

Quantifying Travel Demand at the University of New Brunswick Fredericton and Saint John Campuses: Results from a Multiday Cordon Study



Habib Debly, M. Eng
Supervisor Trevor Hanson, PhD, P.Eng, Professor
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Executive Summary

This report synthesizes the results of a travel demand study that was conducted for the University of New Brunswick Fredericton (UNBF) and University of New Brunswick Saint John (UNBSJ) campuses. The purpose of this study was to better understand travel demand generated by UNB's campuses to aid in future planning efforts by collecting traffic counts at key cordon points on both campuses, developing trip rates, and determining the mode split for the campuses. The study extended for seventeen days of the Winter term and looked at seven key entry points at both UNB campuses, as well as several buses stops within the campuses. The total two-way travel demand observed in terms of average daily traffic (ADT) was approximately 16300 vehicles, 2500 pedestrians, and 36 cyclists at the Fredericton campus, and 4300 vehicles, 45 pedestrians, and 8 cyclists at the Saint John campus. Trip rates were generated for each campus based on the collected volumes. These rates were compared to those calculated using the *Trip Generation Manual* from the Institute of Transportation Engineers (ITE). While trip generation rates from UNBF were similar to those produced using the *Trip Generation Manual*, there were large differences in rates for UNBSJ. Future work related to this study could include using this study to calibrate travel demand models, estimating GHG emissions, understanding transit travel, and performing this study again during a different time of year to compare travel trends.

Note: This document is a summary of a Master of Engineering report completed by Habib Raymond Debly and only includes key information from the research. This summary was completed by Madeline Whitehouse, B. Eng, MScE Candidate, University of New Brunswick Department of Civil Engineering.

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1 Introduction

The University of New Brunswick (UNB) has a student population of approximately 10,000 and approximately 4,000 employees that are either considered full time or part time, spread across two campuses: UNB Fredericton (UNBF) and UNB Saint John (UNBSJ). Both campuses contribute large volumes of traffic to their respective cities throughout the school year. Despite this contribution, the travel demand for UNB has never been quantified. Previous work on understanding travel at UNB has been limited to parking studies, thus not addressing active and public transit modes of travel. Furthermore, though the *Trip Generation Manual* from the Institute of Transportation Engineers (ITE) can be used to estimate travel demand, it is limited because it only considers vehicle travel, and it is based on limited data.

The purpose of this project was to better understand the travel demand generated by UNB's campuses to produce a foundation for future planning efforts, such as travel demand modelling. Specifically, there was a desire to quantify travel demand by time of day, direction, and mode of travel for both campuses. Four objectives were developed to complete this research:

1. Collect short term traffic counts at key cordon points on both campuses.
2. Summarize and compare results to ITE Trip Generation Rates for universities and compare results to the UNB travel survey.
3. Develop trip rates for UNB based on time of day, day of week and by campus.
4. Determine the commuting mode split for UNBF and UNBSJ.

This research was conducted between January 1st, 2023, and April 30th, 2023, and several limitations were identified prior to starting data collection. The limitations are as follows:

- The cordoned study area for UNBF includes St. Thomas University (STU) and the New Brunswick Community College (NBCC). Therefore, travel to and from these institutions could not be differentiated from travel to and from UNBF.
- Due to time constraints, only transit stops on Pacey Drive at UNBF could be evaluated. Time constraints also resulted on some entrances/exits at UNBF being omitted.
- Share of travel of those walking and cycling may be underrepresented because data was collected during the Winter semester.

2 Methodology

The following section outlines the methodology used to conduct the traffic study on the UNBSJ and UNBF campuses.

2.1 Cordon Areas

Key entrances and exits for UNBSJ and UNBF were identified for data collection. The locations for video recording at UNBSJ are provided in Figure 1. Three entrances/exits were evaluated with Locations 1 and 2 supporting all modes of transportation while Location 3 only supporting pedestrians and cyclists travelling between UNBSJ and the Saint John Regional Hospital. There

are two transit stops at UNBSJ that were also included in the evaluation. These are indicated by red circles.



Figure 1: UNB Saint John cordon area and count locations. Entrances and exits are indicated by arrows. Count locations are circled.

The locations of video recording at UNBF are provided in Figure 2. Five locations were selected, though Location 3, which is primarily used by pedestrians and non-motorized vehicles, was ultimately not included due to time constraints. The remaining entrances and exits support all modes of transportation. Entrances/exits to UNBF from Windsor Street were not included in analysis. Therefore, parking lots associated with the Head Hall complex and STU were not included in the analysis. This was recognized as a limitation as including these access points would give a better representation of the travel demand at UNBF. Only transit stops on Pacey Driver were included for data collection. These are indicated by a red oval.

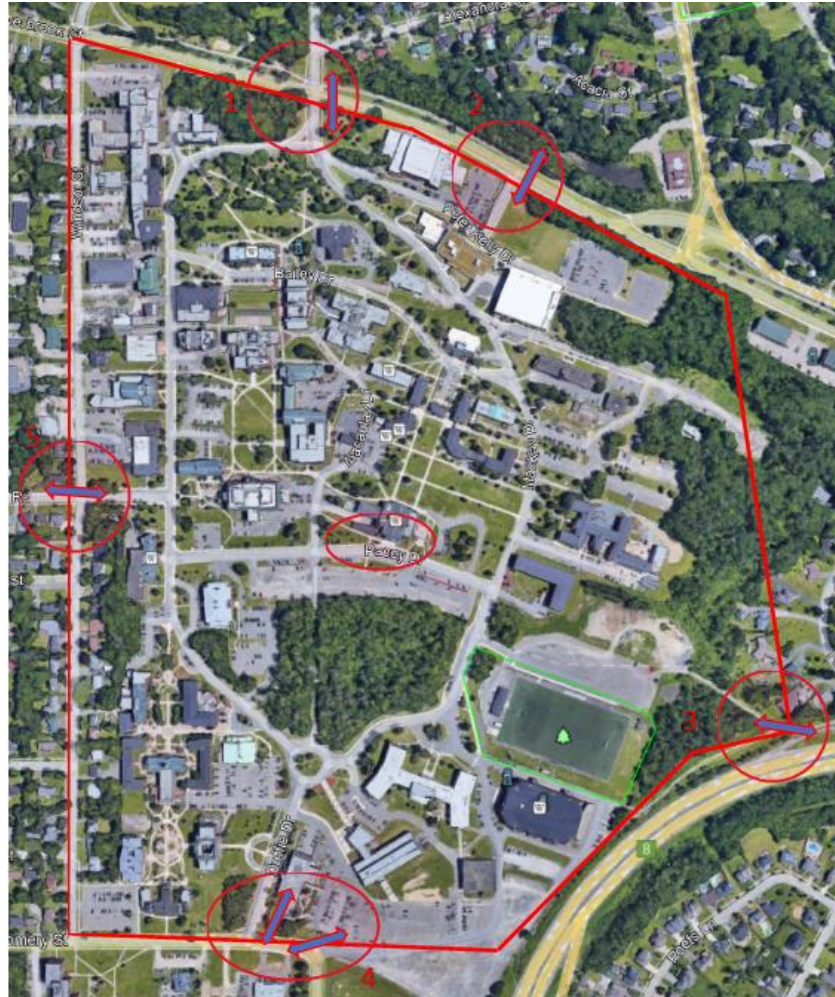


Figure 2: UNB Fredericton cordon area and count locations. Entrances and exits are indicated by arrows and count locations are circled

2.2 Traffic Data Collection

Data collection methods and procedures were carried out in accordance with the *Trip Generation Handbook, 3rd Edition* from the Institute of Transportation Engineers (ITE). It was assumed that cordoning UNB’s campuses created an “Isolated Site” as per the definition provided by ITE. It was also assumed all counted trips were trips to and from the campus, thus no trips were considered “pass through” trips. Data was collected between March 20th, 2023, and April 5th, 2023. The schedule used for data collection is provided in Table 1.

Table 1: Data collection schedule

Campus	Cordon Point	Entrance	Start/End Time	Start Date	End Date
Fredericton	1	University Av. & Beaverbrook	9:30 AM	Monday March 20th	Wednesday, March 22nd
	2	Nicholson & Beaverbrook	9:34 AM	Monday March 20th	Wednesday, March 22nd
	3	Gravel Walk Trail	N/A	N/A	N/A
	4	Duffie Dr.	9:30 AM	Wednesday March 22nd	Friday, March 24th
	4	Wu Centre	9:15 AM	Wednesday March 22nd	Friday, March 24th
	5	Kings College	2:00 PM	Monday March 27th	Wednesday, March 29th
	Transit	1st Pacey Dr. St.	2:05 PM	Monday March 27th	Wednesday, March 29th
	Transit	2nd Pacey Dr. St.	2:21 PM	Monday March 27th	Wednesday, March 29th
Saint John	1	Main Ent.	9:15 AM	Tuesday, March 28th	Thursday, March 30th
	2	Hospital Ent.	10:00 AM	Tuesday, March 28th	Thursday, March 30th
	3	Walk Trail	10:15 AM	Tuesday, March 28th	Thursday, March 30th
	Transit	Bird Hall	10:00 AM	Monday April 3rd	Wednesday April 5th
	Transit	Nursing Building	10:00 AM	Monday April 3rd	Wednesday April 5th

Six Miovision Scout cameras were available to obtain traffic counts at key cordon points at UNBF and UNBSJ. Video was recorded for 48 hours at each location and was used to capture vehicle, pedestrian, bicycle, and transit users. Video was analyzed manually, with 48-hour counts broken into 15-minute intervals so peak hours could be identified. Counts were tallied on paper. Transit data was analyzed by recording when a bus was stopped and counting the number of passengers accessing and egressing the bus. Vehicle occupancy was unable to be detected from the video. The number of transit users were determined by counting the number of passengers entering and existing the bus when it was stopped.

To determine mode of travel, the following guidance was used:

- If a person crosses the study area in a personal passenger vehicle or truck, vehicle is considered the mode of travel.
- If a person crosses the study area in a transit vehicle, transit is considered the mode of travel.
- If a person crosses the study area as a pedestrian or on a bicycle, the mode of travel depends on whether other modes are used on the trip:
 - If a person uses transit on any part of the trip, transit is considered the primary trip mode.

- If a person uses a personal passenger vehicle or truck on any part of the trip (and does not use transit), vehicle is considered the primary trip mode.
- If a person uses a bicycle on any part of the trip (and does not use transit or a motor vehicle), bicycle is considered the primary trip mode.
- If a person walks the entire length of the trip, walking is the primary mode.

This guidance is limited as it is unknown if a person who walked onto campus used transit. Therefore, any person walking onto either campus was considered a walking trip.

3 Results

The following section discusses the results of the study and provides an analysis of the results.

3.1 Summarized Volumes

The Average Daily Traffic (ADT) was determined by taking the 24-hour average of the 48-hour count and was done for each cordon point. The ADT was recorded for vehicle, pedestrian, and bicycle travel and is summarized in Table 2. The UNBSJ pedestrian volume from the walking trail was not included due to time constraints. Pedestrians were not counted at the University Ave & Beaverbrook cordon point at UNBF from 9:00 PM to 12:00 AM of the first day and 10:00 PM to 6:00 AM on the second day of data collection. It was assumed the volumes that would have been captured during this period were negligible as pedestrian counts at other locations during this time frame were small.

Table 2: Campus travel volumes by entrance, mode, and direction (ADT)

Entrance:	Mode					
	Vehicle		Pedestrian		Cyclist	
Fredericton:	In	Out	In	Out	In	Out
Kings College Ent.	1834	1700	685	620	10	6
University Ave & Beaverbrook Ent.	2595	3067	294	301	9	6
Nicholson & Beaverbrook Ent.	706	684	103	97	1	0
Wu Centre Ent.	674	736	83	80	2	1
Duffie Drive Ent.	2263	2022	114	107	0	2
Fredericton Total:	8072	8209	1279	1205	22	15
Saint John:						
Main Tucker Park Ent.	1814	1716	5	4	2	4
Secondary Ent.	313	463	15	21	1	1
Saint John Total:	2127	2179	20	25	3	5

The ADT for the UNBF campus was approximately 16300 veh/day and the ADT for UNBSJ was approximately 4300 veh/day. UNBF vehicle counts may be underestimated since parking lots on Windsor St. were not included in data collection. Pedestrian ADT for UNBF was approximately 2500 pedestrians/day whereas UNBSJ only has 45 pedestrians/day. The resulting volumes show

both campuses are autocentric with only 12% of UNBF travellers walking and 1% of UNBSJ travellers walking. Bicycle travel to and from campus was insignificant, which may be a result of the time of year of data collection.

At UNBF, the University Avenue entrance/exit had the most vehicle traffic, accounting for approximately one third of all vehicles entering and exiting the campus. The Kings College entrance accounted for approximately 50% of pedestrian traffic at UNBF. It should be noted that there are additional areas of UNBF that have pedestrian traffic, but this pedestrian traffic was not captured for this analysis. At UNBSJ, 80% of vehicle traffic entered and exited the campus through the main entrance. This may have occurred because the hospital entrance/exit is a longer trip to the main parking areas. While the hospital entrance/exit accounted for the least vehicle traffic, it accounted for the most pedestrian traffic with 36 pedestrians/day. This could indicate carpooling or parking at the hospital and walking to campus.

Travel volumes were compared to those collected in the UNB Transportation Task Force Parking Survey. Since vehicle occupancy was not detectable through video, vehicle occupancy from Table 4.16 of NCHRP Report 716 for home-based school travel was used. This rate is 1.14 persons per vehicle for daily auto trips. The comparison of the results for persons per mode choice from the UNB parking survey and this study are found in Table 3.

Table 3: Person Trip by Mode Comparison to UNB Transportation Task Force Parking Survey

Mode:	Study Results		Parking Survey
	Fredericton	Saint John	
Vehicle	88%	90%	78%
Walk	12%	1%	11%
Transit	N/A	9%	1%

While the walking percentage for UNBF obtained from this study are similar to the results obtained from the parking survey, which was expected as the UNB Parking Survey was administered at UNBF, the Parking Survey overestimates the walking percentage and underestimates the transit percentage for UNBSJ.

3.2 Travel Trends

The average hourly campus travel trends for UNBF and UNBSJ are provided in Figure 3 and Figure 4, respectively. Both campuses have similar trends with a high peak in the morning and a lower, wider peak in the evening. Therefore, the PM peak is sustained longer than the AM peak. There is also a small peak around the time of a typical lunch period for both campuses.

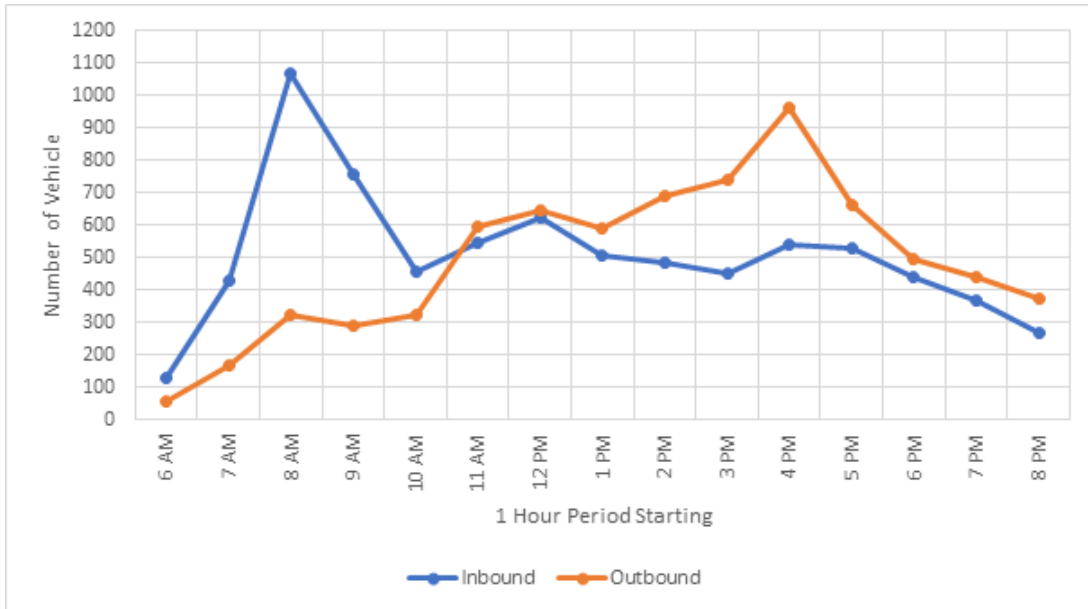


Figure 3: Vehicle travel trends for UNBF.

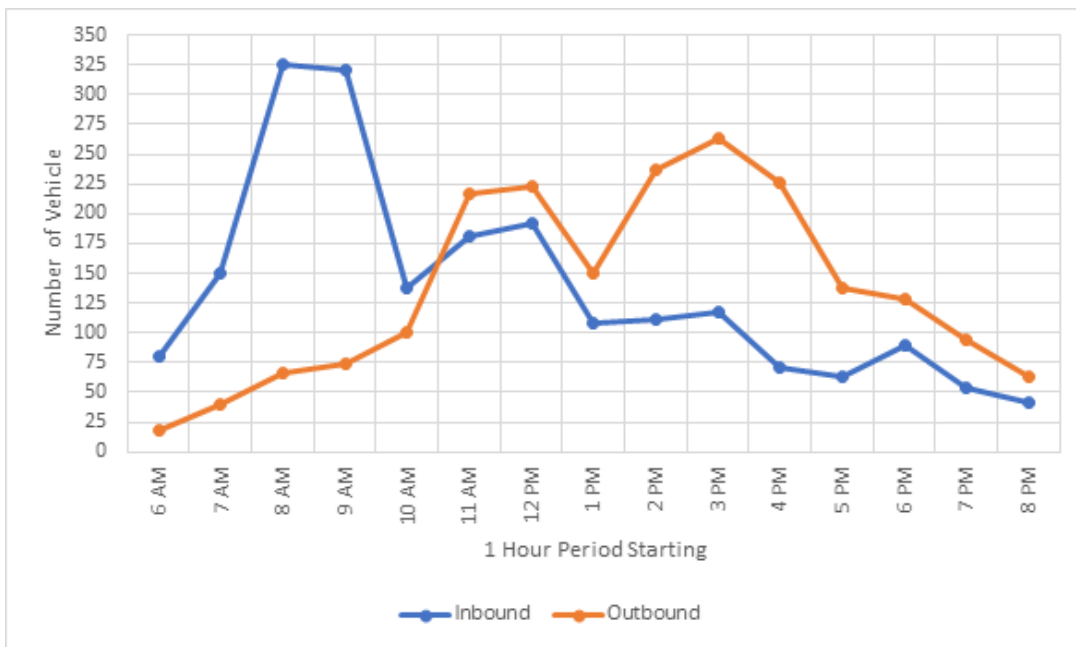


Figure 4: Vehicle travel trends for UNBSJ.

It was acknowledged that classes follow a Monday/Wednesday/Friday (M/W/F) and a Tuesday/Thursday (Tu/Th) schedule. Therefore, the scope of the study was expanded to explore whether there was a noticeable difference in travel patterns based on class schedules. The total hourly vehicle volumes for Monday/Wednesday/Friday (MWF) and Tuesday/Thursday (TTh) for UNBF and UNBSJ are provided in Figure 5 and Figure 6, respectively.

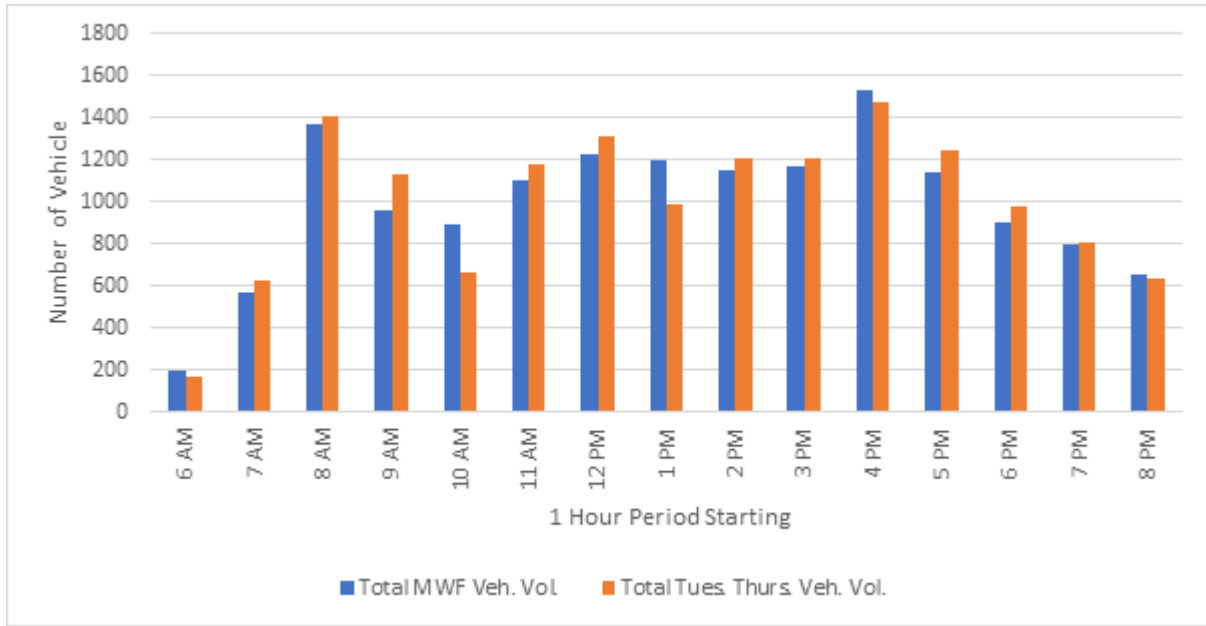


Figure 5: Hourly vehicle volumes by day for UNBF.

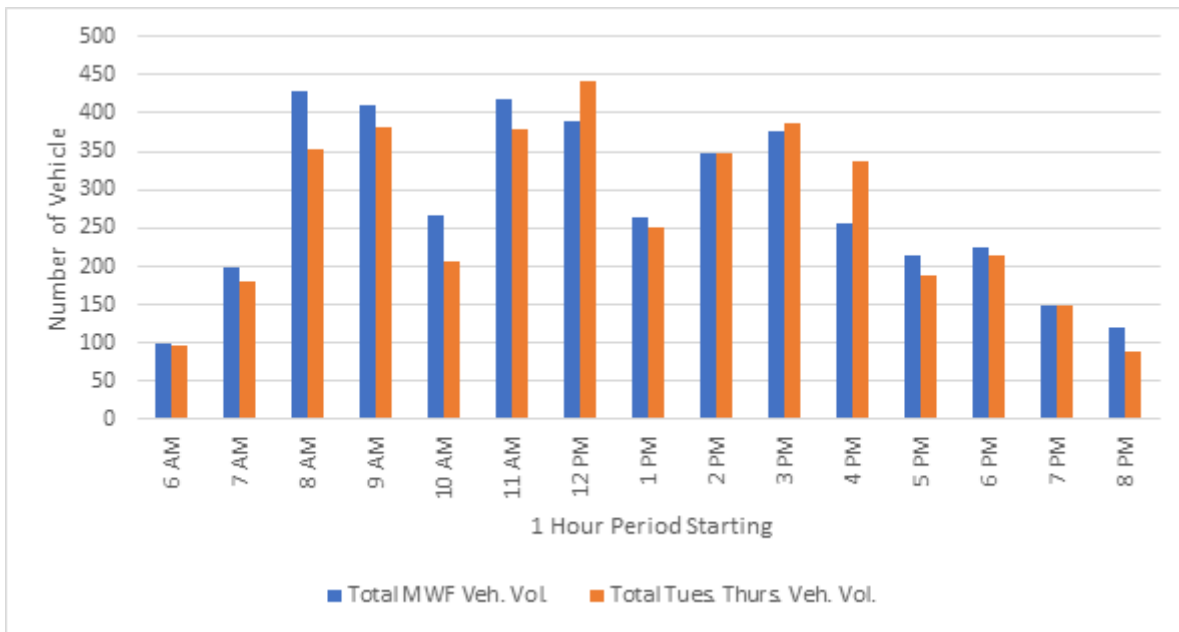


Figure 6: Hourly vehicle volumes by day for UNBSJ.

An analysis was also performed to understand if there were any travel differences on day of week related to classes typically following a MWF schedule and a TTh schedule. Since counts were spread over three days, it was assumed there were no differences in travel patterns over the first and third day, thus they could be combined to represent one day and could be used for comparison. This was done for the entire campus and for each critical entry location. No significant differences in travel trends were observed.

3.3 Peak Flows

Peak hour factors (PHF) were calculated for each entrance evaluated. The PHF was calculated using Equation 1 where the peak directional volume is divided by the peak hour volume which is four times the 15-minute peak.

$$PHF = \frac{\text{Peak Directional Volume}}{4 \cdot \text{Peak 15 Minutes}} \quad 1$$

The results for the AM PHF and resulting peak hour for each entrance/exit is provided in Table 4. The AM Peak Hour for the majority of UNBF was between 7:45 AM and 8:45 AM. The Nicholson & Beaverbrook entrance saw peak hour between 8:00 AM and 9:00 AM and had the lowest peak hour volume. The average PHF for the morning peak was 0.75 with a maximum PHF of 0.89 and a minimum PHF of 0.54. At UNBSJ, the morning peak hour for the main entrance was between 8:30AM and 9:30AM whereas the peak morning hour for the hospital entrance was between 6:30AM and 7:30AM. The average PHF for the morning peak was 0.73, with the main entrance having a PHF of 0.65 and the hospital entrance having a PHF of 0.81.

Table 4: Morning Peak Hour Factor Results

Fredericton:	Peak 15 Min. (In)	Peak Flow	Peak Hr. Vol. (In)	PHF	Tot. Vol. (In + Out)	Time Interval
Kings College Ent.	80	320	243	0.76	318	7:45AM-8:45AM
University Av. & Beaverbrook Ent.	139	556	405	0.73	535	7:45AM-8:45AM
Nicholson & Beaverbrook Ent.	28	112	100	0.89	111	8:00AM-9:00AM
Wu Centre Ent.	70	280	152	0.54	178	7:45AM-8:45AM
Duffie Drive Ent.	81	324	266	0.82	359	7:45AM-8:45AM
Saint John:						
Main Tucker Park Ent.	135	540	352	0.65	386	8:30AM-9:30AM
Hospital Ent.	27	108	88	0.81	113	6:30AM-7:30AM

The results for the PM PHF and resulting peak hour for each entrance/exit is provided in Table 5. The PM Peak Hour for UNBF was not consistent between entrances and exits with the peak hour starting as early as 2:15 PM and ending as late as 5:00PM depending on the location. This variation could be explained by when students' classes end for the day. The average PHF for UNBF was 0.82 with a maximum of 0.91 and a minimum of 0.74. The PM Peak Hour for the main entrance at UNBSJ occurred between 3:45PM and 4:45PM with a PHF of 0.77 whereas the PM Peak Hour for the hospital entrance occurred between 2:45PM and 3:45PM with a PHF of 0.63.

Table 5: Evening Peak Hour Factor Results

Fredericton:	Peak 15 Min. (Out)	Peak Flow	Peak Hr. Vol. (Out)	PHF	Tot. Vol. (In + Out)	Time Interval
Kings College Ent.	65	260	209	0.8	327	3:45PM-4:45PM
University Av. & Beaver Brook Ent.	103	412	376	0.91	533	3:45PM-4:45PM
Nicholson & Beaver Brooke Ent.	39	156	115	0.74	168	4:00PM-5:00PM
Wu Centre Ent.	33	132	108	0.82	142	2:15PM-3:15PM
Duffie Drive Ent.	71	284	233	0.82	441	4:00PM-5:00PM
Saint John:						
Main Tucker Park Ent.	97	388	298	0.77	394	3:45PM-4:45PM
Hospital Ent.	36	144	91	0.63	103	2:45PM-3:45PM

3.4 Pedestrian Trends

Pedestrian travel trends for UNBF were analyzed based on the MWF and TTh class schedules to understand if there were differences in travel trends. Data was aggregated to the hour and to 15-minute intervals and are shown in Figure 7 and Figure 8, respectively. The hourly volumes show pedestrian travel at UNBF is more consistent on MWF compared to TTH. The 15-minute volumes show peaks every hour between 8:00AM and 3:30PM approximately corresponding to when classes start and end. The TTH 15-minute volumes show similar trends, however the peaks are offset from the MWF peaks, thus indicating different class start and end times.

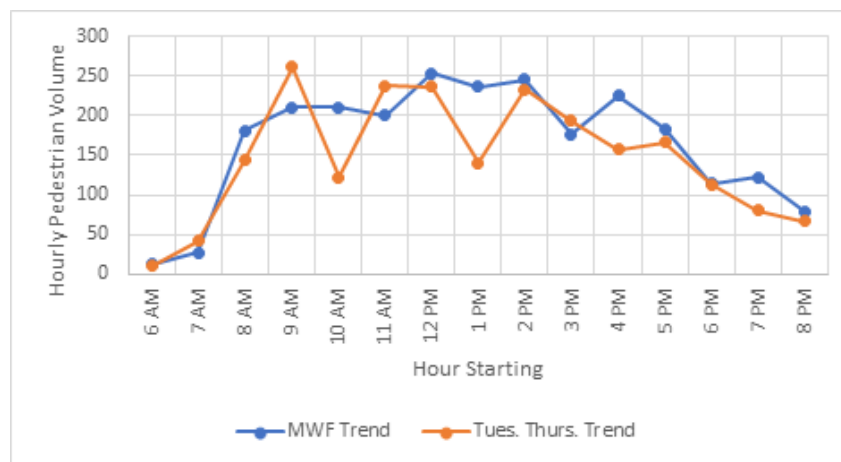


Figure 7: UNBF campus wide pedestrian volume for MWF and TTh aggregated to the hour.

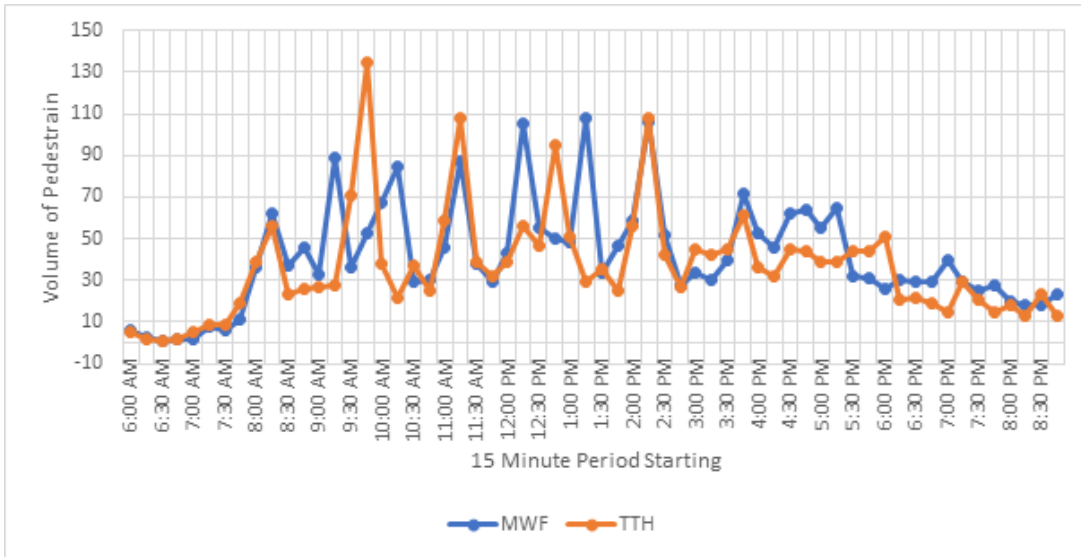


Figure 8: UNBF campus wide pedestrian volume for MWF and TTh aggregated to 15-minutes.

A 48-hour count was performed on the UNBSJ walking trail, however only a subset of the data was analyzed due to time constraints. The results of the walking trail volumes for Tuesday, March 28th, 2023, aggregated to 15-minutes are provided in Figure 9. These results show the 15-minute interval at 1:00PM was the busiest with every other period capturing 5 pedestrians or fewer. Morning, afternoon, and evening peak hours were also analyzed for Wednesday, March 29th, 2023, and identified the 12:30PM lunch period as the most active period. While all data at this location resulted in volumes of less than 50 pedestrians per hour and were not included in the calculated ADTs, they provide a baseline for future study.

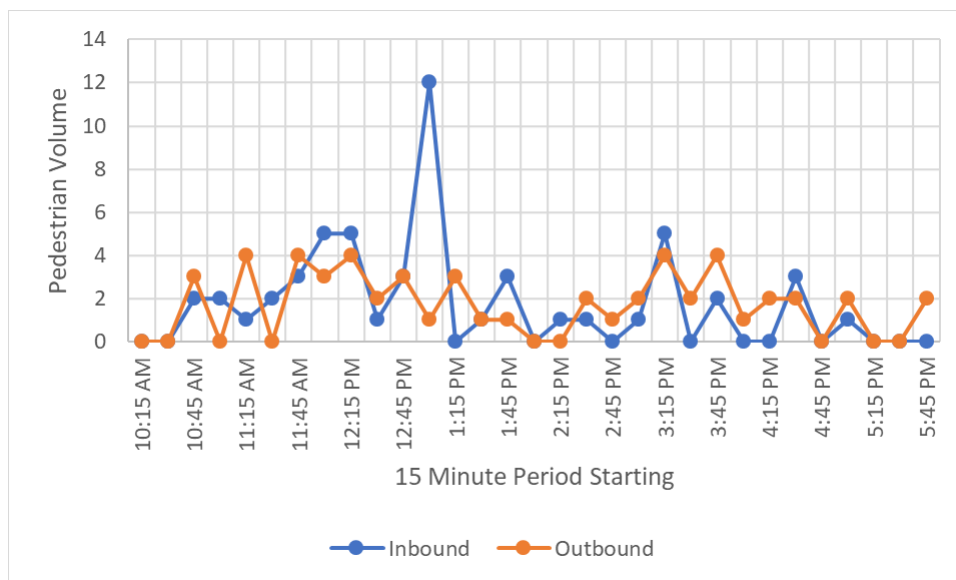


Figure 9: UNBSJ walking trail volumes.

3.5 Transit Travel

Transit use on UNBSJ was primarily concentrated at the transit stop at the Baird Dining Hall where there were 400 people observed entering and exiting the bus. The nursing building bus stop only saw 60 people entering and exiting the bus. These trends are provided in Table 6.

Table 6: UNBSJ Transit ADT Volumes by Stop

	On	Off	Total
Baird Dining Hall	192	214	406
Nursing Building	37	20	57
Total	229	234	463

UNBF transit travel was collected for Pacey Drive at the bus stop outside of the Student Union Building. Approximately 200 travellers used transit at this location. Due to data collection limitations, ADT for bus travel could not be determined. Total volume for one day at this bus stop location is provided in Table 7. There are additional bus stops on the UNBF campus that may have higher volumes than this stop. A better understanding of the demand for transit at UNBF will be possible when data from Fredericton Transit is available.

Table 7: UNBF Pacey Dr. Transit Stop Volumes (Tuesday March 28th, 2023)

	On	Off	Total
SUB Side	33	84	117
Opposite Side	70	15	85
Total:	103	99	202

3.6 Trip Generation Rates

Trip rates for UNBF and UNBSJ were developed by dividing the total cordon area hourly volume by the number of students enrolled to produce campus wide rates. The student enrollment used for UNBF was 9,869. This includes the 7,739 students enrolled at UNBF, the 1,730 students enrolled at STU, and the 400 students enrolled at NBCC. Student enrollment from STU and NBCC were included as this study likely captured most of the vehicle travel to and from these institutions. The student enrollment used for UNBSJ was 2,189. Trip rates for individual entrances and exits were not calculated. The trip rates for UNBF are provided in Table 8 and the trip rates for UNBSJ are provided in Table 9. The overall rates from these tables show there is little variation in trip rates by day, but there is a variation depending on the time of day.

Table 8: UNBF Vehicle Trip Rates by Time of Day and by Day of the Week

College Hill Trip Rates by Time of Day and by Day (Including UNBF, STU and NBCC Enrollment; Trips/Student)					
Hour Period:	T or TH	M, W or F	Average. Day	% Directional Split (Based on Avg. Day)	
				Inbound	Outbound
6 AM	0.017	0.02	0.019	69.2	30.8
7 AM	0.063	0.058	0.06	72	28
8 AM	0.142	0.139	0.141	76.8	23.2
9 AM	0.115	0.097	0.106	72.3	27.7
10 AM	0.068	0.09	0.079	58.8	41.2
11 AM	0.12	0.112	0.116	47.6	52.4
12 PM	0.133	0.124	0.129	49.2	50.8
1 PM	0.1	0.121	0.111	46.2	53.8
2 PM	0.122	0.117	0.119	41.3	58.7
3 PM	0.122	0.119	0.121	38	62
4 PM	0.149	0.155	0.152	36.1	63.9
5 PM	0.127	0.115	0.121	44.5	55.5
6 PM	0.1	0.091	0.095	47	53
7 PM	0.082	0.081	0.081	45.5	54.5
8 PM	0.064	0.066	0.065	42	58
24-hr Day	1.652	1.647	1.65	49.6	50.4

Table 9: UNBSJ Vehicle Trip Rates by Time of Day and Day of the Week

UNB SJ Vehicle Trip Rates by Time of Day and by Day (Trips/Student)					
Hour Period:	T or TH	M, W or F	Average Day	% Directional Split (Based on Avg. Day)	
				Inbound	Outbound
6 AM	0.044	0.046	0.045	82.1	17.9
7 AM	0.082	0.091	0.086	79.1	20.9
8 AM	0.161	0.196	0.179	83.2	16.8
9 AM	0.174	0.187	0.18	81.3	18.7
10 AM	0.095	0.122	0.108	57.8	42.2
11 AM	0.173	0.191	0.182	45.4	54.6
12 PM	0.202	0.178	0.19	46.3	53.7
1 PM	0.115	0.12	0.118	41.7	58.3
2 PM	0.159	0.159	0.159	31.9	68.1
3 PM	0.177	0.172	0.175	30.9	69.1
4 PM	0.154	0.116	0.135	23.8	76.2
5 PM	0.086	0.097	0.092	31.4	68.6
6 PM	0.097	0.103	0.1	41.1	58.9
7 PM	0.068	0.068	0.068	36.7	63.3
8 PM	0.041	0.054	0.048	39.2	60.8
24-hr Day	1.945	1.988	1.966	50	50

The ITE *Trip Generation Manual* was also used to predict trip rates for the UNB campuses and compare them to the calculated trip rates. This model is based on seven studies of institutions where student enrollment was greater than 10,000. Trip rates were calculated for five different time periods: average 24-hour day, peak hour between 7:00AM and 9:00PM, peak hour between 4:00PM and 6:00PM, AM peak hour generator, and PM peak hour generator. The trip rates based on student enrollment only are provided in Table 10. Actual rates that fall outside of the range provided by ITE are highlighted in red.

Table 10: Student Enrollment ITE Trip Rates vs. UNB Trip Rates

ITE Trip Rates vs. Observed UNB Rates					
Time of Day	Rates (Trips/Student)				
Fredericton:	ITE Average Rates	ITE Rate Range	Calc. Rates	Actual Rates	% Diff.
Based on a 24-hr weekday	1.56	1.1-3.31	1.59	1.65	3.8
Peak Hr. between 7 & 9 AM	0.15	0.08-0.21	0.12	0.14	16.7
Peak Hr. between 4 & 6 PM	0.15	0.05-0.77	0.14	0.15	7.1
AM Peak Hr Generator	0.13	0.09-0.15	0.12	0.14	16.7
PM Peak Hr. Generator	0.14	0.1-0.16	0.14	0.16	14.3
Saint John:	ITE Average Rates	ITE Rate Range	Calc. Rates	Actual Rates	% Diff.
Based on a 24-hr weekday	1.56	1.1-3.31	2.34	1.97	15.8
Peak Hr. between 7 & 9 AM	0.15	0.08-0.21	-0.05	0.18	460
Peak Hr. between 4 & 6 PM	0.15	0.05-0.77	0.07	0.14	100
AM Peak Hr Generator	0.13	0.09-0.15	0.13	0.18	38.5
PM Peak Hr. Generator	0.14	0.1-0.16	0.15	0.19	26.7

Trip rates based on full time employment are provided in Table 10. Employment was based on counts performed in 2016, so it was assumed employment between 2016 and 2023 had not changed considerably. While all ITE trip predictions at UNBF had less than a 12% difference when compared to actual trips, the ITE trip predictions showed considerable variation with some percent error upwards of 60%. This was especially apparent for the Peak Hour between 7:00AM and 9:00AM where a negative trip rate was obtained based on student enrollment. Many rates calculated for UNB SJ fall outside of the provided range of rates provided by ITE. These results show the limitations of using ITE Trip Generation rates at smaller universities like UNBSJ.

Table 11: Full Time UNB Employment ITE Trip Rates vs. UNB Rates

Time of Day	Rates (Trips/Full Time Employee)				% Diff.
	ITE Average Rates	ITE Rate Range	Calc. Rates	Actual Rates	
Fredericton:					
Based on a 24-hr weekday	8.89	7.39-12.94	N/A	11.34	N/A
Peak Hr. between 7 & 9 AM	0.75	0.69-0.96	1.03	0.99	3.9
Peak Hr. between 4 & 6 PM	0.79	0.66-1.05	1.09	1.05	3.7
AM Peak Hr Generator	0.76	0.7-1.03	1.09	0.99	9.2
PM Peak Hr. Generator	0.81	0.7-1.15	1.21	1.07	11.6
Saint John:					
Based on a 24-hr weekday	8.89	7.39-12.94	N/A	14.59	N/A
Peak Hr. between 7 & 9 AM	0.75	0.69-0.96	2.52	1.33	47.2
Peak Hr. between 4 & 6 PM	0.79	0.66-1.05	2.67	1.01	62.2
AM Peak Hr Generator	0.76	0.7-1.03	2.81	1.35	52
PM Peak Hr. Generator	0.81	0.7-1.15	3.34	1.41	57.8

4 Limitations

Several limitations for this study were recognized:

- Vehicle occupancy was not captured from video footage so vehicle occupancies from NCHRP Report 716 were used. However, these values cannot be validated.
- Parking lots at UNBF accessed from Windsor Street were not included in analysis despite making up a large amount of daily vehicle travel. While these were areas of interest, they were outside the scope of this work. Similarly, pedestrian paths students may access from Windsor Street were not accounted for. Therefore, a complete representation of travel at UNBF was not captured.
- The cordon area at UNBF included NBCC and STU, thus travel to and from these institutions is likely captured in these results.
- It was not possible to distinguish between those who walked to campus from those who drove to a nearby lot and walked a short distance, which would have been considered a vehicle trip. This is particularly important at the University Ave. Entrance, which is located near the Lady Beaverbrook parking lot where many students park their vehicles and walk to campus.
- Travellers dropped off by a vehicle could not be distinguished.
- Time constraints and equipment limitations resulted in travel at Location 3 on UNBF not being captured, despite being a location of interest.
- Only peak hours for the UNBSJ walking trail connecting the university campus to the hospital were analyzed as only 45 hours of footage was obtained.

5 Conclusions and Recommendations

The purpose of this research was to better understand the travel demand created by UNB Fredericton (UNBF) and UNB Saint John (UNBSJ) by obtaining 48-hour traffic volume counts at key access locations for the two campuses. Approximately 16,300 veh/day were observed at UNBF, and 4,300 veh/day were observed at UNBSJ, though vehicle occupancy is unknown. Approximately 2,500 pedestrians/day were observed travelling to and from UNBF while only 45 pedestrians/day were observed travelling to and from UNBSJ. Bicycle travel was negligible for both campuses. While transit travel was not captured for UNBF, approximately 460 persons/day were observed using transit to access UNBSJ. When looking at AM and PM peak hours for the two campuses. The AM peak hour at UNBF was generally consistent across all access points, whereas there was more variation across the five access points for the PM peak hour. When comparing travel trends by time of day and by day of the week (i.e. MWF versus TTh), there were no significant changes in travel trends. There were also no significant differences in travel trends based on location.

Vehicle trip rates developed for UNBF and UNBSJ show considerable variability by time of day, which was expected. Differences in trip rates based on day (i.e. MWF versus TTh) were also observed, but vehicle trips are consistent between campuses for either group of days. When generating vehicle trip rates based on student enrollment using the ITE Trip Generation Manual and comparing them to the calculated rates, the results for UNBF were much closer to the ITE rates compared to the rates for UNBSJ. Student enrollment for UNBF also included STU and NBCC as it was likely travel to and from these campuses were captured within the counts obtained for UNBF. Percent difference between the ITE rates for UNBSJ and the observed UNBSJ rates produced a percent difference for one scenario of 125% and predicted a negative number of trips. These results highlight that using the ITE Trip Generation Manual for smaller universities may not be a good fit as there is a lack of data associated with smaller universities. Similar results were observed when using full-time employment as the variable for calculation trip generation rates for UNBF and UNBSJ, further highlighting how the model from the ITE Trip Generation manual breaks down when applied to smaller universities.

5.1 Recommendations

Based on the results of this research, the following recommendations can be made:

- Include Windsor Street in data collection for UNBF. Data should be collected using Miovision Scout so all modes can be collected.
- Perform more travel demand studies at different times of year (i.e. Summer and Fall). This will allow seasonal adjustment factors to be developed so AADTs for the campuses can be estimated.
- Gather vehicle occupancy through manual observations.
- Only use full time employment data when estimating campus trips

- Make observations and collect counts where possible before using the rates generated from this document or from the ITE manual. This should be done to ensure there is accuracy with predictions and estimates.

5.2 Future Research

There are several areas for future research based on this research. This study can be used to aid in model calibration for travel demand modelling of the UNB campuses. This data can also be used for UNB specific travel demand models or as a special generator for a larger city-wide travel demand model. Though one of the original goals of this project was to produce average year long estimates of GHG emissions produced by UNBF and UNBSJ, this study can be used to assist in accomplishing this goal. The next step in emissions modelling would be to generate estimates of where trips are produced. Another area of research is to add UNBF transit ridership to this study by using the same data collection procedure of counting those accessing and egressing at each bus stop. A future study focused on transit ridership at UNBF could be performed with the City of Fredericton. Finally, since this study was done in the winter, another study should be performed in the Fall semester to see if there are any notable differences in travel between the two semesters.