⟫TRANS   a joint transportation planning committee serving the national capital region
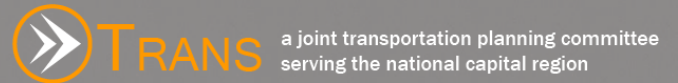
TRIP GENERATION MANUAL

BACKGROUND REPORT

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STUDY PARTICIPANTS

The TRANS Committee is comprised of the following member agencies: National Capital Commission (NCC), Ontario Ministry of Transportation (MTO), City of Ottawa (including OC Transpo), le Ministère des transports du Québec (MTQ), la Ville de Gatineau and la Société de transport de l'Outaouais (STO).

This study was conducted under the direction of a TRANS Steering Committee that included representation from the following agencies:

— **City of Ottawa:** Transportation Planning Service
— **Ville de Gatineau:** Section Planification des transports
— **Ministère des Transports du Québec**: Direction de l'Outaouais and Modélisation des systèmes de transport
— **Société de transport de l'Outaouais**: Stratégies et développement

A joint Project Manager Team from TRANS led the study progress – Ms. Jennifer Armstrong, Senior Project Manager, City of Ottawa and Ms. Nadine Lafond, Responsible – Planification des transports, Ville de Gatineau. The Sub-Committee also included Mr. Eric Robert, Ministère des Transports du Québec and Michael Nowakowski, Société de transport de l'Outaouais.

The practical guidance, local knowledge, expertise and assistance of the above-mentioned organizations is appreciatively acknowledged and recognized.

The TRANS Trip Generation Study has been documented in two separate reports:

— TRANS Trip Generation Summary Report
— TRANS Trip Generation Background Report

1 INTRODUCTION

While planning agencies located on both sides of the Ottawa River have different policies and procedures in fulfilling their respective mandates to review and approve development applications, each have a common interest in ensuring the impacts of proposed developments on the transportation systems are fully assessed and understood as part of the development review process. TRANS, a joint technical committee on transportation systems planning in the National Capital Region (NCR), has played a key role in coordinating area-wide transportation modelling and data collection efforts in the region.

The 2009 TRANS Trip Generation Residential Trip Rates Study Report was prepared to inform practicing transportation planning professionals conducting Transportation Impact Assessment (TIA) studies in the NCR of local travel behaviour. The 2009 report reviewed data sources with respect to their applicability and usefulness in establishing residential trip rates and mode share, building on the success of previous reports and trip generation studies. The report did so by blending locally collected data with non-local databases. The locally collected data included the 2005 TRANS Origin-Destination (OD) Survey and local generator surveys.

Since the development of the 2009 Study Report, TRANS had carried out three years of local generator counts (2010-2012), the 2011 TRANS OD Survey has been completed and the City of Ottawa has updated their TIA Guidelines (2017) which provide an outline of the transportation review required for developers when submitting their development application. The new City of Ottawa TIA Guidelines identify the source of trip generation in order of preference as: TRANS Trip Generation Residential Trip Rates (2009), local trip surveys of a similar development, Institute of Transportation Engineering (ITE) Trip Generation Manual (latest version) and first principles calculations.

The update to the 2009 TRANS Trip Generation Residential Trip Rates Study analyzed and identified residential trip rates and mode share for the NCR using the most recently available data. In addition, the data provided was reviewed and analyzed to identify mode shares for non-residential sites such as schools, employment generators and commercial generators. All trip rates and mode shares were reviewed from the perspective of household type and geographic location. Additional elements that were reviewed included potential influencing factors in a person's trip decision-making process and the impacts of mixed-use development as part of the trip generation process. This has direct implications on site planning, development approvals, and overall planning activity. Finally, a process was outlined to best address any identified gaps in local data collection.

2 TRIP GENERATION – DATA SOURCES

Locally collected data provides the most insight into local travel behaviours. Opportunities to observe and record travel behaviour associated with existing developments offers increased confidence in the analysis of transportation impacts, thereby ensuring appropriate mitigation measures are adequately identified in advance of development build-out. However, comprehensive local generator data collection can be cost prohibitive and time consuming. While some local generator surveys were available for analysis, they were not comprehensive enough to be the sole source of analysis. As such, a combination of the 2011 TRANS Origin-Destination Survey, available local generator surveys and the ITE Trip Generation Manual was used as data sources for the analysis to update the local trip generation rates as well as identify local mode shares. The 2009 TRANS Trip Generation Summary and Study Report were also referenced to validate the findings so as to identify any significant changes in local behaviours throughout the NCR.

2.1 2009 TRANS Trip Generation Study

The 2009 TRANS Trip Generation Study was prepared jointly by area planning agencies (under the umbrella organization of TRANS which includes participation of the National Capital Commission, the City of Ottawa, the City of Gatineau, the Ontario and Quebec Ministries of Transportation, and the transit agencies of Ottawa and Gatineau, STO and OC Transpo). The purpose of the 2009 Study was to update local trip rates to reflect changes in local travel behaviours since the 1988 TRANS Trip Generation Manual.

The 1988 Manual was carried out to review, analyze and develop trip generation rates based on an extensive inventory of special traffic generation counts undertaken between 1977 and 1987 throughout the NCR, including the 1977 Trip Generation Manual and the 1979 Special Generators Analysis Report. To identify resident-based travel behaviour and associated trip generation rates, the region wide 1986 Origin-Destination Survey was also utilized.

The earlier studies ('77 and '79) were largely responsible for identifying the need and justification for an ongoing data collection program. The procedures developed ensured that a complete cordon was drawn around each site and that person travel by all modes was fully tabulated at all possible ingress/egress points to the site. This procedure remains relevant today and will be discussed further in **Section 3.2.1 Local Generator Surveys**.

No new local trip generator surveys had been carried out prior to the 2009 Study. As such, a count program was developed and initiated that collected data at seventeen sites across the region, fifteen of which were residential including four housing types: i) single-family detached homes, ii) semi-detached homes, iii) row or townhomes, and iv) apartments. The recommendation to continue collecting local generator data was proposed and outlined within the Study. The resulting residential trip generation rates were based on a blended trip rate of the local generator site counts (2008), the 2005 Origin-Destination Survey, and the 8th Edition

ITE Trip Generation Manual, and the mode share was identified based on analysis of the 2005 Origin-Destination Survey data. To represent differences in trip rates and mode shares throughout the NCR, the Region was grouped by traffic districts and aggregated into four broad categories: Core, Urban, Suburban and Rural sectors, as shown in **Figure 2-1: National Capital Region by Sector – TRANS Trip Generation Study Report (2009)**. In addition, trip rates and mode share were further adjusted to account for proximity to rapid transit stations by developing a separate trip rate for households located within 600 m of a rapid station.
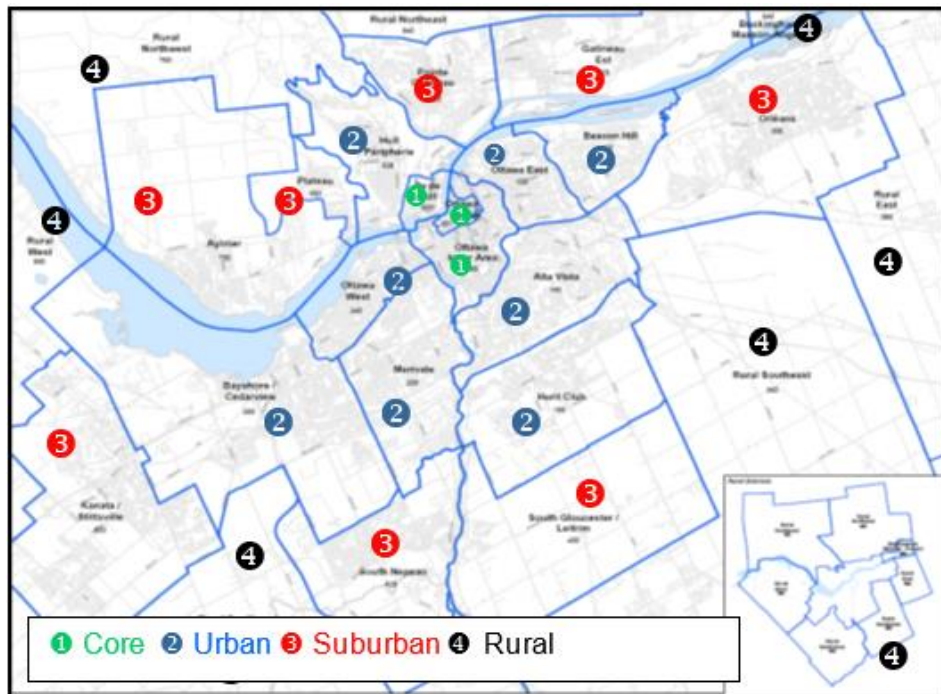
Figure 2-1: National Capital Region by Sector – TRANS Trip Generation Study Report (2009)

2.2 Local Generator Surveys

The local generator survey program established in the 2009 TRANS Trip Generation Study was carried out between 2008 and 2012 within the NCR. While the surveys varied by land use, they primarily focused on residential sites. In total, 55 site surveys were conducted. Most surveys were for multifamily housing and only a small percentage were for single-family detached housing. Greater detail is provided in **Section 3.2.1 Local Generator Surveys**.

2.3 TRANS 2011 Origin-Destination Survey

TRANS completed a comprehensive TRANS OD Survey in the Fall of 2011. Typically carried out on a five to ten-year cycle, comprehensive travel surveys are critical to obtaining a strong understanding of regional travel patterns and identifying future transportation needs. The detailed survey questionnaire selected at random 5% of households across the NCR and

included questions targeted at understanding all decisions and outcomes related to travel activity for each member (aged 5 and above) of the household. In addition, some demographic and socio-economic data was collected including age, gender, employment status, and number of vehicles available to the household. The existing travel behaviour collected, including trip patterns, travel mode choices and socio-economic characteristics, are critical inputs in developing long-range planning tools aimed at understanding and identifying future transportation demands associated with longer-term regional growth strategies. Expansion factors based on household characteristics and demographics were applied to the survey dataset to provide a comprehensive picture of travel behaviour in the NCR. The use of the expansion factors, and the very nature of reported resident-based travel, does limit its use for small area analysis. Furthermore, trip rates and mode share for generators other than residential are difficult to ascertain from the dataset. Further discussion on how the 2011 Origin-Destination Survey results were analyzed is described in **Section 3.2.2 2011 TRANS OD Survey** for residential trip rates and in **Section 4 Development of Residential Mode Share** for residential mode share.

2.4 ITE Trip Generation Manual

Since 1976, the Institute of Transportation Engineers (ITE) has prepared regular Trip Generation Manuals that document observed trip generation rates for a wide range of land use categories based on data submitted voluntarily to ITE by public agencies, developers, consulting firms and associations across the US and Canada. The ITE Trip Generation manual (three volumes) is a tool aimed at planners, developers, transportation professionals, zoning boards and others who are interested in estimating the number of trips generated by proposed developments.

The *ITE Trip Generation Handbook* provides guidance on the proper use of the trip rates presented in the *ITE Trip Generation Manual*. The *ITE Trip Generation Handbook* also provides a step-by-step methodology and example of both internal capture rates and pass-by trips. In addition, it includes definitions of mixed-use sites and provides clarification that some mixed-use developments are classified as a single land use (e.g. shopping centres).

The *ITE Trip Generation Manual (10th Edition)* was used for this study. Updates in the 10th Edition include the ability to isolate Canadian studies from the data sets and an increase in completed person-trip studies. ITE published the 10th Edition Supplement during the assignment, but the supplement was not available at the time of the analysis.

While the ITE publication is a widely used and referenced document, there are concerns and limitations related to how well the data reflects local conditions in the NCR. These concerns and limitations, discussed briefly below, include changes since the 2009 TRANS Trip Generation Study related to the updated ITE Manual (10th Edition).

— **Vehicular trip generation rates:** In previous versions of the *ITE Trip Generation Manual*, the majority of trip generation rates were based only on vehicle trip ends. The 8th Edition

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(November 2008) expanded the data collection form to support the collection of pedestrian and cycling trip generation data. With the shift in data being collected and an interest by practitioners to understand all mode choices offered, the 10th Edition includes person-trip rates for some land uses. This ensures that locations with a proportion of either public transportation and/or non-motorized modes are covered; however, only a small percentage of residential land use data sets currently include person-trip surveys. For example, while multifamily housing (mid-rise) includes nearly a dozen person-trip studies since 2004, there are no person-trip surveys for single-family detached housing (vehicle-trips only).

— **Suburban locations:** It is noted that in most cases the trip generation data submitted to ITE is based on surveys in suburban areas. Consequently, applying ITE trip rates may result in an overestimation of the proportion of vehicle travel for a proposed development as the rates applied do not fully recognize the role of public transportation or other sustainable modes.

— **Primarily single use locations:** As in previous editions, it is noted in most cases the trip generation data submitted to ITE has been associated with single use locations. Adjustments for internal trips at mixed-use developments are included within the ITE Trip Generation Handbook (September 2017), but with more recent development proposals having larger elements of mixed-use developments, the site trip generation would likely be overestimated without the appropriate empirical data to match these developments. Locally, there has not been data collection carried out for mixed-use developments either, as addressed in **Section 8 Mixed-Use Developments**.

— **Age of data:** While ITE adjusts the data included within each manual update, the age of trip data within the manual can be dated and not necessarily reflect current travel behaviour. For example, within the latest edition all residential land uses include data from 1980.

— **Lack of Canadian data:** There are a limited number of Canadian surveys that form part of the largely American ITE survey database. In fact, there are no Canada-based surveys for single-family detached housing and only one for multifamily housing (low-rise). Thus, while it is now possible to isolate Canadian studies in the ITE database, there are not enough studies for most of the residential land uses to produce valuable results.

— **Time of Day:** The *ITE Trip Generation Manual* only includes peak hour trip rates; to better understand transit and active transportation trips, peak period trip rates are preferred over peak hour. Additional discussion on the application of peak period trip rates and necessary conversion factors are described in **Section 3.2.3 ITE Trip Generation Manual**.

The *ITE Trip Generation Manual* remains a valuable resource because it contains trip data for a large number of land use categories (176) and compilations of large dataset for each land use. Additional information on how the ITE data was included within this study and its limitations are described in **Section 3.2.3 ITE Trip Generation Manual**.

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3 DEVELOPMENT OF RESIDENTIAL TRIP GENERATION RATES

3.1 Approach and Methodology

The impacts of proposed development on the local transportation network are identified as part of the development application, review and approval process through site traffic impact studies. Trip generation rates are estimated based on observed traffic counts of similar developments, from the *ITE Trip Generation Manual*, local trip generation rates or focused data collection efforts as part of the assignment, and they are used to estimate future transportation demands for new developments. The *City of Ottawa TIA Guidelines (2017)* direct practitioners to the 2009 TRANS Trip Generation Residential Trip Rates as the first source for local trip rates, followed by local trip surveys of a similar development as a secondary option then the *ITE Trip Generation Manual* (10th Edition) and first principles calculations.

New residential trip rates for the Ottawa-Gatineau area have been calculated using the data available, namely: local generator surveys, the 2011 Origin-Destination Survey data and *ITE Trip Generation Manual* (10th Edition). The rates were analyzed and evaluated based on three criteria:

i) **Time period:** The *City of Ottawa TIA Guidelines (2017)* recommend the use of peak period volumes for analysis; however, modifications to the time period being used can be made as part of the Scoping process set out in the Guidelines. The 2020 Trip Generation Study considered how the trip rates would be represented in the Summary Report for practitioners. It was decided that all residential person-trip rates would be for the peak period, consistent with the municipalities' count programs (7:00 to 9:30 and 15:30 to 18:00). Additional details on this criterium are summarized in **Section 3.1.1 Time Period**.

ii) **Dwelling types**: The influence of varying dwelling types on residential trip rates were taken into consideration. In addition, as there were multiple data sources, how dwelling types were defined also varied. Residential trip rates were calculated for Single-Family Detached Housing, Multifamily Housing (Low-Rise)[1] and Multifamily Housing (High-Rise)[2]. These groupings were made to best match the different household type classifications from each data source. It has fewer categories in comparison to the *ITE Trip Generation Manual* land use categories because the additional details available from the Local Generator Surveys and the 2011 TRANS

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[1] Low-rise housing refers to any building that houses multiple families that is two storeys or less. For example, semi-detached homes, townhouses and rowhouses.

[2] High-rise housing refers to any building that houses multiple families that is three storeys or more. For example, apartment and condo buildings.

Origin-Destination Survey facilitated the merging of some categories. Additional details on how this was carried out are described in **Section 3.1.2 Dwelling Types**.

iii) **Geographic sectors**: The 2009 TRANS Trip Generation Study identified residential trip rates aggregated into geographic sectors. These represented the core, urban, suburban and rural sectors as shown in **Figure 3-1: National Capital Region by Sector**. A review of the previous geographic sectors was carried out to confirm if they remained relevant or if adjustments were required. This is further described in **Section 3.1.3: Geographic Sector Review**.

The resulting residential trip rates are blended rates based on the rates calculated from local generator surveys, the 2011 TRANS Origin-Destination Surveys and the most recent *ITE Trip Generation Manual (10th Edition).*

3.1.1 Time Period

The *ITE Trip Generation Manual* displays trip rates by peak hour. For the TRANS Trip Generation Study, the peak period was chosen as the preferred time period for the following reasons. Firstly, the peak period is more likely to better depict the active and public transportation person-trips, as these trips tend to be more spread out through the morning and afternoon peaks. Secondly, the TRANS Origin-Destination Survey data logs trips throughout the day and does not specify when the peak hour occurs; moreover, the peak hour is not a consistent throughout the NCR and using a peak period results in less subjectivity when selecting the peak time periods across the region.

The local generator surveys and typical traffic data collection within the NCR begin at 7:00 with an AM peak period of 7:00 – 9:30. To be consistent with the data available in the local generator surveys, an AM peak period of 7:00 to 9:30 was carried forward.

3.1.2 Dwelling Types

The definition of dwelling types vary between the *ITE Trip Generation Manual*, the TRANS Origin-Destination Survey and the local generator surveys. Differences are described below.

ITE Trip Generation Manual: The *ITE Trip Generation Manual (8th Edition)* divided the multifamily residential land uses by condominiums and apartments. This distinction was not carried forward in the 10th Edition, where multifamily residential land uses are now differentiated based on the number of floors a building has. The following relevant residential land uses were referenced for this analysis:

— Single-family detached housing

— Multifamily (low-rise): multiple household units on 2 floors

— Multifamily (mid-rise): multiple household units on 3 to 10 floors

— Multifamily (high-rise): multiple household units on 10 or more floors

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Local Generator Surveys: With the number of floors available in the local generator survey data the dwelling types could be categorized in the same way as those land uses noted above from the *ITE Trip Generation Manual (10th Edition).*

TRANS Origin-Destination Surveys: The classification for dwellings within the TRANS Origin-Destination Survey was carried out in a different way than the local generator surveys and presented similar to the land uses defined in the *ITE Trip Generation Manual (8th Edition).* For the analysis, households were grouped into one of the five dwelling types:

— Single-family detached

— Semi-detached

— Row/Townhouse

— Apartment/Condo (tenant)

— Apartment/Condo (owner)

The dwelling types from the TRANS Origin-Destination Survey were organized to be consistent and equivalent to the categories of the *ITE Trip Generation Manual (10th Edition)* and local generator surveys. As such, the semi-detached and row/townhouses in the TRANS Origin-Destination Survey were combined into a new Multifamily (Low-Rise) category. As the number of floors of a dwelling type were not collected as part of the TRANS Origin-Destination Survey it was not possible to distinguish between a mid-rise apartment/condo and a high-rise apartment/condo. Therefore, the multifamily (mid-rise) and multifamily (high-rise) land uses for the local generator surveys and ITE trip rates were combined to align with the TRANS Origin-Destination Survey data. The resulting dwelling types carried forward within this report for the summary of residential trip rates and mode shares are:

— Single-family detached housing;

— Multifamily (low-rise): multiple household units on 2 floors; and

— Multifamily (high-rise): multiple household units on 3 or more floors.

3.1.3 Geographic Sector Review

As previously mentioned, the 2009 TRANS Trip Generation Study presented residential trip generation rates by the four geographic sectors: core, urban, suburban, and rural. Each sector is an aggregate of TRANS' 26 districts (comprised of the 672[3] traffic analysis zones). These geographic sectors and districts are shown in **Figure 3-1: National Capital Region by Sector**.

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[3] The TRANS model is composed of 26 districts further subdivided into 701 traffic analysis zones (29 of which are external zones). The 672 zones represent internal zones only.

Figure 3-1: National Capital Region by Sector

Sectors
- Core
- Suburban
- Urban
- Rural

Source: 2011 TRANS Districts
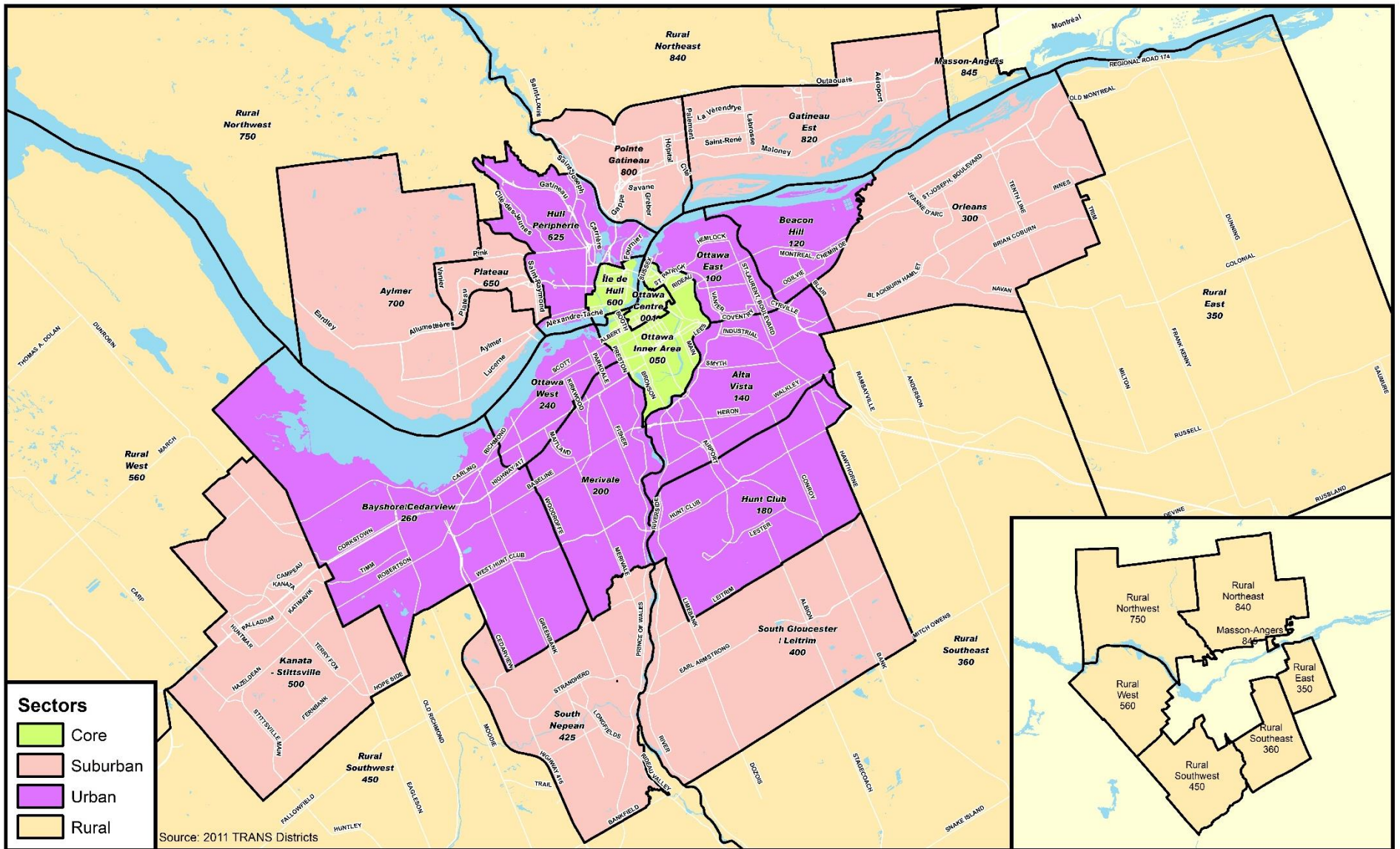
The 2011 TRANS OD Survey data was utilized to carry out a geographic comparison of person-trips by dwelling type to determine whether new geographic sectors should be added or not. **Table 3-1: District and Sector Residential Person-trip Rate by Dwelling Type for Peak Period** shows the average district person-trip rate by dwelling type for the peak period. An initial review of the data indicated that some districts, particularly those bordering two geographic sectors, might more closely relate with the neighbouring geographic sector.

Table 3-1: District and Sector Residential Person-trip Rate by Dwelling Type for Peak Period

District Name	Single- Family		Low-Rise		High-Rise	
	AM	PM	AM	PM	AM	PM
Ottawa Centre	0.75	0.74	1.82	2.53	0.99	0.97
Ottawa Inner Area	1.99	2.18	1.52	1.65	0.84	0.93
Île de Hull	1.22	1.54	1.43	1.77	0.65	0.85
Sector 1: Core - AVERAGE	**1.92**	**2.12**	**1.52**	**1.67**	**0.84**	**0.92**
Ottawa East	1.79	1.74	1.27	1.28	0.68	0.88
Beacon Hill	1.43	1.68	1.18	1.29	0.60	0.73
Alta Vista	1.74	1.79	1.54	1.49	0.80	0.85
Hunt Club	1.95	1.93	1.42	1.54	0.74	0.69
Merivale	1.70	1.82	1.36	1.41	0.78	0.76
Ottawa West	2.01	2.15	1.31	1.55	0.63	0.79
Bayshore / Cedarview	1.73	1.88	1.39	1.49	0.75	0.94
Hull Périphérie	1.54	1.78	1.47	1.50	0.72	0.91
Sector 2: Urban - AVERAGE	**1.75**	**1.86**	**1.38**	**1.45**	**0.72**	**0.84**
Orleans	1.85	2.00	1.11	1.48	0.83	1.08
South Gloucester / Leitrim	2.22	2.66	1.47	1.42	0.87	0.26
South Nepean	1.97	2.14	1.27	1.48	0.95	1.00
Kanata - Stittsville	2.02	2.20	1.25	1.35	0.41	0.78
Plateau	2.20	2.36	1.64	1.98	0.81	0.94
Aylmer	1.65	1.94	1.39	1.67	0.80	0.97
Pointe Gatineau	1.51	1.90	1.51	1.75	0.72	0.95
Gatineau Est	1.40	1.83	1.13	1.51	0.71	0.76
Sector 3: Suburban - AVERAGE	**1.82**	**2.06**	**1.27**	**1.51**	**0.74**	**0.91**
Rural East	1.68	1.79	0.99	1.46	0.72	0.39
Rural Southeast	1.70	1.87	1.15	0.84	0.16	0.32
Rural Southwest	1.62	1.75	0.77	0.74	0.62	0.33
Rural West	1.52	1.77	1.08	1.31	1.05	0.78
Rural Northwest	1.44	1.63	1.21	1.39	1.45	0.90

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District Name	Single- Family		Low-Rise		High-Rise	
	AM	PM	AM	PM	AM	PM
Rural Northeast	1.46	1.74	0.85	1.18	0.92	0.85
Masson-Angers	1.34	1.70	1.30	1.74	0.60	0.80
Sector 4: Rural - AVERAGE	**1.54**	**1.75**	**1.18**	**1.53**	**0.78**	**0.76**

The residential person-trip rates in **Table 3-1: District and Sector Residential Person-trip Rate by Dwelling Type for Peak Period** are conditionally formatted to demonstrate the variability based on geographic sector and dwelling type (dark green representing the highest person-trip rate to red representing the lowest). While there are some individual rate outliers, there is no discernable pattern by geographic sector or district. For example, in the district of Ottawa West (located in the Ottawa Inner Area district), the residential trip rates for single-family homes are more in line with those within the Core whereas the low-rise units rates are consistent with what would be expected within the Urban sector (**Table 3-2: District and Sector Residential Person-trip Rate by Dwelling Type for Peak Period**).

Table 3-2: District and Sector Residential Person-trip Rate by Dwelling Type for Peak Period

Location	Single- Detached		Low-Rise		High-Rise	
	AM	PM	AM	PM	AM	PM
Sector 1: Core	1.92	2.12	1.52	1.67	0.84	0.92
Ottawa West	**2.01**	**2.15**	**1.31**	**1.55**	**0.63**	**0.79**
Sector 2: Urban	1.75	1.86	1.38	1.45	0.72	0.84

For districts that had more variance from the average rates of the sector, a more in-depth review was carried out to identify if this was a result of the district not being well represented within that sector or if there were other factors causing the difference. Two factors were found to have a large influence on the variance of district person-trip rates from the average rate for that sector: i) sample size and ii) household size.

i)   **Sample size:** The TRANS Origin-Destination survey's sample size is 5% of the NCR. Where there are low numbers of a certain dwelling type, the sample size from the survey is even smaller due to a low number of responses. Examples of this include:

— Single-family detached dwellings in the Core;

— Low-rise dwellings in the Core; and

— Low-rise and High-rise dwellings in the Rural sector.

ii) **Household size:** In some instances, the average household size is substantially higher than other districts within the same sector, thereby over-representing the number of person-trips. Examples of this include:

— Detached Dwellings in South Gloucester/Leitrim and Plateau have occupancy rates of 2.69 and 2.64 respectively; this is 5-7% higher than the average occupancy (2.51) for other Suburban districts.

In general, there is noticeable change in person-trip rates between various dwelling types. Consistent for each geographic sector, the single-family dwellings units have the highest residential person-trip rate, while the high-rise dwellings have the lowest. Given that there is not much difference in trip rates by district or geographic sector, the residential person-trip rates carried forward were only categorized by dwelling type.

3.2 Residential Trip Generation Rate Analysis

An analysis on each of the three data sources: local generator surveys, the TRANS 2011 Origin-Destination survey and the *ITE Trip Generation Manual (10th Edition)* was carried out to identify residential person-trip rates by dwelling type. The analysis for each data source is described in the following sections. In each case, residential trip generation rates are represented as person-trip rates.

3.2.1 Local Generator Surveys

Traffic counts for trip generation studies need to be conducted in a manner that identifies all person-trip travel to/from the site by all modes. Surveys in the City of Ottawa were undertaken using the City's Cordon Count Program methodology, with surveyors recording trips entering and leaving the site over the typical 12-hour count period (7:00 AM to 7:00 PM). The City of Gatineau also followed a similar methodology for the trip generation studies; however, the period of the count was reduced to 8 hours (7:00 AM to 10:00 AM, 11:30 AM to 1:30 PM and 3:00 PM to 6:00 PM). All person-trips leaving and/or entering the site were observed and recorded, including walking and cycling trips, to fully identify the total number of person-trips generated by the surveyed land use.

Data Review

From 2008 to 2012, TRANS carried out 55 local generator surveys in the NCR. Of the 55 surveys, two were commercial sites (both located in Gatineau) and four had multiple residential land uses (single-family homes and low-rise units) within the same survey. The single use residential surveys were carried forward for analysis, and they are summarized by year and land use type in **Table 3-3: Summary of Local Generator Surveys by Year and Land Use**. It is noted that only one of the local generator surveys were conducted in Gatineau.

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Table 3-3: Summary of Local Generator Surveys by Year and Land Use

ITE Land Use Code	Household Type	2008	2010	2011	2012	Total
210	Single-Family Detached Housing	6	0	0	0	**6**
220	Multifamily Housing (Low-Rise)	2	0	0	11	**13**
221	Multifamily Housing (Mid-Rise)	0	3	3	0	**6**
222	Multifamily Housing (High-Rise)	3	12	9	0	**24**

The ITE definition of multifamily housing low-rise units (land use code 220) are those with two storeys or less. Mid-rise units (221) are those with three to ten storeys, and high-rise (222) are those with more than ten storeys. As shown in **Table 3-3: Summary of Local Generator Surveys by Year and Land Use**, there were six studies carried out at mid-rise buildings. As discussed above, the multifamily (mid-rise) were combined with multifamily (high-rise) to form one multifamily (high-rise) land use category, defined as multifamily dwellings with three or more floors. This is described previously in **Section 3.1.2 Dwelling Types**. All multifamily (mid-rise) local generator surveys will be referenced as high-rise surveys.

An analysis of the 49 surveys found six had data collection inconsistencies. One survey (high-rise from 2011) had to be removed from the data set as the survey had been conducted on the wrong location. The other five surveys (low-rise from 2012) had omitted several ingress/egress points that would be used by transit riders, pedestrians and cyclists. To retain data collected at these five survey sites, the raw data from each was used to identify a vehicle trip rate. Using the auto (driver) mode share of the districts that contain these survey sites (see **Section 4 Development of Residential Mode Share)** the vehicle trip rate was converted to a person-trip rate. The results of these conversions are summarized in **Table 3-4: Local Generator Surveys – Data Adjustments**.

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Table 3-4: Local Generator Surveys – Data Adjustments

Location	District	Sample Size (Households)	District Auto (Driver) Mode Share		Person-Trip Rate	
			AM Peak Period	PM Peak Period	AM Peak Period	PM Peak Period
Ambassador Avenue at City Park Drive	Beacon Hill	115	45%	48%	1.82	2.46
Crestlea Crescent at Dalehurst Drive	Merivale	41	44%	44%	2.27	1.50
Southgate Road at Johnston Road	Hunt Club	257	44%	47%	0.29	0.82
McClure Crescent at McClintock Way	Kanata-Stittsville	125	52%	58%	1.04	0.62
Woodridge Crescent at Bayshore Drive	Bayshore/ Cedarview	101	43%	44%	0.57	1.32

An assessment of the residential trip generation rates, based on local generator survey, was carried out to identify any outliers in the results that could potentially influence the findings. Each of the residential person-trip generation rates (inbound and outbound trips) were plotted against the number of households for the AM and PM peak periods. These are shown in **Figure 3.2: Peak Period Household Trip Rates** – Local Generator Surveys.
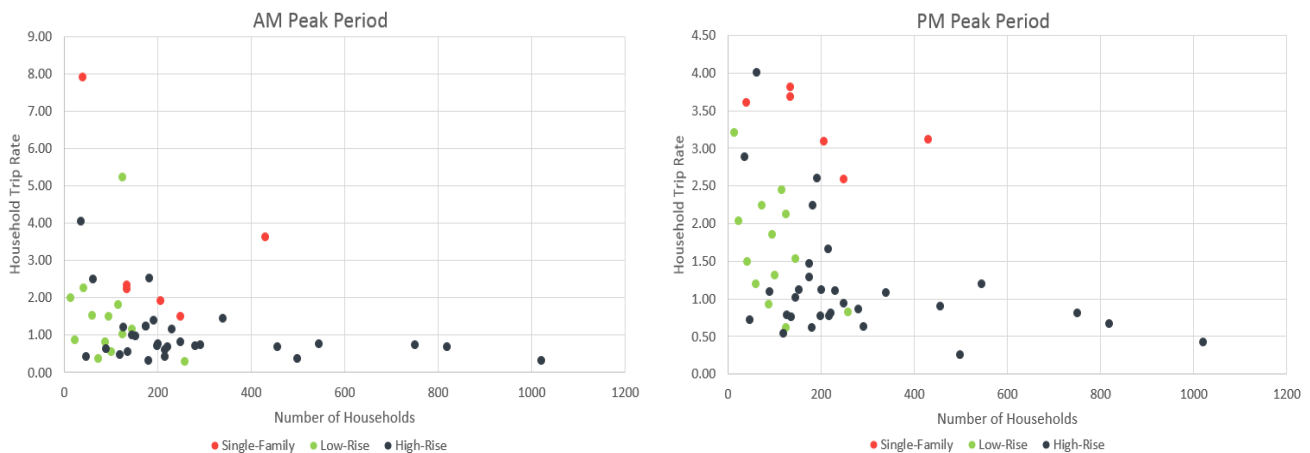
Figure 3.2: Peak Period Household Trip Rates – Local Generator Surveys

The methodology for identifying outliers was carried out in the following steps:

— Calculate the person-trip rates for each local generator survey.

— Calculate the average trip rates of all surveys, categorized by dwelling type within each peak period.

— Compute the difference between each local generator survey rate and their dwelling type average rate. Note, each survey has one difference value for the AM peak period and one for the PM peak period.

— Any part-surveys (one of AM or PM peak period rates) with a difference greater than or equal to one[4] was considered an outlier and removed.

The above methodology removed the high-end outliers but was less effective in removing the surveys with trip rates that were demonstratively low. Thus, any part-survey with a household trip rate of less than 0.35[5] trips during each peak period was removed. In total, 16 part-surveys were removed from the analysis. The distribution of part-surveys removed is shown in **Table 3-5: Local Generator Survey – Outliers**, with the total number of household units removed shown in parentheses.

Table 3-5: Local Generator Survey – Outliers

Household Type	Outlier		Low-End Outlier	
	AM Peak Period	PM Peak Period	AM Peak Period	PM Peak Period
Single-Family Detached Housing	2 (289)	0	0	0
Multifamily Housing (Low-Rise)	3 (454)	1 (14)	1 (257)	0
Multifamily Housing (High-Rise)	3 (279)	4 (470)	2 (1,200)	1 (499)

Residential Trip Generation Rates

With the data adjustments and verification above complete, the residential trip generation rates by dwelling type were calculated for the local generator surveys by weighting each survey based on the number of households (i.e. a survey with 500 households had a greater effect than one with only 50). The resulting residential trip generation rates (inbound and outbound) based on the local generator surveys are summarized in **Table 3-6: Local Generator Surveys-Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)** and detailed in **Appendix A**.

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[4] The value of one was selected based on engineering judgement when reviewing the data.
[5] Cut-off value was selected where there was a "jump" in the trip rates by survey. The AM surveys had only one value between 0.34 and 0.43, and there were no PM surveys with rates between 0.26 and 0.43.

Table 3-6: Local Generator Surveys- Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)

ITE Land Use Code	Dwelling Unit Type	Peak Period	Person-Trip Rate
210	Single-Detached	AM	2.86
		PM	3.16
220	Multi-Unit (Low-Rise)	AM	1.27
		PM	1.45
221+222	Multifamily (High-Rise)	AM	0.80
		PM	0.86

3.2.2 2011 TRANS OD Survey

As mentioned in **Section 2: Trip Generation – Data Sources**, the 2011 TRANS OD Survey was administered by TRANS committee and represents the most comprehensive area-wide survey of local resident-based travel behaviour. The survey, conducted by phone interview, is designed to provide detailed information on the number of daily trips by residents, the reason for their trips and the mode used. Other variables such as household type and location, age, employment status, and vehicle ownership per household, captured in the survey, impact the number and purpose of trips made to/from individual households. The *2009 TRANS Trip Generation Study Report* considered that household composition factors like age and number of persons vary across housing types and therefore potentially have a considerable impact on the reported trip rates. In the end, the OD sample that excluded the households with persons older than 55 years of age was carried forward for analysis based on the assumption that most new residential development proposals would have household residents of ages less than 55. By removing survey respondents older than 55 years of age, the impact of these older households with lower than average trip rates would be removed from the recommended trip rate. This assumption was not carried forward for this study because it was considered to not fairly represent all household demographics. Instead, age was considered as an influencing factor for developments specifically targeted towards older adults (discussed further in **Section 7 Influencing Factors**).

Data Review

The data produced from the TRANS Origin-Destination Survey are based on detailed household interviews. Most often the surveyor speaks to one member of the household, who is asked to provide details regarding all trips made by members of the household during the previous day. This method may lead to underreporting since the responding member may not be as familiar with the details of all trips taken to/from the household, especially those conducted during off-peak travel times.

Additionally, to assure that only home-based trips (trips to or from the residence) were being used to identify residential person-trips, only trips with matching traffic zones (TAZs) to the

household address were included. Since each district contains a number of TAZs, the proposed approach provides finer granularity when analyzing trip patterns. Thus, for the AM peak period, only trips with a matching origin and home TAZ were used in the residential trip rate calculation. Similarly, for the PM peak period, only trips with a matching destination and home TAZ were used.

Non-Residential Trip Factor

While the methodology discussed above does account for most trips made by persons within the household, it excludes non-resident trips to the residential developments, such as service vehicles making trips to residential homes like for maintenance activities or delivery vehicles and private home child care operations or similar home-based businesses.

To account for these trips, a commercial vehicle factor was applied to each residential trip rate. The data from the local generator surveys was reviewed to provide an estimation of non-residential-based travel within residential neighbourhoods. The result was that 3.1% of all trips were not passenger vehicles. A commercial vehicle factor of 1.03 was carried forward.

Residential Trip Generation Rates

The residential person-trip rates based on the 2011 TRANS OD Survey are summarized in **Table 3-7: TRANS Origin-Destination Survey Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)** and include the commercial vehicle factor of 1.03.

Table 3-7: TRANS Origin-Destination Survey Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)

ITE Land Use Code	Dwelling Unit Type	Peak Period	Person-Trip Rate
210	Single-Detached	AM	1.79
		PM	1.99
220	Multi-Unit (Low-Rise)	AM	1.36
		PM	1.54
221+222	Multifamily (High-Rise)	AM	0.78
		PM	0.90

3.2.3 ITE Trip Generation Manual

The local generator surveys (**Section 3.1.2 Dwelling Types)**, identified the person-trips as those entering and/or leaving the site. The approach and methodology are consistent with the trip generation studies submitted to the ITE and published in the *ITE Trip Generation Manual*. As previously indicated in **Section 2 Trip Generation – Data Sources**, there are concerns and limitations regarding the application of ITE rates to a local context. Most notable is that most land use categories within the *ITE Trip Generation Manual* report vehicle trip rates by peak hour, requiring conversion of the reported trip rates to peak period rates, in accordance with

the City of Ottawa TIA Guidelines. The application of the different conversion factors can result in discrepancies between TIA submissions.

Data Review

The peak hour residential trip generation rates (vehicle) for single-family detached, low-rise, mid-rise and high-rise units and taken directly from the *ITE Trip Generation Manual (10th Edition)*, are summarized in **Table 3-8: ITE Residential Trip Generation Rates**. The peak hour trip range column demonstrates the variability between survey locations. The data was first reviewed to consider the potential of isolating only Canadian sites, but the result was a large reduction in the data set, which was considered too small to estimate residential trip rate. To retain the largest data set, the residential trip generation rate studies were not limited to Canadian sites only. In addition, the mid-rise and high-rise categories were combined to be consistent with the housing categories of the local generator survey and the 2011 TRANS Origin-Destination Survey. The combined mid-rise and high-rise rates are shown in the last row of the table.

Table 3-8: ITE Residential Trip Generation Rates

ITE Land Use Code	Residential Land Use	Pk Hr	Number of Studies	Average No. of Units	Peak Hour Trip Rate	Peak Hour Trip Range	Canadian Surveys
210	Single-Family Detached	AM	157	231	0.76	0.36 - 2.27	No Canadian sites
		PM	165	217	1.00	0.49 - 2.98	
220	Multifamily (Low-rise)	AM	36	161	0.56	0.34 - 0.97	Data from BC & Ontario
		PM	35	146	0.67	0.41 - 1.25	
221	Multifamily (Mid-rise)	AM	48	225	0.32	0.06 - 0.77	Data from Alberta, BC & Ontario
		PM	47	211	0.41	0.09 - 1.26	
222	Multifamily (High-rise)	AM	24	405	0.34	0.21 - 0.55	Data from Ontario
		PM	26	385	0.39	0.29 - 0.59	
221+222	High-rise	AM	72	285	0.33	0.06- 0.77	Data from Alberta, BC & Ontario
		PM	73	273	0.40	0.09- 1.26	

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The *City of Ottawa Transportation Impact Assessment Guidelines (2017)* provides a factor of 1.28 for converting from vehicle to person-trips. Factors to convert from peak hour to peak period by time of day were drawn from the 2011 TRANS Model and provided by TRANS. For person-trips the conversion factors are 2.00 and 2.26 for the AM and PM, respectively. Vehicle trips have conversion factors of 2.09 and 2.25 for the AM and PM, respectively. The complete list of adjustment and conversion factors for residential trip generation rates is shown in **Table 3-9: Adjustment Factors for Residential Trip Generation Rates**.

<p style="text-align:center">**Table 3-9: Adjustment Factors for Residential Trip Generation Rates**</p>

Factor Title	Application	Apply To	Period	Factor
Commercial Vehicle Factor	To account for **non-resident-based travel** related to residential land uses, such as service vehicles making trips to residential homes and home-based child care. Applicable to residential trip rates estimated based on the TRANS OD survey to account for non-residential trips bound to residential developments.	Residential person-trip rates	All	1.03
Person-Trip Conversion Factor	**Vehicle to person-trip conversion**, to normalize the measure of trip rates for all data sources. Applicable to the ITE trip generation rates, which are mainly reported as vehicle trip rates.	Vehicle trip rates	All	1.28
Peak Period Conversion Factor	**Peak period to peak hour conversion** because the 2020 TRANS Trip Generation Study reports trip generation rates by peak period. If the practitioner requires peak hour rates, these factors may be applied to the 2020 TRANS Trip Generation Study AM and PM peak period trip generation rates.	Person-trip rates per peak period	AM	0.50
			PM	0.44
		Vehicle trip rates per peak period	AM	0.48
			PM	0.44
		Transit trip rates per peak period	AM	0.55
			PM	0.47
		Cycling trip rates per peak period	AM	0.58
			PM	0.48
		Walking trip rates per peak period	AM	0.58
			PM	0.52

Residential Trip Generation Rates

The vehicle to person-trip conversion factor of 1.28 and the applicable time of day conversion factors were applied to the *ITE* vehicle rates to estimate the peak period person trip rates. The resulting residential person-trip rates based on the *ITE Trip Generation Manual (10th Edition)* are provided in **Table 3-10: ITE Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)**.

Table 3-10: ITE Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)

ITE Land Use Code	Dwelling Unit Type	Peak Period	Person-Trip Rate
210	Single-Detached	AM	2.03
		PM	2.88
220	Multi-Unit (Low-Rise)	AM	1.50
		PM	1.93
221+222	Multifamily (High-Rise)	AM	0.86
		PM	1.15

3.2.4 Blended Residential Person-Trip Rates

A blended rate was developed to consider local trends while using the regional and international data sources to ensure the development of reliable trip rates and have sufficient data sets. Given the difference in sample size, location of studies, and data collection methodology previously discussed, a rank-sum weights method was carried forward. The rank-sum weights method ranks the data sources based on reliability and then distributes the weights using the following equation:

$$wt_i = \frac{K - r_i + 1}{\sum_{j=1}^{K} K - r_j + 1}$$

Here, K is the number of data sources and r is the rank associated with that data source. With only three data sources the weights used were based on rankings from 1 to 3, with 1 being the most desirable. The three data sources were ranked and weighted as first (Weight = 0.50), second (Weight = 0.33) or third (Weight = 0.17).

To rank the three data sources, the study participants as well as other municipal representatives were provided with a worksheet identifying the sample size by data source and resulting residential trip generation rates and were asked to rank the data sources. The sample size (number of households) for each data source, categorized by dwelling type, and the resulting residential trip generation rates (person-trips for the peak period) are summarized in **Table 3-11: Sample Size by Data Source (number of households)** and **Table 3-12: Residential Trip Generation Rates by Dwelling Type (person-trips, peak period),** respectively.

Table 3-11: Sample Size by Data Source (number of households)

Data Source	Single-Family		Low-Rise		High-Rise	
	AM	PM	AM	PM	AM	PM
Local Generator Surveys	902	1,191	804	1,244	6,861	7,371
2011 TRANS OD Survey	13,220	13,220	5,299	5,110	5,412	5,412
ITE Trip Generation Manual	36,267	35,805	5,796	5,110	12,078	12,368

Table 3-12: Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)

Data Source	Single-Family		Low-Rise		High-Rise	
	AM	PM	AM	PM	AM	PM
Local Generator Surveys	2.86	3.16	1.27	1.45	0.80	0.86
2011 TRANS OD Survey	1.79	1.99	1.36	1.54	0.78	0.90
ITE Trip Generation Manual	2.03	2.88	1.50	1.93	0.86	1.15

The study participants providing rankings were also made aware of the data modifications that were required for each data source, as outlined in the previous sections. Once each representative had submitted their rankings individually, a session was held for all rankings to be reviewed and a consensus was reached on which ranking would be carried forward for each dwelling type, the results are shown in **Table 3-13: Data Source Rankings by Dwelling Type**. The participants generally favoured the TRANS Origin-Destination Survey due to its local context and large sample size. After that, participants favoured the ITE rates for single-family detached housing over the local generator surveys since it has a much greater sample size. When the ITE sample size was closer to the other data sources, as was the case for low-rise and high-rise, then the local generator survey rates were preferred due to their local context.

Table 3-13: Data Source Rankings by Dwelling Type

Source	Single-Family	Low-Rise	High-Rise
Local Generator Surveys	3rd	2nd	2nd
2011 TRANS OD Survey	1st	1st	1st
ITE Trip Generation Manual	2nd	3rd	3rd

Applying the weightings to each data source ranking by dwelling type, the blended residential trip generation rates were estimated and are summarized in **Table 3-14: Recommended (Blended) Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)**Table 3-14: Recommended (Blended) Residential Trip Generation Rates by Dwelling Type (person-trips, peak period).

Table 3-14: Recommended (Blended) Residential Trip Generation Rates by Dwelling Type (person-trips, peak period)

ITE Land Use Code	Dwelling Unit Type	Peak Period	Person-Trip Rate
210	Single-Detached	AM	2.05
		PM	2.48
220	Multi-Unit (Low-Rise)	AM	1.35
		PM	1.58
221+222	Multifamily (High-Rise)	AM	0.80
		PM	0.90

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4 DEVELOPMENT OF RESIDENTIAL MODE SHARE

4.1 Approach and Methodology

Identifying existing mode shares is part of the *City of Ottawa Transportation Impact Assessment Guidelines (2017)* (Element 3.1.1: Trip Generation and Mode Shares). The process outlined in the *TIA Guidelines* is to consult the most recent NCR Origin-Destination survey to determine the mode share for the Traffic Assessment Zone (TAZ) where the development is located. As the most comprehensive data source of residential trips, the 2011 TRANS Origin-Destination Survey data was used as the data source to develop residential mode shares at the district level (26 districts). The analysis was broken down into five modes, as reported in the TRANS Origin-Destination Survey: Auto Driver, Auto Passenger, Transit, Cycling and Walking[6] to reflect the full range of transportation options being selected[7]. To remove non-residential trips and reflect the mode share of the household, only outbound trips for the AM Peak and inbound trips for the PM Peak were considered.

As with the residential trip generation rate development, three of the key criteria considered in the mode share analysis include the time period, dwelling type and geographic sector. In addition to this, multi-modal trips were also considered.

i)   **Time period**: For the same rationale as the residential trip generation rate development (see **Section 3.1.1**), the peak periods (AM: 7:00 to 9:30 and PM: 15:30 to 18:00) were analyzed to provide an inclusive representation of the modes. This is because transit and active mode trips may have a different peak within the period than vehicle trips.

ii)   **Dwelling type**: As with the residential trip generation rates, the mode share was analyzed for each of the three dwelling types defined in **3.1.2 Dwelling Types**. Mode share by dwelling type can be found in **Appendix D**.

iii)   **Multi-Modal trips**: While multi-modal trips are not explicitly included in the mode share options listed above, they were considered in the analysis to identify the modes used to/from the development. The TRANS Origin-Destination Survey data reports the sequencing of trips and indicates the primary mode of transportation. The multi-modal trips of interest for residential mode share are those for which the primary mode is transit, but that used a different mode of transportation as their first trip (e.g. cycling or vehicle (Park & Ride)).

iv)   **Geographic Sector**: While the geographic sector was found to not influence the number of trips a household generates, the mode share results tend to vary by geographic sectors. This is directly related to the available transportation facilities and

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[6] This differs from the 2009 TRANS Trip Generation Report which did not include the breakdown for Auto Passengers and combined cycling and pedestrian modes together into a single non-motorized category.
[7] Other transportation modes included airplane, ferry, intercity bus, VIA Rail Train, etc. This consists of only 0.4% of all trips. For this analysis, these trips were omitted.

demographics within an area. The analysis is detailed in **Section 4.4 Geographic Sectors Review**.

4.2 Dwelling Type

To be consistent with the residential trip rate development, the dwelling types considered in the mode share analysis for residential developments are: single-family detached housing, multifamily housing (low-rise) and multifamily housing (high-rise)[8].

Since the TRANS Origin-Destination Survey classifies dwellings differently, some dwelling types were combined to match those defined in **Section 3 Development of Residential Trip Generation Rates**. Thus, semi-detached and row/townhouses were combined into a new low-rise category, and apartment/condo (tenant) and apartment/condo (owner) were combined into a new high-rise category. The single-family detached category from the TRANS OD Survey did not require any changes because the definition is the same as the ITE single-family detached land use category.

4.3 Multi-Modal trips

While the primary mode of transportation for some trips is transit, this may not be the mode of transportation taken from home. For example, if transit is accessed from a Park & Ride (P&R) facility, the first trip away from home would be by vehicle. The multi-modal trip analysis was considered in this study to account for these types of trips (the auto leg of the trip) and to provide guidance into the overall mode share estimation of a development.

Included with the TRANS Origin-Destination Survey data are the sequencing of modes and primary mode for multi-modal trips. The multi-modal trips of interest for the mode share analysis of residential developments are those with transit as the primary mode, but that use a different mode to access the transit stop. Three multi-modal options are considered in the analysis as follows:

— Park and Ride (P&R) trips, which include an Auto Driver and Transit trip, accounted as Auto Driver trip in the analysis;

— Kiss and Ride (K&R) trips, which include an Auto Passenger and Transit trip, accounted as an Auto Passenger trip; and

— Bike and Ride / Rack and Roll trips, which include a Cycling and Transit trip, accounted as a Cycling trip.

P&R trips during the AM peak period were identified in the TRANS Origin-Destination Survey database based on the following attributes: more than one mode in the trip, Transit as primary mode, Auto Driver as mode 1 and Transit as mode 2. A similar identification system was used for the AM peak period K&R (Auto Passenger as mode 1 and Transit as mode 2) and Bike and

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[8] Defined as any multifamily building of three storeys or more.

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Ride trips (Bike as mode 1 and Transit as mode 2). Multi-modal PM peak period trips were analyzed in the reverse order (Transit then Auto Driver/Auto Passenger/Bike), where the trip was classified as the mode used to arrive home.

It should be noted that walk trips to a transit stop were not included in the mode share analysis and maintained as Transit trips.

4.4 Geographic Sectors Review

As with the development of the residential trip generation rates, the geographic sectors previously defined in the 2009 TRANS Trip Generation Study were reviewed to identify if any limits should be refined and if the mode shares differ by geographic sectors. The four previously defined geographic sectors are shown in **Figure 3-1: National Capital Region by Sector.** As the most common mode of transportation and due to the larger variation in mode share across the geographic sectors, the Auto Driver mode was used to assess mode share variation across the 26 districts and the three dwelling categories used in the residential trip generation rate development. The AM and PM peak period Auto Driver mode share results are shown in **Table 4-1: Auto Driver Mode Share by District (Peak Period)**. The coloured conditional formatting illustrates the variation in mode share by district (large variation from the colour of a sector to a district within that sector indicates a wide variation in mode share) . However, as was discussed in the residential trip generation rate development, some of these outliers are a result of small sample sizes. They are discussed in detail below.

Table 4-1: Auto Driver Mode Share by District (Peak Period)

District Name	Single- Family		Low-Rise		High-Rise	
	AM	PM	AM	PM	AM	PM
Ottawa Centre	36%	68%	24%	30%	18%	17%
Ottawa Inner Area	36%	35%	27%	31%	26%	25%
Île de Hull	46%	53%	36%	34%	27%	26%
Sector 1: Core - AVERAGE	37%	36%	27%	31%	25%	24%
Ottawa East	45%	48%	36%	39%	39%	40%
Beacon Hill	51%	52%	45%	48%	48%	52%
Alta Vista	49%	52%	38%	38%	38%	45%
Hunt Club	48%	51%	44%	47%	39%	44%
Merivale	52%	54%	44%	44%	41%	41%
Ottawa West	43%	43%	36%	35%	28%	33%
Bayshore / Cedarview	49%	52%	43%	44%	40%	40%
Hull Périphérie	49%	51%	46%	46%	48%	47%

District Name	Single- Family		Low-Rise		High-Rise	
	AM	PM	AM	PM	AM	PM
Sector 2: Urban Area - AVERAGE	49%	51%	42%	44%	40%	42%
Orleans	48%	54%	47%	51%	54%	61%
South Gloucester / Leitrim	54%	55%	59%	62%	60%	87%
South Nepean	51%	53%	49%	49%	58%	54%
Kanata - Stittsville	52%	56%	52%	58%	43%	55%
Plateau	47%	49%	44%	47%	53%	65%
Aylmer	53%	55%	52%	52%	45%	31%
Pointe Gatineau	55%	55%	46%	52%	44%	52%
Gatineau Est	54%	60%	54%	56%	53%	61%
Sector 3: Suburban - AVERAGE	51%	55%	50%	53%	49%	55%
Rural East	59%	69%	63%	57%	72%	100%
Rural Southeast	58%	66%	70%	64%	62%	0%
Rural Southwest	60%	67%	71%	65%	65%	100%
Rural West	61%	69%	69%	53%	100%	76%
Rural Northwest	61%	65%	46%	52%	63%	49%
Rural Northeast	60%	66%	71%	83%	57%	65%
Masson-Angers	62%	62%	60%	63%	64%	65%
Sector 4: Rural - AVERAGE	60%	66%	61%	63%	63%	64%

The assessment focused on districts that bordered two geographic sectors. The key observations and resulting actions can be summarized as follows:

— Auto Driver mode share for the Ottawa West district / multifamily (high-rise) dwelling type more closely resembles those of the Core than the Urban districts. The Ottawa West district's proximity to rapid transit services and presence of active transportation facilities appear to contribute to this difference. Proximity to rapid transit and active transportation facilities have been carried forward as influencing factors (see **Section 6 Development of Non-Residential Mode Share**).

— The South Gloucester/Leitrim multifamily (low-rise) Auto Driver mode share results more closely resemble the rural districts than the suburban districts. At the time of the 2011 TRANS Origin-Destination Survey, the district had the smallest population of any non-rural

districts in Ottawa[9]. This is expected to have changed in recent years due to the development of additional transit infrastructure and the connection to South Nepean through the Strandherd-Armstrong Bridge.

— The noticeable difference in Auto Driver mode share between geographic sectors could justify maintaining the geographic sector division for mode shares. However, upon further review, there is also differences between districts within the same geographic sector. For example, Auto Driver mode share for the districts of Orleans and Kanata-Stittsville within the Suburban Geographic Sectors vary by 2-11%. As such the decision was made to carry forward the mode share distributions for each of the 26 districts, as opposed to aggregating them at the geographic sector level, unless a district has a small sample size (see next observation).

— The Rural districts have very inconsistent mode share results for the low-rise and particularly for the high-rise dwelling categories. This is due to the very small sample size of these dwelling types in the Rural sector. The same is true for the single-detached dwellings in Ottawa Centre where the mode share is 36% Auto Driver during the AM peak period and 68% during the PM peak period. To account for these inconsistencies related to low sample sizes, a sample size of 50 was adopted as a threshold value. If a district/ dwelling category, like single-detached dwellings in Ottawa Centre, does not meet the threshold sample size, then the mode share would be based on the average value of the geographic sector, and not the individual district. The small sample size was common throughout the Rural districts for multifamily low-rise and high-rise dwelling units. As such, all Rural districts were combined with the exception of the Masson-Angers district. The mode share for Masson-Angers was calculated separately for the following reasons:

    — The sample size is large enough for single-detached and low-rise dwellings;

    — The AM Walking mode share (11%) is higher than the average share of all other Rural districts (2%) for single-detached dwellings;

    — The AM Transit mode share (13%) is lower than the average share of all other Rural districts (24%) for single-detached dwellings;

    — The PM Auto Driver mode share (62%) is lower than the average share of all other Rural districts (67%) for single-detached dwellings; and,

    — Notably, the AM Auto Driver mode share (60%) is lower than the average share of all other Rural districts (66%) for low-rise dwellings.

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[9] Orleans: 117,400; South Gloucester/Leitrim: 17,600; South Nepean: 72,700; Kanata/Stittsville: 105,200 (Source: National Capital Regional Travel Trends, 2016)

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4.5 Residential Mode Shares

As can be expected the general variation in mode share by dwelling type and across the districts are related to:

— **Dwelling type**: Single-detached dwellings tend to have a higher Auto Driver mode share, likely due to socio-economic factors such as household income and the potential of owning a second vehicle.

— **Proximity to the core**: As distance from the city core increases, so too does the Auto Driver and Passenger mode shares. Areas near the core are typically served with a better transit service and contain an infrastructure that supports active modes.

For simplicity, the combined mode shares by district for the peak periods are summarized in **Table 4-2: Residential Mode Share by District (All Dwelling Types, peak period)**. For identifying the residential mode shares by dwelling type please refer to **Appendix D**.

Table 4-2: Residential Mode Share by District (All Dwelling Types, peak period)

District	Auto Driver		Auto Passenger		Transit		Cycling		Walking	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre	18%	18%	3%	10%	26%	21%	1%	1%	52%	51%
Ottawa Inner Area	29%	29%	8%	9%	25%	19%	7%	7%	31%	36%
Île de Hull	32%	32%	7%	10%	30%	23%	8%	8%	23%	27%
Ottawa East	40%	42%	11%	15%	33%	26%	6%	5%	11%	13%
Beacon Hill	48%	50%	11%	18%	28%	21%	2%	2%	11%	9%
Alta Vista	43%	47%	14%	17%	30%	23%	3%	3%	10%	11%
Hunt Club	45%	48%	12%	16%	35%	27%	1%	1%	6%	7%
Merivale	47%	49%	12%	15%	29%	23%	4%	3%	8%	10%
Ottawa West	38%	39%	13%	13%	27%	18%	6%	7%	16%	24%
Bayshore / Cedarview	45%	47%	13%	16%	31%	25%	2%	1%	9%	11%
Hull Périphérie	48%	48%	15%	16%	25%	21%	3%	3%	9%	11%
Orleans	48%	53%	14%	17%	28%	22%	1%	1%	9%	6%
South Gloucester / Leitrim	56%	57%	23%	23%	13%	11%	1%	1%	7%	8%
South Nepean	50%	51%	14%	17%	26%	20%	1%	1%	9%	10%
Kanata - Stittsville	52%	56%	15%	19%	21%	15%	1%	1%	12%	9%
Plateau	48%	53%	15%	15%	29%	24%	4%	2%	5%	6%
Aylmer	52%	52%	17%	20%	23%	18%	2%	2%	7%	8%
Pointe Gatineau	50%	54%	15%	16%	23%	19%	2%	2%	10%	9%
Gatineau Est	54%	59%	15%	18%	21%	16%	1%	1%	10%	7%
Masson-Angers	61%	62%	13%	17%	18%	15%	1%	1%	7%	5%
Other Rural Districts	60%	66%	14%	17%	24%	14%	0%	0%	2%	2%

5 RESIDENTIAL DIRECTIONAL SPLITS

5.1 Approach and Methodology

Directional splits indicate how vehicular traffic is flowing in and out of a residential development. Based on commuter travel patterns, one would generally expect greater outbound traffic during the AM peak and greater inbound traffic during the PM peak for residential land uses. The methodology adopted for developing the directional splits is similar to that of the 2009 TRANS Trip Generation Study. The direction splits were estimated by averaging the directional splits observed in the local generator surveys and the published ITE splits for the three residential land use categories.

5.1.1 ITE Trip Generation Manual

The *ITE Trip Generation Manual* provides directional splits for each land use category within its directory during the peak hour. The mid-rise and high-rise multifamily land use categories were combined to be consistent with combinations carried out in the residential trip generation rate and mode share development.

5.1.2 Local Generator Surveys

The raw data from the local generator surveys was used in the directional splits calculation by dwelling type. All non-outlier surveys carried out between 2010 to 2012 were used in this analysis, along with the single-family detached house survey data used in the 2009 TRANS Trip Generation Study. Additional details on the local generator data used in the directional split estimation is summarized in **Appendix E**.

5.2 Directional Splits

As expected, the flow of traffic during the AM peak period is heavily skewed towards outbound traffic. However, for the PM directional splits, the difference between inbound and outbound is not significant. This could be attributed to the fact that there are some non-work-based trips during the PM peak period. For instance, a person may return home from work in the afternoon only to leave home to run errands. A greater residential trip rate during the PM peak, as shown in **Section 3**, is evidence of such behaviour. The blended directional splits are shown in **Table 5-1: Directional Splits by Dwelling Type (For Vehicles)**.

Table 5-1: Directional Splits by Dwelling Type (For Vehicles)[10]

Dwelling Type	Time of Day	Local Generator Surveys		ITE		Blended Rate	
		Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Single-Family Detached Housing	AM	33%	67%	26%	74%	30%	70%
	PM	60%	40%	64%	36%	62%	38%
Multifamily Housing (Low-Rise)	AM	32%	68%	28%	72%	30%	70%
	PM	53%	47%	59%	41%	56%	44%
Multifamily Housing (High-Rise)	AM	38%	62%	23%	77%	31%	69%
	PM	55%	45%	61%	39%	58%	42%

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[10] A directional split for active transportation was calculated based on the local generator surveys for low-rise and mid-rise land uses. The splits are mostly in-line with the vehicle directional splits, which could be used as a rough assumption for areas with lower vehicle mode share.

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6 DEVELOPMENT OF NON-RESIDENTIAL MODE SHARE

The local generator surveys that have been carried out focused on residential land uses, and the TRANS Origin-Destination Survey is a home-based survey and does not capture any commercial trips (e.g. deliveries). While respondents of the 2011 TRANS Origin-Destination Survey could select non-residential trip destinations, the selections could be as broad as 'Work' and not include the type of business they are traveling to. To supplement the Origin-Destination Survey, TRANS carried out the Special Generators Survey in 2013 for the NCR. This survey collects data on trip patterns made by both residents and non-permanent-residents and associated with large generators such as universities, sporting venues and entertainment centres. The Special Generator Survey is broken down into three separate reports, described below.

i) **Sports and Entertainment**: Intercept surveys were conducted at major sporting, entertainment, and event venues to better understand trip decision-making of the visitors, including their place of residence and awareness of alternative modes of transportation. Between 2013 and 2014, over 5,000 surveys were completed. After applying the necessary expansion factors, information was provided regarding mode share for NCR residents and Out-of-Town visitors, trip purpose, and trip times. An overall summary of the results was presented by venue and for the Region overall.

ii) **Student Survey**: Surveys were conducted at the six largest post-secondary institutions in the NCR to best understand travel behaviour for students. As with Sports and Entertainment, over 5,000 surveys were conducted between 2013 and 2014. Results were presented by institution and an overall summary of the six institutions surveyed. Differences in results between students living on and off campus and travel behaviour by time of day were also identified. Intra-campus trips and faculty members were not captured by the survey.

iii) **Transportation Terminals**: Intercept surveys were conducted at four major intercity transportation terminals such as the Ottawa Macdonald-Cartier International Airport. Survey respondents included intercity travelers and those who picked them up or dropped them off. In total, nearly 2,500 surveys were completed in 2013. Like the other two Special Generator Surveys, the results were presented by terminal and as an overall summary of the four sites surveyed. The summary results were at times differentiated by intercity and local travelers. The survey aimed to understand the travel decisions made **by** each 'type' of traveler, which included those departing from the NCR, those arriving to the NCR, and those who picked them up or dropped them off.

While the focus of this study was to update the residential trip generation rates and mode shares, the available data was also reviewed to determine whether any mode shares could be

identified for other generators. This section describes the analysis and resulting mode shares for the following land uses:

— **Elementary and High Schools**: These cover schools within the NCR in both Ontario and Quebec. Data used for the analysis was based on the 2011 TRANS Origin-Destination Survey and individual school surveys carried out by a Municipality.

— **Employment Generators**: Mode share by district was developed for the AM peak period work trips based on the work trips of the 2011 TRANS Origin-Destination Survey database.

— **Commercial Generators**: Mode share by district for the AM and PM peak periods were developed for commercial trips (e.g. shopping and household maintenance) based on the 2011 TRANS Origin-Destination Survey database.

6.1 Elementary and High Schools

The schooling systems in the provinces of Ontario and Quebec have several differences and as such the mode shares for Ottawa and Gatineau are summarized separately below. The key differences to consider, which could have a slight impact on the presented results, include:

— The student age cut-off by grade differs slightly between Ontario and Quebec; in Quebec a student's age is taken on September 30th and in Ontario it is December 31st.

— Elementary school in Quebec is defined as Kindergarten through Grade 6, whereas in Ontario it is defined as Kindergarten through Grade 8.

— High school is defined as Grades 7 to 11 and Grades 9 to 12 in Quebec and Ontario, respectively.

The influence of the above differences on mode shares is discussed further below.

Data Review

TRANS Origin-Destination Survey*:* The 2011 TRANS Origin-Destination Survey data was filtered based on trip purpose and age. As the ages of elementary and high school students differ in Quebec and Ontario, the following age filters were used:

— Gatineau: Elementary Students ages 5 to 11; High School Students ages 12 to 16

— Ottawa: Elementary Students ages 5 to 13; High School Students ages 14 to 17

The Origin-Destination survey was carried out in the fall of 2011. Given the age cut-offs for each province it is possible that there are some students within the wrong school classification, depending on when their birthday falls. For example, while it is fair to assume that most sixth graders in Gatineau would have turned 11 at the time of the survey (age cut-off September 30th), in Ottawa there is some percentage of students that could be in high school (Grade 9) but have not yet had their 14th birthday (age cut-off December 31st) and therefore still appear in the elementary school definition. This age differential is not considered to be significant for this analysis.

The TRANS Origin-Destination Survey is the only data source available for schools in Ottawa.

Gatineau Student Surveys*:* Between 2006 and 2018 the Ville de Gatineau carried out student surveys at a number of elementary and high schools within the municipality. Thirty-three elementary schools were surveyed to determine their mode of transportation, with a response rate of about 30%. More recently, seven Gatineau high schools were surveyed as part of the 2018 EN FORME survey that evaluated many elements of the lifestyle of high school students within the municipality, including mode of transportation during the fall and winter terms. The response rate on these surveys was 100%. The average mode share during the fall and winter terms was calculated to best represent the year-round mode share.

6.1.1 *Ottawa/Ontario School Mode Share*

The school trip data available for Ontario was obtained from the TRANS Origin-Destination Survey. As noted above, elementary school trips included students age 5 to 13 and high school trips included students age 14 to 17. The mode shares are summarized in **Table 6-1: Ottawa/Ontario School Mode Share**.

Table 6-1: Ottawa/Ontario School Mode Share[11]

School Type	Auto Pass	School Bus	Transit	Walking	Cycling	Other
Ottawa – Elementary Schools	22%	48%	6%	20%	2%	2%
Ottawa – High Schools	17%	19%	38%	18%	3%	5%

The 6% Transit mode share for Ottawa elementary schools can be attributed to the special service provided by OC Transpo to middle schools (Grades 7 and 8). The school service is revised each year to match bell times.

The way the TRANS Origin-Destination Survey records data limits the ability to track return trips from school, so it was assumed that mode shares for return trips would be similar to mode share for trips to school since only a small number of students are likely to change their travel choices within the day.

While the results from the TRANS Origin-Destination Survey provide a baseline for school mode share within the Region, it was decided through discussion with the project team that the mode shares provided in the TRANS Trip Generation Manual for Ottawa schools should be developed on a site-specific basis by obtaining data from the school principal, school board, surveys or other sources.

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[11] Source: TRANS Origin-Destination Survey

6.1.2 Gatineau/Quebec School Mode Share

The 2011 TRANS Origin-Destination Survey data was also reviewed for school trip mode shares in Gatineau/Quebec. In addition, the Ville de Gatineau has conducted many in-school surveys, which have a much higher number of responses than the TRANS OD Survey's 5% sample size. (30% for elementary schools and 100% for high schools through the EN FORME survey). As noted above, the ages for Quebec schools are 6 to 11 for elementary students and 12 to 16 for high school students. The mode shares by source for both elementary and high schools in Gatineau/Quebec are summarized in **Table 6-2: Gatineau/Quebec School Mode Shares**.

Table 6-2: Gatineau/Quebec School Mode Shares[12]

School Type	Auto	School Bus	Transit	Walking	Cycling	Other
TRANS Origin-Destination Survey						
Elementary Schools	30%	41%	0%	25%	2%	2%
High Schools	28%	36%	20%	13%	1%	2%
Local School Surveys/EN FORME						
Elementary School	43%	26%	0%	27%	4%	0%
High School	19%	0%	61%[13]	17%	3%	0%

The Auto Passenger and School Bus mode shares vary considerably between the two Gatineau sources. All other modes of transportation are approximately the same. The difference between the two sources is likely due to sample size.

The recommendation through discussion with the project team was that for the TRANS Trip Generation Manual, the average mode share from the school surveys should be used for estimates of school trip mode share in Gatineau/Quebec because the sample size is larger, and the results were thought to be more accurate. An outlier analysis was conducted for the elementary school surveys, for which a full breakdown is available in **Appendix F**. The results of the analysis indicated that there was no need to remove any surveys from the average.

6.2 Employment Generators

The AM peak period trips are primarily commuter trips. The TRANS Origin-Destination survey is a residential-based survey and as such the Residential Trip Generation Rates and Residential Mode Shares have been summarized in **Sections 3** and **4**, respectively. The 2011 TRANS Origin-Destination Survey data was assessed to identify if any data could be inferred for work-based trips, and while the trip rates could not be obtained from the data, the trips

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[12] Source: Plans de déplacements scolaires between 2006 and 2018 (elementary schools). Rapport Enquête En Forme, 2018 (high schools)
[13] The EN FORME survey does not distinguish between School Bus and Transit, and thus they are grouped into one category.

identified as 'Travel To Work' trips were analyzed to identify AM peak period mode share based on employment location (26 districts). The TRANS Origin-Destination survey did not provide an option to identify a 'Travel From Work' and, given work-related trips that occur throughout the day and varying working schedules, the data could not be organized so as to provide a PM peak period mode share. All mode share data summarized in this section is therefore for the AM peak period only. Considering the strong tendency of employees to use the same mode of transportation when leaving work, it is fair to approximate the PM peak period employment generator mode shares with the AM peak period.

In contrast to residential mode share, the primary mode in multi-modal trips to an employment generator is used when computing the mode share. For instance, a Park & Ride trip from a residence will count the trip as Auto Driver since that is the mode of transportation used to depart/arrive from the dwelling, as discussed in **Section 4 Development of Residential Mode Share**. A Park & Ride trip to an employment generator will be counted instead as a transit trip (the primary mode) since that is the mode of transportation used to arrive at the employment location.

The same methodology used for estimating residential mode shares was used to identify workplace mode shares. Mode shares were estimated by district and the small sample threshold of 50 was used, as described in **Section 4 Development of Residential Mode Share**. The sample size for each district is displayed in **Figure 6.1: Employment Generator Sample Size**. The only non-rural district that did not meet the sample size threshold was the Plateau district, for which the Suburban district average was used. The complete list of sample sizes for each district is available in **Appendix F**.
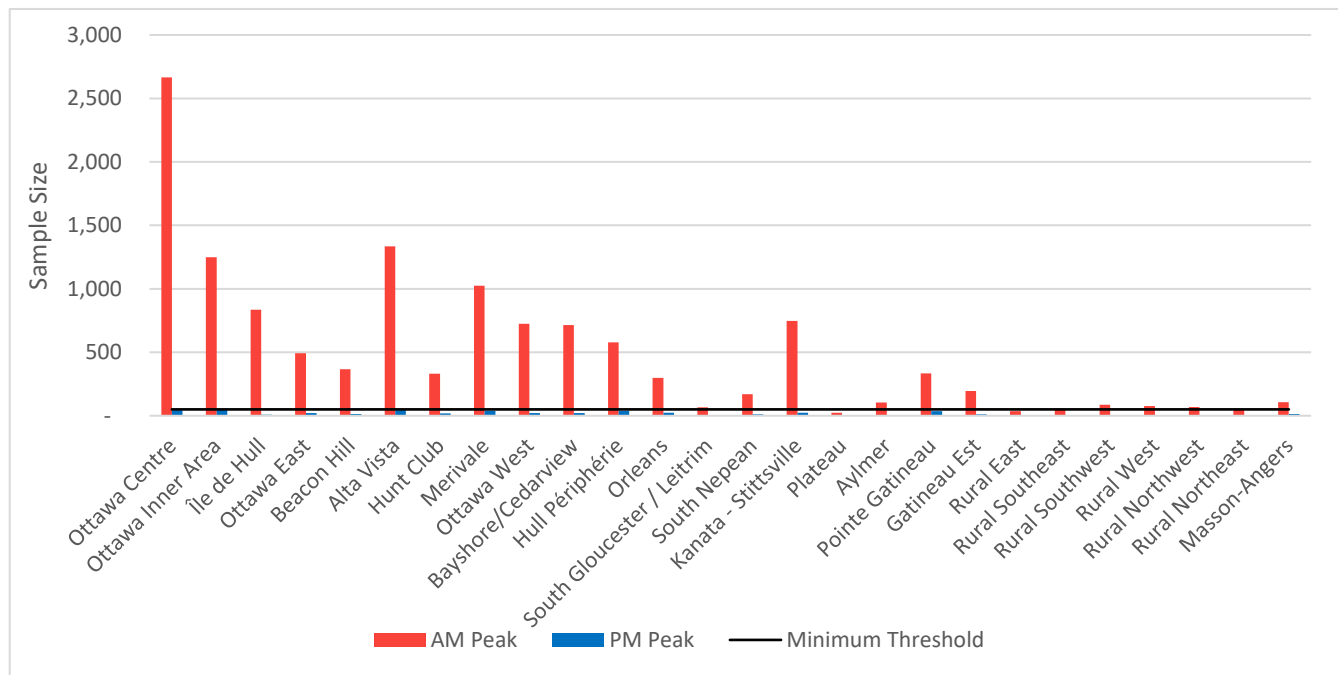
Figure 6.1: Employment Generator Sample Size

While most Rural districts met the minimum sample size threshold, sample sizes were still the smallest compared to the other districts. As such, all Rural districts (with the exception of Masson-Angers) were combined into one district to strengthen the quality of data; this is also consistent with the residential mode shares analysis.

Table 6-3: Employment Generator Mode Share by District (AM Peak Period) provides the mode share by district during the AM peak period for employment generator trips. These trips represent NCR-based workplace trips as they do not include other work-related trips or working on the road trips.

Table 6-3: Employment Generator Mode Share by District (AM Peak Period)

Districts	Auto Driver	Auto Passenger	Transit	Cycling	Walking
Ottawa Centre	24%	7%	54%	4%	11%
Ottawa Inner Area	45%	7%	29%	8%	11%
Île de Hull	40%	9%	40%	5%	6%
Ottawa East	66%	7%	20%	2%	5%
Beacon Hill	73%	6%	16%	2%	3%
Alta Vista	69%	7%	18%	3%	3%
Hunt Club	83%	5%	10%	1%	1%
Merivale	70%	7%	16%	3%	4%
Ottawa West	54%	8%	28%	5%	5%
Bayshore /	77%	6%	10%	3%	4%
Hull Périphérie	75%	7%	12%	3%	3%
Orleans	71%	7%	13%	1%	8%
South Gloucester / Leitrim	89%	7%	2%	1%	1%
South Nepean	80%	10%	5%	1%	4%
Kanata - Stittsville	84%	4%	8%	1%	3%
Plateau	82%	6%	7%	1%	4%
Aylmer	83%	3%	5%	4%	5%
Pointe Gatineau	80%	9%	4%	2%	5%
Gatineau Est	88%	6%	4%	0%	2%
Masson-Angers	89%	3%	2%	1%	6%
Core Districts	32%	7%	45%	5%	10%
Urban Districts	70%	7%	17%	3%	4%
Suburban Districts	82%	6%	7%	1%	4%
Rural Districts	85%	5%	9%	1%	1%

6.3 Commercial Generators

Much like employment generators, the mode share for commercial generators was deduced from the 2011 TRANS Origin-Destination survey data. All trips classified as "shopping,

household maintenance" were grouped together and analyzed as commercial generators. The data analyzed did not include restaurant or recreation trips because these trips are classified separately than other commercial trips in the 2011 TRANS Origin-Destination Survey Data, as they differ in purpose, duration, location, and frequency. The commercial generators instead represent establishments where consumers visit to purchase personal or household items.

Once the shopping and household maintenance trips were isolated a review of the sample sizes for both peak periods demonstrated that fewer of these trips occur in the morning peak period, with most non-rural districts having a sample size between 50 and 100 (only Merivale and Orleans exceeded a sample size of greater than 100). As shown in **Figure 6.2: Commercial Generator Sample Size**, this was not a factor during the PM peak period. A tabular sample size summary is also provided in **Appendix F**.
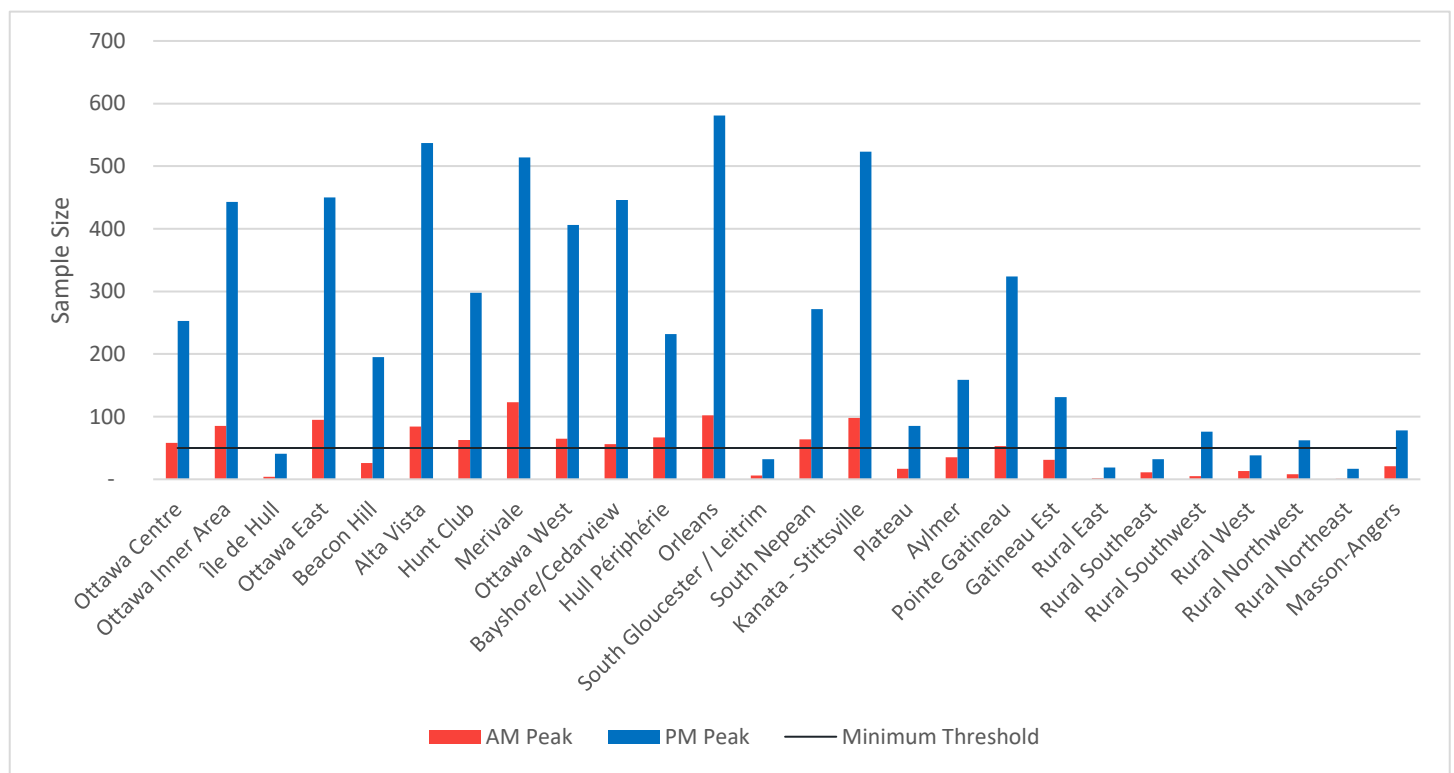
Figure 6.2: Commercial Generator Sample Size

The methodology applied for the residential and employment mode shares was carried into this analysis, including the merging of rural districts (exception Masson-Angers) and use of the geographic sector average for any district with a sample size less than 50. As a result, the geographic sector mode share was applied to six of the non-rural districts in the AM peak period and two non-rural districts in the PM peak period. **Table 6-4: Commercial Generator Mode Share by District** provides the mode share for commercial generators within the NCR by districts.

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Table 6-4: Commercial Generator Mode Share by District

Districts	Auto Driver		Auto Passenger		Transit		Cycling		Walking	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre	28%	19%	3%	12%	48%	30%	1%	2%	20%	37%
Ottawa Inner Area	39%	22%	2%	4%	16%	12%	3%	4%	40%	58%
Île de Hull[14]	34%	22%	2%	7%	30%	18%	2%	3%	32%	50%
Ottawa East	57%	55%	10%	18%	15%	11%	1%	1%	17%	15%
Beacon Hill[15]	67%	59%	12%	18%	8%	7%	0%	1%	14%	13%
Alta Vista	64%	60%	9%	20%	12%	9%	1%	0%	14%	11%
Hunt Club	70%	65%	6%	19%	7%	8%	0%	1%	17%	7%
Merivale	71%	61%	19%	16%	1%	8%	0%	1%	9%	14%
Ottawa West	55%	50%	11%	16%	11%	11%	0%	5%	23%	18%
Bayshore / Cedarview	64%	62%	15%	20%	4%	6%	0%	1%	17%	11%
Hull Périphérie	77%	60%	8%	12%	5%	9%	0%	5%	10%	14%
Orleans	77%	71%	14%	20%	3%	2%	0%	1%	6%	5%
South Gloucester / Leitrim[14]	74%	70%	13%	22%	4%	2%	0%	0%	10%	6%
South Nepean	74%	61%	14%	27%	1%	1%	0%	0%	11%	11%
Kanata - Stittsville	81%	73%	12%	22%	5%	1%	0%	0%	2%	4%
Plateau[15]	74%	70%	13%	22%	4%	2%	0%	0%	10%	6%
Aylmer[15]	74%	70%	13%	15%	4%	1%	0%	0%	10%	14%
Pointe Gatineau	76%	72%	17%	22%	2%	1%	0%	1%	5%	4%
Gatineau Est[15]	74%	75%	13%	21%	4%	1%	0%	0%	10%	3%
Masson-Angers[15]	87%	86%	9%	12%	0%	1%	0%	0%	3%	2%
Core Districts	34%	22%	3%	7%	30%	18%	2%	3%	32%	50%
Urban Districts	67%	59%	12%	18%	8%	8%	0%	1%	14%	13%
Suburban Districts	74%	70%	13%	22%	4%	2%	0%	0%	10%	6%
Rural Districts	87%	80%	9%	14%	0%	1%	0%	2%	3%	4%

[14] Geographic sector average used for AM and PM mode share
[15] Geographic sector average used for AM mode share

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7 INFLUENCING FACTORS

Beyond geographic sector and household type, there are other factors that influence a person's trip decision-making. There were seven influencing factors identified and discussed through the study process:

— Age;
— Proximity to Rapid Transit;
— Proximity to Frequent Transit Service;
— Proximity to Active Transportation Facilities;
— Proximity to Traditional Main Streets; and
— Parking Availability and Pricing.

The data from the 2011 TRANS Origin-Destination Survey was used to carry out a quantitative analysis on the influence age and vehicle ownership have on trip rates and mode shares. These two influencing factors are discussed further in the following sections. At this time, it will be at the discretion of the practitioner as to whether any of these influencing factors will be incorporated into their trip forecasting.

The summary provided for Proximity to Rapid Transit was taken from the 2009 TRANS Trip Generation Study, as the data field defining the walking distance between trip origin and the nearest transit station is not available in the 2011 TRANS Origin-Destination Survey data.

For other influencing factors: Proximity to Frequent Transit, Proximity to Active Transportation Facilities, Proximity to Traditional Main Streets, and Parking Availability and Pricing, there was limited data available for analysis and therefore involved a qualitative review. The qualitative information will be provided to practitioners for consideration when they are preparing their forecasts.

7.1 Age

7.1.1 Trip Rate

While trip types, time of day to travel and mode choice may change over a person's life, a review of the 2011 TRANS Origin-Destination data indicated that there is very little change in total number of daily trips a person makes until the age of 80 years. The average number of trips made per day by a person of any age under the age of 80 years and above 10 is 2.69. The summary of the data is shown in **Table 7-1: Transit Mode Share Splits.**
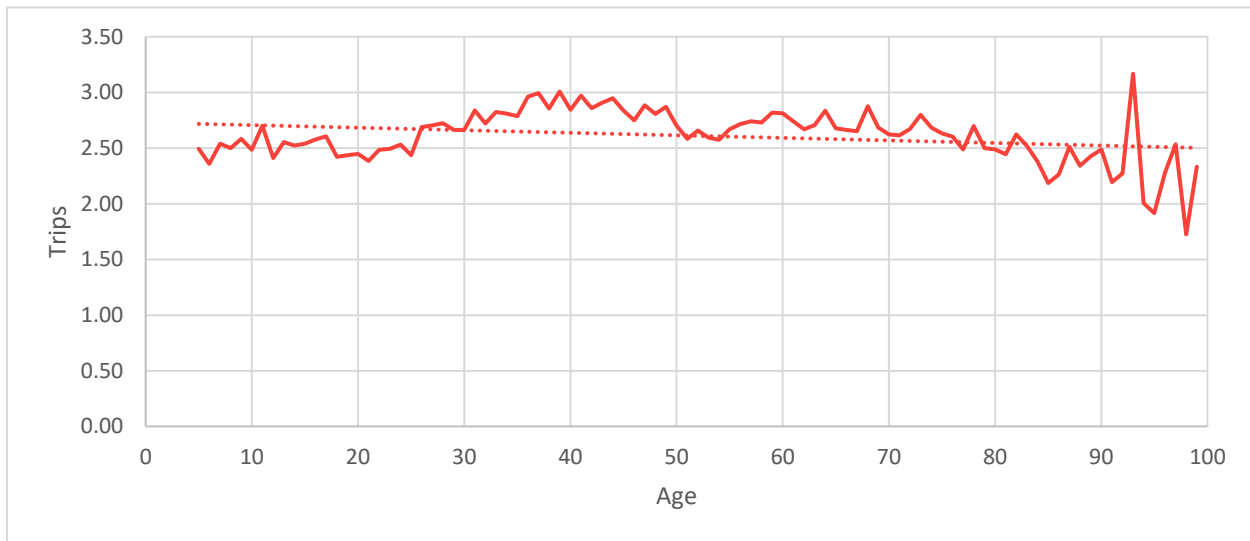
Figure 7.1: Daily Person-Trips by Age

A much greater variance is seen by age in the data when considering the time of day an individual may travel. The AM and PM peak period trip rate by age are summarized in **Figure 7.2: Peak Period Person-Trip Rate by Age**. Those 18 years of age and under have a high number of trips in the morning peak period, with those under the age of 12 also having a high trip rate in the PM peak hour. This is likely reflective of daycare and school drop-offs and pick-ups of working parents. The reduction in trips for those 12 to 18 years of age is likely due to school hours ending outside of the PM peak and middle and high school students making their own trips from school. The lower peak period trip rates for the 18 to early 20s age group is likely because of the high proportion of post-secondary school attendees fall in this age group. There is a steady increase in the trip rates in both peak periods between the age of 20 and the age of 40, after 40 trip rate in the peak periods decreases steadily. A person under 65 years of age have an average person-trip rate of 0.75 in the AM peak period and 0.87 in the PM peak period, while average person-trip rates for a person 65 years of age and older is 0.42 in the AM peak period and 0.58 in the PM peak period.
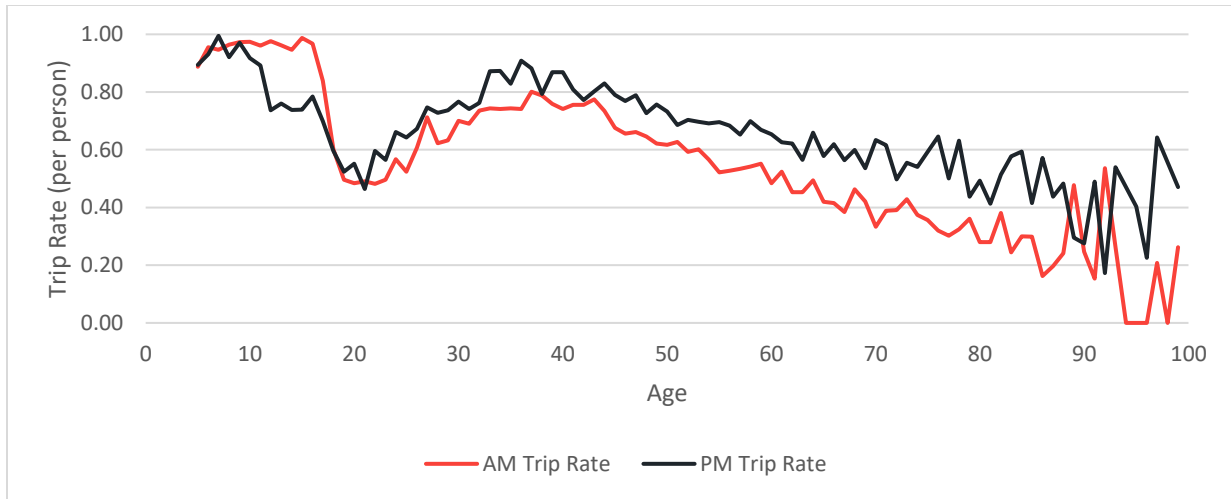
Figure 7.2: Peak Period Person-Trip Rate by Age

The information as presented in **Figure 7.1: Daily Person-Trips by Age** and **Figure 7.2: Peak Period Person-Trip Rate by Age** could be relevant if the development primarily attracts a specific age group. If, for example, the proposed development is focused on providing services or residence to the elderly, practitioners should consider a reduction in the trip rates applied to the peak periods and increased trip rates at other times of the day.

7.1.2 Mode Share

When reviewing the mode choice by age group from the 2011 TRANS Origin-Destination Survey, the auto mode share (Auto Driver) steadily increase from the age of 16 until it plateaus around 70% between the mid-30s and early 70s, then drops off to less than 50% by the age of 90 years. The Auto Passenger mode share is high for those under 10 years of age then drops off to under 10% for the age range 30 to 60 and it begins to rise again after 60. Sustainable transportation (Transit and active modes) are highest for those under 20 years of age and slowly decline from 30 years of age until 80 years of age. The summary of mode choice by age is shown in **Figure 7.3: Mode Share by Age**.

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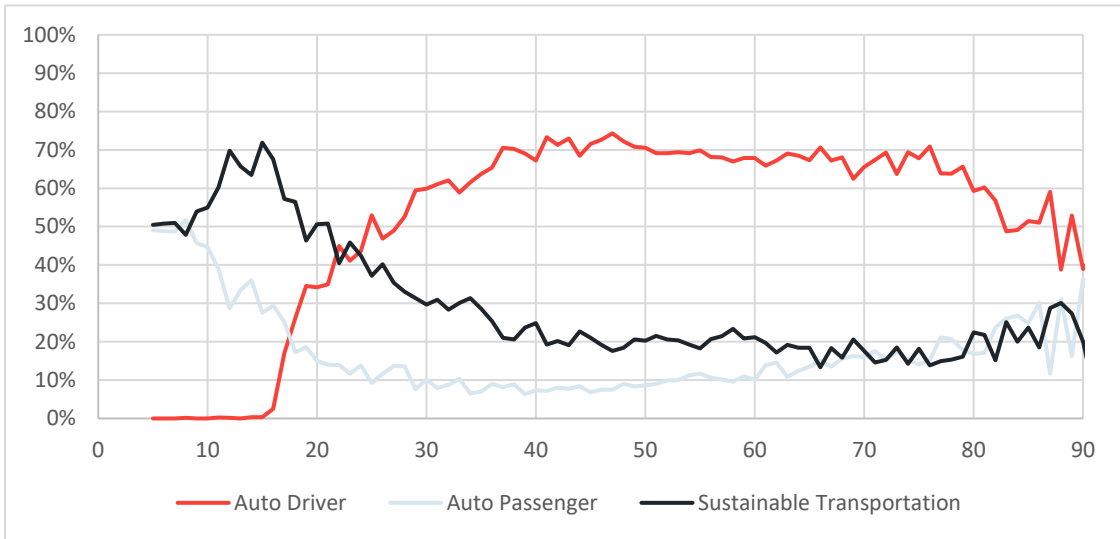
Figure 7.3: Mode Share by Age

A more in-depth review of the sustainable modes showed that both Transit and Walking have noticeable declines in mode share at approximately 20 years of age. Transit mode share declines from the age of 20 years to a person's late 40s, while the Walking mode share declines considerably in the late teens and does not start increasing again until after the age of 60 years. Sustainable mode share by age is shown in **Figure 7.4: Mode Share by Age for Sustainable Modes of Transportation.**

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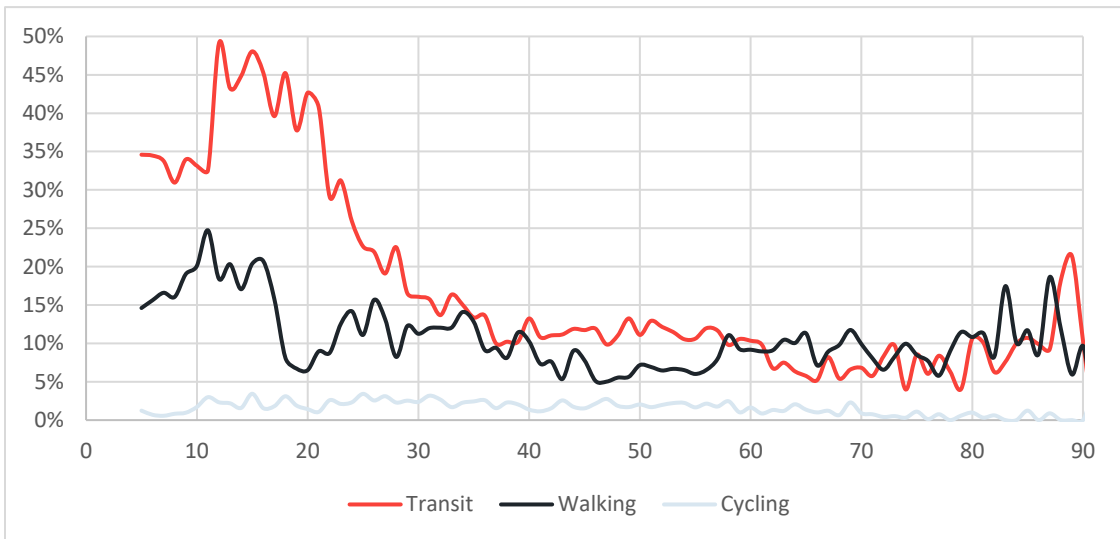
Figure 7.4: Mode Share by Age for Sustainable Modes of Transportation

7.2 Proximity to Rapid Transit

The 2009 TRANS Trip Generation Study applied a "transit bonus" for households within a 600m walking distance from the rapid transit station. Unfortunately, it was not possible to repeat this analysis for the 2020 study since the necessary trip-related information (walking distance to nearest transit station) was not available in the 2011 TRANS OD survey data. The data from the previous report is still relevant in providing a proxy of how proximity to rapid transit affects mode share. The results from the 2009 TRANS Trip Generation Study for transit mode share in the AM and PM peak hours are shown in **Table 7-1: Transit Mode Share Splits**. Transit mode share reaches up to 39% during the AM peak hour for households within 400m of a rapid transit station, compared to 33% when within 2.4km of the station and 27% when more than 2.4km away. It is noted that these results do not reflect the impact of transit-oriented development, which is expected to result in even higher transit and active mode shares.

Table 7-1: Transit Mode Share Splits

Distance to/from Rapid Transit Station (m)	Percent of All Trips	AM		PM	
		Peak Hour	Peak Period	Peak Hour	Peak Period
<400	3 – 6 %	39%	39%	32%	26%
400 – 2,400	40 – 44 %	37%	33%	24%	23%
>2,400	52 – 55 %	30%	27%	16%	18%

More recent data from the City of Ottawa indicates that residents living within an 800m walking distance of rapid transit stations is as high as 80% in the Core sector and as high as 40% in the Suburban sector. The sustainable mode share for all rapid transit stations is shown in **Appendix G**.

7.3 Proximity to Frequent Transit

Though there is no data in the TRANS Origin-Destination Survey to quantitatively analyze the impact of frequent transit services (i.e. frequent bus routes operating at 15-minute intervals or less and connecting to rapid transit routes) on mode shares, proximity to frequent transit route (s) is expected to increase residential transit mode share. It is reasonable to assume that the proximity impacts on mode share are approximately proportional to the frequency, reliability, comfort, etc. of the transit service. While the effect is not expected to be as significant as the effect rapid transit has on the mode share, practitioners should give consideration of proximity to frequent transit service in making adjustments to mode shares.

7.4 Proximity to Active Transportation Facilities

Like proximity to rapid and frequent transit service, a person's proximity to active transportation facilities could influence their mode choice. As per public input, presented in the 2013 Ottawa Cycling Plan (OCP), one of the key measures that could encourage more cycling is implementation of "additional bike facilities". The OCP stated that daily cycling trips had increased by 40% between 2005 and 2011; roughly during that same period (2007 to 2013), 193 km of cycling facilities were built.

Inherently, with more cycling facilities, the network will become more interconnected and more people will be located closer to the bike facilities. Given that most cycling trips are short (the OCP states that over two-thirds of trips are less than 4 km), the increased connectivity should continue to increase the number of trips. Therefore, practitioners should consider increasing cycling mode share / reducing auto mode share for proposed developments located within 1km of a Cross-Town Bikeway (as defined in the 2013 OCP) or other well-defined cycling facility that is separated from vehicle traffic such as separated bike facilities or cycle tracks.

7.5 Proximity to "Traditional Main" Streets

Another factor that may affect both trip frequency and mode share is the proximity to Traditional Main Streets such as Bank Street in The Glebe (Ottawa Inner Area) and Richmond Road in Westboro (Ottawa West). These streets accommodate broader land use including retail, services, restaurants along a densely spaced, pedestrian-friendly mixed-use environment. They are typically located within an existing neighbourhood, have on-street parking and support the use of transit.

Given their proximity to a vast number of retail options, neighbourhood residents might alter their shopping behaviour by primarily visiting the stores on the nearby Traditional Main Street rather than travelling to commercial areas further away. Additionally, neighbourhood residents may make more short and internal trips to the Traditional Main Street, which are more likely to be taken by cycling or walking modes due to the short travel distance and potential lack of parking. Practitioners may consider using higher trip generation rates and higher cycling and pedestrian mode shares / reduced auto and transit mode shares for development sites on or near Traditional Main Streets.

7.6 Parking Availability and Pricing

Parking availability and pricing have a significant impact on person's mode choice when travelling to a place of work or a shopping centre. If an employer (or shopping centre) offers its employees (consumers) free parking on-site, then the employees (consumers) are more likely to drive to work (shopping centre). In contrast, if there is limited or no parking, an employee (consumer) is more likely to use an alternative mode of travel. The

other possibility is to use nearby parking spaces available through a third-party for a fee, but this is a more common occurrence in non-residential locations near or in the core of Ottawa-Gatineau, where transit and active transportation facilities are more accessible and connected. Practitioners should consider adjusting auto mode share based on parking availability and pricing for commercial or office development.

8 MIXED-USE DEVELOPMENTS

Mixed-use developments are defined in the *ITE Trip Generation Handbook* as a single real estate development that consists of two or more ITE land uses where trips can be made from one to the other without using the off-site road network. The *ITE Trip Generation Manual* does not have a specific land use defined for mixed-use development, nor does TRANS have local site surveys for mixed-use developments within the NCR. When developing trip generation for mixed-use sites, current practice is to use a combination of trip generation data for the land use types within the development, apply an internal trip factor and carry out local data collection for similar sites within the local context. A review of local Traffic Impact Assessments for mixed-use developments revealed that consultants are primarily relying on the ITE methodology for estimating internal trips. A review of the methodology was carried out to highlight where any inconsistencies could occur in its application if it were to be included within the TRANS Trip Generation Manual.

8.1 Review of Existing ITE Methodology

A multimodal or mixed-use site requires the estimation of internal trips. The *ITE Trip Generation Handbook (3rd Edition)* outlines a nine-step process for estimating mixed-use trip generation. The methodology is based on the procedure given in the National Cooperative Highway Research Program (NCHRP) report. The report, *NCHRP 684: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments*, includes a classification system for mixed-use developments, a methodology for estimating internal trip capture rates and a data collection framework to assist in estimating trip reductions for internal trips.

The procedure in the *ITE Trip Generation Handbook* is a series of nine steps with steps 1 to 3 carried out by the practitioner. From Step 4 on, a spreadsheet tool available on the ITE website (https://www.ite.org/technical-resources/topics/trip-and-parking-generation/other-resources/) can be used to conduct all necessary calculations. A brief summary of each step is provided below:

— **Step 1: Determine whether methodology is appropriate for study site** –the practitioner reviews conditions that may disqualify a site from being considered as mixed-use. For instance, development types such as shopping centers and office parks are classified under their own respective land use codes and are thus not considered multi-use sites. Additionally, a mixed-use site cannot be in the downtown or central business district since these locations tend to have higher pedestrian activity than other parts of a city.

— **Step 2: Estimate person-trip generation for individual on-site land uses** – requires the practitioner to collect data or information about the individual land uses within the mixed-use development. This includes vehicle trips by direction (inbound &

outbound), mode share and vehicle occupancy for each land use in the proposed development as ascertained from the ITE *Trip Generation Manual* or the TRANS Trip Generation Manual. Person-trips can also be used in place of vehicle trips by inputting vehicle occupancy into Tables 1 and 2 in the ITE spreadsheet tool.

— **Step 3: Estimate proximity between on-site land use pairs** – the walking distance between land use pairs (e.g.: office to retail) is measured by the walking distance from one entrance to the other using a site plan or an online tool like Google Maps. This is used to estimate a proximity adjustment factor which is calculated in Step 4. This information is input to Table 3 in the ITE spreadsheet tool.

— **Step 4: Estimate unconstrained internal person-trip capture rates with proximity adjustments** – data from the six surveys in the *NCHRP 684 Report* is used to estimate the internal capture rate between land use pairs and establish if/how proximity plays a role. The unconstrained internal person-trip capture rate is provided for each origin and destination. Therefore, each land use pair will have four unconstrained internal person capture rates (i.e. from land use 1, to land use 2, from land use 2, and to land use 1)). In contrast, not all land use pairs will need a proximity adjustment. It is also noted that no proximity adjustments are available for the AM peak period within the *ITE Trip Generation Manual*. The output of Step 4 in the ITE spreadsheet tool is the internal person-trip capture rates based on the information provided in Steps 2 and 3. The values can be found in Tables 7.1 and 7.2 (tabs) in the ITE spreadsheet tool.

— **Step 5**: **Estimate unconstrained demand between on-site land use pairs –** using the factors identified in Step 4, the unconstrained demand for each land use pair is calculated four times: twice for each direction of travel (origin and destination) within the spreadsheet tool.

— **Step 6**: **Estimate balanced demand between on-site land use pairs –** the demand for each land use pair is balanced based on the values from Step 5. The lower of the two values for each direction (origin and destination) is chosen as the balanced demand.

— **Step 7: Estimate total internal person-trips between on-site land use pairs –** the internal person-trips between land uses is reported and displayed in Table 4 in the ITE spreadsheet tool.

— **Step 8: Estimate total external person-trips for each land use** – similar to Step 7, the external person-trips to/from the mixed-use development is calculated and reported within Table 5 of the ITE spreadsheet tool.

— **Step 9: Calculate overall internal capture and total external vehicle trip generation –** using the number of internal trips for the whole site and the total number of trips (internal and external), the overall internal capture percentage is calculated and displayed in Tables 5 and 6 of the ITE spreadsheet tool.

For additional detail and information on the above described process refer to Chapter 6 of the *ITE Trip Generation Handbook* (3rd Edition). The process for identifying the internal trips has been demonstrated in an example in **Appendix G**.

While there are no concerns with the methodology from the *NCHRP Report 684,* the data captured, which provides the basis for the analysis, is dated. The unconstrained internal person-trip capture rates and the proximity adjustment factors are calculated based on six surveys conducted in the United States in the 1990s and 2000s. This highlights the need for local data collection for mixed-used developments.

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9 DATA COLLECTION PROGRAM

While the TRANS Origin-Destination Survey data can be used to estimate trip rates and mode shares for residential land uses, there can be limitations, as noted in **Sections 3** and **4**, related to sample size, how data for different dwelling types is collected, how the responses are recorded and lack of reporting for non-residential trips. Going forward it is recommended that TRANS expand and update the existing data set and carry out a specified number of local generator surveys each year. These local generator surveys, in combination with future TRANS Origin-Destination Surveys, will inform development of future trip generation rates and mode shares in updated versions of the TRANS Trip Generation Manual and thereby provide the favoured local context. In addition, it is recommended that the local generator survey results be submitted to ITE for inclusion in future editions of *the ITE Trip Generation Manual* to increase the number of Canadian studies included.

9.1 Historical Data Collection

Past local generator surveys carried out within the NCR by TRANS have been site specific, and primarily in residential areas. From 2008 to 2012, 55 sites were surveyed. These surveys were discussed in detail in **Section 3.2.1: Local Generator Surveys**. From a data collection perspective, the following list summarizes our observations on the past local generator surveys:

— Two commercial sites were surveyed in 2008 (Tim Hortons and Reno-Depot in Quebec);

— The most recent survey carried out for single-family detached dwellings was in 2008;

— No mixed-use developments surveyed;

— Nearly half (24 of 49) of the surveys are of high-rise multifamily dwellings;

— Nearly two thirds (32 of 49) of the surveys are conducted in urban districts;

— Only three surveys were conducted in the Core districts; and

— Only one survey was conducted in the Rural districts.

The TRANS Origin-Destination Survey is a comprehensive telephone survey conducted during the fall, after school is in session, to understand the transportation patterns within the NCR. Participants are asked about the travel activity from the previous day for each person in the household. The timing of the survey (i.e. not on weekends or during the summer) is meant to better capture typical and more stable travel patterns. The upcoming TRANS Origin-Destination Survey will capture changes to travel patterns with the newly opened Confederation Line (expected in Fall of 2021).

9.2 Data collection Methodology

The data collection methodology of the local generator surveys should follow that presented in the *ITE Trip Generation Handbook (3rd Edition).* Chapter 12 of the *ITE Trip Generation Handbook* provides the recommended methodology and framework for data collection of vehicle trips, person-trips, pass-by trips, diverted and primary trips, truck trips, and internal capture trips within a mixed-use development.

The two methods of collecting data, as outlined in the ITE *Trip Generation Handbook*, are observation counts and interview surveys. **Table 9-1: Data Collection Types (Table 12.2 of the ITE Trip Generation Handbook)** summarizes the recommended data collection types for different purposes.

Table 9-1: Data Collection Types (Table 12.2 of the ITE Trip Generation Handbook)

Data Collection Purpose	Characteristics of Data Collection Site	
	Isolated Sites	**Non-Isolated Sites**
Vehicle Trips	Observation Count	Count and Interview
Person-Trips	Observation Count (typically)	Count and Interview
Pass-By-Trips	Count and Interview	Count and Interview
Internal Capture Trips	Count and Interview	Count and Interview

An isolated site is one where an observer can accurately identify the primary mode of transportation for each person arriving or departing from the site. When that is the case, vehicle- and person-trips can be collected through observation counts. In contrast, a non-isolated site requires both observation counts and interview surveys. This would be the case for most mixed-use developments, where it would not be possible to identify the primary mode for getting to the site through observation alone.

For pass-by and diverted trips, the sample questionnaire provided in the *ITE Trip Generation Handbook* includes four questions and it is up to the person carrying out the data collection to ensure that an appropriate number of surveys are conducted, depending on the accuracy and precision required for the assignment. By using common statistical parameters such as confidence intervals (accuracy) and maximum error in mean (precision), the *ITE Trip Generation Handbook* provides targets for the number of surveys required. See Table 12.3 in Chapter 12 of the *ITE Trip Generation Handbook (3rd Edition)* for more detail.

For internal capture rate interview surveys, the questionnaire should gather information related to the origin of the trip (external or internal), travel mode, and land use at the destination. It is recommended that a sample size of at least 50 useable interviews (no less than 30) per land use during a single time period is used.

Full details of the ITE data collection methodology are provided in Chapter 12 of the *ITE Trip Generation Handbook (3rd Edition).* The *ITE Trip Generation Handbook* also includes templates for the data collection programs for consistency.

9.3 Proposed Data Collection Program

9.3.1 Local Generator Surveys

Discussions with the project team suggested that to ensure a sustainable year-to-year program is maintained that an average of 10 surveys be carried out per year. The number of surveys could fluctuate with other surveys or data collection programs (e.g. updated TRANS Origin-Destination Survey). A proposed program is outlined in **Appendix I**.

The data collection program in **Appendix I** has been developed considering historical count data available, corroboration of land use types with the *ITE Trip Generation Manual* and replication of available data within the TRANS Origin-Destination Survey. Factors considered in the data collection program development included data gaps in local generator surveys, gaps in geographic sectors, and increased development of mixed-use residential buildings and mixed-use development sites (e.g. Lansdowne). While most of the survey sites will continue to be residential, the proposed program will also capture trips at mixed-use residential buildings and mixed-use sites. The program has also been developed to create a balance of the different variables across the proposed five-year program.

While the location of the proposed surveys for the mixed-use developments and schools is not critical, the location for the residential land uses should reflect the gaps in geographic sectors identified in the existing local generator survey database. Most of the local surveys have been conducted in the Urban district and very few in the Core and Rural districts. Thus, the geographic distribution of the local generator surveys should start to fill the gaps within the existing database. These conditions are reflected in the proposed program in **Appendix I**.

The residential land uses in **Appendix I** are meant to align entirely with the *ITE Trip Generation Manual* Land Use Codes. For clarification the residential land uses are defined below.

— Single-family detached housing: A unit that provides housing for a single family on individual lots.

— Multifamily housing (low-rise): Apartments, townhomes and condominiums that have one or two levels

— Multifamily housing (mid-rise): Apartments, townhomes and condominiums that have between three floors and up to (but not including) 10 floors

— Multifamily housing (high-rise): Apartments, townhomes and condominiums that have ten floors or more

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— Mid-rise residential with 1st floor commercial: Multifamily housing buildings that have between three floors and up to (but not including) 10 floors and includes retail space on the first level.

— High-rise residential with 1st floor commercial: Multifamily housing buildings with ten floors or more and includes retail space on the first level.

Mixed-Use Developments (min. 3 land uses): Sites that contain at least three separate ITE land uses such as retail, office, residential, restaurants, etc. The schools (elementary and high schools) land use refers to the surveys recommended for schools in Gatineau to enhance their existing data collection. The definition of a multifamily mid-rise and high-rise buildings with 1st floor commercial includes varied land uses on the first floor with more than one type. An example would be a six-storey condominium complex that includes a bank, barbershop, and bakery on the 1st floor.

9.3.2 Data Collection by the private sector

Municipal transportation departments should work with private developers conducting their own data collection to ensure data is consistent with the municipal practices such that it can supplement the local generator database. This could include providing guidance, reviewing the proposed approach or providing current occupancy/unit counts.

9.3.3 TRANS Origin-Destination Survey

As with the past TRANS Trip Generation Manuals the Origin-Destination Survey carried out by TRANS in the NCR is a comprehensive data source for residential trips. Refinements to the questionnaire could prove beneficial if this practice continues. These include suggestions such as:

— Defining the dwelling types to be consistent with the ITE land use codes;
— Classifying multi-modal trips within the survey responses;
— Increasing the granularity of trip purposes to include "work to home" trips; and
— Questions related to parking availability and pricing at the workplace.

9.4 Submission to ITE

Finally, consideration should be given to submitting the results from the local generator surveys to ITE for their Trip Generation Database. As mentioned in **Section 2: Trip Generation – Data Sources**, there is very little Canadian data in the Trip Generation Database. Additionally, there is 30 to 40-year-old survey data still being used. Given the changes in travel behaviour since the 1980s, newer data will better reflect present travel conditions. Local submissions to the ITE database will help strengthen the Canadian data for future work.

A LOCAL GENERATOR SURVEYS

A-1 DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIAL TRIP RATES

APPENDIX A.1 – DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIALTRIP RATES

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
Survey Validation	Convert to Person-Trips (if necessary)	Calculate Residential Trip Rates by Site	Outlier Analysis	Calculate Residential Trip Rate by Dwelling Type
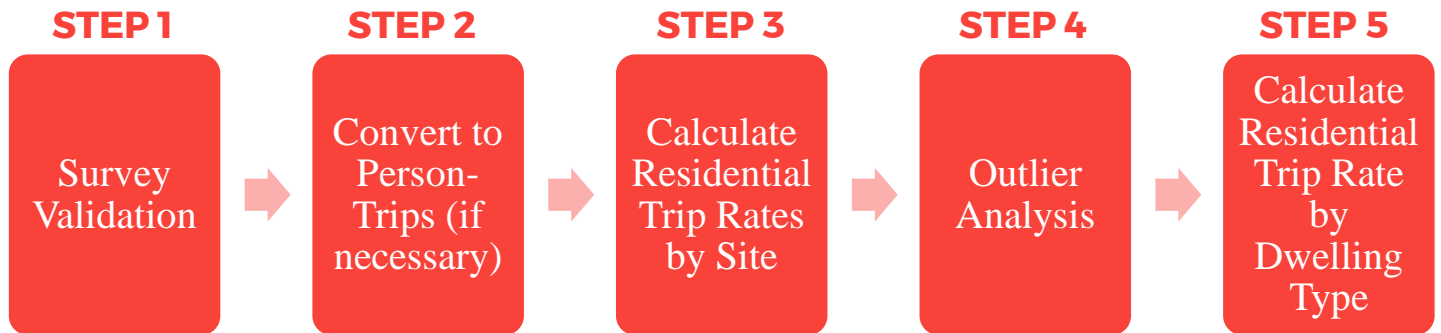
STEP 1: SURVEY VALIDATION

— Remove non-residential survey sites from the dataset

— Identify surveys with data collection issues (e.g. wrong site surveyed or ingress/egress points omitted)

STEP 2: CONVERT TO PERSON-TRIPS (IF NECESSARY)

— Categorize all sites by TRANS district

— Develop vehicle trip rate based on vehicle counts per peak period for each site based on vehicle trips and number of households

— Convert to person-trips per peak period based on district auto driver mode share

STEP 3: CALCULATE RESIDENTIAL PERSON-TRIP RATES BY DWELLING UNIT

— Calculate trip rate per dwelling unit by dividing person-trips during peak period by the number of dwelling units

STEP 4: OUTLIER ANALYSIS

— Compile the person-trip rates by dwelling unit for each survey and categorize each site by dwelling type

— Compute the average trip rates for each dwelling type within each peak period

— Compute the difference between each local generator survey and their dwelling type average. Note, each survey has one difference for the AM peak period and one for the PM peak period.

— Any part-surveys (one of AM or PM peak period rates) with a difference greater than or equal to one and/or a trip rate less than 0.35 is considered an outlier and is removed.

STEP 5: CALCULATE RESIDENTIAL TRIP RATE BY DWELLING TYPE

— Sum the number of households surveyed for each dwelling type excluding the outliers

— Sum person-trips by dwelling type excluding the outliers

— Calculate person-trip rate per peak period by dividing the total person-trips by the number of households per dwelling type

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A-2 *LOCAL GENERATOR SURVEY SITE INFORMATION*

APPENDIX A.2 – LOCAL GENERATOR SURVEY SITE INFORMATION

Location	Year	District	Dwelling Type	# of units (Households)	Person-Trips	
					AM Peak Period	PM Peak Period
40 Landry Street Condo	2010	Ottawa Inner Area	High-Rise	221	155	180
91 Valley Stream Drive Condo	2010	Bayshore/Cedarview	High-Rise	136	76	104
100 Inlet Private Luxury Condo	2010	Orleans	High-Rise	89	57	98
310 Central Park Drive Condo	2010	Merivale	High-Rise	248	208	233
320 Centrum Boulevard Condo	2010	Orleans	High-Rise	47	20	34
840 Montreal Road Apartment	2010	Beacon Hill	High-Rise	175	216	258
960 Teron Road Condo	2010	Kanata/Stittsville	High-Rise	198	142	154
1025 Richmond Road Condo	2010	Ottawa West	High-Rise	216	135	168
1375 Prince of Wales Apartment	2010	Merivale	High-Rise	1020	346	442
1440 Heron Road Condo	2010	Alta Vista	High-Rise	145	145	148
1535 Alta Vista Drive Apartment	2010	Alta Vista	High-Rise	750	564	613
2600 Draper Avenue Apartment	2010	Bayshore/Cedarview	High-Rise	200	154	226
2881 Richmond Road Apartment	2010	Bayshore/Cedarview	High-Rise	455	318	413
3100 Carling Avenue Apartment	2010	Bayshore/Cedarview	High-Rise	230	269	257
3590 Rivergate Way Luxury Condo	2010	Hunt Club	High-Rise	280	199	244
38 Metropole Luxury Condo	2011	Ottawa West	High-Rise	153	149	173
52 Bayswater Avenue Apartment	2011	Ottawa West	High-Rise	174	218	224
150 Queen Elizabeth Apartment	2011	Ottawa Inner Area	High-Rise	127	156	100
156 Waterbridge Drive Condo	2011	South Nepean	High-Rise	36	146	104
211 Wurtemburg Street Apartment	2011	Ottawa Inner Area	High-Rise	291	220	186
1150 Fisher Avenue	2011	Merivale	High-Rise	181	460	407
1241 Kilborn Avenue	2011	Alta Vista	High-Rise	180	58	112
1505 Baseline Road	2011	Merivale	High-Rise	191	268	498
2000 Jasmine Crescent	2011	Beacon Hill	High-Rise	499	188	130
2001 Carling Avenue	2011	Ottawa West	High-Rise	215	95	358
2969 Fairlea Crescent	2011	Alta Vista	High-Rise	62	155	249
3099-3105 Carling Avenue	2011	Bayshore/Cedarview	High-Rise	119	58	65

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Location	Year	District	Dwelling Type	# of units (Households)	Person-Trips	
					AM Peak Period	PM Peak Period
Brockington Crescent at Private Road	2012	Merivale	Low-Rise	59	91	71
Kilborn Avenue at Roseglen Private	2012	Alta Vista	Low-Rise	14	28	45
Kilborn Place at Bank Street	2012	Alta Vista	Low-Rise	23	20	47
Latour Crescent at Gardenway Drive	2012	Orleans	Low-Rise	88	72	82
Private Glenhaven at WestValley Private	2012	Alta Vista	Low-Rise	144	167	222
San Remo Private at Riverside Drive	2012	Alta Vista	Low-Rise	73	27	164
Apartment Buildings Kanata	2008	Kanata/Stittsville	High-Rise	339	493	368
Apartment Riverside Drive Frobisher	2008	Alta Vista	High-Rise	819	571	555
Townhouse Kanata	2008	Kanata/Stittsville	Low-Rise	94	141	174
Condominium Kanata	2008	Kanata/Stittsville	Low-Rise	124	648	263
Riverside Condominium Hurdman	2008	Alta Vista	High-Rise	544	424	652
Single Residential - Kanata	2008	Kanata/Stittsville	Single-Family	40	317	145
Revelstoke	2008	Alta Vista	Single-Family	134	313	494
Tenth Line East of Prestwick	2008	Orleans	Single-Family	205	395	635
South Nepean	2008	South Nepean	Single-Family	133	300	508
Manotick South Island	2008	Rural Southwest	Single-Family	249	373	647
Rivermead	2008	Aylmer	Single-Family	430	1569	1341
Ambassador Avenue at City Park Drive*	2012	Beacon Hill	Low-Rise	115	214	283
Crestlea Crescent at Dalehurst Drive*	2012	Merivale	Low-Rise	41	93	62
Southgate Road at Johnston Road*	2012	Hunt Club	Low-Rise	257	76	216
McClure Crescent at McClintock Way*	2012	Kanata/Stittsville	Low-Rise	125	135	81
Woodridge Crescent at Bayshore Drive*	2012	Bayshore/Cedarview	Low-Rise	101	59	134

* Person-trips converted from vehicle trips

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A-3 *AM OUTLIER ANALYSIS*

APPENDIX A.3 - AM OUTLIER ANALYSIS

Location	Person-Trip Rate	Dwelling Type Average	Difference
Single Residential - Kanata	7.91	2.74	5.17
Condominium Kanata	5.23	1.41	3.82
156 Waterbridge Drive Condo	4.06	0.80	3.26
1150 Fisher Avenue	2.54	0.80	1.74
2969 Fairlea Crescent	2.50	0.80	1.70
Manotick South Island	1.50	2.74	1.25
Southgate Road at Johnston Road	0.29	1.41	1.12
San Remo Private at Riverside Drive	0.37	1.41	1.04
Rivermead	3.65	2.74	0.91
Crestlea Crescent at Dalehurst Drive	2.27	1.41	0.86
Woodridge Crescent at Bayshore Drive	0.57	1.41	0.84
Tenth Line East of Prestwick	1.93	2.74	0.82
Apartment Buildings Kanata	1.46	0.80	0.66
1505 Baseline Road	1.40	0.80	0.60
Kilborn Avenue at Roseglen Private	2.00	1.41	0.59
Latour Crescent at Gardenway Drive	0.82	1.41	0.59
Kilborn Place at Bank Street	0.87	1.41	0.54
South Nepean	2.26	2.74	0.49
1241 Kilborn Avenue*	0.32	0.80	0.48
1375 Prince of Wales Apartment*	0.34	0.80	0.46
52 Bayswater Avenue Apartment	1.25	0.80	0.45
840 Montreal Road Apartment	1.23	0.80	0.44
150 Queen Elizabeth Apartment	1.23	0.80	0.43
2000 Jasmine Crescent	0.38	0.80	0.42
Ambassador Avenue at City Park Drive	1.82	1.41	0.41
Revelstoke	2.34	2.74	0.41
320 Centrum Boulevard Condo	0.43	0.80	0.37
3100 Carling Avenue Apartment	1.17	0.80	0.37
McClure Crescent at McClintock Way	1.04	1.41	0.37
2001 Carling Avenue	0.44	0.80	0.36
3099-3105 Carling Avenue	0.49	0.80	0.31
Private Glenhaven at WestValley Private	1.16	1.41	0.25
91 Valley Stream Drive Condo	0.56	0.80	0.24
1440 Heron Road Condo	1.00	0.80	0.20
38 Metropole Luxury Condo	0.97	0.80	0.17
1025 Richmond Road Condo	0.63	0.80	0.17
100 Inlet Private Luxury Condo	0.64	0.80	0.16
Brockington Crescent at Private Road	1.54	1.41	0.13

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Location	Person-Trip Rate	Dwelling Type Average	Difference
Apartment Riverside Dr Frobisher	0.70	0.80	0.10
2881 Richmond Road Apartment	0.70	0.80	0.10
40 Landry Street Condo	0.70	0.80	0.10
Townhouse Kanata	1.50	1.41	0.09
3590 Rivergate Way Luxury Condo	0.71	0.80	0.09
960 Teron Road Condo	0.72	0.80	0.08
1535 Alta Vista Drive Apartment	0.75	0.80	0.05
211 Wurtemburg Street Apartment	0.76	0.80	0.04
310 Central Park Drive Condo	0.84	0.80	0.04
2600 Draper Avenue Apartment	0.77	0.80	0.03
Riverside Condominium Hurdman	0.78	0.80	0.02

* Indicates the data point was removed because it is a low-end outlier (i.e. person-trip rate less than 0.35

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A-4 PM OUTLIER ANALYSIS

APPENDIX A.4 - PM OUTLIER ANALYSIS

Location	Person-Trip Rate	Dwelling Type Average	Difference
2969 Fairlea Crescent	2.50	0.80	3.09
156 Waterbridge Drive Condo	4.06	0.80	1.96
Kilborn Avenue at Roseglen Private	2.00	1.41	1.75
1505 Baseline Road	1.40	0.80	1.68
1150 Fisher Avenue	2.54	0.80	1.32
Ambassador Avenue at City Park Drive	1.82	1.41	0.99
McClure Crescent at McClintock Way	1.04	1.41	0.84
San Remo Private at Riverside Drive	0.37	1.41	0.78
2001 Carling Avenue	0.44	0.80	0.74
2000 Jasmine Crescent*	0.38	0.80	0.67
Condominium Kanata	5.23	1.41	0.66
South Nepean	2.26	2.74	0.65
Southgate Road at Johnston Road	0.29	1.41	0.64
Kilborn Place at Bank Street	0.87	1.41	0.58
Manotick South Island	1.50	2.74	0.57
840 Montreal Road Apartment	1.23	0.80	0.54
Latour Crescent at Gardenway Drive	0.82	1.41	0.53
Revelstoke	2.34	2.74	0.52
1375 Prince of Wales Apartment	0.34	0.80	0.50
Single Residential - Kanata	7.91	2.74	0.45
Townhouse Kanata	1.50	1.41	0.39
3099-3105 Carling Avenue	0.49	0.80	0.38
52 Bayswater Avenue Apartment	1.25	0.80	0.36
1241 Kilborn Avenue	0.32	0.80	0.31
211 Wurtemburg Street Apartment	0.76	0.80	0.29
Riverside Condominium Hurdman	0.78	0.80	0.27
Brockington Crescent at Private Road	1.54	1.41	0.26
Apartment Riverside Dr Frobisher	0.70	0.80	0.25
320 Centrum Boulevard Condo	0.43	0.80	0.21
38 Metropole Luxury Condo	0.97	0.80	0.20
2600 Draper Avenue Apartment	0.77	0.80	0.20
3100 Carling Avenue Apartment	1.17	0.80	0.19
100 Inlet Private Luxury Condo	0.64	0.80	0.17
91 Valley Stream Drive Condo	0.56	0.80	0.16
Apartment Buildings Kanata	1.46	0.80	0.16
1025 Richmond Road Condo	0.63	0.80	0.15
960 Teron Road Condo	0.72	0.80	0.15
Woodridge Crescent at Bayshore Drive	0.57	1.41	0.14

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Location	Person-Trip Rate	Dwelling Type Average	Difference
150 Queen Elizabeth Apartment	1.23	0.80	0.14
40 Landry Street Condo	0.70	0.80	0.12
1535 Alta Vista Drive Apartment	0.75	0.80	0.11
1440 Heron Road Condo	1.00	0.80	0.09
Private Glenhaven at WestValley Private	1.16	1.41	0.08
Tenth Line East of Prestwick	1.93	2.74	0.07
3590 Rivergate Way Luxury Condo	0.71	0.80	0.06
Rivermead	3.65	2.74	0.05
Crestlea Crescent at Dalehurst Drive	2.27	1.41	0.04
2881 Richmond Road Apartment	0.70	0.80	0.02
310 Central Park Drive Condo	0.84	0.80	0.01

* Indicates the data point was removed because it is a low-end outlier (i.e. person-trip rate less than 0.35

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2011 TRANS ORIGIN-DESTINATION SURVEY

B-1 DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIAL TRIP RATES

APPENDIX B.1 – DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIAL TRIP RATES

STEP 1		STEP 2		STEP 3
Filter Relevant Trips	→	Calculate Trip Rate by Dwelling Type	→	Apply Non-Residential Trip Factor
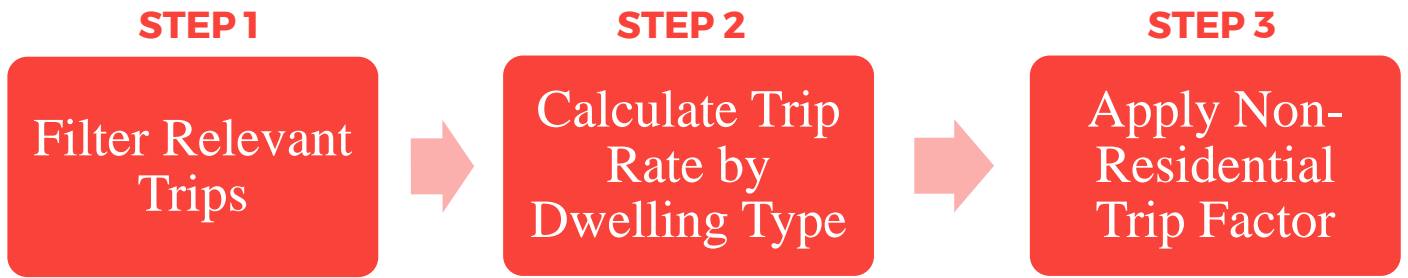
STEP 1: FILTER RELEVANT TRIPS

Given the nature of the TRANS Origin-Destination Survey, the data must be filtered several times before a peak period trip rate could be calculated. The filters include:

— A morning trip from a residential site must start no earlier than the beginning of the AM Peak Period (7:00am) and an evening trip must arrive no later than the end of the PM Peak Period (6:00 pm).

— To account for home-based trips, a trip must have a matching origin and home TAZ, or a matching destination and home TAZ.

STEP 2: CALCULATE TRIP RATE BY DWELLING TYPE

— Apply the household expansion factor and the trip expansion factor from the OD dataset to households and trips, respectively.

— Categorize households and trips by dwelling type

— Calculate the average trip rate for each dwelling type by summing the total expanded households and person-trips and dividing the total person-trips by the number of households for each dwelling type

STEP 3: APPLY NON-RESIDENTIAL TRIP FACTOR

Since one of the filters (Step 1) restricted trips to only outbound during the AM peak period and inbound during the PM peak period, then a non-residential factor of 1.03 must be applied. More information on the data related to the non-residential trip factor are given in Appendix B.2.

B-2 NON-RESIDENTIAL TRIP FACTOR

APPENDIX B.2 – NON-RESIDENTIAL TRIP FACTOR

The non-residential trip factor was applied to the trip rates developed from the TRANS Origin-Destination Survey due to suspected underreporting of non-resident trips related to residential developments such as service vehicles making trips to homes and home-based businesses. The factor was calculated by using the local generator survey data from 2010 to 2012. The results are summarized in the table below.

ITE Land Use	All Vehicles	Non-Commercial Vehicles	Commercial Vehicles	% Commercial Trucks
220	1,216	1,112	104	8.6%
221	631	572	59	9.4%
222	5,665	5,397	268	4.7%
Total	**7,512**	**7,081**	**431**	**5.7%**

The total percentage of commercial trucks (5.7%) was applied as the non-residential trip factor (1.06) to residential trips.

C ITE TRIP GENERATION

C-1 DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIAL TRIP RATES

APPENDIX C.1 – DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIAL TRIP RATES

STEP 1	STEP 2	STEP 3	STEP 4
Retrieve Data from Manual	Merge Land Uses	Covert to Person-trips	Convert to Peak Period
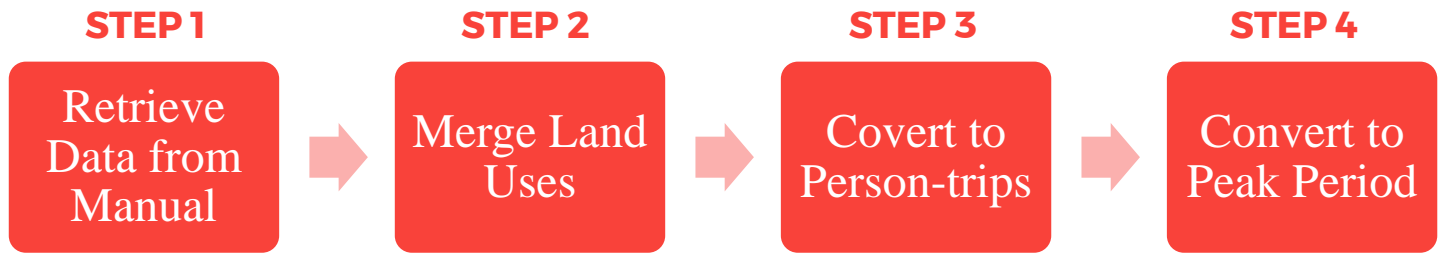
STEP 1: RETRIEVE AND REVIEW DATA FROM MANUAL

— Retrieve dataset information (number of studies, average number of units, peak hour trip rates, etc.) directly from the ITE Trip Generation Manual for each dwelling type. Identify Canadian surveys within the dataset and, if substantial, use only Canadian surveys for analysis.

STEP 2: COMBINE LAND USES

— To align with TRANS Origin-Destination dwelling type groups, merge the multifamily mid-rise (ITE Land Use 221) and multifamily high-rise (ITE Land Use 222) land use categories by calculating a weighted average of the vehicle trip rates for the two land uses.

STEP 3: CONVERT TO PERSON-TRIPS

— Apply the Vehicle to Person-Trip Conversion Factor of 1.28, provided in the *City of Ottawa's Transportation Impact Assessment Guidelines (2017)*, to convert from vehicle trips to person-trips.

STEP 4: CONVERT TO PEAK PERIOD

— Apply the Peak Hour to Peak Period Conversion Factor to convert the person-trip rates per peak hour to person-trip rates per peak period. The conversion rates are 2.00 for the AM peak period and 2.26 for the PM peak period.

D RESIDENTIAL MODE SHARE

D-1 *DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIAL MODE SHARE*

APPENDIX D.1 – DATA REVIEW PROCESS FOR DEVELOPING RESIDENTIAL MODE SHARE

STEP 1		**STEP 2**		**STEP 3**
Restrict Non-Residential Trips	→	Re-Assign Multi-Modal Trips	→	Calculate Mode Share

STEP 1: RESTRICT NON-RESIDENTIAL TRIPS

Restrict AM peak period trips to outbound and PM peak period trips to inbound. This was accomplished by:

— Matching all Home Traffic Analysis Zones (TAZ) with the Origin TAZ during the AM peak period and

— Matching all Home TAZ with the Destination TAZ during the PM peak period

STEP 2: RE-ASSIGN MULTI-MODAL TRIPS

First, the multi-modal trips were identified in the TRANS Origin-Destination survey results. The following traits identified a multi-modal trip:

— More than one mode in the trip

— Transit is the primary mode

— Non-Transit as Mode 1 in the AM peak period (transit in the PM peak period)

— Transit as Mode 2 in the AM peak period (non-transit in the PM peak period)

Once identified, all multi-modal trips (i.e. park and ride, kiss and ride, and bike and ride) were reassigned to best match the residential mode share.

Aggregating trips at district or geographic sectors based on a threshold sample size of 50.

STEP 3: CALCULATE MODE SHARE

— Apply household expansion factor and trip expansion factor from the OD dataset to households and trips, respectively.

— For each mode, categorize households and trips by dwelling type and district

— Calculate the average mode share for each dwelling type and each district by summing up the total households and person-trips in each category and dividing the total person-trips by the number of households in each category.

D-2 SAMPLE SIZE BY DISTRICT AND DWELLING TYPE

APPENDIX D.2 – SAMPLE SIZE BY DISTRICT AND DWELLING TYPE

District	Name	Single-Family Housing		Low-Rise		High-Rise	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	Ottawa Centre	7	8	19	29	267	308
50	Ottawa Inner Area	1223	1346	660	753	786	906
600	Île de Hull	75	89	45	54	88	111
100	Ottawa East	656	654	351	368	333	416
120	Beacon Hill	470	546	272	304	139	166
140	Alta Vista	1223	1275	427	420	311	339
180	Hunt Club	760	753	602	646	116	115
200	Merivale	1254	1369	422	439	242	248
240	Ottawa West	1066	1168	188	224	213	269
260	Bayshore/Cedarview	1057	1145	475	498	283	358
625	Hull Périphérie	625	718	274	291	279	338
300	Orleans	2327	2564	555	706	79	106
400	South Gloucester / Leitrim	420	490	181	175	5	3
425	South Nepean	1443	1575	513	594	55	60
500	Kanata - Stittsville	2104	2292	678	731	64	120
650	Plateau	228	257	223	259	94	104
700	Aylmer	821	967	257	320	66	75
800	Pointe Gatineau	944	1173	285	333	177	232
820	Gatineau Est	759	1009	242	311	78	87
350	Rural East	461	516	11	13	4	2
360	Rural Southeast	591	659	17	11	2	3
450	Rural Southwest	672	722	19	24	7	4
560	Rural West	584	670	10	14	7	8
750	Rural Northwest	599	641	14	18	17	11
840	Rural Northeast	708	838	11	17	18	18
845	Masson-Angers	370	463	145	191	30	35

Highlighted cell indicates sample size is below minimum threshold of 50.

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D-3 SINGLE FAMILY DETACHED HOUSING

APPENDIX D.3 – SINGLE-FAMILY DETACHED HOUSING

District	Auto Driver		Auto Pass		Transit		Cycling		Walk	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre*	37%	36%	13%	12%	17%	13%	9%	8%	25%	30%
Ottawa Inner Area	36%	35%	13%	12%	17%	13%	9%	9%	25%	30%
Île de Hull	46%	53%	13%	12%	13%	11%	0%	0%	28%	24%
Ottawa East	45%	48%	15%	15%	20%	17%	9%	9%	11%	12%
Beacon Hill	51%	52%	15%	21%	20%	16%	2%	4%	12%	8%
Alta Vista	49%	52%	15%	18%	21%	16%	4%	3%	11%	12%
Hunt Club	48%	51%	15%	19%	29%	23%	1%	1%	7%	7%
Merivale	52%	54%	16%	18%	21%	17%	3%	3%	8%	9%
Ottawa West	43%	43%	15%	13%	19%	15%	6%	6%	16%	23%
Bayshore/Cedarview	49%	52%	15%	18%	27%	21%	2%	2%	7%	7%
Hull Périphérie	49%	51%	17%	18%	22%	18%	4%	4%	8%	9%
Orleans	48%	54%	14%	17%	27%	22%	1%	1%	9%	6%
South Gloucester / Leitrim	54%	55%	24%	25%	12%	9%	1%	1%	9%	10%
South Nepean	51%	53%	14%	19%	25%	18%	1%	1%	9%	10%
Kanata - Stittsville	52%	56%	15%	19%	20%	14%	1%	1%	12%	9%
Plateau	47%	49%	17%	19%	24%	21%	4%	3%	7%	9%
Aylmer	53%	55%	17%	21%	23%	17%	2%	2%	6%	5%
Pointe Gatineau	55%	55%	15%	17%	22%	19%	2%	2%	7%	7%
Gatineau Est	54%	60%	16%	18%	20%	14%	0%	1%	10%	7%
Masson-Angers	62%	62%	13%	18%	13%	12%	11%	8%	1%	1%
Other Rural Districts	60%	67%	14%	17%	24%	14%	2%	2%	0%	0%

* Indicates sector average taken due to small sample size

D-4 MULTIFAMILY HOUSING (LOW RISE)

APPENDIX D.4 – MULTIFAMILY HOUSING (LOW-RISE)

District	Auto Driver		Auto Pass		Transit		Cycling		Walk	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre*	27%	31%	9%	10%	25%	20%	9%	9%	30%	30%
Ottawa Inner Area	27%	31%	8%	9%	26%	20%	9%	9%	30%	31%
Île de Hull**	36%	34%	19%	22%	17%	16%	2%	5%	25%	22%
Ottawa East	36%	39%	11%	16%	38%	29%	7%	5%	8%	11%
Beacon Hill	45%	48%	9%	16%	35%	24%	1%	1%	10%	11%
Alta Vista	38%	38%	15%	19%	35%	31%	1%	2%	10%	10%
Hunt Club	44%	47%	11%	15%	38%	29%	1%	1%	6%	8%
Merivale	44%	44%	11%	12%	32%	29%	6%	4%	7%	11%
Ottawa West	36%	35%	12%	12%	24%	16%	10%	10%	19%	27%
Bayshore/Cedarview	43%	44%	11%	14%	31%	25%	1%	1%	13%	15%
Hull Périphérie	46%	46%	22%	17%	22%	22%	4%	3%	6%	11%
Orleans	47%	51%	15%	19%	29%	24%	1%	1%	9%	6%
South Gloucester / Leitrim	59%	62%	20%	18%	16%	17%	1%	1%	4%	3%
South Nepean	49%	49%	13%	13%	26%	24%	2%	2%	9%	12%
Kanata - Stittsville	52%	58%	14%	17%	22%	17%	0%	0%	11%	8%
Plateau	44%	47%	18%	17%	28%	26%	4%	2%	6%	8%
Aylmer	52%	52%	18%	16%	23%	20%	0%	1%	7%	12%
Pointe Gatineau	46%	52%	17%	16%	23%	19%	0%	1%	14%	12%
Gatineau Est	54%	56%	17%	21%	20%	16%	1%	0%	8%	7%
Masson-Angers	60%	63%	15%	15%	21%	17%	4%	3%	1%	1%
Other Rural Districts	66%	62%	13%	19%	21%	16%	1%	3%	0%	0%

* Indicates sector average taken due to small sample size

** Indicates sector average taken for AM peak period only due to small sample size

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D-5 MULTIFAMILY HOUSING (HIGH-RISE)

APPENDIX D.5 – MULTIFAMILY HOUSING (HIGH-RISE)

District	Auto Driver		Auto Pass		Transit		Cycling		Walk	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre	18%	17%	2%	9%	26%	21%	1%	1%	52%	52%
Ottawa Inner Area	26%	25%	6%	8%	28%	21%	5%	6%	34%	39%
Île de Hull	27%	26%	3%	8%	37%	27%	12%	11%	21%	28%
Ottawa East	39%	40%	7%	14%	38%	28%	2%	3%	13%	15%
Beacon Hill	48%	52%	9%	16%	30%	28%	3%	0%	10%	4%
Alta Vista	38%	45%	12%	16%	42%	28%	2%	2%	7%	9%
Hunt Club	39%	44%	6%	11%	44%	35%	1%	2%	9%	9%
Merivale	41%	41%	6%	11%	42%	33%	2%	2%	8%	13%
Ottawa West	28%	33%	11%	11%	41%	26%	3%	7%	16%	23%
Bayshore/Cedarview	40%	40%	12%	15%	38%	33%	2%	1%	8%	11%
Hull Périphérie	48%	47%	11%	15%	30%	23%	1%	3%	10%	13%
Orleans	54%	61%	7%	13%	29%	21%	0%	0%	10%	6%
South Gloucester / Leitrim*	50%	53%	15%	17%	25%	21%	1%	1%	9%	9%
South Nepean	58%	54%	6%	15%	30%	25%	2%	0%	4%	7%
Kanata – Stittsville	43%	55%	26%	19%	28%	21%	0%	0%	4%	5%
Plateau	53%	65%	9%	7%	35%	25%	3%	2%	1%	1%
Aylmer	45%	31%	17%	21%	25%	23%	0%	4%	13%	20%
Pointe Gatineau	44%	52%	15%	15%	24%	20%	3%	2%	14%	11%
Gatineau Est	53%	61%	10%	10%	25%	25%	0%	0%	12%	4%
Masson-Angers*	63%	64%	15%	18%	19%	16%	0%	0%	3%	1%
Other Rural Districts	63%	64%	15%	18%	19%	16%	0%	0%	3%	1%

* Indicates sector average taken due to small sample size

D-6 SINGLE FAMILY DETACHED HOUSING (ALL MODES)

APPENDIX D.6 – SINGLE-FAMILY DETACHED HOUSING (ALL MODES)

District	Auto Driver		Auto Passenger		Transit		Cycling		Walking		Park and Ride		Kiss and Ride		Bike and Ride	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre	36%	36%	13%	12%	17%	13%	9%	8%	25%	30%	0%	0%	0%	0%	0%	0%
Ottawa Inner Area	36%	35%	13%	12%	17%	13%	9%	9%	25%	30%	0%	0%	0%	0%	0%	0%
Île de Hull	46%	53%	13%	12%	13%	11%	0%	0%	28%	24%	0%	0%	0%	0%	0%	0%
Ottawa East	44%	47%	15%	15%	20%	17%	9%	9%	11%	12%	0%	0%	0%	0%	0%	0%
Beacon Hill	51%	52%	14%	21%	20%	16%	2%	4%	12%	8%	0%	0%	0%	0%	0%	0%
Alta Vista	49%	51%	14%	17%	20%	16%	4%	3%	11%	12%	0%	0%	0%	0%	0%	0%
Hunt Club	47%	49%	14%	19%	29%	23%	1%	1%	7%	7%	1%	1%	1%	0%	0%	0%
Merivale	51%	54%	15%	18%	21%	17%	3%	3%	8%	9%	0%	0%	0%	0%	0%	0%
Ottawa West	43%	43%	14%	13%	19%	15%	6%	6%	16%	23%	0%	0%	0%	0%	0%	0%
Bayshore/Cedarview	49%	52%	14%	18%	27%	21%	2%	2%	7%	7%	0%	0%	1%	0%	0%	0%
Hull Périphérie	48%	50%	16%	18%	22%	18%	4%	4%	8%	9%	0%	1%	1%	0%	0%	0%
Orleans	47%	53%	14%	17%	27%	22%	1%	1%	9%	6%	1%	1%	0%	0%	0%	0%
South Gloucester / Leitrim	54%	54%	24%	24%	12%	9%	1%	1%	9%	10%	1%	1%	1%	1%	0%	0%
South Nepean	48%	50%	13%	18%	25%	18%	1%	1%	9%	10%	2%	2%	1%	0%	0%	0%
Kanata - Stittsville	51%	54%	14%	19%	20%	14%	1%	1%	12%	9%	1%	1%	1%	0%	0%	0%
Plateau	46%	48%	17%	18%	24%	21%	4%	3%	7%	9%	1%	1%	0%	0%	0%	0%
Aylmer	50%	52%	17%	21%	23%	17%	2%	2%	6%	5%	3%	3%	0%	1%	0%	0%
Pointe Gatineau	54%	55%	15%	17%	21%	19%	2%	2%	7%	7%	0%	0%	0%	0%	0%	0%
Gatineau Est	53%	60%	16%	18%	20%	14%	0%	1%	10%	7%	1%	0%	0%	0%	0%	0%
Masson-Angers	62%	61%	13%	17%	13%	12%	1%	1%	11%	8%	0%	1%	0%	1%	0%	0%
Rural Districts	58%	64%	13%	17%	24%	14%	0%	0%	2%	2%	2%	2%	1%	0%	0%	0%

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D-7 MULTIFAMILY HOUSING (LOW-RISE ALL MODES)

APPENDIX D.7 – MULTIFAMILY HOUSING (LOW-RISE ALL MODES)

District	Auto Driver		Auto Passenger		Transit		Cycling		Walking		Park and Ride		Kiss and Ride		Bike and Ride	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre	27%	31%	9%	10%	25%	20%	9%	9%	30%	30%	0%	0%	0%	0%	0%	0%
Ottawa Inner Area	27%	31%	8%	9%	26%	20%	9%	9%	30%	31%	0%	0%	0%	0%	0%	0%
Île de Hull	36%	31%	19%	10%	17%	20%	2%	9%	25%	30%	0%	0%	0%	0%	0%	0%
Ottawa East	36%	38%	10%	16%	38%	29%	7%	5%	8%	11%	0%	0%	0%	0%	1%	0%
Beacon Hill	44%	48%	9%	16%	35%	23%	1%	1%	10%	11%	0%	0%	0%	0%	0%	0%
Alta Vista	38%	38%	15%	19%	35%	31%	1%	2%	10%	10%	0%	0%	1%	0%	0%	0%
Hunt Club	43%	46%	11%	15%	38%	29%	1%	1%	6%	8%	0%	0%	0%	0%	0%	0%
Merivale	44%	44%	11%	11%	32%	29%	6%	5%	7%	11%	0%	0%	0%	0%	0%	0%
Ottawa West	35%	35%	12%	12%	24%	16%	10%	10%	19%	27%	0%	0%	0%	0%	0%	0%
Bayshore/Cedarview	42%	44%	11%	14%	31%	25%	1%	1%	13%	15%	0%	0%	0%	0%	0%	0%
Hull Périphérie	46%	46%	22%	17%	22%	22%	4%	3%	6%	11%	0%	0%	0%	0%	0%	0%
Orleans	45%	50%	14%	18%	29%	24%	1%	1%	9%	6%	1%	1%	1%	0%	0%	0%
South Gloucester / Leitrim	58%	62%	20%	18%	16%	17%	1%	1%	4%	3%	1%	0%	0%	0%	0%	0%
South Nepean	48%	48%	13%	13%	26%	24%	2%	2%	9%	12%	1%	1%	0%	0%	0%	0%
Kanata - Stittsville	50%	56%	14%	17%	22%	17%	0%	0%	11%	8%	2%	2%	1%	0%	0%	0%
Plateau	44%	46%	17%	17%	28%	26%	4%	2%	6%	8%	0%	0%	0%	0%	0%	0%
Aylmer	51%	50%	17%	16%	23%	20%	0%	1%	7%	12%	1%	1%	1%	0%	0%	0%
Pointe Gatineau	45%	51%	16%	15%	23%	19%	0%	1%	14%	12%	1%	1%	1%	0%	0%	0%
Gatineau Est	53%	54%	17%	21%	19%	16%	2%	1%	8%	7%	1%	1%	0%	0%	0%	0%
Masson-Angers	60%	62%	15%	15%	21%	17%	1%	1%	4%	3%	0%	1%	0%	0%	0%	0%
Rural Districts	61%	61%	14%	16%	21%	17%	1%	1%	3%	3%	0%	2%	0%	0%	0%	0%

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D-8 MULTIFAMILY HOUSING (HIGH-RISE ALL MODES)

APPENDIX D8 – MULTIFAMILY HOUSING (HIGH-RISE ALL MODES)

District	Auto Driver		Auto Passenger		Transit		Cycling		Walking		Park and Ride		Kiss and Ride		Bike and Ride	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ottawa Centre	18%	17%	2%	9%	26%	21%	1%	1%	52%	52%	0%	0%	0%	0%	0%	0%
Ottawa Inner Area	26%	25%	6%	8%	28%	21%	6%	6%	34%	39%	0%	0%	0%	0%	0%	0%
Île de Hull	27%	26%	3%	8%	37%	27%	12%	11%	21%	28%	0%	0%	0%	0%	0%	0%
Ottawa East	39%	40%	7%	14%	38%	28%	2%	3%	13%	15%	0%	0%	0%	0%	0%	0%
Beacon Hill	47%	51%	9%	16%	30%	28%	3%	0%	11%	4%	0%	1%	0%	0%	0%	0%
Alta Vista	37%	44%	11%	14%	41%	28%	2%	2%	7%	9%	1%	1%	1%	2%	0%	0%
Hunt Club	39%	44%	6%	10%	44%	34%	1%	2%	9%	9%	0%	0%	0%	1%	0%	0%
Merivale	41%	41%	5%	10%	42%	32%	3%	2%	8%	13%	0%	0%	1%	1%	0%	0%
Ottawa West	28%	33%	11%	11%	41%	26%	3%	7%	16%	23%	0%	0%	0%	0%	0%	0%
Bayshore/Cedarview	40%	40%	12%	15%	38%	32%	2%	1%	8%	11%	0%	0%	0%	0%	0%	0%
Hull Périphérie	47%	47%	11%	15%	29%	23%	1%	3%	10%	13%	1%	0%	1%	0%	0%	0%
Orleans	54%	60%	7%	13%	29%	21%	0%	0%	10%	6%	0%	0%	0%	0%	0%	0%
South Gloucester / Leitrim	48%	54%	12%	13%	27%	22%	2%	1%	10%	8%	1%	1%	0%	0%	0%	0%
South Nepean	58%	54%	5%	15%	30%	25%	2%	0%	4%	7%	0%	0%	1%	0%	0%	0%
Kanata - Stittsville	43%	55%	26%	19%	28%	21%	0%	0%	4%	5%	0%	0%	0%	0%	0%	0%
Plateau	50%	64%	8%	6%	34%	25%	3%	2%	1%	1%	3%	1%	1%	1%	0%	0%
Aylmer	41%	28%	17%	21%	25%	23%	0%	4%	13%	20%	4%	3%	0%	0%	0%	0%
Pointe Gatineau	44%	52%	15%	15%	24%	20%	3%	2%	14%	11%	0%	0%	0%	0%	0%	0%
Gatineau Est	52%	58%	10%	10%	25%	25%	0%	0%	12%	4%	1%	3%	0%	0%	0%	0%
Masson-Angers	63%	63%	15%	15%	19%	16%	0%	0%	3%	1%	1%	2%	0%	3%	0%	0%
Rural Districts	63%	63%	15%	15%	19%	16%	0%	0%	3%	1%	1%	2%	0%	3%	0%	0%

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E DIRECTIONAL SPLITS

E-1 DATA REVIEW PROCESS FOR DEVELOPING DIRECTIONAL SPLITS

APPENDIX E.1 – DATA REVIEW PROCESS FOR DEVELOPING DIRECTIONAL SPLITS

STEP 1	STEP 2	STEP 3
Collect ITE Directional Splits	Calculate Local Generator Survey Directional Splits	Blend the Two Sources
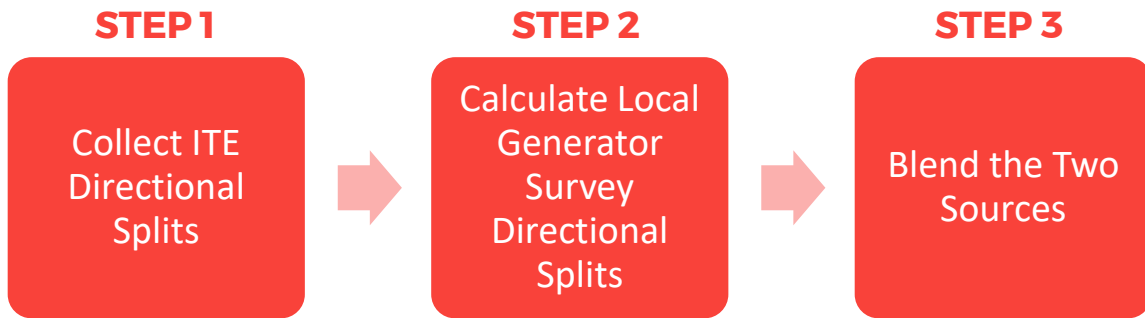
STEP 1: COLLECT ITE DIRECTIONAL SPLITS

— Retrieve directional splits by ITE Land Use directly from the ITE Trip Generation Manual. As in the trip rate development process, to align with TRANS Origin-Destination dwelling type groups, the multifamily mid-rise (ITE Land Use 221) and multifamily high-rise (ITE Land Use 222) were merged by calculating a weighted average of the directional splits for the two land uses.

STEP 2: CALCULATE LOCAL GENERATOR SURVEY DIRECTIONAL SPLITS

— From the local generator surveys, the directional splits were calculated by dwelling type. Further breakdown is available in Appendix E.2.

STEP 3: BLEND THE TWO SOURCES

— A 50/50 blend of the two data sources was completed. The same method was used in the 2009 TRANS Trip Generation Study.

E-2 LOCAL GENERATOR SURVEY DIRECTIONAL SPLITS

APPENDIX E.2 – LOCAL GENERATOR SURVEY DIRECTIONAL SPLITS

Dwelling Type	Year	Location	AM TOTAL		PM TOTAL	
			Inbound	Outbound	Inbound	Outbound
High-Rise	2010	40 Landry Street Condo	25	59	58	29
		91 Valley Stream Drive Condo	34	24	25	46
		100 Inlet Private Luxury Condo	10	28	45	27
		310 Central Park Drive Condo	88	22	72	72
		320 Centrum Boulevard Condo	3	11	18	8
		840 Montreal Road Apartment	33	77	81	55
		960 Teron Road Condo	18	53	66	39
		1025 Richmond Road Condo	21	57	65	38
		1375 Prince of Wales Apartment			108	149
		1440 Heron Road Condo	22	72	65	32
		1535 Alta Vista Drive Apartment	91	170	186	145
		2600 Draper Avenue Apartment	20	57	41	50
		2881 Richmond Road Apartment	63	143	194	98
		3100 Carling Avenue Apartment	63	78	89	51
		3590 Rivergate Way Luxury Condo	47	93	111	66
	2011	38 Metropole Luxury Condo	28	52	62	28
		52 Bayswater Avenue Apartment	66	19	21	60
		150 Queen Elizabeth Apartment	20	28	18	15
		211 Wurtemburg Street Apartment	27	81	26	73
		1241 Kilborn Avenue			40	25
		1505 Baseline Road	115	73	Outlier	
		2000 Jasmine Crescent	13	119		
		2001 Carling Avenue	28	23	57	102
		3099-3105 Carling Avenue	8	28	38	13
Low-Rise	2012	Brockington Crescent at Private Road	22	37	22	25
		Kilborn Avenue at Roseglen Private	4	11	Outlier	
		Kilborn Place at Bank Street	6	10	16	13
		Latour Crescent at Gardenway Drive	17	29	25	26
		Private Glenhaven at WestValley Private	15	72	77	36
		San Remo Private at Riverside Drive			47	47
		Ambassador Avenue at City Park Drive	40	62	78	60
		Crestlea Crescent at Dalehurst Drive	13	22	17	16
		Southgate Road at Johnston Road	9	23	47	45
		McClure Crescent at McClintock Way	23	37	22	19
		Woodridge Crescent at Bayshore Drive	7	24	16	38
		Low-Rise Total	**32%**	**68%**	**53%**	**47%**
		High-Rise Total	**38%**	**62%**	**55%**	**45%**

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F NON-RESIDENTIAL MODE SHARE

F-1 GATINEAU/QUEBEC SCHOOL OUTLIER ANALYSIS

APPENDIX F.1 – GATINEAU/QUEBEC SCHOOL OUTLIER ANALYSIS

Considering the quantity of data provided from the Gatineau elementary school surveys, a brief outlier analysis was conducted. The purpose of the analysis, much like the local generator survey outlier analysis, was to determine if there were any surveys that were notably different than the others. The analysis was conducted for 33 elementary schools in Gatineau. The analysis was not conducted for the seven high schools as the sample size was already quite small.

The mode share of each school was compared to both the district and Gatineau average. The table below shows the average mode share by district and the standard deviation (in parenthesis) from the district average.

District	Number of Schools	Mode Share (Standard Deviation)			
		Car Passenger	School Bus	Cycling	Walking
Île de Hull*	1	17%	44%	0%	40%
Hull Périphérie	7	41% (5%)	20% (13%)	3% (3%)	32% (10%)
Plateau*	2	37%	39%	2%	22%
Aylmer	7	44% (10%)	30% (15%)	5% (7%)	21% (12%)
Pointe Gatineau	5	42% (7%)	19% (10%)	6% (3%)	33% (8%)
Gatineau Est*	3	49%	12%	0%	39%
Masson-Angers	8	45% (10%)	29% (20%)	4% (0%)	22% (11%)
ALL GATINEAU	**33**	**43% (10%)**	**26% (16%)**	**4% (4%)**	**27% (12%)**

*No standard deviation calculated for district due to small sample size

The schools that varied by more than 1.5 standard deviations for each respective mode of transportation by district and for all of Gatineau were identified. The standard deviation of 1.5 was chosen to account for the small sample size and anticipated variation between schools. The mode shares by school are shown in the following table, with the highlighted cells indicating that the value varies by at least 1.5 standard deviation from the district average

District	School Name	Car Passenger	School Bus	Cycling	Walk
Hull Périphérie	École Saint-Paul	40%	6%	0%	54%
	École Jean-de-Brébeuf	42%	18%	6%	33%
	École Côte-du-Nord	39%	33%	7%	21%
	École du Lac-des-Fées	41%	17%	6%	36%
	Internationale du Mont-Bleu	51%	2%	2%	25%
	du Dôme	35%	42%	0%	23%
	Parc-de-la-Montagne	41%	22%	1%	36%
Aylmer	École du Village	27%	51%	1%	21%
	des Rapides-Deschênes	43%	49%	4%	5%
	des Tournesols	53%	34%	0%	13%
	Euclide-Lanthier	54%	22%	0%	23%
	du Vieux-Verger	54%	24%	0%	22%
	De la Forêt	43%	2%	9%	46%
	des Cavaliers	36%	28%	19%	17%

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District	School Name	Car Passenger	School Bus	Cycling	Walk
Pointe Gatineau	École du Nouveau-Monde Édifice Renaud	42%	14%	3%	41%
	du Vallon	55%	10%	12%	24%
	le Petit-Prince	35%	17%	8%	40%
	du Tremplin	45%	15%	5%	35%
	Massé	34%	39%	3%	24%
Masson-Angers	St-Jean-de-Brébeuf	40%	44%	0%	16%
	Monseigneur Charbonneau	65%	5%	0%	30%
	Sacré-Cœur	47%	13%	11%	30%
	Quatre-vents	52%	2%	7%	40%
	du Ruisseau	42%	32%	4%	22%
	St-Michel	27%	63%	4%	6%
	St-Laurent	49%	41%	1%	8%
	Du Boisé	39%	34%	4%	23%

There are three schools (De la Forêt in Aylmer, du Vallon in Pointe Gatineau, and St-Michel in Masson-Angers) that have two of their mode shares deviate considerably from the average. The remaining schools have no more than one mode outside the pre-determined acceptable range. Next, the Mode shares with values varying by at least 1.5 standard deviation from the city average by school are shown in the following table (highlighted cells.) There are two schools (École du Village in Aylmer and St-Michel in Masson-Angers) with at least two of their modes deviating from the average. St-Michel has a noticeable deviation from the district and city-wide average and as such was removed from the analysis as an outlier.

District	School Name	Car Passenger	School Bus	Bike	Walk
Île de Hull	École Notre-Dame	17%	44%	0%	40%
Hull Périphérie	École Saint-Paul	40%	6%	0%	54%
	École Jean-de-Brébeuf	42%	18%	6%	33%
	École Côte-du-Nord	39%	33%	7%	21%
	École du Lac-des-Fées	41%	17%	6%	36%
	Internationale du Mont-Bleu	51%	2%	2%	25%
	du Dôme	35%	42%	0%	23%
	Parc-de-la-Montagne	41%	22%	1%	36%
Plateau	École des Deux-Ruisseaux	49%	33%	0%	18%
	du Marais	25%	44%	5%	26%
Aylmer	École du Village	27%	51%	1%	21%
	des Rapides-Deschênes	43%	49%	4%	5%
	des Tournesols	53%	34%	0%	13%
	Euclide-Lanthier	54%	22%	0%	23%
	du Vieux-Verger	54%	24%	0%	22%
	De la Forêt	43%	2%	9%	46%
	des Cavaliers	36%	28%	19%	17%

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District	School Name	Car Passenger	School Bus	Bike	Walk
Pointe Gatineau	École du Nouveau-Monde Édifice Renaud	42%	14%	3%	41%
	du Vallon	55%	10%	12%	24%
	le Petit-Prince	35%	17%	8%	40%
	du Tremplin	45%	15%	5%	35%
	Massé	34%	39%	3%	24%
Gatineau Est	des Cépages	61%	4%	0%	34%
	de l'Escalade	52%	2%	0%	46%
	de la Traversée	33%	30%	0%	38%
Masson-Angers	St-Jean-de-Brébeuf	40%	44%	0%	16%
	Monseigneur Charbonneau	65%	5%	0%	30%
	Sacré-Cœur	47%	13%	11%	30%
	Quatre-vents	52%	2%	7%	40%
	du Ruisseau	42%	32%	4%	22%
	St-Michel	27%	63%	4%	6%
	St-Laurent	49%	41%	1%	8%
	Du Boisé	39%	34%	4%	23%

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F-2 EMPLOYMENT AND COMMERCIAL GENERATOR SAMPLE BY DISTRICT

APPENDIX F.2 – EMPLOYMENT AND COMMERCIAL GENERATOR SAMPLE SIZE BY DISTRICT

The methodology for establishing the employment and commercial generator mode shares followed that used for the residential mode share development and were developed by district. This included a minimum sample size requirement of 50 for each district in both peak periods. The sample size by trip purpose, district and time are summarized in the table below. Highlighted cells indicate sample size of less than 50, in these cases the geographic sector average was carried forward as the mode share. Due to the extreme shortage of PM peak period trips for employment, only a mode share for the AM peak period was developed.

District	Sector	District Name	Employment		Shopping	
			AM Peak	PM Peak	AM Peak	PM Peak
1	1	Ottawa Centre	2,666	43	58	253
50	1	Ottawa Inner Area	1,248	51	85	443
600	1	Île de Hull	836	9	4	41
100	2	Ottawa East	492	21	95	450
120	2	Beacon Hill	367	13	26	195
140	2	Alta Vista	1,335	43	84	537
180	2	Hunt Club	330	18	63	298
200	2	Merivale	1,025	39	123	514
240	2	Ottawa West	725	21	65	406
260	2	Bayshore/Cedarview	714	21	56	446
625	2	Hull Périphérie	579	39	67	232
300	3	Orleans	298	23	102	581
400	3	South Gloucester / Leitrim	67	5	6	32
425	3	South Nepean	169	10	64	272
500	3	Kanata - Stittsville	747	24	98	523
650	3	Plateau	24	4	17	85
700	3	Aylmer	105	6	35	159
800	3	Pointe Gatineau	333	36	53	324
820	3	Gatineau Est	194	11	31	131
350	4	Rural East	35	3	2	19
360	4	Rural Southeast	51	5	11	32
450	4	Rural Southwest	87	2	5	76
560	4	Rural West	76	6	13	38
750	4	Rural Northwest	70	2	8	62
840	4	Rural Northeast	53	1	1	17
845	4	Masson-Angers	108	13	21	78

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G PROXIMITY TO RAPID TRANSIT STATIONS

G-1 DATA FROM CITY OF OTTAWA (SOURCE: 2016 CENSUS)

Sustainable Mode Share
(Walk + Bike + Transit + Vehicle Passengers)

Residents Living within 800m
Walking Distance of Rapid Transit Stations
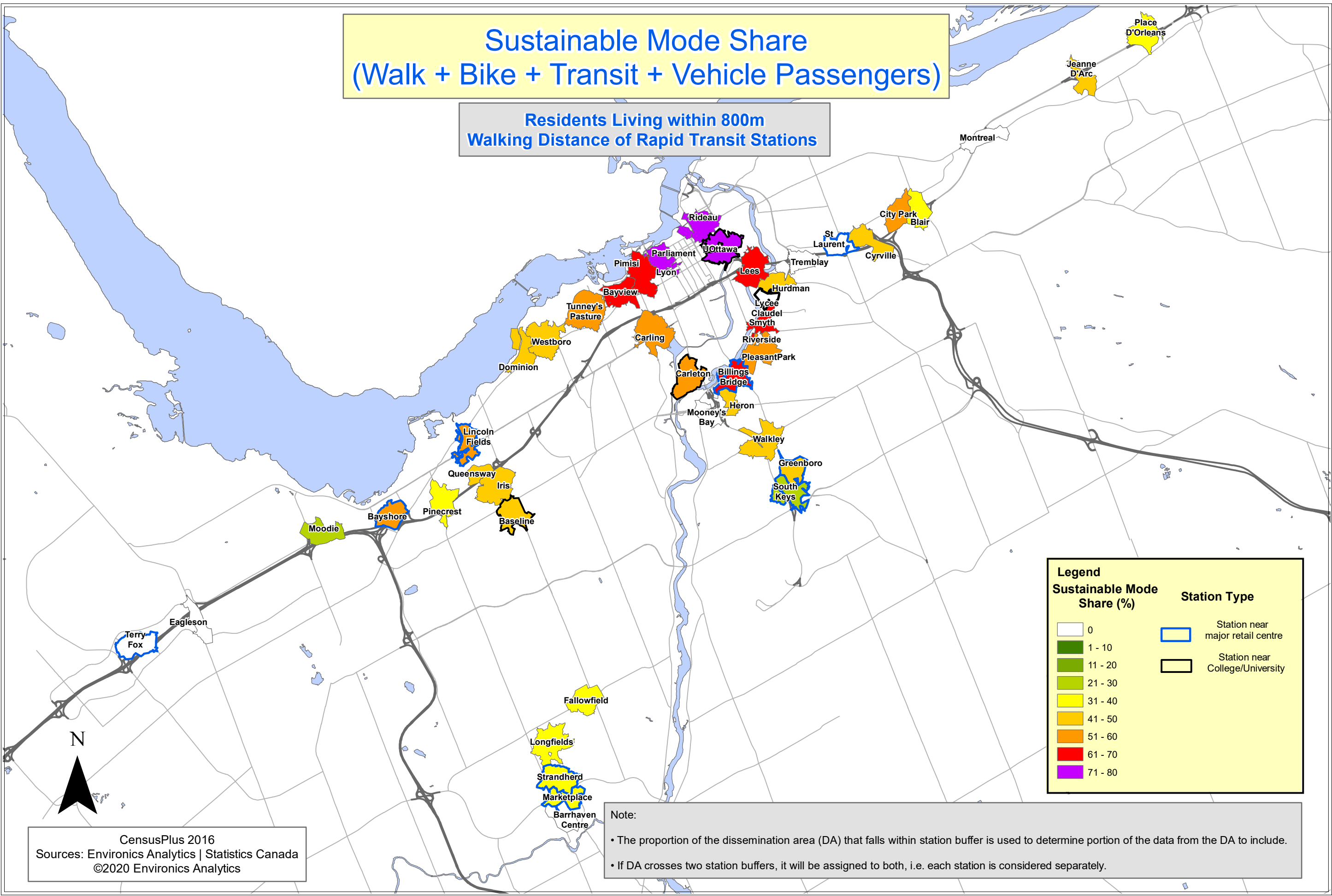
Legend

Sustainable Mode Share (%)

- 0
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80

Station Type

- Station near major retail centre
- Station near College/University

CensusPlus 2016
Sources: Environics Analytics | Statistics Canada
©2020 Environics Analytics

Note:
- The proportion of the dissemination area (DA) that falls within station buffer is used to determine portion of the data from the DA to include.
- If DA crosses two station buffers, it will be assigned to both, i.e. each station is considered separately.

H

MIXED USE DEVELOPMENT EXAMPLE

H-1 DEMONSTRATION OF MIXED-USE DEVELOPMENT INTERNAL CAPTURE RATE CALCULATION

APPENDIX H.1 – DEMONSTRATION OF MIXED-USE DEVELOPMENT INTERNAL CAPTURE RATE CALCULATION FOR A MIXED-USE SITE

For demonstration purposes, an example of an internal capture rate calculation for a mixed-use site using the methodology from the *ITE Trip Generation Handbook (3rd Edition)* and the ITE spreadsheet tool (https://www.ite.org/technical-resources/topics/trip-and-parking-generation/other-resources/) is given below. The example development site has three different proposed land uses. The demonstrated calculation is for the PM peak period.

The ITE methodology is a nine-step procedure. The analyst must complete steps 1 through 3 before entering the data into the ITE spreadsheet tool (also referred to as NCHRP Report 684 Estimator), which will complete steps 4 through 9 and output the internal capture rate for the mixed-use development. The example below steps through all nine steps of the procedure.

> **Demonstration Development Proposal:**
>
> The following defines the example case on how to calculate internal trips utilizing the methodology outlined in the ITE *Trip Generation Handbook* and supplemental spreadsheet tool. The example case is an existing 500,000 square foot mixed-use development in the Beacon Hill district of Ottawa. The trips were developed from carrying out local surveys

Step 1: Determine whether methodology is appropriate for study site

Here, the analysis must identify whether the site is in fact by definition a mixed-use development. The analyst should consider at least the following factors:

— Development Type – must be a single site that is integrated for pedestrians and vehicles to travel within
— Development Location – should not be located within or adjacent to the central business district
— Development Size – must be between 100,000 and 2 million square feet
— Land Use Mix – at least two of the following land uses: retail, restaurant, office, residential, hotel, and/or cinema/entertainment
— ITE Trip Generation Manual Database – Ensure that the specific mixed-use area is not already covered in the ITE Trip Generation Manual. Sites like a shopping centre, office building with ground floor retail, and office park with retail are ITE Land Uses that already account for internal trip rates
— Time Period for Analysis – the capture rates in the ITE Trip Generation Manual are only available for AM and PM peak periods

For greater detail, please refer to Chapter 6 of the *ITE Trip Generation Handbook (3rd Edition).*

Demonstration Development Proposal:

For the example, the development site is confirmed to be a mixed-use development due to the following factors:

— Development Type: the mixed-use development is a single site, with internal pedestrian connectivity. The combination of retail, residential, and office is not a pre-existing ITE land-use code (e.g. office park).
— Development Location: The Beacon Hill district is not close to the central business district in Ottawa. Therefore, the location of the mixed-use development site is acceptable.
— Development Size: The development is between the sizes of 100,000 and 2 million square feet.
— Land Use Mix: There are three different land uses (retail, residential, and office) on the development site.
— ITE Trip Generation Manual Database: The combination of retail, residential, and office is not a pre-existing ITE land-use code (e.g. office park).
— Time Period for Analysis: The time period for this analysis will be the PM peak period.

Step 2-3: Estimate person-trip generation for individual on-site land uses and proximity between on-site land use pairs

These two steps include identification of the following information for the individual land uses within the mixed-use development, using ITE or other trip generation rates and vehicle occupancy and mode share from the 2020 TRANS Trip Generation Study. The following data is required:

— Vehicle trips by direction (Inbound & Outbound)
— Mode share (Inbound & Outbound)
— Vehicle occupancy (Inbound & Outbound)
— Walking distance from entrance to entrance for each land use pairing

Note that person-trips can be used in lieu of vehicle trips, if available. If this is the case, then there is no need to identify the vehicle occupancy.

Demonstration Development Proposal:

Table 1 summarizes the data identified for the demonstration site.

Table 1: Mixed-Use Example - Data Identification

Land Use	Vehicle Occupancy	Vehicle Trips (peak hour)		Distance from Other Land Use (ft)			Mode Share	
		Entering	Exiting	Retail	Office	Residential	Transit	Non-Motorized
Retail	1.15	475	514	-	500	750	20%	10%
Office	1.15	36	177	500	-	1,000	10%	5%
Residential	1.15	81	43	750	1,000	-	20%	10%

Intermediate Step: Input values to ITE Spreadsheet Tool (NCHRP Report 684 Estimator)

To complete steps 4 to 9, the data collected in steps 2 and 3 must be properly input to the ITE Spreadsheet Tool. These intermediate steps (A-D) are defined below.

There are six tabs in the ITE Spreadsheet tool:

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- Page 1-A: Editable sheet for AM peak hour internal trip rates
- Page 2-A: Non-editable sheet for AM peak hour internal trip rates
- Page 1-P: Editable sheet for PM peak hour internal trip rates
- Page 2-P: Non-editable sheet for PM peak hour internal trip rates
- Table 7.1: Non-editable sheet of unconstrained internal trip capture rates and proximity adjustments for trip origins
- Table 7.2: Non-editable sheet of unconstrained internal trip capture rates and proximity adjustments for trip destinations

The analyst is only required to enter data into Page 1-A and 1-P.

Demonstration Development Proposal:

For the example, we are calculating the PM peak hour internal trip capture rate only, therefore Page 1-P will require the data inputs. Page 1-P is formatted such that only the cells highlighted in yellow can be edited as shown in Figure (page 1-P prior to data entry.)

The data entry requirements for Page 1-P, as marked on the Figure 1 are defined as follows:

- Step A: Input defined information for project
- Step B: Input vehicle trips by direction for each land use within the proposed development
- Step C: Input vehicle occupancy, transit mode share, and non-motorized mode share for each land use within the proposed development
- Step D: Input measured walking distance from entrance to entrance for each land use pairing (from proposed development site plan)

It is noted that if person-trips were estimated instead of vehicle trips, the person-trips should be input into Page 1-P for the vehicle trips with a vehicle occupancy of 1 applied.

NCHRP 684 Internal Trip Capture Estimation Tool

Project Name:		**Organization:**
Project Location:		**Performed By:**
Scenario Description:		**Date:**
Analysis Year:		**Checked By:**
Analysis Period:	PM Street Peak Hour	**Date:**

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail				0		
Restaurant				0		
Cinema/Entertainment				0		
Residential				0		
Hotel				0		
All Other Land Uses[2]				0		
				0	0	0

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized	Veh. Occ.[4]	% Transit	% Non-Motorized
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Figure 1: Empty Page 1-P (Source: Institute of Transportation Engineers)

Demonstration Development Proposal:

A completed input sheet for the demonstration project is shown in **Figure 2**.

NCHRP 684 Internal Trip Capture Estimation Tool			
Project Name:	Example	Organization:	TRANS
Project Location:	NCR	Performed By:	-
Scenario Description:	Mixed-Use Development	Date:	2020
Analysis Year:	2020	Checked By:	-
Analysis Period:	PM Street Peak Hour	Date:	2020

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				213	36	177
Retail				989	475	514
Restaurant				0		
Cinema/Entertainment				0		
Residential				124	81	43
Hotel				0		
All Other Land Uses[2]				0		
				1,326	592	734

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized	Veh. Occ.[4]	% Transit	% Non-Motorized
Office	1.15	20%	10%	1.15	20%	10%
Retail	1.15	10%	5%	1.15	10%	5%
Restaurant						
Cinema/Entertainment						
Residential	1.15	20%	10%	1.15	20%	10%
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		500			1000	
Retail					750	
Restaurant						
Cinema/Entertainment						
Residential		750				
Hotel						

Figure 2: Completed Page 1-P (Source: Institute of Transportation Engineers)

Once all data has been input into the worksheet; Steps 4 through 9 are run by clicking the "Calculate" in the bottom left corner, the results will appear in Table 5 of Page 1-P.

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Demonstration Development Proposal:

The results of the demonstration project show an internal capture trip rate of 15% which is used to adjust the trip generation forecasts for the mixed-use development as shown Figure 3.

Table 5-P: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	1,524	680	844
Internal Capture Percentage	15%	17%	14%
External Vehicle-Trips[5]	921	408	513
External Transit-Trips[6]	156	63	93
External Non-Motorized Trips[6]	79	33	46

Figure3: Table 5 of ITE Spreadsheet on Page 1-P

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DATA COLLECTION PROGRAM

I-1 PROPOSED DATA COLLECTION PROGRAM

APPENDIX I.1- PROPOSED DATA COLLECTION PROGRAM

	Existing				2021				2022				2023				2024				2025				2021-2025			
	Core	Urban	Suburban	Rural	Core	Urban	Suburban	Rural	Core	Urban	Suburban	Rural	Core	Urban	Suburban	Rural	Core	Urban	Suburban	Rural	Core	Urban	Suburban	Rural	Core	Urban	Suburban	Rural
Single-Family Detached Housing	-	1	4	1	-	2	2	-	-	1	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-	4	3	1
Multi-family Housing (Low-Rise)	-	9	4	-	-	-	2	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1	-	-	2	4	-
Multi-family Housing (Mid-Rise)	1	2	2	-	-	1	1	-	-	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	3	3	-
Multi-family Housing (High-Rise)	2	20	3	-	1	-	1	-	-	-	-	-	1	-	1	-	-	-	-	-	1	-	1	-	3	-	3	-
Mid-Rise Residential (w/ 1st floor commercial)	-	-	-	-	-	2	1	-	-	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	4	3	-
High-Rise Residential (w/ 1st floor commercial)	-	-	-	-	1	1	1	-	-	-	-	-	1	-	1	-	-	-	-	-	1	1	-	-	3	2	2	-
Mixed-Use Developments (min. 3 Land Uses)	-	-	-	-	-	1	1	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	2	-
Schools	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1	2	1	1
TOTAL	3	32	13	1	2	8	9	-	1	3	3	1	2	1	4	-	-	4	3	1	2	3	2	-	7	19	21	2

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