

TRAFFIC IMPACT STUDY

PAPER MILL LAKE AREA



PREPARED FOR:
UNITED GULF CONSTRUCTION INC.

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1 INTRODUCTION

Background

In 1994 Bedford Town Council approved a development agreement (D.A.) for 221 acres of Residential Comprehensive Development District (RCDD) zoned land in the vicinity of Paper Mill Lake in Bedford. A portion of these lands were developed in the 1990s and the Development Agreement still applies to the remaining lands. A condition of the agreement is that not more than 100 single family dwelling units should be developed on the south side of Kearney Run without the proposed collector street (Nine Mile Drive) extending from what is now Oceanview Drive in the Crestview subdivision to Hammonds Plains Road. This was because the only access/egress to the area was via Moirs Mill Road and Nelsons Landing Boulevard to the Bedford Highway.

Since that time, the road network has changed significantly with the construction of the Larry Uteck interchange, Oceanview Drive, Nine Mile Drive, Southgate Drive, and Larry Uteck Boulevard. This has clearly relieved pressure on the two roadway connections to the Bedford Highway, which was the basis for the original 100 dwelling unit limit.

WSP Canada Inc. has been retained to prepare a Traffic Impact Study to determine whether these changes to the roadway network will allow for additional growth in the RCDD lands without compromising traffic functionality and the intent of the 100 dwelling unit limit.

A Traffic Impact Study Usually Considers Four Questions

A TIS usually consists of determining answers for the following questions:

1. **What is the existing transportation situation** adjacent to the study site? How have volumes changed historically?
2. **What transportation changes are expected** at key Study Area locations? How many vehicle and active mode trips are expected to be generated by the proposed development during weekday peak hours? What routes are the trips expected to use to travel within and through the Study Area?
3. **What transportation impacts will occur** on Study Area roads, sidewalks, and intersections?
4. **What transportation improvements are required** to mitigate project impacts on Study Area travel? Are there transportation modifications that should be made to improve the travel experience for all users?

Study Objectives

The objectives of the study are to:

1. Develop projected future background weekday AM and PM peak hourly volumes and daily two-way traffic volumes for Study Area roads that do not include trips generated by proposed site development.
2. Estimate the number of weekday AM and PM peak hour trips and daily two-way trips that will be generated by the proposed development.
3. Distribute and assign site generated trips to Study Area intersections to project future volumes that include site generated trips.
4. Evaluate impacts of site generated traffic on the performance and level of service of study intersections and the volume threshold expectations of collector and local streets in the study area.
5. Estimate daily two-way volumes on key study area streets.

2 STUDY AREA DESCRIPTIONS

Description of Proposed Development and Site Access

The development site is shown in Figure 1. It is bound between the Bedford Highway and the Bicentennial Highway to the north and south of Paper Mill Lake. The study area, along with key connection points to the adjacent roadway network is shown in Figure 2. For the purpose of this study, the lands are divided into three areas:

Area A: This is an area of approximately 39 acres within the RCDD lands south of Paper Mill Lake. Development of these lands would result in the 100 unit limit specified in the original agreement being exceeded. Determining the impact of developing these lands is the objective of this study

Area B1: This consists of two areas within the RCDD zone that are adjacent to, but not part of the current development proposal.

Area B2: This is an area of approximately 60 additional acres within the RCDD lands north and west of Paper Mill Lake. While these lands are currently not proposed for development, their eventual presence, along with the extension of Nine Mile Drive through them to Hammonds Plains Road, are being considered in this study to help determine longer term traffic patterns and the functional requirement of Nine Mile Drive as a completed connection between Larry Uteck Boulevard and Hammonds Plains Road.

Current access to the site is primarily via Moirs Mill Road and Oceanview Dr/Amin St/Nelsons Landing Blvd to the Bedford Highway and via Nine Mile Drive to Larry Uteck Boulevard. Future access to the site from Hammonds Plains Road via an extension of Nine Mile Drive is expected to be built as Area B is developed.

Existing Road Descriptions

HRM Engineering has indicated that both Moirs Mill Road and Nine Mile Drive are considered collector streets. All other streets within the study area, in particular Oceanview Drive, Amin Street and Nelsons Landing Boulevard, are considered local streets.

Intersection Descriptions

Bedford Highway/Moirs Mill Road is a signalized T-intersection. The northbound Bedford Highway approach has a single through lane, a left turn storage lane and a signalized pedestrian crossing. The southbound Bedford Highway approach has two through lanes, although these taper to a single lane shortly after the intersection. The Moirs Mill Road approach has separate lanes for left and right turns and a signalized pedestrian crossing.



Photo 1: Looking north to Moirs Mill Road/Bedford Highway Intersection

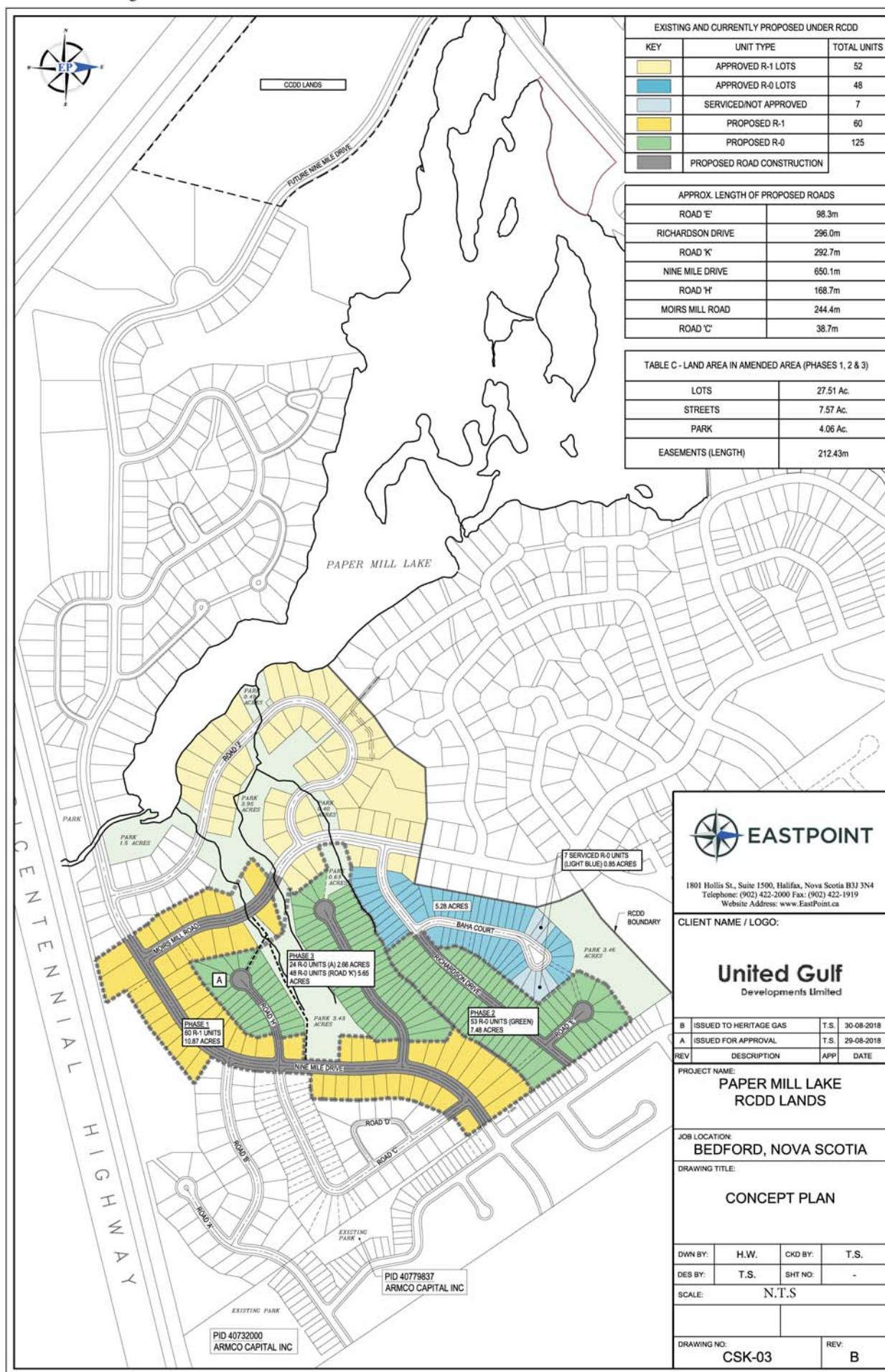


Figure 1: Development Site

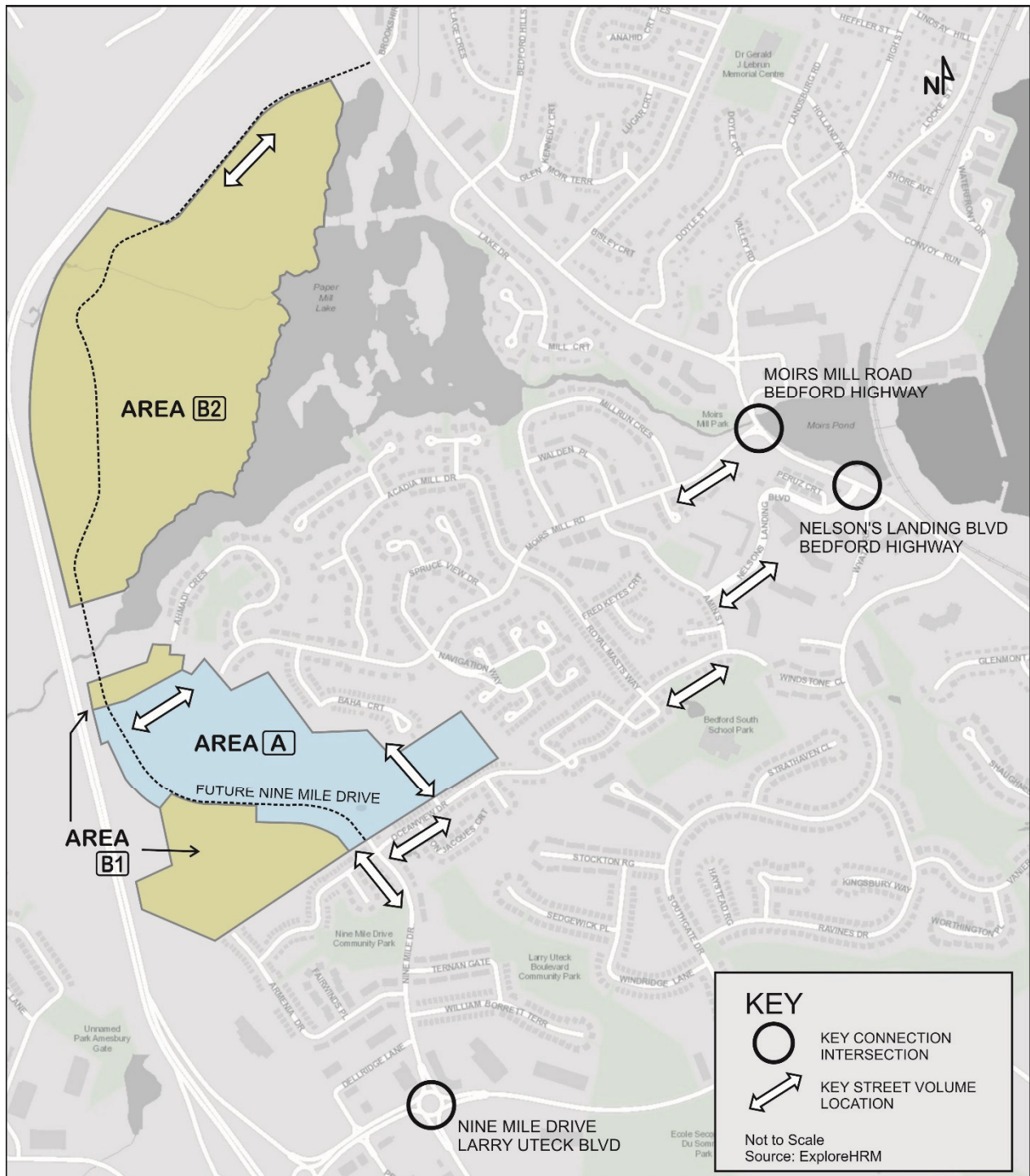


Figure 2: Study Area and Roadway Connections

**Intersection
Descriptions
(Continued)**

Bedford Highway /Nelsons Landing Boulevard is an unsignalized T-intersection with stop control on the Nelsons Landing Boulevard approach. The northbound Bedford Highway approach has a single through lane and a left turn storage lane. The southbound Bedford Highway approach has a single lane for through and right movements plus a curbside bike lane. There is a pedestrian crossing on this leg controlled by overhead pedestrian-activated lights. The Nelson's Landing Boulevard approach has sufficient space for both left and right turning traffic. This approach has a pedestrian crossing that is uncontrolled.

Nine Mile Drive / Larry Uteck Boulevard is a roundabout with a two-lane circulating roadway. All four approaches to this intersection have a marked pedestrian crossing and two approach lanes.



Photo 2: Looking south on Nine Mile Drive toward Larry Uteck Blvd.



Photo 3: Looking west on Larry Uteck Blvd at Nine Mile Drive

**Traffic Volume
Data**

Intersection turning movement counts were conducted by WSP at all three study intersections during November 2018 using MioVision technology. Daily two-way traffic volume counts were conducted in November 2018 using radar counters.

**Traffic Growth
Rate**

Traffic growth on the roadway network, over and above the addition of traffic from the development, needs to be considered. For this study, all counted peak hour traffic volumes on the adjacent roadway network have been increased by five percent. With regional growth

rates normally in the range of half a percent per year, this provides for an assessment horizon of approximately ten years. Counted traffic volumes within the study area street network have been increased by one percent. Since this area (outside of the development lands being assessed) is now substantially fully built, this one percent increase accounts for some very minor future in-filling.

***Projected 2021
Background
Volumes***

Projected AM and PM peak hour and two-way daily background volumes are shown diagrammatically in Figure A-1, Appendix. They consist of the counted traffic volumes plus the projected growth.

***Active
Transportation
/ Transit***

The site has good accessibility for pedestrians, with concrete sidewalks on one side of all study area streets and both sides of Nine Mile Drive. The area has been well-designed for active transportation connections within the community and on-going plans to improve the Bedford Highway as an active transportation corridor create a high opportunity for making functional active transportation trips.

The development area is served by transit route 91 with potential to increase penetration of that route into the lands once they are developed. The Bedford Highway is a planned high-frequency bus corridor, and its proximity to the development site (900m to 1,400m) for accessing by walking, biking or an efficient bus transfer will make transit an attractive travel choice. There is opportunity for this corridor to become even more attractive for transit trips with commuter rail or high-speed ferry being future possibilities.

3 TRIP GENERATION, DISTRIBUTION, AND ASSIGNMENT

Anticipated Land Use for Proposed Multi-Use Development

Each of the three sub-areas within the study area has different land use components and trip distribution characteristics. The proposed and anticipated land use is described below.

Area A: This is the area currently being proposed for development. The development consists of single family homes and a small neighbourhood office/retail centre. This area is connected to the roadway network via Moirs Mill Road and Nelsons Landing Boulevard to the Bedford Highway and via Nine Mile Drive to Larry Uteck Boulevard.

Area B1: This area is adjacent to Area A, but not part of the current development application. It is expected to contain single family homes and semi-detached residential units.

Area B2: This area may be developed in the future and is not part of the current development application. The purpose of including this area in the analysis is to project the ultimate traffic loading on collector roadways within the study area. In addition to the existing connections described above for Area A, development of this area would establish an additional connection to Hammonds Plains Road via an extension of Nine Mile Drive. This area consists of single family homes, small-size multi-unit residential buildings (6 to 8 units on two or three floors), medium-size multi-unit residential buildings (3-10 story buildings) and a school.

Assessment Scenarios

Two assessment scenarios are examined in this study:

Scenario One: Area A is developed and vehicles access the regional roadway network using the existing connection points.

Scenario Two: Areas A, B1 and B2 are developed and Nine Mile Drive is extended to an intersection at Hammonds Plains Road.

Estimation of Total Site Generated Trips

Generation of trips for each of the proposed land uses is determined by applying the *Trip Generation Handbook, 10th Edition* (Institute of Transportation Engineers, Washington, 2017). This reference provides a calculation for the anticipated number of trips produced by each type of land use based on data collected from studies across North America. Trip generation is summarized for Area A in Table 1, for Area B1 in Table 2 and for B2 in Table 3.

It should be noted that the *ITE Trip Generation Handbook* provides “driveway counts” for each of the land uses, meaning that the counts consider only the trip directly entering or exiting the site. For an assessment of a larger, comprehensive study area such as this one, engineering judgement needs to be employed to determine how many of these trips stay within the study area and how many originate from or are destined to areas outside of the study area. In cases where a trip stays within the study area, it will have been identified as a trip that originates from one of the study area land uses and is destined to another land use within the study area. Even though this is one single trip, it will have been calculated as a trip from both the origin and the destination, so a reduction calculation is required to prevent double-counting. For example, a resident of the study area making a trip to a local convenience store (commercial site) to purchase goods and return home

will create one trip out of their driveway and one trip in, as well as one trip into the commercial site and one trip out. But rather than four trips being created there are only two: home-to-store and store-to-home. Accordingly, some adjustments to the rates have been made based on the following assumptions.

Table 1 – Trip Generation Estimates Area A

Land Use ¹	Units ²	Trip Generation Rates ³					Trip Generation Estimates ³				
		AM Peak		PM Peak		Daily	AM Peak		PM Peak		Daily
		In	Out	In	Out	2-way	In	Out	In	Out	2-way
Single Family (Land Use 210)	192	Equations from Pages 2 to 4					35	106	120	70	1895
Small Office Bldg (Land Use 712)	6 KGLA	1.59	0.33	0.78	1.67	16.19	10	2	5	10	97
Specialty Retail (Land Use 826)	6 KGLA	0.76	0.60	1.19	1.52	44.32	5	4	7	9	266
Total Trip Generation Estimate							50	112	132	89	2258
15% Reduction for Non-Auto Trips							8	17	20	13	339
40% Reduction for Internal Commercial Trips							2	2	3	4	106
Corresponding Reduction for Residential Trips to/from Commercial Area							2	2	4	3	106
Adjusted Trip Estimates							38	91	105	69	1707
NOTES: 1. Rates and equations are from Trip Generation, 10th Edition, Institute of Transportation Engineers, 2017. 2. Number of Dwelling Units for Residential; KGLA is 'Gross Leasable Area x 1000 SF'. 3. Rates are 'vehicles per hour per unit'; trips generated are 'vehicles per hour for peak hours'. 4. Since the 10th Edition does not include rates for Specialty Retail, rates for Land Use 826 from the 9th Edition have been used. The equation for 'Peak Hour of Adjacent Street Traffic' has been used to estimate PM peak hour trips. AM trip rates have been assumed to be 50% of PM rates with reversal of directional split.											

Table 2 – Trip Generation Estimates Area B1

Land Use ¹	Units ²	Trip Generation Rates ³					Trip Generation Estimates ³				
		AM Peak		PM Peak		Daily	AM Peak		PM Peak		Daily
		In	Out	In	Out	2-way	In	Out	In	Out	2-way
Single Family (Land Use 210)	71	Equations from Pages 2 to 4					14	41	46	27	759
Semi-Detached (Land Use 210)	44	Equations from Pages 2 to 4					9	27	29	17	489
Total Trip Generation Estimate							23	68	75	44	1248
15% Reduction for Non-Auto Trips							3	10	11	7	187
Adjusted Trip Estimates							20	58	64	37	1061
NOTES:											
1. Rates and equations are from Trip Generation, 10th Edition, Institute of Transportation Engineers, 2017.											
2. Number of Dwelling Units for Residential											
3. Rates are 'vehicles per hour per unit'; trips generated are 'vehicles per hour for peak hours'.											

Table 3 – Trip Generation Estimates Area B2

Land Use ¹	Units ²	Trip Generation Rates ³					Trip Generation Estimates ³				
		AM Peak		PM Peak		Daily	AM Peak		PM Peak		Daily
		In	Out	In	Out	2-way	In	Out	In	Out	2-way
Single Family (Land Use 210)	152	Equations from Pages 2 to 4					28	85	96	56	1528
Low-Rise Multi (Land Use 220)	48	Equations from Pages 31 to 33					5	18	19	11	322
Medium-Rise Multi (Land Use 230)	248	Equations from Pages 73 to 75					22	62	65	41	1350
School ⁴ (Land Use 520)	450 students	0.36	0.31	0.08	0.09	1.89	162	140	36	41	851
Total Trip Generation Estimate							217	305	216	149	4051
15% Reduction for Non-Auto Trips							33	46	32	22	608
40% Reduction for Internal Primary and Pass-by School Trips							65	56	14	16	340
Adjusted Trip Estimates							119	203	170	111	3103
NOTES: <ol style="list-style-type: none"> 1. Rates and equations are from Trip Generation, 10th Edition, Institute of Transportation Engineers, 2017. 2. Number of Dwelling Units for Residential 3. Rates are 'vehicles per hour per unit'; trips generated are 'vehicles per hour for peak hours'. 4. Refer to Appendix B for more detail on school trip calculations. 											

Increased Transit and Active Transportation

The normal trip generation rates are measured in suburban areas, typically with lower transit and active transportation use. This study area is well-positioned to take advantage of improving transit service and active transportation connections proposed in the *Integrated Mobility Plan*. This will reduce the number of vehicle trips generated by each type of land use. Although the Integrated Mobility Plan strives for 25% of generated trips to use non-vehicle modes of travel, a more conservative reduction of 15% has been applied for this study.

Trips to Neighbourhood Office/Commercial Site

The proposed office/commercial site is small enough that it can be expected many of the trips into and out of the site, for the commercial use(s) in particular, will originate from within the study area. To prevent a single trip from being counted twice (generated once by the residential unit and again by the commercial site) the total number of trips generated by the commercial site is reduced. For this analysis, an assumption of 40% of all trips to the commercial site originating from within the study area was made based on knowledge of other similar sites in the region. No reduction was made for the office use.

Trips to School Site

Similar to the office/commercial site, a school site will generate trips that originate from both inside and outside of the study area. A site survey of a nearby proxy school (Bedford South Elementary School) was used to gauge the characteristics of trips entering and leaving the site. It was determined that during the morning peak, 50% of all trips would

be school staff entering the site from outside of the study area, 40% of trips would be student “drop-off” trips originating from a home within the study area and destined to a location outside of the study area, and 10% of trips would be student “drop-off” trips that leave from a home in the study area and return to that home. More details on the site survey and the school trip analysis is provided in Appendix B.

Size of the School

Although a site will be set aside in the future for a local school, the exact size and type of school will not be determined until a later date. To develop a reasonable assumption of trip generation, an elementary school with a student population of 450 has been assumed. For comparative purposes, the sizes of other schools in the area are shown in Table 4. In addition to some new collector area, this school would likely result in redistribution of some of the Bedford South collection area, resulting in a single school with a student population of about 600 becoming two schools each with a student population of 450. To be conservative, no trip reduction for the Bedford South Elementary School has been assumed.

Table 4 – Typical School Sizes in the Vicinity of the Site

School	Students (2018)
Basinview Drive	620
Kingswood	616
Bedford South	612
Rockingham	491
Sunnyside	287
Bedford & Forsythe	256
Michael Wallace	180

Source: hrce.ca/about-our-schools

Trip Distribution and Assignment

Primary site trips generated by the proposed development were assigned to the roadway network based on counted volumes and local knowledge of the area considering major trip origins and destinations in the region. Some guidance was also taken from previous studies that considered trip distribution in this area (Table 5). Separate trip distribution assumptions were made for Scenario One (Figure 3) and Scenario Two (Figure 4). Trip distribution characteristics for Area B1 were assumed to be the same as for Area A.

Table 5 – Trip Distribution Estimates from Previous Studies

	To/From Hammonds Plains Road	To/From Bedford Hwy then north	To/From Bedford Hwy then south	To/From Larry Uteck Blvd
Beasy Nicoll 1990	40%	34%	26%	N/A
Streetwise 1994	50%	30%	20%	N/A
ARTM 2005	N/A	65%	35%	N/A
DesignPoint 2016	N/A	50%		50%

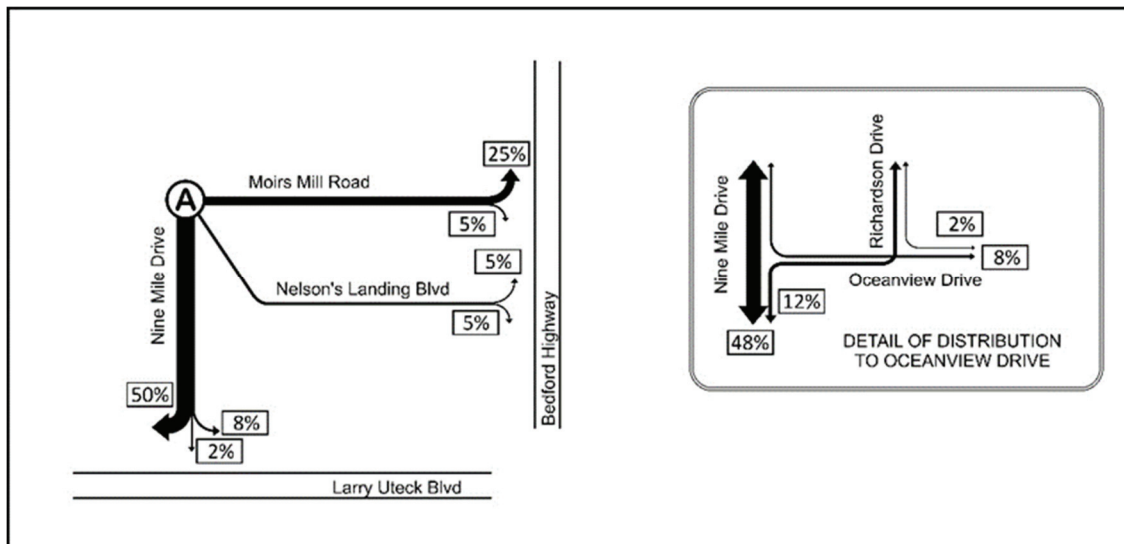


Figure 3 – Trip Distribution Assumptions – Scenario One

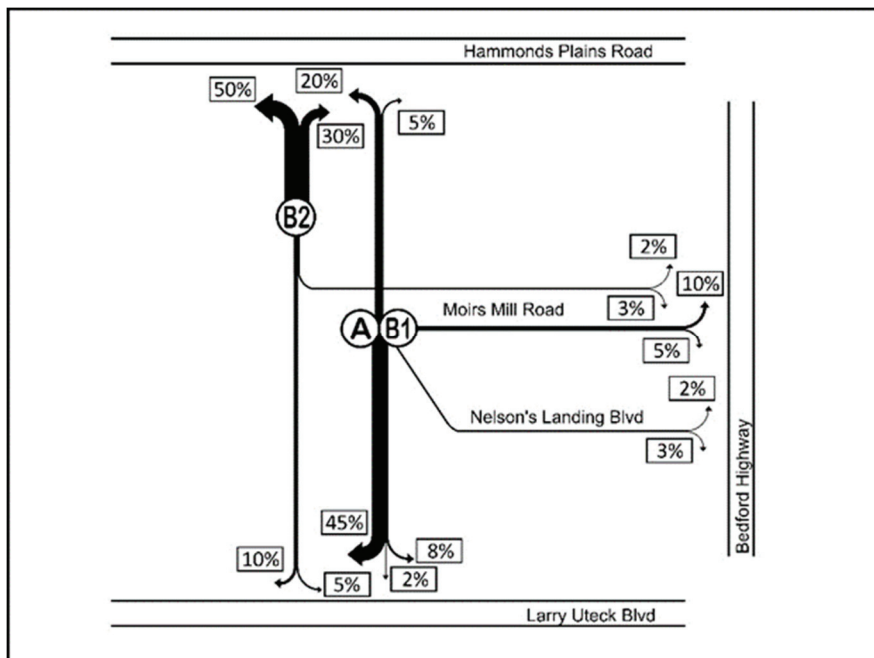


Figure 4 – Trip Distribution Assumptions – Scenario Two

Redistributing Background Traffic

The creation of a new connections to the regional roadway network will result in shifting of existing traffic to new routes. Two redistribution scenarios have been included in the analysis, described below and illustrated in Figure 5.

Redistribution #1

Some traffic currently generated on Moirs Mill Road and streets that connect to it access Larry Uteck Boulevard via Amin Street and Oceanview Drive. In Scenarios One and

Two, Moirs Mill Road is connected to Nine Mile Drive and a new connection is made to Oceanview Drive via Richardson Drive. Both of these new connections provide a more direct route to Larry Uteck Boulevard and can both be expected to attract traffic away from Amin Street and Oceanview Drive. The volume of traffic assumed to be redistributed is 600 vehicles per day or approximately 34% of the traffic currently on Amin Street, split evenly between the two optional routes.

Redistribution #2

A new connection to Hammonds Plains Road via Nine Mile Drive in Scenario Two can be expected to shift current traffic patterns. For this assessment, it was assumed that 20% of traffic currently using Moirs Mill Road to access the Bedford Highway and 10% of traffic using Nelson's Landing Boulevard will be shifted to this new connector.

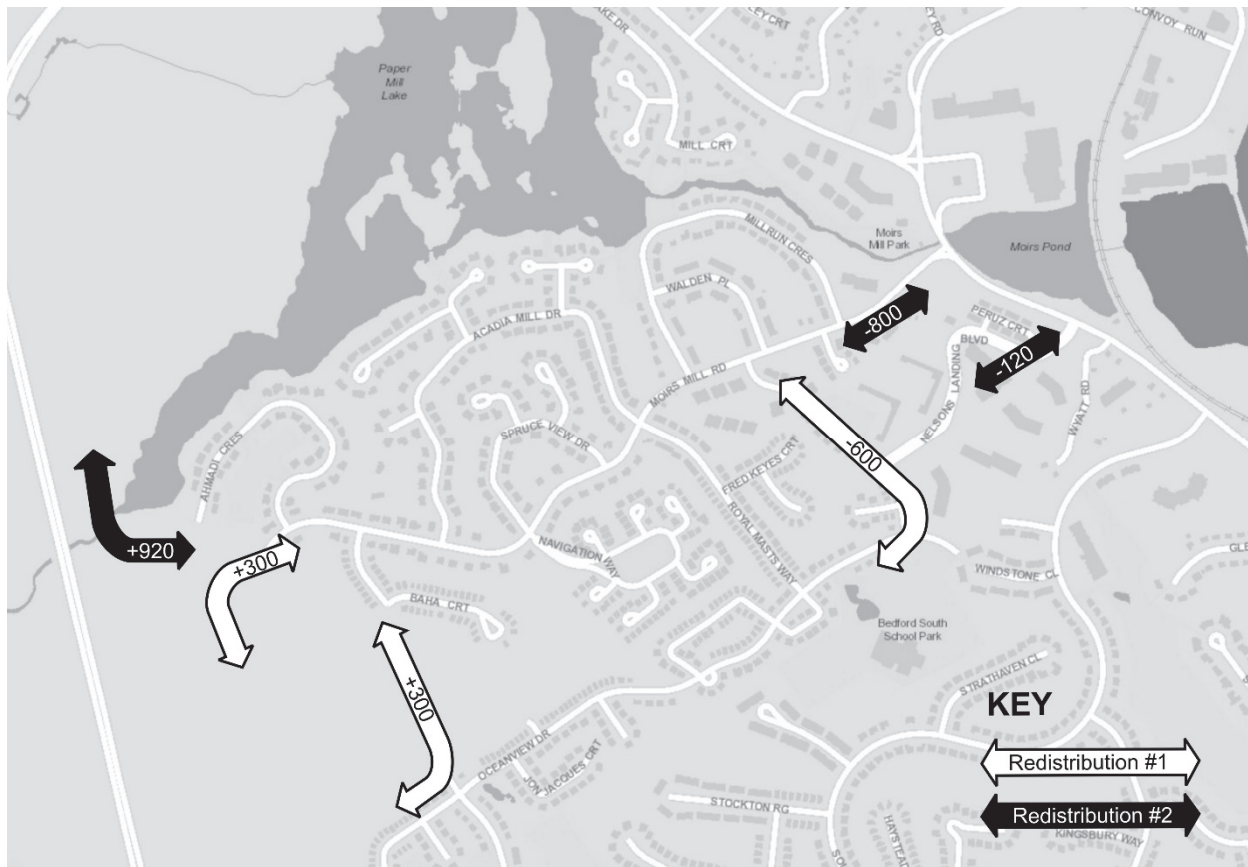


Figure 5 – Redistribution of Existing Traffic to New Connections

Projected Traffic Volumes that Include Site Generated Trips

Trips generated by the proposed development (Figure A-2, Appendix A) have been added to the projected background volumes (Figure A-1, Appendix A) to provide projected AM and PM peak hourly and daily traffic volumes, illustrated diagrammatically in Figure A-3, Appendix A.

4 INTERSECTION OPERATIONAL ANALYSIS

Daily Volumes by Street Classification

HRM's Municipal Guidelines specify that 3,000 vehicles per day is characteristic of a Local Street. It further suggests that Collector Streets normally accommodate up to 12,000 vehicles per day while Major Collector Streets may exceed a daily volume of 12,000. Projected daily volumes for the key study area streets are summarized in Table 6.

Table 6 – Two-way Daily Volumes on Key Collector and Local Streets

Street	Classification	Existing	Scenario One	Scenario Two
Moirs Mill Rd (W of Bedford Hwy)	Collector	4,100	4,550	3,700
Moirs Mill Rd (E of Nine Mile Dr)	Collector	0	800	1,700
Nelsons Landing Blvd	Local	1,150	1,350	1,200
Oceanview Dr (W of Amin Street)	Local	1,750	1,150	1,200
Oceanview Dr (E of Nine Mile Dr)	Local	3,250	3,450	3,800
Nine Mile Dr (S of Oceanview Dr)	Collector	4,700	4,700	5,750
Nine Mile Dr (S of Hammonds Pl Rd)	Collector	0	0	4,200
Richardson Drive	Local	0	550	500

Moirs Mill Road

Volumes on Moirs Mill Road remain within the normal range of a collector street. In the original *Paper Mill Lake Area Traffic Impact Study* (Streetwise Traffic Engineering, 1994) that led to the establishment of the 100-lot limit for this area, a maximum volume of 5,000 vehicles per day was set for Moirs Mill Road. While this limit may no longer have status for the municipality, it is comforting to see that volumes nonetheless remain below this threshold due to the additional connection to Larry Uteck Boulevard that was not anticipated in the original study.

Nelsons Landing Boulevard

Little increase to volume on Nelsons Landing Boulevard is expected and volumes remain well below the normal local street volumes.

Oceanview Drive

Portions of Oceanview Drive currently exceed the characteristic 3,000 vehicle daily volume for a local street and that volume is expected to increase by about 800 vehicles per day at the Nine Mile Drive end under Scenario One. Volume will be well below current levels in the section near Amin Street in both Scenarios One and Two due to better connections being made to Nine Mile Drive for Moirs Mill Road traffic. Increasing delay at the Nelsons Landing Boulevard intersection at the Bedford Highway along with traffic calming measures on Oceanview Drive being considered by HRM may reduce this volume even further.

Nine Mile Drive

Daily volumes on Nine Mile Drive for full build-out (Scenario Two) are projected to range between 4,000 and 6,000. The street can be expected to operate successfully as a two-lane Collector Street with these volumes.

**Intersection
Capacity
Analysis
Results**

Synchro 10.0 (signalized and stop control intersections) and *SIDRA* (roundabout intersection) have been used for performance evaluation of Study Area intersections for projected design hourly volumes without and with the addition of Scenario One site generated trips. Analysis results are included in Appendix A and summarized in Tables 7 to 9 below and indicate that all movements at all three intersections are expected to operate within HRM Guidelines without and with the addition of traffic generated by Scenario One.

Moirs Mill Rd/Bedford Hwy (Table 7) – Overall performance at the intersection is expected to be satisfactory both without and with the addition of site generated trips. All movements are expected to operate within HRM acceptable limits.

Table 7 – Intersection Capacity Moirs Mill Rd/Bedford Hwy (Scenario One)

LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement				Overall Intersection
	Moirs Mill Road		Bedford Highway		
	EB-L	EB-R	NB-LT	SB-TR	Delay
AM Design Hourly Volumes without Site Generated Trips					
Delay	50.3	10.9	6.7	6.3	12.8
v/c	0.69	0.14	0.35	0.35	
Queue	58.2	8.3	48.5	47.8	
AM Design Hourly Volumes with Site Generated Trips					
Delay	49.9	11.5	7.4	6.9	13.9
v/c	0.72	0.15	0.36	0.36	
Queue	63.4	9.3	52.4	51.8	
PM Design Hourly Volumes without Site Generated Trips					
Delay	56.7	15.8	6.7	7.2	10.6
v/c	0.64	0.09	0.49	0.57	
Queue	49.3	6.7	71.0	96.9	
PM Design Hourly Volumes with Site Generated Trips					
Delay	56.6	14.8	7.6	8.1	11.7
v/c	0.67	0.10	0.53	0.60	
Queue	54.1	7.1	78.9	108.5	

Nelsons Landing Boulevard (Table 8) – Delay at the stop-controlled leg of this intersection is currently high, particularly in the PM peak. As expected, that delay will increase with additional site-generated traffic. This intersection could be evaluated for possible signalization, it does not meet the volume threshold in the signalization warrant (75 vehicles per hour approaching) and signalization would work contrary to the aim of minimizing volumes on the local streets that feed the intersection. Maintaining status quo as a deterrent to high use of this connection is recommended and is similar to several other stop-controlled intersections on major roadways (including along the Bedford Highway).

Nine Mile Drive/Larry Uteck (Table 9) – Overall performance at this roundabout intersection is expected to be satisfactory both without and with the addition of site generated trips, all movements are expected to operate within HRM acceptable limits.

**Intersection
Capacity
Analysis
Results
(Continued)**

Table 8 – Intersection Capacity: Nelsons Landing Blvd/Bedford Hwy (Scenario One)

LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement					Overall Intersection
	Nelsons Landing Boulevard		Bedford Highway			
	EB-L	EB-R	NB-L	NB-T	SB-TR	Delay
AM Design Hourly Volumes without Site Generated Trips						
Delay	28.2	12.0	8.7	0.0	0.0	1.6
v/c	0.20	0.09	0.04	0.33	0.32	
Queue	5.4	2.2	0.9	0.0	0.0	
AM Design Hourly Volumes with Site Generated Trips						
Delay	29.8	12.1	8.8	0.0	0.0	1.8
v/c	0.23	0.10	0.04	0.33	0.33	
Queue	6.5	2.4	1.0	0.0	0.0	
PM Design Hourly Volumes without Site Generated Trips						
Delay	102.3	15.4	10.3	0.0	0.0	1.7
v/c	0.38	0.09	0.05	0.52	0.50	
Queue	10.7	2.2	1.3	0.0	0.0	
PM Design Hourly Volumes with Site Generated Trips						
Delay	124.4	15.6	10.4	0.0	0.0	2.2
v/c	0.48	0.10	0.06	0.53	0.50	
Queue	13.6	2.4	1.5	0.0	0.0	

Table 9 – Intersection Capacity: Nine Mile Drive/Larry Uteck Blvd (Scenario One)

LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement												Overall Intersection
	Larry Uteck Boulevard						Starboard Drive			Nine Mile Drive			
	EB-L	EB-T	EB-R	WB-L	WB-T	WB-R	NB-L	NB-T	NB-R	SB-L	SB-T	SB-R	Delay
AM Design Hourly Volumes without Site Generated Trips													
Delay	11.2	3.8	3.8	14.2	6.5	6.4	12.3	5.9	6.0	14.2	6.9	6.2	8.1
v/c	0.33	0.33	0.33	0.47	0.47	0.47	0.44	0.20	0.20	0.25	0.25	0.30	
Queue	13.0	13.0	13.0	21.0	22.0	22.0	17.0	6.0	6.0	8.0	8.0	11.0	
AM Design Hourly Volumes with Site Generated Trips													
Delay	11.2	3.8	3.9	14.5	6.8	6.6	12.4	6.0	6.1	14.4	7.1	6.6	8.3
v/c	0.34	0.34	0.34	0.48	0.48	0.48	0.45	0.21	0.21	0.28	0.28	0.37	
Queue	13.0	14.0	14.0	22.0	23.0	23.0	18.0	6.0	6.0	9.0	9.0	14.0	
PM Design Hourly Volumes without Site Generated Trips													
Delay	12.7	5.1	5.2	19.1	11.0	10.7	16.6	8.3	8.4	14.3	6.8	6.3	10.6
v/c	0.60	0.60	0.60	0.57	0.57	0.57	0.68	0.44	0.44	0.29	0.29	0.29	
Queue	33.0	33.0	33.0	31.0	33.0	33.0	38.0	17.0	17.0	10.0	11.0	11.0	
PM Design Hourly Volumes with Site Generated Trips													
Delay	13.2	5.6	5.6	21.1	12.8	12.4	17.6	8.9	9.0	14.6	7.1	6.4	11.4
v/c	0.63	0.63	0.63	0.61	0.61	0.61	0.71	0.46	0.46	0.33	0.33	0.33	
Queue	37.0	37.0	37.0	35.0	38.0	38.0	41.0	18.0	18.0	12.0	13.0	13.0	

Analysis uses an Environmental factor of 1.2 for all approaches.

**Internal
Unsignalized
Intersections**

Although it is not practical to undertake a microscopic projection of turning movements at internal intersections, the projected corridor volumes provide a good sense of what intersection control might be required.

Nine Mile Drive at Moirs Mill Road – With a total daily volume in the range of 6,000 at this intersection and traffic on Nine Mile being about twice the volume on Moirs Mill Road, this intersection is well suited to all-way stop control. With this type of control, a single lane approach on each leg is appropriate.

Nine Mile Drive at Oceanview Drive – This intersection is similar to the previous intersection, although directional volumes will be even more balanced. Again, all-way stop control is anticipated with single lane approaches in all directions.

Oceanview Drive at Richardson Drive – Volumes here dictate stop control on the Richardson Drive approach. Volumes turning left onto Richardson Drive are expected to be too low to warrant a left turn storage lane on Oceanview Drive. On-street parking controls within proximity of the intersection will improve operation.

5 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 SUMMARY

Description of the Proposed Development	<p>1. Consideration is being given to allowing addition development within an existing RCDD zone in the Paper Mill Lake area. The expansion is proposed to include:</p> <ul style="list-style-type: none">• 185 single family residential units;• 6,000 square feet of leasable neighbourhood retail floor space; and,• 6,000 square feet of office floor space. <p>The conditions of the Development Agreement currently limit the number of lots that can be developed based on the volume of traffic that would be placed on collector and local streets in the area.</p>
Access to the Development Area	<p>2. Vehicular access to the area currently consists of connections to the Bedford Highway via Moirs Mill Road and Nelsons Landing Boulevard and to Larry Uteck Boulevard via Nine Mile Drive. When the original Development Agreement was put in place, this latter connection was not available. An additional scenario was considered in this assessment whereby a fourth connection is established northward to Hammonds Plains Road via an extension of Nine Mile Drive.</p>
Study Area Roads	<p>3. Traffic on several streets in the area was considered. Volumes were evaluated for Moirs Mill Road (collector), Nine Mile Drive (collector), Nelsons Landing Boulevard (local), Oceanview Drive (local) and Richardson Drive (local).</p>
Background Traffic Volumes	<p>4. Projected future weekday AM and PM peak hour background volumes were estimated using growth rate of 5%. With an annual traffic growth on 0.5% being typical in this area, 5% represents a development horizon of approximately ten years. An overall growth rate of 1% was used for streets internal to the study area.</p>
Estimation of Site Generated Trips	<p>5. Trip generation estimates, were prepared using rates published in <i>Trip Generation, 10th Edition</i> (Institute of Transportation Engineers, Washington, 2017). Modifications were made to consider the effects of transit and active transportation as well as synergies within the development area.</p>
Trip Distribution and Assignment	<p>6. Primary vehicle trips generated by the development have been assigned to study area streets and intersections based on observation, field survey, local knowledge and previous traffic assessments in the area.</p>
Development Scenarios	<p>7. Two development scenarios were created for this assessment. Scenario One represents the currently proposed development and its impact on the street network with its existing configuration. Scenario Two was considered to help determine longer term traffic patterns and the functional requirement of Nine Mile Drive as a completed connection between Larry Uteck Boulevard and Hammonds Plains Road.</p>

<i>Volumes on Local and Collector Streets</i>	8. Traffic volumes on all streets are consistent with the suggested characteristics of their street classification with the exception of Oceanview Drive. Both existing and projected volumes on this street are slightly above the suggested upper volume of 3,000 vehicles per day for section of the street near Nine Mile Drive. Volumes on Richardson Drive are not expected to be of a magnitude that exceed a local street.
<i>Summary – Intersection Capacity Analysis</i>	9. The existing Bedford Highway intersections at Moirs Mill Road and at Nelsons Landing Boulevard, along with the Nine Mile Drive/Larry Uteck Boulevard roundabout will continue to operate within their capacity with the addition of traffic from the proposed development. The unsignalized approach at Nelsons Landing Boulevard and the Bedford Highway currently experiences high delays on the stop-controlled approach and this will increase with added traffic from the development. All intersections are expected to continue to operate within HRM Guidelines.

5.2 RECOMMENDATIONS

<i>Nelsons Landing Boulevard Intersection</i>	10. Although signalization may reduce delays on Nelsons Landing Boulevard, the volume is lower than the warrant threshold (75 per hour) and signalization is neither desirable nor recommended as it would increase the attractiveness of the local street connections to it. As Moirs Mill Road provides an alternative signalized connection to the Bedford Highway with adequate capacity, higher delays at Nelson's Landing Boulevard should not be considered problematic.
<i>Oceanview Drive</i>	11. Although two-way traffic volumes on Oceanview Drive are above the 3,000 daily vehicle characteristic for a local street, they are not significantly above this level and will not increase substantially with the addition of development site traffic. Traffic calming measures and increasing delay on Nelsons Landing Boulevard will help to moderate this volume. Furthermore, future extension of Nine Mile Drive to Hammonds Plains Road will ultimately result in a slight reduction in Oceanview Drive volume.
<i>Nine Mile Drive</i>	12. Nine Mile Drive can be expected to carry traffic volumes at full build-out of the Paper Mill Lake area not in excess of 6,000 vehicles per day. This is suited to a two-lane collector roadway standard.
<i>Public Transit and Active Transportation</i>	13. Continue to develop the Bedford Highway as a corridor for both transit and active transportation. The study area has good connectivity to this corridor and the development area can be expected to produce high percentages of transit and active transportation trips.

5.3 CONCLUSIONS

<i>Impacts to Vehicular Traffic</i>	14. With implementation of recommendations above, trips generated by Scenario One site development are not expected to have a significant impact to levels of performance on adjacent intersections or to the regional road network.
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APPENDIX

A

TRAFFIC VOLUME DATA AND INTERSECTION PERFORMANCE ANALYSIS



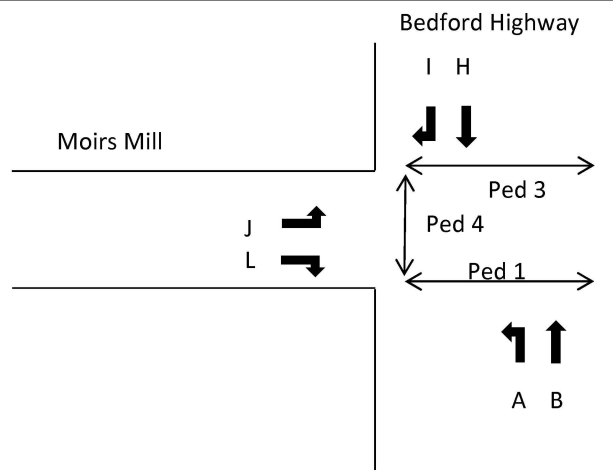
<div>Table A-1</div> <div>Bedford Highway @ Moirs Mill</div> <div>Bedford, NS</div> <div>Wednesday, November 7, 2018</div>		<div><div><div>Bedford Highway</div><div>I H</div><div><div><div></div><div></div></div></div><div><div>Moirs Mill</div><div>J L</div><div><div></div><div></div></div></div><div><div>Ped 3</div><div>Ped 4</div><div>Ped 1</div><div>A B</div></div></div></div>																																																																																																																																																		
		<div>AM Peak Period Volume Data</div> <table><tr><th colspan="2" rowspan="2">Time</th><th colspan="2">Bedford Highway Northbound Approach</th><th colspan="2">Bedford Highway Southbound Approach</th><th colspan="2">Moirs Mill Eastbound Approach</th><th rowspan="2">Total Vehicles</th></tr><tr><th>A</th><th>B</th><th>H</th><th>I</th><th>J</th><th>L</th></tr><tr><td>07:00</td><td>07:15</td><td>2</td><td>83</td><td>92</td><td>5</td><td>30</td><td>8</td><td>220</td></tr><tr><td>07:15</td><td>07:30</td><td>3</td><td>92</td><td>76</td><td>11</td><td>41</td><td>13</td><td>236</td></tr><tr><td>07:30</td><td>07:45</td><td>0</td><td>117</td><td>98</td><td>15</td><td>42</td><td>9</td><td>281</td></tr><tr><td>07:45</td><td>08:00</td><td>3</td><td>119</td><td>101</td><td>26</td><td>41</td><td>11</td><td>301</td></tr><tr><td>08:00</td><td>08:15</td><td>4</td><td>117</td><td>107</td><td>27</td><td>38</td><td>11</td><td>304</td></tr><tr><td>08:15</td><td>08:30</td><td>4</td><td>122</td><td>120</td><td>31</td><td>58</td><td>8</td><td>343</td></tr><tr><td>08:30</td><td>08:45</td><td>2</td><td>125</td><td>115</td><td>18</td><td>58</td><td>9</td><td>327</td></tr><tr><td>08:45</td><td>09:00</td><td>5</td><td>157</td><td>114</td><td>29</td><td>40</td><td>14</td><td>359</td></tr><tr><td colspan="2">AM Peak Hour</td><td>15</td><td>521</td><td>456</td><td>105</td><td>194</td><td>42</td><td>1333</td></tr><tr><td>07:00</td><td>08:00</td><td>8</td><td>411</td><td>367</td><td>57</td><td>154</td><td>41</td><td>1038</td></tr><tr><td>08:00</td><td>09:00</td><td>15</td><td>521</td><td>456</td><td>105</td><td>194</td><td>42</td><td>1333</td></tr><tr><td colspan="2"></td><td colspan="2">Ped 1</td><td colspan="2">Ped 3</td><td colspan="2">Ped 4</td><td>Total Peds</td></tr><tr><td>07:00</td><td>08:00</td><td colspan="2">12</td><td colspan="2">0</td><td colspan="2">7</td><td>19</td></tr><tr><td>08:00</td><td>09:00</td><td colspan="2">13</td><td colspan="2">0</td><td colspan="2">19</td><td>32</td></tr></table>								Time		Bedford Highway Northbound Approach		Bedford Highway Southbound Approach		Moirs Mill Eastbound Approach		Total Vehicles	A	B	H	I	J	L	07:00	07:15	2	83	92	5	30	8	220	07:15	07:30	3	92	76	11	41	13	236	07:30	07:45	0	117	98	15	42	9	281	07:45	08:00	3	119	101	26	41	11	301	08:00	08:15	4	117	107	27	38	11	304	08:15	08:30	4	122	120	31	58	8	343	08:30	08:45	2	125	115	18	58	9	327	08:45	09:00	5	157	114	29	40	14	359	AM Peak Hour		15	521	456	105	194	42	1333	07:00	08:00	8	411	367	57	154	41	1038	08:00	09:00	15	521	456	105	194	42	1333			Ped 1		Ped 3		Ped 4		Total Peds	07:00	08:00	12		0		7		19	08:00	09:00	13		0		19
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* Count completed by WSP

Table A-2
Bedford Highway
@
Nelsons Landing Boulevard

Bedford, NS

Wednesday, November 7, 2018



AM Peak Period Volume Data

Time	Bedford Highway Northbound Approach		Bedford Highway Southbound Approach		Nelsons Landing Boulevard Eastbound Approach		Total Vehicles
	A	B	H	I	J	L	
07:00 07:15	2	82	108	1	7	12	212
07:15 07:30	5	89	90	4	8	5	201
07:30 07:45	1	98	98	3	12	7	219
07:45 08:00	6	115	116	6	8	7	258
08:00 08:15	9	111	108	5	9	10	252
08:15 08:30	14	123	117	5	3	12	274
08:30 08:45	11	111	127	5	11	17	282
08:45 09:00	2	146	112	4	12	6	282
AM Peak Hour	36	491	464	19	35	45	1090
07:00 08:00	14	384	412	14	35	31	890
08:00 09:00	36	491	464	19	35	45	1090
	Ped 1		Ped 3		Ped 4		Total Peds
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08:00 09:00	0		5		4		9

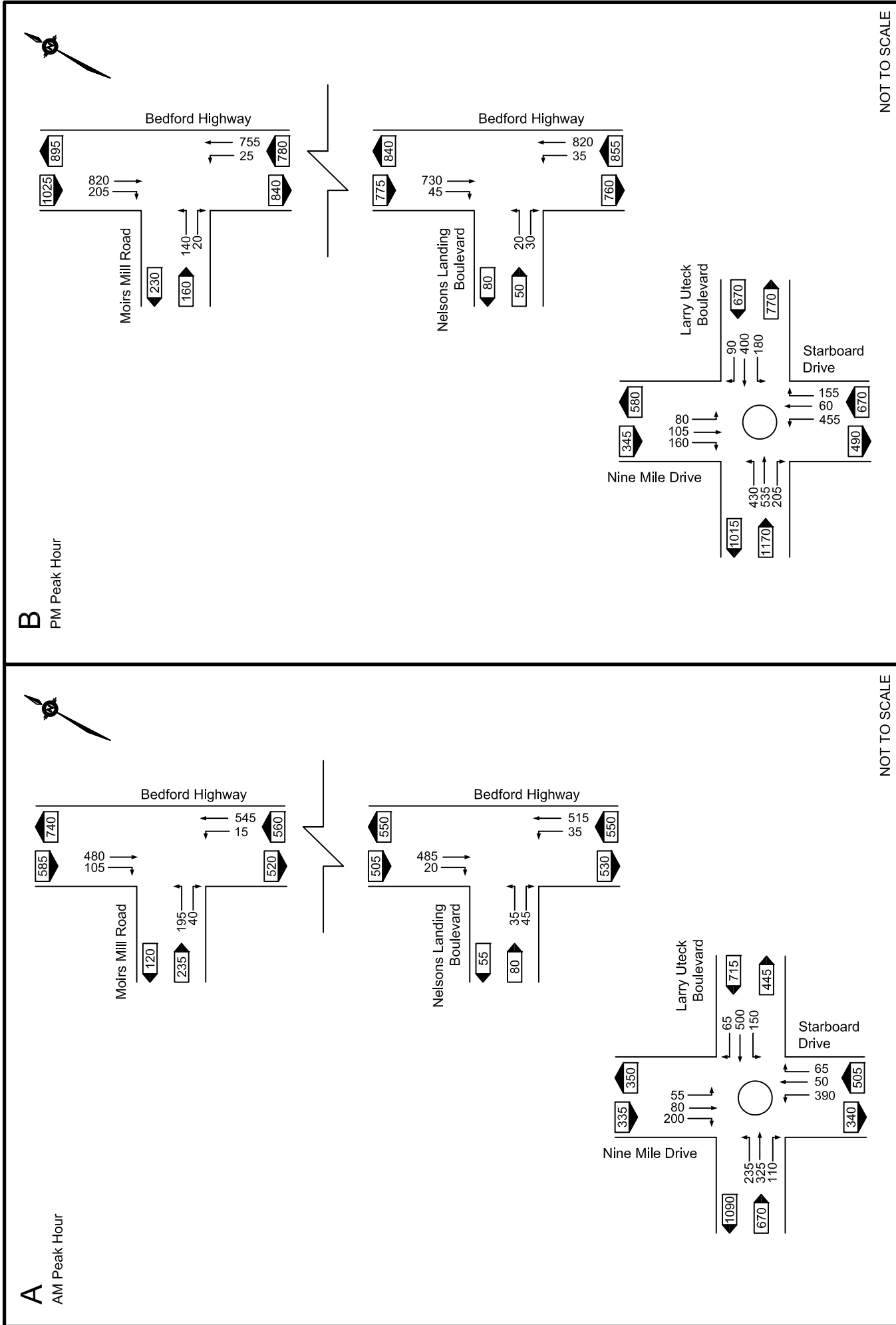
PM Peak Period Volume Data

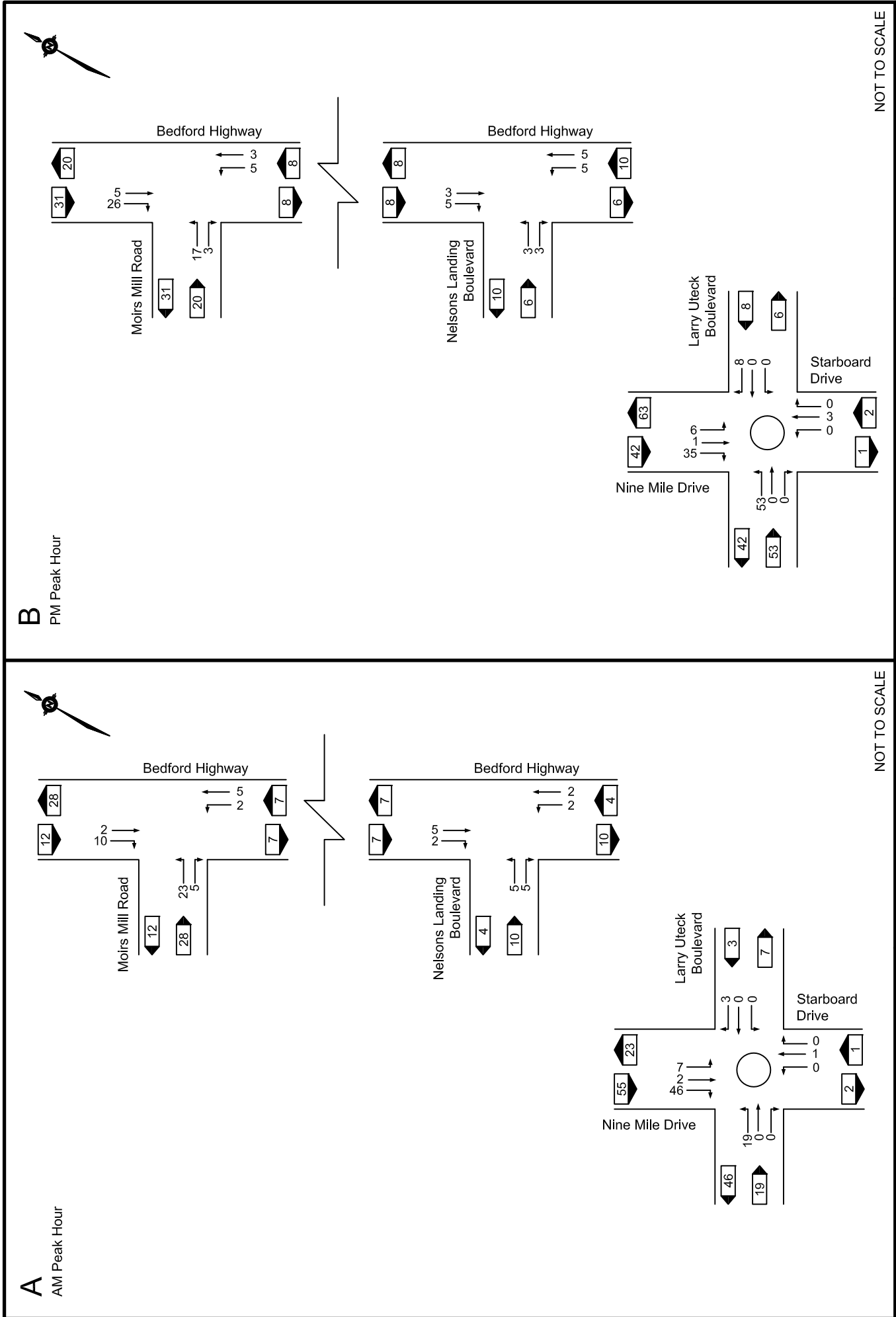
Time	Bedford Highway Northbound Approach		Bedford Highway Southbound Approach		Nelsons Landing Boulevard Eastbound Approach		Total Vehicles
	A	B	H	I	J	L	
16:00 16:15	9	202	151	7	8	7	384
16:15 16:30	11	211	166	11	4	6	409
16:30 16:45	11	183	179	5	7	14	399
16:45 17:00	7	204	178	8	4	8	409
17:00 17:15	7	182	171	22	4	4	390
17:15 17:30	12	179	172	10	6	10	389
17:30 17:45	6	182	161	16	1	12	378
17:45 18:00	15	152	145	8	7	5	332
PM Peak Hour	36	780	694	46	19	32	1607
16:00 17:00	38	800	674	31	23	35	1601
17:00 18:00	40	695	649	56	18	31	1489
	Ped 1		Ped 3		Ped 4		Total Peds
16:00 17:00	0		19		10		29
17:00 18:00	0		18		6		24

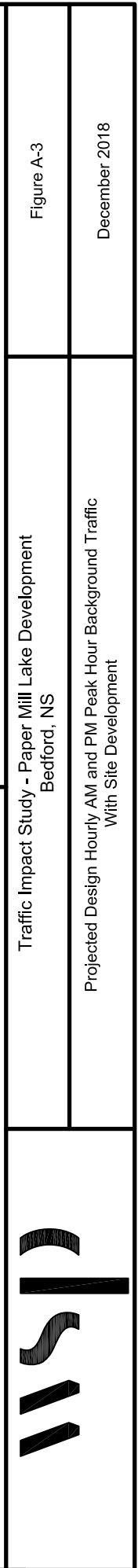
* Count completed by WSP

<div>Table A-3</div> <div>Larry Uteck Boulevard</div> <div>@</div> <div>Nine Mile Drive / Starboard Drive</div> <div>Bedford, NS</div> <div>Thursday, November 15, 2018</div>				<div><div><div><div><div></div><div></div><div></div></div><div><div>J</div><div>K</div><div>L</div></div></div><div><div><div></div><div></div><div></div></div><div><div>Ped 3</div><div>Ped 4</div><div>Ped 2</div><div>Ped 1</div></div></div><div><div><div></div><div></div><div></div></div><div><div>A</div><div>B</div><div>C</div></div></div></div><div><div><div></div><div></div><div></div></div><div><div>I</div><div>H</div><div>G</div></div></div><div><div><div></div><div></div><div></div></div><div><div>F</div><div>E</div><div>D</div></div></div></div> <div>Nine Mile Drive</div> <div>Larry Uteck Boulevard</div> <div>Starboard Drive</div>										
AM Peak Period Volume Data														
Time		Starboard Drive Northbound Approach			Larry Uteck Boulevard Westbound Approach			Nine Mile Drive Southbound Approach			Larry Uteck Boulevard Eastbound Approach			Total Vehicles
		A	B	C	D	E	F	G	H	I	J	K	L	
07:00	07:15	58	5	11	24	81	7	5	13	43	21	45	22	335
07:15	07:30	87	10	12	31	110	8	6	8	61	35	50	12	430
07:30	07:45	96	11	10	30	103	11	7	11	56	40	66	20	461
07:45	08:00	86	14	12	25	111	11	12	23	52	42	98	20	506
08:00	08:15	97	9	18	47	134	18	8	12	50	56	70	25	544
08:15	08:30	105	10	13	26	122	21	17	20	47	55	73	33	542
08:30	08:45	99	16	11	37	123	14	11	25	69	63	78	25	571
08:45	09:00	85	13	21	38	95	13	17	24	34	61	87	25	513
AM Peak Hour		386	48	63	148	474	66	53	81	200	235	308	108	2170
07:00	08:00	327	40	45	110	405	37	30	55	212	138	259	74	1732
08:00	09:00	386	48	63	148	474	66	53	81	200	235	308	108	2170
		Ped 1			Ped 2			Ped 3			Ped 4			Total Peds
07:00	08:00	1			1			0			5			7
08:00	09:00	2			2			1			4			9
PM Peak Period Volume Data														
Time		Starboard Drive Northbound Approach			Larry Uteck Boulevard Westbound Approach			Nine Mile Drive Southbound Approach			Larry Uteck Boulevard Eastbound Approach			Total Vehicles
		A	B	C	D	E	F	G	H	I	J	K	L	
16:00	16:15	109	25	40	50	92	18	11	21	28	83	121	42	640
16:15	16:30	126	17	20	42	87	24	20	29	39	107	121	54	686
16:30	16:45	119	16	44	46	91	18	14	25	41	118	124	50	706
16:45	17:00	113	11	43	40	103	21	21	26	47	99	141	54	719
17:00	17:15	92	16	44	49	102	25	25	25	31	102	124	46	681
17:15	17:30	93	15	36	46	62	18	18	12	31	108	144	55	638
17:30	17:45	96	9	35	36	93	22	18	19	32	94	133	48	635
17:45	18:00	84	8	36	40	88	19	13	19	32	70	127	44	580
PM Peak Hour		450	60	151	177	383	88	80	105	158	426	510	204	2792
16:00	17:00	467	69	147	178	373	81	66	101	155	407	507	200	2751
17:00	18:00	365	48	151	171	345	84	74	75	126	374	528	193	2534
		Ped 1			Ped 2			Ped 3			Ped 4			Total Peds
16:00	17:00	12			14			5			5			36
17:00	18:00	3			2			1			6			12

* Count completed by WSP







Daily Traffic Volume Projections

Table A1 - Two-Way Traffic Volumes – Scenario One











Street Location	Background Traffic	Background Traffic Growth	Redistribution #1	Site Generated Traffic	Total
Moirs Mill Road (west of Bedford Hwy)	4019	40		512	4571
Moirs Mill Road (at Nine Mile Dr)	0	0	+300	512	812
Nelson's Landing Boulevard	1174	12		171	1357
Oceanview Drive (west of Amin Street)	1740	17	-600	171	1157
Oceanview Drive (east of Nine Mile Dr.)	3226	32	-300	469	3427
Nine Mile Drive (south of Oceanview Dr)	3624	36		1024	4684
Richardson Drive	0	0	+300	250	550

Table A2 - Two-Way Traffic Volumes – Scenario Two

Street Location	Backgrnd Traffic	Backgrnd Traffic Growth	Redist #1	Redist #2	Internal School Trips	Site Generated Traffic	Total
Moirs Mill Road (west of Bedford Hwy)	4019	40		-800		457	3707
Moirs Mill Road (at Nine Mile Dr)	0	0	+300	+920	+50	457	1718
Nelson's Landing Boulevard	1174	12		-120		151	1217
Oceanview Drive (west of Amin Street)	1740	17	-600	-120		151	1188
Oceanview Drive (east of Nine Mile Dr.)	3226	32	-300			842	3791
Nine Mile Drive (south of HamPlns Rd)	0	0		+920		3388	4171
Nine Mile Drive (south of Oceanview Dr)	3624	36				2125	5759
Richardson Drive	0	0	+300			188	488

Papermill Lake TIS
1: Bedford Highway & Moirs Mill Road

Page A-8
AM Design Hourly Volumes without Site Generated Trips



						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	195	40	15	545	480	105
Future Volume (vph)	195	40	15	545	480	105
Satd. Flow (prot)	1789	1601	0	2634	2566	0
Flt Permitted	0.950			0.924		
Satd. Flow (perm)	1789	1601	0	2436	2566	0
Satd. Flow (RTOR)		43			30	
Lane Group Flow (vph)	212	43	0	608	636	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	2	
Permitted Phases		4	2			
Total Split (s)	35.0	35.0	65.0	65.0	65.0	
Total Lost Time (s)	6.0	6.0		5.5	5.5	
Act Effect Green (s)	17.1	17.1		71.4	71.4	
Actuated g/C Ratio	0.17	0.17		0.71	0.71	
v/c Ratio	0.69	0.14		0.35	0.35	
Control Delay	50.3	10.9		6.7	6.3	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	50.3	10.9		6.7	6.3	
LOS	D	B		A	A	
Approach Delay	43.7			6.7	6.3	
Approach LOS	D			A	A	
Queue Length 50th (m)	39.0	0.0		27.7	27.3	
Queue Length 95th (m)	58.2	8.3		48.5	47.8	
Internal Link Dist (m)	241.6			32.5	268.6	
Turn Bay Length (m)		25.0				
Base Capacity (vph)	518	494		1738	1839	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.41	0.09		0.35	0.35	

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.69
 Intersection Signal Delay: 12.8
 Intersection Capacity Utilization 64.6%
 Analysis Period (min) 15












Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 1: Bedford Highway & Moirs Mill Road

 Ø2 (R) 65 s	 Ø4 35 s
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Papermill Lake TIS
2: Bedford Highway & Nelsons Landing Boulevard

Page A-9
AM Design Hourly Volumes without Site Generated Trips

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	45	35	515	485	20
Future Volume (Veh/h)	35	45	35	515	485	20
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	49	38	560	527	22
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					252	
pX, platoon unblocked	0.90	0.90	0.90			
vC, conflicting volume	1174	538	549			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1136	426	438			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	80	91	96			
cM capacity (veh/h)	193	563	1005			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	
Volume Total	38	49	38	560	549	
Volume Left	38	0	38	0	0	
Volume Right	0	49	0	0	22	
cSH	193	563	1005	1700	1700	
Volume to Capacity	0.20	0.09	0.04	0.33	0.32	
Queue Length 95th (m)	5.4	2.2	0.9	0.0	0.0	
Control Delay (s)	28.2	12.0	8.7	0.0	0.0	
Lane LOS	D	B	A			
Approach Delay (s)	19.1		0.6		0.0	
Approach LOS	C					
Intersection Summary						
Average Delay			1.6			
Intersection Capacity Utilization			39.1%	ICU Level of Service		A
Analysis Period (min)			15			

Papermill Lake TIS
1: Bedford Highway & Moirs Mill Road

Page A-10
PM Design Hour without Site Generated Trips



						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	140	20	25	755	820	205
Future Volume (vph)	140	20	25	755	820	205
Satd. Flow (prot)	1789	1601	0	2632	2558	0
Flt Permitted	0.950			0.854		
Satd. Flow (perm)	1789	1601	0	2252	2558	0
Satd. Flow (RTOR)		22			34	
Lane Group Flow (vph)	152	22	0	848	1114	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	2	
Permitted Phases		4	2			
Total Split (s)	36.0	36.0	74.0	74.0	74.0	
Total Lost Time (s)	6.0	6.0		5.5	5.5	
Act Effect Green (s)	14.7	14.7		83.8	83.8	
Actuated g/C Ratio	0.13	0.13		0.76	0.76	
v/c Ratio	0.64	0.09		0.49	0.57	
Control Delay	56.7	15.8		6.7	7.2	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	56.7	15.8		6.7	7.2	
LOS	E	B		A	A	
Approach Delay	51.6			6.7	7.2	
Approach LOS	D			A	A	
Queue Length 50th (m)	31.3	0.0		41.5	57.8	
Queue Length 95th (m)	49.3	6.7		71.0	96.9	
Internal Link Dist (m)	241.6			32.5	268.6	
Turn Bay Length (m)		25.0				
Base Capacity (vph)	487	452		1716	1957	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.31	0.05		0.49	0.57	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.64
 Intersection Signal Delay: 10.6
 Intersection Capacity Utilization 74.0%
 Analysis Period (min) 15












Intersection LOS: B
 ICU Level of Service D

Splits and Phases: 1: Bedford Highway & Moirs Mill Road

 Ø2 (R)	 Ø4
74 s	36 s











Papermill Lake TIS
2: Bedford Highway & Nelsons Landing Boulevard

Page A-11
PM Design Hour without Site Generated Trips

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	30	35	820	730	45
Future Volume (Veh/h)	20	30	35	820	730	45
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	33	38	891	793	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh						
Upstream signal (m)					252	
pX, platoon unblocked	0.77	0.77	0.77			
vC, conflicting volume	1784	818	842			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1872	609	641			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	62	91	95			
cM capacity (veh/h)	57	379	723			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	
Volume Total	22	33	38	891	842	
Volume Left	22	0	38	0	0	
Volume Right	0	33	0	0	49	
cSH	57	379	723	1700	1700	
Volume to Capacity	0.38	0.09	0.05	0.52	0.50	
Queue Length 95th (m)	10.7	2.2	1.3	0.0	0.0	
Control Delay (s)	102.3	15.4	10.3	0.0	0.0	
Lane LOS	F	C	B			
Approach Delay (s)	50.1		0.4		0.0	
Approach LOS	F					
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			53.2%	ICU Level of Service		A
Analysis Period (min)			15			

Papermill Lake TIS
1: Bedford Highway & Moirs Mill Road

Page A-12
AM Design Hourly Volumes with Site Generated Trips



						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	218	45	17	550	482	115
Future Volume (vph)	218	45	17	550	482	115
Satd. Flow (prot)	1789	1601	0	2634	2560	0
Flt Permitted	0.950			0.918		
Satd. Flow (perm)	1789	1601	0	2421	2560	0
Satd. Flow (RTOR)		45			33	
Lane Group Flow (vph)	237	49	0	616	649	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	2	
Permitted Phases		4	2			
Total Split (s)	35.0	35.0	65.0	65.0	65.0	
Total Lost Time (s)	6.0	6.0		5.5	5.5	
Act Effct Green (s)	18.5	18.5		70.0	70.0	
Actuated g/C Ratio	0.18	0.18		0.70	0.70	
v/c Ratio	0.72	0.15		0.36	0.36	
Control Delay	49.9	11.5		7.4	6.9	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	49.9	11.5		7.4	6.9	
LOS	D	B		A	A	
Approach Delay	43.4			7.4	6.9	
Approach LOS	D			A	A	
Queue Length 50th (m)	43.5	0.6		30.0	29.7	
Queue Length 95th (m)	63.4	9.3		52.4	51.8	
Internal Link Dist (m)	241.6			32.5	268.6	
Turn Bay Length (m)		25.0				
Base Capacity (vph)	518	496		1693	1800	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.46	0.10		0.36	0.36	

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.72
 Intersection Signal Delay: 13.9
 Intersection Capacity Utilization 65.8%
 Analysis Period (min) 15












Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 1: Bedford Highway & Moirs Mill Road

 Ø2 (R) 65 s	 Ø4 35 s
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Papermill Lake TIS
2: Bedford Highway & Nelsons Landing Boulevard

Page A-13
AM Design Hourly Volumes with Site Generated Trips

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	40	50	37	517	490	22
Future Volume (Veh/h)	40	50	37	517	490	22
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	43	54	40	562	533	24
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh						
Upstream signal (m)					252	
pX, platoon unblocked	0.89	0.89	0.89			
vC, conflicting volume	1187	545	557			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1148	425	438			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	90	96			
cM capacity (veh/h)	187	559	996			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	
Volume Total	43	54	40	562	557	
Volume Left	43	0	40	0	0	
Volume Right	0	54	0	0	24	
cSH	187	559	996	1700	1700	
Volume to Capacity	0.23	0.10	0.04	0.33	0.33	
Queue Length 95th (m)	6.5	2.4	1.0	0.0	0.0	
Control Delay (s)	29.8	12.1	8.8	0.0	0.0	
Lane LOS	D	B	A			
Approach Delay (s)	20.0		0.6		0.0	
Approach LOS	C					
Intersection Summary						
Average Delay			1.8			
Intersection Capacity Utilization			40.7%	ICU Level of Service		A
Analysis Period (min)			15			

Papermill Lake TIS
1: Bedford Highway & Moirs Mill Road

Page A-14
PM Design Hour with Site Generated Trips



						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	157	23	30	758	825	231
Future Volume (vph)	157	23	30	758	825	231
Satd. Flow (prot)	1789	1601	0	2632	2550	0
Flt Permitted	0.950			0.822		
Satd. Flow (perm)	1789	1601	0	2167	2550	0
Satd. Flow (RTOR)		25			38	
Lane Group Flow (vph)	171	25	0	857	1148	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	2	
Permitted Phases		4	2			
Total Split (s)	36.0	36.0	74.0	74.0	74.0	
Total Lost Time (s)	6.0	6.0		5.5	5.5	
Act Effect Green (s)	15.8	15.8		82.7	82.7	
Actuated g/C Ratio	0.14	0.14		0.75	0.75	
v/c Ratio	0.67	0.10		0.53	0.60	
Control Delay	56.6	14.8		7.6	8.1	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	56.6	14.8		7.6	8.1	
LOS	E	B		A	A	
Approach Delay	51.3			7.6	8.1	
Approach LOS	D			A	A	
Queue Length 50th (m)	35.2	0.0		45.5	64.2	
Queue Length 95th (m)	54.1	7.1		78.9	108.5	
Internal Link Dist (m)	241.6			32.5	268.6	
Turn Bay Length (m)		25.0				
Base Capacity (vph)	487	454		1628	1925	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.35	0.06		0.53	0.60	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.67
 Intersection Signal Delay: 11.7
 Intersection Capacity Utilization 74.9%
 Analysis Period (min) 15












Intersection LOS: B
 ICU Level of Service D

Splits and Phases: 1: Bedford Highway & Moirs Mill Road

 Ø2 (R) 74 s	 Ø4 36 s
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Papermill Lake TIS
2: Bedford Highway & Nelsons Landing Boulevard

Page A-15
PM Design Hour with Site Generated Trips

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	23	33	40	825	733	50
Future Volume (Veh/h)	23	33	40	825	733	50
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	25	36	43	897	797	54
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					252	
pX, platoon unblocked	0.75	0.75	0.75			
vC, conflicting volume	1807	824	851			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1911	596	632			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	52	90	94			
cM capacity (veh/h)	53	377	711			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	
Volume Total	25	36	43	897	851	
Volume Left	25	0	43	0	0	
Volume Right	0	36	0	0	54	
cSH	53	377	711	1700	1700	
Volume to Capacity	0.48	0.10	0.06	0.53	0.50	
Queue Length 95th (m)	13.6	2.4	1.5	0.0	0.0	
Control Delay (s)	124.4	15.6	10.4	0.0	0.0	
Lane LOS	F	C	B			
Approach Delay (s)	60.2		0.5		0.0	
Approach LOS	F					
Intersection Summary						
Average Delay			2.2			
Intersection Capacity Utilization			53.4%	ICU Level of Service		A
Analysis Period (min)			15			

APPENDIX

B

SCHOOL TRIP

PROJECTION DETAILS



APPENDIX B SCHOOL TRIP PROJECTION DETAILS

Background

As noted in Section 3 of this report, the ITE trip generation numbers provide only a driveway count and judgement needs to be made to determine how many of those driveway trips have an origin or destination outside of the study area and how many remain inside.

Site Count at Bedford South Elementary School

An onsite trip generation count was undertaken at Bedford South Elementary School to substantiate assumptions made for trip generation at the proposed school in Area B2. This school was judged to be a good proxy for the proposed school as due to its proximity to the study area. Bedford South Elementary School has a passenger pickup area that is separated from the staff parking lot. This makes allows for counting of three types of trips:

- Primary trips – staff arriving at the site in the morning and departing in the afternoon
- Pass-by trips - parents driving from home in the morning, dropping child(ren) off, then continuing on to work or vice versa in the afternoon.
- Internal primary trips – parents driving to the site, dropping child(ren) off, then returning home

The data from the site count (below) shows that approximately half of the trips are Primary (enter or exit the staff parking lot) and the other half are either Pass-by or Internal Primary (enter or exit the student drop-off area). Without actually surveying parents, it is not possible to determine how many of the drop-off trips are Pass-by and how many are Internal Primary. We believe an assumption that 80% of these trips are Pass-by is reasonable.

TIME	Passenger Pickup Area		Parking Lot	
	IN	OUT	IN	OUT
8:00 – 8:15	18	19	36	0
8:15 – 8:30	32	32	11	2
8:30 – 8:45	7	6	2	0
8:45 – 9:00	1	1	3	0
AM Total	58	58	52	2
16:15 – 16:30	5	8	0	6
16:30 – 16:45	4	1	1	4
16:45 – 17:00	2	3	0	5
17:00 – 17:15	3	2	0	3
PM Total	14	14	1	18

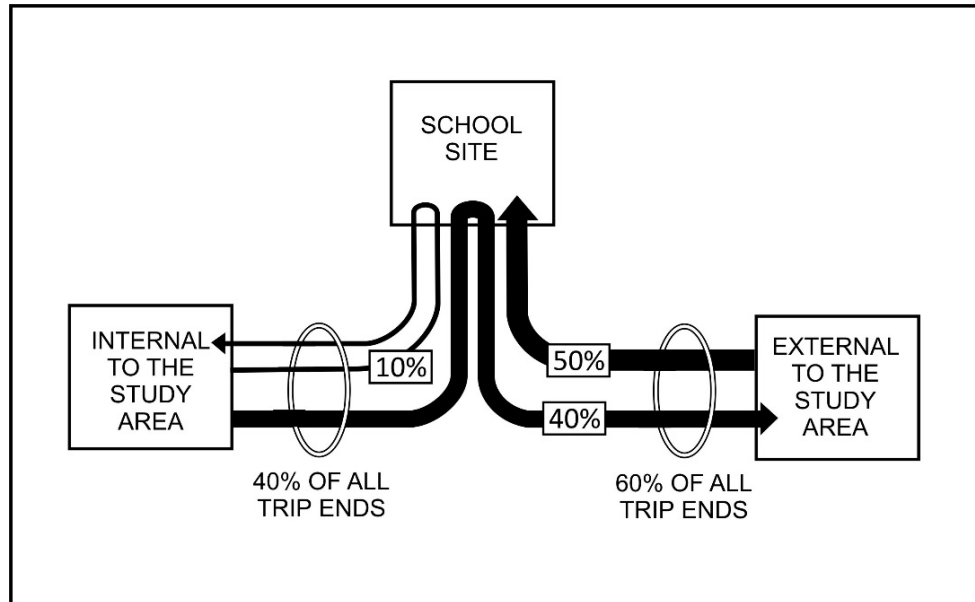
Note: Counts were taken on June 25, 2019 at Bedford South Elementary School
Time periods counted correspond to the peak traffic on adjacent streets

School Catchment

The figure on the next page shows the catchment area for Bedford Elementary School and demonstrates that a school of this type can be expected to serve students in an area no larger than the study area used in this study. This provides us confidence that virtually all of the student drop-off trips will originate within the study area in the morning and be destined to it in the afternoon.

Trip Distribution Summary

The figure below shows the relative volume of each of the three trip types identified. The result is that it is to be expected 60% of trip ends will be outside of the study area and 40% will be internal to the study area. This explains why a 40% trip reduction is used in Table 3 when determining trips entering and exiting the study area. Some of the internal trips are added to the internal streets as shown in Appendix A.



Note: This diagram illustrates morning peak trips. Afternoon peak trips would be the reverse of this diagram.

A Conservative Analysis

Overall, we believe this analysis of school-generated traffic is very conservative. Since the nature of the school that will be located here (if any) is unknown, this provides good assurance that any variety of school can be accommodated.

Firstly, the trip generation numbers used from the ITE Handbook are about 50% higher than what was counted at the proxy site. The assumption that all primary trips to the site (staff) have an origin and destination outside of the study area is also conservative.