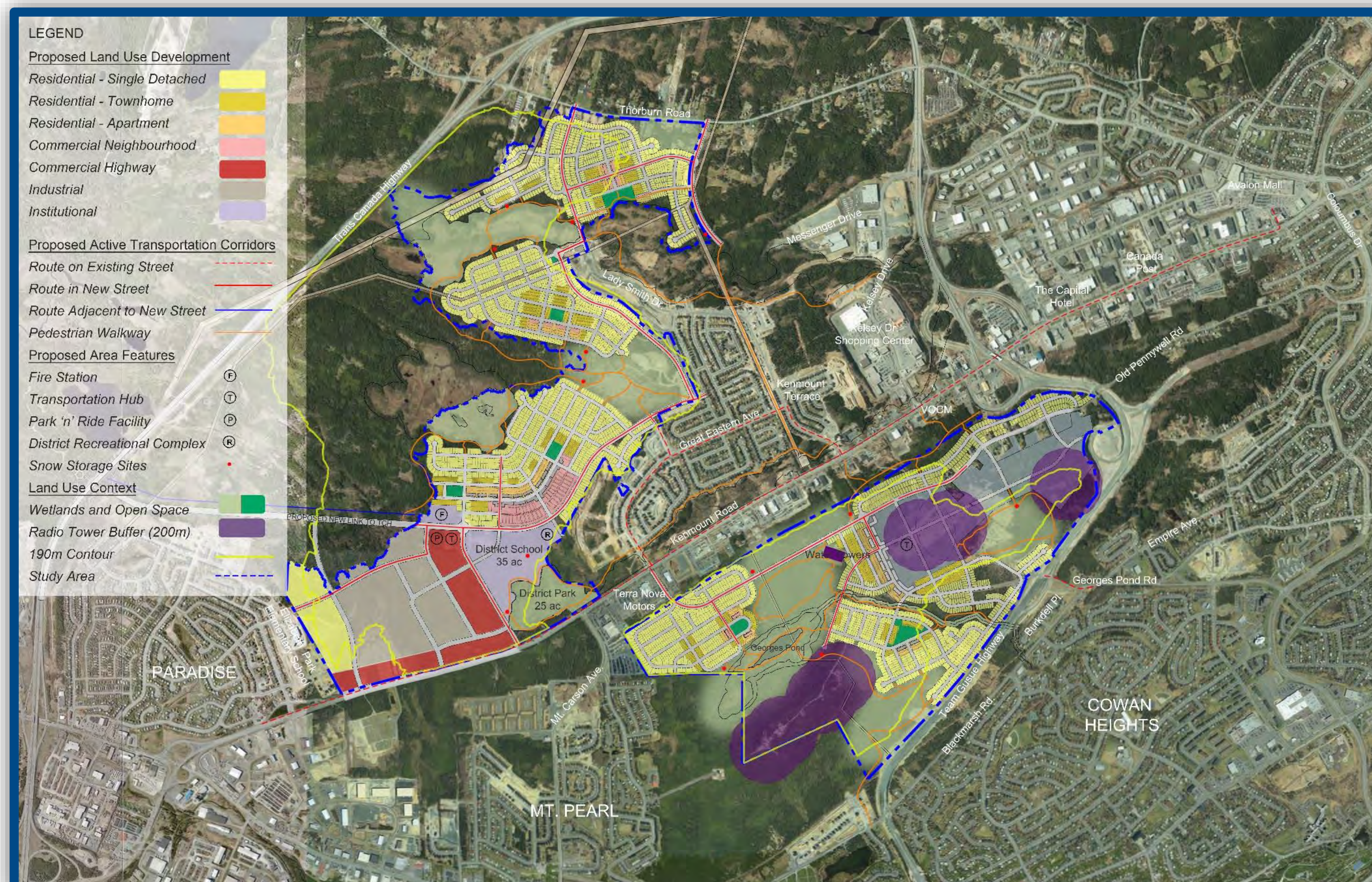
ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Kenmount Concept Plan for Lands Above 190 metres

Kenmount Road, St. John's, NL



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HATCH

Draft
September 2017

TRACT

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

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A Executive Summary

The City of St. John's has engaged the consulting firms: Hatch (formerly Hatch Mott MacDonald) and Tract Consulting to prepare in cooperation, a Comprehensive Land Use Development Plan for the undeveloped, vacant lands located in the Kenmount Valley above the 190 metre contour elevation. The Study Area includes lands to the North of Kenmount Road bounded by the Watershed boundary, the Town of Paradise boundary, Kenmount Road to the South and the Kenmount Terrace residential development to the East. It also includes the lands South of Kenmount Road bounded by the City of Mount Pearl municipal boundary to the West and the Team Gushue Highway to the East.

The lands located in the Study Area were rezoned by the City in 2012 to the new Comprehensive Development Area-Kenmount (CDA-Kenmount) Zone in anticipation of the potential future development of these lands on the basis of piped municipal water and sewer services. Given the magnitude of the Study Area, approximately 365 hectares, and the number of private and public land owners holding properties in the area, the City determined that it would be appropriate to engage consultants with expertise in the area of integrated land use planning and engineering for the purpose of creating a Comprehensive Land Use Development Plan to recommend a development layout for various types of land uses with appropriate planning and zoning designations; a road layout with appropriate access and egress points; determine municipal infrastructure requirements; and to identify and reserve out environmentally important and sensitive areas located in the study area.

The City's terms of reference for this planning project indicate a number of factors that were to be considered by the consultants in the preparation of the Development Plan with a view to creating future complete community neighbourhoods in this area of the city. These factors included suitable connections to the municipal and regional road systems; access to public transit; internal connectedness of the land uses; public open spaces, parks and trails; the integration of traffic calming measures into road system design; maintenance and enhancement of green infrastructure; having a suitable variety of residential building forms and a mixture of residential and non-residential land uses.

An important component of the project's terms of reference is the requirement for the consulting team to consult the various parties owning lands in the Study Area, collect their ideas for potential development of their properties, evaluate them in light of the City's overall planning objectives for the Study Area and to create a Comprehensive Land Use Development Plan which balances the interests of individual property owners with the wider interests and objectives of the whole community.

Planning for the development of the lands above the 190 metre contour elevation in the Study Area is based upon requirements set out in the project terms of reference and existing Provincial and City planning policies affecting land use and development in St. John's. A site assessment of the Study Area by the consulting team determined areas suitable for development, and identified limitations to development that may affect the use of these lands. Consultation with owners of properties in the Study Area was undertaken by the consulting team to understand the development objectives of their respective properties. Seven (7) substantial contiguous pockets of lands suited for development were identified, with their limits shaped by the Study Area boundary, significant areas of steeply sloping grounds and a network of wetlands, ponds and streams with their buffers.

Together, the City's aims for land development, the capacity of the land to support development and the property owners' aspirations informed the preparation of a Land Use Development Plan that outlines the proposed land use pattern, open space system and street network recommended for the Study Area. This Plan was provided for detailed review by the City's project steering committee and applicable major land owners. Revisions to the plan were made based upon feedback received and the design of site services proceeded by the consulting team based upon the revised plan. Planning policy recommendations governing land use development, including proposed zoning designations, were then developed by the consulting team.

The Comprehensive Land Use Development Plan as prepared by the consulting team for the Lands above the 190m Contour is shown in executive summary Figure A.

The design of the Comprehensive Land Use Development Plan is based upon the concept of "smart growth". This planning theory proposes that new communities contain a diversity of land uses and provide residents with diverse options in housing. Also, smart growth communities reduce reliance on private automobiles for transportation by facilitating transit use, active transportation and creating walkable neighbourhoods. This report elaborates on the key tenets of smart growth as they relate to the Study Area.

The City's Terms of Reference for this project specify that the Comprehensive Land Use Development Plan shall make provision for residential uses, accommodating single detached homes through to higher density housing types such as semi-detached houses, townhouses and apartment buildings for rental or for condominium ownership.

This Land Use Development Plan proposes a varied mix of residential housing forms, from single-detached houses on standard sized building lots (15 metres frontage and minimum 450 square metres lot area), to single-detached houses on smaller building lots (12 metres lot frontage and minimum 350 square metres lot area), semi-detached houses, townhouses and apartment buildings. The Plan's proposed mix of residential land uses can potentially yield a total of approximately 4520 new residential units at a residential density of 31.2 units per net hectare for an estimated residential full build-out population of approximately 10,850 persons.

As part of the goal of achieving a more complete community for the Study Area, the proposed land use mix under the Comprehensive Land Use Development Plan has been extended beyond only residential developments. The Plan makes provision for a combined potential total of approximately 18,700 square metres of retail floor space, and approximately 37,400 square metres of potential office space. These designated areas will be within easy access of many of the areas proposed for residential development. Additionally, the Plan makes provision for neighbourhood commercial service sites, and generous amounts of acreage are proposed for the park and open space development along with an extensive trail system for connections both within and to areas outside the Study Area. It is important to note that areas which have been identified as environmentally important areas and prominent hill tops are proposed to be reserved out from future urban development. As part of the community planning exercise, the Plan identifies potential sites for the future development of new school buildings, a neighbourhood park/recreational complex and a fire station.

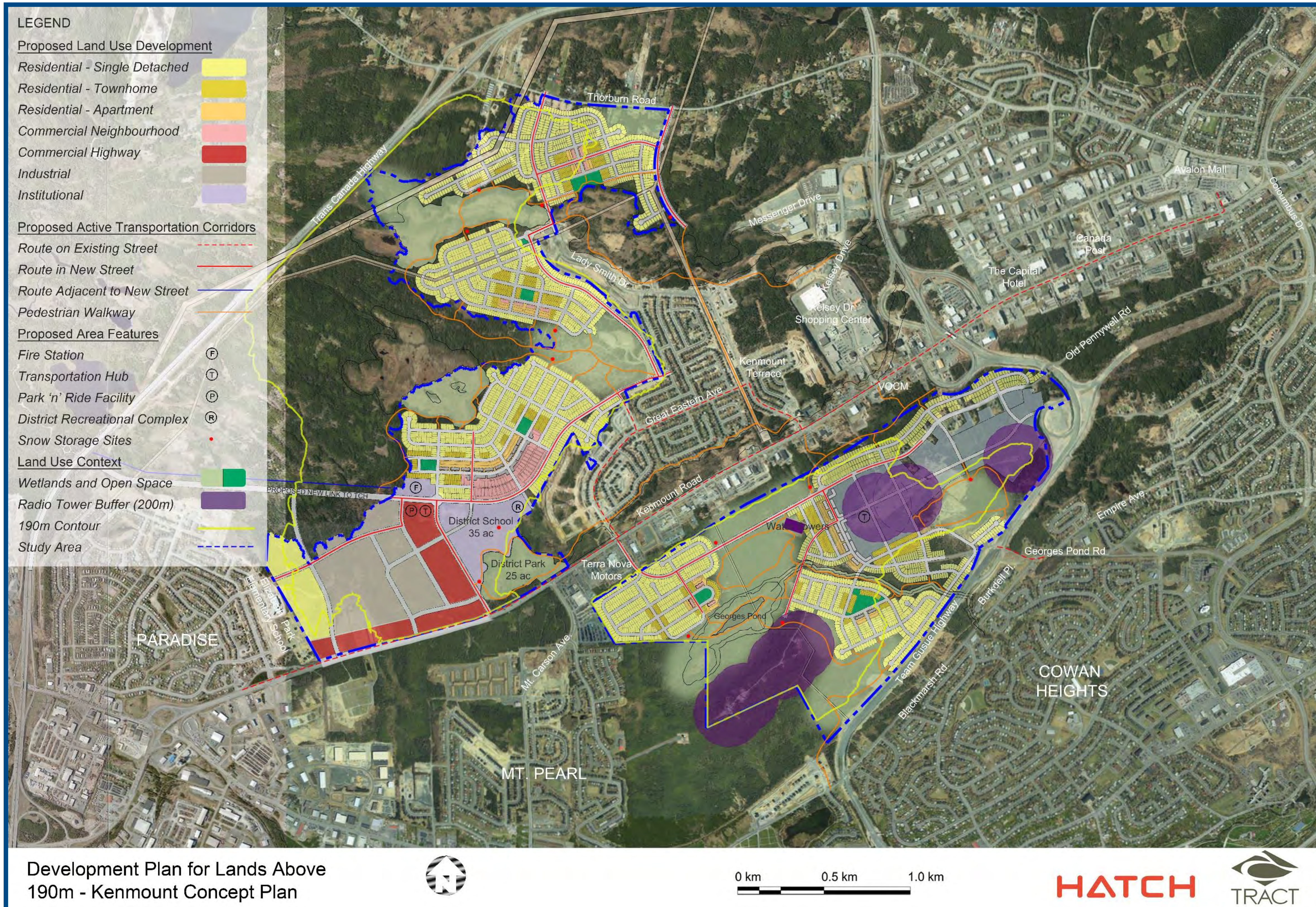

Figure A - Draft Comprehensive Land Use Development Plan

B Traffic

As part of the overall development of the comprehensive land use plan for the lands above the 190 metre contour in the Kenmount Road area Hatch completed a number of different traffic related tasks that were required under the studies terms of reference. These tasks included:

- Determination of access points and the internal road network layout
- Collection of any required traffic count data
- The Traffic Impact Analysis
- Transit Review
- Regional Fire Department – Coverage Review

B.1 Access points and the internal road network layout.

On the north side of Kenmount Road the access options considered included connections to Kenmount Road, the Outer Ring Road, internal connections to Kenmount and connections to Thorburn Road; all of which were utilized to formulate the road network in this portion of the study area. On the south side of Kenmount Road the access options included connections to Kenmount Road, Wyatt Boulevard, Old Pennywell Road and to Captain Whelan Drive. All but the Wyatt Boulevard connection were used in creating the road network on the south side of Kenmount Road. However, further feasibility review is recommended for providing connections to Wyatt Boulevard and aligning the internal road system with Mount Carson Avenue/Wyatt Boulevard.

The preliminary land use data were used to develop the anticipated trip generation for each of the 7 development clusters. The City of St. John's travel demand model was used for the analysis. For the existing condition the model was calibrated at the screenline level using the actual 2013 traffic volumes. The number of external trips to/from the area surrounding the study area were estimated based on a land inventory study that identified future land uses within the study area and the anticipated growth in external areas that was already incorporated into the model. The estimated number of Home-Based Work (HBW), Home-Based Non-Work (HBO), and Non-Home-Based (NHB) trips were then estimated and further adjusted in the model based on household size and income index. A capacity constrained traffic assignment was prepared for each existing and horizon year. These assignments provided weekday peak hour link volumes that were subsequently converted to turning movements based on existing traffic patterns and manual adjustment in locations where the model assignment appeared to vary significantly from existing patterns or would be affected by new development.

With the exception of two roadways on the north side of Kenmount Road all other roadways require one lane in each direction to accommodate the projected traffic demands associated with the development. Promising connections to the Outer Ring Road (Roadway 1) and a collector road connection to Kenmount Road (Roadway 2) to accommodate the projected traffic volumes should be examined further in subsequent more detailed studies of the development servicing requirements for full build out.

The vertical and horizontal alignments of all the main collector and arterial routes in the study area were reviewed to ensure they could actually be built within an acceptable standard in the locations proposed. None of the grades on any of the main routes throughout the study area exceeds 8%. The construction costs of roads serving the lands north and south of Kenmount Road (Roads 1-9) are estimated at 46 million dollars. Plan and profile sheets of the all the major routes in the study are contained in Appendix B-3.

B.2 Traffic Data

The majority of the traffic count data used in this study was collected by the City of St. John's and provided to Hatch. There were a number of other intersections where traffic count data was required for the purposes of the analysis but that had not been collected by the City of St. John's. These locations were counted by Hatch staff. All traffic count data provided by the City of St. John's and collected by Hatch for this study are contained in Appendix B-1.

B.3 Transportation Analysis

There were 7 different development areas/ clusters proposed for development under this comprehensive land use plan. It is estimated that approximately 4500 dwelling units will be created on the full build out of areas 1-4 and 5-7. In total 55% of the developable lands will evolve into some form of residential housing. The remaining 45% will consist of a mixture of retail, office, commercial, industrial and institutional type land uses.

The City's 2025 VISUM transportation planning model was modified in the study area and refined for the purposes of completing the analysis for this report. Existing traffic analysis zones (TAZ's) were modified and split into new zones to accommodate the land uses proposed under the proposed land use development plan for this project.

The traffic analysis for this project consisted of four different modeling scenario's including:

- Scenario S0 - Existing conditions
- Scenario S1 - 2025 projection of normal growth with no development in the study area.
- Scenario S2 - 2025 projection of normal growth and development in the study area with no improvements to the road network.
- Scenario S3 - 2025 projection of normal growth and development in the study area with improvements in place to the road network.

It is noted that the volumes used for the analyses of these scenarios were derived from the City's Transportation Travel Demand Model. Since the model calibration and validation has not been completed, these volumes should only be considered as a rough estimate of the projected volumes across screen lines and not as link-by-link detailed volumes.

For scenario S0 the Synchro and SimTraffic analysis conducted for both the AM and PM peak periods were based on existing traffic count data. AM and PM peak hour volumes for each of the remaining scenarios were extracted from the 2025 VISUM models created for this project.

The results of analysis for scenario S0 show, for the most part, that most of the intersections within the study area perform well during both the AM and PM peak traffic periods. There are some noted exceptions.

The results of the analysis for scenario S1 show that by 2025, and without development of the Study Area lands, congestion will be occurring on the major arterial routes in the afternoon peak hour as some intersections reach their effective capacity.

The results of the analysis for scenario S2 show that by 2025 and with development of the lands, conditions will deteriorate from those under scenario S1, with more intersections reaching their effective capacity in the afternoon peak hour.

The results of scenario S3 show that in 2025, with some improvement to the road system described in Section 2.2.3.5, there is improvement in the level of service at some of the intersections within the study area, but congested conditions remain on several of the key intersections throughout the study area.

The full build out of the study area is expected to generate approximately 110,000 two-way daily trips in the study area; 55,000 trips in and 55,000 trips out over a 24-hour period. These volumes are significant and the effects on the level of service at many of the study area intersections are quite pronounced.

It was concluded from the transportation analysis that to accommodate the anticipated growth in travel demand in the Study Area and in the City in general, a balanced transportation strategy is needed that encourages less reliance on the private automobile and more on using transit, cycling and walking.

B.4 Balanced Transportation Strategy

To facilitate improvement of transit service to the development area a number of recommendations are made with respect to improving the community development and road concept to provide continuous collector roads internal to the development, with appropriate connections to the key surrounding roads and intersections. Additional study is needed to confirm the feasibility of some of these road alignments and connections. The study recommends achieving an aggressive transit catchment service standard of locating transit routes such that at least 90 percent of residents are within a 400m walk of this route. Transit will play a major role in ensuring the development plans for the lands above the 190 metre contour are successful from a transportation perspective. In addition to planning an internal transit network, it will be important to ensure that appropriate facilities including shelters, layby areas, and cycling racks/lockers are located in the focal areas of each of the development areas.

A comprehensive and supporting active transportation network is proposed within the community to encourage greater cycling and walking. Consideration for some refinement of the planned road alignments and property lot arrangement are suggested to improve accessibility and safety.

It is recommended that the City proceed with additional more detailed assessment of the key network improvements suggested under scenario S3 using refined traffic volume forecasts and land use information to confirm the development phasing, need and timing for these improvements. In conjunction with refinements to the land use and transportation network in the Study Area and improved local transit service, it is recommended that the City work with neighboring municipalities and the Provincial Government to collectively change the policies on sustainable development. Part of this approach will be to put in place equitable cost sharing agreements that will allow the successful implementation of a transit system serving St. John's, Paradise and Mount Pearl as a cornerstone of a balanced and integrated transportation plan. The overall goal is to reduce the reliance on single passenger automobiles.

B.5 Fire Protection Services

As these new areas of land open up for development there will be a need to construct a new fire station on the lands on the north side of Kenmount Road. Hatch used the isochrones parameters feature of the VISUM software and the 2025 planning model to determine the response times from existing and planned St. John's Regional Fire Department facilities in the area. In order to keep response times in the majority of the study area to 4 minutes or less, a new fire station in area 1 of the planned development will be required.

C Municipal Services

C.1 Sanitary Sewer

Design of the sanitary sewer system was carried out following the requirements of the St. Johns Subdivision Design Manual, latest edition. The ArcGIS system was utilized in the delineation of the eight (8) sanitary sewer sub-catchment areas and assisted in determining the flow estimates and establishing the connection points to the existing sanitary sewer system. The sub-catchments were designed to maximize the use of gravity flow toward the existing sanitary sewer connection points however, the use of three (3) lift stations are required to pump the sewage flows form lower elevations where gravity flow was not possible.

To accommodate the full build out of the 190m contour the existing infrastructure has to be upgraded. The sanitary sewer from sub-catchment E on the south side of Kenmount Road will be directed to the existing system at the intersection of Blackmarsh Road / Canada Drive. In order to accommodate the additional flow there are seven (7) sections of 200mm diameter sanitary sewer between Fair Haven Place and Burgeo Street will have to be upgraded to a 300mm diameter line. The sanitary sewer flow from sub-catchments A and F are proposed to connect to the existing sanitary sewer mains on the north and south side Kenmount Road. In order to use these two lines a 71m section of existing 300mm sanitary sewer main on Parrells Lane would have to be upgraded to 375mm diameter thereby increasing the capacity to approximately 105 L/s. The sanitary sewer from sub-catchments from B and G proposed new 3000m long 300mm diameter sanitary sewer line from the 190m development to behind Canadian Tire on Kelsey Drive. The flows from the remaining sub-catchments C, D and H would be directed to the Southwest Development Area Trunk Main via connections to the existing infrastructure.

C.2 Storm Sewer

The CDA Kenmount area is subject to the City of St. John's Stormwater Management Plan which requires a zero-net-increase in runoff between predevelopment and post development. The City of St. John's Subdivision Design Manual specifies that the Soil Conservation Service (SCS) method shall be used to estimate pre and post development runoff. The major watercourses located within the study area are Yellow Marsh Brook, Leary's Brook, and Kitty Gaul Brook, which drain the three largest basins. The stormwater analysis lumped parameter runoff models of the proposed development area were generated with a number of different configurations using the computer program XPSWMM.

The model results indicated an increased post development peak flow of approximately 1.0 m^3/s, an increase of 0.5 m^3/s from the "Regional Stormwater Detention Study" (CBCL, 2013). The increase is a result of additional impervious areas in the current proposed land development. A review of the assumed municipal zoning in the 2013 study indicates that a large part of the basin was expected to remain zoned as rural. However, the current development plans proposed in this report show this area as mostly low and medium density residential. The available storage of 14,300 m^3 at Yellow Marsh may be used for stormwater detention initially, supplemented by local storm water detention for subsequent development once the Yellow Marsh storage capacity is exceeded.

The analysis also delineated a total of 22 sub-catchments that will potentially require local stormwater detention within the study area. Small scale stormwater detention options will have to be considered by the land developers within each of the above sub-catchments.

C.3 Water System

Design of the water service system was carried out following the requirements of the St. Johns Subdivision Design Manual, latest edition. In order to accurately size the proposed system components and calculate the varying pressures throughout the system, it was necessary to develop a computerized model of the water network. Input parameters into the Bentley WaterGEMS model were selected based on various criteria from the Subdivision Design Guide and the Atlantic Canada Guidelines for Water Systems.

The water model analysis results indicated the need for a new storage above the 261m elevation in order to meet 190m system demands. It is proposed to lift the water from the existing Kenmount tanks to the active storage elevation, between elevation 261m and 267m, via a new booster pumping station is required. The existing Kenmount tanks operate in the range of approximately 224m to 226.7m, therefore the new pumping system will be required to deliver the maximum daily flow of 162L/s at approximately 40m of lift.

It is proposed to construct two (2) storage tanks each of approximately 4300 m^3 storage above the minimum water elevation 261m. The tanks would be located at an approximate elevation of 252m to 255m. Ideally the tanks would be located at the crest of the of hill which is at elevation 261m as this would eliminate the dead storage and enable the tanks be smaller. However, given the close proximity of communication towers is unclear what effects the storage tanks would have on the communications.

Due to the range of topography and the resulting pressure range, pipe sizes were selected which resulted in flow velocities well below the maximum permissible. In addition, a number of PRV were proposed in order to attempt to maintain maximum pressures during minimum demands.

APPENDICES - SEE SEPARATE DOCUMENT

Appendix A – Land Use Planning

Appendix B – Traffic

Appendix C – Municipal Services

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1 Planning and Open Spaces

1.1 The Foundation

This study was commissioned by the City of St. John's to set out a plan for the future development of lands above the 190m elevation, adjacent to Kenmount Road, within the City. This Comprehensive Land Use Development Plan provides the basis for the revision of City policy required to permit development of the lands within the study site.

The 190m elevation was the traditional limit employed by the City when considering the future expansion of municipal water and sewer services. No urban development was possible on the lands within the study site due to the lack of municipal services. In the summer of 2012, the City of St. John's adopted amendments (*St. John's Urban Region Regional Plan*, the *St. John's Municipal Plan*, and the *St. John's Development Regulations*) to permit future servicing and development of lands above 190m elevation. This report sets out a vision and detailed plan of how urban growth may be accommodated on these lands.

1.1.1 Purpose and Objectives

The terms of reference for the project requires the preparation of a detailed plan for the development of vacant lands within the study area to serve as a basis for continuing policy development that will guide development. The plan is to balance the wishes of the of property owners in the area with the needs and aspirations of the wider community.

The urban form created should provide a complete community, providing residents with places to live, work, shop and play at all stages of life. The planned community is to be walkable, have convenient commercial services and amenities, and provide a variety of forms of housing to meet the needs of a diverse population at various stages of life. The open space system is to provide great public parks, walking trail connections and respond to the opportunity for great public views overlooking the city, and to protect environmentally sensitive lands.

Figure 1 - Draft of the Kenmount Site Location of Lands Above the 190 Contour

The plan will establish a development layout for a variety of land uses and with appropriate zoning designations; establish a street layout with appropriate traffic functionality for private vehicles and municipal transit, and access points and connections to the municipal road network. The plan will determine the municipal infrastructure requirements needed to service the planned development.

1.1.2 Kenmount Site Location

The focus of the study is undeveloped land in the Kenmount Valley above the 190m elevation, as shown in Figure 1. The land under consideration lays to the north and south of Kenmount Road, to the east of the municipal boundaries with Mount Pearl and Paradise. This largely forested land forms a topographic separation between the three regional watersheds, and is visually prominent from many areas in the urban core of the city. To the south of Kenmount Road, the study site is an elongated steep ridge covered with dense evergreen forest and crowned with several significant wireless facilities towers. To the north of Kenmount Road, the site has more gentle relief and sparser forest cover, and abuts streams and large wetlands. The land within the study area is owned by a number of private individuals and the province, and is sparsely populated.

1.1.3 Land Ownership Patterns

A number of large land parcels within the study site are owned by private firms with an interest in land development. It is assumed that the Crown owns several large parcels, while two wireless facilities companies and the heirs of a private land owner each own substantial tracts. Many small parcel owners have also been identified.

Many parcels have somewhat irregular shapes; some parcels appear not to have direct road frontage on existing public streets. To provide a coherent street network and make efficient and coordinated use of the land available, some sort of land consolidation may be required at some stage in the development process.

1.1.4 Civic Policy Context

The Government of Newfoundland and Labrador turns over much of the functional responsibility for land use planning to municipalities under the Urban and Rural Planning Act, (2000). At the broadest level, land use in St. John's is controlled by St. John's Urban Region Regional Plan. The municipality sets out its intent for planning, use and development of land in the St. John's Municipal Plan. The St. John's Development Regulations provide the specific guidance required to implement the municipal plan by regulating land use and setting out development standards. A series of related municipal planning documents provide additional guidance on specific aspects of development and land use, such as the St. John's Recreation and Parks Master Plan, Urban Forestry Management Master Plan, and St. John's Cycling Plan.

1.1.5 Infrastructure and Servicing Challenges

As currently built-out, the distribution system for household water is unable to service new development on high ground. The effect of increased demand and elevation of the terrain do not permit water to be supplied in the quantity and pressure required for effective service. Upgrades to the system will be required to meet the needs of increased development above the 190m elevation.

The City's Stormwater Management Policy mandates a zero-net-increase in runoff between pre-development and post-development storm flows, and the employment of detention measures as part of new development in this part of the city. The rationale for this stringent requirement is to protect downstream property and the stream environment from flooding and degradation caused by the more rapid drainage of stormwater that could result from new development without proper planning. After exploring a number of options for stormwater detention in the area north of Kenmount Road, the *Regional Stormwater Detention Feasibility Study* (CBCL, 2013) recommends construction of a dry pond with an earth embankment berm at Yellow Marsh as the best solution to achieve the required control of stormwater flows. Yellow Marsh is an existing wetland lying to the north of the northern section of the study site.

Full development of the large land mass contained within the study area could result in thousands of new homes and a significant increase in automobile traffic, as well as the need to service new communities with transit and active transportation infrastructure (trails and bicycle routes). New streets and trails can be built, but these must also be linked into the existing transportation infrastructure in a way that is safe and does not create excessive traffic congestion. Property ownership patterns and the steep terrain within the study are major factors in the design of streets and trails.

1.1.6 Planning Methodology

Planning for the development of lands above the 190m contour is based upon requirements set out in the project terms of reference and existing provincial and municipal policy affecting land use and development. A site assessment of the landscape determined areas suitable for development, and identified limitations to development that may affect the use of these lands. Consultation with owners of larger land holdings was undertaken by the consulting team to understand their aims for land development.

Together the city's aims for land development, the capacity of the land to withstand development and the property owners' aspirations informed the preparation of a draft land use plan that outlined proposed land use pattern, open space system and street network recommended for the site. This plan was provided for detailed review by the project committee at the City of St. John's and land owners. Revisions to the plan were made based upon the feedback received and design of site services proceeded based upon the revised plan. Policy recommendations governing land use were then developed for the project site.

1.2 Understanding the Land Base

This section reviews key landscape characteristics of the study site to understand which lands are suited for urban development, and which lands should be conserved as open space to protect the ecological and visual quality of the landscape.

1.2.1 Identifying Lands Suitable for Development

Limiting characteristics of the site are considered and brought together to provide a comprehensive planning context highlighting areas suited for urban development. Many characteristics of the site may not pose an absolute limit to development, but provide useful information to help shape the final land use plan. A visual description of the land characteristics described in the following text is shown in Figure 2 - Land Characteristics of the Kenmount Site.

1.2.2 Topography and Geology

The landform of the study area including Kenmount Hill reflects the bedrock geology of the region. Resistant bedrock knobs and ridges oriented southeast - northeast give the landscape its present day form, which has been only subtly smoothed by glacial processes.

At 261m elevation Kenmount Hill is the highest of the peaks surrounding the historic centre of St. John's. Signal Hill (154m), the White Hills (160m), Mount Scio (224m) and the Southside Hills (239m) are its nearest neighbours in elevation and symbolic importance in defining the skyline of city (King, 1990). The land southeast of Kenmount Hill drains to the Waterford River, while water on the northwest side of the hill flows to Leary's Brook, Long Pond and Rennies River. The terrain north of Kenmount Road rises to a high point of 225m, to the northwest of Kenmount Terrace. This high land separates the watershed of the Broad Cove River that flows to the northwest from that of the Leary's Brook, Long Pond, Rennies River system that flows to the northeast.

The sometimes steep topography and shallow depth of till and soil over the bedrock will necessitate rock breaking or blasting operations to construct underground services, foundations and streets. The low moisture holding capacity of soils are a limit to plant forest development and a challenge for stormwater management – speeding the rates at which runoff will depart the site. The conservation of soil and till for re-use in site reinstatement will be an important factor in permitting the reestablishment of forest cover in disturbed areas of the site. Although the topography of the Kenmount Terrace development was more subdued, conditions for excavation on the study site may be somewhat similar.

References:
Heringa, P.K. *Soils of the Avalon Peninsula, Newfoundland*. Report No. 3 Newfoundland Soil Survey. N.P. Research Branch Agriculture Canada, 1981.

King, Arthur F. *Geology of the St. John's Area*. St. John's: NL Department of Mines and Energy, 1990.

1.2.3 Vegetation

Land cover within the study area is composed of forest, shrub land, farmland, barrens and developed land. The native forest of the region is part of the Boreal forest biome which is characterized by a cool climate, a short growing season and young relatively poor soils, and dominated by coniferous trees.

The forest is composed of Balsam fir, mixed with some black spruce, white spruce, white birch, yellow birch, trembling aspen and red maple. Juniper would also be found on poorly drained ground. Where growing conditions are good, balsam fir would make up to 75% of the trees on a site, and possibly grow to 15m height at maturity. White pine was once an important part of the forest mix but disease and over cutting have eliminated it from forests on the Avalon Peninsula. Shrubs and herbs commonly found lower in the forest structure include bunchberry, bristly club-moss, raspberry, gooseberry, northern twinflower, blueberry, sheep-laurel, dogberry, goldenrod, pin cherry and serviceberry.

The ability of forest to succeed on a given site is dependent upon the depth of soils and till over the bedrock, microclimate and seasonal soil moisture deficits. The inability of trees to anchor roots in the earth limits the potential for their growth in height. Often trees in the forest provide mutual support allowing them to grow tall together where individually they would not succeed.

Where existing tree stands are opened to the wind by clearing, subsequent wind throw can lead to the gradual collapse of the entire remnant stand. Efforts to counter this challenge should strive to reduce wind impact by avoiding straight line forest edges where cut back, allowing windfall trees to remain as a form of shelter for the trees which remain standing, employing other techniques to protect remnant trees from the wind, and avoid unnecessary damage to tree roots that provide stand resilience by twining together. Stands with greater width are likely to be more resilient to wind throw then narrow strips of trees left with little support.

On very exposed locations forest reestablishment may be limited by exposure to wind. Caution should be exercised in the decision to remove forest cover in exposed locations if the expectation is that remnant stands will survive, or that new growth can be established.

Shallow growing media over bedrock are prone to moisture shortage which can limit tree growth. Heringa reports that the best forest growth may occur on lower slopes where soil moisture and soil depth are likely to be in greater supply. Site reinstatement intended to permit forest regrowth must provide sufficient depth of growing media if trees are to be established. Where trees must be removed, the best opportunity for natural forest regeneration occurs when the forest root mat remains undisturbed and seeds and young trees are left intact to restock the forest. A second-best solution would be the conservation and reuse of forest soil and duff as the surface for restored forest areas. Changes to site grading and drainage that cause soils to dry out more quickly may limit future potential for future forest growth.

1.2.4 Wetlands, Streams and Waterbodies

Despite the relatively high terrain occupied by the study site, Georges Pond and other significant wetlands, streams are located within the study area. These were identified in a 1993 study: *Significant Waterways and Wetlands of St. John's Newfoundland*, and along with an appropriate Environmentally Valuable Area buffers, were mapped by the City of St. John's. The study area is also bounded by the watershed of the Broad Cove River, which is protected as the drinking water supply for the Town of Paradise.

The Newfoundland and Labrador Water Resources Act restricts development with wetlands, stream and water bodies and requires the preservation of a 15m buffer adjacent to them. This policy aims to preserve fragile habitat from destruction, allow for the storage and filtering of storm waters, and to mitigate impacts on property that may be caused by flooding. The City of St. John's stormwater detention policy requires a zero net increase in runoff caused by development occurring anywhere on the study site. These policies are particularly important for the mitigation of development impacts that harm the hydrological and ecological functioning of the Rennies River and Waterford River systems downstream.

The mapped wetlands, stream, Georges Pond and buffers must be protected from intensive development. Parkland developments of trails and boardwalks and may be permitted within wetland areas. Suitable land adjacent to the wetlands, streams and ponds should be retained to permit construction of more intensive park infrastructure that may be required to support public enjoyment of the protected spaces. Intensive land development outside the buffer areas should strive to support policy objectives by employing best practices for enhanced stormwater flows. Given Georges Pond location on high ground with little developed land contributing runoff, storm water management should strive to maintain high quality water within the pond by ensuring storm drainage released into the pond is treated in natural or constructed wetlands before it reaches the pond itself.

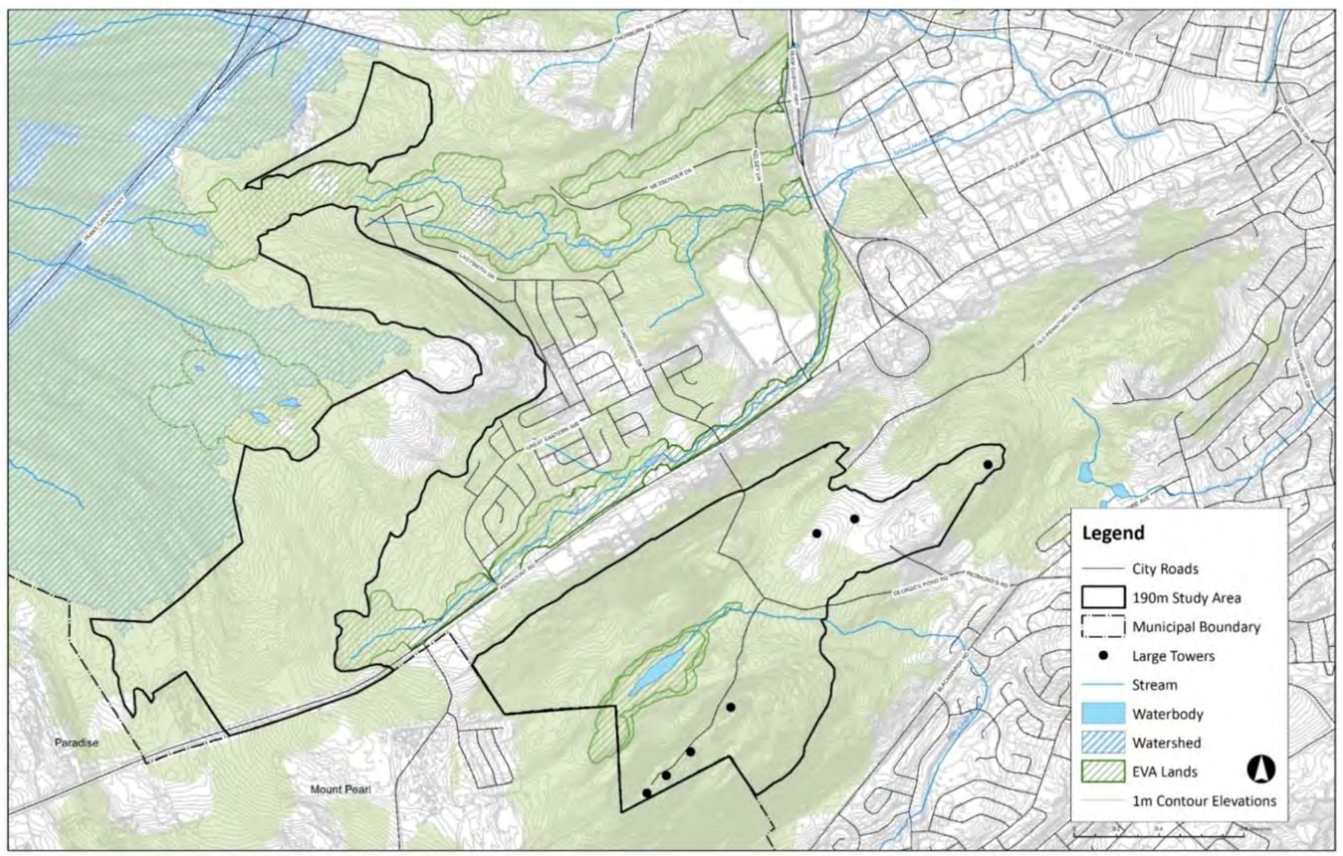


Figure 2 - Draft of Land Characteristics of the Kenmount Site

1.2.5 Slope

The Kenmount site is characterized by areas of steep slopes and high ground. These areas are more exposed to the elements, which can create environments less comfortable for human habitation, increase the damage to structures caused by high winds and wind driven rain, and a severely limit the opportunity for vegetation to become re-established once cleared from the site. The City has responded to these challenges in the St. John's *Municipal Plan and St. John's Development Regulations* by permitting steep slopes in excess of 15% to be designated as Environmentally Valuable Areas and preserved from development as such.

The strong southeast – northwest ridge form of the landscape south of Kenmount Road creates extensive areas of steep (>15%) terrain on the northwest and southeast sides of the hill. These are readily visible in the form of the long, steep treed slope at the rear of the businesses to the side of Kenmount Road and the treed slopes above Blackmarsh Road and Team Gushue Highway. These significant land areas containing slopes of 15% or greater should be retained as part of the public open space network, and not intensively developed. The slope analysis is shown in Figure 3 below.

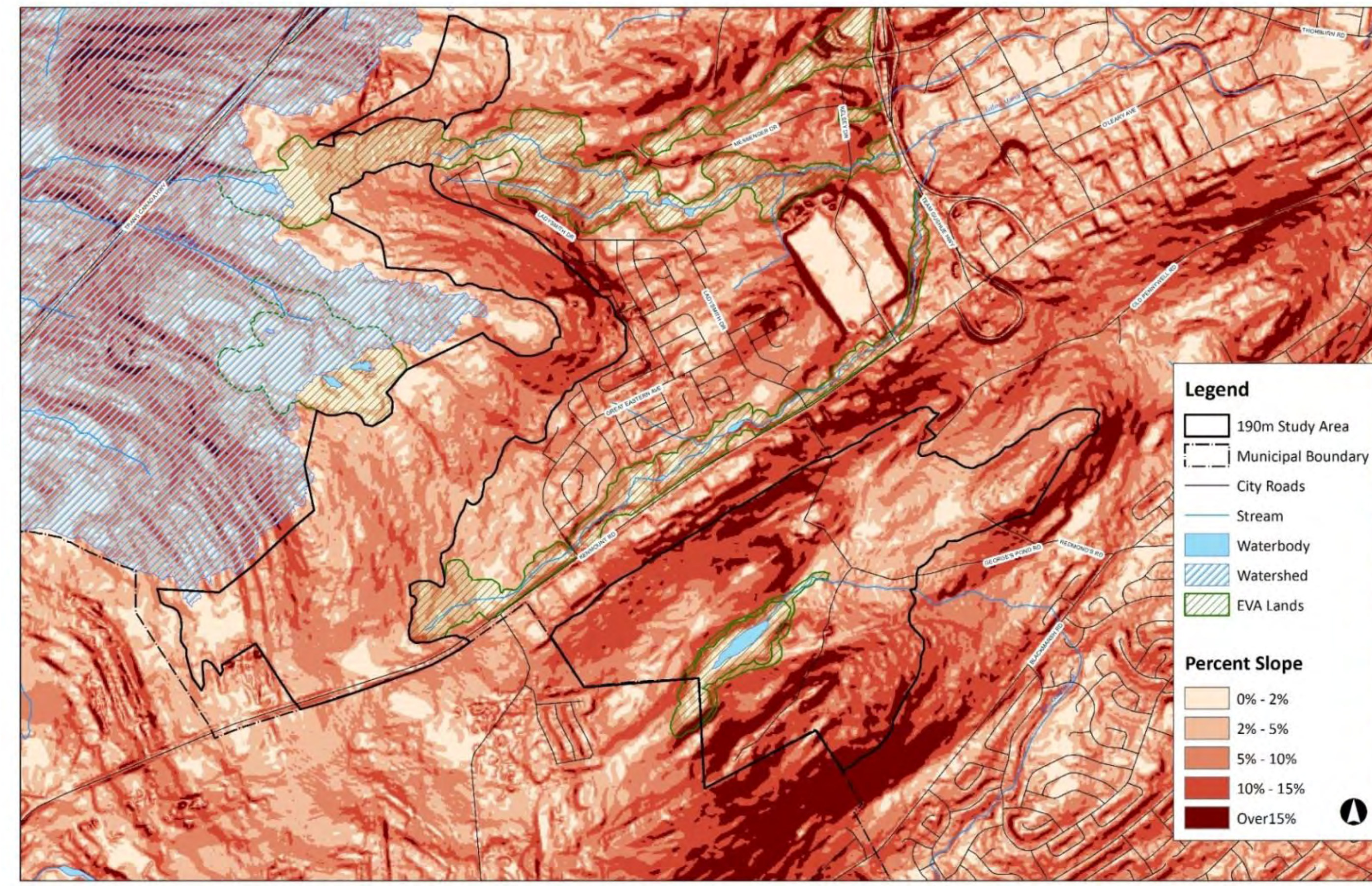


Figure 3 - Draft of Slope Analysis of Kenmount Site and Surrounding Lands

1.2.6 Landscape Character

The green hills surrounding St. John's are a defining characteristic of the city. The ring of hills (Mount Scio, White Hills, Signal Hill, Southside Hills, Kenmount Hill) defines a green enclosure for the city that makes the rugged environment and hardy spirit of the place highly visible and accessible for residents and visitors of the city. Each hilltop is a landmark in its own right and all have become a focal point for human contact with the environment and for recreation. That each is named, and that local residents generally know the names and the hills, attests to their power as physical and mental landmarks in the city.

Viewed from Signal Hill and high points within the city, Kenmount Hill and the surrounding forest and farmland form a prominent green wedge in the landscape that separates the Waterford River valley from Leary's Brook valley. The ridge defined by Kenmount separates Mount Pearl from St. John's and for all who approach the city from the west, forms an important gateway to the city. The cluster of communications towers on the highest ground emphasizes the height and prominence of the hill and make it visible by night. Large water tanks developed on the hillside have a different character and would benefit from screening to reduce their visibility, though this may be a challenge to achieve.

The steep green hillsides, hilltops and wireless facilities towers bring the hill into sharp contrast with adjacent developed areas. Where the flanks of the hill have been developed for housing, the loss of forest cover has caused the hill to lose definition in contrast to its surroundings.

In St. John's, the urban network of green spaces and trails are centered on the streams and ponds that extend from the hills through the city to the ocean. Green hilltop spaces have become the setting for cross country skiing, hiking, mountain biking and as refuges to enjoy the natural environment and the views. This pattern has extended to Kenmount Hill and the surrounding lands in a limited way. The hill is well used for mountain biking, though no formal public facilities for recreation have been developed here. The Team Gushue highway and Kenmount Road form substantial barriers for pedestrian access to the hill, though opportunities exist to create trail connections.

Development should strive to preserve high ground as a visual amenity and for use as public open space where compatible with communications infrastructure. For Kenmount Hill to retain significance within the urban landscape the scale of land to be preserved should be substantial and vegetation on the hilltops retained. Steep hillside slopes provide an opportunity for preservation of green space for use as public open space, forest preservation and shelter. Public access to preserved green spaces should be developed to provide access to the best views and recreation compatible with the natural environment. The installation of additional wireless facilities towers would not necessarily detract from the visual quality of the landscape. Future water towers that may be required to service development should be examined for their potential visual impact and designed to mitigate their visibility.

1.2.7 Wireless Facilities

Several significant wireless facilities towers are located on high ground south of Kenmount Road. The westernmost towers occupy steep terrain not well suited to development, the eastern most three towers restrict land development opportunities due to the potential impacts of Radio Frequency (RF) exposure, which the City has recognized by implementing a 200m buffer around the towers where residential and recreational land uses are prohibited. The significant wireless facility towers and the associated 200m buffer are shown below in Figure 4.

Radio frequency interference (RFI) is also a concern associated with the operation of the towers. In a wider area near Kenmount Hill, the operation of radio and electronic devices can be impaired by the interference generated by the towers. Any development in the general area should incorporate measures to prevent or minimize RFI within any developments.

Increasing urbanization in the region, public sensitivity to possible impacts of radio frequency (RF) and RFI exposure, and the wide setbacks to be maintained between dwellings and the towers now makes relocation of the towers a challenge. It is expected the towers will remain in place for the foreseeable future; future technological advances may bring changes that would remove these restrictions on development.

Figure 4 - Draft of Significant Wireless Facility Towers and Associated 200m Land Use Buffer

1.2.8 Conclusion

Seven substantial contiguous pockets of lands suited for development have been identified, with their limits shaped by the study site boundary, significant areas of steeply sloping ground and a network of wetlands ponds and streams with their buffers. Land otherwise suited to urban development in the southeast part of the site is limited by the presence of radiofrequency electromagnetic fields; the City of St. John's therefore restricts residential and parks development on these lands. Much of the site is affected by radio frequency interference and precautions to prevent nuisance to developed land uses should be required as a condition of development.

A green framework of lands not suitable for urban development provides an excellent opportunity to provide communities with access to open space and to retain valued wetlands and streams, and views from high ground. The need to limit development on steep slopes provides a convenient secondary benefit of preserving forest cover on prominent high lands.

1.3 Landscape Management Framework

This section describes the rationale for managing the landscape so that valued functions of the land are optimized in the context of the development planned.

1.3.1 Preserving Valued Ecosystems

The landscape functions associated with water (hydrology and habitat) provide a useful measure for assessing the impacts of human activity on the land, and a valuable guide for management of the landscape to sustain ecological quality. When runoff, wetlands, stream and water bodies are maintained in good health, ecological aspects of the landscape are considered to be well managed. Provincial legislation requires wetlands and stream habitats to be preserved. City policy requires development of the site to result in no net increase in storm flows for the 100-year storm event; adherence to these policies will make a significant step toward good water management. Ideally, impacts on the rate and quality of storm water runoff would be altered as little as possible by site development.

Natural landscape areas should be maintained with native vegetation in most areas so that storm water flows are minimized and water quality is enhanced. Major landscape interventions in natural areas should include efforts to mitigate development impacts on storm water. As well as retaining water to avoid downstream flooding, water should be infiltrated or treated in manmade or natural wetlands to remove added nutrients and sediment before it is introduced into ponds or streams.

In the urban environment, forest cover should be promoted where possible to intercept rainfall, permeable surfaces used, where possible, to reduce runoff, and runoff waters treated to remove nutrients and sediment before being introduced into natural waterways. Large parking areas should incorporate onsite treatment of storm water.

Preservation of native vegetation helps to provide habitat for plants and animals, and also contributes water management, microclimatic and aesthetic landscape qualities. Natural landscape areas should be maintained with native vegetation where consistent with human use of the landscape for recreation. Disturbed areas should have vegetation restored. Non-native plants should not be introduced to natural landscape areas.

In urbanized areas, woodland cover should be maximized where consistent with human use of the land. All streets and neighbourhood parks should be treed with the aim of developing a substantial tree canopy over time. Where options are practical, permeable green surfaces should be used in place of impermeable surfaces.

1.3.2 Development Clusters

Development clusters make sense from servicing and social perspectives, but also facilitate preservation of better quality habitats for plants and animals.

Wildlife movement is enhanced when the natural landscape is less fragmented, and species do not need to negotiate travel through developed areas. Retaining substantial well connected habitat clusters, as opposed to a larger number of smaller habitat patches, can accommodate species with larger habitat requirements. Larger blocks of landscape can permit the development of interior habitats which may host less adaptable species that do not thrive in edge conditions.

Management of the open space should strive to promote the maintenance of a diversity of valued habitats, to permit sensitive human use of the landscape, and facilitate the recovery of impacted landscapes that can be improved in ecological function. Parking areas, service buildings, picnic sites and trails should be located to minimize disruption of natural environments caused by habitat loss or fragmentation. Interventions to accommodate human activity within the natural areas should be designed to provide valued habitat diversity that mitigates damage to the landscape. Interpretation and educational programs can increase public understanding of the landscape qualities being protected.

Landscape corridors, linear habitats that connect separate natural landscape patches, should be enhanced with plantings to provide habitat and enhance opportunities for wildlife movement. The linear wetland area adjacent to Kenmount Road, and hydro corridors within the developed areas will be maintained during development and the habitat they provide should be managed for optimal habitat function and connectivity (consistent with the needs of the utility). Street crossings of wetland areas should be designed to mitigate the barrier they pose to wildlife mobility.

The proposed district park space, and the park defined by Kenmount Hill and Georges Pond will effectively become small habitat islands within the wider developed urban landscape. The challenge to maintain wildlife habitat here will be greater as wildlife and plant movement between islands and the broader natural environment will be limited by development. Unnecessary loss or fragmentation of the habitat in these areas should be avoided, and the largest contiguous landscape areas should be preserved. Thin corridors connecting these islands to adjacent patches should be carefully guarded.

Intensively developed areas of the site should also be managed to enhance landscape connectivity and habitat value. The use of native plants, plants with high habitat value and the creation of viable habitats within the urban landscape can enhance the ecological value of the entire site. Clustering of native vegetation may be a more effective way to establish plants in exposed environments following development. Streetscapes, park spaces and backyards may also be managed to provide habitat and enhance landscape connectivity.

1.3.3 Microclimate

The high terrain and challenging weather emphasize the importance of managing the microclimatic impacts of development on site. The high ground can be expected to endure very strong winds that amplify the impacts of rain and snow, and reduce the warming influence of the sun. The resulting cooler conditions and wind can damage property, impede the plant growth and affect human comfort in the landscape.

In areas to be retained as open space, natural vegetation cover should generally be retained, particularly on high ground. Landscape works to accommodate human needs on high grounds should be carefully considered to prevent the creation of overly exposed conditions. Naturally sheltered areas should be exploited where practical for site developments.

In the urban areas to be developed, architecture and landscape planting should be strategically employed to create more comfortable public places. Building height, roof forms, indentations, awnings, and canopies may be used to create sheltered spaces. The usual methods of establishing street tree plantings may need to be modified to promote plant survival and growth in more exposed urban environments. Mass plantings of clustered trees and shrubs may help create conditions where in time a second generation of plants can be established in more conventional manner. While it is difficult to establish plants in the landscape, it is of increased importance they be provided to moderate conditions for people.

1.3.4 Retaining Landscape Character

In St. John's, the green hilltops, lakes and streams provide the context around which urban development has taken place for more than 400 years. This pattern of traditional development and land use has resulted in a visual landscape pattern that has meaning and value for the community, even as times have changed and the land use needs have dramatically altered. As the landscape assessment has shown, preserving the rugged and harsh higher ground is extremely important for climatic, cultural, and environmental reasons.

In the natural environment, native vegetation should be maintained and used exclusively to retain green cover on the hilltops, steep slopes, and near Georges Pond and local streams. Vegetation should be managed to permit human enjoyment from key views on high ground and but also to provide sheltered places with year-round comfort for recreation to allow contact with a diversity of natural plant communities. Human access for utilitarian or recreational use should be carefully managed to avoid the creation of unwanted scars that tend to be long lasting in the local landscape.

Structures and clearings in the landscape should be carefully sited to minimize adverse visual impacts, and follow up earth forming and planting should be completed to mitigate those impacts. A plan for landscape restoration at the existing water towers should be prepared, and any necessary towers in the future should be subject to a visual analysis that considers their siting, colouring, and recommended mitigation measures. Site improvements in the open spaces should reflect the rugged quality of the landscape and past agricultural use of the land. Simple, robust, rustic treatments and furnishings should be used to reinforce the local identity. Remnants of past uses (foundations, field clearings, garden trees and shrubs) may be preserved to help tell the story of the area through the landscape.

A strong connection to the local character should also be built into the urban landscape. Building form, materials and colours can all echo distinctive Newfoundland architectural themes while allowing considerable latitude for individuality in meeting resident needs. The grid street system will provide a degree of urbanity but will require successful street tree plantings to develop a more intimate human scale over time. Detailing of urban spaces can use accent materials, local vegetation and furnishings to create streetscapes that have some individuality and that cannot be mistaken for relatively anonymous suburban landscape to be found in many Canadian communities. Main street buildings housing retail, commercial, and multi-unit residence should exhibit a high standard of design and sensitivity to the local context.

1.4 Recreation, Open Space and Active Transportation Plan

The recreation, open space and active transportation (AT) plan sets out a framework for the conservation of natural spaces as a means to protect valued natural functions and to allow compatible human use. It also sets out a plan for a network active transportation linkages through the development and to the wider community.

The protection of the natural landscape in the headwaters of the Waterford and Rennies River systems helps mitigate detrimental downstream impacts from development that could further compromise the ecological integrity of these urban streams. Lands recommended for conservation as open space will permit key ecological processes to be maintained, by buffering stormwater flows, cleansing stormwater, and preserving substantial habitat patches and corridors necessary to sustain native flora and fauna.

Conservation of the natural landscape also provides benefits for residents of the proposed development area and the broader community. Conservation of forest cover on high ground will mitigate the potential negative visual impacts of development on the urban landscape and the local climate, and increase human comfort and the appeal of the landscape. The network of green spaces permits development of an active transportation trail system and recreation spaces that provide a valuable alternative to use of the private automobile for transportation, and promotes physical activity and restorative contact with the natural environment.

The opportunity provided by the natural environment to bring members of the community together face to face strengthens the social ties that build community. Development of the open space network must meet the needs of all for access and safety as a way to build an inclusive community.

1.4.1 Active Transportation Network

A primary goal of the open space network is to build-in a viable transportation alternative to the private automobile, and to complement the regional transit network. The success of the AT network is dependent upon the strength of connections beyond the study site itself. Recommendations presented below should be read in conjunction with the *City of St. John's Cycling Master Plan*, 2009.

The AT trail network should consist of trails and multi-use paths that are at least 3m wide up to 4m in width (where possible) to safely accommodate a variety of non-motorized trail users, and two-way trail traffic. The trail itself should have a paved surface to facilitate snow and ice control, illumination for night time use, periodic benches, waste containers, way-finding information, and plantings to help provide shelter and improved visual character. Key destinations (mixed use neighbourhood core areas, district recreation facility and the Avalon Mall) should provide transit shelters, shower facilities and bike lockers to increase the feasibility of using active transportation for commuting.

The proposed new arterial streets connecting Kenmount Road with the Trans-Canada Highway are to have a 3 - 4m wide active transportation corridor constructed parallel to the street. It is preferred that this corridor be located within the natural landscape separate from the four lane street, to provide improved visual quality and vegetative shelter for users.

The Avalon Mall is an important transit hub and a worthwhile near-distance target for the AT system to be developed. Therefore, Great Eastern Avenue and Kenmount Road should be retrofitted to include a new 3 – 4m wide active transportation corridor outside the driving lanes. The route should extend the entire length of Great Eastern Avenue and on Kenmount Road from the municipal boundary to Columbus Drive, with the possible future potential to extend along Prince Philip Drive to major centres including the Health Sciences Centre, Memorial University and the Confederation Building. Undeveloped land on the north side of Kenmount Road and substantial green frontages on developed properties may provide the terrain needed to construct this route.

Local collector streets are to include a paved AT route trail separate from the automobile lanes, but contained within the street right-of-way of new local collector streets. The hydro corridor extending from Kenmount Road northward to the proposed new Bristol Park should also be developed with the standard 3 - 4m AT trail cross section.

Residential streets will have continuous sidewalks on both sides of the street, which will link up to active transportation routes and other trails through public open spaces to form a continuous network. Streets in mixed-use community core areas are to have a broader paved surface that provides space for street furnishings, planters, street trees, temporary display of merchandise outdoors, seasonal sidewalk patios, sandwich boards, and heavier pedestrian use. All sidewalks are to be illuminated, have a continuous planting of street trees, and periodic sitting areas scaled to the level of pedestrian traffic.

A complete streets philosophy and approach to the planning and design of the neighbourhood network and the surrounding main road network has been followed in developing guidelines for the roadway cross sectional elements. This approach seeks to ensure that roadways are planned for all users so that greater choice is provided to inhabitants to use either non-motorized forms of travel (active transportation) or transit as alternatives to using the private automobile. Very often this involves setting priorities for various modes of travel to ensure that the choice between them is balanced and that that they are accessible to all. This requires that at a minimum, sidewalks are provided on both sides of streets and that transit services are provided on collector routes through the neighbourhood so that they are readily accessible by at least 90 percent of residents (90 percent of residents/employees are to be within a 400m walking distance of a bus stop). Recreational and utilitarian bicycle use is encouraged by providing off-street mixed-use paths (where possible), or on-street facilities including buffered bicycle lanes (cycle tracks) on busy thoroughfares, or a network of on-street bicycle lanes, sharrows or signed routes. The travel behavior and transportation choices are determined in large part by the zoning and land use mix that is present in the neighbourhood and the connectivity of the various transportation facilities within the neighbourhood as well as external to it. Zoning that permits a mixture of land uses that encourages shorter trips and increases the potential for greater internal trip making is to be encouraged as this will increase the potential for greater use of active modes of travel. The built form of the development will also influence the use of alternative modes. For example, planning for connected routes through the neighbourhood that can serve transit with a development pattern and type that places the majority of residents/employees within a 5 to 10-minute walk of a transit route will encourage greater transit ridership. These principles have been kept in mind in the development of both the land use mix and pattern and transportation and transit networks in the development.

Typical cross sections for arterial, collector and local streets are provided in Appendix B-4. The final active transportation and transit facility requirements should be reviewed again at the development stage to ensure that continuous networks of pedestrian, cyclist and transit facilities are provided throughout the neighbourhood that are connected to similar facilities on the surrounding network.

Implementation of the AT network should proceed in step with development, so that a direct and contiguous route and sufficient lands to allow economical construction and good visual quality is obtained. A basic functional trail network should be in operation when people take up residence in the development, so that patterns of use may be established early on. The network should be completed as a condition of occupancy for developed properties. Later retrofitting of the built environment for active transportation (AT) is unlikely to achieve a high level of functionality and convenience for users, and is certain to be costlier to implement. City initiatives may be required to advance planning and development of the AT route along Kenmount Road. Implementation of the AT network proposed should be coordinated with the *City of St. John's Cycling Plan*, Metrobus and the adjacent municipalities to ensure the well-coordinated and contiguous system is achieved in the long term.

1.4.2 Pedestrian Trails

Trail development will encourage active transportation and provide a recreational outlet and an opportunity for contact with the natural environment.

Major highways that encircle the study site (Trans-Canada Highway, Team Gushue Highway, Kenmount Road and Thorburn Road) pose a challenge to integration of local trails with the wider Grand Concourse network and trails system and recreation offerings within C.A. Pippy Park. But this challenge needs to be addressed effectively in development planning and construction to prevent the imposition of additional impediments to trail connectivity and the quality of trail users' experience. Trails proposed within the development must connect with routes in C.A. Pippy Park north and south of the Trans-Canada Highway, Branscombes Pond, Cowan Park, and into Mount Pearl and Paradise (Newfoundland T'Railway).

Within the development site, trails should connect neighbourhood clusters to one another, link residential areas with local workplaces and shopping areas, connect open spaces into a neighbouring network, and provide access to parks and lookouts to be developed on higher ground. The development concept plan provides a schematic routing for the main trail system.

Trail links should extend to local sidewalks; trail access points between homes should have a minimum width of 15m to allow proper buffering of trails adjacent to private yards. Trail separation from the rear property lines of homes should maintain a minimum setback of 15m for home owners' privacy and to provide the best trail user experience. It is preferred that trail connections be made in the natural environment, and as second best option through existing utility corridors, and thirdly, along local streets.

Construction of trails should provide a sound gravel trail base suited for year round use, with a preferred width of 2.4m and a minimum width of 2.0m for main trails. Trail construction should strive to provide a high level of accessibility for all users, as is compatible with the preservation of the natural processes and landscape character. Trail implementation should be carried out by experienced designers and builders, and be warrantied to stand up to all local standards for trail development.

1.4.3 Neighbourhood Parks

Neighbourhoods parks provided within community clusters help to give definition to the neighbourhood centre, and meet the day to day needs of nearby residents for year round access to the outdoors. Park spaces are proposed in central locations with ample street frontage to ensure passive surveillance for the security of park users and to prevent potential misuse and upset to neighbouring residents. Local parks will also provide a focal point for neighbourhood activity that will help build a sense of community. For residents on small lots or in multi-unit buildings with limited open space, neighbourhood parks will provide an important amenity, and will require a relatively high level of development to meet user needs.

At a minimum, neighbourhood parks should provide hard surface paths that may be cleared for year round use, seating, shade, some form of shelter from the elements, play spaces and facilities to meet the needs of local pet owners. Public art, community gardens, and neighbourhood events should be facilitated as add-on elements that could be sponsored by neighbourhood organizations to tailor the park to better meet local needs and build community pride and ownership.

1.4.4 Community Park Spaces

The wetlands, steep slopes and exposed hill top areas make up a significant area of terrain not well suited to urban development, but which will constitute a significant contribution to the urban parks network and the planned community. These park spaces will help conserve ecological functions, and soften the visual impact intensive development will have upon the landscape, and help to provide shelter from the exposed conditions prevalent on some of the highest terrain to be developed within the city. These parks can be expected to be very popular, given the local popularity of Signal Hill, Pippy Park and local lakes and ponds for hiking and water based recreation.

Basic parks developments (trails, site furnishings, lookout areas, forest management) within these areas will provide residents with access to these natural spaces and viewpoints for recreation in a manner consistent with the need to maintain natural processes and the aesthetic quality of the landscape. Informal use of high lands for mountain bicycling activity should be organized and managed in consultation with current users to permit continued use in a manner consistent with resource conservation, shared public use of open spaces, and ongoing operation of wireless facilities infrastructure.

To the north of Kenmount Road, a significant hilltop park space on the Hiscock family property provides an excellent view of the landscape to the east, and may be a suitable location to reflect the historic use of the site for agriculture and forestry. Reforestation of some areas may be advantageous to provide improved microclimate and retain the presence of "pine clad hills" locally and within the wider cityscape. Programming for this park space may include off street parking for park users, trails, washrooms and drinking water supply, overhead shelter, picnic and barbeque facilities, play areas, winter sliding hill, a lookout that takes advantage of the views, and presentation of the cultural landscape of the area.

To the south of Kenmount Road, the lands adjacent to Georges Pond provide a second green space suited to parks development, given the attractive water body and sheltered location between the hilltops. Nearby high ground should be exploited to permit enjoyment of the views, and Kenmount should be preserved permanently as a forested hill. Programming for this park space may include off street parking for park users, trails, washrooms and drinking water supply, overhead shelter, picnic and barbeque facilities, play areas and winter sliding area, facilities to complement the recreational use of the pond in summer and winter, a lookout that takes advantage of the views, and presentation of the natural landscape.

Wireless facilities towers on Kenmount meet a valued need which is not easily relocated, and can be expected to remain in place for the foreseeable future. The tower service access road, power supply, supporting buildings, towers, braces and associated fencing should be carefully integrated into the surrounding parkland. Informal dump sites must be cleaned up, and green cover should be re-established over disturbed ground where consistent with operational needs. Redundant equipment should be removed from site. Service roads may serve double duty as a trail for park users, providing passive surveillance and helping to reduce vandalism. Similarly, the water towers must be maintained, but greening of the surrounding landscape would help blend them with the landscape. Interpretation of the functions the wireless facilities and water towers play would make them fit better within the park landscape.

Planning for the network of natural spaces, more developed park core areas and trails should be integrated to provide a cohesive local open space system. Planning for the study area has not uncovered significant habitat for flora or fauna, nor explored the cultural history of the site in detail; this should be explored in greater detail as part of master plan for parks development on the site. Planning for these park areas should carefully assess the expected level of use and size facilities to ensure park use does not lead to degradation of the landscape, nuisance for area residents or unanticipated operational challenges.

1.4.5 District Recreation Centre

With an anticipated community population of more than 10,000 people, a district recreation centre is warranted to meet the needs of the community for comprehensive recreation offerings.

The recreation centre will provide an opportunity to bring the population of the area together socially, fostering a collective sense of community for new residents north and south of Kenmount Road, residents of Kenmount Terrace, and workers in the adjacent commercial, business and industrial areas.

If required, a local school could be situated at the park site where sharing of facilities would provide students with enriched recreation opportunities, improve daytime utilization of recreation facilities, and reduce the total cost of recreation facilities. Field areas and natural areas within the district park may be designed for use as temporary storm water storage areas.

The facilities to be incorporated in the district recreation centre would require a significant investment, and would best be determined by a feasibility study that is able to assess the potential demand and fit within the City's recreation master plan. None-the-less, current recreation trends indicate the following elements are likely to be merited:

Indoor:

- Leisure pool (places for preschoolers, tots and parents; therapy pool, sauna, hot tub, zero entry for pool, two lap lanes, water spray elements)
- Active multi-purpose rooms (2-3)
- Pre-school room
- Indoor play spaces for children
- Double gymnasium & indoor walking track
- Climbing wall
- Cardio facilities
- Strength training room
- Public washrooms and change rooms
- Community meeting spaces (lounges for seniors and for youth)
- Concession
- Office space for staff
- Support space for maintenance, mechanical, and janitorial

Outdoor:

- Patio
- Connections to Active Transportation routes and local trails
- Public park space with low maintenance horticultural features and display gardens
- Community gardens
- Nature interpretation and educational facilities
- At least two illuminated play fields (one freeplay, a double soccer field, possibly a cricket field)
- Ball field for minor & senior play
- Small skatepark
- Multi-purpose hard surface courts
- Pre-school play space
- Dogpark
- Multi-purpose outdoor events space (may overlap with other fields)

Other facilities that could be merited include:

- Privately operated daycare facility
- Water slide, swirl pool or dry sauna may be merited with leisure pool
- Handball/racquetball courts
- All weather regulation size soccer pitch illuminated for nighttime play

As indicated above, a follow-up study is merited to verify recreation needs and to set out a design program, preliminary site concept plan and phasing for this facility. The land area shown in the concept plan (Figure A) sets aside 35 acres for the school district and 25 acres for the park district, including the wetland. Adequate land is available for both uses.

1.5 Land Use Concept

1.5.1 Introduction

This section outlines the rationale for the planning and design of development proposed above the 190m contour, and general requirements for development.

1.5.2 Smart Growth

The design of the development area is based upon the concept of smart growth. This theory proposes that new communities contain a diversity of land uses and provide residents with diverse options in housing. Also, smart growth communities reduce reliance on the private automobile for transportation by facilitating transit use, active transportation and creating walkable neighbourhoods. Smart growth communities complement existing communities, conserve valuable natural areas, and create attractive environments that reflect an individual sense of place. The following discussion elaborates on the key tenets of smart growth as they relate to the study site.

1.5.3 Mix of Land Uses

Avoiding the strict segregation of land uses allows for the creation of more interesting, healthy and convenient communities. Locally providing for daily needs facilitates access by youth, seniors and others who might not be able to count upon a private automobile to deliver them to desired settings. While striving to avoid monotonous places, careful design is needed to ensure the composition of diverse forms of housing, neighbourhood retail and business areas results in a coherent and compatible assembly.

Two mixed-use community development areas are proposed on the site – one to the north of Kenmount Road and a second to the south. These areas create small pedestrian friendly downtown areas that will service the needs of local residents and create a focal point for the social life of the community. Commercial activity is excluded from smaller neighbourhood clusters to focus demand on the two mixed use centres, and to ensure the viability of businesses which locate there. Adjacent highway commercial areas should be controlled to limit competition with neighbourhood commercial areas.

Areas for more expansive land uses are located adjacent to the mixed use community core areas, providing local employment and a pool of employees who help support local businesses in the community centre, without detracting from the compact and walkable character of those community centres.

Ample open spaces surround the developed lands, providing a counterbalance to the moderately dense community form, without compromising walkability at community centres.

1.5.4 Choice in Housing

A diversity of housing is proposed to provide the market with choices in housing form, size and tenure that will meet the needs of a broad spectrum of the population throughout their lifespan. The provision of adaptable housing forms would also help meet this goal. The right mix of housing would make it possible for residents to live their lives in within their chosen neighbourhood and thereby maintain social ties and supports. The mixture of housing forms also helps to prevent social exclusion or isolation that might otherwise arise as an unintended consequence of monotonous developments of single home types.

In neighbourhood development clusters, various forms of housing on small or compact lots and in multi-unit buildings is organized to define a village centre near a neighbourhood park space. The proportions of the housing types respond to market demand, and the needs to achieve minimum average residential densities needed to justify convenient transit service. In mixed use community centres a higher density of housing is required to support commercial activity and to differentiate development clusters.

1.5.5 Transit Oriented Development

Transit oriented development (TOD) aims to create the conditions that would permit the delivery of convenient and economical mass transit, reducing reliance on the private automobile. TOD is achieved by creating compact community core areas well serviced by transit, shops and services which thereby draw the surrounding residents on foot. These complementary elements enable the creation of a community business centre and promote transit ridership. Residential development within walking range (~600m) of the community core is to average at least 25 units per hectare of non-public land, and not be less than 17 units per hectare. It is recommended that all residential areas to be developed meet or exceed these minimum standards. Higher residential densities in buildings up to 5 storeys in height should be permitted where surface parking does not occupy more than 50% of the development site.

By creating viable alternatives to the private automobile, the ability of seniors and youth to access local shops, services, recreation offerings and social settings is increased. With an attractive transit option, life may be more economical for local resident families who may be able to avoid the purchase of a second car, or even live car free. By reducing the proportion of trips taken by private car, new development can contribute less to traffic congestion and the need for costly surface parking or parking structures elsewhere in the city.

Two mixed use community core areas are proposed as the focal points for TOD. Four subsidiary neighbourhood clusters are proposed to provide a supporting population base for business, along with the Kenmount Terrace community and proposed commercial, business and industrial areas. Community commercial areas create an urban street at the periphery of residential areas, while enjoying high visibility, access and sufficient surface parking adjacent to collector streets.

1.5.6 Complete Streets

The provision of complete streets complements TOD. As discussed in Section 1.4.1, compete streets provide safe, convenient and attractive travel for motorists, cyclists and pedestrians. Continuous and well organized walks and bicycle lanes, accessible and safe street crossings, lighting, seating, landscape planting to enhance personal comfort and add visual interest are all part of making the street complete. Recommendations are discussed in the recreation and open space plan section.

1.5.7 Active Transportation

Various forms of transportation power by human energy are collectively known as Active Transportation (AT). The local grid street network, trails in open spaces, and dedicated paths for AT within collector street corridors all enhance the viability of walking, running or cycling as a means of transport. Recommendations are discussed in the recreation and open space plan section.

1.5.8 Design Standards

The creation of more dense and diverse environments that enrich living conditions and transportation alternatives must be supported with a higher than ordinary level of design in the public realm. Less spacious separations between properties and land uses require a higher level of physical design to ensure a compatible fit is achieved. The success of community retail spaces and the marketability of more compact residential communities relies upon attractive streetscapes and buildings with strong "curb appeal". Commercial and business park areas adjacent to community developments need to define a quality urban environment that encourages interplay with community retail areas, and is in harmony with adjacent residential areas. Parks and open spaces play a more important role in areas where private gardens are limited.

All buildings, particularly multi-unit residential structures, retail and office buildings in community core areas need to achieve high standards of design in terms of their relationship to the pedestrian environment and the streetscape as a whole. Retail and residential streetscapes need to be tailored to reflect an urban feel. Neighbourhood parks and less developed open space areas will attract high level of use from residents and the wider community, and merit well considered design as well.

Detailed design guidelines for architecture, urban design and open space should be put in place to ensure a consistent high standard of design is achieved in all development. Fairness would indicate that guidelines be put in place before any development is permitted, so the costs and benefits are shared among developers and property owners.

1.6 Residential Land Use Planning

1.6.1 Neighbourhood Development Areas

The St. John's Municipal Plan notes that: "Perhaps the single most important function of municipal government is assisting in the provision of suitable, affordable, and attractive environments for housing of all groups in the population." The Municipal Plan also notes that "Residential development is by far the largest category of urban land use in St. John's. As such, it has a major influence on the character of the city and the quality of life of its inhabitants." Part III, Section 2.2.1 of the Municipal Plan states that: "The City views the neighbourhood as the basis for comprehensive planning of the residential environment. The Plan notes that through public initiatives and appropriate development, the City shall encourage and guide the development of such areas so as to conserve and improve their individual quality."

This Development Concept Plan has been crafted so as to develop liveable, sustainable neighbourhoods rather than simply new residential developments. It places emphasis on the more efficient use of lands in the Study Area and less reliance on automobiles through smaller lot compact forms of housing, higher density residential uses, and provides opportunities for choice in housing styles.

1.6.2 Transit Oriented Development

The City's Terms of Reference for the preparation of the Development Concept Plan note that:

"Affordable and convenient transportation is important for residents to travel from their home to their place of work or school and to other destinations for necessary services or amenities. Land use planning needs to support public transit in terms of the location and layout of neighbourhoods, including higher density residential as well as commercial services, served by well-designed roads. The Development Concept Plan must consider public transit in its design, incorporating the principles of transit-oriented design (TOD)."

A transit oriented development is generally regarded as a mixed-use residential and commercial area or development designed to maximize access to public transit which often offers features to encourage transit ridership. A transit-oriented neighbourhood typically has a centre with a transit station/stop/hub normally surrounded by higher density residential development with progressively lower density residential development spread outward from the centre.

A transit oriented development places the highest residential and employment densities near to frequent transit stops and steps these densities down to transition to surrounding neighbourhoods. Such developments are designed to try to ensure a good diversity of land uses; a mix of housing types and good balance between residential development and places of employment so that people are not too far from work, shopping facilities, services and other destinations. Such developments work to be pedestrian and bicycle friendly to allow residents alternatives to constantly having to use their vehicles to travel to work or to shops and services.

This Development Concept Plan has been designed to incorporate the principles of transit oriented design. It designates two transportation hubs-one on the north side of Kenmount Road and one on the south side of the road. Adjacent to the hub on the north side of Kenmount Road, a park and ride areas has been designated. Near the two transportation hubs are areas designated for commercial and office developments which will provide opportunities for places of employment for the future new residents of the Study Area. The recommended pattern of residential development designates higher density development near the transportation hubs and the places of employment and then recommends lower density developments away from the commercial centres.

An extensive system of bicycle and pedestrian trails has been designated in the Development Concept Plan to provide opportunities for residents to travel within the new development area and to the adjoining Kenmount Terrace residential area.

The Development Concept Plan recommends the establishment of seven (7) neighbourhood development phase areas, six (6) of which are proposed to feature residential developments. The development phases are set out based on topography, current applications for development, preservation of nature and environmentally sensitive areas more so than land ownership patterns. The intent is to provide for staged orderly growth in a coordinated fashion. The intent would be to concentrate land development within one development phase area first before moving to development in the next development phase area. In this fashion, development in the Study Area evolves in a more compact fashion, infrastructure and roads are provided for in a more coordinated manner and development does not become fragmented and piecemeal. The proposed order of development is set out in detail in Chapter 4 of this report which deals with Implementation Strategy.

1.6.3 Housing Mix

Section 5.1 of the City's Terms of Reference for the preparation of the Comprehensive Land Use Development for lands located above the 190 metre contour in the Kenmount Road specifies that the final concept plan will make provision for residential uses, accommodating single detached houses through to higher density housing such as semi-detached houses, row houses, and apartment buildings for rental or for condominium ownership.

This Development Concept Plan proposes a varied mix of residential housing forms, from single detached homes on standard sized building lots (15 metres lot frontage and minimum 450 square metres lot area), to single detached homes on smaller lots (12 metres lot frontage and minimum 360 square metres lot area), semi-detached homes, townhomes and apartment buildings. The proposed mix of residential land uses is set out in detail in Section 1.6 of this report which sets out the Land Use Summary.

The Development Concept Plan's proposed mix of residential land uses can potentially yield a total of approximately 4520 new residential units at a residential density of 31.2 units per net hectare for an estimated residential build-out population of approximately 10,850 persons. The percentage of proposed multi-residential units and the number of residential units per net hectare is higher than traditional for most residential developments in St. John's such as the newly constructed residential subdivisions on the north side of Kenmount Road, west of the Kelsey Drive area where the new residential developments to date have been entirely constructed as single detached homes on standard sized building lots (15 metre lot frontage and 450 square metres lot area).

The proposed higher residential densities and yields of the Development Concept Plan are in keeping with the policies and objectives of the St. John's Municipal Plan. Specifically, Part III-City Wide Objectives and Policies-Urban Form of the Municipal Plan provides that:

a) Section 1.2.2-Development Density:
"The City shall encourage increased density in all areas where appropriate."

b) Section 1.2.3.-Residential Development:
1) "The City shall increase densities in residential areas where feasible and desirable from a general planning and servicing point of view."
2) "The City shall encourage a compatible mix of residential buildings of varying densities in all zones."
3) "The City shall minimize sprawl by encouraging large-scale integrated developments in all expansion areas."

c) Section 1.2.4-Mixed Use
"The City shall encourage the mixture of land uses in all areas."

In promoting a mixture of housing types, the Development Concept Plan will offer a range of housing types to the local residential market and provide increased opportunities for affordable housing. To implement the Development Concept Plan's intention of promoting a range of housing types, the following development policies are recommended to the City in its use of this Development Concept Plan to guide and regulate development in the coming years in the geographic area included within the boundaries of the Plan.

<u>1. Standard Sized Residential Building Lots:</u>
The Development Concept Plan recognizes the ongoing demand in the local housing market for the provision of standard sized residential building lots (minimum lot frontage of 15 metres; minimum lot area of 450 square metres) and recommends that 51% of the housing mix be allowed to develop in this manner for a total of 1575 lots. However, it is recommended that the City explore opportunities to enhance the streetscape of the Concept Plan area by staggering front line setbacks for adjacent homes from a consistent 6 metre building line to alternates of 5 metres and alternate side yard requirements between homes from 1.2 metres to 1.5 metres to provide for more variety of spacing between houses.

<u>2. Smaller Sized Residential Building Lots:</u>
The Development Concept Plan promotes the development of smaller residential building lots for single detached houses (12 metres frontage and 350 square metres lot area). The Development Concept Plan provides that approximately 31% of the housing mix be allowed to develop in this manner for a total of 1208 building lots.

<u>3. Carriage Homes-A New Type of Accessory Residential Unit</u>
It is recommended that the City may wish to consider allowing a new type of residential dwelling in the Kenmount Road Development Concept Plan area: "Carriage Homes".

A Carriage House is a residential dwelling in a stand-alone building on a residential property that also contains a single detached dwelling. The Carriage House may be a purpose-built building or may be a conversion of addition to an existing garage or accessory building.
A Carriage House can be possible alternative to a subsidiary apartment in a single detached home. A Carriage Home provides an above ground living environment and more privacy in most cases than would a subsidiary apartment.

There are municipalities in Canada; it appears to be primarily British Columbia, where Carriage Homes have been successfully introduced as a means of increasing residential densities where it is considered appropriate to do so and as a means of providing opportunities for affordable housing. There are specific regulations for Carriage Homes which have been drafted so as to ensure that the lot housing the Carriage House is sufficiently large; that the privacy of neighbours is safeguarded and that the character of a neighbourhood is maintained. The following are some requirements that have been drafted by some municipalities to regulate Carriage Homes:

a) Only one (1) Carriage House is permitted per property and it is only allowed on properties featuring a single-detached house; no other types of housing are permitted to have a Carriage House. Some municipalities may require the lot to be larger than a standard sized building lot for a single detached house in order for approval to be given for the establishment of a Carriage House.

b) A Carriage House may not be sited or located on a separate parcel from the principle dwelling unit.

c) Some municipalities may require that a Carriage House cannot be occupied as a residence except where the owner of the property primarily resides in either the Carriage House or the principal dwelling unit. If the registered owner ceases to reside in either the Carriage House or the principal dwelling unit, the Carriage House is not permitted to be rented out.

d) Carriage Houses must be located to the rear of the principal dwelling unit.

e) Generally, Carriage Houses are permitted to be constructed to a maximum of 60% of the total net floor area of the principal dwelling unit or up to a specific floor area, whichever figure is less.

f) The Carriage House can be built up to a specific height or the same height of the principal dwelling unit, whichever is less.

g) There are normally specific yard setbacks specified so as to protect the privacy of neighbouring residential properties.

h) There must be one (1) dedicated off-street parking space for the Carriage House.

i) A property which has a subsidiary apartment is not normally permitted to have a Carriage House and a property which has a Carriage House is not permitted to have a subsidiary apartment.

Carriage Homes could potentially be an alternative to subsidiary apartments in the Development Concept Plan area on the basis that new homebuyers would advised that these types of units are allowed in the area before purchasing in this area and would have that understanding before purchasing/building their homes.

It is also recommended that traditional subsidiary apartments as defined under the St. John's Development Regulations be allowed in the Development Concept Plan area subject to the current requirements of the Development Regulations.

<u>4. Promotion of a Variety of Housing Types</u>
It is recommended that a full range of housing types be allowed and promoted under the Development Concept Plan in order to increase residential densities in keeping with the City's municipal planning objectives and to provide a choice of housing options for new residents.

<u>5. Mixed Use Buildings</u>
It is recommended that commercial-office buildings be allowed to include residential dwelling units on the second and higher storeys of the building. This provides opportunities for easy access to shopping and services for the buildings' residents, establishes higher residential densities to make effective use of land and offers alternative choices in housing types for residents.

<u>6. Mandating a Variety of Housing Types</u>
In order to ensure that lands included in the Kenmount Development Concept Plan area are ultimately developed in a manner so as to provide a variety of housing types and to increase residential densities from traditional new suburban development, it is recommended that the City consider enacting residential zoning for a portion of the Study Area which, while providing the opportunity for a variety of housing styles under a single zone designation, requires that a minimum percentage of a residential development must be allocated for housing other than single detached houses on standard residential building lots (minimum 15 metre frontage; minimum lot area of 450 square metres). Information on this recommendation is contained in Chapter 1.9.2 of this report dealing with Policy and Regulatory Recommendations.

1.7 Neighbourhood Commercial and Employment Generation Uses

1.7.1 Introduction

As part of the goal of achieving a more complete community for the Development Concept Plan area, the proposed land use mix under the land use plan has been extended beyond only residential developments. The plan makes provision for a combined potential total of approximately 18,700 square metres of retail floor space and approximately 37,400 square metres of potential office space. These designated areas, which will be within walking and bicycling distance from many of the areas proposed under the plan for residential development, will provide convenient access to shopping and services and significant opportunities for employment for future new residents. In addition, there are areas in close proximity to the Study Area which have previously been designated by the City for future commercial and industrial development and these areas too will provide opportunities for shopping, services and employment for the future new residents. Additionally, it should be noted that the significant number of existing residents in the Kenmount Terrace area to the east of the Study Area and the rapidly growing Elizabeth Park area in the Town of Paradise to the west of the Study Area, jointly provide a large potential market for new business developments to establish in the area included within the boundaries of the Development Concept Plan.

The Development Concept Plan proposes that there be one major central neighbourhood commercial location to service both the north side and south side of the Study Area. This commercial node has been located in close, convenient proximity to the proposed transit location. Given the projected potential full build out population of approximately 11,000 persons who could live in the Study Area, the number of existing residents who live in the Kenmount Terrace area, and the large of number of existing residents in the nearby Elizabeth Park and surrounding areas within the Town of Paradise, there is every reason to believe that this new commercial area on the north side of Kenmount Road has the potential to be major new commercial core in the southwest sector of the city. A second smaller neighbourhood commercial centre has also been proposed for the south side of Kenmount Road, also near a proposed transit hub.

It is recommended that commercial buildings in the Study Area be allowed and encouraged have a residential component. This serves to establish an around the clock residential presence in the commercial areas designated under the Development Concept Plan, increases residential densities and provides opportunities to residents for a choice of housing types. The proposed zoning for the Study Area makes provision for a residential component.

To provide additional convenient opportunities for access to shopping and services for both future new residents and existing residents in the Kenmount Road area it is noted that:

1. The proposed zoning for the areas designated for multi-storey residential buildings (apartment buildings) will be Apartment Low Density (A1) as defined under the St. John's Development Regulations. The A1 Zone allows as Discretionary Uses: convenience stores, service shops and uses complementary to an apartment building.

2. The proposed zone integrates the new residential zoning designation with strategically placed pockets of Commercial Neighbourhood (CN) zoning to allow neighbourhood commercial services that are easily accessible and in close proximity to residents.

3. More and more, telecommuting and people working from home is occurring. This trend is expected to continue and to grow. The Development Concept Plan recognizes and promotes this trend by making provision in the proposed zoning for all the residential housing forms to allow home offices and home occupations. Home offices are defined under the St. John's Development Regulations as secondary use of a residential dwelling unit by at least one resident of the dwelling unit for a business or occupation which does not involve clients coming to the home. Home occupations are defined under the Development Regulations as a secondary use of a dwelling unit by at least one of resident of the dwelling unit for some type of occupations or business activity which could involve clients coming to the dwelling unit. Examples of home occupations would be a hairdressing establishments, dance studios, yoga studios, massage therapy clinics. Home offices are proposed to allow as Permitted Use under the zoning for the Development Concept Plan, while home occupations are proposed to be allowed as Discretionary Uses.

1.8 Institutional Public Services

The Terms of Reference for this project provide that the Development Concept Plan will include a land use category for Institutional Public Services (e.g. possible school sites, or location for a future community centre, equipment depot, or other required uses).

1.8.1 School Sites

The consulting team has met with facilities management/planning staff of the Newfoundland and Labrador English School District to discuss the need to designate one or more potential future school sites in the Development Concept Plan. The School District staff have advised that given the projected potential full build-out population of the Study Area: the remaining residential lands to be developed in the Kenmount Terrace area and the rapidly growing population in the Town of Paradise, that they see the need for two school sites to be designated in the Study Area-one school site for a primary elementary school and one site for a junior high school site. School site criteria have been discussed with the School District staff and based on these discussions; one large site to accommodate both proposed school buildings (35 acres) has been designated for the north side of Kenmount Road. The park adjacent to the school site is proximate to a wetland area and could contain amenities such as hiking or biking trails, rest areas and scenic lookouts and wildlife/habitat information. This school site would of course, be subject to the future detailed review and approval of the School District and appropriate Provincial Government officials.

1.8.2 Fire Station

Discussions have been held with the Director of the St. John's Regional Fire Services Department (Fire Chief) who has advised of the planning criteria to be used in establishing the potential need for a fire station in the Study Area.

The consulting team has reviewed response times for fire fighting vehicles coming from the existing fire station on Kenmount Road, the new fire station on Blackmarsh Road and the new fire station to be built on Topsail Road in Paradise to the geographic area included within the boundaries of the Development Concept Plan. As a result of this analysis, it has been determined that a new fire station will be required to ensure adequate firefighting coverage to the Study Area. A proposed site for a new fire station has been designated for the north side of Kenmount Road and this site is indicated on the Development Concept Plan Land Use Map.

1.8.3 Community Centre/Recreational Complex

The Development Concept Plan proposes a new community centre/recreational complex site for the north side of Kenmount Road. This facility could feature both indoor and outdoor recreational facilities. The proposed location has the advantage of being in close proximity to the designated transit hub, in close proximity to the designated commercial node and in close proximity to the planned residential areas on both sides of Kenmount Road. It is also located in good proximity to the existing and future stages of the Kenmount Terrace residential area and the neighbouring Elizabeth Park subdivision in Paradise and other nearby residential neighbourhoods in Paradise and Mount Pearl. As a result, there would be a large residential population for the community centre/recreational complex to draw upon.

1.8.4 Municipal Equipment Building

The consulting team has discussed the potential need for a new municipal equipment building in the geographic area included in the Development Concept Plan.

It should be noted that the City of St. John's has recently undertaken a proposal call for consulting services to undertake a review of the City's current practices for its snow clearing operations. As part of this study, the selected consulting team could consider if a new municipal equipment building is required in the Kenmount Road area to make snow clearing operations more effective. Additionally, as development of the lands located above the 190 metre contour in the Kenmount Road area occurs over the coming years, the City's Department of Public Works and Parks can monitor the progress and amount of development taking place. The Department can determine at the appropriate stage if a new municipal depot building is required to be established in this part of the city to help ensure effective snow clearing operations.

1.9 Policy and Regulatory Recommendations

The City's Terms of Reference for the preparation of this Land Use Development Concept Plan note that the completed Plan will become a Planning Area Development Scheme (i.e. a secondary or local part as part of the St. John's Municipal Plan). The Terms of Reference specify that the Plan will use the land use designations of the St. John's Municipal Plan and the land use zones in the St. John's Development Regulations in its written text and maps. The text of the Plan is to support its mapping by including:

a) A statement of the rationale for each land use designation;
b) The objectives for lands within each designation;
c) The land use policies for each type of designation; and
d) Recommended development standards or guidelines.

1.9.1 Municipal Plan Designation for the Development Concept Plan

In 2012, as part of the planning process to allow urban development above the 190 metre contour elevation in the Kenmount Road area, the St. John's Municipal Council agreed to redesignate lands in the Study Area from the "Rural Land Use District" and the "Restricted Land Use District" under the St. John's Municipal Plan to a new Land Use District called the "Southlands/Kenmount Land Use District". This District identifies lands above the 190 metre contour elevation in the Southlands area and in the Kenmount Road area which have the potential to be developed in the future for a range of land uses utilizing municipal water and sewer services. The Municipal Plan notes that no development utilizing municipal water and sewer services or on-site water and sewer services shall be permitted in these two geographic areas until such time as the City's Department of Planning, Development and Engineering determines that the areas are available for serviced development. The Municipal Plan notes that the range of Permitted Zones and Conditional Zones in this Land Use District shall be determined by Council.

In making its decision to create a new Land Use District for the lands above the 190 metre contour in the Kenmount Road area, it was Council's intention that no future map amendments to the Municipal Plan would be required to be enacted once it is determined that the area is available for serviced development. It was Council's intention that appropriate new zoning would be introduced based upon the preparation of a Development Concept Plan for the area. It was intended that the area would remain in the Southlands/Kenmount Land Use District which authorizes Council to introduce a range of zoning without further Municipal Plan amendments.

Notwithstanding Council's intentions with respect to retain the Study Area in the Southlands/Kenmount Land Use District, the consulting team has determined that parts of the Study Area were apparently inadvertently not included in the Municipal Plan amendment from 2012 and remain in the Rural and Restricted Land Use Districts. It is recommended that the City initiate steps to redesignate these areas to the Southlands/Kenmount Land Use District. It is further recommended that these same lands which were not included within the appropriate Municipal Plan amendment be rezoned to the appropriate new Zone designations to implement the Development Concept Plan. The modified boundary of the study area that reflects the lands that were inadvertently not included in the aforementioned Municipal Plan Amendment are shown in Figure 5.The lists of proposed designations for the Development Concept Plan are set out in detail the next section.

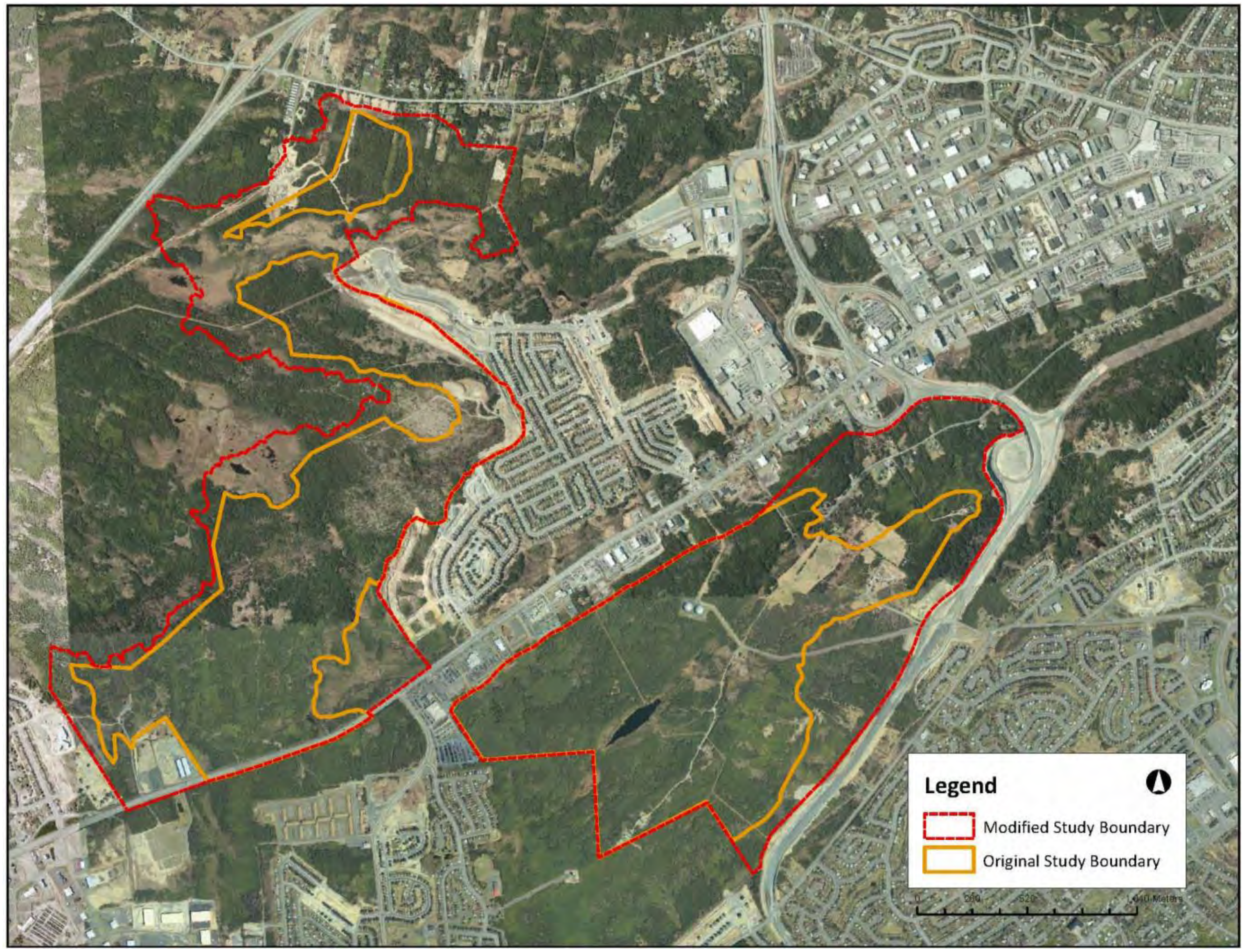


Figure 5 - Draft of Modifications of the Study Area Boundary for the Purposes of the Development Concept Plan

The Department of Municipal Affairs undertook a corresponding amendment to the St. John's Urban Region Regional Plan (the "Regional Plan") in 2012 to redesignate the lands located above the 190 metre contour elevation in the Southlands and Kenmount Road areas from "Rural" to "Urban Expansion". The Regional Plan amendment was required in order to enable Council to approve its amendments to the St. John's Municipal Plan. The policies of the Regional Plan and the current scale of its mapping are such that no further amendments are anticipated to be required to be made to the Regional Plan to make either the amendment to the mapping of the Municipal Plan which is recommended above or to introduce new zoning for the Study Area to implement this Development Concept Plan.

1.9.2 Proposed Zone Designations for the Development Concept Plan Area

The current zone designation of the Study Area is the "Comprehensive Development Area: Kenmount Road (CDA-Kenmount) Zone. This was a new zone approved by Council and placed on the Study Area in 2012. This zone is essentially a type of "holding zone" which allows existing uses to continue and which authorizes the reconstruction and replacement of and additions to existing buildings provided that Council may refuse permission for a replacement or reconstruction or addition if Council is of the opinion that such a Development would adversely affect the Development of the Comprehensive Development Area. It was intended that the CDA: Kenmount Zone would remain in place until such time as a comprehensive development plan was prepared for the lands along both sides of Kenmount Road located above the 190 metre contour elevation. Upon preparation of the Development Plan, it was intended that Council would assign appropriate detailed zoning to the area.

As noted, the City's Terms of Reference for this planning project provide that the Development Concept Plan will use the land use zones of the St. John's Development Regulations in its written text and maps. However, subsequent discussions with the City staff have indicated the City is open to the establishment of new planning designations if the direction, scope and recommendations of the Development Concept Plan warrant doing so.

It is recommended that the zoning designations applied to the lands subject to the Development Concept Plan be a combination of zones currently existing in the St. John's Development Regulations and proposed new zones designed to implement the objectives of the Plan.

It is proposed that seven zones be used to implement the proposed land use plan for the Kenmount Study Area:

1.9.2.1 *Open Space (O) Zone*

This zone is proposed to be assigned to parks and open spaces designated, developed and maintained by the City to meet the recreational requirements of the area included within the boundaries of the Development Concept Plan.

It is proposed that the Open Space (O) Zone with its list of Permitted Uses and Discretionary Uses and Zone Requirements as it is currently set out within the text of the St. John's Development Regulations, be applied and maintained without modification for the Study Area.

1.9.2.2 *Open Space Reserve (OR) Zone*

This zone is proposed to be assigned to all Environmentally Valuable Areas (EVA's) located within the Study Area which includes important waterways, wetlands and areas within a slope over 15% which is considered by the City to be undevelopable.

It is proposed that the Open Space Reserve (OR) Zone with its list of Permitted Uses and Discretionary Uses and Zone Requirements as it is currently set out within the text of the St. John's Development Regulations, be applied and maintained without modification for the Study Area.

1.9.2.3 *Institutional (INST) Zone*

This zone is proposed to be assigned to lands used for the administration and delivery of public services primarily government, public, social, religious, recreation, and educational facilities. This zone may also include some public services provided by the private sector. It is a zone normally applied to land and buildings owned and used by the three levels of government and major institutions such as hospitals, churches, educational and cultural facilities.

It is proposed that the Institutional (INST) Zone with its list of Permitted Uses and Discretionary Uses and Zone Requirements as it is currently set out within the text of the St. John's Development Regulations, be applied and maintained without modification for the Study Area.

1.9.2.4 *Residential-Kenmount West (RK-West) Zone*

This is a proposed new zone to that would be assigned to all those areas within the Study Area proposed for future new residential development. It is based in some measure upon the existing Residential Kenmount (RK) Zone listed in the St. John's Development Regulations. The RK Zone was drafted by the City a decade ago as part of the process of preparing a comprehensive land use plan for those areas in the vicinity of Kenmount Road which ultimately developed/are currently developing as the commercial areas in the Kelsey Drive and Messenger Drive areas and the area on the north side of Kenmount Road which has developed and continues to develop as the Kenmount Terrace residential subdivision area.

The RK Zone was drafted so as to provide flexibility in the type of housing forms that could be constructed and to enable an increase in traditional residential densities for new suburban areas without the necessity of going through the rezoning process. At the same time, the RK Zone was drafted and enacted so as to ensure that for any new development project or stage of a development project which is submitted to the City, that a minimum of 50% of the new units to be constructed must be single detached dwellings on standard sized building lots (minimum lot area of 450 square metres and a minimum lot frontage of 15 metres). In spite of the flexibility allowed by the RK Zone, the Kenmount Terrace neighbourhood continues to be developed relatively uniformly with single detached housing on standard sized building lots, consistent with similar neighbourhoods developed during the 1970's.

The proposed new Residential Kenmount-West (RK-West) Zone has been drafted in an effort to provide the flexibility to allow a range and mixture of housing forms in the Study Area without the necessity of going through a rezoning process to accommodate specific housing projects, while at the same time working to ensure that there is a reasonable balance between the traditional form of suburban housing and higher residential densities. This is in keeping with the Terms of Reference for the preparation of the Kenmount Development Concept Plan which provides that: "The Development Concept Plan must lay out the residential developments proposed for the study area, identifying locations for a variety of housing forms at various densities." The proposed new Zone was drafted so as to allow the establishment of neighbourhood types of commercial uses and services in residential areas so that residents will have ease of access to such uses and services without having consistently to drive to these locations.

It is proposed that the RK-West Zone allow the following uses as Permitted Uses:

Residential Uses
- Single Detached Dwellings on Standard Sized Building Lots
- Single Detached Dwellings on Smaller Sized Building Lots
- Semi-Detached Dwellings
- Duplex Dwellings
- Townhousing
- Subsidiary Apartments
- Accessory Buildings

Recreational
- Parks

Other
- Family Home Child Care Services (subject to Section 7.6 of the St. John's Development Regulations)
- Home Office (subject to Section 7.9 of the St. John's Development Regulations)

Discretionary Uses
- Apartment Buildings
- Carriage Houses (subject to criteria that would be established by City based on information contained in Section 1.6 of the Study Report)
- Bed and Breakfast Operations (subject to Section 7.27 of the St. John's Development Regulations)
- Day Care Centre (Subject to Section 7.6 of the St. John's Development Regulations)
- Home Occupation (Subject to Section 7.6 of the St. John's Development Regulations)
- Parking Lot (Subject to Section 7.13 of the St. John's Development Regulations)
- Private Park
- Public Utility
- Service Shops (Subject to Section 7.19 of the St. John's Development Regulations)
- Uses Complementary to an Apartment Building

Proposed Zone Requirements for the Residential Kenmount West (RK-West) Zone
It is proposed that the Zone Requirements for the list of proposed Permitted Uses and Discretionary Uses in the new Zone would be the same as they currently exist for the Residential Kenmount (RK) Zone with the added condition that while Townhouses are proposed to be allowed as a Permitted Use in the new Zone, that Townhouses be required to be designed and constructed so that there are no more than six (6) townhomes within each block of townhouses.

Mandatory Mix of Residential Uses in the Residential Kenmount West (RK-West) Zone
In order to ensure that lands included within the boundaries of the Development Concept Plan are developed so as to offer a choice in the variety of housing styles and to increase residential densities so as to make optimal use of the installation of municipal services which will be installed to facilitate urban development in this area, it is recommended that the RK-West Zone have a requirement that 35% of the new residential units to be constructed for any development project or stage of a development project which is submitted to the City, must be of a form other than Single-Detached Houses on Standard Sized Building Lots and the proposed mix of residential uses other than Single Detached Houses on Standard Sized Building Lots will be subject to the approval of Council with conditions and/or restrictions that Council may deem appropriate to impose.

1.9.2.5 Apartment Low Density (A1) Zone

This zone would be applied to the sites proposed under the Development Concept Plan for multi-storey residential apartment buildings.

The A1 Zone allows Apartment Buildings and Seniors' Apartment Buildings (as defined under the St. John's Development Regulations) to a maximum building height of three (3) storeys (not exceeding 12 metres). The zone allows a range of Discretionary Uses including convenience stores in Apartment Buildings, Service Shops, and Uses complementary to an Apartment Building and a Seniors' Apartment Building.

The A1 Zone also allows Townhousing as a Permitted Use.

It is recommended that the A1 Zone as currently written in the text of the St. John's Development Regulations be applied to the Kenmount Development Concept Plan with the proviso however, that Townhouses not be permitted in this Zone in the area subject to the Development Concept Plan. This condition could be written as an amendment to the text of the Development Regulations. This step is recommended to ensure that the areas under the Plan that are recommended to be developed as multi-storey buildings, are in fact developed for this purpose rather than another type of residential development.

1.9.2.6 Commercial Kenmount West (CK-West) Zone

This is a proposed new commercial zone proposed to be assigned to the areas designated for future commercial development in the Study Area. The new zone is based in some measure upon the existing Commercial Mixed Use (CM) Zone which is used in the Churchill Square area and the Commercial Mixed Use-Pleasantville (CM-Pleasantville) Zone which was drafted and enacted for the redevelopment plan prepared by Tract Consulting in conjunction with other consultants for the Canada Lands Company for the redevelopment of the former Federal Government Lands in Pleasantville.

The proposed new CK-West Zone is designed to allow a significant range of commercial, office and service uses with the provision for mixed commercial-residential buildings. The new Zone will provide opportunities for employment for the residents living in the Kenmount Road area. The new Zone proposes to not allow land intensive-low employment land uses such as commercial vehicle sales lots as it is the objective to make optimal use of the developable land base in the Study Area and to maximize opportunities for developments which would generate more employment opportunities on a smaller land base.

The following is a list of proposed Permitted Uses and Discretionary Uses for the new Zone along with proposed Zone requirements:

<u>**Permitted Uses-CK-West Zone**</u>

<u>Commercial Uses</u>

- Bakery
- Bank (subject to Section 7.30 of the St. John's Development Regulations)
- Clinic
- Commercial Uses
- Communications Use
- Custom Workshop
- Dry Cleaning Establishment
- Eating Establishment (subject to Sections 7.21 and 7.31 of the St. John's Development Regulations)
- Hotel
- Laundromat
- Lounge (Subject to Section 7.21 of the St. John's Development Regulations)
- Office
- Parking Area
- Printing Establishment
- Retail Store
- Service Shop
- Service Station and Gas Bar (Subject to Sections 7.20 and 7.30 of the St. John's Development Regulations)
- Light Industrial Use

<u>Residential Uses</u>

- -Residential Dwelling Units on the second and higher storeys of a Building
- -Bed and Breakfast Operations (Subject to Section 7.27 of the St. John's Development Regulations)

<u>Public Uses</u>

- Church
- Cultural Centre
- Library
- School

<u>Recreational Uses</u>

- Park

<u>Other Permitted Uses</u>

- Day Care Centre (Subject to Section 7.6 of the St. John's Development Regulations)
- Public Use
- Public Utility

<u>**Proposed Discretionary Uses-CK-West Zone**</u>

- Car Washing Establishment (Subject to Section 7.30 of the St. John 's Development Regulations)
- Place of Amusement
- Place of Assembly
- Private Park
- Recycling Depot

<u>**Proposed Zone Requirements -CK-West Zone**</u>

The following requirements shall apply to all Uses except for Parks, Private Parks and Service Stations/Gas Bars

- Maximum Floor Area Ratio: 3.0
- Maximum Building Height: 4 storeys (not exceeding 15 metres).
- At Council's discretion and subject to the preparation of a Land Use Assessment Report (an "LUAR") prepared by a proponent under Terms of Reference approved by Council and to public review of the LUAR in accordance with the provisions of Section 5.5 of the St. John's Development Regulations prior to Council making a decision on the LUAR, Council may allow an increase in building height up to a maximum of 6 storeys (not exceeding 24 metres).
- Maximum Residential Density: One (1) Residential Dwelling Unit per 50 square metres of Lot Area

1.9.2.7 Commercial Office (CO) Zone

It is recommended that the Commercial Office (CO) Zone be applied to the area designated on the south side of Kenmount Road as a business park.

The CO Zone is a commercial zone which allows primarily office use as some limited retail and service shop uses. It also allows residential dwelling units located on the second and/or higher storeys of a building as a Permitted Use and also allows a Seniors' Apartment Buildings as a Permitted Use.

It is recommended that the Commercial Office (CO) Zone as it is currently written in the text of the St. John's Development Regulations be applied to the area proposed as a business park on the south side of Kenmount Road with the provision however, that residential dwelling units and Seniors' Apartment Buildings and uses complementary to a Seniors' Apartment Building not be allowed under this zone for the area subject to the Development Concept Plan. A text amendment can be written to the CO Zone to apply this restriction to the CO Zone.

1.9.2.8 Commercial Neighbourhood Zone

It is recommended that the Commercial Neighbourhood (CN) Zone can be applied to the areas identified as strategic commercial locations within residential neighbourhoods, as identified in Section 1.7

The CN Zone is a commercial zone which allows retail and personal services for residential areas provided as convenience stores, a public library, a clinic or in other uses and forms compatible with residential neighbourhoods. The CN Zone also permits dwelling units to be located in the second and/or higher storey of building.

It is recommended that the Commercial Neighbourhood (CN) Zone as it is currently written in the text of the St. John's Development Regulations be applied to the areas proposed to serve as neighbourhood commercial centers.

1.9.2.9 Other Recommendations Regarding Zoning

It is recommended that lands adjoining the Study Area that are also located above the 190 metre contour elevation and which are presently zoned other than "Comprehensive Development Area-Kenmount Road (CDA-Kenmount) Zone, be retained in their current zone designations.

1.10 Financial Options for Comprehensive Land Use Planning

1.10.1 Introduction

Urban expansion and development often lead directly to an increase in the demand for water, sewer, drainage, parks, roads and other types of community infrastructure and amenities. At the present time, the City of St. John's charges a Development Fee applied to the subdivision or development of property or the construction of extensions to existing buildings. The Development Fee is applied primarily for the purposes of raising monies to be placed in a dedicated City fund for purposes such as the acquisition of land for new parkland and recreational developments, the rehabilitation of existing City parks and recreational developments and trail development and maintenance.

The current City Development Fee structure which was adopted by the St. John's Municipal Council in October of 2013 is as follows:

- Residential Developments: $2000 per each new residential unit.
- Non-Residential Developments: $20 for each one (1) square metre of gross floor area.
- Mixed Use Developments: $2000 per each new residential unit and $20 for each one (1) square metre of gross floor area of all non-residential areas of a building.

The St. John's Development Regulations currently provide that where the City requires the dedication of lands for public recreational purposes, the amount of the Development Fee shall be reduced by the value of the raw land so dedicated, along with the value of any equipment required and/or specified by the City.

The City also applies a Subdivision Application Fee of $200 per Lot for each new Lot created as a result of the subdivision of a property. The Subdivision Application Fee does not apply to the Homestead Lot.

The preparation of the Development Concept Plan for the Kenmount Road Study Area provides an opportunity for the City to consider several new financing options to adequately support new growth and to pay for a number of aspects of the future costs of growth, not just those applicable to open space and recreational development.

The following sections identify two municipal financing options currently employed by many municipalities in British Columbia that the City of St. John's may wish to consider for the financing of future infrastructure and community amenities in the geographic area which makes up the Kenmount Development Concept Plan Area and possibly for other areas of the city.

1.10.2 Development Cost Charges

Development Cost Charges ("DCC's") are fees collected from land developers by municipalities to assist in financing the cost of upgrading or providing infrastructure services. The DCC concept is designed to help defray the cost of future infrastructure upgrades/maintenance needs that evolve as a result of the cumulative and ongoing impacts of growth. DCC's are intended to support development by providing a means to finance municipal capital projects related to highways, roads, drainage, sewers, water or developing and acquiring parkland needed to support new development. DCC's are applied as a one-time charge against residential, commercial, industrial and institutional developments. They are usually collected by the local municipal authority at the time of subdivision approval or at the time that a building permit is issued. The DCC infrastructure levy is calculated by a municipality by means of a formula that identifies long term infrastructure capital and maintenance needs for a determined development area.

The following are some examples of projects that DCC's are used to fund:

- Highways: road extension construction, highway improvements, bridge construction, intersection upgrades, and pedestrian/bike corridor improvements.
- Water: water main upgrades, pump station upgrades and water reservoir improvements
- Sewer: sewage lift stations and sewer main improvements
- Drainage: drainage and flood protection facilities
- Park Acquisition and Development: parkland acquisition and development of municipal parks

DCC's are extensively used by local municipalities and regional authorities in British Columbia under the authority of Provincial legislation and there is extensive literature on the purpose and application of DCC's there. A review of some of this literature has determined that:

1. DCC's are applied to all forms of development: residential, commercial, institutional, industrial, etc. Normally, a per unit charge is applied to residential developments at the time of either subdivision, or in the case of higher density residential uses, at the time of issuance of a building permit. For commercial and other non-residential uses, the DCC is applied on a square footage area amount at the time of the issuance of a building permit.

2. DCC's are in addition to on-site infrastructure work for which the developer is directly financially responsible to support their own individual development such as the construction of new roads, water services and storm and sanitary sewer services.

3. DCC's are not used for replacing, operating, and maintaining parks, roads, water mains, sanitary and storm sewers already in place to serve a municipality's existing residents.

4. Generally, infrastructure construction begins after enough DCC's have been collected by the local government for the project; however, in certain circumstances, construction must begin before enough funds have been collected. In these circumstances, either the local government or the developer will "front-end" the cost. These costs are then recovered through DCC's as the development progresses.

5. DCC's are normally kept in a separate fund from a local government's general operating fund. A local government may only spend DCC monies, and the interest earned on them, for the specific projects and services for which they were collected. For example, DCC's collected for sewer infrastructure in a new development may only be spent on applicable sewer infrastructure systems near the new development.

6. DCC's can be specified according to different zones or specified areas of a municipality as they relate to different classes and amount of development and different DCC fee schedules can be applied in different geographic areas of the municipality based on the identified infrastructure needs of a particular area of the municipality.

7. A review of DCC's rates for different municipalities in British Columbia shows a trend that a higher DCC rate is normally applied to lower density residential developments and that the DDC rate is applied at a reduced rate per residential dwelling unit for higher density residential developments such as townhomes and apartment buildings. In some cases, DCC's are waived/reduced for some residential developments if a portion of the development is constructed as affordable housing units.

8. A review of a municipality or regional authority's DCC's fee structure is normally undertaken annually.

9. In order to assist in establishing its DCC fee schedule, municipalities develop a detailed list of future/long-term community needs and associated costs for varied community projects that will be required by the municipality as a result of the cumulative impacts of growth and increased densities.

1.10.3 Community Amenity Fee Contributions

Community amenities are generally facilities or improvements needed to service a growing population or to create a more complete, livable community through the provision of such facilities as recreational facilities, transportation facilities, cultural centres, fire stations, and libraries.

Community Amenity Fee Contributions ("CAC's") are voluntary in-kind or cash contributions provided by property developers to a municipality when a municipality grants development rights through rezoning which allows an increase in residential densities. Demands on municipal facilities can increase as a result of the rezoning of properties because of new residents and employees in the area as a result of a rezoning to allow a development. To lessen the financial burden on the community, CAC's address this increased demand by adding and expanding municipal facilities.

A number of municipalities in British Columbia have by practice and procedure determined that for each new rezoning that proposes an increase in residential density, that the developer is requested to make a voluntary contribution on a per unit basis to help offset the future cost of capital needs. Unlike Development Cost Charges (DCC's), CAC's are not applied to basic infrastructure such as municipal water and sewer services and roads, but only to community amenities such as the types of facilities noted above.

Like the use of DCC's, for the CAC concept to be effectively employed, it is important for a municipality to prepare and update a detailed list of future community infrastructure needs and associated costs for community projects that will be required by the municipality to meet the needs of cumulative growth and increased densities.

It is recommended that the City of St. John's determine if the City is interested in exploring the feasibility of introducing Development Cost Charges and/or Community Amenity Fees as methods of attempting to ensure that developers contribute in an equitable manner so as to help pay for the costs of various forms of community infrastructure, amenities and projects that will be required to be provided by the City as a result of new urban growth in the Kenmount Study Area and perhaps other parts of St. John's. If the City determines that it is interested in exploring these options, then it is recommended that the City contact the Department of Municipal Affairs to determine if current Provincial legislation would authorize the City to introduce and apply these two new financial options or if the legislation would need to be first amended.

2 Traffic

2.1 Background

2.1.1 Introduction

As part of the overall development of the comprehensive land use plan for the land areas above the 190 metre contour in the Kenmount Road area, Hatch was required to complete a number of different tasks under the Traffic and Transportation section 5.2 of the terms of reference for this study including:

- The determination of the required access points and the layout of the internal road network
  - Deliverable – Conceptual drawings of the proposed road network along with the appropriate report documentation.
- Collection of required traffic count data
  - Deliverable – All intersection and roadway traffic counts collected and used in the course of the study shall be organized and properly documented and included with the report appendices.
- Standard traffic impact analysis
  - Deliverable – Analysis to be properly documented in the final report, electronic files for Synchro and SimTraffic models, and the calibrated VISUM model(s) to be included in appropriate appendices. Schematic drawings of intersection improvements including any new auxiliary lanes or lane extensions should be provided complete with cost estimates.
- Transit: a review of transit operations in the study area
  - Deliverable – Appropriate report documentation and minutes of meetings to be included in appendices and a transit plan for the study areas.
- Regional Fire Department – Coverage review
  - Deliverable – The consultant will be expected to graphically represent the travel times from the fire stations noted above into the new areas opened up for development above the 190 metre contour and to use this analysis to make recommendations on the need for an additional fire station, and if required, to identify potential locations for the new station that would be suitable to address any travel time concerns.

2.1.2 Study Area

The study area for this project is shown in Figure 6. This area conforms to the Original Study Boundary shown in Figure 5. It includes lands to the North of Kenmount Road bounded by the watershed boundary, the Town of Paradise boundary, Kenmount Road to the South and the Kenmount Terrace development to the East. It also includes the lands south of Kenmount Road bounded by the Mount Pearl boundary to the west, and the Team Gushue Highway to the east and the rear property lines of the businesses on Kenmount Road extending from Kelsey Drive to Wyatt Boulevard to the north.

The overall development area consists of 382 ha of undeveloped land.

Figure 6 - Draft of Study Area

2.1.3 Data Collection

Due to the scale of the development, the study area contains roadways and intersections under the jurisdiction of St. John's, Mount Pearl, and the Newfoundland and Labrador Department of Transportation and Works (NLDTW). These key intersections and roadways are shown in Figure 7 and include the following:

<u>Intersections Zone 1 (North of Kenmount Rd)</u>

1. Outer Ring Road & Thorburn Road
2. Thorburn Road & Goldstone Street
3. Thorburn Road & Austin Street
4. Thorburn Road & Mount Scio Road
5. Thorburn Road & O'Leary Avenue
6. Thorburn Road & Prince Philip Drive
7. Thorburn Road Loop Ramp @ Freshwater Street
8. Kenmount Road & Avalon Mall
9. Kenmount Road & Pippy Place
10. Kenmount Road & Kelsey Drive
11. Kelsey Drive & Kiwanis Street
12. Kelsey Drive & Team Gushue Highway
13. Kenmount Road & Ladysmith Drive

14. Kenmount Road & Great Eastern Avenue
15. Kenmount Road & Mount Carson Avenue
16. Kenmount Road & Brougham Drive

Roadways Zone 1 (North of Kenmount Rd)

1. Outer Ring Road between Topsail Road & Thorburn Road
2. Thorburn Road West of Columbus
3. Kenmount Road East of Mount Carson Avenue
4. Kelsey Drive
5. Goldstone Street

Intersections Zone 2 (South of Kenmount Rd)

1. Columbus Drive & Old Pennywell Road
2. Columbus Drive & Mundy Pond Road
3. Columbus Drive & Blackmarsh Road
4. Columbus Drive & Captain Whelan Drive
5. Captain Whelan Drive & Blackmarsh Road/Hamlyn Road
6. Empire Avenue & Blackmarsh Road & Captain Whelan Drive
7. Captain Whelan Drive & Team Gushue Highway
8. Topsail Road & Blackmarsh Road
9. Topsail Road & Mount Carson Avenue

Roadways Zone 2

1. Team Gushue Highway
2. Topsail Road West of Burgeo Street
3. Blackmarsh Road at City Limits
4. Captain Whelan Drive
5. Columbus Drive South of Thorburn Road

Existing traffic volumes for the 2013 base year were based on data provided by the City of St. John's and traffic counts conducted by Hatch through local university students. The City of St. John's provided the following four-hour intersection counts:

- Thorburn Road & Goldstone Street – February 2012
- Thorburn Road & Austin Street – November 2012
- Thorburn Road & Mount Scio Road – January 2012
- Thorburn Road & O'Leary Avenue – October 2012
- Thorburn Road & Prince Philip Drive – March 2013
- Thorburn Road Loop Ramp @ Freshwater Street – October 2012
- Kenmount Road & Avalon Mall – October 2012
- Kenmount Road & Pippy Place – October 2012
- Kenmount Road & Kelsey Drive – May 2011
- Kenmount Road & Ladysmith Drive – March 2011
- Kenmount Road & Great Eastern Avenue – March 2011
- Kenmount Road & Mount Carson Avenue – May 2011
- Columbus Drive & Old Pennywell Road – April 2013
- Columbus Drive & Mundy Pond Road – April 2013
- Columbus Drive & Blackmarsh Road – April 2013
- Columbus Drive & Captain Whelan Drive – April 2013
- Captain Whelan Drive & Blackmarsh Road/Hamlyn Road – October 2013
- Empire Avenue & Blackmarsh Road & Captain Whelan Drive – October 2013

Hatch conducted four-hour intersection counts (7:00 – 9:00 AM, 4:00 – 6:00 PM) at the following intersections:

- Outer Ring Road & Thorburn Road – September 2013
- Kelsey Drive & Kiwanis Street – September 2013
- Kelsey Drive & Team Gushue Highway – September 2013
- Kenmount Road & Brougham Drive – September 2013
- Topsail Road & Blackmarsh Road – September 2013
- Topsail Road & Mount Carson Avenue – September 2013

The traffic count data is included in Appendix B-1.

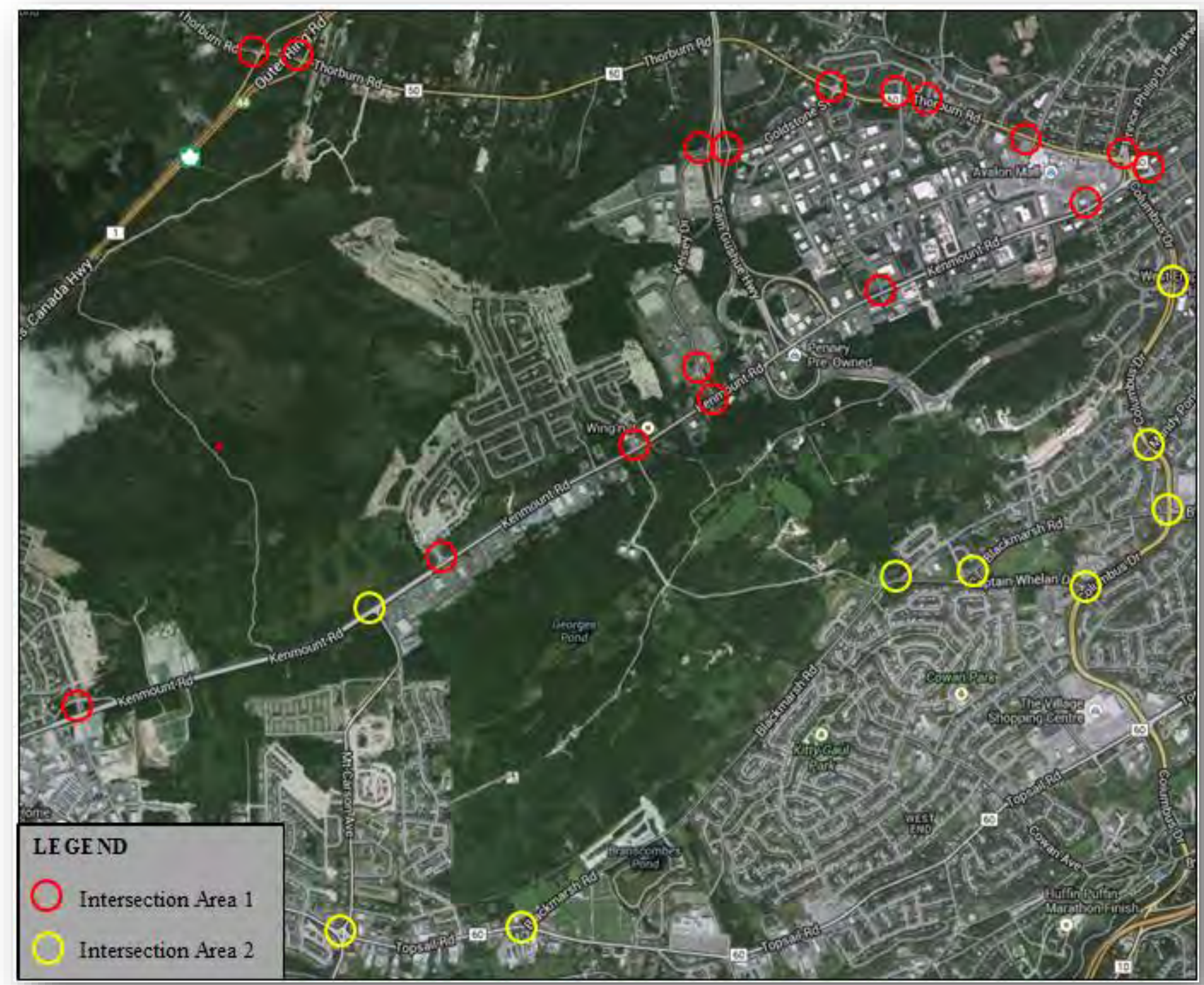


Figure 7 - Draft of Key Intersections in Areas 1 & 2

2.1.4 Study Methodology

The scope of the technical analysis conducted as part of the transportation study was based on the Terms of Reference provided by City of St. John's on April 25, 2013. Figure 8 provides a conceptual summary of this approach.

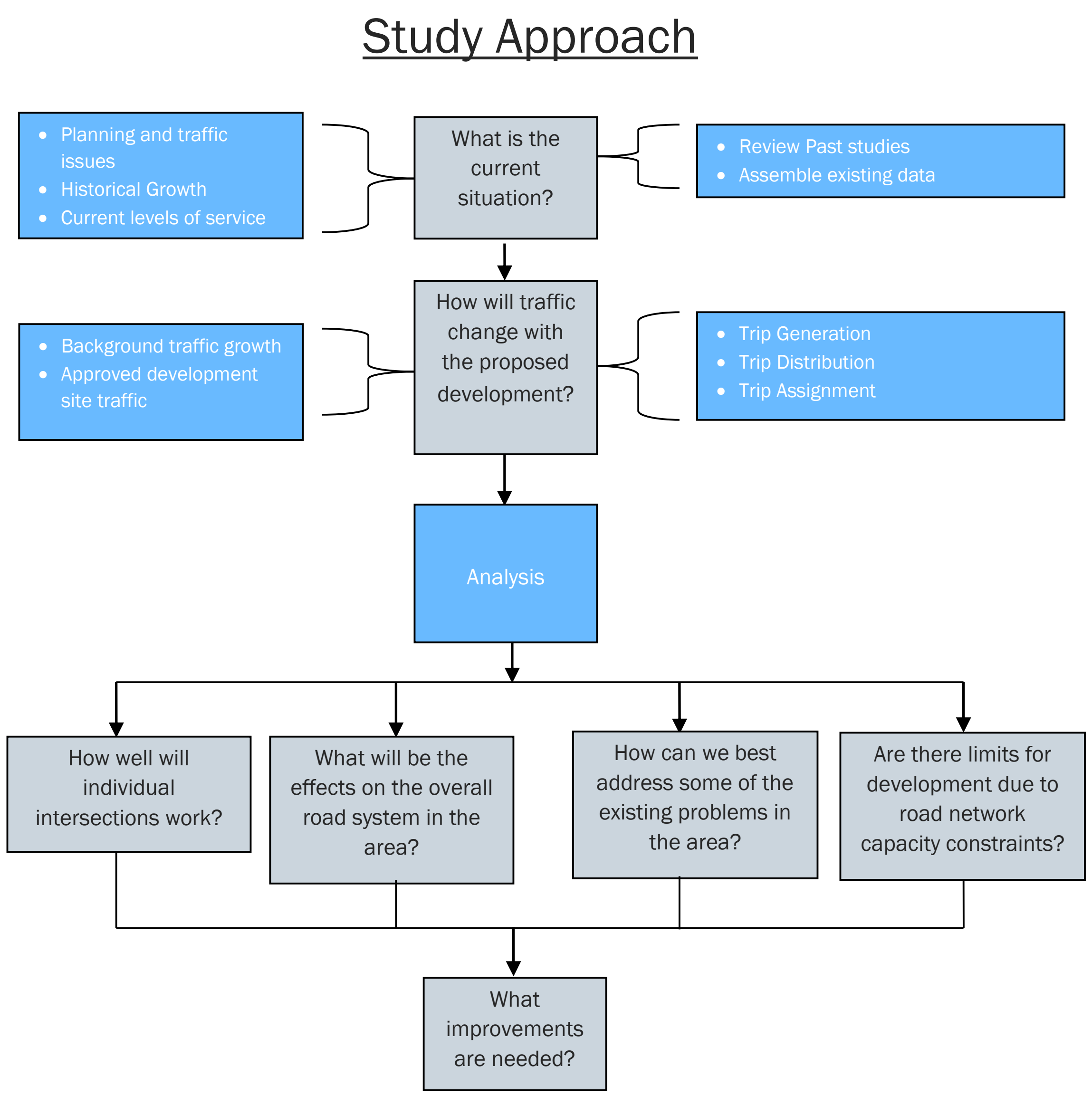


Figure 8 - Draft Study Approach

2.1.5 Intersection Measures of Performance

Intersection measures of performance were reviewed and compared for different network and traffic volume scenarios during the analysis that was completed for this study. The analysis used industry standard techniques.

The main evaluation tool used in the analysis for this report was the *Synchro Traffic Signal Coordination Software* which analyzes typical measures of performance based on the methodology of the Highway Capacity Manual (Transportation Research Board, 2000). The *SimTraffic* micro-simulation traffic software was also used in the course of the analysis to illustrate and identify interactions between individual driver types and the effects of adjacent or closely spaced intersections. The ARCADY/Junctions 8 software was used to analyze roundabout options. ARCADY uses the TRL/Kimber empirical method to assess roundabouts.

Three primary measures of performance are typically used to evaluate the performance of an intersection. These are outlined below:

Volume to Capacity Ratio (v/c) – Volume to capacity ratios relate the estimated traffic volumes (demand volume) to the theoretical maximum volume that could be accommodated (capacity volume/adjusted saturation flow rate). As the v/c ratio approaches 1.0, the movement has reduced ability to accommodate any additional volume of traffic. Generally, intersection control or road infrastructure movements can alleviate any reduced residual capacity

Level of Service (LOS) – LOS is a qualitative measure which describes operational conditions. It is based on service measures such as freedom to manoeuvre, travel time, speed, and traffic interruptions. LOS is expressed as a scale from 'A' to 'F,' where LOS A represents free flow conditions or very low delay (less than 10 seconds per vehicle at an intersection), and LOS F represents delay times that are unacceptable to motorists using the facility (greater than 50 seconds at a STOP sign control or greater than 80 seconds at traffic signals). Generally speaking, a minimum LOS E is considered acceptable; however, the desirable design level of service is generally accepted as being LOS D or better.

Tables in this report and in Appendix B-7 use the following colour code to identify the six levels of service:

A	B	C	D	E	F

Queue Capacity – Queue capacity at intersections is critical to the performance of the network. As part of the analysis process, queue lengths were examined and recommendations were made to ensure that sufficient vehicle storage is available to maintain efficient traffic flow. The 95th percentile queue length is the length of queue which is exceeded only 5% of the time.

The analysis tables in the following sections and in Appendix B-7 display the LOS, ratio, delay per vehicle, and queue length results for turning movements of each approach to the intersection as calculated by Synchro. The average delay per vehicle simulated in SimTraffic, the equivalent LOS based on these delays, and the 95th percentile queue lengths are also summarized. The traffic volume figures also show the intersection LOS.

2.1.6 VISUM

The City of St. John's VISUM model was used for the existing conditions analysis and to forecast future traffic volumes. VISUM is a macroscopic transportation planning modelling software package that is used to model transportation networks and travel demand to forecast traffic flows under a different network conditions. In 2011, Hatch developed a number of regional VISUM transportation planning models for the City of St. John's including models for the A.M. and P.M. peak hours for traffic conditions present in 2010, 2015 and 2025. For the existing conditions analysis, the model was calibrated at the screenline level using the actual 2013 traffic volumes and was used for the study area. To estimate the number of external trips to/from areas beyond the study area, a land inventory study was performed to identify future land uses within the study area and to estimate number of trips assigned to these areas. For the purposes of completing this study, Hatch used an updated version of the 2025 model to complete the required analysis which includes commercial, industrial and residential development that is likely to occur in the St. John's Metro area by the year 2025. It also includes new road infrastructure such as the Team Gushue Highway that are expected to be completed by that time frame.

The 2025 VISUM model includes the following developments in the following areas of the St. John's Metropolitan Area:

- Brookfield Plains
- Kilbride
- Pleasantville
- Bayview Estates and Pine Ridge Estates in Torbay
- Commercial development on Glencoe Drive in Mount Pearl
- Southlands build-out
- Glencrest development (project in approval phase in southeast quadrant of Pitts Memorial Drive/Outer Ring Road interchange)
- Greeleytown Rd/Kerry Ave. (Conception Bay South)

2.1.7 Access and Internal Road Network Layout

Consideration for providing access to the lands above the 190 metre contour in the study area was separated into two parts; lands north and south of Kenmount Road. Each of these areas is served by key transportation facilities that connect the Study area to other areas in St. John's and to the communities of Mount Pearl and Paradise. Kenmount Road runs between the north and south development areas. Thorburn Road borders the north area and the Team Gushue Highway (TGH) borders the south area and links Kenmount and Thorburn Roads. The Outer Ring Road/TransCanada Highway (TCH) connecting Paradise and the north part of the City of St. John's is located just north of the north development area. The development area also is immediately west of the existing Kenmount Terrace neighbourhood and east of built up areas of the Town of Paradise.

Connectivity with the existing road network is essential for direct connection to higher tier highways, controlled access facilities and arterial roads. Providing a continuous and supportive collector network within the neighbourhood will reduce the amount of traffic that must use the boundary arterials and key intersections. Given the proximity of the site to the main arterials and highways serving this part of the City as well as Mount Pearl and Paradise, connections to both Kenmount and Thorburn Roads as well as Team Gushue Highway, Elizabeth Park, Wyatt and the Outer Ring Road would be desirable. Creation of an east-west collector road to tie into a future Brier Avenue and secondary collector to connect to Empire Avenue and Blackmarsh Road is also desirable. This would complete the grid with continuous facilities that are spaced adequately to ensure connecting intersections function well. Internal to the development areas, continuous collector roads that can serve as transit routes through the area and that are located centrally to the residential or commercial catchments will be necessary to support the traffic movement function of the boundary arterials as well as provide a degree of local access.

Based on these guiding principles, access to the development areas north and south of Kenmount Road were examined. Specifically, the following access opportunities were considered in the study:

North Side of Kenmount Road

- Direct access onto Kenmount Road,
- Access to Thorburn Road, and,
- Access to the Outer Ring Road,
- Connections to the existing street stubs left undeveloped in Kenmount Terrace.

South Side of Kenmount Road

- Access onto Kenmount Road,
- Access onto Wyatt Boulevard,
- Access onto Old Pennywell Road,
- Access onto Captain Whelan Drive via the Team Gushue Interchange with Captain Whelan Drive, Empire Avenue and Blackmarsh Road
- An interchange reconfiguration with the new access road (Brier Avenue) leading from the Team Gushue Highway to Columbus Drive.

The options considered for both sides of Kenmount Road are shown in Figure 9.

Figure 9 - Draft of Access Options to the Study Area

2.1.8 Access Opportunities North Side of Kenmount Road

The Town of Paradise is considering a new interchange on the Outer Ring Road to the north and west of the development area north of Elizabeth Park. Extension of an internal collector or arterial road within the development to this interchange could be done that could service not only the lands above the 190 Contour but also parts of the Town of Paradise and is shown as Road 1 in Figure 10. Such a connection would likely consist of a 2-lane arterial with provision for future widening to a 4-lane arterial or major collector type of facility. This connection would be extended easterly through the heart of the north development lands and connect with collector north – south collector roads connecting to Kenmount Road and through the development northerly to Thorburn Road.

Ladysmith Drive, a north – south collector road currently ends north of Kenmount Terrace. Extension of the road to the north on a curvilinear alignment through the north development lands to connect to Thorburn Road should be considered. Given the intersection and interchange spacing on Thorburn Road, there is adequate space for two collector road connections. The westerly one of these would be the extension of Ladysmith Drive and is shown as Road 5 in Figure 10. The easterly one could be the extension of Messenger Drive from Kelsey Drive curving to the north and connecting to Thorburn Road and is shown as Road 6 in Figure 10. However, connecting these roads to the existing Ladysmith Drive and providing a more direct connection to Messenger Drive (where a community centre is being built and a route to the retail uses on Kelsey Drive is available) should be promoted. These facilities will not be totally centrally located within the development lanes. Areas to the west would still require a continuous north south connection to Ladysmith Drive in the north and to Kenmount Road in the south shown conceptually as Roads 3 and 4 in Figure 10. Given the intersection spacing and grid network, at least two collector connections to Kenmount Road should be considered. The preliminary land use and road network plan for the development lands (see Appendix A) identified an open space and District Park will be located opposite Mount Carson/Wyatt Boulevard. Ideally a connection to Wyatt Boulevard would improve network continuity and would separate residential and commercial traffic. This opportunity should be further examined in the neighbourhood planning stage. However, respecting the current open space plan, the next possible collector road connection would be to the west of the park, located between planned commercial uses on the west and a District School on the east. This is shown as Road 2 in Figure 10. The extent of the proposed commercial and industrial development along the north side of Kenmount road westerly to the Town of Paradise provides opportunity for at least two more collector connections to Kenmount Road, spaced approximately 400m apart.

Based on these findings, there is sufficient spacing to accommodate one arterial/major collector connection to the Outer Ring Road, two collector road connections to Thorburn Road and at least two collector road connections to Kenmount Road. While there appears to be ample opportunity to connect to the surrounding road system, providing direct and continuous routes through the neighbourhood was necessary to provide transit service with a high ridership catchment potential. Extending Ladysmith and Messenger Drives partly achieve this. The provision of an additional collector roadway to the west of Ladysmith Drive located centrally to the residential area and connecting to a possible connection to the Outer Ring Road and Kenmount Drive is needed to achieve the planned transit service and ridership potential.

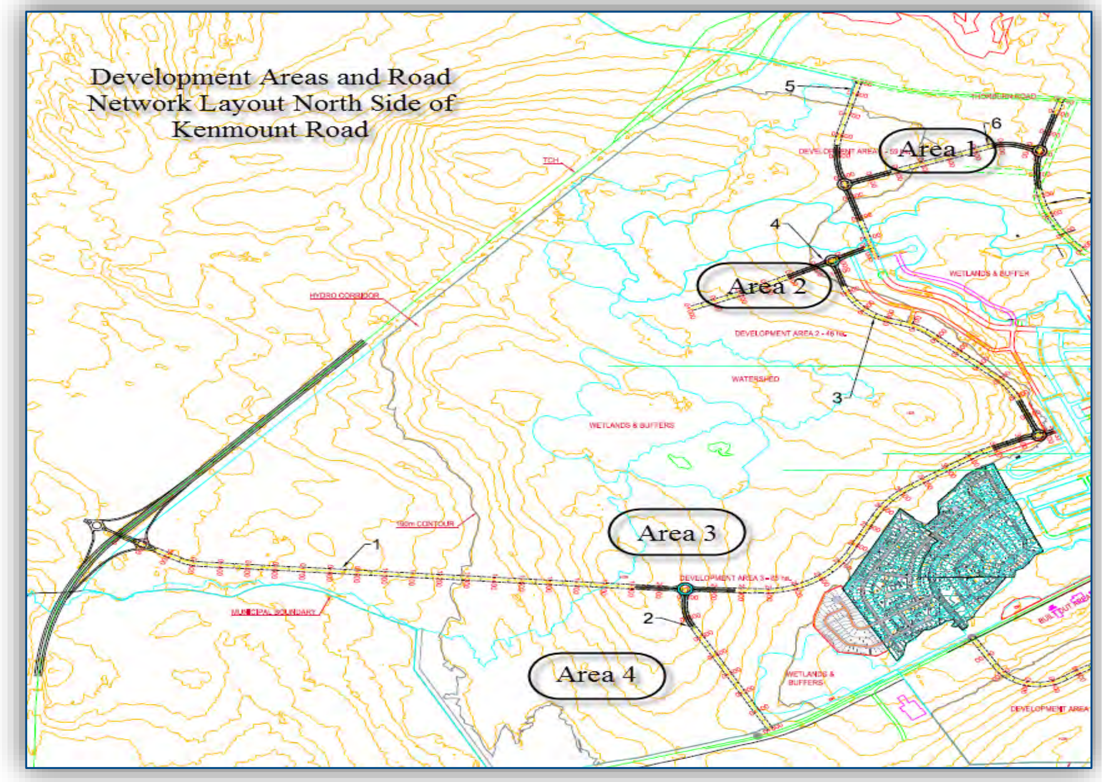


Figure 10 - Draft of Network Layout North Side of Kenmount Rd.

2.1.9 Access Opportunities South Side of Kenmount Road

On the South side of Kenmount Road, the proposed development area is limited in terms of the number of available access points to the surrounding road network. The road network configuration proposed for the south side of Kenmount Road is shown in Figure 11.

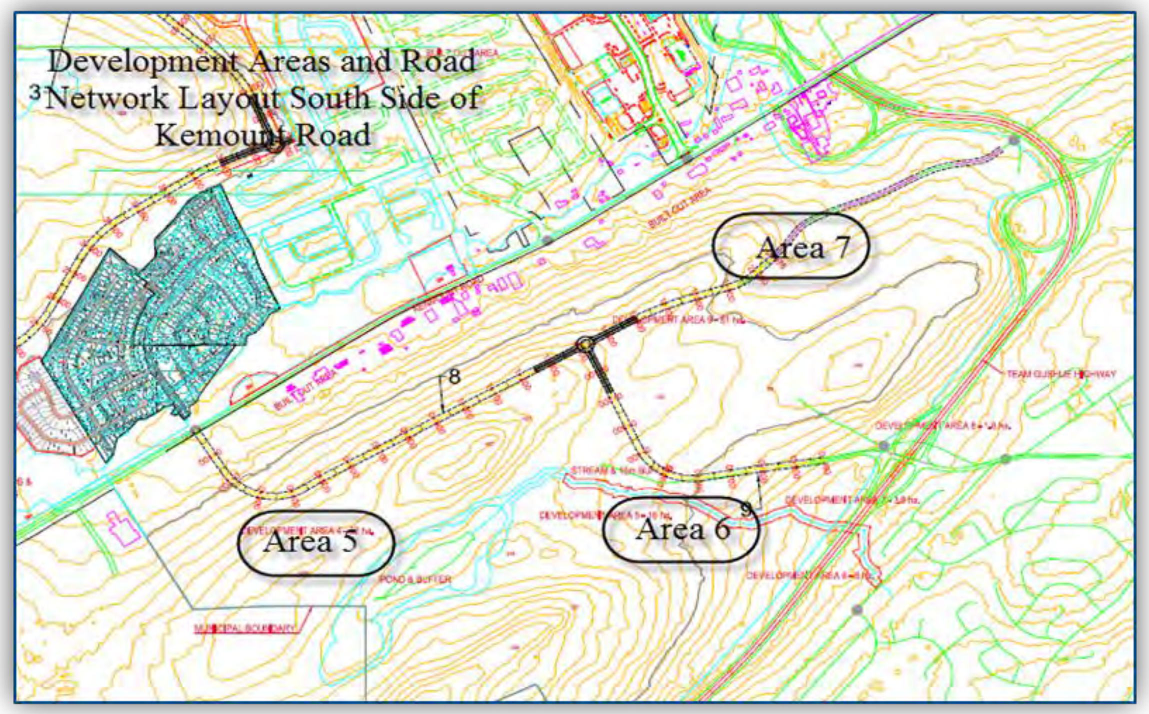


Figure 11 - Draft of Network Layout South Side of Kenmount Rd.

Roadway 8 connects to Kenmount Road at the Great Eastern Avenue intersection with Kenmount Road. From this point it is routed in a southerly direction through the New Terra Nova Motors development parking lot for a distance of approximately 300 metres. It then turns and follows the ridge line parallel to Kenmount Road and eventually connects with the future Brier Avenue. Roadway 9 extends from the Captain Whelan Drive interchange with the Team Gushue Highway and connects with Roadway 8 as indicated in Figure 11. Together, these roads can provide at least 3 lanes of access/egress to the south development area.

An alternative access connection is available to the access proposed across the Terra Nova Motors property. This access would utilize a road reservation at the rear property line of Avalon Ford and would involve some roadway realignments on Wyatt Boulevard. It would also involve a reconfiguration of the road network in Area 5 of the proposed development that could be further examined at the more detailed neighbourhood planning stage.

2.1.10 Horizontal and Vertical Alignments

A surface model for the entire study area was created with the lidar data provided by the City of St. John's using the Civil 3D software package. The horizontal and vertical alignments for the roadways 1 thru 9 were checked to ensure they comply with the applicable TAC standards. The route selection process was sensitive to the areas grades; none of the new core streets in the study area have profile grades that exceed 8%.

The plan and profile sheets are noted in drawings SK#001, SK#002, and SK#003 which are contained in Appendix B-3.

It is noted however, that at the present time the internal road network and connection with the boundary roads is conceptual only and will need to be reviewed during subsequent more detailed neighbourhood planning stages. This will provide opportunities to re-examine the lot and street arrangement to identify and confirm the feasibility to provide improved road spacing and continuity. Some of the areas to be re-examined include:

- Potential for providing a continuous north – south collector road west of Ladysmith Drive to ensure that transit ridership catchment guidelines are met;
- Potential for collector connection to Wyatt Boulevard; and
- Confirming the access location across the Terra Nova Motors property.

2.1.11 Considerations for Public Transit

On February 11, 2014, Hatch met with the staff of Metrobus and reviewed the preliminary plan of the land use concept plan for the development of the lands above the 190 contour in the Kenmount Road area. Metrobus was given a preliminary road layout of the planned the development.

While there were no significant concerns expressed with the concept plan at that time a number of points were discussed and are worthy of being noted.

- Within each of the development areas planned, there will be office and neighbourhood retail type uses; places where residents will gather. These areas are expected to become the focal points of the neighbourhoods created within these development areas. Metrobus would like to ensure that as part of the development processes, laybys, shelters and bike rack/and/or bike lockers should are incorporated in the planning and development processes for these areas.
- Dedicated bus laybys on the collector status roadways that runs between the development areas will not be required.
- Bus stops should be spaced between 200 and 400 metres apart.
- Bus shelters should be installed where the number of passengers at a stop exceeds 25 passengers per day.
- The road networks within the development areas should be designed such that 90% of the development area is within 400 metres walking distance of a transit stop.

2.1.12 Regional Fire Department – Coverage Review

As the lands in the areas above the 190 metre contour open up for the development, the St. John's Regional Fire Department would like to ensure that these new areas of development are adequately covered with the required firefighting capacity and within appropriate response times.

In order to answer this question, Hatch used the 2025 regional VISUM model under full development in the study area and the isochrones graphics parameter feature of the software. This feature was set up to map response times from a number of different locations in the City and in surrounding areas under the PM Peak hour traffic conditions in different colors. The idea is to map response time intervals from existing and planned fire station locations to determine if the new areas of development are adequately serviced. The following response times were used: < 4 mins, 4-5 mins, 5-6 mins, 6-7 mins, 7-8 mins, 8-9 mins, 9-10 mins, etc. The mapping colors correspond to the delay times noted.

As part of the initial review the following existing and planned fire stations were included in the analysis:

- The Mount Pearl Fire Station
- The Brookfield Road Fire Station
- The fire station presently under construction on Blackmarsh Road
- The fire station on O'Leary Avenue
- The planned fire station on Topsail Road in the Town of Paradise
- Central Fire Station
- Kent's Pond Fire Station

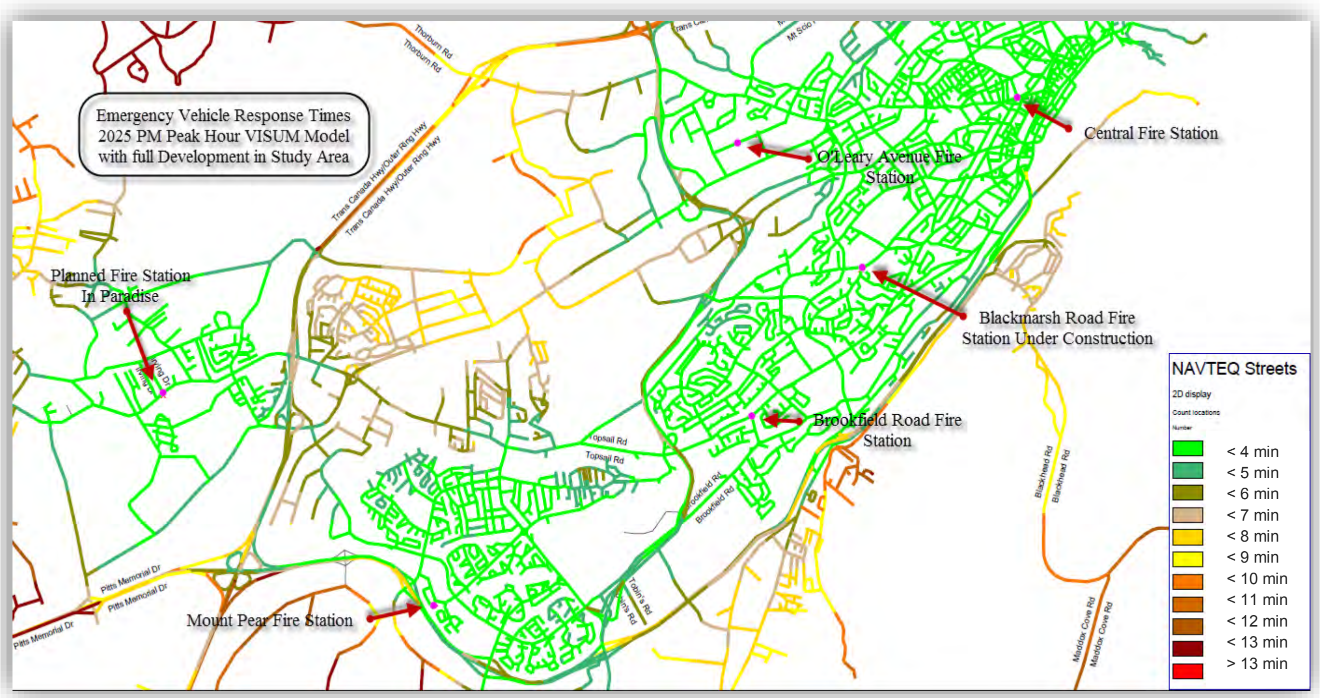


Figure 12 - Draft of Isochrones Analysis - Response Time Coverage in Study Area

As indicated in Figure 12 most of the planned streets with in the study area have emergency vehicle response times of greater than 4 minutes in duration. In fact, certain streets within the study area have response times of in excess of 10 minutes. It would appear, based on the analysis completed, that an additional fire station is required in or near the study area which would reduce the response times on the vast majority of the streets to four minutes or less. The location of the needed fire station in the study area was determined by a process of trial and error. The optimal location is shown in Figure 13.

While the response times in the study area improve substantially with the addition of a new fire station location, it should be noted that response times in both models consider congestion that is expected to be present on the network during the PM Peak hour. It is likely that an emergency vehicle travelling with its emergency lights activated would likely achieve slightly better response times than those shown in both isochrones analyses.

It is recommended that a new fire station be constructed in the area of where Street 1 intersects with Street 2. This will reduce response times in the majority of the proposed development to within acceptable limits.

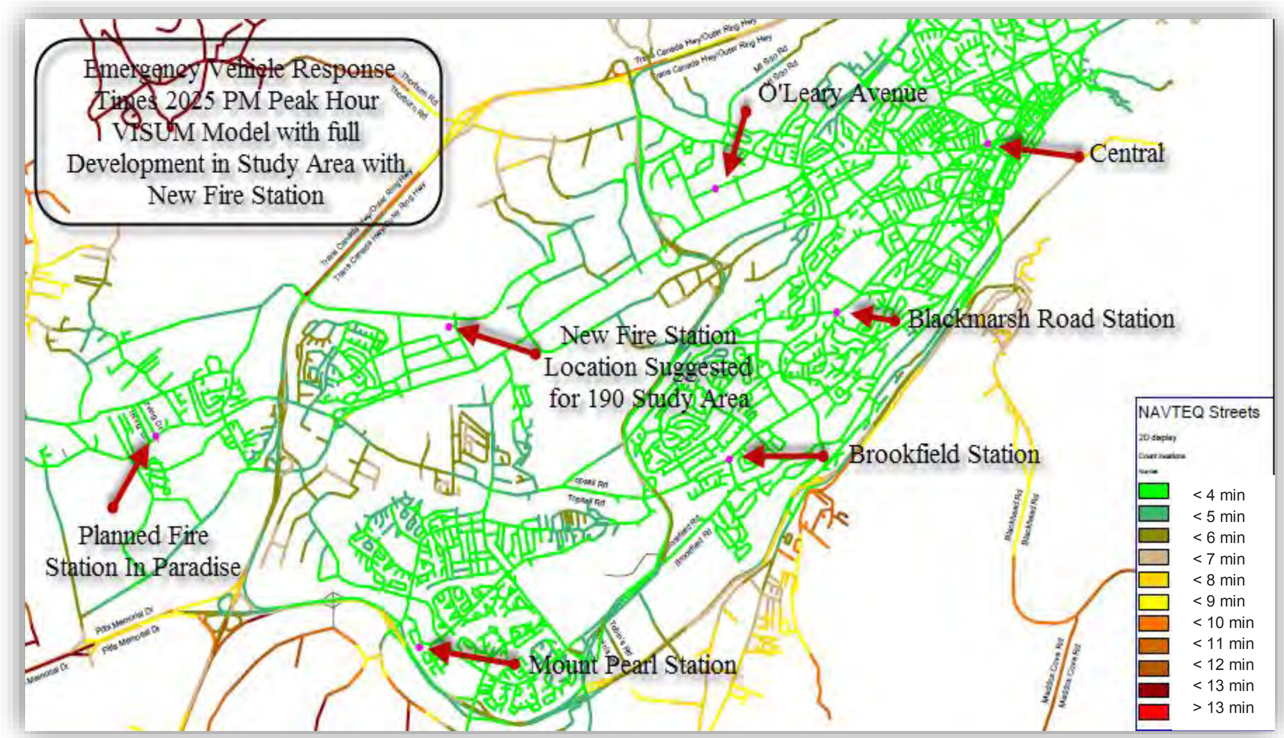


Figure 13 - Draft of Emergency Response Time Coverage with a New Fire Station in the Study Area

2.1.13 Internal Road Network Costs

At a preliminary level of analysis, the estimated costs for the routes 1 thru 9 shown in Figure 10 and Figure 11 have been estimated below in Table 1. Overall, the costs of these facilities are estimated to be approximately $46 million. This estimate is for road construction only, it does not include storm, sanitary or water distribution. There are six (6) roundabouts throughout the internal network and have been included in the table below.

Table 1 - Internal Road Network Costs

Internal Road Network Costs		
Item	**DESCRIPTION**	**ESTIMATED COST**
1 a)	Route 1 - Outer Ring Road to Roundabout	$ 8,810,546
1 b)	Route 1 - Roundabout to Roundabout	$ 4,406,968
2	Route 2	$ 3,233,210
3	Route 3	$ 3,217,431
4	Route 4	$ 1,951,286
5	Route 5	$ 2,376,618
6	Route 6	$ 2,008,053
7	Route 7	$ 1,921,419
8	Route 8	$ 6,115,974
9	Route 9	$ 2,916,409
10	Roundabouts (Six throughout the new development)	$ 9,000,000
	TOTAL	$ 45,957,914

2.2 Traffic Analysis

2.2.1 Land Use Assumptions

As indicated previously there are a total of 7 different areas proposed for development under the comprehensive development plan being suggested for this project. Four of these development areas are on the North side of Kenmount Road and the other 3 are on the South side of Kenmount Road. It is anticipated that approximately 4500 dwelling units will be created on the full build out of areas 1-4 and 5-7. In total, 55% of the developable lands will be in some form of residential housing; the remaining 45% will consist of a mixture of Retail, Office, Commercial, Industrial and Institutional type land uses.

The full details of the planned land uses for areas 1-7 are noted in Table 2.

Table 2 - Land Utilization

LAND AREA	Standard Lot Units	Reduced Lot Units	Attached Units	Multi Units	Gross Retail Area (m^2)	Gross Office Area (m^2)	Combined Office and Retail (Ha)	Highway Commercial (Ha)	Business Park(Ha)	Industrial(Ha)	Institutional (Ha)
1	401	160	153	144							
2	208	250	144	144							
3	355	220	161	324	10000	20000	7.22				
4								22.9	10.9	27.9	3.6
5	146	235	74	108			7.15				
6	196	151	69	72			7.15				
7	269	192	151	192	8703	17406	6.95		29.82		
Total Number Units	1575	1208	752	984							
Area (m^2)					8703	17406					
Area (Ha)							28.47	22.9	40.72	27.9	3.6

Land use information for census tract areas beyond the study area provided by the City of St. John was used to forecast number of trips produced by and attracted to the external zones in the model. The trip purpose was categorized in three groups, Home-Based Work (HBW), Home-Based Non-Work (HBO), and Non-Home-Based (NHB) trips. The initial rates were further adjusted in the model based on household size and income index. Table 3 below provides final daily trip rates per household and vehicle occupancy based on trip purposes.

Table 3 - Daily Trip Generation Rates based on Trip Purpose

Trip Purpose	Person Trips (NCHRP 365)	Vehicle Trips (St. John's)	Vehicle Occupancy
HBW	1.71	1.52	1.13
HBO	4.8	4.61	1.04
NHB	2.96	1.88	1.57

For trip attraction, jobs were classified into five categories: retail, industrial, medical, service and education. Daily trip attraction rates per household were calculated using regression models and provided in the following table.

Table 4 - Daily Trip Attraction Rates based on Trip Purpose

Trip Purpose	Service	Retail	Industrial	Medical	Educational	Household
HBW	1.22	1.22	1.22	1.22	1.22	0.00
HBO	1.70	9.00	0.60	0.60	0.60	1.20
NHB	1.20	3.80	0.50	0.50	0.50	1.20

The peak hour trips used in the operational analysis are based on daily trips. There was no household travel survey data available in St. John to estimate peak hour trips percentage in daily trips at the time of this study. The model uses national average split factors.

2.2.2 VISUM Model Refinement

The traffic analysis zones for the 2025 regional transportation planning model were modified and refined for the purposes of completing the VISUM analysis for this report. Approximately 10 new zones were either split or added to the model to allow a more controlled traffic assignment and to improve the trip generation of the model. The VISUM zones modified and the attributes added are noted in Table 5.

Table 5 - 190m Contour Land Use Areas

	2025 Full Development					
Zone #	Single Family Dwelling Units	Multi-Family Dwelling Units	Retail ha	Industrial ha	Office ha	Institutional ha
531	561	297				
532	458	288				
533	575	485				
534				27.9	10.9	5.7
535	381	182				
536	347	141				
537	461	343				
538			22.9			
539					36.8	

The locations of the traffic analysis zones and the multi-point assignments for the updated 2025 VISUM model are shown in Figure 14.

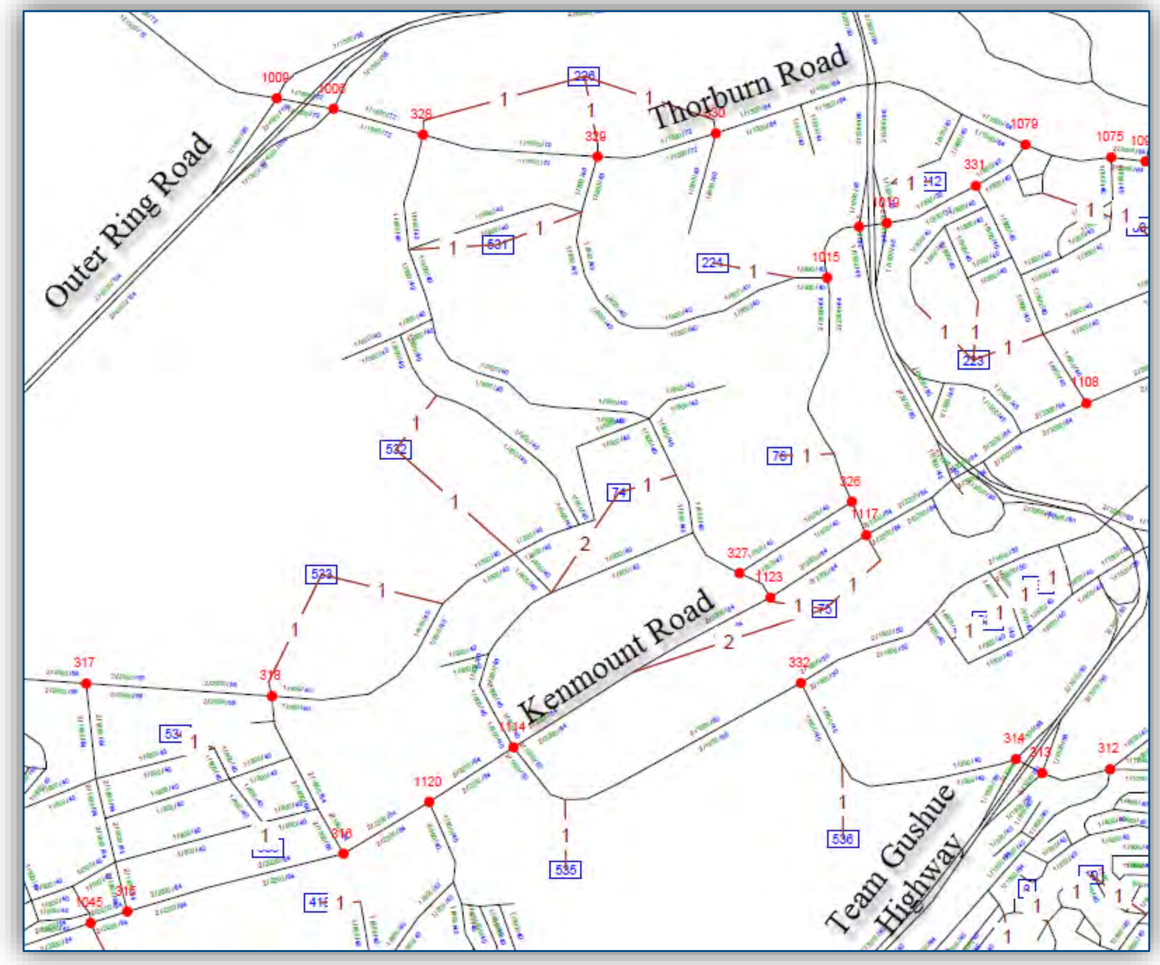


Figure 14 - Draft 2025 VISUM Model

The network links and connectors in Figure 14 are a conceptual representation of the network that permits the assignment of trips to and from each of the land use zones to the network and assessment of the impact that these trips will have on the wider-area network. The actual intersection, road spacing and accesses to development determined at the site plan stage of development may be different than that used in the model. These differences should not affect the assignment of traffic to the overall network.

2.2.3 Analysis Scenarios

In total, there were four different modelling scenario's used in the course of completing the analysis for this study. These scenarios included:

- Scenario 0: Existing Conditions (2013)
- Scenario 1: 2025 projection of normal growth with no development in the study area.
- Scenario 2: 2025 projection of normal growth and development in the study area with no improvements to the road network.
- Scenario 3: Includes conditions present with Scenario 2 but with improvements in place to the road network.

The traffic volume forecasts were completed using the updated 2025 VISUM model. The operational analysis of the existing conditions was completed using Synchro, SimTraffic, ARCADY and HCS2010. An electronic copy of Synchro and VISUM files will be submitted to the City of St. John's along with the final report.

A traffic assignment was prepared for each existing and horizon year that provided link volumes based on each link's constraints (i.e., speed, number of lanes and capacity of each lane) in the model. Link volumes from the model were converted to turning movement counts based on existing turning movement patterns and manually adjusted in locations where the model assignment appeared to vary significantly from existing patterns or would be affected by new development.

2.2.3.1 Scenario 0 – Existing Conditions

Scenario 0 examines the existing conditions in the study area. Synchro and SimTraffic analysis were completed on the study area intersections based on existing adjusted volumes, lane configurations, and traffic signal timing plans.

The existing road network configuration was assembled into a Synchro model based on GIS information provided by the City of St. John's, the Interactive Map of St. John's, and through the use Google Earth View. Where necessary, site conditions were verified through site visits. The existing lane configurations and intersection controls applied for the analysis are illustrated in Figure 15. The major roadways found in the study area are described below:

Thorburn Road is classified as an arterial roadway. The segment extending from Columbus Drive to the Goldstone Street intersection is a five lane undivided roadway with a posted speed limit of 50km/h. The segment of roadway extending from Goldstone Street to the Outer Ring Road interchange consists of two lanes and has a posted speed limit of 50 km/hr. This roadway is a main thoroughfare for the connection between the City of St. John's and the Town of Portugal Cove- St. Philip's. It also a main connection for traffic on the Outer Ring Road travelling to the Avalon Mall and the University area.

Kenmount Road is a five lane undivided major arterial road with posted speed limits of 50 km/hr and 60km/hr. This arterial services a large commercial and retail area of the City and provides access to the City of St. John's from the City of Mount Pearl and the Town of Paradise.

Columbus Drive is a four lane divided arterial road with a posted speed limit of 70 km/hr. Segments of the roadway leading to Thorburn Road have additional lanes. Columbus Drive is a limited access roadway with controlled signalised intersections along its length. This arterial roadway is a main thoroughfare travelling north and south in the west end of St. John's.

Blackmarsh Road is a 2 lane undivided minor arterial road with a posted speed limit of 50 km/hr. This arterial road services a large number of residential and commercial surrounding it and provides access to major arterials including Columbus Drive and in future to Team Gushue Highway.

Ladysmith Drive is a 2 lane undivided collector road with a posted speed limit of 30 to 40 km/hr. This collector road connects local roads in Residential Kenmount-West (RK-West) area to Kenmount Road. In Future, this road will extend northerly to provide access to Thorburn Road.

The existing cross sections for each of the major roads in the study area are summarized in Table 6. Future roadways should be designed to incorporate context sensitive complete streets design philosophy. This includes treatments to accommodate all road users such as provision of multi-use paths, on and off street bike lanes. A context sensitive design approach will also balance the competing priorities of all travel modes and often results in reduced dimensions of the conventional driving and auxiliary turn lanes. Table 6 presents treatments for various arterial and collector roads that embody these principles. The classification of the main study area streets and the corresponding roadway standard cross sections are provided in Appendix B-4.

Table 6 - Roadway Functional Classification and Design Standard

Road	From – To	Functional Classification	Right-of-Way Width (m)	Design Cross Section
Thorburn Road	Columbus Drive to Goldstone Street	Urban Arterial Undivided (UAU-60)	23.5	Standard Boulevard Street – 5 Lanes
	Goldstone to Outer Ring Road	Urban Arterial Undivided (UAU-60)	20.5	Standard Boulevard Street – 2 Lanes
Kenmount Road	Columbus Drive to Allston Street	Urban Arterial Undivided (UAU-60)	23.5	Standard Boulevard Street – 5 Lanes
Columbus Drive	Old Pennywell Road to Topsail Road	Urban Arterial Divided (UAD-90)	23.5	Standard Boulevard Street – 4 Lanes
	Thorburn Road to Old Pennywell Road	Urban Arterial Divided (UAD-90)	30.5	Standard Boulevard Street – 6 Lanes
Blackmarsh Road	Campbell Avenue to Topsail Road	Urban Arterial Undivided (UAU-60)	20.5	Standard Boulevard Street – 2 Lanes
Ladysmith Drive	Kenmount Road northerly to Thorburn Road.	Urban Collector (UC-50)	17.5	Standard Collector Street – 2 Lanes
Future Roads				
Future Access Road 1	Thorburn Road to Messenger Drive	Urban Collector Undivided (UAU-60)	29.0	Standard Collector 4 Lanes with Multi-use path, sidewalk and planting strips
Future Access Road 2	Thorburn Road to Ladysmith Drive	Urban Collector Undivided (UAU-60)	29.0	Standard Collector 4 Lanes with Multi-use path, sidewalk and planting strips
Future Access Road 3	Outer Ring Road Access to Kenmount Road	Urban Arterial Undivided (UAU-60)	33.0	Standard Arterial 4 Lanes with Multi-use path, sidewalk and wider planting strips
Future Access Road 4	Outer Ring Road Access to Kenmount Road	Urban Collector Undivided (UAU-60)	29.0	Standard Collector 4 Lanes with Multi-use path, sidewalk and planting strips

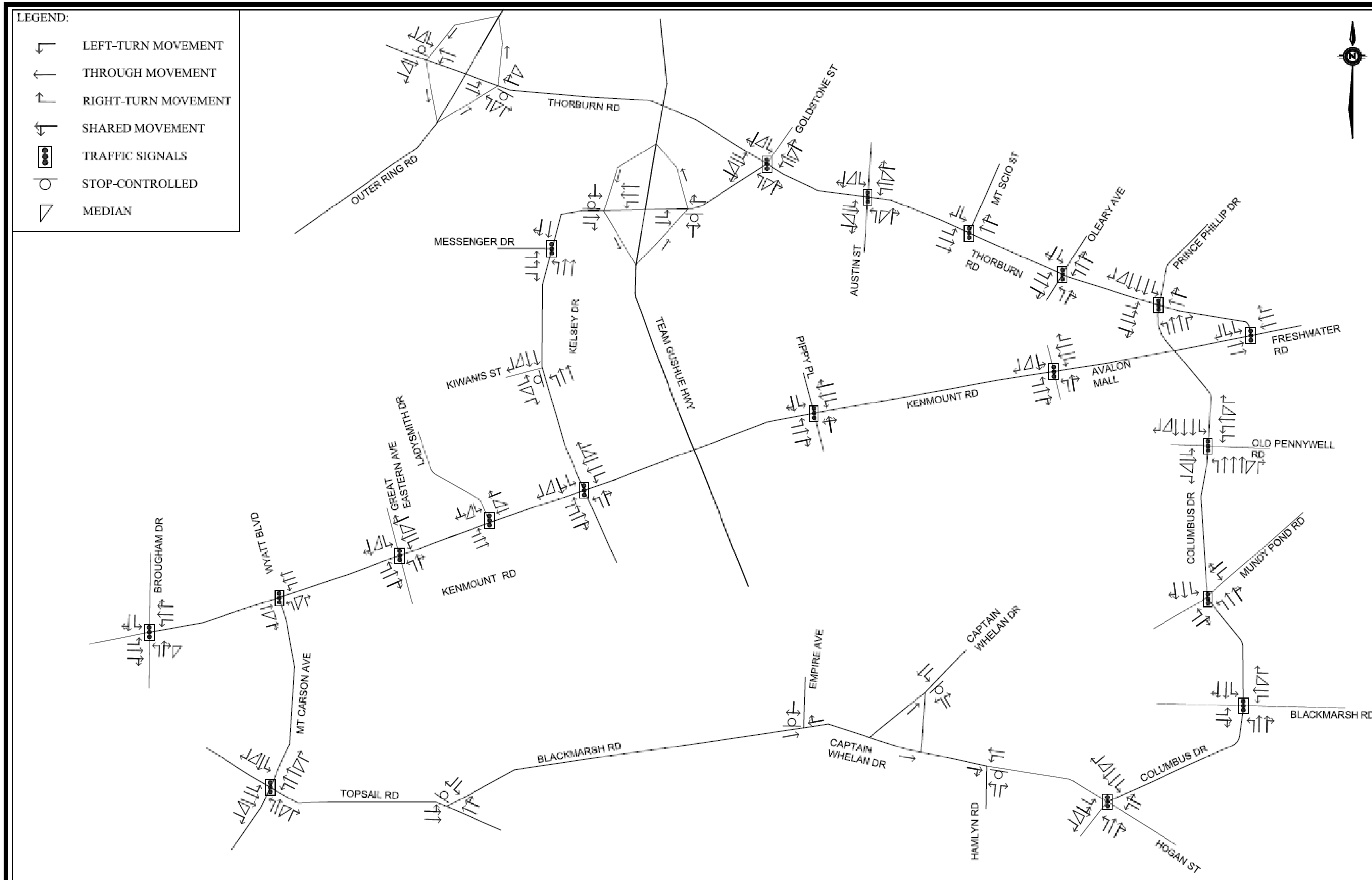


Figure 15 - Draft of Existing Lane Configuration

The Synchro and SimTraffic analysis of the existing conditions scenario (S0) was completed using for the models created for both the AM and PM peak hour traffic conditions. For each of these conditions, a detailed summary table was created that reports for each movement: the Synchro delay in seconds, Level of Service (LOS), volume to capacity ratios (v/c ratios), and queue length, and the SimTraffic average batch run delay in seconds, the equivalent LOS, and the 95th percentile queue in metres for both the a.m. and p.m. peak traffic hours. The detailed summary reports are included within Appendix B-5. A higher level summary table that reports on the overall intersection performance has been included within the test of the report that follows. The results of the analysis are color coded in the volume diagrams, the detailed summary tables included within Appendix B-5 and in the summary tables that report on overall intersection performance.

For the signalized intersections, traffic signal timings were based on the existing traffic signal timing plans provided by the City of St. John's, and the Department of Transportation and Works of Newfoundland and Labrador (NLDTW). Peak hour factors and heavy vehicle percentages were adjusted based on available existing count data. The SimTraffic delay is based on the average delays recorded for a batch run of 10 SimTraffic 8.0 model simulations.

The LOS for each movement as calculated by Synchro is shown by colour in Figure 16. The analysis summaries are shown in Table 7 and Table 8 and detailed results are included in Appendix B-5.

<u>Discussion of the Results S0</u>

Figure 16 illustrates the LOS results during both the AM and PM peak hour periods at all intersections with the study area. For the most part, most of the intersections within the study area perform well during both the AM and PM peak hour periods. There are however a number of noted exceptions including:

- Outer Ring Road Ramp terminals with Thorburn Road: Both ramp terminals suffer from poor levels of service during both the AM and PM peak hour periods.
- Thorburn Road @ Prince Philip Drive: The westbound through movement suffers from poor levels of service during both peak hour periods.
- Pippy Place @ Kenmount Road. The southbound right and left turning movements and the eastbound left turning movement suffer from poor levels of service in the AM peak hour. The southbound movements also suffering from poor level of service in the PM peak hour period.
- Goldstone Street @ Team Gushue Highway: The northbound and southbound off ramps suffers from congestion and queuing in in the PM peak hour. The southbound ramp also suffering from poor levels of service and congestion in the AM peak hour.
- Kenmount Road @ Ladysmith: Westbound through movements suffers from congestion and poor levels of service during the PM peak hour.
- Kenmount Road @ Wyatt Boulevard: The westbound left and the northbound right turning movements have poor levels of service in the PM peak hour. The northbound right is problematic in the AM peak hour.
- Kenmount Road @ Brougham Drive: The westbound through movement has a poor level of service in the PM peak hour. All movements in the northbound approach suffer from levels of congestion in the AM and PM peak hour periods.
- Blackmarsh Road @ Columbus Drive: The southbound left turning movement suffers from a poor level of service in the PM peak hour.
- Captain Whelan Drive @ Columbus Drive: All movements on the east and westbound approaches of this intersection suffer from poor levels of service and congestion during both the AM and PM peak traffic periods.
- Blackmarsh Road @ Topsail Road. The northbound left turning movement has a poor level of service in both the AM and PM peak hour traffic periods.
- Topsail Road @ Mount Carson Avenue. The eastbound right, westbound left and southbound through movement all suffer from poor levels of service and congestion during the PM peak hour.

Again, the analysis summaries are shown in Table 7 and Table 8 and detailed results for all approach movements are included in Appendix B-5.

<u>Unsignalized Intersection Warrants Analysis</u>

There are a number of existing unsignalized intersections throughout the road network included within the study area that are currently operating at failing levels of service. A traffic signal warrants analysis was conducted on a number of these locations to determine whether or not the installation of traffic signals is needed.

The locations included:

- Outer Ring Road NB and SB Ramp terminals with Thorburn Road
- Topsail Road & Blackmarsh Road
- Kelsey Drive & Team Gushue Highway SB and NB Ramp terminals

The traffic signal warrant analysis followed the methodology of the Transportation Association of Canada's (TAC) *Traffic Signal Warrant Handbook* (TAC, March 2007). The warrant calculations were conducted using the six-hour traffic volumes collected by Hatch. The summary results of the warrant calculations are noted below. The detailed calculations are contained in Appendix B-6.

- Outer Ring Road SB/Thorburn Road warranted traffic signals with 105 warrant points.
- Outer Ring Road NB/Thorburn Road warranted traffic signals with 127 warrant points.
- Blackmarsh Road/ Topsail Road warranted traffic signals with 183 warrant points.
- Team Gushue Highway SB/Kelsey Drive warranted traffic signals with 119 warrant points.
- Team Gushue Highway NB/Kelsey Drive did not warrant traffic signals with 54 warrant points. It should be noted that traffic signals are likely to be warranted with the high traffic volumes projected in the PM peak hour in the 2025 Full Build-out (Scenario 2).

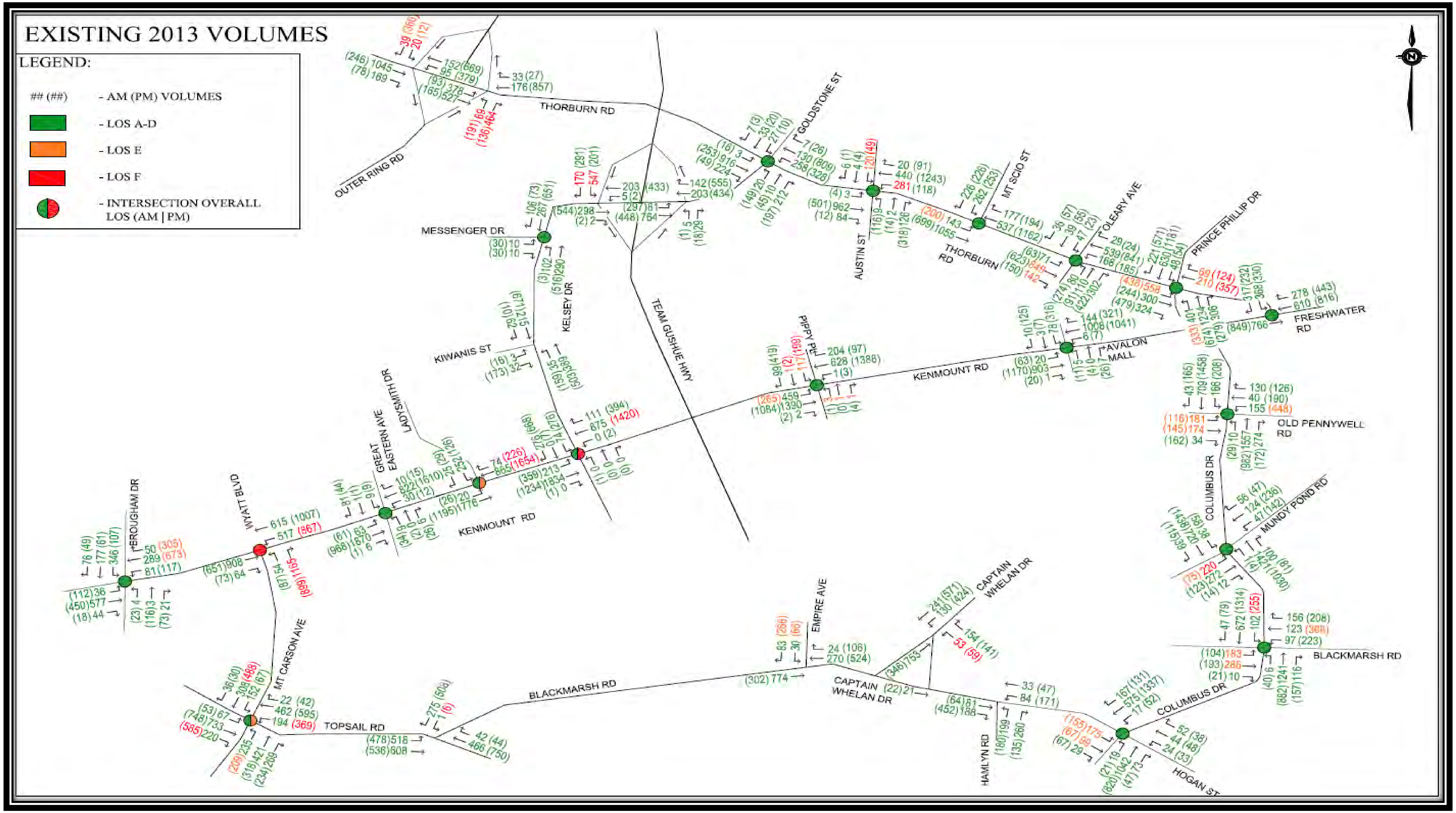


Figure 16 - Draft of Existing 2013 AM (PM) Peak Hour Traffic

Table 7 - Existing - 2013 Synchro Analysis AM Peak Hour Results

Existing Road Network	AM Peak Hour			
	Synchro		SimTraffic	
Intersection	Delay/Veh (s)	LOS	Delay/Veh (s)	Equivalent LOS
Outer Ring Road (SB) & Thorburn Road	2.9	-	51.8	F
Outer Ring Road (NB) & Thorburn Road	126.0	-	23.5	C
Goldstone Street & Thorburn Road	23.1	C	9.7	A
Austin Street & Thorburn Road	26.0	C	15.2	B
Mt Scio Road & Thorburn Road	17.3	B	15.3	B
O'Leary Avenue & Thorburn Road	50.4	D	52.9	D
Columbus Drive & Thorburn Road	35.8	D	33.7	C
Thorburn Road & Freshwater Road	14.1	B	10.6	B
Avalon Mall & Kenmount Road	9.0	A	5.1	A
Pippy Place & Kenmount Road	20.9	C	15.6	B
Kelsey Drive & Kenmount Road	13.8	B	13.2	B
Kelsey Drive & Kiwanis Street	0.9	-	2.4	A
Team Gushue Hwy (SB) & Kelsey Drive	206.7	-	66.1	F
Team Gushue Hwy (NB) & Kelsey Drive	1.1	-	1.3	A
Ladysmith Drive & Kenmount Road	26.9	C	24.8	C
Great Eastern Avenue & Kenmount Road	11.5	B	13.5	B
Wyatt Boulevard & Kenmount Road	127.0	F	55.5	E
Brougham Drive & Kenmount Road	35.2	D	50.7	D
Columbus Drive & Old Pennywell Road	41.8	D	33.8	C
Columbus Drive & Mundy Pond Road	29.8	C	39.8	D
Columbus Drive & Blackmarsh Road	37.1	D	32.3	C
Columbus Drive & Captain Whelan Drive	21.6	C	170.2	F
Hamlyn Road & Captain Whelan Drive	7.9	-	8.4	A
Empire Avenue & Blackmarsh Road	1.5	-	10.4	B
Blackmarsh Road & Topsail Road	6.1	-	10	A
Blackmarsh Road & Captain Whelan Drive	5.6	-	3.6	A
Mt Carson Ave/ Commonweath Ave & Topsail Road	32.7	C	36.4	D

Table 8 - Existing - 2013 Synchro Analysis PM Peak Hour Results

Existing Network		PM Peak Hour			
Intersection		Synchro		SimTraffic	
Street	Movement	Delay/Veh (s)	LOS	Delay/Veh (s)	Equivalent LOS
Outer Ring Road (SB) & Thorburn Road		12.4	-	16.8	C
Outer Ring Road (NB) & Thorburn Road		110.3	-	20.1	C
Goldstone Street & Thorburn Road		12.8	B	11.3	B
Austin Street & Thorburn Road		14.4	B	12.3	B
Mt Scio Road & Thorburn Road		27.3	C	26.6	C
O'Leary Avenue & Thorburn Road		36.8	D	35.1	D
Columbus Drive & Thorburn Road		45.0	D	41.5	D
Thorburn Road & Freshwater Road		12.5	B	9.0	A
Avalon Mall & Kenmount Road		25.7	C	15.7	B
Pippy Place & Kenmount Road		39.7	D	32.6	C
Kelsey Drive & Kenmount Road		89.2	F	49.6	D
Kelsey Drive & Kiwanis Street		3.0	-	4.6	A
Team Gushue Hwy (SB) & Kelsey Drive		117.9	-	65.8	F
Team Gushue Hwy (NB) & Kelsey Drive		3.1	-	25.7	D
Ladysmith Drive & Kenmount Road		61.5	E	64.2	E
Great Eastern Avenue & Kenmount Road		10.7	B	16.6	B
Wyatt Boulevard & Kenmount Road		85.9	F	24.5	C
Brougham Drive & Kenmount Road		47.9	D	104.6	F
Columbus Drive & Old Pennywell Road		45.5	D	35.9	D
Columbus Drive & Mundy Pond Road		28.5	C	25.0	C
Columbus Drive & Blackmarsh Road		53.9	D	55.7	E
Columbus Drive & Captain Whelan Drive		21.0	C	94.8	F
Hamlyn Road & Captain Whelan Drive		8.7	-	4.0	A
Empire Avenue & Blackmarsh Road		12.0	-	10.5	B
Blackmarsh Road & Topsail Road		16.8	-	9.9	A
Blackmarsh Road & Captain Whelan Drive		20.1	-	4.5	A
Mt Carson Ave/ Commonwealth Ave & Topsail Road		62.7	E	4.4	F

2.2.3.2 Scenario 1 – 2025 Normal Growth with No Development

The Scenario 1 model is based on growth that is projected to occur regionally to the year 2025. It includes planned growth in the region; however, it does not include any of the planned development in the lands above the 190 metre contour. Some planned improvements for the road network include the following:

- Unsignalized intersection at Thorburn Road and Future Access Road # 1 (Node 329)
- Unsignalized intersection at Ladysmith Drive and Kiwanis Street
- Signalized intersection at Blackmarsh Road and Captain Whelan Drive
- Signalized intersection at Captain Whelan Drive and Hamlyn Road
- Interchange at Team Gushue Highway and George's Pond Road

This VISUM model was used to obtain approach movement traffic volumes at all intersections included within the study area for both the AM and PM peak hours. A summary of the intersection turning movements under Scenario 1 is included in Appendix B-7. It is noted that the volumes used for the analyses of these scenarios were derived from the City's Transportation Travel Demand Model. Since the model calibration and validation has not been completed, these volumes should only be considered as a rough estimate of the projected volumes across screen lines and not as link-by-link detailed volumes.

<u>Discussion of the Results S1</u>

The traffic conditions under Scenario 1 in the PM peak hour are poor with longs delays and congestion present on one or more approaches at most intersections within the study area. Intersections are expected to operate acceptably in the AM peak hour.

Congestion on the road network is showing up on the major east – west corridors of Kenmount and Thorburn Roads at selected intersections in the PM peak hour. It is also showing up in the north – south corridors including Columbus Drive particularly in the PM peak hour. It is also beginning to become apparent at the ramp terminals of the Thorburn Road interchange with the Outer Ring Road (TCH). This is probably due to a lack of alternative routes linking Paradise, Mount Pearl and the Cowan Heights area of St. John's.

2.2.3.3 Scenario 2 – 2025 Scenario 1 plus Full Development Build Out

The Scenario 2 model is based on growth that is projected to occur regionally to the year 2025. The model includes planned growth in the region and the full build out of the planned development in the lands above the 190 metre contour. Recommended improvements to the road network to support planned development include new connections and intersections of Future Access Road #2 with Thorburn Road, and Future Access Roads #3 and # 4 with Kenmount Road.

The recommended street network for the north side, including Future Access Roads 1 (Messenger Drive Extension) and 2 (Ladysmith Drive Extension) at Thorburn Road (Nodes 328 and 329 respectively), provide opportunities to connect Thorburn Road to Kenmount Road to carry future demand between them. Future Access Road 1 will connect to Kenmount Road via Messenger Drive and then Kelsey Drive. Future Access Road 2 will be continued southerly to Ladysmith Drive which has intersection with Kenmount Road. For the reasons discussed in Section 2.2.9, the proposed network doesn't include direct connection to Mount Carson Avenue but has included connections to Kenmount Road on either side of Mount Carson Avenue. This network arrangement was developed to locate a district park and preserve natural area north of Mount Carson Avenue/Wyatt Boulevard. As noted above, the feasibility of making a direct connection to Mount Carson Avenue/Wyatt Boulevard should be made in a subsequent more detailed neighbourhood planning stage.

This VISUM model was used to obtain approach movement traffic volumes at all intersections included within the study area for both the AM and PM peak hours. A summary of the intersection turning movement volumes for Scenario 2 is included in Appendix B-7.

<u>Discussion of the Results S2</u>

For the most part, many of the intersections within the study area have one or more movements that are performing poorly and predominantly so, in the PM peak hour.

Similar to Scenario 1, there is congestion at intersections along the major east-west routes of Thorburn Road and Kenmount Road, and the north-south route of Columbus Drive. The additional traffic from the full build out of planned developments has worsened traffic operations at the intersections of Kenmount Road with Great Eastern Avenue and Wyatt Boulevard to the western part of the study area; in particular, the intersections at Great Eastern Avenue and Wyatt Boulevard are significantly more congested in the AM and PM peak hours respectively, with poor levels of service. Traffic operations are also found to worsen significantly at the southbound off-ramp terminal of TGH. The new intersections of Future Access Road 2 with Thorburn Road and of Future Access Roads 3 and 4 with Kenmount Road operate below acceptable levels of service in the PM peak hours.

2.2.3.4 Scenario 3 – 2025 Scenario 2 plus Improvements

The Scenario 3 model is based on growth that is projected to occur regionally to the year 2025. The model includes planned growth in the region and the full build out of the planned development in the lands above the 190 metre contour. This VISUM model was used to obtain approach movement traffic volumes at all intersections included within the study area for both the AM and PM peak hours. A summary of the intersection traffic volumes under this scenario is provided in Appendix B-7.

In an effort to improve the level of service throughout the study area intersections, a number of improvements, including traffic signals, signal timing changes, and auxiliary lane additions were made to the road network within the study area. The improvements include widening Thorburn Road to two through lanes in each direction west of Team Gushue Highway and providing additional turning lanes at a number of intersections in the southern part of the study area. Traffic signals were considered at several intersections across the road network, as well as a roundabout at the intersection of Blackmarsh Road and Captain Whelan Drive. The changes are listed below.

- Additional Lanes
  - Thorburn Road/Outer Ring Road SB
    - Westbound Through Lane
    - Eastbound Through Lane
  - Thorburn Road/Outer Ring Road NB
    - Westbound Through Lane
    - Eastbound Through Lane
    - Westbound Right-turn Lane
  - Mount Scio Road/Thorburn Road
    - Westbound Right-turn Lane
    - Southbound Left-turn Lane
  - Brougham Drive/Kenmount Road
    - Northbound Right-turn Lane
  - Topsail Road/Blackmarsh Road
    - Eastbound Left-turn

- Westbound Right-turn Lane
- Columbus Drive/Mundy Pond Road
  - Westbound Left-turn

- New Traffic Signals
  - Thorburn Road/Outer Ring Road SB & NB
  - Future Access Road #1, #2 & #3
  - Kelsey Drive/Team Gushue Highway SB & NB
  - Topsail Road/Blackmarsh Road
  - Hamlyn Road/Captain Whelan Drive
  - Blackmarsh Road/Captain Whelan Drive
  - George's Pond Road/Team Gushue Highway SB & NB

- New Roundabout
  - Blackmarsh Road/Captain Whelan Drive

Discussion of the Results of Scenario 3

Even with the improvements in place as noted above, several intersections along the main corridors in the study area continue to display poor levels of service during the PM peak hour.

There are a number of different approaches that could be taken by the City of St. John's with respect to dealing with the capacity issues that are presented by this development and accommodating future growth in the City. These include:

1. Do not allow any development above the 190 metre contour to proceed. Without the development, there will still be challenges in the study area in 2025, some of which could be mitigated with the implementation of the suggested improvements listed above.

2. The City of St. John's could proceed with a widening plan for Kenmount Road, Thorburn Road and for Columbus Drive. While such an approach could theoretically obtain the required network capacity, it would be at a heavy price; the widening would be very expensive to build and would have serious implications to most if not all of the businesses in the Kenmount Road and O'Leary's Industrial Park areas.

3. The overall planned development for the lands above the 190 metre contour could be throttled or limited in size to reduce the amount of traffic that will be generated on full build out. This would however, have implications on the planning goals of creating complete sustainable neighbourhoods within this development. The economics associated with the cost of the infrastructure and the taxation return on the investment may be diminished with a reduced amount of development.

4. Knowing the outcomes and implications of the full build out of this development over the next 10-20 years, the City of St. John's could proceed with the development with the understanding that it will have to work in conjunction with other municipalities in the metro area and the Provincial Government cooperatively to collectively change the policies on sustainable development and to put in place equitable cost sharing agreements that will see a successful implementation of a regional transit service with the overall goal to be a significant network wide reduction of the reliance on single passenger vehicles. A number of connections from the development to the external road network were identified in the study as key connections. These include connections to:
   - Kenmount Road and Thorburn Road.
   - Elizabeth Park, Wyatt Boulevard and the Outer Ring Road.
   - Extension of Messenger Drive and Ladysmith Drive to complete the collector road grid.
   - Creation of an east-west collector road to tie into a future Brier Avenue and secondary collector to connect to Empire Avenue and Blackmarsh Road is also desirable.

   In conjunction with these connections, accommodation of the anticipated future growth in the City and in the study area will require a broader more integrated transportation strategy designed to offer inhabitants greater travel choices. This would include the following:

- Ensuring that the planned road network within the study area is transit supportive, and provides continuous mid-block collector roadways designed for transit routes through the neighbourhood, so that approximately 90 percent of inhabitants are within a 400m walk of a transit stop and that internal roads are connected to existing similar facilities. For example, provision of a collector road west of Ladysmith Drive that connects as directly as possible to the planned transit hub and to Kenmount Road at Wyatt Boulevard/Mount Carson Avenue.
- Ensuring that internal and external roads incorporate active transportation facilities including on and off-road cycling facilities in accordance with the City's Cycling Master Plan, and sidewalks that are accessible to those who may be mobility challenged. Typical cross sections for selected arterial, collector and local streets are provided in Appendix B-4.
- Developing and implementing travel demand strategies designed to reduce the demand for the private automobile. Encouraging businesses, industry and developers to provide greater support for cycling and transit users. Also to consider providing transit improvements on key corridors to reduce the overall travel time for transit users. This might include the use of queue jump lanes, far side stop locations in protected bays and transit priority measures.
- Considering alternative types of intersection design and control at selected intersections. This would include considering the use of roundabouts where these intersections van provide improved operational and safety performance compared to signalized intersections.
- Undertaking corridor widening to accommodate vehicular travel demand, only when other measures have been explored fully.

It is recommended that the City adopt an integrated strategy to accommodating future travel in the study area that in conjunction with Approach 4 above includes each of these measures.

(1) Roundabouts as an Alternative to Signals Control

There are a number of intersections within the study that could provide improved levels of service if they were configured as roundabouts as opposed to traditional type intersections with signals control. The ramp terminals of the Outer Ring Road with Thorburn Road is an example of where roundabouts would provide better levels of service over the traditional signals type of control. A concept plan of this configuration is shown in Figure 17.

Figure 17 - Draft of Outer Ring Road/Thorburn Road Roundabout Concept

The ARCADY analysis for both the AM and PM peak periods provides good level of service results, shown below in Table 9 and Table 10.

Table 9 - Outer Ring Road/Thorburn Road 2025 AM ARCADY Results

	AM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	A1 - 2025 S5						
ORR SB/ Thorburn Rd - WB	0.24	?	2.06	0.19	A	2.48	A
ORR SB/ Thorburn Rd - SB	0.01	?	3.34	0.01	A		
ORR SB/ Thorburn Rd - EB	0.57	1.02	2.67	0.36	A		
ORR NB/ Thorburn Rd - WB	0.23	?	1.86	0.19	A	2.90	A
ORR NB/ Thorburn Rd - EB	0.37	?	2.31	0.27	A		
ORR NB/ Thorburn Rd - NB	0.10	?	4.06	0.09	A		

Table 10 - Outer Ring Road/Thorburn Road 2025 PM ARCADY Results

	PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	A1 - 2025 S5						
ORR SB/ Thorburn Rd - WB	5.01	14.28	10.05	0.84	B	12.04	B
ORR SB/ Thorburn Rd - SB	1.13	3.00	25.22	0.54	D		
ORR SB/ Thorburn Rd - EB	1.09	?	4.91	0.52	A		
ORR NB/ Thorburn Rd - WB	2.78	4.00	6.39	0.74	A	5.68	A
ORR NB/ Thorburn Rd - EB	0.49	1.00	2.51	0.33	A		
ORR NB/ Thorburn Rd - NB	0.67	1.00	6.66	0.40	A		

Similarly, the proposed access through the Terra Nova Motors site to the development on the south side of Kenmount is also taxed from a level of service perspective when it operates with as a traffic signal under the Scenario 3 volumes. Significant reductions in delay and improvement in the level of service are expected if this intersection were reconfigured to operate as a roundabout. Again, a possible concept plan for the Scenario 3 volumes is shown below in Figure 18. The 3-lane roundabout in Figure 18 is the design concept to accommodate the full buildout of the area that identifies areas where additional property may be required and that can be protected from future development. A staged implementation of this ultimate concept could occur in response to traffic growth in the area and could include an initial single-lane roundabout during the initial stages of development.

Figure 18 - Draft Roundabout Configuration - Kenmount Road at Great Eastern Avenue

The Thorburn Road intersection with Prince Philip Drive is another example of a relatively complex, busy intersection that is expected to suffer from congestion and poor levels of service under the S3 volumes. A roundabout conversion such as the one shown in Figure 19 may provide some reduction in delay and better levels of service. Please note this configuration was not analysed in ARCADY.

More complete drawings of the conceptual roundabout configurations shown above are contained in Appendix B-8.

Figure 19 - Draft Roundabout Configuration Thorburn Road Intersection with Prince Philip Drive

2.2.4 Existing Network Improvements / Costs

The improvements suggested in Section 2.2.3.4 have been conceptually estimated in the table below, Table 11, to show what is required on the existing road network to improve the congestion and provide the LOS as seen in Scenario 3. The location of each improvement referred to in Table 11 is shown in Figure 20. The design characteristics of each improvement including requirements for storage length, length of parallel lane, and length of taper for all auxiliary lanes are shown in Table 12 and have been used as a basis to estimate the costs for these improvement concepts. Three roundabouts have been added as optional items to be included in the road network, which will improve the congestion at those intersections. Schematic drawings for the roundabouts are provided in Figure 17 to Figure 19.

Table 11 - Existing Road Network Improvements/ Costs

Existing Network Improvements/ Costs			
ITEM	DESCRIPTION	ESTIMATED COST	
Outer Ring Road NB & SB / Thorburn Road			
1	Install Traffic Signals at both intersections	$	250,000
2	Install WB Auxiliary Right Turning Lane at NB Intersection	$	45,000
3	Install two additional through lanes (one each direction)	$	6,300,000
4	Install roundabouts (Optional)	$	1,500,000
	Sub-total	$	8,095,000
Future Access Rd # 2 / Thorburn Road			
5	Install Traffic Signals	$	200,000
	Sub-total	$	200,000
Future Access Rd # 1 / Thorburn Road			
6	Install Traffic Signals	$	200,000
	Sub-total	$	200,000
Mt. Scio Street / Thorburn Road			
7	Install WB Auxiliary Right Turning Lane	$	18,000
8	Install SB Auxiliary Left Turning Lane	$	45,000
	Sub-total	$	63,000
Team Gushue Highway NB & SB / Kelsey Drive			
9	Install Traffic Signals	$	250,000
	Sub-total	$	250,000
Wyatt Boulevard / Mt. Carson Avenue			
10	Install EB Auxiliary Right Turning Lane at NB Intersection	$	76,500
	Sub-total	$	76,500
Future Access Rd # 3 / Kenmount Road			
11	Install Traffic Signals	$	200,000
12	Install SB Additional Left-turn	$	90,000
13	Install WB Auxiliary Right Turning Lanes	$	90,000
14	Install EB Auxiliary Left Turning Lanes	$	90,000
	Sub-total	$	470,000
Brougham Drive / Kenmount Road			
15	Install NB Auxiliary Right Turning Lane	$	45,000
	Sub-total	$	45,000
Topsail Road / Blackmarsh Road			
16	Install Traffic Signals	$	250,000
17	Install WB Auxiliary Right Turning Lanes	$	45,000
18	Install EB Auxiliary Left Turning Lanes	$	45,000
	Sub-total	$	340,000
Columbus Drive / Mundy Pond Road			
19	Install WB Auxiliary Left Turning Lane	$	54,000
	Sub-total	$	54,000
Captain Whelan Drive / Team Gushue Highway NB & SB			
20	Install traffic signals at both intersections	$	250,000
	Sub-total	$	250,000
Great Eastern Avenue / Kenmount Road			
21	Install roundabouts (Optional)	$	2,000,000
	Sub-total	$	2,000,000
Thorburn Road / Prince Philip Drive / Columbus Drive			
22	Install roundabouts (Optional)	$	3,000,000
	Sub-total	$	3,000,000
General			
23	Optimize and coordinate signal timings	$	25,000
	Sub-total	$	25,000
	TOTAL	**$**	**15,068,500**

Note: Please See Figure 20

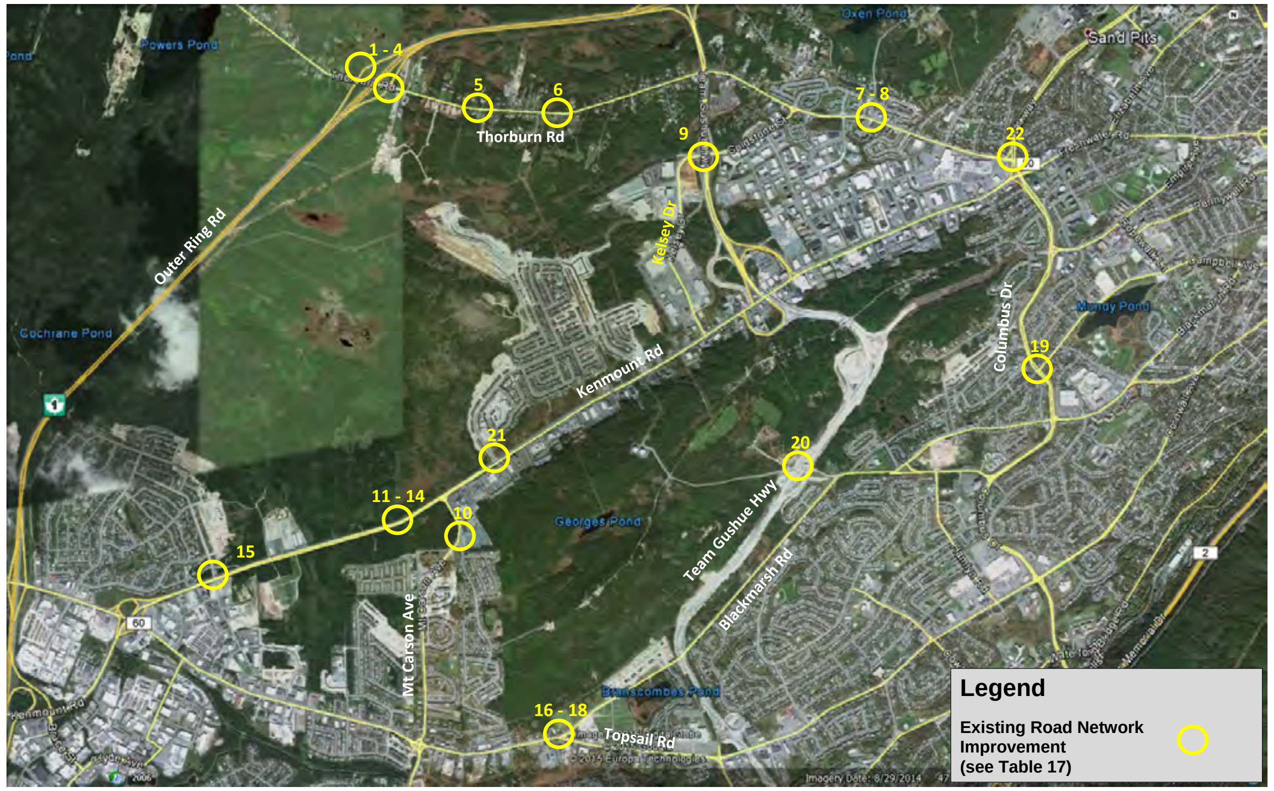


Figure 20 - Draft of Existing Road Network Improvement Locations

Table 12 - Characteristic of Network Improvement

Item	Description	Design Speed (kph)	Storage Length (m)	Parallel Lane Length (m)	Taper (m)[1]	Total Auxiliary Lane (m)
2	Install WB Auxiliary Right Turning Lane at NB Intersection	80	50	60	70	180
3	Install two additional through lanes (one each direction)	-	-	-	-	-
4	Install roundabouts (Optional)	Schematic drawing has been provided in the report				-
7	Install WB Auxiliary Right Turning Lane	60	20	30	50	100
8	Install SB Auxiliary Left Turning Lane	60	50	-	200	250
10	Install EB Auxiliary Right Turning Lane at NB Intersection	60	15	30	50	95
12	Install SB Additional Left-turn	60	100	-	200	300
13	Install WB Auxiliary Right Turning Lanes	80	100	60	70	230
14	Install EB Auxiliary Left Turning Lanes	80	100	50	130	280
15	Install NB Auxiliary Right Turning Lane	60	50	30	50	130
17	Install WB Auxiliary Right Turning Lanes	80	50	60	70	180
18	Install EB Auxiliary Left Turning Lanes	80	50	50	130	230
19	Install WB Auxiliary Left Turning Lane	60	60	-	200	260
21	Install roundabouts (Optional)	Schematic drawing has been provided in the report				-
22	Install roundabouts (Optional)	Schematic drawing has been provided in the report				-

[1] :For dual left turn lanes the total auxiliary lane length is based on provision for two taper lengths and one storage length

2.3 Recommendations

Based on this transportation analysis of the development and road network planned for the lands above the 190 Contour, the following are recommended:

2.3.1 Access

Access to the lands on the north side of Kenmount Road be reserved to the following roads:

1. To Messenger Drive: With extension of Messenger Drive into the development area with a secondary connection to Thorburn Road. This will provide access from the development to Thorburn Road to the north and to Kelsey Drive and TGH interchange to the east.
2. To Ladysmith Drive: With the extension of Ladysmith to the north to connect to a north – south collector road that connects to Thorburn Road and traversing the entire development area, this will provide access from the development to a continuous collector road connecting Thorburn Road in the north and Kenmount Road in the south and provide connectivity between the north and south sides of the development.
3. To other roadways in Kenmount Terrace: Where feasible, connection of collector and/or local streets in the planned development area with Kenmount Terrace will provide opportunities for residents in both areas to access facilities and services without the need for travel on the boundary collector and arterial network.
4. To Thorburn Road: Two collector road connections to Thorburn Road should be preserved for collection to the collector road network. This might include the extension of Messenger Drive and Ladysmith Drive, noted in 1 above or to other collector roads through the development.
5. To Kenmount Road: A collector road connection aligning with Wyatt Boulevard/Mount Carson Avenue is desirable and should be examined further in subsequent more detailed neighbourhood planning. This access would serve primarily residential traffic from the development area. In conjunction with this access or in the absence of it, additional collector road access to the planned commercial and industrial development from the District Park and School westerly that provides a grid network with collector road spacing of approximately 400m on Kenmount Road.
6. Access Management Opportunities: Undertake a review of private access to Kenmount Road from the Boundary to Avalon Mall to identify opportunities where access can be consolidated or be limited to restricted turns (right turns only), or eliminated entirely.
7. Encourage the development of a possible interchange to the Outer Ring Road by the Town of Paradise. If this interchange goes ahead, extend the collector street internal to the development area westerly to connect to this interchange.
8. Provide additional connections to the Town of Paradise roads into Elizabeth Park via Canterbury Drive and Ellesmere Avenue.

Access to the lands on the south side of Kenmount Road be reserved to the following roads:

9. To Kenmount Road: A collector road connection aligning with Great Eastern Avenue.
10. To Team Gushue Highway: at Brier Avenue via a primary connection of the extension of an east – west collector road; and via a connection to Georges Pond/Captain Whelan Drive.
11. To Old Pennywell Road: via an indirect minor link from the development lands.
12. To Mount Carson Avenue/Wyatt Boulevard: Potential connection to either Wyatt Boulevard/Mount Carson Avenue to be reviewed during subsequent neighbourhood planning stages.

2.3.2 Internal Road Network

13. In the development areas north of Kenmount Road there is a need to provide an additional continuous collector street that ties the three development sub-areas together and is located centrally to them. This

collector road could connect to Thorburn Road and to the extension of Ladysmith Drive in the north and to the east – west collector adjacent to the core areas of the District School and commercial area.

14. It is recommended that the community plan be reviewed in subsequent more detailed development planning to determine the feasibility of this collector alignment. As this roadway potentially will be serving travel between several of the sub-areas and adjacent existing development, direct residential frontage should be discouraged so that residences are not fronting onto a major community link. This community link will provide an access function to the neighbourhood to reduce potential for short-cutting on other local roads.
15. If this collector street is feasible, it would function as a primary transit route linking the area to the planned transit hub. It is recommended that it be located such that approximately 90 percent of residents are within 400m of transit services on this road. Active transportation links are to be maintained on the collector road.
16. With the planned commercial, recreational and institutional uses in the southwest part of the development plan north of Kenmount Road, and links to the neighbouring communities, it is possible that these areas will evolve into vibrant village centres with the appropriate land use policies and direct collector road links to transit, pedestrian and cycling facilities. Continuous routing of this collector road between Thorburn Road in the north and to Kenmount Road and possibly Mount Carson Avenue/Wyatt Boulevard in the south would encourage and support this evolution.

2.3.3 Growth Management

This traffic analysis has demonstrated that a smart growth, sustainable approach to managing growth in the development lands and the City at large is desirable and necessary to avoid impacts associated with continually expanding existing roads to accommodate primarily single occupant private automobiles. It is recommended that the City adopt a balanced strategy to accommodating future travel in the study area that would involve the following actions.

16. Ensuring that the planned road network within the study area is transit supportive, and provides continuous mid-block collector roadways designed for transit routes through the neighbourhood, so that approximately 90 percent of inhabitants are within 400m of transit service and that internal roads are connected to existing similar facilities. For example, provision of a collector road west of Ladysmith Drive that connects as directly as possible to the planned transit hub and to Kenmount Road at Wyatt Boulevard/Mount Carson Avenue.
17. Ensuring that internal and external roads incorporate active transportation facilities including on and off-road cycling facilities in accordance with the City's Cycling Master Plan, and sidewalks that are accessible to those who may be mobility challenged. Typical cross sections for selected arterial, collector and local streets are provided in the Appendix B-4.
18. Develop and implement travel demand strategies designed to reduce the demand for the private automobile. Encouraging businesses, industry and developers to provide greater support for cycling and transit users. Also to consider providing transit improvements on key corridors to reduce the overall travel time for transit users. This might include the use of queue jump lanes, far side stop locations in protected bays and transit priority measures.
19. Considering alternative types of intersection design and control at selected intersections. This would include considering the use of roundabouts where these intersections van provide improved operational and safety performance compared to signalized intersections.
20. Undertaking corridor widening to accommodate vehicular travel demand, only when other measures have been explored fully.

3 Municipal Service

3.1 Sanitary Sewer Services

3.1.1 Reference Documents

Design of the sanitary sewer system was carried out following the requirements of the St. Johns Subdivision Design Manual, latest edition. Where the Design Manual doesn't comment on a particular design area, the DOE Guidelines for the Design, Construction, and Operation of Water and Sewerage Systems were referenced.

3.1.2 Sanitary Sewer Demand Estimate

The sanitary sewer flow rates were calculated using the sanitary sewer generation rates as indicated in the terms of reference and the City of St. John's Sub Division Design Manual.

Average Daily Demand: The average daily flows were calculated from flow allowances based on expected population and land-use types. The following flow allowances, as presented in the terms of reference, were used:

Table 13 - City of St. John's Average Sewage Flow Rates

Land Use	Average Sewage – Flow Rate
Residential	275 L/c/d
Commercial	28000 L/ha/d
Business Park	28000 L/ha/d
Industrial	39000 L/ha/d
Institutional	34000 L/ha/d

Peak Hourly Demand: A peaking factor was calculated for the development based on an equivalent population for the entire area. Equivalent population was calculated based on the methodology outlined in the *Subdivision Design Manual*. Once an equivalent population was determined, the Harman equation (below) was used to calculate the Peak Hourly factor.

$$M = \frac{1 + 14}{4 + P^{1/2}}$$

Where:

M = the ratio of the peak rate of flow to the average rate of flow

P = the equivalent population, in thousands. * The equivalent population of the non-residential areas was adjusted in accordance with the *Subdivision Design Guide*.

Infiltration allowance rate: The infiltration allowance was calculated based on a minimum rate of 22,500 l/ha/day.

3.1.3 Sub-Catchments Areas

The ArcGIS system files provided by the City of St. John's were utilized in the delineation of the sanitary sewer sub-catchment areas were, the determining the flow estimation and establishing the connection points to the existing sanitary sewer system. The sub-catchments were designed to maximize the use of gravity flow toward the existing sanitary sewer connection points, which are illustrated in Figure 21. However, the use of lift stations could not be avoided completely and there are three (3) lift stations identified for the 190m development area (refer to Figure 21 for lift station locations). The three proposed lift stations are located as follows:

- Area B – The calculated peak dry weather flow (PDWF) to the lift station is 59.2 L/s. It is proposed that this area be pumped up Kenmount Road and then gravity feed to the existing system behind Canadian Tire of Kelsey Drive via a new 300mm diameter sewer main.
- Area H – The calculated PDWF design flow to the lift station is 15.3 L/s.
- Area F – The calculated PDWF design flow to the lift station is 5.0 L/s.

The PDWF was calculated for each sub-catchment area using the land use designations identified in this report. The calculation sheets for the flow determination of each sub-catchment area is detailed in Appendix A. Table 14 below summaries the flow rates and potential connection points to the existing system.

Table 14 - Sanitary Sewer Flows and Connections

Connection Locations	PDWF Flow Rate L/s	Catchment Area
Existing 300mm main on south side of Kenmount Road	23.4	A
New 300mm main on north side of Kenmount Road	82.7	B
Existing System at Lady Anderson Street	18.0	C
Existing System at Ladysmith Drive	30.0	D
Existing system at Blackmarsh Road/Canada Drive	61.7	E
Existing 300mm main on south side of Kenmount Road	49.9	F
Existing System on Great Eastern Avenue which will flow To new 300mm main on north side of Kenmount Road	49.5	G
Existing system on Messenger Drive	33.5	H

Following the design of the sub-catchments and suggested connection points to the existing system, the information was submitted to the City of St. John's Engineering Department to determine if there was sufficient capacity within the current system to accommodate the design flows from the 190m contour development.

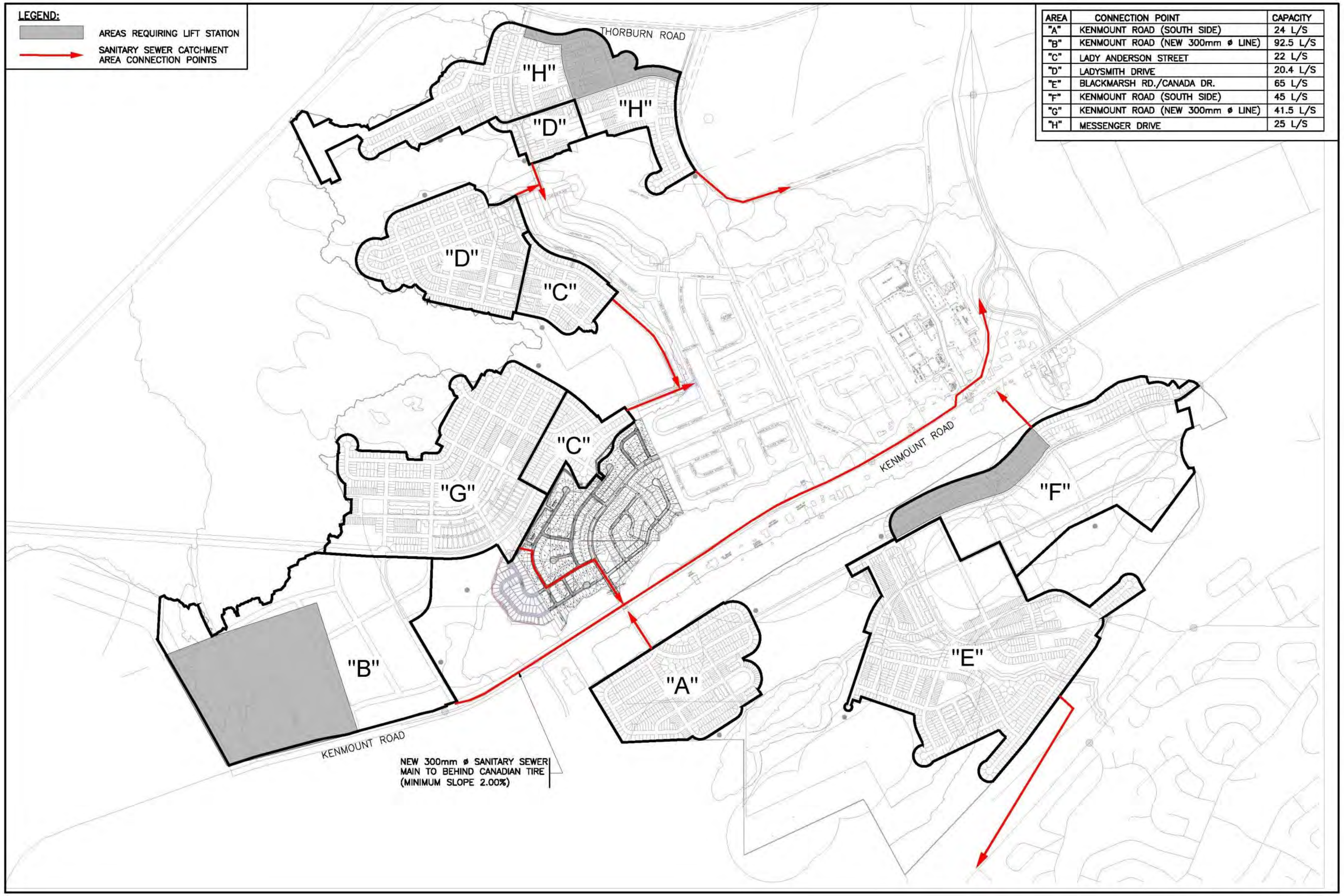


Figure 21 - Draft Sub-Catchment Areas

The analysis indicated the following upgrades would be required to accommodate full build out of the 190m development.

1. The flows from sub-catchments B and G would require a new 300mm diameter sanitary sewer line, with a minimum 2% slope, to be constructed from the new manhole #45 on Kenmount Road to the existing trunk main behind Canadian Tire on Kelsey Drive. The sanitary sewer then flows into the Southwest Development Area Trunk Main. The new line would be approximately 3000m (refer to Figure 22).

2. The flows from sub-catchments A and F are proposed to connect to the existing sanitary sewer mains on Kenmount Road. Currently there is a 300mm line on the south side of Kenmount Road which terminates approximately 285m east of Wyatt Boulevard and there is a 300mm line on the north side that terminates approximately 1250m east of Wyatt Boulevard. In order to use these two lines, a 71m section of existing 300mm sanitary sewer main on Parrell's Lane would have to be upgraded to 375mm diameter. Completing this upgrade would provide an additional capacity of 33 L/s in the north side sewer and 72 L/s in the south side sewer. Thus, it is proposed to connect to the existing 300 mm diameter sewer on the south side of Kenmount Road. Sub-catchment area F would also connect to the south sewer line. These two flows combine for a total of 73 L/s which would leave the south sanitary sewer main with no additional capacity. However, the north side sewer main would still have an additional 33 L/s capacity available.

Figure 22 - Draft of Upgrades to Existing System on Kenmount Road

3. The flows from sub-catchment E is proposed to flow into the Waterford Valley System via a connection at Blackmarsh Road/Canada Drive intersection. In order accommodate the 61.7 L/s flow seven (7) sections of 200mm diameter sanitary sewer between Fair Haven Place and Burgeo Street will have to be upgraded to a 300mm diameter line (refer to Figure 23).

Figure 23 - Draft of Upgrades Required at Fair Haven Place and Burgeo Place

3.1.4 Sanitary Sewer Distribution System

The main distribution system was identified in each of the sub-catchment areas. The catchment area was subdivided into smaller tributary areas to determine the main sanitary sewer distribution lines. The drawings in Appendix A detail the proposed main distribution collection system. The pipe sizes were determined for the main trunk lines in each sub-catchment. The distribution system, where possible, follows the road network and the slopes of the pipes shown on the drawings in general follow the contours of the development area. The minimum pipe gradient was 0.5% and maximum pipe gradient was kept to 12%, which reflects the maximum local street gradient in the subdivision manual. The design calculations and capacity analysis of the proposed system was completed in the City of St. John's standard excel format, which is referenced in Appendix C.

The sanitary sewer design flows and pipe slopes should be revisited during the detailed design of the development area. The elevations used to perform the calculations were extracted from the undeveloped topography and slopes were assumed so that velocity criteria were met. The present design flows will inevitably change as the elevations and grades of the road network, and subsequently the network, are further developed.

3.1.5 Sanitary Sewer System Phasing

The required upgrades to the existing system are significant, especially the new 300mm sanitary line required on Kenmount Road which extends behind Canadian Tire on Kelsey Drive (refer to Figure 22). Limited development can proceed in Sub-Catchments B and G areas with the upgrade of the 300mm line on Parrell's Lane. This would provide an additional capacity of 105 L/s (72 L/s in the south side sewer main and 33 L/s in the north side sewer main). These lines would also have to be extended up to the 190m Contour development area discharge points. It should be noted that the development in sub-catchment areas A / B / G / F would have to be limited to approximately 105 L/s until the new 300mm diameter trunk main can be completed on Kenmount Road.

Limited development can also occur in sub-catchment E until the upgrades are completed on the existing sanitary sewer sections between Fair Haven Place and Burgeo Place (refer to Figure 23). The current additional capacity at the Blackmarsh Road/Canada Drive Intersection, without any upgrades, is approximately 16 L/s. Thus, the existing system can accommodate limited development before the proposed upgrades are required.

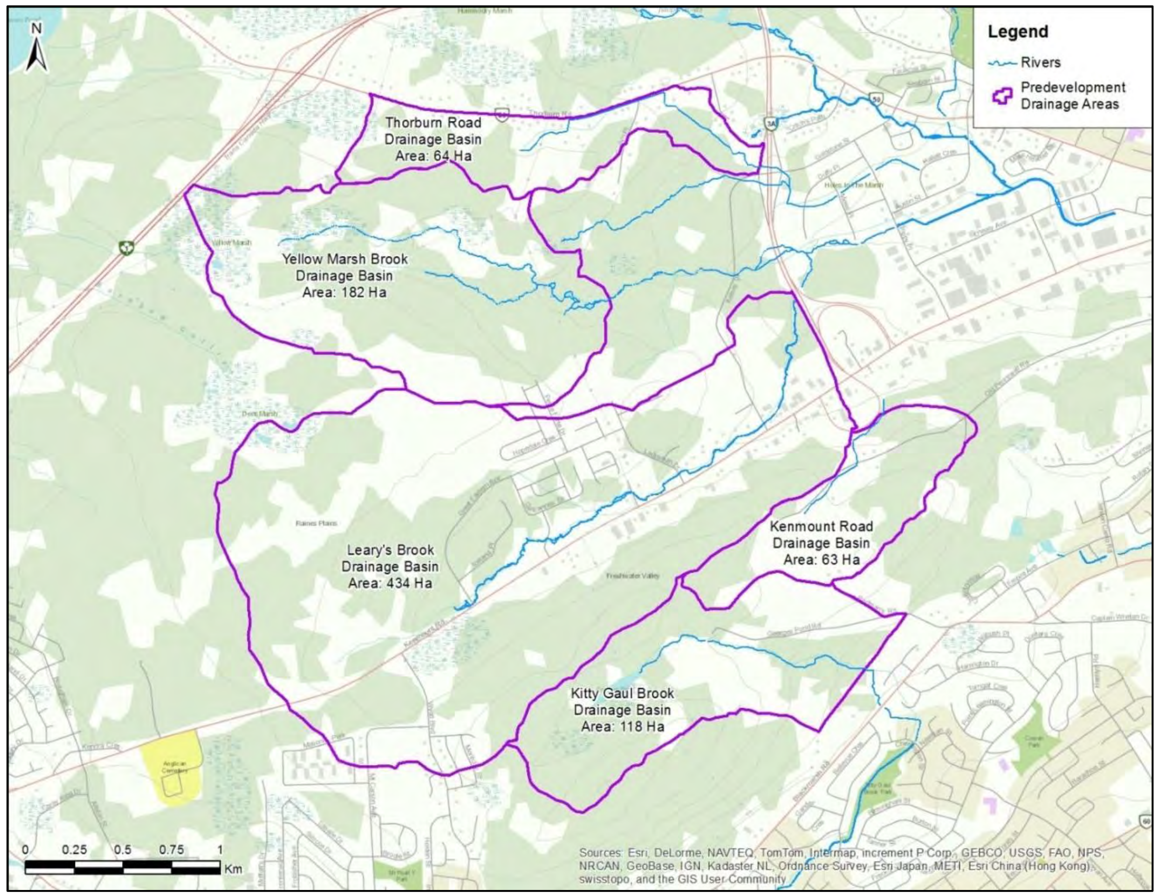


Figure 24 - Draft of Drainage Basin Overview

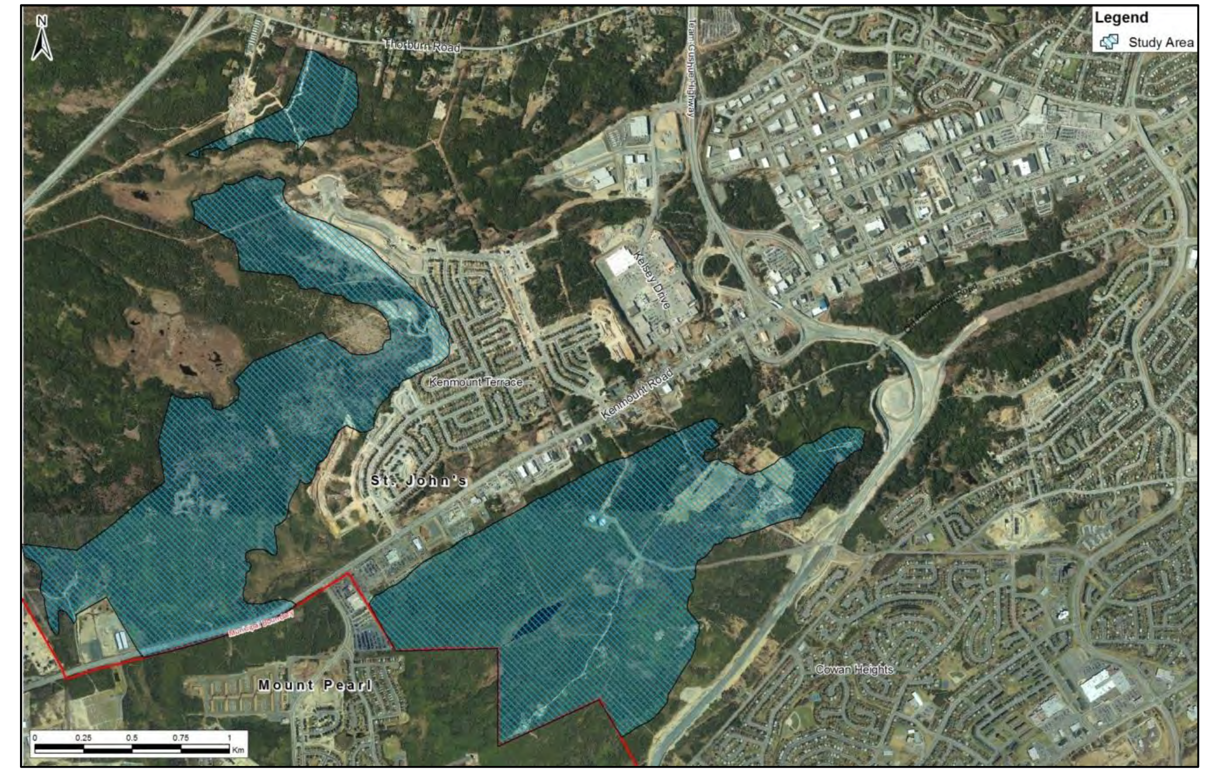


Figure 25 - Draft Overview of the CDA Kenmount Area Stormwater Analysis

3.2 Stormwater Analysis

3.2.1 Drainage Basin Delineation

The proposed development area is encompassed by the five drainage basins shown on Figure 24. The areas were delineated using 1 m interval contours that were provided by the City of St. John's.

The major watercourses located within the study area are Yellow Marsh Brook, Leary's Brook, and Kitty Gaul Brook, which drain the three largest basins. There are two smaller basins that drain towards Thorburn Road and Kenmount Road. The "Regional Stormwater Detention Feasibility Study" (CBCL, 2013) identified Yellow Marsh Brook as the only suitable watercourse on which to construct a regional stormwater detention facility. Therefore, the drainage area of Yellow Marsh Brook was delineated only to the proposed location of the regional stormwater facility. The topography of the study area is characterized by the steep hills that surround the upper extent of the Kenmount Valley. The ground coverage consists of wetlands along flat areas and valleys, and coniferous forest and some barrens along the slopes and peaks. The ground coverage of the Kenmount Valley is visible on the aerial photography shown in Figure 25, which also shows an outline of the CDA Kenmount area.

3.2.2 Stormwater Detention Modeling

The CDA Kenmount area is subject to the City of St. John's Stormwater Management Plan which requires a zero-net-increase in runoff between predevelopment and post development. The City of St. John's Subdivision Design Manual specifies that the Soil Conservation Service (SCS) method shall be used to estimate pre and post development runoff. SCS curve numbers were assigned to the various municipal zones provided by the City according to tables 8-4 through 8-5 of the design manual. The curve numbers are summarized in Table 15. Maps showing the respective predevelopment and post development municipal zones are shown on Figures 26 and 27 below. The drainage boundaries shown on Figure 27 were estimated to represent the post development basins based on the proposed road layout.

Table 15 - SCS Curve Numbers

Zone Type	Zone Code	Curve Number
Apartment – Low Density	A1	87
Comprehensive Development Area – Kenmount Road	CDA Kenmount	69
Commercial Highway	CH	93
Commercial Kenmount	CK	93
Commercial Neighbourhood	CN	92
Industrial General	IG	88
Institutional	INST	92
Open Space	O	69
Open Space Reserve	OR	69
Rural	R	69
Residential-Medium Density	R2	85
Residential-High Density	R3	85
Residential Kenmount	RK	85
Rural Residential	RR	70
Rural Residential Infill	RRI	70
Watershed	W	69

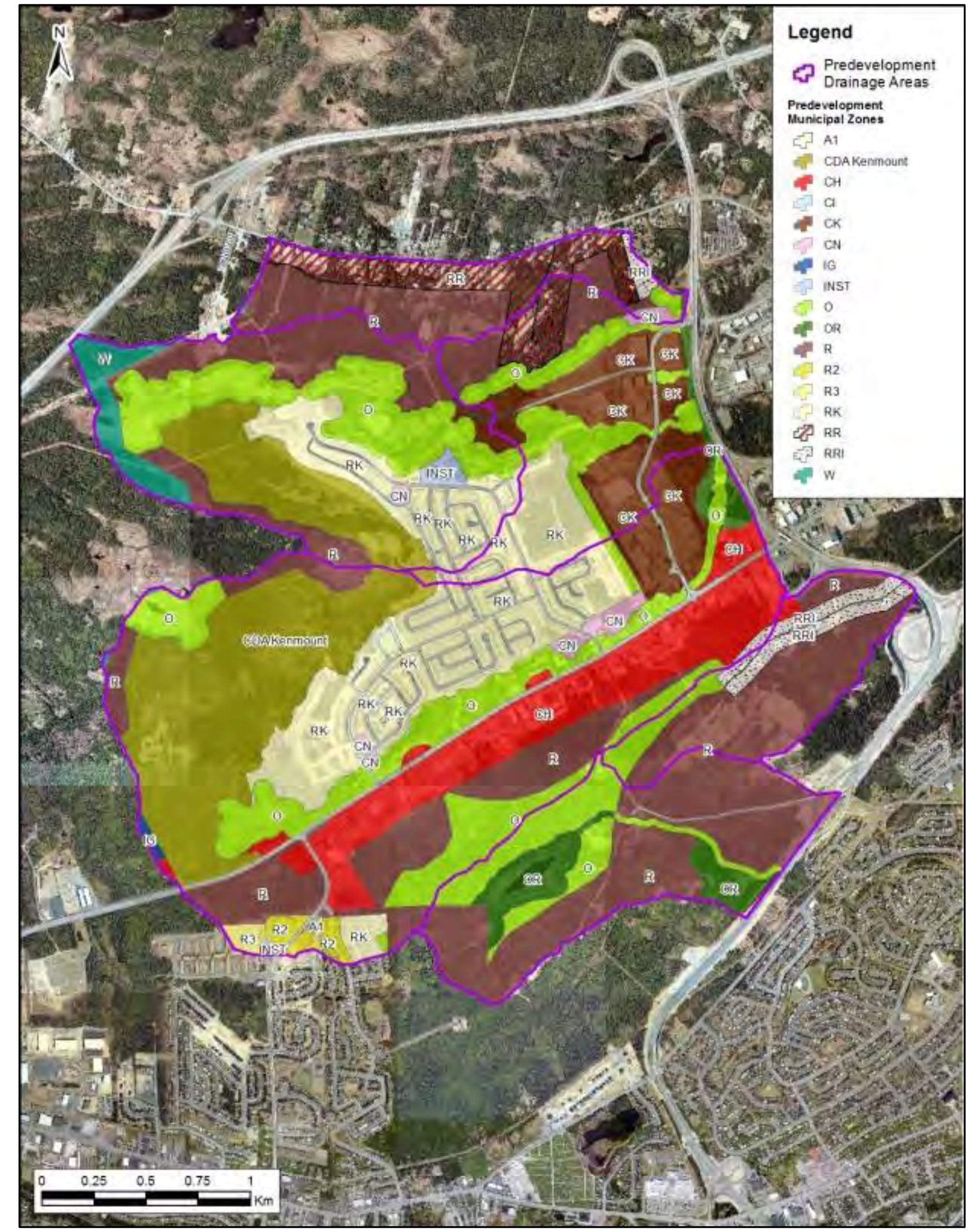


Figure 26 - Draft Predevelopment Municipal Zones

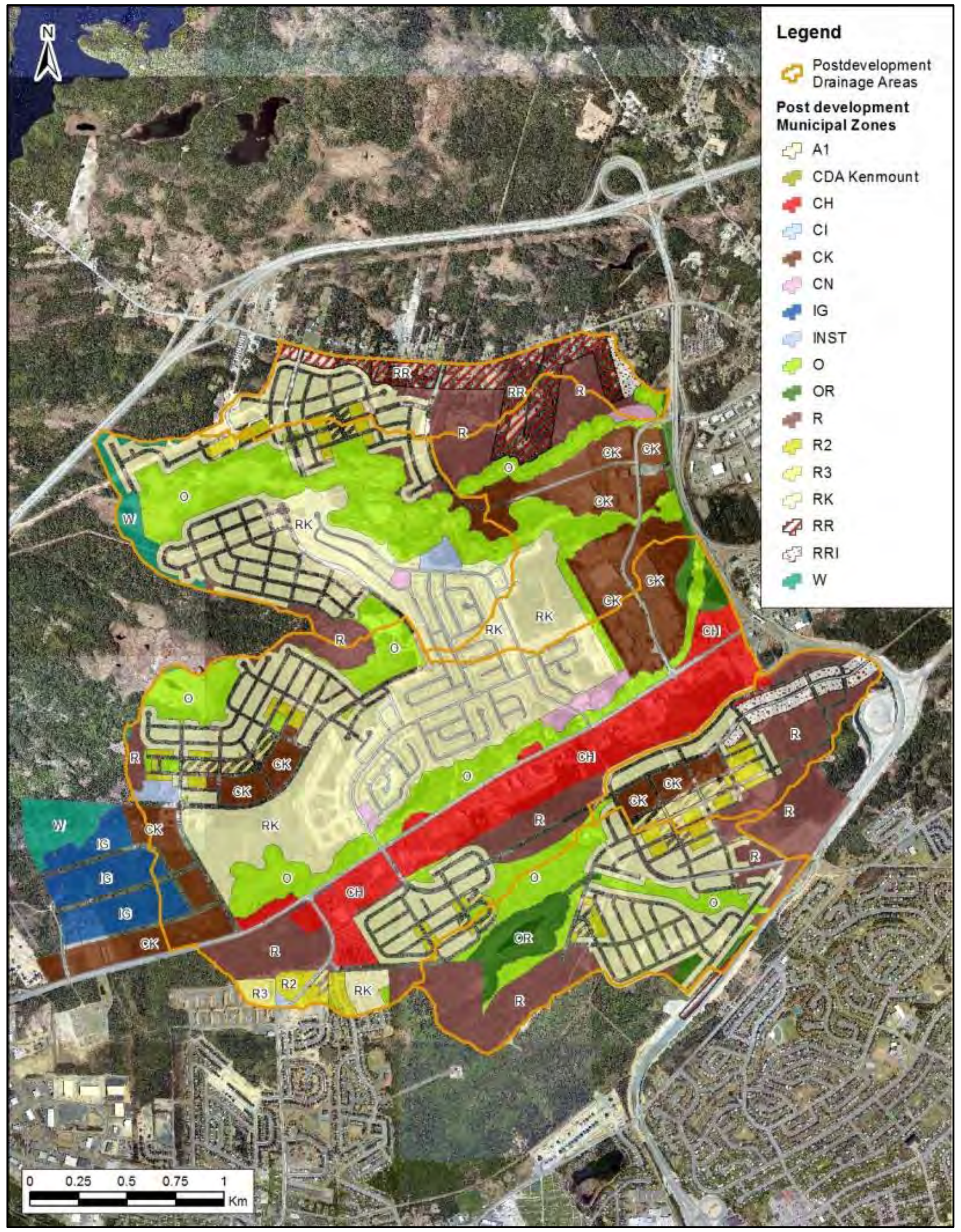


Figure 27 - Draft of Proposed Municipal Zones

Lumped parameter runoff models of the proposed development area were generated with a number of different configurations using the computer program XPSWMM. The model configurations are as follow:

1. Pre and post development runoff models of the Yellow Marsh Brook basin
2. Post development runoff model of the Yellow Marsh Brook basin with a regional stormwater detention facility
3. Pre and post development runoff models of the sub-catchments located within the Thorburn Rd, Leary's Brook, Kenmount Rd, and Kitty Gaul Brook basins.
4. Post development models of the sub-catchments within the Thorburn Rd, Leary's Brook, Kenmount Rd, and Kitty Gaul Brook basins with local stormwater detention

3.2.3 Yellow Marsh Brook Regional Stormwater Detention Facility

The pre-development and post development results of the Yellow Marsh Brook simulations are summarized in Tables 16 and 17 respectively. The results of the 2013 Regional Stormwater Detention Study are included for comparison.

Table 16 - Pre-Development XPSWMM Results for Yellow Marsh Brook

Study	Drainage Area (km^2)	Average Weighted SCS Curve Number	Time of Concentration (mins)	Peak Flow (m^3/s)
Present Study	1.82	72.8	86.7	4.07
Regional Stormwater Detention Study (CBCL, 2013)	1.69	73.3	61.5	4.04

Table 17 - Post Development XPSWMM Results for Yellow Marsh Brook

Study	Drainage Area (km2)	Average Weighted SCS Curve Number	Time of Concentration (mins)	Peak Flow (m^3/s)
Present Study	1.79	81.1	67.6	5.10
Regional Stormwater Detention Study (CBCL, 2013)	1.69	76.9	55.5	4.50

The increased post development flow is a result of additional impervious areas in the current proposed land development. A review of the assumed municipal zoning in the 2013 study indicates that a large part of the basin was expected to remain zoned as rural. However, the current development plans proposed by Hatch and Tract show this area as mostly low and medium density residential.

The 2013 study estimated that 14,300 m^3 of storage is available at the proposed facility location. However, to maintain the existing peak flow based on the proposed land development, a regional detention facility would require approximately 32,000 m^3 of storage volume. The available storage of 14,300 m^3 at Yellow Marsh may be used for stormwater detention initially, supplemented by local storm water detention for subsequent development once the Yellow Marsh storage capacity is exceeded. Preliminary pre- and post-development hydrographs were developed in support of the recommendations herein. However, because the final storage demand calculations and detention siting is outside the scope of this report, detailed modeling should be completed to support development as it occurs.

3.2.4 Local Stormwater Detention

A total of 22 sub-catchments that will potentially require local stormwater detention were delineated within the study area. Sub-catchments 4 through 11 drain into Yellow Marsh Brook but have been included in this analysis to estimate the volume that would be required for local detention. The sub-catchments are shown in Figures 28 and 29 below.

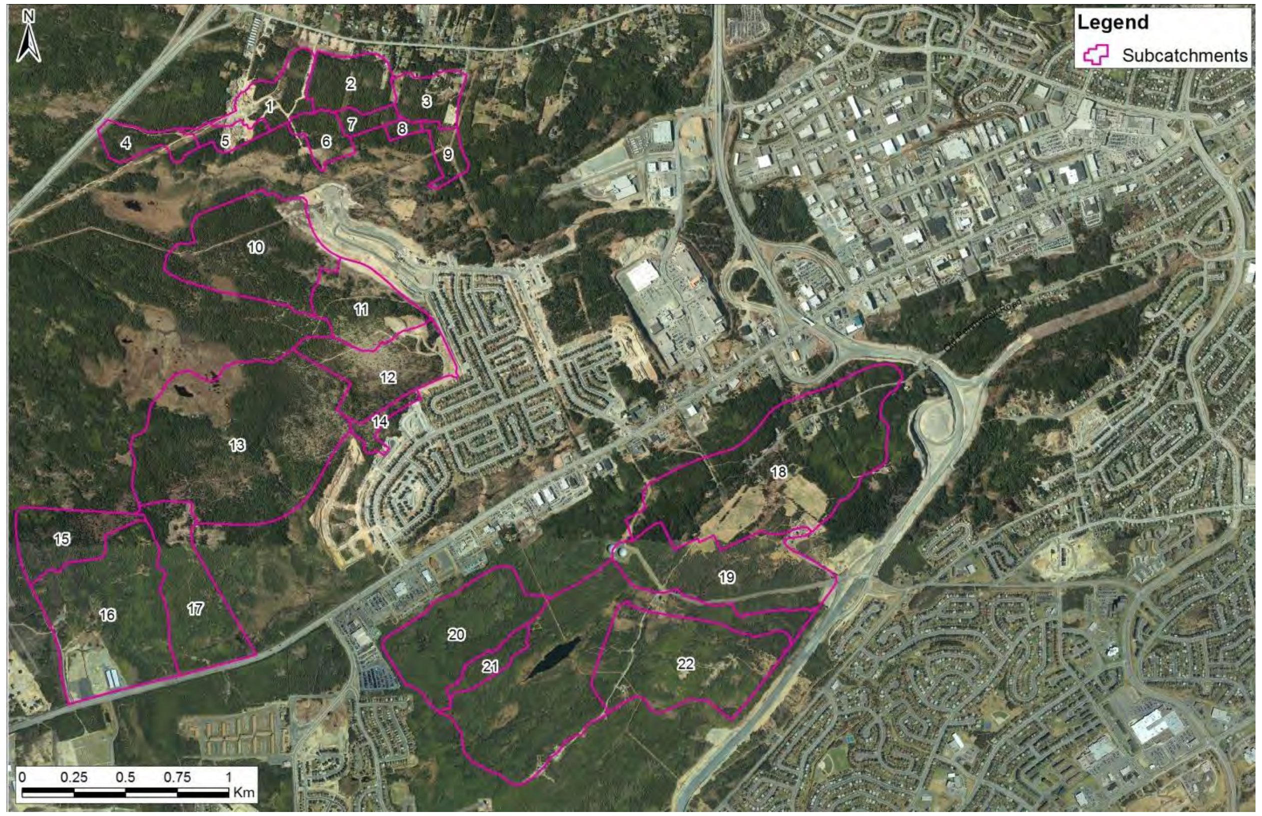


Figure 28 - Draft of Local Stormwater Detention Sub-Catchments

Small scale stormwater detention options will have to be considered by the land developers within each of the above sub-catchments. It is not feasible to determine preliminary designs of these small detention facilities given that the final development scheme is subject to change based on the proposed developments of individual stakeholders. Engineering design of the local stormwater detention facilities will require smaller scale studies that focus on the future developments within the sub-catchments. At this stage it is more practical to estimate the total stormwater storage volumes required for the sub-catchments as a whole. To accomplish this, storage nodes with a controlled outflow were assigned to the outlet of each sub-catchment in the XPSWMM model. The results of the simulations are summarized in Table 18 below. The post development hydrographs included stormwater detention facilities are included in Appendix C.

Table 18 - Pre and Post Development Peak Outflows and Storage Requirements

Sub-Catchment	Drainage Area (km^2)	Predevelopment Peak Flow (m^3/s)	Post development Peak Flow (m^3/s)	Approx. Required Storage Volume (m^3)
1	0.092	0.195	0.321	4538
2	0.105	0.225	0.361	5027
3	0.074	0.158	0.240	2944
4	0.057	0.120	0.176	1821
5	0.036	0.078	0.122	1665
6	0.052	0.113	0.178	2486
7	0.028	0.060	0.094	1318
8	0.012	0.026	0.042	605
9	0.039	0.083	0.134	1927
10	0.310	0.691	1.056	13544
11	0.153	0.328	0.464	4353
12	0.190	0.398	0.499	2992
13	0.653	1.359	2.074	23624
14	0.030	0.065	0.102	1365
15	0.131	0.283	0.346	1891
16	0.396	1.243	1.365	6024
17	0.219	0.525	0.811	11860
18	0.591	1.276	1.795	16964
19	0.302	0.648	0.976	11182
20	0.255	0.545	0.852	10930
21	0.043	0.094	0.148	2058
22	0.345	0.730	1.127	13627

3.2.5 Storm Sewer Design

Storm water inflows were calculated for the proposed storm sewer layout using the prescribed methodology in division 5 of the CSJ Subdivision Design Manual. A total of 73 preliminary manhole locations were identified and local drainage areas were delineated to each. The complete storm sewer calculation spreadsheet and distribution system is included in Appendix A and the inflows to each manhole are summarized in Table 19.

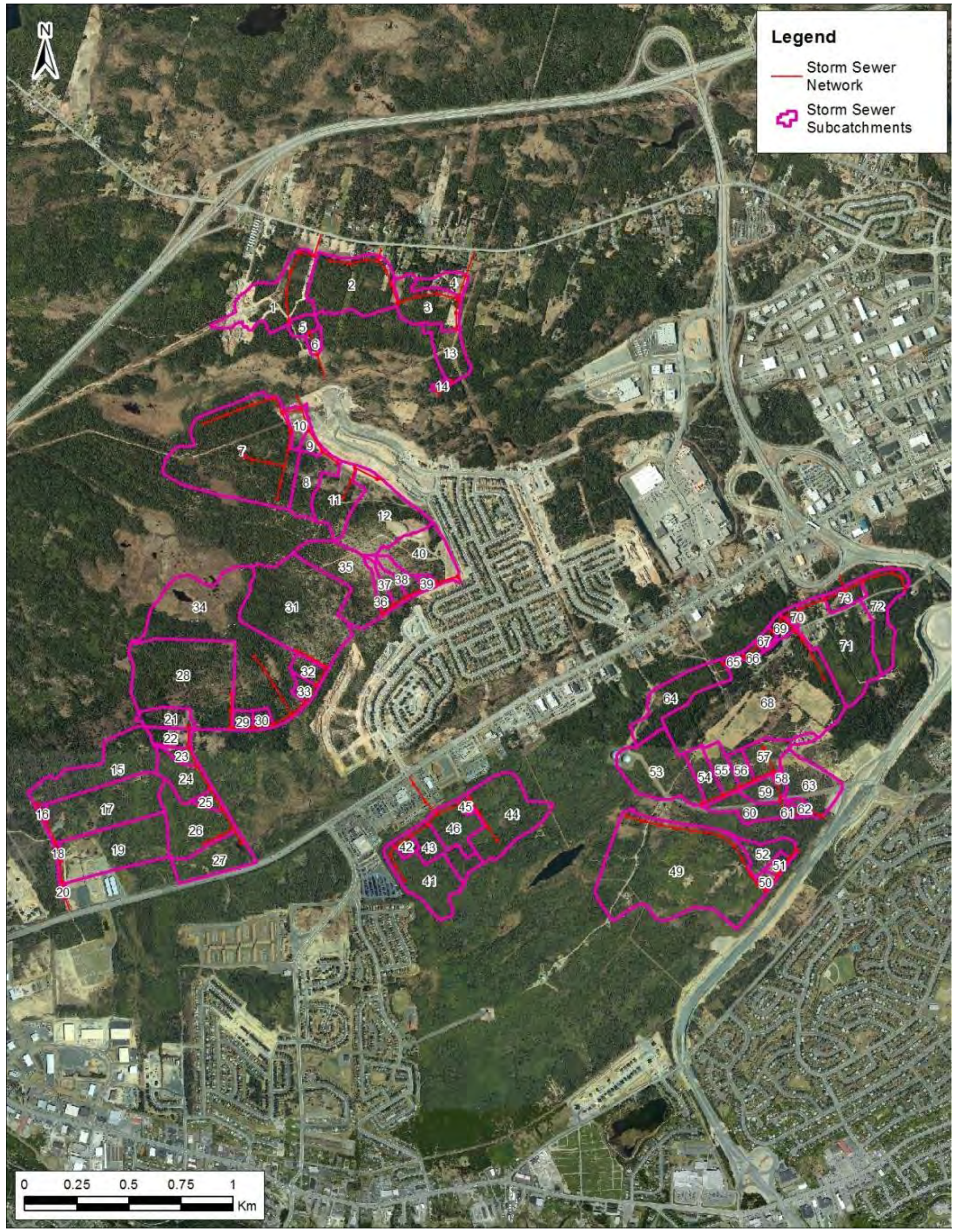


Figure 29 - Draft of Storm Sewer Catchments

Table 19 - Summary of Manhole Inflows

Manhole Number	Total Drainage Area (ha)	Runoff (L/s)	Manhole Number	Total Drainage Area (ha)	Runoff (L/s)	Manhole Number	Total Drainage Area (ha)	Runoff (L/s)
1	9.2	1310	26	16.8	5646	51	31.8	4553
2	10.5	1869	27	21.9	7396	52	34.5	5008
3	5.5	998	28	17.9	1714	53	8.9	1205
4	7.4	1283	29	18.8	2045	54	11.4	1626
5	1.1	207	30	19.7	2340	55	13.6	2275
6	1.9	359	31	18.7	2683	56	15.0	2643
7	24.0	3875	32	20.2	3203	57	18.4	3096
8	4.2	1068	33	21.2	3440	58	18.7	3174
9	5.1	1289	34	65.3	7728	59	20.7	3627
10	30.7	5589	35	8.0	1000	60	23.9	4213
11	5.4	1318	36	9.3	1152	61	24.2	4305
12	15.3	3850	37	10.7	1318	62	24.8	4430
13	3.9	727	38	12.3	1513	63	30.2	5325
14	3.6	639	39	12.8	1576	64	6.5	935
15	9.4	1612	40	19.0	2050	65	6.9	1065
16	9.7	1721	41	6.7	1177	66	7.4	1177
17	21.1	5623	42	7.6	1387	67	8.0	1329
18	21.3	5717	43	11.2	2306	68	29.6	6587
19	32.2	9438	44	9.7	1390	69	38.6	6831
20	32.3	9508	45	10.2	1489	70	39.2	7004
21	2.3	590	46	25.4	4456	71	51.4	8749
22	4.1	1204	47	n/a	4456	72	6.0	1011
23	5.1	1541	48	n/a	4456	73	59.1	10162
24	8.8	2839	49	30.4	4228			
25	9.7	3145	50	31.0	4374			

3.2.6 Recommendations

A summary of recommendations is provided below.

1. The available storage of 14,300 m^3 at Yellow Marsh may be used for stormwater detention initially, supplemented by local storm water detention for subsequent development once the Yellow Marsh storage capacity is exceeded.
2. Land developers can likely reduce the cost of local stormwater detention by investing end-of-pipe solutions in collaboration with adjacent developers. Otherwise, onsite detention will likely be required for individual developments.
3. The storm sewer design flows and pipe sizes should be revisited when engineering design of the roads has progressed further. The elevations used to perform the calculations were extracted from the undeveloped topography and slopes were assumed so that velocity criteria were met. The present design flows will inevitably change as the elevations and grades of the road network, and subsequently the storm network, are further developed.

3.3 Water Services

3.3.1 Reference Documents

Design of the water service system was carried out following the requirements of the St. John's Subdivision Design Manual, latest edition. Where the Design Manual doesn't comment on a particular design area, the Atlantic Canada Guidelines for Water Systems were referenced. Past reports concerning the regional supply system were also reviewed. In general, the following references were used:

- *St. John's Subdivision Design Manual*
- *Atlantic Canada Guidelines for Water Systems, 2004*
- *Water Supply for Public Fire Protection, Fire Underwriters Survey (1999)*
- *Regional Water Study, Newfoundland Design Associates (1994)*
- *Regional Water Study Update, Newfoundland Design Associates (2007)*
- *Development Above the 190 Water System Analysis, Newfoundland Design Associates (2013)*, hereafter referred to as the *190 Water System, NDAL (2013)*

3.3.2 Water Demand Estimates and Scenarios

Average daily domestic water demands were calculated using the sanitary sewer generation rates as indicated in the terms of reference, and assuming that sewage generation represents 90% of water consumption. This parallels the method used in *190 Water System*, *NDAL (2013)*.

Four different flow condition scenarios were developed for input in the model, including the following (refer to Appendix C for Calculations):

- *Maximum Daily Demand*
- *Peak Hourly Demand*
- *Maximum Daily Demand Plus Fire Flow*
- *Minimum Hourly Demand*

Average Daily Demand: Average daily flows were calculated from flow allowances based on expected population and land-use types. Average daily flows form the basis to calculate design flows but are not included in the model because they are not related to key performance specifications. The following flow allowances, as presented in the terms of reference, were used:

Table 20 - City of St. John's Domestic Water Usage Rates

Land Use	Average Sewage Flow Rate	Average Domestic Water Usage Rate *
Residential	275 L/c/d	306 L/c/d
Commercial/Business Park	28000 L/ha/d	31111 L/ha/d
Industrial	39000 L/ha/d	43333 L/ha/d
Institutional	34000 L/ha/d	37777 L/ha/d

* Average Domestic Water Usage Rate was calculated by assuming Sewage represents 90% of water consumption rates (Sewage Rate/0.9)

Peaking factors used in water system model were selected for the modeled areas based on equivalent populations. Equivalent populations were calculated based on the methodology outlined in the *Subdivision Design Manual*.

Maximum Daily Demand: Utilizing the equivalent populations calculated for each area, the Maximum Day Demand factor was selected from the *Atlantic Canada Guidelines for Water Systems* (Table 7.1). Factors used in water system model were selected on a modeled area basis, as opposed to a single factor being used for the entire development.

Peak Hourly Demand: Utilizing the equivalent populations calculated for each area, the Peak Hourly Demand factor was selected from the *Atlantic Canada Guidelines for Water Systems* (Table 7.1). Factors used in water system model were selected on a modeled area basis, as opposed to a single factor being used for the entire development.

Minimum Hourly Demand: Utilizing the equivalent populations calculated for each area, the Minimum Hourly Demand factor was selected from the *Atlantic Canada Guidelines for Water Systems* (Table 7.1). Factors used in water system model were selected on a modeled area basis, as opposed to a single factor being used for the entire development. Minimum Hourly Demands were used when evaluating high pressure areas during low flows.

Max Day Demand + Fire Flow: Fire flow demands were calculated based on the procedures as outlined in the *Water Supply for Public Fire Protection*. When estimating fire flows for commercial and industrial areas, aerial photography was used to measure typical building sizes in the area.

The resulting flows for the various scenarios are summarized in the following table. Detailed calculation spreadsheets are included within Appendix C of this report.

Table 21 - Water System - Design Flow Scenario

Scenario	Peaking Factor		Flow (L/s)	
Average Daily Flow	N/A		Overall - 85 Area 1 – 7 Area 2 – 6 Area 3 – 13	Area 4 – 28 Area 5 – 5 Area 6 – 7 Area 7 – 20
Maximum Daily Flow	Overall – 1.90 Area 1 – 2.25 Area 2 – 2.50 Area 3 – 2.00	Area 4 – 2.00 Area 5 – 2.50 Area 6 – 2.50 Area 7 – 2.00	Overall – 162 Area 1 – 16 Area 2 – 16 Area 3 – 25	Area 4 – 55 Area 5 – 12 Area 6 – 17 Area 7 – 40
Peak Hourly Flow	Overall – 2.85 Area 1 – 3.38 Area 2 – 3.75 Area 3 – 3.00	Area 4 – 3.00 Area 5 – 3.75 Area 6 – 3.75 Area 7 – 3.00	Overall - 243 Area 1 – 25 Area 2 – 24 Area 3 – 38	Area 4 – 83 Area 5 – 18 Area 6 – 25 Area 7 – 60
Minimum Hourly	Overall – 0.60 Area 1 – 0.45 Area 2 – 0.45 Area 3 – 0.50	Area 4 – 0.50 Area 5 – 0.45 Area 6 – 0.45 Area 7 – 0.50	Overall – 51 Area 1 – 3 Area 2 – 3 Area 3 – 6	Area 4 – 14 Area 5 – 2 Area 6 – 3 Area 7 – 10
Fire Flow*				
• *Single Family Residential*	N/A		133	
• *Townhouse Residential*	N/A		100	
• *Low Density Apartment*	N/A		167	
• *Commercial & Industrial*	N/A		233	

* Fire Flow demands presented were added to the model in addition to Maximum Daily Demands

3.3.3 Model Development

The proposed development was divided into seven distinct areas as shown in Appendix C. The areas are differentiated geographically as well as by proposed land use. While the delineated areas differ from the sanitary sewer sub-catchment areas depicted in Figure 21, sanitary generation rates are sufficiently detailed to allow direct correlation between the water and sanitary areas.

In order to accurately size the proposed system components and calculate the varying pressures throughout the system, it was necessary to develop a computerized model of the water network. Input parameters into the Bentley WaterGEMS model were selected based on various criteria from the *Subdivision Design Guide* and the *Atlantic Canada Guidelines for Water Systems*.

Model input parameters were as follows:

1. Pipe Data

The proposed pipe network configuration was developed using base map information combined with the proposed road network layout. These maps were brought into the WaterGEMS model as background images and the pipe network was drawn overtop. While only pipes 300mm and larger needed to be sized as part of this study, additional network elements were added in order for the model to calculate residual pressures at key locations. Pipe material was assumed to be PVC and the Hazen Williams C factor was assumed to be 130.

2. Junction Data

Pipe junctions were placed in locations where two pipes connected, demands were allocated, and where pressure calculations were required. Elevations were automatically assigned to junctions based on the available DTM surface representing existing topography. These elevations were deemed to be sufficiently accurate for the purposes of this model, and were left at ground level because the pressure criteria are based at ground level.

3. Tank Data

A new tank was required as part of the proposed development, and it was assumed that it would be constructed on the hill at the South West corner of the development area. This area was selected as it is the highest location within the development area and the nature of the existing topography requires that the effective storage volume be above elevation 261m. When the initial water level was set in the model, it was set at the minimum effective water level (261m) to ensure that minimum pressures were achieved throughout the system at all times.

4. Demand Allocation

Demands were calculated for each development area as described in Section 3.1.2 and assigned to representative nodes. The aggregation level included only the parts of the hydraulic network that have a significant impact of the behaviour of the system. Only tie-ins and main intersections were included. Some nodes with zero "0" demands weren't aggregated to other nodes, as it was intended to show other relevant information (ex. pressures at the ground level)

Where demands were particularly high, the total demand for the area was divided between a few nodes to more accurately reflect the spatial variation. Calculated Fire flow demands were assigned to representative nodes within each area.

3.3.4 Required Regional System Upgrades

Prior to this undertaking, Newfoundland Design Associates Ltd. was retained by the City to perform an evaluation of the impacts of various proposed developments above the 190m contour on the Bay Bulls Big Pond regional water supply system. Several development scenarios were assessed using H2O Map modeling software and the various required upgrades to the regional system were identified. The following scenarios were particularly applicable to the Southwest Development Area (SWDA):

- June 2009 maximum day demand with 100% SWDA demand.
- June 2009 maximum day demand with 100% Glencrest, Mount Pearl, and SWDA demands.
- 2026 demand with 100% SWDA demand.
- 2026 demand with 100% Glencrest, Mount Pearl, and SWDA demands.

The required upgrades were summarized as follows:

Table 22 - Required Upgrades

Scenario	1 (c)	1 (d)	2 (c)	2 (d)
Description	**2026 + 100% SWDA**	**2026 + 100% Glencrest, MTP, & SWDA**	**June 2009 + 100% SWDA**	**June 2009 + Glencrest, MTP & SWDA**
Demand (m^3/day)	123,670	152,057	97,420	125,807
BBBP High Lift Pumps	+2 pumps	+2 pumps	-	+2 pumps
1050mm T.M. BBBP to Ruby Line	-	1200mm	-	
Ruby Line Pumps to Mount Pearl	+2 pumps	+2 pumps	-	+1 pump
600mm T.M. Topsail Rd. to Kenmount P.S.	-	-	750mm	750mm

It is also worth noting that the reliable yield for Bay Bulls Big Pond is estimated to be approximately 104,600 m^3/day, and additional capacity will be required.

3.3.5 Proposed Distribution System Requirements

The proposed zoning allows for a range of residential development types, as well as potentially large usage commercial and industrial developments. Combined with a topography which has a total range of nearly 70m, the primary distribution system consists of an elevated storage tank and several defined pressure zones.

The following guidelines were considered when determining system requirements:

Table 23 - Water Analysis Design Guidelines

Minimum Residual Pressure at ground level during Max day + Fire Flow	150 kPa
Minimum Residual Pressure at ground level during Peak hour Flow	300 kPa
Maximum Desirable Pressure during minimum hour demand	650 kPa
Max Design Velocity during Maximum day conditions	1.5 m/s
Max Design Velocity during Fire Flow conditions	3.0 m/s

3.3.6 Pumping Requirements

In order to lift water from the existing Kenmount tanks to the active storage elevation, between elevation 261m and 267m, a new booster pumping station is required. The existing Kenmount tanks operate in the range of approximately 224m to 227.7m, therefore the new pumping system will be required to deliver the maximum daily flow of 162L/s at approximately 40m of lift.

In order to reduce up-front costs, it is recommended that two equivalent pumps capable of handling the average daily flow for full buildout conditions (85L/s), with an empty slot for a third equivalent pump. This arrangement will provide redundant pumping capacity during the early phases of development, and an arrangement which will allow for pump cycling plus a standby pump when full buildout is achieved.

3.3.7 Storage Requirement

To meet the requirements of the development area, it is proposed that a new storage reservoir be constructed on the hill at the south west corner of the development area (peak El. 261m). The effective storage for this development will need to be above elevation 261m. Therefore, constructing the storage tank as high as possible on this hill will reduce the "dead" storage and thereby reduce cost. Another benefit of this location is that the hill has an existing access road, used for maintenance of the 3 existing radio towers.

Determining the required effective storage elevation for the new tank was an iterative process, balancing distribution piping size, tank construction cost, and pressure maintenance. Through the modeling process it was found that a minimum water elevation of 261m satisfied the minimum residual pressure requirements throughout the system while minimizing pipe size requirements.

The storage volume requirement was calculated using the method as presented in the *Atlantic Canada Guidelines for Water Systems*. The calculation is summarized below:

$$S = A + B + C$$

Where:

S = Total Storage Requirement, m^3
A = Fire Storage, m^3 (equal to the required fire flow over required duration)
B = Peak Balancing Storage, m^3 (25% of maximum day demand)
C = Emergency Storage, m^3 (25% of A + B)

Table 24 - Water Storage Tank Volume Analysis

	Calculation Information	*Storage Volume (m^3)*
[A] (Fire Storage)	Max Fire Flow Demand = 16,000 L/min Fire Flow Duration = 3.5 hrs (City of St. John's Specifications)	3360 m^3
[B] (Peak Balancing Storage)	Maximum Day Demand = 162 L/s	3500 m^3
[C] (Emergency Storage)	A + B = 6860 m^3	1715 m^3
	Total Storage Required	8575 m^3

It is proposed to construct two (2) storage tanks, each of approximately 4300 m^3 storage above the minimum water elevation 261m for a total of 8600 m^3 of storage. The tanks would be located at an approximate elevation of 252m to 255m. Ideally the tanks would be located at the crest of the of hill which is at elevation 261m as this would eliminate the dead storage and enable the tanks be smaller. However, given the close proximity of communication towers it is unclear what effects the storage tanks would have on communications. Reservoir style tanks with width greater than height would be preferred over standpipe style tanks with height greater than width to mitigate interference with the towers. One storage tank would be constructed immediately and the second tank would be constructed as the 190m area development area progresses and there is a need for additional storage capacity.

3.3.8 Water Age Analysis

The water age analysis for the facilities considers the permanent system under full development conditions because development staging and levels of service required for initial stages of development have not been defined. Actual average daily demand for a given phase of development will depend on the area of each phase coming on line as well as the percentage land use of each area. However, it is possible to make some general statements about approaches to ensure adequate turnover during phased development. Actual storage and flow demands will be developed during detail design of development phases.

Adequate turnover time is 72 hours as recommended in the *Atlantic Canada Guidelines for Water Systems*. At the average daily demand of 85 L/s for the final development, the turnover time for 8600 m^3 of stored water is approximately 28 hours. A daily demand of 34 L/s will have a turnover time of approximately 70 hours.

For the single tank system with 4300 m^3 of storage, a daily demand of 34 L/s will have a turnover time of approximately 35 hours. A daily demand of 17 L/s will have a turnover time of approximately 70 hours.

Because average day demand is an average, actual daily demand will fluctuate. It is not recommended to operate the tanks at theoretical average day demands that approach 70 hours. Instead, the single tank should be used until the storage requirements, determined by the method in Section 3.3.7, are no longer adequate for the interim phases of development. This approach will minimize turnover time during initial phases of development.

Once detailed analysis of development phasing requires more than 4300 m^3 of storage, the second tank can be brought online.

If initial stages of development produce average daily demands with turnover times less than 72 hours for the single tank, the level control will need to be set to limit the tank fill level. Fill levels should be set to provide only the minimum storage volume by the methods of Section 3.3.7, thus minimizing the turnover time required.

3.3.9 Distribution Piping System

It was required, as part of this review, that all pipes sized 300mm or larger need to be established in the overall water network. While there are maximum velocity requirements which guide pipe size selection, it is often a combination of factors which govern. In the proposed development, due to the range of topography and the resulting pressure range, pipe sizes were selected which resulted in flow velocities below the maximum permissible.

In addition, a number of PRV were proposed in order to maintain maximum pressures during minimum demands. Some nodes, however, are shown to be above the maximum desirable level. It is recommended that further system optimization should be made to some areas, especially Area 7 in the southwest sector of the proposed development. See the Appendix C for calculation details.

Maintenance of residual pressures during Fire Flow conditions governed the selected of pipe sizes in most cases. Due to the length of the required transmission main, pipe size has a large influence over the head loss in the system, especially on the north side of Kenmount road.

It was determined that a 500mm PVC transmission main provided a good balance between capacity and tank height, while still maintaining a level of flow velocity (see Figure 30 for a system schematic).

3.3.10 Analysis Results

The water distribution system developed using WaterGEMS software was analyzed to assess conformance with the City of St. John's requirements. Detailed results are contained in Appendix C, and are summarized as follows;

Minimum Residual Pressure at ground level during Max day + Fire Flow ≥ 150 kPa	YES
Minimum Residual Pressure at ground level during Peak hour Flow ≥ 300 kPa	YES
Maximum Desirable Pressure during minimum hour demand ≤ 650 kPa	NO *
Max Design Velocity during Maximum day conditions ≤ 1.5 m/s	YES
Max Design Velocity during Fire Flow conditions ≤ 3.0 m/s	YES

* Meeting this desired requirement at all nodes fell outside the scope of this work; further system optimization during detail design will be required to refine this performance specification.

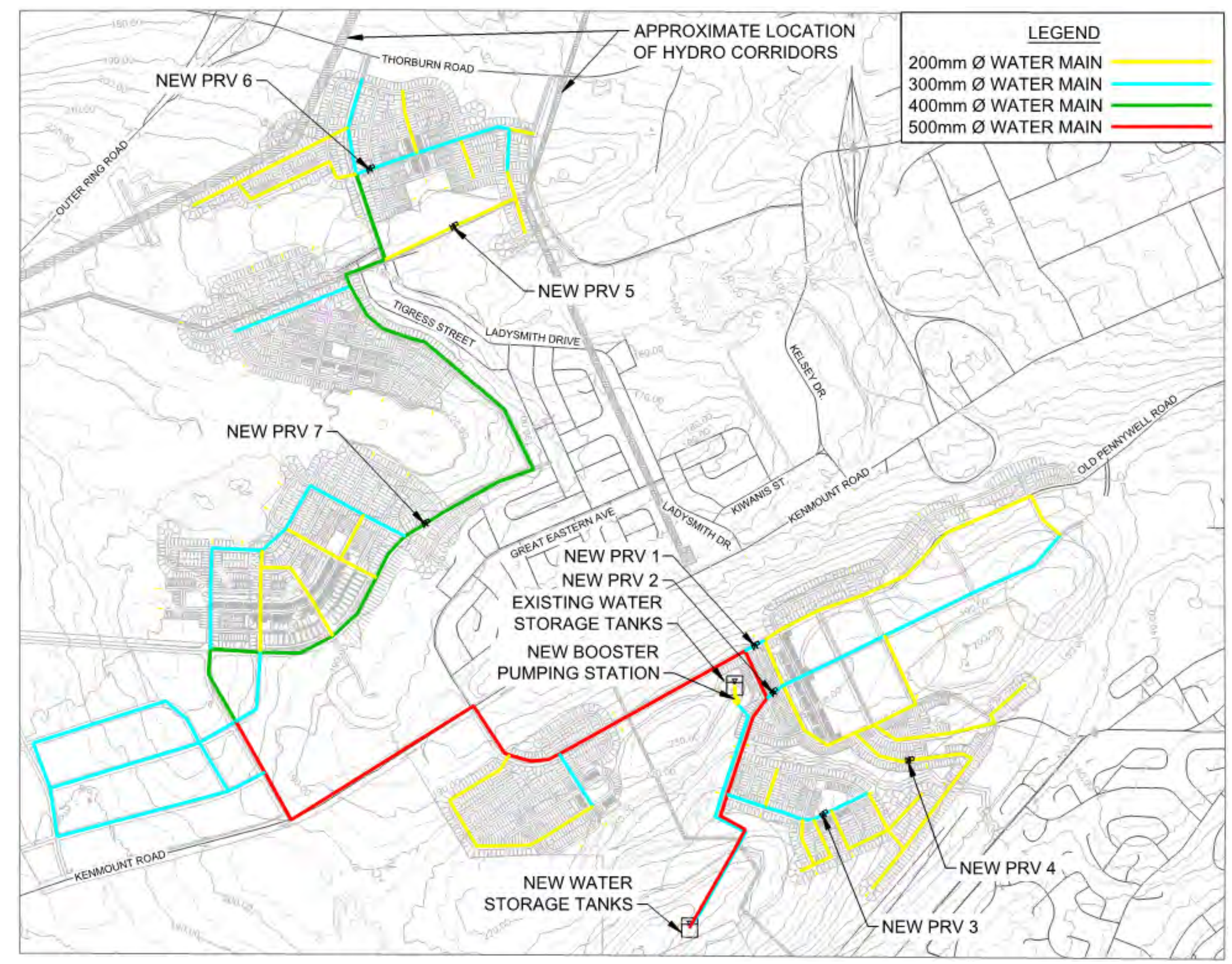


Figure 30 – Draft Water Distribution System Schematic (also refer to Appendix C)

3.4 Cost Estimate

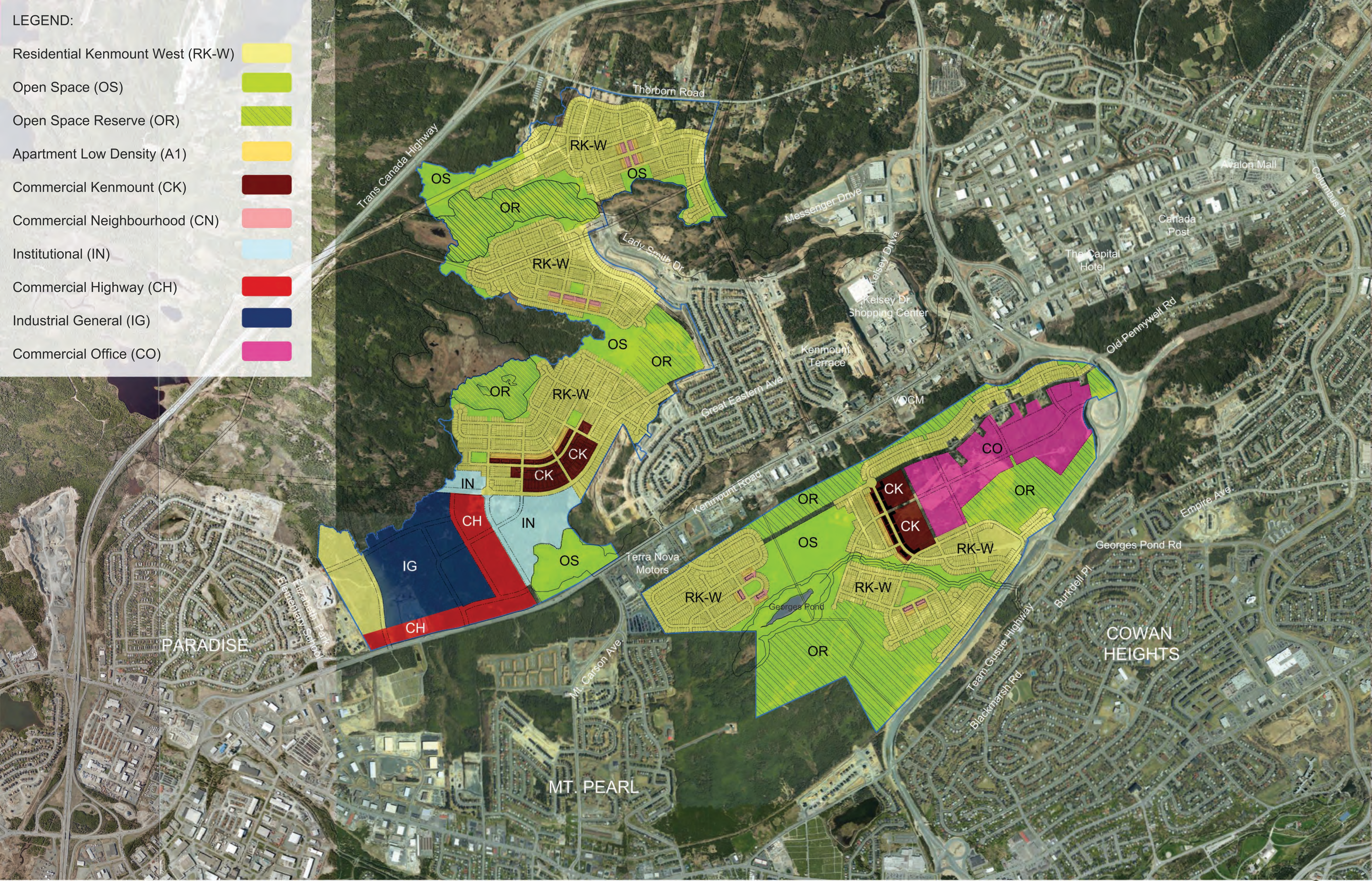
A Class' D' cost (+/-20%) was developed for the 190m contour development area water infrastructure and includes the following items:

- Water transmission mains 300mm diameter and above
- Water storage tanks and chlorination system off the tanks
- Pumphouse outside the existing storage tanks to supply the new tank (s)
- Pressure reducing valves.

The total estimated cost for water system infrastructure identified above (considering only pipe sizes 300mm and above) is $23.3M. A detailed breakdown can be found in Appendix C.

APPENDIX A

1 – LAND USE DRAWING



Proposed Zoning Designation for Lands Above 190m Contour

MAY 2014

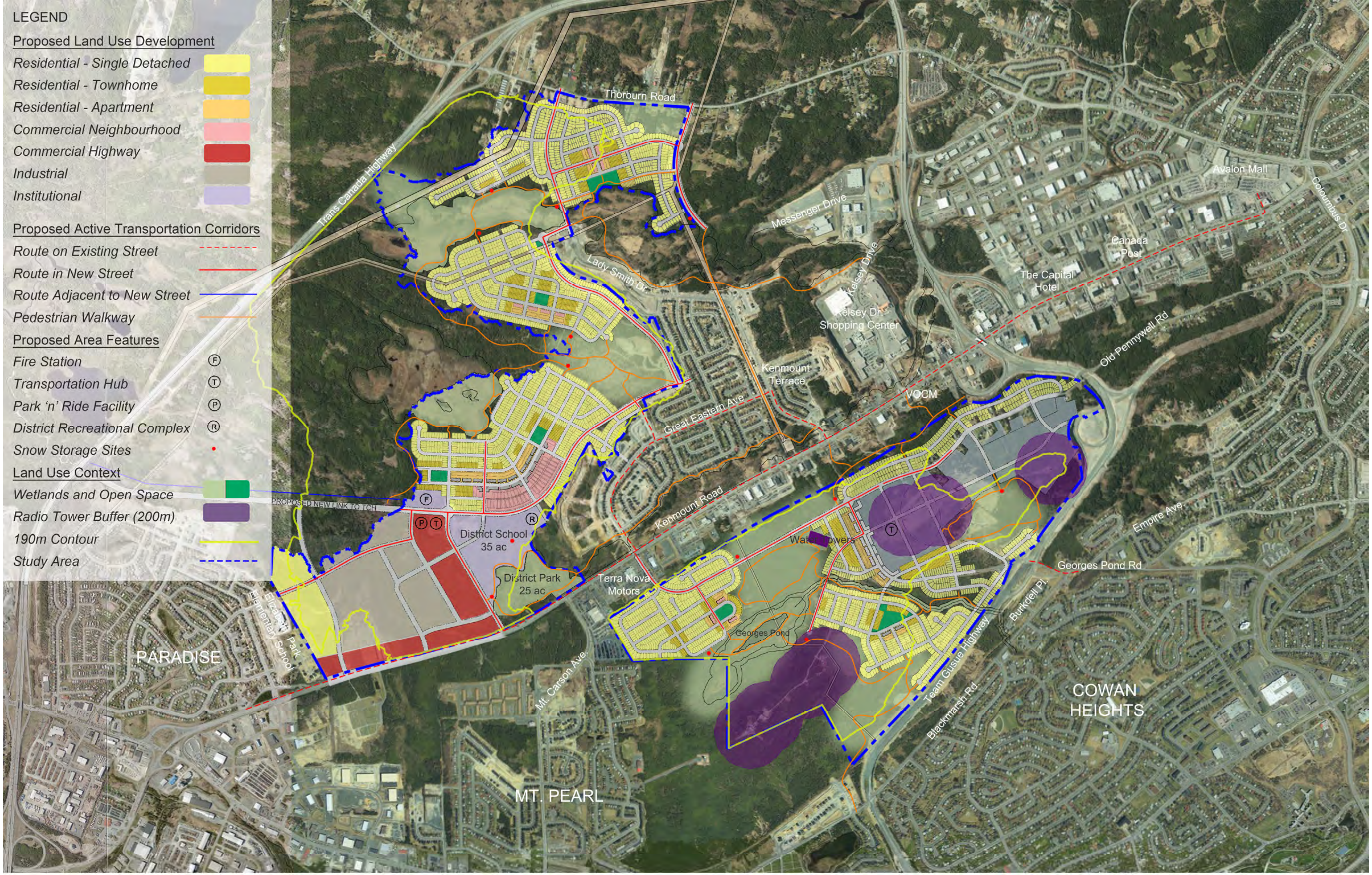
0 km 0.5 km 1.0 km

HATCH

TRACT

APPENDIX A

2 – OVERALL MAP DRAWING



Development Plan for Lands Above 190m - Kenmount Concept Plan

0 km 0.5 km 1.0 km

HATCH TRACT

APPENDIX B

B-1: TURNING MOVEMENT COUNTS

B-2: TRIP GENERATION SENSITIVITY ANALYSIS

B-3: PLAN & PROFILE DRAWINGS

B-4: TYPICAL CROSS-SECTIONS

B-5: SYNCHRO RESULTS

B-6: TRAFFIC SIGNAL WARRANT ANALYSIS

B-7: 2025 INTERSECTION TRAFFIC VOLUMES

B-8: ROUNDABOUTS CONCEPTS

APPENDIX B-1

1 – TURNING MOVEMENT COUNTS FROM THE CITY OF ST. JOHN’S

City Of St. John's

Department of Public Works
Traffic Division

Blackmarsh Rd @ Captain Whelan Drive
Turning Movement Count
October 16 2013

File Name : Blackmarsh @ Captain Whalen October 16 2013
Site Code : 00000000
Start Date : 2013/10/16

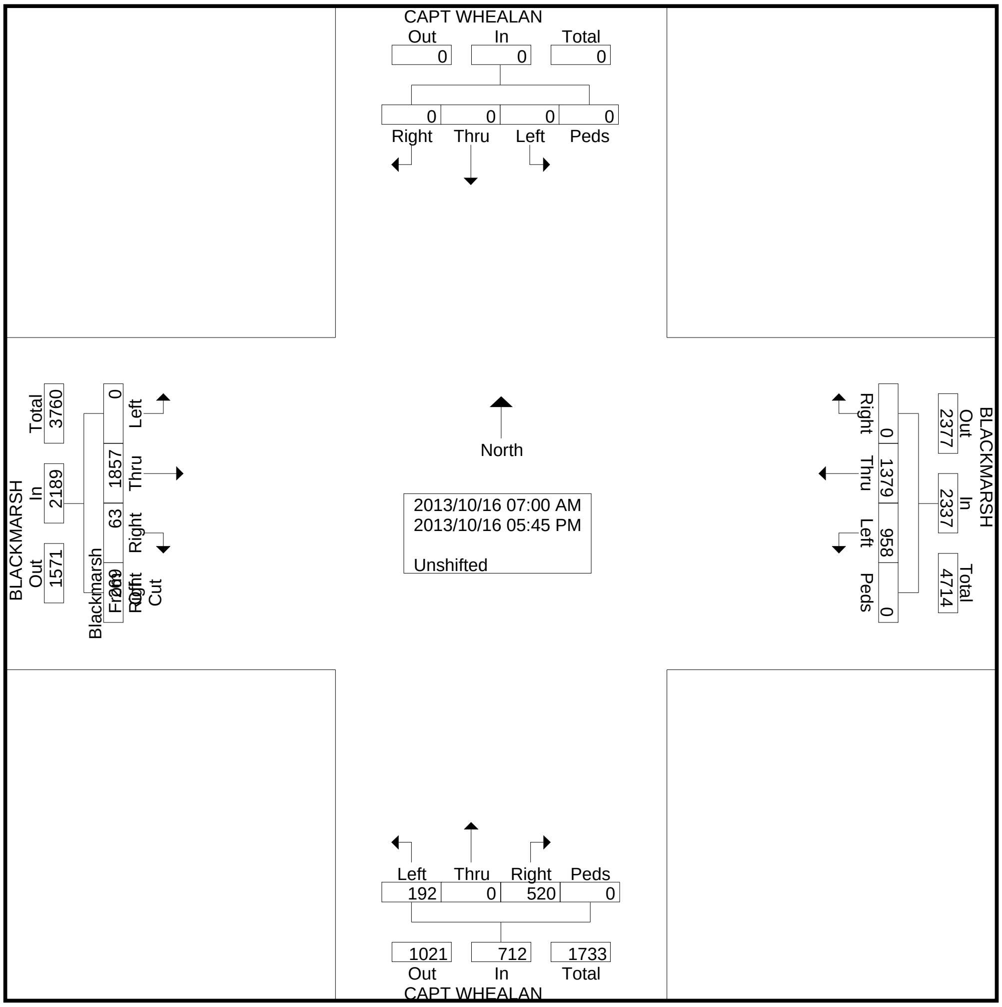
Groups Printed- Unshifted

	CAPT WHEALAN From North				BLACKMARSH From East				CAPT WHEALAN From South				BLACKMARSH From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Right Cut Off From Blackmarsh	Int. Total
07:00 AM	0	0	0	0	0	27	9	0	6	0	7	0	1	67	0	8	125
07:15 AM	0	0	0	0	0	33	16	0	20	0	7	0	1	112	0	6	195
07:30 AM	0	0	0	0	0	54	21	0	24	0	16	0	3	156	0	17	291
07:45 AM	0	0	0	0	0	69	34	0	30	0	13	0	4	184	0	23	357
Total	0	0	0	0	0	183	80	0	80	0	43	0	9	519	0	54	968
08:00 AM	0	0	0	0	0	55	41	0	48	0	10	0	6	202	0	24	386
08:15 AM	0	0	0	0	0	63	34	0	52	0	14	0	8	211	0	26	408
08:30 AM	0	0	0	0	0	39	37	0	44	0	8	0	3	145	0	15	291
08:45 AM	0	0	0	0	0	51	40	0	16	0	8	0	4	113	0	17	249
Total	0	0	0	0	0	208	152	0	160	0	40	0	21	671	0	82	1334
04:00 PM	0	0	0	0	0	129	69	0	41	0	15	0	1	70	0	12	337
04:15 PM	0	0	0	0	0	155	103	0	27	0	18	0	8	82	0	20	413
04:30 PM	0	0	0	0	0	155	89	0	32	0	15	0	5	82	0	14	392
04:45 PM	0	0	0	0	0	132	138	0	38	0	16	0	4	111	0	18	457
Total	0	0	0	0	0	571	399	0	138	0	64	0	18	345	0	64	1599
05:00 PM	0	0	0	0	0	129	94	0	44	0	10	0	5	71	0	21	374
05:15 PM	0	0	0	0	0	127	98	0	34	0	14	0	3	79	0	14	369
05:30 PM	0	0	0	0	0	79	76	0	34	0	15	0	4	107	0	16	331
05:45 PM	0	0	0	0	0	82	59	0	30	0	6	0	3	65	0	18	263
Total	0	0	0	0	0	417	327	0	142	0	45	0	15	322	0	69	1337
Grand Total	0	0	0	0	0	1379	958	0	520	0	192	0	63	1857	0	269	5238
Apprch %	0	0	0	0	0	59	41	0	73	0	27	0	2.9	84.8	0	12.3	
Total %	0	0	0	0	0	26.3	18.3	0	9.9	0	3.7	0	1.2	35.5	0	5.1	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Blackmarsh @ Captain Whalen October 16 2013
Site Code : 00000000
Start Date : 2013/10/16
Page No : 2

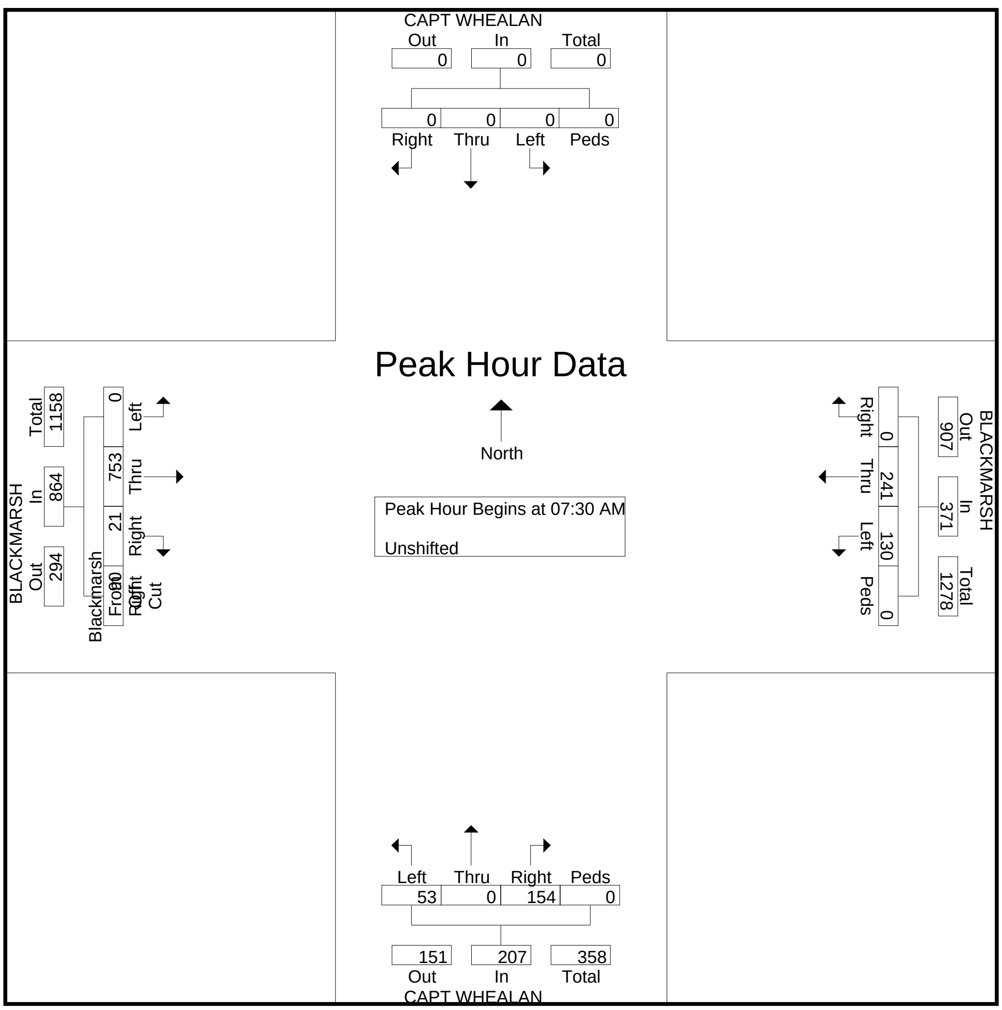


City Of St. John's

Department of Public Works
Traffic Division

File Name : Blackmarsh @ Captain Whalen October 16 2013
Site Code : 00000000
Start Date : 2013/10/16
Page No : 3

	CAPT WHEALAN From North					BLACKMARSH From East					CAPT WHEALAN From South					BLACKMARSH From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Right Cut Off From Blackmarsh	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	0	0	0	0	0	54	21	0	75	24	0	**16**	0	40	3	156	0	17	176	291
07:45 AM	0	0	0	0	0	0	**69**	34	0	**103**	30	0	13	0	43	4	184	0	23	211	357
08:00 AM	0	0	0	0	0	0	55	**41**	0	96	48	0	10	0	58	6	202	0	24	232	386
08:15 AM	0	0	0	0	0	0	63	34	0	97	**52**	0	14	0	**66**	**8**	**211**	0	**26**	**245**	**408**
Total Volume	0	0	0	0	0	0	241	130	0	371	154	0	53	0	207	21	753	0	90	864	1442
% App. Total	0	0	0	0		0	65	35	0		74.4	0	25.6	0		2.4	87.2	0	10.4		
PHF	.000	.000	.000	.000	.000	.000	.873	.793	.000	.900	.740	.000	.828	.000	.784	.656	.892	.000	.865	.882	.884

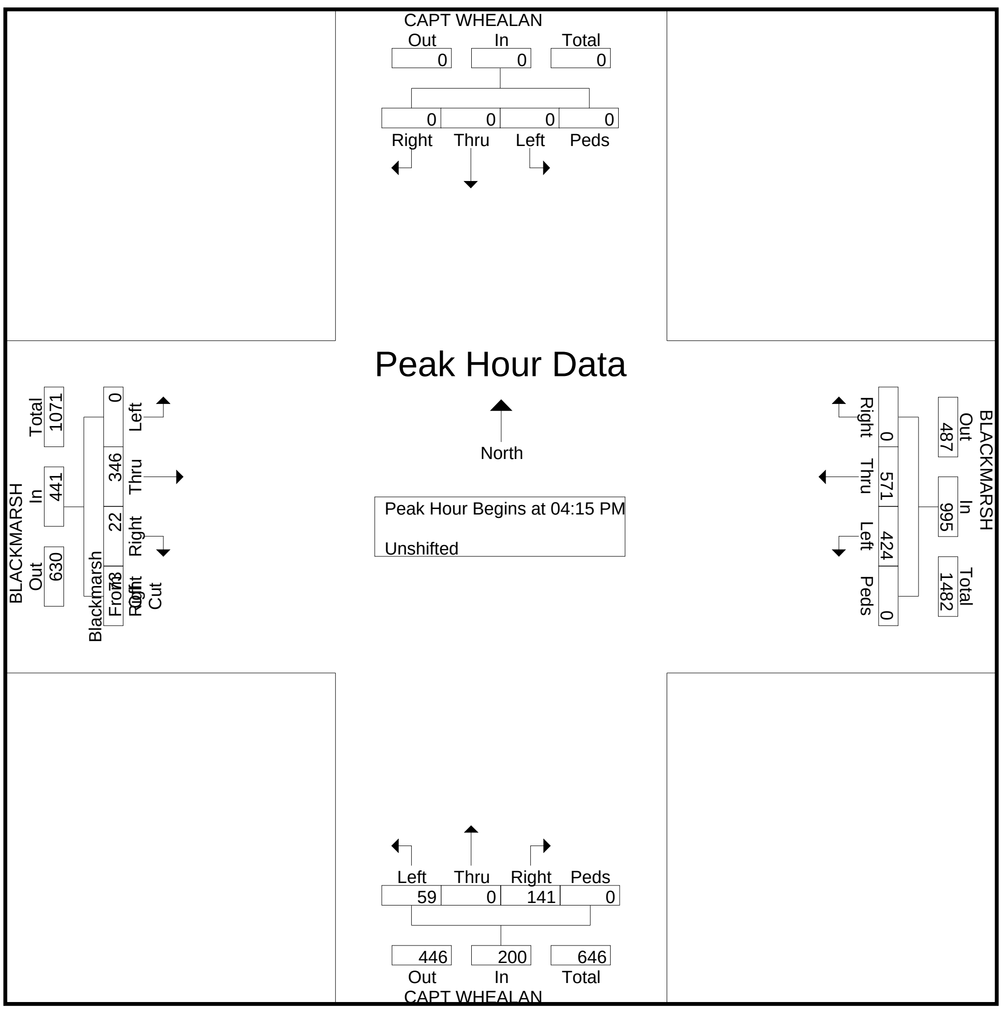


City Of St. John's

Department of Public Works
Traffic Division

File Name : Blackmarsh @ Captain Whalen October 16 2013
Site Code : 00000000
Start Date : 2013/10/16
Page No : 4

	CAPT WHEALAN From North					BLACKMARSH From East					CAPT WHEALAN From South					BLACKMARSH From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Right Cut Off From Blackmarsh	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	0	0	0	0	0	**155**	103	0	258	27	0	**18**	0	45	**8**	82	0	20	110	413
04:30 PM	0	0	0	0	0	0	155	89	0	244	32	0	15	0	47	5	82	0	14	101	392
04:45 PM	0	0	0	0	0	0	132	**138**	0	**270**	38	0	16	0	**54**	4	**111**	0	18	**133**	**457**
05:00 PM	0	0	0	0	0	0	129	94	0	223	**44**	0	10	0	54	5	71	0	**21**	97	374
Total Volume	0	0	0	0	0	0	571	424	0	995	141	0	59	0	200	22	346	0	73	441	1636
% App. Total	0	0	0	0		0	57.4	42.6	0		70.5	0	29.5	0		5	78.5	0	16.6		
PHF	.000	.000	.000	.000	.000	.000	.921	.768	.000	.921	.801	.000	.819	.000	.926	.688	.779	.000	.869	.829	.895



City Of St. John's

Department of Public Works
Traffic Division

Captain Whelan Drive @ Hamlyn Road
Turning Movement Count
October 16 2013

File Name : Captain Whelan Drive @ Hamlyn Road October 16 2013
Site Code : 00000000
Start Date : 2013/10/16
Page No : 1

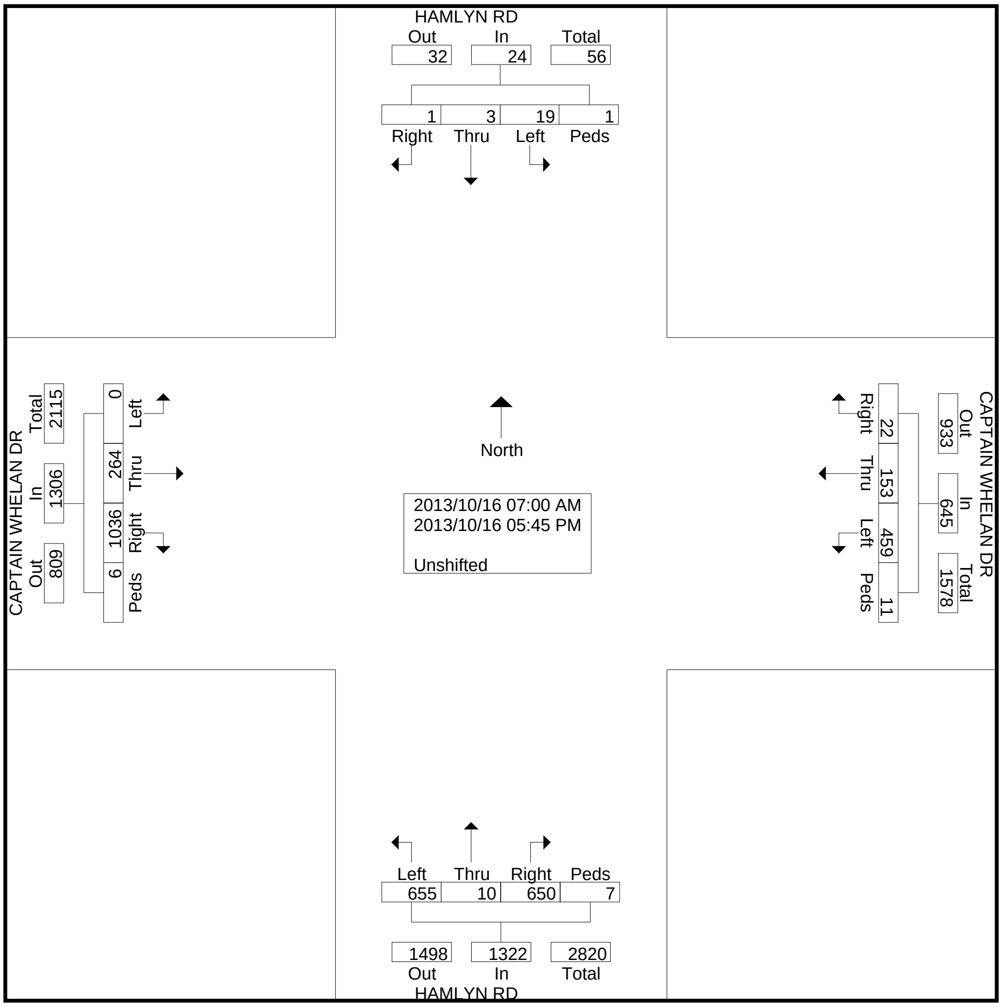
Groups Printed- Unshifted

	HAMLYN RD From North				CAPTAIN WHELAN DR From East				HAMLYN RD From South				CAPTAIN WHELAN DR From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	5	7	6	0	26	0	12	0	14	6	0	0	76
07:15 AM	0	0	4	0	1	4	12	0	35	2	24	0	18	9	0	0	109
07:30 AM	0	1	2	0	1	12	14	0	53	2	43	0	24	18	0	0	170
07:45 AM	0	0	2	0	4	11	18	0	63	0	35	1	35	30	0	0	199
Total	0	1	8	0	11	34	50	0	177	4	114	1	91	63	0	0	554
08:00 AM	0	0	2	0	4	9	23	1	87	1	60	1	54	14	0	0	256
08:15 AM	1	1	2	0	0	10	26	1	68	0	61	0	55	22	0	0	247
08:30 AM	0	0	3	1	5	3	17	2	42	0	43	0	44	15	0	0	175
08:45 AM	0	0	4	0	1	8	11	0	28	0	29	0	37	15	0	1	134
Total	1	1	11	1	10	30	77	4	225	1	193	1	190	66	0	1	812
04:00 PM	0	1	0	0	0	14	42	3	28	1	51	2	73	18	0	0	233
04:15 PM	0	0	0	0	0	7	38	0	32	2	46	1	111	20	0	1	258
04:30 PM	0	0	0	0	1	18	41	0	30	0	48	0	119	11	0	0	268
04:45 PM	0	0	0	0	0	12	53	0	40	0	44	2	119	15	0	2	287
Total	0	1	0	0	1	51	174	3	130	3	189	5	422	64	0	3	1046
05:00 PM	0	0	0	0	0	10	39	1	33	0	42	0	103	18	0	0	246
05:15 PM	0	0	0	0	0	7	50	2	29	2	40	0	100	15	0	0	245
05:30 PM	0	0	0	0	0	17	29	0	22	0	35	0	82	18	0	2	205
05:45 PM	0	0	0	0	0	4	40	1	34	0	42	0	48	20	0	0	189
Total	0	0	0	0	0	38	158	4	118	2	159	0	333	71	0	2	885
Grand Total	1	3	19	1	22	153	459	11	650	10	655	7	1036	264	0	6	3297
Apprch %	4.2	12.5	79.2	4.2	3.4	23.7	71.2	1.7	49.2	0.8	49.5	0.5	79.3	20.2	0	0.5	
Total %	0	0.1	0.6	0	0.7	4.6	13.9	0.3	19.7	0.3	19.9	0.2	31.4	8	0	0.2	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Captain Whelan Drive @ Hamlyn Road October 16 2013
Site Code : 00000000
Start Date : 2013/10/16
Page No : 2

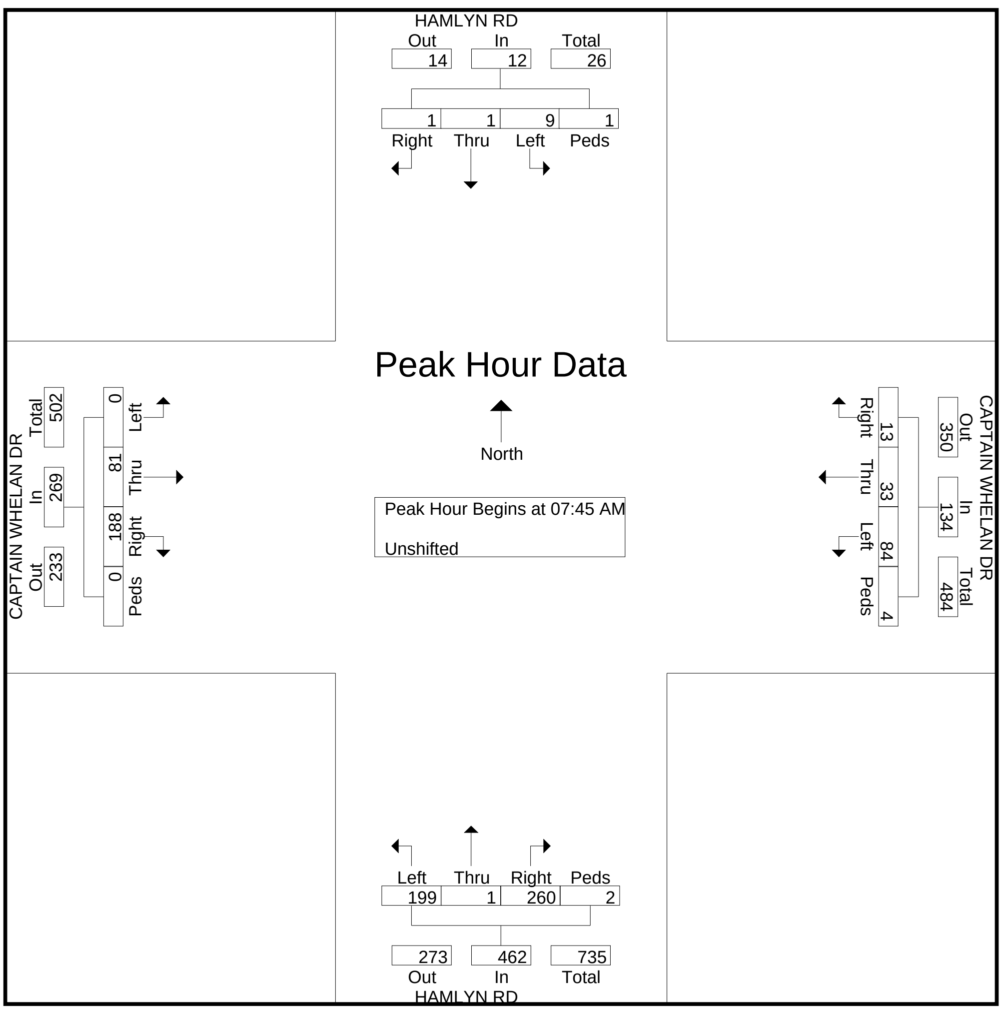


City Of St. John's

Department of Public Works
Traffic Division

File Name : Captain Whelan Drive @ Hamlyn Road October 16 2013
Site Code : 00000000
Start Date : 2013/10/16
Page No : 3

	HAMLYN RD From North					CAPTAIN WHELAN DR From East					HAMLYN RD From South					CAPTAIN WHELAN DR From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	0	0	2	0	2	4	**11**	18	0	33	63	0	35	**1**	99	35	**30**	0	0	65	199
08:00 AM	0	0	2	0	2	4	9	23	1	**37**	**87**	**1**	60	1	**149**	54	14	0	0	68	**256**
08:15 AM	**1**	**1**	2	0	**4**	0	10	**26**	1	37	68	0	**61**	0	129	**55**	22	0	0	**77**	247
08:30 AM	0	0	**3**	**1**	4	**5**	3	17	**2**	27	42	0	43	0	85	44	15	0	0	59	175
Total Volume	1	1	9	1	12	13	33	84	4	134	260	1	199	2	462	188	81	0	0	269	877
% App. Total	8.3	8.3	75	8.3		9.7	24.6	62.7	3		56.3	0.2	43.1	0.4		69.9	30.1	0	0		
PHF	.250	.250	.750	.250	.750	.650	.750	.808	.500	.905	.747	.250	.816	.500	.775	.855	.675	.000	.000	.873	.856

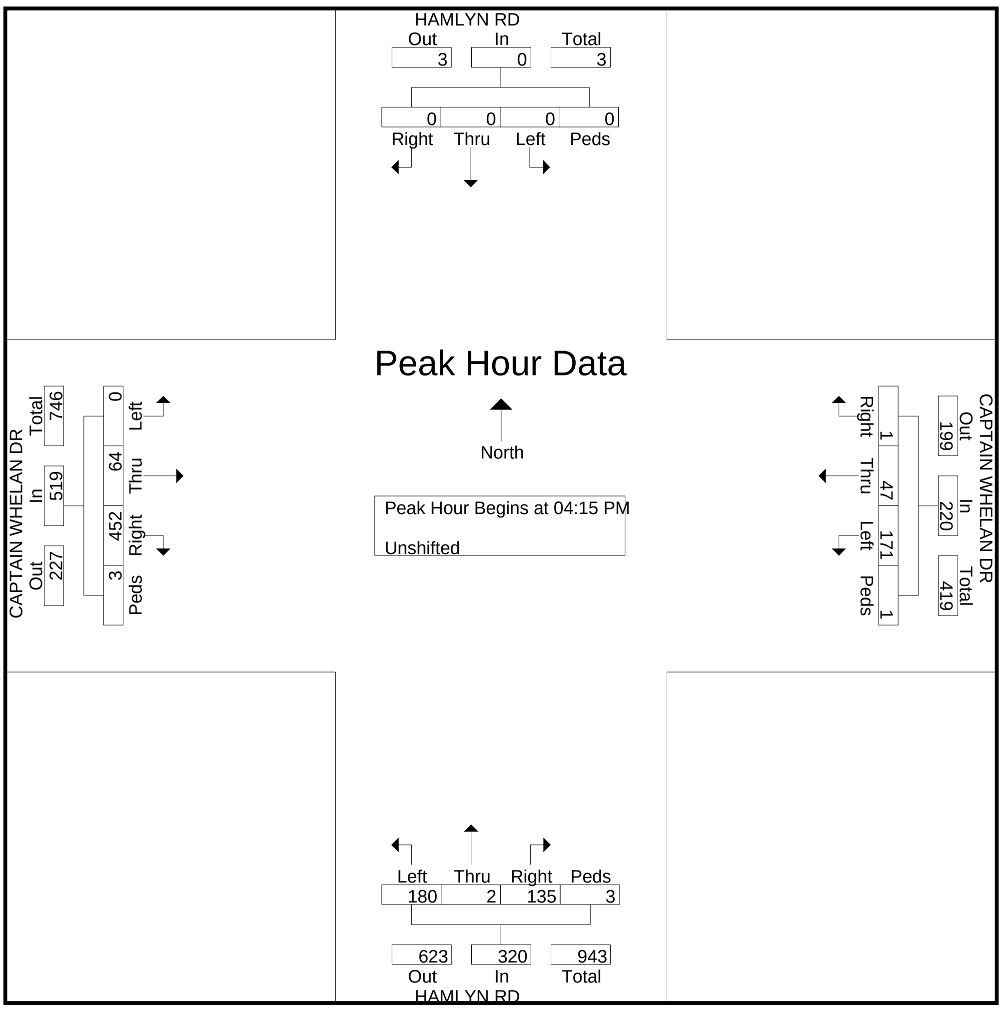


City Of St. John's

Department of Public Works
Traffic Division

File Name : Captain Whelan Drive @ Hamlyn Road October 16 2013
Site Code : 00000000
Start Date : 2013/10/16
Page No : 4

	HAMLYN RD From North					CAPTAIN WHELAN DR From East					HAMLYN RD From South					CAPTAIN WHELAN DR From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	0	0	0	0	0	7	38	0	45	32	**2**	46	1	81	111	**20**	0	1	132	258
04:30 PM	0	0	0	0	0	**1**	**18**	41	0	60	30	0	**48**	0	78	**119**	11	0	0	130	268
04:45 PM	0	0	0	0	0	0	12	**53**	0	**65**	**40**	0	44	**2**	**86**	119	15	0	**2**	**136**	**287**
05:00 PM	0	0	0	0	0	0	10	39	**1**	50	33	0	42	0	75	103	18	0	0	121	246
Total Volume	0	0	0	0	0	1	47	171	1	220	135	2	180	3	320	452	64	0	3	519	1059
% App. Total	0	0	0	0		0.5	21.4	77.7	0.5		42.2	0.6	56.2	0.9		87.1	12.3	0	0.6		
PHF	.000	.000	.000	.000	.000	.250	.653	.807	.250	.846	.844	.250	.938	.375	.930	.950	.800	.000	.375	.954	.922



City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Blackmarsh Rd
Turning Movement Count
April 16 2013

File Name : Columbus @ Blackmarsh 2013
Site Code : 00000000
Start Date : 2013/04/16
Page No : 1

Groups Printed- Unshifted

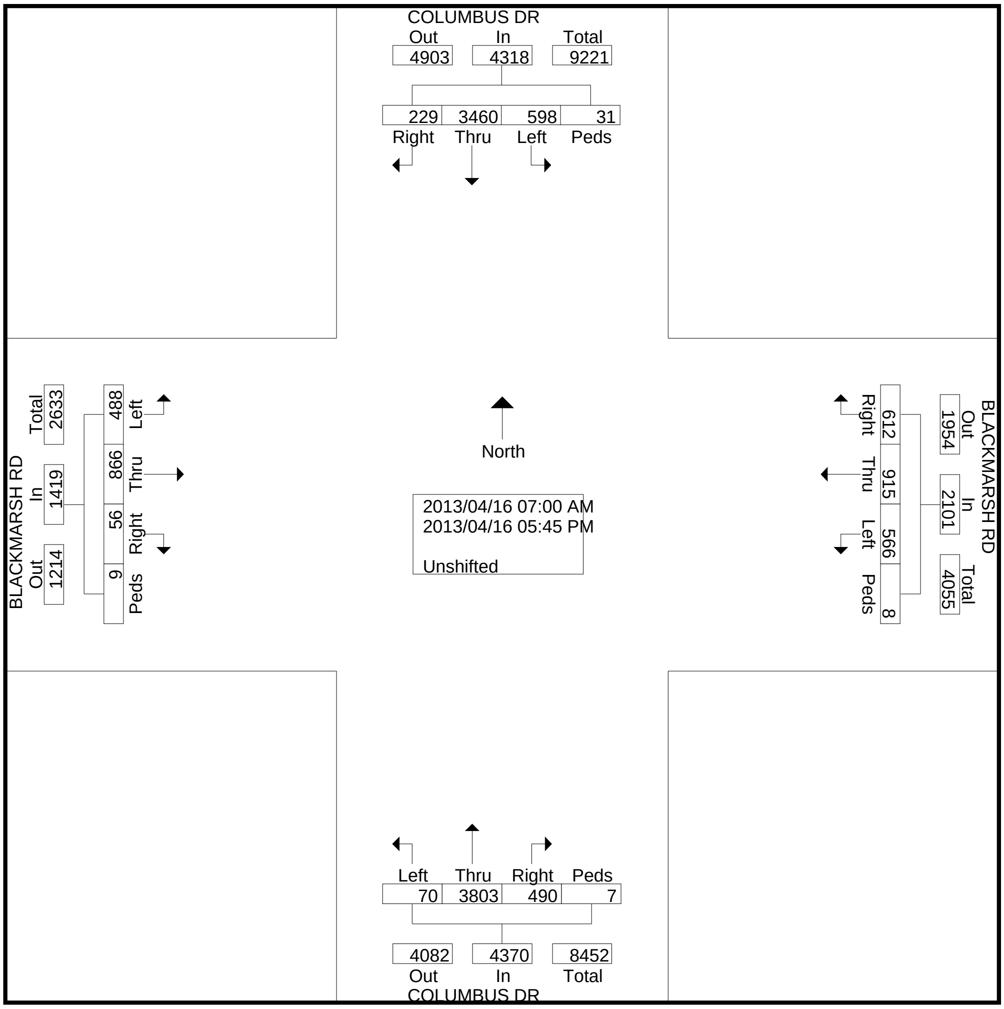
	COLUMBUS DR Southbound				**BLACKMARSH RD Westbound**				**COLUMBUS DR Northbound**				**BLACKMARSH RD Eastbound**				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	10	80	9	1	15	9	7	0	9	144	2	0	2	25	15	0	328
07:15 AM	5	81	13	2	27	16	8	0	28	204	0	0	1	45	27	0	457
07:30 AM	3	120	22	0	27	27	12	0	27	253	1	0	2	71	35	1	601
07:45 AM	15	179	29	2	43	37	20	0	31	288	2	0	2	73	36	0	757
Total	33	460	73	5	112	89	47	0	95	889	5	0	7	214	113	1	2143
08:00 AM	12	169	21	2	32	23	18	0	22	329	1	0	2	62	58	1	752
08:15 AM	13	171	27	0	44	33	28	0	31	310	2	0	4	82	44	1	790
08:30 AM	7	153	25	5	37	30	31	1	32	314	1	0	2	69	45	0	752
08:45 AM	8	156	21	0	43	34	20	1	21	227	1	1	1	64	23	0	621
Total	40	649	94	7	156	120	97	2	106	1180	5	1	9	277	170	2	2915
04:00 PM	18	287	46	3	36	98	54	0	35	251	6	0	2	37	27	2	902
04:15 PM	24	316	38	4	38	113	59	1	32	206	5	3	5	48	30	2	924
04:30 PM	15	339	48	1	46	114	47	0	30	249	8	0	5	43	21	0	966
04:45 PM	22	361	73	0	47	82	65	1	40	214	15	1	5	49	23	1	999
Total	79	1303	205	8	167	407	225	2	137	920	34	4	17	177	101	5	3791
05:00 PM	22	310	66	3	65	89	52	0	39	221	9	0	6	61	21	0	964
05:15 PM	20	304	68	2	50	83	59	0	48	198	8	2	5	40	39	0	926
05:30 PM	17	236	48	5	31	66	53	4	35	196	8	0	7	44	18	1	769
05:45 PM	18	198	44	1	31	61	33	0	30	199	1	0	5	53	26	0	700
Total	77	1048	226	11	177	299	197	4	152	814	26	2	23	198	104	1	3359
Grand Total	229	3460	598	31	612	915	566	8	490	3803	70	7	56	866	488	9	12208
Apprch %	5.3	80.1	13.8	0.7	29.1	43.6	26.9	0.4	11.2	87	1.6	0.2	3.9	61	34.4	0.6	
Total %	1.9	28.3	4.9	0.3	5	7.5	4.6	0.1	4	31.2	0.6	0.1	0.5	7.1	4	0.1	

City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Blackmarsh Rd
Turning Movement Count
April 16 2013

File Name : Columbus @ Blackmarsh 2013
Site Code : 00000000
Start Date : 2013/04/16
Page No : 2



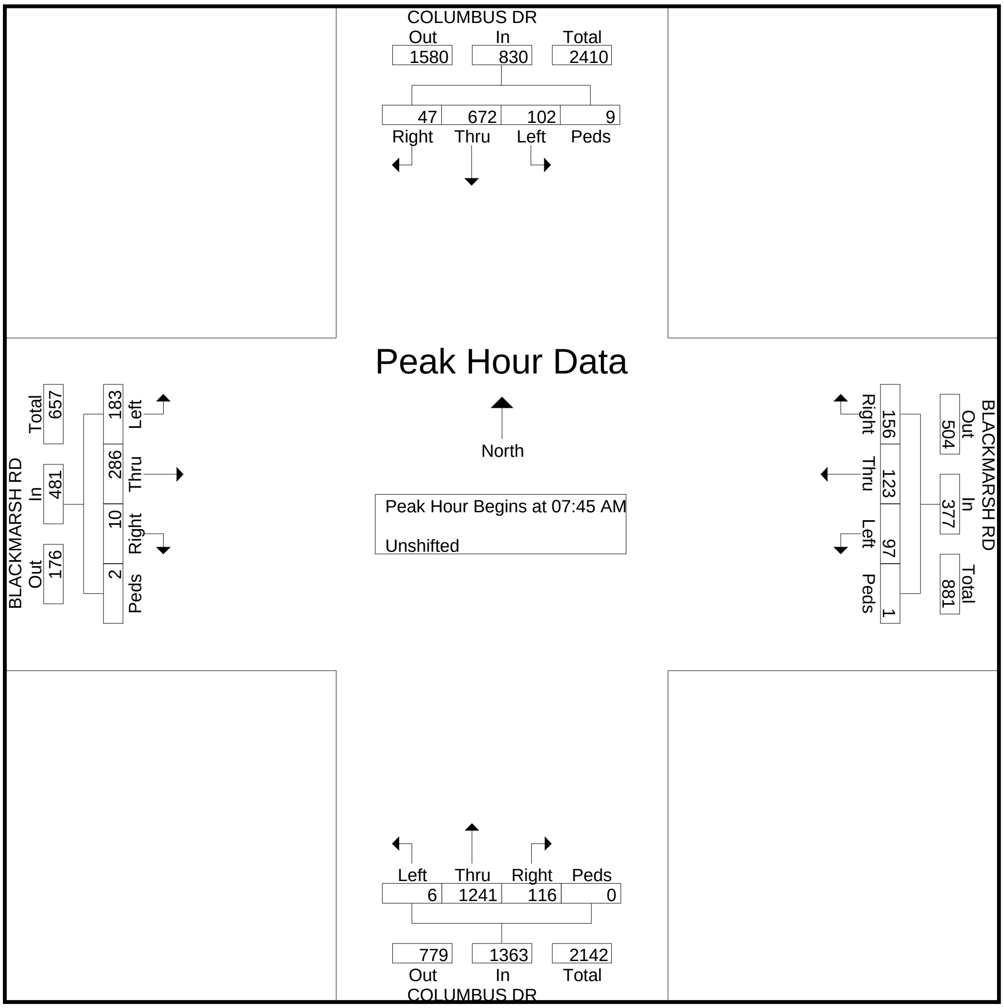
City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Blackmarsh Rd
Turning Movement Count
April 16 2013

File Name : Columbus @ Blackmarsh 2013
Site Code : 00000000
Start Date : 2013/04/16
Page No : 3

	COLUMBUS DR Southbound					BLACKMARSH RD Westbound					COLUMBUS DR Northbound					BLACKMARSH RD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	**15**	**179**	**29**	2	**225**	43	**37**	20	0	100	31	288	**2**	0	321	2	73	36	0	111	757
08:00 AM	12	169	21	2	204	32	23	18	0	73	22	**329**	1	0	**352**	2	62	**58**	**1**	123	752
08:15 AM	13	171	27	0	211	**44**	33	28	0	**105**	31	310	2	0	343	**4**	**82**	44	1	**131**	**790**
08:30 AM	7	153	25	**5**	190	37	30	**31**	**1**	99	**32**	314	1	0	347	2	69	45	0	116	752
Total Volume	47	672	102	9	830	156	123	97	1	377	116	1241	6	0	1363	10	286	183	2	481	3051
% App. Total	5.7	81	12.3	1.1		41.4	32.6	25.7	0.3		8.5	91	0.4	0		2.1	59.5	38	0.4		
PHF	.783	.939	.879	.450	.922	.886	.831	.782	.250	.898	.906	.943	.750	.000	.968	.625	.872	.789	.500	.918	.966



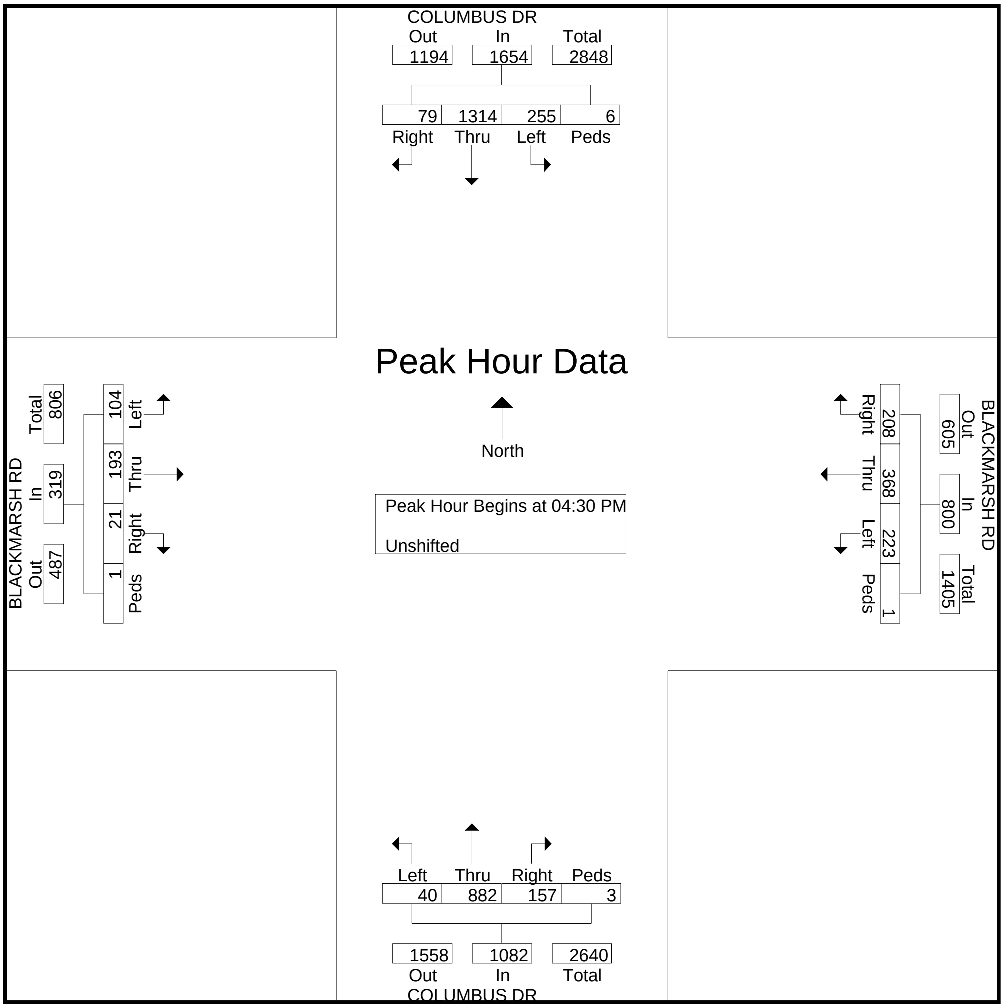
City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Blackmarsh Rd
Turning Movement Count
April 16 2013

File Name : Columbus @ Blackmarsh 2013
Site Code : 00000000
Start Date : 2013/04/16
Page No : 4

	COLUMBUS DR Southbound					BLACKMARSH RD Westbound					COLUMBUS DR Northbound					BLACKMARSH RD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	15	339	48	1	403	46	**114**	47	0	**207**	30	**249**	8	0	**287**	5	43	21	0	69	966
04:45 PM	**22**	**361**	**73**	0	**456**	47	82	**65**	**1**	195	40	214	**15**	1	270	5	49	23	**1**	78	**999**
05:00 PM	22	310	66	**3**	401	**65**	89	52	0	206	39	221	9	0	269	**6**	**61**	21	0	**88**	964
05:15 PM	20	304	68	2	394	50	83	59	0	192	**48**	198	8	**2**	256	5	40	**39**	0	84	926
Total Volume	79	1314	255	6	1654	208	368	223	1	800	157	882	40	3	1082	21	193	104	1	319	3855
% App. Total	4.8	79.4	15.4	0.4		26	46	27.9	0.1		14.5	81.5	3.7	0.3		6.6	60.5	32.6	0.3		
PHF	.898	.910	.873	.500	.907	.800	.807	.858	.250	.966	.818	.886	.667	.375	.943	.875	.791	.667	.250	.906	.965



City Of St. John's

Department of Engineering
Traffic Division

Columbus Dr @ Captain Whelan Dr
Turning Movement Count
April 25 2013

File Name : Columbus @ Capt Whelan 2013
Site Code : 00000000
Start Date : 2013/04/25
Page No : 1

Groups Printed- Unshifted - Bank 1

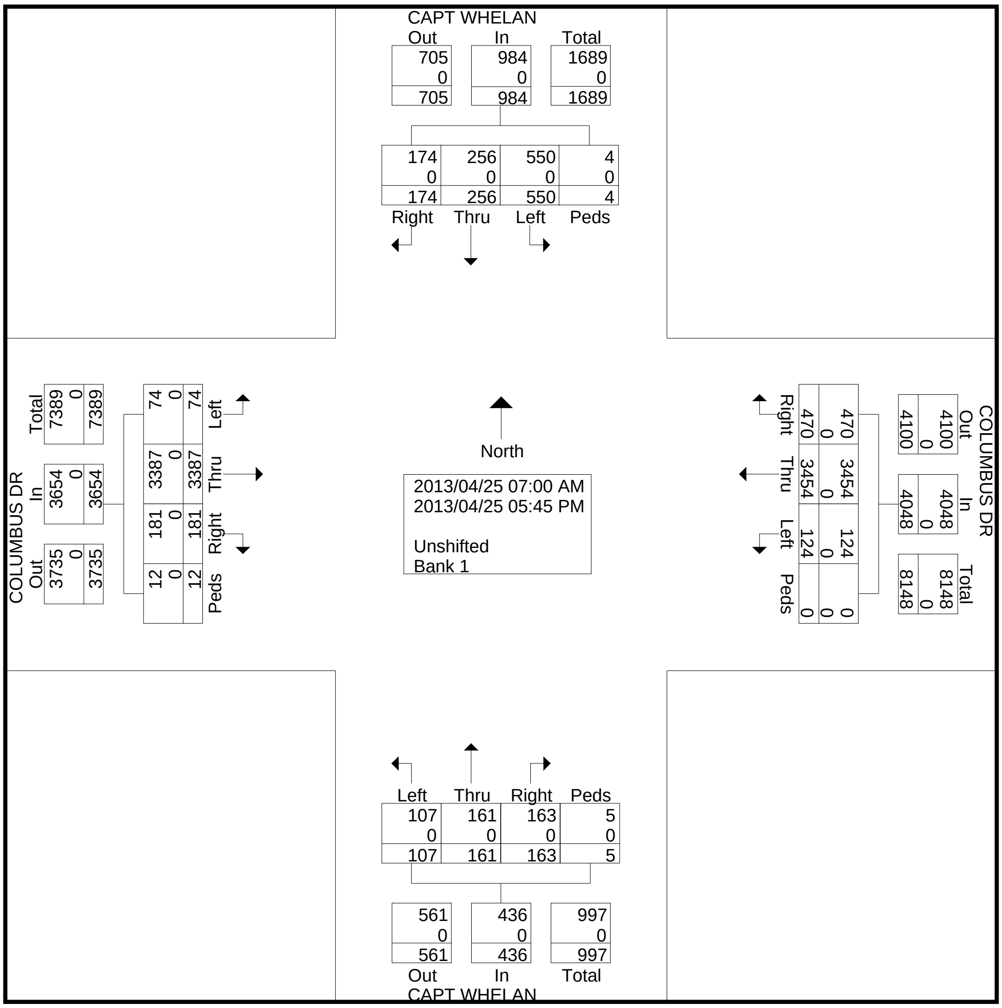
	CAPT WHELAN From North				COLUMBUS DR From East				CAPT WHELAN From South				COLUMBUS DR From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	4	4	18	1	9	74	2	0	16	4	1	0	4	168	5	0	310
07:15 AM	5	6	18	0	11	79	1	0	7	3	1	0	3	208	6	3	351
07:30 AM	5	10	34	0	20	106	4	0	7	9	8	0	6	237	3	0	449
07:45 AM	11	19	33	0	48	163	2	0	12	7	8	0	15	282	7	1	608
Total	25	39	103	1	88	422	9	0	42	23	18	0	28	895	21	4	1718
08:00 AM	9	24	46	1	36	130	8	0	12	22	4	0	17	252	1	1	563
08:15 AM	6	33	54	0	50	131	4	0	13	11	9	0	28	259	7	0	605
08:30 AM	3	23	42	0	33	151	3	0	15	4	3	0	13	249	4	1	544
08:45 AM	6	12	29	0	20	163	2	0	12	7	5	0	5	210	3	0	474
Total	24	92	171	1	139	575	17	0	52	44	21	0	63	970	15	2	2186
*** BREAK ***																	
04:00 PM	19	17	44	0	24	309	16	0	9	10	6	1	16	230	6	2	709
04:15 PM	16	13	32	0	34	359	12	0	7	11	9	1	8	195	4	0	701
04:30 PM	21	17	47	1	32	332	14	0	12	14	10	1	12	210	5	0	728
04:45 PM	11	20	32	1	41	337	10	0	10	13	8	0	11	185	6	0	685
Total	67	67	155	2	131	1337	52	0	38	48	33	3	47	820	21	2	2823
05:00 PM	20	19	40	0	30	322	19	0	6	9	11	1	12	193	3	0	685
05:15 PM	17	18	26	0	30	328	14	0	10	11	10	1	11	202	3	2	683
05:30 PM	9	8	24	0	34	227	6	0	7	9	8	0	10	98	7	2	449
05:45 PM	12	13	31	0	18	243	7	0	8	17	6	0	10	209	4	0	578
Total	58	58	121	0	112	1120	46	0	31	46	35	2	43	702	17	4	2395
Grand Total	174	256	550	4	470	3454	124	0	163	161	107	5	181	3387	74	12	9122
Apprch %	17.7	26	55.9	0.4	11.6	85.3	3.1	0	37.4	36.9	24.5	1.1	5	92.7	2	0.3	
Total %	1.9	2.8	6	0	5.2	37.9	1.4	0	1.8	1.8	1.2	0.1	2	37.1	0.8	0.1	
Unshifted	174	256	550	4	470	3454	124	0	163	161	107	5	181	3387	74	12	9122
% Unshifted	100	100	100	100	100	100	100	0	100	100	100	100	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

City Of St. John's

Department of Engineering
Traffic Division

Columbus Dr @ Captain Whelan Dr
Turning Movement Count
April 25 2013

File Name : Columbus @ Capt Whelan 2013
Site Code : 00000000
Start Date : 2013/04/25
Page No : 2



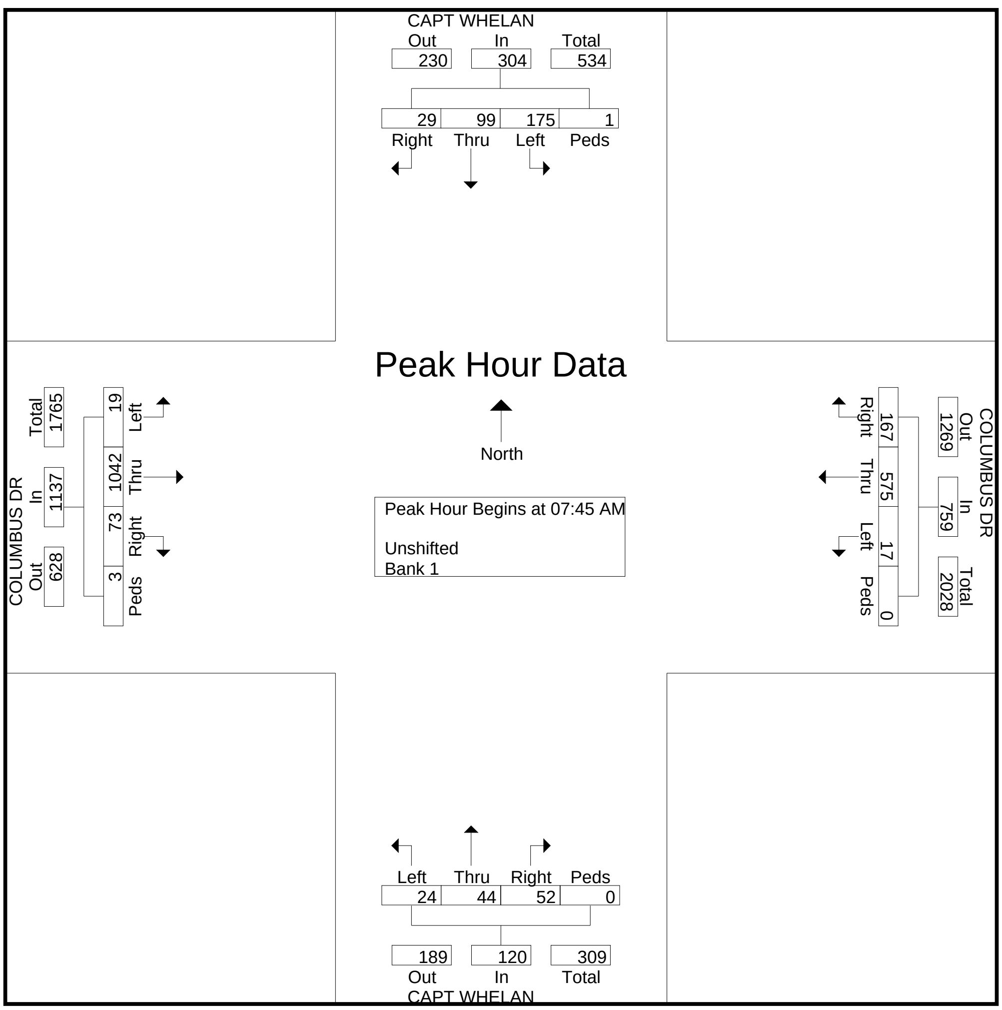
City Of St. John's

Department of Engineering
Traffic Division

Columbus Dr @ Captain Whelan Dr
Turning Movement Count
April 25 2013

File Name : Columbus @ Capt Whelan 2013
Site Code : 00000000
Start Date : 2013/04/25
Page No : 3

	CAPT WHELAN From North					COLUMBUS DR From East					CAPT WHELAN From South					COLUMBUS DR From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	**11**	19	33	0	63	48	**163**	2	0	**213**	12	7	8	0	27	15	**282**	**7**	**1**	**305**	**608**
08:00 AM	9	24	46	**1**	80	36	130	**8**	0	174	12	**22**	4	0	**38**	17	252	1	1	271	563
08:15 AM	6	**33**	**54**	0	**93**	**50**	131	4	0	185	13	11	**9**	0	33	**28**	259	7	0	294	605
08:30 AM	3	23	42	0	68	33	151	3	0	187	**15**	4	3	0	22	13	249	4	1	267	544
Total Volume	29	99	175	1	304	167	575	17	0	759	52	44	24	0	120	73	1042	19	3	1137	2320
% App. Total	9.5	32.6	57.6	0.3		22	75.8	2.2	0		43.3	36.7	20	0		6.4	91.6	1.7	0.3		
PHF	.659	.750	.810	.250	.817	.835	.882	.531	.000	.891	.867	.500	.667	.000	.789	.652	.924	.679	.750	.932	.954



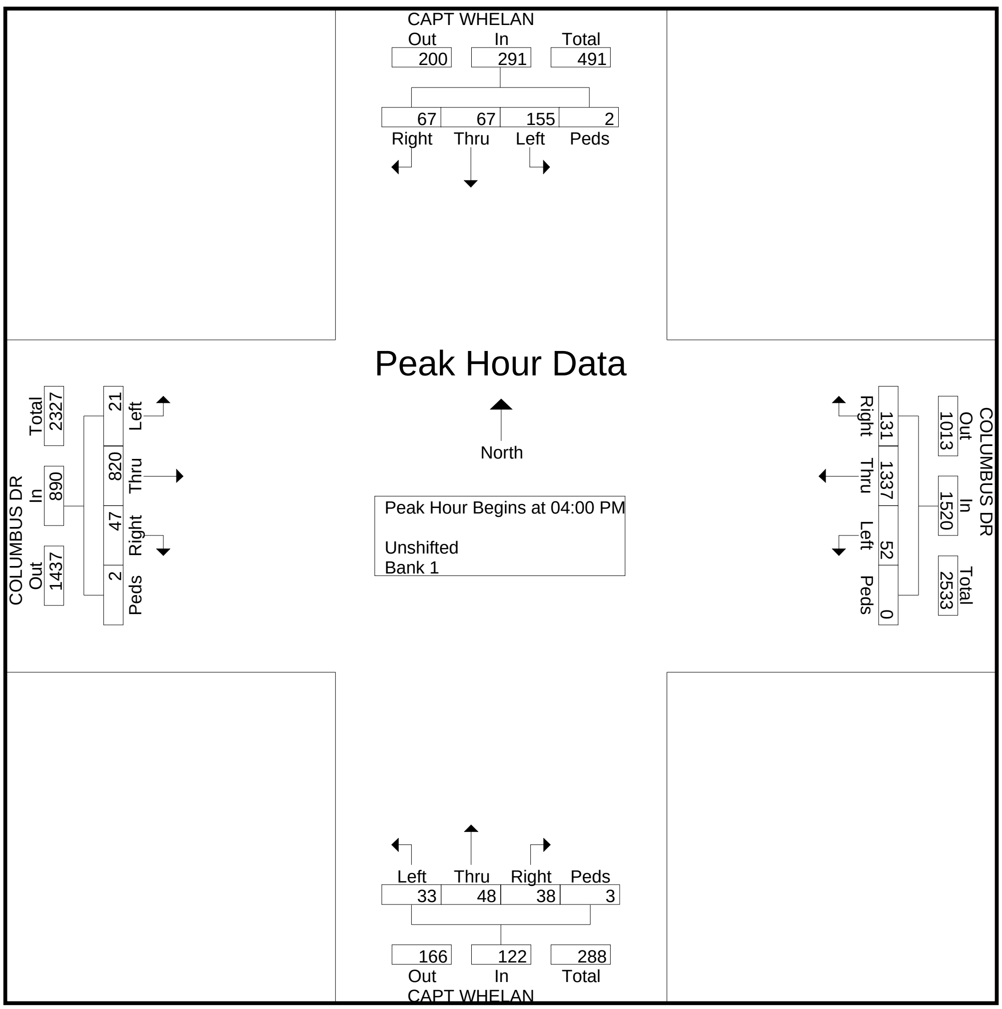
City Of St. John's

Department of Engineering
Traffic Division

Columbus Dr @ Captain Whelan Dr
Turning Movement Count
April 25 2013

File Name : Columbus @ Capt Whelan 2013
Site Code : 00000000
Start Date : 2013/04/25
Page No : 4

	CAPT WHELAN From North					COLUMBUS DR From East					CAPT WHELAN From South					COLUMBUS DR From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	19	17	44	0	80	24	309	**16**	0	349	9	10	6	**1**	26	**16**	**230**	**6**	**2**	**254**	709
04:15 PM	16	13	32	0	61	34	**359**	12	0	**405**	7	11	9	1	28	8	195	4	0	207	701
04:30 PM	**21**	17	**47**	**1**	**86**	32	332	14	0	378	**12**	**14**	**10**	1	**37**	12	210	5	0	227	**728**
04:45 PM	11	**20**	32	1	64	**41**	337	10	0	388	10	13	8	0	31	11	185	6	0	202	685
Total Volume	67	67	155	2	291	131	1337	52	0	1520	38	48	33	3	122	47	820	21	2	890	2823
% App. Total	23	23	53.3	0.7		8.6	88	3.4	0		31.1	39.3	27	2.5		5.3	92.1	2.4	0.2		
PHF	.798	.838	.824	.500	.846	.799	.931	.813	.000	.938	.792	.857	.825	.750	.824	.734	.891	.875	.250	.876	.969



City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Mundy Pond Rd	File Name : Not Named 1
Turning Movement Count	Site Code : 00000000
April 17 2013	Start Date : 2013/04/17
Power outage 7:00 - 7:34	Page No : 1

Groups Printed- Unshifted

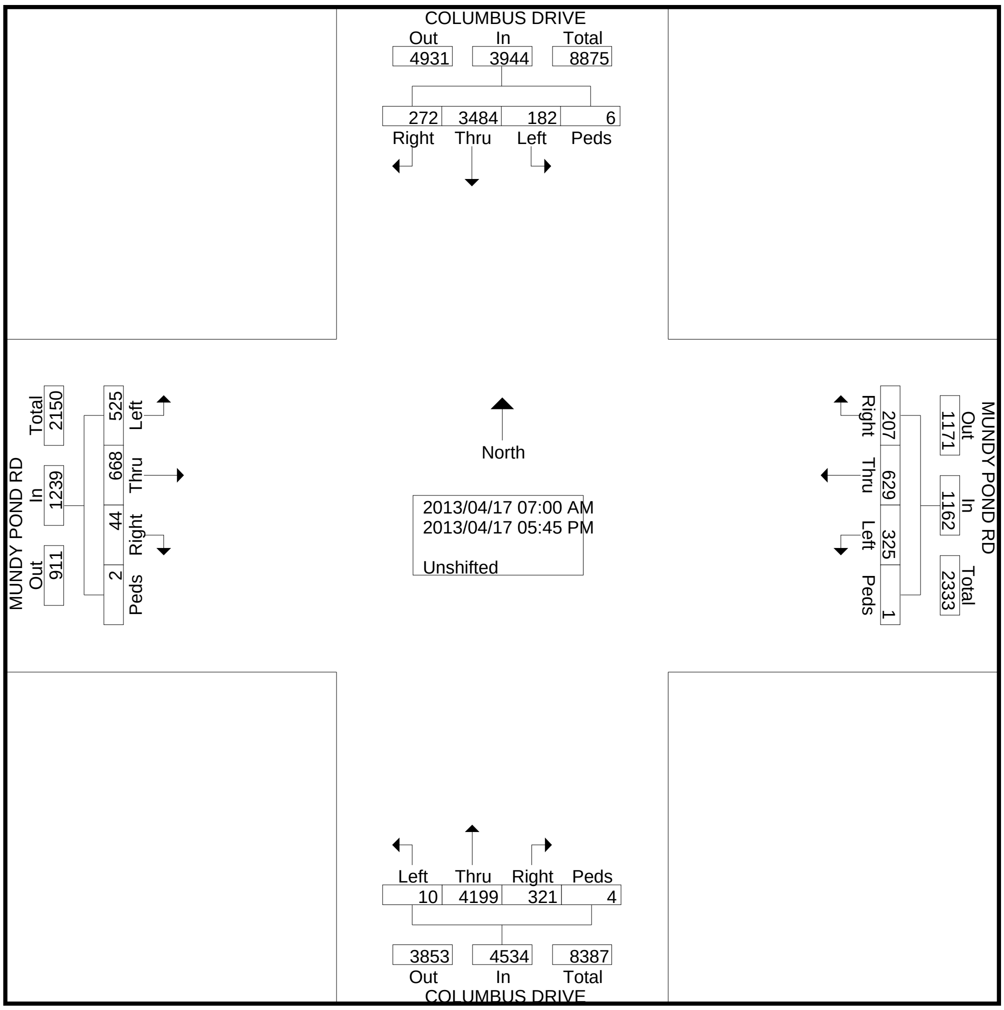
	COLUMBUS DRIVE Southbound				**MUNDY POND RD Westbound**				**COLUMBUS DRIVE Northbound**				**MUNDY POND RD Eastbound**				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	4	68	4	0	0	10	3	0	13	135	0	0	2	20	30	0	289
07:15 AM	2	59	4	0	16	22	8	0	15	171	0	0	2	45	37	0	381
07:30 AM	7	107	7	0	10	18	6	0	15	282	1	0	4	39	46	0	542
07:45 AM	12	160	14	1	7	26	15	0	22	349	1	0	5	60	44	0	716
Total	25	394	29	1	33	76	32	0	65	937	2	0	13	164	157	0	1928
08:00 AM	7	194	10	0	7	30	8	0	26	343	0	1	2	61	55	0	744
08:15 AM	13	195	6	1	19	28	12	0	38	382	0	0	3	76	58	0	831
08:30 AM	7	171	8	0	23	40	12	0	14	347	0	0	2	75	63	0	762
08:45 AM	11	160	12	1	16	25	13	0	23	276	0	1	0	63	45	0	646
Total	38	720	36	2	65	123	45	0	101	1348	0	2	7	275	221	0	2983
04:00 PM	20	160	6	1	21	72	39	0	18	235	0	0	4	20	21	0	617
04:15 PM	34	308	20	0	16	57	27	1	16	237	0	0	2	24	18	0	760
04:30 PM	32	354	11	0	13	64	36	0	22	271	2	0	3	21	17	0	846
04:45 PM	38	363	17	2	13	58	28	0	20	277	2	0	7	35	22	0	882
Total	124	1185	54	3	63	251	130	1	76	1020	4	0	16	100	78	0	3105
05:00 PM	25	357	10	0	14	80	46	0	18	253	0	0	2	41	18	0	864
05:15 PM	20	364	20	0	7	34	32	0	21	229	0	2	2	26	18	0	775
05:30 PM	21	264	21	0	13	27	21	0	23	207	3	0	1	25	18	2	646
05:45 PM	19	200	12	0	12	38	19	0	17	205	1	0	3	37	15	0	578
Total	85	1185	63	0	46	179	118	0	79	894	4	2	8	129	69	2	2863
Grand Total	272	3484	182	6	207	629	325	1	321	4199	10	4	44	668	525	2	10879
Apprch %	6.9	88.3	4.6	0.2	17.8	54.1	28	0.1	7.1	92.6	0.2	0.1	3.6	53.9	42.4	0.2	
Total %	2.5	32	1.7	0.1	1.9	5.8	3	0	3	38.6	0.1	0	0.4	6.1	4.8	0	

City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Mundy Pond Rd
Turning Movement Count
April 17 2013
Power outage 7:00 - 7:34

File Name : Not Named 1
Site Code : 00000000
Start Date : 2013/04/17
Page No : 2



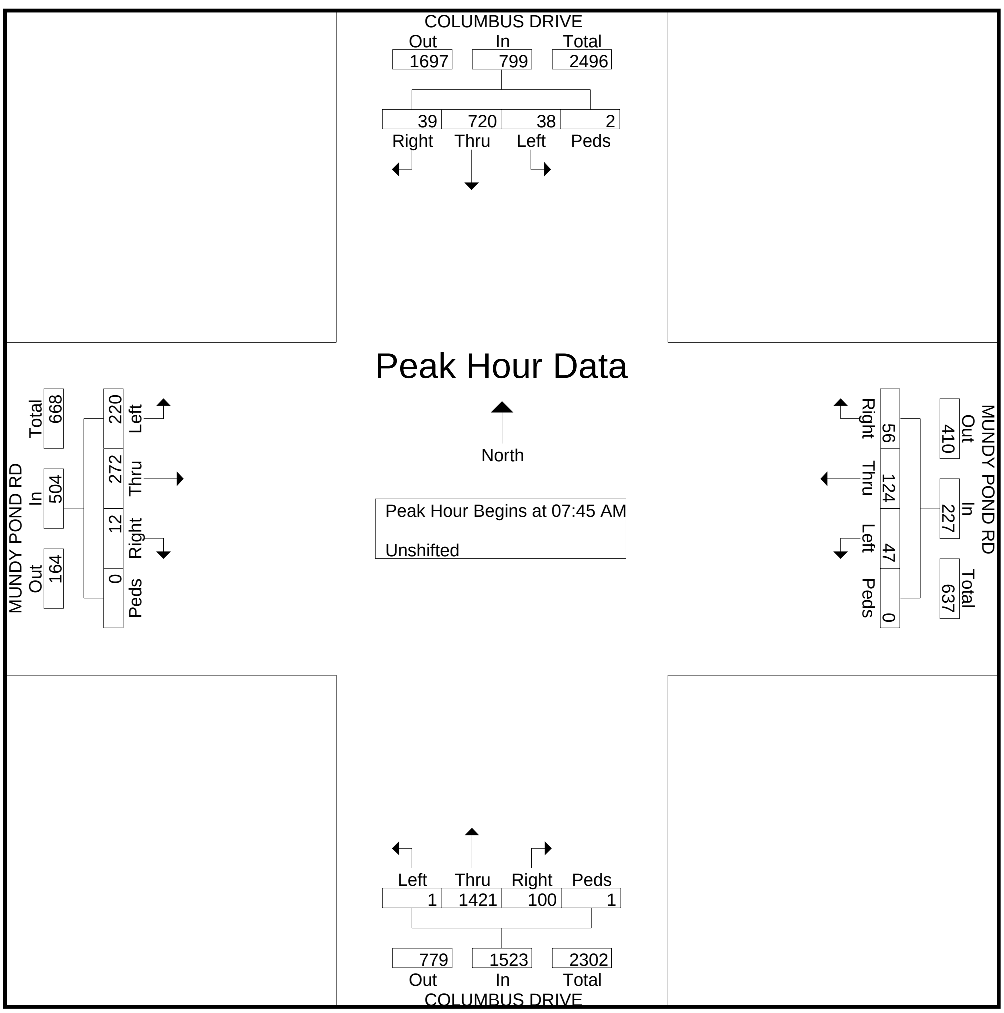
City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Mundy Pond Rd
Turning Movement Count
April 17 2013
Power outage 7:00 - 7:34

File Name : Not Named 1
Site Code : 00000000
Start Date : 2013/04/17
Page No : 3

	COLUMBUS DRIVE Southbound					**MUNDY POND RD Westbound**					**COLUMBUS DRIVE Northbound**					**MUNDY POND RD Eastbound**					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	12	160	**14**	**1**	187	7	26	**15**	0	48	22	349	**1**	0	372	**5**	60	44	0	109	716
08:00 AM	7	194	10	0	211	7	30	8	0	45	26	343	0	**1**	370	2	61	55	0	118	744
08:15 AM	**13**	**195**	6	1	**215**	19	28	12	0	59	**38**	**382**	0	0	**420**	3	**76**	58	0	137	**831**
08:30 AM	7	171	8	0	186	**23**	**40**	12	0	**75**	14	347	0	0	361	2	75	**63**	0	**140**	762
Total Volume	39	720	38	2	799	56	124	47	0	227	100	1421	1	1	1523	12	272	220	0	504	3053
% App. Total	4.9	90.1	4.8	0.3		24.7	54.6	20.7	0		6.6	93.3	0.1	0.1		2.4	54	43.7	0		
PHF	.750	.923	.679	.500	.929	.609	.775	.783	.000	.757	.658	.930	.250	.250	.907	.600	.895	.873	.000	.900	.918



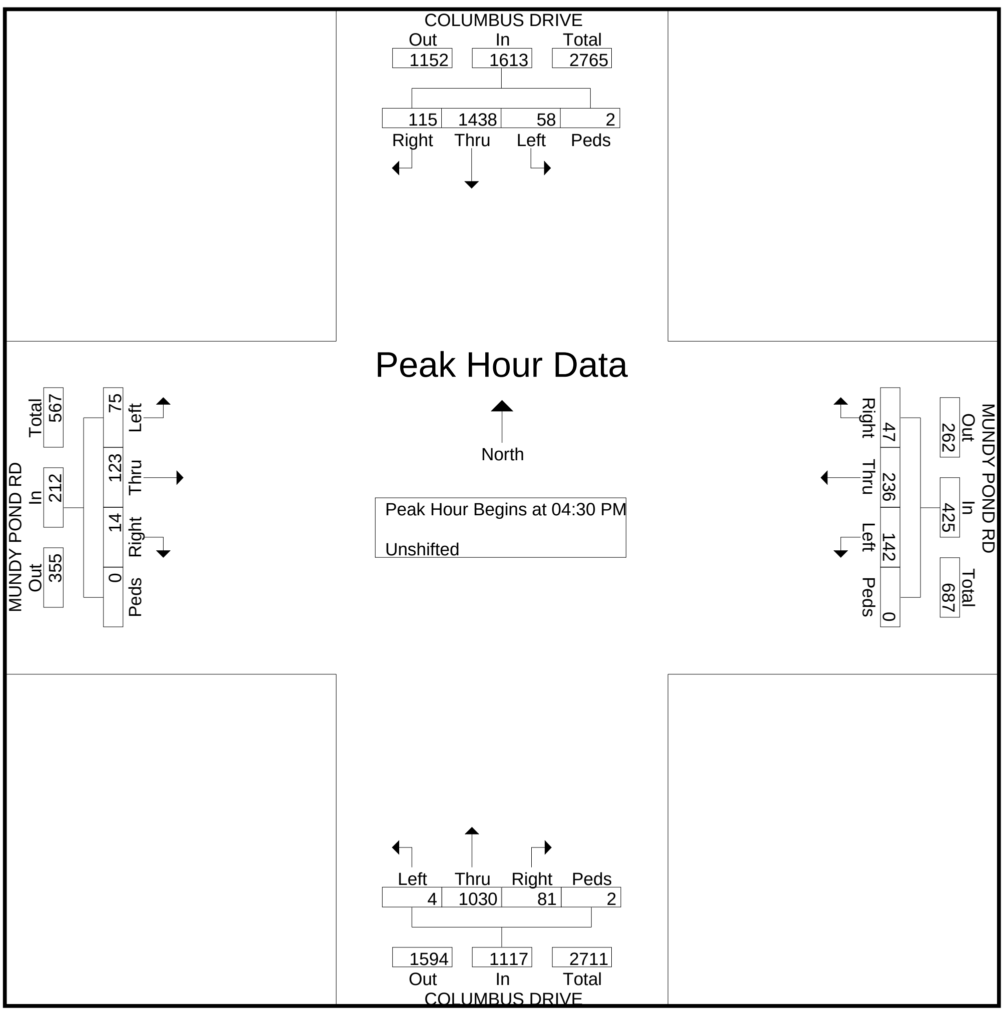
City of St. John's

Department of Engineering
Traffic division

Columbus Dr @ Mundy Pond Rd
Turning Movement Count
April 17 2013
Power outage 7:00 - 7:34

File Name : Not Named 1
Site Code : 00000000
Start Date : 2013/04/17

	COLUMBUS DRIVE Southbound					MUNDY POND RD Westbound					COLUMBUS DRIVE Northbound					MUNDY POND RD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	32	354	11	0	397	13	64	36	0	113	**22**	271	**2**	0	295	3	21	17	0	41	846
04:45 PM	**38**	363	17	**2**	**420**	13	58	28	0	99	20	**277**	2	0	**299**	**7**	35	**22**	0	**64**	**882**
05:00 PM	25	357	10	0	392	**14**	**80**	**46**	0	**140**	18	253	0	0	271	2	**41**	18	0	61	864
05:15 PM	20	**364**	**20**	0	404	7	34	32	0	73	21	229	0	**2**	252	2	26	18	0	46	775
Total Volume	115	1438	58	2	1613	47	236	142	0	425	81	1030	4	2	1117	14	123	75	0	212	3367
% App. Total	7.1	89.2	3.6	0.1		11.1	55.5	33.4	0		7.3	92.2	0.4	0.2		6.6	58	35.4	0		
PHF	.757	.988	.725	.250	.960	.839	.738	.772	.000	.759	.920	.930	.500	.250	.934	.500	.750	.852	.000	.828	.954



City of St. John's

Department of Engineering
Traffic division

Columbus Drive @ Thorburn Rd
March 14, 2013
Turning Movement Count

File Name : Columbus Dr @ Thorburn Road March 14 2013
Site Code : 00000000
Start Date : 2013/03/14
Page No : 1

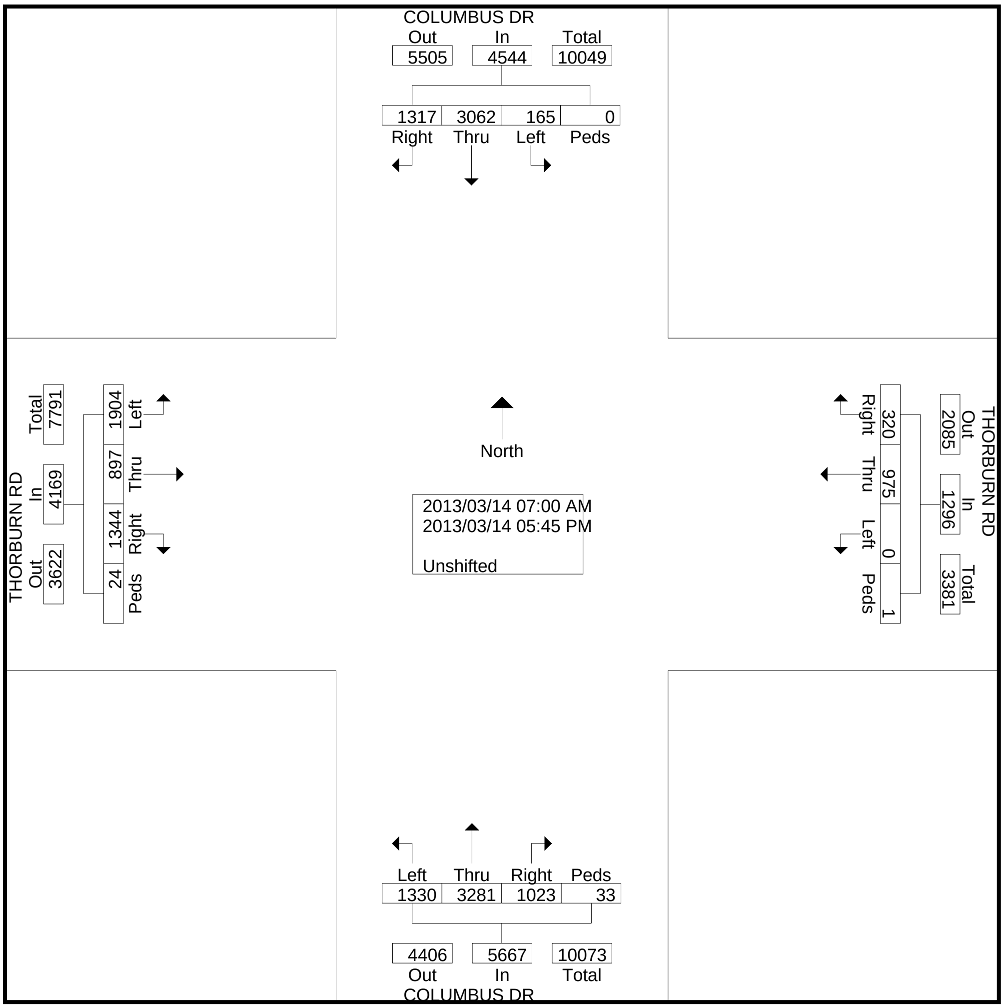
Groups Printed- Unshifted

	COLUMBUS DR Southbound				THORBURN RD Westbound				COLUMBUS DR Northbound				THORBURN RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:00 AM	23	66	1	0	4	11	0	0	24	136	38	0	29	21	105	0	458
07:15 AM	35	84	1	0	12	18	0	0	34	185	38	0	31	24	152	1	615
07:30 AM	53	123	5	0	16	21	0	0	74	232	66	1	50	47	137	0	825
07:45 AM	71	196	14	0	18	38	0	0	89	301	96	1	80	48	134	0	1086
Total	182	469	21	0	50	88	0	0	221	854	238	2	190	140	528	1	2984
08:00 AM	46	156	11	0	18	42	0	1	56	288	100	3	91	85	136	0	1033
08:15 AM	48	133	12	0	18	61	0	0	86	327	108	2	77	90	130	0	1092
08:30 AM	56	145	11	0	15	69	0	0	75	318	97	2	76	77	158	1	1100
08:45 AM	51	143	9	0	22	57	0	0	84	266	99	0	63	63	124	1	982
Total	201	577	43	0	73	229	0	1	301	1199	404	7	307	315	548	2	4207
*** BREAK ***																	
04:00 PM	66	145	13	0	27	89	0	0	61	133	87	1	135	74	121	1	953
04:15 PM	162	294	19	0	34	89	0	0	69	148	75	3	96	42	106	3	1140
04:30 PM	137	295	13	0	26	106	0	0	64	192	78	5	142	68	114	0	1240
04:45 PM	128	285	11	0	30	84	0	0	76	159	96	5	113	60	119	1	1167
Total	493	1019	56	0	117	368	0	0	270	632	336	14	486	244	460	5	4500
05:00 PM	144	307	11	0	34	78	0	0	70	175	84	3	128	74	99	13	1220
05:15 PM	110	270	15	0	19	84	0	0	50	165	103	2	95	42	96	0	1051
05:30 PM	108	243	12	0	9	61	0	0	54	129	84	2	72	45	83	1	903
05:45 PM	79	177	7	0	18	67	0	0	57	127	81	3	66	37	90	2	811
Total	441	997	45	0	80	290	0	0	231	596	352	10	361	198	368	16	3985
Grand Total	1317	3062	165	0	320	975	0	1	1023	3281	1330	33	1344	897	1904	24	15676
Apprch %	29	67.4	3.6	0	24.7	75.2	0	0.1	18.1	57.9	23.5	0.6	32.2	21.5	45.7	0.6	
Total %	8.4	19.5	1.1	0	2	6.2	0	0	6.5	20.9	8.5	0.2	8.6	5.7	12.1	0.2	

City of St. John's
Department of Engineering
Traffic division

Columbus Drive @ Thorburn Rd
March 14, 2013
Turning Movement Count

File Name : Columbus Dr @ Thorburn Road March 14 2013
Site Code : 00000000
Start Date : 2013/03/14
Page No : 2



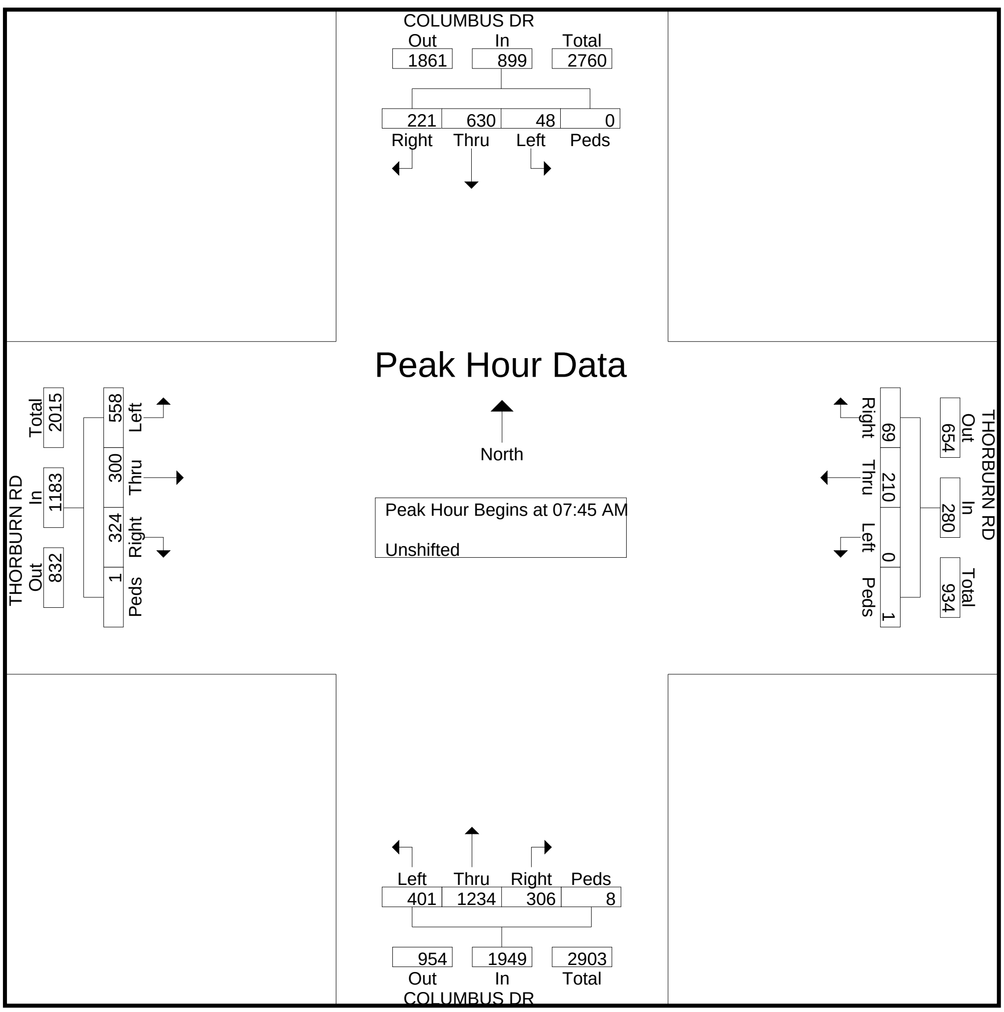
City of St. John's

Department of Engineering
Traffic division

Columbus Drive @ Thorburn Rd
March 14, 2013
Turning Movement Count

File Name : Columbus Dr @ Thorburn Road March 14 2013
Site Code : 00000000
Start Date : 2013/03/14
Page No : 3

	COLUMBUS DR Southbound					THORBURN RD Westbound					COLUMBUS DR Northbound					THORBURN RD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	**71**	**196**	**14**		**281**	**18**	38	0	0	56	**89**										
08:00 AM	46	156	11	0	213	18	**42**	**0**	**1**	61	56	288	100	**3**	447	**91**	**85**	**136**	**0**	**312**	1033
08:15 AM	48	133	12	0	193	18	61	0	0	79	86	**327**	**108**	2	**523**	77	**90**	130	0	297	1092
08:30 AM	56	145	11	0	212	15	**69**			**84**	75	318	97	2	492	76	77	**158**	**1**		**1100**
Total Volume	221	630	48	0	899	69	210	0	1	280	306	1234	401	8	1949	324	300	558	1	1183	4311
% App. Total																					
PHF	.778	.804	.857	.000	.800	.958	.761	.000	.250	.833	.860	.943	.928	.667	.932	.890	.833	.883	.250	.948	.980



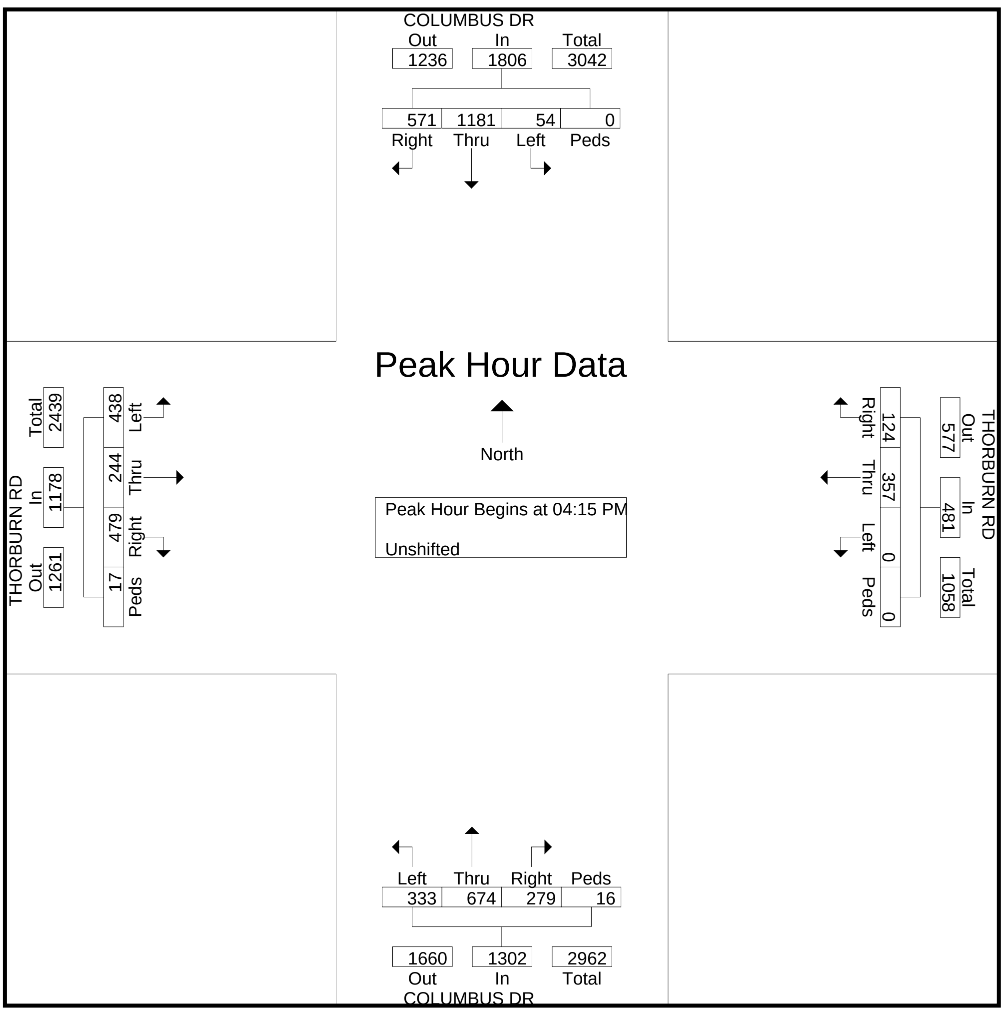
City of St. John's

Department of Engineering
Traffic division

Columbus Drive @ Thorburn Rd
March 14, 2013
Turning Movement Count

File Name : Columbus Dr @ Thorburn Road March 14 2013
Site Code : 00000000
Start Date : 2013/03/14
Page No : 4

	COLUMBUS DR Southbound					**THORBURN RD Westbound**					**COLUMBUS DR Northbound**					**THORBURN RD Eastbound**					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	**162**		**19**		**475**	**34**	89	0	0	123	69	148	75	3	295	96	42	106	3	247	1140
04:30 PM	137	295	13	0	445	26	**106**			**132**	64	**192**		**5**	**339**	**142**				**324**	**1240**
04:45 PM	128	285	11	0	424	30	84	0	0	114	**76**		**96**	5	336	113	60	**119**			
05:00 PM	**144**	**307**	11	0	462	34	78	0	0	112	70	175	84	3	332	128	**74**	99	**13**	**314**	**1220**
Total Volume	571	1181	54	0	1806	124	357	0	0	481	279	674	333	16	1302	479	244	438	17	1178	4767
% App. Total	31.6	65.4	3	0		25.8	74.2	0	0		21.4	51.8	25.6	1.2		40.7	20.7	37.2	1.4		
PHF	.881	.962	.711	.000	.951	.912	.842	.000	.000	.911	.918	.878	.867	.800	.960	.843	.824	.920	.327	.909	.961



City Of St. John's

Department of Public Works
Traffic Division

Columbus Dr @ Old Pennywell Rd
Turning Movement Count
April 11 2013

File Name : Columbus @ Empire Pennywell 2013
Site Code : 00000000
Start Date : 2013/04/11
Page No : 1

Groups Printed- Unshifted

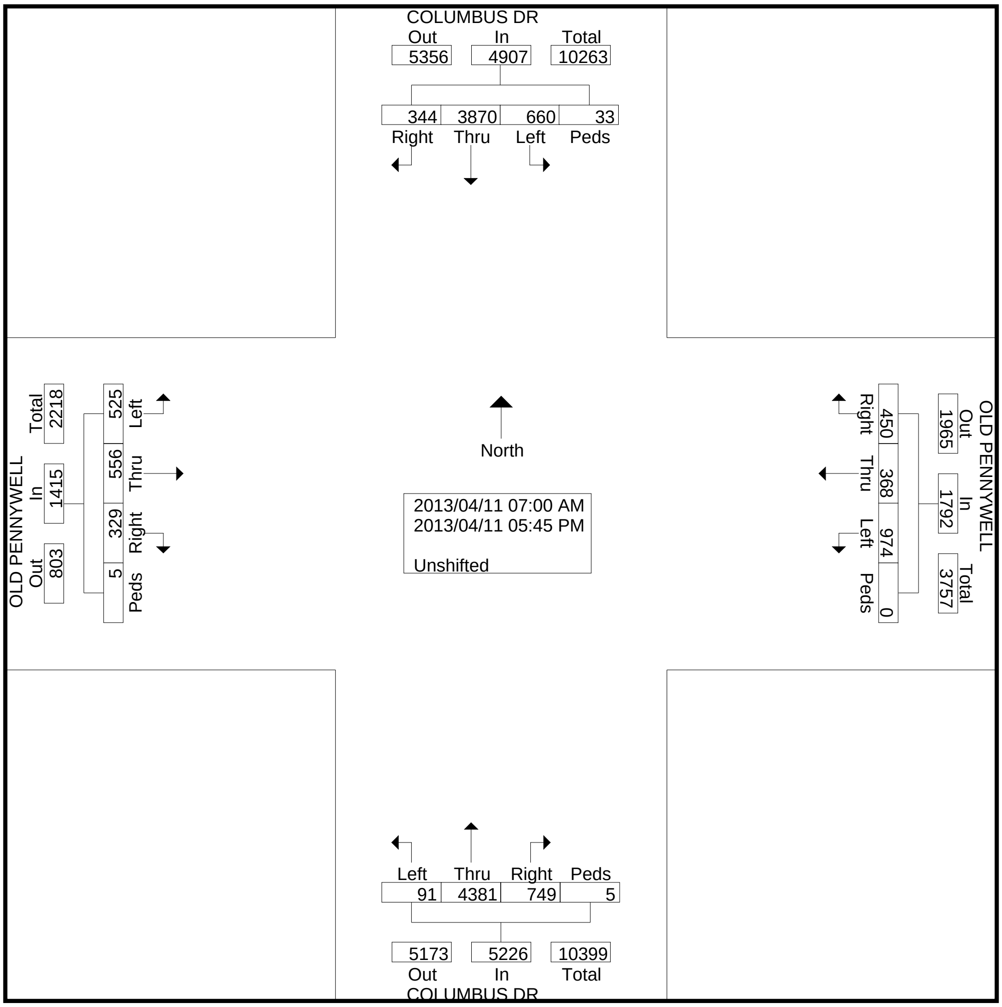
	COLUMBUS DR From North				OLD PENNYWELL From East				COLUMBUS DR From South				OLD PENNYWELL From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	5	78	18	0	10	6	6	0	28	166	4	0	7	23	26	0	377
07:15 AM	6	138	21	0	9	2	8	0	21	145	8	0	6	25	23	0	412
07:30 AM	5	147	23	3	38	8	19	0	34	313	1	0	7	29	31	1	659
07:45 AM	15	173	37	1	30	6	30	0	65	371	3	0	14	40	48	0	833
Total	31	536	99	4	87	22	63	0	148	995	16	0	34	117	128	1	2281
08:00 AM	12	176	41	2	33	12	40	0	51	391	3	0	6	40	43	0	850
08:15 AM	7	212	48	6	35	11	46	0	83	418	2	1	9	52	46	1	977
08:30 AM	9	148	40	3	32	11	39	0	75	377	2	0	5	42	44	2	829
08:45 AM	7	177	47	2	25	4	33	0	51	334	5	0	10	31	29	1	756
Total	35	713	176	13	125	38	158	0	260	1520	12	1	30	165	162	4	3412
04:00 PM	44	367	44	2	29	36	90	0	47	235	8	0	28	44	29	0	1003
04:15 PM	27	326	45	0	33	54	105	0	46	249	5	0	18	27	28	0	963
04:30 PM	39	366	55	0	42	53	132	0	51	214	10	0	45	52	26	0	1085
04:45 PM	53	374	48	3	24	43	94	0	40	259	11	0	47	39	39	0	1074
Total	163	1433	192	5	128	186	421	0	184	957	34	0	138	162	122	0	4125
05:00 PM	46	392	60	1	27	40	117	0	35	260	3	1	52	27	23	0	1084
05:15 PM	26	325	51	6	21	25	79	0	45	250	11	3	30	24	29	0	925
05:30 PM	27	265	50	2	28	31	81	0	42	197	9	0	24	31	29	0	816
05:45 PM	16	206	32	2	34	26	55	0	35	202	6	0	21	30	32	0	697
Total	115	1188	193	11	110	122	332	0	157	909	29	4	127	112	113	0	3522
Grand Total	344	3870	660	33	450	368	974	0	749	4381	91	5	329	556	525	5	13340
Apprch %	7	78.9	13.5	0.7	25.1	20.5	54.4	0	14.3	83.8	1.7	0.1	23.3	39.3	37.1	0.4	
Total %	2.6	29	4.9	0.2	3.4	2.8	7.3	0	5.6	32.8	0.7	0	2.5	4.2	3.9	0	

City Of St. John's

Department of Public Works
Traffic Division

Columbus Dr @ Old Pennywell Rd
Turning Movement Count
April 11 2013

File Name : Columbus @ Empire Pennywell 2013
Site Code : 00000000
Start Date : 2013/04/11
Page No : 2



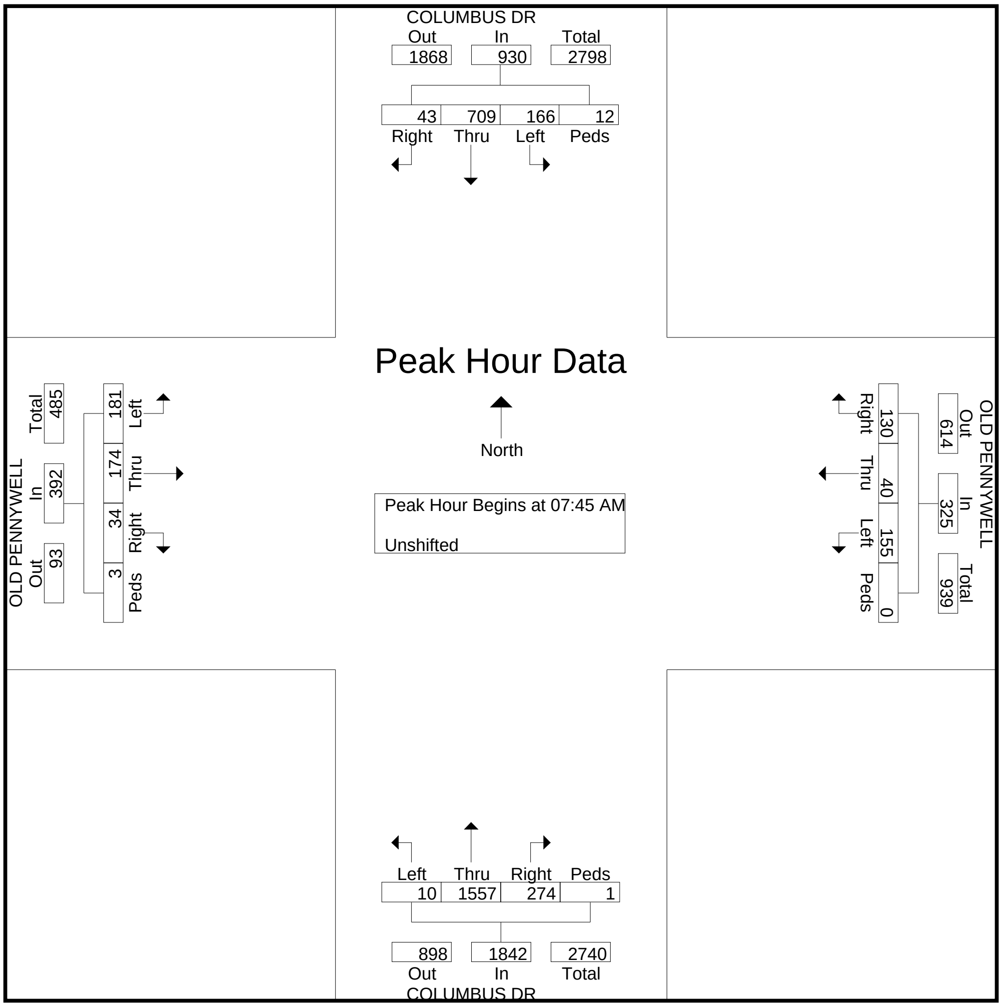
City Of St. John's

Department of Public Works
Traffic Division

Columbus Dr @ Old Pennywell Rd
Turning Movement Count
April 11 2013

File Name : Columbus @ Empire Pennywell 2013
Site Code : 00000000
Start Date : 2013/04/11

	COLUMBUS DR From North					OLD PENNYWELL From East					COLUMBUS DR From South					OLD PENNYWELL From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	**15**	173	37	1	226	30	6	30	0	66	65	371	**3**	0	439	**14**	40	**48**	0	102	833
08:00 AM	12	176	41	2	231	33	**12**	40	0	85	51	391	3	0	445	6	40	43	0	89	850
08:15 AM	7	**212**	**48**	**6**	**273**	**35**	11	**46**	0	**92**	**83**	**418**	2	**1**	**504**	9	**52**	46	1	**108**	**977**
08:30 AM	9	148	40	3	200	32	11	39	0	82	75	377	2	0	454	5	42	44	**2**	93	829
Total Volume	43	709	166	12	930	130	40	155	0	325	274	1557	10	1	1842	34	174	181	3	392	3489
% App. Total	4.6	76.2	17.8	1.3		40	12.3	47.7	0		14.9	84.5	0.5	0.1		8.7	44.4	46.2	0.8		
PHF	.717	.836	.865	.500	.852	.929	.833	.842	.000	.883	.825	.931	.833	.250	.914	.607	.837	.943	.375	.907	.893



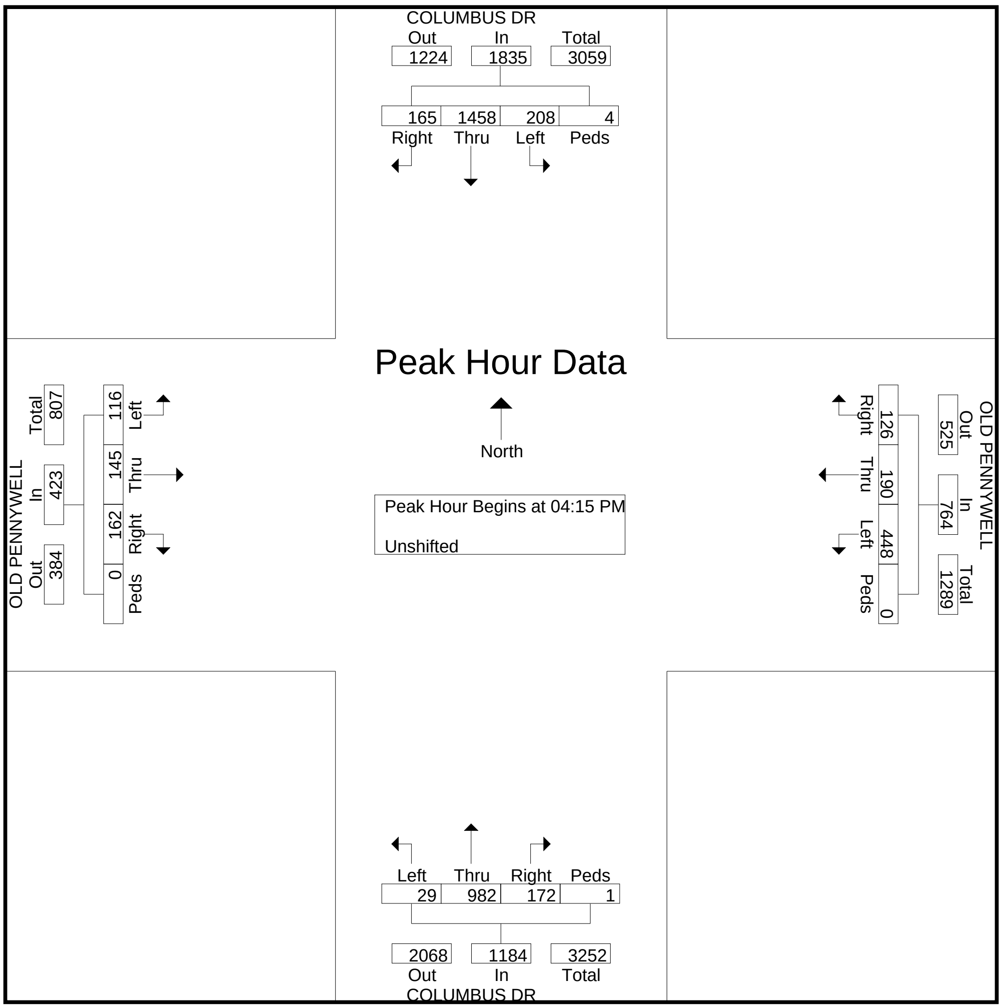
City Of St. John's

Department of Public Works
Traffic Division

Columbus Dr @ Old Pennywell Rd
Turning Movement Count
April 11 2013

File Name : Columbus @ Empire Pennywell 2013
Site Code : 00000000
Start Date : 2013/04/11
Page No : 4

	COLUMBUS DR From North					OLD PENNYWELL From East					COLUMBUS DR From South					OLD PENNYWELL From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	27	326	45	0	398	33	**54**	105	0	192	46	249	5	0	300	18	27	28	0	73	963
04:30 PM	39	366	55	0	460	**42**	53	**132**	0	**227**	**51**	214	10	0	275	45	**52**	26	0	123	**1085**
04:45 PM	**53**	374	48	**3**	478	24	43	94	0	161	40	259	**11**	0	**310**	47	39	**39**	0	**125**	1074
05:00 PM	46	**392**	**60**	1	**499**	27	40	117	0	184	35	**260**	3	**1**	299	**52**	27	23	0	102	1084
Total Volume	165	1458	208	4	1835	126	190	448	0	764	172	982	29	1	1184	162	145	116	0	423	4206
% App. Total	9	79.5	11.3	0.2		16.5	24.9	58.6	0		14.5	82.9	2.4	0.1		38.3	34.3	27.4	0		
PHF	.778	.930	.867	.333	.919	.750	.880	.848	.000	.841	.843	.944	.659	.250	.955	.779	.697	.744	.000	.846	.969



City of St. John's

Department of Engineering
Traffic division

Kenmount Road @ Avalon Mall
October 16, 2012
Turning Movement Count

File Name : Kenmount @ Avalon Mall 16 Oct 2012
Site Code : 00000000
Start Date : 2012/10/16
Page No : 1

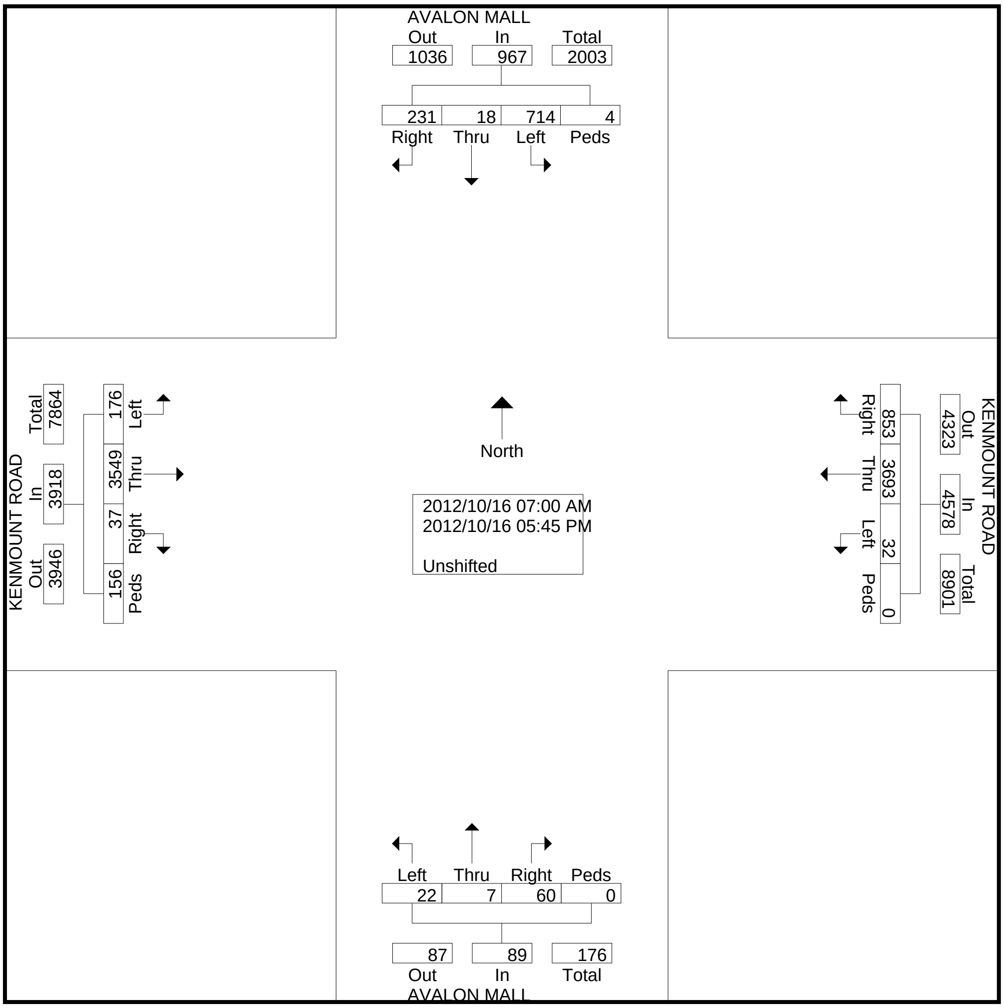
Groups Printed- Unshifted

	AVALON MALL Southbound				KENMOUNT ROAD Westbound				AVALON MALL Northbound				KENMOUNT ROAD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	1	0	5	0	7	89	0	0	0	0	0	0	0	98	2	1	203
07:15 AM	1	0	6	1	16	143	0	0	0	0	0	0	0	115	3	5	290
07:30 AM	0	2	21	0	17	240	1	0	1	0	0	0	1	148	4	6	441
07:45 AM	2	1	22	2	38	271	2	0	3	0	1	0	0	208	3	9	562
Total	4	3	54	3	78	743	3	0	4	0	1	0	1	569	12	21	1496
08:00 AM	3	1	12	1	32	212	1	0	0	0	1	0	1	231	6	0	501
08:15 AM	2	0	21	0	31	279	2	0	1	0	1	0	0	217	7	5	566
08:30 AM	3	1	23	0	43	246	1	0	3	0	2	0	0	247	4	1	574
08:45 AM	6	0	28	0	38	246	2	0	0	0	1	0	2	215	10	7	555
Total	14	2	84	1	144	983	6	0	4	0	5	0	3	910	27	13	2196
BREAK																	
04:00 PM	29	2	74	0	73	253	4	0	9	0	2	0	7	276	20	17	766
04:15 PM	29	2	66	0	72	285	6	0	6	1	4	0	4	263	14	15	767
04:30 PM	40	1	83	0	69	259	1	0	10	1	3	0	3	319	10	13	812
04:45 PM	21	1	80	0	109	250	0	0	5	1	2	0	5	283	19	26	802
Total	119	6	303	0	323	1047	11	0	30	3	11	0	19	1141	63	71	3147
05:00 PM	35	3	87	0	71	247	0	0	5	1	2	0	8	305	20	8	792
05:15 PM	24	2	64	0	93	280	3	0	7	2	2	0	3	229	16	14	739
05:30 PM	16	1	68	0	68	199	4	0	3	1	0	0	0	213	24	21	618
05:45 PM	19	1	54	0	76	194	5	0	7	0	1	0	3	182	14	8	564
Total	94	7	273	0	308	920	12	0	22	4	5	0	14	929	74	51	2713
Grand Total	231	18	714	4	853	3693	32	0	60	7	22	0	37	3549	176	156	9552
Apprch %	23.9	1.9	73.8	0.4	18.6	80.7	0.7	0	67.4	7.9	24.7	0	0.9	90.6	4.5	4	
Total %	2.4	0.2	7.5	0	8.9	38.7	0.3	0	0.6	0.1	0.2	0	0.4	37.2	1.8	1.6	

City of St. John's

Department of Engineering
Traffic division

File Name : Kenmount @ Avalon Mall 16 Oct 2012
Site Code : 00000000
Start Date : 2012/10/16
Page No : 2

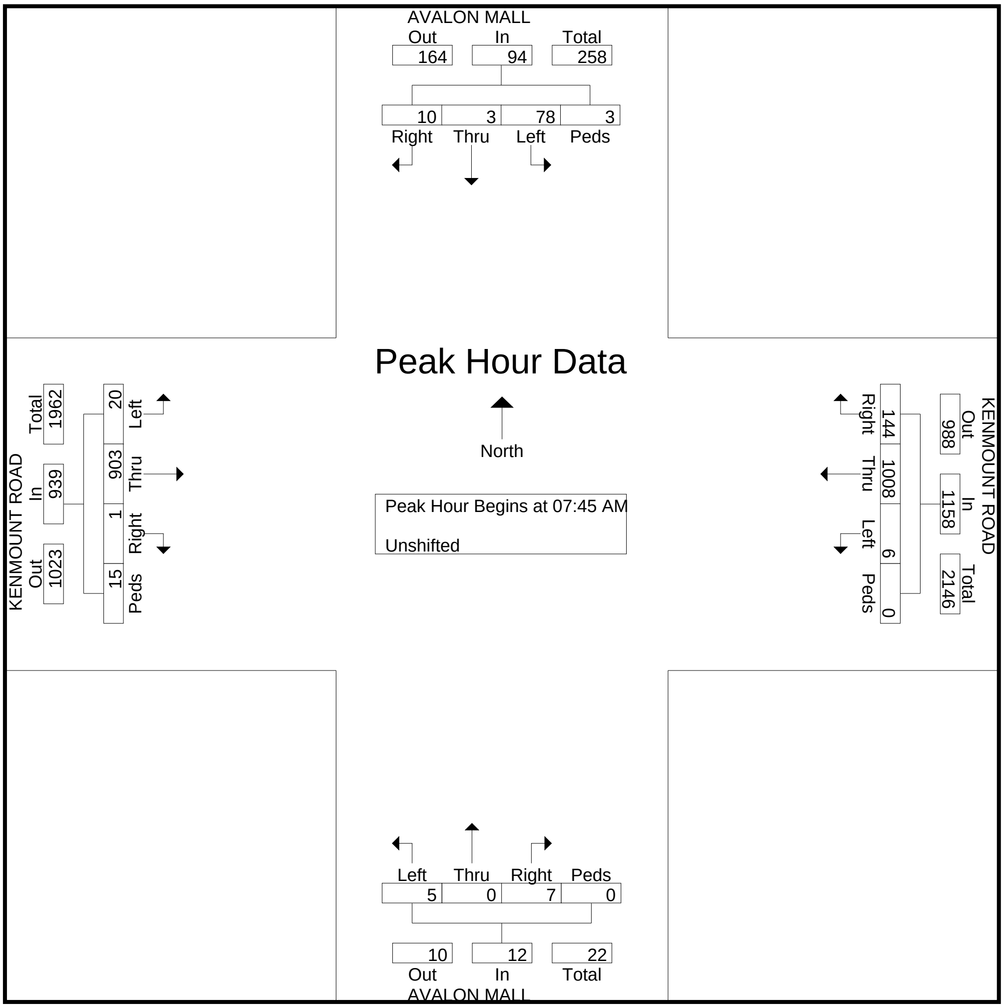


City of St. John's

Department of Engineering
Traffic division

File Name : Kenmount @ Avalon Mall 16 Oct 2012
Site Code : 00000000
Start Date : 2012/10/16
Page No : 3

	AVALON MALL Southbound					KENMOUNT ROAD Westbound					AVALON MALL Northbound					KENMOUNT ROAD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	**2**	1	22	2	27	38	271	2	0	311	**3**	**0**	**1**	**0**	**4**	**0**	**208**	**3**	**9**	220	562
08:00 AM	**3**															**1**	231	6	0	238	501
08:15 AM	2	0	21	0	23	31	**279**			**312**								**7**	5	229	566
08:30 AM	3	1	**23**			**43**	246	1	0	290	3	0	**2**		**5**	0	**247**			**252**	**574**
Total Volume	10	3	78	3	94	144	1008	6	0	1158	7	0	5	0	12	1	903	20	15	939	2203
% App. Total	10.6	3.2	83	3.2		12.4	87	0.5	0		58.3	0	41.7	0		0.1	96.2	2.1	1.6		
PHF	.833	.750	.848	.375	.870	.837	.903	.750	.000	.928	.583	.000	.625	.000	.600	.250	.914	.714	.417	.932	.959

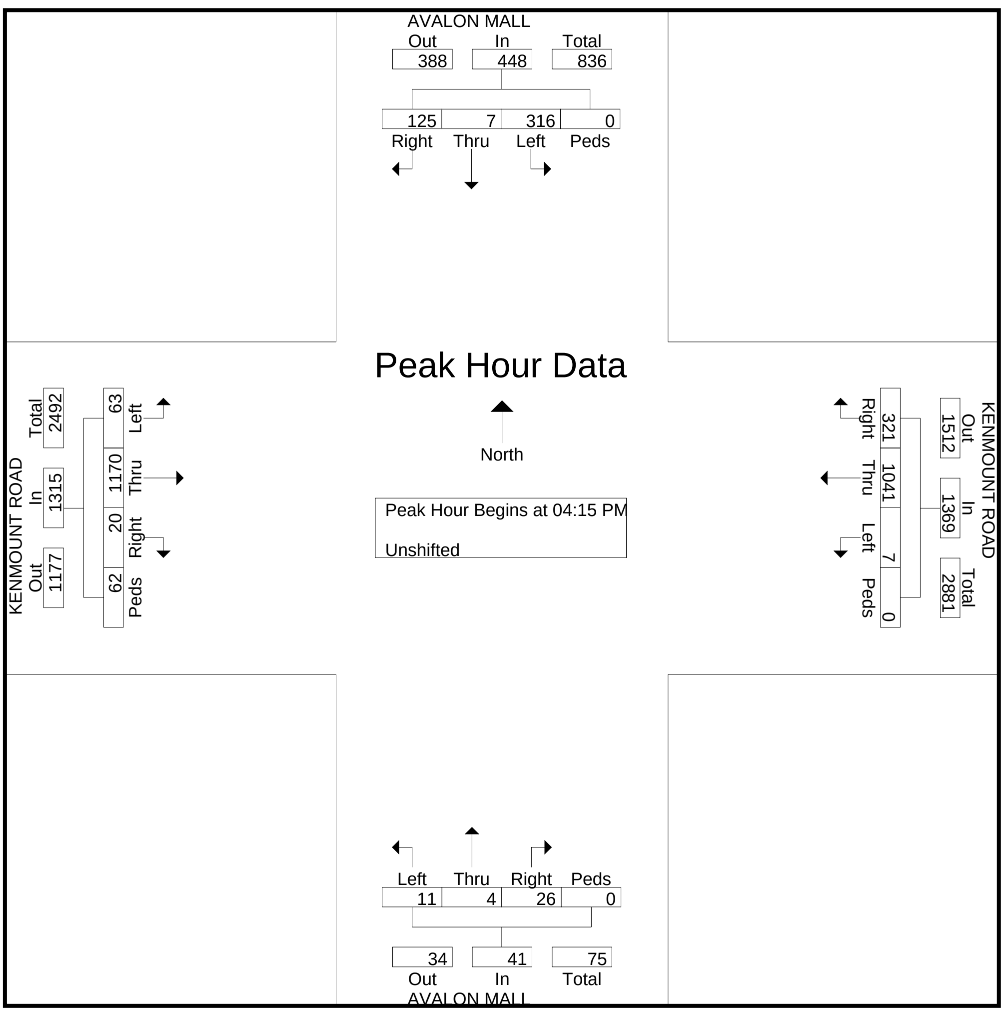


City of St. John's

Department of Engineering
Traffic division

File Name : Kenmount @ Avalon Mall 16 Oct 2012
Site Code : 00000000
Start Date : 2012/10/16
Page No : 4

	AVALON MALL Southbound					KENMOUNT ROAD Westbound					AVALON MALL Northbound					KENMOUNT ROAD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	**29**	**2**	**66**	**0**	**97**	**72**	285	6	0	363	6	1	**4**	**0**	**11**	**4**	**263**	**14**	**15**	**296**	**767**
04:30 PM	**40**										**10**				**14**	3	**319**			**345**	**812**
04:45 PM	**21**	**1**	**80**	**0**	**102**	**109**	250	0	0	359	5	1	2	0	8	5	283	19	**26**	333	802
05:00 PM	35	**3**	**87**		**125**	71	247	0	0	318	5	1	2	0	8	**8**	305	**20**	8	341	792
Total Volume	125	7	316	0	448	321	1041	7	0	1369	26	4	11	0	41	20	1170	63	62	1315	3173
% App. Total	27.9	1.6	70.5	0		23.4	76	0.5	0		63.4	9.8	26.8	0		1.5	89	4.8	4.7		
PHF	.781	.583	.908	.000	.896	.736	.913	.292	.000	.943	.650	1.00	.688	.000	.732	.625	.917	.788	.596	.953	.977



City Of St. John's

Department of Public Works
Traffic Division

Kenmount Road @ Great Eastern Ave
Turn Movement Count
March 2, 2011

File Name : Kenmount @ Great Eastern March 2011
Site Code : 00000000
Start Date : 2011/03/02
Page No : 1

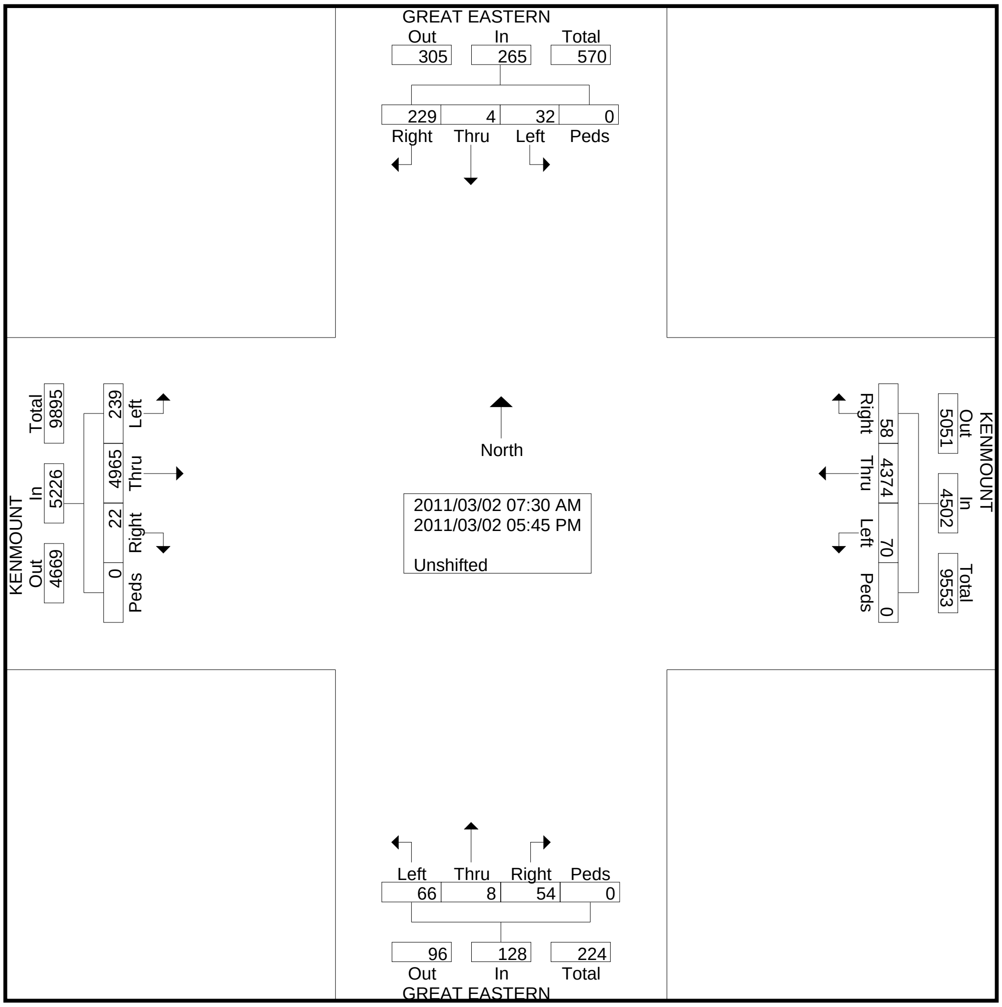
Groups Printed- Unshifted

	GREAT EASTERN From North				KENMOUNT From East				GREAT EASTERN From South				KENMOUNT From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:30 AM	15	2	2	0	9	78	3	0	4	0	2	0	7	391	16	0	529
07:45 AM	21	1	1	0	2	235	9	0	1	0	1	0	4	476	9	0	760
Total	36	3	3	0	11	313	12	0	5	0	3	0	11	867	25	0	1289
08:00 AM	22	0	3	0	4	193	6	0	0	0	1	0	2	484	22	0	737
08:15 AM	23	0	1	0	2	187	9	0	5	0	2	0	0	470	11	0	710
08:30 AM	15	0	4	0	2	207	6	0	0	0	5	0	0	440	21	0	700
08:45 AM	9	0	0	0	2	172	5	0	4	0	1	0	4	319	14	0	530
Total	69	0	8	0	10	759	26	0	9	0	9	0	6	1713	68	0	2677
09:00 AM	12	0	1	0	5	171	4	0	0	0	0	0	1	270	5	0	469
09:15 AM	10	0	2	0	4	186	2	0	2	3	3	0	0	246	7	0	465
Total	22	0	3	0	9	357	6	0	2	3	3	0	1	516	12	0	934
04:00 PM	14	0	4	0	2	402	5	0	4	0	4	0	1	222	21	0	679
04:15 PM	12	1	3	0	5	375	5	0	4	0	6	0	0	232	13	0	656
04:30 PM	11	0	2	0	1	430	3	0	15	1	9	0	1	242	11	0	726
04:45 PM	11	0	1	0	4	421	1	0	2	1	9	0	0	231	18	0	699
Total	48	1	10	0	12	1628	14	0	25	2	28	0	2	927	63	0	2760
05:00 PM	10	0	3	0	5	384	3	0	5	0	10	0	0	263	19	0	702
05:15 PM	11	0	2	0	4	331	5	0	4	3	8	0	1	257	22	0	648
05:30 PM	15	0	1	0	3	318	3	0	4	0	5	0	1	214	16	0	580
05:45 PM	18	0	2	0	4	284	1	0	0	0	0	0	0	208	14	0	531
Total	54	0	8	0	16	1317	12	0	13	3	23	0	2	942	71	0	2461
Grand Total	229	4	32	0	58	4374	70	0	54	8	66	0	22	4965	239	0	10121
Apprch %	86.4	1.5	12.1	0	1.3	97.2	1.6	0	42.2	6.2	51.6	0	0.4	95	4.6	0	
Total %	2.3	0	0.3	0	0.6	43.2	0.7	0	0.5	0.1	0.7	0	0.2	49.1	2.4	0	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Great Eastern March 2011
Site Code : 00000000
Start Date : 2011/03/02
Page No : 2

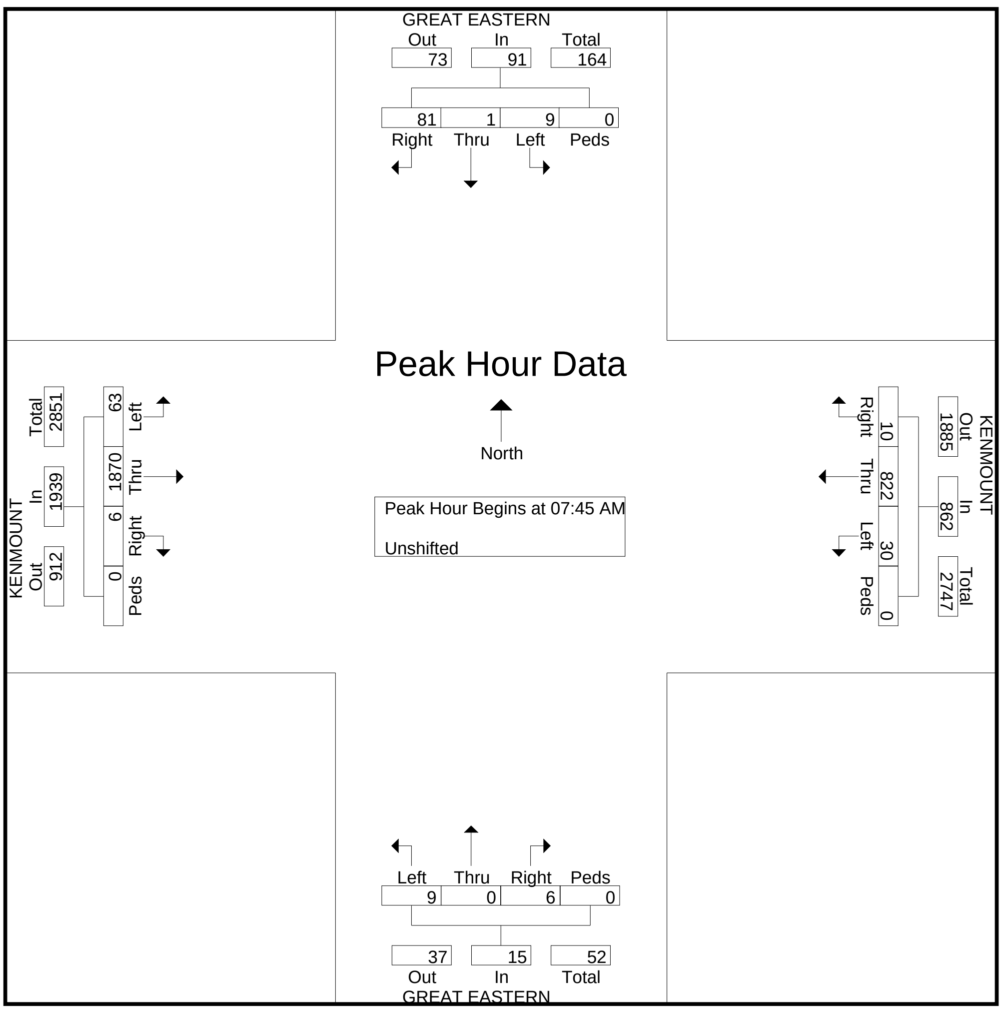


City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Great Eastern March 2011
Site Code : 00000000
Start Date : 2011/03/02

	GREAT EASTERN From North					KENMOUNT From East					GREAT EASTERN From South					KENMOUNT From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	21	**1**	1	0	23	2	**235**	**9**	0	**246**	1	0	1	0	2	**4**	476	9	0	489	**760**
08:00 AM	22	0	3	0	**25**	**4**	193	6	0	203	0	0	1	0	1	2	**484**	**22**	0	**508**	737
08:15 AM	**23**	0	1	0	24	2	187	9	0	198	**5**	0	2	0	**7**	0	470	11	0	481	710
08:30 AM	15	0	**4**	0	19	2	207	6	0	215	0	0	**5**	0	5	0	440	21	0	461	700
Total Volume	81	1	9	0	91	10	822	30	0	862	6	0	9	0	15	6	1870	63	0	1939	2907
% App. Total	89	1.1	9.9	0		1.2	95.4	3.5	0		40	0	60	0		0.3	96.4	3.2	0		
PHF	.880	.250	.563	.000	.910	.625	.874	.833	.000	.876	.300	.000	.450	.000	.536	.375	.966	.716	.000	.954	.956

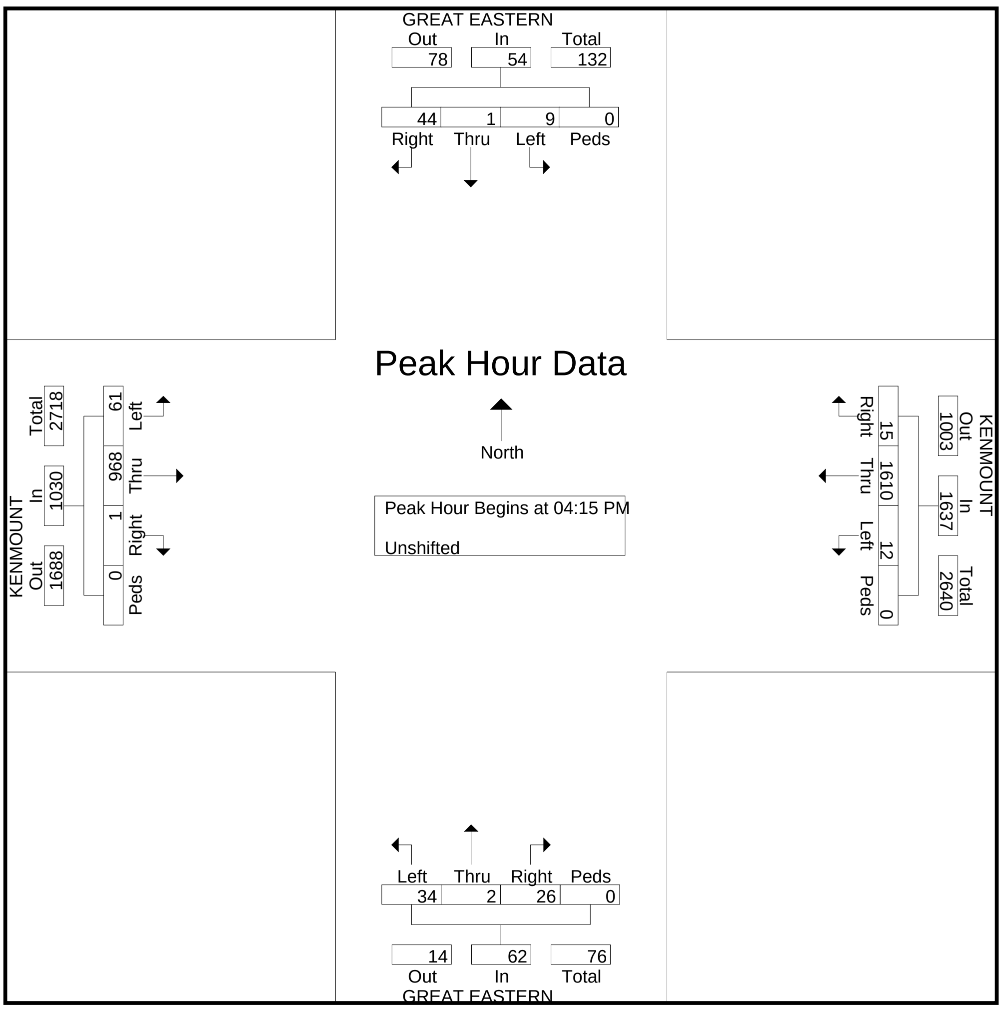


City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Great Eastern March 2011
Site Code : 00000000
Start Date : 2011/03/02
Page No : 4

	GREAT EASTERN From North					KENMOUNT From East					GREAT EASTERN From South					KENMOUNT From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	**12**	**1**	**3**	0	**16**	**5**	375	**5**	0	385	4	0	6	0	10	0	232	13	0	245	656
04:30 PM	11	0	2	0	13	1	**430**	3	0	**434**	**15**	**1**	9	0	**25**	**1**	242	11	0	254	**726**
04:45 PM	11	0	1	0	12	4	421	1	0	426	2	1	9	0	12	0	231	18	0	249	699
05:00 PM	10	0	3	0	13	5	384	3	0	392	5	0	**10**	0	15	0	**263**	**19**	0	**282**	702
Total Volume	44	1	9	0	54	15	1610	12	0	1637	26	2	34	0	62	1	968	61	0	1030	2783
% App. Total	81.5	1.9	16.7	0		0.9	98.4	0.7	0		41.9	3.2	54.8	0		0.1	94	5.9	0		
PHF	.917	.250	.750	.000	.844	.750	.936	.600	.000	.943	.433	.500	.850	.000	.620	.250	.920	.803	.000	.913	.958



City Of St. John's

Department of Public Works
Traffic Division

Kenmount Road @ Kelsey Drive
Turning Movement Count
June 18, 2013

File Name : Not Named 1
Site Code : 00000000
Start Date : 2013/06/18
Page No : 1

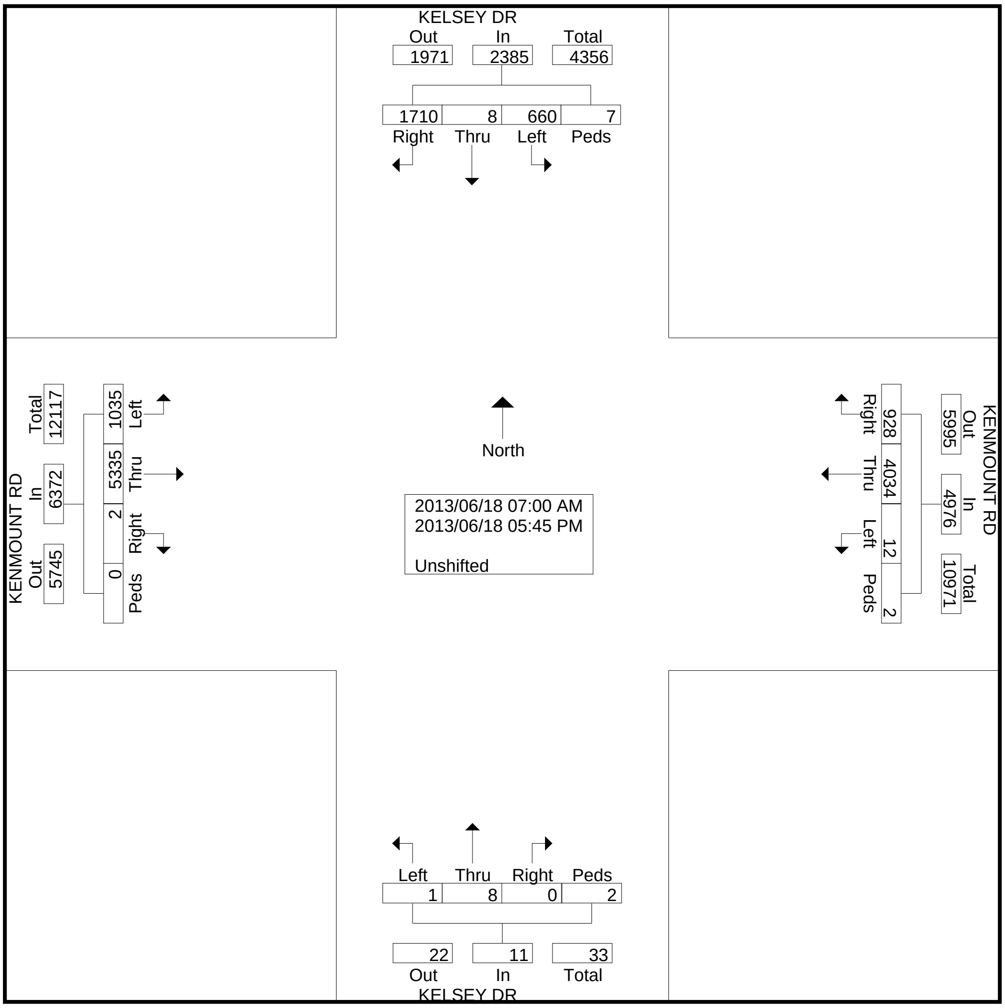
Groups Printed- Unshifted

	KELSEY DR From North				KENMOUNT RD From East				KELSEY DR From South				KENMOUNT RD From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	22	0	12	0	13	82	0	2	0	0	0	0	0	226	23	0	380
07:15 AM	39	0	12	0	10	147	0	0	0	0	0	0	0	269	25	0	502
07:30 AM	82	0	10	1	28	169	0	0	0	0	0	0	1	411	32	0	734
07:45 AM	76	0	15	0	15	242	0	0	0	0	0	0	0	480	57	0	885
Total	219	0	49	1	66	640	0	2	0	0	0	0	1	1386	137	0	2501
08:00 AM	72	0	13	0	35	236	0	0	0	0	0	0	0	448	44	0	848
08:15 AM	69	0	13	0	29	194	0	0	0	0	0	0	0	463	62	0	830
08:30 AM	59	0	33	0	32	203	0	0	0	0	0	0	0	443	50	0	820
08:45 AM	71	1	21	0	33	199	10	0	0	0	0	0	0	375	59	0	769
Total	271	1	80	0	129	832	10	0	0	0	0	0	0	1729	215	0	3267
04:00 PM	163	0	97	0	85	356	0	0	0	8	0	0	0	274	67	0	1050
04:15 PM	179	6	60	0	102	338	2	0	0	0	0	0	1	247	92	0	1027
04:30 PM	153	1	80	2	89	404	0	0	0	0	0	0	0	353	76	0	1158
04:45 PM	184	0	68	2	105	321	0	0	0	0	1	0	0	317	117	0	1115
Total	679	7	305	4	381	1419	2	0	0	8	1	0	1	1191	352	0	4350
05:00 PM	152	0	68	1	98	357	0	0	0	0	0	1	0	317	74	0	1068
05:15 PM	128	0	71	0	85	310	0	0	0	0	0	0	0	244	95	0	933
05:30 PM	148	0	45	1	93	264	0	0	0	0	0	1	0	235	84	0	871
05:45 PM	113	0	42	0	76	212	0	0	0	0	0	0	0	233	78	0	754
Total	541	0	226	2	352	1143	0	0	0	0	0	2	0	1029	331	0	3626
Grand Total	1710	8	660	7	928	4034	12	2	0	8	1	2	2	5335	1035	0	13744
Apprch %	71.7	0.3	27.7	0.3	18.6	81.1	0.2	0	0	72.7	9.1	18.2	0	83.7	16.2	0	
Total %	12.4	0.1	4.8	0.1	6.8	29.4	0.1	0	0	0.1	0	0	0	38.8	7.5	0	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Not Named 1
Site Code : 00000000
Start Date : 2013/06/18
Page No : 2

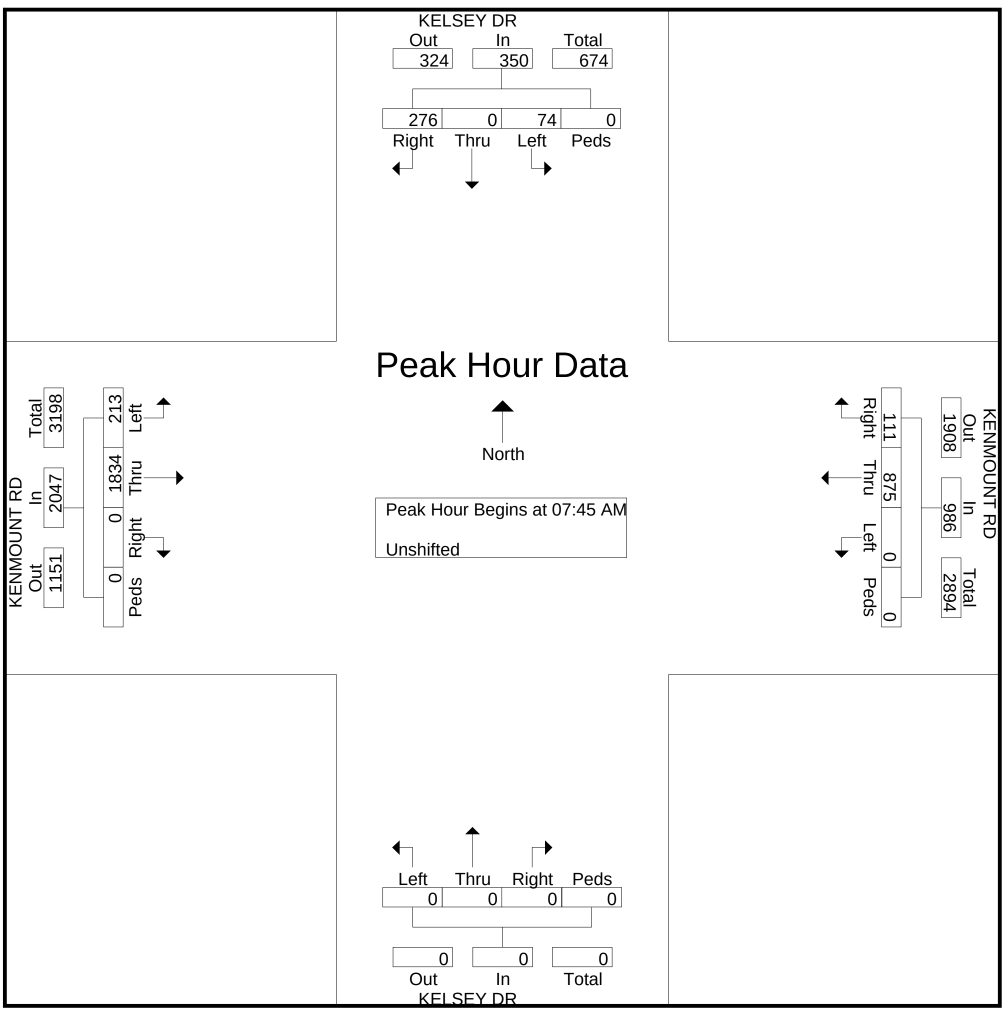


City Of St. John's

Department of Public Works
Traffic Division

File Name : Not Named 1
Site Code : 00000000
Start Date : 2013/06/18

	KELSEY DR From North					KENMOUNT RD From East					KELSEY DR From South					KENMOUNT RD From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	**76**	0	15	0	91	15	**242**	0	0	257	0	0	0	0	0	0	**480**	57	0	**537**	**885**
08:00 AM	72	0	13	0	85	**35**	236	0	0	**271**	0	0	0	0	0	0	448	44	0	492	848
08:15 AM	69	0	13	0	82	29	194	0	0	223	0	0	0	0	0	0	463	**62**	0	525	830
08:30 AM	59	0	**33**	0	**92**	32	203	0	0	235	0	0	0	0	0	0	443	50	0	493	820
Total Volume	276	0	74	0	350	111	875	0	0	986	0	0	0	0	0	0	1834	213	0	2047	3383
% App. Total	78.9	0	21.1	0		11.3	88.7	0	0		0	0	0	0		0	89.6	10.4	0		
PHF	.908	.000	.561	.000	.951	.793	.904	.000	.000	.910	.000	.000	.000	.000	.000	.000	.955	.859	.000	.953	.956

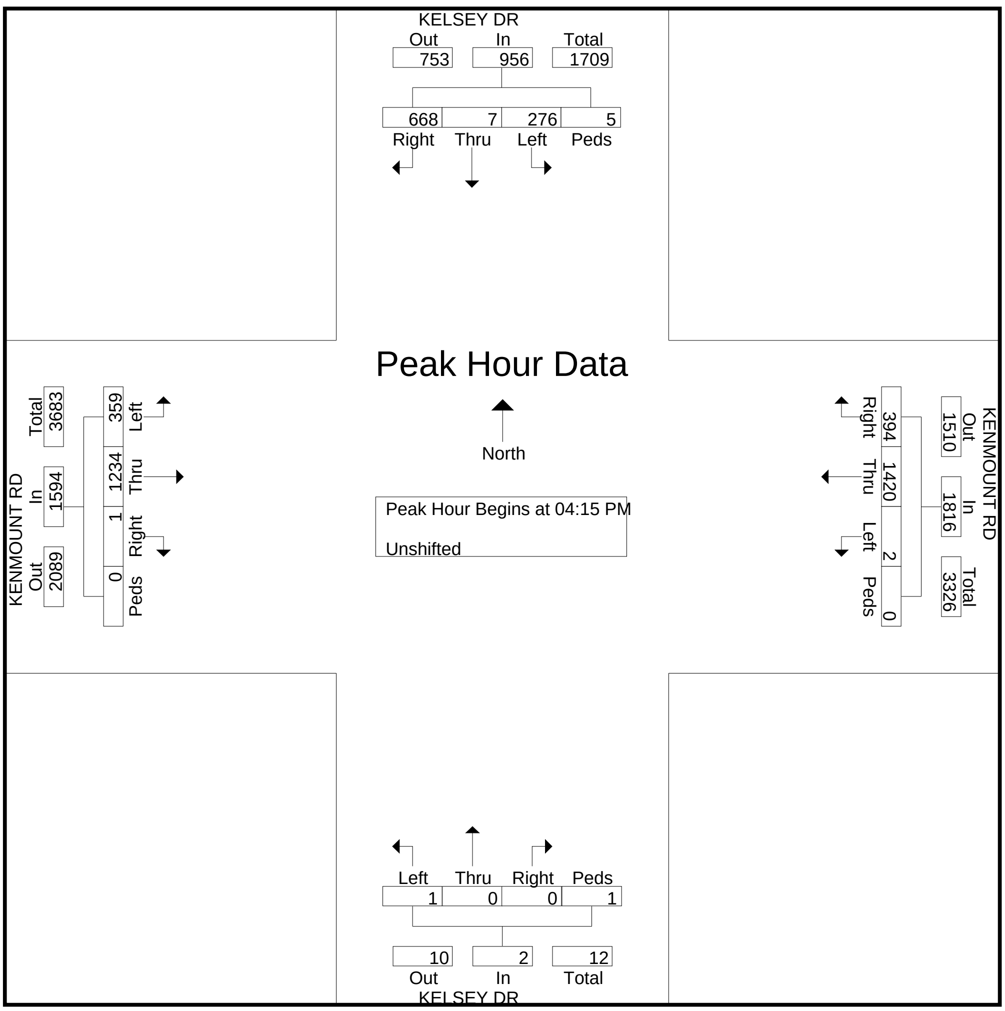


City Of St. John's

Department of Public Works
Traffic Division

File Name : Not Named 1
Site Code : 00000000
Start Date : 2013/06/18
Page No : 4

	KELSEY DR From North					KENMOUNT RD From East					KELSEY DR From South					KENMOUNT RD From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	179	**6**	60	0	245	102	338	**2**	0	442	0	0	0	0	0	**1**	247	92	0	340	1027
04:30 PM	153	1	**80**	**2**	236	89	**404**	0	0	**493**	0	0	0	0	0	0	**353**	76	0	429	**1158**
04:45 PM	**184**	0	68	2	**254**	**105**	321	0	0	426	0	0	**1**	0	**1**	0	317	**117**	0	**434**	1115
05:00 PM	152	0	68	1	221	98	357	0	0	455	0	0	0	**1**	1	0	317	74	0	391	1068
Total Volume	668	7	276	5	956	394	1420	2	0	1816	0	0	1	1	2	1	1234	359	0	1594	4368
% App. Total	69.9	0.7	28.9	0.5		21.7	78.2	0.1	0		0	0	50	50		0.1	77.4	22.5	0		
PHF	.908	.292	.863	.625	.941	.938	.879	.250	.000	.921	.000	.000	.250	.250	.500	.250	.874	.767	.000	.918	.943



City Of St. John's

Department of Public Works
Traffic Division

Kenmount Road @ Lady Smith Drive
Turn Movement Count
March 3, 2011

File Name : Kenmount @ Lady Smith March 3 2011
Site Code : 00000000
Start Date : 2011/03/03
Page No : 1

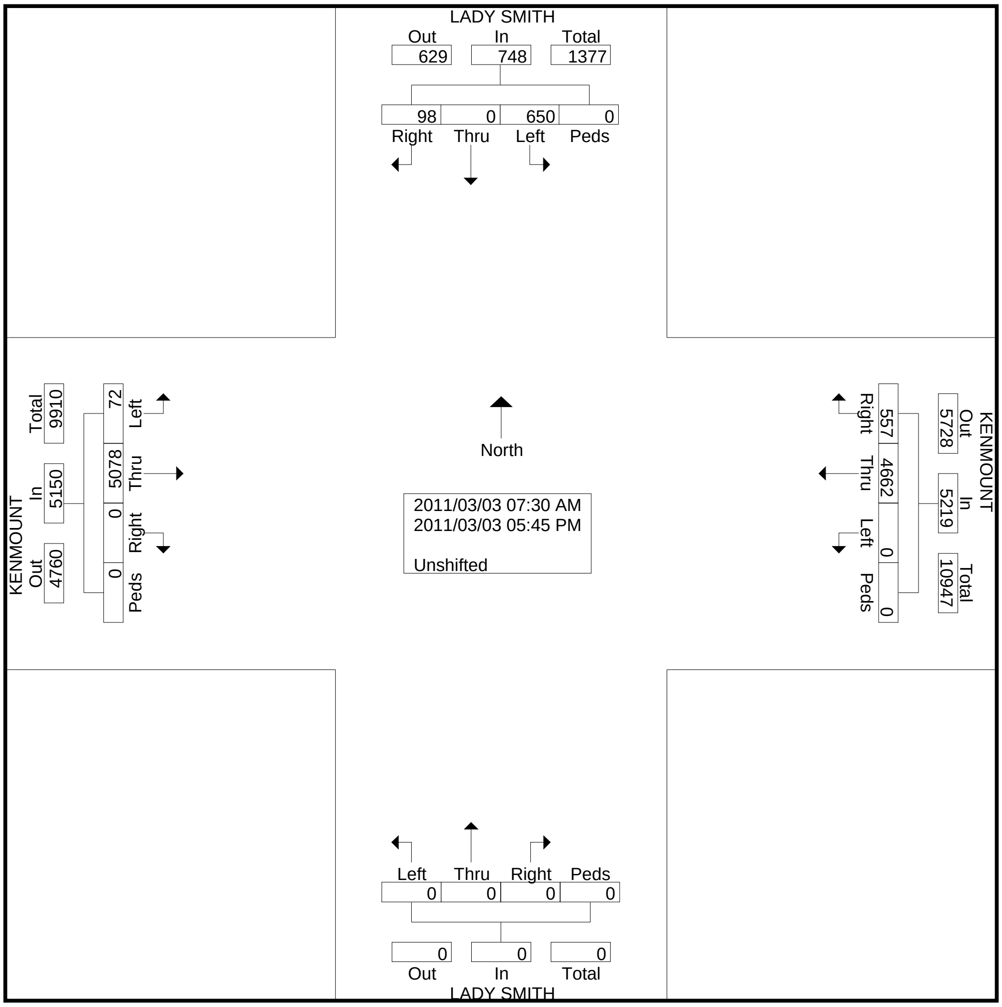
Groups Printed- Unshifted

	LADY SMITH From North				KENMOUNT From East				LADY SMITH From South				KENMOUNT From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:30 AM	6	0	59	0	14	209	0	0	0	0	0	0	0	371	6	0	665
07:45 AM	7	0	70	0	20	251	0	0	0	0	0	0	0	461	1	0	810
Total	13	0	129	0	34	460	0	0	0	0	0	0	0	832	7	0	1475
08:00 AM	5	0	62	0	17	182	0	0	0	0	0	0	0	443	10	0	719
08:15 AM	7	0	61	0	23	223	0	0	0	0	0	0	0	501	3	0	818
08:30 AM	6	0	50	0	17	207	0	0	0	0	0	0	0	374	4	0	658
08:45 AM	4	0	43	0	20	209	0	0	0	0	0	0	0	355	3	0	634
Total	22	0	216	0	77	821	0	0	0	0	0	0	0	1673	20	0	2829
09:00 AM	6	0	26	0	19	178	0	0	0	0	0	0	0	252	5	0	486
09:15 AM	4	0	15	0	13	195	0	0	0	0	0	0	0	235	1	0	463
Total	10	0	41	0	32	373	0	0	0	0	0	0	0	487	6	0	949
04:00 PM	11	0	32	0	43	410	0	0	0	0	0	0	0	256	4	0	756
04:15 PM	5	0	31	0	53	398	0	0	0	0	0	0	0	257	4	0	748
04:30 PM	7	0	27	0	54	455	0	0	0	0	0	0	0	316	3	0	862
04:45 PM	9	0	33	0	57	397	0	0	0	0	0	0	0	295	9	0	800
Total	32	0	123	0	207	1660	0	0	0	0	0	0	0	1124	20	0	3166
05:00 PM	8	0	35	0	62	404	0	0	0	0	0	0	0	327	10	0	846
05:15 PM	5	0	29	0	52	364	0	0	0	0	0	0	0	222	2	0	674
05:30 PM	6	0	49	0	54	319	0	0	0	0	0	0	0	222	2	0	652
05:45 PM	2	0	28	0	39	261	0	0	0	0	0	0	0	191	5	0	526
Total	21	0	141	0	207	1348	0	0	0	0	0	0	0	962	19	0	2698
Grand Total	98	0	650	0	557	4662	0	0	0	0	0	0	0	5078	72	0	11117
Apprch %	13.1	0	86.9	0	10.7	89.3	0	0	0	0	0	0	0	98.6	1.4	0	
Total %	0.9	0	5.8	0	5	41.9	0	0	0	0	0	0	0	45.7	0.6	0	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Lady Smith March 3 2011
Site Code : 00000000
Start Date : 2011/03/03
Page No : 2

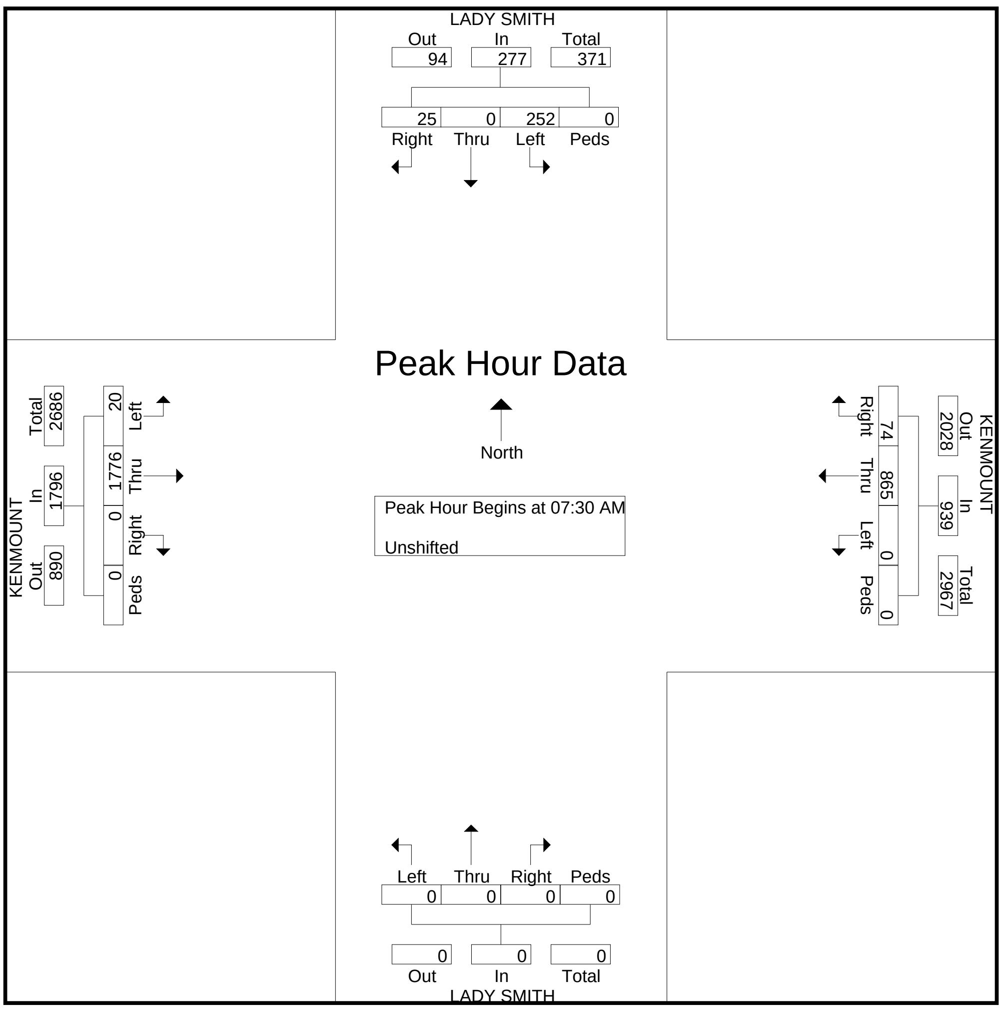


City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Lady Smith March 3 2011
Site Code : 00000000
Start Date : 2011/03/03
Page No : 3

	LADY SMITH From North					KENMOUNT From East					LADY SMITH From South					KENMOUNT From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	6	0	59	0	65	14	209	0	0	223	0	0	0	0	0	0	371	6	0	377	665
07:45 AM	**7**	0	**70**	0	**77**	20	**251**	0	0	**271**	0	0	0	0	0	0	461	1	0	462	810
08:00 AM	5	0	62	0	67	17	182	0	0	199	0	0	0	0	0	0	443	**10**	0	453	719
08:15 AM	7	0	61	0	68	**23**	223	0	0	246	0	0	0	0	0	0	**501**	3	0	**504**	**818**
Total Volume	25	0	252	0	277	74	865	0	0	939	0	0	0	0	0	0	1776	20	0	1796	3012
% App. Total	9	0	91	0		7.9	92.1	0	0		0	0	0	0		0	98.9	1.1	0		
PHF	.893	.000	.900	.000	.899	.804	.862	.000	.000	.866	.000	.000	.000	.000	.000	.000	.886	.500	.000	.891	.921

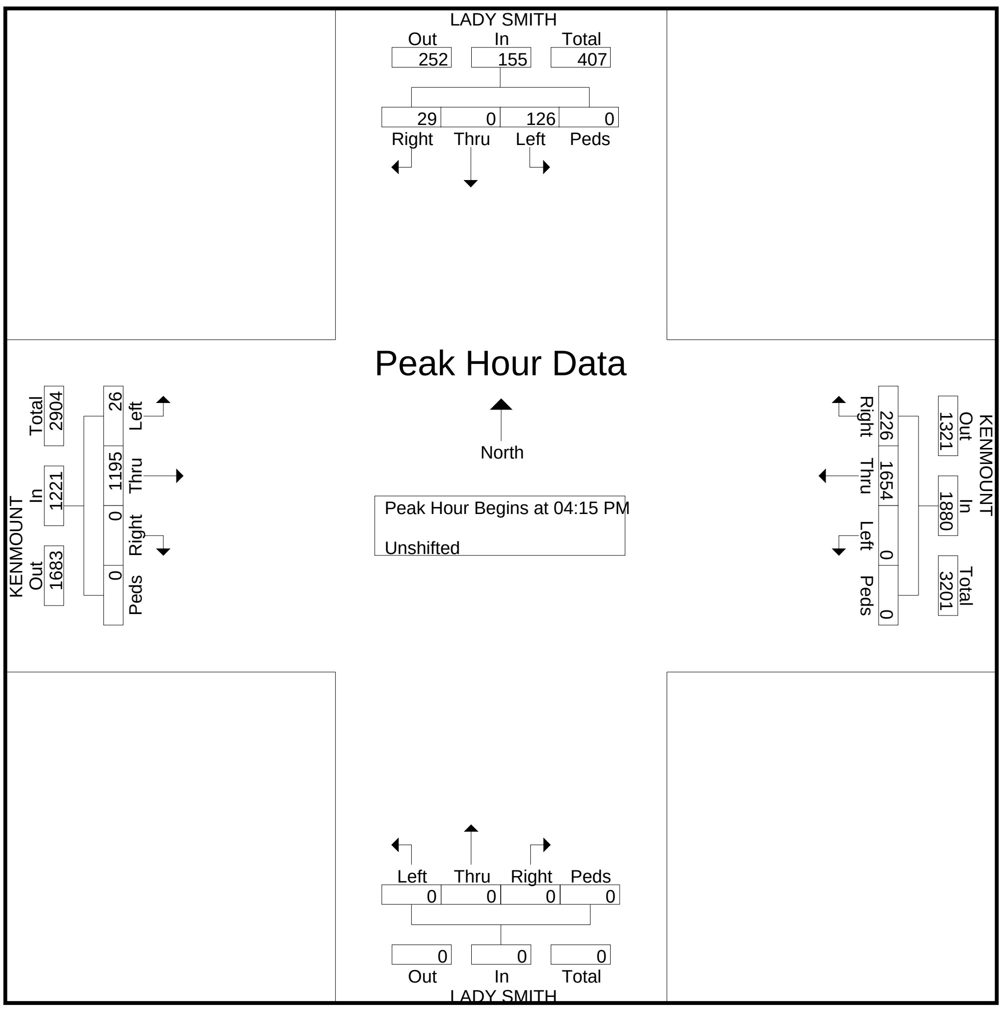


City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Lady Smith March 3 2011
Site Code : 00000000
Start Date : 2011/03/03
Page No : 4

	LADY SMITH From North					KENMOUNT From East					LADY SMITH From South					KENMOUNT From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	5	0	31	0	36	53	398	0	0	451	0	0	0	0	0	0	257	4	0	261	748
04:30 PM	7	0	27	0	34	54	**455**	0	0	**509**	0	0	0	0	0	0	316	3	0	319	**862**
04:45 PM	**9**	0	33	0	42	57	397	0	0	454	0	0	0	0	0	0	295	9	0	304	800
05:00 PM	8	0	**35**	0	**43**	**62**	404	0	0	466	0	0	0	0	0	0	**327**	**10**	0	**337**	846
Total Volume	29	0	126	0	155	226	1654	0	0	1880	0	0	0	0	0	0	1195	26	0	1221	3256
% App. Total	18.7	0	81.3	0		12	88	0	0		0	0	0	0		0	97.9	2.1	0		
PHF	.806	.000	.900	.000	.901	.911	.909	.000	.000	.923	.000	.000	.000	.000	.000	.000	.914	.650	.000	.906	.944



City Of St. John's

Department of Public Works
Traffic Division

Kenmount Rd @ Pippy Place
Ocotober 18, 2012
Turning Movement Count

File Name : kenmount @ pippy 18 oct 2012
Site Code : 00000000
Start Date : 2012/10/18
Page No : 1

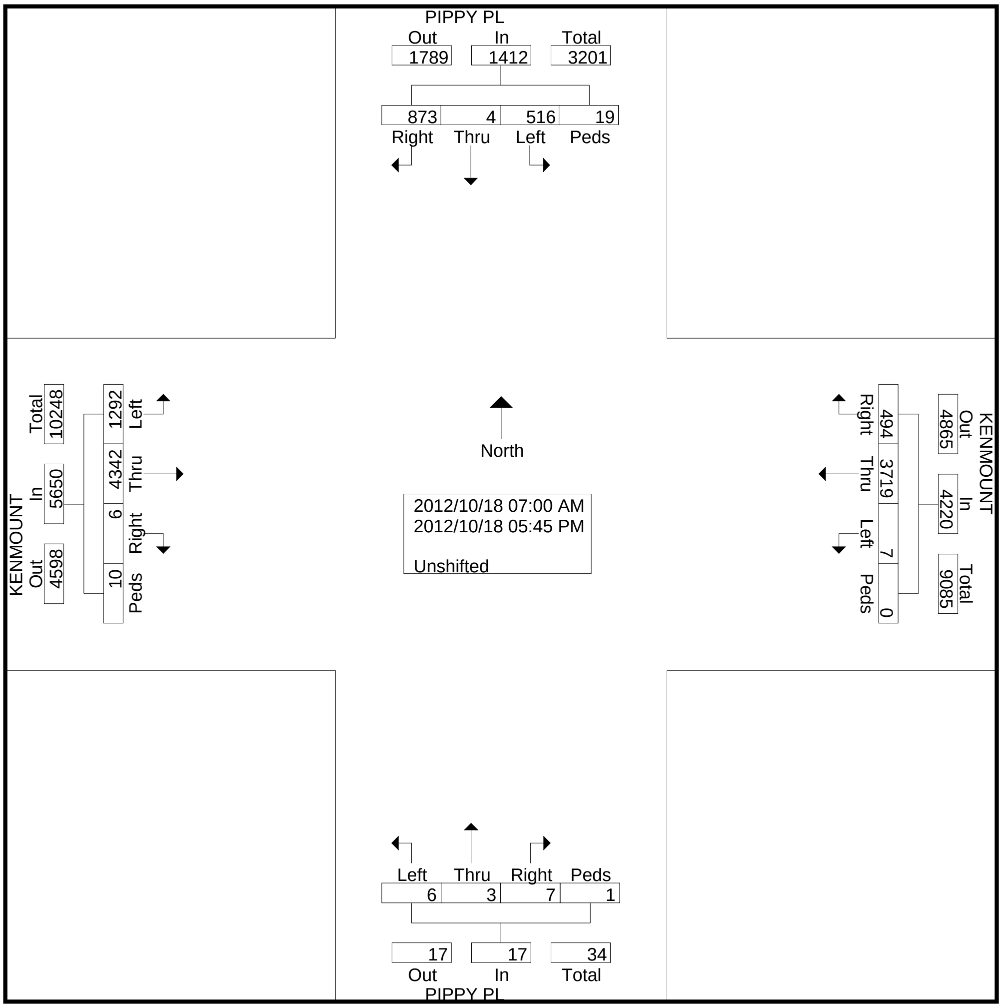
Groups Printed- Unshifted

	PIPPY PL From North				KENMOUNT From East				PIPPY PL From South				KENMOUNT From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	5	0	10	0	19	80	0	0	0	0	0	0	0	135	65	0	314
07:15 AM	9	0	6	0	12	86	2	0	0	0	1	0	0	194	78	0	388
07:30 AM	16	0	20	2	16	158	0	0	0	0	0	1	2	293	92	1	601
07:45 AM	21	0	22	1	52	179	0	0	0	0	0	0	1	342	96	0	714
Total	51	0	58	3	99	503	2	0	0	0	1	1	3	964	331	1	2017
08:00 AM	21	1	38	5	46	144	0	0	0	0	1	0	0	328	112	1	697
08:15 AM	19	0	26	1	59	155	1	0	0	0	2	0	0	351	125	1	740
08:30 AM	38	0	31	0	47	150	0	0	1	1	0	0	1	369	126	2	766
08:45 AM	24	0	33	0	52	154	0	0	0	0	1	0	0	264	92	1	621
Total	102	1	128	6	204	603	1	0	1	1	4	0	1	1312	455	5	2824
04:00 PM	112	1	40	1	30	335	0	0	1	0	0	0	0	251	76	1	848
04:15 PM	82	0	47	0	31	331	0	0	0	0	0	0	0	236	88	0	815
04:30 PM	116	1	51	6	23	355	0	0	0	0	1	0	0	306	66	1	926
04:45 PM	92	0	53	0	23	358	0	0	1	0	0	0	0	258	63	0	848
Total	402	2	191	7	107	1379	0	0	2	0	1	0	0	1051	293	2	3437
05:00 PM	129	1	48	1	20	344	3	0	3	0	0	0	2	284	48	1	884
05:15 PM	89	0	35	1	21	322	1	0	1	0	0	0	0	271	68	1	810
05:30 PM	54	0	28	1	16	258	0	0	0	2	0	0	0	237	54	0	650
05:45 PM	46	0	28	0	27	310	0	0	0	0	0	0	0	223	43	0	677
Total	318	1	139	3	84	1234	4	0	4	2	0	0	2	1015	213	2	3021
Grand Total	873	4	516	19	494	3719	7	0	7	3	6	1	6	4342	1292	10	11299
Apprch %	61.8	0.3	36.5	1.3	11.7	88.1	0.2	0	41.2	17.6	35.3	5.9	0.1	76.8	22.9	0.2	
Total %	7.7	0	4.6	0.2	4.4	32.9	0.1	0	0.1	0	0.1	0	0.1	38.4	11.4	0.1	

City Of St. John's

Department of Public Works
Traffic Division

File Name : kenmount @ pippy 18 oct 2012
Site Code : 00000000
Start Date : 2012/10/18
Page No : 2

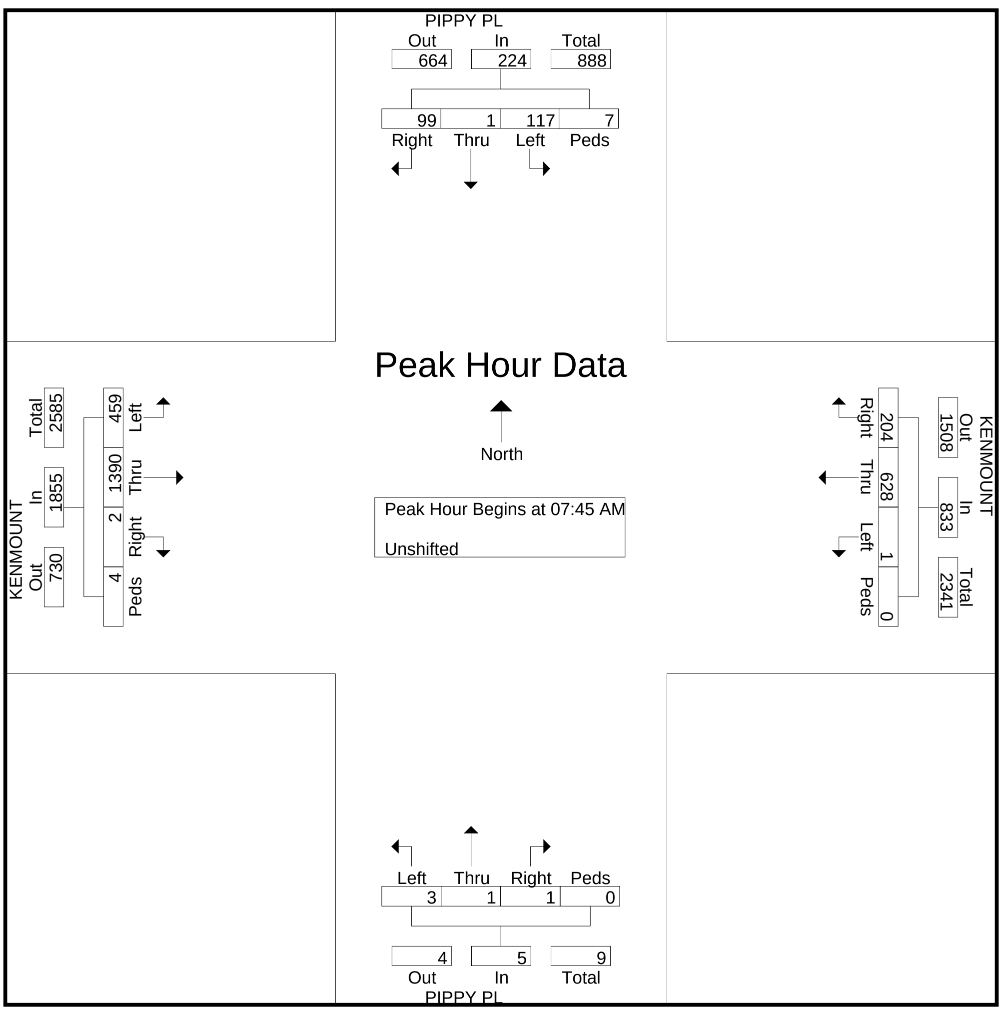


City Of St. John's

Department of Public Works
Traffic Division

File Name : kenmount @ pippy 18 oct 2012
Site Code : 00000000
Start Date : 2012/10/18
Page No : 3

	PIPPY PL From North					KENMOUNT From East					PIPPY PL From South					KENMOUNT From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	21	0	22	1	44	52	**179**	0	0	**231**	0	0	0	0	0	**1**	342	96	0	439	714
08:00 AM	21	**1**	**38**	**5**	65	46	144	0	0	190	0	0	1	0	1	0	328	112	1	441	697
08:15 AM	19	0	26	1	46	**59**	155	**1**	0	215	0	0	**2**	0	**2**	0	351	125	1	477	740
08:30 AM	**38**	0	31	0	**69**	47	150	0	0	197	**1**	**1**	0	0	2	1	**369**	**126**	**2**	**498**	**766**
Total Volume	99	1	117	7	224	204	628	1	0	833	1	1	3	0	5	2	1390	459	4	1855	2917
% App. Total	44.2	0.4	52.2	3.1		24.5	75.4	0.1	0		20	20	60	0		0.1	74.9	24.7	0.2		
PHF	.651	.250	.770	.350	.812	.864	.877	.250	.000	.902	.250	.250	.375	.000	.625	.500	.942	.911	.500	.931	.952

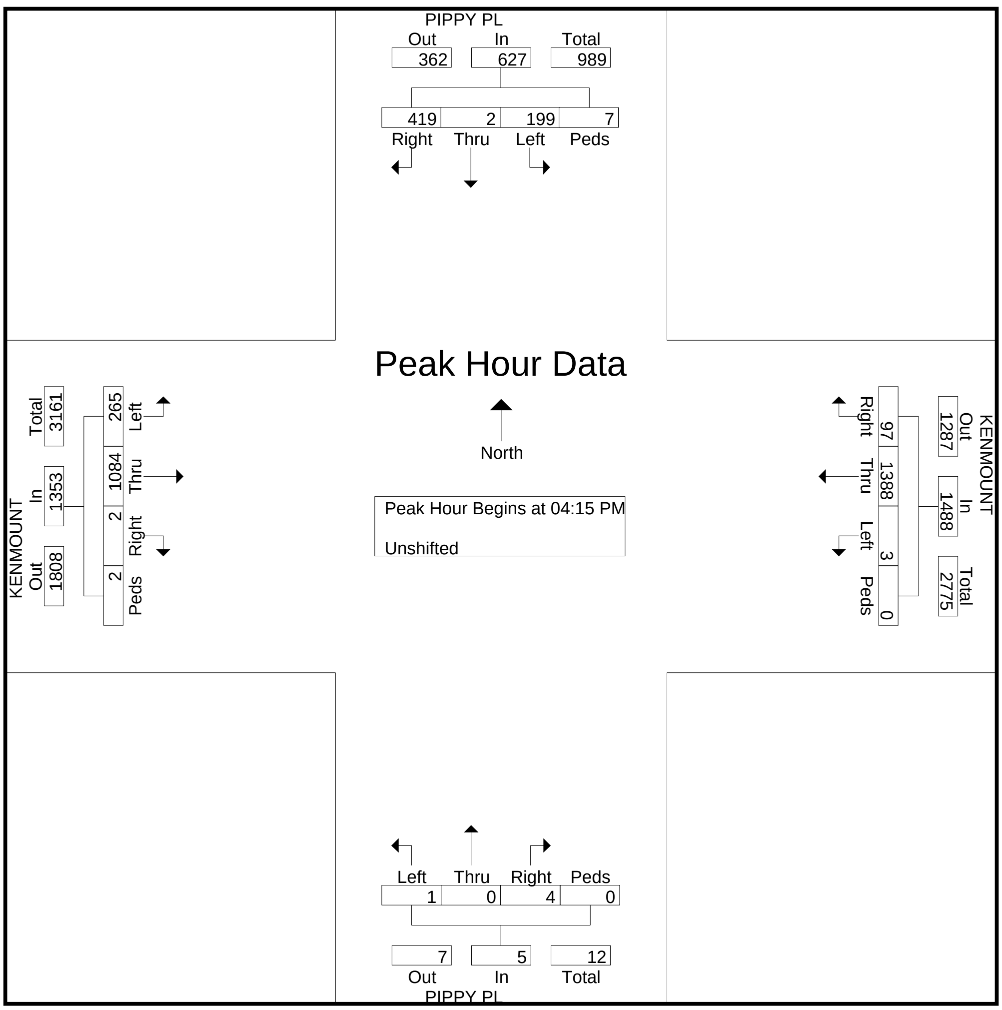


City Of St. John's

Department of Public Works
Traffic Division

File Name : kenmount @ pippy 18 oct 2012
Site Code : 00000000
Start Date : 2012/10/18
Page No : 4

	PIPPY PL From North					KENMOUNT From East					PIPPY PL From South					KENMOUNT From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	82	0	47	0	129	**31**	331	0	0	362	0	0	0	0	0	0	236	**88**	0	324	815
04:30 PM	116	**1**	51	**6**	174	23	355	0	0	378	0	0	**1**	0	1	0	**306**	66	**1**	**373**	**926**
04:45 PM	92	0	**53**	0	145	23	**358**	0	0	**381**	1	0	0	0	1	0	258	63	0	321	848
05:00 PM	**129**	1	48	1	**179**	20	344	**3**	0	367	**3**	0	0	0	**3**	**2**	284	48	1	335	884
Total Volume	419	2	199	7	627	97	1388	3	0	1488	4	0	1	0	5	2	1084	265	2	1353	3473
% App. Total	66.8	0.3	31.7	1.1		6.5	93.3	0.2	0		80	0	20	0		0.1	80.1	19.6	0.1		
PHF	.812	.500	.939	.292	.876	.782	.969	.250	.000	.976	.333	.000	.250	.000	.417	.250	.886	.753	.500	.907	.938



City of St. John's

Department of Engineering
Traffic division

Kenmount Rd @ Thorburn Loop Ramp
October 30, 2012
Turning Movement Count

File Name : Kenmount Rd @ Thorburn Loop Ramp October 30, 2012
Site Code : 00000000
Start Date : 2012/10/30
Page No : 1

Groups Printed- Unshifted

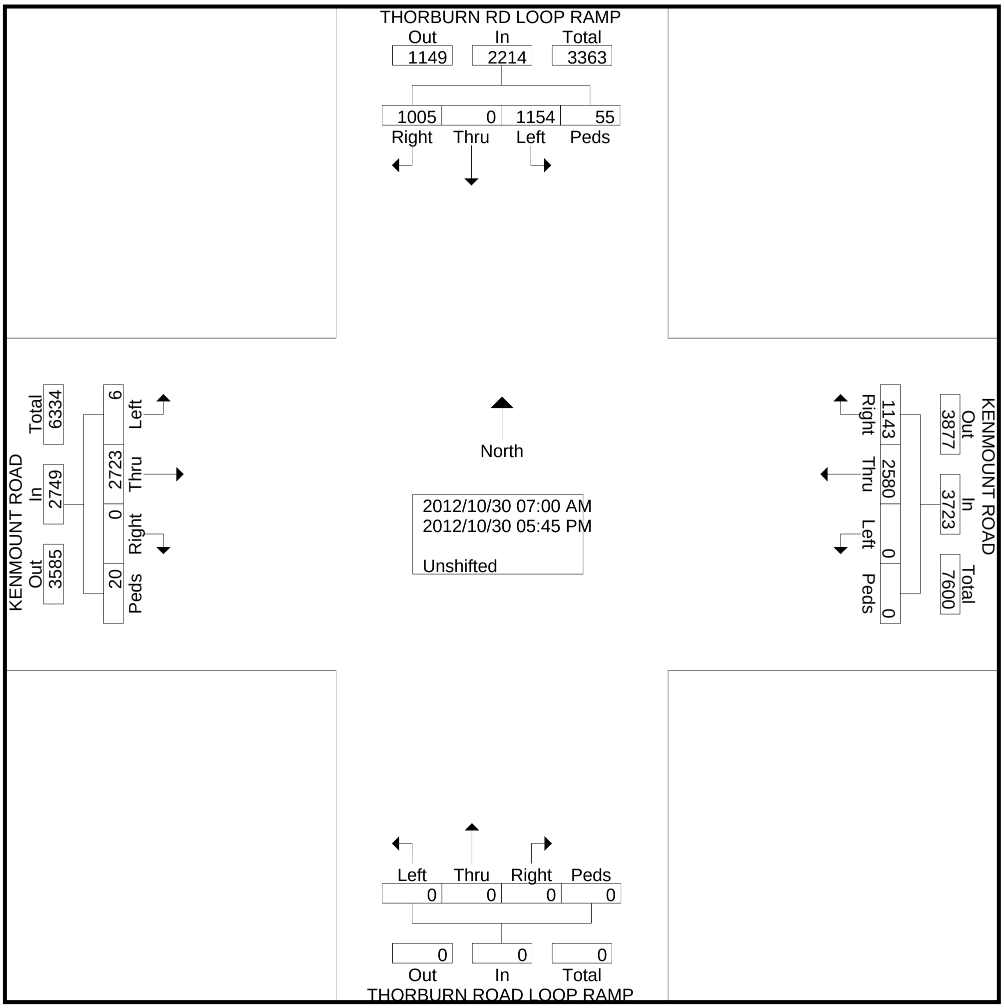
	THORBURN RD LOOP RAMP Southbound				KENMOUNT ROAD Westbound				THORBURN ROAD LOOP RAMP Northbound				KENMOUNT ROAD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	22	0	21	0	17	57	0	0	0	0	0	0	0	72	0	0	189
07:15 AM	36	0	24	2	20	68	0	0	0	0	0	0	0	87	1	0	238
07:30 AM	65	0	51	2	35	107	0	0	0	0	0	0	0	125	0	0	385
07:45 AM	94	0	70	1	47	152	0	0	0	0	0	0	0	160	0	2	526
Total	217	0	166	5	119	384	0	0	0	0	0	0	0	444	1	2	1338
08:00 AM	87	0	66	0	71	118	0	0	0	0	0	0	0	169	0	0	511
08:15 AM	78	0	90	0	71	136	0	0	0	0	0	0	0	199	0	0	574
08:30 AM	72	0	117	0	72	179	0	0	0	0	0	0	0	203	0	1	644
08:45 AM	80	0	95	3	64	177	0	0	0	0	0	0	0	195	1	0	615
Total	317	0	368	3	278	610	0	0	0	0	0	0	0	766	1	1	2344
*** BREAK ***																	
04:00 PM	65	0	80	10	76	207	0	0	0	0	0	0	0	165	1	2	606
04:15 PM	69	0	67	5	80	192	0	0	0	0	0	0	0	171	0	2	586
04:30 PM	61	0	72	4	125	208	0	0	0	0	0	0	0	242	0	2	714
04:45 PM	57	0	81	6	116	195	0	0	0	0	0	0	0	199	0	3	657
Total	252	0	300	25	397	802	0	0	0	0	0	0	0	777	1	9	2563
05:00 PM	71	0	97	7	104	201	0	0	0	0	0	0	0	226	0	1	707
05:15 PM	43	0	80	3	98	212	0	0	0	0	0	0	0	182	2	3	623
05:30 PM	51	0	75	3	86	198	0	0	0	0	0	0	0	172	0	2	587
05:45 PM	54	0	68	9	61	173	0	0	0	0	0	0	0	156	1	2	524
Total	219	0	320	22	349	784	0	0	0	0	0	0	0	736	3	8	2441
Grand Total	1005	0	1154	55	1143	2580	0	0	0	0	0	0	0	2723	6	20	8686
Apprch %	45.4	0	52.1	2.5	30.7	69.3	0	0	0	0	0	0	0	99.1	0.2	0.7	
Total %	11.6	0	13.3	0.6	13.2	29.7	0	0	0	0	0	0	0	31.3	0.1	0.2	

City of St. John's

Department of Engineering
Traffic division

Kenmount Rd @ Thorburn Loop Ramp
October 30, 2012
Turning Movement Count

File Name : Kenmount Rd @ Thorburn Loop Ramp October 30, 2012
Site Code : 00000000
Start Date : 2012/10/30
Page No : 2



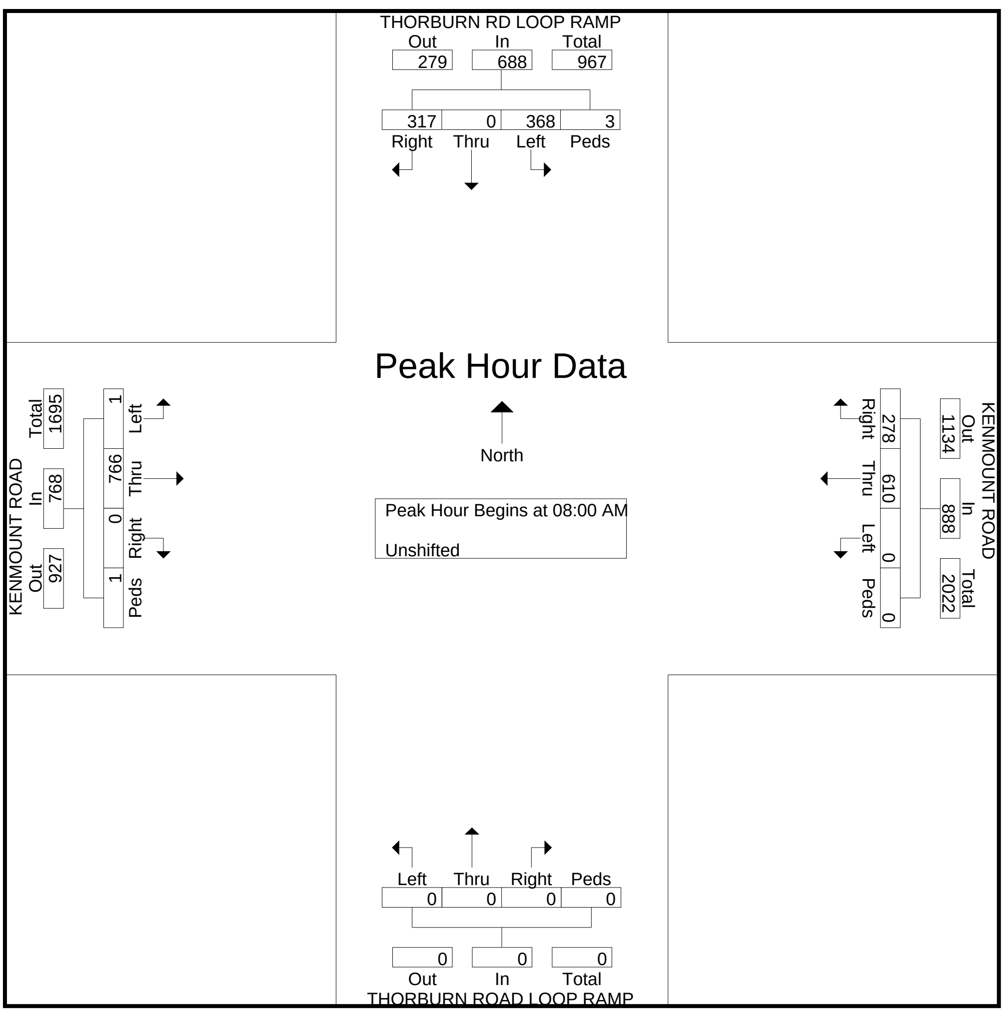
City of St. John's

Department of Engineering
Traffic division

Kenmount Rd @ Thorburn Loop Ramp
October 30, 2012
Turning Movement Count

File Name : Kenmount Rd @ Thorburn Loop Ramp October 30, 2012
Site Code : 00000000
Start Date : 2012/10/30

	THORBURN RD LOOP RAMP Southbound					KENMOUNT ROAD Westbound					THORBURN ROAD LOOP RAMP Northbound					KENMOUNT ROAD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	**87**																				
08:15 AM	**78**	**0**	**90**	**0**	**168**	**71**	**136**	**0**	**0**	**207**	**0**	**0**	**0**	**0**	**0**	**0**	**199**	**0**	**0**	**199**	**574**
08:30 AM	**72**	**0**	**117**	**0**	**189**	**72**	**179**	**0**	**0**	**251**	0	0	0	0	0	0	**203**	0	**1**	**204**	**644**
08:45 AM	80	0	95	**3**														**1**			
Total Volume	317	0	368	3	688	278	610	0	0	888	0	0	0	0	0	0	766	1	1	768	2344
% App. Total	46.1	0	53.5	0.4		31.3	68.7	0	0		0	0	0	0		0	99.7	0.1	0.1		
PHF	.911	.000	.786	.250	.910	.965	.852	.000	.000	.884	.000	.000	.000	.000	.000	.000	.943	.250	.250	.941	.910



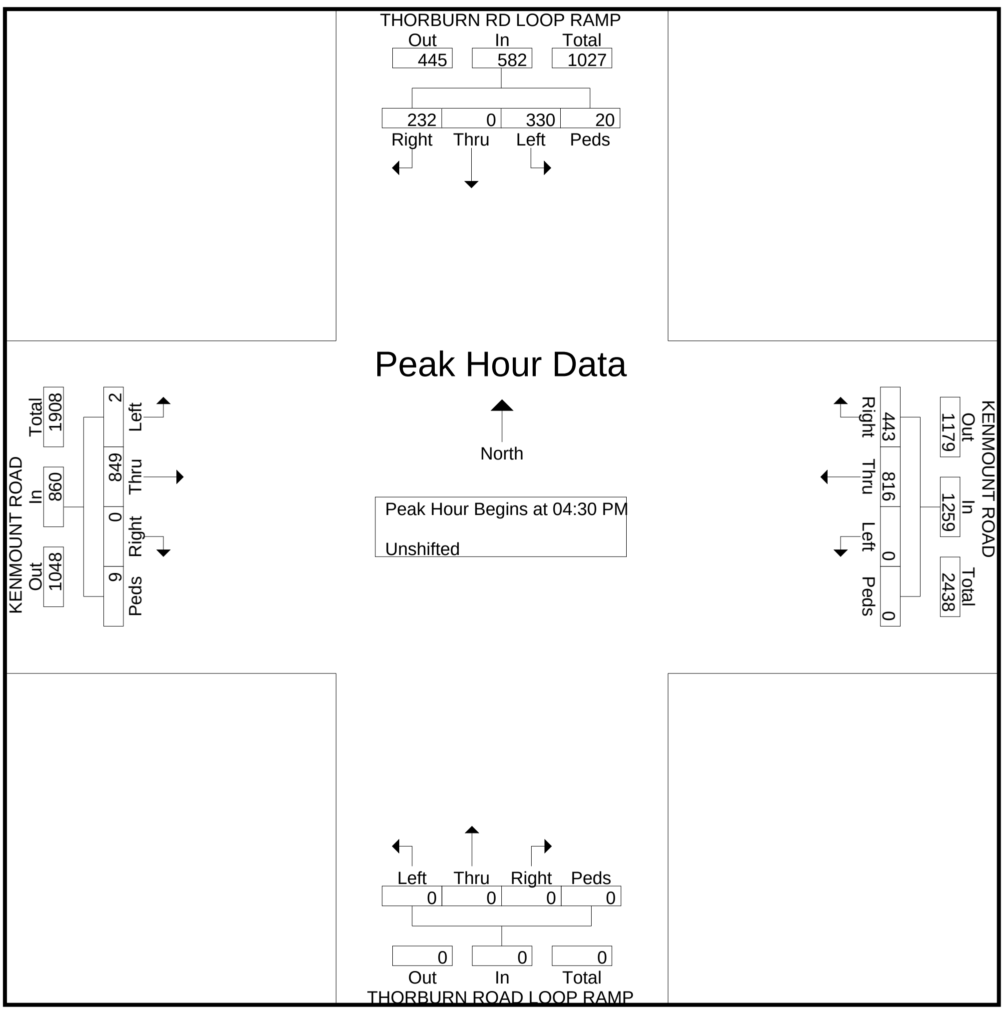
City of St. John's

Department of Engineering
Traffic division

Kenmount Rd @ Thorburn Loop Ramp
October 30, 2012
Turning Movement Count

File Name : Kenmount Rd @ Thorburn Loop Ramp October 30, 2012
Site Code : 00000000
Start Date : 2012/10/30

	THORBURN RD LOOP RAMP Southbound					KENMOUNT ROAD Westbound					THORBURN ROAD LOOP RAMP Northbound					KENMOUNT ROAD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	61	0	72	4	137	**125**	208	0	0	**333**	0	0	0	0	0	0	**242**	0	2	**244**	**714**
04:45 PM	57	0	81	6	144	116	195	0	0	311	0	0	0	0	0	0	199	0	**3**		
05:00 PM	**71**	**0**	**97**	**7**	**175**	104	201	0	0	305	0	0	0	0	0	0	226	0	1	227	707
05:15 PM	43	0	80	3	126	98	**212**											**2**			
Total Volume	232	0	330	20	582	443	816	0	0	1259	0	0	0	0	0	0	849	2	9	860	2701
% App. Total	39.9	0	56.7	3.4		35.2	64.8	0	0		0	0	0	0		0	98.7	0.2	1		
PHF	.817	.000	.851	.714	.831	.886	.962	.000	.000	.945	.000	.000	.000	.000	.000	.000	.877	.250	.750	.881	.946



City Of St. John's

Department of Public Works
Traffic Division

Kenmount Road @ Wyatt Blvd
Turning Movement Count
June 19, 2013

File Name : Kenmount @ Wyatt June 19 2013
Site Code : 00000000
Start Date : 2013/06/19
Page No : 1

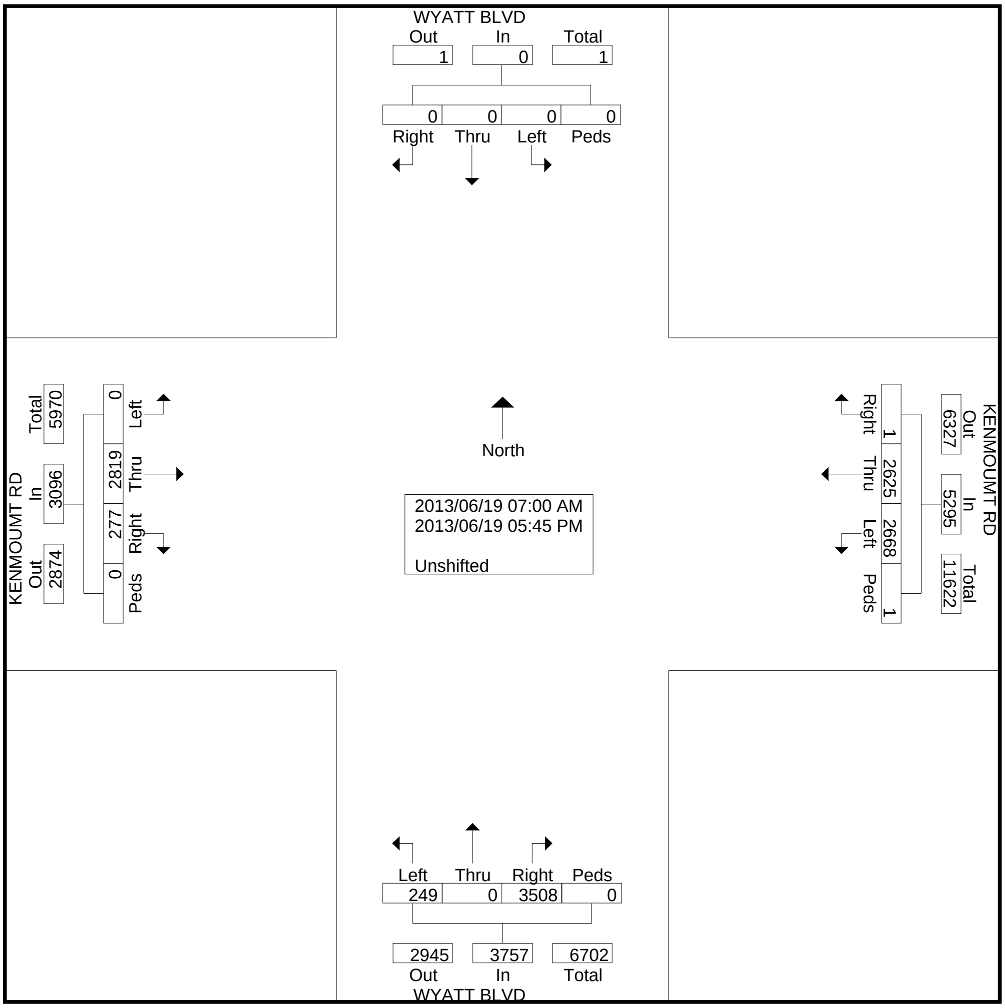
Groups Printed- Unshifted

	WYATT BLVD From North				KENMOUMT RD From East				WYATT BLVD From South				KENMOUMT RD From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	0	54	46	0	126	0	5	0	10	119	0	0	360
07:15 AM	0	0	0	0	0	84	68	0	154	0	8	0	15	144	0	0	473
07:30 AM	0	0	0	0	0	123	109	0	300	0	9	0	21	215	0	0	777
07:45 AM	0	0	0	0	0	176	133	1	317	0	14	0	13	232	0	0	886
Total	0	0	0	0	0	437	356	1	897	0	36	0	59	710	0	0	2496
08:00 AM	0	0	0	0	0	148	127	0	278	0	17	0	18	234	0	0	822
08:15 AM	0	0	0	0	1	168	148	0	270	0	14	0	12	227	0	0	840
08:30 AM	0	0	0	0	0	107	147	0	228	0	14	0	25	182	0	0	703
08:45 AM	0	0	0	0	0	99	121	0	189	0	13	0	15	210	0	0	647
Total	0	0	0	0	1	522	543	0	965	0	58	0	70	853	0	0	3012
04:00 PM	0	0	0	0	0	200	209	0	142	0	14	0	19	183	0	0	767
04:15 PM	0	0	0	0	0	289	220	0	246	0	16	0	10	135	0	0	916
04:30 PM	0	0	0	0	0	297	194	0	299	0	34	0	22	186	0	0	1032
04:45 PM	0	0	0	0	0	221	244	0	212	0	23	0	22	147	0	0	869
Total	0	0	0	0	0	1007	867	0	899	0	87	0	73	651	0	0	3584
05:00 PM	0	0	0	0	0	119	217	0	210	0	25	0	19	151	0	0	741
05:15 PM	0	0	0	0	0	243	249	0	169	0	10	0	19	152	0	0	842
05:30 PM	0	0	0	0	0	179	228	0	187	0	13	0	17	159	0	0	783
05:45 PM	0	0	0	0	0	118	208	0	181	0	20	0	20	143	0	0	690
Total	0	0	0	0	0	659	902	0	747	0	68	0	75	605	0	0	3056
Grand Total	0	0	0	0	1	2625	2668	1	3508	0	249	0	277	2819	0	0	12148
Apprch %	0	0	0	0	0	49.6	50.4	0	93.4	0	6.6	0	8.9	91.1	0	0	
Total %	0	0	0	0	0	21.6	22	0	28.9	0	2	0	2.3	23.2	0	0	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Wyatt June 19 2013
Site Code : 00000000
Start Date : 2013/06/19
Page No : 2

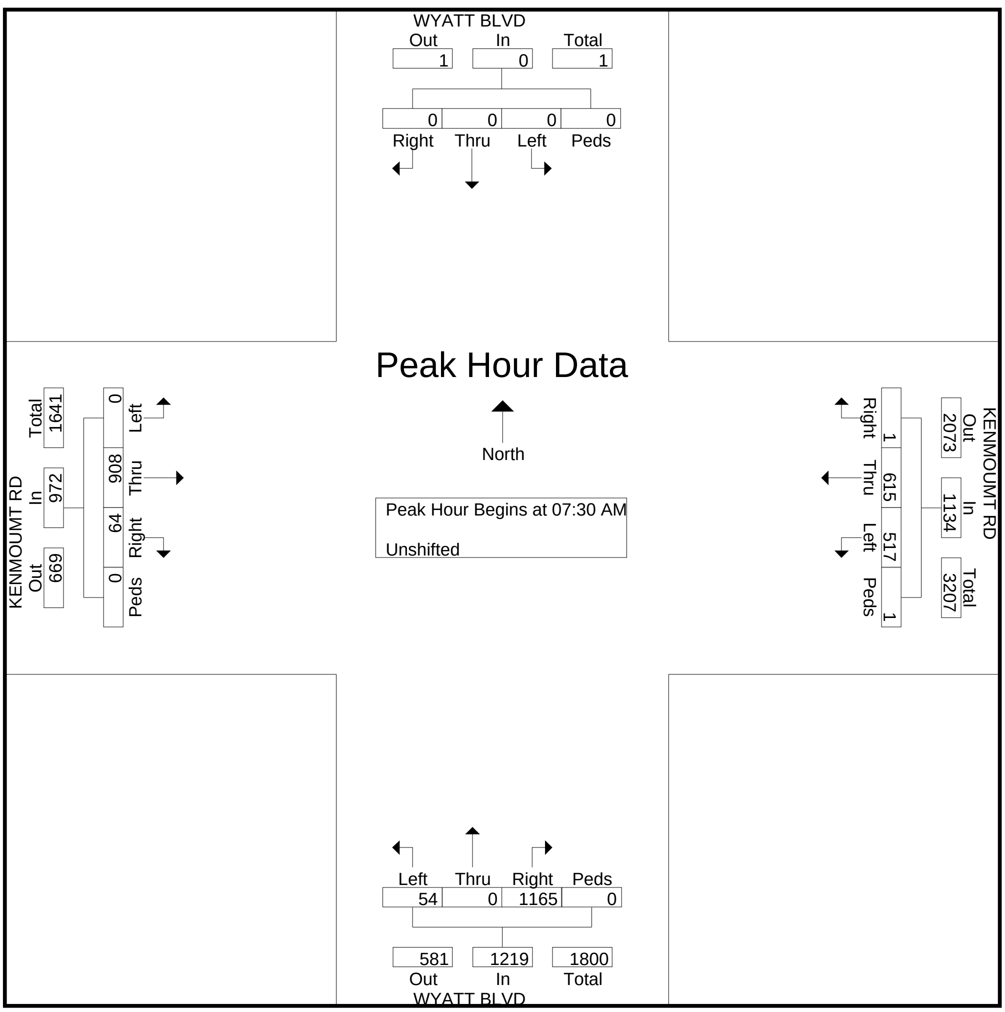


City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Wyatt June 19 2013
Site Code : 00000000
Start Date : 2013/06/19

	WYATT BLVD From North					KENMOUMT RD From East					WYATT BLVD From South					KENMOUMT RD From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	0	0	0	0	0	123	109	0	232	300	0	9	0	309	**21**	215	0	0	236	777
07:45 AM	0	0	0	0	0	0	**176**	133	**1**	310	**317**	0	14	0	**331**	13	232	0	0	245	**886**
08:00 AM	0	0	0	0	0	0	148	127	0	275	278	0	**17**	0	295	18	**234**	0	0	**252**	822
08:15 AM	0	0	0	0	0	**1**	168	**148**	0	**317**	270	0	14	0	284	12	227	0	0	239	840
Total Volume	0	0	0	0	0	1	615	517	1	1134	1165	0	54	0	1219	64	908	0	0	972	3325
% App. Total	0	0	0	0		0.1	54.2	45.6	0.1		95.6	0	4.4	0		6.6	93.4	0	0		
PHF	.000	.000	.000	.000	.000	.250	.874	.873	.250	.894	.919	.000	.794	.000	.921	.762	.970	.000	.000	.964	.938

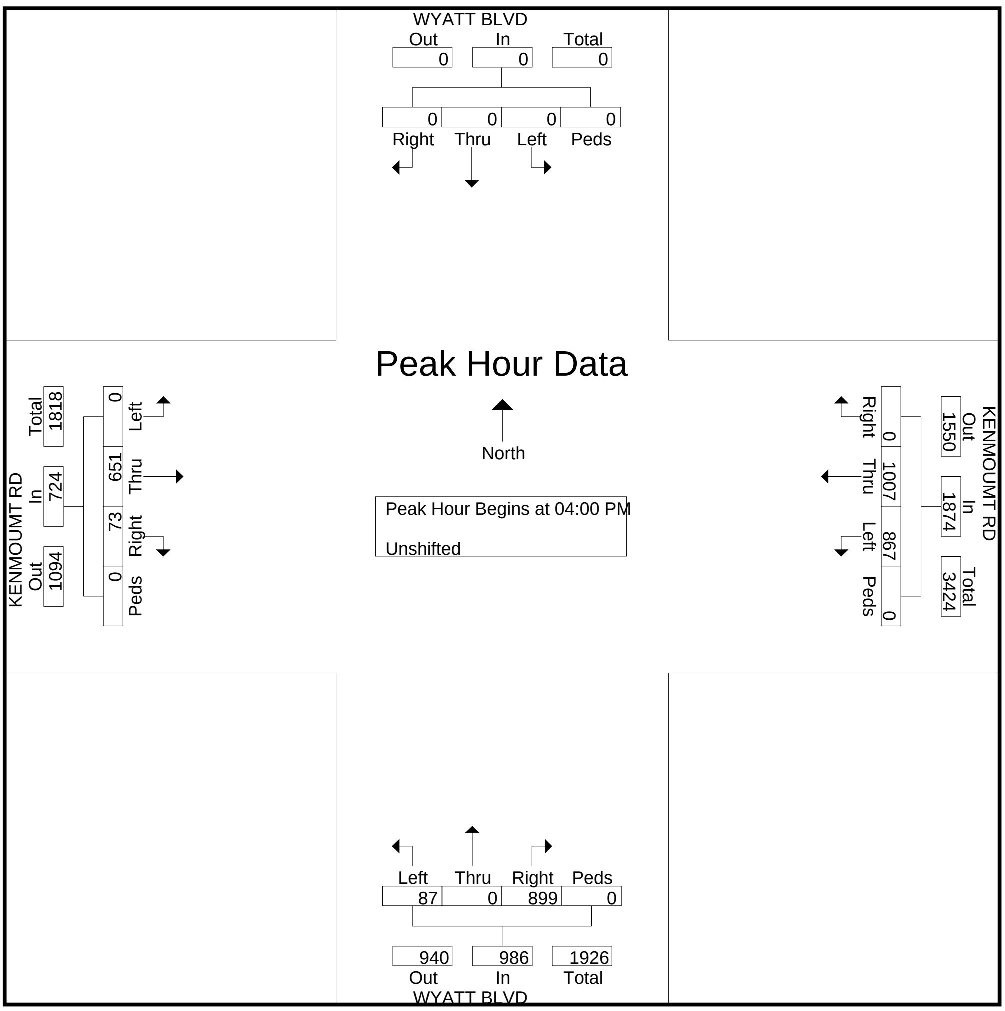


City Of St. John's

Department of Public Works
Traffic Division

File Name : Kenmount @ Wyatt June 19 2013
Site Code : 00000000
Start Date : 2013/06/19

	WYATT BLVD From North					KENMOUMT RD From East					WYATT BLVD From South					KENMOUMT RD From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	0	0	0	0	0	0	200	209	0	409	142	0	14	0	156	19	183	0	0	202	767
04:15 PM	0	0	0	0	0	0	289	220	0	**509**	246	0	16	0	262	10	135	0	0	145	916
04:30 PM	0	0	0	0	0	0	**297**	194	0	491	**299**	0	**34**	0	**333**	**22**	**186**	0	0	**208**	**1032**
04:45 PM	0	0	0	0	0	0	221	**244**	0	465	212	0	23	0	235	22	147	0	0	169	869
Total Volume	0	0	0	0	0	0	1007	867	0	1874	899	0	87	0	986	73	651	0	0	724	3584
% App. Total	0	0	0	0		0	53.7	46.3	0		91.2	0	8.8	0		10.1	89.9	0	0		
PHF	.000	.000	.000	.000	.000	.000	.848	.888	.000	.920	.752	.000	.640	.000	.740	.830	.875	.000	.000	.870	.868



City of St. John's

Department of Engineering
Traffic division

Thorburn Road @ Bambrick/Austin
November 1, 2012
Turning Movement Count

File Name : Thorburn Road @ Austin Nov 1, 2012
Site Code : 00000000
Start Date : 2012/11/01
Page No : 1

Groups Printed- Unshifted

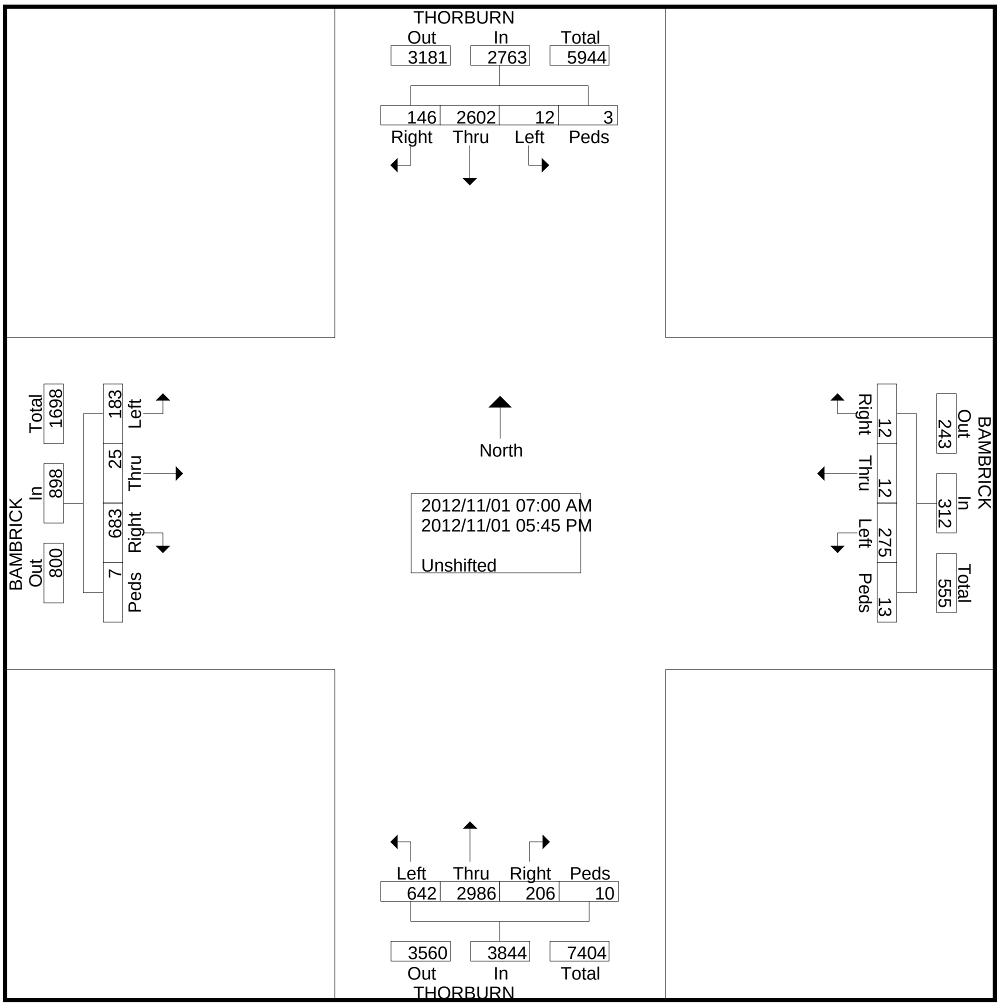
	THORBURN Southbound				BAMBRICK Westbound				THORBURN Northbound				BAMBRICK Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:00 AM	4	116	0	0	0	1	12	0	2	40	15	1	3	0	0	0	194
07:15 AM	5	155	0	0	0	1	10	0	2	71	31	1	12	0	1	0	289
07:30 AM	12	233	2	0	2	1	21	1	6	104	22	0	18	1	0	0	423
07:45 AM	21	245	2	0	2	0	26	0	2	117	66	0	26	1	0	0	508
Total	42	749	4	0	4	3	69	1	12	332	134	2	59	2	1	0	1414
08:00 AM	15	258	1	0	0	0	32	3	10	117	50	1	27	0	3	1	518
08:15 AM	26	258	0	0	1	2	36	0	3	68	73	1	41	0	3	0	512
08:30 AM	22	201	0	0	3	2	26	3	5	138	92	0	32	1	3	1	529
08:45 AM	15	161	1	0	1	0	20	1	5	120	59	1	31	0	3	0	418
Total	78	878	2	0	5	4	114	7	23	443	274	3	131	1	12	2	1977
*** BREAK ***																	
04:00 PM	9	114	0	0	2	0	7	1	15	129	34	0	70	3	24	0	408
04:15 PM	1	114	0	1	0	0	13	1	20	226	33	0	58	3	15	0	485
04:30 PM	5	132	0	1	0	1	8	1	20	305	38	2	104	2	39	2	660
04:45 PM	4	124	2	1	0	1	11	0	14	290	24	0	54	2	19	0	546
Total	19	484	2	3	2	2	39	3	69	950	129	2	286	10	97	2	2099
05:00 PM	1	114	1	0	1	1	14	1	38	297	29	2	105	7	44	1	656
05:15 PM	2	131	1	0	0	1	16	1	19	351	27	0	55	3	14	1	622
05:30 PM	2	116	1	0	0	1	11	0	27	334	27	1	36	1	10	1	568
05:45 PM	2	130	1	0	0	0	12	0	18	279	22	0	11	1	5	0	481
Total	7	491	4	0	1	3	53	2	102	1261	105	3	207	12	73	3	2327
Grand Total	146	2602	12	3	12	12	275	13	206	2986	642	10	683	25	183	7	7817
Apprch %	5.3	94.2	0.4	0.1	3.8	3.8	88.1	4.2	5.4	77.7	16.7	0.3	76.1	2.8	20.4	0.8	
Total %	1.9	33.3	0.2	0	0.2	0.2	3.5	0.2	2.6	38.2	8.2	0.1	8.7	0.3	2.3	0.1	

City of St. John's

Department of Engineering
Traffic division

Thorburn Road @ Bambrick/Austin
November 1, 2012
Turning Movement Count

File Name : Thorburn Road @ Austin Nov 1, 2012
Site Code : 00000000
Start Date : 2012/11/01
Page No : 2



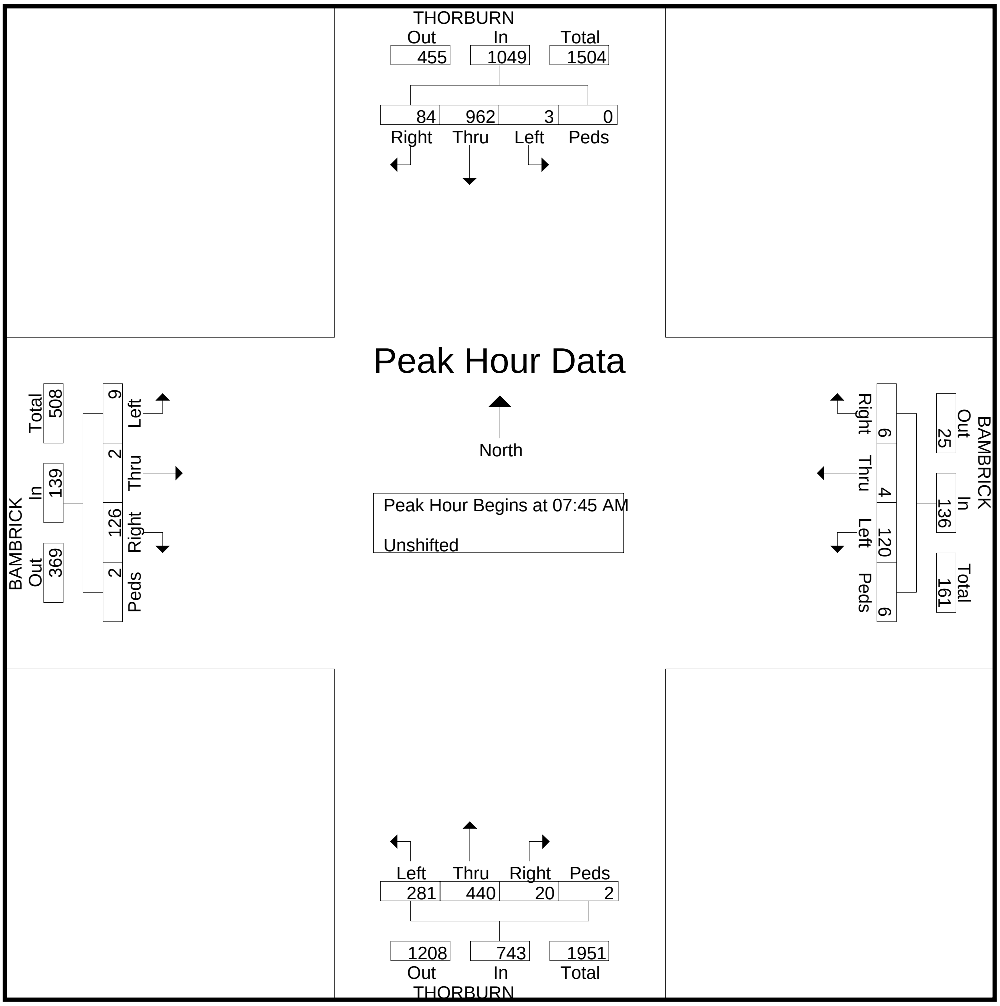
City of St. John's

Department of Engineering
Traffic division

Thorburn Road @ Bambrick/Austin
November 1, 2012
Turning Movement Count

File Name : Thorburn Road @ Austin Nov 1, 2012
Site Code : 00000000
Start Date : 2012/11/01
Page No : 3

	THORBURN Southbound					BAMBRICK Westbound					THORBURN Northbound					BAMBRICK Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	21	245	**2**	0	268	2	0	26	0	28	2	117	66	0	185	26	**1**	0	0	27	508
08:00 AM	15	**258**	1	0	274	0	0	32	**3**	35	**10**	117	50	**1**	178	27	0	**3**	**1**	31	518
08:15 AM	**26**	258	0	0	**284**	1	**2**	**36**	0	**39**	3	68	73	1	145	**41**	0	3	0	**44**	512
08:30 AM	22	201	0	0	223	**3**	2	26	3	34	5	**138**	**92**	0	**235**	32	1	3	1	37	**529**
Total Volume	84	962	3	0	1049	6	4	120	6	136	20	440	281	2	743	126	2	9	2	139	2067
% App. Total	8	91.7	0.3	0		4.4	2.9	88.2	4.4		2.7	59.2	37.8	0.3		90.6	1.4	6.5	1.4		
PHF	.808	.932	.375	.000	.923	.500	.500	.833	.500	.872	.500	.797	.764	.500	.790	.768	.500	.750	.500	.790	.977



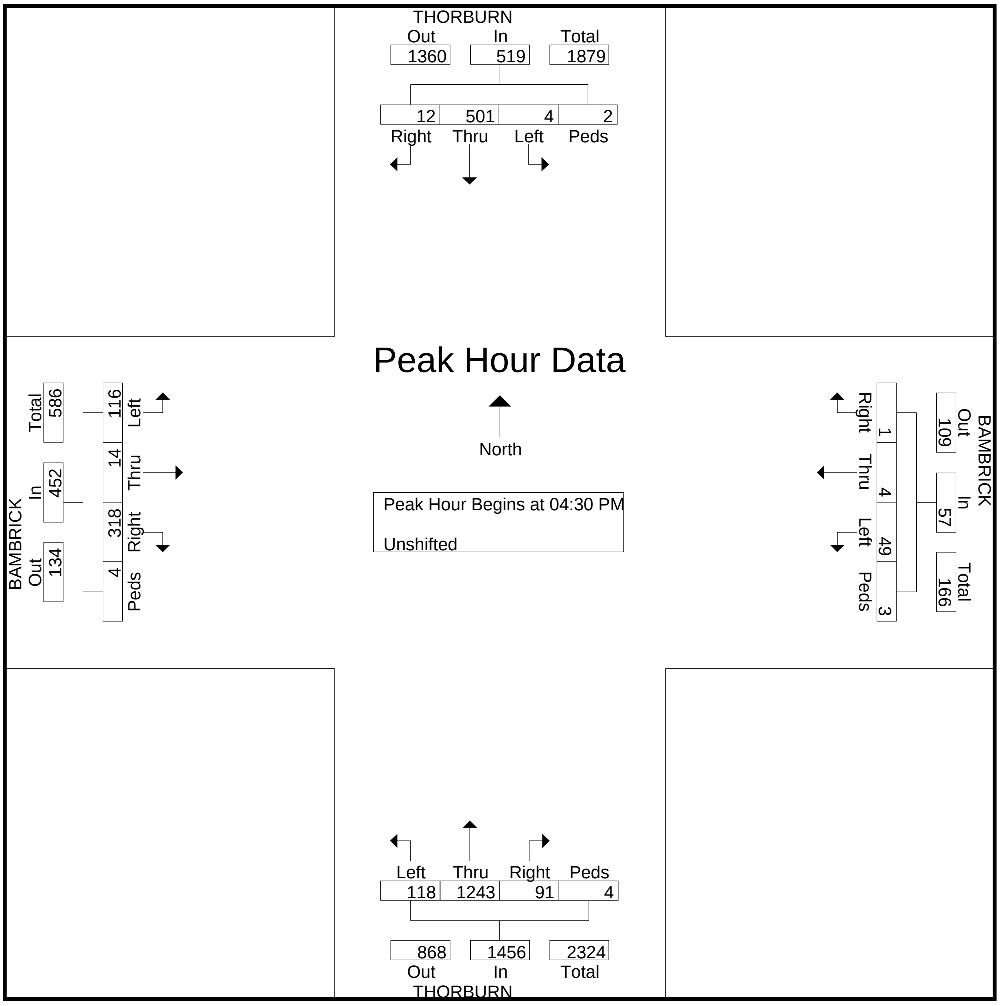
City of St. John's

Department of Engineering
Traffic division

Thorburn Road @ Bambrick/Austin
November 1, 2012
Turning Movement Count

File Name : Thorburn Road @ Austin Nov 1, 2012
Site Code : 00000000
Start Date : 2012/11/01
Page No : 4

	THORBURN Southbound					BAMBRICK Westbound					THORBURN Northbound					BAMBRICK Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	**5**	**132**	0	**1**	**138**	0	**1**	8	**1**	10	20	305	**38**	**2**	365	104	2	39	**2**	147	**660**
04:45 PM	4	124	**2**	1	131	0	1	11	0	12	14	290	24	0	328	54	2	19	0	75	546
05:00 PM	1	114	1	0	116	**1**	1	14	1	17	**38**	297	29	2	366	**105**	**7**	**44**	1	**157**	656
05:15 PM	2	131	1	0	134	0	1	**16**	1	**18**	19	**351**	27	0	**397**	55	3	14	1	73	622
Total Volume	12	501	4	2	519	1	4	49	3	57	91	1243	118	4	1456	318	14	116	4	452	2484
% App. Total	2.3	96.5	0.8	0.4		1.8	7	86	5.3		6.2	85.4	8.1	0.3		70.4	3.1	25.7	0.9		
PHF	.600	.949	.500	.500	.940	.250	1.00	.766	.750	.792	.599	.885	.776	.500	.917	.757	.500	.659	.500	.720	.941



City of St. John's

Department of Engineering
Traffic division

Default Comments
Change These in The Preferences Window
Select File/Preference in the Main Scree
Then Click the Comments Tab

File Name : Thorburn Rd @ Goldstone St, February 21, 2012
Site Code : 00000000
Start Date : 2012/02/21
Page No : 1

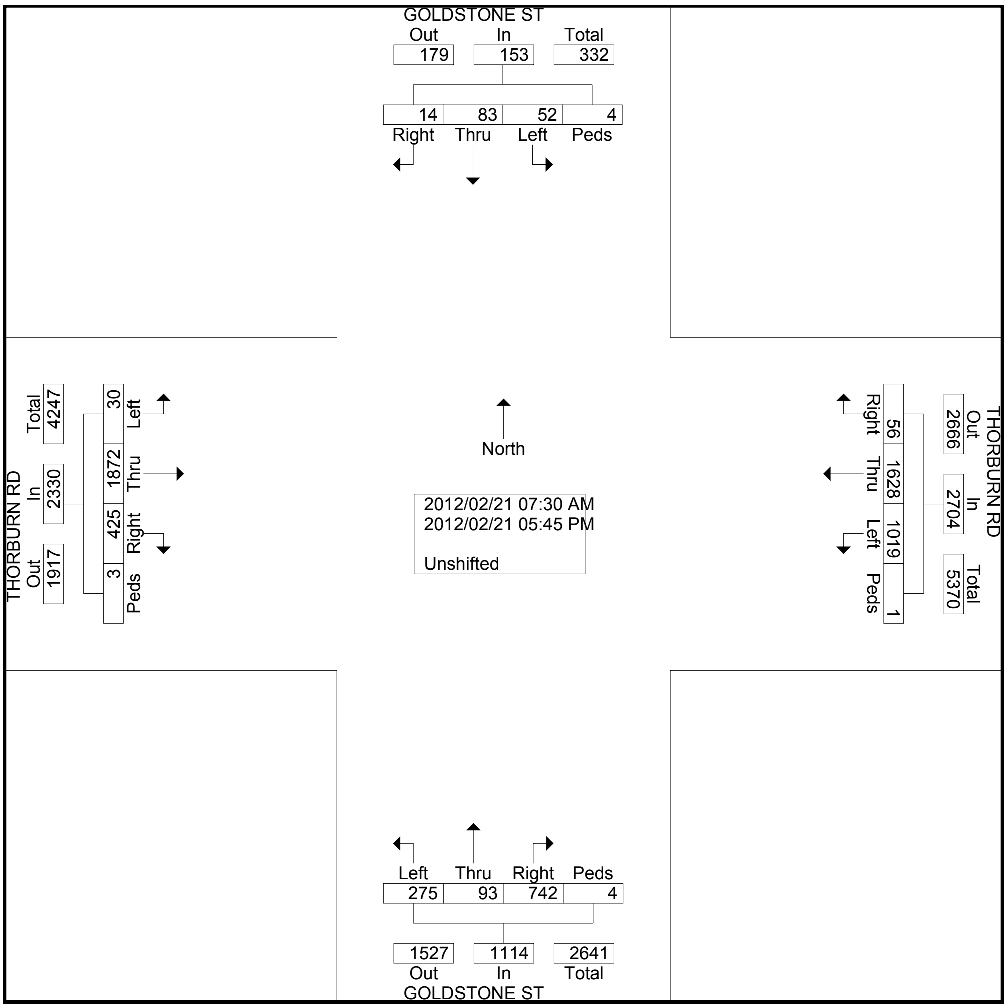
Groups Printed- Unshifted

	GOLDSTONE ST Southbound				THORBURN RD Westbound				GOLDSTONE ST Northbound				THORBURN RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:30 AM	1	3	3	0	3	48	56	0	32	2	5	0	35	202	1	0	391
07:45 AM	2	12	9	1	5	28	57	0	43	2	5	0	38	200	1	0	403
Total	3	15	12	1	8	76	113	0	75	4	10	0	73	402	2	0	794
08:00 AM	3	8	11	0	0	32	62	0	57	2	3	0	75	286	0	0	539
08:15 AM	1	10	5	0	1	34	79	0	58	4	4	0	63	250	1	0	510
08:30 AM	1	3	2	0	1	36	60	0	54	2	8	0	48	180	1	0	396
08:45 AM	0	6	4	0	1	50	59	0	48	4	5	0	33	137	1	0	348
Total	5	27	22	0	3	152	260	0	217	12	20	0	219	853	3	0	1793
09:00 AM	0	2	0	0	0	32	43	0	42	2	6	0	20	77	0	0	224
09:15 AM	1	4	4	0	0	32	43	0	41	2	7	0	17	67	1	0	219
*** BREAK ***																	
Total	1	6	4	0	0	64	86	0	83	4	13	0	37	144	1	0	443
*** BREAK ***																	
04:00 PM	0	3	0	0	6	171	83	0	37	8	26	0	10	52	1	1	398
04:15 PM	1	5	0	0	5	156	70	0	49	7	23	0	13	66	1	0	396
04:30 PM	0	8	1	0	4	212	90	1	35	9	41	3	15	74	4	0	497
04:45 PM	1	7	4	0	8	227	89	0	51	15	29	0	16	62	1	0	510
Total	2	23	5	0	23	766	332	1	172	39	119	3	54	254	7	1	1801
05:00 PM	1	3	2	1	9	187	79	0	57	9	52	0	10	65	7	1	483
05:15 PM	1	2	3	2	5	183	70	0	54	12	27	1	8	52	4	1	425
05:30 PM	1	3	2	0	6	112	44	0	41	8	16	0	10	46	3	0	292
05:45 PM	0	4	2	0	2	88	35	0	43	5	18	0	14	56	3	0	270
Total	3	12	9	3	22	570	228	0	195	34	113	1	42	219	17	2	1470
Grand Total	14	83	52	4	56	1628	1019	1	742	93	275	4	425	1872	30	3	6301
Apprch %	9.2	54.2	34	2.6	2.1	60.2	37.7	0	66.6	8.3	24.7	0.4	18.2	80.3	1.3	0.1	
Total %	0.2	1.3	0.8	0.1	0.9	25.8	16.2	0	11.8	1.5	4.4	0.1	6.7	29.7	0.5	0	

City of St. John's

Department of Engineering
Traffic division

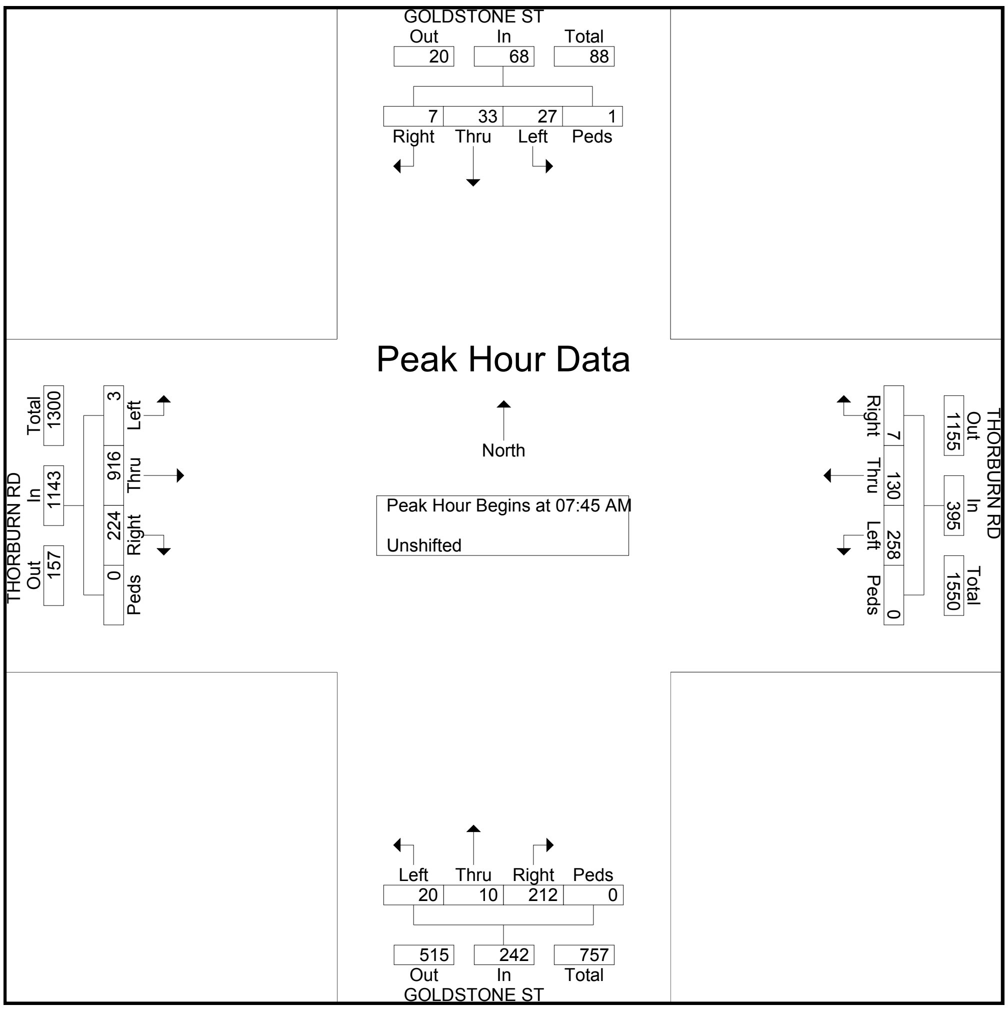
File Name : Thorburn Rd @ Goldstone St, February 21, 2012
Site Code : 00000000
Start Date : 2012/02/21
Page No : 2



City of St. John's
Department of Engineering
Traffic division

File Name : Thorburn Rd @ Goldstone St, February 21, 2012
Site Code : 00000000
Start Date : 2012/02/21
Page No : 3

	GOLDSTONE ST Southbound					THORBURN RD Westbound					GOLDSTONE ST Northbound					THORBURN RD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	2	**12**	9	**1**	**24**	**5**	28	57	0	90	43	2	5	0	50	38	200	**1**			
08:00 AM	**3**	**8**	**11**	**0**	**22**	**0**	**32**	**62**	**0**	**94**	**57**	**2**	**3**	**0**	**62**	**75**	**286**	0	0	**361**	**539**
08:15 AM	1	10	5	0	16	1	34	**79**		**114**	**58**	**4**			**66**	63	250	1	0	314	510
08:30 AM	1	3	2	0	6	1	**36**						**8**	0	64	48	180	1	0	229	396
Total Volume	7	33	27	1	68	7	130	258	0	395	212	10	20	0	242	224	916	3	0	1143	1848
% App. Total	10.3	48.5	39.7	1.5		1.8	32.9	65.3	0		87.6	4.1	8.3	0		19.6	80.1	0.3	0		
PHF	.583	.688	.614	.250	.708	.350	.903	.816	.000	.866	.914	.625	.625	.000	.917	.747	.801	.750	.000	.792	.857

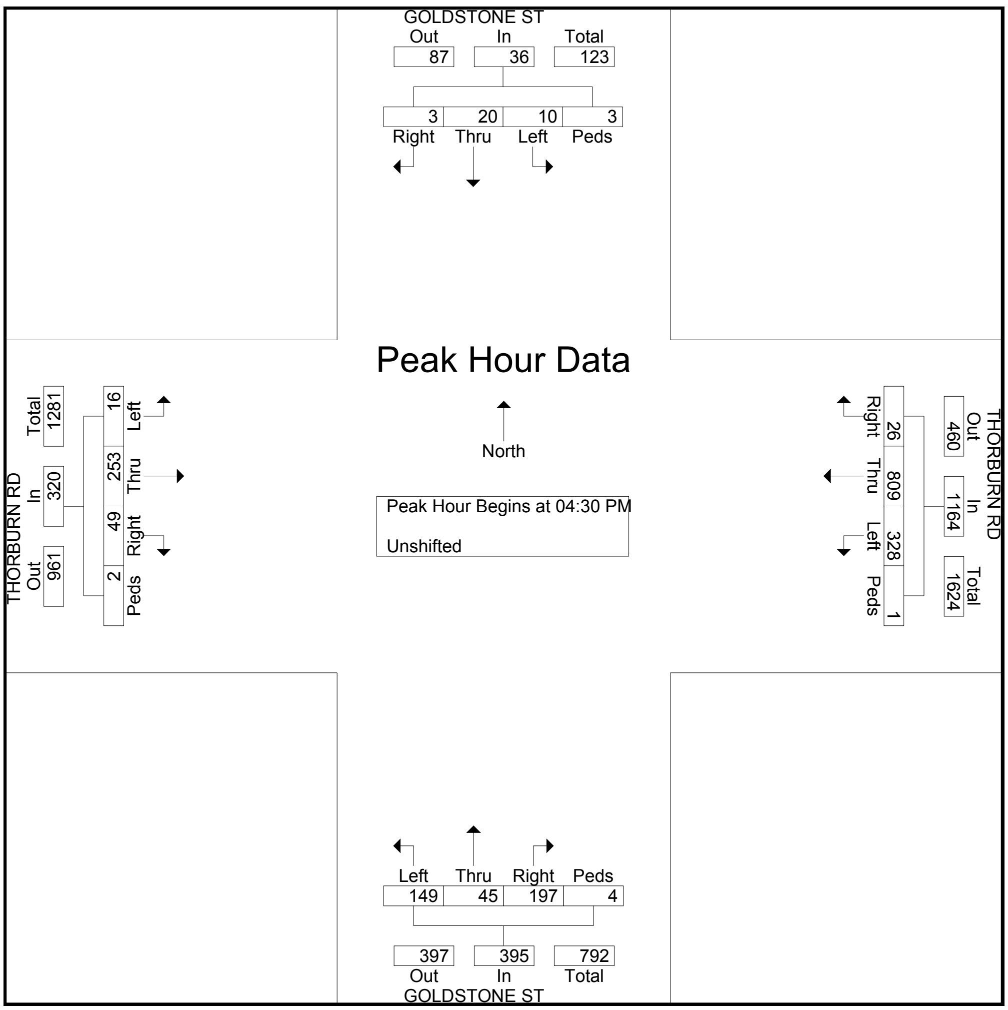


City of St. John's

Department of Engineering
Traffic division

File Name : Thorburn Rd @ Goldstone St, February 21, 2012
Site Code : 00000000
Start Date : 2012/02/21
Page No : 4

	GOLDSTONE ST Southbound					THORBURN RD Westbound					GOLDSTONE ST Northbound					THORBURN RD Eastbound					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	0	**8**	1	0	9	4	212	**90**	**1**	307	35	9	41	**3**			**74**	4	0	**93**	497
04:45 PM	**1**		**4**		**12**	8	**227**			**324**	51	**15**				**16**					**510**
05:00 PM	1	3	2	1	7	**9**	187	79	0	275	**57**		**52**	0	**118**	10	65	**7**	**1**		
05:15 PM	**1**	**2**	**3**	**2**	**8**	**5**	**183**	**70**	**0**	**258**	**54**	**12**	**27**	**1**	**94**	**8**	**52**	**4**	**1**	**65**	**425**
Total Volume	3	20	10	3	36	26	809	328	1	1164	197	45	149	4	395	49	253	16	2	320	1915
% App. Total	8.3	55.6	27.8	8.3		2.2	69.5	28.2	0.1		49.9	11.4	37.7	1		15.3	79.1	5	0.6		
PHF	.750	.625	.625	.375	.750	.722	.891	.911	.250	.898	.864	.750	.716	.333	.837	.766	.855	.571	.500	.860	.939



City Of St. John's

Department of Public Works
Traffic Division

Thorburn Rd @ O'Leary/Larkhall
Turning Movement Count
October 2, 2012

File Name : Thorburn Rs @ Larkhall St Oct 2 2012
Site Code : 00000000
Start Date : 2012/10/02
Page No : 1

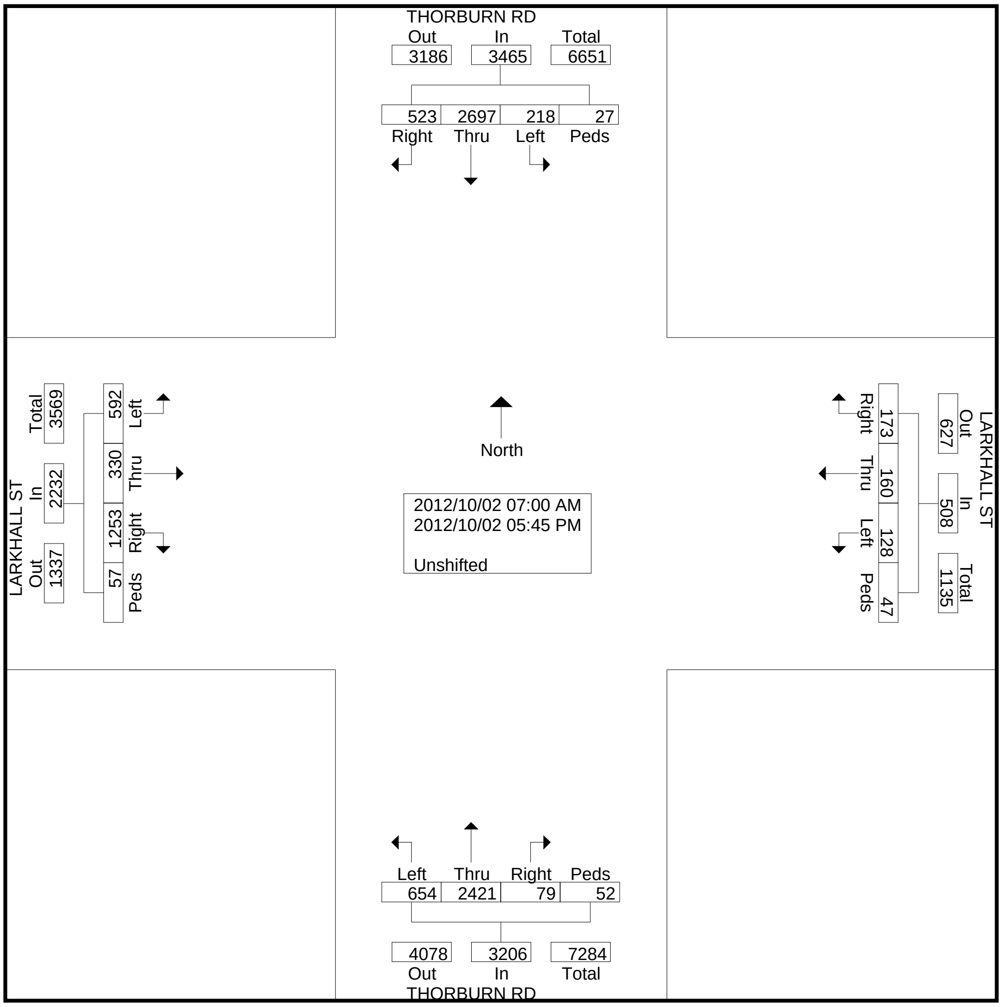
Groups Printed- Unshifted

	THORBURN RD From North				LARKHALL ST From East				THORBURN RD From South				LARKHALL ST From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	19	120	3	0	4	3	2	0	1	65	12	0	49	8	10	1	297
07:15 AM	16	150	8	0	3	2	1	1	1	76	17	2	53	9	11	0	350
07:30 AM	16	197	6	2	8	8	7	2	2	97	31	3	46	17	10	2	454
07:45 AM	42	214	10	1	10	9	9	2	5	136	47	2	63	23	16	2	591
Total	93	681	27	3	25	22	19	5	9	374	107	7	211	57	47	5	1692
08:00 AM	34	201	20	2	7	7	4	0	1	110	42	0	88	23	17	1	557
08:15 AM	29	212	21	1	8	9	15	13	16	129	33	5	88	38	25	2	644
08:30 AM	37	222	20	8	11	14	19	5	7	164	46	0	63	26	22	3	667
08:45 AM	31	162	14	2	6	8	6	3	2	113	55	4	71	20	18	0	515
Total	131	797	75	13	32	38	44	21	26	516	176	9	310	107	82	6	2383
04:00 PM	43	179	15	0	11	13	11	5	5	214	50	5	101	24	52	1	729
04:15 PM	32	138	14	0	25	16	13	3	4	191	56	3	77	18	54	6	650
04:30 PM	29	158	17	2	14	15	7	7	9	233	34	4	125	25	81	10	770
04:45 PM	43	156	11	3	13	16	4	0	6	196	60	3	101	23	66	9	710
Total	147	631	57	5	63	60	35	15	24	834	200	15	404	90	253	26	2859
05:00 PM	33	151	17	1	17	16	7	3	4	223	50	3	105	23	75	4	732
05:15 PM	45	158	18	0	13	8	5	2	5	189	41	5	91	20	52	7	659
05:30 PM	33	140	10	5	12	8	13	0	4	145	39	7	71	16	45	4	552
05:45 PM	41	139	14	0	11	8	5	1	7	140	41	6	61	17	38	5	534
Total	152	588	59	6	53	40	30	6	20	697	171	21	328	76	210	20	2477
Grand Total	523	2697	218	27	173	160	128	47	79	2421	654	52	1253	330	592	57	9411
Apprch %	15.1	77.8	6.3	0.8	34.1	31.5	25.2	9.3	2.5	75.5	20.4	1.6	56.1	14.8	26.5	2.6	
Total %	5.6	28.7	2.3	0.3	1.8	1.7	1.4	0.5	0.8	25.7	6.9	0.6	13.3	3.5	6.3	0.6	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Thorburn Rs @ Larkhall St Oct 2 2012
Site Code : 00000000
Start Date : 2012/10/02
Page No : 2

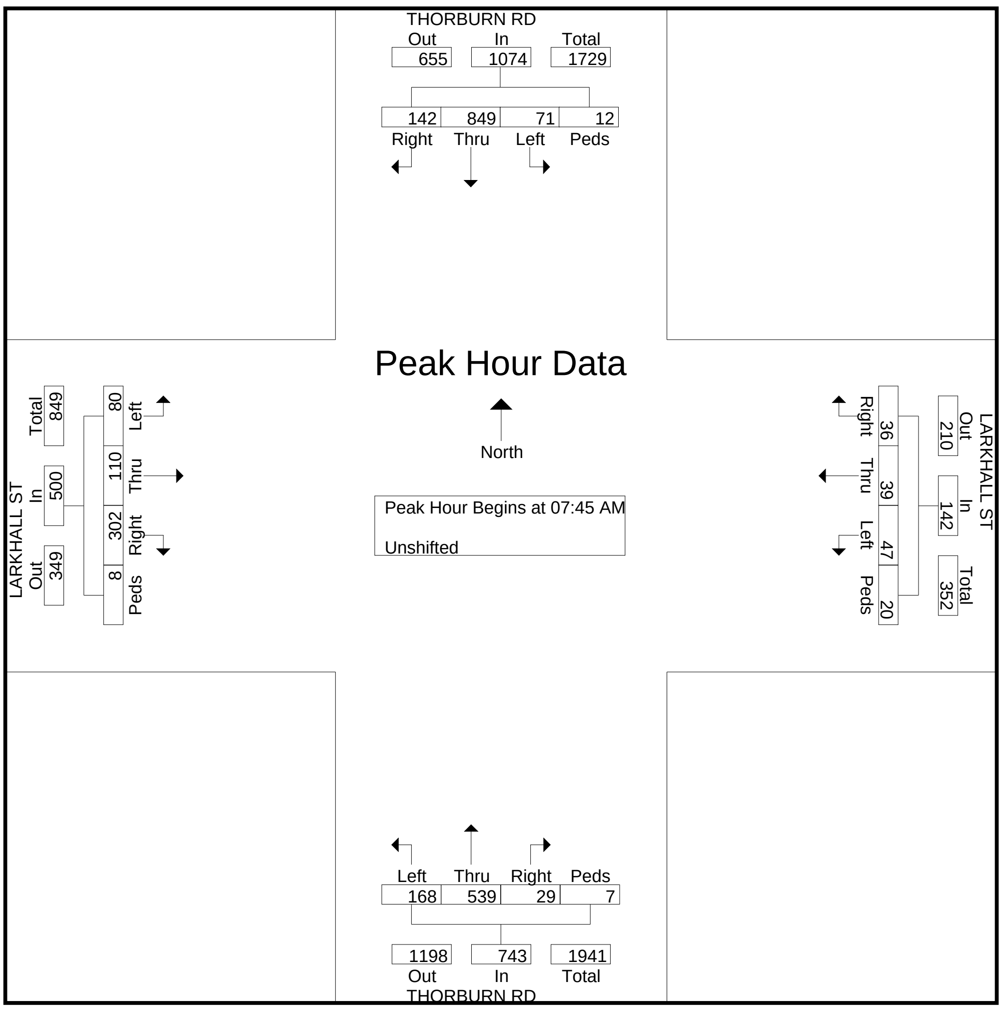


City Of St. John's

Department of Public Works
Traffic Division

File Name : Thorburn Rs @ Larkhall St Oct 2 2012
Site Code : 00000000
Start Date : 2012/10/02
Page No : 3

	THORBURN RD From North					LARKHALL ST From East					THORBURN RD From South					LARKHALL ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	**42**	214	10	1	267	10	9	9	2	30	5	136	**47**	2	190	63	23	16	2	104	591
08:00 AM	34	201	20	2	257	7	7	4	0	18	1	110	42	0	153	**88**	23	17	1	129	557
08:15 AM	29	212	**21**	1	263	8	9	15	**13**	45	**16**	129	33	**5**	183	88	**38**	**25**	2	**153**	644
08:30 AM	37	**222**	20	**8**	**287**	**11**	**14**	**19**	5	**49**	7	**164**	46	0	**217**	63	26	22	**3**	114	**667**
Total Volume	142	849	71	12	1074	36	39	47	20	142	29	539	168	7	743	302	110	80	8	500	2459
% App. Total	13.2	79.1	6.6	1.1		25.4	27.5	33.1	14.1		3.9	72.5	22.6	0.9		60.4	22	16	1.6		
PHF	.845	.956	.845	.375	.936	.818	.696	.618	.385	.724	.453	.822	.894	.350	.856	.858	.724	.800	.667	.817	.922

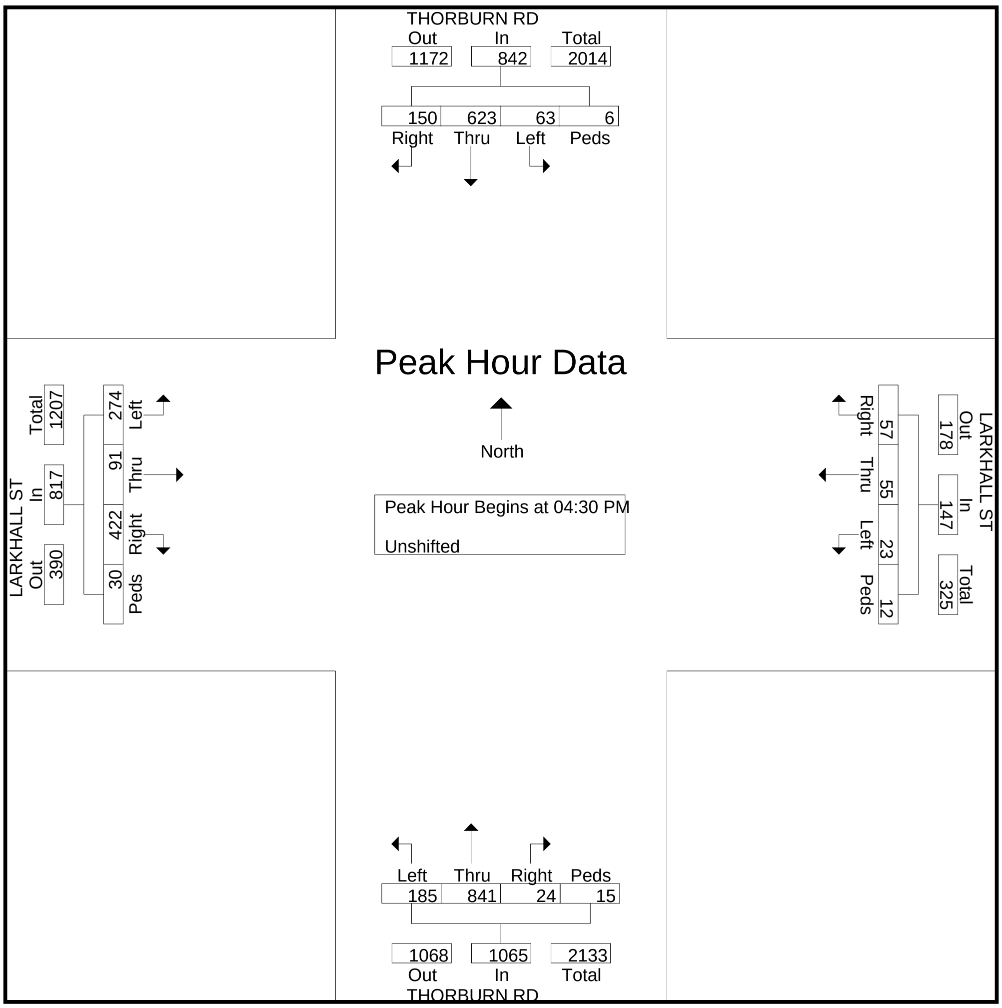


City Of St. John's

Department of Public Works
Traffic Division

File Name : Thorburn Rs @ Larkhall St Oct 2 2012
Site Code : 00000000
Start Date : 2012/10/02
Page No : 4

	THORBURN RD From North					LARKHALL ST From East					THORBURN RD From South					LARKHALL ST From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	29	**158**	17	2	206	14	15	**7**	**7**	**43**	**9**	**233**	34	4	**280**	**125**	**25**	**81**	**10**	**241**	**770**
04:45 PM	43	156	11	**3**	213	13	**16**	4	0	33	6	196	**60**	3	265	101	23	66	9	199	710
05:00 PM	33	151	17	1	202	**17**	16	7	3	43	4	223	50	3	280	105	23	75	4	207	732
05:15 PM	**45**	158	**18**	0	**221**	13	8	5	2	28	5	189	41	**5**	240	91	20	52	7	170	659
Total Volume	150	623	63	6	842	57	55	23	12	147	24	841	185	15	1065	422	91	274	30	817	2871
% App. Total	17.8	74	7.5	0.7		38.8	37.4	15.6	8.2		2.3	79	17.4	1.4		51.7	11.1	33.5	3.7		
PHF	.833	.986	.875	.500	.952	.838	.859	.821	.429	.855	.667	.902	.771	.750	.951	.844	.910	.846	.750	.848	.932



City Of St. John's

Department of Public Works
Traffic Division

Turning Movement
Thorburn Rd @ Mt. Scio Rd
Jan 19, 2012

File Name : Thorburn Rd. @ Mt. Scio Rd. Jan 19, 2012
Site Code : 00000000
Start Date : 2012/01/19
Page No : 1

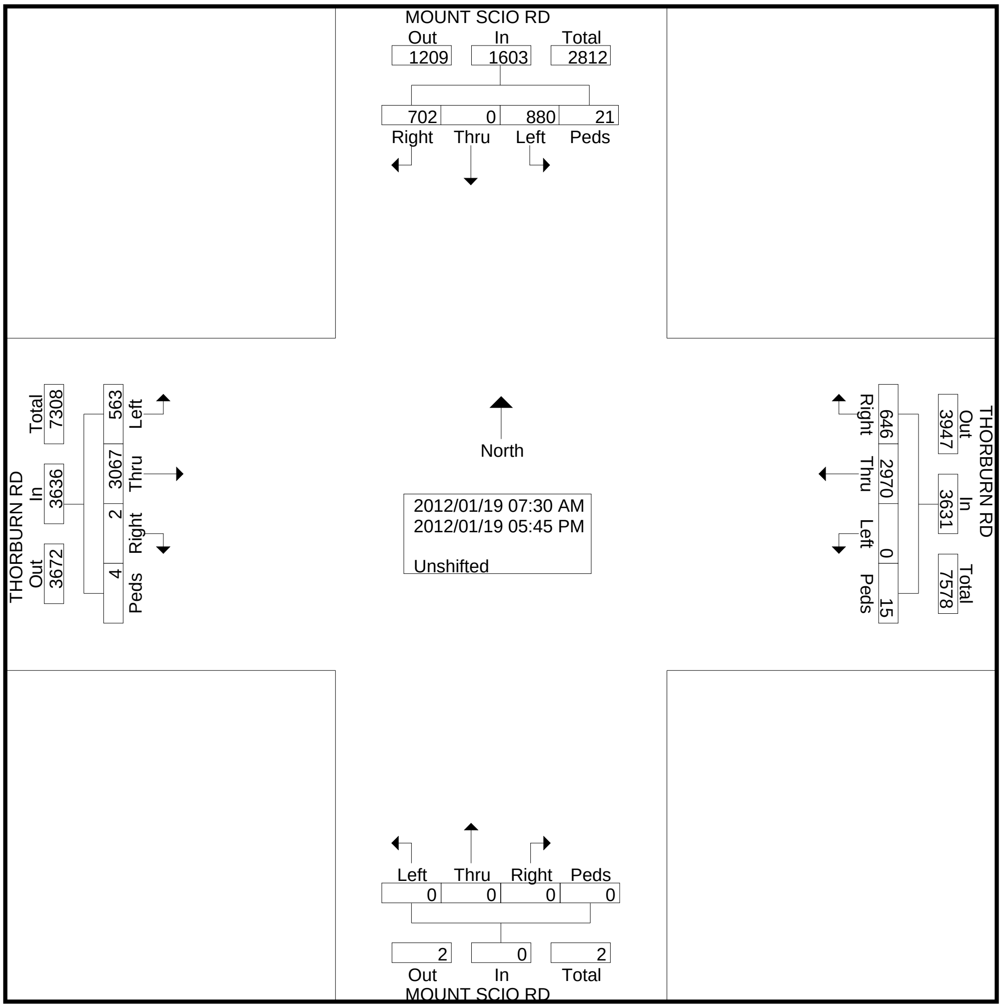
Groups Printed- Unshifted

	MOUNT SCIO RD From North				THORBURN RD From East				MOUNT SCIO RD From South				THORBURN RD From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:30 AM	40	0	47	0	23	120	0	1	0	0	0	0	0	276	23	0	530
07:45 AM	53	0	58	1	28	124	0	1	0	0	0	0	0	243	31	1	540
Total	93	0	105	1	51	244	0	2	0	0	0	0	0	519	54	1	1070
08:00 AM	48	0	85	3	41	110	0	2	0	0	0	0	0	255	44	0	588
08:15 AM	59	0	67	2	42	159	0	1	0	0	0	0	0	306	33	0	669
08:30 AM	66	0	52	1	66	144	0	0	0	0	0	0	0	251	35	0	615
08:45 AM	52	0	44	0	44	135	0	0	0	0	0	0	0	186	20	0	481
Total	225	0	248	6	193	548	0	3	0	0	0	0	0	998	132	0	2353
09:00 AM	18	0	32	0	19	110	0	0	0	0	0	0	0	158	15	0	352
09:15 AM	26	0	24	0	22	96	0	1	0	0	0	0	0	162	13	0	344
*** BREAK ***																	
Total	44	0	56	0	41	206	0	1	0	0	0	0	0	320	28	0	696
*** BREAK ***																	
04:00 PM	64	0	54	1	51	289	0	3	0	0	0	0	2	161	51	0	676
04:15 PM	57	0	56	1	38	298	0	1	0	0	0	0	0	182	51	0	684
04:30 PM	54	0	83	6	48	269	0	1	0	0	0	0	0	185	61	0	707
04:45 PM	51	0	60	0	57	306	0	0	0	0	0	0	0	171	37	0	682
Total	226	0	253	8	194	1162	0	5	0	0	0	0	2	699	200	0	2749
05:00 PM	31	0	78	1	61	280	0	2	0	0	0	0	0	161	58	1	673
05:15 PM	39	0	56	1	41	236	0	1	0	0	0	0	0	134	40	1	549
05:30 PM	22	0	49	2	35	148	0	1	0	0	0	0	0	119	22	0	398
05:45 PM	22	0	35	2	30	146	0	0	0	0	0	0	0	117	29	1	382
Total	114	0	218	6	167	810	0	4	0	0	0	0	0	531	149	3	2002
Grand Total	702	0	880	21	646	2970	0	15	0	0	0	0	2	3067	563	4	8870
Apprch %	43.8	0	54.9	1.3	17.8	81.8	0	0.4	0	0	0	0	0.1	84.4	15.5	0.1	
Total %	7.9	0	9.9	0.2	7.3	33.5	0	0.2	0	0	0	0	0	34.6	6.3	0	

City Of St. John's

Department of Public Works
Traffic Division

File Name : Thorburn Rd. @ Mt. Scio Rd. Jan 19, 2012
Site Code : 00000000
Start Date : 2012/01/19
Page No : 2

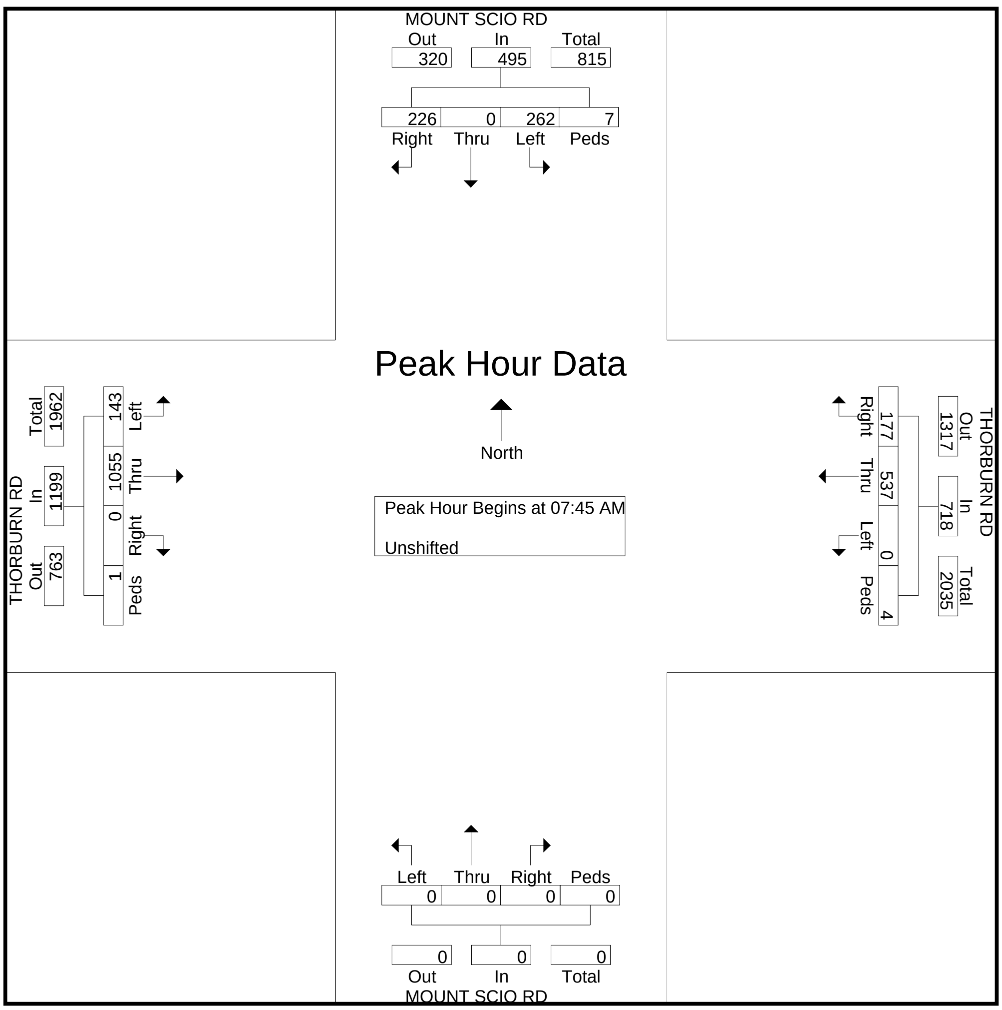


City Of St. John's

Department of Public Works
Traffic Division

File Name : Thorburn Rd. @ Mt. Scio Rd. Jan 19, 2012
Site Code : 00000000
Start Date : 2012/01/19

	MOUNT SCIO RD From North					THORBURN RD From East					MOUNT SCIO RD From South					THORBURN RD From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	53	0	58	1	112	28	124	0	1	153	0	0	0	0	0	0	243	31	**1**	275	540
08:00 AM	48	0	**85**	**3**	**136**	41	110	0	**2**	153	0	0	0	0	0	0	255	**44**	0	299	588
08:15 AM	59	0	67	2	128	42	**159**	0	1	202	0	0	0	0	0	0	**306**	33	0	**339**	**669**
08:30 AM	**66**	0	52	1	119	**66**	144	0	0	**210**	0	0	0	0	0	0	251	35	0	286	615
Total Volume	226	0	262	7	495	177	537	0	4	718	0	0	0	0	0	0	1055	143	1	1199	2412
% App. Total	45.7	0	52.9	1.4		24.7	74.8	0	0.6		0	0	0	0		0	88	11.9	0.1		
PHF	.856	.000	.771	.583	.910	.670	.844	.000	.500	.855	.000	.000	.000	.000	.000	.000	.862	.813	.250	.884	.901

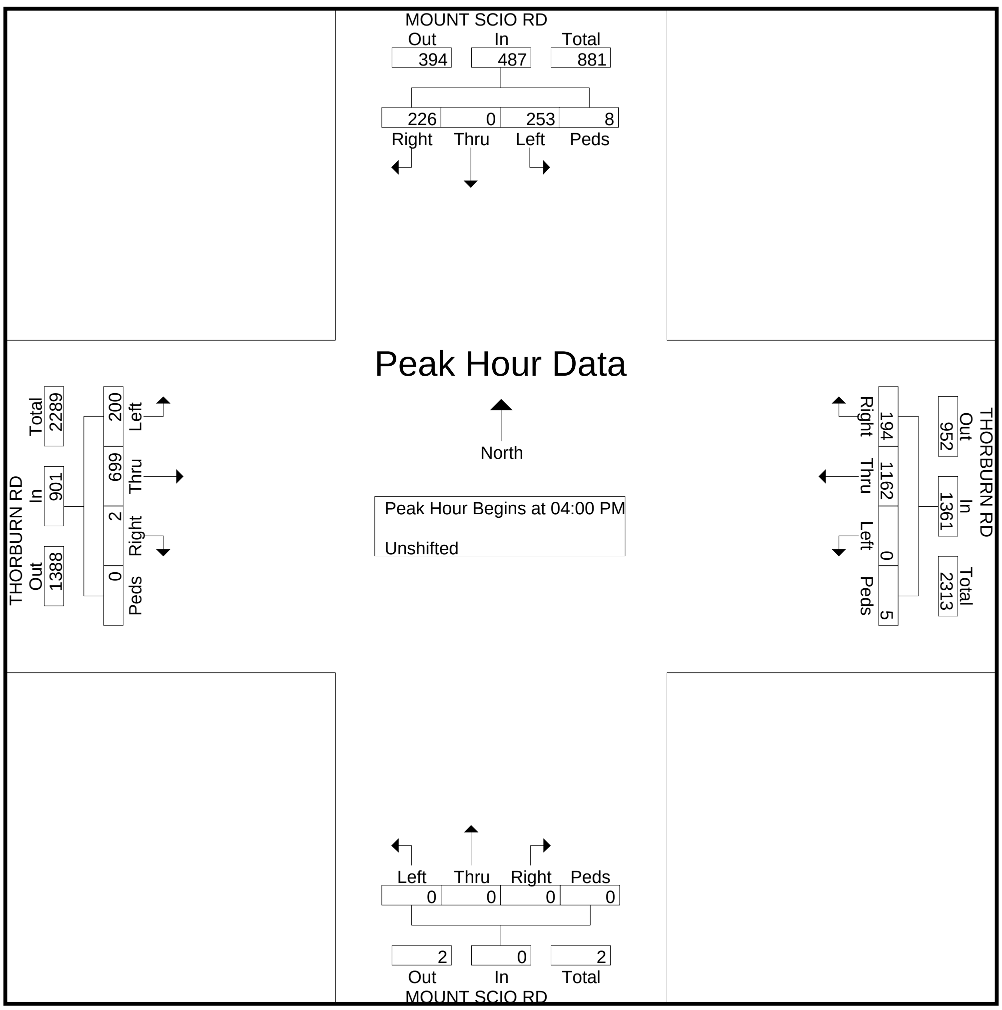


City Of St. John's

Department of Public Works
Traffic Division

File Name : Thorburn Rd. @ Mt. Scio Rd. Jan 19, 2012
Site Code : 00000000
Start Date : 2012/01/19
Page No : 4

	MOUNT SCIO RD From North					THORBURN RD From East					MOUNT SCIO RD From South					THORBURN RD From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	**64**	0	54	1	119	51	289	0	**3**	343	0	0	0	0	0	**2**	161	51	0	214	676
04:15 PM	57	0	56	1	114	38	298	0	1	337	0	0	0	0	0	0	182	51	0	233	684
04:30 PM	54	0	**83**	**6**	**143**	48	269	0	1	318	0	0	0	0	0	0	**185**	**61**	0	**246**	**707**
04:45 PM	51	0	60	0	111	**57**	**306**	0	0	**363**	0	0	0	0	0	0	171	37	0	208	682
Total Volume	226	0	253	8	487	194	1162	0	5	1361	0	0	0	0	0	2	699	200	0	901	2749
% App. Total	46.4	0	52	1.6		14.3	85.4	0	0.4		0	0	0	0		0.2	77.6	22.2	0		
PHF	.883	.000	.762	.333	.851	.851	.949	.000	.417	.937	.000	.000	.000	.000	.000	.250	.945	.820	.000	.916	.972



APPENDIX B-1

2 – TURNING MOVEMENT COUNTS BY HATCH

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052
Intersection: Topsail Road / Blackmarsh Road
Date: Thursday, September 12, 2013
Counted by: Zhimin Ma & Scott
Weather
Comments

Time Period	Eastbound Approach							Westbound Approach							Northbound Approach							Southbound Approach							15-min	Hourly
Starting:	Left		Through		Right			Left		Through		Right			Left		Through		Right			Left		Through		Right			Vehicle	Vehicle
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Volumes	Volumes
7:15 AM	70	3	57	2	0	0		0	0	48	1	5	0		0	0	0	0	0	0	0	0	0	0	0	31	0		217	
7:30 AM	114	9	122	4	0	0		0	0	100	7	4	0		0	0	0	0	0	0	0	0	0	0	0	105	4		469	
7:45 AM	115	6	138	1	0	0		0	0	126	0	12	1		0	0	0	0	0	0	0	0	0	0	0	77	6		482	
8:00 AM	141	3	120	2	0	0		0	0	95	2	14	0		0	0	0	0	0	0	0	1	0	0	0	53	2		433	1601
8:15 AM	118	4	167	7	0	0		0	0	123	3	4	1		0	0	0	0	0	0	0	0	0	0	0	87	0		514	1898
8:30 AM	126	5	170	3	0	0		0	0	112	5	10	0		0	0	0	0	0	0	0	0	0	0	0	49	1		481	1910
8:45 AM	93	7	143	6	0	0		0	0	102	1	9	0		0	0	0	0	0	0	0	0	0	0	0	47	5		413	1841
9:00 AM	63	6	119	4	0	0		0	0	70	3	5	0		0	0	0	0	0	0	0	2	0	0	0	53	5		330	1738
2-Hour Totals:	840	43	1036	29	0	0	0	0	0	776	22	63	2	0	0	0	0	0	0	0	0	3	0	0	0	502	23	0	3339	
2-Hour Vehicles:	883		1065		0			0		798		65			0		0		0			3		0		525			3339	
Truck Percentage:	5%		3%		######			######		3%		3%			######		######		######			0%		######		4%			4%	
AM Peak Hour:	500	18	595	13	0	0	0	0	0	456	10	40	2	0	0	0	0	0	0	0	0	1	0	0	0	266	9	0	1910	PHF:
7:45 AM - 8:45 AM	518		608		0			0		466		42			0		0		0			1		0		275			1910	0.93
Truck Percentage:	3%		2%		######			######		2%		0%			######		######		######			0%		######		0%			3%	
4:00 PM	58	0	77	0	0	0		0	0	129	2	5	0		0	0	0	0	0	0	0	1	0	0	0	79	3		354	
4:15 PM	99	4	112	0	0	0		0	0	148	5	6	0		0	0	0	0	0	0	0	1	0	0	0	97	1		473	
4:30 PM	110	1	144	3	0	0		0	0	222	4	10	0		0	0	0	0	0	0	0	1	0	0	0	123	7		625	
4:45 PM	111	1	129	1	0	0		0	0	186	2	13	0		0	0	0	0	0	0	0	5	0	0	0	155	3		606	2058
5:00 PM	140	0	148	1	0	0		0	0	185	0	15	0		0	0	0	0	0	0	0	0	0	0	0	101	4		594	2298
5:15 PM	112	3	108	2	0	0		0	0	145	6	6	0		0	0	0	0	0	0	0	0	0	0	0	115	0		497	2322
5:30 PM	113	0	113	2	0	0		0	0	153	3	7	0		0	0	0	0	0	0	0	0	0	0	0	94	5		490	2187
5:45 PM	84	0	80	0	0	0		0	0	103	0	3	0		0	0	0	0	0	0	0	3	0	0	0	80	1		354	1935
2-Hour Totals:	827	9	911	9	0	0	0	0	0	1271	22	65	0	0	0	0	0	0	0	0	0	11	0	0	0	844	24	0	3993	
2-Hour Vehicles:	836		920		0			0		1293		65			0		0		0			11		0		868			3993	
Truck Percentage:	1%		1%		######			######		2%		0%			######		######		######			0%		######		3%			2%	
PM Peak Hour:	473	5	529	7	0	0	0	0	0	738	12	44	0	0	0	0	0	0	0	0	0	6	0	0	0	494	14	0	2322	PHF:
4:30 - 5:30 PM	478		536		0			0		750		44			0		0		0			6		0		508			2322	0.93
Peak Hour Factor:	1%		1%		######			######		2%		0%			######		######		######			0%		######		0%			2%	
6-Hour Total:	**1667**	**52**	**1947**	**38**	**0**	**0**	**0**	**0**	**0**	**2047**	**44**	**128**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**1346**	**47**	**0**	**7332**	

HV - heavy vehicles - includes trucks and buses

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052

Intersection: Topsail Road/ Commonwealth Avenue/ Mount Carson Avenue

Date: September 17 (AM) & 25 (PM), 2013

Counted by: Robert & Tao Li (AM), Robert & Scott (PM)

Weather

Comments Scott was 5 minutes late and added 50% to the 4:00-4:15 count (EB & SB) [PM]

Time Period	Eastbound Approach							Westbound Approach							Northbound Approach							Southbound Approach							15-min	Hourly
Starting:	Left		Through		Right			Left		Through		Right			Left		Through		Right			Left		Through		Right			Vehicle	Vehicle
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Volumes	Volumes
7:00 AM	8	0	151	1	14	0		6	0	68	1	5	0		45	2	85	1	50	0		9	0	17	1	12	0		476	
7:15 AM	6	0	115	0	30	0		26	0	79	5	1	0		37	2	100	0	53	4		11	0	38	0	7	0		514	
7:30 AM	10	0	155	0	15	0		52	0	107	2	1	0		65	0	93	0	69	1		19	0	45	0	4	0		638	
7:45 AM	24	1	180	5	34	0		50	3	138	2	3	0		62	0	100	1	66	1		55	1	92	0	5	0		823	2451
8:00 AM	9	0	183	0	70	4		51	1	94	3	5	0	1	66	1	120	1	55	2	4	43	0	103	1	10	0		822	2797
8:15 AM	12	0	192	4	63	0		31	0	111	4	6	0		54	0	93	0	72	2	4	23	0	60	1	11	0		739	3022
8:30 AM	21	0	166	3	48	1		57	1	107	3	8	0		52	0	105	1	68	3		30	0	51	0	10	0		735	3119
8:45 AM	15	0	159	4	43	0		32	0	91	0	6	1		49	1	94	0	74	0		17	0	39	0	7	1		633	2929
2-Hour Totals:	105	1	1301	17	317	5	0	305	5	795	20	35	1	1	430	6	790	4	507	13	8	207	1	445	3	66	1	0	5380	
2-Hour Vehicles:	106		1318		322			310		815		36			436		794		520			208		448		67			5380	
Truck Percentage:	1%		1%		2%			2%		2%		3%			1%		1%		3%			0%		1%		1%			1%	
AM Peak Hour:	66	1	721	12	215	5	0	189	5	450	12	22	0	1	234	1	418	3	261	8	8	151	1	306	2	36	0	0	3119	PHF:
7:45 - 8:45 AM	67		733		220			194		462		22			235		421		269			152		308		36			3119	0.95
Truck Percentage:	1%		2%		0%			3%		3%		0%			0%		1%		3%			1%		1%		0%			2%	
4:00 PM	12	0	102	1	38	0		63	0	77	3	6	0		26	0	36	1	49	0		7	0	57	0	9	0		487	
4:15 PM	11	0	162	1	65	3		73	0	59	4	15	0		50	0	58	3	50	0		11	0	97	1	4	0		667	
4:30 PM	17	1	179	1	125	0	1	85	0	145	3	16	1		50	2	71	0	63	1		12	0	102	0	7	0	1	881	
4:45 PM	6	0	175	3	148	2		110	0	158	5	9	0		51	0	80	1	49	1		17	0	118	2	8	0		943	2978
5:00 PM	25	0	216	1	183	0	1	91	1	151	1	5	0		52	0	73	0	66	1		23	0	123	1	6	0	1	1019	3510
5:15 PM	4	0	171	2	127	0		82	0	130	2	11	0		54	0	92	1	53	0		15	0	142	0	9	0		895	3738
5:30 PM	19	0	151	1	126	1		81	0	110	0	5	1		45	1	70	1	48	1		19	0	113	0	9	0	1	802	3659
5:45 PM	10	0	92	1	59	0		59	1	90	3	4	0		46	0	78	0	61	0		6	0	117	1	7	0		635	3351
2-Hour Totals:	104	1	1248	11	871	6	2	644	2	920	21	71	2	0	374	3	558	7	439	4	0	110	0	869	5	59	0	3	6329	
2-Hour Vehicles:	105		1259		877			646		941		73			377		565		443			110		874		59			6329	
Truck Percentage:	1%		1%		1%			0%		2%		3%			1%		1%		1%			0%		1%		0%			1%	
PM Peak Hour:	52	1	741	7	583	2	2	368	1	584	11	41	1	0	207	2	316	2	231	3	0	67	0	485	3	30	0	2	3738	PHF:
4:30 - 5:30 PM	53		748		585			369		595		42			209		318		234			67		488		30			3738	0.92
Peak Hour Factor:	2%		1%		0%			0%		2%		2%			1%		1%		1%			0%		1%		0%			1%	
6-Hour Total:	**227**	**2**	**2549**	**28**	**1188**	**11**	**2**	**949**	**7**	**1715**	**41**	**106**	**3**	**1**	**804**	**9**	**1348**	**11**	**946**	**17**	**8**	**317**	**1**	**1314**	**8**	**125**	**1**	**3**	**11709**	

HV - heavy vehicles - includes trucks and buses

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052

Intersection: Thorburn Road / Outer Ring Rd (SB)

Date: Wednesday, September 18, 2013

Counted by: Robert & Justin (AM), Justin & Scott (PM)

Weather

Comments

Time Period Starting:	Eastbound Approach							Westbound Approach							Northbound Approach							Southbound Approach							15-min Vehicle Volumes	Hourly Vehicle Volumes
	Left		Through		Right			Left		Through		Right			Left		Through		Right			Left		Through		Right				
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds		
7:00 AM	0	0	66	1	26	3	0	15	0	20	8	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	0	0	145	
7:15 AM	0	0	125	1	41	8	0	11	1	19	4	0	0	0	0	0	0	0	0	0	0	4	1	0	0	5	0	0	220	
7:30 AM	0	0	205	1	41	3	0	16	2	24	5	0	0	0	0	0	0	0	0	0	0	5	3	0	0	7	0	0	312	
7:45 AM	0	0	225	6	43	6	0	30	6	33	6	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	1	0	360	1037
8:00 AM	0	0	333	3	44	2	0	25	2	31	4	0	0	0	0	0	0	0	0	0	0	3	1	0	0	8	2	0	458	1350
8:15 AM	0	0	265	1	32	5	0	13	0	30	9	0	0	0	0	0	0	0	0	0	0	7	2	0	0	7	3	0	374	1504
8:30 AM	0	0	210	2	32	5	0	17	2	29	10	0	0	0	0	0	0	0	0	0	0	3	1	0	0	17	0	0	328	1520
8:45 AM	0	0	122	1	10	3	0	14	0	21	7	0	0	0	0	0	0	0	0	0	0	3	0	0	0	10	1	0	192	1352
2-Hour Totals:	0	0	1551	16	269	35	0	141	13	207	53	0	0	0	0	0	0	0	0	0	0	29	8	0	0	60	7	0	2389	
2-Hour Vehicles:	0		1567		304			154		260		0			0		0		0			37		0		67			2389	
Truck Percentage:	######		1%		12%			8%		20%		######			######		######		######			22%		######		10%			6%	
AM Peak Hour:	0	0	1033	12	151	18	0	85	10	123	29	0	0	0	0	0	0	0	0	0	0	16	4	0	0	33	6	0	1520	PHF:
7:45 AM - 8:45 AM	0		1045		169			95		152		0			0		0		0			20		0		39			1520	0.83
Truck Percentage:	######		1%		0%			11%		19%		######			######		######		######			20%		######		0%			5%	
4:00 PM	0	0	42	4	8	2	0	86	0	113	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	46	3	0	308	
4:15 PM	0	0	42	4	14	0	0	121	3	118	7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	54	0	0	364	
4:30 PM	0	0	52	2	17	4	0	102	8	139	6	0	0	0	0	0	0	0	0	0	0	3	0	0	0	78	1	0	412	
4:45 PM	0	0	65	0	18	2	0	93	3	165	8	0	0	0	0	0	0	0	0	0	0	2	0	0	0	91	0	0	447	1531
5:00 PM	0	0	62	4	15	4	1	90	0	160	12	0	0	1	0	0	0	0	0	0	0	2	1	0	0	85	0	0	435	1658
5:15 PM	0	0	61	0	18	0	0	83	0	172	7	0	0	0	0	0	0	0	0	0	0	4	0	0	0	110	1	0	456	1750
5:30 PM	0	0	65	0	20	0	0	48	2	150	8	0	0	0	0	0	0	0	0	0	0	4	0	0	0	75	1	0	373	1711
5:45 PM	0	0	44	0	19	2	0	33	0	100	2	0	0	0	0	0	0	0	0	0	0	8	0	0	0	49	2	0	259	1523
2-Hour Totals:	0	0	433	14	129	14	1	656	16	1117	50	0	0	1	0	0	0	0	0	0	0	28	1	0	0	588	8	0	3054	
2-Hour Vehicles:	0		447		143			672		1167		0			0		0		0			29		0		596			3054	
Truck Percentage:	######		3%		10%			2%		4%		######			######		######		######			3%		######		1%			3%	
PM Peak Hour:	0	0	240	6	68	10	1	368	11	636	33	0	0	1	0	0	0	0	0	0	0	11	1	0	0	364	2	0	1750	PHF:
4:30 - 5:30 PM	0		246		78			379		669		0			0		0		0			12		0		366			1750	0.96
Peak Hour Factor:	######		2%		13%			3%		5%		######			######		######		######			8%		######		0%			4%	
6-Hour Total:	**0**	**0**	**1984**	**30**	**398**	**49**	**1**	**797**	**29**	**1324**	**103**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**57**	**9**	**0**	**0**	**648**	**15**	**0**	**5443**	

HV - heavy vehicles - includes trucks and buses

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052

Intersection: Thorburn Road / Outer Ring Rd (EB)

Date: Wednesday, September 18, 2013

Counted by: Scoot & Chris (AM), Robert (PM)

Weather:

Comments: Only turning movements counted in PM

Time Period Starting:	Eastbound Approach							Westbound Approach							Northbound Approach							Southbound Approach							15-min Vehicle Volumes	Hourly Vehicle Volumes
	Left		Through		Right			Left		Through		Right			Left		Through		Right			Left		Through		Right				
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds		
7:00 AM	20	0	41	0	0	0	0	0	0	26	0	3	1	0	9	8	0	0	91	1	0	0	0	0	0	0	0	0	200	
7:15 AM	52	0	73	2	0	0	0	0	0	27	1	3	1	0	5	3	0	0	108	2	0	0	0	0	0	0	0	0	277	
7:30 AM	41	0	130	2	0	0	0	0	0	18	1	5	0	0	4	5	0	0	120	3	0	0	0	0	0	0	0	0	329	
7:45 AM	78	1	130	5	0	0	0	0	0	51	7	5	3	0	20	5	0	0	122	6	0	0	0	0	0	0	0	0	433	1239
8:00 AM	121	0	144	4	0	0	0	0	0	46	1	7	2	0	9	2	0	0	96	4	0	0	0	0	0	0	0	0	436	1475
8:15 AM	88	0	140	1	0	0	0	0	0	32	3	4	2	0	10	5	0	0	115	1	0	0	0	0	0	0	0	0	401	1599
8:30 AM	89	1	100	3	0	0	0	0	0	32	4	10	0	0	11	7	0	0	118	2	0	0	0	0	0	0	0	0	377	1647
8:45 AM	51	2	71	0	0	0	0	0	0	28	1	3	3	0	7	5	0	0	97	4	0	0	0	0	0	0	0	0	272	1486
2-Hour Totals:	540	4	829	17	0	0	0	0	0	260	18	40	12	0	75	40	0	0	867	23	0	0	0	0	0	0	0	0	2725	
2-Hour Vehicles:	544		846		0			0		278		52			115		0		890			0		0		0			2725	
Truck Percentage:	1%		2%		######			######		6%		23%			35%		######		3%			######		######		######			4%	
AM Peak Hour:	376	2	514	13	0	0	0	0	0	161	15	26	7	0	50	19	0	0	451	13	0	0	0	0	0	0	0	0	1647	PHF:
7:45 AM - 8:45 AM	378		527		0			0		176		33			69		0		464			0		0		0			1647	0.94
Truck Percentage:	1%		2%		0%			######		9%		21%			28%		######		3%			######		######		0%			4%	
4:00 PM	15	3			0	0	0	0	0			5	0	0	32	1	1	0	28	3	0	0	0	0	0	0	0	0	88	
4:15 PM	15	2			0	0	0	0	0			5	0	0	34	4	0	0	38	0	0	0	0	0	0	0	0	0	98	
4:30 PM	23	0			0	0	0	0	0			10	2	0	40	1	0	0	42	2	0	0	0	0	0	0	0	0	120	
4:45 PM	23	0			0	0	0	0	0			7	0	0	47	3	0	0	37	0	0	0	0	0	0	0	0	0	117	423
5:00 PM	25	0			0	0	0	0	0			13	0	0	36	4	0	0	33	0	0	0	0	0	0	0	0	0	111	446
5:15 PM	18	1			0	0	0	0	0			3	1	0	41	4	0	0	28	1	0	0	0	0	0	0	0	0	97	445
5:30 PM	26	0			0	0	0	0	0			3	0	0	54	2	0	0	37	0	0	0	0	0	0	0	0	0	122	447
5:45 PM	18	0			0	0	0	0	0			3	0	0	31	1	0	0	31	1	0	0	0	0	0	0	0	0	85	415
2-Hour Totals:	163	6	0	0	0	0	0	0	0	0	0	49	3	0	315	20	1	0	274	7	0	0	0	0	0	0	0	0	838	
2-Hour Vehicles:	169		0		0			0		0		52			335		1		281			0		0		0			838	
Truck Percentage:	4%		######		######			######		######		6%			6%		0%		2%			######		######		######			4%	
PM Peak Hour:	92	1	0	0	0	0	0	0	0	0	0	26	1	0	178	13	0	0	135	1	0	0	0	0	0	0	0	0	447	PHF:
4:45 - 5:45 PM	93		0		0			0		0		27			191		0		136			0		0		0			447	0.92
Peak Hour Factor:	1%		######		0%			######		######		4%			7%		######		1%			######		######		0%			3.6%	
6-Hour Total:	**703**	**10**	**829**	**17**	**0**	**0**	**0**	**0**	**0**	**260**	**18**	**89**	**15**	**0**	**390**	**60**	**1**	**0**	**1141**	**30**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3563**	

HV - heavy vehicles - includes trucks and buses

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052
Intersection: Kelsey Drive / Team Gushue Highway (SB)
Date: Thursday, September 19, 2013
Counted by: Scott
Weather:
Comments: Counted all movements

Time Period	Eastbound Approach							Westbound Approach							Northbound Approach							Southbound Approach							15-min	Hourly
Starting:	Left		Through		Right			Left		Through		Right			Left		Through		Right			Left		Through		Right			Vehicle	Vehicle
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Volumes	Volumes
7:00 AM	0	0	20	5	0	0	0	0	0	14	1	0	0	0	0	0	0	0	0	0	0	59	0	0	0	22	2	0	123	
7:15 AM	0	0	27	2	0	0	0	2	0	27	1	0	0	0	0	0	0	0	0	0	0	68	3	0	0	39	0	0	169	
7:30 AM	0	0	48	3	0	0	0	0	0	27	2	0	0	0	0	0	0	0	0	0	0	98	1	0	0	49	3	0	231	
7:45 AM	0	0	58	8	0	0	0	2	1	56	1	0	0	0	0	0	0	0	0	0	0	152	4	0	0	47	11	0	340	863
8:00 AM	0	0	73	5	1	0	0	0	0	37	1	0	0	0	0	0	0	0	0	0	0	130	3	0	0	32	4	0	286	1026
8:15 AM	0	0	77	1	1	0	0	1	0	62	1	0	0	0	0	0	0	0	0	0	0	122	6	0	0	27	2	0	300	1157
8:30 AM	0	0	72	4	0	0	0	1	0	40	5	0	0	0	0	0	0	0	0	0	0	128	2	0	0	40	7	0	299	1225
8:45 AM	0	0	65	5	0	0	0	0	0	37	2	0	0	0	0	0	0	0	0	0	0	115	2	0	0	28	2	0	256	1141
2-Hour Totals:	0	0	440	33	2	0	0	6	1	300	14	0	0	0	0	0	0	0	0	0	0	872	21	0	0	284	31	0	2004	
2-Hour Vehicles:	0		473		2			7		314		0			0		0		0			893		0		315			1689	
Truck Percentage:	######		7%		0%			14%		4%		######			######		######		######			2%		######		10%			6%	
AM Peak Hour:	0	0	280	18	2	0	0	4	1	195	8	0	0	0	0	0	0	0	0	0	0	532	15	0	0	146	24	0	1225	PHF:
7:45 AM - 8:45 AM	0		298		2			5		203		0			0		0		0			547		0		170			1225	0.90
Truck Percentage:	######		6%		0%			20%		4%		######			######		######		######			3%		######		0%			5%	
4:00 PM	0	0	90	4	0	0	0	1	0	81	2	0	0	0	0	0	0	0	0	0	0	45	3	1	0	54	3	0	284	
4:15 PM	0	0	109	4	2	0	0	1	0	93	1	0	0	0	0	0	0	0	0	0	0	51	3	0	0	65	2	0	331	
4:30 PM	0	0	153	1	0	0	1	1	0	129	0	0	0	1	0	0	0	0	0	0	0	50	3	0	0	61	2	0	400	
4:45 PM	0	0	127	1	1	0	0	0	0	109	5	0	0	0	0	0	0	0	0	0	0	45	3	0	0	71	3	0	365	1380
5:00 PM	0	0	146	3	0	0	0	0	0	99	1	0	0	0	0	0	0	0	0	0	0	46	2	0	0	72	0	0	369	1465
5:15 PM	0	0	113	0	1	0	0	1	0	90	0	0	0	0	0	0	0	0	0	0	0	48	4	0	0	82	0	0	339	1473
5:30 PM	0	0	108	0	1	0	0	0	0	78	1	0	0	0	0	0	0	0	0	0	0	34	3	0	0	47	0	0	272	1345
5:45 PM	0	0	69	0	1	0	0	0	0	70	1	0	0	0	0	0	0	0	0	0	0	46	3	0	0	51	0	0	241	1221
2-Hour Totals:	0	0	915	13	6	0	1	4	0	749	11	0	0	1	0	0	0	0	0	0	0	365	24	1	0	503	10	0	2601	
2-Hour Vehicles:	0		928		6			4		760		0			0		0		0			389		1		513			2088	
Truck Percentage:	######		1%		0%			0%		1%		######			######		######		######			6%		0%		2%			3%	
PM Peak Hour:	0	0	539	5	2	0	1	2	0	427	6	0	0	1	0	0	0	0	0	0	0	189	12	0	0	286	5	0	1473	PHF:
4:30 - 5:30 PM	0		544		2			2		433		0			0		0		0			201		0		291			1473	0.92
Peak Hour Factor:	######		1%		0%			0%		1%		######			######		######		######			6%		######		0%			2%	
6-Hour Total:	**0**	**0**	**1355**	**46**	**8**	**0**	**1**	**10**	**1**	**1049**	**25**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1237**	**45**	**1**	**0**	**787**	**41**	**0**	**4605**	

HV - heavy vehicles - includes trucks and buses

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052

Intersection: Kelsey Drive/ Team Gushue Highway (NB)

Date: Thursday, September 19, 2013

Counted by: Robert (AM) & Chris (PM)

Weather

Comments: Only turning movements counted in AM & PM

Time Period Starting:	Eastbound Approach							Westbound Approach							Northbound Approach							Southbound Approach							15-min Vehicle Volumes	Hourly Vehicle Volumes
	Left		Through		Right			Left		Through		Right			Left		Through		Right			Left		Through		Right				
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds		
7:00 AM	8	5			0	0	0	0	0			12	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	27	
7:15 AM	6	1			0	0	0	0	0			12	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	22	
7:30 AM	12	0			0	0	0	0	0			28	2	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	47	
7:45 AM	16	4			0	0	0	0	0			41	4	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	69	165
8:00 AM	16	3			0	0	0	0	0			34	1	0	2	0	0	0	7	0	0	0	0	0	0	0	0	0	63	201
8:15 AM	16	1			0	0	0	0	0			30	1	0	3	0	0	0	12	1	0	0	0	0	0	0	0	0	64	243
8:30 AM	22	3			0	0	0	0	0			30	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	61	257
8:45 AM	11	3			0	0	0	0	0			32	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	50	238
2-Hour Totals:	107	20	0	0	0	0	0	0	0	0	0	219	11	0	7	0	0	0	38	1	0	0	0	0	0	0	0	0	403	
2-Hour Vehicles:	127		0		0			0		0		230			7		0		39			0		0		0			403	
Truck Percentage:	16%		######		######			######		######		5%			0%		######		3%			######		######		######			8%	
AM Peak Hour:	70	11	0	0	0	0	0	0	0	0	0	135	7	0	5	0	0	0	28	1	0	0	0	0	0	0	0	0	257	PHF:
7:45 AM - 8:45 AM	81		0		0			0		0		142			5		0		29			0		0		0			257	0.93
Truck Percentage:	14%		######		0%			######		######		5%			0%		######		3%			######		######		0%			7%	
4:00 PM	44	3			0	0	0	0	0			120	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	
4:15 PM	61	3			0	0	0	0	0			120	0	0	0	0	0	0	6	0	1	0	0	0	0	0	0	0	190	
4:30 PM	76	1			0	0	0	0	0			159	0	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	242	
4:45 PM	66	1			0	0	1	0	0			124	2	1	1	0	0	0	4	0	0	0	0	0	0	0	0	0	198	801
5:00 PM	87	2			0	0	1	0	0			150	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	242	872
5:15 PM	56	1			0	0	2	0	0			91	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	149	831
5:30 PM	53	0			0	0	0	0	0			59	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	113	702
5:45 PM	35	0			0	0	0	0	0			63	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	100	604
2-Hour Totals:	478	11	0	0	0	0	4	0	0	0	0	886	9	4	1	0	2	0	17	1	1	0	0	0	0	0	0	0	1405	
2-Hour Vehicles:	489		0		0			0		0		895			1		2		18			0		0		0			1405	
Truck Percentage:	2%		######		######			######		######		1%			0%		0%		6%			######		######		######			1%	
PM Peak Hour:	290	7	0	0	0	0	2	0	0	0	0	553	2	2	1	0	1	0	17	1	1	0	0	0	0	0	0	0	872	PHF:
4:45 - 5:45 PM	297		0		0			0		0		555			1		1		18			0		0		0			872	0.90
Peak Hour Factor:	2%		######		0%			######		######		0%			0%		0%		6%			######		######		0%			1.1%	
6-Hour Total:	**585**	**31**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**1105**	**20**	**4**	**8**	**0**	**2**	**0**	**55**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1808**	

HV - heavy vehicles - includes trucks and buses

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052 Weather

Intersection: Kenmount Drive/ Brougham Drive Comments

Date: Tuesday, September 24, 2013

Counted by: Chris & Scott

Time Period Starting:	Eastbound Approach on Kenmount							Westbound Approach on Kenmount						
	Left		Through		Right			Left		Through		Right		
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds
7:00 AM	0	0	82	2	0	0		6	0	25	2	3	0	
7:15 AM	1	0	18	5	0	0		10	0	35	1	5	0	
7:30 AM	4	0	141	2	9	0		14	0	72	5	8	0	
7:45 AM	3	1	144	5	9	0		32	0	92	1	11	0	
8:00 AM	13	1	125	13	13	1		12	0	64	3	12	0	
8:15 AM	14	0	143	4	12	0		23	0	52	0	19	0	
8:30 AM	3	0	131	0	10	1		12	0	53	2	4	0	
8:45 AM	8	0	108	2	10	0		17	0	47	7	4	0	
2-Hour Totals:	46	2	892	33	63	2	0	126	0	440	21	66	0	0
2-Hour Vehicles:	48		925		65			126		461		66		
Truck Percentage:	4%		4%		3%			0%		5%		0%		
AM Peak Hour:	34	2	553	24	43	1	0	81	0	280	9	50	0	0
7:30 - 8:30 AM	36		577		44			81		289		50		
Truck Percentage:	6%		4%		2%			0%		3%		0%		
4:00 PM	14	0	71	5	5	0		26	2	102	3	41	0	
4:15 PM	15	0	77	4	4	0		21	0	148	9	35	0	
4:30 PM	25	0	130	3	4	1		37	3	195	4	69	0	
4:45 PM	21	0	97	5	4	1		26	0	167	6	74	0	
5:00 PM	44	0	122	3	3	0		30	0	136	4	79	1	
5:15 PM	22	0	88	2	5	0		21	0	157	4	81	1	
5:30 PM	13	0	79	3	4	0		9	0	128	4	44	1	
5:45 PM	24	0	97	1	1	0		15	0	88	5	35	1	
2-Hour Totals:	178	0	761	26	30	2	0	185	5	1121	39	458	4	0
2-Hour Vehicles:	178		787		32			190		1160		462		
Truck Percentage:	0%		3%		6%			3%		3%		1%		
PM Peak Hour:	112	0	437	13	16	2	0	114	3	655	18	303	2	0
4:30 - 5:30 PM	112		450		18			117		673		305		
Peak Hour Factor:	0%		3%		11%			3%		3%		1%		
6-Hour Total:	**224**	**2**	**1653**	**59**	**93**	**4**	**0**	**329**	**5**	**1561**	**60**	**524**	**4**	**0**

Time Period Starting:	Northbound Approach on Allston Street							Southbound Approach on Brougham Drive							15-min Vehicle Volumes	Hourly Vehicle Volumes
	Left		Through		Right			Left		Through		Right				
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds		
7:00 AM	0	0	1	1	3	1		49	0	7	0	11	0		193	
7:15 AM	0	0	4	0	6	0		51	1	18	0	17	0		172	
7:30 AM	0	0	0	0	3	1		74	1	38	0	11	1		384	
7:45 AM	1	0	0	0	2	0		101	0	49	0	24	1		476	1225
8:00 AM	1	0	1	0	1	1		95	0	47	1	23	0		427	1459
8:15 AM	2	0	1	1	13	0		75	0	42	0	14	2		417	1704
8:30 AM	1	1	1	0	7	0	1	62	1	31	0	9	1	1	330	1650
8:45 AM	1	1	1	1	4	0		45	0	30	1	9	0		296	1470
2-Hour Totals:	6	2	9	3	39	3	1	552	3	262	2	118	5	1	2695	
2-Hour Vehicles:	8		12		42			555		264		123			2695	
Truck Percentage:	25%		25%		7%			1%		1%		4%			3%	
AM Peak Hour:	4	0	2	1	19	2	0	345	1	176	1	72	4	0	1704	PHF:
7:30 - 8:30 AM	4		3		21			346		177		76			1704	0.89
Truck Percentage:	0%		33%		10%			0%		1%		5%			3%	
4:00 PM	8	0	12	0	3	0		29	0	14	0	7	0		342	
4:15 PM	6	0	17	0	72	0		21	0	15	0	7	0		451	
4:30 PM	5	0	22	0	18	1		29	0	17	0	16	0		579	
4:45 PM	3	1	28	0	17	1		28	0	15	0	14	0		508	1880
5:00 PM	6	1	31	0	27	1		22	0	17	0	8	0		535	2073
5:15 PM	7	0	35	0	8	0		28	0	12	0	11	0		482	2104
5:30 PM	15	1	18	0	7	0		35	0	13	0	8	0		382	1907
5:45 PM	0	0	8	0	3	0		23	0	15	0	12	0		328	1727
2-Hour Totals:	50	3	171	0	155	3	0	215	0	118	0	83	0	0	3607	
2-Hour Vehicles:	53		171		158			215		118		83			3607	
Truck Percentage:	6%		0%		2%			0%		0%		0%			2%	
PM Peak Hour:	21	2	116	0	70	3	0	107	0	61	0	49	0	0	2104	PHF:
4:30 - 5:30 PM	23		116		73			107		61		49			2104	0.91
Peak Hour Factor:	9%		0%		4%			0%		0%		0%			2%	
6-Hour Total:	**56**	**5**	**180**	**3**	**194**	**6**	**1**	**767**	**3**	**380**	**2**	**201**	**5**	**1**	**6302**	

HV - heavy vehicles - includes trucks and buses

INTERSECTION TURNING MOVEMENT COUNT - SUMMARY

Project #: 325052
Weather:
Intersection: Kelsey Drive/ Kiwanis Street
Comments: PM count is from 4:30 - 6:30
Date: September 24 (PM) & 26 (AM), 2013
Counted by: Robert & Scott

Time Period	Eastbound Approach							Westbound Approach							Northbound Approach							Southbound Approach							15-min	Hourly
Starting:	Left		Through		Right			Left		Through		Right			Left		Through		Right			Left		Through		Right			Vehicle	Vehicle
	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Cars	HV	Cars	HV	Cars	HV	Peds	Volumes	Volumes
7:00 AM	1	0	0	0	1	1		0	0	0	0	0	0	0	1	1	11	1	0	0		0	0	27	1	0	1		46	
7:15 AM	0	0	0	0	2	3		0	0	0	0	0	0	0	3	0	42	3	0	0		0	0	37	1	0	0		91	
7:30 AM	0	0	0	0	3	0		0	0	0	0	0	0	0	2	2	43	2	0	0		0	0	64	5	0	0		121	
7:45 AM	1	1	0	0	4	3		0	0	0	0	0	0	0	6	2	93	5	0	0		0	0	80	2	2	0		199	457
8:00 AM	0	0	0	0	4	4		0	0	0	0	0	0	0	7	2	101	5	0	0		0	0	1	0	56	1		181	592
8:15 AM	0	0	0	0	6	3		0	0	0	0	0	0	0	5	4	90	2	0	0		0	0	66	4	1	0		181	682
8:30 AM	0	1	0	0	5	3		0	0	0	0	0	0	0	7	2	92	1	0	0		0	0	57	5	0	2		175	736
8:45 AM	0	0	0	0	6	4		0	0	0	0	0	0	0	14	3	102	5	0	0		0	0	55	4	1	0		194	731
2-Hour Totals:	2	2	0	0	31	21	0	0	0	0	0	0	0	0	45	16	574	24	0	0	0	0	0	387	22	60	4	0	1188	
2-Hour Vehicles:	4		0		52			0		0		0			61		598		0			0		409		64			1188	
Truck Percentage:	50%		######		40%			######		######		######			26%		4%		######			######		5%		6%			7%	
AM Peak Hour:	1	2	0	0	19	13	0	0	0	0	0	0	0	0	25	10	376	13	0	0	0	0	0	204	11	59	3	0	736	PHF:
7:45 AM - 8:45 AM	3		0		32			0		0		0			35		389		0			0		215		62			736	0.92
Truck Percentage:	67%		######		0%			######		######		######			29%		3%		######			######		5%		0%			7%	
4:30 PM	1	0	0	0	14	1		0	0	0	0	0	0	0	28	0	107	0	0	0		0	0	150	1	0	0		302	
4:45 PM	4	0	0	0	49	5		0	0	0	0	0	0	0	50	2	129	3	0	0		0	0	170	2	2	0		416	
5:00 PM	8	0	0	0	35	2		0	0	0	0	0	0	0	33	1	139	1	0	0		0	0	190	1	4	0		414	
5:15 PM	1	0	0	0	35	2		0	0	0	0	0	0	0	29	3	101	1	0	0		0	0	160	0	3	0		335	1467
5:30 PM	3	0	0	0	43	2		0	0	0	0	0	0	0	41	0	129	0	0	0		0	0	147	1	1	0		367	1532
5:45 PM	3	0	0	0	30	0		0	0	0	0	0	0	0	36	0	94	0	0	0		0	0	151	2	4	0		320	1436
6:00 PM	5	0	0	0	21	0		0	0	0	0	0	0	0	35	0	93	1	0	0		0	0	145	1	8	0		309	1331
6:15 PM	3	0	0	0	34	0		0	0	0	0	0	0	0	33	0	90	0	0	0	2	0	0	114	0	4	0		278	1274
2-Hour Totals:	28	0	0	0	261	12	0	0	0	0	0	0	0	0	285	6	882	6	0	0	2	0	0	1227	8	26	0	0	2741	
2-Hour Vehicles:	28		0		273			0		0		0			291		888		0			0		1235		26			2741	
Truck Percentage:	0%		######		4%			######		######		######			2%		1%		######			######		1%		0%			1%	
PM Peak Hour:	16	0	0	0	162	11	0	0	0	0	0	0	0	0	153	6	498	5	0	0	0	0	0	667	4	10	0	0	1532	PHF:
4:45 - 5:45 PM	16		0		173			0		0		0			159		503		0			0		671		10			1532	0.92
Peak Hour Factor:	0%		######		6%			######		######		######			4%		1%		######			######		1%		0%			2%	
6-Hour Total:	**30**	**2**	**0**	**0**	**292**	**33**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**330**	**22**	**1456**	**30**	**0**	**0**	**2**	**0**	**0**	**1614**	**30**	**86**	**4**	**0**	**3929**	

HV - heavy vehicles - includes trucks and buses

APPENDIX B-2

TRIP GENERATION SENSITIVITY ANALYSIS

Table 1 based on lower ITE rates

Area	Zoning	Use	Land Area	Unit	Total DU's	Lot Coverage	New Area	Unit	ITE LU Code	Ave Daily Rate	Daily Trips	In	Out	Am Peak Rate	Trip Gen	In Rate	In Trips	Out Rate	Out Trips	Pm Peak Rate	Trip Gen	In Rate	In Trips	Out Rate	Out Trips
1	R1	Low Density Residential			561				230	5.81	3259	1630	1630	0.44	247	17%	42	83%	205	0.52	292	67%	195	33%	96
1	R2	Semi- Detached Units			153				230	5.81	889	444	444	0.44	67	17%	11	83%	56	0.52	80	67%	53	33%	26
1	R3	Multi-family units			144				221	6.59	949	474	474	0.46	66	21%	14	79%	52	0.58	84	65%	54	35%	29
2	R1	Low Density Residential			458				230	5.81	2661	1330	1330	0.44	202	17%	34	83%	167	0.52	238	67%	160	33%	79
2	R2	Semi- Detached Units			144				230	5.81	837	418	418	0.44	63	17%	11	83%	53	0.52	75	67%	50	33%	25
2	R3	Multi-family units			144				221	6.59	949	474	474	0.46	66	21%	14	79%	52	0.58	84	65%	54	35%	29
3	R1	Low Density Residential			575				230	5.81	3341	1670	1670	0.44	253	17%	43	83%	210	0.52	299	67%	200	33%	99
3	R2	Semi- Detached Units			161				230	5.81	935	468	468	0.44	71	17%	12	83%	59	0.52	84	67%	56	33%	28
3	R3	Multi-family units			324				221	6.59	2135	1068	1068	0.46	149	21%	31	79%	118	0.58	188	65%	122	35%	66
4	C1	Retail	22.9	ha		25%	615900	s.f. GFA	820	42.94	26447	13223	13223	1.00	616	61%	376	39%	240	3.73	2297	49%	1126	51%	1172
4		Business Park	10.9	ha		25%	293200	s.f. GFA	770	12.76	3741	1871	1871	1.43	419	84%	352	16%	67	1.29	378	23%	87	77%	291
4		Industrial	27.9	ha		25%	750400	s.f. GFA	110	6.97	5230	2615	2615	0.92	690	88%	608	12%	83	0.97	728	12%	87	88%	641
4		Institutional (School Assumed)	3.6	ha		20%	77500	s.f. GFA	520	15.43	1196	598	598	5.20	403	56%	226	44%	177	1.21	94	45%	42	55%	52
		Total	65.3		2664																				

	Daily	In	Out		Am Peak		In		Out		Pm Peak		In		Out
Totals	52569	26285	26285		3313		1774		1539		4919		2288		2631

Lane required using 900 veh/hr/lane		
Am Peak In	**2.0**	
Am Peak Out	**1.7**	
Pm Peak In	**2.5**	
Pm Peak Out	**2.9**	

Note: ITE Code 223 doesn't have daily rate, but Code 221 has it.

Table 2 based on lower ITE rates

Area	Zoning	Use	Land Area	Unit	Total DU's	Lot Coverage		Unit	ITE LU Code	Ave Daily Rate	Daily Trips	In	Out	Am Peak Rate	Trip Gen	In Rate	In Trips	Out Rate	Out Trips	Pm Peak Rate	Trip Gen	In Rate	In Trips	Out Rate	Out Trips
5	R1	Low Density Residential			381				230	5.81	2214	1107	1107	0.44	168	17%	28	83%	139	0.52	198	67%	133	33%	65
5	R2	Semi- Detached Units			74				230	5.81	430	215	215	0.44	33	17%	6	83%	27	0.52	38	67%	26	33%	13
5	R3	Multi-family units			108				221	6.59	712	356	356	0.46	50	21%	10	79%	39	0.58	63	65%	41	35%	22
6	R1	Low Density Residential			347				230	5.81	2016	1008	1008	0.44	153	17%	26	83%	127	0.52	180	67%	121	33%	60
6	R2	Semi- Detached Units			69				230	5.81	401	200	200	0.44	30	17%	5	83%	25	0.52	36	67%	24	33%	12
6	R3	Multi-family units			72				221	6.59	474	237	237	0.46	33	21%	7	79%	26	0.58	42	65%	27	35%	15
6	C1	Retail	3.575	ha		25%	96200	s.f. GFA	820	42.94	4131	2065	2065	1.00	96	61%	59	39%	38	3.73	359	49%	176	51%	183
6		Office	3.575	ha		25%	96200	s.f. GFA	710	11.01	1059	530	530	1.55	149	88%	131	12%	18	1.49	143	17%	24	83%	119
7	R1	Low Density Residential			461				230	5.81	2678	1339	1339	0.44	203	17%	34	83%	168	0.52	240	67%	161	33%	79
7	R2	Semi- Detached Units			151				230	5.81	877	439	439	0.44	66	17%	11	83%	55	0.52	79	67%	53	33%	26
7	R3	Multi-family units			192				221	6.59	1265	633	633	0.46	88	21%	19	79%	70	0.58	111	65%	72	35%	39
7	C1	Retail	10000	gross s.m.			107600	s.f. GFA	820	42.94	4620	2310	2310	1.00	108	61%	66	39%	42	3.73	401	49%	197	51%	205
7		Office	17406	gross s.m.			187300	s.f. GFA	710	11.01	2062	1031	1031	1.55	290	88%	255	12%	35	1.49	279	17%	47	83%	232
7		Business Park	29.82	ha		25%	802000	s.f. GFA	770	12.76	10234	5117	5117	1.43	1147	84%	963	16%	183	1.29	1035	23%	238	77%	797

	Land Area	Total DU's
Total	7.15	1855

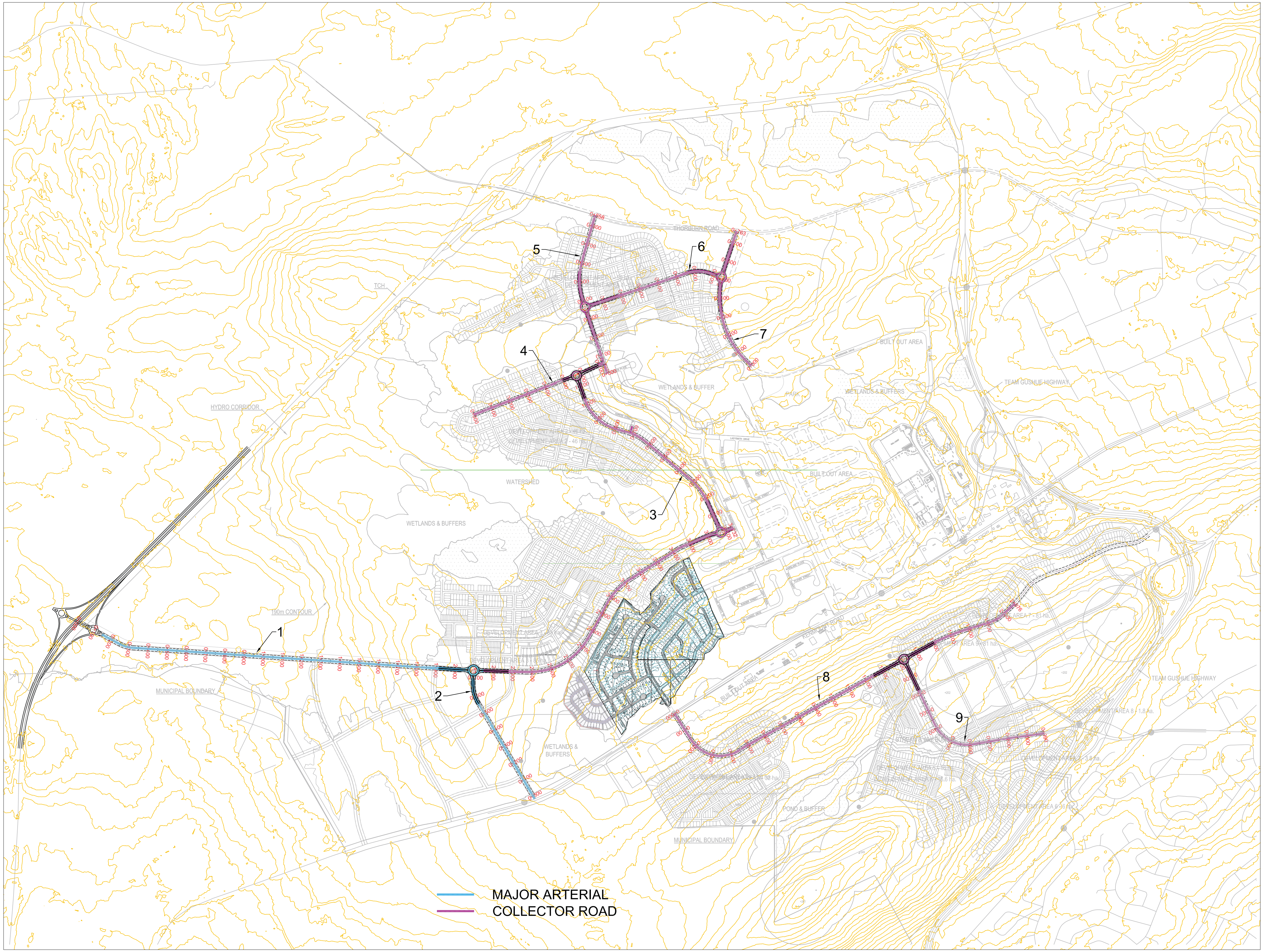
	Daily	In	Out		Am Peak		In		Out		Pm Peak		In		Out
Totals	33174	16587	16587		2614		1621		992		3204		1339		1865
Lane required using 900 veh/hr/lane							**1.8**		**1.1**				**1.5**		**2.1**

Note: Numbers in Red are different with numbers in Table 2 in the report

APPENDIX B-3

PLAN & PROFILE DRAWINGS

1 – SK#001
2 – SK#002
3 – SK#003



ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

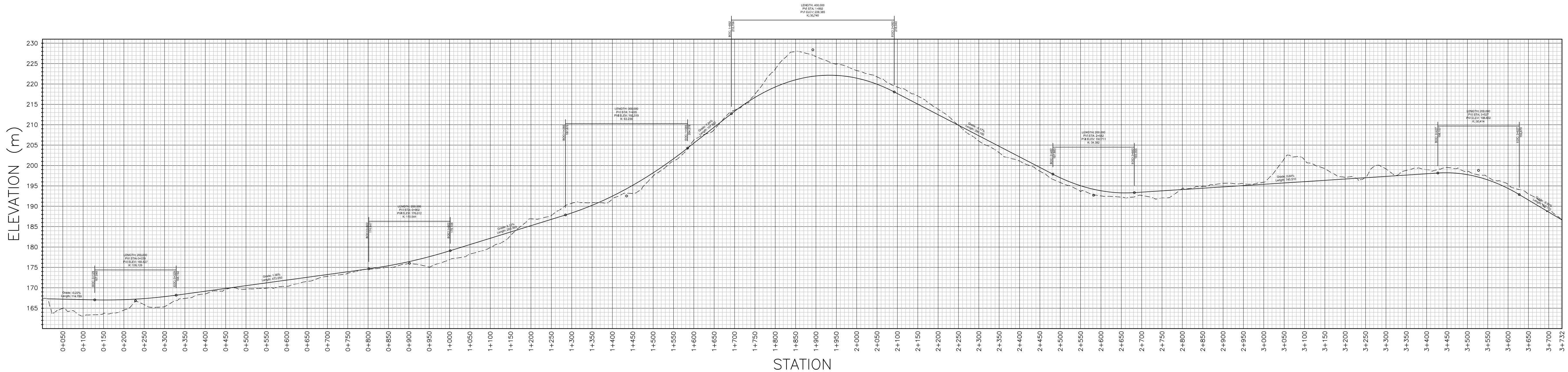
SITE PLAN
SK #001

N

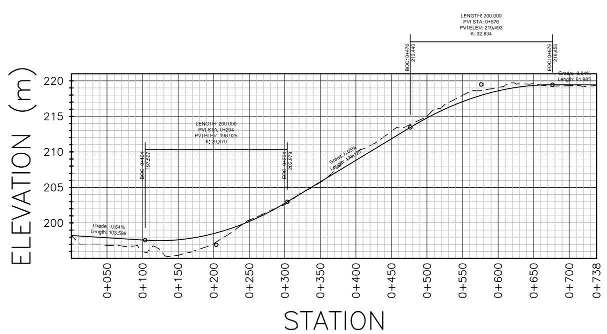
0 10 20 30 40 50
SCALE 1:500

HATCH

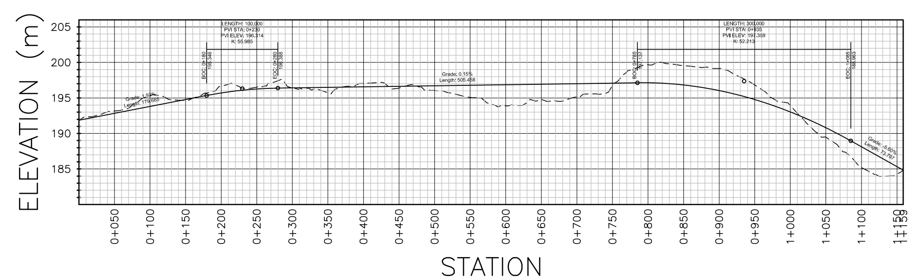
TRACT



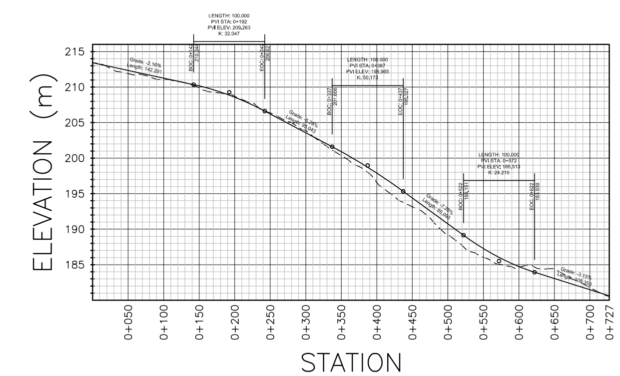
ALIGNMENT−01 Profile View



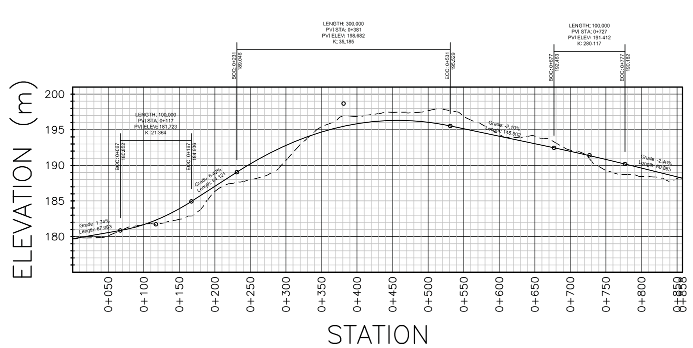
ALIGNMENT−02 Profile View



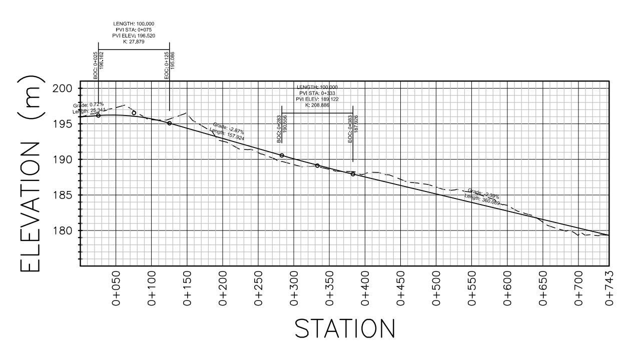
ALIGNMENT−03 Profile View



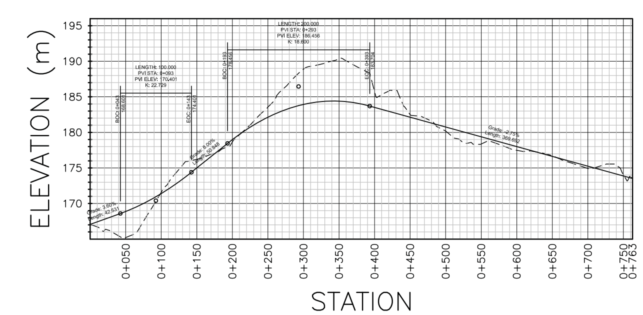
ALIGNMENT−04 Profile View



ALIGNMENT−05 Profile View



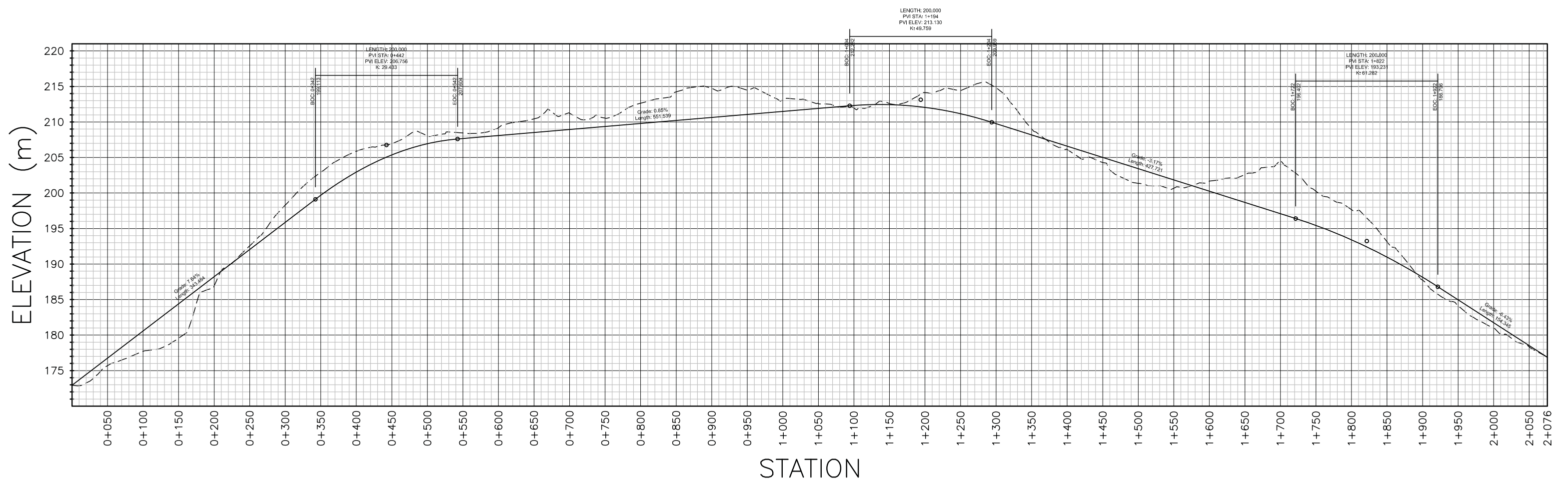
ALIGNMENT−06 Profile View



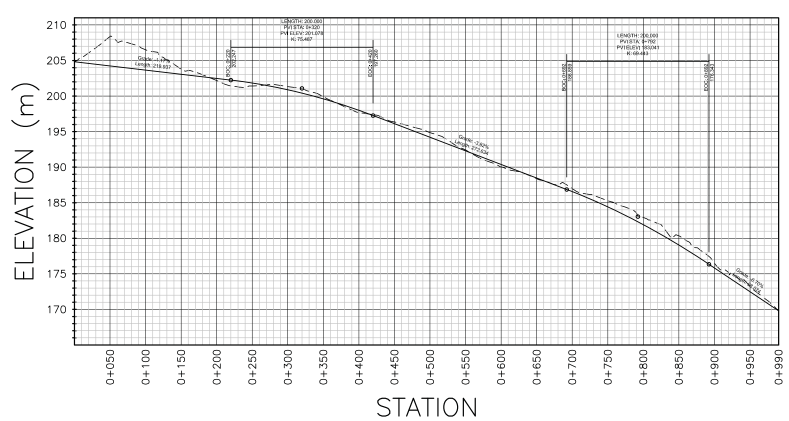
ALIGNMENT−07 Profile View

ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

ROAD PROFILES - 1 OF 2
SK #002



ALIGNMENT–08 Profile View



ALIGNMENT–09 Profile View

ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

ROAD PROFILES - 2 OF 2
SK #003

HATCH

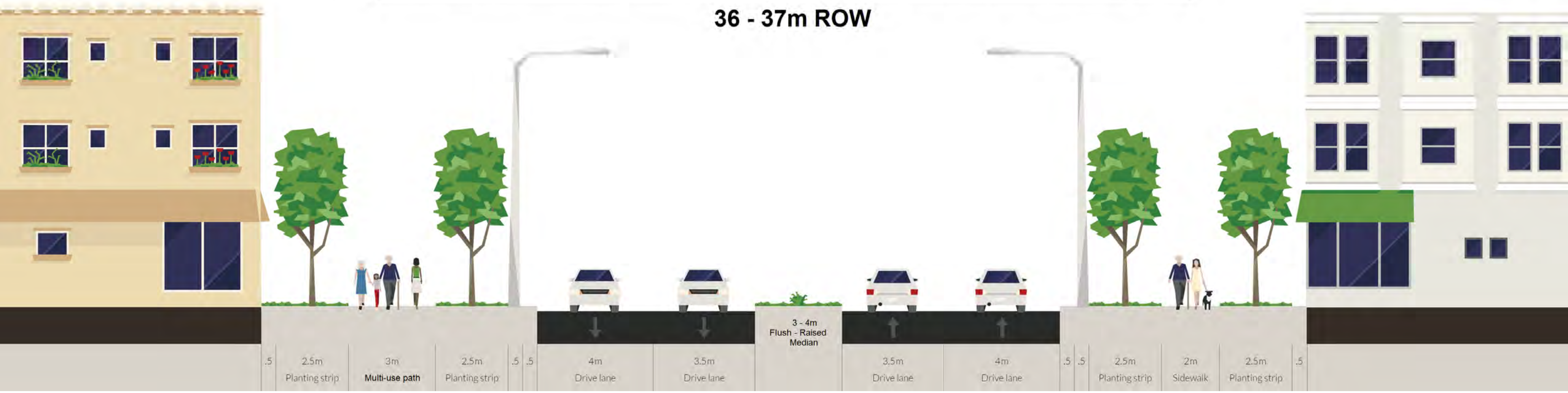
TRACT

APPENDIX B-4

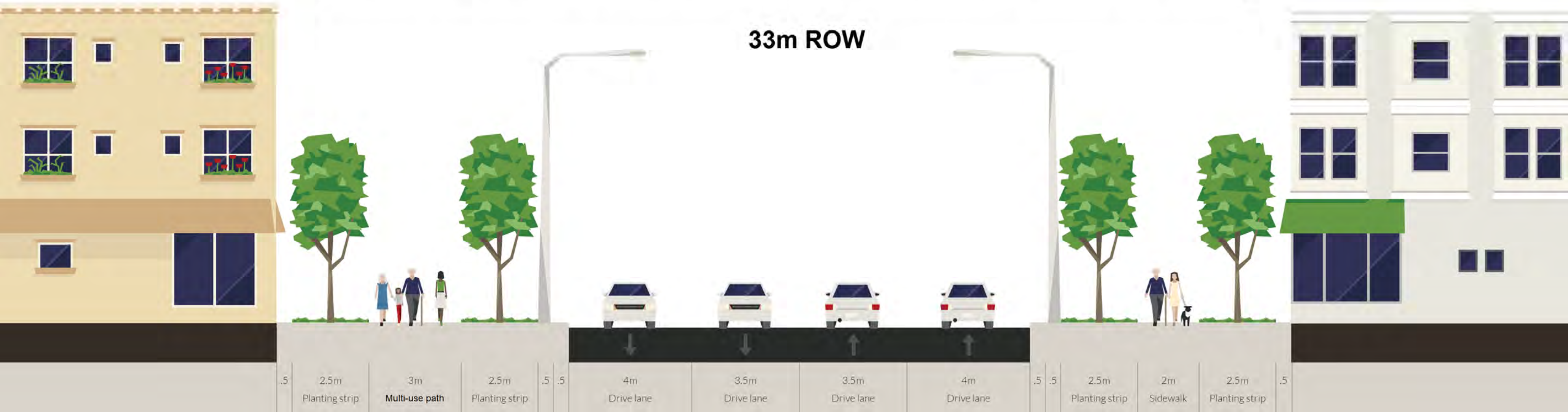
TYPICAL CROSS-SECTIONS

Urban Arterial Divided (UAD)

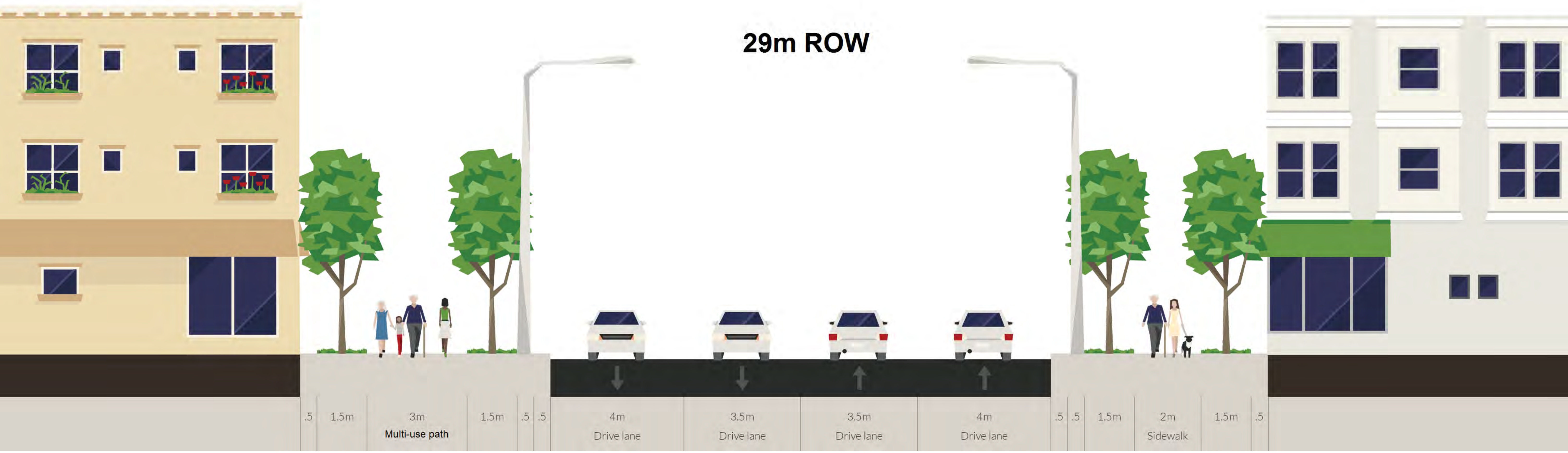
36 - 37m ROW



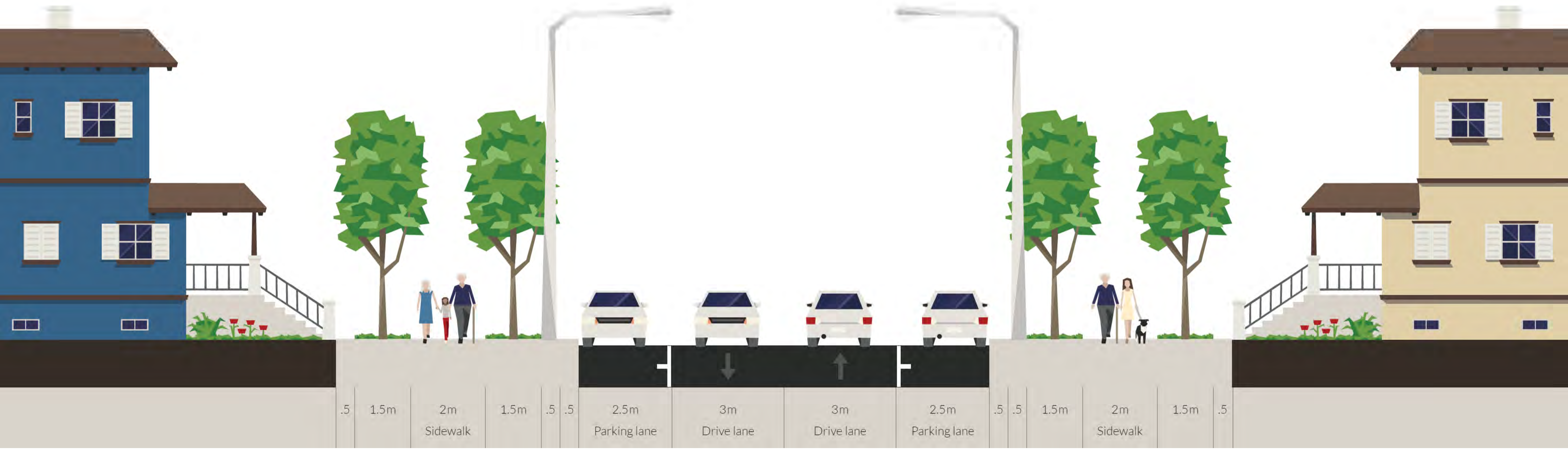
Urban Arterial Undivided (UAU)



Urban Collector Undivided (UCU)



Urban Local



.5
1.5m
2m
Sidewalk
1.5m
.5
.5
2.5m
Parking lane
3m
Drive lane
3m
Drive lane
2.5m
Parking lane
.5
.5
1.5m
2m
Sidewalk
1.5m
.5

APPENDIX B-5

SYNCHRO RESULTS

1 – EXISTING CONDITIONS (SCENARIO 0) SYNCHRO & SIMTRAFFIC ANALYSIS RESULTS

Existing Road Network

AM Peak Hour

Intersection		Synchro				SimTraffic		
Street	Movement	Delay/Veh (s)	LOS	V/C	Queue (m) 95th%ile	Delay/Veh (s)	Equivalent LOS	Queue (m) 95th%ile
Outer Ring Road (SB) & Thorburn Road						**51.8**	**F**	
Thorburn Road	Eastbound Left - Turn	0.0	-	0.86	0.0	12.3	B	12.0
	Eastbound Through					10.6	B	
	Westbound Through	13.8	B	0.22	6.3	301.6	F	117.6
	Westbound Right - Turn	0.0	-	0.11	0.0	49.0	E	239.7
Outer Ring Road (SB)	Southbound Left - Turn	53.0	F	0.50	17.9	695.2	F	171.7
	Southbound Through					-	-	
	Southbound Right - Turn					432.6	F	17.7
Outer Ring Road (NB) & Thorburn Road						**23.5**	**C**	
Thorburn Road	Eastbound Through	8.7	A	0.29	9.2	5.2	A	26.6
	Eastbound Right - Turn	0.0	-	0.33	0.0	1.9	A	0.6
	Westbound Left - Turn	0.0	-	0.13	0.0	19.2	C	74.7
	Westbound Through					11.8	B	
Outer Ring Road (NB)	Northbound Left - Turn	383.1	F	1.76	277.2	80.9	F	276.1
	Northbound Through					-	-	
	Northbound Right - Turn					66.6	F	
Goldstone Street & Thorburn Road			C			**9.7**	**A**	
Thorburn Road	Eastbound Left - Turn	13.3	B	0.01	2.1	9.8	A	7.2
	Eastbound Through	22.8	C	0.80	134.7	13.2	B	72.7
	Eastbound Right - Turn					5.7	A	78.8
	Westbound Left - Turn	38.5	D	0.80	84.6	19.1	B	52.0
	Westbound Through	3.8	A	0.06	8.1	3.1	A	14.2
	Westbound Right - Turn					3.1	A	13.7
Goldstone Street	Northbound Left - Turn	34.4	C	0.13	9.0	39.9	D	13.8
	Northbound Through	11.8	B	0.57	19.3	1.2	A	17.1
	Northbound Right - Turn					3.5	A	
	Southbound Left - Turn	49.4	D	0.41	12.5	39.8	D	17.2
	Southbound Through	30.4	C	0.20	14.0	33.8	C	20.1
	Southbound Right - Turn					2.6	A	
Austin Street & Thorburn Road			C			**15.2**	**B**	
Thorburn Road	Eastbound Left - Turn	11.7	B	0.01	1.8	22.8	C	9.8
	Eastbound Through	16.5	B	0.61	109.1	15.6	B	74.8
	Eastbound Right - Turn					12.9	B	79.0
	Westbound Left - Turn	89.2	F	1.07	79.6	24.7	C	57.0
	Westbound Through	5.9	A	0.21	27.5	5.5	A	46.5
	Westbound Right - Turn					3.5	A	24.2
Austin Street	Northbound Left - Turn	32.0	C	0.04	5.8	36.0	D	9.3
	Northbound Through	8.7	A	0.36	14.9	35.6	D	5.0
	Northbound Right - Turn					2.6	A	
	Southbound Left - Turn	57.9	E	0.72	42.1	40.7	D	44.2
	Southbound Through	22.3	C	0.04	5.0	40.8	D	6.3
	Southbound Right - Turn					1.9	A	
Mt Scio Road & Thorburn Road			B			**15.3**	**B**	
Thorburn Road	Eastbound Left - Turn	10.2	B	0.39	22.2	17.2	B	43.4
	Eastbound Through	11.4	B	0.53	87.5	11.6	B	88.2
	Westbound Through	16.6	B	0.44	71.0	14.7	B	70.2
	Westbound Right - Turn					8.4	A	52.5
Mt Scio Road	Southbound Left - Turn	54.8	D	0.81	82.4	38.2	D	64.1
	Southbound Right - Turn	7.2	A	0.48	15.8	11.5	B	86.4
O'Leary Avenue & Thorburn Road			D			**52.9**	**D**	
Thorburn Road	Eastbound Left - Turn	20.8	C	0.24	19.7	72.0	E	78.7
	Eastbound Through	77.3	E	1.05	188.9	92.2	F	230.5
	Eastbound Right - Turn					96.2	F	236.1
	Westbound Left - Turn	43.7	D	0.75	62.6	30.8	C	47.9
	Westbound Through	28.9	C	0.47	75.5	19.5	B	61.9
	Westbound Right - Turn					17.0	B	60.0
O'Leary Avenue	Northbound Left - Turn	17.5	B	0.20	18.5	23.0	C	50.8
	Northbound Through	42.1	D	0.88	99.0	39.3	D	111.8
	Northbound Right - Turn					31.1	C	
	Southbound Left - Turn	20.9	C	0.34	11.4	29.3	C	23.6
	Southbound Through	18.0	B	0.22	14.9	28.0	C	25.6
	Southbound Right - Turn					12.8	B	

Columbus Drive & Thorburn Road			D			**33.7**	**C**	
Thorburn Road	Eastbound Left - Turn	59.0	E	0.88	89.4	47.4	D	74.7
	Eastbound Through	15.4	B	0.47	45.3	24.4	C	54.2
	Eastbound Right - Turn					25.7	C	101.0
	Westbound Through	58.6	E	0.81	44.1	47.1	D	34.6
	Westbound Right - Turn					36.9	D	46.2
Prince Phillip Drive	Northbound Left - Turn	34.5	C	0.88	97.0	35.7	D	94.9
	Northbound Through	40.3	D	0.87	178.1	16.5	B	212.1
	Northbound Right - Turn	17.3	B	0.38	50.6	26.5	C	134.8
	Southbound Left - Turn	20.9	C	0.29	11.9	37.0	D	22.0
	Southbound Through	36.7	D	0.51	60.8	2.7	A	66.2
	Southbound Right - Turn	6.4	A	0.40	19.0	33.7	C	7.0
Thorburn Road & Freshwater Road			B			**10.6**	**B**	
Freshwater Road	Eastbound Through	7.9	A	0.34	53.5	7.1	A	51.8
	Westbound Through	7.4	A	0.27	41.2	8.5	A	53.5
	Westbound Right - Turn	1.5	A	0.25	9.5	3.2	A	26.6
Thorburn Road	Southbound Left - Turn	41.0	D	0.62	47.1	31.4	C	46.7
	Southbound Right - Turn	23.0	C	0.71	50.1	7.5	A	32.5
Avalon Mall & Kenmount Road			A			**5.1**	**A**	
Kenmount Road	Eastbound Left - Turn	5.2	A	0.06	3.4	10.5	B	10.2
	Eastbound Through	5.6	A	0.36	46.0	3.3	A	32.0
	Eastbound Right - Turn					5.8	A	35.7
	Westbound Left - Turn	9.8	A	0.02	2.6	14.9	B	6.1
	Westbound Through	10.2	B	0.47	88.2	4.9	A	44.5
	Westbound Right - Turn	2.4	A	0.14	8.6	1.6	A	14.8
Avalon Mall	Northbound Left - Turn	28.2	C	0.03	3.3	29.6	C	6.0
	Northbound Through	0.0	A	0.02	0.0	-	-	7.3
	Northbound Right - Turn					5.4	A	
	Southbound Left - Turn	38.0	D	0.44	24.2	32.8	C	27.4
	Southbound Through					21.8	C	
	Southbound Right - Turn	0.2	A	0.04	0.0	1.0	A	-
Pippy Place & Kenmount Road			C			**15.6**	**B**	
Kenmount Road	Eastbound Left - Turn	32.2	C	0.81	130.1	24.5	C	76.6
	Eastbound Through	6.9	A	0.55	105.5	7.8	A	88.8
	Eastbound Right - Turn					5.9	A	74.4
	Westbound Left - Turn	25.0	C	0.01	1.5	34.4	C	5.6
	Westbound Through	30.2	C	0.69	125.2	18.0	B	77.9
	Westbound Right - Turn					18.4	B	89.6
Pippy Place	Northbound Left - Turn	48.6	D	0.05	5.1	58.0	E	7.8
	Northbound Through					69.2	E	
	Northbound Right - Turn					13.8	B	
	Southbound Left - Turn	73.4	E	0.75	60.3	53.9	D	51.2
	Southbound Through					41.1	D	21.6
	Southbound Right - Turn	11.5	B	0.38	15.4	7.2	A	
Kelsey Drive & Kenmount Road			B			**13.2**	**B**	
Kenmount Road	Eastbound Left - Turn	33.1	C	0.48	25.4	32.7	C	30.8
	Eastbound Through	10.8	B	0.79	120.5	12.3	B	69.1
	Eastbound Right - Turn					-	-	82.1
	Westbound Left - Turn	0.0	-	-	-	13.2	B	-
	Westbound Through	16.4	B	0.59	75.1	-	-	75.6
	Westbound Right - Turn	1.1	A	0.15	2.4	5.3	A	-
Kelsey Drive	Northbound Left - Turn	0.0	-	-	-	-	-	-
	Northbound Through	0.0	-	-	-	-	-	-
	Northbound Right - Turn					-	-	-
	Southbound Left - Turn	30.2	C	0.17	14.3	29.8	C	44.9
	Southbound Through	30.2	C	0.17	14.3	0.5	A	
	Southbound Right - Turn	10.4	B	0.63	20.2	4.3	A	7.9
Kelsey Drive & Kiwanis Street						**2.4**	**A**	
Kiwanis Street	Eastbound Left - Turn	9.7	A	0.04	0.9	6.6	A	8.7
	Eastbound Right - Turn	-	-	0.00	0.0	2.3	A	1.7
Kelsey Drive	Northbound Left - Turn	8.2	A	0.03	0.8	4.9	A	9.6
	Northbound Through	0.0	-	0.12	0.0	3.1	A	0.0
	Southbound Through	0.0	-	0.07	0.0	0.9	A	18.2
	Southbound Right - Turn	0.0	-	0.04	0.0	2.4	A	24.3
Team Gushue Hwy (SB) & Kelsey Drive						**66.1**	**F**	
Kelsey Drive	Eastbound Through	0.0	-	0.19	0.0	1.0	A	-
	Eastbound Right - Turn	0.0	-	0.00	0.0	0.5	A	-
	Westbound Left - Turn	8.3	A	0.01	0.1	3.6	A	3.3
	Westbound Through	0.0	-	0.07	0.0	0.6	A	0.6
Team Gushue Hwy (SB)	Southbound Left - Turn	353.1	F	1.72	363.5	113.9	F	227.7
	Southbound Through					110.9	F	
	Southbound Right - Turn					66.1	F	

Team Gushue Hwy (NB) & Kelsey Drive						**1.3**	**A**	
Kelsey Drive	Eastbound Left - Turn	8.5	A	0.08	1.9	4.6	A	18.4
	Eastbound Through	0.0	-	0.48	0.0	1.0	A	-
	Westbound Through	0.0	-	0.22	0.0	1.1	A	2.8
	Westbound Right - Turn					0.8	A	
Team Gushue Hwy (NB)	Northbound Left - Turn	19.0	C	0.12	3.2	11.3	B	15.4
	Northbound Through					-	-	
	Northbound Right - Turn					4.7	A	
Ladysmith Drive & Kenmount Road			C			**24.8**	**C**	
Kenmount Road	Eastbound Left - Turn	11.3	B	0.08	5.6	33.3	C	20.7
	Eastbound Through	29.5	C	0.90	236.1	28.8	C	134.8
	Westbound Through	21.3	C	0.54	109.1	19.0	B	116.9
	Westbound Right - Turn					11.1	B	146.0
Ladysmith Drive	Southbound Left - Turn	30.2	C	0.28	37.8	27.9	C	43.3
	Southbound Right - Turn					5.6	A	56.6
Great Eastern Avenue & Kenmount Road			B			**13.5**	**B**	
Kenmount Road	Eastbound Left - Turn	3.2	A	0.14	5.0	16.8	B	14.6
	Eastbound Through	13.4	B	0.77	206.5	14.0	B	111.1
	Eastbound Right - Turn					13.7	B	131.8
	Westbound Left - Turn	4.6	A	0.16	2.9	24.2	C	17.8
	Westbound Through	7.3	A	0.36	50.4	12.6	B	151.6
	Westbound Right - Turn					12.8	B	205.0
Great Eastern Avenue	Northbound Left - Turn	38.9	D	0.10	6.3	31.3	C	8.4
	Northbound Through	0.2	A	0.03	0.0	-	-	7.3
	Northbound Right - Turn					10.8	B	
	Southbound Left - Turn	38.7	D	0.10	6.3	34.7	C	9.7
	Southbound Through	16.1	B	0.43	13.2	37.0	D	2.9
	Southbound Right - Turn					1.8	A	
Wyatt Boulevard & Kenmount Road			F			**55.5**	**E**	
Kenmount Road	Eastbound Through	42.7	D	0.82	151.2	21.4	C	94.9
	Eastbound Right - Turn					10.8	B	93.2
	Westbound Left - Turn	52.1	D	0.92	165.7	22.2	C	90.9
	Westbound Through	6.6	A	0.27	34.0	4.9	A	65.2
Wyatt Boulevard	Northbound Left - Turn	42.2	D	0.17	23.2	69.6	E	492.5
	Northbound Right - Turn	299.1	F	1.61	382.5	139.1	F	420.6
Brougham Drive & Kenmount Road			D			**50.7**	**D**	
Kenmount Road	Eastbound Left - Turn	38.7	D	0.19	15.6	52.7	D	33.4
	Eastbound Through	38.7	D	0.81	79.8	37.6	D	82.3
	Eastbound Right - Turn					30.9	C	86.4
	Westbound Left - Turn	43.4	D	0.41	29.2	46.7	D	34.6
	Westbound Through	25.7	C	0.38	40.4	18.6	B	44.2
	Westbound Right - Turn					25.7	C	48.8
Brougham Drive	Northbound Left - Turn	36.0	D	0.02	3.5	2134.5	F	98.0
	Northbound Through	18.0	B	0.13	7.8	983.5	F	
	Northbound Right - Turn					249.3	F	14.6
	Southbound Left - Turn	48.2	D	0.84	105.5	114.0	F	252.6
	Southbound Through	20.1	C	0.37	63.1	17.3	B	108.4
	Southbound Right - Turn					11.3	B	
Columbus Drive & Old Pennywell Road			D			**33.8**	**C**	
Old Pennywell Road	Eastbound Left - Turn	66.9	E	0.80	79.7	56.7	E	60.5
	Eastbound Through	55.4	E	0.67	67.9	57.0	E	102.4
	Eastbound Right - Turn	0.4	A	0.09	0.0	4.7	A	35.1
	Westbound Left - Turn	51.0	D	0.49	27.7	43.7	D	36.4
	Westbound Through	47.5	D	0.23	18.8	41.5	D	22.1
	Westbound Right - Turn	2.8	A	0.37	0.0	2.7	A	-
Columbus Drive	Northbound Left - Turn	13.6	B	0.03	1.6	19.9	B	17.4
	Northbound Through	46.3	D	0.91	166.9	38.1	D	122.1
	Northbound Right - Turn	14.1	B	0.39	32.6	5.4	A	37.1
	Southbound Left - Turn	53.9	D	0.74	58.3	32.1	C	45.1
	Southbound Through	38.5	D	0.29	75.0	30.1	C	66.2
	Southbound Right - Turn	5.8	A	0.05	5.6	4.8	A	0.3
Columbus Drive & Mundy Pond Road			C			**39.8**	**D**	
Mundy Pond Road	Eastbound Left - Turn	83.6	F	0.95	92.5	88.6	F	86.3
	Eastbound Through	37.4	D	0.58	79.8	49.7	D	180.3
	Eastbound Right - Turn					41.7	D	
	Westbound Left - Turn	33.7	C	0.31	17.3	50.9	D	31.8
	Westbound Through	32.0	C	0.48	46.0	34.1	C	67.5
	Westbound Right - Turn					26.4	C	
Columbus Drive	Northbound Left - Turn	8.0	A	0.00	0.0	-	-	1.3
	Northbound Through	20.5	C	0.94	242.2	41.4	D	169.2
	Northbound Right - Turn					44.2	D	214.8
	Southbound Left - Turn	30.7	C	0.25	16.8	30.8	C	20.6
	Southbound Through	29.6	C	0.40	117.4	22.2	C	77.9
	Southbound Right - Turn					22.3	C	81.9

Columbus Drive & Blackmarsh Road			D			**32.3**	**C**	
Blackmarsh Road	Eastbound Left - Turn	33.4	C	0.53	47.6	41.5	D	71.1
	Eastbound Through	58.0	E	0.82	94.1	44.7	D	93.8
	Eastbound Right - Turn					34.0	C	
	Westbound Left - Turn	32.6	C	0.49	26.8	38.8	D	34.2
	Westbound Through	38.3	D	0.36	40.1	38.2	D	42.4
	Westbound Right - Turn	7.3	A	0.38	14.6	2.8	A	10.0
Columbus Drive	Northbound Left - Turn	13.3	B	0.02	2.7	19.3	B	14.1
	Northbound Through	44.3	D	0.94	217.3	35.4	D	132.3
	Northbound Right - Turn					29.4	C	133.0
	Southbound Left - Turn	52.6	D	0.60	36.1	36.9	D	38.4
	Southbound Through	20.6	C	0.39	67.3	24.5	C	70.2
	Southbound Right - Turn					22.9	C	73.0
Columbus Drive & Captain Whelan Drive			C			**170.2**	**F**	
Captain Whelan Drive	Eastbound Left - Turn	60.2	E	0.67	52.5	451.7	F	104.8
	Eastbound Through	58.5	E	0.65	54.0	561.4	F	472.5
	Eastbound Right - Turn	0.8	A	0.11	0.0	70.7	E	493.9
	Westbound Left - Turn	48.1	D	0.17	13.2	151.5	F	51.2
	Westbound Through	38.0	D	0.54	27.2	190.4	F	180.9
	Westbound Right - Turn					178.3	F	
Columbus Drive	Northbound Left - Turn	13.2	B	0.05	6.8	20.6	C	12.8
	Northbound Through	17.7	B	0.60	129.1	19.1	B	14.9
	Northbound Right - Turn					5.4	A	17.1
	Southbound Left - Turn	15.5	B	0.11	6.9	29.9	C	48.9
	Southbound Through	13.5	B	0.31	56.5	5.9	A	14.9
	Southbound Right - Turn	2.6	A	0.19	10.8	2.8	A	2.1
Hamlyn Road & Captain Whelan Drive						**8.4**	**A**	
Hamlyn Road	Eastbound Through	0.0	-	0.17	0.0	15.9	C	60.3
	Eastbound Right - Turn					9.7	A	
	Westbound Left - Turn	8.1	A	0.07	1.8	7.3	A	12.6
	Westbound Through	0.0	-	0.02	0.0	3.8	A	
Hamlyn Road	Northbound Left - Turn	15.5	C	0.39	13.9	6.6	A	21.1
	Northbound Right - Turn	11.3	B	0.33	11.1	12.6	B	51.3
Empire Avenue & Blackmarsh Road						**10.4**	**B**	
Blackmarsh Road	Eastbound Through	0.0	-	0.49	0.0	14.2	B	-
	Westbound Through	0.0	-	0.19	0.0	0.5	A	-
	Westbound Right - Turn					0.3	A	-
Empire Avenue	Southbound Left - Turn	15.9	C	0.27	8.3	17.1	C	13.4
	Southbound Right - Turn					5.8	A	
Blackmarsh Road & Topsail Road						**10.0**	**A**	
Topsail Road	Eastbound Left - Turn	10.9	B	0.53	24.4	19.9	C	197.8
	Eastbound Through					10.1	B	380.2
	Westbound Through	0.0	-	0.20	0.0	3.6	A	0.7
	Westbound Right - Turn					4.3	A	14.6
Blackmarsh Road	Southbound Left - Turn	0.0	-	-	0.0	15.5	C	21.5
	Southbound Right - Turn	13.8	B	0.41	15.2	4.8	A	23.9
Blackmarsh Road & Captain Whelan Drive						**3.6**	**A**	
Captain Whelan Drive	Eastbound Through	0.0	-	0.48	0.0	1.0	A	1.2
	Eastbound Right - Turn					-	-	
	Westbound Left - Turn	10.4	B	0.17	4.8	7.8	A	22.1
	Westbound Through	0.0	-	0.15	0.0	0.8	A	-
Blackmarsh Road	Northbound Left - Turn	50.5	F	0.43	14.3	22.0	C	20.2
	Northbound Right - Turn	22.1	C	0.45	16.9	11.5	B	31.8
Mt Carson Ave/ Commonweath Ave & Topsail Road			C			**36.4**	**D**	
Topsail Road	Eastbound Left - Turn	17.1	B	0.18	15.8	29.0	C	45.8
	Eastbound Through	39.1	D	0.75	104.5	40.8	D	110.9
	Eastbound Right - Turn	8.2	A	0.38	23.2	16.3	B	60.1
	Westbound Left - Turn	26.1	C	0.63	40.5	29.7	C	50.7
	Westbound Through	26.2	C	0.37	55.5	22.3	C	126.9
	Westbound Right - Turn	0.1	A	0.03	0.0	10.2	B	20.8
Mt Carson Avenue	Northbound Left - Turn	38.4	D	0.75	57.4	34.1	C	64.7
	Northbound Through	51.3	D	0.84	141.5	47.3	D	133.6
	Northbound Right - Turn	6.0	A	0.44	19.2	3.3	A	30.4
	Southbound Left - Turn	45.2	D	0.74	43.8	76.9	E	52.7
	Southbound Through	46.3	D	0.72	95.7	66.5	E	177.5
	Southbound Right - Turn	0.2	A	0.07	0.0	36.0	D	31.9

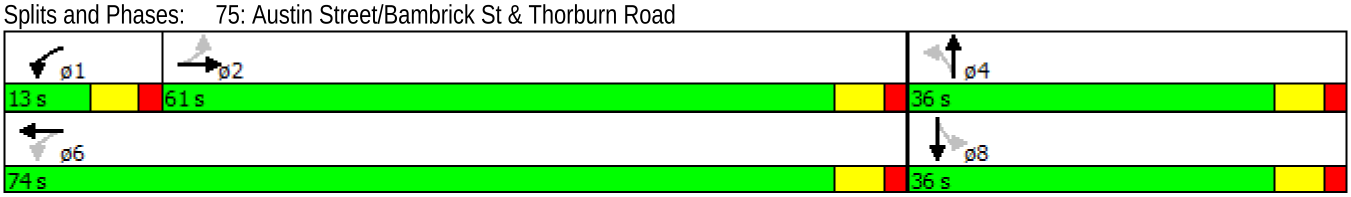
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	3	962	84	281	440	20	9	2	126	120	4	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.0	3.4	3.4	3.0	3.5	3.5	3.0	3.5	3.5
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	55.0		0.0	60.0		0.0	60.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.988			0.993			0.852			0.912	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	3419	0	1652	3436	0	1652	1569	0	1652	1680	0
Flt Permitted	0.471			0.150			0.750			0.641		
Satd. Flow (perm)	819	3419	0	261	3436	0	1304	1569	0	1114	1680	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		12			8			137			7	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		389.2			166.0			219.5			145.1	
Travel Time (s)		28.0			12.0			15.8			10.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.88	0.88	0.88	0.93	0.93	0.93	0.92	0.92	0.92	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	3	1093	95	302	473	22	10	2	137	141	5	7
Shared Lane Traffic (%)												
Lane Group Flow (vph)	3	1188	0	302	495	0	10	139	0	141	12	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Total Split (s)	61.0	61.0		13.0	74.0		36.0	36.0		36.0	36.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	55.2	55.2		68.2	68.2		17.2	17.2		17.2	17.2	
Actuated g/C Ratio	0.57	0.57		0.70	0.70		0.18	0.18		0.18	0.18	
v/c Ratio	0.01	0.61		1.07	0.21		0.04	0.36		0.72	0.04	
Control Delay	11.7	16.5		89.2	5.9		32.0	8.7		57.9	22.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	11.7	16.5		89.2	5.9		32.0	8.7		57.9	22.3	
LOS	B	B		F	A		C	A		E	C	
Approach Delay		16.5			37.5			10.3			55.1	
Approach LOS		B			D			B			E	
Queue Length 50th (m)	0.2	72.3		~22.0	14.6		1.6	0.3		25.2	0.8	
Queue Length 95th (m)	1.8	109.1		#79.6	27.5		5.8	14.9		42.1	5.0	
Internal Link Dist (m)		365.2			142.0			195.5			121.1	
Turn Bay Length (m)	55.0			55.0			60.0			60.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	463	1939		282	2406		402	578		343	523	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.01	0.61		1.07	0.21		0.02	0.24		0.41	0.02	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 97.5
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.07
Intersection Signal Delay: 26.0 — Intersection LOS: C
Intersection Capacity Utilization 79.4% — ICU Level of Service D
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: 75: Austin Street/Bambrick St & Thorburn Road

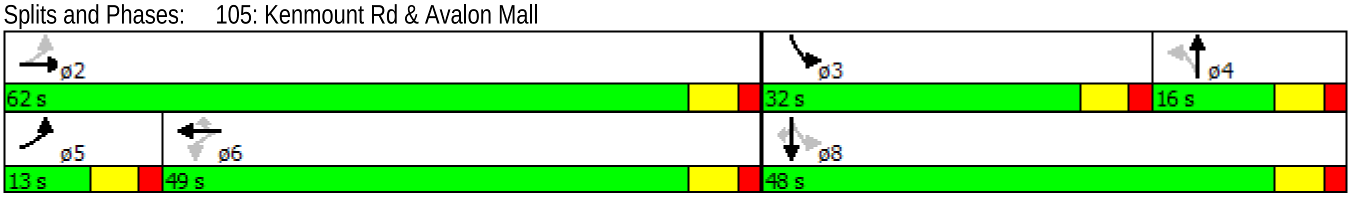


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	903	1	6	1008	144	5	0	7	78	3	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.3	3.5	3.0	3.4	3.5	3.5	3.5	3.5	4.0	4.8	4.2
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	16.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		0	1		1	1		0	0		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt						0.850		0.850				0.850
Flt Protected	0.950			0.950			0.950				0.954	
Satd. Flow (prot)	1652	3421	0	1652	3461	1566	1750	1566	0	0	2014	1689
Flt Permitted	0.186			0.307			0.690				0.728	
Satd. Flow (perm)	323	3421	0	534	3461	1566	1271	1566	0	0	1537	1689
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						161		322				89
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		288.0			296.2			135.5			126.3	
Travel Time (s)		20.7			21.3			9.8			9.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.77	0.77	0.77	0.78	0.78	0.78
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	21	931	1	7	1145	164	6	0	9	100	4	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	21	932	0	7	1145	164	6	9	0	0	104	13
Turn Type	pm+pt	NA		Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm
Protected Phases	5	2			6			4		3	8	
Permitted Phases	2			6		6	4			8		8
Total Split (s)	13.0	62.0		49.0	49.0	49.0	16.0	16.0		32.0	48.0	48.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0			6.0	6.0
Act Effct Green (s)	62.9	64.2		59.3	59.3	59.3	12.5	12.5			12.9	12.9
Actuated g/C Ratio	0.74	0.76		0.70	0.70	0.70	0.15	0.15			0.15	0.15
v/c Ratio	0.06	0.36		0.02	0.47	0.14	0.03	0.02			0.44	0.04
Control Delay	5.2	5.6		9.8	10.2	2.4	28.2	0.0			38.0	0.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Delay	5.2	5.6		9.8	10.2	2.4	28.2	0.0			38.0	0.2
LOS	A	A		A	B	A	C	A			D	A
Approach Delay		5.6			9.2			11.3			33.8	
Approach LOS		A			A			B			C	
Queue Length 50th (m)	0.9	26.7		0.3	35.8	0.2	0.8	0.0			15.3	0.0
Queue Length 95th (m)	3.4	46.0		2.6	88.2	8.6	3.3	0.0			24.2	0.0
Internal Link Dist (m)		264.0			272.2			111.5			102.3	
Turn Bay Length (m)	55.0			16.0								

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	349	2585		372	2415	1141	202	520			763	883
Starvation Cap Reductn	0	0		0	0	0	0	0			0	0
Spillback Cap Reductn	0	0		0	0	0	0	0			0	0
Storage Cap Reductn	0	0		0	0	0	0	0			0	0
Reduced v/c Ratio	0.06	0.36		0.02	0.47	0.14	0.03	0.02			0.14	0.01

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 84.9	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.47	
Intersection Signal Delay: 9.0	Intersection LOS: A
Intersection Capacity Utilization 49.5%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 105: Kenmount Rd & Avalon Mall



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	753	0	130	241	53	154
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	818	0	141	262	58	167
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			818		1363	818
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			818		1363	818
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			83		57	55
cM capacity (veh/h)			810		134	376

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	818	141	262	58	167
Volume Left	0	141	0	58	0
Volume Right	0	0	0	0	167
cSH	1700	810	1700	134	376
Volume to Capacity	0.48	0.17	0.15	0.43	0.45
Queue Length 95th (m)	0.0	4.8	0.0	14.3	16.9
Control Delay (s)	0.0	10.4	0.0	50.5	22.1
Lane LOS		B		F	C
Approach Delay (s)	0.0	3.6		29.3	
Approach LOS				D	

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	774	270	24	30	83
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	841	293	26	33	90
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	320				1148	307
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	320				1148	307
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				85	88
cM capacity (veh/h)	1240				220	733

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	841	320	123
Volume Left	0	0	33
Volume Right	0	26	90
cSH	1700	1700	453
Volume to Capacity	0.49	0.19	0.27
Queue Length 95th (m)	0.0	0.0	8.3
Control Delay (s)	0.0	0.0	15.9
Lane LOS			C
Approach Delay (s)	0.0	0.0	15.9
Approach LOS			C

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	518	608	466	42	1	275
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	557	654	501	45	1	296
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						3
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	501				1965	273
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	501				1965	273
tC, single (s)	4.2				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	47				96	59
cM capacity (veh/h)	1052				26	725

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	775	436	334	212	297
Volume Left	557	0	0	0	1
Volume Right	0	0	0	45	296
cSH	1052	1700	1700	1700	727
Volume to Capacity	0.53	0.26	0.20	0.12	0.41
Queue Length 95th (m)	24.4	0.0	0.0	0.0	15.2
Control Delay (s)	10.9	0.0	0.0	0.0	13.8
Lane LOS	B				B
Approach Delay (s)	6.9		0.0		13.8
Approach LOS					B

Intersection Summary			
Average Delay	6.1		
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		

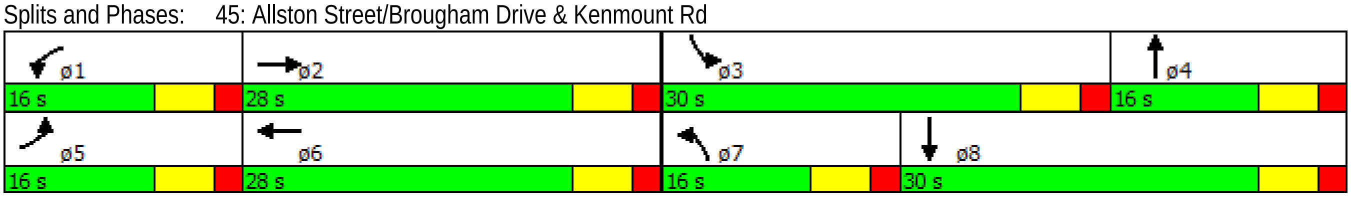
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	36	577	44	81	289	50	4	3	21	346	177	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	50.0		0.0	50.0		0.0	0.0		30.0	0.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.989			0.978			0.867			0.955	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1722	3476	0	1789	3471	0	1789	1480	0	1789	1783	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1722	3476	0	1789	3471	0	1789	1480	0	1789	1783	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8			20			24			23	
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		727.2			1392.7			202.9			587.5	
Travel Time (s)		54.5			104.5			15.2			44.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	4%	2%	2%	3%	2%	2%	33%	10%	2%	2%	5%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	40	648	49	91	325	56	4	3	24	389	199	85
Shared Lane Traffic (%)												
Lane Group Flow (vph)	40	697	0	91	381	0	4	27	0	389	284	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases												
Total Split (s)	16.0	28.0		16.0	28.0		16.0	16.0		30.0	30.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	10.4	20.4		10.4	23.4		10.4	10.4		21.3	35.0	
Actuated g/C Ratio	0.13	0.25		0.13	0.28		0.13	0.13		0.26	0.42	
v/c Ratio	0.19	0.81		0.41	0.38		0.02	0.13		0.84	0.37	
Control Delay	38.7	38.7		43.4	25.7		36.0	18.0		48.2	20.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	38.7	38.7		43.4	25.7		36.0	18.0		48.2	20.1	
LOS	D	D		D	C		D	B		D	C	
Approach Delay		38.7			29.1			20.3			36.3	
Approach LOS		D			C			C			D	
Queue Length 50th (m)	6.4	59.3		15.0	27.7		0.6	0.5		63.0	28.5	
Queue Length 95th (m)	15.6	#79.8		29.2	40.4		3.5	7.8		#105.5	63.1	
Internal Link Dist (m)		703.2			1368.7			178.9			563.5	
Turn Bay Length (m)	50.0			50.0								

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	216	965		224	1093		224	206		539	768	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.19	0.72		0.41	0.35		0.02	0.13		0.72	0.37	

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 82.5	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.84	
Intersection Signal Delay: 35.2	Intersection LOS: D
Intersection Capacity Utilization 66.5%	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: 45: Allston Street/Brougham Drive & Kenmount Rd



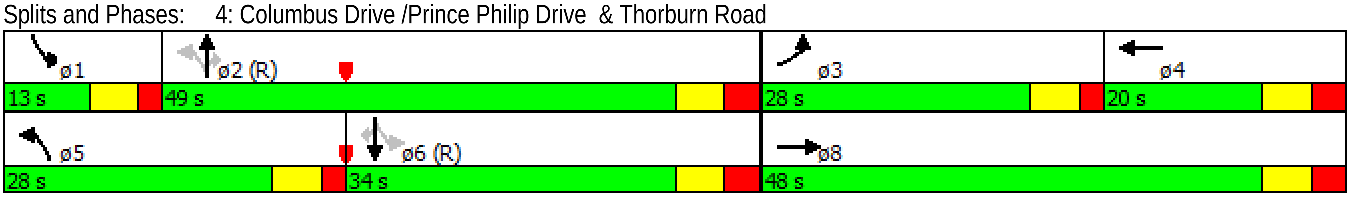
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	558	300	324	0	210	69	401	1234	306	48	630	221
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.8	3.8	2.4	3.8	3.8	3.5	3.8	4.2	3.5	3.8	4.0
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	150.0		150.0	0.0		0.0	175.0		0.0	110.0		90.0
Storage Lanes	1		1	0		0	1		1	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.91	1.00
Ped Bike Factor	1.00	0.99			1.00		1.00		0.98			0.98
Frt		0.922			0.963				0.850			0.850
Flt Protected	0.950						0.950			0.950		
Satd. Flow (prot)	3395	3309	0	0	3469	0	1750	3618	1689	1750	5198	1654
Flt Permitted	0.950						0.240			0.138		
Satd. Flow (perm)	3384	3309	0	0	3469	0	442	3618	1663	254	5198	1628
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		284			33				274			246
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		385.8			49.4			746.3			113.4	
Travel Time (s)		27.8			3.6			53.7			8.2	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.96	0.96	0.96	0.80	0.80	0.80	0.95	0.95	0.95	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	581	312	338	0	262	86	422	1299	322	53	700	246
Shared Lane Traffic (%)												
Lane Group Flow (vph)	581	650	0	0	348	0	422	1299	322	53	700	246
Turn Type	Prot	NA			NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	3	8			4		5	2		1	6	
Permitted Phases							2		2	6		6
Total Split (s)	28.0	48.0			20.0		28.0	49.0	49.0	13.0	34.0	34.0
Total Lost Time (s)	6.0	7.0			7.0		6.0	7.0	7.0	6.0	7.0	7.0
Act Effct Green (s)	21.4	40.1			12.7		56.9	45.5	45.5	37.0	29.0	29.0
Actuated g/C Ratio	0.19	0.36			0.12		0.52	0.41	0.41	0.34	0.26	0.26
v/c Ratio	0.88	0.47			0.81		0.88	0.87	0.38	0.29	0.51	0.40
Control Delay	59.0	15.4			58.6		34.5	40.3	17.3	20.9	36.7	6.4
Queue Delay	0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.0	15.4			58.6		34.5	40.3	17.3	20.9	36.7	6.4
LOS	E	B			E		C	D	B	C	D	A
Approach Delay		36.0			58.6			35.5			28.4	
Approach LOS		D			E			D			C	
Queue Length 50th (m)	62.5	29.5			35.1		85.4	152.6	42.0	5.5	48.2	0.0
Queue Length 95th (m)	#89.4	45.3			44.1		m97.0	m#178.1	m50.6	11.9	60.8	19.0
Internal Link Dist (m)		361.8			25.4			722.3			89.4	
Turn Bay Length (m)	150.0						175.0			110.0		90.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	679	1411			439		490	1497	849	180	1368	610
Starvation Cap Reductn	0	0			0		0	0	0	0	0	0
Spillback Cap Reductn	0	0			0		0	0	0	0	0	0
Storage Cap Reductn	0	0			0		0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.46			0.79		0.86	0.87	0.38	0.29	0.51	0.40

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 35.8 Intersection LOS: D
Intersection Capacity Utilization 85.6% 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.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 4: Columbus Drive /Prince Philip Drive & Thorburn Road

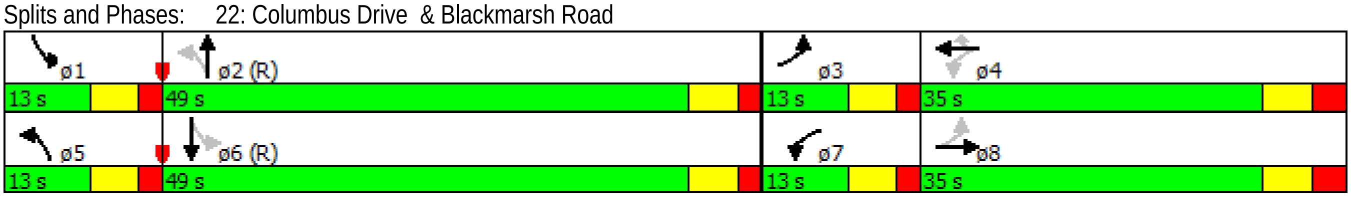


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	183	286	10	97	123	156	6	1241	116	102	672	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.5	3.5	3.5	3.5	3.5	3.0	4.0	4.0	3.0	4.0	4.0
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	70.0		0.0	75.0		75.0	80.0		0.0	70.0		0.0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	1.00	1.00		1.00		0.98	1.00	1.00			1.00	
Frt		0.995				0.850		0.987			0.990	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1750	1832	0	1750	1842	1566	1652	3640	0	1652	3653	0
Flt Permitted	0.657			0.276			0.335			0.076		
Satd. Flow (perm)	1207	1832	0	508	1842	1541	582	3640	0	132	3653	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2				179		10			8	
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		398.4			185.4			678.8			457.2	
Travel Time (s)		28.7			13.3			34.9			23.5	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.93	0.93	0.93	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	201	314	11	111	141	179	6	1334	125	107	707	49
Shared Lane Traffic (%)												
Lane Group Flow (vph)	201	325	0	111	141	179	6	1459	0	107	756	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases	8			4		4	2			6		
Total Split (s)	13.0	35.0		13.0	35.0	35.0	13.0	49.0		13.0	49.0	
Total Lost Time (s)	6.0	7.0		6.0	7.0	7.0	6.0	6.0		6.0	6.0	
Act Effct Green (s)	31.6	23.6		31.6	23.6	23.6	53.6	46.6		59.2	57.8	
Actuated g/C Ratio	0.29	0.21		0.29	0.21	0.21	0.49	0.42		0.54	0.53	
v/c Ratio	0.53	0.82		0.49	0.36	0.38	0.02	0.94		0.60	0.39	
Control Delay	33.4	58.0		32.6	38.3	7.3	13.3	44.3		52.6	20.6	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	33.4	58.0		32.6	38.3	7.3	13.3	44.3		52.6	20.6	
LOS	C	E		C	D	A	B	D		D	C	
Approach Delay		48.6			24.0			44.2			24.6	
Approach LOS		D			C			D			C	
Queue Length 50th (m)	31.4	65.9		16.4	25.6	0.0	0.6	160.3		18.7	38.9	
Queue Length 95th (m)	47.6	94.1		26.8	40.1	14.6	2.7	#217.3		#36.1	67.3	
Internal Link Dist (m)		374.4			161.4			654.8			433.2	
Turn Bay Length (m)	70.0			75.0		75.0	80.0			70.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	381	467		225	468	525	351	1548		177	1921	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.53	0.70		0.49	0.30	0.34	0.02	0.94		0.60	0.39	

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 81 (74%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.94	
Intersection Signal Delay: 37.1	Intersection LOS: D
Intersection Capacity Utilization 86.2%	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: 22: Columbus Drive & Blackmarsh Road

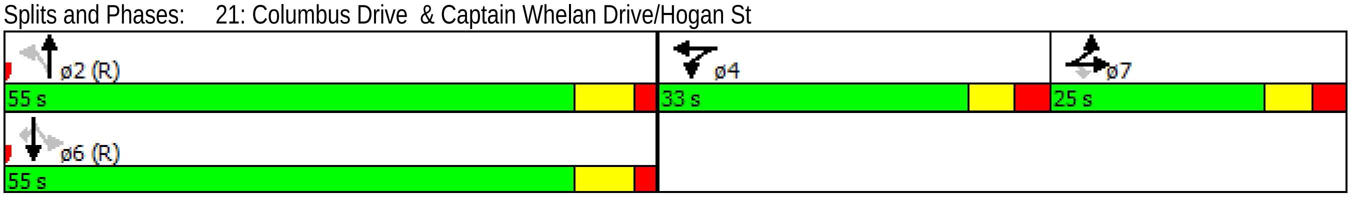


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	99	29	24	44	52	19	1042	73	17	575	167
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.2	3.4	3.0	4.0	4.5	4.5	3.2	3.5	3.8	3.2	3.5	3.8
Grade (%)		-5%			0%			0%			0%	
Storage Length (m)	140.0		30.5	80.0		0.0	100.0		0.0	100.0		225.0
Storage Lanes	1		1	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Ped Bike Factor	1.00	1.00	0.98	1.00	0.99		1.00	1.00				0.97
Frt			0.850		0.919			0.990				0.850
Flt Protected	0.950	0.986		0.950			0.950			0.950		
Satd. Flow (prot)	1647	1749	1515	1848	1868	0	1691	3459	0	1691	3500	1619
Flt Permitted	0.950	0.986		0.950			0.389			0.165		
Satd. Flow (perm)	1641	1747	1491	1844	1868	0	691	3459	0	294	3500	1576
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			106		49			8				184
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		474.2			187.8			348.7			678.8	
Travel Time (s)		34.1			13.5			17.9			34.9	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.80	0.80	0.80	0.92	0.92	0.92	0.91	0.91	0.91
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	194	110	32	30	55	65	21	1133	79	19	632	184
Shared Lane Traffic (%)	23%											
Lane Group Flow (vph)	149	155	32	30	120	0	21	1212	0	19	632	184
Turn Type	Split	NA	Perm	Split	NA		Perm	NA		Perm	NA	Perm
Protected Phases	7	7		4	4			2			6	
Permitted Phases			7				2			6		6
Total Split (s)	25.0	25.0	25.0	33.0	33.0		55.0	55.0		55.0	55.0	55.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	7.0
Act Effct Green (s)	15.4	15.4	15.4	10.8	10.8		65.8	65.8		65.8	65.8	65.8
Actuated g/C Ratio	0.14	0.14	0.14	0.10	0.10		0.58	0.58		0.58	0.58	0.58
v/c Ratio	0.67	0.65	0.11	0.17	0.54		0.05	0.60		0.11	0.31	0.19
Control Delay	60.2	58.5	0.8	48.1	38.0		13.2	17.7		15.5	13.5	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	60.2	58.5	0.8	48.1	38.0		13.2	17.7		15.5	13.5	2.6
LOS	E	E	A	D	D		B	B		B	B	A
Approach Delay		53.7			40.0			17.7			11.1	
Approach LOS		D			D			B			B	
Queue Length 50th (m)	33.3	34.6	0.0	6.3	15.2		1.9	82.7		1.7	34.4	0.0
Queue Length 95th (m)	52.5	54.0	0.0	13.2	27.2		6.8	129.1		6.9	56.5	10.8
Internal Link Dist (m)		450.2			163.8			324.7			654.8	
Turn Bay Length (m)	140.0		30.5	80.0			100.0			100.0		225.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	271	288	334	425	467		402	2016		171	2037	994
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	0
Reduced v/c Ratio	0.55	0.54	0.10	0.07	0.26		0.05	0.60		0.11	0.31	0.19

Intersection Summary	
Area Type: Other	
Cycle Length: 113	
Actuated Cycle Length: 113	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.67	
Intersection Signal Delay: 21.6	Intersection LOS: C
Intersection Capacity Utilization 56.9%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 21: Columbus Drive & Captain Whelan Drive/Hogan St



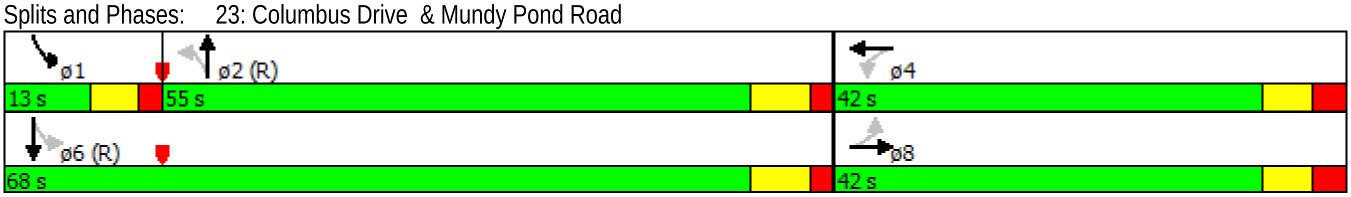
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	220	272	12	47	124	56	1	1421	100	38	720	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.0	3.4	3.4	3.0	3.7	3.7	3.0	3.7	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	70.0		0.0	60.0		0.0	75.0		0.0	100.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Frt		0.994			0.953			0.990			0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	1809	0	1652	1727	0	1652	3537	0	1652	3545	0
Flt Permitted	0.498			0.414			0.341			0.067		
Satd. Flow (perm)	864	1809	0	718	1727	0	592	3537	0	116	3545	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			22			8			8	
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		417.2			267.3			457.2			657.1	
Travel Time (s)		30.0			19.2			23.5			33.8	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.93	0.93	0.93	0.72	0.72	0.72	0.89	0.89	0.89	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	237	292	13	65	172	78	1	1597	112	41	783	42
Shared Lane Traffic (%)												
Lane Group Flow (vph)	237	305	0	65	250	0	1	1709	0	41	825	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Total Split (s)	42.0	42.0		42.0	42.0		55.0	55.0		13.0	68.0	
Total Lost Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		6.0	7.0	
Act Effct Green (s)	31.9	31.9		31.9	31.9		56.3	56.3		65.1	64.1	
Actuated g/C Ratio	0.29	0.29		0.29	0.29		0.51	0.51		0.59	0.58	
v/c Ratio	0.95	0.58		0.31	0.48		0.00	0.94		0.25	0.40	
Control Delay	83.6	37.4		33.7	32.0		8.0	20.5		30.7	29.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	83.6	37.4		33.7	32.0		8.0	20.5		30.7	29.6	
LOS	F	D		C	C		A	C		C	C	
Approach Delay		57.6			32.3			20.5			29.7	
Approach LOS		E			C			C			C	
Queue Length 50th (m)	47.6	53.1		10.4	38.5		0.0	~216.1		6.7	70.6	
Queue Length 95th (m)	#92.5	79.8		17.3	46.0		m0.0	m#242.2		16.8	117.4	
Internal Link Dist (m)		393.2			243.3			433.2			633.1	
Turn Bay Length (m)	70.0			60.0			75.0			100.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	274	576		228	564		303	1813		166	2069	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.86	0.53		0.29	0.44		0.00	0.94		0.25	0.40	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 100 (91%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 29.8 Intersection LOS: C
Intersection Capacity Utilization 82.5% 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.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 23: Columbus Drive & Mundy Pond Road



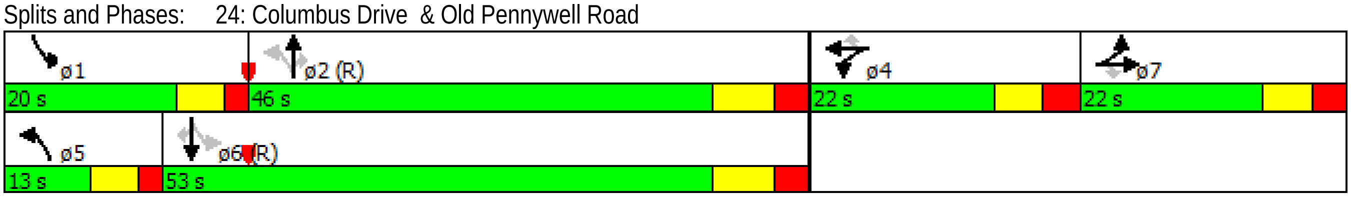
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	181	174	34	155	40	130	10	1557	274	166	709	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.4	4.2	3.8	3.5	3.5	4.2	3.0	3.5	3.7	3.0	3.5	3.5
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	45.0		80.0	65.0		70.0	100.0		140.0	100.0		75.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Ped Bike Factor	1.00		0.98	1.00		0.98	1.00		0.97			0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1730	1987	1619	3395	1842	1689	1652	5029	1601	1652	5029	1566
Flt Permitted	0.950			0.950			0.354			0.084		
Satd. Flow (perm)	1723	1987	1592	3384	1842	1661	614	5029	1559	146	5029	1525
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			238			238			304			169
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		162.7			211.3			299.5			746.3	
Travel Time (s)		11.7			15.2			15.4			38.4	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.91	0.91	0.91	0.90	0.90	0.90	0.94	0.94	0.94
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	218	210	41	170	44	143	11	1730	304	177	754	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	218	210	41	170	44	143	11	1730	304	177	754	46
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	7		4	4		5	2		1	6	
Permitted Phases			7			4	2		2	6		6
Total Split (s)	22.0	22.0	22.0	22.0	22.0	22.0	13.0	46.0	46.0	20.0	53.0	53.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.0	8.0	8.0	6.0	8.0	8.0
Act Effct Green (s)	17.4	17.4	17.4	11.3	11.3	11.3	50.7	41.7	41.7	61.3	56.7	56.7
Actuated g/C Ratio	0.16	0.16	0.16	0.10	0.10	0.10	0.46	0.38	0.38	0.56	0.52	0.52
v/c Ratio	0.80	0.67	0.09	0.49	0.23	0.37	0.03	0.91	0.39	0.74	0.29	0.05
Control Delay	66.9	55.4	0.4	51.0	47.5	2.8	13.6	46.3	14.1	53.9	38.5	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.9	55.4	0.4	51.0	47.5	2.8	13.6	46.3	14.1	53.9	38.5	5.8
LOS	E	E	A	D	D	A	B	D	B	D	D	A
Approach Delay		55.9			31.3			41.3			39.8	
Approach LOS		E			C			D			D	
Queue Length 50th (m)	44.6	42.1	0.0	18.1	8.9	0.0	1.4	145.9	26.5	36.5	58.5	1.1
Queue Length 95th (m)	#79.7	#67.9	0.0	27.7	18.8	0.0	m1.6	m#166.9	m32.6	#58.3	75.0	m5.6
Internal Link Dist (m)		138.7			187.3			275.5			722.3	
Turn Bay Length (m)	45.0		80.0	65.0		70.0	100.0		140.0	100.0		75.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	273	314	452	462	251	432	348	1905	779	273	2592	867
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.80	0.67	0.09	0.37	0.18	0.33	0.03	0.91	0.39	0.65	0.29	0.05

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 41.8 Intersection LOS: D
Intersection Capacity Utilization 80.5% 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.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 24: Columbus Drive & Old Pennywell Road



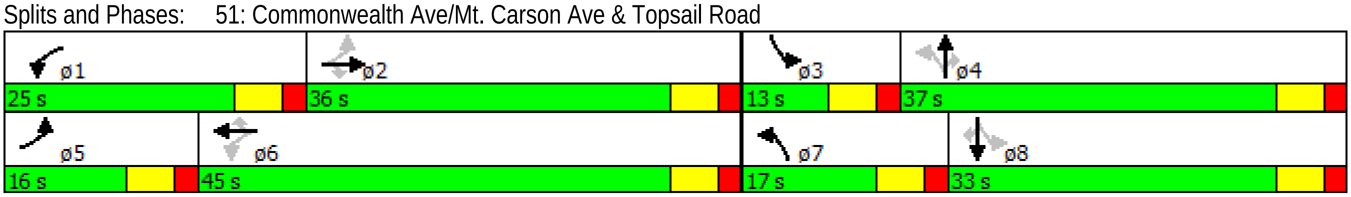
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	67	733	220	194	462	22	235	421	269	152	308	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	60.0		40.0	100.0		30.0	0.0		0.0	40.0		30.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1772	3544	1601	1789	1883	1585	1789	1883	1601
Flt Permitted	0.475			0.153			0.261			0.207		
Satd. Flow (perm)	895	3579	1601	285	3544	1601	492	1883	1585	390	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			206			147			283			206
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		1093.2			920.0			219.2			1135.0	
Travel Time (s)		78.7			66.2			15.8			81.7	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	3%	3%	2%	2%	2%	3%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	73	772	232	204	486	23	247	443	283	160	324	38
Shared Lane Traffic (%)												
Lane Group Flow (vph)	73	772	232	204	486	23	247	443	283	160	324	38
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	16.0	36.0	36.0	25.0	45.0	45.0	17.0	37.0	37.0	13.0	33.0	33.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Act Effct Green (s)	37.8	29.7	29.7	48.1	37.6	37.6	39.7	28.6	28.6	31.6	24.6	24.6
Actuated g/C Ratio	0.37	0.29	0.29	0.47	0.37	0.37	0.39	0.28	0.28	0.31	0.24	0.24
v/c Ratio	0.18	0.75	0.38	0.63	0.37	0.03	0.75	0.84	0.44	0.74	0.72	0.07
Control Delay	17.1	39.1	8.2	26.1	26.2	0.1	38.4	51.3	6.0	45.2	46.3	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.1	39.1	8.2	26.1	26.2	0.1	38.4	51.3	6.0	45.2	46.3	0.2
LOS	B	D	A	C	C	A	D	D	A	D	D	A
Approach Delay		31.0			25.3			34.8			42.6	
Approach LOS		C			C			C			D	
Queue Length 50th (m)	8.1	75.2	3.8	24.3	39.9	0.0	33.1	82.8	0.0	20.3	59.3	0.0
Queue Length 95th (m)	15.8	104.5	23.2	40.5	55.5	0.0	#57.4	#141.5	19.2	#43.8	95.7	0.0
Internal Link Dist (m)		1069.2			896.0			195.2			1111.0	
Turn Bay Length (m)	60.0		40.0	100.0		30.0				40.0		30.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	434	1052	616	412	1388	716	330	571	678	216	498	575
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.73	0.38	0.50	0.35	0.03	0.75	0.78	0.42	0.74	0.65	0.07

Intersection Summary	
Area Type: Other	
Cycle Length: 111	
Actuated Cycle Length: 102.5	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.84	
Intersection Signal Delay: 32.7	Intersection LOS: C
Intersection Capacity Utilization 85.5%	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: 51: Commonwealth Ave/Mt. Carson Ave & Topsail Road

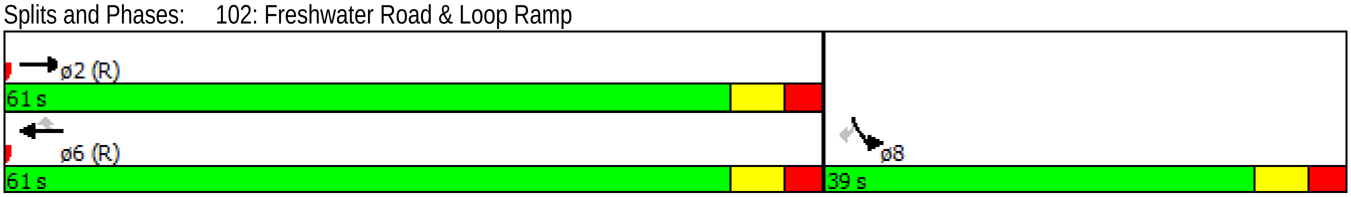


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	766	610	278	368	317
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	4.3	4.3	4.3	4.3	3.8	4.3
Grade (%)		0%	0%		0%	
Storage Length (m)	0.0			40.0	95.0	0.0
Storage Lanes	0			1	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	0.95	0.95	1.00	0.97	1.00
Ped Bike Factor						
Frt				0.850		0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3814	3814	1706	3509	1706
Flt Permitted					0.950	
Satd. Flow (perm)	0	3814	3814	1706	3509	1706
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				312		208
Link Speed (k/h)		50	50		50	
Link Distance (m)		191.2	153.6		119.3	
Travel Time (s)		13.8	11.1		8.6	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.88	0.88	0.89	0.89	0.91	0.91
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	0	870	685	312	404	348
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	870	685	312	404	348
Turn Type		NA	NA	Perm	NA	Perm
Protected Phases		2	6		8	
Permitted Phases				6		8
Total Split (s)		61.0	61.0	61.0	39.0	39.0
Total Lost Time (s)		7.0	7.0	7.0	7.0	7.0
Act Effct Green (s)		67.4	67.4	67.4	18.6	18.6
Actuated g/C Ratio		0.67	0.67	0.67	0.19	0.19
v/c Ratio		0.34	0.27	0.25	0.62	0.71
Control Delay		7.9	7.4	1.5	41.0	23.0
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		7.9	7.4	1.5	41.0	23.0
LOS		A	A	A	D	C
Approach Delay		7.9	5.6		32.7	
Approach LOS		A	A		C	
Queue Length 50th (m)		32.3	23.9	0.0	37.8	25.0
Queue Length 95th (m)		53.5	41.2	9.5	47.1	50.1
Internal Link Dist (m)		167.2	129.6		95.3	
Turn Bay Length (m)				40.0	95.0	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)		2569	2569	1250	1122	687
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		0.34	0.27	0.25	0.36	0.51

Intersection Summary	
Area Type: Other	
Cycle Length: 100	
Actuated Cycle Length: 100	
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.71	
Intersection Signal Delay: 14.1	Intersection LOS: B
Intersection Capacity Utilization 48.2%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 102: Freshwater Road & Loop Ramp



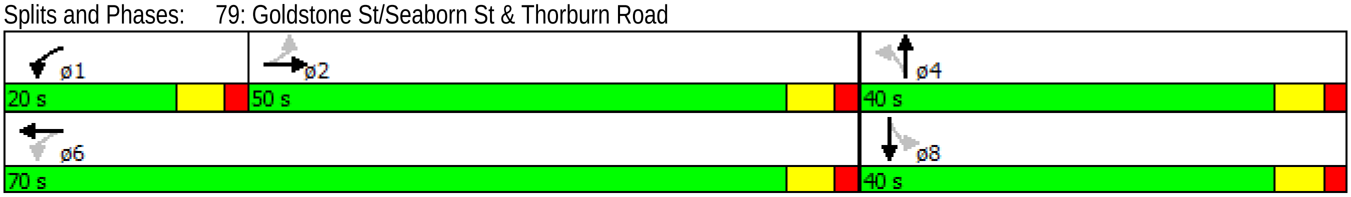
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	3	916	224	258	130	7	20	10	212	27	33	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.0	3.4	3.4	3.0	4.0	4.0	3.0	4.0	4.0
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	65.0		0.0	85.0		0.0	50.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.971			0.992			0.857			0.974	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	3360	0	1652	3433	0	1652	1667	0	1652	1895	0
Flt Permitted	0.658			0.084			0.726			0.374		
Satd. Flow (perm)	1144	3360	0	146	3433	0	1262	1667	0	650	1895	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		33			8			214			8	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		85.0			389.2			240.7			135.3	
Travel Time (s)		6.1			28.0			17.3			9.7	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.99	0.99	0.99	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	4	1104	270	280	141	8	20	10	214	32	39	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	4	1374	0	280	149	0	20	224	0	32	47	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Total Split (s)	50.0	50.0		20.0	70.0		40.0	40.0		40.0	40.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	44.2	44.2		64.3	64.3		10.7	10.7		10.7	10.7	
Actuated g/C Ratio	0.51	0.51		0.74	0.74		0.12	0.12		0.12	0.12	
v/c Ratio	0.01	0.80		0.80	0.06		0.13	0.57		0.41	0.20	
Control Delay	13.3	22.8		38.5	3.8		34.4	11.8		49.4	30.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	13.3	22.8		38.5	3.8		34.4	11.8		49.4	30.4	
LOS	B	C		D	A		C	B		D	C	
Approach Delay		22.8			26.5			13.6			38.1	
Approach LOS		C			C			B			D	
Queue Length 50th (m)	0.3	86.2		27.2	2.3		3.0	1.5		5.0	5.9	
Queue Length 95th (m)	2.1	134.7		#84.6	8.1		9.0	19.3		12.5	14.0	
Internal Link Dist (m)		61.0			365.2			216.7			111.3	
Turn Bay Length (m)	55.0			65.0			85.0			50.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	580	1722		351	2537		494	784		255	748	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.01	0.80		0.80	0.06		0.04	0.29		0.13	0.06	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 87
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 23.1 Intersection LOS: C
Intersection Capacity Utilization 84.2% 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: 79: Goldstone St/Seaborn St & Thorburn Road



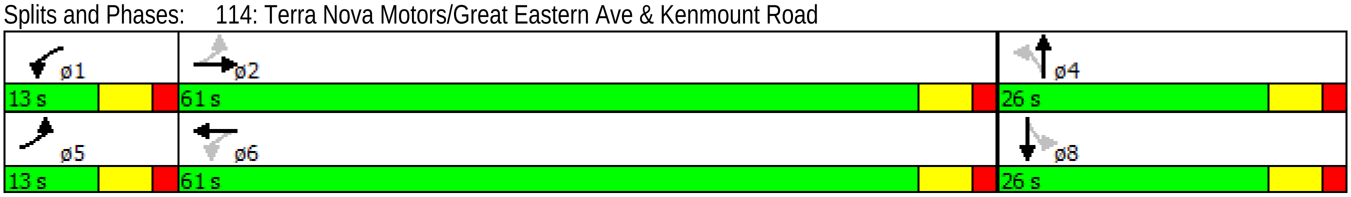
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	63	1870	6	30	822	10	9	0	6	9	1	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.7	3.7	3.5	3.7	3.7	3.0	3.5	3.5	3.0	3.5	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	45.0		0.0	25.0		0.0	65.0		0.0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.999			0.998			0.850			0.852	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1750	3575	0	1750	3571	0	1652	1566	0	1652	1569	0
Flt Permitted	0.286			0.067			0.714			0.753		
Satd. Flow (perm)	527	3575	0	123	3571	0	1241	1566	0	1309	1569	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			2			129			88	
Link Speed (k/h)		50			50			48			48	
Link Distance (m)		482.2			1319.1			190.4			243.7	
Travel Time (s)		34.7			95.0			14.3			18.3	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	68	2033	7	33	893	11	10	0	7	10	1	88
Shared Lane Traffic (%)												
Lane Group Flow (vph)	68	2040	0	33	904	0	10	7	0	10	89	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2			6			4			8		
Total Split (s)	13.0	61.0		13.0	61.0		26.0	26.0		26.0	26.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	65.4	62.9		63.6	60.3		6.8	6.8		6.8	6.8	
Actuated g/C Ratio	0.77	0.74		0.75	0.71		0.08	0.08		0.08	0.08	
v/c Ratio	0.14	0.77		0.16	0.36		0.10	0.03		0.10	0.43	
Control Delay	3.2	13.4		4.6	7.3		38.9	0.2		38.7	16.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	3.2	13.4		4.6	7.3		38.9	0.2		38.7	16.1	
LOS	A	B		A	A		D	A		D	B	
Approach Delay		13.0			7.2			22.9			18.4	
Approach LOS		B			A			C			B	
Queue Length 50th (m)	1.8	126.3		0.9	32.6		1.6	0.0		1.6	0.2	
Queue Length 95th (m)	5.0	#206.5		2.9	50.4		6.3	0.0		6.3	13.2	
Internal Link Dist (m)		458.2			1295.1			166.4			219.7	
Turn Bay Length (m)	55.0			45.0			25.0			65.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	508	2650		227	2534		293	468		309	437	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.13	0.77		0.15	0.36		0.03	0.01		0.03	0.20	

Intersection Summary	
Area Type: Other	
Cycle Length: 100	
Actuated Cycle Length: 84.9	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 11.5	Intersection LOS: B
Intersection Capacity Utilization 69.5%	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: 114: Terra Nova Motors/Great Eastern Ave & Kenmount Road



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	81	188	84	33	199	260
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	88	204	91	36	216	283
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			292		409	190
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			292		409	190
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		61	67
cM capacity (veh/h)			1269		556	852

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	292	91	36	216	283
Volume Left	0	91	0	216	0
Volume Right	204	0	0	0	283
cSH	1700	1269	1700	556	852
Volume to Capacity	0.17	0.07	0.02	0.39	0.33
Queue Length 95th (m)	0.0	1.8	0.0	13.9	11.1
Control Delay (s)	0.0	8.1	0.0	15.5	11.3
Lane LOS		A		C	B
Approach Delay (s)	0.0	5.8		13.1	
Approach LOS				B	

Intersection Summary			
Average Delay	7.9		
Intersection Capacity Utilization	41.5%	ICU Level of Service	A
Analysis Period (min)	15		

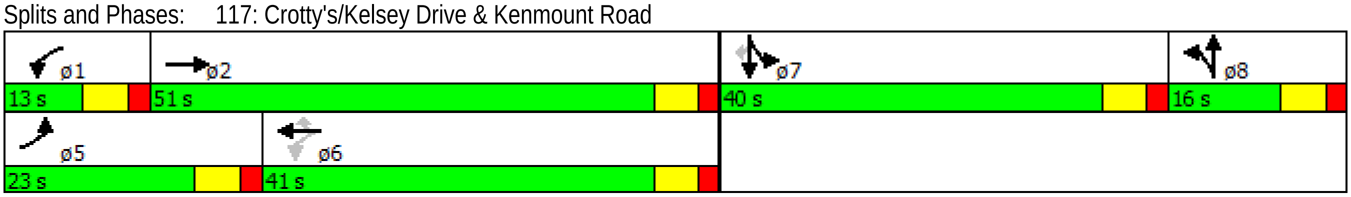
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	213	1834	0	0	875	111	0	0	0	74	0	276
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.5	3.5	3.0	3.7	3.4	3.5	4.0	4.0	3.4	3.4	3.5
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	75.0		0.0	50.0		130.0	0.0		25.0	0.0		60.0
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Ped Bike Factor												
Frt						0.850						0.850
Flt Protected	0.950									0.950	0.950	
Satd. Flow (prot)	3395	3500	0	1739	3579	1548	1842	1946	0	1644	1644	1566
Flt Permitted	0.950									0.950	0.950	
Satd. Flow (perm)	3395	3500	0	1739	3579	1548	1842	1946	0	1644	1644	1566
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						191						307
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		493.9			512.5			37.4			398.8	
Travel Time (s)		35.6			36.9			2.7			28.7	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.96	0.96	0.96	0.87	0.87	0.87	0.25	0.25	0.25	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	222	1910	0	0	1006	128	0	0	0	82	0	307
Shared Lane Traffic (%)										50%		
Lane Group Flow (vph)	222	1910	0	0	1006	128	0	0	0	41	41	307
Turn Type	Prot	NA		pm+pt	NA	Perm	Split			Split	NA	Perm
Protected Phases	5	2		1	6		8	8		7	7	
Permitted Phases				6		6						7
Total Split (s)	23.0	51.0		13.0	41.0	41.0	16.0	16.0		40.0	40.0	40.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Act Effct Green (s)	10.1	51.2			35.0	35.0				10.6	10.6	10.6
Actuated g/C Ratio	0.14	0.69			0.47	0.47				0.14	0.14	0.14
v/c Ratio	0.48	0.79			0.59	0.15				0.17	0.17	0.63
Control Delay	33.1	10.8			16.4	1.1				30.2	30.2	10.4
Queue Delay	0.0	0.0			0.0	0.0				0.0	0.0	0.0
Total Delay	33.1	10.8			16.4	1.1				30.2	30.2	10.4
LOS	C	B			B	A				C	C	B
Approach Delay		13.2			14.7						14.5	
Approach LOS		B			B						B	
Queue Length 50th (m)	14.7	75.0			49.7	0.0				5.3	5.3	0.0
Queue Length 95th (m)	25.4	120.5			75.1	2.4				14.3	14.3	20.2
Internal Link Dist (m)		469.9			488.5			13.4			374.8	
Turn Bay Length (m)	75.0					130.0						60.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	782	2426			1698	834				758	758	887
Starvation Cap Reductn	0	0			0	0				0	0	0
Spillback Cap Reductn	0	0			0	0				0	0	0
Storage Cap Reductn	0	0			0	0				0	0	0
Reduced v/c Ratio	0.28	0.79			0.59	0.15				0.05	0.05	0.35

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 73.8
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 13.8 Intersection LOS: B
Intersection Capacity Utilization 79.9% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 117: Crotty's/Kelsey Drive & Kenmount Road



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	3	32	35	389	215	62
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	35	38	423	234	67
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		4				
Median type				None	None	
Median storage veh)						
Upstream signal (m)				399		
pX, platoon unblocked						
vC, conflicting volume	521	117	234			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	521	117	234			
tC, single (s)	8.1	6.9	4.7			
tC, 2 stage (s)						
tF (s)	4.2	3.3	2.5			
p0 queue free %	99	96	97			
cM capacity (veh/h)	342	913	1156			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	38	38	211	211	117	117	67
Volume Left	3	38	0	0	0	0	0
Volume Right	35	0	0	0	0	0	67
cSH	999	1156	1700	1700	1700	1700	1700
Volume to Capacity	0.04	0.03	0.12	0.12	0.07	0.07	0.04
Queue Length 95th (m)	0.9	0.8	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	9.7	8.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	A	A					
Approach Delay (s)	9.7	0.7			0.0		
Approach LOS	A						

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	22.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	20	1776	865	74	252	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	4.0	4.0	4.0	3.5	4.0
Grade (%)		0%	0%		0%	
Storage Length (m)	35.0			0.0	50.0	0.0
Storage Lanes	1			0	1	0
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	0.95	0.95	0.95	0.97	0.95
Ped Bike Factor						
Frt			0.988		0.987	
Flt Protected	0.950				0.956	
Satd. Flow (prot)	1750	3697	3652	0	3372	0
Flt Permitted	0.174				0.956	
Satd. Flow (perm)	321	3697	3652	0	3372	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			10		9	
Link Speed (k/h)		50	50		50	
Link Distance (m)		1319.1	493.9		193.0	
Travel Time (s)		95.0	35.6		13.9	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	22	1930	940	80	274	27
Shared Lane Traffic (%)						
Lane Group Flow (vph)	22	1930	1020	0	301	0
Turn Type	pm+pt	NA	NA		NA	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Total Split (s)	13.0	76.0	63.0		44.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Act Effct Green (s)	68.3	68.3	60.9		38.0	
Actuated g/C Ratio	0.58	0.58	0.51		0.32	
v/c Ratio	0.08	0.90	0.54		0.28	
Control Delay	11.3	29.5	21.3		30.2	
Queue Delay	0.0	0.0	0.0		0.0	
Total Delay	11.3	29.5	21.3		30.2	
LOS	B	C	C		C	
Approach Delay		29.3	21.3		30.2	
Approach LOS		C	C		C	
Queue Length 50th (m)	2.1	197.6	87.3		26.4	
Queue Length 95th (m)	5.6	236.1	109.1		37.8	
Internal Link Dist (m)		1295.1	469.9		169.0	
Turn Bay Length (m)	35.0				50.0	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)	269	2188	1883		1089	
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	0.08	0.88	0.54		0.28	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 118.3	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.90	
Intersection Signal Delay: 26.9	Intersection LOS: C
Intersection Capacity Utilization 67.1%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 123: Kenmount Road & Ladysmith Drive

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	143	1055	537	177	262	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.4	3.3	3.3
Grade (%)		0%	0%		0%	
Storage Length (m)	65.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Ped Bike Factor						
Frt			0.963			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1652	3461	3333	0	1711	1531
Flt Permitted	0.276				0.950	
Satd. Flow (perm)	480	3461	3333	0	1711	1531
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			53			263
Link Speed (k/h)		50	50		50	
Link Distance (m)		166.0	286.5		159.8	
Travel Time (s)		12.0	20.6		11.5	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.87	0.87	0.94	0.94	0.86	0.86
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	164	1213	571	188	305	263
Shared Lane Traffic (%)						
Lane Group Flow (vph)	164	1213	759	0	305	263
Turn Type	pm+pt	NA	NA		NA	Perm
Protected Phases	5	2	6		8	
Permitted Phases	2					8
Total Split (s)	18.0	74.0	56.0		36.0	36.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)	68.2	68.2	52.8		22.8	22.8
Actuated g/C Ratio	0.66	0.66	0.51		0.22	0.22
v/c Ratio	0.39	0.53	0.44		0.81	0.48
Control Delay	10.2	10.8	16.6		54.8	7.2
Queue Delay	0.0	0.6	0.0		0.0	0.0
Total Delay	10.2	11.4	16.6		54.8	7.2
LOS	B	B	B		D	A
Approach Delay		11.3	16.6		32.7	
Approach LOS		B	B		C	
Queue Length 50th (m)	11.2	60.5	44.6		58.0	0.0
Queue Length 95th (m)	22.2	87.5	71.0		82.4	15.8
Internal Link Dist (m)		142.0	262.5		135.8	
Turn Bay Length (m)	65.0				50.0	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)	454	2291	1735		499	633
Starvation Cap Reductn	0	629	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.36	0.73	0.44		0.61	0.42

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 103	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.81	
Intersection Signal Delay: 17.3	Intersection LOS: B
Intersection Capacity Utilization 57.9%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 90: Thorburn Road & Mount Scio Rd

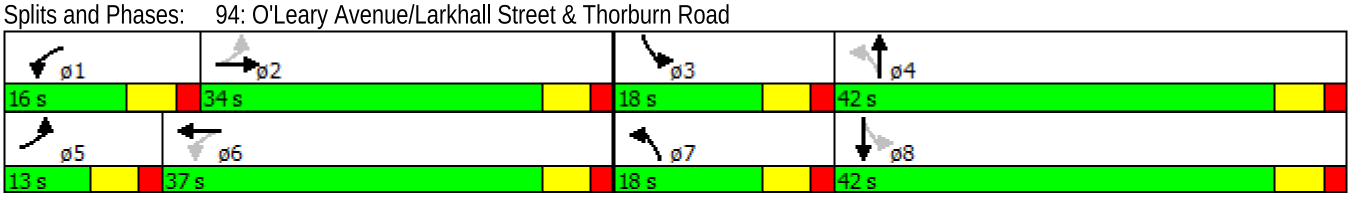
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	71	849	142	168	539	29	80	110	302	47	39	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.5	3.5	3.0	3.5	3.5	3.0	3.3	3.3	3.0	3.3	3.3
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	60.0		0.0	110.0		0.0	105.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	1.00			1.00		0.99	0.98		1.00	0.99	
Frt		0.979			0.992			0.890			0.928	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	3410	0	1652	3466	0	1652	1572	0	1652	1656	0
Flt Permitted	0.382			0.114			0.664			0.149		
Satd. Flow (perm)	661	3410	0	198	3466	0	1147	1572	0	258	1656	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		16			5			134			45	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		341.5			167.2			171.2			115.5	
Travel Time (s)		24.6			12.0			12.3			8.3	
Confl. Peds. (#/hr)	5		5	5		5	5		10	10		5
Confl. Bikes (#/hr)												
Peak Hour Factor	0.91	0.91	0.91	0.94	0.94	0.94	0.85	0.85	0.85	0.68	0.68	0.68
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	78	933	156	179	573	31	94	129	355	69	57	53
Shared Lane Traffic (%)												
Lane Group Flow (vph)	78	1089	0	179	604	0	94	484	0	69	110	0
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Total Split (s)	13.0	34.0		16.0	37.0		18.0	42.0		18.0	42.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	35.9	28.7		42.5	35.0		34.8	27.6		33.1	26.8	
Actuated g/C Ratio	0.38	0.30		0.45	0.37		0.36	0.29		0.35	0.28	
v/c Ratio	0.24	1.05		0.75	0.47		0.20	0.88		0.34	0.22	
Control Delay	20.8	77.3		43.7	28.9		17.5	42.1		20.9	18.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	20.8	77.3		43.7	28.9		17.5	42.1		20.9	18.0	
LOS	C	E		D	C		B	D		C	B	
Approach Delay		73.5			32.3			38.1			19.1	
Approach LOS		E			C			D			B	
Queue Length 50th (m)	8.6	~127.8		21.1	50.5		10.5	65.8		7.6	9.3	
Queue Length 95th (m)	19.7	#188.9		#62.6	75.5		18.5	99.0		11.4	14.9	
Internal Link Dist (m)		317.5			143.2			147.2			91.5	
Turn Bay Length (m)	60.0			110.0			105.0			30.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	322	1036		244	1272		504	690		276	668	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.24	1.05		0.73	0.47		0.19	0.70		0.25	0.16	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 95.5
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.05
Intersection Signal Delay: 50.4 Intersection LOS: D
Intersection Capacity Utilization 85.8% 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: 94: O'Leary Avenue/Larkhall Street & Thorburn Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	378	527	0	0	176	33	69	0	464	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	402	561	0	0	187	35	73	0	494	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									2			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	187			561			1570	1552	561	1570	1570	205
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	187			561			1570	1552	561	1570	1570	205
tC, single (s)	4.1			4.1			7.4	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.8	4.0	3.3	3.5	4.0	3.3
p0 queue free %	71			100			0	100	6	100	100	100
cM capacity (veh/h)	1387			1011			61	81	525	4	79	836

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	402	561	222	567
Volume Left	402	0	0	73
Volume Right	0	0	35	494
cSH	1387	1700	1700	322
Volume to Capacity	0.29	0.33	0.13	1.76
Queue Length 95th (m)	9.2	0.0	0.0	277.2
Control Delay (s)	8.7	0.0	0.0	383.1
Lane LOS	A			F
Approach Delay (s)	3.6		0.0	383.1
Approach LOS				F

Intersection Summary			
Average Delay	126.0		
Intersection Capacity Utilization	91.7%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	1045	169	95	152	0	0	0	0	20	0	39
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	0	1259	204	114	183	0	0	0	0	24	0	47
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												2
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	183			1259			1773	1773	1361	1773	1671	183
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	183			1259			1773	1773	1361	1773	1671	183
tC, single (s)	4.1			4.2			7.1	6.5	6.2	7.3	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.3	3.7	4.0	3.3
p0 queue free %	100			78			100	100	100	50	100	95
cM capacity (veh/h)	1392			523			51	65	181	48	75	859

Direction, Lane #	EB 1	WB 1	WB 2	SB 1
Volume Total	1463	114	183	71
Volume Left	0	114	0	24
Volume Right	204	0	0	47
cSH	1700	523	1700	143
Volume to Capacity	0.86	0.22	0.11	0.50
Queue Length 95th (m)	0.0	6.3	0.0	17.9
Control Delay (s)	0.0	13.8	0.0	53.0
Lane LOS		B		F
Approach Delay (s)	0.0	5.3		53.0
Approach LOS				F

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	91.7%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	459	1390	2	1	628	204	3	1	1	117	1	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.7	3.7	3.4	3.4	3.7	3.7	3.7	3.3	3.7	4.8
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	65.0		0.0	40.0		0.0	0.0		0.0	115.0		0.0
Storage Lanes	1		0	1		0	0		0	1		0
Taper Length (m)	7.5			7.5			2.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt					0.963			0.973			0.851	
Flt Protected	0.950			0.950				0.971		0.950		
Satd. Flow (prot)	1652	3461	0	1789	3333	0	0	1779	0	1711	1603	0
Flt Permitted	0.140			0.180						0.950		
Satd. Flow (perm)	243	3461	0	339	3333	0	0	1833	0	1711	1603	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					35			1			115	
Link Speed (k/h)		50			50			48			50	
Link Distance (m)		307.6			467.7			50.9			160.1	
Travel Time (s)		22.1			33.7			3.8			11.5	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.92	0.92	0.86	0.86	0.92	0.92	0.92	0.86	0.92	0.86
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	483	1463	2	1	730	237	3	1	1	136	1	115
Shared Lane Traffic (%)												
Lane Group Flow (vph)	483	1465	0	1	967	0	0	5	0	136	116	0
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Prot	NA	
Protected Phases	5	2			6			4		3	8	
Permitted Phases	2			6			4					
Total Split (s)	43.0	90.0		47.0	47.0		22.0	22.0		18.0	40.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Act Effct Green (s)	84.2	84.2		45.9	45.9			5.9		11.8	14.1	
Actuated g/C Ratio	0.76	0.76		0.42	0.42			0.05		0.11	0.13	
v/c Ratio	0.81	0.55		0.01	0.69			0.05		0.75	0.38	
Control Delay	32.2	6.9		25.0	30.2			48.6		73.4	11.5	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	32.2	6.9		25.0	30.2			48.6		73.4	11.5	
LOS	C	A		C	C			D		E	B	
Approach Delay		13.2			30.2			48.6			44.9	
Approach LOS		B			C			D			D	
Queue Length 50th (m)	61.6	51.0		0.1	84.7			0.8		28.1	0.2	
Queue Length 95th (m)	#130.1	105.5		1.5	125.2			5.1		#60.3	15.4	
Internal Link Dist (m)		283.6			443.7			26.9			136.1	
Turn Bay Length (m)	65.0			40.0						115.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	658	2640		140	1406			267		186	574	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	0.73	0.55		0.01	0.69			0.02		0.73	0.20	

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 110.3
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 20.9 Intersection LOS: C
Intersection Capacity Utilization 74.0% 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: 108: Kenmount Road & Pippy Place

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	81	764	0	0	203	142	5	0	29	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	87	822	0	0	218	153	5	0	31	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	371			822			1290	1367	822	1322	1290	295
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	371			822			1290	1367	822	1322	1290	295
tC, single (s)	4.2			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	92			100			96	100	92	100	100	100
cM capacity (veh/h)	1124			808			132	136	373	115	151	745

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	87	822	371	37
Volume Left	87	0	0	5
Volume Right	0	0	153	31
cSH	1124	1700	1700	294
Volume to Capacity	0.08	0.48	0.22	0.12
Queue Length 95th (m)	1.9	0.0	0.0	3.2
Control Delay (s)	8.5	0.0	0.0	19.0
Lane LOS	A			C
Approach Delay (s)	0.8		0.0	19.0
Approach LOS				C

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	298	2	5	203	0	0	0	0	547	0	170
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	331	2	6	226	0	0	0	0	608	0	189
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	226			331			644	568	331	568	568	113
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	226			331			644	568	331	568	568	113
tC, single (s)	4.2			4.5			7.5	6.5	6.9	7.6	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.4			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			100	100	100	0	100	79
cM capacity (veh/h)	1311			1105			283	429	665	402	429	919

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	SB 1
Volume Total	331	2	6	113	113	797
Volume Left	0	0	6	0	0	608
Volume Right	0	2	0	0	0	189
cSH	1700	1700	1105	1700	1700	464
Volume to Capacity	0.19	0.00	0.01	0.07	0.07	1.72
Queue Length 95th (m)	0.0	0.0	0.1	0.0	0.0	363.5
Control Delay (s)	0.0	0.0	8.3	0.0	0.0	353.1
Lane LOS			A			F
Approach Delay (s)	0.0		0.2			353.1
Approach LOS						F

Intersection Summary			
Average Delay	206.7		
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	908	64	517	615	54	1165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.5	3.5	3.5	3.5	3.7
Grade (%)	0%			0%	0%	
Storage Length (m)		0.0	85.0		0.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)			7.5		7.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Ped Bike Factor						
Frt	0.990					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	3433	0	1750	3500	1750	1601
Flt Permitted			0.098		0.950	
Satd. Flow (perm)	3433	0	181	3500	1750	1601
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	6					564
Link Speed (k/h)	60			60	50	
Link Distance (m)	397.1			482.2	381.2	
Travel Time (s)	23.8			28.9	27.4	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.98	0.98	0.92	0.92	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	927	65	562	668	57	1226
Shared Lane Traffic (%)						
Lane Group Flow (vph)	992	0	562	668	57	1226
Turn Type	NA		pm+pt	NA	NA	Perm
Protected Phases	2		1	6	4	
Permitted Phases			6			4
Total Split (s)	45.0		46.0	91.0	29.0	29.0
Total Lost Time (s)	6.0		6.0	6.0	6.0	6.0
Act Effct Green (s)	42.2		85.0	85.0	23.0	23.0
Actuated g/C Ratio	0.35		0.71	0.71	0.19	0.19
v/c Ratio	0.82		0.92	0.27	0.17	1.61
Control Delay	42.7		52.1	6.6	42.2	299.1
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	42.7		52.1	6.6	42.2	299.1
LOS	D		D	A	D	F
Approach Delay	42.7			27.4	287.7	
Approach LOS	D			C	F	
Queue Length 50th (m)	115.5		104.0	26.6	11.3	~302.2
Queue Length 95th (m)	#151.2		#165.7	34.0	23.2	#382.5
Internal Link Dist (m)	373.1			458.2	357.2	
Turn Bay Length (m)			85.0			

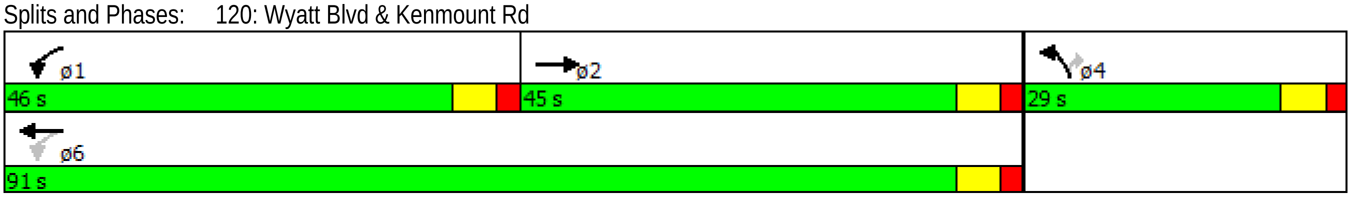
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Base Capacity (vph)	1212		651	2479	335	762
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.82		0.86	0.27	0.17	1.61

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.61	
Intersection Signal Delay: 127.0	Intersection LOS: F
Intersection Capacity Utilization 109.3%	ICU Level of Service H
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: 120: Wyatt Blvd & Kenmount Rd



Summary of All Intervals

Run Number	1	10	2	3	4	5	6
Start Time	6:50	6:50	6:50	6:50	6:50	6:50	6:50
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5	5
# of Recorded mScheduledIntervals	4	4	4	4	4	4	4
Vehs Entered	20159	20122	20271	20040	19955	19938	20544
Vehs Exited	19968	19921	20154	19901	19856	19775	20293
Starting Vehs	1406	1346	1462	1438	1379	1358	1345
Ending Vehs	1597	1547	1579	1577	1478	1521	1596
Travel Distance (km)	49234	49249	50020	49540	49505	49307	50396
Travel Time (hr)	2519.6	2515.7	2706.1	2661.6	2401.3	2548.5	2553.7
Total Delay (hr)	1506.4	1501.8	1674.2	1642.0	1381.8	1533.7	1516.0
Total Stops	32609	32810	33647	32292	31332	32027	34255
Fuel Used (l)	4976.4	4986.3	5186.9	5115.9	4885.5	5003.7	5077.3

Summary of All Intervals

Run Number	7	8	9	Avg
Start Time	6:50	6:50	6:50	6:50
End Time	8:00	8:00	8:00	8:00
Total Time (min)	70	70	70	70
Time Recorded (min)	60	60	60	60
# of Intervals	5	5	5	5
# of Recorded mScheduledIntervals	4	4	4	4
Vehs Entered	20065	20137	19915	20116
Vehs Exited	20006	19973	19809	19962
Starting Vehs	1417	1409	1376	1380
Ending Vehs	1476	1573	1482	1539
Travel Distance (km)	49505	49109	49004	49487
Travel Time (hr)	2465.5	2529.5	2522.4	2542.4
Total Delay (hr)	1445.4	1516.5	1513.6	1523.1
Total Stops	32126	32201	33003	32618
Fuel Used (l)	4951.6	4973.1	4967.0	5012.4

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording #1

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	5389	5389	5441	5346	5384	5347	5515
Vehs Exited	5120	4974	5127	5050	5150	5038	5092
Starting Vehs	1406	1346	1462	1438	1379	1358	1345
Ending Vehs	1675	1761	1776	1734	1613	1667	1768
Travel Distance (km)	12864	12543	12691	12648	12675	12574	12452
Travel Time (hr)	490.2	483.0	508.2	508.6	471.9	488.9	481.5
Total Delay (hr)	225.8	225.4	245.9	248.0	210.9	230.3	224.8
Total Stops	8400	8562	8905	8662	8336	8476	8430
Fuel Used (l)	1153.9	1135.3	1162.7	1159.0	1131.3	1141.7	1126.0

Interval #1 Information Recording #1

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	5235	5420	5337	5373
Vehs Exited	5042	4999	5026	5062
Starting Vehs	1417	1409	1376	1380
Ending Vehs	1610	1830	1687	1706
Travel Distance (km)	12573	12663	12579	12626
Travel Time (hr)	478.2	493.1	481.2	488.5
Total Delay (hr)	219.0	231.9	222.4	228.4
Total Stops	8402	8859	8513	8541
Fuel Used (l)	1132.1	1148.9	1128.4	1141.9

Interval #2 Information Recording #2

Start Time	7:15
End Time	7:30
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	4727	4640	4698	4625	4680	4571	4831
Vehs Exited	4873	4890	4937	4898	4753	4787	5017
Starting Vehs	1675	1761	1776	1734	1613	1667	1768
Ending Vehs	1529	1511	1537	1461	1540	1451	1582
Travel Distance (km)	12157	12108	12293	11928	12074	11991	12491
Travel Time (hr)	564.9	559.7	605.2	612.7	529.1	578.2	580.3
Total Delay (hr)	314.7	309.8	351.2	367.1	280.7	331.7	323.6
Total Stops	7837	7760	7699	7342	7495	7408	8174
Fuel Used (l)	1178.3	1174.2	1223.2	1209.2	1139.4	1182.3	1209.9

Interval #2 Information Recording #2

Start Time	7:15
End Time	7:30
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	4735	4685	4689	4685
Vehs Exited	4863	5031	4905	4896
Starting Vehs	1610	1830	1687	1706
Ending Vehs	1482	1484	1471	1497
Travel Distance (km)	12091	12298	12176	12161
Travel Time (hr)	558.4	575.4	573.2	573.7
Total Delay (hr)	309.2	322.0	322.1	323.2
Total Stops	7544	7708	7866	7684
Fuel Used (l)	1172.7	1192.7	1187.1	1186.9

Interval #3 Information Recording #3

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	5277	5373	5410	5318	5179	5398	5437
Vehs Exited	5057	5108	5034	5022	5095	5173	5187
Starting Vehs	1529	1511	1537	1461	1540	1451	1582
Ending Vehs	1749	1776	1913	1757	1624	1676	1832
Travel Distance (km)	12208	12331	12832	12678	12705	12807	12976
Travel Time (hr)	684.0	692.7	751.4	725.0	668.1	713.7	701.3
Total Delay (hr)	432.7	438.9	486.5	464.2	406.4	450.0	433.9
Total Stops	8556	8542	9010	8456	8087	8761	9318
Fuel Used (l)	1286.4	1304.0	1379.0	1347.7	1299.4	1342.9	1347.2

Interval #3 Information Recording #3

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	5370	5343	5238	5329
Vehs Exited	5052	5080	5034	5080
Starting Vehs	1482	1484	1471	1497
Ending Vehs	1800	1747	1675	1745
Travel Distance (km)	12591	12334	12402	12586
Travel Time (hr)	669.4	694.4	693.7	699.4
Total Delay (hr)	410.1	439.6	438.6	440.1
Total Stops	8370	8347	8600	8600
Fuel Used (l)	1293.9	1297.4	1306.4	1320.4

Interval #4 Information Recording #4

Start Time	7:45
End Time	8:00
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	4766	4720	4722	4751	4712	4622	4761
Vehs Exited	4918	4949	5056	4931	4858	4777	4997
Starting Vehs	1749	1776	1913	1757	1624	1676	1832
Ending Vehs	1597	1547	1579	1577	1478	1521	1596
Travel Distance (km)	12006	12267	12205	12286	12051	11935	12478
Travel Time (hr)	780.5	780.3	841.3	815.3	732.1	767.7	790.6
Total Delay (hr)	533.1	527.7	590.5	562.8	483.8	521.7	533.8
Total Stops	7816	7946	8033	7832	7414	7382	8333
Fuel Used (l)	1357.8	1372.8	1421.9	1400.0	1315.5	1336.8	1394.2

Interval #4 Information Recording #4

Start Time	7:45
End Time	8:00
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	4725	4689	4651	4714
Vehs Exited	5049	4863	4844	4924
Starting Vehs	1800	1747	1675	1745
Ending Vehs	1476	1573	1482	1539
Travel Distance (km)	12249	11814	11847	12114
Travel Time (hr)	759.5	766.6	774.4	780.8
Total Delay (hr)	507.2	523.0	530.6	531.4
Total Stops	7810	7287	8024	7786
Fuel Used (l)	1352.8	1334.1	1345.2	1363.1

4: Columbus Drive /Prince Philip Drive & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.7	1.9	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	47.4	24.4	25.7	47.1	36.9	35.7	37.2	16.5	26.5	37.0	2.7	33.7
Travel Dist (km)	204.7	123.9	119.0	8.8	3.0	291.9	886.4	215.3	5.5	69.4	18.6	1946.7
Travel Time (hr)	11.7	5.0	5.0	3.3	1.0	10.2	31.0	6.0	0.5	8.2	0.6	82.5

6: ORR NB & Thorburn Road Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBR	All
Denied Del/Veh (s)	0.0	0.0	0.2	0.1	56.5	51.2	15.1
Total Del/Veh (s)	5.2	1.9	19.2	11.8	80.9	66.6	23.5
Travel Dist (km)	106.6	183.2	76.4	13.5	19.9	139.1	538.8
Travel Time (hr)	3.0	4.3	2.6	0.4	3.1	19.0	32.3

9: ORR SB & Thorburn Road Performance by movement

Movement	EBT	EBR	WBL	WBT	SBL	SBR	All
Denied Del/Veh (s)	6.3	6.4	7.3	5.6	36.8	32.0	7.3
Total Del/Veh (s)	12.3	10.6	301.6	49.0	695.2	432.6	51.8
Travel Dist (km)	262.3	42.6	25.5	44.3	3.3	6.8	384.8
Travel Time (hr)	11.3	1.9	8.8	3.5	4.1	5.5	35.1

15: Messenger Drive Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.1	4.2	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	8.0	3.0	4.1	0.5	0.5	0.5	1.1
Travel Dist (km)	1.8	2.2	28.8	82.0	51.4	20.0	186.3
Travel Time (hr)	0.1	0.1	0.8	1.8	1.1	0.5	4.3

19: Team Gushue Hwy NB Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBR	All
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.1	0.1	0.0
Total Del/Veh (s)	4.6	1.0	1.1	0.8	11.3	4.7	1.3
Travel Dist (km)	11.2	105.4	31.9	16.2	0.9	6.3	171.9
Travel Time (hr)	0.4	2.7	0.8	0.5	0.0	0.2	4.6

21: Columbus Drive & Captain Whelan Drive/Hogan St Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	1456.2	1460.0	1429.7	1241.4	1084.8	1089.7	3.9	0.1	0.1	0.0	0.0	0.0
Total Del/Veh (s)	451.7	561.4	70.7	151.5	190.4	178.3	20.6	19.1	5.4	29.9	5.9	2.8
Travel Dist (km)	2.6	137.6	9.6	1.8	55.0	15.2	8.5	15.4	18.5	120.1	237.4	19.4
Travel Time (hr)	10.1	523.3	34.0	7.1	212.4	61.9	0.3	0.5	0.4	3.5	4.5	0.3

21: Columbus Drive & Captain Whelan Drive/Hogan St Performance by movement

Movement	All
Denied Del/Veh (s)	912.7
Total Del/Veh (s)	170.2
Travel Dist (km)	640.9
Travel Time (hr)	858.3

22: Columbus Drive & Blackmarsh Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	2.9	0.7	0.7	0.0	0.0	0.0	2.4	0.2	0.3	0.1	0.0	0.0
Total Del/Veh (s)	41.5	44.7	34.0	38.8	38.2	2.8	19.3	35.4	29.4	36.9	24.5	22.9
Travel Dist (km)	74.1	111.0	4.0	17.9	22.7	26.5	2.1	428.6	39.4	45.0	301.2	22.7
Travel Time (hr)	4.0	6.0	0.2	1.5	1.8	0.7	0.1	18.1	1.6	1.8	9.1	0.7

22: Columbus Drive & Blackmarsh Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.4
Total Del/Veh (s)	32.3
Travel Dist (km)	1095.3
Travel Time (hr)	45.7

23: Columbus Drive & Mundy Pond Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	2.9	0.8	0.7	3.7	0.5	0.4		0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	88.6	49.7	41.7	50.9	34.1	26.4		41.4	44.2	30.8	22.2	22.3
Travel Dist (km)	91.3	109.6	5.7	13.6	34.9	17.0	0.2	649.0	46.3	25.5	513.7	26.0
Travel Time (hr)	7.8	6.1	0.3	1.1	2.1	0.9	0.0	26.6	2.1	0.8	12.8	0.7

23: Columbus Drive & Mundy Pond Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.4
Total Del/Veh (s)	39.8
Travel Dist (km)	1532.8
Travel Time (hr)	61.2

24: Columbus Drive & Old Pennywell Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	3.6	0.8	3.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	56.7	57.0	4.7	43.7	41.5	2.7	19.9	38.1	5.4	32.1	30.1	4.8
Travel Dist (km)	26.9	26.8	4.5	31.2	8.3	21.7	2.8	442.9	77.4	122.3	555.2	33.9
Travel Time (hr)	3.8	3.6	0.2	2.7	0.7	0.6	0.1	23.4	2.0	3.5	15.0	0.6

24: Columbus Drive & Old Pennywell Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.3
Total Del/Veh (s)	33.8
Travel Dist (km)	1354.0
Travel Time (hr)	56.2

28: Hamlyn Road & Captain Whelan Drive Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.2	0.2	0.1
Total Del/Veh (s)	15.9	9.7	7.3	3.8	6.6	12.6	8.4
Travel Dist (km)	19.2	46.7	20.7	87.9	53.5	69.3	297.5
Travel Time (hr)	0.8	1.7	0.5	2.2	1.6	2.6	9.4

29: Team Gushue Hwy SB & Kelsey Dr Performance by movement

Movement	EBT	EBR	WBL	WBT	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.4	0.0	208.3	207.9	124.5
Total Del/Veh (s)	1.0	0.5	3.6	0.6	113.9	110.9	66.1
Travel Dist (km)	31.3	0.2	0.6	27.1	99.1	30.8	189.2
Travel Time (hr)	0.7	0.0	0.0	0.6	52.1	16.2	69.7

40: Kelsey Drive & Kiwanis St Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.2	4.1	1.6	0.0	0.0	0.1	0.3
Total Del/Veh (s)	6.6	2.3	4.9	3.1	0.9	2.4	2.4
Travel Dist (km)	0.2	3.5	10.7	137.2	59.3	17.3	228.2
Travel Time (hr)	0.0	0.1	0.3	3.4	1.3	0.4	5.6

45: Allston Street/Brougham Drive & Kenmount Rd Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	1.0	0.1	0.1	0.0	0.0	0.0	0.2	0.1	4.1	0.2	0.2	0.2
Total Del/Veh (s)	52.7	37.6	30.9	46.7	18.6	25.7	2134.5	983.5	249.3	114.0	17.3	11.3
Travel Dist (km)	26.2	427.0	31.8	111.7	579.8	72.7	0.6	0.4	3.8	208.7	106.0	43.1
Travel Time (hr)	1.1	15.3	1.1	3.5	15.0	1.9	1.8	0.8	1.8	16.3	3.1	1.2

45: Allston Street/Brougham Drive & Kenmount Rd Performance by movement

Movement	All
Denied Del/Veh (s)	0.2
Total Del/Veh (s)	50.7
Travel Dist (km)	1611.8
Travel Time (hr)	63.1

51: Commonwealth Ave/Mt. Carson Ave & Topsail Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.3	0.2	0.2	0.0	0.0	0.0	0.3	0.4	0.3	0.4	0.4	0.3
Total Del/Veh (s)	29.0	40.8	16.3	29.7	22.3	10.2	34.1	47.3	3.3	76.9	66.5	36.0
Travel Dist (km)	73.1	814.1	244.1	186.3	464.2	17.2	50.0	89.2	53.5	175.7	355.2	41.5
Travel Time (hr)	2.1	25.2	6.1	5.6	12.9	0.4	3.4	7.5	1.5	7.1	13.2	1.2

51: Commonwealth Ave/Mt. Carson Ave & Topsail Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.2
Total Del/Veh (s)	36.4
Travel Dist (km)	2564.1
Travel Time (hr)	86.4

53: Topsail Road & Blackmarsh Road Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Total Del/Veh (s)	19.9	10.1	3.6	4.3	15.5	1.4	4.8	10.0
Travel Dist (km)	504.3	586.9	600.5	58.3	0.2	14.9	99.5	1864.5
Travel Time (hr)	14.1	14.3	13.1	1.3	0.0	0.3	2.7	45.8

58: Captain Whelan Drive & Captain Whelan Drive' Performance by movement

Movement	EBT	WBT	SBL	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Del/Veh (s)	4.3	0.8	0.8	1.0
Travel Dist (km)	4.1	36.8	10.2	51.0
Travel Time (hr)	0.1	0.9	0.4	1.4

61: Blackmarsh Road & Empire Avenue Performance by movement

Movement	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.5	0.0	0.0	0.2	0.2	0.3
Total Del/Veh (s)	14.2	0.5	0.3	17.1	5.8	10.4
Travel Dist (km)	1301.8	39.1	3.5	6.7	18.9	1370.1
Travel Time (hr)	30.8	1.2	0.1	0.3	0.7	33.1

62: Captain Whelan Drive' & Blackmarsh Road Performance by movement

Movement	EBT	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.0	3.5	0.5	0.5	0.7	0.5
Total Del/Veh (s)	1.0	7.8	0.8	22.0	11.5	3.6
Travel Dist (km)	113.2	20.7	40.2	1.6	5.2	180.9
Travel Time (hr)	3.1	0.9	0.9	0.4	0.8	6.0

64: Blackmarsh Road/Captain Whelan Drive Performance by movement

Movement	EBL	EBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Del/Veh (s)	4.9	3.5	1.0	3.8
Travel Dist (km)	117.6	6.2	42.0	165.8
Travel Time (hr)	3.9	0.2	1.2	5.3

75: Austin Street/Bambrick St & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.2	0.2	3.9	0.3	0.3
Total Del/Veh (s)	22.8	15.6	12.9	24.7	5.5	3.5	36.0	35.6	2.6	40.7	40.8	1.9
Travel Dist (km)	1.3	402.3	31.7	45.6	73.3	2.8	1.8	0.5	24.2	16.6	0.6	0.8
Travel Time (hr)	0.0	13.1	1.0	3.1	2.3	0.1	0.1	0.0	0.6	2.0	0.1	0.0

75: Austin Street/Bambrick St & Thorburn Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.3
Total Del/Veh (s)	15.2
Travel Dist (km)	601.4
Travel Time (hr)	22.5

79: Goldstone St/Seaborn St & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.3	0.2
Total Del/Veh (s)	9.8	13.2	5.7	19.1	3.1	3.1	39.9	1.2	3.5	39.8	33.8	2.6
Travel Dist (km)	0.2	71.7	12.1	99.2	62.1	2.8	4.6	67.8	40.7	3.3	4.3	0.8
Travel Time (hr)	0.0	5.3	0.8	3.5	1.4	0.1	0.3	1.6	1.1	0.4	0.4	0.0

79: Goldstone St/Seaborn St & Thorburn Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.5
Total Del/Veh (s)	9.7
Travel Dist (km)	369.7
Travel Time (hr)	14.9

90: Thorburn Road & Mount Scio Rd Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.2	3.5	1.0	0.5
Total Del/Veh (s)	17.2	11.6	14.7	8.4	38.2	11.5	15.3
Travel Dist (km)	23.5	180.2	126.4	40.5	40.2	33.5	444.3
Travel Time (hr)	1.3	7.4	4.8	1.4	4.1	1.7	20.6

92: Moss Heather Dr & Thorburn Road Performance by movement

Movement	EBT	EBR	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	3.3	5.2	11.6	5.0	4.0
Travel Dist (km)	294.1	2.4	16.9	190.8	504.2
Travel Time (hr)	7.4	0.1	0.5	4.8	12.8

94: O'Leary Avenue/Larkhall Street & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	22.9	20.0	18.6	0.0	0.0	0.0	3.9	1.1	1.2	3.9	0.2	0.3
Total Del/Veh (s)	72.0	92.2	96.2	30.8	19.5	17.0	23.0	39.3	31.1	29.3	28.0	12.8
Travel Dist (km)	19.8	236.2	38.8	27.9	94.5	4.3	12.8	19.0	50.1	5.5	4.5	4.2
Travel Time (hr)	2.3	31.6	5.5	2.1	5.4	0.2	0.9	1.8	4.2	0.6	0.4	0.3

94: O'Leary Avenue/Larkhall Street & Thorburn Road Performance by movement

Movement	All
Denied Del/Veh (s)	8.7
Total Del/Veh (s)	52.9
Travel Dist (km)	517.6
Travel Time (hr)	55.3

102: Freshwater Road & Loop Ramp Performance by movement

Movement	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.3	2.8	0.0	0.0	0.4
Total Del/Veh (s)	7.1	8.5	3.2	31.4	7.5	10.6
Travel Dist (km)	150.6	87.3	39.9	39.2	33.2	350.3
Travel Time (hr)	4.9	3.3	1.5	4.3	1.7	15.6

105: Kenmount Rd & Avalon Mall Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.8	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.0
Total Del/Veh (s)	10.5	3.3	5.8	14.9	4.9	1.6	29.6	5.4	32.8	21.8	1.0	5.1
Travel Dist (km)	5.0	275.4	0.3	1.7	274.7	37.3	0.6	0.9	9.3	0.4	1.2	606.8
Travel Time (hr)	0.2	6.6	0.0	0.1	7.0	0.9	0.1	0.0	1.0	0.0	0.0	15.9

108: Kenmount Road & Pippy Place Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
Total Del/Veh (s)	24.5	7.8	5.9	34.4	18.0	18.4	58.0	69.2	13.8	53.9	41.1	7.2
Travel Dist (km)	131.6	393.6	0.5	0.5	315.2	98.6	0.1	0.0	0.1	19.2	0.2	15.5
Travel Time (hr)	5.8	10.8	0.0	0.0	9.9	3.3	0.1	0.0	0.0	2.3	0.0	0.6

108: Kenmount Road & Pippy Place Performance by movement

Movement	All
Denied Del/Veh (s)	0.0
Total Del/Veh (s)	15.6
Travel Dist (km)	975.2
Travel Time (hr)	32.8

109: Kenmount Rd & Peet St Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	3.9	0.3	0.1
Total Del/Veh (s)	12.1	3.5	5.9	5.3	34.7	8.5	5.8
Travel Dist (km)	31.6	227.8	173.3	16.6	14.4	17.3	481.0
Travel Time (hr)	1.2	5.8	5.1	0.5	0.9	0.6	14.1

114: Terra Nova Motors/Great Eastern Ave & Kenmount Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.1	3.8	0.2	0.2	0.0
Total Del/Veh (s)	16.8	14.0	13.7	24.2	12.6	12.8	31.3	10.8	34.7	37.0	1.8	13.5
Travel Dist (km)	28.3	852.5	2.5	39.0	1091.2	15.6	1.5	1.3	2.0	0.3	19.1	2053.2
Travel Time (hr)	0.9	25.5	0.1	1.0	25.1	0.4	0.1	0.1	0.1	0.0	0.5	53.8

117: Crotty's/Kelsey Drive & Kenmount Road Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.1	0.0	0.1	1.1	0.1	0.0	1.3	0.2
Total Del/Veh (s)	32.7	12.3	13.2	5.3	29.8	0.5	4.3	13.2
Travel Dist (km)	96.1	825.3	393.4	47.7	23.4	1.1	81.1	1468.1
Travel Time (hr)	3.9	22.8	11.3	1.2	1.1	0.0	2.2	42.5

120: Wyatt Blvd & Kenmount Rd Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.0	0.0	0.9	0.1	302.7	298.4	110.2
Total Del/Veh (s)	21.4	10.8	22.2	4.9	69.6	139.1	55.5
Travel Dist (km)	355.2	22.4	223.4	269.8	17.7	327.4	1215.9
Travel Time (hr)	11.7	0.6	7.6	5.5	6.2	144.3	175.9

123: Kenmount Road & Ladysmith Drive Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.7	0.4	0.1
Total Del/Veh (s)	33.3	28.8	19.0	11.1	27.9	5.6	24.8
Travel Dist (km)	25.1	2189.6	490.9	34.4	46.9	4.1	2791.0
Travel Time (hr)	0.7	58.3	16.1	1.0	3.1	0.1	79.3

Total Network Performance

Denied Del/Veh (s)	154.2
Total Del/Veh (s)	98.9
Travel Dist (km)	49487.0
Travel Time (hr)	2542.4

Intersection: 4: Columbus Drive /Prince Philip Drive & Thorburn Road

Movement	EB	EB	EB	EB	WB	WB	B71	B71	NB	NB	NB	NB
Directions Served	L	L	T	TR	T	TR	T	T	L	T	T	R
Maximum Queue (m)	81.7	82.2	79.2	114.1	37.4	45.2	10.2	32.0	108.4	256.1	331.7	224.0
Average Queue (m)	49.4	52.1	23.5	55.7	20.5	30.0	0.8	5.3	55.2	96.4	103.2	35.0
95th Queue (m)	72.7	74.7	54.2	101.0	34.6	46.2	7.7	22.4	94.9	191.0	212.1	134.8
Link Distance (m)		361.3	361.3		22.0	22.0	92.4	92.4		709.7	709.7	709.7
Upstream Blk Time (%)					10	30						0
Queuing Penalty (veh)					16	44						0
Storage Bay Dist (m)	150.0			150.0					175.0			
Storage Blk Time (%)			0	0						0		
Queuing Penalty (veh)			0	0						0		

Intersection: 4: Columbus Drive /Prince Philip Drive & Thorburn Road

Movement	SB	SB	SB	SB	SB
Directions Served	L	T	T	T	R
Maximum Queue (m)	27.4	72.7	68.6	57.6	9.4
Average Queue (m)	10.5	49.4	45.2	31.5	0.3
95th Queue (m)	22.0	66.2	61.9	50.4	7.0
Link Distance (m)		87.9	87.9	87.9	
Upstream Blk Time (%)			0		
Queuing Penalty (veh)			0		
Storage Bay Dist (m)	110.0				90.0
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 6: ORR NB & Thorburn Road

Movement	EB	EB	WB	NB
Directions Served	L	T	TR	LTR
Maximum Queue (m)	35.2	1.2	80.4	229.7
Average Queue (m)	12.0	0.0	10.7	110.9
95th Queue (m)	26.6	0.6	74.7	276.1
Link Distance (m)		266.9	486.0	297.3
Upstream Blk Time (%)				15
Queuing Penalty (veh)				0
Storage Bay Dist (m)	100.0			
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 9: ORR SB & Thorburn Road

Movement	EB	WB	WB	SB	SB
Directions Served	TR	L	T	LT	R
Maximum Queue (m)	17.7	100.4	223.9	158.6	18.1
Average Queue (m)	3.1	58.2	69.1	73.8	5.4
95th Queue (m)	12.0	117.6	239.7	171.7	17.7
Link Distance (m)	233.2		266.9	169.4	
Upstream Blk Time (%)			8	11	
Queuing Penalty (veh)			19	0	
Storage Bay Dist (m)		100.0			15.0
Storage Blk Time (%)		19	10	72	3
Queuing Penalty (veh)		30	10	30	1

Intersection: 15: Messenger Drive

Movement	EB	EB	EB	NB	SB
Directions Served	L	L	R	L	TR
Maximum Queue (m)	8.1	1.7	10.2	23.1	7.2
Average Queue (m)	2.2	0.1	3.2	7.5	0.6
95th Queue (m)	8.1	1.2	10.7	18.0	3.7
Link Distance (m)	194.8	194.8			183.4
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			10.0	250.0	
Storage Blk Time (%)		0	1		
Queuing Penalty (veh)		0	0		

Intersection: 19: Team Gushue Hwy NB

Movement	EB	WB	B87	NB
Directions Served	L	TR	T	LTR
Maximum Queue (m)	22.0	5.4	179.2	18.1
Average Queue (m)	7.8	0.3	8.8	6.5
95th Queue (m)	18.4	2.8	80.4	15.4
Link Distance (m)		99.7	218.7	206.6
Upstream Blk Time (%)			0	
Queuing Penalty (veh)			1	
Storage Bay Dist (m)	65.0			
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 21: Columbus Drive & Captain Whelan Drive/Hogan St

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	LT	R	L	TR	L	T	TR	L	T	T	R
Maximum Queue (m)	147.3	431.3	371.5	87.3	185.6	17.7	17.8	21.6	56.6	13.6	18.7	4.2
Average Queue (m)	21.8	391.6	202.4	10.3	176.9	4.0	5.5	7.4	25.6	3.0	5.8	0.1
95th Queue (m)	104.8	472.5	493.9	51.2	180.9	12.8	14.9	17.1	48.9	9.7	14.9	2.1
Link Distance (m)		449.3	449.3		171.4		338.0	338.0		652.4	652.4	652.4
Upstream Blk Time (%)		12	9		87							
Queuing Penalty (veh)		21	15		0							
Storage Bay Dist (m)	140.0			80.0		100.0			100.0			
Storage Blk Time (%)	0	92			81							
Queuing Penalty (veh)	0	9			15							

Intersection: 22: Columbus Drive & Blackmarsh Road

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	TR	L	T	R	L	T	TR	L	T	TR
Maximum Queue (m)	77.3	109.5	44.3	53.0	17.1	23.0	146.7	145.8	54.4	79.9	80.8
Average Queue (m)	39.3	57.5	18.5	22.3	1.0	1.6	88.1	87.5	19.3	40.2	44.1
95th Queue (m)	71.1	93.8	34.2	42.4	10.0	14.1	132.3	133.0	38.4	70.2	73.0
Link Distance (m)		381.8		163.9			652.4	652.4		435.8	435.8
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (m)	70.0		75.0		75.0	80.0			70.0		
Storage Blk Time (%)	0	4		0			13			1	
Queuing Penalty (veh)	0	8		0			1			1	

Intersection: 23: Columbus Drive & Mundy Pond Road

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB	B46
Directions Served	L	TR	L	TR	L	T	TR	L	T	TR	T
Maximum Queue (m)	77.3	166.1	45.9	82.8	0.9	212.3	337.8	31.1	83.9	86.8	28.4
Average Queue (m)	55.0	75.6	13.7	34.0	0.1	85.0	100.0	9.0	52.0	56.4	1.0
95th Queue (m)	86.3	180.3	31.8	67.5	1.3	169.2	214.8	20.6	77.9	81.9	28.9
Link Distance (m)		402.4		252.9		435.8	435.8		636.8	636.8	274.8
Upstream Blk Time (%)						0	0				0
Queuing Penalty (veh)						0	0				0
Storage Bay Dist (m)	70.0		60.0		75.0			100.0			
Storage Blk Time (%)	15	4		2		15			0		
Queuing Penalty (veh)	45	8		1		0			0		

Intersection: 24: Columbus Drive & Old Pennywell Road

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB	B46
Directions Served	L	T	R	L	L	T	L	T	T	T	R	T
Maximum Queue (m)	52.4	130.6	60.8	35.0	40.0	26.1	28.5	131.6	132.9	124.2	61.4	63.5
Average Queue (m)	38.4	50.2	4.3	12.4	21.0	10.0	2.1	88.0	90.0	80.3	10.4	2.3
95th Queue (m)	60.5	102.4	35.1	28.9	36.4	22.1	17.4	120.4	122.1	113.2	37.1	64.8
Link Distance (m)		142.8			179.9	179.9		274.8	274.8	274.8		636.8
Upstream Blk Time (%)		0										
Queuing Penalty (veh)		0										
Storage Bay Dist (m)	45.0		80.0	65.0			100.0				140.0	
Storage Blk Time (%)	11	11	0					4		0		
Queuing Penalty (veh)	25	28	0					0		0		

Intersection: 24: Columbus Drive & Old Pennywell Road

Movement	B46	SB	SB	SB	SB	SB
Directions Served	T	L	T	T	T	R
Maximum Queue (m)	63.7	49.2	61.0	70.5	60.7	0.3
Average Queue (m)	2.3	26.0	37.4	45.1	34.2	0.0
95th Queue (m)	65.0	45.1	56.3	66.2	57.4	0.3
Link Distance (m)	636.8		709.7	709.7	709.7	
Upstream Blk Time (%)	0					
Queuing Penalty (veh)	0					
Storage Bay Dist (m)		100.0				75.0
Storage Blk Time (%)					0	
Queuing Penalty (veh)					0	

Intersection: 28: Hamlyn Road & Captain Whelan Drive

Movement	EB	WB	NB	NB
Directions Served	TR	L	L	R
Maximum Queue (m)	58.8	17.0	25.6	53.5
Average Queue (m)	11.3	3.8	12.6	21.2
95th Queue (m)	60.3	12.6	21.1	51.3
Link Distance (m)	299.3		262.5	262.5
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)		70.0		
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 29: Team Gushue Hwy SB & Kelsey Dr

Movement	WB	WB	SB
Directions Served	L	T	LTR
Maximum Queue (m)	7.1	0.6	210.4
Average Queue (m)	0.4	0.0	196.0
95th Queue (m)	3.3	0.6	227.7
Link Distance (m)		130.8	191.8
Upstream Blk Time (%)			90
Queuing Penalty (veh)			0
Storage Bay Dist (m)	60.0		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 31: Bend

Movement	EB
Directions Served	T
Maximum Queue (m)	122.8
Average Queue (m)	5.1
95th Queue (m)	57.5
Link Distance (m)	179.9
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 40: Kelsey Drive & Kiwanis St

Movement	EB	EB	NB	NB	SB	SB
Directions Served	L	R	L	T	T	R
Maximum Queue (m)	15.1	1.7	16.5	38.5	18.0	19.5
Average Queue (m)	1.2	0.1	1.9	0.0	5.3	14.0
95th Queue (m)	8.7	1.7	9.6	0.0	18.2	24.3
Link Distance (m)	120.8			378.5	280.5	
Upstream Blk Time (%)				0		
Queuing Penalty (veh)				0		
Storage Bay Dist (m)		30.0	100.0			20.0
Storage Blk Time (%)	0				0	1
Queuing Penalty (veh)	0				0	1

Intersection: 45: Allston Street/Brougham Drive & Kenmount Rd

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	LT	R	L	TR
Maximum Queue (m)	49.6	92.0	100.4	39.7	51.2	55.5	92.6	24.6	195.7	127.5
Average Queue (m)	11.8	51.6	55.6	18.8	24.2	30.2	29.6	2.0	118.3	34.9
95th Queue (m)	33.4	82.3	86.4	34.6	44.2	48.8	98.0	14.6	252.6	108.4
Link Distance (m)		716.1	716.1		1379.6	1379.6	188.9		576.8	576.8
Upstream Blk Time (%)							0			
Queuing Penalty (veh)							0			
Storage Bay Dist (m)	50.0			50.0				30.0		
Storage Blk Time (%)	0	10		0	0		27	0		
Queuing Penalty (veh)	0	4		0	0		6	0		

Intersection: 51: Commonwealth Ave/Mt. Carson Ave & Topsail Road

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	T	R	L
Maximum Queue (m)	62.3	114.5	116.8	42.5	59.1	58.2	146.4	32.0	73.0	149.0	49.4	42.4
Average Queue (m)	15.9	62.9	69.3	31.8	30.1	29.7	36.8	3.8	37.2	78.4	3.9	34.4
95th Queue (m)	45.8	102.6	110.9	60.1	50.7	48.2	126.9	20.8	64.7	133.6	30.4	52.7
Link Distance (m)		1082.8	1082.8			912.8	912.8		208.3	208.3	208.3	
Upstream Blk Time (%)										0	0	
Queuing Penalty (veh)										0	0	
Storage Bay Dist (m)	60.0			40.0	100.0			30.0				40.0
Storage Blk Time (%)	0	9	24	1			11	0				11
Queuing Penalty (veh)	0	6	54	5			2	0				39

Intersection: 51: Commonwealth Ave/Mt. Carson Ave & Topsail Road

Movement	SB	SB
Directions Served	T	R
Maximum Queue (m)	178.6	32.4
Average Queue (m)	95.5	8.7
95th Queue (m)	177.5	31.9
Link Distance (m)	1121.9	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		30.0
Storage Blk Time (%)	44	0
Queuing Penalty (veh)	84	1

Intersection: 53: Topsail Road & Blackmarsh Road

Movement	EB	EB	WB	WB	SB	SB
Directions Served	LT	T	T	TR	L	R
Maximum Queue (m)	246.6	571.5	0.7	20.2	31.2	22.2
Average Queue (m)	44.6	48.1	0.0	3.2	5.7	16.0
95th Queue (m)	197.8	380.2	0.7	14.6	21.5	23.9
Link Distance (m)	912.8	912.8	1253.0	1253.0	341.5	
Upstream Blk Time (%)	0	0				
Queuing Penalty (veh)	0	3				
Storage Bay Dist (m)						20.0
Storage Blk Time (%)					0	2
Queuing Penalty (veh)					0	0

Intersection: 58: Captain Whelan Drive & Captain Whelan Drive'

Movement	EB
Directions Served	T
Maximum Queue (m)	8.3
Average Queue (m)	0.8
95th Queue (m)	5.0
Link Distance (m)	162.4
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 61: Blackmarsh Road & Empire Avenue

Movement	SB
Directions Served	LR
Maximum Queue (m)	20.6
Average Queue (m)	3.9
95th Queue (m)	13.4
Link Distance (m)	201.4
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 62: Captain Whelan Drive' & Blackmarsh Road

Movement	EB	WB	NB	NB
Directions Served	TR	L	L	R
Maximum Queue (m)	2.5	26.7	25.5	36.0
Average Queue (m)	0.1	12.5	9.7	17.9
95th Queue (m)	1.2	22.1	20.2	31.8
Link Distance (m)	128.2			
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)		40.0	64.0	
Storage Blk Time (%)		0		
Queuing Penalty (veh)		0		

Intersection: 64: Blackmarsh Road/Captain Whelan Drive

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: 75: Austin Street/Bambrick St & Thorburn Road

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (m)	18.0	91.5	92.4	60.8	62.9	40.8	13.2	9.0	53.7	9.2
Average Queue (m)	0.9	37.0	40.3	33.3	15.8	7.7	2.4	0.8	25.6	1.3
95th Queue (m)	9.8	74.8	79.0	57.0	46.5	24.2	9.3	5.0	44.2	6.3
Link Distance (m)		368.4	368.4		145.7	145.7		205.8		132.3
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (m)	55.0			55.0			60.0		60.0	
Storage Blk Time (%)		3		2	0				0	
Queuing Penalty (veh)		0		6	0				0	

Intersection: 79: Goldstone St/Seaborn St & Thorburn Road

Movement	EB	EB	EB	B80	B74	B74	B1	B13	WB	WB	WB	NB
Directions Served	L	T	TR	T	T		T	T	L	T	TR	L
Maximum Queue (m)	13.2	81.2	83.8	60.1	4.9	1.1	1.1	0.6	61.2	25.4	19.4	16.0
Average Queue (m)	0.6	43.1	45.4	3.1	0.2	0.0	0.0	0.0	28.6	2.9	4.2	5.0
95th Queue (m)	7.2	73.7	78.8	30.0	3.4	1.1	1.1	0.6	52.0	14.2	13.7	13.8
Link Distance (m)		65.8	65.8	119.1	390.0	390.0	175.6	140.5		368.4	368.4	
Upstream Blk Time (%)		1	2	0								
Queuing Penalty (veh)		7	11	1								
Storage Bay Dist (m)	55.0								65.0			85.0
Storage Blk Time (%)		4							0			
Queuing Penalty (veh)		0							0			

Intersection: 79: Goldstone St/Seaborn St & Thorburn Road

Movement	NB	SB	SB
Directions Served	TR	L	TR
Maximum Queue (m)	30.2	22.0	25.2
Average Queue (m)	3.7	6.7	8.7
95th Queue (m)	17.1	17.2	20.1
Link Distance (m)	218.7		121.3
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		50.0	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 90: Thorburn Road & Mount Scio Rd

Movement	EB	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	T	TR	L	R
Maximum Queue (m)	62.8	103.2	116.6	79.7	62.9	57.3	118.2
Average Queue (m)	19.5	37.8	43.5	37.8	26.2	43.6	34.7
95th Queue (m)	43.4	78.9	88.2	70.2	52.5	64.1	86.4
Link Distance (m)		145.7	145.7	265.2	265.2		146.8
Upstream Blk Time (%)		0	0				0
Queuing Penalty (veh)		0	1				0
Storage Bay Dist (m)	65.0					50.0	
Storage Blk Time (%)	0	1				9	0
Queuing Penalty (veh)	0	2				22	1

Intersection: 92: Moss Heather Dr & Thorburn Road

Movement	EB	EB	WB	WB	WB
Directions Served	T	TR	L	T	T
Maximum Queue (m)	38.6	44.5	23.1	43.0	35.4
Average Queue (m)	9.5	13.4	7.0	9.1	7.7
95th Queue (m)	28.3	35.4	17.8	29.0	25.5
Link Distance (m)	265.2	265.2		325.0	325.0
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			50.0		
Storage Blk Time (%)				0	
Queuing Penalty (veh)				0	

Intersection: 94: O'Leary Avenue/Larkhall Street & Thorburn Road

Movement	EB	EB	EB	WB	WB	WB	B63	B63	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	T	T	L	TR	L	TR
Maximum Queue (m)	67.4	211.0	220.1	56.4	69.9	65.1	35.7	36.6	70.7	128.2	29.9	35.8
Average Queue (m)	32.2	137.3	144.3	27.5	37.2	37.2	1.3	2.6	16.3	62.7	10.5	11.9
95th Queue (m)	78.7	230.5	236.1	47.9	61.9	60.0	36.4	53.2	50.8	111.8	23.6	25.6
Link Distance (m)		325.0	325.0		147.5	147.5	361.3	361.3		156.6		101.2
Upstream Blk Time (%)								0		1		
Queuing Penalty (veh)								0		0		
Storage Bay Dist (m)	60.0			110.0					105.0		30.0	
Storage Blk Time (%)	0	49							0	3	0	1
Queuing Penalty (veh)	0	36							0	2	0	1

Intersection: 102: Freshwater Road & Loop Ramp

Movement	EB	EB	WB	WB	WB	SB	SB	SB	B71
Directions Served	T	T	T	T	R	L	L	R	T
Maximum Queue (m)	58.5	61.3	60.3	50.8	37.0	51.5	54.9	43.5	0.7
Average Queue (m)	26.6	28.3	30.9	17.3	13.4	25.5	28.9	17.5	0.0
95th Queue (m)	50.2	51.8	53.5	41.3	26.6	43.4	46.7	32.5	0.7
Link Distance (m)	173.1	173.1	137.0	137.0			92.4	92.4	22.0
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (m)					40.0	95.0			
Storage Blk Time (%)				0	0				
Queuing Penalty (veh)				1	0				

Intersection: 105: Kenmount Rd & Avalon Mall

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	SB
Directions Served	L	T	TR	L	T	T	R	L	TR	LT
Maximum Queue (m)	11.2	40.2	41.3	9.6	47.5	52.6	19.0	9.6	9.3	35.0
Average Queue (m)	3.2	13.0	18.0	1.2	19.8	23.5	6.2	1.2	1.7	14.7
95th Queue (m)	10.2	32.0	35.7	6.1	39.7	44.5	14.8	6.0	7.3	27.4
Link Distance (m)		268.1	268.1		280.0	280.0	280.0	121.0	121.0	110.0
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (m)	55.0			16.0						
Storage Blk Time (%)		0			7					
Queuing Penalty (veh)		0			0					

Intersection: 108: Kenmount Road & Pippy Place

Movement	EB	EB	EB	WB	WB	WB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	LTR	L	TR
Maximum Queue (m)	72.4	117.8	95.8	8.3	97.8	108.1	10.3	60.4	26.4
Average Queue (m)	47.3	39.8	37.5	0.4	42.0	51.3	1.9	29.6	12.0
95th Queue (m)	76.6	88.8	74.4	5.6	77.9	89.6	7.8	51.2	21.6
Link Distance (m)		293.7	293.7		454.9	454.9	40.3		142.8
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (m)	65.0			40.0				115.0	
Storage Blk Time (%)	5	0			9				
Queuing Penalty (veh)	34	2			0				

Intersection: 109: Kenmount Rd & Peet St

Movement	EB	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	T	TR	L	R
Maximum Queue (m)	48.0	48.0	52.8	59.0	64.2	30.4	23.4
Average Queue (m)	17.5	14.8	20.1	22.0	26.7	11.5	9.8
95th Queue (m)	34.4	37.5	43.2	47.5	55.5	23.9	18.8
Link Distance (m)		183.4	183.4	176.9	176.9		266.4
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)	60.0					50.0	
Storage Blk Time (%)	0	0					
Queuing Penalty (veh)	0	0					

Intersection: 114: Terra Nova Motors/Great Eastern Ave & Kenmount Road

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (m)	18.0	194.4	242.6	28.1	189.9	309.9	11.7	9.4	12.9	4.4
Average Queue (m)	6.0	29.2	35.7	6.4	21.3	22.6	2.2	1.7	2.6	0.3
95th Queue (m)	14.6	111.1	131.8	17.8	151.6	205.0	8.4	7.3	9.7	2.9
Link Distance (m)		468.6	468.6		1304.6	1304.6		178.3		232.8
Upstream Blk Time (%)		0	0		0	0				
Queuing Penalty (veh)		0	2		0	0				
Storage Bay Dist (m)	55.0			45.0			25.0		65.0	
Storage Blk Time (%)		0		0	1					
Queuing Penalty (veh)		0		0	0					

Intersection: 117: Crotty's/Kelsey Drive & Kenmount Road

Movement	EB	EB	EB	EB	WB	WB	SB	SB	SB
Directions Served	L	L	T	TR	T	T	L	LT	R
Maximum Queue (m)	35.3	36.6	73.2	96.1	90.8	94.8	20.4	53.7	10.8
Average Queue (m)	14.7	19.3	33.5	38.5	38.5	39.3	9.0	7.8	0.4
95th Queue (m)	29.0	30.8	69.1	82.1	72.9	75.6	18.0	44.9	7.9
Link Distance (m)			474.7	474.7	490.5	490.5	378.5	378.5	
Upstream Blk Time (%)								0	
Queuing Penalty (veh)								0	
Storage Bay Dist (m)	75.0	75.0							60.0
Storage Blk Time (%)			0		3	0			0
Queuing Penalty (veh)			0		0	0			0

Intersection: 120: Wyatt Blvd & Kenmount Rd

Movement	EB	EB	B119	WB	WB	WB	NB	NB
Directions Served	T	TR	T	L	T	T	L	R
Maximum Queue (m)	104.1	100.9	279.3	92.3	122.1	106.9	381.8	382.8
Average Queue (m)	56.4	47.0	15.0	52.3	14.5	12.2	348.7	367.0
95th Queue (m)	94.9	93.2	252.4	90.9	64.6	65.2	492.5	420.6
Link Distance (m)	377.0	377.0	1379.6		468.6	468.6	367.2	367.2
Upstream Blk Time (%)			0			0	62	87
Queuing Penalty (veh)			0			0	0	0
Storage Bay Dist (m)				85.0				
Storage Blk Time (%)				3	0			
Queuing Penalty (veh)				8	0			

Intersection: 123: Kenmount Road & Ladysmith Drive

Movement	EB	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	T	TR	L	LR
Maximum Queue (m)	35.1	143.3	143.9	165.9	170.1	50.3	66.2
Average Queue (m)	5.5	91.7	94.6	50.1	56.4	16.0	32.6
95th Queue (m)	20.7	133.2	134.8	116.9	146.0	43.3	56.6
Link Distance (m)		1304.6	1304.6	474.7	474.7		179.9
Upstream Blk Time (%)					0		
Queuing Penalty (veh)					0		
Storage Bay Dist (m)	35.0					50.0	
Storage Blk Time (%)	0	28				0	2
Queuing Penalty (veh)	0	6				0	2

Network Summary

Network wide Queuing Penalty: 685

Intersection		Existing Network						
		PM Peak Hour						
		Synchro				SimTraffic		
Street	Movement	Delay/Veh (s)	LOS	V/C	Queue (m) 95th%ile	Delay/Veh (s)	Equivalent LOS	Queue (m) 95th%ile
Outer Ring Road (SB) & Thorburn Road						**16.8**	**C**	
Thorburn Road	Eastbound Left - Turn	0.0	A	0.20	0.0	1.1	A	4.8
	Eastbound Through					0.8	A	
	Westbound Through	9.0	-	0.30	9.8	7.0	A	25.4
	Westbound Right - Turn	0.0	-	0.41	0.0	4.0	A	1.4
Outer Ring Road (SB)	Southbound Left - Turn	48.6	E	0.86	67.5	83.0	F	151.0
	Southbound Through					-	-	
	Southbound Right - Turn					62.7	F	19.4
Outer Ring Road (NB) & Thorburn Road						**20.1**	**C**	
Thorburn Road	Eastbound Through	10.7	-	0.14	3.6	9.8	A	19.5
	Eastbound Right - Turn	0.0	B	0.11	0.0	0.6	A	-
	Westbound Left - Turn	0.0	-	0.57	0.0	5.9	A	2.0
	Westbound Through					5.1	A	
Outer Ring Road (NB)	Northbound Left - Turn	492.6	F	1.96	203.0	78.7	F	151.8
	Northbound Through					-	-	
	Northbound Right - Turn					66.6	F	
Goldstone Street & Thorburn Road			B			**11.3**	**B**	
Thorburn Road	Eastbound Left - Turn	15.8	B	0.07	5.9	19.2	B	11.3
	Eastbound Through	13.6	B	0.21	27.6	11.4	B	30.7
	Eastbound Right - Turn					2.1	A	27.6
	Westbound Left - Turn	9.3	A	0.53	43.8	13.3	B	52.3
	Westbound Through	6.9	A	0.38	52.0	7.7	A	48.2
	Westbound Right - Turn					6.1	A	51.6
Goldstone Street	Northbound Left - Turn	51.0	D	0.68	44.8	39.7	D	52.4
	Northbound Through	12.5	B	0.53	26.5	13.0	B	31.9
	Northbound Right - Turn					4.1	A	
	Southbound Left - Turn	33.0	C	0.10	6.1	33.9	C	10.1
	Southbound Through	28.0	C	0.08	9.8	30.9	C	14.4
	Southbound Right - Turn					2.5	A	
Austin Street & Thorburn Road			B			**12.3**	**B**	
Thorburn Road	Eastbound Left - Turn	13.0	B	0.03	2.6	29.5	C	5.1
	Eastbound Through	12.4	B	0.30	48.4	10.6	B	36.4
	Eastbound Right - Turn					6.5	A	31.9
	Westbound Left - Turn	7.2	A	0.24	18.1	12.9	B	45.2
	Westbound Through	10.5	B	0.60	119.5	11.3	B	91.9
	Westbound Right - Turn					8.3	A	90.5
Austin Street	Northbound Left - Turn	45.4	D	0.55	38.9	41.0	D	44.2
	Northbound Through	10.5	B	0.65	26.1	41.7	D	13.5
	Northbound Right - Turn					3.7	A	
	Southbound Left - Turn	102.7	F	0.82	23.8	38.5	D	24.3
	Southbound Through	28.8	C	0.02	3.8	36.3	D	6.6
	Southbound Right - Turn					1.9	A	
Mt Scio Road & Thorburn Road			C			**26.6**	**C**	
Thorburn Road	Eastbound Left - Turn	59.3	E	0.88	77.3	35.8	D	54.0
	Eastbound Through	8.6	A	0.35	50.9	11.3	B	63.9
	Westbound Through	30.4	C	0.86	197.4	32.0	C	151.6
	Westbound Right - Turn					27.0	C	145.6
Mt Scio Road	Southbound Left - Turn	53.9	D	0.79	79.2	40.7	D	63.7
	Southbound Right - Turn	10.1	B	0.51	21.7	20.9	C	96.2
O'Leary Avenue & Thorburn Road			D			**35.1**	**D**	
Thorburn Road	Eastbound Left - Turn	22.8	C	0.33	17.3	30.0	C	52.9
	Eastbound Through	41.3	D	0.84	125.7	49.6	D	122.8
	Eastbound Right - Turn					56.6	E	142.0
	Westbound Left - Turn	48.1	D	0.80	68.5	32.0	C	48.1
	Westbound Through	34.6	C	0.73	132.2	21.0	C	86.0
	Westbound Right - Turn					22.0	C	89.3
O'Leary Avenue	Northbound Left - Turn	31.9	C	0.73	59.5	34.5	C	118.4
	Northbound Through	38.8	D	0.91	128.9	50.5	D	171.2
	Northbound Right - Turn					42.6	D	
	Southbound Left - Turn	18.7	B	0.19	6.7	29.2	C	17.8
	Southbound Through	23.6	C	0.41	23.1	36.5	D	40.8
	Southbound Right - Turn					20.1	C	

Columbus Drive & Thorburn Road			D			**41.5**	**D**	
Thorburn Road	Eastbound Left - Turn	60.3	E	0.85	72.3	56.5	E	97.5
	Eastbound Through	16.8	B	0.55	55.2	47.8	D	233.3
	Eastbound Right - Turn					62.9	E	167.3
	Westbound Through	106.9	F	1.09	90.5	61.2	E	47.7
	Westbound Right - Turn					54.1	D	47.1
Prince Phillip Drive	Northbound Left - Turn	62.1	E	0.95	117.6	35.3	D	91.5
	Northbound Through	36.7	D	0.47	92.7	33.3	C	150.9
	Northbound Right - Turn	20.6	C	0.34	60.8	18.0	B	156.2
	Southbound Left - Turn	16.4	B	0.19	12.8	25.8	C	67.1
	Southbound Through	46.6	D	0.89	120.2	47.2	D	118.0
	Southbound Right - Turn	19.1	B	0.80	86.6	6.8	A	96.5
Thorburn Road & Freshwater Road			B			**9.0**	**A**	
Freshwater Road	Eastbound Through	7.3	A	0.37	54.8	5.0	A	56.4
	Westbound Through	7.1	A	0.35	52.3	9.2	A	64.2
	Westbound Right - Turn	1.5	A	0.37	10.1	4.9	A	42.1
Thorburn Road	Southbound Left - Turn	42.9	D	0.62	44.4	32.9	C	43.7
	Southbound Right - Turn	29.5	C	0.67	47.3	9.0	A	30.3
Avalon Mall & Kenmount Road			C			**15.7**	**B**	
Kenmount Road	Eastbound Left - Turn	20.6	C	0.39	13.9	22.8	C	31.1
	Eastbound Through	22.6	C	0.70	126.5	13.3	B	85.4
	Eastbound Right - Turn					11.6	B	87.6
	Westbound Left - Turn	23.0	C	0.06	4.5	30.8	C	9.8
	Westbound Through	34.2	C	0.81	145.7	16.6	B	92.6
	Westbound Right - Turn	4.7	A	0.42	18.9	5.0	A	30.6
Avalon Mall	Northbound Left - Turn	22.6	C	0.06	5.3	25.2	C	8.0
	Northbound Through	8.7	A	0.06	5.5	31.6	C	14.7
	Northbound Right - Turn					10.3	B	
	Southbound Left - Turn	39.6	D	0.75	90.6	35.5	D	91.4
	Southbound Through					35.1	D	
	Southbound Right - Turn	4.3	A	0.22	7.9	1.8	A	14.2
Pippy Place & Kenmount Road			D			**32.6**	**C**	
Kenmount Road	Eastbound Left - Turn	77.8	E	0.94	111.2	37.8	D	69.7
	Eastbound Through	9.2	A	0.47	78.0	6.6	A	69.9
	Eastbound Right - Turn					4.7	A	62.8
	Westbound Left - Turn	16.7	B	0.01	2.1	23.8	C	6.1
	Westbound Through	47.6	D	0.98	262.1	30.7	C	181.8
	Westbound Right - Turn					31.5	C	183.5
Pippy Place	Northbound Left - Turn	0.4	A	0.0	0.0	-	-	7.3
	Northbound Through					-	-	
	Northbound Right - Turn					9.7	A	
	Southbound Left - Turn	64.6	E	0.74	103.0	91.7	F	143.5
	Southbound Through					67.6	E	185.8
	Southbound Right - Turn	50.2	D	0.94	125.4	79.7	E	
Kelsey Drive & Kenmount Road			F			**49.6**	**D**	
Kenmount Road	Eastbound Left - Turn	53.8	D	0.75	63.7	36.6	D	48.4
	Eastbound Through	24.4	C	0.71	204.2	12.2	B	70.4
	Eastbound Right - Turn					13.7	B	75.2
	Westbound Left - Turn	15.0	B	0.01	1.6	75.9	E	17.7
	Westbound Through	204.1	F	1.37	313.3	90.9	F	417.6
	Westbound Right - Turn	8.1	A	0.58	33.1	47.1	D	200.4
Kelsey Drive	Northbound Left - Turn	48.0	D	0.02	1.3	53.2	D	4.9
	Southbound Left - Turn	30.3	C	0.30	50.7	33.5	C	220.7
	Southbound Through	30.3	C	0.30	50.9	30.9	C	
	Southbound Right - Turn	41.2	D	0.96	185.6	40.0	D	90.0
Kelsey Drive & Kiwanis Street						**4.6**	**A**	
Kiwanis Street	Eastbound Left - Turn	15.8	C	0.30	9.7	12.0	B	17.8
	Eastbound Right - Turn	-	-	-	-	3.3	A	12.1
Kelsey Drive	Northbound Left - Turn	10.3	B	0.20	5.7	10.8	B	21.3
	Northbound Through	0.0	-	0.16	0.0	6.5	A	117.6
	Southbound Through	0.0	-	0.21	0.0	1.4	A	9.7
	Southbound Right - Turn	0.0	-	0.01	0.0	2.5	A	17.6
Team Gushue Hwy (SB) & Kelsey Drive						**65.8**	**F**	
Kelsey Drive	Eastbound Through	16.6	C	0.52	22.9	22.1	C	114.6
	Eastbound Right - Turn	0.0	-	0.29	0.0	0.8	A	18.6
	Westbound Left - Turn	0.0	-	0.65	0.0	5.8	A	2.3
	Westbound Through	0.0	-	0.00	0.0	1.4	A	0.6
Team Gushue Hwy (SB)	Southbound Left - Turn	29.3	D	0.13	3.3	215.8	F	253.2
	Southbound Through					-	-	
	Southbound Right - Turn					204.3	F	

Team Gushue Hwy (NB) & Kelsey Drive						**25.7**	**D**	
Kelsey Drive	Eastbound Left - Turn	16.6	C	0.52	22.9	105.3	F	82.1
	Eastbound Through	0.0	-	0.29	0.0	18.3	C	185.0
	Westbound Through	0.0	-	0.65	0.0	5.7	A	17.0
	Westbound Right - Turn					3.7	A	
Team Gushue Hwy (NB)	Northbound Left - Turn	33.2	D	0.15	3.9	256.5	F	32.3
	Northbound Through					787.6	F	
	Northbound Right - Turn					115.7	F	
Ladysmith Drive & Kenmount Road			E			**64.2**	**E**	
Kenmount Road	Eastbound Left - Turn	13.3	B	0.18	6.6	50.9	D	24.7
	Eastbound Through	18.3	B	0.62	118.3	22.3	C	97.2
	Westbound Through	92.6	F	1.12	346.3	91.9	F	479.6
	Westbound Right - Turn					89.5	F	511.0
Ladysmith Drive	Southbound Left - Turn	24.1	C	0.15	20.5	24.8	C	19.2
	Southbound Right - Turn					3.4	A	32.4
Great Eastern Avenue & Kenmount Road			B			**16.6**	**B**	
Kenmount Road	Eastbound Left - Turn	7.5	A	0.29	7.0	23.7	C	19.4
	Eastbound Through	5.0	A	0.37	62.5	10.6	B	96.5
	Eastbound Right - Turn					19.5	B	189.6
	Westbound Left - Turn	3.2	A	0.03	1.7	26.7	C	16.5
	Westbound Through	13.1	B	0.70	149.4	21.7	C	279.4
	Westbound Right - Turn					18.3	B	344.7
Great Eastern Avenue	Northbound Left - Turn	44.8	D	0.32	15.1	32.5	C	17.0
	Northbound Through	17.2	B	0.17	8.1	22.0	C	13.9
	Northbound Right - Turn					7.2	A	
	Southbound Left - Turn	37.6	D	0.08	6.3	31.0	C	9.6
	Southbound Through	15.2	B	0.26	9.9	42.2	D	3.6
	Southbound Right - Turn					1.7	A	
Wyatt Boulevard & Kenmount Road			F			**24.5**	**C**	
Kenmount Road	Eastbound Through	37.7	D	0.66	98.2	30.4	C	75.9
	Eastbound Right - Turn					10.5	B	72.1
	Westbound Left - Turn	181.0	F	1.32	333.5	45.9	D	112.2
	Westbound Through	8.1	A	0.44	63.0	9.2	A	239.8
Wyatt Boulevard	Northbound Left - Turn	44.0	D	0.27	33.8	46.1	D	37.8
	Northbound Right - Turn	123.0	F	1.21	230.1	16.4	B	153.1
Brougham Drive & Kenmount Road			D			**104.6**	**F**	
Kenmount Road	Eastbound Left - Turn	46.8	D	0.51	42.3	44.8	D	43.0
	Eastbound Through	29.9	C	0.48	68.4	30.8	C	56.9
	Eastbound Right - Turn					22.9	C	62.4
	Westbound Left - Turn	47.3	D	0.53	44.0	77.1	E	62.1
	Westbound Through	60.7	E	1.00	184.0	65.7	E	194.6
	Westbound Right - Turn					68.4	E	201.4
Brougham Drive	Northbound Left - Turn	44.0	D	0.14	13.6	3770.7	F	200.1
	Northbound Through					3552.5	F	
	Northbound Right - Turn	43.6	D	0.67	58.9	3531.4	F	-
	Southbound Left - Turn	46.8	D	0.50	41.2	42.1	D	40.2
	Southbound Through	21.8	C	0.22	30.0	17.1	B	28.5
	Southbound Right - Turn					7.1	A	
Columbus Drive & Old Pennywell Road			D			**35.9**	**D**	
Old Pennywell Road	Eastbound Left - Turn	59.3	E	0.65	43.9	47.9	D	49.4
	Eastbound Through	61.0	E	0.70	52.7	51.2	D	64.8
	Eastbound Right - Turn	14.4	B	0.55	18.2	3.8	A	22.4
	Westbound Left - Turn	60.7	E	0.86	77.9	50.7	D	80.9
	Westbound Through	54.7	D	0.68	67.1	44.0	D	62.9
	Westbound Right - Turn	4.5	A	0.32	8.3	3.2	A	16.2
Columbus Drive	Northbound Left - Turn	19.2	B	0.19	7.0	27.7	C	12.7
	Northbound Through	42.6	D	0.64	103.4	34.9	C	76.6
	Northbound Right - Turn	18.8	B	0.29	38.3	3.5	A	18.8
	Southbound Left - Turn	49.0	D	0.77	58.0	32.9	C	75.8
	Southbound Through	52.0	D	0.71	145.4	41.8	D	117.7
	Southbound Right - Turn	23.1	C	0.23	25.7	12.2	B	52.3
Columbus Drive & Mundy Pond Road			C			**25.0**	**C**	
Mundy Pond Road	Eastbound Left - Turn	77.0	E	0.76	37.3	84.3	F	47.6
	Eastbound Through	32.2	C	0.31	38.5	32.9	C	55.5
	Eastbound Right - Turn					27.0	C	
	Westbound Left - Turn	47.0	D	0.67	43.6	46.6	D	67.0
	Westbound Through	53.7	D	0.84	77.7	40.7	D	111.6
	Westbound Right - Turn					32.8	C	
Columbus Drive	Northbound Left - Turn	9.8	A	0.05	0.4	40.8	D	5.3
	Northbound Through	10.0	B	0.68	40.3	18.8	B	53.2
	Northbound Right - Turn					20.2	C	154.6
	Southbound Left - Turn	16.5	B	0.29	13.2	28.0	C	39.4
	Southbound Through	32.0	C	0.78	226.7	21.3	C	128.7
	Southbound Right - Turn					24.8	C	

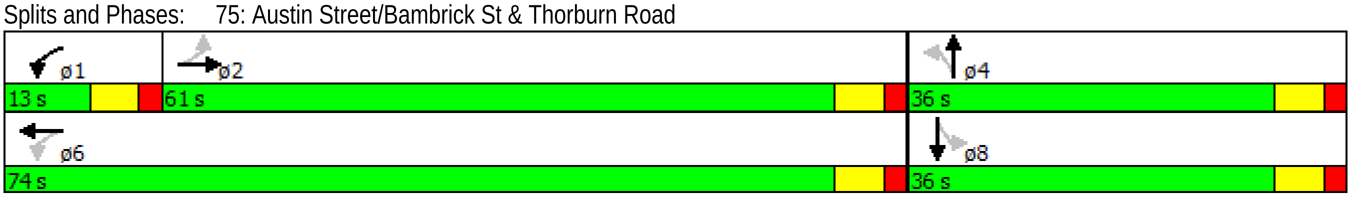
Columbus Drive & Blackmarsh Road			D			**55.7**	**E**	
Blackmarsh Road	Eastbound Left - Turn	37.5	D	0.60	28.6	41.6	D	40.7
	Eastbound Through	39.5	D	0.52	66.3	39.1	D	65.4
	Eastbound Right - Turn					29.8	C	
	Westbound Left - Turn	43.8	D	0.75	59.5	87.8	F	97.5
	Westbound Through	69.3	E	0.93	135.5	62.3	E	196.5
	Westbound Right - Turn	10.8	B	0.45	24.9	17.1	B	88.0
Columbus Drive	Northbound Left - Turn	17.7	B	0.26	10.2	33.2	C	30.0
	Northbound Through	33.7	C	0.79	133.6	32.5	C	94.3
	Northbound Right - Turn					25.8	C	95.8
	Southbound Left - Turn	261.6	F	1.47	107.7	117.4	F	95.5
	Southbound Through	40.1	C	0.90	214.4	63.6	E	291.7
	Southbound Right - Turn					63.1	E	293.7
Columbus Drive & Captain Whelan Drive			C			**94.8**	**F**	
Captain Whelan Drive	Eastbound Left - Turn	63.9	E	0.62	47.0	244.9	F	306.1
	Eastbound Through	63.0	E	0.62	48.6	416.4	F	
	Eastbound Right - Turn	6.6	A	0.28	7.6	38.4	D	317.4
	Westbound Left - Turn	52.9	D	0.24	17.2	185.3	F	63.8
	Westbound Through	46.6	D	0.53	29.8	221.4	F	181.7
	Westbound Right - Turn					211.2	F	
Columbus Drive	Northbound Left - Turn	17.5	B	0.19	8.8	16.3	B	14.5
	Northbound Through	13.8	B	0.44	87.5	16.1	B	15.3
	Northbound Right - Turn					5.0	A	16.0
	Southbound Left - Turn	14.5	B	0.20	15.6	26.8	C	41.8
	Southbound Through	18.5	B	0.68	168.1	4.8	A	12.7
	Southbound Right - Turn	2.4	A	0.14	9.1	4.2	A	4.5
Hamlyn Road & Captain Whelan Drive						**4.0**	**A**	
Hamlyn Road	Eastbound Through	0.0	-	0.33	0.0	3.6	A	9.0
	Eastbound Right - Turn					2.1	A	
	Westbound Left - Turn	9.4	A	0.19	5.1	10.5	B	16.8
	Westbound Through	0.0	-	0.03	0.0	4.1	A	68.3
Hamlyn Road	Northbound Left - Turn	33.6	D	0.62	29.7	7.8	A	26.6
	Northbound Right - Turn	11.2	B	0.20	5.7	3.0	A	16.5
Empire Avenue & Blackmarsh Road						**10.5**	**B**	
Blackmarsh Road	Eastbound Through	0.0	-	0.19	0.0	9.9	A	-
	Westbound Through	0.0	-	0.40	0.0	1.7	A	0.7
	Westbound Right - Turn					0.8	A	
Empire Avenue	Southbound Left - Turn	45.7	E	0.85	63.0	34.4	D	72.9
	Southbound Right - Turn					27.2	D	
Blackmarsh Road & Topsail Road						**9.9**	**A**	
Topsail Road	Eastbound Left - Turn	15.4	C	0.63	34.8	25.4	D	204.9
	Eastbound Through			0.23		9.6	A	352.4
	Westbound Through	0.0	-	0.32	0.0	4.9	A	4.5
	Westbound Right - Turn			0.19		5.9	A	14.9
Blackmarsh Road	Southbound Left - Turn	56.1	F	0.95	96.0	53.0	F	47.5
	Southbound Right - Turn	0.0	-	0.00	0.0	8.2	A	24.8
Blackmarsh Road & Captain Whelan Drive						**4.5**	**A**	
Captain Whelan Drive	Eastbound Through	0.0	-	0.22	0.0	0.7	A	0.7
	Eastbound Right - Turn					-	-	
	Westbound Left - Turn	10.0	A	0.39	14.3	5.5	A	30.7
	Westbound Through	0.0	-	0.37	0.0	2.7	A	7.1
Blackmarsh Road	Northbound Left - Turn	423.7	F	1.42	47.3	37.6	E	26.9
	Northbound Right - Turn	12.0	B	0.23	6.7	4.4	A	23.8
Mt Carson Ave/ Commonweath Ave & Topsail Road			E			**171.5**	**F**	
Topsail Road	Eastbound Left - Turn	17.4	B	0.18	13.1	160.7	F	67.9
	Eastbound Through	47.5	D	0.84	112.0	186.5	F	729.8
	Eastbound Right - Turn	84.4	F	1.07	184.7	238.6	F	42.5
	Westbound Left - Turn	100.5	F	1.08	141.4	78.3	E	117.1
	Westbound Through	27.0	C	0.46	74.4	20.7	C	260.7
	Westbound Right - Turn	0.2	A	0.06	0.0	12.6	B	29.2
Mt Carson Avenue	Northbound Left - Turn	75.0	E	0.95	81.5	42.8	D	64.6
	Northbound Through	39.6	D	0.61	97.3	32.3	C	82.1
	Northbound Right - Turn	5.7	A	0.38	8.3	2.8	A	11.3
	Southbound Left - Turn	23.9	C	0.25	19.3	561.5	F	46.6
	Southbound Through	131.4	F	1.16	199.8	562.3	F	1234.1
	Southbound Right - Turn	0.2	A	0.06	0.0	544.3	F	32.9

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	501	12	118	1243	91	116	14	318	49	4	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.0	3.4	3.4	3.0	3.5	3.5	3.0	3.5	3.5
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	55.0		0.0	60.0		0.0	60.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.996			0.990			0.856			0.975	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	3447	0	1652	3426	0	1652	1577	0	1652	1796	0
Flt Permitted	0.179			0.372			0.754			0.237		
Satd. Flow (perm)	311	3447	0	647	3426	0	1311	1577	0	412	1796	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			13			343			1	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		389.2			166.0			219.5			145.1	
Travel Time (s)		28.0			12.0			15.8			10.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.88	0.88	0.88	0.93	0.93	0.93	0.92	0.92	0.92	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	5	569	14	127	1337	98	126	15	346	58	5	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	5	583	0	127	1435	0	126	361	0	58	6	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Total Split (s)	61.0	61.0		13.0	74.0		36.0	36.0		36.0	36.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	55.3	55.3		68.4	68.4		16.9	16.9		16.9	16.9	
Actuated g/C Ratio	0.57	0.57		0.70	0.70		0.17	0.17		0.17	0.17	
v/c Ratio	0.03	0.30		0.24	0.60		0.55	0.65		0.82	0.02	
Control Delay	13.0	12.4		7.2	9.8		45.4	10.5		102.7	28.8	
Queue Delay	0.0	0.0		0.0	0.7		0.0	0.0		0.0	0.0	
Total Delay	13.0	12.4		7.2	10.5		45.4	10.5		102.7	28.8	
LOS	B	B		A	B		D	B		F	C	
Approach Delay		12.5			10.3			19.5			95.8	
Approach LOS		B			B			B			F	
Queue Length 50th (m)	0.4	27.3		6.5	60.2		21.8	2.9		10.6	0.8	
Queue Length 95th (m)	2.6	48.4		18.1	119.5		38.9	26.1		23.8	3.8	
Internal Link Dist (m)		365.2			142.0			195.5			121.1	
Turn Bay Length (m)	55.0			55.0			60.0			60.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	176	1959		526	2409		405	725		127	557	
Starvation Cap Reductn	0	0		0	574		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.03	0.30		0.24	0.78		0.31	0.50		0.46	0.01	

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 97.4	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.82	
Intersection Signal Delay: 14.4	Intersection LOS: B
Intersection Capacity Utilization 89.3%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 75: Austin Street/Bambrick St & Thorburn Road

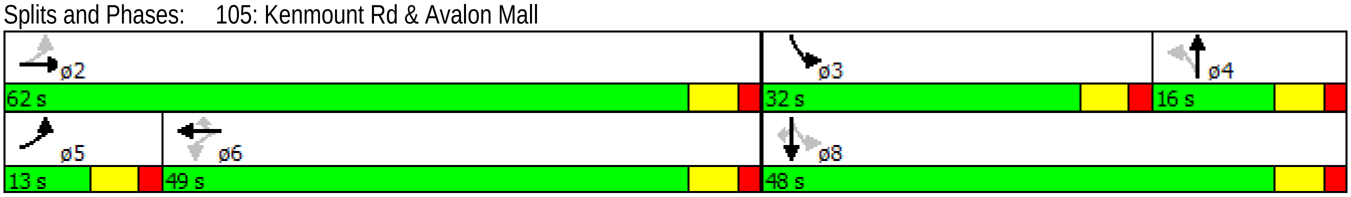


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	63	1170	20	7	1041	321	11	4	26	316	7	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.3	3.5	3.0	3.4	3.5	3.5	3.5	3.5	4.0	4.8	4.2
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	16.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		0	1		1	1		0	0		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.997				0.850		0.869				0.850
Flt Protected	0.950			0.950			0.950				0.953	
Satd. Flow (prot)	1652	3411	0	1652	3461	1566	1750	1601	0	0	2012	1689
Flt Permitted	0.084			0.170			0.330				0.702	
Satd. Flow (perm)	146	3411	0	296	3461	1566	608	1601	0	0	1482	1689
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2				346		34				160
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		288.0			296.2			135.5			126.3	
Travel Time (s)		20.7			21.3			9.8			9.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.77	0.77	0.77	0.78	0.78	0.78
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	65	1206	21	8	1183	365	14	5	34	405	9	160
Shared Lane Traffic (%)												
Lane Group Flow (vph)	65	1227	0	8	1183	365	14	39	0	0	414	160
Turn Type	pm+pt	NA		Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm
Protected Phases	5	2			6			4		3	8	
Permitted Phases	2			6		6	4			8		8
Total Split (s)	13.0	62.0		49.0	49.0	49.0	16.0	16.0		32.0	48.0	48.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0			6.0	6.0
Act Effct Green (s)	56.0	56.0		45.8	45.8	45.8	40.3	40.3			40.3	40.3
Actuated g/C Ratio	0.52	0.52		0.42	0.42	0.42	0.37	0.37			0.37	0.37
v/c Ratio	0.39	0.70		0.06	0.81	0.42	0.06	0.06			0.75	0.22
Control Delay	20.6	22.6		23.0	34.2	4.7	22.6	8.7			39.6	4.3
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Delay	20.6	22.6		23.0	34.2	4.7	22.6	8.7			39.6	4.3
LOS	C	C		C	C	A	C	A			D	A
Approach Delay		22.5			27.3			12.4			29.7	
Approach LOS		C			C			B			C	
Queue Length 50th (m)	6.9	102.0		1.1	121.7	2.5	1.9	0.7			75.2	0.0
Queue Length 95th (m)	13.9	126.5		4.5	145.7	18.9	5.3	5.5			90.6	7.9
Internal Link Dist (m)		264.0			272.2			111.5			102.3	
Turn Bay Length (m)	55.0			16.0								

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	173	1765		125	1464	862	226	616			574	753
Starvation Cap Reductn	0	0		0	0	0	0	0			0	0
Spillback Cap Reductn	0	0		0	0	0	0	0			0	0
Storage Cap Reductn	0	0		0	0	0	0	0			0	0
Reduced v/c Ratio	0.38	0.70		0.06	0.81	0.42	0.06	0.06			0.72	0.21

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 108.3	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.81	
Intersection Signal Delay: 25.7	Intersection LOS: C
Intersection Capacity Utilization 75.9%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 105: Kenmount Rd & Avalon Mall



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	346	0	424	571	59	141
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	376	0	461	621	64	153
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			376		1918	376
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			376		1918	376
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			61		0	77
cM capacity (veh/h)			1182		45	670

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	376	461	621	64	153
Volume Left	0	461	0	64	0
Volume Right	0	0	0	0	153
cSH	1700	1182	1700	45	670
Volume to Capacity	0.22	0.39	0.37	1.42	0.23
Queue Length 95th (m)	0.0	14.3	0.0	47.3	6.7
Control Delay (s)	0.0	10.0	0.0	423.7	12.0
Lane LOS		A		F	B
Approach Delay (s)	0.0	4.3		133.4	
Approach LOS				F	

Intersection Summary			
Average Delay	20.1		
Intersection Capacity Utilization	55.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	302	524	106	66	266
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	328	570	115	72	289
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	685				955	627
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	685				955	627
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				75	40
cM capacity (veh/h)	909				286	483

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	328	685	361
Volume Left	0	0	72
Volume Right	0	115	289
cSH	1700	1700	425
Volume to Capacity	0.19	0.40	0.85
Queue Length 95th (m)	0.0	0.0	63.0
Control Delay (s)	0.0	0.0	45.7
Lane LOS			E
Approach Delay (s)	0.0	0.0	45.7
Approach LOS			E

Intersection Summary			
Average Delay	12.0		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	478	536	750	44	6	508
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	514	576	806	47	6	546
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						3
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	806				2146	427
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	806				2146	427
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	37				58	5
cM capacity (veh/h)	814				15	576

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	706	384	538	316	553
Volume Left	514	0	0	0	6
Volume Right	0	0	0	47	546
cSH	814	1700	1700	1700	583
Volume to Capacity	0.63	0.23	0.32	0.19	0.95
Queue Length 95th (m)	34.8	0.0	0.0	0.0	96.0
Control Delay (s)	15.4	0.0	0.0	0.0	56.1
Lane LOS	C				F
Approach Delay (s)	10.0		0.0		56.1
Approach LOS					F

Intersection Summary			
Average Delay	16.8		
Intersection Capacity Utilization	64.2%	ICU Level of Service	C
Analysis Period (min)	15		

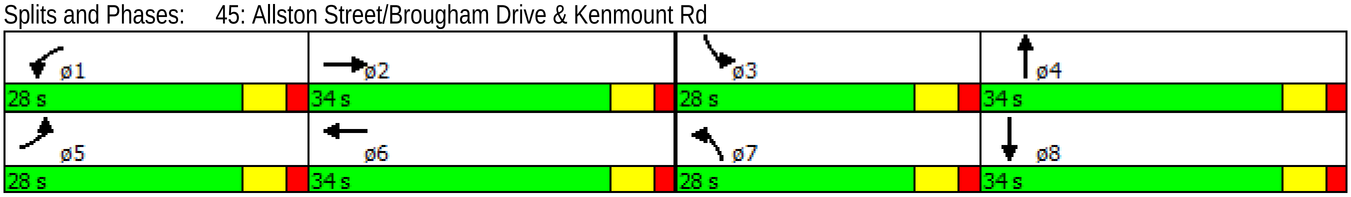
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	112	450	18	117	673	305	23	116	73	107	61	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	50.0		0.0	50.0		0.0	0.0		30.0	0.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.994			0.953			0.942			0.933	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3512	0	1772	3387	0	1674	1761	0	1789	1757	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1789	3512	0	1772	3387	0	1674	1761	0	1789	1757	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			54			24			30	
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		727.2			1392.7			202.9			587.5	
Travel Time (s)		54.5			104.5			15.2			44.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	3%	11%	3%	3%	2%	9%	2%	4%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	123	495	20	129	740	335	25	127	80	118	67	54
Shared Lane Traffic (%)												
Lane Group Flow (vph)	123	515	0	129	1075	0	25	207	0	118	121	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases												
Total Split (s)	28.0	34.0		28.0	34.0		28.0	34.0		28.0	34.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	12.5	28.2		12.7	28.4		10.1	15.4		12.3	28.0	
Actuated g/C Ratio	0.13	0.30		0.14	0.31		0.11	0.17		0.13	0.30	
v/c Ratio	0.51	0.48		0.53	1.00		0.14	0.67		0.50	0.22	
Control Delay	46.8	29.9		47.3	60.7		44.0	43.6		46.8	21.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	46.8	29.9		47.3	60.7		44.0	43.6		46.8	21.8	
LOS	D	C		D	E		D	D		D	C	
Approach Delay		33.2			59.3			43.6			34.2	
Approach LOS		C			E			D			C	
Queue Length 50th (m)	20.2	37.5		21.1	92.4		4.0	29.9		19.4	10.5	
Queue Length 95th (m)	42.3	68.4		44.0	#184.0		13.6	58.9		41.2	30.0	
Internal Link Dist (m)		703.2			1368.7			178.9			563.5	
Turn Bay Length (m)	50.0			50.0								

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	428	1072		424	1073		401	553		428	582	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.29	0.48		0.30	1.00		0.06	0.37		0.28	0.21	

Intersection Summary

Area Type: Other
Cycle Length: 124
Actuated Cycle Length: 92.9
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 47.9 Intersection LOS: D
Intersection Capacity Utilization 75.6% 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: 45: Allston Street/Brougham Drive & Kenmount Rd

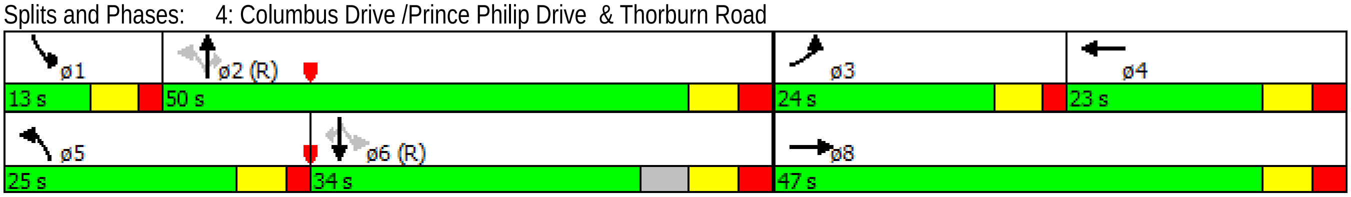


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	438	244	479	0	357	124	333	674	279	54	1181	571
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.8	3.8	2.4	3.8	3.8	3.5	3.8	4.2	3.5	3.8	4.0
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	150.0		150.0	0.0		0.0	175.0		0.0	110.0		90.0
Storage Lanes	1		1	0		0	1		1	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.91	1.00
Ped Bike Factor	1.00	0.99			1.00				0.98	1.00		0.98
Frt		0.901			0.961				0.850			0.850
Flt Protected	0.950						0.950			0.950		
Satd. Flow (prot)	3395	3226	0	0	3462	0	1750	3618	1689	1750	5198	1654
Flt Permitted	0.950						0.108			0.382		
Satd. Flow (perm)	3386	3226	0	0	3462	0	199	3618	1663	703	5198	1628
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		323			37				294			456
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		385.8			49.4			746.3			113.4	
Travel Time (s)		27.8			3.6			53.7			8.2	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.96	0.96	0.96	0.80	0.80	0.80	0.95	0.95	0.95	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	456	254	499	0	446	155	351	709	294	60	1312	634
Shared Lane Traffic (%)												
Lane Group Flow (vph)	456	753	0	0	601	0	351	709	294	60	1312	634
Turn Type	Prot	NA			NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	3	8			4		5	2		1	6	
Permitted Phases							2		2	6		6
Total Split (s)	24.0	47.0			23.0		25.0	50.0	50.0	13.0	34.0	34.0
Total Lost Time (s)	6.0	7.0			7.0		6.0	7.0	7.0	6.0	7.0	7.0
Act Effct Green (s)	17.5	40.0			16.5		57.0	45.6	45.6	39.2	31.2	31.2
Actuated g/C Ratio	0.16	0.36			0.15		0.52	0.41	0.41	0.36	0.28	0.28
v/c Ratio	0.85	0.55			1.09		0.95	0.47	0.34	0.19	0.89	0.80
Control Delay	60.3	16.8			106.9		62.1	36.7	20.6	16.4	46.6	19.1
Queue Delay	0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.3	16.8			106.9		62.1	36.7	20.6	16.4	46.6	19.1
LOS	E	B			F		E	D	C	B	D	B
Approach Delay		33.2			106.9			39.8			37.0	
Approach LOS		C			F			D			D	
Queue Length 50th (m)	49.2	37.1			~75.0		71.2	75.4	41.6	6.2	99.0	35.5
Queue Length 95th (m)	#72.3	55.2			#90.5		#117.6	92.7	60.8	12.8	#120.2	86.6
Internal Link Dist (m)		361.8			25.4			722.3			89.4	
Turn Bay Length (m)	150.0						175.0			110.0		90.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	555	1378			551		371	1499	861	316	1474	788
Starvation Cap Reductn	0	0			0		0	0	0	0	0	0
Spillback Cap Reductn	0	0			0		0	0	0	0	0	0
Storage Cap Reductn	0	0			0		0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.55			1.09		0.95	0.47	0.34	0.19	0.89	0.80

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 1.09	
Intersection Signal Delay: 45.0	Intersection LOS: D
Intersection Capacity Utilization 89.3%	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: 4: Columbus Drive /Prince Philip Drive & Thorburn Road



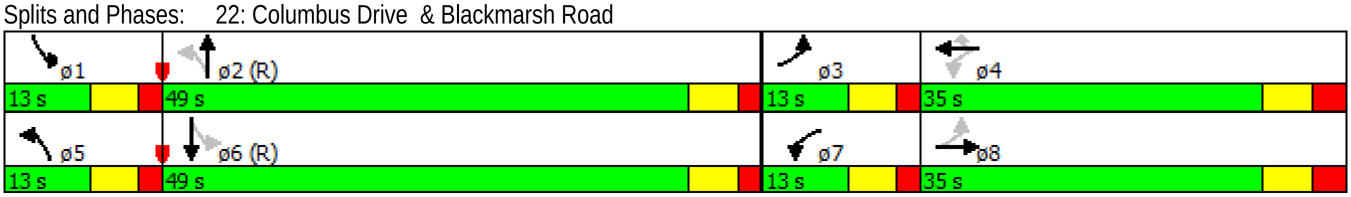
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	104	193	21	223	368	208	40	882	157	255	1314	79
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.5	3.5	3.5	3.5	3.5	3.0	4.0	4.0	3.0	4.0	4.0
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	70.0		0.0	75.0		75.0	80.0		0.0	70.0		0.0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor		1.00		1.00		0.98		1.00			1.00	
Frt		0.985				0.850		0.977			0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1750	1812	0	1750	1842	1566	1652	3597	0	1652	3662	0
Flt Permitted	0.166			0.490			0.093			0.090		
Satd. Flow (perm)	306	1812	0	901	1842	1541	162	3597	0	156	3662	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5				197		22			6	
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		398.4			185.4			678.8			457.2	
Travel Time (s)		28.7			13.3			34.9			23.5	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.93	0.93	0.93	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	114	212	23	256	423	239	43	948	169	268	1383	83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	114	235	0	256	423	239	43	1117	0	268	1466	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases	8			4		4	2			6		
Total Split (s)	13.0	35.0		13.0	35.0	35.0	13.0	49.0		13.0	49.0	
Total Lost Time (s)	6.0	7.0		6.0	7.0	7.0	6.0	6.0		6.0	6.0	
Act Effct Green (s)	35.2	27.2		35.2	27.2	27.2	50.0	43.0		53.2	49.0	
Actuated g/C Ratio	0.32	0.25		0.32	0.25	0.25	0.45	0.39		0.48	0.45	
v/c Ratio	0.60	0.52		0.75	0.93	0.45	0.26	0.79		1.47	0.90	
Control Delay	37.5	39.5		43.8	69.3	10.8	17.7	33.7		261.6	40.1	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	37.5	39.5		43.8	69.3	10.8	17.7	33.7		261.6	40.1	
LOS	D	D		D	E	B	B	C		F	D	
Approach Delay		38.9			47.0			33.1			74.4	
Approach LOS		D			D			C			E	
Queue Length 50th (m)	16.0	42.3		39.3	88.1	6.9	4.5	107.4		~70.2	~135.0	
Queue Length 95th (m)	#28.6	66.3		#59.5	#135.5	24.9	10.2	133.6		m#107.7	#214.4	
Internal Link Dist (m)		374.4			161.4			654.8			433.2	
Turn Bay Length (m)	70.0			75.0		75.0	80.0			70.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	190	464		341	468	539	168	1419		182	1636	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.60	0.51		0.75	0.90	0.44	0.26	0.79		1.47	0.90	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 81 (74%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.47
Intersection Signal Delay: 53.9 Intersection LOS: D
Intersection Capacity Utilization 90.7% 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.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 22: Columbus Drive & Blackmarsh Road

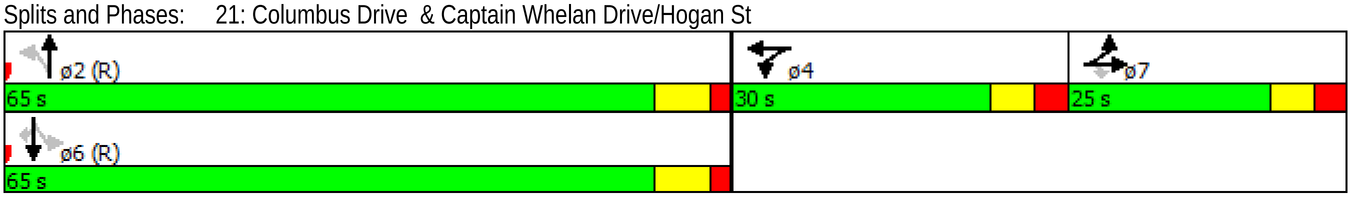


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	155	67	67	33	48	38	21	820	47	52	1337	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.2	3.4	3.0	4.0	4.5	4.5	3.2	3.5	3.8	3.2	3.5	3.8
Grade (%)		-5%			0%			0%			0%	
Storage Length (m)	140.0		30.5	80.0		0.0	100.0		0.0	100.0		225.0
Storage Lanes	1		1	1		0	1		0	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Ped Bike Factor	1.00	1.00	0.98	1.00	0.99			1.00		1.00		0.97
Frt			0.850		0.933			0.992				0.850
Flt Protected	0.950	0.980		0.950			0.950			0.950		
Satd. Flow (prot)	1647	1738	1515	1848	1899	0	1691	3467	0	1691	3500	1619
Flt Permitted	0.950	0.980		0.950			0.112			0.260		
Satd. Flow (perm)	1641	1736	1491	1843	1899	0	199	3467	0	462	3500	1576
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			100		30			7				144
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		474.2			187.8			348.7			678.8	
Travel Time (s)		34.1			13.5			17.9			34.9	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.80	0.80	0.80	0.92	0.92	0.92	0.91	0.91	0.91
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	172	74	74	41	60	48	23	891	51	57	1469	144
Shared Lane Traffic (%)	30%											
Lane Group Flow (vph)	120	126	74	41	108	0	23	942	0	57	1469	144
Turn Type	Split	NA	Perm	Split	NA		Perm	NA		Perm	NA	Perm
Protected Phases	7	7		4	4			2			6	
Permitted Phases			7				2			6		6
Total Split (s)	25.0	25.0	25.0	30.0	30.0		65.0	65.0		65.0	65.0	65.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	7.0
Act Effct Green (s)	14.1	14.1	14.1	11.1	11.1		73.8	73.8		73.8	73.8	73.8
Actuated g/C Ratio	0.12	0.12	0.12	0.09	0.09		0.62	0.62		0.62	0.62	0.62
v/c Ratio	0.62	0.62	0.28	0.24	0.53		0.19	0.44		0.20	0.68	0.14
Control Delay	63.9	63.0	6.6	52.9	46.6		17.5	13.8		14.5	18.5	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	63.9	63.0	6.6	52.9	46.6		17.5	13.8		14.5	18.5	2.4
LOS	E	E	A	D	D		B	B		B	B	A
Approach Delay		50.3			48.3			13.9			17.0	
Approach LOS		D			D			B			B	
Queue Length 50th (m)	28.7	30.2	0.0	9.2	17.8		2.2	56.2		5.4	110.8	0.0
Queue Length 95th (m)	47.0	48.6	7.6	17.2	29.8		8.8	87.5		15.6	168.1	9.1
Internal Link Dist (m)		450.2			163.8			324.7			654.8	
Turn Bay Length (m)	140.0		30.5	80.0			100.0			100.0		225.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	251	264	311	354	388		122	2134		284	2151	1024
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	0
Reduced v/c Ratio	0.48	0.48	0.24	0.12	0.28		0.19	0.44		0.20	0.68	0.14

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.68	
Intersection Signal Delay: 21.0	Intersection LOS: C
Intersection Capacity Utilization 69.5%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 21: Columbus Drive & Captain Whelan Drive/Hogan St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	123	14	142	236	47	4	1030	81	58	1438	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.0	3.4	3.4	3.0	3.7	3.7	3.0	3.7	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	70.0		0.0	60.0		0.0	75.0		0.0	100.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frt		0.985			0.975			0.989			0.989	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	1791	0	1652	1771	0	1652	3532	0	1652	3532	0
Flt Permitted	0.238			0.658			0.085			0.114		
Satd. Flow (perm)	413	1791	0	1141	1771	0	148	3532	0	198	3532	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5			10			9			12	
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		417.2			267.3			457.2			657.1	
Travel Time (s)		30.0			19.2			23.5			33.8	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.93	0.93	0.93	0.72	0.72	0.72	0.89	0.89	0.89	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	81	132	15	197	328	65	4	1157	91	63	1563	125
Shared Lane Traffic (%)												
Lane Group Flow (vph)	81	147	0	197	393	0	4	1248	0	63	1688	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Total Split (s)	42.0	42.0		42.0	42.0		55.0	55.0		13.0	68.0	
Total Lost Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		6.0	7.0	
Act Effct Green (s)	28.6	28.6		28.6	28.6		56.8	56.8		68.4	67.4	
Actuated g/C Ratio	0.26	0.26		0.26	0.26		0.52	0.52		0.62	0.61	
v/c Ratio	0.76	0.31		0.67	0.84		0.05	0.68		0.29	0.78	
Control Delay	77.0	32.2		47.0	53.7		9.8	10.0		16.5	32.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	77.0	32.2		47.0	53.7		9.8	10.0		16.5	32.0	
LOS	E	C		D	D		A	B		B	C	
Approach Delay		48.1			51.5			10.0			31.4	
Approach LOS		D			D			B			C	
Queue Length 50th (m)	15.9	24.4		37.6	77.6		0.2	31.1		9.3	202.4	
Queue Length 95th (m)	#37.3	38.5		43.6	77.7		m0.4	40.3		m13.2	226.7	
Internal Link Dist (m)		393.2			243.3			433.2			633.1	
Turn Bay Length (m)	70.0			60.0			75.0			100.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	131	573		363	570		76	1828		218	2170	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.62	0.26		0.54	0.69		0.05	0.68		0.29	0.78	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 100 (91%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 28.5 Intersection LOS: C

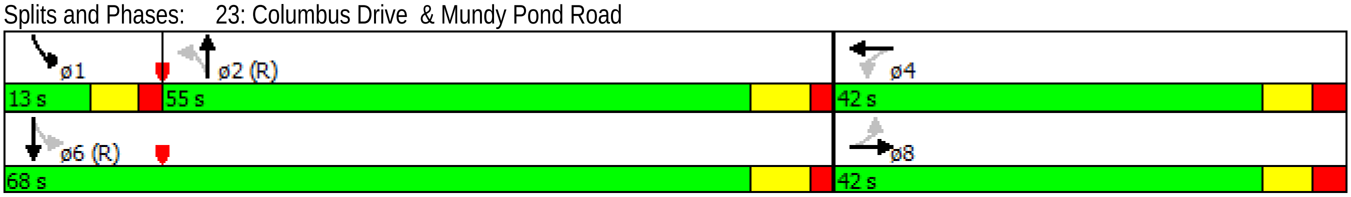
Intersection Capacity Utilization 88.5% ICU Level of Service E

Analysis Period (min) 15

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

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

Splits and Phases: 23: Columbus Drive & Mundy Pond Road



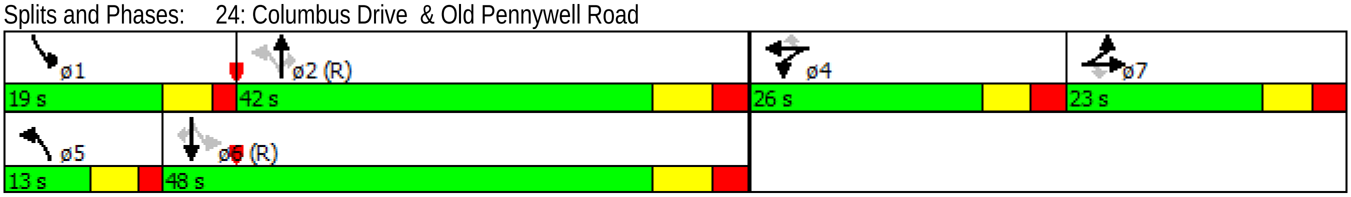
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	145	162	448	190	126	29	982	172	208	1458	165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.4	4.2	3.8	3.5	3.5	4.2	3.0	3.5	3.7	3.0	3.5	3.5
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	45.0		80.0	65.0		70.0	100.0		140.0	100.0		75.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Ped Bike Factor	1.00		0.98	1.00		0.98			0.97			0.97
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1730	1987	1619	3395	1842	1689	1652	5029	1601	1652	5029	1566
Flt Permitted	0.950			0.950			0.108			0.141		
Satd. Flow (perm)	1725	1987	1593	3383	1842	1661	188	5029	1559	245	5029	1525
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			179			179			191			173
Link Speed (k/h)		50			50			70			70	
Link Distance (m)		162.7			211.3			299.5			746.3	
Travel Time (s)		11.7			15.2			15.4			38.4	
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.91	0.91	0.91	0.90	0.90	0.90	0.94	0.94	0.94
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	140	175	195	492	209	138	32	1091	191	221	1551	176
Shared Lane Traffic (%)												
Lane Group Flow (vph)	140	175	195	492	209	138	32	1091	191	221	1551	176
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	7		4	4		5	2		1	6	
Permitted Phases			7			4	2		2	6		6
Total Split (s)	23.0	23.0	23.0	26.0	26.0	26.0	13.0	42.0	42.0	19.0	48.0	48.0
Total Lost Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.0	8.0	8.0	6.0	8.0	8.0
Act Effct Green (s)	13.9	13.9	13.9	18.5	18.5	18.5	46.2	37.2	37.2	57.7	47.9	47.9
Actuated g/C Ratio	0.13	0.13	0.13	0.17	0.17	0.17	0.42	0.34	0.34	0.52	0.44	0.44
v/c Ratio	0.65	0.70	0.55	0.86	0.68	0.32	0.19	0.64	0.29	0.77	0.71	0.23
Control Delay	59.3	61.0	14.4	60.7	54.7	4.5	19.2	42.6	18.8	49.0	52.0	23.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.3	61.0	14.4	60.7	54.7	4.5	19.2	42.6	18.8	49.0	52.0	23.1
LOS	E	E	B	E	D	A	B	D	B	D	D	C
Approach Delay		42.7			50.0			38.6			49.0	
Approach LOS		D			D			D			D	
Queue Length 50th (m)	28.7	36.1	3.1	53.2	42.3	0.0	5.7	91.3	18.6	45.9	128.9	18.3
Queue Length 95th (m)	43.9	52.7	18.2	#77.9	67.1	8.3	m7.0	103.4	m38.3	m58.0	145.4	m25.7
Internal Link Dist (m)		138.7			187.3			275.5			722.3	
Turn Bay Length (m)	45.0		80.0	65.0		70.0	100.0		140.0	100.0		75.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	251	289	384	586	318	434	171	1699	653	297	2187	761
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.61	0.51	0.84	0.66	0.32	0.19	0.64	0.29	0.74	0.71	0.23

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 45.5 Intersection LOS: D
Intersection Capacity Utilization 77.7% 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.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 24: Columbus Drive & Old Pennywell Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	53	748	585	369	595	42	209	318	234	67	488	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	60.0		40.0	100.0		30.0	0.0		0.0	40.0		30.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.406			0.108			0.119			0.404		
Satd. Flow (perm)	765	3579	1601	203	3579	1601	224	1883	1601	761	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			220			147			254			206
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		1093.2			920.0			219.2			1135.0	
Travel Time (s)		78.7			66.2			15.8			81.7	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	58	813	636	401	647	46	227	346	254	73	530	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	58	813	636	401	647	46	227	346	254	73	530	33
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	16.0	36.0	36.0	25.0	45.0	45.0	17.0	37.0	37.0	13.0	33.0	33.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Act Effct Green (s)	37.7	30.0	30.0	55.0	43.9	43.9	42.4	33.6	33.6	34.0	27.0	27.0
Actuated g/C Ratio	0.34	0.27	0.27	0.50	0.40	0.40	0.38	0.30	0.30	0.31	0.24	0.24
v/c Ratio	0.18	0.84	1.07	1.08	0.46	0.06	0.95	0.61	0.38	0.25	1.16	0.06
Control Delay	17.4	47.5	84.4	100.5	27.0	0.2	75.0	39.6	5.7	23.9	131.4	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.4	47.5	84.4	100.5	27.0	0.2	75.0	39.6	5.7	23.9	131.4	0.2
LOS	B	D	F	F	C	A	E	D	A	C	F	A
Approach Delay		61.9			52.8			38.9			112.3	
Approach LOS		E			D			D			F	
Queue Length 50th (m)	6.3	87.7	~116.1	~82.0	55.5	0.0	34.8	66.3	0.0	9.8	~136.1	0.0
Queue Length 95th (m)	13.1	#112.0	#184.7	#141.4	74.4	0.0	#81.5	97.3	18.3	19.3	#199.8	0.0
Internal Link Dist (m)		1069.2			896.0			195.2			1111.0	
Turn Bay Length (m)	60.0		40.0	100.0		30.0				40.0		30.0

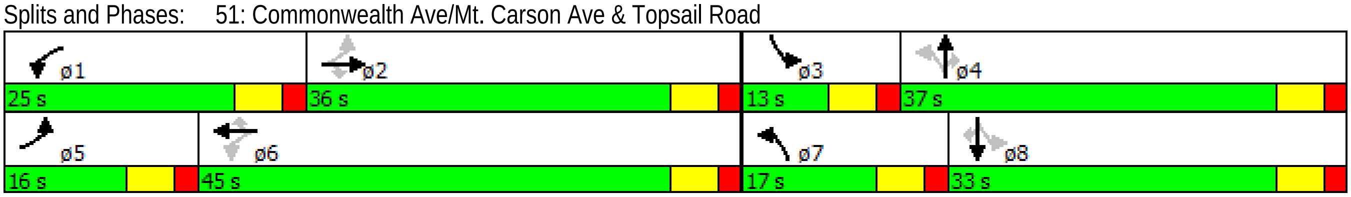
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	367	967	593	372	1414	721	240	569	661	297	458	545
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.84	1.07	1.08	0.46	0.06	0.95	0.61	0.38	0.25	1.16	0.06

Intersection Summary	
Area Type: Other	
Cycle Length: 111	
Actuated Cycle Length: 111	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.16	
Intersection Signal Delay: 62.7	Intersection LOS: E
Intersection Capacity Utilization 101.9%	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: 51: Commonwealth Ave/Mt. Carson Ave & Topsail Road

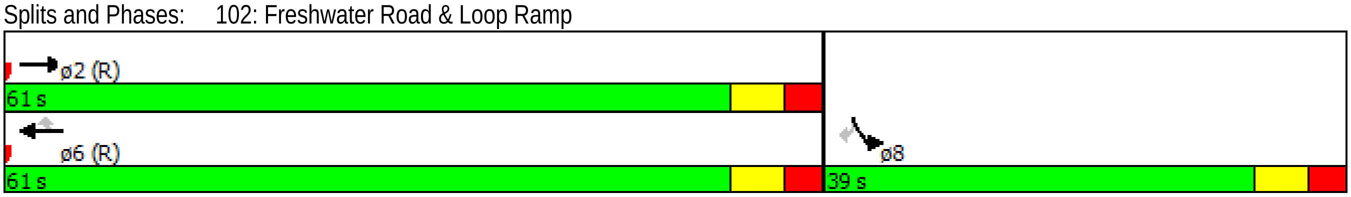


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	849	816	443	330	232
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	4.3	4.3	4.3	4.3	3.8	4.3
Grade (%)		0%	0%		0%	
Storage Length (m)	0.0			40.0	95.0	0.0
Storage Lanes	0			1	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	0.95	0.95	1.00	0.97	1.00
Ped Bike Factor						
Frt				0.850		0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3814	3814	1706	3509	1706
Flt Permitted					0.950	
Satd. Flow (perm)	0	3814	3814	1706	3509	1706
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				498		115
Link Speed (k/h)		50	50		50	
Link Distance (m)		191.2	153.6		119.3	
Travel Time (s)		13.8	11.1		8.6	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.88	0.88	0.89	0.89	0.91	0.91
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	0	965	917	498	363	255
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	965	917	498	363	255
Turn Type		NA	NA	Perm	NA	Perm
Protected Phases		2	6		8	
Permitted Phases				6		8
Total Split (s)		61.0	61.0	61.0	39.0	39.0
Total Lost Time (s)		7.0	7.0	7.0	7.0	7.0
Act Effct Green (s)		69.3	69.3	69.3	16.7	16.7
Actuated g/C Ratio		0.69	0.69	0.69	0.17	0.17
v/c Ratio		0.37	0.35	0.37	0.62	0.67
Control Delay		7.3	7.1	1.5	42.9	29.5
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		7.3	7.1	1.5	42.9	29.5
LOS		A	A	A	D	C
Approach Delay		7.3	5.1		37.3	
Approach LOS		A	A		D	
Queue Length 50th (m)		35.3	32.9	0.0	34.1	25.2
Queue Length 95th (m)		54.8	52.3	10.1	44.4	47.3
Internal Link Dist (m)		167.2	129.6		95.3	
Turn Bay Length (m)				40.0	95.0	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)		2642	2642	1334	1122	624
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		0.37	0.35	0.37	0.32	0.41

Intersection Summary	
Area Type: Other	
Cycle Length: 100	
Actuated Cycle Length: 100	
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.67	
Intersection Signal Delay: 12.5	Intersection LOS: B
Intersection Capacity Utilization 48.6%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 102: Freshwater Road & Loop Ramp

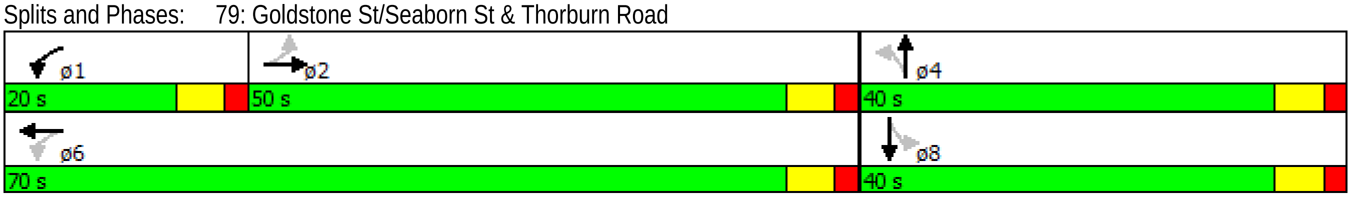


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	253	49	328	809	26	149	45	197	10	20	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.0	3.4	3.4	3.0	4.0	4.0	3.0	4.0	4.0
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	65.0		0.0	85.0		0.0	50.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.976			0.995			0.878			0.979	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	3378	0	1652	3443	0	1652	1708	0	1652	1905	0
Flt Permitted	0.314			0.473			0.739			0.382		
Satd. Flow (perm)	546	3378	0	822	3443	0	1285	1708	0	664	1905	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		24			5			199			4	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		85.0			389.2			240.7			135.3	
Travel Time (s)		6.1			28.0			17.3			9.7	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.99	0.99	0.99	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	19	305	59	357	879	28	151	45	199	12	24	4
Shared Lane Traffic (%)												
Lane Group Flow (vph)	19	364	0	357	907	0	151	244	0	12	28	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Total Split (s)	50.0	50.0		20.0	70.0		40.0	40.0		40.0	40.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	46.1	46.1		64.2	64.2		16.0	16.0		16.0	16.0	
Actuated g/C Ratio	0.50	0.50		0.70	0.70		0.17	0.17		0.17	0.17	
v/c Ratio	0.07	0.21		0.53	0.38		0.68	0.53		0.10	0.08	
Control Delay	15.8	13.6		9.3	6.9		51.0	12.5		33.0	28.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	15.8	13.6		9.3	6.9		51.0	12.5		33.0	28.0	
LOS	B	B		A	A		D	B		C	C	
Approach Delay		13.7			7.5			27.2			29.5	
Approach LOS		B			A			C			C	
Queue Length 50th (m)	1.7	17.2		21.1	29.8		25.3	6.8		1.8	3.6	
Queue Length 95th (m)	5.9	27.6		43.8	52.0		44.8	26.5		6.1	9.8	
Internal Link Dist (m)		61.0			365.2			216.7			111.3	
Turn Bay Length (m)	55.0			65.0			85.0			50.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	272	1699		698	2397		475	756		245	706	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.07	0.21		0.51	0.38		0.32	0.32		0.05	0.04	

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 92.2	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.68	
Intersection Signal Delay: 12.8	Intersection LOS: B
Intersection Capacity Utilization 58.9%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 79: Goldstone St/Seaborn St & Thorburn Road

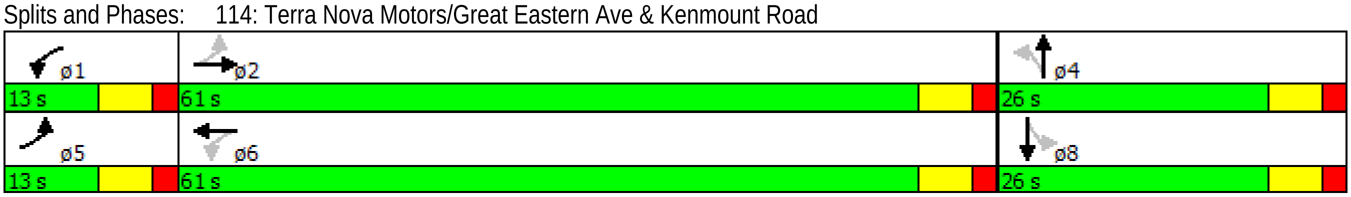


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	61	968	1	12	1610	15	34	2	26	9	1	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.7	3.7	3.5	3.7	3.7	3.0	3.5	3.5	3.0	3.5	3.7
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	55.0		0.0	45.0		0.0	25.0		0.0	65.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt					0.999			0.860			0.853	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1750	3579	0	1750	3575	0	1652	1584	0	1652	1571	0
Flt Permitted	0.073			0.266			0.725			0.738		
Satd. Flow (perm)	134	3579	0	490	3575	0	1260	1584	0	1283	1571	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					1			28			48	
Link Speed (k/h)		50			50			48			48	
Link Distance (m)		482.2			1319.1			190.4			243.7	
Travel Time (s)		34.7			95.0			14.3			18.3	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	66	1052	1	13	1750	16	37	2	28	10	1	48
Shared Lane Traffic (%)												
Lane Group Flow (vph)	66	1053	0	13	1766	0	37	30	0	10	49	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2			6			4			8		
Total Split (s)	13.0	61.0		13.0	61.0		26.0	26.0		26.0	26.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	68.6	68.7		64.1	61.1		8.1	8.1		8.1	8.1	
Actuated g/C Ratio	0.79	0.79		0.74	0.70		0.09	0.09		0.09	0.09	
v/c Ratio	0.29	0.37		0.03	0.70		0.32	0.17		0.08	0.26	
Control Delay	7.5	5.0		3.2	13.1		44.8	17.2		37.6	15.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	7.5	5.0		3.2	13.1		44.8	17.2		37.6	15.2	
LOS	A	A		A	B		D	B		D	B	
Approach Delay		5.2			13.0			32.4			19.0	
Approach LOS		A			B			C			B	
Queue Length 50th (m)	2.0	23.1		0.4	103.2		5.9	0.3		1.6	0.2	
Queue Length 95th (m)	7.0	62.5		1.7	149.4		15.1	8.1		6.3	9.9	
Internal Link Dist (m)		458.2			1295.1			166.4			219.7	
Turn Bay Length (m)	55.0			45.0			25.0			65.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	236	2822		468	2507		290	386		295	399	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.28	0.37		0.03	0.70		0.13	0.08		0.03	0.12	

Intersection Summary	
Area Type: Other	
Cycle Length: 100	
Actuated Cycle Length: 87.1	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.70	
Intersection Signal Delay: 10.7	Intersection LOS: B
Intersection Capacity Utilization 69.2%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 114: Terra Nova Motors/Great Eastern Ave & Kenmount Road



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	64	452	171	47	180	135
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	70	491	186	51	196	147
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			561		738	315
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			561		738	315
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			82		38	80
cM capacity (veh/h)			1010		314	725

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	561	186	51	196	147
Volume Left	0	186	0	196	0
Volume Right	491	0	0	0	147
cSH	1700	1010	1700	314	725
Volume to Capacity	0.33	0.18	0.03	0.62	0.20
Queue Length 95th (m)	0.0	5.1	0.0	29.7	5.7
Control Delay (s)	0.0	9.4	0.0	33.6	11.2
Lane LOS		A		D	B
Approach Delay (s)	0.0	7.3		24.0	
Approach LOS				C	

Intersection Summary			
Average Delay	8.7		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

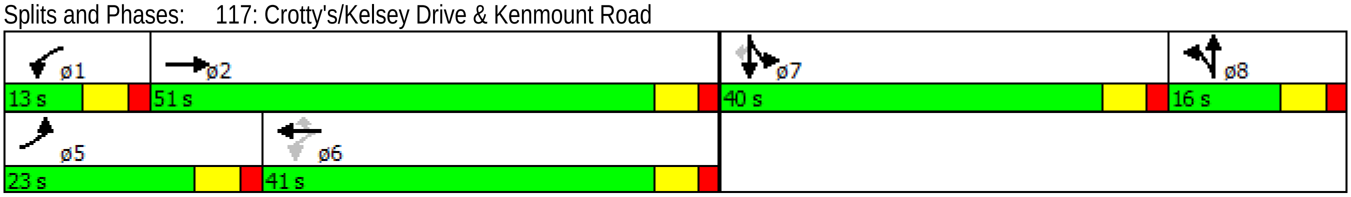
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	359	1234	1	2	1420	394	1	0	0	276	7	668
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.5	3.5	3.0	3.7	3.4	3.5	4.0	4.0	3.4	3.4	3.5
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	75.0		0.0	50.0		130.0	0.0		25.0	0.0		60.0
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Ped Bike Factor												
Frt						0.850						0.850
Flt Protected	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (prot)	3395	3500	0	1652	3579	1548	1750	1946	0	1644	1652	1566
Flt Permitted	0.950			0.127			0.950			0.950	0.955	
Satd. Flow (perm)	3395	3500	0	221	3579	1548	1750	1946	0	1644	1652	1566
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						404						398
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		493.9			512.5			37.4			398.8	
Travel Time (s)		35.6			36.9			2.7			28.7	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.96	0.96	0.96	0.87	0.87	0.87	0.25	0.25	0.25	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	374	1285	1	2	1632	453	4	0	0	307	8	742
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	374	1286	0	2	1632	453	4	0	0	157	158	742
Turn Type	Prot	NA		pm+pt	NA	Perm	Split			Split	NA	Perm
Protected Phases	5	2		1	6		8	8		7	7	
Permitted Phases				6		6						7
Total Split (s)	23.0	51.0		13.0	41.0	41.0	16.0	16.0		40.0	40.0	40.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Act Effct Green (s)	15.7	54.6		42.2	35.2	35.2	10.0			34.2	34.2	34.2
Actuated g/C Ratio	0.15	0.52		0.40	0.33	0.33	0.09			0.32	0.32	0.32
v/c Ratio	0.75	0.71		0.01	1.37	0.58	0.02			0.30	0.30	0.96
Control Delay	53.8	24.4		15.0	204.1	8.1	48.0			30.3	30.3	41.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0			0.0	0.0	0.0
Total Delay	53.8	24.4		15.0	204.1	8.1	48.0			30.3	30.3	41.2
LOS	D	C		B	F	A	D			C	C	D
Approach Delay		31.0			161.4						38.0	
Approach LOS		C			F						D	
Queue Length 50th (m)	37.0	90.5		0.2	~228.2	6.7	0.7			24.6	24.7	78.5
Queue Length 95th (m)	#63.7	#204.2		1.6	#313.3	33.1	1.3			50.7	50.9	#185.6
Internal Link Dist (m)		469.9			488.5			13.4			374.8	
Turn Bay Length (m)	75.0			50.0		130.0						60.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	547	1803		182	1188	783	165			530	533	774
Starvation Cap Reductn	0	0		0	0	0	0			0	0	0
Spillback Cap Reductn	0	0		0	0	0	0			0	0	0
Storage Cap Reductn	0	0		0	0	0	0			0	0	0
Reduced v/c Ratio	0.68	0.71		0.01	1.37	0.58	0.02			0.30	0.30	0.96

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 105.9
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.37
Intersection Signal Delay: 89.2 Intersection LOS: F
Intersection Capacity Utilization 103.9% 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: 117: Crotty's/Kelsey Drive & Kenmount Road



Lands above 190m Contour TMP
Kiwanis Street & Kelsey Drive

Existing 2013 PM
11/8/2013

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	16	173	159	503	671	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	188	173	547	729	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		4				
Median type				None	None	
Median storage veh)						
Upstream signal (m)				399		
pX, platoon unblocked						
vC, conflicting volume	1348	365	729			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1348	365	729			
tC, single (s)	6.8	7.0	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	85	70	80			
cM capacity (veh/h)	113	621	857			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	205	173	273	273	365	365	11
Volume Left	17	173	0	0	0	0	0
Volume Right	188	0	0	0	0	0	11
cSH	678	857	1700	1700	1700	1700	1700
Volume to Capacity	0.30	0.20	0.16	0.16	0.21	0.21	0.01
Queue Length 95th (m)	9.7	5.7	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	15.8	10.3	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	B					
Approach Delay (s)	15.8	2.5			0.0		
Approach LOS	C						

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	26	1195	1654	226	126	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	4.0	4.0	4.0	3.5	4.0
Grade (%)		0%	0%		0%	
Storage Length (m)	35.0			0.0	50.0	0.0
Storage Lanes	1			0	1	0
Taper Length (m)	2.5				2.5	
Lane Util. Factor	1.00	0.95	0.95	0.95	0.97	0.95
Ped Bike Factor						
Frt			0.982		0.972	
Flt Protected	0.950				0.961	
Satd. Flow (prot)	1750	3697	3630	0	3338	0
Flt Permitted	0.063				0.961	
Satd. Flow (perm)	116	3697	3630	0	3338	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			17		26	
Link Speed (k/h)		50	50		50	
Link Distance (m)		1319.1	493.9		193.0	
Travel Time (s)		95.0	35.6		13.9	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	28	1299	1798	246	137	32
Shared Lane Traffic (%)						
Lane Group Flow (vph)	28	1299	2044	0	169	0
Turn Type	pm+pt	NA	NA		NA	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Total Split (s)	13.0	76.0	63.0		44.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	
Act Effct Green (s)	64.6	64.6	57.2		38.1	
Actuated g/C Ratio	0.56	0.56	0.50		0.33	
v/c Ratio	0.18	0.62	1.12		0.15	
Control Delay	13.3	18.3	92.6		24.1	
Queue Delay	0.0	0.0	0.0		0.0	
Total Delay	13.3	18.3	92.6		24.1	
LOS	B	B	F		C	
Approach Delay		18.2	92.6		24.1	
Approach LOS		B	F		C	
Queue Length 50th (m)	2.7	97.9	~302.4		12.3	
Queue Length 95th (m)	6.6	118.3	#346.3		20.5	
Internal Link Dist (m)		1295.1	469.9		169.0	
Turn Bay Length (m)	35.0				50.0	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)	165	2262	1817		1126	
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	0.17	0.57	1.12		0.15	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 114.7	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.12	
Intersection Signal Delay: 61.5	Intersection LOS: E
Intersection Capacity Utilization 67.4%	ICU Level of Service C
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: 123: Kenmount Road & Ladysmith Drive

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	200	699	1162	194	253	226
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.4	3.4	3.3	3.3
Grade (%)		0%	0%		0%	
Storage Length (m)	65.0			0.0	50.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Ped Bike Factor						
Frt			0.979			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1652	3461	3388	0	1711	1531
Flt Permitted	0.071				0.950	
Satd. Flow (perm)	123	3461	3388	0	1711	1531
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			22			233
Link Speed (k/h)		50	50		50	
Link Distance (m)		166.0	286.5		159.8	
Travel Time (s)		12.0	20.6		11.5	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.87	0.87	0.94	0.94	0.86	0.86
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	230	803	1236	206	294	263
Shared Lane Traffic (%)						
Lane Group Flow (vph)	230	803	1442	0	294	263
Turn Type	pm+pt	NA	NA		NA	Perm
Protected Phases	5	2	6		8	
Permitted Phases	2					8
Total Split (s)	18.0	74.0	56.0		36.0	36.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Act Effct Green (s)	68.2	68.2	50.2		22.2	22.2
Actuated g/C Ratio	0.67	0.67	0.49		0.22	0.22
v/c Ratio	0.88	0.35	0.86		0.79	0.51
Control Delay	59.3	8.6	30.4		53.9	10.1
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	59.3	8.6	30.4		53.9	10.1
LOS	E	A	C		D	B
Approach Delay		19.9	30.4		33.2	
Approach LOS		B	C		C	
Queue Length 50th (m)	30.8	33.1	127.6		55.5	4.8
Queue Length 95th (m)	#77.3	50.9	#197.4		79.2	21.7
Internal Link Dist (m)		142.0	262.5		135.8	
Turn Bay Length (m)	65.0				50.0	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)	261	2305	1671		502	614
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	0.88	0.35	0.86		0.59	0.43

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 102.4
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 27.3 Intersection LOS: C
Intersection Capacity Utilization 78.4% 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: 90: Thorburn Road & Mount Scio Rd

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	63	623	150	185	841	24	274	91	422	23	55	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.5	3.5	3.0	3.5	3.5	3.0	3.3	3.3	3.0	3.3	3.3
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	60.0		0.0	110.0		0.0	105.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	0.99			1.00		0.99	0.98			0.99	
Frt		0.971			0.996			0.877			0.924	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1652	3377	0	1652	3483	0	1652	1545	0	1652	1648	0
Flt Permitted	0.171			0.122			0.484			0.168		
Satd. Flow (perm)	297	3377	0	212	3483	0	836	1545	0	292	1648	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		26			3			226			50	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		341.5			167.2			171.2			115.5	
Travel Time (s)		24.6			12.0			12.3			8.3	
Confl. Peds. (#/hr)	5		5	5		5	5		10	10		5
Confl. Bikes (#/hr)												
Peak Hour Factor	0.91	0.91	0.91	0.94	0.94	0.94	0.85	0.85	0.85	0.68	0.68	0.68
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	69	685	165	197	895	26	322	107	496	34	81	84
Shared Lane Traffic (%)												
Lane Group Flow (vph)	69	850	0	197	921	0	322	603	0	34	165	0
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		
Total Split (s)	13.0	34.0		16.0	37.0		18.0	42.0		18.0	42.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Act Effct Green (s)	35.5	28.4		42.3	34.6		38.6	32.0		27.8	21.1	
Actuated g/C Ratio	0.37	0.30		0.44	0.36		0.40	0.33		0.29	0.22	
v/c Ratio	0.33	0.84		0.80	0.73		0.73	0.91		0.19	0.41	
Control Delay	22.8	41.3		48.1	34.6		31.9	38.8		18.7	23.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	22.8	41.3		48.1	34.6		31.9	38.8		18.7	23.6	
LOS	C	D		D	C		C	D		B	C	
Approach Delay		39.9			36.9			36.4			22.8	
Approach LOS		D			D			D			C	
Queue Length 50th (m)	8.3	86.1		26.0	93.7		42.3	77.1		3.7	17.8	
Queue Length 95th (m)	17.3	#125.7		#68.5	#132.2		59.5	#128.9		6.7	23.1	
Internal Link Dist (m)		317.5			143.2			147.2			91.5	
Turn Bay Length (m)	60.0			110.0			105.0			30.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	209	1016		245	1254		439	726		273	657	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.33	0.84		0.80	0.73		0.73	0.83		0.12	0.25	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 96.2

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.91

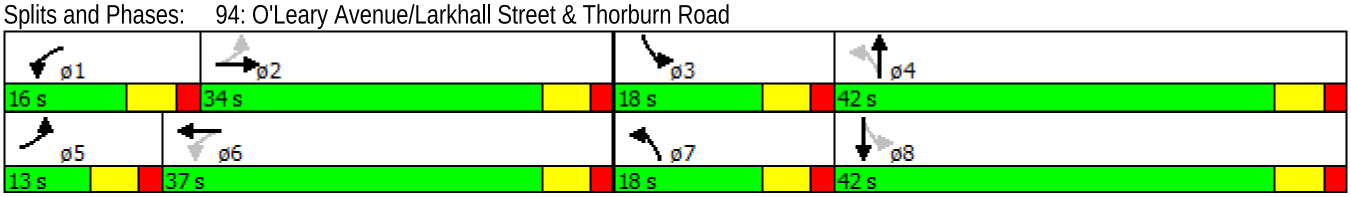
Intersection Signal Delay: 36.8 Intersection LOS: D

Intersection Capacity Utilization 79.0% 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: 94: O'Leary Avenue/Larkhall Street & Thorburn Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	93	165	0	0	857	27	191	0	136	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	101	179	0	0	932	29	208	0	148	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									2			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	932			179			1328	1313	179	1328	1328	946
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	932			179			1328	1313	179	1328	1328	946
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	86			100			0	100	83	100	100	100
cM capacity (veh/h)	735			1396			115	137	863	98	134	317

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	101	179	961	355
Volume Left	101	0	0	208
Volume Right	0	0	29	148
cSH	735	1700	1700	182
Volume to Capacity	0.14	0.11	0.57	1.96
Queue Length 95th (m)	3.6	0.0	0.0	203.0
Control Delay (s)	10.7	0.0	0.0	492.6
Lane LOS	B			F
Approach Delay (s)	3.9		0.0	492.6
Approach LOS				F

Intersection Summary			
Average Delay	110.3		
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	246	78	379	669	0	0	0	0	12	0	366
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	256	81	395	697	0	0	0	0	12	0	381
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												2
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	697			256			1783	1783	297	1783	1743	697
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	697			256			1783	1783	297	1783	1743	697
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.2	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.6	4.0	3.3
p0 queue free %	100			70			100	100	100	73	100	14
cM capacity (veh/h)	899			1303			7	57	743	47	60	441

Direction, Lane #	EB 1	WB 1	WB 2	SB 1
Volume Total	338	395	697	394
Volume Left	0	395	0	12
Volume Right	81	0	0	381
cSH	1700	1303	1700	456
Volume to Capacity	0.20	0.30	0.41	0.86
Queue Length 95th (m)	0.0	9.8	0.0	67.5
Control Delay (s)	0.0	9.0	0.0	48.6
Lane LOS		A		E
Approach Delay (s)	0.0	3.2		48.6
Approach LOS				E

Intersection Summary			
Average Delay	12.4		
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	265	1084	2	3	1388	97	1	0	4	199	2	419
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.0	3.4	3.7	3.7	3.4	3.4	3.7	3.7	3.7	3.3	3.7	4.8
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	65.0		0.0	40.0		0.0	0.0		0.0	115.0		0.0
Storage Lanes	1		0	1		0	0		0	1		0
Taper Length (m)	7.5			7.5			2.5			7.5		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt					0.990			0.892			0.851	
Flt Protected	0.950			0.950				0.990		0.950		
Satd. Flow (prot)	1652	3461	0	1789	3426	0	0	1663	0	1711	1603	0
Flt Permitted	0.056			0.248						0.950		
Satd. Flow (perm)	97	3461	0	467	3426	0	0	1680	0	1711	1603	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					8			126			257	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		307.6			467.7			50.9			160.1	
Travel Time (s)		22.1			33.7			3.7			11.5	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.92	0.92	0.86	0.86	0.92	0.92	0.92	0.86	0.92	0.86
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	279	1141	2	3	1614	113	1	0	4	231	2	487
Shared Lane Traffic (%)												
Lane Group Flow (vph)	279	1143	0	3	1727	0	0	5	0	231	489	0
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Prot	NA	
Protected Phases	5	2			6			4		3	8	
Permitted Phases	2			6			4					
Total Split (s)	25.0	96.0		71.0	71.0		10.0	10.0		24.0	34.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Act Effct Green (s)	90.1	90.1		65.4	65.4			4.0		23.2	25.1	
Actuated g/C Ratio	0.71	0.71		0.51	0.51			0.03		0.18	0.20	
v/c Ratio	0.94	0.47		0.01	0.98			0.03		0.74	0.94	
Control Delay	77.8	9.2		16.7	47.6			0.4		64.6	50.2	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	77.8	9.2		16.7	47.6			0.4		64.6	50.2	
LOS	E	A		B	D			A		E	D	
Approach Delay		22.6			47.6			0.4			54.8	
Approach LOS		C			D			A			D	
Queue Length 50th (m)	56.9	64.5		0.4	~230.1			0.0		54.2	63.0	
Queue Length 95th (m)	#111.2	78.0		2.1	#262.1			0.0		#103.0	#125.4	
Internal Link Dist (m)		283.6			443.7			26.9			136.1	
Turn Bay Length (m)	65.0			40.0						115.0		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)	301	2450		240	1766			174		311	553	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	0.93	0.47		0.01	0.98			0.03		0.74	0.88	

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 127.2
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 39.7 Intersection LOS: D
Intersection Capacity Utilization 97.2% ICU Level of Service F
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: 108: Kenmount Road & Pippy Place

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	297	448	0	0	434	555	1	1	18	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	330	498	0	0	482	617	1	1	20	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1099			498			1948	2257	498	1969	1948	791
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1099			498			1948	2257	498	1969	1948	791
tC, single (s)	4.1			4.1			7.1	6.5	6.3	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.4	3.5	4.0	3.3
p0 queue free %	48			100			96	94	96	100	100	100
cM capacity (veh/h)	635			1066			29	20	564	26	31	390

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total	330	498	1099	22
Volume Left	330	0	0	1
Volume Right	0	0	617	20
cSH	635	1700	1700	171
Volume to Capacity	0.52	0.29	0.65	0.13
Queue Length 95th (m)	22.9	0.0	0.0	3.3
Control Delay (s)	16.6	0.0	0.0	29.3
Lane LOS	C			D
Approach Delay (s)	6.6		0.0	29.3
Approach LOS				D

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	544	2	2	433	0	0	0	0	201	0	291
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	591	2	2	471	0	0	0	0	218	0	316
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	471			591			1147	1066	591	1066	1066	235
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	471			591			1147	1066	591	1066	1066	235
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.6	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.6	4.0	3.3
p0 queue free %	100			100			100	100	100	0	100	59
cM capacity (veh/h)	1087			980			90	220	450	171	220	766

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	SB 1
Volume Total	591	2	2	235	235	535
Volume Left	0	0	2	0	0	218
Volume Right	0	2	0	0	0	316
cSH	1700	1700	980	1700	1700	316
Volume to Capacity	0.35	0.00	0.00	0.14	0.14	1.69
Queue Length 95th (m)	0.0	0.0	0.1	0.0	0.0	253.3
Control Delay (s)	0.0	0.0	8.7	0.0	0.0	352.9
Lane LOS			A			F
Approach Delay (s)	0.0		0.0			352.9
Approach LOS						F

Intersection Summary			
Average Delay	117.9		
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	651	73	867	1007	87	899
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.5	3.5	3.5	3.5	3.5	3.7
Grade (%)	0%			0%	0%	
Storage Length (m)		0.0	85.0		0.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)			7.5		7.5	
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Ped Bike Factor						
Frt	0.985					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	3417	0	1750	3500	1750	1601
Flt Permitted			0.187		0.950	
Satd. Flow (perm)	3417	0	344	3500	1750	1601
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	10					588
Link Speed (k/h)	60			60	50	
Link Distance (m)	397.1			482.2	381.2	
Travel Time (s)	23.8			28.9	27.4	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.98	0.98	0.92	0.92	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	664	74	942	1095	92	946
Shared Lane Traffic (%)						
Lane Group Flow (vph)	738	0	942	1095	92	946
Turn Type	NA		pm+pt	NA	NA	Perm
Protected Phases	2		1	6	4	
Permitted Phases			6			4
Total Split (s)	45.0		46.0	91.0	29.0	29.0
Total Lost Time (s)	6.0		6.0	6.0	6.0	6.0
Act Effct Green (s)	39.0		85.0	85.0	23.0	23.0
Actuated g/C Ratio	0.32		0.71	0.71	0.19	0.19
v/c Ratio	0.66		1.32	0.44	0.27	1.21
Control Delay	37.7		181.0	8.1	44.0	123.0
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	37.7		181.0	8.1	44.0	123.0
LOS	D		F	A	D	F
Approach Delay	37.7			88.0	116.0	
Approach LOS	D			F	F	
Queue Length 50th (m)	77.3		~256.3	51.4	18.7	~152.9
Queue Length 95th (m)	98.2		#333.5	63.0	33.8	#230.1
Internal Link Dist (m)	373.1			458.2	357.2	
Turn Bay Length (m)			85.0			

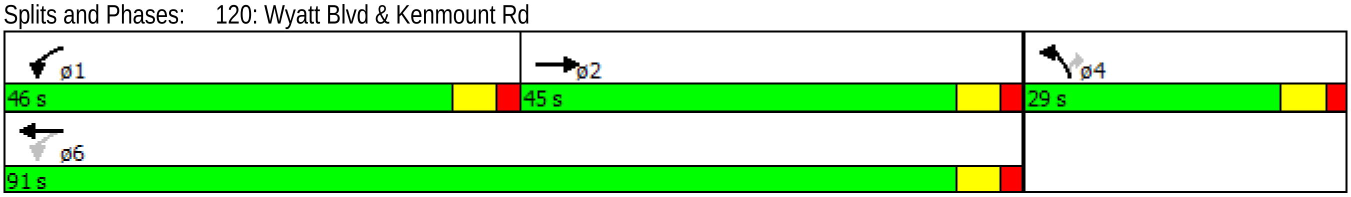
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Base Capacity (vph)	1117		712	2479	335	782
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.66		1.32	0.44	0.27	1.21

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.32	
Intersection Signal Delay: 85.9	Intersection LOS: F
Intersection Capacity Utilization 88.2%	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: 120: Wyatt Blvd & Kenmount Rd



Summary of All Intervals

Run Number	1	10	2	3	4	5	6
Start Time	6:50	6:50	6:50	6:50	6:50	6:50	6:50
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5	5
# of Recorded mScheduledIntervals	4	4	4	4	4	4	4
Vehs Entered	24632	24542	24567	24717	24869	24618	24630
Vehs Exited	24240	24013	24184	24282	24314	24069	24145
Starting Vehs	1719	1712	1723	1686	1755	1583	1644
Ending Vehs	2111	2241	2106	2121	2310	2132	2129
Travel Distance (km)	56955	56592	56602	57056	57035	56385	56807
Travel Time (hr)	3566.0	3586.1	3506.4	3476.1	3586.9	3512.5	3404.7
Total Delay (hr)	2393.3	2422.1	2341.2	2302.3	2411.3	2350.7	2235.7
Total Stops	46322	48739	48124	47942	49311	46796	46741
Fuel Used (l)	6352.3	6343.7	6282.9	6290.9	6368.9	6289.9	6215.2

Summary of All Intervals

Run Number	7	8	9	Avg
Start Time	6:50	6:50	6:50	6:50
End Time	8:00	8:00	8:00	8:00
Total Time (min)	70	70	70	70
Time Recorded (min)	60	60	60	60
# of Intervals	5	5	5	5
# of Recorded mScheduledIntervals	4	4	4	4
Vehs Entered	24967	24631	24865	24702
Vehs Exited	24270	24199	24408	24207
Starting Vehs	1558	1686	1738	1668
Ending Vehs	2255	2118	2195	2163
Travel Distance (km)	57450	56856	56948	56869
Travel Time (hr)	3582.9	3509.8	3623.3	3535.5
Total Delay (hr)	2399.9	2337.7	2451.3	2364.5
Total Stops	49322	48917	50903	48307
Fuel Used (l)	6384.1	6293.3	6406.6	6322.8

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.
No data recorded this interval.

Interval #1 Information Recording #1

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	6596	6453	6527	6617	6645	6522	6654
Vehs Exited	6157	6021	6105	6173	6207	6071	6065
Starting Vehs	1719	1712	1723	1686	1755	1583	1644
Ending Vehs	2158	2144	2145	2130	2193	2034	2233
Travel Distance (km)	14573	14392	14569	14467	14557	14226	14260
Travel Time (hr)	645.0	638.9	645.9	624.9	640.7	613.5	623.6
Total Delay (hr)	344.4	342.7	345.4	327.2	340.2	320.2	329.7
Total Stops	11791	11723	11665	11574	11966	10831	11535
Fuel Used (l)	1396.2	1384.7	1395.1	1377.4	1391.8	1354.7	1362.1

Interval #1 Information Recording #1

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	6645	6559	6653	6587
Vehs Exited	6034	6062	6173	6103
Starting Vehs	1558	1686	1738	1668
Ending Vehs	2169	2183	2218	2148
Travel Distance (km)	14531	14466	14500	14454
Travel Time (hr)	632.8	625.6	666.5	635.7
Total Delay (hr)	333.2	327.2	368.2	337.8
Total Stops	11539	12112	13070	11777
Fuel Used (l)	1378.3	1369.8	1415.8	1382.6

Interval #2 Information Recording #2

Start Time	7:15
End Time	7:30
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	5884	5746	5693	5781	5782	5818	5758
Vehs Exited	6040	5898	5944	5931	5981	5875	6032
Starting Vehs	2158	2144	2145	2130	2193	2034	2233
Ending Vehs	2002	1992	1894	1980	1994	1977	1959
Travel Distance (km)	14163	14038	13822	14179	14163	13857	14226
Travel Time (hr)	789.9	802.5	774.4	768.9	795.7	777.5	766.9
Total Delay (hr)	498.2	513.2	490.2	477.7	504.3	492.3	474.6
Total Stops	11070	11565	11144	11414	11725	11215	11566
Fuel Used (l)	1498.2	1499.0	1465.8	1484.9	1499.9	1473.6	1482.6

Interval #2 Information Recording #2

Start Time	7:15
End Time	7:30
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	5936	5760	5704	5779
Vehs Exited	6068	5875	5953	5958
Starting Vehs	2169	2183	2218	2148
Ending Vehs	2037	2068	1969	1984
Travel Distance (km)	14202	13971	13894	14052
Travel Time (hr)	795.0	769.6	812.4	785.3
Total Delay (hr)	503.0	482.3	526.2	496.2
Total Stops	11521	11578	11701	11441
Fuel Used (l)	1500.9	1468.9	1497.0	1487.1

Interval #3 Information Recording #3

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	6537	6595	6582	6557	6501	6506	6490
Vehs Exited	6165	6134	6120	6172	6107	6192	6175
Starting Vehs	2002	1992	1894	1980	1994	1977	1959
Ending Vehs	2374	2453	2356	2365	2388	2291	2274
Travel Distance (km)	14262	14449	14308	14398	14407	14574	14419
Travel Time (hr)	982.6	1002.7	969.9	957.8	1000.0	988.5	932.2
Total Delay (hr)	689.3	705.1	675.3	661.3	702.9	688.3	635.8
Total Stops	12136	12920	13240	12901	13010	12590	12317
Fuel Used (l)	1669.1	1693.7	1662.5	1655.9	1692.4	1689.5	1638.2

Interval #3 Information Recording #3

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	6625	6468	6641	6547
Vehs Exited	6116	6170	6202	6152
Starting Vehs	2037	2068	1969	1984
Ending Vehs	2546	2366	2408	2380
Travel Distance (km)	14788	14397	14463	14447
Travel Time (hr)	1004.4	982.6	1009.0	983.0
Total Delay (hr)	699.4	685.7	711.1	685.4
Total Stops	13222	13170	13503	12893
Fuel Used (l)	1712.7	1675.9	1705.7	1679.6

Interval #4 Information Recording #4

Start Time	7:45
End Time	8:00
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	5615	5748	5765	5762	5941	5772	5728
Vehs Exited	5878	5960	6015	6006	6019	5931	5873
Starting Vehs	2374	2453	2356	2365	2388	2291	2274
Ending Vehs	2111	2241	2106	2121	2310	2132	2129
Travel Distance (km)	13957	13713	13904	14011	13907	13729	13902
Travel Time (hr)	1148.5	1142.0	1116.1	1124.5	1150.5	1133.0	1082.0
Total Delay (hr)	861.3	861.1	830.4	836.2	863.8	849.9	795.6
Total Stops	11325	12531	12075	12053	12610	12160	11323
Fuel Used (l)	1788.8	1766.3	1759.5	1772.6	1784.8	1772.1	1732.4

Interval #4 Information Recording #4

Start Time	7:45
End Time	8:00
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	5761	5844	5867	5769
Vehs Exited	6052	6092	6080	5991
Starting Vehs	2546	2366	2408	2380
Ending Vehs	2255	2118	2195	2163
Travel Distance (km)	13929	14021	14090	13916
Travel Time (hr)	1150.8	1132.1	1135.5	1131.5
Total Delay (hr)	864.3	842.6	845.8	845.1
Total Stops	13040	12057	12629	12172
Fuel Used (l)	1792.2	1778.8	1788.2	1773.6

4: Columbus Drive /Prince Philip Drive & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	2.0	2.1	2.3	40.2	41.2	0.2	0.0	0.0	0.0	0.0	0.0	4.9
Total Del/Veh (s)	56.5	47.8	62.9	61.2	54.1	35.3	33.3	18.0	25.8	47.2	6.8	41.5
Travel Dist (km)	162.5	92.5	176.5	14.3	4.9	231.6	475.9	189.9	5.6	129.9	48.9	1532.4
Travel Time (hr)	10.8	5.5	12.8	11.2	3.7	8.1	15.9	5.4	0.5	19.0	2.3	95.2

6: ORR NB & Thorburn Road Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBR	All
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.3	0.3	0.1
Total Del/Veh (s)	9.8	0.6	5.9	5.1	78.7	66.6	20.1
Travel Dist (km)	25.8	48.3	447.5	13.2	58.9	41.9	635.6
Travel Time (hr)	0.8	1.0	11.0	0.3	5.7	3.6	22.5

9: ORR SB & Thorburn Road Performance by movement

Movement	EBT	EBR	WBL	WBT	SBL	SBR	All
Denied Del/Veh (s)	0.3	0.3	0.1	0.1	3.1	4.9	1.2
Total Del/Veh (s)	1.1	0.8	7.0	4.0	83.0	62.7	16.8
Travel Dist (km)	58.7	19.3	102.8	192.0	2.0	63.2	438.0
Travel Time (hr)	1.3	0.5	3.1	4.9	0.3	8.7	18.8

15: Messenger Drive Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.1	4.1	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	13.7	4.5	4.6	1.1	0.5	0.5	1.2
Travel Dist (km)	6.0	6.3	0.7	147.6	113.8	13.5	287.9
Travel Time (hr)	0.3	0.2	0.0	3.3	2.5	0.3	6.6

19: Team Gushue Hwy NB Performance by movement

Movement	EBL	EBT	WBT	WBR	NBL	NBT	NBR	All
Denied Del/Veh (s)	1.8	2.5	1.7	2.0	0.1	0.1	0.1	2.0
Total Del/Veh (s)	105.3	18.3	5.7	3.7	256.5	787.6	115.7	25.7
Travel Dist (km)	38.2	58.6	32.5	42.5	0.1	0.2	3.6	175.8
Travel Time (hr)	9.2	3.7	1.6	2.2	0.1	0.2	0.6	17.7

21: Columbus Drive & Captain Whelan Drive/Hogan St Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	1430.5	1370.9	1418.4	1699.1	1686.6	1701.2	3.9	0.1	0.1	0.0	0.0	0.0
Total Del/Veh (s)	244.9	416.4	38.4	185.3	221.4	211.2	16.3	16.1	5.0	26.8	4.8	4.2
Travel Dist (km)	2.7	106.9	6.1	2.2	54.3	5.0	12.6	15.9	13.1	104.5	491.1	46.1
Travel Time (hr)	9.3	388.3	21.2	28.1	766.9	77.1	0.4	0.4	0.3	2.9	9.2	0.9

21: Columbus Drive & Captain Whelan Drive/Hogan St Performance by movement

Movement	All
Denied Del/Veh (s)	985.4
Total Del/Veh (s)	94.8
Travel Dist (km)	860.5
Travel Time (hr)	1305.0

22: Columbus Drive & Blackmarsh Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	2.9	0.4	0.6	0.0	0.0	0.0	2.5	0.2	0.3	3.7	2.8	1.5
Total Del/Veh (s)	41.6	39.1	29.8	87.8	62.3	17.1	33.2	32.5	25.8	117.4	63.6	63.1
Travel Dist (km)	40.7	76.0	7.7	40.2	66.7	34.6	13.3	282.4	51.6	113.8	602.4	38.6
Travel Time (hr)	2.2	3.8	0.3	6.7	8.0	1.8	0.6	11.4	2.0	10.7	34.0	2.3

22: Columbus Drive & Blackmarsh Road Performance by movement

Movement	All
Denied Del/Veh (s)	1.4
Total Del/Veh (s)	55.7
Travel Dist (km)	1367.7
Travel Time (hr)	83.7

23: Columbus Drive & Mundy Pond Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	3.0	0.4	0.4	3.4	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	84.3	32.9	27.0	46.6	40.7	32.8	40.8	18.8	20.2	28.0	21.3	24.8
Travel Dist (km)	31.6	51.2	5.5	38.9	68.2	13.2	1.7	459.6	34.6	38.4	1125.0	77.3
Travel Time (hr)	2.6	2.2	0.2	3.0	4.5	0.8	0.1	12.5	1.1	1.1	28.3	2.1

23: Columbus Drive & Mundy Pond Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.3
Total Del/Veh (s)	25.0
Travel Dist (km)	1945.2
Travel Time (hr)	58.6

24: Columbus Drive & Old Pennywell Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	3.5	1.0	3.5	0.0	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.4
Total Del/Veh (s)	47.9	51.2	3.8	50.7	44.0	3.2	27.7	34.9	3.5	32.9	41.8	12.2
Travel Dist (km)	18.1	21.5	21.7	90.5	38.6	21.7	7.1	275.2	50.6	153.3	1065.4	117.0
Travel Time (hr)	2.2	2.6	0.9	8.7	3.3	0.6	0.3	13.4	1.2	4.6	33.8	2.6

24: Columbus Drive & Old Pennywell Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.3
Total Del/Veh (s)	35.9
Travel Dist (km)	1880.8
Travel Time (hr)	74.2

28: Hamlyn Road & Captain Whelan Drive Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.2	0.2	0.1
Total Del/Veh (s)	3.6	2.1	10.5	4.1	7.8	3.0	4.0
Travel Dist (km)	18.7	136.3	23.2	96.7	47.6	36.7	359.2
Travel Time (hr)	0.5	3.7	0.6	2.5	1.5	1.0	9.8

29: Team Gushue Hwy SB & Kelsey Dr Performance by movement

Movement	EBT	EBR	WBL	WBT	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	407.6	390.4	135.3
Total Del/Veh (s)	22.1	0.8	5.8	1.4	215.8	204.3	65.8
Travel Dist (km)	57.6	0.3	0.2	60.7	27.3	40.0	186.2
Travel Time (hr)	4.6	0.0	0.0	1.4	32.7	46.5	85.3

40: Kelsey Drive & Kiwanis St Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Del/Veh (s)	0.6	3.8	0.0	0.0	0.0	0.0	0.5
Total Del/Veh (s)	12.0	3.3	10.8	6.5	1.4	2.5	4.6
Travel Dist (km)	2.1	18.9	61.1	223.8	172.7	3.0	481.6
Travel Time (hr)	0.1	0.8	1.9	6.3	3.9	0.1	13.1

45: Allston Street/Brougham Drive & Kenmount Rd Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	1.1	0.1	0.2	0.0	0.0	0.0	1901.1	1840.0	1783.3	0.2	0.1	0.1
Total Del/Veh (s)	44.8	30.8	22.9	77.1	65.7	68.4	3770.7	3552.5	3531.4	42.1	17.1	7.1
Travel Dist (km)	79.6	328.0	13.9	148.1	899.0	416.0	0.0	0.1	0.1	64.1	33.8	28.4
Travel Time (hr)	3.2	10.9	0.4	5.5	31.2	14.8	15.8	80.2	47.5	2.7	1.0	0.7

45: Allston Street/Brougham Drive & Kenmount Rd Performance by movement

Movement	All
Denied Del/Veh (s)	197.2
Total Del/Veh (s)	104.6
Travel Dist (km)	2011.0
Travel Time (hr)	214.0

51: Commonwealth Ave/Mt. Carson Ave & Topsail Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.3	0.2	0.3	0.0	0.0	0.0	0.3	0.3	0.2	15.0	14.7	13.5
Total Del/Veh (s)	160.7	186.5	238.6	78.3	20.7	12.6	42.8	32.3	2.8	561.5	562.3	544.3
Travel Dist (km)	60.4	815.8	625.5	347.8	692.6	38.0	44.3	68.0	46.4	64.4	473.8	32.5
Travel Time (hr)	3.9	57.6	54.2	15.8	19.4	0.9	3.5	4.3	1.2	12.4	90.8	6.1

51: Commonwealth Ave/Mt. Carson Ave & Topsail Road Performance by movement

Movement	All
Denied Del/Veh (s)	2.3
Total Del/Veh (s)	171.5
Travel Dist (km)	3309.5
Travel Time (hr)	270.2

53: Topsail Road & Blackmarsh Road Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Total Del/Veh (s)	25.4	9.6	4.9	5.9	53.0	1.9	8.2	9.9
Travel Dist (km)	424.5	497.2	954.5	55.4	2.1	51.3	187.3	2172.3
Travel Time (hr)	12.6	12.1	21.1	1.2	0.1	1.2	5.6	54.0

58: Captain Whelan Drive & Captain Whelan Drive' Performance by movement

Movement	EBT	WBT	SBL	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Del/Veh (s)	5.3	0.8	0.7	0.9
Travel Dist (km)	3.9	32.0	34.2	70.1
Travel Time (hr)	0.1	0.8	1.2	2.1

61: Blackmarsh Road & Empire Avenue Performance by movement

Movement	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.3	0.4	0.1
Total Del/Veh (s)	9.9	1.7	0.8	34.4	27.2	10.5
Travel Dist (km)	736.2	76.7	16.7	13.7	58.5	901.8
Travel Time (hr)	16.9	2.5	0.6	1.0	3.7	24.7

62: Captain Whelan Drive' & Blackmarsh Road Performance by movement

Movement	EBT	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.0	3.3	1.9	2.1	1.1	1.8
Total Del/Veh (s)	0.7	5.5	2.7	37.6	4.4	4.5
Travel Dist (km)	47.8	69.9	96.2	2.0	5.0	220.8
Travel Time (hr)	1.3	2.7	2.8	0.7	0.4	7.9

64: Blackmarsh Road/Captain Whelan Drive Performance by movement

Movement	EBL	EBT	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0		0.0	0.0
Total Del/Veh (s)	3.3	3.3		2.5	2.8
Travel Dist (km)	49.3	3.3	0.0	92.1	144.7
Travel Time (hr)	1.5	0.1	0.0	2.9	4.5

75: Austin Street/Bambrick St & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.6	0.0	0.1	0.2	0.1	0.1	3.4	0.6	0.6	4.1	0.3	0.1
Total Del/Veh (s)	29.5	10.6	6.5	12.9	11.3	8.3	41.0	41.7	3.7	38.5	36.3	1.9
Travel Dist (km)	1.5	184.7	3.6	19.3	205.4	12.9	25.2	2.7	60.0	6.7	0.7	0.2
Travel Time (hr)	0.1	5.5	0.1	0.9	8.4	0.5	2.1	0.2	1.7	0.8	0.1	0.0

75: Austin Street/Bambrick St & Thorburn Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.4
Total Del/Veh (s)	12.3
Travel Dist (km)	523.0
Travel Time (hr)	20.3

79: Goldstone St/Seaborn St & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.2	0.2
Total Del/Veh (s)	19.2	11.4	2.1	13.3	7.7	6.1	39.7	13.0	4.1	33.9	30.9	2.5
Travel Dist (km)	1.2	21.3	2.9	130.5	367.8	9.7	31.5	19.2	38.1	1.3	2.7	0.3
Travel Time (hr)	0.1	1.3	0.1	4.1	9.8	0.2	2.2	0.8	1.0	0.1	0.3	0.0

79: Goldstone St/Seaborn St & Thorburn Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.0
Total Del/Veh (s)	11.3
Travel Dist (km)	626.6
Travel Time (hr)	20.1

90: Thorburn Road & Mount Scio Rd Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.2	0.0	1.0	1.2	3.5	1.1	1.0
Total Del/Veh (s)	35.8	11.3	32.0	27.0	40.7	20.9	26.6
Travel Dist (km)	33.2	116.8	223.4	36.1	41.2	34.9	485.5
Travel Time (hr)	2.9	5.0	15.6	2.4	4.4	2.4	32.7

92: Moss Heather Dr & Thorburn Road Performance by movement

Movement	EBT	EBR	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	4.2	4.0	13.4	3.8	4.2
Travel Dist (km)	243.0	2.8	17.6	292.5	555.9
Travel Time (hr)	6.3	0.1	0.6	7.4	14.3

94: O'Leary Avenue/Larkhall Street & Thorburn Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.8	0.1	0.1	0.0	0.0	0.0	9.2	8.3	8.0	3.7	0.3	0.3
Total Del/Veh (s)	30.0	49.6	56.6	32.0	21.0	22.0	34.5	50.5	42.6	29.2	36.5	20.1
Travel Dist (km)	18.3	196.8	50.5	30.3	153.8	4.1	45.6	15.2	72.1	2.7	6.2	7.1
Travel Time (hr)	0.9	12.9	3.8	2.4	9.4	0.3	4.6	1.9	8.3	0.3	0.8	0.6

94: O'Leary Avenue/Larkhall Street & Thorburn Road Performance by movement

Movement	All
Denied Del/Veh (s)	2.4
Total Del/Veh (s)	35.1
Travel Dist (km)	602.8
Travel Time (hr)	46.1

102: Freshwater Road & Loop Ramp Performance by movement

Movement	EBT	WBT	WBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.6	2.6	0.0	0.0	0.0	0.5
Total Del/Veh (s)	5.0	9.2	4.9	32.9	0.9	9.0	9.0
Travel Dist (km)	221.4	118.2	62.5	35.3	0.7	25.2	463.4
Travel Time (hr)	6.6	4.7	2.6	3.9	0.0	1.3	19.1

105: Kenmount Rd & Avalon Mall Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.1	0.0	0.1	1.0	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.2
Total Del/Veh (s)	22.8	13.3	11.6	30.8	16.6	5.0	25.2	31.6	10.3	35.5	35.1	1.8
Travel Dist (km)	16.7	321.1	5.9	1.9	279.4	88.4	1.2	0.5	3.2	37.9	0.6	13.5
Travel Time (hr)	0.8	10.8	0.2	0.1	10.7	2.6	0.1	0.0	0.2	4.3	0.1	0.4

105: Kenmount Rd & Avalon Mall Performance by movement

Movement	All
Denied Del/Veh (s)	0.1
Total Del/Veh (s)	15.7
Travel Dist (km)	770.2
Travel Time (hr)	30.3

108: Kenmount Road & Pippy Place Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.0	0.0	0.0	2.1	0.3	0.6		0.1	0.0	0.0	0.0	0.1
Total Del/Veh (s)	37.8	6.6	4.7	23.8	30.7	31.5		9.7	91.7	67.6	79.7	32.6
Travel Dist (km)	78.6	347.0	0.5	0.7	537.4	36.3	0.0	0.2	31.9	0.2	66.2	1099.1
Travel Time (hr)	4.5	9.2	0.0	0.0	23.6	1.7	0.0	0.0	6.2	0.0	11.5	56.8

109: Kenmount Rd & Peet St Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.2	0.0	0.0	0.0	4.0	0.2	0.1
Total Del/Veh (s)	11.9	3.7	5.8	7.0	32.4	8.3	5.9
Travel Dist (km)	32.9	222.6	191.2	16.7	13.1	17.3	493.7
Travel Time (hr)	1.3	5.7	5.7	0.6	0.8	0.6	14.6

114: Terra Nova Motors/Great Eastern Ave & Kenmount Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.1	0.2	4.1	0.1	0.2
Total Del/Veh (s)	23.7	10.6	19.5	26.7	21.7	18.3	32.5	22.0	7.2	31.0	42.2	1.7
Travel Dist (km)	28.9	584.2	0.5	14.4	2034.1	16.3	6.4	0.3	4.8	2.3	0.2	11.3
Travel Time (hr)	1.1	17.2	0.0	0.4	50.9	0.4	0.5	0.0	0.2	0.1	0.0	0.3

114: Terra Nova Motors/Great Eastern Ave & Kenmount Road Performance by movement

Movement	All
Denied Del/Veh (s)	0.1
Total Del/Veh (s)	16.6
Travel Dist (km)	2703.8
Travel Time (hr)	71.1

117: Crotty's/Kelsey Drive & Kenmount Road Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	SBL	SBT	SBR	All
Denied Del/Veh (s)	0.8	0.1	0.0	0.0	0.4	0.4	0.1	0.7	0.0	1.5	0.5
Total Del/Veh (s)	36.6	12.2	13.7	75.9	90.9	47.1	53.2	33.5	30.9	40.0	49.6
Travel Dist (km)	151.0	546.7	0.6	1.1	737.7	196.9	0.0	94.3	2.7	212.6	1943.6
Travel Time (hr)	6.8	15.3	0.0	0.1	53.1	9.6	0.0	4.6	0.1	12.0	101.7

120: Wyatt Blvd & Kenmount Rd Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Del/Veh (s)	0.0	0.1	0.9	0.3	0.4	0.4	0.4
Total Del/Veh (s)	30.4	10.5	45.9	9.2	46.1	16.4	24.5
Travel Dist (km)	214.3	22.7	372.5	442.0	32.4	310.8	1394.7
Travel Time (hr)	8.6	0.6	17.7	10.1	1.9	10.8	49.7

123: Kenmount Road & Ladysmith Drive Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Del/Veh (s)	0.5	0.1	0.0	0.0	1.0	0.2	0.1
Total Del/Veh (s)	50.9	22.3	91.9	89.5	24.8	3.4	64.2
Travel Dist (km)	30.1	1401.6	858.8	98.0	22.7	4.6	2415.8
Travel Time (hr)	1.0	35.8	66.4	7.6	1.4	0.1	112.4

Total Network Performance

Denied Del/Veh (s)	187.5
Total Del/Veh (s)	129.1
Travel Dist (km)	56868.7
Travel Time (hr)	3535.5

Intersection: 4: Columbus Drive /Prince Philip Drive & Thorburn Road

Movement	EB	EB	EB	EB	B63	WB	WB	B71	B71	NB	NB	NB
Directions Served	L	L	T	TR	T	T	TR	T	T	L	T	T
Maximum Queue (m)	79.6	138.1	214.9	152.5	0.8	43.0	47.4	68.2	77.1	102.3	208.3	150.7
Average Queue (m)	43.9	51.0	72.6	100.9	0.0	36.0	39.8	24.8	36.6	57.3	59.0	60.3
95th Queue (m)	70.8	97.5	233.3	167.3	0.0	47.7	47.1	63.5	74.9	91.5	150.9	128.6
Link Distance (m)		361.3	361.3		147.5	22.0	22.0	92.4	92.4		709.7	709.7
Upstream Blk Time (%)		0	0			55	73	0	0			0
Queuing Penalty (veh)		0	1			128	168	0	0			0
Storage Bay Dist (m)	150.0			150.0						175.0		
Storage Blk Time (%)			1	13								
Queuing Penalty (veh)			5	16								

Intersection: 4: Columbus Drive /Prince Philip Drive & Thorburn Road

Movement	NB	SB	SB	SB	SB	SB	B44	B44
Directions Served	R	L	T	T	T	R	T	T
Maximum Queue (m)	194.4	87.5	112.6	107.0	108.7	87.9	100.3	154.0
Average Queue (m)	39.9	21.6	87.3	80.4	71.2	33.9	11.8	12.6
95th Queue (m)	156.2	67.1	118.0	105.7	104.1	96.5	60.3	83.3
Link Distance (m)	709.7		87.9	87.9	87.9		472.4	472.4
Upstream Blk Time (%)	0	0	11	5	3	1		0
Queuing Penalty (veh)	0	0	0	0	0	0		0
Storage Bay Dist (m)		110.0				90.0		
Storage Blk Time (%)		0	11		3	1		
Queuing Penalty (veh)		0	6		16	3		

Intersection: 6: ORR NB & Thorburn Road

Movement	EB	WB	NB
Directions Served	L	TR	LTR
Maximum Queue (m)	24.0	3.7	167.6
Average Queue (m)	9.0	0.2	78.1
95th Queue (m)	19.5	2.0	151.8
Link Distance (m)		486.0	297.3
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)	100.0		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 9: ORR SB & Thorburn Road

Movement	EB	WB	WB	SB	SB
Directions Served	TR	L	T	LT	R
Maximum Queue (m)	10.5	33.2	1.9	134.6	19.5
Average Queue (m)	0.8	14.2	0.1	70.4	17.2
95th Queue (m)	4.8	25.4	1.4	151.0	19.4
Link Distance (m)	233.2		266.9	169.4	
Upstream Blk Time (%)				4	
Queuing Penalty (veh)				0	
Storage Bay Dist (m)		100.0			15.0
Storage Blk Time (%)				27	71
Queuing Penalty (veh)				100	9

Intersection: 15: Messenger Drive

Movement	EB	EB	EB	NB	NB	NB	SB	SB
Directions Served	L	L	R	L	T	T	T	TR
Maximum Queue (m)	16.7	13.0	14.8	6.3	4.5	4.0	1.4	1.4
Average Queue (m)	5.8	0.7	6.9	0.3	0.3	0.1	0.1	0.1
95th Queue (m)	13.8	5.9	15.0	3.2	5.9	4.1	1.5	1.0
Link Distance (m)	194.8	194.8			272.9	272.9	183.4	183.4
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)			10.0	250.0				
Storage Blk Time (%)		0	4					
Queuing Penalty (veh)		0	1					

Intersection: 19: Team Gushue Hwy NB

Movement	EB	EB	WB	B87	NB
Directions Served	L	T	TR	T	LTR
Maximum Queue (m)	67.5	136.9	24.7	22.6	30.9
Average Queue (m)	58.9	83.7	6.3	0.8	9.7
95th Queue (m)	82.1	185.0	17.0	23.1	32.3
Link Distance (m)		130.8	99.7	218.7	206.6
Upstream Blk Time (%)		22		0	
Queuing Penalty (veh)		170		0	
Storage Bay Dist (m)	65.0				
Storage Blk Time (%)	43	10			
Queuing Penalty (veh)	201	32			

Intersection: 21: Columbus Drive & Captain Whelan Drive/Hogan St

Movement	EB	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	LT	R	L	TR	L	T	TR	L	T	T	R
Maximum Queue (m)	147.3	314.5	241.5	87.4	187.8	17.4	18.3	20.1	51.1	10.8	18.8	8.2
Average Queue (m)	26.3	272.7	140.6	14.8	177.1	5.3	5.7	6.0	20.8	1.7	4.2	0.6
95th Queue (m)	116.6	306.1	317.4	63.8	181.7	14.5	15.3	16.0	41.8	7.2	12.7	4.5
Link Distance (m)		449.3	449.3		171.4		338.0	338.0		652.4	652.4	652.4
Upstream Blk Time (%)					89							
Queuing Penalty (veh)					0							
Storage Bay Dist (m)	140.0			80.0		100.0			100.0			
Storage Blk Time (%)	0	93		0	84							
Queuing Penalty (veh)	0	10		0	47							

Intersection: 22: Columbus Drive & Blackmarsh Road

Movement	EB	EB	WB	WB	WB	B125	NB	NB	NB	SB	SB	SB
Directions Served	L	TR	L	T	R	T	L	T	TR	L	T	TR
Maximum Queue (m)	54.0	77.0	82.4	182.4	82.5	166.0	49.4	102.7	107.7	77.4	279.8	281.7
Average Queue (m)	20.8	38.8	60.4	106.3	26.0	42.6	8.8	64.8	65.4	68.0	158.3	159.5
95th Queue (m)	40.7	65.4	97.5	196.5	88.0	185.9	30.0	94.3	95.8	95.5	291.7	293.7
Link Distance (m)		381.8		163.9		287.6		652.4	652.4		435.8	435.8
Upstream Blk Time (%)				13		4					0	0
Queuing Penalty (veh)				0		0					0	0
Storage Bay Dist (m)	70.0		75.0		75.0		80.0			70.0		
Storage Blk Time (%)	0	1	13	15	0			2		24	25	
Queuing Penalty (veh)	0	1	77	67	1			1		160	66	

Intersection: 23: Columbus Drive & Mundy Pond Road

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB	B46	B46
Directions Served	L	TR	L	TR	L	T	TR	L	T	TR	T	T
Maximum Queue (m)	52.0	60.1	67.4	133.0	8.3	63.5	334.0	74.7	137.0	143.0	275.3	282.6
Average Queue (m)	23.1	24.8	35.1	58.8	1.0	28.5	45.1	12.8	82.9	89.1	24.3	38.9
95th Queue (m)	47.6	55.5	67.0	111.6	5.3	53.2	154.6	39.4	124.0	128.7	146.3	191.7
Link Distance (m)		402.4		252.9		435.8	435.8		636.8	636.8	274.8	274.8
Upstream Blk Time (%)							0				0	0
Queuing Penalty (veh)							2				0	2
Storage Bay Dist (m)	70.0		60.0		75.0			100.0				
Storage Blk Time (%)	2		1	10		0			2			
Queuing Penalty (veh)	3		4	18		0			1			

Intersection: 23: Columbus Drive & Mundy Pond Road

Movement	B46
Directions Served	
Maximum Queue (m)	223.6
Average Queue (m)	11.9
95th Queue (m)	105.0
Link Distance (m)	274.8
Upstream Blk Time (%)	0
Queuing Penalty (veh)	1
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 24: Columbus Drive & Old Pennywell Road

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB	NB
Directions Served	L	T	R	L	L	T	R	L	T	T	T	R
Maximum Queue (m)	52.2	81.2	34.3	71.6	95.3	75.0	30.8	23.9	79.5	81.6	73.1	28.6
Average Queue (m)	26.9	34.2	1.8	44.4	52.5	37.7	1.1	4.3	55.6	54.3	48.2	5.0
95th Queue (m)	49.4	64.8	22.4	69.9	80.9	62.9	16.2	12.7	76.6	75.4	69.7	18.8
Link Distance (m)		142.8			179.9	179.9			274.8	274.8	274.8	
Upstream Blk Time (%)		0										
Queuing Penalty (veh)		0										
Storage Bay Dist (m)	45.0		80.0	65.0			70.0	100.0				140.0
Storage Blk Time (%)	2	5	0	1	4	0	0					
Queuing Penalty (veh)	6	15	0	1	8	1	0					

Intersection: 24: Columbus Drive & Old Pennywell Road

Movement	SB	SB	SB	SB	SB
Directions Served	L	T	T	T	R
Maximum Queue (m)	94.3	117.8	128.6	111.7	74.6
Average Queue (m)	35.6	85.0	92.4	76.9	10.1
95th Queue (m)	75.8	109.3	117.7	103.3	52.3
Link Distance (m)		709.7	709.7	709.7	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)	100.0				75.0
Storage Blk Time (%)	0	2		3	0
Queuing Penalty (veh)	0	4		5	0

Intersection: 28: Hamlyn Road & Captain Whelan Drive

Movement	EB	WB	WB	NB	NB
Directions Served	TR	L	T	L	R
Maximum Queue (m)	12.7	18.9	93.4	35.3	19.4
Average Queue (m)	2.3	7.1	3.3	14.1	10.6
95th Queue (m)	9.0	16.8	68.3	26.6	16.5
Link Distance (m)	299.3		449.3	262.5	262.5
Upstream Blk Time (%)			0		
Queuing Penalty (veh)			0		
Storage Bay Dist (m)		70.0			
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 29: Team Gushue Hwy SB & Kelsey Dr

Movement	EB	EB	B18	B18	WB	WB	SB
Directions Served	T	R	T	T	L	T	LTR
Maximum Queue (m)	114.9	25.6	113.2	90.8	4.1	0.6	207.4
Average Queue (m)	38.1	1.3	17.1	11.1	0.2	0.0	169.3
95th Queue (m)	114.6	18.6	82.6	66.4	2.3	0.6	253.2
Link Distance (m)	96.2	96.2	183.4	183.4		130.8	191.8
Upstream Blk Time (%)	14	0	0	0			68
Queuing Penalty (veh)	39	1	1	0			0
Storage Bay Dist (m)					60.0		
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 31: Bend

Movement	EB
Directions Served	T
Maximum Queue (m)	120.3
Average Queue (m)	5.0
95th Queue (m)	56.4
Link Distance (m)	179.9
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 40: Kelsey Drive & Kiwanis St

Movement	EB	EB	NB	NB	NB	SB	SB
Directions Served	L	R	L	T	T	T	R
Maximum Queue (m)	26.4	27.3	27.1	150.2	193.2	13.4	16.8
Average Queue (m)	5.2	1.8	11.3	8.0	11.1	1.6	5.1
95th Queue (m)	17.8	12.1	21.3	97.4	117.6	9.7	17.6
Link Distance (m)	120.8			378.5	378.5	280.5	
Upstream Blk Time (%)				0	0		
Queuing Penalty (veh)				0	1		
Storage Bay Dist (m)		30.0	100.0				20.0
Storage Blk Time (%)	0	0				0	0
Queuing Penalty (veh)	0	0				0	0

Intersection: 45: Allston Street/Brougham Drive & Kenmount Rd

Movement	EB	EB	EB	WB	WB	WB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	LT	L	TR
Maximum Queue (m)	51.4	65.8	72.3	52.3	179.8	185.4	190.2	47.4	38.6
Average Queue (m)	23.1	34.7	39.3	34.5	100.4	111.0	187.9	23.0	13.7
95th Queue (m)	43.0	56.9	62.4	62.1	194.6	201.4	200.1	40.2	28.5
Link Distance (m)		716.1	716.1		1379.6	1379.6	188.9	576.8	576.8
Upstream Blk Time (%)							98		
Queuing Penalty (veh)							0		
Storage Bay Dist (m)	50.0			50.0					
Storage Blk Time (%)	0	1		0	35		100		
Queuing Penalty (veh)	1	2		2	41		76		

Intersection: 51: Commonwealth Ave/Mt. Carson Ave & Topsail Road

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	T	R	L
Maximum Queue (m)	62.4	593.4	614.9	42.5	102.2	158.4	424.9	32.4	72.0	93.2	16.6	42.4
Average Queue (m)	25.4	376.0	404.2	42.5	75.0	70.0	64.3	7.4	37.8	51.2	1.0	19.3
95th Queue (m)	67.9	709.9	729.8	42.5	117.1	160.9	260.7	29.2	64.6	82.1	11.3	46.6
Link Distance (m)		1082.8	1082.8			912.8	912.8		208.3	208.3	208.3	
Upstream Blk Time (%)							0					
Queuing Penalty (veh)							0					
Storage Bay Dist (m)	60.0			40.0	100.0			30.0				40.0
Storage Blk Time (%)	0	57	37	50	16	2	20	0				0
Queuing Penalty (veh)	1	31	224	192	49	8	9	1				1

Intersection: 51: Commonwealth Ave/Mt. Carson Ave & Topsail Road

Movement	SB	SB
Directions Served	T	R
Maximum Queue (m)	1109.6	32.5
Average Queue (m)	746.3	9.3
95th Queue (m)	1234.1	32.9
Link Distance (m)	1121.9	
Upstream Blk Time (%)	18	
Queuing Penalty (veh)	0	
Storage Bay Dist (m)		30.0
Storage Blk Time (%)	76	0
Queuing Penalty (veh)	76	2

Intersection: 53: Topsail Road & Blackmarsh Road

Movement	EB	EB	WB	WB	SB	SB
Directions Served	LT	T	T	TR	L	R
Maximum Queue (m)	251.9	574.2	6.1	24.1	56.5	22.6
Average Queue (m)	52.8	44.0	0.3	3.2	19.2	19.8
95th Queue (m)	204.9	352.4	4.5	14.9	47.5	24.8
Link Distance (m)	912.8	912.8	1253.0	1253.0	341.5	
Upstream Blk Time (%)	0	0				
Queuing Penalty (veh)	0	2				
Storage Bay Dist (m)						20.0
Storage Blk Time (%)					1	9
Queuing Penalty (veh)					7	1

Intersection: 58: Captain Whelan Drive & Captain Whelan Drive'

Movement	EB
Directions Served	T
Maximum Queue (m)	10.6
Average Queue (m)	1.8
95th Queue (m)	8.0
Link Distance (m)	162.4
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 61: Blackmarsh Road & Empire Avenue

Movement	B54	WB	SB
Directions Served	T	TR	LR
Maximum Queue (m)	33.2	0.7	90.2
Average Queue (m)	1.2	0.0	31.1
95th Queue (m)	33.8	0.7	72.9
Link Distance (m)	341.5	127.7	201.4
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 62: Captain Whelan Drive' & Blackmarsh Road

Movement	EB	WB	WB	NB	NB
Directions Served	TR	L	T	L	R
Maximum Queue (m)	0.7	35.9	14.4	32.6	29.6
Average Queue (m)	0.0	17.6	0.3	12.7	13.8
95th Queue (m)	0.7	30.7	7.1	26.9	23.8
Link Distance (m)	128.2		160.7		
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)		40.0		64.0	
Storage Blk Time (%)		0	0		
Queuing Penalty (veh)		1	0		

Intersection: 64: Blackmarsh Road/Captain Whelan Drive

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: 75: Austin Street/Bambrick St & Thorburn Road

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (m)	8.7	48.0	40.9	62.1	108.7	106.8	52.4	18.8	30.3	9.2
Average Queue (m)	0.9	17.5	13.7	17.3	40.8	40.9	25.0	3.8	11.4	1.4
95th Queue (m)	5.1	36.4	31.9	45.2	91.9	90.5	44.2	13.5	24.3	6.6
Link Distance (m)		368.4	368.4		145.7	145.7		205.8		132.3
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (m)	55.0			55.0			60.0		60.0	
Storage Blk Time (%)		0		0	3		0	0		
Queuing Penalty (veh)		0		0	4		0	0		

Intersection: 79: Goldstone St/Seaborn St & Thorburn Road

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (m)	13.1	36.3	33.8	65.3	58.2	65.2	64.1	46.1	13.1	16.0
Average Queue (m)	3.5	16.6	12.3	27.3	22.6	24.2	27.4	12.0	3.0	5.1
95th Queue (m)	11.3	30.7	27.6	52.3	48.2	51.6	52.4	31.9	10.1	14.4
Link Distance (m)		65.8	65.8		368.4	368.4		218.7		121.3
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (m)	55.0			65.0			85.0		50.0	
Storage Blk Time (%)				0	0		0	0		
Queuing Penalty (veh)				1	0		0	0		

Intersection: 90: Thorburn Road & Mount Scio Rd

Movement	EB	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	T	TR	L	R
Maximum Queue (m)	61.9	77.3	87.5	148.6	151.1	57.3	125.6
Average Queue (m)	31.9	26.4	31.1	99.8	92.0	45.2	43.1
95th Queue (m)	54.0	55.9	63.9	151.6	145.6	63.7	96.2
Link Distance (m)		145.7	145.7	265.2	265.2		146.8
Upstream Blk Time (%)		0	0				0
Queuing Penalty (veh)		0	0				0
Storage Bay Dist (m)	65.0					50.0	
Storage Blk Time (%)	0	0				10	1
Queuing Penalty (veh)	2	0				26	3

Intersection: 92: Moss Heather Dr & Thorburn Road

Movement	EB	EB	WB	WB	WB
Directions Served	T	TR	L	T	T
Maximum Queue (m)	38.8	52.0	23.2	35.6	38.4
Average Queue (m)	11.8	16.8	7.9	9.0	10.8
95th Queue (m)	31.3	39.5	18.4	25.4	29.2
Link Distance (m)	265.2	265.2		325.0	325.0
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			50.0		
Storage Blk Time (%)				0	
Queuing Penalty (veh)				0	

Intersection: 94: O'Leary Avenue/Larkhall Street & Thorburn Road

Movement	EB	EB	EB	WB	WB	WB	B63	B63	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	T	T	L	TR	L	TR
Maximum Queue (m)	67.3	145.0	158.7	57.2	95.2	98.9	73.0	110.4	112.4	167.6	29.0	53.8
Average Queue (m)	18.2	71.0	87.9	28.6	55.4	58.3	3.9	5.2	59.2	94.1	6.3	20.2
95th Queue (m)	52.9	122.8	142.0	48.1	86.0	89.3	65.5	77.0	118.4	171.2	17.8	40.8
Link Distance (m)		325.0	325.0		147.5	147.5	361.3	361.3		156.6		101.2
Upstream Blk Time (%)							0	0		9		
Queuing Penalty (veh)							0	0		0		
Storage Bay Dist (m)	60.0			110.0					105.0		30.0	
Storage Blk Time (%)		15			0				0	13		4
Queuing Penalty (veh)		10			0				1	39		1

Intersection: 102: Freshwater Road & Loop Ramp

Movement	EB	EB	B68	WB	WB	WB	SB	SB	SB
Directions Served	T	T	T	T	T	R	L	L	R
Maximum Queue (m)	63.9	68.1	1.7	77.7	89.0	47.4	47.4	49.7	38.1
Average Queue (m)	27.5	30.5	0.1	36.0	29.0	22.1	24.0	27.2	15.1
95th Queue (m)	52.9	56.4	1.7	64.2	63.1	42.1	41.7	43.7	30.3
Link Distance (m)	173.1	173.1	280.0	137.0	137.0			92.4	92.4
Upstream Blk Time (%)					0				
Queuing Penalty (veh)					0				
Storage Bay Dist (m)						40.0	95.0		
Storage Blk Time (%)					2	0			
Queuing Penalty (veh)					8	1			

Intersection: 105: Kenmount Rd & Avalon Mall

Movement	EB	EB	EB	WB	WB	WB	WB	B68	B33	NB	NB	SB
Directions Served	L	T	TR	L	T	T	R	T	T	L	TR	LT
Maximum Queue (m)	48.4	100.1	100.2	16.7	109.8	113.4	37.4	1.4	1.0	9.7	17.6	105.8
Average Queue (m)	12.3	48.0	50.9	2.1	50.1	52.4	16.5	0.0	0.0	2.0	5.7	56.5
95th Queue (m)	31.1	85.4	87.6	9.8	89.1	92.6	30.6	1.4	1.0	8.0	14.7	91.4
Link Distance (m)		268.1	268.1		280.0	280.0	280.0	45.8	173.1	121.0	121.0	110.0
Upstream Blk Time (%)												0
Queuing Penalty (veh)												0
Storage Bay Dist (m)	55.0			16.0								
Storage Blk Time (%)		4		0	29							
Queuing Penalty (veh)		3		0	2							

Intersection: 105: Kenmount Rd & Avalon Mall

Movement	SB
Directions Served	R
Maximum Queue (m)	26.1
Average Queue (m)	2.3
95th Queue (m)	14.2
Link Distance (m)	110.0
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 108: Kenmount Road & Pippy Place

Movement	EB	EB	EB	WB	WB	WB	NB	SB	SB	B113
Directions Served	L	T	TR	L	T	TR	LTR	L	TR	T
Maximum Queue (m)	71.2	103.3	80.2	10.0	192.4	193.1	10.2	118.4	159.9	132.4
Average Queue (m)	42.0	32.2	33.0	0.6	108.0	110.2	1.6	81.3	108.8	37.4
95th Queue (m)	69.7	69.9	62.8	6.1	181.8	183.5	7.3	143.5	185.8	139.1
Link Distance (m)		293.7	293.7		454.9	454.9	40.3		142.8	176.2
Upstream Blk Time (%)									22	7
Queuing Penalty (veh)									0	0
Storage Bay Dist (m)	65.0			40.0				115.0		
Storage Blk Time (%)	3	0			29			2	27	
Queuing Penalty (veh)	18	0			1			8	56	

Intersection: 109: Kenmount Rd & Peet St

Movement	EB	EB	EB	WB	WB	B103	SB	SB
Directions Served	L	T	T	T	TR	T	L	R
Maximum Queue (m)	38.9	50.5	55.1	71.3	72.9	194.8	26.3	20.5
Average Queue (m)	17.9	15.9	20.1	23.9	29.0	7.0	10.7	9.5
95th Queue (m)	31.5	38.9	44.4	56.8	62.0	78.7	22.5	17.5
Link Distance (m)		183.4	183.4	176.9	176.9	268.1		266.4
Upstream Blk Time (%)						0		
Queuing Penalty (veh)						0		
Storage Bay Dist (m)	60.0						50.0	
Storage Blk Time (%)		0						
Queuing Penalty (veh)		0						

Intersection: 114: Terra Nova Motors/Great Eastern Ave & Kenmount Road

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (m)	24.4	164.4	312.1	28.8	467.9	590.0	19.5	18.0	13.4	7.8
Average Queue (m)	9.3	17.6	36.6	3.4	61.3	62.4	7.4	5.3	2.6	0.4
95th Queue (m)	19.4	96.5	189.6	16.5	279.4	344.7	17.0	13.9	9.6	3.6
Link Distance (m)		468.6	468.6		1304.6	1304.6		178.3		232.8
Upstream Blk Time (%)		0	0			0				
Queuing Penalty (veh)		0	4			0				
Storage Bay Dist (m)	55.0			45.0			25.0		65.0	
Storage Blk Time (%)				0	6		0	0		
Queuing Penalty (veh)				0	1		0	0		

Intersection: 117: Crotty's/Kelsey Drive & Kenmount Road

Movement	EB	EB	EB	EB	WB	WB	WB	WB	B16	B16	NB	SB
Directions Served	L	L	T	TR	L	T	T	R	T	T	L	L
Maximum Queue (m)	47.0	67.7	96.6	96.7	47.9	384.7	397.6	137.5	5.6	11.3	8.7	153.2
Average Queue (m)	27.9	29.0	35.8	38.0	1.8	222.2	234.1	104.9	0.4	0.8	0.7	39.4
95th Queue (m)	42.3	48.4	70.4	75.2	17.7	401.2	417.6	200.4	7.0	10.1	4.9	109.5
Link Distance (m)			474.7	474.7		490.5	490.5		294.4	294.4	22.0	378.5
Upstream Blk Time (%)						1	1					
Queuing Penalty (veh)						4	9					
Storage Bay Dist (m)	75.0	75.0			50.0			130.0				
Storage Blk Time (%)			0			54	34	1				
Queuing Penalty (veh)			2			1	137	4				

Intersection: 117: Crotty's/Kelsey Drive & Kenmount Road

Movement	SB	SB
Directions Served	LT	R
Maximum Queue (m)	272.4	67.5
Average Queue (m)	103.1	59.2
95th Queue (m)	220.7	90.0
Link Distance (m)	378.5	
Upstream Blk Time (%)	0	
Queuing Penalty (veh)	0	
Storage Bay Dist (m)		60.0
Storage Blk Time (%)	0	34
Queuing Penalty (veh)	1	51

Intersection: 120: Wyatt Blvd & Kenmount Rd

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (m)	86.0	82.2	92.5	244.8	311.8	44.6	172.0
Average Queue (m)	46.1	38.0	81.1	102.7	55.9	20.6	59.9
95th Queue (m)	75.9	72.1	112.2	239.8	191.6	37.8	153.1
Link Distance (m)	377.0	377.0		468.6	468.6	367.2	367.2
Upstream Blk Time (%)					0		
Queuing Penalty (veh)					0		
Storage Bay Dist (m)			85.0				
Storage Blk Time (%)			26	0			
Queuing Penalty (veh)			134	1			

Intersection: 123: Kenmount Road & Ladysmith Drive

Movement	EB	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	T	TR	L	LR
Maximum Queue (m)	32.1	103.8	103.7	462.7	491.3	29.9	40.6
Average Queue (m)	8.3	62.5	61.8	271.6	286.6	6.8	15.8
95th Queue (m)	24.7	97.2	96.1	479.6	511.0	19.2	32.4
Link Distance (m)		1304.6	1304.6	474.7	474.7		179.9
Upstream Blk Time (%)				0	5		
Queuing Penalty (veh)				1	54		
Storage Bay Dist (m)	35.0					50.0	
Storage Blk Time (%)	0	22				0	0
Queuing Penalty (veh)	0	6				0	0

Network Summary

Network wide Queuing Penalty: 2720

APPENDIX B-6

TRAFFIC SIGNAL WARRANT ANALYSIS

City of St. John's - Traffic Signal Warrant Analysis

Main Street (name)	**Thorburn Road**	**Direction (EW or NS)**	**EW**	**Road Authority:**	**City of St. John's**
Side Street (name)	**Outer Ring Road NB**	**Direction (EW or NS)**	**NS**	**City:**	**St. John's**
Quadrant / Int #		**Comments**	**Enter Comments about the analysis here.**	**Analysis Date:**	**2014 Jan 27, Mon**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**			**Count Date:**	**2013 Sep 18, Wed**
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Thorburn Road	WB					1		2,000	1
Thorburn Road	EB	1		1				2,000	1
Outer Ring Road NB	NB	1					1		
Outer Ring Road NB	SB								

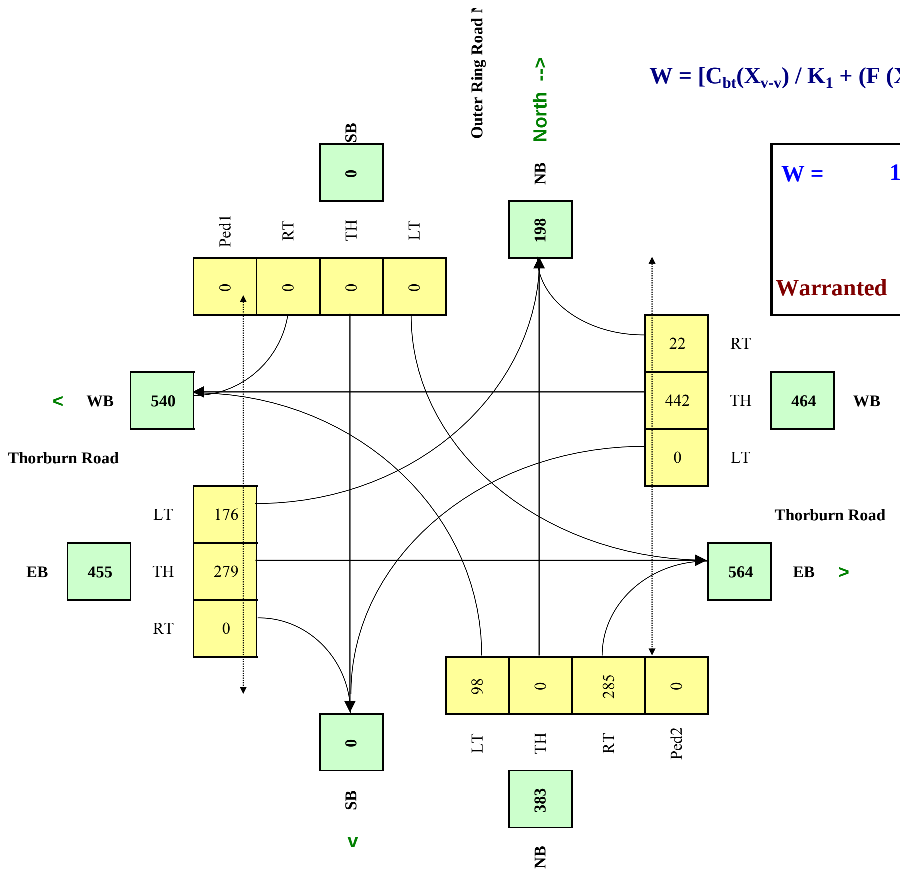
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	200,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Thorburn Road	EW	50	5.0%	n	0.0
Outer Ring Road NB	NS		5.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1 NS**	**Ped2 NS**	**Ped3 EW**	**Ped4 EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 - 8:00	38		441					122	16	191	374					
8:00 - 9:00	37		426					138	24	349	455					
12:00 - 13:00	98		285					442	22	176	279					
13:00 - 14:00	98		285					442	22	176	279					
16:00 - 17:00	153		145					857	27	76	165					
17:00 - 18:00	162		129					650	22	87	120					
Total (6-hour peak)	**586**	**0**	**1,711**	**0**	**0**	**0**	**0**	**2,651**	**133**	**1,055**	**1,672**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**98**	**0**	**285**	**0**	**0**	**0**	**0**	**442**	**22**	**176**	**279**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\ (X_{v\text{-}p})\ L) / K_2] \times C_i$$

W =	**127**	**127**	**0**
		Veh	***Ped***
Warranted			

RESET SHEET

City of St. John's - Traffic Signal Warrant Analysis

Main Street (name)	**Thorburn Road**	**Direction (EW or NS)**	**EW**	**Road Authority:**	**City of St. John's**
Side Street (name)	**Outer Ring Road SB**	**Direction (EW or NS)**	**NS**	**City:**	**St. John's**
Quadrant / Int #		**Comments**	**Enter Comments about the analysis here.**	**Analysis Date:**	**2014 Jan 27, Mon**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**			**Count Date:**	**2013 Sep 18, Wed**
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Thorburn Road	WB	1		1				2,000	1
Thorburn Road	EB					1		2,000	1
Outer Ring Road SB	NB								
Outer Ring Road SB	SB	1					1		

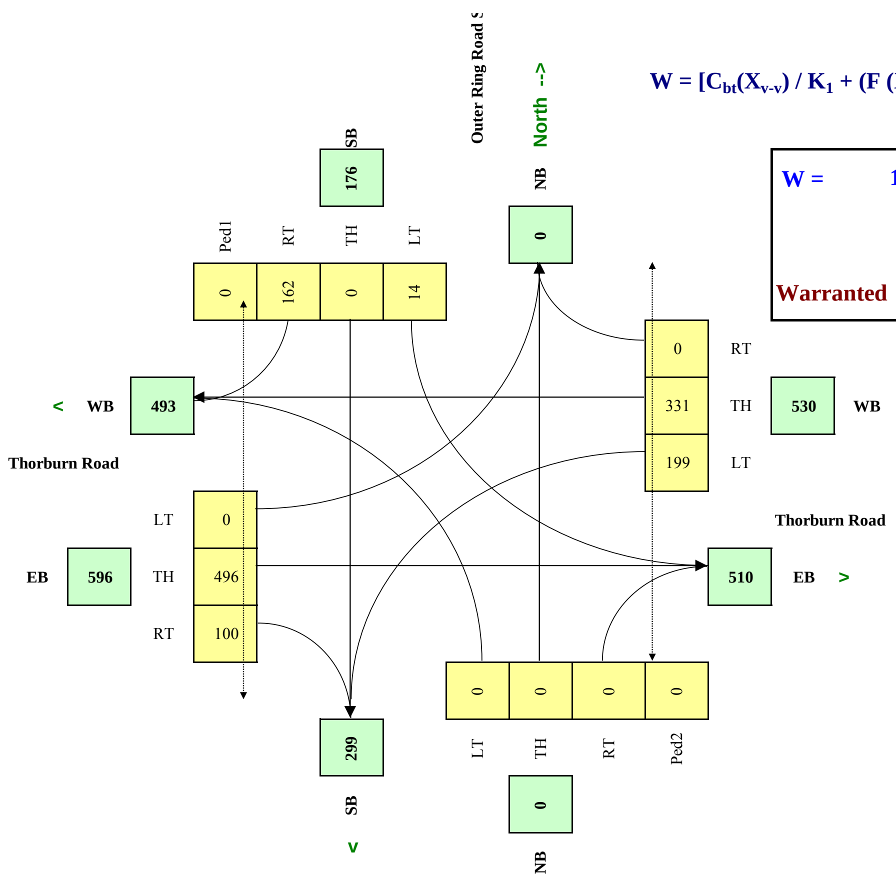
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	200,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Thorburn Road	EW	50	10.0%	n	0.0
Outer Ring Road SB	NS		20.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00				13		18	72	96			621	151				
8:00 - 9:00				16		42	69	111			930	118				
12:00 - 13:00				14		162	199	331			496	100				
13:00 - 14:00				14		162	199	331			496	100				
16:00 - 17:00				10		269	402	535			201	57				
17:00 - 18:00				18		319	254	582			232	72				
Total (6-hour peak)	**0**	**0**	**0**	**85**	**0**	**972**	**1,195**	**1,986**	**0**	**0**	**2,976**	**598**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**14**	**0**	**162**	**199**	**331**	**0**	**0**	**496**	**100**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v-v}) / K_1 + (F (X_{v-p}) L) / K_2] \times C_i$$

W =	**105**	**105**	**0**
		Veh	***Ped***
Warranted			

RESET SHEET

City of St. John's - Traffic Signal Warrant Analysis

Main Street (name)	Topsail Road	Direction (EW or NS)	EW	Road Authority:	City of St. John's
Side Street (name)	Blackmarsh Road	Direction (EW or NS)	NS	City:	St. John's
Quadrant / Int #		Comments	Enter Comments about the analysis here.	Analysis Date:	2014 Feb 21, Fri
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2013 Sep 12, Thu
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Topsail Road	WB			1		1		2,000	2
Topsail Road	EB		1	1			0	1,000	2
Blackmarsh Road	NB								
Blackmarsh Road	SB	1				1			

Are the Blackmarsh Road SB right turns significantly impeded by through movements? (y/n) n

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	200,000
Central Business District	(y/n)	y

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Topsail Road	EW	50	3.0%	y	
Blackmarsh Road	NS		4.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00				1		278		379	36	461						
8:00 - 9:00				2		247		419	29	422						
12:00 - 13:00				4		349		523	33	430						
13:00 - 14:00				4		349		523	33	430						
16:00 - 17:00				8		468		698	34	384						
17:00 - 18:00				3		400		595	31	452						
Total (6-hour peak)	0	0	0	22	0	2,091	0	3,137	196	2,579	0	0	0	0	0	0
Average (6-hour peak)	0	0	0	4	0	349	0	523	33	430	0	0	0	0	0	0

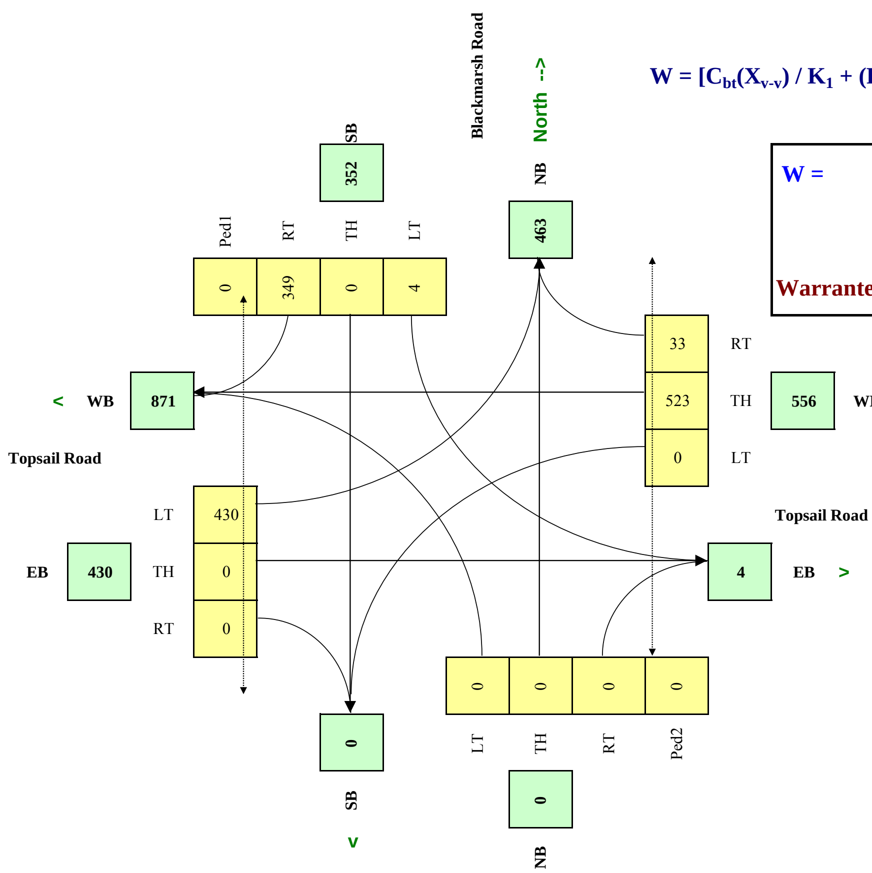
Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	183	183	0
		Veh	Ped

Warranted

RESET SHEET



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City of St. John's - Traffic Signal Warrant Analysis

Main Street (name)	**Kelsey Drive**	**Direction (EW or NS)**	**EW**		**Road Authority:**	**City of St. John's**
Side Street (name)	**Team Gushue Highway SB**	**Direction (EW or NS)**	**NS**		**City:**	**St. John's**
Quadrant / Int #		**Comments**	**Enter Comments about the analysis here.**		**Analysis Date:**	**2014 Mar 13, Thu**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**				**Count Date:**	**2013 Sep 19, Thu**
					Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Kelsey Drive	WB	1		2				1,000	2
Kelsey Drive	EB			1			1	150	1
Team Gushue Highway SB	NB								
Team Gushue Highway SB	SB				1				

the Team Gushue Highway SB SB right turns significantly impeded by through movements? (y/n) n

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	200,000
Central Business District	(y/n)	y

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Kelsey Drive	EW	50	6.0%	n	
Team Gushue Highway SB	NS		6.0%	n	

Set Peak Hours

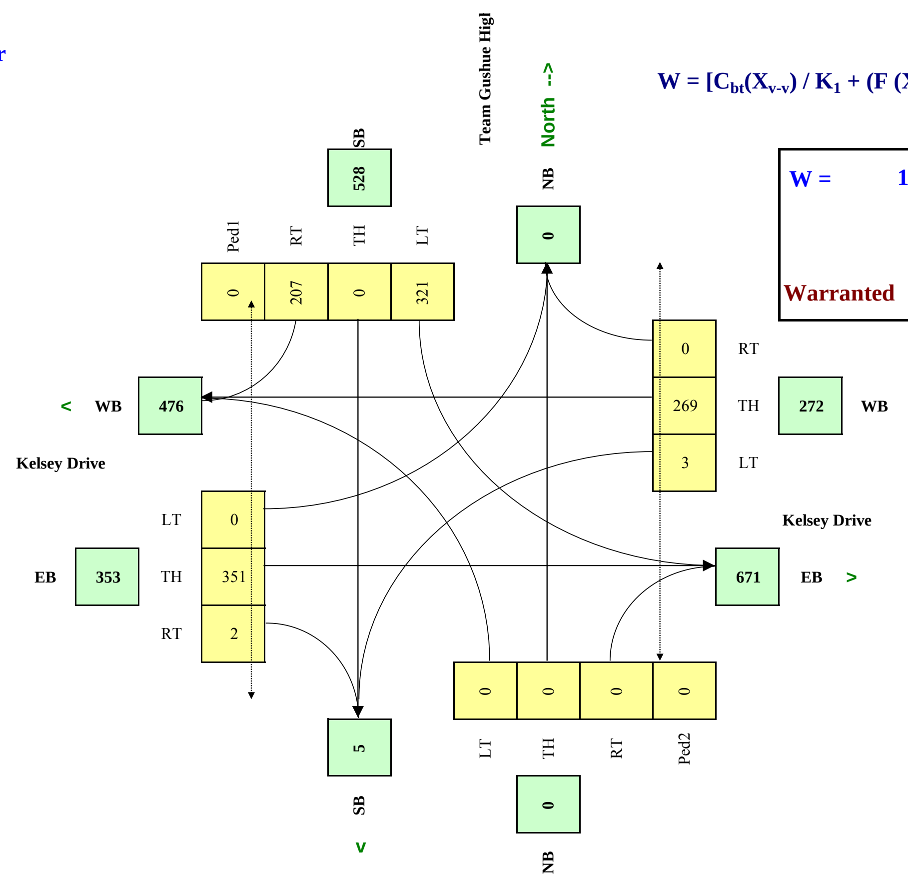
Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1** **NS**	**Ped2** **NS**	**Ped3** **EW**	**Ped4** **EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 - 8:00				385		173	5	129			171	0				
8:00 - 9:00				508		142	2	185			302	2				
12:00 - 13:00				321		207	3	269			351	2				
13:00 - 14:00				321		207	3	269			351	2				
16:00 - 17:00				203		261	3	420			489	3				
17:00 - 18:00				186		252	1	340			439	3				
Total (6-hour peak)	**0**	**0**	**0**	**1,924**	**0**	**1,242**	**17**	**1,612**	**0**	**0**	**2,103**	**12**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**321**	**0**	**207**	**3**	**269**	**0**	**0**	**351**	**2**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F\ (X_{v-p})\ L) / K_2] \times C_i$$

W = **119**	**119**	**0**
	Veh	***Ped***
Warranted		

RESET SHEET



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City of St. John's - Traffic Signal Warrant Analysis

Main Street (name)	Kelsey Drive	**Direction (EW or NS)**	EW	**Road Authority:**	City of St. John's
Side Street (name)	Team Gushue Highway NB	**Direction (EW or NS)**	NS	**City:**	St. John's
Quadrant / Int #		**Comments**	Enter Comments about the analysis here.	**Analysis Date:**	2014 Mar 13, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			**Count Date:**	2013 Sep 19, Thu
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Kelsey Drive	WB					1		150	1
Kelsey Drive	EB	1		1				1,000	1
Team Gushue Highway NB	NB				1				
Team Gushue Highway NB	SB				0				

he Team Gushue Highway NB NB right turns significantly impeded by through movements? (y/n) n

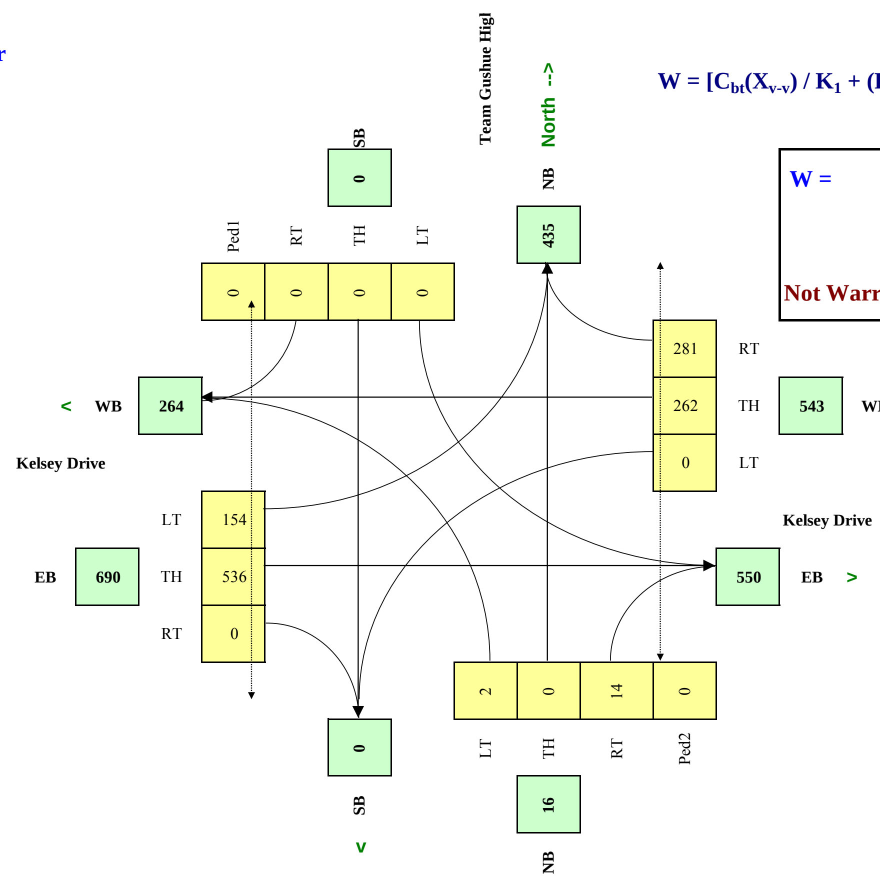
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	200,000
Central Business District	(y/n)	y

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Kelsey Drive	EW	50		n	
Team Gushue Highway NB	NS			n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	1		11					152	101	52	573					
8:00 - 9:00	6		28					203	129	75	764					
12:00 - 13:00	2		14					262	281	154	536					
13:00 - 14:00	2		14					262	281	154	536					
16:00 - 17:00	1		15					434	529	255	448					
17:00 - 18:00	0		3					260	366	234	358					
Total (6-hour peak)	**12**	**0**	**85**	**0**	**0**	**0**	**0**	**1,573**	**1,687**	**924**	**3,215**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**2**	**0**	**14**	**0**	**0**	**0**	**0**	**262**	**281**	**154**	**536**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\ (X_{v\text{-}p})\ L) / K_2] \times C_i$$

W =	**51**	**51**	**0**
		Veh	***Ped***

Not Warranted - Vs<75

RESET SHEET

APPENDIX B-7

2025 INTERSECTION TRAFFIC VOLUMES

Figure B7-1: Scenario 1 - 2025 AM (PM) Peak Hour Traffic

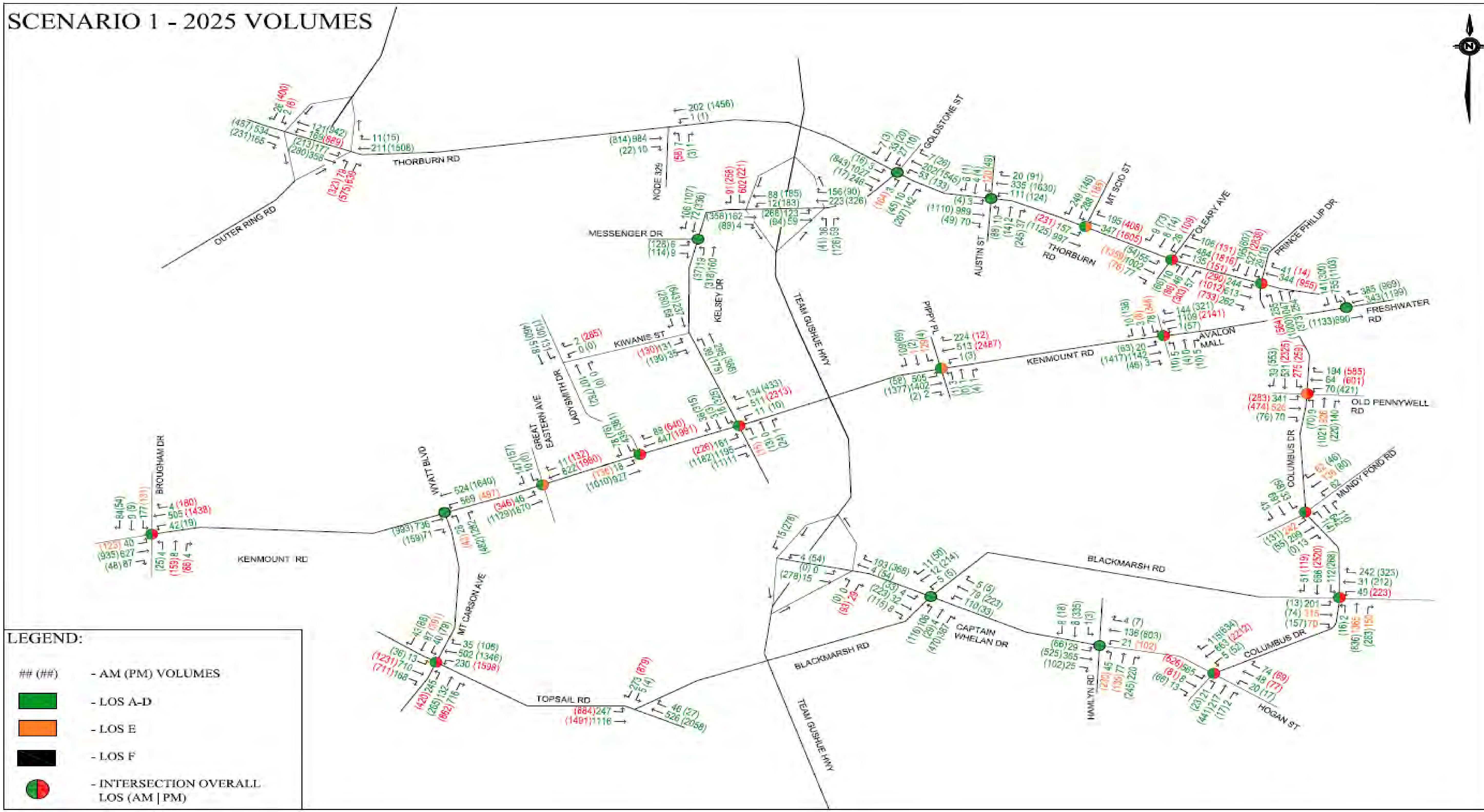


Figure B7-2: Scenario 2 - 2025 AM (PM) Peak Hour Traffic

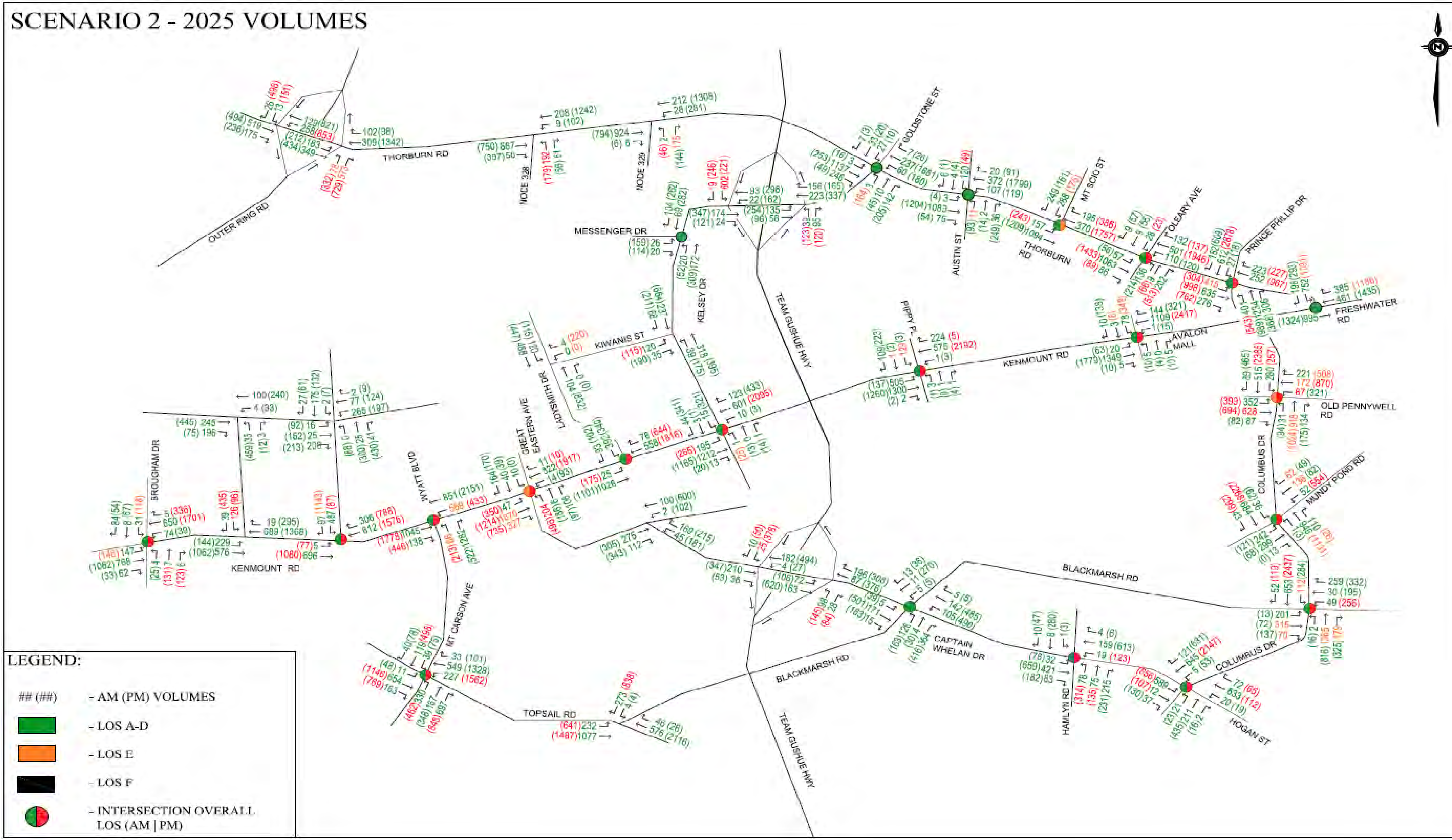
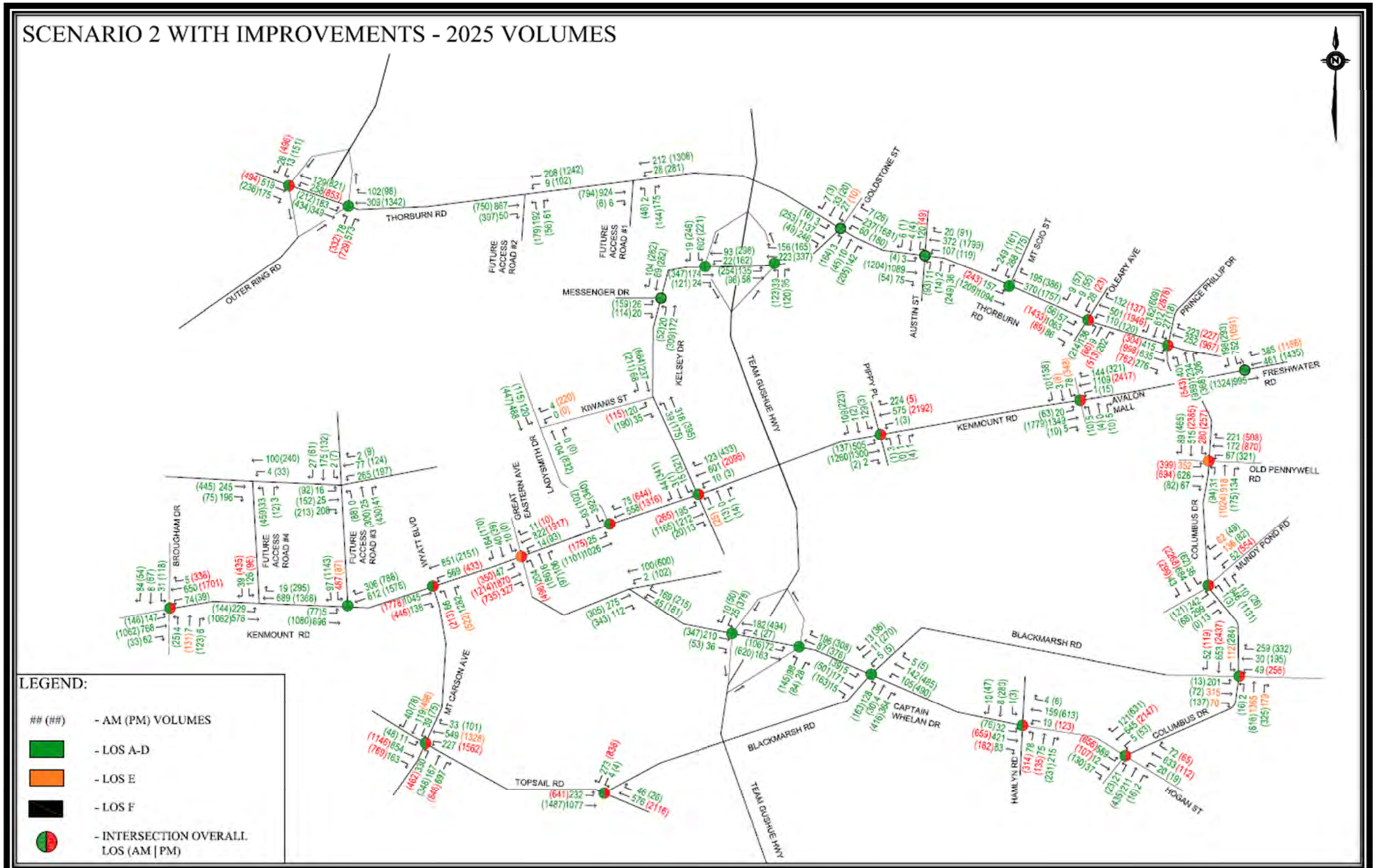


Figure B7-3: Scenario 2 with Improvements - 2025 AM (PM) Peak Hour Traffic



APPENDIX B-8

ROUNDABOUTS CONCEPTS

1 – SK-001
2 – SK-002
3 – SK-003

PLAN

SCALE 1:750

DRAWING NUMBER	DRAWING TITLE

REFERENCE DRAWINGS

ENGINEER STAMP:

NO.	DESCRIPTION	CHK'D	APP'D	DATE

REVISIONS

ENGINEER STAMP:

REV.	ISSUED FOR	AUTH.	BY	DATE
A	–	–	–	–

ISSUE AUTHORIZATION

HATCH

DESIGNED BY:
DATE:
DRAWN BY:
DATE: -
CHECKED BY:
DATE: -
PROJECT MANAGER:
DATE: -
BAR SCALE:

HMM PROJECT No: 325025

DWG SCALE(FULL SIZE): 1:750

CLIENT:

CITY OF ST. JOHN'S

THORBURN RD/COLUMBUS DRIVE
ROUNDABOUT
CONCEPT DRAWING

DWG No: HMM-325052SK-001

SHT No: 1

REV No: A

ANSI A1 (841mm x 594mm) FULL SIZE

FILE NAME: xx

USER NAME:

PLOT DATE:

PLAN

SCALE 1:750

DRAWING NUMBER	DRAWING TITLE	ENGINEER STAMP:	NO.	DESCRIPTION	CHK'D / APP'D / DATE
REFERENCE DRAWINGS			REVISIONS		

REV.	ISSUED FOR	AUTH.	BY	DATE
A	–	–	–	–

ENGINEER STAMP:

ISSUE AUTHORIZATION

HATCH

CLIENT: CITY OF ST. JOHN'S

KENMOUNT RD/GREAT EASTERN AVE.
ROUNDABOUT
CONCEPT DRAWING

DESIGNED BY:
DATE:
DRAWN BY:
DATE: -
CHECKED BY:
-
DATE: -
PROJECT MANAGER:
-
DATE: -
BAR SCALE:

HMM PROJECT No: 325025
DWG SCALE(FULL SIZE): 1:750
DWG No: HMM-325052-SK-002
SHT No: 1
REV No: A

ANSI A1 (841mm x 594mm) FULL SIZE

PLOT DATE:
USER NAME:
FILE NAME: xx

FILE NAME: XX
USER NAME:
PLOT DATE:

DRAWING NUMBER	DRAWING TITLE

REFERENCE DRAWINGS

ENGINEER STAMP:

NO.	DESCRIPTION	CHK'D	APP'D	DATE

REVISIONS

ENGINEER STAMP:

REV.	ISSUED FOR	AUTH.	BY	DATE
A	–	–	–	–

ISSUE AUTHORIZATION

HATCH

DESIGNED BY:
DATE:
DRAWN BY:
DATE: -
CHECKED BY:
-
DATE: -
PROJECT MANAGER:
-
DATE: -
BAR SCALE:

CLIENT:
CITY OF ST. JOHN'S

THORBURN ROAD / TRANS-CANADA
INTERCHANGE
CONCEPT DRAWING

HMM PROJECT No:	DWG SCALE(FULL SIZE)	DWG No:	SHT No	REV No
325025	1:750	HMM-325052-SK-003	1	A

ANSI A1 (841mm x 594mm) FULL SIZE

APPENDIX C

SANITARY

STORM SEWER

WATER SERVICES

APPENDIX C

SANITARY

Flow Determination - Catchment Area A

Location:	Flow to MH 55	
Residential Development Area (Ha)	30	
Residential Population	1351	
Commercial Area (Ha)	0	
Industrial Area (Ha)	0	
Institutional Area (Ha)	0	
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	0	
Equivalent Population (Industrial)	0	
Equivalent Population (Institutional)	0	
Sub-Total Population (Com/Ind/Inst)	0	
Peaking Factor (Harmon) - Residental	3.7	
Peaking Factor (Harmon) - Comm / Indust / Inst	0.0	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	468	7.8 (L/s)
Average Day Flow (L/min)	726.0	12.1 (L/s)
Peak Hour Flow (L/min)	1425.7	23.8 (L/s)

Flow Determination - Catchment Area B

Location:	To MH 35	
Residential Area (Ha)	0	
Residential Population	0	
Commercial Area (Ha)	12.92	
Industrial Area (Ha)	3.23	
Institutional Area (Ha)	3.6	
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	1315	
Equivalent Population (Industrial)	458	
Equivalent Population (Institutional)	445	
Sub-Total Population (Com/Ind/Inst)	2219	
Peaking Factor (Harmon) - Residental	0.0	
Peaking Factor (Harmon) - Comm / Indust / Inst	2.8	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	308.1	5.1 (L/s)
Average Day Flow (L/min)	731.8	12.2 (L/s)
Peak Hour Flow (L/min)	1511.5	25.2 (L/s)

Flow Determination - Catchment Area B

Location:	To MH 47	
Residential Area (Ha)	0	
Residential Population	0	
Commercial Area (Ha)	20.85	
Industrial Area (Ha)	24.7	
Institutional Area (Ha)		
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	2123	
Equivalent Population (Industrial)	3503	
Equivalent Population (Institutional)	0	
Sub-Total Population (Com/Ind/Inst)	5626	
Peaking Factor (Harmon) - Residental	0.0	
Peaking Factor (Harmon) - Comm / Indust / Inst	2.6	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	710.58	11.8 (L/s)
Average Day Flow (L/min)	1785.0	29.7 (L/s)
Peak Hour Flow (L/min)	3458.5	57.6 (L/s)

Flow Determination - Catchment Area C

Location:	To MH 23	
Residential Development Area (Ha)	24.4	
Residential Population	965	
Commercial Area (Ha)	0	
Industrial Area (Ha)	0	
Institutional Area (Ha)	0	
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	0	
Equivalent Population (Industrial)	0	
Equivalent Population (Institutional)	0	
Sub-Total Population (Com/Ind/Inst)	0	
Peaking Factor (Harmon) - Residental	3.8	
Peaking Factor (Harmon) - Comm / Indust / Inst	0.0	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	380.64	6.3 (L/s)
Average Day Flow (L/min)	564.9	9.4 (L/s)
Peak Hour Flow (L/min)	1082.8	18.0 (L/s)

Flow Determination - Catchment Area D

Location:	To MH 12		
Residential Development Area (Ha)	35.8		
Residential Population	1538		
Commercial Area (Ha)	0		
Industrial Area (Ha)	0		
Institutional Area (Ha)	0		
Residential Flow (L/p/day)	275		
Commercial Flow (L/ha/day)	28000		
Industrial Flow (L/ha/day)	39000		
Institutional Flow (L/ha/day)	34000		
Equivalent Population (Commercial)	0		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	0		
Peaking Factor (Harmon) - Residental	3.7		
Peaking Factor (Harmon) - Comm / Indust / Inst	0.0	** 80% of Residental Peaking Factor*	
Inflow & Infiltration Allowance (L/s/ha)	0.26		
Infiltration Allowance (L/ min)	558.48	9.3	(L/s)
Average Day Flow (L/min)	852.2	14.2	(L/s)
Peak Hour Flow (L/min)	1636.9	27.3	(L/s)

Flow Determination Catchment Area E

Location:	To MH 62		
Residential Development Area (Ha)	31.84		
Residential Population	1030		
Commercial Area (Ha)	9.5		
Industrial Area (Ha)	0		
Institutional Area (Ha)	0		
Residential Flow (L/p/day)	275		
Commercial Flow (L/ha/day)	28000		
Industrial Flow (L/ha/day)	39000		
Institutional Flow (L/ha/day)	34000		
Equivalent Population (Commercial)	967		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	967		
Peaking Factor (Harmon) - Residental	3.8		
Peaking Factor (Harmon) - Comm / Indust / Inst	3.0	** 80% of Residental Peaking Factor*	
Inflow & Infiltration Allowance (L/s/ha)	0.26		
Infiltration Allowance (L/ min)	644.904	10.7	(L/s)
Average Day Flow (L/min)	1026.3	17.1	(L/s)
Peak Hour Flow (L/min)	1953.7	32.6	(L/s)

Flow Determination - Catchment Area E

Location:	To MH 64		
Residential Area (Ha)	21.8		
Residential Population	1171		
Commercial Area (Ha)	7.5		
Industrial Area (Ha)	0		
Institutional Area (Ha)			
Residential Flow (L/p/day)	275		
Commercial Flow (L/ha/day)	28000		
Industrial Flow (L/ha/day)	39000		
Institutional Flow (L/ha/day)	34000		
Equivalent Population (Commercial)	764		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	764		
Peaking Factor (Harmon) - Residental	3.8		
Peaking Factor (Harmon) - Comm / Indust / Inst	3.1	** 80% of Residental Peaking Factor*	
Inflow & Infiltration Allowance (L/s/ha)	0.26		
Infiltration Allowance (L/ min)	457.08	7.6	(L/s)
Average Day Flow (L/min)	826.5	13.8	(L/s)
Peak Hour Flow (L/min)	1748.5	29.1	(L/s)

Flow Determination - Catchment Area F

Location:	To MH 61		
Residential Development Area (Ha)	28		
Residential Population	901		
Commercial Area (Ha)	27		
Industrial Area (Ha)	0		
Institutional Area (Ha)	0		
Residential Flow (L/p/day)	275		
Commercial Flow (L/ha/day)	28000		
Industrial Flow (L/ha/day)	39000		
Institutional Flow (L/ha/day)	34000		
Equivalent Population (Commercial)	2749		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	2749		
Peaking Factor (Harmon) - Residental	3.8		
Peaking Factor (Harmon) - Comm / Indust / Inst	2.8	** 80% of Residental Peaking Factor*	
Inflow & Infiltration Allowance (L/s/ha)	0.26		
Infiltration Allowance (L/ min)	858	14.3	(L/s)
Average Day Flow (L/min)	1555.1	25.9	(L/s)
Peak Hour Flow (L/min)	2976.0	49.6	(L/s)

Flow Determination - Catchment Area G

Location:	To MH 24	
Residential Development Area (Ha)	16.5	
Residential Population	763	
Commercial Area (Ha)	1.9	
Industrial Area (Ha)	0	
Institutional Area (Ha)	2.1	
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	193	
Equivalent Population (Industrial)	0	
Equivalent Population (Institutional)	260	
Sub-Total Population (Com/Ind/Inst)	453	
Peaking Factor (Harmon) - Residental	3.9	
Peaking Factor (Harmon) - Comm / Indust / Inst	3.2	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	319.8	5.3 (L/s)
Average Day Flow (L/min)	552.0	9.2 (L/s)
Peak Hour Flow (L/min)	1160.7	19.3 (L/s)

Flow Determination - Catchment Area G

Location:	To MH 29	
Residential Area (Ha)	16.05	
Residential Population	744	
Commercial Area (Ha)	2	
Industrial Area (Ha)	0	
Institutional Area (Ha)		
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	204	
Equivalent Population (Industrial)	0	
Equivalent Population (Institutional)	0	
Sub-Total Population (Com/Ind/Inst)	204	
Peaking Factor (Harmon) - Residental	3.9	
Peaking Factor (Harmon) - Comm / Indust / Inst	3.3	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	281.58	4.7 (L/s)
Average Day Flow (L/min)	462.6	7.7 (L/s)
Peak Hour Flow (L/min)	961.7	16.0 (L/s)

Flow Determination - Catchment Area G

Location:	To MH 34	
Residential Area (Ha)	11.7	
Residential Population	540	
Commercial Area (Ha)	3.3	
Industrial Area (Ha)	0	
Institutional Area (Ha)		
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	336	
Equivalent Population (Industrial)	0	
Equivalent Population (Institutional)	0	
Sub-Total Population (Com/Ind/Inst)	336	
Peaking Factor (Harmon) - Residental	4.0	
Peaking Factor (Harmon) - Comm / Indust / Inst	3.2	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	234	3.9 (L/s)
Average Day Flow (L/min)	401.3	6.7 (L/s)
Peak Hour Flow (L/min)	850.3	14.2 (L/s)

Flow Determination - Catchment Area H

Location:	To MH 9	
Residential Development Area (Ha)	48	
Residential Population	1825	
Commercial Area (Ha)	0	
Industrial Area (Ha)	0	
Institutional Area (Ha)	0	
Residential Flow (L/p/day)	275	
Commercial Flow (L/ha/day)	28000	
Industrial Flow (L/ha/day)	39000	
Institutional Flow (L/ha/day)	34000	
Equivalent Population (Commercial)	0	
Equivalent Population (Industrial)	0	
Equivalent Population (Institutional)	0	
Sub-Total Population (Com/Ind/Inst)	0	
Peaking Factor (Harmon) - Residental	3.6	
Peaking Factor (Harmon) - Comm / Indust / Inst	0.0	** 80% of Residental Peaking Factor*
Inflow & Infiltration Allowance (L/s/ha)	0.26	
Infiltration Allowance (L/ min)	748.8	12.5 (L/s)
Average Day Flow (L/min)	1097.3	18.3 (L/s)
Peak Hour Flow (L/min)	2009.2	33.5 (L/s)

COMPUTATIONS FOR CAPACITIES OF SANITARY SEWER **CITY OF ST. JOHN'S**

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Date: March 2014

Location	Manhole Number		Length	Area		Land Use	Equivalent Population	Peak Flow Factor	Actual Flow			Pipe Capacity						
	From	To	(m)	Increment (ha)	Total (ha)				Sewage (L/s)	Infiltration (L/s)	Total (L/s)	Diameter (mm)	Slope (m/m)	Manning's n	Full Velocity (m/s)	Partial Velocity (m/s)	Full Capacity (L/s)	Additional Capacity (L/s)
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
		1		34.9	34.9	Res	1333	3.7	15.8	9.1	24.8							
	1	2	98		34.9	Res	1333	3.7	15.8	9.1	24.8	200	0.0273	0.013	1.73	1.68	54.20	29.36
	Lift Station	2		8.6	43.5	Res	328	4.1	4.2	11.3	15.6							
	2	3	120		43.5	Res	1661	3.6	19.3	11.3	30.6	200	0.046	0.013	2.24	2.13	70.35	39.76
	3	4	96		43.5	Res	1661	3.6	19.3	11.31	30.6	200	0.077	0.013	2.90	2.64	91.02	60.43
		4		4.3	4.3	Res	164	4.2	2.2	1.1	3.3							
Catchment Area H	4	5	120	0.24	48.0	Res	1825	3.6	21.0	12.5	33.5	200	0.086	0.013	3.06	2.79	96.19	62.69
	5	6	95	0.19	48.2	Res	1825	3.6	21.0	12.5	33.5	200	0.046	0.013	2.24	2.15	70.35	36.80
	6	7	70	0.14	48.4	Res	1825	3.6	21.0	12.6	33.6	200	0.027	0.013	1.72	1.79	53.90	20.31
	7	8	106	0.21	48.6	Res	1825	3.6	21.0	12.6	33.6	250	0.015	0.013	1.48	1.45	72.84	39.20
	8	**9 - Existing System on Messenger Drive**	**120**	**0.24**	**48.8**	**Res**	**1825**	**3.6**	**21.0**	**12.7**	**33.7**	**250**	**0.037**	**0.013**	**2.33**	**2.04**	**114.40**	**80.70**
		10		6.13	6.13	Res	234	4.1	3.1	1.6	4.7							
	10	11	88		6.13	Res	234	4.1	3.1	1.6	4.7	200	0.037	0.013	2.01	1.16	63.09	58.43
		13		29.2	29.2	Res	1304	3.7	15.5	7.6	23.0							
Catchment Area D	13	14	90	0.18	35.3	Res	1304	3.7	15.5	9.2	24.6	200	0.075	0.013	2.86	2.43	89.83	65.19
	14	15	80	0.16	35.5	Res	1304	3.7	15.5	9.2	24.7	200	0.015	0.013	1.28	1.38	40.17	15.49
	15	11	84	0.17	35.7	Res	1304	3.7	15.5	9.3	24.7	200	0.04	0.013	2.09	1.92	65.60	40.88
	11	**12 - Existing System at Tigress Street**	**77**	**0.16**	**35.8**	**Res**	**1538**	**3.7**	**18.0**	**9.3**	**27.3**	**200**	**0.016**	**0.013**	**1.32**	**0.00**	**41.49**	**14.20**
		16		10.86	10.86	Res	485	4.0	6.1	2.8	9.0	200						
	16	17	120	0.36	11.22	Res	485	4.0	6.1	2.9	9.1	200	0.005	0.013	0.74	0.69	23.19	14.13
	17	18	120	0.36	11.58	Res	485	4.0	6.1	3.0	9.2	200	0.007	0.013	0.87	0.79	27.44	18.29
	18	19	90	0.36	11.94	Res	485	4.0	6.1	3.1	9.2	200	0.021	0.013	1.51	1.17	47.53	38.28
	19	20	90	0.36	12.3	Res	485	4.0	6.1	3.2	9.3	200	0.013	0.013	1.19	0.99	37.40	28.06
Catchment Area C	20	22	77	0.36	12.66	Res	485	4.0	6.1	3.3	9.4	200	0.03	0.013	1.81	1.36	56.81	47.38
		21			10.74	Res	497	4.0	6.3	2.8	9.1							
	21	22	100	0.36	11.1	Res	497	4.0	6.3	2.9	9.2	200	0.044	0.013	2.19	1.53	68.80	59.63
	22	**23 - Existing System at Lady Anderson Street**	**73**	**0.36**	**24.12**	**Res**	**982**	**3.8**	**11.9**	**6.3**	**18.2**	**200**	**0.05**	**0.013**	**2.34**	**1.94**	**73.35**	**55.18**

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		24		16.47	16.47	Res	763	3.9	9.4									
		24		0.34	0.34	Comm	35	3.5	0.4									
	24	25	85	16.81	16.81		798		9.8	4.4	14.2	200	0.07	0.013	2.76	2.05	86.78	72.62
	25	26	120	0.52		Comm	53	3.4	0.6									
	25	26	100		17.33		851		10.4	4.5	14.9	200	0.019	0.013	1.44	1.28	45.21	30.34
	26	27	120	0.52		Comm	53	3.4	0.6	0.0	0.6							
	26	27	100		17.85		904		11.0	4.6	15.6	200	0.012	0.013	1.14	1.09	35.93	20.34
	27	28	120	0.52		Comm	53	3.4	0.6	0.0	0.6							
	27	**28**	**86.5**		**18.37**		**957**		**11.5**	**4.8**	**16.3**	**200**	**0.0075**	**0.013**	**0.90**	**0.97**	**28.41**	**12.10**
		29		16.05	16.05	Res	744	3.9	9.2									
		29		0.34	0.34	Comm	35	3.5	0.4									
		29		2.1	2.1	Inst	260	3.3	2.7									
Catchment Area G	29	30	84	18.49	18.49		1004		12.3	4.8	17.1	200	0.0075	0.013	0.90	0.98	28.41	11.30
	30	31	120	0.56		Comm	57	3.4	0.6	0.0	0.6							
	30	31	110		19.05		1061		12.9	5.0	17.9	200	0.05	0.013	2.34	1.92	73.35	55.47
	31	32	120	0.56		Comm	57	3.4	0.6	0.0	0.6							
	31	32	100		19.61		1118		13.5	5.1	18.6	200	0.052	0.013	2.38	1.98	74.80	56.15
	32	27	120	0.56		Comm	57	3.4	0.6	0.0	0.6							
	32	**28**	**96**		**20.17**		**1175**		**14.2**	**5.2**	**19.4**	**200**	**0.032**	**0.013**	**1.87**	**1.68**	**58.68**	**39.26**
		34		11.66	11.66	Res	540	4.0	6.8									
		34		3.26	3.26	Comm	332	3.2	3.4									
	34	**28**	**84**	**14.92**	**14.92**		**872**		**10.2**	**3.9**	**14.1**	**200**	**0.032**	**0.013**	**1.87**	**1.64**	**58.68**	**44.57**
	28	**33 - Existing System at Great Eastern Ave**	**15**		**53.46**		**3004**		**35.9**	**13.9**	**49.8**	**200**	**0.037**	**0.013**	**2.01**	**2.24**	**63.09**	**13.26**
Catchment Area B	47	48	120	45.55	45.55	Com / Indust	5626	2.6	45.8	11.8	57.6	250	0.018	0.013	1.63	1.77	79.79	22.15
	48	49	120	45.55	45.55	Com / Indust	5626	2.6	45.8	11.8	57.6	250	0.015	0.013	1.48	1.65	72.84	15.20
	49	**Lift Station**	**20**	**45.55**	**45.55**	**Com / Indust**	**5626**	**2.6**	**45.8**	**11.8**	**57.6**	**250**	**0.015**	**0.013**	**1.48**	**1.65**	**72.84**	**15.20**
Catchment Area B		36	120	19.75	19.75	C / I / I	2219	2.8	20.1	5.1	25.2							
	36	**37 - New Sewer Main on Kenmount Rd**	**106**	**19.75**	**19.75**	**C / I / I**	**2219**	**2.8**	**20.1**	**5.1**	**25.2**	**250**	**0.01**	**0.013**	**1.21**	**1.15**	**59.47**	**34.24**
Kenmount Road	Focemain	37		45.55	45.55	Com / Indust	5626	2.6	45.8	11.8	57.6							
	36	37		19.75	19.75	C / I / I	2219	2.8	20.1	5.1	25.2							
	37	38	66	0.24	65.54	Com / Indust	7845	2.5	62.4	17.0	79.5	250	0.015	0.013	1.48	1.65	72.84	-6.63
	38	39	70	0.24	65.78	Com / Indust	7845	2.5	62.4	17.1	79.5	250	0.041	0.013	2.45	2.45	120.42	40.90
	39	40	120	0.24	66.02	Com / Indust	7845	2.5	62.4	17.2	79.6	250	0.047	0.013	2.63	2.50	128.93	49.34
	40	41	120	0.24	66.26	Com / Indust	7845	2.5	62.4	17.2	79.7	250	0.035	0.013	2.27	2.38	111.26	31.61
	41	42	120	0.24	66.5	Com / Indust	7845	2.5	62.4	17.3	79.7	300	0.016	0.013	1.73	1.92	122.33	42.61
	42	43	120	0.24	66.74	Com / Indust	7845	2.5	62.4	17.4	79.8	300	0.015	0.013	1.68	1.88	118.44	38.67
	43	44	120	0.24	66.98	Com / Indust	7845	2.5	62.4	17.4	79.8	300	0.029	0.013	2.33	2.40	164.69	84.85
	44	45	120	0.24	67.22	Com / Indust	7845	2.5	62.4	17.5	79.9	300	0.03	0.013	2.37	2.42	167.50	87.60
	33 (Area G)	45			53.46	Com / Res	3004		35.9	13.9	49.8							
	45	46	70	0.24	120.92		10849		98.36	31.4	129.8	300	0.02	0.013	1.94	2.17	136.77	6.97
	46	**Existing Behind Canadian Tire**	**3000**	**6**	**126.92**		**10849**		**98.36**	**33.0**	**131.4**	**300**	**0.02**	**0.013**	**1.94**	**2.17**	**136.77**	**5.41**
		50		9.75	9.75	Res	457	4.0	5.8	2.5	8.3								

COMPUTATIONS FOR CAPACITIES OF SANITARY SEWER **CITY OF ST. JOHN'S**
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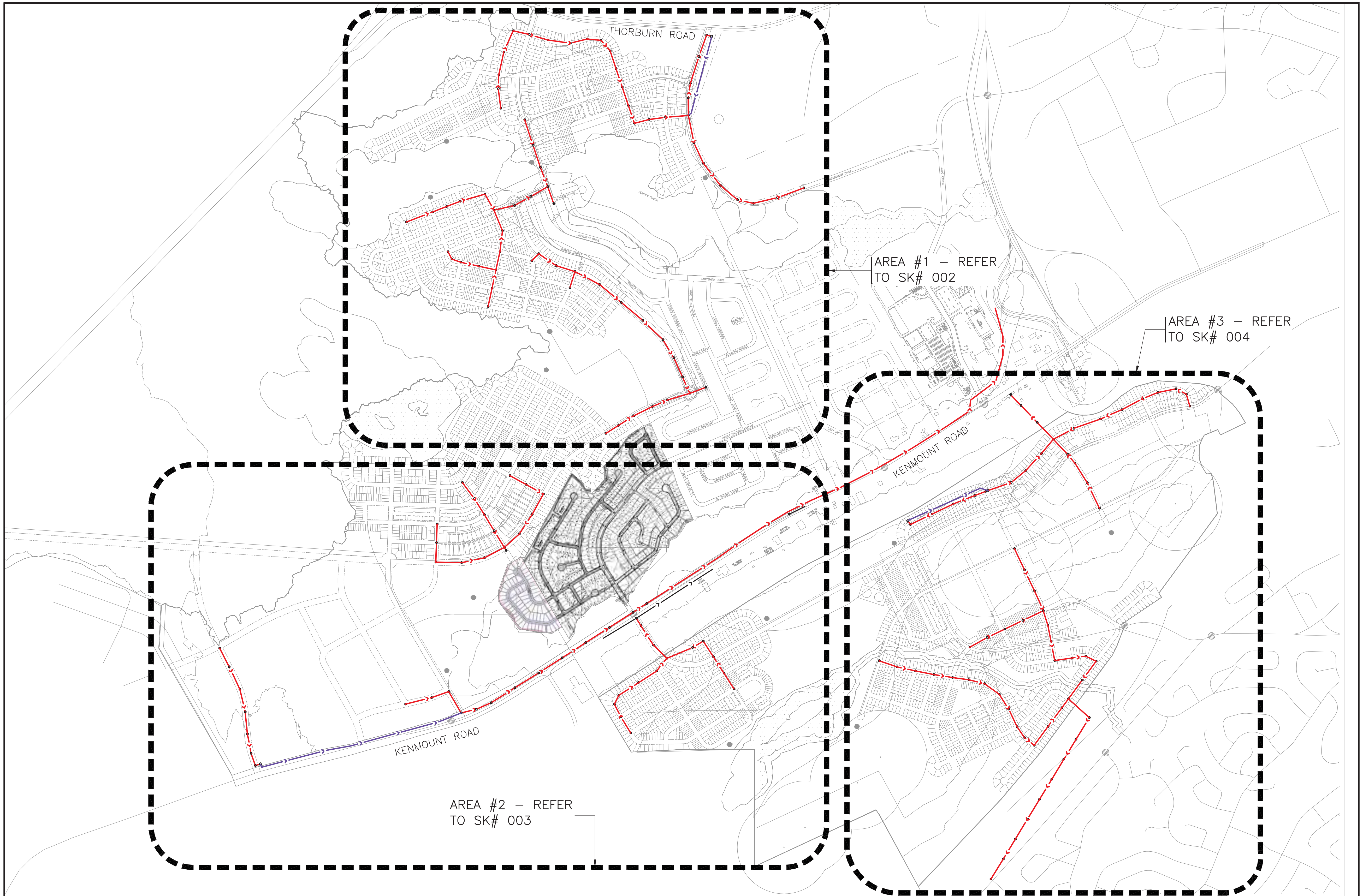
Catchment Area A	50	52	70	9.75	9.75	Res	457	4.0	5.8	2.5	8.3	200	0.042	0.013	2.14	1.45	67.22	58.88
		51		19.1	19.1	Res	895	3.8	10.9	5.0	15.9	200						
	51	52	120	19.1	19.1	Res	895	3.8	10.9	5.0	15.9	200	0.037	0.013	2.01	1.67	63.09	47.22
	52	53	80	0.36	29.21	Res	1352	3.7	16.0	7.6	23.6	200	0.1	0.013	3.30	2.81	103.73	80.16
	53	54	100	0.36	29.57	Res	1352	3.7	16.0	7.7	23.7	200	0.042	0.013	2.14	1.83	67.22	43.56
	54	**55 - Existing Main on South side of Kenmount Rd**	**37**	**0.18**	**29.75**	**Res**	**1352**	**3.7**	**16.0**	**7.7**	**23.7**	**200**	**0.072**	**0.013**	**2.80**	**2.21**	**88.01**	**64.31**
Catchment Area F		56		10.44	10.44	Res	338	4.1	4.4									
		56		18.61	18.61	Comm	5885	2.5	15.3									
	56	58	100	29.05	29.05		6223		19.7	7.6	27.3	200	0.036	0.013	1.98	1.90	62.24	34.98
		57		17.41	17.41	Res	563	3.9	7.1									
		57		8.69	8.69	Comm	885	3.1	8.6									
	57	58	80	26.1	26.1		1448		15.7	6.8	22.5	200	0.06	0.013	2.56	2.20	80.35	57.85
	58	59	100	0.24	55.39	Res / Comm	7671		35.4	14.4	49.8	200	0.06	0.013	2.56	2.66	80.35	30.53
	59	60	100	0.24	55.63	Res / Comm	7671		35.4	14.5	49.9	200	0.1	0.013	3.30	0.00	103.73	53.86
	60	**Existing Main on South side of Kenmount Rd**	**65**	**0.24**	**55.63**	**Res / Comm**	**7671**		**35.4**	**14.5**	**49.9**	**200**	**0.1**	**0.013**	**3.30**	**3.27**	**103.73**	**53.86**
Catchment Area E		62		31.84	31.84	Res	1030	3.8	12.5									
		62		9.48	9.48	Comm	965	3.0	9.4									
	62	63	100	41.32	41.32		1995		21.8	10.7	32.6	200	0.015	0.013	1.28	1.42	40.17	7.61
	63	67	100		41.32		1995		21.8	10.7	32.6	200	0.031	0.013	1.84	2.21	57.75	25.19
		64		19.9	19.9	Res	1171	3.8	14.2									
		64		7.15	7.15	Comm	728	3.1	7.2									
	64	65	100	27.05	27.05		1899		21.4	7.0	28.4	200	0.02	0.013	1.48	1.55	46.39	17.99
	65	66	100	27.05	27.05		1899		21.2	7.0	28.2	200	0.02	0.013	1.48	1.55	46.39	18.15
	66	67	48	27.05	27.05		1899		21.2	7.0	28.2	200	0.015	0.013	1.28	1.37	40.17	11.94
	67	68	120	68.37	68.37		3894		43.0	17.8	60.8	250	0.02	0.013	1.71	1.85	84.11	23.31
	68	**76 - Connection at Blackmash Rd / Canada Drive**	**960**	**1.92**	**70.29**		**3894**		**43**	**18.3**	**61.3**	**250**	**0.02**	**0.013**	**1.71**	**1.87**	**84.11**	**22.83**



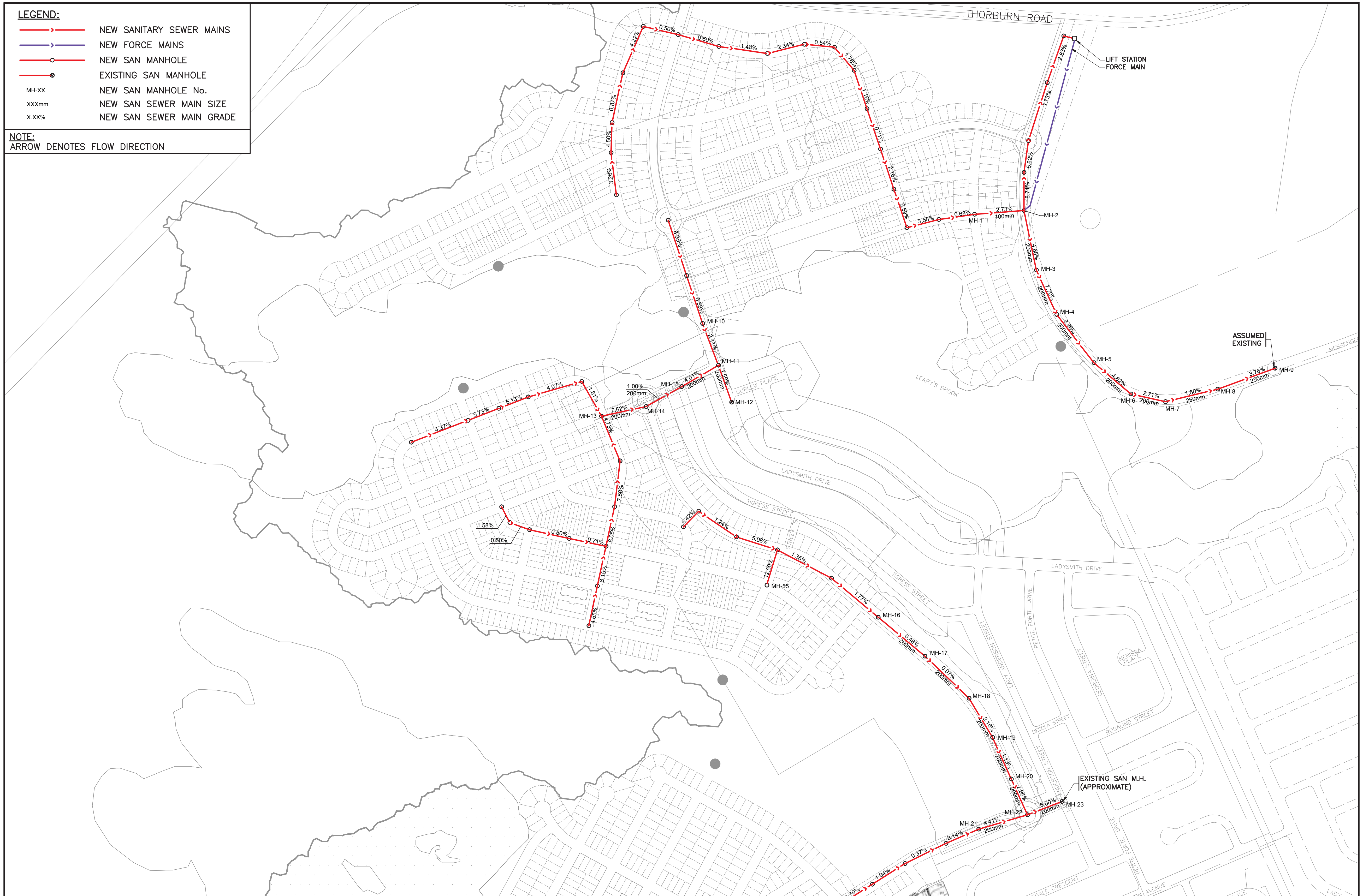
ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

OVERALL SANITARY SEWER PLAN
SK# 001

SCALE = NTS

HATCH

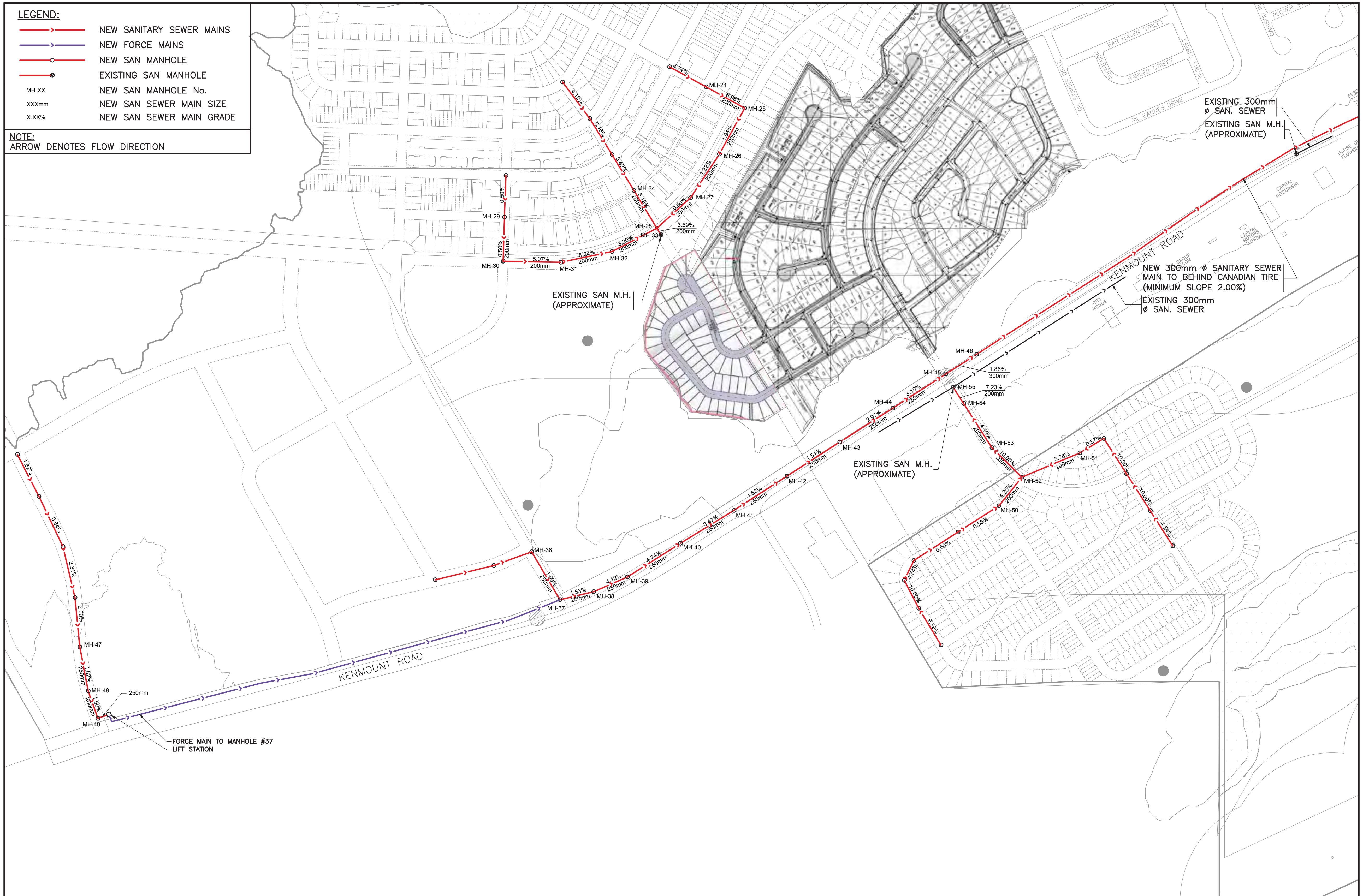
TRACT



ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

PLAN - SAN. SEWER AREA #1
SK# 002

SCALE = NTS



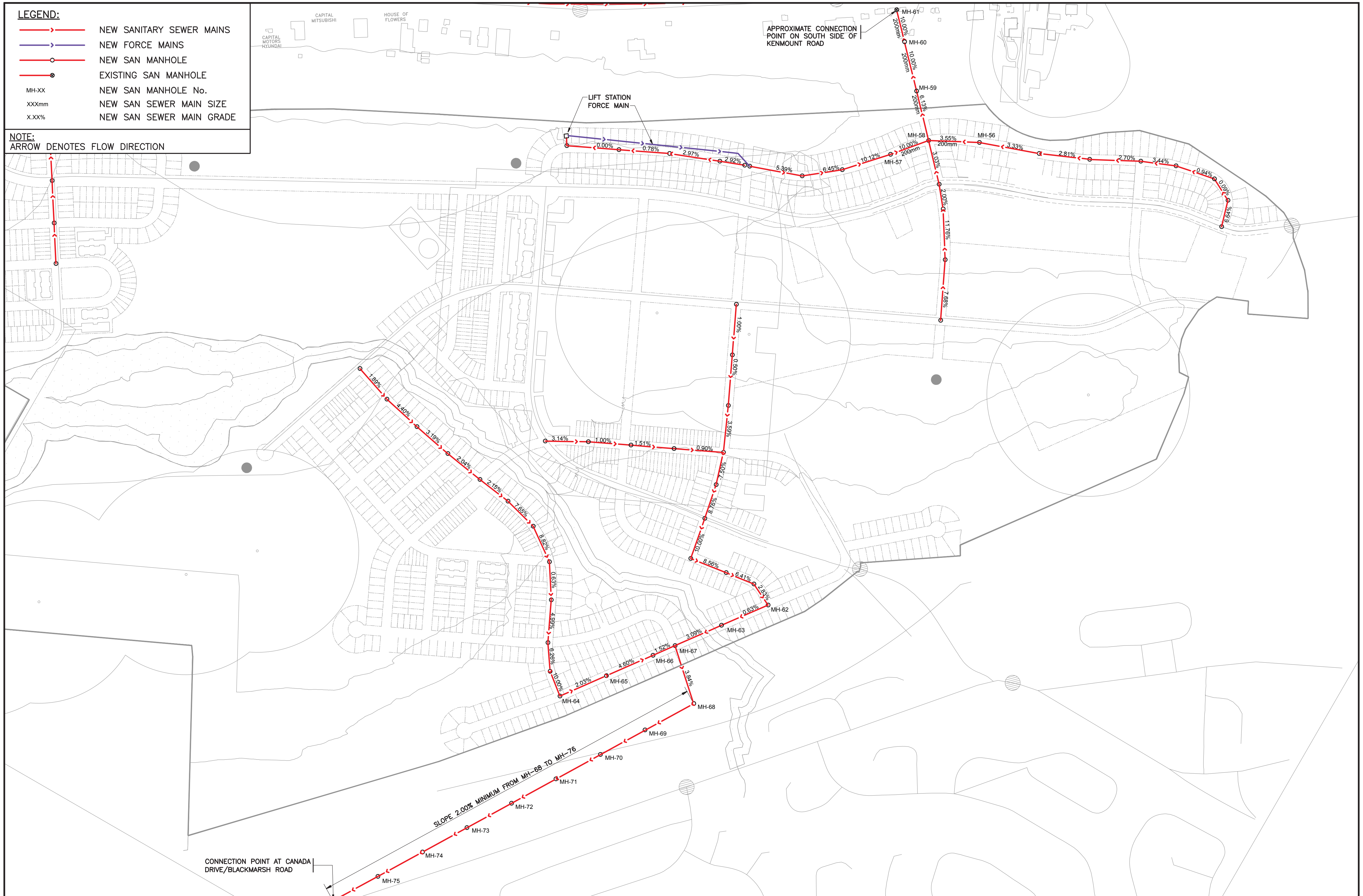
ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

PLAN - SAN. SEWER AREA #2
SK# 003

SCALE = NTS

HATCH

TRACT



ST. JOHN'S LAND USE DEVELOPMENT PLAN A

PLAN - SAN. SEWER AREA #3

SK# 004

SCALE = NTS

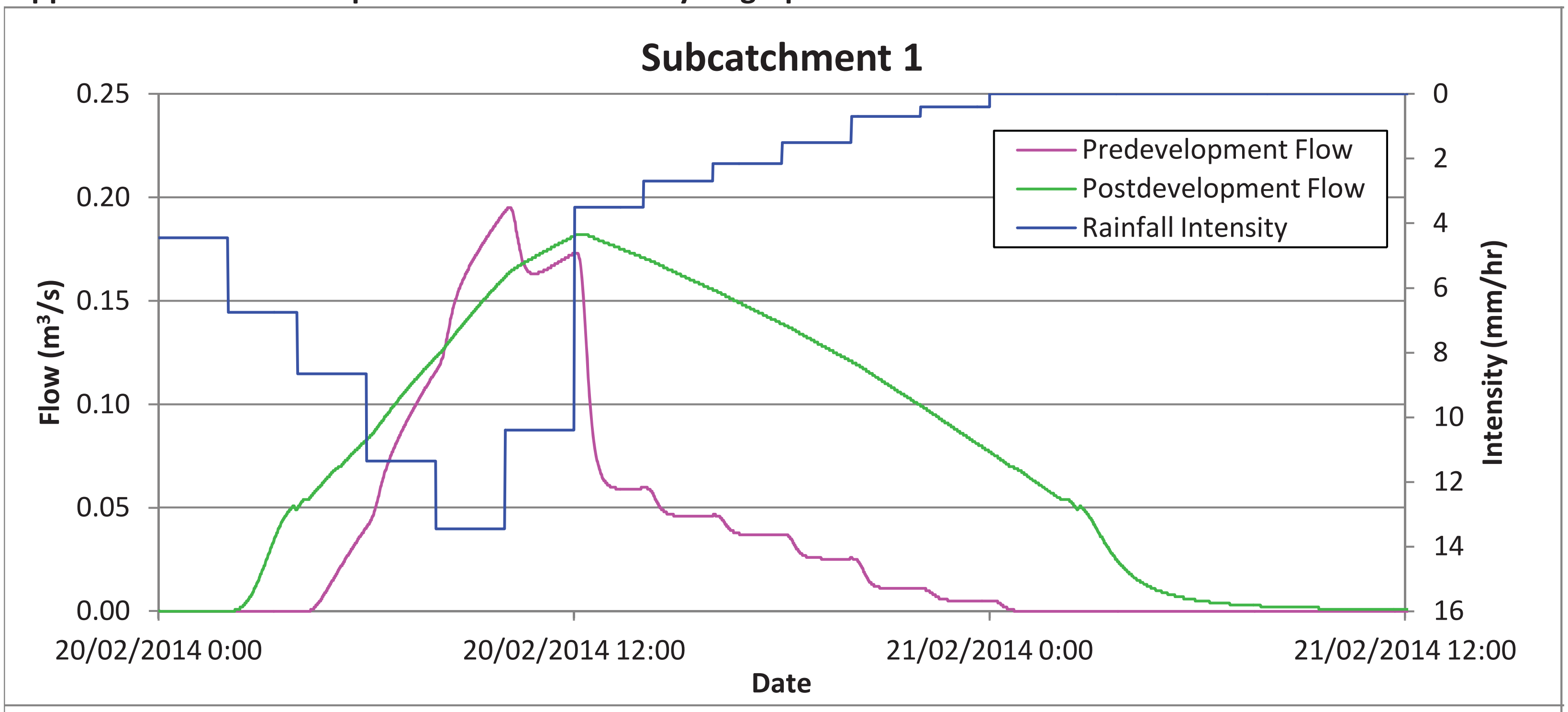
HATCH

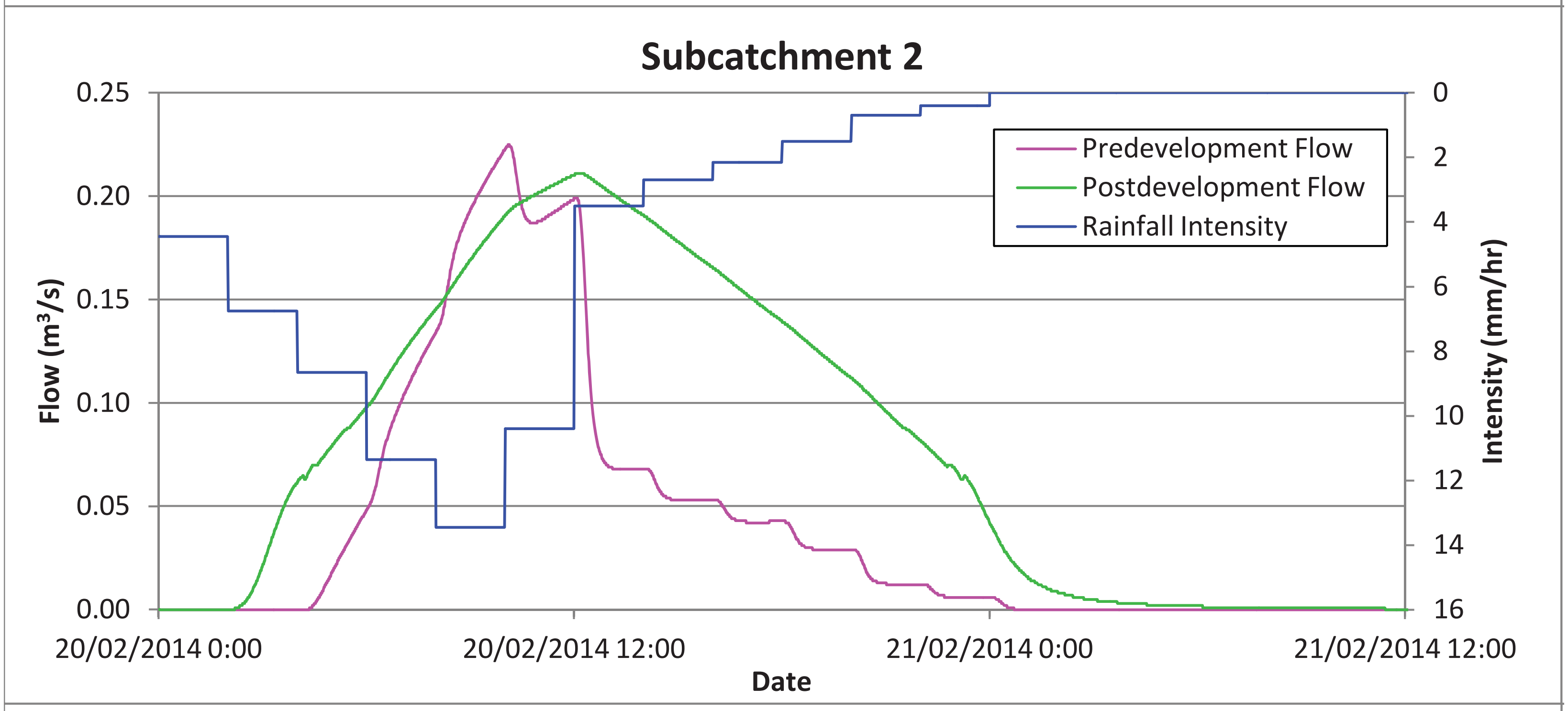
TRACT

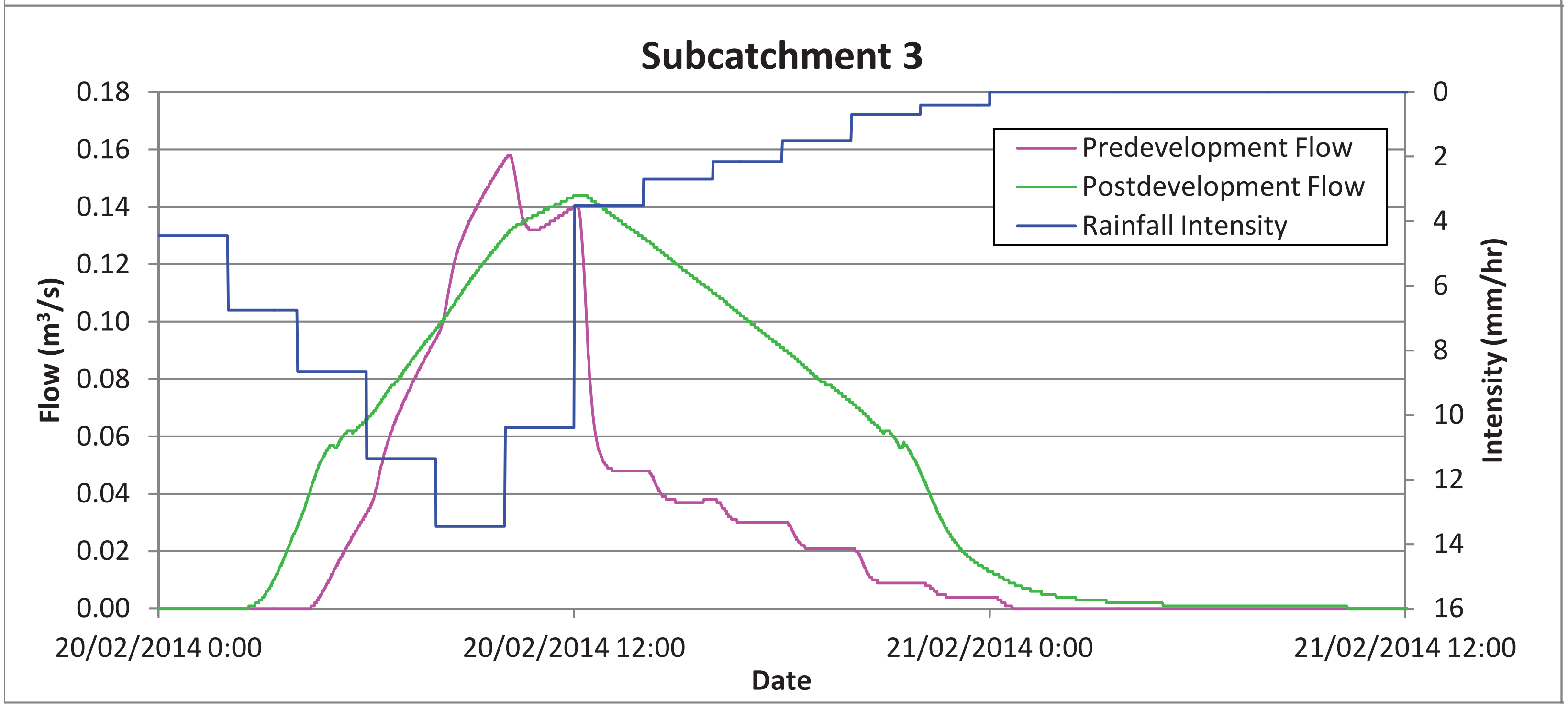
APPENDIX C

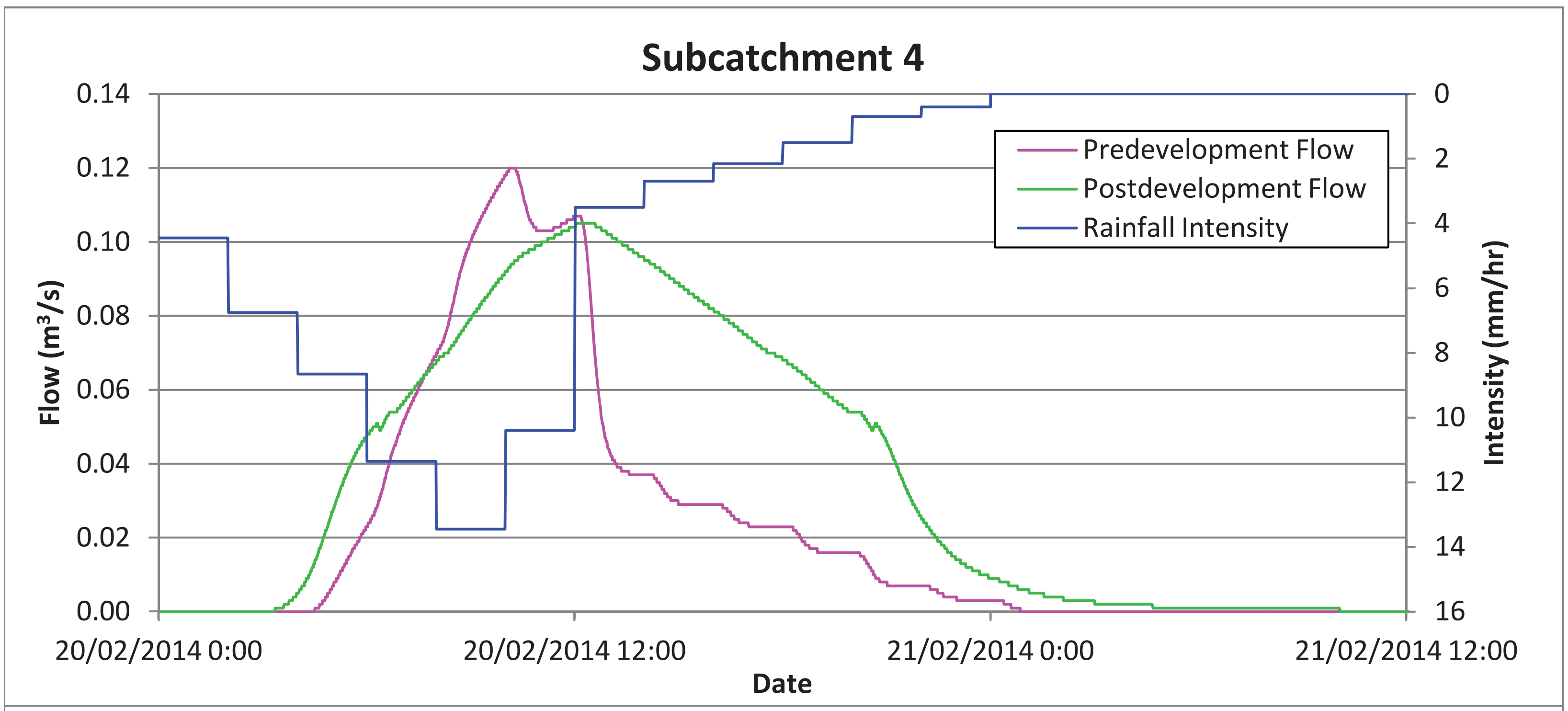
STORM SEWER

Appendix A: Post Development Subcatchment Hydrographs with Stormwater Detention

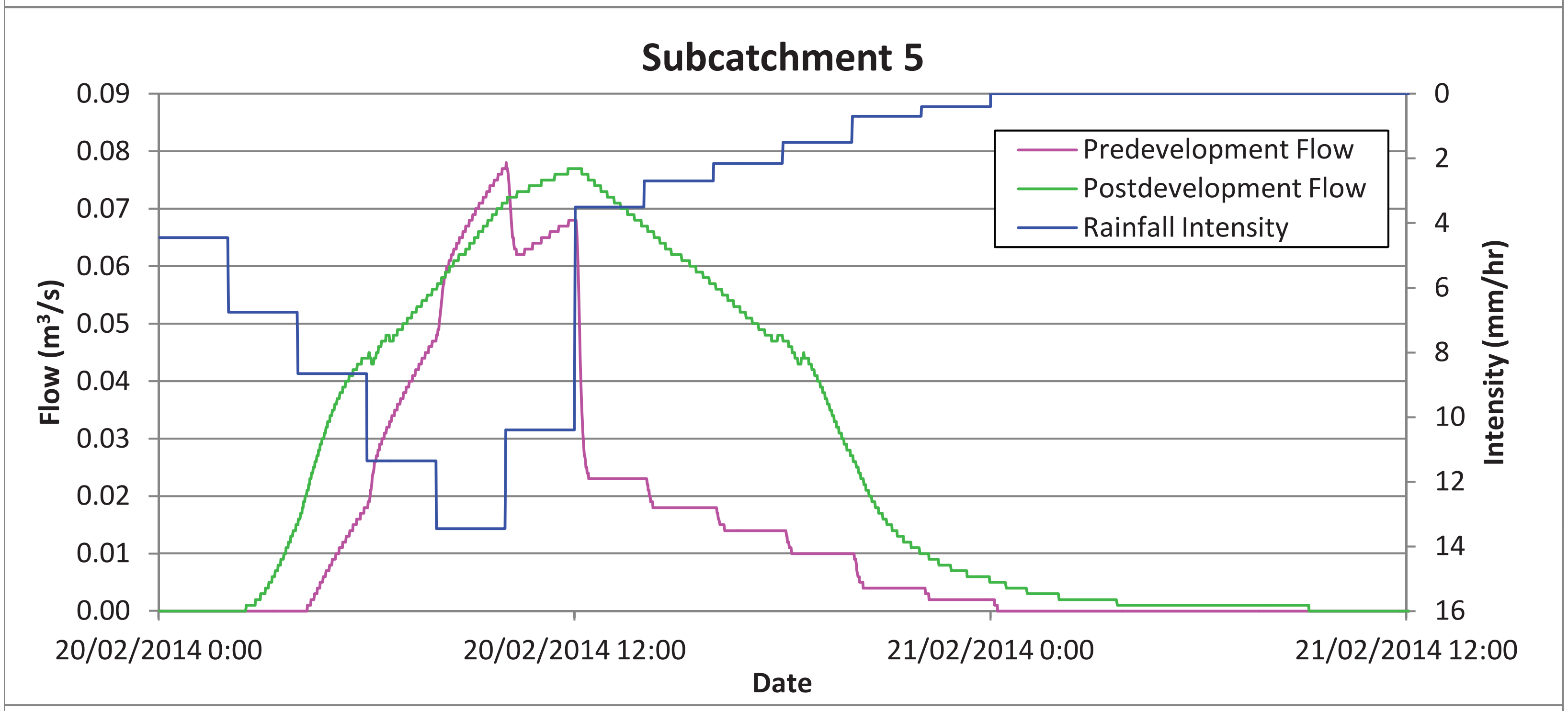




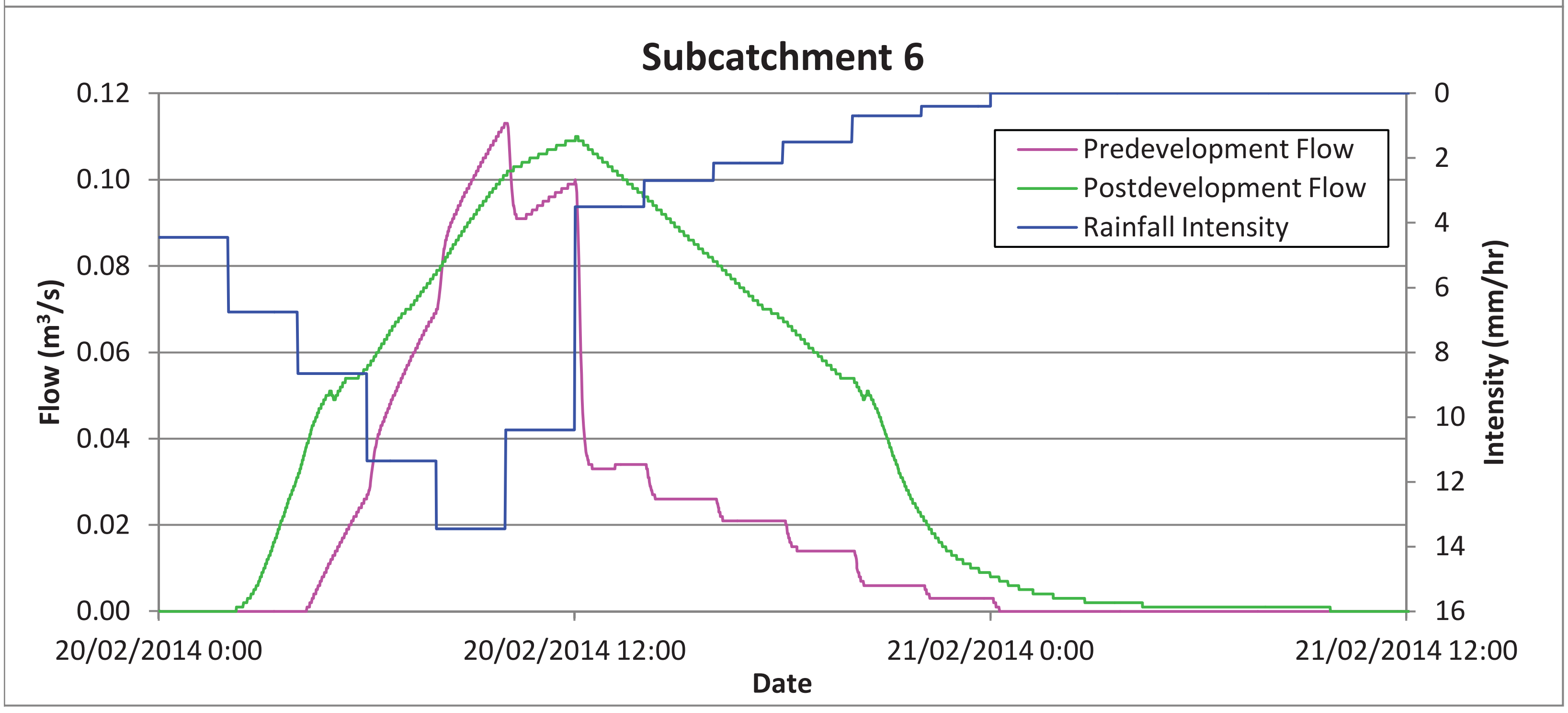




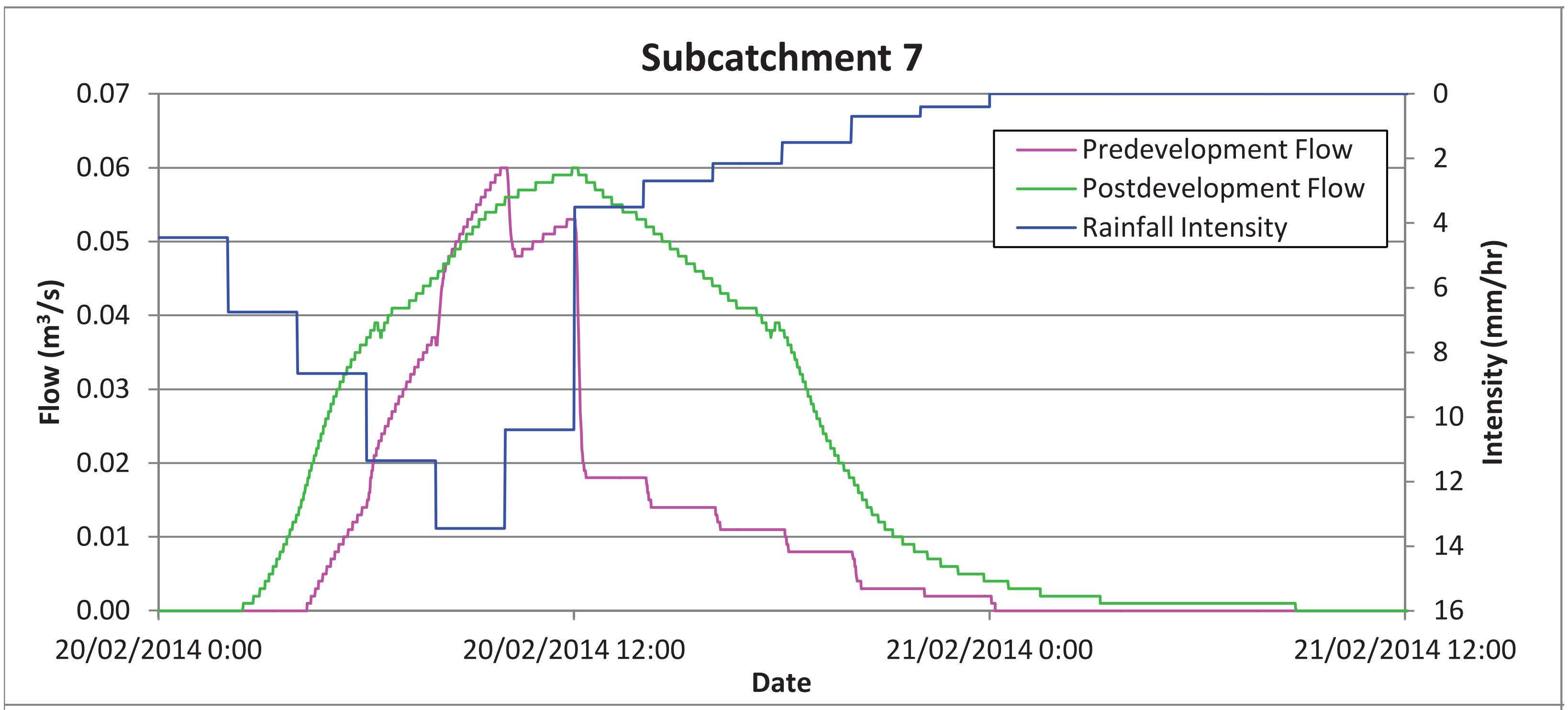
Subcatchment 4
Flow (m³/s)
Intensity (mm/hr)
Date
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
2
4
6
8
10
12
14
16
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00

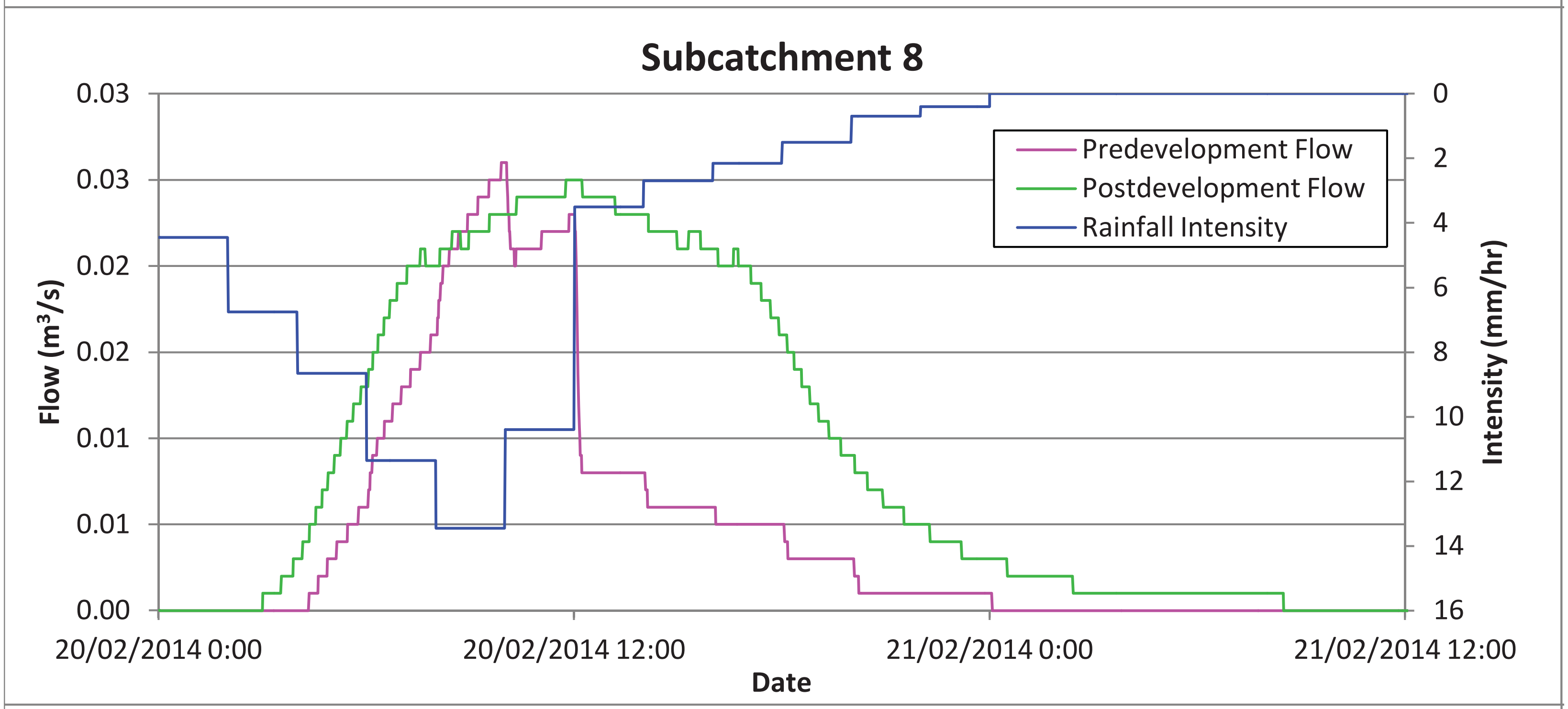


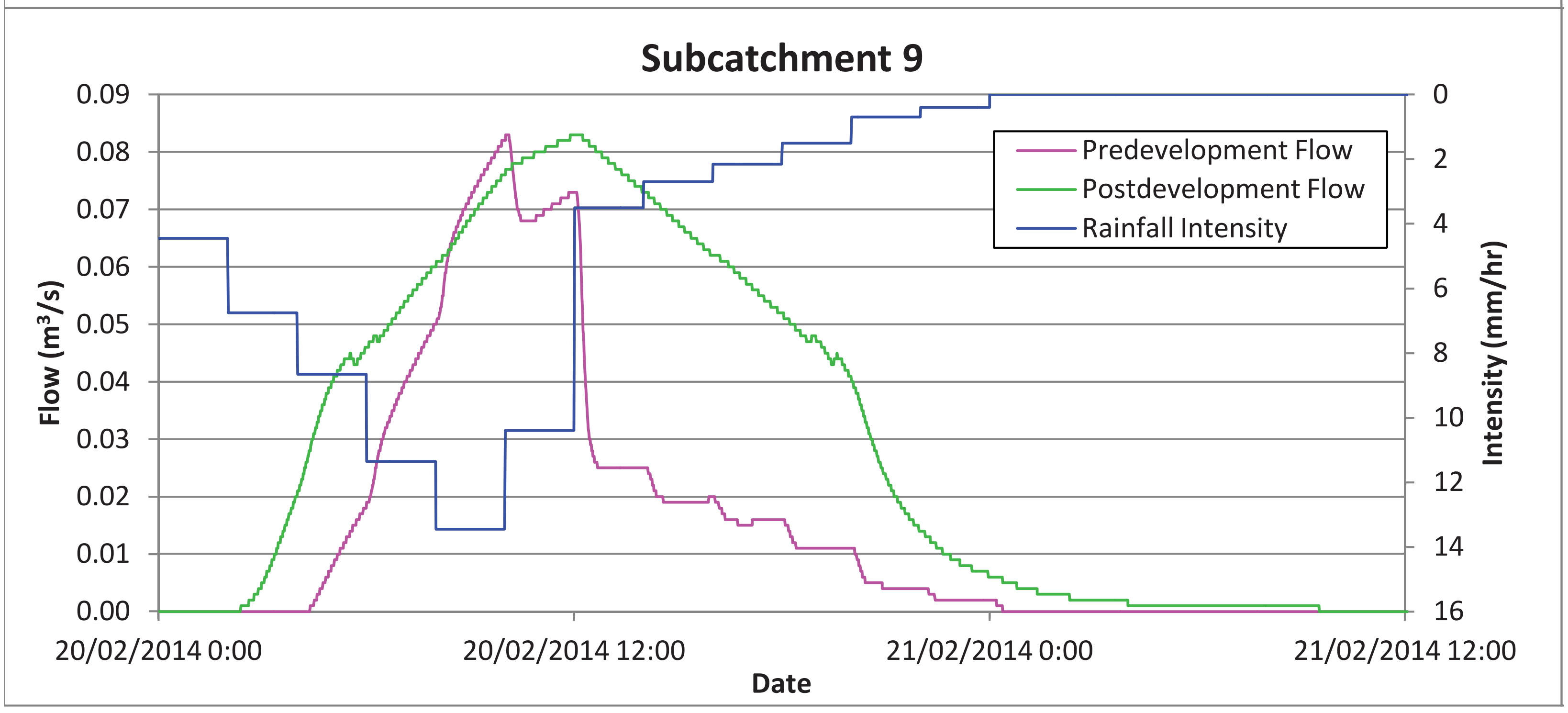
Subcatchment 5
Flow (m³/s)
Intensity (mm/hr)
Date
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
2
4
6
8
10
12
14
16
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00

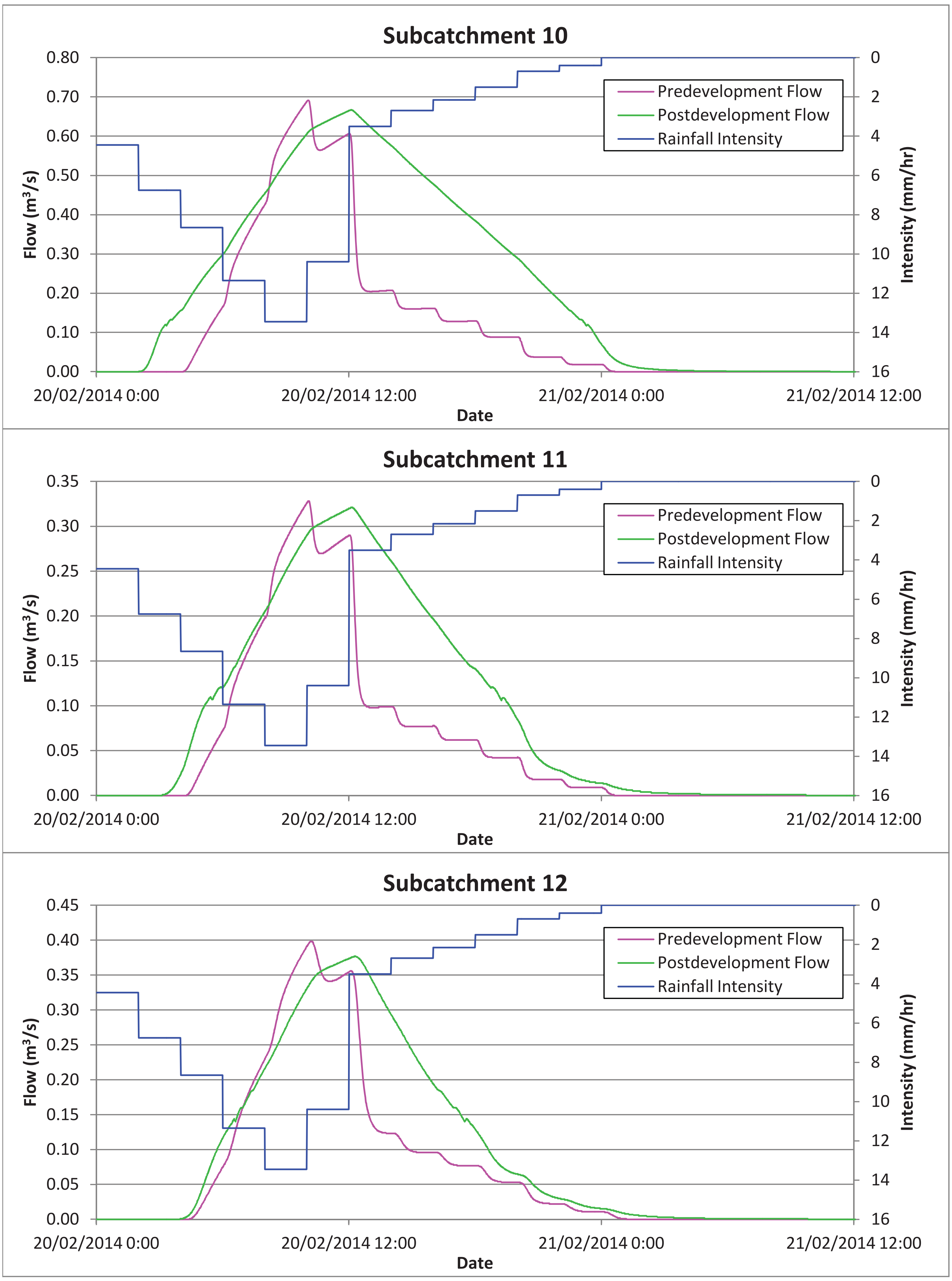


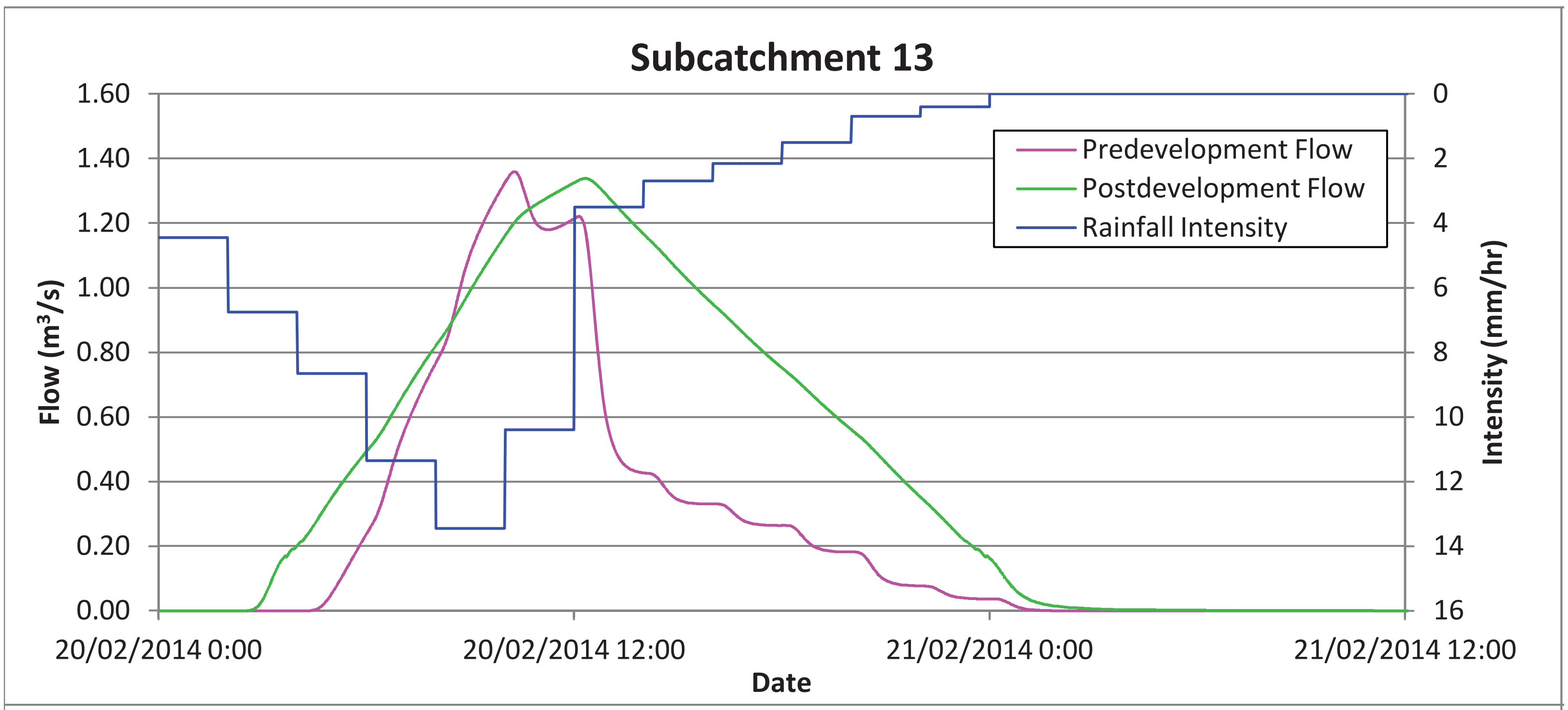
Subcatchment 6
Flow (m³/s)
Intensity (mm/hr)
Date
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
2
4
6
8
10
12
14
16
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00

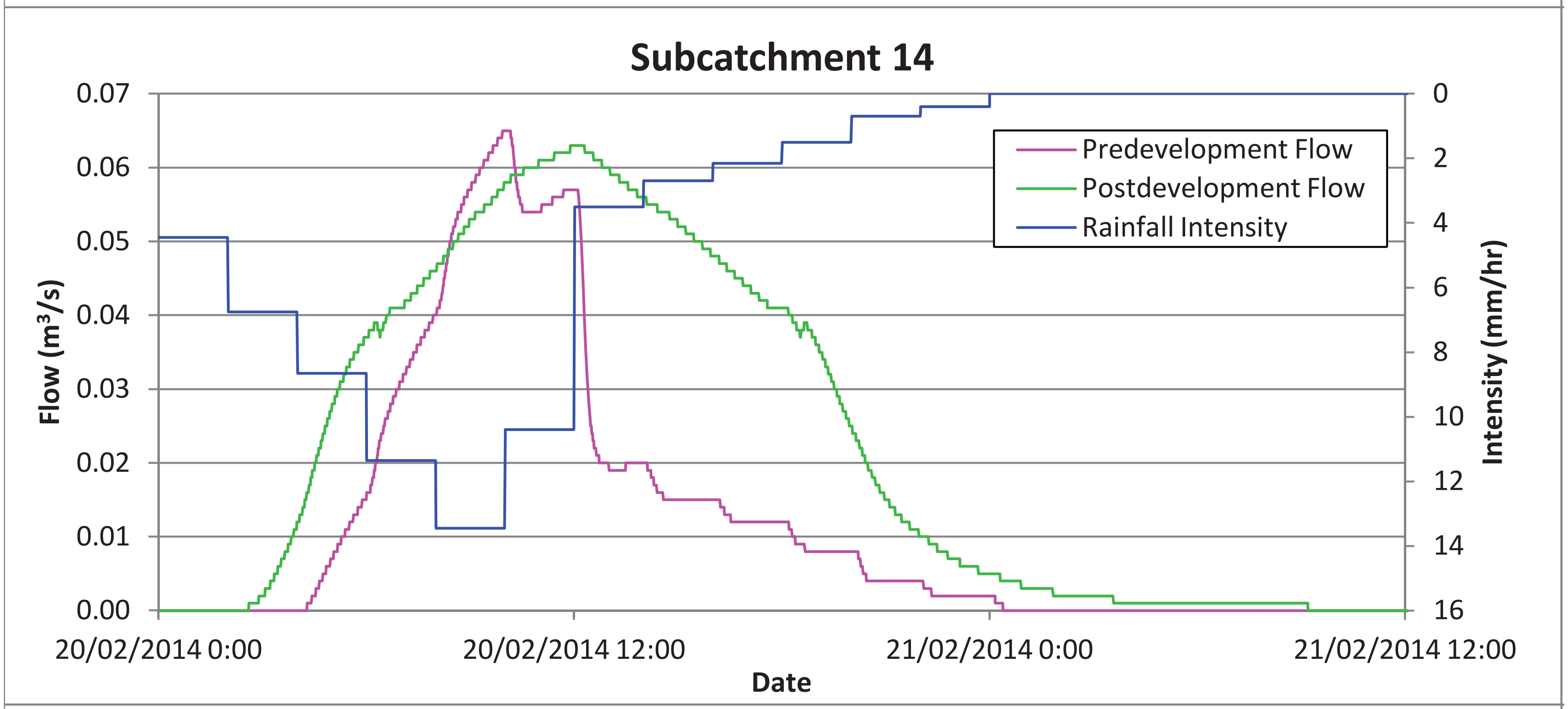

Subcatchment 7
Flow (m³/s)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Intensity (mm/hr)
0
2
4
6
8
10
12
14
16
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date

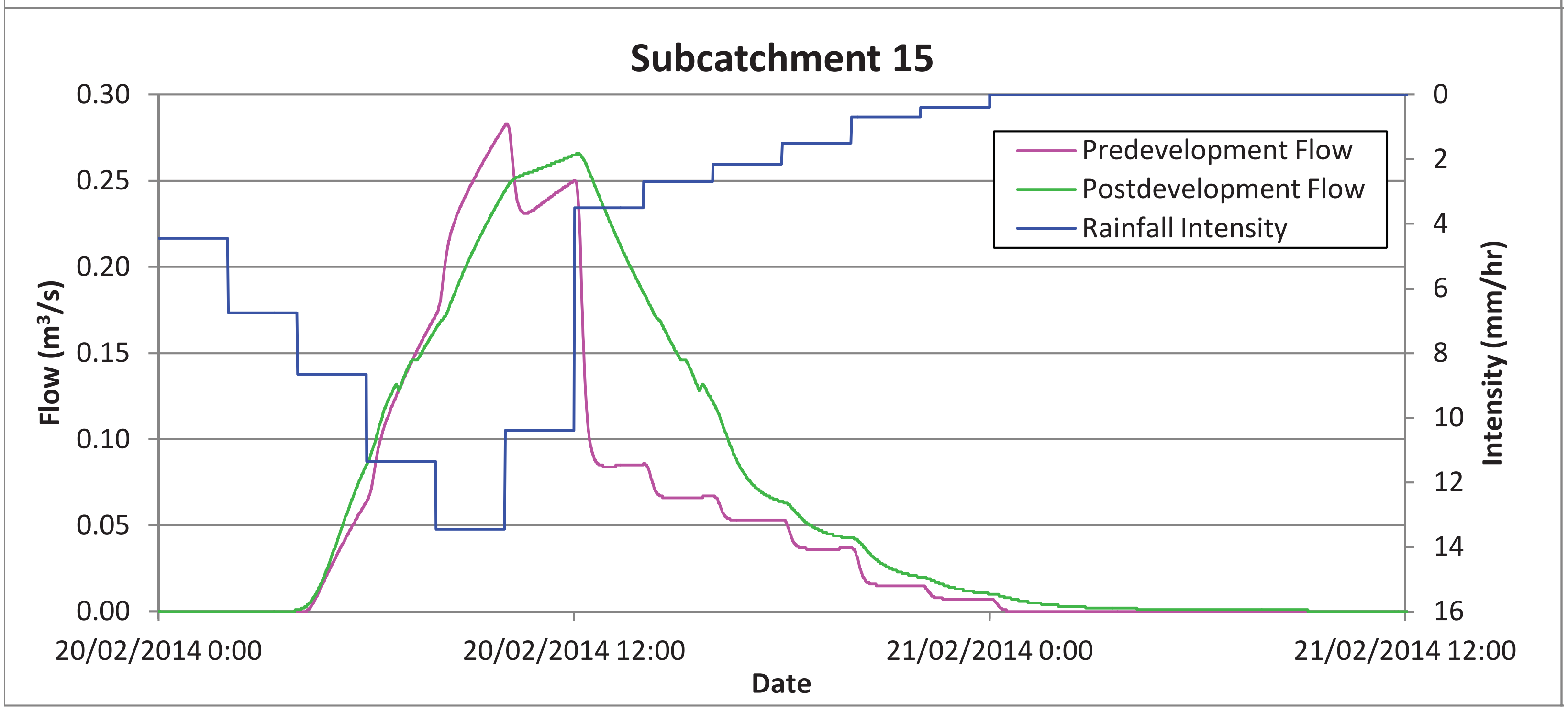

Subcatchment 8
Flow (m³/s)
0.03
0.03
0.02
0.02
0.01
0.01
0.00
Intensity (mm/hr)
0
2
4
6
8
10
12
14
16
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date

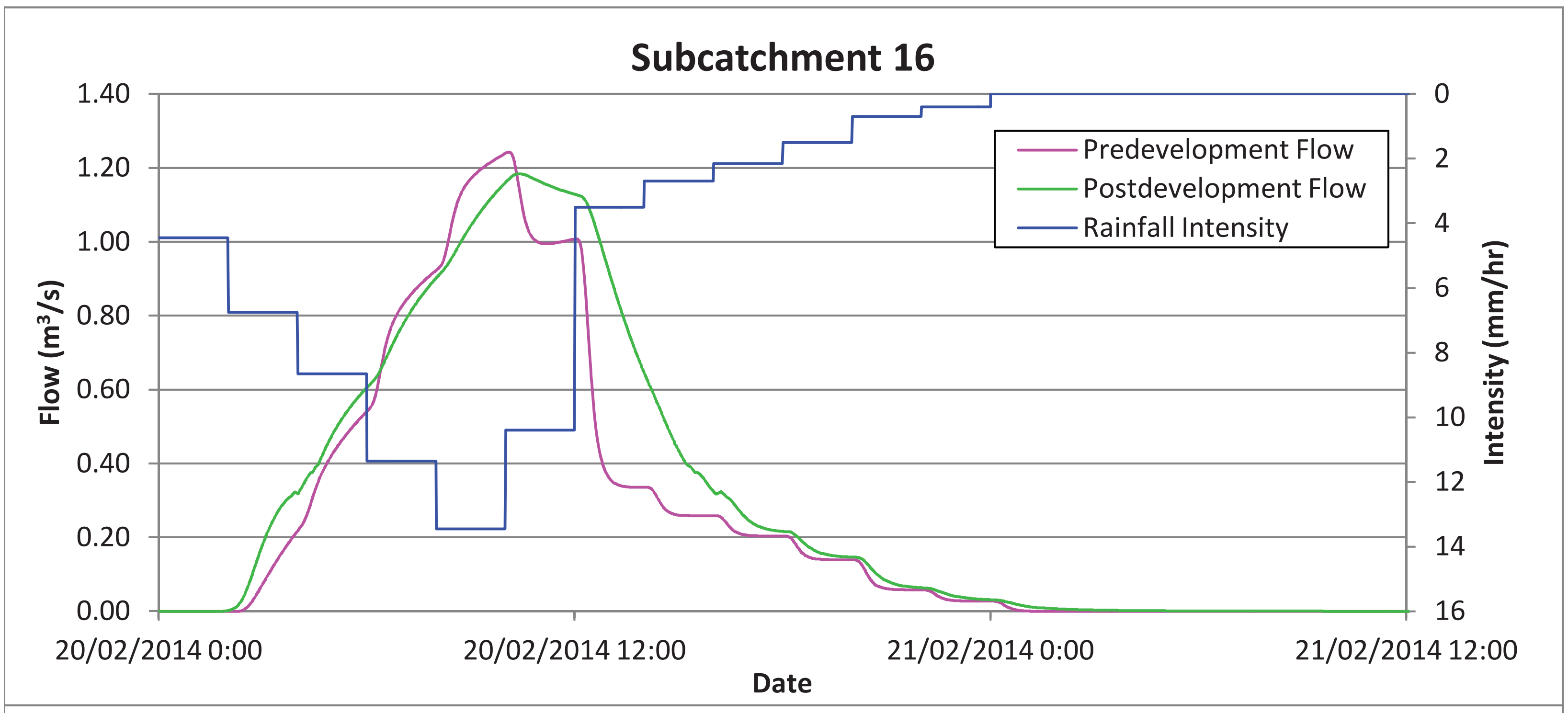

Subcatchment 9
Flow (m³/s)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Intensity (mm/hr)
0
2
4
6
8
10
12
14
16
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date

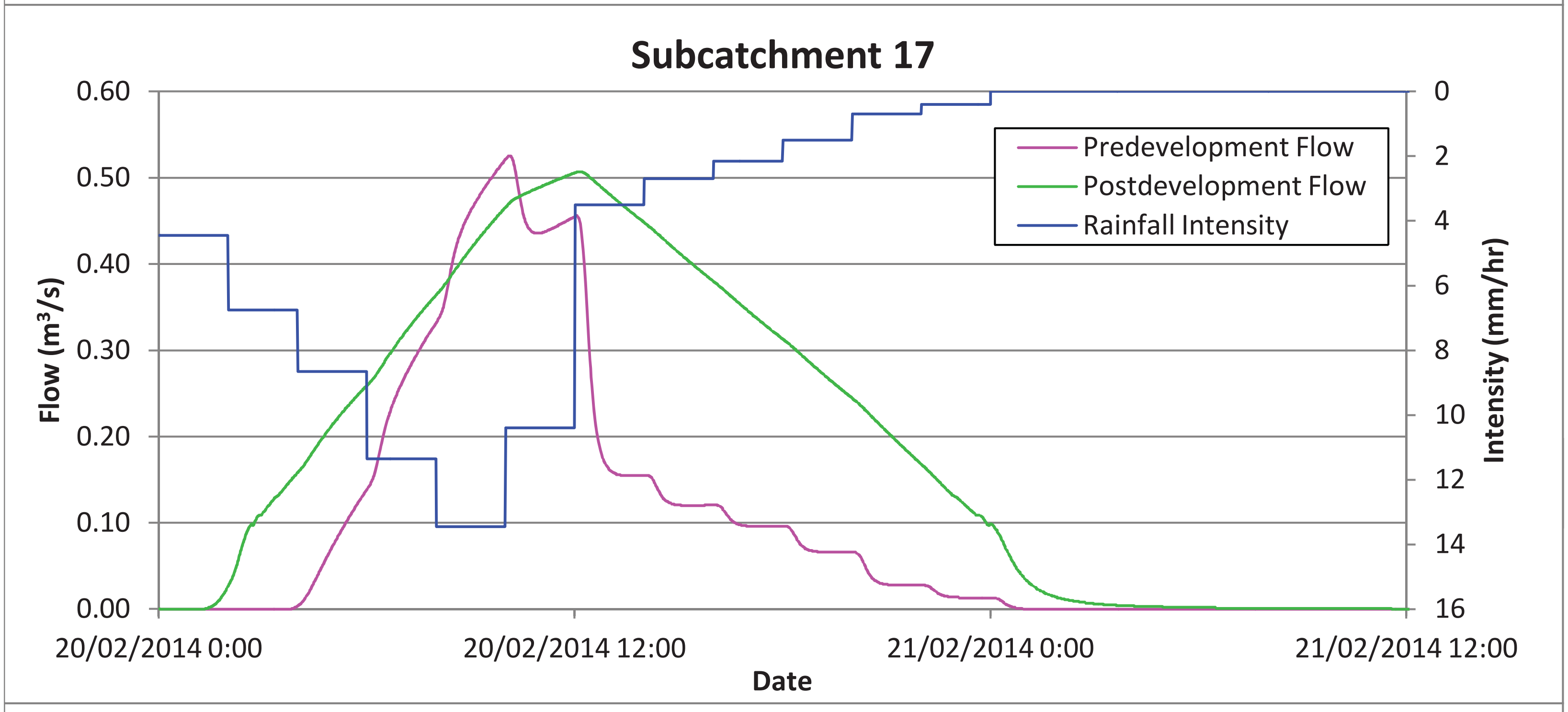

Subcatchment 10
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Flow (m³/s)
0
2
4
6
8
10
12
14
16
Intensity (mm/hr)
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date
Subcatchment 11
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (m³/s)
0
2
4
6
8
10
12
14
16
Intensity (mm/hr)
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date
Subcatchment 12
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (m³/s)
0
2
4
6
8
10
12
14
16
Intensity (mm/hr)
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date

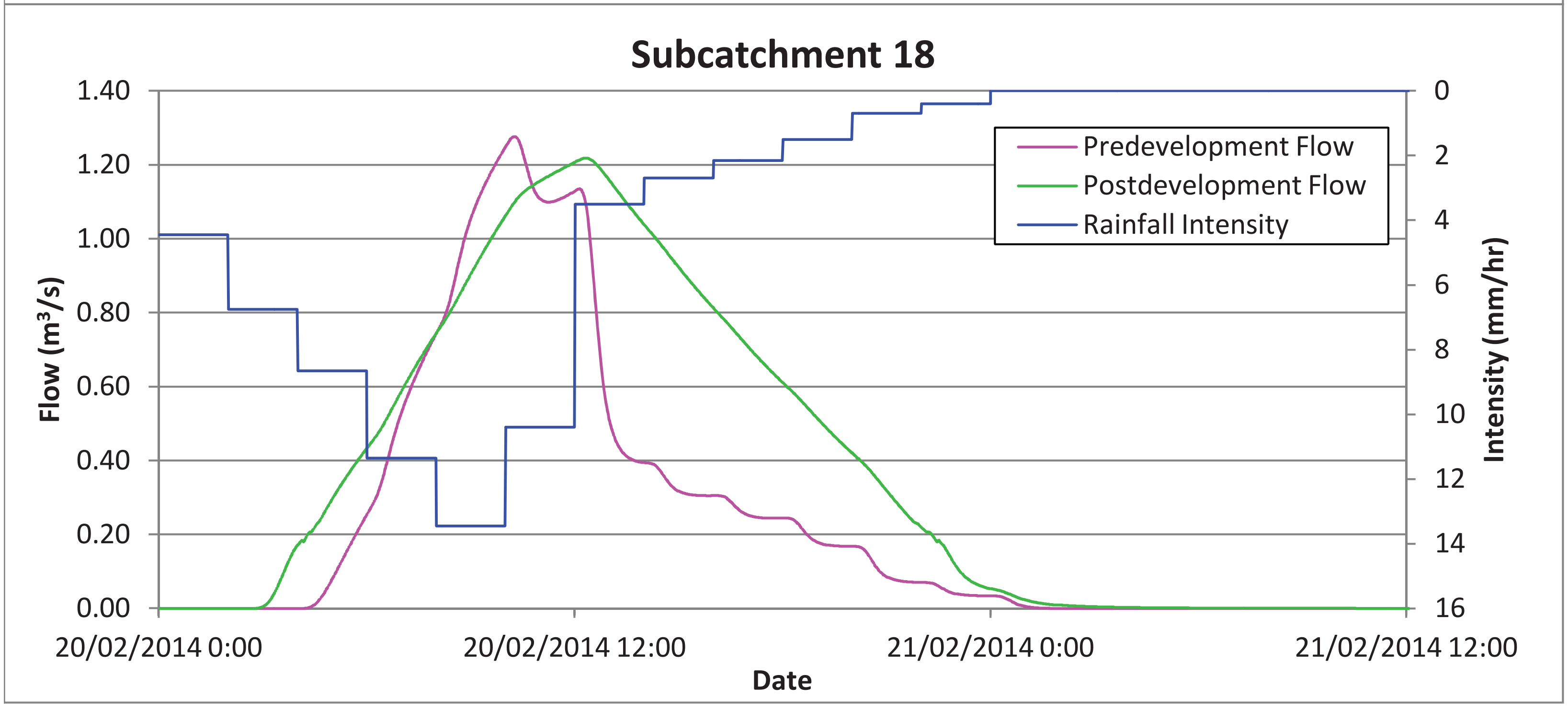

Subcatchment 13
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Flow (m³/s)
0
2
4
6
8
10
12
14
16
Intensity (mm/hr)
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date

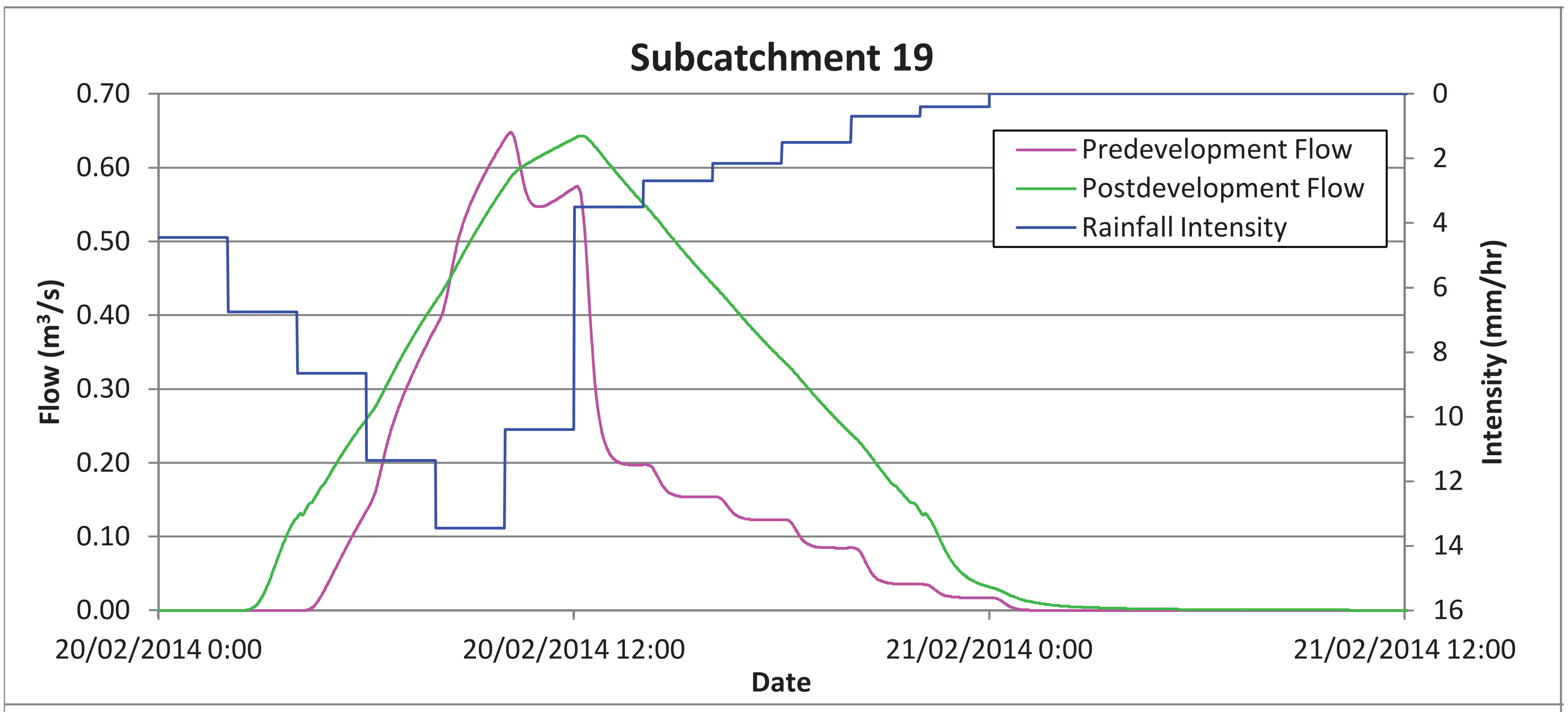

Subcatchment 14
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Flow (m³/s)
0
2
4
6
8
10
12
14
16
Intensity (mm/hr)
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date


Subcatchment 15
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (m³/s)
0
2
4
6
8
10
12
14
16
Intensity (mm/hr)
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date

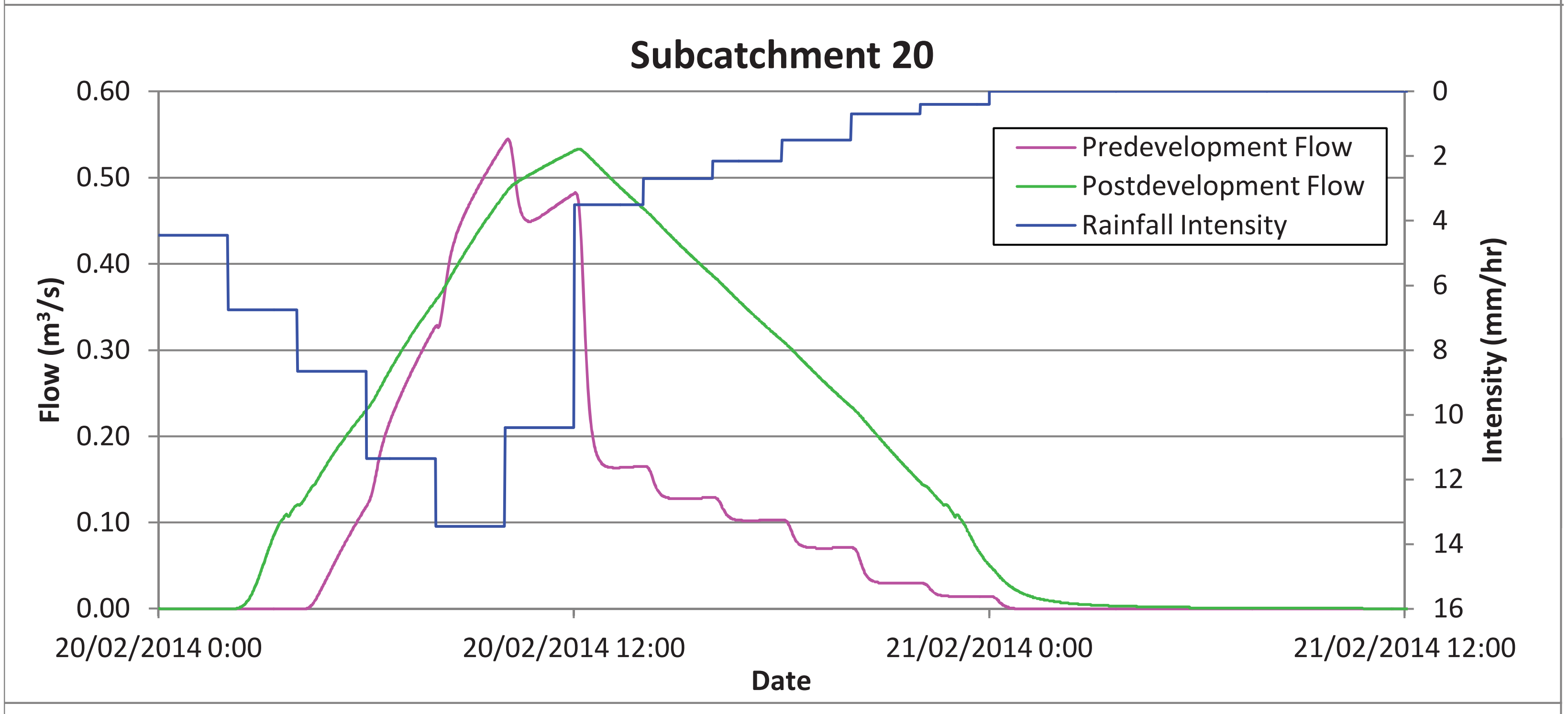

Subcatchment 16
Flow (m³/s)
Intensity (mm/hr)
Date
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
2
4
6
8
10
12
14
16
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00


Subcatchment 17
Flow (m³/s)
Intensity (mm/hr)
Date
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
2
4
6
8
10
12
14
16
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00

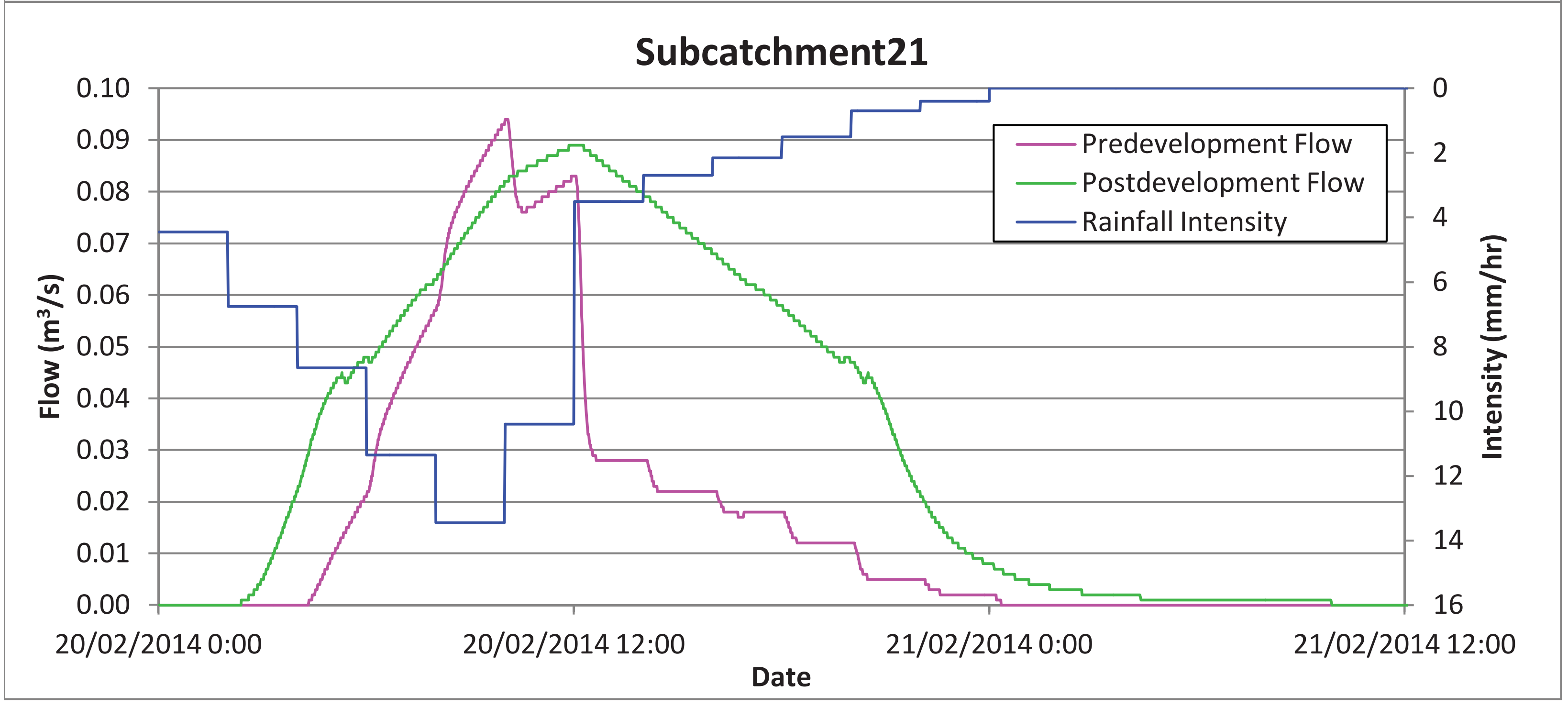

Subcatchment 18
Flow (m³/s)
Intensity (mm/hr)
Date
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
2
4
6
8
10
12
14
16
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00



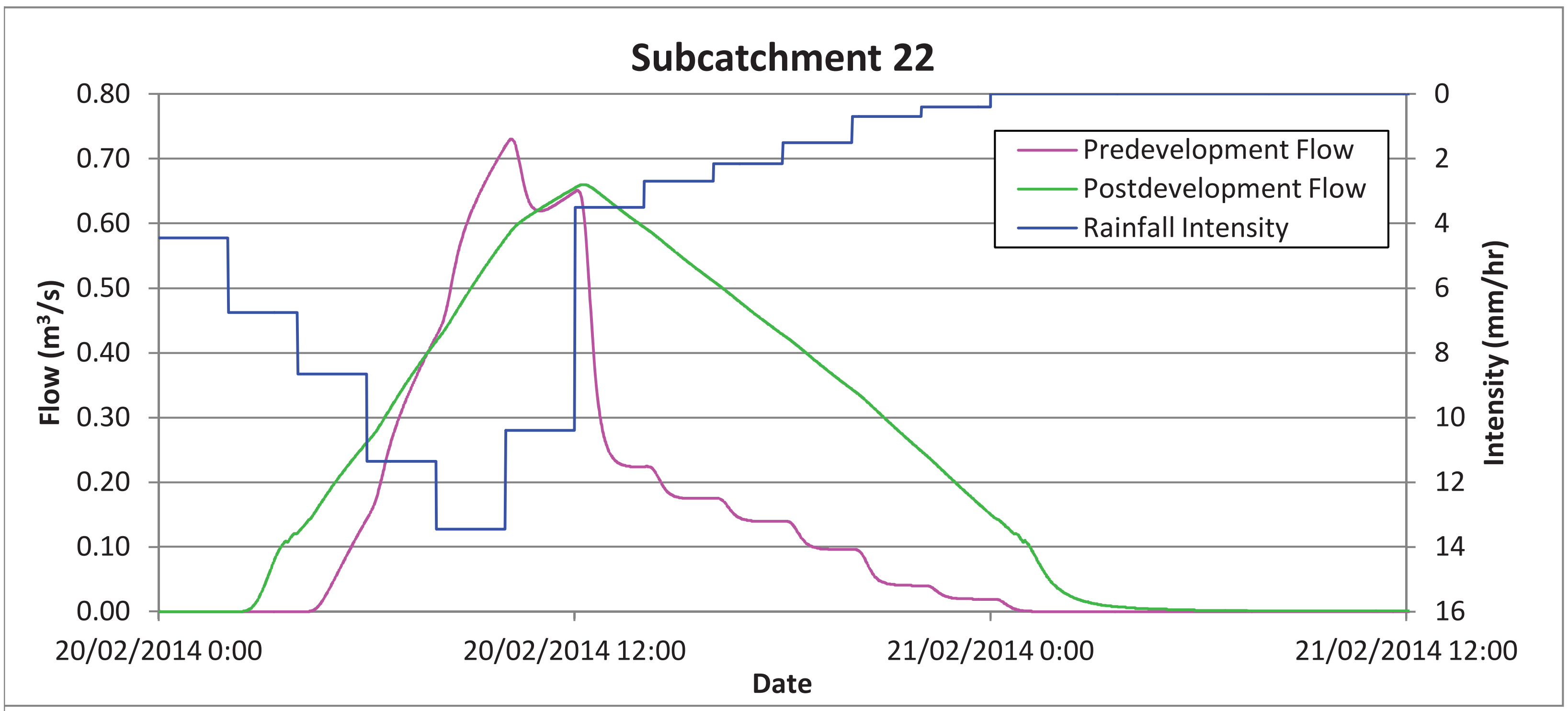
Subcatchment 19
Flow (m³/s)
Intensity (mm/hr)
Date
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
2
4
6
8
10
12
14
16



Subcatchment 20
Flow (m³/s)
Intensity (mm/hr)
Date
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
2
4
6
8
10
12
14
16



Subcatchment21
Flow (m³/s)
Intensity (mm/hr)
Date
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
2
4
6
8
10
12
14
16



Subcatchment 22
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Flow (m³/s)
0
2
4
6
8
10
12
14
16
Intensity (mm/hr)
Predevelopment Flow
Postdevelopment Flow
Rainfall Intensity
20/02/2014 0:00
20/02/2014 12:00
21/02/2014 0:00
21/02/2014 12:00
Date

COMPUTATIONS FOR CAPACITIES OF STORM SEWER

CITY OF ST. JOHN'S

Date: March 2014

Manhole Number			Area			Time of Concentration				Pipe Capacity						
From (3)	To (4)	Length (m) (5)	Increment (ha) (6)	Total (ha) (7)	Runoff Coeff (8)	Inlet Time (min) (9)	Total (min) (11)	Intensity (mm/hr) (12)	Runoff (L/s) (13)	Diameter (mm) (14)	Slope (m/m) (15)	Pipe Material (16)	Manning's n (17)	Full Velocity (m/s) (18)	Full Capacity (L/s) (20)	Additional Capacity (L/s) (21)
1	Outlet	106	9.2	9.2	0.67	15.7	15.7	76.7	1310	900	0.019	CSP	0.0180	2.81	1788	478
2	Outlet	63	10.4	10.5	0.69	14.5	14.5	93.6	1869	1000	0.017	CSP	0.0200	2.55	2002	133
3	4	120	5.5	5.5	0.69	12.8	12.8	93.6	998	800	0.017	CSP	0.0180	2.50	1256	258
4	Outlet	120	1.9	7.4	0.58	11.4	11.4	93.6	1283	800	0.031	CSP	0.0180	3.35	1682	399
5	6	115	1.1	1.1	0.72	12.3	12.3	93.6	207	300	0.070	CSP	0.0150	3.13	221	14
6	Outlet	118	0.8	1.9	0.77	10.9	10.9	93.6	359	400	0.051	CSP	0.0150	3.24	407	48
7	10	93	24.0	24.0	0.62	13.8	13.8	93.6	3875	1200	0.040	CSP	0.0200	4.48	5068	1194
8	9	120	4.2	4.2	0.67	9.5	9.5	135.3	1068	650	0.040	CSP	0.0180	3.31	1098	30
9	10	120	0.8	5.1	0.70	6.3	6.3	135.3	1289	650	0.058	CSP	0.0180	3.97	1319	30
10	Outlet	65	1.6	30.7	0.71	6.9	6.9	135.3	5589	1400	0.030	CSP	0.0230	3.74	5757	168
11	12	120	5.4	5.4	0.65	9.7	9.7	135.3	1318	900	0.014	CSP	0.0180	2.39	1519	201
12	Outlet	120	9.9	15.3	0.68	6.7	6.7	135.3	3850	1200	0.045	CSP	0.0200	4.75	5376	1526
13	Outlet	60	0.3	3.9	0.76	5.6	5.6	135.3	727	600	0.060	CSP	0.0180	3.84	1086	359
14	13	87	3.6	3.6	0.69	10.8	10.8	93.6	639	600	0.028	CSP	0.0180	2.62	741	101
15	16	90	9.4	9.4	0.66	14.7	14.7	93.6	1612	900	0.018	CSP	0.0180	2.77	1764	152
16	17	106	0.3	9.7	0.97	4.1	4.1	135.3	1721	1200	0.005	CSP	0.0200	1.58	1792	71
17	18	100	11.3	21.1	0.91	8.6	8.6	135.3	5623	1600	0.023	CSP	0.0244	3.38	6799	1177
18	19	95	0.3	21.3	1.00	4.4	4.4	135.3	5717	1600	0.020	CSP	0.0244	3.15	6326	610
19	20	85	10.8	32.2	0.91	9.1	9.1	135.3	9438	1800	0.025	CSP	0.0250	3.71	9451	13
20	Outlet	65	0.2	32.3	1.00	4.2	4.2	135.3	9508	1800	0.030	CSP	0.0250	4.07	10353	845
21	22	100	2.3	2.3	0.68	6	6	135.3	590	800	0.005	CSP	0.0180	1.34	675	85
22	23	100	1.8	4.1	0.92	6.2	6.2	135.3	1204	800	0.023	CSP	0.0180	2.86	1436	231
23	24	120	1.0	5.1	0.93	6.1	6.1	135.3	1541	800	0.035	CSP	0.0180	3.55	1787	245
24	25	120	3.7	8.8	0.93	8	8	135.3	2839	1000	0.035	CSP	0.0200	3.71	2916	77
25	26	108	0.9	9.7	0.94	4.1	4.1	135.3	3145	1000	0.035	CSP	0.0200	3.71	2916	-229
26	27	77	7.2	16.8	0.93	8.1	8.1	135.3	5646	1400	0.040	CSP	0.0230	4.32	6648	1003
27	Outlet	18	5.1	21.9	0.91	8.7	8.7	135.3	7396	1500	0.040	CSP	0.0244	4.26	7532	137
28	29	110	17.9	17.9	0.65	30.6	30.6	53	1714	800	0.051	CSP	0.0180	4.28	2150	436
29	30	100	0.9	18.8	0.93	4.5	4.5	135.3	2045	800	0.052	CSP	0.0180	4.35	2186	141
30	34	96	0.8	19.7	0.93	4	4	135.3	2340	1000	0.032	CSP	0.0200	3.55	2788	448
31	32	100	18.7	18.7	0.67	20.9	20.9	76.7	2683	1200	0.019	CSP	0.0200	3.12	3530	847
32	33	100	1.5	20.2	0.92	4.4	4.4	135.3	3203	1400	0.010	CSP	0.0230	2.15	3307	104
33	34	87	1.0	21.2	0.62	5.2	5.2	135.3	3440	1800	0.005	CSP	0.0250	1.66	4227	787
34	Outlet	120	24.4	65.3	0.54	56.1	56.1	53	7728	1800	0.037	CSP	0.0250	4.51	11482	3754
35	36	70	8.0	8.0	0.59	18.7	18.7	76.7	1000	800	0.017	CSP	0.0180	2.48	1245	245
36	37	76	1.3	9.3	0.56	25.6	25.6	76.7	1152	900	0.010	CSP	0.0180	2.10	1333	181
37	38	90	1.4	10.7	0.55	28.7	28.7	76.7	1318	1200	0.005	CSP	0.0200	1.58	1792	474

38	39	70	1.7	12.3	0.55	25.9	25.9	76.7	1513	1200	0.031	CSP	0.0200	3.97	4491	2978
39	40	100	0.5	12.8	0.65	16.9	16.9	76.7	1576	1200	0.044	CSP	0.0200	4.71	5322	3745
40	Outlet	120	6.2	19.0	0.52	31.4	31.4	53	2050	1200	0.065	CSP	0.0200	5.71	6461	4411
41	42	100	6.7	6.7	0.67	10.8	10.8	93.6	1177	1400	0.005	CSP	0.0230	1.53	2350	1173
42	43	93	0.9	7.6	0.61	7.4	7.4	135.3	1387	1400	0.006	CSP	0.0230	1.64	2532	1145
43	46	70	3.5	11.2	0.69	9.9	9.9	135.3	2306	1400	0.043	CSP	0.0230	4.45	6853	4547
44	45	53	9.7	9.7	0.67	19.5	19.5	76.7	1390	1200	0.006	CSP	0.0200	1.69	1913	523
45	46	120	0.4	10.2	0.60	5.7	5.7	135.3	1489	1200	0.038	CSP	0.0200	4.36	4927	3438
46	47	80	4.1	25.4	0.62	10.7	10.7	93.6	4456	1400	0.045	CSP	0.0230	4.58	7051	2596
47	48	100	n/a	n/a	n/a	n/a	n/a	n/a	4456	1400	0.045	CSP	0.0230	4.58	7051	2596
48	Outlet	45	n/a	n/a	n/a	n/a	n/a	n/a	4456	1400	0.045	CSP	0.0230	4.58	7051	2596
49	50	100	30.4	30.4	0.65	21.2	21.2	76.7	4228	1400	0.020	CSP	0.0230	3.08	4736	508
50	51	100	0.6	31.0	0.64	6	6	135.3	4374	1400	0.035	CSP	0.0230	4.04	6219	1845
51	52	47	0.8	31.8	0.63	6.8	6.8	135.3	4553	1600	0.015	CSP	0.0244	2.74	5515	962
52	Outlet	60	2.7	34.5	0.64	10.5	10.5	93.6	5008	1600	0.045	CSP	0.0244	4.72	9490	4481
53	54	90	8.9	8.9	0.63	28.4	28.4	76.7	1205	800	0.031	CSP	0.0180	3.37	1692	487
54	55	85	2.4	11.4	0.66	11.2	11.2	93.6	1626	900	0.027	CSP	0.0180	3.37	2146	520
55	56	85	2.2	13.6	0.78	9.8	9.8	135.3	2275	900	0.033	CSP	0.0180	3.75	2388	113
56	57	98	1.4	15.0	0.70	9.1	9.1	135.3	2643	1000	0.031	CSP	0.0200	3.47	2726	83
57	58	65	3.4	18.4	0.63	15.0	15.0	76.7	3096	1400	0.011	CSP	0.0230	2.26	3472	376
58	59	70	0.3	18.7	0.70	4.8	4.8	135.3	3174	1400	0.055	CSP	0.0230	5.06	7796	4622
59	60	84	2.0	20.7	0.62	8.4	8.4	135.3	3627	1400	0.050	CSP	0.0230	4.83	7433	3805
60	61	75	3.2	23.9	0.70	10	10	93.6	4213	1400	0.045	CSP	0.0230	4.58	7051	2838
61	62	59	0.4	24.2	0.67	4.3	4.3	135.3	4305	1400	0.045	CSP	0.0230	4.58	7051	2746
62	63	50	0.5	24.8	0.60	5.7	5.7	135.3	4430	1400	0.028	CSP	0.0230	3.63	5592	1162
63	Outlet	120	5.4	30.2	0.64	10.8	10.8	93.6	5325	1400	0.040	CSP	0.0230	4.32	6648	1323
64	65	110	6.5	6.5	0.68	21.2	21.2	76.7	935	600	0.048	CSP	0.0180	3.44	972	36
65	66	80	0.5	6.9	0.76	5.7	5.7	135.3	1065	700	0.045	CSP	0.0180	3.69	1419	354
66	67	100	0.4	7.4	0.67	5.2	5.2	135.3	1177	700	0.045	CSP	0.0180	3.69	1419	242
67	69	80	0.6	8.0	0.65	5.2	5.2	135.3	1329	700	0.075	CSP	0.0180	4.76	1832	503
68	69	89	29.6	29.6	0.68	14	14	93.6	6587	1600	0.030	CSP	0.0244	3.87	7787	1200
69	70	100	1.0	38.6	0.66	7.2	7.2	135.3	6831	1600	0.036	CSP	0.0244	4.19	8429	1597
70	71	120	0.6	39.2	0.72	6.1	6.1	135.3	7004	1600	0.033	CSP	0.0244	4.06	8163	1159
71	73	100	12.2	51.4	0.55	13.3	13.3	93.6	8749	1800	0.028	CSP	0.0250	3.94	10020	1271
72	73	100	6.0	6.0	0.65	11.6	11.6	93.6	1011	700	0.027	CSP	0.0180	2.86	1099	88
73	Outlet	83	1.7	59.1	0.62	6.9	6.9	135.3	10162	1800	0.040	CSP	0.0250	4.70	11955	1793

ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

OVERALL STORM SEWER PLAN
SK# 001

N

SCALE = NTS

HATCH

TRACT

ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

PLAN - STORM SEWER AREA #1
SK# 002

SCALE = NTS

HATCH

TRACT

ST. JOHN'S LAND USE DEVELOPMENT PLAN A

PLAN - STORM SEWER AREA #2
SK# 003

SCALE = NTS

ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

PLAN - STORM SEWER AREA #3
SK# 004

SCALE = NTS

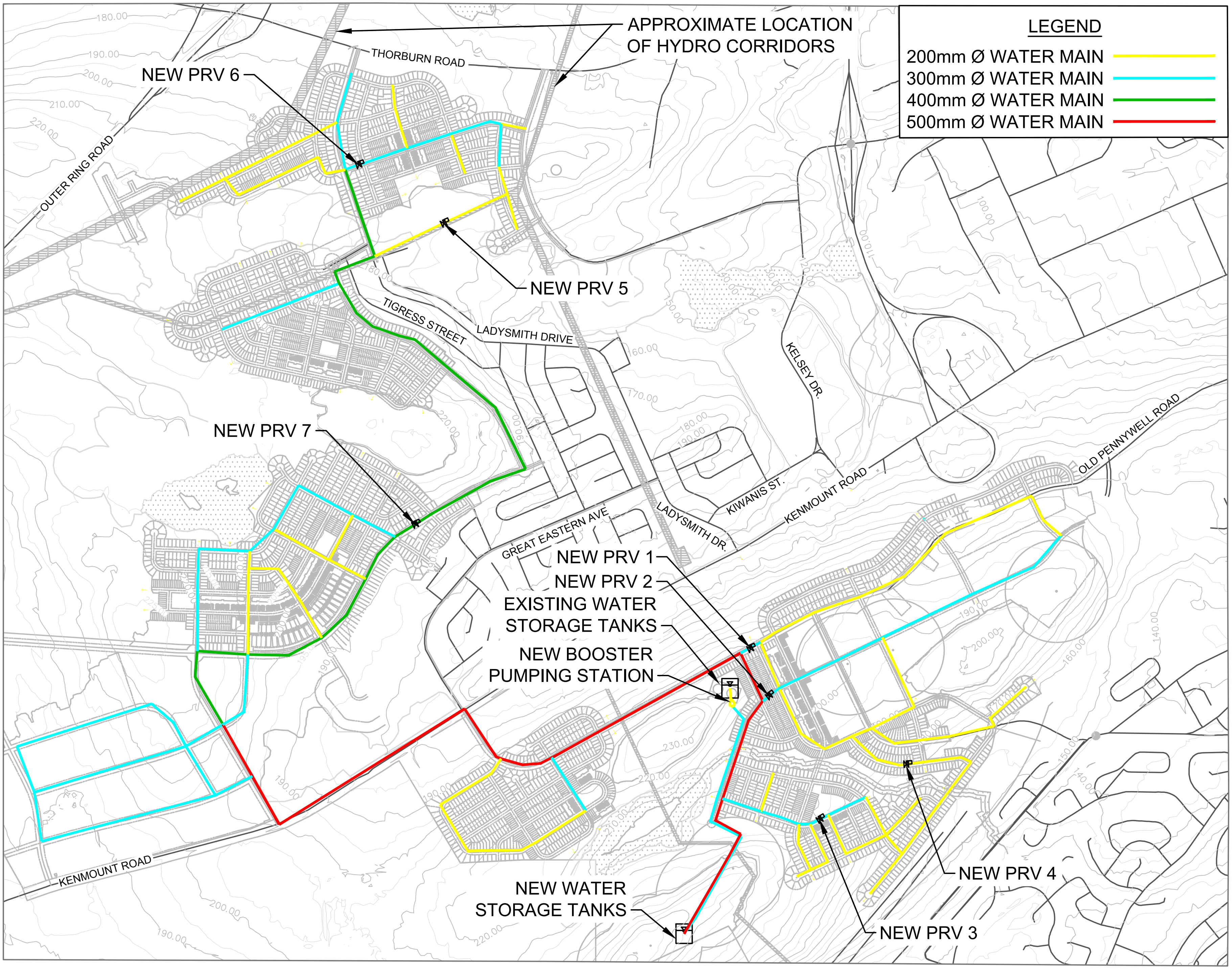
HATCH

TRACT

APPENDIX C

WATER SERVICES

ST. JOHN'S LANDS ABOVE 190m DEVELOPMENT - WATER MODEL AREAS



ST. JOHN'S LAND USE
DEVELOPMENT PLAN A

WATER MAIN
LAYOUT

HATCH

TRACT

Flow Calculation - 190m Development Area

Residential Development Area (Ha)	268.1		
Residential Population	10845		
Commercial Area (Ha)	84.65		
Industrial Area (Ha)	27.9		
Institutional Area (Ha)	5.7		
Residential Flow (L/p/day)	**306**		
Commercial Flow (L/ha/day)	**31111**	** Based on sewage collection rates of 90% the average day water demand rates*	
Industrial Flow (L/ha/day)	**43333**		
Institutional Flow (L/ha/day)	**37778**		
Equivalent Population (Commercial)	8606		
Equivalent Population (Industrial)	3951		
Equivalent Population (Institutional)	704		
Sub-Total Population (Com/Ind/Inst)	13261		
Total Equivalent Population	24106		
Peaking Factor (Table 7.1, Atl Canada Gudelines)	2.85	** Factors for Entire 190m Development Area*	
Max Day Factor	1.90		
Min Hourly Factor	0.6		
Average Day Flow (L/min)	5119	85	(L/s)
Max Day Flow (L/min)	9726	162	(L/s)
Peak Hour Flow (L/min)	14590	243	(L/s)
Minimum Hourly Flow (l/min)	3072	51	(L/s)

Flow Calculation - Model Area 1

Residential Development Area (Ha)	55		
Residential Population	2059		
Commercial Area (Ha)	0		
Industrial Area (Ha)	0		
Institutional Area (Ha)	0		
Residential Flow (L/p/day)	306		
Commercial Flow (L/ha/day)	31111	** Based on sewage collection rates of 90%*	
Industrial Flow (L/ha/day)	43333	*the average day water demand rates*	
Institutional Flow (L/ha/day)	37778		
Equivalent Population (Commercial)	0		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	0		
Total Equivalent Population	2059		
Peaking Factor (Table 7.1, Atl Canada Gudelines)	3.38		
Max Day Factor	2.25	** Factors for Area Population*	
Min Hourly Factor	0.45		
Average Day Flow (L/min)	437	7	(L/s)
Max Day Flow (L/min)	983	16	(L/s)
Peak Hour Flow (L/min)	1477	25	(L/s)
Minimum Hourly Flow (l/min)	197	3	(L/s)

Flow Calculation - Model Area 2

Residential Development Area (Ha)	48		
Residential Population	1789		
Commercial Area (Ha)	0.0		
Industrial Area (Ha)	0.0		
Institutional Area (Ha)	0		
Residential Flow (L/p/day)	306		
Commercial Flow (L/ha/day)	31111	** Based on sewage collection rates of 90%*	
Industrial Flow (L/ha/day)	43333	*the average day water demand rates*	
Institutional Flow (L/ha/day)	37778		
Equivalent Population (Commercial)	0		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	0		
Total Equivalent Population	1789		
Peaking Factor (Table 7.1, Atl Canada Gudelines)	3.75		
Max Day Factor	2.50	** Factors for Area Population*	
Min Hourly Factor	0.45		
Average Day Flow (L/min)	380	6	(L/s)
Max Day Flow (L/min)	949	16	(L/s)
Peak Hour Flow (L/min)	1424	24	(L/s)
Minimum Hourly Flow (l/min)	171	3	(L/s)

Flow Calculation - Model Area 3

Residential Development Area (Ha)	55.4	
Residential Population	2544	
Commercial Area (Ha)	7.2	
Industrial Area (Ha)	0.0	
Institutional Area (Ha)	2.1	
Residential Flow (L/p/day)	306	
Commercial Flow (L/ha/day)	31111	** Based on sewage collection rates of 90%*
Industrial Flow (L/ha/day)	43333	*the average day water demand rates*
Institutional Flow (L/ha/day)	37778	
Equivalent Population (Commercial)	732	
Equivalent Population (Industrial)	0	
Equivalent Population (Institutional)	259	
Sub-Total Population (Com/Ind/Inst)	991	
Total Equivalent Population	3535	
Peaking Factor (Table 7.1, Atl Canada Gudelines)	3.00	
Max Day Factor	2.00	** Factors for Area Population*
Min Hourly Factor	0.5	

Average Day Flow (L/min)	750	13 (L/s)
Max Day Flow (L/min)	1501	25 (L/s)
Peak Hour Flow (L/min)	2251	38 (L/s)
Minimum Hourly Flow (l/min)	375	6 (L/s)

Flow Calculation - Model Area 4

Residential Development Area (Ha)	0		
Residential Population	0		
Commercial Area (Ha)	33.8		
Industrial Area (Ha)	27.9		
Institutional Area (Ha)	3.6		
Residential Flow (L/p/day)	306		
Commercial Flow (L/ha/day)	31111	** Based on sewage collection rates of 90%*	
Industrial Flow (L/ha/day)	43333	*the average day water demand rates*	
Institutional Flow (L/ha/day)	37778		
Equivalent Population (Commercial)	3436		
Equivalent Population (Industrial)	3951		
Equivalent Population (Institutional)	444		
Sub-Total Population (Com/Ind/Inst)	7832		
Total Equivalent Population	7832		
Peaking Factor (Table 7.1, Atl Canada Gudelines)	3.00		
Max Day Factor	2.00	** Factors for Area Population*	
Min Hourly Factor	0.5		
Average Day Flow (L/min)	1664	28	(L/s)
Max Day Flow (L/min)	3329	55	(L/s)
Peak Hour Flow (L/min)	4993	83	(L/s)
Minimum Hourly Flow (l/min)	832	14	(L/s)

Flow Calculation - Model Area 5

Residential Development Area (Ha)	30.0	
Residential Population	1351	
Commercial Area (Ha)	0.0	
Industrial Area (Ha)	0.0	
Institutional Area (Ha)	0.0	

Residential Flow (L/p/day)	306	
Commercial Flow (L/ha/day)	31111	** Based on sewage collection rates of 90%*
Industrial Flow (L/ha/day)	43333	*the average day water demand rates*
Institutional Flow (L/ha/day)	37778	

Equivalent Population (Commercial)	0
Equivalent Population (Industrial)	0
Equivalent Population (Institutional)	0
Sub-Total Population (Com/Ind/Inst)	0

Total Equivalent Population	1351

Peaking Factor (Table 7.1, Atl Canada Gudelines)	3.75	
Max Day Factor	2.50	** Factors for Area Population*
Min Hourly Factor	0.45	

Average Day Flow (L/min)	287	5 (L/s)
Max Day Flow (L/min)	717	12 (L/s)
Peak Hour Flow (L/min)	1075	18 (L/s)
Minimum Hourly Flow (l/min)	129	2 (L/s)

Flow Calculation - Model Area 6

Residential Development Area (Ha)	19.9		
Residential Population	1171		
Commercial Area (Ha)	7.2		
Industrial Area (Ha)	0.0		
Institutional Area (Ha)	0.0		
Residential Flow (L/p/day)	306		
Commercial Flow (L/ha/day)	31111	** Based on sewage collection rates of 90%*	
Industrial Flow (L/ha/day)	43333	*the average day water demand rates*	
Institutional Flow (L/ha/day)	37778		
Equivalent Population (Commercial)	727		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	727		
Total Equivalent Population	1898		
Peaking Factor (Table 7.1, Atl Canada Gudelines)	3.75		
Max Day Factor	2.50	** Factors for Area Population*	
Min Hourly Factor	0.45		
Average Day Flow (L/min)	403	7	(L/s)
Max Day Flow (L/min)	1007	17	(L/s)
Peak Hour Flow (L/min)	1511	25	(L/s)
Minimum Hourly Flow (l/min)	181	3	(L/s)

Flow Calculation - Model Area 7

Residential Development Area (Ha)	59.8		
Residential Population	1931		
Commercial Area (Ha)	36.5		
Industrial Area (Ha)	0.0		
Institutional Area (Ha)	0.0		
Residential Flow (L/p/day)	306		
Commercial Flow (L/ha/day)	31111	** Based on sewage collection rates of 90%*	
Industrial Flow (L/ha/day)	43333	*the average day water demand rates*	
Institutional Flow (L/ha/day)	37778		
Equivalent Population (Commercial)	3711		
Equivalent Population (Industrial)	0		
Equivalent Population (Institutional)	0		
Sub-Total Population (Com/Ind/Inst)	3711		
Total Equivalent Population	5642		
Peaking Factor (Table 7.1, Atl Canada Gudelines)	3.00		
Max Day Factor	2.00	** Factors for Area Population*	
Min Hourly Factor	0.5		
Average Day Flow (L/min)	1198	20	(L/s)
Max Day Flow (L/min)	2397	40	(L/s)
Peak Hour Flow (L/min)	3595	60	(L/s)
Minimum Hourly Flow (l/min)	599	10	(L/s)

DESCRIPTION	CHECKED	DEPARTMENT MANAGER	PROJECT
Fire Flow Calculations	DESIGNED	PROJECT MANAGER	Land Use Development Plan above 190m Contour
	DEPARTMENT	DATE	REFERENCE

SINGLE FAMILY RESIDENTIAL DWELLINGS

Assume max. 2 storeys in height
Assume ordinary construction
Assume less than 3m separation (worst case)

Using short method,

FIRE FLOW REQUIRED = 8,000 L/min = 133 L/s

DESCRIPTION	CHECKED	DEPARTMENT MANAGER	PROJECT
Fire Flow Calculations	DESIGNED	PROJECT MANAGER	Land Use Development Plan above 190m Contour
	DEPARTMENT	DATE	REFERENCE

TOWNHOMES (wood frame, no sprinkler, no 2hr fire wall)

Assume footprint of each unit = 100m^2
Assume max. 2 storeys in height
Assume 5 units per townhome complex
Assume no 2hr fire wall separation

Total Area = 1,000m^2

Assume wood frame construction

F = 220*C*√A = 220*1.5*√1000 = 10,436 L/min Therefore, use 10,000 L/min

Assume Limited Combustible contents, reduction factor = 15% = 1,500 L/min

Therefore revised Fire Flow = 8,500 L/min

Assume no sprinklers

Exposure

side 1	assume 3.1 to 10m	charge = 20%
side2	assume 3.1 to 10m	charge = 20%
front	assume 30.1 to 45m	charge = 5%
back	assume 10.1 to 20m	charge = 15%

TOTAL CHARGE = 60% = 5,100 L/min

Therefore revised Fire Flow = 13,600 L/min

FIRE FLOW REQUIRED = 14,000 L/min = 233 L/s

HATCH

DESCRIPTION	CHECKED	DEPARTMENT MANAGER	PROJECT
Fire Flow Calculations	DESIGNED	PROJECT MANAGER	Land Use Development Plan above 190m Contour
	DEPARTMENT	DATE	REFERENCE

TOWNHOMES (wood frame, no sprinkler, 2hr fire wall)

Assume footprint of each unit = 100m^2
Assume max. 2 storeys in height
Assume 5 units per townhome complex
Assume 2hr fire wall separation, allowing each unit to be considered separately

Total Area = 200m^2

Assume wood frame construction

F = 220*C*√A = 220*1.5*√200 = 4,666 L/min   Therefore, use 5,000 L/min

Assume Limited Combustible contents, reduction factor = 15% = 750 L/min

Therefore revised Fire Flow = 4,250 L/min

Assume no sprinklers

Exposure

side 1	firewall	charge = 10%
side2	assume 3.1 to 10m	charge = 20%
front	assume 30.1 to 45m	charge = 5%
back	assume 10.1 to 20m	charge = 15%

TOTAL CHARGE = 50% = 2,125 L/min

Therefore revised Fire Flow = 6,375 L/min

FIRE FLOW REQUIRED = 6,000 L/min = 100 L/s

DESCRIPTION	CHECKED	DEPARTMENT MANAGER	PROJECT
Fire Flow Calculations	DESIGNED	PROJECT MANAGER	Land Use Development Plan above 190m Contour
	DEPARTMENT	DATE	REFERENCE

APARTMENT BUILDINGS (low-density, therefore max 3 storeys)

Assume footprint of building = 1000m^2
Assume max. 3 storeys in height

Total Area = 3,000m^2

Assume non-combustible construction

F = 220*C*√A = 220*0.8*√3,000 = 9,640 L/min   Therefore, use 10,000 L/min

Assume Limited Combustible contents, reduction factor = 15% = 1,500 L/min

Therefore revised Fire Flow = 8,500 L/min

Assume automatic sprinklers, reduction factor = 30% = 2,550 L/min

Exposure

side 1	assume 3.1 to 10m	charge = 20%
side2	assume 3.1 to 10m	charge = 20%
front	greater than 45m	charge = 0%
back	assume 20.1 to 30m	charge = 10%

TOTAL CHARGE = 50% = 4,250 L/min

Therefore revised Fire Flow = 10,200 L/min

FIRE FLOW REQUIRED = 10,000 L/min = 167 L/s

DESCRIPTION	CHECKED	DEPARTMENT MANAGER	PROJECT
Fire Flow Calculations	DESIGNED	PROJECT MANAGER	Land Use Development Plan above 190m Contour
	DEPARTMENT	DATE	REFERENCE

COMMERCIAL AND INDUSTRIAL BUILDINGS

Assume footprint of building = 5,000m^2 (100m x 50m)
Assume single storey

Total Area = 5,000m^2

Assume non-combustible construction

F = 220*C*√A = 220*0.8*√5,000 = 12,445 L/min Therefore, use 12,000 L/min

Assume Combustible contents, reduction factor = 0%

Assume automatic sprinklers, reduction factor = 30% = 3,600 L/min

Exposure

side 1	assume 10.1 to 20m	charge = 15%
side2	assume 10.1 to 20m	charge = 15%
front	assume 30.1 to 45m	charge = 5%
back	assume 20.1 to 30m	charge = 10%

TOTAL CHARGE = 45% = 5,400 L/min

Therefore revised Fire Flow = 13,800 L/min

FIRE FLOW REQUIRED = 14,000 L/min = 233 L/s

Fire Flow Analysis - Fire within Area 1

	Fire Flow Node[1]	Required Fire Flow[1] (L/s)	Required Fire Flow Available (Y/N)	Min. System Residual Pressure @ Req'd Flow (kPa)	Max. Fire Flow Available[2] (L/s)
Fire Flow Area 1	J-74	167	Y	196	187

[1] Location and Required Fire Flow based on proximity to apartment buildings

[2] Maximum fire flow available while maintaining minimum system pressure of 150 kPa.

PRV Parameters during Area 1 Fire Flow

Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	40	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	17	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	29	FALSE	TRUE
PRV-6	146	FALSE	TRUE
PRV-7	199	FALSE	TRUE

Fire Flow Analysis - Fire within Area 2

	Fire Flow Node[1]	Required Fire Flow[1] (L/s)	Required Fire Flow Available (Y/N)	Min. System Residual Pressure @ Req'd Flow (kPa)	Max. Fire Flow Available[2] (L/s)
Fire Flow Area 2	J-17	167	Y	158	170

[1] Location and Required Fire Flow based on proximity to apartment buildings (model not developed further into Area 2)

[2] Maximum fire flow available while maintaining minimum system pressure of 150 kPa.

PRV Parameters during Area 2 Fire Flow

Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	40	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	17	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	8	FALSE	TRUE
PRV-7	199	FALSE	TRUE

Fire Flow Analysis - Fire within Area 3

	Fire Flow Node[1]	Required Fire Flow[1] (L/s)	Required Fire Flow Available (Y/N)	Min. System Residual Pressure @ Req'd Flow (kPa)	Max. Fire Flow Available[2] (L/s)
Fire Flow Area 3	J-55	167	Y	269	251

[1] Location and Required Fire Flow based on proximity to apartment buildings

[2] Maximum fire flow available while maintaining minimum system pressure of 150 kPa.

PRV Parameters during Area 3 Fire Flow

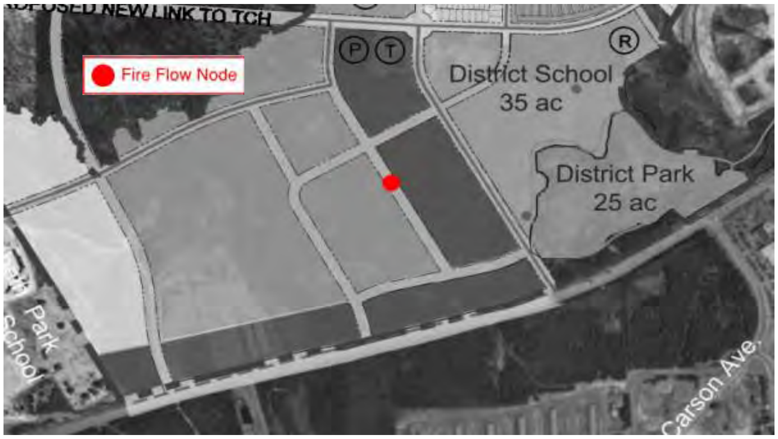
Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	40	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	17	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	8	FALSE	TRUE
PRV-7	32	FALSE	TRUE

Fire Flow Analysis - Fire within Area 4

	Fire Flow Node[1]	Required Fire Flow[1] (L/s)	Required Fire Flow Available (Y/N)	Min. System Residual Pressure @ Req'd Flow (kPa)	Max. Fire Flow Available[2] (L/s)
Fire Flow Area 4	J-33	233	Y	172	248

[1] Location and Required Fire Flow based on being central to commericial/industruial core

[2] Maximum fire flow available while maintaining minimum system pressure of 150 kPa.



PRV Parameters during Area 4 Fire Flow

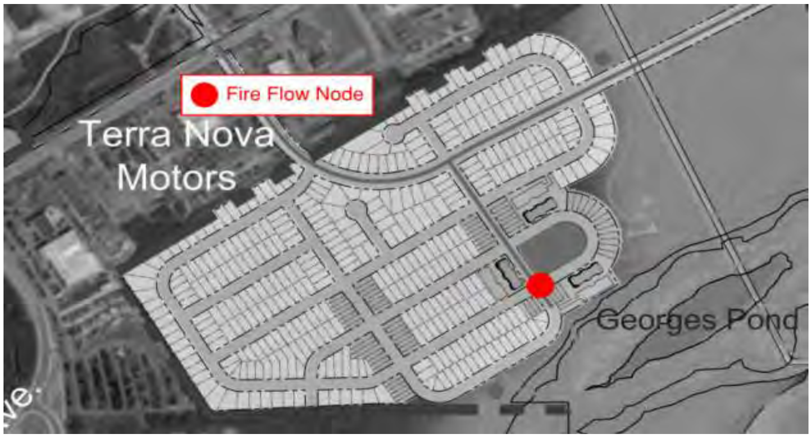
Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	40	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	17	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	8	FALSE	TRUE
PRV-7	32	FALSE	TRUE

Fire Flow Analysis - Fire within Area 5

	Fire Flow Node[1]	Required Fire Flow[1] (L/s)	Required Fire Flow Available (Y/N)	Min. System Residual Pressure @ Req'd Flow (kPa)	Max. Fire Flow Available[2] (L/s)
Fire Flow Area 5	J-116	167	Y	260	270

[1] Location and Required Fire Flow based on proximity to apartment buildings

[2] Maximum fire flow available while maintaining minimum system pressure of 150 kPa.



PRV Parameters during Area 5 Fire Flow

Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	40	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	17	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	8	FALSE	TRUE
PRV-7	32	FALSE	TRUE

Fire Flow Analysis - Fire within Area 6

	Fire Flow Node[1]	Required Fire Flow[1] (L/s)	Required Fire Flow Available (Y/N)	Min. System Residual Pressure @ Req'd Flow (kPa)	Max. Fire Flow Available[2] (L/s)
Fire Flow Area 6	J-49	167	Y	308	371

[1] Location and Required Fire Flow based on proximity to apartment buildings

[2] Maximum fire flow available while maintaining minimum system pressure of 150 kPa.

PRV Parameters during Area 6 Fire Flow

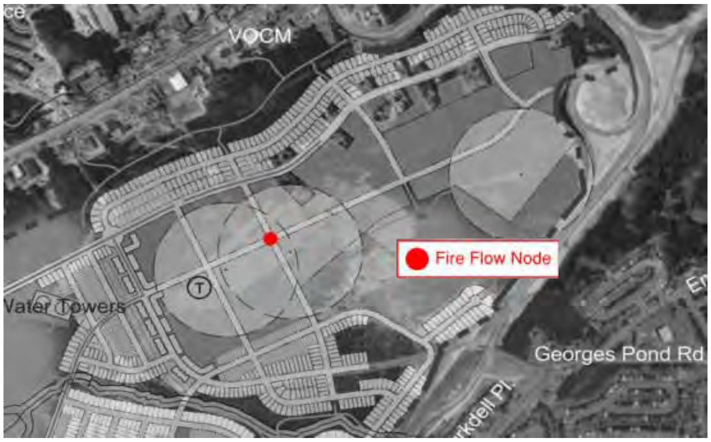
Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	44	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	180	FALSE	TRUE
PRV-4	4	FALSE	TRUE
PRV-5	0	TRUE	FALSE
PRV-6	8	FALSE	TRUE
PRV-7	32	FALSE	TRUE

Fire Flow Analysis - Fire within Area 7

	Fire Flow Node[1]	Required Fire Flow[1] (L/s)	Required Fire Flow Available (Y/N)	Min. System Residual Pressure @ Req'd Flow (kPa)	Max. Fire Flow Available[2] (L/s)
Fire Flow Area 7	J-86	233	Y	298	429

[1] Location and Required Fire Flow based on proximity to apartment buildings

[2] Maximum fire flow available while maintaining minimum system pressure of 150 kPa.



PRV Parameters during Area 7 Fire Flow

Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	126	FALSE	TRUE
PRV-2	147	FALSE	TRUE
PRV-3	17	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	8	FALSE	TRUE
PRV-7	32	FALSE	TRUE

PRV Parameters during Low Flow Scenario

Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	10	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	3	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	2	FALSE	TRUE
PRV-7	6	FALSE	TRUE

PRV Parameters during Maximum Daily Flow Scenario

Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	40	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	17	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	8	FALSE	TRUE
PRV-7	32	FALSE	TRUE

PRV Parameters during Peak Hourly Flow Scenario

Label	Flow (L/s)	Is Closed?	Is Open?
PRV-1	60	FALSE	TRUE
PRV-2	0	TRUE	FALSE
PRV-3	25	FALSE	TRUE
PRV-4	0	TRUE	FALSE
PRV-5	0	TRUE	FALSE
PRV-6	12	FALSE	TRUE
PRV-7	49	FALSE	TRUE

Note:
In scenarios presented above, PRV-2, PRV-4 and PRV-5 are closed. These PRVs will be open under the following scenarios;

PRV-2: Open under Area 7 Fire Flow conditions
PRV-4: Open under Area 6 Fire Flow conditions
PRV-5: Open under Area 1 Fire Flow conditions

WaterGEMS WATER MODEL RESULTS

RESIDUAL PRESSURE DURING LOW FLOW — above 650 kPa =

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
30	J-2	199.27	0	265.75	651
31	J-3	219.99	0	265.73	448
33	J-4	219.54	0	265.73	452
35	J-5	206.39	0	265.73	581
37	J-6	192.64	0	265.72	715
39	J-7	195.56	0	265.72	687
41	J-8	203.07	0	265.72	613
43	J-9	198.61	0	246.75	471
45	J-10	192.12	0	246.75	535
47	J-11	195.21	0	246.74	504
49	J-12	195.89	0	246.74	498
53	J-14	189.23	0	246.74	563
55	J-15	196.27	0	246.74	494
57	J-16	204.25	0	246.73	416
59	J-17 (Area 2 Fire Flow Node)	209.44	0	246.73	365
61	J-18 (Area 2 Demand)	214.29	3	246.73	317
63	J-19	185.4	0	246.74	600
65	J-20	179.74	0	246.74	656
67	J-21	186.87	0	246.74	586
69	J-22	189.3	0	246.73	562
71	J-23 (Area 1 Demand 1)	195.97	1	246.73	497
73	J-24	196.53	0	227.99	308
75	J-25 (Area 1 Demand 2)	187.71	1	227.99	394
77	J-26	179.15	0	227.99	478
79	J-27	211	0	265.73	536
82	J-28	214.1	0	265.73	505
84	J-29 (Area 4 Demand-2)	192.93	5	265.71	712
86	J-30	196.69	0	265.74	676
89	J-31	201.49	0	265.73	629
91	J-32 (Area 4 Demand-3)	188.84	5	265.71	752
93	J-33 (Area 4 Fire Flow Node)	220.67	0	265.72	441
95	J-34 (Area 4 Demand-1)	193.18	5	265.71	710
126	J-41	206.57	0	242.76	354
129	J-42	207.08	0	265.81	575
131	J-43	172.93	0	265.79	909
134	J-44	204.56	0	242.71	373
138	J-45	213.87	0	265.92	509
144	J-46	230.7	0	265.96	345
147	J-47	215.09	0	265.95	498
150	J-48 (Area 6 Fire Flow Node)	182.48	0	227.4	440
152	J-49	204.17	0	265.92	604
157	J-51	198.82	0	242.7	430
161	J-53	225.35	0	265.81	396
163	J-54 (Area 5 Demand)	214.65	2	265.8	501
165	J-55 (Area 3 Fire Flow Node)	207.5	0	265.72	570
167	J-56 (Area 3 Demand-3)	208.48	1	265.72	560
169	J-57	217.17	0	265.72	475
171	J-58 (Area 3 Demand-4)	214.23	1	265.72	504
173	J-59	205.66	0	265.72	588
175	J-60 (Area 3 Demand-2)	211.01	1	265.72	535
177	J-61	210.16	0	265.72	544
179	J-62 (Area 3 Demand-1)	213.62	1	265.72	510
181	J-63	196.6	0	246.73	491
183	J-64	189.16	0	246.73	564
185	J-65	196.97	0	246.73	487
187	J-66	200.44	0	246.73	453
189	J-67	202.22	0	246.73	436
191	J-68	210.97	0	246.73	350
193	J-69	211.02	0	246.73	350
195	J-70	184.85	0	227.99	422
197	J-71	182.01	0	227.99	450
200	J-72	186.76	0	227.99	403
202	J-73	175.79	0	227.99	511
204	J-74 (Area 1 Fire Flow Node)	190.75	0	227.99	364
207	J-75	191.22	0	227.99	360
209	J-76	188.09	0	227.99	390
211	J-77 (Area 6 Demand	177.63	3	227.39	487
213	J-78	168.1	0	227.39	580
215	J-79	160.68	0	227.39	653
217	J-80	207.31	0	265.92	574
222	J-82	166.79	0	227.39	593
224	J-83	195.52	0	242.7	462
225	J-84	191	0	242.72	506
227	J-85	169.59	0	227.39	566
229	J-86 (Area 7 Fire Flow Node)	194.9	0	242.7	468
232	J-87 (Area 7 Demand-1)	188.5	4	242.69	530
235	J-88	180.18	0	242.69	612
243	J-92	180.6	0	242.71	608
246	J-93	196	0	242.72	457
250	J-95	202.08	0	242.74	398
253	J-96	203.97	0	242.75	380
256	J-97	207.62	0	265.88	570
259	J-98	214.96	0	265.86	498
269	J-99	167.26	0	242.69	738
271	J-100 (Area 7 Demand-2)	167.65	4	242.69	734
274	J-101	158.96	0	227.39	670
276	J-102	200.39	0	242.7	414
279	J-103	190	0	242.7	516
281	J-104	185.75	0	242.69	555
283	J-105	172.27	0	242.69	689
285	J-106	157.97	0	227.39	679
288	J-107	171.55	0	227.39	546
290	J-108	217.23	0	265.92	477
292	J-109	209.85	0	265.92	549
296	J-110	200.6	0	265.92	639
298	J-111	211.08	0	265.92	537
302	J-112 (Area 7 Demand-3)	164	2	242.68	770
304	J-113	168.5	0	242.68	726
306	J-114	193.9	0	265.8	704
308	J-115	191.63	0	265.8	726
312	J-116 (Area 5 Fire Flow Node)	221.88	0	265.81	430
317	J-117	182.47	0	227.99	445
344	J-119	205.08	0	265.72	593
356	J-121	197.82	0	265.72	666
358	J-122	205.59	0	265.72	588
415	J-123	207.95	0	265.72	565
462	J-127	202.85	0	265.92	617
466	J-128	194	0	227.39	327
468	J-129 (Area 6 Fire Flow Node)	195.94	0	227.4	308

below 300 kPa =

RESIDUAL PRESSURE AVERAGE DAY FLOW — above 650 kPa =

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
30	J-2	199.27	0	265.02	643
31	J-3	219.99	0	264.94	440
33	J-4	219.54	0	264.93	444
35	J-5	206.39	0	264.93	573
37	J-6	192.64	0	264.91	707
39	J-7	195.56	0	264.9	679
41	J-8	203.07	0	264.89	605
43	J-9	198.61	0	246.75	471
45	J-10	192.12	0	246.73	534
47	J-11	195.21	0	246.71	504
49	J-12	195.89	0	246.7	497
53	J-14	189.23	0	246.69	562
55	J-15	196.27	0	246.69	493
57	J-16	204.25	0	246.68	415
59	J-17 (Area 2 Fire Flow Node)	209.44	0	246.68	364
61	J-18 (Area 2 Demand)	214.29	6	246.67	317
63	J-19	185.4	0	246.69	600
65	J-20	179.74	0	246.69	655
67	J-21	186.87	0	246.68	585
69	J-22	189.3	0	246.68	562
71	J-23 (Area 1 Demand 1)	195.97	7	246.68	496
73	J-24	196.53	0	227.99	308
75	J-25 (Area 1 Demand 2)	187.71	0	227.99	394
77	J-26	179.15	0	227.99	478
79	J-27	211	0	264.95	528
82	J-28	214.1	0	264.93	497
84	J-29 (Area 4 Demand-2)	192.93	9	264.87	704
86	J-30	196.69	0	264.97	668
89	J-31	201.49	0	264.94	621
91	J-32 (Area 4 Demand-3)	188.84	9	264.87	744
93	J-33 (Area 4 Fire Flow Node)	220.67	0	264.91	433
95	J-34 (Area 4 Demand-1)	193.18	9	264.87	702
126	J-41	206.57	0	242.75	354
129	J-42	207.08	0	265.27	569
131	J-43	172.93	0	265.18	903
134	J-44	204.56	0	242.56	372
138	J-45	213.87	0	265.7	507
144	J-46	230.7	0	265.84	344
147	J-47	215.09	0	265.8	496
150	J-48 (Area 6 Fire Flow Node)	182.48	7	227.39	439
152	J-49	204.17	0	265.69	602
157	J-51	198.82	0	242.54	428
161	J-53	225.35	0	265.24	390
163	J-54 (Area 5 Demand)	214.65	5	265.22	495
165	J-55 (Area 3 Fire Flow Node)	207.5	0	264.91	562
167	J-56 (Area 3 Demand-3)	208.48	3	264.9	552
169	J-57	217.17	0	264.91	467
171	J-58 (Area 3 Demand-4)	214.23	3	264.9	496
173	J-59	205.66	0	264.89	580
175	J-60 (Area 3 Demand-2)	211.01	3	264.89	527
177	J-61	210.16	0	264.89	536
179	J-62 (Area 3 Demand-1)	213.62	3	264.89	502
181	J-63	196.6	0	246.68	490
183	J-64	189.16	0	246.68	563
185	J-65	196.97	0	246.68	487
187	J-66	200.44	0	246.68	453
189	J-67	202.22	0	246.68	435
191	J-68	210.97	0	246.68	350
193	J-69	211.02	0	246.68	349
195	J-70	184.85	0	227.99	422
197	J-71	182.01	0	227.99	450
200	J-72	186.76	0	227.99	403
202	J-73	175.79	0	227.99	511
204	J-74 (Area 1 Fire Flow Node)	190.75	0	227.99	364
207	J-75	191.22	0	227.99	360
209	J-76	188.09	0	227.99	390
211	J-77 (Area 6 Demand	177.63	0	227.39	487
213	J-78	168.1	0	227.39	580
215	J-79	160.68	0	227.39	653
217	J-80	207.31	0	265.69	571
222	J-82	166.79	0	227.39	593
224	J-83	195.52	0	242.53	460
225	J-84	191	0	242.52	504
227	J-85	169.59	0	227.39	566
229	J-86 (Area 7 Fire Flow Node)	194.9	0	242.52	466
232	J-87 (Area 7 Demand-1)	188.5	7	242.5	528
235	J-88	180.18	0	242.5	610
243	J-92	180.6	0	242.56	606
246	J-93	196	0	242.62	456
250	J-95	202.08	0	242.67	397
253	J-96	203.97	0	242.73	379
256	J-97	207.62	0	265.54	567
259	J-98	214.96	0	265.46	494
269	J-99	167.26	0	242.5	736
271	J-100 (Area 7 Demand-2)	167.65	7	242.5	733
274	J-101	158.96	0	227.39	670
276	J-102	200.39	0	242.53	412
279	J-103	190	0	242.5	514
281	J-104	185.75	0	242.47	555
283	J-105	172.27	0	242.44	687
285	J-106	157.97	0	227.39	679
288	J-107	171.55	0	227.39	546
290	J-108	217.23	0	265.69	474
292	J-109	209.85	0	265.7	547
296	J-110	200.6	0	265.7	637
298	J-111	211.08	0	265.69	534
302	J-112 (Area 7 Demand-3)	164	6	242.4	767
304	J-113	168.5	0	242.4	723
306	J-114	193.9	0	265.22	698
308	J-115	191.63	0	265.23	720
312	J-116 (Area 5 Fire Flow Node)	221.88	0	265.27	425
317	J-117	182.47	0	227.99	445
344	J-119	205.08	0	264.89	585
356	J-121	197.82	0	264.91	657
358	J-122	205.59	0	264.91	581
415	J-123	207.95	0	264.9	557
462	J-127	202.85	0	265.69	615
466	J-128	194	0	227.39	327
468	J-129 (Area 6 Fire Flow Node)	195.94	0	227.4	308

below 300 kPa =

RESIDUAL PRESSURE MAX DAY FLOW — above 650 kPa =

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
30	J-2	199.27	0	262.14	615
31	J-3	219.99	0	261.83	409
33	J-4	219.54	0	261.8	414
35	J-5	206.39	0	261.78	542
37	J-6	192.64	0	261.72	676
39	J-7	195.56	0	261.66	647
41	J-8	203.07	0	261.63	573
43	J-9	198.61	0	246.73	471
45	J-10	192.12	0	246.65	534
47	J-11	195.21	0	246.53	502
49	J-12	195.89	0	246.49	495
53	J-14	189.23	0	246.42	560
55	J-15	196.27	0	246.4	491
57	J-16	204.25	0	246.38	412
59	J-17 (Area 2 Fire Flow Node)	209.44	0	246.35	361
61	J-18 (Area 2 Demand)	214.29	16	246.31	313
63	J-19	185.4	0	246.42	597
65	J-20	179.74	0	246.41	653
67	J-21	186.87	0	246.4	583
69	J-22	189.3	0	246.39	559
71	J-23 (Area 1 Demand 1)	195.97	8	246.39	493
73	J-24	196.53	0	227.98	308
75	J-25 (Area 1 Demand 2)	187.71	8	227.96	394
77	J-26	179.15	0	227.96	478
79	J-27	211	0	261.89	498
82	J-28	214.1	0	261.81	467
84	J-29 (Area 4 Demand-2)	192.93	18	261.62	672
86	J-30	196.69	0	261.98	639
89	J-31	201.49	0	261.85	591
91	J-32 (Area 4 Demand-3)	188.84	18	261.62	712
93	J-33 (Area 4 Fire Flow Node)	220.67	0	261.76	402
95	J-34 (Area 4 Demand-1)	193.18	18	261.62	670
126	J-41	206.57	0	242.7	354
129	J-42	207.08	0	263.12	548
131	J-43	172.93	0	262.78	879
134	J-44	204.56	0	242.02	367
138	J-45	213.87	0	264.82	499
144	J-46	230.7	0	265.37	339
147	J-47	215.09	0	265.19	490
150	J-48 (Area 6 Fire Flow Node)	182.48	0	227.38	439
152	J-49	204.17	0	264.73	593
157	J-51	198.82	0	241.97	422
161	J-53	225.35	0	263.01	369
163	J-54 (Area 5 Demand)	214.65	12	262.91	472
165	J-55 (Area 3 Fire Flow Node)	207.5	0	261.72	531
167	J-56 (Area 3 Demand-3)	208.48	6	261.66	520
169	J-57	217.17	0	261.73	436
171	J-58 (Area 3 Demand-4)	214.23	6	261.69	464
173	J-59	205.66	0	261.64	548
175	J-60 (Area 3 Demand-2)	211.01	6	261.64	496
177	J-61	210.16	0	261.63	504
179	J-62 (Area 3 Demand-1)	213.62	6	261.63	470
181	J-63	196.6	0	246.39	487
183	J-64	189.16	0	246.39	560
185	J-65	196.97	0	246.39	484
187	J-66	200.44	0	246.39	450
189	J-67	202.22	0	246.39	432
191	J-68	210.97	0	246.39	347
193	J-69	211.02	0	246.39	346
195	J-70	184.85	0	227.96	422
197	J-71	182.01	0	227.96	450
200	J-72	186.76	0	227.96	403
202	J-73	175.79	0	227.96	511
204	J-74 (Area 1 Fire Flow Node)	190.75	0	227.97	364
207	J-75	191.22	0	227.97	360
209	J-76	188.09	0	227.97	390
211	J-77 (Area 6 Demand	177.63	17	227.29	486
213	J-78	168.1	0	227.29	579
215	J-79	160.68	0	227.29	652
217	J-80	207.31	0	264.74	562
222	J-82	166.79	0	227.29	592
224	J-83	195.52	0	241.94	454
225	J-84	191	0	241.9	498
227	J-85	169.59	0	227.29	565
229	J-86 (Area 7 Fire Flow Node)	194.9	0	241.87	460
232	J-87 (Area 7 Demand-1)	188.5	15	241.78	521
235	J-88	180.18	0	241.78	603
243	J-92	180.6	0	242.03	601
246	J-93	196	0	242.23	452
250	J-95	202.08	0	242.44	395
253	J-96	203.97	0	242.63	378
256	J-97	207.62	0	264.19	554
259	J-98	214.96	0	263.88	479
269	J-99	167.26	0	241.78	729
271	J-100 (Area 7 Demand-2)	167.65	15	241.77	725
274	J-101	158.96	0	227.29	669
276	J-102	200.39	0	241.94	407
279	J-103	190	0	241.85	507
281	J-104	185.75	0	241.76	548
283	J-105	172.27	0	241.7	679
285	J-106	157.97	0	227.29	678
288	J-107	171.55	0	227.29	545
290	J-108	217.23	0	264.74	465
292	J-109	209.85	0	264.78	538
296	J-110	200.6	0	264.78	628
298	J-111	211.08	0	264.74	525
302	J-112 (Area 7 Demand-3)	164	10	241.59	759
304	J-113	168.5	0	241.59	715
306	J-114	193.9	0	262.93	676
308	J-115	191.63	0	262.96	698
312	J-116 (Area 5 Fire Flow Node)	221.88	0	263.11	403
317	J-117	182.47	0	227.96	445
344	J-119	205.08	0	261.64	554
356	J-121	197.82	0	261.71	625
358	J-122	205.59	0	261.7	549
415	J-123	207.95	0	261.69	526
462	J-127	202.85	0	264.74	606
466	J-128	194	0	227.34	326
468	J-129 (Area 6 Fire Flow Node)	195.94	0	227.39	308

below 300 kPa =

RESIDUAL PRESSURE PEAK HOUR FLOW — below 300 kPa =

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
30	J-2	199.27	0	257.69	572
31	J-3	219.99	0	257.01	362
33	J-4	219.54	0	256.95	366
35	J-5	206.39	0	256.91	494
37	J-6	192.64	0	256.77	628
39	J-7	195.56	0	256.64	598
41	J-8	203.07	0	256.57	524
43	J-9	198.61	0	246.71	471
45	J-10	192.12	0	246.52	532
47	J-11	195.21	0	246.27	500
49	J-12	195.89	0	246.18	492
53	J-14	189.23	0	246.03	556
55	J-15	196.27	0	245.99	487
57	J-16	204.25	0	245.93	408
59	J-17 (Area 2 Fire Flow Node)	209.44	0	245.87	356
61	J-18 (Area 2 Demand)	214.29	24	245.79	308
63	J-19	185.4	0	246.02	593
65	J-20	179.74	0	246	648
67	J-21	186.87	0	245.97	578
69	J-22	189.3	0	245.96	555
71	J-23 (Area 1 Demand 1)	195.97	13	245.95	489
73	J-24	196.53	0	227.98	308
75	J-25 (Area 1 Demand 2)	187.71	12	227.93	394
77	J-26	179.15	0	227.93	477
79	J-27	211	0	257.14	452
82	J-28	214.1	0	256.98	420
84	J-29 (Area 4 Demand-2)	192.93	28	256.57	623
86	J-30	196.69	0	257.34	594
89	J-31	201.49	0	257.06	544
91	J-32 (Area 4 Demand-3)	188.84	27	256.57	663
93	J-33 (Area 4 Fire Flow Node)	220.67	0	256.87	354
95	J-34 (Area 4 Demand-1)	193.18	28	256.57	620
126	J-41	206.57	0	242.63	353
129	J-42	207.08	0	259.82	516
131	J-43	172.93	0	259.07	843
134	J-44	204.56	0	241.17	358
138	J-45	213.87	0	263.48	486
144	J-46	230.7	0	264.64	332
147	J-47	215.09	0	264.26	481
150	J-48 (Area 6 Fire Flow Node)	182.48	0	227.36	439
152	J-49	204.17	0	263.3	579
157	J-51	198.82	0	241.04	413
161	J-53	225.35	0	259.58	335
163	J-54 (Area 5 Demand)	214.65	18	259.35	438
165	J-55 (Area 3 Fire Flow Node)	207.5	0	256.76	482
167	J-56 (Area 3 Demand-3)	208.48	9	256.65	471
169	J-57	217.17	0	256.8	388
171	J-58 (Area 3 Demand-4)	214.23	9	256.7	416
173	J-59	205.66	0	256.61	499
175	J-60 (Area 3 Demand-2)	211.01	9	256.6	446
177	J-61	210.16	0	256.58	454
179	J-62 (Area 3 Demand-1)	213.62	9	256.58	420
181	J-63	196.6	0	245.95	483
183	J-64	189.16	0	245.95	556
185	J-65	196.97	0	245.95	479
187	J-66	200.44	0	245.95	445
189	J-67	202.22	0	245.95	428
191	J-68	210.97	0	245.95	342
193	J-69	211.02	0	245.95	342
195	J-70	184.85	0	227.93	422
197	J-71	182.01	0	227.93	449
200	J-72	186.76	0	227.93	403
202	J-73	175.79	0	227.93	510
204	J-74 (Area 1 Fire Flow Node)	190.75	0	227.96	364
207	J-75	191.22	0	227.96	360
209	J-76	188.09	0	227.96	390
211	J-77 (Area 6 Demand	177.63	25	227.17	485
213	J-78	168.1	0	227.17	578
215	J-79	160.68	0	227.17	651
217	J-80	207.31	0	263.32	548
222	J-82	166.79	0	227.17	591
224	J-83	195.52	0	240.96	445
225	J-84	191	0	240.84	488
227	J-85	169.59	0	227.17	564
229	J-86 (Area 7 Fire Flow Node)	194.9	0	240.86	450
232	J-87 (Area 7 Demand-1)	188.5	20	240.73	511
235	J-88	180.18	0	240.73	593
243	J-92	180.6	0	241.25	594
246	J-93	196	0	241.66	447
250	J-95	202.08	0	242.09	392
253	J-96	203.97	0	242.48	377
256	J-97	207.62	0	262.13	533
259	J-98	214.96	0	261.46	455
269	J-99	167.26	0	240.73	719
271	J-100 (Area 7 Demand-2)	167.65	20	240.73	715
274	J-101	158.96	0	227.17	668
276	J-102	200.39	0	240.99	397
279	J-103	190	0	240.71	496
281	J-104	185.75	0	240.41	535
283	J-105	172.27	0	240.18	665
285	J-106	157.97	0	227.17	677
288	J-107	171.55	0	227.17	544
290	J-108	217.23	0	263.31	451
292	J-109	209.85	0	263.4	524
296	J-110	200.6	0	263.4	615
298	J-111	211.08	0	263.31	511
302	J-112 (Area 7 Demand-3)	164	20	239.79	742
304	J-113	168.5	0	239.79	698
306	J-114	193.9	0	259.4	641
308	J-115	191.63	0	259.46	664
312	J-116 (Area 5 Fire Flow Node)	221.88	0	259.79	371
317	J-117	182.47	0	227.93	445
344	J-119	205.08	0	256.61	504
356	J-121	197.82	0	256.74	577
358	J-122	205.59	0	256.72	500
415	J-123	207.95	0	256.71	477
462	J-127	202.85	0	263.31	592
466	J-128	194	0	227.28	326
468	J-129 (Area 6 Fire Flow Node)	195.94	0	227.39	308

PIPE VELOCITIES - MAXIMUM DAILY FLOW (pipes with zero flow omitted) — max =

ID	Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	zen-Williar	Flow (L/s)	Velocity (m/s)
34	P-2	101	J-3	J-4	392.9	PVC	130	37	0.31
36	P-3	199	J-4	J-5	392.9	PVC	130	20	0.16
38	P-4	306	J-5	J-6	392.9	PVC	130	33	0.27
40	P-5	292	J-6	J-7	392.9	PVC	130	31	0.26
42	P-6	203	J-7	J-8	392.9	PVC	130	27	0.23
46	P-8	410	J-9	J-10	392.9	PVC	130	32	0.26
48	P-9	548	J-10	J-11	392.9	PVC	130	32	0.26
50	P-10	194	J-11	J-12	392.9	PVC	130	32	0.26
56	P-13	86	J-14	J-15	297	PVC	130	16	0.23
58	P-14	121	J-15	J-16	297	PVC	130	16	0.23
60	P-15	132	J-16	J-17 (Area 2 Fire Flow Node)	297	PVC	130	16	0.23
62	P-16	153	J-17 (Area 2 Fire Flow Node)	J-18 (Area 2 Demand)	297	PVC	130	16	0.23
64	P-17	50	J-14	J-19	392.9	PVC	130	16	0.13
66	P-18	168	J-19	J-20	392.9	PVC	130	16	0.13
68	P-19	201	J-20	J-21	392.9	PVC	130	16	0.13
70	P-20	80	J-21	J-22	392.9	PVC	130	16	0.13
72	P-21	77	J-22	J-23 (Area 1 Demand 1)	392.9	PVC	130	16	0.13
81	P-26	217	J-27	J-3	392.9	PVC	130	37	0.31
83	P-27	168	J-27	J-28	297	PVC	130	23	0.33
85	P-28	619	J-28	J-29 (Area 4 Demand-2)	297	PVC	130	19	0.27
87	P-29	215	J-2	J-30	487.6	PVC	130	112	0.6
88	P-30	233	J-30	J-27	487.6	PVC	130	80	0.43
90	P-31	163	J-30	J-31	297	PVC	130	32	0.46
92	P-32	703	J-31	J-32 (Area 4 Demand-3)	297	PVC	130	19	0.28
94	P-33	217	J-28	J-33 (Area 4 Fire Flow Node)	297	PVC	130	17	0.24
96	P-34	553	J-33 (Area 4 Fire Flow Node)	J-34 (Area 4 Demand-1)	297	PVC	130	17	0.24
101	P-36	233	J-35	J-36	297	PVC	130	-43	0.62
109	P-40	39	J-38	T-2	204	PVC	130	-43	1.32
111	P-41	387	J-36	J-39	297	PVC	130	-43	0.62
114	P-43	26	J-38	PMP-1	204	PVC	130	21	0.66
115	P-44	16	PMP-1	J-39	204	PVC	130	21	0.66
117	P-45	25	J-38	PMP-2	204	PVC	130	22	0.66
118	P-46	16	PMP-2	J-39	204	PVC	130	22	0.66
133	P-54	855	J-43	J-2	487.6	PVC	130	112	0.6
136	P-56	194	J-44	J-41	204	PVC	130	-26	0.8
142	P-59	71	T-1	CV-1	297	PVC	130	-43	0.62
143	P-60	369	CV-1	J-35	297	PVC	130	-43	0.62
145	P-61	351	T-1	J-46	487.6	PVC	130	181	0.97
148	P-63	98	J-46	J-47	487.6	PVC	130	181	0.97
149	P-64	201	J-47	J-45	487.6	PVC	130	181	0.97
158	P-69	197	J-44	J-51	204	PVC	130	6	0.19
160	P-70	109	J-51	J-83	204	PVC	130	6	0.19
164	P-72	270	J-53	J-54 (Area 5 Demand)	204	PVC	130	8	0.25
166	P-73	247	J-5	J-55 (Area 3 Fire Flow Node)	204	PVC	130	7	0.2
170	P-75	238	J-4	J-57	297	PVC	130	18	0.26
172	P-76	163	J-57	J-58 (Area 3 Demand-4)	297	PVC	130	18	0.26
176	P-78	238	J-59	J-60 (Area 3 Demand-2)	204	PVC	130	1	0.02
178	P-79	185	J-8	J-61	297	PVC	130	-5	0.07
180	P-80	242	J-61	J-62 (Area 3 Demand-1)	297	PVC	130	-1	0.02
205	P-93	176	J-24	J-74 (Area 1 Fire Flow Node)	297	PVC	130	8	0.12
206	P-94	180	J-74 (Area 1 Fire Flow Node)	J-25 (Area 1 Demand 2)	297	PVC	130	8	0.12
212	P-97	168	J-48 (Area 6 Fire Flow Node)	J-77 (Area 6 Demand	204	PVC	130	10	0.29
219	P-101	44	J-80	J-49	297	PVC	130	15	0.22
226	P-104	188	J-83	J-84	204	PVC	130	6	0.19
234	P-109	399	J-87 (Area 7 Demand-1)	J-86 (Area 7 Fire Flow Node)	297	PVC	130	-16	0.23
237	P-111	417	J-88	J-87 (Area 7 Demand-1)	297	PVC	130	-1	0.02
248	P-117	184	J-93	J-92	204	PVC	130	14	0.42
252	P-119	192	J-95	J-93	204	PVC	130	14	0.42
254	P-120	68	J-41	J-96	204	PVC	130	14	0.42
255	P-121	176	J-96	J-95	204	PVC	130	14	0.42
257	P-122	417	J-45	J-97	487.6	PVC	130	164	0.88
261	P-125	843	J-98	J-42	487.6	PVC	130	124	0.66
262	P-126	207	J-97	J-98	487.6	PVC	130	164	0.88
267	P-129	51	J-41	PRV-1	297	PVC	130	-40	0.58
268	P-130	37	PRV-1	J-98	297	PVC	130	-40	0.58
270	P-131	197	J-88	J-99	204	PVC	130	1	0.03
272	P-132	366	J-99	J-100 (Area 7 Demand-2)	204	PVC	130	1	0.03
273	P-133	235	J-100 (Area 7 Demand-2)	J-92	204	PVC	130	-14	0.42
277	P-135	195	J-86 (Area 7 Fire Flow Node)	J-102	297	PVC	130	-20	0.29
278	P-136	255	J-102	J-44	297	PVC	130	-20	0.29
282	P-138	139	J-103	J-104	204	PVC	130	10	0.31
284	P-139	109	J-104	J-105	204	PVC	130	10	0.31
301	P-150	189	J-80	J-111	204	PVC	130	2	0.05
303	P-151	184	J-105	J-112 (Area 7 Demand-3)	204	PVC	130	10	0.31
307	P-153	211	J-54 (Area 5 Demand)	J-114	204	PVC	130	-4	0.12
309	P-154	208	J-42	J-115	487.6	PVC	130	116	0.62
310	P-155	245	J-115	J-43	487.6	PVC	130	112	0.6
311	P-156	303	J-114	J-115	204	PVC	130	-4	0.12
313	P-157	246	J-42	J-116 (Area 5 Fire Flow Node)	297	PVC	130	8	0.12
314	P-158	235	J-116 (Area 5 Fire Flow Node)	J-53	204	PVC	130	8	0.25
316	P-160	327	J-12	J-14	392.9	PVC	130	32	0.26
324	P-166	197	J-103	J-84	204	PVC	130	-6	0.19
331	P-171	157	J-45	J-109	297	PVC	130	17	0.25
337	P-173	224	J-28	J-31	297	PVC	130	-13	0.18
342	P-174	191	J-34 (Area 4 Demand-1)	J-29 (Area 4 Demand-2)	297	PVC	130	-1	0.02
343	P-175	194	J-29 (Area 4 Demand-2)	J-32 (Area 4 Demand-3)	297	PVC	130	-1	0.01
345	P-176	161	J-7	J-119	204	PVC	130	4	0.11
346	P-177	10	J-119	J-59	204	PVC	130	1	0.02
347	P-178	198	J-61	J-119	204	PVC	130	-3	0.09
350	P-179	195	J-62 (Area 3 Demand-1)	J-60 (Area 3 Demand-2)	297	PVC	130	-8	0.11
351	P-180	128	J-60 (Area 3 Demand-2)	J-56 (Area 3 Demand-3)	297	PVC	130	-13	0.19
354	P-182	200	J-58 (Area 3 Demand-4)	J-56 (Area 3 Demand-3)	297	PVC	130	12	0.17
355	P-183	321	J-27	J-5	297	PVC	130	20	0.28
357	P-184	158	J-6	J-121	155	PVC	130	1	0.08
359	P-185	161	J-121	J-122	155	PVC	130	1	0.08
397	P-198	43	J-23 (Area 1 Demand 1)	PRV-6	297	PVC	130	8	0.12
398	P-199	37	PRV-6	J-24	297	PVC	130	8	0.12
412	P-208	80	J-8	PRV-7	392.9	PVC	130	32	0.26
413	P-209	88	PRV-7	J-9	392.9	PVC	130	32	0.26
416	P-211	90	J-55 (Area 3 Fire Flow Node)	J-123	204	PVC	130	7	0.2
417	P-212	67	J-123	J-56 (Area 3 Demand-3)	204	PVC	130	8	0.25
418	P-213	118	J-122	J-123	155	PVC	130	1	0.08
464	P-224	80	J-127	J-111	204	PVC	130	-2	0.05
465	P-225	163	J-49	J-127	204	PVC	130	-2	0.05
467	P-226	162	J-77 (Area 6 Demand	J-128	204	PVC	130	-7	0.23
470	P-228	150	J-129 (Area 6 Fire Flow Node)	J-48 (Area 6 Fire Flow Node)	297	PVC	130	10	0.14
471	P-229	154	J-129 (Area 6 Fire Flow Node)	J-128	204	PVC	130	7	0.23
473	P-230	78	J-49	PRV-3	297	PVC	130	17	0.25
474	P-231	14	PRV-3	J-129 (Area 6 Fire Flow Node)	297	PVC	130	17	0.25
475	P-232	157	J-109	J-80	297	PVC	130	17	0.25
476	P-233	287	J-86 (Area 7 Fire Flow Node)	J-103	204	PVC	130	4	0.11

City of St. Johns
St. John's Land Use Development Plan "A"
HMM Project No: 325052
Preliminary Cost Estimate - Class "D"

The quantities set out in this schedule are estimated quantities only and are not to be taken as final quantities by the Contractor.
Only pipe sizes 300mm and greater have been included in this estimate, with lengths extracted from WaterGEMS model.
The unit prices bid shall include all labour, plant, materials, overhead, duties, and profit and all other obligations and liabilities under the contract.
HST is to be applied in accordance with SGC 1.0. Totals shall be determined by multiplying the quantity by the tendered unit price.

SECTION	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
DIVISION #1					
01005	**Maintain Existing Systems**				
	1. Maintain Existing Water System	L.S.	Unit	$25,000.00	$25,000.00
01010	**Mobilization & Demobilization**	L.S.	Unit	$500,000.00	$500,000.00
01020	**Cash Allowance**				
	Pole Re-location/Shoring/bracing	Allow.		$10,000.00	$10,000.00
	Reinstatment Allowance	Allow.		$20,000.00	$20,000.00
	Public Announcements	Allow.		$5,000.00	$5,000.00
	Contribution in Aid of Hydro	Allow.		$50,000.00	$50,000.00
01500	**Temporary Facilities**				
	Engineers Site Office	L.S.	Unit	$20,000.00	$20,000.00
01560	**Environmental Requirements**				
	Silt Fence	m	500	$10.00	$5,000.00
01570	**Traffic Regulations**				
	Flagpersons Wages	Hour	2000	$18.50	$37,000.00
01710	**Reinstatement and Cleaning**				
	Ditching	m	3000	$20.00	$60,000.00
DIVISION #2					
02111	**Clearing & Grubbing**				
	Clearing	ha.	16	$10,000.00	$160,000.00
	Grubbing	ha.	16	$10,000.00	$160,000.00
02223	**Excavation, Trenching & Backfill**				
	Main Trench Excavation				
	1. Rock	m^3	7000	$90.00	$630,000.00
	2. Common	m^3	35000	$28.00	$980,000.00
	Imported Backfill				
	1. Common	m^3	1000	$18.00	$18,000.00
	Granular Pipe Bedding				
	1. Type 1	m^3	14500	$30.00	$435,000.00
	Rock Underbedding	m^3	1000	$50.00	$50,000.00
	Supply & Placement of Marking Tape				
	1. Plastic Tape	m	11175	$1.50	$16,762.50
	2. Metallic Tape	m	11175	$1.50	$16,762.50
02233	**Selected Granular Base & Sub Base**				
	1. Class A Granular Base	m^3	500	$45.00	$22,500.00
02270	**Rip-Rap Protection**				
	Rip-Rap Hand Laid With Sod	m^3	50	$150.00	$7,500.00

02434	**Pipe Culverts**				
	Supply & Placement of Pipe Culvert				
	1. 600 mm dia. HDPE 320 kPa	m	50	$175.00	$8,750.00
	Supply & Placement of Debris Rack	Each	8	$1,000.00	$8,000.00
	Supply & Placement of Concrete Headwall	m^3	10	$2,000.00	$20,000.00
02574	**Reshaping & Patching of Asphalt Pavement**				
	Removal of Asphalt Pavement	m^2	200	$20.00	$4,000.00
	Patching of Asphalt Pavement (Includes 100mm Class "A")	m^2	200	$60.00	$12,000.00
	Cutting of Asphalt Pavement	m	100	$15.00	$1,500.00
02713	**Water Mains**				
	Supply & Installation of Water Mains				
	1. 300 mm dia. PVC DR 18	m	9735	$320.00	$3,115,200.00
	2. 400 mm dia. PVC DR 18	m	3540	$425.00	$1,504,500.00
	3. 500 mm dia. PVC DR 18	m	3875	$525.00	$2,034,375.00
	Supply & Install Fittings C/W Restaining Flanges				
	1. 300mm dia. Fittings	Each	30	$750.00	$22,500.00
	2. 400mm dia. Fittings	Each	15	$1,500.00	$22,500.00
	3. 500mm dia. Fittings		15	$3,000.00	$45,000.00
	Concrete Thrust Blocks	m^3	50	$500.00	$25,000.00
	Supply and Install Fire Hydrant c/w 10m of 150mm water main and 150mm dia. Gate Valve.	Each	75	$10,000.00	$750,000.00
	Supply & Install 300 mm dia. Gate Valve	Each	35	$7,500.00	$262,500.00
	Supply & Install 400 mm dia. Gate Valve	Each	16	$8,500.00	$136,000.00
	Supply & Install 500 mm dia. Butterfly Valve	Each	12	$12,000.00	$144,000.00
	Supply & Install air release chamber including all civil, structural, mechanical and watermain fittings within foundation walls	Each	3	$25,000.00	$75,000.00
	Supply & Install PRV and chamber	Each	7	$300,000.00	$2,100,000.00
	Swabbing of Water Mains				
	1. 300mm	m	9735	$7.50	$73,012.50
	2. 400mm	m	3540	$7.50	$26,550.00
	3. 500mm	m	3875	$7.50	$29,062.50
	Locate & Connect to Existing System	Each	4	$2,500.00	$10,000.00
	Water Booster Pumping Station	Each	1	$750,000.00	$750,000.00
	Water Storage Tank	Each	2	$1,500,000.00	$3,000,000.00
	Booster Chlorination Station	Each	1	$80,000.00	$80,000.00
	a. Subtotal:				**$17,487,975.00**
	b. HST @ 13%:				**$2,273,436.75**
	c. Contingency @ 20%:				**$3,497,595.00**
	d. Total:				**$23,259,006.75**