EAST KILBRIDE AREA
COMPREHENSIVE LAND USE DEVELOPMENT PLAN
DRAFT REPORT (JANUARY 25TH, 2019)

NOTICE FROM CITY OF ST. JOHN'S

The attached report is a DRAFT REPORT and has not been adopted by Council. The City of St. John's makes no representations whatsoever as to the information contained therein or as to the accuracy of the information contained therein.

EAST KILBRIDE AREA
COMPREHENSIVE LAND USE DEVELOPMENT PLAN

DRAFT REPORT

Prepared for:
City of St. John's

Date:
January, 2019

Project No.
143046.00

Prepared by:
CBCL LIMITED
Consulting Engineers

Draft Report Revised	Jennifer Bursey	January 25, 2019	Greg Sheppard
Draft Report	Susann Hickey	February 22, 2018	Greg Sheppard
Issue or Revision	***Reviewed By:***	***Date***	***Issued By:***

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January 25, 2019

Mr. Brendan O'Connell, P.Eng.
Director of Engineering
Dept. of Planning, Development and Engineering
City of St. John's
PO Box 908
St. John's, NL A1C 5M2

Dear Mr. O'Connell:

RE: Kilbride Area Comprehensive Development Plan
Draft Report

We are pleased to provide you with our Draft Report for the above-noted project. The revisions to this Draft Report include edits to Maps 11 to 15 to reflect changes to future lot layouts.

Yours very truly,

CBCL Limited

Greg Sheppard, P.Eng.
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CANADA'S BEST MANAGED COMPANIES

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EXECUTIVE SUMMARY

Introduction

East Kilbride offers some of the last remaining areas designated for future urban expansion in the City of St. John's. This study details the process of identifying suitable lands for development within the Study Area (including Kilbride and Shea Heights) and preparing a concept plan with appropriate planning attributes.

Existing Conditions and Analysis

The City of St. John's is expected to have a projected growth of between 4,000 and 16,000 over the next decade. Kilbride has become a popular area of the City for residential development. While current housing demand is with single detached residential units, increasing student and senior populations suggest a need for rental units within the area. The neighbourhood is currently serviced by existing transit, and is in close proximity to existing schools, supermarkets, and other retail services. This accessibility, paired with the attractive views of the Waterford Valley, makes it likely that demand for housing in the Study Area will continue.

The undeveloped lands within the area are generally characterized by mature forest stands and wetlands. This places importance on consideration of watercourses, ponds, streams, and wetland areas, which are analyzed using a 'Conservation Priority' assignment approach. Topography is another important consideration for the Study Area because of its general slope towards the Waterford Valley. The slope is mostly gentle with 70% of the area lying within the acceptable range for development of 0-15% grade. However, in the Shea Heights area, the nature of the terrain presents issues with accessing the suitable slopes. Elevation is another important consideration for the Study Area with maximum elevations of 230 metres. There are certain areas where the City's snow storage policies are required.

The current Municipal Plan designations within the area has almost 70% of the Study Area designated for open space/conservation or restricted development. The restricted development designation is applied to lands not suitable for development because of exposure to steep slopes, unstable soils, poor drainage, or susceptibility to flooding or other natural hazards. As part of this study, the restricted development areas were reviewed in more detail to determine whether any areas in the designations could be suitable for development. There is also 32% of the study area designated for residential, of which, 7% is designated for Comprehensive (urban) Development.

Existing land use in Kilbride consists of residential, institutional, commercial, and industrial. Residential is the primary land use, with the other uses being limited and concentrated along the main collector streets. There is currently some land in use for agriculture in the Study Area, for crop or forage production, but the remaining land is undeveloped, forested land. The majority of land within the Study

Area is privately-owned, with the exception of 33 hectares surrounding Shea Heights, and the site of the Petty Harbour Long Pond Water Treatment Plant in Kilbride.

Services within the Study Area include parks, schools, sewer and water, and transportation. The City of St. John's has a recent Open Space Master Plan (2014) that is responsible for the Study Area's well-serviced status regarding existing parks and open spaces. There is also mention of a lack of a formal pedestrian network with connections to the larger City trail and open space system in the Open Space Master Plan. There is only one school in the Study Area, but the school system includes other schools nearby. Shea Heights and Kilbride are serviced by separate sanitary sewer lines, but share the same water supply system.

Metrobus Transit provides hourly bus service in the Study Area. In a 2011 study, Shea Heights and Kilbride were identified as areas of low ridership with insufficient development density to warrant a 30-minute level of bus service. The City Cycling Plan identified Bay Bulls Road and Blackhead Road as part of the City cycling network. There is a St. John's Bike Task Force established to work out the details of these cycling services. A detailed traffic report was conducted as part of this study and determined that the current transportation network is reaching its capacity to handle vehicular traffic. Continued growth in development is expected to put strain on the existing road network, suggesting probable need for substantial upgrades.

An overall analysis of the existing conditions was conducted to identify lands that have potential for development in the Study Area. The results of this suitability analysis show that Shea Heights has limited potential for additional development, and the land between Shea Heights and Kilbride is mainly steep slopes, limiting development potential. The best suitable land for development is located in the Kilbride portion of the Study Area. Services in the area are sensitive to any new development in the Study Area. Upgrades to the existing street network will be needed to accommodate expected traffic increases, and there is limited capacity in the sanitary sewer system. The water supply system will require upgrades, and storm water detention facilities are mandatory with new developments.

Development Concept

The development concept is prepared to meet high standards for transportation network access and connections, design and access for parks and open space, complete neighbourhood mixed use qualities, and efficient municipal services. The design is meant to accommodate anticipated growth of the City of St. John's with an urban level of servicing for municipal services. The plan has an emphasis on natural preservation of environmentally sensitive areas, steeply sloped topography, while still aiming to maintain the character of existing subdivision areas. The planned development concept could accommodate a population of approximately 2,560 with a density of 40 persons per hectare.

The concept expands existing residential neighbourhoods, transitioning from the established existing housing to a greater mix of residential uses, densities, and housing forms in other parts of the development area. Complete neighbourhoods require residential densities that will support commercial services, which is unlikely for the Shea Heights portion of the Study Area due to issues of difficult terrain. The concept allows for complete neighbourhood densities to be reached for the Kilbride portion by describing development as containing a range of housing from single detached to multi-unit residential forms.

Streets are designed in the concept to minimize dead-end cul-de-sacs and provide good connectivity for vehicles. However, in Shea Heights, constraints of topography do not provide opportunities for an integrated street network creating a proposal with four cul-de-sac streets to access potential

developable areas off the main spine. The developments have block lengths between 60 metres and 360 metres. Street connections to new development areas will come from Bay Bulls Road, Valleyview Road, Griffins Lane, Old Petty Harbour Road, Densmore's Lane, and Parkridge Drive. A new street is proposed for the south end of the Study Area.

Municipal services are accounted for in the concept with strong consideration of issues discovered during analysis. Upgrades to the water supply system will allow for the supply of water to the higher elevations in Kilbride and the Beaver Pond area, and will replace the existing pump station and reservoir in Shea Heights. Accommodations are made for the stormwater detention policy with the addition of detention ponds. The concept includes a complete Open Space Concept Plan within the development concept. A full traffic analysis informed a list of suggestions for road network changes to ensure transportation network connections and access points function safely and efficiently. Lastly, the concept offers a list of land use policy amendments that will ensure the goals and development objectives are achieved.

CHAPTER 1 INTRODUCTION

1.1 Purpose

Lands in East Kilbride are one of the last remaining areas designated for future urban expansion in the City of St. John's.

The purpose of this study is to identify lands suitable for development within the Study Area and prepare a concept plan with appropriate planning and zoning designations, a conceptual street network, plans for municipal water and wastewater services, parks and open space.

This report provides the context for a comprehensive land use development plan, describing existing physical and environmental conditions, housing market and demographics, land use, infrastructure, and transportation. It highlights the challenges and opportunities for development that are considered and addressed in the development plan.

1.2 Study Area

The area considered in this report (the Study Area) is shown in Figure 1.1 and on Map 1 (Appendix A) and includes lands currently identified in the City's Municipal Plan for future comprehensive urban development. It also includes developed portions of Kilbride and Shea Heights and the area between the Richmond Hill subdivision and Shea Heights. To the west, the Study Area is bound by the Bay Bulls Highway (Route 10) and Pitts Memorial Drive, and to the east, by the boundaries of the Petty Harbour Long Pond Protected Water Supply Area. To the south, lands are part of the St. John's Agricultural Development Area (ADA).

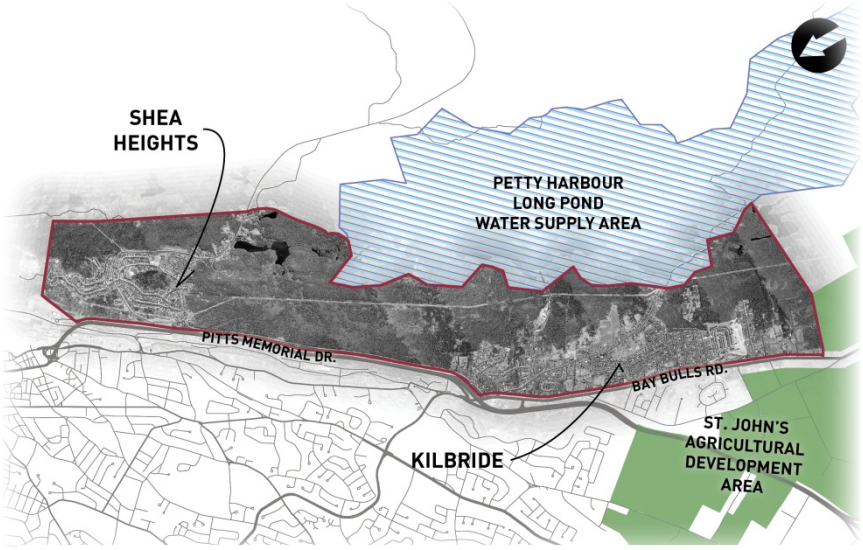

Figure 1.1: Study Area

The Study Area is approximately 844 hectares (2086 acres).

Table 1.1: Basic Geographical Characteristics of the Study Area

Characteristic	Descriptor
Longitudinal range	52°41'W-52 °455'W
Latitudinal range	47°33'N-47°29'N
Landmass Area	844 ha
Range of altitude	20m - 230m

1.3 Planning Context

1.3.1 St. John's Municipal Plan and Development Regulations

Lands within the Study Area are located within City Planning Areas 13 and 14. In addition to the lands designated in the St. John's Municipal Plan for Comprehensive Development, other lands are designated and zoned Residential, Open Space, Rural, and Restricted.

This study reviewed all undeveloped areas, regardless of the current land use designation, for potential for development.

1.3.2 Envision St. John's: Draft Municipal Plan

The development plan for the Study Area reflects, and is consistent with, the vision, goals, objectives and policies of the Draft City Municipal Plan. The Plan calls for complete neighbourhoods that are well-planned, walkable, have access to neighbourhood services, and respect and protect the environment. The Plan also promotes a greater mix of uses and higher density residential development necessary to support complete neighbourhoods.

1.3.3 Parks, Recreation, and Open Space

For the past decade, the City has been actively planning for and developing a robust open space system that includes recreational facilities, sports fields, parks and pedestrian networks. In particular, the Grand Concourse Authority has created an extensive regional network of pedestrian walkways that connect the City with Mount Pearl, Paradise and Conception Bay South. Within the Study Area, there are a number of parks and recreation facilities to serve the needs of existing neighbourhoods.

The City's 2014 Open Space Master Plan identifies a hierarchy of public parks and open spaces as well as principles for their placement and design which are reflected in the development plan.

1.3.4 Transportation

The development plan addresses transportation needs by proposing a street network that provides a number of options for traffic flow to and from the main collector and arterial streets. The conceptual street network is connected with minimal cul-de-sacs, which will facilitate provision of transit service to the area. A pedestrian pathway network connects streets, parks and opens space throughout the developable area.

1.3.5 Water and Sewer Servicing

Water system upgrades are required to provide water to the Study Area. There is limited downstream capacity in existing trunk sanitary sewers. Flows from the developable areas have been checked against the City's existing hydraulic models.

1.3.6 Stormwater Management

Municipal Plan policy concerning development in and adjacent to floodplains, wetlands and waterways is reflected in the concept plan. Floodplains are identified and development is planned around sensitive areas. The City's Net-Zero-Increase-in-Runoff policy is taken into account and storm water detention areas are incorporated into the plan. Consideration is also given to combining areas identified for storm water detention and open space use.

1.4 Structure of the Report

This chapter has briefly outlined the planning context for the Land Use Development Plan for East Kilbride. Chapter 2 presents a description of existing conditions of the land, services, environment and a discussion of demographic and housing market considerations. In Chapter 3, the constraints and opportunities for development within the Study Area are presented and lands suitable for development are identified.

The final chapter presents the concept development plan, goals, objectives and policies that will guide future development.

Maps referenced in the following sections are in Appendix A, which are bound under separate cover.

CHAPTER 2 EXISTING CONDITIONS

2.1 Market and Demographics

2.1.1 Demographics

In 2011, the City of St. John's had a population of 106,172, just over half (54%) of the population of the St. John's Census Metropolitan Area - CMA. Between 2006 and the most recent census, the population increased by 8.8%, due in large part to a robust local and provincial economy associated with offshore petroleum, other natural resources, and ancillary businesses. The increase can also be explained to some degree to a shift of population from smaller, rural parts of the province to the St. John's region, as people move closer to the available jobs and services such as health care and education.

Figure 2.1 shows the City's population profile. The shape of the pyramid is indicative of a population with a growing proportion of people aged 65 years and over. In 2011, the percentage of population aged 65+ was 14.7% and this is expected to increase over the next decade as people in the 45-55 age cohorts continue to age. People of working age between 15 to 64 years old make up 71.5% of the population. Fewer young people at the bottom of the pyramid mean that over time the population will begin to decline.

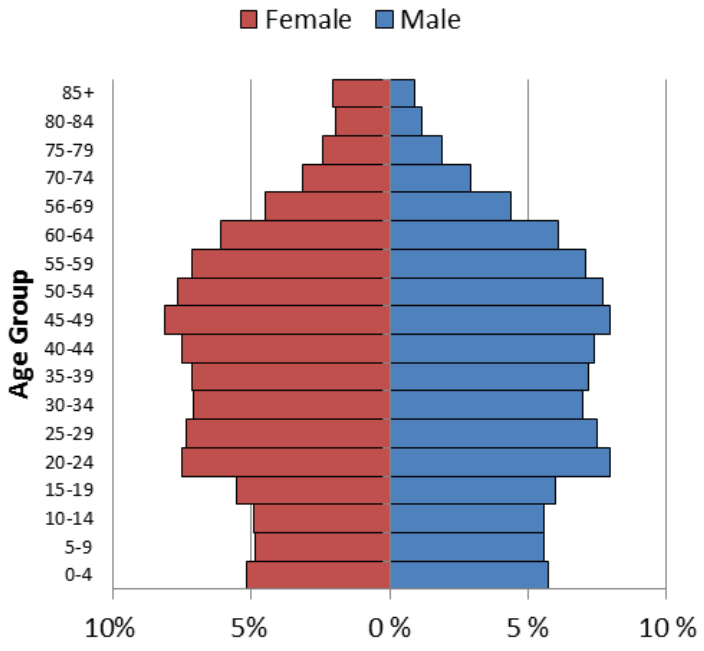

Figure 2.1: Population Pyramid – City of St. John's (Statistics Canada, 2011)

Population projections prepared for the City by the Provincial Department of Finance - Economic Research and Analysis Division (ERA) shown in Figure 2.2, predict that the population to 2036 will increase to about 110,000 by 2026, then start to decline under a scenario of low anticipated growth. Medium and high growth scenarios show population increasing to 114,649 and 122,037 respectively by 2036.

Under these scenarios, the population could increase by between 4,000 and 16,000 over the next decade. With an average household size of 2.5, this would translate into a potential demand for between 1,600 and 6,400 housing units over the next decade.

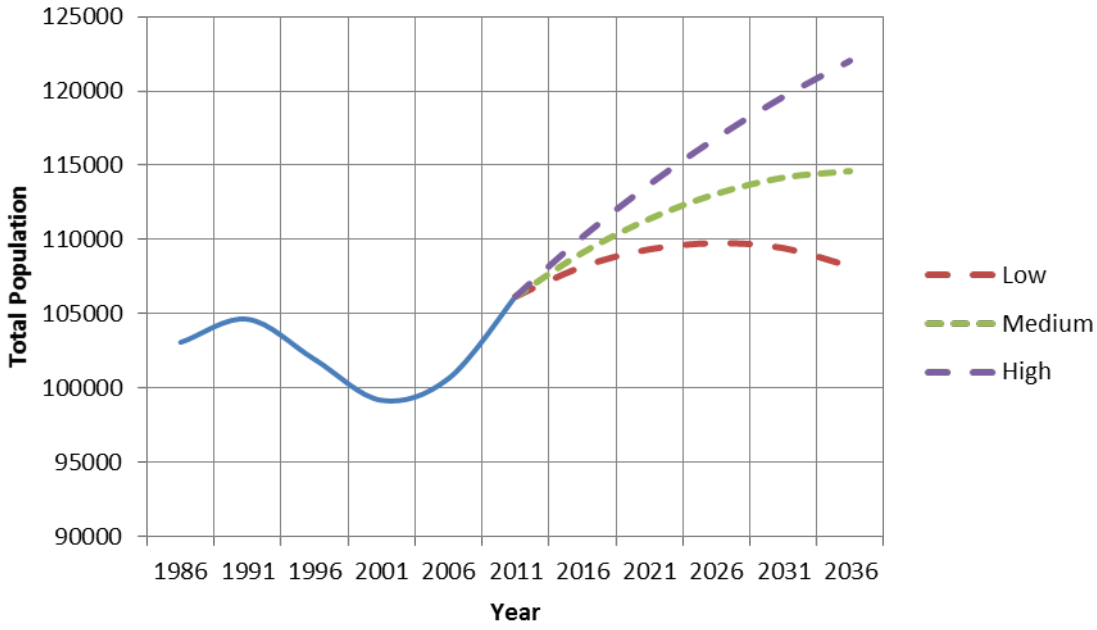

Figure 2.2: Total Population – City of St. John's, 1986 to 2036 (St. John's, 2014)

2.1.2 Housing and Market Conditions

Housing construction in the City has been strong over the past two decades with slight declines in recent years (Figure 2.3). The Canada Mortgage and Housing Corporation reports that the City of St. John's had a total of 759 starts in 2013 and 503 in 2014 (CMHC Starts and Completions Survey, 2015).

At the same time, the average cost of housing has risen. In the decade between 2004 and 2014, the value of homes increased 149%, and during the first quarter of 2015, the average single-detached house price (absorbed unit price) in the City is $490,531 (CMHC Starts and Completion Survey, 2015).

Within the Study Area, there has been limited new development in the Shea Heights area due to the nature of the topography. City staff indicated that there is some demand in this area for more residential building lots to accommodate localized demand.

Kilbride has become a popular area of the City and residential demand has led to development of several new subdivisions and a condominium development in this area. As a neighbourhood, the area is serviced by public transit. Schools, supermarkets and other retail services are nearby – a short drive but outside comfortable walking distance – and with access to Pitts Memorial Drive and the Crosstown

Arterial, Kilbride is easily accessible to employment centres in Mount Pearl/Paradise, the downtown and the area of the university/Health Sciences Centre.

The Study Area offers attractive views of the Waterford Valley, Bowring Park and the agricultural areas of Kilbride. As a result, it is likely that demand for housing in this area will continue.

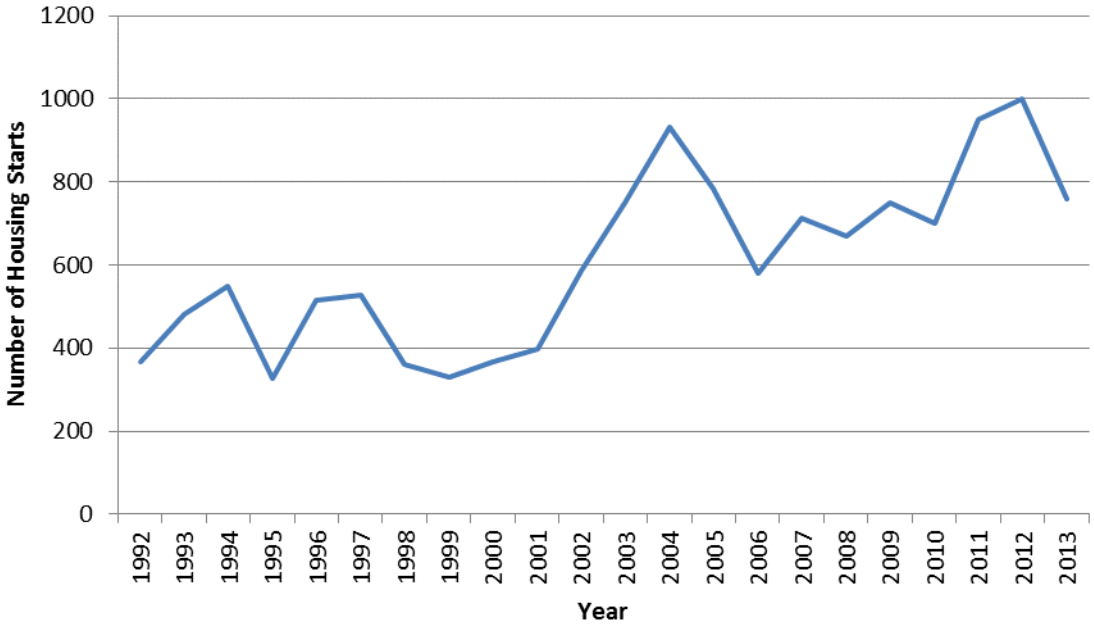

Figure 2.3: Historical Housing Starts – City of St. John's, 1992 to 2014 (CMHC, 2014)

While the majority of housing continues to be in the form of single detached dwellings, multi-unit residential buildings represent an increasingly larger proportion of new housing stock as illustrated in Figure 2.4. While the housing market is expected to slow in 2015, demand for rental units is expected to remain stable due to high home prices, the presence of a significant postsecondary student population, and a growing number of retirees who are seeking smaller housing units (CMHC Housing Market Outlook Fall 2014). In a 2015 study of senior housing needs, the City identified a growing need for housing for seniors, typically characterized as smaller, more affordable units (SHS Consulting, 2015).

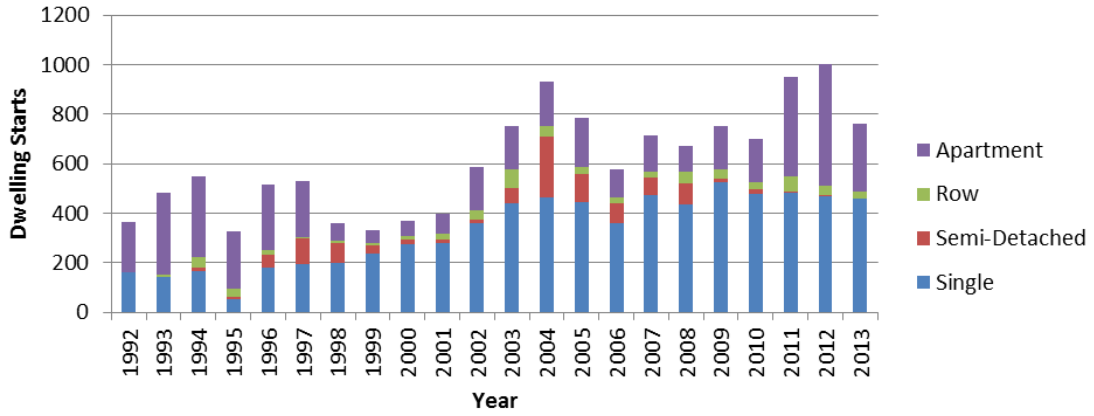

Figure 2.4: Historical Starts by Dwelling Type – City of St. John's, 1992 to 2013 (CMHC, 2014)

2.2 Environment and Land Use

2.2.1 Natural Environment

Undeveloped lands within the Study Area are generally characterized by mature stands of forest and wetland areas. The area lies within the Southeastern Barrens Sub-region of the Maritime Barrens Ecoregion1, which is characterized by almost pure stands of Balsam Fir, broken by extensive open heathland[1].

Transmission line corridor and stands of Balsam Fir.

Watercourses, ponds, streams, and wetland areas are important considerations for development within the Study Area and these are identified on Map 2, Appendix A).

2.2.1.1 Wetland Classifications

Wetland areas within the Study Area were analyzed and classified in terms of 'Conservation Priority.' A detailed description of the evaluation is included in Appendix B.

Wetlands can, and most often do, contain areas of multiple conservation priorities. The assignment of these is contextual, and depends upon a number of factors, including:

- Landscape position and affiliation with water features;
- Overall size of the wetland, or wetland complex;
- Broad vegetation community (i.e., bog, fen, marsh, swamp, etc.), as well as the associated rarity, and sensitivity/resilience of these, and
- Evidence of apparent disturbance (i.e., right of way clearing, ATV traffic, cutting, etc.)

Map 3 (Appendix A) shows the wetland areas and their Conservation Priority interpreted as follows:

Low: Wetlands containing some combination of the following:

- Common wetland types (typically swamps, some bogs);
- Hydrologically isolated;
- Small in size, or fragmented from a larger wetland;
- Composed of resilient vegetation (predominantly woody);
- Having varying degrees of pre-existing disturbance, and
- Possibly posing the least constraints from a constructability perspective, potentially containing less water, and shallower peat layers.

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1 Government of Newfoundland and Labrador. (2014, September 29). Maritime Barrens Ecoregion. Retrieved from Department of Natural Resources: http://www.nr.gov.nl.ca/nr/forestry/maps/mbarrens_eco.html#2

High: Wetlands containing some combination of the following:

- Rarer wetland types (fens, marshes, some bogs);
- Hydrologically connected to waterbodies/watercourses, or obviously contributing to these;
- Generally larger in size, or part of a wetland complex;
- Composed of more sensitive vegetation (predominantly herbaceous, and scattered woody vegetation);
- Generally less disturbed, and
- May pose the greatest constraints to constructability, potentially containing more water, and deeper peat layers.

Beaver Pond Area, Shea Heights

Moderate: This middle category of priority is somewhat conservative. Normally, wetlands in this category of priority are fairly unexceptional, but are elevated to this status due to their large size, or due to their association with other more exceptional features (wetland or otherwise).

For this study, all wetlands have been excluded from development, regardless of classification.

2.2.2 Topography

The topography within the Study Area varies, but generally, the entire area slopes towards the Waterford Valley. Slope and elevation are shown in Maps 4 and 5 (Appendix A). Elevations range from a low point of about 20 metres above sea level near the western boundary of the site to 230 metres above sea level on the eastern side. Slopes with a 0-15% grade are typically acceptable for development. The analysis (see Table 3.1) shows that about 70% of the area has slope that is acceptable for development. The steepest areas (20% and over) are in the area between Shea Heights and Kilbride.

Steep slopes pose a constraint to development. Within the Study Area, the best slopes are in the southern portion. Between the Richmond Hill Subdivision and Shea Heights, steep slopes mean that there is relatively little opportunity for development. In the Shea Heights area, there are some areas where the topography is suitable to accommodate development. However, the nature of the terrain presents issues for accessing these areas.

Table 2.1: Slope Categories within the Study Area

Slope Category	Percent of Study Area
0-8%	29%
8-15%	41%
15-20%	16%
20%+	14%

2.2.3 Snow Storage Areas

The City has identified areas, typically at higher elevations, that experience heavy winter snowfall. In areas developed for residential use, this is problematic for snowclearing operations. The City has developed a policy concerning the provision of adequate snow storage in these areas that will apply to any new development. Figure 2.5 shows the areas subject to the policy within the Study Area. While these areas are identified only for lands designated for future urban development, it is assumed lands that are proposed for development at higher elevations would also be subject to the policy.

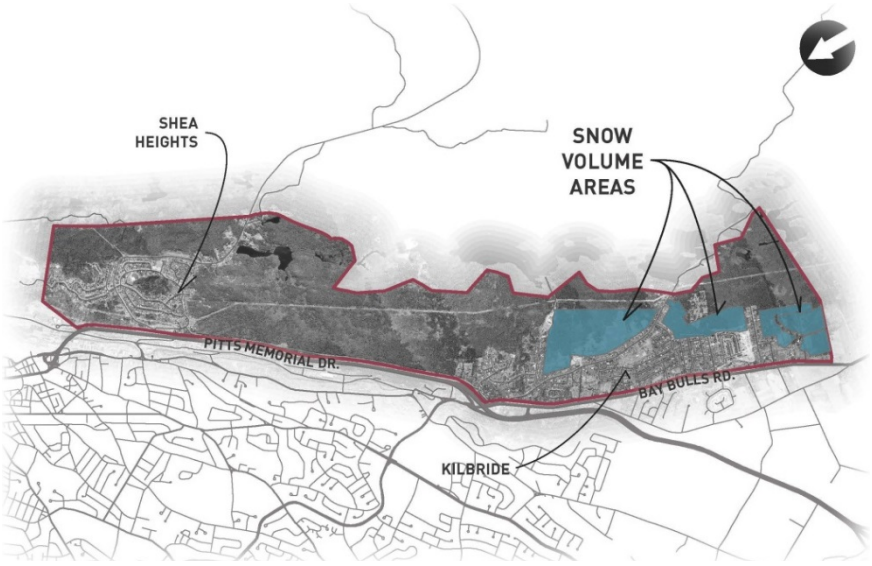

Figure 2.5: Areas Subject to City Snow Storage Policy within the Study Area

2.2.4 Existing Land Use

Developed areas in Kilbride and Shea Heights are primarily residential with single detached dwellings forming the majority of the housing stock. In the older parts of Kilbride, there are some multi-unit residential buildings. Institutional, commercial, and industrial uses are limited and are located along the main collector streets – Bay Bulls Road (Route 10) and Route 11.

Commercial uses generally serve local needs. Shea Heights has a convenience store, daycare, pharmacy, community health centre, and some small restaurants. In the Kilbride portion of the Study Area, a similar mix of local commercial uses exist spread out along Route 10, such as restaurants, convenience stores, personal care services and auto repair shops.

A power transmission line cuts through the area, as well as a number of old trails. A service road beginning at the Richmond Hill Subdivision running parallel to the Pitts Memorial Drive accesses a City water reservoir in Shea Heights.

Some land in the Study Area in Kilbride is currently used for agriculture for crop or forage production. The remainder of the area is undeveloped forested land.

2.2.5 Parks and Open Space

Within the Study Area there are a number of open spaces and recreational facilities serving existing neighbourhoods. These include neighbourhood and community parks and tot lots. Table 2.2 summarizes parks and recreation facilities within the Study Area.

Table 2.2: Study Area Parks and Recreation Facilities

Name	Classification	Amenities	Access and Location
Shea Heights	Community Park	• Baseball diamond • Pathways and trails • Signage • Trees and shrubs • On-site parking	• Located centrally in Shea Heights community • Located on collector road • Accessible by walking /cycling • Linked by neighbourhood sidewalks and nearby marked street crossings
Chapman Crescent	Tot Lot	• Small playground • Pathways and trails • Lighting	• Poor street frontage • Located centrally in neighbourhood • Accessible by walking and cycling • Bus stop located at park entrance on Fahey Street
Harry Yetman, Shea Heights	Neighbourhood Park	• Benches • Lighting • Signage • Multi-use court • Playground	• Located centrally within community • Sufficient two-sided street frontage • Located in close proximity to school • Accessible by walking and cycling • Linked to adjacent school yard
Mooney Crescent	Tot Lot	• Benches • Small playground • Signage	• Available on-street parking • Located centrally within neighbourhood • Two-sided street frontage • Accessible by walking and cycling
Kilbride Lions Park	Community Park	• Baseball diamond • Multi use courts • Soccer field • Benches • Lighting • Playground • Pathways and trails	• Located centrally between neighbourhoods • Linked to neighbourhood sidewalks • Dedicated parking lot • Accessible by walking and cycling
Purcell Street Park	Neighbourhood Park	• Benches • Lighting • Multi-use field • Playground	• Located centrally within neighbourhood • Two-sided street frontage • Accessible by walking and cycling • Linked to neighbourhood sidewalks

Overall, the residential hubs and expanding urban developments in the Study Area appear to be well-serviced by existing park and open space areas. This is supported by the City's recent Open Space Master Plan (2014), which utilized the National Recreation and Parks Association (NRPA) baseline data to identify gaps in service provision of local park space. The Plan found the Study Area, as part of Ward 5, to be well-served. Additional analysis and consultation found that the existing parks and open spaces meet the needs of the public located within the immediate service area.

Mooney Crescent Park, Kilbride.

2.2.6 Schools

There is one school in the Study Area. Located in Shea Heights, St. John's Bosco is a K-9 school. In the Kilbride area, children attend Hazelwood Elementary and Beaconsfield Junior High. Children from the area, including Shea Heights, are served from the new Waterford Valley High School on Topsail Road.

2.2.7 Municipal Plan Designations

Map 6 (Appendix A) shows the current Municipal Plan designations within the Study Area. Almost 70% of the area is currently designated for open space/ conservation or rural development (See Figure 2.6). Within the area identified for residential development, about 60 hectares, or 7% of the total Study Area, is designated for Comprehensive (urban) Development.

The "Rural" land use designation is applied to lands that are not intended for development. These areas were reviewed more closely as part of this study to determine whether any areas within this designation could be suitable for development.

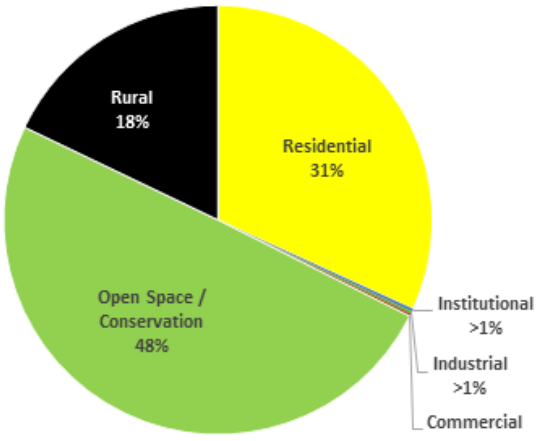

Figure 2.6: Designated Land Use - Study Area (City of St. John's, 2014)

2.2.8 Land Ownership

An inventory of land ownership in the Study Area, focusing on undeveloped lands, was provided by the City. Of the properties identified, the majority are privately-owned with parcels varying in size from less than 0.5 hectares to over 35 hectares. Map 7 (Appendix A) shows the pattern of land ownership identified in the Study Area.

City-owned land within the Study Area includes 33 hectares surrounding the Shea Heights residential neighbourhood, and a parcel in Kilbride, which is the site of the Petty Harbour Long Pond Water Treatment Plant (WTP).

2.3 Infrastructure

2.3.1 Water Supply System

Kilbride is serviced by the new Petty Harbour Long Pond WTP and Shea Heights is serviced by the Windsor Lake WTP.

2.3.2 Sanitary Sewer Services

The sanitary trunk sewer in Bay Bulls Road services the Kilbride portion of the Study Area. A trunk sewer located south of the Waterford River services the Shea Heights area.

2.3.3 Storm Sewer System

Runoff from the developable lands will be discharged to existing water courses. However, in keeping with the City's Stormwater Management policy, runoff from any new development must be limited to that of pre-development conditions.

2.4 Transportation

2.4.1 Street Network

The existing road network shown on Map 8 (Appendix A) within or adjacent to the Study Area includes the arterial, four-lane highway - Pitts Memorial Drive; Bay Bulls Road, which is the main collector road in the Kilbride area; and a number of two-lane roads running through residential areas such as Blackhead Road and Linegar Avenue in Shea Heights, and Old Petty Harbour Road and Huntingdale Drive in Kilbride. Other minor local residential streets connect with these main traffic routes.

The current network is reaching its capacity to handle vehicular traffic in a number of locations. Based on a review of the St. John's Transportation Study and discussions with City staff, it is anticipated that continued growth in residential, commercial, and industrial development will strain the capacity of the existing road network and intersections in the Study Area, creating

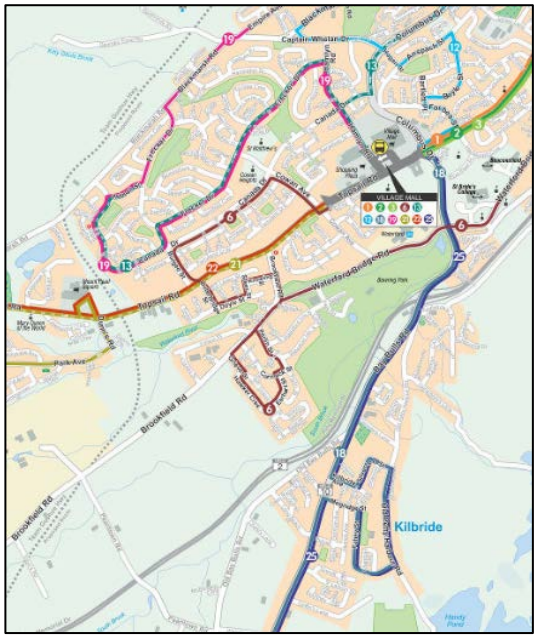

Figure 2.7: Public Transit Routes, Shea Heights and Kilbride Areas
Source: Metrobus Transit

periods of excessive congestion in the future. Substantial upgrades to local intersections may be required to accommodate anticipated future additional traffic demand.

A detailed description of traffic conditions and street classifications is included in Appendix C.

2.4.2 Public Transit

Metrobus Transit provides an hourly bus service in the area. In Shea Heights, Route 11 provides direct access to the downtown and transfer node at the Avalon Mall. In Kilbride, Routes 25 and 18 provide access to the transfer node at the Village Mall. In a 2011 study, Metrobus identified both Kilbride and Shea Heights as areas of low ridership with insufficient development density to warrant a 30-minute level of bus service.

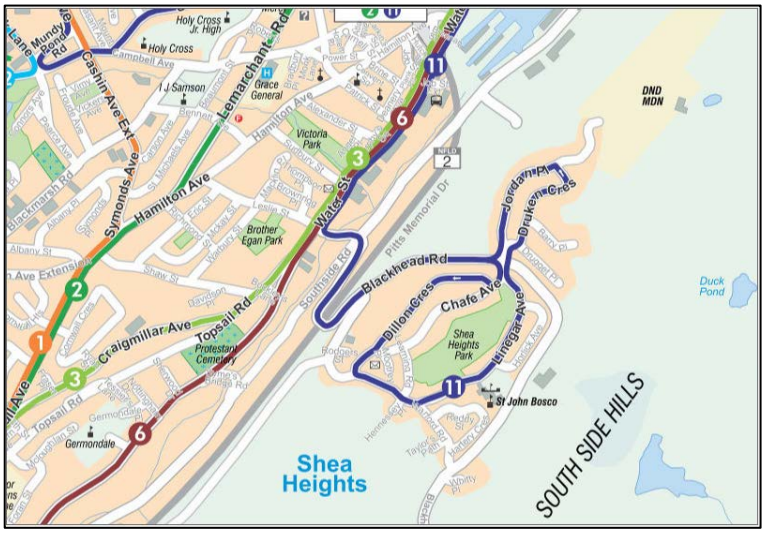

Figure 2.8: Public Transit Routes, Shea Heights and Kilbride Areas
Source: Metrobus Transit

2.4.3 Cycling

The City Cycling Plan identifies the Bay Bulls Road and Black Head Road as part of the City cycling network. Bike lanes are proposed along Blackhead Road through Shea Heights, and paved shoulder is proposed along Bay Bulls Road to encourage cycling. The Cycling Plan encourages development of multi-use trails, and provision for cyclists in new street design. We understand that the City is establishing a St. John's Bike Task Force to research cycling connections for the whole City, which will influence these design plans.

2.4.4 Pedestrian Pathways

Few formal pedestrian pathways exist within the Study Area. Pedestrian movement is primarily along sidewalks. In undeveloped areas, there are a number of informal pathways and trails used for walking and off-road vehicle use. The lack of a more formal pedestrian network with connections to the larger City trail and open space system has been identified as an issue in the City's Master Plan.

Examples of formal and informal pathways in the Study Area

CHAPTER 3 ANALYSIS

3.1 Opportunities and Constraints for Development

In preparing a development plan for the Study Area, an analysis was conducted to identify lands that have potential for development.

Map 9 (Appendix A), shows the constraints to development posed by topography, existing street networks and development patterns, water servicing limits, and natural features. Development of the area is constrained primarily by two factors: slope and access. Slopes in excess of 15% are considered above the limit for development. The steepest areas are between Shea Heights and Kilbride where slopes exceed 20%. As such, options are limited for connecting these two parts of the Study Area with a street and complementary development.

3.1.1 Wetlands

Approximately 55 hectares of wetlands were identified within the Study Area. Wetlands with moderate to high priority are not recommended for development. Areas of low priority for development should be evaluated further as part of application review.

3.1.2 Floodplains

The 1:100 AEP event for future development conditions were mapped for four streams within the Study Area. The methodology and results of this analysis is included in Appendix D. These areas, as well as additional floodplains previously mapped by the City are precluded from urban development.

3.2 Land Suitability for Development

A high level analysis was performed to identify areas that appear, based on existing information, as having slopes that are suitable for development. This analysis was further refined based on more detailed delineation of wetlands and mapping of floodplains in the Study Area.

Map 10 (Appendix A) shows five areas that appear suitable for development.

3.3 Transportation

Considerations of street connections and access to the areas identified as suitable for development required an analysis of the street network and its capacity to accommodate additional traffic demands.

The steep topography, presence of waterways and wetlands, and existing development patterns, all pose constraints for developing street connections to areas suitable for development.

Generally, street connections in the southern part of the Study Area are more feasible because of favourable slopes, several existing streets to which new development could connect, and availability of land for new connections to higher capacity roads and Pitts Memorial Drive. In and around Shea Heights, there are pockets of suitably sloped land, but street connections would require construction through less than ideal topography.

Traffic data was collected and modelled to assess the capacity of the existing street network to accommodate future development in the Kilbride portion of the Study Area. The results of this analysis are presented in Appendix C. The analysis shows that that development of additional lands in Kilbride will have a detrimental impact on most of the existing intersections considered in the analysis. However, by implementing a number of upgrades to Bay Bulls Road and introducing some signalized intersections, the anticipated traffic from new development is accommodated, and satisfactory performance is maintained during the morning and afternoon peak periods.

3.4 Water, Sanitary and Drainage Systems

The Petty Harbour Long Pond WTP supplies water to the existing developed areas of Kilbride. Therefore, it will also supply water to any new developments in this area. To meet the service pressure and water storage requirements, a new pumping station, transmission main, and water storage tanks are required. Based on land availability at higher elevations and topographic constraints associated with siting the tanks, the 180-metre contour was selected as the upper service limit.

The existing downstream sanitary trunk sewers have additional capacity and can accommodate new development in the Study Area; there are some local sewers in existing side streets that cannot accommodate new development (see section 4.6.2). Further, detention facilities will be required to manage stormwater runoff. Significant land requirements are associated with these facilities.

3.5 Conclusions

The results of the suitability analysis show that:

1. There is limited potential for additional development in and around the Shea Heights portion of the Study Area that can be easily and efficiently developed;
2. The best land that is suitable for development is in the Kilbride portion of the Study Area;
3. While there is suitable land in the area of the Richmond Hill subdivision, there is limited access due to the pattern of existing development, a floodplain, and steep grades;
4. Land between Shea Heights and Kilbride is characterized by steep slopes, which limits development potential;
5. New development in the Study Area will require upgrades to the existing street network to accommodate anticipated traffic volumes;
6. The water supply system including proposed enhancements, will limit development to below the 180-metre contour;
7. The existing sanitary sewer system has limited capacity for new development, and
8. Stormwater detention facilities must be provided for newly developed lands.

CHAPTER 4 DEVELOPMENT CONCEPT

4.1 Goals for Development

The City has established the following goals for development within the Study Area:

- Provide suitable street connections to the municipal and regional road systems;
- Ensure a safe and efficient street network that facilitates access to public transit;
- Plan high-quality parks, trails and public open spaces in a manner that is consistent with the City's Open Space Master Plan, connecting existing and future development;
- Provide for complete neighbourhoods – with a variety of residential building forms, and a mix of residential and non-residential uses, and
- Ensure efficient delivery of municipal services and high standard of urban design.

4.1.1 General Principles

The East Kilbride Area is designed to accommodate a portion of the anticipated growth of the City of St. John's. New growth that is provided for in the Plan area will be developed with an urban level quality for servicing, including water, sanitary sewer, storm drainage, streets, and utilities.

The plan and policies emphasize the protection and preservation of the following features:

- Environmentally sensitive areas including waterways and wetlands;
- Steeply sloping topography, and
- Character of existing subdivision areas.

A suitable transportation system, including upgrades to existing streets will be necessary to accommodate future development and the associated traffic demand. Other modes of transportation are encouraged by design, connected streets, neighbourhoods, and open spaces.

Development should contain a range of housing options such as single detached and multi-unit residential forms to ensure a balanced, age-friendly residential neighbourhood.

Opportunities for neighbourhood retail and commercial services should be provided within the development.

A conceptual open space system that links residential neighbourhoods to parks, natural areas, and services should be a priority.

4.2 Concept Development Plan

The concept plan presented in Maps 11, 11-1 and 11-2 (Appendix A) incorporates the results of the foregoing analysis, and proposes development in areas 2, 3, 4 and 5 on Map 10 (Appendix A) that appear suitable and accessible. In consideration of the lack of possible opportunities to access Area 1 and its small size relative to other areas, it is not included in the development concept.

In the Shea Heights area, development potential is limited to narrow pockets that can be developed along a road outlining Beaver Pond. In this case, the use of cul-de-sacs allows for access to the limited developable lands.

A future street connection between Shea Heights and Kilbride was considered and analysis was undertaken to identify an acceptable route. However, this connection is not recommended because of steep slopes and the presence of wetlands and floodways, which limit development potential.

4.3 Street Layout and Access

Streets are designed to minimize dead-end cul-de-sacs and provide good connectivity for vehicles, transit and pedestrians. Block lengths are between 60 and 360 metres. The following is a list of street connections to the new development areas (illustrated in Maps 11, 11-1 and 11-2 of Appendix A), and commentary on property impacts and feasibility of each:

- Development Area 2
    - Blackhead Road
        - A single, main street that outlines Beaver Pond is proposed, with two connections to Blackhead Road. The street layout can be designed to meet the City's minimum standard for acceptable street grades and to account for the environmental constraints posed by the presence of wetlands and streams in the area.
        - Four cul-de-sac streets are proposed to access potentially developable areas off the main spine.
- Development Area 3
    - Densmore's Lane
        - Extend new road into Area 3 using vacant lot located between Civic #27 and #33.
- Development Area 4
    - Densmore's Lane
        - Extend new road into Area 4 using vacant lot located between Civic #32 and #38. Width of existing property is slightly less than 15 metres.
    - Old Petty Harbour Road via Parkridge Drive
        - Extend new road into Area 4 using area between Civic #151 and #153. Width of existing property is 13.3 metres.
    - Old Petty Harbour Road
- Development Area 5
    - Old Petty Harbour Road
    - Bay Bulls Road via Griffins Lane
    - Bay Bulls Road via Valleyview Lane
    - Bay Bulls Road

- Extend road into Area 5 using property between Civic #305 and #309. Width of property is 10 metres; however, it appears that there is property available that could be acquired for the road right-of-way.

Further, in areas with steep topography, streets are designed to intersect natural contours at 45 degree angles where practical. This has been done to minimize the extent of excavation required for rear yards (which assists in reducing the possibility of creating drainage challenges on developed lots) and to minimize the grades of new streets (which benefits snow clearing operations and enhances safety).

4.4 Population Estimates

Estimates for the population that could be accommodated in each development area are shown in Table 4.1. Assuming a population density of 40 persons per hectare, the total development concept could accommodate a population of approximately 2,560.

Table 4.1: Population Estimates

Development Area	Developable Area (ha)	Population (40 pph rounded to nearest 5)
2	10.5	420
3	7.6	305
4	14.2	570
5	31.6	1,265
Total	**63.9**	**2,560**

4.5 Proposed Land Use Mix

Development is planned as an expansion of existing residential neighbourhoods in Kilbride. The concept plan provides for a transition of housing from established neighbourhoods to a greater mix of residential uses, densities, and housing forms in other parts of the development area. While the primary land use will be for residential purposes, a complete neighbourhood requires residential densities that will also support commercial services such as convenience stores, small grocery stores, shops and personal services. Development policies and land use zoning provide guidance for establishing a variety of residential building forms and mix of uses.

Commercial and institutional uses are envisaged as being located close to neighbourhoods and amenities such as parks and open space, connected by street and pedestrian networks.

In the Shea Heights portion of the Study Area, the difficult terrain and limited lands that are suitable for development restrict residential density potential. It is unlikely that densities for this development area will be sufficient to support commercial uses.

4.6 Municipal Services

4.6.1 Water Supply System

For the purposes of this study, the following assumptions were made in calculating the estimated water system demands:

- Average daily residential water consumption is 500 litres per capita per day (as per the 2015 Regional Drinking Water Study);
- Residential population density of 40 people per hectare (as per the Terms of Reference), and
- Maximum Day Factor for New Development: As per guidelines for population size in *"Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution, and Operation of Drinking Water Supply Systems".* (Factor of 1.5 used in the maximum day demand calculations below).

The predicted maximum day demands for the developable areas under the full build-out condition are:

- Shea Heights (Development Area 2): 315 m^3/day
- Kilbride (Development Areas 3, 4 and 5): 1,605 m^3/day

The developable areas will be serviced by the new Petty Harbour Long Pond WTP. A top service elevation of 180 metres was selected based on new lands that could be opened for development. Features of the proposed water supply upgrades are described below and illustrated on Figures 4.1-4 and Maps 12, 12-1 and 12-2 (Appendix A):

- Top water level of proposed tanks = 215 metres;
- The proposed pump station will be located at the PHLP WTP. PRVs will also be located in the pump station;
- The PH-A pressure zone will be fed through a PRV. A connection to the existing water distribution system will be made at the top of Densmore's Lane;
- A new pressure zone will be fed through a PRV located in the proposed pump station. The reason for this PRV is to regulate the pressure when the pumps are operating. The new zone will service most of the proposed developable areas;
- The water distribution system located throughout the developable areas will include looped systems for redundancy;
- The Densmore's Lane pump station will be decommissioned;
- The Beaver Pond area in Shea Heights will be connected directly to the proposed transmission main;
- The Shea Heights area will be fed through a PRV and then connected at Linegar Avenue;
- The Shea Heights pump station and tank will be decommissioned, and
- It will also be possible to feed the downtown through a PRV located at Linegar Avenue. Approximately 1,000 metres of watermain is required to connect to the downtown water distribution system.

A Class 'D' cost estimate for the proposed water supply system upgrades is provided in Appendix E.

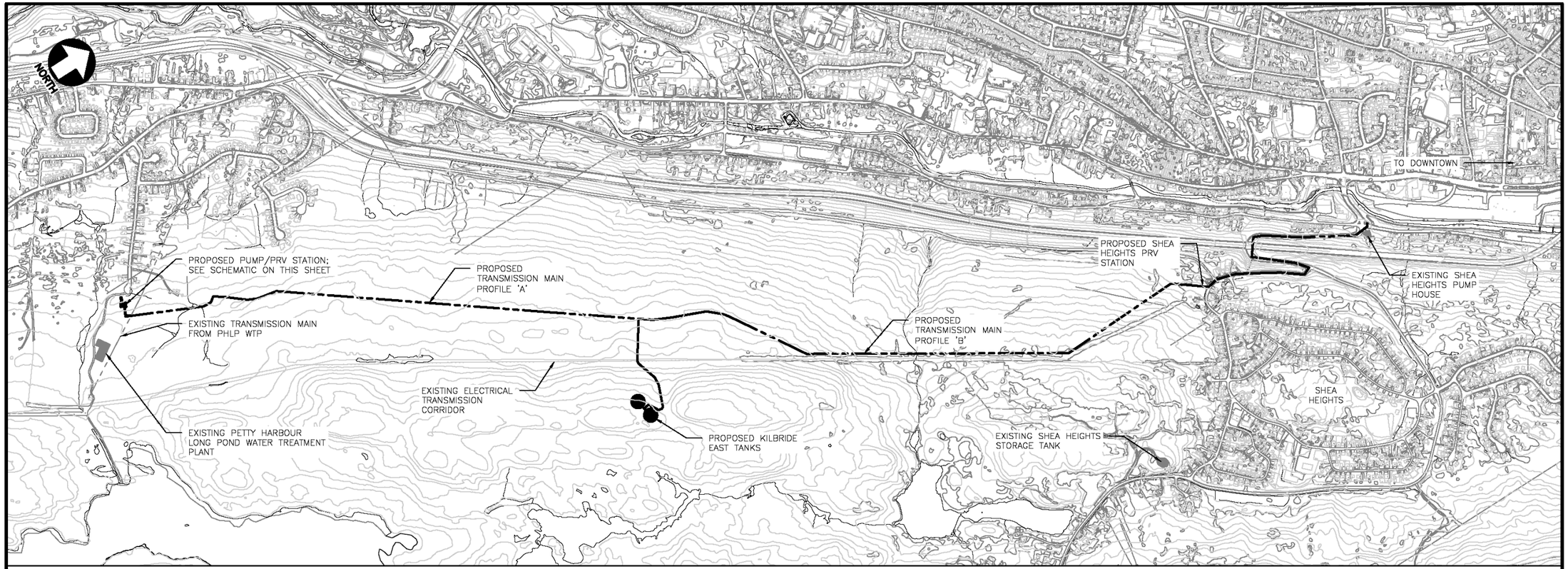

Figure 4.1: Proposed Water Distribution Infrastructure

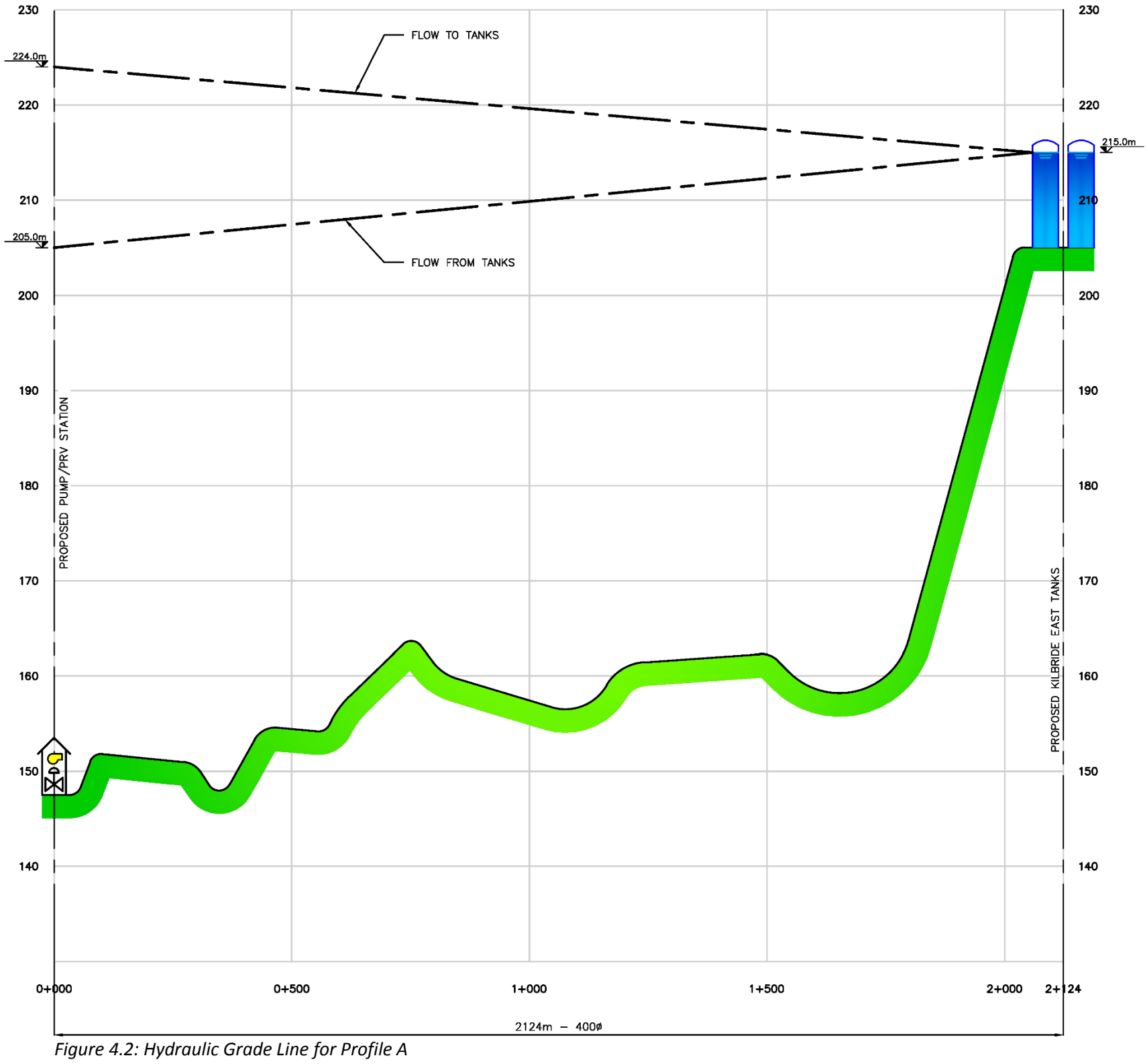

Figure 4.2: Hydraulic Grade Line for Profile A

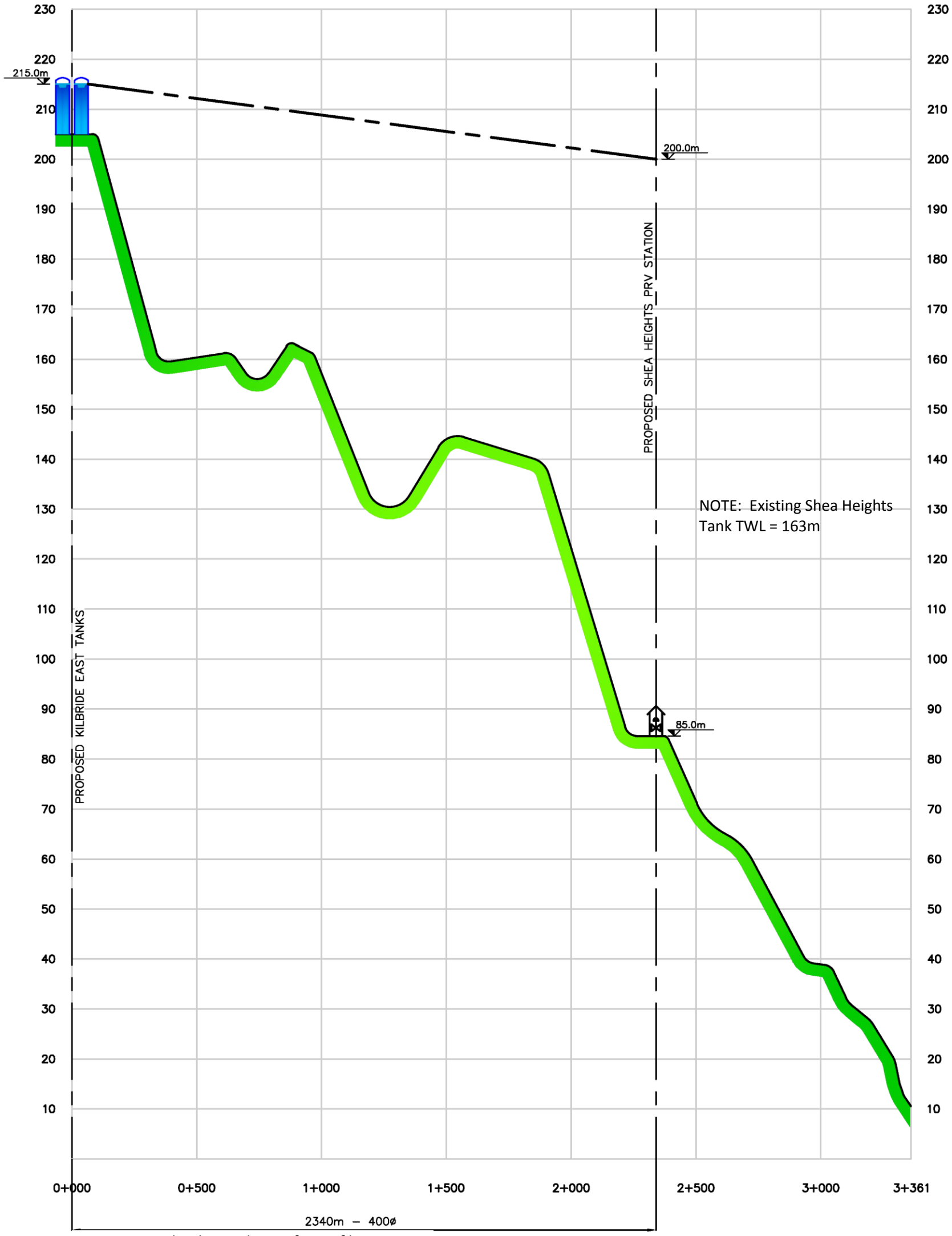

Figure 4.3: Hydraulic Grade Line for Profile B

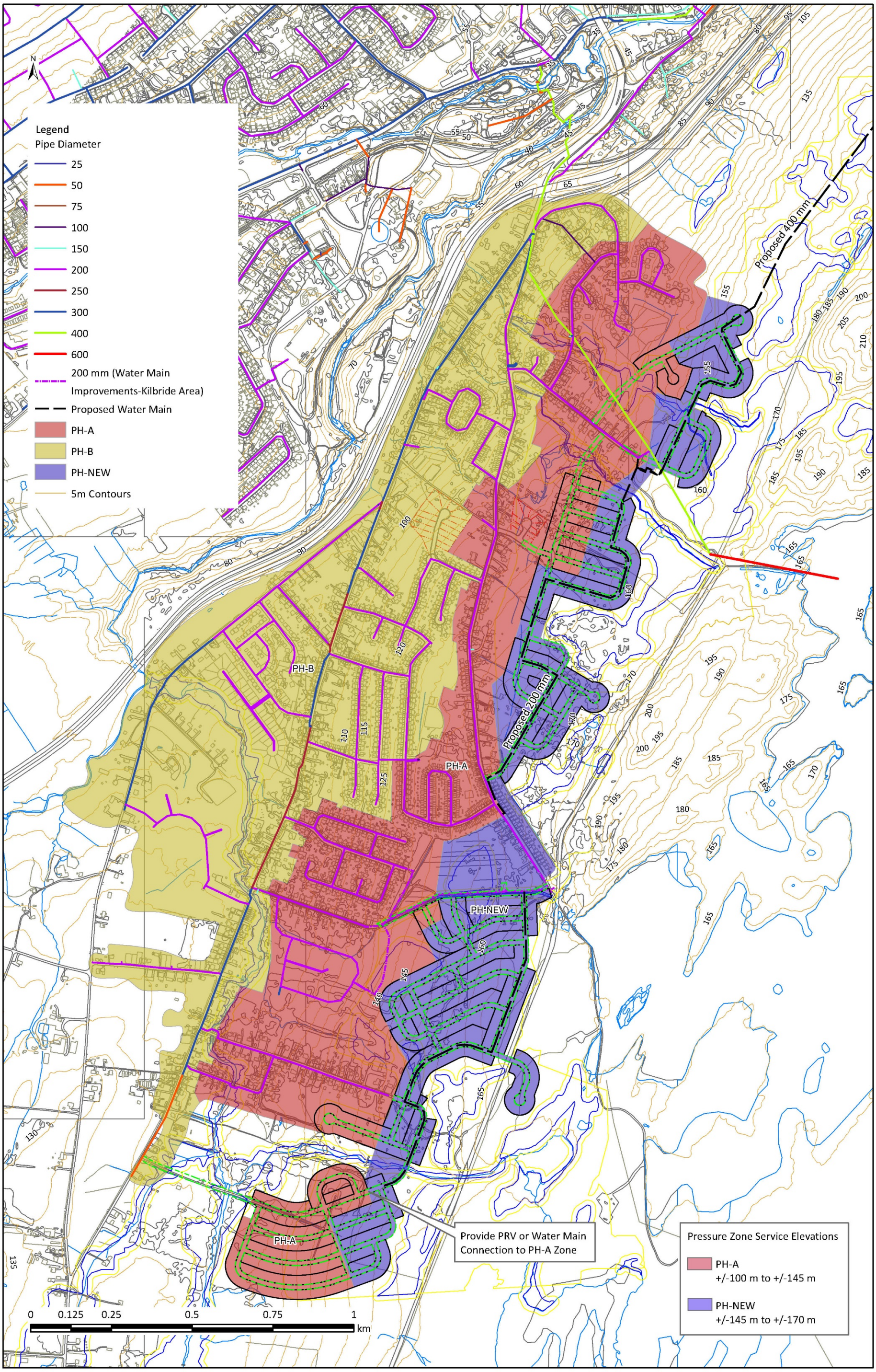

Figure 4.4: Proposed Pressure Zones for Kilbride Area

4.6.2 Sanitary Sewer System

The developable areas were divided into five sanitary sewer sub-catchments. Design flows for each sub-catchment were calculated using the City's Subdivision Design Manual. The sub-catchments, proposed connection points, design flows and sewer capacities are provided in Table 4.2. The sub-catchment and proposed connection points are also shown on Maps 12, 12-1 and 12-2 (Appendix A).

Table 4.2: Sanitary Servicing

Development Area (see Map 10)	Proposed Connection Location	Node (see Map 12)	Design Flow (L/s)	Available Sewer Capacities (L/s)	Notes
2	Blackhead Road	1	11.5		See note 1.
3	Densmore's Lane – East	2	5.4	0	See note 2.
4	Densmore's Lane – West	3	11.1	0	See note 2.
5	Griffins Lane	4	9.5	60	Adequate capacity.
5	Valleyview Road	5	5.9	18	Adequate capacity.
5	Bay Bulls Road	6	9.8		See note 3.

Notes:

1. The sanitary sewer system in Shea Heights can accommodate the design flow if work is done to remove the infiltration from the existing system.
2. The existing Denmore's Lane sewer is at capacity because the Petty Harbour Long Pond WTP is using most of the available capacity for its backwash system. As such, the Densmore's Lane sanitary sewer will have to be twinned to accommodate development.
3. Existing trunk sewer in Bay Bulls Road must be extended from Walsh's Lane to the proposed street connection at Bay Bulls Road.

As per the Terms of Reference, the capacities of the proposed receiving sewers were provided by the City. Class 'D' cost estimates for the Bay Bulls Road Sewer extension and the Denmore's Lane sewer twinning are provided in Appendix E.

4.6.3 Stormwater Management

In keeping with the City's stormwater management policy, detention ponds are proposed along the western edge of the development area as shown in Map 12-2 (Appendix A). The ponds have been sized in accordance with the City's Subdivision Design Manual. The XPSWMM models have been reviewed by City staff and copies of the models will be included with the final report. Preliminary pond sizes are presented in Table 4.3. Class 'D' cost estimates are provided in Appendix E.

Table 4.3: Proposed Stormwater Detention Ponds

Pond Location	Required Volume (m^3)
1	6,800
2	11,800
3	7,500
4	4,100

4.7 Open Space Concept Plan

A proposed open space plan, shown in Maps 13, 13-1 and 13-2 (Appendix A), was designed in accordance with the principles and design process set out in the City's Open Space Master Plan. A summary that includes the topographic characteristics of the proposed parks is found in Appendix F. The Open space plan includes:

- Placing trails close to identified wetlands and waterways to form a greenway system, with through-connections to proposed parks and residential areas to maximize the connectivity of the open spaces. Routing of trails also took into consideration slope, natural areas, and overall connectivity, as well as incorporating established pathways where possible;
- Identifying parks in adjacent neighbourhoods and considering where to locate new parks and facilities relative to these existing spaces;
- Designing development to provide connections to the open space system;
- Taking solar orientation, slope of land, and ease of connection to development areas in the design of the greenway and trail system, and
- Opportunities for incorporating open space with areas for proposed stormwater detention.

The Open Space Plan identifies a pedestrian trail network that provides continuous connections to and from parks, adjacent neighbourhoods, and civic or commercial destinations. Over 15 km of trails are identified, including a connection between Kilbride and Shea Heights, portions of which can be developed along a proposed water transmission line.

Two community parks are proposed – one site just over two hectares close to the Kilbride Lions Park, and another larger site near the most southern boundary of the Study Area. These locations are suggested for the relatively flat land and where there are opportunities to co-locate park space with areas identified for stormwater detention.

Four Neighbourhood Parks are proposed – two in Shea Heights, and two in the Kilbride portion of the Study Area. The areas identified for neighbourhood parks range in size from approximately 0.5 to 1.6 hectares.

The placement of the parks is designed to provide park space within a 10 minute walk (800 metres) from homes in the proposed development as well as homes in already developed areas within the Study Area.

Maps 13, 13-1 and 13-2 (Appendix A) also show lands currently designated in the City's Municipal Plan for open space. As a result of the analysis of wetland and floodplains, additional areas are proposed to be included in the Open Space land use designation/district.

The power transmission line that runs through the Study Area is currently used by local residents as a recreational corridor for walking and off-road vehicle use. Consideration could be given to the continuation of this corridor as part of the open space system with pedestrian trails located along the edge or adjacent to the transmission right of way. The connection could be classified as a greenway and could function as an open space connection to parks, schools, and neighbourhoods.

4.8 Traffic Analysis

Analysis of existing traffic volumes indicated that development of lands within the Kilbride portions of the Study Area would have a significant and detrimental impact on the functioning of the existing street

network. To mitigate the anticipated traffic impacts stemming from the future development, construction of a new connector roadway was considered, connecting existing intersections of Bay Bulls Road/Pitts Memorial Ramps and Old Petty Harbour Road/Densmore's Lane. It appeared that this would redistribute traffic away from the very short existing connector between Bay Bulls Road and Old Petty Harbour Road, relieving congestion at that location. However, construction of this connector road would require purchase and demolition of several homes.

Upon further review, it became apparent that the topography in this area would dictate road slopes in the range of 17-20%, which is too steep for a public street. Therefore, a connection to Old Petty Harbour Road further north was also considered. Here, acceptable street slopes of 9-10% could be achieved. However, because this alignment would not connect directly to Densmore's Lane and would involve a 'switchback' layout, it was concluded that this option would be less successful in reducing congestion, and that the existing traffic patterns would remain as the preferred routes for most motorists.

An alternative to the connector road concepts includes making changes to the existing streets and intersections to better accommodate future peak period traffic demands. After exploring various strategies, it was found that the following changes could accommodate the estimated 2025 build-out volumes:

- Bay Bulls Road
    - More southbound capacity for through traffic will be needed; therefore, provide 2 southbound lanes to coincide with the 2 existing northbound lanes. This will require widening in the vicinity of the Old Petty Harbour Road intersection.
    - Implement signal coordination along the Bay Bulls Road corridor.
    - Reduce corridor cycle lengths to 80 seconds for the AM peak period and 60 seconds for the PM peak period.
- Intersection of Bay Bulls Road/Pitts Memorial Drive Ramps
    - Eastbound left turns from Pitts Memorial onto Bay Bulls Road northbound are quite heavy, particularly during the morning peak period. Therefore, we recommend that a double left turn movement be implemented, and this can be achieved by simply making the existing right turn lane a shared left/right lane; there are already 2 northbound receiving lanes on Bay Bulls. This greatly reduces delays and queuing for left turning traffic, but it slightly increases both of those measures for the right turns. Note however than the right turning volumes are significantly lower.
    - The northbound approach includes a shared left-thru lane, a configuration which should be avoided on high volume roads such as this because they increase the potential for rear-end collisions. Our concept allows this lane to remain, but we noted that relatively few motorists turn left here to access Pitts Memorial eastbound (our count data showed 39 vehicles during AM peak hour and none (0) during PM peak hour). Addressing this situation by widening to add a dedicated northbound left turn lane would have significant property impacts. Therefore, the City should consider prohibiting left turns at this intersection and simply sending that traffic to the other eastbound on-ramp 400 metres further north. Right turning volumes onto that ramp are even lower (10-15 vehicles/hour) so it may not be worth keeping this eastbound access open. Therefore, the on-ramp lane could be reversed to become the second eastbound left turn lane and the dedicated right turn lane could remain, resulting in a [L | L | R] lane configuration.
- Intersections of Old Petty Harbour Road with Bay Bulls Road & Huntingdale Drive
    - Add a channelizing island and modify the westbound right turn movement to make it free-flow into a new northbound lane on Bay Bulls Road that would extend to connect

directly with the on-ramp to Pitts Memorial eastbound. We found that providing a free-flow right turn movement to be the best way to accommodate the significant demand during the AM peak.

- However, construction of this new lane would have significant property impacts, particularly considering the close proximity of both the Dong Fong Restaurant and Huntingdale Drive. Therefore, continuing with a yield condition for the WB right turn movement, along with careful adjustment of the signal timing and implementation of an overlap phase (WB RTs + SB LTs) may provide sufficient capacity in lieu of constructing a new northbound lane to facilitate free-flow operation.
- Construction of a roundabout to replace the traffic signal would also remove the need for an additional northbound lane, but as discussed in the Traffic Analysis Memo (Appendix C) it would have significant property impacts and geometric challenges. Therefore, intersection traffic control should remain as traffic signals.
- Modify the existing geometry to formally make Old Petty Harbour Road the through movement, with Huntingdale Drive forming a T-intersection with it.

Provided in Appendix C is a sketch (Sk1) of these proposed changes along with analysis of the AM and PM peak hour intersection performance. This approach has several advantages over the construction of a new connector road including reduced costs, reduced impact on properties and homes, clarification of right-of-way at Huntingdale Drive approach, and safety enhancements such as the potential removal of a shared thru-left lane (not shown in Sk1).

4.9 Land Use Policy

Map 14 (Appendix A) shows the proposed Land Use Districts. Changes in the current Municipal Plan expand the Residential District to accommodate areas for new development, the protection of floodplains, wetlands and proposed parks. Policies of the Municipal Plan will apply to all Land Use Districts within the Study Area.

4.9.1 Residential

In addition to the policies of the Municipal Plan, the following objectives and policies will apply to future urban development in the Study Area.

Objectives

To achieve a mix of types of residential buildings both within the overall development area and within street sections.

Policies

In the Shea Heights Area, the primary land use will be for low-density residential use. In areas identified for development in Kilbride, a greater mix of housing forms are proposed with low density residential development providing a transition between existing neighbourhoods and areas zoned for higher density residential development.

Within any development, there shall be a mix of housing types within street blocks. In low-density areas, semi-detached and duplex dwellings may be located at street corners and around neighbourhood parks and open spaces.

In areas identified for higher density residential use, multi-family housing in the form of townhouses, semi-detached and duplex dwellings will be permitted, and other forms of small, innovative multi-family dwellings will be encouraged. In subdivision developments, higher density uses will be required to be placed around parks and open space areas.

Non-Residential Uses
Small-scale commercial/retail uses such that will serve local neighbourhood needs such as convenience stores and personal service shops may be permitted and proposed sites zoned for their use. They shall be located along main through streets, typically at or near intersections.

4.9.2 Neighbourhood Commercial
In addition to the policies of the Municipal Plan, the following objectives and policies will apply to future urban development in the Study Area.

Objectives
To develop neighbourhood commercial land uses in compact neighbourhood clusters that compliment adjacent land uses to meet the various needs of a diverse community.

Policies
Neighbourhood commercial land uses will complement the areas identified for development in Kilbride, where a greater mix of housing forms is proposed. Commercial development shall be centrally located in residential areas and clustered near other land uses like parks, trails, and open space areas.

In low density areas, small business and personal service uses will be encouraged. In areas of higher density, retail uses and general assembly uses will be encouraged and be required to be placed around parks and open spaces.

4.10 Land Use Zoning
The proposed Land Use Zoning shown on Maps 15, 15-1 and 15-2 (Appendix A) provide for extension of existing low density residential development with higher density provided for in Kilbride in two locations, the largest at the southern end of the Study Area. An apartment zone is also proposed, close to the Bay Bulls Road that could accommodate multi-unit residential development.

4.11 Urban Design

4.11.1 Subdivision Design and Lot Layout
Subdivisions shall be designed to provide an adequate lot size to accommodate required parking, snow storage and yards. Lot grading shall avoid extensive cut and fill. Multi-unit buildings may be designed around a central courtyard. Parking should be located at the rear of multi-unit buildings.

4.11.2 Building Design
Buildings shall be designed to accommodate the natural grade of the lot so as to avoid significant areas of cut and fill.

4.11.3 Street Design

Residential streets shall be designed to accommodate multi-modes of transportation in accordance with the City's Complete Streets Policy (currently under development). Provision for transit service and corresponding transit infrastructure shall also be required in the detailed design of streets.

4.11.4 Parks and Open Space Design

Parks shall be designed in accordance with the City Open Space Master Plan.

4.12 Proposed Phasing Plan

Suggested phasing for development:

- Shea Heights area – long term – 7-10 years;
- Southern portion of development area – short term – 1-5 years;
- Central area – medium term – 5-7 years.

4.13 Amendments to the St. John's Municipal Plan and Development Regulations

The City is completing a review of its Municipal Plan and Development Regulations. To implement the recommendations of this study, an amendment could be prepared to be incorporated into the Final Plan and Regulations. In the meantime the City could amend the current 2003-2013 Municipal Plan and Development Regulations to incorporate the recommendations of the East Kilbride Area Comprehensive Land Use Development Plan into the documents. Since the planning area boundaries do not exactly align with the scheme area, there would need to be some simple statements to the sections of the current Plan to recognize the scheme area (regardless of planning area). There need not be an incorporation of the policies of the scheme because in approving the scheme, Council would approve the policies under the Plan.

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APPENDIX A

Maps

(Bound Under Separate Cover)

APPENDIX B

Wetland Classification and Conservation Priority Areas

CBCL LIMITED
Consulting Engineers

MEMORANDUM

DATE: JUNE 7, 2015

PROJECT NO: 143046.01

MEMO TO	Mary Bishop, FCIP
PROJECT NAME	East Kilbride Development Area Study
SUBJECT	Wetland Classification and Conservation Priority Areas
FROM	Ian Bryson
COPIES TO	

187 Kenmount Road
ICON Building
St. John's, NL
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1.1 Wetlands Classification

A number of wetland types were readily identifiable in the field, primarily bogs, fens, swamps and marshes. As a word of caution, bog and fen are both vernacular terms which have been used for a very long time, but have only in the last century been rigorously defined scientifically (Rydin & Jeglum 2006). In Newfoundland, as in many other parts of the world, there is a tendency for peatlands (i.e., bogs and fens) to be collectively referred to as 'bog'. This is a tendency which is repeated in some of earlier scientific literature on the topic of peatlands, up until about 1960 (Rydin & Jeglum 2006). Within the present discussion on wetlands, the definition of bog and fen are based upon the scientific definition of these wetland classes as elaborated below.

1.1.1 Bog Wetland Class

A bog is a type of peatland which is characterized by its distinct hydrology, which is sourced primarily from precipitation such as snow, rain and fog. Bogs are virtually unaffected by surface runoff and groundwater, and consequently surface waters are low in dissolved minerals and quite acidic (National Wetland Working Group, 1997; Rydin & Jeglum, 2006). Acidity in bogs is further enhanced by the release of organic acids during the decomposition of *Sphagnum* moss, which is the dominant substrate of these peatlands (National Wetland Working Group, 1997). The various species of *Sphagnum* mosses that compose wetlands have a unique capacity to store water in both living and dead plant tissues. As a result of this increased moisture retention, anaerobic conditions form, which inhibits the decomposition of the *Sphagnum*, resulting in an ever increasing peat layer. This process of bog formation, known as ombrotrophication, increasingly isolates the bog flora from groundwater influence (Rydin & Jeglum, 2006). Peat formations are generally quite deep, on average 3-5 m in most of Canada, and occasionally up to 10 m in exceptional cases (National Wetland Working Group 1997).

In many areas of Newfoundland, bogs are mostly treeless; although within the Study Area, *Picea mariana* (black spruce) and *Larix laricina* (tamarack) may be found at the peripheries, and scattered throughout. These tree species are often stunted in their growth form. Bogs frequently contain a profuse growth of ericaceous dwarf shrubs including *Kalmia latifolia* (sheep laurel) and *K. polifolia* (bog laurel), *Chaemadaphne calyculata* (leatherleaf), *Ledum groenlandicum* (Labrador tea), *Gaylussacia dumosa* and *G. baccata*.

The presence of trees within bogs is often indicative of depth to water table, with patterns varying from completely or partially wooded at the wetland edges, grading to completely treeless at the centre (Rydin & Jeglum, 2006).

Herbaceous vegetation is typically dominated by *Sphagnum* mosses, with *S. fuscum* being the dominant peat forming species in Newfoundland (Wells & Pollet, 1983). Lesser amounts of graminoid species are also characteristic of bogs, with *Carex oligosperma*, *Eriophorum spp.*, *Rhyncospora alba* and *Scirpus cespitosus* (deergrass) forming 'lawns' in the wetter hollows and flats (Rydin & Jeglum, 2006; Wells & Pollet, 1983). Herbaceous species such as *Utricularia spp.* (bladderworts), *Sarracenia purpurea* (pitcher plant) are commonly encountered amongst the lawn community. Lichens such as *Cladina spp.* (reindeer lichen) are often interspersed with *Sphagnum* and ericaceous shrubs in the dryer bogs and on bog hummocks.

The majority of the bogs within the Study Area are located in well-defined basins within the landscape and typically have a relatively flat to slightly sloping (<5%) surface.

1.1.2 Fen Wetland Class

Fens are peatlands that have a fluctuating water table that is either at or slightly below the wetland surface (Rydin & Jeglum 2006) and are rich in dissolved minerals derived from the influence of surrounding mineral soils (National Wetland Working Group 1997). In Newfoundland, fens are highly variable in their size, ranging from small forest openings to large expanses on exposed uplands (Wells & Pollet 1983).

In general, vegetation in fens varies depending on water table position and degree of mineral enrichment in the wetland. Wet, nutrient poor fens are more prone to be dominated by *Sphagnum* and graminoids, whereas dryer nutrient poor fens tend to be dominated by ericaceous shrubs and dwarf *Picea mariana*. As dissolved mineral content increases, there is a greater dominance of graminoid, particularly sedges, decreased presence of *P. mariana* and an increased presence of *Larix laricina*.

Fens are among the most diverse in terms of their vegetation and can support large numbers of rare and endangered vascular plant species (Bedford & Godwin, 2003) particularly in calcareous areas (Johnson & Leopold, 1994). Species richness is generally greater for herbs, bryophytes and ferns and allies in fens (Warner & Asada, 2006), whereas species richness of trees and lichens is greater in bogs than in fens (Warner & Asada, 2006). Fens often occupy a moderately sloping (5-30%) position in the landscape (slope fens), or may develop adjacent to waterbodies such as lakes, ponds and streams (riparian fen). Riparian fens may also be subject to occasional inundation by floodwaters (National

Wetland Working Group, 1997). In most cases, peat forms the interface between the wetland and its associated waterbody. The two components of riparian fens are shore fens (associated with lakes or ponds) and stream fens (associated with rivers or streams). In each of these, the water table within the wetland is directly affected by the water level of its associated waterbody, whether normal or flooded. Peat deposits occasionally will contain inorganic material deposited during flooding (National Wetland Working Group, 1997). A defined vegetation gradient is typical in these wetlands, with graminoids and bryoids proximal to the waters' edge, grading to shrubs and trees with increasing lateral and vertical distance from water.

1.1.3 Marsh Wetland Class

Marshes are mineral based (or occasionally peat based) wetlands which are periodically inundated by standing or flowing water. These waters are nutrient rich, and their levels tend to fluctuate seasonally. The dominant vegetation comprises numerous herbaceous emergent species such as *Typha spp.* (cat-tails), *Juncus spp.* (rushes), *Calamagrostis spp.* (reed grasses) and sedges (*Carex spp.*); in shallow open water areas, there is occasional submergent and floating leaved species (Wells & Pollet, 1983).

Marshes in Newfoundland are often sub-categorized into either riparian marshes or basin marshes. Riparian marshes may occupy the riparian zones of rivers and streams, typically in swales bordering, but not directly attached to, the waterbody. These receive their hydrologic regime from overland flow of water from adjacent uplands, and from periodic overbank flooding from the stream or river (National Wetland Working Group, 1997). Basin marshes are located in well-defined topographic basin in inland areas, and may receive water inflow from groundwater discharge, overland flow or river inflow (National Wetland Working Group 1997).

1.1.4 Swamp Wetland Class

Swamps are a class of minerotrophic (ground or surface water influenced) wetlands which are predominantly vegetated with trees or shrubs and have a water table at or below the wetland surface. These can be either mineral or peat based wetlands; in the case of the latter, the organic material is generally highly decomposed and often high in wood content (National Wetland Working Group, 1997). Within the Study Area, swamps are typically dominated by *P. mariana* and *L. laricina* in the tree layer, *Alnus incana* (Speckled alder) and *Salix spp.* (willows) in the shrub layer, and *Osmunda cinnamomea* (Cinnamon fern), *C. canadensis*, and *Carex spp.* in the herbaceous layer.

Swamps can occupy a wide array of landscape positions, including riparian areas, basins, drainageways, broad slopes. Vegetation cover can be indicative of the nutrient regime of the wetland, with richer sites often tending towards a predominance of deciduous trees or shrubs. Coniferous species are tolerant of a broader range of nutrient availabilities (National Wetland Working Group, 1997).

1.2 Wetland Functions

All wetlands, especially those in urban and suburban contexts, perform a series of valued function within the landscape. Some of the apparent functions being provided by the Study Area wetlands are described briefly as follows:

1.2.1 Flood Prevention

Generally speaking, a landscape containing wetlands is more effective than one lacking wetlands, in terms of attenuating peak flows, storing and absorbing water. The vegetation structure of the Study Area wetlands, containing a significant measure of woody species, serves to effectively slow the flow of flood waters, protecting downstream infrastructure and lessening the burden on municipal stormwater services. Wetlands are natural sponges owing to their often deep layer of organic peats (bogs and fens in particular), which retain a significant volume of water, and often dissipate this water back into the local water table.

1.2.2 Carbon Sequestration and Water Quality Enhancement

The very dense vegetation, irregular microtopography and relatively flat internal gradient of many of the Study Area wetlands contribute to retaining any sediment, including organic carbon sources, that are delivered to it. This in turn, helps to stabilize and retain phosphorous which is often adsorbed to sediments. The acidic soils that commonly underlie bogs, and to a lesser extent fens, help to slow the decomposition of organic material and thus carbon sequestration in the form of sphagnum peat (bogs), sedge peat (fens), is often quite high in these wetlands. Carbon sequestration in swamps is also significant, as realized through the accretion and slow decomposition of woody debris.

1.2.3 Habitat Value

The Study Area wetlands also provide valuable habitat for both aquatic and terrestrial taxa. The abundance of natural land cover in the surrounding area is beneficial to all taxa and contributes positively to this function. More specifically, aquatic taxa such as many invertebrates and amphibians benefit from a multitude of inundated depressions, pools and ponds that are present within the wetlands (various types) for both breeding and foraging. Native plant diversity is supported by extensive natural land cover in surrounding buffer areas, and the various wetland's irregular microtopography promotes hydrologic variation, which in turn encourages greater species diversity (Alsfeld et al., 2009). Correspondingly, pollinator habitat is also supported by the diversity of native plants, supplying a broad seasonal distribution of possible pollen and nectar sources. The Study Area wetlands also assumed to maintain base-flows to local watercourses, which in turns supports and sustains populations of fish. Lastly, songbirds, raptors and mammals benefit from nearby contiguous forested habitat and relatively low human-derived impacts, given the suburban context of the Study Area.

1.3 Wetland Conservation Priority

Given both the observed and interrupted distribution of wetlands within the Study Area, and their apparent wetland functions as described above, the wetlands have been assigned to conservation priority categories of 'Low', 'Moderate', and 'High'. These categories are elaborated upon below.

Low: This categories denotes wetlands containing some combination of the following:

- Relatively common wetland types (typically swamps, some bogs);

- Hydrologically isolated;
- Small in size, or fragmented from a larger wetland;
- Composed of resilient vegetation (predominantly woody);
- Having varying degrees of pre-existing disturbance;
- Possibly posing the least constraints from a constructability perspective, potentially containing less water, and shallower peat layers.
- Apparently having minimal functional value for one or more of the functions identified above.

High: This categories denotes wetlands containing some combination of the following:

- Rarer wetland types (fens, marshes, some bogs);
- Hydrologically connected to waterbodies/watercourses, or obviously contributing to these;
- Generally larger in size, or part of a wetland complex;
- Composed of more sensitive vegetation (predominantly herbaceous, and scattered woody vegetation)
- Generally less disturbed;
- May pose the greatest constraints to constructability, potentially containing more water, and deeper peat layers.
- Apparently having high functional value for one or more of the functions identified above.

Moderate: This intermediate category may contain wetlands that are themselves likely to be fairly average in terms of their intrinsic character, but are elevated to this status due to their large size (and associated increase in functional value), or due to their association with other more exceptional features such as watercourses or wetland areas ranked as 'high' conservation priority.

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Photo 1: Typical bog conditions within Study Area, grading to treed swamp at periphery.

Photo 2: Typical treed swamp conditions (background) adjacent to existing right-of-way development

Photo 3: Typical Fen Conditions

Photo 4: Wetlands in the Study Area May Often be in Association with a Watercourse

Photo 5: Pre-existing impacts to wetlands are present along transmission corridor (primarily ATV traffic)

APPENDIX C

Traffic Analysis

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MEMORANDUM

DATE: JULY 22, 2016

PROJECT NO: 143046.01

MEMO TO	Greg Sheppard, P.Eng.
PROJECT NAME	Kilbride Land Use Study
SUBJECT	Development of Kilbride Areas – Traffic Analysis [Revised to address City comments & include updated Development Areas]
FROM	Mark MacDonald, P.Eng.
COPIES TO	

1. Introduction

This memo has been prepared as part of the East Kilbride Area – Comprehensive Land Use Development Planning Study to provide an overview of the potential traffic impacts associated with development of the suitable tracts of land within the Kilbride area. These are shown on Map 10 (Appendix A) as Areas 2, 3, 4, and 5; Area 1 is within Shea Heights and is not included in this traffic analysis.

Table 4.1, presented in the main report, shows that roughly 2,400 people are expected to eventually inhabit Areas 2 thru 5. The prime objective of this traffic analysis is to determine what traffic impacts can be expected for the existing street/intersection network if single family residential subdivisions are developed throughout Areas 2, 3, 4 and 5. The traffic analysis used the following methodology:

1. Establish appropriate study intersections to include for this analysis and compile recent turning movement traffic counts for them.
2. Use Synchro/SimTraffic software to assess and summarize the peak period performance of these intersections with the existing 2014-15 AM and PM peak hour volumes.
3. Forecast future traffic volumes for the 2025 horizon year. Consult with VISUM forecasts to develop an appropriate background growth rate.
4. Use Synchro/SimTraffic to assess and summarize performance of study intersections with 2025 No Build scenario (without Areas 2 - 5 developed).
5. Use ITE trip generation manual and density assumptions to estimate the number of AM and PM trips to be generated by Areas 2 - 5, and distribute that traffic throughout the existing street network via the proposed access points.
6. Add new traffic from Areas 2 - 5 to the 2025 No Build scenario to obtain the 2025 Build volumes. Assess and summarize intersection performance for this scenario.
7. Use Synchro/SimTraffic to investigate options and strategies to mitigate any traffic impacts resulting from the addition of traffic from Areas 2 to 5.

8. Summarize findings and conclusions, and recommend the needed street network changes to facilitate development of Areas 2 to 5.

Attached to this memo are the following:

- Sk1 – Proposed Functional Road & Intersection Improvements
- Summary tables of the Synchro/SimTraffic analysis results for the 4 scenarios
- Volume Diagrams for the 4 analysis scenarios (colour-coded according to the Synchro/SimTraffic analysis results to show which movements are performing poorly)
- Synchro/SimTraffic analysis reports for each scenario

2. Study Intersections

Given the location of the Kilbride Development Areas, all access will be via Bay Bulls Road, a major north-south collector through the area. Old Petty Harbour Road is a minor collector that will be used by future residents of Areas 2 and 3, and some from Area 4 as well. However, all development areas will have multiple access points and many intermediate intersections along both of these roadways will serve the traffic generated by them. The following seven key intersections were included in this study. The accompanying figures refer to the node numbers assigned in the Synchro/SimTraffic models; these are included in the Synchro reports and the Level of Service summary tables for reference.

1. Bay Bulls Road & Pitts Memorial WB Ramp [10]
2. Bay Bulls Road & Old Petty Harbour Road [20]
3. Old Petty Harbour Rd & Huntingdale Drive [30]
4. Bay Bulls Road & Pitts Memorial Ramps [40]
5. Old Petty Harbour Road & Densmores Lane [50]
6. Bay Bulls Road & Old Bay Bulls Road (north) [60]
7. Bay Bulls Road & Old Bay Bulls Road (south) [70]

AM and PM peak period turning movement count data was collected at all of these intersections in June 2014 as part of the larger project, except for numbers 4 and 5. Therefore, CBCL used our Miovision Scout equipment to obtain traffic data counts at these locations on March 31 and April 1, 2015.

3. Existing Conditions Analysis

Synchro/SimTraffic software (latest build of Version 9) was used to create a model of the study intersections, including configurations, lane assignments, traffic control, and signal timing/phasing. Separate models were developed to represent the AM and PM peak hours; for each of these, turning movement traffic volumes, peak hour factors, and heavy vehicle percentages were entered. Current signal timing and phasing information was provided by the City, but timing was modified and optimized wherever it was beneficial. Therefore, the AM and PM analyses often include different timing plans to best suit the traffic demands at those times of day. In addition to the attached summary table, the analysis results are discussed below.

1. Bay Bulls Road & Pitts Memorial WB Ramp
    - No problems to report
2. Bay Bulls Road & Old Petty Harbour Road

- Generally performs well during both peak periods
- Westbound queue during AM peak frequently spills back through Old Petty Harbour / Huntingdale intersection (only ~20m of queue storage available)

3. Old Petty Harbour Rd & Huntingdale Drive
    - Some queuing/delay issues for northbound and southbound approaches during the AM peak, primarily due to close proximity of adjacent traffic signal and heavy flows trying to access Bay Bulls Road north (SimTraffic LOS E for southbound approach during AM peak)
4. Bay Bulls Road & Pitts Memorial Ramps
    - No major operational issues at intersection
    - Eastbound queue spill-back may occasionally extend into the highway northbound through lanes during the AM peak.
    - The eastbound left turn queue frequently blocks access to the right turn lane.
5. Old Petty Harbour Road & Densmores Lane
    - No problems to report
6. Bay Bulls Road & Old Bay Bulls Road (north)
    - No problems to report
7. Bay Bulls Road & Old Bay Bulls Road (south)
    - No problems to report

4. Development of 2025 No Build Volumes

As per the RFP, 2025 was selected as the planning horizon for this study. To proceed with this analysis, future turning movement traffic volumes needed to be forecast for that year, so CBCL used the City's previously-developed VISUM model as a guide. This model has incorporated several planned road network changes such as completion of the Team Gushue Highway as well as anticipated residential and commercial growth. From this model, CBCL discovered that uniform application of an annual growth rate of 1.5% to the 2014-15 count data would most closely approximate the forecast link volumes generated by VISUM. It should be noted that while many of the VISUM link volumes were closely replicated by this growth rate, several others could not be duplicated. However, we feel that the selected rate would conservatively account for any future background traffic, especially considering that estimated traffic from Development Areas 2 thru 5 will be added explicitly.

The cumulative 1.5% annual growth rate results in a substantial overall increase of 17.8% for the existing 2014-2015 volume data. A diagram showing the resulting 2025 No Build volumes is attached to this memo.

5. Analysis of 2025 No Build Scenario

The 2025 No Build volumes were analysed using Synchro/SimTraffic and the analysis results are discussed below:

1. Bay Bulls Road & Pitts Memorial WB Ramp
    - No problems to report
2. Bay Bulls Road & Old Petty Harbour Road
    - Generally performs well during both peak periods

- Westbound queue during AM peak frequently spills back through Old Petty Harbour / Huntingdale intersection (only ~20m of queue storage available)

3. Old Petty Harbour Rd & Huntingdale Drive
   - Some queuing/delay issues for northbound and southbound approaches during the AM peak, primarily due to close proximity of adjacent traffic signal and heavy flows trying to access Bay Bulls Road north (SimTraffic LOS F for southbound approach during AM peak)
4. Bay Bulls Road & Pitts Memorial Ramps
   - No major operational issues at intersection
   - Eastbound queue spill-back may occasionally extend into the highway northbound through lanes during the AM peak.
   - The eastbound left turn queue frequently blocks access to the right turn lane.
5. Old Petty Harbour Road & Densmores Lane
   - No problems to report
6. Bay Bulls Road & Old Bay Bulls Road (north)
   - No problems to report
7. Bay Bulls Road & Old Bay Bulls Road (south)
   - No problems to report

6. Traffic Forecasting & Trip Generation for Areas 2 / 3 / 4 / 5

We forecast the new trips anticipated to be generated by development of Areas 2, 3, 4, and 5 for single family residential land use. As per the City's RFP, a population density of 40 persons/hectare was used; Figure 1 provides the potential populations of each area based on this density. Using the Institute of Traffic Engineers (ITE) Trip Generation Manual with the approximate number of persons, CBCL estimated the number of trips to be generated by Areas 2, 3, 4, and 5. The following tables show the calculations and summarize the anticipated number of AM and PM peak hour trips to be generated by each area upon full build-out.

PM Peak Hour of Adj. Street	0.280	66%	34%	183	95	**278**
PM Peak Hour of Adj. Street	0.280	66%	34%	86	44	**130**

These new trips were distributed to the existing road network according to several assumptions which are listed below.

- Overall distribution of new trips was taken from the City's 2025 VISUM model:
  - Columbus Drive corridor 50%
  - Route 2 east 22.5%
  - Route 2 west 10%
  - Bay Bulls Road south/Goulds 5%
  - Walshs Lane / Pearl Town Road 12.5%
  - **Total** **100%**
- Area 2
  - 70% will enter/exit via Densmores Lane
  - 30% will enter/exit via Huntingdale Drive
- Area 3
  - 10% will enter/exit via Densmores Lane

    - 45% will enter/exit via Parkridge Drive
        - Assumed 20% of outbound trips would use Cemetery Lane
        - Remainder of these outbound trips + all inbound trips would use Old Petty Harbour Road
    - 40% will enter/exit via the planned Kilbride Avenue extension (through Meadowgreen Place)
    - 5% will enter/exit via direct connection to Old Petty Harbour Road
- Area 4
    - 100% will enter/exit via the Lannon Street, Griffins Lane, and Connellys Lane connections to Bay Bulls Road
    - Assumed 0% would use the Old Petty Harbour Road connection on a regular basis
- Area 5
    - 100% will enter/exit via the direct connection to Bay Bulls Road

The estimated 2025 Build traffic volumes were developed by adding the anticipated future traffic from Areas 2 thru 5 to the 2025 No Build volumes. The resulting volume diagram is provided with this memo.

7. Analysis of 2025 Build Scenario

The 2025 Build volumes were analysed using Synchro/SimTraffic and the analysis results are discussed below:

1. Bay Bulls Road & Pitts Memorial WB Ramp
    - No problems to report
2. Bay Bulls Road & Old Petty Harbour Road
    - The westbound right turn and northbound approach anticipated to have queuing, V/C, and/or LOS issues during the AM peak period
    - Generally good performance for other movements and during other times
3. Old Petty Harbour Rd & Huntingdale Drive
    - Significant/severe queuing/delay issues for northbound and southbound approaches during the AM peak, primarily due to close proximity of adjacent traffic signal and heavy flows trying to access Bay Bulls Road north
4. Bay Bulls Road & Pitts Memorial Ramps
    - Significant queuing, V/C, and delay issues for the eastbound left turn movement during both peaks
    - Excessive queues and V/C ratios for northbound AM and southbound PM
5. Old Petty Harbour Road & Densmores Lane
    - No problems to report
6. Bay Bulls Road & Old Bay Bulls Road (north)
    - LOS E for northeast approach during AM peak
7. Bay Bulls Road & Old Bay Bulls Road (south)
    - No problems to report

From this assessment, it is clear road network changes will be needed to accommodate the estimated future traffic volumes when Development Areas 2 thru 5 are built out.

8. Investigation of Improvements / Analysis with 2025 Build Volumes

To mitigate the anticipated traffic impacts stemming from the addition of traffic generated by the future development of Areas 2 thru 5, CBCL first considered construction of a new connector roadway. This road would have connected the existing intersections of Bay Bulls Road / Pitts Memorial Ramps and Old Petty Harbour Road / Densmores Lane. It seemed that a road such as this would be successful in redistributing some traffic away from the very short existing connector between Bay Bulls Road and Old Petty Harbour Road and therefore relieve some of the congestion at that location. With a new, longer connector further south, it may be possible to remove the traffic signals at the existing connector and convert that intersection to right-in/right-out only.

Construction of this new connector road would require purchase and demolition of several homes. However, we soon discovered that the topography in this area would require road slopes in the range of 17-20%, much too steep for a public street. We then looked at connecting to Old Petty Harbour Road further north instead, and it was found that acceptable slopes of 9-10% could be achieved. However, because this alignment would not connect directly to Densmores Lane and would involve a 'switchback' layout, we anticipate it would be less successful in reducing congestion, and that the existing traffic patterns would remain as the preferred routes for most motorists.

Therefore, CBCL decided to consider other potential changes to the existing streets and intersections which could better accommodate the various peak period traffic demands. These are outlined below:

- Intersection of Bay Bulls Road & Pitts Memorial ramps
    - Closure of the access to eastbound Pitts Memorial and repurposing of that lane for use as a second eastbound left turn lane (as per May 29, 2015 version of this memo)
        - Have since decided this wouldn't be necessary, though the existing shared left/thru lane would remain
    - Replacement of the traffic signal with a roundabout
        - Would require a multi-lane layout with an ICD of roughly 50-55m and this would have major impacts on the adjacent properties and business
        - Significant challenges associated with the existing topography
        - This intersection is likely better served with traffic signals
- Intersection of Bay Bulls Road & Old Petty Harbour Road
    - Closure of this intersection
        - Not feasible without a new connector street which was ruled out
        - Nearest connection would then be the eventual Kilbride Avenue extension, but is ~1.2 km to the south so not considered viable

        - Cemetery Lane (~750m south) not considered viable alternate connector due to the steep grades of ~15% and because most of it is one-way westbound
    - Removal of signal and conversion to right-in/right-out
        - This arrangement wouldn't provide left turn access; southbound left turn volumes are significant and need to be accommodated either here or at a nearby connector road
        - Therefore, not feasible without a new connector street which was ruled out
    - Consideration of an overlapping right turn phase to boost capacity for westbound right turns
        - This change is not sufficient to accommodate the AM demands
    - Provision of a dual right turn movement onto Bay Bulls Road
        - Looked at 2 versions of this:
            - Shared left-right lane + dedicated right turn lane (no right turns on red)
            - Shared left-right lane + dedicated right turn lane separated by a channelizing island to permit right turns on red for the dedicated lane only
        - Both of these options appear to provide adequate capacity, but the City wants to avoid a dual right turn movement
    - Replacement of the traffic signal with a roundabout
        - Would require a multi-lane layout with an ICD of roughly 50-55m and realignment of a portion of Bay Bulls Road
        - This would have impacts on the adjacent properties and business
            - 1-2 homes + the Don Fong Restaurant may have to be removed
            - The Irving parking lot may have to be relocated
            - Impacts to driveways and yards
        - Additional challenges associated with connecting Old Petty Harbour Road and Huntingdale Drive
            - Could consider closing Huntingdale approach, but this would involve re-routing more than 150 vehicles during the AM and PM peak periods so it should remain
        - However, if a roundabout could successfully be designed and built to suit this location, it could have several advantages:
            - Should perform better than the existing signals and have sufficient capacity to accommodate all future traffic from the Development Areas
            - Should remove the need to construct an alternate connector roadway elsewhere or other costly strategies to provide the needed capacity enhancements
            - Could facilitate access management improvements along Bay Bulls Road, particularly for the Irving/Tim Hortons driveways

- The City may wish to explore this option further. A complete review would benefit from having additional turning movement counts done at the Pitts Memorial on-ramp and the Irving/Tim Hortons driveways.

After exploring various strategies, we settled on the following changes which can accommodate the estimate 2025 Build volumes:

- Bay Bulls Road
  - More southbound capacity for through traffic needed so widen to provide 2 southbound lanes to coincide with the 2 existing northbound lanes
  - Implement signal coordination along the Bay Bulls Road corridor
  - Reduce corridor cycle lengths to 80 seconds for the AM peak period and 60 seconds for the PM peak period
- Intersection of Bay Bulls / Pitts Memorial Ramps
  - Modify existing eastbound right turn lane to be a shared lane for left and right turn movements
  - [Also considered removing the potentially dangerous northbound shared left-thru lane by adding a dedicated northbound left turn lane, but this widening would have significant property impacts.]
- Intersections of Bay Bulls / Old Petty Harbour Road / Huntingdale Drive
  - Add a channelizing island and modify the westbound right turn movement to make it free-flow into a new lane on Bay Bulls Road that would extend to connect directly with the on-ramp to Pitts Memorial
  - Modify the existing geometry to formally make Old Petty Harbour Road the through movement, with Huntingdale Drive forming a T-intersection with it

The proposed changes associated with making the Old Petty Harbour right turn movement free-flow onto Bay Bulls Road would result in a six-lane cross section adjacent to the Irving/Tim Hortons, and this may be an issue for egress left turns and access to the on-ramp. To mitigate this, we would recommend a southward extension of the existing median to prevent left turn egress from the northerly driveway; this is illustrated in Sk1. There would also be challenges with the needed widening, particularly due to the proximity of Huntingdale Drive. This change would also result in a weaving section roughly 140m long.

The proposed changes are illustrated in an attached figure. CBCL again used Synchro/SimTraffic software to carry out AM and PM peak hour analyses of the 2025 Build volumes with the changes in place. The results are provided in the analysis reports and summary tables attached to this memo, and are outlined below.

1. Bay Bulls Road & Pitts Memorial WB Ramp
   - No problems to report
2. Bay Bulls Road & Old Petty Harbour Road
   - No problems to report
3. Old Petty Harbour Rd & Huntingdale Drive
   - No problems to report

4. Bay Bulls Road & Pitts Memorial Ramps
    - No problems to report
5. Old Petty Harbour Road & Densmores Lane
    - No problems to report
6. Bay Bulls Road & Old Bay Bulls Road (north)
    - No problems to report
7. Bay Bulls Road & Old Bay Bulls Road (south)
    - No problems to report

As shown, the proposed changes adequately address the deficiencies that were summarized in Section 7 and represent a major improvement over our findings without the network capacity enhancements.

9. Conclusions and Recommendations

We conclude from this analysis that full development of Areas 2, 3, 4, and 5 will have a detrimental impact on many of the study intersections in their current configurations. By implementing the suggested upgrades to Bay Bulls Road and the signalized intersections, the anticipated traffic from these Development Areas can be accommodated while maintaining satisfactory performance during the morning and afternoon peak periods.

This approach has several advantages over the construction of a new connector road including reduced costs, reduced impact on properties and homes, clarification of right-of-way at the Huntingdale Drive approach, and an access management improvement for the Irving / Tim Hortons. However as mentioned, there would be challenges with implementing this plan and the City may wish to consider further review of a roundabout to replace the traffic signals at the Bay Bulls Road / Old Petty Harbour Drive intersection.

We trust this memo meets your expectations with respect to development of Areas 2, 3, 4, and 5. Please don't hesitate to contact us with any questions or if further information is required.

Yours truly,

CBCL Limited

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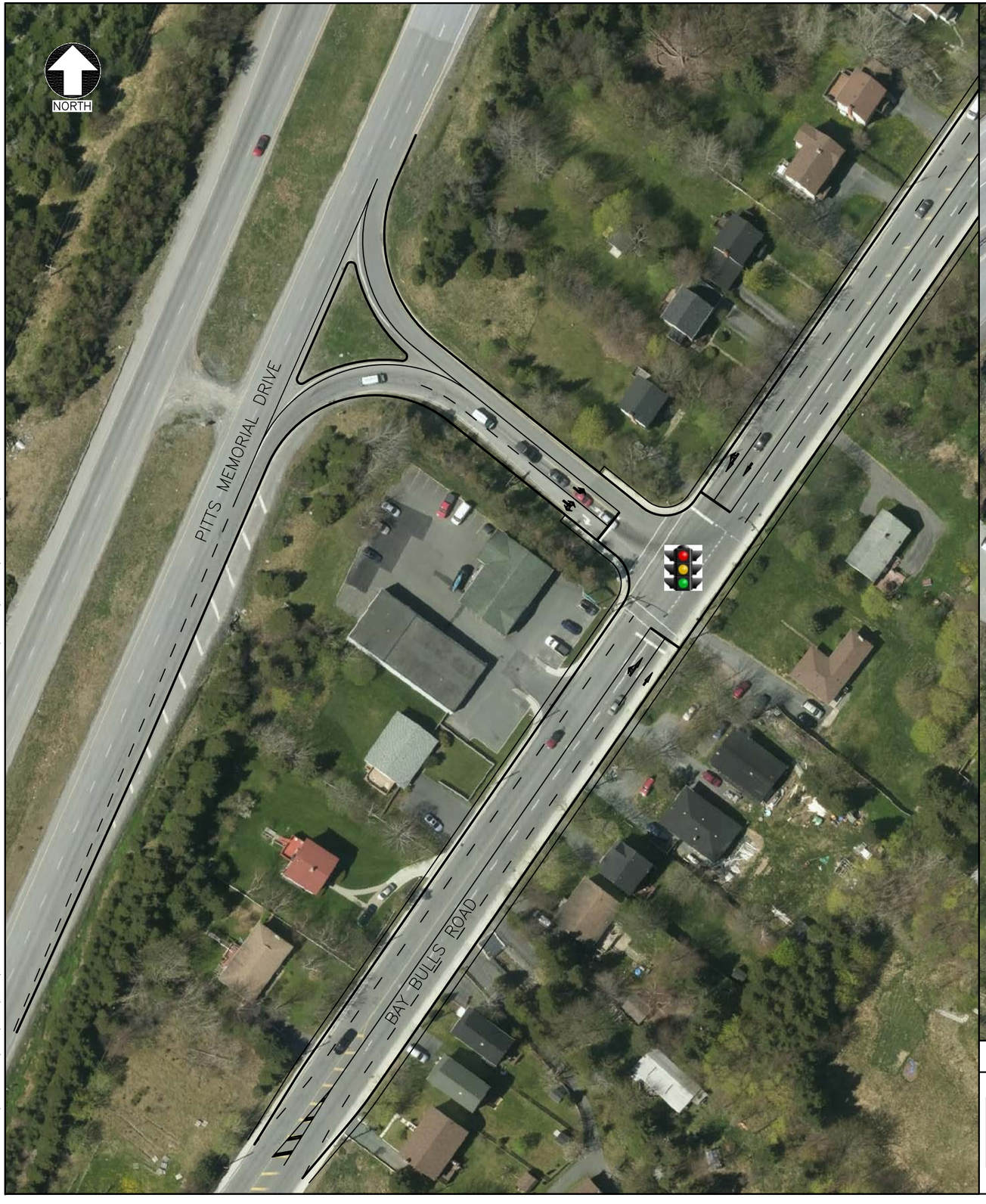
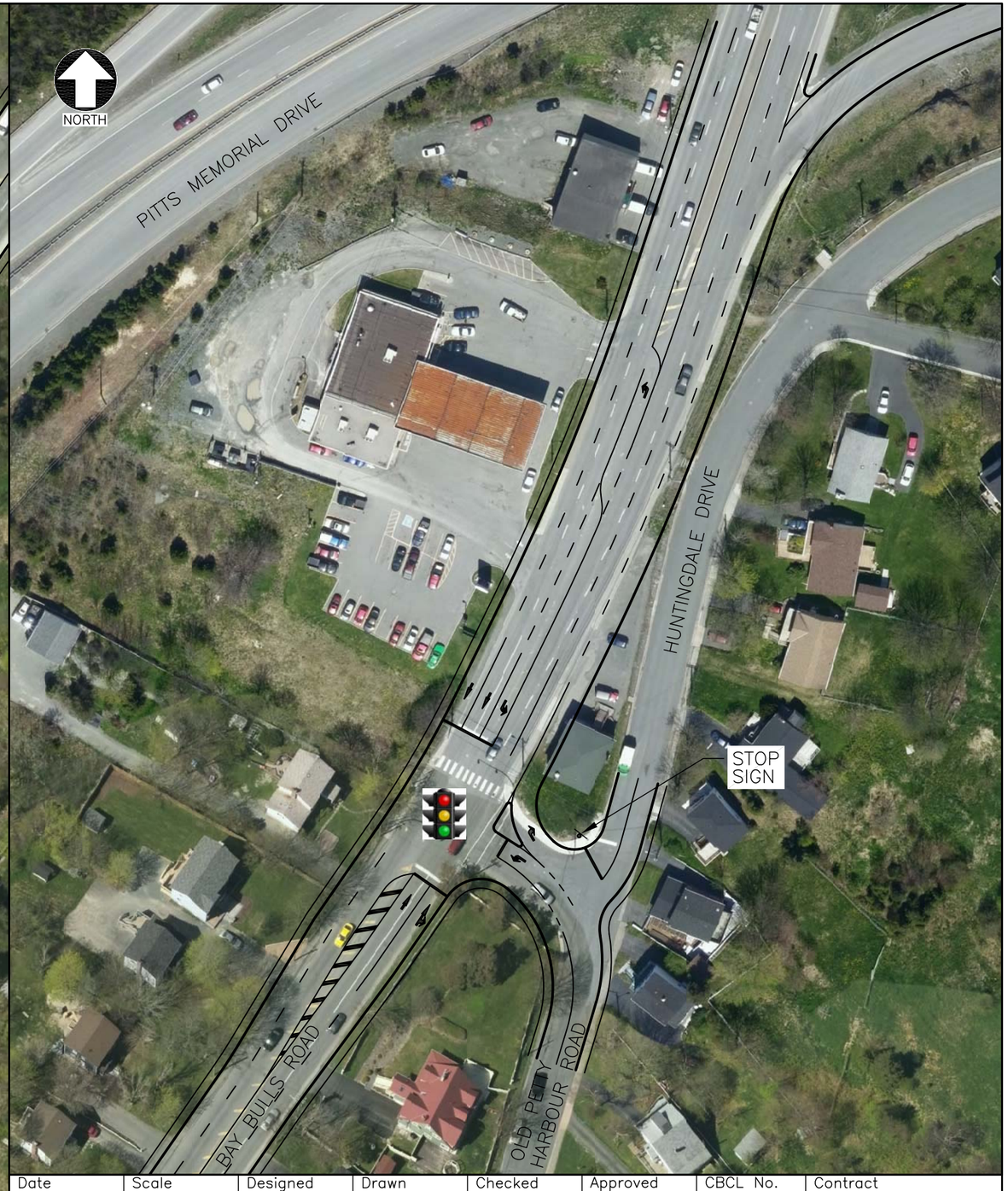
Project No: 143046.01





Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
DEC 7/15	1:1000	MRM	SEM			143046.01	

CBCL LIMITED
Consulting Engineers
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CITY OF SAINT JOHN'S
EAST KILBRIDE CDA

DEVELOPMENT AREAS 2/3/4/5
FUNCTIONAL ROAD AND
INTERSECTION IMPROVEMENTS

Sketch

SK1

Kilbride Comprehensive Land Use Development Plan
Development of Areas 2 / 3 / 4 / 5
CBCL Limited 143046.01
December 7, 2015

Table 1 - Synchro/SimTraffic Analysis Results: 2014-15 Existing AM

Intersection [Synchro Node No.]	Lane Group / Movement	AM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	24.7	0.37	38.1	D	17.6	28.7	C
	NB Thru	74.8	0.53	7.2	A	55.5	8.0	A
	SB Thru	9.6	0.09	4.4	A	20.1	4.6	A
	Overall			**8.3**	**A**		**8.0**	**A**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left	-	-	0.0	A			A
	WB Right	80.5	0.87	39.6	D	19.1	8.8	A
	NB Thru/Right	140.0	0.74	22.1	C	109.1	21.4	C
	SB Left	18.3	0.48	15.7	B	26.6	22.5	C
	SB Thru	25.6	0.16	7.8	A	29.7	8.6	A
	Overall			**23.9**	**C**		**17.5**	**B**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	0.0	0.01	7.3	A	7.1	2.0	A
	NB Left/Thru	-	-	0.0	A	56.0	14.0	B
	SB Thru/Right	2.1	0.09	8.7	A	41.2	42.1	E
	Overall			**1.8**	**A**		**15.7**	**C**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left	129.3	0.79	27.2	C	28.6	21.7	C
	EB Right	2.3	0.01	8.0	A	106.0	18.5	B
	NB Left/Thru	106.3	0.73	22.6	C	95.0	21.3	C
	SB Thru/Right	53.6	0.35	17.3	B	37.4	12.0	B
	Overall			**23.2**	**C**		**18.8**	**B**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	1.4	0.06	9.6	A	14.4	3.6	A
	SB Left/Thru	0.0	0.01	7.7	A	3.3	2.8	A
	Overall			**1.7**	**A**		**0.7**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	3.5	0.16	16.1	C	11.0	7.8	A
	NB Left	0.0	0.00	7.6	A	-	0.0	A
	Overall			**1.2**	**A**		**1.1**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	1.4	0.08	7.8	A	14.1	2.2	A
	SE Left/Right	1.4	0.06	9.6	A	15.6	3.7	A
	Overall			**2.1**	**A**			**A**

Notes:
Analysis by CBCL Limited using Synchro/SimTraffic 8.0 (Build 8.0.806.77)
1. 95% Queue - 95th percentile queue [highlighted if >100m]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

Table 1 (con't) - Synchro/SimTraffic Analysis Results: 2014-15 Existing PM

Intersection [Synchro Node No.]	Lane Group / Movement	PM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	85.4	0.78	47.3	D	66.9	34.6	C
	NB Thru	44.7	0.29	10.7	B	48.0	9.7	A
	SB Thru	60.3	0.37	11.5	B	24.0	6.7	A
	Overall			**18.1**	**B**		**11.9**	**B**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left	7.8	0.06	35.1	D	10.0	31.3	C
	WB Right	17.1	0.50	10.5	B	18.8	5.3	A
	NB Thru/Right	66.8	0.46	23.6	C	61.1	22.3	C
	SB Left	40.0	0.47	6.6	A	45.6	12.7	B
	SB Thru	78.5	0.45	6.5	A	81.7	6.9	A
	Overall			**13.0**	**B**		**12.6**	**B**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	0.7	0.05	7.3	A	12.2	1.7	A
	NB Left/Thru	-	-	0.0	A	8.2	0.8	A
	SB Thru/Right	0.7	0.04	8.5	A	14.9	14.4	B
	Overall			**1.5**	**A**		**1.2**	**A**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left	67.8	0.61	33.4	C	31.1	21.9	C
	EB Right	10.7	0.17	8.7	A	64.4	22.2	C
	NB Left/Thru	18.1	0.17	6.2	A	30.1	5.4	A
	SB Thru/Right	150.7	0.81	17.3	B	93.4	11.9	B
	Overall			**16.9**	**B**		**12.6**	**B**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	0.7	0.03	9.1	A	11.9	2.9	A
	SB Left/Thru	0.0	0.02	7.4	A	4.1	1.8	A
	Overall			**1.2**	**A**		**0.5**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	2.1	0.10	16.1	C	10.5	10.1	B
	NB Left	0.0	0.00	0.0	A	-	0.0	A
	Overall			**0.6**	**A**		**1.6**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	0.7	0.05	8.2	A	15.9	2.7	A
	SE Left/Right	4.2	0.18	11.5	B	19.9	7.1	A
	Overall			**2.4**	**A**		**2.2**	**A**

Notes:
Analysis by CBCL Limited using Synchro/SimTraffic 8.0 (Build 8.0.806.77)
1. 95% Queue - 95th percentile queue [highlighted if >100m]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

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Table 2 - Synchro/SimTraffic Analysis Results: 2025 No Build AM

Intersection [Synchro Node No.]	Lane Group / Movement	AM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	30.2	0.45	43.7	D	17.4	31.4	C
	NB Thru	96.6	0.61	8.0	A	67.2	10.3	B
	SB Thru	10.7	0.10	4.2	A	21.0	4.7	A
	Overall			**9.2**	**A**		**10.0**	**A**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left	-	-	0.0	A	-	0.0	A
	WB Right	104.1	0.90	40.8	D	21.4	8.6	A
	NB Thru/Right	138.3	0.83	27.7	C	105.9	23.4	C
	SB Left	25.3	0.57	21.3	C	33.8	22.8	C
	SB Thru	28.8	0.20	9.0	A	36.9	9.9	A
	Overall			**27.9**	**C**		**18.6**	**B**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	0.7	0.02	7.3	A	7.2	2.9	A
	NB Left/Thru	-	-	0.0	A	67.3	15.6	C
	SB Thru/Right	2.8	0.11	8.7	A	53.5	72.2	F
	Overall			**1.8**	**A**		**21.1**	**C**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left	175.7	0.90	39.4	D	27.3	24.7	C
	EB Right	2.4	0.01	8.0	A	111.1	22.3	C
	NB Left/Thru	119.5	0.84	28.0	C	112.8	25.3	C
	SB Thru/Right	56.5	0.40	18.4	B	45.8	14.8	B
	Overall			**30.1**	**C**		**22.1**	**C**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	1.4	0.07	9.9	A	13.8	2.8	A
	SB Left/Thru	0.0	0.01	7.8	A	4.0	2.2	A
	Overall			**1.8**	**A**		**0.7**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	5.6	0.22	19.4	C	12.4	8.8	A
	NB Left	0.0	0.00	7.7	A	-	0.0	A
	Overall			**1.4**	**A**		**1.3**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	2.1	0.09	7.9	A	19.0	2.5	A
	SE Left/Right	2.1	0.08	9.8	A	16.1	3.7	A
	Overall			**2.2**	**A**		**2.0**	**A**

Notes:
Analysis by CBCL Limited using Synchro/SimTraffic 8.0 (Build 8.0.806.77)
1. 95% Queue - 95th percentile queue [highlighted if >100m]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

Table 2 (con't) - Synchro/SimTraffic Analysis Results: 2025 No Build PM

Intersection [Synchro Node No.]	Lane Group / Movement	PM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	79.7	0.78	36.7	D	65.2	27.6	C
	NB Thru	55.0	0.39	13.4	B	53.9	10.7	B
	SB Thru	75.1	0.51	14.8	B	24.2	7.5	A
	Overall			**18.5**	**B**		**11.8**	**B**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left	7.3	0.06	28.7	C	11.3	18.2	B
	WB Right	16.5	0.51	8.9	A	19.1	5.8	A
	NB Thru/Right	77.3	0.63	26.2	C	71.0	24.1	C
	SB Left	69.5	0.62	13.5	B	63.3	16.6	B
	SB Thru	104.8	0.56	8.8	A	69.6	18.9	B
	Overall			**15.9**	**B**		**15.0**	**B**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	1.4	0.06	7.4	A	12.7	1.8	A
	NB Left/Thru	-	-	0.0	A	21.1	3.3	A
	SB Thru/Right	1.4	0.05	8.5	A	18.3	10.3	B
	Overall			**1.5**	**A**		**1.9**	**A**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left	85.5	0.76	45.0	D	32.2	33.1	C
	EB Right	11.1	0.20	8.6	A	87.0	32.0	C
	NB Left/Thru	18.5	0.19	6.0	A	29.8	4.7	A
	SB Thru/Right	201.7	0.89	23.2	C	102.3	13.3	B
	Overall			**22.0**	**C**		**15.3**	**B**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	0.7	0.04	9.4	A	13.3	2.1	A
	SB Left/Thru	0.7	0.04	7.5	A	6.8	2.3	A
	Overall			**1.9**	**A**		**0.9**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	3.5	0.14	19.1	C	11.5	12.9	B
	NB Left	0.0	-	0.0	A	-	0.0	A
	Overall			**0.7**	**A**		**2.2**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	1.4	0.06	8.4	A	24.0	4.3	A
	SE Left/Right	6.3	0.23	12.5	B	23.5	8.5	A
	Overall			**2.5**	**A**		**2.9**	**A**

Notes:
Analysis by CBCL Limited using Synchro/SimTraffic 8.0 (Build 8.0.806.77)
1. 95% Queue - 95th percentile queue [highlighted if >100m]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

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Table 3 - Synchro/SimTraffic Analysis Results: 2025 Build AM

Intersection [Synchro Node No.]	Lane Group / Movement	AM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	27.8	0.46	28.4	C	26.8	21.8	C
	NB Thru	142.2	0.79	14.3	B	74.4	14.1	B
	SB Thru	13.8	0.15	5.9	A	22.4	6.3	A
	Overall			**13.9**	**B**		**13.2**	**B**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left	3.2	0.01	27.0	C	3.3	20.4	C
	WB Right	157.2	1.03	75.1	E	26.8	10.8	B
	NB Thru/Right	228.0	1.01	50.2	D	161.3	38.5	D
	SB Left	53.2	0.85	54.2	D	38.2	30.6	C
	SB Thru	40.5	0.27	9.9	A	39.4	10.6	B
	Overall			**50.8**	**D**		**30.5**	**C**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	0.7	0.02	7.3	A	7.5	4.4	A
	NB Left/Thru	-	-	0.0	A	135.1	62.7	F
	SB Thru/Right	2.8	0.13	8.8	A	99.2	326.3	F
	Overall			**1.8**	**A**		**73.1**	**F**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left	213.8	1.02	70.5	E	27.9	37.5	D
	EB Right	3.0	0.01	11.7	B	110.3	42.0	D
	NB Left/Thru	187.4	0.99	46.8	D	151.1	41.6	D
	SB Thru/Right	70.8	0.43	17.6	B	69.8	15.4	B
	Overall			**48.7**	**D**		**33.3**	**C**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	3.5	0.14	10.6	B	17.6	5.2	A
	SB Left/Thru	0.7	0.03	7.8	A	7.5	2.6	A
	Overall			**2.9**	**A**		**1.1**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	9.1	0.32	29.1	D	18.7	17.5	C
	NB Left	0.0	0.00	7.9	A	0.0	0.0	A
	Overall			**1.6**	**A**			**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	2.1	0.09	8.0	A	18.7	2.7	A
	SE Left/Right	2.1	0.08	10.0	A	14.8	4.4	A
	Overall			**2.1**	**A**		**2.2**	**A**

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2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

Table 3 (con't) - Synchro/SimTraffic Analysis Results: 2025 Build PM

Intersection [Synchro Node No.]	Lane Group / Movement	PM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	92.2	0.85	34.6	C	67.5	22.0	C
	NB Thru	53.4	0.59	16.3	B	63.1	31.3	C
	SB Thru	93.3	0.82	22.6	C	22.8	12.9	B
	Overall			**22.9**	**C**		**20.1**	**C**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left	9.1	0.08	34.0	C	11.7	32.1	C
	WB Right	19.4	0.59	10.4	B	18.5	7.4	A
	NB Thru/Right	100.6	0.73	32.0	C	86.9	31.3	C
	SB Left	123.4	0.73	23.1	C	88.1	23.9	C
	SB Thru	176.7	0.71	11.4	B	82.8	12.9	B
	Overall			**20.4**	**C**		**20.1**	**C**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	1.4	0.07	7.4	A	17.7	2.0	A
	NB Left/Thru	-	-	0.0	A	23.0	3.2	A
	SB Thru/Right	1.4	0.06	8.6	A	17.6	13.4	B
	Overall			**1.5**	**A**		**2.2**	**A**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left	108.3	0.93	74.8	E	28.4	55.5	E
	EB Right	12.1	0.23	9.5	A	108.3	56.0	E
	NB Left/Thru	29.1	0.38	6.9	A	85.6	91.3	F
	SB Thru/Right	343.0	0.99	53.2	D	141.5	18.4	B
	Overall				**A**		**28.5**	**C**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	2.1	0.09	10.3	B	13.7	7.9	A
	SB Left/Thru	2.1	0.08	7.6	A	10.5	2.5	A
	Overall			**2.8**	**A**		**1.3**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	6.3	0.23	31.0	D	13.9	25.2	D
	NB Left	0.0	0.00	0.0	A	0.0	0.0	A
	Overall			**0.9**	**A**			**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	1.4	0.06	8.4	A	18.7	3.6	A
	SE Left/Right	6.3	0.23	12.7	B	24.5	8.7	A
	Overall			**2.4**	**A**		**2.7**	**A**

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1. 95% Queue - 95th percentile queue [highlighted if >100m]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

Kilbride Comprehensive Land Use Development Plan
Development of Areas 2 / 3 / 4 / 5
CBCL Limited 143046.01
December 7, 2015

Table 4 - Synchro/SimTraffic Analysis Results: 2025 Build w Improvements AM

Intersection [Synchro Node No.]	Lane Group / Movement	AM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	35.9	0.56	41.5	D	28.9	31.3	C
	NB Thru	109.5	0.71	8.1	A	66.3	6.9	A
	SB Thru	14.2	0.14	4.9	A	23.1	4.7	A
	Overall			**9.3**	**A**		**7.5**	**A**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left/Right	3.2	0.02	31.0	C	5.0	32.3	C
	WB Right	0.0	0.35	0.6	A	14.4	0.8	A
	NB Thru/Right	95.5	0.65	8.8	A	76.6	6.9	A
	SB Left	31.1	0.54	22.5	C	41.4	26.6	C
	SB Thru	7.2	0.09	0.7	A	12.0	1.7	A
	Overall			**7.1**	**A**		**6.4**	**A**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	0.7	0.02	7.3	A	9.8	2.0	A
	NB Left/Thru	-	-	0.0	A	7.5	1.3	A
	SB Thru/Right	2.8	0.13	8.8	A	20.9	6.7	A
	Overall			**1.8**	**A**		**2.2**	**A**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left/Right	70.0	0.82	36.3	D	105.9	35.1	D
	NB Thru	103.1	0.74	14.7	B	89.8	19.5	B
	SB Thru	16.3	0.19	6.0	A	21.8	7.3	A
	Overall			**19.5**	**B**		**20.4**	**C**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	3.5	0.14	10.6	B	15.7	5.0	A
	SB Left/Thru	0.7	0.03	7.8	A	10.4	2.8	A
	Overall			**2.9**	**A**		**1.2**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	9.1	0.32	29.1	D	1.6	16.3	C
	NB Left	0.0	0.00	7.9	A	9.5	0.0	A
	Overall			**1.6**	**A**		**1.9**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	2.1	0.09	8.0	A	22.9	2.9	A
	SE Left/Right	2.1	0.08	10.0	A	14.8	4.5	A
	Overall			**2.1**	**A**		**2.2**	**A**

Notes:
Analysis by CBCL Limited using Synchro/SimTraffic 8.0 (Build 8.0.806.77)
1. 95% Queue - 95th percentile queue [highlighted if >100m]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

Table 4 (con't) - Synchro/SimTraffic Analysis Results: 2025 Build w Improvements PM

Intersection [Synchro Node No.]	Lane Group / Movement	PM Peak Hour						
		Synchro Analysis				SimTraffic Analysis		
		95th % Queue[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Queue[5] (m)	Delay / Veh.[6] (s)	LOS[7]
Bay Bulls Rd & Pitts Mem. WB Ramp [10] (Signalized)	WB Left/Right	92.2	0.86	35.6	D	74.7	23.7	C
	NB Thru	39.6	0.57	13.9	B	58.5	12.5	B
	SB Thru	93.3	0.80	21.7	C	22.8	7.2	A
	Overall			**21.9**	**C**		**11.7**	**B**
Bay Bulls Rd & Old Petty Harbour Rd [20] (Signalized)	WB Left/Right	6.7	0.07	21.8	C	14.7	31.2	C
	WB Right	0.0	0.16	0.2	A	2.0	0.6	A
	NB Thru/Right	55.4	0.47	11.5	B	59.9	12.0	B
	SB Left	58.4	0.74	13.3	B	62.0	14.2	B
	SB Thru	52.8	0.32	6.1	A	44.5	3.3	A
	Overall			**8.8**	**A**		**8.0**	**A**
Old Petty Harbour Rd & Huntingdale Dr [30] (Unsignalized)	EB Left/Right	1.4	0.07	7.4	A	16.4	1.7	A
	NB Left/Thru	-	-	0.0	A	7.4	1.7	A
	SB Thru/Right	1.4	0.06	8.6	A	17.3	9.3	A
	Overall			**1.5**	**A**		**1.3**	**A**
Bay Bulls Rd & Pitts Memorial Ramps [40] (Signalized)	EB Left/Right	27.9	0.56	22.7	C	66.9	21.7	C
	NB Thru	24.2	0.32	6.5	A	37.4	11.0	B
	SB Thru	81.9	0.60	9.8	A	109.8	9.9	A
	Overall			**11.2**	**B**		**12.3**	**B**
Old Petty Harbour Rd & Densmores Ln [50] (Unsignalized)	WB Left/Right	2.1	0.09	10.3	B	14.6	7.1	A
	SB Left/Thru	2.1	0.08	7.6	A	11.1	2.5	A
	Overall			**2.8**	**A**		**1.3**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (N) [60] (Unsignalized)	NE Left/Right	5.6	0.22	32.0	D	13.5	30.8	D
	NB Left	0.0	0.01	15.7	C	6.4	0.0	A
	Overall			**0.9**	**A**		**3.6**	**A**
Bay Bulls Rd & Old Bay Bulls Rd (S) [70] (Unsignalized)	NB Left	1.4	0.06	8.4	A	20.3	3.8	A
	SE Left/Right	6.3	0.23	12.7	B	22.1	8.4	A
	Overall			**2.4**	**A**		**2.7**	**A**

Notes:
Analysis by CBCL Limited using Synchro/SimTraffic 8.0 (Build 8.0.806.77)
1. 95% Queue - 95th percentile queue [highlighted if >100m]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.90]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]
5. 95% Queue - SimTraffic 95th Queue [highlighted if >100m]
6. Delay/Veh. - SimTraffic Total per Vehicle [highlighted for LOS E or F]
7. LOS - SimTraffic Equivalent Level of Service

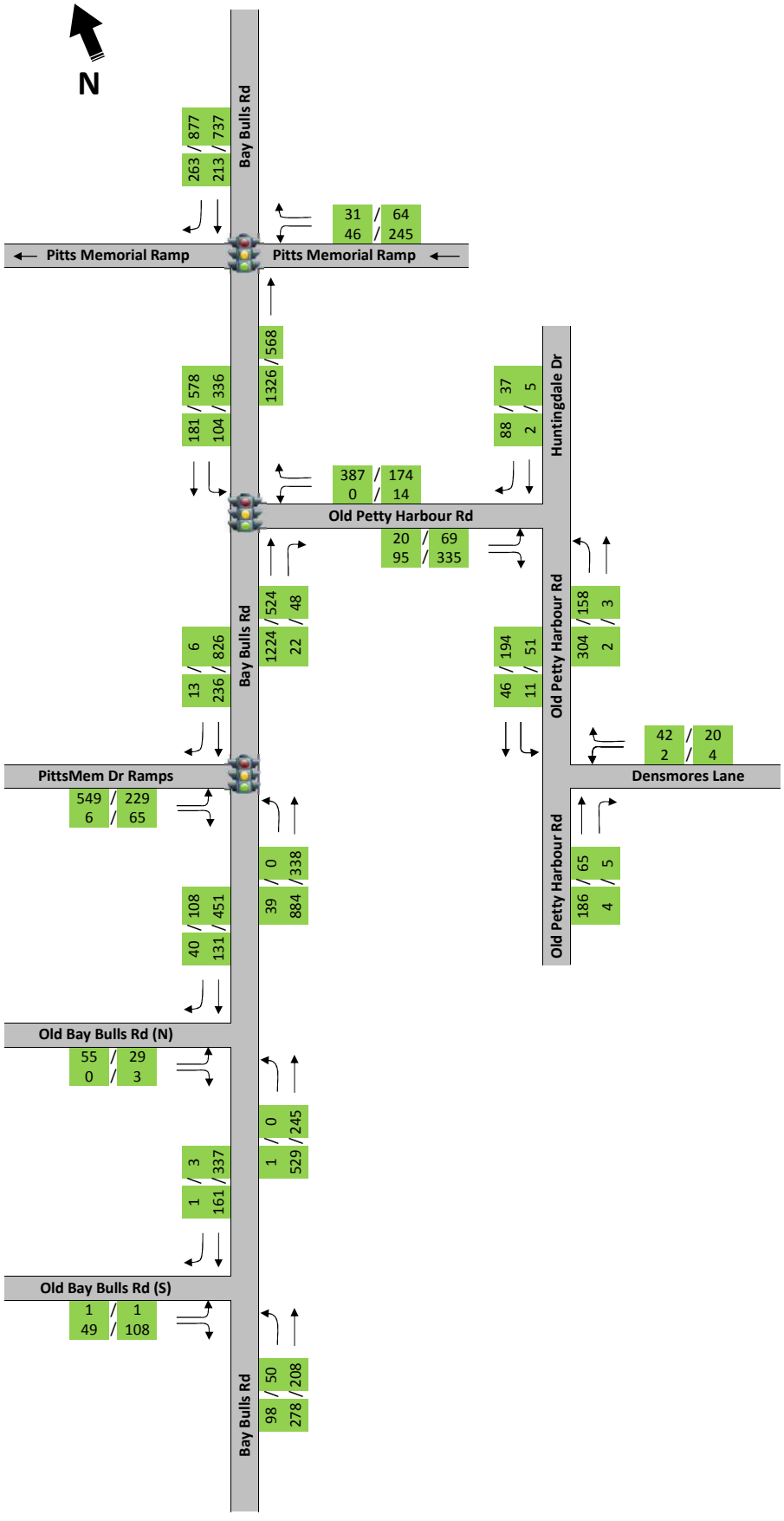
CBCL LIMITED
Consulting Engineers

City of St. John's - Kilbride Land Use Planning Study

Existing Peak Hour Volumes (June 2014 & March/April 2015 counts)

LEGEND
AM PEAK HR / PM PEAK HR

(Not Drawn to Scale)



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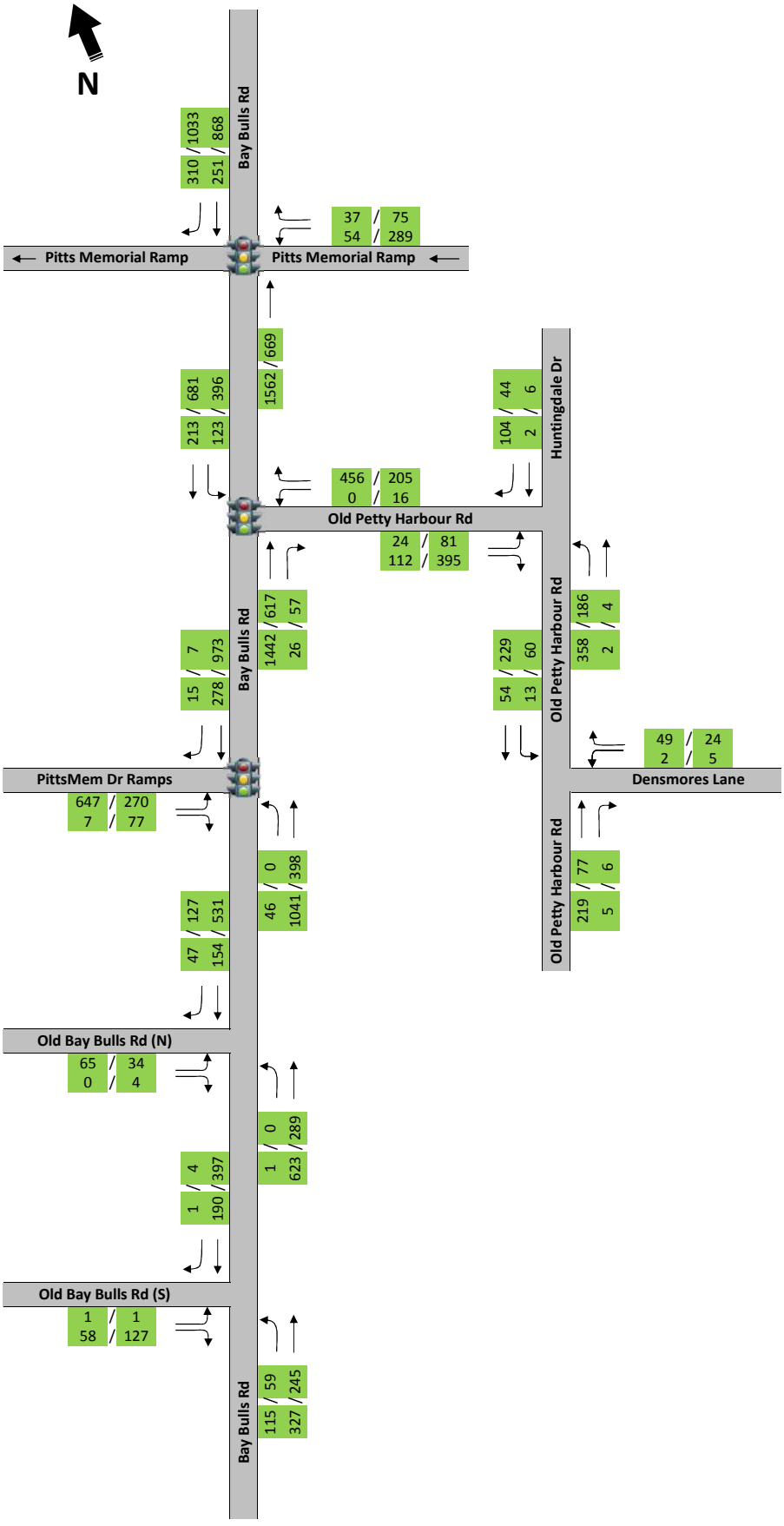
City of St. John's - Kilbride Land Use Planning Study

Estimated 2025 NoBuild Volumes

LEGEND
AM PEAK HR / PM PEAK HR

(Not Drawn to Scale)

Background Traffic Growth Rate: 1.5%
# of Years from 2014: 11



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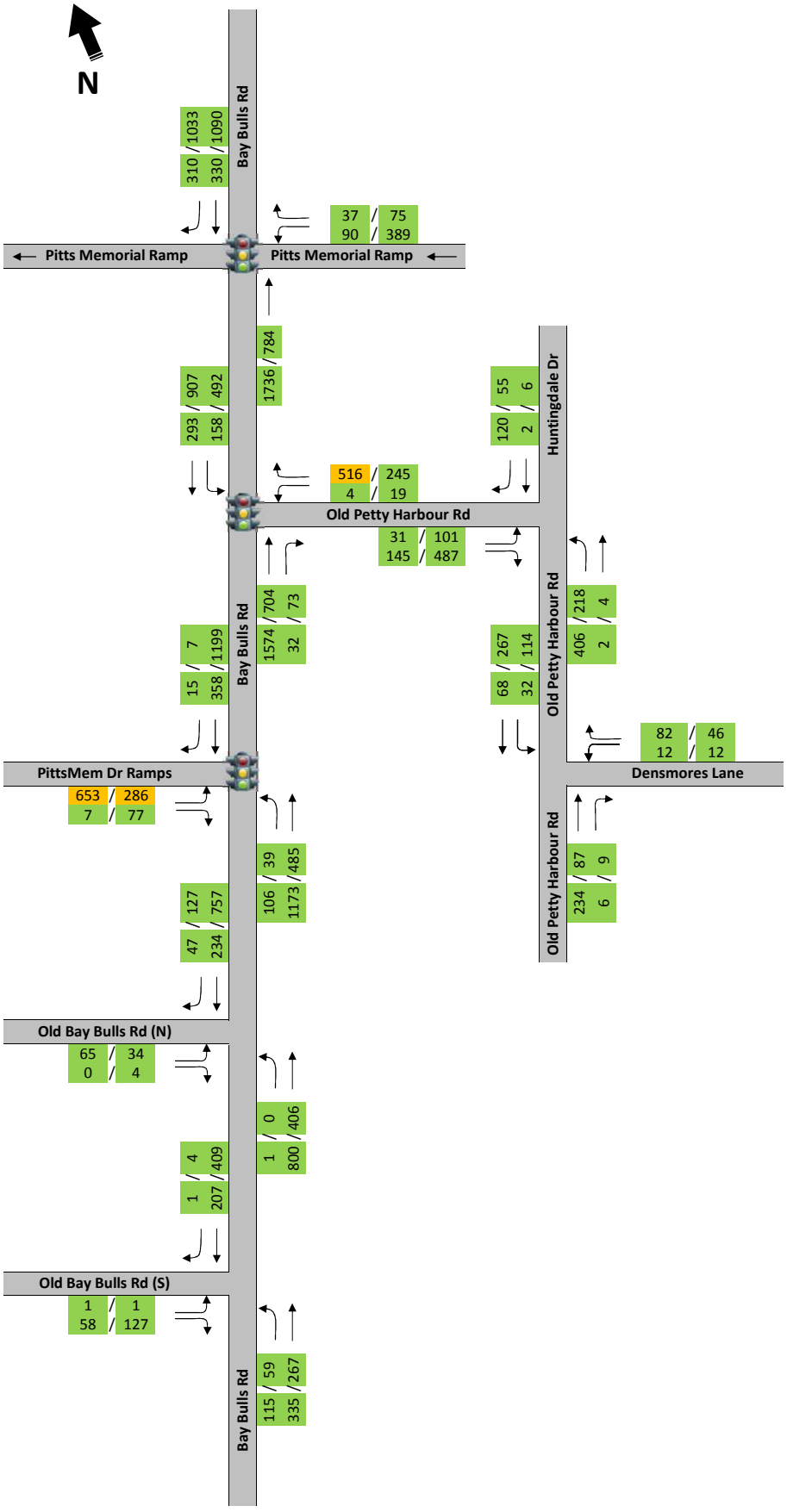
City of St. John's - Kilbride Land Use Planning Study

Estimated 2025 Build Volumes (w/ Traffic from Areas 2 - 5)

LEGEND
AM PEAK HR / PM PEAK HR

(Not Drawn to Scale)



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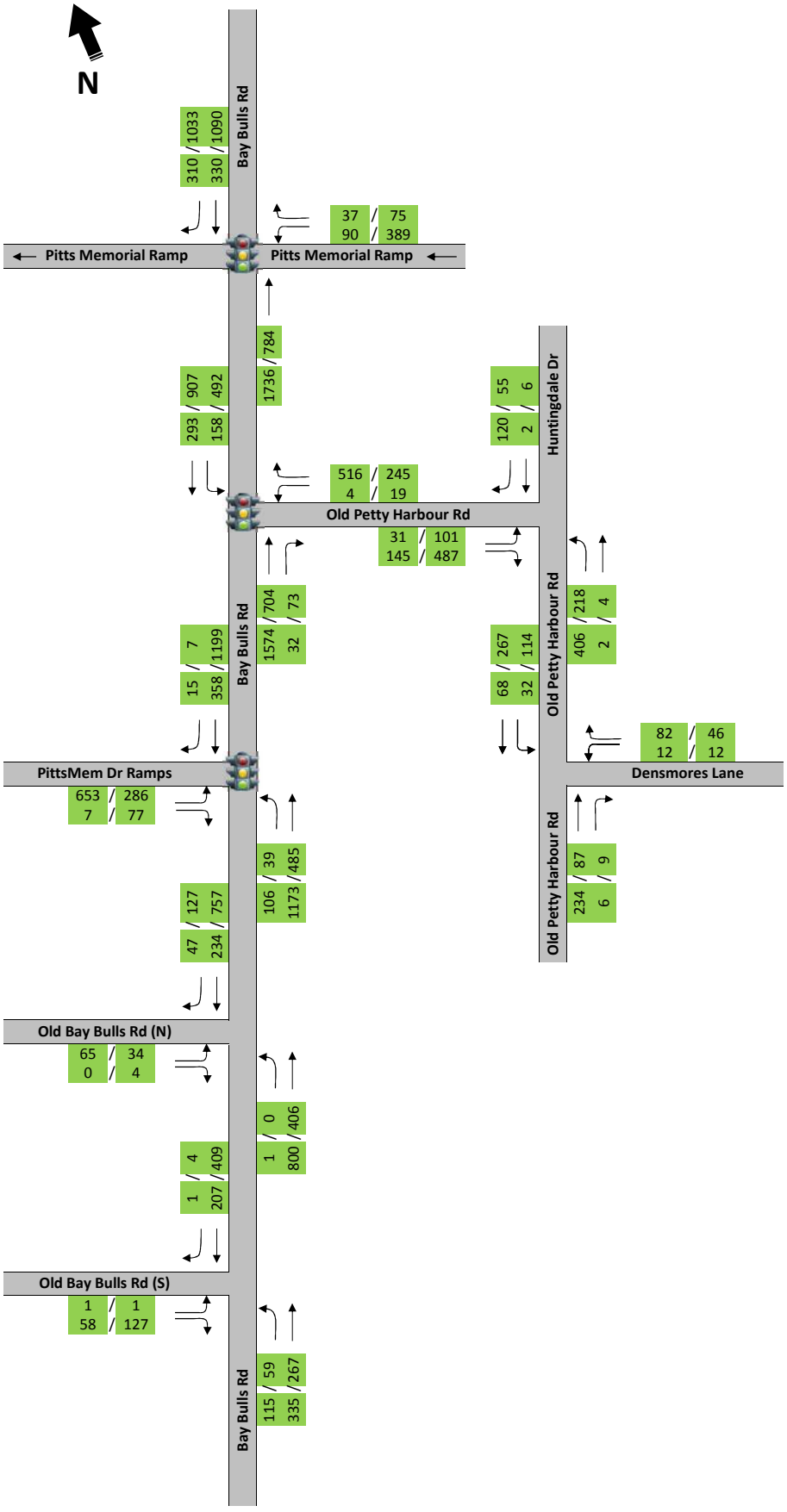
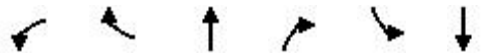
City of St. John's - Kilbride Land Use Planning Study

Estimated 2025 Build Volumes w/ Improvements

LEGEND
AM PEAK HR / PM PEAK HR

(Not Drawn to Scale)

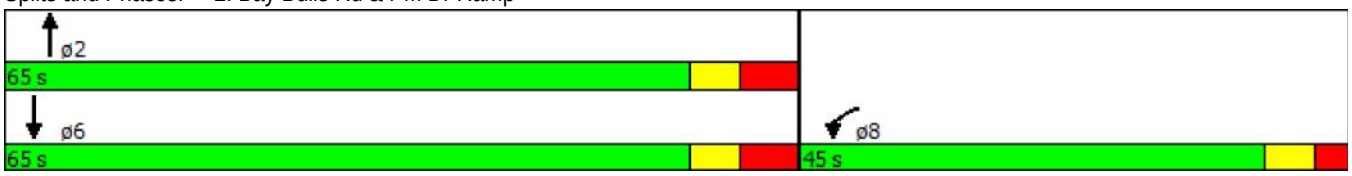


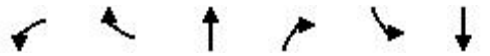


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	46	31	1326	0	0	213
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	1730	0	3579	0	0	3579
Flt Permitted	0.971					
Satd. Flow (perm)	1730	0	3579	0	0	3579
Right Turn on Red		No		Yes		
Satd. Flow (RTOR)						
Link Speed (k/h)	60		70			70
Link Distance (m)	228.4		279.2			59.5
Travel Time (s)	13.7		14.4			3.1
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	49	33	1411	0	0	227
Shared Lane Traffic (%)						
Lane Group Flow (vph)	82	0	1411	0	0	227
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	45.0		65.0			65.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	10.6		61.0			61.0
Actuated g/C Ratio	0.13		0.74			0.74
v/c Ratio	0.37		0.53			0.09
Control Delay	38.1		7.2			4.4
Queue Delay	0.0		0.0			0.0
Total Delay	38.1		7.2			4.4
LOS	D		A			A
Approach Delay	38.1		7.2			4.4
Approach LOS	D		A			A
Queue Length 50th (m)	12.0		51.8			5.3
Queue Length 95th (m)	24.7		74.8			9.6
Internal Link Dist (m)	204.4		255.2			35.5
Turn Bay Length (m)						
Base Capacity (vph)	799		2654			2654
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.10		0.53			0.09

Intersection Summary			
Area Type:	Other		
Cycle Length: 110			
Actuated Cycle Length: 82.2			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.53			
Intersection Signal Delay: 8.3		Intersection LOS: A	
Intersection Capacity Utilization 58.3%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 2: Bay Bulls Rd & PM Dr Ramp





Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	0	387	1224	22	104	181
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	1883	1601	3568	0	1789	1883
Flt Permitted					0.092	
Satd. Flow (perm)	1883	1601	3568	0	173	1883
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		163	2			
Link Speed (k/h)	48		70			70
Link Distance (m)	34.6		204.8			279.2
Travel Time (s)	2.6		10.5			14.4
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	416	1316	24	112	195
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	416	1340	0	112	195
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		4			6	
Total Split (s)	34.0	34.0	53.0		13.0	66.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)		20.5	47.2		60.3	60.3
Actuated g/C Ratio		0.22	0.51		0.65	0.65
v/c Ratio		0.87	0.74		0.48	0.16
Control Delay		39.6	22.1		15.7	7.8
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		39.6	22.1		15.7	7.8
LOS		D	C		B	A
Approach Delay			22.1			10.7
Approach LOS			C			B
Queue Length 50th (m)		44.8	96.4		6.9	12.6
Queue Length 95th (m)		80.5	140.0		18.3	25.6
Internal Link Dist (m)	10.6		180.8			255.2
Turn Bay Length (m)						
Base Capacity (vph)		598	1816		234	1223
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.70	0.74		0.48	0.16

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 92.8			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.87			
Intersection Signal Delay: 23.9		Intersection LOS: C	
Intersection Capacity Utilization 68.5%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: Bay Bulls Rd & Old Petty Harbour Rd

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	20	95	304	2	2	88
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	106	338	2	2	98

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	2	0	106	0	828	2
Stage 1	-	-	-	-	678	-
Stage 2	-	-	-	-	150	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1620	-	-	-	306	1082
Stage 1	-	-	-	-	452	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1620	-	-	-	0	1082
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

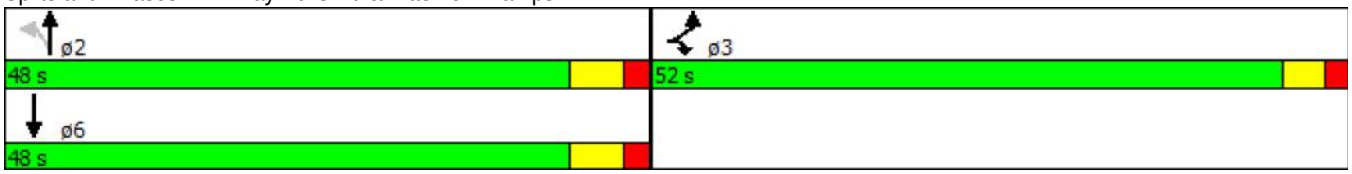
Approach	EB	NB	SB
HCM Control Delay, s	1.3	0	8.7
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1620	-	1082
HCM Lane V/C Ratio	-	-	0.014	-	0.092
HCM Control Delay (s)	-	-	7.3	-	8.7
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0	-	0.3

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	549	6	39	884	236	13
Satd. Flow (prot)	1789	1601	0	3571	1870	0
Flt Permitted	0.950			0.928		
Satd. Flow (perm)	1789	1601	0	3321	1870	0
Satd. Flow (RTOR)		7			3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	597	7	42	961	257	14
Shared Lane Traffic (%)						
Lane Group Flow (vph)	597	7	0	1003	271	0
Turn Type	Prot	Prot	Perm	NA	NA	
Protected Phases	3	3		2	6	
Permitted Phases			2			
Total Split (s)	52.0	52.0	48.0	48.0	48.0	
Total Lost Time (s)	5.0	5.0		6.0	6.0	
Act Effct Green (s)	30.3	30.3		29.5	29.5	
Actuated g/C Ratio	0.42	0.42		0.41	0.41	
v/c Ratio	0.79	0.01		0.73	0.35	
Control Delay	27.2	8.0		22.6	17.3	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	27.2	8.0		22.6	17.3	
LOS	C	A		C	B	
Approach Delay	27.0			22.6	17.3	
Approach LOS	C			C	B	
Queue Length 50th (m)	63.7	0.0		55.2	22.9	
Queue Length 95th (m)	129.3	2.3		106.3	53.6	
Internal Link Dist (m)	71.9			112.7	128.1	
Turn Bay Length (m)	25.0					
Base Capacity (vph)	1254	1125		2094	1180	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.48	0.01		0.48	0.23	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 71.6	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.79	
Intersection Signal Delay: 23.2	Intersection LOS: C
Intersection Capacity Utilization 83.4%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 4: Bay Bulls Rd & PittsMem Ramps



Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	2	42	186	4	11	46
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	46	202	4	12	50

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	278	204	0	0	207	0
Stage 1	204	-	-	-	-	-
Stage 2	74	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	712	837	-	-	1364	-
Stage 1	830	-	-	-	-	-
Stage 2	949	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	706	837	-	-	1364	-
Mov Cap-2 Maneuver	706	-	-	-	-	-
Stage 1	830	-	-	-	-	-
Stage 2	940	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.6	0	1.5
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	830	1364	-
HCM Lane V/C Ratio	-	-	0.058	0.009	-
HCM Control Delay (s)	-	-	9.6	7.7	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.2	0	-

Intersection	
Int Delay, s/veh	2.1

Movement	NBL	NBT	SBT	SBR	SEL	SER
Vol, veh/h	98	278	161	1	1	49
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	107	302	175	1	1	53

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	176	0	-	0	691	176
Stage 1	-	-	-	-	176	-
Stage 2	-	-	-	-	515	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1400	-	-	-	410	867
Stage 1	-	-	-	-	855	-
Stage 2	-	-	-	-	600	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1400	-	-	-	372	867
Mov Cap-2 Maneuver	-	-	-	-	372	-
Stage 1	-	-	-	-	855	-
Stage 2	-	-	-	-	545	-

Approach	NB	SB	SE
HCM Control Delay, s	2	0	9.6
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1400	-	845	-	-
HCM Lane V/C Ratio	0.076	-	0.064	-	-
HCM Control Delay (s)	7.8	0	9.6	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	0.2	-	-

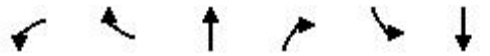
Intersection	
Int Delay, s/veh	1.2

Movement	NBL	NBT	SBT	SBR	NEL	NER
Vol, veh/h	1	529	131	40	55	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	575	142	43	60	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	186	0	-	0	741	164
Stage 1	-	-	-	-	164	-
Stage 2	-	-	-	-	577	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1388	-	-	-	384	881
Stage 1	-	-	-	-	865	-
Stage 2	-	-	-	-	562	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1388	-	-	-	384	881
Mov Cap-2 Maneuver	-	-	-	-	384	-
Stage 1	-	-	-	-	865	-
Stage 2	-	-	-	-	561	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	16.1
HCM LOS			C

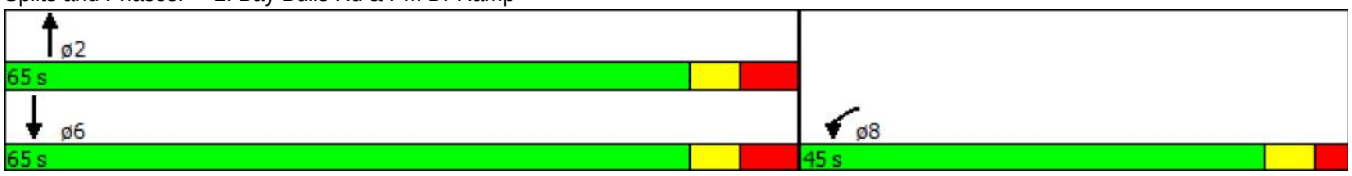
Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
Capacity (veh/h)	384	1388	-	-	-
HCM Lane V/C Ratio	0.156	0.001	-	-	-
HCM Control Delay (s)	16.1	7.6	0	-	-
HCM Lane LOS	C	A	A	-	-
HCM 95th %tile Q(veh)	0.5	0	-	-	-

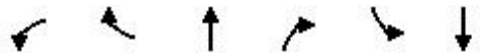


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	245	64	568	0	0	737
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	1761	0	3579	0	0	3579
Flt Permitted	0.962					
Satd. Flow (perm)	1761	0	3579	0	0	3579
Right Turn on Red		No		Yes		
Satd. Flow (RTOR)						
Link Speed (k/h)	60		70			70
Link Distance (m)	228.4		279.2			59.5
Travel Time (s)	13.7		14.4			3.1
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	261	68	604	0	0	784
Shared Lane Traffic (%)						
Lane Group Flow (vph)	329	0	604	0	0	784
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	45.0		65.0			65.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	22.7		56.2			56.2
Actuated g/C Ratio	0.24		0.59			0.59
v/c Ratio	0.78		0.29			0.37
Control Delay	47.3		10.7			11.5
Queue Delay	0.0		0.0			0.0
Total Delay	47.3		10.7			11.5
LOS	D		B			B
Approach Delay	47.3		10.7			11.5
Approach LOS	D		B			B
Queue Length 50th (m)	56.4		26.3			36.3
Queue Length 95th (m)	85.4		44.7			60.3
Internal Link Dist (m)	204.4		255.2			35.5
Turn Bay Length (m)						
Base Capacity (vph)	707		2119			2119
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.47		0.29			0.37

Intersection Summary			
Area Type:	Other		
Cycle Length: 110			
Actuated Cycle Length: 94.9			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 18.1		Intersection LOS: B	
Intersection Capacity Utilization 51.2%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 2: Bay Bulls Rd & PM Dr Ramp





Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	14	174	524	48	336	578
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	1789	1601	3532	0	1789	1883
Flt Permitted	0.950				0.289	
Satd. Flow (perm)	1789	1601	3532	0	544	1883
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		187	10			
Link Speed (k/h)	48		70			70
Link Distance (m)	34.6		204.8			279.2
Travel Time (s)	2.6		10.5			14.4
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	15	187	563	52	361	622
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	187	615	0	361	622
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		4			6	
Total Split (s)	28.0	28.0	41.0		34.0	75.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)	12.2	12.2	35.1		69.2	69.2
Actuated g/C Ratio	0.13	0.13	0.38		0.74	0.74
v/c Ratio	0.06	0.50	0.46		0.47	0.45
Control Delay	35.1	10.5	23.6		6.6	6.5
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	35.1	10.5	23.6		6.6	6.5
LOS	D	B	C		A	A
Approach Delay	12.3		23.6			6.5
Approach LOS	B		C			A
Queue Length 50th (m)	2.4	0.0	40.6		15.3	31.5
Queue Length 95th (m)	7.8	17.1	66.8		40.0	78.5
Internal Link Dist (m)	10.6		180.8			255.2
Turn Bay Length (m)						
Base Capacity (vph)	422	520	1332		776	1394
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.04	0.36	0.46		0.47	0.45

Intersection Summary			
Area Type:	Other		
Cycle Length: 103			
Actuated Cycle Length: 93.4			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.50			
Intersection Signal Delay: 13.0		Intersection LOS: B	
Intersection Capacity Utilization 58.0%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: Bay Bulls Rd & Old Petty Harbour Rd

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	69	335	158	3	5	37
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	77	372	176	3	6	41

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	3	0	372	0	880	3
Stage 1	-	-	-	-	354	-
Stage 2	-	-	-	-	526	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1619	-	-	-	286	1081
Stage 1	-	-	-	-	630	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1619	-	-	-	0	1081
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

Approach	EB	NB	SB
HCM Control Delay, s	1.3	0	8.5
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1619	-	1081
HCM Lane V/C Ratio	-	-	0.047	-	0.043
HCM Control Delay (s)	-	-	7.3	-	8.5
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0.1	-	0.1

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	229	65	0	338	826	6
Satd. Flow (prot)	1789	1601	0	3579	1882	0
Flt Permitted	0.950					
Satd. Flow (perm)	1789	1601	0	3579	1882	0
Satd. Flow (RTOR)		71			1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	249	71	0	367	898	7
Shared Lane Traffic (%)						
Lane Group Flow (vph)	249	71	0	367	905	0
Turn Type	Prot	Prot		NA	NA	
Protected Phases	3	3		2	6	
Permitted Phases			2			
Total Split (s)	28.0	28.0	72.0	72.0	72.0	
Total Lost Time (s)	5.0	5.0		6.0	6.0	
Act Effct Green (s)	15.4	15.4		39.9	39.9	
Actuated g/C Ratio	0.23	0.23		0.59	0.59	
v/c Ratio	0.61	0.17		0.17	0.81	
Control Delay	33.4	8.7		6.2	17.3	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	33.4	8.7		6.2	17.3	
LOS	C	A		A	B	
Approach Delay	27.9			6.2	17.3	
Approach LOS	C			A	B	
Queue Length 50th (m)	26.2	0.0		8.8	71.7	
Queue Length 95th (m)	67.8	10.7		18.1	150.7	
Internal Link Dist (m)	71.9			112.7	128.1	
Turn Bay Length (m)	25.0					
Base Capacity (vph)	663	638		3236	1702	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.38	0.11		0.11	0.53	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 67.2	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.81	
Intersection Signal Delay: 16.9	Intersection LOS: B
Intersection Capacity Utilization 65.7%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 4: Bay Bulls Rd & PittsMem Ramps

Intersection	
Int Delay, s/veh	1.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	4	20	65	5	21	194
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	22	71	5	23	211

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	330	73	0	0	76	0
Stage 1	73	-	-	-	-	-
Stage 2	257	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	665	989	-	-	1523	-
Stage 1	950	-	-	-	-	-
Stage 2	786	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	654	989	-	-	1523	-
Mov Cap-2 Maneuver	654	-	-	-	-	-
Stage 1	950	-	-	-	-	-
Stage 2	773	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.1	0	0.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	911	1523	-
HCM Lane V/C Ratio	-	-	0.029	0.015	-
HCM Control Delay (s)	-	-	9.1	7.4	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	2.4

Movement	NBL	NBT	SBT	SBR	SEL	SER
Vol, veh/h	50	208	337	3	1	108
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	54	226	366	3	1	117

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	370	0	-	0	703	368
Stage 1	-	-	-	-	368	-
Stage 2	-	-	-	-	335	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1189	-	-	-	404	677
Stage 1	-	-	-	-	700	-
Stage 2	-	-	-	-	725	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1189	-	-	-	383	677
Mov Cap-2 Maneuver	-	-	-	-	383	-
Stage 1	-	-	-	-	700	-
Stage 2	-	-	-	-	687	-

Approach	NB	SB	SE
HCM Control Delay, s	1.6	0	11.5
HCM LOS			B

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1189	-	672	-	-
HCM Lane V/C Ratio	0.046	-	0.176	-	-
HCM Control Delay (s)	8.2	0	11.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.6	-	-

Intersection	
Int Delay, s/veh	0.6

Movement	NBL	NBT	SBT	SBR	NEL	NER
Vol, veh/h	0	245	451	108	29	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	266	490	117	32	3

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	608	0	-	0	815	549
Stage 1	-	-	-	-	549	-
Stage 2	-	-	-	-	266	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	970	-	-	-	347	535
Stage 1	-	-	-	-	579	-
Stage 2	-	-	-	-	779	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	970	-	-	-	347	535
Mov Cap-2 Maneuver	-	-	-	-	347	-
Stage 1	-	-	-	-	579	-
Stage 2	-	-	-	-	779	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	16.1
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
Capacity (veh/h)	359	970	-	-	-
HCM Lane V/C Ratio	0.097	-	-	-	-
HCM Control Delay (s)	16.1	0	-	-	-
HCM Lane LOS	C	A	-	-	-
HCM 95th %tile Q(veh)	0.3	0	-	-	-

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	0.7	0.7

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.1	0.1	0.0	0.3	0.0
Total Del/Veh (s)	28.7	4.1	8.0	4.6	8.0

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.2	0.4	0.0	0.0	0.2
Total Del/Veh (s)	0.2	8.8	21.4	12.2	22.5	8.6	17.5

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBT	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.3	0.3	0.1	0.2	0.2
Total Del/Veh (s)	2.0	0.8	0.8	14.0	10.8	12.9	42.1	15.7

Total Network Performance

Denied Del/Veh (s)	0.2
Total Del/Veh (s)	29.2

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	18.0	50.6	52.2	15.8	17.6
Average Queue (m)	7.7	22.8	28.6	5.9	8.4
95th Queue (m)	17.6	51.0	55.5	16.4	20.1
Link Distance (m)	211.8	270.0	270.0		
Upstream Blk Time (%)					0
Queuing Penalty (veh)					0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	NB	NB	SB	SB
Directions Served	R	T	TR	L	T
Maximum Queue (m)	19.8	106.2	95.1	27.2	30.6
Average Queue (m)	16.4	75.1	61.6	15.4	12.7
95th Queue (m)	19.1	109.1	97.9	26.6	29.7
Link Distance (m)	15.1	199.3	199.3	270.0	270.0
Upstream Blk Time (%)	39				
Queuing Penalty (veh)	77				
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	10.1	59.5	41.2
Average Queue (m)	1.3	29.6	19.8
95th Queue (m)	7.1	56.0	41.2
Link Distance (m)	15.1	140.8	76.2
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	0		
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 77

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	3.9	4.1	0.5	0.2	0.2	0.5	1.4
Total Del/Veh (s)	21.7	18.5	21.3	18.8	12.0	8.5	18.8

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.1	0.1	0.2	0.1	0.1	0.1	0.2
Total Del/Veh (s)	3.6	3.1	0.2	0.0	2.8	0.1	0.7

Total Network Performance

Denied Del/Veh (s)	1.3
Total Del/Veh (s)	18.1

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB
Directions Served	L	R	LT	T	TR
Maximum Queue (m)	27.1	94.6	94.8	78.1	36.7
Average Queue (m)	26.3	64.9	61.1	43.8	21.0
95th Queue (m)	28.6	106.0	95.0	80.4	37.4
Link Distance (m)		90.4	129.6	129.6	144.8
Upstream Blk Time (%)		4			
Queuing Penalty (veh)		0			
Storage Bay Dist (m)	25.0				
Storage Blk Time (%)	31	1			
Queuing Penalty (veh)	2	4			

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	12.2	2.7
Average Queue (m)	7.8	0.4
95th Queue (m)	14.4	3.3
Link Distance (m)	218.6	113.6
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 6

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	NEL	All
Denied Del/Veh (s)		0.3	0.2	0.2	0.1	0.3
Total Del/Veh (s)		0.7	0.5	0.1	7.8	1.1

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.3	0.3	0.2			0.1	0.3
Total Del/Veh (s)	2.2	1.9	0.7			3.7	1.8

Total Network Performance

Denied Del/Veh (s)	0.3
Total Del/Veh (s)	1.8

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NE
Directions Served	LR
Maximum Queue (m)	11.5
Average Queue (m)	5.3
95th Queue (m)	11.0
Link Distance (m)	243.0
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	13.6	15.2
Average Queue (m)	4.6	7.8
95th Queue (m)	14.1	15.6
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	1.1	1.1

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.3	0.4	0.0	3.4	1.5
Total Del/Veh (s)	34.6	5.8	9.7	6.7	11.9

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBL	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0
Total Del/Veh (s)	31.3	0.5	5.3	22.3	8.4	12.7	6.9	12.6

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.2	0.1	0.1	0.1	0.1
Total Del/Veh (s)	1.7	0.7	0.8	0.1	14.4	4.6	1.2

Total Network Performance

Denied Del/Veh (s)	1.5
Total Del/Veh (s)	23.9

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	63.3	46.1	45.6	22.0	22.4
Average Queue (m)	40.8	20.0	23.1	18.2	18.5
95th Queue (m)	66.9	47.7	48.0	23.3	24.0
Link Distance (m)	211.8	270.0	270.0		
Upstream Blk Time (%)				0	0
Queuing Penalty (veh)				0	0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	WB	NB	NB	SB	SB
Directions Served	L	R	T	TR	L	T
Maximum Queue (m)	10.7	16.7	59.2	48.2	45.8	74.4
Average Queue (m)	2.5	13.9	40.3	25.4	25.0	23.1
95th Queue (m)	10.0	18.8	61.1	50.8	45.6	81.7
Link Distance (m)	15.1	15.1	199.3	199.3	270.0	270.0
Upstream Blk Time (%)	2	5				0
Queuing Penalty (veh)	2	5				0
Storage Bay Dist (m)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	12.1	8.9	12.4
Average Queue (m)	3.1	1.8	7.8
95th Queue (m)	12.2	8.2	14.9
Link Distance (m)	15.1	140.8	76.2
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	1		
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 8

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBT	SBT	SBR	All
Denied Del/Veh (s)	3.7	0.8	0.1	0.9	0.4	1.1
Total Del/Veh (s)	21.9	22.2	5.4	11.9	6.9	12.6

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)		0.1	0.2	0.1	0.2	0.2	0.2
Total Del/Veh (s)	2.9	2.0	0.1	0.0	1.8	0.2	0.5

Total Network Performance

Denied Del/Veh (s)	1.0
Total Del/Veh (s)	12.9

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB
Directions Served	L	R	LT	T	TR
Maximum Queue (m)	26.8	57.4	28.4	12.8	82.1
Average Queue (m)	22.9	28.5	16.1	4.0	52.0
95th Queue (m)	31.1	64.4	30.1	12.8	93.4
Link Distance (m)		90.4	129.6	129.6	144.8
Upstream Blk Time (%)					0
Queuing Penalty (veh)					0
Storage Bay Dist (m)	25.0				
Storage Blk Time (%)	12	1			
Queuing Penalty (veh)	8	3			

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	9.8	2.8
Average Queue (m)	4.3	0.5
95th Queue (m)	11.9	4.1
Link Distance (m)	218.6	113.6
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 11

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBT	SBT	SBR	NEL	NER	All
Denied Del/Veh (s)	0.2	0.4	0.4	0.1	0.1	0.4
Total Del/Veh (s)	0.5	1.8	0.5	10.1	4.7	1.6

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.2	0.2	0.3	0.4		0.2	0.3
Total Del/Veh (s)	2.7	1.3	1.2	0.7		7.1	2.2

Total Network Performance

Denied Del/Veh (s)	0.3
Total Del/Veh (s)	2.4

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NE
Directions Served	LR
Maximum Queue (m)	8.5
Average Queue (m)	4.7
95th Queue (m)	10.5
Link Distance (m)	243.0
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	15.7	20.1
Average Queue (m)	5.1	11.6
95th Queue (m)	15.9	19.9
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	54	37	1562	0	0	251
Satd. Flow (prot)	1728	0	3579	0	0	3579
Flt Permitted	0.971					
Satd. Flow (perm)	1728	0	3579	0	0	3579
Satd. Flow (RTOR)						
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	57	39	1662	0	0	267
Shared Lane Traffic (%)						
Lane Group Flow (vph)	96	0	1662	0	0	267
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	19.0		71.0			71.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	10.8		66.9			66.9
Actuated g/C Ratio	0.12		0.76			0.76
v/c Ratio	0.45		0.61			0.10
Control Delay	43.7		8.0			4.2
Queue Delay	0.0		0.0			0.0
Total Delay	43.7		8.0			4.2
LOS	D		A			A
Approach Delay	43.7		8.0			4.2
Approach LOS	D		A			A
Queue Length 50th (m)	15.5		69.8			6.4
Queue Length 95th (m)	30.2		96.6			10.7
Internal Link Dist (m)	204.4		255.2			35.5
Turn Bay Length (m)						
Base Capacity (vph)	234		2710			2710
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.41		0.61			0.10

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 88.4	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.61	
Intersection Signal Delay: 9.2	Intersection LOS: A
Intersection Capacity Utilization 64.8%	ICU Level of Service C
Analysis Period (min) 15	

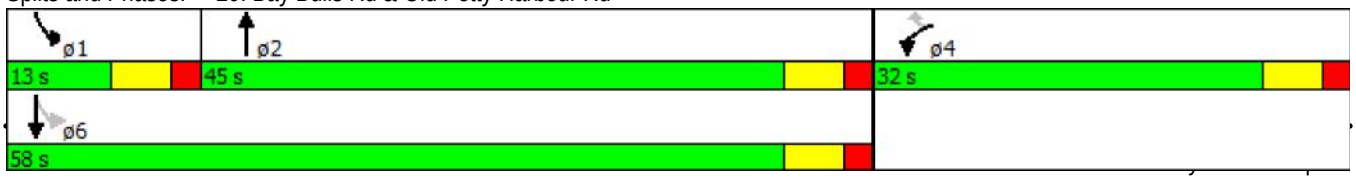
Splits and Phases: 10: Bay Bulls Rd & PM Dr Ramp

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	0	456	1224	26	123	213
Satd. Flow (prot)	1883	1601	3568	0	1789	1883
Flt Permitted					0.088	
Satd. Flow (perm)	1883	1601	3568	0	166	1883
Satd. Flow (RTOR)		181	3			
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	490	1316	28	132	229
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	490	1344	0	132	229
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		4			6	
Total Split (s)	32.0	32.0	45.0		13.0	58.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)		22.0	39.1		52.2	52.2
Actuated g/C Ratio		0.26	0.45		0.61	0.61
v/c Ratio		0.90	0.83		0.57	0.20
Control Delay		40.8	27.1		21.3	9.0
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		40.8	27.1		21.3	9.0
LOS		D	C		C	A
Approach Delay			27.1			13.5
Approach LOS			C			B
Queue Length 50th (m)		51.3	106.3		9.5	17.3
Queue Length 95th (m)		#104.1	#138.3		#25.3	28.8
Internal Link Dist (m)	10.6		180.8			255.2
Turn Bay Length (m)						
Base Capacity (vph)		610	1620		232	1139
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.80	0.83		0.57	0.20

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 86.2
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 27.9 Intersection LOS: C
Intersection Capacity Utilization 72.9% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 20: Bay Bulls Rd & Old Petty Harbour Rd



Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	24	112	358	2	2	104
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	27	124	398	2	2	116

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	2	0	124	0	976	2
Stage 1	-	-	-	-	798	-
Stage 2	-	-	-	-	178	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1620	-	-	-	251	1082
Stage 1	-	-	-	-	398	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1620	-	-	-	0	1082
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

Approach	EB	NB	SB
HCM Control Delay, s	1.3		8.7
HCM LOS			A

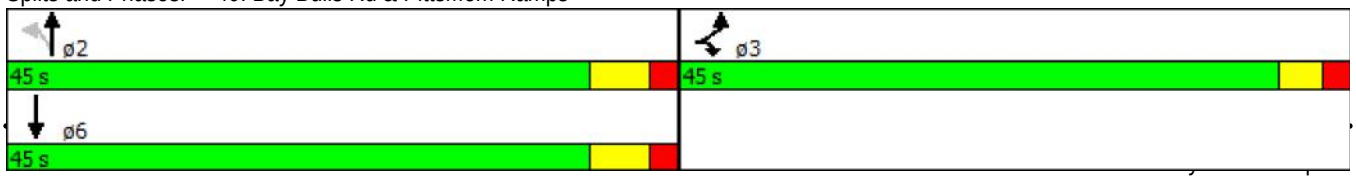
Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1620	-	1082
HCM Lane V/C Ratio	-	-	0.016	-	0.109
HCM Control Delay (s)	-	-	7.3	-	8.7
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0.1	-	0.4

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	647	7	46	1041	278	15
Satd. Flow (prot)	1789	1601	0	3571	1870	0
Flt Permitted	0.950			0.922		
Satd. Flow (perm)	1789	1601	0	3299	1870	0
Satd. Flow (RTOR)		8			4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	703	8	50	1132	302	16
Shared Lane Traffic (%)						
Lane Group Flow (vph)	703	8	0	1182	318	0
Turn Type	Prot	Prot	Perm	NA	NA	
Protected Phases	3	3		2	6	
Permitted Phases			2			
Total Split (s)	45.0	45.0	45.0	45.0	45.0	
Total Lost Time (s)	5.0	5.0		6.0	6.0	
Act Effct Green (s)	35.5	35.5		34.9	34.9	
Actuated g/C Ratio	0.44	0.44		0.43	0.43	
v/c Ratio	0.90	0.01		0.84	0.40	
Control Delay	39.4	8.0		28.0	18.4	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	39.4	8.0		28.0	18.4	
LOS	D	A		C	B	
Approach Delay	39.0			28.0	18.4	
Approach LOS	D			C	B	
Queue Length 50th (m)	107.5	0.0		92.1	35.9	
Queue Length 95th (m)	#175.7	2.4		119.5	56.5	
Internal Link Dist (m)	71.9			112.7	128.1	
Turn Bay Length (m)	25.0					
Base Capacity (vph)	899	809		1617	918	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.78	0.01		0.73	0.35	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 81.6
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 30.1 Intersection LOS: C
Intersection Capacity Utilization 95.7% ICU Level of Service F
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 40: Bay Bulls Rd & PittsMem Ramps



Intersection	
Int Delay, s/veh	1.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	2	49	219	5	13	54
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	53	238	5	14	59

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	328	241	0	0	243	0
Stage 1	241	-	-	-	-	-
Stage 2	87	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	666	798	-	-	1323	-
Stage 1	799	-	-	-	-	-
Stage 2	936	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	659	798	-	-	1323	-
Mov Cap-2 Maneuver	659	-	-	-	-	-
Stage 1	799	-	-	-	-	-
Stage 2	926	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.9	0	1.5
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	791	1323	-
HCM Lane V/C Ratio	-	-	0.07	0.011	-
HCM Control Delay (s)	-	-	9.9	7.8	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.2	0	-

Intersection	
Int Delay, s/veh	1.4

Movement	NBL	NBT	SBT	SBR	NEL	NER
Vol, veh/h	1	623	154	47	65	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	677	167	51	71	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	218	0	-	0	872	193
Stage 1	-	-	-	-	193	-
Stage 2	-	-	-	-	679	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1352	-	-	-	321	849
Stage 1	-	-	-	-	840	-
Stage 2	-	-	-	-	504	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1352	-	-	-	321	849
Mov Cap-2 Maneuver	-	-	-	-	321	-
Stage 1	-	-	-	-	840	-
Stage 2	-	-	-	-	503	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	19.4
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
Capacity (veh/h)	321	1352	-	-	-
HCM Lane V/C Ratio	0.22	0.001	-	-	-
HCM Control Delay (s)	19.4	7.7	0	-	-
HCM Lane LOS	C	A	A	-	-
HCM 95th %tile Q(veh)	0.8	0	-	-	-

Intersection	
Int Delay, s/veh	2.2

Movement	NBL	NBT	SBT	SBR	SEL	SER
Vol, veh/h	115	327	190	1	1	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	125	355	207	1	1	63

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	208	0	-	0	812	207
Stage 1	-	-	-	-	207	-
Stage 2	-	-	-	-	605	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1363	-	-	-	348	833
Stage 1	-	-	-	-	828	-
Stage 2	-	-	-	-	545	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1363	-	-	-	308	833
Mov Cap-2 Maneuver	-	-	-	-	308	-
Stage 1	-	-	-	-	828	-
Stage 2	-	-	-	-	483	-

Approach	NB	SB	SE
HCM Control Delay, s	2.1	0	9.8
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1363	-	810	-	-
HCM Lane V/C Ratio	0.092	-	0.079	-	-
HCM Control Delay (s)	7.9	0	9.8	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.3	-	0.3	-	-

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	289	75	669	0	0	868
Satd. Flow (prot)	1761	0	3579	0	0	3579
Flt Permitted	0.962					
Satd. Flow (perm)	1761	0	3579	0	0	3579
Satd. Flow (RTOR)						
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	307	80	712	0	0	923
Shared Lane Traffic (%)						
Lane Group Flow (vph)	387	0	712	0	0	923
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	42.0		48.0			48.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	21.8		39.2			39.2
Actuated g/C Ratio	0.28		0.51			0.51
v/c Ratio	0.78		0.39			0.51
Control Delay	36.7		13.4			14.8
Queue Delay	0.0		0.0			0.0
Total Delay	36.7		13.4			14.8
LOS	D		B			B
Approach Delay	36.7		13.4			14.8
Approach LOS	D		B			B
Queue Length 50th (m)	51.3		31.2			43.6
Queue Length 95th (m)	79.7		55.0			75.1
Internal Link Dist (m)	204.4		255.2			35.5
Turn Bay Length (m)						
Base Capacity (vph)	803		1820			1820
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.48		0.39			0.51

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 77.1	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.78	
Intersection Signal Delay: 18.5	Intersection LOS: B
Intersection Capacity Utilization 57.9%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 10: Bay Bulls Rd & PM Dr Ramp

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	16	205	617	57	396	681
Satd. Flow (prot)	1789	1601	3532	0	1789	1883
Flt Permitted	0.950				0.205	
Satd. Flow (perm)	1789	1601	3532	0	386	1883
Satd. Flow (RTOR)		220	11			
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	17	220	663	61	426	732
Shared Lane Traffic (%)						
Lane Group Flow (vph)	17	220	724	0	426	732
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		4			6	
Total Split (s)	28.0	28.0	32.0		30.0	62.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)	12.2	12.2	26.1		56.2	56.2
Actuated g/C Ratio	0.15	0.15	0.32		0.70	0.70
v/c Ratio	0.06	0.51	0.63		0.62	0.56
Control Delay	28.7	8.9	26.2		13.5	8.8
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	28.7	8.9	26.2		13.5	8.8
LOS	C	A	C		B	A
Approach Delay	10.3		26.2			10.5
Approach LOS	B		C			B
Queue Length 50th (m)	2.3	0.0	45.8		22.5	40.4
Queue Length 95th (m)	7.3	16.5	77.3		69.5	104.8
Internal Link Dist (m)	10.6		180.8			255.2
Turn Bay Length (m)						
Base Capacity (vph)	491	599	1153		689	1315
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.03	0.37	0.63		0.62	0.56

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 80.4
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 15.9 — Intersection LOS: B
Intersection Capacity Utilization 64.1% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 20: Bay Bulls Rd & Old Petty Harbour Rd

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	81	395	186	4	6	44
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	90	439	207	4	7	49

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	4	0	439	0	1037	4
Stage 1	-	-	-	-	418	-
Stage 2	-	-	-	-	619	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1618	-	-	-	231	1080
Stage 1	-	-	-	-	591	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1618	-	-	-	0	1080
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

Approach	EB	NB	SB
HCM Control Delay, s	1.3		8.5
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1618	-	1080
HCM Lane V/C Ratio	-	-	0.056	-	0.051
HCM Control Delay (s)	-	-	7.4	-	8.5
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0.2	-	0.2

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	270	77	0	398	973	7
Satd. Flow (prot)	1789	1601	0	3579	1882	0
Flt Permitted	0.950					
Satd. Flow (perm)	1789	1601	0	3579	1882	0
Satd. Flow (RTOR)		84			1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	293	84	0	433	1058	8
Shared Lane Traffic (%)						
Lane Group Flow (vph)	293	84	0	433	1066	0
Turn Type	Prot	Prot		NA	NA	
Protected Phases	3	3		2	6	
Permitted Phases			2			
Total Split (s)	24.0	24.0	66.0	66.0	66.0	
Total Lost Time (s)	5.0	5.0		6.0	6.0	
Act Effct Green (s)	16.5	16.5		48.4	48.4	
Actuated g/C Ratio	0.22	0.22		0.63	0.63	
v/c Ratio	0.76	0.20		0.19	0.89	
Control Delay	45.0	8.6		6.0	23.2	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	45.0	8.6		6.0	23.2	
LOS	D	A		A	C	
Approach Delay	36.9			6.0	23.2	
Approach LOS	D			A	C	
Queue Length 50th (m)	43.6	0.0		13.1	124.5	
Queue Length 95th (m)	#85.5	11.1		18.5	#201.7	
Internal Link Dist (m)	71.9			112.7	128.1	
Turn Bay Length (m)	25.0					
Base Capacity (vph)	466	480		2810	1478	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.63	0.17		0.15	0.72	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 76.5	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.89	
Intersection Signal Delay: 22.0	Intersection LOS: C
Intersection Capacity Utilization 75.8%	ICU Level of Service D
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 40: Bay Bulls Rd & PittsMem Ramps

Intersection	
Int Delay, s/veh	1.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	5	25	77	6	60	229
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	27	84	7	65	249

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	466	87	0	0	90	0
Stage 1	87	-	-	-	-	-
Stage 2	379	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	555	971	-	-	1505	-
Stage 1	936	-	-	-	-	-
Stage 2	692	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	527	971	-	-	1505	-
Mov Cap-2 Maneuver	527	-	-	-	-	-
Stage 1	936	-	-	-	-	-
Stage 2	657	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.4	0	1.6
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	851	1505	-
HCM Lane V/C Ratio	-	-	0.038	0.043	-
HCM Control Delay (s)	-	-	9.4	7.5	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0.1	-

Intersection	
Int Delay, s/veh	0.7

Movement	NBL	NBT	SBT	SBR	NEL	NER
Vol, veh/h	0	289	531	127	34	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	314	577	138	37	4

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	715	0	-	0	960	646
Stage 1	-	-	-	-	646	-
Stage 2	-	-	-	-	314	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	885	-	-	-	285	472
Stage 1	-	-	-	-	522	-
Stage 2	-	-	-	-	741	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	885	-	-	-	285	472
Mov Cap-2 Maneuver	-	-	-	-	285	-
Stage 1	-	-	-	-	522	-
Stage 2	-	-	-	-	741	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	19.1
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
Capacity (veh/h)	297	885	-	-	-
HCM Lane V/C Ratio	0.139	-	-	-	-
HCM Control Delay (s)	19.1	0	-	-	-
HCM Lane LOS	C	A	-	-	-
HCM 95th %tile Q(veh)	0.5	0	-	-	-

Intersection	
Int Delay, s/veh	2.5

Movement	NBL	NBT	SBT	SBR	SEL	SER
Vol, veh/h	59	245	397	4	1	127
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	64	266	432	4	1	138

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	436	0	-	0	829	434
Stage 1	-	-	-	-	434	-
Stage 2	-	-	-	-	395	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1124	-	-	-	340	622
Stage 1	-	-	-	-	653	-
Stage 2	-	-	-	-	681	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1124	-	-	-	317	622
Mov Cap-2 Maneuver	-	-	-	-	317	-
Stage 1	-	-	-	-	653	-
Stage 2	-	-	-	-	635	-

Approach	NB	SB	SE
HCM Control Delay, s	1.6	0	12.5
HCM LOS			B

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1124	-	617	-	-
HCM Lane V/C Ratio	0.057	-	0.225	-	-
HCM Control Delay (s)	8.4	0	12.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.2	-	0.9	-	-

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	0.8	0.8

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.1	0.1	0.0	0.4	0.1
Total Del/Veh (s)	31.4	3.9	10.3	4.7	10.0

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.3	0.4	0.0	0.0	0.2
Total Del/Veh (s)	0.5	8.6	23.1	12.4	22.8	9.9	18.6

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBT	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.4	0.2	0.1	5.5	1.0
Total Del/Veh (s)	2.9	0.9	0.9	15.6	8.6	68.5	72.2	21.1

Total Network Performance

Denied Del/Veh (s)	0.5
Total Del/Veh (s)	33.2

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 5: Bay Bulls Rd & Columbus Dr

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	16.4	57.2	58.4	15.9	18.2
Average Queue (m)	7.6	29.0	34.2	7.3	10.3
95th Queue (m)	17.4	65.0	67.2	18.8	21.0
Link Distance (m)	211.8	270.0	270.0		
Upstream Blk Time (%)				0	0
Queuing Penalty (veh)				0	0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 13: Columbus Dr & Topsail Rd

Movement	
Directions Served	
Maximum Queue (m)	
Average Queue (m)	
95th Queue (m)	
Link Distance (m)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	NB	NB	SB	SB
Directions Served	R	T	TR	L	T
Maximum Queue (m)	21.0	101.2	83.3	32.7	34.4
Average Queue (m)	17.0	75.9	59.8	19.3	16.6
95th Queue (m)	21.4	105.9	91.5	33.8	36.9
Link Distance (m)	15.1	199.3	199.3	270.0	270.0
Upstream Blk Time (%)	41				
Queuing Penalty (veh)	94				
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	5.3	62.9	40.4
Average Queue (m)	1.5	35.2	24.7
95th Queue (m)	7.2	67.3	53.5
Link Distance (m)	15.1	140.8	76.2
Upstream Blk Time (%)	0		4
Queuing Penalty (veh)	0		0
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 94

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	4.8	1.7	0.5	0.2	0.3	0.2	1.7
Total Del/Veh (s)	24.7	22.3	25.3	22.4	14.8	6.8	22.1

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)		0.1	0.2	0.4	0.1	0.1	0.2
Total Del/Veh (s)		2.8	0.3	0.1	2.2	0.1	0.7

Total Network Performance

Denied Del/Veh (s)	1.5
Total Del/Veh (s)	21.2

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB
Directions Served	L	R	LT	T	TR
Maximum Queue (m)	27.2	97.2	106.0	84.2	43.5
Average Queue (m)	26.7	78.2	77.5	58.7	27.2
95th Queue (m)	27.3	111.1	112.8	91.9	45.8
Link Distance (m)		90.4	129.6	129.6	144.8
Upstream Blk Time (%)		10	0		
Queuing Penalty (veh)		0	0		
Storage Bay Dist (m)	25.0				
Storage Blk Time (%)	37	2			
Queuing Penalty (veh)	3	12			

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	11.0	3.7
Average Queue (m)	7.8	0.5
95th Queue (m)	13.8	4.0
Link Distance (m)	218.6	113.6
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 15

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	NEL	All
Denied Del/Veh (s)		0.5	0.2	0.2	0.1	0.4
Total Del/Veh (s)		0.8	0.6	0.2	8.8	1.3

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.3	0.3	0.2			0.1	0.3
Total Del/Veh (s)	2.5	2.3	0.7			3.7	2.0

Total Network Performance

Denied Del/Veh (s)	0.3
Total Del/Veh (s)	2.1

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NE
Directions Served	LR
Maximum Queue (m)	11.8
Average Queue (m)	6.2
95th Queue (m)	12.4
Link Distance (m)	243.0
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	18.8	15.5
Average Queue (m)	7.0	9.2
95th Queue (m)	19.0	16.1
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	1.1	1.1

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.4	0.5	0.0	5.7	2.5
Total Del/Veh (s)	27.6	5.6	10.7	7.5	11.8

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBL	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.1
Total Del/Veh (s)	18.2	0.8	5.8	24.1	13.3	16.6	8.9	15.0

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.2	0.0	0.2	0.1	0.1	0.1	0.1
Total Del/Veh (s)	1.8	0.9	2.3	3.3	10.3	7.8	1.9

Total Network Performance

Denied Del/Veh (s)	2.4
Total Del/Veh (s)	25.8

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	56.3	41.1	47.1	21.9	22.4
Average Queue (m)	39.5	21.6	26.5	18.9	19.4
95th Queue (m)	65.2	51.3	53.9	22.7	24.2
Link Distance (m)	211.8	270.0	270.0		
Upstream Blk Time (%)				1	1
Queuing Penalty (veh)				0	0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	WB	NB	NB	SB	SB
Directions Served	L	R	T	TR	L	T
Maximum Queue (m)	10.4	16.6	63.0	55.4	52.6	60.0
Average Queue (m)	3.6	14.2	48.0	36.2	35.7	28.6
95th Queue (m)	11.3	19.1	71.0	63.2	63.3	69.6
Link Distance (m)	15.1	15.1	199.3	199.3	270.0	270.0
Upstream Blk Time (%)	0	7				
Queuing Penalty (veh)	0	8				
Storage Bay Dist (m)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	11.2	17.7	15.7
Average Queue (m)	3.5	5.3	9.6
95th Queue (m)	12.7	21.1	18.3
Link Distance (m)	15.1	140.8	76.2
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	2		
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 10

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBT	SBT	SBR	All
Denied Del/Veh (s)	3.7	0.9	0.1	1.1	0.8	1.2
Total Del/Veh (s)	33.1	32.0	4.7	13.3	9.2	15.3

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Total Del/Veh (s)	3.0	2.1	0.1	0.0	2.3	0.6	0.9

Total Network Performance

Denied Del/Veh (s)	1.0
Total Del/Veh (s)	15.0

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB
Directions Served	L	R	LT	T	TR
Maximum Queue (m)	27.0	68.7	24.5	10.9	84.8
Average Queue (m)	24.1	40.0	15.3	4.0	60.8
95th Queue (m)	32.2	87.0	29.8	13.1	102.3
Link Distance (m)		90.4	129.6	129.6	144.8
Upstream Blk Time (%)		1			0
Queuing Penalty (veh)		0			0
Storage Bay Dist (m)	25.0				
Storage Blk Time (%)	26	3			
Queuing Penalty (veh)	20	7			

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	10.1	6.3
Average Queue (m)	5.9	1.4
95th Queue (m)	13.3	6.8
Link Distance (m)	218.6	113.6
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 27

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBT	SBT	SBR	NEL	NER	All
Denied Del/Veh (s)	0.3	0.5	0.5	0.1	0.1	0.4
Total Del/Veh (s)	0.5	2.7	1.0	12.9	4.4	2.2

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.2	0.3	0.4	0.5		0.2	0.3
Total Del/Veh (s)	4.3	2.1	1.4	0.9		8.5	2.9

Total Network Performance

Denied Del/Veh (s)	0.4
Total Del/Veh (s)	3.2

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NE
Directions Served	LR
Maximum Queue (m)	9.7
Average Queue (m)	5.4
95th Queue (m)	11.5
Link Distance (m)	243.0
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	21.7	24.4
Average Queue (m)	7.6	13.6
95th Queue (m)	24.0	23.5
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	90	37	1736	0	0	330
Future Volume (vph)	90	37	1736	0	0	330
Satd. Flow (prot)	1748	0	3579	0	0	3579
Flt Permitted	0.966					
Satd. Flow (perm)	1748	0	3579	0	0	3579
Satd. Flow (RTOR)						
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	96	39	1847	0	0	351
Shared Lane Traffic (%)						
Lane Group Flow (vph)	135	0	1847	0	0	351
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	17.0		43.0			43.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	10.0		38.9			38.9
Actuated g/C Ratio	0.17		0.65			0.65
v/c Ratio	0.46		0.79			0.15
Control Delay	28.4		14.3			5.9
Queue Delay	0.0		0.0			0.0
Total Delay	28.4		14.3			5.9
LOS	C		B			A
Approach Delay	28.4		14.3			5.9
Approach LOS	C		B			A
Queue Length 50th (m)	13.6		84.8			8.6
Queue Length 95th (m)	27.8		#142.2			13.8
Internal Link Dist (m)	204.4		255.2			35.5
Turn Bay Length (m)						
Base Capacity (vph)	293		2338			2338
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.46		0.79			0.15

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 59.6	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.79	
Intersection Signal Delay: 13.9	Intersection LOS: B
Intersection Capacity Utilization 69.7%	ICU Level of Service C
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: Bay Bulls Rd & PM Dr Ramp

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	4	516	1574	32	158	293
Future Volume (vph)	4	516	1574	32	158	293
Satd. Flow (prot)	1789	1601	3568	0	1789	1883
Flt Permitted	0.950				0.074	
Satd. Flow (perm)	1789	1601	3568	0	139	1883
Satd. Flow (RTOR)		146	3			
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	4	555	1692	34	170	315
Shared Lane Traffic (%)						
Lane Group Flow (vph)	4	555	1726	0	170	315
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		4			6	
Total Split (s)	33.0	33.0	54.0		13.0	67.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)	27.0	27.0	48.0		61.0	61.0
Actuated g/C Ratio	0.27	0.27	0.48		0.61	0.61
v/c Ratio	0.01	1.03	1.01		0.85	0.27
Control Delay	27.0	75.1	50.2		54.2	9.9
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	27.0	75.1	50.2		54.2	9.9
LOS	C	E	D		D	A
Approach Delay	74.8		50.2			25.4
Approach LOS	E		D			C
Queue Length 50th (m)	0.6	~93.5	~173.2		17.0	26.4
Queue Length 95th (m)	3.2	#157.2	#228.0		#53.2	40.2
Internal Link Dist (m)	10.6		110.1			255.2
Turn Bay Length (m)						
Base Capacity (vph)	483	538	1714		200	1148
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.01	1.03	1.01		0.85	0.27

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 100	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.03	
Intersection Signal Delay: 50.8	Intersection LOS: D
Intersection Capacity Utilization 86.5%	ICU Level of Service E
Analysis Period (min) 15	

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 20: Bay Bulls Rd & Old Petty Harbour Rd

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	31	145	406	2	2	120
Future Vol, veh/h	31	145	406	2	2	120
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	34	161	451	2	2	133

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	2	0	161	0	1134	2
Stage 1	-	-	-	-	904	-
Stage 2	-	-	-	-	230	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1620	-	-	-	203	1082
Stage 1	-	-	-	-	356	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1620	-	-	-	0	1082
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

Approach	EB	NB	SB
HCM Control Delay, s	1.3		8.8
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1620	-	1082
HCM Lane V/C Ratio	-	-	0.021	-	0.125
HCM Control Delay (s)	-	-	7.3	-	8.8
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0.1	-	0.4

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	653	7	106	1173	358	15
Future Volume (vph)	653	7	106	1173	358	15
Satd. Flow (prot)	1789	1601	0	3564	1874	0
Flt Permitted	0.950			0.787		
Satd. Flow (perm)	1789	1601	0	2816	1874	0
Satd. Flow (RTOR)		7			3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	710	8	115	1275	389	16
Shared Lane Traffic (%)						
Lane Group Flow (vph)	710	8	0	1390	405	0
Turn Type	Prot	Prot	Perm	NA	NA	
Protected Phases	3	3		2	6	
Permitted Phases			2			
Total Split (s)	44.0	44.0	56.0	56.0	56.0	
Total Lost Time (s)	5.0	5.0		6.0	6.0	
Act Effct Green (s)	39.0	39.0		50.0	50.0	
Actuated g/C Ratio	0.39	0.39		0.50	0.50	
v/c Ratio	1.02	0.01		0.99	0.43	
Control Delay	70.5	11.7		46.8	17.6	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	70.5	11.7		46.8	17.6	
LOS	E	B		D	B	
Approach Delay	69.8			46.8	17.6	
Approach LOS	E			D	B	
Queue Length 50th (m)	~140.8	0.1		134.3	47.6	
Queue Length 95th (m)	#213.8	3.0		#187.4	70.8	
Internal Link Dist (m)	71.9			112.7	99.9	
Turn Bay Length (m)	25.0					
Base Capacity (vph)	697	628		1408	938	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	1.02	0.01		0.99	0.43	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 100	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.02	
Intersection Signal Delay: 48.7	Intersection LOS: D
Intersection Capacity Utilization 105.6%	ICU Level of Service G
Analysis Period (min) 15	

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 40: Bay Bulls Rd & PittsMem Ramps

Intersection	
Int Delay, s/veh	2.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	12	82	234	6	32	68
Future Vol, veh/h	12	82	234	6	32	68
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	13	89	254	7	35	74

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	401	258	0	0	261	0
Stage 1	258	-	-	-	-	-
Stage 2	143	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	605	781	-	-	1303	-
Stage 1	785	-	-	-	-	-
Stage 2	884	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	588	781	-	-	1303	-
Mov Cap-2 Maneuver	588	-	-	-	-	-
Stage 1	785	-	-	-	-	-
Stage 2	859	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.6	0	2.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	750	1303	-
HCM Lane V/C Ratio	-	-	0.136	0.027	-
HCM Control Delay (s)	-	-	10.6	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.5	0.1	-

Intersection	
Int Delay, s/veh	1.6

Movement	NBL	NBT	SBT	SBR	NEL	NER
Traffic Vol, veh/h	1	800	234	47	65	0
Future Vol, veh/h	1	800	234	47	65	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	870	254	51	71	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	305	0	-	0	1152	280
Stage 1	-	-	-	-	280	-
Stage 2	-	-	-	-	872	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1256	-	-	-	219	759
Stage 1	-	-	-	-	767	-
Stage 2	-	-	-	-	409	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1256	-	-	-	219	759
Mov Cap-2 Maneuver	-	-	-	-	219	-
Stage 1	-	-	-	-	767	-
Stage 2	-	-	-	-	408	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	29.1
HCM LOS			D

Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
Capacity (veh/h)	219	1256	-	-	-
HCM Lane V/C Ratio	0.323	0.001	-	-	-
HCM Control Delay (s)	29.1	7.9	0	-	-
HCM Lane LOS	D	A	A	-	-
HCM 95th %tile Q(veh)	1.3	0	-	-	-

Intersection	
Int Delay, s/veh	2.1

Movement	NBL	NBT	SBT	SBR	SEL	SER
Traffic Vol, veh/h	115	335	207	1	1	58
Future Vol, veh/h	115	335	207	1	1	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	125	364	225	1	1	63

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	226	0	-	0	840	226
Stage 1	-	-	-	-	226	-
Stage 2	-	-	-	-	614	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1342	-	-	-	335	813
Stage 1	-	-	-	-	812	-
Stage 2	-	-	-	-	540	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1342	-	-	-	296	813
Mov Cap-2 Maneuver	-	-	-	-	296	-
Stage 1	-	-	-	-	812	-
Stage 2	-	-	-	-	477	-

Approach	NB	SB	SE
HCM Control Delay, s	2	0	10
HCM LOS			B

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1342	-	790	-	-
HCM Lane V/C Ratio	0.093	-	0.081	-	-
HCM Control Delay (s)	8	0	10	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.3	-	0.3	-	-

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	389	75	784	0	0	1090
Future Volume (vph)	389	75	784	0	0	1090
Satd. Flow (prot)	1768	0	3579	0	0	3579
Flt Permitted	0.960					
Satd. Flow (perm)	1768	0	3579	0	0	3579
Satd. Flow (RTOR)						
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	414	80	834	0	0	1160
Shared Lane Traffic (%)						
Lane Group Flow (vph)	494	0	834	0	0	1160
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	28.0		32.0			32.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	19.1		23.1			23.1
Actuated g/C Ratio	0.33		0.40			0.40
v/c Ratio	0.85		0.59			0.82
Control Delay	34.6		16.3			22.6
Queue Delay	0.0		0.0			0.0
Total Delay	34.6		16.3			22.6
LOS	C		B			C
Approach Delay	34.6		16.3			22.6
Approach LOS	C		B			C
Queue Length 50th (m)	47.8		37.4			59.2
Queue Length 95th (m)	#92.2		53.4			#93.3
Internal Link Dist (m)	204.4		255.2			35.5
Turn Bay Length (m)						
Base Capacity (vph)	639		1418			1418
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.77		0.59			0.82

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 58.2	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.85	
Intersection Signal Delay: 22.9	Intersection LOS: C
Intersection Capacity Utilization 69.6%	ICU Level of Service C
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

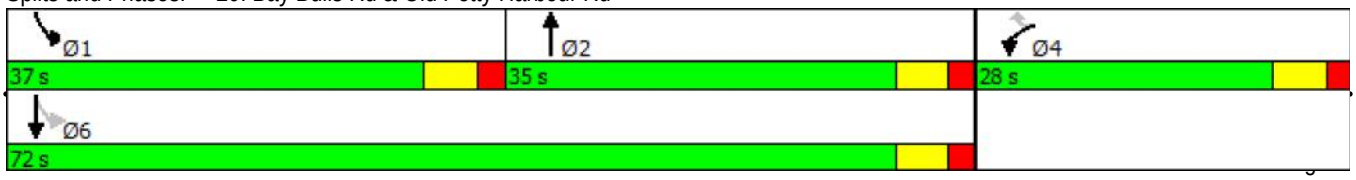
Splits and Phases: 10: Bay Bulls Rd & PM Dr Ramp

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	19	245	704	73	492	907
Future Volume (vph)	19	245	704	73	492	907
Satd. Flow (prot)	1789	1601	3528	0	1789	1883
Flt Permitted	0.950				0.147	
Satd. Flow (perm)	1789	1601	3528	0	277	1883
Satd. Flow (RTOR)		263	11			
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	20	263	757	78	529	975
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	263	835	0	529	975
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		4			6	
Total Split (s)	28.0	28.0	35.0		37.0	72.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)	12.2	12.2	29.1		66.2	66.2
Actuated g/C Ratio	0.13	0.13	0.32		0.73	0.73
v/c Ratio	0.08	0.59	0.73		0.73	0.71
Control Delay	34.0	10.4	32.0		23.1	11.3
Queue Delay	0.0	0.0	0.0		0.0	0.1
Total Delay	34.0	10.4	32.0		23.1	11.4
LOS	C	B	C		C	B
Approach Delay	12.1		32.0			15.5
Approach LOS	B		C			B
Queue Length 50th (m)	3.1	0.0	63.5		51.9	68.4
Queue Length 95th (m)	9.1	19.4	100.6		#123.4	176.7
Internal Link Dist (m)	10.6		110.1			255.2
Turn Bay Length (m)						
Base Capacity (vph)	436	589	1142		722	1378
Starvation Cap Reductn	0	0	0		0	26
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.05	0.45	0.73		0.73	0.72

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 90.4	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.73	
Intersection Signal Delay: 20.4	Intersection LOS: C
Intersection Capacity Utilization 72.4%	ICU Level of Service C
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 20: Bay Bulls Rd & Old Petty Harbour Rd



Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	101	487	218	4	6	55
Future Vol, veh/h	101	487	218	4	6	55
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	112	541	242	4	7	61

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	4	0	541	0	1255	4
Stage 1	-	-	-	-	489	-
Stage 2	-	-	-	-	766	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1618	-	-	-	172	1080
Stage 1	-	-	-	-	549	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1618	-	-	-	0	1080
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

Approach	EB	NB	SB
HCM Control Delay, s	1.3		8.6
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1618	-	1080
HCM Lane V/C Ratio	-	-	0.069	-	0.063
HCM Control Delay (s)	-	-	7.4	-	8.6
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0.2	-	0.2

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	286	77	39	485	1199	7
Future Volume (vph)	286	77	39	485	1199	7
Satd. Flow (prot)	1789	1601	0	3564	1882	0
Flt Permitted	0.950			0.599		
Satd. Flow (perm)	1789	1601	0	2144	1882	0
Satd. Flow (RTOR)		84			1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	311	84	42	527	1303	8
Shared Lane Traffic (%)						
Lane Group Flow (vph)	311	84	0	569	1311	0
Turn Type	Prot	Prot	Perm	NA	NA	
Protected Phases	3	3		2	6	
Permitted Phases			2			
Total Split (s)	24.0	24.0	76.0	76.0	76.0	
Total Lost Time (s)	5.0	5.0		6.0	6.0	
Act Effct Green (s)	18.8	18.8		70.0	70.0	
Actuated g/C Ratio	0.19	0.19		0.70	0.70	
v/c Ratio	0.93	0.23		0.38	0.99	
Control Delay	74.8	9.5		6.9	39.3	
Queue Delay	0.0	0.0		0.0	13.9	
Total Delay	74.8	9.5		6.9	53.2	
LOS	E	A		A	D	
Approach Delay	60.9			6.9	53.2	
Approach LOS	E			A	D	
Queue Length 50th (m)	59.6	0.0		20.6	219.3	
Queue Length 95th (m)	#108.3	12.1		29.1	#343.0	
Internal Link Dist (m)	71.9			112.7	99.9	
Turn Bay Length (m)	25.0					
Base Capacity (vph)	340	373		1504	1320	
Starvation Cap Reductn	0	0		0	60	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.91	0.23		0.38	1.04	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 99.8	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.99	
Intersection Signal Delay: 43.0	Intersection LOS: D
Intersection Capacity Utilization 88.5%	ICU Level of Service E
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 40: Bay Bulls Rd & PittsMem Ramps

Intersection	
Int Delay, s/veh	2.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	12	46	87	9	114	267
Future Vol, veh/h	12	46	87	9	114	267
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	13	50	95	10	124	290

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	637	99	0	0	104	0
Stage 1	99	-	-	-	-	-
Stage 2	538	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	441	957	-	-	1488	-
Stage 1	925	-	-	-	-	-
Stage 2	585	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	397	957	-	-	1488	-
Mov Cap-2 Maneuver	397	-	-	-	-	-
Stage 1	925	-	-	-	-	-
Stage 2	527	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.3	0	2.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	741	1488	-
HCM Lane V/C Ratio	-	-	0.085	0.083	-
HCM Control Delay (s)	-	-	10.3	7.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.3	0.3	-

Intersection	
Int Delay, s/veh	0.9

Movement	NBL	NBT	SBT	SBR	NEL	NER
Traffic Vol, veh/h	0	406	757	127	34	4
Future Vol, veh/h	0	406	757	127	34	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	441	823	138	37	4

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	961	0	-	0	1333	892
Stage 1	-	-	-	-	892	-
Stage 2	-	-	-	-	441	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	716	-	-	-	170	341
Stage 1	-	-	-	-	400	-
Stage 2	-	-	-	-	648	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	716	-	-	-	170	341
Mov Cap-2 Maneuver	-	-	-	-	170	-
Stage 1	-	-	-	-	400	-
Stage 2	-	-	-	-	648	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	31
HCM LOS			D

Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
Capacity (veh/h)	179	716	-	-	-
HCM Lane V/C Ratio	0.231	-	-	-	-
HCM Control Delay (s)	31	0	-	-	-
HCM Lane LOS	D	A	-	-	-
HCM 95th %tile Q(veh)	0.9	0	-	-	-

Intersection	
Int Delay, s/veh	2.4

Movement	NBL	NBT	SBT	SBR	SEL	SER
Traffic Vol, veh/h	59	267	409	4	1	127
Future Vol, veh/h	59	267	409	4	1	127
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	64	290	445	4	1	138

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	449	0	-	0	865	447
Stage 1	-	-	-	-	447	-
Stage 2	-	-	-	-	418	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1111	-	-	-	324	612
Stage 1	-	-	-	-	644	-
Stage 2	-	-	-	-	664	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1111	-	-	-	302	612
Mov Cap-2 Maneuver	-	-	-	-	302	-
Stage 1	-	-	-	-	644	-
Stage 2	-	-	-	-	618	-

Approach	NB	SB	SE
HCM Control Delay, s	1.5	0	12.7
HCM LOS			B

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1111	-	607	-	-
HCM Lane V/C Ratio	0.058	-	0.229	-	-
HCM Control Delay (s)	8.4	0	12.7	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.2	-	0.9	-	-

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	1.1	1.1

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.2	0.2	0.0	0.4	0.1
Total Del/Veh (s)	21.8	3.9	14.1	6.3	13.2

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBL	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	20.4	0.5	10.8	38.5	36.5	30.6	10.6	30.5

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBT	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	2.5	0.0		133.1	24.7
Total Del/Veh (s)	4.4	0.8	1.0	46.9	62.7		326.3	73.1

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	17.4	20.0	1.6	1.2	0.1	0.1	5.7
Total Del/Veh (s)	37.5	42.0	41.6	35.7	15.4	9.7	33.3

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.1	0.1	0.2	0.4	0.0	0.0	0.1
Total Del/Veh (s)	5.2	3.4	0.3	0.2	2.6	0.4	1.1

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBT	SBT	SBR	NEL	All
Denied Del/Veh (s)	0.7	0.3	0.2	0.1	0.6
Total Del/Veh (s)	1.1	0.8	0.3	17.5	2.0

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.3	0.4	0.2	0.1		0.1	0.3
Total Del/Veh (s)	2.7	2.5	0.8	0.2		4.4	2.2

Total Network Performance

Denied Del/Veh (s)	6.4
Total Del/Veh (s)	53.7

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	27.3	66.8	70.8	18.9	19.8
Average Queue (m)	12.9	45.5	50.6	9.4	14.5
95th Queue (m)	26.8	69.8	74.4	20.0	22.4
Link Distance (m)	211.8	270.0	270.0		
Upstream Blk Time (%)				0	0
Queuing Penalty (veh)				0	0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	WB	NB	NB	B1	B1	SB	SB
Directions Served	L	R	T	TR	T	T	L	T
Maximum Queue (m)	3.4	28.9	140.1	141.8	77.3	76.8	38.6	38.0
Average Queue (m)	0.4	19.2	122.0	124.1	36.4	37.8	21.8	20.9
95th Queue (m)	3.3	26.8	162.6	161.3	109.3	113.6	38.2	39.4
Link Distance (m)	15.1	15.1	123.4	123.4	111.5	111.5	270.0	270.0
Upstream Blk Time (%)		58	22	23	1	1		
Queuing Penalty (veh)		153	201	209	11	12		
Storage Bay Dist (m)								
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	9.1	116.6	80.7
Average Queue (m)	1.5	73.1	63.3
95th Queue (m)	7.5	135.1	99.2
Link Distance (m)	15.1	213.0	76.2
Upstream Blk Time (%)	0		51
Queuing Penalty (veh)	0		0
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB
Directions Served	L	R	LT	T	TR
Maximum Queue (m)	27.3	98.1	136.1	124.7	56.1
Average Queue (m)	26.8	89.8	106.4	88.2	33.3
95th Queue (m)	27.9	110.3	151.1	135.7	69.8
Link Distance (m)		90.5	129.6	129.6	111.5
Upstream Blk Time (%)		28	9	5	
Queuing Penalty (veh)		0	0	0	
Storage Bay Dist (m)	25.0				
Storage Blk Time (%)	49	7			
Queuing Penalty (veh)	3	46			

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	17.3	8.2
Average Queue (m)	10.2	1.7
95th Queue (m)	17.6	7.5
Link Distance (m)	218.6	134.5
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NE
Directions Served	LR
Maximum Queue (m)	18.6
Average Queue (m)	8.6
95th Queue (m)	18.7
Link Distance (m)	243.0
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	17.7	13.5
Average Queue (m)	7.4	8.9
95th Queue (m)	18.7	14.8
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 635

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	1.4	1.4

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.5	0.4	0.0	18.7	8.3
Total Del/Veh (s)	22.0	5.4	13.7	8.8	12.6

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBL	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Total Del/Veh (s)	32.1	0.4	7.4	31.3	23.0	23.9	12.9	20.1

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.2	0.1	0.1	0.0	0.2	0.1	0.1
Total Del/Veh (s)	2.0	1.1	3.2	1.9	13.4	8.2	2.2

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	6.0	3.1	0.4	0.1	12.1	11.8	7.9
Total Del/Veh (s)	55.5	56.0	91.3	27.5	18.4	16.2	28.5

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.1	0.1	0.1	0.2	0.0	0.0	0.0
Total Del/Veh (s)	7.9	2.5	0.2	0.1	2.5	0.9	1.3

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBT	SBT	SBR	NEL	NER	All
Denied Del/Veh (s)	0.4	0.8	0.7	0.1	0.1	0.6
Total Del/Veh (s)	0.6	3.7	1.4	25.2	7.0	3.1

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.3	0.2	0.4	0.4		0.2	0.3
Total Del/Veh (s)	3.6	1.5	1.6	0.7		8.7	2.7

Total Network Performance

Denied Del/Veh (s)	7.3
Total Del/Veh (s)	31.3

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	66.1	64.5	64.1	22.7	24.6
Average Queue (m)	41.0	33.2	37.9	18.9	19.1
95th Queue (m)	67.5	63.0	63.1	21.7	22.8
Link Distance (m)	211.8	270.0	270.0		
Upstream Blk Time (%)				0	1
Queuing Penalty (veh)				0	0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	WB	NB	NB	SB	SB
Directions Served	L	R	T	TR	L	T
Maximum Queue (m)	11.8	16.6	84.8	84.4	90.4	82.4
Average Queue (m)	3.9	15.2	54.1	56.5	50.0	44.6
95th Queue (m)	11.7	18.5	86.9	84.7	88.1	82.8
Link Distance (m)	15.1	15.1	123.4	123.4	270.0	270.0
Upstream Blk Time (%)	2	15				
Queuing Penalty (veh)	2	20				
Storage Bay Dist (m)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	18.6	21.5	16.5
Average Queue (m)	5.8	9.5	9.4
95th Queue (m)	17.7	23.0	17.6
Link Distance (m)	15.1	213.0	76.2
Upstream Blk Time (%)	1		
Queuing Penalty (veh)	5		
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB	B1
Directions Served	L	R	LT	T	TR	T
Maximum Queue (m)	27.2	92.6	75.7	64.8	123.6	41.3
Average Queue (m)	26.4	64.1	52.0	38.2	92.7	9.9
95th Queue (m)	28.4	108.3	85.6	76.8	141.5	41.5
Link Distance (m)		90.5	129.6	129.6	111.5	123.4
Upstream Blk Time (%)		9			6	
Queuing Penalty (veh)		0			59	
Storage Bay Dist (m)	25.0					
Storage Blk Time (%)	49	5				
Queuing Penalty (veh)	38	14				

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	11.9	12.0
Average Queue (m)	8.1	2.3
95th Queue (m)	13.7	10.5
Link Distance (m)	218.6	134.5
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NE
Directions Served	LR
Maximum Queue (m)	15.4
Average Queue (m)	6.4
95th Queue (m)	13.9
Link Distance (m)	243.0
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	19.3	25.1
Average Queue (m)	7.4	14.3
95th Queue (m)	18.7	24.5
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 139

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	90	37	1736	0	0	330
Future Volume (vph)	90	37	1736	0	0	330
Satd. Flow (prot)	1748	0	3579	0	0	3579
Flt Permitted	0.966					
Satd. Flow (perm)	1748	0	3579	0	0	3579
Satd. Flow (RTOR)						
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	96	39	1847	0	0	351
Shared Lane Traffic (%)						
Lane Group Flow (vph)	135	0	1847	0	0	351
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	19.0		61.0			61.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	11.1		58.1			58.1
Actuated g/C Ratio	0.14		0.73			0.73
v/c Ratio	0.56		0.71			0.14
Control Delay	41.5		8.1			4.9
Queue Delay	0.0		0.0			0.0
Total Delay	41.5		8.1			4.9
LOS	D		A			A
Approach Delay	41.5		8.1			4.9
Approach LOS	D		A			A
Queue Length 50th (m)	19.3		32.9			9.2
Queue Length 95th (m)	35.9		109.5			14.2
Internal Link Dist (m)	204.4		101.8			35.5
Turn Bay Length (m)						
Base Capacity (vph)	262		2600			2600
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.52		0.71			0.14

Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 80	
Offset: 62 (78%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.71	
Intersection Signal Delay: 9.6	Intersection LOS: A
Intersection Capacity Utilization 69.7%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 10: Bay Bulls Rd & PM Dr Ramp

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	4	516	1574	32	158	293
Future Volume (vph)	4	516	1574	32	158	293
Satd. Flow (prot)	1789	1601	3568	0	1789	3579
Flt Permitted	0.950				0.084	
Satd. Flow (perm)	1789	1601	3568	0	158	3579
Satd. Flow (RTOR)		303	4			
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	4	555	1692	34	170	315
Shared Lane Traffic (%)						
Lane Group Flow (vph)	4	555	1726	0	170	315
Turn Type	Prot	Free	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		Free			6	
Total Split (s)	16.0		54.0		10.0	64.0
Total Lost Time (s)	6.0		6.0		3.0	6.0
Act Effct Green (s)	10.0	80.0	59.6		73.8	75.6
Actuated g/C Ratio	0.12	1.00	0.74		0.92	0.94
v/c Ratio	0.02	0.35	0.65		0.54	0.09
Control Delay	31.0	0.6	8.8		22.5	0.7
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	31.0	0.6	8.8		22.5	0.7
LOS	C	A	A		C	A
Approach Delay	0.8		8.8			8.3
Approach LOS	A		A			A
Queue Length 50th (m)	0.5	0.0	54.0		0.0	0.0
Queue Length 95th (m)	3.2	0.0	95.5		#31.1	7.2
Internal Link Dist (m)	10.6		110.1			129.3
Turn Bay Length (m)					60.0	
Base Capacity (vph)	223	1601	2657		313	3382
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.02	0.35	0.65		0.54	0.09

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green, Master Intersection
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 7.1 Intersection LOS: A
Intersection Capacity Utilization 74.9% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 20: Bay Bulls Rd & Old Petty Harbour Rd

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	31	145	406	2	2	120
Future Vol, veh/h	31	145	406	2	2	120
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	34	161	451	2	2	133

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	2	0	161	0	1134	2
Stage 1	-	-	-	-	904	-
Stage 2	-	-	-	-	230	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1620	-	-	-	203	1082
Stage 1	-	-	-	-	356	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1620	-	-	-	0	1082
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

Approach	EB	NB	SB
HCM Control Delay, s	1.3		8.8
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1620	-	1082
HCM Lane V/C Ratio	-	-	0.021	-	0.125
HCM Control Delay (s)	-	-	7.3	-	8.8
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0.1	-	0.4

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	653	7	106	1173	358	15
Future Volume (vph)	653	7	106	1173	358	15
Satd. Flow (prot)	3475	0	0	3564	3557	0
Flt Permitted	0.953			0.859		
Satd. Flow (perm)	3475	0	0	3074	3557	0
Satd. Flow (RTOR)	1				9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	710	8	115	1275	389	16
Shared Lane Traffic (%)						
Lane Group Flow (vph)	718	0	0	1390	405	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			2	6	
Permitted Phases			2			
Total Split (s)	27.0		53.0	53.0	53.0	
Total Lost Time (s)	5.0			6.0	6.0	
Act Effct Green (s)	20.2			48.8	48.8	
Actuated g/C Ratio	0.25			0.61	0.61	
v/c Ratio	0.82			0.74	0.19	
Control Delay	36.3			14.7	6.0	
Queue Delay	0.0			0.0	0.0	
Total Delay	36.3			14.7	6.0	
LOS	D			B	A	
Approach Delay	36.3			14.7	6.0	
Approach LOS	D			B	A	
Queue Length 50th (m)	51.7			74.5	10.8	
Queue Length 95th (m)	70.0			103.1	16.3	
Internal Link Dist (m)	71.9			112.7	99.9	
Turn Bay Length (m)	50.0					
Base Capacity (vph)	956			1873	2171	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.75			0.74	0.19	

Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 80	
Offset: 62 (78%), Referenced to phase 2:NBTL and 6:SBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.82	
Intersection Signal Delay: 19.5	Intersection LOS: B
Intersection Capacity Utilization 78.9%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 40: Bay Bulls Rd & PittsMem Ramps

Intersection	
Int Delay, s/veh	2.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	12	82	234	6	32	68
Future Vol, veh/h	12	82	234	6	32	68
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	13	89	254	7	35	74

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	401	258	0	0	261	0
Stage 1	258	-	-	-	-	-
Stage 2	143	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	605	781	-	-	1303	-
Stage 1	785	-	-	-	-	-
Stage 2	884	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	588	781	-	-	1303	-
Mov Cap-2 Maneuver	588	-	-	-	-	-
Stage 1	785	-	-	-	-	-
Stage 2	859	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.6	0	2.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	750	1303	-
HCM Lane V/C Ratio	-	-	0.136	0.027	-
HCM Control Delay (s)	-	-	10.6	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.5	0.1	-

Intersection	
Int Delay, s/veh	1.6

Movement	NBL	NBT	SBT	SBR	NEL	NER
Traffic Vol, veh/h	1	800	234	47	65	0
Future Vol, veh/h	1	800	234	47	65	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	250
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	870	254	51	71	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	305	0	-	0	1152	280
Stage 1	-	-	-	-	280	-
Stage 2	-	-	-	-	872	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1256	-	-	-	219	759
Stage 1	-	-	-	-	767	-
Stage 2	-	-	-	-	409	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1256	-	-	-	219	759
Mov Cap-2 Maneuver	-	-	-	-	219	-
Stage 1	-	-	-	-	767	-
Stage 2	-	-	-	-	408	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	29.1
HCM LOS			D

Minor Lane/Major Mvmt	NELn1	NELn2	NBL	NBT	SBT	SBR
Capacity (veh/h)	219	-	1256	-	-	-
HCM Lane V/C Ratio	0.323	-	0.001	-	-	-
HCM Control Delay (s)	29.1	0	7.9	0	-	-
HCM Lane LOS	D	A	A	A	-	-
HCM 95th %tile Q(veh)	1.3	-	0	-	-	-

Intersection	
Int Delay, s/veh	2.1

Movement	NBL	NBT	SBT	SBR	SEL	SER
Traffic Vol, veh/h	115	335	207	1	1	58
Future Vol, veh/h	115	335	207	1	1	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	125	364	225	1	1	63

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	226	0	-	0	840	226
Stage 1	-	-	-	-	226	-
Stage 2	-	-	-	-	614	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1342	-	-	-	335	813
Stage 1	-	-	-	-	812	-
Stage 2	-	-	-	-	540	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1342	-	-	-	296	813
Mov Cap-2 Maneuver	-	-	-	-	296	-
Stage 1	-	-	-	-	812	-
Stage 2	-	-	-	-	477	-

Approach	NB	SB	SE
HCM Control Delay, s	2	0	10
HCM LOS			B

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1342	-	790	-	-
HCM Lane V/C Ratio	0.093	-	0.081	-	-
HCM Control Delay (s)	8	0	10	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.3	-	0.3	-	-

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	389	75	784	0	0	1090
Future Volume (vph)	389	75	784	0	0	1090
Satd. Flow (prot)	1768	0	3579	0	0	3579
Flt Permitted	0.960					
Satd. Flow (perm)	1768	0	3579	0	0	3579
Satd. Flow (RTOR)						
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	414	80	834	0	0	1160
Shared Lane Traffic (%)						
Lane Group Flow (vph)	494	0	834	0	0	1160
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases						
Total Split (s)	28.0		32.0			32.0
Total Lost Time (s)	7.0		9.0			9.0
Act Effct Green (s)	19.6		24.4			24.4
Actuated g/C Ratio	0.33		0.41			0.41
v/c Ratio	0.86		0.57			0.80
Control Delay	35.6		13.9			21.7
Queue Delay	0.0		0.0			0.0
Total Delay	35.6		13.9			21.7
LOS	D		B			C
Approach Delay	35.6		13.9			21.7
Approach LOS	D		B			C
Queue Length 50th (m)	47.8		26.0			59.2
Queue Length 95th (m)	#92.2		39.6			#93.3
Internal Link Dist (m)	204.4		101.8			35.5
Turn Bay Length (m)						
Base Capacity (vph)	618		1457			1457
Starvation Cap Reductn	0		0			0
Spillback Cap Reductn	0		0			0
Storage Cap Reductn	0		0			0
Reduced v/c Ratio	0.80		0.57			0.80

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.86	
Intersection Signal Delay: 21.9	Intersection LOS: C
Intersection Capacity Utilization 69.6%	ICU Level of Service C
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: Bay Bulls Rd & PM Dr Ramp

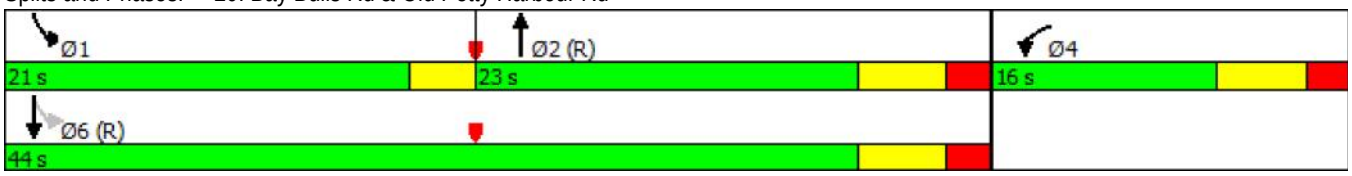
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	19	245	704	73	492	907
Future Volume (vph)	19	245	704	73	492	907
Satd. Flow (prot)	1789	1601	3528	0	1789	3579
Flt Permitted	0.950				0.247	
Satd. Flow (perm)	1789	1601	3528	0	465	3579
Satd. Flow (RTOR)		263	18			
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	20	263	757	78	529	975
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	263	835	0	529	975
Turn Type	Prot	Free	NA		pm+pt	NA
Protected Phases	4		2		1	6
Permitted Phases		Free			6	
Total Split (s)	16.0		23.0		21.0	44.0
Total Lost Time (s)	6.0		6.0		3.0	6.0
Act Effct Green (s)	10.0	60.0	29.9		50.6	51.2
Actuated g/C Ratio	0.17	1.00	0.50		0.84	0.85
v/c Ratio	0.07	0.16	0.47		0.74	0.32
Control Delay	21.8	0.2	11.5		13.3	6.1
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	21.8	0.2	11.5		13.3	6.1
LOS	C	A	B		B	A
Approach Delay	1.7		11.5			8.6
Approach LOS	A		B			A
Queue Length 50th (m)	1.9	0.0	12.8		2.6	0.0
Queue Length 95th (m)	6.7	0.0	#55.4		m58.4	m52.8
Internal Link Dist (m)	10.6		110.1			129.3
Turn Bay Length (m)					60.0	
Base Capacity (vph)	298	1601	1767		788	3054
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.07	0.16	0.47		0.67	0.32

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green, Master Intersection	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.74	
Intersection Signal Delay: 8.8	Intersection LOS: A
Intersection Capacity Utilization 70.7%	ICU Level of Service C
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 20: Bay Bulls Rd & Old Petty Harbour Rd



Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Vol, veh/h	101	487	218	4	6	55
Future Vol, veh/h	101	487	218	4	6	55
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	112	541	242	4	7	61

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	4	0	541	0	1255	4
Stage 1	-	-	-	-	489	-
Stage 2	-	-	-	-	766	-
Critical Hdwy	4.12	-	-	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.218	-	-	-	4.018	3.318
Pot Cap-1 Maneuver	1618	-	-	-	172	1080
Stage 1	-	-	-	-	549	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %		-		-		
Mov Cap-1 Maneuver	1618	-	-	-	0	1080
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-

Approach	EB	NB	SB
HCM Control Delay, s	1.3		8.6
HCM LOS			A

Minor Lane/Major Mvmt	NBL	NBT	EBL	EBR	SBLn1
Capacity (veh/h)	-	-	1618	-	1080
HCM Lane V/C Ratio	-	-	0.069	-	0.063
HCM Control Delay (s)	-	-	7.4	-	8.6
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0.2	-	0.2

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	286	77	39	485	1199	7
Future Volume (vph)	286	77	39	485	1199	7
Satd. Flow (prot)	3403	0	0	3564	3575	0
Flt Permitted	0.962			0.802		
Satd. Flow (perm)	3403	0	0	2870	3575	0
Satd. Flow (RTOR)	32				1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	311	84	42	527	1303	8
Shared Lane Traffic (%)						
Lane Group Flow (vph)	395	0	0	569	1311	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			2	6	
Permitted Phases			2			
Total Split (s)	24.0		36.0	36.0	36.0	
Total Lost Time (s)	5.0			6.0	6.0	
Act Effct Green (s)	12.0			37.0	37.0	
Actuated g/C Ratio	0.20			0.62	0.62	
v/c Ratio	0.56			0.32	0.60	
Control Delay	22.7			6.5	9.8	
Queue Delay	0.0			0.0	0.0	
Total Delay	22.7			6.5	9.8	
LOS	C			A	A	
Approach Delay	22.7			6.5	9.8	
Approach LOS	C			A	A	
Queue Length 50th (m)	18.7			13.2	59.7	
Queue Length 95th (m)	27.9			24.2	81.9	
Internal Link Dist (m)	71.9			112.7	99.9	
Turn Bay Length (m)	50.0					
Base Capacity (vph)	1099			1768	2203	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.36			0.32	0.60	

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.60
Intersection Signal Delay: 11.2 Intersection LOS: B
Intersection Capacity Utilization 62.9% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 40: Bay Bulls Rd & PittsMem Ramps

Intersection	
Int Delay, s/veh	2.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	12	46	87	9	114	267
Future Vol, veh/h	12	46	87	9	114	267
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	13	50	95	10	124	290

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	637	99	0	0	104	0
Stage 1	99	-	-	-	-	-
Stage 2	538	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	441	957	-	-	1488	-
Stage 1	925	-	-	-	-	-
Stage 2	585	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	397	957	-	-	1488	-
Mov Cap-2 Maneuver	397	-	-	-	-	-
Stage 1	925	-	-	-	-	-
Stage 2	527	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.3	0	2.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	741	1488	-
HCM Lane V/C Ratio	-	-	0.085	0.083	-
HCM Control Delay (s)	-	-	10.3	7.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.3	0.3	-

Intersection	
Int Delay, s/veh	0.9

Movement	NBL	NBT	SBT	SBR	NEL	NER
Traffic Vol, veh/h	0	406	757	127	34	4
Future Vol, veh/h	0	406	757	127	34	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	250
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	441	823	138	37	4

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	961	0	-	0	1333	892
Stage 1	-	-	-	-	892	-
Stage 2	-	-	-	-	441	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	716	-	-	-	170	341
Stage 1	-	-	-	-	400	-
Stage 2	-	-	-	-	648	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	716	-	-	-	170	341
Mov Cap-2 Maneuver	-	-	-	-	170	-
Stage 1	-	-	-	-	400	-
Stage 2	-	-	-	-	648	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	30.3
HCM LOS			D

Minor Lane/Major Mvmt	NELn1	NELn2	NBL	NBT	SBT	SBR
Capacity (veh/h)	170	341	716	-	-	-
HCM Lane V/C Ratio	0.217	0.013	-	-	-	-
HCM Control Delay (s)	32	15.7	0	-	-	-
HCM Lane LOS	D	C	A	-	-	-
HCM 95th %tile Q(veh)	0.8	0	0	-	-	-

Intersection	
Int Delay, s/veh	2.4

Movement	NBL	NBT	SBT	SBR	SEL	SER
Traffic Vol, veh/h	59	267	409	4	1	127
Future Vol, veh/h	59	267	409	4	1	127
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	64	290	445	4	1	138

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	449	0	-	0	865	447
Stage 1	-	-	-	-	447	-
Stage 2	-	-	-	-	418	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1111	-	-	-	324	612
Stage 1	-	-	-	-	644	-
Stage 2	-	-	-	-	664	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1111	-	-	-	302	612
Mov Cap-2 Maneuver	-	-	-	-	302	-
Stage 1	-	-	-	-	644	-
Stage 2	-	-	-	-	618	-

Approach	NB	SB	SE
HCM Control Delay, s	1.5	0	12.7
HCM LOS			B

Minor Lane/Major Mvmt	NBL	NBT	SELn1	SBT	SBR
Capacity (veh/h)	1111	-	607	-	-
HCM Lane V/C Ratio	0.058	-	0.229	-	-
HCM Control Delay (s)	8.4	0	12.7	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.2	-	0.9	-	-

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	0.9	0.9

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.1	0.2	0.0	0.7	0.1
Total Del/Veh (s)	31.3	4.0	6.9	4.7	7.5

19: Bay Bulls Rd Performance by movement

Movement	NBT	NBR	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Del/Veh (s)	4.5	4.0	2.4	4.1

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBL	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Total Del/Veh (s)	32.3	0.1	0.8	6.9	3.9	26.6	1.7	6.4

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBT	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.0		0.2	0.1
Total Del/Veh (s)	2.0	0.7	0.9	1.3	0.4		6.7	2.2

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	3.9	2.6	0.7	0.3	0.0	0.0	1.3
Total Del/Veh (s)	35.1	30.6	19.5	16.2	7.3	2.4	20.4

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.1	0.2	0.2	0.2	0.0	0.0	0.1
Total Del/Veh (s)	5.0	3.5	0.2	0.1	2.8	0.6	1.2

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	NEL	All
Denied Del/Veh (s)		0.7	0.2	0.2	0.2	0.5
Total Del/Veh (s)		1.0	0.9	0.2	16.3	1.9

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.4	0.3	0.2			0.1	0.3
Total Del/Veh (s)	2.9	2.5	0.8			4.5	2.2

Total Network Performance

Denied Del/Veh (s)	0.9
Total Del/Veh (s)	21.2

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	30.6	60.0	62.1	19.6	17.0
Average Queue (m)	15.0	34.3	38.3	14.3	5.1
95th Queue (m)	28.9	65.2	66.3	23.1	16.0
Link Distance (m)	211.8	113.9	113.9		
Upstream Blk Time (%)					0
Queuing Penalty (veh)					0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 19: Bay Bulls Rd

Movement	NB	NB	NB
Directions Served	T	T	R
Maximum Queue (m)	43.8	63.3	29.0
Average Queue (m)	4.4	7.8	2.9
95th Queue (m)	45.6	64.2	36.3
Link Distance (m)	148.7	148.7	148.7
Upstream Blk Time (%)	0	0	0
Queuing Penalty (veh)	0	2	0
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	WB	NB	NB	B1	SB	SB	SB
Directions Served	L	R	T	TR	T	L	T	T
Maximum Queue (m)	4.5	16.5	69.2	79.2	0.8	41.8	14.1	13.3
Average Queue (m)	0.9	2.9	31.4	37.2	0.1	23.0	2.9	2.5
95th Queue (m)	5.0	14.4	66.0	76.6	1.4	41.4	12.0	11.1
Link Distance (m)	15.6	15.6	123.5	123.5	109.8		148.7	148.7
Upstream Blk Time (%)		0						
Queuing Penalty (veh)		1						
Storage Bay Dist (m)						60.0		
Storage Blk Time (%)						0		
Queuing Penalty (veh)						0		

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	11.9	6.8	21.9
Average Queue (m)	2.4	0.8	13.1
95th Queue (m)	9.8	7.5	20.9
Link Distance (m)	15.6	213.0	76.2
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	0		
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB	SB
Directions Served	L	LR	LT	T	T	TR
Maximum Queue (m)	52.3	92.0	106.5	83.9	25.0	20.9
Average Queue (m)	45.0	84.4	66.4	49.8	14.8	10.2
95th Queue (m)	69.6	105.9	107.7	89.8	26.7	21.8
Link Distance (m)		86.8	131.5	131.5	109.8	109.8
Upstream Blk Time (%)		20	0			
Queuing Penalty (veh)		0	0			
Storage Bay Dist (m)	50.0					
Storage Blk Time (%)	2	37				
Queuing Penalty (veh)	5	121				

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	17.0	11.9
Average Queue (m)	9.5	2.7
95th Queue (m)	15.7	10.4
Link Distance (m)	218.6	134.5
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NB	NE
Directions Served	LT	L
Maximum Queue (m)	0.9	10.6
Average Queue (m)	0.1	2.7
95th Queue (m)	1.6	9.5
Link Distance (m)	259.8	236.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	26.0	13.9
Average Queue (m)	7.4	8.1
95th Queue (m)	22.9	14.8
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 130

4: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	NBT	All
Denied Del/Veh (s)	0.0	0.0
Total Del/Veh (s)	1.3	1.3

10: Bay Bulls Rd & PM Dr Ramp Performance by movement

Movement	WBL	WBR	NBT	SBT	All
Denied Del/Veh (s)	0.5	0.4	0.0	10.7	5.1
Total Del/Veh (s)	23.7	6.2	12.5	7.2	11.7

19: Bay Bulls Rd Performance by movement

Movement	NBT	NBR	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Del/Veh (s)	3.1	3.1	3.5	3.3

20: Bay Bulls Rd & Old Petty Harbour Rd Performance by movement

Movement	WBL	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	31.2	0.2	0.6	12.0	8.7	14.2	3.3	8.0

30: Old Petty Harbour Rd & Huntingdale Dr Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.1	0.1	0.1	0.0	0.2	0.2	0.1
Total Del/Veh (s)	1.7	0.9	0.9	1.7	9.3	4.4	1.3

40: Bay Bulls Rd & PittsMem Ramps Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.4	0.5	0.3	0.1	0.1	0.0	0.2
Total Del/Veh (s)	21.7	17.0	24.0	11.0	9.9	6.9	12.3

50: Old Petty Harbour Rd & Densmores Ln Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Del/Veh (s)	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Total Del/Veh (s)	7.1	2.7	0.2	0.1	2.5	0.9	1.3

60: Old Bay Bulls Rd & Bay Bulls Rd Performance by movement

Movement	NBT	SBT	SBR	NEL	NER	All
Denied Del/Veh (s)	0.3	0.9	0.9	0.1	4.6	0.7
Total Del/Veh (s)	0.5	4.0	1.7	30.8	10.4	3.6

70: Bay Bulls Rd & Old Bay Bulls Rd Performance by movement

Movement	NBL	NBT	SBT	SBR	SEL	SER	All
Denied Del/Veh (s)	0.3	0.3	0.3	0.8		0.1	0.3
Total Del/Veh (s)	3.8	1.7	1.5	0.9		8.4	2.7

Total Network Performance

Denied Del/Veh (s)	2.6
Total Del/Veh (s)	18.8

Intersection: 4: Bay Bulls Rd & PM Dr Ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Bay Bulls Rd & PM Dr Ramp

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	T	T	T
Maximum Queue (m)	73.5	54.6	59.1	24.1	19.7
Average Queue (m)	45.8	29.2	35.2	19.3	16.9
95th Queue (m)	74.7	52.9	58.5	22.6	22.8
Link Distance (m)	211.8	113.9	113.9		
Upstream Blk Time (%)				1	0
Queuing Penalty (veh)				0	0
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 19: Bay Bulls Rd

Movement	NB
Directions Served	T
Maximum Queue (m)	15.2
Average Queue (m)	1.5
95th Queue (m)	26.5
Link Distance (m)	148.7
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 20: Bay Bulls Rd & Old Petty Harbour Rd

Movement	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (m)	13.0	1.6	51.1	58.4	58.2	60.2	48.7
Average Queue (m)	5.4	0.2	27.1	32.2	36.1	14.7	14.1
95th Queue (m)	14.7	2.7	50.9	59.9	62.0	55.3	44.5
Link Distance (m)	15.6	15.6	123.5	123.5		148.7	148.7
Upstream Blk Time (%)	2	0					
Queuing Penalty (veh)	3	0					
Storage Bay Dist (m)					60.0		
Storage Blk Time (%)					2	0	
Queuing Penalty (veh)					11	1	

Intersection: 30: Old Petty Harbour Rd & Huntingdale Dr

Movement	EB	NB	SB
Directions Served	LR	LT	TR
Maximum Queue (m)	16.9	8.9	18.4
Average Queue (m)	5.2	1.3	9.3
95th Queue (m)	16.4	7.4	17.3
Link Distance (m)	15.6	213.0	76.2
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	3		
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 40: Bay Bulls Rd & PittsMem Ramps

Movement	EB	EB	NB	NB	SB	SB
Directions Served	L	LR	LT	T	T	TR
Maximum Queue (m)	45.3	66.8	59.6	41.0	59.9	62.6
Average Queue (m)	8.8	41.4	30.4	14.9	39.0	40.5
95th Queue (m)	37.1	66.9	57.2	37.4	60.7	63.8
Link Distance (m)		86.8	131.5	131.5	109.8	109.8
Upstream Blk Time (%)		0				
Queuing Penalty (veh)		0				
Storage Bay Dist (m)	50.0					
Storage Blk Time (%)	0	4				
Queuing Penalty (veh)	0	6				

Intersection: 50: Old Petty Harbour Rd & Densmores Ln

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (m)	13.8	12.8
Average Queue (m)	8.2	2.8
95th Queue (m)	14.6	11.1
Link Distance (m)	218.6	134.5
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 60: Old Bay Bulls Rd & Bay Bulls Rd

Movement	NE	NE
Directions Served	L	R
Maximum Queue (m)	13.2	6.7
Average Queue (m)	3.1	1.3
95th Queue (m)	13.5	6.4
Link Distance (m)	236.8	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		25.0
Storage Blk Time (%)	1	
Queuing Penalty (veh)	0	

Intersection: 70: Bay Bulls Rd & Old Bay Bulls Rd

Movement	NB	SE
Directions Served	LT	LR
Maximum Queue (m)	21.5	23.1
Average Queue (m)	7.9	13.5
95th Queue (m)	20.3	22.1
Link Distance (m)	141.3	360.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 24

APPENDIX D

Floodplain Analysis

CBCL LIMITED
Consulting Engineers

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We are a professional team working together, to provide quality services that satisfy our customers, and contribute to our mutual success.

ISO 9001
Registered Company

MEMORANDUM

DATE: JUNE 16, 2015

PROJECT NO: 143046.01

MEMO TO	Greg Sheppard, P.Eng.
PROJECT NAME	Kilbride Land Use Study
SUBJECT	East Kilbride Development Area Flood Plain Analysis
FROM	Yanzhen Ou, M.ASc., M.Eng P.Eng Alex Wilson, M.Eng P. Eng,.
COPIES TO	

The scope of work for this study is to assemble hydrologic and hydraulic models to reflect potential future land uses, and to prepare floodplain maps for the 1:100 AEP event for future development conditions in East Kilbride area. There are four major brooks in this study which has been included in Figure 1.

Data Collection and Floodplain Cross Sections:
The following data was collected and reviewed for the floodplain mapping study:

- LiDAR mapping of the Study Area at 3m resolution;
- Brooks cross-sections from survey; and
- Hydraulic structure measurements obtained from field investigations.

The cross sections were produced generally every 200m. The LiDAR data was used to obtain the cross-section data in the brook floodplain. Survey data was used to estimate the brook portion of each cross section where the LiDAR data is intercepted by the surface of the water and becomes unreliable. Finalised floodplain cross sections used in the model were therefore a combination of the LiDAR data and the Brook channel survey data.

Watershed Delineation and Watershed Properties:
Watershed delineations was performed using 3m resolution LiDAR data along these brooks. Maps of the watershed delineations are presented in Figure 2 and 3.

Watershed characteristics were estimated for each sub-watershed and are presented in Table 1.

Design Hyetograph:
The alternating block method was used to estimate a synthetic hyetograph shape which including climate change impacts to precipitation. Figure 4 illustrates the 1:100 AEP hyetographs.

Table 1: Watershed Characteristics

NAME	AREA (ha)	WIDTH (m)	SLOPE (%)	PERCENT IMPERV. (%)	SURFACE ROUGHNESS IMPERV.	SURFACE ROUGHNESS PERV.	SUCTION HEAD (mm)	HYDRAULIC CONDUCTIVITY (mm/hr)
S1	6.91	142.82	7.60	80.00	0.02	0.50	200	0.001
S10	5.75	85.55	9.40	80.00	0.02	0.50	200	0.001
S11	6.41	99.98	8.70	80.00	0.02	0.50	200	0.001
S12	1.79	39.88	9.00	80.00	0.02	0.50	200	0.001
S14	4.04	182.36	6.20	80.00	0.02	0.50	200	0.001
S15	16.73	249.50	8.40	80.00	0.02	0.50	200	0.001
S16	0.74	85.10	4.60	80.00	0.02	0.50	200	0.001
S17	2.92	127.89	7.60	80.00	0.02	0.50	200	0.001
S18	3.26	87.23	8.40	80.00	0.02	0.50	200	0.001
S19	1.65	72.64	10.00	80.00	0.02	0.50	200	0.001
S2	4.46	103.05	5.90	80.00	0.02	0.50	200	0.001
S20	9.00	100.38	6.10	80.00	0.02	0.50	200	0.001
S21	9.48	235.82	6.30	80.00	0.02	0.50	200	0.001
S22	79.10	417.89	2.40	80.00	0.02	0.50	200	0.001
S23	7.80	209.26	5.00	80.00	0.02	0.50	200	0.001
S24	12.10	350.19	7.10	80.00	0.02	0.50	200	0.001
S25	17.25	243.29	4.20	80.00	0.02	0.50	200	0.001
S26	64.74	613.43	3.10	80.00	0.02	0.50	200	0.001
S27	27.02	310.87	6.80	80.00	0.02	0.50	200	0.001
S28	6.24	168.26	2.50	80.00	0.02	0.50	200	0.001
S29	2.05	179.50	1.60	80.00	0.02	0.50	200	0.001
S3	6.86	207.00	8.70	80.00	0.02	0.50	200	0.001
S4	1.30	101.33	9.40	80.00	0.02	0.50	200	0.001
S5	0.30	47.49	6.10	80.00	0.02	0.50	200	0.001
S6	7.70	216.63	10.00	80.00	0.02	0.50	200	0.001
S7	1.86	85.84	13.90	80.00	0.02	0.50	200	0.001
S8	0.47	52.89	10.30	80.00	0.02	0.50	200	0.001
S9	3.22	79.41	5.30	80.00	0.02	0.50	200	0.001

Hydrologic/ Hydraulic Analysis:

The modeling software XPSWMM, Version 13 (with Service Pack 1 installed), was used to create a hydrologic model of the Study Area. The 1:100 AEP flood flows for brooks were estimated under the calculated design event.

The purpose of the hydraulic analysis is to translate the 1:100 AEP flood flows, estimated during the hydrologic analysis, into floodplain mapping. Hydraulic modeling was carried out using 1D XPSWMM model.

Model Assumptions and Limitation:

- It was assumed that the upstream lake doesn't contribute any flow into these brooks;

- At the brook sections without survey, it was assumed that the channel has the same shape as the closest one which has survey information; and
- The downstream boundary water levels for Brook 3 and 4 were obtained from the Kilbride Brook Flood Study which was performed by CBCL in 2002.

Floodplain Mapping:

Maps 2 and 3, of Appendix A, contain the floodplain mapping for the 1:100 AEP flood events for the future development conditions.

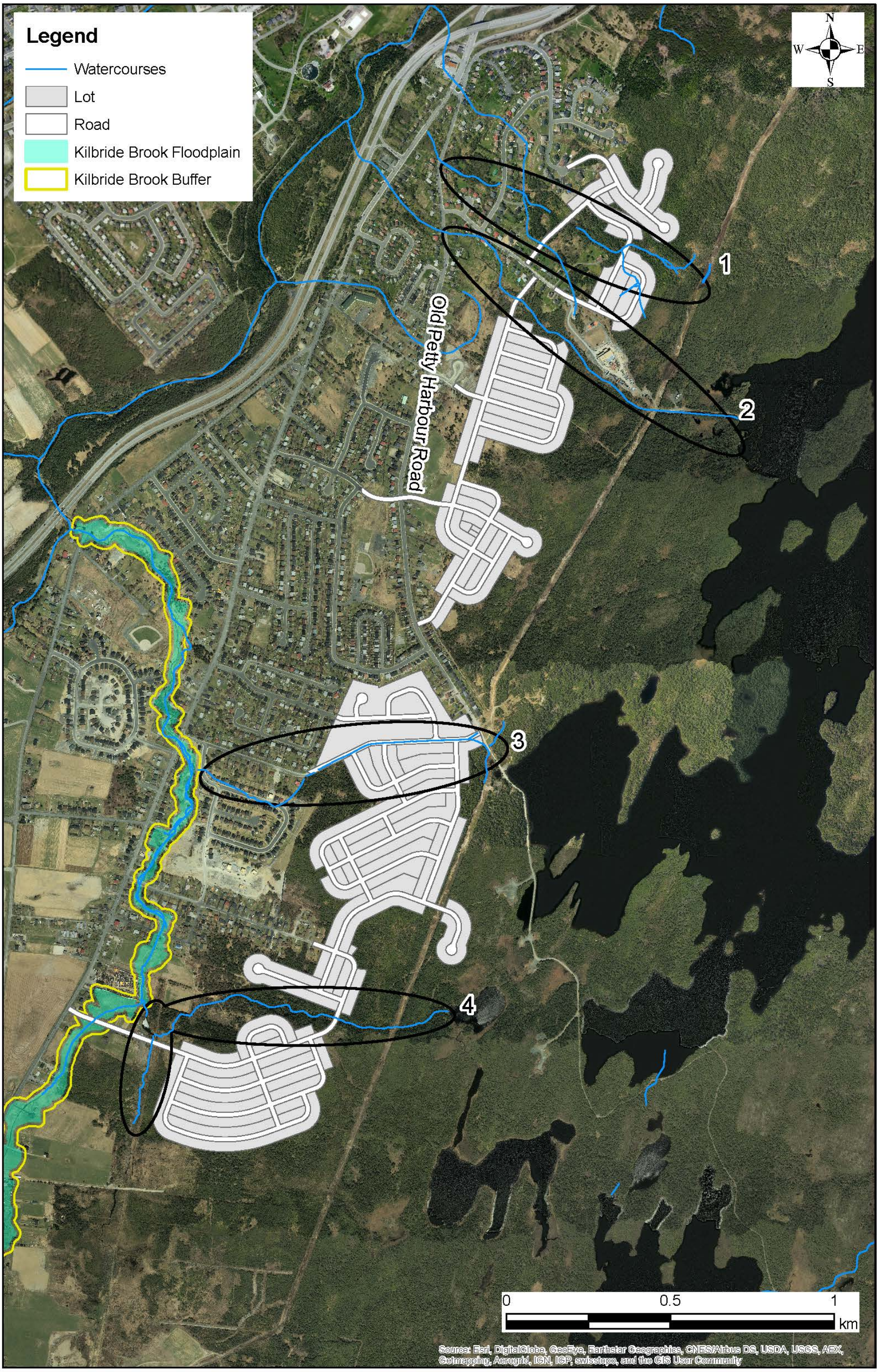

Figure 1: Study Area

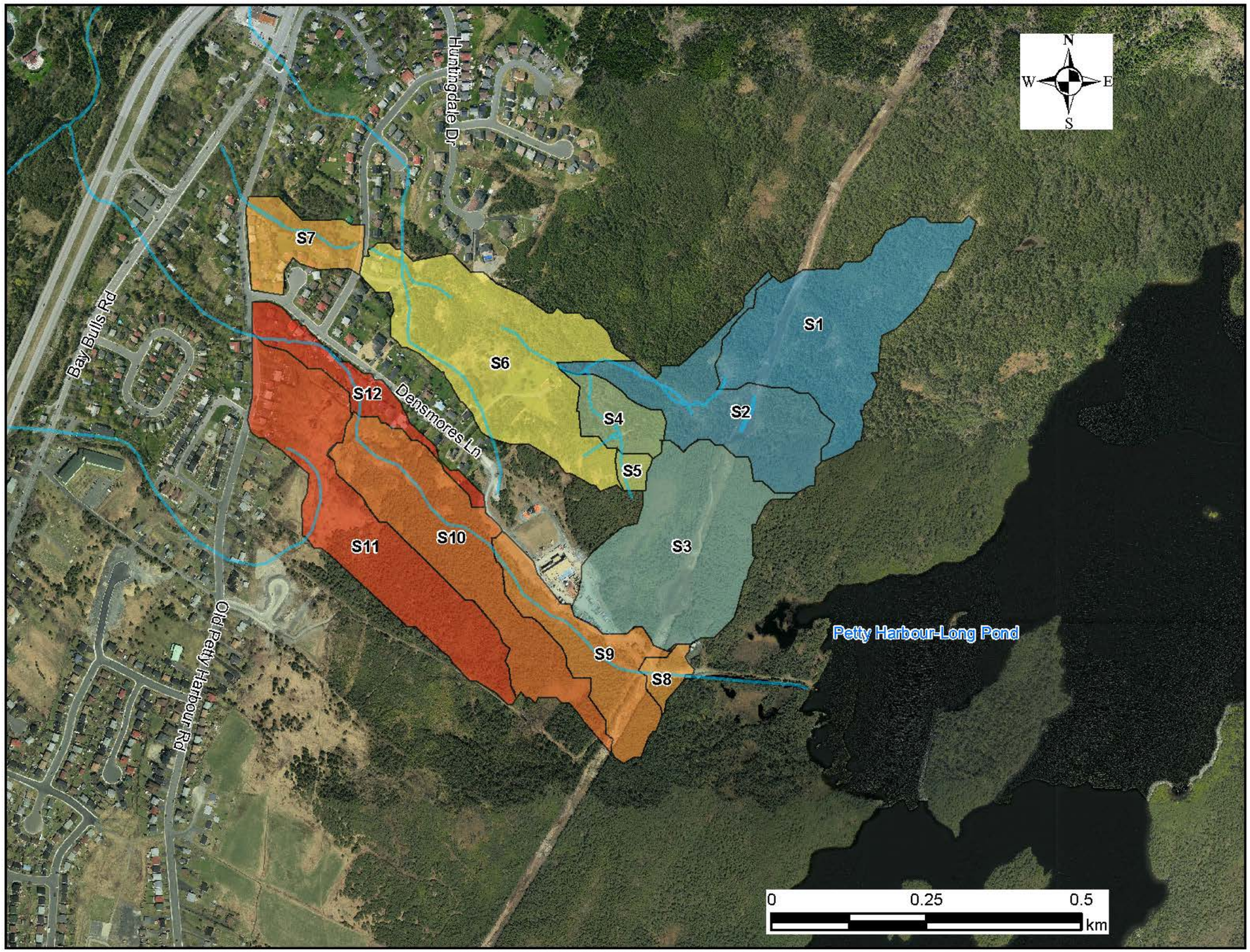

Figure 2: Watersheds Delineation for Brook 1 and 2

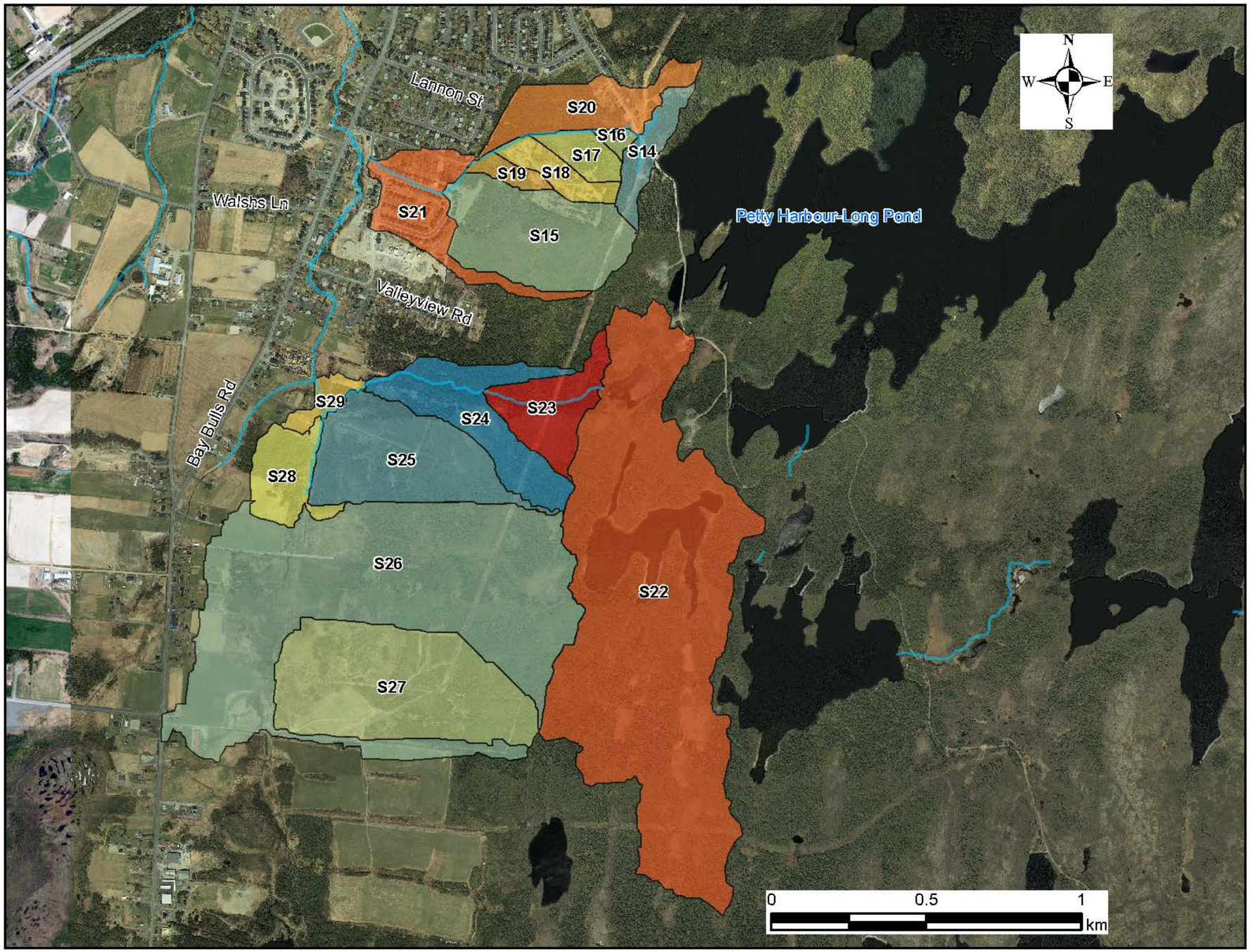

Figure 3: Watersheds Delineation for Brook 3 and 4

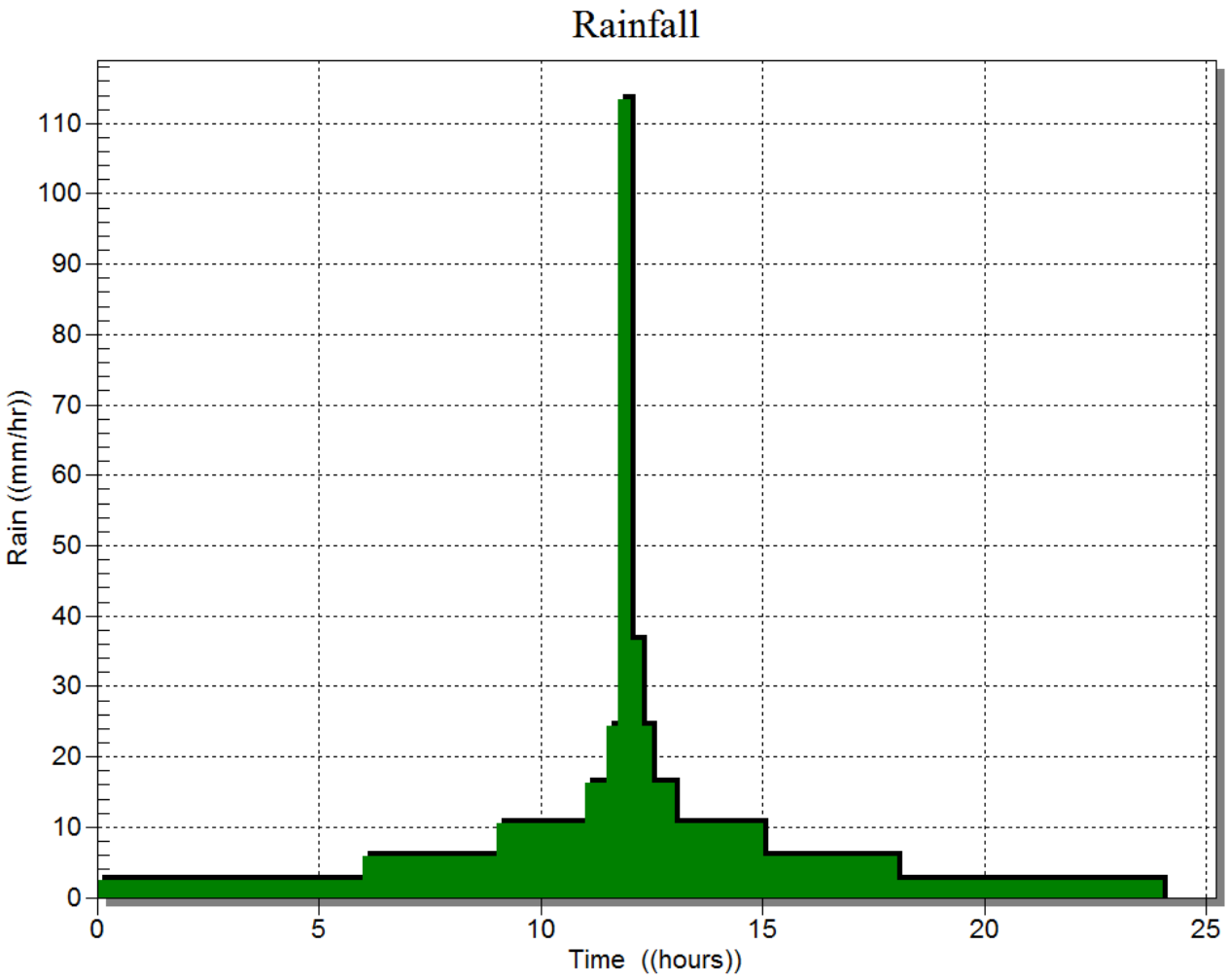

Figure 4: 1:100 AEP Hyetograph

APPENDIX E

Cost Estimates

Class 'D' Cost Estimate

Project: East Kilbride Water Transmission and Storage Infrastructure
Date: March 31, 2016
Prepared by: CBCL Limited

The section numbers correspond to the City of St. John's Construction Specifications Book.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
153	MOBILIZATION/DEMOBILIZATION	LS	1	$500,000.00	$500,000
211	TRENCH EXCAVATION				
	SR	CM	8000	$65.00	$520,000
	OM	CM	8000	$30.00	$240,000
	Bedding	CM	4600	$45.00	$207,000
	Marker Tape	LM	5180	$3.00	$15,540
223	MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS				
	Pressure Reducing Valve Chamber Complete	EA	1	$350,000.00	$350,000
	Air Release/Vacuum Valve Chamber Complete	EA	8	$15,000.00	$120,000
230	WATERMAINS				
	Connection to Existing Main	LS	3	$2,500.00	$7,500
	Pipe and Fittings, 400mm PVC, DR18	LM	5180	$850.00	$4,403,000
	Butterfly Valves - 400mm	EA	10	$12,500.00	$125,000
311	CLEARING AND GRUBBING	HA	40	$20,000.00	$800,000
321	STREET EXCAVATION				
	SR	CM	6000	$35.00	$210,000
	OM	CM	14000	$15.00	$210,000
	Asphalt Removal	SM	3200	$5.00	$16,000
322	BORROW				
	Gravel Borrow	CM	5000	$12.00	$60,000
323	GRAVEL FOR STREETS				
	Granular "A"	TONNE	800	$22.00	$17,600
	Granular "B"	TONNE	1600	$20.00	$32,000
351	HOT MIX ASPHALTIC CONCRETE				
	Surface Courses	TONNE	350	$160.00	$56,000
	Base Courses	TONNE	350	$160.00	$56,000
OTHER	NEW PUMP HOUSE				
	Site, Building, Mech & Elec Complete	LS	1	$1,800,000.00	$1,800,000
OTHER	NEW STORAGE TANKS				
	3.5 ML Bolted Steel Tank Complete	LS	2	$1,400,000.00	$2,800,000

Class 'D' Cost Estimate

Project: East Kilbride Water Transmission and Storage Infrastructure
Date: March 31, 2016
Prepared by: CBCL Limited

The section numbers correspond to the City of St. John's Construction Specifications Book.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
OTHER	**NEW STORAGE TANKS CONTROL BUILDING**				
	Site, Building Complete	**LS**	**1**	**$500,000.00**	**$500,000**
OTHER	**DECONSTRUCT EXISTING SHEA HTS PUMP HOUSE**				
	Pumps, piping and all building components	**LS**	**1**	**$100,000.00**	**$100,000**
OTHER	**DECONSTRUCT EXISTING SHEA HTS STORAGE TANK**				
	Tank and piping	**LS**	**1**	**$250,000.00**	**$250,000**

Subtotal =	$13,395,640
Contingency (10%) =	$1,339,564
Engineering (15%) =	$2,210,281
Subtotal =	$16,945,485
HST (13%) =	$2,202,913
TOTAL =	**$19,148,398**
BUDGET =	**$19,200,000**

This opinion of probable costs is presented on the basis of experience, qualifications and best judgement. It has been prepared in accordance with acceptable principles and practices. Sudden market trend changes, non-competitive bidding situations, unforeseen labour and material adjustments and the like are beyond the control of CBCL Limited. We cannot warrant or guarantee that actual costs will not vary significantly from the opinion provided.

Class 'D' Cost Estimate

Project: East Kilbride Sanitary Sewer-Bay Bulls Rd
Date: March 31, 2015
Prepared by: CBCL Limited

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

CBCL LIMITED
Consulting Engineers

The section numbers correspond to the City of St. John's Construction Specifications Book.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
153	MOBILIZATION/DEMOBILIZATION	LS	1	$80,000.00	$80,000
211	TRENCH EXCAVATION				
	SR	CM	1600	$65.00	$104,000
	OM	CM	3200	$30.00	$96,000
	Bedding	CM	700	$45.00	$31,500
	Marker Tape	LM	615	$3.00	$1,845
221	SANITARY SEWER				
	Connection to Existing Main	LS	1	$2,500.00	$2,500
	Pipe, 750mm Concrete CL 140D	LM	300	$590.00	$177,000
	Pipe, 600mm Concrete CL 140D	LM	315	$430.00	$135,450
223	MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS				
	1800mm Dia Manhole	EA	7	$15,000.00	$105,000
321	STREET EXCAVATION				
	Asphalt Removal	SM	2100	$5.00	$10,500
322	BORROW				
	Gravel Borrow	CM	500	$12.00	$6,000
323	GRAVEL FOR STREETS				
	Granular "A"	TONNE	520	$22.00	$11,440
	Granular "B"	TONNE	1040	$20.00	$20,800
351	HOT MIX ASPHALTIC CONCRETE				
	Surface Courses	TONNE	225	$160.00	$36,000
	Base Courses	TONNE	225	$160.00	$36,000
530	REINSTATEMENT				
	Gravel Driveways	SM	65	$5.00	$325
	Asphalt Driveways	SM	70	$30.00	$2,100

Subtotal =	$856,460
Contingency (15%) =	$128,469
Engineering (15%) =	$147,739
Subtotal =	$1,132,668
HST (13%) =	$147,247
TOTAL =	**$1,279,915**
BUDGET =	**$1,300,000**

Class 'D' Cost Estimate

Project: East Kilbride Sanitary Sewer-Bay Bulls Rd
Date: March 31, 2015
Prepared by: CBCL Limited

The section numbers correspond to the City of St. John's Construction Specifications Book.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL

This opinion of probable costs is presented on the basis of experience, qualifications and best judgement. It has been prepared in accordance with acceptable principles and practices. Sudden market trend changes, non-competitive bidding situations, unforeseen labour and material adjustments and the like are beyond the control of CBCL Limited. We cannot warrant or guarantee that actual costs will not vary significantly from the opinion provided.

Class 'D' Cost Estimate

Project: East Kilbride Sanitary Sewer-Densmore's Lane Twinning
Date: March 31, 2015
Prepared by: CBCL Limited

The section numbers correspond to the City of St. John's Construction Specifications Book.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
153	MOBILIZATION/DEMOBILIZATION	LS	1	$25,000.00	$25,000
211	TRENCH EXCAVATION				
	SR	CM	400	$65.00	$26,000
	OM	CM	700	$30.00	$21,000
	Bedding	CM	200	$45.00	$9,000
	Marker Tape	LM	360	$3.00	$1,080
221	SANITARY SEWER				
	Connection to Existing Manhole	LS	1	$2,500.00	$2,500
	Sewer, 200mm PVC DR35	LM	360	$90.00	$32,400
223	MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS				
	1200mm Dia Manhole	EA	6	$8,000.00	$48,000
321	STREET EXCAVATION				
	Asphalt Removal	SM	1100	$5.00	$5,500
322	BORROW				
	Gravel Borrow	CM	200	$12.00	$2,400
323	GRAVEL FOR STREETS				
	Granular "A"	TONNE	275	$22.00	$6,050
	Granular "B"	TONNE	545	$20.00	$10,900
351	HOT MIX ASPHALTIC CONCRETE				
	Surface Courses	TONNE	120	$160.00	$19,200
	Base Courses	TONNE	120	$160.00	$19,200
530	REINSTATEMENT				
	Asphalt Driveways	SM	85	$30.00	$2,550

Subtotal =	$230,780
Contingency (10%) =	$23,078
Engineering (15%) =	$38,079
Subtotal =	$291,937
HST (13%) =	$37,952
TOTAL =	**$329,888**
BUDGET =	**$400,000**

Class 'D' Cost Estimate

Project: East Kilbride Sanitary Sewer-Densmore's Lane Twinning
Date: March 31, 2015
Prepared by: CBCL Limited

The section numbers correspond to the City of St. John's Construction Specifications Book.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL

This opinion of probable costs is presented on the basis of experience, qualifications and best judgement. It has been prepared in accordance with acceptable principles and practices. Sudden market trend changes, non-competitive bidding situations, unforeseen labour and material adjustments and the like are beyond the control of CBCL Limited. We cannot warrant or guarantee that actual costs will not vary significantly from the opinion provided.

Preliminary Cost Estimate
Stormwater Detention Pond #1
East Kilbride Area Comprehensive Development Plan
February 9, 2018

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

CBCL LIMITED
Consulting Engineers

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
211	**TRENCH EXCAVATION**				
	Solid Rock	CM	50	$75.00	$3,750
	Other Material	CM	325	$15.00	$4,875
	Bedding (Granular 'B')	CM	80	$50.00	$4,000
222	**STORM SEWER**				
	450mm PVC	LM	100	$300.00	$30,000
223	**MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS**				
	Hydraulic Control Structures	EA	2	$12,000.00	$24,000
	Headwall	EA	2	$10,000.00	$20,000
311	**CLEARING AND GRUBBING**				
	Clearing	HA	1.00	$10,000.00	$10,000
	Grubbing	HA	1.00	$10,000.00	$10,000
322	**BORROW**				
	Gravel Borrow	CM	3,900	$22.00	$85,800
323	**GRAVEL FOR STREETS**				
	Maintenance Grade No. 1	t	50	$22.00	$1,100
324	**EXCAVATION FOR DITCHES**				
	Other Material	CM	250	$20.00	$5,000
417	**HYDRAULIC RIP-RAP**				
	Class 1	CM	40	$75.00	$3,000

This opinion of probable costs is presented on the basis of experience, qualifications and best judgement. It has been prepared in accordance with acceptable principles and practices. Sudden market trend changes, non-competitive bidding situations, unforeseen labour and material adjustments and the like are beyond the control of CBCL Limited. We cannot warrant or guarantee that actual costs will not vary significantly from the opinion provided.

Subtotal =	$197,775
Contingency (20%) =	$39,555
Subtotal =	$237,330
Engineering (15%) =	$35,600
Subtotal =	$272,930
HST (15%) =	$40,939
TOTAL =	$313,869
BUDGET =	$310,000

Preliminary Cost Estimate
Stormwater Detention Pond #2
East Kilbride Area Comprehensive Development Plan
February 9, 2018

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

CBCL LIMITED
Consulting Engineers

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
211	**TRENCH EXCAVATION**				
	Solid Rock	CM	100	$75.00	$7,500
	Other Material	CM	500	$15.00	$7,500
	Bedding (Granular 'B')	CM	100	$50.00	$5,000
222	**STORM SEWER**				
	450mm PVC	LM	125	$300.00	$37,500
223	**MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS**				
	Hydraulic Control Structures	EA	2	$12,000.00	$24,000
	Headwall	EA	1	$10,000.00	$10,000
	Manhole	EA	1	$10,000.00	$10,000
311	**CLEARING AND GRUBBING**				
	Clearing	HA	1.25	$10,000.00	$12,500
	Grubbing	HA	1.25	$10,000.00	$12,500
321	**STREET EXCAVATION**				
	Solid Rock	CM	2,000	$50.00	$100,000
	Other Material	CM	20,500	$15.00	$307,500
322	**BORROW**				
	Gravel Borrow	CM	6,400	$22.00	$140,800
417	**HYDRAULIC RIP-RAP**				
	Class 1	CM	20	$75.00	$1,500

This opinion of probable costs is presented on the basis of experience, qualifications and best judgement. It has been prepared in accordance with acceptable principles and practices. Sudden market trend changes, non-competitive bidding situations, unforeseen labour and material adjustments and the like are beyond the control of CBCL Limited. We cannot warrant or guarantee that actual costs will not vary significantly from the opinion provided.

Subtotal =	$668,800
Contingency (20%) =	$133,760
Subtotal =	$802,560
Engineering (15%) =	$120,384
Subtotal =	$922,944
HST (15%) =	$138,442
TOTAL =	$1,061,386
BUDGET =	$1,060,000

Preliminary Cost Estimate
Stormwater Detention Pond #3
East Kilbride Area Comprehensive Development Plan
February 9, 2018

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

CBCL LIMITED
Consulting Engineers

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
211	**TRENCH EXCAVATION**				
	Solid Rock	CM	50	$75.00	$3,750
	Other Material	CM	375	$15.00	$5,625
	Bedding (Granular 'B')	CM	80	$50.00	$4,000
222	**STORM SEWER**				
	450mm PVC	LM	100	$300.00	$30,000
223	**MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS**				
	Hydraulic Control Structures	EA	2	$12,000.00	$24,000
	Headwall	EA	1	$10,000.00	$10,000
	Headwall	EA	1	$10,000.00	$10,000
311	**CLEARING AND GRUBBING**				
	Clearing	HA	1.30	$10,000.00	$13,000
	Grubbing	HA	1.30	$10,000.00	$13,000
321	**STREET EXCAVATION**				
	Solid Rock	CM	1,500	$50.00	$75,000
	Other Material	CM	15,500	$15.00	$232,500
322	**BORROW**				
	Gravel Borrow	CM	4,500	$22.00	$99,000
417	**HYDRAULIC RIP-RAP**				
	Class 1	CM	30	$75.00	$2,250

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Subtotal =	$518,375
Contingency (20%) =	$103,675
Subtotal =	$622,050
Engineering (15%) =	$93,308
Subtotal =	$715,358
HST (15%) =	$107,304
TOTAL =	$822,661
BUDGET =	$820,000

Preliminary Cost Estimate
Stormwater Detention Pond #4
East Kilbride Area Comprehensive Development Plan
February 9, 2018

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

CBCL LIMITED
Consulting Engineers

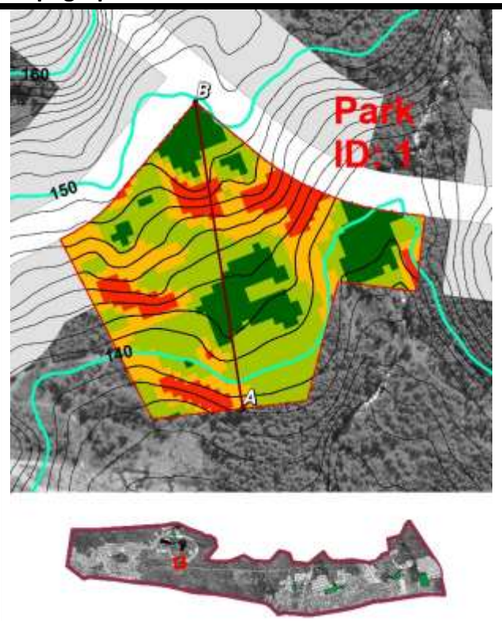
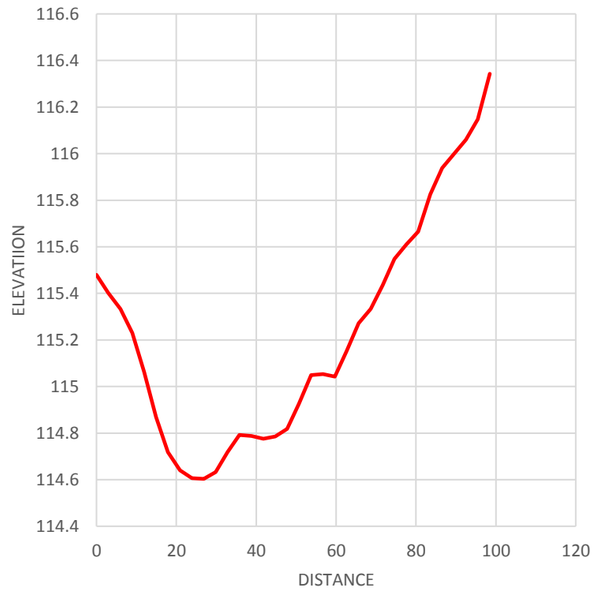
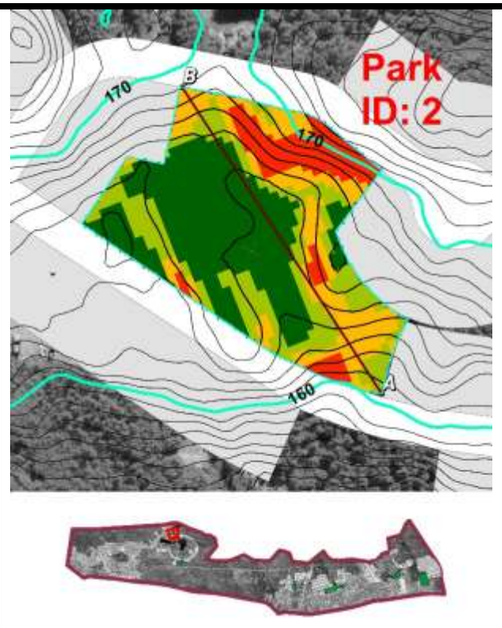
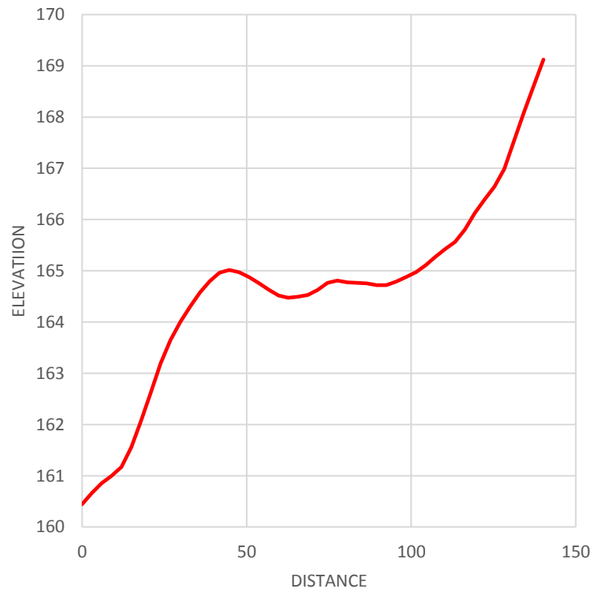
SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
211	**TRENCH EXCAVATION**				
	Solid Rock	CM	100	$75.00	$7,500
	Other Material	CM	550	$15.00	$8,250
	Bedding (Granular 'B')	CM	135	$50.00	$6,750
222	**STORM SEWER**				
	450mm PVC	LM	165	$300.00	$49,500
223	**MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS**				
	Hydraulic Control Structures	EA	2	$12,000.00	$24,000
	Manhole	EA	2	$10,000.00	$20,000
311	**CLEARING AND GRUBBING**				
	Clearing	HA	1.00	$10,000.00	$10,000
	Grubbing	HA	1.00	$10,000.00	$10,000
321	**STREET EXCAVATION**				
	Solid Rock	CM	2,500	$50.00	$125,000
	Other Material	CM	23,500	$15.00	$352,500
322	**BORROW**				
	Gravel Borrow	CM	2,250	$22.00	$49,500
417	**HYDRAULIC RIP-RAP**				
	Class 1	CM	75	$75.00	$5,625

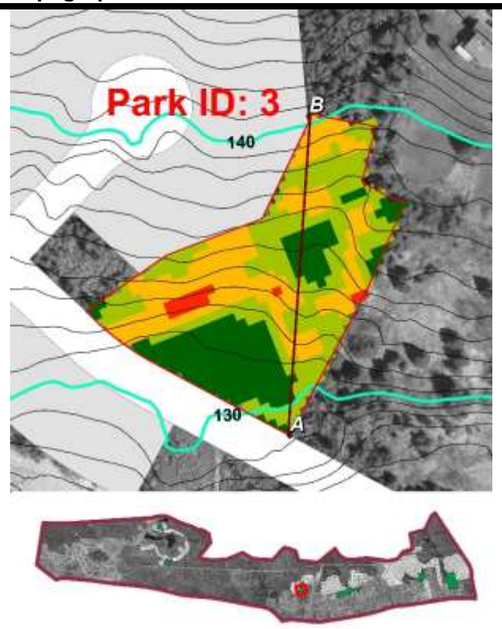
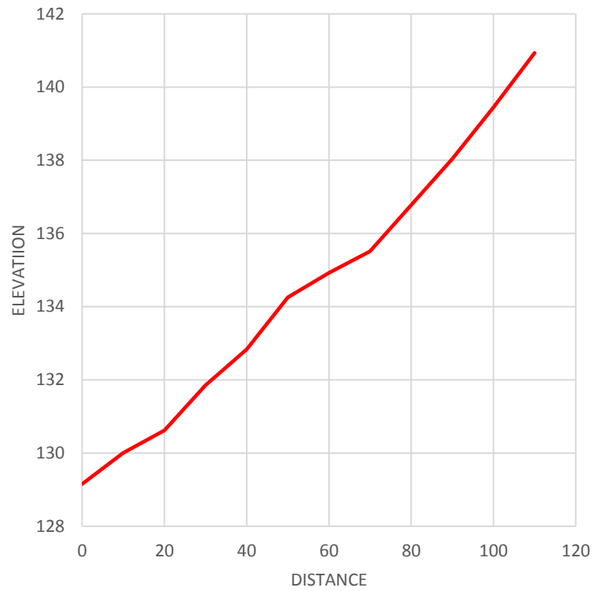
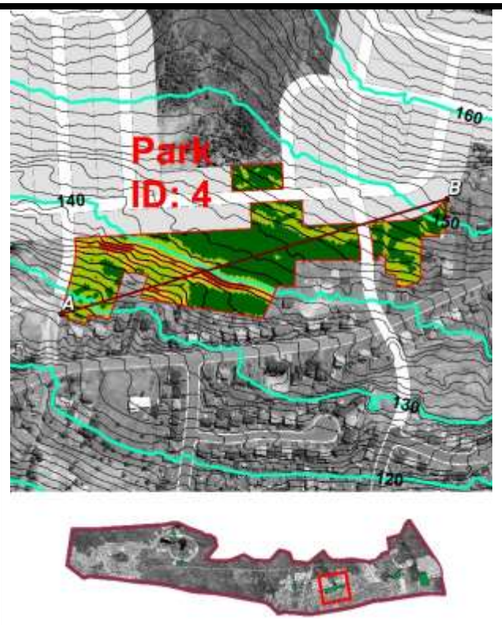
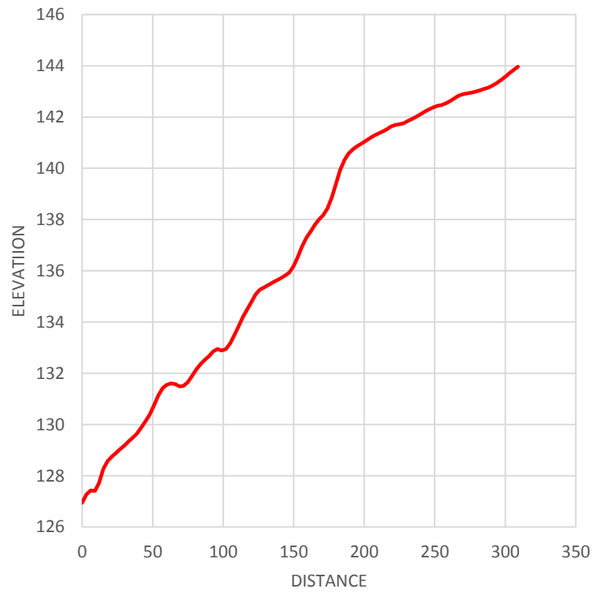
This opinion of probable costs is presented on the basis of experience, qualifications and best judgement. It has been prepared in accordance with acceptable principles and practices. Sudden market trend changes, non-competitive bidding situations, unforeseen labour and material adjustments and the like are beyond the control of CBCL Limited. We cannot warrant or guarantee that actual costs will not vary significantly from the opinion provided.

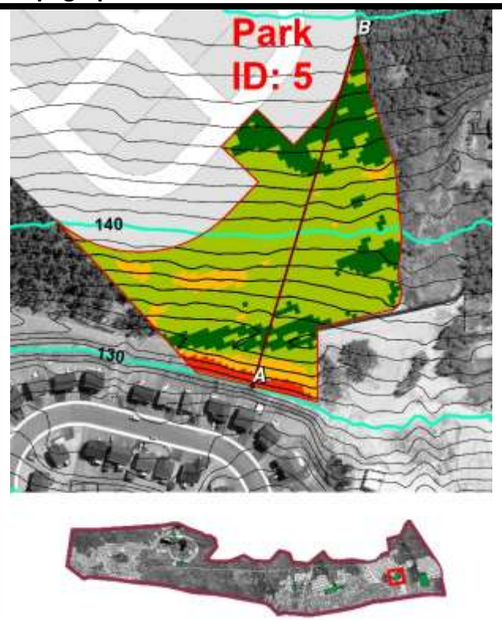
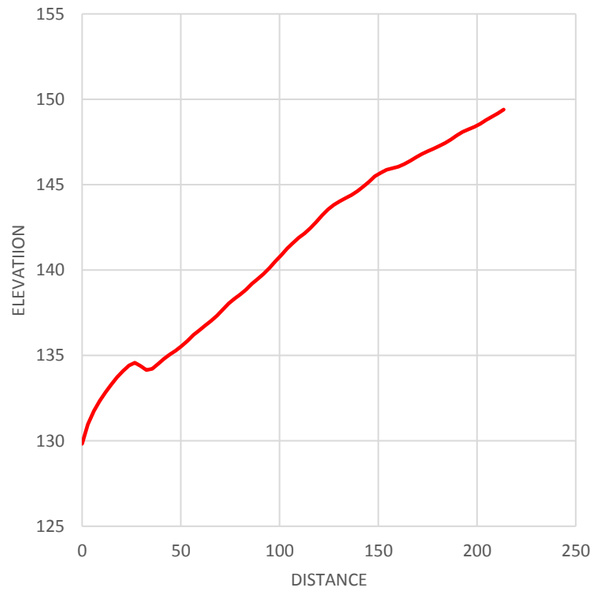
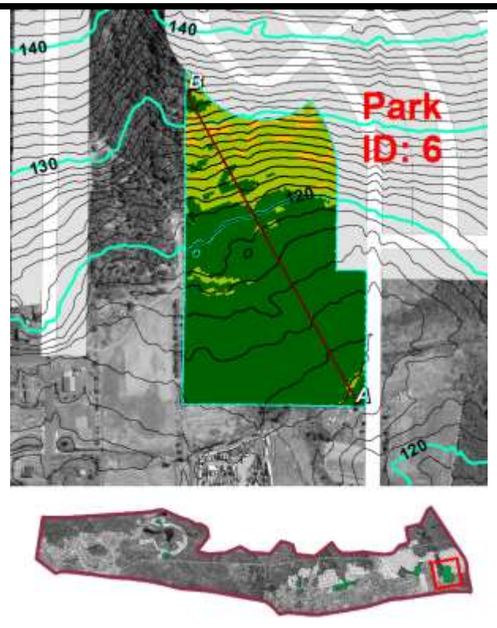
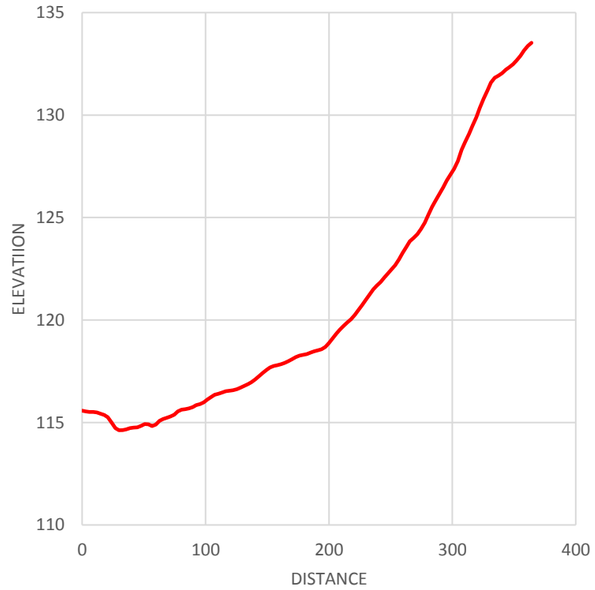
Subtotal =	$661,125
Contingency (20%) =	$132,225
Subtotal =	$793,350
Engineering (15%) =	$119,003
Subtotal =	$912,353
HST (15%) =	$136,853
TOTAL =	$1,049,205
BUDGET =	$1,050,000

APPENDIX F

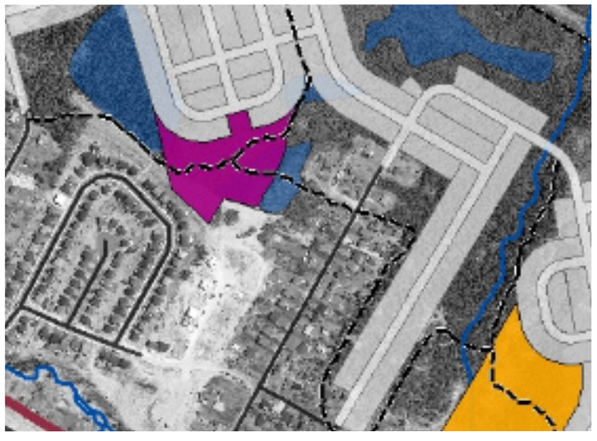
Park and Open Space Summary

Park ID	Type	Size	Street Frontage	Min/Max Elevation	Percent Slope		Topographic Overview	Profile (A to B)
1	Neighbourhood Park	1 ha	180m	137/150m	0-8%	20%		
					8-14%	41%		
					14-20%	27%		
					20+%	12%		
2	Neighbourhood Park	.8 ha	220m	160/172m	0-8%	40%		
					8-14%	25%		
					14-20%	22%		
					20+%	13%		

Park ID	Type	Size	Street Frontage	Min/Max Elevation	Percent Slope		Topographic Overview	Profile (A to B)
3	Neighbourhood Park	.5 ha	80m	130/141m	0-8%	27%		
					8-14%	39%		
					14-20%	32%		
					20+%	2%		
4	Community Park	3.4	315m	127/151m	0-8%	52%		
					8-14%	34%		
					14-20%	11%		
					20+%	3%		

Park ID	Type	Size	Street Frontage	Min/Max Elevation	Percent Slope		Topographic Overview	Profile (A to B)
5	Neighbourhood Park	1.8 ha	30m	131/149m	0-8%	24%		
					8-14%	65%		
					14-20%	24%		
					20+%	3%		
6	Community Park	4.8 ha	135m	115/135m	0-8%	73%		
					8-14%	23%		
					14-20%	4%		
					20+%	0%		

APPENDIX A
EAST KILBRIDE DEVELOPMENT PLAN MAPS



EAST KILBRIDE DEVELOPMENT PLAN MAPS
DRAFT

Prepared for:
City of St. John's

Date:
January 2019

Project No.
143046.00

Prepared by:
CBCL LIMITED
Consulting Engineers

DRAFT

SHEA HEIGHTS

KILBRIDE

DRUKEN CRES
JORDAN PL
BLACKHEAD RD
LINEGAR AVE
CHAFE AVE
DILLON CRES
BLACKHEAD CRES
WATER ST
LEMARCHANT RD
SYMONDS AV
CORNWALL AVE
WATERFORD BRIDGE RD
SHEA HEIGHTS ACCESS RD
PITTIS MEMORIAL DR
EMPIRE AVE
COLUMBUS DR
BLACKMARSH RD
KENMOUNT RD
TOPSAIL RD
DENSMORES LANE
OLD PETTY HARBOUR RD
FAHEY ST
SKANES AVE
LANNON ST
GRIFFINS LANE
CAPE PINE ST
VALLEYVIEW RD
BAY BULLS RD

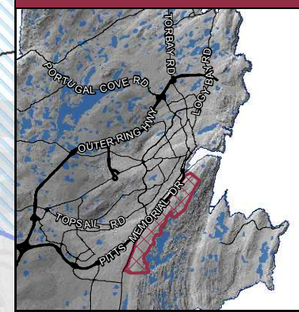
MAP 1
Study Area

Drawn by: JF	Date: 26/07/2016
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- POWER TRANSMISSION LINE
- COMPREHENSIVE DEVELOPMENT AREAS
- PETTY HARBOUR LONG POND WATER SUPPLY AREA

KEY PLAN



MAP PARAMETERS

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Projection: Transverse Mercator
Datum: North American 1983
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false northing: 0.0000
central meridian: -53.0000
scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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St. John's, NL,
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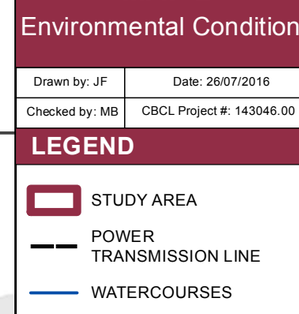
MAP 2
Environmental Conditions

Drawn by: JF	Date: 26/07/2016
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- POWER TRANSMISSION LINE
- WATERCOURSES
- WETLANDS
- PETTY HARBOUR LONG POND WATER SUPPLY AREA
- FLOODPLAIN

KEY PLAN



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Units: Meter

SCALE

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0 250 500 m

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MAP 3
Wetland Conservation Priority

Drawn by: JF	Date: 26/07/2016
Checked by: MB	CBCL Project #: 143046.00

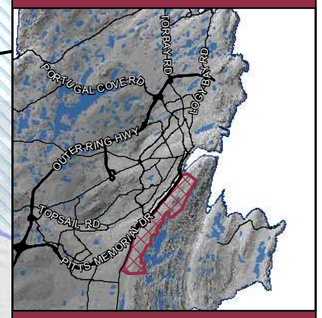
LEGEND

- STUDY AREA
- POWER TRANSMISSION LINE
- WATERCOURSES

WETLAND CONSERVATION PRIORITY

- HIGH
- MODERATE
- LOW
- PETTY HARBOUR LONG POND WATER SUPPLY AREA
- FLOODPLAIN

KEY PLAN



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latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 4
Slope Constraints

Drawn by: JF	Date: 28/07/2017
Checked by: MB	CBCL Project #: 143046.00

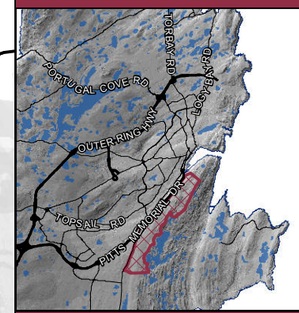
LEGEND

- STUDY AREA

SLOPE PERCENTAGE

- 0 - 8%
- 8 - 15%
- 15 - 20%
- 20% +
- CONTOURS 10m INTERVAL
- 180 m CONTOUR

KEY PLAN



MAP PARAMETERS

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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 5
Elevation

Drawn by: JF	Date: 26/07/2016
Checked by: MB	CBCL Project #: 143046.00

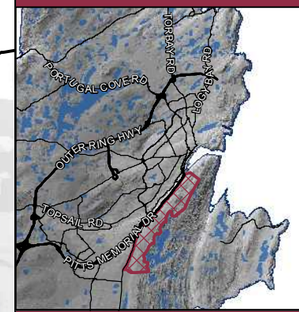
LEGEND

- STUDY AREA
- CONTOURS 10 m INTERVAL
- 180 m INTERVAL

ELEVATION

- HIGH: 280 m
- LOW: -2 m

KEY PLAN



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Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 6
Existing Land Use Designations

Drawn by: JF	Date: 26/07/2016
Checked by: MB	CBCL Project #: 143046.00

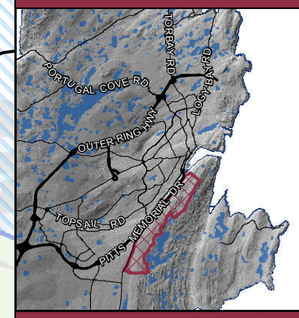
LEGEND

- STUDY AREA

LAND USE DESIGNATIONS

- COMPREHENSIVE DEVELOPMENT AREAS
- RESIDENTIAL
- COMMERCIAL
- AGRICULTURE
- RURAL
- OPEN SPACE / CONSERVATION
- INDUSTRIAL
- PUBLIC
- PIPPY PARK
- WATERSHED

KEY PLAN



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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 7
Land Ownership Pattern

Drawn by: JF	Date: 21/07/2016
Checked by: MB	CBCL Project #: 143046.00

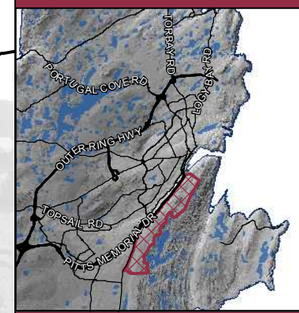
LEGEND

- STUDY AREA

LAND OWNERSHIP

- PRIVATE
- CROWN
- CITY OF ST.JOHN'S
- POWER TRANSMISSION LINE

KEY PLAN



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Projection: Transverse Mercator
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false northing: 0.0000
central meridian: -53.0000
scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 8
Existing Street Network

Drawn by: JF	Date: 25/07/2016
Checked by: MB	CBCL Project #: 143046.00

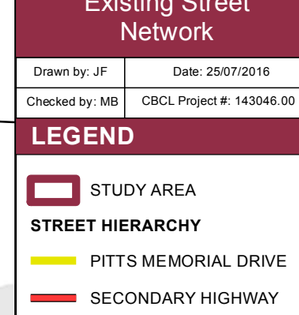
LEGEND

- STUDY AREA

STREET HIERARCHY

- PITTS MEMORIAL DRIVE
- SECONDARY HIGHWAY
- MAJOR ROAD
- LOCAL STREET

KEY PLAN



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false northing: 0.0000
central meridian: -53.0000
scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

NORTH

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MAP 9
Development Constraints

Drawn by: JF	Date: 09/02/2018
Checked by: MB	CBCL Project #: 143046.00

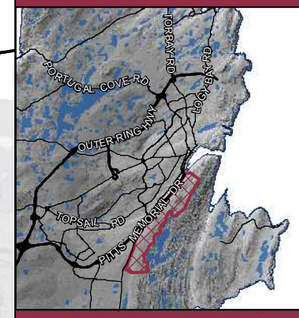
LEGEND

- STUDY AREA
- POWER TRANSMISSION LINE
- 180 m CONTOUR
- WATERCOURSES
- WETLANDS
- FLOODPLAIN
- DEVELOPED AREAS

SLOPE PERCENTAGE

- 0 - 8%
- 8 -15%
- 15 -20%
- 20% +

KEY PLAN



MAP PARAMETERS

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Projection: Transverse Mercator
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false northing: 0.0000
central meridian: -53.0000
scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE	NORTH
1:20,000	
0 250 500 m	

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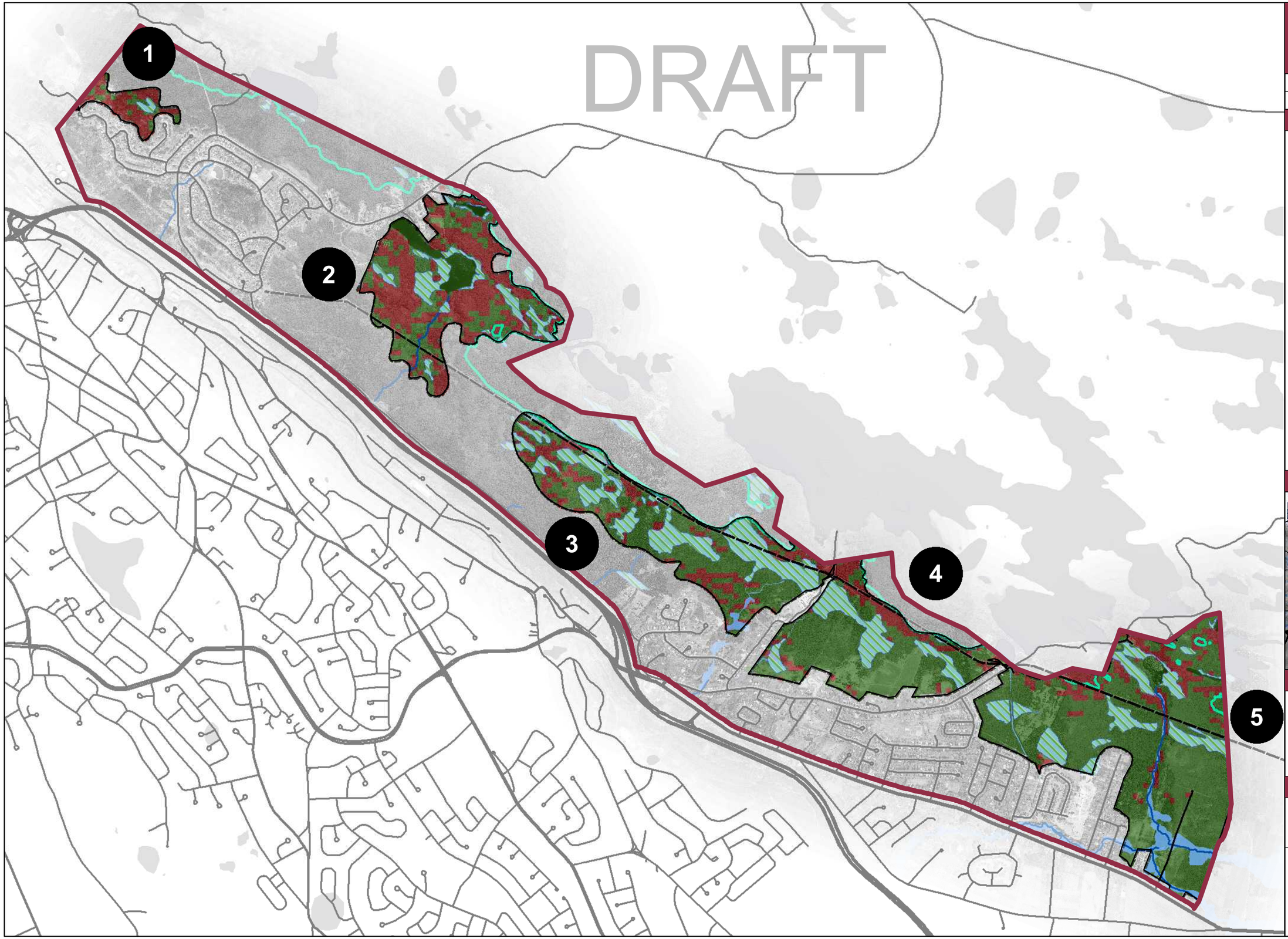


MAP 10
Developable Areas

Drawn by: JF	Date: 21/07/2016
Checked by: MB	CBCL Project #: 143046.00

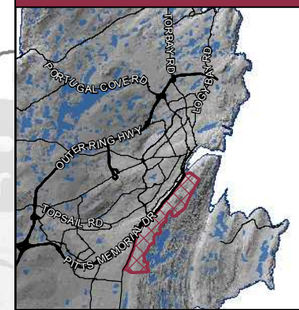
LEGEND

- STUDY AREA
- POWER TRANSMISSION LINE
- 180 m CONTOUR
- WETLANDS
- WATERCOURSES
- FLOODPLAIN

DEVELOPABILITY

- SLOPE LESS THAN 14%
- SLOPE GREATER THAN 14%

KEY PLAN



MAP PARAMETERS

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latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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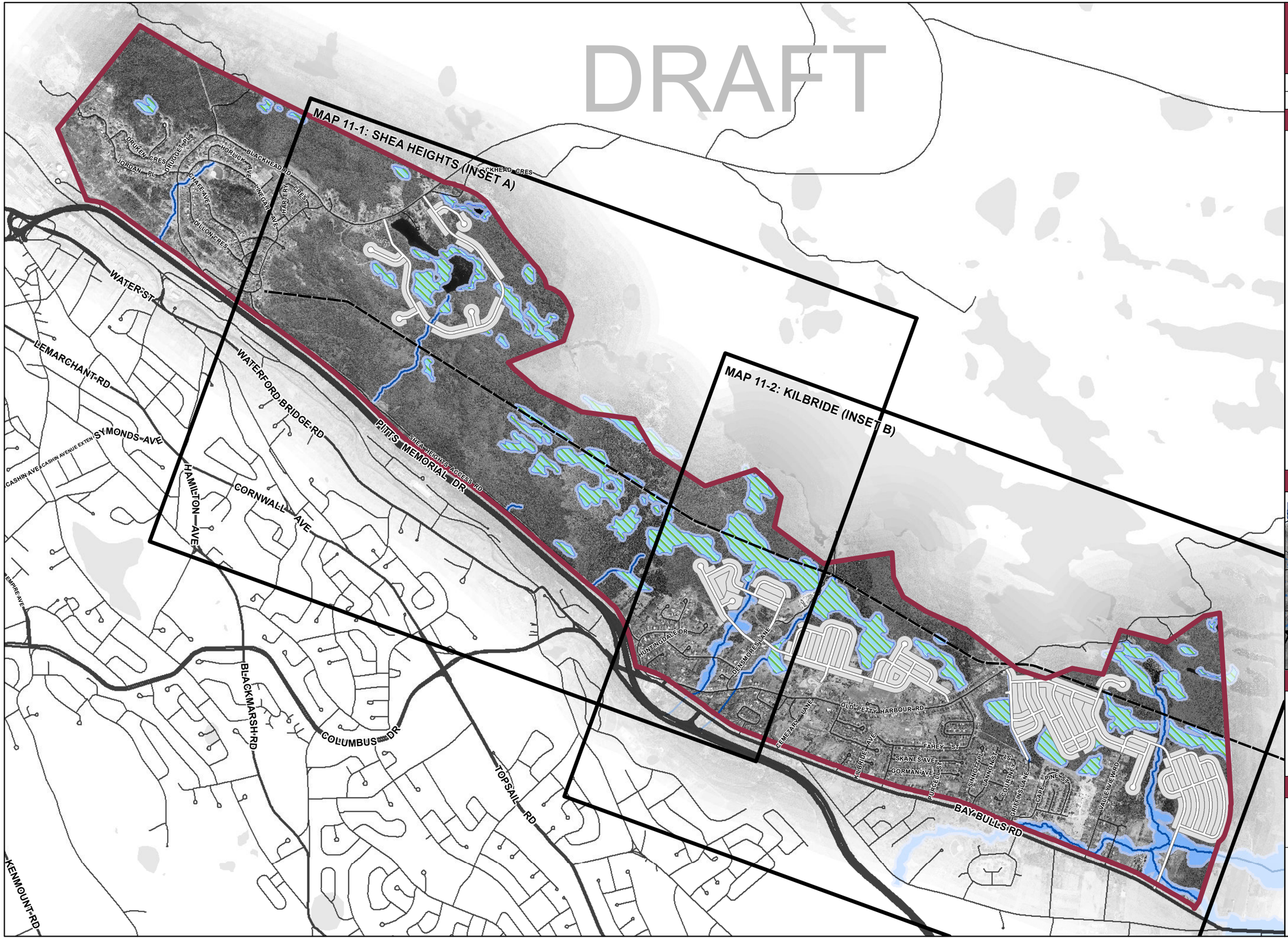


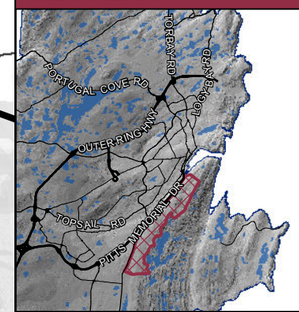
MAP 11
Development Concept

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- DEVELOPMENT CONCEPT
- POWER TRANSMISSION LINE
- WATERCOURSES
- WETLANDS
- FLOODPLAIN
- WATERBODY BUFFER

KEY PLAN



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Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 11-1
Shea Heights Development Concept

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

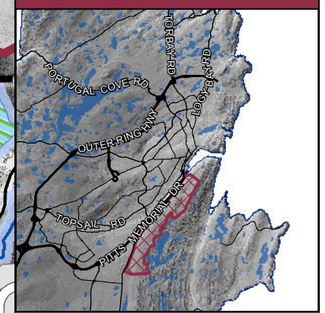
LEGEND

- STUDY AREA
- DEVELOPMENT CONCEPT
- POWER TRANSMISSION LINE
- WATERCOURSES
- WETLANDS
- FLOODPLAIN
- WATERBODY BUFFER

MAP 11-2: KILBRIDE (INSET B)

BLACKHEAD RD
BLACKHEAD RD
GRES
WARFORD RD
VINEGAR AVE
SHEA HEIGHTS ACCESS RD
WATERFORD BRIDGE RD
PITTS MEMORIAL DR
CORNWALL AVE
HAMILTON AVE
TOPSAIL RD
COLUMBUS DR
HUNTINGDALE DR
DENSMORE LANE
OLD PETTY HARBOUR RD
BAY BULLS RD

KEY PLAN



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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE	NORTH
1:10,000	

0 125 250 m

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MAP 11-1: SHEA HEIGHTS (INSET A)

HUNTINGDALE DR
DENSMORES LANE
MOONEY CRES
CEMETARY LANE
OLD PETTY HARBOUR RD
SIVERTON ST
KILBRIDE AVE
MOGRIDGE ST
SKANES AVE
GORMAN AVE
PURCELL ST
FAHEY ST
SINNOTT PL
LANNON ST
GRIFFINS LANE
CAPE PINE ST
VALLEYVIEW RD
COLUMBUS DR
BAY BULLS RD
PITTS MEMORIAL DR

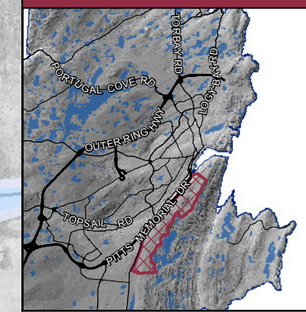
MAP 11-2
Kilbride Development Concept

Drawn by: JF	Date: 24/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- DEVELOPMENT CONCEPT
- POWER TRANSMISSION LINE
- WATERCOURSES
- WETLANDS
- FLOODPLAIN
- WATERBODY BUFFER

KEY PLAN



MAP PARAMETERS

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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:10,000

0 125 250 m

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EXISTING SHEA HEIGHTS PUMP HOUSE

EXISTING SHEA HEIGHTS STORAGE TANK

MAP 12-1: SHEA HEIGHTS (INSET A)

PROPOSED TRANSMISSION MAIN ALIGNMENT

PROPOSED TANKS

PROPOSED SHEA HEIGHTS PRV STATION

MAP 12-2: KILBRIDE (INSET B)

PETTY HARBOUR LONG POND WATER TREATMENT PLANT

PROPOSED PUMPHOUSE

JORDAN PL
BLACKHEAD RD
CHAFE AVE
DILLON CRES
LINEGAR AVE
WATER ST
SHEA HEIGHTS ACCESS RD
PITTS MEMORIAL DR
CORNWALL AVE
WATERFORD BRIDGE RD
BLACKMARSH RD
COLUMBUS DR
TOPSAIL RD
KENMOUNT RD
CASHIN AVE
CASHIN AVENUE EXTEN
EMPIRE AVE
HUNTINGDALE DR
OLD PETTY HARBOUR RD
FAHEY ST
LANNON ST
CAPE PINE ST
BAY BULLS RD

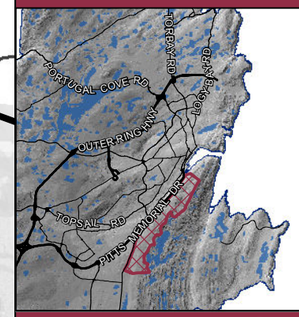
MAP 12
Servicing Layout

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- SANITARY CONNECTIONS
- TRANSMISSION MAIN
- POWER TRANSMISSION LINE
- SANITARY CATCHMENT
- STORM WATER DETENTION PONDS
- DEVELOPMENT CONCEPT

KEY PLAN



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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 12-1
Shea Heights Servicing Layout

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- SANITARY CONNECTIONS
- TRANSMISSION MAIN
- POWER TRANSMISSION LINE
- SANITARY CATCHMENT
- STORM WATER DETENTION PONDS
- DEVELOPMENT CONCEPT

NOTE:
SANITARY CONNECTION NODE LABELS AND POND LABELS CORRESPOND TO THE LABELS USED IN THE SUPPORTING CALCULATIONS.

EXISTING SHEA HEIGHTS STORAGE TANK

NODE 1

BLACKHEAD RD

BLACKHEAD CRES

WARFORD RD

VINEGAR AVE

PROPOSED TANKS

PROPOSED SHEA HEIGHTS PRV STATION

PROPOSED TRANSMISSION MAIN ALIGNMENT

SHEA HEIGHTS ACCESS RD

WATERFORD BRIDGE RD

PITTS MEMORIAL DR

CORNWALL AVE

HAMILTON AVE

TOPSAIL RD

COLUMBUS DR

MAP 12-2: KILBRIDE (INSET B)

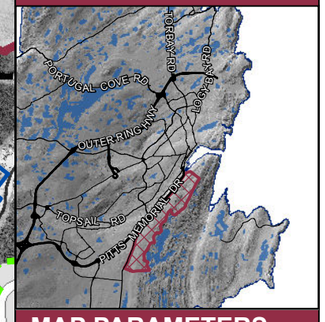
PROPOSED PUMPHOUSE

HUNTINGDALE DR

OLD PETTY HARBOUR RD

BAY BULLS RD

KEY PLAN



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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE	NORTH
1:10,000	
0 125 250 m	

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MAP 12-1: SHEA HEIGHTS (INSET A)

Pond	Volume (m^3)
1	6,800
2	11,800
3	7,500
4	4,100

PETTY HARBOUR
LONG POND
WATER TREATMENT PLANT

PROPOSED
PUMPHOUSE

TRANSMISSION
MAIN

NODE 2

NODE 3

NODE 4

NODE 5

NODE 6

POND 1

POND 2

POND 3

POND 4

HUNTINGDALE DR

MOONEY CRES

CEMETARY LANE

OLD PETTY HARBOUR RD

SILVERTON ST

KILBRIDE AVE

MOGRIDGE ST

SKANES AVE

GORMAN AVE

PURCELL ST

FAHEY ST

SINNOTT PL

LANNON ST

GRIFFINS LANE

CAPE PINE ST

VALLEYVIEW RD

COLUMBUS DR

BAY BULLS RD

PITTS MEMORIAL DR

MAP 12-2
Kilbride
Servicing Layout

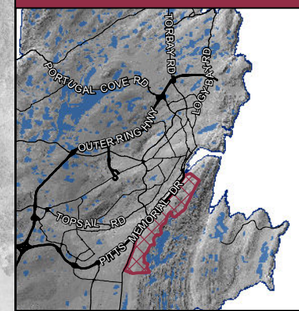
Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- SANITARY CONNECTIONS
- TRANSMISSION MAIN
- POWER TRANSMISSION LINE
- SANITARY CATCHMENT
- STORM WATER DETENTION PONDS
- DEVELOPMENT CONCEPT

NOTE:
SANITARY CONNECTION NODE LABELS AND POND LABELS CORRESPOND TO THE LABELS USED IN THE SUPPORTING CALCULATIONS.

KEY PLAN



MAP PARAMETERS

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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:10,000

0 125 250 m

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MAP 13-1: SHEA HEIGHTS (INSET A)

MAP 13-2: KILBRIDE (INSET B)

OVER 15 km OF TRAILS

MUDDY POND PARK

BOWRING PARK

MOONEY CRESCENT PARK

KILBRIDE LIONS PARK

PURCELL PARK

HUCK WILLIAMS PARK

WATER ST

LEMARCHANT RD

ST MONDS AVE

CASHIN AVE

CASHIN AVENUE EXTENSION

EMPIRE AVE

HAMILTON AVE

CORNWALL AVE

BLACKMARSH RD

COLUMBUS DR

KENMOUNT RD

WATERFORD BRIDGE RD

PITTS MEMORIAL DR

SHEA HEIGHTS ACCESS RD

TOPSAIL RD

BAY BULLS RD

BLACKHEAD RD

BLACKHEAD CRES

DRUFEN CRES

JORDAN PL

KILBRIDGET PL

HORLICK PL

VINEGAR AVE

HARRIERN CRES

CHAFE AVE

DILLON CRES

HUNTINGDALE DR

BENSMORE LANE

CEMETARY LANE

OLD PETTY HARBOUR RD

KILBRIDE AVE

FAHEY ST

SKANES AVE

GORMAN AVE

PURCELL ST

FINNOTT PL

LANNON ST

GOURNEY PL

GOURNEYS LANE

CAPE PINE ST

VALLEYVIEW RD

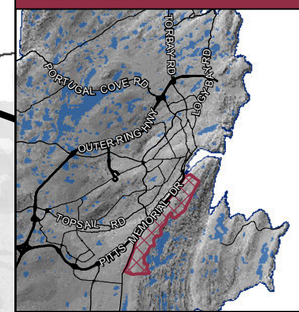
MAP 13
Open Space Plan

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- COMMUNITY TRAIL
- DEVELOPMENT CONCEPT
- COMMUNITY PARK
- NEIGHBOURHOOD PARK
- DESIGNATED OPEN SPACE
- WET AREAS

KEY PLAN



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Units: Meter

SCALE

1:20,000

0 250 500 m

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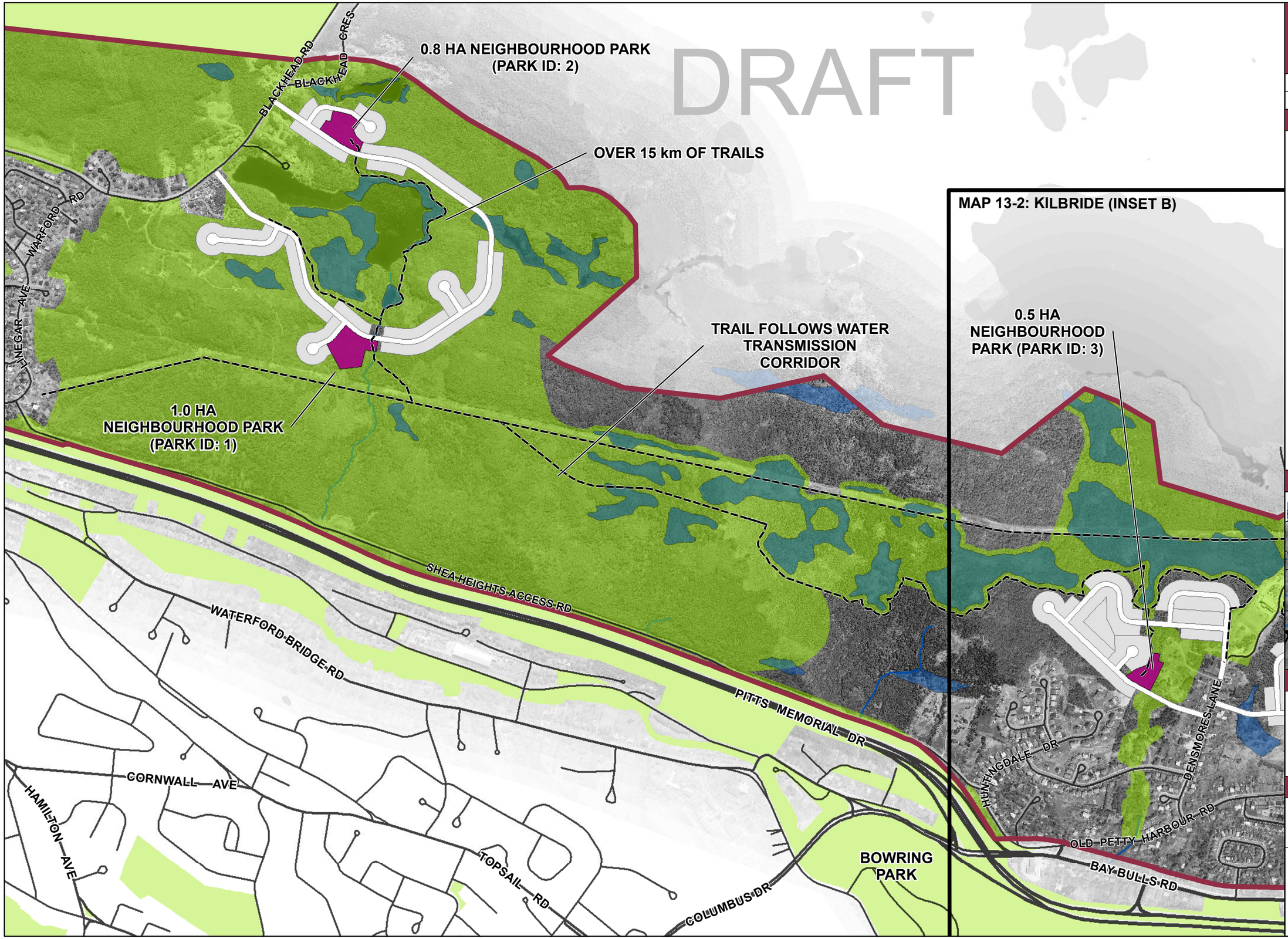


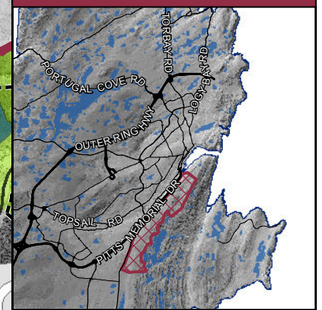
MAP 13-1
Shea Heights Open Space Plan

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- COMMUNITY TRAIL
- DEVELOPMENT CONCEPT
- COMMUNITY PARK
- NEIGHBOURHOOD PARK
- DESIGNATED OPEN SPACE
- WET AREAS

KEY PLAN



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Units: Meter

SCALE

1:10,000

0 125 250 m

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MAP 13-1: SHEA HEIGHTS (INSET A)

TRAIL FOLLOWS WATER TRANSMISSION CORRIDOR

OVER 15 km OF TRAILS

3.4 HA COMMUNITY PARK (PARK ID: 4)

TRAIL FOLLOWS NATURAL FEATURES AND EXISTING FOOTPATHS

0.5 HA NEIGHBOURHOOD PARK (PARK ID: 3)

1.6 HA NEIGHBOURHOOD PARK (PARK ID: 5)

HUNTINGDALE DR

DENSMORES LANE

MOONEY CRES

CEMETARY LANE

OLD PETTY HARBOUR RD

SILVERTON ST

KILBRIDE AVE

MOGRIDGE ST

SKANES AVE

GORMAN AVE

PURCELL ST

FAHEY ST

SINNOTT PL

LANNON ST

GRIFFINS LANE

CAPE PINE ST

VALLEYVIEW RD

COLUMBUS DR

BAY BULLS RD

PITTS MEMORIAL DR

BOWRING PARK

KILBRIDE LIONS PARK

PURCELL PARK

HUCK WILLIAMS PARK

4.8 HA COMMUNITY PARK (PARK ID: 6)

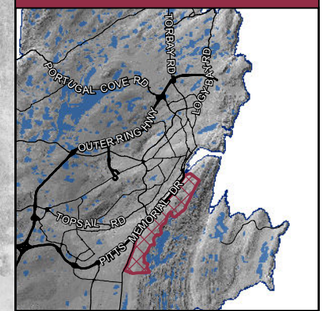
MAP 13-2
Kilbride
Open Space Plan

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

- STUDY AREA
- COMMUNITY TRAIL
- DEVELOPMENT CONCEPT
- COMMUNITY PARK
- NEIGHBOURHOOD PARK
- DESIGNATED OPEN SPACE
- WET AREAS

KEY PLAN



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latitude of origin: 0.0000
Units: Meter

SCALE

1:10,000

0 125 250 m

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MAP 14
Land Use Districts

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

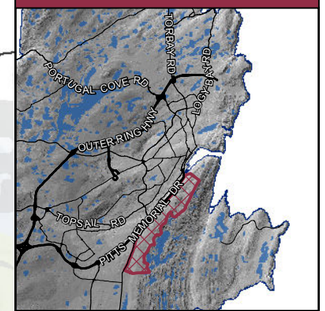
LEGEND

- STUDY AREA

LAND USE DISTRICTS

- RESIDENTIAL
- COMMERCIAL
- RURAL
- OPEN SPACE / CONSERVATION
- INDUSTRIAL
- PUBLIC

KEY PLAN



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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 15
Land Use Zoning

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

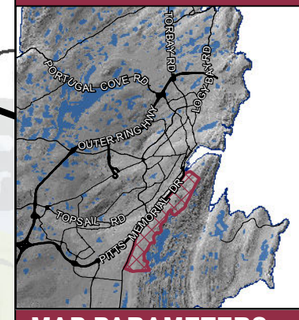
STUDY AREA

A1	APARTMENT LOW DENSITY
CEM	CEMETERY
CN	COMMERCIAL NEIGHBOURHOOD
IG	INDUSTRIAL GENERAL
INST	INSTITUTIONAL
O	OPEN SPACE
OR	OPEN SPACE RESERVE
R	RURAL
R1	RESIDENTIAL LOW DENSITY
R2	RESIDENTIAL MEDIUM DENSITY

MAP 15-1: SHEA HEIGHTS (INSET A)

MAP 15-2: KILBRIDE (INSET B)

KEY PLAN



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scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:20,000

0 250 500 m

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MAP 15-1
Shea Heights
Land Use Zoning

Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

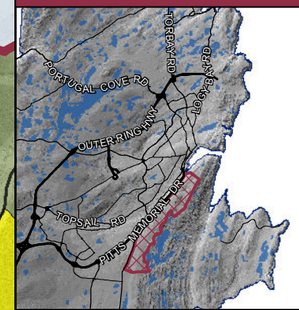
STUDY AREA

A1	APARTMENT LOW DENSITY
CEM	CEMETERY
CN	COMMERCIAL NEIGHBOURHOOD
IG	INDUSTRIAL GENERAL
INST	INSTITUTIONAL
O	OPEN SPACE
OR	OPEN SPACE RESERVE
R	RURAL
R1	RESIDENTIAL LOW DENSITY
R2	RESIDENTIAL MEDIUM DENSITY

MAP 15-2: KILBRIDE (INSET B)

BLACKHEAD RD
BLACKHEAD CRES
WARFORD RD
SHEA HEIGHTS ACCESS RD
WATERFORD BRIDGE RD
PITTS MEMORIAL DR
CORNWALL AVE
HAMILTON AVE
TOPSAIL RD
COLUMBUS DR
HUNTINGDALE DR
BRENNAN FIELD
OLD PETTY HARBOUR RD
BAY BULLS RD

KEY PLAN



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SCALE

1:10,000

0 125 250 m

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MAP 15-1: SHEA HEIGHTS (INSET A)

HUNTINGDALE DR
BRENNAN FIELD
OLD PETTY HARBOUR RD
TOONEY CRES
CEMETERY LANE
SILVERTON ST
KILBRIDE AVE
MOGRIDGE ST
SKANES AVE
GORMAN AVE
FAHEY ST
PURCELL ST
SINNOTT PL
LANNON ST
COURTNEY ST
GRIFFINS LANE
CAPE PINE ST
VALLEYVIEW RD
COLUMBUS DR
BAY BULLS RD
PITTS MEMORIAL DR
CEM

MAP 15-2
Kilbride
Land Use Zoning

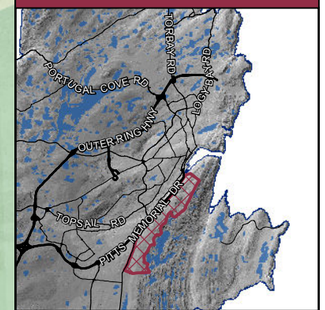
Drawn by: JF	Date: 25/01/2019
Checked by: MB	CBCL Project #: 143046.00

LEGEND

STUDY AREA

A1	APARTMENT LOW DENSITY
CEM	CEMETERY
CN	COMMERCIAL NEIGHBOURHOOD
IG	INDUSTRIAL GENERAL
INST	INSTITUTIONAL
O	OPEN SPACE
OR	OPEN SPACE RESERVE
R	RURAL
R1	RESIDENTIAL LOW DENSITY
R2	RESIDENTIAL MEDIUM DENSITY

KEY PLAN



MAP PARAMETERS

Coordinate System: NAD83 MTM zone 1
Projection: Transverse Mercator
Datum: North American 1983
false easting: 304,800.0000
false northing: 0.0000
central meridian: -53.0000
scale factor: 0.9999
latitude of origin: 0.0000
Units: Meter

SCALE

1:10,000

0 125 250 m

NORTH

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