City of Courtenay

OFFICIAL COMMUNITY PLAN
PHASE 1 BACKGROUND RESEARCH REPORT

VERSION 2.0
JUNE 2020

CITY OF
COURTENAY

Note to reader: this report is a resource document only and has been assembled using a wide variety of data sources. Specific terminology regarding land use, business sector, housing or other data classifications throughout the report may differ slightly based on data source. The terminology used in the report shall not be used to interpret the Courtenay Official Community Plan, Zoning Bylaw, or other City regulations.

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The City of Courtenay respectfully acknowledges that we are located within the unceded traditional territory of the K'ómoks First Nation.

Executive Summary

There are countless ways to describe the qualities of a community, and they cover diverse realms that include natural systems, social and economic aspects, buildings, infrastructure, public spaces, and more. This document begins to build a baseline for Courtenay, focusing on key factors that are important to understand in creating Official Community Plan policies and to tackling the climate emergency at the local level. The baseline will be an important reference point against which future urban growth and structure scenarios wil be developed and tested.

Part 1 offers a history of Courtenay, beginning with Time Immemorial.
Part 2 provides a snapshot of existing conditions, including: community greenhouse gas (GHG) emissions; population and demographics; jobs; housing; regional context; current land use inventories; land use mix including access to daily needs and amenities; population and employment densities; urban form including connectivity, gateways, and streetscape character; streets and movement for walking, cycling, transit, vehicles, and goods movement; environment and ecology; and human-made infrastructure including water and sewage, solid waste, rainwater management, flood management, and food systems. Part 2 also offers a brief overview of existing plans and strategies that relate to and will influence and/or be influenced by the new OCP.

Part 3 provides an overview of community energy and emissions in Courtenay for both the baseline in 2016 (as above) and a forecast to the year 2051 under existing business-as-usual conditions. Part 3 also introduces the neighbourhood boundary process that forms part of the broader OCP process, and summarizes the overall baseline analyses in terms of “emerging themes”.

The emerging themes are not intended to be all encompassing. However they do begin to capture some of the important trends and big picture challenges/opportunities that this OCP process might consider as it embarks on a plan to tackle the climate emergency and deliver on an array of other community goals.

The emerging themes are:

- The climate emergency has arrived in Courtenay
- Transportation is the largest challenge and the greatest opportunity
- Land use policy is climate policy
- Growth has become less efficient over time
- Downtown is a strength and a precedent
- The city has access and choice, but not in every neighbourhood
- Local ecology offers both unique character and the vital services of nature
- Courtenay's people are at the heart of this OCP's success

These themes will continue to be shaped by the community’s input on aspirations, challenges, and opportunities. They will be further evolved as additional analysis and planning are undertaken in future phases of the OCP process.

Part 1.

COURTENAY YESTERDAY

Looking ahead to the future begins with understanding from where we have come.

> **“Comox” is an anglicization of K’ómoks, which is derived from the Kwakw’ala term, kw’umalha, meaning “plentiful, rich, or wealthy”**

1.1 TIME IMMEMORIAL

<<The following text focuses on the K’ómoks First Nation. Permission is needed to use this language, and to confirm its accuracy.>>

Since Time Immemorial the K’ómoks First Nation have stewarded and cared for the lands and waters that make up Courtenay today.

The following text is borrowed from the K’ómoks Comprehensive Community Plan:

“Comox” is an anglicization of K’ómoks, which is derived from the Kwakw’ala term, kw’umalha, meaning “plentiful, rich, or wealthy”. Oral history and archaeology describes a rich and bountiful relationship between the K’ómoks people and the land of plenty. K’ómoks traditional territory stretches across the Salish Sea from the lands currently known as Vancouver Island, extending north of Salmon River to south of the Englishman River watershed. K’ómoks First Nation members are Kwakwaka’wakw and Northern Coast Salish people who assert their shared heritage, history and culture. Their language and spiritual practices are tied to the lands, waters, and resources that are found in the K’ómoks area.

The technologies that were applied in harvest, preparation, and cultivation of local resources were appropriate to the environment, resource, and spiritual beliefs. Fish weirs, duck nets, berry

According to Island Comox cultural traditions, the origin of the people began at the meeting of the Quinsam (kwaniwsam) and Campbell Rivers. Mary Clifton, the last speaker of the Island Comox dialect, has conveyed the origin story of a man named Shalhk'em and woman named Tisitl'a that "dropped down from the sky" at kwaniwsam (Quinsam) in present-day Campbell River. With them, they brought the mask and garments of the Xwayxway and together became the first ancestors of the Island Comox people. For the descendants of the Shalhk'em and Tisitl'a, kwaniwsam remains the central location in which Island Comox territory moves outward to Salmon River in the north, Cape Lazo in the south, and the islands in the Salish Sea (formally the Strait of Georgia).

picking techniques and clothing design met the needs of the K'ómoks people and for generations provided variety, utility and sense of cultural uniqueness. Mask dances and songs filled the winter nights and season. Property was distributed to guests in potlatches, and naming ceremonies honored the youth, leaders and elders of the communities.

The K'ómoks First Nation have inhabited central Vancouver Island from the height of the mountains to the Eastern coastline and adjacent islands in the Salish Sea since time immemorial. The families who make up the present day First Nation share a rich history and traditions traced back to Pentlatch, Kwakwaka'wakw, Coast Salish, and Nuu-cha-Nulth groups. Current archaeological research confirms the occupation of the K'ómoks First Nation territory by First Peoples thousands of years before first contact with Europeans."

1.2 A PLANETARY PERSPECTIVE

Courtenay is both defined and influenced by large scale environmental forces. The land on which the Comox Valley is located formed approximately 400 million years ago as submarine volcanic eruptions gave rise to Vancouver Island. Eighty million years ago a warm shallow sea covered the area. Since then, the same tectonic forces that created the island have lifted the area up to expose an ancient seafloor. The valley's geology produced a lush watershed habitat for the first people who inhabited the region. The abundance of natural resources, such as coal seams, fertile soils, and timber, subsequently attracted an influx of people from around the world.

Over this same time period, the Earth's climate has continuously changed; however, since the mid 20th century, planetary warming has increased exponentially as a result of human based activities (Figure 1.1). This has led to large scale changes in planetary health, including global temperature rise, warming oceans, glacial retreat, ocean acidification, and sea level rise. As the climate continues to shift, the severity and frequency of extreme weather events in British Columbia will also increase, resulting in greater climate risks such as wildfires, flooding, and extended periods of drought.

1.3 THE COURTENAY RIVER

Courtenay's history is intertwined with the rivers that intersect the city. The Puntledge and Tsolum Rivers merge to become the Courtenay River. It was the building of a bridge across this river that enabled the development of the west side of Courtenay and the eventual establishment of Courtenay as a regional centre. The Courtenay River and surrounding watersheds continue to be guiding elements in the city's evolution, reminding residents of the bioregion of which they are apart and must protect.

Image - The Courtenay River Floods, December 2014.

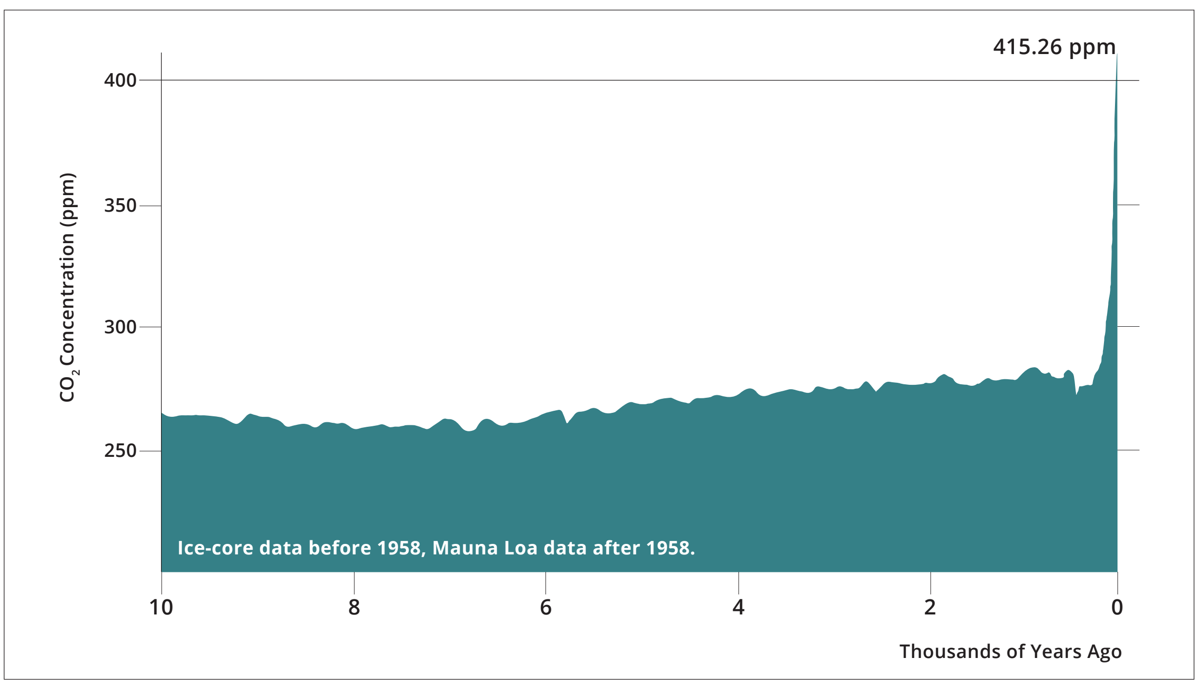

Figure 1.1 - CO_2 Concentration Over Time as Recorded by Measurements of Arctic Ice and the Mauna Loa Observatory. Courtesy of the Scripps Institution of Oceanography.

1.4 TIMELINE OF COURTENAY HISTORY

TIME IMMEMORIAL

Since Time Immemorial the K'ómoks have stewarded and cared for the lands and waters that make up Courtenay today.

1916

DOWNTOWN HEART

The downtown heart of Courtenay establishes on the west side of the river, with the first City Hall built in 1916. During this time, Courtenay experiences rapid development, in part through the Land Settlement Board of BC, which promoted land settlement and development work.

1937

THE RIVI

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Courtenay
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1977.

196

1901

EARLY SETTLERS

Early settlers arrive in the Comox Valley after the gold rush in the 1860s, profiting from an abundant valley well-suited for agriculture and logging. A series of developments, including Pidcock's mill in 1872, a bridge connecting the east and west side of the river in 1874, McPhee's general store in 1894, the Comox Co-operative Creamery in 1901, and the arrival of the Canadian Pacific Railway in 1914, solidify Courtenay's position as an emerging city. The City of Courtenay incorporates on January 1st, 1915.

1928

IMPORTANT CIVIC ASSETS

This period of time saw the development of two important sites in the city's history – the Native Sons Hall and Lewis Park.

1950s

ER

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ooding. This is
replaced with
oinwalls starting in

EAST SIDE DEVELOPMENTS

Development of Crown Isle Golf Resort and Community, Canadian Tire, Superstore Plaza, and North Island College, all shift the focus to the east side of the river.

1980s

1996

CONTINUED GROWTH

In 1996 Courtenay gained the distinction of being 'the fastest growing city in all of Canada.'

SHIFTING PRIORITIES

The Rotary Trail along the E&N Rail corridor is constructed, contributing to the continued expansion of the city's walking and cycling network, emphasizing the role of green infrastructure as part of the city's fabric.

0s

ARTS, CULTURE, AND RECREATION

Significant growth in land area during this period parrallels expansion of culture, arts, and recreation opportunities, including Puntledge Park, Comox Valley Sports Centre, and a new Civic Theatre.

2010s

s

1970s

CHANGING COMMERCIAL LANDSCAPE

To alleviate increased vehicular traffic, a bridge crossing at 17th St. is constructed. The construction of Driftwood Mall commences, shifting commercial activity south of the Downtown precinct.

2000s

TODAY

A comprehensive overview of Courtenay as it exists today forms Parts 2 and 3 of this document.

THE MODERN CITY EMERGES

With increasing population and changing technology, the City of Courtenay evolves as a modern city - School District 71 forms in 1946, a sewer system, concrete sidewalks, and the current 5th St. bridge are all developed. The first set of apartments are built in 1956 at the corner of 14th Street, at Grieve Avenue.

A VARIETY OF EXPERIENCES

This time period sees both an expansion of "Big Box" stores as well as a rejuvenation of public buildings, including a new Public Library and Fire Hall, renovated Civic Theatre (renamed Sid Williams Theatre), Comox Valley Art Gallery, the Courtenay & District Museum, renovations of the Native Sons Hall and City Hall – all reinforcing downtown as the continued heart of Courtenay.

1.5 ANNEXATION HISTORY

Since Courtenay's incorporation in 1915, the geographic extent of the city's boundary has expanded significantly on both the west and east sides of the Courtenay River (Figure 1.2).

As is typical in other communities, the oldest part of the city is the present-day downtown core. West Courtenay is generally older than East Courtenay, both in terms of incorporation into the City and in the age of the building stock, which is discussed in the following pages.

Within about a half century of incorporation (by 1968), Courtenay roughly doubled in size. **During the following half century (until 2013), physical growth was far more significant, with the City more than tripling in size.** This was due not only to population growth, but to a lower density pattern of development that is less spatially efficient.

How growth is managed during the next half century will have a tremendous impact on whether Courtenay is able to achieve its GHG emission reduction targets.

Figure 1.2 - Courtenay Boundary Extension History. Source: City of Courtenay.

1.6 RESIDENTIAL BUILDING AGE

The distribution of the age of homes in Courtenay highlights the various eras of development that have occurred since the 1900s, and is presented in Figure 1.3.

Newer residential buildings are largely concentrated in East Courtenay around Lerwick Road, Crown Isle, and Mission Road, while older buildings are concentrated in the Old Orchard area and south of the downtown core. A few newer developments are also concentrated in clusters on the periphery of West Courtenay near the city's boundary.

As also evidenced in Figure 1.2 (Boundary Extension History), the bulk of physical growth has occurred in recent decades, with newer homes accounting for significant expansion at the city's periphery.

Although there is no clear correlation between building age and GHG emissions, Figure 1.3 reveals how neighbourhood-level approaches to greening the building sector (e.g. through retrofits) may vary across the city, depending on the age of the building stock.

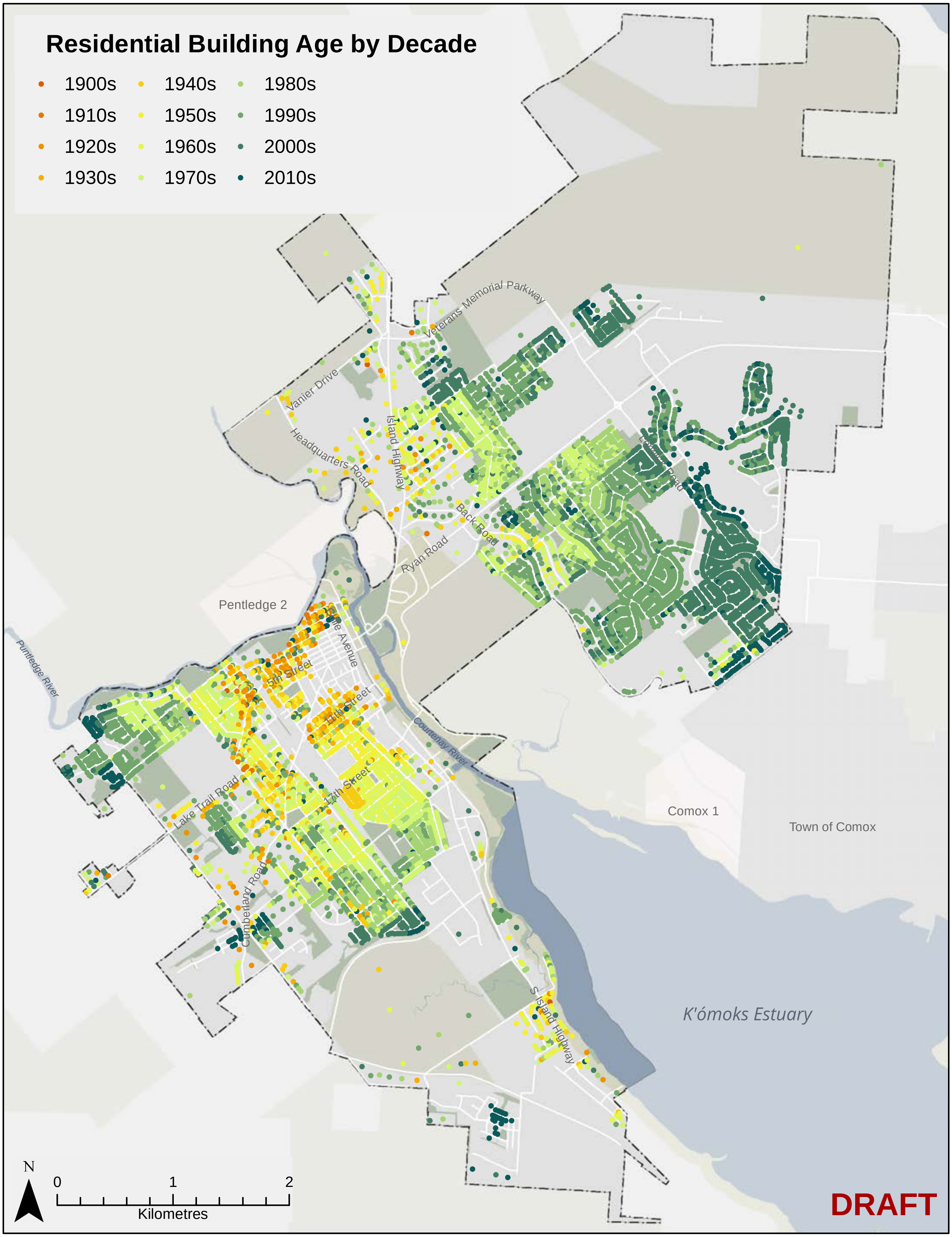


Figure 1.3 - Residential Building Age by Decade. Data Source: BC Assessment, 2016.

1.7 NON-RESIDENTIAL BUILDING AGE

Figure 1.4 reveals the pattern of growth for non-residential (often commercial) development. Until the 1980s, the majority of non-residential buildings were focused in the downtown core and in a corridor extending southeast along Cliffe Avenue.

Since then, and specifically during the 1990s, 2000s, and 2010s, several areas of new buildings emerge in low-density clusters outside of the core. These include the area around Driftwood Mall and Canadian Tire in South Courtenay, and a cluster of 'big box' developments in East Courtenay around the Real Canadian Superstore and Costco.

The density of older buildings in the downtown core contributes to a unique sense of place, history, and identity, and helps establish a pedestrian-oriented environment. Older commercial buildings are also typically at a scale that attracts and is appropriate for smaller – and potentially locally owned – retail spaces.

Conversely, newer commercial buildings at the periphery tend to be large-format (or "big box"), geared toward chain stores and creating more car-centric/ dependent environments.

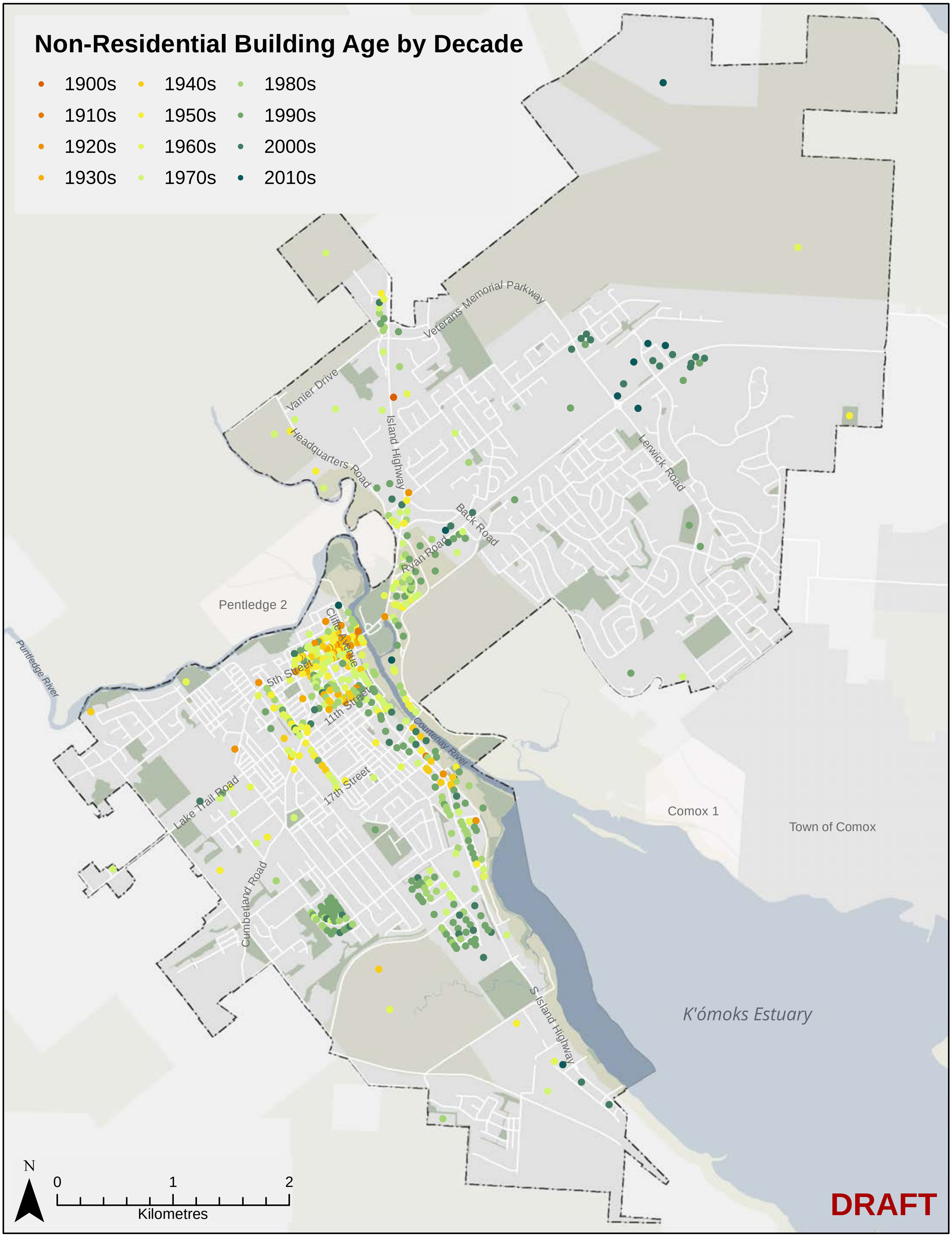


Figure 1.4 - Non-Residential Building Age by Decade. Data Source: BC Assessment, 2016.

Part 2.

COURTENAY TODAY

The climate crisis is here. Exploring different future urban scenarios to tackle this crisis – and to meet a host of other community goals – begins with creating a baseline of existing conditions today.

2.1 COMMUNITY EMISSIONS

Courtenay – along with the rest of the world – is in the midst of a climate emergency. Determining how to best tackle this crisis begins with understanding current emissions.

Modelling for the 2016 baseline year was completed using the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC Protocol) framework, which organizes emissions sources by three scopes (Figure 2.3). Scopes considered in Courtenay's emissions inventory and modelling include all of Scopes 1 and 2, as well as some of Scope 3 (emissions resultant from energy generation outside the city boundary).

Courtenay's total community emissions in 2016 was 93,200 tonnes of carbon dioxide equivalent (tCO2e). The emissions resulted from energy use in buildings, transportation, and infrastructure, as well as solid waste and wastewater decomposition.

Transportation accounts for 59% of Courtenay's emissions, and is thus the area in which most change must occur. As explored throughout Part B, land use and urban form play a vital role in reducing transportation-related emissions. They also fall under "Scope 1" – meaning that they are within the City boundary – and are within the jurisdiction and influence of City Hall.

Compared to most Canadian cities, Courtenay's total community emissions are low and at 2.9 tCO2e/year per capita, Courtenay is well below the provincial average of 13 tCO2e/year and national average of 19.5 tCO2e/year. Even so, reductions in emissions are paramount in order to meet internationally established targets that prevent global temperatures rising above 1.5 degrees Celsius, Furthermore, other imperatives for pursuing energy efficiency and emissions reductions in the community include pollution reduction, economic justifications, and health benefits.

A forecast for community emissions to the year 2051 under existing business-as-usual policies, actions, and strategies, is included in Part 3 of this document.

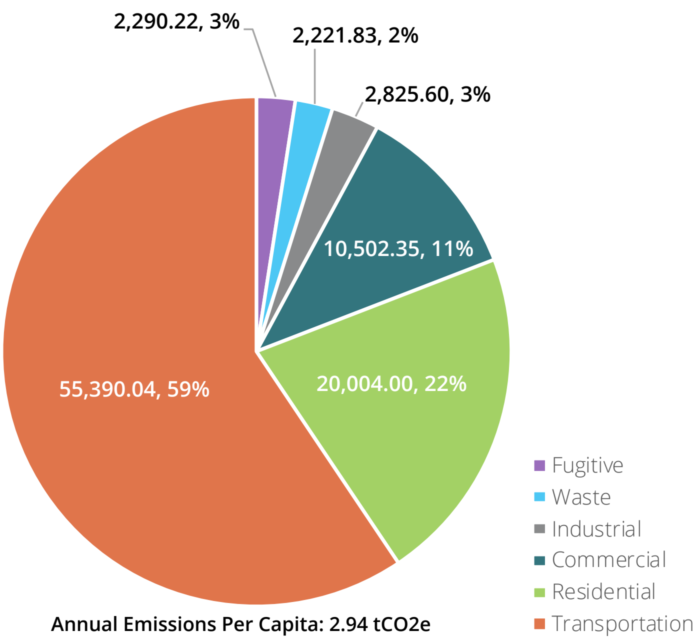


Figure 2.1 - Courtenay Emissions By Sector for Baseline Year 2016. Source: Sustainability Solutions Group, 2020.

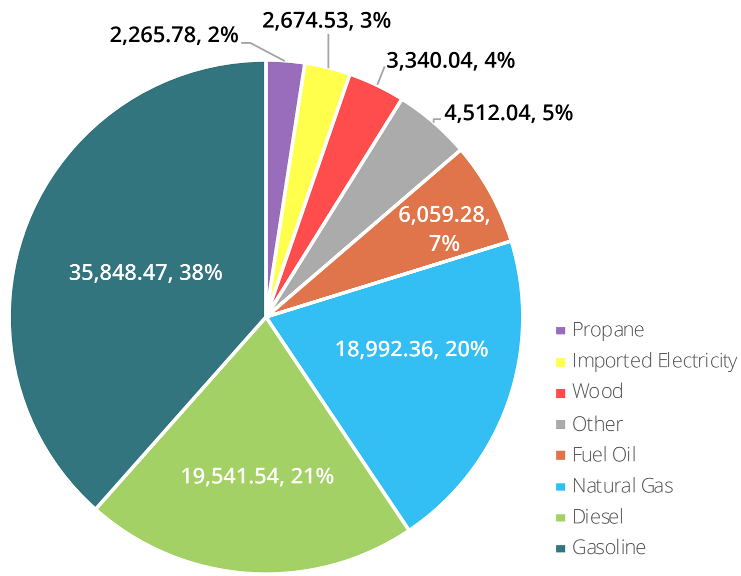


Figure 2.2 - Courtenay Emissions By Source for Baseline Year 2016. Source: Sustainability Solutions Group, 2020.

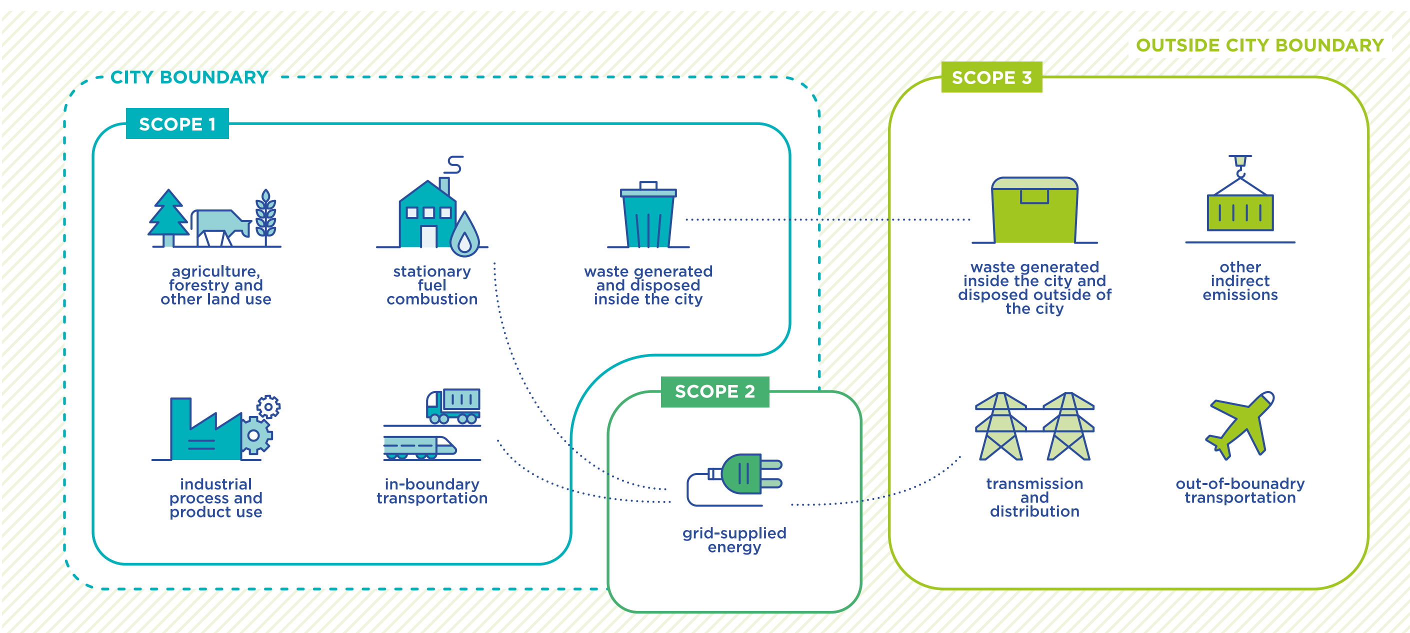


Figure 2.3- GPC Emissions Scopes as They Relate to Geographic and Inventory Boundaries. Source: Consumption-Based Inventories of C40 Cities.

2.2 PEOPLE, EMPLOYMENT, AND HOUSING

2.2.1 POPULATION AND DEMOGRAPHICS

Courtenay has an estimated current population of 25,595, projected to grow by 27% to reach a total of 32,502 by 2051, with interim populations of 31,696 in 2041 and 30,085 in 2031.

As presented on the opposing page, the population is expected to continue aging, with substantial growth among the 75+ age group. Conversely, the population of residents aged 25 and under is expected to decrease during this period.

The city has a current average age of 45.8 which is slightly higher than the provincial average of 42.3, as of the 2016 Statistics Canada Census. Although the entire province is expected to age during the projection period, it is expected that Courtenay will continue to have a slightly older average age when compared to larger urban centres on Vancouver Island such as Victoria, which consistently attracts a younger demographic due to more employment and education opportunities. The aging population is also correlated with an average household size of 2.1, lower than the provincial average of 2.4.

The average household income within the city is currently $69,468. The average total income of one-person households is $39,728, whereas the average total income of two or more person households is $84,204. These figures are lower than respective provincial averages of $90,354, $46,696, and $108,010. The city has a relatively even distribution of incomes, with 41% of households earning between $20,000 and $60,000 per year.

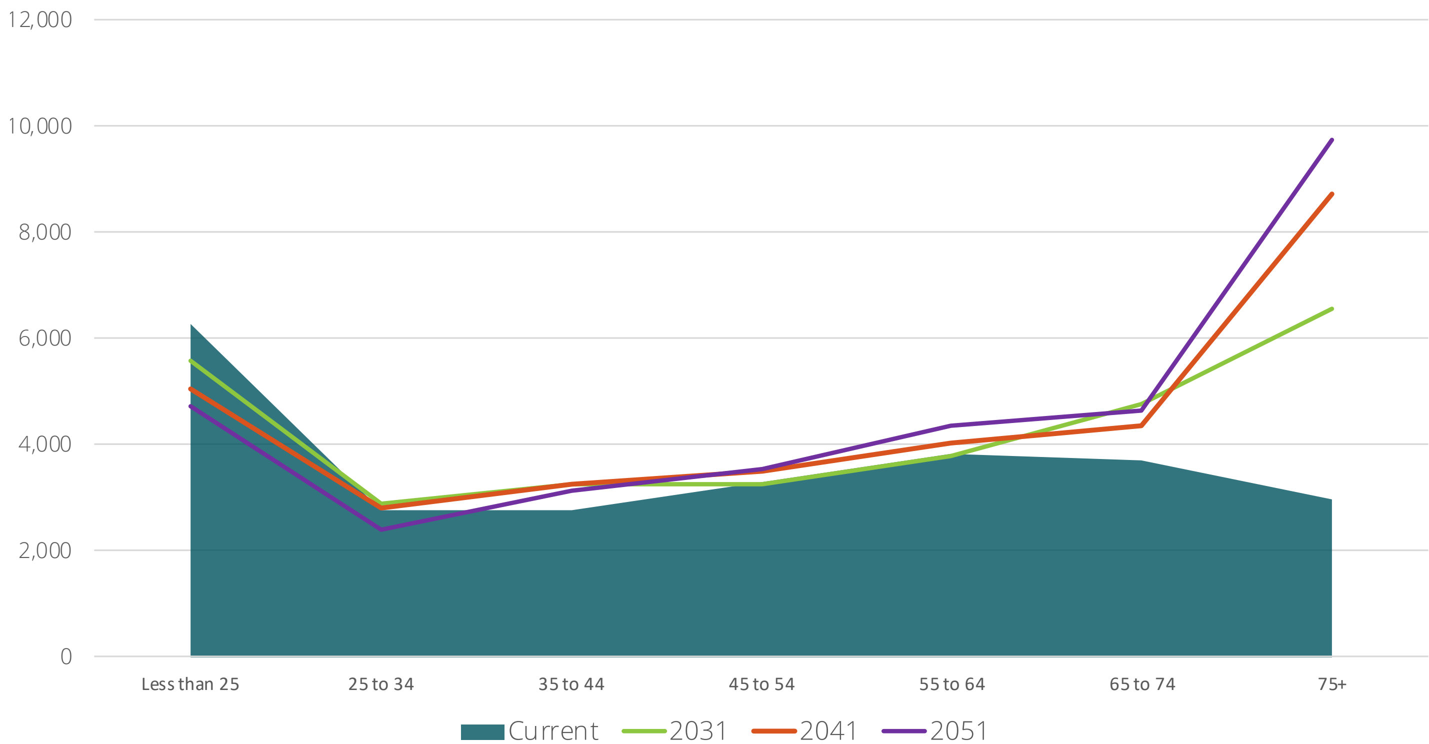


Figure 2.4 - Courtenay Population Projections By Age Cohort to 2031, 2041, and 2051.
Data Sources: Statistics Canada, 2016; Colliers International Consulting (2020);Turner Drake & Partners Ltd. (2020)

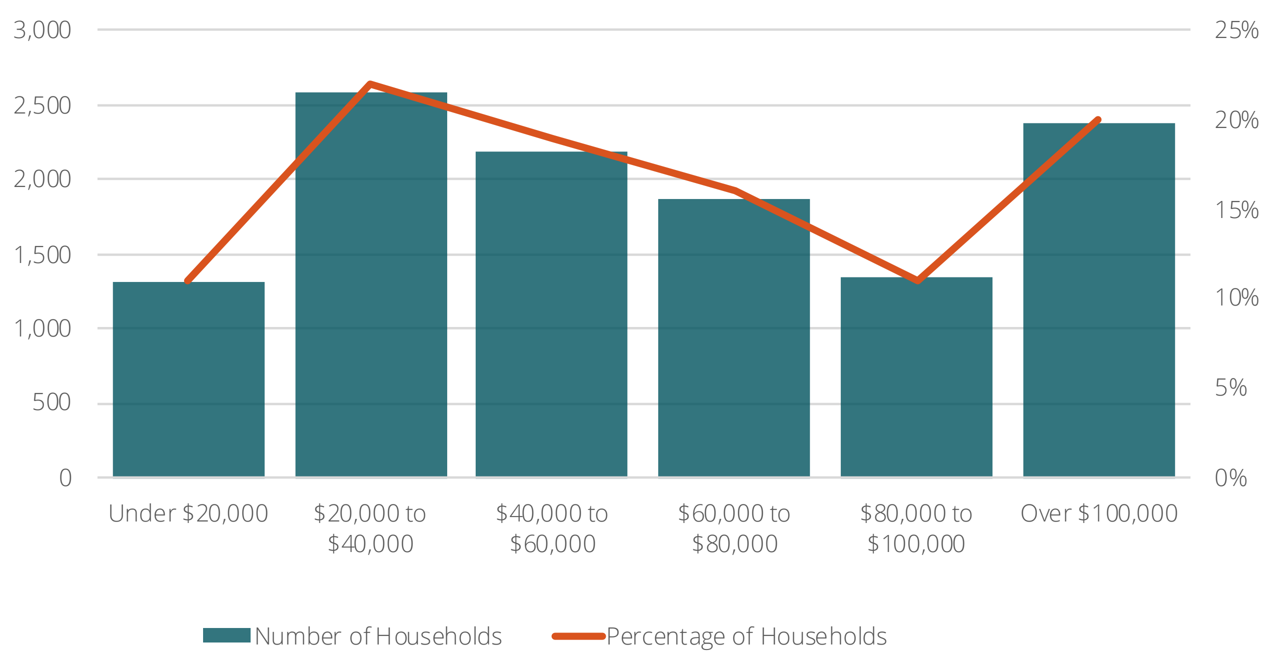


Figure 2.5 - Distribution of Courtenay Household Income by Number and Percentage of Households.
Data Source: Statistics Canada, 2016.

Courtenay is experiencing an increasing reliance on in-migration, primarily from other areas of the province, to help mitigate declining births and youth cohort age totals.

Additionally, there has been a small amount of immigration within the city. As outlined in Figure 2.7, approximately 12.6% of the population are immigrants. 7.4% of which are from Europe, 2.7% from Asia, 1.7% from the Americas, and 0.5% from Africa.

Compared with other municipalities across Canada, there are fewer racialized people in Courtenay.

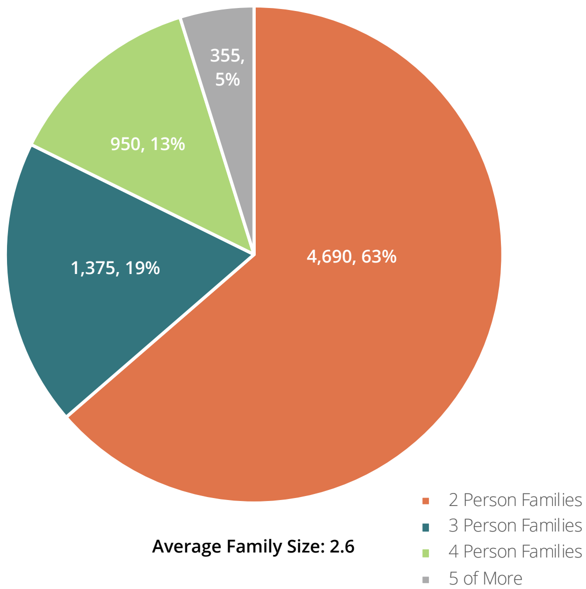


Figure 2.6 - Courtenay Family Composition. Data Source: Statistics Canada, 2016.

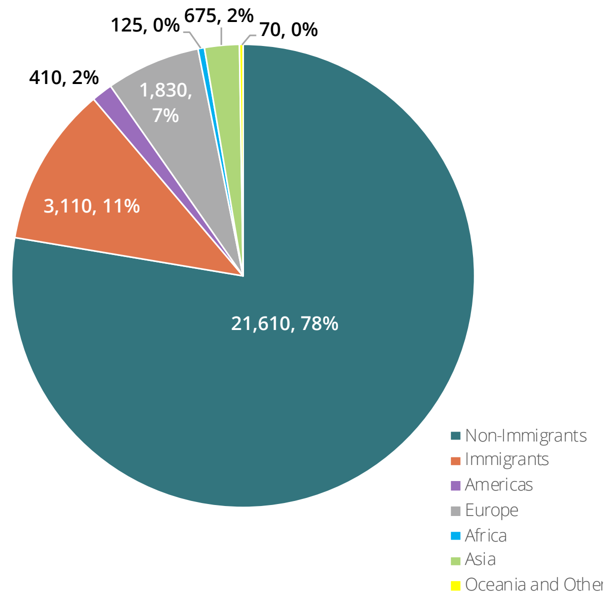


Figure 2.7 - Courtenay Population by Immigrant Status. Data Source: Statistics Canada, 2016.

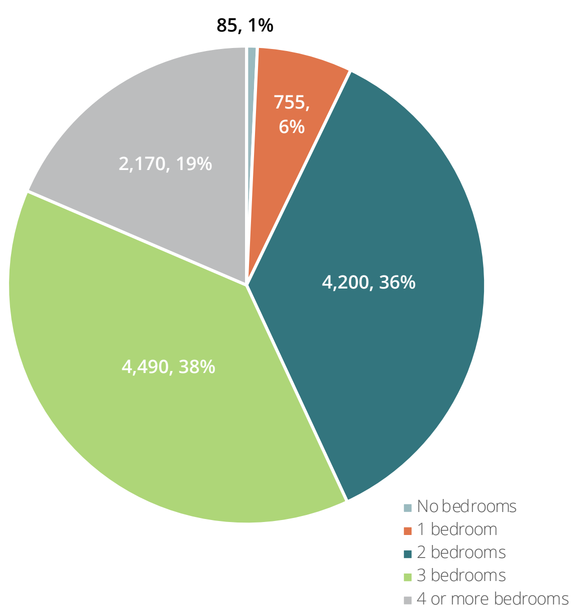


Figure 2.8 - Courtenay Households by Number of Bedrooms. Data Source: Statistics Canada, 2016.

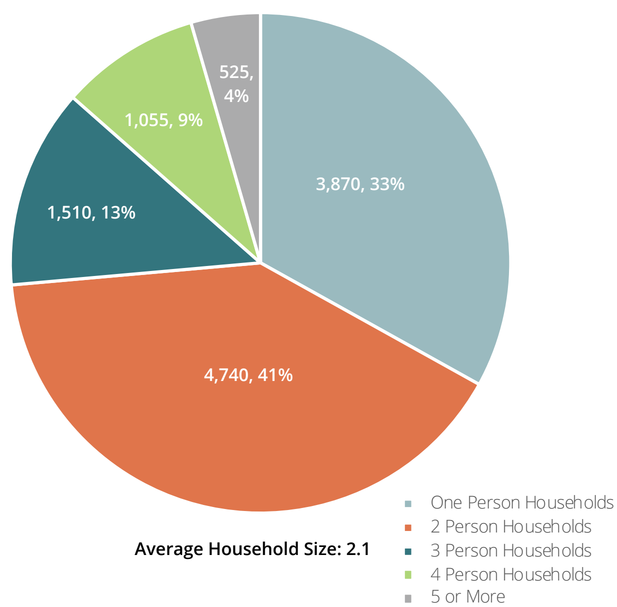


Figure 2.9 - Courtenay Household Structure by Number of Persons in Households. Data Source: Statistics Canada, 2016.

2.2.2 EMPLOYMENT

In terms of employment, Courtenay is expected to continue to be the primary employment centre within the CVRD. As such, it is important to examine the labour force within this trade area to identify future job growth potential within the city. The total working age population of the Comox Valley is expected to grow from 50,270 to 55,430 by 2041. Under the assumption that the participation rate and unemployment rate will remain steady over the projection period, this is expected to result in approximately 2,630 new jobs among all employment sectors in the CVRD.

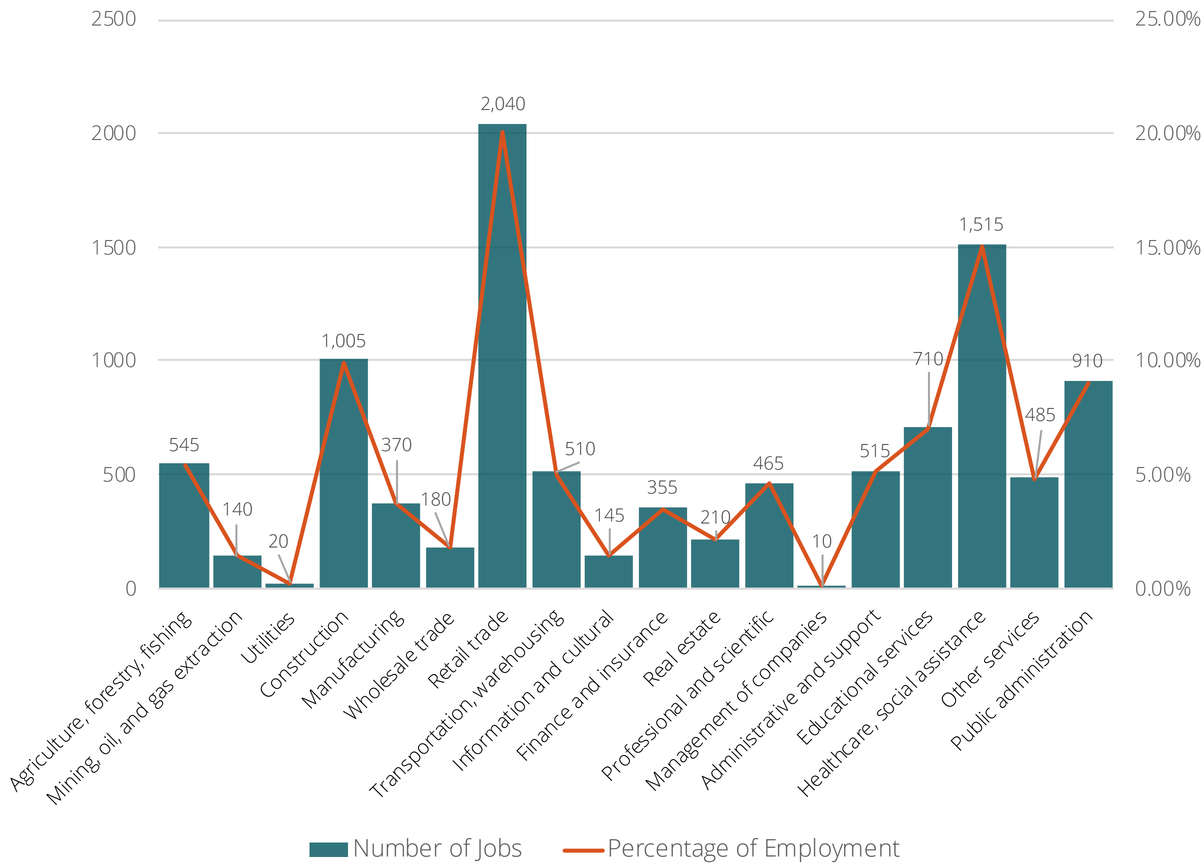


Figure 2.10 - Courtenay Employment by Category. Source: Colliers International Consulting (2020).

Employment Statistic	Current	2031	2041	Growth
CVRD Working Age Population	50,270	61,455	55,430	5,160
In the Labour Force	28,000	34,230	30,875	2,874
Employed	25,620	31,321	28,250	2,630
Unemployed	2,380	2,910	2,624	244
Not in the Labour Force	22,270	30,134	24,556	2,286
Participation Rate	55.70%	55.70%	55.70%	
Employment Rate	91.50%	91.50%	91.50%	
Unemployment Rate	8.50%	8.50%	8.50%	

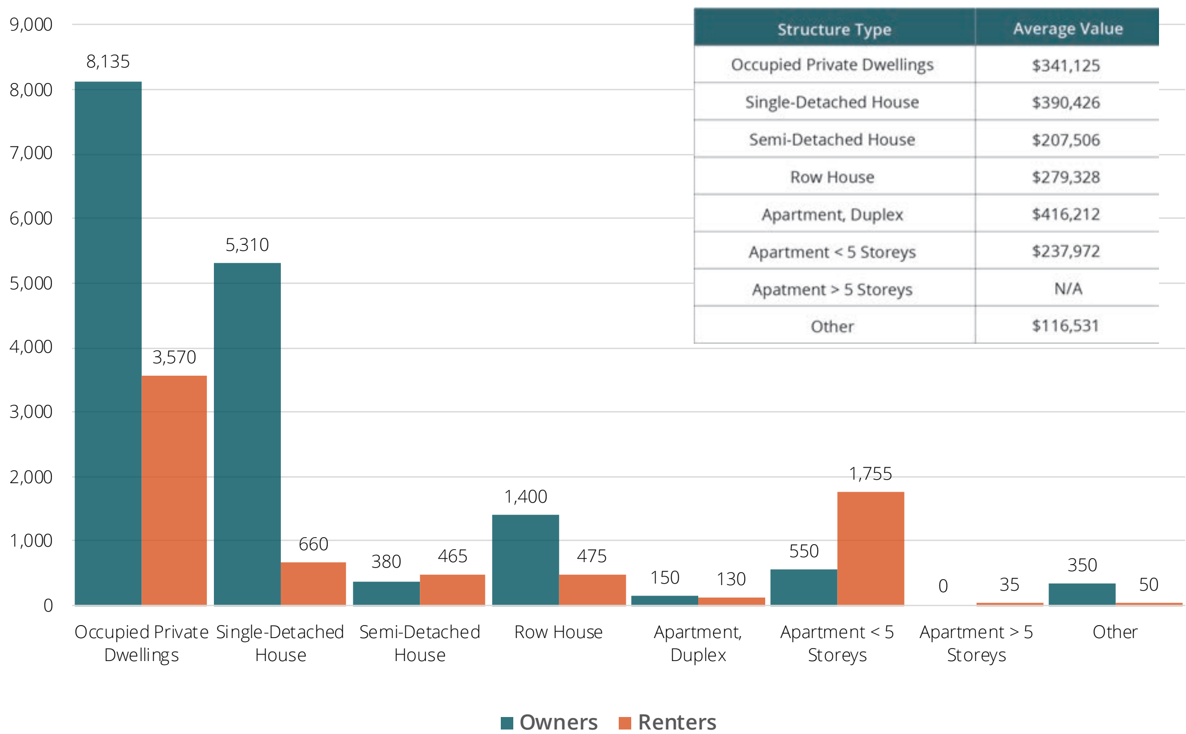
Table 2.1 - Comox Valley Regional District Employment Projections. Source: Colliers International Consulting (2020).

2.2.3 HOUSING

As estimated by CMHC, there is a total of approximately 11,705 dwelling units within the city, 8,135 (69.5%) of which are owned and 3,570 (31.5%) are rented. There are 5,970 (51%) single-detached houses, 2,305 (19.7%) units in apartments under 5 storeys, 1,875 (15.9%) row houses, 845 (7.2%) semi-detached houses, 275 (2.4%) duplex apartments, and 35 (0.3%) units in apartments over 5 storeys.

While the average household size of 2.1 people is low – with almost three quarters of the population living in either 1 or 2 person households – over half of dwellings are single-detached houses. This suggest that residents are "overhoused" in terms of land use efficiency.

Figure 2.12 presents both the location and number of dwelling types across Courtenay. While multi-unit homes are distributed in neighbourhoods across the city, they are more prevalent in West Courtenay and in the multi-unit area along Braidwood Road between Ryan Road and North Island Highway.



Structure Type	Average Value
Occupied Private Dwellings	$341,125
Single-Detached House	$390,426
Semi-Detached House	$207,506
Row House	$279,328
Apartment, Duplex	$416,212
Apartment < 5 Storeys	$237,972
Apatment > 5 Storeys	N/A
Other	$116,531

Figure 2.11 - Courtenay Housing By Typology and Tenure. Source: Colliers International Consulting (2020).

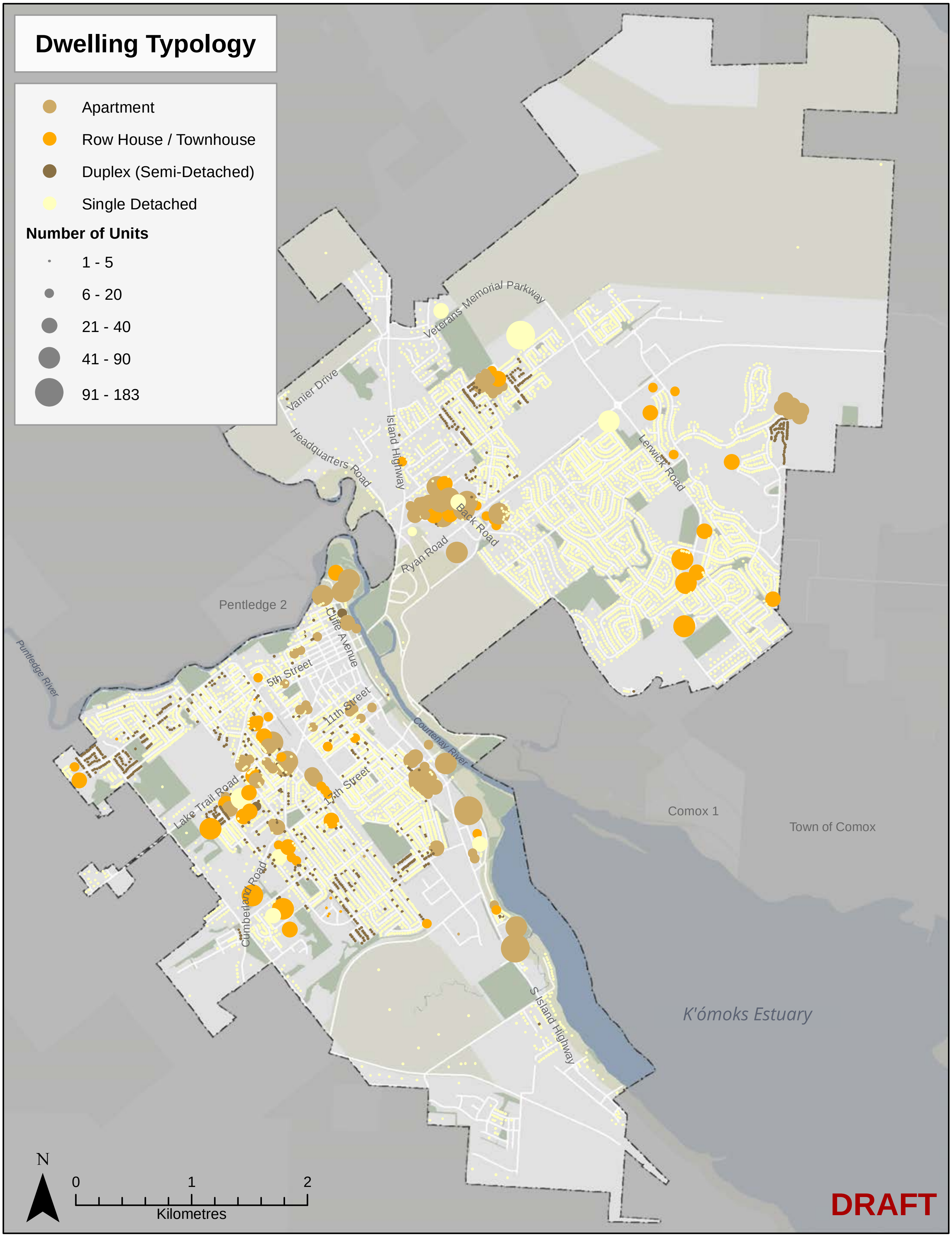


Figure 2.12 - Courtenay Dwelling Typologies by Number of Units. Data Source: BC Assessment, 2016.

The average value of owned private dwellings ranges from $207,506 for semi-detached houses, up to $390,426 for single-detached houses. Among all dwelling types, CMHC estimates an average value of $341,125.

The age of housing stock in Courtenay is relatively new, with the majority of homes (67.8%) constructed after 1981 (Figure 2.13). As such, the majority of housing in Courtenay is in good condition, with only 5% of dwellings needing major repairs (Figure 2.14). These dwellings represent an opportunity to retrofit to improve building performance or to renew with higher standards of efficiency in new construction and potentially greater density.

Further information – including housing affordability – from the Housing Needs Assessment will be incorporated in to the OCP process as it becomes available.

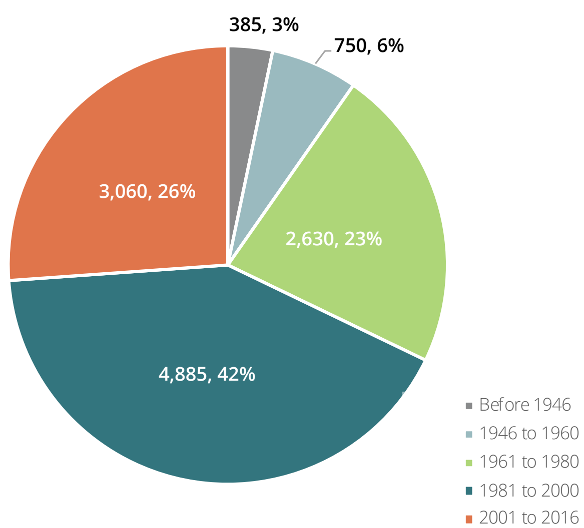


Figure 2.13 - Courtenay Housing by Period of Construction. Source: Colliers International Consulting (2020).

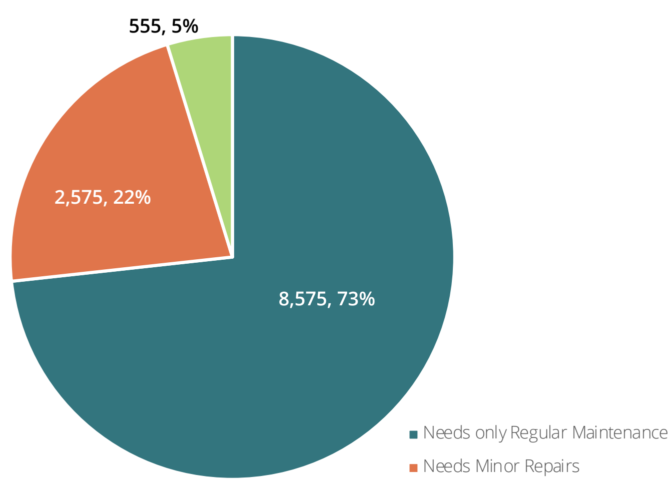


Figure 2.14 - Courtenay Condition of Dwellings. Source: Colliers International Consulting (2020).

Image - Billy Booth House (1913) in Old Orchard Neighbourhood.

Image - 1970s Duplex in West Courtenay.

Image - Single Detached House in Crown Isle.

Image - Trumpeter's Landing, An Example of a Newer Condo Development From the 2010s. Source: Mark Beeler Personal Real Estate Corporation.

2.3 REGIONAL CONTEXT

Courtenay is part of the Comox Valley in the Northern half of Vancouver Island, overlooking the Strait of Georgia subregion of the Salish Sea. Made up of numerous watersheds, The region is home to one of the most significant estuaries in British Columbia, including tidal mud flats, lagoons, salt marshes, and important low-lying forest habitats.

As described in Part 1, the City of Courtenay resides within the traditional territory of the K'ómoks First Nation, and in what is today the Comox Valley Regional District (CVRD). According to the CVRD Regional Growth Strategy, the K'ómoks First Nation's traditional territory extends from the south side of the Englishman River drainage, north along the height of land on the Vancouver Island Range, east along the height of land on the north side of the Salmon River Valley, across the Johnstone Strait to Call Inlet, and southeast down the centre of the Strait of Georgia back to the south side of the Englishman River, including islands and portions of the mainland. There is overlap of shared territory with Sliammon, Homalco, Nanoose, Cape Mudge, Campbell River, Qualicum, and Kwiakah First Nations.

Today the CVRD encompasses the Village of Cumberland, the Town of Comox, and the electoral areas of Baynes Sound, Lazo North, and Puntledge-Black Creek. Its neigbours include the K'ómoks First Nation community. The region is also home to Provincial parks and the Agricultural Land Reserve, and is connected to the broader Vancouver Island and Mainland through a network of highways, railway, ferry lines, and flights from the Comox Valley Airport.

The CVRD's Regional Growth Strategy provides a framework for future decision-making and land use, and sets basic direction for planning, policies, and action. The vision for the CVRD is as follows:

The Comox Valley will continue to evolve as a region of distinct, well-connected and well-designed urban and rural communities. As stewards of the environment, local governments, the K'ómoks First Nation, public agencies, residents, business, and community and non-governmental organizations will work collaboratively to conserve and enhance land, water, and energy resources, and ensure a vibrant local economy and productive working landscape.

One of its eight goals is to "minimize regional greenhouse gas emissions and plan for adaptation".

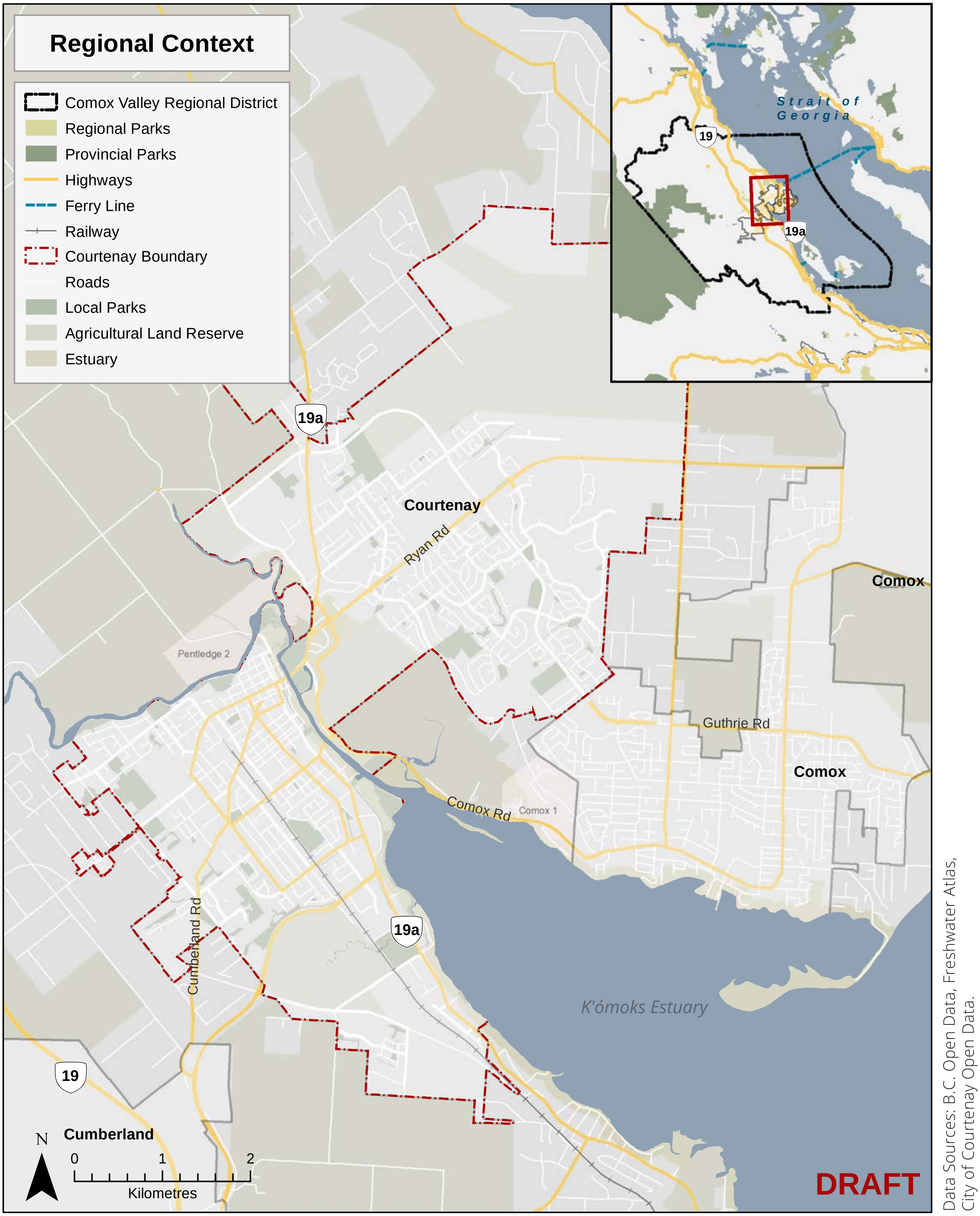


Figure 2.15 - Regional Context of Courtenay within the Comox Valley.

2.4 LAND USE

Land use policy is climate policy.

The largest contributor to local greenhouse gas emissions in Courtenay and in most other B.C. municipalities is transportation. While local governments cannot regulate vehicle emission standards, they have direct control over the degree to which residents travel by foot, bicycle, and transit. This is because land use – or the type, location, and intensity of residential, commercial, industrial, institutional and other land-based activities – is a primary driver of transportation behaviour.

Further, land use policy shapes the types of buildings and homes in a community. It dictates the composition of residential buildings, ranging from single-detached homes to an array of multi-family homes. With shared walls and other efficiencies, multi-family buildings produce significantly lower per capita greenhouse gas emissions.

Urban form goes hand in hand with land use. It includes the quality, distribution, and integration of buildings and other physical elements such as open spaces, transportation networks, natural features and ecological systems, and community facilities. A more compact urban form, in which growth is carefully managed and concentrated, also has a tremendous impact on a community's carbon footprint.

As such, the importance of land use in reducing greenhouse gas emissions at the local level cannot be overstated. This also means that land use policy and regulation, including Official Community Plans and Zoning Bylaws, comprise one of the most powerful tools at the disposal of local governments in responding to the climate emergency.

Other ways in which land use, urban form, and growth management influence a city's success include:

- **Servicing** – This includes civic infrastructure, ranging from roads to sewers to transit. The efficiency of providing these services to citizens across the city is influenced by the distribution and intensity of development.

Land use policy is climate policy.

- **Municipal Finances and Taxes** – Servicing efficiency in turn impacts the cost of providing services, which affects the City's financial bottom line and ultimately taxes paid by residents and businesses.

- **Community Character** – This refers to the "look and feel" and overall attractiveness of a city. The height and type of buildings, and the uses within them, influence street life and help shape a distinguishable visual identity that creates a unique sense of place. Establishing infill and redevelopment guidelines – something that will be undertaken as part of this OCP process – is an important means in maintaining and enhancing community character.

- **Housing Choices** – Different building types offer different housing choices, including the types of homes (e.g. single family house, townhouse, apartment) available for individuals and families. Land use policies also influence housing affordability, and a concurrent Affordable Housing Strategy will be developed as part of this OCP process.

- **Transportation Choices** – As already noted, the intensity and distribution of buildings, along with land use and transportation infrastructure, greatly impact how people choose to move around. Some forms of development make it convenient, safe, and desirable to move around on foot, by bike, or by transit, while other forms of development effectively limit transportation choices to travel by car. Transportation choice in turn influences an individual's level of physical activity, and thus their health and safety.

- **Protection of Agricultural Land and Natural Areas** – The physical footprint of a city and the degree to which growth is managed within existing built up areas greatly influences a community's ability to protect its surrounding natural areas and agricultural lands from encroaching development.

- **Neighbourhoods** – An important component of the OCP process is to identify neighbourhood planning areas. Understanding how to define neighbourhoods is a first step in the process, which involves identifying how land use and urban form relates to the functioning of distinct and relatively self-sustaining sub-areas of the city.

Image - Downtown Courtenay With Comox Glacier in View.

2.4.1 INVENTORY OF CURRENT LAND USES

Current land use regulations – or zoning – are presented in Figure 2.16.

Since existing uses can be inconsistent with current zoning, an inventory of existing building types is presented in Figure 2.17. It demonstrates a very clear agglomeration of specific uses, with:

- mixed use and office buildings focused in the downtown area and in the Rosewall Crescent area;
- commercial buildings focused in the downtown area and extending south along Cliffe Avenue and north across the river, and at lower densities in the Lerwick commercial area and along the North Island Highway in northern Courtenay; and
- industrial buildings focused in south part of the Cliffe Avenue area, Rosewood Crescent area, and McPhee Avenue area.

Very few non-residential buildings fall outside of these areas, revealing that **neighbourhoods that are residential in nature are predominantly single use.**

Figure 2.18 presents new development by type, using the most recently available data (2016). It reveals that most recent development – as of 2016 – has been low density (single detached) residential. The number of new dwellings by type, which provides more detail, will be available in the next phase of the OCP process and once the Housing Needs Assessment data become available.

Inventories of retail, office, and industrial uses are outlined in the following pages. Projections for future demand will be developed in the next phase of the OCP process.

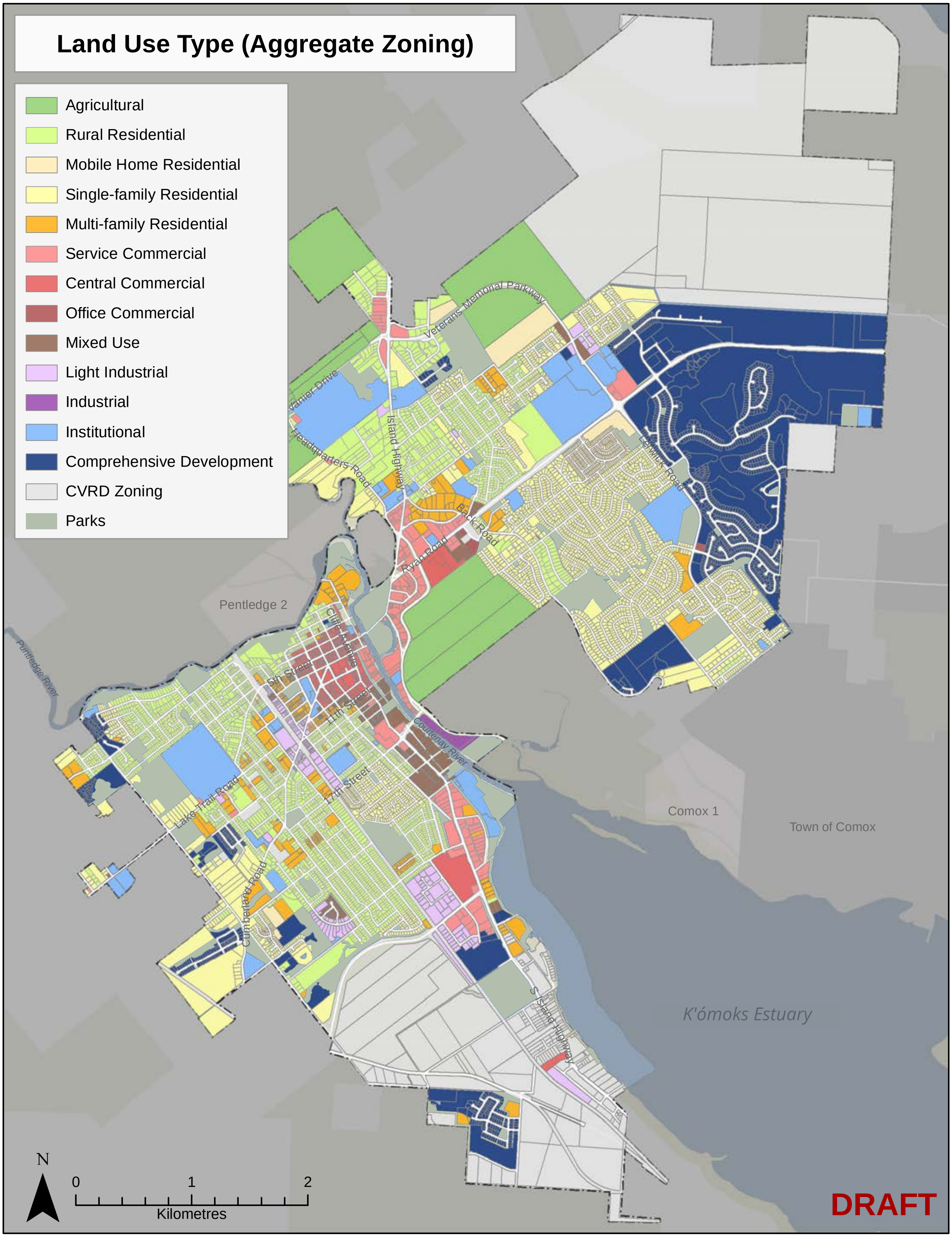


Figure 2.16 - Zoning Map of Courtenay. Data Source: City of Courtenay.

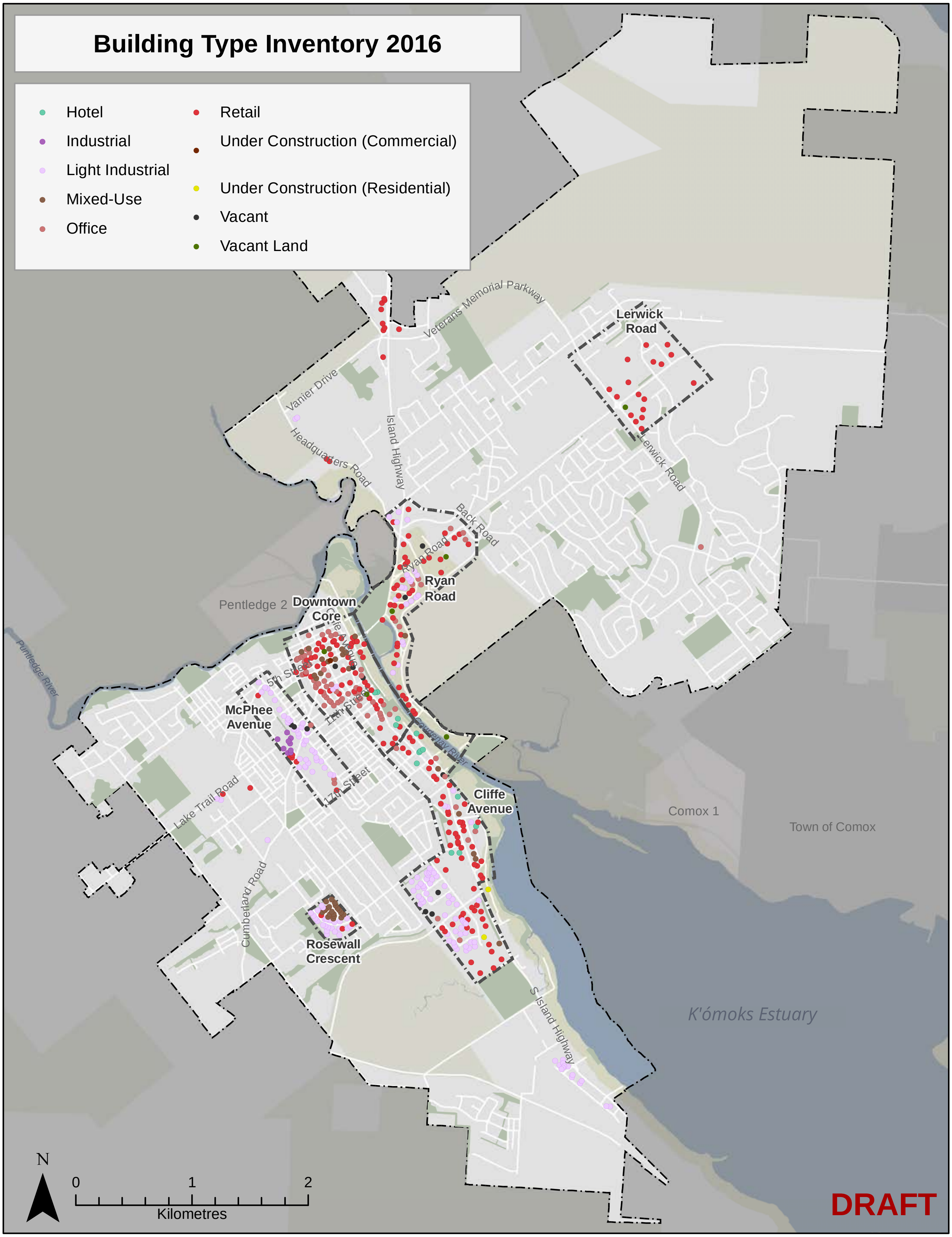


Figure 2.17 - Courtenay Building Type Inventory.

Data Source: BC Assessment, 2016.

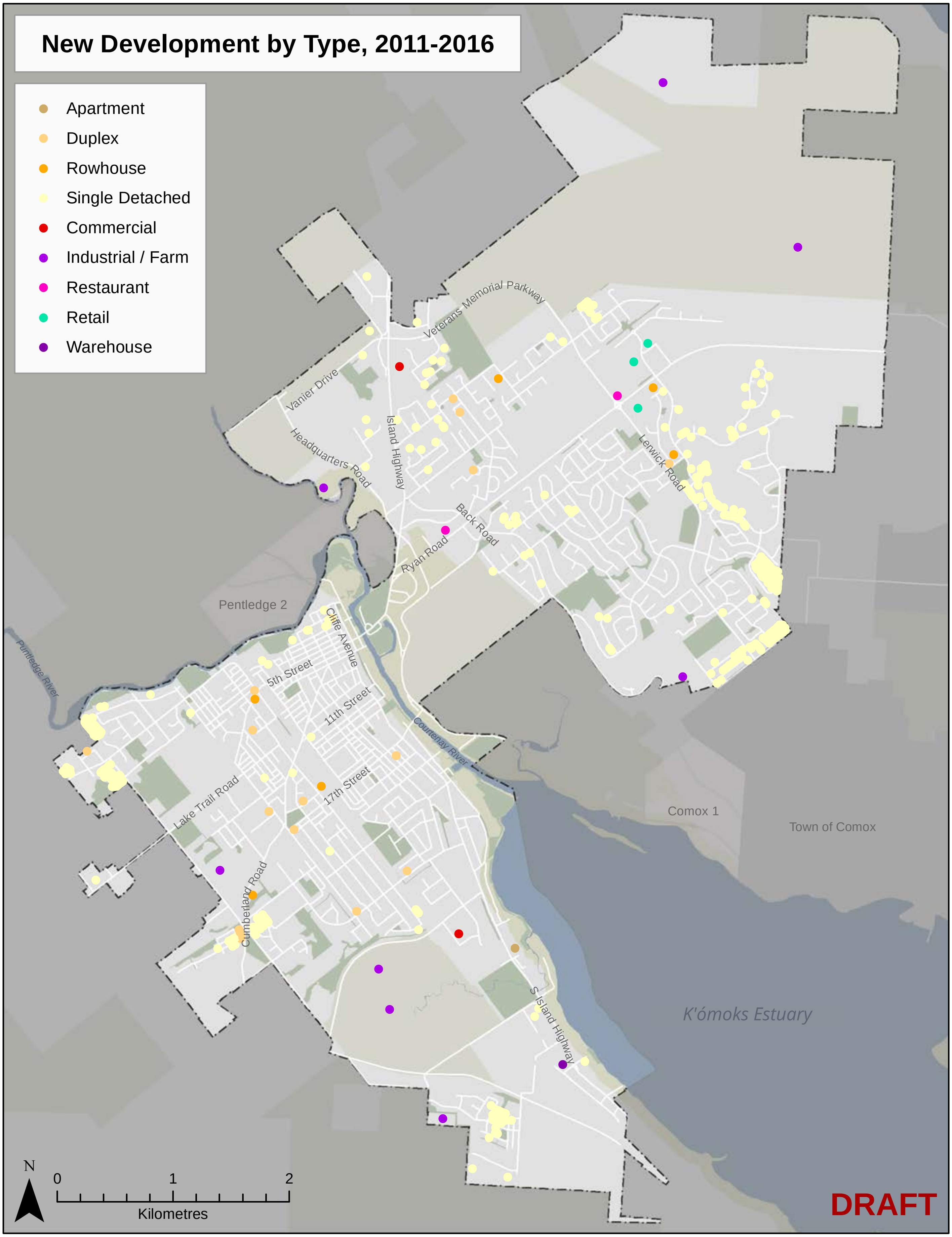


Figure 2.18 - Courtenay's New Development by Type from 2011-2016. Data Source: BC Assessment, 2016.

RETAIL

The City of Courtenay currently has an inventory of approximately 2.72 million square feet of retail floorspace with a vacancy rate of 7.8% resulting from numerous large footprint vacancies including the former Thrifty's Downtown and Canadian Tire. This vacancy rate is within a healthy range, with potentially some oversupply in some categories.

The real estate inventory has been broken down into 6 subareas (see Figure 2.17), consisting of: Cliffe Avenue, Downtown Core, Ryan Road, Lerwick Road, McPhee Avenue, and Rosewall Crescent. Currently, the most supply is located within the Cliffe Avenue Subarea (36.3%), followed by Downtown Core (25.3%), Lerwick Road (17.2%), and Ryan Road (16.6%).

The higher vacancy rate in the downtown area is due to the recent closure of Thrifty's.

Figure 2.19 - Courtenay Retail Inventory by Sector (Total 2,715,087 sf).
Data Source: Colliers International Consulting (2020).

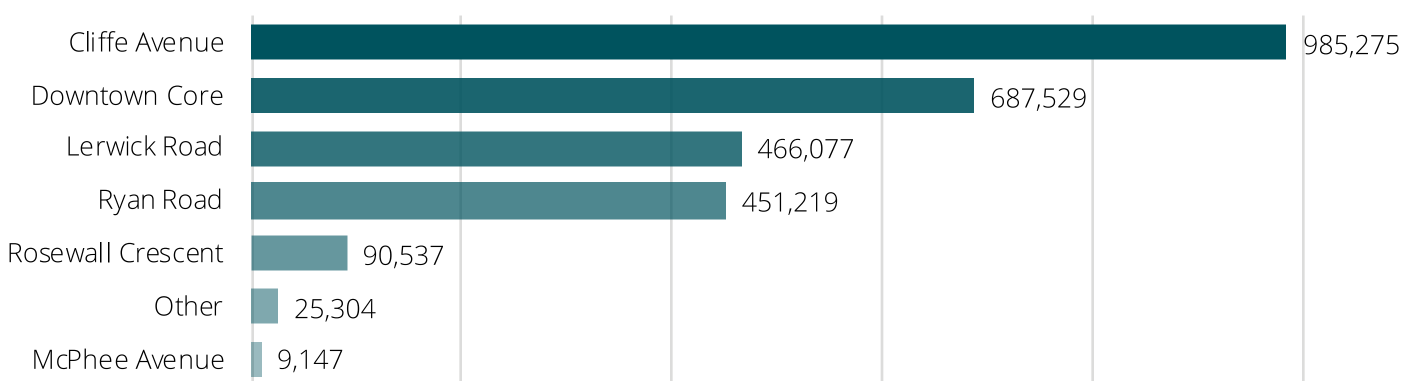


Figure 2.20 - Courtenay Retail Inventory by Subarea (Total 2,715,087 sf).
Data Source: Colliers International Consulting (2020).

OFFICE

The City of Courtenay currently has an inventory of approximately 624,000 square feet of office floorspace with a vacancy rate of 8.1%. The majority of office floorspace is located in the Downtown Core (64.8%), followed by the Ryan Road Subarea (16.0%), and the Cliffe Avenue Subarea (12.8%).

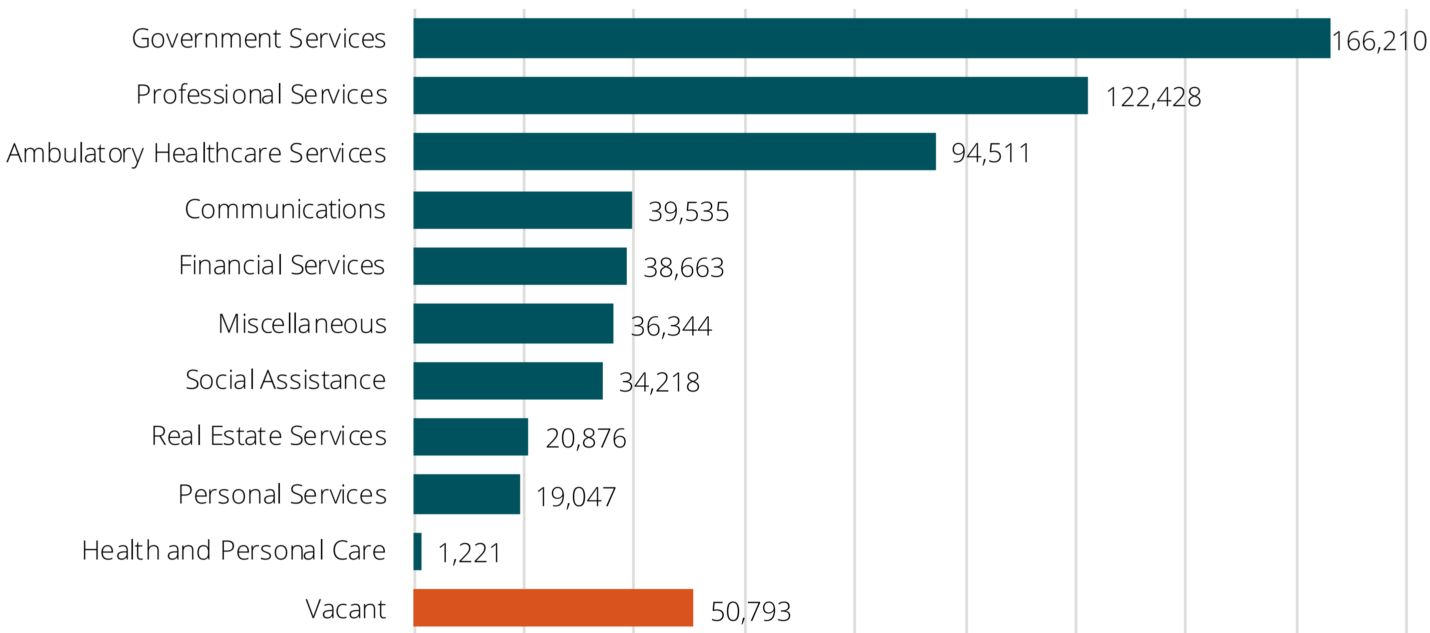


Figure 2.21 - Courtenay Office Inventory by Sector (Total 623,846 sf).
Data Source: Colliers International Consulting (2020).

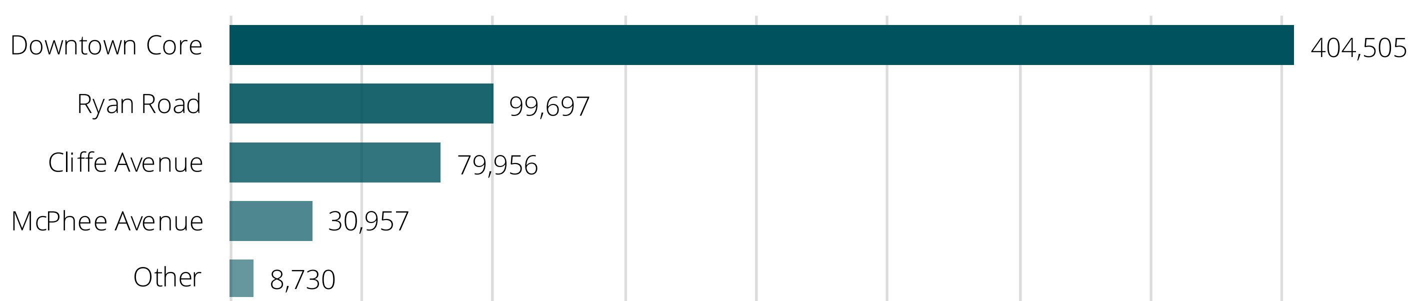


Figure 2.22 - Courtenay Office Inventory by Subarea (623,846 sf).
Data Source: Colliers International Consulting (2020).

INDUSTRIAL

The City of Courtenay currently has an inventory of approximately 1.05 million square feet of industrial floorspace with a vacancy rate of 2.4%. The majority of industrial floorspace is located in the Cliffe Avenue Subarea (34.2%), followed by the McPhee Avenue (23.6%), and Rosewall Crescent (17.8%) Subareas.

Overall the industrial inventory seems quite healthy with a low vacancy rate. There is lack of supply in larger urban centres such as Nanaimo and Victoria, which may drive more demand in the Courtenay area and elsewhere on Vancouver Island.

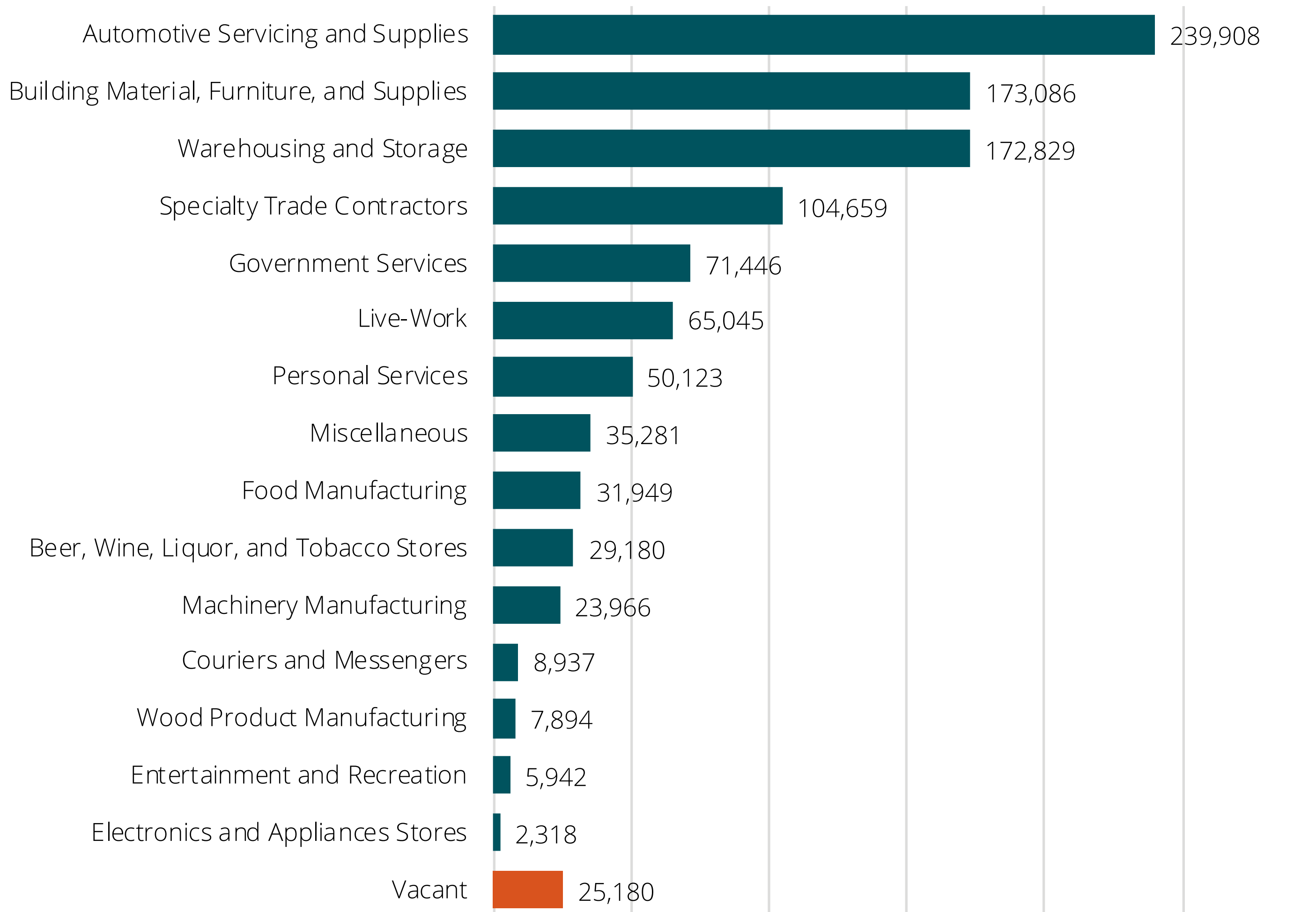


Figure 2.23 - Courtenay Industrial Inventory by Sector (Total 1,047,743 sf).
Data Source: Colliers International Consulting (2020).

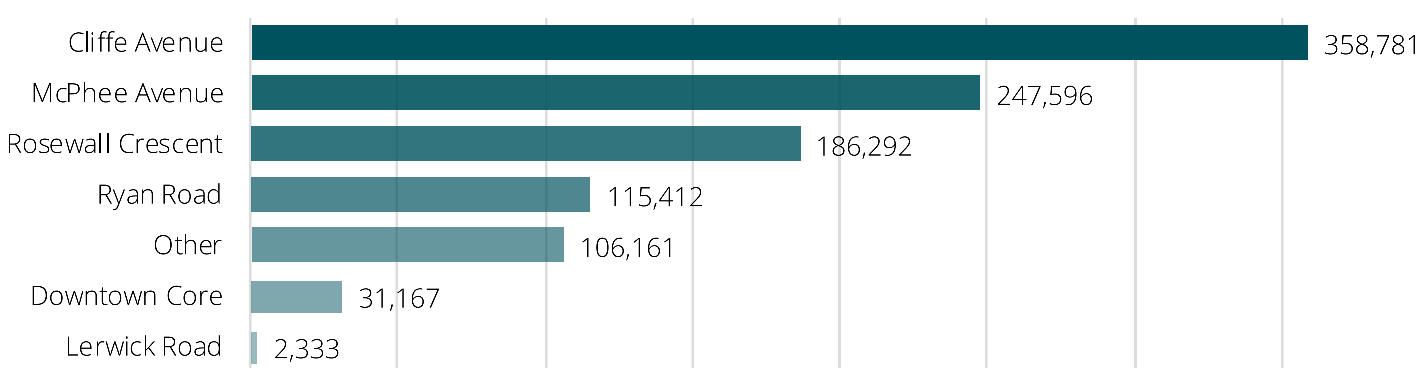


Figure 2.24 - Courtenay Industrial Inventory by Subarea (Total 1,047,743 sf).
Data Source: Colliers International Consulting (2020).

2.4.2 LAND USE MIX

Land use mix refers to the diversity of land uses (e.g. residential, commercial, industrial, institutional, agricultural, etc) within a given area. Higher degrees of land use mixes are associated with "complete communities", wherein residents have easy access to a variety of amenities and services within their neighbourhood. These include shops and restaurants, cultural and civic facilities (e.g. museums, libraries, galleries), employment opportunities, recreational destinations (e.g. parks, community centres), and more. This mix allows residents to live, work, shop, play, and learn close to home.

Land use mix is important for creating distinct, vibrant neighbourhoods that support businesses and offer housing and transportation choice. For example, with other variables such as residential density held as constants, the odds of a person walking are twice as high in areas with a high degree of mixed uses than in areas with a low degree of mixed uses. Residents living near multiple and diverse retail destinations also generally make more frequent and shorter shopping trips, and more by walking and cycling. A higher degree of land use mix also translates into a stronger sense of community, where residents are more likely to know their neighbours, participate politically, trust others, form community networks, and be socially engaged.

Figures 2.25 through 2.33 illustrate access to important destinations within a typical walkshed. Studies have shown that **people are much less likely to choose to walk as a mode of travel beyond a 5-10 minute walk, which is roughly 400-800 meters** (and based on an average walking speed of 5 km per hour). All of the walking distances presented in the maps in this section are based on real travel distance through the transportation network (e.g. sidewalks, trails, etc), rather than distance "as the crow flies". This enables an accurate assessment of the actual travel experience of people in Courtenay.

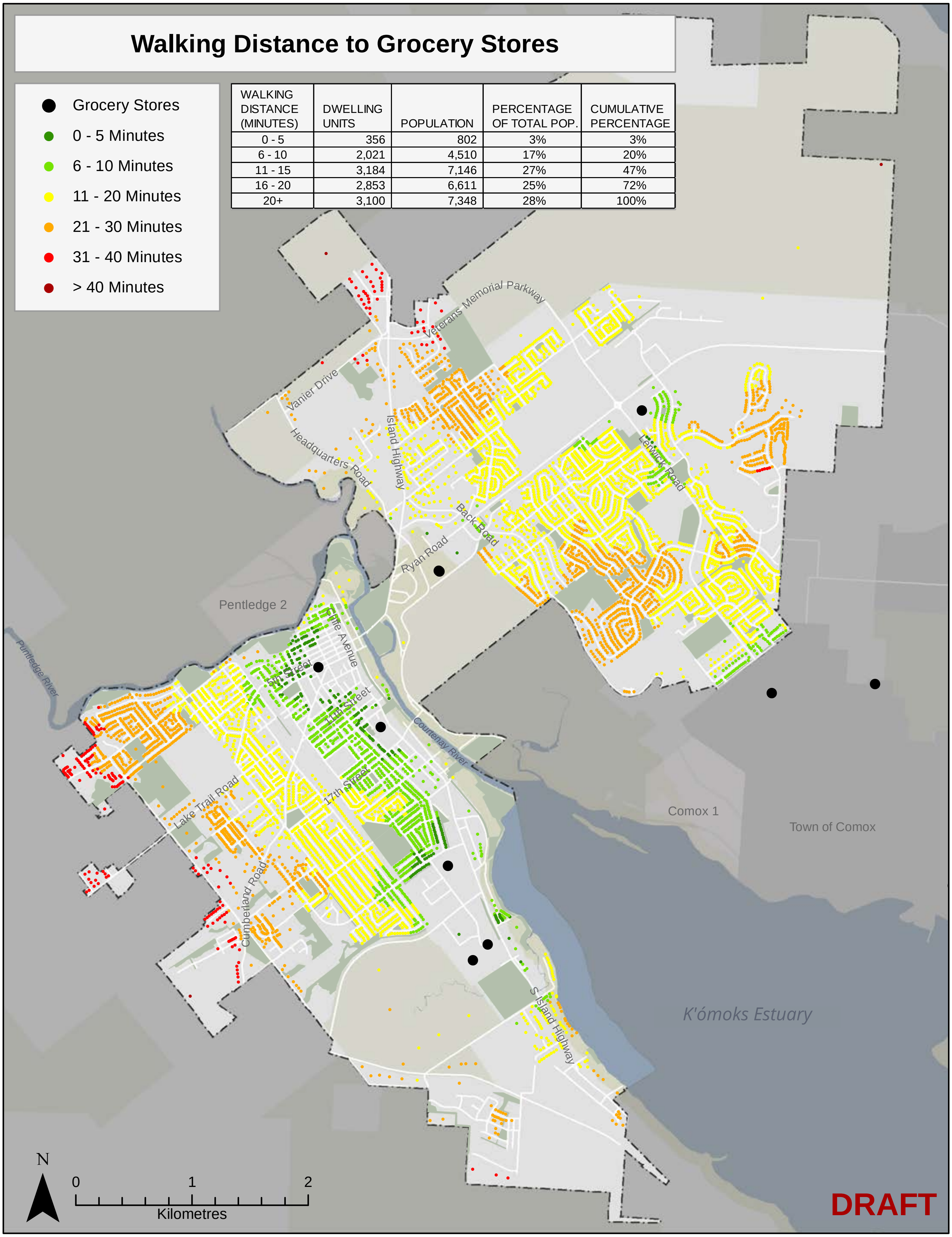
Image - Comox Valley Farmers' Market in Downtown Courtenay. Source: Bill Jorgensen.

GROCERY STORES

Grocery stores are an important proxy for land use mix, as they are among the top trip generators outside of work and school. As shown in Figure 2.25, just three percent of Courtenay residents live within a 5 minute walk of a grocery store, and 20 percent of residents live within a 10 minute walk. Most of these residents live in older neighbourhoods and in or near the historic downtown.

An appropriate target within the context of a climate emergency would be for all or nearly all residents to have a grocery store within walking distance of home.

Walking Distance to Grocery Stores



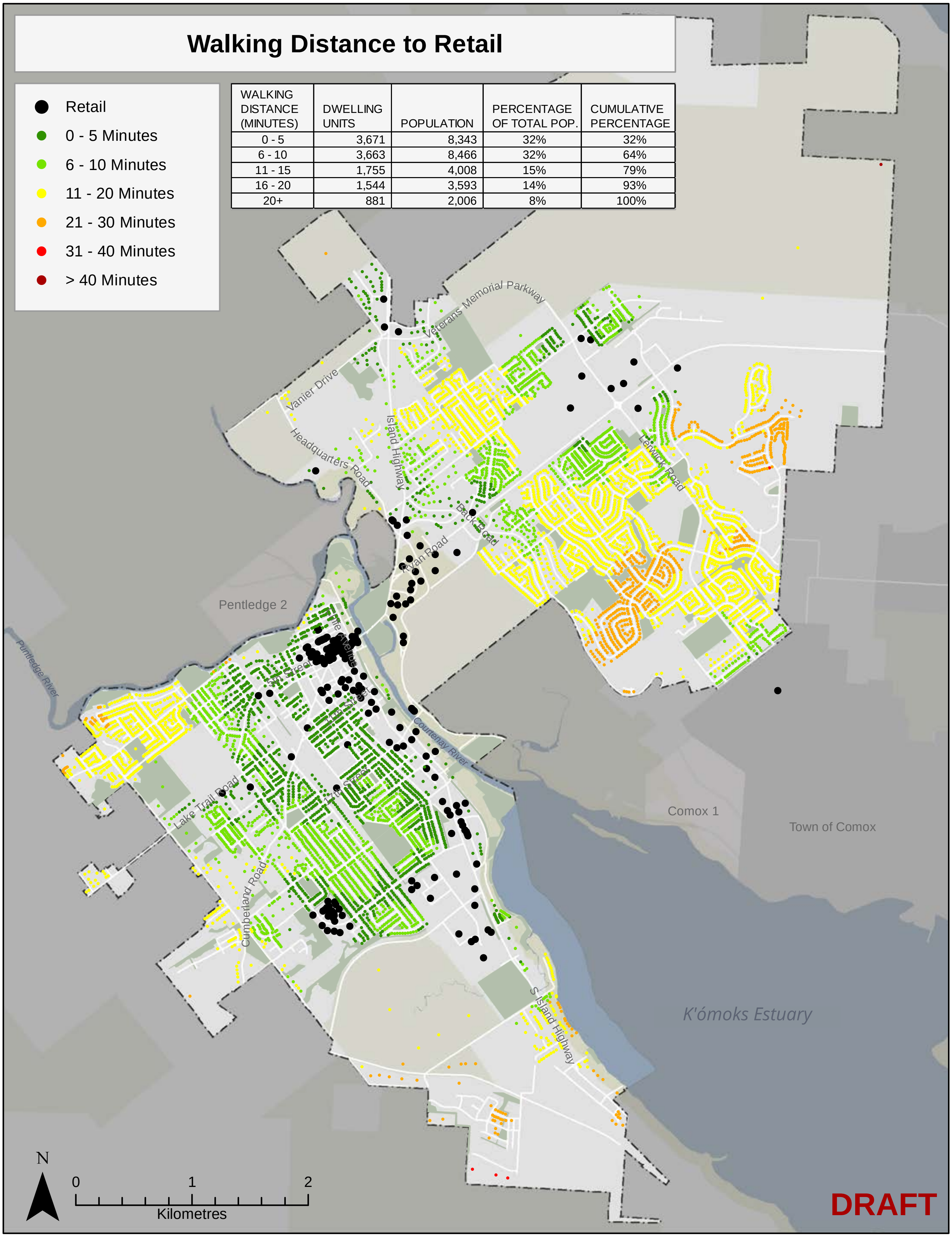
WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	356	802	3%	3%
6 - 10	2,021	4,510	17%	20%
11 - 15	3,184	7,146	27%	47%
16 - 20	2,853	6,611	25%	72%
20+	3,100	7,348	28%	100%

Data Sources: Google Search on November 29, 2019 for grocery stores selling produce and OpenStreetMap Network with pedestrian tags for distance analysis.

Figure 2.25 - Walking Distance to Grocery Stores.

RETAIL

Residents' proximity to other daily commercial needs is presented in Figure 2.26, which shows that almost two thirds of Courtenay's population residents within a 10-minute walk of retails areas. These are promising numbers, particularly as over 90 percent are within a 20-minute walk. Newer neighbourhoods – including Crown Isle and South Lerwick – generally perform more poorly than older neighbourhoods.



WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	3,671	8,343	32%	32%
6 - 10	3,663	8,466	32%	64%
11 - 15	1,755	4,008	15%	79%
16 - 20	1,544	3,593	14%	93%
20+	881	2,006	8%	100%

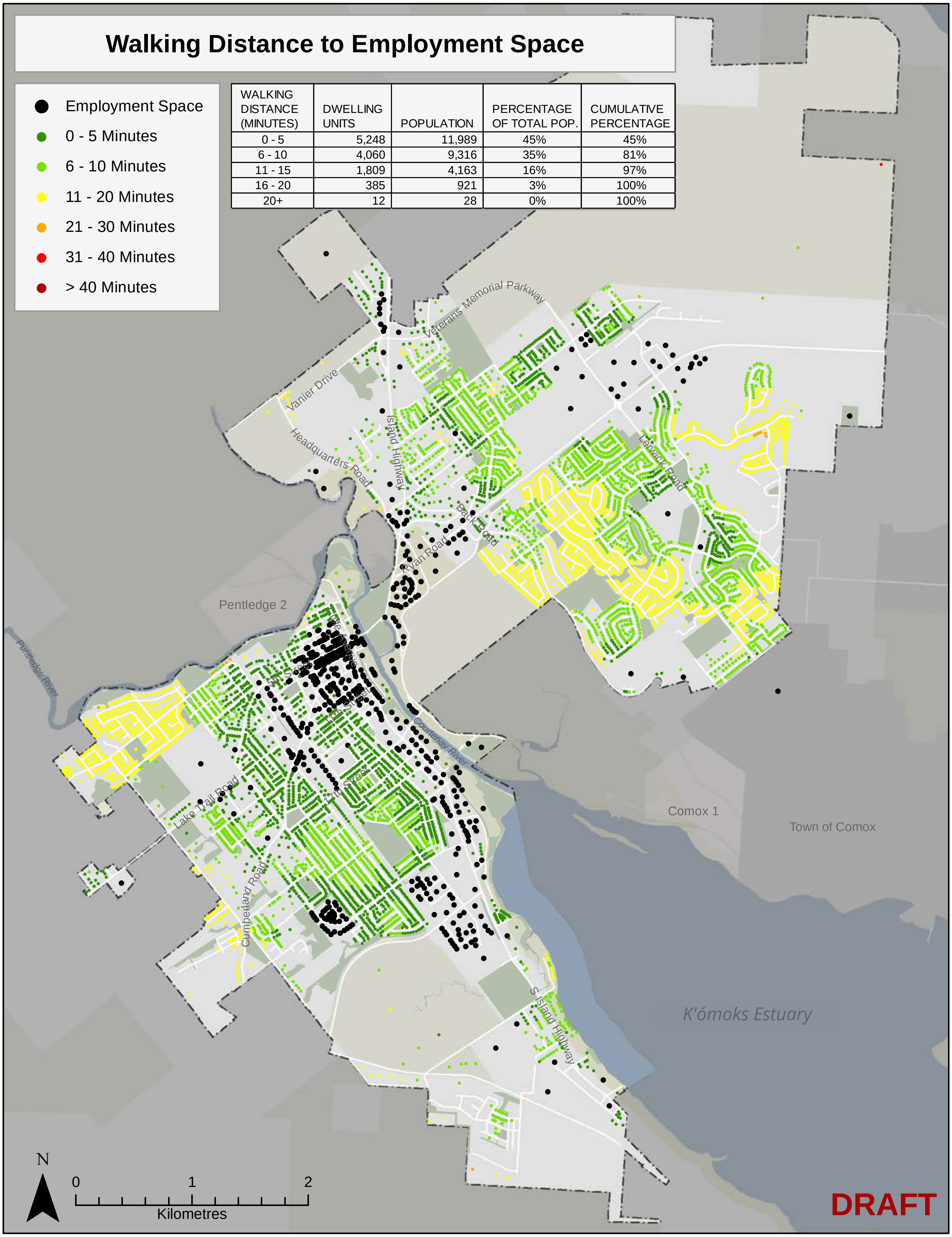
Data Sources: BC Assessment, 2016 (actual use codes) and OpenStreetMap network with pedestrian tags for distance analysis.

Figure 2.26 - Walking Distance to Retail Stores.

EMPLOYMENT

Jobs are also a top trip generator. While comprehensive data linking individual residents with their job locations do not exist, Figure 2.27 nonetheless helps paint a picture of proximity to potential employment spaces. Employment spaces were identified using BC Assessment's Actual Use Codes.

Almost half (45 percent) of residents live within a 5-minute walk of an employment space, and over 80 percent live within a 10-minute walk of an employment space. Again, older neigbourhoods – which tend to have a greater mix of uses and are generally more compact – outperform newer neighbourhoods in this area.



WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	5,248	11,989	45%	45%
6 - 10	4,060	9,316	35%	81%
11 - 15	1,809	4,163	16%	97%
16 - 20	385	921	3%	100%
20+	12	28	0%	100%

Data Sources: BC Assessment, 2016 (actual use codes) and OpenStreetMap network with pedestrian tags for distance analysis.

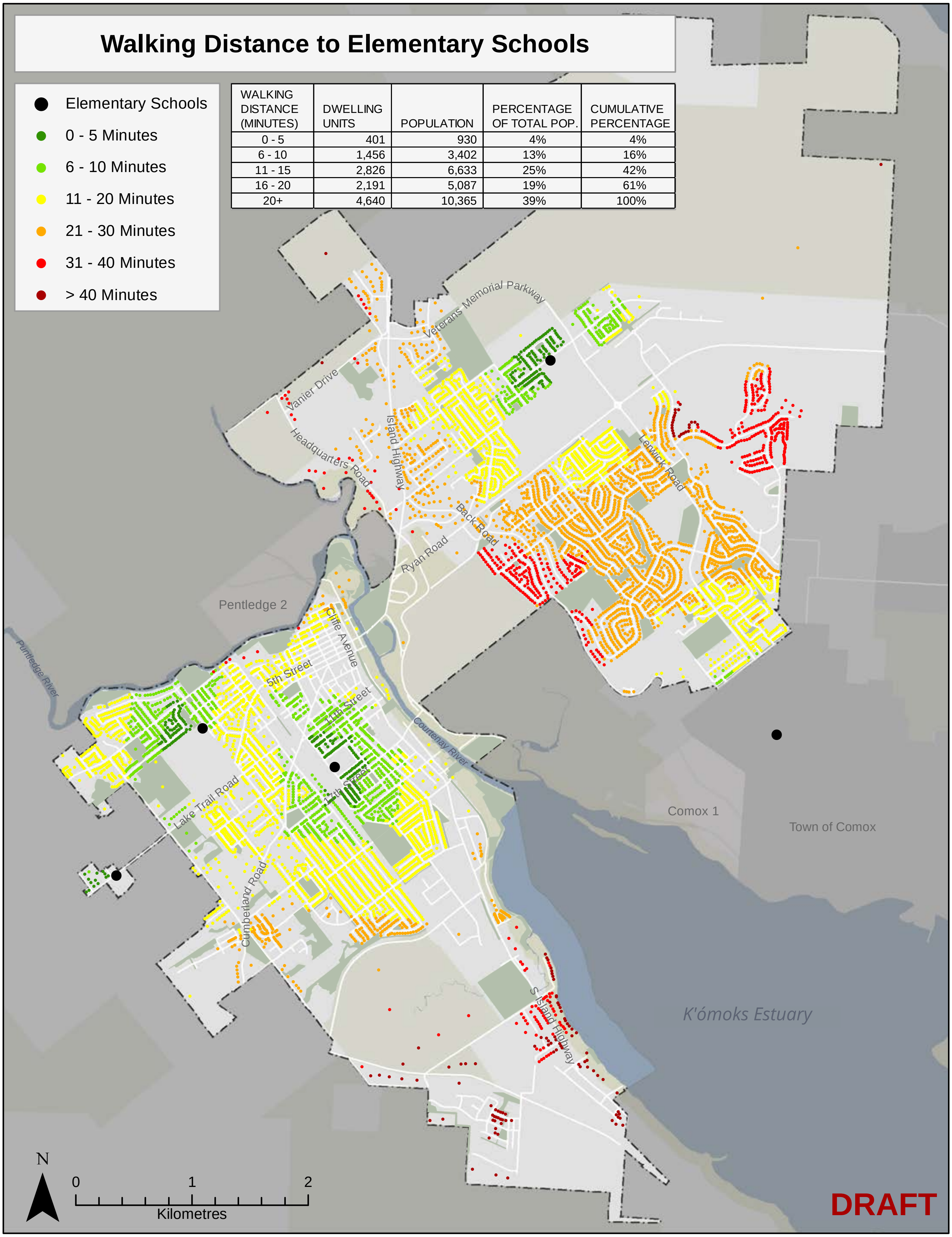
Figure 2.27 - Walking Distance to Employment.

SCHOOLS

Elementary and secondary schools are also top trip generators. Figures 2.28 and 2.29 present residential proximity to the City's four elementary schools, and a fifth elementary school nearby in the Town of Comox. **Only four percent of residents live within a five-minute walk of an elementary school, and 16 percent within a 10 minute walk.**

Three percent of residents live within a five-minute walk of one of Courtenay's three secondary schools (including the community middle school), and 14 percent live within a 10 minute walk.

Since school sizes dictate the number of schools in a given community and are often outside the direct influence of land use policy, urban design – and specifically neighbourhood connectivity – have a major role to play in improving pedestrian access to schools. The concept of connectivity and its performance in Courtenay is discussed further in the Urban Form section of this report.

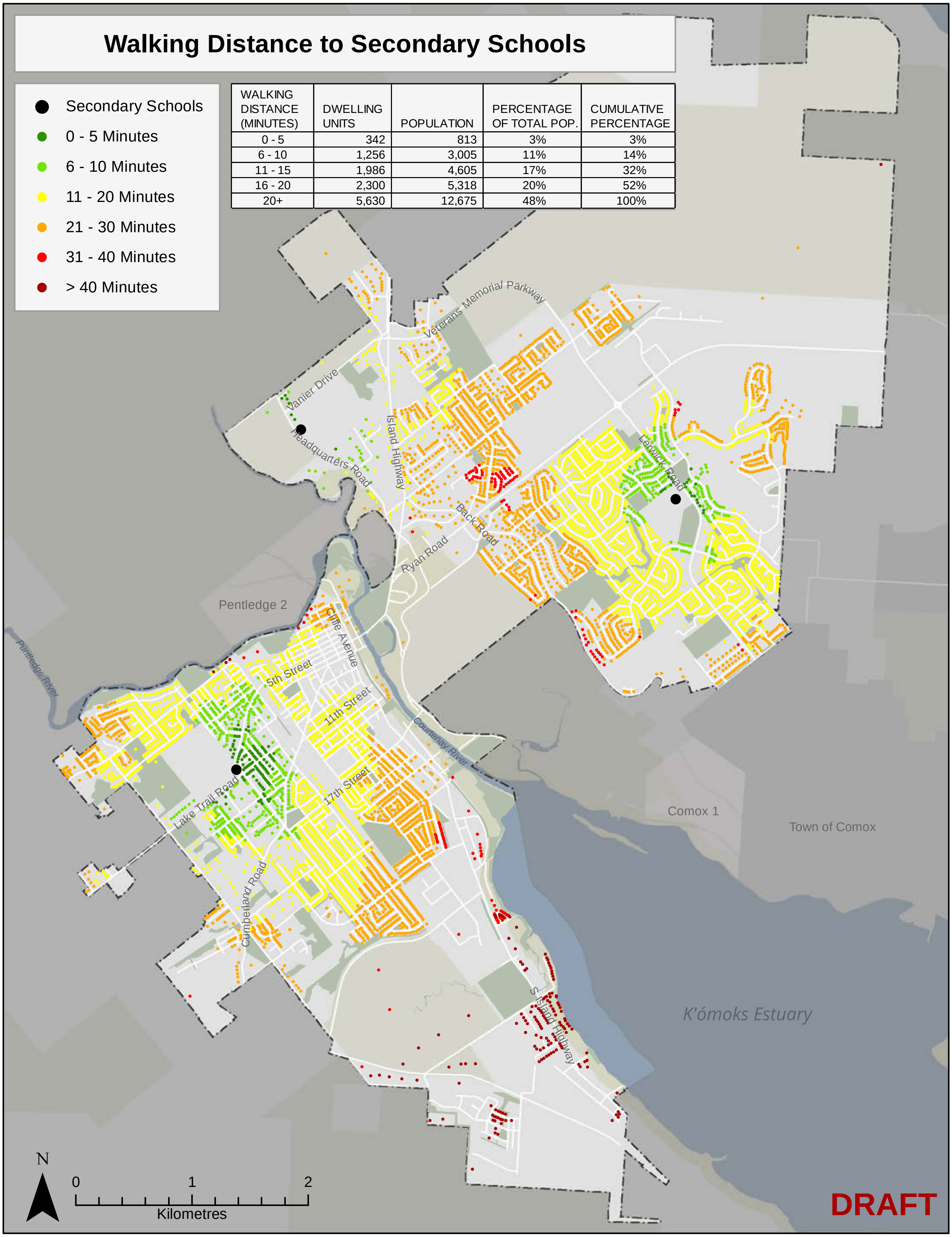


WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	401	930	4%	4%
6 - 10	1,456	3,402	13%	16%
11 - 15	2,826	6,633	25%	42%
16 - 20	2,191	5,087	19%	61%
20+	4,640	10,365	39%	100%

Data Sources: B.C. Open Data and OpenStreetMap network with pedestrian tags for distance analysis.

Figure 2.28 - Walking Distance to Elementary Schools.

Image - Lake Trail Community Middle School. Source: Comox Valley Schools.



WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	342	813	3%	3%
6 - 10	1,256	3,005	11%	14%
11 - 15	1,986	4,605	17%	32%
16 - 20	2,300	5,318	20%	52%
20+	5,630	12,675	48%	100%

Data Sources: B.C. Open Data and OpenStreetMap network with pedestrian tags for distance analysis.

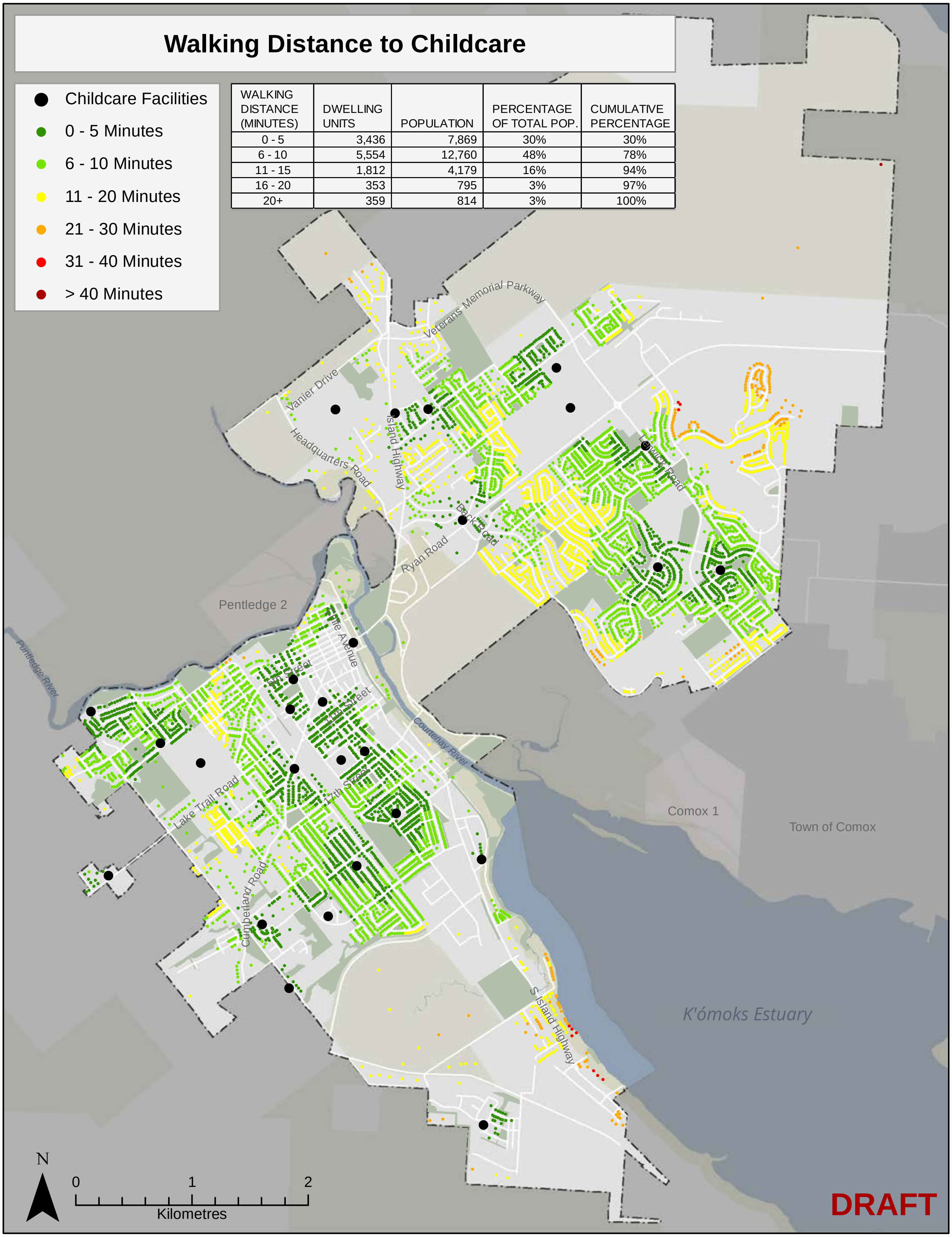
Figure 2.29 - Walking Distance to Secondary Schools.

CHILDCARE FACILITIES

Inclusive and equitable communities have childcare spaces distributed throughout a community. Providing proximity to this important use is also important for encouraging walking at the earliest ages, building a culture of active, low-carbon travel. Figure 2.3 shows that 30 percent of residents live within a 5-minute walk of a childcare space , and almost 80 percent live within a 10-minute walk. These are encouraging numbers as they also paint a positive picture in areas that do not perform as well with other land use metrics.

Walking Distance to Childcare

WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	3,436	7,869	30%	30%
6 - 10	5,554	12,760	48%	78%
11 - 15	1,812	4,179	16%	94%
16 - 20	353	795	3%	97%
20+	359	814	3%	100%



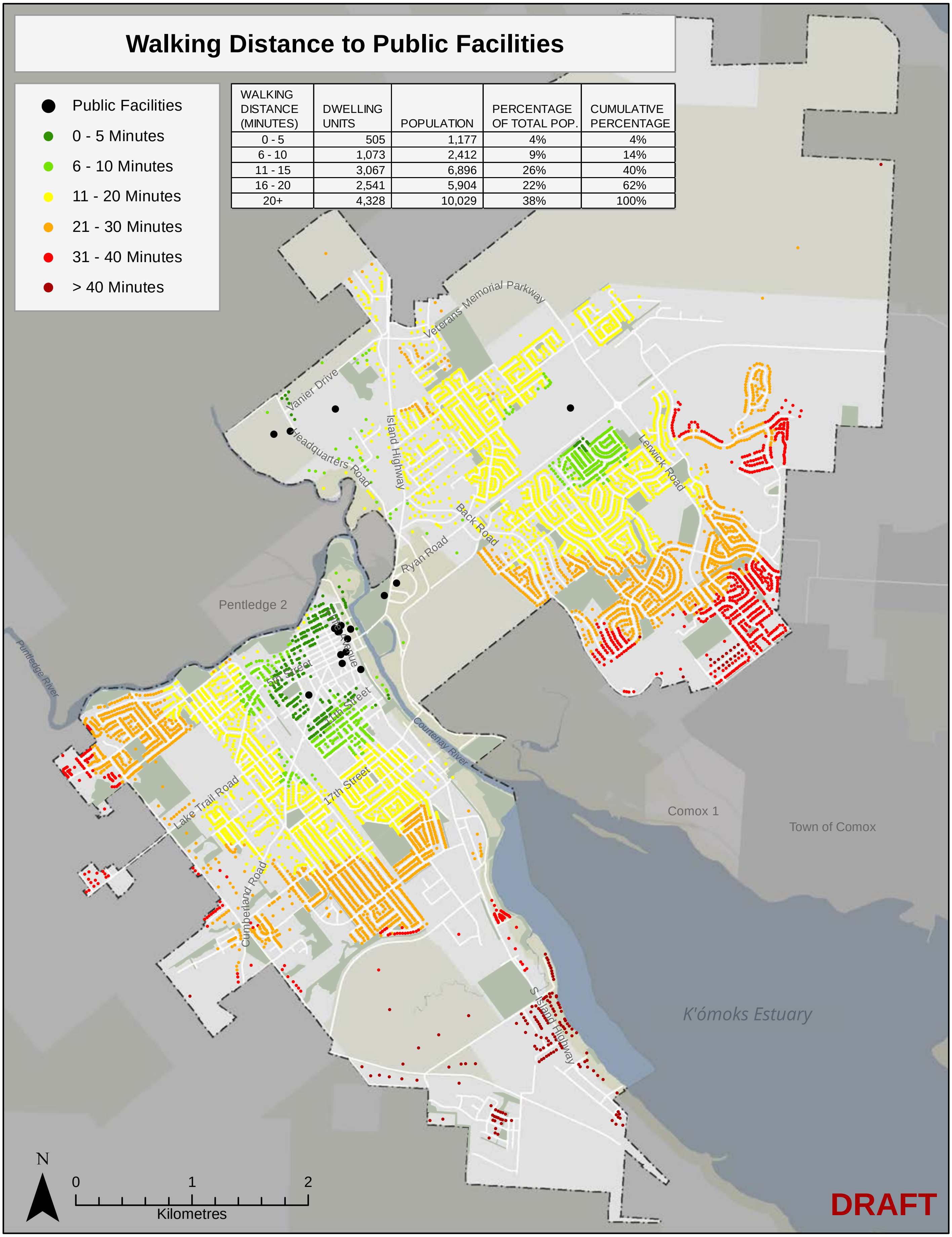
Data Sources: B.C. Open Data and OpenStreetMap network with pedestrian tags for distance analysis.

Figure 2.30 - Walking Distance to Childcare Facilities.

PUBLIC FACILITIES

Community centres and other public facilities are important social hearts and gathering spaces, bringing neighbours together and providing opportunities for recreation, culture, learning, and more. Figure 2.31 presents walking distance to these facilities, which include halls (community halls, lodges, clubs, etc) and recreational and cultural buildings. Fourteen percent of residents live within a 10-minute walk of public facilities, and 40 percent live within 15 minutes of such facilities.

As with many other destinations and services, public facilities concentrate in older areas and specifically in the downtown. While it is important to have such facilities in every neighbourhood, a concentration of community spaces in a city's downtown adds character, creates a sense of shared identity, and establishes a draw to the city's centre and cultural heart.



WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	505	1,177	4%	4%
6 - 10	1,073	2,412	9%	14%
11 - 15	3,067	6,896	26%	40%
16 - 20	2,541	5,904	22%	62%
20+	4,328	10,029	38%	100%

Data Sources: BC Assessment, 2016 (actual use codes) and OpenStreetMap network with pedestrian tags for distance analysis.

Figure 2.31 - Walking Distance to Public Facilities.

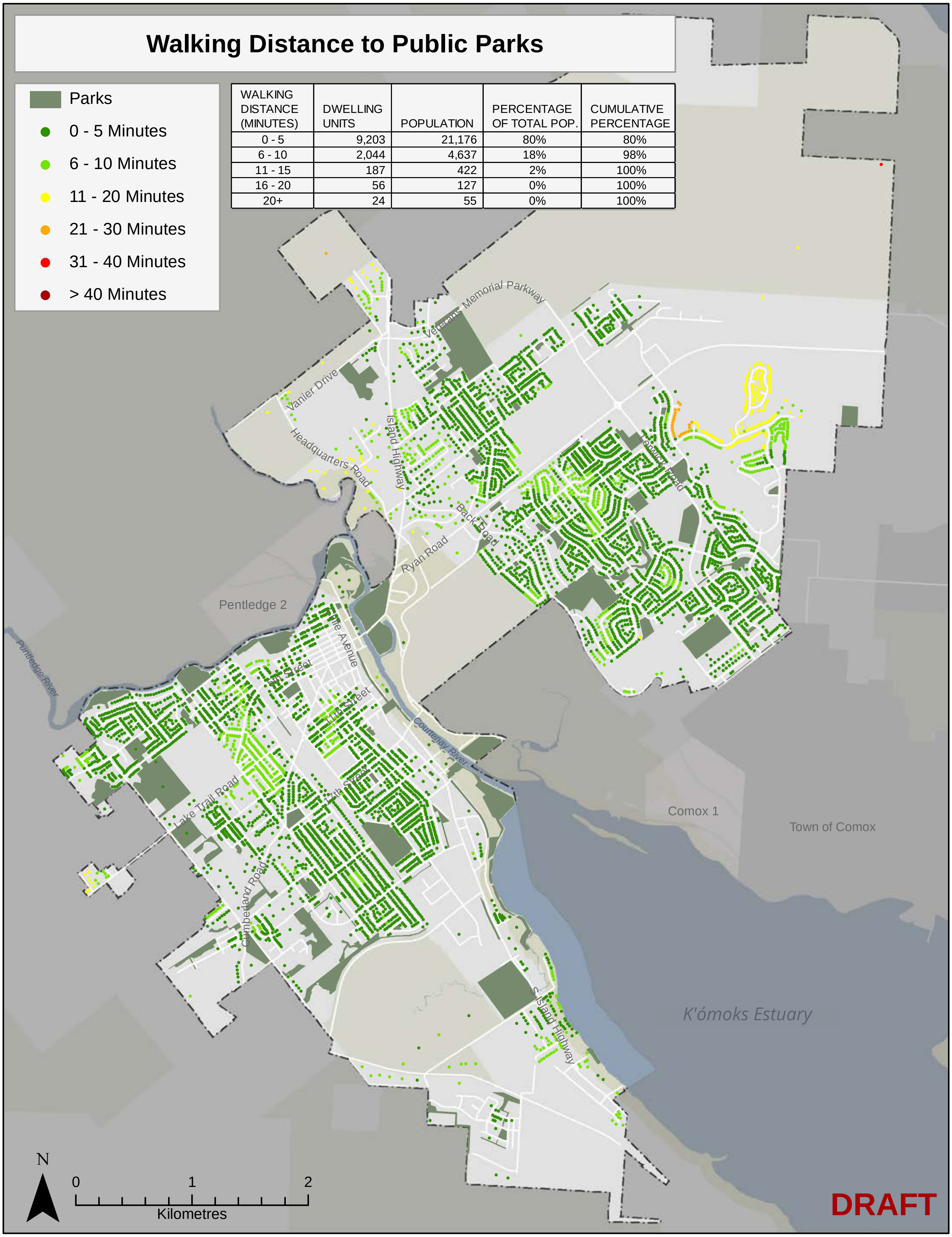
PARKS AND OPEN SPACES

Access to parks, green spaces, natural areas, and other open spaces is important to both individual health and community well-being. These spaces are unique and valuable in Courtenay, and nearly all households – 98 percent of the population – are within a 10 minute walk of a park. This is a tremendous asset.

Further discussion on parks and natural areas – including their role in ecological function – is included in Section 2.8: Ecology and Environment.

Walking Distance to Public Parks

WALKING DISTANCE (MINUTES)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 5	9,203	21,176	80%	80%
6 - 10	2,044	4,637	18%	98%
11 - 15	187	422	2%	100%
16 - 20	56	127	0%	100%
20+	24	55	0%	100%



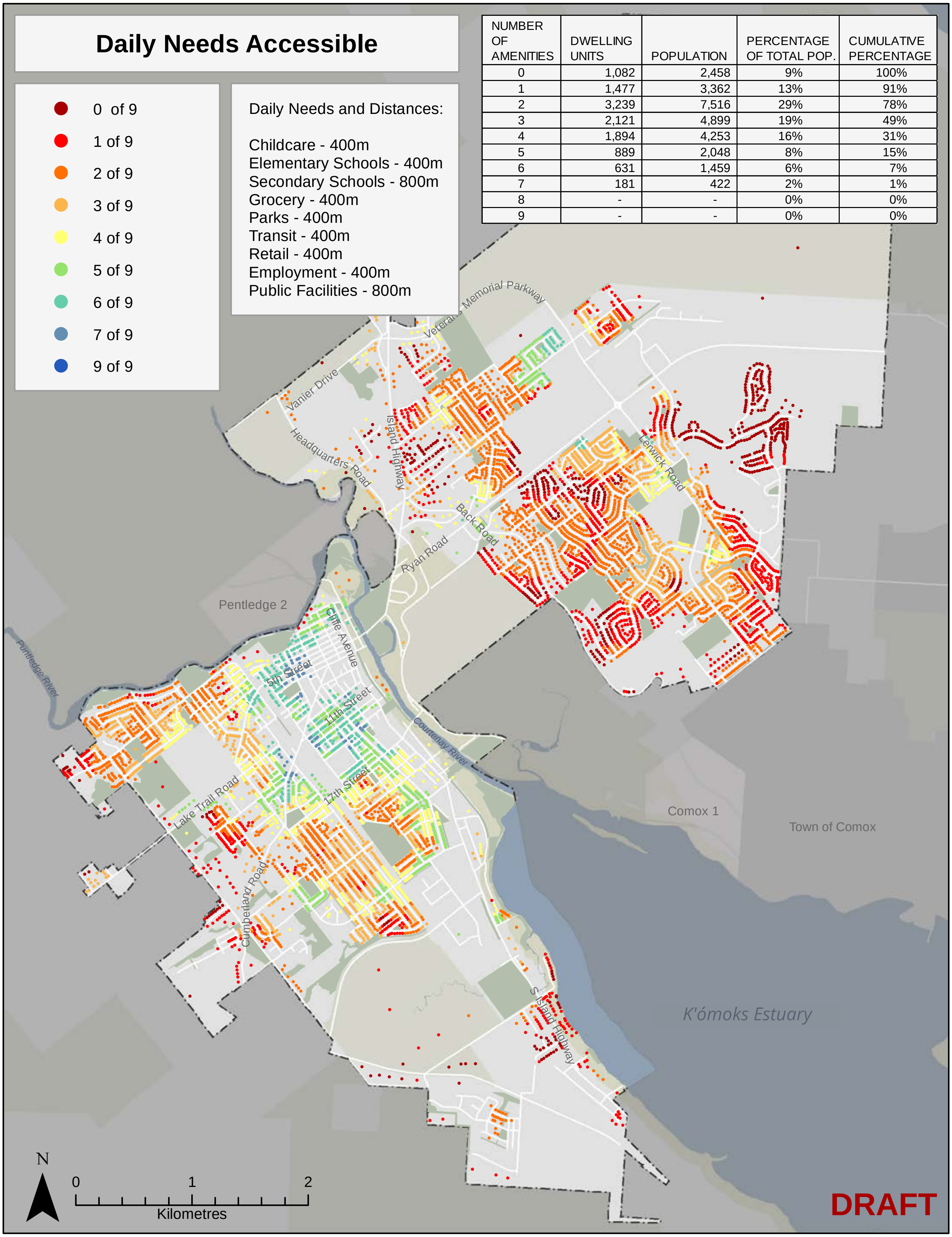
Data Sources: City of Courtenay Open Data and OpenStreetMap network with pedestrian tags for distance analysis.

Figure 2.32 - Walking Distance to Public Parks.

LAND USE MIX SUMMARY

Figure 2.33 brings together the components of land use mix analyzed in this section by summarizing access to daily needs. It reveals that the highest performing area is in the downtown core area, and generally that older areas provide better access than newer ones, particularly predominantly low-density, single use neighbourhoods.

Densities and urban design also play an important role in access to daily needs, and likelihood of travel by foot, bicycle, or transit. They are further explored in the sections that follow.



NUMBER OF AMENITIES	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0	1,082	2,458	9%	100%
1	1,477	3,362	13%	91%
2	3,239	7,516	29%	78%
3	2,121	4,899	19%	49%
4	1,894	4,253	16%	31%
5	889	2,048	8%	15%
6	631	1,459	6%	7%
7	181	422	2%	1%
8	-	-	0%	0%
9	-	-	0%	0%

Data Sources: Composite of all data used in Figures 2.25-2.32.

Figure 2.33 - Composite Map of Daily Needs Accessible to Courtenay Residents based on Typical Walksheds.

2.5 DENSITIES

Density refers to the number of people, homes, or jobs within a certain area. Higher residential density, often in the form of multi-family housing, can result in: energy savings; lower per capita municipal infrastructure and service costs (e.g. roadways, water and sewer infrastructure, transit, municipal services like fire stations, recreation centres, and schools, etc); greater housing choices and affordability; more vibrant street life and public realm; a larger proportion of trips take by foot, bike, and transit; and, as a result, reduced greenhouse gas emissions.

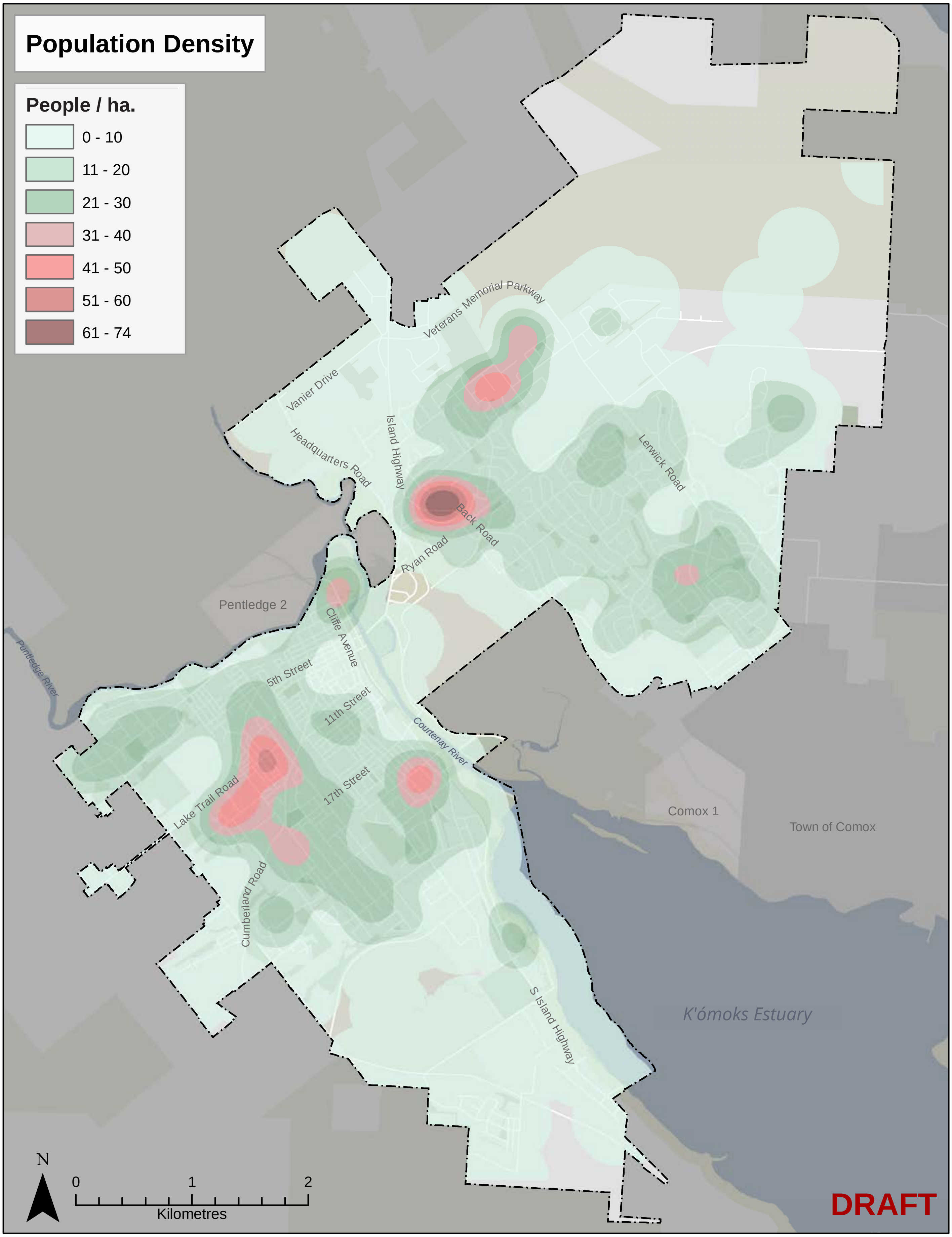
As such, densities are a vital part of the land use discussion and are paramount to tackling the climate emergency at the local level.

2.5.1 POPULATION DENSITY

Research shows that gross residential densities need to exceed approximately 32 people per hectare, before even a minor shift away from predominant vehicle use is seen. It is important to note, however, that this is considered a bare minimum, with even higher densities needed to support significant transportation choice and amenities.

Figure 2.34 presents population density in Courtenay. It reveals that most areas (shown in green) do not have residential densities that meet or exceed the minimum thresholds to be considered walkable or supportive of frequent transit service, which partly explains why the modal split currently favours vehicle use. Many of these residential densities are also insufficient to create the amount of customers needed to support neighbourhood-serving businesses like cafés and neighbourhood grocers, which in turn influences access to amenities, street life, and overall vitality.

At the same time, pockets of density (shown in pink) that do meet and exceed these thresholds offer promising local precedents that can be modelled elsewhere in the city.



Data Source: Population estimated using dwelling units provided by 2016 BC Assessment data.

Figure 2.34 - Courtenay Population Density.

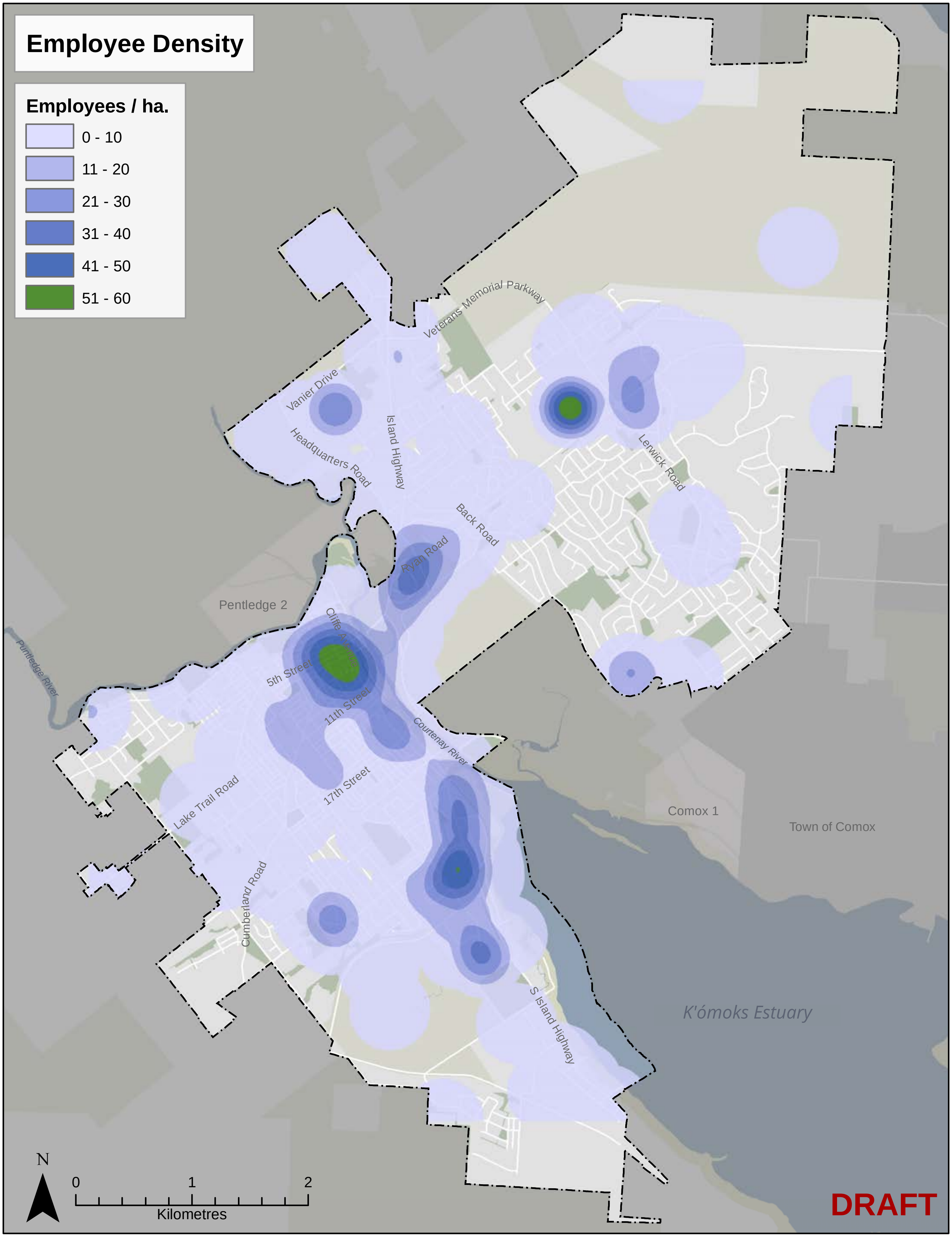
2.5.2 EMPLOYMENT DENSITY

Employment density is also very important to reducing greenhouse gas emissions, as the concentration of jobs in a particular area can affect transit ridership even more strongly than the concentration of its residents. For employment, research shows that a minimum threshold of anywhere from 50 to 185 jobs per hectare is needed for a significant modal shift from single-occupancy vehicle use to walking and transit use. For activity centres and corridors, employment densities could be considered in tandem with residential densities, as they both contribute to transit viability (for example) in central/ nodal urban areas.

Figure 2.35 presents employment density in Courtenay. It shows pockets of high job density at important employment anchors, including the downtown area and commercial area to the north, North Island College and North Island Hospital Comox Valley, and other retail areas. The employment densities in a couple of these areas (shown in green) meet or exceed minimum thresholds for transit supportiveness.

Ideally, areas of higher population density are also be areas of higher employment density, suggesting that a large proportion of residents could walk to work. When compared with Figure 2.34 (Population Density), areas of employee density tend not to directly overlap or integrate with areas of population density. This is likely due to the rarity of truly mixed use neighbourhoods.

However a number of employee density nodes are immediately adjacent to population density nodes, including in the downtown area and North Island College / North Island Hospital area.



Data Source: BC Assessment, 2016 (actual use codes).

Figure 2.35 - Courtenay Employee Density.

2.6 URBAN FORM

2.6.1 CONNECTIVITY

Street connectivity is a measure of travel directness and availability of alternative routes through a network, which influences the real distance traveled between a point of origin (e.g. home) and a destination (e.g. transit stop, retailer, etc).

In fact, **connectivity is one of the most significant factors in the frequency and quantity of walking trips, which in turn also supports transit.**

CONNECTED VS DEAD END STREETS

Connected streets provide multiple route options throughout the community while 'dead-end and loop streets' serve adjacent properties only. Figure 2.36 presents connected streets and dead end streets in Courtenay.

The downtown area, which was incorporated in 1915, reflects a traditional small block grid pattern that was common to this era. These small blocks are well connected and provide many options for travel by foot, bicycle, and vehicle. This small block grid pattern lends well to public transportation and car share systems because they are more walkable than large and discontinuous block patterns.

In comparison, street pattern in areas that developed towards the end of the 20th century and towards the beginning of the 21st century reflect larger blocks and curvilinear streets with less connectivity. Many of these streets have the primary function of serving adjacent properties only, and wayfinding can be challenging. Establishing connectivity for walking and cycling in these areas depends more heavily on off-street pedestrian networks between property lines and along designated trail corridors.

INTERSECTION DENSITY

The "street pattern" diagrams on page 71 illustrates the significant difference between crow-fly distance and street network (i.e. actual travel) distance in poorly connected and well connected urban networks. Generally speaking, communities with smaller blocks – and therefore more opportunities to change direction while on foot – are considered highly connected.

However there are many ways in which to measure connectivity; one of the most common is intersection density, with research demonstrating that a minimum of 50 intersections per square kilometre – or 0.5 intersections per hectare – is needed before pedestrian travel becomes more commonplace.

Figure 2.37 presents connectivity across Courtenay, as defined by the number of intersections with a minimum of three intersecting connections in a given area. Areas that meet or exceed the minimum threshold of 0.5 intersections per hectare in yellow/green/blue/violet. As is the case in most cities, these areas are often grid-like with smaller block sizes, and found in the older areas near the downtown.

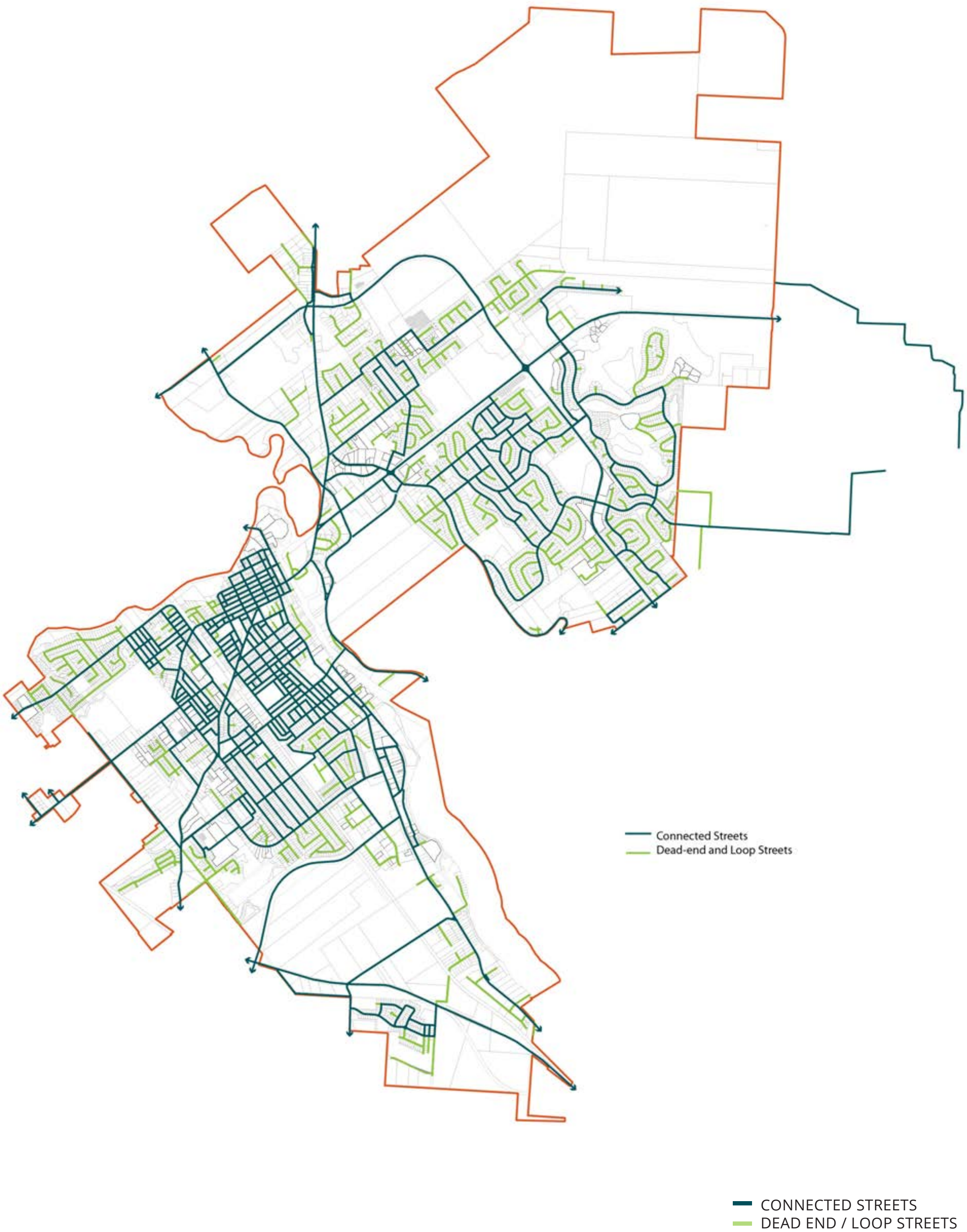


Figure 2.36 - Connected and Dead End / Loop Streets of Courtenay.
Data Source: City of Courtenay Open Data. Please note that this diagram does not include informal cul-de-sac pedestrian connections.

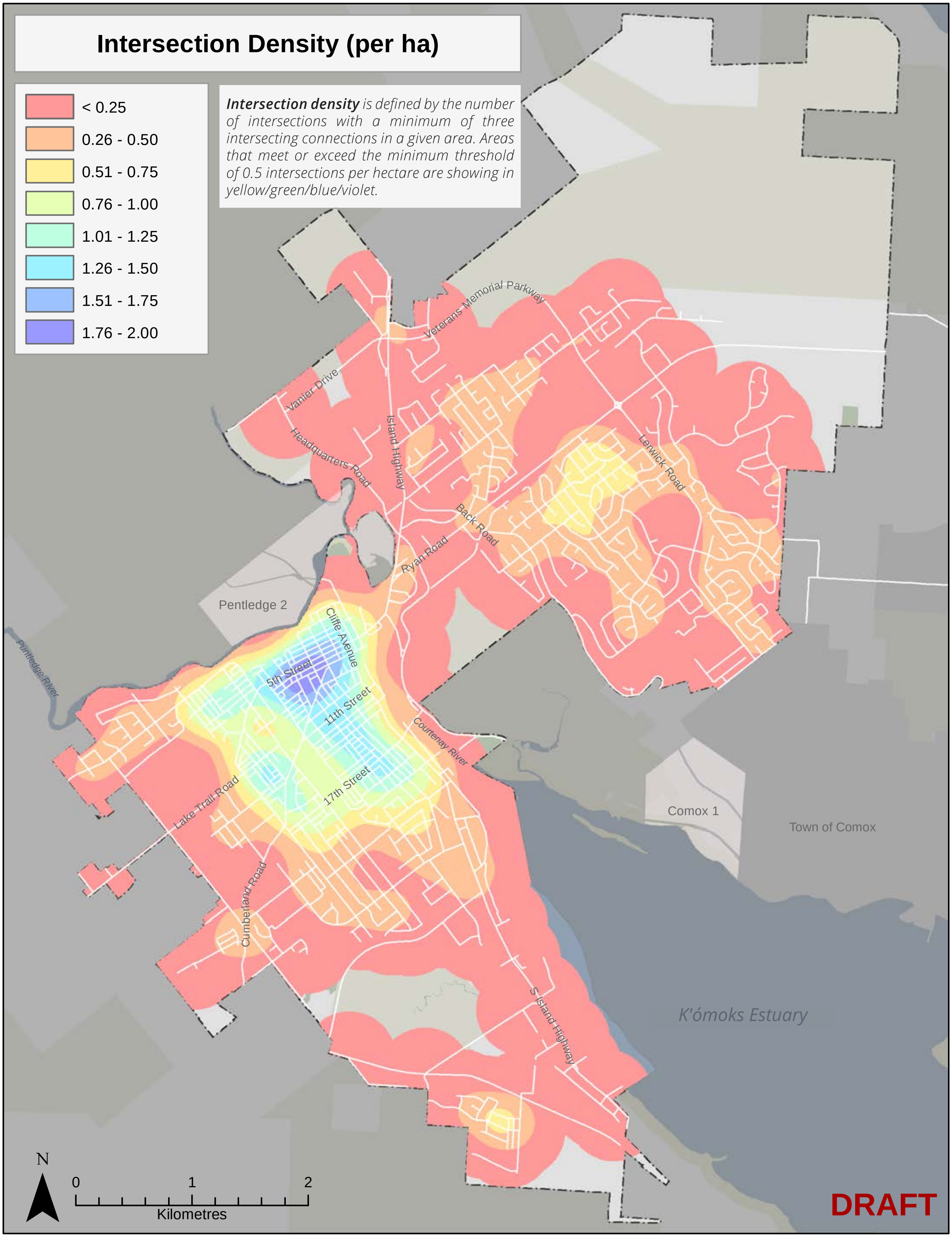


Figure 2.37 - Intersection Densities of Courtenay. Data Source: City of Courtenay Open Data.

STREET PATTERN

Below are three examples of street patterns with varying levels of connectivity. Each circle's radius represents a five minute (400 metre) walk between two locations, while the green solid line shows the actual distance required to travel.

5th Street

Moray Ave

Perth Place

5 mins

7 mins

14 mins

STREET COMPOSITION

Streets are public places. While they function as corridors in terms of moving people, they are equally important as places for sitting, playing, socializing, shopping, lingering, and more. They comprise an important part of the social fabric of the community, and help establish a sense of place and identity. Indeed, streets are place for people as much as are parks and community centres.

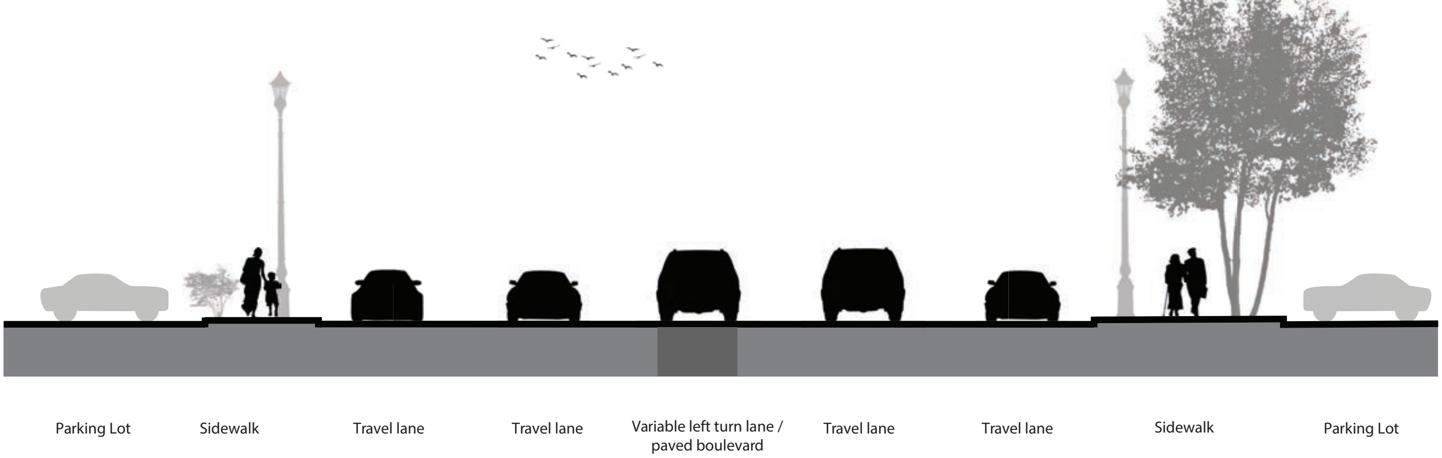
Streetscape quality – including relationships between buildings and public spaces like sidewalks –have significant influence on the experience and therefore desirability of walking and cycling in a city. As such, they also influence modal share and therefore are a part of strategies to reduce greenhouse gas emissions.

The street section examples on the opposing page present a range of approaches to urban design and space allocation for different modes. Cliffe Avenue at 26th Avenue is showing a pattern of development that places buildings away from the street and provides no buffer between travel lanes and sidewalk spaces. This prioritizes efficient vehicle movement at the cost of pedestrian comfort, and makes the overall mobility network less efficient

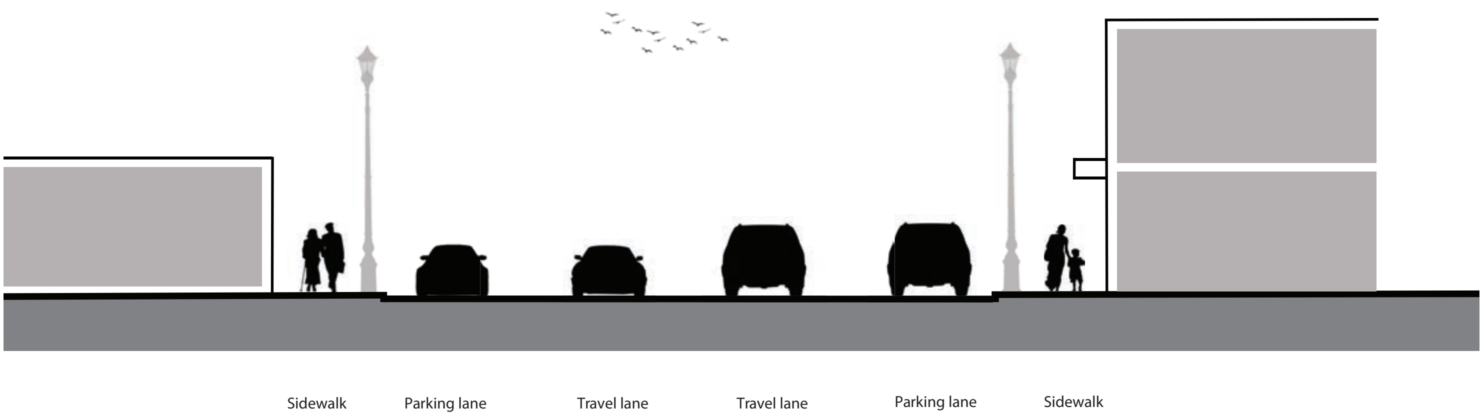
Sixth Street at Cliffe Avenue situates buildings adjacent to sidewalks, contributing to the human scale of the street and offering protection from the elements. It also offers a parking lane / buffer that separates pedestrians from traffic.

The 5th Street "Complete Street" goes further in dedicating spaces for cyclists, and providing both parking spaces and bioswales that offer a buffer from traffic. This intervention improves pedestrian comfort and safety, and also serves an ecological function in capturing, infiltrating, and cleaning rain water.

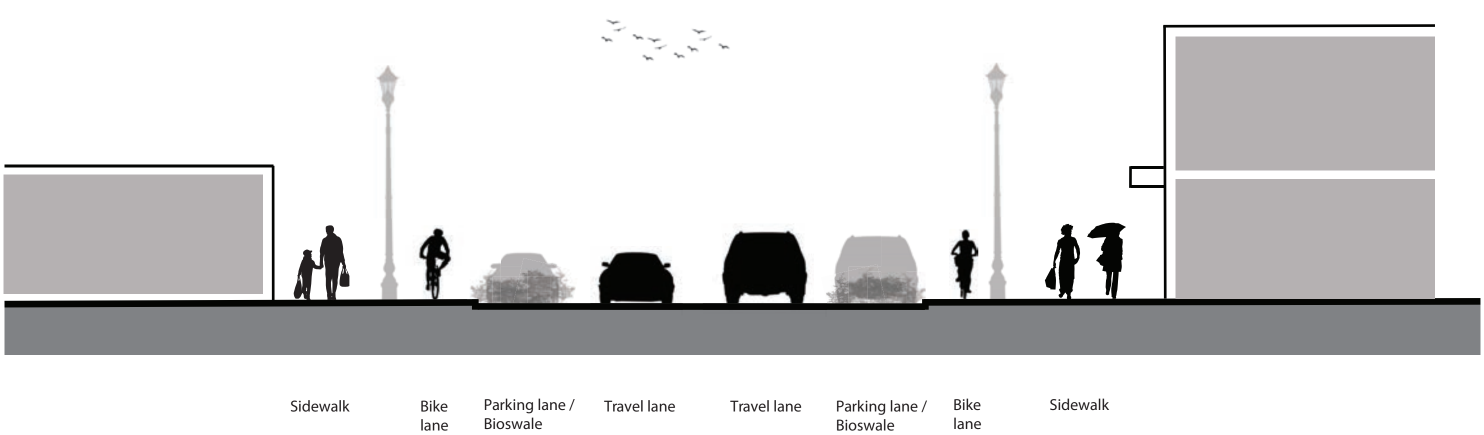
Note: This section is not to scale and will be updated.



Cliffe Avenue at 26th Avenue



6th Street at Cliffe Avenue



5th Street Complete Street

2.6.2 GATEWAY AND TRANSITION ZONES

This section provides a qualitative urban design analysis of major 'gateway' streets into Courtenay. The Legal and Perceived Gateway diagram identify areas where the City of Courtenay boundary exists (legal gateways) as well as areas where physical cues indicate that one is crossing a threshold into the city (perceived gateways).

The numbers on the diagram refer to the images and/or descriptions on the following pages which summarize the changes in urban form that are experienced as one travels along these gateway streets.

Figure 2.38 - Legal and Perceived Gateways of Courtenay.

ISLAND HIGHWAY / CLIFFE AVENUE

1. LEGAL BOUNDARY

The legal boundary and gateway into the City of Courtenay along Island Highway heading north is characterized by lush and rural character with significant coniferous trees lining either side of the street.

2. RURAL / SUBURBAN CHARACTER

The mix of land uses and urban form are of rural and suburban character.

3. PERCEIVED GATEWAY

The transition through Milliard Nature Park into the more developed core of Courtenay marks a perceived gateway where the rural and suburban character transitions into urban edge.

4. URBAN EDGE

Development along this portion of Cliff Avenue is characterized by a mix of development forms that create an urban edge condition. Buildings range from being set back from the street with surface parking, to being more pedestrian oriented with smaller setbacks and parking to the rear.

5. URBAN CORE

Where blocks become smaller there is opportunity to establish a clear 'high street' feel along Cliffe Avenue and sense of arrival in the downtown.

1.

2.

3.

4.

COMOX VALLEY PARKWAY

6. LEGAL BOUNDARY

The legal boundary and gateway into the City of Courtenay along Comox Valley Parkway heading into Courtenay is characterized by lush and rural character with trees lining either side of the street.

6.

7. TRANSITION

A bend in the road and the railline mark the perceived gateway into the urban area of Courtenay. Developments in this area are of a suburban / industrial character.

7.

CUMBERLAND ROAD

8. LEGAL BOUNDARY

Heading from south northward on Cumberland Road, one transitions from a rural-suburban experience to mixture of rural-suburban and pacific northwest forest experience with the presence of single detached homes and Capes Park just north of the legal boundary.

8.

9. RURAL / URBAN TRANSITION

The experience along Cumberland Road is a gradual transition from rural-suburban to suburban. Where Cumberland Road meets 8th Street the experience becomes more urban, with taller buildings (up to three storeys) that frame the street with smaller setbacks.

9.

2.6.3 WALKABILITY SUMMARY

Figure 2.39 offers a summary snapshot of how land use and urban form are performing in Courtenay from the perspective of walkability. It combines considerations for connectivity (intersection density), land use mix (commercial areas and more), and density (population density).

The map demonstrates how the downtown area is most walkable, followed by other older areas immediately surrounding the downtown area and across the river to the northeast. The least walkable areas are on the City's periphery to the north and south, and they offer opportunity for improvement once the scenario planning component of the OCP is underway.

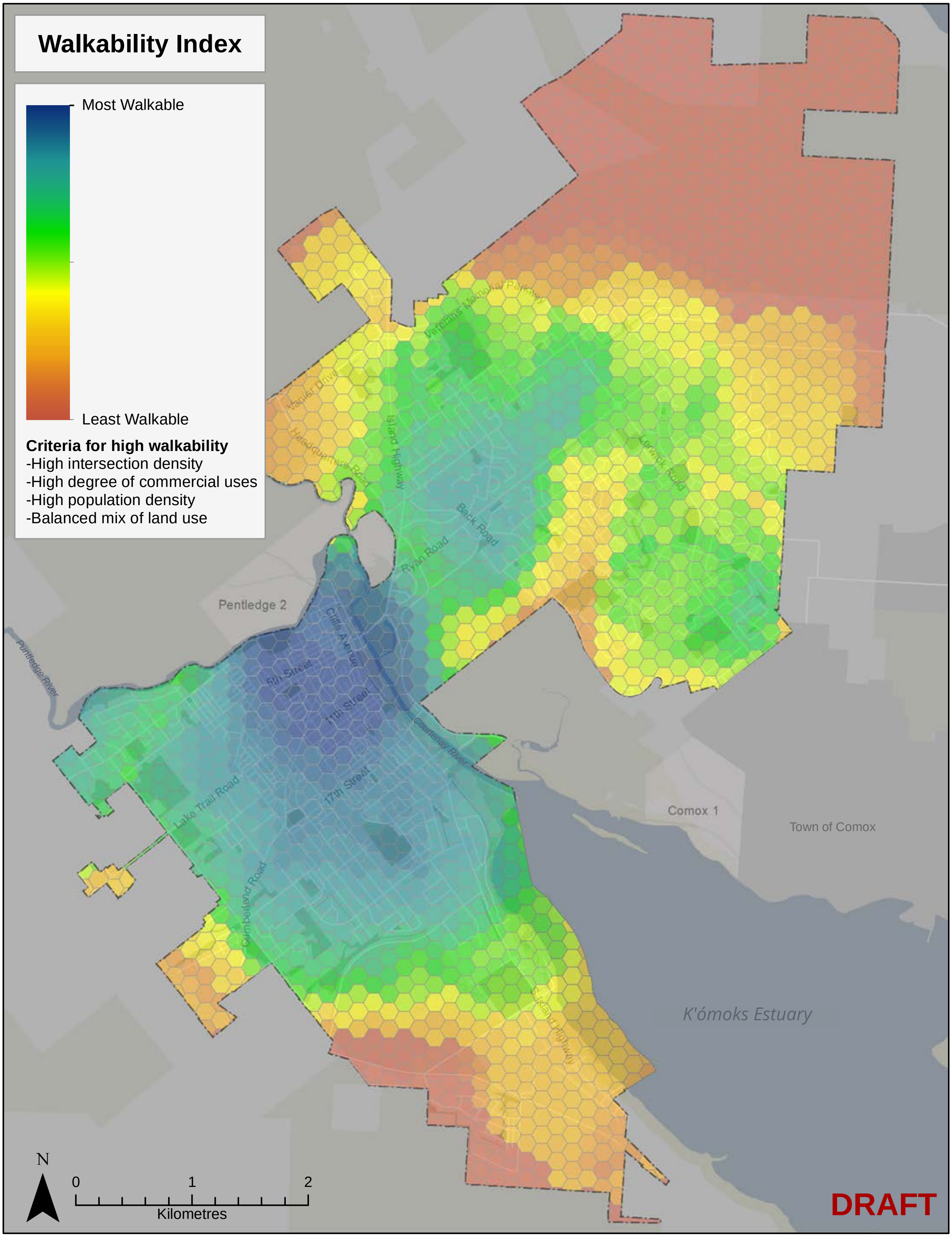


Figure 2.39 - Walkability Index of Courtenay. Data Sources: BC Assessment, 2016 and City of Courtenay Open Data.

2.7 STREETS AND MOVEMENT

Courtenay's existing transportation network is primarily oriented toward private vehicles. There are numerous challenges facing the pedestrian, cycling, and transit networks that require attention during the planning phases of the OCP process. The City's Transportation Master Plan (TMP) currently identifies a target to double the percentage of trips by sustainable modes — walking, cycling, and public transit — from 15% to 30%. In order to achieve this target, a number of actions will need to be implemented from the TMP and can be further supported through the OCP review process.

This section builds from and adapts the information found in the "Connecting Courtenay" TMP. The plan includes medium and long-term plans for all modes of transportation over the next 20 years and beyond. The plan was adopted by Courtenay Council in September 2019. The following sections provide an overview of Courtenay's transportation conditions today including its pedestrian network, cycling network, transit system, and overall road network.

2.7.1 HOW WE GET AROUND

Courtenay's transportation system will need to support and accommodate more residents, jobs, and services in the future. The type of transportation infrastructure and services available to people affect how they choose to travel. How residents move around in the city also has a direct impact on the climate. As noted previously in this document, whether travelling to work, school, or to complete daily errands, trips taken by the private vehicle have the largest impact on Courtenay's greenhouse gas emissions. Emissions from the transportation sector in Courtenay accounts for 59% of total emissions in the city (55,390 metric tons of carbon dioxide equivalent based on 2016 estimates).

There is an imperative to address Courtenay's current and future transportation challenges while meeting the diverse needs of residents of all ages and abilities. These challenges include:

- As already noted, a mixture of urban and suburban scale and form of land use patterns that means travelling by car is the most convenient for the majority of trips;
- Population growth of approximately 60% over the next 20 years, increasing the pressure on travel demands and transportation infrastructure;

- Aging population due to the city as a destination for retirees and active seniors, elevating the importance of providing accessible and multi-modal transportation options;
- Consistent travel demand throughout the day due the older demographic of the community, with congestion present during the morning, afternoon, and midday periods.

The majority of people in Courtenay rely on their car, with 85% of all trips by Courtenay residents by private vehicle according to the City's TMP model. This is followed by 15% of trips by sustainable modes—7% of trips by walking, 4% by cycling, and 4% by public transit. This mode share – the proportion of trips taken for a given mode – is generally consistent for commute trips, with 83% of commute trips to work or school by private vehicle (car, van, truck), including both drivers (77%) and passengers (6%) according to the 2016 Census by Statistics Canada. When compared to six similar sized communities in British Columbia, approximately 75% of people drive to work compared to 83% of people in Courtenay (see Figure 2.40).

The City's TMP currently identifies a target to double the percentage of trips by sustainable modes—walking, cycling, and public transit, from 15% to 30% (see Figure 2.41).

Figure 2.42 presents mode share by dissemination area. This information is particularly meaningful when we compare it against the figures on page 83, where the links between transportation behaviour and density, connectivity, and land use mix becomes apparent at the neighbourhood level.

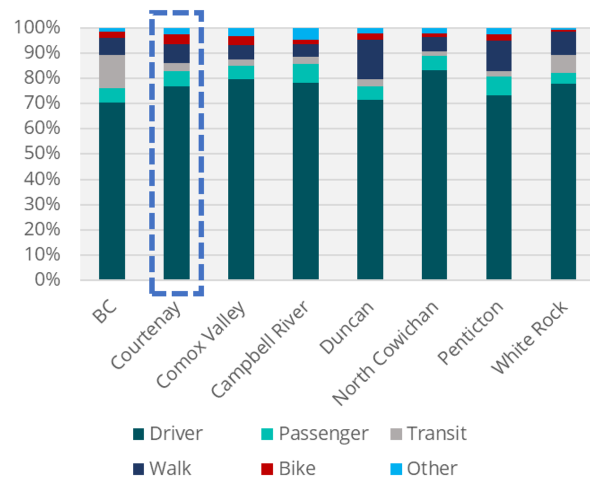


Figure 2.40 - Mode Share to Work (2016). Source: Connecting Courtenay Transportation Master Plan (2019).

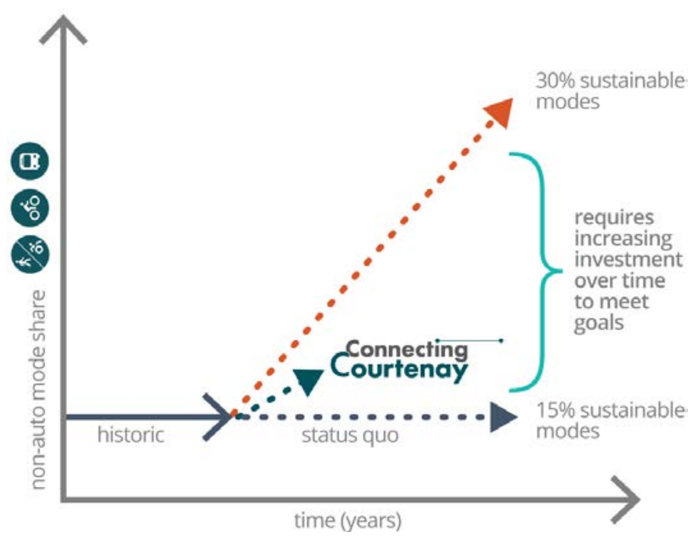


Figure 2.41 - Sustainable Mode Share Target. Source: Connecting Courtenay Transportation Master Plan (2019).

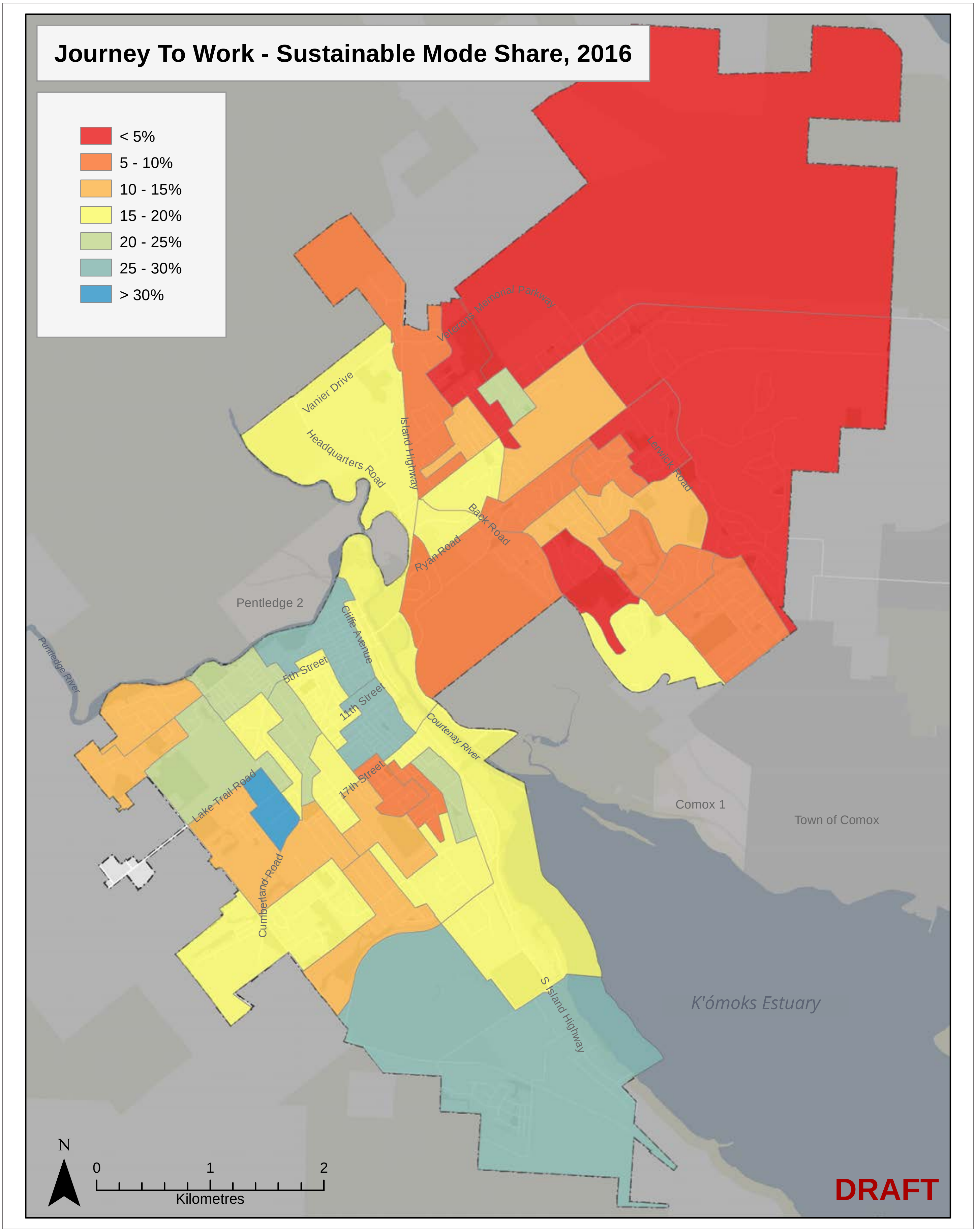
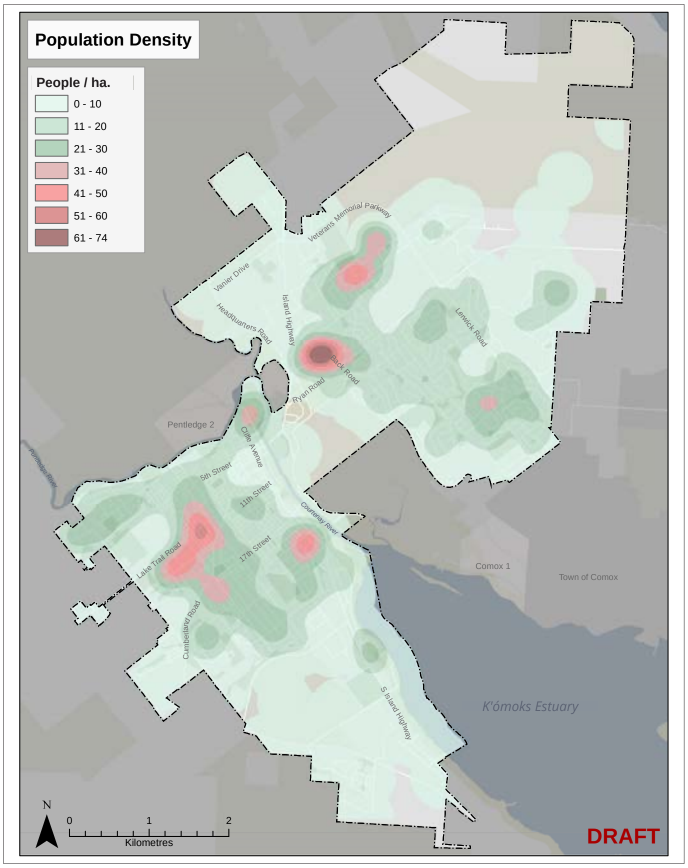
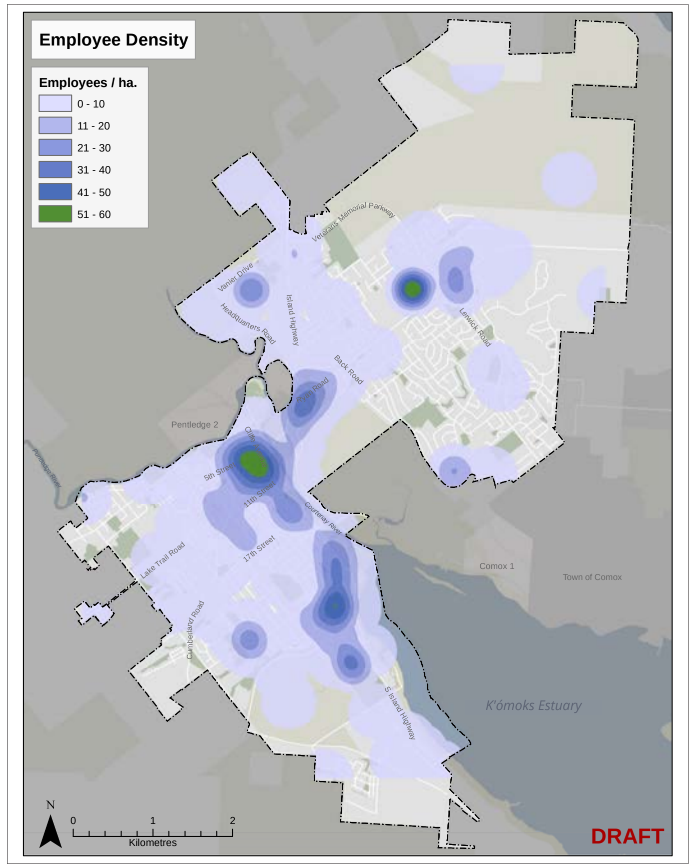
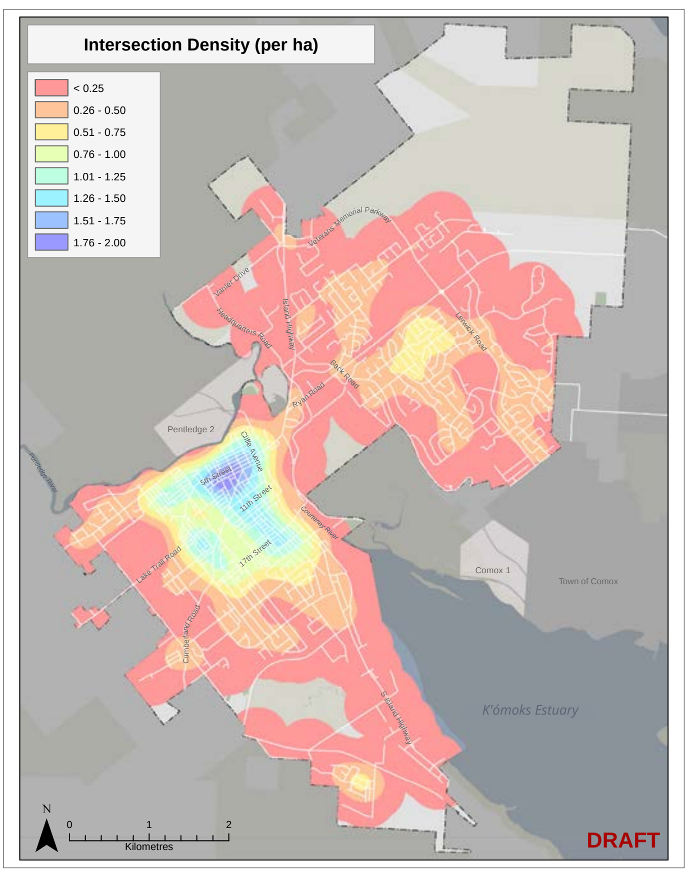
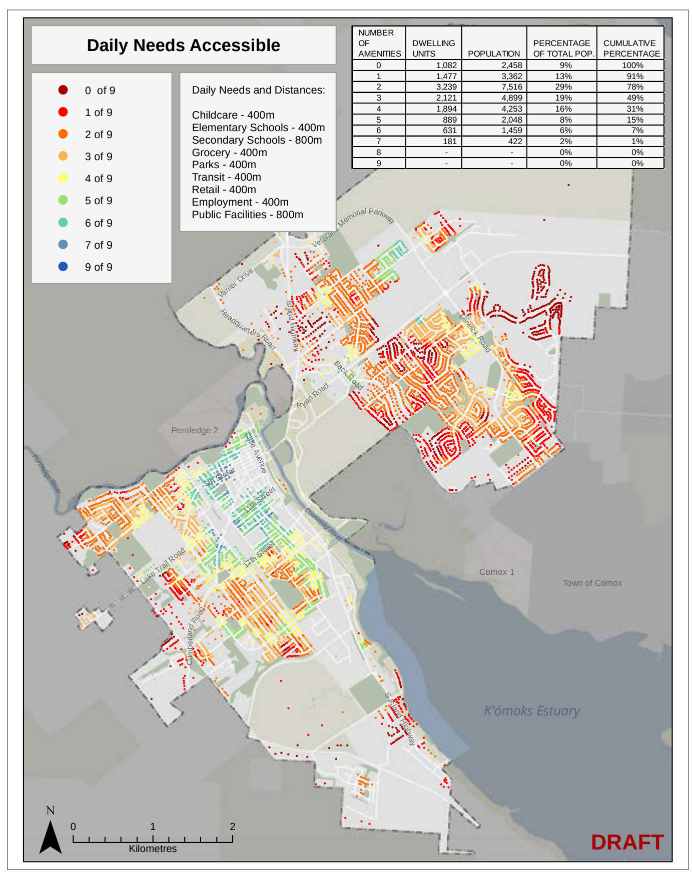


Figure 2.42 - Journey to Work by Sustainable Mode Share and Dissemination Area in Courtenay.
Data Source: Statistics Canada Journey to Work Mode Share, 2016 by Dissemination Area.









NUMBER OF AMENITIES	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0	1,082	2,458	9%	100%
1	1,477	3,362	13%	91%
2	3,239	7,516	29%	78%
3	2,121	4,899	19%	49%
4	1,894	4,253	16%	31%
5	889	2,048	8%	15%
6	631	1,459	6%	7%
7	181	422	2%	1%
8	-	-	0%	0%
9	-	-	0%	0%

2.7.2 WHY WE MOVE AROUND

As demonstrated in Section 2.6, land use decisions influence how people travel throughout a community, and in turn, transportation decisions influence where land use, development, economic, and community activity happens.

There are four key categories of destinations in Courtenay as described in the City's TMP (see Figure 2.43).

1. **Commercial Areas.** Downtown Courtenay is an important destination for employment, shopping, and recreation. Proximity of residential areas surrounding the urban core make walking, cycling, and transit possible. More suburban character commercial uses exist around Ryan Road and Lerwick Road, and these areas are generally less accessible by walking and cycling due to their location and design.

2. **Community Facilities.** Many of Courtenay's important cultural, civic and recreational facilities are located downtown, including City Hall, the library, Florence Filberg Centre, Native Sons Hall, Comox Valley Art Gallery, Courtenay and Distric Museum and Paleontology Centre, as well as various community festivals. The North Island Hospital Comox Valley and North Island College are both located north of Ryan Road and west of Lerwick Road. A number of other facilities such as Courtenay & District Memorial Outdoor Pool, Lewis Centre, Lewis Park, and LINC Youth Centre are located off of Old Island Highway.

3. **Regional Destinations.** The Comox Valley Airport is located east of the city and is primarily accessed through the city via Ryan Road, as is Canadian Forces Base Comox. Mount Washington Alpine Resort and Strathcona Provincial Park are nearby regional outdoor attractions. The Comox and Cumberland communities are also both important regional destinations.

4. **Schools.** There are nine schools in Courtenay: five elementary schools, one community middle school, and three secondary schools. The city is also home to one of four North Island College campuses.

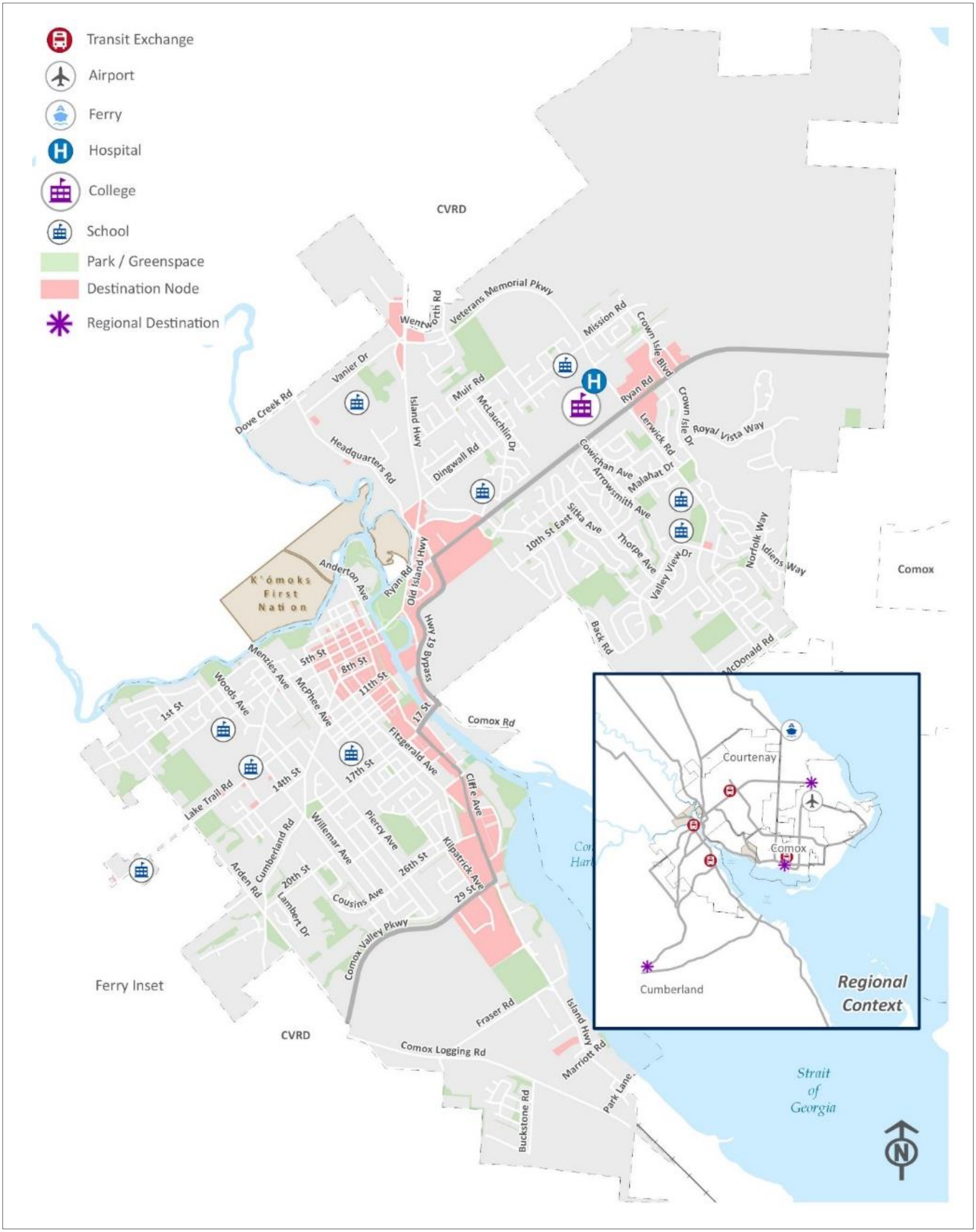


Figure 2.43 - Community Destinations in Courtenay. Source: Connecting Courtenay Transportation Master Plan (2019).

PEDESTRIAN NETWORK

Walking, including using a mobility device, is fundamental to all forms of transportation. It is a part of every trip, whether travelling by car, transit, or bicycle. Ensuring people can freely, safely, and comfortably move by foot or by wheel ensures an equitable community that is accessible to people of all ages and abilities. Walking currently accounts for 8% of all trips within Courtenay.

The City has an extensive walking network, with approximately 173 kilometres of sidewalks. However, there are still gaps in the network that need to be addressed to develop a better and more continuous pedestrian system (see Figure 2.44). Approximately 65% of all streets currently have sidewalks on at least one side, with only 36% of all streets only have a sidewalk on both sides. Key challenges for the pedestrian network include:

- **Gaps in the sidewalk network make walking unsafe and uncomfortable.** This is present on major roads where traffic speeds and volumes are high, and along transit routes where passengers rely on sidewalks or other walkways to access bus stops.

- **Lack of safe crossings on some major roads can be barriers to walking.** Lack of safe crossings can be particularly challenging when combined with low light or low visibility and for pedestrians with slower travel speeds.

- **Accessibility challenges along existing sidewalks and crossings making those with mobility aids travel longer distances to cross or not travel at all.** Poor accessibility can include sidewalks in disrepair, landscaping encroaching on sidewalk, poorly located push-buttons, and inadequate curb let-downs.

The City's TMP identifies a number of actions and network improvements, including new sidewalks, new multi-use pathways, improvements to multi-use trails, new trails and connections, new and improved river crossings, and enhanced intersections and improved accessibility, along with programs to promote and support walking. Making these investments is critical to reducing community wide GHGs.

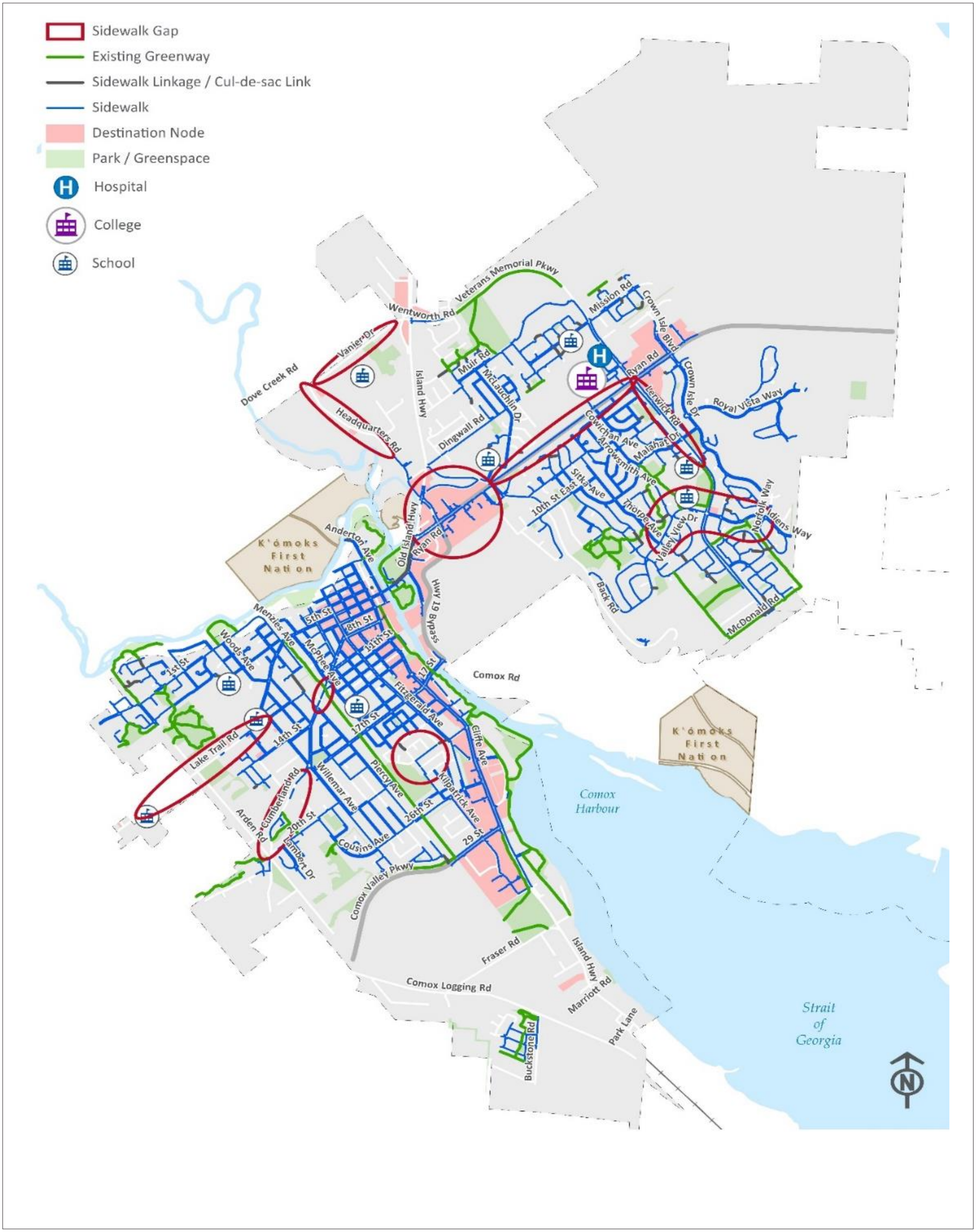


Figure 2.44 - Existing Pedestrian Network. Source: Connecting Courtenay Transportation Master Plan (2019).

CYCLING NETWORK

Cycling can be an enjoyable, relatively low cost, healthy, and sustainable form of transportation. Cycling is already a popular recreational activity in Courtenay due to the community's supportive climate and landscape, but positioning cycling to be the preferred mode for everyday purposes for people of all ages and abilities requires investment in dedicated cycling infrastructure. Cycling currently accounts for 4% of all trips within Courtenay.

The City has approximately 30 kilometres of bicycle facilities, but it is limited and largely off-street. There are only 500m of protected bicycle lanes, which represents 0.5% of the entire bicycle network. As part of the engagement process for the City's TMP, the public was asked to respond to a survey, which asked a series of questions including "what could we do to make it easier to bike in Courtenay?" Over 50% of the respondents identified the need for more bike lanes that are physically protected from traffic. The provision of high-quality protected or off-road facilities that are physically separated from motor vehicle traffic can support a greater diversity of users.

Key challenges for the cycling network include:

- **Limited network of designated routes.** Courtenay has very few protected and off-street cycling routes that connect to key destinations, with residents reporting that they do not feel safe riding in traffic.

- **Without a more cycling-friendly river crossing option, cycling is less likely to be an attractive option for trips that involve crossing the river.** Although popular off-street pathway facilities act as the spine to the current network, there are inherent barriers in some locations. When the pathway is busy, cycling can be a challenge and intersections can be difficult to safely navigate.

- **Many neighbourhood routes that are comfortable to ride on are unsigned.** Cyclists currently use local roads to make many trips, however, they can be hard to locate and are not clearly marked for potential cyclists and drivers.

- **Lack of secure bicycle parking** results in many cyclists not having a safe and secure place to store their bicycles at the end of their trip.

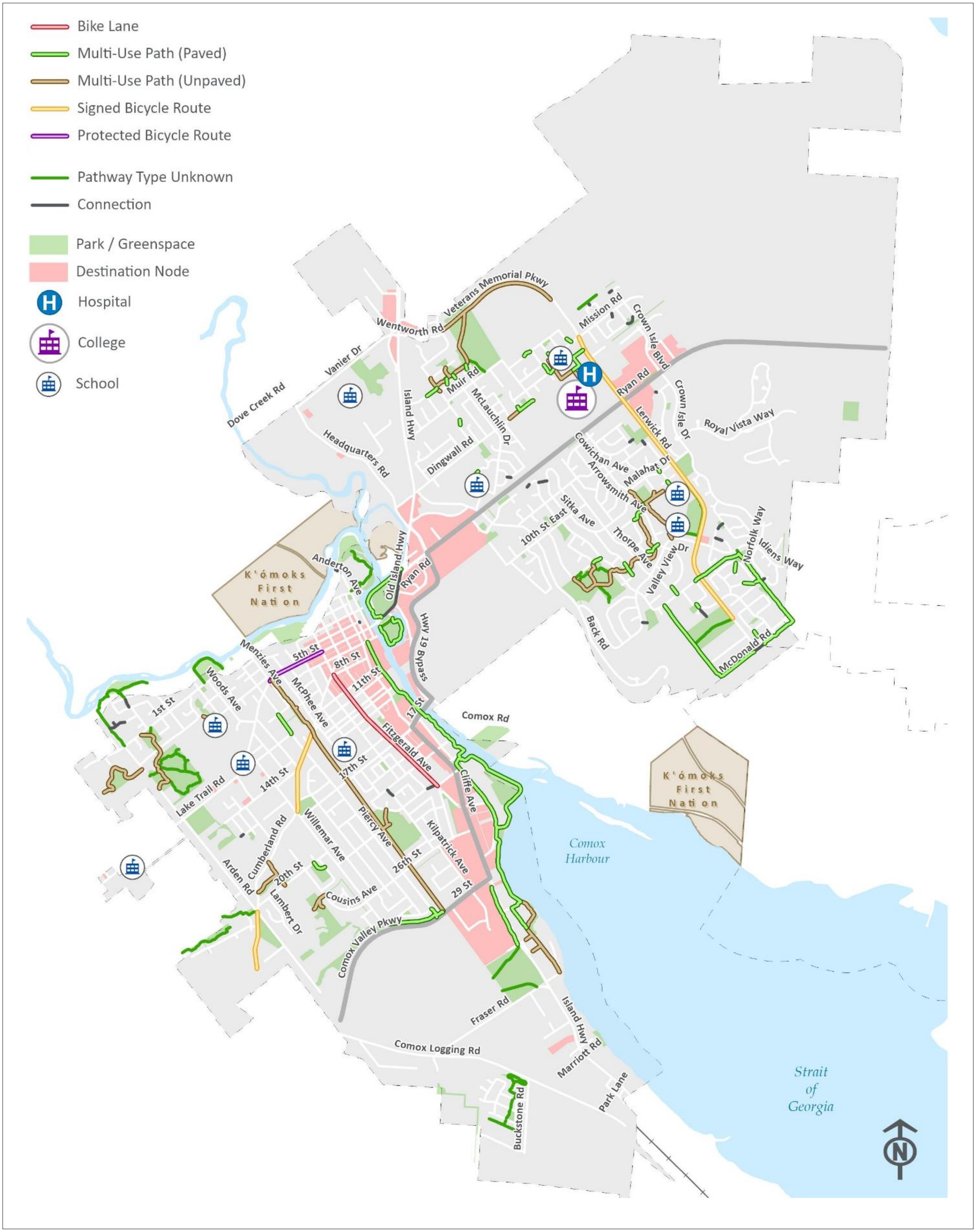


Figure 2.45 - Existing Cycling Network. Source: Connecting Courtenay Transportation Master Plan (2019).

The City's TMP identifies a toolbox of bicycle facilities and intersection treatments that can guide the planning and design of the Courtenay's cycling infrastructure, along with network improvements and supportive facilities and programs to promote and support cycling. These include all ages and abilities facilities, end-of-trip facilities, bicycle-transit integration, facility maintenance, cycling amenities, wayfinding, educational programs, promotional events, and network maps.

ELECTRIC BICYCLES

Electric bicycles (e-bikes) are bicycles with an electric motor of 500 watts or less, and functioning pedals that are limited to a top speed of 32 km/h without pedaling. Electric bicycles make cycling more attractive for a greater diversity of the population, particularly for seniors, women, and people with disabilities, as they increase the maximum length of bicycle trips, minimize the impact of hills and other terrain challenges, and allow people to bike with heavier cargo loads. Further, electric bicycles can help communities achieve their GHG emission reduction targets. **With supportive cycling infrastructure in place, e-bikes have the potential to substitute for, or completely replace, almost all trips taken by a gasoline powered car, which could address congestion issues within urban areas.**

As electric bikes are an emerging form of mobility, there is limited research that has quantified the impact of these bikes on vehicle ownership. A recent study presented results of a North American survey of electric bike owners. The study reported that e-bikes have the capacity to replace various modes of transportation commonly used for utilitarian and recreational trips including motor vehicles, public transit, and regular bicycles. Specifically, the study reported that 62% of e-bike trips replaced trips that otherwise would have been taken by car. Of these trips previously taken by car, 45.8% were commute trips to work or school, 44.7% were other utilitarian trips (entertainment, personal errands, visiting friends and family, or other), and 9.4% were recreation or exercise trips. The average length of these previous car trips was 15 kilometres.

As an emerging mobility form, there is limited ownership data available in Courtenay. Six bicycle retailers operating in the Comox Valley were surveyed to assess current interest and sales levels among Courtenay residents (see Table 2.2). All six retailers reported electric bikes in their inventory and have shown a year-over-year increase in sales with a range of demographics purchasing and/or expressing interest.

Retailer	Total Sales, 2018	Total Sales, 2019	Growth in Sales	% of Total Sales
Trail Bicycles	10	30	3x	20%
Mountain City Cycle	60	120	2x	25-30%
Black's Cycle	20	75	3.75x	30%
Comox Bike Company	20	70	3.5x	25%
Beaufort Cycles	12	25	2x	10%
Dodge City Cycles	N/A			<2%

Table 2.2 - Electric Bicycle Sales at Retailers in Comox Valley (2018-19).
Data Source: Data collected by WATT Consulting Group through phone interviews with local bike retailers.

Image: Electric Cargo Delivery Bicycle. Source: Stephen Rees (Flickr).

Image: Electric Family Bicycle. Source: Waltarrrrr (Flickr).

Image: Multi-use Path Along Courtenay River. Source: Hike Bike Travel.

Image: City of Courtenay Council and Other Residents Biking Along Fifth Street Complete Street. Source: Comox Valley Record/Scott Stanfield photo.

The biggest opportunity in the development industry is that we are relatively young in our development history, and we have very little that is permanent, or that has gone so far that it cannot be undone, or changed as we move forward.

- OCP Advisory Committee Member

TRANSIT NETWORK

Public transit is a critical component of a successful transportation network. It often serves as the primary alternative to driving for longer trips, especially for those who do not own a vehicle. A well connected, reliable, and frequent transit system can help a community reduce its reliance on private vehicles and thereby reduce its overall GHG emissions in the transportation sector. Public transit currently accounts for 4% of all trips within Courtenay.

The City is served by the Comox Valley transit system, which provides 13 routes across the region to various communities including the Town of Comox, Village of Cumberland, and smaller towns, as well. Courtenay has four transit exchanges located across the City including Downtown, Driftwood Mall, North Island College, and the Comox Valley Aquatics Centre. Even though transit accounts for a small percentage of overall trips in the City, ridership data indicate that transit use is growing in the region. The Comox Valley Transit Future Plan indicated that the system's annual ridership in 2014 was 465,982. **More recent data from BC Transit's 2018/2019 fiscal year indicated that ridership was 674,908—a 44% increase over this 5 year period.**

As shown in table 2.3 below, the 1 Fitzgerald, which is the Frequent Transit Network route, carries the majority of the passengers in the Comox Valley transit system.

Bus Route	% of Total Ridership
1 Fitzgerald	57%
2 Cumberland/ Anfield Centre	2%
3 Comox Local	7%
4 Driftwood Mall / Comox Mall via Comox Rd	2%
5 Vanier	1%
6 Uplands	8%
7 Arden	2%
8 Downtown / Anfield Centre	3%
10 Fanny Bay / Downtown Courtenay	3%
11 Airport via Powell R. Ferry / Downtown	2%
12 Oyster River / Downtown Courtenay	3%
20 Cumberland via Royston	1%
99 VMP Connector	7%
Total	**100%**

Table 2.3 - October 2019 Transit Ridership, Comox Valley Transit System. Source: BC Transit. Monthly Route Performance (October 2019).

The Comox Valley Transit 2014 Plan is being reviewed for priority setting, representing an opportunity to align transit with land use goals.

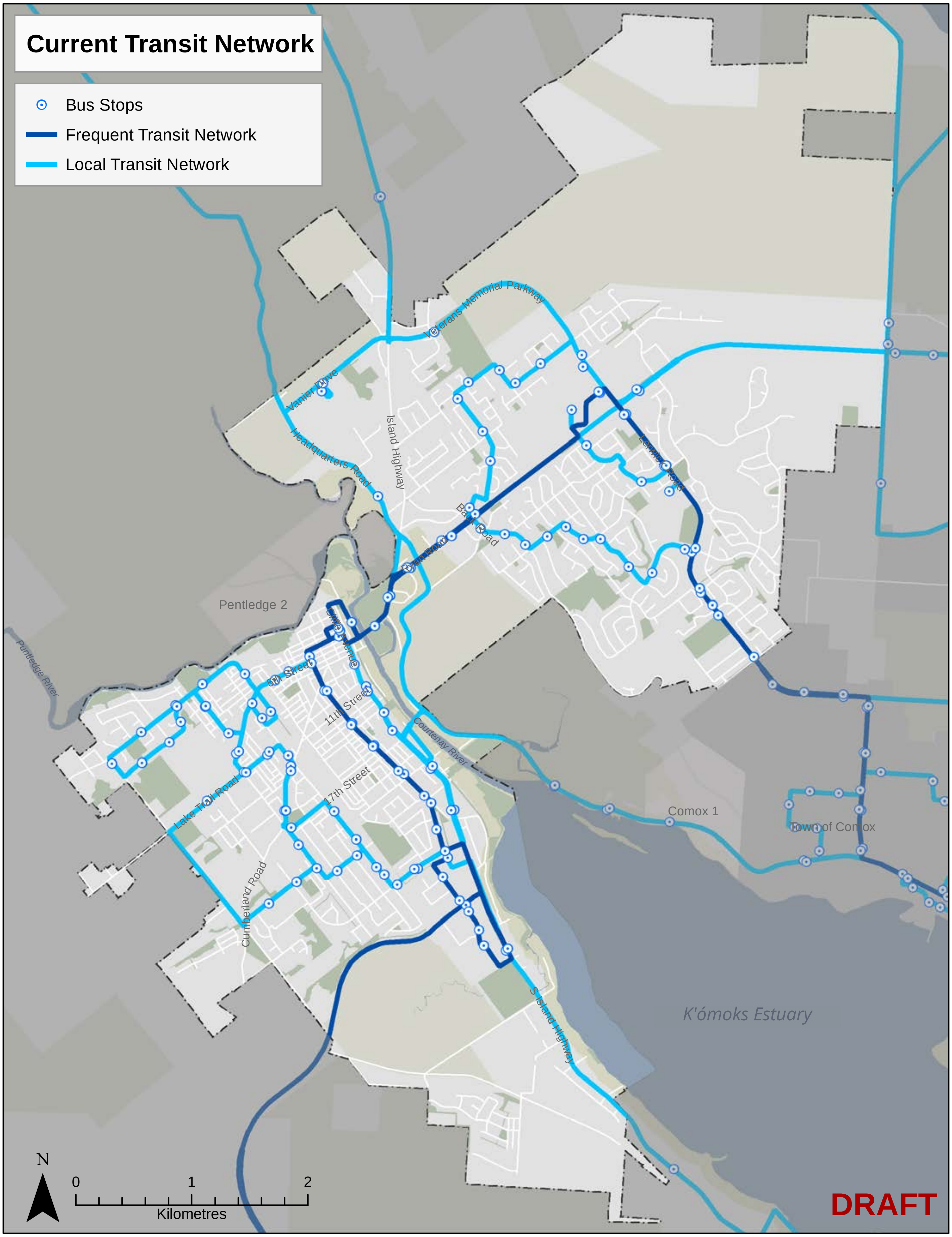


Figure 2.46 - Current Transit Network.

Data Source: Google Transit Feed Specifications (GTFS).

Even though a number of actions in the 2014 Comox Valley Transit Future Plan have been implemented, the transit system still faces a number of challenges in Courtenay. The Connecting Courtenay community survey identified transit as the least attractive travel mode with 60% of the respondents indicating it is not effective. A number of respondents—over 75%—indicated that they had never used public transit. Key challenges for the transit network include:

- **Transit service is infrequent.** In 2018, BC Transit introduced a Frequent Transit Network for its Route 1, which now provides 20-minute frequency in the peak hours and 30 to 60 minute frequency off-peak. However, all other routes in the system still operate at one-hour frequency during the peak hour, which limits convenience for those trying to access different destinations in the region.

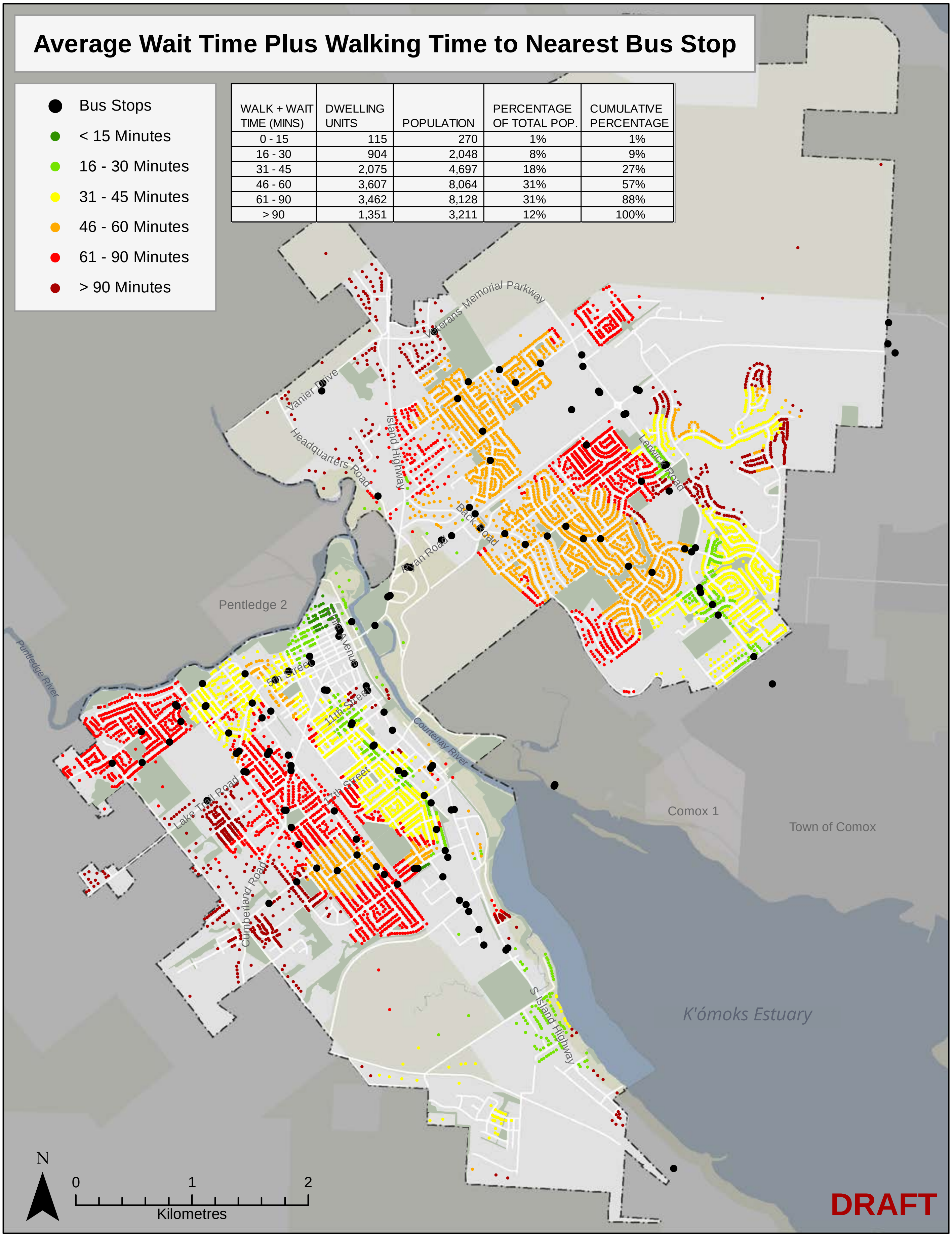
- **Limited weekend and evening service.** For those working and/or completing non-work trips during weekday evenings and on weekends, limited service makes transit a less attractive option. This can be particularly challenging for those who rely on transit for work and non-work trips.

- **Routes are indirect and the system is complex.** Some of the transit routes are not direct resulting in longer travel times. More than 50% of the respondents to the community survey indicated that they do not take transit more often because it takes longer than other modes.

Beyond the main challenges identified above, the community has also reported other problems that are limiting transit use including: people with mobility challenges can have difficulty accessing the transit system; limited customer amenities (e.g., benches, shelters) through the system; and bus travel times are not reliable because they are subject to the same delays as private vehicles.

BC Transit and the Comox Valley Regional District are currently updating the Comox Valley Transit Future Plan with a new set of updated priorities to be released in 2020.

Although the majority of dwellings are within a relatively short (10 minute) walk from a bus stop, the opposing map (Figure 2.47) highlights the challenge of infrequent bus service combined with walking distances. Average wait times are calculated using Monday to Friday schedule, with the large majority being 30 minutes or longer. These wait times make transit infeasible for many people.



WALK + WAIT TIME (MINS)	DWELLING UNITS	POPULATION	PERCENTAGE OF TOTAL POP.	CUMULATIVE PERCENTAGE
0 - 15	115	270	1%	1%
16 - 30	904	2,048	8%	9%
31 - 45	2,075	4,697	18%	27%
46 - 60	3,607	8,064	31%	57%
61 - 90	3,462	8,128	31%	88%
> 90	1,351	3,211	12%	100%

Data Sources: Google Transit Feed Specifications, BC Assessment, 2016, OpenStreetMap network with pedestrian tags for distance analysis.

Figure 2.47 - Average Wait Time Plus Walking Time to Nearest Bus Stop in Courtenay (Last Mile Analysis).

ROAD NETWORK

The road network forms the skeleton of a community's transportation system. Courtenay has adopted a transportation planning philosophy that focuses on managing existing transportation infrastructure before investing in major road network improvements. Approaches to transportation planning that seek to increase the amount of road supply in order to reduce congestion can make it easier to travel by car, which ultimately encourages more traffic. Driving currently accounts for 85% of all trips within Courtenay.

Vehicular travel demand is forecast to increase along major corridors and key areas. For example, travel demand for crossing the river between the eastern and western areas of Courtenay are forecast to increase by approximately 22% from 2018 to 2038. Figure 2.48 outlines existing and forecast traffic volumes during the afternoon peak hour without improvements to the transportation system. Key challenges for the road network include:

- **The network for all modes is constrained by natural barriers** such as Comox Harbour, the Courtenay River, and the Tsolum River.
- **Congestion on key routes that serve provincial regional, and local travel**, including river crossings, Ryan Road and the Highway 19A bypass.
- **Most traffic uses roads in the core area** and the lack of a bypass limits resiliency to incidents and construction.
- **Planned local and regional growth will put pressure on existing corridors**, including on river crossings, the Highway 19A Bypass, Ryan Road and major intersections.
- **Collision hot spots at high volume intersections on corridors with multiple accesses and high left turn volumes.** High collision locations include Lerwick Road and Ryan Road; Old Island Highway and Ryan Road; 17th Street and Cliffe Avenue; and Island Highway and Ryan Road.

The City's TMP identifies three strategy areas to improve the road network: (1) safety and operational improvements; (2) corridor widenings; and (3) new corridors and crossings that should be considered in the short, medium and long-term.

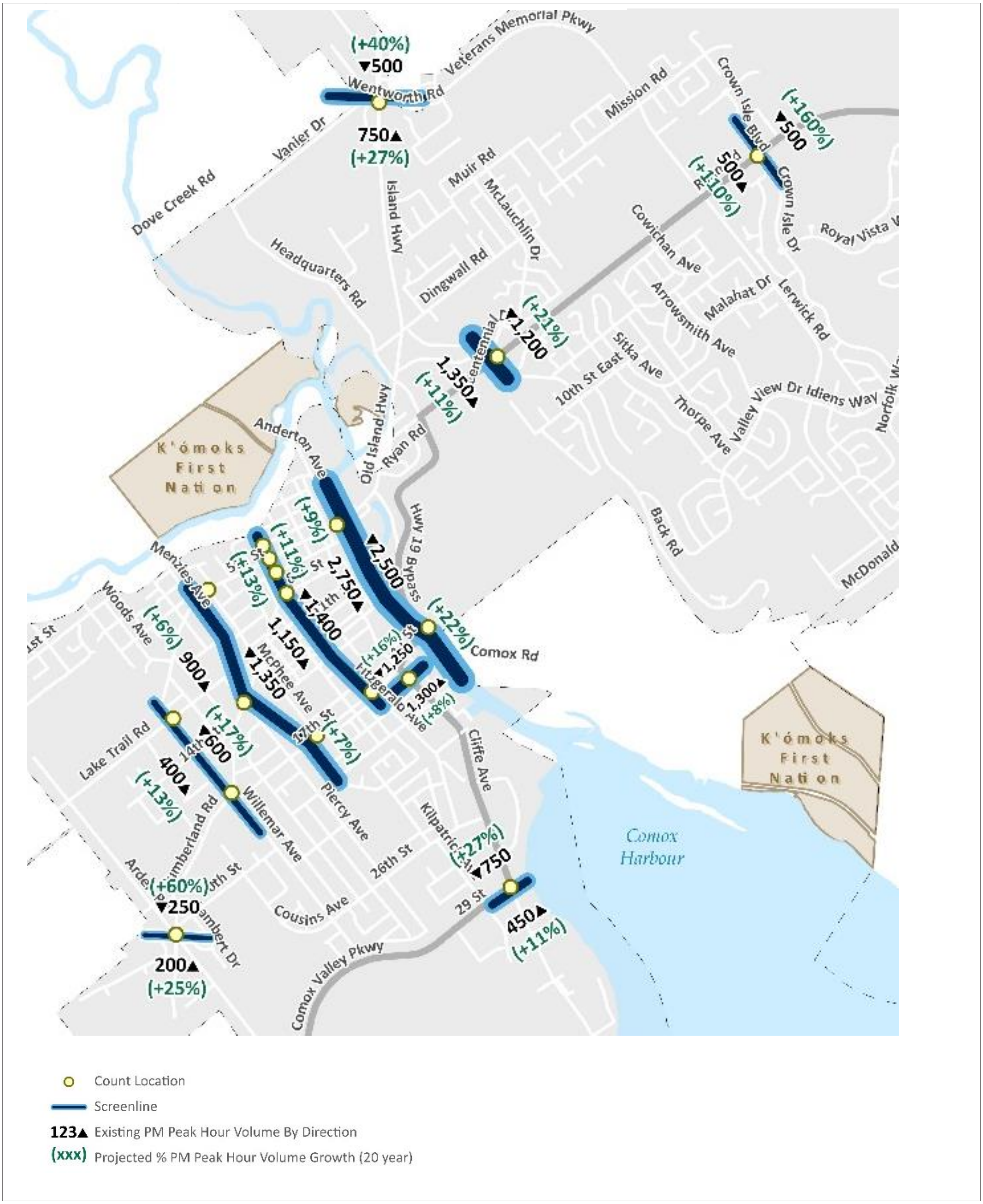


Figure 2.48 - Existing (2018) and Forecast (2038) Afternoon Peak Hour Traffic. Source: Connecting Courtenay Transportation Master Plan (2019).

Courtenay’s road classification system establishes a hierarchy for all roads in the city that identify how they can serve access functions to adjacent land uses and mobility functions to support the movement of traffic. The City’s Subdivision and Development Servicing Bylaw identifies the road classification for the Courtenay’s road network and specifies the minimum recommended widths for each roadway element. These road classifications relate and influence how all other transportation networks (pedestrian, cycling, and public transit) integrate with each other.

TRUCK ROUTES

The successful movement of goods and services in Courtenay depends on an efficient and reliable truck route network. Policy and regulations that identify how trucks and goods movement should be managed as part of the overall road network in Courtenay can support the local economy while managing community livability and protect the environment. For example, 55% of greenhouse gas emissions from the transportation sector in Courtenay are from commercial goods movement.

All provincial, arterial, and industrial/ commercial collector roads in Courtenay are designated as a truck route, with 33 different routes currently identified in the City’s existing Road Network Plan. Furthermore, there are designated truck route areas that permit trucks to access any road within the area. These areas include:

- South Courtenay bounded by 26th Street to the north, Highway 19A/ Cliffe Avenue to the east, Anfield Road to the south, the E&N Railway to the west, and Anfield Road to the south;
- Downtown Courtenay bounded by 3rd Street in the north, Anderton Avenue in the east, 11th Street in the south, and Fitzgerald Avenue in the west (time restriction for certain segments; and
- East Courtenay bounded by the Courtenay River, Dingwall Road, Highway 19A, Braidwood Road, Back Road, Tunner Drive, and Highway 19A.

There is currently limited policy and regulation on truck routes and goods movement described in the City’s Master Transportation Plan, Subdivision and Development Servicing Bylaw, and Traffic Regulation Bylaw.

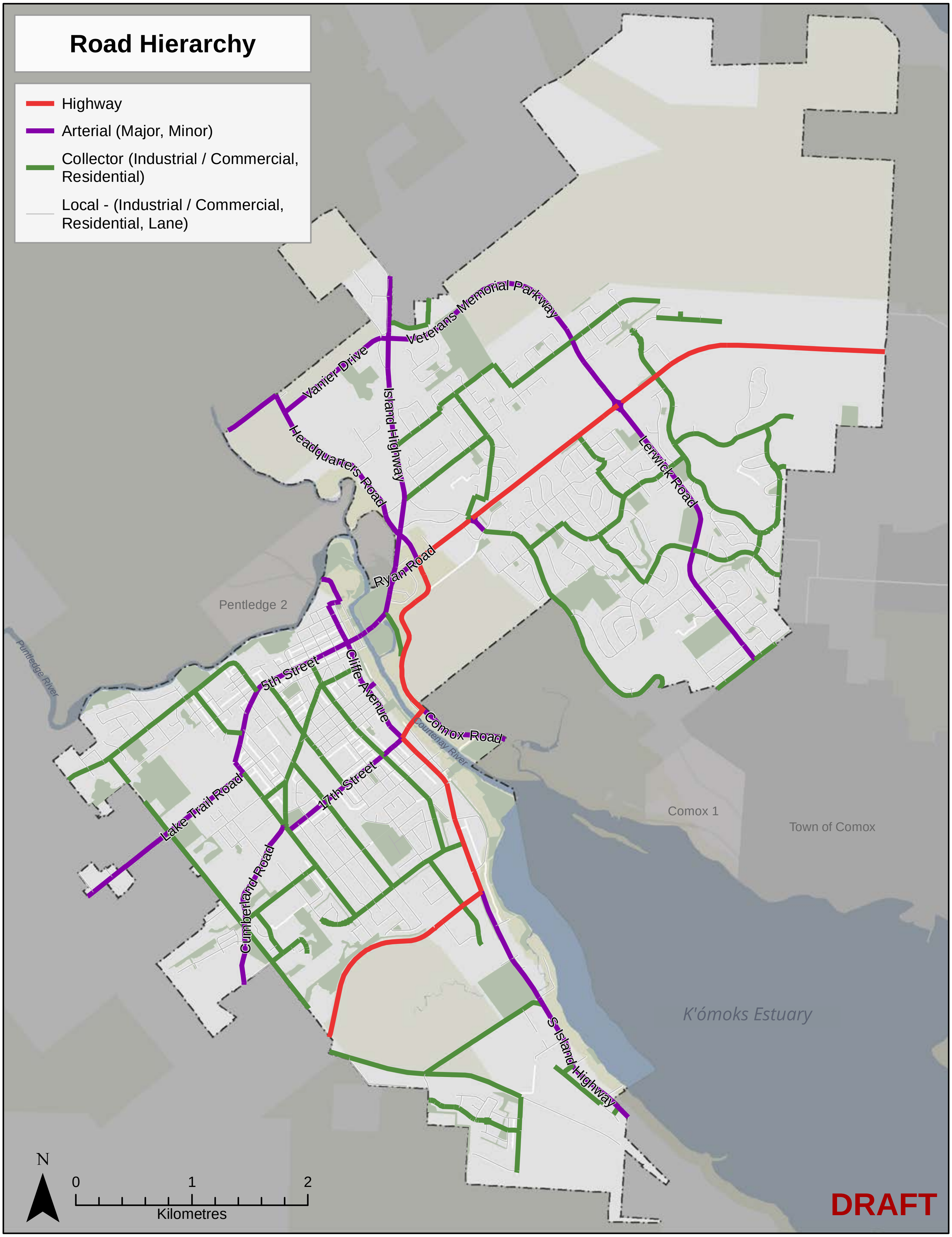


Figure 2.49 - Hierarchy of Courtenay's Roads. Data Source: City of Courtenay Open Data.

PARKING

With driving accounting for 85% of all trips within Courtenay, parking is significant part of the City's transportation network. In Downtown Courtenay, there is a combination of on-street and off-street parking available to employees, residents, and visitors. There are approximately 800 parking stalls in Downtown Courtenay comprising nine public off-street lots, City Hall parking, some private off-street parking, and on-street parking stalls. All public parking is currently free.

ELECTRIC VEHICLES

Electric vehicles are a class of vehicles that run fully or partially on electricity. These vehicles have a battery instead of a gasoline tank, and an electric motor instead of an internal combustion engine. Electric vehicles and other types of zero-emission vehicles can play an important role in reducing community greenhouse gas emissions.

Courtenay can help promote and support electric vehicle adoption through the provision of public electric vehicle charging stations. The City's Strategic Priorities 2019-2022 identifies the expansion of the local electric vehicle charging network as a priority and the City is actively pursuing grant opportunities to help fund new charging stations. There are generally three types of electric vehicle charging stations.

There are currently twelve privately owned publicly accessible electric vehicle charging stations in Courtenay, with eleven Level 2 stations and one Level 3 station. These stations are located on major transportation routes in the city that can support regional travel.

Location	Address	Number of Stations	Station Type
Wayward Distillation House	2931 Moray Avenue	1	Level 2
Brian McLean Chevrolet Buick GMC	2145 Cliffe Avenue	1	Level 2
Best Western Plus - Westerly Inn	1590 Cliffe Avenue	1	Level 2
Courtenay Kia	1025A Comox Rd	1	Level 2
Comox Valley Volkswagen	401 Ryan Road	1	Level 2
Real Canadian Superstore	757 Ryan Road	2	Level 2, Level 3
Comox Valley Hyundai	250 Old Island Hwy	1	Level 2
Westview Ford	4901 North Island Highway	1	Level 2
North Island Hospital	101 Lerwick Road	1	Level 2
Galaxy Motors Courtenay	605 Crown Isle Blvd	1	Level 2
Comox Valley Nissan	535 Silverdale Crescent	1	Level 2

Table 2.4 - Public Electric Vehicle Charging Station Locations in Courtenay. Source: NRCan's Electric Charging and Alternative Fueling Stations Locator and PlugShare.

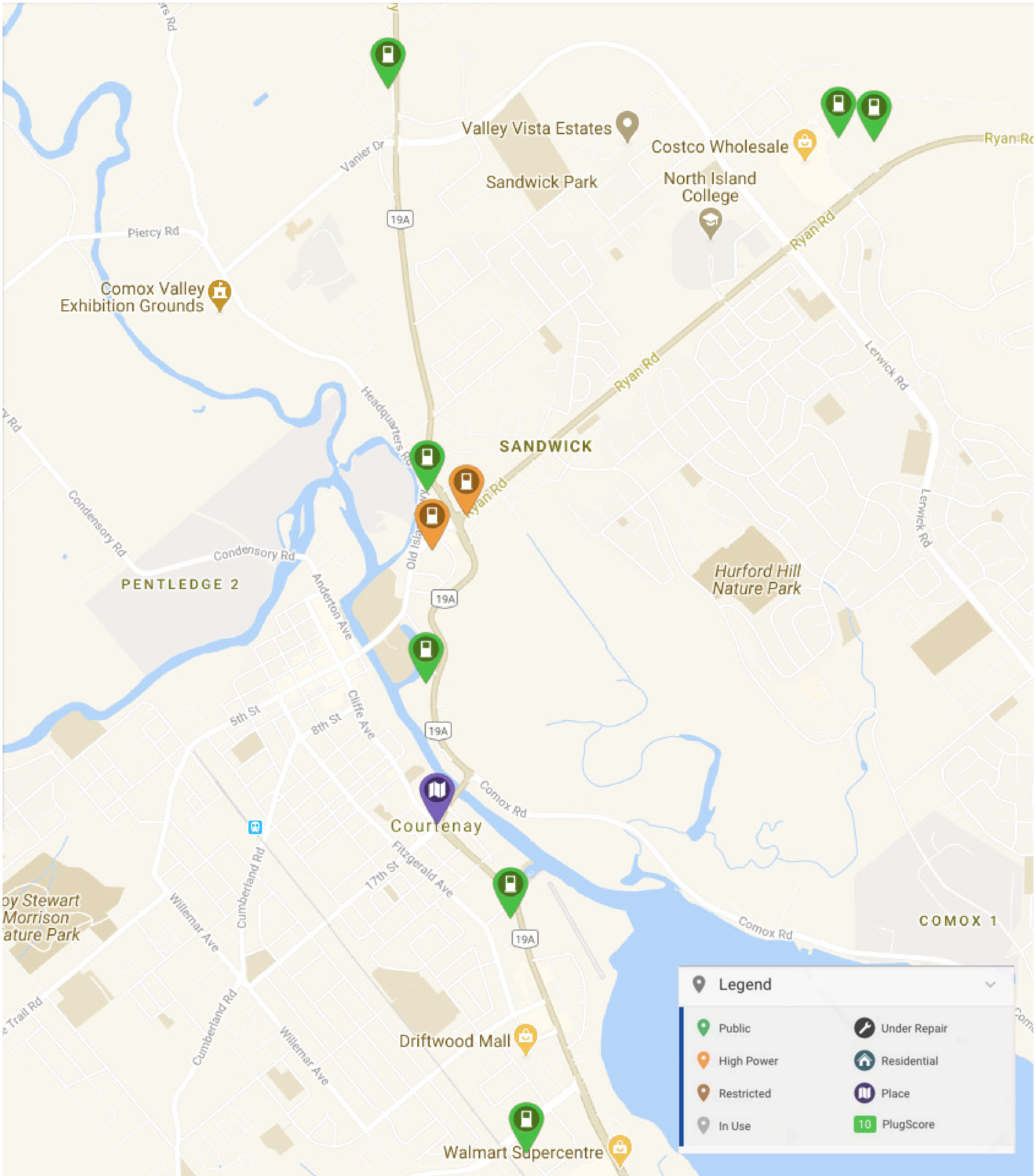


Figure 2.50 - Existing Public Electric Vehicle Charging Network. Source: PlugShare. Last accessed May 29, 2020.

2.8 ENVIRONMENT AND ECOLOGY

2.8.1 UNDERSTANDING COURTENAY'S ECOLOGICAL CONTEXT

Like many communities in "Beautiful British Columbia", the natural environment forms a highly visible and valued part of Courtenay. More than just aesthetic background, the natural environment provides innumerable services to the quality of life of these communities and is habitat to non-human life. Research in urban studies is showing that a relationship with nature is integral to individual wellbeing and therefore must be incorporated into community planning as an essential service, not considered an afterthought or only a matter of beautification. To understand how the natural environment shapes, and is in turn impacted by, Courtenay's community growth and climate change, it's important to start with ecological science fundamentals.

KEY SCIENTIFIC CONCEPTS

An **ecosystem** is the dynamic and interrelated complex of plant and animal communities (biotic elements) and their non-living environment (abiotic elements). All parts of an ecosystem, including physical, chemical, and biological components are interconnected; that is, they each affect and are affected by all other parts. These biotic and abiotic components are linked together through nutrient cycles and energy flows which form the basis of the cycles of all life on Earth in all its biodiversity.

Ecology is the branch of biology that pertains to ecosystems. **Environment** is a more general term that can include the circumstances, objects, or conditions by which anyone or thing is surrounded. Environment is often used, and is used here, to describe the **natural environment** which includes the complex of biotic and abiotic factors that act upon an organism or an ecosystem to ultimately determine its form and survival. It's important to note that all human activities occur within the context of the environment even if those activities are taking place within heavily altered natural environments.

The word 'system' within ecosystem conveys this interdependence and signals the importance of considering the natural environment in its interdependent entirety when making decisions that intentionally or unintentionally manage or change it. In particular, identifying the **formative systems** that give rise to particular ecosystems is critical to sustaining that ecosystem. For example, when protecting a wetland by setting it aside within a development, it is also important to design the development in order to maintain the water source that feeds the wetland.

While perhaps intuitive, this need for a systems thinking approach when considering ecological values is important to highlight as modern human societies worldwide are struggling to manage human activities in such a way as to honor these ecological realities. Ecosystems everywhere are changing as a result. What these changes mean in detail for human activities remains to be understood, but general scientific consensus is sobering. The UN Intergovernmental Science-Policy Platform on Biodiversity and Ecosystems Services 2019 Global Assessment report concluded that "the essential, interconnected web of life on Earth is getting smaller and increasingly frayed" and that "this loss is a direct result of human activity and constitutes a direct threat to human well-being around the world". Climate change is both an indicator of and factor in ecosystem change.

Classifying ecosystems

At the local level, Courtenay's ecosystems are part of larger regional biological, geographical and climatic systems. In BC the following natural environment classification systems are helpful to understanding this context, and indicating what changes may be expected due to climate change:

- Ecoregional Classification system
- Biogeoclimatic Ecosystem Classification (BEC) system
- Koppen Climate Classification system

The **Ecoregional Classification system**[1] is used to stratify BC's terrestrial and marine ecosystem complexity into discrete geographical units at five levels.

[1] https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/ecosystems/broad-ecosystem/an_introduction_to_the_ecoregions_of_british_columbia.pdf

Factors such as climate, physiography, oceanography, hydrology, vegetation and wildlife potential are included. Within this system, the two highest levels, Ecodomains and Ecodivisions, are very broad and place BC globally. The three lowest levels, Ecoprovinces, Ecoregions and Ecosections are progressively more detailed and relate segments of the Province to on another.

The northeast coast of Vancouver Island overlooking the Salish Sea is the northern portion of the **Nanaimo Lowland ecosection**. This is a broad, low-elevation coastal plain on the lee-side of the Vancouver Island Ranges which is comprised of some of the island's highest peaks. The Golden Hinde, the island's tallest point, is almost directly West of Courtenay, and notably the Beaufort Range, Comox Glacier, and Mount Becher occupy the local skyline. The Nanaimo Lowland ecosection is underlain by sedimentary bedrock of the Nanaimo Group deposited in the Upper Cretaceous. This primarily includes sandstone, siltstone, shale and coal.

The **Biogeoclimatic Ecosystem Classification (BEC) system**[2] describes how ecosystems relate at the regional, local and chronological scales. BEC delineates ecological zones (biogeoclimatic units) by vegetation, soils and climate. It also classifies ecological communities, within the ecological zones, based on the potential of the site at climax or mature successional stages (succession refers to the chronological sequences of the ecosystem). Ecological communities within any one ecological zone may be quite diverse, and are not necessarily dominated by the species named within the BEC classification title. Courtenay is located entirely within the Coastal Western Hemlock (CWH), very dry (x) maritime variant (m), lee-ward, rain shadow (1) Zone - **CWHxm1**. This BEC Zone variant is targeted for protection and restoration within the Coastal Douglas Fir Community Partnership provincial conservation efforts given that these Zones are the most at-risk in the province and contain the highest number of species and ecosystems at risk in BC.[3]

The **Koppen Climate Classification system** is commonly used around the world and categorizes the region as being sub-Mediterranean (Cs: C- Temperate, and s- dry summer). More details on current and projected climate are provided in 2.8.3 – Local Ecological Trends: Observed and Expected.

[2] https://www.for.gov.bc.ca/hre/becweb/system/how/index.html#relationship
[3] http://www.cdfcp.ca/

2.8.2 FORMATIVE SYSTEMS AND TOPOGRAPHY OF COURTENAY

Water has historically been and continues to be a major shaper, or formative system, of Courtenay in the form of ice, snow, rain, creeks, rivers, estuary and tides. The Comox Lake Reservoir, outside of the City's boundaries, is fed by headwater streams and glaciers and supplies all of Courtenay's potable water. Managing Courtenay's growth so that these hydrological systems can continue to function, including adapting to climate change, is a foundational part of good land use planning.

Historical glaciation is one of Courtenay's oldest formative systems. Until about 15,000 years ago the region was covered with thick glacial ice. The erosive force of expanding and contracting ice-sheets over time shaped the land affecting drainage patterns. The weight of the ice during this time depressed the land resulting in sea-levels that were very different from today. Courtenay's soils include marine-derived silts, glacial till, glacio-fluvial and fluvial sediments. The soils in the region are particularly fertile by Vancouver Island standards, and support the distinction of being one of the three agricultural regions on the Island.

Post-glacial drainage and erosion went on to from rivers and streams. A distinct Courtenay feature is the presence of major rivers: The Puntledge, Browns and Tsolum rivers converge in Courtenay to form the Courtenay River, which has the distinction of being the shortest navigable river in the world. The Courtenay River drains into the Salish Sea and forms the K'omoks Estuary, one of the most biologically diverse and productive in BC.

Coastal erosion and accretion processes link freshwater and marine habitats when nutrients and minerals from inland are transported downstream by rivers and creeks into coastal ecosystems. Tidal and wave action then transport these sediments both from shallow to deep zones within the ocean, as well as longshore currents which transfer sediment along the coast. This longshore current formative system is what gives rise to the Comox Valley's iconic Goose Spit.

The estuary, and the lands that have since been developed, can also be host to major flood events as is experienced when "king tides" and storm surges associated with high winds flow in from the sea and merge with significant winter rain events draining from the major rivers; rivers whose headwaters originate in some of the highest mountains on Vancouver Island. These flood events are reminders of the important, and uncontrollable, hydrological formative systems that continue to inform life of Courtenay today.

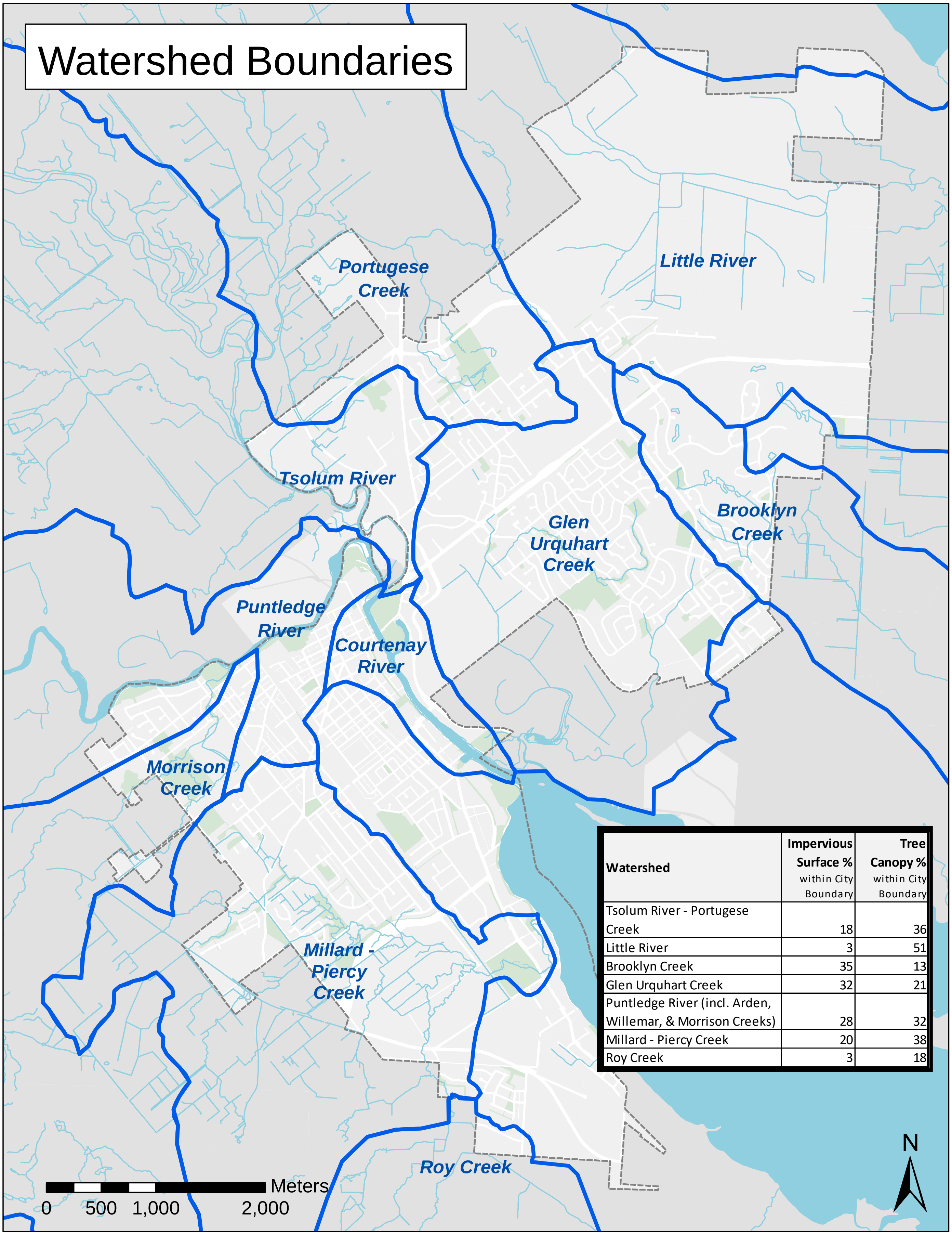
Many other smaller creeks and streams influence Courtenay's pattern at the sub-city, or neighbhourhood, scale. These include Portuguese Creek, Brooklyn Creek, Glen Urquhart Creek, Millard-Piercy Creek, Roy Creek, Little River and Morrison Creek, all of which are either tributaries to the larger rivers, or drain directly into the ocean. All creeks and river watersheds cross more than one jurisdictional boundary which renders a holistic – watershed scale – approach to watershed management difficult. A further challenge for most eastern Vancouver Island watersheds are the naturally low summer flows, which lends them extra sensitive to water extraction impacts and climate change.

A number of topographical features lend distinction, landscape legibility and inform land use opportunities and constraints. For instance, a division between West and East Courtenay can be experienced not only by Courtenay River and the two bridges that cross it, but also by the combined agricultural and conservation lands located within the Courtenay River floodplain. The elevation change experienced when travelling down Ryan Road from North Island College towards highway 19A, or along highway 19A heading south is another example. Topography, floodplain and the resulting travel pinch points effectively split Courtenay into two distinct urbanized zones.

2.8.3 COURTENAY'S WILDLIFE AND ECOLOGICAL ASSETS

The formative systems that have shaped and continue to shape Courtenay also provide habitat to a wide range of species. Some of the most characteristic and indicative are included here.

Forested areas are characterized by Douglas-fir, western hemlock, grand fir, and western red cedar, with sitka spruce near the shoreline. However drier areas include notable stands of Garry oak, which is at the northern limit of its distribution in a chain of Pacific oak woodlands that extend south through Southeastern Vancouver Island, Puget Sound and the Willamette Valley into northern California and beyond. Red alder and bigleaf maple are common fast growing deciduous trees. An understory of salal, mahonia and red huckleberry form a commonly found shrub layer, however with widespread browsing by deer this shrub layer is often underdeveloped and dominated by ferns, notably deer and sword ferns. The City of Courtenay Urban



Watershed	Impervious Surface % within City Boundary	Tree Canopy % within City Boundary
Tsolum River - Portugese Creek	18	36
Little River	3	51
Brooklyn Creek	35	13
Glen Urquhart Creek	32	21
Puntledge River (incl. Arden, Willemar, & Morrison Creeks)	28	32
Millard - Piercy Creek	20	38
Roy Creek	3	18

Figure 2.51 - Watershed Boundaries of Courtenay and Surrounding Region. Source: City of Courtenay.

Forest Strategy (2019) provides more detail about Courtenay's urban forest characteristics, condition and trends.

If allowed to mature, the climax composition of forests in Courtenay support a wide range of wildlife including a number of species of owls, pileated woodpecker, brown creeper, wandering salamander, Columbian black-tailed deer, little brown myotis and American black bear. Even cougar are spotted in the City from time to time.

Low-lying floodplain and estuarine environments feature tidal mudflats, lagoons, salt marshes, and low-lying forest habitats. These ecosystems are rich in sediment, nutrients and food in the form of diatoms, invertebrates and coastal vegetation. Iconic species such as trumpeter swans and great blue heron forage here. Where the few remaining veteran Douglas-fir trees of suitable size and condition exist, these become good contenders for bald eagle nests. In addition to providing habitat to resident amphibians, reptiles, numerous water fowl and migrating salmon, the estuary and surrounding coastal lands are part of the Pacific Flyway and are designated as the internationally important K'ómoks Important Bird Area (IBA).[4]

All **freshwater creeks and rivers** within Courtenay that are large enough to have a name are salmon habitat. The Puntledge, Tsolum and Browns rivers have the potential for large runs of pink, coho, chum and Chinook salmon. Sockeye are now largely extirpated from the region. Where physical barriers do not exist, Courtenay's smaller urban streams either have coho, chum and/or pinks, or have the potential to with rehabilitation. Resident cutthroat and rainbow trout are also present in a number of the local watersheds.

Along with the visiting migratory birds, salmon are good reminders of how interconnected widely ranging (geographically and characteristically) ecosystems are. All local salmon species also travel through the estuary to fulfill their life cycle and rely on it to provide juvenile "nursery" habitat to out-migrating smolts in the spring. This is why ecological restoration efforts such as the 2015 Airpark Lagoon breach, 2018 Simms Park off channel habitat, and the ongoing Kus-kus-sum are so critical and timely.

The **urban and agricultural areas** around Courtenay are home to smaller mammal species and urban friendly birds including introduced species such as the Norway rat and European starling. In these highly modified environments

[4] https://www.ibacanada.ca/site.jsp?siteID=BC272

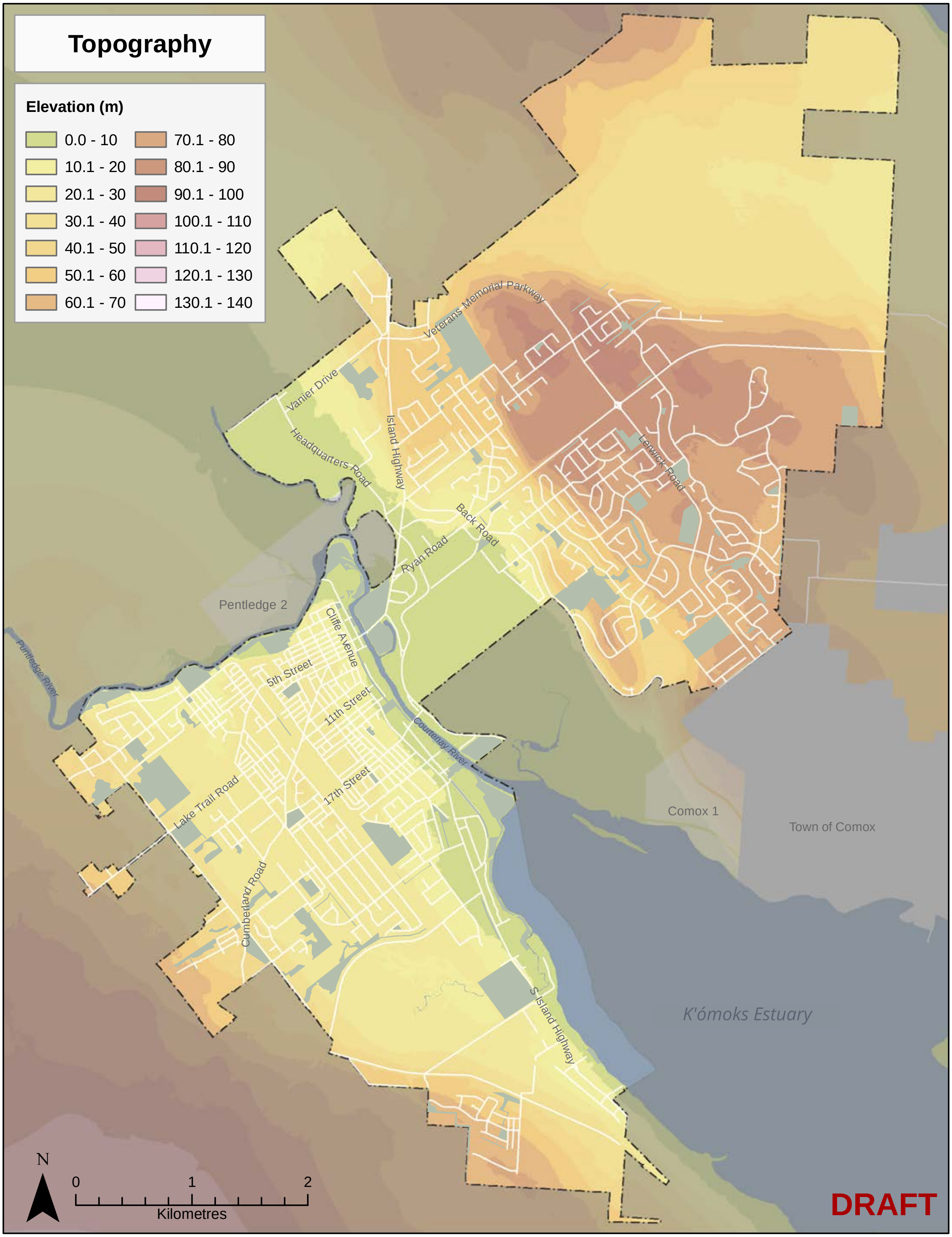


Figure 2.52 - Topography of Courtenay and Surrounding Region. Data Source: City of Courtenay Open Data.

other invasive species take hold such as Scotch broom, Himalayan blackberry and highly destructive Japanese knotweed. To the untrained eye, these species may appear to be part of Courtenay's natural heritage, but in reality they pose significant threats to local biodiversity. Invasive species are a leading factor of species extinction worldwide.

Ecosystem services

Together these ecological assets provide a number of services that improve human health and well-being. They are often defined in four distinct but interconnected categories:

- **Cultural**: benefits that relate to how people value ecosystems for their contribution to quality of life, such as beautification, mental health and healing, sense of place, character, heritage, spirituality, recreation and tourism.
- **Provisioning**: products extracted directly from the natural environment like timber, food, traditional medicine, fresh water and firewood.
- **Regulating**: benefits from the regulation of ecosystem processes like pollination, air and water quality, soil enrichment, erosion prevention, rain and storm water flow, shade and cooling.
- **Supporting**: benefits from supporting habitat, biodiversity and enabling natural processes that maintain the conditions to support life – services that are essential to the production of all other ecosystem services.

While not all of these services can be measured with a dollar value, several municipalities in BC, including Courtenay, are exploring an 'eco-assets' approach to include nature as an asset in their financial accounting system as traditional accounting practices do not account for these services. This can involve assigning financial values to services like flood management or the maintenance of water quality by estimating the cost of replacing those services or the avoided cost of damage. In Courtenay, the Kus-kus-sum restoration project and the Comox Lake reservoir drinking watershed are being examined through this lens. It is a massive institutionalized undertaking to incorporate these evaluations into other disciplines, such as the Public Sector Accounting Board, however it represents a great opportunity to mainstream the valuation of nature into land use decision making.

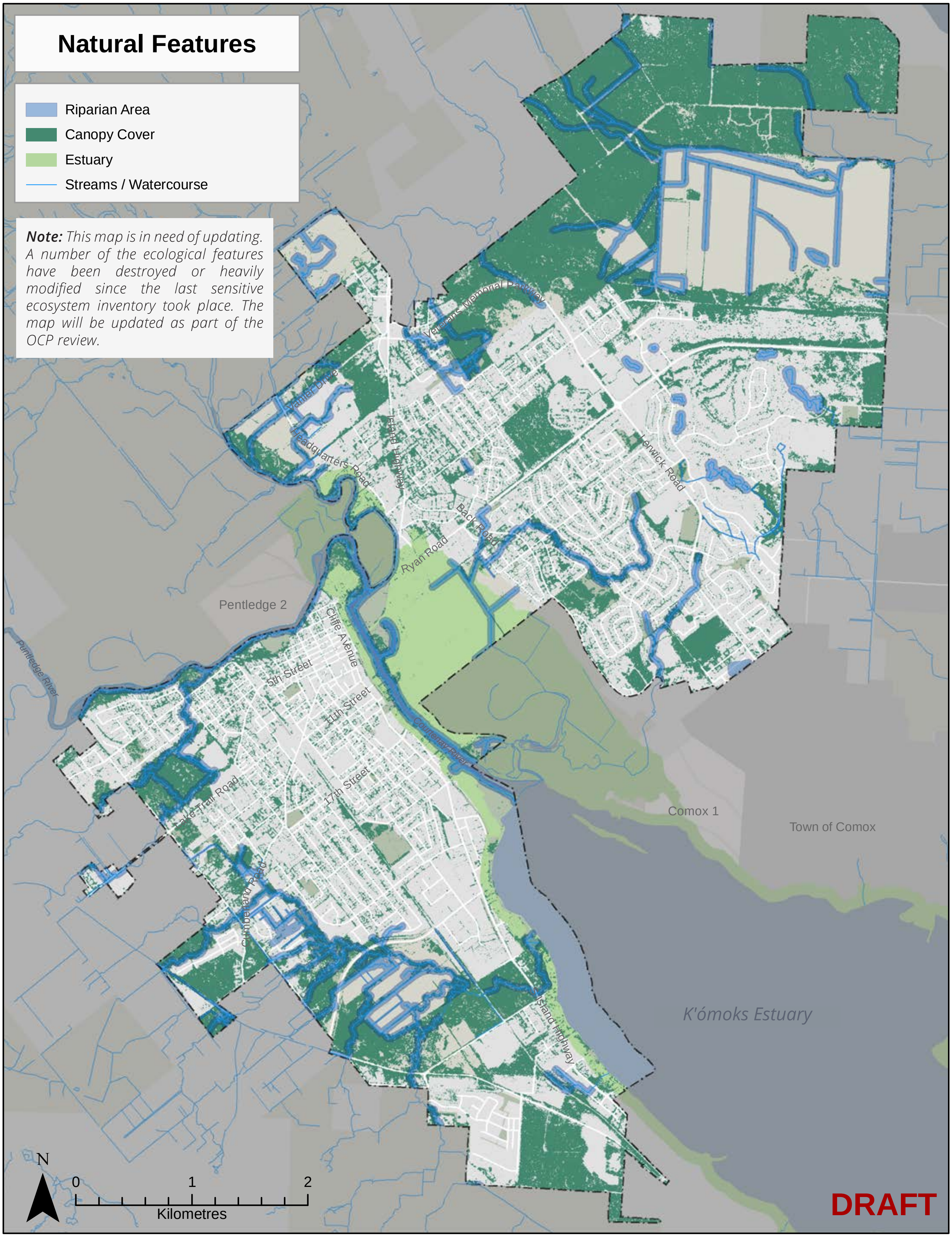


Figure 2.53 - Key Natural Features of Courtenay. Data Source: City of Courtenay Open Data.

2.8.4 LOCAL ECOLOGICAL TRENDS: OBSERVED AND EXPECTED

As is common in many places of the world, locations of high biodiversity and ecological productivity are also of high human interest. Competing uses of these prized locations generally results in ecosystem loss and Courtenay is no exception.

In fact, the eastern coast of Vancouver Island is particularly prized; the 'Nanaimo Lowland' ecosection of which Courtenay is a part is provincially identified as experiencing extreme development pressure. So much so that the BC Conservation Data Centre identifies all naturally occurring forested ecosystems in Courtenay's Biogeoclimatic Coastal Western Hemlock xm zone to be at risk in BC and/or globally.

In an attempt to triage conservation efforts to the most critical of ecosystems, the province identified nine **sensitive ecosystems** in the 1990s to pay particular attention to in the Comox Valley:

- Coastal Bluffs
- Sparsely vegetated dunes and cliffs
- Terrestrial Herbaceous meadows and outcrops
- Riparian zones
- Wetland areas
- Woodlands
- Forests older than 100 years
- Mature forests 60-100 years
- Seasonally flooded agricultural lands

These ecosystems would have dominated the region only 150 years ago. By the 90s, they were reduced to 8% of the total assessment area. In the twenty years following original inventory, these ecosystems were further reduced in the form of fragmentation, significant alteration or outright loss to less than 6% despite these identification efforts.[5] While these data represent the entire Comox Valley, Courtenay's experience is indicative of these trends.

The provincial classification of sensitive ecosystems did not include entire watershed assessment. However it's important to note that most of the watersheds that have lands within the Courtenay's boundaries have been heavily altered by urbanization, agriculture and infrastructure such as highways, ditches and other drainage systems that were designed without maintaining ecological services in mind. Outside of the City's boundaries, resource production and extraction influences some of Courtenay's watersheds. This alteration has affected watershed ability

[5] http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=54324

to provide their numerous ecological services: habitat provision, flood relief, water quality, nutrient cycling, carbon sequestration and drainage.

Within these ecosystems, **a number of species are endangered** and are assigned varying degrees of legal protection. The most high profile of such species from a regulatory perspective is the endemic Morrison Creek Lamprey lives nowhere else on Earth. Because it is listed as an endangered aquatic species under the federal Species At Risk Act, enforceable federal Critical Habitat Orders apply to land in Courtenay. Other endangered species include barn owls on farm lands, little brown bat, red-legged frog, great blue heron, wandering salamander, summer run of Chinook and a number of entire classified ecological communities including all naturally occurring forested ecosystems in Courtenay's Biogeoclimatic CWHxm zone.

Salmon runs are also generally in decline due to particular impacts within each watershed whether occurring within the City's boundaries or not. On the west side of Courtenay, agriculture, urban development and hydrological interruptions that resulted from the construction of Highway 19 heavily affects Millard-Piercy Creek which now dries out along much of the Piercy Creek tributary during the summer. Morrison Creek continues to contain cool and adequate volumes of water, but its headwaters are located within potential logging areas that are being pursued for protection at this time. The Puntledge River flows are regulated by the Hydro dam, and a hatchery is in place to support salmon rehabilitation. Tsolum River salmon runs have bounced back from the devastating impacts of the short lived upstream copper mine in the 1960s, and logging impacts in the upper watershed continue to be monitored. However, the Tsolum experiences demand and supply disparity due to over-allocation of water licenses thereby rarely achieving critical flows needs for salmon. On the east side of Courtenay, Glen Urquhart creek is altered along its entire length, and fish barriers exist at Back Road and 10th St east. In a number of locations, residential homes are only metres away from the open water, and stream bank erosion is occurring due to the flashy nature of water volumes. Originating in the Crown Isle, Brooklyn Creek headwaters have been heavily altered by urban development resulting in impact to flow characteristics and salmon habitat. Little River has been the source of streamkeeper dedication for nearly half a century including a hatchery located on farm land and ongoing restoration efforts. Despite sustained efforts, however, the need for more restoration has been identified due to cumulative negative impacts within the watershed.

In 2018-19 the first comprehensive overview of the **community's urban forest** was undertaken. It revealed that urban forest canopy cover had been decreasing at an accelerating rate in recent years and that canopy cover was highly uneven across the community. Courtenay's Urban Forest Strategy establishes a canopy cover target from the 33% today to 34-40% in the future and includes a number of actions and policy directions to replant and protect key corridors of trees within the community.

Another significant environmental trend are the changes to the **K'ómoks estuary** which used to be much bigger and historically included the commonly known Ducks Unlimited agricultural lands and the commercial lands at the high traffic intersection of Ryan Road and Old Island Highway. These estuarine environments were originally diked to create farmland. Ducks Unlimited Canada and the Nature Trust of BC later acquired much of the altered portions of the historical estuary which is now managed for crops that also leave beneficial residuals to migratory waterfowl in the winter, notably globally-significant numbers of trumpeter swans. Balancing the desirable nature of these coastal zones, however, is risk brought by yearly flooding, sea level rise, and long-term erosion caused by disrupted coastal sediment systems. Traditionally, these forces were combated through 'hard engineering' solutions including breakwalls, riprap, and diking. Rising sea levels due to climate change make these solutions expensive and impractical, as future coastal changes may exceed the limit of what is possible through built solutions. Courtenay will have to contend with a changed relationship to the ocean, and look to green infrastructure solutions. Creating new intertidal habitat, planted riparian zones, and even 'managed retreat' may help to solve larger issues in low-lying areas.

In understanding the changes to Courtenay's natural heritage, it's important to understand that most of these changes have occurred independently of climate change, or have been only marginally influenced by climate change. Increased climate change is an additional factor that will further affect, mostly negatively, Courtenay's remaining native ecosystems.

Canopy Cover by Block (2016)

In this map, tree canopy cover is summarized by 'blocks' of the city defined either by surrounding street boundaries or land use changes.

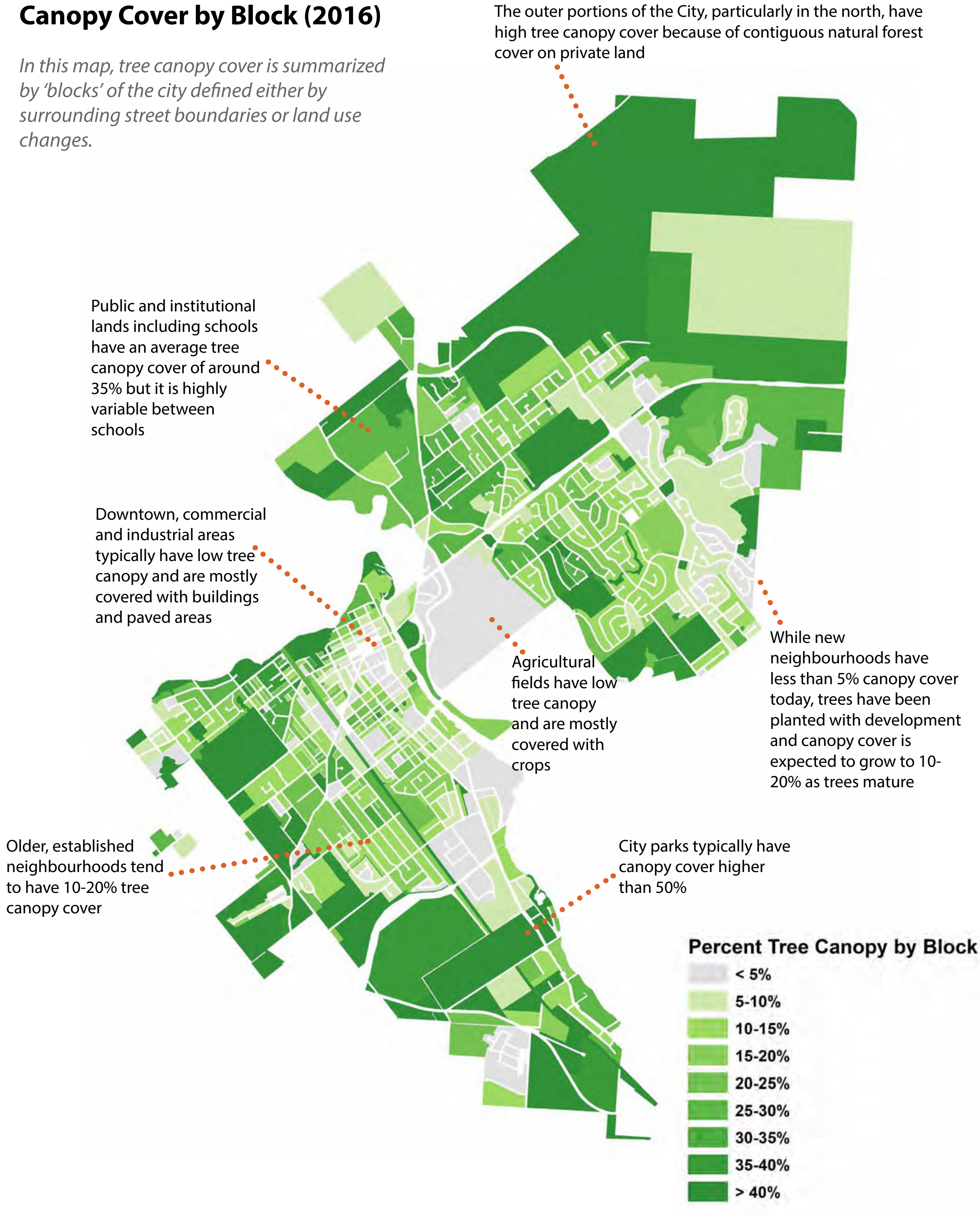


Figure 2.54 - Urban Forest Character of Courtenay. Source: City of Courtenay's Urban Forest Strategy (2019).

Expected changes due to climate change

Climate normals[6] show average yearly precipitation of 1,154 mm and an average yearly temperature of 10°C. Records also show extreme maximums as high as 35°C in July and extreme minimums as low as -21°C in January. More typically, winters are mild and summers are cool, though periods of drought are common in the summer.

Climate change modelling estimates a median increase of 1.5°C to the annual mean temperature in the Comox Valley by 2050. This is accompanied by a 6% increase in annual precipitation, although summer precipitation amounts will decrease by 17%. Annual snowfall in the region is expected to decrease substantially, resulting in reduced winter snowpack to the chagrin of snow sport enthusiasts. The median heating degree days will decrease by 516 degrees. In short, the local climate is anticipated to change to longer, hotter summers with less precipitation, and winters characterized by higher temperatures and more varied storm occurrences.

Local climate impacts expected to accompany these changes include:

- Warmer annual mean temperatures will result in flora and fauna species migration, with some currently local species moving north and species currently south of the biogeoclimatic region moving into the Comox Valley. Changes in species ranges could result in local extinctions (extirpation) of species that are unable to migrate quickly enough. Changes in the marine environment could also mean a switch from a salmon-dominated system to herring dominated system, as have been the case previously[7] ;
- Increased growing degree days and more frost-free days will result in longer growing seasons. A longer growing season would require more demand for irrigation water which would be particularly stressing to the already overextended Tsolum River;
- Hotter springs and summers may allow traditionally more southern crops to be grown in the region;
- Decreased snowpack will mean less water for the summer months, increasing drought risk;
- Increased drought will increase wildfire risk and wildfire smoke presence and airborne particulate pollutants;
- Heat wave frequency and duration is expected to increase. This includes the number of consecutive days with a temperature above 30°C and particularly nights that remain hot, thus exacerbating the effects of the heat wave;

[6] Comox A weather station 1981-2010 http://climate.weather.gc.ca/climate_normals/

[7] https://www.academia.edu/23327812/The_Comox_Harbour_Fish_Trap_Complex_A_Large-Scale_Technologically_Sophisticated_Intertidal_Fishery_from_British_Columbia

- Wetter winters and springs will increase flood risk frequency and severity as well as landslide risk;
- Warmer temperatures and more humid air from increased rainfall in the winter and spring months will result in greater air front variances, resulting in more frequent and intense storms;
- Expected sea level rise will increase coastal erosion rates and seawater ingress to low-lying areas, with a risk of salinating agricultural soils, impacting crop production and affecting arterial roads and highways. For example, Comox Road along the estuary, locally known as Dyke Road given its impounding function, will need to be build up, or abandoned;
- Expected sea level rise will result in higher storm surges; and
- Warmer winters will decrease heating demand in winter months. Conversely, warmer summers will increase demand for air conditioning.

The following tables summarizes the expected climate changes in the region.

Climate Variable	Season	Projected Change from 1961-1990 Baseline	
		Ensemble Median	Range (10th - 90th percentile)
Mean Temperature (°C)	Annual	+1.5 °C	+0.9 °C to +2.3 °C
Precipitation (%)	Annual Summer Winter	+6% -17% +5%	-2% to +11% -26% to +2% -4% to +14%
Snowfall* (%)	Winter Spring	-36% -52%	-55% to -19% -71% to -17%
Growing Degree Days* (degree days)	Annual	+342 degree days	+210 to +532 degree days
Heating Degree Days* (degree days)	Annual	-516 degree days	-786 to -321 degree days
Frost-Free Days* (days)	Annual	+23 days	+13 to +34 days

* These values are derived from temperature and precipitation.

Table 2.5 - Summary of Climate Change for the Comox Valley in the 2050s. Source: Pacific Climate Impacts Consortium data: http://www.plan2adapt.ca/tools/planners?pr=9&ts=8&toy=16

2.8.5 ECOSYSTEMS ROLE IN CLIMATE ACTION AND ADAPTATION

As is common in many places of the The United Nations has declared 2012-2030 the Decade of Ecosystem Restoration[8], recognizing both the important role healthy ecosystems play in mitigating and adapting to climate change as well as their precarious condition virtually everywhere on Earth. Specifically healthy ecosystems are acknowledged for providing sinks and reservoirs of carbon in the form of forests, oceans, wetlands and soil. The restoration of these systems and assets would sequester already emitted greenhouse gases, and in fact forms part of the assumption of Canada's ability to meet greenhouse gas emission targets.[9] However, because ecology is a relatively young science, and researchers and policy makers are only recently earnestly looking to the natural environment for solutions, the specifics of how healthy ecosystems will contribute to climate change are not quantified in detail. That they are important, however, is not in question.

Courtenay is one of the few communities in Canada that has taken steps to begin to quantify ecosystem services and understand this relationship. As part of Courtenay's broader stormwater mitigation and flood management study work underway, the City partnered with the Municipal Natural Assets Initiative (MNAI) to consider the cost and benefits of: widening the Courtenay River; naturalizing the foreshore of a former sawmill site to re-instate natural river flow paths (the restoration effort of which is referred to as Kus-kus-sum); and land acquisition and remediation to gradually remove at-risk buildings from the floodplain.[10]

The study found that widening and naturalizing of almost 1,300 metres of the banks of the Courtenay River would save an anticipated $2.4 million in damage to downstream properties during a one-in-200-year flood event. Historical flooding patterns demonstrates that critical transportation and downtown lands are vulnerable to as frequent as one-in-20-year flood events. This is a first local glimpse into substantial co-benefits afforded when working with natural systems instead of against them. With flooding risk on the rise in Courtenay due to climate change, these proposed solutions are good news.

Courtenay is also part of Canada's first watershed-scale municipal natural asset initiative, which is quantifying the value

[8] https://www.decadeonrestoration.org/
[9] https://www.canada.ca/en/environment-climate-change/news/2020/05/international-day-for-biological-diversity2020-statement-from-the-minister-of-environment-and-climate-change-the-honourable-jonathan-wilkinson.html
[10] https://mnai.ca/pilot-communities/

of the region's major drinking water source: the Comox Lake Reservoir.[11] This work is ongoing and is led by the Comox Valley Regional District.

Additionally, Courtenay's urban forest provides many climate action services that can be quantified: an estimated $600,000 per year in carbon sequestration value, $15,500,000 in carbon storage and $46,000 in annual air quality benefits. With the Urban Forest Strategy directing an increase in canopy cover throughout the City, these contributions will only grow.

The above examples scratch the surface of understanding what value nature provides in cities. A recent report on Canadian projects that incorporated 'natural infrastructure' in addition to, or in replacement of, traditional 'grey' infrastructure highlight that unlike engineered assets, which depreciate in value and require ongoing maintenance budgets, natural assets tend to increase in value and require less maintenance.[12] Natural assets are also often more resilient to climate change. Responding to the trifold challenge facing Canadian communities today, MNAI is an example of a systems based response to complex interrelated problems: declining ecosystem health, aging community infrastructure and unplanned climate change impacts to these natural and built systems.

In considering how to leverage local natural capital it's important to remember that changing climatic conditions will add increased pressure to existing ecosystems, some of which may not be able to adapt. Like a body's immunity defending against disease, poor existing ecosystem health can reduce resilience to additional stress and ability to recover.

For ecosystems that can and do adapt, however, benefits will include the ecosystem services identified earlier. Other benefits for Courtenay include continued pollination, air and water quality, soil enrichment, erosion prevention, rain and storm water flow, shade and cooling. Less tangible benefits are also expected such as therapeutic, mental health and healing, sense of place and spiritual benefits. These may be needed more in the future than ever as climate change is expected to increase collective human anxiety and grief, as is evidenced already in younger generations.[13]

[11] https://mnai.ca/canadas-first-watershed-scale-municipal-natural-asset-management-initiative-is-now-underway/
[12] https://5187fba4-0e62-4c37-af26-b2b843007968.filesusr.com/ugd/8e966a_ccd3c957c4924d199f31b2e1c3db82e1.pdf
[13] https://www.theguardian.com/environment/2020/feb/10/overwhelming-and-terrifying-impact-of-climate-crisis-on-mental-health; https://www.washingtonpost.com/magazine/2020/02/03/eco-anxiety-is-overwhelming-kids-wheres-line-between-education-alarmism/?arc404=true

2.8.6 PARKS, OPEN SPACES, & TRAILS

The City of Courtenay has a well-developed park and greenway system, with locations distributed throughout the city. The recently completed Parks and Recreation Master Plan has identified the various assets, as well as completed a framework for expansion and stewardship, identifying the needs of the community moving forward, and how to meet them. Goals for the future of the system centre around 8 key goals, including:

- Improving connectivity
- Fostering a healthy and active community
- Providing access for all
- Connecting parks and recreation with culture
- Protecting and enhancing beauty
- Protecting and enhancing the environment
- Enhancing communication and partnerships
- Practicing sound financial management

These objectives are in place to ensure that current parkland is protected for future generations. Past planning and policy goals have been aimed at also aligning with previous OCP visions to transform Courtenay into the most livable community in the province.

To do this, the current parkland base has been categorized into five main space types: community parks, neighbourhood parks, natural parks, linear parks, and greenspaces. Each of these can vary in size, but generally speaking, community and neighbourhood parks serve the city as a whole and smaller catchment areas respectively, while linear parks connect along trail systems, and natural parks and green spaces create room for both human use and ecological function. Other spaces that informally bolster the park system include school sites, spaces for future restoration (such as Kus-kus-sum), and the various provincially owned sites in the area (including Hollyhock Marsh). In general, the city aims for all residents to be within a 5-minute walk of at least some of these spaces; and ideally no more than 10 minutes from a larger destination location.

The map shows that the eastern side of Courtenay has much less walkable access to park and open space areas than the older west side. Of the current 11 community parks, the west side is much better served, and the north east has almost no access to parks or trails of any kind. As development continues in these areas, new park spaces will need to be created to serve these populations. Links to the existing park network will also be important to help reduce car based trips. West Courtenay will also see expansion, as increased density in the downtown regions will also necessitate new park spaces. As more and more families and retirees move into these neighbourhoods, existing parks may also need to be retrofitted to include an expansion of uses suitable for all age ranges.

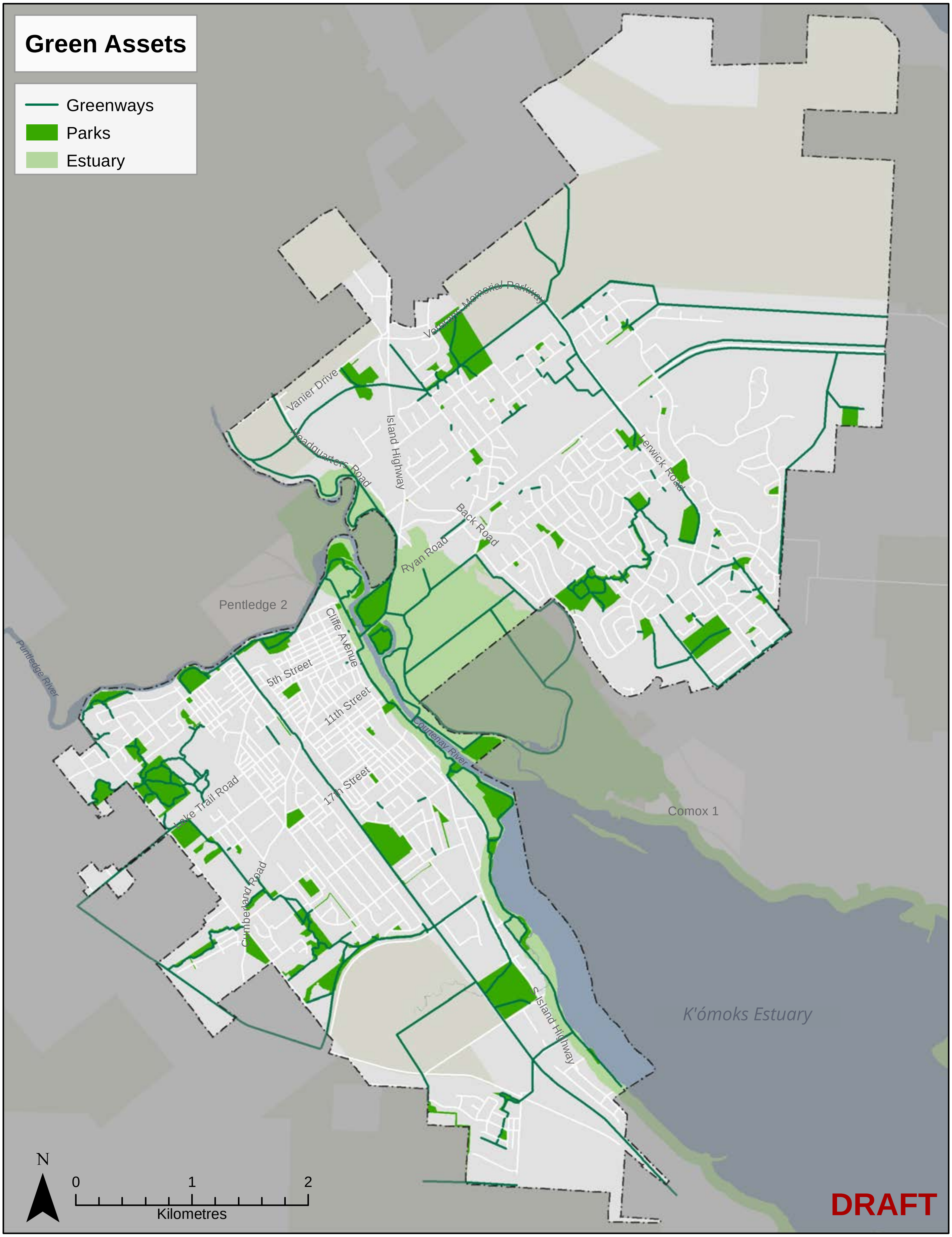


Figure 2.55 - Green Assets of Courtenay. Data Source: City of Courtenay Open Data.

2.8.7 POLICY CONTEXT & DIRECTION

The City currently has a number of policies that influence and regulate land use activities affecting the environment in the form of a Tree Bylaw, Environmental Development Permit Area (DPA) guidelines, Subdivision Servicing Bylaw (which sets standards for rainwater management as a result of development) and the existing Official Community Plan (OCP). In addition, the Comox Valley Regional District Regional Growth Strategy (RGS) contains policies which the City's OCP must reference in the form of a regional context statement.

The RGS identifies the current situation with regards to local government environmental management in the following way, which captures Courtenay's current situation well: "The ecological diversity of the Comox Valley is protected through a number of local government policies. However, development pressure continues to impact natural systems." The broad goal for ecosystems, natural areas and parks identified in this regional land use tool is "Protect, steward and enhance the natural environment and ecological conditions and systems". Among other actions towards this aim, the RGS identifies the importance of positioning regional conservation as an integral component of growth management, and acknowledging the interconnected nature of the environment. The RGS directs environmental protection and policies to follow the principles of precaution, connectivity and restoration. This direction is pertinent to the City's OCP review.

The most significant outcome of the RGS is to direct community growth to the municipalities of Courtenay, Comox and Cumberland which offer more public and utility servicing, transportation options and more compact and efficient land uses as described throughout this Background Report. Because Courtenay is identified to receive much of the region's growth, Courtenay's land base is expected to be mostly comprised of highly altered ecosystems underpinned by a network of the most critical formative systems and environmentally sensitive areas. Identifying these critical, non-negotiable, environmental values and lands within the City's boundaries is foundational to the OCP's ability to deliver good land use planning including the climate friendly directive.

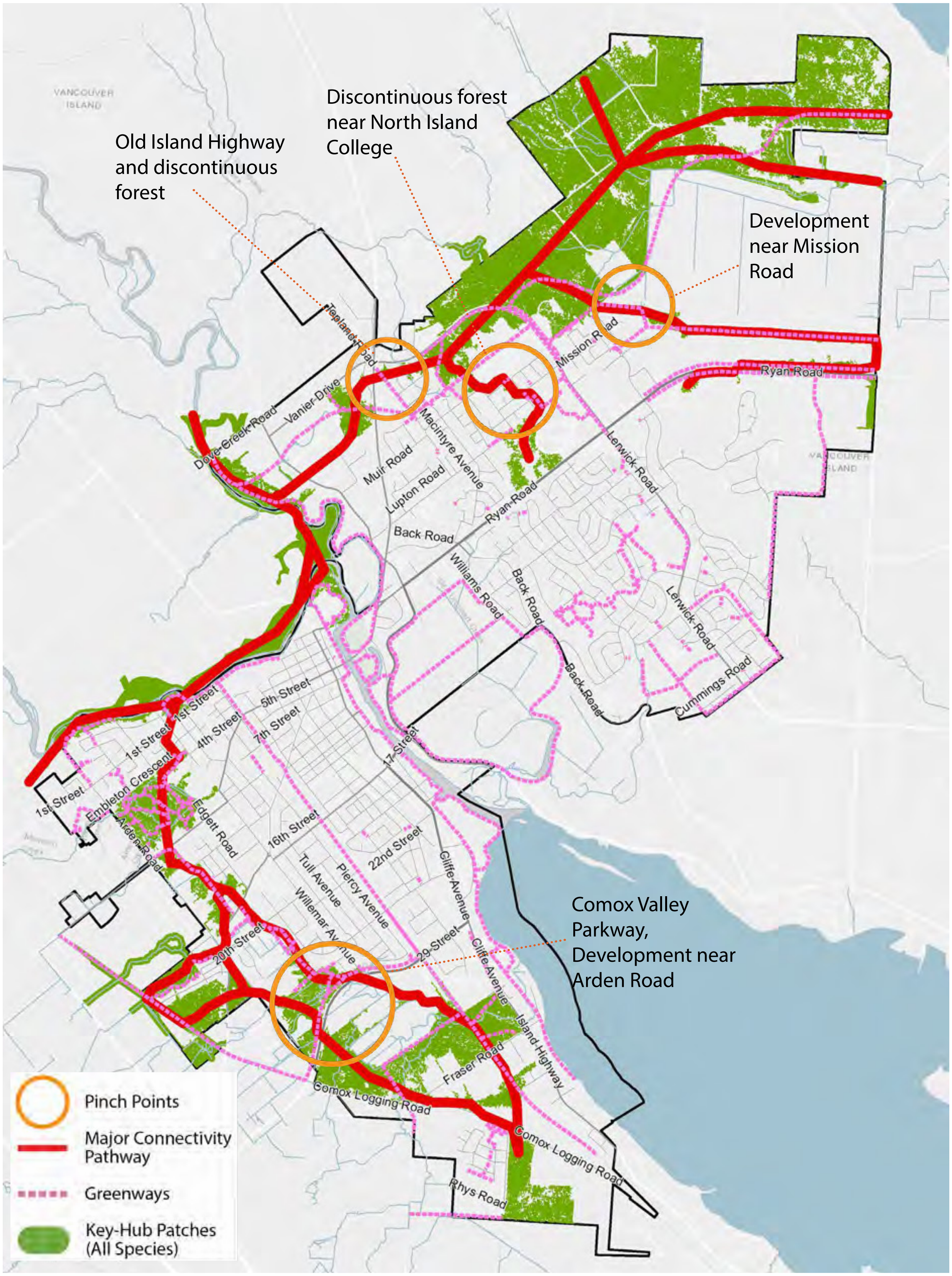


Figure 2.56 - Habitat Areas of Courtenay. Source: City of Courtenay's Urban Forest Strategy (2019).

A number of environmental protection and management concepts have been identified that will be considered as part of the OCP's review to evaluate and incorporate appropriate options for Courtenay. They can be summarized into these high level goals, some of which have, or will require, additional direction contained in other strategies and plans:

- ***Ecosystems and habitat must be connected*** to allow for maximum effectiveness in providing their services, and in many instances to support their formative systems. For Courtenay, creek and river hydrology is critical. The concurrent Integrated Rainwater Management Plan will provide additional analysis and detail to this aim. The Urban Forest Strategy identifies the remaining forest connectivity opportunity to provide a biodiversity corridor for Courtenay as shown in Figure 2.56. This corridor includes Millard-Piercy and Morrison creeks, Puntledge and Tsolum rivers, the Garry oak ecosystems along Vanier Rd., Mission hill, and into both Block 71 and the Crown Isle north lands. How development, conservation and restoration goals can exist within and adjacent these areas will be explored in more detail in this OCP review. In addition to the identified forest corridor, all riparian corridors will be examined for 30m setback protection or restoration to optimize their ecological function.

- ***Endangered species and ecosystems must be protected.*** Fortunately, the forest connectivity opportunities identified in Figure 2.56 correspond with the biogeoclimatic CWHxm zone protection opportunities. Specifically, priorities include all Garry oak ecosystems, all remaining forested stands that are greater than 60 years old and that are either greater than 200ha and/or adjacent to an existing protected area. Given its vulnerability to climate change, the iconic west coast western red cedar has also been proposed for protection. In order for biodiversity corridors, endangered ecosystems and imperilled species habitats to provide their desired functions, priority ecological areas must be identified and designated for perpetual protection.

- ***The urban footprint must be managed.*** Many communities designate urban containment boundaries or a similar land use tool to ensure that as population growth occurs, it is first prioritized into serviced areas with minimal additional environmental impact. The new land use bylaw map can outline where growth should be concentrated. OCP policy can identify what thresholds of growth will trigger additional greenfield lands to be developed. Within the lands designated for development, new construction can be required to be clustered to maximize environmental values on the site, while simultaneously meeting livability and affordability goals.

- ***Green Infrastructure, or Natural Infrastructure, can be incorporated into public and private land.*** Public services such as roads, parks, stormwater system, flood protection are common Green Infrastructure applications from other communities. Green Infrastructure on private land can take the form of tree planting, native landscaping, soil and rainwater management. Fortunately, environmental assets are unique among community assets (such as roads, pipes and parks) because they are living infrastructure that the community can directly help grow, steward and protect. With more than 85% of the land base being private land, the achievement of environmental management goals will depend on how well individuals take initiative and responsibility to play a vital part. When looking at how land uses may change at the neighbourhood scale to accommodate community growth, the City has committed to also examine specific neighbourhood urban forest goals with residents, including in support of food security.

- ***The City must exemplify, lead and work in partnership*** with the public and organizations to steward ecological assets that span property boundaries. The City can embed within the community's growth management framework and operational activities a strong understanding of Courtenay's natural heritage with identified performance outcomes and clear management expectations. This will be an outcome of the OCP review. This will take working with experts in the field, including the environmental non-profit sector, to raise wider awareness and leverage individual action towards these goals.

2.9 HUMAN-MADE INFRASTRUCTURE

2.9.1 WATER AND SEWAGE

Courtenay's sewer utility infrastructure includes over 150 km of sanitary sewer mains, 12 sanitary lift stations, 23 pumps, and nearly 7,000 individual connections. Household and business wastewater is conveyed to the Comox Valley Water Pollution Control Centre, which is operated by the Comox Valley Regional District (CVRD).

Courtenay's water is provided by the CVRD. The water supply is sourced from Comox Lake and collected from the Puntledge River at the BC Hydro penstock. Water travels from the penstock via two transmission pipelines to the CVRD's chlorination station where it is metered, sampled, and chlorinated. Detailed planning and design is now underway for a new water treatment system that will service Courtenay residents among others.

As summarized in Table 2.5 on page 107, both summer precipitation and winter snowfall are forecasted to decrease, which may reduce water supplies in summer months.

2.9.2 SOLID WASTE

The City of Courtenay's solid waste collection service is aimed at reducing the volume of landfill waste by diverting reclaimable materials at the curb. Curbside collection includes garbage, recycling, and yard waste. Residents are also able to recycle specific items, such as glass, foam, and plastic bags, by bringing those materials to the recycling depot.

There is currently no municipal food waste composting service in Courtenay, however a regional organics compositing facility is currently being planned for Campbell River (scheduled to operate in fall 2021) and will serve the Courtenay area.

2.9.3 RAINWATER MANAGEMENT

The City of Courtenay is currently developing an Integrated Rainwater Management Plan that will provide a community-wide framework to proactively manage rainwater through more holistic and natural solutions.

This plan highlights a shift away from traditional strategies for rainwater management that focus solely on drainage and flood prevention, toward green infrastructure and low impact development opportunities as part of Courtenay's urban ecosystem. One example is the 5th Street Complete Street, which showcases alternative options for managing rainfall through rain gardens.

This approach is largely supported by the City's Asset Management By-Law and related initiatives, which integrate natural assets into core asset management and financial processes, with a goal of understanding, managing and valuing natural assets in an equivalent manner as a community's built environment.

Image: 5th Street Complete Street Integrated Rainwater Management.

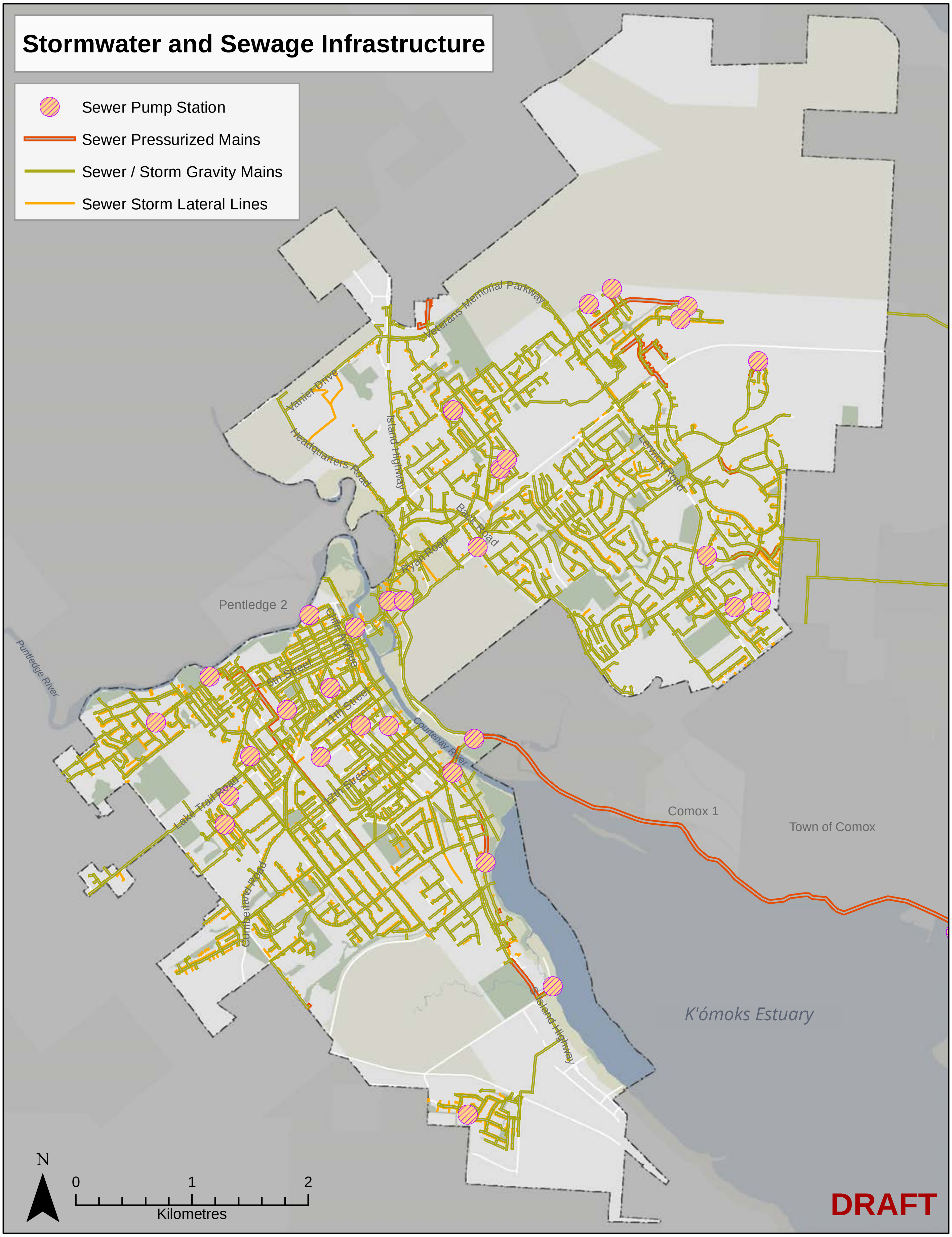


Figure 2.57 - Stormwater and Sewage Infrastructure of Courtenay.

Data Source: City of Courtenay Open Data.

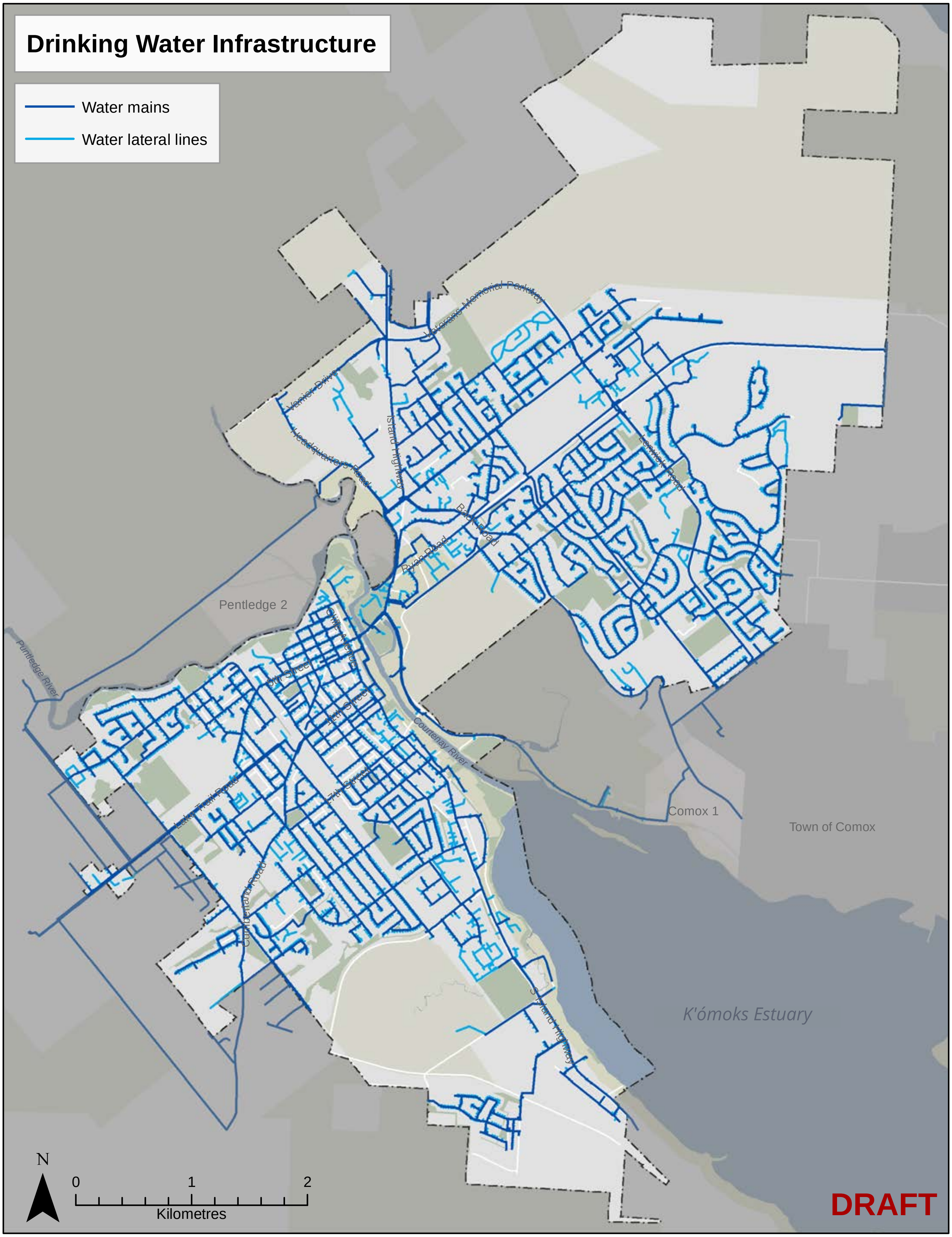


Figure 2.58 - Drinking Water Infrastructure of Courtenay. Data Source: City of Courtenay Open Data.

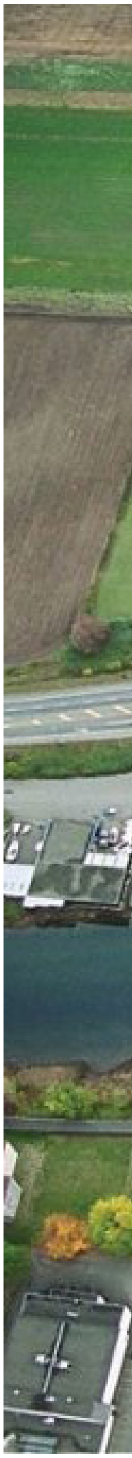
2.9.4 FLOOD MANAGEMENT

As previously introduced in Section 2.8.2, the Comox Valley is expected to experience wetter winters and springs, which will increase frequency and severity of flooding within the region. In response to serious floods that impacted Courtenay in 2009, 2010, and 2014, the City completed an Integrated Flood Management Study in 2015, outlining a series of recommendations and potential options for managing floods under various climactic conditions and different flood protection configurations.

The City is currently developing a long-term mitigation strategy to improve flood protection and evaluate existing dike structures along the major river systems within Courtenay's jurisdiction, as well as updated flood mapping.

As a culturally and environmentally significant initiative, Project Watershed, in partnership with the K'ómoks First Nation (KFN) and the City of Courtenay, are currently working together to purchase and restore the former Field Sawmill site on the Courtenay River. The project partners intend to re-establish the current industrial site as saltmarsh with flow-through channels and riparian habitats, supporting the rehabilitation of flora and fauna within the K'ómoks Estuary, mitigating localized flooding, and providing educational and recreational opportunities.

The project site is named Kus-kus-sum – meaning tree burial– in recognition of its traditional use by the K'ómoks First Nation as the final resting place for their ancestors.



There are many highly engaged non-profit groups and individuals working to steward nature within the city. Many of these individuals are professionals or retired professionals from diverse fields including biology and engineering. As a result, the stewardship sector in the City and in the Comox Valley in general has a high capacity to engage on issues and planning processes important to the environmental health of the city.

- OCP Advisory Committee Member

Image: Kus-kus-sum Field Sawmill Restoration. Source: Dan-Bowen.

2.9.5 FOOD SYSTEMS

The Comox Valley has been a land of plenty whose rich marine and land-based foods have sustained Indigenous people since Time Immemorial. The region also has a more recent commercial fishing and agricultural history, and a growing agriculture sector.

Today, Courtenay's food system plays a role in shaping outcomes as diverse as public health, equity, reconciliation, local economic development, and sustainability. The OCP process provides an opportunity to identify food system goals and actions that can shape these outcomes for the better.

Importantly, the Comox Valley has recently formed a regional Food Policy Council, which provides a forum for advocacy and policy development that works towards the creation of a food system that is ecologically sustainable, economically viable, and socially just. The members are focused on three main areas of food systems policy: increasing food security (access to healthy food), building the local food economy, and supporting food-systems education (sometimes called food literacy).

Within Courtenay, there are several important food system related initiatives and considerations:

- Lush Valley Food Action Society leads a diversity of community food programming, including the Fruit Tree & Farm Gleaning program, healthy food programs such as Young Cooks, Young Hot Meal, and Community Kitchen, as well as production related programs such as the Share the Harvest Community Garden and Garden Share program.
- The Comox Valley Food Bank is located within Courtenay, providing charitable food assistance to residents experiencing food insecurity.
- The Comox Valley Farmers' Market is hosted in Downtown Courtenay, offering direct sales of local, nutritious produce to residents in both the summer and winter.
- The presence of Agricultural Land Reserve (ALR) land within Courtenay will require alignment between the OCP and the procedures and policies established by the Agricultural Land Commission.

The OCP process will look for opportunities to engage with these groups and others involved in Courtenay's local food system.

Image: LUSH Valley Plum Harvest. Source: Comox Valley Record.

Image: Comox Valley Farmers' Market Vendor. Source: Comox Valley Farmers' Market/Bill Jorgensen.

2.10 EXISTING PLANS AND STRATEGIES

The City of Courtenay is guided by a series of policy frameworks, ranging from local plans to city-wide, regional, and provincial policies (Figure 2.59). Below is an overview of key policy documents that will inform and support the development of the OCP.

EXISTING OFFICIAL COMMUNITY PLAN

The City's current Official Community Plan "A Blueprint for Courtenay" was adopted in 2005, establishing a vision for Courtenay as a unique and livable community. In 2010, the City adopted climate change policies to reduce the impact of human-related activities in Courtenay, including greenhouse gas emissions associated with transportation and energy use, water use, waste management, community resilience, and natural capital protection and enhancement. A new plan is needed.

COMOX VALLEY REGIONAL DISTRICT REGIONAL GROWTH STRATEGY

The Comox Valley Regional Growth Strategy (RGS) was adopted in 2010, outlining a framework for sensitive and sustainable long-term growth. This strategy provides direction to electoral areas and member municipalities to consider growth decisions at a regional scale, across a diversity of policy areas, including housing, environmental stewardship, local economic development, transportation, food systems, public health and safety, and climate change. The following vision statement guides the Comox Valley RGS:

The Comox Valley will continue to evolve as a region of distinct, well-connected and well-designed urban and rural communities. As stewards of the environment, local governments, the K'ómoks First Nation, public agencies, residents, businesses and community and non-governmental organizations will work collaboratively to conserve and enhance land, water and energy resources and ensure a vibrant local economy and productive working landscapes.

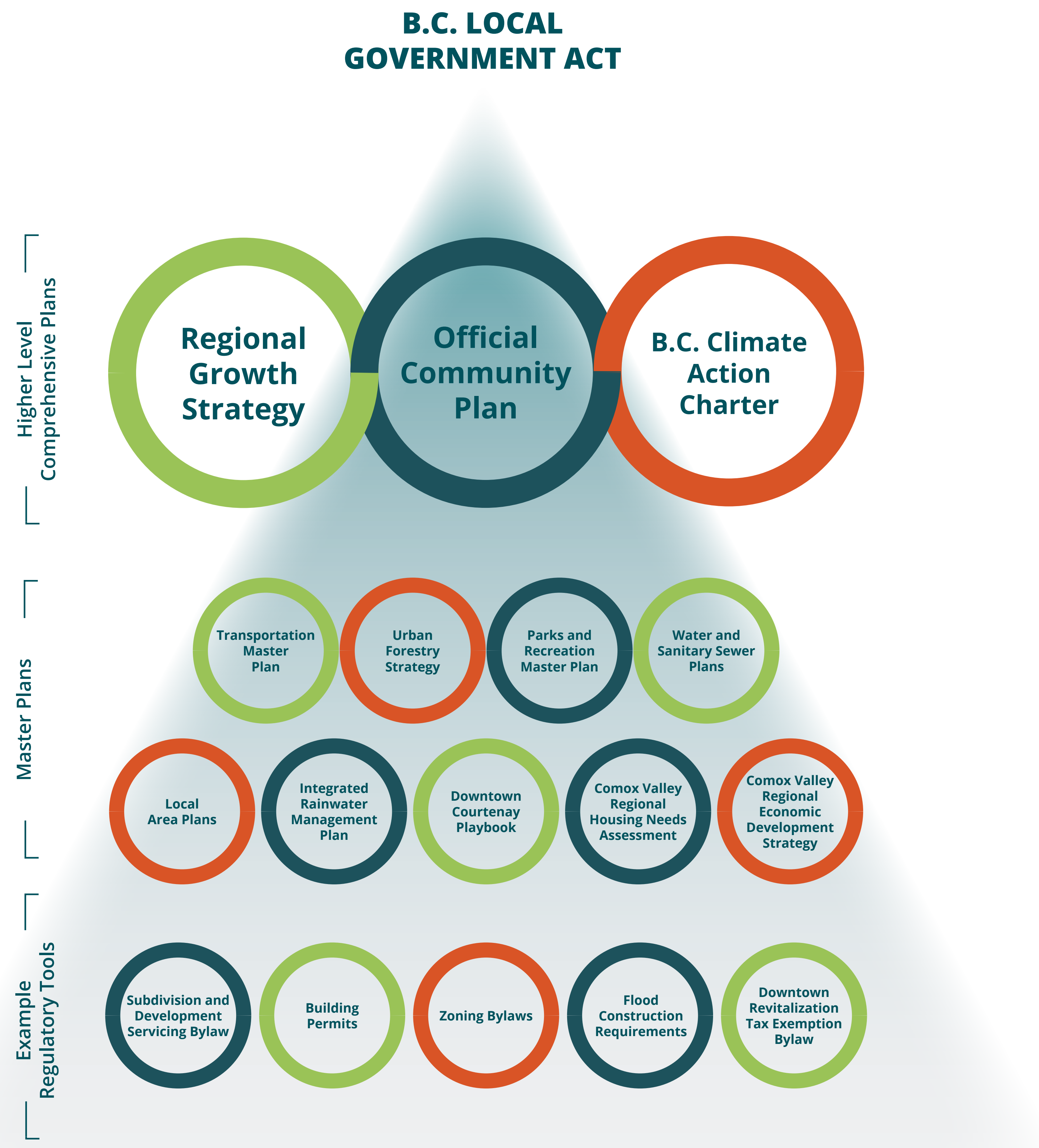


Figure 2.59 - Hierarchy of Plans and Strategies as They Relate to the OCP.

In BC, where Regional Growth Strategies exist, OCPs must include Regional Context Statements to demonstrate their general consistency with regional growth goals. Comox Valley's RGS includes the following goal areas:

Goal 1: Housing

- Ensure a diversity of housing options to meet evolving demographics and needs.

Goal 2: Ecosystems, Natural Areas and Parks

- Protect, steward and enhance the natural environment and ecological connections and systems.

Goal 3: Local Economic Development

- Achieve a sustainable, resilient and dynamic local economy that supports Comox Valley businesses and the region's entrepreneurial spirit.

Goal 4: Transportation

- Develop an accessible, efficient and affordable multi-modal transportation network that connects Core Settlement Areas and designated Town Centres, and links the Comox Valley to neighbouring communities and regions.

Goal 5: Infrastructure

- Provide affordable, effective and efficient services and infrastructure that conserves land, water and energy resources.

Goal 6: Food Systems

- Support and enhance the agricultural and aquaculture sectors and increase local food security.

Goal 7: Public Health and Safety

- Support a high quality of life through the protection and enhancement of community health, safety and well-being.

Goal 8: Climate Change

- Minimize regional greenhouse gas emissions and plan for adaptation.

COMOX VALLEY SUSTAINABILITY STRATEGY

The Comox Valley Sustainability Strategy was adopted in 2010, supporting an integrated approach that responds to global climate change targets through regional level strategies and actions. Although not a binding policy, the Sustainability Strategy is a resource document that sets an overall greenhouse gas emissions reduction target of 80% from 2007 levels by 2050, with the following milestone targets:

- 2020 – 33% (B.C. Legislated)
- 2030 – 50%
- 2040 – 65%
- 2050 – 80%

In the 10 years since the creation of this strategy, carbon neutrality is now the goal for 2050 among a variety of sectors.

B.C. CLIMATE ACTION CHARTER

The B.C. Climate Action Charter is a voluntary agreement that commits Local Governments to the following:

- Become carbon neutral in their corporate operations;
- Measure and report their community's greenhouse gas emissions;
- Create complete, compact, more energy efficient communities.

The City of Courtenay signed on in 2007.

TRANSPORTATION MASTER PLAN

"Connecting Courtenay", the City's Transportation Master Plan, was adopted in September 2019. This plan recognizes the significant interrelationships among land use planning, attractive non-motorized transit networks, and GHG emissions reductions.

This plan includes the following vision statement:

The City of Courtenay supports a transportation network that prioritizes connectivity and access to daily destinations and, through a balanced approach to transportation planning, provides all road users safe choices in their mode of transportation.

This plan includes the following values:

1. Sustainability, Livability & Health
The transportation system is balanced and environmental impacts and GHG emissions are minimized. There is high quality cycling infrastructure, walking is convenient for users of all abilities, and transit is attractive and accessible, while vehicle trips are managed.

2. Safety +Efficiency
Transportation infrastructure is designed and built to be safe for users of all ages and abilities, and especially for the most vulnerable users. At the same time, traffic movements are efficient and reliable, and congestion is minimized. This is achieved first through optimization of existing infrastructure and then through the development of additional capacity, where warranted.

3. Economic Prosperity
Transportation attracts businesses and investment through efficient and reliable mobility for employees, goods, and services. Downtown Courtenay is a vibrant destination.

4. Connectivity
The transportation network has a high degree of connectivity for all modes of transportation. The modes of transportation are integrated to facilitate trips using multiple modes. This multi-modal network is also integrated at a regional level, supporting seamless transportation throughout the Comox Valley.

5. Affordability
The transportation system is affordable and financially sustainable. Individuals and families of all income levels can access transportation. At the same time, infrastructure budgets allow the City to continue to fund other programs and services. Investment in alternative modes has been prioritized, allowing the City to defer some major infrastructure projects.

6. Sustainable Land Use
Development patterns have become more compact and urban, resulting in a more livable community supporting varied travel modes.

URBAN FORESTRY STRATEGY

The City of Courtenay's Urban Forestry Strategy was adopted in 2019. As a community-wide land use concept, this policy document identifies a network of critical remaining forest patches linked by watercourses, and outlines an action framework for the protection, regeneration, and expansion of the urban forest canopy within Courtenay. City trees will play a critical role in the removal of carbon dioxide from the atmosphere, among other valuable ecosystem services.

This strategy includes the following vision:

Courtenay residents envision a future urban forest that is more extensive than today, is connected and accessible, maintains mature trees and ecosystem services, is comprised of a sustainable mix of ages and locally adapted species, and is used as a design treatment to reduce the prevalence of pavement in commercial areas, create neighbourhood distinction and canopy streets on key routes.

A canopy cover target of 34-40% distributed throughout Courtenay will inform the refinement of policies and actions to achieve this Vision, as the urban forest changes to accommodate development, climate change and through the natural life span of trees.

This strategy includes the following goal framework:

- ***Plan strategically*** to inform and monitor land use patterns and integrate the urban forest into civic asset management. Planning actions include consultation activities with individual neighbourhoods, conducting forest fire management planning, adopting policies regarding public trees, and maintaining spatial data on changes to canopy cover.

- ***Manage pro-actively*** to enhance urban forest health, safety and resilience. Management actions pertain to public land and include continuing to develop management responses to risk factors such as climate change, storm, pests and drought, investing more in the early years of tree establishment, and developing clear operating procedures based on level of service expectations.

- ***Protect prudently*** to maintain the quality and connectedness of the urban forest. Protection actions include pursuing options to enhance the protection of significant forest stands and biodiversity corridors, understanding how changes to hydrology and soil through development affect the urban forest, monitoring the Tree Bylaw to ensure it is effectively protecting applicable trees, and making changes when it is not.

- ***Grow the urban forest intentionally*** to provide urban forest benefits when and where they are needed. Growing actions include more planting on public and private land, distributing the canopy cover to areas that need it, enhancing the quality of new planting conditions, and promoting building energy efficiency through strategic planting locations.
- ***Partner effectively*** to share stewardship and promote appreciation of the urban forest. Partnering actions include collaborating with a variety of sectors on stewardship opportunities including the arboriculture community, landscape industry, nurseries, third-party utilities, non-profit societies and students conducting research, investing in public education and communications.

PARKS AND RECREATION MASTER PLAN

The City of Courtenay's Parks and Recreation Master Plan was adopted in 2019. This plan sets forward a framework for decision-making in support of diverse parks, interconnected trails for all ages and abilities, natural areas throughout the City, and multi-use and accessible spaces for indoor and outdoor recreation. Under the goal Protect and Enhance the Environment, numerous objectives are identified that directly support this OCP process through the lens of parks and recreation.

This plan includes the following vision statement:

Parks and recreation in Courtenay support a healthy, engaged, and inclusive community with a high quality of life. Key features are the diverse parks, interconnected trails for all ages and abilities, natural areas throughout the City, and multi-use and accessible spaces for indoor and outdoor recreation. The City is forward-thinking and addresses trends and emerging needs in parks and recreation.

This plan includes the following goals and objectives:

Improve Connectivity

- Establish a system of trails with connections to parks, recreation and culture facilities, commercial areas, schools, and surrounding areas
- Provide access for walking and cycling to all parts of the City
- Improve accessibility to parks and community facilities with transit
- Link the trail system with the active transportation network that serves pedestrians, cyclists and others
- Improve public access to and along the river

Foster a Healthy and Active Community

- Focus on self-directed opportunities to meet needs and increase participation
- Offer diverse programs, including the introduction of physical activity to children and adults
- Link recreation with public health through sharing of information and opportunities
- Provide opportunities to increase participation, such as year-round outdoor activities
- Provide access to nature for all residents

Provide Access for All

- Provide access to parks, facilities and programs for all ages, abilities, genders, and cultures
- Create awareness of opportunities for involvement in recreation
- Make affordable programs available based on need
- Recognize the specific needs of all age groups, including children, youth, and older seniors
- Provide equitable access for all users
- Accommodate growing and emerging recreation activities and changing demographics

Protect and Enhance Beauty

- Enhance the beauty of the community with features such as trees, art, and viewpoints
- Make downtown more liveable with outdoor parks and gathering spaces
- Work on retaining the safe, small-town character of the community
- Retain maintenance standards to keep parks and trails in good condition

Protect and Enhance the Environment

- Acquire and protect significant ecological assets within parks and link these together
- Plan for climate change by considering ecological services and designing to mitigate potential risks
- Focus efforts on protecting and enhancing the river, creeks, estuary, and riparian areas
- Balance recreation access and environmental management

Connect Parks and Recreation with Culture

- Integrate culture into parks and recreation planning, design and programs
- Increase the Indigenous and multi-cultural aspects of programs
- Recognize downtown as a cultural centre
- Consider social, environmental and economic sustainability in the design of parks and facilities

Enhance Communication and Partnerships

- Cultivate partnerships with government, including K'omoks First Nation, private sector
- Improve promotion of programs
- Help to develop leadership through volunteerism
- Enhance community development by supporting parks and recreation groups
- Undertake community engagement on projects and initiatives of interest to residents
- Collaborate with other jurisdictions in the Comox Valley on planning, programming, and funding of services that are regional in scope

Practice Sound Financial Management

- Maximize efficiencies in the use of existing facilities, parks and trails
- Manage fiscal resources to balance needs, budgets, affordability and the public's willingness to pay
- Implement asset management to support sustainable service levels
- Make funding parks and recreation a priority based on the social, environmental and economic benefits derived

DOWNTOWN COURTENAY PLAYBOOK

The Downtown Courtenay Playbook summarizes a community vision for downtown revitalization, along with the goals, principles, strategic tools, and policies for implementing that vision. As a partnership action plan, this process identified five goals:

- Establish Downtown as the Community's Heart
- More People in a Greater Downtown Area
- Make It Easier to Get to and Be Downtown
- Celebrate and Connect to the Rivers
- Identifies key re-development sites and infill opportunities.

Although these goals are not directly tied to GHG emission reductions, a better connected, mixed-use, vibrant Downtown will help reduce the overall environmental impact of Courtenay.

INTEGRATED RAINWATER MANAGEMENT PLAN

The City of Courtenay is currently developing an Integrated Rainwater Management Plan. This plan will adopt a proactive approach that considers the entire ecosystem, anticipates future volumes and identifies more holistic and natural solutions that protect property and habitat.

COMOX VALLEY REGIONAL HOUSING NEEDS ASSESSMENT

The Comox Valley Regional District is currently undertaking a regional housing needs assessment that will communicate a broad range of quantifiable data regarding affordability, population (current and projected), real estate, homelessness and insecure housing, household incomes, dwelling unit types and condition. The findings from this report will be included in subsequent OCP materials.

Image - Comox Valley Art Gallery with Puntledge-designed Welcome Poles.


DUNCAN AVENUE
MORE

Part 3.

COURTENAY TOMORROW

With an understanding of where we have come and where we stand today, trends that will shape the future begin to emerge. These emergent themes begin to set the stage for the planning work ahead.

> "Transitioning a community to clean, low-carbon energy sources requires minimizing energy use and shifting from decades-entrenched fossil fuel-based energy use to renewable energy sources."

3.1 BUSINESS AS USUAL

The following section provides an overview of community energy and emissions in Courtenay for both the baseline 2016 year, and a forecast to the year 2051 under existing business-as-usual conditions. The report concludes with a summary of emissions reduction focus areas that will support the development of community-level policies and actions as part of this OCP process.

City of Courtenay

Community Energy and Emissions Baseline and Business as Usual Report

January 2020

Contents

SUSTAINABILITY SOLUTIONS GROUP

Introduction

This report documents Courtenay's energy use and emissions production for a 2016 baseline year and estimates energy use and emissions production to the year 2050 under a Business as Usual (BAP) scenario. The BAP assumes no additional policies, actions or strategies are implemented by 2050 beyond those that are currently underway. Two steps were taken to develop and quantify the BAP:

- **Data collection:** Energy, emissions, and land-use data was collected from various City and third-party sources. Assumptions were identified to supplement any gaps in observed data. A data, methods and assumptions manual ensures transparency of data and assumptions used.
- **Model calibration:** The model is custom built for the Courtenay context and includes data for population, population assignment to dwellings, jobs assignment to buildings, a surface model of buildings, transportation, waste, industry, and land-use. An energy and emissions inventory baseline year is established (2016) and at each modelling stage the model is calibrated against observed data to ensure accuracy.

Population and demographic information are presented in 5-year increments from 2016 to 2051 for consistency with census years. For ease of reporting, energy and emissions data for 2050 and 2051 are often considered equal in this report.

About Modelling

Modelling for the 2016 baseline year and 2050 BAP scenario was completed using CityInSight, an open source, comprehensive energy, emissions and finance model developed by Sustainability Solutions Group (SSG) and whatIf? Technologies Inc. CityInSight uses the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC Protocol) framework—an international standard for greenhouse gas emissions accounting. The GPC organizes emissions sources by three scopes (Figure A). Scopes considered in Courtenay's emissions inventory and modelling include all of Scopes 1 and 2, as well as some of Scope 3 (emissions resultant from energy generation outside the city boundary).

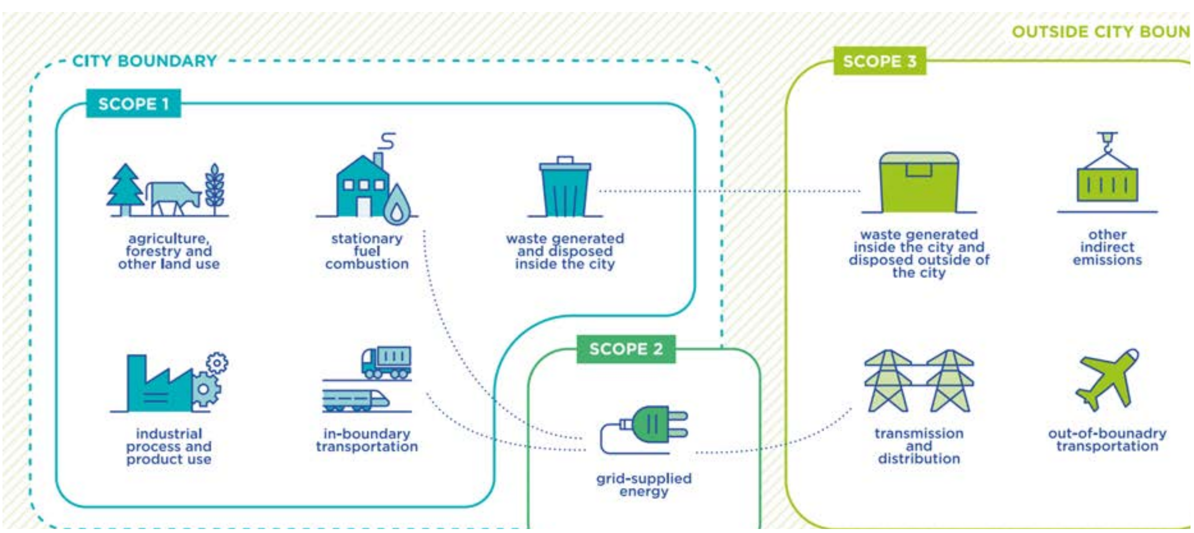


Figure A: GPC emissions scopes as they relate to geographic and inventory boundaries.[1]

[1] Image source: Consumption-Based Inventories of C40 Cities. https://www.c40.org/researches/consumption-based-emissions

BAP scenario modelling accounts for population and demographics trends and estimates, and uses energy and emissions related information from local, provincial, and federal governments to inform modelling assumptions about buildings, transportation, energy use, and solid and liquid waste. Table A lists the central assumptions. More assumptions can be found in the Data Methods and Assumptions Manual Appendix of this report.

Table A: Central BAP assumptions.

	2016				2051				Units
Population*	31,699				40,876				people
Employment	12,255				12,641				jobs
Households	11,510				13,700				homes
Average building energy efficiency	New construction is 10% more efficient every 5 years beginning 2021								%/year
Solid waste (annual)	22,968				28,000				tonnes
Wastewater (central & septic, annual)	8,077,000				9,717,000				m3
Annual personal vehicle kilometres travelled (VKT)	105,264,000				97,851,600				km/year
Transportation mode split	v	t	w	b	v	t	w	b	% v = vehicle t = transit w = walking b = bicycling
Internal trips	85	4	7	4	85	4	7	4	
External outbound trips	100	-	-	-	100	-	-	-	
External inbound trips	100	-	-	-	100	-	-	-	
Electric vehicle uptake rate	30% of new sales by 2030, 80% by 2050								%/year
Fuels GHG intensity**	CO_2	CH_4	N_2O						
Grid electricity	10.67	0.000403	0.0000175						gCO2e/kWh
Gasoline	2316	0.32	0.66						G/L
Natural gas	49								kgCO2e/GJ
Diesel	2690	0.07	0.21						G/L
Fuel oil – residential	2560	0.03	0.01						G/L
Wood – residential	299.8	0.72	0.007						kg/GJ
Wood – industrial	466.8	0.0052	0.0036						kg/GJ

* 2016 census population data is 25,599 people. The population used in modelling is adjusted to include all energy using and emissions producing people in Courtenay, which includes transitional populations – namely students. Climate change migration is not accounted for in the 2050 population estimate, although it is anticipated that migration may increase dramatically as climate change effects impact vulnerable regions across the globe, as we are already beginning to witness in certain regions. As a safer climate change region, Courtenay's 2050 population may increase more than currently anticipated due to this migration.

** Governmental greenhouse gas inventories typically track carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) and emissions—the three main types of greenhouse gases over which governments have most influence. Gases are measured in tonnes released into the atmosphere and are converted into tonnes of carbon dioxide equivalents (tCO2e). This conversion allows comparison of each gas' greenhouse effect (global warming potential, GWP) relative to one unit of CO2. It is calculated by multiplying the greenhouse gas' emissions by its 20 or 100-year global warming potential (Table B).

Table B: Global Warming Potential of the three main greenhouse gases.

Greenhouse Gas	Lifetime in Atmosphere (Years)	GWP Value	
		Over 20 Years	Over 100 Years
Carbon Dioxide (CO_2) (primary sources: fossil fuels, biomass)	30-95	1	1
Methane (CH_4) (primary sources: natural gas, coal, oil)	12.4	86	34
Nitrous Oxide (N_2O) (primary sources: industrial and agricultural activities, fossil fuels)	121	268	298

Table B shows that a tonne of methane is 86 times more effective than a tonne of carbon dioxide at trapping heat in the Earth's atmosphere over a 20-year period. A tonne of nitrous oxide is almost 300 times more effective at trapping heat than carbon dioxide over a 100-year period.

Gigajoules of Energy and Tonnes of Emissions

Energy and emissions measurements are not very meaningful for most people. Here are some helpful visualization aids.

Figure B: The volume of a tonne of greenhouse gas emissions is about equal to a two-storey high sphere.

One million gigajoules of energy (278 megawatt hours) is roughly equal to the amount of energy used by various items in Figure C.[2]

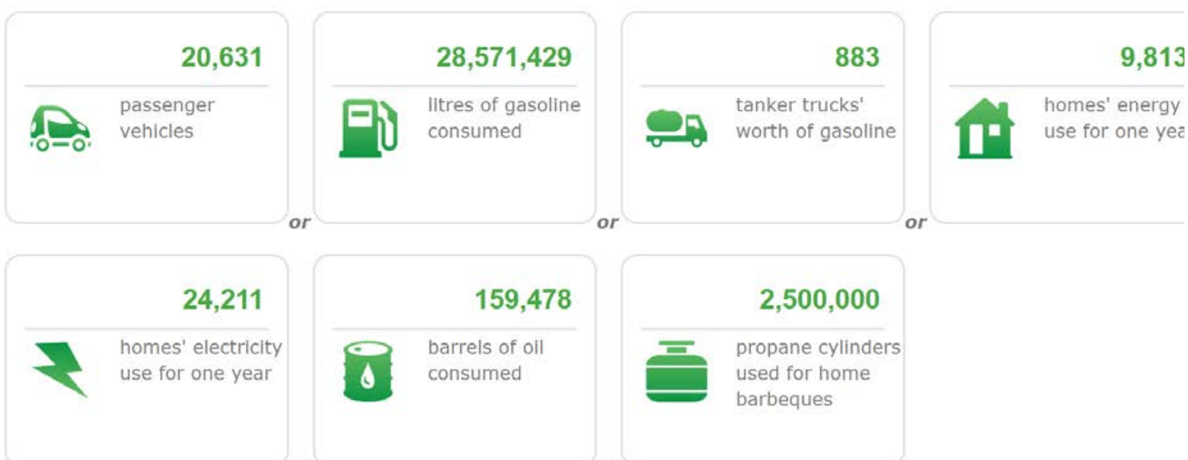


Figure C: Energy use equivalencies for one million GJ of energy.

[2] NRCan Greenhouse Gas Equivalencies Calculator: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/calculator/ghg-calculator.cfm

Courtenay's Present and Projected Energy Use

Total and Per Capita Energy Demand

Total community energy use includes all energy used by buildings, transportation, and infrastructure. Under the BAP scenario energy use is expected to decline 9% by 2050 (Figure D). Although total energy use generally scales with increased population, it is actually expected to decrease over time due to several factors, including:

- Some expected energy efficiency advances in new buildings (e.g. more effective insulation, an increase in new multi-family buildings that are more energy efficient than single family homes);
- Planned federal vehicle fuel efficiency standards;
- Increased electrification of vehicles (electricity use is more efficient than gasoline use); and
- Reduced building heating demand due to an expected decrease in heating degree days in the region (as the annual average temperature increases, resulting in warmer winters).

As these efficiencies and energy use reductions take hold, per capita energy use decreases over time as well.

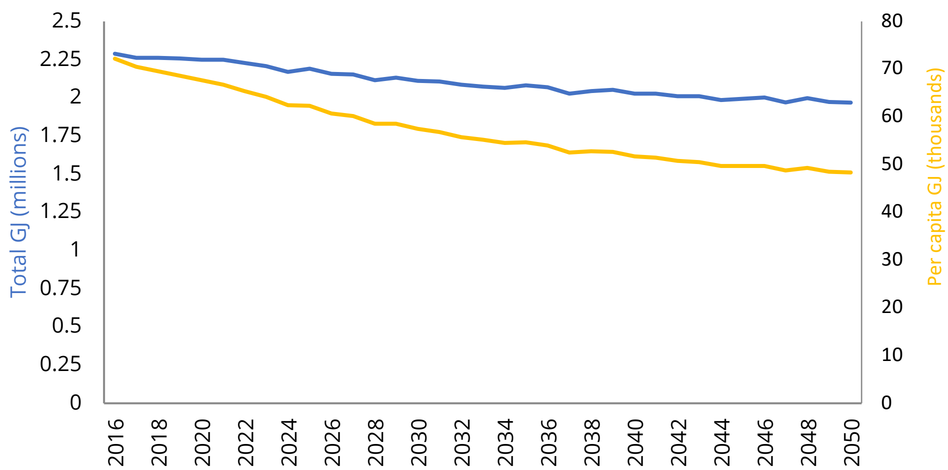


Figure D: Forecasted total community emissions, 2016-2050.

Where Energy Comes From

Gasoline (personal vehicles) and diesel (commercial vehicles), natural gas (space and water heating), wood (space heating), and electricity provide most of Courtenay's energy (Figure E). Gasoline use declines by 2050 as vehicles become more fuel efficient and electrify. Natural gas is also projected to decrease slightly as heating demand decreases. Gasoline, natural gas, and electricity remain areas of focus for efficiency and shifting to clean electricity sources in 2050.

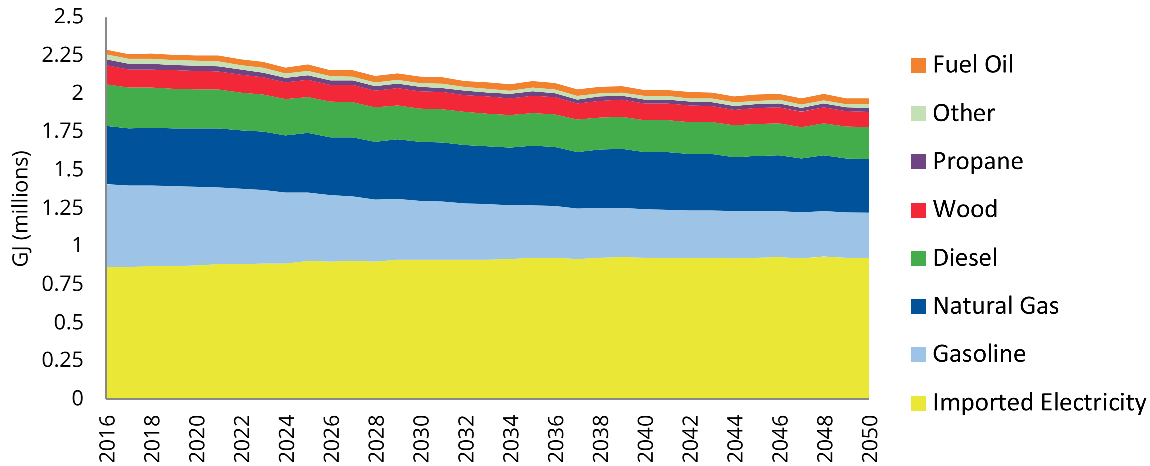


Figure E: Forecasted community energy use by energy source, 2016-2050.

Where Energy is Used

Now and in 2050, the majority of Courtenay's energy is used in the transportation and residential sectors (Figure F). While the transportation sector is expected to see a 37% decline in energy use over the time period, residential sector energy use increases by 6% as new homes are added. Energy use in the commercial and industrial sectors is expected to decline slightly by 2050. There is potential for energy efficiency improvements in all sectors; the largest opportunity being with residential buildings.

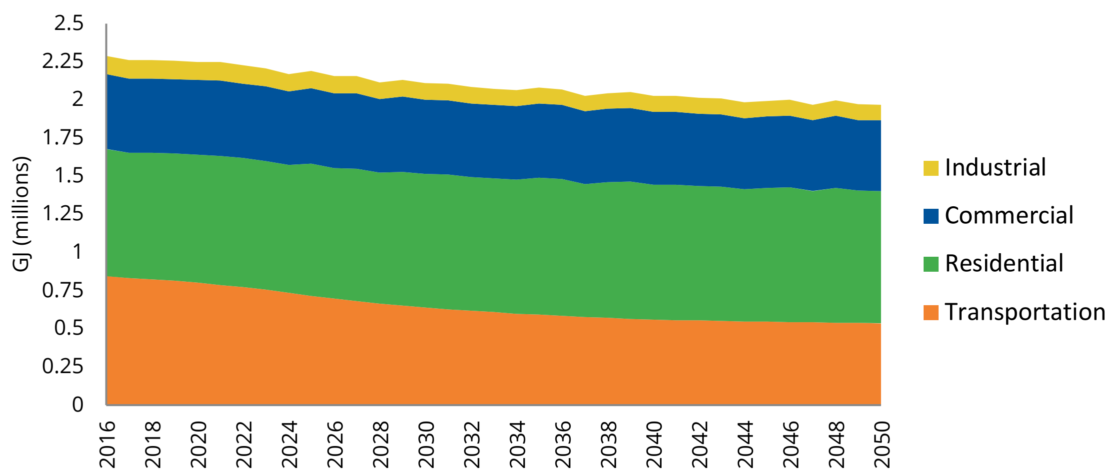


Figure F: Forecasted community energy use by sector, 2016-2050.

How Energy is Used

Figure G shows energy use by end use. Transportation and space heating account for the majority of energy use in 2016 through 2050. Space heating demands decrease by 19% over the time period. Population increases drive increased energy use in water heating, major appliances, and plug loads. Transportation energy consumption decreases over the time period due to improved fuel efficiency standards in vehicles and uptake of electric vehicles (which contributes to increased electricity consumption).

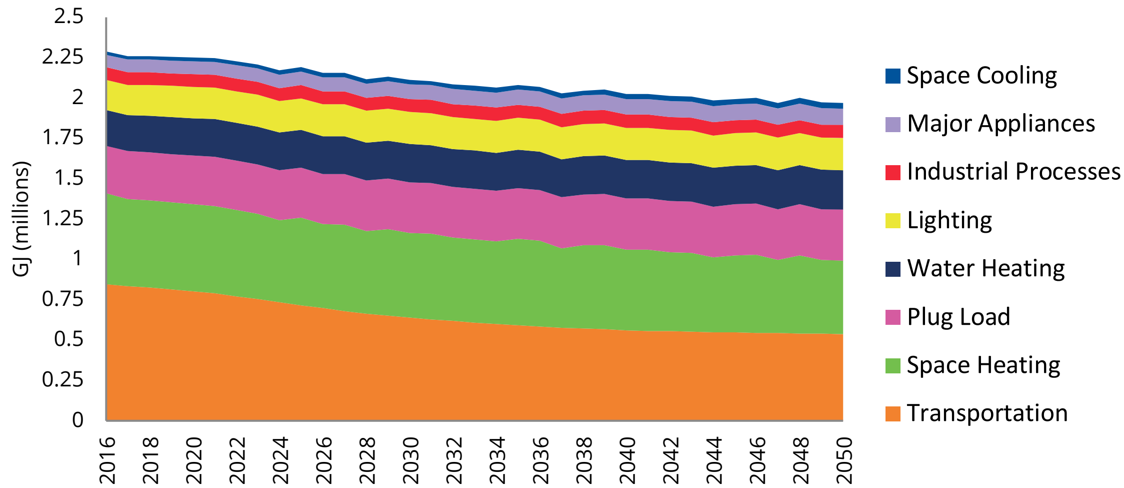


Figure G: Forecasted community energy use by sector, 2016-2050.

Energy Flows

The Sankey diagrams below depict the information in Figures E and F as energy flows across the entire city in 2016 and 2050 (BAP), from its source (left) to its end use sector (middle). Sums of total energy used and lost are on the right. The height of each bar indicates how much energy is supplied, used, or lost. The diagram demonstrates that burning gasoline and diesel in vehicles is not very efficient – much of the transportation fuel energy is wasted. Natural gas use in buildings is more efficient, although a substantial portion of it is also lost. Achieving greater energy efficiency would see the ratio of useful energy to energy conversion loss decrease.

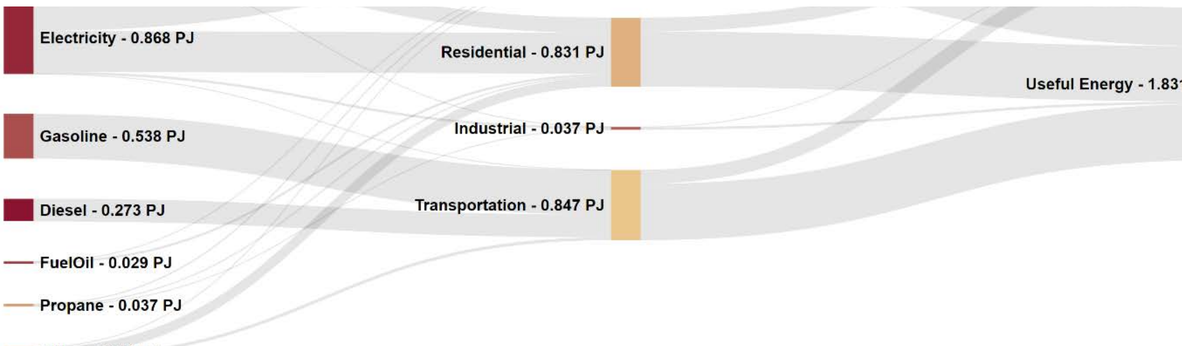


Figure H: Sankey diagram of energy sources, uses, and use/losses, 2016.

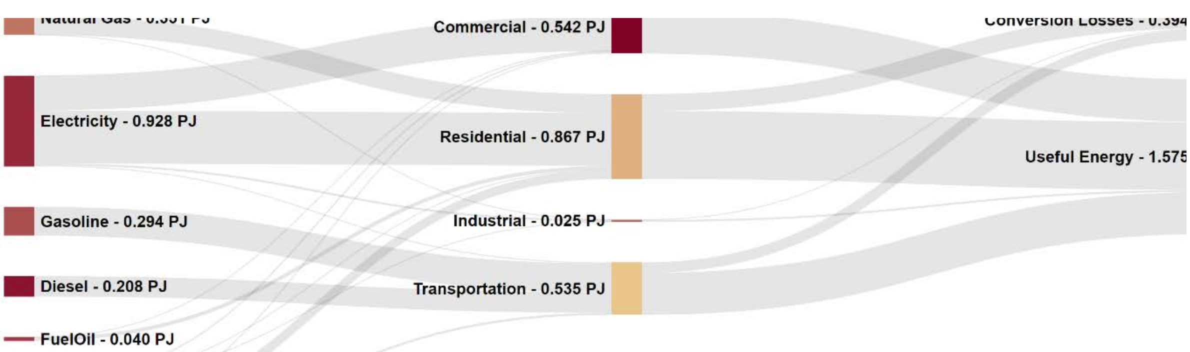


Figure I: BAP Sankey diagram of energy sources, uses, and use/losses, 2050.

Present and Projected Total GHG Emissions

Total GHG Emissions

Courtenay's total community emissions in 2016 was 93,200 tonnes of carbon dioxide equivalent (tCO2e). The emissions resulted from energy use in buildings, transportation, and infrastructure, as well as solid waste and wastewater decomposition. In the BAP scenario, total projected emissions decrease by 22% to 72,400 tCO2e by 2050 (Figure J). This is consistent with the forecasted reduction in energy use, with savings in natural gas and gasoline being the primary drivers of emissions reductions in the BAP scenario. Per capita emissions are expected to decrease 40% from 2.9 tCO2e per person to 1.8 tCO2e over the time period. This is due to decreased energy use, increased energy efficiency, and a greater population.

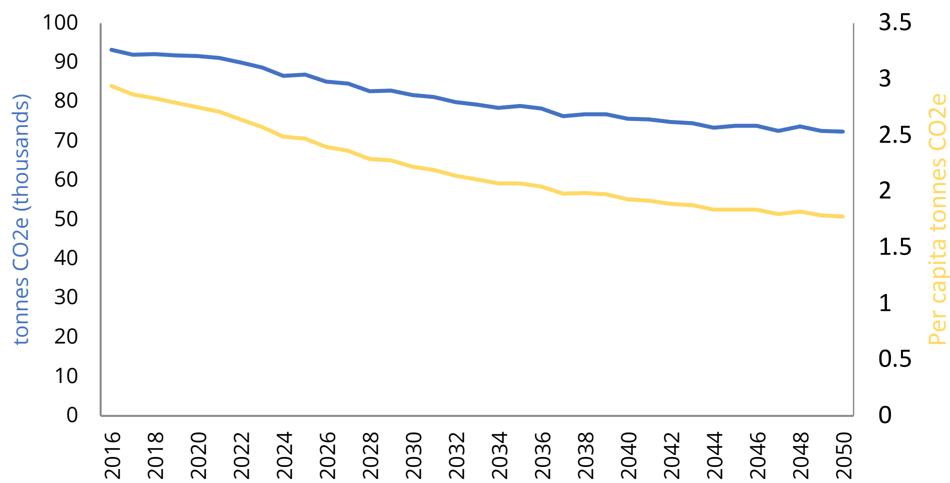


Figure J: Forecasted total and per capita community emissions, 2016-2050.

Emissions from Energy Sources

In 2016, the highest emitting energy source was gasoline, with 39% of total emissions (Figure K). Diesel use was responsible for 21% of emissions while natural gas use was responsible for 20%. Firewood constituted 3% of emissions while waste produced 2.5%. By 2050, gasoline and diesel emissions are forecasted to decrease by 45% and 24%, respectively, due to improved fuel emissions standards, increased vehicle fuel efficiency, and EV uptake. Natural gas emissions decrease slightly by 8%. Waste emissions scale with the expected additional population, increasing by 22%. Electricity emissions increase slightly by 7% with increased electricity demand.

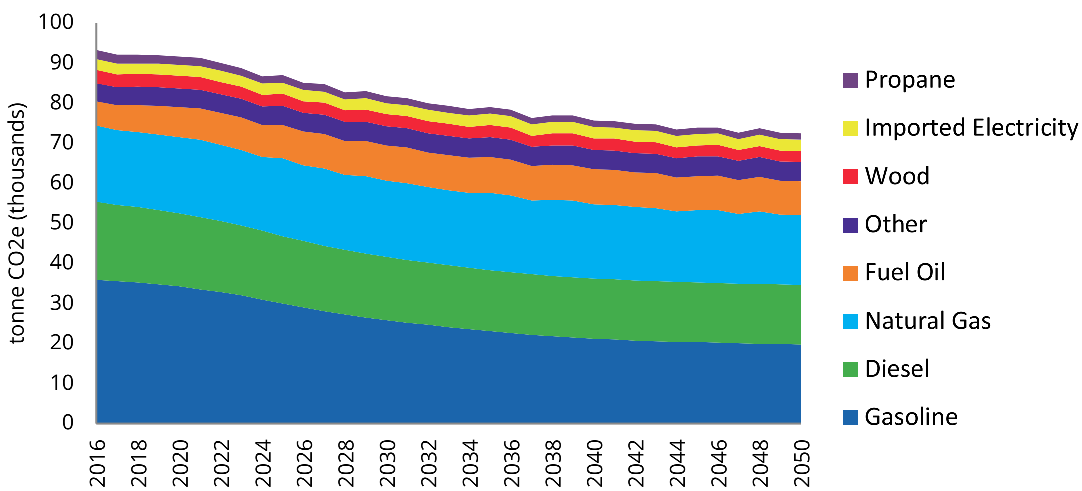


Figure K: Forecasted GHG emissions by energy source, 2016-2050.

Where Emissions are Produced

As the largest users of fossil fuels, it is no surprise that transportation and residences are responsible for the majority of Courtenay's emissions, with 59% and 22% of total 2016 GHG emissions, respectively (Figure L). Emissions decreases are forecasted in these sectors by 2050 as fossil fuel use decreases.

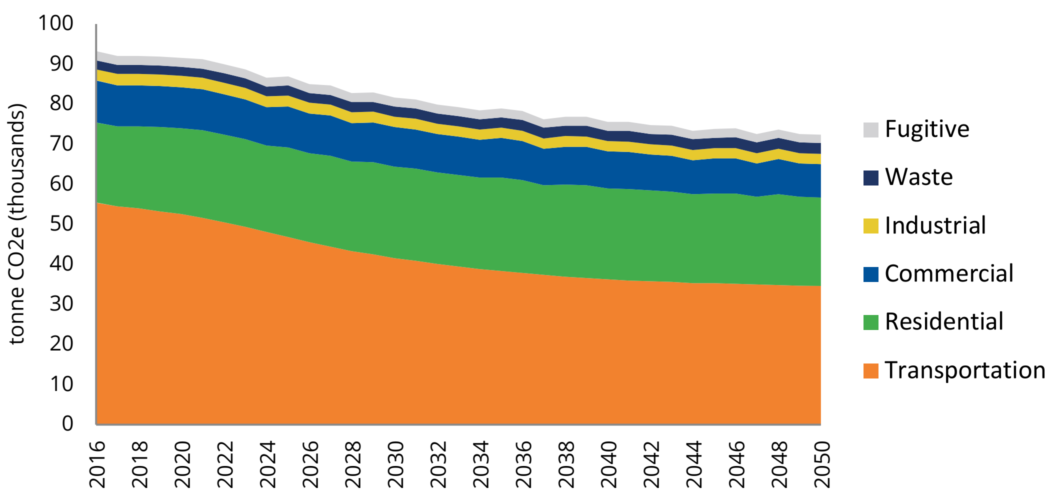


Figure L: Forecasted GHG emissions by sector use, 2016-2050. Fugitive emissions are those attributable to losses in energy transmission (e.g. natural gas escape).

Transportation Fuel Emissions

Courtenay's light trucks (pickup trucks, vans, and SUVs), heavy trucks (commercial vehicles, including pass-through traffic), and cars are responsible for about one-third of transportation emissions each in 2016 (Figure M). This changes by 2050 with an expected increase in light truck ownership (Canada-wide). Although EVs and fuel emissions standards reduce transportation emissions substantially by 2050 (mostly in cars), expected increases in car ownership (light trucks especially) and number of trips result in the levelling off and slight increase in emissions after 2035. Heavy truck emissions and diesel use (Figure N) are high in Courtenay, probably resulting from its geographic positioning as a regional and island-wide hub with substantial pass-through freight traffic.

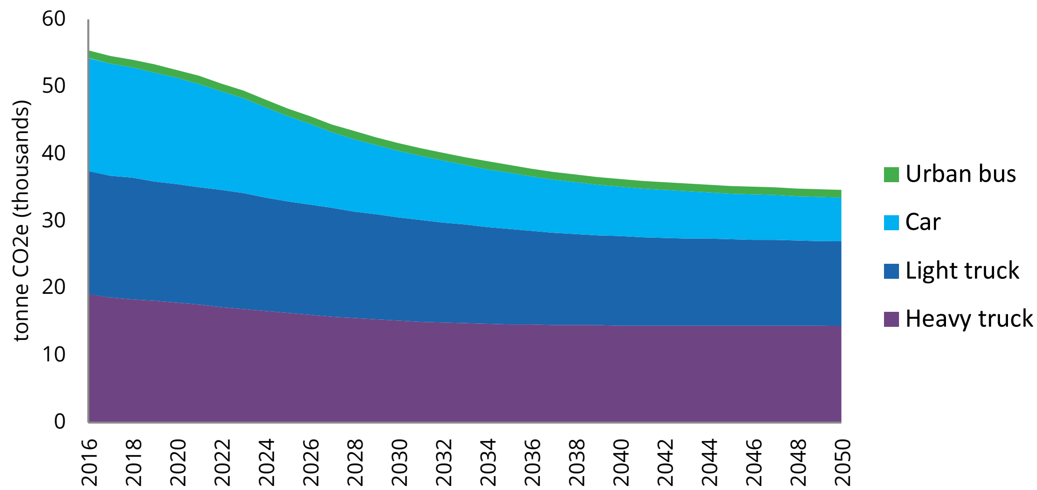


Figure M: Forecasted transportation sector emissions by vehicle type, 2016-2050.

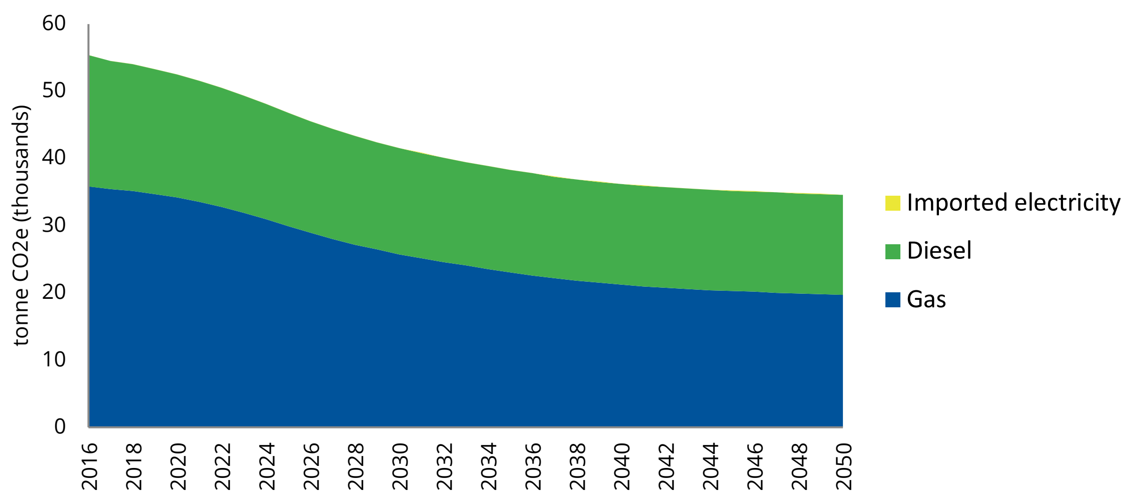


Figure N: Forecasted emissions by transportation fuel use, 2016-2050.

Buildings Emissions Sources

Space and water heating (largely with natural gas) account for 86% of buildings emissions in 2016. Space heating emissions are expected to decline 18% as fewer heating degree days reduce heating demand by 2050. Conversely, space cooling related emissions are expected to increase 55% as cooling degree days rise. Water heating emissions are expected to increase 28% as the population increases. Lighting, appliance, and plug load demands all increase with population as well, with their associated emissions following suit. Although the building components responsible for emissions shift in scale over the next 30 years, total emissions from buildings remains nearly constant between 2016 and 2050.

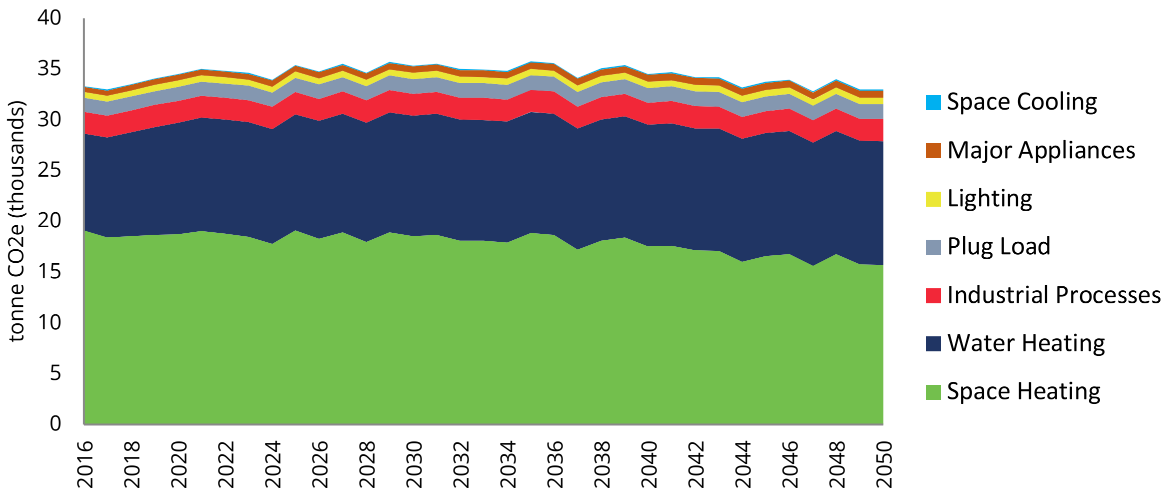


Figure O: Forecasted building sector emissions by end use, 2016-2050.

Solid Waste and Wastewater Emissions

Courtenay produced almost 23,000 tonnes of solid waste in 2016. About 10,000 tonnes were recycled while another 10,000 tonnes ended up in landfills. The remainder was biologically treated. Solid waste is expected to increase almost 22% by 2050, in step with population growth.

Courtenay currently recovers and flares all landfill emissions, thus eliminating solid waste emissions. The recycling of solid waste is assumed to result in zero waste emissions. Emissions associated with the energy used at recycling facilities is accounted for in the buildings energy use sector. Similarly, emissions associated with the transportation of waste are accounted for under the transportation sector. Landfill emissions include those from open and closed landfills.

Over 8 million m3 of wastewater was produced in 2016, the vast majority of which was treated by central treatment facilities. Less than 1% was treated by septic fields. Courtenay's centralized wastewater treatment provides opportunities to improve treatment practices to reduce emissions. Wastewater production is expected to increase in step with population, rising 20% by 2050.

Current Energy and Emissions Outlook

Compared to most Canadian cities, Courtenay's total community emissions are low and at 2.9 tCO2e/year, Courtenay is well below the national average per capita emissions of 19.5 tCO2e/year.[3] Even so, there are pollution reduction, economic justifications, and health benefits to pursuing energy efficiency and emissions reductions actions in the community.

Some efficiency and emissions reductions are already on a good trajectory. Mostly thanks to current federal transportation direction on vehicle fuel efficiency, fuel emissions factors, EV incentives, and decreasing heating degree days, Courtenay's energy and emissions future is expected to improve over today's conditions. Total energy use and emissions are expected to decrease over the next 30 years.

Courtenay's climate emergency declaration and net-zero emissions target translate to an annual reduction of 93,400 tCO2e from today's emissions levels – a 72,400 tCO2e annual decrease in the year 2050. As emissions from the electricity grid are already very low, the emissions reductions actions will have to focus on the transportation and thermal energy sectors.

Transitioning a community to clean, low-carbon energy sources requires minimizing energy use and shifting from decades-entrenched fossil fuel-based energy use to renewable energy sources. Shifting from fossil fuel power to electricity—electrification—provides flexibility in how power is generated, delivered, and used. There are 7 areas of focus for Courtenay's energy efficiency and emissions reduction efforts:

1. **Compact, complete communities.** Historical neighbourhood and city design and development has led to relatively high energy use and high transportation emissions lifestyles. Energy efficient land-use approaches achieve great emissions reductions along with a variety of socio-economic co-benefits.
2. **Efficient buildings.** This area involves making deep energy efficiency retrofits to all buildings in the community and ensuring that new buildings are built to superior energy standards.
3. **Water, Wastewater, and Solid Waste.** Education, awareness and incentive programs coupled with upgrades to the water distribution, wastewater treatment, and solid waste diversion systems aim to achieve energy efficiencies and emissions reductions in these sectors.
4. **Low-carbon transportation.** This area focuses on vehicle electrification, increasing and improving public transit services, and making more trips by walking, cycling and other means of active transportation.
5. **Local clean energy generation.** Energy for buildings and vehicles can be produced locally. Solar photovoltaic systems are a central approach to achieve this, renewable natural gas from waste is another. This area includes actions to divert waste from landfills, generate energy from landfill gas, and minimize fugitive emissions.
6. **Low-carbon energy procurement.** It is challenging to provide all Courtenay's energy needs locally. The energy demand that remains after energy efficiencies are maximized may not be met by local generation alone. Procuring low-carbon energy from outside the city's boundaries bridges the renewable energy and emissions reduction gap.
7. **Carbon sequestration.** Afforestation efforts can provide trees to sequester enough carbon to bridge any remaining emissions gap.

[3] Government of Canada Ministry of Environment and Climate Change: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/sources-sinks-executive-summary-2019.html

3.2 NEIGHBOURHOOD BOUNDARIES

Neighbourhoods are essential elements of any successful city.

This OCP process is an opportunity to explore how the establishment of neighbourhood boundaries in Courtenay could help strengthen communities and support broader OCP goals.

Rooted in both data analysis and lived experience, this process will seek to adopt a layered approach that considers multiple scales and the unique characteristics specific to each area of the city. The development of neighbourhood boundaries will necessarily involve the input of community members and will evolve through an iterative process. The establishment of neighbourhoods will further help track progress throughout the implementation and monitoring of the OCP.

3.3 EMERGING THEMES

A tremendous amount of information is contained in this document. The following is a preliminary list of emerging themes or "takeaways" from the overall analysis. They are not intended to be comprehensive, but rather to begin a conversation with the community about values, aspirations, challenges, and opportunities that the OCP process must embrace:

THE CLIMATE EMERGENCY HAS ARRIVED IN COURTENAY

Along with the rest of the world, Courtenay is facing a climate emergency. With a projected increase of 1.5 degrees Celcius in the Comox Valley by 2050, Courtenay can expect to experience higher flood frequency, salination of agricultural soils due to sea level rise, more summer droughts due to decreased snowpack, increased wildfire risks, and more. Adapting to these changes – and mitigating greenhouse gas emissions – will soon be a part of the way of life in Courtenay.

TRANSPORTATION IN THE LARGEST CHALLENGE AND THE GREATEST OPPORTUNITY

The largest contributor to local GHG emissions in Courtenay is from transportation. Courtenay is car dependent, with 85% of all trips taken by private vehicle. This number is high relative to both British Columbia as a whole, and other similar sized communities in the province. While car dependency is a major challenge that must be overcome, shifting to active modes and transit offers opportunities for not only GHG emission reductions, but also for community well-being and vibrant public life.

LAND USE POLICY IS CLIMATE POLICY

While transportation may be the challenge, land use is the solution. The most important drivers of transportation behavior are land use and urban form, both of which are within the jurisdiction and influence of local governments like the City of Courtenay. Specifically, there is much room to increase Courtenay's land use mix, population and employment densities, and physical connectedness to thresholds that support walking, cycling, and transit use.

GROWTH HAS BECOME LESS EFFICIENT OVER TIME

Related to land use is growth management. Since the City of Courtenay was incorporated in 1915, physical growth has steadily become less efficient over time. While central areas are more compact in nature, newer areas – including low-density single detached neighbourhoods and large format commercial areas – have expanded at the City's periphery in recent decades. There is a general trend from "urban" to "suburban", which influences everything from transportation patterns to infrastructure costs.

DOWNTOWN IS A STRENGTH AND A PRECEDENT

Downtown is a successful anchor and heart in Courtenay. It is walkable and distinct, and fosters public life and a unique sense of place and identity. While there can only ever be "one downtown", its design and program demonstrate that urbanism works in Courtenay.

THE CITY HAS ACCESS AND CHOICE BUT NOT IN EVERY NEIGHBOURHOOD

Courtenay is rich with cultural, recreational, commercial, educational, and employment destinations, and different housing types are available across the city. This richness of access exists at a city level, however it is currently not extended to all neighbourhoods, particularly in newer areas. In other words, the city is "complete" but its neighbourhoods are not. There is opportunity to extend access and choice – for housing and transportation modes – so that it reaches all areas of the city.

LOCAL ECOLOGY OFFERS BOTH UNIQUE CHARACTER AND THE VITAL SERVICES OF NATURE

While all cities form a part of broader bioregions, it is rare for local ecologies to shape the character of a community to the extent they do in Courtenay. Whether it's the role of the river in shaping settlement history, or the stunning views, or the location of the city at one of the province's most important estuaries, the ecological systems of which Courtenay is a part are highly visible and character-defining. Along with City parks, these areas provide residents exceptional access to green and blue spaces – which have intrinsic and recreational value – while at the same time providing habitat to other beings and free services of nature such as flood relief. Courtenay's green spaces and ecological areas comprise a truly special and vital asset, and will play an important role in helping the city adapt to a changing climate.

Part 4.

APPENDIX

4.1 COMMUNITY ENERGY AND EMISSIONS DATA METHODS AND ASSUMPTIONS MANUAL

City of Courtenay

Community Energy and Emissions Data Methods and Assumptions Manual

January 2020

Contents

SUSTAINABILITY SOLUTIONS GROUP

Summary

This Data, Methods and Assumptions (DMA) manual details the modelling approach used to provide community energy and emissions benchmarks and projections and provides a summary of the data and assumptions used in scenario modelling. The DMA makes the modelling elements fully transparent and illustrates the scope of data required for future modelling efforts.

Accounting and Reporting Principles

The municipal greenhouse gas (GHG) inventory baseline development and scenario modelling approach correlate with the Global Protocol for Community-Scale GHG Emissions Inventories (GPC). The GPC provides a fair and true account of emissions via its principles:

Relevance: The reported GHG emissions shall appropriately reflect emissions occurring as a result of activities and consumption within the Town boundary. The inventory will also serve the decision-making needs of the Town, taking into consideration relevant local, subnational, and national regulations. Relevance applies when selecting data sources and determining and prioritizing data collection improvements.

Completeness: All emissions sources within the inventory boundary shall be accounted for. Any exclusions of sources shall be justified and explained.

Consistency: Emissions calculations shall be consistent in approach, boundary, and methodology.

Transparency: Activity data, emissions sources, emissions factors and accounting methodologies require adequate documentation and disclosure to enable verification.

Accuracy: The calculation of GHG emissions should not systematically overstate or understate actual GHG emissions. Accuracy should be enough to give decision makers and the public reasonable assurance of the integrity of the reported information. Uncertainties in the quantification process should be reduced to the extent possible and practical.

Scope

Geographic Boundary

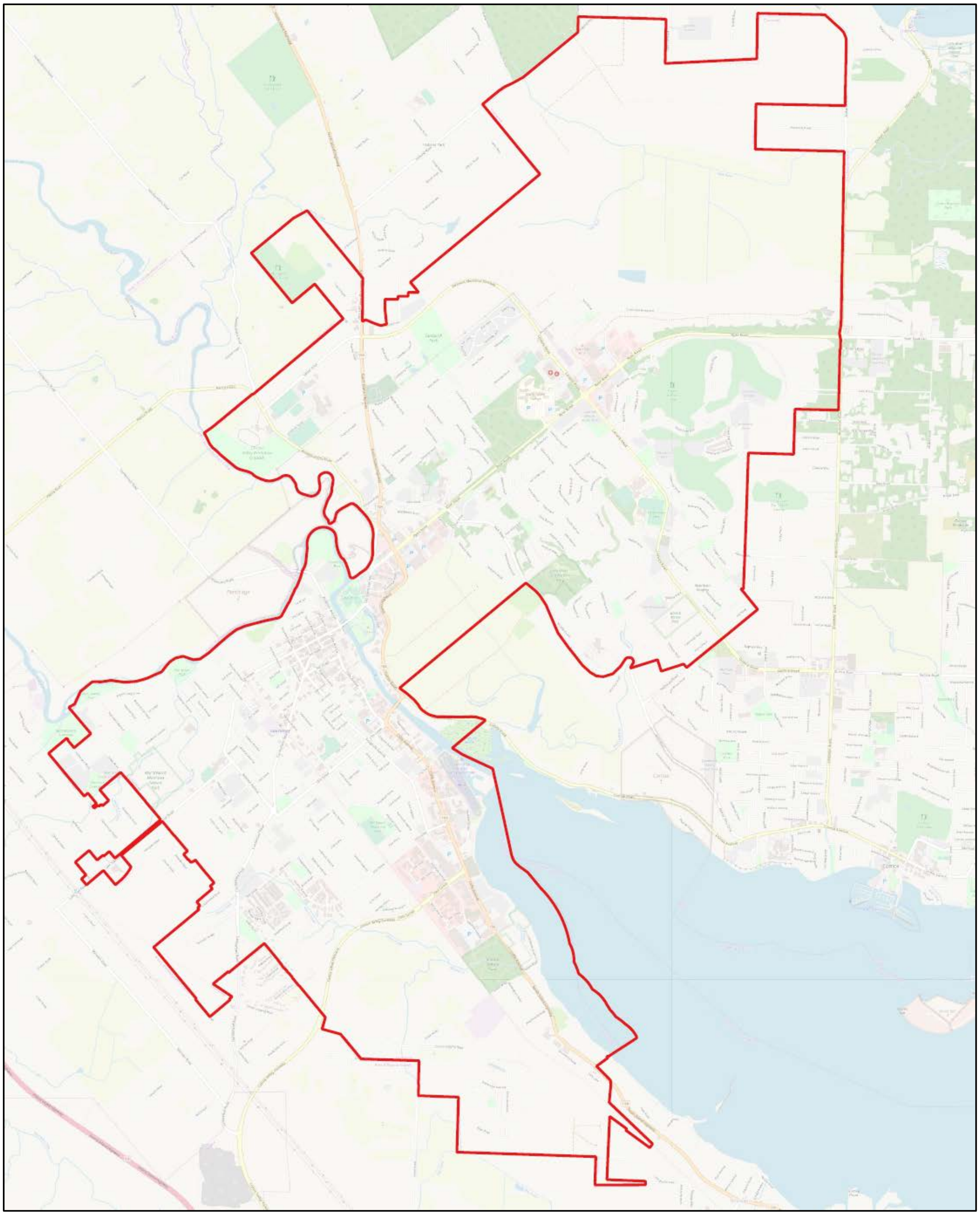


Figure 1: Geographical boundary considered for the project.

Time Frame of Assessment

The modelling time frame will be from 2016-2050, with 2016 as a baseline year. The census of 2016 is a key data source used to establish the baseline year. Model calibration for the baseline year uses as much locally observed data as possible.

Energy and Emissions Structure

The total energy for a community is defined as the sum of the energy from each of the aspects:

$$Energy_{city} = Energy_{transport} + Energy_{buildings} + Energy_{waste\&wastewatergen}$$

Where:

$Energy_{transport}$ is the movement of goods and people.
$Energy_{buildings}$ is the generation of heating, cooling and electricity.
$Energy_{wastegen}$ is energy generated from waste.

The total GHG for a community is defined as the sum of the GHG from each of the aspects:

$$GHG_{landuse} = GHG_{transport} + GHG_{energygen} + GHG_{waste\&wastewater} + GHG_{agriculture} + GHG_{forest} + GHG_{landconvert}$$

Where:

$GHG_{transport}$ is emissions generated by the movement of goods and people.
$GHG_{energygen}$ is emissions generated by the generation of heat and electricity.
$GHG_{waste\&wastewater}$ is emissions generated by solid and liquid waste produced.
$GHG_{agriculture}$ is emissions generated by food production.
GHG_{forest} is emissions generated by forested land.
$GHG_{landconvert}$ is emissions generated by the lands converted from natural to modified conditions.

Emissions Scope

The inventory will include emissions Scopes 1 and 2, and some aspects of Scope 3. Refer to Appendix 1 for a list of included GHG emission sources by scope.

Table 1. GPC scope definitions.

Scope	Definition
1	All GHG emissions from sources located within the municipal boundary.
2	All GHG emissions occurring from the use of grid-supplied electricity, heat, steam and/or cooling within the municipal boundary.
3	All other GHG emissions that occur outside the municipal boundary as a result of activities taking place within the boundary.

The Model

CityInSight is an energy, emissions, and finance model developed by Sustainability Solutions Group and whatIf? Technologies. The model integrates fuels, sectors, and land-uses and is partially disaggregated. It enables bottom-up accounting for energy supply and demand, including renewable resources, conventional fuels, energy consuming technology stocks (e.g. vehicles, appliances, dwellings, buildings), and all intermediate energy flows (e.g. electricity and heat). Energy and GHG emissions values are derived from a series of connected stock and flow models, evolving based on current and future geographic and technology decisions/assumptions (e.g. EV uptake rates). The model accounts for physical flows (e.g. energy use, new vehicles by technology, VKT) as determined by stocks (buildings, vehicles, heating equipment, etc.).

CityInSight incorporates and adapts concepts from the system dynamics approach to complex systems analysis. For any given year, CityInSight traces the flows and transformations of energy from sources through energy currencies (e.g. gasoline, electricity, hydrogen) to end uses (e.g. personal vehicle use, space heating) to energy costs and to GHG emissions. An energy balance is achieved by accounting for efficiencies, conservation rates, and trade and losses at each stage in the journey from source to end use.

Table 2. CityInSight characteristics.

Characteristic	Rationale
Integrated	CityInSight models and accounts for all city-scale energy and emissions related sectors and captures relationships between sectors. The demand for energy services is modelled independently of the fuels and technologies that provide the energy services. This decoupling enables exploration of fuel switching scenarios. Physically feasible scenarios are established when energy demand and supply are balanced.
Scenario-based	Once calibrated with historical data, CityInSight enables the creation of dozens of scenarios to explore different possible futures. Each scenario can consist of either one or a combination of policies, actions and strategies. Historical calibration ensures that scenario projections are rooted in observed data.
Spatial	Built environment configuration determines walkability and cyclability, accessibility to transit, feasibility of district energy, and other aspects. CityInSight therefore includes spatial dimensions that can include as many zones (the smallest areas of geographic analysis) as deemed appropriate. The spatial components can be integrated with GIS systems, land-use projections, and transportation modelling.
GHG reporting framework	CityInSight is designed to report emissions according to the GHG Protocol for Cities (GPC) framework and principles.

Economic impacts	CityInSight incorporates a high-level financial analysis of costs related to energy (expenditures on energy) and emissions (carbon pricing, social cost of carbon), as well as operating and capital costs for policies, strategies, and actions. This allows for the generation of marginal abatement costs.

Model Structure

The major components of the model and the first level of their modelled relationships (influences) are represented by the blue arrows in Figure 2. Additional relationships may be modelled by modifying inputs and assumptions - specified directly by users, or in an automated fashion by code or scripts running "on top of" the base model structure. Feedback relationships are also possible, such as increasing the adoption rate of non-emitting vehicles in order to meet a GHG emissions constraint.

The model is spatially explicit. All buildings, transportation, and land use data are tracked within the model through a GIS platform, and by varying degrees of spatial resolution. A zone type system is applied to divide the Town into smaller configurations, based on the Town's existing traffic zones (or another agreeable zone system). This enables consideration of the impact of land-use patterns and urban form on energy use and emissions production from a baseline year to future dates using GIS-based platforms. CityInSight's GIS outputs can be integrated with the Town's mapping systems.

For any given year various factors shape the picture of energy and emissions flows, including: the population and the energy services it requires; commercial floorspace; energy production and trade; the deployed technologies which deliver energy services (service technologies); and the deployed technologies which transform energy sources to currencies (harvesting technologies). The model makes an explicit mathematical relationship between these factors - some contextual and some part of the energy consuming or producing infrastructure - and the energy flow picture.

Some factors are modelled as stocks - counts of similar things, classified by various properties. For example, population is modelled as a stock of people classified by age and gender. Population change over time is projected by accounting for: the natural aging process, inflows (births, immigration), and outflows (deaths, emigration). The fleet of personal use vehicles, an example of a service technology, is modelled as a stock of vehicles classified by size, engine type and model year, with a similarly classified fuel consumption intensity. As with population, projecting change in the vehicle stock involves aging vehicles and accounting for major inflows (new vehicle sales) and major outflows (vehicle discards). This stock-turnover approach is applied to other service technologies (e.g. furnaces, water heaters) and harvesting technologies (e.g. electricity generating capacity).

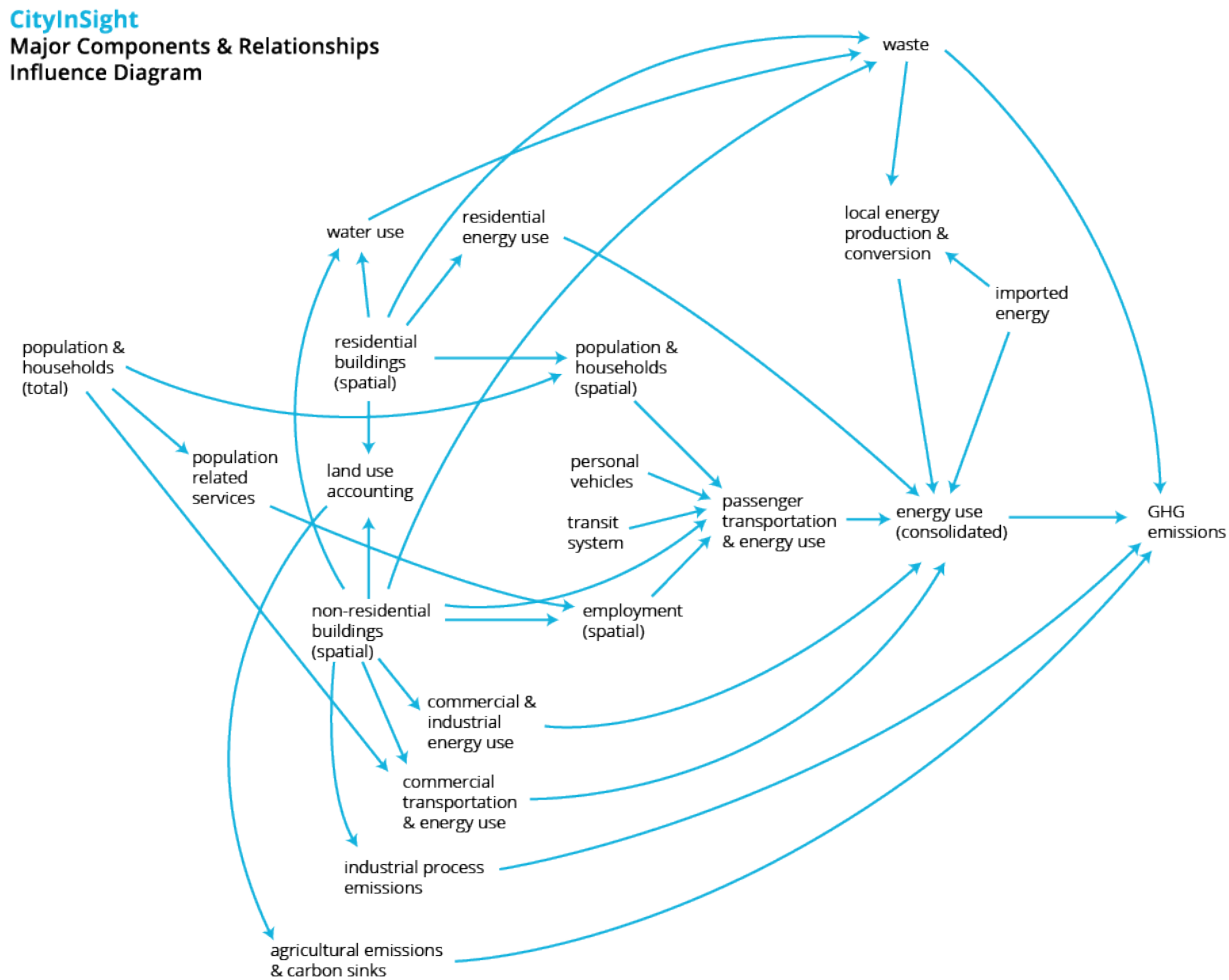


Figure 2. Representation of CityInSight's structure.

Sub-models

Population and demographics

Town-wide population is modelled using the standard population cohort-survival method, disaggregated by single year of age and gender. It accounts for various components of change: births, deaths, immigration and emigration. The age structured population is important for analysis of demographic trends, generational differences and implications for shifting energy use patterns. These numbers are calibrated against existing projections.

Residential buildings

Residential buildings are spatially located and classified using a detailed set of 30+ building archetypes capturing footprint, height and type (single, double, row, apt. high, apt. low), in addition to year of construction. This enables a “box” model of buildings and the estimation of surface area. Coupled with thermal envelope performance and degree-days the model calculates space conditioning energy demand independent of any space heating or cooling technology and fuel. Energy service demand then drives stock levels of key service technologies (heating systems, air conditioners, water heaters). These stocks are modelled with a stock-turnover approach capturing equipment age, retirements, and additions - exposing opportunities for efficiency gains and fuel switching, but also showing the rate limits to new technology adoption and the effects of lock-in (obligation to use equipment/infrastructure/fuel type due to longevity of system implemented). Residential building archetypes are also characterized by number of contained dwelling units, allowing the model to capture the energy effects of shared walls but also the urban form and transportation implications of population density.

Non-residential buildings

These are spatially located and classified by a detailed use/purpose-based set of 50+ archetypes. The floorspace of these archetypes can vary by location. Non-residential floorspace produces waste and demand for energy and water, and provides an anchor point for locating employment of various types.

Spatial population and employment

City-wide population is made spatial through allocation to dwellings, using assumptions about persons-per-unit by dwelling type. Spatial employment is projected via two separate mechanisms: population-related services and employment - which is allocated to corresponding building floorspace (e.g. teachers to school floorspace) - and floorspace-driven employment (e.g. retail employees per square metre).

Passenger Transportation

The model includes a spatially explicit passenger transportation sub-model that responds to changes in land-use, transit infrastructure, vehicle technology, travel behaviour change, and other factors. Trips are divided into four types (home-work, home-school, home-other, and non-home-based), each produced and attracted by different combinations of spatial drivers (population, employment, classrooms, non-residential floorspace). Trips are distributed - trip volumes are specified for each zone of origin and zone of destination pair. For each origin-destination pair, trips are shared over walk/bike (for trips within the walkable distance threshold), public transit (for trips whose origin and destination are serviced by transit), and automobile. A projection of total personal vehicles kilometres travelled (VKT) and a network distance matrix are produced following the mode share calculation. The energy use and emissions associated with personal vehicles is calculated by assigning VKT to a stock-turnover personal vehicle model. The induced approach is used to track emissions. All internal trips (trips within the boundary) are accounted for, as well as half of the trips that terminate or originate within the municipal boundary. Figure 3 displays trip destination matrix conceptualization.

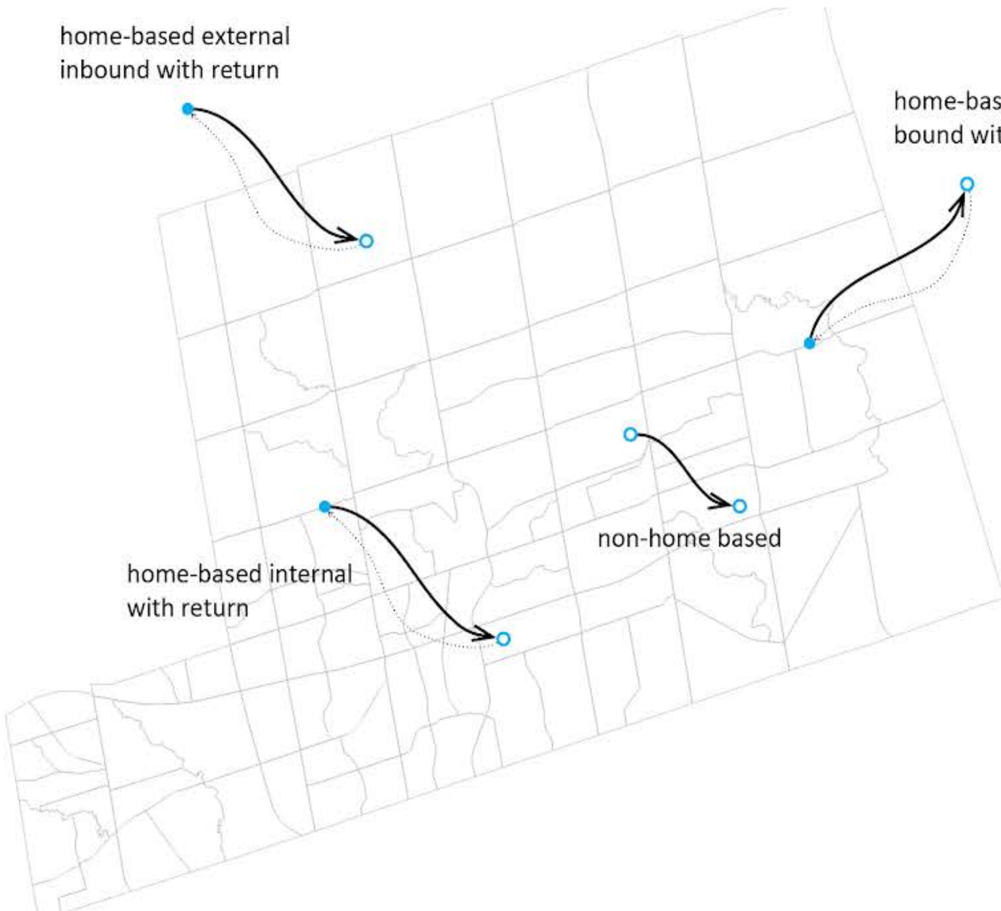


Figure 3. Conceptual diagram of trip categories.

Waste & Wastewater

Households and non-residential buildings generate solid waste and wastewater. The model traces various pathways to disposal, compost and sludge including those which capture energy from incineration and recovered gas. Emissions accounting is performed throughout the waste sub-model.

Energy flow and local energy production

Energy produced from primary sources (e.g. solar, wind) is modelled alongside energy converted from imported fuels (e.g. electricity generation, district energy, CHP). As with the transportation sub-model, the district energy supply model has an explicit spatial dimension and can represent areas served by district energy networks.

Finance and employment

Energy related financial flows and employment impacts are captured through an additional layer of model logic (not shown explicitly in Figure 2). Calculated financial flows include the capital, operating, and maintenance cost of energy consuming stocks and energy producing stocks, including fuel costs. Employment related to the construction of new buildings, retrofit activities and energy infrastructure is modelled. The financial impact on businesses and households of the strategies is assessed. Local economic multipliers are also applied to investments.

Model Calibration for Local Context

Data request & collection

Local data was supplied by the municipality. Assumptions were identified to supplement any gaps in observed data. The data and assumptions were applied in modelling per the process described below.

Zone system

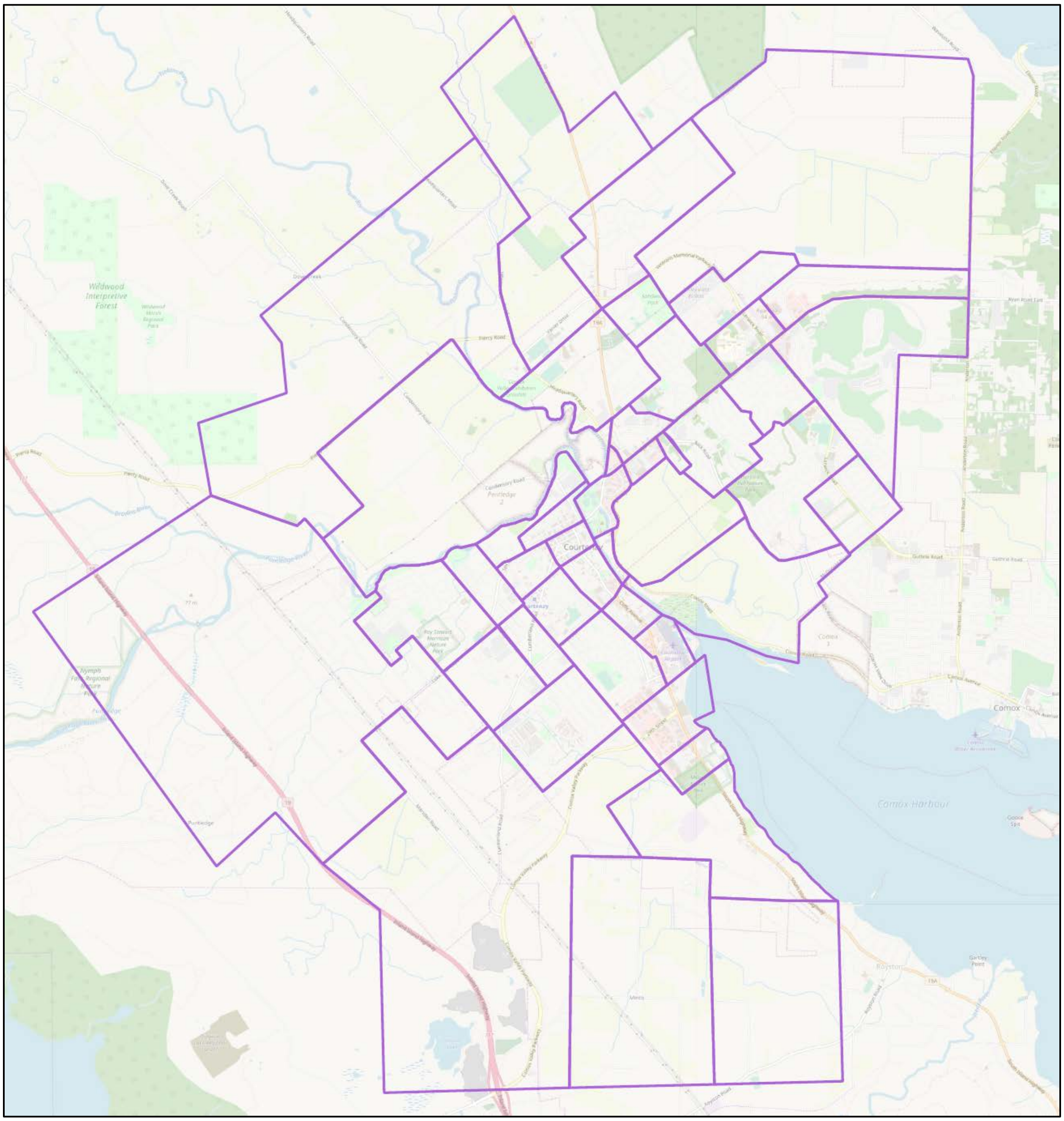


Figure 4. Zone system used in modelling.

CityInSight is spatially explicit; population, employment, residential and non-residential floorspace, are allocated and tracked spatially within the model's zone system. These elements drive stationary energy demand. The passenger transportation sub-model, which drives transportation energy demand, also operates within the same zone system.

Buildings

Buildings data, including building type, building footprint area, number of storeys, total floorspace area, number of units, and year built was sourced from provincial property assessment data. Buildings were allocated to specific zones using their spatial attributes, based on the zone system.

Buildings are classified using a detailed set of buildings archetypes (see Appendix 2). These archetypes capture footprint, height and type (e.g. single-family home, semi-attached home, etc.), enabling the creation of a "box" model of buildings, and an estimation of surface area for all buildings.

Residential buildings

The model multiplies the residential building surface area by an estimated thermal conductance (heat flow per unit surface area per degree day) and the number of degree days (heating and cooling) to derive the energy transferred out of the building during winter months and into the building during summer months. The energy transferred through the building envelope, the solar gain through the building windows, and the heat gains from equipment inside the building constitute the space conditioning load to be provided by the heat systems and the air conditioning. The initial thermal conductance estimate is a provincial average by dwelling type from the Canadian Energy System Simulator (CanESS). This initial estimate is adjusted through the calibration process as the modelled energy consumption in the residential sector is forced to track on observed residential fuel consumption in the baseline year.

Non-residential buildings

The model calculates the space conditioning load as it does for residential buildings with one distinction: the thermal conductance parameter for non-residential buildings is based on floor space area instead of surface area. CanESS provides the initial estimate of the non-residential thermal conductance by building sector.

Starting values for output energy intensities and equipment efficiencies for other residential and non-residential end uses are also provincial averages from CanESS. All parameter estimates are further adjusted during the calibration process. The calibration target for non-residential building energy use is the observed commercial and industrial fuel consumption in the baseline year.

Using assumptions for thermal envelope performance for each building type, the model calculates total energy demand for all buildings, independent of any space heating or cooling technology and fuel.

Population and employment

Federal census population and employment data was spatially allocated to residential (population) and non-residential (employment) buildings. This enables indicators to be derived from the model (such as emissions per household) and drives the BAP energy and emissions projections (buildings, transportation, waste).

Population for 2016 was spatially allocated to residential buildings using initial assumptions about persons-per-unit (PPU) by dwelling type. These initial PPUs are then adjusted so that the total population in the model (which is driven by the number of residential units by type multiplied by PPU by type) matches the total population from census/regional data.

Employment for 2016 was spatially allocated to non-residential buildings using initial assumptions for population-related services and employment, allocated to corresponding building floorspace (e.g. teachers to school floorspace); and floorspace-driven employment (e.g. retail employees per square metre). Like population, these initial ratios are adjusted within the model so that the total employment derived by the model matches total employment from census/regional data.

Transportation

The model includes a spatially explicit passenger transportation sub-model that responds to changes in land-use, transit infrastructure, vehicle technology, travel behaviour change, and other factors. Trips are divided into four types (home-work, home-school, home-other, and non-home-based), each produced and attracted by different combination of spatial drivers (population, employment, classrooms, non-residential floorspace). Trip volumes are distributed as pairs for each zone of origin and zone of destination (Figure 4). For each origin-destination pair, trips are shared over walk/bike (for trips within the walkable distance threshold), public transit (for trips whose origin and destination are serviced by transit), and automobile. Total personal VKT is produced when modelling mode shares and distances. The energy use and emissions associated with personal vehicles is calculated by assigning VKT to model of personal vehicle ownership.

The passenger transportation model was anchored with the travel demand forecasting models from the Travel Demand Forecasting: Parameters and Techniques paper, informing the spatial travel demand model and the results compared for reasonableness against indicators such as average annual VKT per vehicle. For medium-heavy duty commercial vehicle transportation, the ratio of local retail diesel fuel sales to provincial retail diesel fuel sales was used to estimate non-retail diesel use.

The modelled stock of personal vehicles (by size, fuel type, efficiency, vintage) was informed by provincial vehicle registration obtained from Statistics Canada. The total number of personal use and corporate vehicles is proportional to the projected number of households in the BAP.

The GPC induced activity approach is used to account for emissions. All internal trips (within boundary) as well as half of the trips that terminate or originate within the municipal boundary are accounted for. This approach allows the municipality to understand its transportation impacts on its peripheries and the region.

Transit VKT and fuel consumption was modelled based on data provided by BC Transit.

Waste

Solid waste stream composition and routing data (landfill, composting, recycling) was sourced from local data sources. The base carbon content in the landfill was estimated based on historical waste production data. Total methane emissions were estimated for landfills using the first order decay model, with the methane generation constant and methane correction factor set to default, as recommended by and based on values from IPCC Guidelines for landfill emissions. Data on methane removed via recovery was provided by the landfill.

Data and Assumptions

Refer to Appendices 3 and 4 for a detailed list of data sources and assumptions used for CityInSight modelling.

Scenario Development

CityInSight supports the use of scenarios as a mechanism to evaluate potential futures for communities. A scenario is an internally consistent view of what the future might turn out to be—not a forecast, but one possible future outcome. Scenarios must represent serious considerations defined by planning staff and community members. They are generated by identifying population projections into the future, identifying how many additional households are required, and then applying those additional households according to existing land-use plans and/or alternative scenarios. A simplified transportation model evaluates the impact of the new development on transportation behaviour, building types, agricultural and forest land, and other variables.

Business-As-Planned Scenario

The Business-As-Planned (BAP) scenario estimates energy use and emissions volumes from the baseline year (2016) to the target year (2050). It assumes an absence of substantially different policy measures from those currently in place.

Methodology:

1. Calibrate model and develop 2016 baseline using observed data and filling in gaps with assumptions where necessary.
2. Input existing projected quantitative data to 2050 where available:
    - Population, employment and housing projections by transport zone
    - Build out (buildings) projections by transport zone
    - Transportation modelling from the municipality
3. Where quantitative projections are not carried through to 2050, extrapolate the projected trend to 2050.
4. Where specific quantitative projections are not available, develop projections through:
    - Analyzing current on the ground action (reviewing action plans, engagement with staff, etc.), and where possible, quantifying the action.
    - Analyzing existing policy that has potential impact and, where possible, quantifying the potential impact.

Low Carbon Scenario Modelling

CityInSight projects how energy flow and emissions profiles will change in the long term by modelling potential changes in the context (e.g. population, development patterns), projecting energy services demand intensities, and projecting the composition of energy system infrastructure.

Policies, actions and strategies

Alternative behaviours of various energy system actors (e.g. households, various levels of government, industry, etc.) can be mimicked in the model by changing the values of CityInSight's user input variables. Varying their values creates "what if" type scenarios, enabling a flexible mix-and-match approach to behavioral models which connect to the physical model. CityInSight can explore a wide variety of policies, actions and strategies via these variables. The resolution of CityInSight enables the user to apply scenarios to specific neighbourhoods, technologies, building or vehicle types or eras, and configurations of the built environment.

Methodology

1. Develop a list of potential actions and strategies;
2. Identify the technological potential of each action (or group of actions) to reduce energy and emissions by quantifying actions:
    a. If the action or strategy specifically incorporates a projection or target; or,
    b. If there is a stated intention or goal, review best practices and literature to quantify that goal; and
    c. Identify any actions that are overlapping and/or include dependencies on other actions.
3. Translate the actions into quantified assumptions over time;
4. Apply the assumptions to relevant sectors in the model to develop a low-carbon scenario (i.e. apply the technological potential of the actions to the model);
5. Analyze results of the low-carbon scenario against the overall target;
6. If the target is not achieved, identify variables to scale up and provide a rationale for doing so;
7. Iteratively adjust variables to identify a pathway to the target;
8. Develop marginal abatement cost curve for low carbon scenario;
9. Define criteria to evaluate low carbon scenario (i.e. identify criteria for multi-criteria analysis);
10. Prioritize actions of low carbon scenario;
11. Reflect prioritization in final low-carbon scenario, removing and scaling the level of ambition of actions according to the evaluation results.

Addressing Uncertainty

There is extensive discussion of the uncertainty in models and modelling results. The assumptions underlying a model can be from other locations or large data sets and do not reflect local conditions or behaviours, and even if they did accurately reflect local conditions, it is exceptionally difficult to predict how those conditions and behaviours will respond to broader societal changes and what those broader societal changes will be.

The modelling approach uses four strategies for managing uncertainty applicable to community energy and emissions modelling:

1. **Sensitivity analysis:** One of the most basic ways of studying complex models is sensitivity analysis - quantifying uncertainty in a model's output. To perform this assessment, each of the model's input parameters is drawn from a statistical distribution in order to capture the uncertainty in the parameter's true value (Keirstead, Jennings, & Sivakumar, 2012).

Approach: Each input variable is modified by ±10-20% to illustrate the impact that an error of that magnitude has on the overall total.

2. **Calibration:** One way to challenge untested assumptions is the use of 'back-casting' to ensure the model can 'forecast the past' accurately. The model can then be calibrated to generate historical outcomes, calibrating the model to better replicate observed data.

Approach: Variables are calibrated in the model using two independent sources of data. E.g. the model calibrates building energy use (derived from buildings data) against actual electricity data from the electricity distributor.

3. **Scenario analysis:** Scenarios are used to demonstrate that a range of future outcomes are possible given the current conditions and that no one scenario is more likely than another.

Approach: The model will develop a reference scenario.

4. **Transparency:** The provision of detailed sources for all assumptions is critical to enabling policy-makers to understand the uncertainty intrinsic in a model.

Approach: Modelling assumptions and inputs are presented in this document.

Appendix 1: GPC Emissions Scope Table

Blue rows = Sources required for GPC BASIC inventory
Green rows = Sources required GPC BASIC+ inventory
Red rows = Sources required for territorial total but not for BASIC/BASIC+ reporting

Exclusion Rationale Legend

N/A	Not Applicable, or not included in scope
ID	Insufficient Data
NR	No Relevance, or limited activities identified
Other	Reason provided in other comments

					in tonnes				
GPC ref No.	Scope	GHG Emissions Source	Inclusion	Exclusion rationale	CO2	CH4	N2O	Total CO2e	Total Emissions
I	STATIONARY ENERGY SOURCES								
I.1	Residential buildings								
I.1.1	1	Emissions from fuel combustion within the city boundary	Yes		15,270	2,832	389	18,491	
I.1.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes		1,455	2	7	1,464	
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes		48	0	0	49	
I.2	Commercial and institutional buildings/facilities								
I.2.1	1	Emissions from fuel combustion within the city boundary	Yes		11,301	264	105	11,670	
I.2.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes		1,032	1	5	1,038	
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes		34	0	0	35	
I.3	Manufacturing industry and construction								
I.3.1	1	Emissions from fuel combustion within the city boundary	Yes		486	0	10	497	
I.3.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes		86	0	0	86	**Buildings**
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes		3	0	0	3	**33,332**

I.4	Energy industries								
I.4.1	1	Emissions from energy used in power plant auxiliary operations within the city boundary	No	NR	0	0	0	0	
I.4.2	2	Emissions from grid-supplied energy consumed in power plant auxiliary operations within the city boundary	No	NR	0	0	0	0	**Local energy**
I.4.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption in power plant auxiliary operations	No	NR	0	0	0	0	**0**
I.4.4	1	Emissions from energy generation supplied to the grid	No	NR	0	0	0	0	
I.5	Agriculture, forestry and fishing activities								
I.5.1	1	Emissions from fuel combustion within the city boundary	No	NR	0	0	0	0	
I.5.2	2	Emissions from grid-supplied energy consumed within the city boundary	No	NR	0	0	0	0	
I.5.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	No	NR	0	0	0	0	
I.6	Non-specified sources								
I.6.1	1	Emissions from fuel combustion within the city boundary	No	NR	0	0	0	0	
I.6.2	2	Emissions from grid-supplied energy consumed within the city boundary	No	NR	0	0	0	0	
I.6.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	No	NR	0	0	0	0	
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal								
I.7.1	1	Emissions from fugitive emissions within the city boundary	No	NR	0	0	0	0	
I.8	Fugitive emissions from oil and natural gas systems								**Fug. emissions**
I.8.1	1	Emissions from fugitive emissions within the city boundary	Yes		1	2,290	0	2,290	**2,290**

II	TRANSPORTATION							
II.1	On-road transportation							
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the city boundary	Yes		40,508	69	421	40,997
II.1.2	2	Emissions from grid-supplied energy consumed within the city boundary for on-road transportation	Yes		0	0	0	0
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes		14,305	28	59	14,393
II.2	Railways							
II.2.1	1	Emissions from fuel combustion for railway transportation occurring within the city boundary	No	NR	0	0	0	0
II.2.2	2	Emissions from grid-supplied energy consumed within the city boundary for railways	No	NR	0	0	0	0
II.2.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	NR	0	0	0	0
II.3	Water-borne navigation							
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring within the city boundary	No	N/A	0	0	0	0
II.3.2	2	Emissions from grid-supplied energy consumed within the city boundary for waterborne navigation	No	N/A	0	0	0	0
II.3.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	N/A	0	0	0	0
II.4	Aviation							
II.4.1	1	Emissions from fuel combustion for aviation occurring within the city boundary	No	N/A	0	0	0	0

II.4.2	2	Emissions from grid-supplied energy consumed within the city boundary for aviation	No	N/A	0	0	0	0	
II.4.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	N/A	0	0	0	0	
II.5	Off-road								
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring within the city boundary	No	NR	23	0	3	26	**Transport**
II.5.2	2	Emissions from grid-supplied energy consumed within the city boundary for off-road transportation	No	NR	0	0	0	0	**55,390**

III	WASTE								
III.1	Solid waste disposal								
III.1.1	1	Emissions from solid waste generated within the city boundary and disposed in landfills or open dumps within the city boundary	Yes		0	0	0	0	
III.1.2	3	Emissions from solid waste generated within the city boundary but disposed in landfills or open dumps outside the city boundary	Yes		0	0	0	0	
III.1.3	1	Emissions from waste generated outside the city boundary and disposed in landfills or open dumps within the city boundary	No	N/A	0	0	0	0	
III.2	Biological treatment of waste								
III.2.1	1	Emissions from solid waste generated within the city boundary that is treated biologically within the city boundary	Yes		0	278	183	461	
III.2.2	3	Emissions from solid waste generated within the city boundary but treated biologically outside of the city boundary	No	N/A	0	0	0	0	
III.2.3	1	Emissions from waste generated outside the city boundary but treated biologically within the city boundary	No	N/A	0	0	0	0	
III.3	Incineration and open burning								
III.3.1	1	Emissions from solid waste generated and treated within the city boundary	No	N/A	0	0	0	0	

III.3.2	3	Emissions from solid waste generated within the city boundary but treated outside of the city boundary	No	N/A	0	0	0	0	
III.3.3	1	Emissions from waste generated outside the city boundary but treated within the city boundary	No	N/A	0	0	0	0	
III.4	Wastewater treatment and discharge								
III.4.1	1	Emissions from wastewater generated and treated within the city boundary	Yes		0	1,449	312	1,761	
III.4.2	3	Emissions from wastewater generated within the city boundary but treated outside of the city boundary	No	NR	0	0	0	0	**Waste & WW**
III.4.3	1	Emissions from wastewater generated outside the city boundary	No	N/A	0	0	0	0	**2,222**

IV	INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)								
IV.1	1	Emissions from industrial processes occurring within the city boundary	No	ID	0	0	0	0	
IV.2	1	Emissions from product use occurring within the city boundary	No	ID	0	0	0	0	

V	AGRICULTURE, FORESTRY AND LAND USE (AFOLU)								
V.1	1	Emissions from livestock within the city boundary	No	NR	0	0	0	0	
V.2	1	Emissions from land within the city boundary	No	NR	0	0	0	0	
V.3	1	Emissions from aggregate sources and non-CO2 emission sources on land within the city boundary	No	NR	0	0	0	0	

VI	OTHER SCOPE 3								
VI.1	3	Other Scope 3	No	N/A	0	0	0	0	

TOTAL	**93,234**

Appendix 2: Building Types in CityInSight

Residential Building Types	Non-residential Building Types	
Single_detached_1Storey_tiny	college_university	commercial_retail
Single_detached_2Storey_tiny	school	commercial
Single_detached_3Storey_tiny	retirement_or_nursing_home	commercial_residential
Single_detached_1Storey_small	special_care_home	retail_residential
Single_detached_2Storey_small	hospital	warehouse_commercial
Single_detached_3Storey_small	municipal_building	warehouse
Single_detached_1Storey_medium	fire_station	religious_institution
Single_detached_2Storey_medium	penal_institution	surface_infrastructure
Single_detached_3Storey_medium	police_station	energy_utility
Single_detached_1Storey_large	military_base_or_camp	water_pumping_or_treatment_station
Single_detached_2Storey_large	transit_terminal_or_station	industrial_generic
Single_detached_3Storey_large	airport	food_processing_plants
Double_detached_1Storey_small	parking	textile_manufacturing_plants
Double_detached_2Storey_small	hotel_motel_inn	furniture_manufacturing_plants
Double_detached_3Storey_small	greenhouse	refineries_all_types
Double_detached_1Storey_large	greenspace	chemical_manufacturing_plants
Double_detached_2Storey_large	recreation	printing_and_publishing_plants
Double_detached_3Storey_large	community_centre	fabricated_metal_product_plants
Row_house_1Storey_small	golf_course	manufacturing_plants_miscellaneous
Row_house_2Storey_small	museums_art_gallery	_processing_plants
Row_house_3Storey_small	retail	asphalt_manufacturing_plants
Row_house_1Storey_large	vehicle_and_heavy_equiptment_service	concrete_manufacturing_plants
Row_house_2Storey_large	warehouse_retail	industrial_farm
Row_house_3Storey_large	restaurant	barn
Apartment_1To4Storey_small		
Apartment_1To4Storey_large		
Apartment_5To14Storey_small		
Apartment_5To14Storey_large		
Apartment_15To24Storey_small		
Apartment_15To24Storey_large		
Apartment_25AndUpStorey_small		
Apartment_25AndUpStorey_large		
inMultiUseBldg		

Appendix 3: Emissions Factors Used

Category	Value	Comment
Natural gas	49 kg CO_2e/GJ	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Tables A6-1 and A6-2, Emission Factors for Natural Gas.
Electricity	2016 and 2051 (g/kWh): CO_2: 10.7 CH_4: 0.000952 N_2O: 0.000243	2017 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions
Gasoline	g/L CO_2: 2316 CH_4: 0.32 N_2O: 0.66	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–12 Emission Factors for Energy Mobile Combustion Sources
Diesel	g/L CO_2: 2690 CH_4: 0.07 N_2O: 0.21	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–12 Emission Factors for Energy Mobile Combustion Sources
Fuel oil	Residential g/L CO_2: 2560 CH_4: 0.026 N_2O: 0.006 Commercial g/L CO_2: 2753 CH_4: 0.026 N_2O: 0.031 Industrial g/L CO_2: 2753 CH_4: 0.006 N_2O: 0.031	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–4 Emission Factors for Refined Petroleum Products
Wood	Residential kg/GJ CO_2: 299.8 CH_4: 0.72 N_2O: 0.007 Commercial kg/GJ CO_2: 299.8 CH_4: 0.72 N_2O: 0.007 Industrial kg/GJ CO_2: 466.8	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–56 Emission Factors for Biomass

	CH4: 0.0052 N2O: 0.0036	
Propane	Transport g/L CO2: 1515 CH4: 0.64 N2O: 0.03 Residential g/L CO2: 1515 CH4 : 0.027 N2O: 0.108 All other sectors g/L CO2: 1515 CH4: 0.024 N2O: 0.108	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–3 Emission Factors for Natural Gas Liquids Table A6–12 Emission Factors for Energy Mobile Combustion Sources
Waste	Landfill emissions are calculated from first order decay of degradable organic carbon deposited in landfill. Derived emission factor in 2016 = 0.015 kg CH4/tonne solid waste (assuming 70% recovery of landfill methane); 0.050 kg CH4/tonne solid waste not accounting for recovery.	Landfill emissions: IPCC Guidelines Vol 5. Ch 3, Equation 3.1
Wastewater	CH4: 0.48 kg CH4/kg BOD N2O: 3.2 g / (person * year) from advanced treatment 0.005 g /g N from wastewater discharge	CH4 wastewater: IPCC Guidelines Vol 5. Ch 6, Tables 6.2 and 6.3; MCF value for anaerobic digester N2O from advanced treatment: IPCC Guidelines Vol 5. Ch 6, Box 6.1 N2O from wastewater discharge: IPCC Guidelines Vol 5. Ch 6, Section 6.3.1.2

Greenhouse gases	Carbon dioxide (CO2), methane (CH4) and nitrous oxide (N20) are included. Global Warming Potential CO2 = 1 CH4 = 34 N2O = 298	Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3) are not included.

Appendix 4: Data and Assumptions

Category		Assumption	Source	Comments/Notes
DEMOGRAPHICS				
Population & employment				
	Population	31,699 (2016) to 40,740 (2050), including student populations	City, census	
	Employment	12,255 (2016) to 12,663 (2050).	Colliers	
BUILDINGS				
New buildings growth				
	Building growth projections	Single Detached ____ Double ____ Row ____ Apartment ____ Commercial ____ Industrial ____ Institutional ____	CityInSight Model projection	New residential dwelling units is based on population growth and current building mix. New non-residential floor space is based on additional jobs. Known planned developments will be taken into account.
New buildings energy performance				
	Residential		Use Step Code as a guideline now - 2021 no change 2022-2026 20% more efficient 2027-2031 40% more efficient 2032-2050 60% more efficient	
	Multi-residential			
	Commercial & Institutional			
	Industrial			
Existing buildings energy performance				
	Residential	Existing building stock unchanged; efficiency held constant from 2016-2050.		
	Multi-residential			
	Commercial & Institutional			
	Industrial			
End use				
	Space heating	Fuel shares for end use unchanged; held from 2016-2050.	CityInSight Modelling	
	Water heating			
	Space cooling			

Projected climate impacts			
Heating & cooling degree days	Heating Degree days are expected to decrease, and cooling degree days will increase	https://www.pacificclimate.org/data/statistically-downscaled-climate-scenarios	
ENERGY GENERATION			
Low or zero carbon energy generation (community scale)			
Solar PV	2016 solar capacity is held constant		
Ground mount solar	No ground mount solar installation		
District Energy Generation	DE held constant to 2050		
Wind	No wind turbine installations		
TRANSPORT			
Transit			
Expanded transit	No expansion expected.		
Electrify transit system	Electrification per BC Transit plans: all electric by 2040.		
Active			
Cycling & walking infrastructure	Modal Split expected to stay the same to 2050		
Private/personal use			
Electrify municipal fleet	No further electrification expected.		
Electrify personal vehicles	8% market share by 2030 trending up towards 2050	Canada's Electric Vehicle Policy Report Card 2016. Axsen, Goldberg, Melton (Simon Fraser University), Electric Mobility Canada	
Electrify commercial vehicles	No major change expected		No Data at this time for trends
Vehicle kilometers travelled	VKT is expected to increase toward 2050	CityInSight Model Assumptions based on population and job growth within the City	VKT projections are driven by buildings projections. The number and location of dwellings and non-residential buildings over time in the BAU drive the total number of internal and external person trips. Person trips are converted to vehicle trips using the baseline vehicle occupancy. Vehicle kilometres travelled is calculated from vehicle trips using the baseline distances between zones and average external trip distances.

	Vehicle fuel efficiencies	Vehicle fuel consumption rates reflect the implementation of the U.S. Corporate Average Fuel Economy (CAFE) Fuel Standard for Light-Duty Vehicles, and Phase 1 and Phase 2 of EPA HDV Fuel Standards for Medium- and Heavy-Duty Vehicles. Canada typically follows these standards as well.	EPA. (2012). EPA and NHTSA set standards to reduce greenhouse gases and improve fuel economy for model years 2017-2025 cars and light trucks. Retrieved from https://www3.epa.gov/otaq/climate/documents/420f12050.pdf http://www.nhtsa.gov/fuel-economy	Fuel efficiency standards are applied to all new vehicle stocks starting in 2016.
	Vehicle share	Personal vehicle stock share changes between 2016-2050. Commercial vehicle stock unchanged 2016-2050.	CANSIM and Natural Resources Canada's Demand and Policy Analysis Division.	The total number of personal use and corporate vehicles is proportional to the projected number of households in the BAU.
WASTE				
	Waste generation	Existing per capita waste generation rates unchanged.		Waste generation per capita held constant form 2016-2050.
	Waste diversion	Existing waste diversion rates unchanged.		Waste diversion rates held constant form 2016-2050.
	Waste treatment	Existing waste treatment processes unchanged.		No change in waste treatment processes assumed 2016-2050.
FINANCIAL				
	Energy costs	Energy intensity costs by fuel increase incrementally between 2016-2050 per projections.	National Energy Board. (2016). Canada's Energy Future 2016. Government of Canada. Retrieved from https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016pt/nrgyftrs_rprt-2016-eng.pdf	NEB projections extend until 2040; extrapolated to 2050. Energy cost intensities are applied to energy consumption by fuel, derived by the model, to determine total annual energy and per household costs.
	Carbon tax	2020: $45/tonne 2021: $50/tonne Increasing to $150/tonne by 2050	BC Government https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax	

4.2 GLOBAL, NATIONAL, REGIONAL, AND LOCAL CLIMATE CHANGE ACTION DIRECTION

Global, National, Regional, and Local Climate Change Action Direction

Municipalities and their organizations are rallying to the challenge of emissions reduction and climate change mitigation, recognizing that they have an important contribution to make to climate protection, and that many urban quality of life co-benefits can be gained through climate actions. According to C40, a leading global network of cities addressing climate change, approximately 70% of global emissions are under the direct or indirect control or influence of municipal governments.[1] This represents an amazing opportunity for cities to lead on climate action.

Global Trends Overview

Energy systems and technologies are changing rapidly, creating opportunities and challenges for municipalities. Examples of key trends include:

- **Governments increasingly support low or zero-carbon energy options**: Federal and provincial policies are increasingly adopting low or zero-carbon energy system approaches. This results in a shift from fossil fuel industry subsidy and investment to support for renewable energy and conservation activities.
- **Costing carbon creates new opportunities**: There is a growing market for carbon reductions as emitting become increasingly costly.
- **Renewable energy is more accessible than ever**: It is becoming easier for households and businesses to generate their own energy. Net-metering arrangements with power providers and the ease of establishing small utilities and energy resellers provide support for small-scale renewable energy projects. The costs of renewable energy technologies like wind turbines and solar photovoltaic systems keep dropping. Renewable energy system uptake is also spurred by new financing mechanisms.
- **Energy storage technologies are changing the grid**: Technologies like large lithium-ion batteries are already available for houses and businesses. Installations will increase rapidly as their costs continue to decline.
- **New models of electric vehicles are available every day**: Electric vehicle sales are increasing quickly across the country. EV ranges are increasing and charging options are more common, creating consumer security. As EV prices continue to decline and more models become available, EVs will increasingly displace internal combustion engine vehicles.
- **Heating systems remain a challenge, but new options are coming online**: Heat pumps continue to improve in efficiency and more models than ever are available. District energy is gaining traction as an efficient system for providing heating and cooling to communities, with the flexibility to add or subtract energy sources as required.
- **New financing strategies are increasing participation**: Municipalities and financial institutions are offering mechanisms that reduce financial barriers to energy retrofits and renewable technologies. PACE programs are a good example. Municipalities around the world are creating

[1] C40 website: https://www.c40.org/why_cities

innovative policies and strategies to support or engage with these trends while advancing local priorities such as reducing air pollution, stimulating economic development and new employment opportunities, increasing the livability of the community, and improving affordability.

Global Climate Change Outlook

The Intergovernmental Panel on Climate Change (IPCC) convenes the work of thousands of the world's leading climate scientists. From its assessment reports governments can create GHG inventories and plans to mitigate and adapt to climate change.[2]

The global scientific consensus is that the activities we require and that we choose to live our day-to-day lives have direct consequences to our environment and climate; climate change is caused by human activity.[3] Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate.[4]

Recent analysis shows that current government emissions reduction pledges are insufficient to meet the Paris Agreement goal, and the emissions trajectory of current policies misses the goal by a large margin. Limiting warming to 1.5°C implies reaching net zero CO2 emissions globally around 2050 and concurrent deep reductions in emissions of non-CO2 forcers, particularly methane.[5]

Canada's International Commitments

Canada is a signatory to the Paris Agreement (2015), committing to set emissions reduction targets and submit progress reports to the United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement aims to strengthen the global climate change response by keeping global temperature rise this century well below 2.0°C relative to pre-industrial levels, and to pursue efforts to limit temperature increase even further to 1.5°C, to avoid the severe climate change impacts projected to occur if 1.5°C of warming is surpassed.

Canada has committed to achieving a 30% reduction in emissions below 2005 levels by 2030 under the Agreement. Canada's commitment is presented and updated in its Mid-century, Long-term, Low-

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[2] Seto, K. C. et al. (2014). Human settlements, infrastructure and spatial planning. http://pure.iiasa.ac.at/11114

[3] More details on the relationship between climate change and greenhouse gases: www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter01_FINAL.pdf

[4] IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press. p.4. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

[5] 2018: Technical Summary. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. https://www.ipcc.ch/sr15/technical-summary

greenhouse Gas Development Strategy[6] wherein a goal of reducing net emissions by 80% under 2005 levels by 2050 is also set.[7]

Canada's National Commitments

There are several policies issued by the federal government that guide provincial and municipal climate change efforts. Under federal jurisdiction, many of the national policies have direct relevance and application to climate change, energy, and emissions efforts in Banff National Park.

The Pan-Canadian Framework on Clean Growth and Climate Change

The Pan-Canadian Framework (2016) is a plan to grow the Canadian economy while reducing emissions and building resilience to adapt to a changing climate.[8] It summarizes Canada's approach to GHG emissions reduction by 2030, addressing clean technology, innovation, and jobs; carbon pricing mechanisms adapted to the specific circumstances of each Province and Territory; and in particular the realities of Canada's Indigenous peoples and Arctic and sub-Arctic regions.[9] The Framework provides climate action direction to provinces and cities and consists of several key themes:

- Carbon pricing;
- Complementary climate actions;
- Adaptation and building resilience;
- Clean technology, innovation and jobs;
- Reporting and transparency;
- Rights of Indigenous Peoples; and
- Collaboration.

The Pan-Canadian Framework is the umbrella direction under which provinces and municipalities make their climate change efforts.

Carbon Pricing

Following direction in the Pan Canadian Framework, the Greenhouse Gas Pollution Pricing Act (2018) has established a Canadian benchmark carbon price that begins at $20/tCO2e in 2019, rising to $50/tCO2e in 2022. The federal carbon pollution pricing system has two parts:

- A trading system for large industry, known as the output-based pricing system; and
- A regulatory charge on fuel (fuel charge).

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[6] Canada's Mid-century, Long-term, Low-greenhouse Gas Development Strategy, 2016: http://unfccc.int/files/focus/long-term_strategies/application/pdf/canadas_mid-century_long-term_strategy.pdf
[7] More information on the Government of Canada Paris Agreement: https://www.canada.ca/en/environment-climate-change/services/climate-change/paris-agreement.html
[8] Government of Canada. Pan-Canadian Framework on Clean Growth and Climate Change: http://publications.gc.ca/collections/collection_2017/eccc/En4-294-2016-eng.pdf
[9] Prime Minister's Office: http://pm.gc.ca/eng/news/2016/03/03/communique-canadas-first-ministers

Provinces and Territories can implement their own carbon pricing that meets or exceeds this national benchmark. Those that do not must adopt the national benchmark, as Alberta must do now that the current provincial government has rescinded the province's carbon pricing.[10]

Provincial Commitments

Climate Change Accountability Act (CCAA) (2007)

(formerly *Greenhouse Gas Reduction Targets Act*)

BC's GHG emissions are to be reduced by at least 40 per cent below 2007 levels by 2030, 60 per cent by 2040, and 80 per cent by 2050. Starting in 2020, the province will report every even year on the risks to BC that could reasonably be expected from a changing climate, progress towards reducing those risks, actions to achieve that progress, and plans to continue progress.

Carbon Neutral Government – Program Requirements (2008)

Provided authority by the CCAA, all public sector organizations (PSOs) are to follow a five-step process to achieve carbon neutrality: measure, reduce, offset, report, and verify GHG emissions.

Carbon Tax Act (2008)

The escalating tax was phased in on July 1, 2008 starting at $35 per tonne of carbon dioxide equivalent emissions, increasing to $50 per tonne in 2021. Revenue generated from the carbon tax is used to protect affordability, maintain industry competitiveness, and encourage new clean initiatives.

Greenhouse Gas Emission Reporting Regulation (2016)

This Regulation requires industrial operations emitting over 10,000 tCO_2e/year to report their GHG pollution annually. Operations emitting over 25,000 tCO_2e are required to have their emission reports independently verified.

Clean Energy Act (2010)

The *Clean Energy Act* sets provincial energy objectives and mechanisms related to electricity self-sufficiency, clean and renewable energy, energy efficiency, greenhouse gas emission reductions and fuel switching to lower-carbon-intensity energy. The Act has three priority areas:

1. Ensuring Electricity Self-Sufficiency at Low Rates
2. Harnessing B.C.'s Clean Power Potential to Create Jobs in every Region
3. Strengthening Environmental Stewardship and Reducing Greenhouse Gases

These provincial priority areas translate to clean energy, clean transportation, energy efficient building, and decrease solid waste direction at the municipal level.

Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act (2008)

This Act sets requirements for the use of renewables in transportation fuel blends and fulfills B.C.'s commitment to adopt a low-carbon fuel standard similar to that of California. The Act provides authority

[10] Government of Canada Ministers' letter to provinces and territories on next steps in pricing carbon pollution: https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/pricing-carbon-pollution/ministers-letter-provinces-territories.html

for the Renewable and Low Carbon Fuel Requirements Regulation (enacted in December 2009), which is decreasing the amount of carbon in B.C.'s transportation fuels.

Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act (2008)

This Act focuses on reducing GHG emissions from certain industrial operations while increasing opportunities in the bioenergy sector. For example, waste-management operations (including landfills, composting facilities and sewage treatment plants) are required to manage GHGs by reducing emissions or capturing them. They then have the option of realizing the economic opportunity presented by the waste's energy-generating potential. The *Act* provided authority for the Landfill Gas Management Regulation (2009). Additionally, the *Act* enables regulation of zero and net-zero GHG emissions for electricity generation.

Local Government (Green Communities) Statutes Amendment Act (2008)

This Act, referred to as Bill 27, gives local governments legislative power in reducing greenhouse gas emissions, conserving energy, and working towards creating more compact and sustainable communities. The amendments require GHG emission reduction targets in local Official Community Plans and Regional Growth Strategies and supporting policies and actions. It also includes the Climate Action Revenue Incentive Program (CARIP), which is a conditional grant program that provides funding to local governments equal to 100% of the carbon taxes they pay directly to support municipal operations. Conditions include being a signatory of the Climate Action Charter and reporting annually on climate actions taken and progress on carbon neutrality.

Climate Action Charter (2007)

The Province continues to collaborate with local governments through a voluntary agreement known as the Climate Action Charter. Almost every local government in B.C. is a signatory. Initiated at the Union of B.C. Municipalities (UBCM) Conference in 2007, local governments commit to taking climate actions, including:

- Becoming carbon neutral in their corporate operations;
- Measuring community-wide emissions; and
- Creating complete, compact, energy-efficient urban and rural communities.

Energy Efficiency Act (1996)

This Act sets energy performance standards for devices that use, control or affect the use of energy, such as household appliances, heating and cooling systems, lighting, and some industrial equipment.

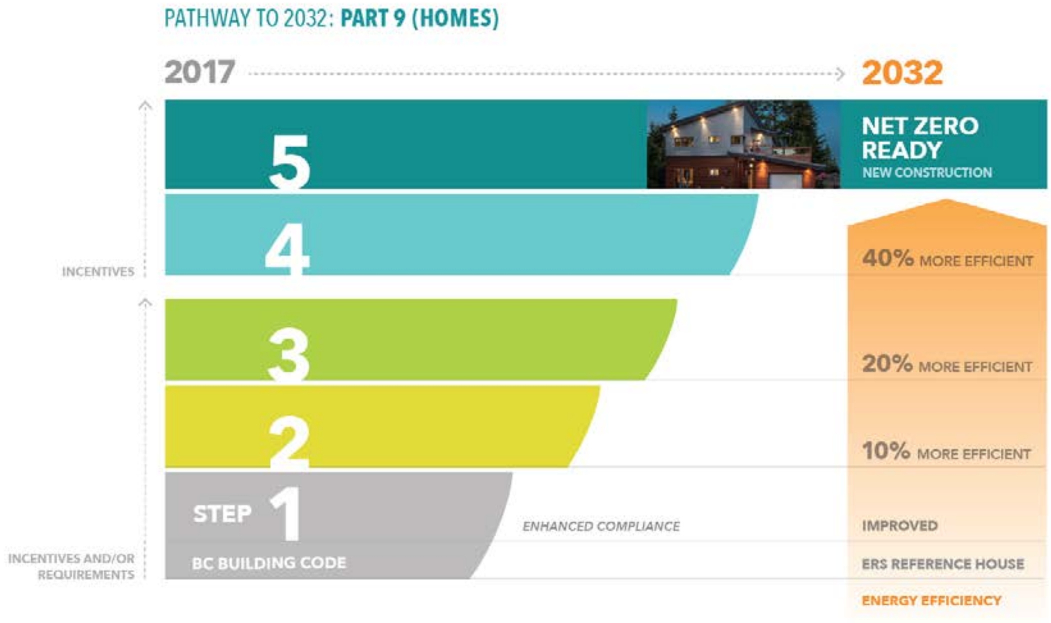
Building Code Amendments and Regulations (2014)

In December 2014, the B.C. Building Code introduced new energy-efficiency requirements for houses and small buildings. These include the Solar Hot Water Ready requirement, a provincial regulation that communities can voluntarily adopt. It requires new single-family homes in adoptive communities to be built to accommodate installation of solar hot water systems.

BC Step Code

BC has a goal for all new buildings to be net-zero energy ready by 2032. The Step Code is an optional compliance path in the BC Building Code that local governments may use to incentivize or require a level of energy efficiency in new construction that goes above and beyond the requirements of the BC

Building Code. Builders may voluntarily use the BC Energy Step Code as a new compliance path for meeting the energy-efficiency requirements of the BC Building Code.



CleanBC Communities Fund[11]

The fund provides provincial and federal funding for projects that will focus on the management of renewable energy, access to clean-energy transportation, improved energy efficiency of buildings and the generation of clean energy.

Energy Ministry Programming

Energy ministry programming supports local governments and Indigenous communities transitioning their energy systems toward cleaner, low-carbon options, e.g. CELP Community Energy Solutions such as efficiency retrofits and district energy and CEV Charging Infrastructure Program.

Transportation Ministry Funding

Transportation Ministry funding is available to local governments, e.g. the BikeBC program, to support capital expenditures on improvements to community infrastructure. Additional funding is being made available to municipalities and indigenous communities via the federal Investing in Canada Infrastructure Program.

BC Preliminary Strategic Climate Risk Assessment (2019)[12]

The climate risk assessment evaluates the likelihood of 15 climate risk events that could occur in B.C. along with their health, social, economic and environmental consequences. It is the first report of its kind in Canada to examine provincial-scale climate risks. Key findings include:

- The greatest risks to B.C. are severe wildfire season, seasonal water shortage, heat wave, ocean acidification, glacier loss, and long-term water shortage.
- Other risks that have the potential to result in significant consequences include severe river flooding and severe coastal storm surge, although these events are less likely to occur.
- Nearly all risk event scenarios (except moderate flooding and extreme precipitation and landslide) would have major province-wide consequences in at least one category

Regional Commitments

The Comox Valley Sustainability Strategy (2010)[13] adopts the provincial emissions reduction target of -80% of 2007 emissions levels by 2050. It also commits to reducing energy use per capita by 50% and/or will not increase overall energy use from current levels. A variety of other targets are set in the plan, including for decreased water use and wastewater treatment, ecosystem protection, waste diversion, local food production, economic diversity, and housing affordability. Sustainability Strategy progress reporting is published as a 'dashboard'.[14]

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[11] https://www2.gov.bc.ca/gov/content/transportation/funding-engagement-permits/funding-grants/investing-in-canada-infrastructure-program/green-infrastructure/cleanbc-communities-fund

[12] Summary document: https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/climate-risk-summary.pdf

[13] https://www.comoxvalleyrd.ca/sites/default/files/docs/Projects-Initiatives/1rs_cvsustainabilitystrategy_18feb2010.pdf

[14] https://www.comoxvalleyrd.ca/sites/default/files/docs/Services/p_cvrd_climate_change.pdf

The Comox Valley Regional District's Regional Growth Strategy (RGS, 2010)[15] includes a climate change chapter that restates the GHG emissions reduction targets as well as municipal policy objectives for the building, transportation, waste, deforestation, renewable energy generation, and climate change adaptation sectors. Annual reports on RGS progress are published on the CVRD website.[16]

Incentives and Subsidy Programs

Federal Programs

The Federal Incentives for Zero-Emission Vehicles program offers rebates on EV purchases, varying by vehicle class.

Provincial Programs

In addition to climate change action enabling legislation, the Province also offers energy efficiency incentive programs under its cleanBC programming.[17] Rebates and incentives are offered for new and existing homes.

The Province's Clean Energy Vehicles for BC (CEVforBC) program offers battery electric, fuel cell, and hybrid electric vehicle purchase subsidies.

Corporate Programs

BC Hydro Programs

BC Hydro offers a variety of energy efficiency programming to home and business owners, those interested in owning electric vehicles, and communities.

Home renovation rebates

- Heat pump retrofits
- Water heater tank upgrades
- Insulation and windows upgrades
- Fireplace upgrades
- Energy assessments
- Energy efficient appliance upgrades

Business programs

- Strategic Energy Management program membership and support
- Leaders in Energy Management Program
  - Energy Manager Associates Program

[15] https://www.comoxvalleyrd.ca/sites/default/files/uploads/bylaws/bylaw-120_comox_valley_regional_district_regional_growth_strategy.pdf
[16] https://www.comoxvalleyrd.ca/RGS
[17] https://betterhomesbc.ca/

- Commercial Energy Management Assessment program
- Energy performance contracts (for facilities managers)
- Continuous Optimization program (for large buildings)
- Energy studies and audits
- Industrial project incentives (for industrial customers using over 500 MWh/year)

Electric vehicles

- Home, apartment, and workplace charger rebates

Communities

- Sustainable Communities program
- Community energy managers
- Community energy and emissions planning support
- Social housing retrofit support program
- Indigenous community energy efficiency training programs

Fortis BC Programs

Like BC Hydro – and often in partnership with BC Hydro – Fortis BC offers energy efficiency rebate programs including:

- Insulation upgrade rebates
- Natural gas furnace upgrade rebates
- Natural gas water heater rebates
- Appliance maintenance rebates
- Bathroom fan and showerhead rebates (ENERGY STAR)
- Clothes washer and dryer rebates (ENERGY STAR)
- Home EV charging station rebates
- Home energy evaluations
- Heat pump rebates and loans
- Furnace and boiler rebates
- Home renovation rebates
- Lighting upgrades rebates
- New home construction rebates for energy efficiency
- Windows and doors rebates

Estimated Climate Changes for the Comox Valley

Climate change modelling estimates a median increase of 1.5°C to the annual mean temperature in the Comox Valley by 2050. This is accompanied by a 6% increase in annual precipitation, although summer precipitation amounts will decrease by 17%. Annual snowfall in the region is expected to decrease substantially, resulting in much reduced winter snowpack. The median heating degree days will decrease by 516 degrees.

Local climate impacts expected to accompany these changes include:

- Fewer heating degree days will decrease heating demand in winter months;
- Increased growing degree days and fewer frost days will result in longer growing seasons;
- Hotter springs and summers may allow traditionally more southern crops to be grown in the region;
- Warmer annual mean temperatures will result in flora and fauna species migration, with some currently local species moving north and species currently south of the bioclimatic region moving into the Comox Valley;
- Wetter winters and springs will increase flood risk frequency and severity as well as landslide risk;
- Decreased snowpack will mean less water for the summer months, increasing drought risk;
- Warmer temperatures and more humid air from increase rainfall in the winter and spring months will result in greater air front variances, resulting in more frequent and intense storms;
- Expected sea level rise will increase coastal erosion rates and seawater ingress to low-lying areas, with a risk of salinating agricultural soils and impacting crop production;
- Expected sea level rise will result in higher storm surges; and
- Increased drought will increase wildfire risk and wildfire smoke presence and airborne particulate pollutants.

The following tables summarizes the expected climate changes in the region.

Summary of climate change for the Comox Valley in the 2050s.[18]

Climate Variable	Season	Projected Change from 1961-1990 Baseline	
		Ensemble Median	Range (10th to 90th percentile)
Mean Temperature (°C)	Annual	+1.5 °C	+0.9 °C to +2.3 °C
Precipitation (%)	Annual Summer Winter	+6% -17% +5%	-2% to +11% -26% to +2% -4% to +14%

[18] Pacific Climate Impacts Consortium data: http://www.plan2adapt.ca/tools/planners?pr=9&ts=8&toy=16

Snowfall* (%)	Winter Spring	-36% -52%	-55% to -19% -71% to -17%
Growing Degree Days* (degree days)	Annual	+342 degree days	+210 to +532 degree days
Heating Degree Days* (degree days)	Annual	-516 degree days	-786 to -321 degree days
Frost-Free Days* (days)	Annual	+23 days	+13 to +34 days

* These values are derived from temperature and precipitation.

Climate Atlas Report Modelled Temperature and Weather Changes[19]

RCP 8.5: High Carbon climate future (GHG emissions continue to increase at current rates)

Variable	Period	1976-2005		2021-2050			2051-2080	
		Mean	Low	Mean	High	Low	Mean	High
Precipitation (mm)	annual	1429	114	1483	1828	1196	1562	1948
Precipitation (mm)	spring	267	15	276	418	159	280	422
Precipitation (mm)	summer	117	4	109	183	41	103	184
Precipitation (mm)	fall	437	27	453	652	295	489	694
Precipitation (mm)	winter	607	40	642	887	454	691	963
Mean Temperature (°C)	annual	9.6	10.	11.2	12.3	11.5	12.9	14.3
Mean Temperature (°C)	spring	8.6	8.	10.3	12	9.8	11.7	13.7
Mean Temperature (°C)	summer	16.7	17.	18.5	20.1	18.7	20.5	22.3
Mean Temperature (°C)	fall	9.6	9.	11.2	12.5	11.3	12.9	14.5
Mean Temperature (°C)	winter	3.2	2.	4.8	6.5	4.5	6.5	8.3
Tropical Nights	annual	0	0	0	1	0	2	7
Very hot days (+30°C)	annual	4	1	10	21	5	20	37
Very cold days (-30°C)	annual	0	0	0	0	0	0	0
Date of Last Spring Frost	annual	April 3	Jan. 16	Feb. 26	April 2	Jan. 1	Feb. 1	March 18
Date of First Fall Frost	annual	Nov. 5	Oct. 23	Nov. 24	Dec. 25	Nov. 6	Dec. 10	Dec. 30
Frost-Free Season (days)	annual	212	21	268	321	252	310	359

RCP 4.5: Low Carbon climate future (GHG emissions much reduced)

Variable	Period	1976-2005		2021-2050			2051-2080	
		Mean	Low	Mean	High	Low	Mean	High
Precipitation (mm)	annual	1430	1142	1485	1837	1170	1518	1899
Precipitation (mm)	spring	267	157	273	416	164	280	419
Precipitation (mm)	summer	118	49	107	179	41	103	179
Precipitation (mm)	fall	436	276	463	657	281	471	670
Precipitation (mm)	winter	609	410	643	886	425	662	908
Mean Temperature (°C)	annual	9.6	10	11	12	10.7	11.9	13.1
Mean Temperature (°C)	spring	8.7	8.4	10.1	11.7	9.2	10.9	12.6
Mean Temperature (°C)	summer	16.7	16.9	18.3	19.7	17.5	19.2	20.9
Mean Temperature (°C)	fall	9.6	9.6	10.9	12.2	10.3	11.7	13
Mean Temperature (°C)	winter	3.2	2.7	4.5	6.2	3.8	5.6	7.2
Tropical Nights	annual	0	0	0	0	0	0	1
Very hot days (+30°C)	annual	4	1	9	19	2	13	26
Very cold days (-30°C)	annual	0	0	0	0	0	0	0
Date of Last Spring Frost	annual	April 4	Jan. 21	March 4	April 8	Jan. 3	Feb. 15	March 26
Date of First Fall Frost	annual	Nov. 5	Oct. 23	Nov. 21	Dec. 21	Oct. 28	Nov. 30	Dec. 29
Frost-Free Season (days)	annual	212	211	259	306	234	286	342

[19] Climate Atlas of Canada data: https://climateatlas.ca/data/city/373/plus30_2030_45/line

Where did this data come from?

Global Climate Models (GCMs) are used to depict how the climate is likely to change in the future. Since no one climate model can be considered 'correct', it is important to use many GCMs to capture a range of possible conditions. The GCM data we used were obtained from the Pacific Climate Impacts Consortium (PCIC). PCIC collected temperature and precipitation data produced by 24 different models and used advanced statistical techniques to create high-resolution (daily, 10km) versions of the data for all of Canada (for more information visit pacificclimate.org).

What are the RCP 8.5 and RCP 4.5 future climate scenarios?

One of the most important inputs into GCM simulations of the future climate is the expected concentration of greenhouse gases (GHGs; especially carbon dioxide) in the atmosphere as a result of human activity. In the scientific literature these future GHG concentrations are used to calculate Representative Concentration Pathways (RCPs). The High Carbon scenario (RCP8.5) assumes that we continue to emit very large amounts of carbon dioxide from the burning of fossil fuels; the Low Carbon scenario (RCP4.5) assumes that drastic reductions of emissions in the coming decades will stabilize the concentration of GHGs in the atmosphere by the end of this century. We did not use RCP2.6, an even lower emissions scenario.

How are the minimum, mean, and maximum calculated?

We used an ensemble of 24 different GCMs to analyze the future climate. The mean values are the average values of this ensemble over the 1976-2005, 2021-2050 and 2051-2080 periods. The range of values in each time period is indicated by the High (90th percentile) and Low (10th percentile) values in the tables. This means about 10% of the predicted values are above the "High" value, and 10% are lower than the "Low" value.

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