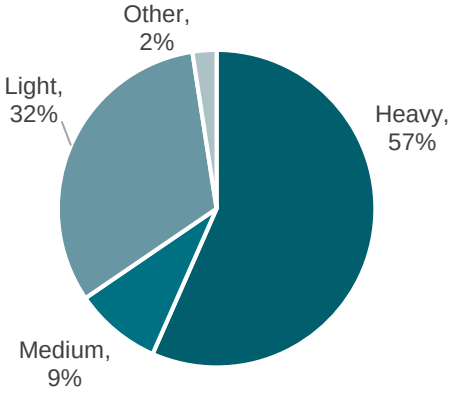
Distribution of Employment



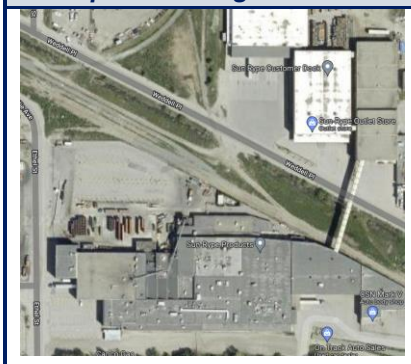
Density of Truck Trips



Commercial Vehicle Type



Examples of Freight-Related Establishments



Sun-Rype Products

- Western Canada's largest producer of fruit juices, fruit snacks and energy bars

Calona Vineyards

- Wine production facility described as BC's original winery

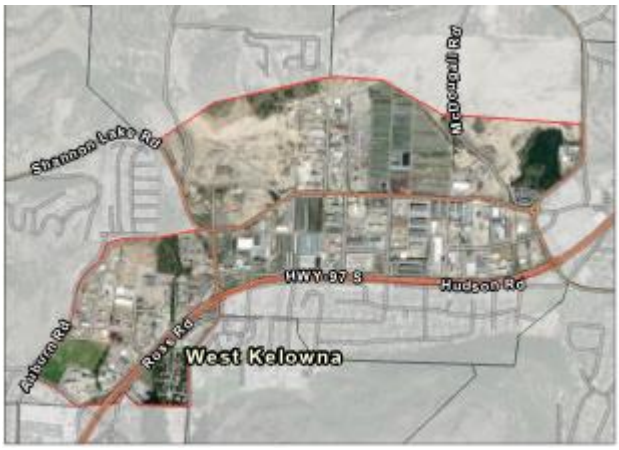
Crown West Steel Fabricators

- Producers of steel, stainless steel and aluminum fabrications

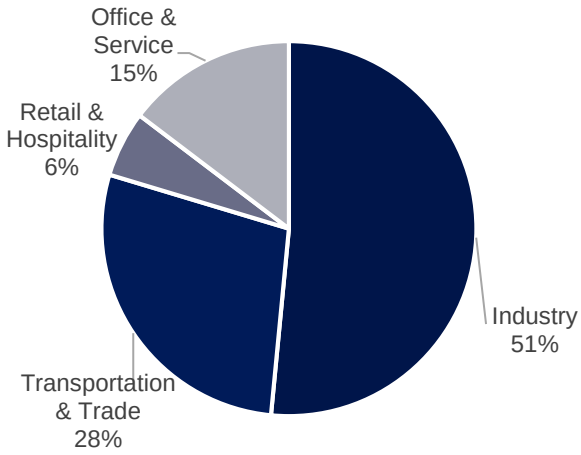
Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

West Kelowna Business Cluster

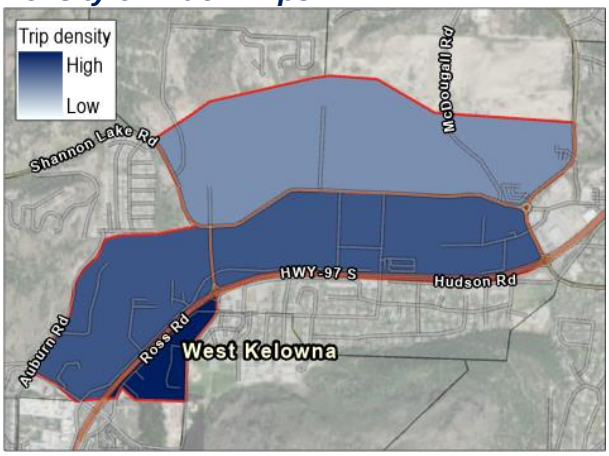
View of Cluster



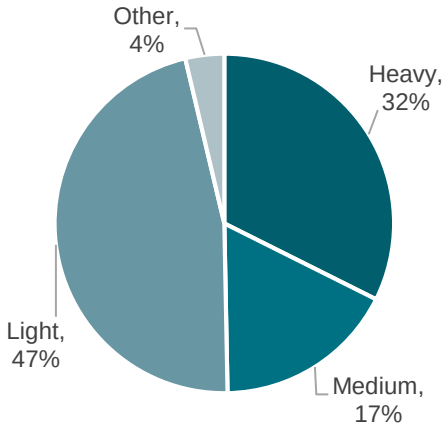
Distribution of Employment



Density of Truck Trips



Commercial Vehicle Type



Examples of Freight-Related Establishments

Alpine Aerotech

- Full-service helicopter maintenance company with two locations in BC

Bylands Nursery

- Nursery growing diverse mix of plant material (e.g., trees, shrubs, flowers)

Emil Anderson Construction

- Contractor for road building, aggregate production, construction

Sources: Employment data from Scott's, for 2019.Commercial vehicle data from Geotab, for 2019. Aerial imagery from Google Earth for 2022, © CNES/Airbus, City of Kelowna, Maxar Technologies, Province of BC, RDCO.

Appendix D Examples of supply chains in the Central Okanagan

Agri-food

Sector overview

Agriculture is a small, but important (some say "defining")[101] goods-generating economic sector within the Central Okanagan region. Crop production is particularly important in the Central Okanagan, with tree fruits (e.g., apples, apricots, cherries, peaches and plums) and grapes (used in winemaking) being some of the most important crops. In particular, the vast majority of Canada's cherries are produced in and around the Central Okanagan.[102] Total cherry exports from BC are over $70 million annually.[103] In addition to traditional crops, some stakeholders noted that cannabis production is an emerging sector in the region.[104]

Agriculture is a small, but important (some say "defining") goods-generating economic sector within the Central Okanagan region . . . In addition, agriculture is at the nexus of several other sectors with a larger share of employment in the Central Okanagan region.

In addition, agriculture is at the nexus of several other sectors with a larger share of employment in the Central Okanagan region. Most notably, from a goods movement perspective, agricultural production is a direct input food/beverage manufacturing in the region (and elsewhere), including juicing and winemaking. There are approximately 180 licensed wineries in the Central Okanagan with about 40 wineries in the Kelowna area.[105] The wine industry in the Central Okanagan represents an estimated $576 million economic impact. [106]

The agri-food sector also supports other regional industries, including being a tourism draw and providing product for retail and hospitality industry sales.[107] The Central Okanagan Economic Development Commission indicates that "[a]gritourism represents a major area of economic growth and opportunity in the Central Okanagan with traditional farm operators developing sustainable agriculture-related businesses that provide farm experiences for visitors to enjoy."

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[101] E.g., Parsons. 2015. Central Okanagan Planning Study: Current Conditions Report.
[102] An internal MOTI briefing note estimated over 96% of cherries are produced in BC, most of which are produced in the Central Okanagan and surrounding area.
MOTI. 2021. Regional Goods Movement Analysis –Central Okanagan (Desktop Study). Unpublished analysis.
[103] CPCS based on Statistics Canada, Canadian International Merchandise Trade data
[104] Amato, T. 2021. West Kelowna approves cannabis production facility in the city's Business Park. Kelowna Capital News. https://www.kelownacapnews.com/news/west-kelowna-approves-cannabis-production-facility-in-citys-business-park/
[105] Central Okanagan Economic Development Commission. 2018 Central Okanagan Economic Profile, p.15
[106] MOTI estimate, using the total province-wide impact of the wine industry and share of activity located in the Central Okanagan.
MOTI. 2021. Regional Goods Movement Analysis –Central Okanagan (Desktop Study). Unpublished analysis.
[107] Central Okanagan Economic Development Commission. 2018 Central Okanagan Economic Profile

We have defined an agri-food sector composed of agriculture and food/beverage manufacturing. In 2020, agri-food made up around 3% of regional employment. Absolute employment levels in the agricultural sector are expected to grow slightly by 2040, and are expected to slightly decline in share.[108]

Supply chain illustration

Agri-food is an export-oriented industry from the Central Okanagan, i.e., goods are produced and flow out of the Central Okanagan region. Some inputs to agriculture are required (e.g., fertilizers, etc.). Figure D-3 shows some typical supply chain patterns from the Central Okanagan. In general, the steps involve transporting produce from the farm to a processing facility (for packing or processing, e.g., into to beverages) and then exporting the products from the Central Okanagan region to export facilities or distribution centres. Some of the variations at each major step include:

Figure D-1: Example refrigerated trailer

Source: JardonB/Wikipedia/CC BY-SA 4.0

Figure D-2: Examples of refrigerated marine containers

Source: Andrea Puggioni/Wikipedia/CC BY 2.0

- *Farm to processing facility:* Produce, such as tree fruits, will be consolidated from farms at a processing plant in the Central Okanagan. For shorter-duration trips between farm to processing (about two hours was cited as one benchmark by stakeholders due to perishability), fruit can be trucked unrefrigerated. Shorter duration trips might also be made by smaller trucks, including pick-ups. Some companies will have receiving facilities within two hours of the farm to consolidate and refrigerate loads, before sending them to a processing facility. Other companies will have hydrocoolers at farms to keep produce cool and maintain integrity. Longer duration trips, including those trips coming from orchards outside of the Central Okanagan, will usually use 53' refrigerated trailers according to stakeholders (Figure D-1).
- *Processing facility to export facilities / distribution:* There are multiple distribution channels that depend on whether the product is destined for consumption in Canada or export overseas. Produce destined for overseas export will be trucked to Vancouver, for export via 40-foot refrigerated marine container (Figure D-2) or air freight (usually belly cargo).[109] For retail distribution, produce and wine will usually be sent to retail distribution centres (warehouses) first. Sometimes, these products will use the available truck capacity freed up from trucks transporting products to retail stores in the Central Okanagan. Producers and retailers do explore sending

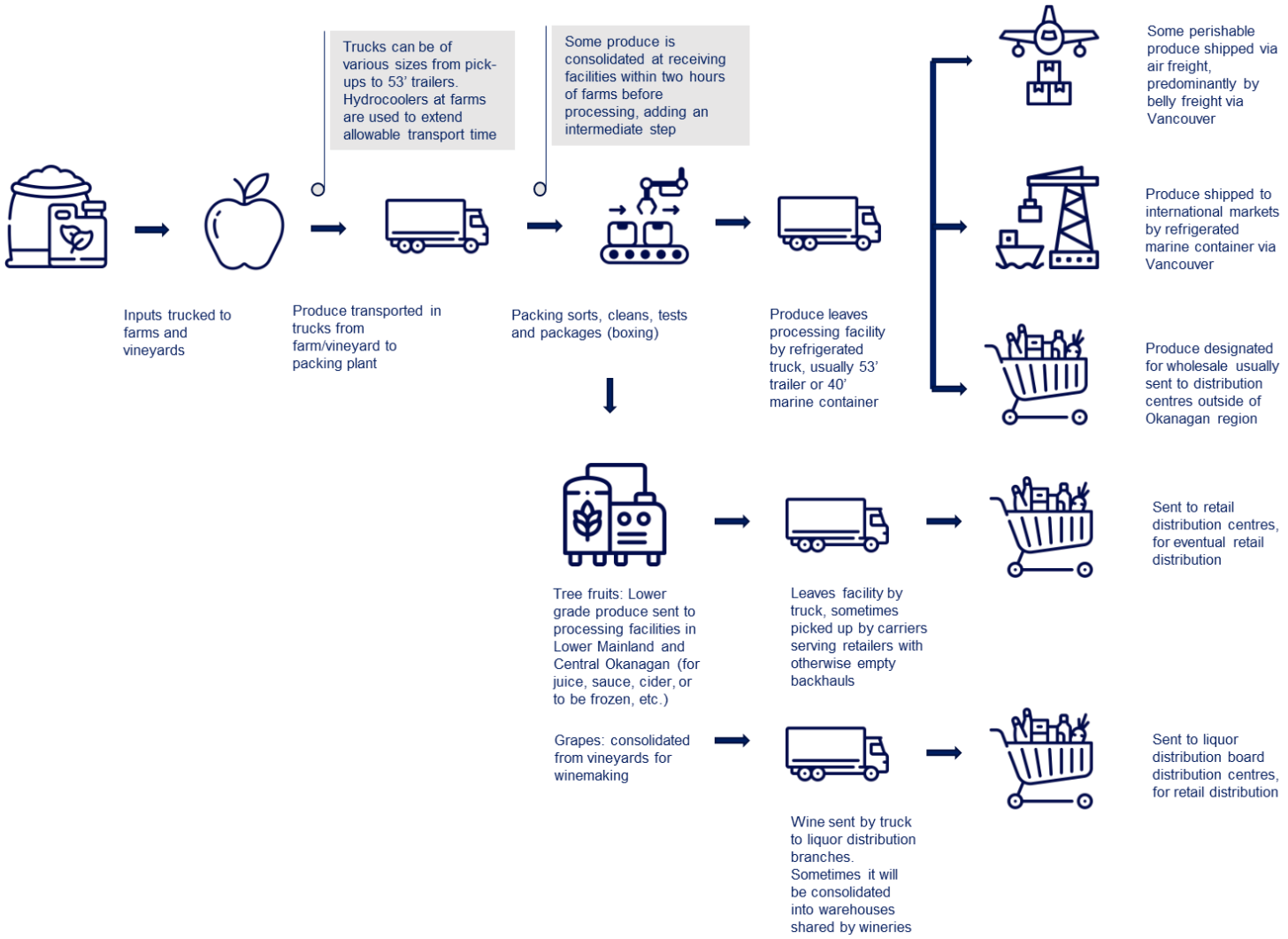
[108] Parsons. 2016. Central Okanagan Planning Study: Future Conditions Report.
This is based on the agricultural sector alone. This study did not split food and beverage processing within the analysis.

[109] For marine export, the 40-foot container will be trucked to the Central Okanagan empty, loaded in the Central Okanagan and returned. For air transport, a 53-foot refrigerated trailer will be used to truck produce to Vancouver.

products directly from processing facilities to stores in the Central Okanagan (e.g., on pallets), though it is not the predominant supply chain.

- *E-commerce (not shown):* Some companies, sell their products directly to consumers in retail or using e-commerce platforms. Couriers are typically used to transport e-commerce sales. Courier vans can pick up the goods at the shipper in a van and send it to a facility near the airport. Depending on the speed of service, these products can then be sent by courier company aircraft or truck to the centre nearest to the customer destination.

Figure D-3: Agri-food illustrative supply chains



Source: CPCS based on stakeholder feedback

Supply chain considerations

Figure D-4 describes some of the considerations in designing agri-food supply chains. Though consideration of transportation cost is pervasive with designing any supply chain, addressing travel time and reliability considerations are primary considerations due to product perishability, particularly for products such as cherries.

This means that delays due to congestion or outages, particularly ones that are unexpected, could have higher value impacts than a typical commodity.[110] For example, if a pick-up load of cherries (e.g., 3,000 kg) were spoiled en route to a packing plant and had to be sold for freezing or in the juicing (diminishing its value by about 80%)[111], the loss to producers might be over $10,000.[112] (By comparison, the *average* default cargo time value used by MOTI is $0.360 per hour for a tractor trailer, which also reflects that some trucks are moving unloaded.)[113] Other costs from congestion mentioned by stakeholders can include the additional storage costs (from a missed flight) and underused plant capacity (if a plant runs out of cherries to process). The rapid perishability as well as customer demands for timeliness means that the cargo value of time is higher than nonperishable inventory.

Figure D-4: Agrifoods supply chain considerations

Consideration	Primary	Elaboration
Cost		• Shipping produce must satisfy travel time requirements first for perishability. However, to the extent a product can stand up to longer travel times, shippers will seek to lower cost by selecting lower-cost modes, e.g., shipping by marine container versus air for overseas exports. • A shipping container might have a cost of the order of $100/tonne but take 30 days to reach its destination, whereas air freight might be $4,000-$8,000/tonne[114] but take three days to reach its destination. Roughly, air freight is an order-of-magnitude higher in cost, but an order-of-magnitude less in travel time. • One stakeholder mentioned a recent “tripling” of trucking costs to/from the Central Okanagan as being unsustainable.
Travel time	✓	• Transportation travel time is a primary factor in terms of how agricultural product stakeholders design their supply chains, due to product perishability. In particular, the travel time from a farm to a processing facility dictates whether refrigerated trucks or hydrocooling is required on farm. It also dictates whether consolidation occurs at or near a farm. For example, for a shipment from farms outside of the region, shippers might try to consolidate a large enough load to ship in a 53-foot refrigerated trailer. By comparison, a farm within two hours of a receiving facility might send their product out by pick-up truck. • However, once a supply chain has been designed, the travel time itself is less important than its reliability. For example, some grades of cherries

[110] BC MOTI Default Values for Benefit Cost Analysis In British Columbia 2018
[111] According to stakeholder comments
[112] Calculated as 80% of 3,000 kg (the carrying capacity of a one-tonne truck such as an F-350) and assuming $5 per kg of cherries. (In August 2021, the Canadian International Merchandise Trade Database reported average unit values for cherries of between $4 per kg to 15 per kg).
[113] It is noted that benefit-cost analyses need to use average values that reflect the breadth of commodities being carried. The point of this section is to illustrate that these average values do not reflect the full breadth of possible impacts.
[114] Freightos. Air Freight & Air Cargo Shipping: Air Freight Charges, Rates, Costs & Quotes

Consideration	Primary	Elaboration
		that can stand up to longer transport times are exported by marine shipping container to save costs (versus air shipments).
Reliability	✓	• Once a supply chain has been designed, travel time reliability is an important consideration for produce. • If a processing plant runs out of harvested fruit for processing, one stakeholder noted that there will be hundreds of workers not being productive. The implication is that an overall outage of a transportation corridor could impact production costs. • For goods exported by air, after completing regulatory requirements, there is often only one hour of buffer time available for delays, after accounting for driving time between the Central Okanagan and YVR, to meet a flight cut-off.[115] If this buffer is exceeded, products might not make it to another flight the next day (or even a couple of days later). This increases warehousing costs in the Lower Mainland and impacts the reputation of the shipper (which could impact pricing power), because customers are often expecting products for certain events.
Risk/ Information		• One stakeholder mentioned that they tried using rail, but have concerns about the ability to maintain temperature. • Team members have also heard concerns about fruit bruising from bumpy roads.

Source: CPCS compiled based on stakeholder feedback and other sources

[115] For example, Korean Air Cargo's cut-off in Vancouver for perishables is three hours before the flight. https://cargo.koreanair.com/Branch-Details?airport_code=YVR

Business locations and popular routes

Agricultural activity drives goods movement activity (including transportation of harvested fruit). There are 22,500 hectares of agricultural land in the Central Okanagan. Agricultural land is throughout the region, but the largest contiguous stretch in East Kelowna.

During harvest, produce from these areas is received and processed at facilities in the Central Okanagan, notably in the four clusters in the bulleted list below.

Agri-food businesses are located throughout the region (Figure D-5), but a there are areas with higher concentration, including:

- **North End:** By employment, the largest agri-food cluster identified is in the Kelowna North End, which includes a large beverage manufacturer, packing plant and urban winery
- **Near Jim Bailey Industrial Park:** There is also a cluster, albeit more distributed, around the Jim Bailey Industrial Park, including large packing plants on both sides of Highway 97
- **Old Vernon Road:** There is a fruit packing plant along Old Vernon Road
- **Lake Okanagan:** Several wineries are located along Lake Okanagan, including on the Westside (near Boucherie Road) and in Kelowna (near Lakeshore Drive)

The Geotab data, combined with the distribution of employment throughout the region, allows for the identification of popular routes[116] used by vehicles in each economic sector. The Geotab data sample does have a relatively limited sample of agricultural trips. However, the data illustrates that agri-food (more so than other sectors, notably forestry or manufacturing) relies on the broader transportation network to access Highway 97, including:

- In Kelowna, Old Vernon Road east of Highway 97; Rutland Road south of Highway 97; Gordon Drive, Lakeshore Drive and Benvoulin Road south of Highway 97; and Gordon Drive, Spall Road and Clement Avenue North of Highway 97
- Gelatly Road and Shannon Lake Drive in West Kelowna

Popular routes used by the agri-foods sector are shown in Figure D-6. The scale is described in the box. Potential absences from the popular routes (given the presence of adjacent agricultural areas, but potentially not reflected due to data sample limitations) include roads in east and south Kelowna, as well as Boucherie Road.

Though these are the popular routes according to the available data, because of the wide coverage of agricultural areas, many rural roads in these areas will also be used for farm equipment during harvest.

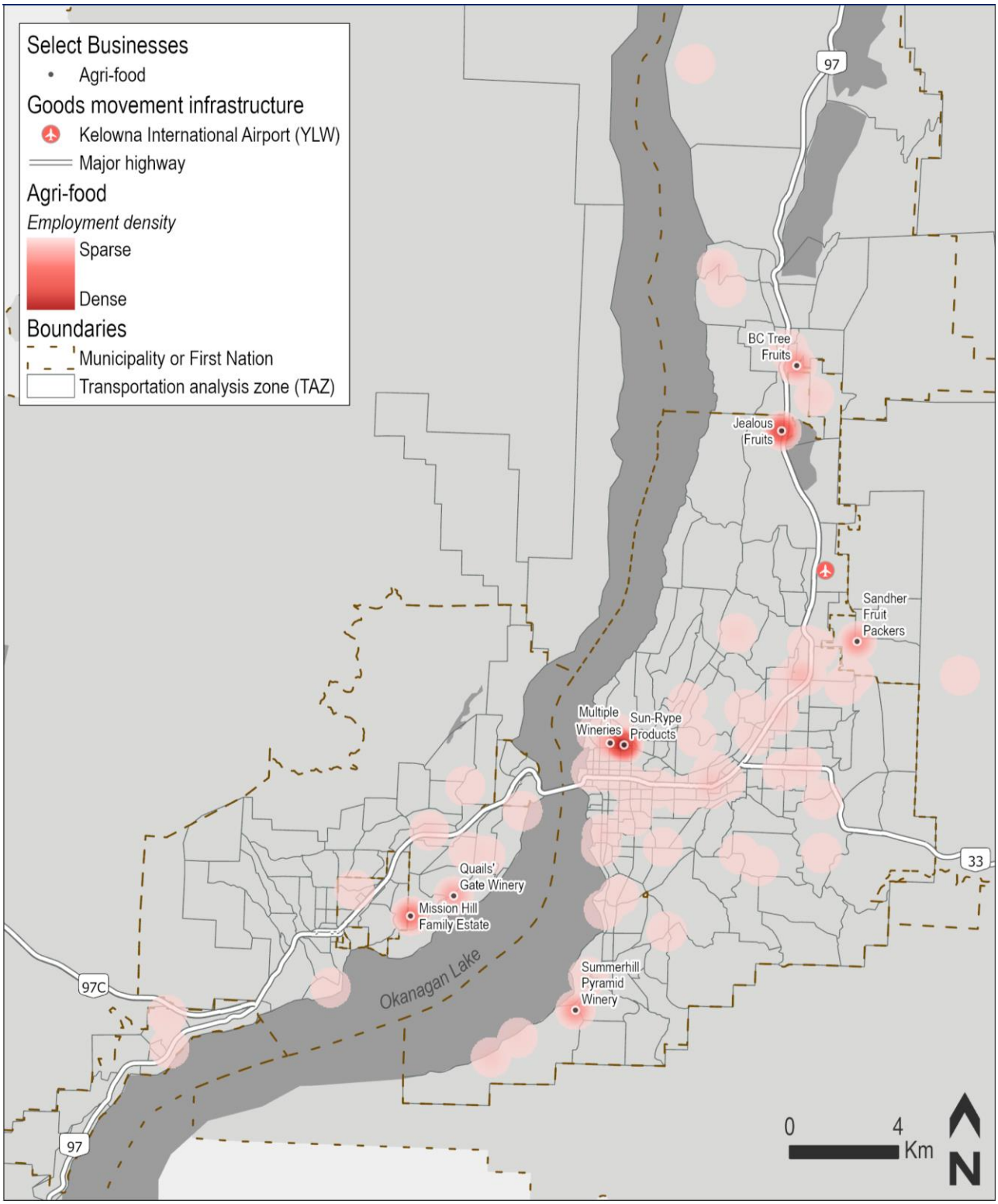
Definition of "light," "moderate" and "heavy" moderate use popular routes

As noted previously, the volumes provided by the truck GPS data are based on a sample of goods movement vehicles (i.e., include only a subset of all trucks). Accordingly, the volumes are associated with "light," "moderate" and "heavy" are useful for relative comparison only. The following scale was used:

- **Light** – 10-50 units of volume (Also, implies that trucks are definitely operating on this corridor)
- **Moderate** – 50-250 units of volume
- **Heavy** – greater than 250 units of volume

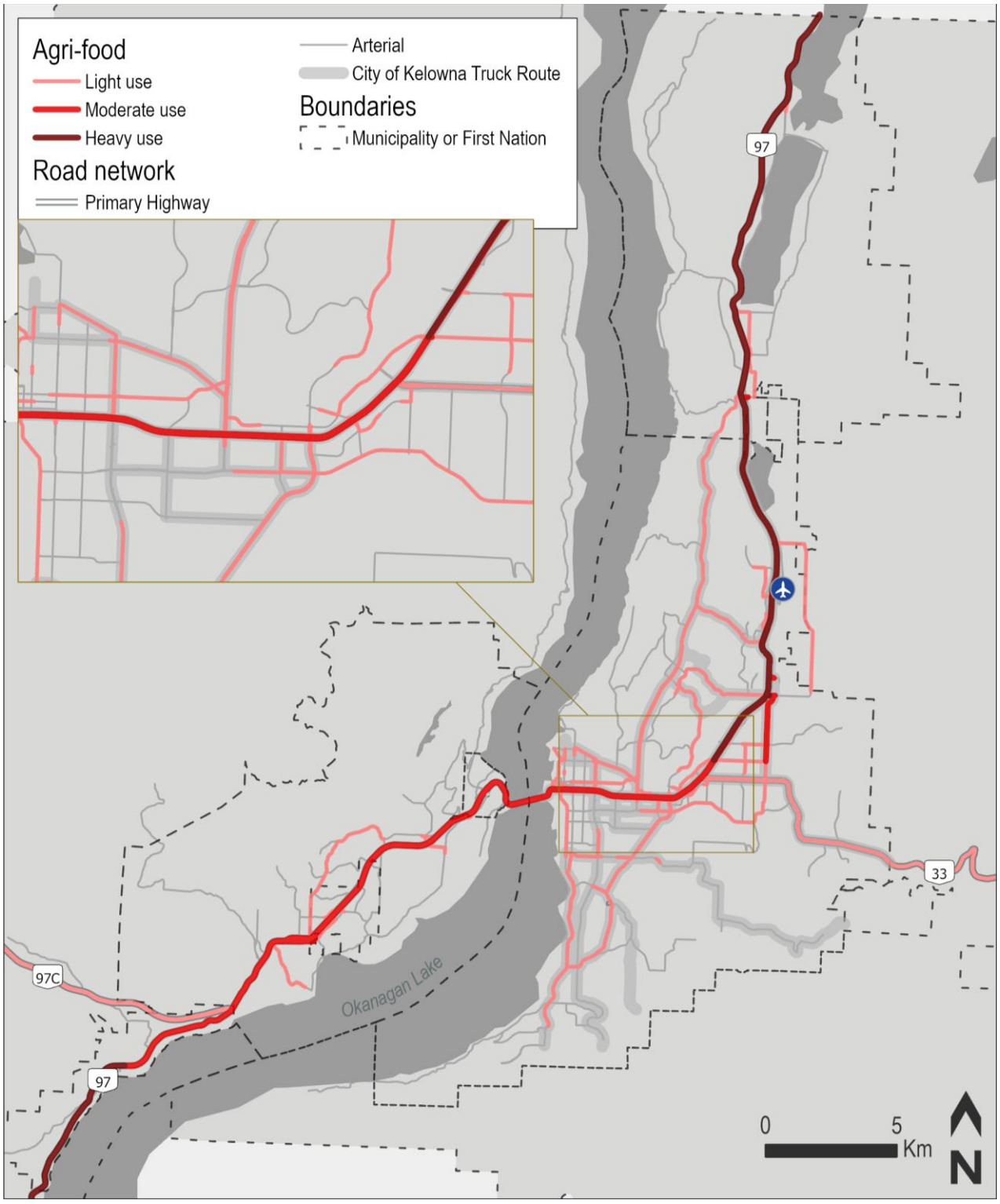
[116] The Geotab data identify the relative volume of trips between each origin-destination, by 2-digit NAICS sector. In turn, we further estimated the split between agri-food, forestry products and other manufacturing based on the proportion of employment at the 3-digit NAICS). Because Geotab suppresses (does not publish) routes with low-volumes, the presence of trips means that a corridor was used, but the absence of trips does not conclusively indicate that no trips used this corridor.

Figure D-5: Agri-food employment density



Note: In August 2022, BC Tree Fruits Announced it would be relocating its main packing facility to Oliver, though receiving facilities would exist throughout the region. Source: CPCS analysis based on Geotab data

Figure D-6: Popular routes used by agri-foods sector



Source: CPCS analysis based on Geotab data

Forestry products

Sector overview

Similar to agriculture, forestry is a small industry by share of employment (about 3% of the businesses sampled), but well integrated with other facilities outside the Central Okanagan (e.g., lumber, pulp and pellet mills, and bio-energy plants elsewhere in BC). Also like agriculture, we have defined forestry products to include both primary extraction as well as value-added activities such as processing. In the Central Okanagan, there is notably wood product manufacturing (NAICS 321) (i.e., lumber mills).

Limited growth in employment was expected beyond 2016.[117] Further, there have been recent declines in the sector within the Central Okanagan. In 2020, Tolko Industries closed its plant in the North End which had an estimated 192 million board feet in annual capacity.[118] This closure impacted between 130-300 jobs, depending on the source and baseline time horizon noted.[119] We understand that there may still be some log storage activities ongoing within Kelowna, which would drive transportation activities.

However, a major mill remains operational in the region. Gorman Brothers has a plant on the Westside with an estimated 127 million board feet in annual capacity.[120] Gorman Brothers also owns other facilities in Canoe, Revelstoke, Lumby and Oroville, Washington.[121] Tolko's Lake Country Mill near the Jim Bailey Industrial Park makes wood packaging products, including palettes and fruit crates.[122]

Supply chain illustration

Figure D-8 shows a typical forestry product supply chain. Forestry product manufacturing in the Central Okanagan relies on both flows into and out of the Central Okanagan.

Coming in, logs are transported to the Central Okanagan by logging truck (e.g., Figure D-7). Because of the need to source input timber of a certain quality, and the general availability of timber in the interior of BC, logs can be sourced from as far away as the BC Cariboo region, Alberta or Washington State.[123] Dimensional lumber (e.g., 2x4s) is also imported to the region from other mills for processing into higher-value products (e.g., tongue-and-groove boards, panelling, flooring, etc.).

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[117] Parsons. 2016. Central Okanagan Planning Study: Future Conditions Report.
This is based on the agricultural sector alone. This study did not split food and beverage processing within the analysis.

[118] Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2019. 2019 Major Timber Processing Facilities in British Columbia

[119] Canadian Press. 2019. Tolko Industries to cut back mill operations in Kelowna, B.C., affecting 127 jobs. https://www.theglobeandmail.com/canada/article-mill-closure-in-bc-will-cost-127-jobs-in-kelowna
Baker, R. Tolko Kelowna mill closure marks end of the line for decades-old facility | CBC News. https://www.cbc.ca/news/canada/british-columbia/tolko-kelowna-mill-workers-1.5354407

[120] Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2019. 2019 Major Timber Processing Facilities in British Columbia

[121] Gorman Brothers. https://www.gormanbros.com/contact/

[122] Tolko – Lake Country. https://tolkobins.com/tolko-lake-country/

[123] There are expected to be declines in the allowable annual cut going forward as well in the Central Okanagan.
Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2022. Allowable annual cut level reduced in Okanagan Timber Supply Area. https://news.gov.bc.ca/releases/2022FLNRO0004-000116

Once logs or lumber arrive in the Central Okanagan, they are processed into boards at mills. In turn, these boards are trucked out to rail transload facilities, usually in Calgary and Oroville, Washington, as well as the marine container transload facilities in the Lower Mainland. At rail transload facilities, the lumber is loaded onto rail cars, including centrebeams, which in turn is sent by train to destinations around North America. At marine transload facilities, lumber is loaded into marine shipping containers, which are usually 40-foot high-cube containers. The containers are then trucked ("drayed") to container terminals in the Lower Mainland for export by container vessel. This detail is not shown in this image, but the transloading, drayage and vessel loading make up a significant fraction of the overall cost of transportation, despite all occurring within the Lower Mainland.

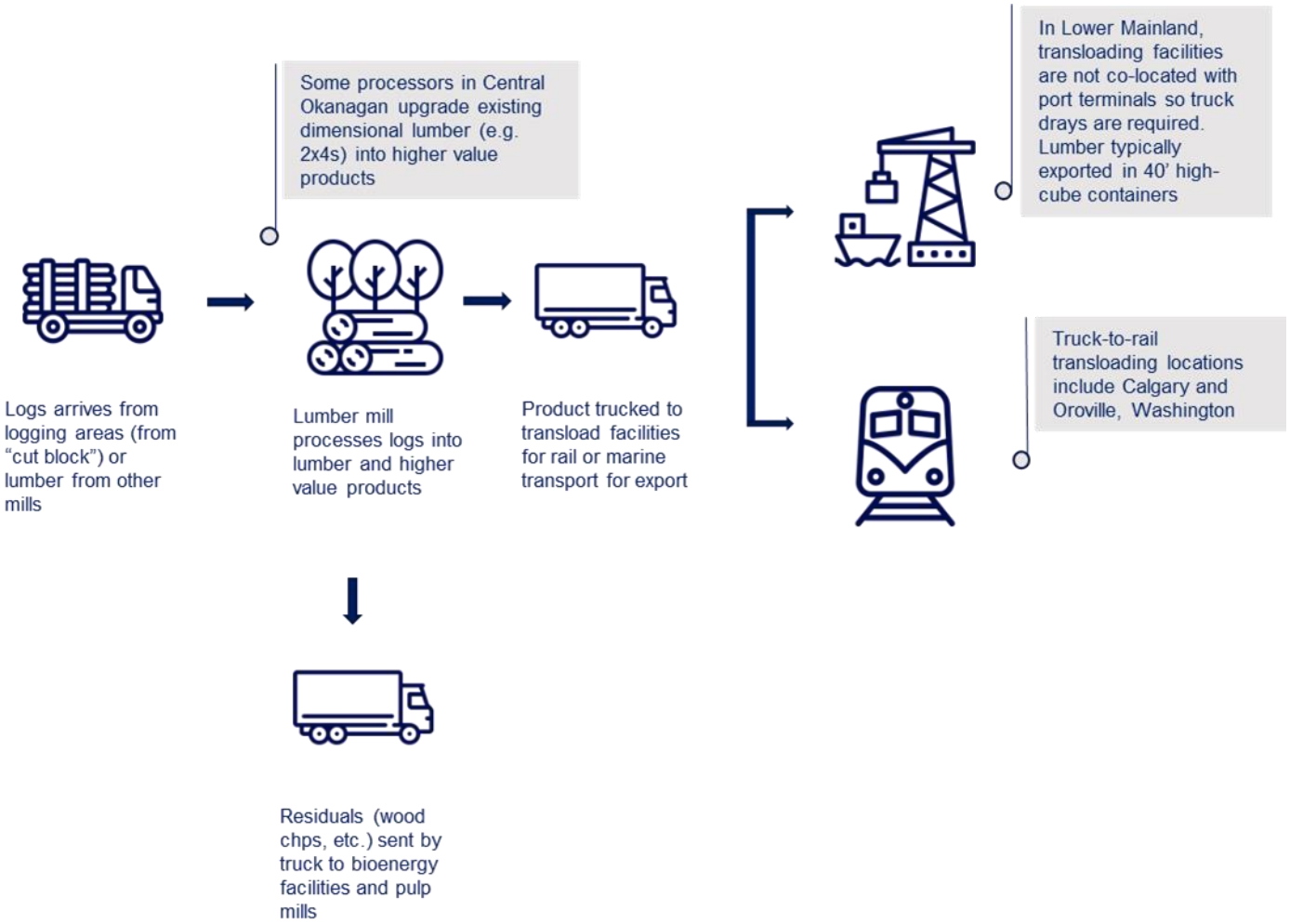
Figure D-7: Logging truck in BC

Source: iStock

Lumber production also produces by-products ("residuals"). Residuals, such as wood chips, are shipped out to the broader Okanagan region, as well as Kamloops or the Lower Mainland. Wood chips are used in bioenergy production, pulp production, and wood pellet production. The number of outbound trucks carrying residuals can be of the same order of magnitude as those of finished goods (order of 10s of trucks per day at a facility). Some likely cross most of Central Okanagan given the location of processing facilities.

It was noted that there are not big seasonal variations in flows overall. However, some origins and destinations might shift throughout the year based on end-market demand.

Figure D-8: Forestry products supply chain



Supply chain considerations

Figure D-9 describes some of the considerations in designing forestry supply chains. Transportation costs are a significant factor in designing forestry product supply chains, particular for residuals which are very low-value products. In the Central Okanagan, the additional travel times due to congestion (estimated at 0.5-1.0 hour to/from Vernon) are a concern in that additional trucks are required or a premium is required to ship goods overnight.

However, arguably, transportation reliability and access to multiple markets and modes are more crucial, as the inability to export their products even for a short period of time (less than one day) can result in a shut down if storage capacity is reached. For example, if multiple trucks are delayed along Highway 97 due to longer than usual congestion, it might lead to a plant shut down due to not having enough storage for residuals on site.

Outages are also a concern. During the highway outages in November/December 2021, a stakeholder noted it was not cost-effective for producers to reroute wood chip shipments. It is also important that producers have access to multiple outlets (e.g., transloading facilities outside of the region) to take advantage of market pricing and to mitigate against the regular outages that can occur on Highways 5 and 1.

Figure D-9: Forestry products supply chain considerations

Consideration	Primary	Elaboration
Cost	✓	• Freight costs are a significant factor in the forestry industry, in particular for residuals, which are very low-value products (the cost of freight can be higher than the value of the product itself). • During the November/December road outages, some companies were unwilling/unable to pay the additional cost of rerouting certain products through the US due to the higher costs.
Travel time		• Travel time itself was not noted as especially important for forest products to/from the Central Okanagan, though does influence cost through trucking rates (which is extremely important).
Reliability	✓	• A reliable transportation network is critical for forestry products, even for low-value residuals. There can be limited storage onsite (much less than one day) for wood chips to build up at certain facilities. A series of multiple trucks arriving late can result in a plant having to shut down due to storage capacity being reached.
Risk/information	✓	• Forestry product producers mitigate risk by having access to multiple markets (i.e., domestic, US and overseas) and routings/modes (e.g., rail-based and marine-based modes).

Source: CPCS compiled based on stakeholder feedback and other sources

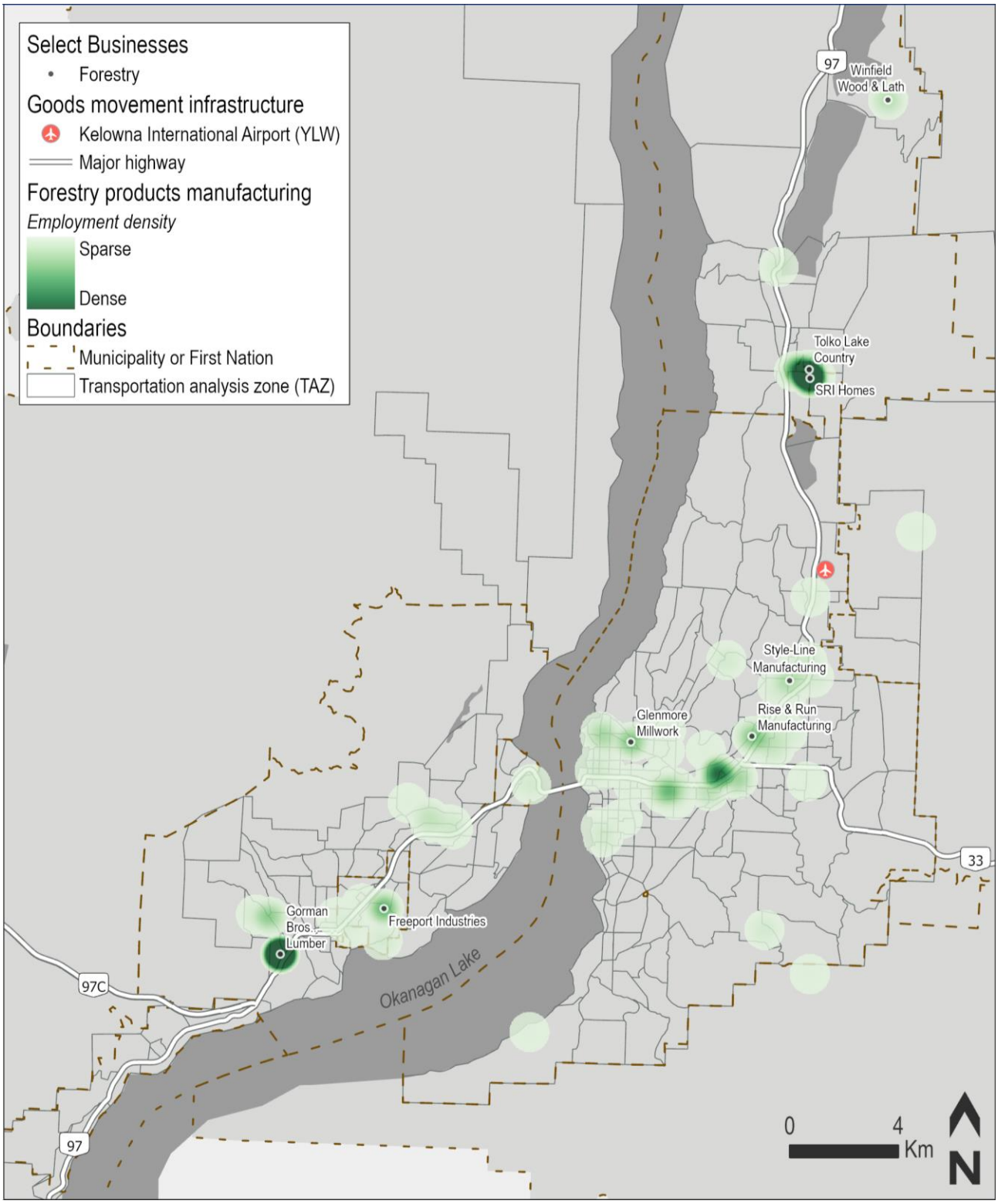
Business locations and popular routes

Forestry products businesses, though distributed through the region, are more concentrated along Highway 97 than agri-foods (Figure D-10). By employment, clusters of forestry products businesses include:

- **Jim Bailey Industrial Park area:** There is a large manufactured home manufacturer in this area as well as Tolko Lake Country division
- **Westside:** Gorman Brothers Lumber is located at the interchange of Glenrosa Road with Highway 97
- **Highway 97 corridor:** Some forestry products retailers and distributors (e.g., home improvement retailers which receive lumber) are also classified as part of this sector

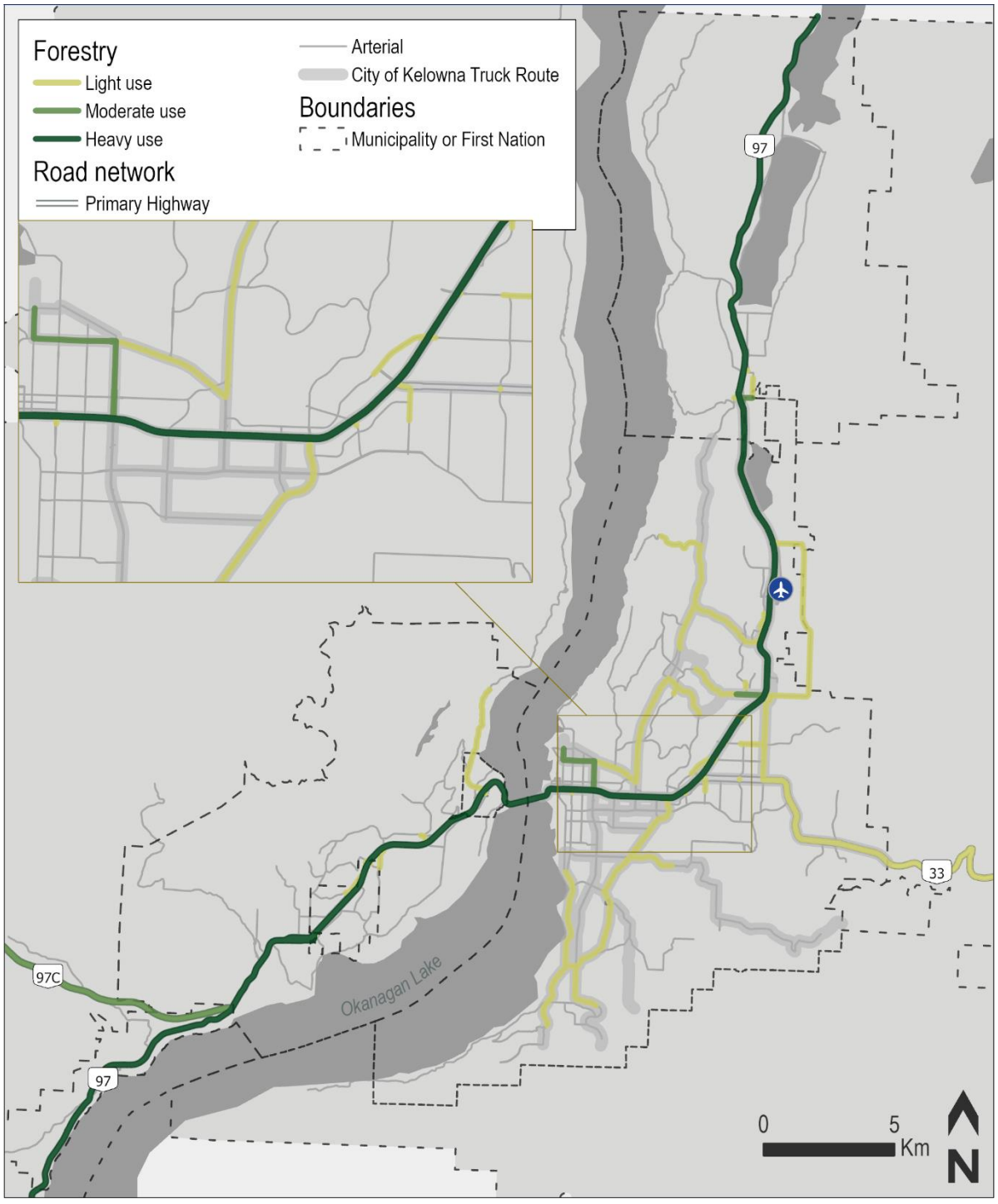
Accordingly, the popular routes used by the forestry products sector are concentrated along the provincial highway network, particularly Highway 97, more so than the other sectors (Figure D-11). However, there is still some volume moving to the North End, which is due to the data being taken from 2019. Some residual log storage activities may have continued, according to stakeholders.

Figure D-10: Forestry products employment density



Source: CPCS analysis based on Geotab data

Figure D-11: Popular routes used by forestry products sector



Source: CPCS analysis based on Geotab data

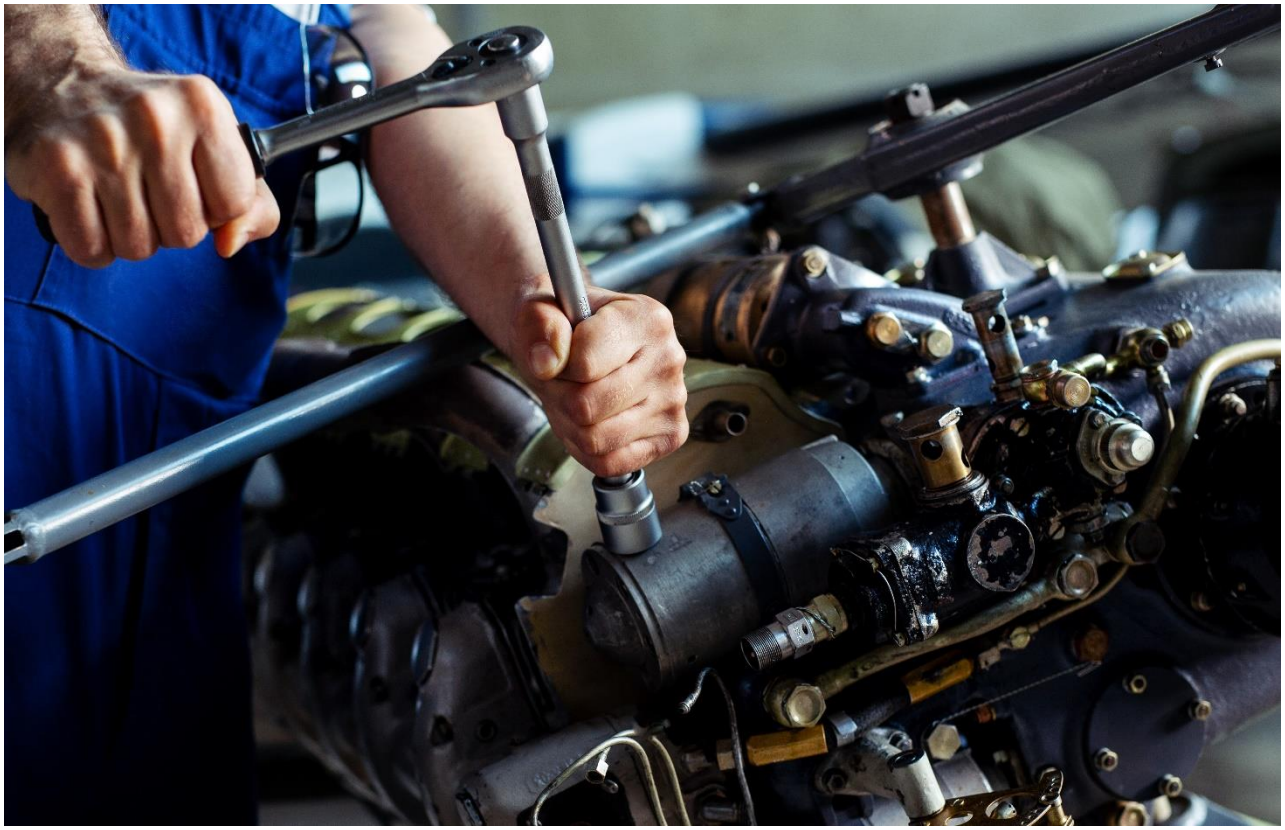
Other manufacturing

Sector overview

Manufacturing, which is the physical or chemical transformation of goods, encompasses a wide range of sectors. The Central Okanagan has a relatively diverse manufacturing sector,[124] making up approximately 12% of the total employment in the businesses sampled. It is expected to continue growing at half the rate of population growth.[125] The Central Okanagan Economic Development Commission (COEDC) identifies the following sectors as being present in the Central Okanagan:

- high-tech aerospace (e.g., Figure D-12)
- metal, plastic, concrete and fiberglass product manufacturing
- fabricated metal manufacturing
- non-metallic mineral manufacturing (e.g., aggregate production)
- transportation equipment manufacturing[126]

Figure D-12: Aircraft maintenance engineer repairing an engine



Source: iStock

[124] Central Okanagan Economic Development Commission. 2018 Central Okanagan Economic Profile
[125] Parsons. 2016. Central Okanagan Planning Study: Future Conditions Report.
[126] During our scan of businesses, we also noticed the presence of mobile home manufacturers, which would draw from some of the previous sectors mentioned, notably wood product manufacturers (though may source from outside of the Central Okanagan).

Aerospace is particularly significant, with the COEDC noting that

> A cluster of 30 aerospace companies form a significant part of the manufacturing industry in the Central Okanagan. This includes the anchor company KF Aerospace – the region's largest private employer with 700 employees – which provides maintenance, engineering and pilot training services. The aerospace industry is further supported by the Kelowna International Airport.

We note several of the aerospace manufacturers in the region also provide maintenance and engineering services, so could be better construed as remanufacturing.

In this section, we will profile an aerospace manufacturing supply chain, because of its strategic relevance to the region. It also epitomizes the supply chain of a very high-value product.

Supply chain illustration

Manufacturing supply chains involve importing goods to a facility for processing, assembly or repair. The finished good might in turn be exported to other aircraft assembly facilities or installed in an aircraft in the region that has been sent for repair (Figure D-13). In turn, the finished goods might be incorporated into an aircraft being assembled or repaired.

While the supply chain illustration is conceptually simple, it is in practice complex, requiring careful coordination of a wide variety of inbound goods (which in turn are produced elsewhere globally), production schedules at multiple facilities, and outbound shipping in a timely fashion to ensure it meets customer timing for repair or assembly within an aircraft.

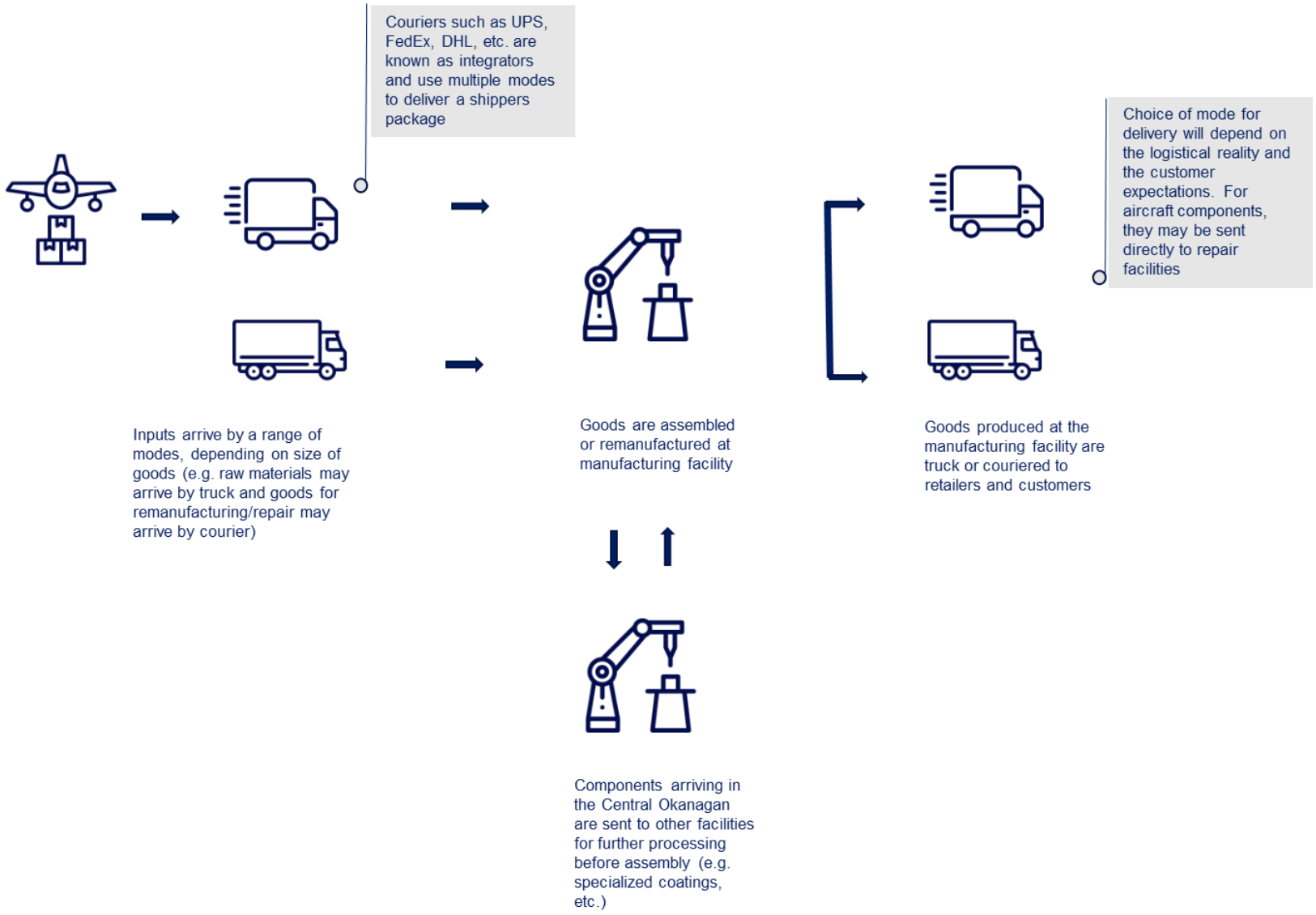
In the case of the aerospace sector in the Central Okanagan, the inbound goods can include not only intermediate goods like metal shapes (e.g., for housings or structures), plastics, electronic components, etc., but also existing aircraft parts like avionics for repair or remanufacturing. There can be more variety and volume of inbound components than outbound products.[127] The products can arrive from other manufacturers globally, predominantly by air (i.e., by courier). Larger components such as metal shapes can also arrive by truck.

Once in the region, while a single facility might be used for assembly, that facility will send goods out by truck (e.g., hotshot point-to-point courier) for additional processing, such as specialized coatings, before returning for assembly.

This is a common feature across multiple manufacturing sectors, i.e., that goods will circulate over the same transportation corridors in various states of assembly. For example, it is commonly cited that automotive parts used for vehicle production in Eastern Canada will cross the border multiple times before finally being assembled in a vehicle.

[127] In another sector found in the Okanagan – manufactured homes – the final product is in fact much larger and requires more consideration in transport. Sectors are unique in this regard.

Figure D-13: Other manufacturing



Supply chain considerations

Figure D-14 describes some of the considerations in designing aerospace supply chains. Transportation costs are viewed as a part of the cost structure and subordinate to meeting travel time, reliability and risk considerations. High-speed, reliable and traceable air-based courier networks are crucial to aerospace supply chains. In turn, reliable access to/from courier depots around YLW are viewed as crucial, as well as continued air cargo services (i.e., by courier). A stakeholder noted that they are sometimes willing to pay extra to "hotshot" (direct point-to-point) courier cargo to a courier depot at the airport from Kelowna. However, they cannot afford to regularly have cargo miss a courier cutoff and arrive late at their customer facility. The implications of this could be a lower probability of receiving future contracts. Likewise, inbound cargos cannot regularly arrive late, even by a couple of hours, and still meet production schedules. While difficult to quantify, it speaks to the need for reliable travel times along Highway 97.

Figure D-14: Manufacturing supply chain considerations

Consideration	Primary	Elaboration
Cost		• While transportation cost is relevant for certain manufacturing sectors, it is subordinate to travel time, reliability and risk. Cost of transportation is viewed as a cost of doing business (i.e., built into the cost structure). Shippers will often pay for a premium (faster) service, or hotshot courier, a part to ensure it arrives on time or early. • It is important to note that while certain manufacturing industries can accept this cost, it is not universal across all manufacturing sectors.
Travel time	✓	• Minimizing transportation travel time is increasingly important for inbound products, because of global parts shortages increasing ordering lead times. Air service is predominantly used to transport inbound products. • Likewise, short travel times are crucial to export products (see note above regarding cost) and shippers will sometimes pay a premium for faster service to ensure it meets customer commitments and assembly schedules. An aircraft might be waiting for a part to be repaired and put back into service. Even a small seaplane might charter for $1000 per hour, so even a one-day delay in returning to service can be significant revenue loss for an operator.[128] • Within the Central Okanagan, it was noted that as the travel time between locations in the Central Okanagan and courier depots around YLW influences the pick-up cutoff window for courier companies offering national and international networks via air. In turn, to ensure a product is sent out by air on a given day, a shipper might pay a premium to hotshot courier a shipment to a courier depot near the airport, to ensure that a shipment can meet a connecting flight.
Reliability	✓	• Reliability of travel times is also important, as stakeholders will plan assembly schedules down to a given day, so expect a part to show up to meet schedules. • Likewise, if manufacturers do not deliver to their customers on time, they can be hit with damages (i.e., reduction in revenue) or reputation loss (measured by contract metrics). In turn, this can limit the ability to receive contracts in the future.

[128] E.g. https://highadventureair.com/custom-charters/. The actual cost of operating the aircraft net of fuel, regular maintenance, pilot, etc. is considerably less.

Consideration	Primary	Elaboration
Risk/ information	✓	• Aircraft parts can often be unique to an aircraft that is no longer in production (i.e., effectively irreplaceable).[129] Therefore, there is an extremely low tolerance for loss and high requirement for traceability. • It was noted that air transport is being used to minimize risk of road outages as well.

Source: CPCS compiled based on stakeholder feedback and other sources

Business locations and popular routes

Except for the Kelowna North End, manufacturing activity is clustered along the Highway 97 corridor (Figure D-15). Some particular clusters include:

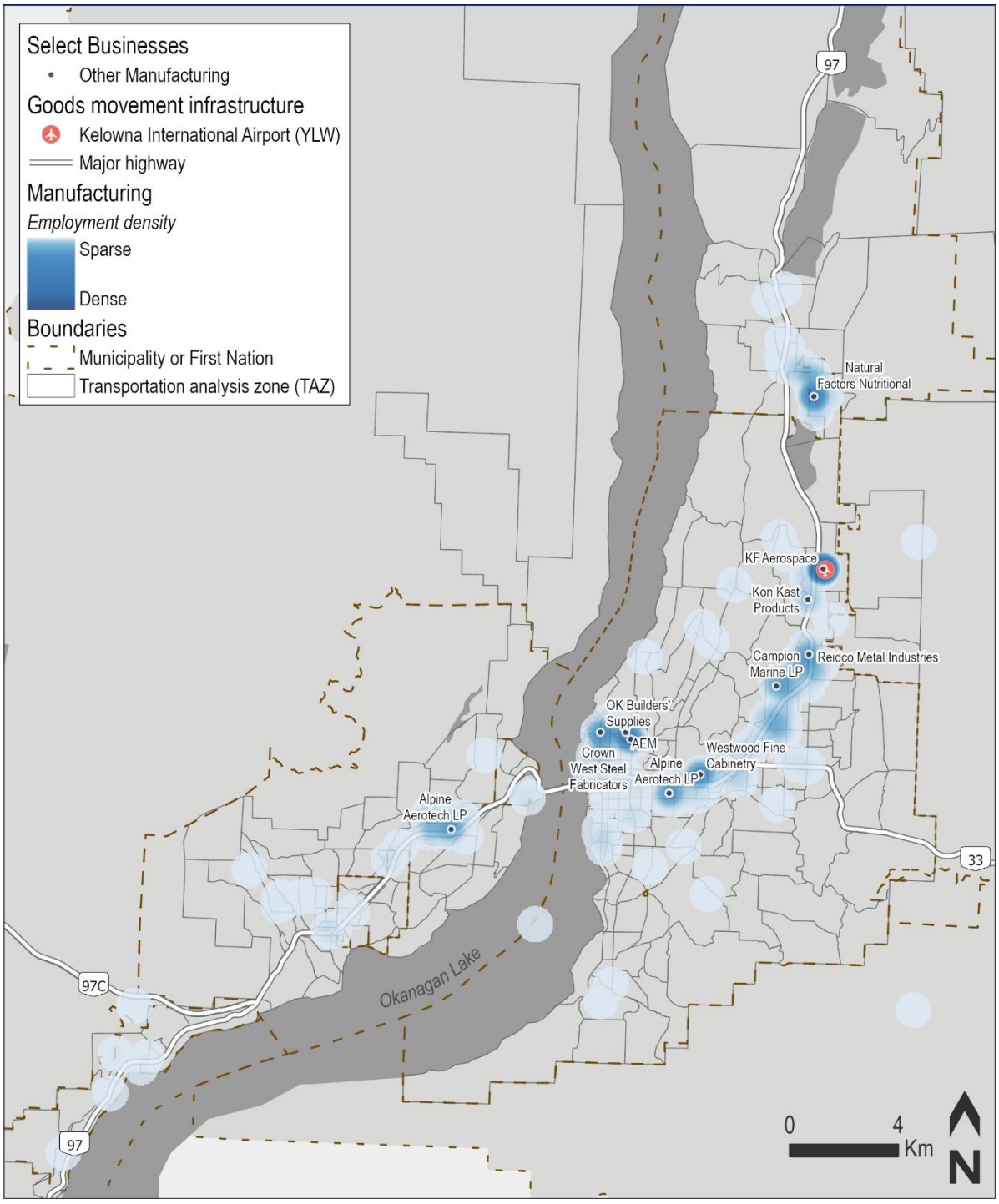
- **Jim Bailey Industrial Park**
- **North End Neighbourhood in Kelowna**
- **YLW**
- **Industrial and commercial areas along Highway 97 from Jim Hindle Drive to Burtch Road**
- **Industrial area in West Kelowna**

There is also a diversity of manufacturing subsectors represented, including aerospace, metal fabricators, ready-mix cement, nutritional and medical products.

Again, Highway 97 is the primary corridor; other routes off Highway 97 are used to access businesses that are located off Highway 97 (Figure D-16). In addition, there is also a relatively high volume of trips to the Kelowna North End to serve non-forestry manufacturing such as the production of ready-mix cement.

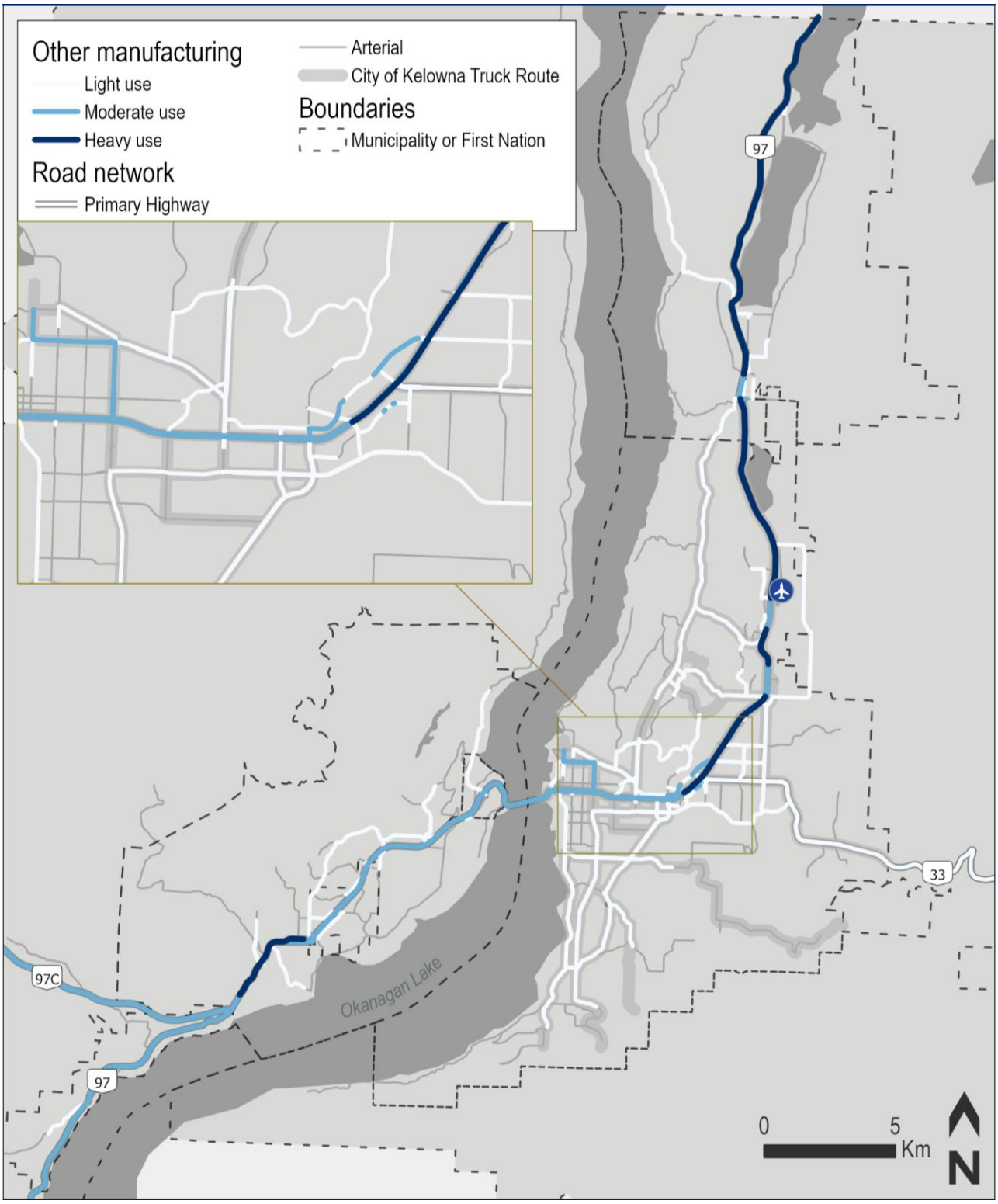
[129] Given the paramount importance of safety in the aviation sector, a component might be unique to a given aircraft or aircraft type. Given that many aircraft are no longer in production, there may be no replacement for a part.

Figure D-15: Other manufacturing employment density



Source: CPCS analysis based on Geotab data

Figure D-16: Popular routes used by other manufacturing sector



Source: CPCS analysis based on Geotab data

Wholesale and retail trade

Sector overview

Wholesale and retail trade makes up about 17% of the Central Okanagan region's employment. Of equal if not greater importance, the wholesale and retail trade sectors ensure that the Central Okanagan region residents, businesses and tourists can get the products they need to ensure a quality of life and enable other economic sectors. In particular, the wholesale and retail trade sector includes food retailers.[130]

A previous study for MOTI forecasted that employment is expected to grow with population, though "the ratio of jobs to population is expected to be lower than the last 10-year average."[131] Given that population is expected to continue growing in the Central Okanagan, continued growth in wholesale and retail trade sectors is expected.

Supply chain illustration

Figure D-18 shows the organization of retail supply chains. Again, the specific locations and routings of facilities depend on the broader network of retail locations within a company. However, the following are some general guidelines for how the Central Okanagan is served:

- **Manufacturer and supplier to distribution centres:** Goods arrive from multiple origins (including from Canada, the US[132] and overseas), and are consolidated at distribution centres (DCs, i.e., warehouses) across Canada. Goods arriving from Canada are sent by truck or intermodal (container on rail and truck, see Figure D-17). Goods arriving from the US are trucked, as limited cross-border rail services exist. Goods arriving from overseas can involve multiple steps, including drayage of the marine container[133] to a DC/transloading facility, transloading into a 53-foot domestic container and/or intermodal (rail and truck) depending on the location of the DC.
  - DCs are located in urban areas including the Lower Mainland, Calgary, Edmonton, and the Greater Toronto Area. Goods to/from the Central Okanagan are usually primarily served out of a Lower Mainland DC, if a retailer has a DC there. However, it is also common for goods to be shipped from DCs across Canada on regular schedules to the Central Okanagan.
  - Some retailers also use DCs to serve e-commerce orders.
- **DCs to stores:** Goods are sent to stores by truck (usually in a 53-foot trailer or domestic container) or in some cases intermodal (rail and truck). Stores might also receive shipments directly from vendors. For retail goods, truck trailers will usually cube out (i.e., reach their maximum volume rather than weight first), so some retailers are piloting longer 60-foot containers, under permit.
- **Stores to DCs:** Some retailers will send a small fraction of their trucks back to DCs loaded with pallets, recycling or returns. They will also try to arrange pick-ups with vendors in the Central

[130] Some discussions noted the importance of their industry in supplying the Central Okanagan during emergencies (e.g., ensuring that there is adequate bottled water for crews during forest fire season, etc.).
[131] Parsons. 2016. Central Okanagan Planning Study: Future Conditions Report.
[132] Goods from Canada or the US might also have been imported. However, some sellers to retailers prefer to import the goods themselves. From the point of view of the retailer, they appear to originate in Canada but have also placed demands on the transportation system.
[133] Typically, 40-foot marine containers are used for retail goods because they are lighter, and will reach their volume rather than weight limit first (i.e., cube out).

Okanagan to return to their DCs, though they noted that there are lower volumes of outbound shipments from the Central Okanagan than inbound shipments.

- Some retailers use stores to serve e-commerce orders sent by courier

Figure D-17: Road-rail intermodal transportation images

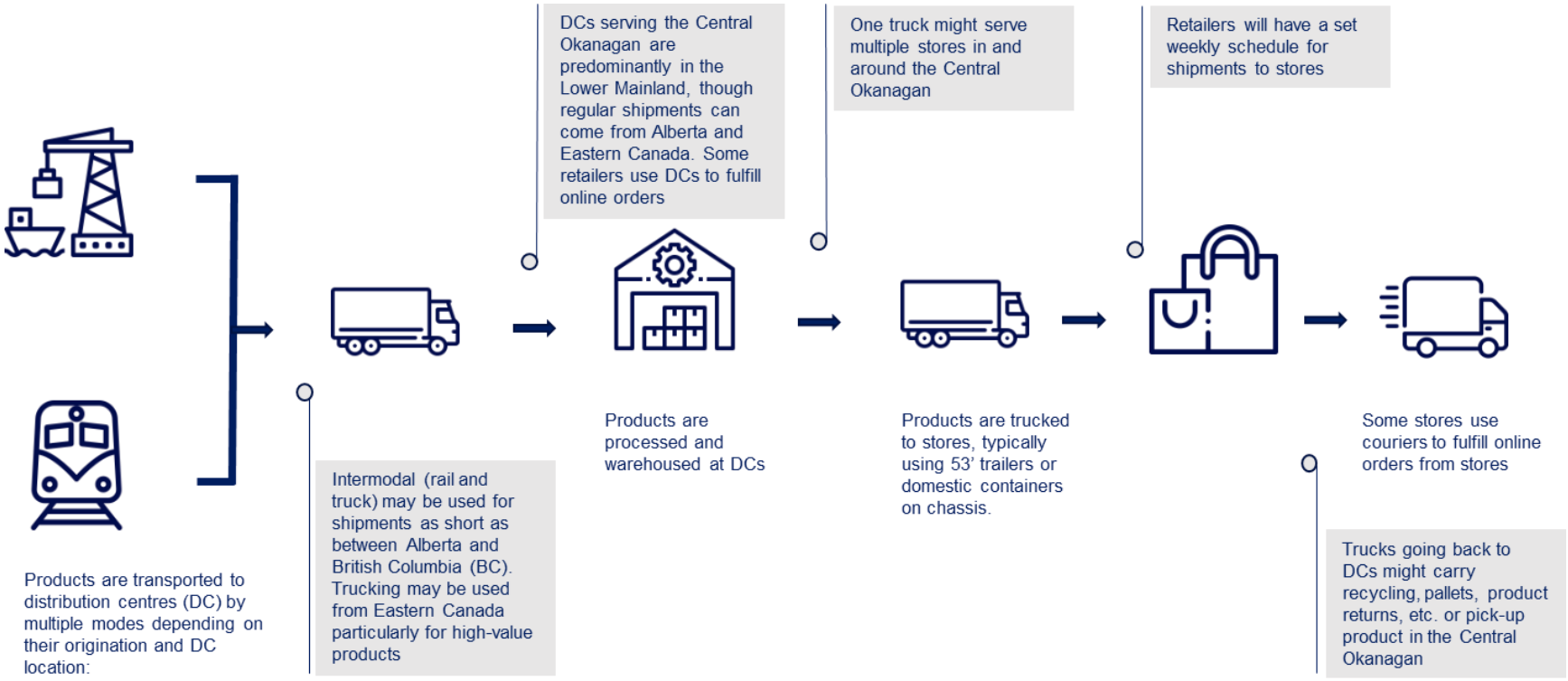
Truck hauling container to or from a rail intermodal terminal (domestic 53-foot refrigerated containers shown)

Container being offloaded from a truck chassis (marine 40-foot container shown)

Double-stack containers on well cars (domestic 53-foot refrigerated containers shown)

Source: CPCS

Figure D-18: Wholesale and retail trade supply chain



Source: CPCS

Supply chain considerations

Figure D-19 describes some of the considerations in designing retail supply chains. Minimization of overall transportation and warehousing cost is a primary consideration.

Stakeholders noted that they will use sophisticated optimization models to identify where to locate warehouses that minimizes inbound and outbound transportation and warehousing costs to serve their store network. Most of the retailers and distributors serving the Central Okanagan use distribution centres (DCs) located in the Lower Mainland, and to a lesser extent, Calgary and Edmonton. While retailers can manage regular outages, longer duration outages can have implications for their ability to resupply. In addition, this DC network means that larger retailers are using larger trailers (e.g., 53-foot) to consolidate loads (as well as to minimize the empty backhaul back to the DC) to be cost-effective.[134] In turn, this means that they will need to be able to access their stores and customers in commercial areas in the region using these trailers. When raised, stakeholders generally did not perceive it to be viable (from a private-sector perspective) to add DCs in the Central Okanagan.

Figure D-19: Retail supply chain considerations

Consideration	Primary	Elaboration
Cost	✓	• Cost minimization of overall transportation and warehousing cost is primary concern in the design of supply chains for retail locations. • Because only trucks can serve retail locations, there is usually no flexibility in modal decisions, though intermodal shipments can be used when transporting from DCs in Eastern Canada to the Central Okanagan.
Travel time	✓	• Minimizing travel time is arguably not the primary consideration for transporting many retail goods to stores. Intermodal (rail and truck), as well as marine shipping are commonly used, which are less costly than alternative modes (air and truck alone) but have longer transit times. It is also common to transload between marine containers and 53-foot domestic containers, to reduce transportation costs. • However, speed to customer for e-commerce orders is a primary factor.
Reliability		• Generally, stakeholders were less concerned about reliability on a day-to-day basis than the potential for longer duration (more than 24 hours) outages between the Lower Mainland, and Central Okanagan and Alberta. Some stakeholders noted that it is not uncommon for there to be outages across all accesses to/from the Central Okanagan of the order of 24 hours (due to winter storms).
Risk/information		• Sometimes a retailer will send high-value goods long distances (i.e., Toronto to the Lower Mainland) by truck rather than intermodal (rail and truck) to minimize risk of product damage from handling.

Source: CPCS compiled based on stakeholder feedback and other sources

Business locations and popular routes

Wholesale and retail trade businesses are concentrated along Highway 97 corridor (Figure D-20). These businesses represent a spectrum including warehouse facilities (i.e., at Jim Bailey), “big box” retailers to small storefront or home-based businesses. The subsequent supply chain analysis is

[134] Relatively, there are more goods coming into the Central Okanagan than going out, so trailers will often depart empty.

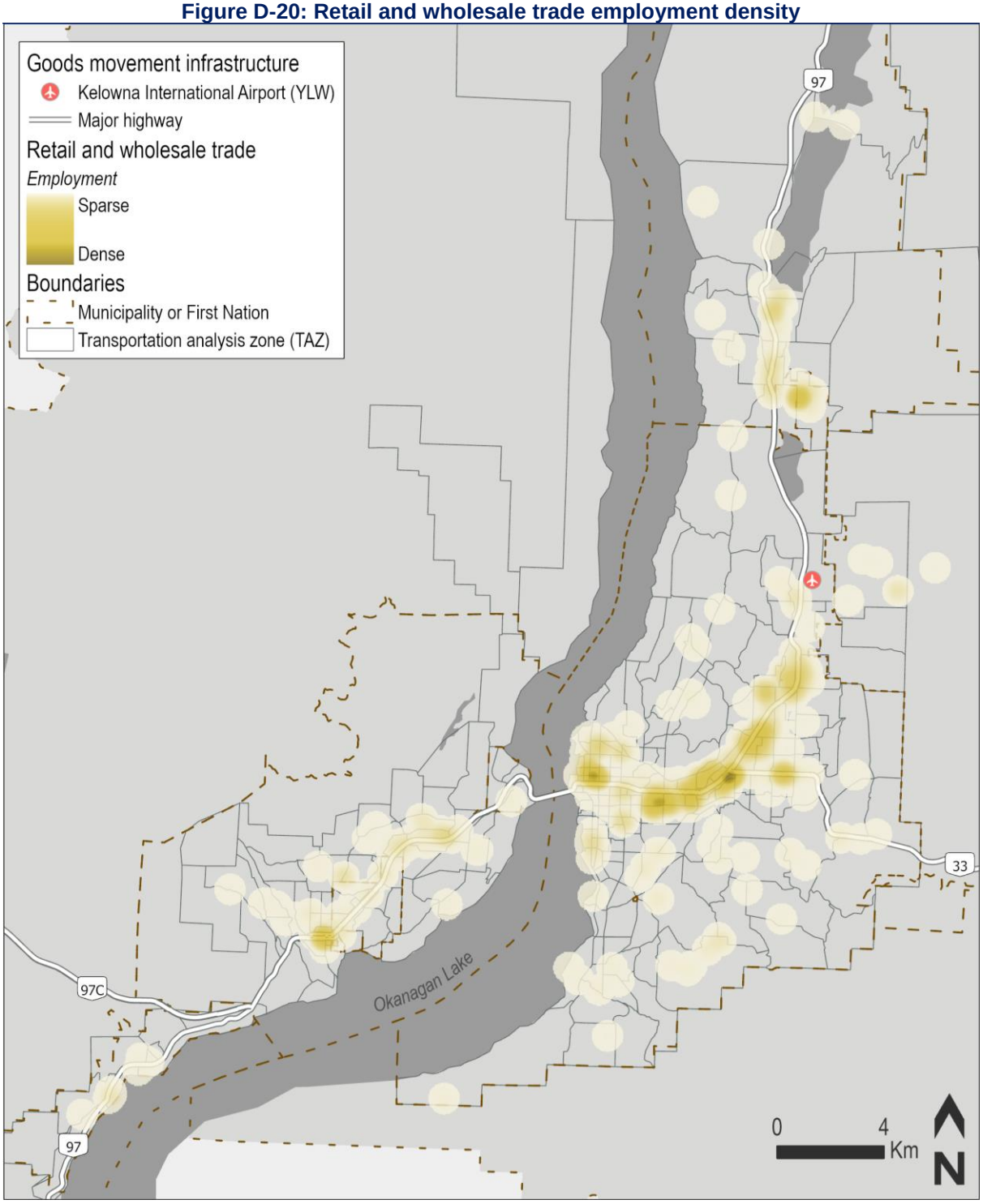
most illustrative of “big box” retail supply chains, but all retail businesses generate goods movement activity.

Unlike the other sectors identified, there are also more businesses located in central business districts, including Downtown Kelowna and along Main Street in Lake Country. There are also business plazas located throughout the region, including relatively large clusters at South Pandosy and in Rutland, and smaller ones such as along Anders Road in West Kelowna.

In addition, small businesses (by employment) are located throughout the region. Several stakeholders noted that home-based businesses are common in the region, including goods-generating businesses such as artisanal product manufacturing. These businesses in turn generate courier and less-than-truckload size deliveries.

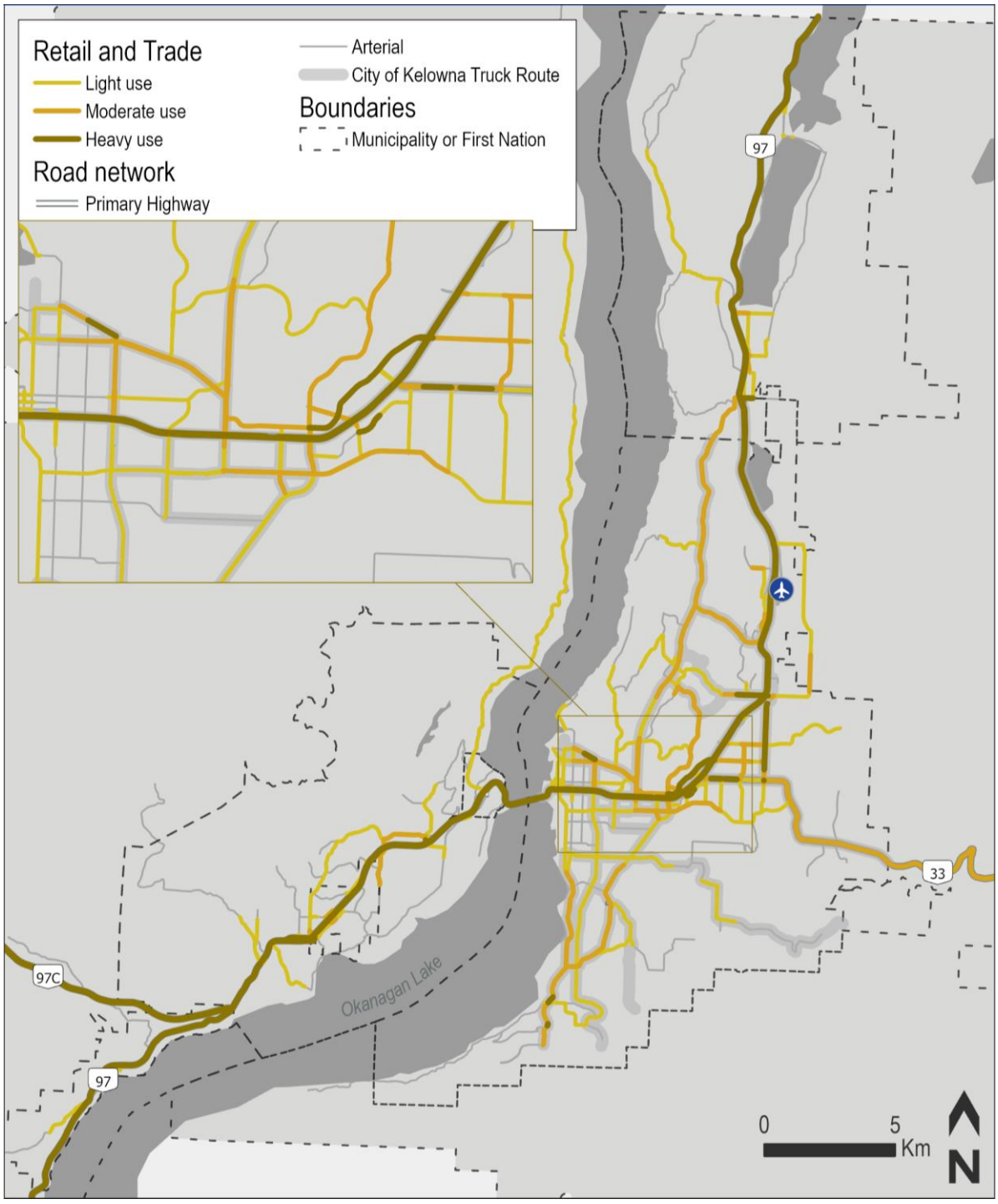
Accordingly, the wholesale and retail trade sector uses the widest range of routes throughout the region, similar in pattern to the Kelowna truck route (Figure D-21).

Figure D-20: Retail and wholesale trade employment density



Source: CPCS analysis based on Scott's data

Figure D-21: Popular routes used by wholesale and retail trade sector



Source: CPCS analysis based on Geotab data

Appendix E Current and future goods movement travel and technology trends

Disruptors

This section describes three major disruptors and their potential implications on freight transportation. The disruptors are climate change, the digitalization of the supply chain and supply chain blockages. The perspective is broad and even global, although where possible implications specific to British Columbia and the Central Okanagan are noted. This discussion provides the context for the ensuing descriptions of emerging logistical technologies and practices and ways to transition to a more sustainable future for goods movement.

Adaptation of transportation infrastructure to climate change

Central Okanagan businesses and residents rely directly on goods arriving/departing on a relatively small number of highway corridors that link the Central Okanagan with the Lower Mainland and Alberta.

MOTI is a leader in adapting transportation infrastructure to climate change, through the incorporation of climate modelling, risk analysis and more in the planning, design, operation and maintenance of BC's highways.[135] The Government of BC has also issued a Climate Preparedness and Adaptation Strategy which includes an action "beginning in 2022, the Province will embark on a nine-year, $295 million climate adaptation program that will include replacement and rehabilitation of existing culverts, increasing reliability and resilience of the extensive provincial highway network to new climate conditions."[136]

Nonetheless, Central Okanagan residents and businesses have first-hand experience with the impact of transportation infrastructure outages through the 2021 wildfire and floods, the frequency and severity of which are likely to increase due to climate change. Stakeholders described these impacts in several ways. They noted especially the disruption of highway connections to the Lower Mainland during the November/December floods, which cut off the supply of goods and services to the region, but other challenges, such as the disruption to electrical power, were also cited.

[135] *Adapting Transportation Infrastructure to Climate Change*, BC MOTI, https://www2.gov.bc.ca/gov/content/transportation/transportation-environment/climate-action/adaptation, accessed May 24, 2022, and *Considerations for Addressing Climate Change Adaptation for Transportation Infrastructure in Highway Management, Design, Operation and Maintenance in British Columbia*, Revision 10, BC MOTI et al., 2014.

[136] Government of BC. 2022. Climate Preparedness and Adaptation Strategy Actions for 2022-2025

Goods movement infrastructure outages due to ground hazards (e.g., rockfalls, washouts, etc.) have disproportionally high cost relative to their frequency.

Goods movement infrastructure outages due to ground hazards (e.g., rockfalls, washouts, etc.) have disproportionally high cost relative to their frequency. As illustration, the Transportation Safety Board of Canada noted (in 2004): "In Canada, 2 per cent of rail accidents are related to geological hazards such as rock falls, landslides, and washouts. However, these accidents account for 12 per cent of the direct costs of all rail accidents, in part because they often take place in remote locations and result in long service outage times."[137] Rail service indirectly impacts the Central Okanagan by resupplying distribution centres in the Lower Mainland, and roads and highways are exposed to similar impacts. We also anticipate that this relationship would be similar for road transportation as well. Tangibly, one stakeholder noted that during the outages in November/December 2021, they had to reprioritize their capacity to ensure that essential goods could be delivered to vulnerable populations (e.g., long-term care facilities).

Looking ahead, a 2021 study analyzes the impact of climate change on Canada's roads, highways, railways and other publicly and privately owned infrastructure.[138] The study, prepared by the Canadian Climate Institute, a government-funded NGO, focuses on adaptation. It modelled various climate change impact scenarios to the end of the century. The study notes that "a warming and increasingly volatile climate over the coming decades will increase the stress on Canada's roads and railways and reduce their reliability and level of service." These stresses will be added to the ongoing need to rehabilitate and reconstruct the existing aging infrastructure, for which "necessary repairs and upgrades are already overdue and underfunded." The study cites the damaging and deteriorative impacts of rising heat, increasing rainfall, and changing freeze-thaw patterns on road pavement. Rising summer temperatures can cause rails to kink and deform, which in turn forces trains to be slowed or stopped because of the potential for derailments.

Figure E-1 summarizes the stressors, resultant damages and implications for paved roads, unpaved roads and rail lines. The table also lists potential adaptation scenarios aimed at increasing the durability and resilience of pavements and the underlying sub-bases and the implementation of track temperature sensors to inform the need for slowdowns and stoppages.

Figure E-1: Climate-related damages, costs and adaptation scenarios for road and rail infrastructure

Infrastructure type	Stressor	Damage sources (causes)	Outcomes without adaptation	Adaptation scenario
Paved roads	Temperature	Surface degradation and increased roughness due to thermal cracking and rutting	Increased maintenance and repair costs to maintain level of service; delays	Alter asphalt mix to include binder with appropriate temperature performance
	Precipitation	Erosion of base and sub-base due to infiltration; increased cracking		Modify binder / sealant and increase base layer depth

[137] Transportation Safety Board of Canada. 2004. Railway Investigation Report R04Q0040. https://www.tsb.gc.ca/eng/rapports-reports/rail/2004/r04q0040/r04q0040.html

[138] Except where noted, the ensuing discussion is derived from *Under Water: The Costs of Climate Change for Canada's Infrastructure*, Canadian Climate Institute, 2021.

Infrastructure type	Stressor	Damage sources (causes)		Outcomes without adaptation	Adaptation scenario
	Freeze-thaw	Base layer degradation due to soil heaving; increased surface damage from settling and movement			Modify design to increase surface density and reduce infiltration
Unpaved roads		Precipitation	Surface erosion and rutting	Increased maintenance and repair costs to maintain level of service; delays	Increase base material depth to increase strength and drainage
Rail lines		Temperature	Track expansion and buckling during heat events	Increased repair costs; blanket speed orders and widespread delays	Install track temperature sensors to target speed orders

Source: Table 5.1, *Under Water: The Costs of Climate Change for Canada's Infrastructure*, Canadian Climate Institute, 2021.

It should be noted that the adaptation "scenarios" cited in Figure E-1 have significant costs, and the practicalities of implementing them on a large scale must also be considered. Moreover, the study does not account for the costs of rebuilding entire road and rail rights-of-way that resulted from the washouts and other types of catastrophic impacts incurred by the 2021 floods.

The study stresses the need for governments at all levels to act now in addressing the shortfalls in rehabilitating and strengthening existing infrastructure through policy and funding mechanisms, noting that delays or retroactive refits will be more expensive.

At the same time, the study recognizes that the impacts extend far beyond the increased costs of maintaining and repairing the actual infrastructure, notably reductions in service levels and reliability. These reductions in turn add delays and uncertainty to the flow of goods, further adding to the costs of transporting goods and "reverberat[ing] through supply chains and industries, multiplying costs and reducing economic productivity."

These costs are elaborated in a 2020 modelling analysis which found that the gross domestic product (GDP) impacts of network disruptions were far more pronounced than the value of the delays incurred. The research noted that many resiliency analyses rely on the latter alone. They also use traveller values of time to assess a monetary impact, whereas a more appropriate measure would be the value of reliability. In other words, the economic impact must be tied to the imposed unreliability, rather than to the costs of delays alone. The research also notes that resiliency should be measured across an entire network (because the impacts of individual blockages will propagate) and should consider the ability of the network to recover to expected speeds (travel times) systemwide, even if individual roads and intersections remain disrupted.[139]

Finally, although not addressed in the 2021 study, potential climate change impacts on aviation and its costs should also be noted. These include impacts on aircraft performance due to higher temperatures, reducing passenger and cargo payloads (maximum takeoff weights) and aircraft

[139] M Kurth, W Kozlowski, A Ganin, A Mersky, B Leung, J Dykes, M Kitsak and I Linkov, *Lack of resilience in transportation networks: Economic implications*, Transportation Research Part D: Transport and Environment 86, September 2019.

ranges, and requiring runway extensions – all of which could be considerations for the future expansion of air cargo services at YLW.[140]

Digitalization of the supply chain

Many noteworthy logistical technologies and practices are shaping goods movement. However, all of these have been enabled by the digitalization of the supply chain (and of transportation, purchasing, manufacturing and much more) that has arisen from the rapid expansion in computing and communications capabilities over the past two decades. These expanded capabilities have greatly extended connectivity across all links in the supply chain, from the source of raw materials, manufacturers, brokers and transporters of all modes through distributors, retailers and the end purchaser.

The changes have been enabled by profound technological developments such as the internet, wireless communication, smartphones, cloud computing, automation in manufacturing, radio-frequency identification (RFID, which traces the containers being moved and not just the vehicles that are carrying them), electronic payments, cryptocurrency (which speeds up transactions among the many participants in the sourcing manufacture and delivery of a product), and additive (3D) manufacturing processes.[141] The resultant high rates of transmission speeds and high frequency of access points along a supply chain means that multiple actors can access and act upon the same piece of information at virtually the same time. These actors include the shipper, the carrier(s), the purchaser, regulatory authorities, security agencies, financial transactors, accountants, insurers and more. These capabilities have resulted in an unprecedented rate of adoption of new technology – meaning that the pace of change in consumer/business purchasing (i.e., the shift to online purchasing) and in delivering these purchases is accelerating.

These developments have been aided by the parallel rise in the Internet of Things (IoT), which is a network of physical objects that have embedded sensors that communicate directly with the internet and each other as well as with the cloud, making the data they generate widely available, and in the Industrial Internet of Things (IIoT), in which the centralized control of manufacturing and production can be facilitated by intelligent devices and a network that drives industrial production. The IoT and the IIoT have generated huge amounts of data that describe consumption patterns, monitor activity levels and so on. These “big data” in turn have enabled developments such as artificial intelligence (e.g., by identifying consumer preferences to encourage additional sales and alerting businesses when stocks must be replenished, among other goods movement implications), as well as new mobility technologies such as autonomous vehicles.[142]

For the Central Okanagan, this increasingly ‘wired’ way of doing things underscores the importance of having strong internet access throughout the region, with digital infrastructure now being considered as basic a service as power, water, roads and so on. Pervasive and reliable Wi-Fi allows businesses to set up anywhere, thereby reducing the need for workers to congregate at a factory or another centralized workplace; although that also means that the spatial and temporal demands for shipping and receiving become broader and more diffuse. The *Calgary Goods Movement Strategy*

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[140] *Climate change: its impact on aviation. The time to plan is now.*, CAPA - Centre for Aviation, posted January 8, 2019; and *Effects of Climate Change on Aviation Business and Economics*, Fact Sheet, International Civil Aviation Organization, 2020.

[141] The examples cited in this discussion focus on goods movement. However, these technologies clearly have many other applications.

[142] G. Forger et al., *Material Handling & Logistics U.S. Roadmap 2.0*, Material Handling Institute, Charlotte, NC, April 2017.

and other similar studies have noted the need to include fibre cabling as part of the servicing package for industrial properties, as a means of attracting new investment and businesses.[143]

Study stakeholders commented on a related topic, namely the desire to go paperless with shipping documents. The aim is to ensure that the documents are not lost and to avoid having to generate multiple copies of the same document for a single shipment (hence there is an added cost). They expressed a desire for assistance, perhaps from government, to train companies and work with couriers to help speed up their transition to digital. Stakeholders noted that couriers will tell shippers the type of information they need (e.g., commodity codes) but not how or where to find this information. Nonetheless, some challenges remain. Despite significant advancements, technology and efforts elsewhere, such as the Vancouver Fraser Port Authority's West Coast Supply Chain Visibility Program, increasing the automation of reporting for real-time action and/or planning purposes remains challenging due to issues like confidentiality, challenges with exchanging data.

There is another implication for small and medium-sized businesses in the Central Okanagan region. Based on a comment from a mid-sized business stakeholder, while they know they should digitize their shipping documents, it is a learning curve to learn how to do this. They noted that it took a concerted effort, for example, to even understand what tariff codes (Harmonized System – HS) to use.

Supply chain disruptions

The pandemic years have brought significant disruptions in global supply chains, with supplies of some foods, consumer products and raw materials in Canada still being subject to shortages and delays. The 2021 floods brought these disruptions into sharp focus for Central Okanagan residents and businesses.[144] Although not raised in this study's stakeholder engagement, Canadian shippers elsewhere have also raised concerns over the impacts of civil blockades and industrial action on the reliability of supply chains.

Initially, pandemic-related lockdowns caused the inventory levels of several products and commodities to fall. In Canada, the closure of 'non-essential' businesses impacted the approximately 40% of all imported goods that fall into the nonessential category. One result was that inbound containers of these goods could not be unloaded or distributed for several months, ultimately resulting in container shortages at key global ports. Some Canadian manufacturers instead switched to air freight to access critical components that are produced offshore. However, because most goods are shipped in the bellies of passenger aircraft, the severe curtailing of scheduled flights (an 85% reduction) significantly reduced this capacity. Finally, some Canadian manufacturers faced non-traditional shifts in the demand with virtually no notice. While some industries shut down for several months (e.g., vehicle production), others saw massive increases in demand (e.g., food, paper products and pharmaceuticals).[145]

Now, as consumers and economies emerge from the extended lockdowns, pent-up demands continue to deplete available inventories. These shortages have been further exacerbated by container shortages, severe weather events in BC and elsewhere, the blocking of the Suez Canal (a critical global trade route) by the *Ever Given* container ship and continued labour shortages. The

[143] *Calgary Goods Movement Strategy*, The City of Calgary, 2018.
[144] Except where noted, this discussion is drawn from B Vakil, *The Latest Supply Chain Disruption: Plastics*, Harvard Business Review, online, dated March 26, 2021, and AM Spence, *Why Are Supply Chains Blocked?*, Council of Foreign Relations, online, dated November 3, 2021. The quotes are taken from Spence.
[145] *Building Supply Chain Resilience*, conducted for Supply Chain Canada, York Region (Ontario) and the cities of Markham, Richmond Hill and Vaughan, September 2021.

ongoing war in Ukraine and the ensuing sanctions on Russian interests have also disrupted the availability of several key commodities to global markets, including wheat, fertilizers and various precious metals; all of which adds in acute ways to the pandemic-generated considerations by several national governments (including Canada's) of the merit of repatriating the supply of certain critical products.

Broadly, the global supply chains that produce consumer and business products and their components have a multitude of sources, commodities and add-on processes that can stretch around the world. This global chain enables the availability of a wide range of products and goods to consumers and businesses at competitive prices, in the Central Okanagan and across the country. The same efficiencies and cost optimizations that are built into the supply chain also allow Central Okanagan businesses to extend their market reach.

To make this work, for suppliers and purchasers, by design, global supply chains "are complex, decentralized, and wound tightly, in order to maximize efficiency and minimize waste." However, "while this approach works in normal times, it cannot handle major shocks or perturbations. Decentralization, in particular, leads to underinvestment in resilience, because the private returns on such investments are much smaller than the systemwide returns or benefits."

Stated simply, the *resilience* of supply chains is being questioned (see box), and their inherent complexity means the impacts of perturbations along the chain are difficult to anticipate. There is no single definition of resiliency, but generally it refers to the ability of a system to adapt to changing conditions and recover rapidly from disruptions. However, adding resiliency (redundancy and more) is expensive, and the modelling tools to anticipate perturbations in a usable manner do not exist. One observer notes that the pandemic exposed existing challenges in some supply chains, wherein the lack or inability to "map, monitor and protect" the full extent of the supply chain resulted in critical failures in their production activities – hence the need to develop early warning capabilities and jump, if necessary, to alternate suppliers.

Western Canadian stakeholder views on resiliency

WESTAC's 2022 COMPASS Report, based on a survey of supply chain and government executives, identifies "Business Disruptions" and "Climate Change" as two of the "Top 5 Business Challenges." However, "Infrastructure and Capacity" was identified as a top "Transportation Challenge," and over 90% were "most concerned with *insufficient capacity* and aging infrastructure [CPCS emphasis added]". In addition, more than one third of respondents believed supply chain *competitiveness* has worsened over the last 12 months. By comparison, 80% of respondents indicated that the supply chains are "resilient."

The implication is that while resiliency merits additional attention, overall capacity and competitiveness appear to be of greatest concern to supply chain participants.

The surge in demand for consumer and business products and goods exceeds the supply, at least for now. While some economists expect the resultant supply disruptions will be short-lived, some participants in global supply chains expect that shortages, backlogs and imbalances between supply and demand will persist well into 2022 and perhaps beyond. Even if the situation stabilizes in the next one or two years, pandemic-induced shifts in the composition of labour markets (e.g., more people working from home; inducements to bring in more automation in certain industries) and inflationary pressures in dangerous and stressful jobs (health care is notable; many cargo workers were stranded on ships for months) may have longer-term impacts on the economics and viability of different supply chains. Study stakeholders noted that supply chain disruptions have resulted in extended lead times to get parts, meaning that they have had to compensate by using faster delivery services (e.g., premium air courier services) in order to maintain delivery schedules to their customers. Stakeholders also noted increased shipping costs as a result of these disruptions and other trends.

Global logistics trends

This section describes trends within or impacting the global logistics sector. These are organized according to five themes:

- the impact of increased capacity in goods movement infrastructure and services
- the repatriation of supply chains to North America
- automation of manufacturing
- last-kilometre deliveries (focusing on e-commerce)
- distribution networks

The relevance to or impact on the Central Okanagan region is also noted.

Capacity constraints and opportunities

Infrastructure is a vital element in maintaining and enhancing a region's competitiveness. Multimodal connectivity, road quality and rail and air efficiency are cited as ways to assess how infrastructure supports a region's competitiveness.[146] In other words, the ease and reliability with which a region is linked to suppliers and markets, which in turn impacts the costs of shipping goods and providing consumers and businesses with desired products at affordable prices. Properly planned infrastructure, among other elements, is also critical for promoting equitable and sustainable growth.[147]

Major changes to goods movement infrastructure and operations continue to be implemented around the world. These reflect growth in global population and the ensuing global demand for goods. To keep pace in a cost-effective manner, in Canada and elsewhere the size (capacities) of ships, aircraft and port facilities and the length of trains have all increased. Various provinces have also increased maximum allowable truck weights.[148]

There is continued growth in the use of long-combination vehicles (LCVs), which allow a single tractor to haul two or three trailers.[149] MOTI has indicated that the number of permit requests to use LCVs to/from Kelowna has increased and stakeholders indicated that they are being used. A study for Alberta Transportation found that LCV movements have the potential to lower unit fuel consumption by 30%.[150] Similarly, in that study, the unit cost of transportation was reduced by about 30%.[151] However, MOTI indicated that there are challenges, including the safety and efficiency of these long vehicles when turning off Highway 97 in Kelowna, as the roadway geometry was not designed for such vehicles.

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[146] K Schwab, editor, *The Global Competitiveness Report 2019*, World Economic Forum, Geneva, 2019.
[147] Ibid.
[148] A Lightstone, T Belony and J-F Cappuccilli, *Understanding Goods Movement in Canada: Trends and Best Practices*, Transportation Association of Canada, Ottawa, February 2021.
[149] LCVs (Rocky Mountain Doubles up to 32m in overall length and Turnpike Doubles up to 41m in overall length) are permitted on Highways 97 and 97C to and from specified points in Kelowna. *LCV Operating Conditions & Routes*, BC Ministry of Transportation and Infrastructure, February 18, 2022.
[150] The study indicated that the same amount of freight could be moved with 30% less fuel.
[151] Woodroffe & Associates and Trimac Logistics. 2001. Economic Efficiency of Long Combination Vehicles in Alberta.
http://www.transportation.alberta.ca/Content/docType61/production/LCVEconomicEfficiencyReport.pdf

Several domestic, cross-border and international developments are shaping how goods are transported to, from and within Canada:

- Rail. Canada's two Class I railways, Canadian National (CN) and Canadian Pacific (CP), both provide transcontinental service, reaching Atlantic and Pacific ports and, with CP's recent purchase of the Kansas City Southern Railroad (KCS), both also reach Gulf of Mexico ports.[152] In addition to serving Canada's major cities, both railways have direct access to Chicago, which is the continent's primary rail transfer point. KCS also provides CP access to Mexico's vehicle and other manufacturing plants. To be most cost-effective, CN and CP focus on longer trains that haul single types of commodities (e.g., grain, potash or containers) over longer distances. This focus has also generally led to a concentration of access points on the two railways.[153] Of greatest relevance for the Central Okanagan, for container shipments, the closest truck-rail intermodal terminals are in the Lower Mainland, Calgary and Edmonton. However, there has been a recent reversal of this trend; Ashcroft Terminal near Kamloops started receiving container train service in early 2022, which could facilitate the movement of import and export containerized cargo to/from the Central Okanagan.[154]

  Otherwise, the Central Okanagan region is no longer served by rail. CN in Vernon, connecting to CN's transcontinental mainline through Kamloops, is the closest rail access to the region. CP's transcontinental line also passes through Kamloops.

- Marine. Prince Rupert is the closest West Coast port to Asia and is attractive for transcontinental rail shipments to Central Canada and Chicago, via CN, as well as export-oriented cargo. However, Vancouver is much closer to the Central Okanagan region.[155] The Vancouver Fraser Port Authority (VFPA) predicts that despite recent expansions at existing container terminals in the Lower Mainland, absent further expansion, marine container traffic will outpace available capacity by the late-2020s.[156] VFPA and private-sector terminal operators (GCT and DP World) are pursuing expansions and efficiency improvements, but they are subject to regulatory approvals. The Lower Mainland is also subject to congestion and a lack of industrial space to meet the growing demand for processing containers.

  To address the lack of space for processing and storing inbound and outbound containers, Ashcroft has developed an inland terminal (as noted above).[157] Calgary has also developed as a key Western Canadian distribution hub, taking advantage of the availability of large industrial sites at CN's intermodal terminal just outside the city and ready access to the TransCanada Highway.[158]

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[152] The purchase remains subject to regulatory approval.
[153] As another example: the once-ubiquitous Prairie grain elevator has been replaced by a small number of access points that require farmers to transport grains over longer distances to reach the railhead.
[154] Szakonyi, M. 2022. New CP service for Canadian Tire unlocks inland port serving Vancouver. https://www.joc.com/maritime-news/new-cp-service-canadian-tire-unlocks-inland-port-serving-vancouver_20220303.html
[155] The truck GPS data analysis found no truck trips travelling between the Central Okanagan region and Prince Rupert.
[156] Vancouver Fraser Port Authority. 2021. Vancouver Fraser Port Authority view on container forecast volumes. https://www.portvancouver.com/wp-content/uploads/2021/03/2021-01-19-PDF-Vancouver-Fraser-Port-Authority-view-on-container-forecast-volumes.pdf
[157] https://www.ashcroftterminal.com.
[158] *Calgary Goods Movement Strategy, Stage 3 Report: Opportunities*, The City of Calgary, 2018.

Broader shipping industry trends impacting the movement of goods across Canada should be noted, although they less directly impact the Central Okanagan region. The 2016 opening of the expanded Panama Canal tripled the size of container ships that can transit the Canal, to 13,000 – 14,000 TEUs.[159] The expansion allows more ships carrying goods from Southeast Asian sources to offload directly at East Coast ports, which are closer to the continent's major population centres. This lengthens the overall transit time but because more of the transit is spent on water and less on rail or truck, unit transportation costs are reduced. In anticipation of the expansion, major East Coast and Gulf of Mexico ports underwent major capacity expansions and improved rail intermodal connections to key population centres. Some of these centres are within a competitive distance for transporting goods by truck rather than by rail once they are offloaded at the nearest port.

The expanded Panama Canal further strengthens a gradual shift of Asia-origin container ships from West Coast to East Coast North America ports, generated by capacity constraints at and from the ports and by a history of labour shutdowns on the West Coast. The expanded East Coast ports also benefit from automated loading and unloading as well as the improved rail connections.[160] Canada's East Coast ports are too far north to compete for the expanded Panama Canal trade. One analysis notes that in terms of time and directness, it is faster (though more costly) to serve Eastern and Central Canadian cities via the West Coast.[161] However, Eastern Canadian ports have benefited from expansions made to the Suez Canal that allow the passage of 24,000 TEU ships,[162] and Halifax and Montréal are among the first ports of call for European vessels. In addition, East Coast ports are also positioned to capture trade from the Indian subcontinent via Suez.[163] (Both ports have direct links to Class I railways. Montréal, although having a relatively small capacity, serves as a relief to New York / New Jersey ports.)

- Air. Air cargo comprises mail, general airfreight and express (courier) shipments. Mail and general airfreight are commonly carried in the bellies of scheduled passenger aircraft, meaning that the capacity for these cargos is linked to aircraft size and to service frequency. Cargo carriers and couriers also provide scheduled air services.

  In many large urban areas, important concentrations of employment have arisen around the airport. For example, the airport vicinity around Toronto Pearson International Airport is now the second-largest concentration of jobs in the Greater Toronto and Hamilton Area, after downtown Toronto. The jobs are in industrial sectors related to airport operations, as well as complementary transportation, distribution and logistics sectors.

  However, much of the development growth around airports has been uncoordinated and piecemeal, thereby limiting potential growth and running into constraints, such as traffic congestion. This has led some urban areas to improve the coordination of land use and transportation plans in the vicinity of the airport, to allow for further growth of airport-related

[159] TEU (twenty-foot equivalent unit) is a standard unit of measure of container size. Ship capacities are measured in TEUs.
[160] J Bhadury, *Panama Canal expansion and its impact on East and Gulf coast ports of U.S.A.*, Maritime Policy and Management43(8), July 2016.
[161] ET Yu and SC Wirasinghe, *Impact of the Panama Canal Expansion on Canadian Logistics*, Transportation Research Annual Meeting, 2015.
[162] A Habibic, *Spotted: 24,000 TEU Ever Alp transits Suez Canal on its maiden voyage*, Offshore Energy, posted January 18, 2022.
[163] Port of Halifax. 2021. Port of Halifax Welcomes Direct Call with India through MSC Indus 2 service. https://www.portofhalifax.ca/port-of-halifax-welcomes-direct-call-with-india-through-msc-indus-2-service/

and ancillary industries such as transportation, logistics and manufacturing, while providing seamless and congestion-free access for travellers, workers and goods movement.[164]

To further strengthen these anchors, many urban areas have investigated the idea of establishing an aerotropolis around their airport. The aerotropolis concept involves building a well-connected, multi-use community focused on the airport, thereby allowing manufacturers to have a critical mass of ancillary industries and an easily accessible destination for workers while exploiting the proximity to the airport to access remote suppliers and markets.[165] For example, the Edmonton International Airport Authority, the City of Leduc and Leduc County (where the airport is located) have developed the Alberta Aerotropolis concept to build on the large quantity of open space in and around the airport by adding distribution centres, retail activities, offices, hotels and other uses, and complementing the nearby existing Nisku oil and gas industrial concentrations.[166] As another example on a smaller scale, Hamilton International Airport, seeking to attract industries from the congested Toronto area to a facility that operates 24 hours a day,[167] recently opened a multi-tenant 'end-of-runway' distribution centre. This concept brings smaller manufacturers and distributors, who otherwise could not afford their own distribution centres, adjacent to the airport's air courier depots, thereby avoiding congestion on the ground access for time-sensitive shipments. The City of Hamilton has designated adjacent lands as a major employment growth district.

Repatriation of supply chains

Over the past several decades, many Canadian and US manufacturers have relocated some or all their business processes to countries that have lower labour, production and logistics costs, and that are closer to raw materials and suppliers – notably, East Asia but also Mexico and other Latin American countries. This trend to offshoring has been enabled by and in turn has defined the globalization of supply chains.

More recently, *some* repatriation of the supply chain to or close to North America is taking place. This refers to the return or transfer of manufacturing processes from remote sites to locations closer to a firm's original location or headquarters. The decision to repatriate or not, characterized variously by reshoring back to the home country or near-sourcing (or near-shoring) to nearby countries, is driven by several factors:

- Increased labour costs, especially in China, have been cited as a key factor. However, not all processes have been shifted back to North America: China's rising costs have spurred the transfer of manufacturing to other Asian countries, of which Vietnam is a notable example. There are indications that manufacturing in south Asia and even Africa could displace some Chinese manufacturing. (This also influences the shipping pattern changes noted above, as East Coast ports are in a better position to capture trade from south Asia.)
- Cost equivalency, in which the total 'landed' cost of many products that were manufactured in Asia (including transportation and import costs) have become almost equivalent to the costs of manufacturing these products in North America. Non-costed factors, such as the complexities

[164] Ibid.
[165] About the Aerotropolis, http://www.aerotropolis.com/airportCities/about-the-aerotropolis.
[166] MXD Development Strategists / Stantec, 2015, Alberta Aerotropolis, Aerotropolis Viability Study – Final Report, the Leduc Partnership (Edmonton International Airport Authority, City of Leduc and Leduc County).
[167] By comparison, Toronto Pearson International Airport has limited overnight flights and its groundside accesses are subject to continued and severe congestion.

of collaborating over a distance, nonconforming material substitutions, quality, safety and intellectual property rights, are also considerations.[168]

- Productivity, efficiency and security. Although wages in Asia and elsewhere are still lower than those in North America, productivity and efficiency in North America are greater, especially for high-quality and complex products. Increasing automation in North America means that, once the difference in shipping costs is considered, it is as or more cost-effective to near source some types of manufacturing. Security challenges are also considerations.
- Time-to-market, which is the time elapsed between the conception of a product and its availability for sale, is becoming shorter, which in turn influences the demand for shorter supply chains.[169] Delivery times are also a factor, with the now-closer proximity to the customer reducing transit time to weeks instead of months. Repatriation also offers shorter and more secure supply chains that can reduce the costs of goods over time.
- Supply chain resilience. The recent pandemic shutdowns have focused industry's attention on supply chain resilience, which refers to the ability to prepare for unexpected events and disruptions, respond and recover quickly. To anticipate future disruptions, a 2021 study recommended that firms accelerate digitalization of the supply chain, focus on dual sourcing or on increasing inventory of critical components to allow manufacturers to get through disruptions, create alternative manufacturing and logistics capacity, and consider near-shoring, among other actions.[170]
- 'Critical' supply chains. The recent pandemic-induced concerns about the availability of 'critical' health, food and other supplies have brought repatriation into the spotlight. A 2022 paper focuses on Canada's health care supply chain, whose prioritization of lowest-cost producers was seen as resulting in the country's overdependence on a single region (China). In turn, critical supplies were held up by lockdowns in China and disruptions in transportation networks. The paper argues that consistent nationwide monitoring of supplies and requirements is needed, along with the identification of anticipated risks and the involvement of frontline health-care workers in procurement decisions. Diversification of product sources and policies that support domestic manufacturers were also seen as needed.[171]

The repatriation of manufacturing to North America is largely seen as benefiting jobs in Mexico, rather than Canada or the United States. The 2020 USMCA trade agreement attempted to constrain the 'back door' entry of Asian (especially Chinese) products to the United States via Canada and Mexico, which the NAFTA had been seen as permitting, thereby making the United States more attractive for repatriating certain types of manufacturing. However, because Mexico's wage differentials are similar to those of countries like China and given Mexico's preferential access to the US market gained through USMCA, Mexico is seen as becoming more attractive for near-sourcing compared to Canada and the USA, offsetting losses in automotive and textile industries.[172]

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[168] B Goldense, *Onshoring, Nearshoring, Offshoring, and Now Reshoring*, posted at www.machinedesign.com, November 16, 2018.
[169] P Cariou, *Changing demand for maritime trades, Report summary*, presentation to the International Transport Forum, April 15-16, 2019.
[170] *Building Supply Chain Resilience*, conducted for Supply Chain Canada, York Region (Ontario) and the cities of Markham, Richmond Hill and Vaughan, September 2021.
[171] AW Snowdon, Advancing Supply-Chain Resilience for Canadian Health Systems, University of Calgary, The School of Public Policy Publications, Volume 15:1, January 2022.
[172] M Kendall, USMCA Agreement a "Big Win," both for Mexico and the Nearshore Industry, posted www.nearshoreamericas.com, October 10, 2018.

In any event, under NAFTA, repatriation had been slow and sporadic, and there is no evidence yet that the situation with USMCA, its 2020 successor, has changed significantly.

On the other hand, Canada and the United States can compete with Mexico on manufacturing that requires high skill levels or advanced manufacturing processes (which, although conductive to automation, still require higher skilled hence more expensive labour for operation and maintenance), has higher productivity (i.e., is less labour-intensive per unit of output) and focuses on high-value products or components.

To date, local occurrences of near shoring in the Central Okanagan appear to be limited. One example is Breathe Medical Manufacturing, a manufacturer of medical masks located in the Central Okanagan, which "went from 0 to 180 employees [in 2020]."[173] However, this example appears to be driven by the urgent need for personal protection equipment during the pandemic. Evidence of nearshoring as a large-scale trend in the Central Okanagan is still limited.

Automation of manufacturing

Automation has been deployed in Canadian manufacturing for several years, perhaps best exemplified by the use of robots in vehicle manufacturing. However, its use is spreading, along with the deployment of new technologies such as 3D printing. Key aspects are described below, especially with respect to their implications on the repatriation or diffusion of manufacturing.

- Automation and advanced manufacturing involve innovations such as robotics and 3D printing. Increased use of robotics, which have high purchase costs, in a near-source location can still be more cost-effective than an overseas production process that relies on inexpensive labour.[174] This is true even though there is evidence that automation is growing overseas, especially as a replacement for workers in rapidly aging countries such as South Korea and Japan. The substitution of automation for labour allows these countries to maintain their economic growth (GDP) even as the labour force diminishes. As measured by the number of robots, globally automation is greatest in the electrical/electronics and automotive industries. Handling applications dominate, followed by welding and assembly of products. In terms of absolute numbers, Canada was the 14th largest market in the world, with 2,600 operational industrial robots (compared with 30,800 in the United States and 3,400 in Mexico). Although Canada's installations of operational industrial robots dropped in 2020 (possibly due to the pandemic shutdowns), the numbers are expected to recover to pre-pandemic levels. Factors influencing the growth in automation include a shift to high mix/low volume production (customization, which requires more flexible production), short lifecycles of certain products (which require fast adaptation of new skills), increased product complexity, shortages of skilled labour, increased global competitiveness, digitalization of manufacturing, growing consumer markets, energy efficiency-driven technology shifts and regionalized production (i.e., production that is not offshored).[175]

[173] Munro, R. 2021. COVID created this Kelowna company but will Canada keep it going? https://infotel.ca/newsitem/covid-created-this-kelowna-company-but-will-canada-keep-it-going/it82851
[174] M Seppälä, Logistics Megatrends and Their Potential Effects on Demand for Logistics Premises in Finland. Notwithstanding the source, this research focuses mainly on global trends and references.
[175] International Federation of Robotics, *World Robotics 2021*, media livestream, October 28, 2021, *Executive Summary World Robotics 2021 Industrial Robots*, October 2021, *US robot density now more than double that of China*, media release, April 3, 2019, and *World Robotics Industrial Robots 2018*, press conference presentation, October 18, 2018.

- 3D printing (additive manufacturing) allows for the mass customization of products. One result is that a proportion of goods that were previously produced overseas can be near-sourced closer to the markets in which they are sold (the same concept applies for domestically produced goods). This would reduce ocean shipping and air cargo volumes. It also means that inventory levels would fall as goods are made to order, thereby reducing the demand for warehousing. Tiers of component suppliers could also be eliminated, as manufacturing processes are re-bundled within a single facility, thereby shortening the supply chain. Instead, a new logistics sector would emerge to deal with the storage and movement of the raw materials that feed the 3D printers. Moreover, as 3D printers become more affordable to the general public, the home delivery market of these materials would increase.[176]

  The need for parts warehouses and large inventories of spare parts would decrease. In some industries, significant redundancy is built into supply chains, to ensure that a critical part is always available, even if that part is needed only rarely. 3D printing could obviate the need for this redundancy by printing spare parts on demand. The technology also allows customization in a much shorter timeframe than is available through traditional manufacturing. 3D printing facilities located in direct proximity to transportation hubs (e.g., airports) allow a product to be customized and then shipped immediately to its destination. Similarly, repair parts can be made on demand and then delivered quickly, reducing lead times and improving levels of customer satisfaction.[177]

Rapid growth in 3D printing capabilities, especially for metals and metal alloys, has led some observers to predict that the technology can address pandemic-related supply chain blockages. One observer notes that finding an alternative supplier in the case of a supply chain disruption can take several months, since it requires the development of new tooling, new molds and so on, whereas 3D printing could be deployed within weeks. One computer supplier in the UK used its 3D printers to print 2.3 million medical components during the pandemic, noting that the components could be customized and produced on demand quickly and locally where they are needed most.[178]

Last-kilometre delivery

This section discusses trends in the last-kilometre (final step) of the delivery of goods to customers. Much of the discussion concerns the demand for immediate pick-up and delivery, or express delivery, which had been growing quickly in recent years before the onset of the pandemic accelerated this growth significantly.

Data on deliveries are held as confidential by courier companies. Nonetheless, two statistics on e-commerce growth characteristics through the pandemic-induced lockdowns serve as meaningful proxies:

- In 2019, e-commerce accounted for 6.9% of Canadian retail sales. By 2021, the share had almost doubled, to 13.4%.[179]
- Annual growth in Canadian e-commerce sales volumes is expected to increase by +/-10% in 2022, 2023 and 2024, dropping slightly to 9% in 2025. These forecasts suggest that the

[176] J McKendrick, *3D printing may put global supply chains out of businesses: report*, www.zdnet.com, posted October 9, 2012.
[177] *3D printing and the future of supply chains*, DHL Trend Research, November 2016.
[178] J Kite-Powell, *Can 3D Printing Solve Supply Chain Issues in 2022?* Forbes, posted December 29, 2021.
[179] P Briggs, *Canada Ecommerce Forecast 2021*, Insider Intelligence Trends, Forecasts & Statistics, posted July 13, 2021. Note that the source data for these estimates are not defined, hence the numbers shown here must be considered as indicative.

pandemic-induced spur to e-commerce purchasing will have some staying power, even as the economy recovers.[180]

Last-kilometre deliveries have been profoundly shaped by the digitalization of the supply chain, which in turn has enabled profound changes in retailing. In particular, the move towards omni-channel retailing has vastly increased the ways in which consumers, businesses, and individuals can purchase goods. For goods movement, a key implication is that retail models have evolved from a centralized distribution supply chain in which consumers visit brick-and-mortar stores to purchase goods, which are supplied to these stores through a centralized distribution supply chain. This supply chain features hub-and-spoke distribution, meaning that a single distribution centre (hub) supplies stores in a specific territory. Today, although brick-and-mortar stores remain important, the interaction between consumers and retailers can now take multiple, flexible forms: the "omni-channel" retailing model allows consumers to purchase products online (e-commerce) without setting foot in a store, have the product delivered to their home or workplace, or pick up the product at a location of their choice.[181]

Some big-box retailers are expanding beyond their traditional suburban bases to establish small downtown 'planning centres' where customers can examine a range of products before ordering them online, rather than leaving with their purchases. This development seeks to avoid the fate of retailers such as Sears that were not competitive in the e-commerce world while also recognizing "generational trends like urbanization, demand for sustainability and reduced car use" among today's consumers.[182]

At the same time, urban form, demographics, purchasing preferences and the structure of the economy have also been changing:[183]

- More high-rise buildings and infill development
- Proliferation of jobs and work sites in the office, service and retail sectors
- Greater occurrence of smaller businesses and more multi-business office buildings
- The appearance of nationally recognized stores with less storage space and high inventory turnover
- Growth of deliveries to buildings and residences that are not equipped with the appropriate facilities (external and internal)
- Higher demand for same-day and just-in-time deliveries
- Population resurgence and gentrification pressures
- Increased per capita purchasing power
- Changing lifestyles and millennial generation influences which impact discretionary spending and non-essential purchases

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[180] A Feger, *Canada's ecommerce sales to reach nearly $80 billion in 2022*, Insider Intelligence Trends, Forecasts & Statistics, posted February 8, 2022. Note that the source data for these estimates are not defined, hence the numbers shown here must be considered as indicative.
[181] A Hooper and D Murray, *E-Commerce Impacts on the Trucking Industry*, American Transportation Research Institute, Arlington, VA, February 2019.
[182] *A topsy-turvy world; as retailers abandon the high street, why is IKEA moving in?* Schumpeter column, The Economist, issue of January 26, 2019.
[183] *Philadelphia Delivery Handbook*, Delaware Valley Regional Planning Commission, Philadelphia, April 2017.

- Consumer insistence on fresh and ethnically diverse food items

Together, these changes have impacted deliveries in several ways:

- Consumers increasingly demand quick and reliable delivery directly to the doorstep
- This has resulted in increased growth in residential deliveries and in the frequency of express deliveries, which in turn have led to strained delivery networks. A related implication is that the network of distribution centres is evolving
- Another result is that deliveries are increasingly being made outside the traditional 9-5 work hours into evenings and weekends. These deliveries commonly comprise restaurant meals, groceries, online purchases and other goods or services that are made to a wide range of land uses, including residential areas of diverse densities, mixed use commercial areas and retail, and tourism and entertainment districts. This also points to the lack of data on the movements of the light vehicles and delivery vans that are involved in this activity
- There is an increased demand for highly specialized ("right glove") services, such as the transfer of tissue and fluids between hospitals to meet surgery requirements and schedules
- Disruptive technologies, such as crowdshipping apps that allow individuals to informally move small parcels on demand, are emerging as competitors to established courier and delivery companies. Distributors such as Skip the Dishes use a related model in which independent contractors deliver hot meals to consumers. One result is that anyone can be a courier, using the vehicle of their choice to deliver goods. This also points to the difficulty in measuring the movements of the vehicles involved in this activity
- There are indications that the evolution of distribution networks is resulting in increased use of medium-sized trucks over tractor-trailers, and that the average length of haul is declining, according to recent US research[184]
- The role of drivers is also changing. For example, some drivers not only deliver the product, but they may also assemble and install it
- Finally, some observers have commented that although e-commerce growth has generated additional activity by delivery vehicles (measured as vehicle-kilometres travelled, or VKT), there is some suggestion that this additional VKT has been partially offset by reductions in trips that purchasers otherwise would make if they had to shop in person

Costs are a principal factor in effecting these changes. To offset rising labour costs, manufacturing and distribution processes are increasingly being automated. For example, partnering with UK online grocer Ocado, Sobeys is introducing its fourth automated Canadian grocery distribution centre (and its first in BC) in the Lower Mainland in 2025. The distribution centre will support online grocery purchases.[185] Note that these automated facilities can operate 24/7. In theory, automated distribution centres can be spaced vertically rather than horizontally, so they could potentially be sited within build-up areas, closer to customers, thereby raising the possibility of using smaller and greener delivery vehicles for last-kilometre deliveries (potentially at lower cost) while also avoiding taking up prime rural lands. To date, factors including additional construction costs and reduced rentable space mean that multi-story warehouses are only being constructed in the most expensive land markets in North America (e.g., New York, San Francisco, etc.).[186]

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[184] A Hooper and D Murray, *E-Commerce Impacts on the Trucking Industry*.
[185] *Sobeys to launch automated Ocado online fulfillment center in Vancouver*, Warehouse Automation, February 8, 2022.
[186] Prologis. https://www.prologis.com/what-we-do/resources/are-multistory-warehouses-the-future

Another result is that couriers and retailers have begun to experiment with lower-cost delivery alternatives, such as delivery lockers and self pick-up. These are discussed further in Section 4.3.4.

There are also concerns that the current low-cost (i.e., free delivery) is not sustainable. Although the share of e-commerce purchases will continue to grow, demand could be tempered as costs to consumers rise. Amazon offers free two-day shipping to its Canadian Prime customers; however, these customers have already paid an annual premium to be offered this service. The guaranteed delivery also means that individual packages cannot always be consolidated into existing delivery routes. That, coupled with the increased demand generated by the 'free service, has required more drivers driving more delivery vehicles, making fewer stops per route, with an accompanying increase in fuel consumption, greenhouse gas (GHG) and air pollutant emissions. Also, from a financial perspective, although larger distributors like Amazon and Walmart suggest they can absorb the cost, smaller retailers, which aim to compete with the larger distributors, cannot do so.[187] Finally, it should be noted that even though e-commerce purchases may have reduced personal VKTs, many of these purchases are delivered separately, even if purchased from the same source – purchases that otherwise might have been consolidated into a single shopping trip.

Study stakeholders corroborated these points: as an industry, "we have done a terrible job explaining the impact of the choices, in particular the non-aggregation of purchases (e.g., ordering just one item at a time, rather than combining things into a single purchase like most people would do if they were going to the store)." Stakeholders recognized the impact of increased deliveries on infrastructure and costs. They noted the need to work on messaging these impacts to the public: "No such thing as free shipping." The industry needs to find a different way to make these deliveries. "We need to have that conversation."

Finally, it should be noted that more traditional types of goods movement continue to grow, even as technological innovations are deployed. This is exemplified by growth in the delivery of large consumer products to stores, the scheduled daily restocking of neighbourhood supermarkets and the delivery of aggregates to construction sites – all of which are commonly made by heavy trucks. Some carriers are also using longer single-trailer vehicles to make traditional deliveries of the types noted above.

Distribution networks

Retailers have long developed their own networks to store and distribute products to their customers. The networks cover a large geography and represent a hierarchy. Mega distribution centres are at the top of the hierarchy, with regional and local distribution centres (DCs) traditionally serving as depots that receive and sort products from various sources before they are transmitted onwards to stock individual stores.

The nature of DCs is evolving, driven by ongoing changes in retailing, costs, technology, land availability and market reach. Today, with the growth in business-to-consumer (B2C) and business-to-business (B2B) transactions via e-commerce and other retail channels, final deliveries are made directly to customers directly from the DC. Plans for a new Amazon fulfillment centre in Kelowna reflect the growing need to meet local B2C and B2B demands.

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[187] J Standring, *Why Free Shipping Isn't Free – And What You Can Do To Help*, moneyGenius, posted December 13, 2021; T Nguyen, *Amazon's 1-Day Shipping is Convenient – and Terrible for the Environment*, Vox, posted October 16, 2019 (also cited by the University of Washington's Supply Chain Transportation & Logistics Center); and L DePillis, *America's addiction to absurdly fast shipping has a hidden cost*, CNN Business, posted July 15, 2019.

Nonetheless, an important trend that informs this study is that major Central Okanagan retailers are often served by DCs located outside the region, notably in the Lower Mainland but also in Calgary. In other words, in this network hierarchy, it may be more cost-efficient for retailers to serve different urban areas from centralized DCs.[188] These trends are consistent with the emergence across North America of mega distribution centres that, due to their size, can be located away from urban areas.

These mega distribution centres serve a large geography, within which they can serve smaller DCs that are located closer to the inner urban cores. Last-mile delivery is made from these local DCs via established modes. Given their dependence on global supply chains, some of these mega distribution centres now seek to co-locate near ports and other international gateways. In any event, they also depend on easy access to major highways to serve the local DCs. The mega DCs and their network of small, local DCs are set up to provide quick service to consumers (and businesses) who increasingly make purchases online and expect a fast delivery to their doorstep. Autonomous vehicles would contribute to the development of this system because they allow a single mega distribution centre to reach a more broadly distributed network of local DCs within a single day.[189]

Retailers' ability to provide quick delivery service across an increasingly larger catchment area is also seen as contributing to another retail trend. Namely, e-commerce allows manufacturers to bypass retail stores and deliver purchases directly to customers (B2C and B2B). One outcome is that some retail chains are closing brick-and-mortar stores, and shopping centres are adding entertainment and dining venues to retain their attractiveness. There would also be an impact on parking requirements for both passenger and goods vehicles.[190]

It is conceivable that local DCs could replace some smaller local shopping centres. One motivation for SmartCentres' establishment of its customer pick-up points is to increase the attraction of its shopping centre locations – effectively, these are mini-DCs that serve several retail brands while also enticing more 'walk-by traffic' at the existing shopping centre stores. Customer pick-up points conceivably could be deployed in the Central Okanagan region in lieu of a larger DC, perhaps consolidating shipments from different retailers that are in the Lower Mainland and elsewhere.

Trends in goods movement technologies and operations

This section discusses key trends in goods movement technologies and operations. The discussion has three parts:

- Connected and autonomous vehicles
- Uncrewed aerial and ground vehicles (drones and robots, respectively)
- Operations, focusing on measures to improve the flow and safety of trucks as they pass through intersections and on truck-only lanes

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[188] As an example, the Eastern Ontario city of Cornwall has become a distribution hub for Shoppers Drug Mart, Walmart and other retailers. Cornwall serves Ottawa and Montreal, both approximately 90 minutes by expressway. Cornwall offers an ample land supply, a skilled labour force and proximity to the major expressway network and the United States (just across the St. Lawrence River). Ottawa is also served directly by DCs in the Toronto area, approximately 4.5 hours away by expressway. On the other hand, two local retailers headquartered in Ottawa recently relocated their central DCs closer to Cornwall in order to access a larger market. Source: DKCI, *Goods Movement Backgrounder*, City of Ottawa, 2019.

[189] G Carlson, *Warehousing*, Urbanism Next, University of Oregon, Portland, Spring 2017.

[190] BY Clark, N Larco and RF Mann, *The Impacts of Autonomous Vehicles and E-Commerce on Local Government Budgeting and Finance*, Urbanism Next, University of Oregon, Portland, August 2017.

The topics are discussed in the ensuing sections.

Connected and autonomous vehicles (C/AV)

Autonomous transportation is topical, with high-profile news articles about tests of autonomous, or self-driving, passenger vehicles and trucks. The Society of Automotive Engineers has defined five levels of automation, ranging from driver assistance (level 1) to full automation (level 5).[191] Although research and pilot tests have achieved high or full automation, the commercial state of autonomy still requires some driver assistance.

Many observers consider long-haul trucking to be the most automatable form of freight transport. In part this reflects the ubiquity of trucking for long-haul freight movement. It also reflects the relatively simpler environment in which long-haul trucks operate, with relatively fewer potential conflicts that must be negotiated and more sustained constant speeds that can occur between stops, compared with trucks that operate in urban environments. Observers suggest that fleets are most likely to take up autonomous vehicles (and other technologies) before individuals will, given that they can negotiate lower unit purchase prices and can achieve economies of scale for vehicle operating and maintenance costs.

Despite the continuing stream of technological advancements in autonomous vehicle technology and well-publicized interest by some large trucking fleets to test autonomous vehicles, several technology leaders note that significant gaps must still be overcome before autonomous vehicles become commonplace. Foremost among the technological gaps is the need for Artificial Intelligence applications, upon which entirely self-driving (level 5) vehicles must rely to interpret and react to its environment dynamically to achieve a far greater rate of reliability in covering unusual situations that work everywhere than exists today.[192] Moreover, although they are open to new technologies, recent consultations with individual trucking executives in other studies indicate that the uptake will depend on several factors, notably cost and the reliability of the technology. Liability, insurance, regulatory and public acceptability parameters – factors beyond the control of individual trucking firms - also have yet to be sorted out. In any event, no stakeholders consulted for this study raised C/AV as a trend likely to impact goods movement to/from/within the Central Okanagan in the next 10 years.

In the short term, connected trucks – more formally known as Cooperative Truck Platooning Systems (CTPS) - have emerged as a more practical advancement. CTPS uses sensors and wireless communications to allow two or more tractor-trailers to travel closely together. This reduces aerodynamic drag between the vehicles, which in turn reduces fuel consumption (hence operating costs) and emissions. The distances, speeds, acceleration and braking are all controlled by CTPS. However, individual drivers can leave the platoon – CTPS is a level 1 application, meaning that it is a driver-assisted technology. A driver must be present in each vehicle, and individual drivers can always accelerate or decelerate, hence leave the platoon. CTPS is intended mainly for long-haul trucking on controlled- or limited-access highways. Individual trucks can join or leave the platoon at any time, which can make CTPS more easily adaptable to existing configurations at entry or exiting interchanges while relying on the driver to cover the first and last kilometre legs of the journey.[193]

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[191] T Littman, *Autonomous Vehicle Implementation Predictions.* Victoria Transport Policy Institute, citing the Society of Automotive Engineers' *International Standard J3016*, 2018.

[192] Ibid.

[193] *Workshop Primer,* The Road To Cooperative Truck Platooning Systems Deployments in Canada, Transport Canada, Ottawa, October 24, 2018.

Industry analysts note the potential cost reductions associated with autonomous vehicles as being key to the rate and extent of industry's uptake. In the United States, driver wages and benefits comprised almost half (45%) industry-wide average trucking costs in 2020. Fuel costs were only about 19% of costs in 2020 - the lowest over the last 10 years due to low fuel prices during the pandemics - but have between as high as 40% (in 2012).[194] Autonomous vehicles are expected to reduce both costs.[195] A 2017 OECD study estimated that reductions of the order of 30% could be achieved in vehicle operating costs, accounting for driver wages and benefits, fuel efficiency and improved safety among other elements.[196]

Thus, there is a cost-reduction incentive for trucking firms to adopt autonomous vehicles. In addition, autonomous vehicles would not be constrained by driver hours-of-service regulations, meaning that trucks could have a much greater utilization than exists today.[197] Autonomous trucks would also be able to travel longer distances, again given the removal of the hours-of-service constraint. This could further help the dispersal of distribution centres to remote, lower-cost rural locations.

Uncrewed delivery vehicles

Drones and robots are uncrewed vehicles used to deliver parcels to consumers and businesses. In the literature, they are referred to as UAVs (uncrewed or unmanned aerial vehicles) and UGVs (uncrewed or unmanned ground vehicles) respectively.[198] Both technologies offer several potential advantages:

- Deliver a purchase quickly on demand, using the most direct routing possible. UAVs are not inhibited by the configuration of the road network or by topographical obstacles such as lakes, rivers or mountains. UGVs use existing sidewalks and bikeways, operating at low speeds, of the order of 4 miles per hour (6.5 kilometres per hour). Some UGVs, though not all, can negotiate ramps, steps and curbs.
- Wait for a value-add process to take place at the destination, then return the package to the originator – for example, a robot could deliver time-sensitive documents for the recipient's signature, wait while the documents are signed, and then return the signed documents directly to the originator. Audi is using indoor drones to deliver single items directly to the production at its German vehicle plant.[199]
- Reduce 'last-kilometre' cost – for example, by launching a drone from a delivery truck as it nears the destination, having the drone make the final delivery and then having the drone join the truck as it proceeds on its itinerary. This avoids the truck having to travel the final distance for the delivery.

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[194] *An Analysis of the Operational Costs of Trucking: 2021 Update*, American Transportation Research Institute, 2021. Note that the cited figures are provided by the American Transportation Research Institute, whose sources largely reflect long-distance heavy trucking. It is also assumed that the US cost breakdowns are transferable to Canada.

[195] D Egan and A Mullen, *Automated Trucking, A CBRE Research Perspective*, CBRE, November 2017.

[196] *Managing the Transition to Driverless Road Freight Transport*, International Transport Forum, OECD, Paris, 2017.

[197] Ibid.

[198] Except where noted, the ensuing discussion is drawn from HL Lee, Y Chen, B Gillai and S Rammohan, *Technological Disruption and Innovation in Last-Mile Delivery*, White Paper, Stanford Graduate School of Business, June 2016.

[199] S Baur and M Hader, *USD 5.5 billion market volume for non-military drones globally*, Roland Berger, posted February 19, 2020.

- Provide cost-effective and timely delivery for one-off or customized purchases. For example, a specialized industrial component or perhaps even a human body part generated through 3D production technology could be shipped by drone, thereby avoiding the need to send a partially full delivery vehicle. With their relatively high payload (up to 100 pounds or 45 kilograms), UGVs can make multiple deliveries to several customers in proximity. Customers can also use a real-time mobile app to track a UGV's location and unlock the goods upon arrival from a secure compartment.
- Serve remote or rural areas at lower cost than is now possible (especially UAVs), given the low densities, low volumes and long distances involved.
- Supply medicines, food and other supplies quickly in emergencies – for example, using UAVs to reach flooded areas where access roads and other means of transport have been disrupted.

With these advantages, uncrewed vehicles have the potential to reduce or even eliminate entirely delivery truck activity (measured as vehicle-kilometres travelled, or VKT) as well as the associated externalities such as fuel consumption and GHG emissions,[200] as well as congestion and accidents. Applications continue to extend the operational and regulatory boundaries – for example, in late 2021, Edmonton International Airport used drones to deliver a parcel from the airport to a nearby site. In addition to demonstrating the technology in cold weather conditions, this was the first authorized commercial application of drone use at an airport. The airport authority plans to use drones for selected last-kilometre deliveries. The commercial arrangement is also noteworthy, in that two local courier companies are involved with Air Canada Cargo serving as the agent for the drone manufacturer, Drone Delivery Canada (DDC).[201]

Although the technologies are maturing, several factors impede the broader uptake of uncrewed vehicles:

Figure E- 2: Piloted UGV-style vehicle in Toronto

[200] JK Stolaroff, C Samaras, ER O'Neill, AS Mitchell and D Ceperley, *Energy use and lifecycle greenhouse gas emissions of drones for commercial package delivery*, Nature Communications, volume 9, February 2018.

[201] C Gibson, *Edmonton International Airport to use drones to deliver commercial cargo packages*, Global News, posted December 3, 2021.

Source: CPCS

- Evolving regulatory environment. There are limitations to the use of uncrewed vehicles beyond the site line of the operator. For drones, the key limitations concern the need for reliable 'detect-and-avoid' systems to avoid aircraft, other drones and obstacles. These limitations are receding as the software and GPS-based tracking technologies evolve, and several countries have given regulatory approval for drone flights over crowds and urban areas. DDC and another supplier have been issued licences. In DDC's case, the permit is temporary pending resolution of DDC's status as a "Canadian" company.[202] Similar avoidance concerns apply to robots, especially given the imperative to avoid pedestrians on sidewalks, vehicles at intersections and other obstacles such as sidewalk furniture, poles and so on.
- Payload and distance limitations. Current commercial UAVs have limited capacity to move anything but relatively small packages. As noted, UGVs have a higher payload and can serve multiple customers; however, given their relatively slow speed, they are intended to operate only within a short distance of a local hub or retail outlet. Both UAVs and UGVs require frequent recharging, meaning that they cannot be used for long distances or UAVs for multiple trips between charges. As a result, they are seen as mainly complementing but not (yet) able to replace delivery vehicles for last-kilometre deliveries.[203]
- Operating costs relative to other means of delivery. These are linked to residential/job densities and to the volumes delivered to a given destination. Higher volumes reduce unit costs, but these reductions have not yet reached a point where they offset current means of delivery (which involve labour). It should also be noted that UAVs are significantly more expensive than UGVs, although UGVs are effective only over very short distances.
- Pricing to the consumer. The key monetary benefit of uncrewed vehicle delivery is the ability for the recipient to receive their purchase immediately – but there is necessarily a premium involved for speedy deliveries that not all purchasers are willing to pay. Note that the 'free' delivery now offered by some distributors for express delivery is seen by some observers as a means of building a customer base and attracting customers from competitors, hence is not expected to be sustainable over the medium to long term.
- Liabilities, in the case of accidents – who (or what) is responsible. Similarly, the insurance requirements are not fully clear.
- Safety mechanisms, in the event of a mechanical failure – e.g., shutting off the propellers and safely landing the drone. There have also been several recent and well-publicized incidents of drones intruding into the flight paths of commercial aircraft.
- Communications with other automated vehicles and with infrastructure. The interaction of UAVs and UGVs with other vehicles and infrastructure is evolving.

[202] D Tyler, BP Bedard and K Haroune, *Canada Issues licence for drone cargo transportation services*, Lexology, posted July 29, 2021.
[203] R Kellermann, T Biehle and L Fischer, *Drones for parcel and passenger transportation: A literature review*, Transportation Research Interdisciplinary Perspectives 4, published January 23, 2020.

- Lack of space for deliveries at the destination. For example, drones require a space of 2 square metres, which implies the need for a backyard or some other space, away from children, trees, power lines, swimming pools and so on. Not all destinations have this space available. High-density condominiums or office towers would require a designated landing pad, for example on the building's roof.
- Public acceptance of drones and robots is increasing, especially where the value proposition is evident (e.g., for medical or humanitarian support), but concerns remain about safety, intrusion and so on.[204]
- Security and privacy. There are concerns about drones and robots potentially gathering data about consumers' or businesses' purchasing habits and other characteristics, which in turn could be used for marketing or for nefarious purposes. Security of the transportation system, of which UAVs and UGVs are a part, is also of concern.[205] Theft is a concern with UGVs, although on board high-resolution cameras and the operator's ability to disable the GPS guidance offer some deterrence.

Operations and safety

This section discusses trends and approaches for improving truck operations and safety. A broad analysis of operational and safety approaches is beyond the scope of a strategic study like the COGMS, and no specific safety issues have been identified. However, three topics were raised in discussions with the client and study stakeholders:

- Use of Intelligent Transportation Systems (ITS) technology to improve intersection throughput and safety.
- Truck-only lanes to better manage the flow of trucks and other vehicles, especially on Highway 97.
- Hours-of-service and electronic logging devices (raised indirectly by stakeholders, regarding the need for drivers to find safe parking locations as they reach their hours-of-service limits).

These are described below.

ITS technologies for intersection control

This discussion considers three Intelligent Transportation System (ITS) technologies that can improve the throughput and safety of trucks and other vehicles at intersections:

- Freight Signal Priority, for application at individual intersections or corridors.
- Adaptive Traffic Control Systems, for area-wide application.
- Real-time intelligent speed adaptation, for application at individual intersections, corridors or areas.

Each is described below.

Freight Signal Priority (FSP), also known as Truck Signal Priority, is an adaptive traffic signal modification that extends green time to allow an approaching truck to pass through an intersection

[204] K Schechtner, L Casullo, A Garbarczyk, P Crist and J Egeland, *(Un)certain Skies? Drones in the World of Tomorrow*, OECD / International Transport Forum, Paris, 2018.
[205] E Serafinelli, *Imaging the social future of drones*, Convergence: The International Journal of Research into New Media Technologies, volume 0(0), pages 1-16, 2022.

without stopping.[206] The primary aim is to increase safety by reducing the potential for a truck to run a red light and cause a collision. Secondarily, FSP can reduce the delays and congestion that can result from the longer time required by slow-moving heavy trucks to accelerate to the posted speed limit. FSP can also reduce road maintenance requirements by limiting the stop-and-go conditions that add wear-and-tear to road pavement. Finally, by keeping trucks moving, FSP can reduce operational and labour costs as well as vehicle emissions.

FSP gives priority to a heavy truck that is close to the traffic signal and for which it would be difficult to stop on an amber light, especially on high-speed roads and downhill approaches. Uphill approaches can also merit an FSP to allow the truck to clear the intersection with sufficient green time. FSP can also be deployed on corridors that have high volumes of heavy trucks, such as approaches to intermodal terminals, industrial areas or distribution centres.

Compared with Transit Signal Priority (TSP), which focuses on a unique fleet or fleets of transit vehicles, FSP requires different detection technology because the wide range of vehicle owners makes it practically impossible to deploy the same equipment on all trucks. As a result, authorities must use intersection detection equipment that can identify an approaching truck and determine its speed. This requires two types of equipment:

- Traffic signal controller software that can distinguish a truck priority request from a transit priority request and configure an extended green time.
- Detection equipment that can classify vehicles, identify large trucks (typically by length), and determine the speed of an approaching truck.

Although FSP and TSP both extend the amount of green time, it should be noted that TSP can also bring up the green early.

Although initial FSP applications were in rural roads – the system was initially conceived for isolated intersections on rural highways – recent applications have been in urban areas. For example, the Florida Department of Transportation (DOT) implemented FSP to better manage trucks and other vehicles in a transportation and logistics area near the cargo entrance to the Port of Miami. Various studies have assessed urban performance, including a potential FSP at a major intersection along a key freight corridor in Portland, Oregon, and the performance of different combinations of FSP and TSP along a 4.4 mile (7.1 km) signalized corridor in Fort Lauderdale, Florida. Both analyses found benefits to travel times along the primary corridor, albeit with potentially some increase in delay at the side street approaches. The Fort Lauderdale analysis found that the greatest reductions in corridor travel times occurred with combinations of FSP and TSP together (i.e., benefits can be gained for both trucks and buses together), which also demonstrated the lowest increase in side-street congestion levels.[207]

Adaptive Traffic Control Systems: Whereas FSP can be deployed at individual signalized intersections or along individual corridors, some cities have deployed a broader traffic signal control system. According to a 2016 study, these systems have been implemented in cities across Canada

[206] This discussion is drawn from *Freight or truck signal priority*, Washington State Department of Transportation, https://tsmowa.org/category/signal-operations/freight-or-truck-signal-priority.
[207] M Mahmud, *Evaluation of Truck Signal Priority at N Columbia Blvd and Martin Luther King Jr. Blvd Intersection: VISSIM Micro-Simulation Analysis of Truck Signal Priority*, 2014, and S Manta, *Evaluation of Freight and Transit Signal Priority Strategies for Improving Transportation Operations in Urban Corridors*, Thesis, Florida Atlantic University, Boca Raton, FL, 2019.

and elsewhere to facilitate smooth and safe traffic movements and minimum delay.[208] Two of the most important types are actuated traffic signals and Adaptive Traffic Control Systems (ATCSs). Actuated traffic signals maintain a green signal on the busiest street until a pedestrian or a vehicle on the less-travelled side street approaches the intersection. ATCS continuously adjusts the length of green time based on traffic conditions, demand and system capacity to accommodate current traffic patterns. The City of Toronto's Split Cycle Offset Optimization Technique (SCOOT) system is a well-known Canadian example of an ATCS, although it focuses on selected routes (i.e., it does not cover the entire network of traffic signals). Halifax and Red Deer also use SCOOT.[209]

Actuated signals are widely used. Several vendors have developed their own ATCSs, which offer varying benefits. For example, according to the manufacturer, Toronto's SCOOT reduces delay by 17%, stops by 22%, fuel consumption by 5.7% and hydrocarbon emissions by 5%. (Note that the time periods and conditions on which these reductions are based are not described, nor is the method of calculation, and these figures are for all traffic.) However, different systems have varying objectives, designs, and functions. The applications also vary in terms of coverage and local conditions.

However, ATCSs have not been widely deployed for two main reasons:

- Higher cost, with the average US installation cost per intersection ranging from US$20,000 to almost US$80,000.
- Uncertain outcomes - for example, compared with pre-timed operations, results can vary according to corridor characteristics and traffic conditions at different times of day, delays can increase at other adjoining intersections.

Several measures are commonly used to measure the effectiveness of ATCS. These include route travel time, travel time reliability, delay, traffic volume and derived measures such as fuel consumption, emissions, and benefit-cost analyses. Some studies have suggested that the impacts on performance differ according to site-specific problems, the coverage (e.g., whether side streets are included), and the selected metrics. The analytical methods and data have also varied.

Real-time intelligent speed adaptation: Recent advancements have tested ways to have the vehicle adapt to signals, rather than adjusting the signal timings. Under Transport Canada's *Advanced Connectivity and Automation in the Transportation System Program* (ACATS),[210] the City of Ottawa and several partners evaluated how providing infrastructure to vehicle (I2V) information could help drivers minimize speed variation, improve fuel efficiency and reduce emissions as they approach traffic signals. The EcoDrive II study followed an initial study that established the use of the *Green Light Optimized Speed Advisory* (GLOSA) technology. GLOSA is an example of a real-time intelligent speed adaptation.

In GLOSA, drivers are provided with a computed speed to allow them to successfully pass through an upcoming signalized intersection during the green phase. With this information, the vehicle's

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[208] Except where noted, this discussion is drawn from X Ban, J Wojotowicz and W Li, *Decision Making Tool for Applying Adaptive Traffic Control Systems*, Report C-13-04, New York State Energy Research and Development Authority and New York State Department of Transportation, Albany, NY, 2016.

[209] Toronto is considering updating or replacing its SCOOT system, which is now about 30 years old. A key advancement offered by various vendors, including that of SCOOT, is the replacement of the need for hard wiring by wireless technology.

[210] For more information, see https://tc.canada.ca/en/road-transportation/innovative-technologies/automated-connected-vehicles/projects-funded-program-advance-connectivity-automation-transportation-system.

glide path can be optimized to reduce unnecessary fuel consumption if it is maintained at a speed that does not require it to stop – for example, reducing the speed while approaching a red light so that it reaches the stop line shortly after the light changes to green.

As its title suggests, EcoDrive's focus was on reducing fuel consumption and emissions. A test fleet of seven vehicles achieved fuel savings of between 5% and 7%. Rates varied by driver (according to driver acceptance of and acting upon the I2V information), road type, congestion levels, and other factors. The pilot project initially targeted heavy trucks that must travel close to Ottawa's downtown to cross the Ottawa River to/from neighbouring Gatineau, Québec. The presence of these heavy trucks has contributed to downtown congestion, operations and safety problems with vulnerable road users. In the event, specific results for trucks are not available, and the program apparently ultimately had a broader coverage in any event.

The project report recommends conducting future tests during winter conditions to see the impact of fuel consumption variation and potentially whether increased and advanced awareness of the ability to safely travel through an intersection could result in improved safety at intersections and a reduction in collisions under winter driving conditions. The EcoDrive I2V system and its associated technologies were also seen as an opportunity to train the "intelligent driver" via machine learning to improve the driving profile for enhanced fuel efficiency and safety.[211]

Truck-only lanes

Truck-only lanes, or dedicated truck lanes, are lanes designated for use by trucks. The purpose of these lanes is to separate trucks from other mixed-flow traffic, to enhance safety and/or stabilize traffic flow. Lanes that are dedicated to or give priority to trucks can help optimize truck speeds and reduce crashes, while also reducing the incidence of general-purpose lane closures and the associated increase in congestion, fuel consumption and emissions.[212]

Most studies have considered truck-only lanes for freeways. A small number of dedicated truck lanes have been implemented on freeways in the United States, including sections of the New Jersey Turnpike, the South Boston Bypass Road (see box) and the Los Angeles I-5 truck bypass lanes. Not all these lanes are exclusive to trucks. A 2005 study proposed the introduction of truck-only tolled lanes on the Atlanta region's freeway system. Even with tolls, the trucking community generally accepted the estimated benefits, which also included reduced congestion on the non-tolled lanes.[213] However, the proposal was not adopted.

[211] City of Ottawa, Carleton University et al., *EcoDrive II, Final Report to Transport Canada, I2V Connected Vehicle Pilot Project – City Fleet, Signalized Intersection Approach and Departure Optimization Application*, City of Ottawa, March 2020.
[212] CH2M Hill, *Analysis of Freeway Operational Strategies Related to the Use of Managed Lanes by Trucks*, prepared for San Diego Association of Governments, 2012.
[213] CJ Espiritu, *Identifying Potential Freeway Segments for Dedicated Truck Lanes*, San Jose University, 2013.

Case Study: South Boston Bypass

As part of the redevelopment of the South Boston Waterfront, grade-separated, limited-access truck-only roads were constructed to ensure continued reliable freight access to the commercial district, even as rail tracks were removed for redevelopment. The South Boston Bypass, a 1.5-mile haul road, was converted from an underutilized rail line and constructed to allow unimpeded travel for trucks and buses from the South Boston Expressway, bypassing residential neighborhoods. However, in recent years there have been increasing pressures to open access to the corridor to all vehicles, in order to decrease overall traffic congestion on other routes. MassDOT has performed several pilot projects (6-months and 1-year) in recent years in order to evaluate the traffic impacts of opening up the corridor to general-purpose traffic. This case study illustrates some of the challenges of dedicating roads and lanes to commercial vehicles.

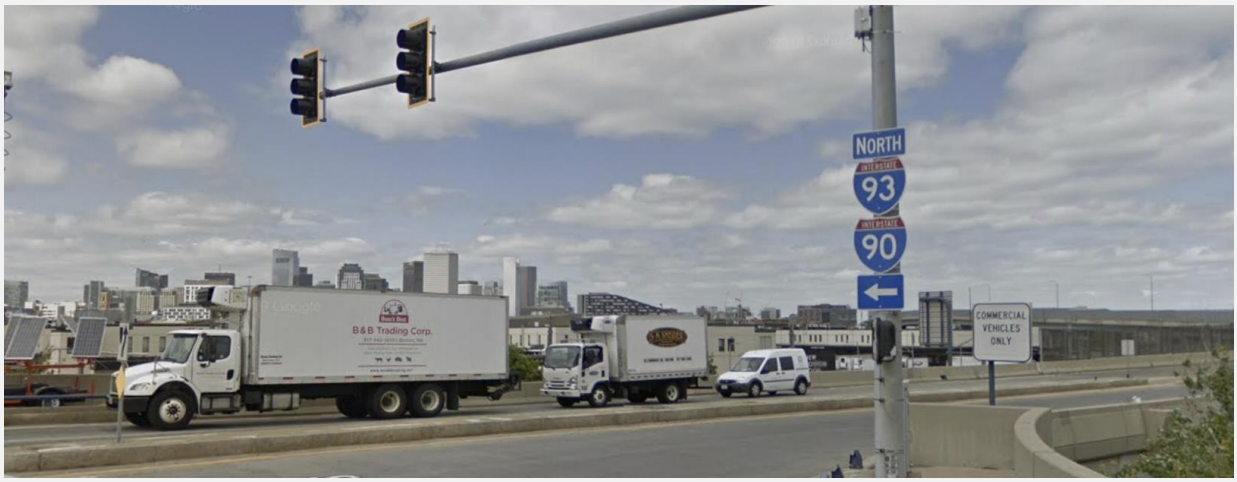

Image Source: Google Street View (2016)

A 2014 Transportation Association of Canada (TAC) study examined truck lanes in Canada. The study takes a broader definition of truck-only lanes, looking at operational as well as physical treatments on arterials as well as freeways. The focus is on urban areas. There are very few applications in Canada, with only a single arterial truck lane that serves as a bypass around downtown Ottawa. There are no physically separated freeway truck lanes anywhere in the country. Truck lanes exist at a few border crossings. The study considers LCV routes as falling under the truck lane category, because these are allowed only on pre-approved routes (mainly freeways) whose use in urban areas can be restricted during certain times of day. (Ottawa and Winnipeg are examples of such restrictions.) Benefits of truck lanes can include travel time savings, reliability improvements, safety improvements and emission reductions. Costs are related to the provision, operation and maintenance of infrastructure. Challenges include the underutilization of truck lanes (which counters the desired benefits), truck-car interaction and weaving (depending on the freeway configuration), additional right-of-way requirements for physically separated lanes, and in some configurations shared use of a lane with transit or high-occupancy vehicles (HOVs) during certain times of day. The study offers several planning, design and operational factors to be considered in assessing the need, applicability, practicality and feasibility of implementing a truck lane, whether on an arterial or a freeway.[214]

In 2017, the Council of Peel Region, Canada's largest multimodal freight hub, directed staff to investigate the feasibility of introducing a truck lane restriction pilot study at Highway 50 and Derry Road, two arterials that have high volumes of heavy truck traffic (the former is the key access to a

[214] The ensuing discussion is drawn from G Rempel et al., *Truck Lanes in Canadian Urban Areas: Resource Document*, Transportation Association of Canada, Ottawa, 2014.

CP intermodal rail terminal). The investigation was triggered by concerns about traffic congestion and safety. Micro-simulation modelling analyses found that the proposed restrictions would not yield significant travel time savings or traffic safety improvements. Field surveys found that trucks generally already operate safely on these corridors. Staff concluded that experience has "demonstrated that truck lane restrictions are not the most appropriate mitigation tactic to address congestion and safety concerns," and "education and outreach were recommended to address concerns with truck traffic and safety." As a result, the pilot was not implemented.[215]

Truck-lane restrictions are variations to the concept: The most common application is to restrict trucks from certain lanes in congested urban areas, sometimes at certain times of day.

Electronic logging devices and hours-of-service

Long-haul truck drivers are subject to hours-of-service rules, including, but not limited to, driving a maximum of 13 hours per day. As a safety measure, drivers must pull over and park safely prior to these hours being exceeded.

Their hours must be recorded in a log that is maintained in the vehicle. However, due to problems of reliability and the veracity of existing (mostly paper) logs, the United States mandated a changeover to electronic logging devices (ELDs) by December 2019. This applied to long-haul drivers regardless of jurisdiction. Short-haul drivers (in effect, urban drivers) are exempt.

In Canada, although drivers are transitioning to ELDs, mandatory use is not required until January 1, 2023. In the interim, licensing agencies are focusing on awareness and education. MOTI has noted that the exact timelines for implementation of ELDs in British Columbia will depend on several factors including the availability of certified ELDs and potential implications of the pandemic. In the meantime, BC carriers that operate solely within the province and extra-provincial carriers operating in BC are not required to use an ELD within British Columbia. (Drivers are still required to log their hours of service.) BC-based and other carriers that operate outside the province are required to follow the requirements of these other jurisdictions, which (in the case of the United States) require the use of ELDs.[216]

ELDs will tighten the timeframe within which drivers can seek safe and secure parking locations. Study stakeholders commented that they observed trucks running red lights on Highway 97, potentially because drivers were attempting to reach their destinations before their hours-of-service limits were reached. Stakeholders also suggested that ELDs would level the playing field among trucking companies because the technology would improve compliance with hours-of-service requirements. Recent studies by various provinces and states have suggested the need for additional parking sites along highways and even in urban areas to ensure that drivers have a safe place to park and rest when their limits are reached. In this regard, MOTI conducted a truck parking study in the Lower Mainland in 2015, and a serviced 40-space truck parking and rest area was opened in Delta in 2016.

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[215] Peel Region*, Report to Regional Council, Feasibility of a Truck Restricted Lanes Pilot Project on Regional Road 5 (Derry Road) and Regional Road 50 (Highway 50),* Peel Region, Brampton, Ontario, meeting of March 29, 2018.

[216] *National Safety Code Bulletin Re: Electronic Logging Devices (ELDs) in British Columbia*, Bulletin # 01-2021, BC Ministry of Transportation and Infrastructure, updated March 17, 2022.

Measures to reduce conflicts between trucks and vulnerable road users

This section provides an overview of measures that can be deployed to reduce conflicts between trucks and vulnerable road users (VRUs; that is, cyclists and pedestrians). The subject is multifaceted, and it should be noted that a full discussion, for example to support a *Vision Zero* strategy, is beyond the scope of the COGMS.

A 2014 paper summarizes the challenges.[217] Although the frequency of conflicts between trucks and cyclists or pedestrians "may not be the most common [road safety] situation encountered … [they are] the most dangerous." The situation is most acute at intersections, in several ways:

- Special needs, such as truck manoeuvrability and cyclists' need to be seen, are very different and "rarely are given priority [in intersection configuration and operation] over the mobility and safety needs" of autos.
- Cyclists and trucks share road space with all other road users, unless separated by time (e.g., through phased signals).
- Cyclists are more exposed than pedestrians because they are on the roadway, "often without marked space and in the case of the cyclist usually without any special signal phasing."
- At very low speeds, balance can also be a problem, especially for novice or older cyclists. Cyclists are also heterogeneous, with wide-ranging levels of ability. The diversity in cyclists' ages also is a factor, in that knowledge of the rules of the road and the ability to process and act on information can vary by age.

The ensuing discussion overviews two specific groups of initiatives and trends:

- Road engineering initiatives
- Vehicle technology and industry-led initiatives

Notwithstanding this focus, it should be noted that the successful implementation of these initiatives is based on several factors, which should be considered in the development of a truck-VRU safety program. These factors include a clear vision and agreed upon objectives for truck – cyclist safety, consistency with other plans and policies, tangible and practical solutions that meet the local context, and meaningful consultation with and engagement of all stakeholders, including government, the private sector and the public.

This is illustrated by a 2018 Canadian study that describes a range of safety measures that can be deployed to protect both VRUs and heavy vehicle drivers. This initiative, mandated by Canada's Ministers of transportation, is a collaborative effort that included participation by an advisory panel made of cycling, pedestrian and trucking advocates among other stakeholders and experts. The study examined best practices around the world, consulted with stakeholders and the public, and developed a tool to assess the effectiveness of each measure. It should be noted that the study considers sustainable development goals hence it is applicable, for example, to Complete Streets initiatives. The study report describes:

- Road safety strategies, principles and approaches that can be applied nationally and locally (for example, *Vision Zero*), as well as municipal bicycle and walking strategies.

[217] W Pattinson and RG Thompson, *Trucks and Bikes: Sharing the Roads*, 8th International Conference on City Logistics, Procedia – Social and Behavioral Sciences 125 (2014), p. 251-261.

- Countermeasures (i.e., safety measures), some of which are specific to VRUs and heavy vehicles while others consider all road users. These are organized into eight groups:
  - Automated enforcement – e.g., speed and red-light cameras
  - Communications, awareness and education – e.g., commercial vehicle driver training
  - Intersection design and traffic control
  - Roadway and cycling infrastructure
  - Rules of the road – e.g., bicycle helmets and use
  - Side guards and side skirts (vehicle equipment)
  - Speed – e.g., traffic calming strategies and devices
  - Visibility and conspicuity – e.g., audible sensors on vehicles [218]

Road engineering initiatives

These initiatives consider the design and operation of the right-of-way, especially intersections. Approaches include:[219]

- Protected bicycle lanes, including the provision of separate spaces for right-turning cyclists and vehicles. Introducing a time separation for the use of the individual lanes can provide trucks with a larger radius turn (i.e., by overlapping the bicycle lane).
- Mirrors on signal posts, to enable the drivers of large vehicles to see in otherwise blind spots.
- Separate signal phases, to separate in time the movements of unprotected road users.
- High deflection/low speed roundabouts, which can be provided with mountable outer perimeters for large vehicles.
- ITS applications, such as warning signals that detect that presence of unprotected road users.

These and other treatments can be found in the NACTO *Urban Bikeway Design Guide*.[220]

Although not 'engineering' initiatives *per se*, accounting for bicycle volumes can also be used to inform regulatory/operational decisions such as the designation of truck routes, turning restrictions, etc.

Vehicle technology and industry-led initiatives

This discussion considers vehicle technology initiatives, such as side underrun protection panels fitted to trucks, cabin redesign to lower driver eye height and improve short-range field of view. Many of these have been introduced by fleet owners as retrofits to their vehicles, and these industry-led initiatives are often accompanied by driver education programs (i.e., more than technology). Hence this discussion considers vehicle technology and industry-led initiatives together.

Three ongoing approaches exemplify the initiatives:

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[218] *Safety Measures for Cyclists and Pedestrians Around Heavy Vehicles, Summary Report*, Transport Canada, June 2018.
[219] W Pattinson and RG Thompson, *Trucks and Bikes: Sharing the Roads*.
[220] National Association of City Transportation Officials, New York. See http://nacto.org/publication/urban-bikeway-design-guide/.

- **Lafarge (large Canadian fleet).** Lafarge, a nationwide concrete supplier, provides a Canadian example of how technologies and other initiatives have been deployed to improve truck – VRU safety. Lafarge designed and implemented a thick nylon panel that sits between the rear wheels of a truck. Paired with a metal bar that runs from the first rear wheel to the front wheel, the panel and bar are intended to prevent cyclists and pedestrians from getting trapped beneath the vehicle.[221] The "Guardian" is part of a *Cyclist Safety Strategy* launched in 2015 by Lafarge to reduce the impact of concrete delivery on communities. The strategy has five elements: health promotion (promotion of cycling through advocacy for "the highest safety standards achievable to protect cyclists," infrastructure (promotion of Complete Streets), driver education, cyclist education and vehicle safety.[222]

  The last element, vehicle safety, features four enhancements, described below and illustrated in Figure E-3:[223]

  - Cyclist warning signs, placed on the right rear bumper of the vehicle, to remind cyclists that they cannot be seen if they pass the truck to its right.
  - Additional side mirrors to reduce the driver's blind spot.
  - Auxiliary turn signals, mounted on the right side of the vehicle where they can be seen by cyclists that are positioned alongside the vehicle.
  - Truck side guards, as described above. Although side guards have been mandatory in Europe since 1994, no such requirements exist nationwide in Canada, although in July 2022, Vancouver City Council mandated their use on all heavy truck owned and contracted by the city.[224]

Figure E-3: Examples of vehicle retrofits – Lafarge safety program

Side guards – bar (L) and nylon panel (R)


Extra mirrors

[221] *Trucks fitted with new guard could save cyclists' lives*, CBC News, May 1, 2015, http://www.cbc.ca/news/canada/toronto/trucks-fitted-with-new-guard-could-save-cyclists-lives-1.3057155
[222] *Cycling safety*, https://www.lafarge.ca/en/cycling-safety.
[223] *Vehicle safety*, https://www.lafarge.ca/en/vehicle-safety.
[224] J Grant, *Vancouver council mandates side guards for city-owned heavy trucks after cyclist's death*, CBC News, posted July 21, 2022.

Extra turn signals at pedestrian / cyclist height

Warning signs

Source: *Lafarge Cycling Strategy*, https://www.lafarge.ca/en/cycling-safety

- **London - blind spot reduction.** In the United Kingdom, Transport for London introduced a world-first mandatory system to reduce blind spots for drivers of large vehicles. Since October 2020, all heavy goods vehicles (HGVs) more than 12 tonnes gross vehicle weight require an "HGV safety permit" to operate on all roads in Greater London, 24/7. To support this initiative, Transport for London developed a Direct Vision Standard (DVS). The standard "measures a driver's direct view through the windows of an HGV cab," which is communicated in terms of a star rating that "indicates the level of risk to people walking and cycling near the vehicle." The star ratings range from zero (poor, defined as limited direct vision) to five (excellent, defined as increased direct vision). A zero rating requires the vehicle to be fitted with mitigating safety features before it is permitted to enter the area. These features comprise additional front and side mirrors, side underrun protection (guards), external pictorial stickers and markers for VRUs (e.g., "Blind spot – take care"), a sensor system that alerts the driver to the presence of a VRU, an audible vehicle manoeuvring system that warns VRUs of a left turn (i.e., a right turn in Canada) and a fully operational camera monitoring system. Some HGVs are exempt – e.g., mobile cranes, which are "specialist, low-mileage vehicles requiring special permission to operate in London."[225]

  The initiative supports London's *Vision Zero* plan: Transport for London notes that although HGVs accounted for just 3% of overall miles driven in London (by all vehicles) between 2018 and 2020, they were involved in nearly half (41% of fatal collisions with cyclists and 19% of those involving pedestrians. Over the first year of operation, the number of serious injuries involving HGVs in 2021 had dropped by 64% compared with 2017, from 48 to 17 incidents. The permitting system also saw a reduction in fatal collisions in which vision was cited as a contributing factor. By mid-July 2022, almost 200,000 safety permits had been issued and more than 112,000 HGVs had been with safety measures. Average daily compliance was very high, with more than 94% of HGVs in Greater London now operating with a safety permit and trucking companies reporting that they are incorporating DVS requirements into future purchasing decisions.[226]

- **Construction logistics.** Another UK-wide initiative focuses on improving the safety of construction vehicles. *Construction Logistics and Community Safety* (CLOCs) is an industry-led initiative to reduce collisions between construction vehicles and pedestrians and cyclists. CLOCS has developed voluntary nationwide standards although it is intended for

[225] *HGV safety permit guidance for operators entering London*, Mayor of London and Transport for London, November 2019.
[226] R Reidy, *Lorry safety scheme delivers improvements in London*, Traffic Technology International, https://www.traffictechnologytoday.com, posted July 7, 2022.

implementation on a project-by-project basis. It involves four actions by regulators, clients, principal contractors and fleet operators. The four actions are:[227]

- Construction logistic plans to identify and reduce potential impacts of the construction supply chain on the road network
- Site monitoring visits
- The Fleet Operator Recognition Scheme, which is a voluntary accreditation scheme for fleet operators to raise the level of quality within their operations and exemplify best practices in safety, efficiency and environmental protection
- The use of vehicles that have enhanced safety features such as greater direct vision, lower axle heights and side underrun protection

Alternative fuels

Alternative propulsion vehicles have emerged over the last several years as viable options to those powered by conventional internal combustion engines. Hybrid-electric, electric, fuel cell, and natural gas vehicles are considered in the literature to be the most promising technologies for urban goods movement and are discussed below. Multiple stakeholders noted there is still limited availability of alternative fuel vehicles and uncertainty over which technology will emerge as dominant, which could vary by application (e.g., long haul versus urban return-to-base operations).

Hybrid-electric

A hybrid engine combines a conventional internal combustion engine and a rechargeable battery-powered electric motor for propulsion. Hybrid propulsion systems shut off the vehicle engine under idling conditions or situations of low engine power demand. They also recover or recycle energy from braking and deceleration. Trucks whose regular driving cycles feature a high incidence of stop-and-go activities, such as medium-duty urban delivery vehicles, can benefit from hybrid engines,[228] as can trucks that must idle to operate ancillary machinery.

The magnitude of reductions in fuel consumption and GHG and Criteria Air Pollutant (CAP) emissions depends on the duty cycle, on the type of hybrid technologies used, and the degree to which the technologies are integrated into the propulsion system.[229] One owner of a fleet of hybrid utility trucks estimated that its hybrid trucks reduced diesel fuel consumption by 47%. The significance is that utility trucks spend an average of half of every workday idling in order to power their buckets and other electronics.[230]

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[227] *Implementation*, Construction Logistics and Community Safety, https://www.clocs.org.uk.
[228] HC Frey and Kuo, P-Y, *Best Practices Guidebook for Greenhouse Gas Reductions in Freight Transportation, Final Report*, prepared for the US Department of Transportation, North Carolina State University, Raleigh, NC, October 2007.
[229] *Draft Technology Assessment: Heavy-Duty Hybrid Vehicles*, California Air Resources Board, Sacramento, CA, November 2015.
[230] C Mims, *Hybrid Trucks Are Here for the Long (Medium and Short) Haul*, Scientific America, April 20, 2009.

Another source estimated reductions in GHG and NOx of 10%-60%. The same source noted that Purolator's Canadian fleet of hybrid gasoline and hybrid diesel medium-sized trucks reduced fuel consumption by 33% (25-30% for hybrid gasoline and 45% for hybrid diesel).[231]

The incremental costs for hybrid technology range from $8,000 - $10,000 (USD) for light and medium-sized trucks (such as delivery vans, about 20-25% of the purchase cost) to $200,000 (USD) for heavy (Class 8) trucks (about 50% of the purchase cost).[232] This variation and high cost make it difficult for fleet owners to achieve a reasonable payback period without government subsidies.[233] One original equipment manufacturer estimates a 2–5-year payback period with government subsidies in place.[234] However, there is some consideration that costs would drop over time. Also, rebates from any future provincial or federal green vehicles subsidies could reduce the payback period.

Even as technology improves, cost, performance and weight remain key challenges. The incremental costs of hybrids can be partially or wholly offset by government incentive programs. Although hybrids are well suited to urban stop-and-go delivery cycles (typical of urban courier deliveries), improvements to acceleration performance are needed for high-power demand on-road applications. The additional weight associated with batteries – 135 kg for smaller vehicles but more than 2 tonnes for heavy vehicles – can offset the fuel savings that otherwise would be gained.[235]

Electric

Most electric vehicles are powered by rechargeable batteries.[236] They can be recharged at plug-in recharging stations. The distance after which the battery must be recharged ('plugged in') varies by vehicle type and manufacturer, although these distances are steadily increasing as the battery technology advances.

However, notwithstanding recent developments in long-distance electric vehicles by Tesla, Volvo and others, plug-in electrically powered trucks continue to be best suited for urban delivery cycles that have return-to-base operations (where the vehicle returns after its shift for overnight charging), fixed routes of 40-80 miles in length (65-130 km), frequent stops (which allow for regenerative braking), diminishing load (where the truck is lighter after each delivery, helping to extend the vehicle range) and lower-speed operation to preserve battery power. In contrast, compared with diesel, tractors used to haul one or more trailers gain few benefits from electrification because they mostly operate over long distances at constant cruise speeds where diesel is highly efficient. Diesels also allow a longer range than electric powertrains.[237]

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[231] R Parish, *Medium and Heavy-Duty Hybrid Trucks for Municipal Operations*, presentation, Calstart – presentation to the Federation of Canadian Municipalities, September 16, 2010.
[232] DY Lee, VM Thomas and MA Brown, *Electric Urban Delivery Trucks: Energy Use, Greenhouse Gas Emissions, and Cost-Effectiveness,* Environmental Science & Technology, volume 47 number 14, 2013.
[233] S Lyden, *The Latest Developments in Hybrid-Electric Medium-Duty Trucks*, TruckingInfo, March 2014.
[234] *The Business Case for Hybrid-Electric Medium-Duty Trucks*, GreenFleet Magazine, November 2012.
[235] Ibid.
[236] Overhead catenary is another, though much less common, means of supplying electric power. It is commonly used for light rail transit, for example, as in Calgary and Edmonton. It has been tested in Sweden for long-haul trucks. However, it requires an investment in infrastructure along a right-of-way (in Sweden's case, a highway) as well as in the vehicles (which, to be able to run off the grid, must also have a rechargeable battery).
[237] S Lyden, *The State of All-Electric Trucks in the U.S. Medium-Duty Market*, GreenFleet Magazine, January 2014; and S Joshi, M Dahodwala, N Ahuja, F Dhanraj et al., *Evaluation of Hybrid, Electric and Fuel*

The environmental benefits of urban delivery vehicles are well established. One US study found urban that all-electric delivery vans, which do not emit any tailpipe GHGs, emitted 42-61% less GHGs than their conventional counterparts, when accounting for the GHGs emitted over the vehicles' lifecycles (i.e., including vehicle manufacturing, electricity/fuel production and transmission, and so on). Results varied according to actual vehicle usage and efficiency. Vehicles with less frequent stops and higher average speeds also reduced fuel use and GHG emissions but in lower quantities, and overall costs were slightly higher.[238]

Several jurisdictions require that certain proportions of new trucks sold by a target date are to be zero-emission vehicles. However, the relatively low energy density of batteries relative to diesel fuel, coupled with the typical operational profile of heavy trucks (tractor-trailer vehicles), represents a significant challenge for broader industry uptake. A 2021 paper examined alternate means to meet near-term regulatory requirements while electric vehicle technology is still maturing. The paper found that a diesel hybrid provided the most cost-effective solution, while range extender electric vehicles (an auxiliary electric motor, powered by diesel, that extends the vehicle's main electric motor) had the most potential to reduce GHGs. All-electric vehicles could achieve cost parity with diesel vehicles if the required driving range is limited to 100-150 miles (160 – 240 kilometres). Although these findings are drawn from simulation models rather than field tests, the authors note that the overall benefit of all-electric trucks "depends significantly" on future advancement in battery technology and in extending vehicle ranges.[239]

Well-publicized battery and range advancements continue to be achieved with light-duty (passenger) vehicles. A 2018 California study notes that the reliability and durability of battery-based systems has improved steadily in recent years, with electric delivery trucks having operating ranges between 110 and 160 kilometres.[240] However, the life expectancy of a heavy-duty vehicle can exceed 1 million miles (1.6 million kilometres), and in the United States the average age of commercial trucks is about 14 years. As a result, components and systems for heavy-duty vehicles must be significantly more durable than those of light-duty vehicles. Medium and heavy-duty vehicles also have significantly greater per-kilometre energy demands. Coupled with long daily driving distances, this means these vehicles will require large batteries. Fast-charging these batteries (another requirement for long-haul vehicles) will require substantial power (more than a megawatt, compared with 350 kilowatts for a light-duty vehicle under an extremely fast charge). Component efficiency is also critical to accrue fuel savings that will pay back the very high cost of energy storage within a few years.[241]

On the other hand, a 2021 paper estimates that significant reductions in battery prices and improvements in their energy density now make Class 8 vehicles cost-competitive with diesel equivalents, offering a 13% lower cost of ownership per mile, a 3-year payback and net savings of

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Cell Powertrain Solutions for Class 6-7 Medium Heavy-Duty Vehicles, SAE International Journal of Advances and Current Practices in Mobility, 3(6), 2021. According to the FHWA's widely used vehicle classification standard, vehicle classes 6 and 7 are single unit trucks with 3 and 4+ axles respectively (https://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/vehicle-types.cfm).

[238] DY Lee, VM Thomas and MA Brown, *Electric Urban Delivery Trucks: Energy Use, Greenhouse Gas Emissions, and Cost-Effectiveness*.

[239] S Joshi, M Dahodwala, N Ahuja, F Dhanraj et al., *Evaluation of Hybrid, Electric and Fuel Cell Powertrain Solutions for Class 6-7 Medium Heavy-Duty Vehicles*.

[240] G Giuliano, White L and Dexter S, *Developing Markets for Zero-Emission Vehicles in Goods Movement*, National Center for Sustainable Transportation, University of California at Davis, March 2018.

[241] D Smith, R Graves, B Ozpineci, PT Jones, J Lustbader et al., *Medium- and Heavy-Duty Vehicle Electrification; An Assessment of Technology and Knowledge Gaps*, report ORNL/SPR-2020/7, Oak Ridge National Laboratory and National Renewal Energy Laboratory, December 2019.

$200,000 over a 15-year lifetime, all with only a 3% reduction in payload capacity (which, the paper argues, can be offset cost effectively by light-weighting the vehicle. The paper notes that only a small proportion of trucks regularly use their maximum payload in any event). With the appropriate fast or extremely fast chargers in place at truck stops (which would require an upfront investment), vehicles could be recharged during mandated driver breaks.[242] While this analysis represents US conditions and diesel/electricity unit costs (which have also fluctuated significantly in recent months), the findings suggest that continued advancements in technology and cost reductions show promise for potentially advancing the uptake of heavy-duty electric vehicles.

A 2018 European study found that the use of electric urban delivery vehicles is influenced by the number and location of charging stations. Given that the currently estimated "guaranteed" range is 200 km before the vehicle must be recharged, the availability of urban charging stations is key to the deployment of electric delivery vehicles and the design of their routes. Another option is to set up battery exchange stations, where the electric can get a new battery and does not have to wait to recharge. However, costs and the lack of standardization among vehicle manufacturers preclude this option.[243]

Another 2018 study summarizes other factors for success. The study summarizes the experience of Renault, a leading global manufacturer of electric light commercial vehicles (ELCVs), which are defined as vehicles weighing less than 3.5 tonnes:[244]

- Two thirds of ELCVs sold in Europe are not used for freight transport or logistical activities (Renault is based in France). Instead, they are used as vehicles for repair people, businesses and public services. In other words, there are complementary uses for what are ostensibly goods movement vehicles.
- Future bans on diesel and gasoline vehicles in several European cities, implemented by concerns about climate change and air pollution, are encouraging industries to adopt other technologies.
- Achieving Renault's leadership position (which will eventually be surpassed by Chinese manufacturers) required significant investment as part of a strategic move. In other words, a significant, long-term investment is required by vehicle manufacturers before new technologies become widespread.
- Electric vehicles are inherently connected to the electric grid. They require charging facilities and have specific maintenance requirements.
- Owners of big urban fleets have been the first adopters of electric mobility at a significant scale. These large fleets have specific types of vehicles dedicated to specific tasks for their lifetimes, which makes it possible for a vendor to supply a standardized vehicle at a competitive cost. (In contrast, individual households want a personal vehicle that can be used for a wide range of purposes.)
- Vehicle design involves a balance among costs, payload and range in order to deliver a marketable product. However, not all electric vehicle characteristics are optimized to their maximum potential. For example, Renault's ELCVs do not use superchargers (i.e., fast

[242] A Phadke, A Khandekar, N Abhyanker, D Wooley and D Rajagopal, *Why Regional and Long-Haul Trucks Are Primed for Electrification Now*, Lawrence Berkeley National Laboratory, March 2021. Class 8 vehicles are four-axle tractor-trailer combinations.

[243] L Dablanc, Z Liu, M Koning, J Klauenberg, LK de Oliveria et al., *Observatory of Strategic Developments Impacting Urban Logistics*, IFSTTAR, Paris, 2017.

[244] F Furtado, *Towards Road Freight Decarbonisation: Trends, Measures and Policies*, OECD / International Transport Forum, Paris, December 2018.

recharging), because most business and commercial customers are not willing to take on the additional costs that are associated with dedicated infrastructure and having the personnel to maintain it. Their operations allow nighttime battery recharging. Hence, although features such as supercharging are technically possible, they are not financially attractive.

- The market for ELCVs is increasing, although it is still very small. Without subsidies and other incentives, the profitability of investing in these vehicles is quite narrow. Autonomy without recharging limits the distance able to be travelled; however, if the ELCVs are not used enough then the lower energy costs do not offset the higher initial price. Nonetheless, as technology and the market mature, the range of profitability and affordability will increase, as will uptake.

This experience, albeit in a European context, suggests that subsidies, regulations and other incentives might be needed to increase the uptake of ELCVs, along with the implementation and maintenance of public supercharging stations, deployment of ELCVs for government fleets, and the preparation of benefits cases to help inform fleet purchase decisions.

Study stakeholders noted another challenge: namely, the availability and price of electric vehicles. One truck fleet owner operator noted that the availability of commercial vehicles, electric and conventional, has been limited, so they must rent vehicles to meet their needs in the interim.

Hydrogen fuel cell

Hydrogen fuel cell vehicles offer an alternative to plug-in electric vehicles.[245] Fuel cell vehicles use chemical processes to generate electricity from compressed hydrogen gas – i.e., the process is chemical rather than combustion. Electricity to power the vehicles and water, which is discharged through the tailpipe, are the only products. A 2020 study notes that, compared with battery-powered electric trucks, hydrogen fuel cell vehicles can offer greater load-carrying capacity (i.e., the weight of the battery is avoided), longer driving ranges (currently limited by battery capacity) and shorter fuelling times.

However, although the technology exists, it has not been operated at a large scale for long-haul trucks (although it is used for urban transit). The Alberta Zero Emissions Truck Electrification Collaboration (AZETEC) plans to construct and test two Canadian-made, heavy-duty hydrogen fuel cell electric vehicles that will carry freight year-round between Edmonton and Calgary, beginning in 2022. AZETEC is a partnership of government, carriers, fuel cell manufacturers, energy distributors and others. In addition to testing performance under extreme weather conditions, AZETEC will test long-distance operations and the supporting hydrogen fuelling infrastructure.[246] Of direct relevance to the Central Okanagan, the 2020 study notes that although the technology is suitable to winter conditions it works best in “less mountainous regions,” although the source notes that, like battery-powered vehicles, the technology continues to evolve.

The technology requires the availability of large quantities of hydrogen, which is produced today in bulk for petroleum processing, fertilizer production and other industrial uses. This is often called “grey” hydrogen, as it is produced from natural gas, which emits carbon dioxide, and can also be a source of methane leaks (another potent greenhouse gas). If carbon dioxide is captured during the hydrogen production process, it is known as “blue” hydrogen. Hydrogen can also be produced from electricity, which if sourced from renewable production, is considered “green” hydrogen. In short,

[245] Except where noted, this discussion is based on R Mihelic et al., *Making Sense of Heavy-Duty Hydrogen Fuel Cell Tractors*, North American Council for Freight Efficiency, December 2020.
[246] K Banks, *With federal funding to build a hydrogen fuelling station in Edmonton, all the pieces are now in place to start testing Canadian-made, heavy-duty, hydrogen fuel cell trucks carrying real-world payloads on a 700-kilometre route in 2022*, Electric Autonomy Canada, published June 15, 2021.

the relative greenhouse gas emissions reduction potential is highly dependent on the source of the hydrogen production.

As an opportunity, study stakeholders indicated that some larger Canadian distributors would consider using their own supply of hydrogen, which is produced at certain DCs across Canada, to supply forklifts at distribution centres to power fuel cell vehicles.

Natural gas (CNG and LNG)

Natural gas is an abundant, domestically produced fuel source. It offers lower GHG and CAP emissions compared with gasoline and diesel fuels.[247] The fuel comes in two forms: liquefied natural gas (LNG) and compressed natural gas (CNG).

CNG is more effective for smaller vehicles and is particularly suited when the vehicles return every day to the same depot, which makes it easier to refuel and have the necessary infrastructure – hence CNG is more suited to urban goods movement. A common example is the deployment of CNG-powered vehicles in many Canadian municipal waste removal fleets, including in the Central Okanagan region. This in turn can leverage the potential of renewable natural gas, produced from the methane that would be otherwise be released to the atmosphere at landfills.[248] LNG is more suited to heavy-duty vehicles for long-haul operations.[249]

It should be noted that natural gas engine technologies and storage (tank) requirements can vary by vehicle class:

- 'Return-to-base' heavy-duty trucks (i.e., trucks that start and end their shift at a depot or terminal) typically use a spark-ignited engine. A heavy-duty vehicle using natural gas fuel is about 10% less efficient than a diesel-fuelled equivalent.
- Class 8 trucks typically require a high-pressure direct injection engine (HPDI), as well as two LNG tanks are required. For this type of engine, the fuel efficiencies are about the same as for a spark-ignited engine. Payback periods range from 3.3 years for heavy-duty long-haul trucks, 4.0 years for 'return-to-base' heavy-duty trucks and 6.5 years for urban refuse trucks.
- A spark-ignited engine can use CNG or LNG. Due to the high injection pressures required, HPDI engines can use only LNG; however, LNG has a limited holding time.[250]

Significant infrastructure is required for LNG and CNG fuelling. LNG refuelling stations rely on bulk delivery of fuel via tanker trucks, as well as special storage facilities to keep the gas in a liquid state. There is a significant lack of commercially available LNG stations in Canada, which effectively precludes its broad use for goods movement.[251]

Additional capital costs are required to implement the technology, both as retrofits to conventionally powered vehicles and as a premium for the purchase of new vehicles. At the same time, a 2019 study estimates that savings can be achieved in per-unit energy costs compared with diesel, of the

[247] Marbek, *Study of Opportunities for Natural Gas in the Transportation Sector*, prepared for Natural Resources Canada, Ottawa, March 2010.
[248] FortisBC. Renewable Natural Gas. https://www.fortisbc.com/services/sustainable-energy-options/renewable-natural-gas
[249] F Furtado, *Towards Road Freight Decarbonisation: Trends, Measures and Policies*.
[250] O Delgado and Muncrief R, *Assessment of Heavy-Duty Natural Gas Vehicle Emissions: Implications and Policy Recommendations*, International Council on Clean Transportation, Washington, DC, July 2015.
[251] *Natural Gas Refuelling Stations*, Canadian Natural Gas Vehicle Alliance, www.cngva.org. No date.

order of 1.6 times for LNG-powered tractors used in long-haul service, 2.1 times for CNG-powered tractors used in long-haul service, 1.4 times for CNG waste removal vehicles and 1.2 times for high-use CNG delivery and service vehicles.[252]

In addition, infrastructure costs are very high. The typical cost for an LNG station is $2.5 million, $2-3 million for a fast-fill CNG station, and $250,000 for a smaller capacity slow-fill CNG station. Note that the time required for slow filling might not be feasible for some truckers.

Lifecycle GHG reductions have been estimated for natural gas fuelled trucks, compared with diesel fuel. These reductions account for upstream fuel production, distribution, storage and so on. However, they vary by vehicle type, operation and use. A 2015 study found that GHG reductions from CNG and LNG powered trucks varied by truck size.[253] A 2021 European study found that heavy-duty natural gas vehicles achieved 5-6% reductions in GHGs compared with diesel and diesel-hybrid vehicles. Reductions in several air pollutant emissions were also achieved, although to varying degrees. However, an assessment of costs over the vehicles' lifecycle found that diesel remained an economically attractive option, notwithstanding its poorer environmental behaviour. Natural gas heavy-duty vehicles are not (yet) economically competitive with diesel, and diesel hybrids are neither economically competitive nor environmentally efficient.[254]

Finally, conditions specific to Canadian operations should be noted. A two-year study of cold-weather operations of CNG waste removal trucks in Winnipeg and Montreal found no significant operational concerns. The most common factors impacting satisfactory performance in cold climates were fuel quality and contaminants.[255]

[252] *Natural Gas Use in the Medium and Heavy-Duty Vehicle Transportation Sector, Roadmap 2.0*, Canadian Natural Gas Vehicle Alliance, June 2019.
[253] F Tong, P Jaramillo and IML Azevedo, *Comparison of Life Cycle Greenhouse Gases from Natural Gas Pathways for Medium and Heavy-Duty Vehicles*, Environmental Science & Technology 49, 2015.
[254] M Rial and J Pérez, *Environmental performance of four different heavy-duty propulsion technologies using Life Cycle Assessment*, Transportation Research Interdisciplinary Perspectives 11, 2021.
[255] A Lawson et al., *Evaluation of the Winter Performance of Compressed Natural Gas Refuse Trucks*, Go With Natural Gas, prepared for Transport Canada, November 2013.

Appendix F Best practice review of sustainable urban goods movement

Uptake of alternative fuel vehicles

Although, as described, the state of the technologies continues to advance rapidly, the technologies nonetheless can be considered as established and known in the goods movement community, and not merely a theory or concept.

The key issue for this chapter then, is how to influence the *uptake* of alternative fuel technologies to support sustainability targets. As described in the COGMS Phase 1 Technical Memorandum, the Province has legislated targets for graduated reductions of GHG emissions, culminating in an 80% reduction relative to 2007 levels by 2050. The memorandum refers to the CleanBC Roadmap to 2030, citing five actions that are relevant to goods movement: reducing distance travelled, encouraging a shift to energy-efficient modes, accelerating the shift to zero-emission vehicles, making commercial transportation more energy efficient and implementing the Province's hydrogen strategy.

In goods movement studies elsewhere, the consultants have found that the uptake of new technologies is the subject of much speculation and differing opinions. Reliability and implementation and operating costs are critical determinants for vehicle owners, especially for technologies that were initially developed in the United States and must then be adapted for use in Canada's cold-weather climate.[256] Impact on day-to-day operations is a key concern to vehicle owners, who operate in a highly competitive market. Even relatively straightforward changes can have an impact. While not related specifically to alternative fuel technologies, goods movement stakeholders in a recent Winnipeg goods movement strategy were concerned about how snow clearance could work on a Complete Streets corridor – that is, whether there was sufficient right-of-way space in a Complete Streets corridor to allow trucks and other vehicles to circulate safely.[257]

In stakeholder consultations conducted by the consultants for other studies, some observers view large commercial fleets as being the only participants in the goods movement industry that can afford to test and implement new alternative fuel technologies – that is, the capital cost premiums associated with purchasing alternative fuel vehicles can be prohibitively expensive for independent owners. Other observers have noted the need for specially trained staff who can operate and maintain the new technologies.

New low and zero-emissions technologies are now being deployed for urban deliveries. Electric or hybrid delivery vans are being more commonplace for last-kilometre deliveries. Transportation firms are increasingly using alternative-fuel vehicles for larger loads, such as LNG, and all-electric long-haul vehicles are now being tested in several countries. Other couriers and delivery services are using cargo bicycles to cover short distances.

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[256] *White Paper on Proposed Phase II Green-House Gas Emissions & Fuel Efficiency Regulations for Heavy Trucks in Canada*, Canadian Trucking Alliance, Toronto, 2016.
[257] *Winnipeg Goods Movement Study*, draft final report, City of Winnipeg, 2021 (unpublished).

However, some government intervention may be needed to offset the high purchase costs of alternative fuel vehicles, as well as to supply the power supply infrastructure, such as LNG fuelling stations and publicly available electric vehicle recharging stations. Changing technologies, such as electrically powered refrigerator trucks, require continuous operation to be economically viable, and this in turn could mean that governments will be pressed to allow off-hours deliveries using these admittedly quieter vehicles.

Example of alternative-fuel vehicle uptake in the Central Okanagan

In 2019, the Central Okanagan's waste management contractor implemented a fleet of 26 compressed natural gas (CNG) garbage trucks, citing up to 40% fewer greenhouse gas emissions, along with reduced criteria pollutants. These would be fuelled at a station at the E360S yard, which is adjacent to a public station. The implementation was facilitated by partnership between E360S and FortisBC, along with government funding, who collectively provided a $1.9 million investment (FortisBC - $800,000; federal government - $600,000; and E360S - $500,000). FortisBC also provided $1.1 million to E360S to facilitate the CNG vehicle purchase by E360S. The reduction in GHG's is also facilitated by FortisBC's renewable natural gas plant at the Glenmore Landfill, which captures released methane that would otherwise be released to the environment. This is an example of a private-sector collaboration supported by public funding to increase the uptake of alternative-fuel vehicles.

Source: CPCS based on:

- MacNaull, S. 2019. Central Okanagan's new garbage contractor introduces compressed natural gas trucks. The *Daily Courier.*
- King, J. 2022. Not expected to change the overall supply to change, but might shift the type of industry and locations within the neighbourhood. *Global News*

The ensuing discussion is divided into three parts:

- Technical, monetary, operational and infrastructure factors influencing the uptake of alternative fuel vehicles.
- Low- or zero-emission zones – a regulatory / planning measure.
- Rightsizing vehicles – a fleet management measure.

Technical, monetary, operational and infrastructure factors

This section considers factors that influence the uptake of alternative fuel vehicles. The factors focus on cost parity with conventional vehicles, but also consider monetary/financial incentives and disincentives, the overall logistics set-up, the availability of charging networks, vehicle availability (the critical mass of the market), regulations and driver availability.

A 2020 study envisions the global deployment of commercial ZEVsprogressing as follows:[258]

- The state of ZEV technology suggests that light and medium vehicles for urban and regional use will be deployed first – these are vehicles that are operated in established delivery routes and can be recharged each night at their depots. Their total costs of ownership (TCO) are now comparable with conventional vehicles. As technology improves and market volumes increase, heavier truck classes that have longer ranges will be deployed.
- In the meantime, various barriers hinder wider ZEV uptake including high upfront vehicle cost, limited vehicle availability (complicated now by shortages of 'green' minerals), limited access to

[258] *Zero-emission freight: Vehicle market and policy development briefing for C40 Cities*, C40 Cities, 2020.

charging/refuelling infrastructure, limited awareness by operators, a lack of competitive zero-emission fuel pricing, and limited service and support networks.

- There is a need to address these barriers now. Potential solutions include financial incentives such as purchase price subsidies, innovative financing and business models, financial support for developing charging networks, updated codes and design standards to enable charging network infrastructure, regulations (such as ZEV mandates for new vehicle sales and GHG standards) demonstration projects and collaboration to encourage scaling up of vehicles.

Other studies focus on specific elements of the market:

- Light electric vehicles. A Dutch study examined the factors that influence the deployment and uptake of e-cargo bicycles, e-cargo mopeds and small electric vehicles (such as street cleaners). Deployment of vehicles of this size depends on appropriately located hubs within the overall distribution network (e.g., in the core near a high density of customers), robust distribution processes (streamlined and reliable), cooperation among all actors (customers, couriers and suppliers), understanding of the costs involved and good communications and organization. For this type of logistics, these EVs are best suited to time-critical shipments, small numbers of shipments per trip, short distances between stops, trips in areas where vehicular speeds are relatively low and areas with strict vehicle restrictions or privileges for these light EVs. The vehicles might also address current driver shortages, since operators do not require drivers licences or special training, and socially disadvantaged people could also be deployed.[259]
- Light commercial EVs. A 2020 study explores the factors that impact the uptake of light commercial electric vehicles in Europe, noting their potential impact in reducing GHGs given the predominance of light vehicles in urban goods movement. The most important factor is the total cost of ownership (TCO) which accounts for capital, operating, maintenance, fuel and other costs that are incurred by the owner. TCO costs are comparable with those of conventional vehicles. However, their uptake is still relatively low compared with that of medium and large commercial electric vehicles whose differentials in TCOs relative to those of conventional vehicles is fully covered in several countries by financial incentives. The study identifies financial market barriers: depreciation may not be properly considered, given owners' insufficient experience to date with battery life and durability (and the need to replace them) and the lack of a second-hand market for light commercial EVs. Non-financial market barriers include buyers' perceptions, inadequate recharging infrastructure and the relatively few model choices available (which might not suit buyers' needs). Addressing these concerns through, for example, favourable taxation policies and government support for developing the recharging infrastructure could help establish a viable market and reduce uncertainty for vehicle manufacturers and potential buyers. Other monetary incentives include vehicle purchase subsidies and additional taxes imposed on polluting vehicles. Regulatory incentives could also be considered – for example, accounting for the additional weight of the battery in assessing driver licensing classifications (i.e., not penalizing a commercial driver whose licence class may be tied to vehicle weight).[260]
- EV charging infrastructure. A 2022 review notes the need for government support for the deployment of publicly available EV charging infrastructure, at least until enough vehicles are

[259] EA Moolenurgh, JHR van Duin, S Balm, M van Altenburg and W Ploos van Amstel, *Logistics concepts for light electric freight vehicles: a multiple case study from the Netherlands*, Transportation Research Procedia 46, 2020.
[260] A Tsakalidis, J Krause, A Julea, E Peduzzi, E Pisoni and C Thiel, *Electric light commercial vehicles: Are they the sleeping giant of electromobility?*, Transportation Research Part D 86, 2020.

deployed to justify a private (or other) operator to develop a network. Support could take the form of regulations requiring the building out of charging stations, fiscal policies, mandating EV-charging readiness for new buildings and installation of chargers in existing buildings. Coordination of plans for grid expansion and enhancements is also needed to ensure that the capacity is available to support anticipated growth in EV use and could include digital technologies to facilitate two-way communications and pricing between EVs and grids.[261]

- EV supply chains. EVs require a broad range of raw material inputs, whose extraction and processing can require long lead times.[262] The rapidly growing demand for green metals such as cobalt, lithium and nickel must be sourced from countries around the world, not all of which have the necessary infrastructure and capacity.[263] (Of relevance, Canada is no longer a top source for some key metals, which implies that the country's traditional supply chains and capabilities may no longer be adequate to meet the needs.) Innovation and alternative chemistries that require smaller amounts of these metals, as well as extensive battery recycling, can manage the demand and avoid supply chain bottlenecks.
- EV energy supply. As Canadian distributors and retailers start to deploy large EV fleets, experts note the importance of ensuring that an adequate power supply is available to them. This means investing in on-site charging infrastructure but also ensuring that local and provincial utilities have the capacity to deliver energy reliably and in the necessary quantities. Unlike a for-profit company, which can act on investment decisions relatively quickly, utilities (which are generally regulated) can require significant lead time to build transformers and other infrastructure. Accordingly, potential fleet owners, utilities and other government agencies (site development approvals, environmental assessments and so on) must work in tandem and provide adequate lead time to enable the desired scale up of electric vehicle uptake.[264]

Low or zero-emission zones

Low or zero-emission zones are cities or sections of cities that are restricted to vehicles that meet certain emissions criteria.[265] Several cities in Europe have implemented these zones, including London and Paris. The difference between low and zero-emission zones is that, although the former are open to alternative fuel vehicles that reduce emissions compared to traditional vehicles, the latter are open only to electric vehicles or non-motorized vehicles. Regardless, the zones can reduce GHG and air pollutant emissions while also helping to lower congestion, especially from last-kilometre deliveries. They also provide an incentive to vehicle manufacturers and owners to accelerate the manufacture and purchase of green vehicles. Transporters operating in these cities have chosen to purchase clean vehicles or to replace trucks with cargo bikes and other alternatives.

Implementations have offered various features and approaches:

- Rotterdam features the use of bus lanes by green commercial vehicles, a waiver for restricted access to pedestrian areas and collaborative public-private development of green construction logistics hubs. Note that the 30-40 largest Dutch cities were mandated to

Rotterdam features the use of bus lanes by green commercial vehicles…

[261] *Global EV Outlook 2022*, International Energy Agency, 2022.
[262] Ibid., except where otherwise noted.
[263] *Green commodities, The new superpowers*, The Economist, edition of March 26, 2022.
[264] *On the Road to Electric Truck*, Private Motor Truck Council of Canada, webinar, February 17, 2022.
[265] Except where noted, this discussion is drawn from *Zero-Emission Zones, How-to Guide*, Transport Decarbonisation Alliance, C40 Cities and Polis, The Netherlands, December 2020.

implement zero-emission freight zones by 2025, through the introduction of the Dutch National Climate Agreement. The Agreement offers state financial support, guidance and expertise to municipalities for developing zero-emission freight zones.

- London has been extending its low-emission zones. The original Ultra Low Emission Zone (ULEZ) coincided with the city's congestion pricing cordon. The rest of the city was designated as a Low Emission Zone (LEZ). Vehicles up to 3.5t gross vehicle weight (GVW) crossing into the ULEZ zone must pay both the congestion pricing charge and a ULEZ charge; however, zero-emission vehicles are exempt from both charges. Vehicles over 3.5t must pay the congestion charge but not the ULEZ charge. However, they must still pay an LEZ charge if they do not meet the LEZ's emission standard.[266] In 2021, the ULEZ area was expanded significantly; it now covers 15-20% of the city's area.
- Santa Monica, part of the Los Angeles metropolitan area, introduced a voluntary zero-emissions delivery zone in 2020. The city is working with parcel, food/grocery and furniture last-kilometre deliverers on "good faith" to develop and implement zero-emission deliveries within the zone. Technologies include e-cargo bikes and other micro-mobility devices for smaller deliveries, small EV vehicles for larger deliveries, and maintenance/charging support for this equipment; digital curb space management including priorities, reservations and enforcement; and the testing of new business models and policies, information clearinghouses and more.

Green loading zones

A related policy to low or zero-emission zones is green loading zones (GLZs), which are curb spaces that are designated for the sole use of zero-emission vehicles. Like zero-emission zones, GLZs serve to reduce emissions and incentivize green vehicle take-up. They can offer dedicated spaces and free parking. A 2021 study analyzed the potential for introducing GLZs in New York City. Drawing from a survey of trucking companies, couriers, retailers and distributors, the study found interest in the concept and in the take-up of green vehicles. However, respondents noted several barriers in the latter, identifying especially the need for larger or additional government subsidies for purchasing electric vehicles and for reduced toll or parking rates especially for EVs (i.e., the latter for parking at any loading space). Nonetheless, respondents noted an overall willingness to pay for GLZs at similar rates to those at other commercial loading spaces. The study made several recommendations:

- Make GLZs available to green vehicles (not only EVs) and to cargo bikes. Adequate curb space might be needed to accommodate multiple step-side vans as well as small vehicles and cargo bicycles, with the number of spaces accounting for utilization and dwell times to maximize their use.
- Explore piloting GLZs in the city's commercial centres (in New York City's case, Lower Manhattan and commercial areas of Midtown Manhattan), which respondents felt would be the most beneficial locations (i.e., focus on the city's commercial core).
- The preferred layout for GLZs is several spaces distributed across several (consecutive) blocks (i.e., ensure the GLZs are close to where deliveries are made but ensure they are not overly concentrated in one location).
- Although some cities offer GLZ spaces free to users, respondents were comfortable with paying for the spaces if the rates did not exceed current parking prices in the selected areas.

[266] *Ultra Low Emission Zone*, Transport for London, www.tfl.gov.uk, accessed May 27, 2022.

Nonetheless, some companies were willing to pay a modest increase over that rate to avoid parking tickets (i.e., given the strong demand for street parking overall).[267]

Rightsizing vehicles

Rightsizing commercial vehicle fleets is a management practice that can help fleet owners build and maintain a vehicle inventory that meets their needs while also optimizing vehicle use, conserve fuel, reduce emissions and reduce costs.[268] The practice recognizes that, over time, fleet inventories can include vehicles that are rarely used or that no longer are suitable to current needs. Rightsizing thus provides an opportunity for fleet managers to replace existing vehicles with alternative fuel vehicles, hence its inclusion in this discussion. When considering the replacement of a vehicle, fleet managers can consider whether the vehicle is of the optimal vehicle type, class and size for the job, the vehicle's fuel consumption of and whether it can be replaced by lighter, more fuel-efficient vehicles, whether the vehicle is still cost effective to operate or is no longer fulfilling its purpose and more. Fleet managers can also examine the vehicle's activity and can also consult drivers as to how the vehicle is actually used.

A 2014 guide for US Government fleet managers looks at the development of a strategy to rightsize agency fleets. The strategy should align or optimize the composition of the fleet, so that each vehicle is as fuel efficient and cost-effective as possible while meeting overall agency operational needs and achieving environmental objectives and regulations. The strategy should consider whether reassigning, replacing or eliminating a vehicle would reduce fuel and maintenance costs without compromising fleet activities. The strategy should aim to achieve the minimum number of fuel-efficient vehicles required to meet the agency's needs, including identifying opportunities to eliminate vehicles that exceed these requirements.[269] Although the guide is directed at government agencies, the same process could be deployed by private businesses as well.

The preceding discussion focuses on initiatives that can be taken by fleet managers. Regulations can also have the effect of forcing fleet operators to use smaller vehicles. As an example, the City of Vancouver's parking bylaw generally has low or non-existent off-street loading requirements for accommodating large trucks. Most loading requirements are for Class B spaces (3m x 8.5m), with larger Class C (3.5m x 17m) spaces required for larger manufacturing, warehouse, hospital, and retail and similar uses. Effectively, this means that smaller vehicles are more often used for deliveries throughout Vancouver. Geometric and operational constraints can also allow a relaxation of Class C requirements, especially in the downtown. One result is that there can be loading from larger trucks on-street at night, and another is that during the day Class C trucks load from the back lanes that permeate downtown Vancouver and other parts of the city. [270]

Stakeholder discussions on alternative fuel vehicles

The topic of alternative fuel vehicles generated considerable discussion among stakeholders. Key points are summarized below:

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[267] T Maxner, P Goulianou, A Ranjbari and A Goodchild, *NYC Zero-Emission Urban Freight and Green Loading Zone Market Research*, Supply Chain Transportation & Logistics Center, University of Washington, Seattle, January 2021.

[268] Except where noted, this discussion is drawn from *Rightsizing Your Vehicle Fleet to Conserve Fuel*, U.S. Department of Energy, https://afdc.energy.gov/conserve/rightsizing.html. No date. Accessed August 3, 2022.

[269] *Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance, Comprehensive Federal Fleet Management Handbook*, US Department of Energy, January 2014.

[270] DKCI, *Goods Movement Backgrounder*, prepared for the City of Ottawa, 2019.

Stakeholders noted that they want to achieve sustainability objectives and that the public should be made aware of this.

Stakeholder discussions concerned the uptake of zero-emission vehicles. Provincial mandates are proposed for all new truck sales to be zero-emission vehicles by 2050 for medium-duty vehicles and 2060 for heavy-duty vehicles. A stakeholder explained the rationale for the timing of these horizons: "We know the [BC] fleet grows by 1% per year and there is 3% turnover, [so] we have a 4% change opportunity every year. To achieve a 40% emissions reduction in the commercial vehicle sector by 2030, we need 40% of the fleet on the road to be zero-emission vehicles by 2030 (i.e., 25,000 trucks in BC). Our opportunity to change the fleet is 2,400 trucks per year (i.e., roughly 4% x ~60,000) but we cannot get zero emission trucks today. Despite announcements in the late 2010s, Tesla will only hit the market next year. These vehicles need 1.5 hours [to charge] and [fleet owners must invest in] $1 million dollars of charging equipment. The increased tare weight also reduces load-carrying capacity. We are not going to hit the target by 2030, but [we] can improve by 2040s, that's why we landed on 2050 and 2060."

However, stakeholders noted that the average age for a truck is 12 years currently, and that this is likely to get worse due to the pandemic-induced supply chain delays. "What you are buying today, you are going to have for 2040. We are only two [purchasing] cycles away."

Stakeholders noted that, in the meantime, electric vehicles are not available today.[271]

Some stakeholders questioned the need for public charging infrastructure. They noted that return-to-base trip patterns (i.e., vehicles return to their home base every day), which comprise about half the economic activity in the trucking sector, are the most attractive candidates for electrification. However, for this group, charging would be done at the base rather than using public charging infrastructure.

In response to the possibility of using rest areas for charging, stakeholders noted that rest areas are needed, but not necessarily for charging.

Stakeholders noted that uncertainty over which zero-emissions technology (or technologies) will become dominant makes it difficult to invest – the "VHS versus Betamax analogy." One possibility was to implement parking locations and "running conduit" to prepare for different technologies (e.g., supply a pipe large enough for cable or hydrogen) – build the flexibility – but don't try to pick winners and losers.

Stakeholders also noted that customers scrutinize the environmental impacts of shipping and the sourcing of green components used by carriers. Customers wanted to see the environmental impacts of these components – whether materials are being recycled or ensuring that certain products are not used. Customers also want to know carriers' sustainability and environmental policies. To meet corporate objectives and customer scrutiny, stakeholders noted that they must source certain components from further afield – e.g., lead-free components and proper suppliers.

Finally, stakeholders noted that there is an increased demand for shipping lithium-ion batteries, which are dangerous goods. This will generate challenges, because the batteries must be transported by ground services: lithium-ion batteries above a certain size cannot be shipped by air without specialized packaging, training and labelling.

[271] Stakeholders in another consultation noted that heavy-duty commercial vehicles ordered in mid-2022 would not be available for anywhere between 12 and 18 months.

Cargo bicycles

Overview

Cargo bicycles have been used for last-kilometre deliveries in cities around the world.[272] They are most suitable in dense urban areas, notably city centres, where (compared with conventional motorized delivery vans) cargo bicycles can offer faster speeds because cyclists can circumvent traffic congestion and avoid the need to find a parking spot while eliminating GHG and CAP emissions for the same trip. The benefits are tangible; A 2021 study in central London found that cargo bicycle deliveries were 1.61 times faster than those made by delivery van, and – over the course of a 98-day evaluation period – 3,900 kg of CO2 and more than 5.5 kg of NOx were avoided.[273]

Other benefits include reduced vehicle purchase cost, lower operating costs, avoidance of parking costs, avoidance of the need for a driver's licence or special driver training and the positive public relations visibility associated with the reduced environmental impact.[274] The emergence of e-bicycles offers an opportunity to move greater loads over longer distances, overcoming human-powered bicycles' disadvantages of lower range, lower payload and driver fatigue.

Applications include mail delivery, courier services, parcel services, home delivery (such as restaurant meals) and internal deliveries within large company grounds (e.g., a university campus). Cargo bicycles are integral to microhub operations, where they can offer business-to-business service for high-valued time-sensitive deliveries. Figure F-1 shows a cargo bicycle that is used by the German postal service to serve the Kurfürstendamm pedestrian mall in central Berlin – i.e., a central, high-density commercial street from which vehicles are prohibited. Figure F-1 also shows a cargo bicycle that is used by a green launderer in downtown Montreal – an environmentally friendly business model that offers customers the convenience of pick-ups and deliveries to and from their offices (and which can operate in winter).

Success factors

High delivery densities are seen as the first factor for a successful commercial application – hence the preponderance of applications in dense city centres. Complementary success factors include regulations (e.g., in which bicycles are permitted access to existing loading areas or to areas that are not available to vehicles, such as pedestrian zones) and pricing incentives such as the avoidance of a parking fee. A 2017 study and a 2021 follow-up note the importance of clarifying the classifications of cargo bicycles (especially e-bicycles which are larger and wider) under provincial and municipal traffic regulations, to allow them to use public roads and bicycle lanes for delivery purposes. The same studies note the need to consider cargo bicycles in the planning of cycling networks and in facility design (for example, providing sidewalk space to park and lock a cargo bicycle).[275] Wider cycle lanes may be required to accommodate larger e-bicycles. Steeper gradients

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[272] Except where noted, this discussion is based on S Narayanan and C Antoniou, *Electric cargo cycles – A comprehensive review*, Transport Policy 116, 2022.

[273] E Verlinghieri, I Itova, N Collignon and R Aldred, *The Promise of Low-Carbon Freight*, Possible in association with the University of Westminster and the KR Foundation, August 2021.

[274] B Lenz and Riehle E, *Bikes for Urban Freight? Experience in Europe*, Journal of the Transportation Research Board No. 2379, Transportation Research Board, Washington, DC, 2013.

[275] N Vijayakumar, *Cyclelogistics, Opportunities for moving goods by bicycle in Toronto*, Pembina Institute, 2017 and M Stout and S Kaddoura, *Cargo e-bikes for urban deliveries, Regulatory approaches and standards*, Pembina Institute, 2021. See also *Cargo E-Bike Pilot*, report to the Infrastructure and Environment Committee, City of Toronto, November 18, 2021.

and a lack of overnight storage facilities can be barriers to take-up for cargo bicycles. A paucity in the availability of charging stations can be a barrier for e-bicycles, whose battery capacity of 50 – 80 kilometres is less than the required daily itinerary ranges of up to 200 kilometres.

Sample applications

Most large-scale deployments have been in Europe. In North America, a pilot project was launched in New York City in 2019 with three courier firms and 100 bicycles, since then expanded to 6 firms and 350 cargo bicycles. On average, each bicycle covers 20 service miles (32 kilometres) each day, equal to the distance otherwise served by motorized delivery vehicles. Each bicycle generates CO2 savings of approximately 7 tons annually (6.4 tonnes).[276] The success of the pilot led to its permanent establishment. The successful deployment of cargo bicycles in a winter environment is exemplified by Montreal's Colibri project.

Also noteworthy because of its multinational potential, in 2015 DHL Express, an international courier company (which is owned by the German postal service), introduced Cubicycles. Illustrated in Figure F-1, the Cubicycle is an electric four-wheel cargo bicycle with a container that can carry a load of up to 125 kg in weight and 1 cubic metre in volume. The containers are standardized to match the dimensions of a standard shipping pallet, which allows easier and faster transfer between modes. Cubicycles have been deployed in seven European cities and Cubicycle couriers cover an average of 50 kilometres each day. The Cubicycles are part of DHL's City Hub microhub concept that aims to reduce carbon emissions in inner-city deliveries.[277]

Figure F-1: Cargo bicycles in Canada and Europe

Cargo bicycle, German postal service, central Berlin

Source: DKCI

Cargo bicycle, cleaning service in central Montreal

Source: DKCI

Cubicycle electric cargo bicycle, Brussels

Source: DHL News

Efficiencies in deliveries

This section describes technologies and practices that influence how deliveries can be made more efficient on the part of carriers, shippers and receivers. Four topics are presented:

- 'Proximity point' customer pick-ups of parcels
- Load utilization (optimizing the use of vehicle cargo space)
- Load efficiency and load management, e.g., by combining deliveries
- Local delivery plans to better manage deliveries

[276] *Commercial Cargo Bicycle Pilot, Evaluation Report*, New York City Department of Transportation, May 2021.
[277] WP van Amstel, *DHL expands green urban delivery with City Hub for cargo bicycles*, www.citylogistics.info, posted March 3, 2017.

Proximity point pick-up

Delivering a package directly to the customer's home or business is meant to be convenient for the customer. However, growing e-commerce purchases have resulted in increased vehicle traffic in residential areas. In many cases (though not for all purchases), someone must be available to receive the package. While this may be less problematic for businesses, it can impact a household's planned daily activities. If the courier cannot leave the package at the destination, either a follow-up delivery must be attempted or scheduled, or the customer must pick up the package at a depot – in any event, additional costs and inefficiencies are imposed on the courier.

To address these challenges, couriers and shippers have developed two related 'proximity point' options, whereby packages can be retrieved at locations that are close or convenient to customers instead of having them delivered directly to them. These options avoid the need for customers to wait for a delivery, minimize wasted courier time and costs by avoiding trips to addresses when the purchaser is not available to receive the delivery, and reduce the potential for theft when a parcel is left unattended at the doorstep.[278]

- Parcel lockers can be located at office buildings, grocery stores, convenience stores and other retail locations (see left image in Figure F-2 for an example). Customers retrieve their orders by entering a unique code on the locker touch screen. Retailers may also be looking to leverage these lockers for returns as well.[279] While this is primarily a private sector initiative, the public sector could have a role in terms of facilitating such a system by planning for central locations in neighbourhoods or requiring new condos to have sufficient lockers to accommodate online purchases. Various European postal services and couriers use this approach. Canada Post's community mailboxes essentially offer this type of service, whereby the recipient can be notified by e-mail of the delivery (if a tracking number is provided). This approach takes advantage of Canada Post's nationwide delivery network.
- Self pick-up is another proximity point option that allows customers to pick up purchases at a location and time of their choice. SmartCentres, a major Canadian shopping centre developer, has introduced pick-up depots at selected suburban locations in municipalities across Canada, including two 'Penguin Pick-Up' locations opening soon in Vancouver. Customers can purchase a consumer product online from a range of large retail chains, from which it is delivered to one of the shopping mall depots where the customer can then pick it up at his or her convenience. According to the developer, the pick-up points have the advantage of reducing distribution costs while increasing the utilization of delivery vehicles that already are travelling to the malls and potentially increasing customer foot traffic in the mall (i.e., exposure to the mall's retailers). Some malls were selected for these depots because they were underutilized and had space available for customer parking. An example is provided in the centre image in Figure F-2. Although this is mainly a private-sector initiative, there can be implications on zoning. One municipality noted that the use of the shopping mall for this purpose could change its effective designation to that of a distribution centre if traffic, loading and parking demands changed significantly, and in turn could require reconsideration of future site plan approval requirements.[280] The pandemic has also seen large increases in consumers picking up online purchases from the nearest store branch (see the right image in Figure F-2 for an example of an installation at a national grocery chain).

[278] L Ranier, S Digiesi, B Silvestri and M Roccotelli, *A Review of Last Mile Logistics Innovations in an Externalities Cost Reduction Vision*, Sustainability 10, 782, 2018.
[279] J Ellis, *Online Retailers Are Desperate to Stem a Surging Tide of Returns*, Bloomberg, 2017.
[280] David Kriger Consultants Inc., *Goods Movement Study*, Town of Oakville, Ontario, 2016.

Figure F-2: Examples of package pick-up options

Amazon pick-up locker, Whole Foods, Los Angeles

Source: DKCI

Penguin Pick-Up, South Oakville Mall, Oakville, Ontario

Source: DKCI

Loblaws grocery store pick-up, Ottawa

Source: DKCI

The impact on courier operations (hence costs) should be noted. A 2020 analysis noted that lockers are more desirable for couriers as an option to manage last-kilometre deliveries because they are less disruptive than urban consolidation centres (UCCs, which are intermediate points used to consolidate large quantities of deliveries before onward shipment by smaller vehicles). UCCs impose an increased handling cost for the transshipment, notwithstanding their other benefits, which commonly means that some level of financial subsidy is required. Accordingly, "consolidation of the very last mile is more desirable [to couriers] than a consolidation of the second-to-last mile for logistics players, as the level of disruption would be manageable."[281]

Load utilization

Load utilization deploys methods for truck and fleet owners to optimize the space of a truck trailer. The primary motivations are to improve vehicle utilization and driver productivity – both of which can lead to reduced fuel consumption and emissions. Two common practices are noted:

- Decking systems or load bars add a second tier to truck trailers, thereby allowing truckers to take advantage of the full height of each trailer by using two tiers. Adding a decking system can increase the available cargo space inside a vehicle. These can double the available floor space. Some systems feature adjustable heights, so that different sized cargos can be loaded. Although some carriers avoid the costs of the decking system by double-stacking pallets or boxes, there is more potential for damage without the deck, if the top pallet falls over or the bottom pallet is crushed by the one on top.[282] Erb Group (Ontario) has invested heavily in deck trailers, which feature load bars that can be adjusted for height. A large portion of Erb's markets is in food and pharmaceuticals, which have restrictions on stacking pallets due to weight and the fragility of the packaging that is used – for example, fruit, yogurt and boxed meats must be loaded so that, when stacked, the weight of the product does not cause damage during transport. The deck trailers allow increased stacking without damaging the product, as illustrated below. Erb also

[281] *The Future of the Last-Mile Ecosystem*, World Economic Forum, Cologny/Geneva, Switzerland, 2020.
[282] J Park, *How to Maximize Trailer Space*, Truckinginfo, posted May 13, 2021.

specifies that its trailers should be designed to optimize capacity for cargos that cannot be stacked (cubing out).[283]

- Side loading involves loading the trailer from its side, rather than its end – thereby enabling pallets to be turned 90°, which uses the available floor space more efficiently. In 2008, Walmart in the US began side loading of pallets (rather than via the rear doors), thereby increasing the number of pallets shipped in a truck from 26 to 30 units. Over a six-year period, Walmart was able to deliver 335 million more pallets while driving 300 million less miles.[284]

Load efficiency / load management

Load efficiency deploys methods to reduce empty loads and empty backhauls, potentially reducing the number of vehicle trips and vehicle-kilometres travelled (VKT). Methods including load matching software, in which neighbouring businesses can develop plans to combine their deliveries, long-haul trucking companies can collaborate to offset each other's empty backhauls, and trucking companies can dispatch the nearest available drivers to pick up loads – all aimed at reducing non-productive VKT. Matching loads offers drivers the opportunity to increase their incomes. Note that load efficiency complements increased load utilization, discussed in the preceding subsection.

Examples include:

- Load consolidation, which is load bundling and minimum order quantities, with carriers and customers working together to consolidate shipments:[285]
  - Consolidation from multiple shippers. For example, a receiver might receive one delivery daily from each of six different shippers. The receiver can work with the shippers to coordinate the consolidation of all the shipments into a single daily delivery. Shippers can implement this process as well.
  - Consolidation from a single shipper. A single shipper might be making deliveries to several individual receivers who are located close to each other, thus generating several trips to the same vicinity each day. Using a coordinated scheduling tool provided by the shipper, the receivers could collectively agree to take receipt of the deliveries at the same time of day, which could be served by a single trip from the shipper.
- Crowdshipping, or on-demand shipping, in which customers use 'Uber-like' apps to bypass traditional brokerages in securing a pick-up from an independent driver who transports the goods by his/her own mode.[286] The extent to which crowdshipping serves as a disruptive technology for traditional brokerages and large fleet operators is not clear, although some analysts suggest that crowdshipping will be most effective in niche markets, such as short-

[283] 'Cubing out' refers to the reaching of a trailer's capacity in terms of the cargo's volume rather than through its weight. This means that a trailer could achieve its capacity even though it is only partially full, hence the desirability of improving trailer design to allow for more improved utilization. SmartWay, *Erb Group – SmartWay Case Study*, Supply Chain Management Association, Toronto, April 2013.
[284] J Mathers, E Craft, M Norsworthy and C Wolfe, *The Green Freight Handbook*, Environmental Defense Fund, Washington, DC 2014.
[285] *Philadelphia Delivery Handbook*, Delaware Valley Regional Planning Commission, Philadelphia, April 2017.
[286] F Furtado, *Towards Road Freight Decarbonisation; Trends, Measures and Policies*, International Transport Forum, Paris, December 2018.

distance or short-duration trips.[287] Also, although crowdshipping can lower delivery costs and times, it does not necessarily result in a full load.

- Online freight exchanges, or digital freight matching, are tools that allow shippers to match loads to drivers. These are similar in concept to crowdshipping but act as online brokerages with a narrower pool of potential service providers. Because they focus on specific types of cargos, the vehicles are more specialized, and drivers require specific training and certification. They are typically used for regional or long-haul shipments.[288]
- Load efficiency has been applied to reduce empty backhauls for long-haul trips. For example, in the United States Ocean Spray ships products from its New Jersey plant to a Florida distribution centre, while Tropicana ships products in the opposite direction. The two combined their capacity, using intermodal rail, to minimize empty backhaul, with Ocean Spray reporting GHG reductions of 65%. Daltile, a ceramic tile manufacturer, and Whirlpool, an appliance maker, have a similar collaboration.[289]
- Anticipated delivery horizons. Fast Moving Consumer Goods (FMCG) are low-cost consumer products that sell quickly, such as toiletries and foods, hence stocks require frequent replenishment. A recent study analyzed ways to reduce GHG emissions from FMCG distribution. The greatest potential reductions occur when an anticipated horizon for orders is introduced (rather than on-demand ordering), deliveries are consolidated to weekly or biweekly frequencies, and minimum order quantities are specified before deliveries are made (bundling orders until a certain weight is achieved).[290]
- Distributor measures. Many truck and fleet owners have taken up load efficiency measures. E-commerce retailers such as Amazon, eBay and Expedia are considering the deployment of on-demand trucking, which would allow loads to be moved in smaller vehicles. They have invested in new firms such as Convoy, to address reduced capacity in the trucking industry to meet quick delivery times, and to improve transparency in the shipment process and in carrier communications.
- Reusable modular boxes. Couriers are investing in ways to improve load utilization while reducing package waste. The *Modulushca* initiative has developed a prototype system of modular, reusable boxes that can be stacked in pallets and make better use of the volume-weight capacity of a trailer, hence requiring fewer trucks to move the same amount of goods. The aim is to promote the widespread adoption of this system as a standard that fits the operations and other requirements of suppliers and retailers.[291] UPS worked with several consumer product companies to develop Loop, which is a customized, durable tote that can be reused, thereby replacing disposable packaging and cardboard boxes. Empty totes are picked up by the courier when the next delivery is made.[292]

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[287] T Dreibus, *On-Demand Shipping Startups Compete to be "Uber of Trucking"*, posted at www.trucks.com, April 13, 2016.
[288] F Furtado, *Towards Road Freight Decarbonisation; Trends, Measures and Policies*.
[289] J Mathers, E Craft, M Norsworthy and C Wolfe, *The Green Freight Handbook*.
[290] J Igl and F Kellner, *Exploring greenhouse gas reduction opportunities for retailers in Fast Moving Consumer Goods distribution networks*, Transportation Research Part D 50, 2017.
[291] F Furtado, *Towards Road Freight Decarbonisation; Trends, Measures and Policies*.
[292] K Gutmann, *Why the Milkman Model Is the Future of Consumption*, UPS Longitudes blog, January 25, 2019. The *Loop* system has been likened to the former practice of dairies delivering full milk bottles to households and picking up the empty bottles for reuse.

Local delivery plans

A 2014 Pembina Institute study of 'green' goods movement options in Toronto proposed having neighbouring businesses coordinate deliveries. Local delivery plans would be developed by businesses, property managers and tenants to assess the potential for combining deliveries and making them more reliable, efficient and cost effective, thereby reducing the overall number of trips and disruptions in the area. Large office and retail buildings could consolidate tenant deliveries to minimize the number of deliveries and improve the use of the buildings' loading facilities. Local business improvement associations (BIAs) could use delivery plans to coordinate and better plan delivery times and locations as a means of addressing congestion and truck parking issues. Cited benefits are reduced total trips, better utilization of truck capacity, increased reliability and significant cost savings for shippers and consignees.[293]

In 2017, Pembina conducted two Neighbourhood Freight Forums in Duke Heights, a large industrial area in Toronto, in collaboration with the local BIA, the City of Toronto and others. The Forum was intended as a prototype for additional applications. The Forum brought together businesses to find solutions that can reduce gridlock, improve delivery reliability and reduce fuel use. The Forum examined opportunities for deploying off-hours deliveries, cargo bicycles and other initiatives.[294]

Similar initiatives have been established elsewhere. The Central London Freight Quality Partnership (FQP) was established in 2006 by eight London boroughs and Transport for London. The FQP works with academia and service providers, local businesses, police and other public organizations to understand goods movement issues and sustainable delivery solutions in central London.[295] Of note, the City of London require a plan for managing deliveries and services to be included in applications for site planning approval. Landlords and tenants are also required to prepare a plan at first occupancy, six months later and then annually or whenever there is a change in occupancy or usage. The plans must account for safe, clean and efficient ways to manage deliveries – showing how vehicles can enter and exit the site without reversing, promoting use of non-motorized vehicles and encouraging staff to use proximity point pick-ups, as examples respectively. The plans are required to develop measurable objectives and targets.[296]

Of note, the City of London require a plan for managing deliveries and services to be included in applications for site planning approval.

Curbside management

This section examines ways to better manage the curbside for loading and deliveries. Six topics are presented. For all these topics, the primary objective is to reduce traffic congestion and, in consequence, reduce fuel consumption, GHGs and air pollutants while improving safety and convenience for a public space that is shared by multiple users. The six topics are:

- Management of on-street parking for pick-ups and deliveries
- Vehicle reception points (time sharing of road space)
- Parking reservation and availability apps

[293] K Grond and E Angen, *Delivering the Goods: Opportunities for low-carbon goods movement in Toronto*, The Pembina Institute, Calgary, April 2014.
[294] Pembina Institute, *Neighbourhood Freight Forum*, April 11, 2017, and *Forum #2*, September 5, 2017.
[295] D Zimmerman and L Wiginton, *Improving Urban Freight Efficiency, Global best practices in reducing emissions in goods movement*, The Pembina Institute, Calgary, April 2017.
[296] *Delivery and Servicing Plan Guidance*, Transport for London, December 2020.

- Online wayfinding
- Off hours delivery
- Off-street parking and loading

Management of on-street parking for pick-ups and deliveries

Improvements to the use of public space for loading can make deliveries and pick-ups more efficient while at the same time increasing the viability of businesses and their attraction to the public. A 2017 guide lists several approaches for determining the supply and location of on-street parking:[297]

- Provide the appropriate amount of loading zones to support the commercial activity and character of the street (i.e., match the supply to the environment)
- Provide longer loading spaces to accommodate multiple vehicles and allow for better access
- Assign preference to end-of-block loading zones
- For mid-block loading zones, provide curb cuts and ramps to allow access for hand trucks and pallet jacks
- Provide a buffer of at least five feet (1.5 metres) between loading zones and curbside bike lanes
- Provide longer-term parking for general contractor vehicles (e.g., construction and utilities) that is separate from loading zones (and which may not be located immediately in front of a particular building)

Other factors can also be considered:

- Courier access. A 2009 study examined ways to improve courier access in dense urban areas, notably through designed parking bays similar to those provided for buses in downtown areas and the provision of dedicated courier parking spaces close to building entrances.[298]
- Loading in alleyways. Loading and waste pick-up areas behind restaurants and stores in central London have been consolidated, making deliveries and pick-ups more efficient while also making the vicinities more attractive to patrons of these establishments. In turn, vehicle movement has been reduced, air quality has improved, and in some locations, retail sales and property values have increased.[299] The 2018 Calgary Goods Movement Strategy recommended that municipal authorities examine the feasibility of allowing couriers to use the city's many downtown alleys for deliveries.[300]
- Park and walk. Drivers often note their desire to park as close as possible to the delivery address, to save time and reduce the burden of carrying parcels on foot over long distances in sometimes inclement weather. However, not all deliveries require such close proximity and, in any event, drivers may use one stop to serve several nearby destinations. Some municipalities have implemented loading zones that are located close to but not directly in front of primary delivery addresses. For example, the Town of Oakville, Ontario introduced a system of Commercial Loading Zones (CLZs) on several parallel and intersecting streets to remove

[297] *Philadelphia Delivery Handbook*, Delaware Valley Regional Planning Commission, Philadelphia, 2017.
[298] Ryerson Institute of Housing & Mobility, *Challenges Facing Express Delivery Services in Canada's Urban Centres*, prepared for the Canadian Courier and Logistics Association, Toronto, 2009.
[299] S Hodge, *Highlighting Best Practices, New York City & London Peer Exchange*, Philadelphia Delivery Symposium, Delaware Valley Regional Planning Commission et al., Philadelphia, 2015.
[300] *Calgary Goods Movement Strategy*, The City of Calgary, 2018.

loading from Lakeshore Road, the primary downtown commercial road. The CLZ system is designed to ensure that no business on Lakeshore Road is further than one half block, or 60 metres, away from a CLZ. The CLZs were introduced as part of a general upgrade of Lakeshore Road to a shared corridor profile.[301] Stakeholders in the current study have previously noted the relocation of loading spaces to the streets that intersect the Sparks Street Mall, to remove deliveries from the latter.

- Delineation of courier space on sidewalks. Where wide sidewalks exist, some agencies have demarcated sidewalk space for couriers and other small vehicles that are serving large, multi-tenant offices in dense urban cores. These have the advantage of moving vehicles off the street while causing minimal disruptions to pedestrian flow. As the leftmost image in Figure F-3 shows, white painted squares delineate the parking space on the sidewalk. The figure also shows that the courier vehicles are removed from the adjacent bus lanes (background, right). The designated spaces also can encourage park-and-walk activity by courier drivers. By comparison, the rightmost figure illustrates the more common practice of street parking which impedes traffic.

Figure F-3: Peak period courier parking alternatives

Designated sidewalk space for couriers, PM peak period, downtown Perth, Australia

Source: DKCI

Street parking inconveniencing traffic, PM peak period, downtown Hamilton, Ontario

Source: DKCI

Vehicle reception points (time sharing of road space)

The 'vehicle reception point' (VRP) concept involves the use of on-street space during certain designated times of the day. There are two types of VRPs: one involves on-street loading bays, at which drivers can park their vehicles while making the final few metres of their delivery on foot.

The other involves road time-sharing space, which reorganizes the use of roads that have large numbers of shops and where illegal parking and double parking occur due to the lack of available delivery spaces. The concept involves dedicating the road to the parking of delivery vehicles of any size for a limited portion of the day, with parking generally limited to 30 minutes. As an example, Barcelona, Spain introduced a road time-sharing VRP in the city's commercial centre. Variable message signs are used to designate the users and times: general traffic between 8:00 and 10:00 am and 5:00 and 9:00 pm (covering the commuter peak periods), 10:00 am to 5:00 pm for deliveries, and 9:00 pm to 8:00 am for residential parking. The VRP was developed in consultation with trucking firms, retailers and other stakeholders. In addition to the signage and demarcations, the municipality also had to increase enforcement costs, including those aimed at ensuring that residents who have parked their vehicles for the night have removed them by the morning. The VRP has improved traffic

[301] DKCI, *Town of Oakville Goods Movement Study Final Report*, Town of Oakville, March 2016.

flow, with travel times reduced by 12% to 15%. The municipality has deployed the VRP progressively for new lanes.

Three keys to success were identified: the municipality conducted the necessary preparatory studies, the police enforcement effort was augmented appropriately, and a sufficiently large road network allowed the introduction of the VRP without disturbing traffic flows (i.e., drivers could find alternate routes).[302]

In a related initiative, the City of Toronto investigated delivery vehicle staging zones as part of its 2017 curbside management strategy. The measure involves the dedication of time-limited on-street space to next-in-queue trucks that are waiting to access off-street loading spaces in high demand buildings. The aim is to reduce illegal on-street parking, lane blockages and vehicle circulation.[303]

Online parking reservation systems and real-time parking availability apps

Online parking reservation and availability systems aim to improve driver's awareness of the availability of loading zones for deliveries. This allows the driver to minimize circulation, thereby potentially improving productivity and reducing operating costs, traffic congestion, fuel consumption, GHG emissions and air pollutants.

One example is Columbus, Ohio, an important multimodal US inland port, where the recently launched *Smart Columbus* initiative plans to incorporate real-time data into an app that drivers can use to see when and where it is best to stop and unload. The app is also intended to indicate delivery zone availability and it will include an advanced reservation capability for these limited spaces.[304] Another app at the inland port site will provide truck drivers (and other drivers) real-time traffic information.[305]

Implementation of paid access to on-street loading zones can reduce the duration of occupancy and ensure that zones are more likely to be available when needed. The District of Columbia introduced its *Commercial Loading Management Program* in 2015, which uses paid permits to manage access to the district's 500+ curbside loading zones. Operators can either purchase annual or daily passes or drivers can pay for loading space upon parking, via mobile service or a smartphone app. After initial industry pushback, the district subsequently found that delivery companies now value the reliability offered by the real-time system, which saves time and reduces parking violations. In 2022, annual permits were priced at $323 USD per vehicle, daily permits were $25 and mobile payments were $2.30+ per hour.[306] Local authorities also cite the importance of stakeholder consultation in establishing the *Program*'s success. They note that the *Program* sends a message to local businesses – many of which are restaurants and small businesses - that the district recognizes the

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[302] D Patier and F Toilier, *Urban Logistics Spaces: What Models, What Uses and What Role for Public Authorities?* In E Taniguchi and RG Thompson, editors, *City Logistics 2: Modeling and Planning Initiatives*, ISTE – Wiley, Hoboken, NJ, 2018.

[303] *Curbside Management Strategy: Improving How Curbside Space is Used*, City of Toronto, 2017, cited in MF Mitman, S Davis, I Ballús Armet and E Knopf, *Curbside Management Practitioners Guide*, Institute of Transportation Engineers, Washington, DC, 2020. The status of the initiative is unknown.

[304] L Rosencrance, *In Columbus smart city initiative, transportation takes the wheel*, IoT Agenda, 6 November 2017, http://internetofthingsagenda.techtarget.com/feature/In-Columbus-smart-city-initiative-transportation-takes-the-wheel. The status of these initiatives is unclear.

[305] *Smart Cities Info*, The City of Columbus, accessed June 2022. The status of these initiatives is unclear.

[306] *Freight Management, Trucks and Deliveries in the District*, District of Columbia Department of Transportation, http://godcgo.com/freight/, cited in MF Mitman, S Davis, I Ballús Armet and E Knopf, *Curbside Management Practitioners Guide*.

importance that loading has in supporting the local economy. They have also collected extensive data on loading demands.[307]

Other initiatives have also underscored the importance of consulting industry and businesses. For example, as part of a bus route improvement on a Brooklyn corridor, New York City authorities asked local businesses their preferences for on-street loading zones with varying levels of restrictions while also monitoring demands, with closer locations having shorter time restrictions. The city was then able to develop a system that balanced the needs of businesses with other users.[308] The importance of consulting industry was also highlighted by external stakeholders to this study. Stakeholders recognized the potential benefits of parking reservation schemes but noted the need to ensure that carriers and drivers are willing to use them, and that the system is not abused by those who do not want to follow the protocols. It is also important that apps, etc. do not overwhelm the drivers so that their attention is more focused on finding a parking spot and looking at the app or smart phone than it is on the driving tasks.

Online wayfinders

Several urban authorities have developed web tools that inform carriers, businesses and the general public about truck routes, local conditions and goods movement trends. These systems take advantage of the near-universal availability of mobile phones to truckers and the corresponding move away from reliance on paper-based maps. Recent examples include:

In 2020, TransLink and MOTI released an online truck route planner for Metro Vancouver. The tool allows truck operators to pre-plan optimal routes, considering vehicle dimensions, municipal bylaws, vertical clearances, bridge load limits and major road closures on truck routes. Accounting for pandemic restrictions, the tool also features information about open businesses and facilities, washroom and parking availability for truckers (important also for long-haul drivers), and restaurants and hotels that are open to the public.[309]

Peel Region's Freight Information Hub is an interactive online map that provides information on road restrictions, road quality, closures, venues of interest to the trucking community (such as truck stops, weigh stations and motels that have trailer parking) and freight-oriented destinations, such as warehouses and distribution centres, quarries, intermodal rail terminals and Toronto Pearson International Airport. The map can be refreshed to show up-to-date road closures and incidents.[310]

The District of Columbia's interactive freight map, which shows loading zones, truck restrictions and bus routes, is illustrated in Figure F-4. Note that the loading zone attributes are shown including address, days and hours of operation, length and side of street.

Eco-navigation is a variation to this approach. It uses real-time traffic information and proposes the most fuel-efficient routes by avoiding congestion, steep ramps and [major] intersections. Because it optimizes fuel consumption, rather than travel times, it can result in longer trip times. It is most

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[307] Sources: *Commercial Loading Zone Management Program*, US Federal Highway Administration, Washington, DC, 2017, and E Cleckley, *How to create an efficient urban freight system?*, Philadelphia Delivery Symposium, Delaware Valley Regional Planning Commission et al., Philadelphia, 2015.

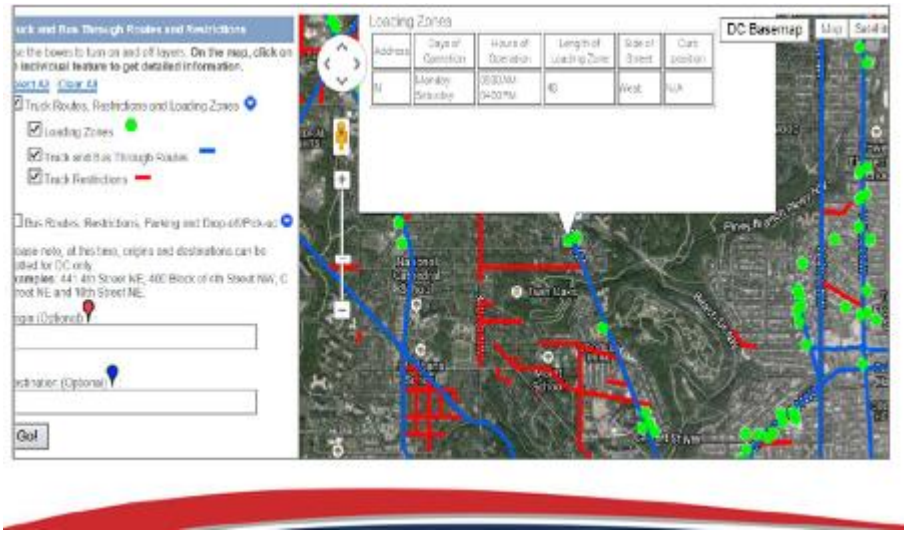
[308] M Roe and Toocheck C, *Curb Appeal, Curbside Management Strategies for Improving Transit Reliability,* National Association of City Transportation Officials, New York, 2017.

[309] *New planning tool simplifies regional truck navigation*, TransLink, posted July 17, 2020. The app can be found at https://translink.apps.gov.bc.ca/trp/.

[310] The online map can be found at http://www.peelregion.ca/planning-maps/freight/.

effective for urban and suburban areas, where fuel consumption can be reduced by 5-10%, but it is not as impactful on interurban highways.[311,312]

Figure F-4: Interactive freight map – District of Columbia



Source: E Cleckley, *How to create an efficient urban freight system?*, Philadelphia Delivery Symposium, Delaware Valley Regional Planning Commission et al., Philadelphia, 2015.

Off-hours delivery

Off-hours delivery (OHD, also known as off-peak delivery) occurs when delivery companies make deliveries to businesses and residences in the evenings and overnight, i.e., outside the times of day when traffic is busiest. In 2009 and 2010, the City of New York conducted an OHD pilot test in Manhattan, using a financial incentive to attract participants. Compared with daytime deliveries, the OHD pilot reduced travel times for delivery trucks, reduced stop service times (from 100 to 30 minutes on average, reflecting improved site access), improved travel time reliability, reduced parking tickets and the associated costs, increased driver productivity and allowed some fleet operators to reduce vehicle requirements. Drivers experienced less congestion and greater availability of parking. Restaurants reported greater reliability in the delivery of fresh food products.[313] A 2017 study reports that no noise complaints were received during the pilot and drivers overwhelmingly preferred delivering during the off-hours. As a result, the federal and state governments agreed to co-fund an expansion of the OHD program.[314]

The Ontario Ministry of Transportation conducted an OHD pilot in the Greater Golden Horseshoe (the Toronto-centred mega-region). The pilot assessed OHD generally and specifically as a potential means to reduce traffic during the 2015 PanAmerican/Parapan Games. Pilots were conducted before, during and after the Games. Approximately 100 retail, food and grocery businesses in 40

[311] F Furtado, *Towards Road Freight Decarbonisation: Trends, Measures and Policies*, International Transport Forum.

[313] *Off-Hour Deliveries*, in *Sustainable Streets Index 2010*, New York City Department of Transportation, 2010.

[314] D Zimmerman and L Wiginton, *Improving Urban Freight Efficiency, Global best practices in reducing emissions in goods movement*, The Pembina Institute, Calgary, April 2017.

municipalities participated. During the Games, businesses shifted more than 18,000 deliveries to off-peak periods, equivalent to removing 4,500 truck trips during the peak periods. Very few noise complaints were recorded.[315]

Large retailers, such as Canadian Tire Corporation and the provincial alcohol retailer, experienced positive results like those of the New York City OHD. Trucking companies also noted that drivers were able to complete additional deliveries compared to a daytime shift. However, other distributors experienced problems with customers not being receptive to night-time deliveries, either due to the unavailability of receiving staff or concerns about the security of unattended deliveries. Staff at one suburban municipality noted that although they were in favour of OHD its implementation would require a change in noise bylaws, which would be challenging politically. Noise concerns were noted at downtown high-rise condominiums when deliveries were made to ground floor or nearby retailers or restaurants, in part because loading spaces in the condominiums had not been well designed to serve these other uses.

To this end, various technologies are available to mitigate noise impacts while also maintaining vehicle safety and the security of loads. These include the use of video cameras (to eliminate the need for back-up horns, which are a key cause of noise), training staff in noise abatement, low noise accessories to reduce engine noise, specially designed cargo handling equipment and the use of noise-absorbing materials (e.g., barrier mats that curb equipment vibration). Keyless entry and deliveries regarding a key to secure unattended external storage areas allow deliveries to be made securely, and one major Canadian retailer uses this process at several of its stores.[316]

A 2019 follow-up in Peel Region (just west of Toronto) found faster average speeds for OHD (18% faster compared with daytime deliveries), along with reduced GHGs (-10% GHGs per kilometre) and CAP emissions. However, average service times at stops increased by 15% compared to daytime deliveries, in part because the available staff were busy with other activities in the off hours (e.g., to ensure that products are available when the store opens each morning, restocking shelves often takes place overnight).[317]

A 2018 paper provides further insight that may be more directly applicable to the densities and traffic conditions that characterize Central Okanagan. The paper assessed the transportation efficiency of a Stockholm OHD pilot. The assessment found that driving efficiency (avoidance of delays, etc.), delivery reliability, energy efficiency and service efficiency all improved. However, these gains were more apparent when the OHD results were compared with daytime commuter peak periods than they were against midday deliveries. In other words, the OHD efficiency gains varied according to varying daytime congestion levels (in contrast to New York City and Toronto, where congestion is pervasive throughout the day). Under these conditions, OHD might not always replace daytime deliveries but instead would provide transporters and receivers with additional flexibility. The assessment used vehicle GPS data, fleet management data and logistics information to evaluate these impacts.[318]

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[315] D Zimmerman and L Wiginton, *Improving Urban Freight Efficiency, Global best practices in reducing emissions in goods movement*.

[316] J Holguín-Veras, Marquis R, Campbell S et al., *Fostering the Use of Unassisted Off-Hour Deliveries*, Journal of the Transportation Research Board No. 2379, Transportation Research Board, Washington, DC, 2013.

[317] K Mousavi, S Khan, G Amirjamshidi and M Roorda, *Pilot Off-Peak Delivery Program in the Region of Peel, Final Report*, Smart Freight Centre, Toronto, January 30, 2020.

[318] J Fu and Jenelius E, *Transport efficiency of off-peak urban goods deliveries: A Stockholm pilot study*, Case Studies on Transport Policy 6, 2018.

The successful implementation of an OHD program requires a coordinated effort among municipalities, carriers and their customers. For example, customer staff who normally would be present during the daytime to help load or unload a vehicle might not be available at night. Noise bylaws also may require a review. Contractors in Ottawa proposed allowing deliveries to construction sites prior to 7:00 am (the current noise bylaw's restriction) to avoid the AM commuter peak and to avoid delays to the start of work at the site.[319]

Off-street parking and loading

This topic is discussed last, although it properly can be seen as the primary approach for managing on-street loading – that is, build in off-street parking into new and retrofitted construction. The discussion considers enhanced building design requirements for loading and unloading.

Off-street parking and loading is the primary approach for managing on-street loading – that is, build in off-street parking into new and retrofitted construction.

In many cities, buildings have not been designed to handle current truck sizes or, especially, changes in delivery methods such as the increase in courier and express deliveries that require fast access to the front door, rather than to the loading dock. A 2015 guide describes the requirements:[320]

> Enhanced building codes for off-street parking and loading facilities require consideration of the characteristics of the network, building designs, existing regulations, and vehicle characteristics. The planning process should involve the private real estate sector as well as public planning and economic development agencies, as these changes may involve building codes, land use regulations, and the retrofitting of existing buildings and facilities. Changing design standards and building/zoning codes will carry a low cost. Retroactively updating existing developments for off-street loading facilities will carry a high cost.

The guide cites the advantages of enhancing building codes as reduced congestion, fuel consumption, GHG and air pollutant emissions, enhanced safety, increased operational efficiency, infrastructure improvements and lower probabilities for unintended consequences (e.g., illegal parking). Disadvantages can include private sector stakeholder acceptance, high capital investments, the need to update existing development requirements, the need for political consensus and available space for off-street loading. There is also the need to ensure that building owners, tenants, shippers, couriers, truckers and other stakeholders are involved in any initiatives to enhance building design.

A 2017 research report notes that off-street loading facilities are not always practical or possible in certain building configurations. Also, dedicating space for loading on the property instead of on the street can increase the size and land cost of development, especially in high-value inner areas and downtowns. In these cases, one option may be to consolidate loading docks for multiple businesses on the same block.

The 2017 report also notes the need to first identify buildings that have the potential to add or enhance an off-street loading facility. Regulations can be added (or updated) to address buildings

[319] DKCI, *Ottawa Goods Movement Backgrounder*, City of Ottawa, 2019.
[320] J Holguín-Veras et al., *Improving Freight System Performance in Metropolitan Areas: A Planning Guide*, NCFRP Report 33, National Cooperative Freight Research Program, Transportation Research Board, Washington, DC, 2015.

of a certain size or anticipated use to ensure the development of off-street facilities and integration of truck deliveries with minimal conflict with the street or sidewalk. The report cites the example of the City of Seattle, which requires new developments to provide off-street loading areas while also reserving some on-street parking for commercial vehicles. Seattle also permits smaller vehicles to use alleys to load and unload without disrupting vehicular or pedestrian traffic on the nearby streets and sidewalks.[321] By reducing the space requirements for off-street loading space dimensions, the City of Vancouver's parking bylaw effectively promotes the use of smaller delivery vehicles.[322] The City also promotes the use of its pervasive downtown back/side lane system for deliveries as well as off-hours delivery.

Complete Streets

Overview

The 'shared corridor' concept – also known as Complete Streets or Liveable Streets - promotes corridor designs and operations that provide a safe and attractive environment for all corridor travellers, especially vulnerable road users (VRUs, that is, cyclists and pedestrians). Some municipalities have adopted design guidelines and policies that are to be applied to new corridors and to retrofits of existing corridors.

In practice Complete Streets initiatives in many communities have focused on accommodating non-motorized travellers and transit into urban road rights-of-way, with much less said about the treatment of goods movement vehicles, except in industrial areas. A 2021 survey of nine Canadian municipalities found that goods movement was considered in the development of their Complete Streets policies and guidelines, although to varying degrees – especially with respect to how and if goods movement stakeholders were consulted.[323]

Although non-motorized travellers and transit clearly have a critical need, less attention has been given to accommodating trucks and delivery vehicles than it has to other modes.[324] For example:

- Curb extensions, despite their other benefits, can block site access for a truck
- Roundabouts, which are intended to improve road user safety, can be difficult for trucks to manoeuvre
- Many Complete Streets initiatives place a bicycle lane next to the curb, which must be crossed by drivers making deliveries from their vehicles, even if they are parked in designated loading areas

A 2019 guide points out that, among other consequences, the failure to account for goods movement in Complete Streets often results in unanticipated navigation, parking challenges, conflicts and associated congestion and emissions impacts. The guide addresses designs that are

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[321] C Lamm et al., *Guide for Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments*, NCHRP Report 844, National Cooperative Highway Research Program, Transportation Research Board, Washington, DC, 2017.
[322] *Parking Bylaw 6059, Section 5 – Off-Street Loading Space Regulations*, City of Vancouver, bylaw amended as of January 1, 2019.
[323] D Kriger and M Seera, *Complete Streets and Goods Movement: The Canadian Experience*, ITE Journal, November 2021.
[324] J Green, *Complete Streets vs. Trucks*, The Dirt, online newsletter of the American Society of Landscape Architects, January 21, 2015. See http://dirt.asla.org/2015/01/21/complete-streets-vs-trucks/.

appropriate for the context, accommodation of large vehicle turns, conflict reduction between trucks and VRUs, and adequacy of loading, parking and delivery space, among other topics.[325]

The ensuing discussion is organized according to five related themes:

- Managing the interaction between on-street loading and bicycles through planning
- Managing the movement of goods across bicycle lanes through operations and design
- Loading in pedestrianized areas
- Designation of truck level of service targets
- Design guidelines for roads and intersections

Managing the interaction between on-street loading and bicycles through planning

Truck – bicycle conflicts arise from truck intrusions in the bicycle lane, by parking in the lane or crossing the lane to park. The conflicts are either direct, or because of bicycles moving to get around the trucks, indirect. Other conflicts arise from the proximity of parked trucks to the bicycle lane, wherein bicycles had moved to get around the vehicles or had been 'doored.'[326]

A review of US and Canadian cities (Vancouver) found two common approaches to reducing truck-bicycle conflicts. First, research has found that clearly marked, bicycle-specific facilities are safer for cyclists, compared with on-road cycling with traffic or off-road cycling with pedestrians and other users. Figure F-5 shows downtown Ottawa's Laurier Avenue West cycling lane, which is physically delineated from the adjacent road lanes.

Figure F-5: Physically delineated bicycle lane, Laurier Avenue West, Ottawa

Source: DKCI

[325] A Conway, J Williamson, M Gjorgjievska, Q Chen, L Prasad, C Xing, D Peters, S Hodge, N Mammes and M Klatsky, *Complete Streets Considerations for Freight and Emergency Vehicle Operations*, New York State Energy Research and Development Authority, Albany, New York, 2019.

[326] K Gelino, Krass C, Olds J and Sandercock M, *Why Can't We Be Friends? Reducing Conflicts Between Bicycles and Trucks*, University of Washington, Seattle, December 2012.

The second approach worked with the local cycling and goods movement "communities" to develop potential solutions, such as physical separation, alternate routes, better signalization at dangerous intersections and road modifications to improve flow. The implementation of a given solution(s) is based on location-specific factors, such as lane width, vehicle speed, availability of alternate routes, proximity to destinations and the importance of the route to each user group.[327]

The Ontario Ministry of Transportation's 2016 Freight Supportive Guidelines provide guidance on the accommodation of truck and cyclist "interactions." These include:[328]

- Planning for appropriate truck and bike networks and avoiding or limiting the number of roads that are designated for both trucks and cyclists in order to reduce conflicts between these two road users
- Considering provision of a separate bike path if the road is designated as a truck route and a bike route
- Ensuring adequate widths of on-street bike lanes
- Providing bike lane markings, pavement markings and signage to alert motor vehicle drivers of the bike route
- Installing truck access signs prior to major truck access points that may be shielded from the view of cyclists

Managing the movement of goods across bicycle lanes through operations and design

The preceding section speaks to design and layout, whereas there is also a need to consider actual delivery operations – in particular, how individual addresses can be accessed for deliveries and pick-ups; how cargos can be moved across bicycle lanes, which are typically at the curbside; and where on-street loading zones should be located so as not to intrude on the bicycle lanes.

An operational/regulatory approach is offered by a demonstration project in Brooklyn, New York, which examined ways to accommodate bicycle lanes and on-street loading. The project converted a two-way street with bicycle lanes on each side of the street (which experienced intrusions of trucks for unloading), to a one-way street, with the bicycle lanes paired on one side of the street, and the other side converted to a curbside loading lane. Another treatment moved the loading lane beside the curbside bicycle lanes, meaning that trucks could park adjacent to, but not block, the bicycle lanes. At night, curbside delivery is permitted on the bicycle lane to a 24-hour pharmacy.[329] At the same time, a truck operator in another study pointed out that, although cyclist activity may be low at night, it is under these conditions that cyclists are most vulnerable: there are fewer cyclists travelling so drivers are not expecting them and they are difficult to see, especially once they are diverted from the bicycle lane.[330]

A 2019 guide provides two related design treatments to avoid the movement of goods across bicycle lanes:[331]

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[327] Gelino et al., *Why Can't We Be Friends? Reducing Conflicts Between Bicycles and Trucks*.
[328] *Freight-Supportive Guidelines*, Ontario Ministry of Transportation, Toronto, 2015.
[329] A Conway, Faivre G and Conway M, *Accommodating Freight on Mixed-Use Urban Streets*, presentation to the METRANS International Urban Freight Conference, Long Beach, California, October 9, 2013.
[330] DKCI, *Goods Movement Backgrounder*, City of Ottawa, 2019.
[331] A Conway et al., *Complete Streets Considerations for Freight and Emergency Vehicle Operations*, 2019.

- Offset bicycle (and bus) lanes, in which the loading lane is located next to the curb, inside the bicycle lane. This can take the form of pavement markings to delineate the bicycle lane (though without physical barriers), as with the Brooklyn example above, or a cut-out from the sidewalk (which can also be delineated by an upstream bulb extension of the sidewalk). In this way, trucks avoid parking in the bicycle lane, although they must cross the lane to enter or exit the parking space. On the other hand, cyclists still run the risk of being doored by parked vehicles.
- Mountable sidewalk or sidewalk cutouts, which could be considered where excess sidewalk space is available. In this concept, the truck crosses the bicycle lane, which is beside the curb, and mounts the curb to park on the sidewalk. Parking space is delineated on the sidewalk (see the Perth courier vehicle example in Figure F-6 or is carved out from the sidewalk. This arrangement has the benefit of keeping the vehicle out of the bicycle lane, although the lane must be crossed and parking on the sidewalk can create conflicts with pedestrians. The cut-out also permanently removes sidewalk capacity.

Loading in pedestrianized areas

This section considers time-specific access for trucks in areas where there is significant foot traffic. Trucks are allowed to access the streets directly next to pedestrian malls/markets and make deliveries directly to vendors during the designated times of day.

This approach was implemented to serve Findlay Market in Cincinnati, Ohio. Trucks are allowed access to the streets directly next to Market stalls and can make deliveries directly to vendors prior to 10:00 am. Most deliveries occur between 7:00 and 10:00 am, after which time trucks must park on adjacent streets and drivers must deliver goods by hand. This approach allows the area to remain a “vibrant, pedestrian-focused location during the busy lunchtime and afternoon hours” while ensuring that deliverers and vendors have viable options for access goods. Internal stakeholders commented that this approach can work if deliveries are all made by smaller vehicles; in any event, the approach must be tailored to the local context. External stakeholders also noted the need to accommodate food trucks and other trucks that operate in pedestrianized areas in which a lot of tourists and visitors circulate.

Figure F-6 shows a similar treatment in a region that, like Central Okanagan, is a prominent venue for visitors. The figure shows a delivery being made early in the morning to stores and offices on a pedestrian street in Queenstown, New Zealand, before these establishments have opened for the day. At other times, either the deliveries are not made, or the vehicles must park on adjacent streets and the driver must deliver the goods by hand.

Figure F-6: Access control in a pedestrianized area
Courier van, pedestrian street, Queenstown, NZ (early morning before stores open)

Source: DKCI

Designation of truck level of service targets

Many Complete Street guidelines accept that, in industrial areas, trucks and other vehicular traffic will have priority over other corridor users. However, it is important to recognize that high truck volumes can be found anywhere in the urban environment. Clearly, accommodating large trucks in all areas is not appropriate, although goods, especially those delivered by couriers, still need to reach all areas in the city.[332]

The City of Seattle has developed a framework to address these conflict points. In Seattle's Complete Streets policy context, mobility is noted as the policy's second priority, after safety.[333] Consistent with these two priorities, on streets that have been designated as "Major Truck Streets," the policy requires that design and operational improvements "support" all modes and "are consistent with freight mobility."[334] A Major Truck Street is defined as:

> … an arterial street that accommodates significant freight movement through the city, and to and from major freight traffic generators. The street is typically a designated principal arterial . . . Major Truck Streets generally carry heavier loads and higher truck volumes than other streets in the City…[335]

[332] Some cities such as Regina and Ottawa have implemented or are proposing two-tiered truck route networks to 'right-size' truck flows according to the environmental context. While this is not a design approach, it can be used as a complementary step to a more permanent solution. See *The Regina Traffic Bylaw No. 9900*, as amended, City of Regina, March 2, 2022, and *Transportation Master Plan*, Draft 1.0, City of Ottawa, December 2021.

[333] *Complete Streets in Seattle*, City of Seattle. https://www.seattle.gov/transportation/projects-and-programs/programs/urban-design-program/complete-streets-in-seattle.

[334] Ibid.

[335] *Truck Classification Legend Definitions*, City of Seattle. See http://www.seattle.gov/transportation/streetclassmaps/trucklegend.pdf.

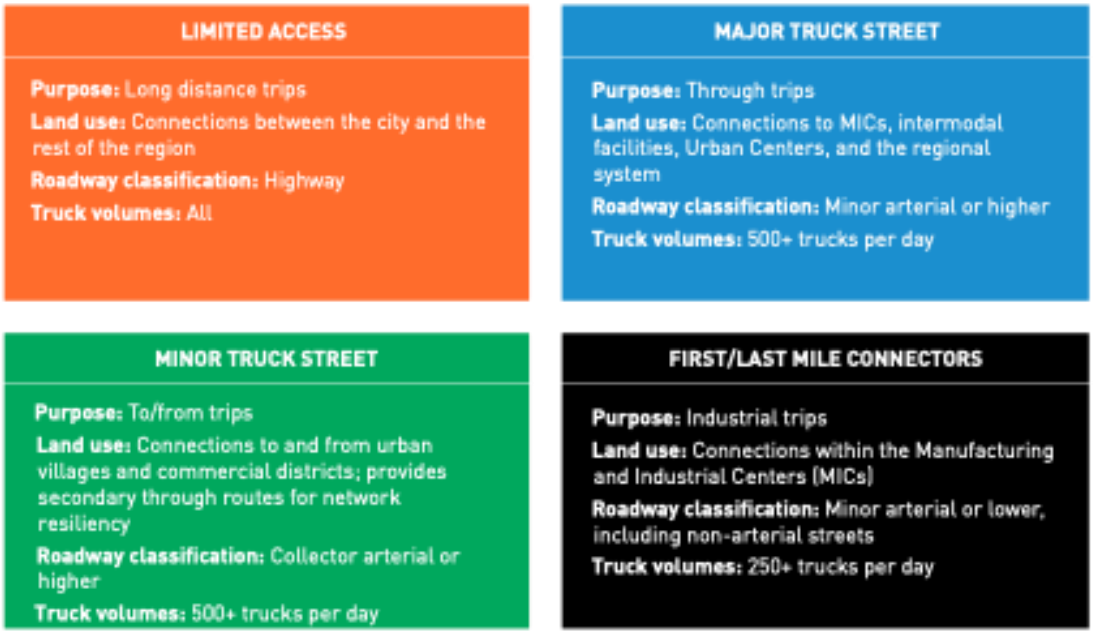
A Major Truck Street does not have to be within an industrial area; instead, it can include arterials anywhere in the city that are "significant" to freight activity. On a Major Truck Street:

> Because freight is important to the basic economy of the City and has unique right-of-way needs to support that role, freight will be the major priority on streets classified as Major Truck Streets. Complete Street improvements that are consistent with freight mobility but also support other modes may be considered on these streets.

In 2016, Seattle updated its freight network. In doing so, it grouped the city's roads and highways into four categories. The categories are illustrated in Figure F-7. Seattle network connects 'urban centres,' 'urban villages,' commercial districts and other non-industrial generators, in addition to manufacturing and industrial centres and intermodal terminals. The document also points out that:[336]

> Designating a street as part of the freight network will not necessarily change its overall function, design or character. Rather, the designation underscores the importance of ensuring that goods movement can be accommodated on that street in a safe manner.

Figure F-7: Seattle's freight network designations and criteria



Source: Figure 4-3, *City of Seattle Freight Master Plan*, City of Seattle, September 2016.

Moreover, the implementation of Complete Streets, if not well planned, can lead to conflicts such as lane widths being too narrow for trucks and truck turning radii sometimes coming in conflict with pedestrian curb extensions and traffic calming treatments. Although many guidelines provide general indications of ways to serve all corridor users, from the perspective of goods movement, the key difficulty is "considering site-specific requirements and treating every block and intersection for its specific needs."[337] To harmonize goods movement needs and the implementation of Complete Streets schemes on individual corridors, one observer proposes three steps:

- Plan to support – not eliminate – goods movement from the corridor

[336] *City of Seattle Freight Master Plan*, City of Seattle, September 2016.

[337] A Bassok et al*., Smart Growth and Urban Goods Movement*, NCFRP Report 24, National Cooperative Freight Research Program, Transportation Research Board, Washington, DC, 2013.

- Ask goods movement operators what they need and what could work for them (as noted, the aforementioned 2021 survey of Canadian municipalities found that this did not always happen)
- Think beyond corridor design alone – for example, by making capacity and signal timing modifications at upstream intersections that are better suited to handle truck traffic to divert that traffic before it reaches the shared corridor[338]

The sidebar on the next page expands on these steps by outlining some of the challenges for accommodating goods movement in Complete Streets schemes, and how these challenges can be addressed through planning and design. Going forward, Complete Streets schemes can consider opportunities to switch to small, zero-/low-emission vehicles and other potential initiatives that can manage goods movement.

It must be emphasized that the objective of this discussion is not to give priority to trucks on Complete Streets but rather to ensure that goods can still be moved and unloaded in Complete Streets schemes. Accommodating goods movement does not necessarily mean designing infrastructure to primarily benefit trucks. For example, as noted in the textbox, strategies such as relocating stop bars to enable truck turning movements while minimizing the distances pedestrians must cross the street can be considered. Other concepts include moving deliveries to the back of the building and strategically placed on-street loading zones with time restrictions.[339]

It must be emphasized that the objective of this discussion is not to give priority to trucks on Complete Streets but rather to ensure that goods can still be moved and unloaded in Complete Streets schemes.

How can Complete Streets accommodate goods movement

When planners and engineers are considering how to make an existing thoroughfare into a Complete Street, they most often focus on improving accommodations for pedestrians, including those with vision or mobility impairments, cyclists, and transit users when the street is a current or future bus route. Those involved in goods movement are often left out of the Complete Streets design conversation. But goods movement can be an important component of Complete Streets, especially when one of the objectives of the new streetscape is to encourage economic development, which often occurs in the form of neighborhood-scale retail and commercial space. Restaurants and shops will require daily deliveries, and residences and offices may rely on parcel services, making truck traffic an unavoidable part of street life.

Planning for goods movement from the outset will help ensure a successful design that truly accommodates all users.

It is important to distinguish between different types of goods movement when looking at land-use plans and urban design. Good planning can lead to the creation of a network of urban truck routes that can best accommodate trucks that are not providing local delivery service, whether they are travelling through the city or going from a factory or warehouse/distribution center to a freeway interchange. Once designated, these routes will be less desirable for Complete Street treatment. Local judgment is still important, as in a situation where a “Main Street” serves as a truck route but must also accommodate all users. Local deliveries and services like garbage removal are the kind of goods movement that must be addressed in the Complete Streets context. Vehicles may range in size from relatively small parcel service and delivery trucks to tractor-trailers.

[338] P Plumeau, *Complete Streets and Goods Movement, Options and Considerations*, Talking Freight, May 21, 2014.

[339] *Complete Streets Fact Sheet*, New York State Association of MPOs (Metropolitan Planning Organizations), 2011.

While some of our cities were designed with mid-block alleys for rear delivery, most were not. Few neighborhood businesses have on-site loading docks. Most often delivery trucks must compete for curbside space.

Successful Complete Streets projects rely on stakeholder involvement. Outreach to current businesses must include discussion of their delivery needs, with the potential for meeting with their suppliers as well. Find out the type of trucks that are being used, and frequency, duration, and time of day of deliveries. Ask if deliveries can be made in off-hours when the street is not busy with people. Then consider loading zones. The City of Philadelphia has included loading zone requests in their Complete Streets program. Determine how much curb front is needed, the hours the loading zone will operate, and the duration of stay (typically no more than 30 minutes). Develop an enforcement plan, which is necessary to make loading zones work. Position loading zones so they will have a minimal impact on parking and bus stops. Local stakeholders can often be helpful in determining an acceptable trade-off in the competition for curb space.

Intersection design should be reviewed to ensure that pedestrian crossing distances are short, while still allowing for delivery truck turning movements.

Consider mountable curbs on medians and roundabouts, and marking stop bars further back to allow turning trucks to swing into the opposite lane.

It is important to plan ahead. If the land use objective is for mixed-use development or redevelopment, consider how the street will accommodate additional truck traffic, and work with economic development officials and developers to create off-street delivery areas.

Most importantly, be creative in accommodating goods movement in your Complete Streets designs as you consider the needs of all users. Ignoring goods movement may detract from the ultimate success of the project and its economic development potential.

Source: Complete Streets 2.0 Fact Sheet, 2016, New York State Association of MPOs.

Design guidelines for roads and intersections

To support their Complete Streets guidelines and policies, some Canadian cities have developed road and intersection design guidelines. The (US) National Association of City Transportation Officials' (NACTO's) *Urban Street Design Guide* is a widely used standard.[340] Recent Canadian applications offer references that are adaptable to the Canadian context and are described below.

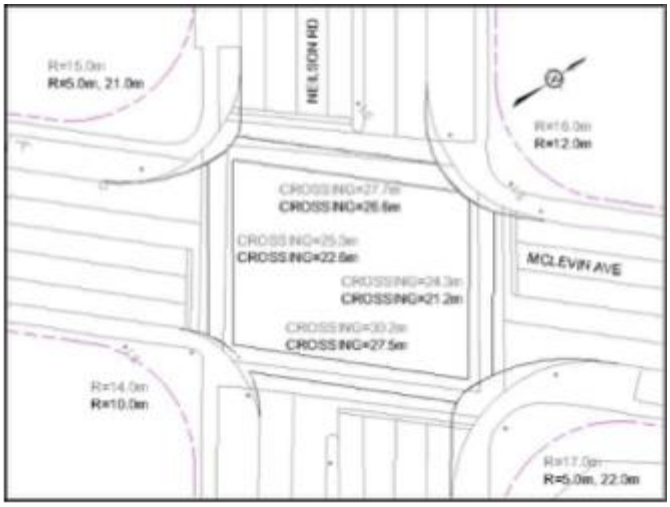
City of Toronto Curb Radii Guideline

The 2017 City of Toronto *Curb Radii Guideline* is a context-sensitive update to traditional intersection design guidelines that seeks to improve the safety of vulnerable users such as pedestrians and cyclists while responding to the needs of all road users. The Toronto *Guideline* considers road classification, truck volumes, expected vehicle types, land use, approach lane widths, departing lane widths, intersection angle and the presence of bus routes and bicycle lanes. The *Guideline* notes that most intersection corners in the city are oversized and could be reduced without significant impacts to turning vehicles and pedestrians.

Benefits of reducing curb radii include reduced pedestrian crossing distances, reduced vehicle turning speeds, improved driver sight angle and increased pedestrian storage space. The *Guideline* also notes a decline in the volume of large trucks (tractor-trailers) in the city, associated with a drop in manufacturing, conversion of industrial lands to residential use and residential densification. As a result, "many sections of arterial roads with very infrequent large truck volumes have overdesigned curb radii." However, the *Guideline* considers the needs of intersections that are in areas having "large truck percentages," although no threshold is defined. Figure F-8 shows an example of the application of the *Guideline* to the retrofit of an intersection in suburban Toronto. The retrofit resulted in a significant improvement in driver yielding behaviour to pedestrians.

[340] *Urban Street Design Guide*, National Association of City Transportation Officials, New York City, 2013.

Figure F-8: Example of intersection retrofit in suburban Toronto
Original dimensions are shown in grey. Proposed and constructed dimensions are shown in black



Source: City of Toronto Curb Radii Design Guidelines, 2016 TAC Road Safety Engineering Award Submission, City of Toronto, undated

The *Guideline* introduced flexibility using a context-sensitive approach, which allows for different treatments according to the road classification and adjacent land use. The approach is based on the distinction between a design vehicle, which is the largest "frequent" vehicle type making a right turn at an intersection whose turns should be accommodated with "relative ease," and a control vehicle, which is typically the largest vehicle making a right turn at an intersection, make up a "small fraction" of vehicles and, under the *Guideline*, will have "less available space" to make the turn.[341] This is a Canadian adaptation of a NACTO *Urban Street Design Guide* concept. The *Guideline* notes that different vehicle types should be used as design and control vehicles for different intersection control types.

The Toronto *Guideline* is noteworthy because of its innovation to Canadian practice, its comprehensiveness and its deployment of the concept of design and control vehicles. It has served as a model for other Canadian cities. The *Guideline* also has been deployed in the City of Toronto's *Road Safety Strategic Plan*.

City of Ottawa Protected Intersection Design Guide

This 2021 guide addresses a gap in the literature by providing a consistent approach to the design of 'protected intersections,' which are used to make it safer for vulnerable road users as they approach and cross an intersection. The Guide provides guiding principles, design requirements, descriptions of various types of protected intersections, functional and detailed design elements and signal and lane arrangement measures. The Guide pays special attention to accessibility requirements for all users, including guidance on the path of travel, delineation between cycle tracks and sidewalks and the provision of tactile walking surface indicators. The Guide notes the importance of context when determining the appropriate design treatment, including accounting for the presence of truck routes, the road function, turning movement volumes and the appropriate choice of a design vehicle. Where a large radius is needed to accommodate large design and control

[341] *Curb Radii Guideline, Version 1.1*, City of Toronto Transportation Services, June 2017 and *City of Toronto Curb Radii Design Guidelines, 2016 TAC Road Safety Engineering Award Submission*, City of Toronto, undated.

vehicles, corner aprons (or truck aprons) can be deployed to better manage the movement of turning trucks and other large vehicles through the intersection.[342]

The Guide is the winner of the Transportation Association of Canada's 2022 *Mobility Achievement Award* for "[demonstrating] excellence in the delivery of integrated or multimodal mobility for people and goods, while reinforcing the social, economic and environmental pillars of sustainability."[343]

Freight-Supportive Guidelines

The *Freight-Supportive Guidelines* (2015) is a comprehensive reference of best practices for freight and land use planning. Prepared by the Ontario Ministry of Transportation, the *Guidelines* provide a comprehensive set of strategies and direction in land use and transportation planning, site design, road design and operations, and implementation strategies. Use of the Guidelines is not mandatory; however, they were developed with municipal applications in mind. The Guidelines aim to:

> ... help municipalities, planners, engineers, developers and other practitioners create safe, and efficient freight-supportive communities… The *Guidelines* include best practices, examples and implementation tools that are applicable to a wide range of communities and municipalities, and also provide direction for long-term, local implementation of freight-supportive policies and practices across Ontario. In this context, the *Guidelines* are intended to:
>
> - Provide direction for land use planning, site design practices and operational procedures that help with the movement of freight;
> - Assist municipalities in understanding and planning for the various modes and types of vehicles used in the movement of freight; and
> - Support the overall economic health and competitiveness of Ontario's municipalities.
>
> The *Guidelines* can assist in the creation of communities, individual developments and transportation networks that are capable of supporting freight industries while integrating and balancing the compatibility of surrounding land uses and the needs of other transportation system users.

The *Guidelines* describe practices for incorporating goods movement into policy documents such as Official Plans[344] and zoning bylaws, as well as site-development needs, specifically:

- Land use and transportation planning, with strategies for incorporating goods movement considerations into the municipal planning process in balance with other objectives. The Guidelines also describe the "freight audit," a process to inform planning decisions to enable the safe and efficient movement of goods.
- Site design, with a range of general measures that can be applied to site plans and specific initiatives that are tailored to different land uses. The approach addresses how site design for goods movement can be coordinated with the design for active transportation and transit.
- Road design and operations, which incorporates goods movement into the design and operation of municipal roads.

Tools and actions are provided to help implement the strategies. The guidelines suggest that sustainable freight systems, such as the systems the Guidelines endeavour to encourage, make "positive contribution to the environmental, social and economic sustainability of the communities

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[342] Alta Planning + Design Canada, Inc., *Protected Intersection Design Guide*, City of Ottawa, September 2021.
[343] *TAC Mobility Achievement Award,* https://www.tac-atc.ca/en/about-tac/awards/mobility-achievement.
[344] i.e., Official Community Plans.

they serve." Some of the specific benefits cited in the document include limiting the impacts of freight on other road users and communities, reducing emissions and improving mobility of freight.

Although the Freight Supportive Guidelines are not specific to Complete Streets or to road design guidelines, they are noted here because of their broad treatment of goods movement planning, which helps ensure that the planning and design of complete streets and roads generally are considered in the context of the adjoining land uses and development. The Guidelines remain the most comprehensive treatment of the subject in Canada today.[345]

Other potential solutions include adding loading zones in dense residential areas in addition to conventional commercial loading zones, to accommodate the rapid growth in direct-to-consumer deliveries and thereby reduce illegal parking and disruptions to transit buses and other traffic. Municipalities also can design wider bikeways that support package and food deliveries by bicycle, create 'reservable' loading zones that allow freight companies to 'park and walk' instead of driving door-to-door and explore off-peak freight delivery incentives for busy mixed-use environments.[346]

Finally, it can be noted that although many couriers and distributors use a variety of vehicles according to specific customer needs and the location that is being served, the retrofitting of a Complete Streets corridor can have the effect of forcing transporters to use smaller vehicles in that location, which may be an objective of the retrofit. This allows an improved manoeuvrability on a now narrower corridor and can also improve load efficiency if the smaller vehicle replaces a partially empty large vehicle. It also promotes the diversion of goods movement to low/zero-emission vehicles. On the other hand, some authorities have noted that the use of smaller vehicles can increase labour, fuel and operating costs, if the smaller vehicle must make multiple trips that formerly could be made by a large truck in a single trip. Moreover, increased trips to the same destination can mean increased competition for limited loading spaces.[347] All these factors can be taken into consideration in Complete Streets designs.

Logistics and land use

This section examines two means of consolidating loads for onward last-kilometre delivery in congested areas by smaller, greener vehicles. The two means are urban consolidation centres and microhubs. The discussion also considers inland ports which, among other objectives, can enable the transfer of large volumes of commodities from long-haul truck to rail.

Urban consolidation centres

Urban consolidation centres (UCCs), also known as urban distribution centres or urban logistics spaces, are "intended to optimize the delivery of goods in cities, on the functional and environmental levels, by setting up break-in-bulk points."[348] UCCs bundle or consolidate goods at strategically located points for onward delivery to consolidate less than full loads, reduce congestion and promote

[345] *Freight-Supportive Guidelines*, Ontario Ministry of Transportation, Toronto, 2015.
[346] M Roe and Toocheck C, *Curb Appeal, Curbside Management Strategies for Improving Transit Reliability*, National Association of City Transportation Officials, New York, 2017.
[347] A Bassok et al., *Smart Growth and Urban Goods Movement*, NCFRP Report 24, National Cooperative Freight Research Program, Transportation Research Board, Washington, DC, 2013.
[348] D Patier and F Toilier, *Urban Logistics Spaces: What Models, What Uses and What Role for Public Authorities?* In *City Logistics 2: Modeling and Planning Initiatives*, Taniguchi E and RG Thompson (Eds.), Wiley, Hoboken, New Jersey, 2018.

the use of sustainable modes (i.e., cargo bicycles and small electric vehicles) over the now-shorter final delivery legs.

The literature identifies four types of delivery consolidation ('bundling'), of which only bundling in depots (i.e., UCCs) has achieved significant benefits. This type of consolidation allows different carriers to combine their cargo at a central location. The aim is to reduce the number of trucks circulating on nearby streets. This increases the number of stops made per vehicle (productivity) and allows the combination of route itineraries or schedules (efficiency). UCCs have been promoted in several countries, almost entirely in Europe, the United Kingdom and Japan.[349]

There are three categories of UCCs:[350]

- UCCs that serve all or part of an urban area. This category, which constitutes the large majority of UCCs, is typically associated with the supply of retail products to nearby stores, but can also be used to supply office products and food supplies for restaurants. This category often serves a specific urban district, especially where narrow streets and historic layouts predominate and, as a result, there are many goods movement issues: vehicle congestion and delay, restricted access times, insufficient parking, a preference for pedestrians-only plans, and high levels of air pollution.
- UCCs serving large sites with a single landlord. Notably, serving retailers and restaurants that are located at airports, shopping centres and hospitals. The use of airport and shopping centre UCCs is driven by owners' desire to maximize retail space by minimizing onsite storage and the need for multiple delivery bays. For hospitals, the aim is to reduce onsite stock levels and storage space.
- Construction consolidation centres (CCCs). These UCCs are used to consolidate construction materials and tools for major building projects. The aims are to ensure that sites are well stocked while avoiding time-of-day delivery or noise restrictions (construction activity often starts early in the morning), minimizing delivery delays (which can shut down construction activities), reducing construction vehicles' impact on congestion and minimizing the need for on-street loading space at the site (which may not be available).

Whereas single-landlord UCCs can mandate that all tenants use the facility for their deliveries, and municipalities can require that contractors and suppliers use a CCC, typically no such obligations exist for the first, dominant category of UCCs. Similarly, single-landlord UCCs can be self-financing through charges built into tenants' rental arrangements, and municipalities can require owners to finance a CCC. As a result, the success rate of UCCs that serve all or part of an urban area has been mixed.[351]

Several complementary measures have been deployed to promote the acceptance and use by retailers of these UCCs, including shared and secure use of storage space by retailers, and the coordination of shipments among retailers, outsourcing of deliveries. For example, 11 department stores in the Kyoto-Osaka-Kobe area of Japan have been cooperating in the delivery of goods to consumers, although they still compete in sales. The program, in place since 1989, has reduced

[349] The other types are bundling in time (where a carrier consolidates its loads into fewer scheduled trips), bundling in activities (which aims to consolidate the deliveries of infrequent deliveries) and bundling in routing (optimizing the number of stops made on an itinerary). Except where noted, the ensuing discussion is drawn from Yamada T, *Cooperative Freight Transport Systems*. In *City Logistics: Mapping the Future*, Taniguchi E and RG Thompson (Eds.), CRC Press, Boca Raton, Florida, 2015.
[350] J Allen, M Browne, A Woodburn and J Leonardi, *The Role of Urban Consolidation Centres in Sustainable Freight Transport*, Transport Reviews, published online May 12, 2012.
[351] Ibid.

delivery vehicle kilometre travelled and labour hours. An initiative in Yokohama, Japan complemented a UCC with secure parking spaces for trucks, the enforcement of the removal of illegally parked vehicles, improved street crossings and the introduction of low-emission vehicles. Participation is voluntary. However, almost all trucking companies have complied with the system, which uses the UCC to transfer goods to compressed natural gas vehicles and human-powered carts for the final trip (about one kilometre). The use of UCCs has also been advocated to handle e-commerce deliveries and waste removal.

However, many test cases have had only a short lifespan – for example, in 2018 only 17 of 44 UCCs introduced in France in previous years were still in operation, although eight new projects were being considered. Factors include the additional costs of the transshipment (which otherwise would not be needed), the value of these additional costs exceeding the distribution system's overall performance, withdrawal of private sector partners because they could not establish a viable business case, difficulties in attracting partners' interest, problems with security (including thefts at the UCCs) and consumers who were highly sensitive to the resultant increase in products' prices.[352] The imposition of transfer penalties on carrier operations has also been noted.

As a result, there has been greater emphasis on strengthening the business case for the first, dominant category of UCCs. This has been done through increased government support, pricing mechanisms (e.g., road tolls) and the provision of additional services at these centres. As well, Intelligent Transportation Systems offer the potential to implement virtual consolidation centres, through improved communications between carriers and retailers. Access restrictions to large vehicles in core areas that are heavily pedestrianized and which have narrow streets (as in some parts of Paris, France), or which have strong security needs (as for retailers at Heathrow Airport in London), have resulted in viable distribution centres – although it is unclear whether or not this would be the case in the absence of restrictions.[353]

Microhubs

Microhubs are small consolidation facilities that supplement large UCCs. They are commonly found in central urban areas, bringing last-kilometre delivery closer to final customers. The concept has several variations, including both permanent and mobile applications. Several variations are described below, along with the relevance to uptake in Central Okanagan:[354]

- Conversion of underused mall space into micro-fulfillment centres. SmartCentres' Penguin pick-up service, is an example, although courier companies are also exploring the concept. Relevance: This is an example of how to repurpose existing vacant retail space, while reducing delivery vehicle VKT by promoting a multipurpose trip by the purchaser (e.g., picking up a purchase on the way home from work).
- Underground microhub. In late 2021, the City of Madrid launched a pilot microhub in a central underground parking garage. The microhub will allow distributors to use the facility for last-kilometre delivery to nearby homes, supermarkets and local stores using electric motorcycles

[352] D Patier and F Toilier, *Urban Logistics Spaces: What Models, What Uses and What Role for Public Authorities?*
[353] R Van Duin and J Muñuzi, *Urban Distribution Centers*. In *City Logistics: Mapping the Future*, Taniguchi E and RG Thompson (Eds.), CRC Press, Boca Raton, Florida, 2015.
[354] J Steinberg, *Delivery Notice: Sustainable Urban Freight Solutions for the Last Mile*, The Conference Board of Canada, Ottawa, 2022.

that can be charged in the garage, thereby improving air quality in the city centre.[355] Relevance: This is an example of the use of an existing centrally located parking facility to support a microhub.

- Business model for premium deliveries. In Ottawa, a local courier company noted that bicycle couriers are used to complement motorized delivery vehicles, especially to make deliveries downtown where parking is difficult to find. The choice of mode depends on the door-to-door travel time and the expected delivery envelope (i.e., customers pay premiums to have deliveries guaranteed within a certain period). The travel times are based on couriers' experience and consider their expectations of time spent in traffic and in looking for a parking space.[356] Relevance: This is an example of a sustainable practice that is driven by business principles (making it more amenable to private sector take-up). It offers flexibility in operation rather than an either-or trucks versus bicycles choice (making it more readily adaptable to a courier company's existing operations), and it works in a winter climate.
- Mobile microhubs. DHL, a global courier company, has implemented CityHubs in seven western European cities. The concept relies on the delivery of up to four trailers from a suburban depot to the inner city – i.e., the CityHub is mobile. These trailers are then unloaded and, depending on the delivery size, are placed on electric Cubicycles or electric scooters for final delivery by these small electric vehicles. The use of standardized containers enables rapid transfers among modes. The CityHub concept and the associated small electric vehicles are part of DHL's initiative for its logistics to be carbon-free by 2050.[357] Relevance: This is an example of a large-scale operation that uses standardized containers to provide last-kilometre deliveries. The operation also offers flexibility in locating the 'depot' (the delivery truck) at convenient locations, while also allowing for transfers of pick-ups to the truck for onward distribution at the main processing depot.
- Multi-tenant distribution mini-centre. Started in 2019, Montréal's Colibri Project uses the former downtown bus terminal as a central urban warehouse where a small number of large trucks could deliver packages for sorting and onward delivery by a fleet of e-cargo bikes operated by multiple couriers. The Colibri Project resulted from the City of Montréal's consultations with central business owners on ways to address the adverse impacts of deliveries in the city centre, with bicycle deliveries being one of 20 ideas put forward. Importantly, the City of Montréal already owned the former bus terminal which was vacant, has multiple bays and site access suitable for large vehicles and is located atop a key transfer point on Montréal's subway network. The Project attracted Purolator, a national courier, and two local couriers. The couriers share a general space while having their own areas to manage their own packages. The site also provides centralized overnight maintenance of the couriers' e-cargo bike fleets. In addition to ensuring the availability of the e-cargo bikes for the start of each workday, the centralized maintenance also resolved initial challenges associated with cold weather operating conditions. Combined, the three couriers make 800 deliveries daily and the e-cargo bikes can operate in snowy conditions even when trucks cannot. For its part, Purolator converted six existing truck delivery routes to e-cargo bike service, while retaining a small delivery truck to deliver large items that could not be handled by bicycles. The revised concept resulted in a 15% increase in deliveries and an overall increase in cost efficiencies (afforded by the lower costs of the e-cargo bikes compared with the trucks). An additional gain was achieved when the City granted the e-

[355] I Duxfield, *Madrid develops logistics microhub to boost low emissions delivery*, Eltis (Urban Mobility Observatory), posted October 26, 2021.
[356] David Kriger Consultants Inc., *Goods Movement Backgrounder*, City of Ottawa, April 2019.
[357] WP van Amstel, *DHL Express opens Cityhub in Groningen (NL)*, www.citylogistics.info, posted August 13, 2018.

cargo bikes permission to access pedestrian zones at any time, which were restricted to regular delivery trucks after midmorning.[358] Relevance: The Project demonstrates the importance of working with downtown businesses to understand their operations and delivery requirements, the ability to deploy a central location for multiple courier companies to share as a depot, the benefits of centralized maintenance to service the e-cargo bikes, the viability of operating e-cargo bikes in winter conditions, broader access afforded to e-cargo bikes over trucks, and the importance of having an available site (i.e., a financial subsidy to make the initiative financially attractive to participants, as noted in the UCC discussion).

- Neighbourhood delivery hub. In the summer of 2021, a neighbourhood delivery hub was pilot tested in Seattle. The concept is a "central drop-off/pick-up location for goods and services at the neighborhood level that can be used by multiple delivery providers, retailers, and consumers." Goods are brought to the hub by truck, then prepared for final delivery within a short bicycling distance. The hubs can include other amenities such as e-bike or scooter rentals, charging stations, parcel lockers and gathering spaces such as parks and cafés. The aim is to move delivery operations and complementary services closer to the end customer, potentially reducing congestion, lowering emissions (GHGs and air pollutants), consolidating deliveries, reducing vehicle-kilometres travelled and enable low/zero-emission last-kilometre deliveries. The 3½-month pilot evaluated the operational and environmental benefits of the hub, using e-cargo bikes as the vehicle for final delivery. Compared with a truck itinerary serving the same neighbourhood, delivery by e-cargo bicycle was more efficient, needing to cover less distance on average per package delivered (although the bicycle could not handle as many packages per hour as the truck). CO2 emissions per package were reduced by 30%. Overall, despite the short duration of the pilot test (and in summer weather), the evaluation found that the concept "can enable productive and more environmentally urban last-mile delivery compared to traditional delivery trucks (specifically cargo vans)."[359] Relevance: This is an example of how a microhub could be integrated with existing or complementary services, giving people multiple reasons to convene at a walkable/cyclable location near where they live.

Inland ports

Inland ports are multimodal facilities located away from traditional marine ports and other international gateways. They support intermodal transfer, typically among some combination of road, rail and air, potentially supporting a modal shift from (especially) trucks to rail. They also provide space for value-added processing and distribution. Inland ports are commonly connected to international gateways by road, rail and/or air.[360] Western Canadian examples include Winnipeg's CentrePort (air, rail and road connections), Regina's Global Transportation Hub (rail and road) and Edmonton's Port Alberta (air and road).

In BC, Ashcroft Terminal is served by both transcontinental railways and offers direct access to Highways 1 and 5.[361] A key motivation for the terminal's development was the lack of container storage space at Metro Vancouver's ports. The direct rail access provides an efficient way to reduce the number of empty containers at the ports while adding further opportunities for value-added

[358] B Lyster, *Montreal's Colibri eCargo Bike Project is a Rising Star in Mobility Solutions*, EBike International, posted April 1, 2021, and *Decarbonized Delivery Makes Urban Logistics Greener and More Effective*, City of Montréal, last modified July 13, 2021.
[359] Supply Chain Transportation & Logistics Center, *The Seattle Neighborhood Delivery Hub Pilot Project: An Evaluation of the Operational Impacts of a Neighborhood Delivery Hub Model on Last-Mile Delivery*, University of Washington, Seattle, September 2021.
[360] M Comerford, *Inland Ports: An Efficient Alternative*, Inbound Logistics, posted April 2020.
[361] *About Us*, Ashcroft Terminal, www.ashcroftterminal.com.

processing. A 2014 feasibility study conducted for the Corporation of Delta (home to the Deltaport container terminal at Roberts Bank) estimated that the development an inland port at Ashcroft (i.e., an expansion of the existing terminal) could achieve significant reductions in local truck traffic to/from Deltaport and in local congestion levels and GHG emissions. Other benefits include reduced demand for space to store empty containers and reduced pressure for development on Delta's agricultural lands.[362]

For Central Okanagan, there is an opportunity for logging operators to truck forestry products for transloading onto trains at Ashcroft or transfer containers of forestry products at Ashcroft, instead of trucking them to the Lower Mainland for export. The same opportunities apply to grain, specialty crops and other products that require space for handling.[363] Federal government funding was provided in 2018 for a multi-commodity storage warehouse that could support "natural resource producers, allowing them improved access to domestic and international markets."[364] Data on the types, tonnages and origins of commodities moved through Ashcroft are not available. Further analysis would be needed to examine the potential opportunities for Central Okanagan.

It should be noted, however, that the 2014 study did not consider the use of the Ashcroft terminal to distribute consumer and other goods imported via Deltaport to Interior communities, given that 65% of all import containers are already loaded directly onto eastbound trains and, more important, the volume of containers trucked to Kamloops/Okanagan was too low to justify a scheduled rail service – i.e., at 20,000 containers annually in 2014, the market was considered to be too small.[365]

[362] *Inland Port Study*, Council Report, The Corporation of Delta, September 4, 2014, and *Inland Intermodal Cargo Facility Study for the Corporation of Delta, draft 1.6*, August 15, 2014.
[363] *Canaan Group sets up at Ashcroft Terminal*, Inside Logistics, posted February 6, 2015.
[364] *Feds to fund improvements to Ashcroft Terminal*, Inside Logistics, posted May 18, 2018.
[365] *Inland Intermodal Cargo Facility Study for the Corporation of Delta, draft 1.6*, 2014.

Appendix G Analysis of truck routes

The City of Kelowna, through bylaw, has defined truck routes. Peachland has also designated Princeton Avenue on its truck route. In Kelowna, trucks over 13,700 kg in gross vehicle weight (roughly corresponding to heavy trucks in the Geotab data) are restricted to truck routes generally, unless proceeding to their final destination from the truck route by the "most direct route," or vice versa. Individual truck routes may be further restricted by time of day (i.e., trucks might only be able to operate on some between 7:00 AM and 7:00 PM). The 2040 OCP designates time restrictions of 7:00 AM to 7:00 PM on some roads and 7:00 AM to 10:00 PM on other roads, with Highway 97 available to truck traffic 24 hours a day.[366]

In other words, trucks can operate anywhere in the region (unless otherwise prohibited, e.g., due to bridge weight or height restrictions), but the route they must take to/from their destination/origin along the truck route can be more circuitous than the most direct route. An example of this circuity is trucks arriving from the Lower Mainland heading to Kelowna's North End, particularly to destinations closer to Ellis Street (or vice-versa). These trucks are required to follow Highway 97 and then Gordon Drive to access the North End, rather than via Ellis Street or Richter Street.

Beyond these regulations, in any community trucks can be prohibited from road segments due to neighbourhood concerns about cut-through traffic, noise, vibration and safety, the desire to avoid conflicts with incompatible land uses or vulnerable road users and more. For example, we understand that Gordon Drive is the designated truck route at least in part to avoid conflicts with heavy trucks moving through downtown Kelowna to the North End.

In addition, the Province's Commercial Vehicle Safety and Enforcement rules permit long combination vehicles (LCVs) on specified routes between Highway 97 and their designated origin/destination (see box "As per CVSE1014: LCV Operating Conditions & Routes"). The City of Kelowna does not specify LCV-permitted routes, but Bylaw No. 8120 specifies maximum allowable vehicle weight and dimensions, and a process for permitting vehicles that exceed these weights and dimensions.

To assess whether there is desire for trucks to use an alternative route not on the existing truck route network, we have mapped existing truck routes and heavy truck volumes, as well as goods movement generators. For mapping clarity, we have not shown volumes on the provincial highway network.[367] We assume most heavy trucks will be able to continue operating unrestrictedly on these highways, subject to provincial standards.

Figure G-1 shows the truck route network mapped against generators of heavy truck volumes. Truck routes generally radiate outward from Highway 97, with some routes paralleling Highway 97 for varying lengths (e.g., Glenmore Road/Drive and Springfield Road). The truck route network appears to adequately connect Kelowna's goods movement generators, with all zones having the heaviest volume density (**darkest blue**) located directly adjacent to the truck route network or a provincial highway.

[366] Map 13.4, *Truck Route Overlay*, 2040 Official Community Plan, City of Kelowna, 2022.
[367] The volumes on provincial highways can be an order of magnitude larger than those on the surrounding road network, so it is difficult to see flows on the surrounding road network while illustrating these flows.

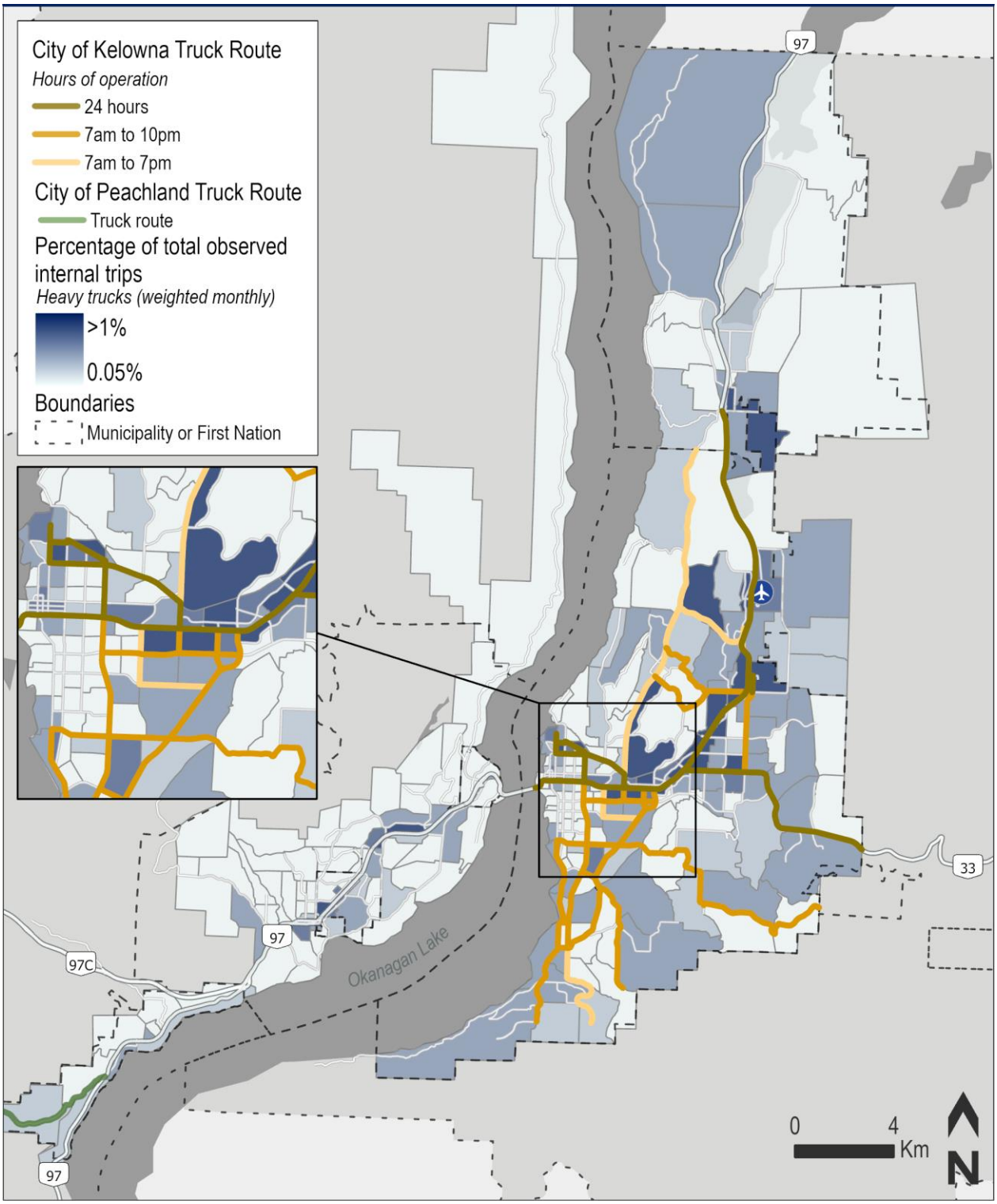
However, no north-south routes are designated between Lake Okanagan and Gordon Drive. This contributes to some trucks trips between areas west of Kelowna, and the North End or South Pandosy having to take more circuitous routes, as trucks coming from the west must stay on Highway 97 to/from Gordon Drive.[368] On the other hand, not designating additional north-south routes appears to limit the number of truck trips that travel through Downtown Kelowna and through the residential and institutional areas south of Highway 97 (e.g., Kelowna General Hospital). As noted at the end of this section, connectivity to goods movement generators and volumes are only two of many considerations in designating truck routes.

As per CVSE1014: LCV Operating Conditions & Routes

- Merritt (Highway 5/Hwy 97C interchange) to Kelowna (1100 Mayfair Road) From Highway 5 (Coquihalla Highway) northbound Exit 286 to Highway 97C (Okanagan Connector) eastbound heading toward Kelowna, exit Highway 97C to Highway 97 northbound, right turn at McCurdy Road, left turn on Mayfair Road, and left turn into 1100 Mayfair Road, and same route in reverse
- Kelowna (1505 Hardy Street) to Langley (9818-198BStreet) From 1505 Hardy Street, right turn onto Hardy Street, Right Turn merge onto Highway 97 southbound, Highway 97C ((Okanagan Connector) westbound), Highway 5 (Coquihalla Highway) southbound, Highway 1 westbound, Highway 1 westbound exit onto 176th Street, turn left onto 176th Street (Hwy 15), turn left onto Golden Ears Way, turn left onto 192nd Street, continue onto 98A Ave, turn right onto New Telegraph Trailer, turn left onto Telegraph Trail, turn left onto 196A Street, continue onto 98 Ave, continue to 9818-198B Street.
- Kelowna (1005 Ethel Street) – for Rocky Mountain Doubles only Inbound via Hwy 97 EB, Gordon Drive, Trench Place, Crowley Ave onto Ethel Place to site Outbound via Ethel Place, Tranch Place, Crowley Ave, Gordon Drive onto Hwy 97 WB
- Kelowna (2805 Acland Rd) From Highway 97 North, east on Edwards Road, north on Acland Road, east into site at 2805 Acland Rd and the same route in reverse
- Kelowna (2610 Enterprise Way) from Highway 33/Highway 97 intersection, west on Highway 33 to Enterprise Way, Enterprise Way to site at 2610 Enterprise Way, and same route in reverse
- Langley (9818-198B Street) to Kelowna From 9818-198B Street, turn left onto 96th Ave, turn right onto 199A Street, continue to 200th Street, turn left onto Hwy 1 (EB) on-ramp Highway 1 to Highway 5 (Coquihalla Highway), Highway 5 (Coquihalla Highway) northbound Exit 286 to Highway 97C (Okanagan Connector), eastbound heading toward Kelowna, exit Highway 97C to Highway 97 northbound, exit Highway 97 via left turn onto Loyd Rd, left turn into 354 Totom Ave.
- Alternative route from Highway 97 in Kelowna to site would be: Right turn from Highway 97 onto Stremel Rd, left turn onto Finns Rd, merge onto Finlay Rd, cross Highway 97 via Loyd St signalized intersection, left turn into 354 Totom Ave.
- 27. Kelowna (354 Totem Ave) to Langley From 354 Totom Ave, left turn out of yard onto Loyd Rd, right turn and merge on Hwy 97 southbound, Highway 97C ((Okanagan Connector) westbound), Highway 5 (Coquihalla Highway) southbound, Highway 1 westbound, Highway 1 westbound exit onto 176th Street, turn left onto 176th Street (Hwy 15), turn left onto Golden Ears Way, turn left onto 192nd Street, continue onto 98A Ave, turn right onto New Telegraph Trailer, turn left onto Telegraph Trail, turn left onto 196A Street, continue onto 98 Ave, continue to 9818-198B Street

[368] The degree of circuity varies by the specific origin and destination. For example, trips destined north of Gordon Drive experience no circuity. Trips destined areas near Richter might experience delays of 5-10 minutes by using Gordon Drive, depending on time of day and congestion.

Figure G-1: Truck routes and heavy truck generators, 2019

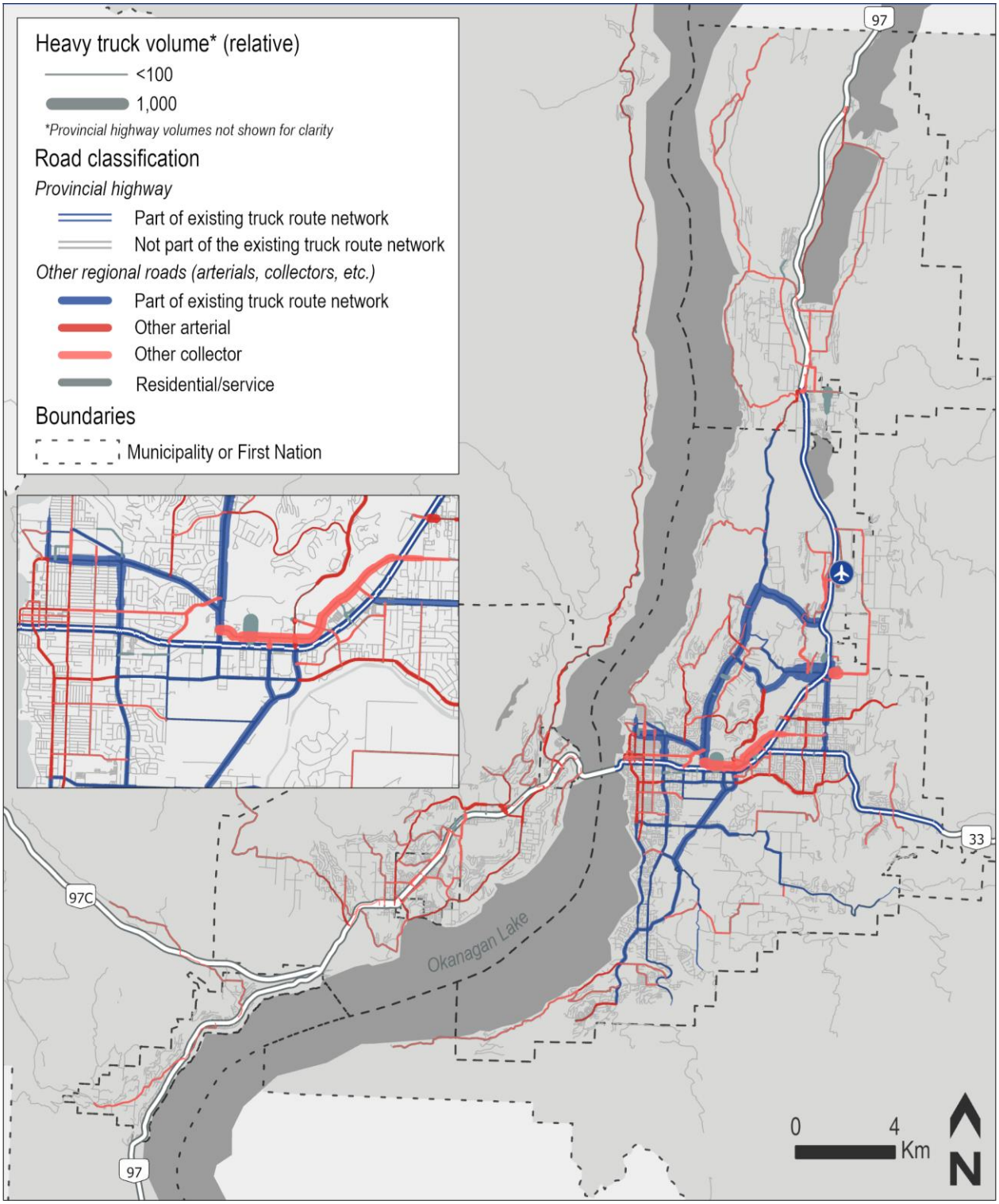


Source: CPCS analysis of Geotab data and City of Kelowna truck routes

Figure G-2 maps the relative volume of heavy trucks on Kelowna's truck route network (in **blue**) and on other roads (in shades of **red**). Most of the truck activity is concentrated on the truck route

network. However, some corridors off Highway 97 have high heavy truck volumes compared to existing truck routes. We identified the top 10 by volume in Figure G-3.

Figure G-2: Truck routes and heavy truck volumes shown, 2019



Source: CPCS analysis of Geotab data and City of Kelowna truck routes

Figure G-3: Top 10 links not on the truck network and not on Highway 97

Rank	Road name	Relative heavy truck volume	Notes/ observations
0	John Hindle Drive (between Glenmore Rd N and Hwy 97)	1.0*	Reference road, for which the sample volume was 870.
1	Hardy St (between Hwy 97 and old railway corridor)	1.6	Most direct path off of Highway 97 to access City of Kelowna yard
2	Beaver Lake Rd (between Hwy 97 and Jim Bailey Rd)	1.5	Most direct path off of Highway 97 to access Jim Bailey
3	Old Vernon Rd (between Acland Rd and Norris Rd)	1.3	Most direct path off of Hwy 97 to access industrial park
4	Westlake Rd (between Hwy 97 and Stevens Rd)	1.3	Most direct path off of Hwy 97 to access industrial park
5	*Enterprise Way (between Spall Rd and Hwy 97)*	*1.1*	*Partially for access, but also appears to be a through corridor*
6	Jim Bailey Rd (between Beaver Lake Rd and Jim Bailey Crescent)	1.1	Most direct path to access Jim Bailey Industrial Park
7	McCurdy road (between Hwy 97 and Alsgard St)	0.9	Possible high traffic resulting from construction in the area.
8	Norris Rd South (north of Old Vernon Road)	0.6	An industrial park access
9	Leathead Rd (between Hwy 97 and Dease Rd)	0.6	A relatively direct route to access industrial park north of Leathead Rd
10	Adams Rd (between Edwards Rd and Sexsmith Rd)	0.6	An industrial park access corridor

Source: CPCS analysis of Geotab data. * The relative volume is the average monthly heavy truck traffic compared to traffic on John Hindle Drive (a known truck route) during the same time period. The average monthly traffic was estimated based on four months of data from 2019.

Outside the designated truck route, most roads with high heavy truck volumes are either (1) accesses to a commercial or industrial area off the truck route (notably off Highway 97) or (2) access properties within an industrial area. Because these roads are generally the most direct first- or last-kilometre accesses to/from the adjacent industrial sites, heavy trucks can use these routes according to the bylaw.

While they do not need to be specifically designated for enforcement purposes, there is potentially policy value to designating these (and similar commercial and industrial accesses) as truck routes or, as part of a strategic goods movement network, for several reasons:[369]

- Consider ways to manage truck traffic according to the corridor context, if necessary, such as two-tiered truck route designations. For example, Regina's two-tiered truck route network prohibits large trucks from operating through certain inner city residential neighbourhoods, although medium-sized trucks are permitted.
- Inform asset management plans and priorities, so that future road and intersection improvements can accommodate heavy vehicles safely. For example, Durham Region, an urban/rural municipality east of Toronto, recognizes that future road upgrades should be able to remove seasonal road restrictions.

[369] Whereas truck routes are considered an operational/regulatory designation that can be modified in short order, strategic goods movement networks are meant to inform more permanent initiatives such as asset management decisions, corridor plans and land use plans.

- Inform future corridor plans for Complete Streets, especially to ensure that vulnerable road users and trucks can both be accommodated safely (and, if appropriate to the right of way's design and operational characteristics, identify the need for physically separating active transportation pathways from the road or to avoid co-locating truck routes and Complete Streets). A just-released plan for the Toronto-centred mega-region identified and resolved conflicts between 'truck heavy' corridors and planned transit improvements.
- Inform plans for geometric design to accommodate long-combination vehicles (LCVs). MOTI has a designated a series of routes over which LCVs are permitted. While these routes might follow the shortest path to their destination, LCVs are longer and heavier vehicles and thus have different design considerations to move safely and fluidly across the network.
- Inform plans for adjacent land uses and alert potential property owners or lessees as to how the road is used. The City of Calgary provides one example, in which the large majority of future industrial land development is intended to be located within one kilometre of its Primary Goods Movement Network, which is distinct from its Truck Route Bylaw.

It should be noted that Enterprise Way, while not currently a truck route, has truck volumes comparable to existing truck routes. Enterprise Way provides the most direct access to local businesses from the truck route network. However, the high truck volumes suggest that the route may also act as a bypass to Highway 97. In addition, there are moderate relative truck volumes flowing along Rifle Road and Dilworth Drive, which in turn connects to Enterprise Way and Highway 97. Accordingly, consideration should be given to designating Enterprise Way as a truck route.

Outside Kelowna, there are heavy truck volumes on non-truck routes, including Main Street and Pelmewash Parkway in Lake Country and Boucherie Road in West Kelowna. However, relative to heavy truck volumes on Highway 97, these volumes are small, and may partially be serving businesses in the area. These municipalities also have a sparser road grid than Kelowna, so few alternatives exist to accessing commercial and industrial areas. Formally designating these corridors as truck routes could result in increased through truck traffic on corridors parallel to Highway 97, which was not viewed as desirable.

Nonetheless, outside the City of Kelowna municipalities should consider the benefits of formally designating a truck route network. As a priority, with potential road network developments being considered north of Ellison/Duck Lake, consideration should be given to establishing truck route(s) for access to the Jim Bailey Industrial Park. A potential extension of Commonwealth Avenue to Highway 97 or Glenmore Road North would result in heavy trucks flowing through a residential area on the Duck Lake reserve. Commonwealth Drive could be designated a truck route only during daytime hours (7:00 AM-7:00 PM), to avoid noise in the evening and overnight, provided other access (i.e., Beaver Lake Road) is maintained as well. There would also be a gap in the truck route along Glenmore Drive in Lake Country if Commonwealth Road were connected.

It is important to note that this assessment is based exclusively on an analysis of truck volumes, the routes used by trucks and the locations of major truck trip generators. The decision to include, or not, a particular road segment in a truck route network must account for volume, connectivity and road function but also must consider other factors.

Appendix H Monetization of delay methodology

Most stakeholders pointed to congestion along Highway 97 as being a primary issue. Stakeholders also pointed to a range of infrastructure and non-infrastructure solutions that might address this issue. This calculation aims to quantify the significance of this issue from a goods movement perspective at a rough, order-of-magnitude level, in order to provide some guidance on the types of solutions that could be explored.

We reiterate that the estimates presented represent the potential addressable delay. Any given infrastructure or non-infrastructure solution implemented will only be able to reduce a portion of this delay. In addition, simplifying assumptions were made to address data limitations and make the calculations tractable given the scope of this study.

Using three daytime periods (AM [7-9]; Mid-day [9-15]; and PM [15-18]) from the truck GPS (Geotab-sourced) data, we estimate two values of delay and reliability on **a per vehicle basis:**

1. *The value of delay*, i.e., the value associated with the additional travel time between congested daytime average travel times (in each of the three periods considered) and overnight travel times. When computing the overnight travel time, the overnight travel *speed* was factored by 90% to reflect the possibility of speeding impacting travel times.

2. *The value of (un)reliability,* i.e., the value associated with the variability between **average** travel time and longer travel times that can be experienced during the day (as measured by the 95th percentile travel time). This estimate aims to follow NCHRP Report 925, Estimating the Value of Truck Travel Time Reliability. This was estimated in each of the three periods.[370]

For both estimates, in order to compute the daily value of delay, we estimate of the number of trucks impacted daily for each of the three time periods considered: AM (7-9); Mid-day (9-15); and PM (15-18). This estimate was based on the following:

i. The average daily volume of medium- and heavy-good movement vehicles counted at the WR Bennett Bridge in 2021. Because medium vehicles include non-goods movement (MOTI classifies vehicles based on length), the estimate of medium trucks assumed only 20% of medium vehicles are goods movement related. MOTI counts were used as the truck GPS data is based on a sample of goods movement vehicles (without an associated expansion factor available).

[370] NCHRP Report 925 using one-hour periods in estimating the value of reliability (versus 3-6 hour estimates in our analysis). Our approach may overestimate the 95th percentile in any given period, as it considers a larger sample of time. However, we also noted that Google Maps, when using the “depart at function”, would provide a wide range of possible travel times, regardless of the time of day.

ii. An estimate of the proportion of trucks operating along the entire corridor from WR Bennett Bridge to McCurdy Road (an attrition factor). This was estimated based on the average of counts at the WR Bennett Bridge and Lake Country Highway 97 count station.

iii. Once these daily estimates were made, they were distributed across the three time periods based on the relative daily distribution provided by the truck GPS data.

The daily value of delay and 95th percentile delay was then estimated using the product of the daily truck volumes in each of the three periods, and the respective delay values per truck.

To estimate the daily value of delay (Item #1), we multiplied the daily delay by the value of time used in current MOTI BC Default Values for Benefit-Cost, 2018, inflated by 6% to 2021.

To estimate the daily value of (un)reliability (Item #2), we multiplied the Daily 95th percentile delay by a value of reliability. The value of reliability is very context specific. As a BC-specific value was not available, rather than apply the NCHRP Report 925 value directly (which is US-based), we capped the value of unreliability at two-times the value of time.[371]

Both values were annualized using 365 days per year.

We estimated the approximate present value of the annual delay using a uniform series present value factor (P/A), assuming a 6% discount rate. We estimated no growth in traffic volumes or congestion (delay) in this estimate.

Further details are provided in the tables below.

[371] NCHRP Report 925 estimated value of reliability using a stated preference survey that was approximately 2.5-times higher than the value of time. An interpretation of this finding is that trucks value improvements to reliability (e.g. 95th percentile travel time) more than improvements to average time.

Estimated delay along Highway 97 between WR Bennett Bridge and McCurdy Road

CPCS, based on Geotab data, October 2021

Input assumptions

Days per year	365	Calculations are based on AADT
Discount rate	6%	Noted in MOTI, BCA Guidance
P/A, 6%, 25 years	12.783	
Traffic volume at WRB, medium	1108	2021, based on MOTI counts, assuming 20% of count are goods movement related (vs other types of non-goods movement vehicles)
Traffic volume at WRB, heavy	1550	2021, based on MOTI counts
Attrition, medium	72%	Proportion of trucks that travel along entire segment, estimated as average of WRB Bridge and Lake Country H97 count
Attrition, heavy	86%	Proportion of trucks that travel along entire segment, estimated as average of WRB Bridge and Lake Country H97 count
Value of time, medium	$38.11	BC Default Values for Benefit-Cost, 2018, Straight truck time-related costs + Driver Value of Time
Value of time, heavy	$47.10	BC Default Values for Benefit-Cost, 2018, Tractor/trailer time-related costs + Driver Value of Time
Value of reliability	$85	NCHRP Report 925, Estimating the Value of Truck Travel Time Reliability, estimates ~$200 CAD (or approximately 2.3 times the value of time) on average; however, is heterogenous depending on factors such as the type of cargo, trip distance, etc. We have capped our estimate at 2-times the MOTI value of time.
Inflation (2018-2021)	6%	Based on Bank of Canada Inflation Calculator

Calculation of number of trucks impacted

		AADT	AM (7-9)	Mid-day (9-15)	PM (15-18)	Notes
			18.0%	67.0%	6.4%	Based on Geotab distribution
Daily truck volume	Medium	1,108	199	743	71	
	Heavy	1,550	279	1,039	99	
Daily trucks experiencing delay	Medium	799	144	536	51	Total volume x attrition
	Heavy	1,338	240	897	85	

Calculation of delay

Average delay per truck			1.5	3.5	4.3	Average delay in each direction
Minutes						Difference between average overnight travel time. Overnight speed factored by 90%
Total daily delay	Medium		217	1,886	218	Trucks experiencing delay x average delay
Minutes	Heavy		363	3,158	365	
Daily value of delay	Medium	$1,563	$146	$1,270	$147	Daily delay x value of time x inflation
$	Heavy	$2,617	$245	$2,126	$246	
	Total	**$4,179**	**$391**	**$3,396**	**$393**	
Annual value of delay	Medium	$570,358	$53,320.37	$463,454.57	$53,583.37	Daily value of delay x days per year
$	Heavy	$955,040	$89,282.67	$776,034.76	$89,723.05	
	Total	**$1,525,399**	**$142,603**	**$1,239,489**	**$143,306**	
Capitalized value	Medium	$7,290,890				Based on 25-years, no traffic growth
	Heavy	$12,208,282				
	Total	**$19,499,173**				

Calculation of (un)reliability

95th percentile delay per truck			6.9	8.8	9.9	95th percentile speed - average travel speed
Minutes						
Daily 95th percentile delay	Medium		991	4,731	502	95th percentile delay x trucks experiencing delay
Minutes	Heavy		1,659	7,923	841	
Daily value of (un)reliability	Medium	$8,840	$1,407	$6,719	$713	
$	Heavy	$14,802	$2,356	$11,251	$1,195	
	Total	**$23,642**	**$3,763**	**$17,971**	**$1,908**	
Annual value of (un)reliability	Medium	$3,226,631	$513,605	$2,452,613	$260,413	Based on 25-years, no traffic growth
$	Heavy	$5,402,855	$860,009	$4,106,796	$436,050	
	Total	**$8,629,486**	**$1,373,614**	**$6,559,409**	**$696,463**	
Capitalized value	Medium	$41,246,026				
	Heavy	$69,064,698				
	Total	**$110,310,724**				
Annual value of both	Medium	$3,796,989	$566,925	$2,916,068	$313,996	Sum of value of delay and (un)reliability
$	Heavy	$6,357,896	$949,292	$4,882,830	$525,773	

	Total	**$10,154,885**	**$1,516,217**	**$7,798,898**	**$839,770**	

Capitalized value (both)	Medium	$48,536,916
	Heavy	$81,272,980
	Total	**$129,809,897**

Note: All figures unrounded for calculation purposes

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