

**HALO CAR WASH
3555 BORRISOKANE ROAD
OTTAWA, ONTARIO**

TIA STRATEGY REPORT

May 16, 2022

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Prepared for:

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756 TIA Strategy.doc

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TIA STRATEGY REPORT

INTRODUCTION

Halo Car Wash Inc. has proposed the development of a parcel of land at the southeast corner of the intersection of Borrisokane Road and Flagstaff Drive in the community of Barrhaven. The property has a net lot area of 5,342 m², and has a municipal address of 3555 Borrisokane Road. The property is currently vacant. Halo Car Wash Inc. proposes to develop the land by constructing an automated car wash. The site will have one site access point onto Flagstaff Drive which borders the north limit of the site. The site access would be located approximately 95 m east of the Flagstaff/Borrisokane intersection (centreline to centreline).

The firm of D. J. Halpenny & Associates Ltd. has been retained to prepare a Transportation Impact Assessment report in support of the Site Plan Application. The following documents the steps which conform to the City of Ottawa *Transportation Impact Assessment Guidelines (2017)*. Exhibit 1 in the Appendix presents the consultant Certification Form.

STEP 1 - SCREENING

A Screening Form has been prepared for the project and is provided as Exhibit 1.1 in the Appendix. The Screening Form was submitted to the City of Ottawa which determined that the Trip Generation and Safety Triggers were met and a Transportation Impact Assessment (TIA) study must continue onto the next stage. The following will address the requirements of the Scoping Document.

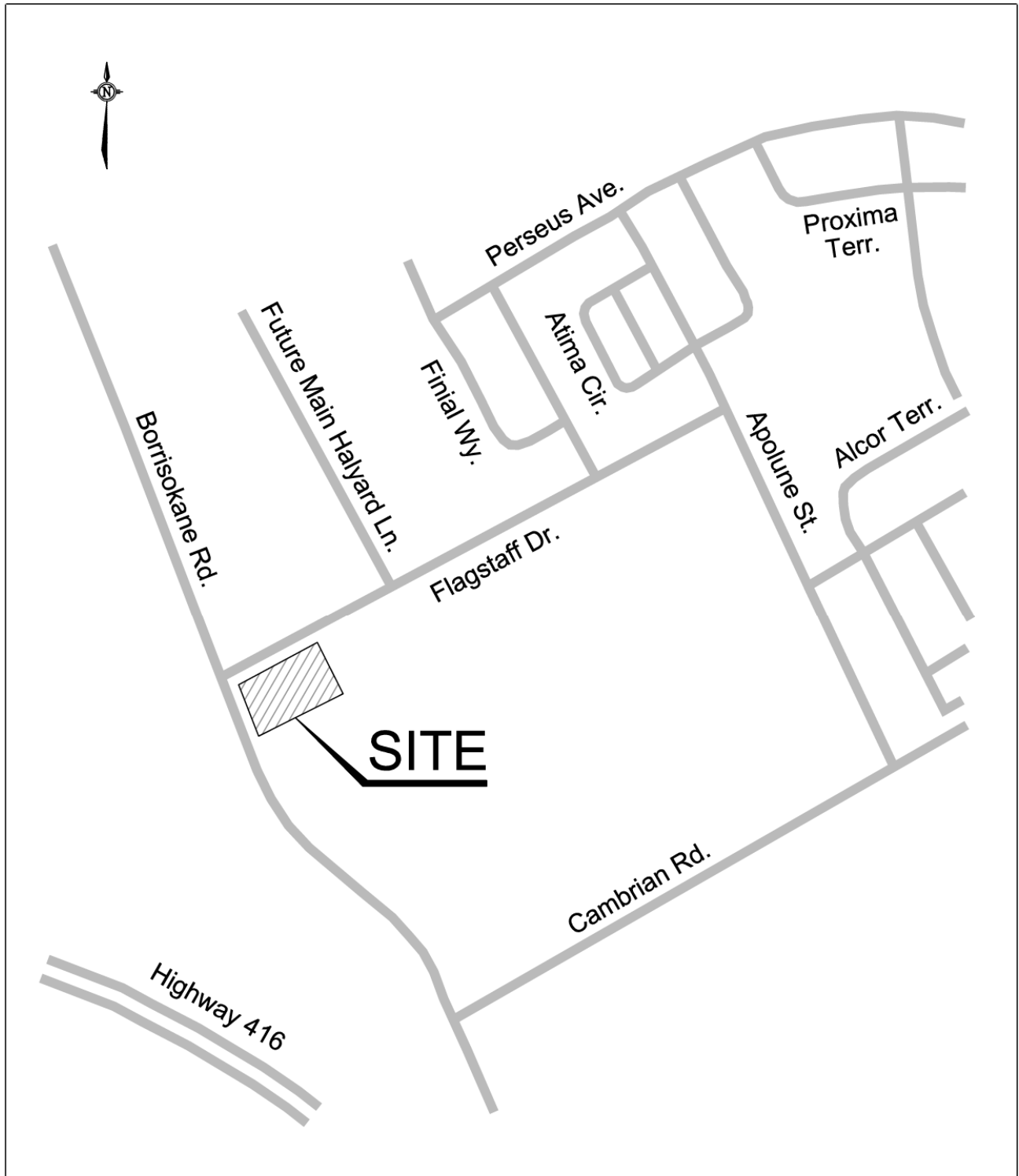
STEP 2 - SCOPING

MODULE 2.1 – Existing and Planned Conditions

Element 2.1.1 – Proposed Development

The Halo Car Wash is proposed on a vacant parcel of land at 3555 Borrisokane Road in the Nepean community. Figure 2.1 shows the location of the development in the community.

FIGURE 2.1
SITE LOCATION PLAN



NOT TO SCALE

The property is 5,342 m² in size and is located at the southeast corner of Borrisokane Road and Flagstaff Drive. The lands are currently zoned “IL” - Light Industrial which will support the proposed development. The Halo Car Wash will be an automated car wash in a one storey building with a Gross Floor Area (GFA) of 473 m². The site will provide parking for 21 vehicles including 1 barrier free space. Three of the spaces will be for staff parking with the balance of spaces available for the hand drying and vacuuming of vehicles by their owners. The car wash will provide sufficient queuing space for 24 vehicles at the ticket dispenser.

The site will have one access point onto Flagstaff Drive from a 7.5 m urban road located approximately 95 m east of Borrisokane Road. The car wash will be constructed in a single phase with completion expected by the year 2023. Figure 2.2 shows a conceptual site plan of the development.

Element 2.1.2 – Existing Conditions

ROADS

The west limit of the site will border Borrisokane Road. Borrisokane Road is identified as an arterial road in the City of Ottawa *Transportation Master Plan* (TMP). The road is a north-south two lane rural road with a pavement width of 7.0 m, gravel shoulders and no sidewalks. The road is not designated as a Spine Route in the TMP and contains no cycling facilities. The road has a posted speed limit of 80 km/h in the vicinity of the site.

Flagstaff Drive will border the north limit of the site and is currently under construction as part of the development of the residential community in the area. Flagstaff Drive will be a future east-west urban collector road with pedestrian sidewalks. The access road to the site will be from Flagstaff Drive.

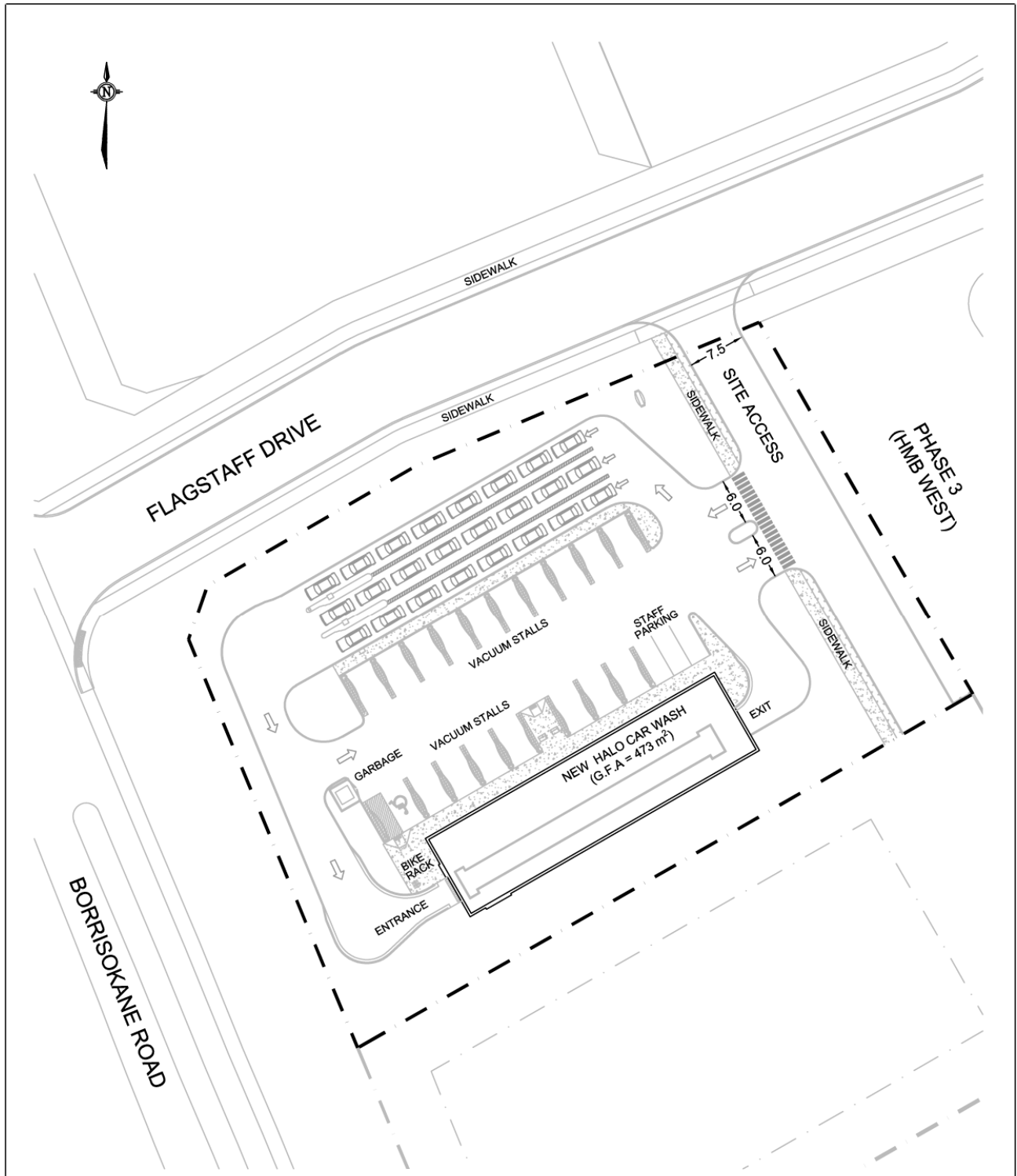
Cambrian Road is an east-west arterial road located 450 m south of Flagstaff Drive. The road is a two-lane rural road with a 7.0 m pavement width with gravel shoulders. Cambrian Road is not designated as a Spine Route in the TMP and contains no cycling facilities. The road has a posted speed limit of 70 km/h.

INTERSECTIONS

Flagstaff/Borrisokane Intersection - The intersection is a two-way stop controlled “T” intersection with a stop sign at the westbound Flagstaff Drive approach. The intersection has not been completed and is still in the construction phase. Below is the existing lane configuration of the Flagstaff/Borrisokane intersection and a photograph taken March 6, 2022 of the Flagstaff Drive approach looking east:

Northbound Borrisokane Rd.	One shared through/right lane
Southbound Borrisokane Rd.	One shared left/through lane
Westbound Flagstaff Drive	One shared left/right turn lane (Stop sign)

FIGURE 2.2
CONCEPTUAL SITE PLAN



NOT TO SCALE

INTERSECTION OF FLAGSTAFF/BORRISOKANE - Looking Eastbound



Cambrian/Borrisokane Intersection - The intersection is a two-way stop controlled “T” intersection with a stop sign at the westbound Cambrian Road approach. The intersection currently contains no auxiliary turn lanes. The intersection has the following lane configuration with an aerial photograph of the intersection from geoOttawa provided below:

Northbound Borrisokane Rd.	One shared through/right lane
Southbound Borrisokane Rd.	One shared left/through lane
Westbound Cambrian Road.	One shared left/right turn lane (Stop sign)

INTERSECTION OF CAMBRIAN/BORRISOKANE - Aerial



The most recent weekday peak AM and PM hour traffic counts at the intersection of Cambrian Road and Borrisokane Road were obtained from the City of Ottawa and are provided in the Appendix as Exhibit 2.1 for the 2018 counts. Figure 2.3 presents the weekday peak hour and traffic counts at the intersection.

TRANSIT

The section of Borrisokane Road between Cambrian Road and Strandherd Drive is currently not served by OC Transpo. There is no transit service within a 400 m walk of the site. The transit routes in the surrounding area are shown in Exhibit 2.2 which was obtained from the OC Transpo system map. As developments in the area are completed and occupied, transit service and routes would be evaluated and determined.

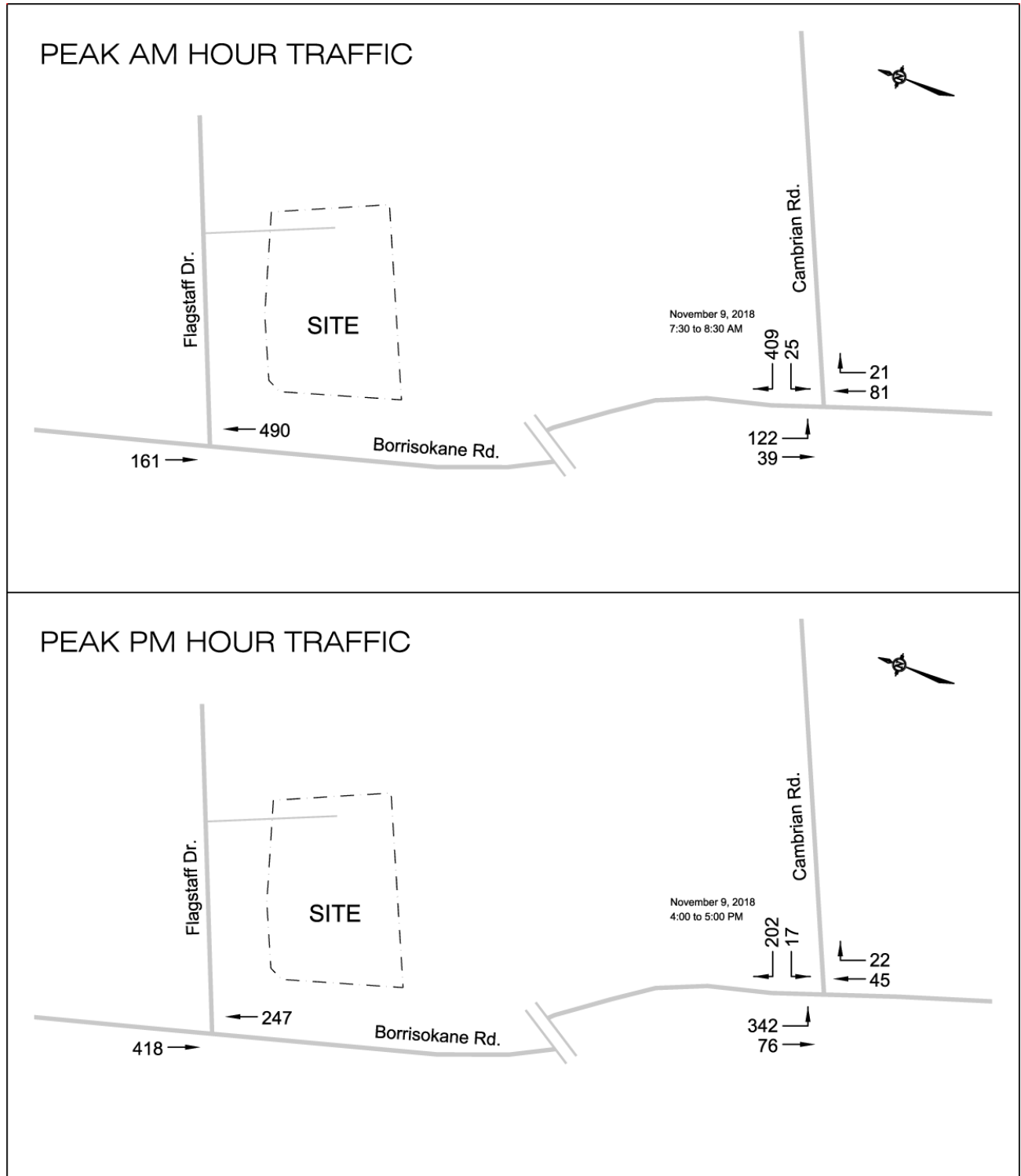
COLLISION HISTORY

Collision reports were obtained through Open Data Ottawa for the five year time period between the years January 1, 2016 and December 31, 2020. The collision reports were obtained for the Cambrian/Borrisokane intersection. At the time the collision data was obtained, the Flagstaff/Borrisokane intersection was not constructed. Reported collisions were also obtained along the road segments of Borrisokane Road between Cambrian Road and the Jock River, and Cambrian Road between Borrisokane Road and Apolune Street. Table 2.1 summarizes the collisions by year and type.

**TABLE 2.1
 COLLISION SUMMARY**

YEAR	COLLISION TYPE					TOTAL
	REAR END	ANGULAR	TURNING	SIDESWIPE	OTHER	
Cambrian Road at Borrisokane Road Intersection						
2016	2				2	4
2017	1				1	2
2018					1	1
2019						0
2020	3	1	1			5
Borrisokane Road Segment between Cambrian Road and the Jock River						
2016					1	1
2017					5	5
2018					5	5
2019						0
2020	1				1	2
Cambrian Road Segment between Borrisokane Road and Apolune Street						
2016					1	1
2017						0
2018						0
2019						0
2020						0

FIGURE 2.3
2018 PEAK AM AND PM HOUR TRAFFIC COUNTS



NOT TO SCALE

SURROUNDING AREA

The area along Borrisokane Drive in the vicinity of the site is currently vacant and is mainly used for agricultural purposes. There are currently no roads or driveways within 300 m of the site at the Flagstaff/Borrisokane intersection. Draft plan submissions show a future local street (Main Halyard Lane) on the north side of Flagstaff Drive approximately 120 m east of the site access. Site plan and subdivision applications are being prepared which would complete the construction of Flagstaff Drive. The City of Ottawa will construct the Flagstaff/Borrisokane intersection as a project funded by development charges.

Borrisokane Road is a two lane rural road with no traffic management measures in place. The posted speed limit in the vicinity of the site is 80 km/h.

Traffic counts taken on November 9, 2018 were obtained from the City of Ottawa for the Cambrian/Borrisokane intersection which were used to determine the existing volume of traffic along Borrisokane Road past the site. The peak hour counts are provided as Exhibit 2.1 in the Appendix and are shown in Figure 2.3. The counts determined that 651 vehicles travelled past the site during the peak hour between 7:30 and 8:30 AM, and 665 vehicles during the peak hour between 4:00 and 5:00 PM. The counts determined that there were no pedestrian or cycling trips along Borrisokane Road past the site during the 2018 weekday peak AM or PM hours. With transit service not provided in the vicinity of the site, there were no peak hour travel demands recorded in the area for modes other than vehicular travel.

Element 2.1.3 – Planned Conditions

The *Transportation Master Plan 2013* (TMP) was examined to determine if there were any roadway or intersection modifications to the municipal road network. With construction and improvements to the roadway infrastructure being triggered by and constructed by private developers, there are no roadway improvements identified in the TMP within the study area.

The following are proposed or recently developed property within a one kilometer radius of the site:

- 3387 Borrisokane Road - Glenview Homes
The development is located on the north side of Flagstaff Drive. The subdivision will contain 288 dwelling units plus a school. Full build-out is expected by 2022.
- Half Moon Bay West - Mattamy Homes
The subdivision is located east and south of the site and will contain 973 dwelling units. Full build-out is expected by 2024.
- 3640 Greenbank Road - Tamarack Corporation
The Meadows in Half Moon Bay - Phase 5 as a subdivision located southeast of the Cambrian/Borrisokane intersection. The development will consist of 346 dwelling units with a completion date of 2022.
- 3713 Borrisokane Road - ABIC Manufacturing

An industrial subdivision located southeast of the Cambrian/Borrisokane intersection, with Phase 1 completed by 2022.

- 3717 Borrisokane Road - Caivan Communities

The subdivision is located southeast of the intersection of Cambrian Road and Borrisokane Road. The subdivision will consist of 600 dwelling units with a completion date of 2024.

As part of the proposed residential development in the area, Flagstaff Drive would be extended to Borrisokane Road as a collector road. The Flagstaff/Borrisokane intersection would be constructed by the City of Ottawa, funded by development charges. The intersection would be a two-way stop controlled “T” intersection with the westbound approach comprising of an exclusive left turn lane and exclusive right turn lane (stop sign). Borrisokane Road would be modified to include an exclusive southbound left turn lane at the Flagstaff/Borrisokane intersection.

MODULE 2.2 – Study Area and Time Periods

Element 2.2.1 – Study Area

The study area for the Halo Car Wash will be confined to the road sections of Borrisokane Road between Cambrian Road and the Jock River, Flagstaff Road between Borrisokane Road and Apolune Street, and Cambrian Road between Borrisokane Road and Apolune Street. The study would include the site access onto Flagstaff Drive, the Flagstaff/Borrisokane and Cambrian/Borrisokane intersections. The study will examine the intersection geometry and roadway segments in accordance with the City of Ottawa *Transportation Impact Assessment Guidelines (2017)*.

Element 2.2.2 – Time Periods

The time period for the analysis would be the weekday peak PM time period of the background roadway traffic. This would be the peak period of traffic along Borrisokane Road and adjacent streets to the site. The nature of a car wash is that it would generate few AM peak hour trips.

Element 2.2.3 – Horizon Years

The TIA will address the impact of the site generated trips from the proposed Halo Car Wash. The horizon year of the study will be the completion of the car wash at the year 2023. The analysis will further examine the impact at the year 2028 which represents five years beyond completion.

MODULE 2.3 – Exemptions Review

The exemptions, which provide possible reductions to the scope of work of the TIA Study, were examined using Table 4: Possible Exemptions which is provided in the City’s *Transportation Impact Assessment Guidelines (2017)*. Utilizing the table, the following lists the possible exemptions proposed for the TIA Study report:

MODULE	ELEMENT	EXEMPTION CONSIDERATIONS
Design Review Component		
4.1 Development Design	4.1.2 Circulation and Access	No – The circulation of vehicles throughout the site and queuing at the ticket dispenser will be examined.
	4.1.3 New Street Networks	Yes - Only required for subdivisions.
4.2 Parking	4.2.1 Parking Supply	No – The parking supply will be compared to that required as determined from City By-laws.
	4.2.2 Spillover Parking	Yes - Parking will meet the City of Ottawa By-laws. A car wash would not have parked unattended vehicles.
Network Impact Component		
4.5 Transportation Demand Management	All Elements	Yes – The automated car wash would have few employees.
4.6 Neighbourhood Traffic Management	4.6.1 Adjacent Neighbourhoods	No – The site will have access onto Flagstaff Drive, a future collector road.
4.8 Network Concept		Yes - The site would not generate more than 200 person-trips per peak hour in excess of the volume permitted by established zoning.

STEP 3 - FORECASTING

MODULE 3.1 - Development-generated Travel Demand

Element 3.1.1 – Trip Generation and Mode Shares

The Halo Car Wash will be an automated car wash facility which will provide no additional services beyond a parking area for vehicle owners to vacuum and towel dry their vehicles. The nature of an automated car wash is that the weekday peak periods of the car wash facilities are in the afternoon when drivers are returning home from work. The number of expected site generated trips utilized the statistical data in the Institute of Transportation Engineers (ITE) document, *Trip Generation Manual 10th Edition*. The trip generation data determined the average vehicle trip rate for an Automated Car Wash (ITE Land Use 948). The trip rate for a weekday peak PM hour of the adjacent street traffic was 14.20 Trips/1000 sq.ft. GFA. The data graph is provided in the Appendix as Exhibit 3.1, with no peak AM hour trip data available from ITE. The trip distribution was 50% entering and 50% exiting the site.

The auto-trips are shown in Table 3.1 and are the product of the 473 m² (5,091.3 ft²) gross floor area of the facility and the trip generation rate of 14.20 Trips/1000 ft² GFA. The number of future person-trips was determined by the number of auto-trips calculated from the ITE trip rates, and multiplied by 1.28 (from the TIA Guidelines) to convert auto-trips to person-trips. Table 3.1 shows the future peak PM hour auto-trips and person-trips.

**TABLE 3.1
 PM PEAK HOUR SITE GENERATED TRIPS**

Trips	Peak PM Hr. AUTO-TRIP	Peak PM Hr. PERSON-TRIPS
Halo Car Wash	72 veh.	92 per.

The Trip Reduction Factors which were provided in the TIA Guidelines were applied to the land uses as discussed below:

- 1) *Deduction of Existing Development Trips* - The site is a vacant parcel of land. There would be no trip deduction applied for an existing on-site use.
- 2) *Pass-by Vehicle Trips* - Pass-by trips are trips that are already on the road and are passing by the site on their way to their primary destination. They are not considered new trips generated by the site. The surveys provided in the *ITE Trip Generation Handbook 3rd Edition* for a Gasoline/Service Station (a similar land use to that of the proposed site) were utilized to determine the average pass-by trip percentage which was applied to the peak PM hour. The average pass-by trip percentage was determined to be 42 percent, with 58 percent of the trips as primary trips.
- 3) *Synergy or Internalization* - The site will consist only of the automated car wash. There would be no trip reduction due to shared trips between multiple uses.

The expected number of primary and pass-by person-trips following the application of the three Trip Reduction Factors is shown in Table 3.2.

**TABLE 3.2
 TOTAL PM PEAK HOUR SITE GENERATED PERSON-TRIPS**

Trips	FUTURE PERSON-TRIPS
Primary Trips	53 per.
Pass-by Trips (Reduction 42%)	39 per.

The Halo Car Wash is located along Borrisokane Road, north of Cambrian Road in what the City of Ottawa designates as “South Nepean”. The mode share for peak PM hour trips was determined from Table 13 in the *TRANS Trip Generation Manual - Summary Report 2020* for a Commercial Generator. With a car wash use, the mode share of all trips would be a combination of Auto Driver and Auto Passenger. The analysis has utilized the Auto Passenger mode share from Table 13 of the TRANS document, and assumed the balance of the trips as Auto Driver trips. Table 3.3 presents the peak PM hour mode share, and the peak PM hour primary and pass-by person-trips.

**TABLE 3.3
 MODE SHARE SUMMARY (PM Peak Hour Person-Trips)**

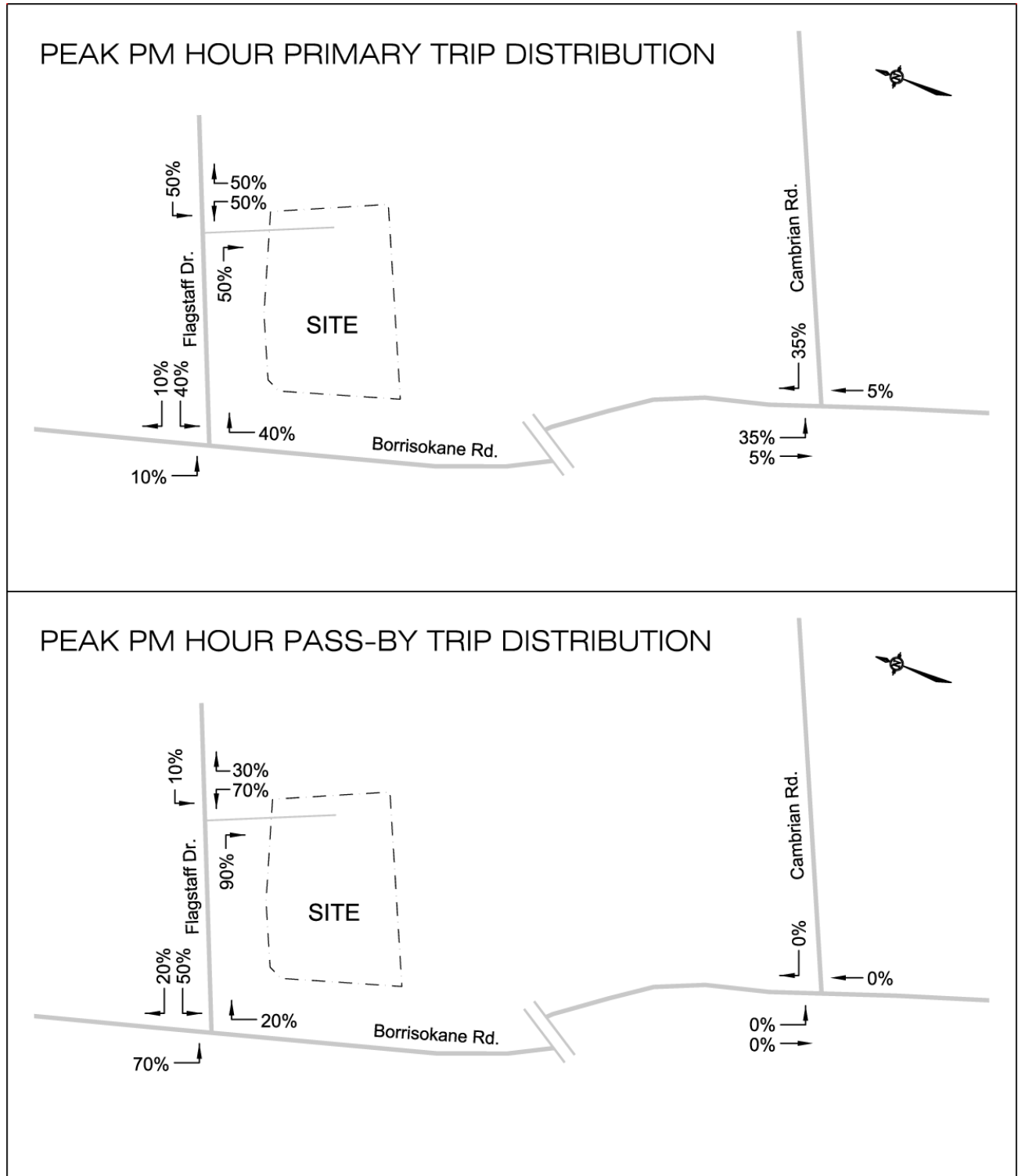
FUTURE MODE SHARE TARGETS FOR AN AUTOMATED CAR WASH			
Travel Mode	PM % Peak Hr.	Primary Per. Trips	Pass-By Per. Trips
Auto Driver	73%	39	28
Auto Passenger	27%	14	11
Transit	0%	0	0
Cycling	0%	0	0
Walking	0%	0	0
Total	100%	53 Trips	39 Trips

Element 3.1.2 – Trip Distribution

The distribution of the peak hour site generated primary trips from the Halo Car Wash was determined by a combination of examining the *2011 NCR Household Origin-Destination Survey* for the origin/destination of peak PM hour trips for the South Nepean Area, the size and location of the surrounding residential areas, and other traffic studies completed for developments in the vicinity of the site. The distribution of primary site generated trips is shown in Figure 3.1.

The pass-by and diverted site generated trips are trips already on the road and passing by or in the vicinity of the site. The distribution of pass-by trips was determined from the traffic counts of existing traffic at adjacent intersections to the site, and the convenience of routes entering and exiting the site from the mainstream traffic. The distribution of pass-by site generated trips is shown in Figure 3.1.

FIGURE 3.1
PRIMARY AND PASS-BY TRIP DISTRIBUTION



Element 3.1.3 – Trip Assignment

The distribution of site generated primary and pass-by vehicle-trips entering and exiting was determined by applying the directional distribution shown the ITE trip generation graph in Exhibit 3.1. The statistical graph distributes the site trips to 50 percent entering and 50 percent exiting for both the primary and pass-by peak PM hour trips. The peak hour vehicle-trips (auto driver) are shown in Table 3.4, and were proportioned onto the surrounding roads at the distribution presented in Figure 3.1. Figure 3.2 shows the peak PM hour site generated trips.

**TABLE 3.4
 PEAK HOUR ASSIGNMENT OF VEHICLE-TRIPS**

TRIP TYPE \ PEAK HOUR TRIPS	WEEKDAY PEAK PM HR.		
	TOTAL	ENTER	EXIT
Primary Trips	39	20 (50%)	19 (50%)
Pass-by Trips	28	14 (50%)	14 (50%)
Total Vehicle-Trips	67	34	33

MODULE 3.2 - Background Network Travel Demands

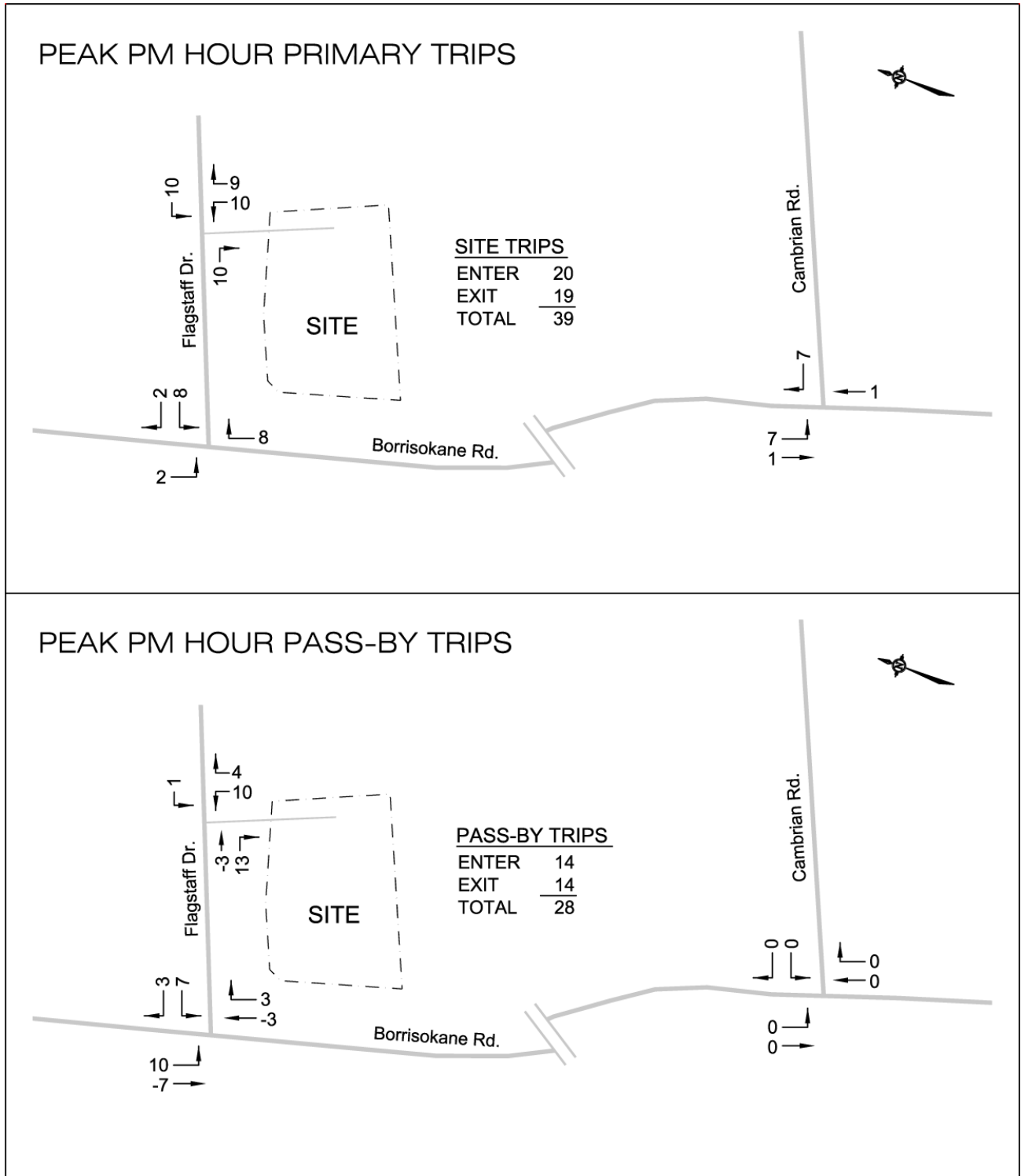
Element 3.2.1 – Transportation Network Plans

The City of Ottawa *Transportation Master Plan (TMP) 2013* was reviewed to identify transit and roadway projects in the vicinity of the development along with other traffic studies. The TMP did not identify any new roadway or transit projects within the study area, with roadway improvements completed by private developers as part of the subdivision developments in the area. The Flagstaff/Borrisokane intersection will be constructed by the City of Ottawa and funded by development charges.

The study has reviewed the traffic impact assessment reports for five subdivision developments within the study area. The developments are listed in Element 2.1.3 Planning Conditions, with the site generated trips accounted for as background traffic for this TIA analysis.

The development studies have identified the extension of Flagstaff Drive to Borrisokane Road, the construction of the Flagstaff/Borrisokane intersection with auxiliary turn lanes, and the reconstruction of the Cambrian/Borrisokane intersection with auxiliary turn lanes and future traffic control signals.

FIGURE 3.2
PEAK PM HOUR SITE GENERATED PRIMARY AND PASS-BY TRIPS



NOT TO SCALE

Element 3.2.2 – Background Growth

The traffic growth from the proposed subdivision developments in the area would account for the majority of growth in the area. Any additional growth would be attributed to further development beyond the study area. The study has utilized a 2 percent annual average compounded growth which was applied to the 2018 traffic counts obtained from the City of Ottawa for the Cambrian/Borrisokane intersection. The annual growth of 2 percent was consistent with the growth factor used in other approved traffic studies in the area. The following is the growth factor which was applied to the existing traffic counts at the Cambrian/Borrisokane intersection.

2018 → 2023 = 1.104 Completion
2018 → 2028 = 1.219 Completion + 5 Years

The annual growth factor was applied to all approaches to the Cambrian/Borrisokane intersection, and to the through movements along Borrisokane Road past the site. All traffic along Flagstaff Drive would be from proposed subdivision developments east of the site.

Element 3.2.3 – Other Developments

Other residential development in the area which would contribute to the increase in background traffic was accounted for following the review of the site generated trips from other Transportation Impact Assessment (TIA) study reports in the area which were discussed in Element 2.1.3. The Halo Car Wash study has utilized the trips generated at the completion of developments from the other TIA reports in the 2023 and 2028 background traffic.

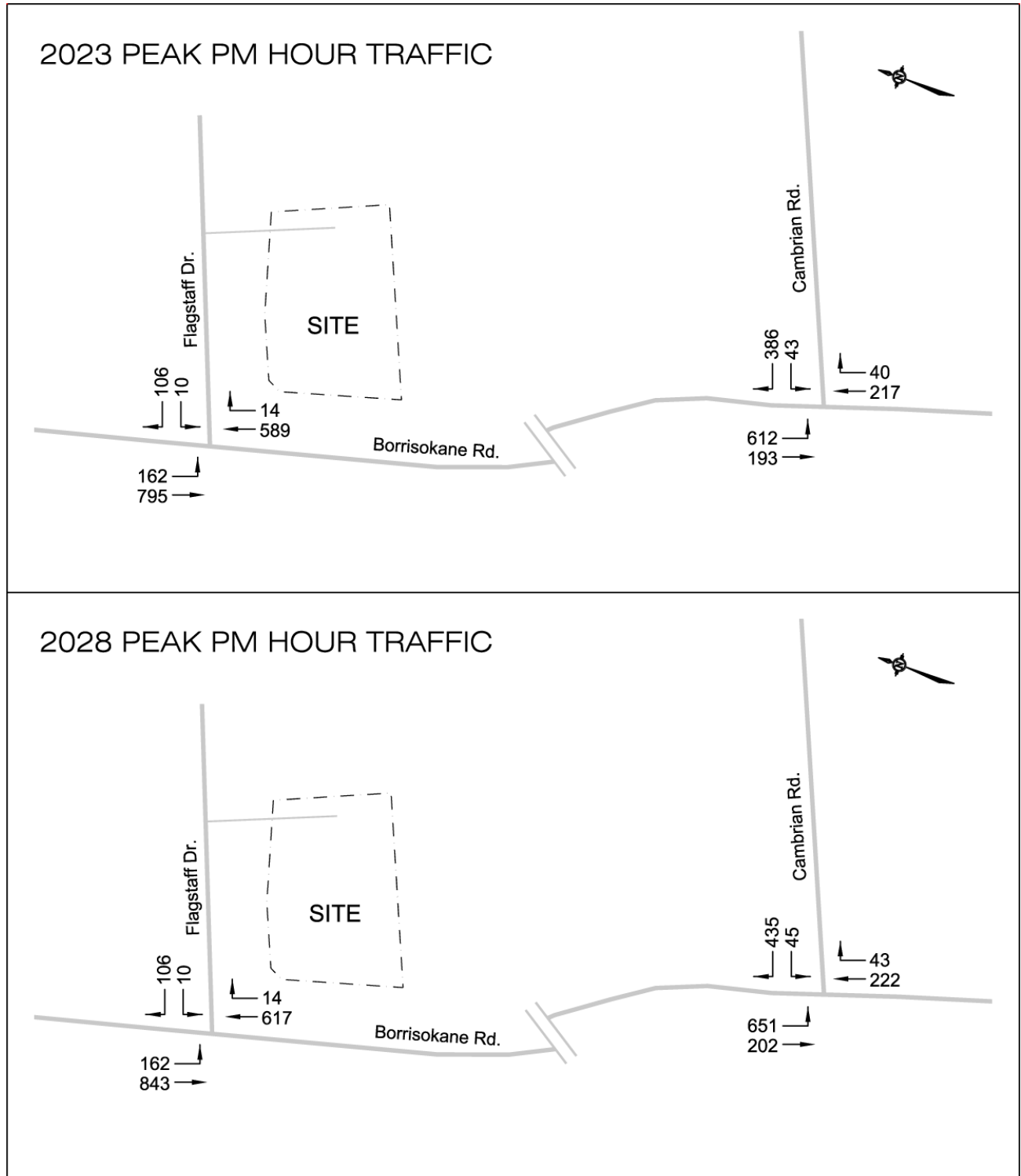
Figure 3.3 presents the 2023 and 2028 PM peak hour background vehicle traffic (does not include trips from the proposed Halo Car Wash) which accounts for the annual average compounded growth factor, and trips generated by other proposed subdivisions in the study area.

MODULE 3.3 - Demand Rationalization

The Halo Car Wash is located in a developing area of south Nepean. The car wash will generate a relatively low volume of peak hour trips during the PM period of the adjacent roads, with approximately half of the trips as by-pass trips generated from traffic already travelling along the adjacent roads. The expected trip demand would have a minor impact on the surrounding roadway network. The trip demand would not result in an issue with capacity of the intersections within the study area.

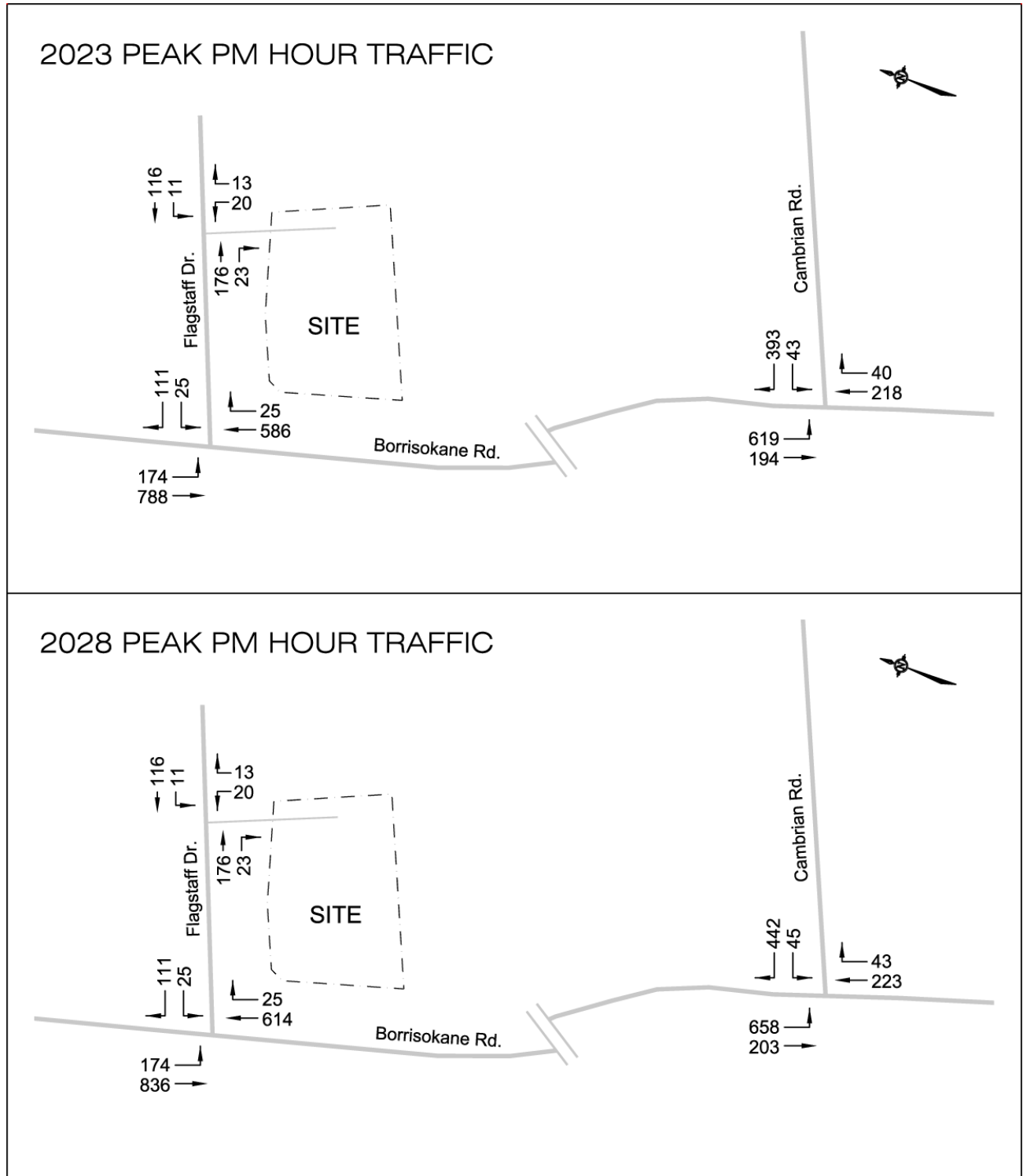
The total vehicular traffic is the sum of the peak PM hour site generated primary and pass-by trips (Figure 3.2), and the peak hour background traffic for the years 2023 and 2028 (Figure 3.3). Figure 3.4 presents the total balanced 2023 and 2028 peak PM hour vehicular traffic.

FIGURE 3.3
2023 AND 2028 PEAK PM HOUR BACKGROUND TRAFFIC



NOT TO SCALE

FIGURE 3.4
2023 AND 2028 PEAK PM HOUR TOTAL TRAFFIC



NOT TO SCALE

STEP 4 – ANALYSIS

MODULE 4.1 – Development Design

Element 4.1.1 – Design for Sustainable Modes

The Halo Car Wash is a commercial facility catering to the automatic washing of vehicles. The use would support few alternative modes of travel with the majority of trips made up of auto drivers and auto passengers. The site will provide a bike rack at the entrance to the facility for employees and 21 parking spaces including 1 barrier free space. The parking would be mainly used for the hand drying of vehicles and the vacuuming of the interior of the vehicle. Three of the parking spaces would be reserved for employees.

As Flagstaff Drive is constructed, the roadway will have pedestrian sidewalks along both sides of the street with the site providing a connecting link to the municipal sidewalk network.

There are currently no OC Transpo bus routes in the immediate area, but as the surrounding residential area is completed bus service will be provided.

The study has utilized the *TDM - Supportive Development Design and Infrastructure Checklist* for a Non-Residential Development which is provided below. The checklist examines the opportunity to implement facilities which are supportive of sustainable modes.

TDM-Supportive Development Design and Infrastructure Checklist: Non-Residential Developments (office, institutional, retail or industrial)

Legend	
REQUIRED	The Official Plan or Zoning By-law provides related guidance that must be followed
BASIC	The measure is generally feasible and effective, and in most cases would benefit the development and its users
BETTER	The measure could maximize support for users of sustainable modes, and optimize development performance

TDM-supportive design & infrastructure measures: Non-residential developments		Check if completed & add descriptions, explanations or plan/drawing references
1. WALKING & CYCLING: ROUTES		
1.1 Building location & access points		
BASIC	1.1.1 Locate building close to the street, and do not locate parking areas between the street and building entrances	<input type="checkbox"/>
BASIC	1.1.2 Locate building entrances in order to minimize walking distances to sidewalks and transit stops/stations	<input type="checkbox"/>
BASIC	1.1.3 Locate building doors and windows to ensure visibility of pedestrians from the building, for their security and comfort	<input type="checkbox"/>
1.2 Facilities for walking & cycling		
REQUIRED	1.2.1 Provide convenient, direct access to stations or major stops along rapid transit routes within 600 metres; minimize walking distances from buildings to rapid transit; provide pedestrian-friendly, weather-protected (where possible) environment between rapid transit accesses and building entrances; ensure quality linkages from sidewalks through building entrances to integrated stops/stations (see <i>Official Plan policy 4.3.3</i>)	<input checked="" type="checkbox"/> Bus service and bus stops will be provided as the surrounding area is developed and occupied
REQUIRED	1.2.2 Provide safe, direct and attractive pedestrian access from public sidewalks to building entrances through such measures as: reducing distances between public sidewalks and major building entrances; providing walkways from public streets to major building entrances; within a site, providing walkways along the front of adjoining buildings, between adjacent buildings, and connecting areas where people may congregate, such as courtyards and transit stops; and providing weather protection through canopies, colonnades, and other design elements wherever possible (see <i>Official Plan policy 4.3.12</i>)	<input checked="" type="checkbox"/> A sidewalk is provided along the access road to the building

TDM-supportive design & infrastructure measures: <i>Non-residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
REQUIRED	1.2.3 Provide sidewalks of smooth, well-drained walking surfaces of contrasting materials or treatments to differentiate pedestrian areas from vehicle areas, and provide marked pedestrian crosswalks at intersection sidewalks (<i>see Official Plan policy 4.3.10</i>)	<input checked="" type="checkbox"/> The sidewalk along the access road will have pavement markings across all entrances and exits to the site
REQUIRED	1.2.4 Make sidewalks and open space areas easily accessible through features such as gradual grade transition, depressed curbs at street corners and convenient access to extra-wide parking spaces and ramps (<i>see Official Plan policy 4.3.10</i>)	<input checked="" type="checkbox"/> Sidewalks will be depressed at the crossing of all curbs
REQUIRED	1.2.5 Include adequately spaced inter-block/street cycling and pedestrian connections to facilitate travel by active transportation. Provide links to the existing or planned network of public sidewalks, multi-use pathways and on-road cycle routes. Where public sidewalks and multi-use pathways intersect with roads, consider providing traffic control devices to give priority to cyclists and pedestrians (<i>see Official Plan policy 4.3.11</i>)	<input checked="" type="checkbox"/> The site is well connected to the pedestrian sidewalk network
BASIC	1.2.6 Provide safe, direct and attractive walking routes from building entrances to nearby transit stops	<input checked="" type="checkbox"/> Future transit stops will be accessible by city sidewalks
BASIC	1.2.7 Ensure that walking routes to transit stops are secure, visible, lighted, shaded and wind-protected wherever possible	<input type="checkbox"/>
BASIC	1.2.8 Design roads used for access or circulation by cyclists using a target operating speed of no more than 30 km/h, or provide a separated cycling facility	<input type="checkbox"/>
1.3 Amenities for walking & cycling		
BASIC	1.3.1 Provide lighting, landscaping and benches along walking and cycling routes between building entrances and streets, sidewalks and trails	<input type="checkbox"/>
BASIC	1.3.2 Provide wayfinding signage for site access (where required, e.g. when multiple buildings or entrances exist) and egress (where warranted, such as when directions to reach transit stops/stations, trails or other common destinations are not obvious)	<input type="checkbox"/>

TDM-supportive design & infrastructure measures: <i>Non-residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
2. WALKING & CYCLING: END-OF-TRIP FACILITIES		
2.1 Bicycle parking		
REQUIRED	2.1.1 Provide bicycle parking in highly visible and lighted areas, sheltered from the weather wherever possible (see <i>Official Plan policy 4.3.6</i>)	<input checked="" type="checkbox"/> Bicycle racks are located close to the building entrance
REQUIRED	2.1.2 Provide the number of bicycle parking spaces specified for various land uses in different parts of Ottawa; provide convenient access to main entrances or well-used areas (see <i>Zoning By-law Section 111</i>)	<input checked="" type="checkbox"/> The number of bicycle parking spaces will meet the required spaces under the zoning by-laws
REQUIRED	2.1.3 Ensure that bicycle parking spaces and access aisles meet minimum dimensions; that no more than 50% of spaces are vertical spaces; and that parking racks are securely anchored (see <i>Zoning By-law Section 111</i>)	<input checked="" type="checkbox"/> All bike rack and bicycle storage spaces are horizontal
BASIC	2.1.4 Provide bicycle parking spaces equivalent to the expected number of commuter cyclists (assuming the cycling mode share target is met), plus the expected peak number of customer/visitor cyclists	<input type="checkbox"/>
BETTER	2.1.5 Provide bicycle parking spaces equivalent to the expected number of commuter and customer/visitor cyclists, plus an additional buffer (e.g. 25 percent extra) to encourage other cyclists and ensure adequate capacity in peak cycling season	<input type="checkbox"/>
2.2 Secure bicycle parking		
REQUIRED	2.2.1 Where more than 50 bicycle parking spaces are provided for a single office building, locate at least 25% of spaces within a building/structure, a secure area (e.g. supervised parking lot or enclosure) or bicycle lockers (see <i>Zoning By-law Section 111</i>)	<input type="checkbox"/>
BETTER	2.2.2 Provide secure bicycle parking spaces equivalent to the expected number of commuter cyclists (assuming the cycling mode share target is met)	<input type="checkbox"/>
2.3 Shower & change facilities		
BASIC	2.3.1 Provide shower and change facilities for the use of active commuters	<input type="checkbox"/>
BETTER	2.3.2 In addition to shower and change facilities, provide dedicated lockers, grooming stations, drying racks and laundry facilities for the use of active commuters	<input type="checkbox"/>
2.4 Bicycle repair station		
BETTER	2.4.1 Provide a permanent bike repair station, with commonly used tools and an air pump, adjacent to the main bicycle parking area (or secure bicycle parking area, if provided)	<input type="checkbox"/>

TDM-supportive design & infrastructure measures: <i>Non-residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
3. TRANSIT		
3.1 Customer amenities		
BASIC	3.1.1 Provide shelters, lighting and benches at any on-site transit stops	<input type="checkbox"/>
BASIC	3.1.2 Where the site abuts an off-site transit stop and insufficient space exists for a transit shelter in the public right-of-way, protect land for a shelter and/or install a shelter	<input type="checkbox"/>
BETTER	3.1.3 Provide a secure and comfortable interior waiting area by integrating any on-site transit stops into the building	<input type="checkbox"/>
4. RIDESHARING		
4.1 Pick-up & drop-off facilities		
BASIC	4.1.1 Provide a designated area for carpool drivers (plus taxis and ride-hailing services) to drop off or pick up passengers without using fire lanes or other no-stopping zones	<input type="checkbox"/>
4.2 Carpool parking		
BASIC	4.2.1 Provide signed parking spaces for carpools in a priority location close to a major building entrance, sufficient in number to accommodate the mode share target for carpools	<input type="checkbox"/>
BETTER	4.2.2 At large developments, provide spaces for carpools in a separate, access-controlled parking area to simplify enforcement	<input type="checkbox"/>
5. CARSHARING & BIKESHARING		
5.1 Carshare parking spaces		
BETTER	5.1.1 Provide carshare parking spaces in permitted non-residential zones, occupying either required or provided parking spaces (<i>see Zoning By-law Section 94</i>)	<input type="checkbox"/>
5.2 Bikeshare station location		
BETTER	5.2.1 Provide a designated bikeshare station area near a major building entrance, preferably lighted and sheltered with a direct walkway connection	<input type="checkbox"/>

TDM-supportive design & infrastructure measures: <i>Non-residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
6. PARKING		
6.1 Number of parking spaces		
REQUIRED	6.1.1 Do not provide more parking than permitted by zoning, nor less than required by zoning, unless a variance is being applied for	<input type="checkbox"/>
BASIC	6.1.2 Provide parking for long-term and short-term users that is consistent with mode share targets, considering the potential for visitors to use off-site public parking	<input type="checkbox"/>
BASIC	6.1.3 Where a site features more than one use, provide shared parking and reduce the cumulative number of parking spaces accordingly (<i>see Zoning By-law Section 104</i>)	<input type="checkbox"/>
BETTER	6.1.4 Reduce the minimum number of parking spaces required by zoning by one space for each 13 square metres of gross floor area provided as shower rooms, change rooms, locker rooms and other facilities for cyclists in conjunction with bicycle parking (<i>see Zoning By-law Section 111</i>)	<input type="checkbox"/>
6.2 Separate long-term & short-term parking areas		
BETTER	6.2.1 Separate short-term and long-term parking areas using signage or physical barriers, to permit access controls and simplify enforcement (i.e. to discourage employees from parking in visitor spaces, and vice versa)	<input type="checkbox"/>
7. OTHER		
7.1 On-site amenities to minimize off-site trips		
BETTER	7.1.1 Provide on-site amenities to minimize mid-day or mid-commute errands	<input type="checkbox"/>

Element 4.1.2 – Circulation and Access

All service truck deliveries will be made within the site. The service vehicles to the site would comprise mainly of cube vans, with the site geometry and circulation capable of accommodating a medium single-unit truck. The access road from Flagstaff Drive would have a width of 7.5 m, with the access to the site having a 6.0 m wide entrance lane and 6.0 m wide exit lane separated by a median.

Element 4.1.3 – New Street Networks

Exempt as determined in the Scoping Document.

MODULE 4.2 – Parking

Element 4.2.1 – Parking Supply

The site will contain a Halo Car Wash facility with a parking lot providing 21 parking spaces including 1 barrier free space. Three of the spaces would be reserved for staff and the remaining for patrons to towel dry and vacuum the inside of their vehicle. The site is located within Area C (Suburban) on Schedule 1A, which would not require any vehicle parking spaces under the City of Ottawa Zoning By-law.

The car wash will have one tunnel automated facility with queuing space for 24 vehicles behind the ticket dispenser. The Zoning by-law requires space for 10 queued vehicles before the tunnel and 1 space after the tunnel.

The site will provide a bike storage rack close to the main entrance to the facility which will be used by staff of the car wash. The Zoning By-law requires storage for a minimum of 1 bicycle determined as follows:

$$1 \text{ space} / 1,500 \text{ m}^2 \text{ of GFA} = 473 \text{ m}^2 = 1 \text{ TOTAL Required storage spaces}$$

Element 4.2.2 – Spillover Parking

Exempt as determined in the Scoping Document.

MODULE 4.3 – Boundary Street Design

The City of Ottawa Complete Streets concept allows for the safe movement of everyone whether they choose to walk, bike, drive, or take public transit. The boundary roads to the Halo Car Wash would consist of Borrisokane Road adjacent to the west limit of the site, the proposed Flagstaff Drive bordering the north limit of the site, and Cambrian Road located 450 m south of the site.

The multi-modal level of service for the Borrisokane Road segment between Cambrian Road and the Jock River, Flagstaff Drive between Borrisokane Road and Apolune Street, and Cambrian Road between Borrisokane Road and Apolune Street, were determined utilizing the City of Ottawa publication, *Multi-Modal Level of Service (MMLOS) Guidelines*. The following examined the MMLOS for the various modes of travel along the street segments of Flagstaff Drive as shown in Exhibit 4.1 in the Appendix, Borrisokane Road in Exhibit 4.2, and Cambrian Road in Exhibit 4.3.

Flagstaff Drive - Borrisokane Road to Apolune Street

Pedestrian Level of Service (PLOS)

Flagstaff Drive is a future urban collector road which is currently under construction. The roadway will be constructed to collector road standards with an 11 m pavement width and sidewalks along both sides of the roadway. The sidewalks would be a

minimum of 1.8 m wide with a boulevard between the sidewalk and edge of curb. The speed limit would be 50 km/h.

The pedestrian Level of Service (PLOS) for the Flagstaff Drive road segment as determined in the City of Ottawa *Multi-Modal Level of Service (MMLoS) Worksheet* was a PLOS “B”.

Bicycle Level of Service (BLOS)

Flagstaff Drive would be a two lane collector road with no designated cycling lanes. The bicycle level of service was determined as a BLOS “F”.

Transit Level of Service (TLOS)

There currently is no transit service in the area. Service routes will be examined as residential development is completed in the area. The transit level of service was determined to be a TLOS “D” based on the road classification.

Truck Level of Service (TkLOS)

The truck level of service was determined to be a TkLOS “B”.

Borrisokane Road - Cambrian Road to the Jock River

Pedestrian Level of Service (PLOS)

Borrisokane Road is a two lane north-south rural road with a pavement width of 7.0 m and gravel shoulders. The road does not provide pedestrian sidewalks. The posted speed limit is 80 km/h in the vicinity of the site.

The pedestrian Level of Service (PLOS) for the Borrisokane Road segment was determined as a PLOS “F”.

Bicycle Level of Service (BLOS)

Borrisokane Road is not designated as a Spine Route in the TMP cycling network. There are no cycling lanes provided with the road segment having a BLOS “F”.

Transit Level of Service (TLOS)

There currently is no transit service along Borrisokane Road. The roadway classification determined the transit level of service to be a TLOS “D”.

Truck Level of Service (TkLOS)

The truck level of service was determined to be a TkLOS “C”.

Cambrian Road - Borrisokane Road to Apolune Street

Pedestrian Level of Service (PLOS)

Cambrian Road is a two lane east-west rural road with a pavement width of 7.0 m and gravel shoulders. The road does not provide pedestrian sidewalks. The posted speed limit is 70 km/h in the segment between Borrisokane Road and Apolune Street.

The pedestrian Level of Service (PLOS) for the Cambrian Road segment was determined as a PLOS “F”.

Bicycle Level of Service (BLOS)

Cambrian Road is not designated as a Spine Route in the TMP cycling network. There are no cycling lanes provided with the road segment having a BLOS “F”.

Transit Level of Service (TLOS)

With no transit routes currently available in the area, the transit level of service was based on the road classification and was determined to have a TLOS “D”.

Truck Level of Service (TkLOS)

The truck level of service was determined to be a TkLOS “C”.

Traffic collisions along the Borrisokane Road segment between Cambrian Road and the Jock River are shown in Table 2.1 in Element 2.1.2. Over the five year period between January 1, 2016 and December 31, 2020, 13 collisions were recorded along the Borrisokane Road segment. Of the 13 collisions, 12 were labeled other (SMV) and 1 was a rear end collision. The Cambrian/Borrisokane intersection recorded 12 collisions, of which 6 were rear end, 4 were other, 1 was angular and 1 was turning movement. The pattern of collisions did not identify any measures which could be taken to reduce the number of collisions.

The Flagstaff Drive segment which is currently under construction along with the Borrisokane Road and Cambrian Road segments were analyzed to determine the level of service which was compared to the MMLOS targets for pedestrians, bicycles, and transit. The calculated Level of Service (LOS) was determined using the Multi-Modal Level of Service Worksheet provided as Exhibits 4.1, 4.2 and 4.3 in the Appendix. The LOS targets were obtained from Exhibit 22 of the *Multi-Modal Level of Service (MMLOS) Guidelines* for a “General Urban Area” as designated in the Official Plan - Urban Policy Plan. Table 4.1 summarizes the MMLOS results for the road segments and targets using the 2028 traffic and road configuration.

**TABLE 4.1
 MULTI-MODAL (MMLOS) SEGMENT SUMMARY TABLE**

STREET SEGMENT	Level of Service (LOS) – 2028				
	Pedestrian	Bicycle	Transit	Auto	Truck
Flagstaff Drive					
Calculated	B	F	D	N/A	B
Target	C	D	N/A	N/A	D
Borrisokane Road					
Calculated	F	F	D	N/A	C
Target	C	D	N/A	N/A	D
Cambrian Road					
Calculated	F	F	D	N/A	C
Target	C	D	N/A	N/A	D

The pedestrian level of service (PLOS) along Borrisokane Road and Cambrian Road did not meet the target due to the volume of traffic, speed of traffic, and lack of pedestrian sidewalks. Although the Halo Car Wash is not expected to generate much pedestrian traffic, the PLOS would be improved by providing pedestrian sidewalks and reducing the operating speed of traffic.

The lower level of the bicycle level of service (BLOS) could be improved by lowering the operating speed of traffic and to provide a bike lane or paved shoulder.

Transit routes and service times have not been established due to the developing residential community. The transit level of service (TLOS) target was not determined.

The truck level of service (TkLOS) meets the target value.

MODULE 4.4 – Access Intersection Design

Element 4.4.1 – Location and Design of Access

The Site Access is located on the south side of Flagstaff Drive approximately 95 m east of Borrisokane Road (centerline to centerline). The Site Access has a private road with an urban cross section and a pavement width of 7.5 m. The access has a 1.8 m sidewalk with a 1.0 m boulevard which connects the interior of the site with the municipal sidewalk along Flagstaff Drive. The site connects to the private road with a 6.0 m entrance and 6.0 m exit separated by a 2.0 m median (see Figure 2.2).

East of the Site Access is the proposed Main Halyard Lane which is a local street on the north side of Flagstaff Drive located approximately 120 m east of the Site Access (centerline to centerline). There are 8 townhouse units proposed on the north side of

Flagstaff Drive with private driveways onto the road. The driveways would be located 60 m to 100 m east of the Site Access.

The on-site garbage container is located close to the vehicle entrance to the car wash tunnel which would provide easy access to the emptying of the container. The Site Access road and the entrance to the car wash are of sufficient width for access to the garbage container and service vehicles entering and exiting the site.

Element 4.4.2 – Intersection Control

The Site Access will be a private road which will be a full movement intersection controlled by a stop sign at the northbound Site Access approach.

The intersection of Flagstaff Drive and Borrisokane Road is currently under construction. Construction of the intersection will be completed by the City of Ottawa and funded by development charges. The intersection will be a “T” intersection constructed with auxiliary turn lanes and will be initially controlled by a stop sign at the westbound Flagstaff Drive approach. A traffic signal warrant analysis will be conducted on a regular basis by the city with traffic signals installed once warrants are met. For the TIA analysis, a traffic signal warrant analysis was conducted for the expected traffic at the years 2023 and 2028 (Figure 3.4). The warrant analysis utilized the methodology documented in the *Ontario Traffic Manual, Book 12, Traffic Signals*. Exhibit 4.4 in the Appendix presents the 2023 and 2028 traffic signal warrant analysis which determined that the intersection did not meet the warrant. The 2023 and 2028 traffic analysis will assume the intersection to be controlled by a stop sign at the westbound Flagstaff Drive approach.

The intersection of Cambrian Road and Borrisokane Road is currently a “T” intersection with two-way stop control signs. The intersection contains no auxiliary turn lanes. As development in the area progresses, the intersection will be reconstructed with auxiliary turn lanes with traffic control signals installed when warrants are met. The report has conducted a traffic signal warrant analysis for the Cambrian/Borrisokane intersection. The analysis, which is presented in Exhibit 4.5, determined that the intersection did not meet the warrants. The TIA analysis for the 2023 and 2028 total traffic will assume the intersection to be a two-way stop controlled intersection.

Element 4.4.3 – Intersection Design

The operational analyses of the Site Access/Flagstaff, Flagstaff/Borrisokane and Cambrian/Borrisokane intersections were completed for the number of peak PM hour vehicle trips using the existing traffic counts (existing Cambrian/Borrisokane only), at the year 2023 at the completion of the car wash, and at the year 2028. As documented in the *Multi-Modal Level of Service (MMLoS) Guidelines*, only signalized intersections are considered for the multi-modal intersection LOS measures. Vehicle LOS was determined utilizing the HCM guidelines and the HCS software.

VEHICLE LEVEL OF SERVICE (LOS) – Intersection Capacity Analysis

The analysis of the intersections will use the *Highway Capacity Software Version 7.9.5*, which uses the capacity analysis procedure as documented in the *Highway Capacity Manual (HCM) 2010 and HCM 6th Edition*.

For unsignalized intersections, the level of service of each lane movement and approach is determined as a function of the average control delay of vehicles at the approach. The following relates the level of service of each lane movement with the expected control delay at the approach.

LEVEL OF SERVICE	AVERAGE CONTROL DELAY	
Level of Service A	0-10 sec./vehicle	Little or No Delay
Level of Service B	>10-15 sec./vehicle	Short Traffic Delays
Level of Service C	>15-25 sec./vehicle	Average Traffic Delays
Level of Service D	>25-35 sec./vehicle	Long Traffic Delays
Level of Service E	>35-50 sec./vehicle	Very Long Traffic Delays
Level of Service F	>50 sec./vehicle	Extreme Delays – Demand Exceeds Capacity

The expected length of queue at the critical lane movements for an unsignalized intersection was determined by the calculation of the 95th percentile queue at the lane approach as shown on the analysis work sheets provided in the Appendix. The 95th percentile queue length is the calculated 95th greatest queue length out of 100 occurrences at a movement during a 15-minute peak period. The 95th percentile queue length is a function of the capacity of a movement and the total expected traffic, with the calculated value determining the magnitude of the queue by representing the queue length as fractions of vehicles.

The results of the analysis are discussed in detail in the following sections:

Site Access and Flagstaff Drive Intersection

The Site Access/Flagstaff will be a “T” intersection with Flagstaff Drive forming the eastbound and westbound approaches, and the Site Access the northbound approach. Flagstaff Drive will be an 11 m wide collector road completed for the area development. The Site Access will be a 7.5 m wide private driveway controlled by a stop sign at the northbound approach. The intersection will have the following lane configuration:

Northbound Site Access	One shared left/right turn lane (Stop Sign)
Eastbound Flagstaff Road	One shared through/right lane
Westbound Flagstaff Drive	One shared left/through lane

The operational analysis determined that during the peak PM hour at the years 2023 and 2028, the intersection operated at a Level of Service (LOS) “B”. The intersection met the vehicle Level of Service target of LOS “D” for a General Urban Area. During the 2028 peak PM hour total traffic analysis, the 95th percentile queue at the northbound Site Access approach was determined to be 0.2 vehicles and at the westbound

Flagstaff Road approach 0.0 vehicles. The operation of the intersection is summarized in Table 4.2 with the 2023 and 2028 analysis sheets provided as Exhibit 4.6 and 4.7.

TABLE 4.2
SITE ACCESS/FLAGSTAFF INTERSECTION – LOS, Delay & v/c

APPROACH	WEEKDAY PEAK PM HOUR Total - 2023 (2028)		
	LOS	Control Delay (sec/veh)	Volume to Capacity (v/c)
WB Left/Through - Flagstaff	A (A)	0.7 (0.7)	0.01 (0.01)
NB Left/Right - Site Access	B (B)	10.4 (10.4)	0.05 (0.05)
TOTAL INTERSECTION	B (B)	10.4 (10.4)	0.02 (0.02)

The intersection would operate at an acceptable level of service following the completion of Flagstaff Drive and the development of the car wash site. There would be no requirement for any intersection modification beyond a private approach permit.

Flagstaff Drive and Borrisokane Road Intersection

The Flagstaff/Borrisokane intersection will be constructed by the City of Ottawa under development charge funds. The intersection will be constructed with auxiliary turn lanes with the intersection configuration as follows at the opening of the car wash in 2023:

Northbound Borrisokane Rd.	One shared through/right lane
Southbound Borrisokane Rd.	One exclusive left turn lane
	One through lane
Westbound Flagstaff Drive	One exclusive left turn lane (Stop sign)
	One exclusive right turn lane (Stop Sign)

The intersection was analysed as a two-way stop controlled intersection which did not trigger the warrants for the installation of traffic control signals. For the 2023 and 2028 peak PM hour background traffic, the intersection operated at a LOS “C”, with the westbound left turn movement functioning at a LOS “F” due to the high volume of traffic along Borrisokane Road. Table 4.3 summarizes the operation of the intersection with the background traffic analysis provided as Exhibit 4.8 and 4.9.

For the expected 2023 and 2028 total traffic scenarios which included the site generated trips, the intersection operated at a LOS “D” for the 2023 total traffic and a LOS “E” for the expected 2028 traffic. The westbound left turn movement did function at a LOS “F” during both the 2023 and 2028 due to the high volume of traffic along Borrisokane Road, but did not exhibit a low v/c ratio due to the low volume of traffic at the westbound left turn movement. The 2028 total traffic scenario determined the 95th

percentile queue at the westbound left turn movement to be 1.9 vehicles, and 0.8 vehicles at the southbound left turn movement. The intersection would not meet the LOS “D” criteria for a General Urban Area for the expected 2028 traffic. The City of Ottawa will be monitoring the intersection to determine when traffic control signals are warranted.

The operation of the intersection is summarized in Table 4.3 with the 2023 and 2028 analysis sheets provided as Exhibit 4.10 and 4.11.

Examining the number of site generated primary and pass-by trips from the site, the car wash would not generate the volume of traffic which would trigger any modifications to the Flagstaff/Borrisokane intersection.

**TABLE 4.3
 FLAGSTAFF/BORRISOKANE INTERSECTION – LOS, Delay & v/c**

APPROACH	WEEKDAY PEAK PM HOUR Background - 2023 2028 Total - 2023 (2028)		
	LOS	Control Delay (sec/veh)	Volume to Capacity (v/c)
WB Left - Flagstaff	F F F (F)	71.9 82.7 104.0 (125.8)	0.17 0.19 0.44 (0.50)
WB Right - Flagstaff	C C C (C)	15.2 15.7 15.4 (15.9)	0.25 0.26 0.26 (0.27)
SB Left - Borrisokane	A A A (B)	9.8 9.9 9.9 (10.1)	0.19 0.19 0.21 (0.21)
TOTAL INTERSECTION	C C D (E)	20.1 21.5 31.7 (36.1)	0.21 0.21 0.23 (0.24)

Cambrian Road and Borrisokane Road Intersection

The intersection of Cambrian Road and Borrisokane Road is an existing “T” intersection with Cambrian Road forming the westbound stop controlled approach and Borrisokane the northbound and southbound approaches. There are no exclusive turn lanes with all approaches consisting of a single lane. The intersection was analyzed using the 2018 traffic counts and the existing lane configuration. The operational analysis determined that the intersection operated at a LOS “B” during the 2018 peak PM hour. The analysis is summarized in Table 4.4 and Exhibit 4.12.

Following the addition of the proposed background development (not including the car wash trips), the 2023 and 2028 peak PM hour background traffic scenario (Figure 3.3) determined the intersection to operate at a LOS “F”. Despite not meeting the traffic signal warrants (Exhibit 4.5), the high volume of traffic along Borrisokane Road resulted in a LOS “F” at the westbound Cambrian Road left turn movement which lowered the overall intersection level of service. Table 4.4 shows the intersection operation for the

2023 and 2028 background traffic, with the analysis sheets provided as Exhibit 4.13 and Exhibit 4.14.

Following the development of the Halo Car Wash site, the overall 2023 and 2028 total peak PM hour traffic analysis determined that there was only a minor impact on the operation of the intersection with no changes in the level of service. The 2028 total traffic scenario determined the 95th percentile queue at the westbound Cambrian Road left turn movement to be 5.5 vehicles, 4.6 vehicles at the westbound right turn movement, and 3.7 vehicles at the southbound left turn movement. Table 4.4 summarizes the 2023 and 2028 total traffic scenario with the analysis sheets provided as Exhibit 4.15 and Exhibit 4.16.

**TABLE 4.4
 CAMBRIAN/BORRISOKANE INTERSECTION – LOS, Delay & v/c**

APPROACH	WEEKDAY PEAK PM HOUR		
	Existing - 2018	Background - 2023	2028 Total - 2023 (2028)
	LOS	Control Delay (sec/veh)	Volume to Capacity (v/c)
WB Left - Cambrian *	- F F F (F)	- 342.9 528.1 366.6 (562.3)	- 1.15 1.15 1.19 (1.57)
WB Right - Cambrian *	B C C C (C)	11.6 15.2 17.2 15.5 (17.6)	0.30 0.55 0.62 0.56 (0.63)
SB Left - Borrisokane *	A B B B (B)	8.1 10.8 11.4 10.9 (11.5)	0.24 0.52 0.56 0.53 (0.56)
TOTAL INTERSECTION	B F F F (F)	11.6 48.1 65.1 50.1 (67.9)	0.26 0.54 0.60 0.55 (0.60)

*Note - For the 2018 traffic, the analysis used the existing lane configuration which contained no auxiliary turn lanes. The westbound approach is shown as WB Right, and the southbound approach as SB Left.

Trips from the Halo Car Wash would not trigger any modifications to the Cambrian/Borrisokane intersection. The operation of the intersection should be monitored to determine when traffic control signals would be warranted.

MODULE 4.5 – Transportation Demand Management

Element 4.5.1 – Context for TDM

Exempt as determined in the Scoping Document.

Element 4.5.2 – Need and Opportunity

Exempt as determined in the Scoping Document.

Element 4.5.3 – TDM Program

Exempt as determined in the Scoping Document.

MODULE 4.6 – Neighbourhood Traffic Management

Element 4.6.1 – Adjacent Neighbourhoods

The Halo Car Wash would have a site access onto Flagstaff Drive which is designated as a collector road. The primary trips to/from the site along Flagstaff Drive east of the site would not be high enough to place the future traffic volumes above the collector road threshold. The site would have a minor impact on the traffic through the adjacent neighbourhoods.

MODULE 4.7 - Transit

Element 4.7.1 – Route Capacity

There currently is no transit service in the area as the area is still in the residential development stage. As development progresses, the level of transit service and routes will be determined to service the area. Draft roadway plans of Flagstaff Drive show future nearside eastbound and westbound bus stops at the corner of Main Halyard Lane and Flagstaff Drive, a distance of 120 m east of the car wash access.

Element 4.7.2 – Transit Priority

Flagstaff Drive is a collector road which the development of the car wash facility would not trigger the need for transit priority measures due to the site access and transit capacity demands.

MODULE 4.8 – Review of Network Concept

Exempt as determined in the Scoping Document.

MODULE 4.9 – Intersection Design

Element 4.9.1 – Intersection Control

The Site Access/Flagstaff intersection will be a private driveway controlled by a stop sign at the northbound access approach.

A traffic signal warrant analysis conforming to the methodology documented in the *Ontario Traffic Manual, Book 12, Traffic Signals* was conducted for the Flagstaff/Borrisokane and Cambrian/Borrisokane intersections. The analysis determined that the intersections did not meet the warrants, but would need to be monitored to determine if traffic signals should be installed in the future. Exhibit 4.4 and Exhibit 4.5 in the Appendix presents the 2023 and 2028 traffic signal warrant analysis.

Element 4.9.2 – Intersection Design

The Site Access/Flagstaff, Flagstaff/Borrisokane and Cambrian/Borrisokane intersections were all examined utilizing the *Highway Capacity Software, Version 7.9.5*, which uses the capacity analysis procedure as documented in the *Highway Capacity Manual (HCM) 2010 and HCM 6th Edition*. With the *Multi-Modal Level of Service (MMLOS) Guidelines* stating that only signalized intersections are considered for the multi-modal analysis, only the vehicle level of service was examined.

The intersections were analyzed in Element 4.4.3 - Intersection Design to determine the level of service at all three intersections. The calculated level of service was compared to the level of service targets listed in Exhibit 22 of the *Multi-Modal Level of Service (MMLOS) Guidelines*. The MMLOS for each intersection determined the vehicle target for arterial and collector roads in a General Urban Area to be a LOS “D”. The operational analysis was completed for the existing, 2023 and 2028 background and 2023 & 2028 total traffic for the existing Cambrian/Borrisokane intersection, the 2023 and 2028 background and total traffic at the Flagstaff/Borrisokane intersection, and the 2023 and 2028 total traffic at the Site Access/Flagstaff intersection. The analysis and level of service targets are shown in Table 4.5.

**TABLE 4.5
 WEEKDAY PEAK PM HOUR INTERSECTION ANALYSIS – LOS**

INTERSECTION	Existing - 2018 Background - 2023 2028 Total - 2023 (2028)	
	LOS Analysis	LOS Target
Site Access/Flagstaff	- - - B (B)	- - - D (D)
Flagstaff/Borrisokane	- C C D (E)	- D D D (D)
Cambrian/Borrisokane	B F F F (F)	D D D D (D)

SUMMARY

A Site Plan has been prepared for the development of a 5,342 m² vacant parcel of land at 3555 Borrisokane Road. The site is located at the southeast corner of the proposed intersection of Flagstaff Drive and Borrisokane Road. The Site Plan proposes the land to be developed as an automated car wash facility.

Halo Car Wash Inc. have proposed a single tunnel automated car wash which would consist of a single storey building with a gross floor area of 473 m² (5,091.3 ft²). The site will have one access onto a private Site Access road which will connect to Flagstaff Drive at a location 95 m east of Borrisokane Road. The site will contain four aisles

behind the ticket dispenser which would be capable of storing 24 vehicles in the car wash queue. The car wash facility is expected to be completed and operational by the year 2023.

The Transportation Impact Assessment report has established a study area which would include the Flagstaff Drive, Borrisokane Road and Cambrian Road segments, and the Site Access/Flagstaff, Flagstaff/Borrisokane and Cambrian/Borrisokane intersections. The operational analysis will be conducted for the weekday peak PM hours at the completion of the car wash facility in 2023, and at five years beyond completion at the year 2028. The TIA analysis has examined all modes of transportation along the road segments and the intersections within the study area. The transportation analysis has determined the following:

1. The proposed Halo Car Wash would only contain an automated car wash, with parking for patrons to towel dry their vehicle or vacuum the interior. The regular hours of the car wash are 7:00 AM to 8:00 PM Monday to Saturday, and Sunday from 8:00 AM to 7:00 PM.
2. The car wash development would provide 21 parking spaces including 1 barrier free space, and a bicycle storage rack for cyclists. The site would provide vehicular and bicycle parking which would exceed City of Ottawa By-laws.
3. The site will have an access onto a 7.5 m wide private road, which would connect to Flagstaff Drive at the Site Access/Flagstaff intersection.
4. The car wash would generate 67 primary and pass-by vehicle trips during the weekday peak PM hour of the adjacent street traffic, of which 34 trips would be entering and 33 trips exiting the site.
5. The MMLOS analysis of the street segment determined that the pedestrian level of service (PLOS) along Flagstaff Drive was a PLOS "B" which exceeded the MMLOS target. The PLOS along Borrisokane Road and Cambrian Road did not meet target due to the volume and speed of traffic, and lack of a municipal sidewalk. The bicycle level of service (BLOS) did not meet target along Flagstaff Drive, Borrisokane Road and Cambrian Road due to the speed of traffic and lack of a bike lane or paved shoulder. The truck level of service (TkLOS) exceeded target along all three road segments.
6. The proposed Site Access and Flagstaff Drive would be a two-way stop controlled "T" intersection with the Site Access forming the northbound stop controlled approach. There would be no exclusive turn lanes at any of the approaches. The intersection would operate at an acceptable LOS "B" during the 2023 and 2028 peak PM hour.
7. The intersection of Flagstaff Drive and Borrisokane Road is currently under construction. The final construction will be completed by the City of Ottawa and funded by development charges which would include an exclusive westbound

Flagstaff Drive left turn lane and exclusive southbound Borrisokane Road left turn lane. The City will be monitoring the intersection to determine when traffic control signals will be warranted. A traffic signal warrant analysis was conducted for the expected 2028 traffic which determined that the intersection did not meet the warrants for the installation of traffic signals. The operational analysis was conducted assuming a two-way stop controlled intersection with westbound and southbound exclusive turn lanes. The analysis determined that the intersection operated at a LOS "C" during the peak 2023 and 2028 background traffic, and at a LOS "D" during the 2023 total and LOS "E" during the 2028 total traffic scenarios. The lower level of service was attributed to the westbound Flagstaff Drive left turn movement which had a low volume of traffic and functioned at an acceptable volume to capacity ratio.

8. The Cambrian Road and Borrisokane Road intersection is an existing two-way stop controlled intersection. The study conducted a traffic signal warrant analysis for the expected 2028 traffic which determined the intersection did not meet the warrants for the installation of traffic signals. The 2023 and 2028 operational analysis was conducted assuming the intersection was controlled by a stop sign at the westbound Cambrian Road approach, and there were exclusive westbound Cambrian Road and southbound Borrisokane Road left turn lanes. The intersection was determined to operate at a LOS "F" during the 2023 and 2028 peak PM hour. The low level of service was due to the westbound Cambrian Road left turn movement.
9. The development of the Halo Car Wash facility would result in a minor impact on the surrounding roads which would not trigger any modifications to the roadways or intersections in the study area. The Flagstaff/Borrisokane intersection will be constructed and monitored for traffic signals by the City of Ottawa. The Cambrian/Borrisokane intersection will be reconstructed by private development south of the car wash site.

Prepared by:

David J. Halpenny

David J. Halpenny, M. Eng., P. Eng.



APPENDIX

CERTIFICATION FORM

SCREENING FORM

TRAFFIC COUNTS

AREA OC TRANSPO TRANSIT ROUTES

ITE TRIP GENERATION GRAPH

MMLOS ROAD SEGMENT ANALYSIS WORKSHEET

HCS OPERATIONAL ANALYSIS WORKSHEETS

EXHIBIT A.1 CERTIFICATION FORM

Transportation Impact Assessment Guidelines



Certification Form for TIA Study PM

TIA Plan Reports

On 14 June 2017, the Council of the City of Ottawa adopted new Transportation Impact Assessment (TIA) Guidelines. In adopting the guidelines, Council established a requirement for those preparing and delivering transportation impact assessments and reports to sign a letter of certification.

Individuals submitting TIA reports will be responsible for all aspects of development-related transportation assessment and reporting, and undertaking such work, in accordance and compliance with the City of Ottawa's Official Plan, the Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines.

By submitting the attached TIA report (and any associated documents) and signing this document, the individual acknowledges that s/he meets the four criteria listed below.

CERTIFICATION

- I have reviewed and have a sound understanding of the objectives, needs and requirements of the City of Ottawa's Official Plan, Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines;
- I have a sound knowledge of industry standard practice with respect to the preparation of transportation impact assessment reports, including multi modal level of service review;
- I have substantial experience (more than 5 years) in undertaking and delivering transportation impact studies (analysis, reporting and geometric design) with strong background knowledge in transportation planning, engineering or traffic operations; and
- I am either a licensed¹ or registered² professional in good standing, whose field of expertise
 - is either transportation engineering
 - or transportation planning .

^{1,2} License of registration body that oversees the profession is required to have a code of conduct and ethics guidelines that will ensure appropriate conduct and representation for transportation planning and/or transportation engineering works.

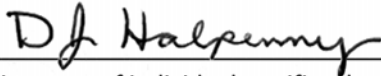
Transportation Impact Assessment Guidelines

Dated at this day of , 20 .

(City)

Name :

Professional title:



Signature of individual certifier that s/he meets the above criteria

Office Contact Information (Please Print)	
Address:	<input type="text" value="P.O. Box 774"/>
City / Postal Code:	<input type="text" value="Manotick ON K4M 1A7"/>
Telephone / Extension:	<input type="text" value="613-692-8662"/>
E-Mail Address:	<input type="text" value="David@DJHalpenny.com"/>

Stamp

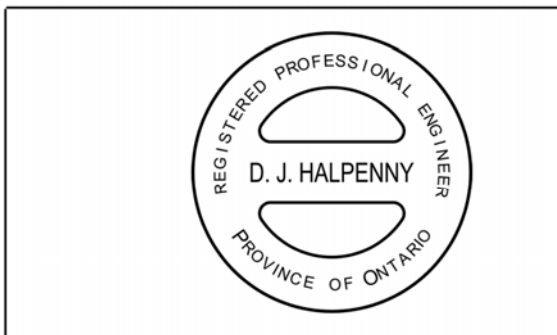


EXHIBIT 1.2 SCREENING FORM

City of Ottawa 2017 TIA Guidelines Screening Form

1. Description of Proposed Development

Municipal Address	3555 Borrisokane Road, Ottawa
Description of Location	Southeast corner of Borrisokane Rd. and Flagstaff Dr.
Land Use Classification	"IL" - Light Industrial Zone
Development Size (units)	Halo Car Wash - 473 m ² GFA
Development Size (m ²)	5,342 m ² Lot Area
Number of Accesses and Locations	One access onto Flagstaff Drive, 100 m east of Borrisokane Rd.
Phase of Development	Single Phase of development
Buildout Year	2023

If available, please attach a sketch of the development or site plan to this form.

2. Trip Generation Trigger

Considering the Development's Land Use type and Size (as filled out in the previous section), please refer to the Trip Generation Trigger checks below.

Land Use Type	Minimum Development Size
Industrial	5,000 m ²

	Yes	No
- 473 m ² Car Wash < 5,000 m ² Minimum Development Size		
- Peak PM Hour ITE Land Use Code 948 Trip Rate = 14.20 veh trips/1000 ft ² = 72 peak PM hr. vehicle-trips or 92 person-trips > 60 person-trips Trigger	X	

* If the development has a land use type other than what is presented in the table above, estimates of person-trip generation may be made based on average trip generation characteristics represented in the current edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual.

If the proposed development size is greater than the sizes identified above, the Trip Generation Trigger is satisfied.

3. Location Triggers

	Yes	No
Does the development propose a new driveway to a boundary street that is designated as part of the City's Transit Priority, Rapid Transit or Spine Bicycle Networks?		X
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone? *		X

**DPA and TOD are identified in the City of Ottawa Official Plan (DPA in Section 2.5.1 and Schedules A and B; TOD in Annex 6). See Chapter 4 for a list of City of Ottawa Planning and Engineering documents that support the completion of TIA).*

If any of the above questions were answered with 'Yes,' the Location Trigger is satisfied.

4. Safety Triggers

	Yes	No
Are posted speed limits on a boundary street are 80 km/hr or greater?		X
Are there any horizontal/vertical curvatures on a boundary street limits sight lines at a proposed driveway?		X
Is the proposed driveway within the area of influence of an adjacent traffic signal or roundabout (i.e. within 300 m of intersection in rural conditions, or within 150 m of intersection in urban/ suburban conditions)?		X
Is the proposed driveway within auxiliary lanes of an intersection?		X
Does the proposed driveway make use of an existing median break that serves an existing site?		X
Is there is a documented history of traffic operations or safety concerns on the boundary streets within 500 m of the development?		X
Does the development include a drive-thru facility?	X	

If any of the above questions were answered with 'Yes,' the Safety Trigger is satisfied.

5. Summary

	Yes	No
Does the development satisfy the Trip Generation Trigger?	X	
Does the development satisfy the Location Trigger?		X
Does the development satisfy the Safety Trigger?	X	

If none of the triggers are satisfied, the TIA Study is complete. If one or more of the triggers is satisfied, the TIA Study must continue into the next stage (Screening and Scoping).

EXHIBIT 2.1
2018 TRAFFIC COUNT SUMMARY - Borrisokane/Cambrian



Transportation Services - Traffic Services

Work Order
38148

Turning Movement Count - Full Study Summary (No AADT) Report

BORRISOKANE RD @ CAMBRIAN RD

Survey Date: Friday, November 09, 2018

Total Observed U-Turns

Northbound: 0 Southbound: 0

Eastbound: 0 Westbound: 2

Full Study

Period	BORRISOKANE RD								CAMBRIAN RD								Grand Total		
	Northbound				Southbound				Eastbound				Westbound						
	LT	ST	RT	NB TOT	LT	ST	RT	SB TOT	STR TOT	LT	ST	RT	EB TOT	LT	ST	RT		WB TOT	STR TOT
06:30 07:30	0	30	13	43	103	28	0	131	174	0	0	0	0	5	0	308	313	313	487
07:30 08:30	0	81	21	102	122	39	0	161	263	0	0	0	0	25	0	409	434	434	697
08:30 09:30	0	66	18	84	140	34	0	174	258	0	0	0	0	19	0	332	351	351	609
15:30 16:30	0	43	13	56	295	63	0	358	414	0	0	0	0	11	0	202	213	213	627
16:30 17:30	0	39	18	57	328	65	0	393	450	0	0	0	0	11	0	191	202	202	652
17:30 18:30	0	23	2	25	369	49	0	418	443	0	0	0	0	5	0	190	195	195	638
18:30 19:30	0	6	2	8	147	18	0	165	173	0	0	0	0	1	0	96	97	97	270
Sub Total	0	288	87	375	1504	296	0	1800	2175	0	0	0	0	77	0	1728	1805	1805	3980
U Turns	0			0	0			0	0	0			0	2			2	2	2
Total	0	288	87	375	1504	296	0	1800	2175	0	0	0	0	79	0	1728	1807	1807	3982

Comments:

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.

2018 PEAK AM HOUR TRAFFIC COUNTS - Borrisokane/Cambrian



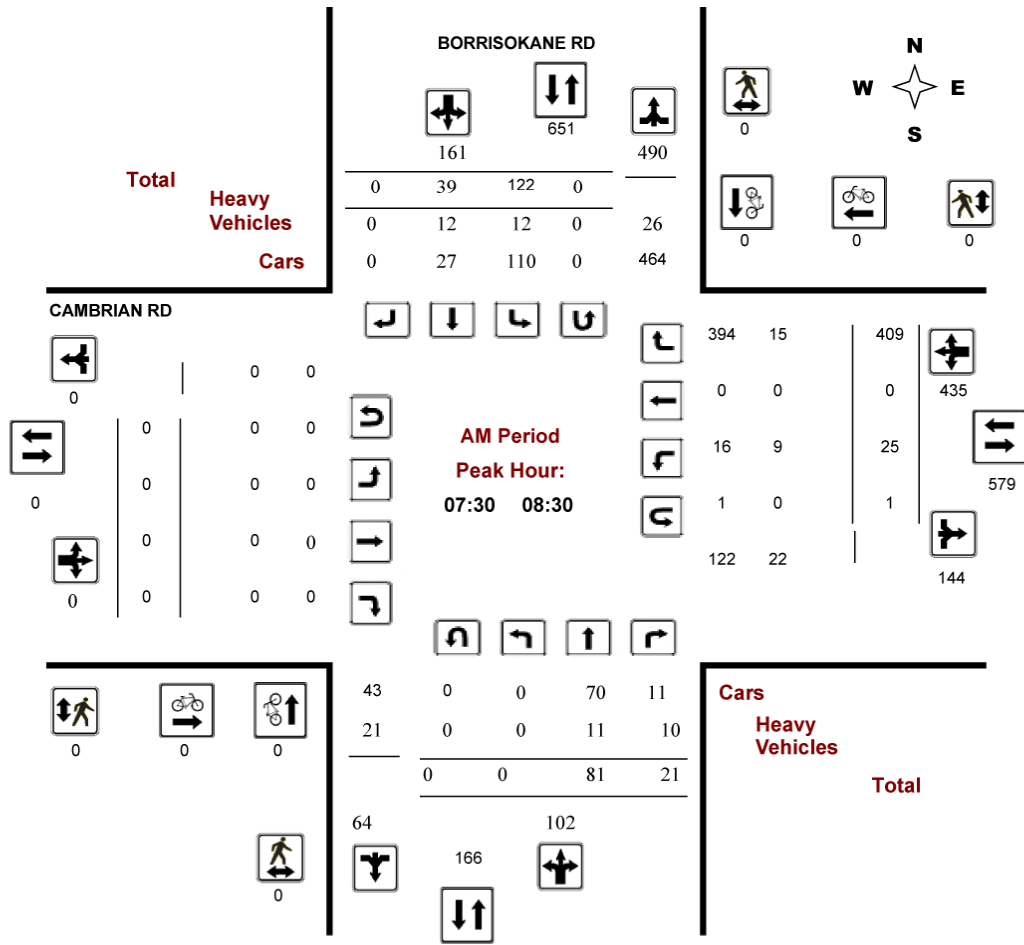
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BORRISOKANE RD @ CAMBRIAN RD

Survey Date: Friday, November 09, 2018
Start Time: 06:30

WO No: 38148
Device: Miovision



2018 PEAK PM HOUR TRAFFIC COUNTS - Borrisokane/Cambrian



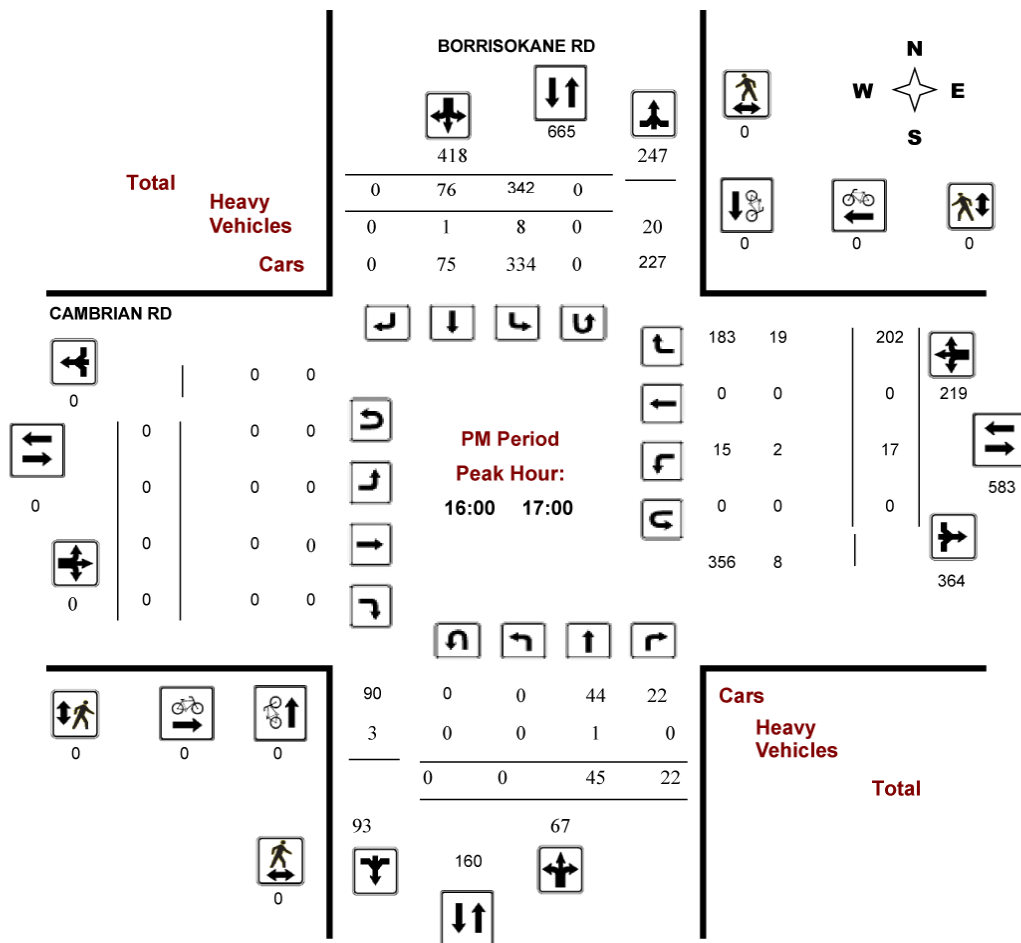
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BORRISOKANE RD @ CAMBRIAN RD

Survey Date: Friday, November 09, 2018
Start Time: 06:30

WO No: 38148
Device: Miovision



Comments

EXHIBIT 2.2 AREA OC TRANSPO TRANSIT ROUTES



EXHIBIT 3.1
ITE - PEAK PM HOUR TRIP GENERATION GRAPH

**Automated Car Wash
 (948)**

Vehicle Trip Ends vs: 1000 Sq. Ft. GFA
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: General Urban/Suburban
 Number of Studies: 1
 1000 Sq. Ft. GFA: 2
 Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
14.20	14.20 - 14.20	*

Data Plot and Equation

Caution – Small Sample Size

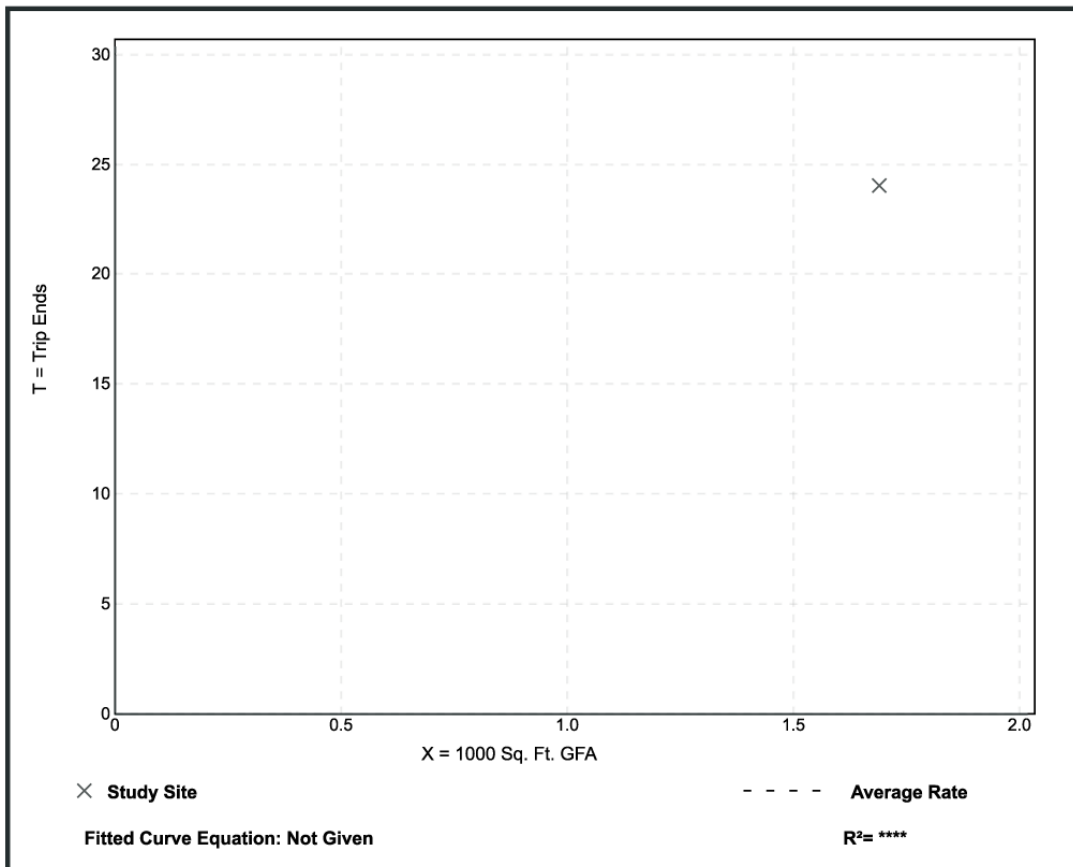


EXHIBIT 4.1
2028 MMLOS ROAD SEGMENT - Flagstaff Drive

Multi-Modal Level of Service - Segments Form

Consultant		Project	Halo Car Wash
Scenario	Total 2028 Traffic	Date	Apr-22
Comments	Flagstaff Drive		
	Borrisokane Road to Apolune Street		

SEGMENTS		Flagstaff Dr.	Borrisokane-Apolune		
			1	k	3
Pedestrian	Sidewalk Width	B	1.8 m		
	Boulevard Width		0.5 - 2 m		
	Avg Daily Curb Lane Traffic Volume		≤ 3000		
	Operating Speed		> 50 to 60 km/h		
	On-Street Parking		yes		
	Exposure to Traffic PLoS		B	-	-
	Effective Sidewalk Width		2.0 m		
Pedestrian Volume	250 ped/hr				
Crowding PLoS	B	-	-		
Level of Service	B	-	-		
Bicycle	Type of Cycling Facility	F	Mixed Traffic		
	Number of Travel Lanes		2-3 lanes total		
	Operating Speed		≥ 60 km/h		
	# of Lanes & Operating Speed LoS		F	-	-
	Bike Lane (+ Parking Lane) Width		≥ 1.8 m		
	Bike Lane Width LoS		A	-	-
	Bike Lane Blockages		Rare		
	Blockage LoS		A	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge		
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes		
Sidestreet Operating Speed	>50 to 60 km/h				
Unsignalized Crossing - Lowest LoS	C	-	-		
Level of Service	F	-	-		
Transit	Facility Type	D	Mixed Traffic		
	Friction or Ratio Transit:Posted Speed		Vt/Vp ≥ 0.8		
	Level of Service		D	-	-
Truck	Truck Lane Width	B	> 3.7 m		
	Travel Lanes per Direction		1		
	Level of Service		B	-	-

EXHIBIT 4.2
2028 MMLOS ROAD SEGMENT - Borrisokane Road

Multi-Modal Level of Service - Segments Form

Consultant Scenario Comments	Total 2028 Traffic	Project Date	Halo Car Wash
	Borrisokane Road		Apr-22
	Cambrian Road to the Jock River		

SEGMENTS		Borrisokane Rd.	Cambrian-Flagstaff Flagstaff-Jock		Section
			1	k	3
Pedestrian	Sidewalk Width	F	no sidewalk	no sidewalk	
	Boulevard Width		n/a	n/a	
	Avg Daily Curb Lane Traffic Volume		> 3000	> 3000	
	Operating Speed		> 60 km/h	> 60 km/h	
	On-Street Parking		no	no	
	Exposure to Traffic PLoS		F	F	-
	Effective Sidewalk Width		2.0 m	2.0 m	
	Pedestrian Volume		250 ped/hr	250 ped/hr	
Crowding PLoS	B	B	-		
Level of Service	F	F	-		
Bicycle	Type of Cycling Facility	F	Mixed Traffic	Mixed Traffic	
	Number of Travel Lanes		2-3 lanes total	2-3 lanes total	
	Operating Speed		≥ 60 km/h	≥ 60 km/h	
	# of Lanes & Operating Speed LoS		F	F	-
	Bike Lane (+ Parking Lane) Width		≥ 1.8 m	≥ 1.8 m	
	Bike Lane Width LoS		A	A	-
	Bike Lane Blockages		Rare	Rare	
	Blockage LoS		A	A	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge	< 1.8 m refuge	
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes	≤ 3 lanes	
	Sidestreet Operating Speed		>50 to 60 km/h	>50 to 60 km/h	
Unsignalized Crossing - Lowest LoS	C	C	-		
Level of Service	F	F	-		
Transit	Facility Type	D	Mixed Traffic	Mixed Traffic	
	Friction or Ratio Transit:Posted Speed		Vt/Vp ≥ 0.8	Vt/Vp ≥ 0.8	
	Level of Service		D	D	-
Truck	Truck Lane Width	C	≤ 3.5 m	≤ 3.5 m	
	Travel Lanes per Direction		1	1	
	Level of Service		C	C	-

EXHIBIT 4.3 2028 MMLOS ROAD SEGMENT - Cambrian Road

Multi-Modal Level of Service - Segments Form

Consultant		Project	Halo Car Wash
Scenario	Total 2028 Traffic	Date	Apr-22
Comments	Cambrian Road		
	Borrisokane Road to Apolune Street		

SEGMENTS		Flagstaff Dr.	Borrisokane-Apolune		Section
			1	k	3
Pedestrian	Sidewalk Width	F	no sidewalk		
	Boulevard Width		n/a		
	Avg Daily Curb Lane Traffic Volume		> 3000		
	Operating Speed		> 60 km/h		
	On-Street Parking		no		
	Exposure to Traffic PLoS		F	-	-
	Effective Sidewalk Width		1.2 m		
	Pedestrian Volume		250 ped/hr		
Crowding PLoS	B	-	-		
Level of Service	F	-	-		
Bicycle	Type of Cycling Facility	F	Mixed Traffic		
	Number of Travel Lanes		2-3 lanes total		
	Operating Speed		≥ 60 km/h		
	# of Lanes & Operating Speed LoS		F	-	-
	Bike Lane (+ Parking Lane) Width		≥ 1.8 m		
	Bike Lane Width LoS		A	-	-
	Bike Lane Blockages		Rare		
	Blockage LoS		A	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge		
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes		
Sidestreet Operating Speed	≥ 65 km/h				
Unsignalized Crossing - Lowest LoS	E	-	-		
Level of Service	F	-	-		
Transit	Facility Type	D	Mixed Traffic		
	Friction or Ratio Transit:Posted Speed		Vt/Vp ≥ 0.8		
	Level of Service		D	-	-
Truck	Truck Lane Width	C	≤ 3.5 m		
	Travel Lanes per Direction		1		
	Level of Service		C	-	-

EXHIBIT 4.4

2023 & 2028 LEFT TURN LANE WARRANT ANALYSIS - Flagstaff/Borrisokane

**MINIMUM WARRANTS FOR INSTALLATION OF TRAFFIC SIGNAL
 USING PROJECTED VOLUME**

Intersection Location: Flagstaff Drive and Borrisokane Road, City of Ottawa

Projected Volume: Year 2023 Total Traffic

JUSTIFICATION	DESCRIPTION	MINIMUM REQUIREMENT 1 LANE EACH DIRECTION HIGHWAYS		COMPLIANCE		
		FREE FLOW	RESTR. FLOW	SECTIONAL		ENTIRE %
				NUMERICAL	%	
1. VEHICULAR VOLUME	A. Vehicle volume all approaches (Average hour)	480	720	855	119	27%
	B. Vehicle volume, along minor roads, (average hour)	120	255 170	68	27	
2. DELAY TO CROSS TRAFFIC	A. Vehicle volume, along artery (average hour)	480	720	787	109	17%
	B. Combined vehicle and pedestrian volume crossing artery from minor streets, (average hour)	50	75	13	17	

Projected Volume: Year 2028 Total Traffic

JUSTIFICATION	DESCRIPTION	MINIMUM REQUIREMENT 1 LANE EACH DIRECTION HIGHWAYS		COMPLIANCE		
		FREE FLOW	RESTR. FLOW	SECTIONAL		ENTIRE %
				NUMERICAL	%	
1. VEHICULAR VOLUME	A. Vehicle volume all approaches (Average hour)	480	720	893	124	27%
	B. Vehicle volume, along minor roads, (average hour)	120	255 170	68	27	
2. DELAY TO CROSS TRAFFIC	A. Vehicle volume, along artery (average hour)	480	720	825	115	17%
	B. Combined vehicle and pedestrian volume crossing artery from minor streets, (average hour)	50	75	13	17	

Projected Average Hour - Use the sum of the PM Peak volumes divided by 2

NOTES:

- Vehicle volume warrants (1A) and (2A) for intersections of roadways having two or more moving lanes in one direction, should be 25% higher than the values given above.
- Warrant values for free flow apply when the 85 percentile speed of artery traffic equals or exceeds 70 Km/h or when the intersection lies within the built-up area of an isolated community having a population of less than 10,000.
- Warrant values for restricted flow apply to large urban communities when the 85 percentile speed of artery traffic does not exceed 70 Km/h.
- The lowest sectional percentage governs the entire Warrant.
- For "T" intersections the warrant values for minor road should be increased by 50 % (Warrant 1B only).
- The crossing volumes are defined as:
 - Left turns from both minor road approaches
 - The heaviest through volume from the minor road
 - 50% of the heavier left turn movement from major road when both of the following are met:
 - the left turn volume > 120 vph.
 - the left turn volume plus the opposing volume > 720 vph.
 - Pedestrians crossing the major road.

EXHIBIT 4.5

2023 & 2028 LEFT TURN LANE WARRANT ANALYSIS - Cambrian/Borrisokane

MINIMUM WARRANTS FOR INSTALLATION OF TRAFFIC SIGNAL USING PROJECTED VOLUME

Intersection Location: Cambrian Road and Borrisokane Road, City of Ottawa

Projected Volume: Year 2023 Total Traffic

JUSTIFICATION	DESCRIPTION	MINIMUM REQUIREMENT 1 LANE EACH DIRECTION HIGHWAYS		COMPLIANCE		
		FREE FLOW	RESTR. FLOW	SECTIONAL		ENTIRE %
				NUMERICAL	%	
1. VEHICULAR VOLUME	A. Vehicle volume all approaches (Average hour)	480	720	754	105	85%
	B. Vehicle volume, along minor roads, (average hour)	120	255 170	218	85	
2. DELAY TO CROSS TRAFFIC	A. Vehicle volume, along artery (average hour)	480	720	536	74	29%
	B. Combined vehicle and pedestrian volume crossing artery from minor streets, (average hour)	50	75	22	29	

Projected Volume: Year 2028 Total Traffic

JUSTIFICATION	DESCRIPTION	MINIMUM REQUIREMENT 1 LANE EACH DIRECTION HIGHWAYS		COMPLIANCE		
		FREE FLOW	RESTR. FLOW	SECTIONAL		ENTIRE %
				NUMERICAL	%	
1. VEHICULAR VOLUME	A. Vehicle volume all approaches (Average hour)	480	720	807	112	96%
	B. Vehicle volume, along minor roads, (average hour)	120	255 170	244	96	
2. DELAY TO CROSS TRAFFIC	A. Vehicle volume, along artery (average hour)	480	720	564	78	31%
	B. Combined vehicle and pedestrian volume crossing artery from minor streets, (average hour)	50	75	23	31	

Projected Average Hour - Use the sum of the PM Peak volumes divided by 2

NOTES:

- Vehicle volume warrants (1A) and (2A) for intersections of roadways having two or more moving lanes in one direction, should be 25% higher than the values given above.
- Warrant values for free flow apply when the 85 percentile speed of artery traffic equals or exceeds 70 Km/h or when the intersection lies within the built-up area of an isolated community having a population of less than 10,000.
- Warrant values for restricted flow apply to large urban communities when the 85 percentile speed of artery traffic does not exceed 70 Km/h.
- The lowest sectional percentage governs the entire Warrant.
- For "T" intersections the warrant values for minor road should be increased by 50 % (Warrant 1B only).
- The crossing volumes are defined as:
 - Left turns from both minor road approaches
 - The heaviest through volume from the minor road
 - 50% of the heavier left turn movement from major road when both of the following are met:
 - the left turn volume > 120 vph.
 - the left turn volume plus the opposing volume > 720 vph.
 - Pedestrians crossing the major road.

EXHIBIT 4.6 2023 PEAK PM HOUR TOTAL TRAFFIC ANALYSIS - Site Access/Flagstaff

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Site Access/Flagstaff							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Flagstaff Drive							
Analysis Year	2023							North/South Street	Site Access							
Time Analyzed	Peak PM Hour Total							Peak Hour Factor	0.92							
Intersection Orientation	East-West							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p>Major Street: East-West</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume (veh/h)			176	23		11	116			20		13				
Percent Heavy Vehicles (%)						1				1		1				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized																
Median Type Storage					Undivided											
Critical and Follow-up Headways																
Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.11				6.41		6.21				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.21				3.51		3.31				
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						12					36					
Capacity, c (veh/h)						1359					706					
v/c Ratio						0.01					0.05					
95% Queue Length, Q ₉₅ (veh)						0.0					0.2					
Control Delay (s/veh)						7.7					10.4					
Level of Service (LOS)						A					B					
Approach Delay (s/veh)						0.7				10.4						
Approach LOS										B						

EXHIBIT 4.7 2028 PEAK PM HOUR TOTAL TRAFFIC ANALYSIS - Site Access/Flagstaff

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Site Access/Flagstaff							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Flagstaff Drive							
Analysis Year	2028							North/South Street	Site Access							
Time Analyzed	Peak PM Hour Total							Peak Hour Factor	0.92							
Intersection Orientation	East-West							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p style="text-align: center;">Major Street: East-West</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	0	0
Configuration				TR		LT					LR					
Volume (veh/h)			176	23		11	116			20		13				
Percent Heavy Vehicles (%)						1				1		1				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized																
Median Type Storage						Undivided										
Critical and Follow-up Headways																
Base Critical Headway (sec)						4.1				7.1		6.2				
Critical Headway (sec)						4.11				6.41		6.21				
Base Follow-Up Headway (sec)						2.2				3.5		3.3				
Follow-Up Headway (sec)						2.21				3.51		3.31				
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						12					36					
Capacity, c (veh/h)						1359					706					
v/c Ratio						0.01					0.05					
95% Queue Length, Q ₉₅ (veh)						0.0					0.2					
Control Delay (s/veh)						7.7					10.4					
Level of Service (LOS)						A					B					
Approach Delay (s/veh)						0.7				10.4						
Approach LOS										B						

EXHIBIT 4.8

2023 PEAK PM HOUR BACKGROUND TRAFFIC ANALYSIS - Flagstaff/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Flagstaff/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Flagstaff Drive							
Analysis Year	2023							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Background							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p>Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R				TR		L	T	
Volume (veh/h)						10		106			589	14		162	795	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized						No										
Median Type Storage						Undivided										
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.43		6.23						4.13		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.53		3.33						2.23		
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						11		115						176		
Capacity, c (veh/h)						64		469						927		
v/c Ratio						0.17		0.25						0.19		
95% Queue Length, Q ₉₅ (veh)						0.6		1.0						0.7		
Control Delay (s/veh)						71.9		15.2						9.8		
Level of Service (LOS)						F		C						A		
Approach Delay (s/veh)						20.1								1.7		
Approach LOS						C										

EXHIBIT 4.9

2028 PEAK PM HOUR BACKGROUND TRAFFIC ANALYSIS - Flagstaff/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Flagstaff/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Flagstaff Drive							
Analysis Year	2028							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Background							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p>Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R				TR		L	T	
Volume (veh/h)						10		106			617	14		162	843	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized						No										
Median Type Storage						Undivided										
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.43		6.23						4.13		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.53		3.33						2.23		
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						11		115						176		
Capacity, c (veh/h)						57		450						903		
v/c Ratio						0.19		0.26						0.19		
95% Queue Length, Q ₉₅ (veh)						0.6		1.0						0.7		
Control Delay (s/veh)						82.7		15.7						9.9		
Level of Service (LOS)						F		C						A		
Approach Delay (s/veh)						21.5								1.6		
Approach LOS						C										

EXHIBIT 4.10 2023 PEAK PM HOUR TOTAL TRAFFIC ANALYSIS - Flagstaff/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Flagstaff/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Flagstaff Drive							
Analysis Year	2023							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Total							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p>Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R				TR		L	T	
Volume (veh/h)						25		111			586	25		174	788	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)							0									
Right Turn Channelized							No									
Median Type Storage							Undivided									
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.43		6.23							4.13	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.53		3.33							2.23	
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						27		121							189	
Capacity, c (veh/h)						61		467							920	
v/c Ratio						0.44		0.26							0.21	
95% Queue Length, Q ₉₅ (veh)						1.7		1.0							0.8	
Control Delay (s/veh)						104.0		15.4							9.9	
Level of Service (LOS)						F		C							A	
Approach Delay (s/veh)							31.7								1.8	
Approach LOS							D									

EXHIBIT 4.11

2028 PEAK PM HOUR TOTAL TRAFFIC ANALYSIS - Flagstaff/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Flagstaff/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Flagstaff Drive							
Analysis Year	2028							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Total							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p>Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R				TR		L	T	
Volume (veh/h)						25		111			614	25		174	836	
Percent Heavy Vehicles (%)						3		3						3		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized						No										
Median Type Storage						Undivided										
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.43		6.23						4.13		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.53		3.33						2.23		
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						27		121						189		
Capacity, c (veh/h)						54		449						896		
v/c Ratio						0.50		0.27						0.21		
95% Queue Length, Q ₉₅ (veh)						1.9		1.1						0.8		
Control Delay (s/veh)						125.8		15.9						10.1		
Level of Service (LOS)						F		C						B		
Approach Delay (s/veh)						36.1								1.7		
Approach LOS						E										

EXHIBIT 4.12 2018 PEAK PM HOUR EXISTING TRAFFIC ANALYSIS - Cambrian/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Cambrian/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Cambrian Road							
Analysis Year	2018							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Existing							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p>Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	1	0	0	0	1	0	0	0	1	0
Configuration							LR					TR			LT	
Volume (veh/h)						17		202			45	22		342	76	
Percent Heavy Vehicles (%)						8		8						3		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized																
Median Type Storage						Undivided										
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.48		6.28						4.13		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.57		3.37						2.23		
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)								238							372	
Capacity, c (veh/h)								785							1521	
v/c Ratio								0.30							0.24	
95% Queue Length, Q ₉₅ (veh)								1.3							1.0	
Control Delay (s/veh)								11.6							8.1	
Level of Service (LOS)								B							A	
Approach Delay (s/veh)								11.6							7.0	
Approach LOS								B								

EXHIBIT 4.13

2023 PEAK PM HOUR BACKGROUND TRAFFIC ANALYSIS - Cambrian/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Cambrian/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Cambrian Road							
Analysis Year	2023							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Background							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p style="text-align: center;">Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R					TR		L	T
Volume (veh/h)						43		386			217	40		612	193	
Percent Heavy Vehicles (%)						8		8						3		
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized						No										
Median Type Storage						Undivided										
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.48		6.28						4.13		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.57		3.37						2.23		
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						47		420						665		
Capacity, c (veh/h)						41		767						1278		
v/c Ratio						1.15		0.55						0.52		
95% Queue Length, Q ₉₅ (veh)						4.6		3.4						3.1		
Control Delay (s/veh)						342.9		15.2						10.8		
Level of Service (LOS)						F		C						B		
Approach Delay (s/veh)						48.1								8.2		
Approach LOS						F										

EXHIBIT 4.14 2028 PEAK PM HOUR BACKGROUND TRAFFIC ANALYSIS - Cambrian/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Cambrian/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Cambrian Road							
Analysis Year	2028							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Background							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p style="text-align: center;">Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R					TR		L	T
Volume (veh/h)						45		435			222	43			651	202
Percent Heavy Vehicles (%)						8		8							3	
Proportion Time Blocked																
Percent Grade (%)							0									
Right Turn Channelized							No									
Median Type Storage							Undivided									
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.48		6.28							4.13	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.57		3.37							2.23	
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						49		473							708	
Capacity, c (veh/h)						32		760							1268	
v/c Ratio						1.51		0.62							0.56	
95% Queue Length, Q ₉₅ (veh)						5.4		4.4							3.6	
Control Delay (s/veh)						528.1		17.2							11.4	
Level of Service (LOS)						F		C							B	
Approach Delay (s/veh)							65.1									8.7
Approach LOS							F									

EXHIBIT 4.15 2023 PEAK PM HOUR TOTAL TRAFFIC ANALYSIS - Cambrian/Borrisokane

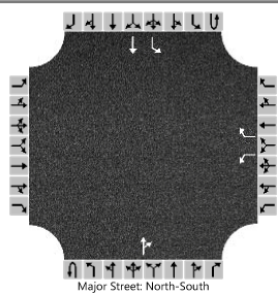
HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Cambrian/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Cambrian Road							
Analysis Year	2023							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Total							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
 <p>Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R					TR		L	T
Volume (veh/h)						43		393			218	40			619	194
Percent Heavy Vehicles (%)						8		8							3	
Proportion Time Blocked																
Percent Grade (%)							0									
Right Turn Channelized							No									
Median Type Storage							Undivided									
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2							4.1	
Critical Headway (sec)						6.48		6.28							4.13	
Base Follow-Up Headway (sec)						3.5		3.3							2.2	
Follow-Up Headway (sec)						3.57		3.37							2.23	
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						47		427							673	
Capacity, c (veh/h)						39		766							1276	
v/c Ratio						1.19		0.56							0.53	
95% Queue Length, Q ₉₅ (veh)						4.7		3.5							3.2	
Control Delay (s/veh)						366.6		15.5							10.9	
Level of Service (LOS)						F		C							B	
Approach Delay (s/veh)							50.1								8.3	
Approach LOS							F									

EXHIBIT 4.16 2028 PEAK PM HOUR TOTAL TRAFFIC ANALYSIS - Cambrian/Borrisokane

HCS7 Two-Way Stop-Control Report																
General Information								Site Information								
Analyst								Intersection	Cambrian/Borrisokane							
Agency/Co.								Jurisdiction	City of Ottawa							
Date Performed	4/27/2022							East/West Street	Cambrian Road							
Analysis Year	2028							North/South Street	Borrisokane Road							
Time Analyzed	Peak PM Hour Total							Peak Hour Factor	0.92							
Intersection Orientation	North-South							Analysis Time Period (hrs)	0.25							
Project Description	Halo Car Wash															
Lanes																
<p>Major Street: North-South</p>																
Vehicle Volumes and Adjustments																
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		1	0	1	0	0	1	0	0	1	1	0
Configuration						L		R				TR		L	T	
Volume (veh/h)						45		442			223	43		658	203	
Percent Heavy Vehicles (%)						8		8						3		
Proportion Time Blocked																
Percent Grade (%)							0									
Right Turn Channelized							No									
Median Type Storage							Undivided									
Critical and Follow-up Headways																
Base Critical Headway (sec)						7.1		6.2						4.1		
Critical Headway (sec)						6.48		6.28						4.13		
Base Follow-Up Headway (sec)						3.5		3.3						2.2		
Follow-Up Headway (sec)						3.57		3.37						2.23		
Delay, Queue Length, and Level of Service																
Flow Rate, v (veh/h)						49		480						715		
Capacity, c (veh/h)						31		759						1267		
v/c Ratio						1.57		0.63						0.56		
95% Queue Length, Q ₉₅ (veh)						5.5		4.6						3.7		
Control Delay (s/veh)						562.3		17.6						11.5		
Level of Service (LOS)						F		C						B		
Approach Delay (s/veh)							67.9								8.8	
Approach LOS							F									