

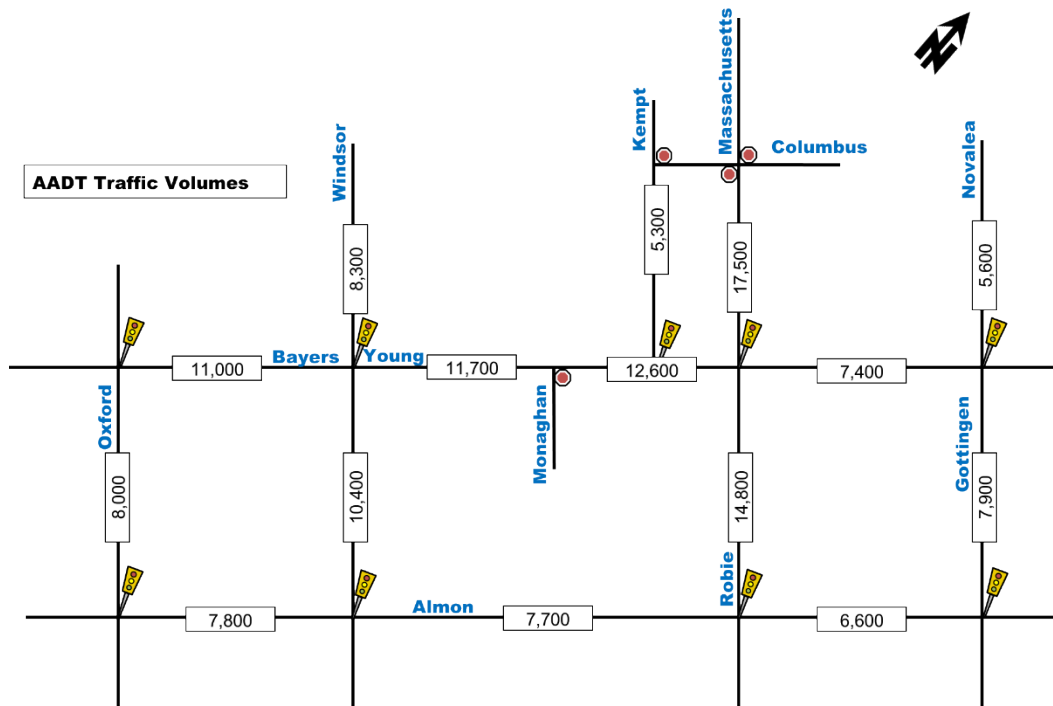
4.0 EXISTING TRANSPORTATION EVALUATION

4.1 TRAFFIC VOLUMES AND SPEEDS

4.1.1 TRAFFIC VOLUMES

Traffic data obtained from HRM includes turning movement traffic counts at study area intersections, as well as volume and speed data along some of the road segments. A data log of all traffic data obtained from HRM has been provided in **Appendix C**, along with the data used for analysis. **Figure 4-1** illustrates the two-way Average Annual Daily Traffic (AADT) along study area roads, while **Figure 4-2** illustrates mid-block peak hour traffic volumes in each respective travel direction along the roads. Additionally, weekday hourly (between 6:00am and 6:00pm) traffic volumes along different roads in the study area have been illustrated graphically as shown in **Figure 4-3**.

Figure 4-1: Average Annual Daily Traffic (AADT) Along Study Area Roads



Existing Transportation Evaluation

Figure 4-2: Mid-Block AM(PM) Peak Hour Traffic Volumes

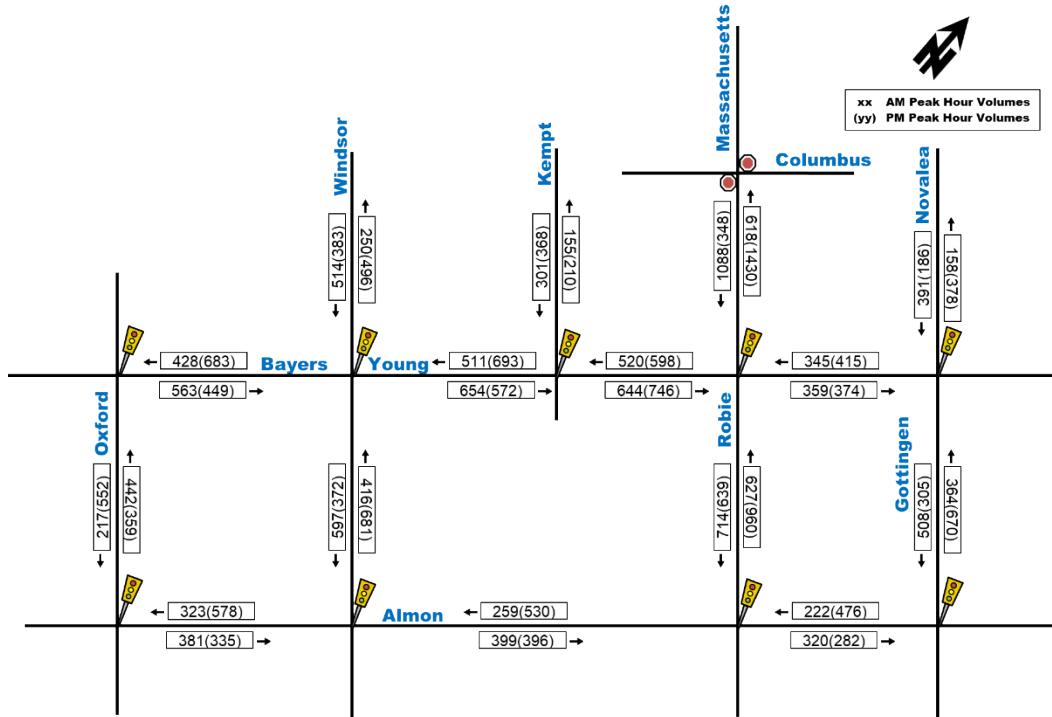
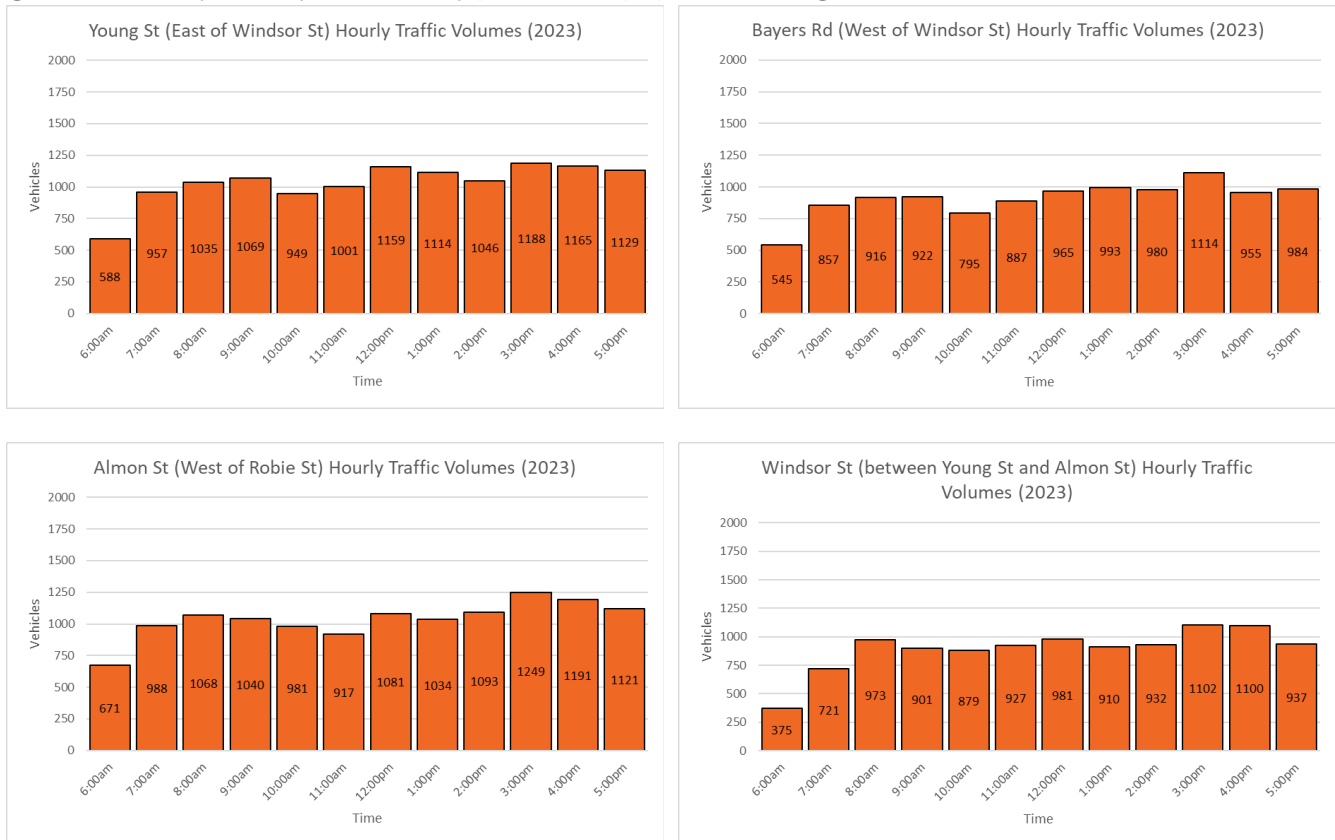
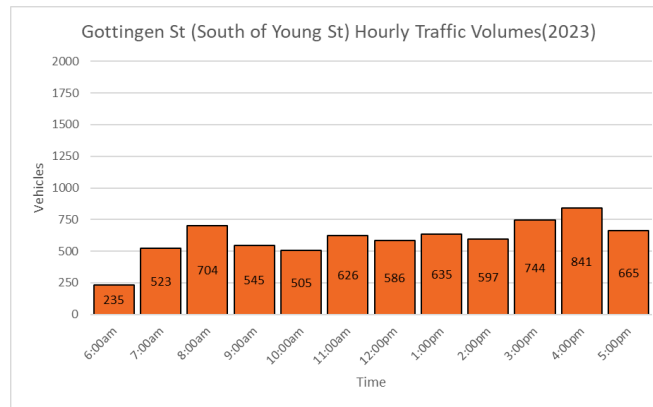
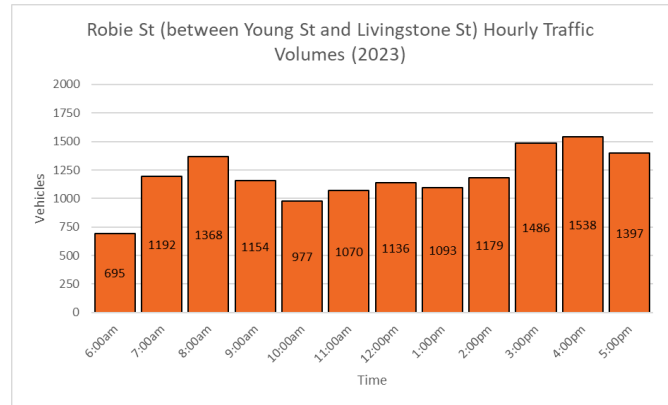
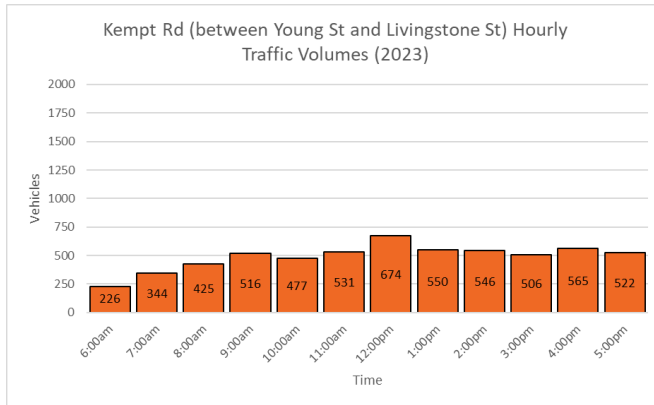


Figure 4-3: Weekday Two-Way Vehicle Hourly (6:00am-6:00pm) Volumes Along Various Roads



Existing Transportation Evaluation

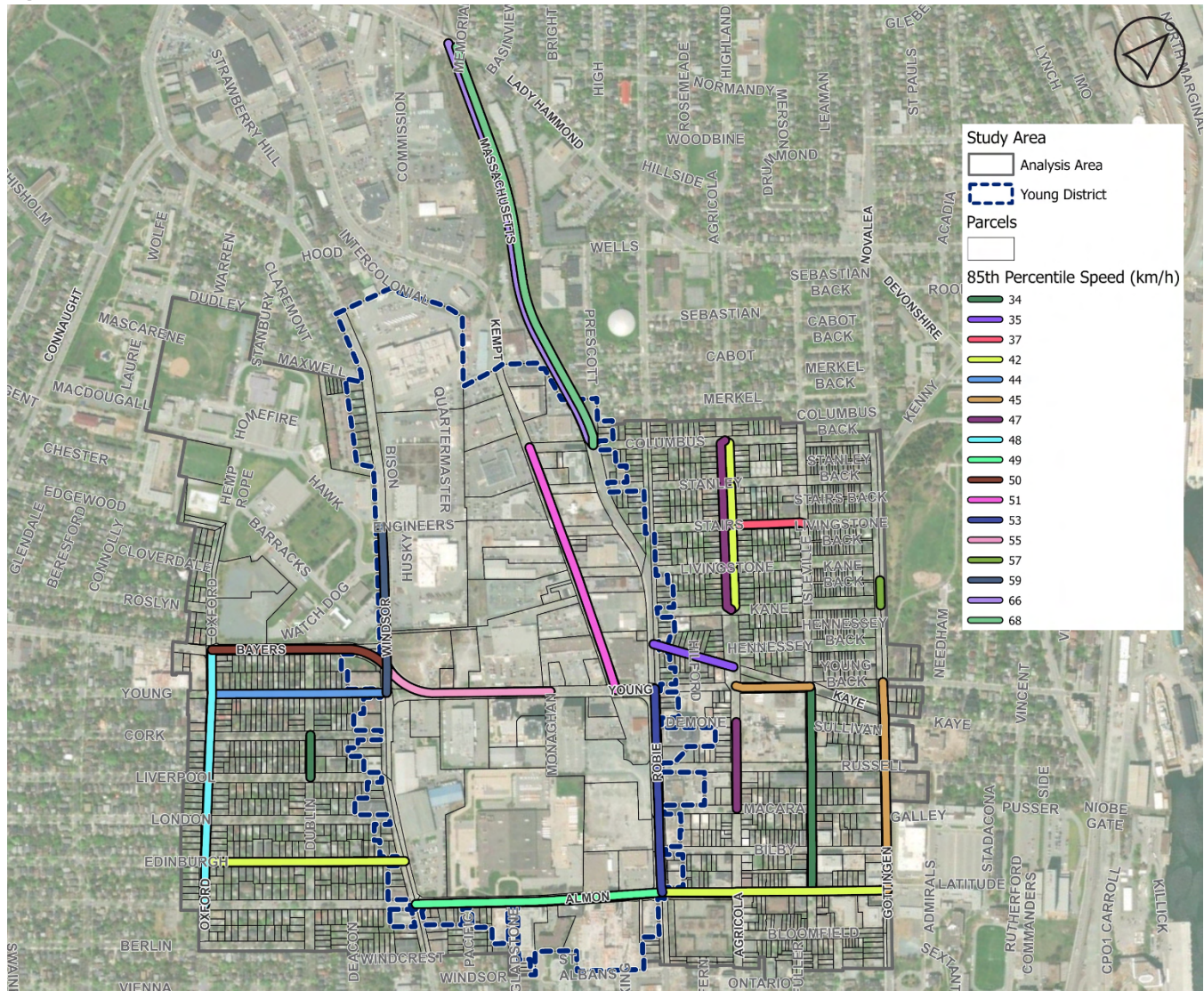


4.1.2 VEHICLE SPEEDS

Study area roads all have a speed limit of 50km/h. Based on speed data provided by HRM along most segments (Figure 4-4), the 85th percentile speed along most roads does not exceed the speed limit, with the exception of the following:

- Novalea, Drive between Young Street and Kane Place where the 85th percentile speed is 57km/h. Despite the permitted on-street parking causing some friction, the cross-section of the road provides wide travel lanes which naturally increase comfort and speed of vehicles.
- Massachusetts Avenue, between Columbus Street and Lady Hammond Road, where the 85th percentile speed is 67km/h. The low friction and wide lanes along this road segment as it connects to Highway 111 may be a contributing factor to this.
- Robie Street, between Young Street and Almon Street, where the 85th percentile speed slightly exceeds speed limit with 53km/h. This is a relatively long stretch of a straight road (350m), with no crossings or intersections causing interruptions to traffic in between, which may be the reason for the higher recorded speeds.

Figure 4-4: 85th Percentile Vehicle Speeds (km/h)



4.2 NETWORK GAPS

The following evaluation is intended to identify transportation network gaps, with a focus on the walking and cycling networks. A review of existing conditions shows that the Young District currently lacks transit-oriented community supportive infrastructure, including fine-grained streets, pedestrian and cycling connections, bus stop amenities, and human-scale developments, among others. Mapping of existing and planned active travel and transit facilities was reviewed and key destinations including employment, elementary and secondary schools, public uses including recreational centres and parks, and transit stops were identified.

4.2.1 WALKING/ROLLING AND CYCLING

CONNECTIVITY

Several gaps have been identified:

- Limited Network Permeability:

Existing Transportation Evaluation

- There are no continuous north-south connections within the Young District. North-south travel is restricted to Windsor Street in the west and Robie Street in the east, along with the east side of Kempt Road.
- Young Street and Almon Street are the only east-west connections through the Young District. There are no additional east-west links north of Young Street.
- **Lack of Connectivity to Surrounding Areas:**
 - Although sidewalks are provided along both sides of most streets within the study area, there is some lack of permeable connectivity for both pedestrians and cyclists to the adjacent neighborhoods.
 - It is noted, however, that planned AAA bikeways along Windsor Street provide connectivity to the adjacent West End Mall and Strawberry Hill Future Growth Nodes, respectively.

PEDESTRIAN INFRASTRUCTURE GAPS

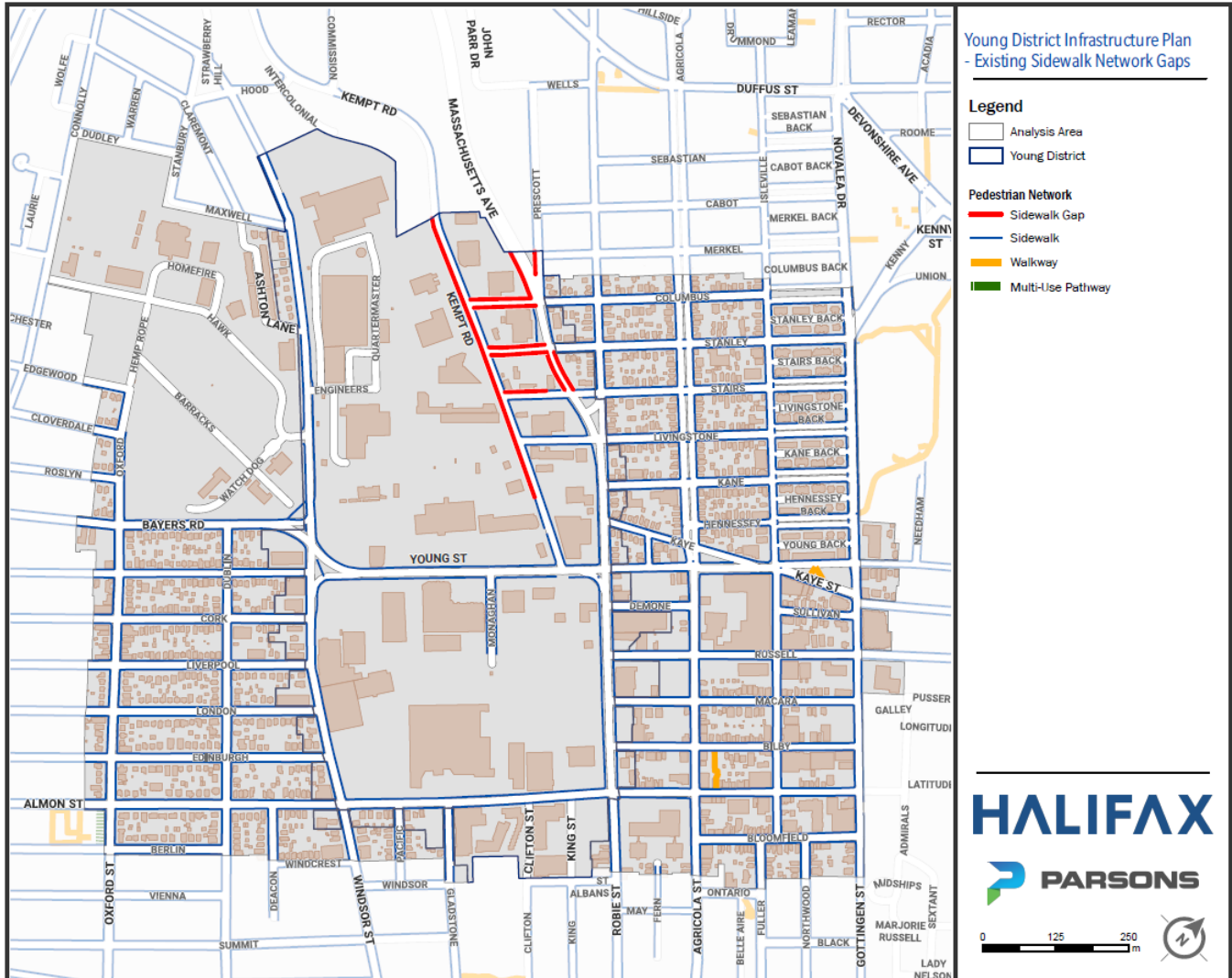
- **Missing Sidewalks:** As illustrated in **Figure 4-5**, Kempt Road, Massachusetts Avenue and connecting streets have notable sidewalk gaps.
- **Pedestrian Crossing Challenges:**
 - Limited pedestrian crossing opportunities, particularly along Robie Street and Windsor Street, with distance of approximately 380m between nearest crosswalks.
 - Bayers/Windsor/Young intersection (skewed crossings and long crossing distances).

CYCLING INFRASTRUCTURE GAPS:

The current cycling infrastructure within the study area is limited to Almon Street and Windsor Street, both located along the boundaries of the Young District. There is a noted lack of continuous east-west and north-south cycling connections within the Young District, including:

- **Lack of Continuous Protected Cycling Facilities along major roads:**
 - Young Street
 - Robie Street
 - Kempt Road
- **Lack of Continuous Local Bikeways:**
 - Internal north-south bikeway connecting to the bikeway on Almon Street.
 - Internal east-west bikeway connection north of Young Street.
 - Internal east-west bike connection south of Young Street between Windsor Street and Isleville Street.

Figure 4-5: Existing Sidewalk Network Gaps



4.2.2 STREET CONNECTIVITY INDEX/INTERSECTION DENSITY

A block density analysis was used to assess the spatial distribution and characteristics of the city blocks within the Young District and the analysis area. The analysis evaluated block size, shape, and distribution to identify the connectivity, continuity, and permeability of the study area's transportation network. The purpose of this analysis was to determine how effectively different modes of transportation (e.g., walking, cycling, public transit, and vehicular traffic) can navigate through the urban environment and its effectiveness in supporting multimodal transportation. Specifically, the analysis aims to:

- **Assess Connectivity:** Determine the directness and availability of multiple routes within the network, facilitating efficient movement for all transportation modes.
- **Evaluate Continuity:** Identify unbroken and seamless routes that support smooth travel across the urban area.
- **Measure Permeability:** Assess the ease with which pedestrians, cyclists, and vehicles can traverse the network, ensuring multiple access points and route options.

The key performance measures used in block density analysis include:

- **Block Size:** The average area of individual blocks, typically measured in square metres or hectares.

Existing Transportation Evaluation

- **Intersection Density:** The number of intersections per unit area, usually per square kilometre.
- **Link-Node Ratio:** The ratio of street segments (links) to intersections (nodes), indicating the degree of network connectivity.

For this analysis, detailed street network and block boundaries data was collected for the Young District and the analysis area, and shown in **Figure 4-6**. The total area analyzed was 1.47 square kilometers (147ha), including 0.60 square kilometres (60ha) in the Young District and 0.87 square kilometres (87ha) in the analysis area. For this analysis, intersections are represented by locations where two or more public roads meet and by interchanges where three or more roads intersect to provide access and exits forming triangle, cloverleaf, and diamond shaped interchanges. The block density analysis results are shown in **Table 4-1** below.

Figure 4-6: The Young District Property Parcels

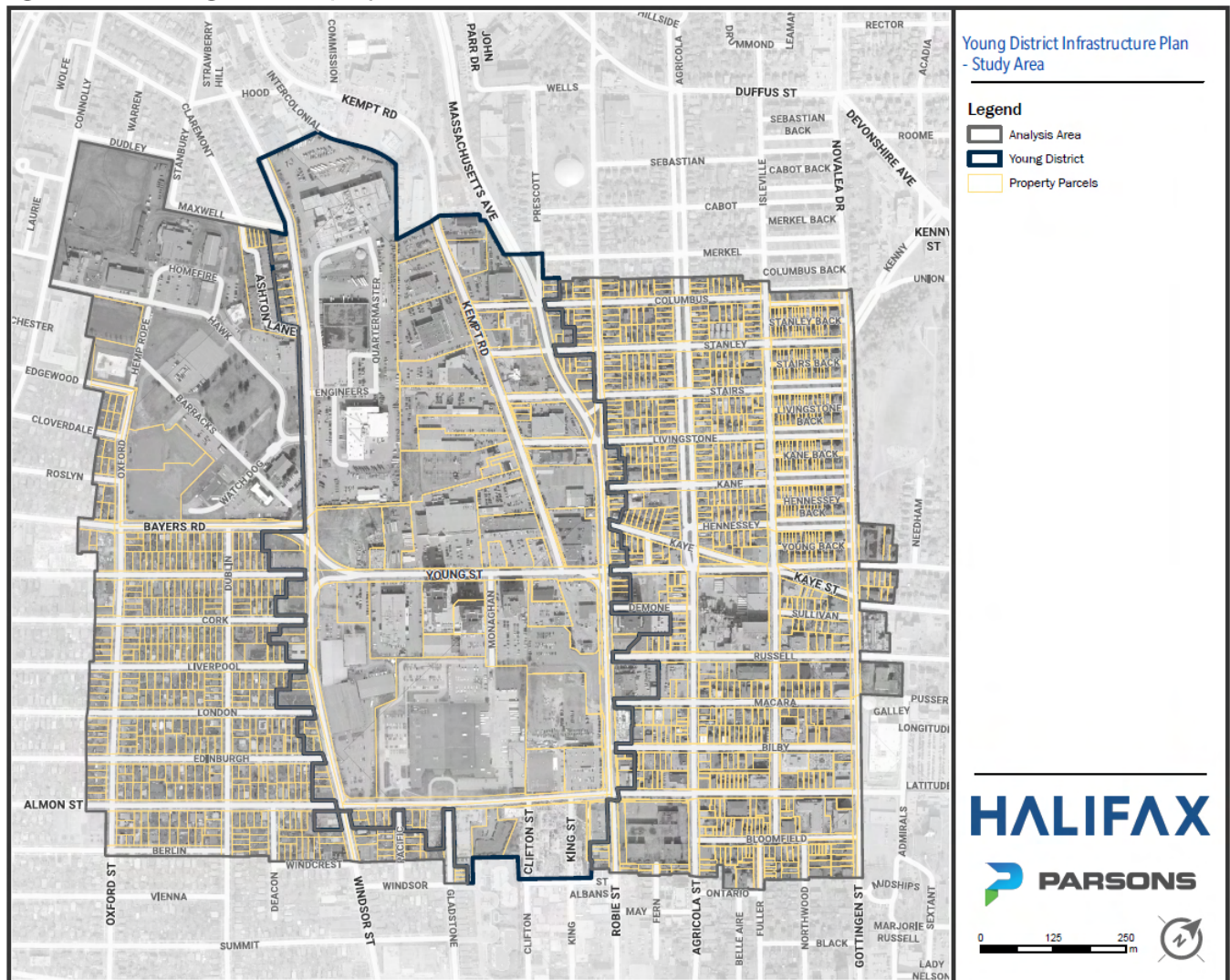


Table 4-1: Block Density Analysis Summary

LOCATION	Block Size		Intersection Density			Link-Node Ratio			
	TOTAL AREA (KM ² / HA)	NUMBER OF BLOCKS	AVERAGE BLOCK SIZE (M ²)/(HA)	NUMBER OF INTERSECTIONS	INTERSECTION DENSITY (PER KM ²)	TOTAL LENGTH OF STREET SEGMENTS (KM)	NUMBER OF STREET SEGMENTS	AVERAGE STREET SEGMENT (KM)	LINK-NODE RATIO
THE YOUNG DISTRICT	0.60/60	17	35,506/3.6	39	64.6	9.0	71	0.127	1.82
ANALYSIS AREA	0.87/87	105	8,276/0.8	97	111.6	25.2	217	0.116	2.24

CONNECTIVITY

Street connectivity is the measure of interconnection between streets and intersections, which considers intersection density and link to node ratio. Intersection density represents the number of intersections per unit area, and results in an intersection index. The greater the intersection index, the smaller the block sizes, and therefore the easier it is for pedestrians, cyclists, and vehicles to navigate the network. Link to node ratio represents the relationship between road segments and intersections. Typically, a link to node ratio score of 1.4 represents the ideal target for street connectivity, with higher values indicating better connectivity.¹

The Young District has a low intersection index (64.6 intersections/km²) and a large average block size (35,506 m²) indicating that the network is difficult to navigate for various modes of transportation. Although, the link to node ratio (1.82) indicates that the network is well connected. This would suggest that an increase in links to improve directness of routing should correspond to a similar increase in nodes to maintain connectivity.

The surrounding analysis area intersection index is notably high (111.6 intersections/km²) indicating, as confirmed by the small average block size (8,276 m²), that the surrounding residential network is reasonably navigable. Furthermore, the link to node ratio of 2.24 indicates a high level of street connectivity within the analysis area.

CONTINUITY

Continuity represents the ease of navigating through a space and is measured by block alignment and the presence of barriers. Block alignment considers consistency of block sizes and the distribution, acting as an indicator of network predictability and smoothness when navigating through a space. Whereas barriers represent instances that would impact the network's predictability or smoothness.

For pedestrians, cyclists, and vehicles the regular block size and alignment within the Young District and analysis area suggests good continuity, facilitating smooth and predictable travel along the periphery of, and within, the Young District. Monaghan Drive is an exception, as it terminates at Canada Post inside the Young District.

The identified sidewalk gap on Kempt Road and Massachusetts Avenue present continuity barriers when navigating the north end of the study area, particularly along Kempt Road where the disconnect creates challenges to navigate between the Young District and Strawberry Hill.

¹ Jennifer Dill, Ph.D. (2004) Measuring Network Connectivity for Bicycling and Walking, School of Urban Studies and Planning, Portland State University.

Existing Transportation Evaluation

Barriers to pedestrian travel include inconsistent sidewalk placement and the five-lane crossing of Robie Street. The width of Young Street can also be considered a barrier in the context of a transit-oriented community.

For north-south traveling cyclists, cycling facilities are provided on the west-side of the Young District area along Windsor Street. East-west cycling travel is provided via Almon Street. The lack of cycling infrastructure and the large block size poses a barrier to east-west traveling cyclists within the Young District, particularly north of Almon Street where the only opportunity is Young Street in the existing network.

By comparison, the small average block sizes and consistent alignment of the analysis area suggests good continuity, facilitating smooth and predictable travel for both north-south and east-west traveling cyclists.

PERMEABILITY

Permeability represents the ease of accessing destinations and is measured by average block size. A block represents an impenetrable area that impacts movement through the environment, therefore the greater the block size the greater the obstruction of movement. As mentioned above, the Young District study area has a large average block size of 35,506 m², indicating low permeability due to infrequent intersections and access points, while the small average block size for the analysis area (8,276m²), indicates high permeability, allowing for easy movement through frequent intersections and access points.

CONCLUSION

The block density analysis reveals that the average block size, intersection index, and link to node ratio indicates the Young District would be enhanced by smaller average block sizes, an increase in link density and a corresponding increase in node density. Link alignment should remain continuous where possible.

Within the analysis area, block density analysis indicates a well-connected, continuous, and permeable transportation network for various modes of transportation.

4.3 EXISTING VEHICLE OPERATIONS

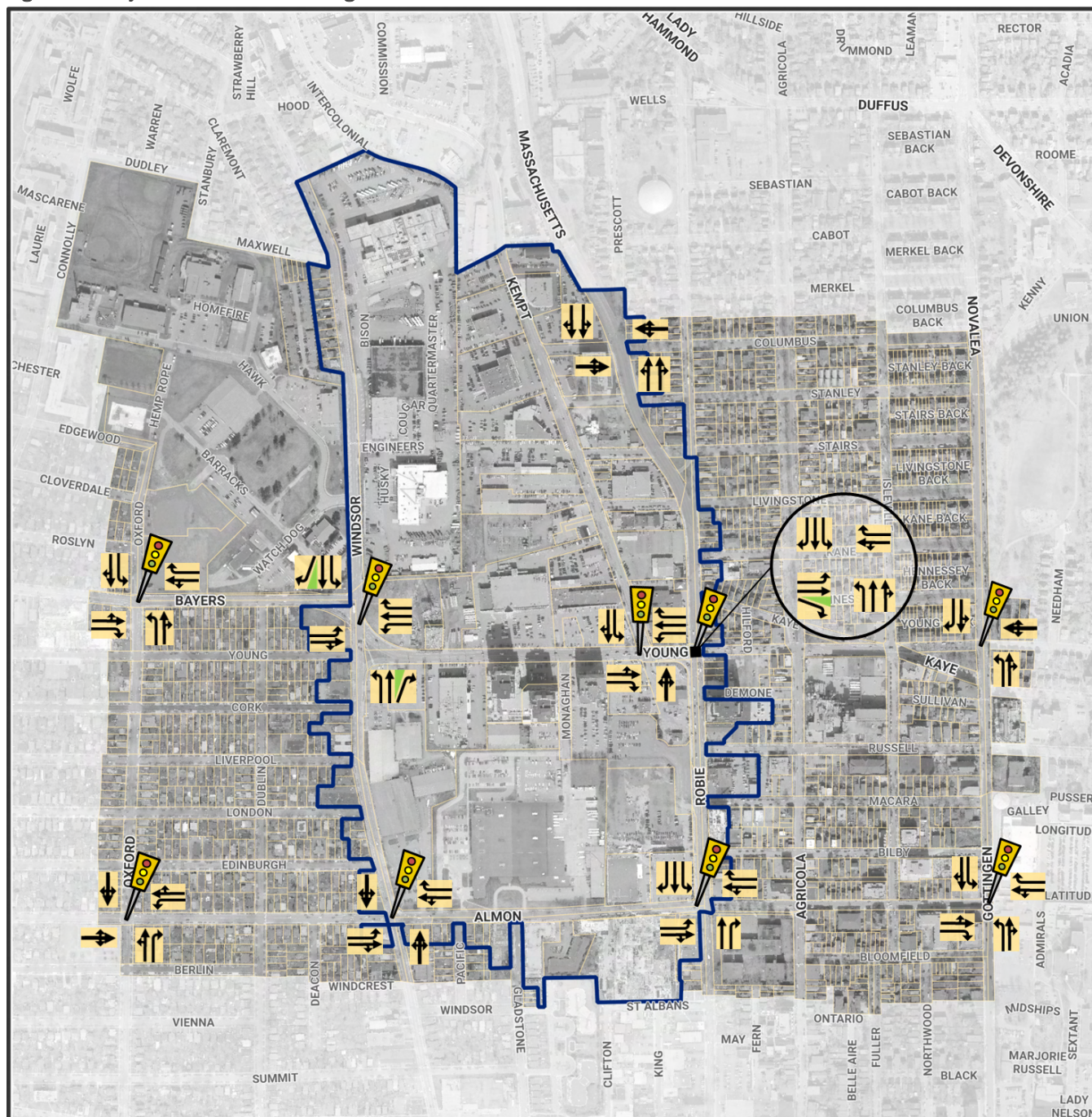
The vehicle delays at an intersection, measured in seconds per vehicle, is translated into Level of Service (LOS) letter-grade scoring ranging from A to F. These letter grades are defined in the Highway Capacity Manual to represent the quality of service experienced by the driver when navigating an intersection based on the delay experienced by the driver. The level of service corresponding to the average vehicle delay are specified below in **Table 4-2** for signalized and unsignalized intersections.

Table 4-2: Intersection Level of Service

LOS	Average Delay (s/veh)	
	SIGNALIZED INTERSECTION	UNSIGNALIZED INTERSECTION
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

A traffic operational analysis was undertaken at key study area intersections to determine intersection performance. The analysis was conducted using Synchro v11, with analysis reports provided in **Appendix I**. The lane configurations at each key intersection included in the analysis are illustrated in **Figure 4-7**.

Figure 4-7: Key Intersection Lane Configurations



Synchro results are summarized in **Table 4-3**, which provides delays, v/c ratios, the 95th percentile queue lengths and the respective storage lengths where relevant. The results are based on the HCM 2000 methodology and a Peak Hour Factor (PHF) of 0.9, as per the municipality's Transportation Impact Study Guidelines. Red font indicates that movement capacity or available storage length was exceeded. The analysis was conducted for the afternoon peak hour only, which is considered the most critical time period of the day.

Existing Transportation Evaluation

Table 4-3: Intersection PM Peak Hour Traffic Operations

Intersections	Movements	Volume (veh/h)	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)	Storage Length (m)
Oxford Street/Bayers Road	EBLT	377	9	A	0.47	A	50	-
	EBR	64	7	A	0.05	A	3	25
	WBLT	599	15	B	0.75	C	#97	-
	WBR	65	7	A	0.05	A	3	55
	NBL	195	19	B	0.60	A	38	65
	NBTR	163	15	B	0.33	A	26	-
	SBL	30	14	B	0.10	A	8	30
	SBTR	54	14	B	0.11	A	11	-
	Overall	-	13	B	0.78	-	-	-
Windsor Street & Bayers Road/Young Street	EBL	72	32	C	0.36	A	25	35
	EBTR	384	45	D	0.80	C	108	-
	WBL	100	22	C	0.41	A	22	35
	WBT	446	29	C	0.66	B	107	-
	WBR	81	19	B	0.07	A	9	40
	NBL	183	20	B	0.53	A	38	85
	NBTR	511	25	C	0.70	B	126	-
	SBL	61	27	C	0.32	A	22	25
	SBTR	322	31	C	0.62	B	87	-
	Overall	-	29	C	0.78	-	-	-
Young Street/Kempt Road	EBLT	494	13	B	0.53	A	99	400
	EBR	44	8	A	0.03	A	4	50
	WBL	30	6	A	0.08	A	m4	25
	WBT	472	8	A	0.46	A	41	50
	WBR	96	5	A	0.09	A	m4	30
	NBLTR	204	45	D	0.78	C	53	-
	SBL	186	48	D	0.80	C	52	25
	SBTR	182	28	C	0.28	A	23	-
	Overall	-	20	B	0.62	-	-	-
Robie Street/Young Street	EBL	172	12	B	0.43	A	29	20
	EBT	327	12	B	0.37	A	55	50
	EBR	247	10	A	0.25	A	22	50
	WBLT	355	29	C	0.61	B	#107	125
	WBR	68	33	C	0.05	A	10	25
	NBL	123	39	D	0.72	C	#41	125
	NBTR	837	30	C	0.77	C	85	-
	SBL	27	24	C	0.31	A	11	60
	SBT	375	28	C	0.66	B	80	-
	SBR	98	20	B	0.08	A	9	-
	Overall	-	24	C	0.66	-	-	-

Existing Transportation Evaluation

Intersections	Movements	Volume (veh/h)	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)	Storage Length (m)
Gottingen Street/Novalea Drive & Young Street	WBLTR	207	28	C	0.43	A	51	-
	NBL	230	6	A	0.41	A	15	30
	NBTR	440	6	A	0.47	A	23	-
	SBLT	136	10	A	0.15	A	20	-
	SBR	50	9	A	0.04	A	5	55
	Overall	-	11	B	0.45	-	-	-
Oxford Street/Almon Street	EBLTR	193	18	B	0.35	A	38	-
	WBL	67	12	B	0.14	A	m12	30
	WBTR	511	23	C	0.68	B	m124	-
	NBLT	215	19	B	0.31	A	44	-
	NBR	12	16	B	0.01	A	1	25
	SBLTR	552	41	D	0.89	D	#159	-
	Overall	-	28	C	0.78	-	-	-
Windsor Street/Almon Street	EBL	59	24	C	0.27	A	m18	-
	EBTR	276	25	C	0.43	A	m64	-
	WBLT	388	27	C	0.63	B	92	-
	WBR	142	19	B	0.17	A	19	-
	NBLTR	534	47	D	0.92	E	#154	-
	SBLTR	372	36	D	0.81	D	#106	-
	Overall	-	33	C	0.70	-	-	-
Robie Street/Almon Street	EBL	108	25	C	0.41	A	25	20
	EBTR	288	23	C	0.42	A	63	-
	WBLT	359	39	D	0.71	C	101	-
	WBR	117	26	C	0.12	A	16	25
	NBT	660	82	F	1.06	F	#225	-
	NBR	14	20	B	0.01	A	0	-
	SBL	44	66	E	0.67	B	#28	-
	SBT	505	27	C	0.69	B	114	-
	SBR	96	21	C	0.08	A	10	-
	Overall	-	45	D	0.86	-	-	-
Gottingen Street/Almon Street	EBLT	43	12	B	0.06	A	12	-
	EBR	80	12	B	0.06	A	9	-
	WBLT	96	13	B	0.13	A	23	-
	WBR	51	12	B	0.04	A	7	-
	NBL	189	41	D	0.73	C	48	30
	NBTR	441	34	C	0.76	C	87	-
	SBL	9	24	C	0.07	A	m4	-
	SBTR	296	27	C	0.49	A	57	-
	Overall	-	28	C	0.39	-	-	-
Massachusetts Avenue/ Columbus Street (Unsignalized)	EBLTR	77	138	F	0.88	D	38	-
	WBLTR	62	32	D	0.34	A	11	-
	NBLTR	1,430	1	A	0.03	A	1	-
	NBLTR		0	A	0.46	A	0	-

Existing Transportation Evaluation

Intersections	Movements	Volume (veh/h)	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)	Storage Length (m)
	SBLTR	384	2	A	0.03	A	1	-
	SBLTR		0	A	0.14	A	0	-
	Overall	-	29	C	-	-	-	-

There are some traffic restrictions in regard to certain movements at some intersections, which includes no northbound left-turns at the intersection of Robie/Almon and no eastbound movements at the intersection of Young/Gottingen/Novalea. Additionally, there are Leading Pedestrian Phases (LPI) provided at certain intersections, including Oxford/Bayers (all crosswalks), Windsor/Almon (all crosswalks), Young/Kempt (east/west crosswalks), and Robie/Almon (east/west crosswalks).

Based on the results, signalized intersections and the respective critical movements operate acceptably, with the exception of the NBT at the intersection of Robie Street/Almon Street, which operates at capacity. The eastbound movements of the unsignalized Massachusetts Avenue/Columbus Street intersection operates at capacity due to high delays resulting from high through volumes on Massachusetts Avenue.

The 95th percentile queue lengths do not exceed available storage at most locations, with the exception of the SBL at Young Street/Kempt Road and the NBL at Gottingen Street/Almon Street.

4.4 EXISTING VISSIM ANALYSIS SUMMARY

In addition to the SYNCHRO analysis, a VISSIM traffic model was developed for the afternoon peak hour. VISSIM is a microscopic traffic simulation software used to analyze the performance of existing transportation networks by replicating real-world traffic patterns. The model is calibrated using observed traffic volumes, speeds, and signal timings to accurately reflect current conditions. This allows an evaluation of travel times and operational issues under today's conditions before testing future scenarios. An assessment of the network was undertaken through three industry-standard metrics:

- **Network vehicle-hours-travelled (VHT):** This metric represents the total time spent by all vehicles traveling within the modelled network during a specific period. It is calculated as the sum of travel times for all vehicles across all road segments. VHT is used to measure congestion and traffic delays, as higher VHT indicates more time spent in travel due to slower speeds or delays.
- **Vehicle-kilometres-travelled (VKT):** This metric quantifies the total distance traveled by all vehicles in a network over the analysis period. VKT helps in assessing travel demand, network utilization, and fuel consumption.
- **Total Network Delay:** This metric measures the total delay for all vehicles across the entire network compared to the ideal theoretical travel time.

Overall VISSIM traffic operations micro-simulation model network values for the cumulative VHT and VKT of the Young District modelling area were recorded for the PM peak hours. At a given level of demand, higher values for these metrics would typically indicate increased delay and less direct driving routes in the network.

4.5 NETWORK ANALYSIS

The three network analysis metrics (VHT, VKT and Total Delay) are summarized in **Table 4-4** for the existing PM peak hour. The cumulative total network delay for the PM peak hour is approximately 144 hours for the nearly 9,000 vehicles, resulting in an average of approximately 1 minute of delay per vehicle throughout the peak hour when travelling through the study area network.

Table 4-4: PM Peak Hour Results - Network VHT and VKT for the Existing Conditions Scenario

Scenario	Afternoon Peak Hour (PM)			
	Peak Hour Volume ^{1F2} (veh/hr)	VHT (hrs)	VKT (km)	Total Delay (hrs)
GP Traffic	8,950	293	5,667	144
Transit	54	3	48	1.8

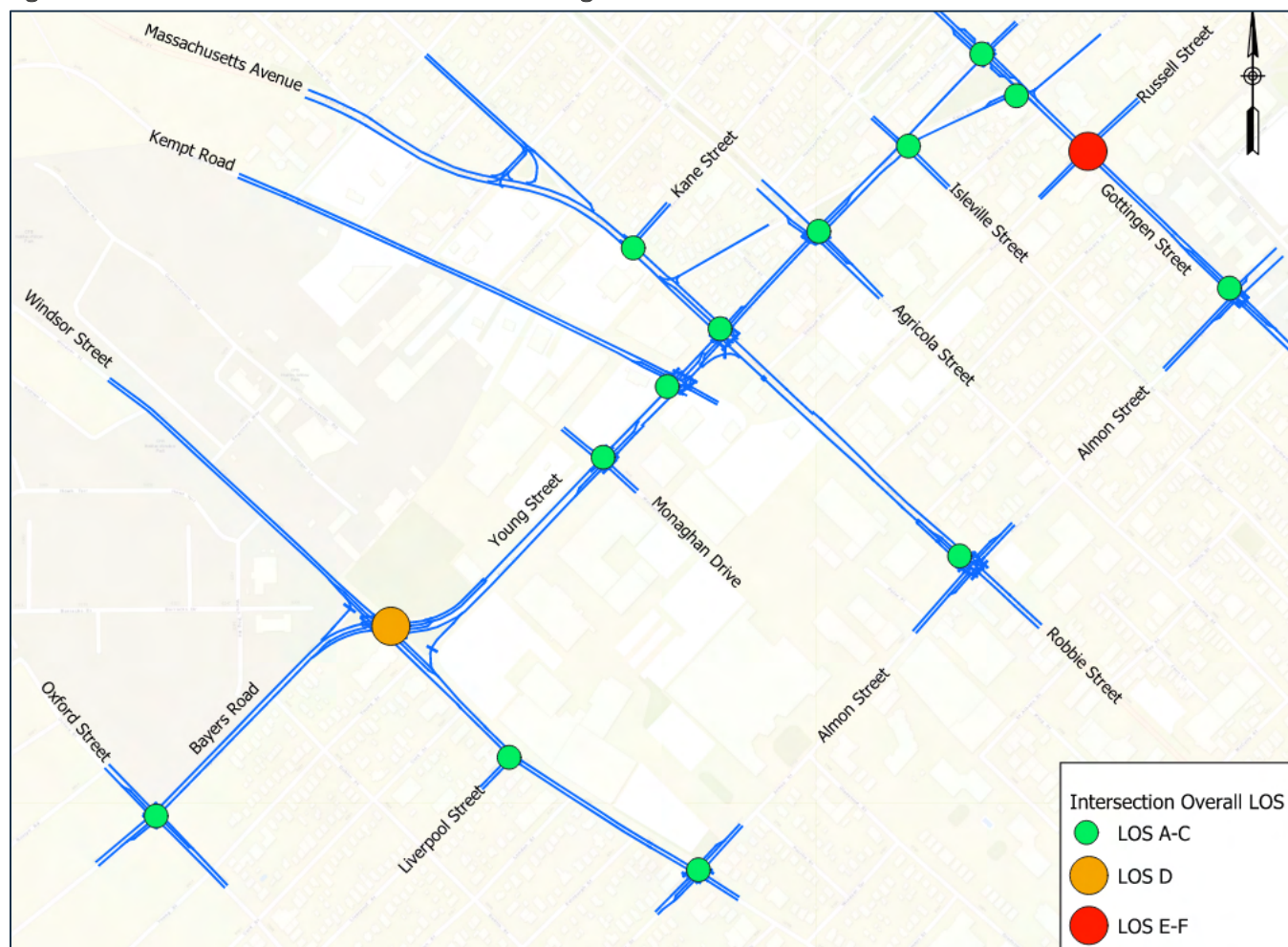
4.5.1 VISSIM LEVEL OF SERVICE

The LOS metrics presented in this report refer to the average delay experienced by vehicles in the VISSIM micro-simulation model, which are a separate result to the intersection control delays produced by Synchro. While the VISSIM metrics are useful in identifying locations with operational challenges, they do not provide the same letter grade as would have been calculated through an HCM-based Synchro analysis, and therefore should not be directly compared to Synchro outputs. The overall intersection level of service is presented in **Figure 4-8**.

² Volume is the sum of vehicles that have left the network before the end of the analysis hour and the number of vehicles remaining in the network at the end of the analysis hour.

Existing Transportation Evaluation

Figure 4-8: Overall Intersection Level of Service – Existing PM Peak Hour



The majority of intersections operate with an overall LOS A to C. The Russell Street/Gottingen Street intersection was found to operate with an overall LOS F.

Table 4-5 summarizes all critical movements that operate with an LOS E or worse

Table 4-5: VISSIM PM Peak Hour Results – LOS of Critical Movements

Intersection	Control Type	Movement	LOS
Bayers Road/Young Street/Windsor Street	Signalized	EBL	E
Kempt Road/Young Street	Signalized	SBL	E
Almon Street/Windsor Street	Signalized	SBL	E
Robie Street/Almon Street	Signalized	EBL	F
Russell Street/Gottingen Street	Unsignalized	NBL/T/R	E

4.5.2 TURNING MOVEMENT QUEUE LENGTHS

For each scenario, queue lengths are averaged for the PM peak period using outputs from the VISSIM model. Turning movements with average queue lengths that exceed the available storage length are identified.

Existing Transportation Evaluation

Vehicle turning movement queues are analyzed through the comparison of average and maximum peak hour queue lengths to the available storage length and distance to the next upstream intersection. **Table 4-6** provides a summary of the number of all movements that exceed available length for the existing PM peak hour.

Table 4-6: Summary of VISSIM Model Queue Results

Scenario	Movement Queue Count			
	Average Queue		Maximum Queue	
	Exceeds Storage	Exceeds Upstream Intersection	Exceeds Storage	Exceeds Upstream Intersection
Existing PM Peak Hour	2	3	13	23

Graphics mapping where average queue lengths exceed available storage lengths under existing condition can be found in **Figure 4-9**, and graphics mapping where maximum queue lengths exceed available storage length can be found in **Figure 4-10**.

Figure 4-9: Intersection Movement Average Queue Length – Existing PM Peak

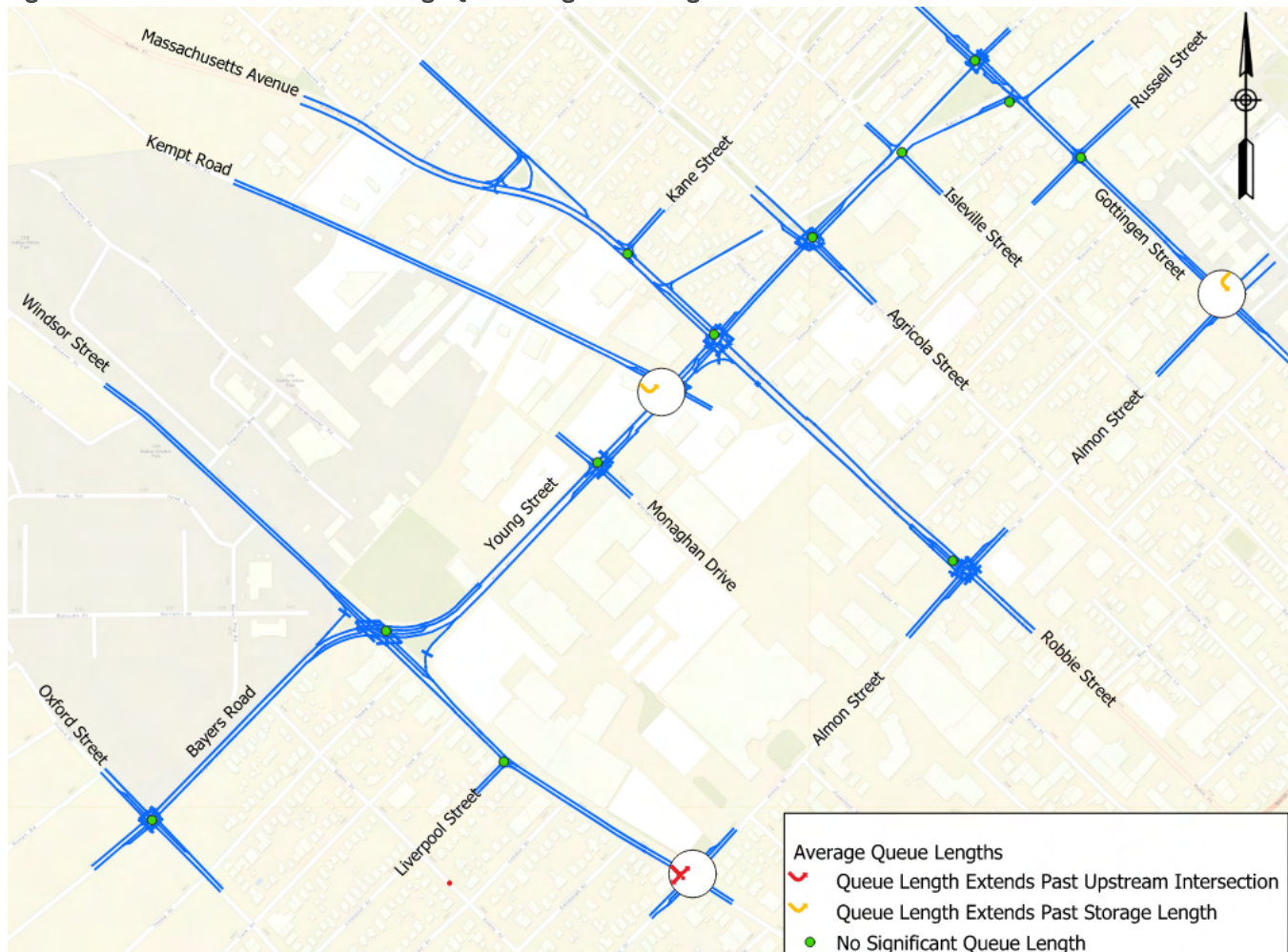


Figure 4-10: Intersection Movement Maximum Queue Length – Existing PM Peak



Table 4-7 provides a summary of all movements where the maximum queues exceed the available storage length or upstream distance.

It is observed that the majority of traffic congestion occurs along Bayers Road/Young Street and Gottingen Street. Notably, the short storage lengths on Young Street at the intersections of Kempt Road and Robie Street are particularly problematic, with frequent congestion issues noted in the model leading to queues that often spill back between these intersections, likely resulting in exacerbating the traffic delays in the area.

Table 4-7: Summary of Modelled VISSIM Queues Exceeding Storage Capacities

Intersection	Movement	Storage length (m)	Upstream length (m)	Average Modelled Queue length (m)	Maximum Modelled Queue length (m)
Bayers Road/Young Street/Windsor Street	EBL	65	300	8	45
	NBL	75	170	6	88
	WBL	38	280	1	61
	SBT	N/A	145	29	166
	NBT	N/A	170	21	175
Young Street/Kempt Road	SBL	30	200	47	216
	EBT/L	52	100	20	94
	WBT	N/A	50	15	79
	WBR	N/A	50	15	79
Young Street/Robie Street	EBL	20	50	17	86
	EBT	N/A	50	25	87
	WBL/T	N/A	127	28	152
	WBR	22	127	12	142
	NBL	125	350	14	65
	EBR	50	50	0	45
Young Street/Agricola Street	SBR	20	70	1	45
	NBL	35	125	4	78
	EBL/T/R	N/A	130	16	148
Young Street/Novalea Drive/Gottingen Street	NBL	30	45	2	36
	NBT/R	N/A	45	7	68
Almon Street/Gottingen Street	WBL	10	60	11	60
	NBT/R	N/A	70	8	73
Almon Street/Windsor Street	EBL	25	100	4	53
	SBL/T/R	N/A	70	73	265
Kaye Street/Gottingen Street	SBT	N/A	45	10	55
Russell Street/Gottingen Street	SBL/T/R	N/A	80	48	117
Robie Street/Almon Street	NBT	N/A	130	22	88
	SBT	N/A	340	14	174
	EBL	30	100	29	87

4.5.3 TRANSIT ROUTE TRAVEL TIME AND TRANSIT MOVEMENT DELAY

Transit performance has been analyzed based on several key metrics: transit route travel times, transit route delays within the model, and vehicle delays for specific transit movements. These metrics provide a comprehensive overview of transit efficiency and areas of concern. Based on the analysis of transit movement vehicle delays, the following movements have been identified as critical movement with high delay:

- Bayers Road/Young Street & Windsor Street Southbound through
- Bayers Road/Young Street & Windsor Street Northbound through

- Young Street/Robie Street Northbound left-turn
- Almon Street/ Windsor Street Northbound through
- Almon Street/ Windsor Street Southbound through
- Russell Street/Gottingen Street Northbound through

It is noted that the VISSIM multi-modal traffic operations microsimulation model measures vehicle and transit delay in the same way except that one additional delay factor is included in the transit measurement, as it does not apply to general purpose traffic: the acceleration and deceleration at bus stops.

4.6 MULTI-MODAL LEVEL OF SERVICE

Multimodal Level of Service (MMLOS) analysis was conducted at relevant study area intersections and street segments, which have been identified in **Figure 4-11**. Intersection MMLOS results are summarized in Figure 4-12. and illustrated on a map in

Figure 4-13, while segment MMLOS results are summarized in **Figure 4-14** and illustrated on a map in **Figure 4-15**. Detailed analysis sheets are provided in **Appendix J**.

Nearly all intersection and segment analysis results indicate that pedestrian, cycling and transit LOS results do not meet the targets for the Regional Centre, while truck (goods movement) and automobile results meet or exceed the respective targets. The targets indicated for each travel mode reflect both the 'basic' and 'priority' targets for the pedestrian, cycling and transit travel modes and 'basic' for the goods movement and automobile travel modes, as found in the HRM MMLOS Framework (2019) based on the Regional Centre area. Given transit priority measures along each of Bayers Road, Young Street, Massachusetts Avenue and Robie Street, targets used for transit LOS reflect priority targets at those particular locations. For pedestrians, Young Street, Kempt Road, Monaghan Drive and Robie Street LOS reflect priority targets. For cycling, Young Street, Kempt Road and Windsor Street LOS reflect priority targets.

4.6.1 PEDESTRIAN

INTERSECTIONS

The LOS is affected by number of uncontrolled conflicts, long wait times and crosswalk lengths at intersections. None (0%) of the intersections were found to meet the respective LOS targets. Nearly all intersections provide a LOS C or D, where smaller intersections with shorter crossing distances are more favorable such as along Oxford Street or Gottingen Street. The Young/Windsor intersection provides a LOS E for pedestrians due to the number of uncontrolled conflicts (permitted right and left-turn movements), along with long crossing distances, particularly as a result of the skewed intersection configuration.

SEGMENTS

The LOS is affected by facility width or distance between marked crossings along road segments. Approximately 19% of the segments were found to meet the respective LOS targets. Most road segments were found to provide LOS ranging from B or D for pedestrians, with the exception of the west side of Kempt Road, where no or discontinuous sidewalk facilities are provided, resulting in LOS F result. The short Young Street segment between Kempt Road and Robie Street provides wide pedestrian zones resulting in LOS A for the eastbound segment. Road segments with a shorter distance between pedestrian crossing locations such as Young Street, Windsor Street and east side of Kempt Road provide LOS C, while Robie Street provides lower score of LOS D due to longer distances. Along most roads evaluated, narrow sidewalk widths (less than 1.8m wide) along the respective roads may also be a contributing factor for providing a lower LOS result. The 2m

Existing Transportation Evaluation

wide sidewalks with sufficient pedestrian zones result in LOS B for the Almon Street segments, which meets the targets.

Figure 4-11: Intersections and Street Segments Included in MMLoS Analysis



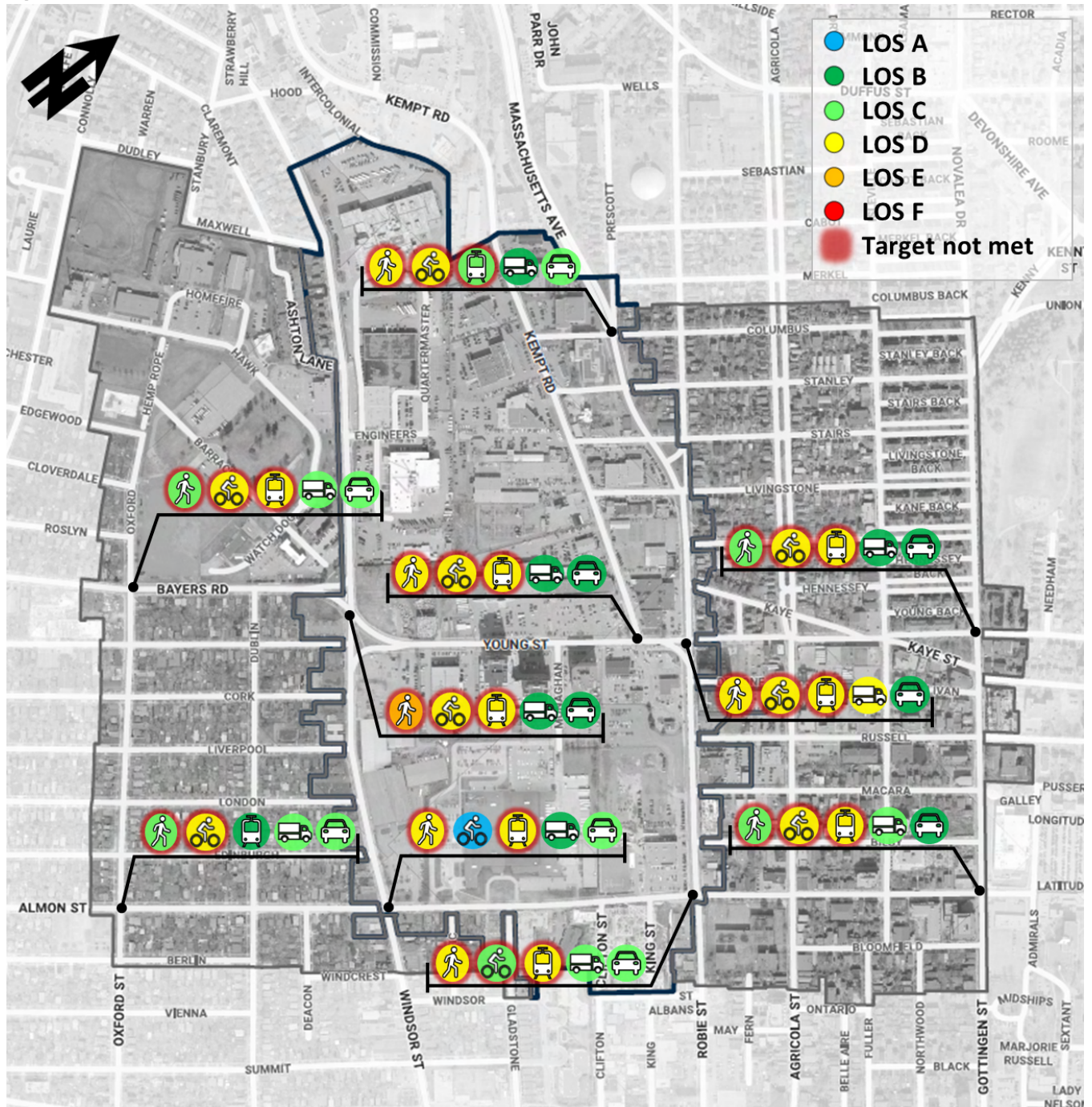
Existing Transportation Evaluation

Figure 4-12: MMLOS Intersection Analysis Results

SCENARIO: Existing Conditions					
Area Type: Regional Centre					
MODE					
Bayers Road / Oxford Street					
Target	B	B	A	D	E
Actual	C	D	D	C	C
Young Street / Bayers Road / Windsor Street					
Target	A	A	A	D	E
Actual	E	D	D	B	B
Young Street / Kempt Road					
Target	A	A	A	D	E
Actual	D	D	D	B	B
Young Street / Robie Street					
Target	A	A	A	D	E
Actual	D	D	D	D	B
Young Street / Gottingen Street / Novalea Drive					
Target	A	A	A	E	E
Actual	C	D	D	B	B
Massachusetts Avenue / Columbus Street					
Target	B	B	A	E	E
Actual	D	D	C	B	C
Gottingen Street / Almon Street					
Target	B	A	A	E	E
Actual	C	D	D	C	B
Robie Street / Almon Street					
Target	A	A	A	D	E
Actual	D	C	D	C	C
Windsor Street / Almon Street					
Target	B	A	B	E	E
Actual	D	A	D	B	C
Almon Street / Oxford Street					
Target	B	A	B	E	E
Actual	C	D	B	C	C

Existing Transportation Evaluation

Figure 4-13: MMLOS Intersection Analysis for All Travel Modes



Existing Transportation Evaluation

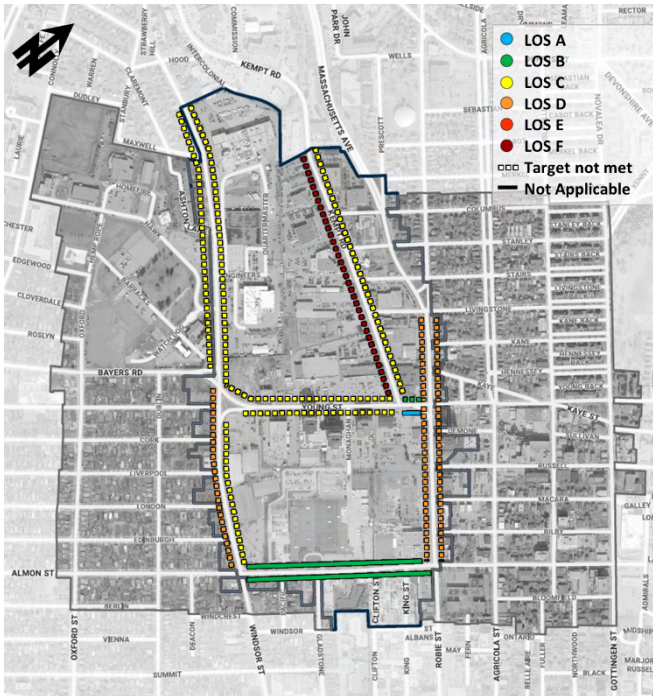
Figure 4-14: MMLOS Segment Analysis Results

SCENARIO: Existing Conditions											Area Type: Regional Centre	
MODE												MODE
DIR	Maxwell Avenue						Maxwell Avenue					DIR
SB	Target	B	A	B	E	E	E	E	B	A	B	Target
↓	Actual	C	C	D	C	D	C	C	D	C	C	Actual
	Bayers Road/Young Street					Windsor	Bayers Road/Young Street					
SB	Target	B	A	B	E	E	E	E	B	A	B	Target
↓	Actual	D	C	D	C	D	E	B	D	C	C	Actual
	Almon Street						Almon Street					
	Columbus Street					Kempt	Columbus Street					
SB	Target	A	A	B	D	E	E	D	B	A	A	Target
↓	Actual	F	D	D	A	D	C	A	D	D	C	Actual
	Young Street						Young Street					
	Windsor Street					Young	Windsor Street					
WB	Target	A	A	A	D	E	E	D	A	A	A	Target
↓	Actual	C	C	A	D	B	A	D	D	D	C	Actual
	Kempt Road					Young	Kempt Road					
WB	Target	A	A	A	D	E	E	D	A	A	A	Target
↓	Actual	B	D	A	D	A	A	B	C	C	A	Actual
	Robie Street						Robie Street					
	Windsor Street					Almon	Windsor Street					
WB	Target	B	A		E	E	E	E		A	B	Target
↓	Actual	B	B		E	D	C	D		B	B	Actual
	Robie Street						Robie Street					
	Livingstone Street					Robie	Livingstone Street					
SB	Target	A	B	A	D	E	E	D	A	B	A	Target
↓	Actual	D	D	C	B	A	C	C	C	D	D	Actual
	Young Street					Robie	Young Street					
SB	Target	A	B	A	D	E	E	D	A	B	A	Target
↓	Actual	D	C	A	D	B	E	C	A	B	D	Actual
	Almon Street						Almon Street					

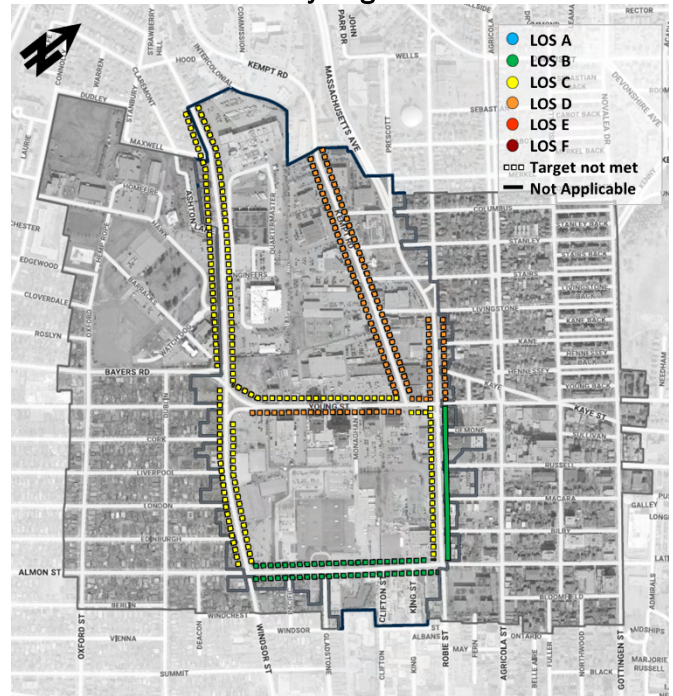
Existing Transportation Evaluation

Figure 4-15: MMLOS Segment Analysis for All Travel Modes

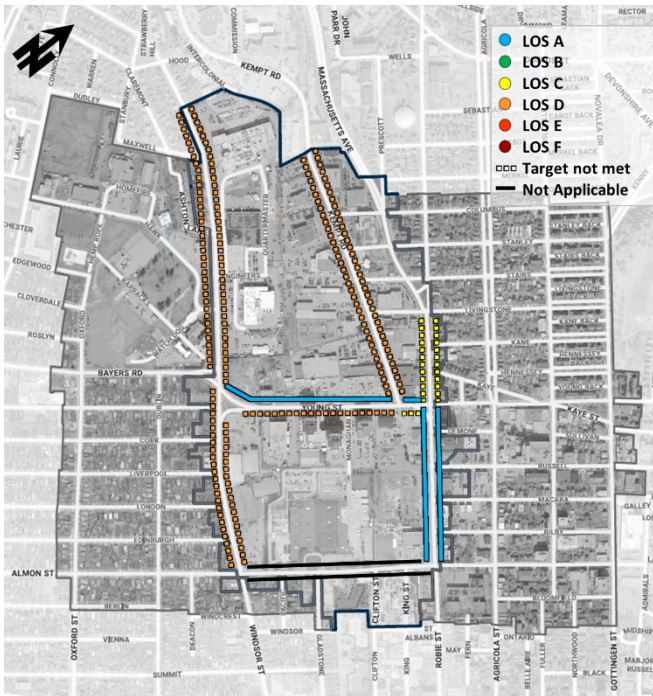
Pedestrian



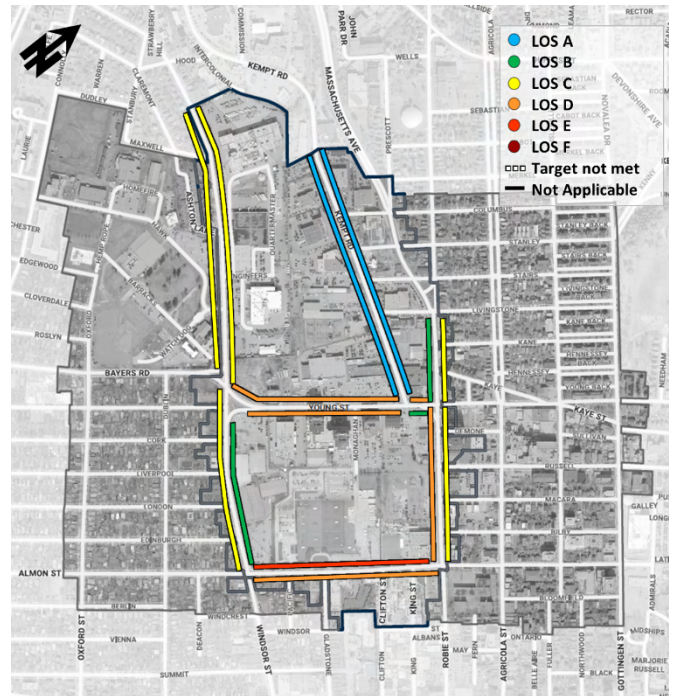
Cycling



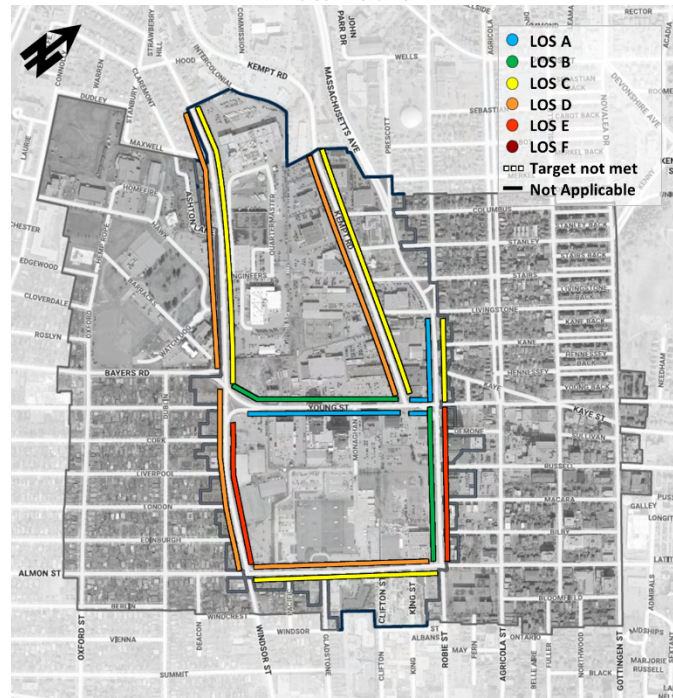
Transit



Goods Movement



Automobile



4.6.2 CYCLING

INTERSECTIONS

The LOS is affected largely by lack of protected cycling facilities at intersections, followed by cycle lengths and uncontrolled crossings. Approximately 10% of the intersections were found to meet the respective LOS targets. Almost all intersections provide LOS D for cyclists, except Windsor/Almon which meets the LOS target and provides LOS A and Robie/Almon which does not meet the target but provides LOS C. Given the cycling facilities currently being provided on Almon Street, the analysis reflects higher LOS results, particularly at the intersection of Windsor/Almon, where all legs provide cycling facilities. LOS at remaining intersections is affected by lack of cycling facilities, high delays and the availability of right-turn auxiliary lanes. A high number of uncontrolled conflicts (permitted right and left-turn movements) at major road intersections such as Bayers/Oxford, Young/Windsor, Young/Robie and Robie/Almon also contribute to the resulting LOS.

SEGMENTS

The LOS is affected by lack of permeability of the road network and high traffic speeds and volumes. Approximately 6.25% of the segments were found to meet the respective LOS targets, where the northbound segment of Robie Street between Almon Street and Young Street provides LOS B due to high permeability from shorter block lengths. Along most road segments, cyclists experience a LOS C or D due to lack of protected facilities. Roads with more private driveway interruptions over shorter distances such as Almon Street, Kempt Road, Robie Street (north of Young Street) and Young Street EB, provide less favorable operations to cyclists, hence the lower LOS. It is noted that Almon Street provides a LOS B given the cycle tracks currently being provided but does not meet the target for priority LOS A due to high number of driveways.

4.6.3 TRANSIT

For transit, it is noted that intersections with low traffic delays along Gottingen Street and at Almon/Oxford meet the respective LOS B target. Road segments with transit priority measures (bus lane) such as

northbound/southbound on Robie Street and westbound on Young Street, also meet their respective LOS A target for a priority corridor; though the bus lanes on Robie Street are daytime (6am – 6pm) bus lanes only and can be used by general traffic outside of the designated hours. All other intersections and road segments do not meet their respective targets.

INTERSECTIONS

The LOS is affected by lack of transit priority measures along transit priority corridors, the v/c ratio and transit delays. Approximately 10% of intersections were found to meet the LOS targets B (along none priority corridors) and A (along priority corridors). At intersections, transit operations range from LOS B to LOS D based on delays experienced and availability of TPMs. Most intersections analyzed provide LOS D for transit, with the exception of the Almon/Oxford intersections, which provides LOS B due to the low delays and congestion experienced by transit routes operating in the northbound/southbound travel directions.

Although bus lanes are provided on Young Street and on Almon Street, along with some TPM measures at intersections, the Young/Robie and Robie/Almon intersections do not provide higher transit scores as buses have to leave their respective lanes near the intersections and join mixed traffic, resulting in an increase in delay and the lack of TPM benefit at the intersection.

SEGMENTS

The LOS is affected by the type of transit facility available, the percentage of bus stops with lay-bys and the ratio of travel speed to ideal speed. Approximately 25% of segments were found to meet the respective target LOS B (along none priority corridors) and A (along priority corridors). Transit operations are somewhat consistent along road segments, where it mostly operates at LOS D along segments with mixed traffic operations and LOS A along segments with bus lanes. Road segments with no transit operations (i.e. Almon Street) are denoted to be Not Applicable.

4.6.4 GOODS MOVEMENT

INTERSECTIONS

LOS are affected by the width of the curb lane, curb radius and delays at intersections. All (100%) intersections were found to meet LOS target E. Intersections provide LOS ranging from B to D for trucks. This is the result of sufficient curb radii at intersections that allow truck to complete their turns, as well as acceptable delays.

SEGMENTS

LOS are affected by curb lane width, speed and availability of space for loading activity along road segments. All (100%) of road segments were found to meet the LOS target E. On road segments, LOS ranges from A to E, where the primary factors affecting the result was narrower curb lanes and lack of permitted loading operations (where applicable such as on arterial roads), resulting in less favorable truck operations, such as along Young Street, Robie Street southbound and Almon Street.

4.6.5 AUTOMOBILE

INTERSECTIONS

LOS are affected by lack of exclusive turn lanes, intersection delays and prohibited turns at intersections. All (100%) intersections were found to meet the LOS target E. At intersections, automobiles experience a LOS B or C as a result of the availability of dedicated turn lanes for most movements and low intersection delays.

SEGMENTS

LOS targets are affected by lack of availability of on-street parking, the midblock v/c ratio and high travel speed to ideal speed ratio along road segments. All (100%) of road segments were found to meet the LOS target E. Along road segments, operations range from LOS B to E for automobiles. Segments that prohibit on-street parking for the majority of the segment result in less favorable LOS results, such as Almon Street westbound and Kempt Road southbound. Segments with higher traffic volumes and midblock delays also result in less favorable LOS results, such as Robie Street northbound and Windsor Street northbound and southbound.

4.7 TRANSIT OPERATIONS

Travel time between bus stops data was obtained from HRM for all bus routes within the study area. The data obtained and used is based on a time period between the months of January 2022 and April 2024, inclusive, and consists of travel times in seconds between each bus stop in the study area for each bus route. The average transit travel times through the study area are plotted as shown in **Table 4-8**, with explanatory notes added for each plot. It is noted that dwell times at bus stops are not included as part of the travel time data.

Based on the information shown, the following summary is noted:

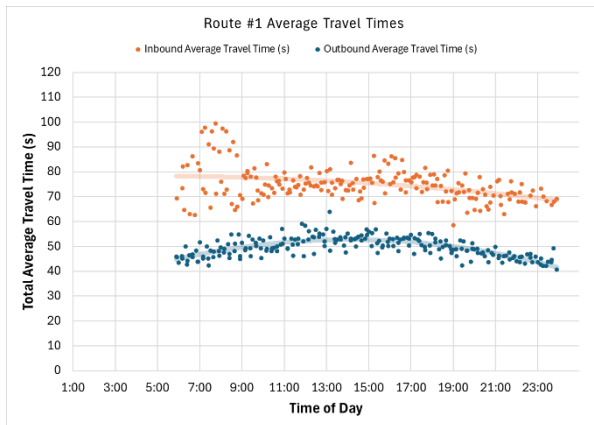
INBOUND TRAVEL DIRECTION

- For local (Route #90) and corridor bus routes (Routes #1, #4, #7A/B, and #8), bus travel times between the respective bus stops within the study area ranges mostly from 1 minute to up less than 2 minutes, with Route #8 being up to 2.5 minutes.
- Corridor Route #4 and local route #90 display a similar trend in travel times, where the highest travel times are experienced during the midday and afternoon peak hours.
- Stop-to-stop travel times of express routes (Routes #135, #136, #137, #138, #194 and #196) mostly range from 4 to 5 minutes, with the exception of the express route #194 where significantly longer travel times between 10 and 20 minutes can be experienced due to less frequent stops and longer distances between stops.
- The longer travel times of express routes are attributed to additional left or right-turns that are completed at the Young/Gottingen, Young/Robie and Young/Kempt intersections.

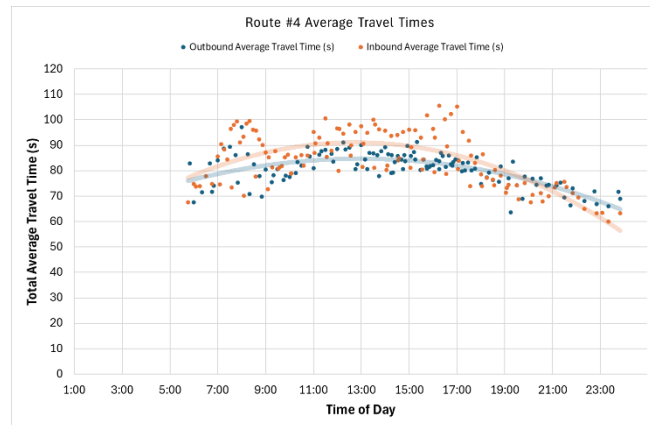
OUTBOUND TRAVEL DIRECTION

- For local (Route #90) and corridor bus routes (Routes #1, #4, #7A/B, and #8), bus travel times between the respective bus stops within the study area ranges mostly from 0.5 minute up to 2 minutes. The exception is bus route #8, where additional delays are experienced due to the NBL at Young/Robie, resulting in travel times up to 4.5 minutes.
- All corridor and local routes display a similar trend in travel times, where the highest travel times are experienced during the midday and afternoon peak hours.
- Stop-to-stop travel times of express routes (Routes #135, #136, #137, #138, #194 and #196) mostly range from 3 to 6 minutes.
- The longer travel times of express routes are attributed to additional left or right-turns that are completed at the Young/Gottingen, Young/Robie and Young/Kempt intersections.

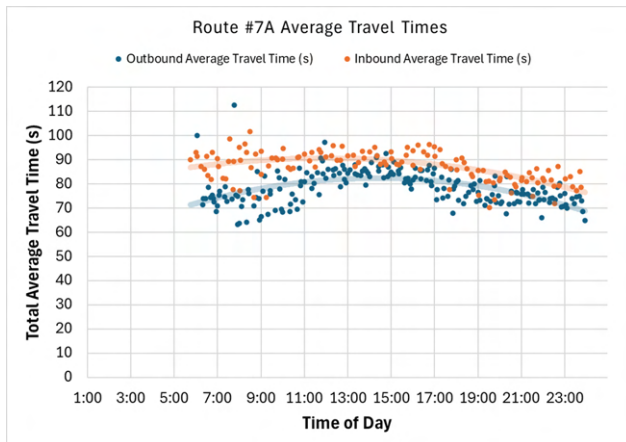
Table 4-8: Average Transit Travel Times for Bus Routes Travelling within Study Area



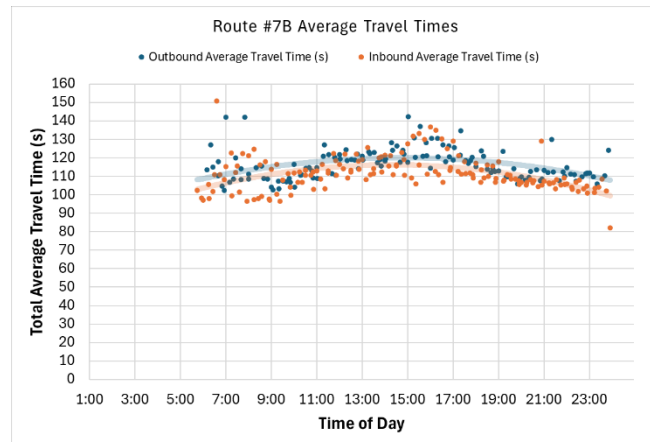
- Corridor route operates along Oxford Street. Includes three inbound stops and two outbound stops, which translates to higher average northbound travel times.
- Travel times through the study area range from 40 seconds to 2 minutes.
- Trends indicate consistent travel time for inbound throughout the day, while outbound travel times are highest at midday/afternoon peak hours and similar during morning and afternoon peaks.



- Corridor route operates along Windsor Street. Includes four outbound and four inbound bus stops, with similar travel times in the two directions.
- Travel times through the study area range from 1 to 2 minutes.
- Trends indicate that travel times are highest at midday and the afternoon peak hours and lowest during evening and night times.

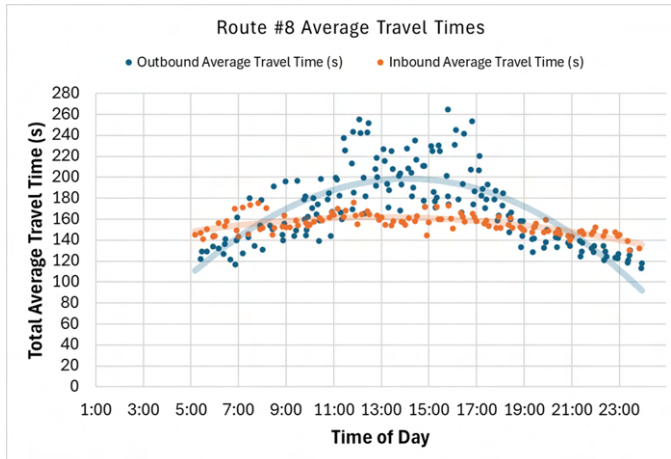


- Corridor route operates clockwise (northbound on Robie Street and southbound on Novalea Drive/Gottingen Street). Includes four outbound and four inbound stops.
- The slightly lower outbound travel times may be due to bus lanes available along the Robie Street segment. Travel times through the study area range from 1 to 2 minutes.
- Trends indicate somewhat consistent inbound travel times throughout the day and slightly higher outbound travel times during the midday/afternoon peak hours.

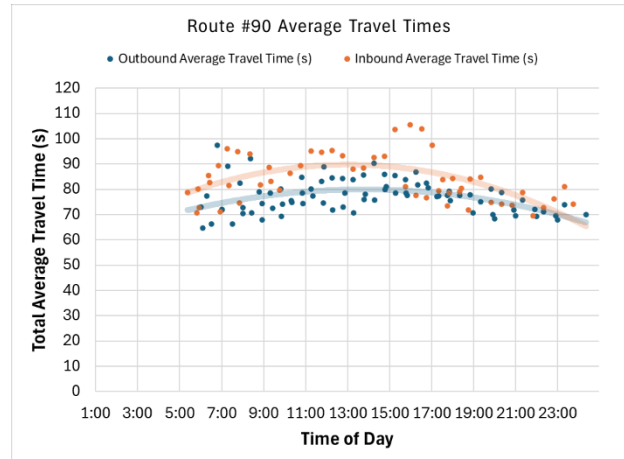


- Corridor route operates counterclockwise (northbound on Novalea Drive/Gottingen Street and southbound on Robie Street). Includes five outbound stops and four inbound stops.
- The longer inbound travel times despite less bus stops indicates slower traffic at the intersections on Robie Street. Travel times through the study area range from 1 to 2.5 minutes.
- Trends indicate slightly higher travel times during the midday/afternoon peak hours.

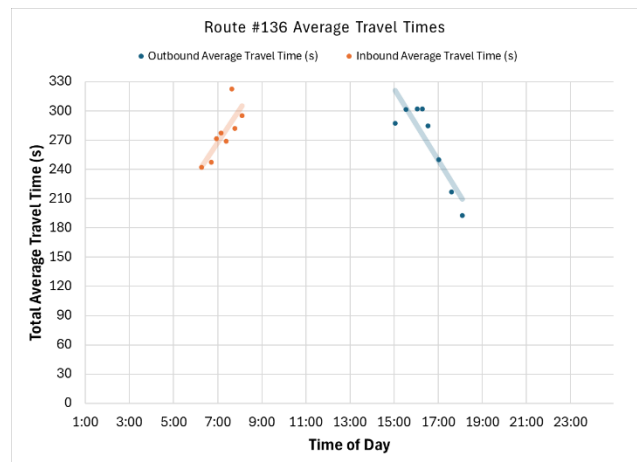
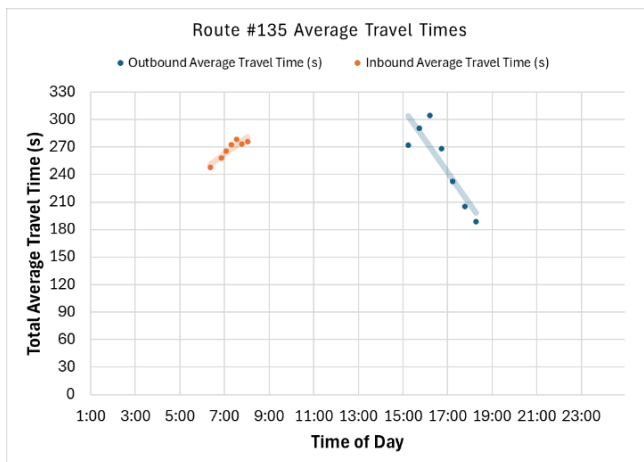
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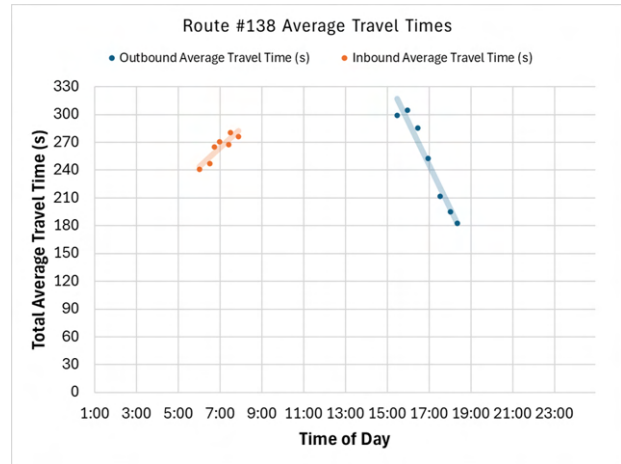
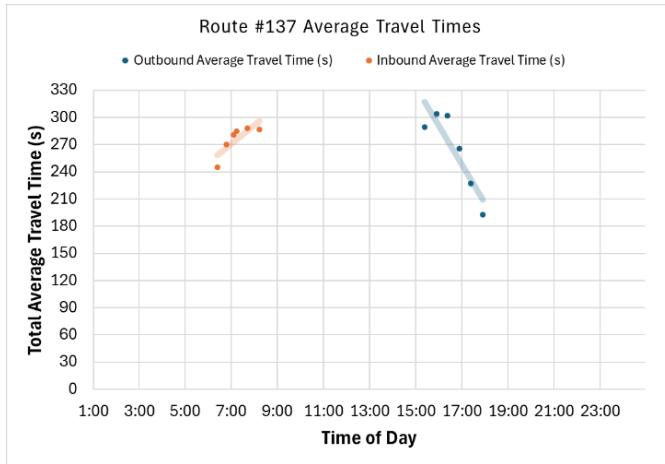
- Corridor route operates on Robie Street, Young Street and Bayers Road. Includes five outbound and five inbound bus stops.
- Travel times through the study area range from 1.5 to 4.5 minutes.
- Trends indicate somewhat consistent inbound travel times throughout the day, while outbound travel time peaks at the midday/afternoon peak hours. Despite the available westbound and northbound bus lanes on Young Street and Robie Street, the additional delay to outbound bus is heavily caused by the NBL movement at the Young/Robie intersection based on a review of travel time between bus stops.



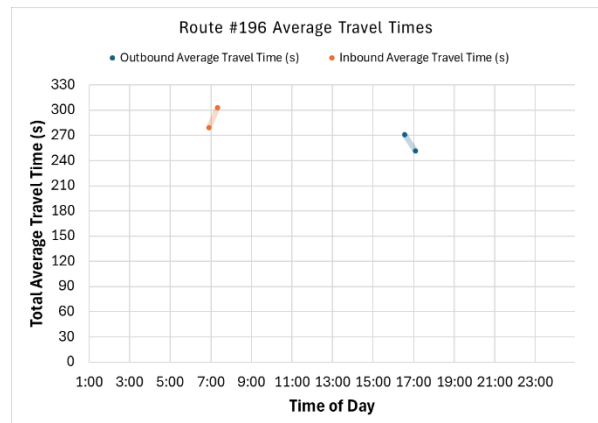
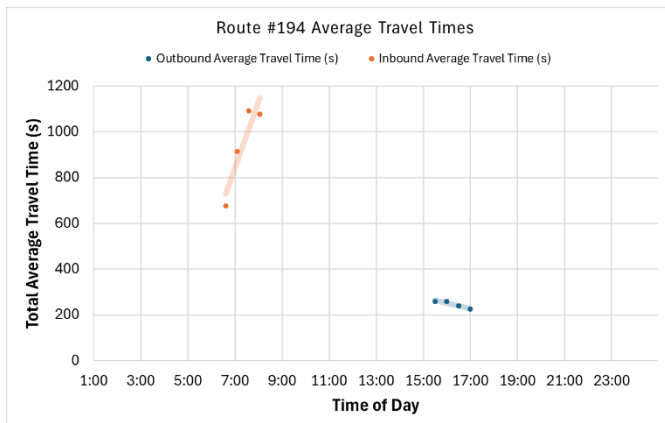
- Local route operates on Windsor Street. Includes four outbound and four inbound bus stops.
- Travel times through the study area range from 1 to 2 minutes.
- Trends are found to be similar to bus route #4, where travel times are highest at midday and the afternoon peak hours and lowest during evening and night times.



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- Express Bus Routes #135, #136, #137 and #138 all operate on Gottingen Street, Young Street, Robie Street/Massachusetts Avenue (for outbound route) and Kempt Road (for inbound route). The buses operate only on weekdays during morning and afternoon peak periods, where the inbound routes operate during the morning peak period and the outbound routes operate during the afternoon peak period. Includes three outbound bus stops and two inbound bus stops.
- Travel times through the study area range from 3 to 6 minutes which are higher compared to the local and corridor routes due to less frequent stops and longer travel distances between assigned stop locations.
- Trends indicate linear increase in travel time during the morning peak period and linear decrease during the afternoon peak period.



- Express route operates on Gottingen Street, Young Street and Bayers Road. The buses operate only on weekdays during morning and afternoon peak periods, where the inbound route operates during the morning peak period and the outbound route operates during the afternoon peak period. Includes two outbound and one inbound bus stops.
- The very high inbound morning travel times of up to 20 minutes is representative of the far distance between the previous stop and the stop within the study area. The outbound afternoon travel times of 5-6 minutes are lower due to more frequent stops.
- Trends indicate linear increase of travel times during the morning peak period, while afternoon peak period travel times are more consistent.
- Express route operates on Gottingen Street, Young Street, Robie Street/Massachusetts Avenue (for outbound route) and Kempt Road (for inbound route). The buses operate only on weekdays with operation times limited to two stop times during the morning and afternoon peak hours. The inbound route operates during the morning peak period and the outbound route operates during the afternoon peak period. Includes three outbound bus stops and two inbound bus stops.
- Travel times through the study area range from 4 to 5.5 minutes and are lower during the afternoon peak period compared to the morning peak period.
- Trends indicate slight change in travel times between the two stop times during the respective peak periods.

4.8 COLLISION AND SAFETY REVIEW

The following section provides a review of 5-year historical collision information from 2018 to 2023, inclusive. The collision data was reviewed for completeness. This included removing collisions outside the study area, ensuring common intersection names (i.e. Young Street/Windsor Road), and reviewing collision locations. The

analysis excludes collisions outside of HRM ROW, such as collision reports which were in a private parking lot. Lastly, collision records without a collision type were also removed from the data set. In select instances, the collision records were reassigned to adjacent intersections rather than mid-block when the comments provided direct evidence. The collision data set includes single motor vehicle (SMV) and multi-vehicle collisions.

The Halifax Regional Municipality Road Safety Strategy (2024) and 2024 Road Safety Annual Report were reviewed to identify collision emphasis areas and align the analysis with current safety trends in HRM. The Young District Infrastructure Plan's role is to contribute towards safe land use planning, safe streets and safe speeds. The following analysis is intended to be a high-level scan to identify potential safety concerns and suggest potential high level mitigation measures.

Following the review of the collision data, a total of 713 collisions have been recorded within the study analysis area from 2018 to 2023, inclusive. These include 525 (74%) intersection collisions and 188 (26%) segment collisions. The following sections summarizes notable collision patterns within the public street right-of-way and identifies countermeasures for key study area intersections and segments. There is an additional focus on vulnerable road users (VRU), particularly where pedestrian and cyclist incidents are reported.

4.8.1 INTERSECTION SAFETY REVIEW

There have been 525 intersection collisions (76% of all collisions, based on location) within the 75 intersections within the Young District study analysis area from 2018 to 2023, inclusive.

Table 4-9 summarizes the total number of collisions by collision type for the 25 intersections with more than 5 total collisions within the analysis period, organized by total frequency of collisions. These intersections account for 432 of the 525 (82%) intersection collision records within the analysis period. The table indicates the intersection control. The collision rate, in collisions-per-million-entering-vehicles (collisions/MEV), provides a simplified measure of collision frequency by level of traffic exposure based on available traffic count information. **Appendix K** provides a summary of all intersections and the raw collision data.

The following collision review has focused on intersections within the Young District area with notable collision patterns, that include: a fatality; a significant collision rate (>0.75 collisions/MEV); or have Vulnerable Road User (VRU) collision patterns. The following intersections have been reviewed in additional detail:

- Robie Street and Young Street
- Robie Street and Almon Street
- Young Street and Kempt Road
- Almon Street and Agricola Street
- Almon Street and Windsor Street
- Young Street-Bayers Road and Windsor Street
- Bayers Road and Oxford Street
- Robie Street at Stairs Street

For each intersection, the intersection severity, type, classification, temporal and VRU-collisions were analyzed. Mitigation measures focused on improving safety have been identified at a high level. The following sections summarize the key points from the analysis.

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There are 13 collision types included in the data set. A review of individual collision descriptions has indicated poor correlation and consistency within the collision data. To provide a more cohesive analysis of collision trends, the following data assumptions were made:

- Left-turn collisions such as “Multiple Vehicle - Left Turn Across Opposing Traffic”, “Multiple Vehicle – Left Turn Against Traffic” and “Multiple Vehicle – One Crossing Path of Other to the Left/Right” have been grouped as “Turning Movement” type collisions. These collisions would typically involve two vehicles that are not travelling in the same direction crossing paths due to one vehicle (or both) making a left-turn movement.
- Right-turning movement related collisions have a distinct category.
- Vehicles travelling in the same direction have been assigned a “Sideswipe” collisions type.

Table 4-9: Summary of Intersection Collisions by Type and Collision Rate

Intersection	Collision Type										COLLISION RATE PER MEV
	TRAFFIC CONTROL	HEAD ON	REAR END	RIGHT ANGLE	RIGHT TURN	SIDE-SWIPE	SMV – OBJECT	SMV-UNATTENDED	TURNING MVMT	TOTAL	
Robie Street/Young Street	Signal	1	13	8	1	18	9	2	26	78	1.01
Robie Street/Almon Street	Signal		10	4	2	11	4	2	20	53	0.83
Young Street/Kempt Road	Signal	1	7	4	1	7	3		8	31	0.64
Almon Street/Windsor Street	Signal		5		1	4	4		7	21	0.46
Almon Street/Agricola Street	Signal		4	1		4	4	1	5	19	0.71
Robie Street/Livingstone Street	Minor Stop		4	3	1	1			10	19	0.48
Young Street/Windsor Street	Signal		10			5		1	3	19	0.32
Young Street/Agricola Street	Signal		3	1	1	2	2	2	6	17	0.43
Bayers Road At Oxford Street	Signal		3	1		3	2		6	15	0.44
Agricola Street/Macara Street	Minor Stop			5	2			2	5	14	0.56
Agricola Street/Bilby Street	Minor Stop			3	1			3	7	14	0.56
Robie Street/Russell Street	Minor Stop		4		1	1	1	1	5	13	0.26
Robie Street/Demone Street	Minor Stop			1		1			10	12	0.24
Almon Street/Oxford Street	Signal			4		1			7	12	0.41
Young Street/Gottingen Street	Signal		5		1	2	3	1		12	0.48
Robie Street/Stamley Street	Minor Stop			3		2		1	5	11	0.84
Robie Street/Stairs Street	Minor Stop	1		3		3		1	3	11	0.22
Agricola Street/Russell Street	Minor Stop		2	1		2		1	4	10	0.53
Young Street/Monaghan Drive	Minor Stop	1	1	1	1		1		4	9	0.27
Almon Street/Isleville Street	Minor Stop			3	2			1	2	8	0.33
Almon Street/Gottingen Street	Minor Stop		3		1	1			3	8	0.32
Robie Street/Columbus Street	All-Stop			1	2		1	1	2	7	0.53
Gottingen Street/Russell Street	All-Stop		2				2	1	2	7	0.37
Gottingen Street/Kaye Street	Minor Stop		5						2	7	0.36
Robie Street/Bilby Street	Minor Stop			1		3			1	5	0.10
Total		4	81	48	18	71	36	21	153	432	

INTERSECTION COLLISIONS - COLLISION TYPE BY YEAR DISTRIBUTION

Table 4-10 summarizes while **Figure 4-16** illustrates the distribution of intersection collisions by each year of the data set. A review of the data set found the following trends within the study area:

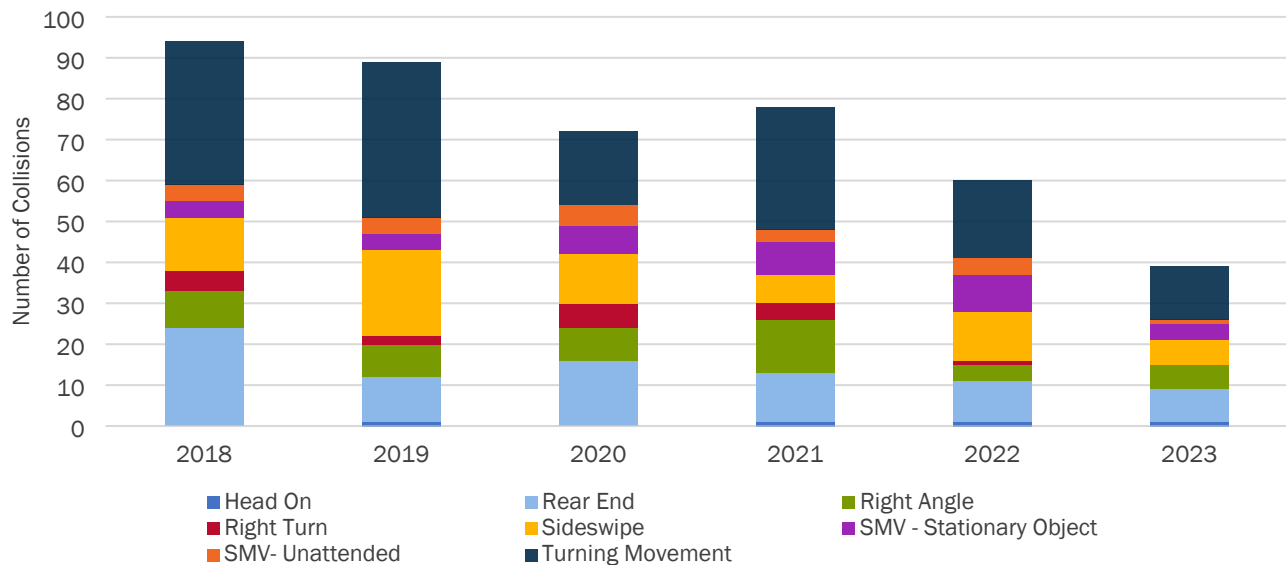
- A general decrease in the total number of collisions from 2018-through-2023. 2023 has 60% less total collisions than 2018, where all categories of collisions except for SMV – Stationary Object decreased.
- Notable decreases in turning movement (63%), rear-end (67%) and sideswipe (54%) type collisions was observed within the data set. There were no right-turn related collisions in 2023, compared with 5 collisions in 2018 and 6 collisions in 2020.

The decrease in the number of collisions can likely be attributed to lower traffic volumes from the COVID-19 pandemic from 2020-through-2023. The Phase 1 of the Robie/Young Street Transit Priority Corridor was installed in October 2020, which may have resulted in safety benefits when considering the change in vehicle capacity at a segment level resulting in slower driver speeds.

Table 4-10: Summary of Intersection Collision Types by Year of Occurrence

Collision Type	2018	2019	2020	2021	2022	2023	Total
Head On		1		1	1	1	4
Rear End	24	11	16	12	10	8	81
Right Angle	9	8	8	13	4	6	48
Right Turn	5	2	6	4	1		18
Sideswipe	13	21	12	7	12	6	71
SMV - Stationary Object	4	4	7	8	9	4	36
SMV - Unattended	4	4	5	3	4	1	21
Turning Movement	35	38	18	30	19	13	153
Total	94	89	72	78	60	39	432

Figure 4-16: Summary of Intersection Collision Types by Year of Occurrence



INTERSECTION COLLISIONS - COLLISION SEVERITY BY YEAR DISTRIBUTION

Table 4-11 summarizes while **Figure 4-17** illustrates the relative change in collision severity at study area intersections to the 2018 base year of collisions. Collisions with an 'unknown' severity were not plotted. Due to the infrequency of fatal collisions, these collision severity typers were also not plotted.

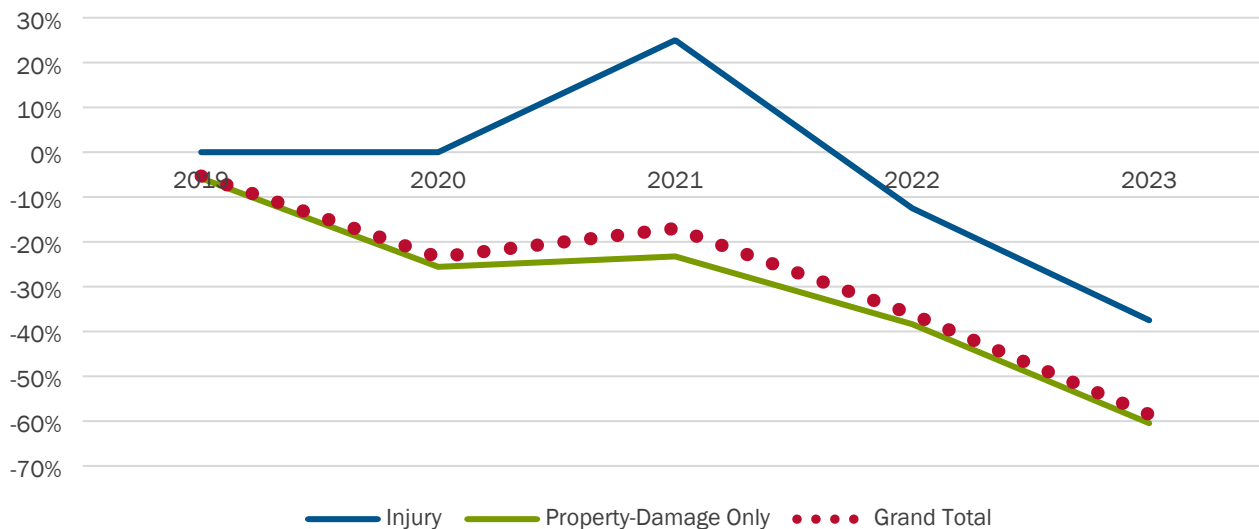
A review of the data set found the following trends within the study analysis area:

- Overall and property-damage only severity type collisions both have similar trends that indicate a decrease of collision each year from the 2018 base year. As indicated, the reduction in traffic volumes due to COVID-19 likely contributes to this trend.
- Despite the decrease in volumes, 2020 and 2021 had similar frequencies of injury collisions at intersections when compared to 2018 and 2019.

Table 4-11: Change in Intersection Collision Severity by Year, Relative to 2018 Base Year

Collision Severity	2018	2019	2020	2021	2022	2023
Fatal				2		
Injury	8	8 (0%)	8 (0%)	10 (25%)	7 (-13%)	5 (-38%)
Property-Damage Only	86	81 (-6%)	64 (-26%)	66 (-23%)	53 (-38%)	34 (-60%)
Total	94	89 (-5%)	72 (-23%)	78 (-17%)	60 (-36%)	39 (-59%)

Figure 4-17: Change in Intersection Collision Severity by Year, Relative to 2018 Base Year



INTERSECTION COLLISIONS - COLLISION SEVERITY BY YEAR DISTRIBUTION

Figure 4-18 illustrates the proportion of intersection collisions by severity for each of the 20 highest intersections within the study analysis area.

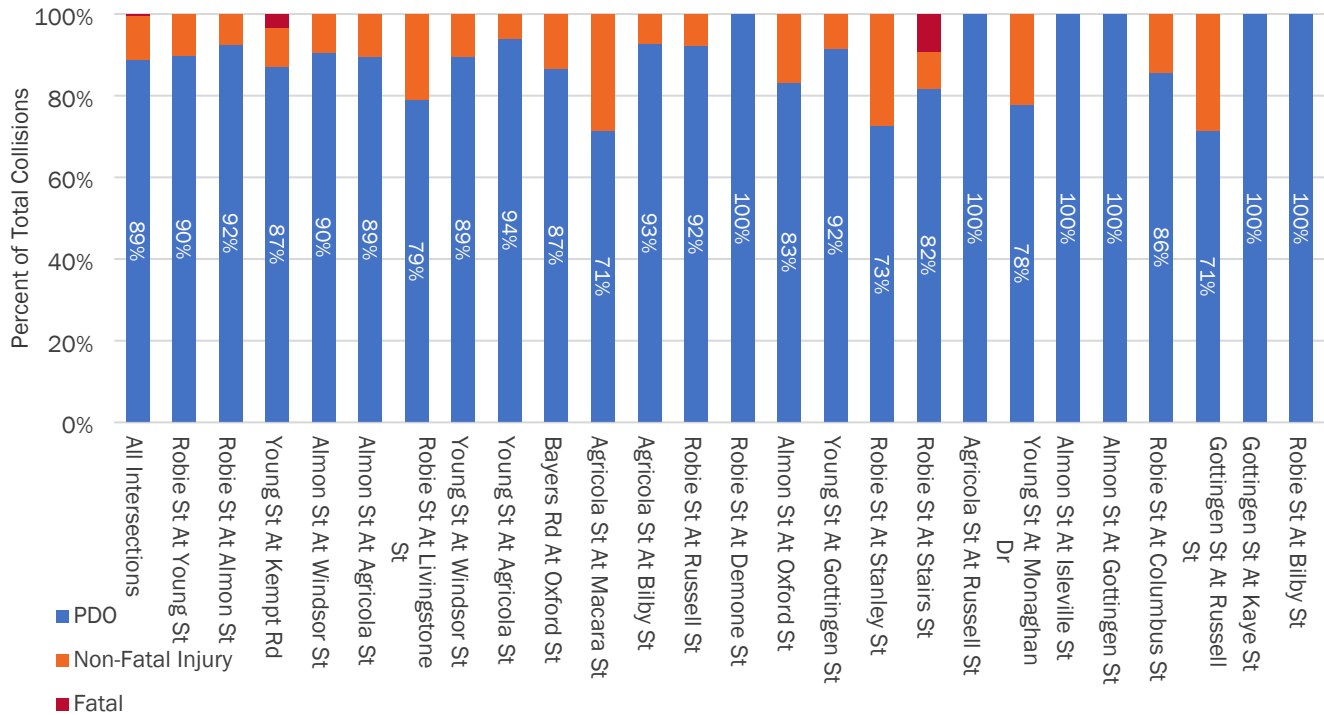
A review of the data set found the following trends within the study analysis area:

- 88% of all intersection collisions were PDO, 10% were non-fatal injuries while 1% were fatal and unknown severity classifications.
- The Robie Street/Stanley Street (29%, 2 of 7 collisions), Agricola Street/Macara Street (29%, 4 of 14 collisions), and Young Street/Monaghan Drive (22%, 2 of 9 collisions) intersections had notably higher proportion of injury collisions than the overall data set. In review, these intersections had typically lower frequency of overall collisions across the 5-year period.

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- A fatal collision occurred at each of Young Street/Kempt Road and Robie Street/Stairs Street within the data set.

Figure 4-18: Intersection Collisions, Proportion of Severity by Intersection Location



INTERSECTION COLLISIONS - COLLISION TYPE BY TIME OF DAY DISTRIBUTION

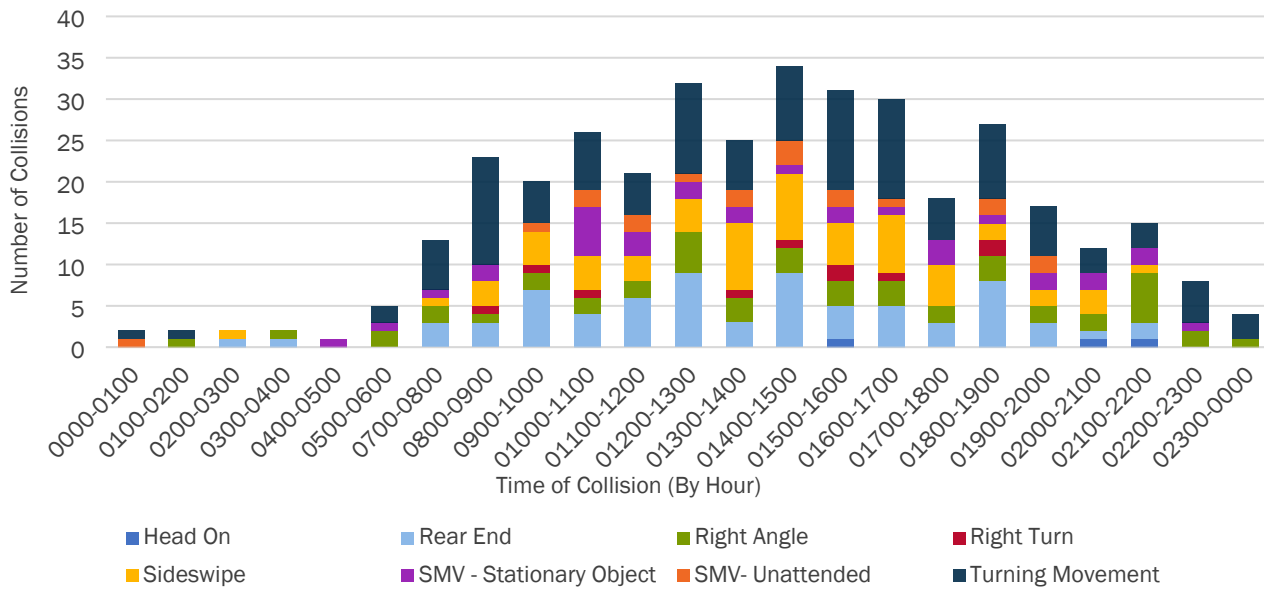
Figure 4-19 illustrates the distribution of collisions by time of day, color coded by collision type. The collisions are plotted by the hour in which they were recorded.

Trends within the study analysis area include:

- The highest hours of collision patterns were found to be 2pm-3pm (34, 8%), noon-1pm (32, 7%), 3pm-4pm (31, 7%). These generally follow the afternoon peak period of travel demand. The noon hour is reflecting of the Young Street and Robie Street corridors having commercial businesses for lunch hour trips.
- The afternoon peak period was found to have the highest collision frequency with 95 (22%) collisions within the dataset (2pm-5pm). This time period aligns with the afternoon peak period, which is considered the higher traffic volume demand period.
- Turning movement collisions were the most observed, occurring roughly equally in the morning and afternoon peak hours (12-13 collisions in each observed hour).

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Figure 4-19: Frequency of Intersection Collisions by Time of Day and Collision Type



INTERSECTION COLLISIONS – EMPHASIS AREAS

HRM's Road Safety Strategy identifies collision emphasis areas being Young Drivers, Aggressive Driving, Distracted Driving, Impaired Driving, and Pedestrian/Cycling Collisions. **Table 4-12** summarizes the number of collisions which were recorded to have at least one of these emphasis areas within the study area for each of the 25 intersections identified as having the highest collision frequency.

Table 4-12: Summary of HRM Road Safety Strategy Emphasis Area Collisions, Independent Events

Intersections	Young Drivers	Aggressive Driving	Distracted Driving	Impaired Driving	Pedestrian Collisions	Bicyclist Collisions
Agricola Street/Bilby Street	3	8				
Agricola Street/Macara Street	4	8	2	1		
Agricola Street/Russell Street	1	4	2			
Almon Street/Agricola Street	5	6	2	1	1	1
Almon Street/Gottingen Street	1					
Almon Street/Isleville Street	2	6	2	1		1
Almon Street/Oxford Street	3	9	2			
Almon Street/Windsor Street	7	6	2	1	1	2
Bayers Road/Oxford Street	8	9	3		1	
Gottingen Street/Kaye Street		1				
Gottingen Street/Russell Street	1	4			1	
Robie Street/Almon Street	19	22	5	1	1	1
Robie Street/Bilby Street	1	3				
Robie Street/Columbus Street	2	4				
Robie Street/Demone Street	5	9				
Robie Street/Livingstone Street	5	7	1			

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Robie Street/Russell Street	7	8	1			
Robie Street/Stairs Street	1	6	1			
Robie Street/Stanley Street	6	7	2			
Robie Street/Young Street	14	15	3		1	
Young Street/Agricola Street	3	7	1			
Young Street/Gottingen Street	1	3	1		1	
Young Street/Kempt Road	8	12	5		2	
Young Street/Monaghan Drive	5	3			1	
Young Street/Windsor Street	6	8	3			
Total	118	175	38	5	10	5

Notable trends within the study and analysis area include:

- Young Drivers were involved in 27% of all intersection collisions. Young Street/Monaghan Drive (56%), Robie Street/Russell Street (54%) and Bayers Road/Oxford Street (53%) are intersections with a notable representation of young drivers among the collisions report.
- Aggressive Driving was considered a factor in 41% of all intersection collisions. In general, turning movement (46% of aggressive driving incidents) and right angle (17% of aggressive driving incidents) collision types were most frequently attributed to 'Aggressive Driving'. Almon Street/Isleville Street (75% of 8 collisions), Almon Street/Oxford Street (75% of 12 collisions) and Robie Street/Stanley Street (64% of 11 collisions) represent the intersections with the highest frequency of collisions involving 'Aggressive Driving'.
- Distracted Driving was considered a factor in 9% of all intersection collisions. Among Distracted Driving cases, the collision types most observed were turning movements (34% of 153 collisions), rear ends (26% of 81 collisions) and right angle (18% of 48 collisions). Turning movement and right angle collisions were typically due to a vehicle not yielding to signage or the traffic signal control. A review of the comments did not indicate any occurrences where a driver was distracted by a device.

4.8.1.1 ROBIE STREET AT YOUNG STREET

The intersection of Robie Street/Young Street recorded a total of 78 collisions (15% of all intersection collisions). 70 (90%) incidents resulted in no injury (property damage only) and 8 (10%) incidents resulted in non-fatal injuries. The collision types which occurred most frequently were Turning Movement (26, 33%), Sideswipe (18, 23%), and Rear-End (13, 17%). The majority of incidents occurred in daylight conditions (57, 73%), followed by collisions occurred in darkness (18, 23%). Road surface conditions during these collisions were predominantly dry (59, 76%), followed by wet (12, 14%). Other conditions such as icy, fresh snow, packed snow, wet snow, and wet surfaces accounted for fewer than two each.

One pedestrian collision was reported. No cyclist collisions were reported at this intersection. The report indicated that an eastbound right turning vehicle struck the arm of a construction worker who was holding a sign. No injuries were reported from this incident.

In summary, the intersection of Robie Street/Young Street has experienced a notable number of collisions, predominantly occurring during daylight hours on dry road surfaces. The most common types are Turning Movement and Sideswipe collisions. While most accidents did not result in injuries, there were still several non-fatal injuries reported. To mitigate these issues, protected intersection movements can be considered to reduce left turn conflicts. This would impact intersection capacity.

Contributing factors to the sideswipe collisions includes the lane drops on the northbound, southbound and eastbound approaches. Unexpected lane drops can result in last-minute lane changes which contribute to sideswipe collision types. A mitigation measure could be to review lane configuration markings and signage to ensure that lane designations are clear to drivers.

An additional possible contributing factor includes the proximity to the Young Street/Kempt Road intersection (55m). Queues between this intersection and Young Street/Robie Street can interfere with intersection operations, create a distraction for drivers, or result in unanticipated stopping maneuvers when travelling eastbound.

4.8.1.2 ROBIE STREET AT ALMON STREET

The intersection of Robie Street/Almon Street recorded a total of 53 collisions (10% of all intersection collisions). 49 (91%) incidents resulted in PDO (property damage only), while the remaining 4 (7%) incidents resulted in non-fatal injuries. The collision types which occurred most frequently were Turning Movement (20, 37%), Sideswipe (11, 20%), and Rear-End (10, 19%). The majority of incidents occurred in daylight conditions (38, 70%), while a remaining third of collisions occurred in darkness (13, 24%). Road surface conditions during these collisions were predominantly dry (40, 74%), followed by wet (11, 20%). Other conditions such as icy, fresh snow, packed snow, wet snow, and wet surfaces accounted for fewer than five each. Nearly half (24, 44%) of recorded collisions occurred during the 2PM-6PM hours, which represent the extended afternoon peak period. Lastly, more than half of collisions were reported in 2018 (16, 30%) and 2019 (14, 26%), while the recent years each account for 8 ($\leq 15\%$) collisions or less. The implementation of a restricted NBL movement likely contributed to the decrease in intersection collisions.

From the collision data review, it is evident that rear-end and turning movement collisions are more frequent compared to other types. This suggests potential issues with traffic flow or driver attentiveness during turns.

There was one pedestrian collision reported at this intersection (2020). The pedestrian collision occurred at night and resulted in no injury (2022). This indicates a need for a streetlighting review, if not already complete per the latest Almon Street bike lane project.

There was also one bicycle collision reported at this intersection, which resulted in no injury. The cyclist attempted to pass a vehicle on its left side, then struck its mirror. The incident occurred during the afternoon peak hour with no notable contributing factors.

Mitigation measures could include protected intersection movements for the westbound approach. No right turns on red movements can also be considered to improve safety for pedestrians and cyclists. The intersection is currently undergoing modifications to accommodate the Almon Street bike lanes.

4.8.1.3 YOUNG STREET AT KEMPT ROAD

The intersection of Young Street/Kempt Road recorded a total of 31 collisions (6% of all intersection collisions). 26 (87%) incidents resulted in a PDO incident (property damage only), while 4 (13%) incidents resulted in non-fatal injuries and 1 (3%) incident resulted in a fatality. The collision types which occurred most frequently were Turning Movement (8, 25%), Sideswipe (7, 23%), and Rear-End (7, 23%). The majority of incidents occurred in daylight conditions (23, 77%), while a remaining third of collisions occurred in darkness (6, 20%). Road surface conditions during these collisions were predominantly dry (21, 70%), followed by wet (5, 17%). Other conditions such as icy, fresh snow, packed snow, wet snow, and wet surfaces accounted for fewer than five each.

There were three pedestrian collisions reported at this intersection. One resulted in a fatality, one resulted in an injury, while the other did not result in an injury. Two incidents were results of left turning vehicles colliding

with pedestrians during the crossing phase. The third incident involved the westbound vehicle running a red light and striking the pedestrian causing injury. Time of day, pavement conditions and weather conditions did not appear to be contributing factors in any pedestrian collision case. There was no bicycle collisions reported at this intersection. The one fatality occurred between a southbound left-turning vehicle and a pedestrian crossing the east leg of the intersection. Glare was considered a contributing factor in the collision.

As noted in the Robie Street/Young Street analysis, the proximity between Kempt Road and Robie Street results in additional conflict opportunities when queues spillback between intersections. Additionally, the ESSO gas station in the southwest quadrant of Robie Street/Young Street presents an opportunity for cut-through traffic, particularly in the north to west direction.

The intersection is slated for proposed intersection modifications, as described in the Planned Infrastructure Projects section. This would effectively make the intersection right-in right-out, removing left turns from the intersection. This would reduce the amount of cut-through traffic from Robie Street, as well as reduce conflicts with turning vehicles. Additional mitigation measures can be reviewed following installation of the intersection modifications.

4.8.1.4 ALMON STREET AT AGRICOLA STREET

The intersection of Almon Street/Agricola Street recorded a total of 23 collisions (5% of all collisions), with a notable collision rate of approximately 0.86 collisions/MEV. 17 (74%) incidents resulted in a non-injury (property damage only), while 2 (9%) incidents resulted in non-fatal injuries and 1 (4%) incident was non-categorized. The collision types which occurred most frequently were Turning Movement (5, 22%), Rear-End (4, 17%), and Sideswipe (4, 17%). The majority of incidents occurred in daylight conditions (17, 74%), while the remainder occurred in darkness (6, 26%). Road surface conditions during these collisions were dry (19, 100%) for all incidents.

There was one pedestrian collision reported at this intersection which occurred in July 2020. The incident resulted in an injury to the pedestrian. Aggressive Driving was attributed as a factor. The incident occurred where the vehicle made a southbound left turn from Agricola Street onto Almon Street, striking the pedestrian who was riding a motorized device.

The single bicycle collision reported at this intersection resulted in no injury occurred in April 2021. The incident involved a Young Demographic individual. The cyclist was struck by a vehicle who was exiting a curbside parking spot during the afternoon peak period.

In summary, the intersection of Almon Street/Agricola Street has experienced a significant number of collisions compared to volume of traffic. The intersection has combined through/left turn movements on the southbound and eastbound approaches, as well as a shared right turn/through movement on the northbound approach. Combined approaches can contribute to rear-end collisions due to sudden stopping, sideswipe collisions when vehicles change lanes, and turning movement incidents when vehicles are rushed to complete a turn. Consideration should be given to reallocating the Agricola Street southbound lane arrangement to provide for a dedicated left turn and shared through/right turn movement, matching the northbound approach. This measure would allow for mitigation measures such as protected left-turns and no right turn on red modifications. Additional right-of-way would need to be acquired to provide dedicated lanes or improvement lane alignment through the intersection.

4.8.1.5 ALMON STREET AT WINDSOR STREET

The intersection of Almon Street/Windsor Street recorded a total of 21 collisions (5% of all intersection collisions); however, the collision rate of approximately 0.48 collisions/MEV is not considered notable. 19 (90%) incidents resulted in a non-injury (property damage only), while the remaining 2 (10%) incidents resulted

in non-fatal injuries. The collision types which occurred most frequently were Turning Movement (7, 33%), Rear-End (5, 24%), and Sideswipe (4, 19%). The majority of incidents occurred in daylight conditions (13, 62%), while the remainder occurred in darkness (5, 24%) and at dusk (3, 14%). Road surface conditions during these collisions were predominantly dry (18, 86%), while 3 (14%) incidents were recorded in wet or snow conditions. Collisions are relatively evenly distributed throughout the year, with a slight increase in October (6, 29%).

One pedestrian collision occurred in October 2018 after the morning peak period resulting in an injury to the pedestrian. The vehicle struck the pedestrian who was crossing the intersection within the crosswalk. There is no indication of direction of travel. Weather and pavement conditions were not contributing factors. The incident involved an individual from the Young Demographic emphasis area.

Two cyclist incidents have occurred at this intersection, both in the month of June during day light hours and were self-reported. Neither resulted in an injury. Both incidents involved cyclists on Windsor Street, one colliding with a right turning vehicle and the other with a left turning vehicle.

In summary, the intersection of Almon Street/Windsor Street has notable incidents with cyclists using the Windsor Street cycle lanes. Improving the Windsor Street cycling facilities to a cycle track with protected intersection measures such as protected intersection corners, advanced walk/bike intervals and no-right-turn-on-red should be considered to mitigate conflicts. Enhanced signage can also be considered to warn drivers of cycling conflicts at the intersection. These measures would also improve safety for pedestrians and vehicles at the intersection.

4.8.1.6 YOUNG STREET/BAYERS ROAD AT WINDSOR STREET

The intersection of Young Street-Bayers Road/Windsor Street recorded a total of 19 collisions (3.5% of all intersection collisions); however, the collision rate of approximately 0.32 collisions/MEV is not considered notable. 15 (79%) incidents resulted in a non-injury (property damage only), while the remaining 4 (21%) incidents resulted in non-fatal injuries. The collision types which occurred most frequently were Rear-End (10, 53%), Sideswipe (5, 26%), and Turning Movement (3, 16%). The majority of incidents occurred in daylight conditions (16, 84%), while the remainder occurred in darkness (2, 11%). Road surface conditions during these collisions were mostly dry (13, 68%), with the remaining occurring in wet conditions (5, 26%). Collisions are generally evenly distributed throughout the year and by time of day.

No pedestrian or cyclist incidents have occurred at this intersection.

In summary, the intersection of Young Street/Windsor Street has experienced a notable number of rear-end collisions, of which 3 had wet conditions as contributing factors. In review of the comments, there appears to be no consistent direction or approach within the 10 incidents. The high-speed nature of the northbound to eastbound channelized island promotes high vehicle speeds and was the location of two incidents. This channelized intersection could be reviewed for opportunities to improve safety for both vehicles and vulnerable modes. Opportunities to realign one intersection leg could be explored to reduce the footprint of the intersection and develop a typical alignment of Young Street-Bayers Road.

4.8.1.7 BAYERS ROAD AT OXFORD STREET

The intersection of Bayers Road/Oxford Street recorded a total of 15 collisions, with no notable patterns among the collision types. 13 (87%) incidents resulted in PDO (property damage only), while the remaining 2 (13%) incidents resulted in non-fatal injuries. One injury occurred in an incident with a pedestrian, where the vehicle turned left onto Bayers Road from Oxford Street and struck the pedestrian crossing the road. A glare/reflection was reported as a contributing factor as the collision occurred in the late afternoon period, while the road surface and weather were considered normal.

The intersection includes afternoon weekday peak period turn restrictions from Bayers onto Oxford Street. No protected movements are provided. To mitigate incidents with pedestrians, protected signal timing, advanced walk phases, and no-right-turn-on-red can be considered.

4.8.1.8 ROBIE STREET AT STAIRS STREET

Among 6 collisions occurring in the vicinity of this intersection, one fatality occurred at the Robie Street/Stairs Street intersection. The fatality occurred in June 2021 during the noon to 1pm hour. Based on a review of the collision report comment, the vehicle travelling westbound on Stairs Street did not obey the stop sign, entering traffic, and was struck by a northbound vehicle. The passenger in the northbound vehicle suffered the fatality. Road conditions were clear and dry. Aggressive Driving was attributed to the collision.

4.8.2 SEGMENT SAFETY REVIEW

Similar to **Table 4-9**, **Table 4-13** summarizes the total number of collisions by type arranged by key street segments within the study area. The table summarizes the total number of collisions by collision type for 17 of the 37 segments which captures 153 (81%) collisions of the 188 segment collisions that have occurred.

For each segment, **Table 4-13** provides the collision rate in collisions-per-million-vehicle-kilometres (collisions/MVkm). For some segments, such as Kaye Street, the short segment length combined with lower traffic volumes results in an unexpectedly elevated collision rate. Similar to the intersection analysis, only collisions within the right-of-way were included in the analysis.

Similar to the previous section, the following sections review the notable collision patterns with key study area segments. Notable segments involve pedestrian and/or cyclist incidents, fatality collisions, or collisions rates above 0.75 collisions/MVkm (collisions-per-million-vehicle-kilometres) due to non-SMV collisions:

- Young Street, Windsor Street to Robie Street (1 pedestrian collision)
- Robie Street, Almon Street to Stairs Street
- Windsor Street, Young Street to Almon Street (1 cyclist collision)
- Kempt Road, Columbus Street to Young Street
- Agricola Street, from Columbus Street to Almon Street (1 cyclist collision)

The following segments were not reviewed in further detail:

- Almon Street, Windsor Street to Robie Street, and Almon Street from Robie Street to Gottingen Street; This segment notably has had 1 pedestrian and 2 bicycle collisions within the 5-year data set. Almon Street is currently undergoing improvements to install AAA bike facilities within the study area. Once completed, this will have an influence on collision patterns along the street.
- Kaye Street, Robie Street to Gottingen Street and Kane Street, Robie Street to Isleville Street are short, low traffic segments which have had several single-motor vehicle (SMV) incidents contributing to elevated collision rate.
- Similarly, Isleville Street from Almon Street to Columbus Street is primarily single-motor vehicle (SMV) (75% of 4 incidents) with low traffic volumes resulting in a high collision rate.

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Table 4-13: Study Area Segments by Collision Type and Collision Rate

Segments	Collision Type								Total	Collision Rate per MVkm
	Head On	Rear End	Right Angle	Right Turn	Sideswipe	SMV - Stationary Object	SMV- Unattended	Turning Movement		
Young Street, Windsor to Robie	3	7	1	1	6	4	1	10	33	1.71
Robie Street, Almon to Stairs		2			7	4	2	5	20	0.82
Agricola Street, Almon to Columbus		1	1	1	2		9		14	0.77
Almon Street, Robie to Gottingen		2	1	1	2	1	2	2	11	2.18
Almon Street, Windsor to Robie		3			1	1	2	2	9	1.08
Windsor Street, Young to Almon		5				1		1	7	0.76
Gottingen Street, Almon to Columbus		5				2			7	0.36
Young Street, Robie to Gottingen					3	2	2		7	0.51
Windsor Street, Bayers to Maxwell		4					2		6	0.52
Massachusetts Avenue, Stairs to Columbus		2			1	3			6	0.25
Kempt Road, Young to Columbus		3					2	1	6	1.01
Kaye Street, Robie to Gottingen							6		6	21.03
Kane Street, Robie to Isleville		2					3		5	5.36
Isleville Street, Almon to Columbus		1					3		4	1.79
Almon Street, Windsor to Oxford		2					2		4	0.46
Bayers Road, Oxford to Windsor		1					1	2	4	0.78
Columbus Street, Kempt to Isleville			1			1	2		4	1.63
Total	3	40	4	3	22	19	39	23	153	

SEGMENT COLLISIONS - YEAR-OVER-YEAR BY COLLISION TYPE

Table 4-14 summarizes while Figure 4-20 illustrates the distribution of segment collisions by each year of the data set. A review of the data set found the following trends within the study area:

- In terms of overall collisions within the ROW, a gradual decrease to 2021 where total collisions begin to increase again. In 2023, total segment collisions were nearly 15% higher than 2018 despite lingering effects of COVID-19 traffic volume impacts.

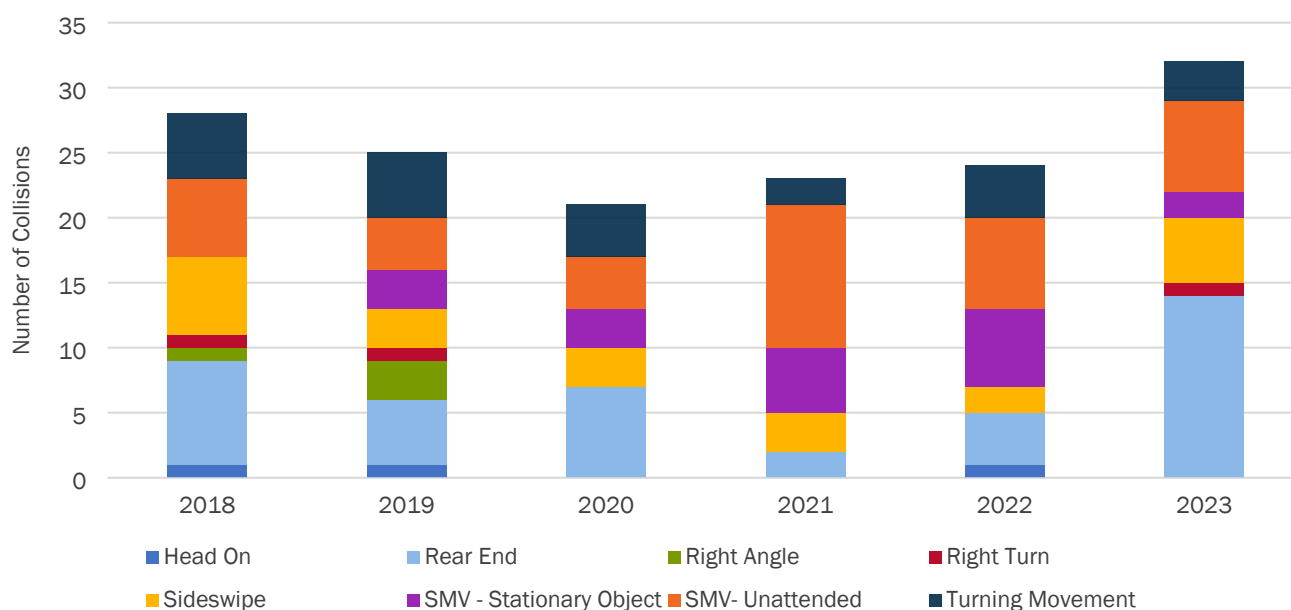
Existing Transportation Evaluation

- The COVID-19 influence on traffic volumes likely contributed to the decrease in collisions observed from 2020-2022.
- Rear-end collisions increased nearly two-fold (8 to 14 incidents) between 2018 and 2023.

Table 4-14: Summary of Segment Collision Types by Year of Occurrence

Collision Type	2018	2019	2020	2021	2022	2023	Total
Head On	1	1			1		3
Rear End	8	5	7	2	4	14	40
Right Angle	1	3					4
Right Turn	1	1				1	3
Sideswipe	6	3	3	3	2	5	22
SMV - Stationary Object		3	3	5	6	2	19
SMV- Unattended	6	4	4	11	7	7	39
Turning Movement	5	5	4	2	4	3	23
Total	28	25	21	23	24	32	153

Figure 4-20: Summary of Segment Collision Types by Year of Occurrence



SEGMENT COLLISIONS - COLLISION SEVERITY BY YEAR DISTRIBUTION

Table 4-15 summarizes while Figure 4-21 illustrates the relative change in collision severity at all study area segments to the 2018 base year of collisions. Collisions with an 'unknown' severity were not plotted. Fatal collisions had not occurred in the 5-year data set.

A review of the data set found the following trends within the study area:

- In terms of frequency of each collision severity within the ROW, injury collisions decreased between 2018-and-2023. The decrease in severity is counter to the increase in total number of collisions over this period.
- Given the low number of injury collisions, the change of 1-2 injury collisions per year is not considered significant between 2018-and-2023.

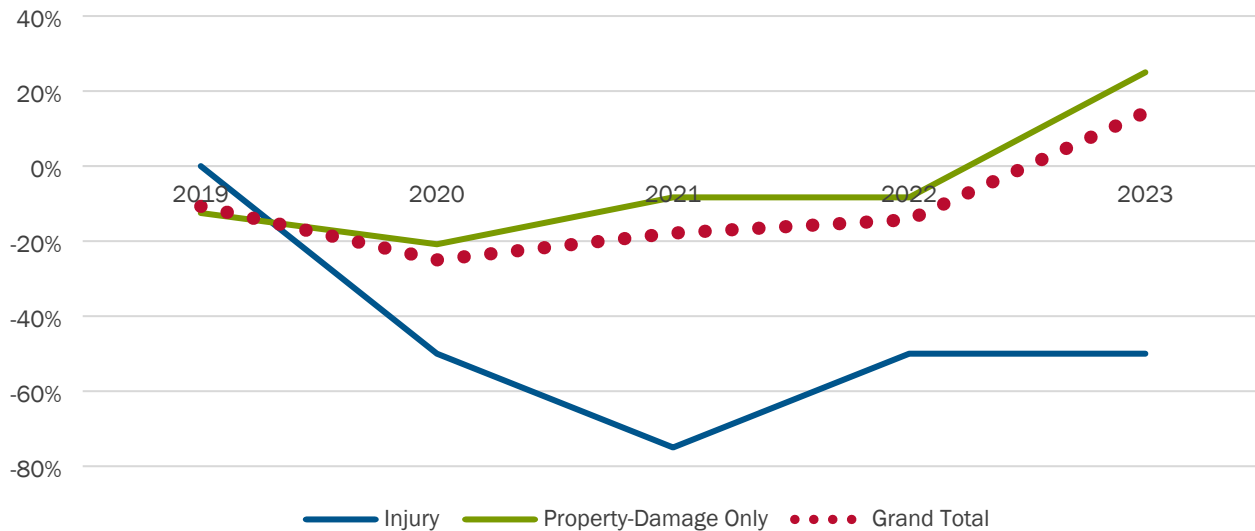
Existing Transportation Evaluation

- Proportionally, in 2018 the proportion of collisions resulting in injury was 14%. After 2019, the proportion decreased to a range of 4% to 10% of collisions, which can suggest a potential declining trend of injuries.

Table 4-15: Change in Segment Collision Severity by Year, Relative to 2018 Base Year

Collision Severity	2018	2019	2020	2021	2022	2023
Fatal						
Injury	4	4 (0%)	2 (-50%)	1 (-75%)	2 (-50%)	2 (-50%)
Property-Damage Only	24	21 (-13%)	19 (-21%)	22 (-8%)	22 (-8%)	30 (25%)
Total	28	25 (-11%)	21 (-25%)	23 (-18%)	24 (-14%)	32 (14%)

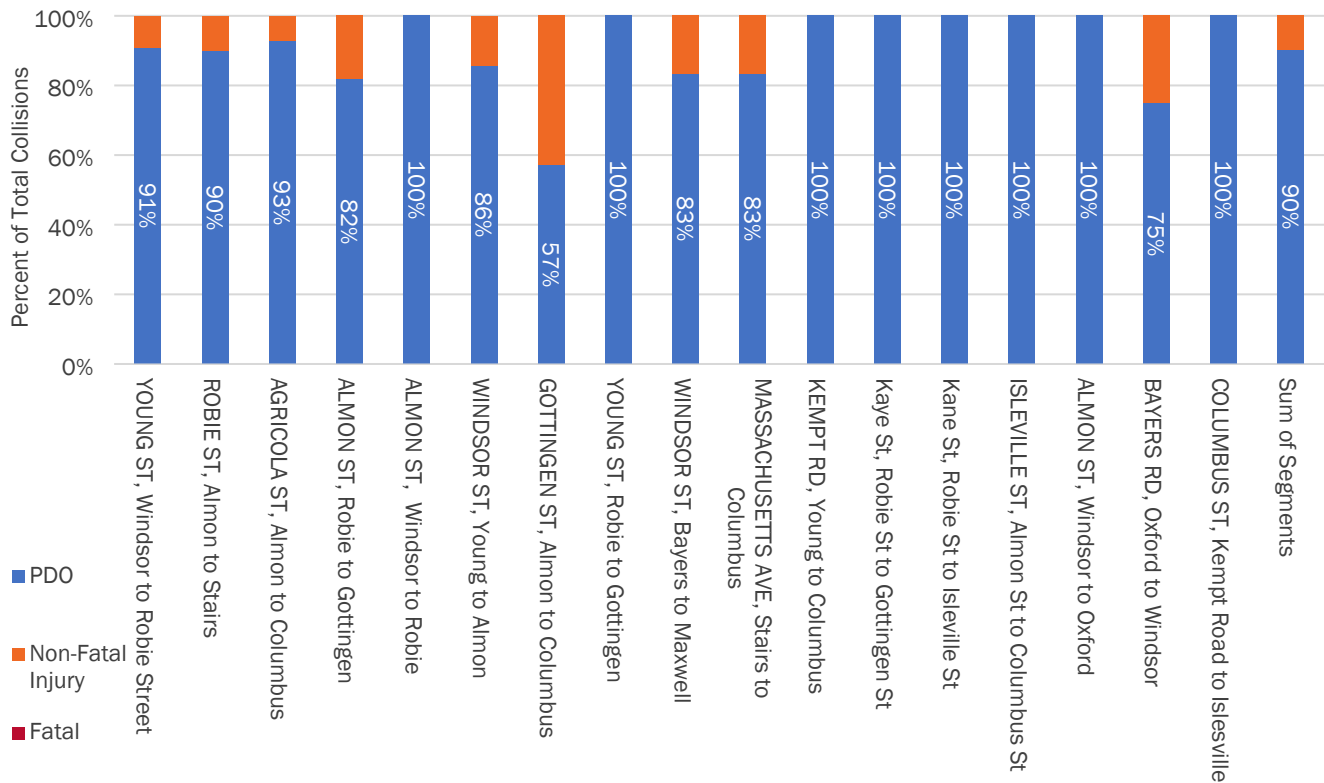
Figure 4-21: Change in Segment Collision Severity by Year, Relative to 2018 Base Year



SEGMENT COLLISIONS - COLLISION SEVERITY BY YEAR DISTRIBUTION

Figure 4-22 illustrates the proportion of segment collisions by severity for each of the 17 highest segments within the study area.

Figure 4-22: Segment Collisions, Proportion of Severity by Intersection Location



The following trends were identified in the data:

- Similar to the intersection collisions, 90% of all intersection collisions were PDO, 10% were non-fatal injuries, while no fatalities occurred on segments within the study area.
- Gottingen Street (43%, 3 of 7 collisions) and Almon Street from Robie to Gottingen (18%, 2 of 11 collisions) had notably higher proportions of injury collisions than the overall data set. In review, these segments had typically lower frequency of overall collisions across the 5-year period. A review of Gottingen Street collision events found injury collisions resulting from a pedestrian collision and two rear-ends.

SEGMENT COLLISIONS - COLLISION TYPE BY TIME OF DAY DISTRIBUTION

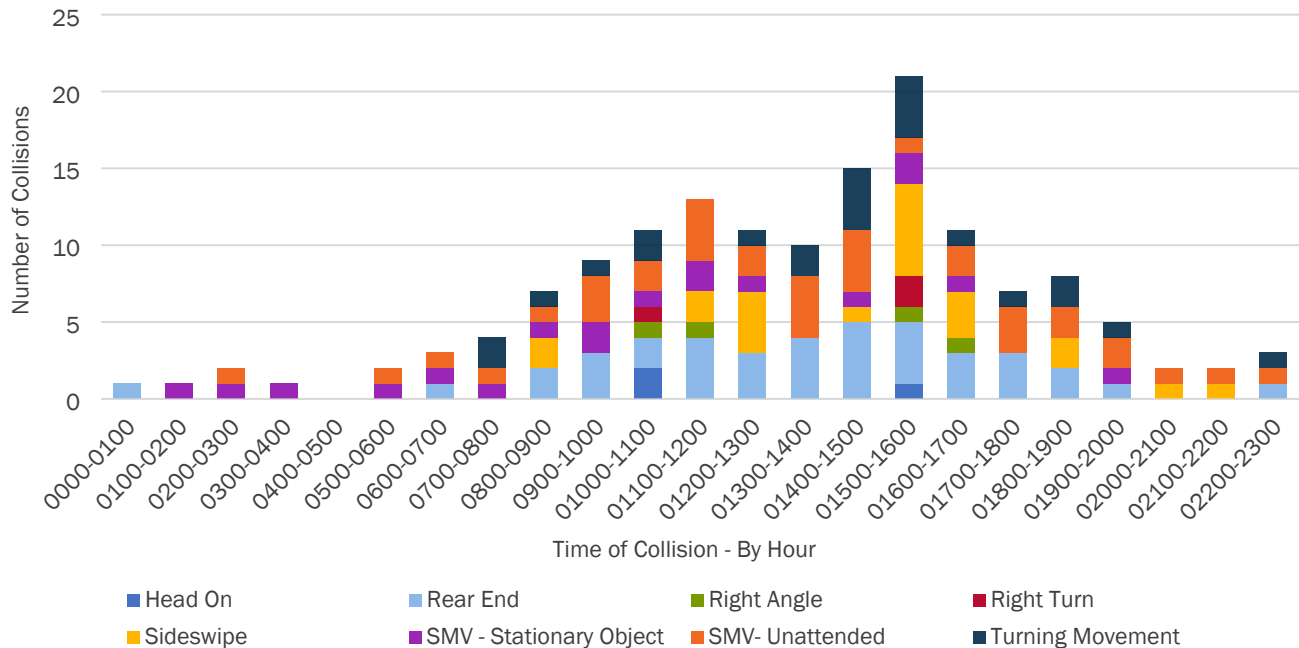
Figure 4-23 illustrates the distribution of segment collisions by time of day, color coded by collision type. The collisions are plotted by the hour in which they were recorded. A review of the data set found the following trends within the study area:

- The highest hours of collision patterns were found to be 3pm-4pm (21), followed by the 2pm-3pm (15), and the 11am-noon (13). These generally follow the afternoon peak period of travel demand and are similar to the patterns experienced at the intersection level. The 11am-noon does not have an obvious collision pattern.

Existing Transportation Evaluation

- The afternoon peak period was found to have the highest collision frequency with 47 collisions within the dataset (2pm-5pm). This time period aligns with the afternoon peak period, which is considered the higher traffic volume demand period.
- Rear-end (12, 25%) and Sideswipe (10, 21%) collision types are most observed in the PM peak period.
- During the overnight period, SMV collisions with stationary objects was found to be the collision type most observed.

Figure 4-23: Frequency of Segment Collisions by Time of Day and Collision Type



SEGMENT COLLISIONS – EMPHASIS AREAS

The Halifax Regional Municipality Road Safety Strategy (2024) identifies collision emphasis areas being Young Drivers, Aggressive Driving, Distracted Driving, Impaired Driving, and Pedestrian/Cycling Collisions. **Table 4-16** summarizes the number of collisions which were recorded to have at least one of these emphasis areas within the study area for each of the notable segments identified as having the highest collision frequency. A review of the data set found the following notable trends within the study area:

- Young Drivers were involved in 24% of the segment collisions, which is similar to the proportion at intersections. Windsor Street, from Almon Street to Young Street (6 collisions), and Massachusetts Avenue from Stairs to Columbus (6 collisions) each had 50% of collisions attributed to Young Driver collisions.
- Aggressive Driving was considered a factor in 25% of the segment collisions. In general, rear-end collisions (36% of aggressive driving incidents) and turning movement (31% of aggressive driving incidents) collision types were most frequently attributed to 'Aggressive Driving'. Under half of the collisions reported on Young Street, between Windsor and Robie Street (42% of 33 incidents) had recorded Aggressive Driving as a factor.
- Distracted Driving was considered a factor in 7% of segment collisions. Among Distracted Driving cases, the collision types most observed were single-motor vehicle related (50%), rear-ends (25%),

and sideswipes (25%). A review of the comments did not indicate any occurrences where a driver was distracted by a device.

Table 4-16: Summary of HRM Road Safety Strategy Emphasis Area Segment Collisions

Segments	Young Drivers	Aggressive Driving	Distracted Driving	Impaired Driving	Pedestrian Collisions	Bicyclist Collisions
Agricola Street, Almon to Columbus	2	2	2			1
Almon Street, Windsor to Robie	2	2				
Almon Street, Robie to Gottingen	3	2			1	2
Almon Street, Windsor to Oxford		2	1	1		
Bayers Road, Oxford to Windsor			1	1		
Columbus Street, Kempt Road to Islesville		3	1			
Gottingen Street, Almon to Columbus	1	3			1	
Islesville Street, Almon to Columbus			1			
Kane Street, Robie to Islesville						
Kaye Street, Robie to Gottingen	1			1		
Kempt Road, Young to Columbus	2					
Massachusetts Avenue, Stairs to Columbus	3	1		1		
Windsor Street, Young to Almon	3	2				1
Windsor Street, Bayers to Maxwell	3	2				
Young Street, Windsor to Robie Street	7	14	2	3	1	2
Young Street, Robie to Gottingen	2	1	1	1		
Robie Street, Almon to Stairs	7	5	1	1	1	1
Total	36	39	10	9	4	7

4.8.2.1 YOUNG STREET, WINDSOR STREET TO ROBIE STREET

The segment of Young Street, between Windsor and Robie Street, recorded a total of 33 collisions. The collision rate of approximately 1.71 collisions/MVkm is considered notable. The collision types which occurred most frequently were Turning Movement (10, 30%), Rear-End (7, 21%), and Sideswipe (6, 18%). Three (9%) head-on collisions also occurred. 30 (91%) incidents resulted in a non-injury (property damage only), while 3 (9%) incidents resulted in non-fatal injuries. The majority of incidents occurred in daylight conditions (30, 91%), while the remainder occurred in darkness (4, 12%) or at dusk (4, 12%). Road surface conditions during these collisions were mostly dry (30, 91%), with the majority of the remainder occurring under wet conditions (7, 21%). 26 (79%) collisions occurred from 1 PM to 6 PM, representing the afternoon peak period when traffic volumes are typically elevated.

Of the 10 Turning Movement collisions, 3 (30%) occurred at the Esso station (6020 Young Street), 3 (30%) occurred with the Young Kempt Centre accesses (6061 Young Street), and 4 (40%) occurred with the Superstore accesses (6141 Young Street). All incidents resulted in PDO. Only 1 (10%) of the 10 collisions had the primary vehicle using the center two-way left turn lane to make a left turn, while the remainder (9, 90%) involved vehicles exiting parking lot accesses.

One (3%) pedestrian incident has been recorded on this segment. The pedestrian collision occurred in the afternoon peak period in February 2019 at the intersection of Young Street and Kempt Road, near 6049 Young Street. The vehicle ran the red light, then struck the pedestrian in the crosswalk, causing injury.

Two (6%) cyclist collisions have been recorded, both resulting in PDO. The first occurred in September 2019, when a vehicle reversed from a parking spot and struck a cyclist during the 11 AM–noon hour. The location was noted as 6141 Young Street, so the collision likely occurred outside the ROW. The second occurred in December 2023 during the afternoon peak period, when a vehicle sideswiped the cyclist fronting the Young Kempt Centre (6061 Young Street). Both incidents occurred in dry and daylight conditions.

Regarding collision patterns, approximately one-third (11, 33%) of the collisions occurred in the block fronting the existing Superstore (6141 Young Street). This included nearly half (4, 40%) of the Turning Movement collisions as well as 2 (67%) of the head-on collisions. In the long-term, opportunities to consolidate accesses and place them on minor streets would benefit collisions on this segment

4.8.2.2 ROBIE STREET, ALMON STREET TO STAIRS STREET

The segment of Robie Street, from Almon Street to Young Street, is characterized by northbound curbside bus lanes, a variety of minor intersections, and minor accesses such as the gas station at Young Street/Robie Street. This segment recorded a total of 20 collisions (5% of all collisions) and a collision rate of approximately 0.82 collisions/MVkm. The collision types which occurred most frequently were Sideswipe (7, 35%) and Turning Movement (5, 25%).

18 (90%) incidents resulted in a non-injury (property damage only), while the remaining 2 (10%) incidents resulted in non-fatal injuries. The majority of incidents occurred in daylight conditions (18, 90%), while the remainder occurred in darkness (2, 10%). Road surface conditions during these collisions were mostly dry (16, 80%), with the majority of the remainder occurring under wet conditions (3, 15%). Collisions were evenly distributed throughout the day and analysis period.

One pedestrian and one cyclist incident have been recorded on this segment. Both collisions occurred during the daylight time with dry surface pavement. The pedestrian collision involved a vehicle turning from 6020 Young Street and striking the pedestrian crossing through traffic who was crossing mid-block (i.e. not at a cross-walk), resulting in an injury to the pedestrian.

The cyclist incident occurred near the Almon Street intersection and also resulted in an injury to the cyclist. The report comment indicates that the cyclists failed to yield to vehicle traffic when crossing Robie Street lanes.

In summary, the collision pattern most evident is the number of sideswipe incidents. As noted in the Robie Street/Young Street intersection safety review, the existing requirement to change lanes and the presence of lane drops within the Robie Street corridor can create confusion among drivers. These geometric factors can lead to slow speeds and safer environments, however proper signage could benefit sideswipe collisions. The planned Robie Street improvements are anticipated to provide enhanced pavement markings and signage. Opportunities for pedestrian crossings should be reviewed.

4.8.2.3 AGRICOLA STREET, COLUMBUS STREET TO ALMON STREET

Agricola Street is a local street with double-sided parking and a single travel lane in each direction. This segment recorded a total of 14 collisions and a collision rate of approximately 0.77 collisions/MVkm. The collision types which occurred most frequently were SMV (9, 64%) and Sideswipe (2, 14%). 13 (93%) incidents resulted in a non-injury (property damage only), while the remaining 1 (7%) incident resulted in non-fatal injuries.

The segment experienced one cyclist collision at 3269 Agricola Street, where the vehicles driver doored the cyclist by opening their door in the path of the cyclist. This resulted in an injury to the cyclist. It occurred during the morning peak period in September 2018, with dry and daylight conditions.

4.8.2.4 WINDSOR STREET, YOUNG STREET TO ALMON STREET

Windsor Street, between Young Street and Almon Street provides for one travel lane in each direction and on-street bike lanes. There are frequent intersections with minor streets on the west side of the roadway. It also fronts the Halifax Forum site. 7 collisions have been recorded, 5 (71%) of which were rear ends with the remaining being one SMV and one turning movement.

A cyclist collision occurred (classified as SMV) which was between a vehicle and a cyclist in January 2023 during the morning peak period at approximately 2901 Windsor Street. The incident resulted in PDO with 'Aggressive Driving' being considered a factor. The collision resulted from a vehicle turning left "into a parking lot" and striking the cyclist, who was proceeding straight. The pavement conditions were snowy.

4.8.2.5 KEMPT ROAD, COLUMBUS STREET TO YOUNG STREET

The segment of Kempt Road, from Columbus Street to Young Street experienced a total of 6 collisions resulting in a collision rate of 1.01 collisions/MVkm. The collision types which occurred most frequently were Rear-End (3), SMV (2) and Turning Movement (1). All records resulted in PDO. There was no notable location pattern, as the 6 incidents all occurred at different municipal addresses.

No pedestrian or cyclist incidents were recorded on this segment.

4.8.3 SUMMARY OF SAFETY RECOMMENDATIONS

The foregoing safety analysis reviewed intersections and segments within the study area. There are several ongoing HRM projects that can affect recommendations for short-term 'quick win' opportunities. The Robie Street-Young Street 60% Design Project, the Windsor Street Tactical Bike Lane project, the Almon Street Bike Lane Construction project, and the planned intersection modifications at Kempt Road/Young Street are considered impactful to recommendations from this study. For example, the Windsor Street Tactical Bike Lane project can implement safety improvements for cyclists.

A review of the collision history and existing desktop conditions was undertaken to identify the following intersection safety modifications be reviewed in additional detail:

- **Robie Street/Young Street:** The prevalence of right angle and turning movement collisions suggests conflicts with turning movements. The westbound approach should be evaluated for a dedicated WB-LT movement which can be phased as a fully protected or protected movement. This could involve reconfiguration of the east leg or acquiring property to increase the intersection capacity.
- **Young Street/Windsor Street/Bayers Road:** The northbound right turn channel results in a shallow angle of intersection between traffic. A "smart channel" approach is recommended, to result in an angle of 70° or greater to the roadway. The "smart channel" treatment is demonstrated to slow vehicle speeds and increase yielding rates to pedestrians and cyclists. As an interim treatment, green surface treatment should also be considered.
- **Young Street/Monaghan Drive Pedestrian Crossing:** Pedestrian safety is a key focus area for HRM. The following recommendations have been identified:
 - **WB Pavement Markings:** It is typical practice to minimize pavement markings after the "Advance Yield to Pedestrian Line" markings. The set of lane direction markings should be removed between the shark teeth and ladder crossing.
 - **Pedestrian Signal:** Young Street has an ADT of approximately 12,000 vehicles/day. Based on Table 1 – Decision Support Tool from Transportation Association of Canada's *Pedestrian Crossing Control Guide* (2018), this places the intersection on the threshold of a pedestrian

signal. The signal could incur some throwaway costs with future Monaghan Drive and Kempt Road improvements.

- **High Volume Driveways on AAA Cycling Routes:** The future Windsor Street tactical improvement is recommended to review the opportunity for green surface treatments at high volume driveways (such as the Halifax Forum at 2901 Windsor Street).

4.9 FIELD OBSERVATIONS

4.9.1 AREA HOT SPOTS

To the north of the study area, the Robie Street-Massachusetts Avenue and Windsor Street corridors serve as primary north-south links connecting the study area to the Windsor Street Exchange, which further connect to the Mackay Bridge/Highway 111 to the east and the Bedford Highway to the west. Mackay Bridge is one of five roadway access points to the Halifax Peninsula and currently operates with a significant amount of congestion during peak periods. While traffic may flow steadily from the study area, it could often be slowed by the capacity limitations in the north. There will be a major reconstruction of the Windsor Street Exchange in the short-term, with construction expected to commence in 2025. The reconstruction aims to improve vehicle movement through the area and add active transportation connections and transit priority measures. To the south, Windsor Street effectively connects to Robie Street at their intersections with Quinpool Road. Robie Street continues to the south end of the peninsula, with notable destinations along the link including the Halifax Infirmary, Saint Mary's University, Dalhousie University and IWK Health Centre.

The Robie Street-Massachusetts Avenue corridor frequently experiences congestion at the intersection of Young Street in the peak directions, particularly in the northbound direction in the afternoon peak. Similarly, both Windsor Street and Robie Street experience northbound congestion in the afternoon peak hour. Other notable north-south links on the Halifax Peninsula include Barrington Street, Gottingen Street, and Agricola Street to the east of the study area, and Oxford Street and Connaught Avenue to the west.

The Bayers Road, Young Street and Almon Street corridors are the primary east-west corridors in the study area. North Street, south of the study area, is also a primary corridor connecting the Macdonald Bridge to Chebucto Road, which continues to the Armdale Rotary. In the afternoon peak hour, the Bayers Road corridor to Connaught Avenue has notable congestion which can extend to westbound Young Street. Young Street is the only major E-W connection until the Windsor Street Exchange (approximately 1.5km distance between the two).

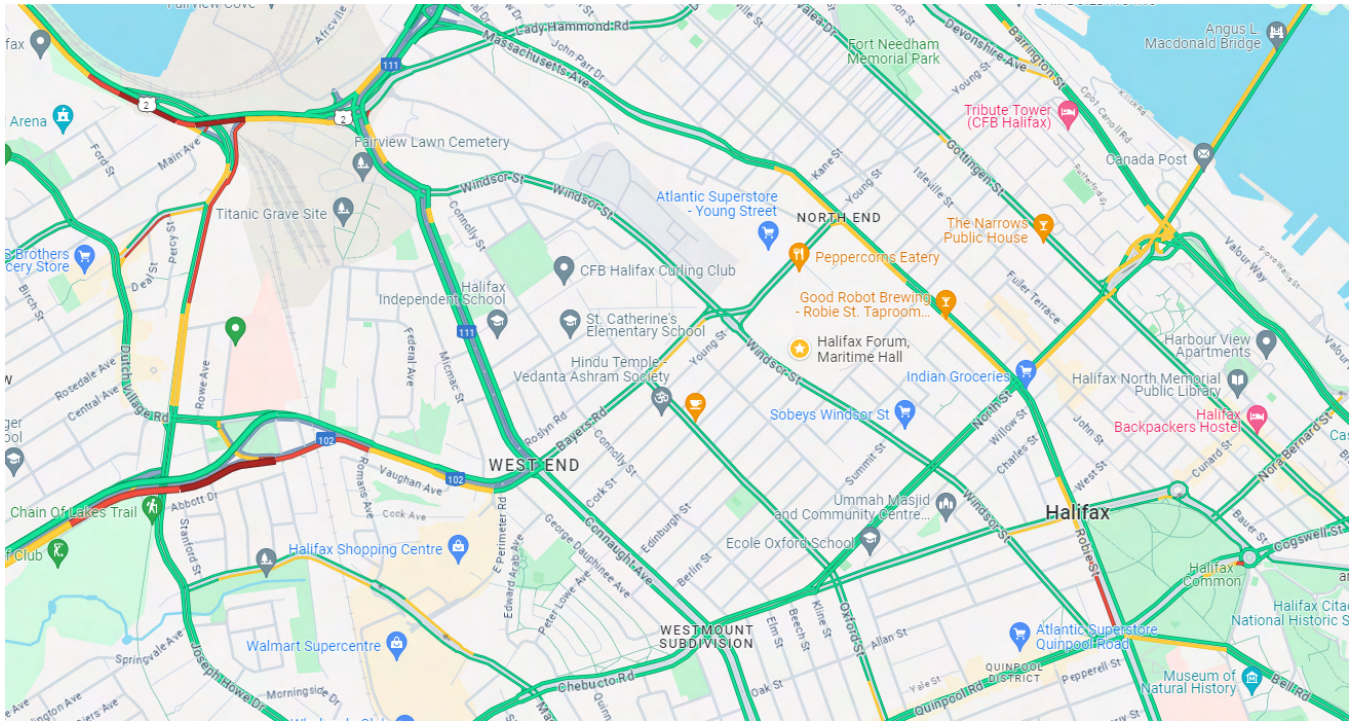
4.9.1.1 TYPICAL TRAFFIC CONDITIONS

Figure 4-24 illustrates typical traffic conditions, as provided through Google™, within the Young District study area during the weekday AM and PM peak periods.

Existing Transportation Evaluation

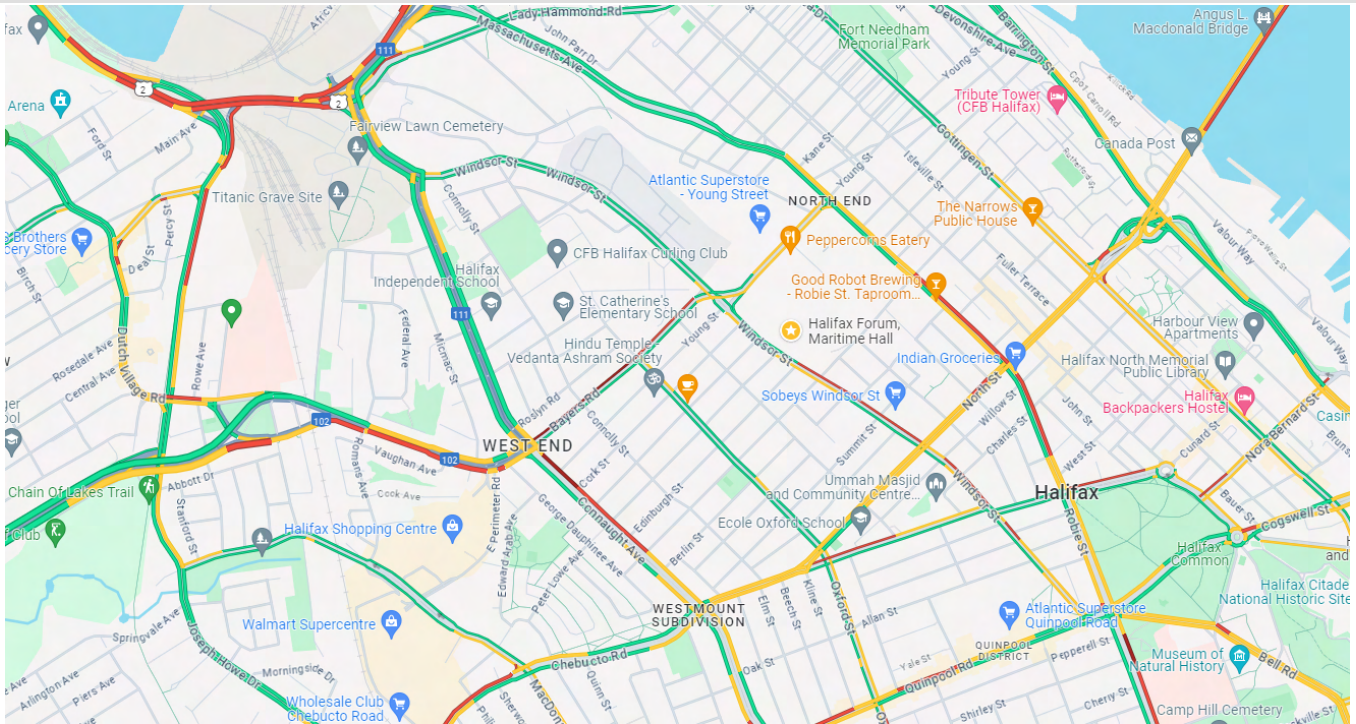
Figure 4-24: The Young District and Surrounding Area Traffic Operational Hotspots (Typical Weekday)

Weekday Morning Peak



Source: Google Maps (July 2024)

Weekday Afternoon Peak



Source: Google Maps (July 2024)

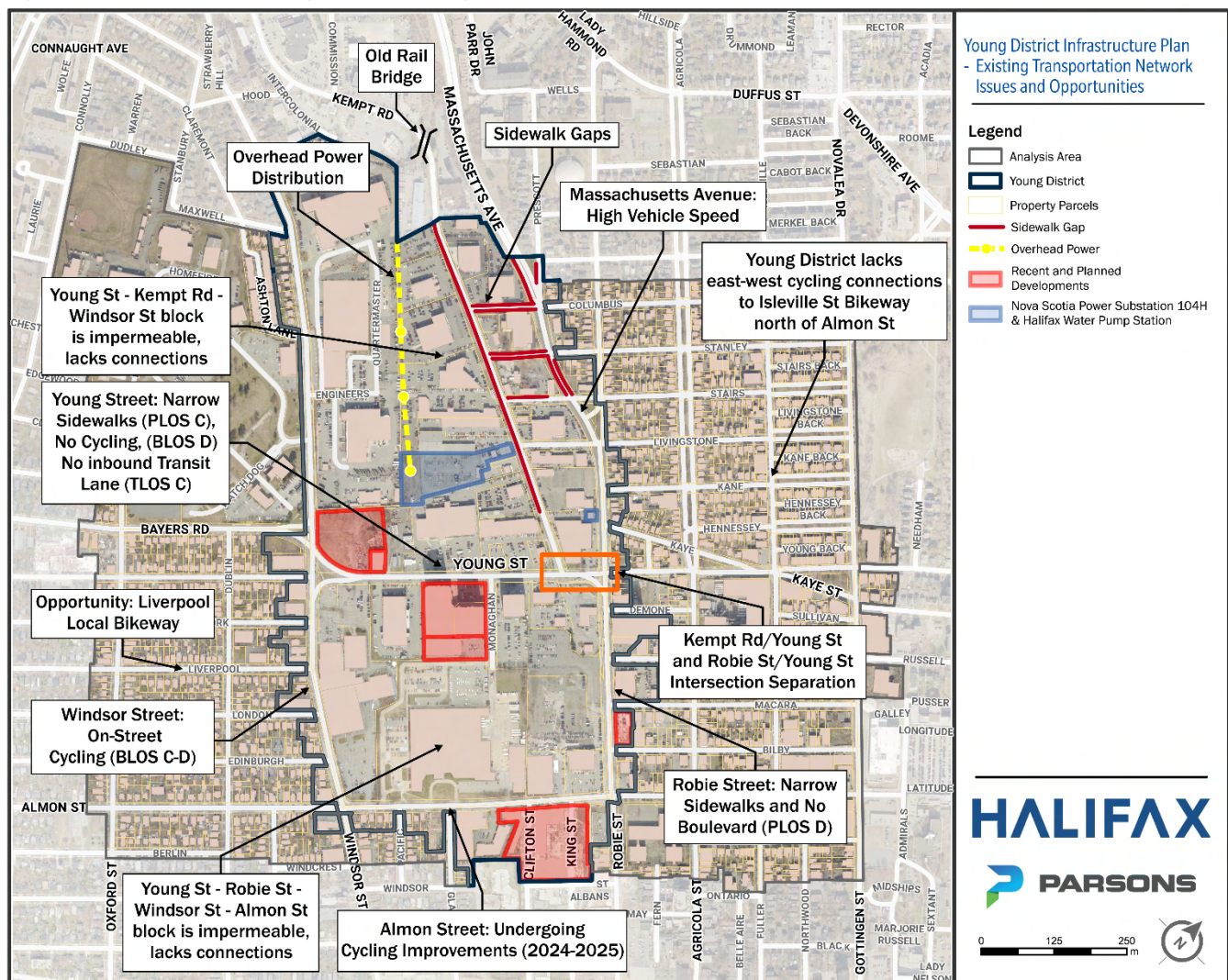
Google™ API travel time was also obtained during the PM peak hour to inform the micro-modelling analysis. During the weekday PM peak (between 3:30 and 5:30pm), the following average travel times relative to their free flow travel times are noted within the study area corridors:

- Robie Street – Columbus Street to Almon Street (900m) – travel times range between 3 and 4 minutes; delays experienced at all intersections on this route are approximately 1 minute; estimated average operating speeds range between 20 and 25 km/h.
- Windsor Street – Ashton Lane to Almon Street (820m) – travel times are approximately 2 minutes; delays experienced at all intersections on this route are approximately 1 minute; estimated average operating speeds range between 25 and 30 km/h.
- Young Street/Bayers Street – Oxford Street to Novalea Drive/Gottingen Street (1,300m) – travel times range between 4 and 5 minutes; delays experienced at all intersections on this route are approximately 2-and-a-half minutes; estimated average operating speeds range between 15 and 20 km/h.

4.10 TRANSPORTATION NETWORK OPPORTUNITIES AND CHALLENGES

Figure 4-25 illustrates the opportunities, constraints, critical deficiencies, and areas of concern in the transportation network. The figure presents the outcome of the existing transportation conditions analysis.

Figure 4-25: Summary of Young District Existing Transportation Issues and Opportunities



PEDESTRIAN NETWORK

- The majority of the study area has sidewalks. There are sidewalk network gaps on Kempt Road, and on local links between Kempt Road and Massachusetts Avenue which should be addressed.
- The Young District area is poorly connected, with long, continuous streets framing large block sizes. Creating smaller blocks would greatly improve connectivity for walking and rolling throughout the district, thereby increasing access to local destinations and transit.
- Safe crossing opportunities should be explored throughout the study area to promote walking connectivity.

CYCLING NETWORK

- Almon Street and Windsor Street serve as the primary cycling corridors within the district. Young Street and Robie Street had poor cycling MMLOS results, and given their separation to adjacent cycling streets, the existing transportation network provides an insufficient amount of cycling infrastructure within the district. The redevelopment of the district presents opportunities for additional cycling routes, which could include redesignating existing or establishing new cycling streets as bicycle routes.
- The Young District area is poorly connected, with long, continuous streets framing large block sizes. Creating smaller blocks would greatly improve connectivity for cyclists.
- Additional cycling connections within and extending from the Young District internal network are needed to complete the cycling network. These connections should be convenient, continuous, and safe.
- Opportunities to provide additional bike crossings within the district will be explored to promote a safer and more connected cycling network.

TRANSIT NETWORK

- The existing network is adequately serviced by a sufficient number of bus stops on the Young District street system. Bus stops within the study area are all accessible.
- The existing network has several transit priority measures in the form of curbside bus lanes, which are provided in one direction along Young Street, both directions on Robie Street south of Young Street, and in one direction on Robie Street north of Young Street. Additional transit priority measures should be explored to benefit the overall transit network.
- Travel times between bus stops tend to be at their highest during midday and afternoon peak hours and are longer when the bus is required to turn left or right at intersections along their respective route. The proximity of Kempt Road, and the intersection of Kempt Road/Young Street, to Robie Street poses a challenge to installing transit priority measures which could benefit transit on the existing street network. The future transit network should seek to avoid small block sizes that restrict transit priority measures. The future network should also explore increasing the separation between Kempt Road and Robie Street.
- There is likely an overall benefit of a transit terminal at the intersection of the Green and Purple rapid transit routes. As a transit-oriented community, the Young District would benefit from a transit terminal with supportive transit priority measures.

STREET NETWORK

- The existing network is generally continuous and well connected. However, large blocks increase the distance of trips, make access to the surrounding land uses challenging, and decreases redundancy to accommodate transit operations. Ideally, block lengths between 80m and 150m are ideal to accommodate people who walk, bike, roll and take transit.

Existing Transportation Evaluation

- The Young District land uses are serviced from arterial roads, where accesses can pose operational and safety concerns. The future network should promote local and service-oriented streets to accommodate access and loading where needed.
- The proximity of the Young Street/Kempt Road and the Robie Street/Young Street intersections are a notable challenge, resulting in increased traffic delays and elevated collision rates. Opportunities to increase the spacing between Kempt Road and Robie Street will be explored.
- Massachusetts Avenue serves as a primary connector to the Windsor Street Exchange and MacKay Bridge network to the north. The number of lanes and operating conditions of Massachusetts Avenue contributes to increased operating speeds within the Young District, creating a potential safety concern. Opportunities to calm traffic through reimagining the function of Massachusetts Avenue within the district will be explored.