COMOX VALLEY
FREQUENT TRANSIT CORRIDOR STUDY

Final Report

Prepared by Watt Consulting Group
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Contents

Appendices

1. Introduction

1.1 Project Overview

The Comox Valley Transit Future Plan (2014) identifies a 25-year plan for the Comox Valley Transit System. This includes a Frequent Transit Network (FTN) as the "highest order" transit corridor that would allow riders to spontaneously travel without having to consult a transit schedule. The FTN would consist of frequent transit service (i.e., 15-minute service during peak periods), a high level of transit stop amenities, transit priority measures, and service branding.

As the next logical step in realizing the FTN vision, BC Transit and local partners are undertaking this technical review to confirm the preferred frequent transit corridor. A Victoria-based consulting firm (Watt Consulting Group, "WATT") was secured to undertake the study under the direction of BC Transit and the Comox Valley Regional District (CVRD), and with local municipalities (Courtenay, Comox, Cumberland) and the Ministry of Transportation + Infrastructure (MoTI) as key stakeholders.

1.2 About this Document

The Final Report (this document) summarizes the results of the evaluation that was undertaken of two frequent transit corridor options. This document is based on preliminary analysis conducted in the Technical Report document that was completed to identify frequent transit corridor options and understand existing conditions as a baseline for further analysis. This report was reviewed by the Working Group assembled for this study and the Comox Valley Transit Management Advisory Committee (TMAC), and used to guide discussions with the local agency stakeholders.

1.3 Background Information

The Comox Valley Transit Future Plan (2014) is the main impetus for undertaking the Frequent Transit Corridor Study. The TFP contains the following objective - "encourage greater transit use and help reduce congestion on the road network and in turn reduce and or delay expenditure on the expansion of road infrastructure to service single occupancy vehicles"[1].

The Comox Valley is projected to reach a population of 87,500 by 2038 – an increase of approximately 37 percent from 2011. The TFP explains how this projected populated increase will require sustained investments in transportation infrastructure and transit to support and meet the demands of the growing population. In light of the projected population growth, the

[1] BC Transit. (2014). Transit Future Plan Comox Valley 2014. Pg. 17. Available online at: https://bctransit.com/servlet/documents/1403643019673

TFP sets a transit mode share target of three percent of all trips by 2038, which will require transit ridership in the Comox Valley to grow from 636,043 to 2.7 million trips per year[2]. This target aligns directly with the Provincial Transit Plan's transit mode share target for regional centres in the province.

As part of the public engagement process for the City of Courtenay's 25 Year Vision for Multi-Modal Transportation strategy, the public expressed a strong interest in using transit if service was more convenient, frequent and reliable. Current transit ridership rates in the City are low with fewer than 3% of workers using transit

There are also a number of local and regional planning documents and studies that provide relevant direction for the Frequent Transit Corridor Study. In 2014, the City of Courtenay released its "25 Year Vision for Multi-Modal Transportation Final Report"[3], which provides a blueprint for meeting the City's transportation needs over the next 25 years.

The City of Courtenay's multi-modal transportation strategy reflects and is guided by the Comox Valley Regional Growth Strategy (RGS)[4] and City of Courtenay Official Community Plan (OCP)[5] – both of which contain shared objectives to [a] increase public transit and [b] develop a transportation system that provides choices for different modes of travel. Specifically, the RGS calls for the "design of a direct transit route through the centre of a population or employment area, without the need for circuitous routing"[6]. The transportation strategy includes objectives around improving transportation corridors in the City including the need to "improve the quality of transit service in the Comox Valley". The specific actions of highest relevance to this study are as follows:

- Pursue options for a new transit exchange downtown which meets bus routing requirements. The exchange would provide a welcoming waiting area for pedestrians, with landscaping / artwork, shelters, benches, information panels, bicycle parking, etc. The exchange will be integrated into the downtown fabric and look at shared use opportunities with retail and commercial businesses.
- Consideration of transit priority measures at signalized intersections to improve transit service in key areas.

[2] Ibid

[3] City of Courtenay. (2014). City of Courtenay 25 Year Vision for Multi-Modal Transportation. Available online at: http://www.courtenay.ca/assets/Departments/Engineering/courtenaytransportationstrategy_finalreport_april2014_web.pdf

[4] Comox Valley Regional District. (2010). Comox Valley Regional Growth Strategy Bylaw No. 120, 2010. Available online at: http://www.comoxvalleyrd.ca/assets/Community/Documents/Bylaw_120_Comox_Valley_Regional_Growth_Strategy_2010.pdf

[5] City of Courtenay. (2005). A Blueprint for Courtenay: Official Community Plan. Available online at: http://www.courtenay.ca/assets/Departments/Development~Services/Bylaw_2387_OCP.pdf.pdf

[6] Comox Valley Regional District. (2010). Comox Valley Regional Growth Strategy Bylaw No. 120, 2010; pg. 34.

The Town of Comox has also identified transit as a priority in its 2011 Official Community Plan[7] and 2011 Comox Transportation Study[8]. The OCP includes a specific objective to reduce dependence on private motor vehicles and increase transportation choice for residents through transit, walking, and bicycling. The Comox Transportation Study recommended a transit exchange within the municipality's downtown area as part of facilitating more frequent and coordinated transit service. The study also recommended an overall increase in transit service within Comox as part of providing better transportation choice to its residents.

The planning and policy direction summarized above has directly informed the scope of work undertaken in completing this study.

[7] Town of Comox. (2011). Town of Comox Official Community Plan. Available online at: http://www.comox.ca/modx/sl-ob.pdf

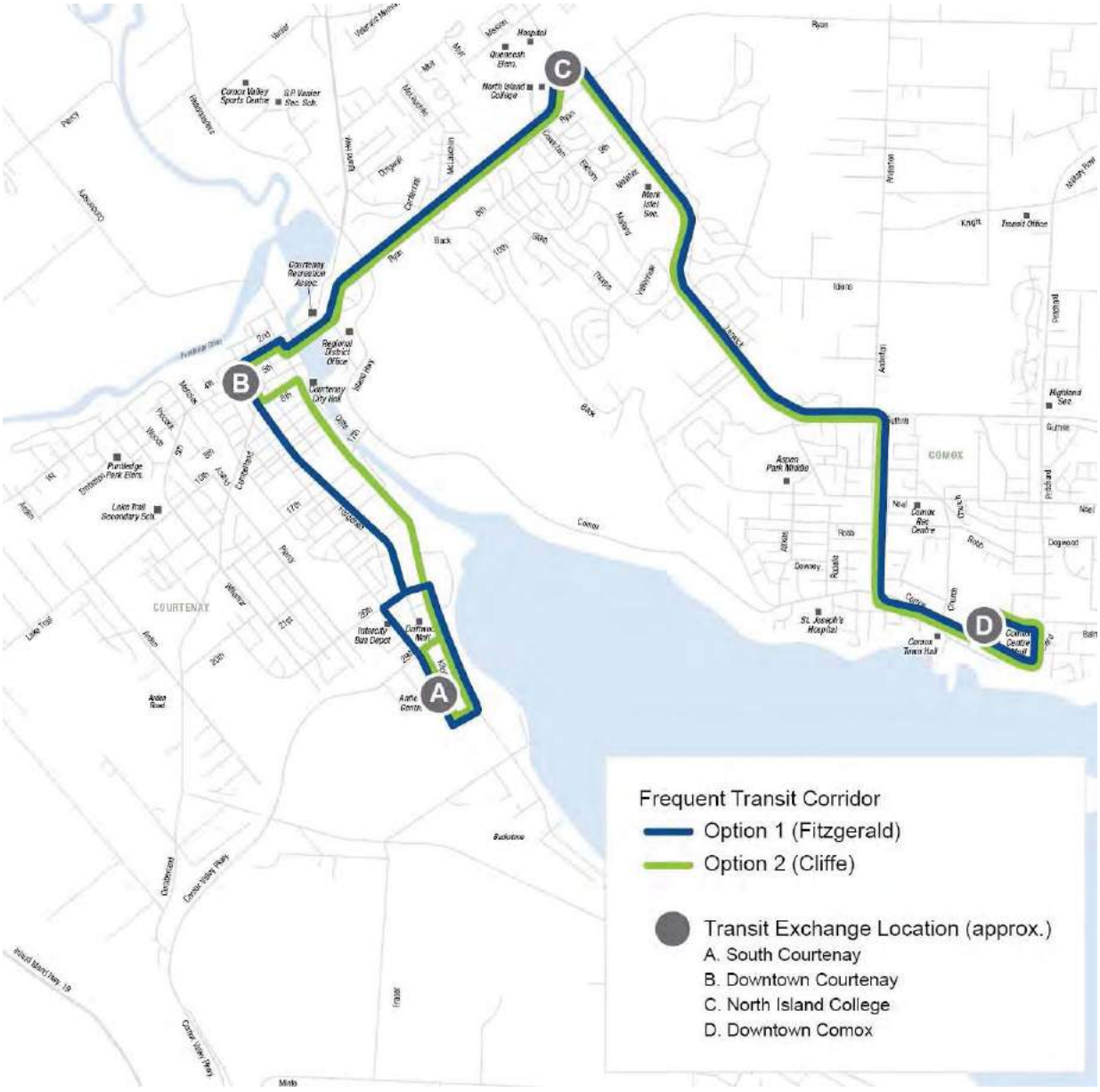
[8] Town of Comox. (2011). Comox Transportation Study 2011. Available online at: http://comox.ca/modx/assets/pdfs/public%20works/Comox%20Transportation%20Study%202011%20(July%2013th).pdf

2. Corridor Options

2.1 Corridor Profiles

The assignment considers two corridor options, as shown on **Map 1**. Both travel between four exchange locations – South Courtenay, Downtown Courtenay, North Island College, and Downtown Comox. The primary difference is that Corridor no.1 (Fitzgerald) travels between South Courtenay and Downtown Courtenay via Fitzgerald Avenue, whereas Corridor no.2 (Cliffe) utilizes Cliffe Avenue and 8th Street.

MAP 1. **FREQUENT TRANSIT CORRIDOR OPTIONS**



WHY THESE TWO CORRIDORS?

A series of corridor options were explored through the *Transit Future Plan* process (2013/2014) and this process to arrive at the two identified options, as follows:

- Option 1 routing is consistent with the preferred routing identified in the *Transit Future Plan*, with the exception of travelling east-west through downtown Courtenay via 4th Street (instead of 2nd Street) to decrease travel time and undue noise/ inconvenience through the neighbourhood north of downtown Courtenay and the addition of a "loop" routing via Kilpatrick Avenue and Cliffe Avenue in south Courtenay.
- The request for proposals (RFP) for this study included two corridor options that were to be the basis of this study. One option was Option 1 included in this study (with minor variation), and the other option utilized the 17th Street Bridge to address concerns that the 5th Street Bridge may not be able to accommodate the additional weight of buses. The two options from the RFP are included in **Appendix A**. It was confirmed by City staff that the 5th Street Bridge can accommodate current and projected future bus loads. Further, this routing increases bus travel time significantly as a result of "back tracking" between south Courtenay and the 17th street Bridge via downtown Courtenay, as well as congestion at the Ryan Road / Island Highway intersection and on either side of the 17th Street Bridge.
- Consideration was given to the corridor travelling between South Courtenay, Downtown Courtenay, and Downtown Comox via the 17th Street Bridge and Comox Road. This corridor was not pursued as it does not serve North Island College (a key trip generator) or the Ryan Road and Lerwick Road corridors. Additionally Comox Road between the 17th Street Bridge and St. Joseph's Hospital is fronted primarily by agricultural land and low density residential, and has limited ridership potential (Local service would still operate on this corridor). This is in line with the Comox Valley Regional Growth Strategy ("RGS") objective to increase public transit use (4-A) and direction that suggests routing should be through population / employment areas without the need for circuitous routing.
- There is uncertainty as to whether the South Courtenay exchange will be at Driftwood Mall, Anfield Centre, or on-street in a nearby location. The proposed route options are illustrated and studied as though the exchange will be at Anfield Centre, but the corridor options could both serve exchanges in alternative locations.

2.2 Travel Distance

Travel distance via Corridor no.1 (Fitzgerald) is approximately 300m shorter in each direction (600m total, two-way) than Corridor No. 2 (Cliffe) due to direct routing between South Courtenay and Downtown Courtenay via Fitzgerald Avenue. See **Table 1**.

TABLE 1. **SUMMARY OF TRAVEL DISTANCE (ONE-WAY), BY CORRIDOR OPTION**

	FTN Corridor **no.1**	FTN Corridor **no.2**
South Courtenay (A) to Downtown Courtenay (B)	3.3 km	3.6 km
Downtown Courtenay (B) to North Island College (C)	3.8 km	
North Island College (C) to Downtown Comox (D)	7.2 km	
Total	**14.3 km**	**14.6 km** (+2%)

2.3 Transit Priority

Transit priority measures were tested to determine where bus travel time along the Frequent Transit Corridor could be improved by implementing transit priority to address locations of delay / congestion without unduly impacting traffic conditions on other roads. Four locations are proposed for transit priority measures, as identified on **Map 2** and described below.

1. Cliffe Avenue / 5th Street
   Buses may currently make the southbound left turn (Cliffe Ave onto 5th St), where other vehicles are prevented. A dedicated protected/permitted left turn signal phase is proposed as a means to ensure buses incur less delay at this location. This improvement would require signal infrastructure upgrades by the City.

2. Old Island Highway / Ryan Road
   A queue jump lane is proposed for the westbound left turn lane at the Old Island Highway / Ryan Road intersection. See **Figure 1**. This would allow westbound buses to access a queue jump lane via the right turn lane to avoid the westbound left turn lane queues and proceed through the intersection in advance of other vehicles using a bus-only signal phase. This improvement would require signal upgrades by the City.

3. Island Highway / Ryan Road
   Signal priority is proposed for through movements on Ryan Road at the Island Highway intersection, where the “green” phase for through movements on Ryan Road would be held for a defined period of time to allow buses to clear the intersection.

4. Cowichan Avenue / Ryan Road
   The Ryan Road / Cowichan Avenue intersection may be signalized to facilitate eastbound left and westbound right turns between Ryan Road and North Island College.

MAP 2. **PROPOSED TRANSIT PRIORITY LOCATIONS**

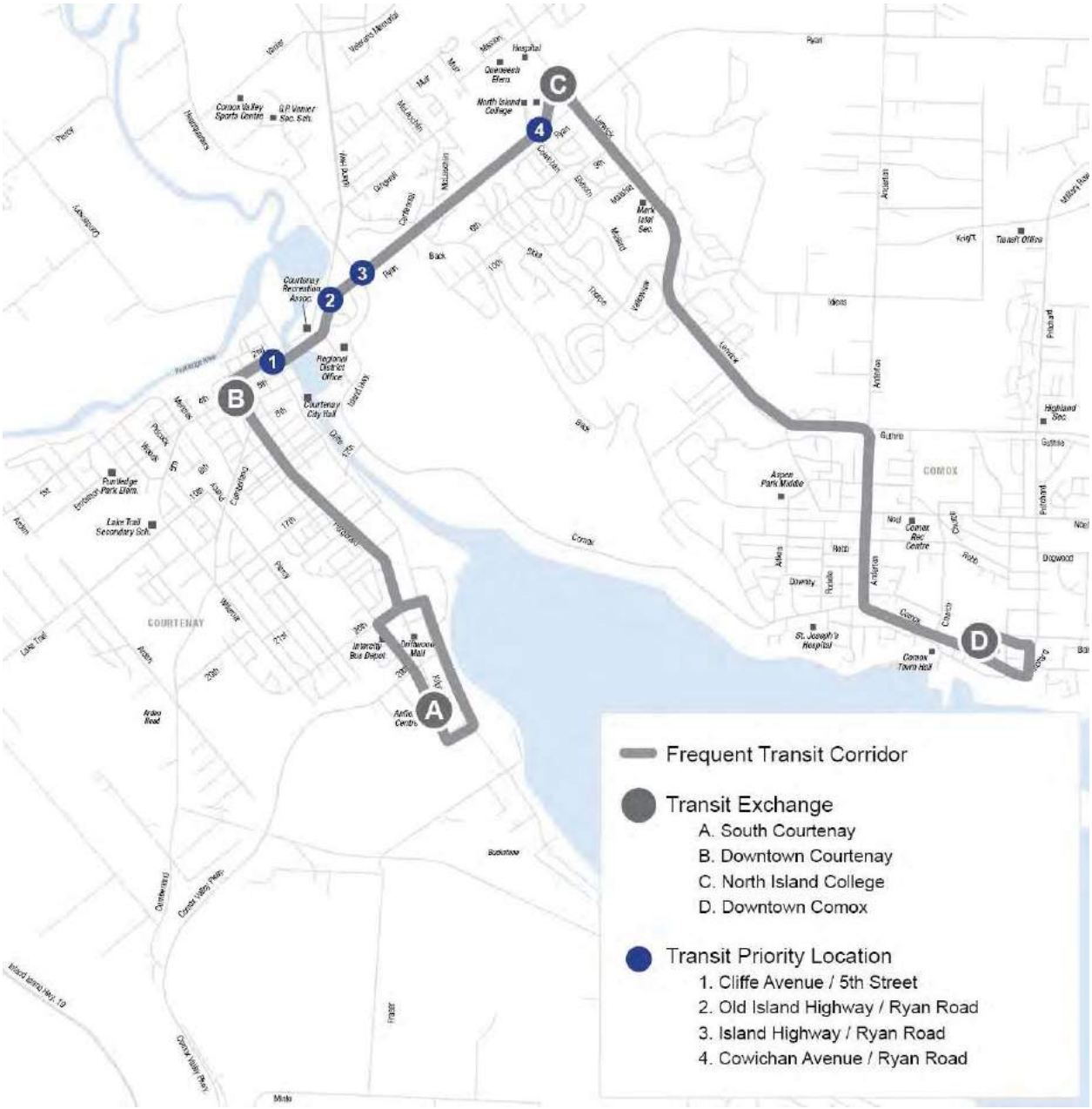


FIGURE 1. **PROPOSED QUEUE JUMP LANE AT OLD ISLAND HIGHWAY / RYAN ROAD**

2.4 Transit Exchanges

Four transit exchanges are identified as part of the frequent transit corridor – South Courtenay, Downtown Courtenay, North Island College, and Downtown Comox. Refer to **Map 1**.

Conceptual designs have been prepared for each preferred exchange location, with alternative locations identified in case the preferred location may not be realized. Both are summarized on the following pages. Sketches showing bus routing to/from the exchanges are included in **Appendix B**.

Exchange locations and functional design requirements are based on direction from the *Transit Future Plan* included in **Table 2** below. Design options reflect the following principles:

- Transfer / Exchange – On or adjacent to the proposed Frequent Transit corridors and allow for transfer to Local routes
- Trip Generator – Within comfortable walking distance (i.e., less than a 5-minute walk) of major trip generators and design / layout seeks to minimize walking distance to the entrance of major trip generators (i.e., downtown core, shopping centre, institution)
- Pedestrian Facilities – Exchange location is connected by high-quality, accessible pedestrian infrastructure or such facilities are included in the design concept (where currently lacking)
- Transit Access – Locations minimize deviation from the proposed Frequent Transit corridors and allow for adequate space for transit vehicle maneuvering
- Impacts – Minimize impacts on landscape/trees, parking, driveways and road capacity

TABLE 2. **TRANSIT EXCHANGE FUNCTIONAL REQUIREMENTS**

Location	Routes to Be Served	CAPACITY		Notes
		Platforms (est.)	Buses / Hour	
A. South Courtenay (Secondary Exchange)	FTN, 2, 3, 10	4	14	• Exact location to be determined (Driftwood Mall or Anfield Centre)
B. Downtown Courtenay (Primary Exchange)	FTN, 6, 3, 5, 7, 8, 11a, 12	6	20	• May be on- or off- street • May be reduced if design includes operator recovery area, washrooms, and drop off area (Kiss + Ride)
C. North Island College (Primary Exchange)	FTN, 11a, 11b, 6, 12	4	12	
D. Downtown Comox (Secondary Exchange)	FTN, 11b, 3	4	10	

Exchange A:

South Courtenay

Although both Anfield Centre and Driftwood Mall were identified as potential options, the preferred South Courtenay exchange location is Anfield Centre. This is a major transit trip generator due to retail/shopping services and employment opportunities. It is anticipated that the Comox Valley Regional District, City of Courtenay, and/or BC Transit will work with property owners at either Anfield Centre or Driftwood Mall to determine the ultimate location and design.

The Anfield Centre design option is an on-street[9] configuration nearby the existing bus stop. **Appendix B** provides more detail, illustrating bus circulation to and from the exchange.

The highlights of the design concept are as follows:

- On-street configuration can reasonably accommodate three platforms – one existing, two new (preferred capacity is four platforms);
- New sidewalk / walkway recommended to connect bus stop platforms with sidewalk on primary internal driveway leading to Wal-Mart's front entrance, approximately 180m (2-minute walk); and
- Results in two parking lot drive aisles being closed and a loss of approximately 12 parking spaces.

[9] Although configured as an "on-street" facility, this segment of Kilpatrick Avenue is a private road on the Anfield Centre site

SOUTH COURTENAY ALTERNATIVE LOCATION

Strong consideration was given to exchange options in the vicinity of Driftwood Mall (where an exchange currently exists). This area is thought to be more ideally situated for local routes serving the southwest areas of Courtenay (i.e., route no.8) and for routing to/from Cumberland via the Comox Valley Parkway / 29th Street.

While a variety of possible locations were identified, the following two locations were considered in detail:

1. Driftwood Mall parking lot (@ Cliffe Ave access) as an off-street facility with four bus berths. The conceptual design resulted in the removal of approximately 70 parking spaces, and would be accommodated by a sidewalk leading on the south side of the primary mall driveway leading directly to the mall entrance.

2. Kilpatrick Avenue (north/east side) between 26th Street and 29th Street as an on-street facility with four bus berths. The design would require that the existing dual left-turn lane in the centre of Kilpatrick Avenue is removed to create enough width for dedicated bus bays, as well as re-routing all busses to travel northbound on Kilpatrick Avenue so they are oriented to access the exchange location (north / east side).

Exchange B:

Downtown Courtenay

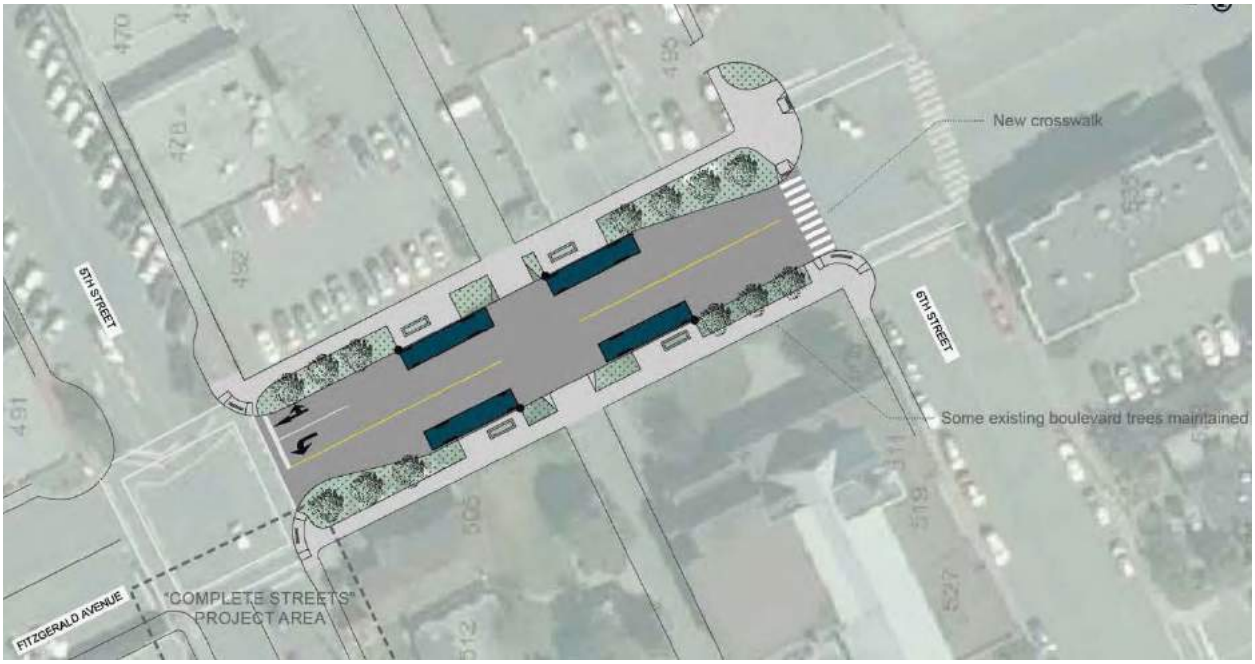
The preferred Downtown Courtenay exchange location is an on-street configuration on Fitzgerald Avenue between 5th Street and 6th Street, providing good access to 5th Street (the downtown "mainstreet") and direct access for routes using Fitzgerald Avenue and/or Cliffe Avenue via 8th Street. The 2015 Downtown Forum Summary identified the need to improve the existing transit terminal[10]. There is opportunity to integrate the preferred exchange into the City's "Complete Streets" initiative for 5th Street, which may result in two of the six platforms on the 4th-5th Street block of Fitzgerald Avenue to accommodate curb extensions at each block end associated with the Complete Streets work. The highlights of the design concept are as follows:

- Capacity for four platforms between 5th and 6th Street, with potential for two more on the 4th-5th Street block, with space for loading/unloading with shelter and wide sidewalks;
- Access to laneways are maintained with sidewalk extensions[11] that prioritizes continuous pedestrian travel on Fitzgerald Avenue;
- Ten existing parking spaces are removed on the block between 5th and 6th Street, with potential for another four spaces removed on the block between 4th and 5th Street.
- A new marked crosswalk and curb extensions are recommended at the 6th Street / Fitzgerald Avenue intersection to accommodate increased pedestrian activity, with sufficient width for a southbound left turn lane for turns onto 6th Street (City plan); and
- Complements Objective 7.1 of Courtenay's 25-year vision for multi-modal transportation where the downtown transit exchange is integrated into the downtown fabric[12].

[10] City of Courtenay. (2015). 2015 Downtown Forum Summary. Available online at: http://www.courtenay.ca/assets/Community/Documents/SR%20DDS%202015-12-07%202015%20Downtown%20Forum%20summary.pdf

[11] Refer to Transportation Association of Canada, Canadian Guide to Neighbourhood Traffic Calming, Section 3.2.4, pg 3-10

[12] City of Courtenay. (2014). City of Courtenay 25 Year Vision for Multi-Modal Transportation. Available online at: http://www.courtenay.ca/EN/main/departments/engineering/traffic-programs-studies/transportation-master-plan-2014.html



ABOUT THE DOWNTOWN COURTENAY EXCHANGE

from the *Transit Future Plan*, pg 85

"The importance of downtown Courtenay operating as a primary exchange will continue with the majority of all future routes expected to circulate or commence and terminate within the downtown of Courtenay. To deliver operational efficiencies including improved inter-modal connections and improved aesthetics the Courtenay transit exchange would be best located on the perimeter of the downtown. Potential exchange locations and upgrades will be identified in consultation with BC Transit, the CVRD, and the City of Courtenay.

The Courtenay OCP directs its transit supportive policies to maintain a pedestrian orientation in downtown and integrated transportation planning (Strategy 2.1.1) by developing a transit terminal downtown where multiple modes of transportation can converge, developing more bicycle paths in the downtown core and developing "friendly" streets and sidewalks. In support of this strategy, the April 2014, City of Courtenay 25 Year Vision for Multi-Modal Transportation Plan directs its transit strategies to peruse options for a new transit exchange downtown which meets bus routing requirements, yet also provides a welcoming waiting area for pedestrians, with landscaping / artwork, shelters, benches, information panels, wide sidewalks, bicycle parking and lighting. The Transportation Plan suggests the exchange would be conveniently located near downtown destinations and retail establishments that cater to bus patrons."

DOWNTOWN COURTENAY ALTERNATIVE LOCATION

8th Street between Cliffe Avenue and England Avenue was identified as the alternative location for Downtown Courtenay. See below. This location is compatible with the FTN Corridor no.2 (Cliffe) (but would require re-routing of Corridor no.1 (Fitzgerald)). Removal of on-street parking would be required, although preliminary observations suggest utilization is moderate in this area. 8th Street is a key corridor for emergency services vehicles and the City expressed concerns over incorporating a transit exchange and increase bus volumes on this route.

Exchange C:

North Island College

The current transit exchange on the North Island College campus is located on the ring road (College Campus Road) in front of the main entrance. The proposed future transit exchange location is on College Road on the east side of the campus immediately adjacent the Aquatic Centre. **Appendix B** provides more detail, illustrating the bus circulation to and from the exchange. The highlights of the design concept are as follows:

- Four bus bays can be accommodated; two on the north side parallel to the curb, two on the south side in a “sawtooth” configuration;
- The exchange is 200m from the NIC main entrance, 75m from the Aquatic Centre entrance, and 250m from the future Comox Valley Hospital front entrance (less to rear entrances); and
- The crosswalk on College Road is proposed to be moved to allow for ideal bus platform locations.

ABOUT THE NORTH ISLAND COLLEGE EXCHANGE

from the *Transit Future Plan*, pg 85-86

"This secondary [primary] exchange is expected to operate within the internal road circulation of the North Island College, Comox Valley Aquatic Centre and new hospital to allow convenient easy walking access to all facilities. This location demonstrates the second highest volume of passenger activity under today's route structure. A Transit exchange in this location is a key component to the function and success of the Frequent Transit Network, providing the most direct route for all transit users accessing this multipurpose locality. The new exchange will support the proposed intensification of the North Island College including the proposed student accommodation to be located on Campus and provide convenient access for employees and visitors to the new Comox Valley hospital.

This exchange will be subject to final design approval by BC Transit and the CVRD and should include:

- Four vehicle platforms to serve standard 12 meter long transit vehicles as well as bus stop poles
- Four platforms enable separation between buses serving Comox and those serving Courtenay plus layover positions
- Buses must be able to arrive and depart from platforms independently and must be able to circulate past other buses in the terminal. The exchange is to be off the main through path of the road network
- A combination of shelters and benches that would allow for seating of twelve people in each direction, plus room for standees)
- Lighting
- Passenger information
- Bike racks
- Garbage receptacles
- Conduit for future use (electronic signage, closed circuit TV, etc.)"

Exchange D:

Downtown Comox

The proposed location for the Downtown Comox exchange is on Port Augusta Road just north of Comox Avenue, which would accommodate at least three bus bays. **Appendix B** provides more detail, illustrating the bus circulation to and from the exchange. Key characteristics of the exchange are summarized as follows:

- Capacity for up to four platforms on Port Augusta Road, which would provide opportunity for transfer between the FTN route and other Local buses;
- Approximately 75m walk to the rear entrance of the Comox Centre Mall, accessed via a new proposed crosswalk;
- Passengers on the eastbound route could alight (i.e., be dropped off) on Comox Avenue (existing stop) or on Port Augusta Road where the route terminates; and
- Local routes may continue to provide service to existing bus stops on Comox Avenue or utilize the proposed Port Augusta platforms.

DOWNTOWN COMOX ALTERNATIVE LOCATION

The east side of Port Augusta Road immediately opposite the preferred west side location was identified as a possible alternative location. The following is a brief overview of the disadvantages of the alternative location:

- The alternative location involves eastbound buses turning left onto Port Augusta Road and not actually providing service along Comox Avenue through the “heart” of downtown Comox. This is a significant disadvantage as it requires that passengers either walk to Comox Avenue or ride the beginning of the FTN westbound service via Balmoral Avenue and Pritchard Road to access Comox Avenue.
- At least five on-street parking spaces would be removed on Port Augusta Road, where none are impacted under the preferred scenario.
- It is assumed under the preferred location that buses will travel via Pritchard Road rather than Stewart Street to avoid the challenging eastbound right-turn at Balmoral Avenue / Stewart Street intersection.

The following is a brief overview of the advantages of the alternative location:

- The alternative location does not require that passenger cross Port Augusta Road to access the Comox Centre Mall and results in shorter walking distance to access a higher concentration of businesses on Comox Avenue east of Port Augusta Road.
- The alternative location is already built to an urban standard with curb-and-gutter and sidewalks in a configuration suitable for a series of bus bays, and would result in lower cost than constructing a new facility on the west side of Port Augusta Road.
- The preferred location requires that buses starting their Westbound trip make a southbound right-turn onto Comox Avenue (Port Augusta Rd SB to Comox Ave WB) that is challenging due to the tight corner radius. The need to make this challenging right-turn movement is eliminated with the west side location.

3. Technical Assessments

A series of technical assessments were completed to understand how each corridor option performs for key criteria and as a basis for the option evaluation task (see Section 4). Analysis is based on projected growth over the next 25 years using historic growth rates and as outlined in local government Official Community Plans (OCPs). Technical assessments were undertaken for the following criteria, and results summarized in the following sections:

1. Travel time for buses on each corridor, with consideration for impact of proposed transit priority measures;
2. Potential ridership within walking distance of each corridor based on the approximate number of residents and employment within 200m;
3. Negative traffic implications incurred on side streets (i.e., not on the transit corridor) as a result of proposed transit priority measures; and
4. The cost implications of each corridor option, including new exchanges, bus stops, and transit priority measures.

25-YEAR TRAFFIC PROJECTIONS

Transit travel time (Section 3.1) and road network impacts (Section 3.3) are based on projected 25-year traffic volumes. BC Stats population data from 1981 to 2011 indicates a historical population growth of 4.5% per year (average) for Courtenay, Comox, and Cumberland (Note: Courtenay, Comox, and Cumberland utilized as regional district boundaries changed during time period). Population growth since 2001 (when the Inland Island Highway was completed) was 2.8% per year. Courtenay's OCP projects population growth at 1.5% per year over the next 25 years.

Tetra Tech EBA's April 5, 2016 memo on the Courtenay River Bridges (5th Street, 17th Street) provides two assessments of traffic growth in Courtenay. The first concludes a projected annual growth rate of 1.7% per year. This traffic growth rate is similar to the averaged growth rate over the projected time period (1.8%). The second assessment, based on actual count data on the bridges in 2005 and 2016, indicates a slight decrease in traffic over the 11-year period (-0.44% per year). The assessment of actual traffic count data indicates that the model is overestimating the future growth on the network; however, static volumes may not be a realistic expectation for the region.

Given the above, a 1% per year growth rate was utilized to project the 25 year horizon traffic volumes used to analyze travel times and traffic impacts. The annual growth rate would likely increase if capacity were added at the 5th Street or 17th Street bridges.

3.1 Transit Travel Time

Transit travel times were assessed for the two corridor options using VISSIM traffic modelling software. The model was setup to reflect existing road network conditions based on recent traffic volume information at key intersections along both corridors. The model was calibrated to reflect in-field travel survey and Google Maps, with an assumed 20% increase in travel time to account for "bus dwell time"[13]. Travel times represent the PM peak period when travel time would be highest.

Once calibrated to represent known current conditions, future traffic volumes were projected onto the network using a growth rate of 1% per year for 25 years (refer to description of annual growth rate above). Transit travel times were calculated for three scenarios, as follows:

1. Travel times were assessed under a scenario where no road network improvements are undertaken. This work allowed the team to identify where intersection improvements (see Bullet no.2) and transit priority initiatives (see Bullet no.3) may decrease transit travel time.

2. Travel times were then assessed under a scenario where intersection improvements are made by the municipalities to address on-going development and growth in traffic, and not specifically to improve transit functioning. Improvements were identified for Comox Avenue / Church Street (new signal)[14] and 5th Street / Fitzgerald Avenue (new signal). It is assumed that these improvements will be made within the 25-year timeframe and are not considered "transit priority" initiatives.

3. Travel times were then assessed on the assumption that the background intersection improvements (see Bullet no.2) have been made and the four transit priority improvements are implemented (see *Section 2.3, Map 2*). This scenario is the basis for the comparison of travel options between the two corridor options, and allows for calculation of the impact of each transit priority location when compared with non-transit priority scenarios (i.e., Bullet no.2).

[13] Bus dwell time accounts for the time that a bus spends stopped and travelling at reduced speed while serving a bus stop

[14] The Comox Avenue / Church Street intersection is not currently part of the Town of Comox's long term (2031) improvement plans. The projected improvements for the Frequent Transit Corridor are for up to the horizon year of 2041 and therefore the improvement for Comox Avenue / Church Street is assumed to occur after 2031.

The analysis of 25-year travel times concludes that Corridor no.1 (Fitzgerald) results in approximately 2 minutes and 15 seconds less travel time (each direction) as compared to Corridor no.2 (Cliffe). See **Table 3**. The difference in travel time occurs between the Downtown Courtenay and South Courtenay exchange locations, and results from a longer route for Corridor no.2 (Cliffe) (approx. 300m each direction), more signalized intersections on Cliffe Avenue, and at least one additional left turn movement where delay may be incurred. The transit travel time savings represents approximately 7.5% of the total corridor travel time.

TABLE 3. **SUMMARY OF TRANSIT TRAVEL TIME, BY CORRIDOR OPTION**

	Corridor **no.1 (Fitzgerald)**	Corridor **no.2 (Cliffe)**
EASTBOUND (Courtenay to Comox)		
South Courtenay (A) to Downtown Courtenay (B)	8:15	11:06
Downtown Courtenay (B) to North Island College (C)	11:32	11:08
North Island College (C) to Downtown Comox (D)	13:46	14:15
Total	**32:42**	**36:29**
WESTBOUND (Comox to Courtenay)		
Downtown Comox (D) to North Island College (C)	12:11	12:48
North Island College (C) to Downtown Courtenay (B)	10:40	10:41
Downtown Courtenay (B) to South Courtenay (A)	5:34	5:29
Total	**28:25**	**28:58**
Total (combined round-trip)	**61:00** rounded	**65:30** rounded
Differential between Two Options	**-7.5% (faster)**	**+7.5% (slower)**

3.2 Potential Ridership

Ridership potential refers to the population contained within reasonable walking distance of each corridor option. Population is based on a projected 25-year growth scenario, and considers both resident and employee populations.

Population projections were developed using a four-step methodology, described below:

1. Defined “buffers” were established at 100m, 200m, and 400m from each corridor. The 200m threshold is being used as the distance within which residents and employees may reasonably consider themselves within walking distance of the corridor. Providing the 100m and 400m distances allows for further consideration.

2. Official Community Plan (OCP) designations that fall within each corridor were identified. Based on the direction given in the OCP and the most applicable Zoning Bylaw land use designation(s), an assumed maximum build-out was calculated per 1,000 m^2 land area as an estimate of the development potential within that designation.

3. The total land area of each OCP designation contained within the corridor options was calculated, then multiplied by the maximum build-out scenario (per 1,000 m^2 land area) to determine the total build-out scenario for each corridor option in terms of both residential units and commercial floor area.

4. The total build-out scenario (residential units and commercial floor area) was converted to residents and employees using assumed people per unit and people per unit floor area ratios.

A detailed discussion of the methodology and findings is included in **Appendix C**. Results are summarized on the following page.

The results of the build-out model exercise demonstrate key differences between the two routes and their development capacities. To illustrate the difference clearly the percentage difference for each route was calculated for number of employees and number of residents allowing for comparison. The route that experienced the most growth is shown in **Table 4** as a positive, while the route with the least growth is shown with a negative.

TABLE 4. **25-YEAR POPULATION DIFFERENCE BETWEEN CORRIDOR OPTIONS**

Area	FTN Corridor no.1 (Fitzgerald)		FTN Corridor no.2 (Cliffe)	
	Residents	Employees	Residents	Employees
Within 100m	**-1.08%**	**-23.16%**	**+1.08%**	**+23.16%**
Within 200m	**-8.04%**	**-12.63%**	**+8.04%**	**+12.63%**
Within 400m	**+4.25%**	**-0.16%**	**-4.25%**	**+0.16%**

Results generally conclude that both resident and employee populations will be greater for Corridor no.2 (Cliffe) as compared to Corridor no.1 (Fitzgerald). The relative increase in the number of employees in Corridor no.2 (Cliffe) is significant at the 100m and 200m thresholds (23.2% at 100m, 12.6% at 200m), while the relative increase in resident population in Corridor no.2 (Cliffe) is less significant (1.1% at 100m, 8.0% at 200m). Corridor no.1 (Fitzgerald) has a 4.3% higher residential population within 400m, and the employee population is virtually identical between both options within 400m.

OCP land use designations that fall with the 100m, 200m, and 400m buffer areas are shown in **Figure 2** (Corridor no.1) and **Figure 3** (Corridor no.2) on the following pages. As the figures demonstrate, Corridor no.1 (Fitzgerald) is directly adjacent to a significant portion of the Urban Residential Designation. These neighbourhoods consist of low density residential uses and are relatively “built-out”, meaning they are already established and major redevelopment potential is limited. Corridor no.2 (Cliffe) travels through lands with a variety of designations, notably Commercial and Multi-Residential Designations. Commercial designations can support both stand-alone commercial development and mixed-used commercial/residential development. Corridor no.2 (Cliffe) experiences greater development potential within the 100m and 200m buffer areas. The Corridors begin to perform similarly at the 400m buffer area, as Corridor no.2 (Cliffe) is limited by the Courtenay River to the northeast.

FIGURE 2. **OCP DESIGNATIONS WITHIN CORRIDOR NO.1 (FITZGERALD)**

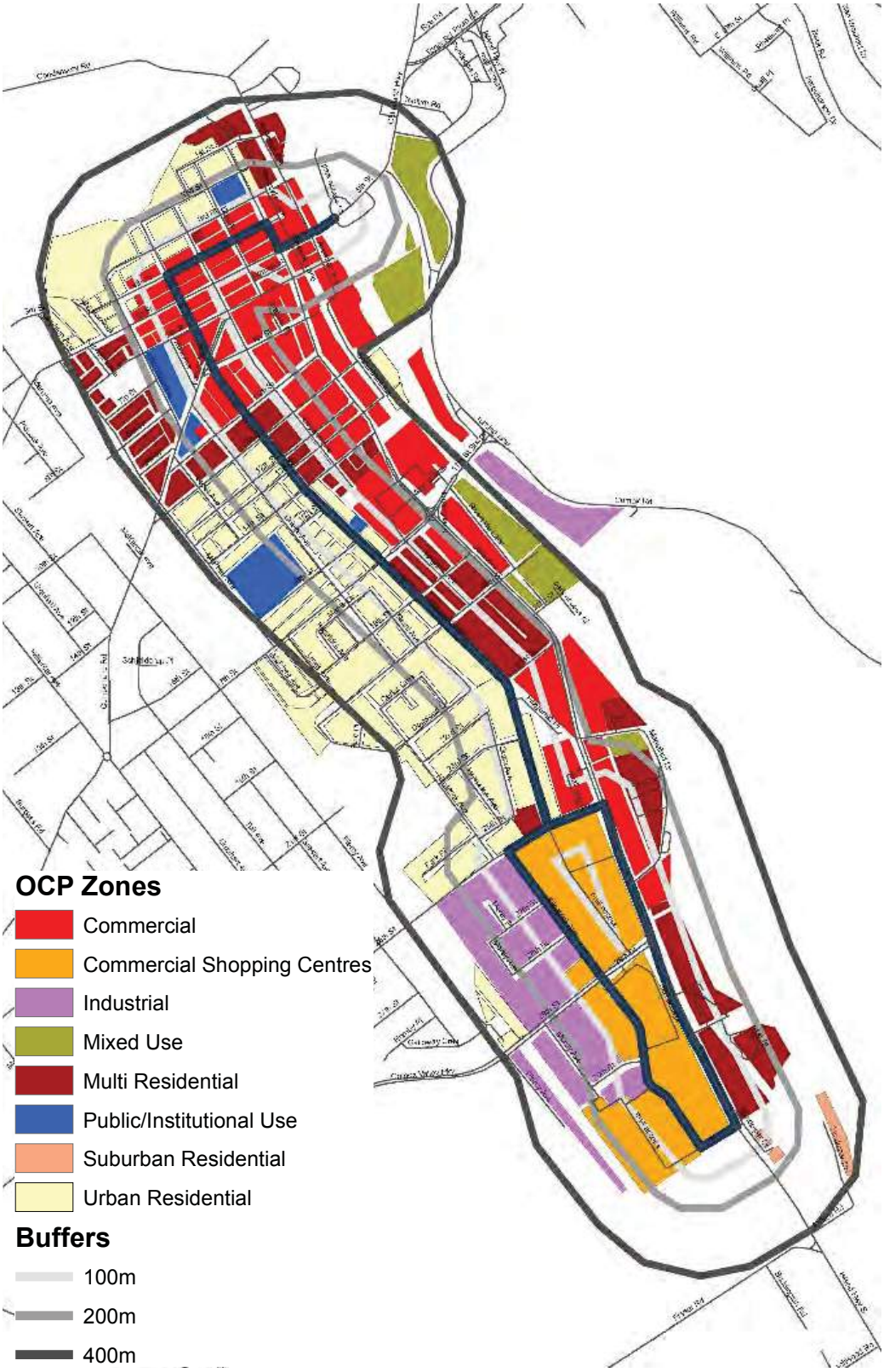
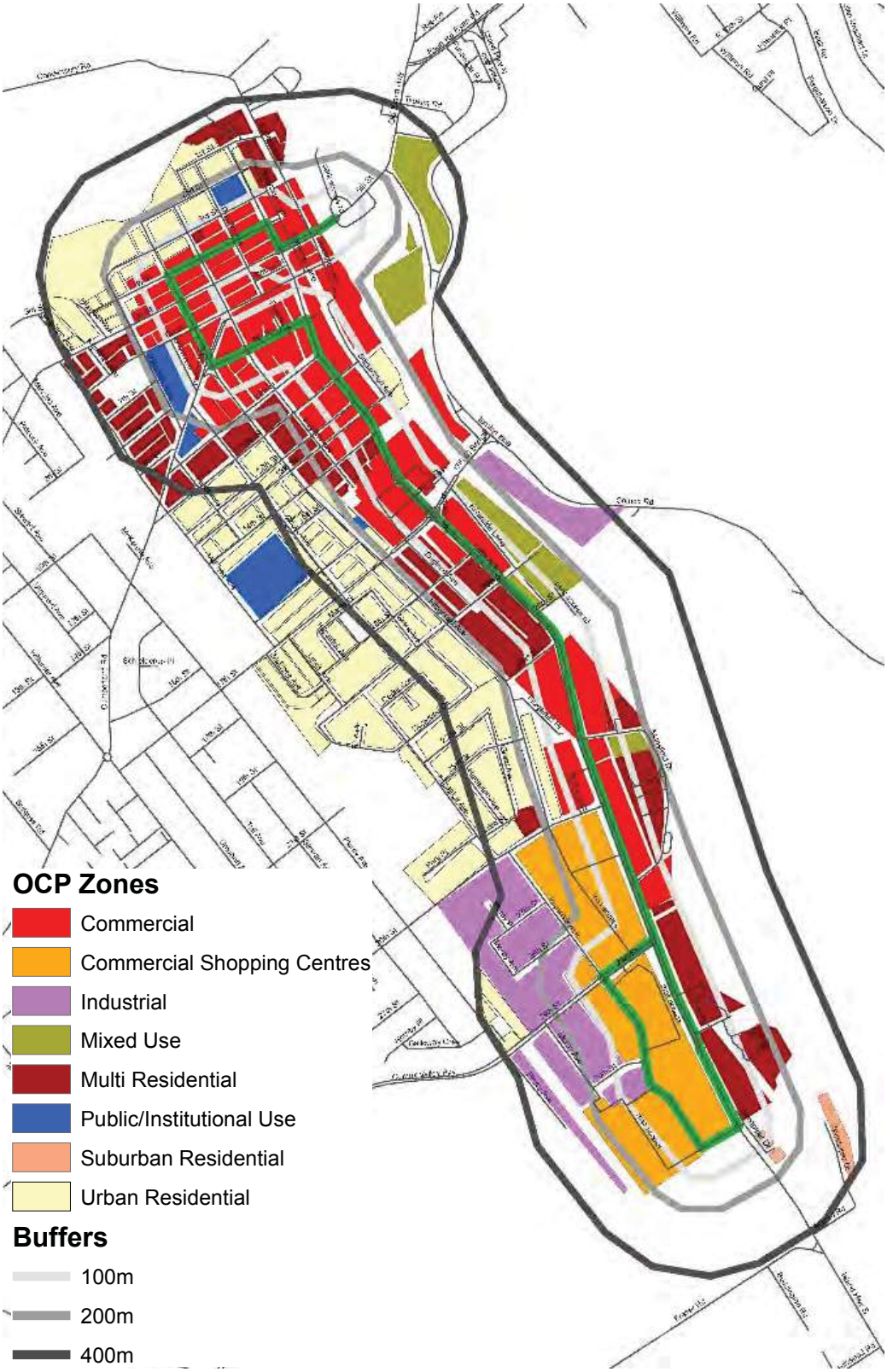


FIGURE 3. **OCP DESIGNATIONS WITHIN CORRIDOR NO.2 (CLIFFE)**



3.3 Road Network Impact

The proposed transit priority locations were reviewed to confirm they are feasible and to assess their impact on non-transit movements. All locations impact both corridor options equally and, as such, road network impact does not factor into the evaluation undertaken in *Section 4*.

1. **Cliffe Avenue / 5th Street** | The proposed protected/permitted left turn phase for the southbound left turn (from Cliffe Ave to 5th Street) provides approximately two-second travel time reduction for buses. The implication to non-transit vehicles is limited. This requires upgrades to the current signal infrastructure.

2. **Old Island Highway / Ryan Road** | The proposed southbound queue jumper lane at the Ryan Road / Old Island Highway intersection will reduce delay incurred by transit vehicles by several seconds, on average, as well as allow the transit vehicle to be at the front of the queue. The queue jumper may add up to 15 seconds of delay for through movements on Old Island Highway, however operations on Old Island Highway remain at an acceptable level of service (LOS C or better). This requires upgrades to the current signal infrastructure.

3. **Island Highway / Ryan Road** | The proposed signal priority treatment for through buses on Ryan Road at the Island Highway has limited impact on non-transit movements. The intersection operates at a poor level of service and is generally unstable during peak periods. The signal priority treatment will not have a significant impact on transit travel times, as queueing on Ryan Road is significant and does not allow the bus to progress to the point that it activates the prioritization. This location is under Ministry of Transportation + Infrastructure jurisdiction.

4. **Cowichan Avenue / Ryan Road** | Signalizing the Cowichan Avenue / Ryan Road intersection will improve transit movements by providing gaps in through traffic on Ryan Road. However, it will increase delays by up to 10 seconds for through movements on Ryan Road (that are currently free flow). It is understood through conversations with the Working Group that this location has been cited as a desired location for pedestrian crossing and signalization, however there are challenges with limited spacing to the Ryan Road / Lerwick Road intersection. This location is under Ministry of Transportation + Infrastructure jurisdiction.

A detailed summary of the impacts of each transit priority measures is included in **Appendix D**.

3.4 Cost Implications

Capital costs associated with both corridor options are identified below. All cost estimates are high level (Class D[15]) for the purposes of establishing budgets and seeking funding. More detailed cost estimates will be required based on more detailed design work.

3.4.1 Bus Stops

High-order bus stops that include a dedicated bus bay, full sidewalk connectivity, passenger shelter, lighting, and other amenities is estimated at $100,000 to $120,000 per bus stop location. Costs would be substantially less where existing infrastructure is already in-place.

Corridor no.2 (Cliffe) is 300m longer in each direction than Corridor no.1 (Fitzgerald). Using spacing criteria of 300-500m between bus stops[16], Corridor no.2 (Cliffe) is expected to have two more bus stops (one each direction). Bus stop infrastructure improvements can be prioritized and phased according to ridership numbers and funding availability.

3.4.2 Transit Priority

Estimated costs for the four transit priority locations are identified in **Table 5**. Transit priority treatments are the same for both corridors, and therefore costs are the same.

TABLE 5. **SUMMARY OF CAPITAL COSTS FOR TRANSIT PRIORITY LOCATIONS**

Transit Priority Location / Treatment	Cost
Queue Jumper (Ryan Rd / Old Island Hwy)	$200,000
New Signalized Intersection (Ryan Rd / Cowichan Ave)	$250,000
Signal Priority (Island Hwy / Ryan Rd and 5th St / Cliffe Ave)	$50,000

[15] A Class D estimate is typically ±50% of the ultimate cost of the project. Due to limited site information, this estimate is a preliminary estimate that indicates the approximate magnitude of cost of the proposed improvements, and is to be used in developing long term capital plans and for preliminary discussions. A 30% contingency factor is used in developing estimates.

[16] Refer to *Comox Valley Transit Future Plan*, pg 119

3.4.3 Transit Exchanges

Estimated costs for the four transit exchange locations are identified in **Table 6**. Costs are the same for both corridor options, and do not include any land acquisition required.

TABLE 6. **SUMMARY OF CAPITAL COSTS FOR TRANSIT EXCHANGES**

Exchange Location	Cost
A. South Courtenay (Anfield Centre)	$700,000
B. Downtown Courtenay	$500,000
C. North Island College	$900,000
D. Downtown Comox	$200,000

4. Option Evaluation

Both corridor options were evaluated using a “multiple accounts” evaluation approach. The evaluation considers the Primary Criteria – Transit Travel Time, Ridership Potential – which were the focus of the technical assessments presented in *Section 3*. Secondary Criteria are also considered, with a more thorough description of the evaluation criteria provided in *Section 4.1*.

The corridor options were evaluated against one another for each criteria. Results (or performance) under each criteria are summarized as follows:

⇑⇑	**Better** (significant difference)
⇑	**Better** (minor difference)
--	**No Difference**
⇓	**Worse** (minor difference)
⇓⇓	**Worse** (significant difference)

The summary of the evaluation are presented in **Table 7**. Results are generally divided, with no obvious preferred option emerging. Further consideration for these results is given in *Section 5*.

TABLE 7. **SUMMARY OF OPTION EVALUATION**

	Criteria	CORRIDOR No.1	CORRIDOR No.2	Comment(s)
PRIMARY CRITERIA	**Transit Travel Time** Estimated bus travel time from end-to-end	⇑⇑	⇓⇓	Travel time is approx. 2-minutes less for Corridor no.1 (Fitzgerald) (one direction), approx. 7.5% less overall
PRIMARY CRITERIA	**Potential Ridership** Resident / employment population within walking distance of the corridor	⇓⇓	⇑⇑	Resident and employee population within 200m is approx. 10% higher for Corridor no.2 (Cliffe)
SECONDARY CRITERIA	**Traffic Impact** Impact of transit vehicles and transit priority measures on the road network	--	--	No difference between options, all transit priority measures included in both corridors
SECONDARY CRITERIA	**Capital Cost** Costs for bus stops, transit exchanges, and transit priority initiatives	⇑	⇓	Assumed two fewer bus stop required for Corridor no.1 (Fitzgerald) (approx. 300m shorter)
SECONDARY CRITERIA	**Land Use Context** Adjacent land use and impact of nuisance associated with transit (noise, vibrations, exhaust)	⇓	⇑	Greater proportion of residential land use on Corridor no.1 (Fitzgerald), currently subjected to less overall traffic nuisance
SECONDARY CRITERIA	**Sidewalk Coverage / Condition** Presence of sidewalks on the corridor and general condition of existing sidewalks	⇓	⇑	Sidewalks on Corridor no.2 (Cliffe) are continuous and generally newer with some boulevard / setback areas
SECONDARY CRITERIA	**Pedestrian Connectivity** Ease of crossing the corridor via crosswalks and street connectivity (intersection density).	⇑	⇓	Better and more frequent crossing opportunities on Corridor no.1 (Fitzgerald)

4.1 Assessment Criteria

The assessment criteria used as the basis of the option evaluation are considered in two broad categories, as follows:

- **Primary Criteria** | Criteria considered the most important in determining the preferred corridor option, and which performance / evaluation is based on more detailed study and quantitative assessment; and
- **Secondary Criteria** | Criteria considered less important in determining the preferred corridor option, and which performance / evaluation is based on less detailed study and more qualitative assessment.

For the purposes of this study, the assessment criteria used to complete the option evaluation are defined, as follows.

- **Transit Travel Time** | The estimated time required for buses to travel from one end of the corridor to the other. Travel time is based on 25-year conditions (i.e., 2041) and assumes transit priority initiatives and background road network improvements are in-place.
- **Potential Ridership** | Potential resident and employment populations within walking distance to each corridor. Results are based on an assumed 25-year build-out scenario (i.e., 2041) and considers resident / employment populations within 100m, 200m, and 400m of each corridor.
- **Traffic Impact** | The negative impact of added transit vehicles and proposed transit priority measures on non-transit traffic conditions.
- **Capital Cost** | The known comparative capitals costs associated with each corridor option, with consideration given to bus stops, transit exchanges, and transit priority initiatives.
- **Land Use Context** | Consideration of the land uses adjacent to each corridor, their compatibility with an adjacent frequent transit service, and the level of nuisance from noise, vibrations, and exhaust due to increased transit service.
- **Sidewalk Coverage / Condition** | The extent to which sidewalks are currently provided (both sides) along the corridor and the general condition / quality of existing sidewalks.
- **Pedestrian Connectivity** | Ease of pedestrian access to and across the corridor based on the availability of intersections and/or marked crosswalks, and intersection density as it relates to walking trips via perpendicular roads and trails.

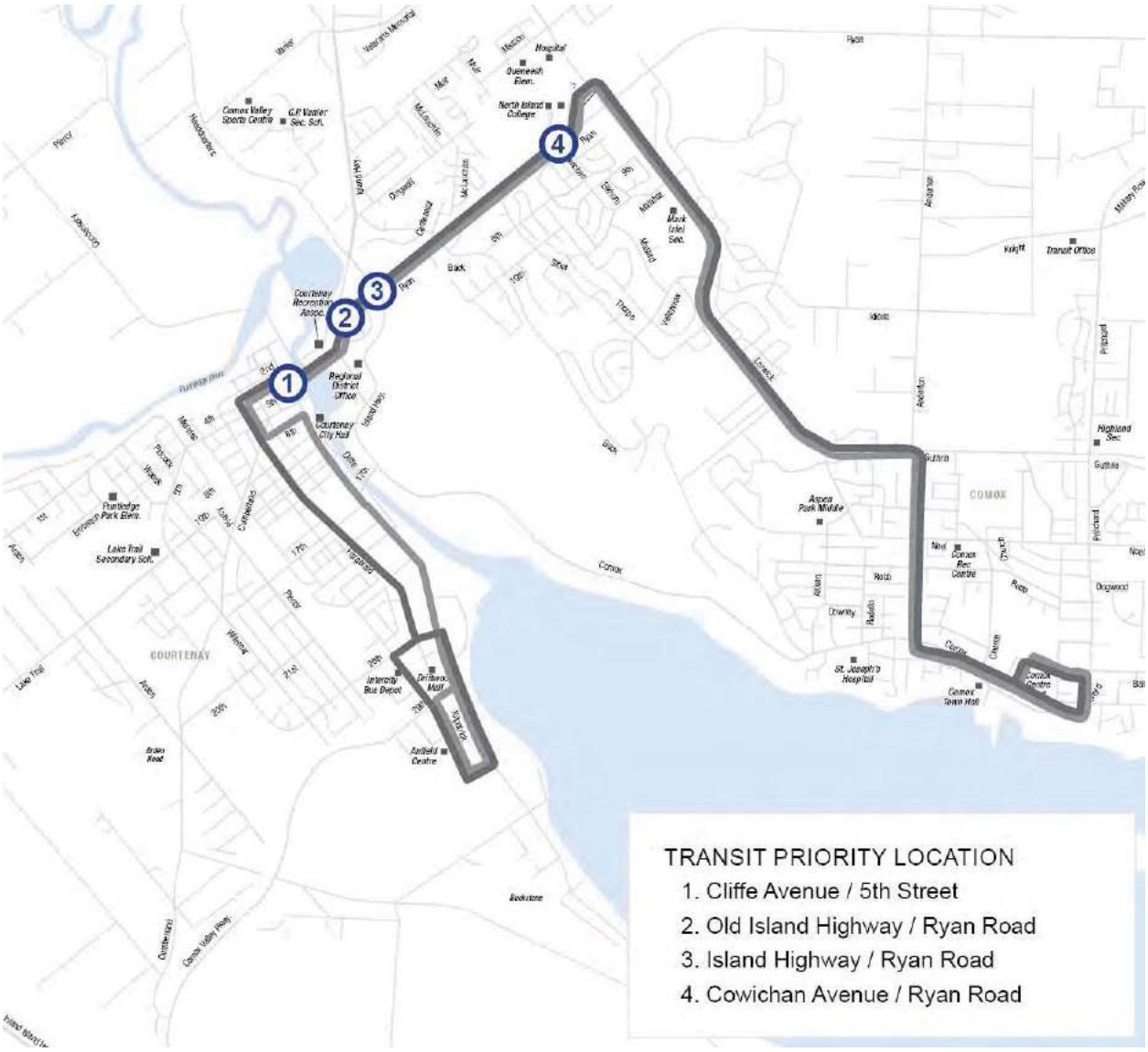
5. Summary

5.1 Preferred Corridor

Corridor No.1 (Fitzgerald) is the recommended Frequent Transit Corridor.

The Corridor is highlighted on **Map 3**, which includes the preferred corridor, exchange locations, and planned transit priority improvements.

MAP 3. **RECOMMENDED FREQUENT TRANSIT CORRIDOR**



5.2 Discussion of Corridor Options

The fundamental trade-off between the two corridor options is a more efficient bus travel time for Corridor no.1 (Fitzgerald) versus increased future density and potential greater ridership for Corridor no.2 (Cliffe). The reduced travel time benefit of Corridor no.1 (Fitzgerald) is a result of lesser travel distance and fewer number of turn movements in the Courtenay section where delay is incurred. These factors exist today and will continue to exist in future.

The benefit of Corridor no.2 (Cliffe) is far less certain than the benefit associated with Corridor no.1 (Cliffe), and is related to a planned increase in future density at the 100m and 200m distances (but not at 400m) resulting in increased potential transit ridership. In contrast to the travel time differential, the difference in density / potential ridership is reliant on future land development in Courtenay to build density around the corridor. The existing land use density does not necessarily favour Corridor no.2 (Cliffe) over Corridor no.1 (Fitzgerald). And, while the City's Official Community Plan (OCP) and related planning initiatives direct density into these areas, there is uncertainty as to whether there is a market for development in these locations and the pace at which development may occur. Further, while 100m, 200m, and 400m distances were the focus of the land use / density assessment as these are understood to represent "accepted" walking thresholds, it is expected that a portion of the population will be willing to walk in excess of 400m to access higher-order transit and Corridor no.1 (Fitzgerald) takes in a larger possible catchment area due to the Courtenay River as a barrier to walking to Corridor no.2 (Cliffe).

Beyond the two primary evaluation measures described above, there were other items given consideration in selecting Corridor no.1 (Fitzgerald) the preferred corridor option, as follows:

1. **Courtenay River** | Land uses immediately east of the Courtenay River have limited resident and employment population, and cannot reasonably walk to access either corridor option (unless accessed via Ryan Road). Fitzgerald Avenue (Corridor no.1) is 350-450m from the River and Cliffe Avenue (Corridor no.2) is 140-180m from the River. This suggests that there are areas beyond the studied thresholds where potential riders may reasonably walk to access Corridor no.1 (Fitzgerald) but that there are no additional riders that may walk from the east of the River to access Corridor no. 2 (Cliffe). The impact of the River as a barrier to accessing transit has a more significant impact on Corridor no.2 (Cliffe).

2. **Walkability** | Corridor no.1 (Fitzgerald) generally exhibits greater "walkability" than Corridor no. 2 (Cliffe), allowing transit to be more easily accessed by pedestrians. Fitzgerald Avenue along Corridor no.1 has a greater number of crossing opportunities, is narrower (curb-to-curb) providing for a short crossing distance, and generally has superior connectivity with perpendicular streets (i.e., greater intersection density). Cliffe Avenue along Corridor no.2 has sidewalks on both sides the length of the corridor that are in good condition, where certain segments of Fitzgerald Avenue lack sidewalks or are in poor condition. Sidewalks are of critical importance along the corridor and are something that should be prioritized for improvement.

3. **Context** | Corridor no. 1 along Fitzgerald Avenue is fronted by a significant number of single-family homes that would be subjected to more noise and vibration resulting from increased transit service, whereas Cliffe Avenue along Corridor no.2 is fronted by a higher proportion of commercial, hotel, and other non-residential uses that are less impacted. Further, Cliffe Avenue is a four-lane road with nearly 3-times the traffic volume as compared to Fitzgerald Avenue, making the nuisance accompanying increased transit service (noise, exhaust, vibrations) less impactful.

5.3 Implementation

It is recommended that BC Transit, in coordination with local partners, undertake an implementation planning exercise to itemize "next steps" resulting from this study. The following items should be addressed:

1. Undertake route planning to identify how local bus routes will be configured to coordinate with the confirmed Frequent Transit Corridor.

2. Work with local governments to confirm and plan for future transit exchanges, giving consideration to coordinating with planned road works and/or future land development. The following should be considered for each location:

    a. South Courtenay - BC Transit, the Comox Valley Regional District, and the City of Courtenay should approach the Anfield Centre property owner to ensure the exchange concept is supported;

    b. Downtown Courtenay – The exchange concept should be integrated into the City's on-going "complete streets" initiative;

    c. North Island College – BC Transit, the Comox Valley Regional District, and the City of Courtenay should work with North Island College to ensure the exchange concept is supported; and

d. Downtown Comox – BC Transit, the Comox Valley Regional District, and the Town of Comox should consider opportunities to enhance the exchange concept in coordination with the redevelopment proposal for the Comox Centre Mall site.

3. Complete an audit of each bus stop location on the corridor to assess general condition and amenities (shelter, bench, lighting, etc) based off the bus stop spacing assessment in **Appendix E**.

4. Assess sidewalk coverage and condition for the entire corridor, and work with local governments and the MoTI to prioritize improvements where sidewalks do not exist, are sub-standard, or are in poor condition.

5. Coordinate with the MoTI and City of Courtenay to advance transit priority measures in the four identified locations (refer to *Section 2.3*).

6. Work with local governments to create a bus stop improvement priority list, giving consideration to coordinating with planned road works and/or future land development.

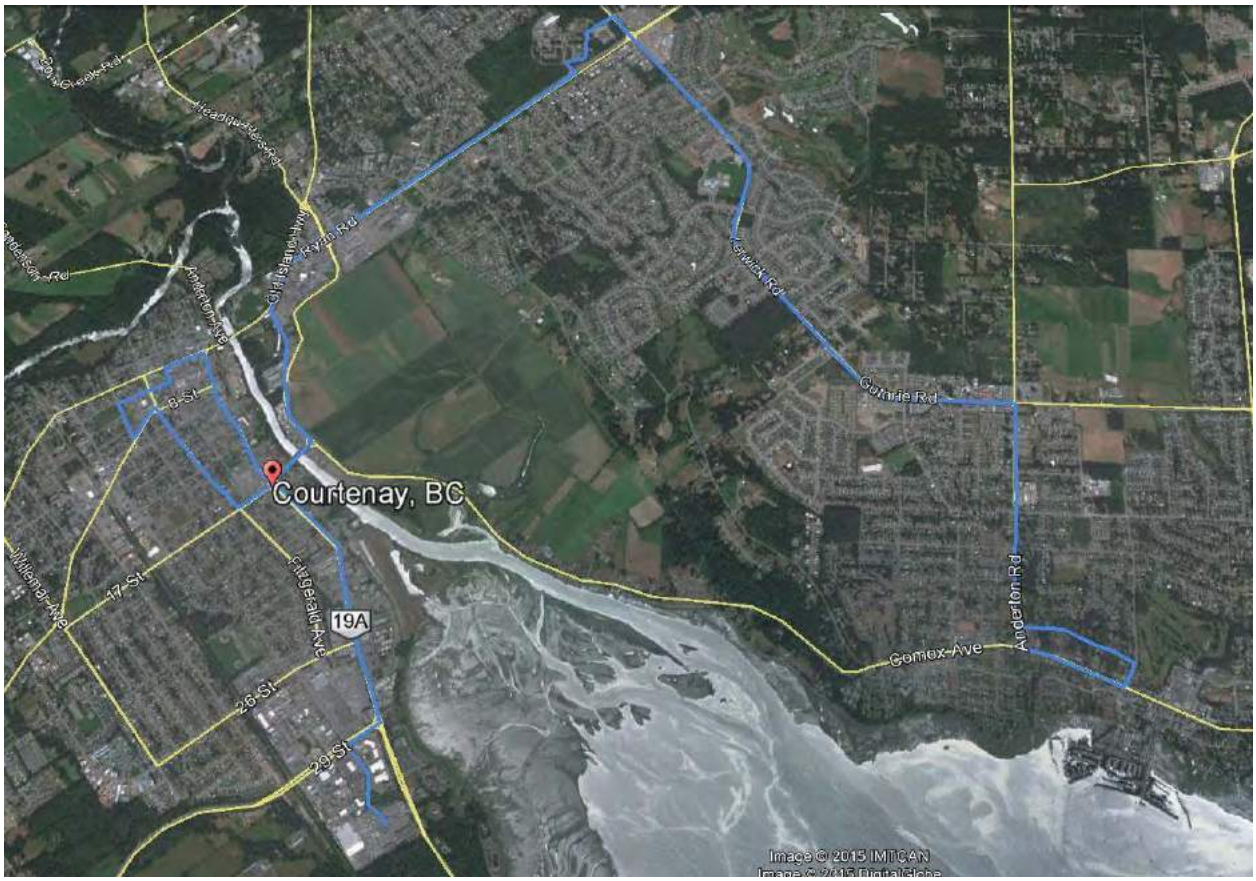
APPENDIX A.

FREQUENT TRANSIT CORRIDOR OPTIONS FROM THE STUDY RFP

Appendix 1: Corridor Options

MAP 1 – Corridor Option 1

MAP 2 - Corridor Option 2



APPENDIX B.

TRANSIT EXCHANGE CONCEPT DESIGNS SHOWING CORRIDOR ROUTING*

*Final corridor routings are subject to on-going feedback through the Transportation Management Advisory Committee (TMAC)

Comox Valley Frequent Transit Corridor Study
TRANSIT EXCHANGE OPTIONS

SOUTH COURTENAY (ANFIELD)

Comox Valley Frequent Transit Corridor Study
TRANSIT EXCHANGE OPTIONS

DOWNTOWN COURTENAY

Comox Valley Frequent Transit Corridor Study
TRANSIT EXCHANGE OPTIONS

NORTH ISLAND COLLEGE

Comox Valley Frequent Transit Corridor Study
TRANSIT EXCHANGE OPTIONS

DOWNTOWN COMOX

APPENDIX C.

SUMMARY OF POTENTIAL RIDERSHIP / DEVELOPMENT BUILD-OUT ANALYSIS

HOW TRANSIT RIDERSHIP POTENTIAL IS DETERMINED

Ridership potential along Corridor no.1 (Fitzgerald) and Corridor no.2 (Cliffe) was determined through a 5 step process. The goal was to establish a quantifiable measure based on the City of Courtenay's Official Community Plan Land Use Designations that could demonstrate each route's capacity for growth in both population and employment potential. Only the areas near the route deviations between Corridor no.1 (Fitzgerald) and Corridor no.2 (Cliffe) were included as the remainder of the route is identical. Below is a discussion of the methodology.

1. **Establish 100m, 200m, + 400m "buffers" around each route**

   Corridor no.1 (Fitzgerald) and Corridor no. 2 (Cliffe) were mapped. The City of Courtenay OCP Designations were also mapped. Buffers were then added to the map at increments of 100m, 200m and 400m for each route. See **Figure 2** and **Figure 3** in Section 3.2 of this report for maps of the buffer areas and the OCP Designations within the buffers.

2. **Calculate the land area for Key OCP designations within each buffer**

   The amount of land within each designation was determined in square meters. This was determined for lands along each route within each buffer.

3. **Calculate assumed maximum build-out ratio for each OCP Designation based on zoning regulations**

   Underlying zoning regulations were examined for each of the OCP designations falling within the buffer. A build-out analysis was then conducted. The build-out analysis consisted of the following steps.

   a. Zoning requirements for lot coverage and height were applied to a base 1,000m² unit of land for each zone. This provided an estimated maximum build-out ratio for every 1000m² unit of land within a given zone for both floor area (non-residential uses) and dwelling units (residential uses). See **Table 1** of this Appendix for zones and build out results. The lot coverage maximum for each zone was applied to the base 1000m² unit of land, this yielded the total coverage allowable per unit of land. Zoning regulations also provided height maximums. The height maximum was translated into number of floors. Lot coverage was then multiplied by the number of floors. This process provided an estimate of the total square footage each zone could support. For example, the MU-2 Zone allows 40% coverage, equaling 400m² of lot coverage when applied to 1000m². Height in the MU-2 is 10m assumed to be 3 floors. The MU-2 Zone allows ground floor commercial uses with residential above yielding a total of 400m² of commercial floor area and 800m² of residential floor area. Residential floor area was then converted to dwelling units based on an average unit size of 75m².

In the case of R-1 and R-2 Zones the process differed. In these zones the number of units is more dependent on the lot size then maximum coverage. As such the number of dwelling units was based on lot size (see **Table 12**).

b. OCP designations considered in the model include – Multi-Residential, Urban Residential, Commercial, Shopping Centre, Industrial, Public Institutional, and Mixed Use. Zones underlying each of the above designations were assigned a weight based on the approximate percentage of land each zone contributed to each designation. The weighted build-out ratios for each zone yielded a ratio of floor area (non-residential uses) and dwelling units (residential uses) for a 1000m² unit of land in each OCP Designation (see **Table 2** of this Appendix). **Tables 12-16** of this Appendix include a list of all assumptions applied to the model.

4. Apply assumed maximum build-out ratios to total land area

1000m² build-out ratios were applied to the total area of land in each designation. The output of this calculation provided an estimate of total number of dwelling units and total non-commercial square footage each designation could support (see **Tables 3-8** of this Appendix).

5. Convert total maximum land use into number of people

Average number of people per household was determined based on the results from the NHS (National Housing Survey), using the total population and number of private households. Total population was 23,575 and the number of private households was 10,890, suggesting an average household size of 2.16 people per unit in Courtenay.[17] Non-commercial square footage was converted into employment by determining the average area per employee based on several business types.[18] Results suggested an average of 72m² per employee (see **Tables 9-11** of this Appendix).

[17] Stats Canada, National Household Survey, 2011, Courtenay. Available online at: https://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=5926010&Data=Count&SearchText=courtenay&SearchType=Begins&SearchPR=59&A1=All&B1=All&Custom=&TABID=1

[18] US Green Building Council, Building Area per Employee by Business Type, 2008. Available online at: http://www.usgbc.org/Docs/Archive/General/Docs4111.pdf

TABLE 1. **BUILD-OUT POTENTIAL, BY ZONE**

Zone	MU-2	R-1	R-2	C-1 no Res	C-1 w Res	C-2 no res	C-2 w Res	C-1A	C-2 no res	CD8	I-2	PA-1	PA-3
Lot Size	1000 m	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Lot Coverage	40%	40%	40%	n/a assume 60%	n/a assume 60%	50%	0.6 FAR	40%	50%	30%	60%	40%	20%
Height	3 fl 10m	2 fl 8m	2 fl 8m	4 fl 13.5m	4 fl 3.5m	2 fl 9.5m	4fl 13.5m	2 fl 9.5m	2 fl 9.5m	2 fl 9.15m	1 fl 15m	3 fl 12m	3 fl 12m
Floor Area (m^2)	1200	800	800	2400	2400	1000	600	800	1000	600	1200	1200	600
Com. Fl.	400	0	0	2400	600	1000	150	800	1000	600	1200	1200	600
Res Floor	800	800	800	0	1800	0	450	0	0	0	0	0	0

TABLE 2. **BUILD-OUT POTENTIAL, BY OCP DESIGNATION**

OCP Designation	Mixed Residential	Urban Residential	Commercial	Shopping Centre	Industrial	Public/ Institutional	Mixed Use
Floor Area (m^2)	400	0	1501.25	960	1200	840	400
Dwelling Units	11	1.5	2.25	0	0	0	11

TABLE 3. **ACHIEVABLE LAND USE WITHIN 100M BUFFER OF CORRIDOR NO.1**

	Multi Residential	Urban Residential	Commercial	Shopping Centre	Industrial	Public/ Institutional	Mixed Use	Total Floor Area
Floor Area	400	0	1501.25	960	1200	840	N/A	-
Dwelling Units	11	1.5	2.25	0	0	0	N/A	-
Designation Area	123703	128743	175650	216548	39893	1801	N/A	-
Units of Land	123.703	128.743	175.65	216.548	39.893	1.801	N/A	-
Floor Area	49481.2	N/A	263694.5625	207886.08	47871.6	1512.84	N/A	570446.3
Dwelling Units	1360.73	199.17	395.21	0	0	0	N/A	-

TABLE 4. **ACHIEVABLE LAND USE WITHIN 100M BUFFER OF CORRIDOR NO.2**

	Multi Residential	Urban Residential	Commercial	Shopping Centre	Industrial	Public/ Institutional	Mixed Use	Total Floor Area
Floor Area	400	0	1501.25	960	1200	840	400	-
Dwelling Units	11	1.5	2.25	0	0	0	11	-
Designation Area	94507	7084	333169	171411	9001	171	16029	-
Units of Land	94.507	7.084	333.169	171.411	9.001	0.171	16.029	-
Floor Area	37802.8	N/A	500169.9613	164554.56	10801.2	143.64	6411.6	719883.8
Dwelling Units	1039.577	10.96	749.63025	0	0	0	176.319	-

TABLE 5. **ACHIEVABLE LAND USE WITHIN 200M BUFFER OF CORRIDOR NO.1**

	Multi Residential	Urban Residential	Commercial	Shopping Centre	Industrial	Public/ Institutional	Mixed Use	Total Floor Area
Floor Area	400	0	1501.25	960	1200	840	N/A	-
Dwelling Units	11	1.5	2.25	0	0	0	N/A	-
Designation Area	230693	272249.0	310390	264114	105754	30441	N/A	-
Units of Land	230.693	272.249	310.39	264.114	105.754	30.441	N/A	-
Floor Area	92277.2	N/A	465972.9875	253549.44	126904.8	25570.44	N/A	964274.9
Dwelling Units	2460.725333	421.169203	698.3775	0	0	0	N/A	-

TABLE 6. **ACHIEVABLE LAND USE WITHIN 200M BUFFER OF CORRIDOR NO.2**

	Multi Residential	Urban Residential	Commercial	Shopping Centre	Industrial	Public/ Institutional	Mixed Use	Total Floor Area
Floor Area	400	0	1501.25	960	1200	840	400	-
Dwelling Units	11	1.5	2.25	0	0	0	11	-
Designation Area	207521	71485	449032	242775	53289	24164	49598	-
Units of Land	207.521	71.485	449.032	242.775	53.289	24.164	49.598	-
Floor Area	83008.4	NA	674109.29	233064	63946.8	20297.76	19839.2	1094265
Dwelling Units	2213.557333	110.587295	1010.322	0	0	0	545.578	-

TABLE 7. **ACHIEVABLE LAND USE WITHIN 400M BUFFER OF CORRIDOR NO.1**

	Multi Residential	Urban Residential	Commercial	Shopping Centre	Industrial	Public/ Institutional	Mixed Use	Total Floor Area
Floor Area	400	0	1501.25	960	1200	840	400	-
Dwelling Units	11	1.5	2.25	0	0	0	11	-
Designation Area	322764	534257	447876	273366	172416	61923	105724	-
Units of Land	322.764	534.257	447.876	273.366	172.416	61.923	105.724	-
Floor Area	129105.6	N/A	672373.845	262431.36	206899.2	52015.32	42289.6	1365115
Dwelling Units	3442.816	826.495579	1007.721	0	0	0	1162.964	-

TABLE 8. **ACHIEVABLE LAND USE WITHIN 400M BUFFER OF CORRIDOR NO.2**

	Multi Residential	Urban Residential	Commercial	Shopping Centre	Industrial	Public/ Institutional	Mixed Use	Total Floor Area
Floor Area	400	0	1501.25	960	1200	840	400	-
Dwelling Units	11	1.5	2.25	0	0	0	11	-
Designation Area	319471	363859	461501	273366	182146	27900	105724	-
Units of Land	319.471	363.859	461.501	273.366	182.146	27.9	105.724	-
Floor Area	127788.4	N/A	692828.3763	262431.36	218575.2	23436	42289.6	1367349
Dwelling Units	3407.690667	562.889873	1038.37725	0	0	0	1162.964	-

TABLE 9. **CONVERSION OF FLOOR AREA/UNITS TO PEOPLE WITHIN 100M BUFFER**

	CORRIDOR NO.1 (Fitzgerald)		CORRIDOR NO.2 (Cliffe)	
	Floor Area / Units	People	Floor Area / Units	People
Commercial	570,446	7,923	719,884	9,998
Residential	1,955	4,223	1,976	4,269

TABLE 10. **CONVERSION OF FLOOR AREA/UNITS TO PEOPLE WITHIN 200M BUFFER**

	CORRIDOR NO.1 (Fitzgerald)		CORRIDOR NO.2 (Cliffe)	
	Floor Area / Units	People	Floor Area / Units	People
Commercial	964,275	13,393	1,094,265	15,198
Residential	3,580	7,733	3,880	8,381

TABLE 11. **CONVERSION OF FLOOR AREA/UNITS TO PEOPLE WITHIN 400M BUFFER**

	CORRIDOR NO.1 (Fitzgerald)		CORRIDOR NO.2 (Cliffe)	
	Floor Area / Units	People	Floor Area / Units	People
Commercial	1,365,115	18,960	1,367,349	18,991
Residential	6,440	13,910	6,172	13,331

TABLE 12. **ASSUMPTIONS FOR ZONES IN MIXED USE + RESIDENTIAL DESIGNATION**

Zone MU-2	Calculated for 1000 square meters unit of land	Resource
	Lot coverage 40%	As per zoning bylaw
	Ht 3 floors based off 10m maximum building height,	As per zoning bylaw
	Achievable floor area 1200 meters squared	Calculated
	Assumption: For 3 floors Ground floor = commercial Upper 2 floors = residential	
	Assumption: Multi-unit dwelling unit size = 75 sq m	
	Assumption: % of OCP Mixed Use designation = 100%	
Zone R-1	Calculated for 1000 square meters unit of land	
	Lot coverage 40%	As per zoning bylaw
	Calculations for dwelling numbers based on minimum lot size 650 sq m	As per zoning bylaw
	Assume 1 dwelling unit per lot (650 sq m)	
	Assumption: % of Urban Residential Designation = 25%	
Zone R-2	Calculated for 1000 square meters unit of land	
	Lot coverage 40%	As per zoning bylaw
	Calculations for dwelling numbers based on minimum lot size 750 sq m for one unit	As per zoning bylaw
	Duplex require 900 sq m lot size (2 units)	As per zoning bylaw
	Assumption: 75% of R-2 zone lots for single dwellings (750 sq m lot size) 25% of R-2 zone lots for duplex dwellings (900 sq m lot size)	
	Overall % of Urban Residential Designation = 75%	

TABLE 13. **ASSUMPTIONS FOR ZONES IN COMMERCIAL DESIGNATION**

Zone C-1 no residential	Calculated for 1000 square meters unit of land	
	Assumption: Lot coverage 60%	No maximum lot coverage in zoning bylaw
	Ht 13.5 m (allows for 4 floors)	As per zoning bylaw
	Assumption: Apply C-1 with no residential to 85% of the overall C1 zone	assuming the majority of commercial development may not have high demand for mixed-use in this city
Zone C-1 with residential	Calculated for 1000 square meters unit of land	
	Assumption: Lot coverage 60%	No maximum lot coverage in zoning bylaw
	Ht 13.5 m (allows for 4 floors)	As per zoning bylaw
	Assumption: Apply C-1 with residential to 15% of the overall C1 zone	assuming the majority of commercial development may not have high demand for mixed-use in this city
	Assumption: For 4 floors Ground floor = commercial Upper 3 floors = residential	
	Assumption: Multi-unit dwelling unit size = 75 sq m	Average 2009 condo size ~800 sq ft., average 2011 condo size ~ 760 sq ft.
C-1 (BOTH)	Assumption: 50% of overall Commercial Designation	Visual comparison of zoning and designation maps
Zone C-2 no residential	Calculated for 1000 square meters unit of land	
	Lot coverage 50%	As per zoning bylaw
	Ht 9.5 m (2 floors)	As per zoning bylaw
	Assumption: Apply C-2 with no residential to 85% of the overall C2 zone	Assumes the majority of commercial does not have high demand for mixed-use
Zone C-2 residential	Calculated for 1000 square meters unit of land	
	Lot coverage 50%	As per zoning bylaw
	0.6 floor area ratio	As per zoning bylaw (more restrictive than lot coverage)
	4 Floor height maximum	As per zoning bylaw
	Assumption: Multi-unit dwelling unit size = 75 sq m	Average 2009 condo size ~800 sq ft., average 2011 condo size ~ 760 sq ft.
	Assumption: Apply C-2 with residential to 15% of the overall C2 zone	assuming the majority of commercial development may not have high demand for mixed-use in this city
C-2 (BOTH)	Assumption: 50% of Commercial Designation	Visual comparison of zoning and designation maps

TABLE 14. ASSUMPTIONS FOR ZONES IN SHOPPING CENTRE DESIGNATION

Zone C-1A	Calculated for 1000 square meters unit of land	
	Lot coverage 40%	As per zoning bylaw
	Ht 9.5 m maximum (assume 2 floors)	As per zoning bylaw
	Assumption: 35% of overall Shopping Centre designation	Visual comparison of zoning and designation maps
Zone C-2 no residential	Calculated for 1000 square meters unit of land	
	Lot coverage 50%	As per zoning bylaw
	Ht 9.5 m (2 floors)	As per zoning bylaw
	Assumption: Apply C-2 with no residential to 55% of Shopping Centre Designation	Assuming within shopping centre designation there is low demand for multi-unit development with residential
Zone CD8	Calculated for 1000 square meters unit of land	
	Lot coverage 30%	As per zoning bylaw
	Ht 9.15 m (2 floors)	As per zoning bylaw
	Assumption: Apply CD8 to 10% of Shopping Centre Designation	Visual comparison of zoning and designation maps

TABLE 15. ASSUMPTIONS FOR ZONES IN INDUSTRIAL DESIGNATION

Zone I-2	Calculated for 1000 square meters unit of land	
	Lot coverage 60%	As per zoning bylaw
	Ht maximum 15 m Assumption – 2 floors	Height allows for 3 floors, but some large or heavy industrial will only have 1 floor, light industrial may have 3 floors
	I-2 Applied to 100% of Industrial Designation	

TABLE 16. ASSUMPTIONS FOR ZONES IN PUBLIC/INSTITUTIONAL DESIGNATION

Zone PA-1	Calculated for 1000 square meters unit of land	
	Lot coverage 40%	As per zoning bylaw
	Ht 12 m (3 floors)	As per zoning bylaw
	PA-1 Applied to 40% of Public/ Institutions Designation	Visual comparison of zoning and designation maps
Zone PA-3	Calculated for 1000 square meters unit of land	
	Lot coverage 20%	As per zoning bylaw
	Ht 12 m (3 floors)	As per zoning bylaw
	PA-3 Applied to 60% of Public/ Institutions Designation	Visual comparison of zoning and designation maps

APPENDIX D.

SUMMARY OF ROAD NETWORK IMPACT ANALYSIS

SUMMARY OF ROAD NETWORK IMPACT ANALYSIS

The four proposed transit priority locations were reviewed to confirm they are feasible and to assess their impact on non-transit movements. Results were summarized in text in *Section 3.3*. Below are the detailed findings.

Delay was assessed for the Ryan Road / Island Highway and Ryan Road / Old Island Highway intersection using the 25-year VISSIM model. Delay was considered for future (2041) conditions without transit priority (assumes background network improvements) and future (2041) conditions with transit priority measures in-place. Results are in **Table 1** and **Table 2** below.

TABLE 1. **RYAN ROAD / OLD ISLAND HIGHWAY DELAY (SECONDS), 2041**

Movement	FUTURE (2041)		FUTURE (2041) WITH TRANSIT PRIORITY	
	Option 1 (Fitzgerald)	**Option 2** (Cliffe)	**Option 1** (Fitzgerald)	**Option 2** (Cliffe)
NBT	1.50	13.96	13.92	15.09
NBR	1.55	1.66	0.00	2.02
SBL	4.69	21.48	22.42	21.17
SBT	1.06	15.40	14.35	14.70
WBL	14.06	14.59	0.00	16.26
WBL Queue Jumper	n/a	n/a	10.17	13.25
WBR	15.13	0.49	1.18	0.73
OVERALL	6.53	10.35	10.57	11.07

TABLE 2. **RYAN ROAD / ISLAND HIGHWAY DELAY (SECONDS), 2041**

Movement	FUTURE (2041)		FUTURE (2041) WITH TRANSIT PRIORITY	
	Option 1 (Fitzgerald)	**Option 2** (Cliffe)	**Option 1** (Fitzgerald)	**Option 2** (Cliffe)
NBL	37.42	32.97	34.68	33.43
NBT	33.81	27.42	27.89	28.94
NBR	7.14	7.5	7.56	7.28
SBL	65.87	65.28	42.82	44.90
SBT	20.88	22.45	20.61	19.48
SBR	2.48	2.68	2.78	2.91
EBL	34.59	34.80	38.53	37.08
EBT	21.85	22.76	24.44	25.59
EBR	1.48	2.41	2.16	3.16
WBL	38.60	37.81	49.09	61.75
WBT	11.05	10.83	13.38	12.75
WBR	1.29	1.27	1.45	1.24
OVERALL	24.55	24.18	25.12	27.7

Synchro traffic modelling software was used to assess traffic conditions at a 25-year timeline for the Ryan Road / Cowichan Avenue and 5th Street / Cliffe Avenue intersections. Results are presented in **Table 3** and **Table 4** below.

TABLE 3. **RYAN ROAD / COWICHAN AVENUE CONDITIONS, 2041**

	Delays (s)		LOS		Queues (m)	
	Stop Control	Signal	Stop Control	Signal	Stop Control	Signal
NB	Err**	11.9	F	B	20m	15m
SBLT	105.5	20.3	F	C	15m	15m
SBR	105.5	10.2	F	B	10m	15m
EBL	12.0	5.3	B	A	15m	20m
EBTR	0.0	3.4	A	A	5m	40m
WBL	10.7	3.9	B	A	15m	25m
WBT	0.0	9.4	A	A	55m	95m
WBR	0.0	1.5	A	A	95m	95m

Ryan Road is Eastbound/Westbound
**Err = error message related to delays exceeding 1,000 seconds

TABLE 4. **5TH STREET / CLIFFE AVENUE CONDITIONS, 2041**

	Delays (s)		LOS		Queues (m)	
	Signal	With P/P Left	Signal	With P/P Left	Signal	With P/P Left
NBT	73.7	73.7	E	E	40m	40m
NBR	29.2	29.5	C	C	205m	205m
SBL	51.5	49.7	D	D	10m	10m
SBTR	55.1	55.1	E	E	70m	70m
EBT	75.5	75.5	E	E	275m	275m
EBR	9.7	9.7	A	A	20m	20m
WBL	75.8	75.8	E	E	305m	305m
WBTR	60.7	60.7	E	E	235m	235m

APPENDIX E.

BUS STOP SPACING ASSESSMENT

OVERVIEW

The following is a review of bus stop locations for the preferred FTN Corridor. The purpose of this review is to:

1. Identify existing bus stop locations on the preferred FTN Corridor; and
2. Review the preferred FTN Corridor to identify existing bus stops that are less than the recommended spacing and/or areas along the corridor that exceed recommended spacing.

SPACING CRITERIA

The Comox Valley Transit Future Plan clarifies that bus stops should be spaced 300 to 500m apart in urban areas, and limited to major destinations, points of interest, and residential concentrations outside of urbanized areas[19]. Transit stops that are spaced too close together lead to slower transit trips and higher transit stop maintenance costs and stops that are too far apart limit passenger access to the system.

FINDINGS

The key results are summarized below and illustrated on a map on the following pages.

- There are 52 existing bus stops on the preferred FTN corridor – 27 northbound, 25 southbound.[20]
- Nine segments were identified where recommended spacing between bus stops (500m) is exceeded. Most are in locations where transit service currently operates and adjacent land uses likely do not necessitate bus stops. The following are locations where service is currently not offered and further consideration should be given to adding bus stops:
    1. 4th Street between Fitzgerald Avenue and Cliffe Avenue (both directions);
    2. Kilpatrick Avenue between 26th Street and Anfield Centre (southbound only); and
    3. Cliffe Avenue between Anfield Road and 26th Street (northbound only).
- Sixteen occurrences were noted where existing bus stop spacing is less than the recommended spacing (300m). Four locations were noted where spacing is less than 200m between stops and should be given further consideration, as follows:
    1. Stops on Cliffe Avenue at the current downtown Courtenay exchange (N7,N8)
    2. Southbound/eastbound stops on Comox Avenue in downtown Comox (N26,N27)
    3. Stops in both directions on Lerwick Road at Inverclyde Way (S9,S10,N17,N18)

[19] Comox Valley Transit Future Plan, pg 118

[20] All bus stops were identified and confirmed using BC Transit's Bus Stop Management System, available online at: http://bct2.baremetal.com:8080/index.php

SUMMARY OF EXISTING BUS STOP SPACING

Bus Stop ID + Location		Spacing
N1 (134007)	Cliffe at Anfield Rd	
		1,400m
N2 (111280)	Fitzgerald at 21st St	
		698m
N3 (111281)	Fitzgerald at 16th St	
		268m
N4 (111282)	Fitzgerald at 13th St	
		341m
N5 (111284)	Fitzgerald at 10th St	
		328m
N6 (111286)	Fitzgerald at 5th St	
		500m
N7 (111486)	Downtown Exchange A	
		42m
N8 (111270)	Downtown Exchange B	
		400m
N9 (111381)	70 Block at 5th St	
		292m
N10 (111296)	Old Island at Puntledge Rd	
		321m
N11 (111297)	Ryan at Puntledge Rd	
		444m
N12 (111298)	1140 Block at Ryan Rd	
		1,870m
N13 (111476)	Lerwick at College Campus	
		360m
N14 (111477)	460 Block at Lerwick Rd	
		570m
N15 (111300)	Lerwick at Malahat Dr	
		772m
N16 (111301)	Lerwick at Valley View Dr	

Bus Stop ID + Location		Spacing
S1 (111324)	Comox at Ellis St	
		444m
S2 (111325)	Anderton at Buena Vista Ave	
		348m
S3 (111326)	Anderton at McKenzie Ave	
		497m
S4 (111368)	Anderton at Bolt Ave	
		419m
S5 (111369)	Anderton at Guthrie	
		200m
S6 (111370)	Guthrie at Stadacona Dr	
		332m
S7 (111371)	Guthrie at Aspen Rd	
		560m
S8 (134014)	Lerwick at McDonald Rd	
		576m
S9 (111372)	Lerwick at Inverclyde Way	
		184m
S10 (111374)	2100 Block at Lerwick Rd	
		310m
S11 (111375)	Lerwick at Valley View Dr	
		871m
S12 (111478)	Lerwick at Malahat Dr	
		558m
S13 (111377)	470 Block at Lerwick Rd	
		344m
S14 (134010)	Colby at Lerwick Rd	
		1,590m
S15 (110305)	Ryan at Back Rd	
		366m
S16 (111378)	1000 Block at Ryan Rd	

Bus Stop ID + Location		Spacing
		436m
N17 (111373)	2130 Block at Lerwick Rd	
		240m
N18 (111302)	Lerwick at Inverclyde Way	
		755m
N19 (111303)	2260 Block at Guthrie Rd	
		600m
N20 (111304)	Guthrie at Stadacona Dr	
		320m
N21 (111305)	Anderton at Guthrie Rd	
		388m
N22 (111306)	Anderton at Bolt Ave	
		504m
N23 (111347)	Anderton at McKenzie Ave	
		335m
N24 (111348)	Anderton at Buena Vista Ave	
		500m
N25 (111349)	Comox at Ellis St	
		456m
N26 (111350)	Comox at Nordin St	
		133m
N27 (111472)	Comox at Stewart St	

Bus Stop ID + Location		Spacing
		376m
S17 (111379)	Ryan at Puntledge Rd	
		324m
S18 (111380)	Old Island at Puntledge Rd	
		1,280m
S19 (111488)	Fitzgerald at 5th St	
		260m
S20 (111271)	Fitzgerald at 10th St	
		370m
S21 (111474)	Fitzgerald at 13th St	
		264m
S22 (134002)	Fitzgerald at 16th St	
		303m
S23 (111272)	Fitzgerald at 18th St	
		305m
S24 (111273)	Fitzgerald at 21st St	
		314m
S25 (111274)	Fitzgerald at 23rd St	

SUMMARY OF BUS STOP LOCATION + SPACING